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The nature of growth:  
The postwar history of the  
economy, energy and the  
environment

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September 2014

I hereby declare that this thesis has not been and will not be, submitted in whole or in part to another University for the award of any other degree.

Signature:.....

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# Acknowledgements

This thesis would not exist without the generous support, often in the face of outrageous provocation, of my supervisors Samuel Knafo, Pete Newell and in a previous incarnation, Jan Selby. As usual, Matthieu Hughes, Steffan Wyn Jones, and most of all, my bruv, Sahil Dutta have read and commented on everything I've written. In some cases numerous times. My thanks also go to Mareike Beck, Earl Gammon, Ben Stephan, Arno Simmons and Mat Paterson for thoughtful feedback at various points throughout this process.

Niamh Kelly's (apparently) near-endless generosity, support and love have enabled me to retain some semblance of sanity in the face of the vast and indifferent cyclopean horror of the PhD process.

And Lola, who has been a constant source of joy, even though she's too young to read this. And a dog.

This work was financially supported by an ESRC studentship. And Niamh Kelly. Again.

# 1. Research Summary

The environment and energy have been fundamental to the growth of the economy. This looks like a straightforward claim. But it is not. In order to understand how these are related, how growth came to be associated with the economy, and how this growth came to be seen as the unshakeable fundament of any environmental politics, this thesis focuses on a brief period of largely postwar history, and almost exclusively on a single country - America. At this time, and in this place, the technical removal of material constraints, the provision of energy, the construction of environmental limits and then their dismantling, forms the complex history of the growth of the environment and the environment of growth. This history created both the possibility of the contemporary political economy of the environment as well as its limits. This thesis traces the way that the economy, energy and the environment were co-constructed, transformed and interwoven in the US from the postwar years through to the mid 1970s, through the assembling, application and reassembling of the economic techniques and technologies that defined growth, scarcity and efficiency. To this end, it orients itself around the impacts of the 1952 President's Materials Policy Commission - known as the Paley Commission, and the think tank that was set up in its wake: Resources For the Future (RFF). The Paley Commission report and the RFF would, through their technical innovations play a key role in the construction of the economy as a separate, measurable and observable sphere of monetary flows, driven by an associated logic of exponential growth; energy as an interchangeable system of sources powering this economy; and the environment, initially as encompassing the economy and defined by finite limits, then reconstructed as external to the economy and where pollution is considered as an example of market failure to be rectified by the internalisation of externalities.

## 2. Introduction

The environment and energy have been fundamental to the growth of the economy. This looks like a straightforward claim. But it is not. In order to understand how these are related, how growth came to be associated with the economy, how energy was understood as powering growth, and how this growth came to be seen as the unshakeable fundament of any environmental politics, this thesis focuses on a brief, quarter century period - from around 1950 to 1975 - of almost exclusively US history. At this time, and in this place, the 'great acceleration', the sudden postwar speeding up of economic growth, oil consumption and environmental despoliation (Steffen, Crutzen & McNeill 2007) began.

This thesis tells the story of the complex, promiscuous nature of postwar growth, and how the great acceleration was initiated through the technical removal of material constraints on the economy beginning in the 1950s, the provision of a system of energy, the subsequent construction of environmental limits and then their dismantling during the 1970s. This process created both the possibility of the contemporary political economy of the environment as well as its limits, and in order to understand this brief period of history, I will begin with a letter.

W. Stuart Symington had only been Chairman of the US National Security Resources Board (NSRB) for nine months when, in December 1950, he wrote to President Truman to formally propose a Presidential Commission on the state of the nation's material resources. Symington, echoing the prevalent fears at the time, stated:

[t]here is nothing more important to the future security of the United States than obtaining, now and in the future, an adequate supply of those raw materials necessary to build up our defences and maintain our economy. Already in many cases shortages of such materials are serious, and in some cases critical (cited in Goodwin 1981a:52-53)

These fears may have been prevalent in 1950, but they weren't universally shared. For William S. Paley, the Columbia Broadcasting Service (CBS) Chairman, or 'absentee landlord' as he was known, given his tendency towards long and increasingly frequent vacations, boredom was a more pressing concern. Paley had been having trouble reengaging with the day-to-day running of his broadcasting company since his return from the second world war; and by 1950, Paley's restlessness and ennui had been noticed by Frank Stanton, the CBS President. Stanton found Paley's predicament perplexing, and was even more surprised when Paley's wife, Babe, one day arrived at his office and declared immediately "We've got to do something about finding something interesting for Bill to do. He's Bored" (cited in Smith 1990:311). Some time after Babe's visit, Stanton was contacted by his old friend, Harry Truman. President Truman was looking for someone to head the commission proposed by Symington to analyse the nation's natural resources, and Stanton, with Babe's concern in mind, suggested Paley. And even more curiously than the palindromic quality of Babe's phrasing, the something that Stanton found for Paley to do - Chair what would become the President's Materials Policy Commission (PMPC), commonly referred to as the Paley Commission - turned out to be a rather interesting something indeed.

The Paley Commissioners were tasked with evaluating America's natural resource position and undertaking 25 year growth projections of the 'basic economic characteristics of our society' (PMPC Vol. 1 1952:3); and they began the first volume of their subsequent five volume report by stating that:

...we share the belief of the American people in the principle of growth. Granting that we cannot find any absolute reason for this belief we admit that to our Western minds it seems preferable to any opposite, which to us implies stagnation and decay. (PMPC Vol. 1 1952:3)

The Paley Commissioners would in fact begin the process of transforming the measurement of resource scarcity and actually securing the 'absolute reason' that escaped them at the time they wrote their report. The debate initiated by the Paley Commission 'owed much to the contributions of the economists of the day who, in the process of diagnosing the linkages between economic growth and nature's "niggardliness," put in place the conceptual apparatus of a new political economy' (Barber 1981a:206).

Coinciding with the timescale of the Paley Commission report's quarter century projections, this thesis traces the postwar development of the the new conceptual apparatus of the economy, energy and the environment as they were constituted (and reconstituted) as abstract natural categories, oriented around the conventional wisdom of the 'growth paradigm' (Dale 2011; Purdey 2010): that continuous, limitless economic growth is both possible and absolutely necessary. These apparently cold, dumb objects of politics - the natural 'laws of the social world', are nothing of the sort, and:

...they occupy a very different position from what the tradition had first thought. They are not *behind* the scene, *above* our heads and *before* the action, but *after* the action, *below* the participants and smack in the *foreground*. They don't cover, nor encompass, nor gather, nor explain; they circulate, they format, they standardize, they coordinate, they have to be explained. (Latour 2005:246; emphasis in original)

When the incoming Eisenhower administration declined to assume responsibility for ongoing assessment and analysis of material resources, William Paley helped found a Washington based think tank entitled Resources For the Future (RFF). RFF should be thought of as a kind of RAND Corporation for the economy, energy and environment. RAND was intimately involved in the development of a raft of economic technologies, from operations research, systems theory, game theory, and what the economic historian Philip Mirowski refers to as the reconstruction of the market as a cybernetic concept - the ultimate decision maker (Mirowski 2002). Similarly, RFF - following in the footsteps of the Paley Commission - developed or popularised a series of economic techniques and technologies: combining price scarcity with resource measurement in the form of working inventories, benefit-cost analysis (BCA), the Materials Balance approach to the environment, and ultimately emissions trading as the primary means of addressing environmental pollution resulting from the growth of the economy.

In fact, linkages between RAND and RFF extend beyond this brute parallel. RFF was founded in 1952 and funded largely by the Ford Foundation, which had then recently been reorganised by H. Rowan Gaither Jr. who was head of the board of RAND and would become President of the board at the Ford Foundation in February 1953 (Amadae 2003:34-39). Gaither's reorganisation was undertaken explicitly to fund

research organisations in the RAND mould, and the USD 150,000 initial grant to RFF bore his imprimatur in spirit, if not his explicit stamp. There is also considerable overlap between the staff economists at RAND and RFF. Indeed, RFF's president through the late 1970s was Charles J. Hitch, who was the author of the 'Bible of the pentagon' in 1960 with Roland McKean, and was the head of the RAND economic division from its 1948 founding until he became the assistant secretary of defence under Robert Macnamara in 1961 - taking with him RAND's game theoretic modelling and instituting the Planning Programming and Budgeting System (PPBS) within the Department of Defence.

The founding of RFF represents, as acclaimed British environmental economist David Pearce maintained, the beginnings of the discipline of environmental economics (2002:57). The organisation was also central to the founding of resource and industrial economics, and particularly if you look through the bibliography of any paper or book on emissions or carbon trading, or indeed environmental governance in general, you will find work generated by RFF scholars there. However, the organisation itself has garnered little academic or popular attention - unlike RAND. As such, in 2002, RFF was described in a piece in the magazine *The National Journal* as 'the most important think tank you've never heard of' (Rauch 2002). Although RFF was jointly awarded the Fondazione Eni Enrico Mattei (FEEM) 20<sup>th</sup> anniversary prize in June 2010<sup>1</sup>, the work and impact of the organisation is rarely explicitly acknowledged.

In this thesis I bring this work, and its impact, to the fore. The technical, economic innovations and popularisations developed by the Paley Commission and RFF economists would lie at the heart of the contemporary, postwar construction of the economy, energy and the environment. From the early postwar years the research, publications and workshops pioneered under the 'Paley approach' (Maass 1953) would play a key role in the postwar constitution of the 'laws of the social world' (Latour 2005:246): The economy as a separate, measurable and observable sphere of monetary flows, driven by an associated logic of exponential growth; energy as an interchangeable system of sources powering this economy; and the environment, initially as encompassing the economy and defined by finite ecospheric

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<sup>1</sup> The prize was awarded to a researcher or research group who had significantly contributed to the development of the field of environmental and resource economics over the last 20 years, and was jointly shared with Harvard economist Martin L. Weitzman.

limits, then reconstituted as external to the economy and where pollution is considered as an example of market failure to be rectified by the internalisation of externalities. By the middle of the 1970s, these developments would provide the fertile ground from which the current world spanning forms of environmental governance would blossom.

The next chapter briefly summarises the conceptual coordinates of this study. Understanding the contemporary prioritisation of growth and the postwar composition of the economy, the system of energy and the environment, requires what I term a promiscuous historical perspective in opposition to the 'natural histories' explicitly or implicitly undertaken from anthropocene, ecomarxist and 'climate capitalism' perspectives. I argue each of these approaches presents naturalised accounts of the causes and drivers of economic growth, fossil fuel use and environmental despoliation and in response I outline the relational and performative basis of promiscuous history - derived from the tenets of actor network theory as a means to capture the historical specificity of the postwar great acceleration (Steffen, Crutzen & McNeill 2007).

In chapter 4 I turn to the economy. Freshly minted at the end of the second world war, this chapter shows how the development of this new, central object of political concern was not immediately removed from its earthy constraints. The end of the war brought with it a resurgent fear of depression, stoked in the US by the economics profession under the influence of Alvin Hansen - the 'American Keynes'. Depression and then national security fears at the beginning of the cold war resulted in the question of growth becoming prevalent. Could the US economy grow? Will the US economy grow? And in short order this led to the question: Do we have the material resources to grow? Fuelled by reports and popular texts at the end of the 1940s that reasserted Malthusian fears about the availability of metals, minerals and other materials President Truman authorised a comprehensive report under the leadership of William Paley. This report undertook a novel approach to the issue of material scarcity, and along with the organisation that would be instituted by Paley in its wake - Resources For the Future - would help secure the economy over the following decades as a discrete ontological object, capable of, and indeed defined by the capacity for infinite growth.

The ability, and indeed the need for growth during the cold war went hand in hand with the development of the system of energy to power this growth, and in chapter 5 I look at how the development of energy as an interrelated system has an altogether less straightforward relationship to its singularly most important component - oil. By the end of the war, oil was the world's most important traded commodity and its flows, predominantly from the Middle East, would come to fuel parallel flows of money within the financial architecture that would be developed at Bretton Woods. However, the development of energy alongside the economy would rapidly come to threaten oil industry profits as the potential peak in domestic oil production, combined with the search for the lowest cost means to power the economy, meant that the historic government price and production supports could be withdrawn.

This threat was overcome by the further application of the 'Paley approach' to oil reserves calculations. The application of economic accounts of scarcity enabled previously unimagined amounts of oil to be discovered, hidden not in the porous rocks of the earth, but in the apparently faulty calculations of oil geologists. The application of economic scarcity enabled new mandatory US government quotas that supported oil prices worldwide and resulted in the vast expansion of oil production through the 1950s and 1960s and the final settling of the energy system, conceptually and practically around the template laid by the oil industry.

While chapters 4 and 5 show how the economy was first stabilised as an object capable of infinite growth, with this growth seemingly assured through the parallel construction of a system of energy, in chapter 6, I trace how their construction led to the development of the environment through the postwar decades in explicit opposition to the economy. Commonly, the focus here is on the development of the new political movement of environmentalism around issues of pollution, or the ascendance of the new discipline of ecology and ecological thinking. Instead I focus on the less told work and impact of bureaucratic and academic economists in provoking the environment as matter of concern - defined by its closure and limits.

The chapter begins by considering the transformation and translation of benefit-cost analysis. Originally a technique developed by the Army Corps of Engineers to evaluate waterway construction projects, with the arrival of the economy as a core political

concern, this was transformed into an economic technology enabling projects to be evaluated with respect to their impact on national growth. Further translated into postwar welfare economics theory, benefit-cost analysis was made into both a portable technology and at the same time became a target for a conservationist backlash against large scale water development projects in the 1950s. Alongside the development of the economy and the system of energy, pollution became a pervasive issue during the 1960s, and RFF fora during the period provided the arena within which economist Kenneth Boulding would launch his influential concept of the Spaceship Earth. The response to these developments from the late 1960s involved both the growth of limits - in the form of new federal environmental regulations at the beginning of the 1970s, but also the famed *Limits to Growth* (1972) report and the development of a popular antigrowth sensibility.

In chapter 7 I show how the economy, energy and the environment, whose development I detailed in the previous three chapters, were brought together by the mid 1970s. I show how the growth of the economy was once again secured and installed not just as the primary concern of politics in general, but could also come to claim the central role it currently occupies within the politics of the environment. During the late 1960s the previously secure system of energy was made to look increasingly fragile and crisis ridden. This reconstruction was undertaken by the oil industry in order to raise energy prices and involved the rehabilitation of Hubbert's peak oil notion and the lowering of fuel reserve estimates in general.

Alongside this, economists - particularly those associated with RFF - helped remake the environment in the image of economic theory. The spread of benefit-cost technology through the federal government, the expansion of economic valuation and the rehabilitation of the concept of externalities through the development of the Materials Balance approach enabled the economics discipline to reassert itself with respect to environmental concerns. Under this approach the environment was reconstructed as no longer at odds with the economy. These developments would enable the construction of new limits to growth in the form of federally mandated environmental regulation, and the infinite growth of the economy was constituted as no longer a threat to a finite global ecology, but became instead the surest means to safeguarding it.

In the brief concluding chapter I bring together the argumentative strands running through this thesis. I highlight here how the economy, energy and the environment were constituted, translated and retranslated over a quarter century period from the early 1950s, in order to enable growth to occupy the place of prime political concern that it does today. The historical analysis undertaken here reveals how the apparent laws defining the economy, energy and the environment were brought to the objects they appear to simply define, through what technical and material means and with what outcomes - in terms of political contestation, reconceptualisation and the development of new powers and agencies.

### 3. The promiscuous history of economy, energy and environment

The dawning of the 1950s in the US marked the beginning of the '[t]riumph of the growth paradigm' (Dale 2011; see also Purdey 2010; Arndt 1978). Here, growth - broadly understood as increasing Gross National Product (GNP)<sup>2</sup>, or more exactly 'an increase of the transactions made on markets (goods, labour and capital markets), measured in monetary terms' (de Bruyn 2000, cited in Purdey 2010:7) would come into a 'golden age' (Dale 2011) lasting until 1973. In the US, and then throughout Western Europe, increasing productivity gains and the massive expansion in consumer goods would be seen as raising the standard of life for all people. As the fear of depression receded and the fear of the Soviet Union advanced, the belief in progress was resurrected and cast primarily as the growth of the economy necessary to out compete the red menace. This was accompanied by the rapid development of the advertising industry and its capacity to help manufacture new wants, new desires and new dreams alongside the corporate techno-optimism that made these dreams come true. As Gareth Dale put it:

Worldwide, growth came to be seen as a proxy for the profitability of national economies and as a magic wand to achieve all sorts of goals: to abolish the danger of returning to depression, to soothe class tensions, to reduce the gap between "developed" and "developing" countries, to carve a path to international recognition, to contain the USSR, to accelerate "the transition to socialism", and so on. (Dale 2011)

Between 1950 and 1973 the average growth in world per capita GDP was 2.91 percent and '[a]t no time in human history have so many people become affluent within one single generation' (Pfister 2010:96). Beginning in the 1960s, a backlash against economic growth developed as its environmental impacts were made manifest. Popularised by the Club of Rome's *Limits to Growth* report in 1972, these concerns would coincide with a global economic downturn and feed into the sense of crisis throughout the decade. This did not impinge on growth as an overriding priority for long however, and by 1975 the opposition of the environment and the economy had been undone and economic growth reinstalled as the unchallenged, paradigmatic concern of the nation.

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<sup>2</sup> and later Gross Domestic Product (GDP)

At the same time as the growth paradigm was taking off in the 1950s, the great acceleration (Steffen, Crutzen & McNeill 2007), or what Christian Pfister has called 'The 1950s syndrome' (Pfister 2010) was also beginning to manifest itself. The postwar years would witness a sudden shift in the relationship between humanity and the global environment:

The human enterprise suddenly accelerated after the end of the Second World War. Population doubled in just 50 years, to over 6 billion by the end of the 20<sup>th</sup> century, but the global economy increased by more than 15-fold. Petroleum consumption has grown by a factor of 3.5 since 1960, and the number of motor vehicles increased dramatically from about 40 million at the end of the War to nearly 700 million by 1996. From 1950 to 2000 the percentage of the world's population living in urban areas grew from 30 to 50% and continues to grow strongly...(Steffen, Crutzen & McNeill 2007:617)

Similarly, Pfister maintains that the explosion in global energy use - predominantly oil, from the 1950s, was sparked by the declining price of fossil fuels and that 'seen in relation to the price of labour and capital, [this] was the most significant cause of the wasteful consumption of raw materials and energy, and the resulting excessive environmental stress' (Pfister 2010:92). The environmental impact of the great acceleration was clearly documented with the rise of global atmospheric carbon dioxide levels, and the concomitant rise of climate change as the environmental crisis celebre, the emblematic problem of global environmental politics (Hajer, 1996). In 1956, the Mauna Loa Observatory in Hawaii first began to continuously monitor atmospheric changes. Shortly afterwards, during the international geophysical year of 1957-1958, geophysicist Hans Suess and oceanographer Roger Revelle discovered that the carbon dioxide content of the atmosphere had risen since its first measurement by Svante Arrhenius in the 1890s. As they put it:

Thus, human beings are now carrying out a large scale geophysical experiment of a kind that could not have happened in the past, nor could it be reproduced in the future. Within a few centuries we are returning to the atmosphere and oceans the concentrated organic carbon stored in sedimentary rocks over hundreds of millions of years. This experiment, if adequately documented, may yield a far-reaching insight into the processes determining weather and climate. (Revelle & Suess 1957, quoted in Pfister 2010:90)

Revelle and Suess observed a change of only 297 parts per million (ppm) from 1900 to about 316 ppm in 1957, and at the time maintained that any risk from climate change would only be felt in the far distant future due to the slow rate of increase. When they talked about the far future, they probably didn't have just over fifty years in mind.

Atmospheric carbon dioxide levels, as measured at the Mauna Loa observatory, reached a symbolic new high of 400 ppm on May 10<sup>th</sup> 2013 - a level not seen on earth for the last 3 million years (Gillis 2013). These levels were accompanied by not just a rising concern, but also increasing certitude that the effects of climate change are already being felt, or as US Secretary of State John Kerry described it during a speech in Jakarta, Indonesia on the 16<sup>th</sup> of February 2014, climate change is 'perhaps the world's most fearsome weapon of mass destruction' (Gordon & Davenport 2014). On the very same day as the groundbreaking atmospheric carbon dioxide figures were released, the Financial Times Stock Exchange (FTSE) 100 index in London also closed on a symbolic high, in this case, the figure of 6,625. This number breached the psychologically important 6,600 level not seen since the pre-financial crisis days of October 2007, and appeared to herald, at least in the UK, what economic commentators and politicians fondly call 'the green shoots of economic recovery', that is - the return to growth. This specific conjunction of record-breaking emissions and financial market figures is coincidental, but the relationships between the objects they represent — the environment, energy and the economy — are anything but:

For the 2.7 billion people now living on less than \$2 a day, economic growth is essential to satisfying the most basic requirements of human dignity. And in wealthier societies, people need growth to pay off their debts. To sustain this growth they must expend vast amounts of energy. Yet our best energy source—fossil fuel—is the main thing contributing to climate change, and climate change, if unchecked, will halt growth. We can't live with growth, and we can't live without it. This contradiction is humankind's biggest challenge, but as long as conventional wisdom holds that growth can continue forever, it's a challenge we can't possibly address. (Homer-Dixon cited in Dale 2011)

How exactly should the relationship between the 'conventional wisdom' of growth and the great acceleration be approached however? How is this historical confluence of the economy, energy and the environment alongside the development of the growth paradigm best understood?

## The natural history of the great acceleration

For Steffen, Crutzen and McNeill, the great acceleration should be seen as a second stage of a new geological epoch: The Anthropocene (2007). This was first suggested by the Nobel-winning chemist Paul Crutzen alongside the marine scientist Eugene F. Stoermer. In a short statement in 2000 they argued that humanity should now be seen as possessing the extravagant and indeed excessive ability to act as a geological force, through the condensation of what was previously the action of millennia on the global atmosphere to around a mere two hundred and fifty years. They dated these years from the beginning of the industrial revolution, with its widespread use of fossil fuels in the form of coal and the related development of steam power (Crutzen & Stoermer 2000; Moore 2014a:2). Crutzen further elaborated on this proposal in a piece to *Nature* in 2002 (Crutzen 2002), and in 2008, the Stratigraphy Commission of the Geological Society of London announced its acceptance of Crutzen's proposal of the end of one geological epoch, and the beginning of another:

The Holocene epoch—the interglacial span of unusually stable climate that has allowed the rapid evolution of agriculture and urban civilization—has ended and... the Earth has entered “a stratigraphic interval without close parallel in the last several million years.” In addition to the buildup of greenhouse gases, the stratigraphers cite human landscape transformation which “now exceeds [annual] natural sediment production by an order of magnitude,” the ominous acidification of the oceans, and the relentless destruction of biota. (Davis 2008; cited in Gibson-Graham & Roelvink 2010:320-321)

The notion of the Anthropocene, while capturing something of the changed relation between humanity and the global environment due to fossil fuel use and technological change, actually ‘creates more fog than light’ (Moore 2014a:2). By attributing epochal change to the *Anthropos* - humanity in general, it becomes impossible to determine the motive force driving the shift to coal and steam and then later to oil and internal combustion during the great acceleration (Malm & Hornborg 2014; Moore 2014a, 1014b). As Malm and Hornborg put it: ‘transhistorical - particularly species wide - drivers cannot be invoked to explain a qualitatively novel order in history’ and that the notion of the Anthropocene misses, at least with respect to the coal-fired industrial revolution is that ‘a clique of white British men literally pointed steam-power as a weapon - on sea and land, boats and rails - against the best part of humankind, from the Niger delta to the Yangtzi delta, the Levant to Latin America (Malm & Hornborg 2014:64). Here then, the environmental change — particularly climate change — wrought by the great acceleration and the triumph of growth, is denaturalised in a first step through its relocation from natural causes to human activities, but then

immediately renaturalised in a second step: 'when derived from an innate human trait, such as the ability to control fire. Not nature, but human nature - this is the Anthropocene displacement' (Malm & Hornborg 2014:65).

Against this natural history, an ecomarxist tradition has sought to make clear that the environmental impacts of the Anthropocene, particularly climate change, should not be seen as *anthropogenic*, but as *sociogenic* (Malm & Hornborg 2014:66). The new geological epoch is not the Anthropocene, but rather the Capitalocene (Moore 2014a, 2014b) or even the Ecocene (Nooorgaard 2013) with respect specifically to the mid 20<sup>th</sup> century great acceleration. Following criticism from environmentalists that a Marxian analysis was of necessity anti-ecological (e.g. Rudy 2005:115), an ecomarxist tradition initiated in the 1970s through the work of thinkers such as Barry Commoner (1971) was further developed from the beginning of the 1990s onwards (see e.g. Benton 1989, 1994; Burkett 1999, 2009; Foster 1999; Kovel 2007; O'Connor 1993; O'Connor 1994, 1998; Redclift & Benton 1994). Here, issues of environmental degradation are broadly viewed as following Marx's logic of the 'metabolic rift' between town and country. Ecomarxism explicitly rejects the possibility of a global capitalist modernity (as the town) being reconcilable with environmental protection or sustainability (country), at least as long as capitalist social relations are underwritten by a reliance on a fossil fuel-based energy systems (Saurin 1994, 2001).

The environment, energy and the economy are viewed here as separable spheres, the former two as natural and the latter as social. The metabolism of the environment and energy by the economy or capital - particularly in its neoliberal guise, is prone to run up against the hard limits of the natural ecology (Commoner 1971). Climate change is understood here as the result of a 'specific pattern of economic growth' (Williams, 1996: 51), or as Redclift has put it; '[t]he concentration on "Growth" has served to obscure the fact that resource depletion and unsustainable development are a direct consequence of growth itself' (Redclift 1987:56) - a growth that is the imperative of fossil capitalism (Altvater 2006; Huber 2009; Malm 2013; Parr 2013; Wrigley 2010).

Altvater, for example, maintains that capitalism and fossil fuels (particularly oil) are fundamentally congruent: 'In comparison with other energy sources fossil energy fulfils almost perfectly the requirements of the capitalist process of accumulation. It fits into capitalism's societal relation to nature' (2006:41). First, Fossil energy enables the

transformation of pre-capitalist space and place into capitalist ones. The local availability of energy is no longer the overriding reason for the location of industry, which has enabled the development of globe spanning logistical chains. Second, fossil energy enables the reconstruction of time: Diurnal and seasonal rhythms no longer constrain production processes when energy is available on a constant basis. Fossil energy also enables the acceleration of these processes and the compression of time and space. Third, the flexibility in production, consumption and transportation provided by fossil energy enabled the ‘...mobilisation and acceleration of economic processes and ... a degree of individualisation of social life never before experienced in human history’ (Altvater 2006:41). Overall:

No managerial decisions could follow the logic of profitability without needing to take energy restrictions or spatial and temporal constraints into account. Accumulation and economic growth, i.e. the “wealth of nations”, became increasingly independent of natural conditions and their limitations. (Altvater 2006:41-42)

The problem with ecomarxist analyses such as Altvater’s (see also Huber 2009; Malm 2013; Malm & Hornborg 2014; Wrigley 2010) is that in challenging the naturalised historical accounts of the Anthropocene thinkers, in overturning a too easy, too shallow reliance upon ‘human nature’ as a baggy explanation for the new geological epoch, there is a reliance upon a form of ‘fossil fuel-fetishism’ (Moore 2014a, 2014b; Newell & Paterson 2011).

Newell and Paterson maintain in a theoretically oriented addendum (2011) to their *Climate Capitalism* (2010) that fossil fuel-based capitalism, however entrenched and enduring, is merely one variant of capitalist social relations (2011:25), and a similar point is also made by Koch (2012). Drawing from Buck (2006), Newell and Paterson argue that approaches which focus on fossil fuel use ‘confuse particular manifestations of capitalism - that is, particular historical social formations - with capitalism itself, thus under-estimating the flexibility of the beast’ (Buck 2006:60). Here, ‘[t]echnological dynamism is at the heart of capitalism, and as a consequence, its technological trajectories are not necessarily set in stone.’ (Newell & Paterson 2011:25) Or oil as the case may be. Newell and Paterson (2011) rightly characterise these forms of analysis as ‘depressing’ with respect to future possibilities for the decarbonisation of a global capitalism that ‘[w]hether we like it or not’ will form the context of responses to climate change’ (Newell & Paterson 2011:23; see also Lane & Stephan 2014) - a decarbonisation that Altvater dismissed as a ‘myth’, or

'bullshit' (Altvater 2006:37). This doesn't overcome the problem of the fetishistic naturalisation of the environment and energy however. Instead, the 'ahistorical and apolitical bottom line' (Moore 2014a:16) of a nature external to capital is joined by an ahistorical and apolitical capitalism in itself divorced from its specific historical instantiations. Both the ecomarxist and climate capitalism accounts then represent a problematic basis from which to undertake a historical accounting of the specific conjunction of the economy, energy and the environment and the rise of economic growth to its paradigmatic status after the second world war.

The 'human nature' of the anthropocene thinkers, the fossil fetishism of ecomarxist approaches and the naturalised, ahistorical 'climate capitalism' each undertake variants of a 'natural history' of growth. This effects a specific methodology which tends towards a strong distinction between historical accounting and causative analysis, where the former is rendered as mere description and the latter as abstract yet non-historical explanation (Knafo, 2010: 495-496). As Bruno Latour argued in his *Politics of Nature*, under these type of accounts:

Even if, through work, knowledge, and ecological transformations, human history can modify nature in a lasting way, can disturb, transform, and perform it, the fact remains that there are two histories, or rather there is one history full of sound and fury that unfolds within a framework that itself has no history, or creates no history.'(Latour, 2004: 33-34)

Once this divorce of history from both explanation and issues of power has taken place, it becomes very difficult to account for both the historical and material specificity of the postwar great acceleration. This has the unfortunate consequence of following Francis Fukuyama's 'end of history' argument - only shifting it back to either a pre-human history when our hominid ancestors learned to control fire (Malm & Hornborg 2014), to the development of capitalism during the 'long sixteenth' century, or to the beginning of industrial capitalism in the 'long 19<sup>th</sup> century' (Moore 2014a:5). Again, this divorce of history from cause flattens multiform, contested historical agencies and powers into the mere dumb action of 'linear' (MacKenzie 2009) or 'diffusion' (Latour 1999b) accounts:

But what should appear extraordinarily bizarre is, on the contrary, the invention of inanimate entities which would do nothing more than carry one step further the cause that makes them act to generate the  $n+1$  consequence which in turn are nothing but the causes of the  $n+2$  consequences. This conceit has the strange

result of composing the world with long concatenations of causes and effects where (this is what is so odd) nothing is supposed to happen, except, probably at the beginning. (Latour, 2010: 10)

What is required here is a much more relational (Moore 2014a; 2014b), and much more promiscuous (Lane 2012, 2014) historical analysis.

## Promiscuous history: relationality, performativity, translation

The conceptual perspective afforded by a promiscuous historical account derives from the actor network theory first developed as a tool for social science research in the 1980s in and through the 'Science and Technology Studies' of Bruno Latour, Michel Callon and John Law (e.g. Callon 1986; Callon & Latour 1981; Latour 1987, 1993a, 1993b, 1999a, 1999b, 2004; Law 1986, 1992). Actor network theory can be thought of as comprising the two intertwined 'stories' (Law 1999:3) of relationality and performativity as a double helix of metaphysical commitments. In the first instance, actor network theory '... takes the semiotic insight, that of the relationality of entities, the notion that they are produced in relations, and applies this ruthlessly to all materials - and not simply those that are linguistic.' Law 1999:4). Entities and objects are hereby understood as deriving their form and attributes as a result of their relations with other objects and entities. Much as John Donne noted with men, for actor network theory, no thing is an island; and objects have no primary qualities, naturalised substance or objective laws withdrawn from, or independent of, their specific relations.

Here the intrinsic nature of humans, fossil fuels or capitalism cannot be taken as separate and separable causal explanations, but must be considered in relation to each other in any historical accounting of the postwar great acceleration. An important point to reiterate here though is that in doing away with essentialist, naturalised qualities and categorical, dualistic distinctions, these are not merely replaced by a formless, homogenous flux of powerless, structureless socio-matter. Power, structural imperatives and what appear as the apparently settled objects of politics exist, but they exist as effects, as outcomes. As I indicated in the introduction, the laws of the social world are not granted existence *ex nihilo*, nor do they wield a brute causal efficacy. Instead, they are to be explained and cannot unproblematically be incorporated within accounts and analyses as the silent arbiters of truth (Harman 2009; Latour 2005, 2010).

The second metaphysical commitment, performativity, derives from the first: ‘...the semiotic approach tells us that entities achieve their form as a consequence of the relations in which they are located. But this means that it also tells us that they are performed in, by, and through those relations (Law 1999:4). The notion of performativity has been developed extensively with a specific focus on economics within the sub-discipline of the Social Studies of Finance (e.g. Callon 1998; MacKenzie 2006; MacKenzie et al 2007). Economics as a discipline is understood as not merely descriptive or analytical. Instead, economists perform the increasingly certain reality of their own propositions, inscribing them into existence through the provision of new analytical techniques, mathematical theora, practical accounting, economic decision technologies, and market tools etc. The economy is not to be seen then as embedded in society, but in economics, and where ‘[e]conomics does not describe an existing external “economy” but brings that economy into being: economics performs the economy, creating the phenomena it describes’(MacKenzie & Millo, 2003:108).

Following Barry (2002, 2013), the constitution of the economy in the mid 20<sup>th</sup> century as a stable object of politics didn’t simply foreclose political contestation around this object, but its very fabrication opened up new forms of politics, around new objects - namely energy and the environment - and resulted in the development of new economic technologies and techniques in order to manage this politics. But it must also be seen as fracturing the prior direct relation between economy and growth. The economy, understood as an object defined by an essential law of growth has a very particular and peculiar quarter-century history from the end of the second world war - one which requires a promiscuous perspective in order to capture the way the economy and its essential law of growth were brought together.

Overall, the term ‘promiscuous history’ I derive in part from Philosopher Levi Bryant (2010). For Bryant, the ‘promiscuous ontology’ undertaken by the relational and performative commitments of actor network theorists involves a kind of indiscriminate realism, a sensitivity to the materially heterogenous composition of social actors and structures:

Within a promiscuous ontology, fictions, signs, corporations, signifiers, etc., are no less *real* than quarks and cane toads. Consequently, if we are to understand the world around us we can’t *privilege* one of these types of entities as overdetermining all the others, but must instead think them as a heterogeneous composition posing a problem of engineering (without an engineer or author). (Bryant 2010; emphasis in original)

This sensitivity to non-human agency - the role played by the material, technical and discursive aspects of the world captures part, but not all of what promiscuous history refers to here. It is not simply the case that we can go back through the postwar development of the economy, energy and the environment and reinstall a cacophony of human and non-human actors through an all-encompassing historical descriptivism. This would run the danger of sliding back into a fossil fuel fetishism, and as Jason Moore argues with respect to coal at the dawning of the age of industrial capitalism:

Geohistorically speaking, whomever says capital implicates coal in the era of large-scale industry: those who say fossil fuels make industrial capitalism are not wrong so much as errant in the insertion of a non-relational object (coal) in the relational process of capital accumulation ... By itself, coal is only a potential actant ... To paraphrase Marx, coal is coal. Only under specific conditions does it become fossil fuel, and come to shape entire historical epochs' (Moore 2014b: 14)

The promiscuous history that I undertake here is, in part, at odds with Moore's claim, and from this perspectives there are no strictly non-relational objects: *coal is coal is the material, technical, social, cultural and discursive relations within which it is embedded at different historical junctures*. However, Moore's warning against fossil fuel fetishisation is well taken, and the same point needs to be made for oil during the postwar triumph of growth. Only under specific conditions does oil become energy, and come to fuel the great acceleration. A promiscuous historical account needs then to be sensitive to the processes that render the complex socionatural world down into apparently silent, stable, factual objects. This is not a case of just opening up the 'black boxes' that comprise the economy, energy and the environment, but of both following the researchers, economists, engineers and political entrepreneurs who conceived and produced these objects, but who became largely invisible once the object was finished (Latour 2004:22-23), and then tracing the technically, materially and socially specific relations between these 'black boxes' and the things they seemingly black box.

This approach demurs then on the possibility of tracking the movement through time of already existing objects (Harman 2009:80), instead a promiscuous history is one that traces the series of translations (Barry 2013; Harman 2009; Latour 1993a, 1999b, 2005) required to construct and reconstruct the economy, energy and the environment. The concept of translation was originally defined by Latour as one of his

four principles of 'irreduction' (Latour 1993a; Harman 2009:14-16). Understood here as the means of linking one thing to another, it aims at capturing the process of constant mediation required to construct the 'laws of the social world' (Latour 2005:246). Translations link the things of the world - but never in a straightforward way. As Graham Harman has put it '[n]othing is pure calculation, nothing follows directly from anything else, nothing is a transparent intermediary. Everything is a mediator, demanding its share of reality as we pass through it towards our goal. Every medium must be negotiated' (2009:18).

Andrew Barry makes this same point slightly differently: 'Translation is a process of replication or imitation *and* differentiation at the same time' (2013:415; emphasis in original). It is never smooth. A Promiscuous historical account draws upon this notion to bring to light the unintended translational consequences that bring forward new relationships, powers and forms of contestation. The triumph of growth as (at least to contemporary mainstream political and economic thought) untranscendable and law-like, was developed through a series of performative translations that were central to the construction and reconstruction of the economy, energy and the environment and would format and standardise the relationship between these objects of politics within an economic narrative. This work was undertaken through the application of new economic tools and technologies developed and deployed by new economic sub-disciplines - first resource economics, then later environmental economics - and largely through the work of economists associated with Resources For the Future.

What do I mean more concretely by an object of politics? In the case of the economy, the approach undertaken here is much informed throughout the thesis by the political theorist Timothy Mitchell. Mitchell has analysed the economy, albeit with a variety of particular emphases, in a series of articles and chapters spanning a near-15 year period (e.g. Mitchell 1998, 2002, 2005a, 2005b, 2008, 2009, 2010, 2011). Drawing from the material semiotics approach espoused by the actor-network thinkers, he argues that, '[t]he economy came into being between the 1930s and 1950s as the field of operation for new powers of planning, regulation, statistical enumeration and representation.' (Mitchell 1998:91).

The economy does not refer simply to a new means to represent pre-existing economic functions however, although it is this in part. Nor does it refer only to the development of new economic processes, or regulations e.g. currency reform,

monetary circulation, exchange rate controls etc., although it bears in part on this too. Instead, the economy should be seen as a technical assemblage or machine composed of figures, tables, monetary flows, economists and their theorems. The economy understood in this way bears a rather more complicated, strange, and often unforeseen relationship to the system of energy and the environment as similarly fabricated objects of politics. As Mitchell argues (2008), shifting the development of the economy chronologically forward to the 1930s does not licence a simple recalibration of e.g. a Polanyian account, merely shifting this forward by a century. Mitchell maintains that Granovetter's (1985) repopularisation of a Polanyian account of embeddedness is limited here as:

...it always invokes some essential form of the economic. The economic refers either to rational action, which in different social and cultural "contexts" is more or less restricted by cultural or social ties, or to materiality, which in different "contexts" is differently stabilized or imagined (Mitchell 2008:1117)

Instead, and to quote Mitchell at length:

Rather than assuming there was always an economy, then, we need to explore the rival metrological projects that brought the economy into being. Understanding the making of the economy as overlapping and sometimes rival metrological projects, we can think about the relationship of economics to the economy in a different way. The two are not separate things. The projects that form the economy involve economics; economics is not outside, representing the economy from some other place. It is caught up in these projects. The success of economics, like all science, is measured in the extent to which it helps make of the wider world places where its facts can survive. (Mitchell 2008:1119)

In his 2011 book *Carbon Democracy*, Mitchell argues that energy and the environment are made into objects of politics in the late 1960s and early 1970s to rival the economy as part of, and as a means to, construct the crisis of the 1973-1974 oil price shocks, and thereby help install the market as a fundamental organising principle of democracy. Here I take the components identified in Mitchell's narrative, reposition them historically, and reassemble the total narrative for different ends, in order to adequately grasp the postwar historical development of the great acceleration. In order to begin this process, it is first necessary to outline how Mitchell approaches the historical development of the economy.

## The national economy

Mitchell argues that for Adam Smith and the political economists of the 18<sup>th</sup> century, the notion of the economy was not related to the structure of production or the exchange of goods within an economy (Mitchell 2005a:128). Rather, the notion of economy referred only to the frugal and prudent husbanding of resources, the undertaking of which was naturally related to notions of progress and growth. Drawing from Tribe (1978) and Poovey (1998), Mitchell (e.g. 1998, 2005, 2011) argues that an earlier tradition of writing on the management of the household or estate was applied by the early political economists to discussions of the state, thereby imagining this as the household of the sovereign. The political economists took as their object of study:

the proper husbanding and circulation of goods and the proper role of the sovereign in managing this circulation...Political economy referred to the economy, or government of the polity, not to the politics of an economy.'(Mitchell 2005a:128)

The second generation of political economists writing at the end of the 18<sup>th</sup> and start of the 19<sup>th</sup> centuries moved away from the tradition, initiated by Smith, of the imaginary of the household. What replaced this focus was not the economy as it is currently used, but rather their object of analysis was the world of 'human settlement, agriculture, and the movements of populations, goods and wealth.' (Mitchell 2005a: 128)

From the late 19<sup>th</sup> century onwards, the classical focus on the frugal and prudent use of resources was displaced by the marginal revolution in the economics discipline. Here, neoclassical economists proscribed the sphere of economic behaviour to the abstract notion of 'the market'. The new science of physics had just displaced the diverse and particular forms of matter and force associated with mechanical forces, heat and light, with the universal concept of energy. Economic theorists such as Jevons, Walras and Menger, enamoured of this theoretical approach sought to translate the singular force of energy into the economic milieu (Mirowski 1989, 2002; Mitchell 1998:85-86). Marginal utility theory was developed to describe economic phenomena solely with recourse to the interactions of buyers and sellers, each seeking to maximise their individual utility values in an abstract market.

It was not only the concept of energy that was translated from one discipline to the other, as economists made use of the language and imagery of physics. Equilibrium and stability, while having had a longer history of usage in classical economics, moved from being theological or biological concepts and mechanistic descriptions of actual markets, production and trades to the natural states of a highly abstract market; and terms such as inflation, contraction, inertia, friction and efficiency were taken to describe market pressures. Finally, economics borrowed from the pre-second law of thermodynamics programme of 'energetics' in physics its methods and models of explanation (Mirowski 2002:7). Mathematics increasingly became the language of economics, and formal proofs and quantitative measurement displaced both the analysis of the nature of the economic phenomena being described as well as the use of natural and mechanistic concepts to describe these economic phenomena (Mirowski 1989, 2002).

However, the need to incorporate processes beyond changing utilities in theories of economic functioning was becoming readily apparent by the depression era of the 1920s and 1930s. Erratic fluctuations in market prices necessitated that these processes, viewed as external to the market, be reincorporated into the discipline's conceptual structures. This would result however, not in a return to the political economy of Smith, or Ricardo or Marx, but in the development of the new concept of 'the economy'. Economy would no longer simply be the means through which progress and growth was achieved; instead it was invested with an ontological vitality, and through the development of a series of measurement processes into an entire metrological system. A system that was carefully tended by a new class of adepts - macro economists - and would come to play a vital role in the economics discipline as economists would claim their central place in the world in the middle of the 20<sup>th</sup> century.

In order to trace the development of the economy as a distinct object of both knowledge and politics - something that inheres not in 'the government of the polity' (Mitchell 2005a:128) but as a '...general structure of economic relations' (Mitchell 1998:85), Mitchell begins, as he notes, in the most obvious place: The publication of John Maynard Keynes' *The General Theory of Employment, Interest*

*and Money* (1936). Although Keynes himself referred to the 'economic society' or 'the economic system as a whole' in this text, it is clear that the coherent structure identified by Keynes is what would shortly thereafter come to be known as the economy. Keynes' approach, and the theory that he developed, arose in response to the immiseration and mass unemployment of the depression years, as well as to the economic programmes deployed by governments to address the depression, and the initiation of welfare and development programmes in the European colonies in response to threats to colonial rule after the first world war. In responding to these programmes, this new approach was concerned not just with the behaviour of the individual human, but by making use of aggregate measures of employment, investment and money supply, the construction of the idea of the economy can be seen as responding to '...the attempt to include in the picture of the economic process other forces besides the "energy" of individual utility (Mitchell 2005a:131)

Following the publication of his *A Treatise on Money* in 1930, Keynes was to break with his Cambridge predecessors, Alfred Marshall, and Arthur Cecil Pigou, and would argue that monetary flows should be conceived as a system in their own right, rather than as *simply another market*. Keynes argued that earlier theorists treated money as a neutral signifier of value, and for them therefore there was no essential difference between a system of exchange using money and a barter system. In contrast, in the earliest surviving drafts of *The General Theory*, from 1932 to 1933, as well as fragmentary lecture notes from the same period, Keynes discusses the difference between the 'real exchange economy' or 'neutral economy' of classical theory and the 'money economy' of the contemporary world (Mitchell 2005a:135).

This represents his first use of the economy in the sense taken for granted today, '... not as an aggregation of markets in different commodities, but as the circulation of money. The economy was the sum of all the moments at which money changed hands.' (Mitchell 2005a:135). However, as Mitchell notes, the importance of Keynes is easy to exaggerate, and this new perspective on what the object of economics was - the economy as the totality of monetary movements - coincided with the crucial development of the econometric tools and technologies required to accurately measure, determine and subsequently represent this new object.

The first econometric model claiming to represent an entire economy was published in 1937 by Jan Tinbergen<sup>3</sup>, the year after Keynes published his *General Theory*. Concerns about the depression drove Tinbergen's early work, similarly to Keynes, and he developed his first model in response to a Dutch government request for anti-depression policies. Three years later, in 1940, Tinbergen, then working for the League of Nations, developed the first large-scale model of the U.S. economy. This birth of econometrics in the late 1930s as an '...attempt to create a mathematical representation of the entire economic process as a self-contained and dynamic mechanism' (Mitchell 1998:85), should not be seen as resulting from some immaculate statistical conception however, but rather in relation to the earlier mechanical models of markets.

While the marginal revolution's adoption of the forces and explanatory models of physics was sweeping through the economics discipline in the late 19<sup>th</sup> century, there was a continuation of mechanical analogies for the functioning of economic processes in the work of American economist Irving Fisher. Fisher's 1892 doctoral dissertation, which would later be referred to by Paul Samuelson as 'the best of all doctoral dissertations in economics' (Samuelson, 1950:254; cited in Mirowski 1989:31) laid the intellectual groundwork for his mechanical model of a market, built the same year, that was comprised of a system pipes, levers, stoppers and cisterns through which water, representing utility, could flow. Fisher used this contraption in his classes at Yale until it was finally replaced by an improved model in 1925, and he maintained that this represented not just an overall picture of the market, but an investigative instrument, allowing variations in the economy to be studied by altering the position of the stoppers and levers that represented market variables (Fisher 1925: iii, 44; cited in Mitchell 1998:86).

Although attempts at calculating national wealth had been undertaken since 1665 and William Petty's estimates of income, expenditure, population, land and other assets of England, Wales and Ireland (Coyle 2014:8), approaches to calculating national wealth had been repeatedly scuppered by a series of vexed problems, such as how to avoid the double counting of goods and money. Even after the first world war, The Dawes

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<sup>3</sup> Who would later share the first Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel for this work.

Committee, set up to estimate Germany's ability to pay war reparations, would founder not just due to a lack of reliable data on national income, but to a failure to develop a useable conception of what it was supposed to count (Mitchell 2005b). While the following 20 years saw numerous attempts in Germany and the United States to remedy this situation, it was not until the innovations of Keynes and the econometricians that this problem became tractable, by reconceptualising the object to be counted.

Like Fisher, the new econometrics scholars, such as Tinbergen and the Norwegian Ragnar Frisch, would approach economic processes through mechanical analogies and models. At the time, this innovation was understood as a shift from a static conception to a dynamic one, where external forces were viewed as displacing and producing dynamic, internal impulses affecting the entire economic machinery. This approach required two conceptual shifts. First, a clear distinction had to be defined and maintained between what Frisch (1933) would call the 'intrinsic structure' of a mechanism and its exterior. Second, this intrinsic structure cannot be thought of any longer as a single market - it must be thought of as 'the whole economic system taken in its entirety' (Mitchell 1998:87).

This whole economic system would be rendered most clearly in the US, when Simon Kuznets of the National Bureau of Economic Research, developing the earlier work of British economist Colin Clark, systematised a method for estimating national income in 1934 (Coyle 2014:12). In 1942 the US Department of Commerce would begin publishing national economic data, and in his 1944 budget speech, President Roosevelt would officially introduce what would become the embodiment of the new idea of the economy; and what Alan Greenspan would refer to in 1999 as 'one of the great inventions of the 20<sup>th</sup> century' (Walker 2007:177) - Gross National Product (GNP). The enumeration of the GNP of an economy made it possible to represent the size, structure (and crucially) the growth of this new totality (Coyle 2014; Fioramonti 2014).

Alongside this, the metrological tools capable of accounting for all the instances of spending and receiving money within a specified geographical space - the national income accounts - would help make this object coextensive with national boundaries;

and in this way, the burgeoning reality of the new notion of the economy rapidly led to a re-imagination of the nation-state (Mitchell 1998:89) as the bearer of this precious burden. This re-imagination was not itself explicitly theorised and was instead introduced as a 'commonsense construct' (Radice 1984:122, cited in Mitchell 1998: 89) which provided the boundaries within which the new aggregate accounts of production, employment, investment, as well as synthetic averages such as interest rates, price levels and real wages could be measured. The subsequent division of economics into micro- and macro-economics would score this 'commonsense' construction of the national economy deep into the bones of the discipline. These conceptual innovations, alongside Keynes' reconsideration of monetary circulation, do not, however, simply denote the development of new forms of economic thought in the form of dynamic models and macroeconomics. Instead, they should be seen as marking the construction of a newly imagined object - the economy.

## Economy and growth

It was not until the turn of the 18<sup>th</sup> century that the idea of progress became commonly understood as involving a specifically material aspect, and the notion of progress began to be applied to standards of living, or national wealth (Purdey 2010:68). In 1776, Adam Smith wrote in the *Wealth of Nations* that '[t]he progressive state is in reality the cheerful and the hearty state to all the different orders of society. The stationary state is dull; the declining melancholy' (quoted in Arndt 1978:7), and by the middle of the 18<sup>th</sup> century - in Britain at least - the conviction that material progress was both possible and desirable was largely settled to the satisfaction of the discipline of classical economics.

Prior to this point, none of the many accomplishments achieved in engineering, architecture, technology, navigation and in numerous other areas and disciplines '... was thought of as "progress" - simply as ingenious contrivances of persons, mostly anonymous, to meet immediate needs' (Tuveson quoted in Purdey 2010:65). Purdey argues that there is no singular casual driver underlying the development of material progress in public thinking (2010:66), and that this should be seen as broadly driven by a series of social, material and intellectual innovations over the preceding three hundred years. The development of capitalism and protestantism spurred innovations

in capital formation and accumulation, while new wealth poured into the European empires through colonial expansion. Alongside this, the Italian renaissance, and later European and specifically French enlightenment thinkers - such as the Abbe de Saint-Pierre - proselytised for the possibility of new material comforts and riches. Later, the industrial revolution in Britain boosted material productivity driven by coal as a new and vastly superior source of energy in comparison to wood and man- or horsepower, and meanwhile, classical political economists followed Adam Smith's lead and promoted material growth, progress and economy in the use of resources.

For the classical economists, the actual desirability of material progress was rarely explicitly discussed or challenged (Arndt 1978:7). Here, their beliefs were in tune with the French encyclopedists and English Utilitarians in viewing the object of government as being the overall happiness of the people - and it was simply taken for granted that material progress was key to avoiding the declining melancholy of the stationary state as described by Smith. Notions of economy and notions of growth were closely intertwined here, and prudence in the husbanding of resources was directly related to the unabated assumption of progress and growth 'the progress of England towards opulence and improvement [would be] universal, continual, and uninterrupted.' (Smith 1776 quoted in Purdey 2010:68). To the extent that growth had limits, these were understood by Smith as inhering in laws, institutions, the size of markets and their impact on the division of labour, and with respect to the example of China given in the *Wealth of Nations* as inhering in the long run in the nature of China's soil and climate. Growth was ultimately conditioned by the state of the land - the 'passive' element of classical growth theory - for Smith (Smith & Skinner 1986), but this was essentially unproblematic given the distant limits of the fertility of the earth; and for the British Empire at least, its continual territorial absorption, population expansion and concomitant stimulation of demand and production (Arndt 1978; Purdey 2010). The second generation of classical economists would, however, view economic growth with a more baleful eye.

The first of this new generation of political economists, the Reverend Thomas Malthus, would take the cycle of populating and cultivating new territories as his central concern. Malthus was writing at the end of the 18<sup>th</sup> century and the start of the 19<sup>th</sup> - at a time when Britain was at war with revolutionary and imperial France, and then

experiencing deteriorating social conditions in industrial cities, mass unemployment and post-war depression. This influenced Malthus' much less optimistic outlook with respect to growth. Malthus, like Smith, believed in the desirability of rising material prosperity and living standards, however, he was far more pessimistic than Smith on the likely possibility of material progress in the future.

For Malthus, the threat of an increasing population, which unless it was checked by moral restraint - a prime concern in the writings of the good Reverend, and a facility he found sadly lacking in the ravening crowds of the poor and indigent - would surely outrun supply, primarily that of food. Not only this, but the potential for excessive saving, and a consequent glut resulting from this, could, from the other side of the classical equation, destroy demand and 'leave no motive to a further increase in production' (Malthus, cited in Arndt 1978:9). Importantly though, this concern of Malthus' was not with a diffuse, amorphous or ever-present notion of scarcity in general. Instead, as Lyla Mehta argues, paraphrasing Xenos (1989): 'Until the late 19<sup>th</sup> century, scarcity connoted a temporally bounded period of scarcity or dearth. Scarcity was experienced cyclically, dependent usually on poor yields' (Mehta 2010:14). Specific scarcities were Malthus' focus, not scarcity in general.

David Ricardo retained a Malthusian focus on land settlement in his narrative on corn production, as well as an expectation of the end of growth as the rate of profit declined - given the transfer of an increasing proportion of income to landlords as rent due to the pressure of an increasing population on limited land. Ricardo was no dire pessimist however:

The question is not whether the Creator did not consult our real happiness by limiting the productive powers of the land, but whether the fact be not, that he has so limited it,—while He has given us an unbounded supply of water, of air, and has set no limits to the use we may make of the pressure of the atmosphere, the elasticity of steam and many other services rendered to us by nature. (Ricardo et al.2004:210)

Unlike Paul Samuelson's later characterisation of him as representing a 'retreat to a gloomy concentration upon the law of diminishing returns' (Samuelson, collected papers; cited in Arndt 1978:9), Arndt indicates that the end of growth and the stationary state can be put off for Ricardo, effectively into the indefinite future, through

the development of foreign trade, exploitation of the almost limitless resources of the non-European world, and through technical progress (Arndt 1978:9-10).

Karl Marx and John Stuart Mill would similarly make use of these organic and cyclical imaginaries. In the case of the former, Marx critiqued the lack of distributive justice under capitalism, but not the concept of material progress per se. The latter, Mill, was the last major classical economist to focus on economic growth in line with the thought of Adam Smith. Mill bore much more lightly a concern with the end of growth in the stationary state that laid heavy on the brows of the other great classical economic thinkers, but on the likelihood of future growth he had little new to say (Arndt 1978:11). He straightforwardly accepted Ricardo's argument on the fall of the rate of profit in the face of population increases without an expansion of productive land.

For the classical political economists then, growth and progress were considered in the brute material terms of the expansion of populations and agriculture, towns, trade and manufactures; and this growth was intrinsically and therefore atomically fused to economy as the ultimate aim in the husbanding of resources, whether these be of the household of the sovereign, of the settlement in its territory, of the city, or even the factory. Outside of the sphere of academic political economy, geopolitical concerns were increasingly intertwined with a rush towards growth at the time, but these were similarly thought of in the very concrete terms of the expansion of colonial holdings and the spread of empire, as Friedrich List would make clear in his admiring assessment of Britain in 1885, a country which:

owes her immense colonial possessions to her surpassing manufacturing power. If other European nations wish to partake of the profitable business of cultivating waste territories and civilising barbarous nations...they must commence with the development of their own internal manufacturing powers, their mercantile marine, and their naval power. (List 1885:270; quoted in Dale 2011)

With the coming of the marginal revolution in the mid-to-late 19<sup>th</sup> century in the work of Jevons, Walras and Menger, the interest in, and concern with growth would largely disappear - replaced by a focus on marginal utility theory in the developing neoclassical tradition. At this point, professional and academic economists broke with

the earlier political economy tradition of Smith, Malthus, Ricardo, Marx and Mill. These changes enabled the reconstruction of the market in specifically mathematical and graphical terms. No longer referring to the social marketplace conceived in relation to agriculture or the factory that Ricardo and Marx had in mind, but 'to a utopic space, formulated geometrically, by the axes of a chart, as the two-dimensional plane on which numerical utilities could meet and balance one another' (Walras 1874[1952]; cited in Mitchell 2005a:129).

After the 1870s the explicit concern with growth in the economics discipline largely disappeared along with the classical notions of social marketplaces and the meaning of economy. Instead, the preoccupation with the market as intersecting utility functions would subsume a concern with growth under the notions of efficiency and Pareto optimality, and as Arndt has noted 'hardly a line is to be found in the writings of any professional economists between 1870 and 1940 in support of economic growth as a policy objective' (Arndt 1978:13). Along with the disappearance of growth, would come the arrival of generalised scarcity. The particular and cyclical scarcities of Malthus - grounded as they were in the failures of a limited natural environment, to provide for the unlimited desires of human nature - were reconceived under the marginal revolution as a general scarcity derived not from an external nature, but from human nature and the inherent tendency that the neoclassical economists divined for human wants to perpetually outrun the means to satisfy these.

Overall, growth was largely coeval with the notion of economy as this was understood prior to the middle of the 20<sup>th</sup> century, and had two notable characteristics within the discipline of economics. First, it was rarely an explicit concern. To the extent that growth was overtly considered by the classical political economists, it was understood simply in terms of material expansion: the appropriation and population of more lands, their cultivation, and expansion of trade. Growth was ultimately dependent upon the expansion and cultivation of the fertile soil, and it would either follow directly from the practice of economy and would develop towards what Smith envisioned as the future of England, namely opulence and improvement; or the possibility of its exhaustion would follow directly from the depletion or otherwise of the resources of nature. Second, for the later marginal theorists, growth would disappear altogether from scholarly analysis as the focus of the discipline shifted from specific marketplaces to an abstract notion of market efficiency. However, the development of the new concept

of the economy as a discrete object brought with it the possibility of new powers, new agencies, new politics, and new policies (e.g. Mitchell 1998, 2008). As I uncover in this thesis, the mid 20<sup>th</sup> century composition of the economy revitalised concerns with resource depletion. This brought about the necessity for the application of the generalised, economic scarcity of the neoclassical economists, and a new conception of growth. This was subsequently stabilised over a quarter century period beginning around 1950, through the innovation of new economic techniques and technologies and the subsequent construction and reconstruction of energy and the environment.

## The promiscuous history of growth

If we want to understand the development of the great acceleration, it is necessary to undertake something other than a natural history of the economy, energy and environment. I maintain that a promiscuous approach - sensitive to the ways that these are composed as objects of politics - is required to appreciate how, through what means, and with what effect the growth of the economy would come to be seen as central to the nation state.

Anthropocene, ecomarxist and 'climate capitalism' perspectives, in their attempt to de-naturalise their objects of enquiry, simultaneously naturalise the causal drivers and contexts they use to explain the development of these objects. These explanans are then rendered as often silent, ahistorical, and divorced from the materially and technologically composed, contested and recomposed objects themselves. Grasping and ultimately contesting the very contemporary focus on economic growth with its manifest environmental impacts requires that its causes not be reduced to the simply human, nor to a fetishised fossil fuel, nor indeed to capitalism. Instead, the relations between these apparent causes need to be brought within the ambit of study and their material instantiation traced over the quarter century period beginning in the middle of the 20<sup>th</sup> century.

Before the expansion of monetary flows, Keynes' analysis of their circulation, the innovations of econometrics and the development of national accounts and GNP, if growth was discussed at all, it was imagined, following the classical political economists as inhering directly in the development of new territories, cities, manufactures and markets, the expansion of trade and, most crucially, the population (Mitchell 1998: 90). The economy as an object of political and academic concern, as

outlined above, was tabulated into existence from the mid 1930s, through the new metrics of national income accounting and GNP. But these measurements were focused on the increased frequency with which paper money changed hands, and not the accumulation of wealth as had previously been counted. Following this new conception of the economy 'it became both possible and necessary to imagine economic growth in new terms, not as material and spatial extension but as the internal intensification of the totality of relations defining the economy as an object.' (Mitchell, 1998:90) The economy, in the process of its development, was therefore torn away from its direct material basis.

The growth of the economy did not inhere in, nor was it measured by, the expansion of population, the conquest and settling of new land, the development of agriculture or the trade in new commodities. Instead, '[i]t could grow without any problem of physical or territorial limits.' (Mitchell 2011:139) And given this lack of limits, without fear of ending, ultimately, in the unavoidable 'declining melancholy' of Adam Smith's stationary state. Ironically, the development of the economy as a dematerialised object capable of apparently infinite growth would result in a refocusing of attention on the material resources of the nation. That is, while the development of the economy, as a separate, measurable and observable sphere of monetary flows was elevated to the level of both essential freedom and natural necessity, this rapidly brought about a concern with this essential growth. The economy was not immediately disinterested from its earthy, material constraints. Instead, the natural resource base of the national economy was itself brought crashing back into the ambit of political and economic consideration in several ways.

First, through the developing cold war the possibility of the growth of the national economy was converted into an absolute necessity. In the postwar world of evidently exhausted mineral and other natural resources, the need for economic growth, understood as the intensification of monetary flows within spatially constrained national boundaries, would at the end of the 1940s and beginning of the 1950s, bring the Reverend Malthus heaving back from the dead; and as the ghost of economics past, the pessimism of resource scarcity would begin rattling its filthy chains around the new, and essential, national economy.

Second, from about the mid-1930s, and at the same time as the economy was being constructed as a discrete and ontologically secure object, the various mineral fuels and

other power sources that sustained the means of production and consumption in the US were beginning to be reconsidered not as separate sources of power, but as a total system of energy. This system was perceived as complexly interrelated and in need of overall coordination in order to enable continued growth.

Third, during the postwar years, a concern with environmental despoliation would continue to grow as the settling of the economy as a central object of politics would be seen to result in ever broader, non-local and pervasive environmental impacts. Eventually, and shortly after both the growth of the economy and the energy to fuel this growth had been secured by a raft of new economic techniques and technologies, this very certainty was reconstructed as a fundamental problem, and the environment was brought to objective life in opposition to the economy.

This would not last however, and fourth, from the late 1960s through to the mid 1970s, both energy and the environment would be reconstructed in such a way as to undermine this opposition and reinstall the primacy of growth. It is to these changes, the relational, performative and therefore promiscuous history of the contemporary composition of the economy, energy and the environment and the eventual development of growth as a core 'law of the social world' that I now turn.

## 4. Economy

In 1949, the US economy was born. Or, to put it a different way, in 1949, in the US, 'the economy' was born. Or to put it differently again, in 1949, eight years after Simon Kuznets, creator of the Gross National Product (GNP), had echoed Dr Frankenstein's concern at the apparent vivacity of his own creation, and warned that 'a national total facilitates the ascription of independent significance to that vague entity called the national economy' (Kuznets 1941; cited in Mitchell 2005a:136) the independent significance of this vague entity was further assured by literally writing it into history. But this was a strange, self-abjuring birth. In 1949, the national economy, given form and figure as national income, GNP and other aggregates, averages and statistics, would be collated, compiled and projected back through American history in a single volume; the Bureau of the census' landmark study: the *Historical statistics of the United States 1789-1945* (United States 1949). And in this way would find that it always and already existed.

This volume was developed as a supplement to the annually produced Statistical Abstract of the United States, and was overseen by the Social Science Research Council Committee (SSRCC) on the Source Book of Historical Statistics. The Chairman of the SSRCC at the time, the economist J. Frederick Dewhurst, who was also the Executive Director of an organisation called the Twentieth Century Fund<sup>4</sup> was instrumental to this project. In a memorandum dated April 12<sup>th</sup> 1945, Dewhurst wrote of the need for 'a volume which would bring together within a single cover the most important of the comprehensive statistical series measuring the economic development of the United States over the past century or more.' (United States 1949:vi). Comprised of over 3000 time series, within fourteen formal categories<sup>5</sup> over 363 pages, the *Historical statistics of the United States 1789-1945* would represent for the first time, in one single place, the entire economic history of the US. But it did more than this. By retrojecting Kuznet's GNP and other national income figures in the

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<sup>4</sup> The Fund was originally incorporated as the nonprofit 'Co-Operative League' in Massachusetts, and would later be renamed as The Century Foundation.

<sup>5</sup> e.g. Wealth and Income; Population Characteristics and Migration; Vital Statistics, health and Nutrition.

form of a series of partial estimations <sup>6</sup> the *Historical Statistics* didn't, in fact, uncover the history of a heretofore existing object - the US national economy; rather, it tabulated and transcribed this object into historical existence. This enumeration constructed the specific US economy as a historical object, and at the same time helped reinforce the idea of the economy as transhistorical. The economy measurable in the form of GNP was rendered outside of the flow of history and therefore capable of containing, of bearing, a history of its own.

The birth of the economy as a discrete object in the world, whose corporeal presence could be captured and weighed by the new aggregate statistical measures pioneered from the mid 1930s onwards, had been substantially completed by 1949. As with all new arrivals however, the occasion was also marked with a certain amount of Trepidation. In 1947, two years before the publication of the *Historical Statistics*, J. Frederick Dewhurst had been responsible for another study - on the natural resources of the US, the impact of the war on these, and how future use would affect the economic position of the nation. *America's Needs and Resources* (Twentieth Century Fund 1947) sought to undertake a comprehensive audit of the material position of the US, and was a highly influential volume. Dewhurst's work here would help set the tone for the widespread post-war concern over the apparent depletion of natural resources in the US and help usher in a reinvigorated postwar Malthusian pessimism.

This chapter begins by tracing the relationship between Dewhurst's two concerns. It unravels how the construction of the economy resulted in a new and overriding political focus on its growth in the aftermath of the second world war, and how this would itself result in the manifest fear of resource depletion and the devastating impact this would have on the economy. In response to this fear, on June 2<sup>nd</sup> 1952, The President's materials Policy Commission (PMPC) published its report: *Resources for Freedom: Foundations for Growth and Security*. More commonly referred to as the Paley Report after its Chair, the Columbia Broadcasting Service (CBS) Chairman, William S. Paley. Alongside a comprehensive assessment of both historical and contemporary mineral, energy and agricultural resource use over its five volumes, the report projected the basic economic characteristics of American society over a twenty

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<sup>6</sup> e.g. time series A 154-164 which represented National Income from 1799-1938 as estimates of realised private product income.

five year span and included the prospect and potential extent of any materials shortages over this period.

The Paley Commission would begin the process of securing the economy as an apparently tangible object in the world bounded spatially and temporally to the nation state, and defined first and foremost by a naturalised law of limitless growth irrespective of any material constraints. For Mitchell (2011:177, footnote 10), the issue of the scarcity of oil and other fuels - considered under the rubric of natural resources - is laid to rest by the Paley commission report. This is not quite the case however. While the conceptual and methodological innovations of the Paley commission helped to further secure the notion of the economy, concerns continued throughout the 1950s regarding the ongoing use of increasingly limited resources and the resurgent necessity for conservation measures. At the same time, the necessity of the growth of the economy was increasingly bearing down on the American political consciousness, given the ever increasing weight of comparison between the new national account statistics (Arndt 1978: 50-51).

Ultimately, these post war concerns were finally exorcised by work undertaken at the end of the 1950s and early 1960s by Resources For the Future (RFF), the think established in 1952 by William Paley in the wake of his commission report. Studies that were published in 1962 and 1963 by RFF were widely read and would kill off the lingering fears of resource scarcity, formalising growth as the fundamental logic of the economy. By 1964 the growth of the economy had come to occupy 'an exalted position in the hierarchy of goals of government policy, both in the United States and abroad, both in advanced and in less developed countries, both in centrally controlled and decentralized economies.' (Tobin 1964:1). This chapter tells this story - of how, in postwar America, the economy got its growth.

## The necessity of growth

In 1940, President Roosevelt had proclaimed 'freedom from want' as one of the basic 'four freedoms'. Similarly, 'economic advancement for all' was one of the peace aims of the Anglo-American alliance as laid out in 1941's Atlantic Charter. While these espoused aims sought economic advancement as the means to the material

betterment of humanity after the war, the settling, during the 1940s, of 'the economy' as a spatially bounded entity coterminous not only with national borders, but with the foundation of the nation itself, would result in both the development of a new politics of growth, and driven by this, new attempts within the economics discipline to theorise the growth of the economy (Arndt 1978:33). In the US, the legacy of the great Depression and New Deal resulted in a continuation of Keynesian macroeconomics oriented around a doctrinal concern with secular stagnation. This approach was particularly associated with Alvin Hansen, the Harvard Professor of Economics who was known as the 'American Keynes'.

Within this rarefied air of US Keynesianism, the construction of 'the economy' as an observable totality provided - with the development of GNP and other macro-economic statistics - a ready marker of potential catastrophe; and indeed, every dip in economic activity and employment in the late 1940s was suspected of heralding the long-feared return to depression. Hansen himself believed that the war was merely a delay to an ultimate reckoning, and along with the majority of the American economics establishment, believed that a return to peace would result in deficit aggregate demand and mass unemployment (Arndt 1978:28).

#### *The economy and the fear of postwar depression*

Paul Samuelson, one of Alvin Hansen's students at Harvard, was influential in propagating this concern with secular decline. In 1943, he wrote in the volume *Postwar economic problems* that 'the most important of [the post-war economic] problems is that of providing for *continuing full employment*' (cited in Arndt 1978:27). Later, in *The New Republic* magazine in September 1944, Samuelson warned again that victory in Europe would result in an increase in unemployment or underemployment of around five million (Samuelson 1944; cited in Lekachman 1966:147). This view was corroborated by a series of econometric projections based on pre-war consumption estimates <sup>7</sup>, that predicted the number of unemployed by the first spring after the cessation of hostilities to be anywhere between 5 and 11 million. (Lekachman 1966:138)

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<sup>7</sup> Notably, these estimates neglected to include war time personal savings and estimations of deferred demand.

Unemployment was not merely an obscure academic concern either. On December 1<sup>st</sup> 1943, the Pabst Brewing company of Milwaukee announced an essay competition on the theme of US post-war employment and future economic growth. They received over 35,000 entries. It was in this atmosphere of manifest concerns over unemployment and the return to depression, that Congress passed the Employment Act of 1946. This imposed on the Federal Government the requirement to maintain at least 'high levels of employment' (Arndt 1978:28), and in order to help implement the act, the Council of Economic Advisors (CEA) was set up to advise the President on national economic policies. Indeed, one early member of the Council, and its second Chairman (from 1949-1953), Leon Keyserling, had, with all the dull prognostication of a fairground fortune teller, already pre-empted the CEA three years earlier by advocating for a council of economic experts in his submission to the Pabst competition. His essay was placed second (Pickens 2009:122)<sup>8</sup>

The development of the CEA effectively institutionalised the discipline of economics within the White House, placing this at the centre of political discourse, and indeed in 'a position that enabled economics to situate itself in the postwar period as the true political science' (Mitchell 1998:88-89). This 'true political science', as [agricultural economist] Edwin Nourse, the first President of the CEA would later claim, was focused clearly on the newly defined object of the economy:

Passage of the Employment Act not only constituted a formal recognition of the integral character of the economics of the economy, but also set up a specific machinery for dealing with this problem in the spirit of science, with the best tools that economic science can provide, and with trained scientific personnel. (Nourse, 1953:15-16; cited in Mitchell 1998:89)

These personnel, bearing the tools of economics and built into a government machinery increasingly focused on the economy and its problems, could situate themselves as presidential viziers<sup>9</sup>, capable of translating GNP and other statistical measures into meaningful and programmatic macro-economic policy prescriptions aimed at addressing the much feared economic decline. The concern with post-war depression that resulted in the development of the CEA was not unique to the US

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<sup>8</sup> Keyserling was at that point a consultant economist to the Senate. The first place Pabst essay winner was Henry Stein who would later act as CEA Chairman from 1972-1974.

<sup>9</sup> similarly to the process under RAND with respect to the air force.

either, and one of the last reports published by the League of Nations in 1945 was focused on employment and stability measures for the post-war world (Arndt 1978:28). However, the fear of mass unemployment accompanying the depression heralded by Hansen and his peers would not for long survive the end of the war. Although initially resistant in the face of high employment and booming demand in the mid-to-late 1940s, this would eventually give way to concerns over precisely this demand and the potential inflationary pressures that it presaged. This change was adroitly captured by the preface of a book on US income stabilisation begun in 1946 but not finished until 1953:

This book...was conceived in 1946 at a time when it appeared that all the instruments of policy might have to be mobilized to meet the problem of a major postwar depression. Later, when first drafts of some of the chapters became available, it seemed inconceivable that there could be a threat to stability from any cause but inflation. (Millikan 1953:v; cited in Arndt 1978:29)

Conjured out of the corpus of statistics that settled the weight of the newly constructed national economy, the fear of depression and decline that spread from the American Keynesians to the public at large would rapidly subside in the US. However, the federal government's response to this fear - in the form of the 1946 employment act and the President's Council of Economic Advisors - would prove to have a broader and more tenacious impact. The solution proposed to the problems of the economy - initially depression, then a fear of inflation - by these economic experts was quite straightforward: The economy must grow. In October 1949 Leon Keyserling, in the first week of his appointment as acting Chairman of the CEA, would expound on his core idea of 'expansion economics' in the first of his Monthly reports to President Truman. Likely the earliest substantive, official pronouncement in favour of the growth of the economy as a policy objective (Arndt 1978:35), Keyserling would claim:

We need more than a slight upward trend of business and employment... Economic stability requires economic growth, and the maximum employment and production objectives of the Employment Act require an expanding economy from year to year... We believe that your announced goal of a 300 billion economy is not just a slogan; it is the central solution to the core problems of our economy. (cited in Arndt 1978:35)

The call for growth explicit in the 'expansion economics' ushered in by Keyserling echoed for the next three years as the 'theme song of the Council of Economic

Advisors' (Smithies 1951; cited in Arndt 1978:35); and from 1949 this song would be played to a more explosive beat.

### *Expansion economics and security*

The detonation of the first Soviet atom bomb in August 1949, two months prior to Keyserling's first monthly report, would help ignite a new anxiety in the US, and the concern with security would be further inflamed in the minds of policymakers by both the release on April 14<sup>th</sup> 1950, of the National Security Council's NSC-68 report - with its depiction of an uncontrollable and monstrous Soviet threat; and the entrance, one month later, of the US into war on the Korean Peninsula. These new security threats immediately reinforced the necessity of economic growth, and an expanding economy rapidly came to be seen as the basis of a response to these threats to the nation. In the three years between 1949 and 1952, growth became a nascent political concern not simply as a means for the achievement of human material betterment, but because the economy as an object could grow, and above all - with the creeping fear of what Walter Lippmann initially named (borrowing from George Orwell) the 'cold war' - must grow.

By 1950 the call for economic growth had been heard not just in the US, but around the globe. In May of that year, the UN Economic Commission for Europe published the third volume in its *Economic Survey of Europe* series. Produced under the auspices of the UN's first Executive secretary, Gunnar Myrdal, and its first Director of research, Nicholas Kaldor, the survey marked a distinct shift of emphasis from growth as a means to full employment and the avoidance of a post-war depression, to full employment as a *means to economic growth* as a central concern. While Myrdal wrote in the preface of this report on the importance of an expanding economy and the expansion of production in order to raise living standards, the shift from *growth as means* to *growth as goal* should be located with respect not just to the development of an expansion economics programme, but with the recent construction of the economy as an object defined primarily by its growth.

The survey took a dim view of what it characterised as a tendency within Western Europe to regard the current economic programmes as part of some short-term and exceptional measures, rather than as the initial phase of a long term drive for economic growth (Arndt 1978:37), growth that the survey authors took as

unproblematic and assured: 'A basic assumption underlying the perspective of a more rapid growth in the future is that it will be a steady and cumulative development' (quoted in Arndt 1978:37). This evidently deplorable lack of concern in Western Europe with secular growth was contrasted in the report with the focus on growth in both the Soviet Union, with its aim to treble industrial output within about twenty years, and the US, with its expectation of matching Truman and Keyserling's desire, and increasing national income by a quarter, to 300 billion USD in just five years (United Nations Economic Commission for Europe 1950:98).

Stephen Purdey has argued that in keeping with the doctrine of neoclassical economics, the post war renaissance in explaining and enhancing processes of growth required a numerical indicator as a means to measure forward motion (Purdey 2010:79), and that GNP served as that newly developed indicator. Contrary to the causal direction of this claim however, it is rather that the development of the economy, enumerated into discrete existence in large part through the development of GNP, that resulted in this new and urgent policy concern with growth; and through the very possibility of comparison shaped the nascent cold war into what economist Richard Norgaard referred to as the 'great GNP race' of the US and USSR (Norgaard 2001; cited in Purdey 2010:79). Not only did the new aggregate statistics enable the national economy to be measured into ever sharper existence then, but GNP and the very possibility of comparison that it allowed created new and further pressures for the cold war.

In 1952, Simon Kuznets noted that the development of academic economists' 'interest in problems of economic growth [was] largely an aftermath of current events' (quoted in Arndt 1978:35), and the rapid segue from depression fears to security concerns can be seen as marking the development of the contemporary interest in the growth of the economy by both policy-makers and the economics profession at large (Purdey 2010:78). However, in the case of the economics discipline, this should not be considered as simply a return to a classical economic concern with growth after the interregnum of the neoclassicals and their focus on market efficiency. Instead, the economy, as a newly imagined, tabulated and historically reconstructed object brings with it both the possibility and the necessity of imagining growth in new ways (Mitchell 1998:90). This new understanding of growth is driven by the newly developed machinery of the economy: increasing monetary flows

within and between nationally bounded territories, new economic techniques and technologies of measurement, developed by the 'true political science' of economics, operated by the personnel of this discipline, and pushed into pre-eminence by the developing architecture of the cold war.

In the same way that the modern conception of 'the economy' differs from classical economic notions of economy as a process, the modern understanding of growth - specifically the growth of 'the economy', is not equivalent to its classical forbear. The politics of this new growth would derive, in the first instance, from the continuation of an American Keynesian programme that was overwhelmingly concerned with a post-war return to depression, and when this depression failed to arrive the concern with national security would take over as the driver of a concern with growth. Indeed, the developing cold war converted the possibility of the growth of the national economy into an absolute necessity. In the post-war world of apparently exhausted natural resources, the need for economic growth, understood as the intensification of monetary flows within spatially constrained national boundaries, would at the end of the 1940s and beginning of the 1950s, bring the Reverend Malthus heaving back from the dead; and as the ghost of economics past, the pessimism of resource scarcity would begin rattling its filthy chains around the new, and essential, national economy.

## The scarcity of natural resources

On May 31<sup>st</sup> 1945, Harold Ickes, who was then Secretary of the Interior, wrote to President Truman proposing: 'a world conservation conference following the end of the war'. Ickes explained that 'the war has taken a heavy toll of the forests, the oil, the coal, and the iron and other metals' (cited in Goodwin 1981a:10), and he maintained that the demands for these materials could hardly be expected to diminish in peacetime. For Ickes, a world conference would enable an inventory of natural resources to be developed on a global scale, and allow the extent of natural resource depletion to be properly evaluated. Following this, techniques for conservation could be established, including the development of synthetic fuel sources and the prevention of the private monopolisation of natural resources. This initial attempt by Ickes to establish the Interior Department's responsibility for both international and domestic natural resource issues was promptly cut short when the proposed conference was

delayed for four years. This postponement would not deter Ickes and his staff for long however, and in November 1945, he held a five day 'Post-war resources Institute' in the Department.

The urgency of Ickes' vision and his desire to convert the Department of the Interior into what would in effect be a Department of Energy, Resources, and the Environment was underlined by the institute's emphasis on the status of post-war scarcity in the US, and its growing dependence on foreign natural resources of all kinds. Alongside this, in the immediate post-war years, the umbral fear of growing resource shortages would begin to stain the bright minds of American economists and policy makers. The potential shortfall in the availability of uranium, the observation of hugely disruptive British coal shortages, and shift from the US as net exporter of oil to net importer all heightened concerns about the continued availability of mineral fuel sources. In 1950 W.E. Warne would state at the fourth World Power Conference that "... the rate of extraction of coal and oil gives rise to anxiety as to the future sources of energy for power production" (Warne 1950; cited in Putnam 1953:117).

*Dewhurst, neo-Malthusianism, and the postwar resource scarcity*

In the face of presidential reticence over the expansion of the Interior Department and changing national goals, Ickes' vision for a single department in charge of national energy policy never came to pass (Goodwin 1981a:14). For the Truman administration, the push for an expanded remit smacked of a New Deal Planning philosophy - with which Truman himself was never comfortable, and with the newly developing fear of communist expansionism, the nation's natural resources and energy were considered too important to be entrusted to a single department (Goodwin 1981a:14-16). While the development of the Interior Department as an institutional locus for energy and resource issues stalled in 1945, the importance of these concerns would be further reinforced for the Truman administration and the general public at large by intermittent shortages in all of the major fuel sources - particularly in the winter months - following the war.

These shortages were temporary, and more often than not related to bottlenecks in refinery capacity, steel shortfalls or transportation issues rather than the outright scarcity of resources. However, the fact that these were accompanied by significant price rises and ongoing public uncertainty as to whether they were merely short run issues or long term problems raised the spectre of neo-Malthusian pessimism regarding the status of material resources (Goodwin 1981a:32). The moans of this shambling revenant would only get louder to the public ear with President Truman's decision to involve the US in the economic recovery of Europe through what would become known as the Marshall Plan. Arising almost immediately from this decision were the questions of what this would mean for the US, and how this would stress an already depleted resource base (Goodwin 1981a:32). In the middle of this developing concern, J. Frederick Dewhurst, the principal force behind the *Statistical History of the United States*, would undertake, at least with respect to the US, the kind of inventory of natural resources and assessment of resource depletion that Harold Ickes had proposed in 1945, but failed to bring to fruition. Dewhurst's project added the weight of numbers to the burgeoning fear of resource depletion and further discoloured the mouldering American imagination.

Dewhurst was, during the war years a staff economist with the Twentieth Century Fund. In this capacity he was tasked with producing both a wide-ranging audit of the material and economic position of the US, as well as the vastly more difficult task of projecting forward the trends revealed by this research. In May 1947, this project would reach fruition with the publication of *America's Needs and Resources*. Here, Dewhurst, alongside the many federal and state employees who were involved in developing the analysis, actually helped undermine depression fears through estimations of deferred consumption and capital goods demand - which were argued to be as high as 60 billion USD (Twentieth Century Fund 1947:653). Alongside this however, the report was clear to state that 'The Development of the American economy has been determined in large measure by the natural resources at our disposal and by our ability to obtain from them the raw materials that supply the foundation of our economic activity' (1947:573). What was of real concern here then, was the impact of the war on the US' natural resource base. The war brought home to the American people, Dewhurst argued, the fact that while the US was 'blessed with a wider abundance of natural resources than any other industrial nation (with the possible exception of the Soviet Union)' (1947:675), they were not self-sufficient in a

wide array of essential raw minerals. Moreover, Dewhurst and his co-authors would reinforce the view that the preceding global conflagration had burned too bright, for too long, and in the process:

It “chewed up” enormous quantities of iron, copper, lead, zinc and aluminium, much of which will never be recovered for further use. The war also resulted in a vast consumption of petroleum, and to a less extent of other exhaustible mineral fuels. On the whole, the war left the United States with a depleted supply of most natural resources, and a critical situation so far as some of the most essential minerals are concerned. Petroleum, copper, lead and zinc “present” the most important scarcity problems for the future.” (Twentieth Century Fund, 1947:675)

*America's Needs and Resources* was covered in *Fortune*, *Life*, *Business Weekly*, *Forbes* and the *New Yorker* magazines as well as numerous other periodicals, and this dense, 800 page tome proved so popular as to exhaust its initial print run in just three weeks, was reprinted in the fourth week, and again in September 1947. That same month, the American Broadcasting Company aired a special radio documentary based on the report (Twentieth Century Fund 1947). In 1949 - the same year as the *Statistical History* - It was reprinted for the fifth time alongside a simplified graphical representation of the report's findings in a volume entitled: *U.S.A., Measure of a Nation*, and a series of three essays based on this new volume were printed in 40 of the nation's leading newspapers (Twentieth Century Fund 1950). The popular dissemination and discussion of Dewhurst's work here would help set the tone for the widespread post-war concern over the apparent depletion of natural resources in the US and help usher in a postwar neo-Malthusian pessimism.

While the report echoed the absolute resource scarcity concerns of Malthus, Dewhurst himself was in fact somewhat sanguine about the ability of future needs of the economy to be met by this depleted supply of natural resources - which he maintained could be provided through the expansion of overseas trade. However, the concern that the nation's material bounty had been exhausted was spread like a pox through the broader American public by a glut of popular books that followed the Dewhurst report. In 1948 Fairfield Osborn published his best-selling book *Our Plundered Planet* (1948), and this was shortly followed, also in 1948, by the even more popular *Road to Survival* (1948) by William Vogt. These books reinvigorated fears of a neo-Malthusian apocalypse driven by resource scarcity and rapidly increasing population (Desrochers

& Hoffbauer 2009; Foster 1998; Hays 1959:41-42). As a contemporary reviewer noted at the time:

As a means of attracting the public's attention to an over-all problem, "Road to Survival" and its prototype, "Our Plundered Planet", certainly have great value. Both books are filled with a wide variety of valuable information. But they make one shudder, and create fear, with a minimum of suggestions as to how we are to extricate ourselves from the dilemma they so ably portray. (Cooke 1949:210)

These books not only grabbed the American public's attention, but their reach extended both beyond popular purview and America's borders. Julian Huxley, the first director of the United Nations Educational, Scientific and Cultural Organization (UNESCO), argued that Osborne's book 'draws attention, in a forceful and compelling way, to one of the most urgent problems of our times...A new ethical attitude is required, in which the proper conservation of the natural and human resources of every country is regarded as a moral duty.' (quoted in Barnett & Morse 1963:28) In 1948, under Huxley's auspices, UNESCO would inaugurate the International Union for Conservation of Nature and Natural Resources (IUCN), an organisation dedicated to the preservation and conservation of the natural world, and later, in 1961, Huxley would go on to co-found the conservationist organisation the World Wildlife Fund.

Coinciding with both the publication of *U.S.A., Measure of a Nation*, and the *Historical statistics of the United States 1789-1945*, in 1949 the Hoover commission reported to President Truman and the Congress would reflect both of Dewhurst's concerns when it stated, with respect to natural resource policy that: '...Federal activities in this field must therefore be studied in the full light of the part which these resources play in our whole manner of life...our country has reached a point in its development that calls for a new concept of the relation of natural resources to its economy.' (quoted in Barnett & Morse 1963:21).

#### *Economy and scarcity: the postwar fears over growth*

The economic technologies and metrics that helped bring about the existence of the economy as a de-materialised sphere of monetary flows capable of ever increasing intensification and therefore growth, did not result in this growth being perceived as unproblematic. How and through what means could the economy - as measured by

Gross National Product (GNP) - grow? As I argued in the last chapter, prior to the 1940s, growth, in the form of the material expansion of territory, population and trade was largely taken for granted as both a good, and natural outcome of economy. Growth was a natural outcome of material expansion. The acquisition of more land and territories, the founding of new cities, developing new markets and trades and growing populations were both the means to and measure of growth. For the classical political economists, growth at some point must end in stagnation as the limits of the land are reached, but with the exception of Malthus, this end was usually conceived of as in the far distant future.

The development of the economy as an object in itself however, required that growth be considered both in new terms and as a new priority. Initially a resurgent fear of post-war depression in the US, enabled and abetted by the development of the new raft of aggregate statistical tools measuring the new economy, would result in the explicit and institutional prioritisation of economic growth via the development of the Council of Economic Advisors (CEA). From 1949 onwards, the tenor of this call would rapidly change, under the influence of the burgeoning cold war, into a concern not with *economic growth* to meet other policy ends, but with a concern with *the growth of the economy* as the primary object of US politics. In this sense, the growth of the economy, similarly to Mitchell's arguments regarding the economy itself, should not be considered as some long-standing, objective order of the world, brought down on stone tablets from Scotland by Adam Smith himself. Instead, the growth of the economy as a preeminent policy objective is a much younger, and indeed predominantly post-war concern.

This new concern almost immediately reinvigorated concerns regarding the newly quantified scarcity of natural resources. The resulting fear of mass resource depletion during the war reasserted and fed into questions of the longer term security of the US, a country with an administration increasingly frightened of the now atomic glow of the Soviet bogeyman. In July 1953, the English Economist P.D. Wiles wrote an article in the American quarterly *Foreign Affairs* (Wiles 1953) that would meet with a responsive audience in the US. Wiles echoed both George Kennan's famous 1946 Long Telegram from Moscow with its emphasis on the 'irrational rapacity' of the Soviet union, as well as the UN Economic commission for Europe's concern with the growth of communist

economies. He argued that 'For the aims of Communism are boundless: a new man or a new earth - the whole earth', and:

...that by whatever other criteria economies may be judged, Communism is at any rate beating 'capitalism', whether in the form of laissez-faire or of the welfare state, in its rate of growth. And in a long cold war the rate of growth is the most important thing, for in the end the country that grows most becomes biggest, and every economic advantage belongs to it, be it military power, dominance in world markets or even a high standard of living. (Wiles 1953)

Although Wiles lamented the 'mendacity' of Soviet statistics (Wiles 1953), he made use of what he argued were the most reliable of these figures in comparing the growth of Soviet and Western economies and came to the conclusion that 'Soviet economic development betters all recorded data for the West' (Wiles 1953). Wiles' particular figures were not unchallenged (Arndt 1978:48), but what is important here is that the very availability of aggregate measures of the economy enabled comparison between nations. Subsequently 'In the 1950s momentous political importance came increasingly to be attached to...comparisons of growth rates' (Norgaard 2001; cited in Purdey 2010:79). As the grinding mechanical howl of the second world war began to fade at the beginning of the 1950s, a resurrected Malthusian concern with the absolute scarcity of material resources - in the form of energy - began to take hold. With the upward ratchet of the great GNP race, and the US being thrust back onto a war footing with its May 1950 entrance into conflict in Korea, this fear would become the cold war's keening echo: Were there enough energy resources available for the necessary growth of the economy? Were the lights going to go out? Was the US, and with it the free world, in danger of being left behind in the cold gloom of the Soviet shadow?

## Resources for Freedom, resources for growth

In the same year that *America's Needs and Resources* was released, the National Security Resources Board (NSRB) was established by the National Security Act of 1947. The NSRB's purpose was to maintain up-to-date information on essential material resources and facilities in case of the outbreak of war (Goodwin 1981a:16), and while it was originally an independent office, in 1949 it was transferred to the Executive office of the President upon the recommendation of the Hoover Commission and here concern only increased regarding the potential availability of resources in

both peacetime and wartime (Goodwin 1981a:18-19). Shortly after his arrival as chairman of the NSRB in 1950, W. Stuart Symington formally approached William Paley, after his recommendation by Frank Stanton, and appealing to his patriotic streak, would ask him to head up a special NSRB committee (Smith 1990:312).

By the end of the year this NSRB committee had been converted into a Presidential commission, and on January 22<sup>nd</sup>, 1951, the White House announced that Paley would lead a five man group known as the President's Materials Policy Commission. In a letter to Paley dated that same day, the President made clear the threat of 'the nation's materials problem' and that shortages of material resources could not be allowed to jeopardise either national security or economic expansion. In order to respond to this materials problem, the Commission, funded under the National Defence budget, was to undertake a detailed review of the future supply of mineral, energy and agricultural resources in the US; including the prospect and potential extent of any materials shortages over a twenty-five-year period, and propose policy responses to deal with these.

The PMPC was initially tasked with producing their report within six months. However, after four months, Paley told Truman that the job would in fact take a further year to complete. In spite of this, money was no object for the commission and in total the federal government spent around USD 900,000. The President's support for the project also extended to his telling cabinet officers to make both personnel and information available to the commission as and when they required (Smith 1990:315). Alongside Paley, the PMPC was formed of five other commissioners. Eric Hodgins was an engineer from MIT, former managing editor of Fortune magazine, and was chosen for the commission precisely because of his skills as a writer (Smith 1990:313). Philip Coombs was the Executive Director of the Commission and was an economics professor at Amherst College. Coombs, had also previously been employed at the Economic Cooperation Administration (ECA) set up in 1948 to administer the Marshall Plan and was also a previous candidate for the position of Director of the Division of Minerals and Fuels when it was first created in the Interior Department in 1950 under Secretary Chapman's order 2602 (Goodwin 1981a:45)

The remaining members of the commission were George Rufus Brown who was the head of the contracting firm Brown & Root<sup>10</sup>; the Republican fundraiser Arthur H. Bunker, who had moved from investment banking at Lehman Brothers to the minerals extraction company Climax Molybdenum; and Edward S. Mason, an economist who ran Harvard's graduate school of public administration. As Coombs later noted:

It was no accident that the majority of commissioners were Republicans...And they were not just ordinary Republicans but important figures. We were likely to come out with controversial policy recommendations for government and industry. If you had a bunch of flaming liberals, you wouldn't be taken seriously. It was pretty hard to make an attack on Bunker, who was a fund-raiser for Republicans. Some might call that calculation, I called it common sense. (Smith 1990:314)

On June 2<sup>nd</sup> 1952, seventeen months after the announcement of its formation, the Commission transmitted its five volume report: *Resources for Freedom: Foundations for Growth and Security*, to the office of the President.

#### *The Paley report and the concern with growth*

When it was published, the PMPC report (usually referred to as the Paley Report) documented clearly the concerns with resource scarcity, and indicated how, in the US alone, consumption of petroleum and other mineral resources since the beginning of WWI had been greater than the total consumption of all the previous centuries put together (Kula 1998:112). This expansion in consumption was accompanied by a shift in the US position from net materials exporter to importer. In 1900, it produced 15 per cent more materials than it consumed, but by 1950 it was consuming 9 per cent more than it produced (Andrews 1999:183). Alongside these assessments of historical material resource use, the economy was given a future history through the commission's 25 year growth projections of the 'basic economic characteristics of our society' (PMPC Vol. 1 1952:3), and given the provenance of the report, growth was a paramount concern for the commission and a key point of difference from the 'constant recycling of the ideas of the early New Deal and those usually associated with the names of Theodore Roosevelt, Gifford Pinchot, and Robert Malthus' (Maass 1953:206). As the commissioners' noted at the beginning of the report:

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<sup>10</sup> Later to become Kellogg, Brown & Root and subsequently sold to Halliburton.

...we share the belief of the American people in the principle of Growth. Granting that we cannot find any absolute reason for this belief we admit that to our Western minds it seems preferable to any opposite, which to us implies stagnation and decay. (PMPC Vol. 1, 1952:3)

The staggering amorphousness of the commissioners account of growth - to our contemporary Western minds at least - is testament to its status as a newly developed concern following the construction of the economy; and although this blunt statement of belief in spite of any 'absolute reason' superficially echoes Adam Smith's concern with the 'declining melancholy' of the stationary state (Smith; cited in Arndt 1978:7), what is clear here is that the focus on growth had taken on a different tenor to that of the first generation of classical economists (Mitchell 1998, 2005a, 2005b). As I discussed above, prior to the middle of the 20<sup>th</sup> century, growth was generally understood in terms of material expansion. More trades, more factories, more commodities produced, larger populations living in bigger cities and ultimately more land and larger empires. Growth and economy were organically interlinked with the former following naturally from the practice of the latter in the husbanding of resources. For the Paley commissioners, and amongst economic thinkers, politicians and the public at large, growth was now being considered as a defining characteristic of a specific object - 'the economy'.

Elsewhere, and apparently not content with basing a belief in growth on the apparent preferences of the 'Western mind', the report also states that its 25 year projections are based on a quantified, but equally unqualified presumption that the historic average rate of growth of 3 per cent a year would continue over the 25 year period of the report's projections (Maass 1953: 207). As I have already discussed, this historic average was itself constructed after the fact through the work of Kuznets in developing the GNP, and through organisations like the Bureau of the Census and SSRCC in reconstructing national accounts figures back through time to the founding of the nation.

The Paley report's growth projections were for a doubling of the size of US GNP, from 273 billion dollars in 1950 to almost 550 billion dollars in 1975, a massive increase that would result in the US' consumption of up to 20 per cent more raw materials than it would produce over the same period, further increasing its reliance on overseas imports (Andrews 1999:183) - particularly of oil (Calel 2011:7). The question of whether the growth of the economy could be maintained in the face of scarce resources lay at

the heart of *Resources for Freedom*. Coombs' calculated common sense enabled the Commissioners to state clearly and succinctly the long term constraints on growth implicit in a reliance on finite natural sources; 'It took nature over 500 million years to store in the ground these stockpiles of "fossil fuels" which civilisation is now consuming in a flash of geologic time' (PMPC Vol. 1 1952:104).

However, the Paley report undertook a fundamental break with the neo-Malthusian pessimism of previous assessments of the materials position of the US, such as Dewhurst's 1947 analysis (Landsberg 1987), and it did this through a concerned focus on the growth of the economy. This approach was underpinned by two particular innovations. First, the report undertook a technical redefinition of the way that resource scarcity was measured: from the absolute scarcity of Dewhurst's report to a relative economic scarcity. Second, and following this redefinition of natural resource scarcity, the report argued not for simple conservation and national self-sufficiency, but the expansion of overseas extractive industries under the banner of a 'least cost principle' in order to ensure future economic growth. It is to these two innovations of the Paley Commission that I will now turn.

### *Scarcity and reserves*

In *America's Needs and Resources*, Wilbert G. Fritz, a former Director of the Wartime Energy Resources Survey, and in 1947 a member of the War Assets Administration, had the responsibility of drafting the chapter on natural resources. Fritz maintained that several factors determined the ability of resource supplies to meet the demands of a growing economy: the extent and exhaustibility of existing reserves, economy in the use of materials, use of a wider variety of materials, and discovery of new sources. In calculating the first and last of these factors, Fritz collated figures from the National Resources Committee, the National Resources Planning Board, his own previous reports, *Oil and Gas* journal estimates and most importantly from the Bureau of Mines reports: the *Minerals Yearbook* and *Mineral Resources of the United States*. The figures from these sources were based on the measurement and estimation of absolute scarcity i.e. the physical stocks of reserves in ground. For example, for crude oil, estimations of reserves were generally made through volumetric analysis (Bowden 1985:212), which involved four basic steps: First, the likely geographical distribution of oil basins was established; second, estimates of oil content per volume of sediments in known areas were collated; third, comparable amounts of oil per volume of

sediment were assumed in similar but unexplored geological areas; fourth, total reserves were calculated by multiplying the volume of unexplored sediments by the estimates of oil per unit volume in known areas.

Volumetric analyses, alongside the other estimations of absolute scarcity that formed the basis of *America's Needs and Resources* study of natural resources resulted in Fritz concluding that: 'It is inevitable of course, as time goes on, that our supplies of mineral resources will come nearer to exhaustion and that our needs will be satisfied with less ease and at higher cost than before.' (Twentieth Century Fund 1947:598) While this was no prelude to a clear cut Malthusian pessimism, '[g]iven a system that permits free access to the world's resources, however, there can be no question of a raw material supply adequate to support and expanding American economy for many decades to come' (Twentieth Century Fund 1947:598), with respect to oil production in the US, the writing was evidently on the wall:

Although new supplies of petroleum will undoubtedly continue to be discovered in the future, we have probably passed the peak of discoveries. Naturally, every oil field found diminishes the chances of finding another one, and almost every new pool that is tapped produces at a steadily diminishing rate over its useful life. Thus, there may be diminishing production from diminishing reserves. (Twentieth Century Fund 1947:588)

Fritz' analysis of the nation's long-term reserves of crude oil should in fact be seen as a continuation of pessimistic assessments of ultimate US oil reserves going back all the way back to the United States Geological Survey (USGS) first survey of reserves undertaken in 1909 by David T. Day. This initial assessment was integrated into the national inventory of mineral wealth and conducted under the supervision of the new National Conservation Commission, chaired by the head of forestry and renowned conservationist Gifford Pinchot (Maduriera 2012:143-144). The survey indicated that between 10 and 24 billion barrels of oil remained underground, and that this would last the country less than 25 years, if upward production and consumption trends were to continue (Day 1909; cited in Madureira 2012:144). Assessments of ultimately recoverable US oil retained this pessimistic conclusion over the next 40 years, in spite of constantly and indeed spectacularly increasing oil production levels, and in the next chapter I will indicate why this pessimism was prevalent in both governmental and industry oil surveys, and what role this pessimism played in the production of oil and oil industry profits.

In comparison to volumetric measures and other geological assessments of natural resources, the PMPC's estimates and predictions focused instead on economic factors such as the costs and prices of end products derived from natural resources, and where 'The growth of demand is at the core of the materials problem we face' (cited in Maass 1953:206). Resource depletion was expressed through rising costs and was not considered as the absolute depletion of physical stocks but of the relative depletion of stocks with respect to each other. This crucial shift from absolute scarcity to (relative) price scarcity by combining the account of energy as a system of interchangeable fuel sources with the neoclassical notion of economic scarcity as 'a kind of open-ended myth' (Xenos 1989:35) — popularised by Lionel Robbins in his *An Essay on the Nature and Significance of Economic Science* (1932) — allowed the commissioners to abstain from the then common concern with resources running out (Landsberg 1987:85), and shift to a new conception of mineral reserves:

Public judgements of the prospects for future petroleum supplies have frequently been distorted because of popular misconceptions concerning the nature of proved reserves. Time after time the fact that proved reserves were equivalent to only about 12 to 15 years' production has come to the attention of publicists who have then sounded the alarm that the United States was about to run out of oil. *Reserves must be considered not as a total reservoir from which all future production is to be drawn, but as the basis of operations, a sort of working inventory.* Proved reserves are indeed like a reservoir, but a reservoir into which there is an inflow as well as an outflow. (PMPC vol. 3 1952:5; emphasis added)

The inflow into the reservoir could be maintained simply by ensuring that the cost of new discoveries does not exceed the general price level of crude oil and associated petroleum products; therefore, as Hans Landsberg put it in his introduction to the reissued report in 1987 'It is a mistaken notion...that on a given day the world will find that the last ounce or foot of a given resource has been used up. *At a cost* there is always more.' (Landsberg 1987:85; emphasis in original). This novel technical innovation of resources understood as working inventory - based on the combination of economic theory and reserves evaluation has the interesting property of effectively inverting the relationship of cost to material scarcity. For analyses prior to Paley such as Dewhurst, natural resource costs are high because they are scarce. However for Paley, high costs now enable the production of ever more resources, and therefore 'The fact that at any time reserves are only a little more than a decade's outflow need not of itself be alarming if a steady inflow can be anticipated. (PMPC vol. 3 1952:5). In his 1953 review of the report Arthur Maas wrote that:

...the Paley approach can be used to introduce a degree of flexibility into analyses of conservation which, too often in the past, have become stuck on inflexible concepts of physical stocks of resources...No other approach to conservation and resources problems offers a framework of analysis so broad and yet so useful and meaningful. (Maass 1953:206)

The PMPC arguably provided more than just a useful and meaningful framework of analysis however, it helped undermine the notion of absolute physical scarcity. By replacing this with a relative notion of economic scarcity, and applying this notion to material reserves calculations through the innovative reconstruction of these as working inventory, the Paley report reinforced an understanding of the economy as an object that can grow irrespective of absolute material constraints, as these material constraints had been abolished. Alongside, and following the reconstruction of reserves calculations, the Paley report pushed for the exploitation of these (no longer absolutely scarce) resources at least cost.

In 1949, Harold Ickes' long delayed world conservation conference would finally take place at Lake Success, New York - albeit under the responsibility of the State Department, and with Ickes' successor at the Department of the Interior - Julius Krug - at the head of the US delegation (Goodwin 1981a:26). *The United Nations Scientific Conference on the Conservation and Utilization of Resources*, not unsurprisingly, would emphasise resource conservation rather than economic growth across the seven substantive volumes that it subsequently published. The geologists, mineral specialists and other natural scientists attendant at the conference would give significant pessimistic voice to resource concerns (Barnett & Morse 1963:31) - a voice in tune with the general consensus of the day on the necessity of resource conservation above all.

In contrast, the Paley report, alongside a general concern with the ongoing growth of the economy, was also crucially concerned with ongoing war-preparedness measures, and made recommendations to balance the supply and demand of materials in part by increasing materials production and distribution - particularly in the areas of steel, aluminium, oil and electricity (PMPC Vol. 1 1952:156). This increase would mean that the necessity for crash programmes required to scale up industrial production during the second world war could be avoided in future conflicts and simultaneously, peacetime growth and industrial employment could be maintained (Andrews 1999:183). A focus on economic scarcity rather than absolute scarcity enabled the PMPC's belief in both the importance, and the unlimited possibility, of this economic

growth. Following this innovation, the report moved away from advocating a New Deal like response focusing on resource conservation (Maass 1953:206) and instead recommended adherence to what it referred to as the 'least cost principle' as a means to govern material resources (Landsberg 1987:84):

the overall objective of a national Materials Policy for the United States should be to ensure an adequate and dependable flow of materials at the lowest cost consistent with national security and with the welfare of friendly nations (PMPC Vol. 1 1952:3)

This led the Commission to reject the narrow goal of self-sufficiency (Andrews 1999:182-183; Landsberg 1987; Maass 1953) and instead it urged the expansion of 'unfettered private enterprise, free from government controls and regulated to the greatest extent by the "spur of the profit motive," "the competitive market structure," and "the price system"' (Maass 1953:209). However, the increased foreign investment in the mineral and extractive industries that was proposed in the report, while unfettered, was not to be entirely unsupported (Maass 1953:209; Andrews 1999:183). For the mineral industries the report advocated the provision of free government services, tax relief, and in the specific case of oil and gas, continued subsidies for exploration costs while simultaneously maintaining production quotas to maintain the necessary inflows into resource inventories below the price of products derived from these natural resources.

Controversially however, the report recommended the elimination of any protective tariffs or laws that discouraged overseas investment in mineral fuels extraction (Smith 1990:317). Maass suggests that the strong bias in favour of unfettered, but aided private enterprise in mineral extraction, particularly in contrast to the treatment of water, agriculture and forestry in the report, is likely due to two factors. First, minerals had not yet been subject to a comprehensive public policy treatment, and such treatment was actively resisted by the leaders of the mineral industries, the US Geological Survey and the Bureau of Mines. Second, the Paley Commission itself included several mineral industry executives, including the Texas oil man George R. Brown, and Arthur Bunker, the President of the Climax Molybdenum company (Maass 1953:209). Therefore, an advocacy for rent as well as minerals extraction can be considered somewhat unsurprising.

### *The Paley approach*

The commission aimed at reaching as wide an audience as possible, in part as a means to influencing policy makers who would be ‘...directly impressed if they see an impressive display of the Report and its recommendations on our major media’ but also because the audience for the report was considered (somewhat tautologically) by Hodgins as ‘everybody who ought to be interested in it’ (Goodwin 1981a:58-59). Prior to the release of the report, a series of hearings were held on various aspects of it, and these focused especially on issues around energy resources as they were ‘a major limiting factor in shifting from scarce to abundant sources of production materials’ (Goodwin 1981a:58). Ten thousand copies of the final report were initially printed, at a cost of \$55,000, and it initially drew high praise from the press, including editorials, features, front covers and interviews. Fortune magazine referred to the report as ‘one of the greatest, most readable government documents of the century’ (quoted in Smith 1990:317). Paley even followed up the publication of the report with a documentary, entitled *Resources for Freedom*, which was televised on CBS in 1954. Anchored by the network’s star newsman, Edward R. Murrow, the film featured deferential interviews with each of the commissioners and enabled Paley to make a final pitch for the approach and recommendations outlined in the report:

The only cause for alarm would be if we closed our eyes to the threat of creeping scarcities and higher costs and pretended that somehow the materials problem would blow over. It won’t...The material problem is everybody’s problem. (quoted in Smith 1990:318)

The report’s 25 year projections of economic growth and material resource use were not uncontested<sup>11</sup> and as Smith notes, the report was unfortunately timed - being released in the midst of a presidential campaign, and where the ultimate winner, Eisenhower, was less enthusiastic than Truman had been regarding the commission’s work (Smith 1990:319). However, the Paley commission was considered important and influential for several reasons. It was separate from the two main sources of attention on materials and energy scarcity within government up to that point: congressional committees and the Interior Department, and it brought together a wide

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<sup>11</sup> see e.g. Clark (1954); also Commission staff such as Palmer Putnam and Arnold C. Harberger who argued that the report’s population predictions were implausibly low (Goodwin 1981a:54 footnote 112).

range of economists and other specialist from all the relevant parts of the government as well as industry and universities (Goodwin 1981a:53). As such, its independence afforded it broad legitimacy both within federal agencies and industry. The Paley report was, as the Harvard water resource economist Arthur Maass noted at the time, 'the most original and significant contribution to the study of resources and public policy since the 1933 report of the Mississippi Valley Committee and the early reports of the National Resources Committee' (Maass 1953:210).

In the report the commissioners advocated for an expansion in reserves estimations as these 'proved particularly meagre and hard to come by' (PMPC Vol. 1 1952:26). In order to address this knowledge deficit, the commission recommended the expansion of programme analysis staff at the Interior Department, particularly in the Bureau of Mines and the USGS in order for the department to 'intensify its fact-gathering and analytical activities' and where '[h]eavy emphasis should be placed upon analysis by professionally trained economists; and the study of geologic, technological and other scientific developments and prospects should be related more than it has been in the past to economic consequences and opportunities.' (PMPC Vol. 1 1952:26) The report had an immediate impact in the US, with federal government agencies and extractive industries reevaluating their resource programmes and beginning to bring their measurement of resource scarcity in line with the 'Paley approach' (Maass 1953:210).

The crucial technical change in the measurement of scarcity, and shift to a 'least cost principle' as a new mode of governance are key here. The development of price scarcity involved the measurement of the scarcity of material resources by reference to the prices of the commodities produced with them - according to the theory of economic scarcity propounded by Lionel Robbins - not a geological measurement or estimation of absolute material reserves. This, alongside natural resource reserves reconceptualised as working inventory, broke the direct connection between material resources and economic growth. It meant that being no longer bound by physical and material constraints, the economy was understood as free to continue a trajectory of continuous growth, a trajectory that a presumption of fixed resource supply - based in the work of the classical political economists, especially Malthus, and brought into the postwar era in part through the work of Frederick Dewhurst - would have denied is

possible. The materials problem, although everybody's problem, was eminently solvable. In this way, the Paley commission, through their 1952 report, helped to further develop the economy as a separate sphere, an ontologically valid object de-linked from specific material resources and characterised by the potential for continuous, illimitable and self-sustaining growth through the exploitation of material resources at least cost.

This did not however, put an immediate end to US fears about the impact of resource scarcity on national growth. The increasing spread and use of national account statistics as a means of national comparison only spurred the explosive focus on the growth of the US national economy, and enabled the tenacious, decade long concern over the necessity of natural resource conservation.

## Resources For the Future and scarcity

In 1954 the Organisation for European Economic Cooperation (OEEC) published the first volume of national account statistics that made use of uniform GNP and other macroeconomic measurements across countries. The OEECs second volume in 1957 was joined by the first UN *Economic Survey of Europe*, based on OEEC figures and was centrally preoccupied with the growth rates of the national economies (Arndt 1978:51). The rise of Nikita Khrushchev to Chairman of the Communist Party of the Soviet Union in 1953 brought about the increasing availability of economic statistics and macroeconomic indicators on the USSR. This information 'thaw' only reinforced the impression of rapid Soviet growth painted by P.D. Wiles in 1953. And as Stephen Purdey noted, competition at this time was not limited to the 'great GNP race' of the US and USSR. Within Europe, the steady eclipse of Britain by the development of France and Germany helped further recast international rivalry in terms of the growth of the economy (Purdey 2010:79). Shortly after the US Senate's condemnation of Joseph McCarthy in 1954, studies commissioned by the Joint Economic Committee of Congress in 1955 and 1957 comparing Soviet growth with that of the Western powers<sup>12</sup> further proved to popular US imagination that just because you're paranoid, it doesn't mean they're not growing faster than you.

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<sup>12</sup> Trends in Economic growth: A Comparison of the Western Powers and the Soviet Bloc (1955); and Soviet Economic Growth: A Comparison with the United States. Both cited in Arndt 1978:49.

The NSC-68 (United States National Security Council 1950) inflamed fear of Soviet expansion continued in 1959 with the public hearings of the Subcommittee on Economic Statistics on 'Comparisons of the United States and Soviet Economies'. This would produce three volumes of expert testimony on the subject, indicating the broad awareness at the time of the apparent necessity of the growth of the economy, and that differences in growth rates between the US and USSR were not merely some statistical abstraction, but a life-or-death metric. As the Princeton economists William J. Baumol and Klaus E. Knorr wrote in 1959, 'We believe that these differences [in the rate of economic growth] do matter and that they may threaten the ability of the United States to survive in a hostile world.' (Baumol & Knorr 1959; quoted in Arndt 1978:49). At this time then, nations more than ever before viewed their power as resting, at base, on the strength of their economies. 'To ensure their independence, they concluded they must grow; if ahead, stay ahead; if behind, catch up' (Abramovitz 1989; cited in Purdey 2010:79).

Beyond the Soviet challenge, six years after the publication of the PMPC report, growth was finally given the 'absolute reason' that had eluded the Paley Commission. In 1958, Nelson and Laurence Rockefeller tasked Henry Kissinger with preparing a report entitled *The Key Importance of Growth to Achieve National Goals* (Dale 2011; Purdey 2010:80), presaging Nelson's campaign for the Republican party nomination in 1960. Heading a panel comprised of economists from large corporations and key universities, Kissinger identified the importance of economic growth as the solution to the pressure on national income 'for all major ailments of Western economies' (Purdey 2010:80). The report began by stating that '[t]he first basic conclusion that emerges from our analysis is the very great importance of maintaining a high rate of growth' (Rockefeller Brother's Fund 1958; cited in Lekachman 1966:179). Hewing closely to the inherent properties of the 'Western mind' as trumpeted by Paley, the Rockefeller's report narrowed down the geography of this image to the ongoing American adventure:

The adventure of the American economy is a continuing reality. The dynamism that has produced the present level of well-being holds out the promise of a still more challenging future. Our nation is dedicated to economic growth. It is also dedicated to full employment...We want to achieve rapid growth and full

employment in a free economy. The freedom of the economy is fundamental to other freedoms we cherish (Rockefeller Brother's Fund 1958; cited in Lekachman 1966:179)

The approach to growth espoused by Kissinger and the Rockerfellers was reiterated in 1960 with the Douglas Congressional committee reporting at the time that '[t]he critical need for economic growth is found in the tasks placed upon the nation, both foreign and domestic... [a] high rate of economic growth is essential if... public responsibilities are to be discharged without limiting the advance in living standards effected through individual efforts.' (quoted in Arndt 1978:46) During the 1960 Presidential election campaign, the growth of the economy was a major campaign issue (Arndt 1978:55), and although Richard Nixon would dismissively refuse to join with his democratic opponent Kennedy 'in playing what is rapidly becoming the most fashionable parlour game of our time - a game we might call "growthmanship"' (Nixon 1960, cited in Arndt 1978:55). The game would move ahead without him. Kennedy's campaign platform promised a growth rate of 5 per cent, which became a central objective once he became President. As Arndt put it, the 5 per cent growth rate became 'the most conspicuous signpost' of the Kenny's promised New Frontier, and one which he asked his Chairman of the CEA Walter Heller, to make good on. This promise was reaffirmed when in December 1961, the US along with 19 other OECD countries signed an agreement to aim at 50% growth of collective real GNP during the decade of the 1960s (Arndt 1978:56).

At the same time, the lingering, and occasionally acute concern with the availability of material resources to fuel the economy remained throughout the 1950s and into the early 1960s; and as Kennedy also stated in a special message to congress on natural resources in the same year as signing the OECD agreement on growth:

From the beginning of civilisation, every nation's basic wealth and progress has stemmed in large measure from its natural resources. This nation has been, and is now, especially fortunate in the blessings we have inherited. Our entire society rests upon - and is dependent upon - our water, our land, our forests and our minerals. How we use these resources influences our health, security, economy, and well-being (Kennedy 1961; cited in Barnett & Morse 1963:21)

What could be called 'The doctrine of increasing natural resource scarcity' (Barnett & Morse 1963) was articulated again in 1953, when Fairfield Osborn revisited the

explicitly Malthusian ground he'd tilled in his 1948 *Our Plundered Planet*, with a new book entitled *Limits of the Earth*. Here he concluded:

We are under the power of a timeless principle, exerting its influence relentlessly on a global scale. This principle ... finds expression in a simple ratio wherein the numerator can be defined as "resources of the earth" and the denominator as "numbers of people." The numerator is *relatively* fixed and only partly subject to control by man. The denominator is subject... to control by man. If we are blind to this law, or delude ourselves into minimizing its power, of one thing we can be assured - the human race will enter into days of increasing trouble, conflict, and darkness. (Osborn 1953:206-207; emphasis in original)

The release, in 1955 of *America's Needs and Resources - A new survey*, Frederick Dewhurst's follow up to his 1947 study, provided a widely read companion piece to a statement that same year by the industrialist Meyer Kestnbaum: 'Natural resources are the foundation of the material prosperity of the Nation - both present and future. Their wise use is therefore the concern not only of all the people but of all levels of government' (cited in Barnett and Morse 1963:20). This statement by Kestnbaum - who was also chairman of a presidential advisory group - was published in the US Commission on Intergovernmental Relations' *Study Committee Report on Natural Resources and Conservation*, and reflected the general redevelopment of the conservationist ethics, concerns and indeed potential politics of the 19<sup>th</sup> and early 20<sup>th</sup> centuries. Clearly, even after the Paley commission's rejection of an explicitly New Deal style conservationist response to the nation's materials problem, the question of how the circle of material resource conservation and the absolute requirement for economic growth could be squared remained.

### *Resources For the Future*

Following on from his report, William Paley had intended for the Federal government to assume responsibility for ongoing, continuous assessment and analysis of resource problems and prospects (Landsberg 1987); the incoming Eisenhower administration declined this proposal however. In the face of Eisenhower's resistance, Paley petitioned, both figuratively and literally, for the creation of a research organisation to

undertake this assessment instead. This resulted in the founding of the private nonprofit Resources for the Future (RFF)<sup>13</sup>

Paley and members of a committee on resource availability and economic growth within the newly reorganised Ford Foundation (Amadae 2003:34-39) set up the new organisation with an initial USD 150,000 grant. RFF's first conference in 1953, which set out its research mission, was attended by 1,600 people in the Shoreham Hotel in Washington D.C. and indicating continuing links with the executive, President Eisenhower invited himself to speak before the assembled mass of researchers, conservationists and members of the business community (Darmstadter 2003:4; Portney 2002). Up until 1977, RFF was funded largely by grants from the Ford Foundation to the tune of USD 47.5 million (Darmstadter 2003:3; Magat 1979:186-187), and during this time a substantial element of the research undertaken by RFF was prompted by, and should itself be considered a continuation of, the 'Paley approach' (Maass 1953:210).

As well as the PMPC report itself, which prompted RFFs initial focus (Portney 2002), Frederick Dewhurst's *America's Needs and Resources* would act as a blueprint for its early years (Cronon 2002), and the organisation began by developing a number of work programmes that would last through the 1950s and into the 1960s. These programmes would cover such themes as resources and national growth, energy in the economy, the economics of multipurpose river development and RFFs ongoing concern with natural resource conservation and what this implies for the other themes. The founding of RFF represented, as David Pearce has maintained, the beginnings of the nascent discipline of environmental economics (2002:57). More immediately however, the organisation would first play a key role in the development of natural resource economics and through its continuing technical innovations in this area would play a central role in further securing the economy as a sphere whose growth was not directly limited by natural resource constraints but was defined instead by its potential for limitless growth. A growth, that as I outlined in the previous section, only became more urgent throughout the 1950s.

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<sup>13</sup> Fairfield Osborn, author of *Plundered Planet*, would be amongst the signatories of this petition, and would also be a board member of the organisation from the beginning.

One of the founder members of RFF, Joseph L. Fisher, became the organisation's President in 1959<sup>14</sup>. Fisher had been a former member of the CEA, which he was appointed to by the first CEA President Edwin Nourse in 1947 to help establish CEA expertise in the area of resource development. Regardless of Nourse's intent in appointing Fisher however, the CEA remained focused on macroeconomic questions and largely eschewed analysis of the status of natural resources (Goodwin 1981a:24). Fisher would have more luck at RFF. In 1958, Fisher (then associate director of RFF) would bring to fruition an event which coincided with the fiftieth anniversary of the first Governor's conference on resource problems convened by President Theodore Roosevelt. The aim of Fisher's RFF conference was to 'shed light on resource conservation problems in the next fifty years by undertaking a critical review of the previous fifty (Jarrett 1958:viii), and the papers presented at the conference were published that same year by RFF under the editorial oversight of RFF staff member Henry Jarrett. As Jarrett rightly pointed out with respect to the papers presented at the conference:

The essays do not lend themselves to summary; as noted earlier they range too widely and are too undogmatic. What can be said here is that they attest - if further proof be needed - the pervasiveness of resource conservation problems and the potential breadth of future conservation policies. (Jarrett 1958:xiii)

Indeed, papers presented by noted economist John Kenneth Galbraith (1958) and Paley commission member Edward S. Mason (1958) - the former on the issue of consumption, the latter on the necessity of government intervention to correct the failure of the free market - strongly reiterated a pessimistic account of ongoing scarcity problems. In contrast to these, papers by Ernest S. Griffith, the Director of the reference Service of the Library of Congress and the Director of the USGS, Thomas B. Nolan (1958), struck remarkably upbeat tones, prefaced upon a considerable technological optimism. I will consider further selected papers from this conference in later chapters as they were involved in contemporary - or prefigured later - developments with respect to energy and the environment. For now it should be noted that the querulous nature of the debate in 1958 fed into ongoing RFF research, and in 1963, RFF's work programme on Resources and National Growth, under the direction of former Bureau of Mines and RAND economist Harold J. Barnett, would culminate

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<sup>14</sup> Fisher would retain this position until his replacement by Charles Hitch in 1974.

with the publication of Barnett and Chandler Morse's study *Scarcity and Growth* (1963). As Fisher made clear in his foreword to *Scarcity and Growth*, Barnett and Morse's book was conceived as a companion publication to Neal Potter and Francis T. Christy Jr.'s *Trends in Natural Resource Commodities* (1963), a study similarly initiated under Barnett's purview as part of the Resources and National Growth Program<sup>15</sup>. And together these reports were conceived as definitive empirical-theoretical analyses of natural resources and economic growth.

#### *The death of absolute resource scarcity*

In the case of Potter and Christy Jr. their RFF supported project resulted in a comprehensive set of economic time series data on major natural resource based commodities in the US from roughly the beginning 1870-1957. Following the format of the Paley approach in focusing on economic factors, they highlighted the difficulty in measuring natural resources directly and noted that 'Natural resources are more "basic" than their products, but economic data on the products are more enlightening and more tractable than those on resources as such.' (Potter & Christy Jr. 1962:2). Their focus on commodity prices is not prefaced simply upon a desire to make use of the most complete data available, but due to a specific understanding of technological progress:

Thus we have come to the conclusion that the most useful as well as the most available data on natural resources are those which are indirect, relating to the products of the resources and not the resources themselves. Moreover, the best economic data are those which do not attempt to eliminate the factors of human knowledge and technology but reflect them in full. Measures of resources which attempt to exclude the effects of advancing technology could not reflect truly either the physical universe or man's relation to it (Potter & Christy Jr 1962:2)

They continue this line of argument in a footnote:

If we look only at the physical, noncultural aspects of resources, it is clear that the scarcity of materials of nature is simply proportional to population. If the population doubles, scarcity doubles. If any ores are used, minerals are obviously (?) scarcer than before they were used. If we do not conjoin the factors of technology (including transportation) and discovery to those of expanding population and depletion, Malthusian conclusions are inevitable. The results of such oversimplification are obvious, and this seems to be the basis of many

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<sup>15</sup> Both these reports were related to a third RFF publication *Resources in America's Future*, also published in 1963 and undertaken by Hans H. Landsberg, Leonard L. Fischmann and Fisher himself. I will consider this study in more detail in the next chapter.

popular predictions of calamity in discussion of population and resources. (Potter & Christy Jr 1962:2)

Potter and Christy Jr's time series is one of the best known empirical studies of scarcity (Kula 1998:114) and incorporated statistics on prices, output and consumption, as well as foreign trade and employment levels and collated this information for four aggregate natural resource-based commodities: agriculture, forestry, minerals, and total extractive resources. Measuring scarcity by reference to the price levels of these commodities, they maintained that the various natural resources, with the exception of forestry, had become less, not more scarce over time. Of course, in manifest contradiction to their clearly espoused theoretical assumptions, they finished their summary by stating: 'In a word ', we offer statistics which have been ordered, simplified, and clarified. We do not offer conclusions, because these require still more facts, as well as a theoretical framework' (Potter & Christy Jr 1962:2). The conclusions and theoretical framework ostensibly missing here would be provided one year later.

Barnett and Morse made use of the statistical information from *Trends in Natural Resource Commodities* in their seminal study of resource scarcity (Baumgartner et al 2006; Halvorsen & Smith 1984; Norgaard 1990). They combined Potter & Christy's historical data with an analysis of contemporary perspectives on resource scarcity, and the classical political economic doctrines of Thomas Malthus and David Ricardo. Beginning from the observation of continuing concerns over the depletion of resources, not just with respect to public policy, but in numerous academic disciplines such as the newly developed field of ecology, as well as demography, political science and indeed economics, they sought to test the classical political economy doctrines of increasing natural resource scarcity.

In order to do this they argued like Potter and Christy Jr. that the long-run scarcity of natural resources is best assessed by looking at economic indicators (Norgaard 1990:20). Drawing on the tradition of neoclassical economics, and specifically Walrasian equilibrium, with its reliance upon an assumption of an underlying uniformity of absolutely convertible matter (Walker 2007:180), they maintained that looking at changes in the physical quality and availability of resources do not account for the past and future effects of technological changes and substitution. Following Ricardo, they focused on the unit cost of extractive products in the four aggregate areas collated by Potter and Christy Jr. (agriculture, forestry, fishery and minerals), where the unit cost

was defined as a weighted labour and capital aggregate divided by net output. As well as unit costs, they considered the real prices of commodities, working on the assumption that the price trends would follow the cost trends, which, as revealed by Potter and Christy Jr., they broadly did. Barnett and Morse argued that if the scarcity hypotheses of Malthus and Ricardo were correct, these would be revealed in the form of increased cost in input to the extractive and agricultural sectors.

They compared the predictions of commodity prices drawn from Malthusian and Ricardian models of fixed resource supply and declining economic quality with those generated by a model of resources in the progressive world using Potter and Christy Jr's data - a model which was characterised by technological innovation, resource substitution, and the continued recovery and discovery of new types of resources (Perez-Carmona 2013:87). In the case of Malthusian absolute limits to natural scarcity, they claimed that such scenarios could only occur in primitive societies which were isolated and possessed only limited resource knowledge and production methods, and also failed to develop social taboos enabling voluntary population restriction (Kula 1998:115).

As such, they maintained that Malthusian scarcity is no longer relevant in the contemporary, 'progressive world' where '[a]dvances in fundamental science have made it possible to take advantage of the uniformity of matter/energy, a uniformity that makes it feasible without preassignable limit to escape the quantitative constraints imposed by the character of the earth's crust.' (Barnett & Morse 1963:11). They claimed therefore that Malthusian scarcity is obsolete (Daly 1991:40), and '[a] limit may exist, but it can be neither defined nor specified in economic terms [...]. *Nature imposes particular scarcities, not an inescapable general scarcity*' (Barnett & Morse 1963: 11; emphasis added).

Ricardian scarcity, which involved unlimited resources in total, but with non-homogenous and declining resource quality, could similarly only occur, argued Barnett and Morse, in a world that is closed to social, scientific and technical progress. And again, '[s]cience, by making the resource base more homogenous, erases the restrictions once thought to reside in the lack of homogeneity. In a neo-Ricardian world, it seems, the particular resources with which one starts increasingly become a matter of indifference' (Barnett & Morse 1963: 11). In short, for Barnett and Morse resource scarcity of both a Malthusian and Ricardian nature was no longer applicable

in the contemporary world and continued concerns over resource availability were no longer warranted, as the growth of the economy was not ultimately constrained by resource scarcity<sup>16</sup>.

Alongside their conclusions on the nature of resource scarcity, Barnett and Morse discussed how to apply the results of their analytical approach to other countries and into the future with respect to the issue of welfare. They are clear that the innovation, substitution, recovery and discovery of resources central to their understanding of the contemporary 'progressive world' are driven by the search for markets - and echoing the Paley report of a decade earlier - that the best means of extracting and increasing the availability of resources, and therefore human welfare, is at 'least cost' - through a free-market system.

Of course, the curiously obvious circularity of argumentation here - with the findings of Potter & Christy Jr. being used to test and verify the theoretical claims of Barnett and Morse, which themselves provide the a priori theoretical justification for precisely which data should be constructed by Potter & Christy Jr.<sup>17</sup> - didn't much trouble the economics profession, then or now. In fact, these two studies, (particularly *Scarcity and Growth*) would come to be widely read and influential. They would be taken as seminal economics texts, and formed the orthodoxy on natural resource use, providing the economic mainstream with proof that a general resource scarcity did not represent an impediment to continued and continual growth<sup>18</sup>. As such, they would ultimately help kill off the lingering fears of absolute scarcity and the necessity for conservation measures that might hamper growth, and in doing so, they further secured the ontological footing of the economy as a distinct sphere, divorced from a natural resource base, and driven by an inherent logic of exponential growth.

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<sup>16</sup> Chandler Morse later recanted this position according to Joan Martinez Alier (personal communication).

<sup>17</sup> As Potter and Christy Jr. themselves make clear (Potter & Christy Jr. (1962).

<sup>18</sup> see e.g. Baumgartner et al. (2006); Daly (1991:40); Dryzek (1997:46); Halvorsen & Smith (1984); Kula (1998); Luks (2010:100); Norgaard (1990); Pearce (2002:58); Perez-Carmona (2013:87); Walker (2007).

## The growth of the economy

The American vision of the future emerges from a past dominated by the imagery of the frontier, the symbolism of the American garden invaded by the conquering machine, and the conviction that the material universe can be mastered by ingenious men. As Seymour Lipset has suggested, America is the first new nation, or at any rate the first nation that has embraced the creative myth of starting from the beginning and making its own history, Americans know, either joyfully or ruefully, that this is the land of youth and novelty, of the bigger and better, of destruction and new construction. For most Americans even temporary stagnation is repugnant, and a permanent halt in the march of progress is an insupportable conception. (Lekachman 1966:179-180)

By the start of the 1960s, to quote James Tobin for a second time, the growth of the economy resided in an 'exalted position' (Tobin 1964:1) amongst government goals and policies. In the US, affirmations of its status and necessity were made by 1960 from the Joint Economic Committee of Congress; the US Chamber of Commerce; the American federation of Labour and Congress of Industrial Organizations; the Committee for Economic Development; the National Planning Association; and by Fortune magazine in a piece entitled 'How the U.S. Can Get 50 Per Cent Richer' (Arndt 1978:57).

I argue throughout this chapter that the development of the economy as a discrete (ontological) object in the world - a metrological machine which, following Timothy Mitchell, is comprised of national account statistics and tables, monetary flows, economists and their theorems - resulted in a new and urgent political concern with growth in the US. In the first instance this developed out of a post-war fear of a return to depression, stoked by Alvin Hansen and his students, for whom the newly developed GNP provided a ready marker of the coming catastrophe, and where every recorded dip in economic activity represented the beginning of the long prophesied return to depression. By the end of the 1940s, the fear of depression had waned, but in its place the shift to Leon Keyserling's expansion economics and the burgeoning security fears at the beginning of the cold war era converted the possibility of the growth of the economy into an absolute and overriding necessity. This, in turn, raised the question of the natural resource base of the US, and the impact of diminished materials availability on the growth of GNP.

Frederick Dewhurst, whose *Historical statistics of the United States* (Twentieth Century Fund 1947) would help to settle the notion of the economy, had already two years before this study, helped to develop the popular resurgence of a Malthusian concern with resource depletion in *America's Needs and Resources*. Dewhurst's twin concerns here highlight that the settling of the notion of the economy had not, at the end of the 1940s and beginning of the 1950s, resulted in a comparable settling of the possibility of growth. In his panoramic survey of the environmental history of the 20<sup>th</sup> century, John McNeill argued that '...economic theory by 1935 to 1960 crystallised as a bloodless abstraction in which nature figured, if at all, as a storehouse of resources waiting to be used. Nature did not evolve, nor did it twitch and adjust when tweaked. Economics, once the dismal science, became the jolly science.' (McNeill 2001: 335-336).

A fundamental part of this 'bloodless abstraction' is that in the post-war period absolute scarcity was 'quietly abolished as a fundamental constraint upon economies' (Walker 2007:179), and I have argued that this was initiated and indeed in large part undertaken by the President's Materials Policy Commission, and its successor Resources For the Future. The development of price scarcity and natural resource reserves as working inventory broke the direct connection between material resources (as absolutely scarce) and economic growth. It meant that being no longer bound by physical and material constraints, the economy was seemingly freed to continue a trajectory of continuous growth - a trajectory that a presumption of fixed resource supply, based in the pre-economy work of the classical political economists, particularly Malthus, would have denied is possible. In this way, the Paley commission and RFF helped to further develop the economy as a separate sphere, an ontologically valid object de-linked from material resources and characterised by the potential for continuous, illimitable and self-sustaining growth, a growth that was delivered in the US during the remainder of the 1950s and 60s - at an average US growth rate of 7.19 percent from 1950 to 1973 in current USD<sup>19</sup> - through the expansion of cheap and abundant oil and other resources extraction following the least cost principle (Altwater 2006; Pfister 2010).

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<sup>19</sup> Figures from United States Bureau of Economics Analysis. Available at: <http://www.bea.gov/iTable.cfm?ID=9&step=1#reqid=9&step=3&isuri=1&904=1950&903=1&906=a&905=1973&910=x&911=0>.

From the Paley report in 1952, to Barnett and Morse's 1963 *Scarcity and Growth*, the technical innovations wrought here in the way that natural resources were measured, considered scarce, and related to the growth of the economy supported the burgeoning development of growth theory within economics. Growth theory - initiated by Robert Solow's *A Contribution to the Theory of Economic Growth* (1956)<sup>20</sup> assumed that nature is 'infinitely expandable, infinitely convertible (or at least infinitely substitutable) and infinitely plowable' (Walker 2007:178). As Jeremy Walker goes on to note, in his later models, Solow would maintain that some natural resources were required for economic growth, 'but the amount of "growth" that could be accomplished with some unspecified initial quantity was again unlimited' (Walker 2007:178). The work of the Paley commission and RFF would enable Solow to claim that 'the world can, in effect, get along without natural resources' (Solow 1974:11), and ten years later fellow Riksbank winner Julian Simon would predict a future 7 billion years of economic growth, interrupted only in the instance of the extinction of the sun (McNeill 2001:336). Not content with a mere 7 billion years growth however, he would also claim the potential restoration of a Lazarus earth:

[t]here is no physical or economic reason why human resourcefulness and enterprise cannot forever continue to respond to impending shortages... and leave us with the bonus of lower costs and less scarcity in the long run. The bonus applies to such desirable resources as better health, more wilderness, cheaper energy, and a cleaner environment (Simon 1996:588)

At around the same time as the economy was being secured through RFFs abolition of absolute material scarcity, Walt Whitman Rostow's 1961 *Stages of economic growth: a non-communist manifesto* would help further the project of development. Rostow employed an 'organismic' metaphor in the book to describe the process of industrialisation. This aped the long discredited biological theory of embryological parallelism popularised at the end of the 19<sup>th</sup> and beginning of the 20<sup>th</sup> centuries by the German biologist Ernst Haeckel's claim that 'ontogeny recapitulates phylogeny'. Rostow argued that the - newly historicised - national economy occupies a set of stages of development from embryo to maturity, and that the developmental pathway of North America and Western Europe was recapitulated, at different stages, in the less developed nation states of the world. Rostow imagined the universal mature endpoint of the national economy in the apparent consumer cornucopia realised in the US in the 1950s, a state achieved through a transition to a modern 'Newtonian' view

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<sup>20</sup> Which would ultimately win him the 1987 Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel.

of a systematically manipulable and transformable nature. This enabled the mature state of an economy to transcend senescence and decline, and instead, through the realisation of 'unlimited production functions', allow growth to become its normal condition. (Walker 2007:179).

In his subsequent role as political advisor to Secretary of Defence Robert MacNamara, Rostow sought to make policy from what he preached, and advocated the systematic bombing of the Vietnamese countryside on the grounds that the forced migration into towns and cities would trigger the process of industrial modernisation. Applied in Cambodia via the bracing tonic of 2.8 million tons of ordnance, Rostow's quack biological metaphor resulted in the skipping of the industrial modernisation stage of the economy in favour of the foetid charnel house stage of 'year zero' auto-genocide (Walker 2007:180-181). But aside from this somewhat piquant outcome, in 1971 Simon Kuznets would publish his *Economic Growth of Nations*. Nearly thirty years after his development of GNP, and eight years after the 1963 RFF reports, Kuznets - who reviewed the entire manuscript of *Scarcity and Growth* - provided here an empirical bookend to the construction of the economy as an ontological discrete sphere defined by a propensity to and ability for, unlimited growth.

In chapter five, I will investigate how the very success of the RFF economists would help bring about a new and unexpected political concern - the environment. Both through the provision of a secure object of politics, whose statistical markers of certainty would begin, from the mid-1960s begin to spell the certain destruction of the natural world, and through the impacts of the pervasive pollution that accompanied the growth of the economy, particularly through the expansion of fossil fuel use. Before I get to this point however, in the next chapter I'll show how the conceptual innovations of the Paley report related to and impacted upon specific developments in the nascent energy industry. Interestingly, the Paley report itself and the developing federal focus on managing the system of energy through the least cost principle would have a rather more complicated impact on the largest, most important, and most powerful energy industry underpinning the growth of this economy: oil.

From the early fifties until about 1957, the increasing focus on energy production at least cost to support the crucial growth of the economy would threaten the oil industry and its profits in general, and independent domestic producers most particularly. This threat would be brought to a peak in 1956 by the oil geologist Marian King Hubbert's

presentation to the American Petroleum Institute (API) of his highly influential petroleum production lifecycle curve. The development and subsequent resolution of this threat, enabling the actual construction of a system of energy through the subsumption of alternate sources of power production by large oil producers as they converted themselves into global energy companies through the 1960s is what I will turn to next.

## 5. Energy

Harold J Barnett helped kill off a concern with resource scarcity in 1963, and established in *Scarcity and Growth* that the continual expansion of the economy was not constrained in a general sense by material resources. But while Barnett's study was rapidly established as canon within the economics discipline and then became the basis for an understanding of the economy and its potential for growth, his particular role in this overall story begins nearly 15 years earlier with a report that he wrote in 1949 as a staff member of the Interior Department. *Energy Uses and Supplies, 1939, 1947, 1965* formed the basis of Interior Department public statements on fuel resources well into the next decade (Goodwin 1981a:37), and alongside another 1949 report by the Hoover Commission, would reiterate to the Truman administration not just the importance of natural resources to the future of the nation, but also the new relationship between the economy and energy - with the latter understood as a system of interchangeable fuel sources powering the newly settled former.

Barnett began his report by maintaining that there are four features inherent to energy resources that justified their careful study and subsequent planning: first, most fuels, and certainly the most predominantly used fuels were finite in nature; second, production increases or fuel substitutions required long lead times; third, fuel resources required large investments for development; and finally, they were frequently produced in noncompetitive industries. While the report reiterated the importance of government and particularly Interior Department oversight over natural resource extraction and development, Barnett developed projections for both the supply and demand of the major fuels into the future through the use - for the first time - of Wassily Leontief's novel neoclassical input-output modelling techniques (Goodwin 1981a:37). Using this technique, and operating under the assumption that a variety of technological advances will result in increased energy efficiency - an assumption, that as I have already shown was central to his later analyses - Barnett concluded that if national output grew as expected by 70 percent between 1947 and 1965, then total fuel requirements in 1965 would increase by 30 percent. This could be met, argued Barnett, by predicted increases in domestic hydropower, natural gas and crude oil

provision, as well as increased crude oil imports, although he expected coal supply to decline. In making these predictions, Barnett highlighted the new relationship between energy and growth that developed as a corollary of the making of the contemporary notion of the economy, and a concern with whether energy supplies were liable to be a limiting factor of the growth of the American economy was paramount here. He showed that there tended to be 'a short-run fixed relationship between gross national product and energy use' (Goodwin 1981a:39) and this implied that energy could indeed be a severe constraint on growth:

If during the next decade GNP were to increase by a third, as the President's Economic Report suggests, then energy requirements would increase about proportionately. This is neutral phrasing. Put another way, GNP is not likely to increase by a third unless energy is forthcoming in adequate volume, at low enough prices, and in the forms which the economy requires. (Barnett 1949, quoted in Goodwin 1981a:39)

In October 1951 the then Secretary of the Interior, Oscar L. Chapman stated that "But, if another full-scale war should come, make no mistake about it, petroleum will be more vital to victory than ever before in our history" (quoted in IPAA 1952:2). In this chapter I detail how oil was not simply important with respect to the potential heating up of the cold war - a war defined and driven by the need for the growth of the economy. At the same time, international flows of oil crucially underwrote parallel flows of money, predominantly US dollars, and helped to maintain the postwar financial architecture established at Bretton Woods in 1944 (Mitchell 2011:111). From the early 1950s on, the increasingly coordinated focus on the total energy system - above and beyond individual fuel sources - would come to threaten the continued provision of the economic incentives put in place in the US from the early 1930s that had made large scale, increasing and apparently low cost oil production possible. The system of quotas and tax treatments that had maintained the price of US oil also propped up the price of Middle Eastern oil through the so-called Texas basing point formula, therefore any threat to these incentives would ultimately threaten the profits of the international oil majors as well as domestic independents. This threat would reach a peak in 1956 with the release of the pessimistic oil reserve estimations of the well-known and influential petroleum geologist M. King Hubbert. If taken seriously, Hubbert's imminent

peak oil estimation<sup>21</sup> implied that price supports were no longer needed to maintain oil production, and indeed that these should give way to conservation measures if a strategic reserve was to be maintained during the cold war.

This is where the technical innovations of the Paley report would play a second role. Alongside helping to secure the economy as a kind of dematerialised sphere capable of infinite growth, I show how the abolition of absolute scarcity in favour of a relative price scarcity would also provide the basis with which the oil industry could contest and undermine both the methodology and the findings of Hubbert. Once this initial threat to oil industry profits from energy - understood as a total system - was successfully challenged, the massive expansion of the oil industry followed through the 1950s and '60s. This involved increasing foreign oil imports to the US, and an increasing share of the total US energy production vis-a-vis other sources. Alongside this, the development of an increasingly real, institutionalised system of energy took place as US domestic and international oil companies converted themselves from single fuel producers into energy companies proper, via the purchase of coal and gas producers as well as the uranium mining concerns on which nuclear power was based. Finally, the future of the energy system was secured by the construction of its past, through the work of analyses published in the early 1960s by Resources For the Future (RFF). These were developed as companion pieces to the reports of Barnett and Morse and Potter and Christy Jr. and would play a comparable role, settling the certainty of energy as a system.

In the last chapter, I described how the development of the economy in its modern sense resulted in a new conception of growth - one that almost immediately turned the bleary eye of the American economics and political establishments towards a focus on natural resources, and the impact any deficit in these would have on the new economy. In *Carbon Democracy*, Timothy Mitchell (2011) argues that it is not until the early 1970s that the industries, materials, transmissions systems and fuels that comprised the nation's power sources are considered as a single system of energy. At this point the various blockages and shortages with respect to the production of individual fuels - wildcat strikes in the Appalachian mountains and increasing

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<sup>21</sup> Hubbert predicted that oil production would peak in the US sometime between 1966 and 1971 (1956).

concentration in the coal industry, the delayed operation of nuclear power plants due to technical setbacks, oil tanker shortages and delayed construction of electrical power stations - 'were suddenly linked together as aspects of a single "energy crisis"'(Mitchell 2011:178).

In chapter 6 I will consider further the development of energy as a total system in crisis: the way this crisis was constructed, tied to the environment and environmental protection measures, and subsequently used to help undermine the new environmental regulations of the early 1970s on the grounds that they represented a 'growth ban' that had been, and continued to be, partly responsible for the energy crisis itself. While the early 1970s saw the development of energy as a fragile system, and indeed as the explicit subject of presidential concern with Richard Nixon giving the first ever energy message to Congress on June 4<sup>th</sup> 1971, energy understood as a total system has a longer history than that implied by Mitchell. This history should in fact be considered as coeval with, and indeed crucially related to the development of the economy. The necessity for growth brought with it a specific concern on the resources required to power this growth, focused on a system of energy, composed of an interrelated and interchangeable set of fuel sources, and the complicated relationship between energy the economy and oil production is the focus of this chapter.

## Economy and energy

With respect to Federal government oversight at least, prior to the middle of the 1930s fuels and power sources were treated largely separately, but from this point forwards, alongside the construction of the US national economy, a succession of groups concerned with the management and planning of natural resources as a whole were constituted in the US. The National Resources Board (1934-1935), the National Resources Committee (1935-1939), and the National Resources Planning Board (1939-1943), represented the first development of a novel concern with natural resources, and particularly energy, as a whole system bound to and substantially underpinning the newly developing national economy.

### *The system of energy*

The boards developed in the 1930s and early 1940s can be seen as reconditioning the conservation ethic of the New Deal era and reconstituting natural resource conservation with respect to the new economy. The broad objectives of these boards were often not entirely clear, but they were concerned in the first instance with the problems of depression and the antimonopolist sentiments of the New Deal, and as such sought out alternative mechanisms to the market as a means to allocate natural resources (Goodwin 1981a:6). In 1939, two years after Tinbergen's first econometric model of the economy, and just five years after Kuznets' 1934 report to congress, the National Resources Committee, under the Chairmanship of Harold J. Ickes, published a major report that would maintain, for the first time, that the four main power sources in use in the US (coal, oil, natural gas, and hydroelectric power) comprised a closely interrelated system of energy. And as such, this system required the overarching attention of government:

It is time now to take a larger view, to recognise more fully than has been possible in the past that each of these energy resources affects the others, and that the diversity of problems affecting them and their interlocking relationships require the careful weighing of conflicting interests and points of view. (Ickes, cited in Goodwin 1981a:7)

At the same time as economic growth was being newly imagined in terms of the intensification of monetary flows within a defined national space, a system of energy - comprised of the formerly separate and separable fuel sources of coal, oil, gas and water - was being imagined as powering these flows. The committee reviewed each of these natural sources and recommended public policy for each of them: public supervision by control of process, distribution, or both to deal with the surplus of coal; the creation of a federal oil conservation board to counter the impending exhaustion of oil and gas; and the expansion of multiple-purpose planning by bodies such as the TVA to manage potential conflicts of interest with respect to water development. This new system of energy could not be grasped and managed in order to service the economy, the 1939 report argued, through the uncoordinated management of the individual fuels. Rather, it recommended the creation of an advisory planning group for the four sources of energy as one part of an overarching planning agency for the natural resources. This agency would be responsible for the production of a 'national energy resources policy' which amounted to more than 'a simple sum' of policies towards the individual fuels (cited in Goodwin 1981a:8).

While the outbreak of war would interrupt these particular proposals, the war itself had the overall effect of further reinforcing energy as a system of closely related, interlocking resources fundamental to the health of the economy. Moreover, during the war, and due in part to the massive exportation of mineral fuels to Europe to underwrite the war effort, the US discovered that its own natural resource independence was rapidly disappearing, and this led to further urgent questions regarding its growing dependence upon foreign sources of energy. Goodwin argues that the importance of the early investigations of the federal planning groups is two-fold. First, they served to educate and sensitise individuals in the legislative and executive branches of government regarding the importance of energy resources in total - not merely as unrelated, singular materials. Second, they raised and publicised issues around the availability of mineral fuel stocks that would become a paramount concern at the end of the war, as the full scale of war induced resource depletion was evaluated and quantified.

#### *The postwar energy for growth*

Harold Locke's 1945 'Post-war Resources Institute', outlined in the last chapter, also included a focus on energy as a crucial theme. The dominant concern of the Institute's energy panels was the interrelated nature of the interchangeable fuel sources and the problems that arose because of this. An example of this interrelationship was given with respect to the challenge that natural gas exploitation would present for the future. One speaker at the conference estimated that unrestricted gas consumption would result in shortages within about ten to twenty years, but during this time, increased gas use could seriously undermine the coal industry. Not only this, but industrial conversion to cheap gas could result in costly reconversion in a relatively short period of time once the gas started to run out (Goodwin 1981a:13). In order to tackle energy problems of this nature, the institute produced a set of six principles, upon which it was argued a national energy policy could be based. The first three principles were concerned solely with the relationship between fuels with respect to energy provision in toto: First, the most economic sources of energy should be used to minimise cost; second, plentiful and depletionless resources should be used whenever possible in place of scarce and depleting resources; third, sources of energy with special characteristics should not be

used for purposes for which other less specialised energy sources are available (Goodwin 1981a:13).

The developing postwar concern with energy as a total system comprised of interchangeable fuel sources may have been clear enough for Ickes in 1945, but the effective institutionalisation of a concern with energy would have to wait for his successors, first Julius Krug and the influential Barnett report *Energy Uses and Supplies*, and then Secretary Oscar L. Chapman. In 1947, the same year that Frederick Dewhurst's *America's Needs and Resources* (1947) was released, Harold Ickes' successor as secretary of the Interior, Julius A. Krug<sup>22</sup>, began an administrative reorganisation of the department - specifically in order to address more effectively the resource depletion issues that were then being made manifestly clear (Goodwin 1981a:34).

Crucial to this reorganisation was the strengthening of the Office of the Secretary and the creation within this office of a programme staff and committee led by Walton Seymour, a former associate of Krug's at the Tennessee Valley Authority (TVA). In October 1947 the United States Geological Survey (USGS) produced for Krug a report detailing the current fuel and energy situation of the US. As was current practice, this report made substantial use of industry data and maintained that the increasingly fraught concern with materials depletion was ill-founded. The report argued that ongoing fuel shortages were not due to long-term resource issues, but instead to transportation and steel production shortfalls (Goodwin 1981a:35-36). Krug remained unsatisfied, and as he complained to Seymour in April 1948, there was a pressing need for:

[A] general study of the Nation's energy and fuel requirements...and our best guess as to how these needs would be met...even some 'guesstimates' would be better than nothing. I don't think any of the past projections by the principal industries involved a realistic appraisal of the total needs of our expanding fully employed economy operating at a tempo which can meet our domestic needs and our increasing commitments abroad (cited in Goodwin 1981a:36)

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<sup>22</sup> Harold Ickes had resigned from the post of Secretary in February 1946 in protest at the mooted appointment of Edwin Pauley to the position of under secretary of the Navy. Pauley had been involved in the oil industry since his founding of The Petrol Corp in 1923, and Ickes maintained that this long association should disqualify Pauley from gaining authority over the valuable naval petroleum reserves (Goodwin 1981a:14).

Eventually, In 1949, Seymour presented to Krug the long awaited Barnett study. This was followed on December 1<sup>st</sup> 1950, by Interior Department Order 2602, issued under Chapman, which established the Office of the Assistant Secretary for Mineral Resources within the Department of the Interior. This new office was comprised of three divisions, focused variously on Minerals and Fuels, Geography, and Oil and Gas, and resulted in the first permanent planning unit within the federal government concerned with energy in general (Goodwin 1981a:44-45). Over and above the individual fuel sources, the office had supervisory responsibility over the Bureau of Mines, the US Geological Survey (USGS) and the Oil and Gas Division.

The Paley Commission report detailed in the last chapter also relied upon a notion of an integrated system of energy in establishing its understanding of the potential long term constraints on the growth of the economy. As the commissioners argued:

the time will come... and perhaps well beyond 1975, when civilisation's energy needs will outrun nature's declining store of fossil fuels available for economic use. Before this happens, ways must be found to harness economically such unconventional sources as solar and atomic energy. (PMPC Vol.1 1952:106)

This perspective was tempered however, by a rather more positive, and politically acceptable conclusion regarding the prospects for material provision and economic growth in the short term; and this is derived, in part, due to the commission's understanding of the system of energy. The Paley approach emphasised the end use of resources (Maass 1953:206) and as such, grouped individual fuel sources under the rubric of energy. Energy would form a core component of the Paley analysis with nearly 20 percent of the summary report devoted to it (Landsberg 1987:90) and where: 'The commission is strongly of the opinion that the Nation's energy problem must be viewed in its entirety and not as a loose collection of independent pieces involving different sources and forms of energy.' (PMPC Vol. 1 1952:129). Beyond the general policy recommendations, their development of integrated estimations for overall energy consumption in 1975 indicated how the Paley Commission approached energy flow from primary production to ultimate consumption.

Reiterating the relative novelty of energy understood as an interrelated system, the PMPC actually maintained that its comprehensive and systemic understanding of energy was a novel one, claiming that previous energy crises had been dealt with on a 'piecemeal basis' (PMPC Vol.1 1952:129). The Paley approach should be seen as a further way in which mineral fuels were being bound into a total system of energy in the post war years, and the PMPC report was emphatic that '... on one point, the Commission is very clear: the hydra heads of energy policy must be reined together.' (PMPC Vol.1 1952:130). As such:

[i]deally, the Nation should have a comprehensive energy policy and program which embraces all the narrower and more specific policies and programs relating to each type of energy and which welds these pieces together into a consistent and mutually supporting pattern with unified direction.' (PMPC Vol. 1 1952:129)

By the early 1950s then, the notion of a system of energy had been born in the US, phoenix-like, from the ashen fear of material and mineral fuel depletion during the conflagration of war. This system of energy should be seen in relation to the near simultaneous construction of 'the economy', and related to this new and increasingly central political object through energy's core role in the enablement of continued and increasingly urgent economic growth. The development of this new political concern with energy for the economy immediately posed a heightened threat to individual fuel production - particularly and most importantly the oil industry. The oil industry, of course already famously truculent with respect to federal oversight, found the developing concern with energy in the Interior Department and more broadly of particular concern. Attempts in congress in 1949 to establish a Petroleum Policy Council ultimately went nowhere, and as Harold Barnett reported, the Chairman of the industry body the National Petroleum Council (NPC), Walter B. Hallanan, opened their January 1950 meeting by describing the Council as 'a buffer to encroachment by Government officials' (cited in Goodwin 1981b:98). In order to assess the meaning of the threat represented by energy to oil, it is necessary to understand both the central importance of oil in the postwar period, and the means through which the vast profits of the oil industry, both domestically and abroad, were secured.

## Oil and the international economy

At the same time as the economy and the system of energy were being stabilised in the US, a new international financial infrastructure was being constructed under the Bretton Woods agreements, and as Mitchell (2011) argues, central to the developing architecture governing monetary flows was the governance of parallel flows of oil. By the end of the second world war, the US had accumulated 80 per cent of the world's gold supply. And by making the dollar the world's reserve currency fixed to gold at \$35 per ounce, with other currencies pegged to the dollar, it was hoped that the explicit goal of the Bretton Woods agreements - to limit international financial speculation - could be achieved. However, dollar circulation would rapidly outpace the US gold supply, and what sustained the value of the dollar in practice was its international use for purchasing the commodities that formed the bulk of international trade, and most importantly, oil. Oil was sold in the currency of the international company that produced the oil, not the country where it was produced, nor the place where it was consumed, and of the seven major international oil companies (the oil majors or seven sisters)<sup>23</sup> only one was British owned (British Petroleum) and one Dutch-British owned (Royal Dutch Shell), the rest were American. This meant that the vast majority of global oil sales were in 'dollar oil' and countries were required to purchase the fuel they needed by using dollars, and therefore, as Mitchell argues 'The value of the dollar as the basis of international finance depended on the flow of oil' (Mitchell 2011:111).

### *Flows of oil, flows of money*

And the oil did flow. From the 1920s onwards, approximately 60 to 80 per cent of world oil production was exported, and by 1970, oil accounted for 60 per cent of all seaborne cargo (Mitchell 2011:37). The postwar reconstruction of Europe and Japan involved vast quantities of oil, in large part due to the conversion of their economies from domestic coal sources of power to imported oil: through rising automobile use, the conversion of railroads from coal to diesel, and significantly, under the impact of

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<sup>23</sup> Coined by Enrico Mattei, the head of the Italian state oil company Ente Nazionale Idrocarburi (ENI), the seven sisters in the 1950s were: Anglo-Persian Oil (which became British Petroleum); Gulf Oil; Standard Oil of California (SoCal); Texaco; Royal Dutch Shell; Standard Oil of New Jersey (Esso); and the Standard Oil Company of New York (SoCony).

economic assistance from the US (Stork 1975:59-60). Under the Marshall Plan and the Economic Cooperation Administration (ECA), European use of oil was intensified, and therefore reliance upon Middle Eastern imports controlled predominantly by the American oil giants was assured. For example, the transition from rail to road freight haulage in Europe was imposed when European requests for freight cars under the Marshall Plan were reduced from 47,000 to 20,000; whilst 65,000 trucks were allocated by the US, in spite of no requests for such (Stork 1975:60-61). By the middle of 1950, 11 per cent of the value of all ECA shipments consisted of oil, and Walter Levy, who resigned from Mobil Oil to head the oil division of the ECA claimed that 'ECA has maintained outlets for American oil in Europe... which otherwise would have been lost.' (quoted in Stork 1975:61)

By the end of the war, oil was both, by value and volume, the largest commodity in world trade (Mitchell 2011:111), and by 1955 it was such a large component of British international trade that a report on the treatment of oil in its accounts maintained that 'the international ramifications of the oil industry (including its tanker operations) are so large and so complex as almost to constitute oil [as] a currency in itself' (cited in Mitchell 2011:119-120). The importance of oil was clearly understood by the postwar planners, with the Bretton Woods architects John Maynard Keynes and Harry Dexter White arguing for the creation of a third institution alongside the International Monetary Fund and the World Bank, an institution to manage trade in oil and other materials (Mitchell 2011:112). Concern with oil and key commodity trade as part of the management of financial movements was shared across the board, with Friedrich Hayek, founder of the Mont Pelerin Society and one of the intellectual leaders of the nascent neoliberal movement, arguing for an 'international commodity standard' (Mitchell 2011:112).

Between the Bretton Woods talks in July 1944, and the meetings at Dumbarton Oaks to agree a successor organisation to the League of Nations later in that same year, a third meeting was held between the US and Britain in Washington in early August. The purpose of this meeting was to establish an International Petroleum Council. The council was envisaged as a form of 'trusteeship' to enable the developing Anglo-American control of Middle Eastern Oil, pre-empting attempts at nationalisation by oil producing countries and constructing a postwar petroleum order, which in the words

of a State Department memo, would create a 'worldwide system of actual administrative control of the world's petroleum resources' (cited in Mitchell 2011:118)

Washington intended for a government agency to play the role of trustee, and the US Petroleum Administration for War had already established, in 1943, a government oil company, the Petroleum Reserves Corporation (PRC), to take control of the oil reserves of Saudi Arabia (Mitchell 2011:114; Goodwin 1981b:68-71). Harold Ickes was to serve as President and chairman of the corporation, and preempting his broader energy concerns sought to acquire the California Arabian Standard oil company and develop a federal Petroleum Reserves Board charged with estimating and administering national reserves of petroleum - whether domestic or overseas. Oil companies railed against this perceived attempt at the creation of a New Deal-style petroleum public utility (Goodwin 1981b:71-72), and ultimately both the PRC and the International Petroleum Council were abandoned. With the move away from trusteeship, control over Middle Eastern oil production by American oil companies was to progress under the rubric of strategic necessity.

The central linkage between oil and the cold war would be made clear by the April 1951 nationalisation of oil production in Iran under a bill developed by Mohammed Mossadeq, who in May of that year would be elected as Prime Minister. Driving the nationalisation were clear and popular misgivings regarding the exploitative oil concession granted by Iran to the British owned Anglo-Iranian Oil Company. Anglo-Iranian had been founded in 1908 as the Anglo-Persian Oil Company following the discovery of large oil fields after having been granted a 60 year concession in 1901. Between 1913 and 1951, Anglo-Iranian grossed \$3 billion, of which only \$624 million went to the Iranian government, the rest being transferred abroad as profit, and from 1944 to 1950, the company's profits increased tenfold while government revenue only increased fourfold (Stork 1975:50). Iranian nationalisation removed Anglo-Iranian from its position as exclusive Iranian producer, and opened up the possibility of an American presence<sup>24</sup> in the country, although the developments were also considered as a threat to further extractive operations, coming as they did shortly after the nationalisation of

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<sup>24</sup> The US had been positioning itself as an alternative ally for the Iranians since the war. Iran was a prime recipient of Truman's Point Four aid programme and a programme for the Country's economic development was undertaken by Overseas Consultant's Inc. - a US company headed by Max Thornburg, former State Department Oil affairs advisor who was also employed by Standard Oil of California (SoCal) (Stork 1975:51).

oil fields in Mexico and Bolivia. As Truman confided to *New York Times* columnist Arthur Krock 'if...the Iranians carry out their plans as stated, Venezuela and other countries on whose supplies we depend will follow suit. That is the great danger in the Iranian controversy with the British' (cited in Stork 1975:52).

In the same month as Mossadeq's election, the New York Times helped cast the Iranian nationalisation into the shadow of the cold war, and stressed the importance of Middle East oil to capitalist and socialist countries: '...the U.S. and Europe could hardly afford to see an important part of the Near East oil resources pass to the control of Russia, *either directly or indirectly through nationalisation*' (cited in Stork 1975:52; emphasis in original). In response to the nationalisation, Anglo-Iranian demanded compensation for both current investment and lost future profits, egregious terms that were of course rejected. They then instituted a boycott, effectively preventing Iran from transporting and marketing its own oil. American oil companies, in solidarity with Anglo-Iranian, also participated in the boycott, bringing Iranian oil production to a virtual standstill.

The economic hardship resulting from this boycott helped lay the festering groundwork for the CIA backed military coup which overthrew Mossadeq in August 1953 and restored the Shah to power. And along with the Shah came the five American oil companies - collectively controlling 40 per cent of a consortium along with Anglo-Iranian (now renamed British Petroleum). While national security and strategic interest with respect to the cold war were presented as the ostensible reason underlying the American companies' move into Iran<sup>25</sup>, the cold war helped a different conflict, between sterling and dollar oil, to be won decisively by the American oil companies. The subsequent global flow of dollar denominated oil would maintain both the value of the dollar and further imbricated US governmental involvement in assuring the vast profits of US oil concerns - profits that had been assured almost from the very beginning by Federal involvement.

#### *The high price of cheap Middle Eastern oil*

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<sup>25</sup> Indeed, at the same time, the five US majors were given an exemption from a pending antitrust suit launched by the Department of Justice on the grounds of national security (Stork 1975:55).

Oil production has always been renowned as a high profit, high risk venture. And like all the best lies, this is based in at least a partial truth. In what Joe Stork has referred to as the 'bonanza years' from 1948-1960 the major oil companies operating in the Middle East transferred approximately \$12.8 billion abroad from total revenue of \$28.4 billion (Stork 1975:56). The basis for these vast profits was the low cost of producing oil in the Middle East combined with a price structure for oil based on the high production costs of the US. A Chase Manhattan study in the early 1960s estimated the average costs of maintaining and expanding production in the Middle East at 16 cents per barrel, compared to 51 cents per barrel for Venezuelan oil and \$1.73 per barrel in the US (Stork 1975:58), and it was through the cartel agreement made between the seven major international oil companies in 1928 (Mitchell 2011:166) and the cartel's use of the so-called Texas basing point formula that global oil prices were tied to US prices.

Until the second world war the US was the world's largest supplier of crude oil and petroleum products and the basing point formula set the price of oil - produced anywhere in the world - at the same price as Texas oil, plus an entirely fictitious transport cost from the gulf of Mexico to the point of purchase. This formula meant that oil produced in the Persian Gulf cost the same to purchase as Texas oil shipped from the the gulf of Mexico. And it was enabled by the vertically integrated structure of the major oil companies, which controlled all aspects of the industry from initial prospecting, through production, refining, transportation and market sale, alongside the joint ventures and non-competitive planning between the oil companies (Stork 1975:58-59).

This system of pricing world oil lasted until the end of the second world war. In 1944 the British Navy launched an investigation into oil prices and the use of the Texas basing point system. In response to this investigation oil companies dropped the fictional transportation cost from the gulf of Mexico, but retained the Texas point price - Middle Eastern oil was still priced equivalently to oil produced in the US, despite significantly lower production costs. In effect, the Persian Gulf became a second basing point (Stork 1975:59). This pricing mechanism remained in place until 1960 and the development of the Oil Producing and Exporting Cartel (OPEC), and it was the

difference between the Texas point price and cheap Middle Eastern production costs that enabled the vast profits of the international oil majors up to this point. But this wasn't the only means through which these profits were guaranteed.

A further way that the profits of the major international oil companies were maintained while risks ameliorated in the middle east was through the profit sharing agreements first pioneered in Venezuela in 1948, but which were brought to the Middle East by Aramco<sup>26</sup> in Saudia Arabia in 1950, and then to Iraq and other countries (Stork 1975:47). The massive increases in postwar production in the Middle East resulted in increasing income to the ruling families and governments of producer countries under the royalties system in place at the time. For example, in Saudia Arabia, The House of Saud saw its income from Aramco production jump from \$1.7 million in 1944 to about \$50 million in 1949, as production increased from 7.8 million barrels per year to 174 million barrels.

However, company profits increased by an even greater degree (from \$2.8 million to \$115 million) as company income per barrel was over \$1.10 while the Saudi regime received only 21 cents. As a consequence, the Saudis pushed for a more equitable division of profits, and ultimately the oil companies, in concert with the US State and Treasury Departments, invented a new 50-50 profit sharing scheme. The Saudi throne would receive 50 per cent of the posted price of oil, but this would be considered an income tax, and not a royalty. This tax could then be offset against income tax in the US. This happy arrangement meant that In 1950, Aramco payments to the House of Saud leaped to \$111.7 million, while taxes payable to the US treasury dropped by an equivalent amount - to nearly zero, maintaining Aramco profit margins at their previous levels (Stork 1975: 46-47).

The profit sharing scheme, in line with the narrative of strategic necessity, was justified at the time on the basis that increased sharing of profits with inept and corrupt yet pliant regimes was necessary to ward off the threat posed by nationalists to the concessions held by the largely American oil majors (Stork 1975:47-48). However, this apparent method of ensuring the strategic security of supply actually operated by

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<sup>26</sup> At this time Aramco was composed of Esso (30%); SoCal (30%); Texaco (30%); Mobil (10%).

securing oil company profits, and amounted to an indirect transfer from the US treasury to the treasuries of oil producing countries. A point George McGhee, the then Assistant Secretary of State for near Eastern, South Asian, and African Affairs conceded in congressional testimony:

Q: But upon recommendation of the National Security Council, the Treasury made the decision to permit Aramco to treat royalties paid to Saudi Arabia as though they were taxes... the impact on the national treasury was direct and dramatic...the effect of the decision was to transfer \$50 million out of the U.S. Treasury and into the Arabian treasury. That was the way it was decided to give Arabia more money and to do it by the tax route. Isn't that correct?

McGhee: Yes, that is one way of looking at it. (Quoted in Stork 1975:48)

The high profit margins of the international oil majors, enabled by the price support of the Texas basing point formula and ensured by the tax offset of the profit sharing scheme resulted in the further expansion of overseas oil production by largely US owned corporations, and the decisive shift in global oil extraction from the US to the Middle East. Oil production in the Middle East was (and still is) a highly lucrative industry not because of the high risks involved, but because of the closely integrated and cooperative nature of oil production combined with extensive governmental support. The basing point formula anchored the price of Middle Eastern oil until the early 1960s on the price of oil produced in the US. But how was the high US price itself maintained?

#### *The domestic US basis of expanding foreign production*

The oil industry and the production of petroleum in the US had, from the very first, a remarkably agnostic relationship with the received wisdom of the economics discipline. Early oil production at the end of the 19<sup>th</sup> and beginning of the 20<sup>th</sup> centuries proved acidly resistant to market competition, leading ultimately to the imposed break up of J.D. Rockefeller's mammoth Standard Oil in 1911, as one of the first breakthroughs of the anti-trust Sherman act. Twenty years later the oil that gushed from the ground in the newly discovered Joiner field in East Texas would wash away the received neoclassical wisdom of supply and demand, and ushered in a series of controls in order to reduce supply and maintain prices. As Craufurd Goodwin notes (1981b:64),

the main argument presented to the public for the close, mutual relationship of the federal and state governments to the oil industry in the US at the time was based on the apparently singular nature of petroleum production. In this case, it was argued that unrestrained competition was uniquely destructive with respect to oil - leading to sub-optimal rates of extraction and waste. The salutary lesson of the Joiner field in East Texas provided a popular imaginary to underwrite this. In late 1930 and early 1931 prospectors in Texas struck oil in what would turn out to be the largest oilfield yet discovered. The vast quantities of oil pumped from the field caused the price of petroleum to collapse, and by August 1931, the Governors of Oklahoma and Texas had declared martial law, and sent the National Guard to occupy oilfields and shut down new wells in order to reflate prices (Mitchell 2011:196).

Martial law was shortly replaced by a nationwide system of output limitations based on quotas (known as 'allowables') for states and state producers, where 'the total national output would in theory add up to an amount corresponding to a desired price on the consumer's demand curve.' (Goodwin 1981b:64). Enforcing the quotas was achieved through the 1935 Connally Hot Oil Act which prohibited interstate movement of any oil which was produced above the quota. Nationwide statistics on demand were produced by the Bureau of Mines. This statistical information was then used by the Interstate Oil Compact Commission to determine quotas and thereby stabilise or adjust prices. Alongside the quota system, in 1932 the domestic oil industry convinced the US government to impose a tariff of 21 cents per barrel on imported oil. This brought about an immediate reduction in imports and hastened Mexico's nationalization of its American-owned oil industry in the Spring of 1938 (Vieter 1984:93).

The final aspect of government price support was the application of preferential tax treatments to incentivise production (Goodwin 1981:63; Stork 1975:59; Vieter 1984). The so-called 'depletion allowance' allowed for 27 and a half percent of profits from the production of domestic oil and gas to be exempt from income taxation, and was originally implemented in 1926. Coal and other mineral fuels received much lower allowances, on the grounds that technically, exploration risks were higher in the oil industry (Vieter 1984:20). The depletion allowance was additional to tax breaks for

'intangible' drilling costs which had been in place since the 1916 Revenue Act and were reconfirmed by Congress in 1954 (Vieter 1984:20).

As Goodwin maintains, from the Depression onwards the regulation of the oil industry through production quotas, import tariffs and tax allowances in the US was mainly contrived by the industry itself - ostensibly to cope with oversupply and maintain oil prices. In maintaining prices in this way, the US government helped encourage and support consistently increasing levels of US oil extraction and expansive and expanding profit margins for the oil industry, at the same time as the overall purchase price of oil was dropping (Pfister 2010; Yergin 1991:785) As Vieter stated in 1984, estimates on the preferential tax treatment to the oil and gas industry alone range from USD 400 million to 2.5 billion annually over the fifty years they had then been in effect (Vieter 1984:20). Through the Texas basing point system and the integrated and non-competitive structure of the international oil majors, even greater increases in oil production and profits were realised overseas, predominantly in the Middle East, given the much reduced production costs. The continued flows of oil, and continued flows of oil company profits, were made possible through the coordinated exclusion - by industry, the US government, and producer country governments - of oil production from competitive forces.

After the war, these oil flows were of crucial importance to the international economy. The maintenance of the dollar as the world's reserve currency, and the stability of the Bretton Woods financial architecture was increasingly secured under the ambit of the developing structure of the cold war. Alongside the consistently, and sometimes explosively growing supply of oil, were the persistent predictions of long-term scarcity and the imminent depletion of US reserves - claims made by both government and industry. And yet, even with the spreading fear of generalised natural resource depletion at the end of the second world war, the oil industry was optimistic and sure of its ability to provide for the future needs of the country (Bowden 1982, 1985).

By the early 1950s, approximately 50 billion barrels of oil had been produced in total in the US, and with projections of total oil reserves in the region of 150-200 billion barrels, the oil industry was looking forward to future production on the level of two to three times the total production of oil over the last 100 years (Bowden 1985:219). This

optimism was made clear in a report released in 1952 - the same year as the Paley report - by the Independent Petroleum Association of America (IPAA). Although the report did not itself estimate remaining oil resources, as Bowden (1982:432) notes, it brought three lines of evidence to bear in support of its upbeat assessment of the industry's future: First, the report argued that it was illogical to believe that the US was running out of oil, as such suggestions in the past had been proved false. Second, US oil production was at an all time high in 1952 and was continuing to increase. Third, US proven reserves were greater in magnitude in 1952 than at any time in the past.

A second report released in 1952, this time by the National Petroleum Council (NPC), made similar claims with respect to the long term availability of oil supplies, but clearly stated the importance of price and production supports: 'Increasing availability of petroleum can be counted on in the United States and worldwide provided reasonable economic incentives and a favorable climate for private investment are maintained.' (NPC 1952:18) However, alongside this, the report also noted the potential threat to oil from other energy sources: 'Energy from other sources at attractive prices may finally bring about a decrease in petroleum demand before any lack of prospects causes a decrease of available supplies.' (NPC 1952:18). The developing notion of a system of interchangeable fuel sources comprising a total system of energy, a system that at least parts of the federal government were keen to regulate, and that was seen as fundamental to powering the newly sacralised economy, was beginning to be recognised as a threat to continued oil production and high profits in the industry. By 1956, claims by two men - the Soviet premier Nikita Krushchev, and the oil geologist and Technocracy Inc. founder M. King Hubbert - laid clear the threat that energy posed to the oil industry.

## Energy and the threat of peak oil

Krushchev's boast in 1956 to the Twentieth Party Congress was a further provocation to the 'West' and confirmed the central importance of growth to the cold war: 'the great advantage of the socialist economic system, the high rate of development of social production, enable us to carry out in an historically very brief period the main task of the U.S.S.R. - to catch up and surpass the most developed capitalist countries in per capita output' (Krushchev; quoted in Arndt 1978:48). Merely one year after

Krushchev's ebullient speech, the USSR's success in the space race with the launch of the first Sputnik would raise US fears of accelerating soviet industrial production to the level of a 'hysterical anxiety' (Lekachman 1966:161). This developing hysteria over the growth of the economy focused further attention on the availability of energy to power this growth and reiterated the explosive potential of atoms for the economy.

#### *Atoms for the economy*

During the August and September of 1949, Harold Ickes' long delayed World Conservation Conference took place in Lake Success, New York. The renamed *Scientific Conference on the Conservation and Utilization of Resources* was ultimately organised under the auspices of the UN, with Julius Krug heading up the US delegation. In his welcoming address, Krug stressed a number of opportunities for the years ahead with respect to energy: '1. The peacetime application of atomic energy. 2. More effective utilisation of solar energy. 3. Development of synthetic fuels, particularly from oil shales' (cited in Goodwin 1981a:26). Noticeable by their exclusion from this list were the expansion of, and support for traditional oil and gas production; although this is unsurprising given Krug's dissatisfaction with the oil industry's ongoing assessment of the energy situation in the US, as outlined in the introduction to this chapter.

Similarly, in 1953 Palmer Cosslet Putnam published his study of energy demands commissioned by the Atomic Energy Commission in 1949. Putnam, who was one of the Paley commission's staff members researching energy resources, would continue the analysis of energy as a single system in this volume. Unsurprisingly for a study commissioned and published by the Atomic Energy Commission, Putnam argued for a widespread electrification of the US and a shift to increasing reliance on nuclear fuels to 60% of total energy input by 2050, on the grounds of imminent domestic fossil fuel peak production dates. Putnam reiterated the relative, economic scarcity notion of the Paley report when he stated that:

There is no such thing as an absolute reserve of coal, oil, and gas. Reserves are relative. There is more coal, oil, and gas in the earth's crust than will ever be used. It is not a question of emptying the bin. It is only a question of deciding how deep it is economical to dig. (Putnam 1953:117)

For Putnam, that depth would soon be reached. He projected that oil and gas would reach peak production between 1955-1960 then go into decline; bituminous coal would begin to decline before 1960, followed by all Eastern US coal by 1975. These projections of the decline of inexpensive mineral fuel sources, and the potential for the expansion of replacement non-mineral fuels as part of an overall system of energy came at a time of ever developing certitude over the necessary growth of the national economy. 1953 also saw President Eisenhower give his famous 'Atoms for Peace' speech to the UN General Assembly, where he claimed: 'The United States knows that peaceful power from atomic energy is no dream of the future. The capability, already proved, is here today.' (Eisenhower 1953). In 1955, the UN would host the International Conference on the Peaceful Uses of the Atom in Geneva, otherwise known as the Atoms for Peace conference, and in 1957 Eisenhower's proposal for an International Atomic Energy Agency (IAEA) under the aegis of the UN, and responsible under Article II of its statute for the drive '... to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world' (IAEA 1957).

While atomic energy may not have been simply a dream of the future as Eisenhower pointed out, it certainly had the potential to be a nightmare for the oil industry. As the oil economist Morris Adelman later stated 'The uncertainty of oil exploration infects, as it were, the economics of investment in competing supply sources. For example, investment in nuclear power is reasonable given one set of expectations of oil discoveries and costs, and wasteful given another.' (Adelman 1972a:41). If doubt was cast over the future availability of mineral fuels, particularly oil and gas - until then the two fastest growing components of the energy system - then alternative sources of energy would have to be found, and this would present a clear threat to the historic systems of price and production supports that underlay the oil industry's profitability. In 1956, the same year that Krushchev would boast about the USSR's unparalleled economic growth and the fundamental advantage of the Soviet economic system, the oil geologist M. King Hubbert presented a report at the annual Spring meeting of the Southern District of the American Petroleum Institute (API) that, in the context of the necessity for abundant energy to fuel economic growth, would come to be seen as a threat to the very basis of the US oil industry.

*Hubbert and peak oil*

Just two years after he received the Arthur L. Day Medal of the Geological Society of America for his work in geophysics, Hubbert, then chief geology consultant for the Shell Development Company and director of the Shell Exploration and Production Research Division in Houston<sup>27</sup>, predicted that the US was nearing the extraction of half of its recoverable petroleum resources. His Peak Oil Thesis made use of a lifecycle curve methodology first introduced by D.F. Hewett in examining production statistics from major metals mining districts in Europe. Hubbert argued that while not all of the criteria identified by Hewett relate to fossil fuels, there is a fundamental principle that is applicable across both: ‘...like the metals, the exploitation of the fossil fuels in any given region must begin at zero, undergo a period of more or less continuous increase, reach a culmination and then decline’ (Hubbert 1973:41-42; cited in Bowden 1985: 212). This fundamental principle describes an industry life cycle curve, and in order to define the area under this curve for petroleum extraction, Hubbert both reviewed published estimates of reserves and made extensive enquires among respected exploration geologists. On the basis of the figures established through his research, Hubbert constructed his famous famous life cycle curve. Through his curve fitting procedure, Hubbert estimated that the total reserves of crude oil in the US measured approximately 150 billion barrels - a figure in line with other contemporary estimates (Bowden 1982; 1985), alongside a prediction that US crude oil production would peak sometime between 1966 and 1971, and then enter into continuous and inexorable decline (Hubbert 1956; Hemmingsen 2010).

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<sup>27</sup> Hubbert was also a co-founder in the 1930s of Technocracy Inc. and was centrally involved in the technocratic movement of the time. Inspired by the institutional economist Thorstein Veblen, the scientific management principles of Frederick Taylor and Edward Bellamy's late 19<sup>th</sup> century utopian novel *Looking Backward*, Technocracy Inc. gained notoriety briefly between 1932 and 1933 but was otherwise a relatively marginal movement in the US. Reacting to the same circumstances that resulted in the construction of the economy, Technocracy Inc. sought to replace the price system and the monetary units that underpinned this with a currency based on a thermodynamic system of energy units (Hemmingsen 2010:535), pre-empting Howard Odum's comparable concept of of ‘emergy’ by a quarter century (e.g. Odum 1996). Hubbert's critique would also encompass the development of the economy from the 1930s onwards, and his concern precisely derived from the separation of the economy as a discrete ontological sphere. As Hemmingsen notes: 'Hubbert was convinced that business and government leaders had erred fundamentally in tying the financial system to monetary growth; in his view, physical and biological constraints made it impossible to continue such growth rates.' (Hemmingsen 2010:536) And as he would later state in an interview at the end of his life: 'It's all interrelated, the biological thing, the ecological thing and minerals, it's all part of a single complex. So what you've got is a contract between the physical, biological world and the monetary world' (Hubbert quoted in Doel 1989c).

Hubbert had been invited to speak by the API in recognition of his geophysical expertise and the importance of geophysical prospecting at the time. He was a former geophysicist for the USGS, former professor of Geophysics at Columbia University and former senior analyst at the Board of Economic Warfare in Washington, and as the letter inviting Hubbert stated, he was 'eminently qualified to discuss future energy sources' (Strang 1955; cited in Hemmingsen 2010:354). These bona fides gave Hubbert's predictions real weight, and these predictions should be seen in relation to his long standing and broader concerns with the inability of the market-driven economy to optimally allocate resources - driven by his technocratic impulses, as outlined in chapter 2.

Hubbert published his first forecasts of a US oil production peak in two periodicals circulated by Technocracy Inc. in 1938. Here he made similar claims to his later 1956 forecast but with a peak oil production date of 1950 at the latest (Hemmingsen 2010:536). This prediction would be reiterated and updated ten years later, at a presentation to the American Association for the Advancement of Science in 1948 (Bowden 1985:211), which was published the next year in *Science*. His prediction here was in fact consistent with the claims that he would later make in 1956, but also outlined his concern with population growth on the grounds that the exploitation of fossil fuels had enabled 'one of the most disturbing ecological influences of recent millennia... the progressive increase of human population' (Hubbert 1949:104). In opposition to Malthus, who saw the human proclivity to procreate as the force driving population expansion limited ultimately by the availability of land suitable for food production, Hubbert maintained that energy supply was both the driver of and ultimate limit to population growth (Hemmingsen 2010:535).

Hubbert's 1956 prediction of a peak in US oil production in the next 10 to 15 years received national attention in the petroleum press, with the magazine *Petroleum Week* featuring Hubbert's speech under the headline 'Is Oil Nearing a Production Crisis?' (Hemmingsen 2010:540). This was in spite of both the public relations office of his employer - Shell Oil - phoning Hubbert from New York just prior to his taking the stage at the API meeting in Texas, and asking him to 'Please tone it down some' (Doel 1989; cited in Hemmingsen 2010: 534). The paper upon which Hubbert's speech was

based was also censored by Shell Oil, with specific predictions about the future of the industry in the pre-print version being replaced by much vaguer statements (Bowden 1985:219). The impact of the Peak Oil Thesis was considered damaging enough to the oil industry to justify near universal condemnation of his methods and almost immediate rebuttals from both industry and the USGS and bureau of mines.

As I indicated earlier in the previous chapter, pessimistic analyses of oil reserves had a history stretching back to the first USGS survey, and Hubbert's ultimate reserves figures were comparable to other estimations at the time, so why was Hubbert's prediction of the imminent decline of US oil production so universally reviled? The curve fitting procedure used by Hubbert - producing the estimated peak production date of just 10 to 15 years time flatly contradicted the optimism of the oil industry, as indicated in the IPAA and NPC reports of 1952; and as Bowden has argued:

As suggested by its title, 'Nuclear Energy and the Fossil Fuels', Hubbert's analysis was more than a simple statement of pessimism about the future of the US oil and gas industry. It suggested that dependence upon fossil fuels, like earlier dependencies upon other non-renewable energy sources, must ultimately give way to a reliance upon renewable sources of energy, specifically nuclear energy. (Bowden 1985:219-220)

#### *Peak production and the threat to oil*

Hubbert concluded that nuclear power would be the only fuel source capable of meeting America's energy needs 'for at least the next hundred years' (Hubbert, 1956:36), and so presented the Peak Oil Thesis as a severe threat to the oil industry in general. This long term threat to the oil industry from other alternative fuel providers (due to the increasing price of increasingly scarce oil) within the overall system of energy included not just atomic power and increasing use of renewables, but also synthetic oil from coal - an energy option that was highlighted in the Paley report (PMPC Vol. 1 1952; PMPC Vol. 3 1952). This threat was supplemented by a more immediate and pressing concern within the oil industry itself: an imminent reduction in oil availability would mean that the system of government quotas, tariffs and tax exemptions encouraging the sustained high levels of domestic production would be unjustified (Mitchell 2011:188). In light of imminent peak oil, both the need to conserve domestic oil reserves (in part for strategic reasons), and the massively expanded overseas production would render government production props unsupportable. The

possibility of the removal of economic incentives for oil production was obviously not popular with either the domestic or international producers (who themselves relied on the maintenance of high domestic oil prices), and as the Humble Oil employed economist Richard Gonzalez argued:

Our freedom and our way of life depend on the degree to which we can assure increasing supplies of domestic energy at reasonable cost. For at least our lifetime, oil and gas will be the most important and useful forms of energy. All of us have good reason to be concerned, therefore, that national policy shall be designed to encourage development of domestic petroleum resources in order that we may have sufficient energy for our economic progress and our national security. In a period when the United States is spending 40 billion dollars annually on defense, it would be foolish to jeopardize the domestic supply of the energy most vital to that defense by unwise policies. There are many good reasons why national policies designed to encourage the development of domestic oil and gas resources should be maintained, but the most important reason is that these policies are essential to provide petroleum for our future progress. (Gonzalez 1957:21)

The threat to domestic oil production from overseas oil was a longstanding issue for independent domestic producers, as can be seen by the imposition of the import tariff in response to the East Texas oil find in the 1930s, and in the post war period this had taken on new force. From 1946 to 1953, imports of cheap overseas oil rose from 5 percent to 10 percent of domestic production (Barber 1981a:220), and as Barber notes (1981a:230), behind the scenes in the White House it had been made clear from the earliest days of the Eisenhower administration that any failure by the executive to protect the domestic oil industry from cheap oil imports would lead to action by the congress to do so. Congressional support for domestic producers was also not limited to the delegations of oil producing states, but also from those members of congress who represented states that did not have known oil deposits - as there was always hope of a big new discovery; and as the international majors had little interest in financing domestic prospecting, the possibility of big new finds was reliant on the health of the domestic independents.

By 1955 an advisory committee to the Eisenhower presidency had recommended a voluntary limit on oil importation, and a provision of the Trade Agreements Extension Act of that year resulted in oil importers being required to supply information on the quantities of oil and petroleum products they were importing. This information revealed imports of oil substantially above the standard recommended by the advisory committee (Barber 1981a: 230-231). Further moves towards the voluntary limitation on

cheap overseas oil were interrupted by the Suez crisis beginning in late 1956. This resulted in the President directing the Secretary of the Interior to authorise 15 US oil companies to collaborate in organising petroleum shipments to NATO members; and resulted in an increase in US production to western Europe - from zero to 300,000 barrels a day from the gulf of Mexico - over the course of November 1956. It also led to government support for the development of a new class of oil supertankers, which could carry several hundred thousand tons of oil (Barber 1981a: 234-235). The new supertankers, along with the development of standardised containerisation, slashed transportation costs and again lowered the cost of imported oil in comparison to domestic oil, and resulted in increasing pressure on domestic producers (Mitchell 2011:154-155; Pfister 2010).

In August 1956, the IPAA filed a formal petition calling for further investigation into oil importation on the basis of a threat to national security, and Robert L. Wood, the Association's President, would take his case directly to the White House in an audience with Eisenhower in September. Wood argued that excess imports were curtailing exploratory activity, resulting in abandoned wells and had "forced state conservation agencies to restrict domestic production below economic levels" (quoted in Barber 1981a: 223-234). Deliberation of this petition was resumed in the spring of 1957 against the backdrop of the Suez crisis and this resulted ultimately in the Report of the Special Cabinet Committee to Investigate Crude Oil Imports, transmitted to the President in July 1957. While this report proposed that guidelines be established for each oil importer - stipulating a maximum import volume, these remained voluntary and non-binding (Barber 1981a: 239); therefore the threat to the domestic oil industry remained in place. By 1958 crude oil production in the US was down 460,000 barrels per day on 1957 levels (Barber 1981:246), and at the beginning of the 1960s importation of cheap overseas oil had increased to around 20 percent of total oil consumption (Landsberg & Schurr 1968:12).

The continuing growth in the importation of Middle Eastern oil in light of the failure of the voluntary limitation schemes brought the federal government closer 'to a formal alliance with regulatory commissions in the oil-producing states in buttressing the prices of domestically produced crude. Free entry of imports had for some time posed a threat to the survival of this price support mechanism' (Barber 1981a:241-241). Increasing imports of crude oil and petroleum products into the US threatened not only

domestic producers however, but the international system of oil production itself - based as this was on the high price of US produced oil, transmitted internationally through the basing point system. If the US price supports for domestically produced crude oil were dismantled, then this would impact on the pricing regime underpinning Middle Eastern oil, and the vast profits of the international majors. Hubbert's Peak Oil Thesis provided a further spur to both increased oil imports to the US and the removal of supports for domestic production in the short term, and the shift away from oil towards other energy sources in order to power the national economy in the long term. This threat had to be neutralised, and the way this was undertaken in the first instance was for oil industry representatives to attack Hubbert's methods, and specifically his apparent insensitivity to economic factors. Re-emphasising the Paley approach to price scarcity and reserves measurement, alternative and much larger estimates of US oil reserves were generated in order to delegitimise the imminent Peak Oil Thesis.

#### *Overcoming Hubbert's peak*

Oil company executives were the first to directly rebut Hubbert's estimates. A series of addresses and articles from 1956 to 1963 by Morgan Davis and Richard Gonzalez of Humble Oil challenged Hubbert's findings from a price-oriented economic perspective (Bowden 1985: 220; Hemmingsen 2010:536). In 1956 Davis was the Vice President of Humble oil<sup>28</sup> and one week after the API meeting he sought to discredit Hubbert's theory at a talk to a local geophysical society in Houston. According to Hubbert, Davis (trained as a geologist) and Gonzalez, a university of Texas economist hired by Davis, would continually refute Hubbert's speeches over the years 'usually within a matter of a week or two' (Doel 1989a). In line with the Paley approach they held a relative, price-based perspective on scarcity and maintained that 'economic, rather than physical, factors account for the existence of scarcity in the marketplace.' (Bowden 1985:221). In a 1957 paper published by Gonzalez in the *Journal of Petroleum Technology* he quotes a 1951 USGS report *Fuel Reserves of the United states*:

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<sup>28</sup> Davis would later become President and then Chairman of the board of Humble oil, Humble oil was a majority owned affiliate of Standard Oil of New Jersey, and in 1960 Humble and Standard along with Standard's other affiliates were consolidated into the single Exxon corporation.

If the future can be judged by the past, oil and gas will be found in sufficient quantities for many years to come. In the United States adequate production has been a direct function of economic incentive. Until the unpredictable date at which that incentive fails to provide the needed supplies, there will be no convincing evidence that we have reached the limits of our ability to expand the potential ultimately recoverable reserves of petroleum. (USGS 1951:35; cited in Gonzalez 1957:18)

Gonzalez and Davis argued that Hubbert's production peak was an arbitrary one, and that instead of peaking, oil production trends would continue in a straight line and consequently the predicted date of oil running out would be pushed further and further into the future (Bowden 1985:220; Hemmingsen 2010:536). Indeed, Gonzalez quoted Interior Department figures indicating that 300 billion barrels of oil were recoverable in the US as opposed to Hubbert's lower estimations. He even argued that this larger figure might come to be seen as conservative due to improvements in production techniques and as additional discoveries are made in both old and new oil provinces (Gonzalez 1957:14).

1958 saw the publication of an RFF study *The Future Supply of Oil and Gas* (Netschert 1958) by RFF staff economist Bruce Netschert. Netschert reviewed a series of reserve estimates in order to come to an overall resource base figure in the order of 500 billion barrels - two and half times higher than Hubbert's upper bound. In order to arrive at this figure, Netschert made use of a variety of reserve estimates, then multiplied these figures by three, on the basis of an estimated 32.7 per cent recovery rate by the *Interstate Oil Compact Commission Committee on Secondary Recovery and Pressure Maintenance* (Netschert 1958:22-24). While Netschert stated that the 500 billion barrel figure represented the total resource base, over and above the recoverable reserves, in a footnote he indicated how an economic approach to technological innovation implies higher reserve figures than the estimates he made use of, how this was prefigured by Gonzalez' 1957 article, and how: '...the full implications of this conclusion, especially in terms of the results of increased recovery over the medium term, have not, in this writer's opinion, received the recognition they deserve' (Netschert 1958:24).

Netschert's analysis, embodying the Paley approach as it was further developed through the early work programmes of RFF, was based on a clear use of relative, price-based scarcity measures in his calculation of reserves. Although generally well

received in the academic press (see e.g. Maxwell 1958; Steiner 1959; Whitaker 1958), Netschert's study would receive a blistering review by Hubbert himself in the *Journal Science* (Hubbert 1958). Hubbert had reviewed the manuscript of *The Future Supply* prior to its publication, a publication that went ahead without any of his explicit concerns being addressed (Doel 1989b), and in *Science* he concluded by stating that Netschert's procedures resulted in:

...estimates of reserves, and of future productive capability, for both oil and gas which, in light of present information, crowd the upper limits of plausibility. These conclusions, accordingly, imply the existence for the next several decades of a state of national self-sufficiency with respect to petroleum and natural gas which may be more illusory than real. Consequently, should they be accepted at face value and made the basis for national policy, the results could prove detrimental to the national welfare. (Hubbert 1958:196)

This was not the sole impact of RFF that year however. As I discussed in the last chapter, 1958 was the year of the RFF's *Perspectives on Conservation* conference, attended by the then Director of the USGS, Thomas B. Nolan. In his paper for the conference, Nolan referenced Hubbert's calculations as interesting, but simply noted that these are a far cry from the discredited earlier pessimistic estimates of total oil supply from twenty years earlier. Nolan's repeated optimistic assertions regarding the future supply of oil (and indeed all material resources) were founded squarely on his understanding of technology and technological progress inherited from neoclassical economics (Walker 2007). In fact, Nolan made clear here that the economic conception of technology is little other than rank alchemy: 'Indeed, it seems entirely probable to me that in the future we may be able to invent, or produce out of abundant materials, new substances that have predictable, specific and desired properties' (Nolan 1958:59).

In the early 1960s more direct critiques of the Peak Oil Thesis shifted from the oil industry to the USGS, with assistant chief geologist Vincent McKelvey<sup>29</sup> becoming a champion of price-based reserves calculations against Hubbert. In 1963 McKelvey leaked an anonymous, unauthorised USGS report to the *Oil & Gas Journal*. This report sought to prove that you could, in fact, turn base metals into gold, and produced a reserves figure of 590 billion barrels, three times greater than Hubbert's estimate of

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<sup>29</sup> McKelvey would later become director of the USGS before his removal in the early 1970s.

200 billion, based in part on the presumption that technological advances had kept price and availability of petroleum constant, despite the increasing difficulty of extraction (Hemmingsen 2010:537).

Similarly to Morgan Davis and Richard Gonzalez, John Ryan, an economist for Standard Oil of New Jersey, would maintain in papers published in the *Bulletin of the American Association of Petroleum Geologists* and the *Journal of Petroleum Technology* in the mid 1960s that Hubbert's analyses crucially ignored the role of economics (Bowden 1985:220-221) and failed to take into account changes in pricing and technology (Hemmingsen 2010:536). As Bowden (1985) and Hemmingsen (2010) note however, the criticisms of Hubbert's Peak Oil Thesis were not based solely on economic interpretations of scarcity measures. Hubbert was also critiqued on the basis that his reliance on production statistics failed to take into account oil geology. This critique was made by L.G. Weeks of Standard Oil of New Jersey, and was also used by John Ryan and Vincent Mckelvey. Ryan in fact described the peak oil model as a 'statistical exercise and is not the result of geological or engineering analysis' (Ryan 1965; cited in Bowden 1985:221).

However, these critiques were made alongside and as part of the much higher estimations of US oil reserves, based upon the shift to the Paley approach's relative, price-based scarcity measures. In line with the Paley report itself then, these high reserve estimations would enable pessimistic evaluations of the availability of US natural resources - in this case, specifically M. King Hubbert's analysis, to be challenged, opposed, and ultimately buried<sup>30</sup> under the weight of contrary statistics.

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<sup>30</sup> Until Hubbert's Peak Oil Thesis was resurrected in the early 1970s, and which will be covered in the final chapter of this thesis.

## Oiling the system of energy

In 1961, Morgan Davis testified at hearings into a potential National Fuels Study. Representing not only Humble Oil, of which he was President at the time, but also the American Petroleum Institute, the Mid-Continental Oil and Gas Association, and the Western Oil and Gas Association, Davis argued:

Fundamentally, no basis exists at this time for concern about the soundness of relying on competition among fuels to serve the public interest, since it appears obvious that this policy has resulted in development of an abundance of energy at reasonable prices...No shortage of domestic fuels exists or is remotely in prospect, provided adequate incentives are maintained... [T]here is no basis in the past record or present situation to require any new policy with respect to fuels and energy. (cited in Barber 1981b:293)

The large reserve estimations developed since 1956 - that made use of the economic factors that Hubbert excluded - proved, to Davis' satisfaction that US oil production was not likely to peak any time soon; and the 'adequate incentives' that Davis referred to had been significantly bolstered two years before with the imposition of a mandatory quota system for oil imports.

### *The restriction and expansion of oil*

Against the backdrop of the ongoing failure of voluntary oil import controls, Eisenhower's Presidential Proclamation 3279 implemented a mandatory import quota system on March 10, 1959. Under the system, petroleum could only be legally imported into the US under license from the Department of the Interior, and this 'closed the remaining gap in a regulatory apparatus supporting the price of domestic crude oil' (Barber 1981a:251). The Interior Secretary was charged with ensuring that imports did not exceed the predetermined proportion of expected domestic demand, set in the first instance at 9 per cent and subsequently modified to a ceiling of 12.2 per cent (Vieter 1984:120). The quota system was based on the assumption of the coexistence of both domestic and imported oil in America, and aside from the overland exemptions for oil from both Canada and Mexico - with the latter having oil shipments diverted to Brownsville, Texas, where they were transported twelve miles

back across the border to Mexico by truck, then re-imported, overland - the mandatory import restrictions were ultimately not hugely protective. By linking oil imports to domestic demand, this enabled a growing volume of oil imports to power a growing economy (Barber 1981a:253; Vietor 1984:130), and in fact from 1960 to 1970 the percentage of overseas oil actually increased slightly from 20 percent to 22.7 percent of total oil consumed (Landsberg & Schurr 1968: 12; de Marchi 1981:476).

What the quotas very clearly were, however, was a means to maintain federal production support of domestic oil. And this was based on the new, large oil reserves figures estimated by industry, RFF and the USGS. These indicated, contra Hubbert, that domestic oil could be effectively exploited without imminent depletion through the maintenance of US oil prices. The quota system itself would last until the beginning of the 1970s and would become, as Mitchell argues, a mechanism for maintaining the postwar international financial system (Mitchell 2011 170-171). Through the restriction of oil imports into the US and the counter-flow of dollars abroad, the quota enabled the US government to limit reserves overseas, and thereby support the price of the dollar. Of course, by the start of the 1970s the postwar financial architecture was pushed to breaking point and at the same time as a new financial regime was being developed, so too was a new mechanism for the pricing and control of oil. The developments of the early 1970s in the energy industry - the ways in which they both led to the construction and subsequent reconstruction of the environment by economists - is explored further in chapter 6.

The implementation of mandatory import controls underwriting the profit margins of domestic oil producers through the reinforcement of federal price controls required that US domestic oil producers could claim large reserves of untapped oil, that could be exploited if adequate incentives were in place. At the same time this helped maintain the vast and increasing production of Middle Eastern oil by the largely American owned international oil majors through the transmission of the comparatively high US oil price via the basing point system. As argued in the previous section, the threat of peak oil was a threat to oil profits given the development and broad understanding of the system of energy understood as interchangeable fuel sources. Price supports made no sense in the face of depleted oil reserves. In the face of this threat - and given the ongoing pressure on the growth of the economy, with both the

potential and advocacy for a shift to alternate forms of energy, including nuclear - reserves measurements were recalibrated in line with the Paley approach of economic price-based scarcity. This resulted in much larger estimates than that given by Hubbert and the previous pessimistic figures going back to 1909 and the first USGS survey, as detailed in the last chapter. This enabled the construction of the system of energy to be converted from a threat to oil company profits, into an opportunity.

In 1959 the threat to oil industry profits from the potential exploitation of alternate fuel sources within an interchangeable system of energy was overcome through the implementation of mandatory oil import quotas. The quotas, alongside the other production support measures implemented by federal and state governments - such as the depletion allowance, ensured the expansion of oil production and consumption vis-a-vis other forms of energy simply through the 'soundness of relying on competition among fuels to serve the public interest' as Morgan Davis so aptly put it in his 1961 testimony (Barber 1981b:293). From this point on, the expansion of energy and energy use in order to feed the necessary growth of the economy was accompanied by the parallel expansion of oil. In the US, from 1950 to 1970 total energy used doubled from 34.6 quadrillion British Thermal Units (BTUs) to 67.8 quadrillion BTUs. At the same time, oil consumption more than doubled, from 13.3 quadrillion BTUs (38 percent of total energy used) to 29.5 quadrillion BTUs (44 percent of total energy used).

During these years, coal production flatlined, going from 12.34 quadrillion BTUs (36 percent of total energy used) to 12.26 quadrillion BTUs (just 18 percent of total energy used)<sup>31</sup>. Throughout this period, nuclear energy would contribute a negligible amount to the expanding energy system. Between 1950 and 1973 the international (non-domestic US) oil industry grew ninefold by an average annual rate of 10 percent, and coal went from providing 75 percent of total energy used in Western Europe in 1955 to just 22 percent by 1972. Meanwhile petroleum had risen from 23 percent to 60 percent (Pfister 2010:103-104).

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<sup>31</sup> Figures from United States Energy Information Administration. Available at: <http://www.eia.gov/beta/MER/?tbl=T01.01#/?f=A>.

This expansion of oil vis a vis other fuel sources within an overall system of energy went hand in hand with two further developments. First, energy was further secured in its systemic form through the simultaneous provision of a future and history by RFF economists. Second, and as an unforeseen consequence of the imposition of mandatory oil quotas in the US, the oil companies would ultimately convert themselves into 'total energy' companies (Stork 1975) through a series of mergers and acquisitions of competing energy sources through the 1960s.

### *Securing the future and history of energy*

When Secretary of the Interior Chapman issued Order 2602 that established the Office of the Assistant Secretary for Mineral Resources in 1950, a complementary increase in research and analysis staff was already being undertaken in the Bureau of Mines and a key concern here was the need for a strong economic research unit. This unit, tasked with going beyond the compilation of statistics, was to produce plans to enable future mineral requirements to be met through the deployment of economic analysis, and was headed up by the first chief economist in the Bureau - Sam H. Schurr (Goodwin 1981a:45). Schurr, along with members of his staff from the Bureau of Mines was also called upon by the Paley commission to detail - as I have already shown - the somewhat complicated tax treatments afforded to mineral fuels production (Goodwin 1981a:56, 1981b:146). Schurr not only held positions at the National Bureau of Economic Research (NBER) and Interior Department, he also worked for the Cowles Commission and in the economics division of RAND, and in 1954, Schurr became Director of the Energy and Mineral Resources Program at RFF<sup>32</sup>.

In 1960, RFF published *Energy in the American Economy* - a study undertaken by Schurr with Bruce C. Netschert. This work provided a detailed historical analysis of energy production, consumption and reserves in the US from 1850 onwards, and projected trends in these areas up to 1975, thus giving both the approach to energy as a total system, and the interconnection between energy and economy an empirical basis. The type of broad statistical and interpretative review undertaken in this work had been wholly lacking up to this point (Darmstadter 2003:4), and the dataset for this book was incorporated into the expanded second printing of the *Historical Statistics of*

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<sup>32</sup> Schurr would ultimately be given the International Association of Energy Economics 'Outstanding contribution to the profession' Award in 1981 and was only the third recipient of the American Institute of Mining, metallurgical, and Petroleum Engineers (AIME) Mineral Economics award in 1968.

*the United States*, also in 1960. In the same way that the 1949 version transcribed the economy into historical existence, the 1960 version did the same for the system of energy, relating this explicitly and directly to the economy, rediscovered through the history of the nation.

Three years later one of the key contributor's to *Energy in the American Economy*, Hans H. Landsberg, would make further use of the history of energy, composed of the economic and statistical data compiled here, in *Resources in America's Future*<sup>33</sup> (Landsberg et al. 1963). Landsberg was also a member of the RFF staff at the time, and this study, which was co-edited by RFF director Joseph Fisher and Leonard L. Fischmann, would examine the role of natural resources in the U.S. economy as well as to projecting their long-term availability. And it was conceived and undertaken in relation to the RFF studies discussed in the last chapter - Barnett and Morse's *Scarcity and Growth* (1963) and Potter and Christy Jr.'s *Trends in Natural Resource Commodities* (1962). Landsberg, who had actually been a colleague of Schurr's on a productivity project within the NBER in the 1930s, would similarly go on to work for RAND and would act as economic advisor to Maurice Strong during the 1972 UN Conference on the Human Environment, a conference which will be briefly touched on in the next chapter<sup>34</sup>.

In *Resources in America's Future*, Landsberg et al. (1963) indicated that economic growth would continue through 1980-2000, and require a: 'tripling of requirements for both energy and metals by the year 2000, almost a tripling of timber, and almost a doubling for farm products and for withdrawal depletions of fresh water' (Landsberg 1964:11). In projecting the size and shape of the future economy, the report's authors made use of several different markers of growth, including: population; GNP; personal consumption expenditures; business investment; government spending; the Federal Reserve Board Index of Industrial Production; and technological change (increasing efficiency of industrial production). While the authors were clear that these markers should be considered as projections and not predictions (Landsberg 1964) they also had the consequence of helping to settle both the objectivity of the separate sphere of the economy, describable through a given set of metrics, and the energy to power this

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<sup>33</sup> This was also published in 1964 in a briefer, simpler format produced by Landsberg and intended for policy makers and lay readers.

<sup>34</sup> In 1983 the International Association of Energy Economics awarded its 'Outstanding contribution to the Profession' award to Landsberg.

economy, understood as comprised of a system of interchangeable fuel sources. *Resources in America's Future* required the development of a statistical appendix of more than 500 pages, but the authors conclusions can be summarised in a few short sentences:

Will these unprecedented amounts [of resources] be forthcoming? The answer is a qualified yes. With due regard to the requirements of other countries, the indications are that the American people can obtain the natural resources and resource products that they will need between now and the year 2000... neither a long view of the past, nor current trends, nor our most careful estimates of future possibilities suggest any general running out of resources in this country during the remainder of the century. (Landsberg 1964:11-12)

In line with *Scarcity and Growth*, *Resources in America's Future* helped secure an understanding of the economy as an object capable of unlimited growth, and unimpeded by material resource constraints. Alongside this however, it helped construct the system of energy as similarly capable of unlimited growth. This growth had, however, through the 1950s and early 1960s been the result of the massive expansion of oil production and consumption, as indicated above, and would continue, as explored below, through the development of the large oil corporations into 'total energy' corporations. At the beginning of the 1960s, RFF would, through the provision of these reports and ongoing research, provide interpretative analysis on energy that previously only the Bureau of Mines and the industry itself had undertaken. Here, the pioneering work of Hans Landsberg and Sam Schurr was fundamental to making RFF into a preeminent body in the fields of 'energy, resources, and environmental economics' (Darmstadter 2003:3) in the 1950s and 1960s.

During his 1964 election campaign the Johnson administration created a plethora of new task forces. These were designed to both bring new recommendations to federal policy and to display the vitality and vivacity of Johnson as a presidential candidate. One of these task forces was given the job of evaluating natural resource policies and was chaired by RFFs president, Joseph Fisher, and included several other RFF staff members including Sam H. Schurr. On November 11<sup>th</sup> 1964, just after Johnson's landslide victory over Barry Goldwater, the RFF task force submitted its ninety-page report *Resource Policies for a Great Society* to the President. The report covered a variety of policies covering diverse areas such as forest management, pollution abatement and flood control and outlined eleven basic categories of recommendations

for policy issues. The eleventh and final category was that of overall energy policy, and reiterating the notion of energy as a total system, the report began with the basic premise that it was 'important to realize that there is widespread substitutability among the Nation's basic energy resources - coal, oil, natural gas, water power and nuclear power. As a result, policies affecting any one of these resources will inevitably also produce important consequences for others' (cited in Cochrane 1981:347).

Following this understanding of energy as a system of interchangeable fuel sources the task force recommended that a special presidential commission on energy policy be instituted in order to develop a set of coherent national energy objectives. This recommendation was strongly rebuffed however in the Interior Department's response to the task force: 'If the nation's energy economy was in a state of disarray and not functioning in a reasonably satisfactory manner, rigorous across-the-board investigation by a Commission on Energy Policy would be indicated. But no such conditions prevail nor are they immediately in prospect.' (cited in Cochrane 1981:350). The development of an overall energy policy would have to wait until the beginning of the 1970s, when the energy economy of the US was indeed brought to an apparent state of disarray, but in the meantime, a lack of federal coordination would enable the further expansion of the oil industry through the construction of 'total energy' companies.

#### *The oil industry becomes the energy industry*

While the quota system was installed in the US in order to protect the price of domestic oil in the face of increasing overseas imports, this measure also had the effect of increasing the supply of crude oil from the Middle East to Europe and other markets as access to the US was curtailed. As production increases had been driven by the disparity between high prices determined in the US - propagated globally by the basing point system rather than any putative demand - and the low production costs in the Middle East, the increased oil supply to Europe rapidly led to a surplus and subsequent pressure to cut prices. The downward pressure on market prices in Europe was further exacerbated by both Britain's 1959 monetary crisis - resulting in an inability to pay for oil imports, and by the reemergence of the Soviet Union as a major supplier of oil (Stork 1975: 87). In order to defend profit margins, the oil majors chose

to reduce the posted price of oil. The posted price was an arbitrary benchmark figure set by the large oil companies. The price of oil in the US was determined by government production and import quotas. This price was conveyed globally by the Texas basing point system, and further trading of oil was usually between the large companies and their affiliate refiners or between the majors at low prices under long-term contracts (Mitchell 2011:167). As outlined above, the posted price was important as it was the determining factor for the profit sharing agreements between the international oil majors and the oil producing countries from the early 1950s onwards. By reducing the posted price in 1959 and again in 1960, the oil majors were able to make the oil producing countries pay for the erosion in profits from the European market by reducing the amount they paid in taxes under the profit sharing agreement (Stork 1975:87-88).

In response, Venezuela, Saudi Arabia, Iraq, Kuwait and Iran formed the Organization of Petroleum Exporting Countries (OPEC) cartel in 1960. Copying the collective arrangements between US states - formalised in 1935 as the Connally Hot Oil Act - to restrict production, the Cartel members sought to press for a restoration of the posted price of non-US oil to pre-1959 levels. The oil companies initially refused to acknowledge the new organisation, and concrete policy by OPEC was not developed until its fourth conference, in 1972 (Stork 1975:94). Throughout the 1960s, OPEC was unsuccessful in restoring the posted price of oil. It did however, prevent any further drop in the posted price. In the face of falling selling prices throughout the decade due to continual over-production and the maintenance of the US import quota, oil company profits began to fall. Putting further pressure on prices was the entrance of small independent and state-owned refineries and marketing operations in the expanding European market. These refineries were happy to purchase crude from independents and thereby further increased the oil surplus in Europe. Stork estimated in 1975 that total oil company profits (while still enormous) were approximately static through the mid to late 1960s while production of oil from the Middle East increased from 2.6 billion barrels in 1963 to 5.5 billion in 1969. The falling rate of return per barrel was a concern to the oil companies, and in response, they simply stopped being oil companies.

Through the 1960s oil firms made use of their continued high profits to actually construct an interrelated system of energy through the purchase of controlling interests in rival power producers, thereby converting themselves into 'Total Energy' companies (Stork 1975:121-125; Mitchell 2011:179). This tactic first became visible in the coal industry with Gulf Oil acquiring the thirteenth largest coal producing in the US, Pittsburgh & Midway Coal in 1963; Continental Oil buying the giant Consolidation Coal in 1966; and Occidental Petroleum taking over over Island Creek Coal (the the third largest producer in the US) in the same year that Standard Oil of Ohio purchased the tenth largest producer, Old Ben Coal. At the same time other major coal producers were taken over by large industrial firms and by the end of the 1960s, eleven of the largest fifteen coal companies were controlled by outside corporate interests, mostly oil companies. Other oil companies sought to purchase coal reserves and land leases. Standard Oil of New Jersey bought 7 million tons of reservers, while Atlantic Richfield became the largest holder of federal coal land leases at 43,500 coal acres. Not only did coal companies increasingly come under the control of oil interests, but the large coal firms also increased their share of coal production from an estimated 40.9 per cent to just under 66 percent (Stork 1975:121-122).

In the case of nuclear, by 1970, eighteen of the twenty five largest petroleum companies had interests in at least one phase of the mining and processing of uranium, with oil companies accounting for 40 percent of the investment in uranium reserves. Two key stages of uranium processing were also controlled exclusively by the oil companies Kerr-McGee and Atlantic Richfield (Stork 1975:122). At the beginning of the 1960s, major oil companies already controlled the majority of America's natural gas production through the co-location of oil and gas fields. However, throughout the 1960s they consolidated their control of the industry and by the late 1960s two dozen oil firms produced three quarters of America's natural gas (Mitchell 2011:179).

The overcoming of potential peak oil - and the threat this presented to oil company profits - resulted in three subsequent developments from the late 1950s through to the late 1960s. The provision of economically informed reserves calculations following the Paley methodology enabled the construction of mandatory import controls in the US and the subsequent maintenance of the price of both domestic and overseas oil, although in the case of the latter this would subsequently fall due to overproduction

and glut in the European markets, in part due to restricted access to the US. The protected profit margins and production supports allowed the further expansion of both Middle Eastern oil in comparison to domestic oil as well as the expansion of oil in the rapidly growing total energy production and consumption. At the same time, the systemic understanding of energy as comprised of interchangeable fuel sources was further secured through the simultaneous provision of a future and history by RFF economists. In parallel with their work on general materials scarcity and the growth of the economy, reports released by RFF at the beginning of the 1960s assured the growth of the economy by providing the certainty of limitless potential energy. Lastly, oil companies would convert themselves into 'total energy' companies through a series of mergers and acquisitions of competing energy sources through the 1960s, driven in the first instance by falling profit rates due to the unforeseen consequences of the imposition of mandatory oil quotas in the US, this development literally institutionalised the system of energy in the form of the massive multi-modal energy corporations.

## The energy for growth

In 1972, RFF would publish Massachusetts Institute of Technology (MIT) economist Morris A. Adelman's *The World Petroleum Market* (1972a)<sup>35</sup>. This study was both initiated by, and financially supported through the work of Sam H. Schurr, at the time still the Director of the Energy and Mineral Resources Program at RFF and also professor of economics at MIT. Here and in another 1972 publication in *Foreign Policy*, Adelman investigated the international oil industry from an economic perspective (Adelman 1972a; 1972b) which as Darmstadter notes, shed light on the 'complex web of transactions and behaviour characterising that market.' (Darmstadter 2003:8). Adelman reconfirmed what is now commonly referred to as the 'cornucopian' view of oil reserves (Dryzek 1997), arguing that for the purposes of economic calculation, the supply of oil was inexhaustible, and reserves that were depleted by extraction were replenished by exploration. Echoing the Paley approach detailed in the last chapter, Adelman argued:

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<sup>35</sup> Adelman was actually the first person to infer market prices for oil in the mid-1960s, using figures published by a group of independent largely German oil dealers and deducting known refining and shipping costs. Here Adelman was the first person to independently reveal the high profits and low costs of Middle Eastern oil production (Mitchell 2011:168).

A stream of investment creates additions to proved reserves from a very large in-ground inventory. The reserves are constantly being renewed as they are extracted. How much was in the ground at the start and how much will be left at the end are unknown and irrelevant. (Adelman 1972a; cited in Mitchell 2012:188)

As we saw in the last chapter, the construction of the economy from the 1930s - and its eventual settling as a secure and discrete object removed from specifically material constraints in the postwar years - was dependent upon the reconstruction of material scarcity in line with economic conceptions. Initially undertaken by the Paley commission and later by the work of RFF, this was largely completed by the middle of the 1960s.

In this chapter I detailed how the construction and settling of the economy was accompanied by the parallel development of energy as a system of interchangeable fuel sources capable of powering the growth of the economy in perpetuity. The prewar development of a Federal concern with the regulation of the energy system, would, in the postwar years come to threaten the continued profits and expansion of the oil industry - profits that had developed and were maintained through continued support by the state and federal government in the form of production subsidies, quotas and special tax treatments. The necessity for the expansion of energy to feed the economy at least cost threatened both ongoing support for the oil industry as well as a shift to alternate power sources, if as M. King Hubbert famously argued in 1956, oil production in the US was rapidly approaching peak production - a peak from which it would rapidly fall.

The development of the system of energy didn't just threaten domestic US oil producers, but also overseas oil production in the Middle East. Here, the vast profits of the largely American owned oil majors were underwritten by the disparity of oil prices and the low production costs in their monopoly concessions. With no market price for oil until the mid 1970s, prices were determined through collusion, anti-competitive practice, monopoly, and as I detail here, through the transmission of the high American price of oil overseas through the Texas basing point system. This global flow of oil also came in the postwar years to underwrite a different flow - that of dollars, the global reserve currency, and in doing so, helped ensure the stability of the Bretton Woods financial architecture. The threat presented to oil by energy was challenged and

ultimately overcome after 1956 through the work of oil industry economists and then the USGS, reasserting the Paley approach to resource scarcity and reserves estimation. This helped maintain pressure for the oil industry's preferred system of regulatory unfettered, but aided, private enterprise. This aid was most clearly represented in 1959, by the implementation of a mandatory oil import quota system at the end of the Eisenhower administration.

This chapter has detailed how the Paley approach to scarcity was a crucial part of a sociotechnical system that enabled the massive expansion of fuel extraction, processing and consumption through the 1950s and 1960s. The reassertion of economic scarcity and the high reserve estimations that resulted enabled the continued provision of high oil production and high oil industry profits even in the face of falling oil prices, through the maintenance of government quotas, tariffs and tax provisions. Growth was coming to be seen as no longer constrained directly by the raw matter of the earth, but rather mediated by the availability of seemingly limitless energy - that curious amalgam of the neoclassical economics interpretation of 19<sup>th</sup> century physics, with a variety of fuel sources understood as components of an interrelated system bound together through the notion of relative scarcity and its resultant price-based drive for technological innovation.

In turn, the high profits this enabled allowed the further expansion of oil - through the increasing share of oil in overall energy production and consumption and continued increases in Middle Eastern production and exportation. In 1960 and 1963 RFF published analyses that further certified the conception of energy as a system divorced from any particular fuel matter by the concurrent retrojection of its history and projection of its future trends. This settling of energy as a total system would go hand in hand with further expansion of oil through the construction of an actual, avowedly non-market system of energy via the increasing control of gas, coal, nuclear and even geothermal production by the large petroleum producers (Stork 1975:121-123).

In chapter six I will show how the system of energy, stabilised through the 1950s and 1960s by the massive expansion of petroleum production consumption within what would become total energy companies, was suddenly, at the the end of the 1960s and beginning of the 1970s, made to look fragile. This apparent fragility led rapidly to an

equally apparent energy crisis. The ultimate outcome of this crisis was more certain however, and in part involved the reconciliation of the economy and the environment through the reconstruction of the latter, securing once more the concern with economic growth as the acme of politics. In the next chapter however, I cover how the environment came to be seen as at odds with the economy in the postwar years, and how the development of environmental concern would call into question not simply the possibility of growth, but the potential impact of growth's evident certainty.

## 6. Environment

Donora, Pennsylvania, would witness the last gasp of the pre-war, pre-national economy understanding of air pollution in the US. Throughout the first half of the 20<sup>th</sup> century, Americans viewed the air quality in their wheezing industrial towns and cities as simply a periodic local problem, best addressed by local governments (Bailey 1998:91). This would begin to change in the post-war years and through the 1950s. In Donora, during October 1948, a particularly severe air pollution event would kill twenty and result in 6,000 cases of illness. In response, local congressional representatives Augustine B. Kelley, Herman P. Eberharter and Robert J. Corbett introduced a variety of bills concerned with the hazards and health effects of air pollution. These bills were limited solely to the provision of further research on the issue and the Donora incident 'caused a ripple of concern but was soon forgotten' (Stern 1982; cited in Bailey 1998:91).

The cloying smog that had come to plague Los Angeles with increasing frequency was somewhat harder to dismiss as a merely local concern however. In chapters 3 and 4, I described how a new conception of growth arose in the postwar years in response to the development of the economy. Ultimately the economy was secured as a discrete object in the world, independent from any particular material resources and with its growth as a central political focus. This was undertaken through the application of new economic understanding of scarcity and at the same time the construction of energy as a limitless system of interrelated fuels capable of powering this growth in perpetuity. The California smog was an early indication of not merely local, but the nationwide blight of air pollution caused by factories and cars, burning the fuel necessary to power the growth of the economy.

In *Beauty, Health, and Permanence*, the American historian Samuel P. Hays argued that the increased concern with environmental issues evident in the US since the end of the second world war is the result of fundamental changes in the American economy (Hays 1987; Bailey 1998:15). For Hays, the growth of the economy from the 1950s onwards enabled the development of a new middle class for whom 'quality of life' became a pressing issue. The development of a 'recreational consumerism' (Bailey

1998:15) that placed a strong emphasis on outdoor leisure pursuits resulted in this class interacting with and enjoying the wilderness of 'the great outdoors' in ways previously unheard of. As part of the developing business and consumption of 'recreation', an unprecedented four million pleasure boats were purchased in the US in the 1950s alone (Flippen 2000:2), and increased levels of car ownership - by 1965 the ratio of adults to cars in the US stood at 1.66:1 (Landsberg & Schurr, 1968) - facilitated access to wilderness areas, further exposing the American public to the natural environment. This access was facilitated through the development of Federal road building projects including the Highways Act of 1956, while the rapidly increasing number of cars also enabled the development of mass suburbanization (Flippen 2000; Hays 1987:23; Paterson 2007), placing ever more Americans in a non-urban, natural environment while simultaneously threatening this environment through the constant expansion of suburban space (Flippen 2000; Warren 2003).

As Bailey argues, Hays' fundamental insight here is that the development of the environment as an object of politics in the post-war period is not simply as a reaction to the depredations of economic growth, but is 'a product of that very growth' (Bailey 1998:15), and this chapter builds upon a literal understanding of this claim, albeit somewhat at odds with Hays' intended meaning. I maintain that it is not simply fundamental changes in the American economy that resulted in the development of environmental concern, rather that the generation of concern with pollution at a national level, and its role in creating a political and popular concern with the environment, must be seen in a more complex relation to the development of the economy and a corollary energy system required to fuel the necessary growth of this new central object of politics.

Since the very beginning of Federal attempts to regulate and lessen the impact of air pollution in the 1950s, there has been controversy over the financial cost and impact on the economy of pollution control (Bailey 1998). This is not confined to the issue of air pollution however: 'the federal government has made major environmental decisions throughout its history and that economic criteria as well as criteria of substantive environmental purposes have been applied to the decisions that have been made' (Andrews 1984:45). In this chapter I begin by looking at the development of the economic technology of benefit-cost analysis. Originally devised by the Army Corps of Engineers for the assessment of water development projects, this technique would be expanded and restructured alongside the development of the economy.

In the 1950s, benefit-cost analysis would be translated into contemporary welfare economic theory and focused ever more closely on the single objective of economic efficiency. This would become a central target of the conservationist backlash against the large multipurpose water projects that were first developed in the New Deal era. This resurgent postwar conservationism was joined at the beginning of the 1960s by the development of a broader environmental concern - focused on the pervasiveness of pollution. In 1966, the economist Kenneth J. Boulding presented his paper *The Economics of the Coming Spaceship Earth* at RFF's sixth research forum, which was concerned with the topic of 'Environmental quality in a growing economy'. Here Boulding would reiterate the earlier analysis of John Kenneth Galbraith, and Boulding's concept of the Spaceship Earth signified not only that the growth of the economy could have negative impacts on the environment, but that it *necessarily* did so, and that this was only likely to get worse.

The Spaceship Earth, iconically represented by the Apollo 8 Earthrise picture in 1968, would help galvanise the nascent popular environmental movement and result ultimately in both the growth of limits - as the incoming Nixon administration undertook an unprecedented expansion of social and environmental regulation in the US - as well as the limits to growth, with a report of the same name being famously released by the Club of Rome to coincide with the United Nations Conference on the Human Environment in Stockholm in 1972. at the beginning of the 1970s these events would help position the economy, driven by a logic of growth, in fundamental opposition to the environment, defined by finite limits (Mitchell 2011).

## The benefits and costs of water

In the last chapter, I outlined the 1939 report to Congress published under the auspices of Harold Ickes of the National Resources Committee which brought together for the first time the four main power sources in the US under the rubric of a system of energy. As I also pointed out that the report made recommendations regarding each individual power source, and that for hydroelectric power, the committee advised the expansion of multiple purpose planning bodies as a means to manage the potentially

conflicting interests in 'flood control, public water supply, stream pollution, irrigation, and navigation' (cited in Goodwin 1981a:8). While this report represents, as I argued, an early shift towards managing energy as an interrelated system in order to service the newly developing notion of a national economy, it also highlights the early development of a new understanding of the environment - brought to light through economic measurement in the service of overall national economic growth. Key here is the development of the technique of benefit-cost analysis that was pioneered by the Army Corps of Engineers. This technique, or analytical technology, was initiated at the turn of the 20<sup>th</sup> century, but would be rethought and reconfigured at the same time as the development of the economy and energy; and ultimately translated into an economic tool capable of being brought to bear on federal environmental development projects impacting on the new economy as whole.

#### *The Army Corps of Engineers and multiple-purpose water development*

In the US, as early as the 1780s, and then later throughout the 19<sup>th</sup> century, congressional debates over the prices and terms on which public lands would be rendered into private hands considered both the economic benefits and the distributions of gains and losses in these decisions. In 1808 Secretary of State Albert Gallatin brought out a report on a navigation programme for the new nation - from that time onward, public water agencies have found it necessary (and desirable) to compare estimated benefits with the costs of proposed development projects (Kneese 2011). Since the 1820s, Congresses and Presidents have also been involved in debates over the use of federal funds for regional environmental projects such as canal, dam and levee building. In these cases economic issues have been at least as prominent as substantive environmental concerns (Andrews 1984:45). At the beginning of the 20<sup>th</sup> century however the Army Corps of Engineers began to develop a specific technique in order to evaluate potential water development projects. The Rivers and Harbours Act of 1902 established within the Corps a board of five engineer officers (the Board of Engineers) who were tasked with the submission of recommendations on river and harbour improvements to the Chief of Engineers. These recommendations were to be based on surveys and engineering reports (Hammond 1960:3-4; McKean 1958:18) and required that:

...the board shall have in view the amount and character of commerce existing or reasonably prospective which will be benefited by the improvement, and the relation of the ultimate cost of such work, both as to the cost of construction and maintenance, to the public commercial interests involved, and the public necessity for the work and propriety of its construction, or maintenance at the expense of the United States (cited in Hammond 1960:4)

Alongside the early development of the Corps of Engineers evaluation techniques, the increasing electrification of the US from the turn of the century had resulted in a large number of mergers amongst the nation's electricity producers and privately owned hydroelectric dams. The developing potential for monopoly in the electric power industry - an increasingly visible issue following the break up of Standard Oil in 1911 - would result in the Water Power Act of 1920, which established federal regulation over hydroelectric power production (Andrews 1999:143). Around the same time, the Rivers and Harbours Acts of 1917 and 1928 had increased the Corps budget for flood control, and the reports of the Board of Engineers, although without much pretence at rigour, were expected to recommend only projects whose promised benefits were greater than their costs (Porter 1995:154).

In the wake of the great Mississippi flood of 1927, Congress authorised the Corps of Engineers to prepare what became known as '308' reports (Porter 1995:154-155). These were comprehensive reports of the United States' river basins, undertaken in order to provide an inventory of America's water-resource problems and potentials. The reports were based on reconnaissance surveys and estimates of project costs but were not intended to be the basis for authorising federal improvements, and they did not provide construction recommendations (McKean 1958:18). Following on from the Water Power Act, the creation of the Federal Power Commission in 1930 led to the development of the massive federal water resource projects such as the Bonneville Power Administration and the Tennessee Valley Authority (TVA), public institutions which had oversight over the major grand-scale dams being built at the time (Goodwin 1981a:4). These were designed not only to achieve electrification but also irrigation, land reclamation, flood prevention and industrialisation as well as other goals - as a multiple-purpose planning measure for whole drainage basins undertaken on a regional basis (Goodwin 1981a:8). The Corps 308 reports would provide '...a backlog of specific projects for accomplishment with Federal funds for emergency relief during the depression in the early 1930s' (Annual report of the Chief of Engineers, U.S. Army 1951:229; cited in McKean 1958:18), and were the best available data on large-scale

projects. These reports thereby laid the foundation for the nation-wide multiple-purpose water resource development programme that developed during the decade (Andrews 1999:164).

At this point however, the evaluation techniques put in place by the Corps were confined to tangible, local costs and benefits such as capital outlay and avoided flood damage estimates (Hammond 1960:4; Lohmann 2009:516). The development of large-scale water resource projects such as the TVA, and the initiation of the big dam era from around 1935 (Billington Jr. et al 2005:383) required the expansion of this limited and unduly restrictive technology in order to ensure that these New Deal measures were undertaken in support of the newly constructed economy. In 1934, Harold Ickes, then the head of the National Resources Board (NRB), appointed a Water Resources Committee whose report in December of that year would recommend 'the development of an equitable system of distributing the costs of water-resource projects, which should include not only private but social accounting - a striking revision of costing technique' (National Resources Board 1934:28; cited in Hammond 1960: 4-5). Drawing on information from the 308 reports (McKean 1958:18), the committee argued that:

...The problem of equities, benefits, and costs is a complicated and difficult one, and one of the most important fundamentals of action is the formulation of general principles governing the relations between them... Especially is it desirable to initiate promptly the study of the part played by intangible factors... Complicated factors of cultural and economic relationships would be involved in such a study but it appears reasonable to explore the possibility of constructing a generalised formula which would serve in any particular project by substitution of ascertainable values for such of the terms of the formula as are pertinent. (National Resources Board 1934:267; cited in Hammond 1960:5)

The development here of a seemingly objective decision technology enabling the Corps of Engineers to publicly justify the fairness of its selected water projects (Porter 1995:149) - taking into account an expanded set of non-local, intangible costs and benefits - should be seen in relation to the parallel development of the economy and energy, in this case in the form of the large federal hydropower projects. Again, under the auspices of Harold Ickes, his National Resources Board helped undertake, within the Army Corps of Engineers, the pre-war expansion of benefit-cost analysis from a

limited engineering technique into one incorporating intangible economic factors and capable of bearing on nationally important water development projects.

The NRB's proposed inclusion of 'Intangible factors' such as aesthetic impacts and recreation opportunities into a 'generalized formula' that would allow commensuration across private, social and environmental factors (Lohmann 2009:18) was formalised in the following years. First, through the Rivers and Harbours Act of 1935, which authorised the Chief of Engineers to continually update 308 studies, taking into account both 'economic factors and accumulated engineering data' (Annual report of the Chief of Engineers, U.S. Army 1951:229; cited in McKean 1958:18). Then through the 1936 Flood Control Act. Section I of the act endorsed the NRB's 1934 recommendations and subsequently mandated that federal investments might be made in projects under its authority 'if the benefits to whomsoever they may accrue are in excess of the estimated costs' (Hammond, 1960:6).

It is at this point then, that the use of a formal-benefit-cost analysis for water-resource development is traditionally dated (Andrews 1984:45; Baram 1980), and this technology would shortly make its way into other federal bodies responsible for multiple-purpose water development projects (Hammond 1960:6; McKean 1958:19). Within these organisations, not only were 'intangible factors' such as aesthetic loss due to the creation of a reservoir weighed against others such as the new pleasure gained from fishing there, but the incorporation of indirect, secondary benefits and costs resulted in an attempt to 'travel down the chain of economic causation' (Hammond 1960:7-8). For example, the Bureau of Reclamation developed analyses that not only calculated the benefit derived from the wheat that could be grown on land irrigated by a potential dam, but also included the value of the bread that could be baked with this wheat (Hammond 1960:7-8; Lohmann 2009:516).

From its turn of the century starting point as an engineering evaluation technique used by the Army Corps of Engineers focused solely on primary, tangible, local benefits and costs, benefit-cost calculations were reconstructed through the addition of 'intangible factors' and indirect benefits and costs into an analytical economic technique capable of being brought to bear on the new, grand-scale water development projects - projects that would have an impact on the equally newly constructed national

economy. And it was the use of this technology that would underpin Ickes' recommendations on hydropower to Congress in his initial 1939 report on energy in the US.

### *The search for consistency*

The main problem with this newly reconstructed and apparently objective economic technology however, was that it didn't seem very objective. Between 1936 and 1939, the Chief of Engineers issued numerous instructions to district offices on how to prepare benefit-cost analyses (McKean 1958:19), but no single overarching method was forthcoming. More importantly than intra-agency inconsistencies in analysis was inter-agency conflict (Campen 1986:17). The Flood Control Act authorised the Agriculture Department's Soil Conservation Service and the TVA to also make use of benefit-cost analysis in establishing and justifying the feasibility of water development projects. In 1939 the Reclamation Project Act provided the Department of Interior's Bureau of Reclamation with the authorisation to undertake irrigation and related water improvement projects if the project costs could be either repaid by the users of water, or offset against other purposes such as flood control, navigation or wildlife preservation. This resulted in the Bureau beginning to undertake benefit-costs analyses for the first time.

The Bureau had been established originally as a part of the United States Geological Survey (USGS) by Theodore Roosevelt after the passage of the 1902 Newlands Reclamation Act, to undertake irrigation projects funded by the proceeds of western land sales separately from the Army Corps of Engineers (Andrews 1999:141). It had, up until 1939, been bound by the concept of 'financial feasibility' in its projects evaluations - a standard, that as Hammond noted, was considered more rigorous than the Corps' benefit-cost procedures (Hammond 1960:6). '[F]inancial feasibility' had been employed here in order to avoid the so-called 'pork-barrel' or politically and locally motivated spending that had become an infamous fixture of regional water projects and Army Corps activities. By the end of the 1930s however, The Army Corps, the Soil Conservation Service, the TVA and the Bureau of Reclamation had all developed a variety of non-standard and mutually inconsistent benefit-cost calculations, and as I indicated in the last section with respect specifically to the

Bureau, its use of indirect benefits and costs differed substantially from its own previous 'financial feasibility' based analyses.

These mutually inconsistent calculations were politically contested and driven by a desire to maximise the extent of an agency's involvement in any specific water development project (Campen 1986:17; Lohmann 2009:516; Porter 1995:161). Porter maintains that this issue developed in part because of the division of federal responsibility in the 1936 Flood Control Act which gave the Corps of Engineers authority over downstream projects, and the Soil Conservation Service was given authority over upstream projects. The Soil Conservation Service favoured smaller upstream dams in comparison to the Corps favoured large downstream dams, and these differences in priorities were played out over differing calculations.

From 1939 onwards the Bureau of Reclamation and the Corps of Engineers found themselves at loggerheads over a proposed reservoir for the King's River in California. This resulted in a 'political quagmire' as both the Bureau and the Corps sought to monopolise benefits numbers to ensure their construction of the potential dam, and would result in California Congressman Alfred Elliott bluntly stating that: 'Hitler could not have selected better people to sabotage the American interests than those who have done that in the San Joaquin Valley' (cited in Porter 1995:169). The people he was referring to were the Bureau of Reclamation, who had undertaken a cost-benefit analysis showing irrigation benefits for the dam were larger than expected flood control benefits, and thereby staking a claim for Bureau oversight - and requiring costs to be repaid by water users.

In the end, the dam would be built by the Corps, but the disposition of water provided by the subsequent reservoir was to be negotiated by the users of that water and the Bureau, leading to rancorous disputes lasting until the early 1960s. Alongside these interagency clashes over the form of benefit-cost analyses, the Corps of Engineers - and the calculations they performed - came under attack from both hydroelectric utilities owners and the railroads who accused the agencies involved of undertaking 'pork-barrel' projects. Overall, bureaucratic battles, internecine conflict and pressure from the powerful electricity and rail interests over disparate benefit-cost calculations resulted in a search for a standardised benefit-cost technique that could be applied

throughout the whole of the federal government (Porter 1995:162-175) and '[benefit-cost] analysis had to be transformed from a collection of local bureaucratic practices into a set of rationalized economic principles.' (Porter 1995:149).

As Richard J. Hammond noted, before America's entry into the second world war, there had been no attempt to develop consistency across agency calculations, or independent verification of these (Hammond 1960:7)<sup>36</sup>. By 1943 however, President Franklin Roosevelt had issued Executive Order 9384, which required federal agencies to submit to the Bureau of the Budget reports 'relating to or affecting federal public works and improvement projects' (cited in Hammond 1960:7). That same year, an 'interdepartmental dinner group of officials from federal water agencies' (Porter 1995:182)<sup>37</sup> was formalised as the Federal Inter-Agency River Basin Committee (FIARBC), and in 1946, this group established a Subcommittee on Benefits and Costs under pressure from the Bureau of the Budget, specifically 'for the purpose of formulating mutually acceptable principles and procedures for determining benefits and costs for water resources projects' (cited in Hammond 1960:9). In 1950, this subcommittee published an interim report entitled 'Proposed Practices for Economic Analysis of River Basin Projects', or, as it was more commonly referred to, the celebrated *Green Book*.

### *The Green Book*

The *Green Book* aimed to provide a comprehensive analysis of benefit-cost techniques undertaken in each of the agencies involved, and from this, to 'develop a systematic, consistent, and theoretically sound framework for the economic analysis of river basin projects and programs' (FIARBC 1950:1). As a means to reconcile conflicting types of benefit-cost analysis across a variety of federal agencies involved in multiple purpose water planning and development, the *Green Book* failed utterly (Porter 1995:185), and its goal to provide a systematic and consistent framework for calculation did little to

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<sup>36</sup> Indeed at the time the generation of the electricity required to produce aluminium for wartime airplanes was a prime concern (Klein 1999:1).

<sup>37</sup> This group included representatives from the Army Corps of Engineers; the Departments of Agriculture, Commerce and Interior; and the Federal Power Commission (Hammond 1960:9, footnote 16).

lessen inter-agency competition and the production of wildly differing figures for water projects. Although it was never officially adopted by the parent committee or by federal agencies, the *Green Book* was still highly influential (Campen 1986:17; Hammond 1960; Kneese 2011:59; Porter 1995:185), and it proved much more successful and significant in providing the basis for a heretofore missing theoretical framework for benefit-cost analysis - in the form of the new welfare economics (Kneese 2011:59; Porter 1995:187-188).

The Green Book itself never made explicit reference to welfare economics however, nor to any specific economic theorist, papers or canonical texts in spite of its reliance on economic theory, likely due to its production by bureaucratic and not academic economists (Porter 1995:188). But the simple importation of the concepts and language of the discipline was clear. The report's call for projects to be developed in the order of their economic efficiency (FIARBC 1950:5) and the use of both utility and generalised scarcity is clear from the exposition of basic concepts:

The phrase "goods and services" as commonly used in the economic sense is utilized in this study to encompass all objects and activities which have the power of satisfying human wants and which may be increased or decreased in amount (or value) as a result of a project. Goods and services which fulfill human needs and desires and which are limited in supply have economic value. Any goods and services for which there is no need or demand have no economic value. In order for the effects of a project to have economic value in terms of benefits or costs it is necessary that there be a need or demand for the goods and services produced by or used for the project. (FIARBC 1950:7)

The initial impetus for the development of a specific technique to evaluate the benefits and costs of water development projects, which was written into the 1902 Rivers and Harbours Act, was, as I have shown above, radically transformed in the 1930s alongside the development of the national economy - made measurable through the new national account statistics. The requirement for the non-local evaluation of large-scale multiple purpose projects followed the lead of Harold Ickes's National Resources Board and involved the incorporation of intangible factors and indirect benefits and costs not benefit-cost calculations. This development was formalised by the 1935 Rivers and Harbours Act and the 1936 Flood Control Act. However, this did not result in a generalised benefit-cost formula, and attempts to reconcile conflicting calculations and analyses made by the federal agencies involved in water development projects would eventually result in the publication of the the FIARBC's *Green Book*. While this

publication failed to reconcile conflicting forms of analysis between agencies, it did succeed in implicitly translating the technology of benefit-cost analysis into welfare economics. As Porter claims: 'The transformation of cost-benefit analysis into a universal standard of rationality, backed up by thousands of pages of rules, cannot be attributed to the megalomania of experts, but rather to bureaucratic conflict in a context of overwhelming public distrust.' (Porter 1995:189)

Maass claimed that the Bureau of Budget bureaucrats and the members of the FIARBC were not acting in a vacuum, but were reflecting the conceptual basis of the new welfare economics with its focus on efficiency considerations, and within welfare economics, the exclusive focus on efficiency resulted ultimately from the ready availability of benefit cost data which were provided automatically through market prices (Maass 1966:213). However, as Porter argues, the reason for the application of welfare economic theory to water development planning by bureaucratic economists, particularly those at the Bureau of Agricultural economics, is unclear: '[c]itations by Mark M. Regan, the most important author of the "Objective Analysis" that provided a template for the *Green Book*, do not suggest a direct translation from high theory.' (Porter 1995:188; italics added).

Regardless of this lack of clarity, the *Green Book* presaged the huge expansion of the employment of economists in the Corps of Engineers (Porter 1995:186), and while economic expertise in benefit-cost analysis was almost non-existent outside of the bureaucracy at the start of the 1950s, three institutions: The Harvard Water Program, the RAND Corporation, and of course the newly formed RFF would, in the late 1950s provide the missing translation of benefit-cost analysis from simply a prosaic water resource technology into the practical application of welfare economic theory. An application that could be used not just in the evaluation of potential water development projects but throughout federal government.

## Welfare economics, efficiency, and the conservationist backlash

In 1958 three seminal applied economics texts systematically brought modern neoclassical welfare economics squarely to bear on benefit-cost analysis (Campen,

1986:17; Hanley & Spash 1993:4-5; Hufschmidt 2011:44; Pearce 1971:14; 2002:58; Porter 1995:188<sup>38</sup>). *Water Resource Development*, written by the Harvard economist Otto Eckstein and published as part of Harvard's Economic Studies series, represented an updated version of Eckstein's 1955 doctoral thesis on the economics of project evaluation in the Federal water-resource programme. Eckstein also collaborated with John V. Krutilla of RFF on *Multipurpose River Development*, produced as part of RFF's studies in water resources. The third book was Roland N. McKean's operations research text, *Efficiency in Government Through Systems Analysis*, which was produced as a RAND Corporation research study.

### *Bringing welfare to water*

Eckstein was the first to undertake a comprehensive appraisal of the benefit-cost studies of water resource development from a welfare economics perspective (Kneese 2011). In the same year that Eckstein completed his PhD, Arthur Maass of the Harvard Graduate School of Public Administration instituted the Harvard Water Program (Reuss 2003). This was focused upon the analysis of current water planning techniques and aimed to bring together government water planners and academics in the fields of engineering, economy theory and public administration in order to improve multipurpose water planning and project evaluation procedures. Eckstein, alongside Robert Dorfman and later Stephen A. Marglin provided economic input to the programme, which was funded by an initial grant of USD 150,000 from the Rockefeller Foundation.

Although Eckstein would spend time at RFF as a temporary staff member through 1956, it was under the auspices of the Harvard Water Program that he eventually published the updated version of his thesis in 1958<sup>39</sup>. After a brief history of federal water planning and development projects *Water Resource Development* begins by outlining a general theoretical framework for benefit-cost analysis from the point of view of welfare economics. It then goes on to discuss general issues of benefit-costs practice 'such as the form of the benefit-cost criterion, interest rates, and adjustments

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<sup>38</sup> Porter also refers to two papers by Julius Margolis (1957, 1959) in his summary of early economic analysis of benefit-cost analysis. The first of Margolis' papers considers indirect, secondary benefits in relation to economic externalities; while his 1959 paper is a review of the three 1958 texts.

<sup>39</sup> Eckstein would also later go on to be a member of the CEA from 1964-1968.

for risk which are encountered in all fields to which the analysis is applied' (Eckstein 1958:17). With the theoretical concepts derived from welfare theory stated, Eckstein moved to a comparison of the theory against the analytical practices of the federal agencies involved in water development in the areas of flood control, navigation, irrigation, electric power generation, and finally in multipurpose cases. From this comparison, Eckstein was able to 'propose certain changes which would make the practices consistent with the theory, and thus also consistent with each other' (Eckstein 1958:17).

Eckstein concluded his study by stating that the surveyed current benefit-cost procedures fall far short of the welfare theory ideal and '[a] benefit-cost ratio of 1.0 does not mean that a project will actually produce more benefit than its cost even if the forecasts of prices prove to be correct, and hence the analysis is not yet a proper means for determining how much money should be spent on the various programmes (Eckstein 1958:273)'. However:

...benefit-cost analysis is an extremely promising evaluation method for public expenditures, which, in the limited cases where it can be applied, could put policy judgements on a much firmer economic basis than is usually possible. While we have many reservations about specific details of procedure, this point is fundamental: with so large a share of the total investment of the country channeled through public bodies and hence subject to political decision making, it is most desirable that benefit-cost techniques, properly designed, be applied as widely as possible, and that the findings be given a heavy weight in policy formation. This conclusion presupposes that the analysis is used to evaluate projects and not merely as a propaganda device. (Eckstein 1958:273-274)

*Multiple Purpose River Development* by John V. Krutilla and Eckstein built, in part, upon the latter's work on water development, but focused more specifically on multiple-purpose river basin development projects and their economic efficiency. Krutilla had joined RFF in 1955 after working previously for the TVA, and by 1958 he was the research associate in charge of economic research in the water resources area at RFF. This text proved to be one of the most important outputs from that RFF research stream. Like *Water Resource Development* much of the text is taken up with the outline of the theory of efficiency in the economists' perfectly competitive economy. However, they also invoke the notion of economic external effects (otherwise known as

externalities) drawing from postwar work by William Kapp (1950) and Tibor Scitovsky (1954). As Mishan defined them:

External effects may be said to arise when relevant effects on production or welfare go wholly or partially unpriced. Being outside the price system such external effects are sometimes looked upon as the by-products, wanted or unwanted, of other people's activities that immediately or indirectly affect the welfare of individuals. (Mishan 1965:6)

Calel (2011:9) traces economic thought on externalities back to Adam Smith, whereas for Kula (1998:68) the concept of externalities proper should be dated to Alfred Marshall and his *Principles of Economics* (1890). However, for Marshall, externalities were only used to refer positively to the benefits accruing to 'economic units' (Kula 1998:68) through general industrial development. It would not be until Marshall's 'star pupil' (Calel 2011:10), Arthur Cecil Pigou, that externalities would be expanded to account for costs as well as benefits. Kula notes that Pigou makes use of the case of woodlands damaged by sparks from railway engines (Pigou 1920), and in his *Economics in Practice* (1935) Pigou gives a number of other examples of externalities, including the now classic economic pedagogic case of soot from factory chimneys making dirty nearby washing that is hung out to dry. Pigou's proposed response to the issue of externalities was for government intervention to correct what he viewed as the faulty 'intertemporal allocation of resources' (Kula 1998:83) - which would come to be Ronald Coase's later *bête noire* (1960). However, for Pigou, externalities were rare, anomalous events.

Krutilla and Eckstein point out that while externalities were regarded at the time by many economists as quite limited in the economy overall, in the water resources field external effects were a pervasive phenomenon (Krutilla & Eckstein 1958:44), and I will return to this question regarding economic externalities later in this chapter as well as in the following one. Krutilla and Eckstein's perspective on the pervasiveness of externalities in river basin management was driven by an understanding of basins as integrated systems, incorporating a systems analysis and operations research perspective (Hanley & Spash 1993:4) - an approach made more explicit in McKean's text. This theoretical approach was then applied to a series of case studies in order to elucidate: the comparative efficiency of differing approaches to the Hell's Canyon project; integrated system development on the Alabama-Coosa river system; and the

analysis of the distribution of benefits and costs in the Willamette river development programme. They concluded, similarly to Eckstein, that while an economic efficiency basis for water resource development may not necessarily be considered socially desirable, nevertheless: 'efficiency is a significant value in our society; in decisions regarding multiple purpose development, the public interest requires that efficiency considerations be given due weight' (Krutilla & Eckstein 1958:277).

The general purpose of Roland N. McKean's *Efficiency in Government Through Systems Analysis* (1958) was broader than the other two texts. It aimed to contribute to the improvement of quantitative analytical tool of benefit-cost analysis in general and to extend the use of this tool beyond just the focus on water resources. This more general focus was due to RAND's already established programme of research on economic efficiency with respect to the military, and McKean, who had been a research economist at RAND since 1951, brought the economic techniques being developed by the corporation for the analysis of military expenditures to the water development field (McKean 1958:vii). The study was produced as the third volume in the Operations Research Society of America's *Publications in Operations Research* series and made broad use of operations research and systems analysis techniques. As defined by McKean, 'Operations research' developed from statistical techniques deployed during the second world war in the comparison of military tactics. In the post war period these techniques were developed and applied to enlarged systems of interrelated components, such as military development and procurement problems, and were developed under the rubric of 'systems analysis'.

McKean's study differs from the Eckstein and Krutilla & Eckstein texts not only in its thoroughgoing application of operations research and systems analysis however, but also in its general approach to efficiency. In the case of the Eckstein and Krutilla & Eckstein, they follow contemporary neoclassical welfare theory in defining efficiency specifically as Pareto-Optimality, by incorporating all purported benefits as well as costs, potential projects can be assigned a rank order. In the case of McKean, he develops and clarifies a subset of benefit-cost analysis that does not rely upon the complete specification of benefits. This subset focuses solely on cost comparisons amongst regulatory and development options, where optimal economic allocation is not necessarily the goal. Within this form of cost-effectiveness analysis, a programme

is deemed efficient if its benefits exceed its costs, but this does not mean however, that the programme is Pareto Optimal, and nor does it provide a preferred order of projects to be undertaken.

While all three of these texts retained a concrete emphasis on water resource development, they were each written with a broader audience of cost-benefit analysts, government personnel and operations researchers in mind, and undertook a synthesis of the theoretical welfare economics literature with the practical concerns of water resource use and development (Pearce 2002:58). The essential step undertaken here was the use of the Kaldor-Hicks compensation criterion - established during the 1930s and 1940s (e.g. Hicks 1939, 1943; Kaldor 1939) - in order to evaluate projects according to the benefit-cost principle:

justifying projects or policies on the basis that benefits exceed costs is wholly consistent with there being losers, i.e., those who suffer the costs. The Kaldor-Hicks compensation criterion had established that projects were nonetheless justified because gainers could compensate losers, such that losers would be no worse off, and gainers would still have a net benefit. This implies that, provided the compensation takes place, no one is actually worse off, thus meeting the long-established Pareto criterion for an improvement in overall well-being. However, actual compensation need not occur: It is necessary only that it could take place. (Pearce 2002:59)

Benefit-cost analyses are frequently, and particularly in the economic and political mainstream, characterised as simply the practical application of welfare economics theory (Campen 1986:15). This is not the case however, and it was not until these landmark 1958 publications that an explicit theoretical framework and justification for benefit-cost analysis was established - over twenty years after the Flood Control Act of 1936 had brought about its regular application (Campen 2006:17). Kneese has argued that 1958 represents the peak of the refinement of benefit-cost analysis of water projects, and that at this point, with the era of big dam projects in the US drawing to a close<sup>40</sup> there were few major projects left as candidates for evaluation by the technique. 'Benefit-cost analysis is, however, not dead; it just moved to other fields of activity' (Kneese 2011:59), and it was its translation into welfare economics that enabled this movement.

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<sup>40</sup> The era of big dam projects would run for a roughly thirty year period from 1935 to 1965, (Billington Jr. et al 2005: 383).

Crucially, in tying the pragmatic technology of benefit-cost calculations to the contemporary discipline of welfare economics that was stabilised in the late '30s and early '40s, benefit-cost analysis was converted from the simple handmaiden of federal dam building and water course projects into a transportable analytical technology, capable of being deployed in multiple milieu. This translation was completed and made explicit in the three texts published in 1958 under the auspices of the Harvard Water Program, RAND and RFF. What began as a limited and prosaic engineering technology developed by the Army Corps in the first decades of the 20<sup>th</sup> century, was by the late 1950s, translated into the broader field of welfare economics. Coterminous with the settling of the economy as an ontologically discrete sphere defined by its potential for limitless growth, and the construction of a system of energy for powering this growth, benefit-cost analysis was developed into an economic technology that could be transported from water development projects and applied to any federal decision making that would potentially impact on this growth.

From the late 1950s on, benefit-cost analysis rapidly became an established academic discipline and a respectable economic speciality (Porter 1995:187)<sup>41</sup>. Transportation studies - particularly of highways programmes - and RAND's ongoing economic quantification of military spending programmes through the development operations research analysis, would provide complementary means through which benefit-cost analysis was expanded from its limited, watery origins. However 'it was not the crucial point of reference for the economists who around 1960 began measuring the benefits and costs of almost every form of government activity. The analysis of water projects was.' (Porter 1995:187). In 1961 the Panel of Consultants to the Bureau of the Budget released their report 'Standards and Criteria for Formulating and Evaluating Federal Water Resource Developments'. The Panel included John Krutilla of RFF and the Harvard Water Program economists Maynard M. Hufschmidt and Stephen Marglin; and one year later, the Harvard Water Program published its own comprehensive multidisciplinary report *Design of Water Resource Systems*, which considered economic efficiency issues and benefit-cost analysis in some depth.

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<sup>41</sup> By the middle of the 1960s, Prest and Turvey's (1965), by their own admission, incomplete survey of the benefit-cost literature, resulted in a bibliography that included ninety references.

In November 1963 the Brookings Institute held a major conference on the topic of benefit-cost analysis at the request of the Bureau of the Budget. Papers presented at this conference applied the technique to such diverse topics and areas of federal government action as 'urban highways, urban renewal, outdoor recreation, civil aviation, government research and development, and public health' (Maass 1966:208). The conference papers were published in 1965 as the volume *Measuring Benefits of Governmental Investments*, edited by the Harvard Water Program economist Robert Dorfman (Dorfman 1965). That same year saw the publication of further benefit-costs texts (e.g. Haveman 1965; Prest & Turvey 1965) as well as the establishment of a unit within the Bureau of the Budget dedicated to adapting and applying benefit-cost and cost-effectiveness analyses to a range of government programmes. (Maass 1966:208).

As Porter argues, benefit-costs techniques were also at this time brought into the economic analysis of public health. Here the economist Burton Weisbrod, using lost productivity as a measure of the value of days and even lives lost to sickness, concluded that the polio vaccination was of doubtful net benefit. Education was also studied, and here the use of gross returns from the labour market in the benefit-cost calculations indicated that while high school, college, and unsurprisingly, MBA programmes should be endorsed, graduate education in science and engineering should not (Porter 1995:188).

Through the 1950s and 1960s an increasingly wide array of potential benefits were developed as surrogate measures of national efficiency driven by the desire of the agencies involved in the developments to justify their own projects, and the 1963 Bureau of the Budget sponsored conference helped this process through the further theoretical development of benefits proxies as well as the application of these to ever further fields of federal government endeavour (Andrews 1984:49). In the following chapter, I will consider the further spread of benefit-cost analysis through the late 1960s, a spread which had been limited up to that point by the Bureau of the Budget's sole focus on a national efficiency objective; and it is this concern with national efficiency, and the response to this, that I turn to next.

The 1934 National Resources Board Committee under Harold Ickes recommended a revision to the costing techniques used to evaluate candidate water resource projects for federal funding, and this represented a fundamental break from the prior focus in the Army Corps of Engineers on purely tangible, local benefits and costs. This radical change, undertaken in order to ensure that the large-scale water resource projects being undertaken under the New Deal adequately reflected the needs of the newly defined, measured and prescriptive national economy. By incorporating intangible factors and secondary, indirect benefits, '[t]he damage a project did to homes and the resulting loss in tax revenue, according to this idea, could be commensurated with and balanced against not just irrigation or power production, but also increased recreation opportunities, aesthetic improvements, and other unmarketed factors (Lohmann 2009:516).

However, the use of the unmarketed factors was largely curtailed through a focus on national efficiency, as proscribed informally in the 1950s *Green Book*, which relied overwhelmingly on the efficiency ranking function (Maass 1966:212). This was then officially propagated through the federal agencies by the Bureau of Budget in 1952's *Budget Circular A-47*. Shortly after the publication of the Budget Circular, agency manuals would begin to be revised to reflect more closely national efficiency concerns, and as Andrews states, 'in practice only demonstrable economic benefits and costs based on market values were included in the analyses' (Andrews 1984:46), and throughout the 1950s the executive agencies 'painted themselves into the efficiency box...In this way benefits to all became virtually restricted to benefits that increase national product' (Maass 1966:212-213). These guidelines for economic analyses of water resource projects would remain in force for the remainder of the 1950s (Campen 1986:17).

For Maass, the subjection of benefit-cost analysis to the single objective of economic efficiency - and its overarching concern with the growth of the economy - fails, first and foremost to take into account the complexity of the majority of governmental functions. Maass was particularly concerned with the failure to consider issues of income redistribution, which could be safely ignored by economists through the simple invocation of Kaldor-Hicks compensation. The issue of consumer sovereignty was also

a clear concern for Maass and he raised questions about the nature of institutional settings, their impact on consumer preferences, and how these can develop at odds with community preferences. While these points would be revisited in later academic critiques of benefit-cost analysis and its usage (see e.g. Sagoff 1990, 2004), during the 1950s and into the 1960s a backlash developed against benefit-cost analysis and the agencies that used this to determine the viability of large-scale water development projects on the grounds of its narrowness and explicit exclusion of broader, non-efficiency factors. As Richard Andrews claimed: 'The very narrowness of [benefit-cost analysis] criteria that made it an effective weapon against the worst pork-barrel subsidy proposals also made it seem the insensitive villain that ignored environmental and social values displaced by development projects' (Andrews, 1984:49), and in 1950 the Echo Park controversy would ultimately bring this critique to the national stage.

In April of that year, Secretary of the Interior Oscar Chapman approved the building of the Echo Park Dam by the Bureau of Reclamation after initial resistance from the National Parks Service. The dam, which would span the Green River in Colorado, was to be a major hydroelectric development project located within the Dinosaur National Monument. This decision immediately provoked a vocal response from wildlife preservation groups, wilderness societies and the conservationist movement who feared that the dam would not only destroy an area of unique wilderness, but set a precedent for the further incursion of water development projects into America's national parks and monuments. On July 22<sup>nd</sup>, Bernard DeVoto, who was a writer for *Harper's Magazine* and served on Secretary of the Interior Oscar Chapman's Advisory Board, wrote an exposé on the Echo Park Dam project in the *Saturday Evening Post* entitled 'Shall We Let them Ruin Our National Parks?' (Billington Jr. et al 2005: 397).

Shortly thereafter, the leaders of thirty-two separate wildlife and conservationist organisations created a lobbying group, the Citizens Committee on Natural Resources, to bring the fight for Echo Park to Washington. This group would contest the construction of the dam for the next six years, and when Congress took up the issue of authorising the dam, the protests against it would attain national status, and sought to highlight the opposition of environmental and wilderness concerns to the national efficiency focus of the Bureau's benefit-cost analyses.

As Fred M. Packard, the executive secretary of the National Parks Service sought to highlight 'The issue is clear-cut, in spite of the fog of technical data and irrelevant side issues that have confused its comprehension by Congress and the public' (cited in Billington Jr. et al 2005:398). David Brower, the Director of the Sierra Club<sup>42</sup> devastatingly critiqued the evaporation figures that formed part of the Bureau's calculations. The projected price figures for power generation from the dam were also revised upwards and aesthetic arguments about the inundation of a national monument were raised and juxtaposed to the (now increasingly shaky) benefit-cost calculations. As a result of this opposition, when President Eisenhower formally authorised the Colorado River Storage Project on April 11<sup>th</sup>, 1956, he did so without the Echo Park Dam (Billington Jr. et al 2005:398).

The Echo Park controversy was a galvanising moment in the history of the post-war conservation movement (Billington Jr. et al 2005: 399). Throughout the remainder of the 1950s, both the technique of benefit-cost analysis, focusing exclusively on national efficiency, and the federal agencies that made use of it to justify large environmental development projects, came under increasing attack from conservation groups on the grounds that this economic technique failed to adequately take into account environmental benefits and costs. The major decision technology used by the Army Corps of Engineers, the Soil Conservation Service, the TVA and the Bureau of Reclamation to approve water development projects was becoming increasingly contested for its narrow focus. The overriding concern with the growth of the economy, through the use of the national efficiency criterion in benefit-cost calculations for environmental development projects, was being increasingly seen as a problem.

In 1946, the Army Corps of Engineers originally presented a plan to develop the Arkansas river in Oklahoma, at the request of Oklahoma Governor Robert S. Kerr. Kerr was not merely State Governor however, he was also owner of Kerr-McGee Oil Industries, and had a huge financial stake in the development of the river as a means to transport oil at lower cost than via rail freight. In testimony Kerr argued 'Let us not

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<sup>42</sup> Brower would later go on to found Friends of the Earth in 1969, when he was ousted from his position at the Sierra Club on the grounds of his drive for a more politically active organisation.

confine this hearing to the minor subject of comparative water-rail freight costs. Rather let us think about building a greater nation' (quoted in Porter 1995:164). Invocation of the growth of the national economy was not however enough in 1946 for the project to go ahead. By 1962, Robert S. Kerr was no longer a State Governor, but a Senator and chairman of the Senate Committee on Rivers and Harbours. In this position, he sponsored guidelines and legislation that established new and broader categories of benefits that could be applied to national efficiency focused benefit-cost calculations (Andrews 1984:46 footnote 4; Porter 1995:164).

The subsequent development of the Robert S. Kerr lock and dam alongside the Robert S. Kerr reservoir, which naturally enough facilitated the cheap transportation of Kerr-McGee Oil, was the kind of project that would result in the *The Nation* branding the Corps of Engineers the army of 'Pork Barrel soldiers' in 1966 (cited in Billington Jr et al 2003:400). It would also help further develop a popular and conservation oriented backlash against benefit-cost procedures as environmental costs were still excluded, and the cost component of equations considered only investment costs: capital, operation, maintenance, and not the full social and environmental effects of disruptions to communities and ecosystems (Andrews 1984:49). This backlash would only get stronger through the 1960s as the issue of pollution caused by economic growth became the rallying banner of the burgeoning environmental movement.

## The polluted Spaceship Earth

While the 1963 RFF reports *Scarcity and Growth* and *Resources in America's Future* (Barnett & Morse 1963; Landsberg et al 1963) signalled the death knell of concerns with resource scarcity and helped secure the economy as an object capable of continued, and exponential growth powered by a limitless system of energy, One year before a popular book had been produced that ignited a concern not with a lack of growth, but with growth itself. In 1962, the former researcher for the U.S. Fish and Wildlife Service, Rachel Carson, would publish her book *Silent Spring*. Originally serialised in three parts in the New Yorker, *Silent Spring* highlighted the ecologically catastrophic impact of the introduction of DDT and other chemical pesticides into contemporary agriculture and sold half a million copies in hardback alone, staying on

the New York Times Bestseller list for 31 weeks (McCormick 1995:55). This book, frequently credited as marking the beginning of the environmental revolution (McCormick 1995:65; Pearce 2002), 'arguably opened the eyes of the American public' (Flippen 2000:4) to the problems that accompanied unalloyed economic and industrial growth in postwar America. Pollution, however, was already at this time a national issue, thanks to the California smog.

### *Pollution becomes pervasive*

The portmanteau term 'smog' was first coined in 1905 by a doctor in London, it would come to prominence however on the west coast of America. Originally mistaken for Japanese gas attacks during the second world war (McNeill 2001:72), it would then be blamed on both wartime industrial production, and then household furnaces, before its eventual identification as largely caused by automobile emissions. The nature of its production significantly undermined the feasibility of local control efforts, and as Christopher Bailey pointed out, local governments were unwilling to broach the broader issue of increasing car ownership and use (Bailey 1998:91). The California smog problem also began to foul popular culture, making a recurring appearance in the works of Raymond Chandler, alongside a parade of breathless dames. In response, the state's congressmen and women attempted to introduce a variety of bills on research, prevention measures and tax relief for the purchase of air pollution control equipment (Bailey 1998: 91-94).

In his 1955 State of the Union message, President Eisenhower announced that he would soon propose 'strengthening programs to combat increasingly serious pollution of our rivers and the growing problem of air pollution' (Eisenhower 1955; cited in Bailey 1998:95). Presidential support for anti-pollution measures resulted in twenty four pollution control bills being introduced in the House that same year, and Eisenhower signed the 1955 Air Pollution Control Act into law on July 14<sup>th</sup> 1955. Bailey states that while care was taken to preserve primary responsibility for air pollution control at the level of the state, the provision for federal surveys, the publication of reports by the Surgeon General, and the authorisation of USD 5 million for demonstration projects, grants for local control agencies and research by the Public Health Service, meant that the 1955 Act prefigured the shift in responsibility for air pollution from the local level to the federal government (Bailey 1998:96-97; Jones 1975:31-32).

Throughout the 1950s and into the early 1960s, expanding heavy industry and energy production, particularly in areas utilising high sulphur coal, resulted in increased and visible industrial air and water pollution. (Flippen 2000). The appearance of pollution in print - thanks to the serialisation of Carson's *Silent Spring* - was added to in December 1962 when a smog disaster in London, estimated to have killed up to 700 people, was widely reported in the US media (Bailey 1998:104). Subsequently, the next year, the same year as the RFF reports, President Kennedy stated in a special message to Congress transmitted on the 7<sup>th</sup> of February 1963 that: 'In light of the known damage caused by polluted air, both to our health and to our economy, it is operative that greater emphasis be given to the control of air pollution by communities, States and the Federal Government.' (quoted in Bailey 1998:106). By the end of that year the 1963 Clean Air Act (CAA) had been passed.

The passage of the act was actually greased by the death of oilman Robert S. Kerr, whose fondness for pork and role in the development of benefit-cost analysis I discussed above. Kerr had been, at the time of his passing, Chairman of the Senate Public Works Committee. His replacement would reorganise the committee, creating a Special Subcommittee on Air and Water Pollution under the Democratic Senator Edmund Muskie. Muskie was a staunch environmental advocate and as well as being central to the passing of the 1963 CAA, he would play a role in the massive expansion of federal environmental regulation after the election of Richard Nixon in 1969. The 1963 CAA, like the 1955 Act, left primary responsibility for controlling air pollution up to state and local governments, however for the first time, and mirroring the developing understanding of pollution as a pervasive, non-local issue, the Secretary of the Department of Health, Education and Welfare was empowered to take legal action against interstate polluters (Bailey 1998:108; Jones 1975:71-76).

Alongside air pollution due to the burning of fossil fuels by the manufacturing industry and by chemical pesticides, the mass use and inadequately or unregulated discharge of chemicals was brought startlingly to the national attention when the Cuyahoga river in Cleveland caught fire in June 1969. Alongside industrial growth, the increasing growth in both consumption and population density in the US were not matched by the development of adequate waste treatment services, resulting in more, and more obvious environmental despoliation. Moreover, municipal dumps often had poor

pollution controls and expensive, sanitary landfills were rarely funded adequately (Flippen: 2000). Not only were domestic energy production, the growth of the national economy, increasing consumption and population density resulting in continual pollution problems, but by the end of the 1960s, the overseas and offshore production and transportation of oil would also result in highly visible environmental catastrophes.

In 1967, the Torrey Canyon Supertanker ran aground off the Cornish coast of England, resulting in what was then the world's largest oil spill; and in 1969, a Union Oil drilling platform in the Dos Cuadras offshore oil field six miles from the California coast experienced a blowout, resulting in the largest oil spill seen in US waters at the time. Within ten days, up to 100,000 barrels of crude oil had spilled into the Santa Barbara Channel and onto beaches in southern California. Pipeline breaks and further leakage in the surrounding area would result in a near continuous, if minimal, oil spillage throughout the remainder of 1969 and into 1970. The Santa Barbara Channel oil spill received widespread media coverage, galvanised environmental action in Richard Nixon's home state of California, and resulted in the newly inaugurated President visiting affected beaches just one month into his first term (Hamblin 2013:190).

Throughout the 1960s, pollution developed into an increasingly pressing issue in the US, and within a country shaken by the ructions of anti-Vietnam war protests, an increasingly vociferous and politically potent movement crystallised around the environment. The Apollo space programme, conceived in early 1960 - just three years after the USSR's Sputnik success - resulted in the launch of Apollo 8 out of the earth's orbit in 1968, and the famed *Earthrise* picture taken by the astronaut William Anders during the fourth orbit of the moon would give the environmental movement its very own motif. Anders stated that after taking the picture "[t]hen I felt like some watcher of the skies, when a new planet swims into his ken", and as the famed science fiction novelist Arthur C Clarke would claim, this image '[f]or millions on earth... must have been the moment when the Earth really became a planet' (McCormick 1995:80). The image of planet Earth - singular, self-contained and fragile in the void of space, would not only galvanise an environmental movement, but it came to epitomise the development of a new approach to the environment, one focused on the closed ecosystem, and named three years earlier, as the Spaceship Earth.

### *The coming Spaceship Earth*

In July 1965, the then US ambassador to the UN Adlai Stevenson gave a speech to the UN economic and social council in Geneva on the problem of global urbanization. In the speech, Stevenson made use of the metaphor of the earth as a spaceship 'on which humanity travelled, dependent on its vulnerable supplies of air and soil' (McCormick 1989:67). This speech was drafted by the former editor of *The Economist*, Barbara Ward<sup>43</sup>, who would, in 1966 publish the book *Spaceship Earth*, based on her 1964 George B. Pegram lecture series at Brookhaven National Laboratories. In *Spaceship Earth*, Ward ascribes the genesis of the spaceship metaphor to the idiosyncratic engineer, thinker and inventor of the geodesic dome, Buckminster Fuller. Fuller, who had been expelled from Harvard University twice only to be eventually invited back as Honorary Professor of Poetry, was the author, in 1964, of a manifesto he titled *The operating manual for spaceship earth*. It would not be until two years later however, that the Spaceship Earth would make its most celebrated and influential appearance in a paper presented by the economist Kenneth E. Boulding entitled *The Economics of the Coming Spaceship Earth* at an RFF conference (Pearce 2002:60).

In 1966, Allen Kneese was the director of research programmes in both water quality and the quality of the environment at RFF, and on March 8<sup>th</sup> and 9<sup>th</sup> the organisation held its sixth research forum on the topic of 'Environmental quality in a growing economy'; this forum was Planned by a staff group led by Kneese. Henry Jarrett would again act as editor for the book ultimately produced from the event, as he did for the the 1958 RFF forum on conservation. He noted in his introduction to the edited volume that resulted from the forum that the changing emphasis from resource concerns to those of the effects of environmental pollutants - understood within RFF as a transition from environmental quantity to environmental quality - resulted in the following question:

Granting that most of the pressures upon the natural environment have been direct or indirect results of a prosperous and expanding economy, does it follow

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<sup>43</sup> Barbara Ward was the former editor the the magazine *The Economist*, and would go on, at the prompting of Maurice Strong, to write the book *Only one earth* (1972) for the 1972 UN conference on the Human Environment with microbiologist Rene Dubois.

that further erosion of environmental quality must continue to be the price of further economic gains?' (Jarrett 1966: xii)

Not only is economic growth queried here in relation to its environmental impacts and pollution caused, but by using the markers of growth developed in the 1963 Landsberg et al. RFF study *Resources in Americas future* - namely population growth, automobile ownership, personal consumption expenditures, and the federal reserve board index of industrial production - Jarrett maintained that '[t]he underlying causes of these discomforts and hazards are to be seen in the same statistics that most of the time are hailed as indicators of economic growth' (Jarrett 1966: ix). Here then, the very assurances of continued growth provided through the metrics and measurements of the early 1960s RFF studies that seemed to kill off concerns over resource scarcity are instead taken to starkly constitute the new problem of the environment. The problem here is not whether economic growth can continue, but that the very certainty of this growth, and the pollution associated with it, is the more pressing concern.

As Jarrett also stated '[i]f RFF projections from 1980 and 2000 are anywhere near the mark, the forces of economic progress working to degrade the environment will become steadily stronger.' (1966: ix). In order to address this issue, six topics were chosen for the forum. For each of these, an expert in the field was invited to prepare a paper highlighting current issues or prospects, and what might be done to alleviate or address them, and another was asked to respond critically to this paper or expand upon the issues raised there. The first topic to be addressed over the two days - resource development, usage and its impact on the environment - would result in the forum's most important output, Boulding's paper *The Economics of the Coming Spaceship Earth*<sup>44</sup>.

Expanding on a brief earlier *Spaceship Earth* piece he had written (1965), Boulding, who would later become President of the American Economics Association, synthesised the early systems theorist Claus Von Bertalanffy and the new discipline of ecology within an economic perspective, and made three innovative claims. First, he

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<sup>44</sup> Although the *Spaceship* metaphor had been used earlier by Buckminster Fuller and Barbara Ward, Boulding maintained that he thought up the metaphor independently, although it was so appropriate and timely that it was, in essence, an idea whose time had come (Boulding 1993:311).

argued that economists in particular had failed to come to grips with the transition from the earth as an open system with an economy maintained in the midst of a throughput from inputs to outputs, to the earth as an effectively closed system, where 'the outputs of all parts of the system are linked to the inputs of other parts. There are no inputs from outside and no outputs to the outside; indeed, there is no outside at all' (Boulding 1966:2). Using the colourful vernacular of spacemen and cowboys, Boulding states that established measurements of economic success do not make sense in the Spaceship Earth (Kula 1998:130). The reason for this, according to Boulding, is that the economy or 'econosphere' is merely a subset of the 'world set' or total ecosphere, and while we tend to treat the former as an open system, the latter is not. Here then, Boulding combines a concern with 'the economy', with the ecological approach outlined by Howard and Eugene Odum (e.g. Odum 1959), and explicitly subsumes 'the economy' under a global ecology.

Second, Boulding would echo the critique of production statistics and GNP as measures of welfare made by Galbraith in his 1958 *Affluent Society* and paper on consumption presented at the RFF forum on conservation in the the same year. Here however, Boulding would maintain that given that the global ecosphere is a closed system, pollution is a paramount and continual concern and it is this that evidenced the 'shadow of the future spaceship' for Boulding, not any potential exhaustion of material resources. From Los Angeles 'running out of air' due to the prevalence of smog, to Lake Erie becoming a 'cesspool', to the issue of DDT raised by Rachel Carson (Boulding 1966:12), pollution was the fundamental concern in a spaceman economy. Under conditions of continuing growth, pollution is pervasive. This diagnosis of pervasive pollution within a 'cowboy economy', driven by consumption and production as the basis of welfare, led to Boulding's prescription for the need to transition to a 'spaceman economy' in concordance with the essentially closed nature of the earth. Whereas in the current 'cowboy economy', the throughput of materials, energy and information - as measured roughly by GNP - was to be maximised, for the latter:

[t]he essential measure of the success of the economy is not production and consumption at all, but the nature, extent, quality, and complexity of the total capital stock, including in this the state of the human bodies and minds included in the system. In the spaceman economy, what we are primarily concerned with is stock maintenance, and any technological change which results in the maintenance of a given total stock with a lessened throughput (that is, less production and consumption) is clearly a gain. (Boulding 1966:8)

The maintenance of stock - material, energy and information - forms the basis of welfare in a spaceman economy (McCormick 1995:80), and throughput - production and consumption - is to be minimised (Boulding 1966:8). As Boulding later noted, '[t]he spaceship metaphor stresses the earth's smallness, crowdedness, and limited resources; the need for avoiding destructive conflict; and the necessity for a sense of world community with a very heterogenous crew' (Boulding 1993:311)

Third, Boulding recognised in the penultimate paragraph of his paper that certain problems of immediate and local pollution were well known to economists under the rubric of external diseconomies (externalities). The concept of externalities, as outlined above, had been, with exception of Kapp (1950) and Eckstein & Krutilla (1958), understood as a strictly limited and local phenomenon. Eckstein & Krutilla's argument that this was not the case with respect to river basins was not typical of the broader literature developed by welfare theorists at the beginning of the 1960s however. As argued by Mishan (1965) and later Ayres & Kneese (1969) - who I will return to in the next chapter - the importance of externalities was generally minimised in the academic literature<sup>45</sup> at this point. Externalities were considered as exceptional cases, minor and negotiable deviations (Ayres & Kneese, 1969:282; see also Cael 2011:10-11). This remained the prevalent perspective within the post-war welfare economics discipline (see also Pearce 2002:59-60)<sup>46</sup>.

Instead, Boulding considered the concept of externalities fundamentally inadequate to deal with the large scale and harder to solve problems of pervasive pollution within the Spaceship Earth. Boulding made clear that the persistent, worsening pollution due to the ongoing expansion of an open 'cowboy economy' within a closed ecosphere is not specific, local and comparable to the practical and immediate concerns focused captured by the notion of externalities. Rather: 'The problems which I have been raising in this paper are of larger scale and perhaps much harder to solve than the more practical and immediate problems of the above paragraph' (Boulding 1966:13).

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<sup>45</sup> see e.g. Buchanan & Stubblebine (1962); Coase (1960); Davis & Whinston (1962); Turvey (1963).

<sup>46</sup> This was, in fact, well displayed by contributions to the RFF forum by Ralph Turvey and Roland McKean (both of whom we have already come across in relation to the development of benefit-cost analysis) to the 1966 RFF forum. For Turvey and McKean externalities are still described as a strictly limited set, given in terms of specific examples.

The RFF conference was the first time that Boulding gave structure to the conceptual outline of the Spaceship Earth. But it was not his most eloquent exposition of his approach to the environmental problem. In testimony to Congress on the *Energy Reorganization act* of 1973, Boulding simply stated (and as I already quoted in the introduction): ‘Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist’ (U.S. Congress 1973). By the late 1960s and early 1970s, the new and urgent fear of the near apocalyptic environmental despoliation of the Spaceship Earth had become a significant object of US politics as well as popular and academic concerns. The conservationist backlash against federal water projects that began in the 1950s - focused on the use of benefit-cost analysis and the myopic justification of projects according to their potential to aid the growth of the economy - was joined by the increasingly obvious consequences of this growth during the 1960s. Crucially, the notion of the Spaceship Earth signified not only that the growth of the economy could have negative impacts on the environment, but that it *necessarily* did so, and that this was only likely to get worse.

## Environmental limits and the antigrowth movement

Shortly after his visit to the California beaches affected by the Santa Barbara oil spill, President Nixon announced during his annual message to Congress that:

The great question of the '70s is, shall we surrender to our surroundings, or shall we make our peace with nature and begin to make reparations for the damage we have done to our air, to our land, and to our water? Restoring nature to its natural state is a cause beyond party and beyond factions. It has become a common cause of all the people of this country... Clean air, clean water, open spaces—these should once again be the birthright of every American. If we act now, they can be. (President Richard Nixon’s annual message to Congress, January 22, 1970)

This message not only echoed the ongoing Vietnamese conflict, but also the antagonistic relationship between growth and the environment conceptualised by the Spaceship Earth, and projected, graphically, by William Anders *Earthrise* photograph. This antagonism was only further inflamed by the ways that Nixon and his administration chose to take his own advice, and act.

Prior to 1970, the US federal government's regulatory focus had almost exclusively been on 'economic regulation' and was concerned predominantly with price setting by natural monopolies and other economic practices. Contestation over major water development projects and the examples of the 1955 Air Pollution Control Act and the 1963 Clean Air Act are exemplary here. Specific pollution concerns and a broader understanding of the environment as a whole were increasingly considered as national and even global concerns, but federal regulation provided few incentives to encourage air and water quality regulation at the state level, and the public investment programmes that it did provide were generally seen as ineffective (Andrews 1984:52). In an attempt to outflank his likely Democratic rivals, Senators Edmund Muskie and Henry "Scoop" Jackson (who were themselves in competition with each other to write the strongest environmental legislation possible in the Senate), Nixon signed into law 1969's National Environmental Policy Act (NEPA) on the first of January 1970 (Bollier & Claybrook 1986:94; Flippen 2000), his first major executive action of what he would later dub 'the environmental decade'.

NEPA contains three principal components: a statement of National environmental policy, provisions for the implementation of this policy by federal agencies, and the establishment of a Council on Environmental Quality to oversee environmental policy (Liroff 1976:4). The first of these emphasises environmental quality as a National priority for the US. Section 101 (a) of the act recognises the 'profound impact of man's activity on the interrelations of all components of the natural environment' and commits the federal government, in cooperation with state and local governments and other concerned public and private bodies to use 'all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfil the social, economic, and other requirements of present and future generations of Americans' (NEPA 1969).

Second, it introduced environmental protection into the mandate of all federal agencies and required 'analysis of environmental impacts for major federal rule makings, programme decisions and specific projects' (Froehlich et al 1991:42). This analysis

could take one of two forms. An agency could either prepare an Environmental Assessment that supported a “finding of no significant impact” with respect to rule-makings, decisions and projects, or prepare an Environmental Impact Statement (EIS). An EIS must both describe significant impacts on the environment, and identify alternative actions that would minimise these environmental impacts, and as an analytical requirement intended to control the behaviour of administrative agencies this environmental tool developed the conceptual logic of the Planning, Programming and Budgeting System (PPBS) of cost analysis first instituted in the Department of Defence under Robert McNamara in the early 1960s (Andrews 1976; 1984:50).

As reported in Flippen (2000) from an interview with John Whitaker (Deputy Assistant to the President for Domestic Affairs) no one in the White House at the time appreciated the importance of the Impact Statement requirement - which was the only ‘true coercive portion of the bill and the one in which environmentalists placed so much faith’ (Flippen 2000:48). Flippen also points out that while Nixon would come to regret this oversight, it was not possible for him to oppose or veto the bill, as this would cast him as anti-environment - a political position considered largely impossible after April’s massive ‘Earth day’ protests (Flippen 2000:48). Important here was that the EIS requirement institutionalised the adversarial basis of the environment and environmental regulation to economic expansion in explicitly weighting environmental costs against economic benefits (Baram 1980:476). And environmental assessment and impact statements rapidly became the focus of environmentalist opposition, particularly to large scale energy production facilities such as dams and mining projects (Andrews 1984:49-50; Billington Jr. et al 2005:401; Hays 1987:143).

Third, the Council on Environmental Quality (CEQ) was established in Title II of NEPA to oversee and coordinate federal environmental efforts, with Russell E. Train, former head of the legal advisory staff of the Treasury, as its President. Although the CEQ had no budgetary powers or agency veto, its tasks included advising the President, monitoring the compliance of other agencies with NEPA, and the provision of public information on environmental issues. With respect to the first of these tasks, the CEQ produced annual reports for the President and Congress on National ‘Environmental Quality’. These documents, which ran from 1970 to 1997, reported on five areas: (1) the status and condition of the major natural, manmade, or altered environmental

classes of the Nation; (2) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programmes and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a programme for remedying the deficiencies of existing programmes and activities, together with recommendations for legislation (NEPA 1969:Title II, sec.201).

The first report, transmitted July 1 1970, stressed the importance of misplaced economic incentives in causing pollution. It maintained that economic incentives are to be demonstrated and evaluated, but used in conjunction with environmental standards - not as a substitute (CEQ 1970). In a similar vein, the 1971 report argued that 'property rights do not extend to the right of individuals and firms to pollute air and water' (CEQ 1971:113). This report also made explicit use of a benefit-cost balancing approach but reiterated the centrality of standards and enforcement, where any economic incentives are to be understood as supplementary measures.

As Richard Andrews has argued, NEPA was 'a profoundly important vehicle' (Andrews 1984:50) designed as 'a government-wide policy framework - in effect, a "super-mandate" - to ensure that all federal agencies would incorporate environmental concerns into their actions.' (Andrews 1999:286). Army Corps of Engineers designed projects would immediately begin to be significantly altered, delayed and even cancelled (Andrews 1976:68-69) under the impact of NEPA requirements to explicitly analyse non-monetary costs and benefits of governmental action (Andrews 1984:50). Importantly, NEPA required that this analysis be undertaken not just for public investment decisions (such as water development projects), but for both regulatory and management decisions as well. This was reaffirmed by early court decisions that maintained 'that all environmental impacts must be reasonably balanced along with economic and other objectives in federal regulatory decisions.' (Andrews 1984:50). It is

to the framework of one of the most important federal environmental regulatory decisions that I now turn.

### *The limits to air pollution*

The expansion of federal regulation initiated under Nixon was not merely in response to the growing public outcry over environmental despoliation and the desire for increasing environmental protection and conservation. The Nixon Administration viewed the issue of clean air in particular as one that could be used both as a means for political advantage, to further the administration goals of regulatory reform within independent agencies, and to counter the growing concern that environmental regulation in some states but not in others left regulated industries at a competitive disadvantage (Mazurek 1994:2). The combination of political response to environmental concern, and the executive's desire to expand federal oversight over regulation resulted in the Clean Air Act of 1970.

As I outlined in the last section, the CAA was actually first passed in 1963, but was amended so substantially by the Nixon administration in 1970 that the original law is rarely referred to. The basis of this 1970 CAA is an 'action-forcing regulatory strategy' (Liroff 1986:19) which was oriented towards achieving so called National Ambient Air Quality Standards (NAAQS) for six 'criteria pollutants' for which environmental impact information was already known<sup>47</sup>. The CAA specified two types of standards for the NAAQS. The primary standards were health based, designed explicitly without regard to economic cost, and considered stringent enough to prevent injury. Secondary standards were designed to prevent negative effects on public welfare that were not directly health related, and included economic and aesthetic considerations (e.g. diminished soil or water productivity, reduced visibility).

The Environmental Protection Agency (EPA) was also instituted in 1970 with the former Assistant Attorney General William D Ruckleshaus as its first administrator. The EPA was developed in part to undertake the provisions of the CAA, and it published its

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<sup>47</sup> Sulphur Dioxide, Carbon Monoxide, Nitrogen Oxide, particulates, hydrocarbons, and photochemical oxidants. A standard was also later established for lead (Liroff 1986:21).

initial ambient air quality standards in April 1971, giving state governments nine months to prepare Statutory Implementation Plans (SIPs). These plans were to detail how the state would bring areas that were currently in non-attainment with the NAAQS into attainment, and how areas already in attainment would have that level of air quality maintained. Several additional constraints were placed on the states with respect to their SIPs. First, and most importantly, the statutory deadline of May 31<sup>st</sup> 1975 was set for attainment of the primary standards. Second, states had only nine months to develop SIPs and submit them to the EPA for approval. Third, new stationary sources of emissions were to be subject to New Source Performance Standards (NSPS).

The NSPS emphasised 'control by technological input' (Cook:1988:36) and they were intended to force polluters to develop new, but achievable technology in order to attain ambient standards. Alongside these standards for 'stationary sources', the subcommittee on Air and Water Pollution of the Senate Public Works Committee - chaired by Senator Muskie - would amend the CAA to include standards for 'mobile sources' (from cars). Muskie took standards developed by the Department of Health, Education and Welfare for exhaust emissions for hydrocarbons, carbon monoxide and nitrogen oxides that were due to come into effect in 1980. Muskie brought this deadline forward to January 1<sup>st</sup>, 1975 under the CAA, bring this closer in line with the deadline for attainment of the primary standards for 'stationary sources' later in the year (Bollier & Claybrook 1986:102-103).

As further environmental regulations were developed the role of the EPA was expanded, and for the first time in US history, the diverse multiplicity of numerous environmental and polluting concerns was considered under the aegis of a single political object, 'the environment'. In fact, Nixon had attempted on several occasions to institutionalise the relationship of energy and environmental regulation through the development of a joint energy and environment department, but this was continually rebuffed by a truculent congress, resulting in the Nixon administration implementing the EPA with a sole environmental remit. By 1977 seventeen new social and environmental regulatory agencies had been created. From 1970 to 1977 the aggregate budgets of these increased from an estimated 1.5 billion USD to 7.3 billion USD (Andrews 1984), and these new agencies oversaw more than a dozen major new

regulatory statutes, involving an approximate tripling of the pages in the federal register (Miller & Yandle 1979).

As part of the unprecedented increase in the amount and scope of social and environmental regulation from 1970 onwards, the CAA was deeply unpopular with industries that found themselves both newly regulated, and under increasing international competitive pressures. Business responded to these events by lobbying against both individual pieces of legislation and the increase in regulation as a whole (Meidinger 1985:468). The “Muskie numbers” for car emissions as they were known were vigorously attacked by US auto makers (Bollier & Claybrook 1986:103). Of course, this lobbying actually began before the bill was passed, as evidenced by Lee Iacocca the Vice President of Ford, who warned, during the debate over the passage of the 1970 CAA, that if the bill were to become law US auto production could come to a halt after January 1<sup>st</sup> 1975. And even if production were to continue, the CAA would force ‘huge hikes in car prices and do irreparable damage to the American economy’ (Iacocca, cited in Porter and van der Linde 1995:107).

Bailey (1998:167-168) argues that industries affected by the legislation (e.g. automobile, steel and energy) rapidly developed a four-pronged response to challenge the new legislation. First, they highlighted putative costs of compliance, following the auto-industry lead, and argued that air pollution controls were responsible for higher prices and unemployment (see also Jones 1975:248-249). Second, they advocated for a pro-industry stance from the Nixon administration. Nixon, ever the paragon of principle, immediately responded by creating the National Industrial Pollution Control Council (NIPCC) by executive order in 1970 under the Department of Commerce. The NIPCC provided privileged access to the business leaders that composed it, and in defiance of federal laws, was closed to non-members. It was widely seen as a back-door for business lobbying against environmental action and immediately set about undermining and challenging the EPA (Andrews 1984:63). Third, affected industries challenged regulations in the courts, with automakers suing the EPA after a petition to delay emissions standards was ignored by EPA administrator William Ruckelshaus (Bollier & Claybrook 1986:103). Fourth, they sought to persuade Congress to amend the law and sympathetic legislators began to introduce amendments designed to weaken legislation.

This concerted attack on the new environmental legislation, and the newly formed agencies instituted to implement it, certainly achieved success in terms of deadline delays, at least for auto standards (Bailey 1998:168-169; Bollier & Claybrook 1986:103), but this critical, anti-environmental backlash was rapidly overtaken by a new popular concern. Although not wholly swept away, the industry organised response to the growth of limits would have to contend with the explosive new fear of the limits to growth.

### *The antigrowth movement*

Boulding's Spaceship Earth launched a raft of further books and studies examining the relationship between economic growth and the environment. Increasing debate on and development of the notion of hard ecological limits to economic growth focused on the wasteful lifestyles of people in modern economies, and maintained that these lifestyles must be changed in order to safeguard the planetary ecology. As Pearce maintains, '[g]radually, the unsustainable lifestyle issue became synonymous with the pursuit of economic growth, and the antigrowth movement was born' (Pearce 2002:60). Within the economics discipline, the long-term feasibility and even desirability of economic growth, settled in 1963 by Barnett & Morse, was subject to attack in the wake of Boulding's well-publicised work (Perez Carmona 2013: 88-89). In 1967, the British economist Ezra J. Mishan published *The Cost of Economic Growth*<sup>48</sup>. Here he condemned the 'growthmania' of economics and politicians, and with the exasperated air of a curmudgeon, pointed out the costs of growth:

Our environment is sinking fast into a welter of disamenities, yet the most vocal part of the community cannot take their eyes from the trade figures to remark the painful event... In the endeavour to arrest this mass flight from reality into statistics, I hope to persuade the reader that the chief sources of social welfare are not to be found in economic growth per se, but in a far more selective form of development which must include a radical reshaping of our physical environment with the needs of pleasant living, and not the needs of traffic or industry, foremost in mind. (Mishan 1967:32)

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<sup>48</sup> This book expands on brief comments made by Mishan in a 1960 review of A.N. Agarwala and S.P. Singh's *The Economics of Underdevelopment* (1958). Here Mishan stated: 'The precondition of sustained growth is sustained discontent' (Mishan 1960:194). Although completed in 1965, before Boulding's Spaceship Earth piece, Mishan was unable to find a publisher for *The Cost of Economic Growth* until 1967.

In 1968 Paul Erlich, who had been greatly influenced by the postwar works of Fairfield Osborn and William Vogt (Desrochers & Hoffbauer 2009), published *The Population Bomb*, reinvigorating a neo-Malthusian discourse concerned with population growth and the absolute scarcity of resources. This was followed in 1970 by the publication of Yale University lectures given to the School of Forestry as part of a 1968-69 symposium on 'Issues in Environmental crises'. Published under the guidance of Visiting Professor and former Secretary of the Interior Stewart L. Udall<sup>49</sup>, *The Environmental Crisis* included contributions from Ehrlich and Kenneth Boulding - with the latter presenting a critique of GNP from his Spaceship Earth perspective, and reiterating the importance of pollution over resource exhaustion:

Resources for the Future says, "We're all right Jack. We've got a hundred years." Its report points to our fossil fuels and our ores, and reassures us that they will be adequate for a century. After that, the deluge. I would not be a bit surprised if we ran out of pollutable reservoirs before our mines and ores are exhausted. There are signs of this happening in the atmosphere, in the rivers, and in the oceans. (Boulding 1970:164)

The same year that Simon Kuznets published his *Economic Growth of Nations* (1971), within the nascent field of ecology, Howard Odum's *Environment, Power and Society* (1971) showed again the importance of waste product buildup in closed environments, and this aspect of pollution was located with respect to the laws of thermodynamics by Barry Commoner in his widely read text *The Closing Circle* (Odum 1971; Commoner 1971). Alongside these analyses, Joseph Schumpeter's student Nicholas Georgescu-Roegen published *The entropy law and the economic process* (1971). Georgescu-Roegen's own student, Herman E. Daly (1971), developed his notion of the 'stationary-state economy' again that same year, and these attacks on 'the economy' as a dematerialised object capable of infinite growth were joined by a Cowles discussion paper by William D. Nordhaus and James Tobin entitled *Is economic growth obsolete?* (1971). The latter was published by the National Bureau of Economic Research a year later and began as follows:

A long decade ago economic growth was the reigning fashion of political economy. It was simultaneously the hottest subject of economic theory and research, a slogan eagerly claimed by politicians of all stripes, and a serious objective of the policies of governments. The climate of opinion has changed dramatically. Disillusioned critics indict both economic science and economic policy for blind obeisance to aggregate material "progress," and for neglect of its costly side effects. Growth, it is charged, distorts national priorities, worsens the

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<sup>49</sup> Udall was Secretary of the Interior from 1960-1969.

distribution of income, and irreparably damages the environment. Paul Ehrlich speaks for a multitude when he says, "We must acquire a lifestyle which has as its goal maximum freedom and happiness for the individual, not a maximum Gross National Product." (Tobin & Nordhaus 1971:1)

## The environment and The Limits to Growth

By the beginning of the 1970s, the concept of national efficiency and the benefit-cost techniques that sought to establish this as the means to evaluate federal environmental - particularly water - development projects, had been widely contested on the grounds that they failed to incorporate environmental impacts into their calculations. At the same time, the unforeseen side effects of the growth of the economy, in the form of widespread pollution, become an important matter of political concern, and the certainty and logic of economic growth itself - established through the abolition of absolute resource scarcity by economists from RFF - had come to be seen as the very engine of this concern. From 1966 and the publication of Boulding's Spaceship Earth essay, through to the late 1970s, an increasingly vociferous counter narrative to the limitless growth of the economy was established within the heterodox economics establishment, ecology and broader academe. And to quote Fischer-Kowalski:

In these approaches the material and energetic flows between societies (or economics) and their natural environment became a major issue, governed by a worry that a "cowboy economy" might not be compatible with "Spaceship Earth"... The common picture of cultural evolution as eternal progress started to give way to a picture of industrial economic growth as a process that potentially implied the ultimate devastation of human life. This must be considered as a basic change in worldview, and it took hold of a wide range of intellectuals across many disciplines. (Fischer-Kowalski 1998:70)

In spite of the breadth and depth of the antigrowth critique, made by well respected and influential scientists and economists, the late 1960s-early 1970s debate over growth remained a predominantly academic one (Perez-Carmona 2013:89) until it was brought to wider public attention with the publication in 1972 of the Club of Rome sponsored Limits to Growth Report (Meadows, et al. 1972). With the publication of this report, the antigrowth perspective became a widespread public and popular discourse (Arndt 1978; Hamblin 2013; McCormick 1995). The Club was an informal think tank comprised of thirty economists, mathematicians, engineers, natural scientists,

philosophers, civil servants and businessmen who had first gathered in Rome in 1968 under the auspices of a leading manager at the firms Olivetti and Fiat, Dr Aurello Peccei (Kula 1998:136). The remit of the group was to consider the future problems of humanity, and to this end, they commissioned the MIT systems theorist and modeller Jay Wright Forrester and later a team from MIT led by the young assistant professor of management and systems dynamics, Dennis Meadows. Forrester developed a model, utilising the new technology of computer simulation and capitalising on Boulding's concept of the Spaceship Earth, that could examine what he and his team considered were the five basic factors that limit economic growth: population growth, agricultural activity, natural resource availability, industrial activity and pollution (Kula 1998:133).

Using figures drawn from Kuznets' *Economic Growth of Nations* and the US Bureau of Mines 1970 report *Mineral Facts and Problems*, *The Limits to Growth* described how the quality of life will decrease progressively as economic growth and population numbers increase, and therefore '...economic growth, with or without growing human numbers, is not only a questionable benefit, it is potentially harmful—even disastrous' (Kula 1998:136). In order to save this situation, *The Limits to Growth* recommended the implementation of a series of specifically antigrowth targets, including:

...30 per cent reduction in birth rates; 50 per cent reduction in pollution generation; 75 per cent reduction in natural resource depletion; 40 per cent reduction in capital formation; 20 per cent reduction in food production, as it fuels population growth' (Kula 1998:135)

The first results of the report were circulated in early 1971, and were analysed by a special ecological commission of the Italian senate. *The Ecologist* magazine released an advanced copy of the report in January 1972, and the final results were published in May 1972 to coincide with the United Nations Conference on the Human Environment in Stockholm. This ensured that the apocalyptic vision of the *The Limits to Growth* represented a watershed report on the grounds that it incorporated both resource depletion and pollution into its analysis - developing the world's first integrated assessment model (Barry 2007; Calel 2011). The Club of Rome followed up this report with a second study, *Mankind at the Turning Point* (Mesarović and Pestel 1974), which was less pessimistic than the first (Kula 1998:144), but by this time the limits literature had been bolstered by the popular and influential *Small is Beautiful* (1973) by the economist E. F. Schumacher, alongside collections of essays published

by Daly and Kenneth N. Townsend entitled *The Steady-State Economy* (1973 [1993<sup>50</sup>]) and Mancur Olson's and Hans Landsberg's RFF sponsored collection *The No-Growth Society* (1973).

In 1974, Nordhaus drew from both Boulding's metaphor of cowboy economies as well as energy reserve figures produced by M. King Hubbert in a piece in the *American Economic Review*. Here he argued that limits theses should be taken seriously and that atmospheric pollutants and the greenhouse effect could constrain economic growth before physical scarcity would become a problem (Nordhaus 1974a). This overall critique was further bolstered in 1977 with the publication of Daly's *Steady-state economics*, and Mishan's *The economic growth debate*. And Hubbert himself in 1976 extended his Peak Oil Thesis to the notion of economic growth in general, and argued, in an essay entitled *Exponential Growth as a Transient Phenomenon* (1976[1993]) that humanity was currently in a transitional state characterised by exponential growth. Shifting to a sustainable no growth future required neither new energy or material resources or new physical and biological knowledge, but it did require a massive cultural shift:

Our principal constraints are cultural. During the last two centuries we have known nothing but exponential growth and in parallel we have evolved what amounts to an exponential-growth culture, a culture so heavily dependent upon the continuance of exponential growth for its stability that it is incapable of reckoning with problems of non growth. (Hubbert 1993:125)

On May 14<sup>th</sup> & 15<sup>th</sup> 1973 the EPA hosted a National Conference on Managing the Environment, held in Washington, D.C. Conceived as a forum within which the problems that had developed regarding the coordination of environmental management could be addressed by public officials and private managers. In his opening address to the conference, acting administrator Robert W. Fri outlined the central concern then vexing the EPA:

It is particularly important to examine critically the great American shibboleth known as growth. It is our own special sacred cow, and in its most exaggerated form it makes environmental management difficult if not impossible. It is the antithesis of stability... We may have to make do - indeed, we must learn to want to make do - with smaller cars, with less energy, with recycling our wastes

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<sup>50</sup> Republished under the title *Valuing the Earth* (1993).

instead of throwing them in the city dump, and adjusting the size of our families to responsible norms. (EPA 1973:6-7)

Fri went on to further develop this ecologically founded concern with the material world throughout his address, but ended on an upbeat note when in finishing he claimed that 'I believe we will realize once again our true dependence on the biological world. Environmental attitudes will be built-in, so to speak, not a topic for debate or study but a way of life' (EPA 1973:7). A concern with the question of growth was shared at the conference through the circulation of a speech delivered in October 1972 by the EPA's first administrator William Ruckelshaus, who just one month before the conference had departed from the EPA in the wake of Nixon's political demise. Ruckelshaus' focus would similarly echo the language of closed ecological systems, spaceman economies and the limits to growth. Within the Spaceship Earth, the finite limits first indicated by Boulding, and later by the antigrowth movement popularised by the Club of Rome, would inadvertently take President Nixon's 'great question of the '70s' to heart, and place the environment fundamentally at odds with the economy (Mitchell 2011). This opposition would not last.

## 7. The nature of growth

In 1975, almost exactly two years after the 1973 EPA conference, On May 12<sup>th</sup> 1975, the then EPA administrator and former President of the Council on Environmental Quality (CEQ), Russell Train gave the first pronouncement on a new concern for environmental regulators in a letter sent to Senator Muskie. While the Senator was still focused on producing stringent environmental legislation, no longer was former administrator Robert Fri's concern with the harmful impact of economic growth on the environment the sole or even the central focus of the EPA. Instead an urgent fear of environmental regulations' harmful impact on economic growth had taken hold:

Under the existing Clean Air Act, if a national ambient air quality standard for any pollutant is being exceeded in an air quality control region after the attainment date, then no further construction or expansion of sources of that pollutant could be permitted in that region. This provision of law coupled with the fact that a substantial number of regions did not attain one or more of the standards on time posed a dilemma for the Committee. On the one hand, protection of the public health remains the predominant goal of the Clean Air Act and the Committee. On the other hand, a complete prohibition on new growth or expansion in non-attainment regions would pose very serious problems. The economic impact on certain urban areas of such a growth ban could be quite harmful (Train 1975).

The growth ban referred to here, with the imminent May 31<sup>st</sup> deadline for US states to attain the air quality standards (NAAQSs) of the CAA, seemed to lay bare the inherent conflict between economic growth and environmental protection with the 'regulatory unreasonableness' (Bardach & Kagan, 1982) of the uniform air quality standards of the 1970 CAA imposing an unacceptable cost burden upon America's energy and manufacturing industries. The growth ban did not however, simply provide the graphic, real-world evidence of certain immutable economic laws on the inefficiency of government regulation. In spite of the claim by Pérez Henríquez that economic development 'was clearly being hampered by environmental regulation' (2013:51), the reverse of this is more accurate. Where states did not meet the 1975 deadline, and most did not, it was the regulatory deadline that was deferred, not growth (Meidinger 1985:453). The apparent crisis represented by the growth ban was also strangely

invisible to the American public, with no references being made to it in the Washington Post or the New York Times during the whole of the 1970s<sup>51</sup>.

With respect to at least one aspect of growth - employment - the effects of regulation on both job losses at existing installations and potential jobs lost from the failure of new operations were likely small through the entirety of 1971-1982 (Tietenberg 1985:95-96). In fact, if job gains within industries producing pollution control equipment are taken into account, the overall impact of the regulations on employment were positive (Portney 1981; cited in Tietenberg 1985:96). But neither is the growth ban simply a legitimising fiction - Russell Train's concern in 1975 was certainly real enough. As environmental economist and long time RFF associate Thomas Tietenberg claimed in the second edition of his highly influential *Emissions trading: an exercise in reforming pollution policy*, the 1975 deadline resulted in the still young EPA facing a political and industrial backlash that required serious consideration of the crucial question: 'Was it possible to solve the air quality problem while allowing further economic growth?' (Tietenberg 2006:7).

In this penultimate chapter, I investigate not how this question came to be answered, but how it came to be seen as crucial in the first place. What would fundamentally change the EPA's perspective on economic growth and environmental pollution? And how would Robert Fri's core concern with the harmful impact of economic growth on environmental stability be converted into Russell Train's equally urgent concern with environmental regulations' harmful impact on economic growth? Here I highlight the importance of two transformations. In the first instance, energy, which as I showed in chapter 4 was settled through the 1950s and 1960s as a dematerialised, stable system, was suddenly made to look fragile and crisis ridden from 1969 onwards. The reason for this sudden fragility was fairly well recognised at the time, although this explanation has been evidently lost to the mists of time and the fog of economic obfuscation:

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<sup>51</sup> Indeed there is only one reference, in either of these papers throughout the whole of the 70s, 80s and 90s, and this is in 1983 in the Washington Post. Similarly, the first explicit references to the growth ban would not appear in the academic literature until the publication of books by Richard A. Liroff (1986) and Brian J. Cook (1988).

The so-called energy crisis in the United States is nothing more or less than a well-coordinated attempt by the oil companies (now the “energy companies”) to extort higher prices and profits from the consuming public for all energy and fuel resources in order to maintain their profit margins, once dependent on total control of low-cost crude oil in the Middle East and elsewhere.’ (Stork 1975:125)

Or, as Allan Hamilton, then treasurer of Exxon (previously Jersey Standard) made clear in 1972: ‘Unless and until the real nature of the crisis is understood, and profit levels become such that the industry is confident that its investments will bear fruit, the supply of energy required will not be forthcoming’ (Hamilton, cited in Stork 1975:125). The energy companies, newly developed over the 1960s (as detailed in the last chapter), were seeing their profits from oil production squeezed by the increasingly powerful OPEC cartel. In order to raise oil prices, while preventing a switch away from oil towards the other, cheaper, fuel sources that comprised the system of energy, they constructed a broader energy crisis. Suddenly reserve figures that had been steadily growing through the 1950s and 1960s peaked and started to decline.

M. King Hubbert’s peak oil estimations for the US were suddenly accepted as the price of foreign oil was brought up to US prices by the OPEC embargo. Industry developed natural gas reserve estimations started to shrink from 1968 and coal prices skyrocketed due to the massive concentration and interlinkages within the new energy industry. As the energy crisis, manufactured to maintain high profit margins in the energy industry, started to impact on the growth of the US economy - already under pressure at the beginning of the 1970s - a second transformation was already being undertaken. The environment, which as I showed in chapter 5 had developed through the 1960s and early 1970s as the limited and closed ecosphere of Boulding and the antigrowth movement, was reconstructed through the effort of RFF economists.

## The sudden fragility of energy

Beginning in 1970, a series of major US policy modifications enabled the importation of increasingly greater volumes of oil to the US from the Middle East. This resulted in the increasing price setting power of OPEC and by 1973 foreign oil prices had been raised to the price level of domestically produced crude and in 1973 Nixon scrapped the mandatory import quota system in favour of a series of tariffs (Bowden 1982:440,

1985:230). Just five months after the *Managing the Environment Conference*, On the 16<sup>th</sup> October 1973, OPEC states decided to raise the posted price of crude oil by 70 per cent. This action came about after a month of failed negotiations in Kuwait with the world's oil companies, and was designed to restore tax rates that had been eroded over the previous two years by rising oil prices and high inflation rates. The next day, Arab gulf states announced a 5 per cent reduction in the production of their oil in response to the US' obstructive role in the Arab-Israeli conflict. Moreover, production was to be reduced by 5 per cent a month until Israel removed its forces from the territories occupied in the June 1967 war. As Mitchell notes (2011:184-185), these two separate events are frequently run together as the 'OPEC embargo' or oil crisis of 1973-1974, and while the actual impact this had, if any, on the overall supply of petroleum and petroleum products to the US is difficult to gauge with any certainty (Mitchell 2011:175), the impact on the psyche of US and Western consumers is well known. As the supply from Arab states was reduced the oil price rose, and the US economy - already under pressure from the ongoing cost of the Vietnam war, the increasing US trade deficit since 1967, and the breakdown in the postwar Bretton Woods agreement in 1971 - saw its growth stall.

Enormous queues for petrol at the pumps in the US, and daily price hikes against a background of inflation and economic slowdown delivered an object and indeed abject lesson on both the principles of neoclassical economics and oil politics to the American people (Mitchell 2011:173). But these lessons did not just arrive on the back of what would later be characterised as Arab intransigence. Instead they should be seen as part of a concerted effort by oil producers and the Nixon and Ford administrations to reconstruct energy in the late 1960s and early 1970s. At this point, energy was converted from a stable system - removed from its particular mineral components through the work of the Paley commission, RFF economists in the 1950s and 1960s, and materially through the conversion of the oil companies themselves into energy companies - into one that was increasingly fragile, vulnerable, and from 1969, in crisis.

### *The energy crisis*

The head of the Federal Power Commission (FPC), John Nassikas predicted in testimony before the Senate Interior Committee on November 13<sup>th</sup> 1969, that the country was facing a deepening natural gas crisis, and that the policies of the FPC should be redesigned to enable greater levels of production (Stork 1975:129). But by the 10<sup>th</sup> August 1970, Nassikas would give a speech at the National Press Club that publicly announced the arrival of not just of a natural gas supply crisis, but of 'The National Energy Crisis'. Nassikas informed his audience that the previous two years of electrical shortages suffered by large US cities, were due, not simply to delays in installing power generation and transmission facilities, but to an overall lack of fuel. Nassikas went on to warn that the nation could shortly be headed for energy rationing, including the potential necessity of manufacturing stoppages, and he maintained that the long-term solution to this crisis lay with the development of nuclear power. In the short term however, he recommended that government regulation, including that focused on anti-trust issues, would have to be relaxed (Mitchell 2011:177-178).

In chapter four we saw how the oil industry developed into the energy industry in part through the international oil companies purchasing controlling interests in the competing energy sources of coal, nuclear, gas and even geothermal. This increased the concentration of energy resources in the hands of a relatively small number of the new energy companies. This allowed these companies greater leeway with respect to price setting and manipulation (Stork 1975:123), and precipitated the natural gas crisis, which began in 1968, when the oil industry decided to remove the control of natural gas prices by Nassikas' organisation, the FPC (Stork 1975:125).

Thirty years previously, in 1938, Congress passed the Natural Gas Act. Covering the inter-state transportation and sale of natural gas, it required that the rates charged be '...just and reasonable, non-discriminatory, and publicly posted' (Stork 1975:125). 1954 saw the Supreme Court rule that the FPC had jurisdiction over sales by producers to interstate pipelines under the Act. As Stork highlights (1975:125-126), the FPC's attempt determined on a company-by-company basis a 'cost-plus-fair-return' massively overwhelmed the administrative capacity of the agency, and subsequently prices began to be approved without much regard to their reasonableness. In an attempt to rectify this state of affairs and cap the resultant spiralling gas prices, the

FPC initiated in the early 1960s an 'area rate method', whereby aggregate data on gas production costs for a regional area were generated, and then used to determine a cost-plus-12 percent price rate for all producers in that area. This pricing regime was challenged in court by industry, but was upheld by the Supreme court in 1968, although it would be increased to a rate of cost-plus-15 percent. This was not enough.

Natural gas producers - largely owned by the oil industry argued that government price regulation at the producing end on the basis of cost-plus-15 percent did not provide a large enough incentive for companies to explore for and develop new reserves in order to meet growing demand (Stork 1975:127). At this point a sudden change occurred in the gas reserves estimations. Industry figures began to show that annual production was now exceeding annual additions to reserves and that the reserves/production ratio had declined from a range of 15 to 19 per cent in the mid 1960s to 11.3 percent in 1971. In 1967 year end gas reserves were measured at a high of 289.3 trillion cubic feet (TCF), but these had dropped by 14.5 per cent to only 247.4 TCF by 1971. These figures were produced by the American Gas Association (AGA) - the industry body. There were no independent government gas reserves figures, and neither were the reserve figures open to inspection by the FPC. The lack of transparency was maintained here on the grounds that the figures were confidential and proprietary - an obviously specious claim, given that rival gas production companies were not restricted from using the figures, and the AGA personnel who compiled these were in the employ of the various gas producers themselves.

As Stork argued as early as 1975, there was no evidence to suggest that the natural gas crisis was anything other than an industry contrivance designed to increase prices. Gas reserve figures dropped inexplicably at the beginning of 1968, then continued their downward trajectory after this point, and this bore no relation to drilling efforts whatsoever. Stork notes that in southern Louisiana and other prime producing locations there was more successful well footage drilled in 1969 than in any year since 1962 (1975:128), and as FTC antitrust chief James Halverson stated with respect to industry figures in testimony before the Senate Antitrust Monopoly Subcommittee in 1973:

...the estimates of proved reserves for a given lease that are reflected in in-house reports... were primarily used for tax purposes, have been found to be lower than the estimates of proved reserves that are used for other in-house purposes such as decisions whether to build a drilling platform on a tract or to sell reserves to a pipeline company. (Halverson 1973, cited in Stork 1975:129)

Moreover, companies argued that the FPC mechanisms resulted in natural gas being sold at too low a price, thereby encouraging wasteful use, and hastening the supply 'crisis' that Nassikas had predicted four years earlier:

I predicted on November 13, 1969, at the first policy hearing on natural gas before the Senate Interior Committee, that there was a deepening gas crisis, that we had to do something about it, and that policies of the FPC should be designed to elicit more supply of gas, better allocate resources, and to amend its policies of pre-existing Commissions to meet these objectives. (Nassikas 1973, cited in Stork 1975:129)

The something that the Nixon White House, Interior Department and FPC chose to do about it, was a de facto deregulation of gas prices. Producers were allowed to increase prices without challenge, authorised by FPC staff and legal counsel with conflicts of interest so manifest as to border on parody<sup>52</sup>.

### *Energy price rises*

The oil industry wanted to increase energy prices across the board however, and so the fuel crisis rapidly spread. With respect to coal prices, these were stable between 1960 and 1965, but due to increasing demand by the electric utility sector prices had risen 22 per cent above the 1960 level by 1969. However, following the oil industry's expansion into coal and the mergers and acquisitions that took place in the mid-to-late 1960s, coal prices had risen by 60 per cent and over 100 percent in some US states just one year later (Stork 1975:123-124). This massive hike in prices bore the mark of the oil companies' disdain for market forces and the economists' laws of supply and demand. Between 1969 and 1970 production increased only 5 percent and total

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<sup>52</sup> e.g. FPC commissioner Rush Moody and general counsel Gordon Gooch were both former lawyers at Houston law firms whose major clients were the very same oil companies they were now in charge of regulating (through their ownership of gas production). See Stork (1975:129-131).

steam consumption had increased only 1.6 percent (Stork 1975:124). It was clear that an increase in demand relative to supply was not driving coal prices steadily upwards, and as an economic analysis by the antitrust division of the FTC concluded at the time: 'the sharp increases in coal prices in 1970 were made primarily to enhance the profits of the coal companies or their parents.' (cited in Stork 1975: 124). At the same time as they were inflating prices through the fiction of a supply shortfall, the energy companies were restructuring the coal market from spot and short-term sales to long-term contracts at prices reflecting this fictional coal shortage (Stork 1975:124).

A further way in which the oil industry helped stoke an apparent crisis in energy production was through the increase in estimates of future demand (Mitchell 2011:180). This was undertaken through the US National Petroleum Council's (NPC) inflated estimation of future energy consumption in 1972 (de Marchi 1981:408; Mitchell 2011:180). The Interior Department had requested this report from the NPC, and here the Council predicted that the US' primary energy consumption would double to 125 quadrillion BTUs by 1985. The actual energy consumption for 1985 was 76.4 quadrillion BTUs<sup>53</sup>. After the 1973-74 oil embargo, similarly inflated estimates would be produced by the Federal Energy Administration's (FEA) 'Project Independence' research group, and I will go into more detail about 'Project Independence' and its impact later in the chapter.

It was against this backdrop that the large international oil companies could safely begin to raise prices in order to offset losses due to the increasing mobilisation of OPEC nations<sup>54</sup>, without fear of a disruptive shift to alternate energy sources by municipal governments, manufacturing and federal government policy. Subsequently, the 1973 oil embargo would result in a windfall that not even the oil industry had expected, quadrupling the price of oil by 1974 and far exceeding the highest price predicted by the NPC in 1972 (Bowden 1985:230). What the industry also didn't expect was the popular and political backlash against this windfall. The energy née oil industry was suddenly forced to justify these price rises, and it did this through a rehabilitation of Hubbert's Peak Oil Thesis. In 1971, oil companies abruptly abandoned

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<sup>53</sup> Figures from United States Energy Information Administration. Available at: <http://www.eia.gov/beta/MER/?tbl=T01.01#/?f=A>.

<sup>54</sup> which at the end of the 1960s now also included Qatar (1961), Indonesia (1962), Libya (1962), the United Arab Emirates (1967), Algeria (1969).

their previous cornucopian estimates, and in line with Hubbert, and following the approach they had already taken with respect to natural gas reserve estimates they began forecasting the end of oil (Bowden 1985; Mitchell 2011:189). This abrupt shift was made possible as increasing OPEC price control and the impact of the embargo on global oil prices meant that the oil majors were no longer reliant upon the types of domestic US price support that I detailed in chapter 4. The shift was also made necessary as continued large reserve estimates undermined the ability of the oil industry to justify its high prices (Bowden 1985:230-231).

A clear example of this shift took place in March 1974, when Vincent McKelvey, then chief geologist at the United States Geological Survey (USGS) released a new estimate of oil reserves to the Senate Committee on Interior and Insular Affairs. McKelvey was, as I showed in chapter 4, an advocate of price-based reserves calculations in opposition to Hubbert, and leaked an anonymous USGS report in 1963 which estimated US reserves figures at 590 billion barrels, three times greater than Hubbert's contemporaneous estimate of 200 billion. Although McKelvey's 1974 estimate was lower than his previous figures, it was still immediately and publicly challenged in a letter by John Moody, the then Vice President of Mobil Oil. Moody, who sent copies of his letter to influential Senators, the National Academy of Science and the Journal *Science*, alleged that McKelvey's figures were ten times higher than any that could be justified by Mobil.

The public uproar that followed resulted in the development of a conference later that year by the National Academy of Science's Panel on Estimation of Mineral Resources. Here, the Academy would follow the oil industry's new, lower estimates and in September of 1974, the USGS produced new estimations, in line with other, lower estimates made that year (Bowden 1985:223). In 1977, the incoming Carter administration would unusually force the resignation of McKelvey. The following week Hubbert would be given the prestigious Rockefeller Public Service Award for his persistence in attempting to bring the 'energy crisis to public attention' (Bowden 1985:211)

Eight months before he would write to Senator Muskie proclaiming the Environmental Protection Agency's new concern with the effect of the air quality provisions of the

1970 CAA, Russell Train addressed the New York Chamber of Commerce on the 3<sup>rd</sup> October 1974. In this address, Train clearly recognised the energy crisis, but even in front of an audience for which you might have expected the administrator of the EPA to soft-pedal an antigrowth environmental message, he did not do so. He took pains to highlight that the EPA's environmental programmes were not costly and not drivers of inflation, but that '[i]n no small measure, our energy, environmental and economic problems reflect the fact that we are living beyond our means' (Train 1974). That is, the concurrent energy and environmental crises were still taken to represent the outcome of an unalloyed focus on growth, and: '[a]bove all, we must develop new values which match the new needs of our times, values which recognize that growth simply for the sake of growth is no longer enough - that we must find ways to nourish our physical needs while promoting the quality of our lives' (Train, 1974).

What is clear here is that while the apparent fragility of the energy system is recognised, the goal of environmental protection is not fully reconciled with the goal of economic growth. This would be undertaken however, through the further spread of the tools of economic valuation of the environment, benefit-cost analysis, the development of the economic theory of Materials Balance and the construction of the discipline of environmental economics predominantly by RFF funded scholarship.

## The environment of economics

In the early 1970s, the economic discipline's response to the social and political upheavals of the time was in danger, as Joan Robinson's 1971 Presidential address to the American Economics Association made clear, of rendering the profession an irrelevance (Robinson 1972). The new environmental regulation was perceived as having shut out economists and economic analyses from the burgeoning field of environmental policy implementation through the development of the EPA (Braadbaart 1998:138–139). Alongside this, the increasing propensity for intricate theoretical models with little real world basis, or as David Pearce put it in 2002 with respect to growth theory, 'elegant if demanding treatises' (Pearce 2002:59), combined with the depredations of a popular environmental movement that attacked precisely the discipline's sovereign ground - economic growth. The fear of irrelevance would not last for long however. In fact, developments in environmental valuation from the middle of the 1960s had, at the beginning of the 1970s, been brought together under the rubric

of the Materials Balance approach which would form the basis of the nascent discipline of environmental economics.

#### *Water quality and the expansion of economic valuation*

As I argued in the last chapter, there was a critical examination of large-scale water resource projects by conservationists throughout the 1950s and 1960s, and here the Bureau of the Budget's mandated focus on national efficiency - in an attempt to curtail 'pork-barrel' spending at the state and regional level - resulted in benefit-cost analysis being cast as a villainous and anti-environmental technique. However, rather than simply undermining this particular economic technology the conservationist backlash would itself spur the rapid development of the theoretical benefit-cost literature, where this development focused on the inclusion of environmental impacts as potential benefits or costs within the scope of benefit-costs analysis, and which maintained that; '[i]n principle, the influence of a market might be simulated, to a first approximation, by introducing a set of shadow (or virtual) prices' (Ayres & Kneese 1969:291). These virtual prices were intended then to value environmental goods, and allow their commensurability with other goods under a common (monetary) unit of measurement. That is, there was a shift from considerations of pure economic efficiency to the broader economic valuation of the environment.

In 1965, the Harvard Water Program came to a close, after publishing its major output two years earlier (Maass 1962). RFF however, would respond in a different way to the conservationist challenge. In 1960, John Krutilla, who was then co-director of RFF's Water Resources Program with RFF president Irving Fox, hired Alan V. Kneese, assistant Professor at the University of New Mexico, to help develop a new research stream at RFF focused on water quality. This programme, responding to the criticisms of large dam projects, and the growing awareness of pollution issues in general, would be central to the development of a large and growing literature and commentary on the application of benefit-cost techniques beyond simple national efficiency. The new techniques developed in this literature enabled the quantification and economic valuation of an ever growing set of environmental benefits and costs, and Hanley & Spash (1993) identified three particular means of valuing the environment that were

initiated during the mid-to-late 1960s: The Travel Cost Method, Hedonic Pricing and Contingent Valuation.

The Travel Cost Method or 'Clawson-Knetsch approach' (Hanley & Spash 1993:83) is an attempt to value non-market environmental goods by measuring consumption behaviour in related markets and using these as a proxy. This was actually first developed by Harold Hotelling in a 1947 paper for the Prewitt report, commissioned by the U.S. National Parks Service. The purpose of the Prewitt report was to establish the worth of national parks which had no entrance fees, and Hotelling's method overcame the problem (of economic valuation, in the absence of entrance fees), by drawing on the differential distances travelled by visitors to the park, and therefore the differential costs associated with this travel. By treating travel costs as prices, Hotelling constructed a demand curve for recreational visits to a park where the area under the curve represented an estimate of the total consumer surplus that accrued to park visitors.

While Hotelling's paper first established this approach, it was ignored by the Parks Service. Indeed, the other contributors to the report agreed that the problem of the economic valuation of National Parks could not in fact be solved (Pearce 2002:66-67; Porter 1995:181). However, Hotelling's method was rehabilitated over a decade later when it was incorporated into a 1958 study of the recreational uses of the Feather River in California (Trice & Wood 1958) and subsequently by two RFF research papers by Marion Clawson<sup>55</sup>(1959) and Clawson and Jack Knetsch (1966). In their 1966 book *Economics of Outdoor Recreation* Clawson and Knetsch emphasised the development of methods and data required to measure the impact of environmental improvements with respect to outdoor recreation (Hanley & Spash 1993:6), and established the Travel Cost Method as a means to quantify the benefits of the new reservoirs created by the big dam projects of the mid 1930s through to the mid 1960s.

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<sup>55</sup> Clawson was an early member of RFF, joining the staff in 1955 after roles in the Department of Agriculture's Bureau of Agricultural Economics in the 1930s and 1940s, and then running the Department of the Interior's Bureau of Land Management from the late 1940s to the early '50s.

Hedonic Pricing, like the Travel Cost Method, is what is known as a 'revealed preference' technique. This refers to an individual's preferences for a non-market good being revealed through the inspection of other markets (Pearce 2002:67), frequently using land and housing market prices. In contrast to the Travel Cost Method however, Hedonic Pricing 'identifies environmental service flows as elements of a vector of characteristics describing a marketed good, typically housing.' (Hanley & Spash 1993:74). It derives from the 'characteristics theory of value' developed initially by Lancaster (1966) and assumes that the 'vector of characteristics' can be deconstructed in such a way as to isolate the environmental variable of interest. Early uses of Hedonic Pricing with respect to air pollution were undertaken by Ridker (1967) and Ridker & Henning (1967) and later Anderson & Crocker<sup>56</sup> (1971). Ridker (1967) was the first to establish a link between property prices and air pollution levels in a study based in St. Louis, Missouri. Undertaking a regression analysis on factors determining property prices, the figure Ridker obtained was the coefficient on air pollution (Pearce 2002:67).

The Contingent Valuation Method was originally proposed by Robert K. Davis, also at RFF, in 1963, in the *Natural Resources Journal* (Davis 1963). This brief paper summarised work from Davis' Harvard University PhD, submitted that same year. In short, Contingent Valuation involves directly questioning a sample of the consumers of a particular environmental service in order to determine how much they would either be willing to pay, or how much financial compensation they would be willing to accept for a specific change in the level of that service (Davis 1963; Hanley & Spash 1993:53). Contingent Valuation differs from the revealed preference methods of Travel Cost and Hedonic Pricing in that it purports to enable non-use values to be captured. That is, the utility derived from the existence of a recreational resource can be determined, even if the individual questioned does not actually avail themselves of that resource.

This approach was further expounded and clarified by John V. Krutilla's (1967) influential paper *Conservation Reconsidered* (Hanley & Spash 1993:5; Saxon 2003). As I outlined in the last chapter, Krutilla was central to the the late 1950s translation of the prosaic water-resource technology of benefit-cost analysis into welfare economics

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<sup>56</sup> Thomas Crocker would go on to make an important contribution to the economic theory of pollution trading.

- thereby enabling it to be made portable and moved to other areas of the federal government. In *Conservation Reconsidered*, Krutilla, as well as popularising the technique, was the first to include non-use values of an environmental amenity as part of an opportunity cost of the development (Pearce 2002:70; Hanley & Spash 1993:66).

The application and use of each of these valuation methods is anything but clearcut, and has indeed been widely contested<sup>57</sup>, but what these methods highlight is that a series of technical innovations to benefit-cost were undertaken during the 1960s in an attempt to put a price on previously unvalued aspects of the environment. These changes were, at least initially, largely undertaken by RFF economists and scholars associated with the organisation, and the expansion of valuation techniques were produced within the new Water Quality Program established by Alan Kneese, John Krutilla and Irving Fox. This shift from a focus on water quantity to water quality, and the attempt to include a wide raft of previously unquantifiable environmental 'goods' into benefit-cost analysis was largely undertaken in response to the initial conservationist backlash against benefit-cost techniques that had railed against the sole use of a national efficiency criterion as the means to justify or disqualify water projects.

Alongside this, the burgeoning environmental movement and increasing concern with pollution issues also drove the expansion of benefit-cost techniques through the inclusion of polluting effects as costs. This expanding literature became increasingly widely used throughout the federal government as a means to identify previously unquantified benefits and costs of environmental development projects. This both reinforced an understanding of the pervasive impact of the growth of the economy on the environment that arose with Carson's *Silence*, Boulding's *Spaceship* and then the Club of Rome's *Limits*, but at the same time began the rehabilitation of the economic concept of externalities. The new valuation techniques provided an ever growing corpus of quantified environmental externalities, while simultaneously helping to reinforce both the apparent validity and practical utility of both benefit-cost analyses and economics in general, to resource and environmental issues.

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<sup>57</sup> e.g. Adler & Posner 2001; Campen 1986; Sagoff 1990, 2004; Hanley & Spash 1993, Lohmann 2009.

Allen Kneese and Blair Bower published *Managing Water Quality* in 1968, which represented a comprehensive report of the RFF's Water Quality Program and presented a broad spectrum economic analysis of water projects within the overall US multiple-purpose water development programme (Kneese, 2011). This included use of the expanded environmental valuation techniques in order to quantify externalities, and justify least cost and economic efficiency perspectives. A year after this comprehensive assessment of water programmes, Kneese would, with the physicist Robert U. Ayres, present a new economic approach to not just water, but the environment in general, that would further rehabilitate an economic approach to the environment.

#### *Materials balance and pollution as externality*

In a paper entitled *Production, Consumption, and Externalities*, that first appeared in the *American Economic Review*, Robert U. Ayres and Allen V. Kneese (1969) presented their materials balance approach to the economic analysis of pollution. This approach was the first outcome from a new research programme focusing on environmental quality generally, directed by Kneese at RFF; and would be presented more fully in an RFF report entitled *Economics and the Environment: A Materials Balance Approach* (with Ralph C. D'Arge from the University of California) in 1970. The development of a broad programme on environmental quality for both Kneese and RFF is both indicative of, and formed a core component of, the new discipline of environmental economics from its resource-focused base at this time. Indeed, *Economics and the Environment* was in the vanguard of a slew of new texts, many driven by RFF research, that focused on precisely this - the economics of the environment (Pearce 2002, p. 59-60; Lane 2012). The Materials Balance approach also presented the basis for what, in the 1990s, would be carried out as material flow analyses of national economies (Fischer-Kowalski 1998:71).

More specifically, the *Materials Balance* approach itself should be seen as a response to the 1966 RFF forum on environmental quality organised by Allen Kneese and detailed in the last chapter. There he raised concerns about the lack of progress in the

application of welfare economics principles to environmental concerns, and importantly, the 1969 and 1970 *Materials Balance* texts take as their starting points the critiques of mainstream economic thought raised by E.J. Mishan and Kenneth Boulding respectively. In order to revivify the economic approach to the environment, which the publication of Boulding's thesis had helped throw into malingering doubt, Ayres & Kneese argued that the mainstream welfare economic perspective on externalities was wrong, and that these were indeed not the 'freakish anomalies' (1969:287) they had previously been supposed in the academic literature.

Following the work of Kapp (1950) the *Materials balance* approach showed that when the flow of materials through an entire economy, with inputs in the form of material resources and outputs in the form of final goods and ultimately residuals (pollutants), is considered, externalities are not exceptional but rather inherent to the economic process (Perez-Carmona 2013:89). Drawing from Ayres' experience as a physicist, and in line with the development of thermodynamic metaphors within the developing ecology literature, they argued that the economics discipline had failed to view production and consumption processes in a way that was consistent with the laws of the conservation of mass (Ayres & Kneese 1969:283). Following this, they claimed that uncompensated externalities must arise unless (1) all inputs are converted into outputs with the production of residuals; (2) all final outputs were utterly destroyed in the process of consumption; or (3) property rights are applied to all relevant aspects of the environment and these are subject to exchange in competitive markets. None of these conditions could be expected to hold as nature does not allow the destruction of matter, yet standard economic theory expects material objects to disappear into the void upon final consumption (Ayres & Kneese 1969:283-284; Fischer Kowalski 1998:71).

This understanding of externalities is wedded to a version of the Walras-Cassel general equilibrium model in order to formally display 'the "pervasiveness" of externalities associated with interrelationships between production, consumption, and environmental sectors when environmental (common property) resources are scarce and therefore have economic value but no price' (Kneese, Ayres & D'Arge 1970:82-83). They further incorporate the Materials Balance approach into a simplified model of the economy in order to show that such an approach can enable Pareto-optimal and therefore economically efficient operation by every sector defined (Kneese,

Ayres & D'Arge 1970:102-103). The purpose of the Materials Balance approach was to develop a theoretical consideration of residuals production by and within the economy, and as Fischer Kowalski maintains:

this contribution by Ayres and Kneese (1969) became a starter to a research tradition capable of portraying the material and energetic metabolism of advanced industrial economies. It was not "man" any more who was materially and energetically linked to nature, but a complex, well-defined social system (Fischer Kowalski 1998:72).

What Fischer Kowalski refers to as a 'well-defined social system' is in fact the economy, established as an independent entity as I showed in chapter 3. Kneese, Ayres and D'Arge would later make this explicit: 'The dollar flow governs and is governed by a combined flow of materials and services (value added)' (Kneese, Ayres & D'Arge 1974:54; cited in Fischer Kowalski 1998:72). What is interesting here is that at the same time as they recognise the material basis of the economy - an object that has been twice divorced from the environment: first through the application of relative price scarcity and the undermining of absolute resource limits, then through the development of energy as a system of interchangeable, and because of this, inexhaustible fuels - the notion of the environment is itself reconstructed. Environmental pollution, understood by Boulding as a pervasive problem of unlimited economic growth within a limited or finite global ecosystem, and therefore an issue fundamentally outside of the remit of mainstream economics, is reconstructed as an issue of economic externalities. Pollution is no longer the result of economic growth, but rather of a failure to adequately price an environment that does not allow the absolute destruction of matter upon economic consumption.

The rehabilitation of the welfare economics concept of externalities within the Materials Balance approach, and the synthesis of this with a general equilibrium model of the economy had the effect of bringing pervasive pollution fully in line with the economic theory of externalities. In doing so, this undermined the opposition of the environment and the economy central to Boulding's Spaceship Earth and *The Limits to Growth* approach and heralded the development of a fully fledged environmental economics, replete with a new understanding of the environment. This understanding crucially took the concerns highlighted by Boulding and the nascent anti-growth movement and yet translated them into a form that helped to secure the economy once more as a central matter of political concern. This defused the conflict between the environment and the

economy by undertaking a timely volte face on the environment and market failure. No longer is environmental pollution the clear indicator of the failure of markets and of a focus on economic growth. Rather, it is due to market failure - pollution results when markets are not implemented in order to adequately price the environment<sup>58</sup>.

The Materials Balance approach spread rapidly through both the discipline of economics and the wider policy making consciousness - the latter through its easy association with Garrett Hardin's highly influential Tragedy of the Commons argument in the journal *Nature* (Hardin 1968). Kneese himself, who was a well-known figure amongst Washington's environmental policymakers also enabled this spread, due to his frequent appearances before Congress at environmental hearings, and from 1972 via his relationship with Senator Peter Domenici and his staff, who was a member of the Senate's environmental affairs subcommittee (Kelman 1981:21). Further work in this vein was sponsored by RFF (e.g. Bohm and Kneese 1971), and by December of 1970, Materials Balance was referred to by Robert Solow as 'the economist's approach to pollution' - which was the title of his vice-presidential address at the annual meeting of the American Association for the Advancement of Science in Chicago (Solow 1971).

#### *The economics of the new environment*

Alan Kneese testified before a congressional committee on 'The Environmental decade' in 1970. Here he clearly espoused the environmental economics position, and argued that environmental and natural resource policy should be based on the sole criterion of economic efficiency (Sagoff 1990:3). Kneese began his testimony by outlining the approach that he saw as opposing his, namely, that there is a need for a new morality or ethic of the natural, and the development of a new set of values in order to avoid environmental despoliation. For Kneese, these claims simply show a 'lack of understanding of what some of the central problems are.' (Kneese 1970:191; cited in Sagoff 1990:4). Problems in fact arise, argued Kneese, because of the lack of property rights with respect to environmental resources:

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<sup>58</sup> Robert Ayres would actually come to recant this position later in his career, see e.g. Ayres (1996; 2001).

Our usual method for limiting the use of resources and leading them to their highest productivity employments is the process which are established in markets through exchanges between buyers and sellers. For common property resources this mechanism does not function...This idea has been well developed in the economics literature. (Kneese 1970:192; cited in Sagoff 1990:5)

The answer? internalise these environmental externalities in order to correct for market failures. The theoretical development of the Materials Balance approach by RFF economists enabled the economics profession as a whole to reassert its providence over issues of environmental regulation in the US, and to undermine the concept of the environment as bounded by finite limits. These developments would help open the door to economic approaches to pollution control. The first through this door was a group of scientists, environmentalists and pressure groups that went by the name of 'The Coalition to Tax Pollution'. Formed in July 1971 and comprised of, amongst others, the Sierra Club, the Wilderness Society, Friends of the Earth and the Federation of American Scientists, the coalition would press for an explicitly economic response to environmental issues.

Drawing on the concept of externalities in their initial press release, they noted that: 'It will be necessary to make the economic self-interest of polluters consistent with the goal of a clean environment if we are to achieve this objective.'(The Coalition to Tax Pollution, cited in Heller 1972:24). This was followed in 1972 by a document published by the coalition outlining evidence from economists on the economic efficiency, vis a vis current regulations, of a sulfur tax. Not just any economists were included here, but alongside Allen Kneese were the hugely influential Kenneth Arrow, Milton Friedman, Paul Samuelson, Robert Solow, James Tobin, and the President's Council of Economic Advisors (CEA).

The call for the internalisation of externalities by the Coalition to Tax Pollution did not have an immediate impact in the US, despite both the broad range and prestige of its members. In 1973 however, the US Water Resource Council would issue a revised criteria document *Principles and Standards for Planning Water and Related Land Resources* (1973) that combined the fundamental commensurability of the environment and the economy as developed through the notion of externalities in

Materials Balance, with the expansion of environmental valuation initiated largely by RFF scholars from the mid-1960s. This document established environmental quality as a coequal objective alongside economic efficiency for water development projects (Andrews 1984: 47; Campen 1986:18-19), and represented for the first time a multi-objective framework for environmental project evaluation beyond just a focus on national efficiency.

Although the reconstruction of the environment through the economic theory of Materials Balance conceptually undermined the conflict between economic growth and environmental sustainability here, in terms of formal economic evaluation through benefit-cost analysis, the OMB still insisted in 1973 on a separation of the objective of 'national economic development' from issues of environmental quality, with the latter being included as 'accounts' rather than objectives (Andrews 1984:47; Campen 1986:19).

Alongside the formation of economic pressure groups and the reconstruction of benefit-cost analysis, an entire sub-discipline, environmental economics, developed at this point from its initial beginnings in the work of RFF economists (Pearce 2002). A series of foundational texts in the discipline were produced between 1970 and 1975, and illustrating its continued centrality, several of these were published under the auspices of, or involved staff members RFF. After Kneese, Ayres and d'Arge elucidated the Materials Balance approach in their *Economics and the Environment* (1970), an important reader would be produced (Dorfman & Dorfman 1972), shortly followed by a slew of influential texts (e.g. Seneca & Taussig, 1974; Baumol & Oates 1975; Kneese & Schultze, 1975)<sup>59</sup>. 1974 saw the publication of the first issue of the new discipline's dedicated journal, the *Journal of Environmental Economics and Management* (JEEM)<sup>60</sup>. This was also when initial empirical analyses were published. These compared, via benefit-cost analysis, the putative economic impacts of environmental regulatory policies established through econometric models (e.g. Atkinson and Lewis, 1974).

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<sup>59</sup> see Kelman (1981) and Gareau & DuPuis 2009).

<sup>60</sup> And in fact the journal was run out of RFF's Washington D.C. headquarters.

The texts would draw a clear distinction between the goals of environmental regulation and the means or instruments of reaching these goals. Baumol and Oates (1975) was particularly important here in enabling the reestablishment of the role of economics in environmental policy (Kula 1998:99). Their text devotes a chapter to the question of how incentive mechanisms can be used to achieve efficiency without optimality. This draws from the approach to cost-effectiveness analysis established by Roland N. McKean in his operations research text, *Efficiency in Government Through Systems Analysis* (1958), and then applied through government in the form of PPB. McKean's distinction between means and ends, further espoused by Baumol and Oates, allowed economic tools, and crucially, economists, to engage with the development of environmental policy forms, where they were previously considered explicitly illegitimate with respect to environmental regulation, as the CAA primary air quality standards and their basis in health, not economic concerns, indicates.

In the early 1970s then, the development and spread of a Materials Balance approach to the environment, and the subsequent development of environmental economics, enabled the economics discipline to rebut Joan Robinson's concern regarding the irrelevance of the discipline. At the same time, the economic technology of benefit-cost analysis became increasingly entrenched within federal government and with the expansion of environmental valuation methods would also help reconstruct the environment and environmental pollution as inadequately internalised externalities. This would have the effect of rather rapidly re-sacralizing economic growth, which arose resplendent like a phoenix from the antigrowth movement's sackcloth and ashes, and became once again what Robert Fri termed in 1973 the 'great American shibboleth' the thing that for the Paley Commission, is 'just better to the western mind'.

## The new limits to growth

In April 1971, Sam Schurr, who was at this point the Director of RFF's Energy and Minerals Program, would head up a two day public forum in Washington, organised by the think tank on *Energy, Economic Growth, and the Environment*. As Schurr noted in his introduction to the RFF book which followed in 1972:

The plans for the Resources for the Future public forum at which these papers were originally presented were guided by an acute awareness of the apparent conflict that has been emerging between two societal objectives that are both of prime importance: providing energy to meet the needs of future economic growth and protecting the quality of the natural environment.' (Schurr 1972:vii)

The merely 'apparent' nature of this conflict would become clear early on in the forum as the issue of economic growth was broached as a bedrock concern and central to the energy-environment debate (Schurr 1972:vii). Aside from establishing economic provenance over environmental issues, pollution and natural resources, Materials Balance would enable the *Limits to Growth* thesis of the Club of Rome to be broadly attacked and ridiculed by mainstream economists and economic commentators. Moreover, it would enable the environment and the newly fragile system of energy to be put together in such a way as to allow the blame for higher energy prices to be shifted onto not just OPEC countries, as Mitchell notes (2011), but onto federal regulation undertaken in order to safeguard the environment and reduce pollution - specifically the 1970 CAA with its imminent 1975 deadline for the attainment of its primary standards - and thus help to directly develop the growth ban.

#### *Energy, economy, and the new limits to growth*

Among the participants at RFF's *Energy, Economic Growth, and the Environment* forum was Walter W. Heller. Heller, as outlined in chapter 3, had previously been Chairman of the Council of Economic Advisors (CEA), and was charged with fulfilling Kennedy's 5 per cent annual growth promise under his *New Frontier*. He had also been a consultant, from 1965-1969, to the executive office of the President and tax advisor to King Hussein of Jordan. Heller introduced the forum by reiterating Robert Solow's characterisation of Materials Balance as the economist's approach to pollution. With this at the core of his presentation on economic growth, the concern over the conflict between this and the environment was thoroughly undermined, leaving Heller to conclude that:

Much if not most of the environmental damage associated with growth is a function of the way we grow - of the nature of our technology and the forms of production. By prohibiting ecologically deadly or dangerous activities and forcing producers to absorb the cost of using air, water, and land areas for waste

disposal, growth technology and production can be redirected into environmentally more tolerable channels (Heller 1972:28).

Following this he stated:

Coupled with a conviction that economic growth can more than atone for its sins is a belief that its environmental vices can be diminished and its virtues magnified by greater use of the pricing system, by putting appropriate price tags on use of the public environment for private gain. (Heller 1972:29)

Kneese, Ayres and D'Arge ended their *Economics and the Environment* with a postlude asking whether the approach raised once again the spectre of a new Malthusianism (Kneese, Ayres & D'Arge 1970:118). Contra to this, Heller's clear exposition of the reconciliation of the growth of the economy and environmental sustainability would highlight how Materials Balance - with its notion of pollution as economic externality - underpinned the backlash against the Malthusianism of the *Limits to Growth*. In the popular press, the Yale economist Henry C. Wallich maintained in *Newsweek* that *The Limits to Growth* represented an attempt 'to stop America dead in her tracks.' (Wallich, quoted in Hamblin 2013:177).

In the UK, *The Times* economics editor Peter Jay disparaged the 'schoolboy howlers' (1972) committed by the report, on precisely the basis that the pessimistic Malthusian claims made had long since been fatally undermined within the economics profession. Or more precisely, since the publication of Barnett & Morse's *Scarcity and Growth* (1963). As the New York Times Review of the *Limits to Growth* put it, '*Limits* is not a "rediscovery of the laws of nature," as the authors claim, but a "rediscovery of the oldest maxim of computer science: Garbage In, Garbage Out"' (Passell, Roberts & Ross 1972; cited in Nafziger 2012:440). In the economics literature opposing critiques would shortly follow making use of the Materials Balance approach to the environment to indicate that any limits are purely economic and due to a failure to adequately price environmental resources and residuals<sup>61</sup>.

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<sup>61</sup> see e.g. Cole and Curnow (1973); Cole et al (1973); Solow (1973); Nordhaus (1974).

The Materials Balance approach, and its rehabilitation of the theory of externalities with respect to environmental pollution led here to an explicit reconciliation of the economy and the environment and the undermining of the *Limits to Growth* thesis. But if these two central objects of politics were no longer at odds, if the environment no longer supplied finite limits to growth, then how could the unprecedented increase in energy prices and concurrent economic slowdown at the beginning of the 1970s be accounted for? Fortunately a response to this was provided by the second topic of Sam Schurr's *Energy, Economic Growth, and the Environment* forum. Not only was the forum interested in 'the effects of energy use on the quality of the natural environment' but also on '...the effects of environmental restrictions on energy costs and availability' (Schurr 1972:viii).

Papers by Phillip Sporn, the former president of the American Electric Power Company, and Richard Gonzalez, formerly of Humble Oil - who we have already encountered undermining M. King Hubbert's Peak Oil Thesis in the late 1950s and early 1960s in chapter 4 - sought to provide evidence of the detrimental impact on economic growth of environmental regulations. Sporn argued that even assuming what he referred to as a low end estimate of cost increases due to environmental regulation of 25 percent, then the annual increase due to environmental regulations alone in the US' electric energy bill by the year 2000 would amount to USD 32 billion, over one and a half times more than the *total* US electric energy bill of USD 20 billion in 1969. As Sporn concluded: 'When in 1776 Tom Paine said: "Tis dearthness only, that gives everything its value," he was speaking of freedom. But could he also have been prophetically alluding to the activities of his countrymen two centuries later in environmental control?' (Sporn 1972:88).

The US government would go about answering this rhetorical question in part through the initiation of 'Project Independence' in 1973. The linking of energy and environmental regulation had been a continual focus of the Nixon administration through the first few years of the 1970s (Mitchell 2011:191). On June 4<sup>th</sup> 1971, Nixon gave his landmark energy message to Congress, and this was reiterated in his later energy policy statement in April of 1973. Indeed, Nixon attempted on several occasions to institutionalise the relationship of energy and environmental regulation through the development of an energy and environment department, but this was continually rebuffed by a truculent Congress, resulting in the Nixon administration

implementing the Environmental Protection Agency (EPA) with a sole environmental remit. And, as evidenced by its May 1973 conference on Managing the Environment, the EPA was rather more focused on the environmental impacts of the economy than the impacts of environmental regulation on economic growth. Finally then, this linkage was implemented with 'Project Independence' just two months before impeachment hearings began against the President, in part through the fusion of economic theory in the form of Materials Balance with the making fragile of the constructed system of energy by the oil industry at the beginning of the 'environmental decade'.

President Nixon would call for a new national endeavour in his *Address to the Nation about Policies to Deal with the Energy Shortages* on November 7<sup>th</sup> 1973: 'Let us set as our national goal, in the spirit of Apollo, with the determination of the Manhattan Project, that by the end of this decade we will have developed the potential to meet our own energy needs without depending on any foreign energy sources' (quoted in de Marchi 1981:448). 'Project Independence' as this endeavour was called was formally initiated by the Federal Energy Administration in March 1974 with the goal of evaluating the nation's energy problems and developing a framework for a national energy policy.

Outlining the alternative energy strategy of increased domestic energy supply in its executive summary, the FEA stated that 'Potential water and environmental constraints would have to be overcome.' (Project Independence: Executive Summary; reprinted in Grayson 1975: 33). Similarly, with respect to coal: 'Production could be expanded greatly by 1985, but lower electric growth, increasing nuclear capacity and environmental restrictions limit this increase' (Project Independence: Executive Summary; reprinted in Grayson 1975: 31). The Executive Summary was also clear about the perceived impact of the 1970 CAA requirements, and their prevention of the expansion of coal use, or even the maintenance of coal use at current levels: 'Rather than stimulating coal use, current Clean Air Act requirements could, by mid-1975, preclude 225 million tons of coal now used in utilities' (Project Independence: Executive Summary; reprinted in Grayson 1975: 32).

President Ford's own energy proposals in 1975 would follow Nixon's lead and seek to re-establish the US' prewar surplus capacity of total energy in order to end its vulnerability to economic disruption caused by restrictions to foreign (predominantly Middle Eastern) oil supply. The President's interim measures included the development

of new sources of natural gas production, further expansion of ongoing programmes - including a massive increase in offshore oil production in Alaska - and the reinvigorated domestic production and use of coal. These would require significant scaling back of the federal oversight of energy production - Ford proposed deregulation of new natural gas production and an initiative to 'decontrol' the price of domestic oil (alongside the enactment of a windfall profit in a failed attempt to prevent the massive hike in prices that would result). It would also require the scaling back of environmental goals; and with specific respect to coal, the President stated that:

Use of our most abundant domestic resource - coal - is severely limited. We must strike a reasonable compromise on environmental concerns with coal. I am submitting clean air amendments which will allow greater coal use without sacrificing clean air-goals. I vetoed the strip-mining legislation passed by the last Congress. With appropriate changes, I will sign a revised version when it comes to the White House. (Ford 1975; reprinted in Grayson 1975:24)

He would go on to boldly outline his vision for a new energy programme:

Within the next ten years, my program envisions: 200 major nuclear power plants, 250 major new coal mines, 150 major coal-fired power plants, 30 major new refineries, 20 major new synthetic fuel plants, the drilling of many thousands of new wells, the insulation of 18 million homes, and the manufacturing and sale of millions of new automobiles, trucks, and buses that use much less fuel. I happen to believe that we can do it... (Ford 1975; reprinted in Grayson 1975:24)

The bringing together of energy and the environment and the subsequent demonisation of the latter for the apparent crisis in the former, was accompanied by the new environmental economics discipline undertaking more specific attacks on the new environmental regulations of the 1970s. As part of this response, the 1970 CAA came under attack almost immediately by economists 'who urged that they be recast to work more flexibly through market incentives' (Andrews 1984:58). As it became clear that there would be a widespread failure to meet CAA standards within the short deadlines given, this regulation was increasingly characterised as ineffective and politically unrealistic by economic commentators. Economic opinion articles in the early 1970s began to urge that the technology-based standards of the CAA be replaced with incentive-based regulatory measures such as charges, taxes or marketable permits, whilst ignoring or heavily discounting any political or administrative difficulties that might be encountered in their implementation (Andrews 1984:58). By 1975, the

growth ban would become not only imminent, *but immanent to environmental regulation*.

#### *Environmental economics and the Clean Air Act's growth ban*

The foundational environmental economics texts written in the early 1970s sought to establish a clear boundary between what would later be labelled 'command-and-control'<sup>62</sup> regulatory mechanisms and economic incentive based mechanisms to environmental regulation, with the latter being 'proved', theoretically, to be the most efficient. This was undertaken by the reconstruction of the CAA as the archetypal command-and-control regulation. One of the most influential and widely cited texts was Kneese and Schultze's (1975) *Pollution, Prices, and Public Policy* (Braadbaart 1998:138; Kelman 1981:21) published by RFF. Alan Kneese's prior accomplishments have been covered in some detail above and in the last chapter, and as indicated he wielded not inconsiderable influence. Similarly, Charles Schultze was the director of the Bureau of the Budget under Lyndon Johnson, and would later serve as the President of the Council of Economic Advisors from 1977 to 1980 (Kelman 1981:21).

As Kelman notes with respect to Kneese & Schultze '... most of the book deals, not with any broader issues involved in the use of economic incentives in environmental policy, but with the unnecessary costs that a standard approach imposes' (Kelman 1981:22). Kneese and Schultze focused particularly on the potential impact of the New Source Performance Standards (NSPS) of the 1970 CAA on economic growth - taking this component of the regulatory apparatus as fundamentally indicative of the regulation as a whole, they criticised the entirety of the early 1970s environmental policies on two grounds (Braadbaart 1998:138). The first of these criticisms was with the focus on zero emissions targets, which Kneese and Schultze maintained were financially unattainable. The second was with the exclusive focus and reliance upon emissions and technology standards to the exclusion of either charges or incentive methods.

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<sup>62</sup> A term I believe was first used (at least in the academic and policy literature) actually later on, by Charles schultze (1977).

Both Seneca and Taussig (1974) and Baumol and Oates (1974) undertake a similar process with what they respectively refer to as 'regulation and prohibition' and 'direct control'. In the case of the latter: '[A] direct control must involve a directive to individual decision makers requiring them to set one or more output or input quantities at some specified levels or prohibiting them from exceeding (or falling short of) some specified levels' (Baumol & Oates 1975:153). Direct controls of this type are then argued to involve the costly and ultimately unwarranted expansion of federal expertise and capacity in terms of determining what is considered best technology and practice. That is, Seneca and Taussig and Baumol and Oates claim there is a duplication of private effort and expertise undertaken at the federal level and therefore an imposition of unnecessary cost.

This reconstruction of the CAA, or perhaps more accurately, the NSPS of the CAA as archetypal command-and-control regulation enables these authors to make the case for the use of economic incentives drawing heavily from efficiency arguments (Braadbaart 1998:140) – where the economic incentives advocated at this point were predominantly limited to charges and taxes. As Kelman (1981:22) notes with respect to Kneese and Schultze, 'most of the book deals, not with any broader issues involved in the use of economic incentives in environmental policy, but with the unnecessary costs that a standard approach imposes'. Summarising this process, Okke Braadbaart argues:

...from the early 1970s onwards environmental economists developed an abstract version of the American Water and Air Act Amendments into a straw man. The opposition of incentives and regulations offered a perfect pedagogical vehicle for exposing the potential benefits of the policy approach championed by economists (Braadbaart 1998:140).

The arguments developed within environmental economics were echoed within the CEQ's yearly *Environmental Quality* reports. In the last chapter I noted that the first two *Environmental Quality* Reports stressed the importance of misplaced economic incentives in causing pollution, and the importance of not extending property rights in such a way as to give firms the apparent right to pollute. However, from 1973-1975, the reports began to display a much greater concern with the apparent costs of pollution abatement under the Federal environmental regulation in comparison to the reports from 1970-1972.

The Ford administration's first report in 1973 discussed pollution damage avoidance and abatement costs, and transaction costs<sup>63</sup> (CEQ 1973). In 1975, the CEQ report had shifted to a focus on the trade off between potential costs. The report noted that Federal laws had the principal effect of reducing damage and avoidance costs, but at the same time, increased abatement and transaction costs. Here, the report argued that the overall goal was to minimise all four (damage, avoidance, abatement and transaction) costs (CEQ 1975). The commensurability of these costs was enabled through the expansion of the economic valuation of environmental impacts, the reconstruction of the environment and environmental pollution under Materials Balance and the development of the growth ban as the CAA became the economic growth killing 'command-and-control' regulation. Or as Playboy magazine parodied it in 1975:

And the Lord spake unto Moses, "There is both good news and bad news. The good news is that plagues shall smite your Egyptian oppressors. The Nile shall be turned to blood. Frogs and locusts shall cover the fields, and gnats and flies shall infest the Pharaoh's people. Their cattle shall die and rot in the pastures, and hail and darkness shall visit punishment upon the land of Egypt. Then will I lead the children of Israel forth, parting the waters of the Red Sea so that they may cross, and thereafter strewing the desert with manna so that they may eat."

And Moses said, "O Lord, that's wonderful; but tell me, what's the bad news?"

And the Lord God replied, "it will be up to you, Moses, to write the environmental impact statement." (Playboy 1975; cited in Liroff 1976:3)

### *The economic impact of environmental regulation*

To follow Playboy's biblical lead, the importance of the growth ban is not due to its apparent retelling of the parable of Paul on the Damascus road. The scales do not fall, suddenly, from the eyes of the environmental spaceman, revealing the underlying economic logic of pollution as externality, the necessity of economic growth, and the moribund nature of environmental regulations. But neither is this merely a fiction. Instead, an historically (and indeed geographically/spatially) specific technical-material world had to be constructed, comprised of lowered reserves calculations, energy

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<sup>63</sup> These being the costs of federal research and enforcement to achieve abatement, and asserted that the goal of policy was to minimise all four types of cost (Andrews 1984:59).

policies, environmental valuations through benefit-cost analysis, economic theories of externalities and Materials Balance, energy flows, and the constant innovation and proselytisation of Resources For the Future.

Only following the Project Independence proposals, and the shifting emphasis within the CEQ and the development of the new discipline of environmental economics, did EPA administrator Russell Train pronounce in 1975 to Senator Muskie that the CAA could represent 'a complete prohibition on new growth or expansion in non-attainment regions would pose very serious problems. *The economic impact on certain urban areas of such a growth ban could be quite harmful*' (Train 1975; emphasis added). It is only at this point then, that we can see the impact of RFF's transformation of the environment from a finite object antithetical to the economy in the late 1960s and early 1970s, into one consonant with economic theory.

The Materials Balance approach and the propagation of this through environmental and bureaucratic economics enabled environment and energy to be brought together in such a way that the historically observed pattern of increasing environmental degradation with increasing economic growth is made merely contingent. Pollution and overuse of resources could then be rendered as a correctable market failure as opposed to the rather more troubling (for contemporary economists and politicians) failure of markets. In short, economy and environment were put together in such a way as to allow, theoretically, the continued infinite growth of the former, and the pillorying of federal environmental regulation for its apparent negative economic impact. In this way, the regulatory response to pollution issues - most importantly the 1970 Clean Air Act (CAA) - was then reconstructed as one of the causes of the ongoing energy crisis. High energy prices, and the concomitant economic impact this was having were due not just to the 'political' intervention of OPEC (Mitchell 2011), but due to the impact of meeting costly environmental standards at home. In this way, Russell Train's urgent concern with the economic impact of environmental regulation was born, and the 1975 deadline for the attainment of air quality standards under the CAA was reconstructed into the looming and leering, imminent and immanent, ban on growth.

## 8. Conclusion: The Economy, energy, environment and the nature of growth

After 1975, the economy could grow all along. This bastardisation of Latour's metaphysical whimsy<sup>64</sup> is intended to capture three crucial aspects of the promiscuous history of postwar growth: First, the economy, energy and the environment had to be constituted, translated and retranslated over a quarter century period from the early 1950s *in order that growth could come to be seen as paradigmatic* (Dale 2011; Purdey 2010). Second, the objects are not simply defined by prematurely naturalised social laws. The inherent growth of the economy, the interchangeable set of power sources that comprise the system of energy, and the environment understood in metabolic terms with environmental pollution resulting from market failure, *all have to be brought to the objects they apparently define*. Third, these objects and the laws that both define them and determine their relations with each other are then retrojected back through historical time, and thereby presented as ahistorical, unchanging, mute causes. That is, the contemporary conceptions of the economy, or energy, or the environment are understood as having always existed, *they just weren't recognised as such*.

A striking example of this kind of peculiarly modern conception (Latour 1993b) can be seen in the work of economist Angus Maddison, who constructed Gross Domestic Product statistics for the world back to AD1000, in what Diane Coyle referred to unironically as an 'extraordinary achievement' (Coyle 2014:11). But this problematic

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<sup>64</sup> In *Pandora's Hope*, Latour states that 'After 1864 airborne germs were there all along' (Latour refers to the work of Louis Pasteur as not simply discovering pre-existing airborne germs in 1864, but co-constituting them as a new composite actor in the world retrojected back through time from 1864 on. I have neither the space nor indeed the competence to adequately explain what could easily appear as a merely vexatious metaphysics of time here, but Graham Harman explains this statement as follows: '[Latour] holds that the true reality of any moment in time is not something that slumbers beneath its surface articulations; rather, the moment is incarnated in those very articulations. To rethink the past for Latour means to produce an alternative version of the past *retroactively*, a time that never really existed at the moment in question' (Harman 2009:84; emphasis in original).

retrojection of contemporary conceptual categories is also present in the work of critical scholars, and both Elmar Altvater (2006) and E.A. Wrigley (2010) make claims regarding the absence of economic growth prior to the exploitation of fossil fuels and the industrial revolution. As I argued earlier in this thesis, specifically contemporary conceptions of growth do not map straightforwardly or unproblematically onto material progress prior to the development of the concept of the economy - constructed according to Mitchell from the 1930s through to the 1950s (e.g. Mitchell 1998). This separates historical description from ahistorical conceptual explanation, rendering the former as 'mere' description, and limiting historical analysis to the social, political and technical imaginary of the present (Knafo 2010).

The composition of the economy, energy and the environment, their definition according to inherent laws, and their subsequent projection back through historical time are involved in the development of the postwar 'growth paradigm'. This is then a 'law of the social world' (Latour 2005) *that does not explain the great acceleration, but instead has to be explained as a fundamental part of that process of changing human-environmental relations*. Again, and to reiterate from the introduction of this thesis, these apparently cold, dumb objects of politics - the economy, energy, and the environment, defined and driven by natural 'laws of the social world', are nothing of the sort:

They are not *behind* the scene, *above* our heads and *before* the action, but *after* the action, *below* the participants and smack in the *foreground*. They don't cover, nor encompass, nor gather, nor explain; they circulate, they format, they standardize, they coordinate, they have to be explained. (Latour 2005:246; emphasis in original)

This thesis has focused on tracing precisely the circulation, formatting, standardisation and ultimate coordination of the economy, energy and the environment through a roughly twenty-five-year period. This approach brings to light the work that was required to enable the great acceleration, the ways in which this work resulted in unintended consequences and new forms of contestation, and the historical specificity of the innovations and technical developments that lay at the heart of contemporary environmental governance.

This contemporary form of governance, prefaced upon the market-based management of the environment, spread from its US beginnings to become the prevailing framework for global and national environmental governance programmes (McAfee 2012); and since 2007 the concepts of 'green growth' and the 'green economy' have come to occupy prominent positions in the policy discourse of international economic and development institutions (e.g. World Bank 2012, OECD 2012, UNEP 2011). Alongside this, the creation of new institutions such as the Global Green Growth Institute in 2012, the establishment of a Green Growth Knowledge Platform, various fora and explicit commitments to green growth as a policy objective at G20 summits and the UN's 2012 Rio+20 meeting are helping to ensure that green growth is firmly established, at least rhetorically, within the global political economy.

While interpretations and differences between the various organisations' use of the terms green growth and green economy vary, the core meaning is simply stated: 'It is economic growth (growth of gross domestic product or GDP) which also achieves significant environmental protection.' (Jacobs 2012:4). Environmental pollution in general and climate change in particular are understood here as market failures. Lord Stern made this point clearly with respect to the latter in his famed 2006 report when he claimed that 'Climate change presents a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen' (Stern 2006:i). That is, greenhouse gases are simply inadequately internalised externalities of production. Given this understanding, it is imperative, as EU Commissioner for Climate Action Connie Hedegaard maintained in 2011, to undertake action on climate change through the implementation of policies that do not impede economic growth and therefore enable greenhouse gas emissions to be cut at least cost (Hedegaard 2011).

This approach to environmental degradation and the growth of the economy form the clearly espoused and firmly entrenched mainstream perspective on the political economy of the environment, and as such has been subject to a broad excoriation from a catholic church of critique. In spite of the claimed potential for decoupling, the possibility of green growth, and the development of a green economy, history very clearly indicates that there is little evidence for this possibility as anything other than an economic philosopher's stone (Koch 2012:123-128). In 2006, the ecomarxist critic Elmar Altvater wrote that the idea that we are living in increasingly virtual, information

based and financialised economies, decoupled from energy and material throughput is a myth. Or as he also more rudely put it, following Harry Frankfurt, the concept of decoupling is nothing but ‘bullshit’ (Altwater 2006:37).

For Altwater, the contemporary capitalist political economy is based upon the use of energy dense fossil fuels. Altwater argued that apparent productivity and efficiency gains are a kind of accounting sleight of hand that hide the massive increases in the use of energy from these fuels, and that if you take into account Energy Return On Energy Input (EROEI), then since the industrial revolution in the late 18<sup>th</sup> century, what we have actually witnessed has been a steady reduction in overall energy efficiency (Altwater 2006:39-40). As I have already shown in chapter 5, nearly forty years before Altwater, Kenneth Boulding stated that with respect to the growth of the economy: ‘Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist.’ (U.S. Congress 1973).

Bullshit espoused by madmen or economists. While I don’t disagree with this overall assessment, this critique of decoupling and the fallacy of exponential economic growth overlooks - as I argued in chapter 2 - precisely what is historically unique about the postwar milieu and the great acceleration. By orienting my analysis around the Paley Commission and then the think tank Resources For the Future - instituted in order to continue work on the economics of natural resources under the ‘Paley approach’ - I have been able to focus on the series of translations required in order to stabilise growth as a postwar paradigm.

This series of translations began, as I argued in chapter 3, with the impact of the newly born economy in the immediate aftermath of the second world war. The end of the war brought with it a resurgent fear of depression, stoked in the US by the economics profession under the influence of Alvin Hansen. Depression and then national security fears at the beginning of the cold war resulted in the question of growth becoming prevalent. Could the US economy grow? Will the US economy grow? Here the work of Frederick Dewhurst played a central role in helping both to further write the economy into history for the first time, and then bringing about a neo-Malthusian concern with its

growth. This concern was addressed by the Paley Commission at the beginning of the 1950s.

The Commission developed a novel approach to the issue of material scarcity and reserves calculations, giving practical import to the concept of scarcity developed as an 'open-ended myth' (Xenos 1989:14) by the neoclassical economists and popularised, at least with respect to economics textbooks, by Lionel Robbins in 1932. Further developing this approach, *Resources For the Future* helped secure the economy as a discrete ontological object, capable of, and indeed defined by, the capacity for infinite growth. Eventually, as Walker notes, material scarcity was 'quietly abolished as a fundamental constraint upon economies' (Walker 2007:179) and with the release of *Scarcity and Growth* (Barnett & Morse 1963), the stage was set for the elaboration of growth theory, development economics and resource economics and their continued use within US domestic and foreign policy throughout the years of the cold war.

The ability, and indeed the need, for growth during the cold war went hand in hand with the development of the system of energy to power this growth. In chapter 4 I investigated how the initial development of energy as an interrelated system threatened the continued profits of the oil industry, and how this threat was later translated into an opportunity for further expansion by oil companies, particularly the large international conglomerates.

By the end of the second world war, oil was the world's most important traded commodity, and its flows - predominantly from the Middle East - would come to fuel parallel but opposite flows of money within the financial architecture developed at Bretton Woods. The 'Peak Oil' Thesis of oil geologist M. King Hubbert in 1956 was seen as a threat by both domestic US oil producers and American owned international oil majors. An imminent peak and then rapid reduction in US oil reserves would have meant that historic government price and production supports in the form of a variety of tax allowances, quota limitations and transportation restrictions under the 1935 Connally Hot Oil Act, would no longer be supportable. Increasing oil scarcity would have resulted in increasing attention, and crucially Federal support, to alternative

power sources in order to maintain the overall levels of energy required for the necessary growth of the economy.

This threat was overcome by the further application of the 'Paley approach' to oil reserves calculations. The application of economic accounts of scarcity enabled previously unimagined amounts of oil to be 'discovered', hidden not in the porous rocks of the earth, but in the apparently faulty calculations of oil geologists. The application of economic scarcity and the concomitant alchemists' belief in 'technology' enabled new mandatory US government quotas that supported oil prices worldwide and enabled the vast expansion of oil through the 1950s and 1960s. The resultant oversupply of oil in the 1960s and the fall in price on the European markets resulted in the oil industry diversifying into alternative forms of fuel production and developing the energy industry proper, as well as unifying oil producing countries in an attempt to protect their own tax revenues by forming the Oil Producing and Exporting Cartel (OPEC). At the same time, Resources For the Future helped constitute both the history and the future of this never before existing industry through its inscription into economic theory.

While chapters 3 and 4 traced how the economy was first stabilised as an object capable of infinite growth, and then how this growth was apparently assured through the parallel construction of a system of energy, in chapter 5, I looked at how these developments provoked an oppositional response - in the form of the environment as finite, bounded and defined by limits - and the development of benefit-cost analysis was a key innovation here. Initially a technique developed by the Army Corps of Engineers to evaluate waterway construction projects, this limited tool, developed by engineers, would be translated ultimately into a portable economic decision technology. This was undertaken first through the inclusion of 'intangible factors' to enable analyses to be brought to bear on the growth and development of the national economy as a whole, and later through the translation of benefit-cost analysis into postwar welfare economics theory - largely through the work of RFF, at the end of the 1950s.

The overriding focus on the economic efficiency of benefit-cost analysis resulted in it becoming a target for the newly reconstituted conservationist movement from the mid

1950s until the end of the 'big dam' era in 1965 (Billington Jr. et al 2005: 383). Alongside this conservationist backlash, pollution became a pervasive issue during the 1960s, and a 1966 RFF forum provided the arena within which economist Kenneth Boulding would launch his concept of the Spaceship Earth. The response to these developments from the late 1960s involved both the growth of limits - in the form of new federal environmental regulations at the beginning of the 1970s, but also the famed *Limits to Growth* (1972) report and the development of a popular antigrowth sensibility.

In this last chapter, I focused on how the economy, energy and the environment were brought together in new ways from the mid-1960s to the mid-1970s. Here, the growth of the economy was once again secured and installed as a primary political concern in response to the challenge of the antigrowth movement of the early 1970s and as a means for both the economics discipline and later administrations to counter the expansion of federal environmental regulation initiated by the Nixon Presidency. During the late 1960s the previously secure system of energy was made to look increasingly fragile and crisis ridden.

This reconstruction was undertaken by the oil industry in order to raise energy prices in general, and involved the rehabilitation of Hubbert's Peak Oil Thesis - previously challenged by the oil industry and the United States Geological Survey under Vincent McKelvey. New, lower estimates of natural gas, then oil, were produced as they were no longer needed to underwrite US domestic price supports. Indeed, higher estimates would have undermined the justification of price hikes which occurred after the events that would come to be run together as the 1973-1974 OPEC oil embargo. Alongside this, economists, particularly those associated with RFF, reconstituted the environment in the image of economic theory.

The spread of benefit-cost technology through the federal government, the expansion of economic valuation and the rehabilitation of the concept of externalities through the development of the Materials Balance approach enabled the economics discipline to reassert itself with respect to environmental concerns. Under this approach the environment was reconstructed as no longer at odds with the economy, and this enabled the construction of new limits to growth in the form of Federally mandated

environmental regulation. In this way the infinite growth of the economy was constituted as no longer a threat to a finite global ecology, and was presented instead as the surest means to safeguard it.

As summarised in a recent Resources For the Future book on the development of pollution emissions trading mechanisms by Blas Pérez Henríquez - the Director of the Center for Environmental Public Policy at Berkeley - the 'regulatory unreasonableness' (Bardach & Kagan, 1982) of the uniform air quality standards developed under the 1970 CAA imposed an unacceptable cost burden to the US' energy and manufacturing industries and resulted in numerous areas of the country failing to attain the National Air Ambient Quality Standards (NAAQSs) required by the regulations by the 1975 deadline. Pérez Henríquez goes on to state: 'With the growth ban coming into effect for these areas, and with high compliance costs for those trying to reduce emissions, economic development was clearly being hampered by environmental regulation' (2013:51). For Pérez Henríquez, these developments provided both the political demand, and the opportunity, for air pollution regulatory reform in the US. For example, a 1975 US Senate report on air pollution control identified several deficiencies with the then current regulations, where '[t]he underlying argument was that only regulatory relief from the stringent CAA framework through a market-based regulatory approach would permit the US to avoid growth stagnation.' (Pérez Henríquez, 2013:51-52).

Aside from being factually incorrect with respect to this last point on the 1975 Senate report<sup>65</sup>, the promiscuous history undertaken through this thesis indicates that contra Pérez Henríquez, *there was, in fact, nothing clear about this process, nor the twenty-five-year history that led up to it*. Constant processes of translation were required throughout the postwar years in order to constitute the growth of the economy as a settled law. Multiple economic innovations, implementations and readjustments, as well as the institutionalisation of entirely new sub-disciplines were undertaken, and Resources For the Future was at the heart of this history. Overall, the great acceleration as a unique, and indeed ongoing period in history is best understood not through the unveiling, but through the making, of the nature of growth.

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<sup>65</sup> Cook (1988:35), who Pérez Henríquez cites here, makes clear that this report was on deficiencies that the Congress had attempted to rectify in 1970.

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