Energy Subsidies: Worthy Goals, Competing Priorities, and Flawed Institutional Design

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The economy literally runs on energy, and energy choices have significant effects on the environment and national security. To influence these choices, the government often relies on targeted subsidies for both "green" energy and hydrocarbons.[2] These subsidies grew by 108% – from $17.9 billion to $37.2 billion per year – between 2007 and 2010.[3] These subsidies pursue worthwhile goals. Indeed, many are quite compelling. But unfortunately, many subsidies under current law have design flaws, which make them less effective or even counterproductive.[4] The goal of this Article is to show how to do better.

This Article focuses on three sets of issues. First, there often is tension between our environmental and national security goals. Unfortunately, the economics literature on energy largely ignores these tradeoffs by omitting national security from the analysis. This Article takes issue with this approach and suggests ways to manage these tradeoffs. Second, as a strategy to deal with these and other costs, this Article criticizes subsidies, and argues that Pigouvian taxes and tradeable permits are better alternatives. They are more cost effective, and less prone to perverse effects. Third, if we are stuck with subsidies for political reasons, this Article offers a number of ways to improve them.

National security needs to be incorporated in the analysis because our energy choices – and, in particular, our dependence on oil – can affect national security in at least two ways. First, the US can face increased defense costs in securing access to oil, for instance, by maintaining a naval presence in the Persian Gulf. Second, some oil producers are geopolitical rivals, who spend oil revenue on terrorism, invasions, or nuclear weapons programs. In ignoring these costs, the literature emphasizes that they are hard to quantify. For instance, when the U.S. deploys forces in the Middle East, determining how much of this cost is attributable to oil, as opposed to other interests (such as countering terrorism), is not straightforward. Even so, difficulties in computing a cost are not a reason to ignore it. After all, climate effects are also uncertain, but commentators still try account for them, and national security warrants a comparable effort. One way to mitigate national security costs is to expand and diversify the supply of oil, but this solution has familiar environmental costs. In contrast, another solution – reducing demand for oil – usually avoids these environmental costs.

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[2] Martin A. Sullivan, *Tech Neutrality, Tax Credits, and the Gas Tax*, Tax Notes, Dec. 23, 2008 (every president since Jimmy Carter has proposed energy subsidies).

[3] EIA. During this period, renewable energy subsidies increased by 186% (from $5.1 billion to $14.7 billion). In total, the U.S. spent $150 billion on green energy through 2014. Brookings study, http://www.brookings.edu/~/media/research/files/papers/2012/4/18%20clean%20investments%20muro/0418_clean_investments_final%20paper_pdf (of this $150 billion, $100 billion is for renewable energy (wind, solar, biofuels, R&D), $15 billion on conservation, $10 billion is for electric cars, $10 billion for high speed rail, $6 billion is for smart grids, $6 billion is for nuclear).

[4] National Research Council, Effects of U.S. Tax Policy on Greenhouse Gas Emissions (William D. Nordhaus, Stephen A. Merrill & Paul T. Beaton, eds.) 10 (2013) ("[C]urrent tax expenditures and subsidies are a poor tool for reducing greenhouse gases and achieving climate change objectives. The committee has found that several existing provisions have perverse effects, while others yield little reduction in GHG emissions per dollar of revenue loss.").

The best way to internalize dualing externalities is a separate Pigouvian tax or tradeable permit regime for each, such as a menu of separate carbon, pollution, and national security taxes. Yet *taxing* what we want to discourage is harder politically than *subsidizing* what we want to encourage, at least in the U.S.[5] As a result, the U.S. often relies on targeted subsidies to promote particular technologies. But unfortunately, subsidies usually are less effective than taxes and permits. This Article identifies a reason, rooted in information and administrative costs, which is new to the literature: to be neutral, taxes have to reach all *sources* of harm, but subsidies have to reach all *ways to mitigate* harm, which is a much longer list. For example, identifying all goods and services that *use* oil, and thus should be taxed, is not easy (*e.g.,* gasoline, diesel, jet fuel, plastics, etc.); yet reaching every step that *reduces* the use of oil, and thus should be subsidized, is even harder (*e.g.,* hybrids, electric cars, smaller gasoline-powered engines, slower driving, carpooling, mass transit, *etc.*) Unfortunately, many subsidies under current law do not *even try* to reach every alternative for abating harm; instead, the government "picks winners," even when it does not have the expertise, information, and incentives to do so effectively. In addition, unlike taxes and permits, subsidies do not increase the price of energy, and thus do not curtail the overall demand for energy.

Given these advantages of taxes and permits over subsidies, the best solution is the menu of taxes or permits described above. If this strategy is politically unattainable, variations of taxes or permits with more political appeal should be considered. For example, one option is a tax that phases out when energy prices are high. Voters should object less to a tax when prices are low. Another strategy is to embed the tax in a lump sum payment. For instance, assume a "saving gas credit" offers $1,000 per year minus an amount based on gasoline usage (*e.g.,* $1.00 per gallon). This sliding scale credit declines as claimants use more gasoline: the credit is $1,000 for those who use no gas, $200 for those who use the average amount, etc.[6] Although this program functions like a tax, it is framed as a "reward" for using less energy.

If none of these alternatives are politically viable – so we are stuck with energy subsidies – institutional design problems under current law should be mitigated. One lesson is not to single out specific technologies. Instead, a broader and more "tech neutral" subsidy offers competing options to consumers. For example, a subsidy to reduce the use of gasoline should not single out hybrids or electric cars. Instead, it should reward greater fuel efficiency (*e.g.,* with $300 for each mile per gallon above 25 mpg), regardless of how it is attained (*e.g.,* with smaller engines, lighter materials, more aerodynamic designs, etc.)

Subsidies also should be precise in rewarding the desired behavior, instead of a proxy for it. Otherwise, the subsidy can have perverse effects. For example, Congress pays 2.3 cents for each kWh of electricity generated with wind. To claim this subsidy, producers sometimes generate electricity that no one needs, and then *pay* customers to take it. This perverse effect

[5] Steven Cohen et al, Sustainability Policy 82 (2015) ("In our view, the focus of climate and energy policy should be to lower the price of clean energy rather than to raise the price of dirty energy.").
[6] The average household uses 800 gallons per year. The credit is $1,000 minus $800, or ($1.00 x 800 gallons).

arises because this subsidy rewards a proxy (*producing* wind energy), instead of the desired result (*replacing* carbon-based energy).

Perverse effects can also arise when subsidies are not coordinated with other regimes. For instance, subsidies for electric and hybrid vehicles have an unintended effect under federal fuel economy (or "CAFÉ") regulations: by increasing the average fuel efficiency of a manufacturer's fleet, they enable auto manufacturers to sell more gas guzzlers.

Energy subsidies also should not pursue both energy policy and distributional goals. In doing so, they usually advance *neither* cost-effectively. To improve the environment or national security, focusing on low-income claimants is less cost-effective. They have less capacity in their budgets, and thus are less responsive. But to channel resources to low-income households, green energy subsidies are less efficient than cash because they are a less flexible currency.

Needless to say, the government does not have to pursue energy policy goals only with subsidies, taxes or permits. For instance, it also can use command and control regulation, "nudges," and disclosure for environmental goals, or foreign aid, treaties, and military deployments for national security. The goal here is not to consider all policy instruments or to determine when each should be used. Instead, this Article assumes the government will use subsidies, taxes, or permits at least some of the time, and offers guidance about how to structure these market-based instruments more effectively.

Part I canvases environmental, economic, and national security market failures associated with energy, and shows how empirical uncertainty and competing goals complicate efforts to correct them. Part II discusses the political advantages of subsidies over taxes and permits, and surveys targeted subsidies under current law. Part III analyzes institutional design challenges in crafting a subsidy's scope. Part IV considers challenges grounded in traditional tax policy, such as effects on labor and savings decisions and distribution. Part V highlights this Article's policy implications, including the superiority of taxes and permits over subsidies, strategies to make taxes and permits more politically palatable, and ways to mitigate institutional design flaws under current law. Part VI is the conclusion.

I. Worthy Goals and Competing Priorities: The Environment, Economy, and National Security

The first step in evaluating energy subsidies is to consider their policy goals, which are rooted in the environment, economy, and national security. Although many of these goals are worthy, they are hard to pursue for two reasons. First, the relevant harms are uncertain. Second, environmental and national security goals sometimes conflict.

A. *Environmental Externalities*

1. *Climate Change*

Climate change is perhaps the most common justification for subsidizing renewable energy. Fossil fuels and industrial processes caused 78% of the increase in greenhouse gas emissions ("GHG's") between 1970 and 2010.[7] According to the Intergovernmental Panel on Climate Change ("IPCC"), GHG's have warmed the atmosphere, so the "period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere."[8] As the Risky Business Project has observed, "the signature effects of human-induced climate change—rising seas, increased damage from storm surge, more frequent bouts of extreme heat—all have specific, measurable impacts on our nation's current assets and ongoing economic activity."[9] The risks include damage to coastal property, declining agricultural yields in some places (possibly offset by rising yields in others), less productivity from outdoor workers, shortages of water, and outbreaks of disease. One way to mitigate these harms is to favor energy that emits fewer GHGs. A subsidy for this alternative energy should equal the marginal benefit of emitting fewer GHG's – that is, the marginal climate harm this energy avoids.

Nevertheless, estimating climate harms is difficult for five familiar reasons. First, the level of emissions from some activities is uncertain. For example, when natural gas is extracted and transported, some escapes into the atmosphere and contributes to climate change. Experts differ about the magnitude of these "fugitive emissions," and thus about the climate impact of natural gas, and the benefit of using it instead of coal.[10] Second, even if emissions can be estimated accurately, their effect on temperature is debated. According to the IPCC, past trends do not supply the answer because they "are very sensitive to the beginning and end dates"; indeed, "the rate of warming over the past 15 years . . . is smaller than the rate calculated since 1951." Third, even if temperature changes can be forecasted accurately, their welfare effects are hard to predict. Some regions could suffer severe or even catastrophic harms, while others could actually benefit (*e.g.*, from longer growing seasons).[11] Fourth, and relatedly, there is a vibrant debate about whether global or national welfare is the appropriate benchmark.[12] National welfare costs are considerably lower, since the U.S. has fewer areas prone to flooding and is cooler than much of the world. Finally, since climate effects are unlikely to emerge for decades, a discount rate is needed to value them. A market rate yields a low present value, undercutting

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[7] Intergovernmental Panel on Climate Change, 2014 Synthesis Report, at 4, http://ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_SPMcorr1.pdf.

[8] *Id.*; *see also* World Bank, *Turn Down the Heat: Confronting the New Climate Normal* xvii (2014), http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/11/20/000406484_20141120090713/Rendered/PDF/927040v20WP00O0ull0Report000English.pdf (citing "growing evidence . . . that . . . warming close to 1.5°C above pre-industrial levels by mid-century is already locked-in to the Earth's atmospheric system").

[9] Kate Gordon, *Risky Business, The Economic Risks of Climate Change in the United States* 2 (2014), http://riskybusiness.org/uploads/files/RiskyBusiness_Report_WEB_09_08_14.pdf.

[10] Thomas Merrill & David M. Schizer, Energy Policy for an Economic Downturn: A Proposed Petroleum Fuel Price Stabilization Plan, 27 Yale J. Reg. 1 (2010).

[11] Posner & Weisbach.

[12] *See, e.g.,* Alan Viard, Comment Submitted to Office of Information and Regulatory Affairs, Office of Management and Budget, Feb. 26, 2014 (arguing that a national measure is more appropriate for unilateral actions by the U.S. government, since the U.S. government's primary mission is to advance national welfare, while a global measure is appropriate for multilateral actions, such as global cooperation pursuant to a treaty).

costly responses today.[13] Some defend market rates as the right benchmark for comparing forward-looking investments.[14] Others favor a lower rate on normative grounds[15] or argue that the *real* market rate is lower than we think if climate change slows economic growth.[16]

Given this uncertainty, there is no consensus about the climate cost of carbon. While the IMF values it at $25 per metric ton of CO2, the Obama administration uses $37, and others have offered much lower or higher numbers.[17] Yet even though these costs are hard to measure, we should still address them. In other words, uncertainty is not a reason for inaction.

2. Pollution

Pollution is another familiar negative externality from energy, and thus is also a reason to subsidize cleaner sources. For example, mining for coal pollutes streams and disfigures landscapes, while burning it causes smog and acid rain.[18] Nuclear power generates radioactive waste, and accidents can emit radiation. Oil pollutes land and water when pipelines leak,[19] tankers crash, and offshore rigs malfunction. Hydraulic fracturing uses toxic chemicals that can pollute water wells if spilled or not disposed of properly.[20] Different types of energy also can cause fires, explosions and seismic activity. These various effects can harm human health, as

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[13] For example, William Nordaus uses a 5.5% discount rate, while Stern uses a 1.4% rate. This disparity is the main reason they offer very different policy recommendations.
[14] Kaplow & Weisbach.
[15] Daniel Farber, Climate Justice.
[16] Elizabeth J. Moyer, Mark D. Woolley, Michael J. Glotter & David A. Weisbach, *Climate Impacts on Economic Growth as Drivers of Uncertainty in the Social Cost of Carbon*, 43 J. Leg. Stud. 401 (2014) ("The IAWG models share one notable feature: although climate damages can become large as a fraction of output, they do not significantly alter economic trajectories."); *id.* at 4 ("Continued economic growth in the face of climate change is inconsistent with many (admittedly qualitative) statements by experts that climate change may have strongly detrimental effects to human society.").

[17] Interagency Working Group on Social Cost of Carbon, United States Government, *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*, at 2 (2010) ($23.8 per metric ton of CO2 emission in 2015, assuming 3% discount rate; 26.3 in 2020); Interagency Working Group on Social Cost of Carbon,*Technical Support Document: - Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866* (May 2013) ("IAWG issued revised estimate in May of 2013: 37 in 2015, 42 in 2020"); Frances C. Moore & Delavane B. Diaz, *Temperature impacts on economic growth warrant stringent mitigation policy*, Nature Climate Change, Jan. 12, 2015, http://www.nature.com/nclimate/journal/v5/n2/pdf/nclimate2481.pdf ("Damages from climate change that directly affect growth rates have the potential to markedly increase the SCC because each temperature shock has a persistent effect that permanently lowers GDP below what it would otherwise be."); *id*. ("implies a social cost of carbon several times larger than previous estimates" of perhaps $220 per ton); Robert R. Murphy, *The Case for a Carbon Tax is Much Weaker Than You Think*, Dec. 1, 2014, http://instituteforenergyresearch.org/analysis/case-carbon-tax-much-weaker-think/.

[18] Michael Graetz, The End of Energy 86, 92 (2010).
[19] The National Research Council estimates the expected cost of spills to be about ¾ of a cent per barrel. Hidden Costs of Energy, at 321.
[20] Merrill & Schizer.

well as property. As with climate change, the magnitude of these effects is uncertain. For example, there is a heated debate about whether hydraulic fracturing contaminates water, and how feasible it is to regulate this risk effectively.[21] The risks of nuclear power also are vigorously contested.

3. *Rapid Economic Development and the Consumption of Finite Resources*

Unlike climate change and pollution, other environmental costs of energy are not persuasive reasons to subsidize alternative energy. For example, although energy development can trigger "boom town" conditions, such as traffic jams, housing shortages, and overtaxed public services, subsidies for alternative energy are an oblique response at best. Instead, local governments should build roads, add new tolls and taxes, provide more services, and the like.

Similarly, the concern that fossil fuels may eventually run out[22] is not a reason to subsidize alternative energy, since there is no market failure. As Harold Hotelling showed in 1931, the market price of hydrocarbons reflects their inherent scarcity. Producers have to decide how much to sell today and how much to save for the future.[23] If they expect to earn more by selling later, they will do so. As a result, the current price incorporates predictions about the future, including assumptions about future demand, extraction costs, and substitutes. Tighter supply increases hydrocarbon prices, creating stronger incentives to develop alternatives.[24]

B. Economy

1. *Four Market Failures: Incomplete Property Rights, Network Effects, Investment Inefficiency, and Energy Shocks*

The case for government intervention in the energy market is grounded not only in the environment, but also in the economy – and, specifically, in four market failures. First, property rights are not always broad enough to afford innovators all the benefits of new ideas. "As a result, market forces will lead to underinvestment in R&D from society's perspective," Ben Bernancke has written, "providing a rationale for government intervention."[25] This argument is

[21] Merrill & Schizer

[22] Cohen, at 6 (articulating principle of sustainability management that it is better to create wealth in ways that do not use up finite resources). Even though concerns about exhausting the supply of hydrocarbons are longstanding – for instance, a founder of Standard Oil dumped his shares in 1885, believing the world's supply of oil was nearly gone – new technologies have consistently been developed to access more. Russell Gold, *Why Peak Oil Predictions Haven't Come True*, Wall St. J., Sept. 29, 2014, http://www.wsj.com/articles/why-peak-oil-predictions-haven-t-come-true-1411937788.

[23] Harold Hotelling, The Economics of Exhaustible Resources, 39 J. Polit. Econ. 137 (1931).

[24] *See generally* Geoffrey Heal, Exhaustible Resources, The New Palgrave Dictionary of Economics. 2nd ed. (Steven N. Durlauf & Lawrence E. Blume eds) (2008) <http://www.dictionaryofeconomics.com/article?id=pde2008_E000165> doi:10.1057/9780230226203.0522

[25] Ben Bernanke, *Promoting Research and Development: The Government's Role*, May 16, 2011, http://www.federalreserve.gov/newsevents/speech/bernanke20110516a.htm

not unique to energy. It is especially persuasive for basic research, since "[t]he most applied and commercially relevant research is likely to be done in any case by the private sector."[26]

Second, transaction costs and network effects can justify a government role in energy infrastructure. For example, new pipelines or power lines require rights of way from thousands of landowners, and eminent domain is a familiar way to manage these costs. Similarly, a vehicle is more useful if filling stations are easy to find. This is a key advantage of petroleum-powered vehicles over natural gas and electric vehicles. As a result, consumers hesitate to buy alternative vehicles, and the resulting shortage of customers keeps more stations from being built. This chicken and egg problem – and the associated network effect – can warrant government intervention.

Third, to justify subsidies, some commentators invoke a market failure known as "investment inefficiency," which causes consumers to underinvest in energy efficient cars, appliances, or other technologies. This underinvestment could derive from credit constraints, as well as from cognitive biases or search costs that cause consumers to overlook potential savings. Since builders and landlords do not benefit (directly) in cutting a buyer or tenant's energy bills, agency costs may also play a role. Nevertheless, the empirical evidence is mixed about whether consumers *actually do* underinvest in energy efficiency. Instead, hidden costs, instead of market failures, may explain why these investments are not made.[27]

The literature also overlooks a subsidy the tax system already offers (unintentionally) to buy these technologies: the return on these purchases – reduced energy bills – is untaxed "imputed" income. In buying a refrigerator, for instance, assume we can spend an extra $1,000 for one that saves $50 per year in electric bills. The return on this $1,000 (lower electric bills) is not taxed. Alternatively, we can spend $1,000 less and invest this savings in a bond, yielding $50 of annual interest, which pays for extra electricity. Yet the return on this $1,000 (interest on a bond) obviously *is* taxable. This differential derives from administrability concerns, rather than a policy choice.

A fourth justification for subsidizing energy – and, in particular, sources that are unlikely to be cut off abruptly – is the harm from sudden supply disruptions.[28] Indeed, of the eleven U.S.

[26] *Id.*
[27] Greenstone.
[28] CEA, at 20 ("Historically, temporarily high oil price shocks arising from foreign supply disruptions have cut GDP growth and reduced employment."); Stephen P.A. Brown & Hillard G. Huntington, *Assessing the U.S. Oil Security Premium*, 38 Energy Econ. 118, 121 (2013) ; Gilbert E. Metcalf, The Economics of Energy Security, Working Paper 19729 (2013), http://www.nber.org/papers/w19729.pdf ("[W]hether the impact of oil shocks on the economy is as large as it once was is a matter of considerable academic analysis. Analyses focus on factors such as the role of improved monetary policy response to oil shocks combined with a decreasing importance of oil in the economy (Nordhaus (2007)), the interplay between oil markets and other sectors (e.g. housing and automobiles) (Hamilton (2009)), and the need to distinguish between supply and demand shocks (Kilian (2008))."). *But see* National Research Council (arguing that price shocks are costly, but do not represent externalities).

recessions since World War II, ten followed a spike in oil prices.[29] Oil (and other types of energy) have this disproportionate impact because they are inputs in all goods and services, and also are part of every household's budget.[30] Thus, higher energy prices means higher costs and less demand. This prospect discourages businesses from hiring and investing, especially if interest rates are increased to keep high energy prices from aggravating inflation.[31] Market prices may not account fully for these effects. Although consumers and businesses know that using more energy magnifies *their exposure* to energy shocks, they do not focus on how *their* consumption exacerbates the exposure of *others*. As individuals use more energy – making supply disruptions more costly – they magnify the risk not just to themselves, but to others as well.[32] "When summed across the 300+ million people in the United States," Brown and Huntington observe, "this small external effect is significant in the aggregate."[33]

2. *Economic Advantages That Do Not Justify Government Intervention*

Successful oil and gas development and "green tech" also offer other economic advantages, such more economic growth and jobs.[34] Yet although some invoke them to justify a subsidy, there is no market failure. As a result, a subsidy could induce *too much* investment, draining resources from other valuable activities.[35]

Similarly, even though reducing oil imports has economic advantages – keeping wealth in the U.S., instead of transferring it to foreign energy producers[36] – the case for the government

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[29] Stephen P.A. Brown & Hillard G. Huntington, *Reassessing the Oil Security Premium*, Resources for the Future Discussion Paper 1 (Feb. 2010).

[30] *See generally* Lutz Killian, *The Economic Effects of Energy Price Shocks*, 46 J. Econ. Lit. 871 (2008) (assessing a range of theories, as well as empirical evidence, about the effects of oil shocks on the broader economy).

[31] Ben S. Bernanke, Mark Gertler & Mark W. Watson, *Systematic Monetary Policy and the Effects of Oil Price Shocks*, 1 Brookings Papers on Economic Activity 91 (1997).

[32] Stephen P.A. Brown & Hillard G. Huntington, *Assessing the U.S. Oil Security Premium*, 38 Energy Econ. 118, 121 (2013) ("those purchasing oil are unlikely to understand or consider how their own oil consumption increases the economy-wide effects of oil supply shock").

[33] Brown & Huntington (estimating this "oil premium" at approximately five dollars per barrel).

[34] *See, e.g.*, Thiemo Fetzer, Fracking Growth, CEP Discussion Paper No 1278 (June 2014) http://cep.lse.ac.uk/pubs/download/dp1278.pdf ("Every oil- and gas sector job creates about 2.17 other jobs. Personal incomes increase by 8% in counties with at least one unconventional oil or gas well. The resource boom translates into an overall increase in employment by between 500,000 - 600,000 jobs."); CEA, at 15 (increase in domestic oil and gas production contributed .2% to GDP growth (or 1/10 of total economic growth) between 2012 and 2013, and the figure is higher if we account for spillover effects, such as greater employment in sectors that service the energy industry); Jason Bordoff & Akos Losz, *Oil Shock*, Horizons, Spring 2015, at 190, 199 (noting tha decline in oil prices in 2014 is likely to increase GDP by .4%, and perhaps twice that when spillover effects are considered).

[35] Indeed, evidence suggests that green tech subsidies are a costly (and even counterproductive) way to create jobs. Graetz at 168, quoting study of TPI industries ($20,000 per worker subsidy for wind; $60k to $300k per worker for solar); id. at 169-70 ($4 billion subsidy, leading to the installation of smart meters, lead to the elimination of 28,000 meter reader jobs, while creating very few jobs since the meters were mostly built overseas).

[36] Cf. Council of Economic Advisors, *The All-of-the-Above Energy Strategy as a Path to Sustainable Economic Growth*, July 2014, 22-24, https://www.whitehouse.gov/sites/default/files/docs/aota_report_updated_july_2014.pdf (noting that drain on purchasing power from oil shocks is especially severe when energy is imported, since resources

to pursue this goal is unclear. Some want the U.S. to use its market power as a huge consumer of oil (so-called "monopsony power") to cut prices by reducing U.S. consumption, thereby saving money on imports. Yet this use of market power would actually *create* a market failure, instead of *repairing* one.[37] In addition, this strategy's premises are outdated in three ways. First, even if this sort of intervention could once be justified by another market failure – the power of OPEC – the cartel's influence has waned.[38] Second, the influence of U.S. consumption on global prices has waned, given our greater energy efficiency and the growing appetite of China and others.[39] Third, the U.S. oil boom has reduced U.S. imports from 60% to 20%.[40] As a result, lower prices cause a transfer to US consumers not only from *foreign* producers, but also from *U.S.* producers.

C. National Security

Another reason for the government to intervene in energy markets is national security.[41] This Article focuses on two external costs: first, the cost of policing access to oil; second, the use of oil revenue by geopolitical rivals to fund policies that harm the U.S. and its allies.

1. *Defense and Foreign Policy Costs*

First, since energy shocks cause economic disruptions, as noted above, avoiding them has been a goal of U.S. foreign policy since the Arab oil embargo of 1973.[42] President George H.W. Bush emphasized this tradition in deploying U.S. troops to repel Saddam Hussein's invasion of Kuwait in 1990:

> My administration, as has been the case with every President from President Roosevelt to President Reagan, is committed to the security and stability of the Persian Gulf. . . . The stakes are high. Our country now imports nearly half the oil it consumes and could face a major threat to its economic independence. Much of the world is even more dependent upon imported oil . . . .[43]

In addition to Operation Desert Storm, the U.S. also has fielded a significant naval presence in the Persian Gulf, operated military bases there, maintained a strategic petroleum reserve, and

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leak out of economy); id. at 3 (noting that trade deficit as percentage of GDP is lowest since the 1990s, and that more than a fifth of narrowing since 2006 peak is attributable to declines in oil imports).

37 National Research Council, at 328.

38 Jason Bordoff & Akos Losz, *Oil Shock*, Horizons, Spring 2015, at 190, 195 ("The American oil revolution . . . has vanquished, at least temporarily, OPEC's ability to set a floor on world oil prices."); *cf. id.* at 1999 (noting that it is "too early to declare the death of OPEC").

39 *Cf. id.* at 194 (noting that China added 500,000 barrels per day to global oil demand each year each year between 2002 and 2007, and that non-OECD nations added a total of 1.3 million bpd during that period).

40 *Id.* at 195.

41 Michael Graetz, The End of Energy (2010).

42 The National Defense Council Foundation describes this commitment as even older, dating back to the U.S. defense commitment offered to Saudi Arabia during World War II. The National Defense Council Foundation, *The Hidden Costs of Oil: An Update*, http://www.ndcf.org/.

43 George H.W. Bush, Address on Iraq's Invasion of Kuwait, Aug. 8, 1990, http://millercenter.org/president/bush/speeches/speech-5529.

offered military and other support to various governments in the Middle East. Some of these regimes have proved unstable, in part because oil-rich economies tend to grow slowly and to fail at developing other industries.[44] To the extent that dependence on oil has caused the U.S. to commit more blood and treasure to national defense – and, for that matter, to support regimes, make commitments, or adopt polices we otherwise would not have favored – these incremental costs are a hidden price of oil.

For example, 383 U.S. soldiers were killed in Operation Desert Storm (along with 100,000 Iraqi soldiers), and the war cost approximately $61 billion.[45] The second Iraq war was longer and more costly, with 4,488 U.S. soldiers killed (along with 3400 contractors and an overall total, including civilians, of 134,000),[46] and an estimated budgetary cost of $1.7 Trillion (along with another $500 billion for health care for veterans).[47] If a portion of these costs are attributable to oil, as some U.S. political leaders suggest, these hidden costs of oil consumption are significant.[48]

Yet for two reasons, the economics literature generally does not account for these costs. First, military expenditures and foreign policy commitments also advance other goals unrelated to energy, including countering terrorism, deterring invasions, discouraging the proliferation of chemical and nuclear weapons, and protecting allies. Isolating the causal role of oil, as opposed to these other goals, is not easy. Second, some commentators consider defense a fixed cost, which is unlikely to change in response to limited shifts in oil supply and demand. As Gilbert Metcalf puts it, "a marginal (or even inframarginal) reduction in oil consumption might not affect our national security planning or spending significantly."[49] Based on these twin concerns, the prevailing view in the economics literature is that defense costs are too speculative to be considered in energy policy. As Bohi and Toman put it,

> "In brief, a defensible estimate of the externality associated with U.S. military spending for oil import security would require an in-depth analysis of what

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[44] Jeffrey D. Sachs & Andrew M. Warner, *Natural Resources and Economic Development: The curse of natural resources*, 45 European Economic Review 827 (2001).

[45] Saudi Arabia and Kuwait covered approximately $30 billion of these costs, and Japan and Germany covered approximately $16 billion, leaving a residual of $15 billion. Gulf War Fast Facts, http://www.cnn.com/2013/09/15/world/meast/gulf-war-fast-facts/

[46] http://icasualties.org/

[47] Costs of War Project, Watkins Institute, Brown University, http://watson.brown.edu/costsofwar/files/cow/imce/Costs%20of%20War%20Executive%20Summary.pdf.

[48] Some U.S. government officials have invoked oil as a motivation for the 2003 invasion of Iraq, although other motivates have been emphasized as well. "Of course it's about oil; we can't really deny that," said Gen. John Abizaid, former head of U.S. Central Command and Military Operations in Iraq, in 2007. Former Federal Reserve Chairman Alan Greenspan made the same point in his memoir: "I am saddened that it is politically inconvenient to acknowledge what everyone knows: the Iraq war is largely about oil." Then-Senator (and later Defense Secretary) Chuck Hagel said the same in 2007: "People say we're not fighting for oil. Of course we are." Antonia Juhasz, *Why the War in Iraq Was Fought for Big Oil*, CNN, Apr. 15, 2013, **http://www.cnn.com/2013/03/19/opinion/iraq-war-oil-juhasz/**.

[49] *See also* Gilbert Metcalf, The Economics of Energy Security, at 19.

> rationales exist for military spending, how the level of spending has been affected by changes in the volume of oil imports, and how the reduction in oil imports would improve economic welfare. No study of these issues has been undertaken. Until an effort that yields a credible measure of the externality involved is completed, this externality is too uncertain to be used in determining energy policy."

Others go further and conclude, as the National Research Council does, that "the marginal cost is essentially zero."[50]

It is true that military and foreign policy commitments spring from a combination of motives, so teasing out the role of oil is challenging. Yet although we should not attribute the *entire* cost of U.S. commitments in the Middle East to oil, it would be equally misguided to attribute *none* to oil. More generally, we are not free to ignore a cost just because it is conceptually and empirically difficult to pinpoint. The contrast with climate change is striking. Even though climate effects are uncertain, commentators still try to account for them. The same should be true of national security.

In addition, even if *modest* changes in oil markets have no effect on U.S. foreign and defense policy, *major* changes can make a difference. The National Research Council acknowledged this point, even in arguing that marginal changes would make no difference. Yet since the NRC published their study in 2010, there has, in fact, been a major change: U.S. oil production has increased by 60% (from 5.48 million barrels per day in 2010 to 8.72 million bpd in 2014). This additional production helped induce a 50% decline in crude prices in 2014-15, and has also eased U.S. geostrategic burdens in various ways. For example, imposing effective multilateral sanctions on Iran was easier because the U.S. could replace Iranian crude that came off the market.[51] In addition, extra U.S. capacity has provided a cushion against oil shocks. For example, although instability in Libya triggered a price spike in 2011, renewed instability there in 2014-15 did not cause another spike.[52] More generally, even though the Middle East is wracked by war and instability, oil is fairly cheap. This affords the U.S. more flexibility in deciding how to address this instability.[53] While this benefit is hard to quantify, ignoring it is not the right answer.

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[50] *See also* National Research Council, at 333. ("[T]he marginal cost is essentially zero. This view is held by a number of other researchers in this area, including Bohi and Toman (1994). The committee adopts this position.").

[51] Daniel Yergin, *Who Will Rule the Oil Market?*, NY Times, Jan. 25, 2015 ("Over a million barrels per day were . . . taken off the market by sanctions imposed on Iran. Without that big surge of shale oil from the United States, it is highly likely that those sanctions would have failed. Prices would have spiked, countries seeking cheaper oil would have broken ranks – and Iran might not be at the nuclear negotiating table today.")

[52] In 2015, Libya is producing only ¼ of the $1.6 million barrels per day it used to export. *Libya Needs Weapons to Defend Its Oil*, Maritime Executive, August 17, 2015. http://www.maritime-executive.com/article/libya-needs-weapons-to-defend-its-oil.

[53] For example, the U.S. announced in August of 2015 that it no longer would have an aircraft carrier in the Persian Gulf at all times. Kristina Wong, *Navy Reducing Presence in Persian Gulf,* Aug. 16, 2015,

Whatever estimate we use for the national security costs of oil, the government should apply it consistently in different policy areas. It is problematic to treat these costs as high in formulating defense and foreign policy, but low in forging energy policy (or vice versa). For example, assume defense policymakers value national security costs at 50 cents per gallon, and are considering a response (e.g., a troop deployment) that costs 45 cents per gallon. At the same time, energy policymakers, who value these costs at only 5 cents per gallon, are considering a response that costs only 10 cents per gallon (e.g., greater fuel efficiency). This use of inconsistent valuations can lead the government to adopt the costlier (military) response, even though a more cost-effective (fuel efficiency) response was available.

2. *A Source of Strength for Geopolitical Rivals*

There is a second way that oil can undermine U.S. national security. In addition to imposing burdens on the U.S., our dependence on oil also strengthens geopolitical rivals. This can happen in three ways. First, rivals solidify power by rewarding key domestic constituencies. Second, they fund their military and, in some cases, terrorist organizations as well.[54] For example, when Russia invaded Crimea in March 2014, oil prices were above $100, and had been for three years. Since Russia earns 75% of its export revenue and 50% of its tax revenue from hydrocarbons, high oil prices afforded Russia the resources (and perhaps also the confidence) to invade its neighbor. Third, the ability to stop selling energy – and thus to undermine their customers' economies – is a source of power. For example, Russian threats to shut off natural gas sales provide leverage over its neighbors,[55] and presumably are one of the reasons why Germany has made major investments in green energy. If relying on oil and gas strengthens adversaries in these ways, it generates additional negative externalities.[56]

Not only does oil revenue *facilitate* harmful behavior by states, but it also can play a role in *causing* it. Specifically, oil wealth can take pressure off nations to modernize their economies

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http://thehill.com/policy/defense/251197-navy-reducing-presence-in-persian-gulf ("Although the Navy has maintained at least one aircraft carrier in or near the Gulf for the last seven years, it is planning longer periods where there will be no carriers there at all.")

[54] Graetz, at 254 (("Dollars we exchanged for oil have strengthened countries that oppose us and have helped fund radical Islamic institutions, including schools, throughout the Middle East. In some cases, oil revenue funds terrorism."); Clifford Winston, Government Failure Versus Market Failure 47 (2007) ("Given recent tensions in the Middle East, it has also been argued that it is not in America's interest to import oil from hostile countries that may use the profits from their exports to fund terrorist activities.").

[55] See National Research Council, at 332 ("[C]ountries dependent on imports subtly modify their policies to be more congenial to suppliers. For example, China is aligning its relationships in the Middle East (e.g., Iran and Saudi Arabia) and Africa (e.g., Nigeria and Sudan) because of its desire to secure oil supplies.").

[56] The National Research Council rejects this view, distinguishing between the bad acts funded by oil revenue (which they concede have negative externalities), and the consumption of oil that generates this revenue (which they argue does not). "U.S. oil consumption that enriches countries with which the United States has differences is not an externality," they contend. "Rather, U.S. oil consumption makes inimical actions possible." NRC, at 332. It seems like a semantic exercise to debate whether the externalities flow from bad acts, or from the revenue facilitating it. NRC offers this distinction to argue that we should target the bad acts, instead of our oil consumption. Yet at least in some contexts, we will want to target both. After all, stopping some bad acts is easier if we reduce the resources available to fund them.

and political institutions. For instance, oil revenue can enable governments to fund a police state,[57] to depend less on the tax revenue (and good will) of citizens, to hide (and steal) revenue, and to buy off dissenters instead of affording them political rights.[58] Oil wealth also can substitute for entrepreneurship and more diversified growth, as well as the social rights they facilitate.[59] Civil wars may also become more likely, as competing groups jockey for control of oil resources.[60] As a result, oil can make regimes more corrupt, unstable, and repressive,[61] although this causal connection is contested and is likely to vary in different contexts.[62]

While starving these oil-producing rivals of revenue diminishes their *capacity* to harm the U.S., it can have mixed effects on their *motivation* to do so. Some could respond by seeking a better relationship with the U.S., for instance, to secure aid, the restoration of trade, or an end to sanctions. In contrast, others could feel freer to defy the U.S. – since they have less to lose – or could even precipitate a crisis to rally (or distract) domestic constituencies.[63] Thus, although the

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[57] Ross, the Oil Curse, *supra*.

[58] *See* Ross the Oil Curse, *supra*, at 63 ("oil has kept autocrats in power by enabling them to increase spending, reduce taxes, buy the loyalty of the armed forces, and conceal their own corruption and incompetence")

[59] Michael L. Ross, Oil, Islam, and Women, 102 Am Pol. Sci. Rev. 107 (2008) (arguing that oil wealth impedes gender equality).

[60] Paul Collier, *Natural Resources and Conflict in Africa,* http://the-beacon.info/blog/wp-content/uploads/2011/05/Natural-Resources-and-Conflict-in-Africa.pdf; Ross, The Oil Curse, *supra*, at 149 (""Since the early 1990s, oil-producing countries have been about 50 percent more likely than other countries to have civil wars").

[61] Michael L. Ross, Does Oil Hinder Democracy?, 53 World Politics (2001) 325 (pooled time-series cross-national data from 113 states between 1971 and 1997 to show that oil exports are strongly associated with authoritarian rule; that this effect is not limited to the Middle East; and that other types of mineral exports have a similar antidemocratic effect, while other types of commodity exports do not).

[62] *See generally* Michael L. Ross, The Oil Curse: How Petroleum Wealth Shapes the Development of Nations (2012) (arguing that oil undermines democratic development, describing and responding to critiques of this idea); *see also, e.g.,* Ahmet T. Kuru, Book Review, The Oil Curse (2012) (Brookings), http://www.brookings.edu/research/opinions/2012/10/06-ross-oil-curse-kuru (critiquing Ross's emphasis on secrecy as reason why oil rich governments are more likely to be authoritarian, and his deemphasis on lack of middle class or developed political institutions); Thad Dunning, Crude Democracy (2008) (arguing that oil can promote both authoritarianism and democracy, but they do so through different mechanisms, and emphasizing democratic trends in Latin America as a counterexample to the "oil curse" thesis); Thad Dunning, *Endogenous Oil Rents*, 43 Compar. Pol. Sci. 379 (2010); Anar Kamil Ahmadov, A Conditional Theory of the 'Political Resource Curse:' Oil, Autocrats, and Strategic Contexts (2011), http://etheses.lse.ac.uk/618/1/Aahmadov_Conditional_Theory_Political_Resource_Curse.pdf (arguing that effects of oil on government are not uniform, and in particular that states vary in percentage of oil revenue claimed by central government); (using former Soviet republics to argue that effects of oil wealth on political institutions can vary, depending on "the spread of alternative political elites, relative size of the ethnic minority with ties to a powerful kin state, and oil production geography").

[63] If commercial ties with the U.S. have a moderating influence, scaling back these ties can be counterproductive. But some reasons why commercial ties can be moderating – such as the development of a middle class to champion internal reforms and better relations with the U.S. – do not apply here. As noted above, oil revenue can stunt this sort of reform in many cases, instead of promoting it.

U.S. is likely to benefit from weakening hostile energy producers, it is possible to imagine other scenarios as well.

A low oil price can also be a mixed blessing for another reason. Although it weakens rivals like Russia, it also hurts allies who produce oil, such as Canada, as well as governments menaced by hostile insurgencies, such as Nigeria.[64] Likewise, Egypt and Jordan could be destabilized if Saudi Arabia cuts its support for them in response to declining oil prices. In principle, the U.S. can respond by increasing foreign aid to offset these adverse effects.[65]

3. The Solution: Slack Capacity Rather Than Domestic Production

To sum up, dependence on oil can increase U.S. defense burdens and strengthen geopolitical rivals. Although the solution typically sought by politicians is domestically-produced oil, this is not entirely responsive. Even if the U.S. imports no oil, U.S. prices would still spike if the Persian Gulf were sealed off. The reason is that European and Asian consumers would bid up the price of U.S. oil if they could not buy Middle Eastern oil.[66] Therefore, the way to mitigate these national security costs is not domestic production *per se*, but slack capacity in the global market. If supply is ample relative to demand, the sudden loss of one supplier is less likely to trigger an energy shock.[67] Prices also are lower, so geopolitical rivals earn less revenue.

While more production in the U.S. can create excess capacity, so can increased production in *other* stable and friendly nations, such as Canada and Brazil. These nations are unlikely to use revenue in ways that harm the U.S. In addition, when new sources of oil are

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[64] Daniel Yergin, *Who Will Rule the Oil Market?*, NY Times, Jan. 25, 2015 (noting that Nigeria is most populous nation in Africa, with largest economy, and that oil revenue represent 95% of exports and 75% of government revenue; "its revenues are falling as it needs more money to fight the Boko Haram insurgency").

[65] The goal here is assumed to be maximizing *national* welfare, but the analysis may not change much if the goal instead is to maximize global welfare. For instance, oil price shocks have adverse consequences for most of the world, although they obviously can be advantageous for oil producers. Destabilizing the Nigerian government presumably is bad not only for the United States, but also for Nigeria and its neighbors. While strengthening the governments of Russia and Iran appeals to the leaders of those countries, it can impose costs even within the borders of those nations (e.g., for dissidents), as well as on their neighbors (e.g., Ukraine).

[66] Douglas R. Bohi & Michael A. Toman, The Economics of Energy Security 53-54 (1993); Gilbert E. Metcalf, *The Economics of Energy Security*, Working Paper 19729 (2013), http://www.nber.org/papers/w19729.pdf (" Even if the United States imported no oil but rather relied on domestic production for all its oil needs, a supply shock elsewhere in the world would lead to a rise in domestic oil prices."). Admittedly, price spikes are especially harmful when oil is imported, since they drain more resources out of our economy, but shocks are still disruptive even when oil is domestically produced. CEA, *All of the Above*, at 27-28 (estimating magnitude of disruptions from oil shocks, concluding that costs associated with importing oil represent only fraction of economic harm – specifically, by ½ to 2/3 of the .5% estimated decline in GDP when oil imports are high and oil prices increase by 10%).

[67] Gilbert Metcalf expresses skepticism about the importance of diversity of supply. He argues that if one existing supplier drops out, another *existing* supplier can make up the shortfall, so "it is not clear that increasing the number of supply sources for an individual country is especially beneficial." Metcalf, *The Economics of Energy Security*. But Metcalf's argument assumes there is *still excess capacity* in the system after some suppliers drop out. Where does this excess capacity come from? Assuring *there is* excess capacity is precisely the reason to expand and diversify supply.

tapped in stable parts of the world, unstable sources represent a shrinking percentage of global oil production, which reduces the likelihood and magnitude of shocks.[68]

Excess capacity arises not only from increased supply, but also from reduced demand. One way to ease demand is greater energy efficiency. Using less energy offers the same national security benefits as new production. Fortunately, the "energy intensity" of the U.S. economy – that is, the amount of energy used per dollar of GDP – has declined significantly, as has petroleum consumption.[69]

Another way to reduce demand for oil is to replace it with other types of energy. For instance, if natural gas can substitute for oil, new supplies of natural gas create the same slack in the oil market – and thus the same national security advantages – as new sources of oil. In the U.S., replacing oil with other energy sources is easier for some functions than others. As a transportation fuel, oil is hard to displace. The "synfuels" program was an unsuccessful attempt in the 1970s to use coal instead. More recently, ethanol and other biofuels have made some inroads. Efforts also are underway to power vehicles with natural gas,[70] hydrogen, and electricity. But gasoline-powered cars still have the formidable advantage of a vast infrastructure of fueling and maintenance facilities.

While the U.S. needs oil for transportation, it hardly uses oil to generate electricity, power industry, or heat homes.[71] Coal, natural gas, nuclear, and renewables perform these functions, offering national security advantages in sparing us from using oil. Yet more than one source of energy can replace oil in these settings. As a result, there is not necessarily a national security advantage in using one, as opposed to another. For instance, if natural gas can substitute for oil, there is less need for coal to do so, and vice versa.

D. Competing Goals: The Environment Versus National Security

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[68]Brown & Huntington, at 119 ("Nonetheless, oil security can be greatly affected by the composition of world oil production. A given geopolitical event occurring in a region of the world is likely to remove a relatively constant proportion of the oil supplies produced in that region. Under these conditions, the increased contribution of unstable oil supplies to world oil markets will lead to bigger oil supply disruptions and bigger oil price shocks.").
In contrast, Gilbert Metcalf asserts – without explanation – that diversifying the supply of oil would not affect oil shocks, although he acknowledges that having alternatives to oil would do so. It's not clear why the analysis should be different.

[69] For each dollar of GDP, the U.S. used 13,381 BTU in 1980, compared with 7328 BTU in 2011. http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=92&pid=46&aid=2&cid=US,&syid=1980&eyid=2011&unit=BTUPUSDM; *see also* Jeremy Scott Diamond et al, *America is Shaking Off Its Addiction to Oil*, Bloomberg, Dec. 11, 2014, http://www.bloomberg.com/graphics/2014-america-shakes-off-oil-addiction/ (U.S. has gone from using over 3.5 barrels per million dollars of GDP to less than 1.5 barrels); CEA, at 10-11 (petroleum consumption has declined since 2006 because of greater fuel efficiency and slower economic growth).

[70] U.S. Dep't of Energy, Alternative Fuels Data Center, http://www.afdc.energy.gov/vehicles/natural_gas.html ("Natural gas powers about 150,000 vehicles in the United States and roughly 15.2 million vehicles worldwide.")

[71] Bill Sanderson, *Home Heating Oil is Now Cheap, But Gas is Even Cheaper*, Marketwatch, Dec. 30, 2014 ("Even though prices are way down, oil can't catch a break from homeowners who remain willing to spend thousands of dollars converting their heating systems to natural gas. Heating oil has been losing market share to natural gas, electricity and other heat sources for years. Only 6% of U.S. homes used oil heat in 2012, government data show.").

To sum up, a number of different market failures can justify government efforts to favor or discourage particular types of energy. A key challenge, however, is that the same energy source can advance national security while burdening the environment.

1. Oil

This tension is clearest with oil. One way to reduce the national security costs of oil, as noted above, is to develop new sources of supply in the U.S. or other stable and friendly nations. This additional supply shrinks the market power and revenue of geopolitical rivals, and also eases pressure to assure access to less secure sources. Yet these national security advantages come at an environmental cost. More consumption generates more GHG's and pollution. In addition, extracting and transporting more oil increases the risk of offshore spills, water contamination from hydraulic fracturing, and pipeline and tanker accidents.

Notably, this conflict does not arise with another strategy for reducing the national security costs of oil: cutting demand through energy efficiency. Using less oil not only reduces national security costs, as discussed above, but also has environmental advantages. For instance, greater fuel economy and better mass transit reduce emissions and pollution.[72]

A third strategy to ease the national security costs of oil – replacing it with other energy sources – can also create tensions with environmental goals, depending on which substitute we use. Some pose greater environmental risks than others. In addition, even if these substitutes reduce the national security costs of oil, they could pose national security risks of their own. Natural gas, coal, and renewables are considered in turn.

2. Natural Gas

A decade ago, it seemed likely that natural gas would begin posing similar national security issues as oil. Domestic natural gas reserves were dwindling and the U.S. was preparing to become a major importer. At the time, the world's leading exporters were Russia, Iran, and Qatar. As a result, importing natural gas would have provided another reason to police access to unstable regions, as well as revenue to geopolitical rivals.

Yet these national security risks never materialized because of an unexpected surge in U.S. natural gas production. Hydraulic fracturing unlocked over one hundred years of supply, and also slashed U.S. natural gas prices from over $12.00 per mbtu in June of 2008 to less than $3.00 per mbtu seven years later.[73] This domestic natural gas – unlike domestic oil – is largely insulated from global supply shocks for two reasons. First, natural gas is much less integrated than oil in the global market. While foreign buyers can buy U.S. oil,[74] and thus can bid up prices

[72] Switching to a dirtier energy source – for instance, by converting coal into a transportation fuel – does not advance environmental goals.
[73] http://www.eia.gov/dnav/ng/hist/rngwhhdm.htm (monthly Henry Hub prices).
[74] Although there is a ban on exporting crude, refined oil can be exported.

during a supply shock, they cannot buy U.S. natural gas because the necessary infrastructure is not yet in place. This will change by the end of the decade, as projects are completed to liquefy natural gas and ship it overseas. But even then, the capacity to reroute domestic supply for export will be limited, especially for rapid shifts in response to supply disruptions abroad.[75] Second, even if international buyers buy significant amounts of U.S. natural gas, U.S. prices should not increase very much because U.S. producers can produce a lot more at nearly the same marginal cost, either for export or domestic consumption.[76]

While this new supply of natural gas offers national security advantages, its environmental impact is mixed. On the positive side of the ledger, natural gas pollutes the air much less than coal. In addition, burning natural gas emits one-third to one-half as many GHGs as burning coal. Indeed, since 2005, GHG emissions have declined more in the U.S. than anywhere else, and the substitution of natural gas for coal is a key reason.[77] Between 2005 and 2013, U.S. GHG's from power generation declined by 15%, and U.S. GHG's declined overall by 9.7%.[78] Even so, natural gas is itself a potent GHG, as noted above, and some escapes into the atmosphere. The volume of these "fugitive" emissions – and thus the extent of natural gas's advantage over coal – is debated. In addition, the U.S. natural gas boom relies on hydraulic fracturing, which has prompted concerns about water contamination and seismic activity. To sum up, then, although the domestic natural gas boom has national security advantages, its implications for the environment are mixed. As a result, there is some tension between environmental and national security goals.

3. Coal

For coal, the environmental harms are worse, while the national security benefits are less clear or, at least, more contingent. It is well understood that coal is especially harmful to the environment, polluting the air more than natural gas and probably emitting more GHG's. In response, defenders of coal sometimes invoke its national security advantages, since the U.S. has ample domestic reserves. Yet the boom in natural gas production has an important implication that has not been adequately recognized: As more natural gas becomes available, the national security case for coal becomes weaker. After all, natural gas offers the same national security advantages – since we also have sizable domestic reserves – at lower environmental cost. The best national security argument for coal is diversification. If the U.S. cannot produce enough

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[75] Bordoff.

[76] Energy Information Administration, Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets (Oct. 2014), http://www.eia.gov/analysis/requests/fe/pdf/lng.pdf (noting that U.S. supply curve is fairly flat); id. ("Across the different export scenarios and baselines, higher natural gas production satisfies about 61% to 84% of the increase in natural gas demand from LNG exports . . .")

[77] CEA, at 3, 32 (estimating that ½ of this decline is attributable to substitution of natural gas for coal, and half is attributable to economic downturn).

[78] EPA, National Greenhouse Gas Data, Feb. 2015, http://www.epa.gov/climatechange/pdfs/usinventoryreport/US-GHG-Inventory-2015-Chapter-2-Trends.pdf (GHG's from power generation declined from 2,402.1 million metric tons ("mmt") to 2,040.5 mmt, and GHGs overall declined (from 5753.5 mmt to 5195.5 mmt).

natural gas to meet its energy needs, coal can fill the gap. Indeed, so far natural gas has displaced coal partially, but not completely.[79] Yet U.S. natural gas production can increase further without a significant rise in natural gas prices, as noted above. Instead of spending billions of dollars on "clean coal" technology, we should focus on mitigating the environmental risks of natural gas.

4. Renewables

While natural gas has environmental advantages over coal, wind and solar energy are even better for the environment, since they emit no GHGs or pollution. As a result, there is a strong (and familiar) environmental case for renewables.

Sometimes proponents of solar and wind power also assert its national security advantages, but these are less clear. After all, if national security were the only priority – requiring a domestic source of energy other than oil – we could rely on natural gas or coal, instead of renewables. In contrast, renewables cannot supply more than a fraction of the nation's energy, at least for the foreseeable future. They are less reliable than hydrocarbons because the sun has to shine or the wind has to blow. With current technology, it is not feasible to store energy generated in favorable conditions for later use. Therefore, renewables need a backup power source, which usually is natural gas. Renewables also still depend on government support, although costs have declined substantially, rendering them competitive in some conditions.[80]

Given these limitations, the best national security arguments for renewables are contingent or long-term ones. First, if we have to stop using domestically-produced natural gas or coal (or both) for environmental reasons, we need another domestic source of energy. Yet this is not really a national security defense of renewables, but an affirmation of the tension between national security and environmental goals. Second, when U.S. natural gas and coal reserves run out – presumably, centuries from now – we will need alternatives. Third, the environmental benefits of renewables could translate into national security benefits over the long term, avoiding famines, droughts, and other sources of instability from climate change.[81] Yet these national security payoffs are uncertain and remote in time.

[79] Coal used to generate two or three times as much electricity as natural gas in the U.S., but in recent years natural gas has been catching up. In April 2015, natural gas generated more electricity for the first time both because cheap natural gas has been causing utilities to add natural gas generates, and because new regulations make coal less attractive. Housely Carr, *Torn Between Two Fossil Fuels*, https://rbnenergy.com/torn-between-two-fossil-fuels-coal-vs-gas-in-the-us-power-sectoris. The newly-final Clean Power Plan will reduce the use of coal in requiring utilities to reduce CO2 emissions by 32% (from 2005 levels) by 2030. Utilities also had been decommissioning coal plants in response to EPA's MATS rules, which were invalidated by the Supreme Court in June 2015. *Michigan v. EPA* (2014), http://www.supremecourt.gov/opinions/14pdf/14-46_bqmc.pdf .

[80] Heale; Lazard.

[81] Graetz, 158: ("Climate change could have significant geopolitical impacts around the world, contributing to poverty, environmental degradation, and the further weakening of fragile governments.")

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To sum up, government interventions in the energy market can be justified by a range of externalities grounded in the environment, economy, and national security. Some rationales are more persuasive than others, but overall the case is strong. Yet a number of the relevant externalities are hard to measure. In addition, some types of energy generate both positive and negative externalities, requiring policymakers to mediate among competing priorities.

II. Current Law: Targeted Subsidies Instead of Pigouvian Taxes

The last Part surveyed a range of market failures affecting energy. Pigouvian taxes and tradeable permits are familiar ways to fix them. Yet unlike many jurisdictions, the U.S. has hardly used them. *Subsidizing* favored types of energy has been easier politically than *taxing* disfavored types. This Part offers an example of how to use a menu of taxes to internalize energy externalities, considers why subsidies are used instead, and canvasses the hodgepodge of targeted subsidies under current law.

A. Targeting the Net Level of All Relevant Externalities: A Menu of Pigouvian Taxes

Enhancing and diversifying the supply of oil (and, to an extent, other energy sources) has national security advantages, but environmental costs. Each goal is important, so how can they be reconciled? Ideally, both environmental and national security harms should be priced,[82] using Pigouvian taxes or tradeable permits. A tax fixes the price, relying on the market to set the volume of activity. In contrast, tradeable permits determine volume, letting the market set the price. Each ends up in (essentially) the same place, incorporating both private and social costs in the price.[83] Four types of taxes or tradeable permits should be considered. For ease of exposition, this discussion uses taxes.

First, a carbon tax (C) should apply to hydrocarbons and other emitting sources. Since C is based on the GHGs they emit, it is higher for coal than oil and natural gas. A range of implementation challenges have to be considered. For example, a different point of collection may be needed for each source, so that natural gas is taxed it when it is extracted, while oil is taxed when it is refined, and so forth.[84]

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[82] Lawrence H. Goulder & Ian W. H. Parry, *Instrument Choice in Environmental Policy*, 2 Rev. Env. Econ. & Pol'y, 152, 169 (2008) ("Apart from administrative considerations, the most cost effective approach is to introduce multiple taxes. Each tax would be set based on the marginal external cost of a different externality, which would yield different incentives to deal with each of the various problems (emissions, congestion, etc.) involved.").

[83] There is a robust literature comparing Pigouvian taxes and tradeable permits. As long as permits are auctioned off for fair value, the results are largely comparable. Indeed, differences that are commonly invoked in the literature (such as the greater flexibility of permits) often fade upon closer inspection. *See* Louis Kaplow & Steven Shavell, *On the Superiority of Corrective Taxes to Quantity Regulation*, 4 Am Law & Econ. Rev. 1 (2002) (defending the superiority of corrective taxes, and noting that Weitzman's widely cited critique of corrective taxes relies on the implausible assumption that they have to be linear and fixed).

[84] For a discussion of implementation issues for a carbon tax, see Metcalf & Weisbach.

Second, another Pigouvian tax (P) should internalize pollution. For instance, the P for offshore oil drilling would reflect oil spill risks. The P for hydraulic fracturing would account for water contamination and seismic risks. The P for nuclear energy would internalize the risk of accidents and disposing of nuclear waste. The P for coal would address air and water pollution, and so forth.[85]

Third, taxes can be added for the cost of roads, as well as negative externalities from traffic and congestion, including delays and accidents. Estimates suggest these costs are quite large.[86] They can be internalized with a Pigouvian tax (T), such as a toll, congestion pricing, or a mileage-based charge.

Fourth, another Pigouvian tax (NS) should internalize national security risks. The most straightforward approach is an extra tax on oil. By reducing consumption, and thus creating more slack in the system, NS would ease pressure on the U.S. to police access to insecure supply, while also reducing the revenue of geopolitical rivals.

In theory, a national security tax can be calibrated more finely, but global integration of the oil market complicates this effort. At first blush, it is tempting to impose an extra tax on oil from geopolitical rivals. The goal of this tax is to force them to sell at a lower price. For example, if the global price for crude is $50, and a $10 tax is imposed on crude from a rival, it has offer a pretax price of $40 in order to compete. Nevertheless, this tax may prove easy to avoid, since identifying the original source of oil is not easy. In addition, like any sanctions regime, this tax cannot succeed if some oil-importing nations do not impose it; then the targeted nation can still sell to them at $50, or perhaps a modest discount.

Likewise, it is also tempting, but difficult, to impose an extra tax on *unstable* suppliers, giving *stable* suppliers a competitive advantage and encouraging them to increase production. But again, if other nations do not follow, unstable sources can simply export to these nations. Another problem is that disadvantaging unstable suppliers (and officially classifying them as "unstable") may destabilize them further. Indeed, it would be challenging, and potentially awkward, for the State department to classify nations as stable or unstable – or, for that matter, as friendly or hostile. These difficulties are avoided if the favored category is narrowed to domestically produced oil, as in some subsidies under current law. But this approach omits friendly and stable producers such as Canada and Brazil, who offer comparable national security benefits, as noted above. In any event, imposing a tax only on imports, or on imports from some nations but not others, can founder not only on these conceptual challenges, but also on trade

[85] In this spirit, the U.S. has a successful tradeable permit regime for sulfur dioxide, which was enacted in the 1990 Clean Air Act amendments to address acid rain. Dallas Burtraw, Innovation Under the Tradable Sulfur Dioxide Emission Permits Program in the U.S. Electricity Sector, Resources for the Future Discussion Paper, 2000, http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-00-38.pdf.

[86] *See, e.g.*, Aaron S. Edlin & Pinar Karaca-Mandic, The Accident Externality from Driving, 114 J. Pol. Econ. 931 (2006) (estimating that adding a driver to a heavily traffic state, such as California, can increase the insurance costs of other drivers by $1725 to $3239 per year, and that a Pigouvian tax could raise $220 billion nationwide).

treaties. If these issues cannot be resolved satisfactorily, the best we can do is an extra national security tax on *all* oil.

To sum up, then, separate Pigouvian taxes can account for the costs of climate change, pollution, congestion, and national security. Under this segmented approach, the total Pigouvian tax would vary for each energy source. For example, oil would be subject to all of these taxes. Coal and natural gas would not be subject to the national security and congestion taxes, but would be subject to the carbon and pollution taxes (though at different levels). Nuclear would be subject to the pollution tax (and perhaps also a charge for securing nuclear power plants), but not the carbon and congestion taxes. Solar and wind would not be subject to any of these taxes.

A potential advantage of this menu of Pigouvian taxes is that other policies, and the administrative burdens and efficiency costs they entail, would no longer be necessary. For example, most energy subsidies under current law could be repealed (although there is still reason to support research and development in energy, as in other fields). Likewise, fuel economy standards and various environmental regulations of power plants could be scaled back as well.

At the same time, there are obvious challenges in administering these taxes. Quantifying the externalities is daunting, as noted above. There also are incremental administrative costs in tailoring individualized taxes in this way. Given these challenges, the best we can do is a rough estimate, which accounts for relative, as well as absolute, levels. For example, even if the externalities from natural gas and coal cannot be estimated with precision, the environmental harm from coal is likely to be worse, so the taxes should reflect this difference.

B. Political Advantages of Energy Subsidies Over Pigouvian Taxes

Although taxes and permits have notable advantages, they face familiar political obstacles. To sidestep these political barriers, the U.S. has used targeted subsidies instead. This choice has policy costs, as Parts III and IV show. Before turning to these problems, this Section briefly considers the political advantages of subsidies over taxes and permits.

1. Resistance to a Carbon Tax or a Higher Gas Tax

Forty countries have some form of carbon tax or tradeable permit, and many nations have higher gasoline taxes than the U.S. But unfortunately, the political opposition in the U.S. to carbon taxes, “cap and trade,” and higher gasoline taxes is familiar.

A key challenge is that these regimes make it more costly to use the targeted type of energy. While these costs create a socially useful incentive, they still are unappealing to consumers.[87] Higher prices also are likely to be salient. Voters would constantly encounter them in filling their tanks and paying electric and heating bills.[88]

In addition, American political institutions are especially responsive to interest group pressure.[89] While many organized interest groups oppose these policies, few lobby for them. For example, even though a carbon tax improves the competitive position of renewable energy, solar and wind producers prefer the more immediate advantage of a subsidy for their technology.

Higher gasoline taxes in the U.S. also are a harder sell because mass transit options are limited and distances are vast in many places. It is easier to live without a car in Berlin, Paris, or Tokyo than in Kansas City, Dallas, or Los Angeles. As a result, the federal gas tax has remained at 18.4 cents per gallon for over twenty years. The tax is supposed to fund highway construction and maintenance, but the highway trust fund has been running a $10 billion annual deficit in recent years. Even so, increasing this tax is a political "hot potato."[90] As President Obama said recently, "The gas tax hasn't been increased for 20 years. There's a reason for that."[91]

2. The Political Allure of Energy Subsidies

In contrast, energy subsides have more favorable political prospects. Although a subsidy for "green" energy advances some of the same environmental goals as a carbon tax – and a subsidy for oil production advances some of the same national security goals as a higher gasoline tax – these subsidies do not inflict pain by *raising* the price of energy we want to *discourage*. Instead, they *lower* the price of an alternative we want to *encourage*.

In addition, although subsidies are salient to those who claim them, they are largely invisible to the average voter. Of course, higher taxes or larger deficits are needed to fund these programs. But voter concerns about taxes and deficits do not usually focus on a particular subsidy, since so many other programs are funded as well.

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[87] Graetz; Stephen Cohen, It's Time to Abandon the Delusion of a Carbon Tax, Sept. 29, 2014, http://www.huffingtonpost.com/steven-cohen/its-time-to-abandon-the-d_b_5899448.html ("No political leader responsible for ensuring the material well-being of his or her people in the modern global economy is going to willingly raise the price of something so central to that economy as the price of energy.").

[88] Neil Hume & Pilita Clark, *Chevron Chief Lashes Out at European Oil Groups on Climate Change*, Financial Times, June 3, 2015, http://www.ft.com/intl/cms/s/0/0625af4c-0a10-11e5-82e4-00144feabdc0.html#axzz3jfrOVvN0 ("I don't think that putting a price on carbon is necessarily the answer. I've never had a customer come to me and ask to pay a higher price for oil, gas or other products.") (quoting John Watson, CEO of Chevron).

[89] *See* Christine Mahone, *Lobbying Success in the United States and the European Union*, 27 J. Publ. Pol. 35 (2007) (emphasizing greater electoral accountability and availability of private campaign finance in US).

[90] A Carbon tax has become comparably toxic in Austrialia, which repealed it only two years after enacting it. After pledging that "[t]here will be no carbon tax under the government I lead," Prime Minister Julia Gillard agreed to a carbon "price" in order to form a coalition with the Green party. For this seeming about-face, the opposition branded her "Ju-Liar," and she lost the leadership of her party. Meanwhile, Tony Abbott, the leader of another party, was elected in part on a pledge to "ax the tax."Julia Baird, A Carbon Tax's Ignoble End, NY Times, July 24, 2014, http://www.nytimes.com/2014/07/25/opinion/julia-baird-why-tony-abbott-axed-australias-carbon-tax.html?_r=0.

[91] Russell Berman, *The Tax That Dare Not Be Hiked*, N.Y. Times, Dec. 7, 2014, http://www.theatlantic.com/politics/archive/2014/12/the-tax-that-dare-not-be-hiked/383428/.

At the same time, organized interest groups enthusiastically support these subsidies, hiring lobbyists, running campaign ads, and contributing to campaigns. Indeed, several energy tax expenditures are "extenders," which are renewed (or not) every year. This structure induces perpetual lobbying, and thus an evergreen flow of campaign contributions.

C. *Targeted Energy Subsidies Under Current Law*

Mindful of these political advantages, Congress has used a wide range of tax expenditures to promote both alternative energy and hydrocarbons.

1. Tax Expenditures Promoting Alternative Energy

Most tax expenditures for alternative energy are narrowly targeted, supporting particular types of technologies. The lion's share were introduced or expanded dramatically by the Obama Administration. They focus on three areas.

The first is "greener" electricity. There is an investment tax credit for investing in solar, wind, and geothermal energy production (costing $600 million in 2014);[92] a production tax credit of 2.3 cents for each kWh of electricity generated from wind or geothermal energy, and half that amount for hydroelectric and some other technologies (costing $1.5 billion in 2014);[93] and the so-called "1603 program," offering upfront grants in lieu of these credits (costing $4.3 billion in 2014).[94] Congress also offers tax credits for energy manufacturing; accelerated depreciation for renewable energy; and subsidies for "clean coal" facilities ($200 million in 2014)[95] and coal plant scrubbers ($400 mil in 2014).[96]

The second focus of these tax expenditures is transportation, including a $7500 credit for plug-in electric vehicles, as well as credits for qualified fuel cell vehicles, hybrids, alternative fuel vehicles, and advanced lean burn technology vehicles. Congress also has provided $400 million in credits for alternative fuels, and $1.3 billion in credits for renewable diesel. Until 2012, there was a credit for ethanol as well. Tax expenditures also support natural gas fueling stations, idling reduction units in trucks, transit passes, and bicycle commuting.

A third set of tax expenditures promote energy-efficiency, including heating and cooling systems, appliances, and insulation in newly-constructed homes ($300 million in 2014), existing homes ($600 million in 2014), and commercial properties ($100 million in 2014). In addition, utilities can offer tax-free rewards to consumers for making energy efficient investments.

3. *Tax Expenditures to Increase and Diversify the Supply of Hydrocarbons*

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[92] Section 48.
[93] Section 45.
[94] Section 1603.
[95] Sections 48A & 48B.
[96] Sections 169, 291.

While alternative energy subsidies are mostly of recent vintage, hydrocarbon subsidies survive from an earlier era. A few focus on consumption (*e.g.*, commuter parking), but most are for producers. These tax expenditures are broader than their alternative energy counterparts, targeting expansive categories of hydrocarbon production instead of particular technologies. The most plausible policy justification for them is national security, although they also reflect the industry's political clout. To induce more production – adding stable sources of supply and reducing the revenue of geopolitical rivals – the tax bill on production is cut in four ways.

The first are special cost recovery rules, which apply only to U.S. production. Ordinarily, when income-producing assets are created, they cannot be deducted immediately. Instead a portion is deducted each year of the asset's useful life. In contrast, an immediate deduction is offered for costs of drilling wells in the U.S, including wages, supplies and fuel ($1.1 billion in 2014).[97] In addition, accelerated depreciation is available for geological and geophysical expenses of U.S. wells ($100 million in 2014).[98] "Percentage depletion" is another special deduction, which cost $1.2 billion in 2014 and is available only to "independent" producers (who do not have refineries or retail distribution) and royalty owners. It allows producers to deduct a designated percentage of revenue, which is assumed to reflect the decline in reserves over time (e.g., 15% for oil).[99] It is especially generous because it can exceed a producer's actual costs. The oil and gas industry defends these cost-recovery rules as comparable to tax benefits claimed by other industries, such as R&D deductions for the pharmaceutical industry.[100]

Second, oil and gas producers are sometimes taxed at a reduced rate. The rate reduction for domestic manufacturing (31.85% instead of 35%) applies to domestic oil and gas producers.[101] In addition, publicly-traded partnerships that hold exploration, refining, and pipeline assets do not pay corporate tax.[102] This tax benefit, scored at $1.1 billion in 2014, is not limited to domestic production.[103]

Third, targeted tax credits are offered for exploration and production when energy prices are low. Section 45(k) funds unconventional production,[104] and the marginal well production

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[97] Section 616 & 617; JCT 24.
[98] Section 167(h).
[99] Section 611, 613, 613A.
[100] *Chevron CEO Speaks to U.S. Senate About Tax Incentives*, http://www.chevron.com/chevron/speeches/article/05122011_chevronceospeakstoussenateabouttaxincentives.news.
[101] Section 199 (allowing a 9% deduction, which translates into a reduced rate of (9 * .35) or 3.15%.
[102] See Section 7704.
[103] Cf. Latham & Watkins, Ten Offshore MLP Facts, www.lw.com/.../LW-offshore-**MLP**-facts (noting that foreign assets often are placed in foreign partnerships that elect to be treated as corporations for US tax purposes, and that these assets avoid U.S. entity level tax by being outside the U.S.)
[104] This includes oil from shale or tar sands, coal seams, or other "tight" formations, as well as biomass and synthetic fuels from coal. This credit is often called the "old Section 29 credit" because of its former position in the Code.

credit[105] and enhanced oil recovery tax credit[106] subsidize low-producing or high-cost U.S. wells. In recent years, high energy prices have rendered these credits unavailable.

Fourth, multinational oil companies receive especially generous treatment of royalties paid to foreign governments. In general, U.S. taxpayers who earn income abroad can claim a credit for foreign taxes, so this income is not taxed twice. The credit is offered for taxes, but not royalties. Oil and gas producers usually have to pay both, since foreign governments own the mineral rights. Obviously, producers prefer to classify payments as taxes, so the U.S. government bears the cost. If this planning strategy succeeds, producers have less incentive to resist high royalties,[107] and U.S. tax dollars are rerouted to foreign governments. This is particularly unfortunate when the foreign government is a geopolitical rival, which uses revenue in ways that undercut U.S. interests. Yet a favorable judicial decision for Exxon has enabled producers to claim foreign tax credits for what arguably are royalties.[108]

III. Institutional Design Challenges: Targeting Harms

While targeted energy subsidies have political advantages, their policy merits are more mixed. Like taxes and permits, subsidies use prices to create incentives, instead of mandating or prohibiting particular practices. This flexibility can promote competition and innovation.[109] Yet designing effective energy subsidies is quite difficult. This Part shows why targeting harms effectively is so hard – indeed, harder with subsidies than with taxes and permits – and suggests ways to do so more successfully. Other commentators have also emphasized advantages of taxes over subsidies, but a number of advantages discussed in this Article are underappreciated or new to the literature. Part IV then considers challenges rooted in traditional tax policy concerns, such as effects on labor and savings choices and distribution.

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[105] Section 38.

[106] Section 43.

[107] One reason the multinational might care is that it can defer US tax by not immediately repatriating foreign earnings. This means it relies on a (deferred) U.S. foreign tax credit to compensate for a (current) foreign tax. Under "new view" assumptions, the deferred credit could still fully compensate for the current tax (e.g., if after-tax returns are the same everywhere and the repatriation tax at a fixed rate is inevitable). Yet this is no longer the case – so firms will, in fact, seek to reduce their foreign taxes (as, indeed, many do) – if these assumptions no longer hold. Daniel N. Shaviro, Fixing U.S. International Taxation 82-85 (2014).

[108] *Exxon v. Commissioner*, 113 T.C. 338 (1999) (applying "dual capacity" rules to treat as a creditable tax a payment that the U.S. Treasury considered a royalty); *see also Philips Petroleum Co. v. Commissioner*, 104 T.C. 256 (1995); Joint Committee, DESCRIPTION OF PRESENT LAW AND SELECT PROPOSALS RELATING TO THE OIL AND GAS INDUSTRY 14 (May 12, 2011) ("Subsequent to the decision in Exxon, anecdotal evidence suggests that a significant number of dual-capacity taxpayers revoked their safe harbor elections and adopted the facts and circumstances method to argue for tax treatment for the entire amount of the qualifying levy.")

[109] Lawrence H. Goulder & Ian W.H. Parry, *Instrument Choice in Environmental Policy*, 2 Rev. Env. Econ. & Pol'y 152, 163 (2008).

A. Neutrality

The market failures discussed in Part II each produce a range of harms, which can emerge in different contexts. To be neutral, taxes, permits and subsidies should treat these harms *the same way*, wherever they arise. This means every source of harm needs to be taxed, and every potential solution needs to be subsidized. Neutrality requires us not only to reach all the alternatives, but to use the right rate for each. Specifically, the tax (or permit price) should equal the marginal harm *caused* by the taxed behavior. Likewise, the subsidy should equal the marginal harm *avoided* by the subsidized activity.

1. The Advantages of Neutrality

This evenhandedness has two familiar advantages. First, it abates harms more cost-effectively. When subsidies, taxes and permits are neutral, heterogeneous individuals are free to abate harms in the way that appeals most to them. The government does not favor one technology over another, a condition known as "tech neutrality." For example, if a national security tax is imposed on oil, some will respond by carpooling or using mass transit, while others will move closer to work or buy fuel-efficient cars. Since consumer preferences vary, firms will develop competing alternatives, including hybrids, fuel-efficient gasoline engines, and vehicles that run on electricity, natural gas, and hydrogen.

In contrast, abatement is less cost-effective when the government singles out some sources of harm or abatement methods, while omitting others. For instance, if the tax applies only to cars, but not to SUVs, many will drive SUVs instead of riding the bus or buying hybrids.[110] Gaps in subsidies create parallel distortions. For example, if the government subsidizes moving closer to work, but not mass transit, some who prefer to ride the bus will buy a new house instead. Others will choose not to move, but they would have been willing to use mass transit if it were subsidized. The result is less progress at higher cost.

In addition to encouraging cost-effective abatement, neutral subsidies and taxes have a second advantage: the government sets the abatement process in motion, but does not have to direct it. Instead of banning or mandating specific practices, the government can rely on market judgments and competition. This is a notable advantage, since government officials often lack the information, expertise, and incentives to evaluate competing abatement options, and are subject to interest group pressure in making these judgments.

2. Administrability and the Inherent Narrowness of Subsidies

[110] By analogy, U.S. fuel economy standards do not reach sport utility vehicles and minivans; this fact no doubt contributed to the increase in their market share from 3% in 1978 to 50% in 2003. Soren T. Anderson, Ian W.H. Parry, James M. Sallee & Carolyn Fischer, *Automobile Fuel Economy Standards: Impacts, Efficiency, and Alternatives*, 5 Rev. Env. Econ. & Pol'y 89, 94 (2011).

Neutrality thus has important advantages for both taxes and subsidies. In principle, neutrality is accomplished the same way for a tax and a subsidy: by ensuring they both cover all the relevant alternatives. In one case, we have to reach all the *sources* of a problem. In the other, we need to cover all the *solutions* to it.

Although these parallel efforts are comparable *in principle*, they are quite different *in practice*. Compared with taxes (and permits), subsidies require more information and better calibrated rules. Perhaps because this difference arises at the level of administration and institutional detail – rather than in principle – the literature has overlooked it. Yet this difference is quite significant. As a practical matter, energy subsidies cannot be neutral, but energy taxes and permits can – or, at least, they can come much closer.

To see the point, compare two ways of internalizing environmental and national security externalities from gasoline, which are assumed to be $X per gallon. One is to impose a tax of $X on every gallon we use. The other is to offer a subsidy of $X for each gallon we conserve.

A neutral tax has to reach every gallon that is used. Admittedly, this is not a straightforward task. For example, robust enforcement is needed, so vendors actually collect the tax; otherwise, they may seek a competitive advantage in charging customers a tax-free price. Likewise, a tax has perverse effects if it covers only gasoline, but not alternatives that impose comparable environmental and national security costs. For example, if a tax reaches gasoline, but not jet fuel, some people will fly instead of driving.[111] To avoid these perverse effects, the tax needs to be broadened to include diesel, propane, jet fuel, plastics, etc. Covering *all* uses of oil is not easy, but we should be able to come fairly close.

In contrast, a comparably comprehensive subsidy is simply not feasible. There are too many ways to reduce gasoline usage. Reaching them all – or even most of them – would require a monumental administrative effort. After all, a truly neutral subsidy has to cover every type of fuel efficient car. It also has to reward other ways of enhancing fuel efficiency, such as slow driving, properly inflated tires, and trips during less congested hours. To be comprehensive, the subsidy also has to encourage us to drive fewer miles. To do so evenhandedly, it has to cover mass transit, bicycling, carpooling, moving closer to work, telecommuting, forgoing discretionary trips, favoring closer destinations over remote ones, and more. To be neutral, the subsidy also has to reward us for reducing how much *others* drive. For instance, the government would cut checks for buying locally grown produce, hiring local service providers, socializing with neighbors, and so on. To be truly neutral, then, a subsidy has to be astonishingly comprehensive. Detailed and complex rules are needed, along with an extraordinary amount of taxpayer-specific information, as well as costly and sophisticated monitoring mechanisms.

[111] In general, air travel has the greatest climate impact per mile travelled, but the comparison to cars, buses, and trains depends on how full each of them is. See generally Jens Borken-Kleefeld, Jan Fuglestvedt, & Terje Berntsen, Mode, load, and specific climate impact from passenger trips. *Environmental Science and Technology:* (2013).

Unlike energy taxes, then, energy subsidies are inevitably going to be selective, favoring some abatement options over others. Since their scope has to be fine-tuned in this way, energy subsidies are likely to be quite complex as well. For these reasons, they are less able than taxes to deliver cost-effective abatement, and are more prone to perverse effects.

Energy subsidies also are especially vulnerable to interest group pressure. Not only do they dispense money – a draw in and of itself – but they do so selectively, benefitting some industries and firms more than others. Energy subsidies also use intricate criteria, which the general public is unlikely to understand or monitor. As a result, energy subsidies are prime targets for lobbying.

3. Broadening Technology-Specific Subsidies

Not surprisingly, then, many green energy subsidies under current law do not *even try* to reach all abatement options. Instead, they place bets on particular technologies. For instance, to make cars more fuel efficient, Congress offers tax credits for specific types of cars, such as plug-in electric vehicles and fuel cell vehicles. In contrast, as Martin Sullivan has emphasized, there is no subsidy for making traditional combustion engines more efficient, for instance, with diesel engines, manual transmissions, turbocharging, or more aerodynamic designs.[112]

The narrowness of subsidies is a good reason to prefer taxes and permits, as noted above. But if we are stuck with subsidies (e.g., for political reasons), we should broaden them. For instance, Sullivan proposes a credit that rewards fuel efficiency (*e.g.*, $300 for each mpg above 25mpg), however it is achieved.[113] In a similar effort to avoid "picking winners," Senator Max Baucus has proposed to consolidate various tax credits for "clean" fuels (*e.g.*, from alcohol, algae, feedstocks, etc.)[114] into a single tech neutral credit:

> "Any fuel that is about 25 percent cleaner than conventional gasoline will generally receive a credit. The cleaner . . . the fuel, the larger the credit. Cleanliness is defined as how clean a given fuel production process is on a lifecycle emissions basis, as determined by the EPA."[115]

Like Sullivan's suggestion for fuel efficient cars, this proposal defines a goal (reducing emissions and pollution from transportation fuel) and offers a reward for achieving it, without

[112] Martin Sullivan, *The Losers in the Energy Subsidy Game*, Tax Notes, Oct. 30, 2008 (listing of 50 ways to save gasoline that are not subsidized).
[113] Although this proposal avoids the problem of "picking winners," it does not avoid another general problem with subsidizing fuel efficiency: since the fuel cost of driving another mile is reduced, drivers drive these cars more. For a discussion of this "rebound" effect, see Part III.C.1.
[114] See Section 40 (fuels from alcohol); Section 41A (biodiesel and renewable diesel).
[115] http://www.finance.senate.gov/imo/media/doc/121813%20Energy%20Tax%20Reform%20Discussion%20Draft%20Summary1.pdf. The proposal also adjusts the credit for the energy density of the fuel.

choosing what technology to use in pursuing it. Baucus has offered a similar proposal for clean electricity production as well.[116]

Compared with the green energy subsidies under current law, hydrocarbons subsidies usually are somewhat broader, and thus more neutral. For example, most do not focus on particular types of drilling,[117] and are available to all hydrocarbon producers.[118] Nevertheless, nearly all are too narrow in applying only to U.S. production, even though production in other secure and friendly nations also can enhance national security, as noted above.

4. Reducing the Overall Demand for Energy

Compared with taxes and permits, subsidies have another disadvantage, which features prominently in the literature: they do not raise energy prices, and thus do not depress overall demand for energy. To see the difference, assume gasoline costs $2.50, and an energy-equivalent amount of ethanol costs $3.00. Ethanol becomes competitive if either the price of gasoline is increased (with a $.50 tax or permit price) or the price of ethanol is reduced (with a $.50 subsidy). Yet although these alternatives have similar *substitution* effects (helping ethanol compete with gasoline), they have different *income* effects (affecting the budget consumers have to spend). The gas tax *raises* the average price of transportation fuel (to $3.00), reducing purchasing power and dampening overall demand for fuel. In contrast, an ethanol subsidy *lowers* the average price of fuel (to $2.50), augmenting purchasing power and increasing the demand for fuel.[119]

While this difference between taxes and subsidies is commonly invoked,[120] it arguably is less important than the literature suggests. The conventional analysis overlooks an important piece of the puzzle: although the *subsidy itself* does not reduce the overall demand for energy, the subsidy *has to be funded*. As a result, consumers (in the aggregate) pay higher taxes than they would if there were no energy subsidy. This heaver tax burden itself has an income effect, which dampens the overall demand for energy. So in the example above, there actually are

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[116] The proposal offers a credit based on the ratio of a producer's emissions over their energy production. A flaw in this proposal is that producers can improve their ratio, and thus earn a more generous credit, by producing renewable energy that no one needs, and paying customers to take it. This problem already arises with the production tax credit, discussed below. See Part III.C.2.

[117] Three focus on particular types of production – the credits for marginal wells, enhanced oil recovery, and unconventional sources – but they are not currently in effect, since they can be claimed only when prices are sufficiently low.

[118] Percentage depletion generally is available only for "independent" producers.

[119] In fact, the U.S. ethanol subsidy, which expired in 2011, arguably did not even create a helpful substitution effect. Since gasoline and ethanol are sold as a blended product, they may function like complements, instead of substitutes. As a result, lowering the price of ethanol reduced the price of the blend, potentially inducing more consumption. NRC, at 93 ("The various tax credits lowered the cost of biofuels and therefore should have encouraged their substitution for petroleum motor fuels. Because biofuels are almost always sold as a blend with petroleum fuels, however, the subsidies also effectively lowered the final delivered package of the petroleum biofuel blend, thereby encouraging additional consumption of petroleum.")

[120] See Goulder & Parry, 155-57 ("Since [subsidies] lower firms' average costs, they provide the wrong incentive regarding the level of output").

competing income effects: On one hand, lower energy prices ($2.50 instead of $3.00) *increase* the demand for fuel. On the other hand, the tax funding this subsidy *reduces* demand for fuel.

For these two income effects to cancel out, they need to affect the *same* people. A key question, then, is how much overlap there is between consumers *benefiting from the subsidy*, on one hand, and consumers *bearing the tax*, on the other. For example, assume the income effect from the ethanol subsidy increases demand for fuel among *low-income* consumers (*e.g.*, because they spend marginal earnings on fuel), but not *high-income* consumers (*e.g.*, because they spend marginal earnings on luxury goods). In other words, the income effect from the subsidy disproportionately impacts low-income consumers. Assume the tax funding this subsidy is an increase in the top bracket. This tax does not reduce the demand for fuel among either low-income consumers (who aren't paying the tax) or high income consumers (who are not spending marginal dollars on fuel). In this scenario, then, the energy subsidy does, in fact, increase overall demand for fuel, even when the tax funding it is taken into account. In other words, the literature's conventional prediction is right. But this is not always true. For instance, if the subsidy and tax *actually do* affect the same people – so their combined effect is distribution neutral – their effects on overall demand should cancel out.

Finally, there is another reason why energy subsidies might increase overall demand for energy, which does not apply to taxes and permits: subsidies tend to focus more on *promoting new sources* of energy (e.g., with solar cells and ethanol) than on *using less* energy (e.g., with telecommuting and buying local produce). After all, subsidies inevitably favor some abatement options over others, since administrability constraints keep subsidies from being comprehensive, as noted above. These constraints may be especially acute in rewarding conservation, since the relevant behavior is hard to monitor. For example, the government cannot easily know when we skip errands, drive more slowly, choose vacations near where we live, and the like. In contrast, buying an electric car or installing solar panels is easy to document. If this sort of administrative constraint biases subsidies toward new sources of energy – instead of conservation and efficiency – then subsidies would, in fact, increase the overall demand for energy. In contrast, a gas or carbon tax should be immune from this bias. They are equally able to reward new sources of energy, on one hand, and conservation, on the other. For instance, a gas tax asks only how many gallons we buy, and requires no information about what we do (or don't do) to use less.[121]

5. Geographical Scope

Another familiar problem arises when subsidies – and also taxes and permits – apply in some countries, but not others. For example, assume Country A either taxes coal, or subsidizes substitutes for it, while Country B does not. Although demand for coal in Country A will decline, there are two offsetting effects. First, coal prices should fall, inducing Country B to use more coal. Second, when selling goods made with coal, such as steel – both in Country A and in other

[121] I am grateful to Louis Kaplow for this observation.

markets – firms in Country B have a comparative advantage.[122] In response, firms in Country A may move production to Country B. Without multilateral coordination, then, Country A's policy could end up merely *shifting* the consumption of coal to other countries, instead of *reducing* it. To mitigate this problem, countries can make contingent commitments, which take effect only if other countries match them. Or they can proceed unilaterally, using the credibility they gain in doing so to urge others to follow.[123]

B. Targeting Results Instead of Proxies

While some subsidies under current law are too narrow, others suffer from a different limitation: they reward the wrong behavior. Specifically, gaps can emerge between the policy goal, on one hand, and the behavior that is rewarded, on the other.

1. Energy Efficiency and Rebound

A familiar example is "rebound," which is a perverse effect of subsidizing energy efficient cars and appliances: consumers end up using them more, so less energy is saved.[124] For instance, consider two options for internalizing the negative externalities of oil, which are assumed to be $1.00 per gallon: a gasoline tax of $1.00 per gallon[125] or a tax credit of $270 per year for fuel efficient "plug-in" hybrid vehicles.[126] Both encourage drivers to buy plug-in hybrids. The credit does so directly, while the gas tax does so indirectly by discouraging the use

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[122] Goulder & Parry, at 170. To blunt this effect, Country A can try to extend its coal tax to these imported goods. Yet determining the influence of coal on their price is difficult, and trade rules further complicate this effort.

[123] Council of Economic Advisers, *All of the Above*, at 39 ("While some might suggest that the growing international share of GHG's is too small to matter, in fact the opposite is true. . . . [B]y taking strong steps to reduce emissions at home, . . . the Administration is in a much stronger position to secure similar commitments from other nations.").

[124] *See* Gilbert E. Metcalf, *Tax Policies for Low-Carbon Technologies*, NBER Working Paper 15054 (June 2009) (discussing rebound). Empirical evidence suggests that consumers do, in fact, react in this way. *See, e.g.,* Meredith Fowlie, Michael Greenstone & Catherine Wolfram, *Do Energy Efficiency Investments Deliver*? Evidence from the Weatherization Assistance Program (2014), https://economics.stanford.edu/files/Fowlie-Greenstone-Wolfram%20--%20Do%20Energy%20Efficiency%20Investments%20Deliver.pdf (finding that participants in the federal Weatherization Assistance Program increased their thermostats on average by .6 degrees F after weatherizing); Soren T. Anderson, Ian W.H. Parry, James M. Sallee & Carolyn Fischer, *Automobile Fuel Economy Standards: Impacts, Efficiency, and Alternatives*, 5 Rev. Env. Econ. & Pol'y 89 (2011) (rebound estimated at about 10% of fuel savings from CAFÉ).

[125] A tradeable permit costing $1.00 would have the same effect.

[126] While a "regular" hybrid uses electricity at low speeds and shifts to gasoline at higher speeds, "plug-in" hybrids use electricity at all speeds, but use some gasoline to generate electricity. https://www.fueleconomy.gov/feg/phevtech.shtml. While there is a tax credit for plug-in hybrids under current law, it generally is $2500 to $7500 per vehicle, depending on the size of the battery. http://www.plugincars.com/federal-and-local-incentives-plug-hybrids-and-electric-cars.html. The $270 per year in the example here is hypothetical, but it is used to establish (seeming) parity with a $1 per gallon gas tax. Specifically, a 2013 hybrid's gas mileage is 42 mileage per gallon ("mpg"), compared with 23 mpg for the average vehicle. If a hybrid drives the average number of miles in a year (13,746), it uses 270 gallons less per year. Since the negative externalities are assumed to be $1 per gallon, the tax credit is $270 per year. See U.S. Department of Energy, *Fuel Economy Guide: Model Year 2013*, http://www.fueleconomy.gov/feg/pdfs/guides/FEG2013.pdf.

of gasoline. Nevertheless, the gas tax is likely to be more effective at reducing gasoline usage. The difference is that the tax increases the cost of using another gallon, while the hybrid credit does not. On the contrary, the credit actually *lowers* the marginal cost of driving by reducing the gasoline used per mile, and thus creating an incentive to drive *more miles*.

The problem with this hybrid credit – and, more generally, with subsidies for energy efficiency – is that they do not reward the *actual* behavior we want (using less energy), but behavior that is *related but different* (using fuel efficient technology). Buying a hybrid is merely a *proxy* for using less gasoline. A proxy could be tempting if it is more administrable, more politically palatable, or more salient. Yet targeting a "proxy," instead of the behavior we actually want, can produce flawed incentives.[127]

This is true not only when we *subsidize* a proxy, but also when we *tax* it (or require a permit for it). For example, assume we impose a $260 annual tax on owners of SUVs as a way to reduce oil consumption.[128] Although SUVs obviously are gas guzzlers, this "product tax" uses an imperfect proxy (the SUV itself), instead of the behavior we want to discourage (use of gasoline). This SUV tax is both too broad (in applying to all SUV's, regardless of how many miles they travel) and too narrow (in excluding gas guzzling sedans).

The point of these examples is that "results-based" policies are more promising than "proxy" policies. The successful example (the gas tax) is more results-based, since it encourages the desired behavior (using less gasoline) instead of conduct that may *correlate* with this behavior (buying a hybrid or not buying an SUV). Admittedly, a gasoline tax is something of a proxy as well. After all, the use of gasoline *per se* is not what troubles us, but the environmental harms from extracting and burning it, as well as the national security costs of policing access and enriching rivals. In this example, then, the difference between "proxy" and "results-based" policies is more a matter of degree than a dichotomy. In other words, a gas tax is also a proxy, but a *better* proxy than these alternatives.

Even so, if we are stuck with an imperfect proxy, one way to improve it is to add more conditions. For example, a hybrid credit reduces gasoline consumption more effectively if another requirement is added: to be eligible, claimants must have mileage-based auto insurance, so they pay higher premiums for driving more. In effect, the task of discouraging rebound is delegated to an insurance company. Admittedly, instead of a "results-based" condition, which

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[127] *See* Don Fullerton, Inke Hong & Gilbert Metcalf, *A Tax on Output of the Polluting Industry is Not a Tax on Pollution, in* Behavioral and Distributional Effects of Environmental Policy 13 (Carol Carraro & Gilbert E. Metcalf, eds. 2001) (considering welfare costs of imperfectly targeted environmental instruments); *Cf.* Goulder & Parry, at 157 ("Still another pricing instrument is a tax on an input, produced good, or service associated with emissions. . . . However, because these taxes do not focus sharply on the externality, they do not engage all of the pollution reduction channels described above, implying a loss of cost-effectiveness.")

[128] Assuming the SUV drives the average number of miles in a year (13,746), and its gas mileage is 16 per gallon, compared with 23 for the average vehicle, it would use 261 gallons less per year. See U.S. Department of Energy, Fuel Economy Guide: Model Year 2013, http://www.fueleconomy.gov/feg/pdfs/guides/FEG2013.pdf. If the negative externalities are $1.00 per gallon, the tax should be $260 per year.

focuses on gasoline usage, the subsidy now uses *two* "proxy" conditions: one favoring fuel efficient cars, and the other constraining how much these cars are driven. Yet the *combination* of these conditions targets the goal better than either can *alone*.

2. Production Incentives and Negative Pricing

A less familiar example of a "proxy" subsidy, which also creates perverse incentives, is the production tax credit. It rewards firms for producing electricity from renewable sources. But unfortunately, the credit is available even if this electricity is *not needed*, and thus does not *actually replace* hydrocarbons. Specifically, Section 45 offers a credit of 2.3 cents for each kWh of electricity generated with wind. Generating electricity from wind is easier at night, but there also is less demand, and electricity generally cannot be stored. Moreover, some windy locations are remote, and do not have transmission lines to send electricity where there is more demand. This means firms have ample opportunities to generate electricity that is not needed. To collect the credit, they *pay customers* to take it.[129] This practice is known as "negative pricing."[130] Hopefully, technology will ameliorate this problem over time. For example, new transmission lines in West Texas have reduced the frequency of negative pricing by shipping excess capacity to Dallas, Houston, and Austin.[131] In addition, improvements in battery and storage technologies would help as well;[132] indeed, one advantage of electric vehicles is that their batteries can store electricity generated at night.

Nevertheless, the root of this problem is that the production tax credit uses a flawed proxy – *producing* renewable energy, instead of *replacing* carbon-based energy. One way to solve this problem is for the credit to reward revenue or profit, instead of production. This way, the government can piggyback on consumer judgments about the energy's value. If consumers won't pay for it, the government should not subsidize it. Alternatively, if these regimes continue to focus on production, we should add another condition: to be eligible for the credit, electricity has to sell for at least a minimum (positive) price.

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[129] *See* Hutzler, at 15 (production tax credit induces firms to keep producing electricity from wind that they can't sell); *cf.* Graetz at 191(noting that power companies often drop price of wind-generated electricity to zero, and describing a wind facility that was built to provide 8 gigabytes, even though projections suggested 4.5 was the maximum needed).

[130] Empirical evidence suggests that wind generation is usually the cause of negative pricing. For example, negative pricing is much more frequent in hours when wind generates a larger percentage of a region's electricity. In West Texas in 2011, for instance, there was negative pricing in over 70% of the hours when wind was generating at least 25% of the region's electricity. Frank Huntowski, Aaron Patterson & Michael Schnitzer, *Negative Electricity Prices and the Production Tax Credit*, Sept. 14, 2012. http://www.hks.harvard.edu/hepg/Papers/2012/Negative_Electricity_Prices_and_the_Production_Tax_Credit_0912.pdf (figure 8, at 12); id. at 12 ("Negative prices are most prevalent when wind output is highest relative to overall demand, such as during the overnight hours in the spring and fall months when wind output is high but demand is relatively low and less power is needed.").

[131] http://breakingenergy.com/2014/10/01/the-more-renewables-you-have-the-more-transmission-youll-need

[132] Bill Tucker, *Promises, Promises, . . . And Energy Storage*, Forbes, Mar. 18, 2015 (noting that the energy storage industry expects to grow by 250% and that improvements would allow electricity from peak generation periods to be used after the sun has set or the wind has stopped blowing).

C. Heterogeneous Harms

Just as it is important for subsidies (as well as taxes and permits) to target the right behavior, they also have to vary for harms that are different. Yet tailoring these instruments to heterogeneous harms is challenging for five reasons. The first four apply to taxes and permits as well, while the fifth is unique to subsidies. Empirical uncertainty is the first challenge. For instance, if we are unsure about how much more GHG's are emitted by coal than natural gas, we don't know how different the tax or subsidy should be, or how much of each to allow if we use tradeable permits.

Second, seemingly identical activities can generate different harms, and detecting these variations sometimes requires nuanced information. For example, an electric car produces different levels of GHG's, depending on how the electricity is generated.[133] In setting the subsidy for these vehicles, we get a different answer if we assume the electricity is generated from coal instead of wind.

Third, assessments of harms are inaccurate if we do not consider the full "life cycle" of an activity. For instance, the carbon footprint of an electric vehicle includes not only the electricity to drive it, but also the GHGs to *manufacture* it. In fact, more GHGs are emitted in manufacturing electric vehicles – and, in particular, their batteries – than gasoline-powered cars.[134] Similarly, although fewer GHG's are released when we burn ethanol instead of gasoline, we also have to consider the GHG's from manufacturing ethanol, as well as from converting forests to farmland. If harms (or benefits) are omitted, the tax or subsidy is mispriced or the wrong number of tradeable permits is issued.

Fourth, in comparing the harm caused by different sources, energy-equivalent amounts should be used, but current law does not always do so. For example, the federal excise tax on gasoline is based on volume – 18.4 cents per gallon – instead of energy content. Since a gallon of gasoline produces more energy than a gallon of ethanol – so more ethanol is needed to drive the same distance – the tax on ethanol is higher.[135] This differential appears to be unintentional, since Congress generally has *favored* ethanol in various ways. These other efforts are undercut by basing the tax on volume, instead of energy content.

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[133] Cohen, at 77-78.

[134] http://www.nap.edu/openbook.php?record_id=12794&page=204 ("Damages from the emissions associated with vehicle manufacture account for a large percentage of the overall life-cycle damages. Thus, even with the large decreases in emissions from generating electricity at fossil-fueled plants, the large damages from the vehicle-manufacture component mean that life-cycle damages for electric vehicles would probably be somewhat greater than those for conventional vehicles, unless there is significant reduction in energy use in manufacturing batteries and other electric vehicle components."); Hutzler, 3/13, at 11 ("When an electric car rolls of the production line, ithas already been responsible for 30,000 pounts of carbon-dioxide emissions, compared with 14,000 pounds for a conventional gasoline-powered vehicle."); Joshua Linn & Virginia McConnell, *How Electric Cars Can Increase Greenhouse Gas Emissions*, at 35-37.

[135] National Research Council, at 84-85.

Finally, subsidies are based on the harm a targeted activity *avoids*, instead of the harm it *causes* (as with taxes and permits). *Avoided* harms are especially hard to measure because, by definition, they never happen. For example, a fuel efficient hybrid reduces emissions more in replacing an SUV than a mini-cooper, but the government cannot know what car the claimant would otherwise drive. Similarly, a wind turbine avoids more emissions in replacing coal than natural gas.[136] Yet identifying which plant is decommissioned is not easy, while identifying which is never built is impossible. The best the government can do is to make assumptions based on general trends (e.g., geothermal tends to replace coal while wind tends to replace natural gas), but these assumptions are not always accurate.[137]

D. Interactions With Other Regulatory Regimes

Even if a subsidy otherwise creates the right incentives, it can interact with other regimes in perverse ways. For example, subsidies for hybrids and electric cars presumably are supposed to enhance the nation's energy efficiency. Yet federal fuel economy (or CAFÉ) regulations already determine the level of fuel efficiency on American roads, leaving these subsidies essentially no room to improve it. Specifically, CAFÉ requires manufacturers to meet an average fuel efficiency standard for their entire fleet.[138] Under this regime, selling a car with *above-average* fuel efficiency enables a manufacturer also to sell a car with *below-average* efficiency. As a somewhat oversimplified example, if the required fleet average is 30mpg, selling a hybrid that gets 45mpg enables a manufacturer to sell a gas guzzler that gets 15mpg.[139] The effect of subsidizing hybrids under CAFÉ, therefore, is to give the manufacturer "cover" to sell a gas guzzler. To be precise, these subsidies allow manufacturers either to sell *more* guzzlers, or to make the guzzlers they sell *even less* fuel efficient.[140] Either way, the subsidies do not improve overall fuel economy, a reality that obviously undercuts the case for them. This perverse effect actually is exacerbated under the new CAFÉ standards for 2017–2021, since they

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[136] David Weisbach, *Designing Subsidies for Law-Carbon Energy*, 20 J. Envtl. & Sustainability L. 1, 14 (2013); Joseph Cullen, *Measuring the Environmental Benefit of Wind-Generated Electricity*, 5 Am. J. Econ. Pol'y, 107, 108 (2013) ("[T]he quantity of emissions offset by wind power will depend crucially on which generators reduce their output.").

[137] Metcalfe, Metcalf, Low Carbon Technologies, at 12.

[138] There actually are two sets of CAFÉ requirements. The National Highway Transportation Safety Administration promulgates one on fuel economy, while the Environmental Protection Agency promulgates another based on GHG's. Anderson, Parry, et al, at 90-91.

[139] In fact, manufacturers can still sell the gas guzzler, even if they don't sell the hybrid, as long as they buy fuel economy credits from a manufacturer that sold one. For instance, Tesla "generates millions in revenues by selling emissions credits to other car makers under California's zero-emissions-vehicle mandate and federal greenhouse rules." Holman W. Jenkins, Jr., *Tesla is a Compliance Company*, Wall St. J., Aug. 7, 2015, http://www.wsj.com/articles/tesla-is-a-compliance-company-1438987210 (noting that).

[140] Joshua Linn & Virginia McConnell, *How Electric Cars Can Increase Greenhouse Gas Emissions*, at 35.

give double weighting to electric vehicles in computing a firm's CAFÉ average. As a result, each subsidized electric vehicle can shelter two guzzlers, instead of one.[141]

A subsidy is more susceptible to this problem than a Pigouvian tax or tradeable permit. This is true even though all these instruments encourage consumers to buy fuel efficient cars. Admittedly, as more people buy them – raising the fleet average – car manufacturers are able to sell more gas guzzlers under CAFÉ. Yet even though taxes and permits are like subsidies in "making room" for gas guzzlers, there is an important difference. Unlike subsidies, taxes and permits increase the cost of driving guzzlers – and thus depress demand for them – by raising the price of gasoline.

Therefore, one way to avoid this problem is to use taxes or permits, instead of subsidies. Yet if we are stuck with subsidies, they need to be coordinated better with CAFÉ. One approach is to exclude subsidized vehicles from the CAFÉ average, so CAFÉ determines the fuel economy only of unsubsidized cars. Another approach is to raise the required fleet average, so it already reflects fuel economy improvements from subsidized vehicles. In fact, the CAFÉ target is scheduled to increase substantially – and the new level is hard to meet without electric vehicles – but the auto industry is lobbying to scale back this scheduled increase.

E. Scarcity Rents

Even if these other problems are solved, subsidies still pose a further challenge: if they succeed in launching viable substitutes for disfavored energy – or are expected to succeed in the future – producers of this disfavored energy are likely to respond by cutting prices. In effect, they sell this energy while they still can. While this dynamic can arise in any market – just as grocery stores discount day-old produce – the effect is especially powerful in extractive industries. As William Hotelling observed, producers of finite resources can either tap their reserve today or save it for sale tomorrow.[142] Therefore, prices today reflect expectations about prices tomorrow. Indeed, prices are not set to equal marginal production costs. They also include "scarcity rents," which reflect how scarce supply is compared with expected demand[143] – both now and in the future.[144] Accordingly, if producers expect an energy innovation (such as shale gas or renewables) to replace a product (like coal) *in the future*, they cut prices *today*, unloading the reserve while they still can get *something* for it.[145] In other words, the prospect of a successful innovation in the future makes fossil fuels even harder to displace today. The more promising the innovation is, the more likely it is to reduce scarcity rents. These price cuts are

[141] Id., at 35.
[142] Hotelling.
[143] In other words, the price (P) equals marginal cost (MC) plus a scarcity rent (SR).
[144] Indeed, the prices should be the same, except that the price tomorrow is increased for time value (since producers must wait to be paid). Heale
[145] They can cut P by X, where $X \leq SR$.

likely to induce consumers to use more energy. As a result, the new source of energy can end up *supplementing* fossil fuels, instead of *replacing* them.[146]

Like subsidies, taxes and permits also can trigger this perverse effect, but in weaker form. When taxes and permits raise the price of hydrocarbons – making them less competitive – they encourage investments in alternative energy. If fossil fuel producers expect these investments to succeed, they are likely to respond with "Hotelling" price cuts. Even so, taxes and permits have an important advantage over subsidies here: they offset these price cuts, at least to an extent, by increasing the price of hydrocarbons.[147] Whether these "Hotelling" cuts are offset completely, or only partially, depends on how large the scarcity rent is, and how it compares with the tax or permit price. For instance, if the scarcity rent is significantly larger than the tax or permit price, the producer can absorb these costs and still cut the price *even more* to compete with the new form of energy.[148] Notably, producers will have an easier time absorbing taxes than the cost of permits: the reason is that permit prices adjust automatically, while taxes do not. Specifically, as producers cut prices, they induce more demand for hydrocarbons –and also more demand for *permits* for this energy – causing permit prices to increase. Taxes, by contrast, would not increase automatically in this way. To my knowledge, these differences in the impact of subsidies, taxes, and permits on Hotelling effects have not been recognized in the literature.

IV. Institutional Design Challenges: Labor and Savings Distortions, Distribution, and Use of the Tax System for Energy Policy

Part III analyzed a number of challenges in targeting harms effectively. This Part assesses four additional challenges, which are grounded in traditional tax policy concerns: first, energy taxes and subsidies can distort labor and savings decisions; second, energy subsidies are a flawed vehicle for pursuing distributional goals;[149] and third, the tax system has familiar limitations in pursuing environmental and national security goals.

A. Labor and Savings Distortions

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[146] Michael Hoel, *Bush Meets Hotelling: Effects of Renewable Energy Technology on Greenhouse Gas Emissions* (2008) ("[F]ossil fuels are non-renewable, and the competitive supply gives a price path of the fuel which depends on present and future demand. When this "Hotelling feature" is taken into consideration, the whole price path of the carbon resource will shift downwards as a response to the reduced cost of the substitute. An implication of this, in combination with the absence of an efficient climate agreement, is that it is no longer obvious that greenhouse gas emissions decline in the near future.")

[147] Where there is a tax (T), P = MC + SR – X + T. Where a permit is required and its cost is A, P = MC + SR – X + A.

[148] As SR becomes smaller – or as T and A become larger – the producer has less room to make further cuts, since it would not want P to fall below MC.

[149] In other work, I have distinguished between the effect of tax expenditures on "programmatic benefits" – that is, the positive and negative externalities they create – and their effect on excess burden and distribution. See generally, Schizer, Limiting Tax Expenditures.

At first blush, a potential disadvantage of subsidies is that they *consume* revenue, while Pigouvian taxes and some tradeable permits *raise* revenue.[150] By this logic, taxes and permits seem to offer a "double dividend." In addition to correcting an externality (the first "dividend"), they can replace other distortive taxes, easing labor and savings distortions (the second "dividend").

Yet this apparent advantage is illusory.[151] After all, carbon and gasoline taxes are not distortion-free. Like other taxes, they also affect labor and savings choices. By increasing the after-tax cost of goods and services, these taxes erode the purchasing power of additional earnings. If an extra dollar of income buys fewer goods and services, the return from working and saving declines.

Even so, carbon and gasoline taxes still are likely to cause milder labor and savings distortions than a progressive income tax, since they are less redistributive. For example, although high-income households spend a larger *amount* on gasoline (and gasoline taxes), they devote a lower *percentage of their income* to these expenses.[152] If a tax becomes less burdensome as taxpayers earn more – and thus is less redistributive – it is less likely to discourage work and saving. Obviously, the opposite is true of a progressive income tax. As a result, replacing it with a (regressive) gas tax can ease labor and savings distortions. But the source of the difference here is redistribution, not the gas tax *per se*. Put another way, carbon and gas taxes should still cause the same labor and savings distortions as other taxes that have *comparable effects on distribution*.[153]

Indeed, using carbon or gas taxes does not commit us to a specific level of redistribution (or labor and savings effects). We can generate whatever redistribution (and labor and savings effects) we want by pairing these taxes with other adjustments to the tax system. For example, assume we want to add a gas tax without changing redistribution. Since a gas tax makes the overall system *less* progressive, this effect can be offset by making the income tax's rate

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[150] Permit regimes can raise revenue if permits are auctioned, instead of given away for free.
[151] See James Fullerton & Gilbert Metcalf, *Environmental Taxes and the Double-Dividend Hypothesis: Did You Really Expect Something for Nothing?*, 73 Chi. Kent L. Rev. 221 (1998).
[152] For example, assume a household with $50,000 of income spends $2,000 on gasoline, and a household with $600,000 of income spends $6,000 on gasoline. Even though the high-income household spends three times as much on gasoline, it devotes a much lower percentage of household income to it (1% versus 4%). As a result, gas taxes represent a much higher percentage of the low-income household's income. For instance, if it is 25% of the purchase price, the $500 tax on the low income household is 1% of their income. In contrast, the $1500 tax is only .25% of the high-income households' income.
[153] Of course, there are other sources of dead weight loss aside from labor and savings distortions, including costs of drafting and enforcing tax rules and of complying (and planning around) them. Compared with distributionally comparable taxes, carbon and gas taxes could offer a different mix of these costs, depending on the details of the relevant taxes.

schedule *more* progressive.[154] Notably, once a gas or carbon tax is paired with this sort of offsetting adjustment – and, in particular, once the overall reform is distribution neutral – labor and savings distortions should not change. As Louis Kaplow has shown, "when reforms are implemented in this distribution-neutral manner, labor supply is unaffected . . . ."[155]

The same is true of energy subsidies. They can affect labor and savings choices in the same way as taxes, as long as they are coupled with the right offsetting adjustments. For instance, an energy subsidy can encourage work and saving by reducing the cost of energy, and thus increasing the purchasing power of marginal earnings. But the taxes funding this subsidy can have the opposite effect. If the overall package has the same impact on distribution as one introducing an energy tax, the two reforms should affect labor and savings choices the same way.

To illustrate this point, the following example pairs an income tax with an energy tax in one case, and an energy subsidy in the other. The point is that either package can generate the same effective marginal rate, and thus the same effect on labor and savings choices and distribution. Assume an average taxpayer would ordinarily spend 9% of her marginal earnings on energy, but a subsidy would increase this level to 10%, while a Pigouvian tax would reduce it to 8%.[156] This average taxpayer has the same 18% effective marginal rate under each of the following three regimes: first, an 18% income tax; second, a 16% income tax paired with a 25% tax on (disfavored) energy purchases; and third, a 20% income tax with a deduction (and thus a subsidy) for (favored) energy purchases:

Tax On An Additional $100 of Earnings

Regime	**Energy Purchased**	**25% Energy Tax**	**Energy Deduction**	**Taxable Income**	**Income Tax Rate**	**Income Tax**	**Total Tax**
18% Income Tax	9	0	0	100	18%	18	18
16% Income Tax With 25% Energy Tax	8	2	0	100	16%	16	18
20% Income Tax With Deduction for Energy	10	0	10	90	20%	18	18

[154] For example, assume a distribution neutral reform introduces a gas tax that raises $250 billion, and cuts income tax revenue from $1 trillion to $750 billion. Since ¼ is raised with a l*ess* redistributive tax, the tax on the rest has to become *more* redistributive.

[155] Louis Kaplow, Optimal Control of Externalities in the Presence of Income Taxation.

[156] In this stylized example, the taxpayer buys hydrocarbons if there is no tax or subsidy. If a Pigouvian tax is imposed on hydrocarbons, she continues to buy them but reduces her consumption. If a subsidy for green energy is enacted instead, she switches to green energy and increases her energy spending.

The energy tax keeps the effective rate at 18% – and thus does not change labor and savings distortions – because it has two offsetting effects. On one hand, it funds a cut in the marginal income tax rate from 18% to 16% (easing distortions). On the other hand, it increases the cost of (disfavored) energy, and thus erodes the purchasing power of marginal earnings (exacerbating distortions).[157] For the average taxpayer, these two effects are perfectly offsetting: the energy tax functions like a 2% tax on marginal earnings, which reverses the 2% cut in the income tax.[158]

Similarly, the energy subsidy also keeps the effective rate at 18% – and thus has the same effect on labor and savings choices as the energy tax – because it also has offsetting effects: On one hand, the stated income tax rate is increased (from 18% to 20%) to fund this subsidy (exacerbating distortions). On the other hand, the deductibility of (favored) energy enhances the purchasing power of marginal earnings (easing distortions). For the average taxpayer, this energy subsidy functions as a 2% marginal rate cut, matching the 2% income tax increase.[159]

Notably, these effects cancel out only for those who buy the *average* amount of energy. *Light* energy users face a *lower* effective tax rate when an energy tax (partially) replaces the income tax, since they buy less energy.[160] For the same reason, they face a *higher* effective rate when an energy subsidy is funded with a higher income tax.[161] The opposite is true of *heavy* energy users. On net, their distortions are eased with an energy subsidy,[162] and exacerbated with an energy tax.[163] In other words, although distribution neutral reforms should not affect labor distortions *on average*, they can do so for particular individuals. Again, energy taxes and subsidies are the same in this way.

B. Distribution

Another potential concern about energy subsidies is that high income claimants are more likely to claim them. According to Severin Borenstein and Lucas Davis, households in the top 20% of the income distribution have claimed 60% of the clean energy credits under current law,

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[157] Lawrence H. Goulder, *Climate Change Policy's Interactions With the Tax System,* 40 Energy Economics 53, 54 (2013).

[158] In the literature, the first is called a tax interaction effect, and the second is called a revenue recycling effect.

[159] In principle, energy taxes and subsidies can affect labor and savings choices in another way as well: by promoting (or discouraging) complements (or substitutes) for leisure. For example, if gasoline taxes disproportionately discourage weekend car trips, they could reduce labor distortions; the opposite would be true, though, if they disproportionately discourage commuting to work.

[160] For example, someone who spends only 1% of their marginal earnings on energy, instead of 10%, has a 16.25% effective marginal rate, instead of an 18% marginal rate: Of $100 of additional earnings, they pay $16 of income tax, plus a 25% tax on the $1 they spend on energy, for a total of $16.25.

[161] On $100 of additional earnings, they deduct the $1 they spend on energy. They then pay a 20% tax on their $99 of taxable income, totaling $19.80.

[162] On $100 of additional earnings, they deduct the $20 they spend on energy. They then pay a 20% tax on their $80 of taxable income, totaling $16.

[163] On $100 of additional earnings, they pay $16 of income tax. They also pay another $5 because of the 25% tax on the $20 of energy they buy, totaling $21.

while households in the bottom 60% have claimed only 10%.[164] As a result, commentators express concern about the distributional impact of these programs, and some credits have been amended to exclude high-income households.[165]

However, the fact that these subsidies are claimed disproportionately by high-income claimants is not surprising. Targeting them actually makes sense when two conditions are satisfied. First, the favored technology involves added (private) costs, which are daunting to low- and middle-income households. For example, hybrid and electric vehicles have significantly higher purchase prices than conventional cars. As a result, low and middle-income are likely to choose cheaper alternatives (conventional cars), which offer comparable private benefits (transportation) without the relevant externalities (reduced GHGs and gasoline consumption).[166] If a hybrid costs $15,000 more than a traditional car, low- and middle-income households are unlikely to buy one unless the subsidy is almost $15,000 subsidy. In contrast, a high-income household can be motivated with less. If a $5,000 subsidy is enough, we put three times as many hybrids on the road for the same money making high-income claimants eligible for the subsidy.[167]

Whether the driver of a hybrid has a high or low income, moreover, the positive externalities are the same. Either way, GHGs and gasoline usage are reduced. This brings us to a second reason to subsidize high-income claimants, which is somewhat unique to energy subsidies: the social benefit is comparable, whether the subsidy is claimed by someone with a high or low income. In subsidizing the hybrid, the objective is not to offer *private* benefits to the driver (*e.g.*, by helping her to afford a car), but to generate *environmental* and *national security benefits* for everyone. This is an important difference from subsidies for retirement savings and health care, for instance, where private benefits for the claimant are a more significant motivation. For the same reason, it is unsatisfying to measure the distributional impact of these energy subsidies by asking who *claims* them, instead of who *benefits* when the targeted harms are abated.[168]

[164] Severin Borenstein & Lucas Davis, The Distributional Effects of U.S. Clean Energy Tax Credits, NBER Working Paper 21437 (July 2015), http://www.nber.org/papers/w21437.pdf. Energy taxes are likely to be more progressive. With a carbon tax, for example, one estimate suggests that the top 20% of the income distribution would pay about four times as much as the bottom 20%. Hassett (2009).

[165] For example, regulators in California recently excluded high income households from state subsidies for electric vehicles. Patrick McGreevy, *California Limits Hybrid Rebates to Households Earning Less Than $500,000,* LA Times, Aug. 23, 2015, http://www.latimes.com/local/politics/la-me-pol-electric-cars-20150824-story.html.

[166] Hunt Alcott, Christopher Knittel & Dmitry Taubinsky, *Tagging and Targeting of Energy Efficiency Subsidies*, 105 Am Econ. Rev. 187, 191 (2015) (empirical analysis showing that subsidies for energy efficient durable goods, such as air conditioners and cars, "preferentially accrue to wealthier consumers").

[167] To be clear, the assumption here is that these subsidies actually reduce GHGs and petroleum consumption, and are not constrained by CAFÉ.

[168] Cf. Schizer, *Limiting Tax Expenditures* (arguing that the people who claim a tax expenditure are not necessarily those who benefit from the positive externalities it creates).

Unfortunately, Congress still includes distributional criteria in some energy subsidies. For example, the Department of Energy spent billions on "weatherizing" the residences of 7 million low-income Americans.[169] Yet focusing on low-income claimants is not cost-effective, as noted above, because the government presumably has to cover a higher percentage of weatherization costs. Not surprisingly, a recent study determined that this program had a negative return.[170]

Another problem with using an energy subsidy to pursue distributional goals is that it is unlikely to be a cost effective way to help low-income households. If the goal is to channel resources to them, an energy subsidy is less efficient than cash, since it can be used only for a designated purpose. For instance, instead of $1,000 to weatherize their home, a low income household would prefer a payroll tax refund of $1,000 (or even $800), which can be used for any purpose.

Therefore, the most promising strategy is to pursue energy goals as cost-effectively as possible, without regard to distribution. Some of the savings can then be allocated to programs that pursue distributional goals efficiently, such as payroll tax cuts or increases in the earned income tax credit.[171]

Even so, favoring low-income claimants still makes sense in three circumstances. First, some market failures, such as credit constraints, disproportionately affect them.[172] For instance, if weatherization pays for itself over time in reduced energy bills, a subsidy is needed only for those who cannot fund the up-front investment. In this case, focusing on low-income households actually is the most cost-effective response. Second, if subsidies are provided through tax deductions or nonrefundable credits, which are less valuable to low-income claimants, a separate program may be needed for them. Third, if separate distributional adjustments (such as the $800 in the example above) are not politically feasible, there is more reason to account for distribution within the energy program itself.

C. Tax as a Leaky Mechanism for Delivering Subsidies

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[169] This program's annual budget increased from $450 million per year in 2009 to $5 billion in 2011 and 2012.

[170] The private return was -4%, and the social return, which includes reducing GHG's, was -3%. Meredith Fowlie, Michael Greenstone & Catherine Wolfram, *Do Energy Efficiency Investments Deliver? Evidence from the Weatherization Assistance Program* (2014), https://economics.stanford.edu/files/Fowlie-Greenstone-Wolfram%20--%20Do%20Energy%20Efficiency%20Investments%20Deliver.pdf

[171] As a stylized example, assume a $200 weatherization grant to a high income claimant has the same environmental benefit as a $1,000 weatherization grant to a (less responsive) low-income claimant. It is Pareto improving to give this grant to the high income claimant, and to pay $800 in unrestricted cash to the low-income claimant, as long as the low-income claimant prefers the flexibility of $800 in cash to $1,000 for weatherization.

[172] Hunt Alcott, Christopher Knittel & Dmitry Taubinsky, *Tagging and Targeting of Energy Efficiency Subsidies*, 105 Am Econ. Rev. 187, 191 (2015) (arguing that subsidies for energy efficient durable goods should be limited to low-income households, since they are more likely to be credit-constrained).

Finally, two other familiar challenges arise when the tax system is used to deliver energy subsidies. First, tax benefits are not equally valuable to everyone. Second, tax administrators do not have expertise about energy policy.

1. Limited Market for Tax Benefits

When structured as tax expenditures, energy subsidies have less influence on some claimants. If not refundable, tax expenditures have no value to nonprofits, loss corporations, as well as foreigners (and others) who pay no U.S. tax. If structured as deductions instead of credits, the subsidy varies with the claimant's bracket. In addition, energy tax expenditures generally are subject to the passive loss rules (exception for working interests in oil and gas and some credits claimed by the real estate industry).[173] This means broad classes of taxpayers (individuals, personal services firms, and closely held firms) can use them to shelter only passive income. Furthermore, some energy tax credits cannot reduce the alternative minimum tax.[174]

These limits raise the cost of capital for renewable projects by narrowing the universe of investors.[175] Profitable utilities and energy producers can fund these projects "in-house," but investors from outside the energy industry are harder to recruit. Nonprofits and many individual investors cannot claim the tax benefits. Although profitable public companies can use them, they often are reluctant to commit capital outside their core areas. Because the pool of potential investors is limited, they can exact more favorable terms. This was especially true during the financial crisis when many of the usual investors, including Lehman brothers, were insolvent or unsure how profitable they would be.[176] In response, the government temporarily replaced some tax credits with direct grants (the so-called Section 1603 credit) for projects begun before December 31, 2011.

2. Drafting and Administering Tax Expenditures: Mismatch in Expertise

Another familiar challenge is that tax experts are not the right government officials to make judgments about energy policy. This is a good reason not to use the tax system for energy programs.

If the tax system is already doing some of the necessary work, though, building on its existing responsibilities is plausible. For example, the tax system already collects a gasoline tax

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[173] Section 469.
[174] See Section 38(c).
[175] Michelle D. Layser, *Improving Tax Incentives for Wind Energy Production: The Case for a Refundable Production Tax Credit* (unpublished manuscript) (2015) (describing costs of raising "tax equity" and proposing to make the credit refundable as a way to avoid these costs); Michael Mendelsohn & John Harper, *§1603 Treasury Grant Expiration: Industry Insight on Financing and Market Implications*, NREL Technical Report (June 2012), http://www.nrel.gov/docs/fy12osti/53720.pdf ("This need for such specialized investors constrains the availability of private capital for renewable energy projects, particularly for projects that are developed by entities that are smaller, have less development experience, or that seek to deploy new or less-proven technologies.")
[176] Mendelsohn & Harper (noting that the number of available tax equity investors dropped from approximately 20 to approximately 5 in 2008-09).

to fund the highway trust fund. If this tax is increased for environmental or national security reasons, the existing administrative infrastructure should be used.

Yet when new taxes or subsidies are added, other agencies should draft and interpret the relevant provisions and resolve any policy issues that arise. Or if a finite benefit has to be allocated among competing claimants – a process Congress has used for some energy tax expenditures, as well as for the low-income housing credit – agencies with more expertise (such as the Department of Energy) should make these judgments.[177] The tax system's role should limited to the ministerial function of dispensing or collecting the money. In this spirit, Senator Baucus's proposals, discussed above, rely on EPA instead of on the IRS to determine the carbon footprint of various technologies, and thus the generosity of the relevant tax expenditure.

V. Policy Implications

The bottom line is that energy subsidies pursue worthy goals, but a number of institutional design flaws undermine their effectiveness. Four implications follow from this assessment: first, the effects of energy on national security warrant more attention in the literature; second, carbon and gasoline taxes and tradeable permits have distinct advantages over energy subsidies; third, given these advantages, if we are unable to enact these instruments for political reasons, we should look for variations that are more politically palatable; fourth, if energy subsidies continue to be used, they need to be strengthened. This Part highlights these implications in turn.

A. National Security

This Article has emphasized two risks to U.S. security when oil markets do not have slack capacity: first, pressure increases on the U.S. to police access to unstable or insecure exporters; second, more revenue flows to geopolitical rivals. Unfortunately, the literature generally has ignored or dismissed these costs on the theory that their magnitude is too hard to estimate, or that only fundamental shifts in energy markets can affect them. Yet difficulties in estimating a cost are not a license to ignore it. In addition, the "shale revolution" is likely to affect the analysis in ways that are not yet fully understood.

In unpacking these effects, we should be precise about which energy sources prompt national security concerns. Given the newly abundant supply of domestic natural gas, the national security argument for coal and renewables has become correspondingly weaker. Indeed, national security issues mainly arise with oil. Efforts to enhance production in friendly and stable regions offer national security advantages, although they have offsetting environmental costs. Efforts to reduce demand through conservation and greater efficiency also yield national security benefits, while advancing environmental objectives as well. As a result, there is a strong

[177] For instance, this sort of process has been used for credits for gasification, coal, advanced nuclear projects, and other advanced energy projects. For a discussion, see Daniel Halperin, Incentives for Conservation Easements: Charitable Deduction or Another Way, 74 Law & Contemp. Probs. 29, 47-49 (2011).

national security argument for higher taxes (or a permit regime) on gasoline, aviation fuel, diesel, and other oil-based products. There also are reasons to favor producers that are friendly and stable (e.g., with a lower tax), but the challenges in administering this differentiated approach are significant. More work is needed on these important issues.

B. Pigouvian Taxes or Tradeable Permits Instead of Subsidies

This Article also shows why Pigouvian taxes or tradeable permits are preferable to subsidies. Several commentators have also come to this conclusion, although the opposite view has supporters as well.[178] In particular, subsidies have five weaknesses. First, although taxes, permits, and subsidies all share the common challenge of reaching all potential substitutes, this task is harder for subsidies. Covering all sources of harm (with taxes or permits) is easier than reaching all options for abating this harm (with subsidies). For example, although identifying all goods and services that *use* oil is not easy, reaching every step that *reduces the use* of oil is harder. Second, and relatedly, instead of trying to cover the waterfront in this way, many green energy subsidies under current law seemingly embrace the opportunity to "pick winners." But it is not clear that government officials have the information, expertise, and incentives to choose which technologies to favor, and they are subject to interest group pressure in attempting to do so. Third, unlike taxes and permits, subsidies often do not increase the price of energy, and thus fail to curtail overall demand. Fourth, subsidies price harm *avoided* by the targeted activity, while taxes and permits price harm *caused* by the targeted activity. Knowing what harm is avoided is inherently more difficult, since (by definition) it does not happen. Finally, if hydrocarbon producers expect viable substitutes for their product to be developed in the future, they are likely to cut prices today. Taxes and permits, which raise the price of hydrocarbons, counter this "Hotelling" effect more effectively than subsidies, which do not.

Given the advantages of taxes and permits over subsidies, the best policy response is a menu of Pigouvian taxes or permits, along the lines discussed above. The environmental, economic, and national security stakes are high, and this approach is most effective in advancing these goals. Although it requires political courage for leaders to adopt these policies, the policy payoff would be significant.

C. Compromises to Attract Political Support

If necessary, this approach can be modified somewhat in order to attract more support. This Section canvasses four ideas, some of which are more familiar than others.

1. Free or Discounted Tradeable Permits

With a permit system, a familiar political compromise is to give away some permits for free or at a discount. This windfall can "buy off" potential opponents, allowing previously

[178] Steven Cohen.

unpriced externalities to be internalized. Unfortunately, though, we lose revenue in discounting permits. Although free permit still distort labor and savings decisions, as discussed above, they cannot fund cuts in other distortive taxes. In other words, there is a tax interaction effect without a revenue recycling effect. Even so, this might still be a price worth paying.

2. Repeal of Subsidies for Hydrocarbons

If we cannot add a Pigouvian tax or a permit system, we can get some of the same benefit by cutting existing subsidies for types of energy we want to discourage. For instance, if the hydrocarbon subsidies discussed above have reduced the price of coal, oil, or natural gas, leading to greater use of these types of energy, cutting or repealing these subsidies would cause these prices to rise, discouraging some consumption at the margin.

Admittedly, the empirics are unclear about whether – and, if so, the extent to which – these subsidies have actually increased the use of hydrocarbons, and which are affected most. For example, the National Resource Council has concluded that these subsidies do not increase GHG's, in part because they believe the disproportionate effect of these subsidies has been to increase natural gas production, which can reduce GHGs in replacing coal. Assuming the NRC is correct, the implication could be to eliminate some subsidies, instead of others. For instance, there should be environmental advantages (without offsetting national security disadvantages) in eliminating the subsidy for coal. Likewise, there may also be national security advantages in narrowing the foreign tax credit regime – and, in particular, denying the credit for royalties – so fewer U.S. tax dollars are redirected to geopolitical rivals.

3. A Petroleum Price Stabilization Plan

Another option, with I have proposed with Thomas Merrill in other work, is a gas tax with two features to make it more politically palatable.[179] First, the tax would kick in only when gasoline prices fall below a specified level. The political advantage of this feature is that, when prices are low, consumers should object less to a price increase. Admittedly, this political advantage comes at a policy cost: externalities are not internalized when the market price is above the threshold. Yet putting a floor on gasoline prices still helps address environmental and national security costs in an important way: Designing more fuel efficient cars is a multi-year process, and manufacturers are more wary of investing in these innovations if they worry that gasoline prices will be low – so consumers will not be interested – by the time the new cars come to market.[180]

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[179] See generally Thomas Merrill & David M. Schizer, *Energy Policy for an Economic Downturn: A Proposed Petroleum Fuel Price Stabilization Plan*, 27 Yale J. Reg. 1 (2010).

[180] A further concern is that a price floor would erode the incentive of gasoline producers or refiners to compete and cut costs. But these incentives remain if the tax is computed based on global crude prices, instead of local gasoline prices. Because the U.S. consumer represents only a fraction of the global market for crude, the U.S. tax should not constrain this price, in the way it could if implemented at the local level. For these and other implementation issues, see Merrill & Schizer.

A second feature to enhance the political prospects of this idea is a rebate. The government would not keep the revenue raised through this program. Instead, each American would receive a check, equal to the tax paid by the average user of gasoline. For example, if $162.5 billion is raised, each of 325 million Americans would receive a $500 check, regardless of how much gasoline they used.[181] As a result, this proposal does not raise revenue; in our view, then, it is plausible not to call it a "tax." Instead, this "price stabilization plan" is a transfer from heavy gasoline users to light users – and thus an incentive to conserve – since those who use less than the average amount receive a net payment. These checks, moreover, should create a political constituency for the program. Yet the lump sum rebate also has a policy price: We forgo the opportunity to use this revenue to replace more distortive taxes.

While this proposal is designed as a gasoline tax, it can be broadened to become a "standby" carbon tax, if other hydrocarbons are included. The levels for gasoline can be adjusted to account for national security harms, and other pollution risks can be priced in as well. Although this structure does not deliver all the policy benefits of noncontingent Pigouvian taxes and permits, it is appealing if these other options are politically unattainable. Unlike the targeted subsidies under current law, this approach does not increase the demand for energy or rely on the government to bet on particular technologies.

4. "Saving Gas" or "Saving the Climate" Credits

Another possibility is to embed a Pigouvian tax inside a lump sum credit, so it can be framed as a "reward" instead of a tax. Claimants receive nothing if they use more than a certain amount of disfavored energy. Using less entitles them to a payment, which becomes more generous as their usage declines. For instance, assume a "saving gas credit" offers $1,000 per year minus an amount based on how much gasoline they use (e.g., $1.00 per gallon). Those who use no gasoline receive a $1,000 credit. Those who use the average amount (800 gallons) receive $200,[182] and those who use 20% more than the average (960 gallons) receive only $40.[183] This sliding-scale credit essentially fuses a $300 lump sum payment with a $1.00 per gallon gasoline tax. Although structured as a subsidy (at least in form), this policy discourages the use of gasoline.[184] This sliding-scale credit is a gasoline tax "in disguise." It can be expanded to mimic a carbon tax. Specifically, a "saving the climate" credit would reward using not just less gasoline, but also less natural gas, coal, and other sources of GHGs as well.

Embedding a Pigouvian tax in a lump sum payment has a notable political advantage: the program can be called a "reward" or "bonus," instead of a "tax." Even so, this political edge can

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[181] Another option is to vary these rebates by region, given variations in density and the availability of mass transit. For instance, the rebate in New York City could be $400, and the rebate in rural Texas could be $600.
[182] $1,000 minus $800, which is $1.00 for each of the 800 gallons.
[183] The $1,000 credit would be reduced by (960 x $1.00) or 960.
[184] Admittedly, this structure is in ways more like a tax than a subsidy, and that of course is the point of it. Notably, though, Mitchell Polinsky has used a subsidy with a structure like this to generalize about problems with subsidies. See Polinsky (considering whether subsidies for pollution abatement increase entry into polluting industries);

be dulled, to an extent, by a credit's budgetary impact. For instance, if the average household uses 800 gallons of gasoline each year,[185] the average "saving gas" credit would be $200.[186] If it is claimed by each of the 115 million households in the United States,[187] the annual cost would be approximately $23 billion.[188] The need to spend this money, which does not arise with a Pigouvian tax, can itself prompt opposition. The source and nature of this resistance turns in part on whether Congress funds the credit with higher taxes, larger deficits, or spending cuts. For example, increasing rates is likely to prompt more opposition than cutting the personal exemption, or some other tax benefit that is not especially salient.[189]

While this sort of credit might have better political prospects in the U.S. than Pigouvian taxes or tradeable permit, it shares a number of their policy advantages. A "saving gas" or "saving the climate" credit creates an incentive to use less gasoline or emit fewer GHG's. With this structure, the government does not favor one abatement method over another. For instance, the "saving gas" credit offers the same $1.00 reward for saving a gallon by telecommuting, buying a hybrid, driving more slowly, carpooling, or some other way.

Even so, compared with Pigouvian taxes or tradeable permits, these credits have four policy disadvantages. First, for households that exhaust the credit by using too much gasoline or emitting too much CO2, the credit offers no incentive to curtail usage.[190] Second, the need for revenue, discussed above, can have policy as well as political costs, at least if revenue is raised with especially inefficient taxes. Notably, there is a tradeoff between these two factors. Increasing the credit amount (*e.g.*, from $1,000 to $1,100) enables the credit to apply to more heavy users, but also increases its budgetary cost.

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[185] The U.S. Energy Information Agency estimated that householders were spending $2,912 on gasoline in 2012, at an average price of $3.70 per gallon. See U.S. Household Expenditures for Energy Account for Nearly 4% of Pretax Income, Feb. 4, 2013. http://www.eia.gov/todayinenergy/detail.cfm?id=9831. This is approximately 800 gallons per household.

[186] The $1,000 credit would be reduced by (800 * 1.00), or $800, to $200.

[187] http://quickfacts.census.gov/qfd/states/00000.html.

[188] A very wide distribution of gasoline consumption could cause the cost to be somewhat higher. Specifically, if a significant percentage of households use substantially more than the average – so that their incremental usage of gasoline no longer reduces the credit – there would a correspondingly larger percentage of the population who use less than the average, and thus would claim a larger credit. Put another way, the government saves the same money from a *heavy* user as from an *extremely heavy* user, but spends more money on an *extremely light* user than on just a *light* user.

[189] Since the credit would be offered to all households, and the personal exemption is claimed by (nearly) all households, the distributional impact is somewhat comparable. Obviously, the trade is favorable for those who use less gasoline, and unfavorable for those who use more, which is the policy's objective. Notably, though, not all taxpayers actually use the personal exemption under current law. Some do not earn enough income to derive any benefit from it. For them, trading it for a refundable gas credit obviously is favorable. At the other end of the income spectrum, the personal exemption is phased out. As a result, very high-income taxpayers also come out ahead in trading some or all of the exemption for this credit. To fine-tune these effects, Congress can make offsetting adjustments (e.g., in rates).

[190] In our example, a claimant receives no credit once she uses her 1000th gallon. There is no further disincentive to use the 1001st or, for that matter, the 2000th. With a $1.00 cent per gallon gas tax, by contrast, there is always a $1.00 disincentive to use each additional gallon.

Third, compared with these credits, Pigouvian taxes offer more frequent reminders to curtail usage: they are imposed each time the relevant type of energy is purchased. In contrast, if these "saving" credits are included on the annual tax return, they are computed only once a year. This difference could cause the credits to be less salient, and thus less effective at encouraging abatement.

Fourth, unlike Pigouvian taxes, "saving" credits require households to track their energy consumption. For instance, to compute the "saving gas" credit, claimants have to know how much gasoline they use, so they can reduce the lump sum credit by the appropriate amount. Yet this information is difficult for claimants to compile and for the government to verify. One approach is to require claimants to buy gas with a special credit card that tracks purchases, and to prohibit (and penalize) cash and other "off the books" purchases. Another approach is for gas stations to report each purchase of gasoline on a national database, including gallons purchased, name on the driver's license, car's license plate, etc. Still another possibility is to track the *miles* a claimant drives, instead of gasoline usage. For instance, service stations can be required to issue certified mileage statements in conducting annual emissions inspections. This mileage can then be divided by the average miles per gallon of the claimant's vehicle, which the government already posts online.[191] Unfortunately, these averages are an approximation at best, since mileage varies with speed and driving conditions. Yet this approach has the advantage of piggybacking on inspections and disclosure that already exists, instead of requiring a new reporting mechanism. Obviously, none of these strategies is ideal. Solving this problem is a key challenge for these credits – and, notably, one that Pigouvian taxes do not face.[192]

D. Better Institutional Design for Energy Subsidies

Given the advantages of Pigouvian taxes or tradeable permits over energy subsidies, the best solution is the menu of taxes or permits described above. If it is politically unattainable, variations of taxes or permits that are more politically plausible should be considered, even if the policy case for them is less compelling. If this strategy fails – in other words, if we are stuck with energy subsidies – we need better institutional design. Specifically, we should fix, or at least mitigate, eight problems discussed in Parts III and IV.

First, in deciding which technologies to favor and how generous to be, we need to account for hidden costs. For instance, although *driving* electric vehicles does not emit GHG's, *manufacturing* them does – indeed, more than gasoline-powered vehicles.

Second, subsidies usually should not single out specific technologies. Instead of a credit for hybrids, for instance, we can enhance fuel efficiency more cost effectively with a credit for

[191] http://www.fueleconomy.gov/feg/pdfs/guides/FEG2013.pdf.
[192] In theory, a gasoline tax would present the same challenge if it were collected on the taxpayer's return, instead of at the pump.

any car with sufficiently high gas mileage. A broader formulation encourages competition and offers options to heterogeneous consumers.

Third, subsidies should target results, instead of proxies. To avoid perverse effects, such as subsidizing energy that is not used, we need to reward the right behavior. For instance, the goal should not be to *produce* electricity from wind *per se*, but to *replace* electricity from coal or gas. If using a proxy is unavoidable (e.g., for administrability reasons), conditions should be included to foreclose perverse outcomes. For instance, a subsidy that rewards production (instead of profit or revenue) should be available only when energy sells for a minimum (or positive) price.

Fourth, subsidies should be coordinated with other regimes to avoid perverse interactions. Under the CAFÉ regulations, for instance, subsidies for electric and hybrid vehicles enable auto manufacturers to sell more gas guzzlers.

Fifth, climate and national security externalities are global. Therefore, policies targeting these issues are more effective if coordinated with other countries.

Sixth, Seventh, we should either not use the tax system to deliver these subsidies or address familiar limitations in doing so. For instance, since tax administrators are not experts in environmental or national security policy, experts in these areas should formulate and interpret the criteria for the subsidy, leaving tax experts the ministerial responsibility of dispensing funds.

Eighth, energy policy objectives and distribution generally should be pursued separately. On one hand, if the goal is to improve national security or the environment, subsidizing low-income claimants ordinarily is less cost-effective; they have less capacity in their budgets, and thus are less responsive. On the other hand, if the goal is to channel resources to low-income households, green energy subsidies are a less efficient currency than cash, which allows claimants to pursue their own priorities.

VI. Conclusion

Energy can have profound effects on our environment, economy, and national security. Unfortunately, the hodgepodge of energy subsidies under current law underperforms in a number of ways. The goals are worthy – indeed, many are compelling – but these subsidies suffer from a range of design flaws. This Article has four main implications for energy policy. First, we need to incorporate national security in the analysis, which is something the economics literature on energy has failed to do. Second, Pigouvian taxes and tradeable permits are likely to serve us better than subsidies. Third, since taxes and permits face political challenges in the U.S., we should consider variations that have better political prospects, even if their policy merits are not as strong. Fourth, if we are stuck with subsidies, we can still improve on current law in a number of ways. For instance, we should broaden the subsidies, target results instead of proxies, and coordinate these subsidies more effectively with other regimes. There is ample room for improvement. This is fortunate, since the stakes are high.