Designing a Durable Energy Policy

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Abstract: Although the U.S. energy system seems to resist the changes necessary to meet today's challenges related to energy security and climate change, the system has gone through massive change several times since 1850. A major driver in each of these earlier transitions was an economic value, such as mobility, that markets could capture. Because environmental and security values are public goods, changing today's energy system will require a policy that creates a market signal reflecting these values. However, it is also necessary to craft a policy framework that is both durable over a long time period and able to adapt to new information as it becomes available. This essay examines some of the possible attributes of a durable and adaptable policy. The discussion is necessarily preliminary because relatively little formal research exists on this topic. However, even a preliminary examination suggests that considerations of policy durability could affect the choice between a carbon tax and a cap-and-trade system.

Since the early 1970s, U.S. policy has sought to create an energy system – both for transportation and for electricity – that is cleaner and more secure than the one we have without significantly raising energy prices. We have made some progress, especially in reducing by about half the energy intensity of the economy (that is, the amount of energy needed to produce a unit of GDP) and in reducing emissions of conventional pollutants.[1] Even so, the National Research Council recently estimated that available technology could reduce energy consumption by a third.[2] Moreover, despite the emergence of electric vehicles and biofuels, our transportation system still depends on petroleum for over 95 percent of its fuel. This dependence exposes our economy to variations in world oil prices over which we have little control. More than 83 percent of our overall energy system still uses fossil fuel; this is better than the 93 percent dependence on fossil fuel in 1973, although the emergence of nuclear power accounts for most of the improvement.[3] Fossil fuels not only create greenhouse gas emissions, but also impose significant health costs on the economy through the emission of conventional pollutants, despite consid-

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erable improvements resulting from the federal Clean Air Act.[4]

We have a long way to go until we have the energy system that we say we want. Fundamentally changing the energy system is no simple task because this system is more than a collection of easily replaced hardware. Rather, it is deeply embedded in both the physical and social infrastructure of the nation.[5] The petroleum, transportation, and electric systems are not only technological but also social; their operation requires behaviors on which modern life has become utterly dependent. One might also suggest that the energy system is deeply embedded in the nation's political infrastructure.

Despite these difficulties, the energy system has at various stages in our history undergone fundamental change. Thus, in 1850, wood produced 90 percent of the energy in the United States. By 1910, coal ran 90 percent of the energy system. And by 1950, oil and natural gas were the fuels of choice for two-thirds of U.S. energy production. It is worth noting that each of these major transitions evolved over about six decades.[6]

But these transitions involved more than simply fuel substitution. In each case, a crucial condition was that a transition in fuel was accompanied by new technology, and together these two elements created new economic value.[7] Thus, the steam engine using coal as a fuel made industrialization and steam transportation possible. Oil coupled with the internal combustion engine created not just automobiles but a mobile society. And electricity generated by a variety of fuels produces clean and convenient light, comfort, and communication. Electricity has also been responsible for an extended surge in total factor productivity in the U.S. economy.[8]

This brief history provides an important insight into the inability of policy to effect dramatic change in the energy system over the last forty years. Each of the past system transformations created an economic value that the market readily captured. If we wanted to ride the rails or cross the ocean using steam power, we could buy a ticket. When we wanted to live in the quiet suburbs while still working in town, we bought a car. Heating, cooling, and light were ours by merely paying the utility bill. But today's goals of energy security, cleanliness, and affordability are different. The first two are public goods that certainly have value, but it is a value external to the market. Affordability – that is, a lower energy bill – is captured in the market (and through government policies to keep prices low), but its effect is to drive the energy system toward reducing cost rather than introducing new technologies that are cleaner and more secure.

Creating the technological change needed to transform the energy system is a complicated process. However, the absence of change-induced economic value is a crucial problem, for history suggests that such value has been a necessary if not sufficient condition to promote change. Indeed, its presence works in two ways: first by sustaining change during a long period of system transformation, and second by driving the development of technology that makes the transformation affordable. With regard to the first effect, economist Robert Heilbroner characterizes economics as the "force field" that enables the steady progression of technology on many fronts.[9] In his view, technology can alter the material condition of human existence. If the change has value and can be priced in the market, the economic system effectively transmits the price signals necessary to sustain the incremental technological improvements that, over time, lead to a life that is in some sense "better."

Joseph Bower and Clayton Christensen, both scholars of business administration, explore the second effect of economic value: the emergence of new technology.[10] Disruptive technological change has been the goal of huge government investments in new energy technology over the past four decades. More often than not, however, disruptive technological change results from unexpected value creation rather than technological breakthrough. Bower and Christensen argue that technology that appears to be disruptive usually enters an existing market as an incremental improvement to an existing product. But once established in this routine application, it becomes apparent that the new technology also makes possible new applications or markets. Thus, magnetic disk storage for mainframe computers became smaller in incremental steps, but at some point became small enough to make personal computers possible. Past transitions in the energy system appear to have followed a similar path. For example, electricity was originally introduced as a substitute for gas lighting using direct current from Edison's Pearl Street Station in New York City. But then alternating current emerged as a preferred technology for transmitting electricity over long distances. Next, alternating current made possible the electric motor, which created new values throughout the economy.

What should we make of this history as we struggle to develop a policy that delivers clean, secure, and affordable energy? One lesson is that because our goals are public goods, we should find a way to create a market price for them; this would encourage the most efficient allocation of resources for producing those goods. Accordingly, we agree with the overwhelming majority of economists who argue that internalizing the cost of energy insecurity and environmental harm is a crucial policy goal.[11] But our understanding of the role of economic value in creating technological change suggests that successful policy must have two other attributes beyond efficiency and environmental effectiveness. First, it must sustain change over a long time period – decades, in the case of the energy system. Thus, any policy to promote the transition of our energy economy must be durable. Second, it must be structured in a way that drives the incremental changes that create technological disruption, taking into account future economic, environmental, and technological shifts that we can only begin to imagine. Thus, long-term policy must also build in flexibility to allow our regulatory structure to adapt to new information.

In focusing on durability and flexibility as important components of transformational energy policy, we do not mean to suggest that these criteria are more important than environmental outcomes and cost-effectiveness. We mean simply to focus on criteria that have received less attention in the debate over which policy instruments would help us transition to a cleaner energy system. So how do we design policy that is both durable and flexible?

We have never embarked on a policy specifically intended to transition our entire energy system to new fuel sources or fundamentally new ways of operating. Yet such a transition is required in order to reduce greenhouse gas emissions to near zero by mid-century, the level necessary to stabilize the climate. We do, however, have at least some models that have produced dramatic shifts in the internalization of pollution externalities through the Clean Air Act (CAA), which contains both traditional "command and control" mechanisms as well as market-based schemes for reducing pollutants. From the forty-year experience of the CAA as well as other programs and policy areas, we can draw lessons about how to craft policy that is adaptable yet long-lasting and about the pitfalls to avoid.

One measure of durability is whether a program not only remains on the books but continues to have real effect long after its passage. By this definition, much of the CAA is durable. It passed in 1970 and was amended in both 1977 and 1990, but its principal provisions – regulating pollutants from automobiles and establishing and implementing National Ambient Air Quality Standards through a system of cooperative federalism – remain in effect. Moreover, the most innovative part of the 1990 amendments, the creation of a cap-and-trade program to regulate the pollutants that cause acid rain, not only remains in effect but has been strengthened and expanded.

Though this measure of durability – that is, merely remaining in effect – may seem modest, other expansive programs adopted with great fanfare have done less well by this measure. For instance, Congress eviscerated almost all the provisions of the sweeping Tax Reform Act of 1986, which repealed many exemptions and loopholes while lowering tax rates, by reopening the loopholes.[12] And the Freedom to Farm Act of 1996, which was designed to phase out farm subsidies, has met a similar fate.[13]

According to public policy scholar Eric Patashnik, one important predictor for whether a policy will remain durable is the degree to which the policy creates a political constituency for its continuation. With respect to taxes, there is little pressure to resist opening up new loopholes while a great deal of pressure – from industry benefiting from the breaks – exists to repeal their closure. The same is true for the cutting and subsequent reinstatement of farm subsidies. This experience should signal caution in putting a market price on carbon externalities generated through the burning of fossil fuels, because a tax on carbon may likewise be subject to erosion over time.

By contrast, policies that create a political constituency seem to fare better over the long run. The success of the Acid Rain Trading Program (adopted as part of the 1990 amendments to the CAA), for example, may have something to do with the fact that emitters of sulfur dioxide (which leads to the formation of acid rain) were awarded valuable allowances that they could use to meet their compliance obligations or could sell or bank to use or trade in future years.[14] Those allowances became valuable currency, and to repeal the program would eliminate their value.

Of course, creating a value by implementing an allowance-based program presumes that the political will existed to create the program in the first place. But once created, the program's value may help resist attack on the underlying policy. For example, California's Global Warming Solutions Act, which seeks to roll back greenhouse gas emissions to 1990 levels by 2020, survived an initiative to halt its implementation largely because the campaign against the initiative was funded by the green technology industry that has emerged in California partially in response to the legislation. Experience with the CAA's trading program suggests that coal-burning utilities might become supporters of an allowance-based program once their opposition to the mere existence of the program has been overcome. And producers of renewable energy and other innovative technologies to reduce emissions may also favor the continuation and even the strengthening of programs that make carbon emissions more expensive (and hence increase demand for their products).

That is not to say that the development of a political constituency in favor of government policy is the only important variable in determining whether the policy will be durable. It is simply to note that the lack of such a constituency may lead to a policy's demise while the presence of a constituency may help ensure its success. And again, in thinking about how to construct a policy that prices the greenhouse gas externalities created by burning fossil fuel, past experience suggests that a cap-and-trade program may prove more durable over time than a tax on carbon emissions.

More traditional environmental regulatory approaches have also proved durable at the federal level. Despite significant congressional opposition since the mid-1990s to various provisions of the CAA, for example, no part of the statute has been repealed. It is unclear exactly why the CAA has remained so durable, but one reason may be its success in producing measurable improvements in clean air across the country. Another reason may be that various presidential administrations have used their administrative discretion to ease in stringent new regulatory requirements rather than imposing them with no notice. A third reason may be that an environmental constituency has developed, providing resistance to repeal efforts.

However, it is worth noting the obvious: simply because a statute remains in effect does not mean that the statute is environmentally effective. Several provisions of the Clean Water Act, for example, saw little to no implementation effort for decades, and observers have documented numerous and sometimes egregious violations of the Act across the country that have gone unenforced.[15] The hazardous air pollutant provisions of the CAA resulted in virtually no pollutants being regulated until Congress stepped in and altered the statutory scheme. These examples reveal that in order for a policy to be both durable and effective, the agency responsible for its implementation needs sufficient staffing to do its job. One suggestion, put forth by law professor Richard Lazarus, is for agencies to be provided with self-financing so that they can build and maintain sufficient staffing levels and insulate themselves from annual budget debates.[16]

In short, for a policy to remain durable across many decades it may need an organized political constituency to ensure that it remains in effect. Cap and trade as well as traditional regulation may fare better on this score than taxes. Additionally, the agency responsible for programmatic implementation needs sufficient staffing to succeed.

Though durability is important, it is by no means sufficient to stimulate the long-term transformation we seek in the energy system. Indeed, policies may sometimes be durable simply because they are weak or ineffectual and thus generate little opposition. Durability over time may be especially likely for policies that remain in place with little change. To produce innovative transformation in our energy system, then, durability needs to be accompanied by processes of evaluation that allow regulators and/or policy-makers to impose changes to the regulatory system in the face of new information. With respect to climate change in particular, although there is near consensus on the fact that human-induced warming is occurring, there is significant uncertainty about a number of dimensions of the problem, including how much warming will occur by when; how fast the global economy will grow over the course of the next several decades; and what innovations in clean energy will develop and at what cost. As more information becomes available about each of these issues, regulatory mechanisms that provide flexibility can incorporate the new information in order to achieve environmental, reliability, or economic goals.

Policy mechanisms to promote flexibility can take a number of forms. They can be triggered automatically once certain events occur. They can require mandatory review by an implementing agency on a regular basis. They can be built directly into a statute. And of course, a legislative body can always amend enabling legislation to respond to new information.

One clear concern about the long-term transformation of our energy system is cost uncertainty. On the one hand, policymakers may fear that a shift to cleaner energy sources will cost more than original estimates due to higher-than-expected compliance costs for greenhouse gas emitters. On the other hand, initial compliance costs may actually be too low to spur the technological innovation necessary to reduce emissions to near zero over the course of the century. Designing flexible policy mechanisms to respond to financial uncertainty in either direction can help avoid these extremes.

The European Union, members of the Regional Greenhouse Gas Initiative, and the state of California have all adopted variations of cap and trade, and even China is considering implementing city-level cap-and-trade programs. Given the dominance of cap and trade as a policy choice for reducing greenhouse gases, we focus here on ways that cap and trade can incorporate mechanisms to protect against financial uncertainty in both directions. If, for example, exogenous events create large upward pressure on allowance prices, thereby increasing the overall cost of compliance with greenhouse gas emissions reduction, a number of mechanisms could help alleviate that pressure. Creating a large enough market for allowances would provide one such means; others include allowing for the banking of allowances, holding some allowances in reserve, allowing for a multiyear compliance period, and promoting transparency and consistency in implementation.[17] By permitting the banking of allowances for use in future years, for example, emitters can purchase allowances at a time when prices are relatively low in order to use them in future compliance periods when allowances might otherwise be more expensive. Systems can also establish allowance price reserves, whereby regulators set aside a portion of allowances that they can make available only if allowance prices reach a predetermined level.[18] The new California cap-and-trade program establishes such a reserve.[19] A more controversial mechanism includes establishing a safety valve that permits the government to issue more allowances in the event that allowance prices reach a certain level; the downside of such a mechanism is that overall emissions rise if new allowances are released, unless emissions in future years are cut more dramatically.[20]

But financial uncertainty can create problems in the other direction as well if one of the goals of a cap-and-trade system is to spur innovation. When allowance prices fall too low, incentives to innovate disappear. Indeed, the problem of too-low allowance prices has plagued the two operational greenhouse gas cap-and-trade programs, the European Union's European Trading System (ETS) and the Regional Greenhouse Gas Initiative. The latter is a relatively modest program requiring only minimal emissions reductions and involving a relatively small portion of the U.S. electricity sector; so the expectations that it would spur technological innovation were never large. But the European Union's ETS has seen prices in the allowance market fall rather dramatically, prompting many critics to complain that the system is failing. The state of Bavaria, in Germany, has just announced that it will no longer trade allowances through the system given the glut of allowances on the market and the consequent lack of trading.[21] Prices have plunged 60 percent in the last year due to both slow economic activity and an accumulation of allowances as a result of declining energy use.[22] Prices peaked at around $30 per allowance prior to the recession and are now hovering around $9.[23] If the cap-and-trade system had been designed to account for the possibility of a massive economic slowdown, the low-end price volatility could have been mitigated.

Before suggesting possible means to mitigate low allowance prices, it is worth noting that the ETS has in fact accomplished its environmental goal of cutting greenhouse gas emissions to the level of the cap. The ETS has met the cap not only through the reduced demand for energy caused by the recession but also through real emissions cuts.[24] Yet as economist Robert Stavins has pointed out, the ETS system has failed in the ancillary goal of stimulating technological innovation. One could view the ETS, then, as successful to date in achieving its environmental objectives but unsuccessful in stimulating the technological change necessary to transition to a much cleaner energy system over the next thirty to fifty years. And given the oversupply of allowances on the market combined with provisions that permit the banking of allowances for use in future compliance periods, the potential for innovation going forward is low absent any changes to the ETS.

Cap and trade could, however, be designed to include flexible mechanisms to anticipate dramatic drops in allowance prices. There are at least two possible approaches. One is essentially the opposite of the allowance mechanism described above, under which allowances are held in reserve and released only if allowance prices escalate to a certain level. Instead, if allowance prices drop below a predetermined level, the regulator would automatically remove allowances from the market. Such a floor would have the effect of not only keeping prices from falling too low to stimulate innovation but also achieving additional environmental benefits through lower emissions. Researchers at Resources for the Future have suggested that imposing what they term a "soft price collar" – with both an allowance reserve and a price floor – "could provide considerable assurance about cost while preventing the possibility that emissions could spiral out of control."[25] Interestingly, though, the current cap-and-trade schemes, including that of California, include only the allowance reserve, not the price floor.

If a principal concern about cap-and-trade programs to reduce greenhouse gas emissions is allowance price volatility in both directions, a major concern of a carbon tax is instead whether it will achieve its environmental objectives. One advantage of a carbon tax over cap and trade is that policy-makers can set the "price" of compliance by choosing the tax rate and base. Thus, concerns about large fluctuations in the cost of compliance inherent in cap and trade do not exist with a carbon tax. A disadvantage of a carbon tax, however, is that it can be difficult to predict what environmental outcome will occur based on the tax rate and base chosen. By contrast, a cap-and-trade system chooses the desired level of emissions reductions and then lets the trading system determine the cost of compliance.

In theory, a tax and a cap-and-trade system work in the same way: by pricing environmental externalities into the cost of producing energy. With a tax, though, policy-makers must choose what cost of compliance (the tax) they believe will achieve a desired level of environmental compliance. If they are wrong because they underpredict the cost of compliance by setting the tax rate too low, emissions will be higher than desired because emitters will choose to pay more in taxes rather than pay to reduce emissions. If, instead, they underpredict the cost of compliance by setting the tax rate too high, they will achieve greater emissions reductions because emitters would likely choose to reduce emissions rather than pay the tax. Given the politics of tax debates, it seems safe to predict that policy-makers would be more apt to set taxes too low – resulting in lower emissions reductions than desired – than they would be to set taxes too high.

Therefore, if taxes are adopted to achieve long-term emissions reductions, just as cap and trade needs to include mechanisms to constrain price volatility, a tax system should incorporate mechanisms to constrain environmental volatility. These mechanisms could include, for example, automatic triggers that increase the carbon tax rate in the event that the tax is not sufficiently high to achieve an emissions target, or that decrease the tax rate if emissions decline by an amount greater than predicted. Or a tax scheme could provide authority to an agency to evaluate environmental outcomes and adjust the tax rate in the event that those outcomes are not being met. These suggestions, though, are politically controversial and highlight why a cap-and-trade system may retain political support more easily than a carbon tax.

Finally, under either a cap-and-trade system or a carbon tax, we may gain new information about the level of emissions reductions necessary to slow climate change or about whether we are regulating the appropriate pollutants. If our initial assumptions prove to be wrong, we will want a means to incorporate new information into whichever system we have chosen for regulating the price of carbon. One approach that forces regulators to take into account new information about environmental progress is modeled on a mechanism included in the CAA. The CAA requires the Environmental Protection Agency to review its National Ambient Air Quality Standards – set for major pollutants – every five years and revise them if necessary to protect public health and welfare. Although it has not always met this statutory deadline, the agency has nevertheless revised the standards on a number of occasions. A carbon tax – or any regulatory policy to reduce greenhouse gas emissions – could include such a regulation-forcing mechanism that requires the regulator to revise the cap periodically based on new information about cost, environmental progress, and/or technological advances.

We have attempted to provide examples of past efforts to incorporate both flexibility and durability into regulatory schemes and have suggested means to do so in a cap-and-trade or tax system to regulate greenhouse gases. But our efforts are only preliminary. Scholarship and policymaking to achieve a long-term transition to a clean energy economy have frequently focused on environmental outcomes and cost-effectiveness with less attention paid to the need for adaptable, yet long-lasting, policies. There is a robust debate, for example, about whether a carbon tax or cap and trade is the superior instrument to achieve our desired environmental outcomes and to do so cost-effectively. In our view, however, less attention has been paid to whether a tax or a cap-and-trade system is more likely to be durable or flexible. We think that cap and trade may be superior on both fronts, but our conclusions are very preliminary. Our broader aim is to focus attention on, and stimulate conversation about, the importance of durability and flexibility in transitioning our energy system – a dramatic transformation that will be achieved without the endogenous market changes that accompanied our earlier energy history.

ENDNOTES

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