Implied Ethics in Energy Policies and Institutions

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Description

This essay by Frank N. Laird outlines how engineering students should examine the ethical issues in energy policies and institutions. The paper was developed for the Energy Ethics in Science and Engineering Education Project and presented at a workshop on the topic.

Body

A small industry has sprung up in the last decade in which analysts propose massive changes to the entire energy system. Government agencies, think tanks, an assortment of environmental and other advocacy groups, and university researchers have produced energy policy studies aimed, more or less, at remaking the system. In one case, a government department has created a new agency within it, charged with catalyzing such a systems change. Since moments of, or proposals for, great change provide “teachable moments,” these studies and institutions can provide important pedagogical fodder for educating engineers about the ethics involved in energy. This paper will develop an approach for using this opportunity to further ethics education for engineers.

Part of the educational task is helping students find the ethics in subjects where they may be buried. The striking feature about ethics in recent policy studies and institutions is their apparent absence. Reading through this literature could lead one to think that the policies they promote involve little or no ethical considerations at all. Some studies have a brief mention of issues related to ethical values, some have none at all, and none of the studies have any serious analysis or reflection on the ethical issues on which they touch. Nonetheless, these analyses are loaded with ethical commitments and implications, and the recently created agency, the Advanced Research Projects Agency-Energy (ARPA-E), discussed below, embodies those ethical ideas. Those commitments and implications become more clear once we understand the social and political components of technological systems and how those systems link up to governing institutions.

That these proposals for a new energy system focus on a technological system my obscure the ethical issues, but it does not eliminate them. Many scholars have shown that the structure and operation of large-scale technological systems (and energy systems are the biggest of the big) are deeply connected to many structural features of a society and so linked to many ethical issues (for an overview related to energy, see Nye 1998; for an overview related to technology more generally, see Nye 2006). To explain why this is the case, we need to discuss more explicitly what we mean by a technological system and how ethical values can be embodied in it. Thomas P. Hughes emphasized that technologies function in society only as part of larger technological systems (Hughes 1987; much of the discussion below comes from this source). This idea of systems, which emphasizes both the components of the system and the interaction of those components, makes two points. First, technologies are not simply machines that operate in isolation. Indeed, most modern technologies cannot operate in isolation. As a thought experiment, ask students to imagine that we could transport a modern car back 500 or 1000 years. Then ask them how many different ways they can think of that the car, now severed from its technological system of automotive transport, would cease to operate. Without gasoline, decent roads, and spare parts the car would quickly move from being a mode of transportation to being a sculpture. In addition, the automotive technological system is tightly connected to the petroleum system, which presupposes well-drilling technology, pipelines, tankers, and refineries.

Second, all the different machines that make up the automotive technological system also require social and political components in order to operate at all. In order to have gasoline available for cars, one needs engineers who can design refineries, geologists who can help find crude oil, financiers who can evaluate proposed oil well or refinery projects, maritime crews that can pilot tankers to their destination, governments that can mobilize resources to build roads, engineers who can staff those government agencies, and so on. All of these professions need social institutions that can recruit and train their practitioners, professional societies that can aid them in their career development, and public or private entities that can fund research and development to advance the state of their arts, to name a few. Technological systems require more than technologies.

It is in these social and political components of technological systems where we can most clearly see the implicit ethical commitments that the systems embody. Every one of these components (and the relationships between them) manifests ethical choices, whether consciously made or not. How and from what groups do educational systems recruit and educate the professionals who will make the system run? Who pays for roads and through what means? What sort of regulatory schemes does the government impose on everything from operating cars to environmental, workplace safety, and labor organization in drilling for oil? The answers to these and dozens of similar questions carry with them profound ethical commitments.

To call these complex arrangements systems does not necessarily mean that some master designer thought through and made conscious decisions about all of their components and the interactions of those components (in this I am departing a bit from Hughes's (1987) discussion of technological systems). The final macro system may be emergent, that is, the result of the coming together of many much smaller systems and the final result may be one that no one chose, or even liked (This usage of emergent is similar to Richard Hiskes's (1998) concept of emergent technological risk.). That said, proposals for deliberate, large-scale changes to that system cannot avoid the consequence that such changes also entail possible changes in the embodied ethical decisions that the existing system possesses. Indeed, even leaving those ethical commitments unchanged is itself an ethical stance. Changing systems means confronting ethics, whether the advocates of change are aware of that dynamic or not.

Parts of these technological systems are institutions, from the universities that educate engineers to the government agencies that regulate oil drilling. In a colloquial sense we often think of institutions as simply organizations. But much social science understands institutions more abstractly, as the concrete embodiment of rules, roles, and processes, all of which are based on ideas, including both ethical values and technical beliefs (to the extent that one can separate the two). Those ideas powerfully shape what any given institution thinks its proper role in society is and how it should best go about realizing its goals. Thus ethical values are built into the problem frames, standard operating procedures, organizational cultures, and even sense of identity that people in those institutions encounter.

Therefore, when energy policy analyses propose a large change to the existing energy system, that change will require action on the part of, and will be mediated by, important institutions, including those of government. It is not surprising that studies proposing such changes often also advocate for a new or much modified institution to set such changes in motion. Much of the institutionalist literature focuses on how institutions mediate social and political interaction, especially between social groups and the state. The purpose of this paper and broader project is different. An awareness of institutionalized ideas, expressed as rules, roles, and processes, can enable students to begin to excavate some of the implied ethical issues buried in existing institutions . By the same token, that kind of ethical analysis can also help students understand the ethical implications of the systemic changes that energy policy proposals make. By making such ethical issues explicit, we can open them up to critical reflection.

This excavation requires three different tasks. The first is descriptive; explicating the ethical issues to which the authors of the studies themselves point, usually in discussing the goals of their policies. Their policies have a purpose and they assume that those purposes are desirable, that they promote some defensible values. What are those values and what ethical commitments do they represent? The second task is to subject those expressed ethical commitments to some critical analysis. Are they coherent or are there internal contradictions in the packages of ethical values that the policies promote? Also, are they defensible in the sense of comparing favorably to some reasonable ethical standards? It can be very difficult to come to a final conclusion about this last question, but if so one at least ought to articulate what the competing ethical standards are.

The third and final task is to ask if the policies that studies advocate have implications for values beyond those that are embodied in the studies' stated goals. Since the energy technological system links together so many different components of a society, a major change in that system will result in changes in more features of the society than just the sources of energy. Some analysts speak about unintended consequences, such as pollution from generating energy. Richard Sclove's (1995) work suggests that those unintended consequences go further than environmental externalities. A group may advocate building a coal-fired power plant with the immediate purpose of generating and selling electricity. It may also describe as a benefit of the plant an indirect result of creating jobs outside of the electricity industry. The advocates of the TVA in the 1930s very much saw the power plants it created as a means of economic development for a very poor area of the United States.

But beyond these stated direct and indirect consequences of a technology are the consequences it has that lie outside any stated purpose. Thus building a coal-fired power plant can have the consequences of creating of smog, emitting greenhouse gases, increasing the demand for coal and for smokestack scrubbers, technologies that pull the pollutants out of the power plants exhaust stream. The demand for more scrubbers leads to jobs in that industry as well as pressure on universities to train engineers for that industry. Not all these unstated consequences are bad. Moreover, the specific unstated consequences depend on the context in which the change takes place. Increasing demand for coal has resulted, in the United States, in mining disasters, mountain top removal, and brutal conflicts between miner's unions and coal companies. However, while both the United States and Germany have strong demands for coal, the results in Germany have been very different politically and socially due to the political role of unions in Germany and the presence of a social democratic party as a major contender for power in German elections. It can be difficult to predict every conceivable unstated consequence of a new technology. Nonetheless, reasonable speculation, aided by historical analogies, can enable the analyst to develop a list of plausible such consequences. The point here is that those unstated consequences deserve ethical analysis as well.

These tasks can form the core of a pedagogical exercise. I will illustrate them using two examples, one from the senior level of government (PCAST 2010)and one from academia (Weiss and Bonvillian (2009). Those reports are compatible in many ways, although the academic study goes into much greater detail and has a much more elaborate analysis of innovation related to energy technologies. There are many other recent studies one could add (e.g. Duderstadt et al. 2009; IPCC 2011; or Koonin and Gopstein 2011).

Task 1: Finding Ethical Values in Stated Goals

The PCAST report presents its goals up front and, like all good reports for senior policy makers, does so several times, in a cover letter, executive summary, and introduction.

“The U.S. must be at the forefront of energy technology innovation over the next decade for reasons of:

- economic competitiveness: renewal of our own energy infrastructure and access to rapidly growing global markets for clean energy technology;

- environment: rapid progress towards lower-carbon energy in this decade as a prudent response to global warming risks; and

- security: scaling-up of technologies that reduce oil dependence and thereby improve both our balance of payments and our security posture.” (PCAST 2010, p. vii)"

The body of the report elaborates these points slightly. Using quotes, including extensive ones, is important for the students’ understanding of the rhetoric and discourse within these studies.

Weiss and Bonvillian (2009) are more subtle about their goals, but come to very similar goals as the PCAST report. They rather take it as a given that we need, in the words of their book title, “an Energy Technology Revolution.” Their purpose is to analyze innovation policies that will give us one. They seek “a balanced, technology-neutral approach to energy policy . . .” They recognize, however, that no energy policy, at least one that is coherent, can be truly “technology-neutral.” “Even in the abstract, to be sure, the idea of technology neutrality has an inescapable limitation, namely, that of the choice of objective. Politics aside, a technology strategy intended to end dependence on oil from foreign sources will differ in important ways from one intended to mitigate global warming by reducing emissions of carbon dioxide (p. 3).” Later in their introduction they repeat this emphasis on technology neutrality. “Given the complexity and unpredictability of this evolution [of new energy technologies], the resulting innovation system should be technology-neutral to the extent possible (p. 10).”

This emphasis on being technology neutral is hard to square with their acknowledgment that different policies and technologies will serve different goals. To be generous, what they must mean is that, given some set of goals on which policy makers agree, the resulting policies should be technology neutral. While this goal may seem naïve (though it could also be tactical), one can understand their underlying sentiment: this program should not become some pork-barrel for promoting the favored technologies of some powerful interests. This is consistent with economic efficiency as a goal of energy policy. For example, if one had the goal of minimizing greenhouse gas emissions from generating electricity, technological neutrality would mean that the analyst would be indifferent between photovoltaic solar cells, concentrating solar thermal power, wind power, geothermal generation, or nuclear power. Layering on top of that goal the criterion of economic efficiency means that one would choose the least expensive of those technologies for any given project.

Economic considerations also show up more explicitly. “The United States should keep in mind, too, that the economic advantages of leadership in technology have been the source of its wealth and well-being. Is it really in America’s interest to cede leadership of a technological revolution in energy to other countries that now also understand the innovation-based growth model (p. 7)?” This quote brings us back to the notion of nationally-based economic competition, same as the PCAST report. Weiss and Bonvillian do not state their goals as directly as the PCAST report, but they clearly share the same goals. The PCAST report also embraces technological neutrality, though it buries the point more deeply in the report. “First, the emphasis should be on the Federal role in establishing technology **options** for future marketplace decisions, not on specific technology deployment targets that, at large scale, are best realized by a collection of private sector economic decisions. . . .The focus on options should be reflected by technology-neutrality of the objectives. (p. 9, emphasis in original)”

Thus the PCAST report and the Weiss and Bonvillian study agree on goals; reduce oil imports, reduce greenhouse gas emissions, and improve U.S. economic competitiveness, all done in a manner that respects market efficiency in terms of choosing specific technologies to deploy, which presumably means letting the market choose the technology with the lowest market price. Before examining the coherence of these goals, it is worth unpacking them at a descriptive level to see what ethical values they contain.

Reducing oil imports. This phrase is often used synonymously with “energy security” and security is the driving ethical value here. In this case security is conceptualized as autonomy, that is, being able to act without worrying about the reactions or concerns of those countries selling oil to you. For example, the United States may feel constrained in its relations with Persian Gulf states out of concern that they would retaliate by reducing production. In addition, such autonomy comes from being insulated from the actions of third parties. The worst-case scenario always involves Saudi Arabia and a coup or an attack on its oil fields that disrupts oil production. In this vision, security comes from autonomy.

Reducing greenhouse gas emissions. Attempting to mitigate or reduce anthropocentric climate change can be an expression of several core values, but mostly likely both of these reports associate this goal with security, since the consequences of climate change could be serious harm to human safety and welfare.This discussion of environmental protection as a security concern assumes an anthropocentric view of the environment, that is, disruption of the environment is a problem insofar as it harms the welfare of human beings. Those taking an ecocentric perspective on the environment would reject such a formulation of the issue. Neither PCAST nor Weiss and Bonvillian state explicitly which perspective they take, but from reading the works as a whole and considering the authors, I can assume they take an anthropocentric approach in describing their views. Thus governments can seek to prevent the storms, sea-level rise, and other consequences of climate change consistent with their obligation to protect the lives and property of their citizens. The fact that climate policy does not reside in the Department of Defense, or any part of the national security establishment, does not refute the notion that a concern about protecting human security motivates the desire to mitigate global warming.

Economic competitiveness and economic efficiency. The ethical values in these goals are related but not identical. Economic efficiency results from the proper and unimpeded functioning of markets. Exactly what that means in practical terms for energy is contested over such issues as to whether and how externalities get incorporated into energy prices. But economic efficiency requires that consumers and producers make their choices without government direction and with the knowledge of market-clearing prices. Schelling (1979, ch. 1), writing in the midst of the 1970s energy crisis, went so far as to call government interference in energy prices the main problem of the “energy crisis.” Government controls that hold down energy prices have been eliminated in the United States, leaving government subsidies and technology choices as the battleground over how free the market should be. If government mandates the use of a particular technology, then consumers are being forced to use a presumably less efficient technology than they would otherwise use, making their transactions less efficient. Most mainstream analysts want to minimize the extent to which their proposals interfere with the market; hence the call for technological neutrality in both the PCAST and Weiss and Bonvillian reports.

One can argue about whether economic efficiency is an ethical value as opposed to a merely technical one; getting the most output for the least input. However, it is rooted in utilitarian notions of the good society, a school of moral philosophy, and a few economists have defended it in moral terms (Stokey and Zeckhauser 1978) and others have critiqued it moral terms (Kelman 1981; MacLean 1980). These debates argue for including it in the category of ethical values.

The goal of economic competitiveness interweaves technical beliefs about how economies work in the international context with ethical beliefs about the obligation of governments to provide economic opportunities for their citizens. The technical points are that a modern energy system at home will provide the needed infrastructure for the growth of businesses, and so jobs, outside of the energy industry and that the ability to export new energy technologies will also drive job growth. The ethical point is that governments should create conditions in which citizens can realize their potential and that promoting job creation is part of that obligation.

The goals of economic competitiveness and economic efficiency may conflict. Advocates of international free trade argue that unimpeded global markets maximize welfare for all nations, making the two goals identical. Critics of that position point to the merchantilist trade policies of the most rapidly growing economies as evidence that the goals are in conflict. Engineering students should not, as a class exercise, be expected to resolve that dispute, but they need to be aware of it.

Task 2: Coherence of and Ethical Standards for Stated Goals

How coherent are these clusters of ethical values and to what do they appeal for their justification? In terms of coherence, several problems stand out, but only one of them is difficult. The emphasis on technology neutrality and economic efficiency at some level conflicts with the very notion that government policy should initiate a major shift in energy technologies; government regulations or subsidies interfere with the efficient functioning of the market. But one can make too much of this contradiction. If important social goals depend on such a shift, there is no reason government policy should not do so as efficiently as possible, making efficiency subservient to other goals. The point is to avoid turning the energy revolution into pork-barrel politics. Within economics-based policy analysis there is a long tradition of recognizing that markets do not always deliver important social goods—hence the need for government to supply them (Stokey and Zeckhauser 1978).

In a similar vein, there are different notions of security. The studies examined here assume that security is independence from the actions of others by becoming self-sufficient in oil, or at least less dependent on potentially hostile or unstable states for it. Thus security derives from autonomy. However, in other policy areas authors talk about security through interdependence, which is of course different than dependence. For example, advocates for free trade assume that U.S. security as well as economic interests are protected by engaging with the rest of the world through trade, not seeking insulation from that trade. If energy is a special case, advocates of U.S. autonomy need to make that argument specifically.

A bigger problem for coherence is conflicts between values, in particular security from foreign oil versus reduced greenhouse gas emissions. As Weiss and Bonvillian note, policies and technologies for pursuing those goals could be quite different. The United States possesses large amounts of coal. If it could find a way to convert that coal to liquid fuels at a price competitive with oil, that strategy could help to reduce oil imports. However, accelerated mining and use of coal would most likely increase greenhouse gas emissions, working against that goal, as well as adding to problems of environmental degradation, public health, and workplace safety. One can try to get off the horns of this dilemma by seeking technologies that will satisfy all of these goals, but that might slow down the accomplishment of any one goal.

The authors state their goals as obviously good things, but we need to ask if there are widely-shared, even if contested, ethical standards which can normatively evaluate these values and goals. The point about contested values is crucial here. Who can be opposed to greater security or greater efficiency? The difficulties arise in the development of specific energy policies from our two sources. First, there are competing conceptualizations of those general values, such as different notions of security and efficiency, noted above. Second, there are contexts in which these two may conflict with each other. Third, are these the only, or most relevant, ethical values that should drive energy innovation?

In terms of competing conceptualizations, the authors could defend their particular positions on the basis that security, seen as autonomy, and efficiency, seen as minimizing government interference in the market, enjoy wide political support. But that is not an ethical reason to choose those conceptualizations, merely a description of their political context. Security and efficiency fall into the category of essentially contested concepts, those which have no theoretical resolution but rather are the subject of battles over their precise meaning in particular contexts (see Stone 2002 for an extended discussion of this problem). For engineering students learning about ethics, using energy policy studies to examine some of those differing definitions of big concepts can help them understand how difficult questions of ethics in engineering can be.

Especially interesting for our case is the question of the ethical values that get left out of the discussion. For example, do the stated goals and the policies that follow from them have any engagement with distributive justice? Do they actually make inequality worse? Neither of these studies emphasize a carbon tax or similar instrument as the solution for energy innovation, arguing that such a tax is nowhere near enough to motivate the large change in the energy system that they seek. Weiss and Bonvillian do assume that some sort of tax on carbon will eventually come into being and act as a complement to the policies they propose. But they never mention that such a tax would be regressive, which is problematic for the United States, since it has seen rapidly growing inequality for the last 30 years. Would energy policy that emphasized distributed justice be substantially different from the program they propose?

Task 2a: Equity and Efficiency-A Digression and Modest Proposal

This problem of equity being in conflict with efficiency is not a simple one. Equity itself is a contested concept. To the extent that it relies on some notion of fairness, it is hard to tell what would be the most equitable approach to using a carbon tax to catalyze change in the energy system. Some economists have articulated these problems clearly. In 1979, during the midst of the energy crisis, Thomas Schelling published an essay, “Thinking Through the Energy Problem,” in which he laid out an economist’s analysis of energy. In 2011 William Nordhaus did a similar thing in a review of two new books on energy in *The New York Review of Books*. The pieces reflect the different circumstances of their times, but they embrace the same basic analytical framework and reveal a conundrum: raising the price of fossil fuels to promote alternative energy sources as a response to environmental threats requires a set of trade-offs that, no matter the choice, are in some ways inequitable.

Schelling's article touches on many issues, but the core of his argument is that energy policy needs to allow the price system in the market to work properly (1979, p. 41). Prices are signals to economic actors that enable them to make rational decisions about how much of any particular type of energy to produce or consume. To the extent that actual prices are different from the price that a free-market would set, then producers and consumers will make inefficient choices. Schelling was writing at a time when the U.S. government had controls on the prices of oil and natural gas (hard as that might be to imagine now). Government had introduced those price controls for a variety of reasons, but by 1979 the controls were clearly serving the purpose of keeping prices that consumers paid below world market-clearing prices. Schelling, and other analysts like him, made the case that government should get rid of such price controls and allow prices to rise to their free-market levels. The federal government eventually did so, and within less than a decade after Schelling's article appeared, government price controls on oil and natural gas were gone.In some states electricity prices are still regulated, but that is because utilities have a monopoly in their service areas. Electricity regulation raises different issues than did oil and natural gas price controls and will not be discussed here.

In part Schelling was responding to critics who argued against lifting price controls. Such a policy change, they argued, would certainly raise the price of energy in 1979, forcing consumers to pay more for driving and domestic heat and hot water, as well as increased prices for other goods and services that required energy to produce. The critics charged that these increased prices would hit the poor the hardest, and so impose the greatest hardship on those least able to bear it. People with low incomes spend a larger portion of their income on basic goods like heat and mobility than do the affluent and so feel the greatest increase in costs as a proportion of their income. This notion is parallel to the argument that sales taxes have the greatest impact on the poor and so are regressive as public policy. As such, allowing prices to rise poses an equity problem. Why should the government proceed with a public policy that makes the poor worse off?

Schelling's response (1979, pp. 59-61) does not deny that markets tolerate and can exacerbate income inequality. His point is that energy policy is not the place to tackle that problem. He distinguishes between micro and macro tools that the government can use to address inequality. Micro tools focus on a small part of the economy to make things cheaper for low income people. In this case, energy price controls reduce what the poor would otherwise have to pay for gasoline, heating oil, and other energy products. Macro tools, in contrast, are not sector-specific and instead could provide the poor with more income, leaving it up to them what to do with it. These macro tools include assorted transfer welfare payments or other forms of cash grants. Schelling argues for the use of macro tools on two grounds. The first is that micro tools like price controls for particular products distort the market, forcing prices away from their optimal levels and so introduce inefficiencies into the market, which could ultimately lower the aggregate welfare of everyone. This is both a technical and normative argument. Schelling's second rationale is more explicitly normative: price controls not only provide a subsidy to the poor, they also provide a subsidy to the affluent and even the rich. Since the wealthy are likely to travel more, heat larger houses, and so on, they get a larger subsidy from price controls in absolute terms; the richer you are, the bigger the subsidy you get. Thus the effect of subsidizing the rich makes price controls suspect from a purely distributional perspective. Schelling's point is that if policy makers are worried about the effects of rising energy prices on the poor, provide them with more generous welfare payments, but let the price of energy go where it may.

Nordhaus makes a similar argument, albeit on a slightly different topic. By 2011 price controls are long gone and the environmental problem of climate change dominates much discussion of energy policy. Also, the year had seen the release of a huge study by the National Academy of Sciences on the *Hidden Costs of Energy* (one of the books that Nordhaus is reviewing in his essay), which are mostly environmental and public health costs that derive from the variety of pollutants that result from burning fossil fuels. The core of Nordhaus's (2011, section 2) argument is that the prices of energy are too low because they do not include the costs of these environmental externalities. (Schelling also addressed externalities, but it was not his only or primary focus.) The costs of these externalities are real and very substantial, especially for coal-fired power plants. Therefore, excluding these external costs from the market prices for energy distorts the market. By forcing the costs of consuming energy onto others, consumers pay less than the real costs of the transactions and so consume more energy than they would if they had to pay the full cost. In other words, without the externalities factored into the price of energy, consumers are getting an inaccurate price signal. The solution to the problem is to impose a tax on various forms of energy that would incorporate these external costs into the prices that consumers actually pay. Such a policy is win-win-win. It would provide additional tax revenues for the government, would make the economy more efficient by providing more accurate price signals, and, since it would reduce fuel consumption, result in less harm to people's health (Nordhaus 2011 end of section 2).

The problem, again, is that a tax on energy would have the regressive effects of all sales taxes (see Warren 2008 for a review of the literature on this point). And again, the same conundrum appears. If government keeps prices lower by not putting the externalities into them via a tax, then it is subsidizing the affluent as well as the poor, and making public health worse along the way.

There is no simple answer to this problem. The pat answer from economists, get the price right and then increase welfare benefits for the poor, would both make the system more efficient and more equitable, a normatively desirable outcome. But what if the government passes the tax on energy but does not also provide the corresponding increase in welfare benefits? In that case the government has accomplished the goal of making energy markets more efficient but has also worsened the inequality problem. While it is hard to predict future outcomes, this combination of increased energy taxes but no compensating increase in welfare payments may be the most likely scenario in the United States. Certainly tax increases are difficult to pass these days, but increased welfare payments for the poor seem like an even more distant goal.

So if one assumes that taxes on energy will *not* be accompanied by increased welfare payments, the analyst is in the position of trying to make a difficult trade-off. How should one value the benefits of requiring affluent consumers to pay the real cost of their energy consumption versus the cost of making the tax system even more regressive and so making the distribution of income even more unequal? Though I am stating this problem in terms of costs and benefits, it is not a purely, or perhaps even primarily, quantitative question.

One point in favor of raising taxes on energy is that European countries already have very stiff taxes on energy consumption, and on consumption generally. Taxes on goods and services in most of Europe are more than twice (in the case of Denmark more than three times) those in the United States (OECD 2010). Despite these very big (and regressive) consumption taxes, the European countries also have much more egalitarian distributions of income than the United States. (See OECD 2011 for a listing of GINI coefficients for the OECD countries. A higher GINI means higher income inequality.) Thus high consumption taxes are not a barrier in and of themselves to reducing inequality. That said, the introduction of a new consumption tax on energy in the United States will, absent compensating increases in welfare benefits, worsen an already bad situation, making the United States even more unequal than other industrial countries. But without such a tax, massive subsidies continue to go to affluent consumers, and public health takes a very serious loss. Nordhaus (2011) notes that the National Academies study estimates the number of premature deaths from air pollution related to energy consumption at 21,000 per year, twice the number of people who die from homicides. Moreover, the poor are disproportionately affected by such pollution. People with incomes below the poverty line have higher rates of respiratory diseases like asthma, which makes them more vulnerable to harm from pollution (Akinbami et al 2011). Therefore, failing to curb air pollution from energy sources by allowing prices to remain lower than their real social costs also has a negative effect on the equity in the sense of the fairness of the distribution of costs and benefits in society.

At this point one might be tempted to try to calculate which course of action, whether or not to tax energy, has the most benefits, or the least harms, for people at the bottom of the income scale. But that is not the approach I take here. Such calculations are remarkably fluid and depend on a host of problematic assumptions, not least such questions of which costs and benefits count, how to value quantitatively morbidity and mortality, and how far down in the income scale the analysis goes to designate people as “poor.” It is better to simply make the point that these policies require trade-offs that are to a large extent incommensurable.

An alternative approach would be to say that it is not the job of the policy analyst to resolve these sorts of conundrums. Making social trade-offs is what policy makers do, and the purpose of policy analysis is not to announce, with no small amount of hubris, what the best policy is, but rather to inform decision makers about what their policy choices entail (Pielke 2007). Pielke also points out that another function of the policy analyst should be to enlarge the range of options that policy makers have. In that spirit, I offer another option for taxing energy consumption, one not based on any pure principles of equity or efficiency but instead on simply moving policies in a better direction than they are moving now. I am not trying simply to split the difference, but rather to advocate for a better policy while acknowledging that an optimal policy does not exist.

The brutal fact is that it is not possible to even calculate, much less enact, optimally efficient policies or those that perfectly satisfy some equity criterion. The National Academy study does quantify, in terms of price, what the real costs of energy would be if all the externalities were included in the price, but those estimates (and they are estimates, even if they are quoted without error bars) have been and will be endlessly critiqued. There is a (not small) cottage industry of quantitative risk assessors who can argue over everything from discount rates to the proper valuation of non-market goods and so can come up with numbers that differ in non-trivial ways from the National Academy estimates. Moreover, even if we think we know what the “real” costs of energy are, it is not clear that putting those costs into the price of energy will result in an optimal or equitable reduction in fossil fuel use. We might have the wrong numbers and, more importantly, energy consumers may not respond rationally to price signals so the market may not work as hoped. So arguments over what the optimal price would be, and whether it would be equitable, are beside the point, even in principle. The key point to take away from the National Academy study is that the costs of energy externalities are real and substantial. From there we can suggest a much more trial-and-error based approach.

Market prices for energy fluctuate. Oil, natural gas, and, to a lesser extent, coal prices change over time, sometimes quite quickly, going both up and down. While some countries spend a great deal of money insulating consumers from that volatility, the United States does not, and consumers know that energy prices are not stable. It is simply a fact of life. These price fluctuations are independent of what the government does in terms of energy taxes. And an increase in the market price of energy affects poor consumers just as much as an increase that comes from taxes; the only question is who gets the additional money.

Therefore, policy makers could push policy in the right direction by taxing energy so that the prices people pay better, though not perfectly, reflect the social costs that energy consumption entails. To take account of the equity problems of increasing prices for the poor, policy makers could make these taxes small compared to the normal price fluctuations that energy markets experience, perhaps no more than

10% of monthly price fluctuations over the past several years. This policy would have only a very small effect on demand for fossil fuels, since consumers would be accustomed to much larger swings in prices from market volatility and likewise a small effect on the regressivity of the total tax system. As a result, it would not have the effect of instigating a major change in consumer behavior based on price. It would, however, raise a significant amount of revenue for the government, which could target the money toward promoting energy efficiency and renewable energy, eventually lowering the demand for fossil fuels and reducing the market price increases that consumers would otherwise experience. Many studies make the point that innovations in energy will need a technology push as well as a market pull, and a small dedicated tax could help to fund that technology push (see Weiss and Bonvillian 2009 for a discussion of that literature).

Task 3 : Ethical Implications of Unstated Consequences

The unstated and indirect consequences of policies that seek innovation in energy present all the challenges of prediction. Analysts can easily speculate about some of them but it is impossible to know if one has come up with all of them or even the most important of them. The point in educating engineers is not to give them the impression that all such consequences are predictable and manageable, but rather to encourage them to expand their imaginative capacity and to realize that technological changes may pose consequences with ethical issues that go beyond the obvious consequences of generating energy. For a meaningful pedagogical exercise, students would need to analyze specific features of energy policy studies. For example, Weiss and Bonvillian (2009, ch. 4) start a road-mapping exercise for technologies such as hydrogen fuel cells, solar energy, LED lights, wind, batteries for plug-in hybrids, and geothermal energy, seeking to understand their paths of innovation for their focal purposes, generating energy at some particular cost. To find their unstated consequences students could study the diverse factors that go into their creation and use. What is the supply chain for each technology and could that supply chain lead to dependency on hostile or unstable countries, environmental damage for the sources of raw materials, or social disruption in the communities that supply those materials? What kinds of skill sets and labor relations will attend manufacturing the technology? How will customers use the technology and will it simply reinforce the current system of highly centralized energy production with an elaborate distribution mechanism or will it encourage more distributed generation of energy, and what are the potential social implications of such a change? Given this more holistic assessment, including the society in which all of these processes will operate, what sorts of ethical values will particular energy innovations promote? Note that it will be both difficult and important in teaching this sort of material to avoid falling into a technological determinist frame. One way to do this is to start a course that would include this exercise with background reading from Nye (2006), which surveys the field of the social implications of technology clearly and succinctly, avoiding many of the traps that newcomers to this field often encounter.

Task 4: Embedding ethical values into institutions

As a final exercise, students can examine what ethical values institutions hold or manifest. Social science conceptualizes institutions as "persistent and connected sets of rules and practices that prescribe behavioral roles, constrain activity, and shape expectations (Keohane and Haas 1993, pp. 4-5)." These rules and practices are based on the ideas that underlie them, both technical ideas and ethical ones. So what ethical values do institutions espouse? Consider ARPA-E, the new agency created in the Department of Energy to advance energy innovation. It articulates its mission as:

1. ARPA-E's mission is to fund projects that will develop transformational technologies that reduce America's dependence on foreign energy imports; reduce U.S. energy related emissions (including greenhouse gasses); improve energy efficiency across all sectors of the U.S. economy and ensure that the U.S. maintains its leadership in developing and deploying advanced energy technologies. (Available at http://arpa-e.energy.gov/About/Mission.aspx along with other information about the agency.)

This bears a striking resemblance to the studies we have discussed above. However, when analyzing an institution, one must also examine its actions. Students could examine several features of the agency's functioning. Which projects has ARPA-E actually funded and how well they correlate with the values stated in their mission? What methodologies does ARPA-E use to evaluate proposed projects and what sorts of ethical values do those methods carry? In particular, what criteria show up most prominently in those methods and what criteria get no mention? What kinds of people staff ARPA-E, representing which professions and which sectors? In short, what are the rules and practices that govern the institution and which ethical values do those rules and practices promote?

Concluding remarks

The point of all these exercises is not that engineering students are expected to solve complex ethical dilemmas or that they can even affect, in the course of their careers, all of the ethical choices bound up in new energy technology. The point instead is to expand their imaginative capacities and ability to reflect critically on the work that they will do as engineers in the institutions that employ them. Contemporary energy policy tends to bury ethical issues beneath the more obvious needs of technical innovation. The point of these exercises in excavation is to enable engineers to see, more often than they might, the ethical possibilities in their activities.

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