Green Competitiveness

Carolyn Fischer[1]

Introduction

Today, the European Union and other major economies are grappling with two grave challenges to sustainable development in the long run: the emissions associated with global climate change and the public sector deficits associated with both cyclical and structural sources, including looming demographic changes. At the same time, they are faced with short-run problems of financial market instability and economic anemia. As a result, there has been a search for solutions that can both stimulate economic growth in the near term and also help lay foundations for a lower carbon economy.

Since 2008, we have observed a surge in "green competitiveness," by which two meanings can be derived. One is a heightened attention in domestic climate and environmental policies to maintaining the competitiveness of trade-exposed industries, many of which have already been weakened by the global economic slowdown, as well as longer-term trends in global competition. The other is a near competition among countries to promote clean energy policies and investments as a growth strategy, seeking to generate new areas of competitiveness.

This paper attempts to address two related questions: To what extent are the goals of environmental protection and economic prosperity mutually compatible or even mutually reinforcing? To what extent is the disproportionate focus of short-term growth strategies on green investments likely to serve these long-term goals?

Background: the Challenges

Climate Change

As documented by the Intergovernmental Panel on Climate Change (IPCC), the overwhelming scientific consensus finds that the emissions of greenhouse gases are contributing to anthropogenic changes to the global climate (IPCC 2007). Stabilizing greenhouse gas emissions will require a massive transformation and decarbonization of the power and transportation sectors over the next decades, as well as improvements in energy efficiency and in agricultural and industrial processes. For this transition to be economically sustainable, efforts

[1] Senior Fellow, Resources for the Future, 1616 P Street, NW, Washington, DC 20036 (fischer@rff.org)

must begin and grow steadily over time, and investments must be made in bringing down the costs of clean energy technologies.

The European Union has been a global leader in mitigation policies, and its 20/20/20 Directive is perhaps the most far-reaching agreement yet to reduce greenhouse gases and promote renewable energy (EU 2009). In addition to the established Emissions Trading System (ETS) for major CO2 emitters, the multinational directive also requires member states to enact their own national policies to meet the targeted 20 percent increase in the share of renewable energy and the targeted 20 percent improvement in energy efficiency by the year 2020.

However, the European Parliament does not only cite meeting CO2 targets as a rationale for renewable energy support. Rather, it also calls out the need for: "promoting the security of energy supply, promoting technological development and innovation and providing opportunities for employment and regional development, especially in rural and isolated areas…, [increasing] export prospects, social cohesion and employment opportunities…[for small] independent energy producers" (EU 2009, 16). A primary energy security concern for Europe is its reliance on imported natural gas, particularly from Russia, which has led to supply disruptions, such as during a dispute between Russia and Ukraine in early 2009. Although renewable sources like wind and solar offer some promise for reducing vulnerability to external supply shocks, they also involve their own vulnerabilities, arising from their natural intermittency. Consequently, building a stable electricity supply system that is able to manage intermittent power sources will require additional investments in infrastructure like smart grids.

Despite these commitments, one might have easily expected the recent global financial crisis to stifle clean energy ambitions. Instead, at least initially, the crisis arguably served to expand public investments in low-carbon power and energy efficiency projects.

Financial Crisis and Green Stimulus

Following the global financial crisis of 2008, like other economies, the EU fell into the deepest recession since the Great Depression (EC 2009). Even as some growth returns, concerns remain about the lingering effects of the recession and continued financial market uncertainty on the long-run growth potential. Prolonged elevated unemployment rates can result in a permanent depreciation of labor force skills. Decreased investment in equipment and research and development (R&D) lead to losses in capital stocks, infrastructure quality, and the kind of innovation that drives long-term productivity growth.

The EU's policy response, in addition to shoring up the banking sector at the center of the financial crisis, was to mount an aggressive fiscal stimulus package, amounting to 5% of GDP in the EU, including the effects of automatic stabilizers (EC 2009). Expansionary fiscal policy is a common response to stimulate aggregate demand in an economy in recession. What was unusual about the worldwide response to the 2008-9 recession was the share of the stimulus devoted to "green" spending that also pursues environmental goals (Barbier 2011). Globally, 16% of stimulus funding was devoted to green projects (HSBC 2009); the EU devoted 59% of its stimulus to green projects, while individual member states and the US each allocated on average about 11% of their stimulus packages.

Green spending can be broken down into three main program areas: 1) low carbon power, including support for renewable energy (geothermal, hydro, wind and solar), nuclear power, and carbon capture and sequestration; 2) energy efficiency, including building retrofits, electrical grid improvements vehicle fuel efficiency, public transport and rail; and 3) other measures for environmental protection like water and waste management. Expenditures included both direct spending and tax credits that were additional to planned expenditures. Table 1, adapted from Barbier (2011), gives the breakdown of green stimulus expenditures from 2008-2009 for the top 5 spenders, the major EU economies, the G20 as a whole, and globally.

Table 1. Global Green Stimulus, from September 2008 through December 2009

		Green Stimulus (US$ bn)						
	Total fiscal stimulus (US$ bn)	**Low carbon power[a]**	**Energy efficiency[b]**	**Waste, water and pollution[c]**	**Total GS**	**GDP (US bn)[d]**	**GS as % of TS**	**GS as % of GDP**
China	649.1	1.6	182.4	34.0	218.8	7,099.0	33.6%	3.1%
United States	976.9	39.3	58.3	20.0	117.7	13,780.0	12.0%	0.9%
South Korea	76.1	30.9	15.2	13.8	59.9	1,206.0	78.7%	5.0%
Japan	711.9	14.0	29.1	0.2	43.3	4,272.0	6.1%	1.0%
European Union[e]	38.8	13.1	9.6		22.8	14,430.0	58.7%	0.2%
Germany	104.8		13.8		13.8	2,807.0	13.2%	0.5%
France	33.7	0.9	5.1	0.2	6.2	2,075.0	18.2%	0.3%
United Kingdom	35.5	0.9	4.9	0.1	5.8	2,130.0	16.3%	0.3%
Italy	103.5		1.3		1.3	1,800.0	1.3%	0.1%
Total G20	**3,004.3**	**105.3**	**330.1**	**78.1**	**513.5**	**63,145.8**	**17.1%**	**0.8%**
Global Total	**3,318.4**	**107.6**	**335.4**	**79.1**	**522.1**	**70,048.7**	**15.7%**	**0.7%**

Source: Barbier (2011)

Notes: [a] Support for renewable energy (geothermal, hydro, wind and solar, nuclear power, and carbon capture and sequestration.

[b] Support for energy conservation in buildings; fuel efficient vehicles; public transport and rail; and improving electrical grid transmission.

[c] Support for water, waste and pollution control, including water conservation, treatment and supply.

[d] Based on 2007 estimated Gross Domestic Product (GDP) in terms of purchasing power parity, from the US Central Intelligence Agency The World Factbook, available at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2001rank.html

[e] Only the direct contribution by the European Union (EU) is included.

As the table indicates, the largest share of green stimulus spending, both globally and among the European economies, was devoted to energy efficiency projects. Underlying this focus was the belief that that these activities were more likely to create jobs quickly, particularly in the hard-hit construction sectors. Indeed, the majority of energy efficiency spending in the EU was dedicated to building conservation. In China, on the other hand, which is still developing its infrastructure, most of the support was spent on grid and rail improvements. The United States and the EU (in its direct spending) also devoted substantial sums of their stimulus spending to low-carbon power.

Several reports argued that green stimulus would enhance short-term growth and employment in "clean energy" sectors, while policies also fostering a more sustainable, low-carbon economic development in the medium term (Barbier 2010a,b; Peterson Institute/WRI 2009; Pew Charitable Trusts 2009; Center for American Progress 2008; UNEP 2008). While the employment potential of energy sector investments is significant, the share of green jobs in the economy remains small,[2] and it is not clear that green stimulus spending generates more jobs per dollar than traditional stimulus spending. Some caution is required, as the empirical evidence on the potential for emissions reduction to drive employment or GDP growth has relied heavily on very unique national or economic circumstances (Berkeley Roundtable 2011).

The Economics of Green Growth

Green growth objectives may have taken on a new urgency in the politics surrounding the stimulus packages, but the broader question of the compatibility of economic growth and environmental protection has been a long-debated question.

Early notions tended to equate economic growth with resource depletion and greater pollution. The Environmental Kuznets Curve literature found indications that income growth ultimately leads to greater demand for environmental protection. However, neither of these strands addresses the question as to whether policies to regulate the environment do themselves promote or restrain economic growth.

[2] Roughly 2 percent or less in the United States (Brookings 2011).

Economic theory has identified several vehicles by which green policies might actually enhance overall economic growth (see, e.g., Hallegatte et al. 2011). Reductions in conventional air pollutants and exposure to toxic compounds improve public health, which can enhance labor productivity by reducing sick days, mortality, and health care expenditures. Better management of natural resources—including water, fisheries, forests, soil, etc.— assists sectors reliant on them. Better management of land use and ecosystems can reduce economic vulnerability to natural risks; for example, maintaining wetlands and regulating coastal construction can improve resiliency to storms.

Some evidence suggests that regulation can draw attention to opportunities for savings and innovation. Using case studies, Porter (1991) and Porter & van der Linde (1995) observe that pollution often reflects a waste of resources and that a reduction in pollution may lead to an improvement in the productivity with which resources are used. They also point to the power of innovation that can be triggered by incentive-based environmental regulations, which can in some instances partially or more than fully offset the costs of compliance. This possibility has come to be known as "The Porter Hypothesis."

It is well known that innovation is a critical driver of the productivity gains that underlie economic growth. Clearly, then, innovation in clean technologies has the potential to enhance productivity. In fact, under the right circumstances, temporary support for clean R&D in tandem with emissions pricing can allow for environmental protection without reducing long-run growth (Acemoglu et al. 2009).

The Rule or the Exception?

Theory and practice have thus established that there are many cases in which environmental policy can enhance growth. However, do these cases represent the rule or the exception?

The traditional view of economists is that environmental regulation imposes constraints on markets that restrict the options available to firms, which by definition must lower their profits. Palmer et al. (1995) note that the Porter Hypothesis violates the notion that firms maximize profits, since if profitable opportunities to reduce pollution are available, firms should already be taking advantage of those opportunities. Since then it has been established that other market failures (like information asymmetries, agency problems, and innovation spillovers) can create room for regulation to improve economic performance as well, but these additional barriers are as likely to hamper environmental policies as enhance their benefits.

Of course, the expectation that environmental policy entails economic costs does not mean it is not worthwhile, as the benefits must be incorporated into the equation. The objective of government policy should not be to promote growth per se but rather societal welfare. That means that valid tradeoffs between economic growth and environmental quality may be made, but good design of environmental policies can minimize those tradeoffs.

Role of Environmental Policy

Ideally, the role of policy is to remove distortions in the economy and make sure market actors take into account the full societal consequences of their actions. For environmental and clean energy policy, some of the key distortions that need to be addressed are

- Damages from emissions
- Spillover benefits of innovation
- Behavioral or coordination barriers to adoption of cleaner technologies or energy efficiency

Research on designing cost-effective environmental policy emphasizes the use of market-based instruments to address distortions. For emissions externalities, this means putting a price on pollution, such as through effluent fees, tradable quotas, or a carbon tax. These policies are cost-effective because they correct incentives rather than dictating behavior, allowing firms to find the cheapest way to comply, and ensuring that all firms face similar costs on the margin. Furthermore, they foster innovation by creating financial benefits for cleaner processes and products.

For environmental policies to be most effective, however, other distortions besides the emissions externality should also be removed or taken into account. Subsidies to fossil fuels not only distort energy markets in costly ways, but they also run counter to climate mitigation efforts; as a result, their removal is an important priority. Supplementary policies to improving access to energy efficiency information and address barriers to technological change can enhance the effectiveness of market-based environmental measures.

Innovation spillovers represent another distortion. When innovators cannot capture the full economic benefits of their technological advances (such as through limitations in the patent system or the ability of competitors to imitate), they have insufficient incentive to innovate, from a societal perspective. Public support for clean innovation can then improve both technological and environmental performance. However, the success of clean technologies depends critically on the presence of emissions pricing to create a financial reward for adopting them. In other words, without environmental regulations to spur adoption, the return to public investments in clean technology innovation can be low, even if the knowledge market failure is large (Fischer 2008).

Fiscal policies also have implications for environmental measures. Sustained and growing public sector expenditures must be paid for with tax revenues that, for reasons of equity and expediency, are typically levied upon factors of production like labor and capital. As of 2010, income taxes average 35% of labor costs in OECD countries (OECD 2011). These taxes serve to drive a wedge between labor supply and demand. Additional consumption tax rates averaging 20% further lower the real wage and distort household tradeoffs between supplying labor and enjoying leisure. When environmental regulations raise the costs of emissions-intensive goods, these increases also lower the real wage. The resulting interactions with the pre-existing taxes have been shown to significantly raise the cost of environmental regulation. A large literature in environmental economics has thus advocated the use of CO2 pricing mechanisms (such as a carbon tax or auctioned cap-and-trade) with the revenues recycled to lower income taxes as a way to minimize costs (Goulder 2002). Revenue recycling is likely to be more important for CO2 than for conventional pollutants regulated in the past with market mechanisms, due to the sheer scope of the emissions.

At the same time, regulating CO2 emissions interacts with another important distortion—the incompleteness of global regulation. While emissions and damages are global in nature, emissions pricing will be undertaken at a subglobal level. In this case, cost increases among energy-intensive, trade-exposed (EITE) sectors in regulated countries would cause energy-intensive activities to shift to noncoalition countries, resulting in "carbon leakage."

On Environment and Competitiveness

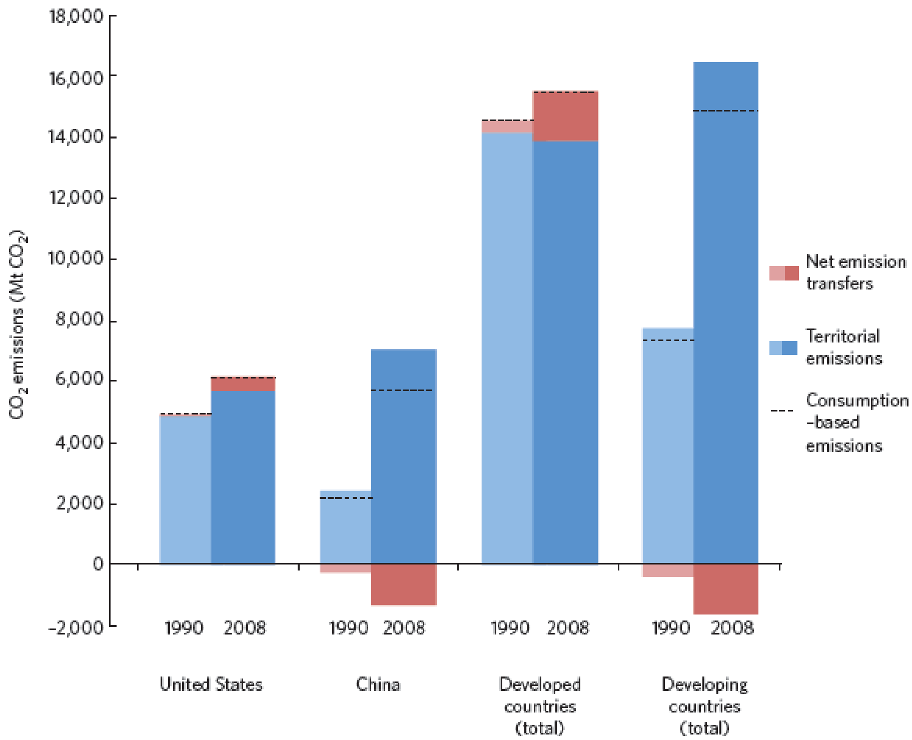
The term "competitiveness," popular in the political lexicon, is ill defined and often critiqued in economics as it relates to trade policy. The well-known trade economist, Paul Krugman (1994), argued that while firms might worry about competitiveness, it is "a meaningless word when applied to national economies." Concerned that the term was being evoked to support protectionist stances, he further warned that "the obsession with competitiveness is both wrong and dangerous."

Competitiveness concerns take on some different meanings in environmental policy, regarding the potential for environmental regulations to induce the shifting of emissions to jurisdictions with less stringent policies. Furthermore, if trade exposed industries are vulnerable to these pressures, then countries may have an incentive to weaken their environmental protections to garner a competitive advantage for those sectors.

Empirical studies, however, find little evidence that environmental regulations harm competitiveness. The effects on net imports or jobs overall seem to be negligible (Morgenstern et al. 2002), although they may be (statistically) significant within specific sectors (Greenstone 2002). Logically, the vulnerable sectors are those that are both particularly pollution intensive and also “footloose,” having low transport costs and low capital intensity. However, analysis of trends in the emissions of conventional air pollutants (SO2, NOx, CO, and volatile organic compounds) does not support the idea that emissions have been moving offshore: compared to thirty years ago, the U.S. imports proportionally more clean goods and proportionally fewer polluting goods (Levinson 2010).

This story may not hold for CO2 emissions, however. Several studies have documented a steady increase in the carbon content of trade, with developed countries being large net importers of carbon (e.g., Peters et al. 2011). The figure portrays the calculations by Peters et al. of the emissions embodied in international trade in 1990 and 2008 for developed and developing countries and the two largest single emitters, the United States and China. Territorial emissions are shown in blue, while net emission transfers from international trade are in red bars; negative values for emission transfers indicate net export of emissions, whereas positive values reflect net import. Consumption-based emissions are the balance between territorial emissions and net transfers, indicated by the dotted line. Not only have traded emissions between developed and developing countries grown rapidly, but for developed countries as a whole, these transfers exceed the reductions in territorial emissions achieved since 1990.

Figure 1: Territorial Emissions and Net Emissions Transfers



Source: Fischer (2011), adapted from Peters et al. (2011)

One may draw other important distinctions between conventional pollutants and greenhouse gases like CO2. For local pollutants, competitiveness impacts are generally not an efficiency concern, as sovereign nations should be free to choose their appropriate level of environmental protection. For global pollutants, however, competitiveness impacts can (in theory) offset some environmental benefits.

Coping with Carbon Leakage

Since the environmental effects of greenhouse gases do not depend on where they are emitted, the environmental integrity of carbon regulation is fully sensitive to leakage. Since existing CO2 regulations are still relatively new, sparse, and with modest prices, it is difficult to detect significant competitiveness or carbon leakage effects at this point. But more comprehensive climate policies do have the potential for significant economywide effects, since reliance on fossil energy sources remains endemic in all major economies. Most studies of carbon leakage have used simulation models of global trade to study the potential effects of stringent regulation. These modeling results suggest that carbon leakage is modest overall but may become large for certain sectors, those that are both energy intensive and trade exposed (Fischer and Fox 2010).

From an economic standpoint, the most efficient way of dealing with carbon leakage is global carbon pricing. However, as of the UNFCCC negotiations in Durban this December, we have only a non-binding agreement to reach an agreement by 2015 to bring all countries under the same legal regime by 2020. In the meantime, as laid out in the Copenhagen Accord in 2009, individual countries will unilaterally pledge their own commitments. In this international framework, coping with these potential competitiveness and leakage effects has been a major focus of internal climate policy discussions among the major economies implementing or proposing to implement significant emissions cap-and-trade programs, including the United States, the European Union, Australia, and New Zealand. The remaining policy options are all second best.

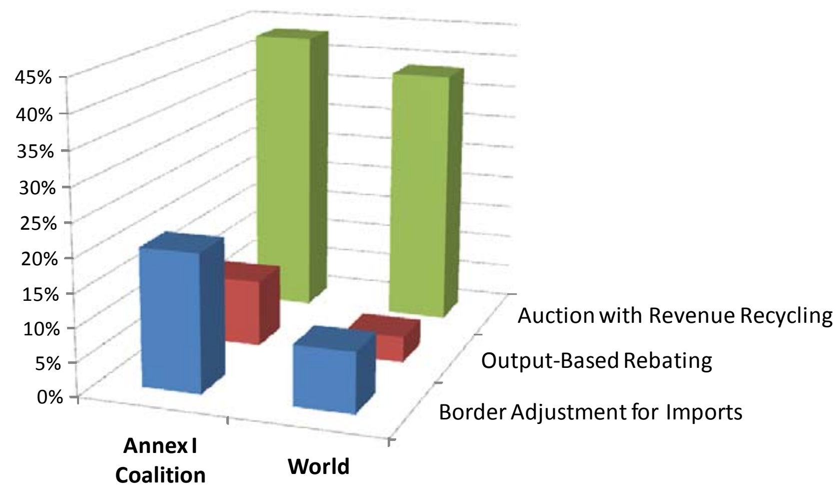
Most governments have chosen to use preferential allocation of emission allowances to energy-intensive manufacturing to allay concerns about losing profits to foreign competitors. A version of free allocation proposed in the U.S., Australia, and New Zealand—output-based rebating—would not only apply industry-specific benchmarks but also update the allocations over time based on recent measures of economic activity, namely production. Since additional production then garners additional allowances, that value functions as a subsidy to production. (The approach is similar to using tradable performance standards, in that above-benchmark emitters face a net liability, while below-benchmark emitters get a net subsidy.) By conditioning the allocation on production behavior, rather than transferring allowances unconditionally, OBR lowers marginal operating costs, which are stronger determinants of competitiveness than fixed costs, at least in the short run.[3] However, while OBR keeps the playing field level by keeping domestic costs from rising, it also keeps consumers from realizing the full cost (including the embodied carbon) of the products. As a consequence, downstream consumers have less incentive to use alternative products or conservation measures to reduce emissions. Although eligible sectors may benefit and leakage may be reduced, those forgone domestic reductions must be made up elsewhere, driving up the emissions price and overall costs to meet the national cap (Fischer and Fox 2007). As a result, these policies are best when targeted narrowly to the EITE sectors most vulnerable to leakage and used when the acting coalition of countries is small (Boehringer et al. 2011).

[3] The U.S. 2009 American Clean Energy and Security Act (H.R. 2454, or ACESA) proposed that the per unit allocation for eligible sectors be 100 percent of average emissions (both direct and indirect), up to a maximum of 15 percent of the total cap. Australia's Carbon Pollution Reduction Scheme would offer the most energy-intensive activities allowances equal to 60 to 90 percent of historical average emissions (direct and indirect), phasing down gradually over time. The European Union is undertaking a similar benchmarking exercise for its next period, but the results will be used to determine grandfathered allowances; still, the fact that allowances will be granted to new entrants and forfeited for significant reductions in capacity means that the allowances are not truly unconditional and in the long run may have properties somewhat similar to OBR. (See Boehringer et al. 2010).

An alternative policy measure is border carbon adjustments (BCA), which require importers to purchase emissions allowances in proportion to the emissions embodied in the foreign production of the goods. This method levels part of the playing field by bringing the price of imported goods up to the level of those at home, retaining the incentives for consumers to find and innovate low-carbon alternatives. To implement full consumption-based emissions pricing, one would also give rebates to exported goods, based on a benchmark of their emissions intensity; the rebates keep domestic goods competitive on world markets, without offering the subsidy at home, like OBR. However, most policy proposals focus only on import adjustments. Studies have shown BCAs can improve the cost-effectiveness of carbon pricing, but they also shift more of the economic burden toward developing countries (Boehringer et al. 2011). They are also best applied narrowly to sectors most vulnerable to leakage (e.g., cement, steel, aluminum), as they can become costly if implemented too broadly. Furthermore, these measures remain controversial, as their WTO consistency is untested.

Given the tradeoffs in using such competitiveness measures to complement unilateral climate policies, it is useful to put the scale of the potential efficiency improvements in context, by comparing them to those that might be achieved by other means. Figure 2 compares the cost improvements from OBR and BCA to those from revenue recycling, relative the costs of a cap-and-trade program in which the allowance values are transferred in lump-sum fashion (as through grandfathering or citizen dividend checks). The scenarios each require a 20% reduction in Annex I emissions net of leakage (so the coalition caps adjust to meet this global reduction target); competitiveness measures are applied only to EITE sectors. The simulation results from this global trade model suggest that, when the Annex I countries are acting together, while remaining countries have no binding targets, border adjustments are more cost effective than rebates, but the benefits of competitiveness measures are dwarfed by the potential benefits of using allowance values to reduce tax rates and improve the efficiency of the economy as a whole.

Figure 2: Scale of Cost-Effectiveness Improvements Relative to Grandfathering



Source: Fischer Fox Emissions and Trade Model.

Environment and Competitiveness: the Role of Technical Progress

Traditionally, discussions of environmental policy and competitiveness have focused on concerns that trade might induce a "race to the bottom," in which countries loosen their standards to preserve the competitiveness of their industrial sectors. An interesting feature of recent environmental policy discussion during the economic crisis is the emphasis on green policy as a source of, not hindrance to, competitiveness. The idea is that innovation in clean energy sectors can generate new jobs and export opportunities.

Indeed, much of the political language surrounding these investments espoused the need to build competitiveness in clean energy sectors, particularly vis-à-vis China. Even prior to the crisis, renewable energy was forming part of a competitiveness strategy among certain EU member states, citing goals of technological innovation, trade advantages, and skilled employment, in addition to decarbonization of the energy sector. For example, for many years, Denmark heavily subsidized wind power development as part of an industrial strategy to become a leading producer. Germany has raised similar hopes to expand domestic jobs through renewable technology exports.

Studies of the Danish experience found their policies to be effective in this dimension (e.g., Buen 2006), but they tend to avoid the question as to whether the benefits exceeded the cost (Fischer and Preonas 2010). Even so, not everyone can be a leader. While some countries spawn green export industries large enough to drive economy-wide growth, others are likely to find a natural limit as to how many countries can enter the field and remain successful. A

Berkeley Roundtable (2011) report warns, “the emphasis on export-led growth may risk a new green mercantilism more damaging than the growth it might create.”

Still, widespread clean technology innovation is necessary for a transition to a low-carbon economy. Furthermore, it is well established that economic growth in general comes from improving productivity. But do clean technology stimulus policies promote growth more than other investments?

A related question is the extent to which innovation in green technologies may crowd out innovation in non-green sectors that also have growth potential. Many types of R&D are likely to have spillovers that justify public policy support, and research markets can draw on common talent pools. Ignoring the potential for crowding out can lead to overestimating the net benefits of environmental policies (Goulder and Schneider 1999). Thus, green-specific innovation policies are more likely to be efficiency-enhancing if they address market failures and barriers specific to green technologies.

Here, there may be some legitimate tension between wanting to avoid “picking winners” and targeting the kinds of advanced technologies needed for long-run climate objectives. Generally, there is deserved skepticism about governments’ abilities in accurately predicting which technologies will be future winners. Thus, it is recommended that basic R&D policy emphasize broad-based incentive measures (R&D tax credits, fundamental research support) that allow markets to find the most useful applications. However, clean technologies may face particular hurdles related to energy market structure, infrastructure, learning curves, and future policy uncertainty that justify policies to support their adoption as well as innovation.

An additional question is whether support for clean energy should be further differentiated by technology. If the goal is simply to have a certain share of renewable energy, then an renewable portfolio standard (RPS) policy (also known as tradable green certificates) should by definition meet that goal in an efficient manner, yet experience has found that feed-in-tariffs (FiTs) tend to be more effective. Practical and empirical evidence indicates the value of price certainty in promoting investments in these emerging technologies. Furthermore, because they are able to price-discriminate, FiTs can achieve a portfolio of renewable energy sources at lower resource costs than an RPS. If an RPS is the most cost-effective mechanism, that result rests on the fact that it tends to promote the most commercially ready technologies, but that also means that advanced technologies with higher spillover or learning externalities are under-incentivized (Fischer and Preonas 2010).

Designing an appropriate policy mix for supporting a portfolio of clean energy technologies is further complicated by the environmental policy context in which it operates.

Notably, once a binding cap-and-trade program is placed on emissions, additional renewable policies of any kind do not affect emissions. Supplemental policies can address other market failures, but their effects on the ETS should be recognized. Policies that expand renewables make it easier to meet the cap, driving down allowance prices to the benefit of the relatively dirty sources and to the detriment of the relatively clean nonrenewable sources (Boehringer and Rosendahl 2010). Support for renewable energy is also more likely to lower consumer prices, again due to the effect on lowering allowance prices. Yet, despite the apparently lower emissions costs, the true costs of meeting the cap may actually be higher, at least from a static efficiency perspective; therefore, it is important to verify a dynamic efficiency rationale in the form of improved innovation incentives. In other words, renewable energy policies need to be approached and evaluated as innovation and technology policies, rather than emissions policies.

Conclusion

Growth and greenness are not mutually exclusive goals, but nor can they be guaranteed to be mutually enhancing. Economic expansion often creates more emissions, and emissions reductions can limit economic opportunities. Yet both growth and greenness are necessary for well-being.

Normally, environmental policies are justified on their health and public welfare merits. Difficult times may diminish public willingness to take on costs to achieve environmental objectives. In contrast, the concept of green growth attained sufficient popularity to have been quite effective in leveraging the economic crisis to pursue green objectives. However, these policies risk serious backlash if the expectations created are unrealistic.

And great expectations have been created. In 2008, President Obama made a campaign pledge to create 5 million green jobs over the next decade, and this goal informed the stimulus spending priorities. The more optimistic estimates of the size of the clean energy sector as of 2007 were half that number (2.4 million), comprising perhaps 2% of the economy, and growing more slowly than overall employment (Brookings 2011). Yet green sectors were asked to absorb 12% of stimulus spending—and implicitly bear a disproportionate share of the success or failure of the recovery.

The true goal of clean technology policies is to spur innovation and lower future mitigation costs, to allow for an easier transition to a low-carbon economy. Most of the benefits are not felt now, but rather accrue in the future. Yet the debate over supporting clean technologies has focused on current jobs and emissions reductions; while these may be a byproduct of the policies, they are likely not to compare favorably by these metrics. In Europe, renewable energy policies do not reduce CO_2 emissions, at least in the sectors that are already capped. Energy efficiency and technology installation jobs are labor intensive but tend to be transient; clean energy manufacturing jobs may persist, but the capital intensity of the industries limits their numbers. Furthermore, they cannot expand their capacity beyond demand for the technologies. For example, experts are expressing concern that the worldwide capacity for manufacturing batteries has far outstripped the demand for electric cars, and factory closures are expected.[4] High-profile bankruptcies in the solar industry, following massive global expansion and falling prices, have generated political backlash in the U.S. against the green recovery tactics and the Department of Energy in particular. If one simply divides the recovery spending by the Department of Energy by the jobs created, one finds spending of nearly $1 million per job.[5] But these simple assessments miss the point: the primary goal is to promote innovation and build our capacity to meet future challenges by investing in a broad portfolio of clean energy endeavors, some of which are bound to fail. Unfortunately, little data is available or being tracked to evaluate the performance toward meeting these true goals, and whether the results are worth the costs, but evaluating them merely on short-term economic effects is inappropriate.

The danger of only promoting environmental policies as "win-win" strategies, and emphasizing the politically expedient justifications (like jobs), is that the case does not get built for why they are truly necessary. When the short-term jobs and other justifications do not perform up to expectations, support for the policies is undermined, making it even more difficult to promote the kind of sustained effort needed to meet long-term challenges. Voters and policymakers must understand that, even if tradeoffs must be made, they are worthwhile. Furthermore, well-designed environmental policies can minimize those tradeoffs and improve efficiency if they harness market incentives to address market distortions. For meeting the climate challenge, this means combining broad-based emissions pricing with market reforms and innovation policies with a targeted portfolio for specific innovation needs. Policies pushing clean technologies must be paced alongside policies that pull consumers to demand them. Done well, significant emissions reductions can clearly be achieved without threatening overall economic growth. But the policies must be sold to the public—on their own merits.

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[5] Data from www.recovery.gov (accessed 12/12/2011).

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