Informal background paper for conference presentation.

Climate Change, Energy Security and Economics: Complementarities and Tradeoffs in Policy Design

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INTRODUCTION

Both climate change and energy security are current policy preoccupations throughout the OECD. Whether through meetings of the Conference of the Parties of the Framework Convention on Climate Change, or through G-8 summits and other venues, leaders of the world's most advanced industrialized countries all have acknowledged the need to address the future risks posed by growing global greenhouse gas emissions (GHGs). Energy security draws attention just as widely, in the face of global oil markets and regional natural gas markets characterized not just by high prices and tight demand-supply balances, but also by instability that can have economic and geopolitical consequences.

It is hardly surprising that there are differences of opinion among countries and among stakeholder groups as to what actions are appropriate for responding to these challenges. However, the general nature of the climate change problem and the resulting need to reduce GHGs is relatively well understood, though the scale of the risks remains uncertain. Disagreement and confusion arise in the specific options for GHG mitigation. In contrast, energy security is less well understood as a concept, with significant differences among stakeholders at national and international levels as to what are the nature of the risks and how they might be reduced. This can lead to poorly aimed policies.

After discussing these differences between the climate change and energy security challenges, I consider some general implications for energy policy. Some energy policies can help advance both security and GHG mitigation goals; others involve more difficult tradeoffs. In either case, care is needed in considering the economic implications of different policy packages. I also emphasize that cooperative multilateral action is needed to achieve significant results in addressing either challenge.

GHG MITIGATION

Although energy efficiency continues to rise in both the more developed and developing worlds, GHG growth continues globally because the trends in energy efficiency and use of cleaner energy resources are being outstripped by population and economic growth, especially in rapidly developing non-OECD countries. This poses a severe challenge for policy makers world wide, because stabilizing atmospheric GHG concentrations – which is required to eventually arrest the adverse consequences of climate change – will require very significant global reductions in GHG emissions over the next 30-70 years. The IPCC has done calculations indicating the degree of reduction in global emissions needed to stabilize atmospheric GHG concentrations, which I reproduce below in Table 1.

Table 1: Global GHG emissions trajectories for different stabilization levels

Concentration of GHGs (ppm CO2-eq.)	Change in average global temperature (˚C)	Interval of maximum annual global emissions	Percent change in global emissions between 2000 and 2050
445 – 490	2.0 – 2.4	2000 – 2015	from -85 to -50
535 – 590	2.8 – 3.2	2010 – 2030	from -30 to +5
710 – 855	4.0 – 4.9	2050 – 2080	from +25 to +85

The first column shows different target ranges for GHG concentrations. To put these somewhat abstract numbers into context, atmospheric concentrations before the Industrial Revolution were on the order of 290 ppm CO2-eq. The second column shows the expected change in average global temperature if the corresponding stabilization target were achieved. The concentration targets can be reached via different trajectories of emissions over time. The third column shows the earliest and latest dates at which global emissions could peak for the concentration target to be realized. The fourth column shows how global emissions would compare in 2050 relative to 2000.

The first row of the table shows that stabilizing concentration at a bit more than 50% above pre-industrial level – which would still imply changes of between 2.0 and 2.4 degrees C – would require huge, rapid reductions in global emissions. Holding the concentration to about twice its pre-industrial level would require global emissions to peak within the next two decades, followed by reductions of up to 30% out to 2050, even while energy use is expected to grow rapidly with economic expansion in the developing world. Moreover, this stabilization target would bring with it a temperature increase of roughly 3˚ C, the outer limit of what the Stern report on climate change damages and mitigation costs would view as relatively tolerable in terms of risks. Even if it were decided to allow concentrations more than 250% above pre-industrial levels, with a very significant change in temperature and other climatic factors and increased risks, the potential growth in future emissions would be well below business as usual given reasonably robust future economic progress and continued availability of low-cost fossil fuels.

It is precisely because the world's stock of fossil fuels remains abundant and relatively low in direct economic cost that we face this challenge. Some observers have claimed that the days of low-cost petroleum are over. This view is not borne out by either public-sector or private-sector scenarios for future oil prices. The US Energy Information Administration (EIA), for example, takes as its "reference case" a world oil price that falls gradually for several years and then increases again, reaching about the same level as current prices in 2030. However, even if oil and gas supplies were to be scarcer than anticipated, both a huge global reserve of coal and relatively affordable technology to convert it to liquid fuel as well as electricity are available.

Even if the means are technically available, achievement of significant decreases in GHGs over the next half-century can be accomplished only with a strong global agreement to do so. This is the case both because no one country – including the US, or China – accounts for such a large share of emissions that unilateral action could be sufficient; and because without strong and credible international agreement, national promises to reduce emissions can unravel through "free riding." However, based on the comments above, it follows that significant global emissions cuts are not likely unless/until there are relatively affordable means to achieve them.

Unfortunately, these means do not yet exist on a scale sufficient to generate the necessary reductions at a cost that would be economically and politically acceptable in many countries, not least the rapidly growing developing countries in which living standards still lag well behind the most advanced industrialized countries. By far the most attractive near term option in principle is improved energy efficiency. There is a role as well for accelerated research on and diffusion of cost-effective renewable energy, as well as technology for trapping and safely storing CO_2 over the longer term.

How, then, are improvements in energy efficiency and shifts toward potentially costlier renewable energy to be accomplished? Here is where analytic and policy disagreements become more pointed. Many advocate the use of "economic instruments." The simplest example is a direct tax on energy related to its CO_2 emissions, as well as taxes on other sources or emissions of GHGs. More commonly advocated, however, is a system of establishing a fixed quota on total emissions while allowing "emission allowances" to be bought and sold; the resulting price then works like a tax to economize on CO_2 emissions. Such mechanisms already are anticipated by the 1997 Kyoto Protocol and are in use today in the European Union.

There is more fundamental disagreement about how much to rely on price signals versus other approaches, either in enhancing energy efficiency or stimulating the further development and utilization of lower-carbon energy sources. On the one hand, many advocates call for higher regulatory standards for fuel efficiency of vehicles, building, and appliances. This approach is receiving increased attention in the United States, especially among environmental advocates. Advocates of economic instruments argue that these effects will be achieved more cost-effectively through price signals.

With respect to new energy resources, there are advocates for a technology-based approach that looks to neither regulations nor price signals, but rather to new technology to bring down the cost of GHG mitigation so that emissions reductions will occur as a result of voluntary choice rather than regulation of any type (standards or economic instruments). This approach is illustrated by R&D efforts to bring down the cost of "cellulosic" ethanol as a substitute for petroleum based motor fuels. However, these technology approaches often are accompanied by subsidies for "early users" of alternative energy forms, whereas advocates of economic instruments would eschew such measures. Mandates for a minimum use of renewables within the electricity sector reflect another strategy.

ENERGY SECURITY

While different analysts emphasize different aspects in varying degrees, there is fairly broad agreement in the energy analysis literature that the big economic challenges of energy security over the longer term stem from high energy prices and volatile markets. High prices can reflect the market power of energy suppliers (OPEC, perhaps Russia in the European natural gas market), or limits on domestic energy supply and delivery capacity. Higher energy prices not only convey economic rents to producers; they also can provide hostile suppliers with a greater measure of geopolitical leverage

Volatile prices are a fact of life in energy markets, but they can be greatly exacerbated by "shocks" due to natural disasters and political disruptions. Aside from imposing hardships on individual households, especially those with more modest incomes, energy price volatility also has been implicated as a source of macroeconomic problems.

Tables 2 and 3 show potential future trends in oil and gas production that help to illustrate these concerns. Figure 1 shows the distribution of world reserves. These show a continuation or increase in supply shares in potentially volatile or hostile regions, including countries and regions where state influence over energy production is significant.

Table 2: World Daily Oil Production (MMB/D)

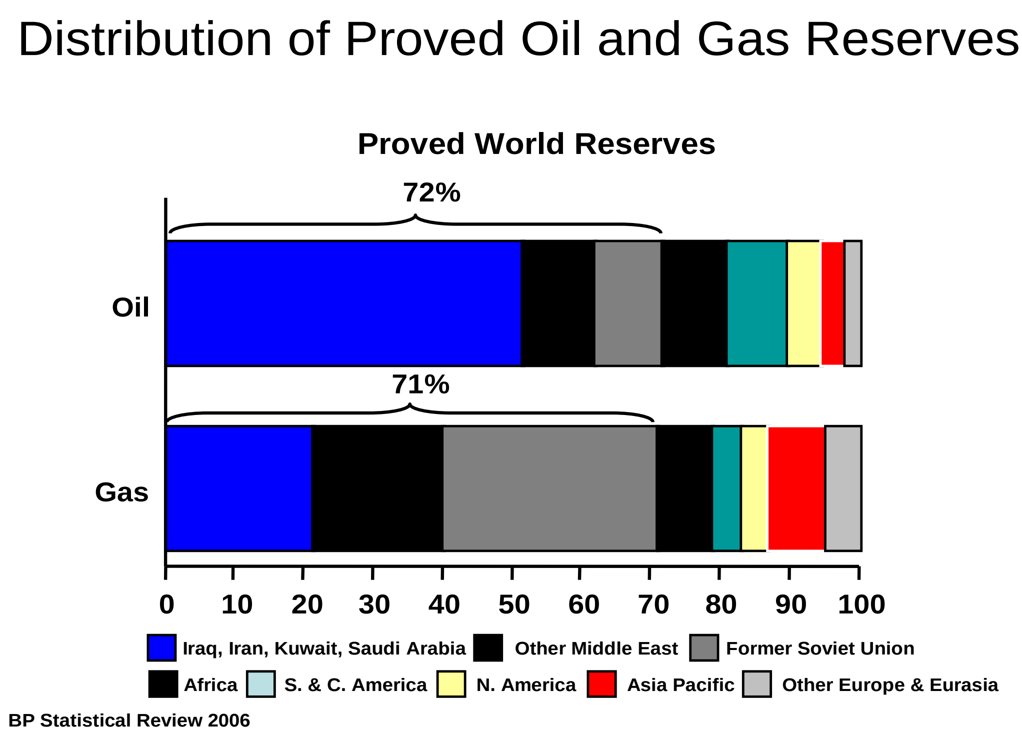
Year	**2003**	**2010**	**2015**	**2020**	**2025**	**2030**
OPEC	29.1	36.7	38.3	40.2	42.8	45.8
Non-OPEC	50.8	54.3	58.6	63.4	67.8	72.0
World	79.9	91.0	96.9	103.6	110.6	117.8

Table 3. World Annual Natural Gas Production (TCF)

Year	**2003**	**2010**	**2015**	**2020**	**2025**	**2030**
OECD	39.3	39.7	42.3	44.0	44.9	45.4
Russia & Other Eurasia	27.9	33.9	38.2	42.0	45.7	51.1
Middle East	9.1	14.2	17.1	19.8	23.1	26.2
Africa	5.1	8.7	11.4	14.3	16.3	18.5
Latin America	4.2	6.7	8.4	9.6	11.4	13.0
Non-OECD Asia	9.7	12.9	16.5	19.9	23.7	27.4
World	95.2	116.1	134.0	149.6	165.1	181.6

Source: 2006 EIA IEO.

Figure 1



Against this backdrop, it is instructive to highlight some of the ways that energy security is invoked in political discussions, either to define the problem or to suggest a favored solution. Many of the ways that energy security is brought into energy policy debate suggest a misunderstanding of the risks. There is, for example, preoccupation with arbitrary degrees of national dependence on oil imports, or with individual sources of oil supply, even though there is a fungible world oil market in which market power depends on global market share and vulnerability depends on total dependence on petroleum, not just imports. Expensive sources of domestic energy alternatives are touted as “increasing national energy independence,” though precisely because they are expensive and fill more niche-like markets, their introduction brings little in the way of practical capacity either to lower long-term price trends or smooth energy price volatility.

Workable solutions to energy security require a suite of near-term and longer-term actions. One is to increase the diversity and competitiveness of energy sources and thereby reduce the market power of current international suppliers. This can be accomplished in part by policies to reduce demand through increased energy efficiency. It also can be fostered by the development of alternative energy resources globally, but only if these alternatives can be produced in significant enough volumes so as to significantly affect world oil or gas prices.

Mitigation of problems from energy price volatility comes from three types of actions: increased flexibility in demand (rapid fuel switching); greater energy efficiency (to reduce the overall economic consequences of an energy price shock); and coordinated use of public and private inventories in a crisis to soften price spikes and dampen speculation. Again, without coordinated international action (since the markets are international), policies by any one country or small group of countries can have only limited impacts.

I have emphasized energy and economic policies for energy security here, although there also are military and diplomatic roles to deter threats and respond to them (keeping in mind the potential vulnerability of energy infrastructure, not just primary production facilities). With respect to the military role, there is a common but misleading argument found in the literature related to the “social cost of oil imports.” This cost for the US sometimes is calculated by taking estimates of total US military expenditure attributed to the Middle East, dividing that by the volume of US oil imports, and then arguing that the resulting (astronomical) figure is an “oil import cost premium” justifying large and costly measures to reduce oil imports.

There are several problems with this line of reasoning. To the extent that military activities even can be attributed to energy, they serve to maintain the entire flow of oil and gas from areas like the Middle East, not just the volume of US oil imports (which mainly come from outside the Middle East in any event). Moreover, these activities serve multiple purposes and it is relatively problematic to assign a certain quantity just to energy safeguarding. Finally, even if that assignment were feasible, an incremental reduction in oil imports or consumption would not generate a corresponding drop in required expenditures. Only an enormous (and at this stage, quite costly) transformation of the global energy system could hope to do so.

POLICY COMPLEMENTARITIES AND TRADEOFFS

Based on these discussions of climate change and energy security, it is easy to identify some “win-win” energy policies. Energy efficiency improvements unambiguously add to both GHG mitigation and energy security. This makes very valuable both efficiency in energy pricing, to avoid explicit or implicit consumption subsidies, and cost-effective technical standards for improved energy efficiency. The balance between market and regulatory measures admits no easy solution and differs from country to country.

Another important area for national and international action is support for both basic R&D in lowering the cost of renewable energy alternatives, including some cost/risk sharing for gaining knowledge from initial investment experience, and efforts to lower barriers for international diffusion of new energy alternatives. Like energy efficiency, renewables can both reduce GHGs and increase options for importers and consumers of oil and gas, thus enhancing energy security. Success in the deployment of technology for safe and effective CO2 capture and sequestration would allow a variety of new or additional coal uses to come into the market without threatening enhanced global warming. It is important at this stage to advance along several of these fronts simultaneously, since the prospects for success of different options remain too uncertain to “pick winners.”

Other options are not necessarily win-win. Pushing to expand potentially costly domestic oil production may reduce oil imports, but that alone does little or nothing to enhance energy security and it does not reduce GHGs. Expanded use of natural gas can reduce GHGs until even lower-carbon energy is more available, as well as contributing to local environmental improvements. However, it may leave countries exposed to energy security problems. Enhanced energy security in the sense used here depends fundamentally on more competitive international energy markets, and on coordinated capacities for mitigating unexpected market shocks through strategic inventories.

Nuclear power warrants some special consideration, since it can reduce GHGs and demand for fossil energy. But obviously this resource comes with its own special challenges, including both long-term waste management and risks of nuclear weapons proliferation as well as plant safety issues. Given the number of nuclear plants already under construction, and the number being planned or discussed, further progress in addressing these issues is an urgent priority, not just a potential future challenge.

The safety issue may be successfully addressed by new generations of nuclear plant designs becoming available. The proliferation issue presents risks that involve both state and non-state actors. However, the risks in either case appear to be significantly greater in connection with the entire nuclear fuel cycle – enrichment, use, and reprocessing – than with the generation of nuclear power alone. This implies the importance of re-evaluating traditional approaches to nuclear materials safeguards, and the mix of carrots and sticks used in international diplomacy to reduce risks associated with enrichment and reprocessing activities by different countries.

Finally, while I have emphasized energy related policies here, risks of future adverse impacts from global warming give rise to another set of international security concerns. These include stunted or failed economic development programs in the developing world, where vulnerability to climate change is greatest; increased destitution; and increased regional conflicts from migrations and competition for scarce resources. In addition to leading efforts for global mitigation of GHGs, the advanced industrialized countries can lead in efforts to support improved adaptation to climate change by the world’s more disadvantaged populations.