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Final Proposal

Abstract

The fact that fossil fuel sources being depleted is widely publicized, and the growing energy crisis means that sources of more sustainable energy must utilized. However, renewable energy continues to be sidelined, as it is not considered cost-competitive with other energy sources. This paper presents a proposal to rectify this situation, and includes two strategies suggested by literature: increased federal R&D and the internalization of externality costs of fuels. The paper also specifies the extent to which these methods should be applied, and suggests a timeline for execution.

Background

Global energy consumption is projected to grow by two-thirds by 2030 (Dorian, 2006). If energy sources keep their current growth rates, fossil fuels will comprise 90% of the energy sources. This is an unacceptable percentage when the environmental damage fossil fuels cause is taken into account. Consider that in 2004, renewable energy only provided 3 percent of total global energy, yet this 3 percent avoided the release of 0.9 billion tons of carbon dioxide (Martinot, 2006). And buildup of greenhouse gasses is not the only negative impact fossil fuels have been associated with; others include acid rain, forest die-off, and even increases in human respiratory diseases.

Considering the consequences of using fossil fuels, it is not surprising that there has been increasing interest in the development and use of alternative energy sources, including both renewable energy and other sources such as nuclear power and natural gas. However, power sources other than renewable energy still have many problems that need to be worked out before they can afford to be used. For example, whenever nuclear energy is brought up, the debate over where to store the radioactive waste rears its head, in addition to the security concerns regarding nuclear power plants in this new age of terrorism. Nuclear energy also faces the problem of production output, namely the fact that it would be very difficult to build enough nuclear plants to have nuclear power comprise a significant portion of the world’s power output. The 30 plants planned in

China and India each, for example, would not provide even 5 percent of the countries' power needs (Flavin, 2006). Even more distressing is the fact that 70 new reactors would need to be built in the next decade just to replace those that are projected to be closed (Flavin, 2006).

On the other hand, renewable energy is ready to be used now, and investment in renewable energy is increasing dramatically, from $14 billion in 2000 to $39 billion last year (Martinot, 2006). With such a heavy investment, it is difficult to dismiss renewable energy as a passing fad. However, the transition from investment in research to investment in commercialization is a difficult one. If policies regarding renewable energy are not changed, unless a major technological breakthrough is made in the field of renewable energy, these technologies will only become competitive after we pass the point where it is too late to start research.

Problem Statement

Since most renewable energy sources have already been proven to be viable from a technological standpoint, the biggest obstacle facing the transition from fossil fuels to renewable energy is renewable energy's lack of cost-competitiveness. In other words, we need to implement policies to reduce the market distortions that make renewable energy appear to be less cost-effective than fossil fuels. For example, as of 2002, the cost of renewable energy was between two to twenty times the cost of coal, and up to thirty times the cost of gas, depending on the energy source (Owen, 2006). "Best-performance" wind power was the closest at approaching the cost of exhaustible fuels, but that is only if the intermittency of renewable energy, and thus the need for backup generation facilities, is ignored.

However, these costs also include the substantial federal subsidies for gas and coal and leave out the externality costs these fuels have. Energy externalities are defined as "the costs imposed on society and the environment that are not accounted for by the producers and consumers of energy" costs such as environmental damage and undesirable climate change (Eyre, 1997). A specific plan for factoring these externalities into the cost of exhaustible fuels is laid out later on in the proposal.

In addition, recently there has been a push by the government to privatize research into renewable energy, which is an important step for commercialization. However, privatization also leads to fragmentation of technology as proprietary techniques are developed, proprietary techniques that would further the technological development of renewable energy far more if they were to be shared with all researchers. Thus it would be wise to keep the current level of federal R&D for renewable energy until the renewable energy market is more firmly established.

Literature Review

There is much literature already written that suggest policy changes. The main two suggestions have been to increase federal R&D investment and to somehow include the externalities of fuels in their costs.

Federal R&D Funding and Patents

A recent study by Robert Margolis and Daniel Kammen reaffirmed the high correlation between R&D investment and patents acquired. In addition, they found that even when the investment was made by the private sector, often the societal benefit was much greater than the private benefit. This is due to the fact that "many of the benefits of R&D are difficult for private firms to appropriate and are thus realized by the broad public" (Margolis, 1999). Thus there tends to be an underinvestment in R&D from the private sector, which must be made up either by incentives from the public for private research, or direct federal funding for R&D.

When Margolis and Kammen wrote their paper, there was a downward trend in R&D investment from the Department of Energy (DOE). This reflected the attempt to move research from the government into the private sector, often a critical step for commercialization of a technology. Unfortunately, this resulted in a decrease in the number of the patents assigned to the DOE as well. This is especially detrimental when we consider that the capital stock for renewable energy has a very long lifetime, as it can take decades to commercialize new power systems. In addition, the privatization of the renewable energy industry raises the probability of the development of proprietary methods, which would severely hinder the fledgling renewable energy industry (Margolis, 2006).

The most compelling point brought up by the Margolis study was that since R&D investment and patents in energy are so highly linearly correlated, it is an indication that there has been consistent under-investment in research by both the private and public sectors. If there had been optimal investment in R&D, any further investment would have diminishing returns, i.e. there would not be a linear correlation between investment and patents (Margolis, 1999). Thus, we need to be increasing R&D funding for energy in both the public and private sectors, rather than trying to transfer funds from public to private. The situation with federal R&D has changed since Margolis and Kammen conducted their study due to increasing fossil fuel costs and the need for greater energy security, but we will need to continue increasing federal investment into energy research if we hope to meet the projected increase in renewable energy to 40-50 percent of total energy production by 2050 (Martinot, 2006).

Internalizing Externality Costs

In addition to suboptimal research funding, renewable energy is also suffering from a lack of cost-competitiveness with other fuels. However, this is only the case if only direct costs are considered. Several of the papers reviewed here suggest internalizing the externality costs of fuels. Externality costs are the costs to health and environment caused by emissions, for example the increase in respiratory diseases and climate change due to greenhouse gasses. Including these externality costs in the prices of fossil fuels would give the energy industry a better, more concrete, idea of the real expense of fossil fuels. However, this would also mean putting a dollar figure on the environmental impact of fossil fuels, something that is difficult to measure. Anthony Owen quantitatively takes a look at this internalizing of externality costs in his paper, where he calculates that if the environmental impact of fossil fuels is included in their costs, renewable energy, especially hydroelectric and wind power, but even more exotic sources like geothermal and photovoltaics, become quite cost-competitive (Owen, 2006).

This internalization can be accomplished in a number of ways. One such policy would be a carbon tax, something some countries have already established. Other methods include federal subsidies; for example the solar power subsidy employed in Hawaii. There is currently a 35 percent credit for residents using solar hot water heating units, making solar heating effectively competitive with other forms of heating (Dorian, 2006). Additionally, studies have shown many people would be willing to pay a premium to have their energy supplied by renewable sources rather than fossil fuels, so subsidies may not even have to be that drastic (Cooper, 1997).

Ethical Implications

Researchers have identified several ethical considerations associated with applying these policy changes. None of them have to do with renewable energy as a technology; they all are centered on the fact that we have a finite amount of financial resources. If we invest in renewable energy, we have no choice but to take away from investments in other areas, such as improving conservation policies for fossil fuels. The question becomes whether the benefits we derive from increasing investment in renewable energy outweigh the costs of decreasing investment in other areas.

The main objection to reducing the market distortions by changing our energy policy is that mandating government policy changes to make renewable energy competitive with other energy sources creates an uneven playing field. Goldemberg and Owen both counter this in their articles by discussing the concept of "learning curves", the phenomenon where as a particular technology matures, there is less and less of a need for the government to intervene to keep it competitive. In other words, the government would only need to be involved for a relatively short amount of time before economies of scale and increased R&D would allow a renewable energy source to be competitive on its own (Goldemberg, 2006; Owen, 2006). In addition, the government already significantly subsidizes the fossil fuel industry to provide consumers with low priced energy, so there should be no objections to the government subsidizing renewable energy as well (Goldemberg, 2006).

Another objection to heavy investment in new renewable energy facilities is the fact that many of the resources we use to establish these new facilities require oil power to create. Cooper rightly points out in his article that this is simply a red herring attempting to distract us from the environmental benefits we will reap from installing new renewable energy capacity, benefits that far outweigh the environmental harm caused. Turner provides quantitative support for this claim in his article, citing the calculation for the financial payback time of photovoltaic cells, which have a 30 year lifetime, to be 3-4 years, and that of wind power, with a lifetime of 20 years, to be a mere

3-4 months (Turner, 1999). The environmental payback time is similarly favorable, with emissions avoided by using photovoltaics equaling the emissions generated in order to manufacture the cells within the third year of operation (Turner, 1999). Considering the increase in efficiency and the decrease in manufacturing costs in the seven years since Turner wrote his article, the payback time, both financial and environmental, for wind power and photovoltaics has been reduced even further. In addition, once a significant renewable energy base has been established, “one can easily envision a renewable energy breeder plant,” a plant where no oil power at all is used to create new renewable energy resources (Turner, 1999).

Objectives

This proposal presents a two-part a roadmap for energy policy changes: increased federal investment in research of renewable energy and the internalization of externalities. If these changes are made, renewable energy will become cost-competitive in a short enough period of time to help governments meet their own prevention of climate change objectives as well as international objectives, such as those mandated by the Kyoto Protocol.

Approach

This section presents the suggested route for implementing these two changes in energy policy. The approach consists of two steps; first educating the policymakers on the importance and urgency of the changes, and then actually implementing the changes.

Education

The first step would be to educate policymakers about renewable energy. Currently, the *CQ Researcher* database has an article on renewable energy, but it is over seven years old. Technology, especially that of a cutting edge field such as renewable energy, changes much more quickly than once every seven years. In addition, the article presents a very quantitative look at renewable energy, making it hard for policymakers to name the specific extent to which a certain policy should be extended. There are more recent articles on specific technologies like biofuels and nuclear power, but there needs to be a another overview article that gives a more qualitative look at the renewable energy industry, and describes the policies in place not only for renewable energy, but also for fossil fuels. For example, the article should include information on the extent of federal subsidies for different energy sources.

Implementation of Suggested Policy Changes

The next step would be actual implementation of policy changes. The most important change is the removal of market distortions of energy prices. This would mean either removing subsidies for fuels like coal and gas, or instating similar subsidies for renewable energy. In addition, the prices of fossil fuels must be changed to reflect their damage to the environment, and the extra revenue generated be used to either further renewable energy research or to research ways to reverse the damage done by fossil fuels. Table 1 shows effective energy prices as of 2002, and Table 2 shows the quantifiable energy costs for several EU countries (Owen, 2006).

Table 1.

Cost of traditional and renewable energy technologies current and expected trends

Energy source	**Technology**	**Current cost of delivered energy (Euro-¢/kWh)**	**Expected future costs beyond 2020 as technology matures (Euro-¢/kWh)**
Coal	Grid supply (generation only)	3–5	Capital costs to decline slightly with technical progress. This may be offset by increases in the (real) price of fossil fuels
Gas	Combined cycle (generation only)	2–4	
Delivered grid electricity from fossil fuels	Off-peak	2–3	
	Peak	15–25	
	Average	8–10	
	Rural electrification	25–80	
Nuclear		4–6	3–5
Solar	Thermal electricity (annual insolation of 2500 kWh/m^2)	12–18	4–10
Solar	Grid connected photovoltaics		
	Annual 1000 kWh/m^2 (e.g. UK)	50–80	~8

Energy source	**Technology**	**Current cost of delivered energy (Euro-¢/kWh)**	**Expected future costs beyond 2020 as technology matures (Euro-¢/kWh)**
	Annual 1500 kWh/m^2 (e.g. Southern Europe)	30–50	~5
		20–40	~4
	Annual 2500 kWh/m^2 (e.g. lower latitude countries)	40–60	~10
Geothermal	Electricity	2–10	1–8
	Heat	0.5–5.0	0.5–5.0
Wind	Onshore	3–5	2–3
	Offshore	6–10	2–5
Marine	Tidal barrage (e.g. proposed River Severn Barrage)	12	12
	Tidal stream	8–15	8–15
	Wave	8–20	5–7
Biomass	Electricity	5–15	4–10
	Heat	1–5	1–5
Biofuels	Ethanol (cf. petrol & diesel)	3–9 (1.5–2.2)	2–4 (1.5–2.2)
Hydro	Large scale	2–8	2–8
	Small scale	4–10	3–10

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Table 2.

External costs for electricity production in the EU (range: Euro-¢/kWh)

Country	**Coal & lignite**	**Peat**	**Oil**	**Gas**	**Nuclear**	**Biomass**	**Hydro**	**PV**	**Wind**
Austria				1–3		2–3	0.1		
Belgium	4–15			1–2	0.5				
Germany	3–6		5–8	1–2	0.2	3		0.6	0.05
Denmark	4–7			2–3		1			0.1
Spain	5–8			1–2		3–5			0.2
Finland	2–4	2–5				1			
France	7–10		8–11	2–4	0.3	1	1		
Greece	5–8		3–5	1		0–0.8	1		0.25
Ireland	6–8	3–4							
Italy			3–6	2–3			0.3		
Netherlands	3–4			1–2	0.7	0.5			
Norway				1–2		0.2	0.2		0–0.25
Portugal	4–7			1–2		1–2	0.03		
Sweden	2–4					0.3	0–0.7		
United Kingdom	4–7		3–5	1–2	0.25	1			0.15
EU range	2–15	2–5	3–11	1–4	0.2–0.7	0–5	0–1	0.6	0–0.25
Median Lower Bound	4	2.5	3	1	0.3	1	0.2	0.6	0.125

(Owen, 2006)

These tables show that if the external costs of fossil fuels are included in their prices, some renewable energy sources would already be cost competitive. However, there must be time for renewable energy infrastructure to be built before we take away the subsidies for fossil fuels, so we should first provide subsidies for renewable energy to make it cost-competitive, then include the external costs of fossil fuels in their prices, and finally remove subsidies for both fossil fuels and renewable energy. However, the data in Table 1 is from 2002, and the data in Table 2 is from 2003, so we need to gather new data on the costs of different energy sources and the current external costs of energy sources.

The second implementation that needs to be made is the increase in federal R&D spending. Currently government spending is decreasing due to an effort to move research to the private sector. This might result in fragmentation of patents and development of proprietary techniques that will hinder further research. However, this privatization is also an essential part of commercializing renewable energy, so it would be best to maintain current levels of federal R&D investment, but make sure research spending does not decrease in this area for another fifteen years. By that point most estimates, including more conservative ones, predict that renewable energy will comprise a large enough proportion of total energy consumption that sustained federal R&D will not be as crucial, and at that point we can decrease government funding of research.

Timeline

The timeline presented here would accomplish the proposed changes over the span of about a year, depending on how long it takes for legislation to make its way though the government. Note that the second and fourth points should be conducted simultaneously.

- Six months for writing of new renewable energy article and publication to CQ Researcher site
- Conduct study over three months of current energy costs, including costs of externalities.
- Internalize external costs of fossil fuels according to new study immediately after completion of study.
- Push for sustained R&D funding for next fifteen years, or until renewable energy reaches at least 15% of total global energy consumption; this should take place right after article is published and presented to Congress

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