Renewable Portfolio Standard

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Glossary

fixed feed-in tariff An offer by government or a utility to purchase electricity from renewables producers at a fixed price, regardless of the producers' costs of production.

green (renewables) certificate A certificate, provided by a regulator to renewables producers for specified units of their electricity output; can be traded to other electricity producers who need it to meet their obligation to produce a minimum percentage of renewable electricity under the renewable portfolio standard.

quantity-based policy A policy that specifies a quantity outcome (as opposed to a price-based policy such as an environmental tax or subsidy); an example is the renewable portfolio standard policy, which requires production of a specific quantity of electricity.

renewable energy Forms of energy (sunlight, wind, geothermal heat, wave power, tidal energy, hydropower, and organic matter) that flow through Earth's biosphere, available for human use indefinitely, provided that the physical basis for their flow is not destroyed.

The renewable portfolio standard (RPS) is a policy instrument to force greater production of electricity from energy sources (usually renewable) that have desirable social and environmental characteristics. By requiring market participants to deliver a minimum amount of electricity, typically as a percentage of total sales, from specific fuels and/or technologies, the RPS is a "quantity-based policy." In Europe, the policy is often referred to as "green certificate" trading. Renewable energy sources are normally defined as sunlight, wind, geothermal heat, wave power, tidal energy, hydropower, and organic matter, but the definition used in a given jurisdiction's RPS may be narrower or broader, depending on local views of the social and environmental characteristics of each technology and fuel.

1. RATIONALE

Renewables appear to have lower social and environmental impacts and risks when compared with electricity derived from conventional sources, such as fossil fuels and nuclear power. Environmental benefits may include reduced emissions contributing to smog or producing acid rain and greenhouse gases relative to a total reliance on fossil fuels, and zero risk of radiation exposure or nuclear weapons proliferation relative to nuclear power. Greater use of renewable sources may also enhance energy security by increasing supply diversity and the use of indigenous fuels, thereby reducing vulnerability to supply disruptions and volatile fuel prices. Renewables can also support economic development through reducing payments for imported fuels (increasing local multiplier effects) and fostering the development of local technical expertise.

Renewables are usually more expensive than conventional electricity sources when compared on a financial cost basis. Because of this, both monopoly and competitive electricity producers have concentrated their investment on conventional electricity technologies, with renewables usually accounting for only a small percentage of the generating stock. The only countries dependent on renewables for electricity generation are those with substantial, low-cost hydropower endowments, such as Brazil, Norway, New Zealand, and Canada. But because many large hydropower facilities disrupt ecosystems, sometimes dramatically, hydro plants exceeding a threshold of, say, 20 MW may be excluded from RPS eligibility.

There are three arguments for why the financial comparison of renewables and conventional generation sources does not reflect the full costs and benefits to society of the alternative sources:

1. Some jurisdictions provide greater subsidies to conventional generation fuels and technologies.
2. The full costs of pollution (externalities) are not included in the financial costs of conventional electricity sources, and are usually much greater than pollution costs for renewables.
3. Although humans have used some renewables (such as wind) for millennia, renewables are today associated with new technologies, the relative costs of which will fall with widespread commercialization because of economies of learning and economies of scale in manufacture.

Thus, although from a strict financial cost perspective (Fig. 1, left side) most renewables are more expensive compared to conventional electricity, the situation may be reversed when these three additional factors are taken into account (Fig. 1, right side). Inclusion of these three factors is referred to as the "long-run, social cost perspective." Whereas it is not certain that renewables are always less expensive on a social cost basis, they are nonetheless recognized as desirable sources of electricity that will have difficulty penetrating the market given the pressure on electricity investors to focus on financial considerations. This constraint is exacerbated if electricity markets continue the current trend toward independent electricity production, mostly by privately owned companies.

In recognition of the possible advantages of renewables on a social cost basis, governments have developed policies to improve the financial competitiveness of renewables. There are four broad categories of measures to support renewables:

1. Assist the commercialization of renewables with indirect support. This may include funding of demonstration projects, audits, evaluations, resource assessments, research and development support, and training.
2. Provide direct financial support to renewables. This may include capital grants, preferential purchase prices, tax advantages, or low-interest loans. Energy price subsidies can be in the form of preferential fixed-price tariffs (feed-in tariffs), a fixed premium on the prevailing electricity price, or a premium payment to renewable electricity producers determined by a "competitive bidding" process.
3. Increase the cost of polluting sources of supply. This may include the reduction or elimination of subsidies to conventional sources, higher energy or pollution taxes (externality taxes), stronger technology regulations, or emission cap regulations.
4. Foster voluntary or mandatory minimum market shares for renewables. This may include voluntary agreements with producers, green tariffs that allow consumers to pay extra for renewables, and the RPS.

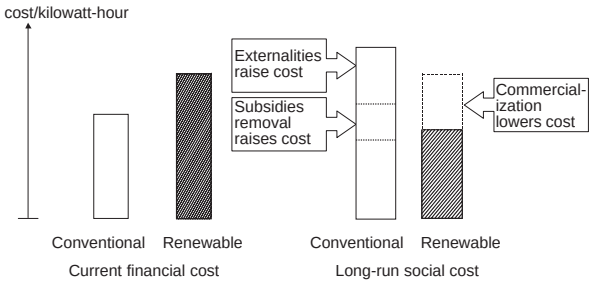

FIGURE 1 Conventional versus renewable electricity: financial and social cost comparison.

Since the energy crisis of the 1970s, governments have especially relied on the first two mechanisms to support renewables. Various indirect support policies (e.g., research and development subsidies) have been in place throughout the past 30 years. But the dominant policy in terms of impact has been direct financial support. Many governments have provided tax credits for renewables. Electric utilities and governments have offered above-market, fixed-tariff prices to acquire electricity from renewables producers. In the United States, the Public Utility Regulatory Policy Act of 1978 required utilities to purchase renewables and other independent electricity at prices that reflected the long-run cost of new, high-cost nuclear and fossil fuel plants. In Europe, fixed-tariff price support was implemented through direct government subsidy (e.g., in Denmark) or cross-subsidy from other utility customers (e.g., in Germany). In the 1990s, however, interest in the third and fourth approaches has increased as governments have explored policies that raise the cost of polluting sources of supply. Europe has focused on pollution regulations and externality taxes, and the United States has focused on regulations and systems that involve emissions caps and tradable permits. Industrialized countries, and increasingly developing countries (e.g., China), have also reduced subsidies to conventional fossil fuel and nuclear energy producers. Voluntary green tariffs and the RPS

emerged in the late 1990s in Europe, the United States, and Australia.

Three characteristics help explain the emerging interest in the RPS: First, an RPS maintains continuous incentives for renewable producers to seek cost reductions (economic efficiency) and can be designed to ensure that these cost reductions are passed on to consumers (equity). This is achieved by mechanisms that establish continuous cost competition among renewable producers for their share of the RPS. Second, because an RPS ensures the attainment of a specific market share, it can be directly linked to government policy objectives. Governments can set an RPS target as part of a package of policies to meet an environmental target such as CO_2 reduction. Third, an RPS minimizes government involvement relative to other measures. The government's budget is not implicated because customers pay producers directly the extra financial cost of renewables, and the selection of winning bids can be left to market forces (competitive bidding) instead of government evaluation. Because the RPS has only recently emerged as a policy tool, there is insufficient experience to provide an empirical evaluation of its performance relative to key alternatives, such as subsidized feed-in tariffs and competitive bidding for subsidies. However, critical issues in its design have already emerged.

2. DESIGN CONSIDERATIONS

Many considerations influence the design of an RPS. Major categories include selection of the target, determining resource eligibility, determining where and to whom the policy is applied, designing flexibility mechanisms, and setting administrative responsibilities. Although these are presented individually here, they cannot be considered in isolation from each other in the design process. A clear set of policy objectives is required for navigating these considerations. These include standard policy objectives, such as effectiveness, economic efficiency, equity, political acceptability, and administrative feasibility, but also the specific environmental and perhaps social goals that are the motivation for the RPS in the first place. For example, the RPS has been linked to the greenhouse gas reduction goals of several jurisdictions. The following discussion of design considerations assumes that the policy objectives include the standard list, as well as those environmental objectives that tend to favor renewables relative to fossil fuel- and nuclear-generated electricity.

2.1 Target Selection

The main challenge of the RPS is determination of the binding target or quota for renewable energy production. There are several aspects to this determination.

2.1.1 Target Size

Setting target size requires consideration of impacts on different objectives, including anticipated costs. These impacts will depend in part on the local cost and availability of renewables and the price of conventional electricity sources. From a political acceptability perspective, the target would be large enough to move the industry toward the environmental objective, but not so large that it results in a dramatic increase in electricity prices. The size of the target can also affect the level of competition among fuels or technologies. For example, if targets could be achieved with a relatively small number of large projects, there may be less competition and little pressure to innovate. Some knowledge of the potential costs and quantities of renewables is therefore important in establishing targets.

2.1.2 Target Timing

Another consideration in selecting the target is timing. Some lead time may be required to permit cost-effective responses to the RPS target. The length of the lead time will depend on the magnitude of the target and the characteristics of eligible resources. If existing facilities are not eligible for meeting targets, sufficient lead time will be required for investments in new facilities. A phase-in period would enable the government to conduct interim evaluations in order to assess impacts and make target adjustments where necessary, thereby maintaining fairly stable compliance costs. However, duration and stability of targets can also be important so that buyers and sellers can more easily negotiate long-term supply contracts. Long-term commitments that guarantee a revenue stream are important for securing low-cost project financing, especially for capital-intensive technologies such as renewables.

2.1.3 One or Multiple Renewables Targets

An issue in target setting is whether there should be one target for which all renewables compete, or a separate target for different classes of renewables. Under the first approach, the lowest cost options would be developed to meet the aggregate target. This approach should advance environmental goals more cost-effectively, but it might do less well in

furthering other objectives, such as greater supply diversity or increased support for newly emerging, but still expensive, types of renewables. Perhaps one renewable (e.g., wind) will capture the entire RPS market even though other renewables would eventually become competitive were they assisted in achieving commercialization and production thresholds. The state of Connecticut designed its RPS with separate targets for Class 1 renewables (solar, wind, landfill gas, and sustainable biomass) and Class 2 renewables (hydropower and municipal solid waste), the intent being to limit the share of hydropower and municipal solid waste within the RPS.

2.1.4 Target Adjustment and Other Cost Cap Measures

If the RPS is set too high, it could substantially increase the price of electricity, with perhaps significant political acceptability and economic performance impacts. There are several ways in which the government (or RPS administrator) could deal with this challenge. First, the RPS target could be voluntary (as in The Netherlands in its initial policy), or converted to voluntary status as higher-than-anticipated costs emerge. Second, the government could adjust the target downward as evidence of high cost emerged. Third, the government could set a modest penalty that participants would pay to the extent that they failed to comply completely with the RPS. This penalty provides assurance to participants that costs will not rise above the penalty level. Fourth, if the RPS includes a system of tradable renewable certificates (green certificates in Europe), the government could offer to sell an unlimited number of these at a modest price, in effect providing a price cap (e.g., The Netherlands). These measures all ensure that costs will not exceed a given level, but at the possible expense of not achieving the RPS target, and the corresponding environmental target associated with it. On the negative side, adjusting targets could jeopardize the credibility and predictability of the program, with serious consequences for its long-term success.

2.2 Eligible Resources

In addition to specific targets, the RPS must establish resource eligibility. This will depend on the objectives for the RPS and the local viability of different types of resources.

2.2.1 Renewables vs Other Desired Technologies

A key eligibility decision is whether the RPS should be limited to renewable sources of electricity or can include other energy/technology combinations. This depends on the objectives and, in some sense, on the comfort level with using the term "renewables" to symbolize the broader concept of environmentally desirable technologies. In Italy, only truly renewable forms of energy are included in the RPS definition. In some jurisdictions, however, fossil fuel-driven cogeneration or fuel cell technology is included because of the higher energy efficiency and lower local emissions of these mechanisms. In proposing its RPS, Australia included solar water heaters that displace electric water heaters that use electricity from fossil fuel plants.

2.2.2 Existing Renewables vs New Investments

Another eligibility consideration is whether the RPS should apply to all renewable resources or only to new investments in renewable resources. Applying it to new investment helps advance the new technology commercialization intent of the RPS, as adopted in the Italian RPS. However, this may increase administrative complexity by requiring ongoing monitoring and regulatory rulings as to whether a given expenditure is just maintenance and refurbishment of an existing facility or a truly new investment (a problem experienced in a different context with the U.S. Clean Air Act). Is a complete reconstruction of a small hydropower facility a new or old investment? If new, what if only the turbines are replaced? If, however, the policy goal is simply to expand output from renewables at the lowest cost, the government may be indifferent regarding investments for reconditioning or for totally new facilities.

2.2.3 Grid-Connected Renewables vs All Renewables

The RPS may apply only to grid-connected facilities or to both grid-connected and off-grid facilities. Although the simplest approach is to focus the policy on changing the grid-transmitted market share of renewables, some would argue that environmental objectives are equally served by the development of renewables anywhere, including off grid. However, administrative realities must be considered. It would be difficult to verify the annual production of a myriad of small off-grid generators, leading to high administrative costs.

2.2.4 Facility Size

The size of resources may also be part of the RPS eligibility determination. Size limits can affect the number of potential projects required to meet the

overall target. They can also indirectly affect objectives such as diversity and the location of projects. The RPS of the state of Maine in the United States had an upper limit of 100 MW, which applied to both existing and new facilities. A limit of 10 or 20 MW is sometimes suggested as the maximum size that should be allowed for hydropower projects to be included in the RPS.

2.2.5 Imports vs Domestic Renewables

External, renewable electricity producers may wish to sell into a jurisdiction with an RPS standard. Again, determination of eligibility depends on the policy objectives. If the expansion of domestic resources is key, imports of renewables may be limited or excluded from the RPS, which does not prevent them from competing in the non-RPS market against conventional generation facilities. In many jurisdictions, external participation in the RPS will require some consideration of existing trade agreements and commercial law, which may limit policymakers' ability to discriminate between domestic supplies and imports. Both Europe and North America are working toward electricity trade rules that should make external participation easier.

2.3 Applicability

The applicability of the RPS target is another important design consideration. Key issues include the geographic coverage of the standard, the applicability of the standard to specific market participants, and whether it should be applied to capacity or energy.

2.3.1 Geographic Coverage

In terms of geographic coverage, the RPS may be most effective if the breadth of its application is matched to the breadth of environmental and other objectives. This explains why the European Union (EU), which sees renewables as a component of its greenhouse gas emission reduction objective, is seeking to achieve an EU-wide RPS. However, the physical limitations to trade must be considered. In some countries, the lack of grid interconnection makes implementation of even a national RPS problematic, unless some form of credit trading is permitted. In these cases, it may be easier initially to set an RPS for each major grid area.

2.3.2 Market Participants Regulated by the RPS

The RPS must specify the market participants to which it applies. Possible participants include producers, wholesale customers or brokers, retail suppliers, distribution utilities, and consumers. Some jurisdictions want the RPS to be associated with final consumption, hoping that the public will better understand its link to environmental or other policy objectives. Denmark's proposed RPS applies to consumers, although distribution utilities or retail suppliers would presumably represent the interests of small consumers. Others believe that the administrative ease of regulating producers is important. Italy has size restrictions so that the standard applies to only about 100 producers nationwide.

2.3.3 Energy Production vs Installed Capacity

The RPS may apply to energy production or installed capacity. Capacity may be easier to verify, but energy production is directly connected to environmental objectives. An energy-determined RPS provides the incentive for producers to maximize production from individual projects, and thereby lower costs.

2.4 Flexibility Mechanisms

An RPS can be less costly to implement, yet still achieve the same target, if there is flexibility in how it is applied both to individual producers and across the entire market.

2.4.1 Account-Balancing Mechanisms for Individual Producers

One way to increase flexibility is to allow those to whom the policy is applied to have some flexibility in the choice of calendar year and in the period for achieving their annual RPS. This is known as an "account-balancing mechanism." For example, the inherent output variability of some types of renewables, such as wind, hinders accurate fulfillment of the RPS target each year. The electricity provider can be given extra months to meet the previous year's commitment as long as the full RPS requirement is achieved on average over a period of years. The Australian RPS has a 3-year balancing mechanism for electricity providers.

2.4.2 Trading Mechanisms between Producers

Another way to increase flexibility is to allow trade among electricity providers so that the RPS target is met in aggregate, even if some providers exceed the RPS and others fail to achieve it. This approach can significantly decrease the total cost of the

RPS because it allows the maximum electricity production from those renewables generators with the lowest costs. This trading can be facilitated by the creation of tradable certificates, hence the European term "green certificate" trading for the RPS. As of 2003, The Netherlands, Italy, England, Australia, and some U.S. states (Texas) had such certificates. The creation of certificates is not essential, however, for trading to occur. The RPS administrator could allow electricity providers to use a variety of instruments to demonstrate achievement of the RPS target in aggregate while they trade among themselves. Contracts between providers could be filed with the administrator and these would be verified against actual inputs to the grid.

2.5 Administrative Responsibilities

There are several administrative responsibilities in implementing a RPS. These could all be handled by one RPS administrator or delegated to specialized agencies.

2.5.1 Setting the RPS Target

The RPS target would likely be set at a senior level of government because it involves critical trade-offs between environmental targets, economic development goals, and concerns about electricity prices.

2.5.2 Certification of Renewables

Certification of renewables could be delegated to the operator of the grid, subject to periodic review by the government agency responsible for administering the RPS. Environmental regulators could help with the definition of what is a renewable resource, although, again, this may be a high-level policy decision.

2.5.3 Compliance Monitoring

Compliance monitoring could be delegated to the operator of the grid, because this entity will already have information on production of connected facilities. If nongrid production is also eligible for the RPS, compliance verification will be much more difficult and may require some other entity.

2.5.4 Setting and Collecting Penalties for Noncompliance

Penalties for noncompliance may be set at senior levels of government, for consistency with other public policies, but could then be administered by the grid operator or environmental agency.

3. EARLY ADOPTERS

The renewable portfolio standard is a new policy tool. Many jurisdictions (national, regional) are studying it, and several have RPS legislation under consideration. But as of 2003, only a few jurisdictions (and only in industrialized countries) have enacted RPS legislation. Although it is too early to assess the effectiveness of the RPS relative to alternative policies, a survey of early adopters provides an initial indication of the preferences of policymakers when trading-off implementation objectives and constraints. Because the RPS legislative situation is so dynamic, this survey is limited to general policy developments, and even some of these may soon change.

3.1 United States

The United States Congress has considered several RPS legislative proposals. In the spring of 2003, the U.S. Senate passed a bill requiring new renewables to provide an additional 1% of U.S. electricity by 2005 and 10% by 2020. The RPS would include a credit trading mechanism between producers to reduce the cost of compliance. The bill also sustains a production tax credit for renewable generators. In 2003, just over 10 U.S. states had enacted an RPS, but many additional states were considering legislation. States with an RPS enacted or in final consideration included Maine, Massachusetts, Connecticut, Pennsylvania, New Jersey, Minnesota, Wisconsin, Iowa, Texas, New Mexico, Arizona, Nevada, and California. Most RPS legislation has been associated with electricity sector reform toward greater generation competition, with RPS targeting electricity retailers. Almost all programs envision flexibility mechanisms (tradable credits), although these are mostly in the development stage. State-level electric utility regulators are usually charged with the responsibility for program administration. Urban waste and landfill gas are often included as eligible resources, and sometimes technologies such as fuel cells and cogeneration.

Variation in the RPS from one state to another reflects the unique circumstances and objectives of each state. At 30%, Maine's RPS target appears ambitious, but the RPS includes all currently operating renewables and the state already generates 50% of its electricity from eligible hydro and biomass resources. RPS advocates hail the Texas RPS as the best-designed and most ambitious policy in the

country. It envisioned the development of an additional 2000 MW of mostly wind power by 2009, which, in combination with existing renewables, would provide about 3% of total state electricity provision. Wind power has expanded rapidly since the inception of the RPS.

3.2 European Union

As part of its effort to establish a liberalized internal electricity market, the EU has been developing harmonized rules on the treatment of renewables in order to avoid distortion of trade and competition in electricity from renewable sources. In 1997, the EU issued a White Paper setting a goal for a minimum 12% share of renewable electricity supply by 2010. In 2000, the EU issued a directive proposal for a community-wide policy. To date, the directive proposal is not binding, nor does it specify the policy that should be used. Nonetheless, interest in the RPS at the EU-wide level is strong, and several countries have implemented the policy and several are close to implementation.

In Italy's RPS, operators who produce and import more than 100 GWh are obliged, from 2001, to provide at least 2% of the electricity produced and imported (net of cogeneration, exports, and self-consumption) from new, renewable generation. Renewables generators earn green certificates, which they can use or trade to nonrenewables producers in a tradable certificate market. The goal of the RPS is to triple electricity production from renewable sources by 2010.

The government of The Netherlands initially negotiated a voluntary RPS with the country's major utilities, but participants behave as if it were mandatory because meeting their RPS quota allows them to avoid an environmental tax. Producers of renewable electricity (utilities and independent power producers) receive for each kilowatt-hour provided to the grid a subsidy, which is financed by an environmental tax throughout the country on conventional energy consumption. Producers and utilities can also trade green energy certificates among themselves to meet their obligation under the RPS.

England has recently implemented an RPS with tradable certificates (called the Renewables Obligation). This replaces its system of the past decade, which involved competitive bidding by potential renewables generators for funds collected from all customers in a tariff charge called the Non-Fossil Fuel Obligation. That system did not stimulate as much renewables production as did the feed-in tariffs for producers of Denmark, Germany, and Spain, but it did lead to declining bid prices for electricity offers to the grid from renewables producers. Sweden, Belgium, and Austria implemented RPS policies in 2003 and several other European countries are close to implementation. Denmark has been known for its generous feed-in tariffs that have fostered the dramatic growth in wind power in that country. But the subsidies are a substantial drain on public resources (100 million Euros in 1998), and the Danish parliament recently developed legislation to create an RPS, slated for implementation in the 2004–2005 period.

3.3 Australia

The Australian federal government enacted a nationwide RPS in 2001 to operate within its competitive electricity market. The policy includes a certificate trading scheme.

4. PRELIMINARY ASSESSMENT

The RPS is a policy tool to expand production of renewable-generated electricity to reflect what its role would be if long-run social costs instead of short-run financial costs were the determinant of electricity generation investment. By establishing a guaranteed market share for renewables producers, the RPS provides a strong incentive for new renewable investment, an ongoing motivation for current and new renewable producers to reduce costs, and a relatively sure means of attaining environmental targets while reducing the requirement for government financial and managerial involvement. The RPS can be applied both to electric utilities that are regulated monopolies and to competitive independent producers, but it is generally associated with jurisdictions that have reformed their electricity sector to increase competition in electricity generation. Several European countries, several U.S. states, and Australia have thus far implemented the RPS, but it is under active consideration in many other jurisdictions. Legislation and implementation are underway for an EU-wide RPS in Europe and a federal-level RPS in the United States.

It is too early to provide an empirical evaluation of the RPS relative to alternative mechanisms. However, the survey reported in here provides

information on the critical considerations in designing an RPS and a general sense of the choices being made by different jurisdictions. A few generalizations can be offered at this early stage in the development of the RPS.

The selection of the RPS target involves a three-way trade-off between environmental improvement, long-term technology strategy, and short-run cost. Jurisdictions that are especially focused on getting the greatest environmental improvement at the least cost will have only one standard for all renewables and may even include technologies that are not renewables. Jurisdictions that are interested in long-term development of advanced renewables technologies will tend to have categories of renewables (and perhaps environmentally desirable technologies that use fossil fuels), ensuring a more diverse mix of renewables and associated clean technologies. Most jurisdictions are concerned with the uncertainty of cost, so cost caps or equivalent mechanisms are common.

In terms of eligibility, most jurisdictions are starting out conservatively, limiting the scope to local renewables, excluding off-grid renewables, and trying to make sure that truly new renewable resources result from the RPS. Geographic application of policies is usually limited to individual electricity jurisdictions. However, with Australia's federal system as an example, there are efforts at the U.S. federal level and the EU level for multi-jurisdictional application. The general tendency is to apply the standard to providers rather than to consumers of electricity. The standard is almost universally applied to energy production rather than to capacity, which is consistent with environmental objectives.

Flexibility mechanisms are widely accepted as desirable. Their implementation is slowed by the administrative complexity that they can entail. Administration of the RPS in the United States and Australia is conducted through a combination of government and delegation to electricity regulators. In Europe, it is more in the domain of government at this point, but various institutional reforms are being undertaken. Thus far, all jurisdictions implementing a RPS have continued with at least some of the other policies that support renewables, whether these be research and development and demonstration projects, tax credits, or subsidized feed-in tariffs. This final point reintroduces the more fundamental concern about how the RPS compares to alternative policies, given the public objectives it was meant to serve. Critiques have argued that the RPS is inevitably flawed because it forces the adoption of particular forms of energy, even though these are but indirect means to an end, such as environmental improvement. In so doing, the RPS may delay or prevent the development and commercialization of technology innovations that would more economically achieve the same objective. If, for example, a key motive for the RPS is to reduce greenhouse gas emissions, a policy focused directly on these emissions—such as a greenhouse gas tax or emission cap and tradable permit system—would open the door to technologies such as the production of hydrogen from coal with capture and permanent storage of all potentially harmful by-products in geological formations. Conceivably, this or other alternatives to renewables could meet all of the public objectives behind the creation of the RPS at a much lower cost, freeing resources for other social objectives.

Advocates of renewable energy have countered that nonrenewable resources such as "clean coal" cannot possibly outperform renewables in providing affordable energy while also satisfying long-term environmental, security, and social objectives. A less exclusionary argument in favor of the RPS is that renewables are likely nonetheless to be part of a future energy mix that might one day also include cleaner fossil fuel and nuclear technologies, but that renewables need special help at this stage to pass critical commercialization thresholds.

In particular, the RPS has several attractive features for driving long-run technological change in renewables. It can provide an incentive that influences the contribution of renewables to new electricity generation investment without changing the costs and economic viability of existing facilities; thus, it produces technological change at a pace consistent with the natural rate of equipment stock turnover and does not force economic obsolescence on existing equipment. For consumer prices, the higher costs of new renewables are blended with the lower costs of existing, conventional generation; price changes are therefore negligible and the likelihood of political acceptability is greater. The RPS ensures that renewables attain critical commercialization thresholds that should enable them to achieve economies of learning and economies of scale, with their costs of producing electricity falling accordingly. If the RPS includes tradable certificates and other flexibility mechanisms, it reduces the policy cost and again increases the likelihood of political acceptability. The RPS can be closely linked to environmental objectives because it provides a higher

level of confidence of the environmental outcome than do price-based policies. The RPS does not require government subsidies, and can even allow a reduced role for government in the policy's administration, because this role is delegated to electricity regulators. Finally, RPS targets can be set and adjusted to ensure that the costs of renewables expansion are not significantly greater than those of alternative means of achieving the slate of policy objectives they are intended to satisfy.

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Further Reading

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