What Policy Choices Do We Have? – The Normative Side of the Story

By Deepak Sivaraman*

Introduction: About 70% of electricity consumed in the United States is generated from fossil based resources. Even though the usage of renewable options such as wind, solar and geothermal, etc. have generally followed an increasing trend in the past decade, it is not nearly enough to address the ever-looming Climate Change problem. With Mr. Kevin Rudd, the newly elected Prime Minister of Australia pledging to join the Kyoto treaty, it is inevitable that the United States will soon be alone in waging a losing battle against the reduction of carbon emissions. Undoubtedly, a turn towards a more sustainable direction is required. As alluring as it is to carry on with a 'Doomsayer's Theory' for the U.S., I actually wanted to present a more Normative side of the story. This article looks at possible policy frameworks that would increase the usage of renewable technologies and the investment in the clean technology sector. What follows is a brief description of each economic policy option considered, its expected influence on the investment in renewable electricity market, and actual real world examples of such a policy framework being instituted. The purpose of this article is to highlight the range of options available to the U.S. in their impending crusade to increase investment in the renewable electricity markets.

Emissions Tax

An Emissions Tax is not a popular policy option, i.e., no one likes taxes, but it is effective and highly controversial, nonetheless. By regulating a pollutant tax ($ / unit pollutant released) all the Government intends to accomplish is to create a level playing field between the fossil based and renewable sources. It is one of the ways in which the fossil based resources are forced to internalize at least a part of their negative externalities. Let us just consider a simple example without getting into too many details, the carbon emissions factor (grams CO_2 / kWh electricity generated) for crystalline PV electricity is ten times less than that of the average national U.S. grid.[1] On the other hand we also know that the price of electricity generated from photovoltaics is much higher than that of grid electricity. Comparing these two prices is akin to comparing apples to oranges, because the environmental attribute (lesser carbon emissions) of the PV technology has not been considered in such a comparative analysis. An emissions tax addresses such a market failure; it increases the cost of fossil fuel based electricity generation thus creating more of a level playing field between the two electricity generation options. Creation of such a level playing field will eventually promote increased investment in renewable electricity production, because now there is more of an incentive to invest in this market.

European countries have different CO_2 tax rates for different sectors, e.g., Sweden has a tax rate of $ 56 – 189 / ton CO_2 depending on the sector considered.[2] Thus, establishing tax rates in the United States (for carbon and other pollutants) is an effective mechanism to encourage investment in renewable electricity production. A certain amount of discretion needs to be exercised however, while setting the tax rate for various pollutants.

Production Subsidies for Renewable Sources

The biggest difference between a subsidy and tax is the answer to the important question of 'Who Bears the Cost?'. Industry pays the Government in a tax world, the opposite prevails in the case of the subsidy. When the Government provides a subsidy to the renewable electricity generators, it will decrease the marginal cost of generating electricity and with all other things remaining equal, will decrease the overall price of electricity in the market. [3] The decrease in price can actually increase electricity demand. A tax scenario penalizes the fossil based generators; a subsidy on the other hand aids the renewable electricity producers thus providing a strong incentive for increased investment in cleaner technologies.

In the United States, DSIRE [4] is an excellent source of information about the incentives provided for clean technologies, both by the federal and state Governments. The state government of California has traditionally been very aggressive in promoting cleaner technologies. The California Solar Initiative for instance contributes $ 3.25 for every watt of photovoltaic capacity installed (for specific sectors), the Emerging Renewables Program provides the $ 2.50 for every watt power of wind capacity installed. Michigan on the other hand provides a one time grant of $ 50,000 for large scale PV installations in schools. The federal Government provides a tax credit incentive of 2 ¢ for every kWh of electricity generated from wind, geothermal and biomass sources. Similar incentives for a number of cleaner technologies exist

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See footnotes at end of text.

from various states in the U.S. It is important to keep in mind that subsidization, while it does promote renewable technologies and investment in the sector, it does not impede the pollutant emissions from the fossil sector.

Fossil Energy Tax

The Energy Tax is akin to the emissions tax discussed above, except for the fact that it imposes a tax not on the pollutant emissions but on the total fossil energy output (e.g. $ / MWh). In most cases, the primary objective of this policy framework is not to completely internalize the damage costs exerted by the carbon emissions externality, but to only reduce the carbon emissions from what it is at present. In Europe a fossil energy tax rate of € 0.5 / MWh electricity generated exists at present. [5] This tax does not promote the use of comparatively less carbon intensive fossil fuels (such as natural gas over coal) because it is the energy output that is being taxed and not the actual emissions, where as the emissions tax scenario would promote the use of lesser carbon intensive fossil fuels.

An energy tax would indirectly promote investment in the renewable electricity sector. Imposing a fossil energy tax will increase the overall market price of electricity (thereby reducing demand to a certain extent) consequently encouraging investment in clean technologies. It has the potential to reduce more emissions from the fossil power sector than when compared to the renewable subsidy framework discussed above.

Allowance Trading Markets

The three policies discussed above operate on a fixed framework (the tax rate or subsidy rate is fixed), on the contrary the permit prices in this policy option change every day. Emissions Trading System (ETS) is a powerful market mechanism that rewards the renewable technologies for their Environmental Attribute. The underlying theme of the ETS is to achieve the same amount of emissions reduction (as in a command – control framework) at a comparatively much lower total cost. This is achieved by taking advantage of the different marginal pollutant abatement costs (MAC) [6] existent among different sectors, industries or even countries. The regulatory agency sets a cap on the total amount of emissions that are allowed annually from the electricity sector. In this framework, the fossil industry would be a net buyer of permits (to adjust the additional amount of emissions it released above its regulated limit), the renewable industry would be a net seller of permits, both industries will trade permits at the existent market price at that time. Hence, the total amount of emissions still binds to the cap.

It is efficient because it achieves the same result at a much lower cost. The renewable technologies can sell their environmental attributes in the market and obtain monetary gains from the trade. This is a definite incentive for increased investment in the clean electricity sector. It is, however, very interesting to note that, as investment increases and the renewable sector expands; it would eventually drive the permit price down. So the regulatory agency needs to set more stringent caps over time to maintain a constant permit price, which in the long run will aid the renewable sector. Well established CO_2 trading markets exist in Europe, in the United States the CO_2 trading market is in its nascent stages.[7] At present the CO_2 allowance price in Europe is 15 – 16 times higher than in the U.S. However, the SO_2 and NO_X trading markets in the U.S. have proved to be very successful over the years. Establishment of a trading market is definitely one of the ways to promote increased investment in the renewable electricity sector.

Renewable Portfolio Standards (RPS)

RPS is a policy mechanism that regulates the energy portfolio of each state, making it binding that a certain fraction of total electricity generation in the state be derived from renewable sources. Not all the states in the U.S. have ratified a RPS framework; conventionally the local state government (e.g., California Energy Commission, Delaware Energy Office, etc.) institutes the policy framework in the relevant state. For instance, at present the state of California and Illinois require 20% and 25% of their energy demand to be generated from renewable sources, respectively, the EERE also contains the list of states in the U.S. that have ratified the RPS until now.[8]

A coal power plant can either install wind turbines or photovoltaics to satisfy its fractional renewable electricity requirement, or it can purchase Green Certificates (GC) in the market. A single GC normally represents one MWh of electricity generated from a renewable source; the coal power plant when it purchases a GC needs to pay a premium (additional price for every unit of electricity) in recognition of the product's environmental attribute. GC's generated from different renewable sources are sold in the market at different premium rates.[9]

Such a premium is a strong driver for increased investment in renewable electricity markets. As long as a state has instituted a RPS framework, there will always be demand for GC's, which is an incentive to invest in the renewable industry. It raises the very interesting question of 'When will the U.S. be ready to adopt a national RPS framework?' The expansion of the renewable industry will decrease the price of GC's, hence the state needs to establish more stringent RPS over time, to prevent the price of GC's from descending too low.

R&D Subsidies for Renewables

Research & Development subsidies are very unique in the fact that they look at future long-term technological development. They neither influence the emissions nor the energy output from either the fossil or renewable sector in the current time (quite contrary to all the other policy frameworks discussed above). Their predominant objective is to provide the particular industry with enough financial opportunities to achieve a technological breakthrough over time i.e., in the case of the PV technology, a technological breakthrough can be a significant increase in the solar cell conversion efficiency or a decrease in manufacturing cost. This would potentially result in a higher deployment of the technology in the future, as it is comparatively more beneficial and less costly to the use the same.

Federal subsidy is the most common form of subsidies provided to the clean technology R&D sector, which increases the investment in the electricity sector. For instance, the U.S. federal Government invested almost $ 4.4 billion and $ 1.2 billion, in the solar and wind technologies, respectively (from 1947 – 1999).[10] In the year 2005 alone, the federal government subsidized the photovoltaic R&D sector by investing $ 76 million.[11] R&D subsidies directly increase the investment in the clean technology sector; however one of the biggest disadvantages of this policy tool is the very high uncertainty involved in the payback on investment.

Technology Learning Curves

The Learning Curve is one of the issues that need to be considered while implementing policy frameworks, especially when Developing technologies are involved. Learning curves represent the reduction in the production costs of a technology, as more and more of the technology is produced over time. For instance, the historical learning curve effect of PV technology has been 80%, i.e., for every doubling of photovoltaic cumulative production, production costs are reduced by 20%.

Let us look at its influence on the allowance trading markets, for example. With time there will be a decrease in the production cost of PV technology, consequently increasing the usage of the technology. A direct implication of such an increased usage of the technology is that it becomes cheaper to abate CO_2 emissions (and other air pollutant emissions) now, i.e., the pollutant allowance price decreases for a constant regulated cap on emissions. Hence if our objective is to increase the usage of cleaner technologies, the Government must respond to the learning curve effect by setting more stringent caps with time, to maintain constant allowance prices. This is one of many implications of the Learning Curve effect on policy frameworks. The regulatory agency needs to be dynamic to achieve any objective over a long period of time. It must constantly respond to the myriad of changes that happen in the technology market over time.

Summary and Conclusions

Technological innovation, social change and policies/regulations are three of the most important drivers that would steer our society towards sustainability. In this article we discussed different policy frameworks that have the potential for promoting investment in the renewable electricity sector. Even though, all of the policies presented above have a common underlying objective, i.e., promoting the usage of renewable sources, they still provide different incentives and provoke different responses. Emissions Tax and Allowance Trading Markets directly influence a reduction in the total amount of CO_2 and pollutant emissions, thus facilitating an increased use of renewable sources (to meet a fixed demand). Energy Tax is different in the fact that it does not penalize emissions, but the total amount of fossil energy generated. It does not require the fossil electricity sector to distinguish between coal and natural gas, but still facilitates the usage of renewable sources, nevertheless. These policy frameworks encourage using renewable sources by imposing a penalty on the electricity generated from fossil based sources. There are more direct ways to achieve the same objective, however. For instance, the renewable production subsidy and RPS both encourage using cleaner technologies to generate electricity more directly. The U.S would be better served if RPS is adopted on a national scale at some point in the future. Last but not the least, the R&D technology subsidies emphasize the Government's long term commitment to the development of cleaner, more sustainable technologies. Policies designed to increase the usage of cleaner, renewable sources are one of the strongest drivers to encourage increased investment in the clean technology sector.

In the United States some of these policies are well developed and already implemented, while others are still in their nascent stages. Implementing one or a combination of these policies will undoubtedly increase investment in the renewable sector, at the same time providing energy and environmental sustainability to the electricity sector.

Footnotes

[1] CO_2 Emission Factor (g / kWh): The multi-crystalline PV module is 60 g / kWh, the U.S. average national grid is 700 g / kWh. Source: Alsema, E.A. Nieuwlaar, E. 2000. Energy viability of photovoltaic systems. Energy Policy (28) 999 – 1010

[2] The regional environmental center for central and eastern Europe. Carbon Taxes. November 2007

[3] The unit price of electricity in the market is a weighted average of the price of electricity generated from different resources

[4] DSIRE: Database of State Incentives for Renewables and Efficiency. Link: http://www.dsireusa.org/

[5] Speck, S. 2003. Liberalization of electricity market and environmental policy issues: synergy or controversy. Energy Research Center of the Netherlands

[6] Marginal Abatement Cost (MAC): The additional amount of cost spent to abate one extra unit of the pollutant ($ / ton)

[7] Chicago Climate Exchange. Link: http://www.chicagoclimatex.com/

[8] Energy Efficiency and Renewable Energy (EERE). States with Renewable Portfolio Standards. Link: http://www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm

[9] Energy Efficiency and Renewable Energy (EERE). Renewable Energy Certificates (REC). Link: http://www.eere.energy.gov/greenpower/markets/certificates.shtml?page=0

[10] Renewable Energy Policy Project. 2001. Marshall Goldberg. Federal Energy Subsidies

[11] Budgets for Photovoltaics R&D. Link: http://www.iea-pvps.org/isr/

USAEE Student Activities

The USAEE, the United States chapter of the IAEE, has the goal of gaining participation and support for the students and young professionals that will lead the field of energy economics in the coming years. The USAEE supports and promotes several efforts relating to the annual conference which will be held in New Orleans this coming December: a best student paper awards with monetary prizes for up to 10 students, scholarship support for conference attendance, a resume service for conference attendees, and student events at the conference. We also have a working paper series which allows free access to the latest energy publications and submissions from members.

We have recently launched a Facebook group for networking among energy professionals. Our hope is that members that already use Facebook will find a convenient way to reconnect with other professionals and to offer feedback directly to the USAEE council on services and programs.

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