Financing America's Transition to Clean, Secure and Sustainable Energy

The Strengthening America's Future Initiative
Issue Paper

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Summary

Energy and climate remain on the 2010 Congressional agenda. However, the timing, final shape and methods used to implementation such legislation remain difficult to predict. No matter what choices are made, policymakers need to avoid an "either-or" approach to meeting the energy needs of our $14 trillion economy. Given the realities of energy supply, we must not demonize inexpensive fossil sources any more than we should overly lionize "green" substitutes that still are establishing their economic competitiveness. Instead, U.S. policy should encourage producers and consumers to pursue energy-efficiency gains where possible while rebalancing our fuels portfolio. This rebalancing requires that we match new applications that are technologically or financially constrained with existing energy-dense sources, just as we must flexibly apply existing energy sources and infrastructure to backstop emerging but intermittent new energy supplies. For example, electric vehicles may immediately and without compromise satisfy urban commuters' requirements but aircraft, trucks and earthmoving equipment likely will require a store of energy at least as energy-dense as petroleum for many years. Similarly, distributed power sources like solar rooftops may optimally power consumer appliances in "green homes" but, for the near-term at least, industrial producers likely will continue to depend on base-load electricity from central station power plants.

The hard work lies ahead in translating carbon prices into increased economic benefit, improved energy security and stricter environmental protection. New, clean energy infrastructure will require trillions of dollars of investments over the next twenty years--an extremely difficult, and delicate, task during the current recession. Despite a growing thirst for greater market regulation in the wake of recent institutional failures, the only practical way for America to finance its cleaner environmental future is to harness the market system and the private investors who make it work. That means a continuation of our centuries-old partnership between the public stewards of natural resources and the private entities that use them. It also means educating energy users about the costs and trade-offs of an economic transformation that will require decades and trillions upon trillions of dollars.

This paper offers six policy recommendations aimed at financing the technologies required to transition to a cleaner energy infrastructure.

Introduction

In the year since the American Recovery and Reinvestment Act allocated more than $32 billion towards clean energy and energy efficiency, the 111th Congress and the President have taken five steps towards major energy policy reforms and setting a price on carbon emissions.

- On June 17, 2009, the Senate Energy Committee reported out the American Clean Energy Leadership Act (ACELA), a measure that included low-cost financing for clean energy projects and a national Renewable Electricity Standard (RES).
- On June 26, the House of Representatives passed the American Clean Energy and Security Act of 2009 (ACES) by 219-212. That comprehensive measure included an RES and financing measures as well as efficiency initiatives and a cap-and-trade program designed to achieve a 17%-by-2020 greenhouse gas (GHG) emissions reduction target relative to a 2005 baseline year.
- On September 30, Senators Barbara Boxer and John Kerry introduced the Clean Energy Jobs and American Power Act (CEJAPA), a cap-and-trade program similar to ACES with a more-stringent 20%-by-2020 GHG target and, among other things, incentives to encourage coal-fired power generators to switch to gas-fired generation.
- As this effort faltered in advance of the December 7-18, 2009 negotiations of the Conference of the Parties (COP 15) in Copenhagen, Denmark, Senators John Kerry (D), Lindsey Graham (R) and Joseph Lieberman (I) sought to build consensus around a comprehensive energy and climate bill that largely would be based on regional and sectoral interests. This initiative emphasized clean energy jobs and increased U.S. manufacturing, greater reliance on domestic fuels, including nuclear power and coal, regulatory predictability, and global action on climate change.
- On December 7, the opening day of the Copenhagen talks, President Obama placed another card on the table: the U.S. Environmental Protection Agency (EPA) issued its long-expected "endangerment finding" that carbon dioxide and five other greenhouse gases posed a threat to public health.

In time, the domestic impact of this agency initiative may be quite significant, but in December 2009 it did little to appease the international community. Copenhagen produced no firm international agreement to cap greenhouse gas emissions for the U.S. or anyone else. Instead, Secretary of State Clinton and President Obama pledged U.S. support to a multi-billion adaptation fund and continued U.S participation in climate negotiations. Back home, the political environment quickly grew more complicated. Health care and financial reform stalled once again in Congress; Massachusetts elected a Republican Senator, thus breaking the Democratic Party's hold on that chamber; and voter anger grew over high unemployment, the rising federal deficit and failed government efforts to shore up the housing market.

I. *Counting Carbons and Adding Up Efficiency Gains*

Fossil fuels – oil, natural gas, and coal – provide about 85 percent of U.S. energy. As a result, the growth of our economy is inextricably linked to hydrocarbon consumption and greenhouse gas emissions. This paper recommends ways to secure financing and engender public support for a multi-trillion-dollar, decades-long strategic shift towards cleaner energy infrastructure, but economic and environmental gains through energy efficiency tactics are available today.
It is here that we begin.

Two useful metrics for comparing the energy efficiency of nations are **energy consumption per unit of GDP** (known as "energy intensity") and **energy consumption *per capita***. U.S. energy intensity of GDP in 2006, the latest year for which robust global data are available, was 8,844 Btu per dollar. This is approximately equal to the global average of 8,870 Btu per dollar, but

35% more than the nearest industrialized peer presented in Figure 1. More glaringly, *per capita* U.S. energy consumption came in nearly double that of these industrialized peers, and more than four times the 2006 global average of 72 million Btu per person. These statistics highlight the tremendous scope of *potential* U.S. efficiency gains.

Figure 1 – Selected National Energy Consumption and Demographic Statistics, 2000-2006

Country	2006 Energy Intensity of GDP, Btu/$ of GDP (2000 dollars)	2000-2006 Energy Intensity of GDP Change	2006 Per Capita Energy Consumption, MMBtu/Person	2000-2006 Per Capita Energy Consumption Change	2000-2006 Average Population Growth	Population Density per Square km, 2006
United States	8,844	-12.3%	335	-4.5%	1.00%	30.71
Denmark	5,375	-7.1%	165	0.6%	0.30%	126.06
Japan	6,496	-7.0%	179	1.0%	0.10%	337.23
France	6,550	-5.6%	179	1.2%	0.55%	110.88
Germany	6,439	-3.2%	178	2.5%	0.05%	230.89

Source: ClearView Energy Partners, LLC, using data from EIA, U.S. Census Bureau and the CIA World FactBook

This is not to say that our nation has not improved: U.S. energy efficiency has been increasing for decades and compares favorably with many industrialized peers on a rate of change basis[1]. But what accounts for the wide performance gulf between the U.S. and industrialized nations across the Atlantic and Pacific oceans?

Cultural factors surely play a role. Americans tend to be more individualistic and less thrifty than many European and Far Eastern nationals. On the other hand, boldly answering the call of the open road may matter less than how far that road goes, and how many people are driving on it. The energy intensity of GDP of the countries presented in Figure 1 is well-correlated with population density (56.2%); *per capita* consumption is even more so (66.3%). Population growth exhibits an even stronger, inverse correlation to energy intensity of GDP (-82.7%) and *per capita* consumption (-89.4%), suggesting that rising U.S. population may limit the scale of future efficiency gains. Accordingly, it may be overly optimistic to expect countries as demographically and geographically disparate as the U.S. and Japan to attain comparable energy efficiency levels.

Low-cost improvements to the envelopes of, and electric lighting within, U.S. residential and commercial buildings could theoretically deploy efficiency gains of between 4 and 8 percent per site in less than a year's time.[2] Utility efficiency programs undertaken at the State level during the last decade have delivered costs of saved electricity (CSE) that average $0.025/kWh, a price that rivals all but the very cheapest (and oldest) conventional electric generating sources. Figure 2 presents State efficiency program data compiled by the American Council for an Energy-Efficient Economy (ACEEE) alongside corresponding performance, climate and consumption statistics for the fourteen states in the ACEEE survey.

Figure 2 – State Energy Efficiency Program Performance, Cooling Degree Days and Power Consumption

State	Average Cost of Saved Electricity ($/kWh)	Average Annual Savings During Survey Period (MWh/Y)	Savings as a % of 2007 Sales	2006-2007 Cooling Degree Days Index (National Average = 100)	2005-2008 per Capita Power Consumption Index (National Average = 100)
CA	$0.029	na	na	74.4	63.0
CT	$0.028	293,075	0.86%	47.2	82.6
IA	$0.017	170,903	0.38%	67.5	93.8
MA	$0.031	423,731	0.74%	37.4	68.6
MN	$0.022	437,771	0.64%	47.7	88.4
NV	$0.020	227,333	0.64%	**179.7**	**104.3**
NJ	$0.026	246,250	0.30%	67.8	78.2
NM	$0.033	35,211	0.16%	73.8	67.7
NY	$0.019	546,333	0.37%	52.9	65.0
OR	$0.016	289,011	0.59%	20.5	**108.7**
RI	$0.030	64,995	0.81%	43.3	64.9
TX	$0.018	477,771	0.14%	**201.5**	**125.3**
VT	$0.027	78,141	1.33%	21.5	63.8
WI	$0.033	63,017	0.09%	17.2	77.9

Source: ClearView Energy Partners, LLC, using data from ACEEE, EIA, NOAA and the U.S. Census Bureau

The low energy efficiency costs and small savings as percentages of sales in Figure 2 suggest that the profiled States still have a long way to go along their efficiency supply curves before additional improvements are likely to become prohibitively expensive.

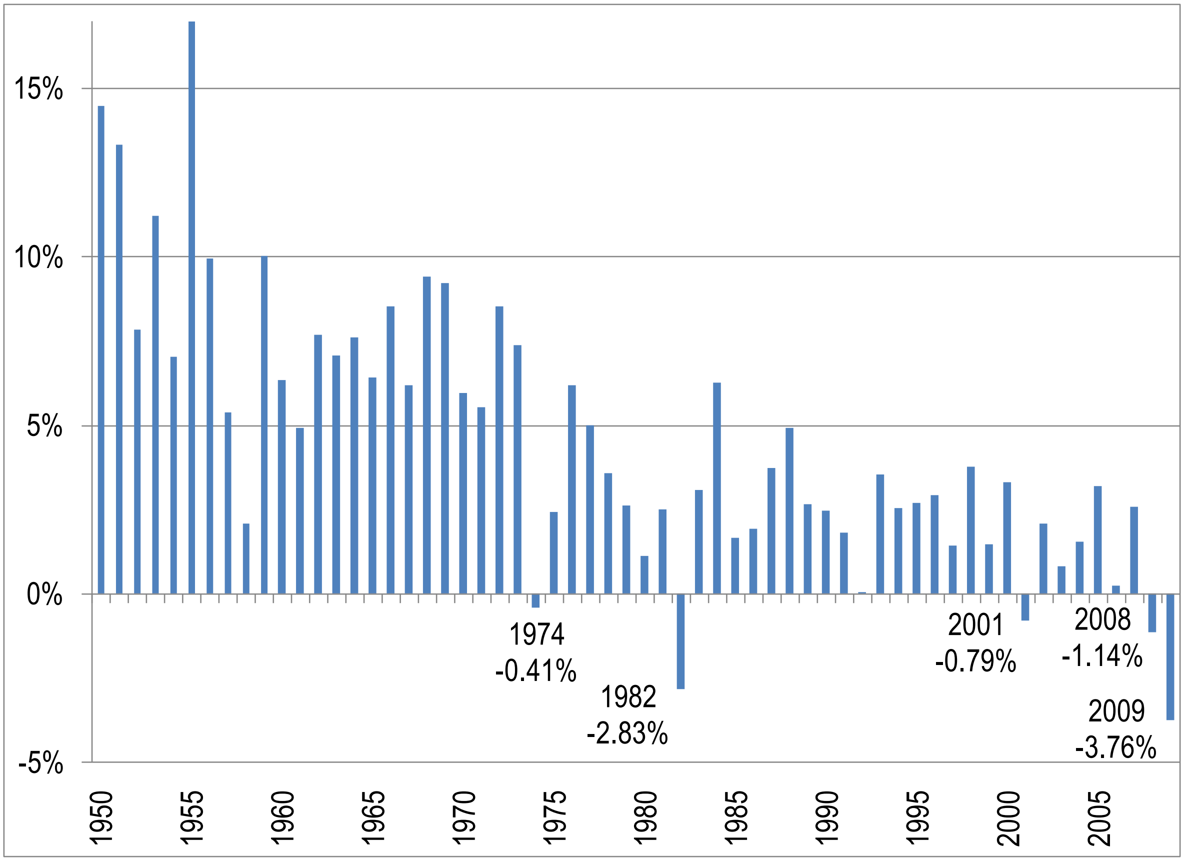
On the other hand, Figure 2 underscores again the risk of generalizing from the specific and highlights a primary obstacle to pursuing national energy efficiency goals on a "top-down" basis. Nearly all of the fourteen States profiled are more temperate and use less power than the rest of country on a national average basis. Electric utilities in these States, like every other, are regulated locally. Accordingly, many of the States whose demographics, economies and climates make it profitable to "decouple" utility payments from delivered volumes and incentivize efficiency have already done so. It may be difficult to encourage other States to decouple unless or until regulatory reforms give federal regulators greater influence over local rate-setting decisions.

II. *Recession Investing is Difficult, Building to Scale is Doubly So*

History teaches us that policies that appear viable during a recession, like California's 1994 electricity market reforms, may become unrealistic when economic growth provokes resurgent energy demand, particularly if sustained underinvestment leads to tighter capacity margins, as in the ensuing electricity crisis six years later. Likewise, slack demand threatens the viability of all technologies and presents the greatest challenges to high-cost alternatives. In May 2009, the

International Energy Agency projected that year-on-year, global renewable energy investment would decline by 38 percent. Green power isn't the only sector likely to feel the pinch. Figure 3 presents the annual growth rate of U.S. electric power demand between 1950 and 2009.

Figure 3 – U.S. Annual Electric Power Demand Growth, 1950-2008 and 2009 Estimate

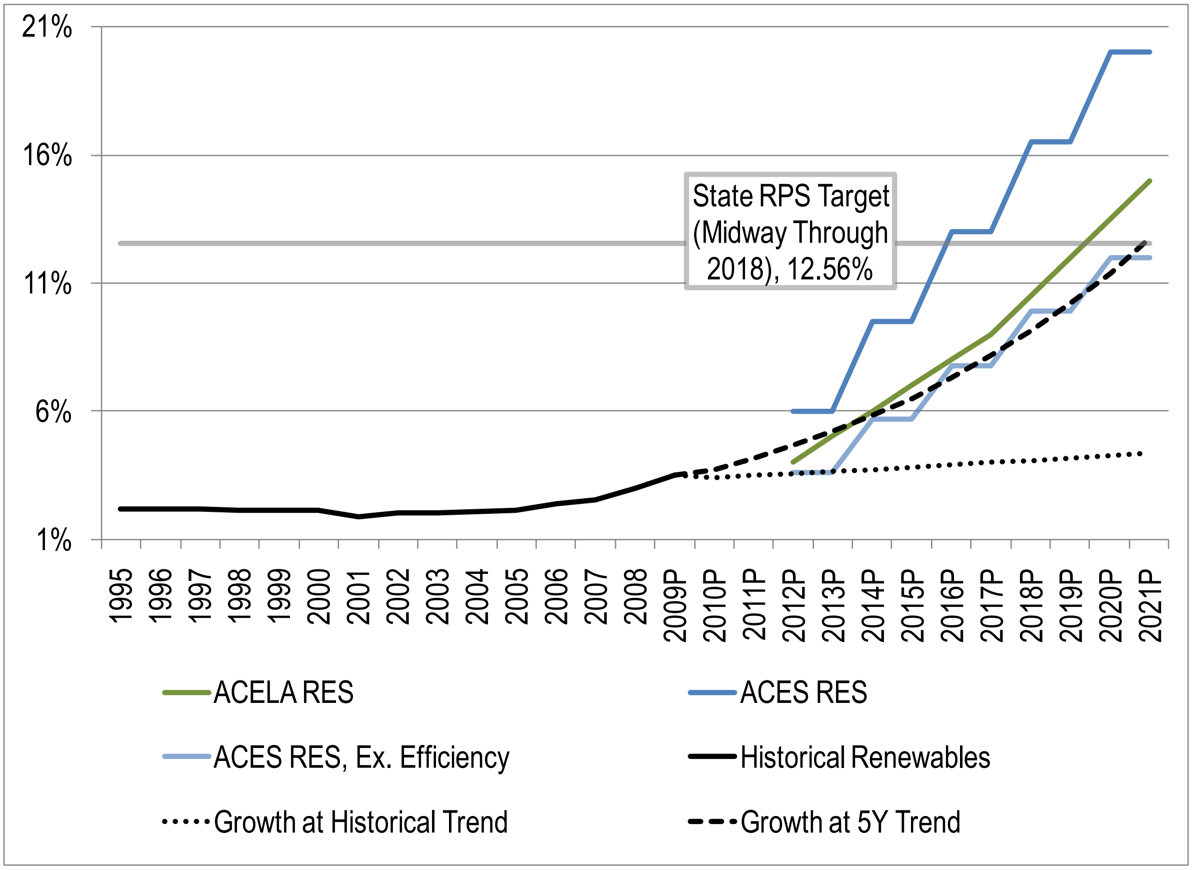


Source: EIA, ClearView Energy Partners, LLC

Since 1950, annual U.S. electric power demand declined only five times and 2009 was the biggest of them all. Even as demand recovers, building efficiency gains from stimulus spending could blunt demand growth in 2010 and 2011. The post-recession economy is a challenging environment for new power investments of any kind, but especially for wind projects, where transmission costs may double those of coal and natural gas plants, as well as solar installations, many of which generate power at 300-400 percent of fossil energy costs even in bright sunlight.

Policies that encourage specific technologies like renewable fuels and green power highlight the most vexing trade-off of all: the realities of scale. Excluding conventional hydroelectric power, only about 2.5 percent of U.S. power generating capacity and about 3 percent of electricity comes from renewable sources. How much energy independence or environmental benefit will an additional 2.5 percent of green capacity or 3 percent of green power provide? Doubling this proportion in three years' time will not be easy or cheap, and it may be impossible to do without importing most of the technology required. Compound annual growth of non-hydroelectric renewable generation in the U.S. averaged a staggering 3.36 percent between 1995 and 2008 and a meteoric 12.94 percent during the last five years. This is brisk relative to total U.S. electric generation, which grew at about 1.01 percent during the same period.

Figure 4 – U.S. Non-Hydroelectric Generation as a % of Sales, 1995 - 2008 Actual; 2009 - 2021 Projected.



Source: EIA, ClearView Energy Partners, LLC

If the renewable share U.S. electric generation were to grow at this faster, five-year rate at the same time that electricity demand as a whole grew at the much slower, historical rate, intermediate-term targets would roughly match the Renewable Electricity Standard (RES) that ACES would establish, subtracting out maximum (40 percent) compliance from energy conservation. Without taking credit for efficiency, the nominal ACES and ACELA standards would require growth substantially ahead of historical trends. But renewable energy growth ahead of national capabilities could have potential downsides, too.

Without a developed green manufacturing base, a post-stimulus spending lapse could make the "green jobs" associated with a stimulus-inspired build-out decidedly "un-renewable." There could be longer-term tradeoffs, as well. The higher labor intensity of renewable energy deployment may not pay as many future dividends as expanding nuclear power, which could empower a highly-skilled workforce of scientists, environmental engineers and power-plant operators. Nor is a rapid growth free from consequences. Ethanol proved a very successful energy security policy, growing from about 3 percent of motor gasoline to about 7.5 percent in less than three years. On the other hand, the food price, water use and air-quality consequences of its rapid diffusion into the fuel supply became a source of concern for many environmentalists and social activists.

III. *Do the Hard Math and Educate the End-User*

Investment decisions and energy efficiency programs may not need to be structured "top-down" once the U.S. sets a carbon price, because most energy efficiency improvements undertaken by individuals, businesses and governments will achieve carbon emissions reductions, which in turn will send market signals to guide investors. With proper disclosure and tracking mechanisms, greener decisions could have near-term monetary value, particularly given the robust nature of U.S. information technology infrastructure.

Just as information systems and point-of-sale computer technologies enabled innovations in brand marketing and microfinance, the Internet offers tremendous potential to aggregate billions of small decisions within our consumption-based economy into economic gain, energy security and environmental protection. "Green power" surcharges today have few takers because most energy users won't choose greener sources that cost more. By contrast, customer-facing programs that quantify and reward higher-efficiency, everyday actions are likely to generate immediate response.

Private firms are already exploring carbon lifecycle labeling initiatives for consumer products: in September, Wal-Mart announced it would begin collecting carbon footprint data from some of its suppliers. The U.S. government has an opportunity to provide better, simpler, more uniform information to consumers about energy.

Potential strategies could include:

1. **Do the hard, green math.** A carbon lifecycle analysis that quantifies the greenhouse gas emissions of goods and services at every stage of their production should be standardized to be useful, and setting standards requires clear and fair answers to several questions. Should the government differentiate between fossil energy feedstocks and conversion technologies, or rely on national average emissions profiles? Separate accounting could give greener producers a competitive advantage. On the other hand, most of the world's incremental oil reserves will require more energy to extract and process than conventional oil, and this could penalize investment in the proximate and secure Canadian oil sands. Similar questions exist for renewable sources. Steelmakers burn metallurgical coal to forge the massive steel bearings and towers for wind farms, and hauling these components to deployment sites requires diesel fuel. Making polysilicon, the precursor material to most solar panels, requires substantial amounts of electricity. Should lifecycle analyses assign lower weightings to upstream energy inputs to compensate for downstream climate and energy security benefits?
2. **Encourage top-down, incremental greening.** Until energy storage technologies mature, intermittent sources (wind, solar, tidal) cannot provide base-load power. In the meantime, pairing distributed solar capacity with new, more efficient coal-fired sources and nuclear power would displace natural gas, making each megawatt-hour incrementally "greener" without the uncertainty associated with wind. In turn, generators could retire lower-

efficiency coal plants and replace them with high-efficiency natural gas assets. Solar is an apt "peaking" fuel because peak solar hours correspond to typical electric demand peaks, and solar panels sited closer to load centers may diminish the new transmission requirements into congested areas. With clear communications, a national GHG inventory data and activism towards public company carbon disclosure need not serve as "scarlet letters" so much as "gold stars", particularly if standardized, federal reports highlight utilities' progress for their shareholders, ratepayers and other stakeholders. Performance-based challenge grants and "greening bonuses" for generators could improve financial outcomes, as well.

3. **Encourage product labeling and rewards programs.** A standard, consumer-friendly unit of value that quantifies the "greenness" of products and services, similar to nutritional information on food products, could align consumer behavior with policy goals. Think of "counting carbons" instead of counting calories or carbohydrates, or "green points" in the same vein as airline frequent flier miles. Carbon prices will give firms a way to monetize behavior change, but government-certified accounting can help bring gains directly to end-users. Tracking green points could give business and industrial energy users a way to redeem their tactical and strategic choices in return for tax benefits from governments and cash rewards from private firms. This mechanism could also facilitate individual and small-business investment even after short-lived "stimulus" payments for home and business efficiency improvement ends. Nor should policymakers discount non-financial benefits. Sending "price signals" usually means raising prices, but consumers respond to other kinds of signals, too. Brand-consciousness and non-price attributes can trump economic factors, even for lower-income consumers.

IV. *Fund Enabling and Retrofit Technologies With Debt…and Oil*

The term "efficiency" doesn't just refer to throughput gains. It also means reusing as much of the infrastructure we already have as possible. **Enabling technologies**, like a "smart," interoperable and bidirectional electrical grid, and **retrofit technologies** for existing infrastructure, like stationary electricity storage devices, will make the transition to clean energy more efficient in every sense of the word. Financing these projects should be a priority.

Some projects may serve multiple purposes. For example, new nuclear power plants could provide clean electricity and enable vehicles fueled by next-generation batteries or hydrogen fuel cells. But nuclear capacity expansion presents practical questions regarding waste storage. Should the U.S. continue to pursue a permanent geological repository for nuclear waste, or will above-ground storage at generating sites or interim storage facilities meet the nation's waste storage goals? Should utilities that contributed to the federal trust fund for Yucca Mountain receive rebates towards above-ground storage? Would waste reprocessing offer a better long-term option and, if so, how will generators finance and implement storage options in the near-term?

Likewise, affordable, post-combustion retrofits to existing coal-fired power plants that capture carbon dioxide could allow communities to retain lower-cost power sources and reduce GHG emissions. In some cases, carbon capture and storage (CCS) could enable improved productivity of domestic oilfields. But full-scale CCS deployments will raise similar questions. Which entities should bear liability for accidental seepage of gases stored underground? Should the federal government provide backstop risk insurance similar to that extended to the nuclear power industry? Should government focus funding on project-specific investments or on subsidizing and coordinating a national carbon dioxide "backbone"?

Big plans require deep pockets. Capital markets have not fully recovered from the recent financial crisis, and inflation could still drive interest rates upward. As a result, many of the investors who provide credit for energy innovations remain cautious. This increases the importance of government supports for the big projects that must come first. Major infrastructure projects could be financed through government-backed debt at little or no net cost to taxpayers, avoiding the "equity subsidy burn-out" that has confronted big-spending clean energy programs in other countries.

Possible courses of action could include:

1. **Smarten the grid from the top down.** Despite its democratizing effects, the civilian Internet did not begin as a decentralized, open network; it began at DARPA and evolved over two decades before becoming the World Wide Web. Although a smart grid should incorporate innovative ideas, a decentralized, heterogeneous electricity transmission network should be incubated by a small number of large, economically viable electric utilities, perhaps within the same region, who agree upon open, common standards. The May 18, 2009 increase in DOE smart grid awards from $20 to $200 million was a step in the right direction. Additional federal assistance may be needed.

2. **Enabling technologies** should receive precedence over other energy subsidies, in terms of their timing and funding. Projects as big as a major grid roll-out, like a new highway system, can deliver incremental benefits as they progress. In addition, enabling technologies are likely to increase the utility of innovations and shorten the adoption time associated with incorporating innovations into existing infrastructure. Because our existing capital stock is likely to be cheaper than any greenfields project, we may wish to consider prioritizing large-scale retrofit technologies that keep the lights on as next-generation infrastructure evolves.

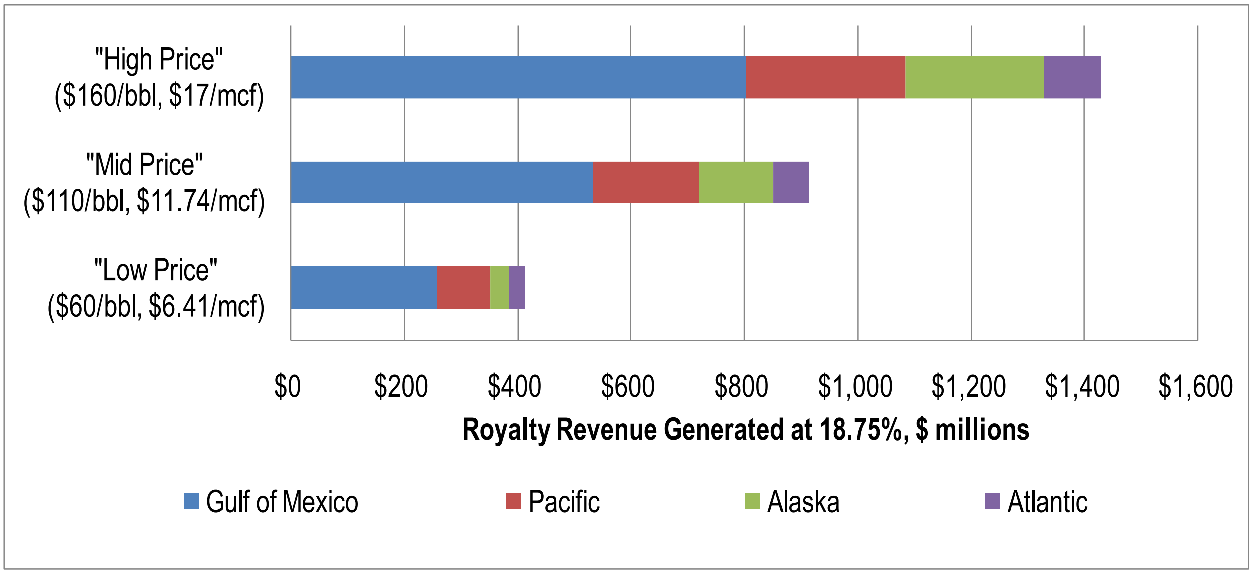
3. **Subsidize debt, not equity.** Subsidies that offset the purchase price of clean energy technologies through tax credits typically give pricing power to manufacturers, encouraging production but not competition, because most tax credits are technology-specific. Government-sponsored loan guarantees can improve the financial prospects of project sponsors willing to consider innovative sources without binding them to specific technologies. Limits are important, however. Low-cost debt in support of mature technologies can distort individual firms' performance and destabilize otherwise competitive industries.

4. **Get Americans to buy in by "buying in."** As an alternative to a "hidden tax" or an across-the-board tax increase, policymakers may want to consider a federal bond issue that appeals directly to the taxpayer. This initiative could raise funds at the same time that it raises awareness of energy challenges and increases the nation's savings rate. Paying for loan guarantees by issuing "green savings bonds" might provide capital, encourage institutional accountability and engender greater public support for clean energy initiatives.

5. **Something old, something new.** Although President Obama hoped to allocate $15 billion per year from carbon auctions proceeds towards clean infrastructure, ACES and CEJAPA direct most program revenues towards at-risk end-user communities and deficit reduction. Higher auction prices would raise more money, but higher costs could also stall investment and economic growth. Expanding production of America's "old" energy resources offers a potential funding solution for our new energy goals.

Figure 5 applies the current 18.75% federal royalty rate for deepwater oil and gas production to January 2009 Minerals Management Service estimates of domestic oil and gas resources on the Outer Continental Shelf (OCS). By this proxy, offshore production could generate $415 billion in federal royalty income at a "low" price scenario. At the "high" price scenario, OCS mineral revenues would total $1.43 billion, more than double the $626.5 million in carbon auction proceeds projected by the Office of Management and Budget in August 2009, and these funds could finance green infrastructure deployment today and subsidize private energy research and development many years into the future.

Figure 5 – Royalty Income Potential from Outer Continental Shelf Oil and Gas Production



Source: ClearView Energy Partners, LLC using data from the U.S. Minerals Management Service

International oil and gas companies, who are among the world's best-positioned firms to finance and deploy clean energy technologies, could potentially be amenable to paying a portion of OCS royalties "in kind" through green investment rather than SPR deliveries.

V. *Prudently Expand the Transportation Fuels Portfolio*

It is no accident that oil fuels 97 percent of the nation's transportation needs; it has repeatedly proven to be a stable, economic and compact source of energy that is available in vast quantities[3]. Oil's well-documented downsides include its negative foreign-exchange impact and combustion emissions, as well as the political implications of "dependence" on imports[4]. As a result, natural gas and electric power are often presented as domestically-produced, alternatives to oil because natural gas burns cleaner and electric cars offer threefold efficiency gains over internal combustion engines.[5] On the other hand, both fuels have limitations that suggest they may provide part, but not all, of the transition to a cleaner infrastructure. Filling the tank with natural gas can take five times longer than a fill-up with gasoline.[6] Charging an electric car with a three-phase, industrial charger requires about 30 minutes and plugging it in at home can require between six and eight hours. Battery limitations mean that drivers may grow anxious about driving more than 60 miles between charges, and there are few places where natural gas passenger vehicles might be fueled.

As important as it is to encourage nascent "green" fuels and vehicles technologies, it is equally important to foster environmentally-sound development and innovation within the oil and gas industry and to reconsider resource policies in light of recent technology gains. U.S. oil and gas companies historically have responded to resource challenges and environmental strictures with innovation. Strict regulation at home and competition with lower-cost producers overseas have endowed us with national technological superiority. Producing more oil and gas at home may do more than improve U.S. energy security; it could improve global environmental stewardship. Simply put: sending dollars overseas when we have oil here at home may also export pollution, because U.S. environmental laws are among the strictest in the world.

Altogether, policies that seek to rebalance America's energy portfolio should align fuels with energy technologies, life-cycle costs of the system and environmental benefits. Five recommendations include:

1. **Upgrade the grid before cars plug in.** Economic contraction, not capacity upgrades, has spared grid operators from rolling blackouts. A small number of small electric cars could deliver immediate and sustainable benefits. A large number of large electric cars could overwhelm generating and transmission assets.[7] Grid investment must come first. Making the long-term shift to electric vehicles may also require new nuclear power generating capacity as a source of emissions-free base-load power.
2. **Increase conventional hybrids penetration.** Conventional hybrid-electric passenger cars can improve fuel economy by as much as 50 percent by using energy that otherwise would be wasted. This is a better way to use domestic oil and displace imports. Policymakers may wish to consider phasing in a requirement that 100 percent of new passenger cars incorporate retrofit-ready, hybrid power trains. Paired with increased environmentally-responsible production of U.S. petroleum assets, this "found energy" may offer the potential to markedly improve energy and climate security at the same time.
3. **Power fleet vehicles with natural gas.** Governments and corporations that own truck fleets could take advantage of historically favorable oil-natural gas price differentials. At realistic future commodity prices[8], most fleets could recover costs and improve margins, sparing 500,000 – 750,000 bbl/d of oil products and reducing vehicle GHG emissions profiles by approximately 28 percent. As with vehicle electrification, however, shifting the transportation portfolio towards natural gas will increase the importance of new supply, in this case, U.S. onshore and offshore production, particularly in light of the rapid decline rates (25-30 percent) of mature lower-48 natural gas resources.
4. **Stabilize and expand offshore oil and gas leasing.** The 85 percent of the U.S. off-shore currently closed off to development was last investigated with 1970s technologies, if at all. The Congressional moratorium that prevented coastal production since the early 1980s lapsed in 2008, but the 2006 Gulf of Mexico Energy Security Act locked off conventional resources in the Eastern Gulf of Mexico through 2022 and established a 125-mile buffer zone around Florida's coastal waters. Is it desirable to force production overseas rather than applying new exploration and production techniques to U.S. resources? Moreover, given our own resource potential, does it make sense to encourage other nations' offshore production without even assessing our own resources?
5. **Preserve expanded natural gas production.** The primary driver for today's low natural gas prices is economic slack, but new pipeline capacity out of the Rocky Mountains and new extraction techniques like "hydraulic fracturing" play strong supporting roles. The abundance of natural gas the nation now enjoys could continue for decades if policies governing access did not change. However, endangered species rulings may soon limit the profitability of Rockies production, despite the lowest costs in the nation, and a redefinition

of drinking water standards could slow or stop development of shale gas resources in Texas, Arkansas, Pennsylvania and New York, undermining environmental security gains.

VI. *Preserve the Integrity of Markets and International Trade*

The global market for GHG emission permits has the potential to become the largest physical commodity market in the world, overtaking crude oil. Although a significant fraction of daily crude volumes are not market-traded, global consumption data imply that more than 30 billion barrels will change hands each year. In practice, the oil market grows 20 to 30 times larger than this notional physical size due to "virtual" volumes created when commercial players hedge their price exposure by trading derivatives contracts with commercial and non-commercial counterparties.

In 2006, the industrialized nations included in Annex I of the U.N. Framework Convention on Climate Change (UNFCCC) emitted an aggregated 22.17 billion metric tons of GHG. 2009 estimates of emission from the Annex I nations plus China and India suggest that the physical compliance market of the future could trade in excess of 33 billion $MtCO_2e$ per year, and a swift economic recovery could expand this market beyond 35 billion $MtCO_2e$ per year even before a new treaty goes into force in 2013. Price volatility of emissions credits—as well as the volatility of oil prices--could encourage hoarding and may erode long-term national plans to transition to a greener energy infrastructure.

As a responsible steward of our global commons, we should preserve America's historical commitment to globalization and trade-based relationships with foreign powers.

Recommendations in support of this goal could include:

1. **Reliable market information.** Markets set prices most efficiently when participants have access to timely, widely-disseminated information. Financial regulatory policies should take steps to promote a diversity of public and private, open and accountable arbiters of information peripheral to global emission markets, especially data providers and verification/ratings agencies.
2. **Regulation that enables innovation.** The early years of a broader GHG market will probably include growing pains similar to those the European Emissions Trading Scheme experienced during its initial three-year phase. Commercial entities will require new and innovative products for collaring price volatility during these bumpy years. Regulation that burdens contracts innovation with excessively time-consuming and costly administrative procedures could destroy value and retard market maturation.
3. **Clarity regarding international transactions.** A "deleveraging" world means a smaller marketplace for industrial exporter nations. Most of these nations, like the U.S., spent savings (or debt) on stimulus measures to keep industrial capacity intact. The combination of big spending and a shrinking market creates risks of protectionism, including the prospect that countervailing trade measures designed to prevent carbon "leakage" could create barriers to global trade that slow – or inhibit – recovery. Despite communications earlier this year by the WTO and UNEP leadership, confusion persists among U.S. and international policymakers regarding the appropriateness and legality of border taxes. U.S. leadership on, support for, and adherence to, a new, WTO-based, multilateral mechanism for preventing and

resolving leakage-related disputes could diminish the risk that *ad hoc,* bilateral, emissions-related actions might ignite a trade war.

Conclusion

Concerns about climate change are driving the call for a significant change in our energy infrastructure. Whether one predicts the social and economic costs of climate change to be high or low, policymakers who seek to “green” the current energy mix need to bear in mind the principles of efficiency, scalability and sustainability and avoid undue regulatory volatility. Pushing aside nuclear power and coal would be a mistake, as would short-term commitments to renewables. Transitioning to a less carbon-intensive economy will require sustained investments by both the public and private sector, and a commitment to efficiency gains. A deep knowledge of technology, costs and trade-offs is required before the U.S. will be able to develop policies that put the right hardware in the ground while building on its R&D and innovation assets, which are key to reindustrializing the United States, growing the economy and increasing jobs, and making the nation more competitive in a changing global economy.

Appendix A: Principles of Durable U.S. Energy Policy

This appendix presents three basic principles likely to contribute to an internally-consistent and durable U.S. energy policy.

Energy projects can stretch for years or even decades, a stark contrast with a political system characterized by annual budgets, biennial Congresses and quadrennial Presidencies. Making American energy cleaner and more secure may require far longer than either public patience or many political careers. It also may require state electric utilities and their regulators to submit to significantly-expanded federal oversight even as the auto industry, itself largely in federal receivership, retools under stringent circumstances and public oversight to compete in a global economy.

Given these financial, technological and regulatory uncertainties, emphasis should be given to policies that are not just “greener” alternatives, but also create near-term value above and beyond the *status quo*. It is important for policymakers to clearly communicate the trade-offs that these energy policies will require the country to make. Political leaders should also seek to distribute change uniformly across the energy value chain. Lastly, periodic review of legislation and regulation will facilitate needed adjustments at well-defined, regular intervals. If policies change too often, or create too much uncertainty, or if efforts are made to directly manage the marketplace under different guises, critical investment decisions could be distorted or postponed, and the nation may end up with dead-ends, overly expensive technologies or insufficient supplies.

Recognize where we are and educate energy users about inherent trade-offs

Fossil energy’s great economic benefit derives, in large part, from natural processes that, over long stretches of time, concentrated the very resources we characterize as “renewable” into dense, stable, readily-transported forms. By contrast, the relatively high costs of clean energy sources tend to reflect the limited scale and high manufacturing- and labor-intensity of replicating natural processes that took millions of years. Making clean energy is an expensive business.

In addition, there needs to be more of a comparative basis for evaluating energy choices. Energy users cannot do all of this unless government establishes standard metrics that properly and consistently quantify the costs of our energy policy decisions in both financial and physical terms. Carbon “lifecycle” analyses remain hotly debated because they tend to penalize energy inefficiencies. This can put incumbent industrial producers at a disadvantage, especially if past decisions rewarded thrift and financial “discipline” discouraged plant upgrades. A clear accounting of the costs associated with America’s energy transition should incorporate carbon lifecycle costs, the full costs of competing systems all the way up the value chain and the economic losses associated with premature scrapping of industrial capacity when calculating the cost of reaching a desired environmental outcome.

Develop policies that address every link of the energy value chain

Government policies influence the value chain that transforms natural resources into finished products at four principal junctures: extraction, conversion, transportation/storage and consumption. For example,

1. Exploration and production companies extract oil from underground reservoirs;
2. Refiners convert oil into gasoline and other products;
3. Commercial traders and shippers move and store these products via pipeline, rail, ship and barge; and
4. Drivers purchase finished fuels for use in their cars and trucks.

In turn,

1. Access rules and royalty rates influence E&P companies;
2. Air and water controls shape refiners' decisions;
3. Regulated rates of return motivate shippers; and
4. Taxes on finished fuels and "gas guzzlers" as well as subsidies for low-emissions vehicles shape the decisions of vehicle manufacturers and purchasers.

Renewable energy sources like wind follow a similar taxonomy:

1. Component makers manufacture turbines, fan blades, gearboxes and bearings;
2. Developers purchase components and build wind farms that convert wind to electricity;
3. Utilities and/or independent grid operators convey electricity to its destination markets for local distribution; and
4. Residential, commercial and industrial customers purchase electricity for buildings and appliances.

Likewise,

1. Import tariffs, country-of-origin policies and income taxes influence manufacturers;
2. Investment and production tax credits encourage developers, while species protection and land-use controls govern wind farm siting;
3. Regulated rates of return and renewable electricity standards motivate utilities; and
4. Conservation tax credits, federal appliance subsidies and time-of-day pricing shape end-use behavior and product line choices.

Effective energy and environmental policies will align incentives at every value chain link.

Follow four standards for a new energy infrastructure

Efficiency includes throughput gains (like better vehicle fuel economy and power plant heat rates) as well as small modifications that can repurpose existing infrastructure, because no gallon of fuel or megawatt hour of electricity will ever be cheaper to manufacture than those produced by physical plant that has already been paid off. Efficiency gains usually satisfy energy security and environmental stewardship goals. At the same time, efficiency gains are the very definition of economic stimulus because they increase output per unit of input.

Sustainability commonly refers to ecological preservation, but sustainable policies must also generate (or at least retain) economic value. Free societies will not long adhere to choices that lower their standards of living and eventually will abandon energy policies that cost more than they save. Even policies that legitimately promise long-term net gains could be abandoned after too many early losses.

Scalability, as a business construct, usually refers to things that get better as they get bigger, often by amortizing a single fixed cost across a greater number of units produced. But scale works the other way, too: processes and technologies that "trickle down" from industrial application to the consumer sector can also enhance return on government investment.

Volatility can come from government actions as well as market behaviors. Price fluctuations are an inevitable consequence of well-functioning, properly-regulated and transparent markets. Policies that enable capital to flow freely and encourage innovation and accountability in equal measure can minimize peaks and troughs. Similarly, sudden energy policy changes – or the risk of sudden changes – can destroy wealth and deter new investment. Governments cannot eliminate price volatility without creating new inefficiency, but they can control regulatory volatility. Policies that phase in and out at well-defined and clearly-communicated signposts will buffer regulatory volatility. [9]

The most effective energy policies will conform to the broad definitions of all four concepts.

Endnotes

[1] The energy intensities of GDP for all five of the nations presented in Figure 1 improved meaningfully between 2000 and 2006 and the U.S. led the pack. Moreover, the U.S. was the only nation of the five to reduce its per capita energy consumption during that time period, although this also reflects the maturity of conservation efforts undertaken by other nations.

[2] U.S. residential and commercial buildings consume about 74 percent of electric power. Electric lighting consumes between 16 percent (residential) and 22 percent (commercial) of this amount and building envelopes (e.g. windows, insulation, HVAC, etc.) consume about another 38 percent. Low-cost retrofits (compact fluorescent bulbs, high-efficiency ballasts, insulation, caulking, furnace filters) can improve lighting efficiency by between 50 and 75 percent and building envelope efficiency by 10 to 15 percent, conservatively estimated. This implies theoretical gains of between 4 and 6 percent for homes and between 5 and 8 percent for businesses.

[3] At prevailing market prices, oil is 2.5 times more energy-dense per dollar than Central Appalachian coal and eight times more energy-dense per dollar than biomass. (This analysis uses the following values: biomass 6,400 Btu/lb at $30/dry ton; Coal: 12,500 Btu/lb at $45/short ton; Crude oil: 5.8MMBtu/bbl at $78/bbl; and natural gas at $5/MMBtu.)

[4] Imports currently comprise about 57 percent, on a net basis, of total U.S. consumption. Canada is the largest source of imports at about 19 percent. Mexico and Saudi Arabia are each about 12 percent. The other major Middle East source is Iraq, at 5 percent.

[5] A plug-in that could operate at 280 Watt-hours per mile might theoretically emit fewer GHGs than a conventional economy car even if it were powered by a 100 percent coal-fired utility.

[6] Despite its low price, the lower energy density of natural gas could inject expense into the petroleum fuels value chain, from the wellhead, where oil currently is about 3.5 times as energy-dense per dollar as natural gas, to the gas pump, where gasoline is about three times more energy-dense per dollar.

[7] If the first 720,000 electric cars subsidized by legislation are <u>very</u> small (280 Wh/mi), they could reduce gasoline demand by 0.3 percent in return for electric load increases of only 0.1 percent. 10 million such cars would offer the attractive prospect of eroding 4.16 percent of gasoline demand, or about 380,000 bbl/d, but the nation's electrical grid is not yet sufficiently "smart" or fungible to manage such a load. If the U.S. economy were running full-tilt, the corresponding national average load increase of 1.3 percent would overwhelm congested areas and would have severe impacts on some localities.

[8] Optimally, oil prices would need to average above $75/bbl and gas prices below $5/mcf, although the breakeven calculation would reflect individual fleet characteristics, costs of capital and vehicle acquisition or retrofit costs.

[9] A blanket "grandfather" clause for energy infrastructure, similar in character to blanket environmental review practices under NEPA, could establish a uniform phase-in or phase-out period for any energy subsidy, mandate or standard, potentially mitigating volatility associated with policy risk.