In Search of 'Good' Energy Policy: *The Social Limits to Technological Solutions to Energy and Climate Problems*[1]

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Abstract

This paper seeks to explore the nature of 'Good' Energy Policy by offering a multi-disciplinary social science and humanities perspective on policy making. The objective in doing this is to understand how to get from where we are today to a 'better' energy policy.

We begin by discussing what we mean by 'policy'. We then go on to characterise and challenge the technologists' approach to energy policy. Next we discuss some key intellectual starting points that explain why policy making in this area is so difficult. We then turn to a set of multi-disciplinary social science and humanities perspectives on energy policy that together form promising areas for research. These are: perception; quantification; well-being; public trust; role of the state; competence and hubris in delivery; and parallels with healthcare. We close by discussing how these perspectives can illuminate whether a policy is 'good', 'bad' or something in between.

Key words: Energy policy, climate problems.

INTRODUCTION

Energy policy is an area traditionally defined as being about three competing policy objectives. These are: security of energy supply; low and affordable energy prices; and minimising the environmental impact of energy production

1 This paper is based on the *In Search of 'Good' Energy Policy* initiative of Energy@Cambridge. The background research for this paper involved interviewing 22 colleagues at the University of Cambridge from 13 different faculties with an interest in energy policy. The author wishes to thank Isabelle de Wouters for her support. The faculties include Economics, Management, Law, History, Land Economy, Social Anthropology, History and Philosophy of Science, Divinity, Psychology, Earth Sciences, Computer Science and Engineering. The author wishes to acknowledge the intellectual debt he owes to his colleagues for generously sharing their ideas, while acknowledging that all opinions and mistakes expressed are his own. He owes further thanks to the helpful comments on earlier drafts of David Reiner, David Newbery and Robert Ritz. The usual disclaimer applies.

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and use. Every country on the planet has some combination of these three policy objectives at the heart of its energy policy.

Energy policy is important, because of the economic significance of energy within individual economies. Expenditures on energy can be around 10% of GDP (for example the UK) and are subject to significant volatility due to changes in international commodity prices. For energy exporting countries, energy can be a significant share of GDP, tax revenue and exports, making these countries particularly vulnerable to the state of the global energy market. In line with this energy companies are significant entities within national economies, partly due to the capital-intensive nature of much of the energy sector and existence of significant economies of scale. In electricity and gas supply there is the scope for the exercise of significant market power, which is why electricity and gas networks have been long subjected to economic regulation and / or government ownership (see Farrer, 1902).

Within countries the price of energy has significant distributional impacts: determining the mix of industrial sectors and being part of the social contract with citizens. Thus in an effort to support energy intensive industry, the industrial price of energy for certain large users can be subsidised. In the absence of other effective forms of social security, reducing household energy prices below cost can be one way for governments to support low income households, because energy consumption rises less than proportionally with income (see Chawla and Pollitt, 2013, for a discussion of this in the UK context). This explains, though does not necessarily excuse, why global fossil fuel subsidies were $493bn in 2014 (IEA, 2015a).

The economic importance of energy to economies, alone, would explain the policy interest in energy pricing. However, the fact that energy is difficult and expensive to store, in the face of the requirement for a continuous supply of it to fuel a modern economy, explains – the often greater – policy interest in energy security. Finally, the scale of energy consumption creates significant local and global environmental impact, with perhaps two thirds of all man made Greenhouse Gas emissions arising from the combustion of fossil fuel energy.

One would think that the sheer ubiquity of energy policy objectives would lead to the emergence of a clear and shared understanding of what makes for 'good' energy policy. However that is not the case. Countries (and indeed regions within them) differ sharply on their approach to energy as evidenced by different levels of tolerance for energy insecurity, wildly differing final energy prices and different attitudes to the environmental aspects of energy production and use. An obvious reason for this is that resource endowments (or ease of access to neighbours endowments) of energy (and of other factors of production) make a difference in national attitudes to energy.

In almost every country energy policy is politically controversial and the subject of debate. This is because energy takes different forms and policy needs to address energy use in electricity, heating and transport and reconcile the interests of households, commercial businesses and industry. Policies that are good for one sector or group of users may not work so well for others. Energy intensive industry, such as steel producers, may simply want the cheapest possible energy and may be unwilling to support policies aiming to clean up the environmental aspects of energy production. Households may express contradictory views on energy, simultaneously wanting cleaner energy, while not being willing to pay more for it or to have renewable sources of energy – such as wind turbines – located near to their property. At the heart of these contradictions is the idea that there is a trade-off between security of supply, low energy prices and the environmental impact, the so-called energy policy 'trilemma'. This says that improving the outcomes of two of the energy policy goals can only be done at the expense of the third.

Many developing countries appear to have disastrous energy policies that manage to worsen energy security, resulting in high delivered prices and are associated with high negative environmental impact . Thus countries, such as Nigeria, have an unreliable and limited public electricity supply service, which sees many households and businesses resorting to using their own dirty diesel generators to back up their electricity supplies (see Oseni and Pollitt, 2015). This results in higher outturn costs, especially when the local environmental impact and inconvenience of using such generators is taken into account.

The willingness of developing countries to tolerate such a mix of policies can be difficult to comprehend in developed countries. However it occurs because bad policy making is not unique to energy and because of different valuations of some aspects of energy supply. Thus energy consumers in developing countries may be more willing to tolerate poor air quality (or less willing and able to pay the costs of cleaning it up) or they may be more willing to get some energy very cheaply, even though such under payment directly leads to very poor continuity of supply. Historians have recently pointed out that in phases of rapid economic development it may be that improving environmental quality may be seen to conflict with energy comfort (see Corton, 2015, on the positive associations of smog in London prior to the 1950s with the home comfort of the open coal fire).

In developed countries, energy policy is not so obviously problematic as supplies are often reliable and the local environmental impact is much less, partly because prices are significantly higher and there is more commitment to the adequate financing of companies involved in energy supply. Instead what we often observe are a large number of individual energy policies, many of which may appear to be sensible on their own, but which in aggregate result in a 'mess' of policies, in the spirit of Rhodes (1988).[3]

A good example of this can be taken from the European Union. The EU has three sets of policies towards energy and climate in the period to 2020. These are the EU Emissions Trading System for Carbon Dioxide permits; a set of national renewable energy targets; and an energy efficiency target. These are known as the 20-20-20 targets, as each of them embodies a target reduction of carbon dioxide of 20% (on 1990); a 20% renewable energy share in final energy; and a 20% reduction in energy use per unit of GDP (relative to 2005). On the face of it the individual policy targets are each quite sensible and give rise to an important set of policies to promote carbon reduction, renewable penetration and energy efficiency. The problem has been that national success on energy efficiency and renewable penetration has come at the expense of making good use of the EU Emissions Trading Scheme, sending the price of carbon dioxide permits down

3 See Lave (1984), who notes the tendency in the US (and everywhere else) to regulate one externality at time, rather than jointly optimize regulations.

and threatening the Scheme's long term viability. The net result is that the overall costs of the transition to low carbon economy have been increased (because of using expensive renewables rather than cheaper coal to gas switching).

Such conflicts between the apparently sensible promotion of individual technologies with desirable characteristics but high costs, at the expense of more cost effective options to deliver the same overall outcome are commonplace in developed countries. A great example of this is the willingness of governments to subsidise domestic solar PV systems, leading to periodic solar 'gold rushes' as a result of overgenerous time limited subsidies. We can also observe that energy policy focussed around the energy trilemma is often influenced by the desire to promote an industrial policy within the energy sector. This is because there are often non-energy policy objectives, which are associated with the energy sector: such as the promotion of new industries on the back of technology deployment in energy or the promotion of regional jobs in the energy sector.

This paper seeks to explore the nature of 'Good' Energy Policy by offering a multi-disciplinary social science and humanities[4] perspective on policy making. The objective in doing this is to understand how to get from where we are today to a 'better' energy policy. We do this in the context of recognising that energy is not the only policy and energy policy objectives may need to be traded off with the desire to promote other 'good' policies in health, education or welfare etc.

In what follows we begin by discussing what we mean by 'policy'. We then go on to characterise and challenge the technologists approach to energy policy. Next we discuss some key intellectual starting points that explain why policy making in this area is so difficult. We then turn to a set of multi-disciplinary social science and humanities perspectives on energy policy that together form promising areas for research. We close by discussing how these perspectives can illuminate whether a policy is 'good', 'bad' or something in between.

4 The humanities include Anthropology, History, Law, Geography, Philosophy, Theology and the Visual Arts, inter *alia*.

WHAT DO WE MEAN BY 'POLICY'?

A dictionary definition of 'Policy' (from Dictionary.com)

'a definite course of action adopted for the sake of expediency, facility etc.'

or

'a course of action adopted by a government, ruler, political party etc…'

The word in English is taken from the middle English word policie meaning government or civil administration. Thus policies are closely aligned with the policing of society by authorities.

Examples of (national) energy policies might include:

UK Clean Air Act 1956, following the great smog of London in 1952, which eventually (together with successor legislation) led to a very significant improvement in air quality in the UK (see Mosley, 2014).

The French nuclear power expansion of 1975-99 saw the French share of electricity provided by nuclear increase to over 75% by the end of the period. This remains one of the two most significant policy induced decarbonisations of a whole economy in history.[5]

The European Union (EU) Emissions Trading Scheme, which began in 2005, included all fossil fuel power plants (and other significant industrial emitters of carbon dioxide) in the EU in a trading scheme for pollution permits.

National (and regional) subsidy schemes to renewable energy have been a significant driver of the global investment in wind and solar power over the last two decades.

Government taxes on diesel fuel have sometimes sought to encourage the use of diesel fuel in automobiles by lowering the tax on diesel relative to gasoline in order to encourage the uptake of diesel cars, with lower carbon dioxide emissions

5 See Jenkins (2012): Sweden and France both achieved rapid rates of whole economy decarbonisation over the period 1971 – 2006 as a result of significant increases in nuclear power.

per mile By contrast other governments have had higher have had higher taxes on diesel to reflect the higher local air pollution caused by diesel (see IEA, 2015).

Of course it is not only national governments that can have policies, local governments, companies and NGOs can all have policies towards energy and environmental protection. In what follows we will focus on national government policies for convenience.

TECHNOLOGY, TECHNOLOGISTS AND ENERGY POLICY

Why do we need a multi-disciplinary social science and humanities based approach to energy policy? One reason is because there is a tendency for debates about the future of energy policy to start with the technology (with generic statements such as 'we need more nuclear/solar/wind energy') and then proceed to policy solutions, with scant attention to the social and political aspects of policy implementation. This can lead to the advocacy of policies, which do not take sufficient account of a wide range of social issues, which are important in any policy debate. This can result in frustration on the part of technologists (I include both engineers and scientists in this group) who think that the technological solutions to energy problems are reasonably clear and that politics is getting in the way of their entirely reasonable solutions. Of course, I am partly caricaturing their approach. However, let me illustrate what I mean with reference to two excellent books, by my colleagues at the University of Cambridge.

The first is David Mackay's 2009 book *Sustainable Energy without the Hot Air*. This is a wonderful piece of work detailing the requirements for energy in the UK in terms of kWh per person per day. Mackay looks at which technologies could successfully deliver the required amount of energy and how much of a contribution they might meaningfully make. In his policy conclusions he suggests that the most economical answer (out of 5 decarbonisation scenarios he outlines) is substantially about nuclear power, which in his view, is perhaps the only reasonably priced low carbon technology available at scale. It almost goes without saying that nuclear has had a very troubled history and hence policies that rely on nuclear for decarbonisation of the whole economy is likely to be problematic to deliver, especially outside a few countries with advanced technology and governance infrastructures.

The second book, is Julian Allwood and Jonathan Cullen's excellent 2012 book *Sustainable Materials with both eyes open.* In this book, Julian and Jonathan document the huge difference between the amount of material (and energy) that goes into the most energy intensive industrial processes (focusing on steel and aluminium). They argue that reductions in material and energy use could be substantially reduced if best practice production methods were adopted throughout the supply chain. However the policies required to deliver such massive reductions in energy use around the world look very challenging given the current diversity of production practices within individual energy intensive industries. This is because a focus on energy efficiency alone ignores the global optimization of the value of product, less the cost of all its inputs, which may involve using more energy and in order to use less of other expensive inputs to create more value (something that economists would want to emphasise).

However both of these books beautifully illustrate two related things. First, technological solutions to support 'good' or 'better' energy policy *do* exist. Second, they also point out the size of the challenge facing certain technologies in scaling up to the level required to be a significant part of the overall solution to energy policy problems.

Why is there this disconnect between the world that technologists might envisage and the reality of policy marking. One starting point is James C. Scott's book 'Seeing like a State: How certain schemes to improve the human condition have failed'. As the title suggests governments are very keen to implement grand schemes (with a scientific basis) to improve the condition of their citizens. What could possibly go wrong on their way to doing this?

We might suggest that there are a number of reasons for this. First, energy is not free. It has opportunity costs which could be measured in terms of education and healthcare (and other government objectives). Hence channelling resources into the energy sector, or indeed into focussing government policy attention on energy, have an opportunity cost. There is a tendency to talk about clean energy policy as if the costs are small and easily affordable by society. *Every* incremental policy cost tends to be small in relation to the whole of GDP (less than 1% of GDP). What technologists forget is elections are won and lost over debates about much smaller differences in the overall budget.

Second, policy interventions often have significant impacts on initial distributions of wealth, income, tax revenues, and jobs. This means that while there may be technical possibilities for substantial impact, those substantial impacts are a draw back for those currently benefiting from the status quo *(e.g.* oil and gas companies; coal miners; local residents and equipment manufacturers). Re-distributional effects resulting from large policy changes need to be evaluated carefully, because they can provide a reason for not going ahead with a project if they are large, negative and highly concentrated for some groups in society.

Third, not everyone is as keen to engage with energy technology as technologists imagine. Technological solutions necessarily mean society needs to be engaged by certain technologies, *i.e.* it must learn to love them. This is most obviously the case with smart electricity and gas meters at the moment, where the assumption is that these will facilitate lots of positive, demand reducing and demand shifting, interaction between the household and their smart meter. This however seems unlikely because a smart meter is not likely to engage consumers as much as a mobile phone.

Fourth, there is a long and sorry history of optimism bias (see HM Treasury, 2013) and hubris in the delivery of large government projects (see Flyvbjerg, 2014). This is true of large pieces of physical and communications infrastructure. This needs to be taken into account in considering the likely policy costs of nuclear power programmes or smart meter rollouts. There is also tendency, especially with respect to new technologies, to over estimate their ability to deliver their nameplate rated benefits. These benefits are usually only available under laboratory (or limited test) conditions and not within the normal operating conditions of a fleet.

Finally, policy development is a process, which has been extensively studied by other disciplines, and technologists are just one lobby group within that process! (as are economists!). Policies rarely survive unaltered from an initial technology based proposal: they end up being altered significantly as a result of the consultation process. A good example of this, once again, is the smart meter rollout programme in the UK, where the technical design of the rollout got much more complicated following the extensive stakeholder consultation that was conducted.

None of this is to any way down play the significance of scientists and engineers in the development of good energy policy. They can do (almost) anything, provided they are given enough money. However the stunning achievements of science and engineering – *e.g.* putting a man on the moon – should be contrasted with the rather more modest progress made by policy makers on world peace and global poverty. For instance, NASA's Apollo Programme from 1961-72 cost $170bn (in 2005 prices)[6] to put 12 men on the moon, and peaked at almost 0.5% of US GDP during that period. However by contrast the UK spends perhaps an extra 1% of its GDP on defence, above the average of its European neighbours.[7] It does this, in large part, because of its desire to participate in international peace making activities, with less obvious overall success. Some policies are inherently difficult (perhaps impossible) to get right.

In spite of the inherent difficulties in getting energy policy right, there is a tendency for much of the policy space to be dominated by optimistic predictions of the future. For the Energy Technologies Institute, in the UK, recently published a document (ETI, 2015) outlining a plan for decarbonisation of the UK economy, to meet the UK's ambitious climate policy goals (80% reduction in Greenhouse Gas emissions by 2050 on 1990 levels). The three key elements of the plan were decarbonise Power (completely by 2035); decarbonise Heat (completely by 2050) and decarbonise Transport (by 50% by 2050). If only it were that simple to achieve!

KEY INTELLECTUAL STARTING POINTS FOR NON-TECHNOLOGISTS

When social scientists and humanities academics look at ‘good’ energy policy problems, they have a number of key starting points, which are often very

6 As reported in https://en.wikipedia.org/wiki/Apollo_program. Accessed 25 November 2015.

7 Compare UK and Germany in for example https://en.wikipedia.org/wiki/List_of_countries_by_military_expenditures. Accessed 25 November 2015.

different from the starting points of a technologist (as exemplified by the Mackay and Allwood and Cullen books above). We highlight five important ones.

What do we mean by 'good' or 'just'?

When we talk about 'good' policy, what are we talking about? Often what we might mean is a policy that is good for the delivery of high quality energy services in our own countries. However what about the impact of our demand for energy on energy producing countries (such as Nigeria)? Consuming more energy in Spain might mean more environmental pollution in Nigeria. If we take a 'good' policy to be one that delivers energy 'justice', how should we define this? Should justice be sought within the current generation of people or between generations or both? A 'good' policy necessarily raises fundamental philosophical and theological questions (see Lewens, 2007 and Bell *et al.,* 2013) as well as being interpreted in particular ways within different academic disciplines.

Vested interests (or legacy investments)

Energy policy is hemmed in by a large number of vested interests. These include fossil fuel companies, electricity and gas companies, large energy equipment companies, local communities who might oppose local energy production development, coal miners who might want coal use to continue in spite of its high carbon dioxide content. Such vested interests might be seen as being 'difficult' by those anxious for change but they reflect legacy investments by society – in fossil fuels, education and location – and cannot justifiably be written off. The need to take past investments into account is important restraint on rapid wholesale system change. This is because past investments may have been made on the basis of long-term guarantees from government on the basis of previous policy objectives. The need to take reasonable account of legacy investments is perfectly sensible because failure to do so may prejudice future investment by raising the cost of capital (or indeed the price of labour or land). Indeed harnessing private investors in promoting 'good' energy policy is often seen as very important to governments (see Dupuy and Vinuales, 2013). Hence vested interests raise important legal, historical and economic dimensions.

The failure of prediction

Energy policy is often justified with reference to projections of the future. However predictions, particularly with respect to energy, have a poor track record. Two examples illustrate the ubiquity of this failure. The first is from Craig *et al.* (2002), who report Atomic Energy Commission projections from 1962, which in line with many others at the time, predicted a very optimistic growth of nuclear power in the decades following 1962 up to 2000. Specifically they suggested that US demand for nuclear power would be 800% more than it actually was in 2000. This was against a backdrop of over-predicting total electricity demand by 150%. These predictions failed to take into anticipate the massive effect of the oil shocks of the 1970s in slowing GDP and energy demand growth and the failure of the optimistic cost predictions for nuclear to be realised. However it is not just long-run predictions that can be wrong. As late as 2010 US oil production was expected to remain reasonably stable for the next few years (IGRC, 2015). The reality was that shale (or tight) oil grew very rapidly between 2010 and 2014. The rise was so significant that, in fact by 2014 US oil production was back near all-time peak production levels. The system failure of energy predictions over both the long and the short run is of especial interest to both historians, economists and management scientists.

Persistence of 'bad' and difficulty of 'good' policies

A key observation in energy policy is that 'bad' policies can persist for a very long time and it is difficult to change them. A great historical example of this is UK coal policy since 1800 as discussed by Fouquet (2011). Fouquet shows that the external costs of excess coal related mortality (as measured by the value of life year) were very high over many decades. Indeed for most of the period 1850 to 1950, the external costs were roughly the same order of magnitude as the value of the coal retailed. In the year of peak external costs (1891), the costs were 17.3% of GDP. It was only in the 1950s, with the passage of the 1956 Clean Air Act, that there was a sustained fall in these death related external costs. Many humanities and social science disciplines – economics, law, history, social anthropology, philosophy, theology – are concerned with how 'good' policies (or associated 'good' human actions) can be so difficult to implement and 'bad' policies can exhibit excessive persistence.

Democracy and public consultation is messy

A final starting point for why the search for 'good' energy policy is so difficult is the fact that energy policy is inevitably going to go through a 'messy' process of public consultation and/or democratic debate. This will necessarily complicate a simple science based policy. Almost by definition consultation means that views received as part of the consultation process will have to be taken into account. This means that the use of technology will be subject to alteration, often in unexpected ways. A key example of this might be in the area of the siting of new power production facilities *(e.g.* a nuclear power plant or a wind park). Usually some aspect of the siting will have to be altered from the original (or theoretically more attractive) design as a result of the consultation process. Such consultation processes are often time consuming and involve the processing of a lot of technical information. The issues around how to take due account of the wider democratic process is of concern to lawyers, economists, management theorists and social anthropologists.

PROMISING MULTI-DISCIPLINARY RESEARCH THEMES

Perception

An important research theme in energy policy (and policy more generally) is how energy policy issues are perceived. This is obviously the case when it comes to energy infrastructure and its visual impact on the landscape. Is a gas pipeline crossing a pristine artic environment perceived of as a source of economic development or as blot on the landscape? Different societal groups may perceive of the problem differently. Indeed local peoples may be very happy for the economic development that the pipeline brings, whereas international NGOs may be campaigning against it. Policies that promote such physical infrastructure *(e.g.* gas and oil pipelines and electricity transmission wires) may be perceived very differently from different perspectives. Social anthropologists are well aware that western environmentalist agendas may be perceived as a form of neo-colonialism in developing countries.

Psychologists, and social scientists more generally, have recently shown growing interest in the science of behaviour change. These interests encompass the theory of planned behaviour (Ajzen, 1991), the concept of nudge (Thaler and Sunstein, 2008) and mindset change (Dweck, 2006). This is essentially an interest in how to change individual and public perception of the issues at hand. Thaler and Sunstein's (2008) book 'Nudge: Improving Decisions About Health, Wealth and Happiness' introduces the concept of libertarian paternalism, whereby governments might seek to manipulate individual behaviours by non-price changes to the way choices are being presented. This sort of idea has been taken up by behavioural economists, in the area of energy consumption, where there have been lots of experiments as to how to encourage individuals to save energy by altering their perception of the salience of the problem (see Pollitt and Shaorshadze, 2013).

One important caveat to 'libertarian paternalism' is that paternalism always involves the idea that someone knows what is good for a large number of others. This presumption needs to be carefully evaluated and raises ethical questions as to the appropriate way to seek to change perceptions and the capacity for unwelcome social manipulation.

Quantification and the use of scientific argument

Many non-science academics are well aware of the seductive attraction of quantification and its dangers. Quantified answers have an air of precision for which there is clearly a demand. Governments and companies pay handsomely for scenarios modelling exercises that seek to quantitatively forecast energy demand and supply. While most people involved in such a process of number generation would readily acknowledge the general shortcomings of such exercises, it is very easy to move from scenario modelling to prediction. Government and corporate energy policy is often substantially based on quantitative predictions about the future. These exercises are undoubtedly useful for producing internally consistent numbers, which show the broad relationships between the key inputs and outputs. However they are easily misused, as the relative preponderance of government-sponsored reports showing ambitious future energy policy targets being met, amply demonstrates. It is also rare to compare scenarios produced by different modelling exercises with a view to understanding why they differ, leading to competing quantitative views of the future, which can be used selectively by policy makers to justify their prior desires to see certain policies enacted. The historical use and evolution of demands for quantification and prediction is clearly a potentially fruitful area of study in the context of seeking to guide better use of prediction around energy in the future.

A fascinating aspect of the use of quantification is the role of burden of proof – something that philosophers (see for example Lewens, 2007, for philosophical perspectives), risk analysts and lawyers worry about. Does someone proposing a new technology need to prove quantitatively that it is safe? Or, does someone opposing the technology need to prove that the risky costs exceed the benefits? The burden of proof in policy making can often be pushed on to the parties least able to bear it. Poorly funded, but potentially badly effected stakeholders, need to prove the government wrong. One way forward is to have independent quantitative assessment capable of being challenged by both sides *(e.g.* by having their particular assumptions added to see their significance), but this may not be possible.

Numbers are often at the heart of scientific arguments around energy, particularly IPCC Reports on Climate Change *(e.g.* IPCC, 2014). The temptation is for scientists to claim that the numbers 'prove' their argument, or that 'on balance' they prove it. Social scientists and philosophers are noticeably more sceptical of the ability of one (or any) set of numbers to prove an argument. All modelling exercises involve a degree of judgement in setting model parameters and may be subject to actual mistakes in the calculations. Scientists can often overclaim for their numbers, and extrapolate from quite small experimental samples or work from design ratings in order to 'estimate' the likely overall impact of a particular policy. To most economists, only an ex post analysis can really 'prove' the efficacy of a policy.

Scientists can get frustrated about the inability of the general public to understand science or to respond to scientific arguments. This leads them down the route of trying to articulate quantitative arguments in terms that they think the general public may be able to better understand. The problem is that this can itself involve even more questionable representations of the numbers.

For instance on 29 April 2014 the ex-U.K. government Chief Scientist said: "Climate change is not….the biggest challenge of our time, it's the biggest challenge of all time."[8] Clearly this is a statement that is capable of being tested against the numbers on the impact of other past and present world problems. He may be right, but is a long way from a precise statement of why the risk-adjusted cost-benefit analysis of a particular course of action on energy is worthwhile. Indeed it is difficult to imagine how one could do a piece of analysis that could be happily summarized by the above quote.

Well-being

The primary reason for the world's massive use of fossil fuel energy is that individuals value the benefits that they produce in terms of the products that they make and the heating and cooling, power and transport services they produce. Fossil fuels have made and are still making the global industrial revolution possible which has increased world population and world GDP per capita way above the levels in 1770.[9] By any reasonable, philosophically grounded, measure the sum-total of human happiness has been increased by this. The picture is complicated somewhat by the pollution that fossil fuels produced which have not historically been priced properly. Thus it is necessary to value both the direct and indirect costs of energy use. These indirect costs are further complicated, in a market economy, by not having true market prices associated with them and hence needing to be derived indirectly.

Governments already have ways of doing social cost benefit analysis, which take non-market pollution values into account and also may take account of the distributional aspects of policy.[10] However philosophers and theologians might

8 Sir David King, quoted at: http://www.businessgreen.com/bg/james-blog/2342417/sir-david-king-climate-change-is-not-the-biggest-challenge-of-our-time-its-the-biggest-challenge-of-all-time

9 Allen (2009) clearly associates the start of the industrial revolution in England with the abundance of cheap coal. Kander *et al.* (2014) discuss energy's role in European history over the last 500 years.

10 See, for example, 'The Green Book' in the UK (HM Treasury, 2011).

question whether there can ever really be a truly quantitative assessment of well-being, which was capable of being practically useful. The key issue being the idea that linear adding up (and trading off) of different elements for different individuals both now and in the future, might be theologically and philosophically problematic. As an economist, I might want to push them to clarify exactly what it is they are concerned about society not valuing properly and argue that some single measure of value is necessary, but clearly there is room for a dialogue.

Aggressive energy policy might well end up being behaviourally intrusive and necessitate significance changes in energy comfort and in lifestyle. This could impact other aspects of quality of life. For instance by taxing home energy heavily, people might spend longer at work undermining family life. It is difficult to think of how one would assess this element of well-being within existing quantitative frameworks for doing cost benefit analysis.

Finally, the conventional approaches to energy policy tend to focus on aggregate targets. Well-being is significantly driven by the actual distributional impact of policies on the ground. Will poorer consumers be able to make the best energy choices in world of rising prices and increasing smart home energy technology? And will richer households buy distributed generation and demand response equipment and hence reduce their contributions to the fixed costs of the electricity grid, leaving poor consumers to pick up more of the share of system costs. This raises questions of both quantitative economic impact and wider questions of fairness that are of interest to several academic disciplines. If the domestic question was not complicated enough, such issues are further complicated by fairness issues between richer and poorer countries with respect to the cost of aggressive policy and the cost of inaction on global environmental issues.

Public Trust

The question of public trust in the policy process and in the delivery entities that the government uses to deliver policy is of fundamental interest to many social scientists and humanities academics. Often it is not the inability to understand the technical issues behind how a policy might be successful that stops the public supporting 'better' energy policy. Instead, it is the lack of confidence that the change from the status quo will be implemented successfully that stops it happening. Often this is based on past experience of failed targets and scandals in delivery and hence may have a rational basis.

The public relations firm Edelman conduct an annual international survey of trust in the government on energy policy and in energy companies (among other things). The results show widespread distrust in many countries. For instance when asked one of their opinion poll panels the extent to which they agree with the statement: 'I trust policy makers to develop and implement appropriate regulations on the energy industry',[11] they got the following interesting results. For the UK the percentage agreeing was 35% and Spain was 29%. For India and Indonesia it was 73% and 68%. India and Indonesia are not known for globally sensible energy policies *(e.g.* energy is often sold way below cost to residential customers in both countries, leading to a large waste of energy). By contrast UK and Spain have been global leaders in trend towards liberalised energy markets. Clearly, there is a national trust deficit of some sort indicated in these figures. Understanding what determines these sorts of differences and the extent to which they limit or facilitate policy is clearly of interest to 'good' energy policy.

The Role of the State

Up to now we have generally presumed that energy policy is the responsibility of the central government that promote policies to achieve its targets. Energy and climate policy generally starts with high level goals and long term policy targets (such as the EU's 20-20-20 goals for 2020). In a very concrete sense it is usually the government that take responsibility for the delivery of the policy targets via their policies. This is one view of the role of the state, acting through central authority. Alternatively, the state can be much more widely defined and the centre can delegate much more responsibility down towards the individual.

This is a key theme in theology. In the world's leading religions – such as Christianity, Islam, Hinduism and Buddhism – there is a strong emphasis

11 Available at: http://www.edelman.com/insights/intellectual-property/2015-edelman-trust-barometer/trust-across-industries/trust-in-energy-top-10-insights-for-communicators/. See slide 52.

on personal action and accountability. One cannot delegate one's own moral responsibility away to the state as an excuse for inaction. This is particularly true in the area of responsible consumption and energy use, but it is clearly also true in liberal democracies where there is a personal obligation to exhibit consistency between private religious beliefs and one's public responsibilities. Such an obligation creates room for a 'public' theology that is based on the position of the religion and its public injunctions to believers and non-believers. A good example of 'public' theology has been the recent Papal Encyclical 'Laudate Si' – On The Care of Our Common Home' written by the current leader of the worldwide Roman Catholic church (a.k.a. the Pope). In this public statement, the Pope calls on world governments to do more to protect the planet from dangerous climate change and on individual Catholics (and others of good will) to do more to support the global effort on decarbonisation.

This is a good example – from within the Christian tradition – of recognising mankind's role as stewards of the Earth. It is an attempt at aligning the support for a particular set of policies with individuals' core beliefs and cultural background (see the discussion in Pollitt, 2011). Many mass social movements have successfully made this connection, in order to call for policy change *(e.g.* the Civil Rights movement in the United States, led by Martin Luther King). Indeed one could argue that it is difficult to get deep grassroots behavioural change without achieving a consistency between the spiritual and the temporal sides of human existence, what one might call the individual 'search for meaning' (Frankl, 1985).

Such attempts at boundary spanning between central government action and personal responsibility, raise fascinating research questions about the appropriate level of governance for energy policy in society and how this might vary in different countries and cultural settings. It also suggests that as societies change then the way energy policy is done may also need to change. Thus a move to more local, inclusive and responsive democracy in liberal societies may require a modification of a traditional centrally coordinated set of energy policies. One related requirement may be for multi-level governance, which means that 'good' policy takes appropriate account of multiple levels of societal governance: national, regional, local, sub-government and civil society groups etc… A requirement for 'good' policy to do this necessarily means a 'restrained' role for the central government[12] and a certain amount of 'messiness' in the way the policy is being delivered at any one time, due to the need to take the different levels of governance into account. This may slow rates of progress on energy policy objectives, but it may lead to better long-run policy making and the process is a 'good' one in itself.

Competence and hubris in delivery

A central concern of business school academics (see Flyvbjerg, 2014) and manufacturing engineers (see Platts, 2003) is project management. Energy policy delivery relies to a significant extent on new investments coming on line on time and on budget. It is the case that whole technologies have been undermined due to their unreliability, even though on paper they might have had desirable nameplate operating characteristics. A key example of this is nuclear power, where operational performance in the UK and the US lagged a long way behind operational performance in some other countries (such as South Korea). Nuclear has also suffered globally from cost overruns and legitimate safety concerns. The only two new nuclear power plants and currently under construction in Europe in 2015 – at Flamanville in France and Okiluoto in Finland – are now both at least three times over budget and running at least six and nine years behind schedule.[13] The Finnish project has been subject to legal dispute between the contractor and the client, with each blaming the other for the current cost overruns.[14]

This indicates a spectacularly poor performance. This sort of poor investment record is due to the difficulties of running large, discrete, complicated multi-company construction projects. Such large projects typically suffer from hubris at the design and commissioning stage. Hubris takes the form of assuming that any problems arising during construction can be fixed quickly and that the most

12 In part due to the deliberate separation of powers under most constitutions. See http://legal-dictionary.thefreedictionary.com/Three+branches+of+government, for a good discussion. Accessed 25 November 2015.

13 For details on cost overruns see http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/France/

14 See for example: http://www.powermag.com/court-orders-olkiluoto-epr-operator-to-release-withheld-payments-to-areva-consortium/ Accessed 24 November 2015.

optimistic build scenario is the most likely: to assume otherwise would probably mean the project would not have been started. Such 'optimism bias' is well documented and even explicitly accounted for in the appraisal of some public projects.[15] In addition, even though the systematic over-run of large construction and IT projects has been identified clearly in the literature, many projects still suffer from it. Indeed, there is theoretical support for conservativism with respect to innovation being the most profitable strategy for a firm.[16]

Hubris arises partly because of the desire of everyone involved to be part of an exciting new engineering project, giving rise to career defining experience. The problem with this is that such opportunities come at the expense of the party that bears the cost over-run. Thus psychological and economic incentive factors explain preferences for new designs – and for redesigns – in spite of the fact that less technologically advanced technologies might give rise to better outturn policy effectiveness *(i.e.* sticking to a previous design and resisting the temptation to tweak it). However it is worth saying that is often not only project managers but politicians and regulators that favour such redesigns, as a new design is often easier to justify public support for than an existing design (especially when the conventional cost benefit analysis is not that convincing).

Parallels to healthcare

In our final research theme, we identify an interesting parallel between energy policy and health policy. Health and energy policy share a number of similar characteristics that would seem to be worth exploring. They are both multi-objective policies. A health trilemma also exists between cost, quality of delivery and comprehensiveness of coverage. If anything, health policy is even more complicated than energy policy because of the multiplicity of health products involved in any healthcare system.

15 See UK government guidance in HM Treasury (2013).

16 See Rasmusen (1992) who discusses the theory behind why conservatism in management should be expected to be most profitable strategy (largely because innovation is costly and risky relative to sticking to the existing business).

In thinking about the parallels, consider the similarities between the policy of reducing energy consumption and the policy of reducing individual sugar and fat consumption (pointed out by Edwin Sherwin in his eponymous book entitled ‘Addicted to Energy’). Both could employ price signals, however the scope for this is somewhat limited by the ability of some consumers to pay and historic concepts of fairness reflected in how they have traditionally been paid for. What might be more efficacious is a combination of price and non-price incentives appealing to nudge concepts. In health this might be a combination of a sugar or salt tax and a public health campaign with innovative engagement activities, this clearly parallels the use of behavioural economics and psychology concepts to engage energy consumers in demand reduction and demand shifting. Given that health raises similar ethical and philosophical questions (see for example, John, 2014), around which consumers to engage and how and the distribution of impacts across consumers, concepts and experiences derived from the healthcare arena might be particularly relevant for energy.

Although healthcare policy is difficult to get right, there are many examples of successful large scale policy interventions. As in energy, the world is a global laboratory for different policy experiments (often individually well funded and carefully assessed) which may have a lot to teach us about ‘good’ energy policy. One example, from the Dutch public healthcare system (see Snoeck Henkemans and Wagemans, 2012) is the right to a second opinion from another physician if you are not satisfied with the medical opinion that you received from your initial physician. On the face of it this looks like an expensive policy, which might significantly raise system costs. However in reality it can lead to an increase in patient satisfaction especially with their initial physician. This is because the right to a second opinion creates more confidence in the first opinion, hence reducing requests for a second opinion. This is an interesting example of a policy that looks as if commits more resources, but can actually end up committing less. It might be that guaranteeing to compensate any customer on smart pricing contract, who ends up worse off than they were on their conventional tariff, might similarly build confidence in smarter contracts, increasing uptake reducing legal claims or disputed meter reading.

POLICY APPLICATIONS

I briefly introduce how these research concepts might be used to illuminate particular policy case studies.

The idea that is that we could look at each case study (and indeed any energy policy case study) through each of the multidisciplinary lenses identified above: perception; quantification; well-being; public trust; role of the state; competence and hubris in delivery; and parallels with healthcare.

We look at three case studies and highlight some of the research theme applications most relevant to each.

Smart Meter rollouts

Smart meter rollout policies, normally involve rolling out two-way smart meters to all domestic and small commercial customers.

Such a policy clearly raises interesting issues in *perception.* Is a smart meter a way of helping consumers control their energy consumption or is it an intrusive bit of government mandated equipment that poses a privacy and data loss risk to individuals? Different jurisdictions have viewed them differently. The Netherlands was forced to slow their rollout and make it non-mandatory when the privacy and data risks were subjected to public scrutiny (see Cuijpers and Koops, 2012). This was not a decisive issue in the early rollout of smart meters to all households in Italy.

Quantification has also been a significant issue with smart meter rollout cost-benefit analyses. In many jurisdictions the presentation of this has been very controversial. This is because governments deliberately framed the question as 100% rollout *versus* no rollout, rather than in terms of what would be the optimal percentage of smart meters to rollout *(e.g.* in the UK). This would have been an obvious question to ask, given that there will be a group of consumers who do not respond enough to make having a smart meter worthwhile. There was also a tendency to over-estimate the likely savings across the whole population of electricity consumers, leading to disappointing demand response in actual use. This was the case in Ontario, where the Auditor General criticised the inadequate analysis of the likely response done prior to a comprehensive rollout there (Office of the Auditor General of Ontario, 2014).

Smart meters also raise *well-being* questions. Smarter is not necessarily better from a consumer point of view. If smart meters are make consumers more conscious of their energy consumption, this may be a bad thing for elderly or vulnerable customers who may be subjected to more anxiety as a result of the information overload of the smart meter. Clearly the branding of smart meters as 'smart' is clever, because it is difficult to be against smartness as a company or a politician. However the assumption that smarter technologies are worth their extra cost or that consumers value their additional functionality is questionable.

Smart meters in many jurisdictions have been subject to a lot of government interference: this raises *role of the state* questions. The UK has taken around 10 years to debate the 100% smart meter rollout and the main rollout of smart meters is not now due to start until 2016. This has delayed the private company led rollout to customers pending government rollout decisions on the functionality of the meters. Britain's meters will be some of the most expensive in the world to install and will probably be obsolete soon after they are installed. This has almost certainly meant that the UK has less smart meters now than it would have had otherwise; that the benefits would otherwise have been higher in the long-run – due to better targeting and a more positive image; and the meters would have been much cheaper to install, due to the companies having an incentive to go cheaper specifications. In short, the centralisation of policy appears to have had strongly adverse consequences.

Policy application: Promotion of Micro-grids

Governments in many jurisdictions are keen to promote distributed generation, often associated with a micro-grid. This promotes the use of local energy resources on the supply and demand side, and facilitates local initiative and innovation.

This policy raises *competence and hubris in delivery* questions. The reason why we moved away from decentralised electricity generation towards a centralised grid was in order to standardise the quality and price of electricity services. This was done by improving the reliance on shared wide area reserves and restricting the capacity to 'island' supply and demand within the system. It also allowed economisation of scarce management and engineering resources, which would otherwise tend to be distributed unevenly. Some distribution companies were bigger and / or more competent than others, while others were starved of resources.[17]

The result of having distributed generation and demand historically was a 'post-code lottery' of differential provision. This has *parallels with healthcare* where the desire to avoid post-code lotteries in national health provision conflicts with the desire to free up hospitals and personal physicians from central control in order to promote competition and innovation. How to work with diversity while still maintaining common standards of provision is a constant struggle for health care systems and may become an issue in systems characterised by micro-grids again.

Policy application: Taxation of diesel fuel

Finally, we look at the issue of the taxation of diesel in Europe. Many European countries actively encouraged the uptake of diesel cars in the 1990s by having a lower (or the same) tax on diesel per litre relative to gasoline. This deliberately valued the carbon dioxide benefits of diesel above the particulate emissions costs.

The recent scandal with VW installing software that faked the emissions performance on their diesel cars during emissions testing has highlighted the issue of *public trust* in the system of testing for particulate emissions from private vehicles.[18] It raises the issue of whether both the private companies producing the emissions *and* the public regulators that were testing them could be trusted. This is especially case because other organisations in Germany allegedly knew what

17 For some discussion along these lines on the England and Wales industry prior to reorganisation into larger regional electricity distribution companies, see Foreman-Peck and Waterson (1985).

18 See the US EPA report on this: http://yosemite.epa.gov/opa/admpress.nsf/a883dc3da7094f97852572a00065d7d8/dfc8e33b5ab162b985257ec40057813b!OpenDocument. Accessed 25 November 2015.

was going on before the public revelation (by the US Environmental Protection Agency) of the scandal. 'Good' energy policy clearly relies on a sort of system trust. This scandal puts a recent spotlight on the issue of how to prevent 'good' policy being thrown off track by dishonesty, a lack of transparency and inappropriate regulation.

CONCLUSIONS

We have argued that developing 'good' energy policy is not straightforward because policy implementation is rarely as simple as technologists would like to portray it. Policy implementation can be subjected to analysis; but comprehensive analysis of how to do 'good' policy is multi-disciplinary in scope. We have discussed common start points from a social science and humanities perspective and introduced a set of promising research themes that suggest how we might go about comprehensively analysing any actual or proposed policy can be subjected.

In closing we offer some encouragements from other areas of public policy *and* from energy. 'Good' policies would seem to exist. For the UK, some of the recent ones might include: the successive raising of pension age to 67 for both men and women, from 65 for men and 60 for women by 2028; mass media anti-drink driving campaigns (see Killoran *et al.,* 2010); and a smoking ban in all public places. In energy, the UK Clean Air Act of 1956, the US EPA's Acid Rain Programme's sulphur trading scheme from 1995 and EU Emissions Trading Scheme (EU ETS) from 2005 are candidates for 'good' policy.

These policies seem to share common characteristics that explain their successful enactment. These include good use of quantitative evidence to show the benefits to society of each, which seems to have been in line with – or below – subsequent performance; extensive stakeholder engagement and positive public support; and due attention to the fairness and distributional issues involved. Given that some of these policies will take many years to be fully realised and involved controversial and economically significant issues, they offer some encouragement that progress with 'good' energy policy is possible.

REFERENCES

Allen, R.C. (2009), *The British Industrial Revolution in Global Perspective,* Cambridge: Cambridge University Press.

Allwood, J.M. and Cullen, J.M. (2011), *Sustainable Materials: With Both Eyes Open,* UIT.

Ajzen, I. (1991), 'The theory of planned behavior,' *Organizational Behavior and Human Decision Processes,* 50 (2): 179–211.

Bell, C.; Chaplin, J. and White, R. (eds.) (2013), *Living Lightly, Living Faithfully,* Faraday Institute for Science and Religion.

Chawla, M. and Pollitt, M.G. (2013) 'Energy-efficiency and environmental policies and income supplements in the UK: Evolution and distributional impacts on domestic energy bills,' *Economics of Energy and Environmental Policy,* 2(1): 19-38.

Corton, C. (2015), *London Fog: The Biography,* Cambridge, MA: Harvard University Press.

Craig, P.P., Gadgil, A. and Koomey, J.G. (2002), 'What Can History Teach Us? A Retrospective Examination of Long-Term Energy Forecasts for the United States,' *Annual Review of Energy and the Environment,* 27: 83-118.

Cuijpers, C. and Koops, B.J. (2013), 'Smart Metering and Privacy in Europe: Lessons from the Dutch Case,' In Gutwirth, S.; Leenes, R.; Hert, P. and Poullet, Y., *European Data Protection: Coming of Age,* Dordrecht: Springer: 269-293.

Dupuy, P.-M. and Vinuales, J. (eds.) (2013), *Harnessing Foreign Investment to Promote Environmental Protection: Incentives and Safeguards,* Cambridge University Press.

Dweck, C. (2006), *Mindset: The New Psychology of Success,* New York: Ballantine Books.

Energy Technologies Institute (2015), *Options, Choices and Actions: UK Scenarios for a low carbon energy system transition,* Loughborough: Energy Technologies Institute.

Farrer, T.H. (1902), *The State in Relation to Trade,* London: Macmillan.

Flyvbjerg, B. (2014), 'What You Should Know About Megaprojects and Why: An Overview,' *Project Management Journal,* 45 (2): 6-19.

Foreman-Peck, J. and Waterson, M. (1985), 'The Comparative Efficiency of Public and Private Enterprise in Britain: Electricity Generation Between the World Wars,' *The Economic Journal,* 95: 83–95.

Frankl, V.E. (1985), *Man's Search For Meaning,* New York: Washington Square Press.

Fouquet, R. (2011), 'Long run trends in energy-related external costs,' *Ecological Economics,* 70 (12): 2380–2389.

Grubb, M.; Pollitt, M. and Jamasb, T. (eds.) (2008), *Delivering a Low Carbon Electricity System,* Cambridge University Press.

H.M. Treasury (2011), *The Green Book: Appraisal and Evaluation in Central Government Treasury Guidance,* London: TSO.

— (2013), *Green Book supplementary guidance: optimism bias,* London: HM Treasury.

IEA (2015a), *World Energy Outlook 2015,* Paris: OECD.

— (2015b), *Energy Taxes and Prices,* Volume 2015 Issue 3, Paris: OECD.

International Risk Governance Council (2015), *Concept Note: Assessment of Future Energy Demand, A methodological review providing guidance to developers and users of energy models and scenarios,* Lausanne: IRGC.

IPCC (2014), *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel* *on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)], Summary for Policy Makers, Geneva: IPCC.

Jenkins, J. (2012), *Historic Paths to Decarbonisation,* Available at: http://thebreakthrough.org/archive/which_nations_have_reduced_car, Accessed 24 November 2015.

John, S. (2014), 'Patient Preference Predictors, Apt Categorisation and Respect for Autonomy,' *Journal of Medicine and Philosophy,* 39: 169–177.

Kander, A.; Malanima, P. and Warde, P. (2014), *Power to the People: Energy in Europe over the Last Five Centuries,* Princeton University Press.

Killoran, A.; Canning, U.; Doyle, N. and Sheppard, L. (2010), *Review of effectiveness of laws limiting blood alcohol concentration levels to reduce alcohol-related road injuries and deaths Final Report,* Centre for Public Health Excellence NICE.

Lave, L.B. (1984) 'Controlling Contradictions among Regulations,' *The American Economic Review,* 74(3): 471–475.

Lewens, T. (ed.) (2007), *Risk: Philosophical Perspectives,* Routledge.

MacKay, D.J.C. (2008), *Sustainable Energy – Without the Hot Air,* UIT.

Mosley, S. (2014), *Air pollution: The impact of the 1956 Clean Air Act,* Available at: https://www.foe.co.uk/blog/air-pollution-impact-1956-clean-air-act Accessed 25 November 2015.

Office of the Auditor General of Ontario (2014), *2014 Annual Report of the Office of the Auditor General,* Toronto: Office of the Auditor General of Ontario.

Oseni, M.O. and Pollitt, M.G. (2015), 'A Firm Level Analysis of Outage Loss Differentials and Self-Generation: Evidence from African Business Enterprises,' *Energy Economics,* doi:10.1016/j.eneco.2015.11.008

Platts, J. (2003), *Meaningful Manufacturing,* William Sessions.

Pollitt, M. (2011), 'Green values in communities: how and why to engage individuals with decarbonization targets,' In Pitelis, C.N.;Keenan, J. and Pryce, V. (eds.), *Green Business, Green Values, and Sustainability,* New York and Oxford: Routledge: 67-80.

Pollitt, M.G. and Shaorshadze, I. (2013), 'The role of behavioural economics in energy and climate policy,' In Fouquet, R. (ed.), *Handbook on Energy and Climate Change,* Cheltenham: Edward Elgar: 523-546.

Pope Francis (2015), Enclyclical Letter *Laudato Si' of the Holy Father Francis, On the Care of Our Common Home,* The Vatican: Vatican Press.

Rasmusen, E. (1992), 'Managerial Conservatism and Rational Information Acquisition,' *Journal of Economics and Management Strategy* (Spring), 1: 175-202.

Rhodes, R.A.W. (1988), *Beyond Westminster and Whitehall: The sub-central Governments of Britain,* London: Allen & Unwin.

Scott, J.C. (1998), *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed,* Yale, CT: Yale University Press.

Sherwin, E.B. (2010), *Addicted to Energy: A Venture Capitalist's Perspective on How to Save Our Economy and Our Climate,* Energy House Publishing.

Snoeck Henkemans, A.F. and Wagemans, J.H.M. (2012), *The reasonableness of argumentation from expert opinion in medical discussions: Institutional safeguards for the quality of shared decision making,* Amsterdam School for Cultural Analysis (ASCA), http://hdl.handle.net/11245/1.375809

Thaler, R.H. and Sunstein, C.B. (2009), *Nudge: Improving Decisions about Health Wealth and Happiness,* London: Penguin.