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SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

Ask an Expert

Frequently Asked Questions

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CLEAN ENERGY MINISTERIAL
Advancing Clean Energy Together

Contents

Frequently Asked Questions (FAQs)

What are smart grids, and what are the implications of smart grid development?

Smart grids leverage information and communications technologies to enable electric grids to operate more reliably and efficiently. These development efforts often involve grid upgrades, and leveraging customers to provide grid support services and enable responsive demand. This customer interaction is made possible through information technologies which enable two-way communication between utilities and grid or customer assets. This communication helps utilities to more closely monitor grid conditions, respond more quickly to outages and foster deeper data-driven decision-making.

Two-way communication technologies enable utilities to interact with customers through devices such as smart meters, customer-sited distributed generation assets and other technologies. By leveraging these technologies, utilities could signal to devices in homes or business, distributed generation or other assets to reduce their demand, increase their generation or provide other support services in response to grid conditions. These efforts can result in lower operational costs, increased utilization of existing grid assets, and an improved understanding of network dynamics. Smart grid investments can also enable more seamless integration and utilization of new technologies onto the grid, such as energy storage and advanced inverters.

Once smart grid development occurs, ratepayers can benefit by having a more resilient, adaptable electrical system. In the scenarios described above, customer data would be shared through more platforms than at present, which has raised concerns regarding data security and privacy. A transition to a smart grid necessitates customer education since ratepayers will have choices to interact with their utility. These customer choices may also be reflected in their final energy bill. Rules, regulations and further policies would be needed to support appropriate implementation strategies, and ensure appropriate cost-sharing between utilities and rate bases, where applicable.

See Also

- Clean Energy Solutions Center: Resource Library: Smart Grid
- EPRI: Smart Grid Resource Center
- Clean Energy Ministerial/21st Century Power Partnership: *Status Report on Power System Transformation*

How can renewable portfolio standards encourage energy development? What is a good portfolio?

Renewable portfolio standards (RPS) require states or countries to meet specified targets for renewable integration into the energy sector. If these targets are not mandatory, they are often referred to as renewable goals, as opposed to standards. RPS are often expressed in terms of a target percentage of renewable and alternative generation's contribution to the energy sector. As of early 2015, RPS were in place in 26 countries at the national level and in 72 states/provinces. In example, California's goal is 33% of the state's electricity consumption from renewable generation by 2020. These targets can be broken down further with targets for each specific technologies and balancing large and small scale projects.

There are a number of methods to enforce these goals and the traditional compliance mechanism is the tradable renewable energy certificate (REC). Many RPS place requirements on distribution utilities while other states centrally procure generation to ensure targets are met. RPS tend to be most successful when paired with a production-based incentive, such as a tax credit, renewable energy credits or long-term power contracts.

Policymakers and regulators should consider their existing energy resources, and future opportunities to determine the appropriate targets for renewable generation. Early RPS favored only the least-expensive renewable technologies, while more recent RPS have specific technology carve-outs to create a more diverse portfolio of renewables. Portfolio composition and qualifying technologies can vary significantly based on local context and policy goals.

See Also

- Clean Energy Solutions Center: Renewable Electricity Standards: Good Practices and Design Considerations
- Clean Energy Solutions Center: Resource Library: Energy Standards
- NREL: *Renewable Portfolio Standards, Resource and Technical Assistance*
- REN21: *Renewables 2015 Global Status Report.*

What are the current regulations in the United States for renewable technologies?

There are limited federal regulations specific to renewable technologies. Wholesale markets are regulated by the Federal Energy Regulatory Commission (FERC), while retail rates are regulated by each individual state. Regulations regarding renewable energy varies vary from state to state. The federal government's final Clean Power Plan sets emission rate reduction targets for each state to meet by 2030. States have flexibility in complying with these plans, which may or may not include renewable generation. The federal government will be providing incentives to encourage early-compliance through renewable and efficiency projects.

Customer-sited renewable generation is supported by net metering in most states, which allows generation above a facility's load to be sold back to utilities. The price of this compensation and facility requirements vary from state to state. Renewable projects 80MW or smaller developed by the private-sector can sell power to utilities as independent power producers in any state and utilities must purchase this power at "avoided cost." This process has been enabled since 1978 under the Public Utilities Regulatory Policy Act (PURPA), Section 210. Utilities can also develop renewable projects independently.

Incentives for renewables also vary from state to state, though local tax credits, debt financing, and performance-based incentives are common. Federal incentives include an investment tax credit for qualifying renewable projects (some of which expire or step-down at the end of 2016). The U.S. has had a production-based tax credit for the first 10 years of operation for wind, geothermal and some bioenergy products, but this incentive expired for projects completed at the end of 2014.

See Also

- PURPA Text
- U.S. Environmental Protection Agency: Final Clean Power Plan Rule
- North Carolina Clean Technology Center: Database of State Incentives for Renewables and Efficiency (DSIRE).

What is the role of demand-side management in energy efficiency? What is the role of regulators in demand-side management?

Demand-side management encourages utility customers to reduce their electricity consumption. This can be completed through volume-based reductions (energy efficiency) or shifting energy usage off-peak times to relieve load on the grid (demand response). FERC order 745 sets out the rules for compensation for demand-side management for wholesale markets (however, this order is currently being challenges and the case is before the US Supreme Court).

Regulators can encourage demand-side management programs through a number of avenues. Energy efficiency resource standards create targets to achieve electricity use reductions by a specific year. This is analogous to renewable portfolio standard for electricity. Regulated utilities can also be encouraged to pursue energy efficiency by decoupling profits from the volume of energy consumed. Otherwise, utilities would have limited incentive to develop programs for their customers to reduce energy consumption, since the usage growth would lead to hire returns.

In some cases, demand response programs and energy efficiency are considered differently in policies. This is because while demand response shift loads, it does not necessarily yield an energy use reduction. However, demand response programs can lead to reduce costs. Regulators and policymakers should consider the relationship between demand side management options in their planning.

See Also

- Energy Information Administration, Demand Side Management Overview and Statistics:
    - Demand-side Management Program
    - Electric Utility Demand Side Management: Archive.

How can energy storage help?

Grid operators have to balance electricity demand and supply. Traditionally, electricity must be distributed and consumed once it is generated. Regulators and system operators must have control over generation resources to ensure supply and demand is balanced. Intermittent generators, such as renewables, can add complexity at high penetrations. Storage can help balance supply and demand by storing generation for consumption at times of need. This time delay can provide peak demand management support, and enable existing generation to be used more cost-effectively. When storage is paired with renewables, it can enable renewable energy generated during off-peak hours to be leveraged during on-peak times. If storage system is sized appropriately, the renewable resource can become a dispatchable resource akin to traditional generation.
There are many different storage technologies available which differ in length of time they can store energy, as well as the amount and type of energy they can store. These technologies include batteries, thermal storage, flywheels, compressed air storage and mature technologies such as pumped storage. These technologies can be distributed or applied by utilities to support their transmission and distribution assets.

Storage also has the ability to provide a number of other grid support services, in addition to helping balance supply and demand. In some markets in Europe and the United States, distributed battery storage is compensated by regulators for providing grid support services such as voltage control, frequency regulation and demand response. Regulators will have to consider the role of storage in energy markets, and establish rules to determine storage's eligibility to participate in grid support programs.

See Also

- Clean Energy Solutions Center: Resource Library: Energy Storage

What are key components of an effective green building rating and appliance labeling program?

At present there are dozens of third-party rating programs for both buildings and products. According to the International Standards Organization (ISO), certification labels can either indicate that requirements have been met for one or more environmental attributes. Many labeling schemes are Type I (ISO 14024) or Type II (ISO 14021) labels, which certify that labels meet requirements for single or multiple environmental attributes, respectively. Type III (14025) labels signify more comprehensive requirements and disclosures for products. These classifications can help distinguish between the many third-party offerings on the market.

According to the US Green Building Council, "green" buildings command higher rents, have lower operating costs and improve occupant health. Green buildings can be labeled or certified under a number of different international standards. These standards can be single or multi-attribute. In example, the U.S. ENERGYSTAR program for buildings and appliances has high brand recognition. The designation can be traced to high performance on an energy usage benchmark against peer buildings or products. The program is focused on a single attribute – energy. In contrast, the LEED and Green Globes standards consider several different attributes, including waste, water, and energy and occupant health when applied to a building. Each category has a series of measurable tasks which can be completed to apply towards building certification. In order for the certification to be maintained, building performance must be verified over a series of years. The green building rating programs with the highest impact must have a measurable and repeatable verification process for building certification or ranking.

Similar to buildings, appliances or products can also have single or multi-attribute labels. In example, the WaterSense label, is used to apply to products which use 20% less water than comparable products, and was created in partnership with the U.S. Environmental Protection Agency. In contrast, the international Green Seal label for products measures life cycle impacts across a number of environmental categories. These labels are most effective when there is clear brand recognition by the general public. In example, the ENERGYSTAR label for appliances was recognized by 89% of U.S. households as signaling more energy efficient products. This was achieved through years of marketing and outreach by the U.S. government and key stakeholders. Consumer outreach would need to be paired with any appliance or product labeling policy for successful adoption, especially given the variety of labels available at present.

If a government is considering requiring buildings or appliances to comply with a particular standard, it should choose labeling programs which are aligned with policy objectives. Many of the most successful labeling programs tend to have similar attributes. These programs provide transparency on their requirements and standards, are objective, have repeatable labeling methodologies which can be scientifically applied to target buildings or products, and are progressive pushing the industry beyond existing codes and standards.

See Also

- Clean Energy Solutions Center: Building Energy Codes: Policy Overview and Good Practices
- Clean Energy Solutions Center: Resource Library: Buildings
- Clean Energy Solutions Center: Resource Library: Appliance and Equipment Standards and Required Labeling
- National Institute of Building Sciences: Green Building Standards and Certification Systems
- Consortium for Energy Efficiency: *National Awareness of ENERGYSTAR for 2014* (registration required)
- U.S. Green Building Council: Green Building Facts (with primary sources).

What are current regulations in the United States for various energy efficiency practices?

Energy efficiency is supported in the United States by a number of different policies. Akin to renewable energy policy, states have jurisdiction over the development of their own energy efficiency support policies. Nationally, the Clean Power Plan encourages the use of energy efficiency as a strategy to achieve carbon emissions reductions, but it does not prescribe a particular policy for states to follow. Given these local nuances, this overview remains broad, noting that there are many variants across the regions of the United States.

To encourage energy efficiency among utility ratepayers, many states have developed mandatory targets for energy efficiency equivalent to a percentage of energy saved of electricity sales. The binding targets can increase over time, are measured and verified, and are typically placed on utilities, analogous to renewable portfolio standards. In response to these requirements, utilities often develop different types of incentive programs for residential, commercial and industrial customers to encourage the installation of efficient technologies such as LED light bulbs, and in some cases directly encourage conservation or peak load management. In exchange, utilities sometimes receive performance payments for achieving efficiency targets. Customer rates can also be used to encourage energy conservation. In example, utilities in California have used an increasing block rate structure, where high energy users are charged at a higher per kWh rate for usage.

U.S. states and local jurisdictions also adopt building codes and standards to encourage energy efficient building stock. Control over codes and standards varies from state to state – in some cases municipalities have direct control over their own codes, while in other cases it is a state responsibility. Some locales have approved stretch energy codes, which require buildings to perform above reference standards such as the IEC 2012. In Massachusetts, a majority of municipalities have opted into this more stringent version of the energy code.

Jurisdictions also have the option of encouraging or requiring the construction of buildings or major renovations to be in line with international standards such as LEED or Green Globes. These actions can be encouraged by development incentives (i.e. density bonuses) or monetary incentives. In 2005, New York City became one of the first U.S. cities to develop green building requirements under Local Law 86. It required that new construction or major renovations receiving city funding meet LEED requirements. The law has continued to evolve with the progression of the green building industry.

An emerging policy practice for energy efficiency are benchmarking and disclosure ordinances. These local policies require building energy usage data to be disclosed annually to the general public. The information can be used by the public, and in some cases buildings are encouraged to improve their energy performance by completing a number of compliance actions. The goal of these policies is that measurement and building-level comparisons will encourage property owners to invest in energy audits of their property in addition to technology investments.

See Also

- Clean Energy Solutions Center: Resource Library: Energy Efficiency

How do we engage venture capitalists and private investment in renewable energy R&D projects?

Research and development (R&D) projects are typically considered high risk, high return investments. In order to suitably manage risk associated with R&D, successful investors require deep technical knowledge, experience leading new tech-based ventures, and/or a clear strategic interest in the specific technology. Outside of the government, typical R&D investors include angels, venture capital, and corporate (strategic) investors.

- **Angel investors** are wealthy individuals who invest in entrepreneurial ventures. They are usually found among an entrepreneur's friends and family and provide seed money to launch the company or maintain it during difficult times.
- **Venture capitalists** pool funds from wealthy investors, investment banks or other financial institutions (e.g. pension funds) to invest in emerging cCorporate investorslack of venture capital for early-stage R&D-based cleantech projects in recent years. Instead, VC has preferred to make investments in later stage and downstream cleantech companies, such as those engaged in innovative financing or web-based activities.
- **Corporate investors** will typically invest in R&D projects via strategic partnerships with universities, private labs, or other technology companies. This affords corporates access to new intellectual property (IP) and improves the competitiveness of their products in the marketplace. It affords their partners access to corporate funding, equipment, or expertise.

Regulators and policymakers can successfully engage these investors – and support R&D projects – by creating opportunities for them to enter the market. In particular, they may focus on streamlining regulatory processes to encourage utilities and end-users to test, demonstrate and deploy innovative, new projects. The path to demonstrate new technologies and to acquire first customers can be challenging, particularly in cleantech. This is especially the case in the power sector, which has historically been a conservative, risk-averse sector that is not well-suited to integrate new and potentially disruptive technologies.

Specific examples may include streamlining permitting and interconnection processes for new technologies. Regulators may also develop real-world test-beds, where new R&D projects can be safely tested on the grid. They may consider, for example, developing a regulatory framework for R&D projects that encourages utilities to deploy new technologies on a limited basis, thus enabling new technology companies to gain valuable data to establish a performance track record and demonstrate their potential value in the marketplace.

See Also

- PwC: *Cleantech MoneyTree Report: Q1 2015*
- Greentech Media: *Cleantech Venture Capital: Why Are These Investors Smiling?*

What bond mechanisms have proven successful in financing RE projects?

The green bond market is large and growing. In 2014, for example, it is estimated that $16.6 billion worth of green bonds were issued. Notably, not all of these were used to finance clean energy projects. Green bonds can encompass a wide range of activities, including clean energy, sustainable waste management, sustainable land use, biodiversity conservation, clean transportation, or clean water projects.

Nonetheless, in recent years, the green bond market has financed hundreds of millions of dollars worth of energy efficiency and renewable energy projects. This encompasses a number of different bond mechanisms, including (1) corporate bonds, (2) asset backed securities, (3) government bonds, (4) project bonds.

Corporate bonds are issued by corporations to finance renewable energy and energy efficiency projects via loans and credit lines to industry participants. Corporate bonds are used to fund clean energy activities, though repayment comes from general corporate funds – not from the project itself. As a result, corporate bonds carry the same rating as other bonds of similar composition from the same issuer. In the U.S., Bank of America kicked off the corporate green bond space in November 2013 with a $500 million issuance to fund renewable energy and energy efficiency projects. In October of 2015, the French energy company EDF issued a $1.25 billion dollar bond to support wind, solar and biogas projects in France, Canada and the US.

Asset backed securities (ABS) are a type of securitization, wherein bond notes are backed by cash flows from underlying receivables such as loans, leases or power purchase agreements (PPAs). Approximately $2.08 billion in green bonds were issued between 2013, when the green ABS market kicked off, and mid 2014. This issuance was spread across five deals, including SolarCity's $54.4 million solar-backed deal; the Western Riverside Council of Government's securitization of a property assessed clean energy (PACE) loans; and Hannon Armstrong Sustainable Infrastructure's $100 million deal backed by a range of solar, wind, and energy efficiency projects across the US. The pace has accelerated in 2015, with some auto companies increasing funding to finance EVs and hybrids. Toyota issued $1.25 billion in bonds to support leasing and loans for low-emission vehicles.

Project bonds are backed by cash flows from one or more large renewable energy projects held in a trust vehicle (i.e. a special purpose vehicle or SPV) which separates the assets from the sponsoring company. In 2013, over $3.1 billion in clean energy deals were financed using project bonds. Approximately $1 billion of this was from the 580 MW Solar Star PV project owned by Berkshire Hathaway Energy. The remainder came from solar, wind and offshore wind transmission projects in the United Kingdom, the US, Canada, and South Africa.

Government bonds are issued by federal, state, or local government agencies to finance renewable energy projects. Within the U.S., the federal government has historically authorized funding for clean renewable energy bonds (CREBs) and qualified energy conservation bond (QECB), which provide the bond holder a direct subsidy or tax incentives in lieu of a portion of the traditional bond interest. In recent years, environmentally oriented municipal bonds in the US have hovered around $230 million per year in new issuance, financed primarily as federal tax credit bonds including CREBs and QECBs.

In addition, a number of states are issuing their own green bonds. For example, New York, Washington DC, and Massachusetts issued a range of green bonds in 2014, which are on track to exceed $910 million (exclusive of any CREBs or QCEBs).

See Also

- Clean Energy Finance Solutions Center: Instrument Summary: Asset-Backed Securities
- Clean Energy Finance Solutions Center: Instrument Summary: Bonds
- Brookings-Rockefeller: *Clean Energy Finance Through the Bond Market*
- Clean Energy Group: *What Investors Want: How to Scale Up Demand for US Clean Energy and Green Bonds*
- Bloomberg New Energy Finance: *Green Bonds Market Outlook 2014*
- Climate Bonds Initiative: *Bonds and Climate Change: The State of the Market in 2015.*

If the government decides to use power purchase agreements as a tool to obtain renewable energy, what are the features of PPAs that must be monitored by regulators, and the steps that should be taken to promote transparency and cost-effectiveness?

Power purchase agreements (PPAs)s are a valuable tool to finance and promote renewable energy sources. Even though PPAs are bilateral contracts between utilities and independent power producers (IPPs)s, regulators can play an important role in promoting transparency and setting the standards and guidelines applicable to these types of agreements. This includes (1) deciding what technologies are eligible, (2) determining the price parameters of the agreements, (3) developing a standard or model PPA contract, (4) providing licenses to operate, (5) setting the terms or interconnection, (6) providing a dispute resolution framework, and (7) making sure that the agreements are "prudent," or "reasonable" to ratepayers or taxpayers. Any role that regulators play should be monitored over time and amended to reflect current market and policy environments.

Often PPA contracts applied to renewable energy are not least-cost in terms of monetary outlays, but could be based on other economic considerations including: (1) supporting less mature technologies that may benefit from scale economies or innovations, (2) encouraging diversity in the generation mix (reducing risk of excessive dependence on a particular technology or input), (3) creating local jobs related to fabrication, installation, operation, and maintenance of renewable energy technologies.

Regulators should track their policies and roles that affect (1) legal infrastructure (including tax treatment of cash flows), (2) any solicitation for bids (and the importance of competition), (3) power sales enhancements (like renewable set-asides or net metering), and (4) tariff design (tariff floors, capacity tariffs, or renewable premiums).

Data from all PPAs should be collected and monitored, including: load factor, capacity factor, availability factor, fuel consumption – for waste or biomass, forced outages, planned outages, O&M costs/kWh, power quality, tariff amount, and expected return on investment.

IPPs will want some of this data to remain proprietary, but as much benchmarking and metrics data should be made availabl e to the public.

See Also

- National Regulatory Research Institute: *When Renewable Energy Policy Objectives Conflict: A Guide for Policymaker*

What are best practices regarding net metering and net-billing policy design?

Net metering and net-billing policies are designed to compensate small to medium sized (generally 2 MW or smaller) distributed renewable energy generators by allowing them to offset some or all of the transmission and distribution charges in addition to being compensated for the supply of energy. For the purposes of this answer, best practices are defined as those that are most effective at encouraging distributed renewable energy generation, compensating these resources in a fair and reasonable way.

Policy decisions that need to be made regarding net metering or net billing are:

- What technologies are eligible?
- How to compensate for excess generation?
  - Retail rate?
  - Avoided cost?
  - Supply, transmission, and distribution?
- Do excess credits roll over?
  - Monthly?
  - Yearly?
  - Indefinitely?
- Are there programmatic limits and caps?
  - Size of individual systems?
  - Aggregate capacity limit for the entire program?
- Who owns the renewable energy certificates (if applicable)?
  - Utility?
  - Customer?
- What utilities apply?
  - Investor owned utilities only?
  - All utilities?
- Can the customer apply credits to other meters either on-site or within the utility's service territory?

Key best practices follow below:

- Do not apply any additional fixed-charges to net metering customers.
- Value credits at the full retail rate.
- Require all utilities to offer net metering.
- Do not provide an aggregate programmatic limit.
- Value excess generation the same as generation used on-site.
- Carry over any excess generation indefinitely.
- The customer retains the RECs.
- Allow for meter aggregation and transfer of credits.

See Also

- Clean Energy Finance Solutions Center: Instrument Summary: Net Metering and Net Billing
- Clean Energy Solutions Center: Resource Library: Net Metering and Interconnection
- National Renewable Energy Laboratory: *Status of Net Metering: Assessing the Potential to Reach Program Caps*

What are the basic principles of network regulation?

The regulatory design decisions that guide the formation and operation of electricity networks (including both the transmission and distribution portions of the electric grid) have a substantial impact on the performance of these networks and the distribution of costs and benefits across grid users. While the practice of network regulation is incredibly varied and constantly in evolution, certain principles have emerged in the way that these networks are regulated and in the way that network owners and operators are remunerated for their incurred costs, which are discussed below.

Transmission

The planning process and ownership structure of transmission networks can vary slightly. Depending on the national context, the transmission network may be (1) centrally planned directly by regulatory authorities, (2) managed by a designated system owner who is remunerated though regulated and likely incentive-based charges, (3) primarily user-driven, with coalitions of grid users proposing expansions, with a regulatory authority determining the allocation of costs, or (4) primarily market-driven, with investors reacting to variable pricing or underserved markets to develop new transmission capacity.

Regardless of the ownership structure, several remuneration principles exist:

1. Transmission service and expansion *costs should be allocated in proportion to the benefits* that various grid users receive, in most cases with a regulatory authority overseeing this allocation .
2. *Transmission charges should not be based on power contracts.* That is, regardless of who a generator or load aggregator contracts with, their transmission charges should be determined by their grid location rather than that of their contractual counterparty.
3. *Transmission charges should be pre-determined and long-term,* so as to provide adequate information to grid agents regarding the costs of investment decisions.
4. *Careful thought should be given to the format of transmission charges,* that is, whether they will be enforced on a flat sum, $/kWh, or $/kW basis. While a $/kWh

charge is attractive for simplicity, transmission charges in that format have been criticized for distorting short-term market price signals.

Finally, it is critical that regulators ensure non-discriminatory access to the transmission grid, to both generators and users. The degree of open access granted to a network depends on the degree of market reform that a particular electricity system has undergone, but in cases where qualified independent actors are able to connect to transmission grid, they should be able to do so without discrimination or favor.

Distribution

Distribution networks are typically managed by a designated monopoly organization. Depending on the jurisdiction, the distribution network operator may or may not also have a monopoly on energy sales to customers in their network (in areas where these responsibilities have been separated, it is imperative that independent power suppliers be granted non-discriminatory distribution network access). In either instance, customer charges that relate to the costs of generation are typically treated separately from those that related to the transmission and distribution of power.

Distribution charges should reflect the costs associated with providing customers with electric service. They are typically structured to have a flat initial connection charge, a flat customer charge to recover fixed operating costs, and a use-of-system charge. The structure of the use-of-system cost has important ramifications, as it sends signals to customers about whether to pursue energy efficiency or distributed generation. Some or all of this charge is recovered on a $/kWh basis, and a utility may charge some or all customers based on their peak kW consumption as well.

As advanced metering technology has become more common, utilities have been able to implement more comprehensive means of structuring customer charges which more accurately reflect the costs of service and which may be used to incentivize conservation on the part of customers.

Remuneration Structure

For both transmission and distribution network operators, regulators are faced with a question of how to structure the amount of revenue that utilities may collect. Previously, most jurisdictions utilized cost-of-service regulation, effectively allowing utilities to collect enough revenue from customers to offset their costs and earn a designated amount of return. A number of jurisdictions have moved away from cost-of-service regulation towards incentive-based remuneration structures due to a concern that cost-of-service rewards over-investment and penalizes efficiency. These new remuneration structures—with the United Kingdom's RPI-X and RIIO structures providing the most notable examples—allow network operators to earn a greater return if they are able to reduce costs while maintaining quality or otherwise achieve pre-determined incentives of various kinds. While more complicated to implement and regulate than cost-of-service regulation, incentive-based structures are increasingly popular for their ability to reduce operating costs and encourage innovation on the part of network operators.

See Also

- Ignacio J. Pérez-Arriaga, ed.: *Regulation of the Power Sector*
- MIT Energy Initiative: *Future of the Electric Grid*
- Lazar and Gonzalez, Regulatory Assistance Project: *Smart Rate Design for a Smart Future.*

How can we design and implement an effective energy efficiency program?

Utilities and regulators have increasingly turned to energy efficiency in recent years to address provide a cost-effective means of solving capacity and grid management concerns while also achieving environmental goals. In doing so, a set of industry practices have been established to guide the design and implementation of future programs. Utilities and regulators interested in designing efficiency should consider the following:

How does energy efficiency fit into utility forecasts?

Utilities and regulators should look to their resource planning process to understand what their future power constraints will look like, and what sort of benefit (typically in terms of avoided energy costs or capacity additions) a reduction in energy demand would provide. Understanding the value of efficiency to utilities and ratepayers is an important first step.

What is the market and the potential?

A first step in designing an efficiency program is to complete a potential study, which looks at the building stock, installed equipment, and customer population within a utility's jurisdiction. Potential studies typically consider in turn the technical potential (the total amount of energy efficiency that could be achieved if all possible efficiency improvements were made), the economic potential (the subset of the technical potential that could be achieved cost-effectively), and the achievable potential (the subset of economic potential that would realistically be achieved through a utility program once market barriers are taken into account). Understanding the achievable potential of energy efficiency, and the relative potential of different types of efficiency improvements, informs utility program planning.

How should incentives be structured?

Utilities should consider the variety of cost-effective measures that they wish to incentivize, and based on the upfront cost of the measure and the long-term value of the savings they provide should establish an incentive level that is appropriate for each measure. Utilities can adapt their incentive structures to favor certain technologies if they wish. Many utilities have offered particularly high incentives (some up to 100% of cost) for

home insulation measures, for example, due to the large impact
and long duration of these measures.

How do we implement a program?

Utilities should devise an implementation plan that is appropriate for each measure. It is rare that measures can be implemented effectively with only mail-in rebates, utilities must instead put the program infrastructure in place to support programs. Programs that target large HVAC equipment or commercial installations often require networks of trade allies, who work with utilities to implement the programs effectively. Simple measures like residential lighting can be achieved without involving end-use customers at all, but instead by providing "upstream" incentives to lighting retailors to buy down the shelf price of efficient products. Many utilities also offer free home or business energy audits or "energy savings kits" which include small but relatively high-impact measures such as faucet aerators and low-flow showerheads, which are used to engage customers and promote other efficiency opportunities as well. Many utility programs, particularly those that target energy savings in low-income populations, rely on community partnerships to promote and implement these measures. Utilities also frequently turn to groups that specializing behavioral marketing to encourage and track non-measure-specific energy savings. Understanding the variety of outreach methods and the tools best utilized for promoting each kind of efficiency program are crucial for a utility to have an effective efficiency program.

How do we know how we are doing?

A best practice in the efficiency sector is to conduct an annual evaluation of all energy efficiency programs. One portion of this is an impact analysis, which measures the total energy savings achieved through a program (and often attempts to tease out the portion of program savings that were truly induced by the program incentive from the "free-rider" savings that likely would have occurred anyways) and which typically includes a cost-benefit analysis to understand the financial impacts of the program on participants, the utility, and non-participating ratepayers. Utilities will often also conduct a process evaluation, which is a more qualitative audit stakeholder's opinions of and satisfaction with the program as well as of the utility's internal operations. Efficiency program planning is a process of continuous refinement and improvement, and the results of these evaluations should inform the program planning process moving forward.

How do I encourage utilities to pursue efficiency?

Regulators can encourage utilities to dedicate themselves to efficiency using different types of incentives. First, a number of regulatory jurisdictions have implemented revenue decoupling for utilities. This separates the amount of energy that a utility sells from the utility's profit. Instead, a reasonable amount of profit is predetermined by the regulator and utility, and the utility is allowed to periodically adjust its rates as consumption increases or decreases in order to ensure that it recovers that amount. Revenue decoupling removes a power disincentive that keeps utilities from supporting efficiency for fear of lowering their sales and thereby eroding their profits. Secondly, many jurisdictions have implemented energy efficiency resource standards which, in a manner similar to Renewable Portfolio Standards, require utilities to achieve a certain level of efficiency savings in a given timeframe. The more effective standards include both a penalty for utilities that fall short of their targets as well as an incentive that rewards utilities that are able to satisfy their requirements while also meeting certain cost-effectiveness thresholds. For regulators, creating a system which directly encourages utilities to pursue energy efficiency is a critical step in meeting energy efficiency targets.

See Also

- Clean Energy Solutions Center: Resource Library: Energy Efficiency
- U.S. Environmental Protection Agency: National Action Plan for Energy Efficiency
- ACEEE: *Integrating Energy Efficiency into Utility Load Forecasts*
- ACEEE: *Cracking the TEAPOT: Technical, Economic, and Achievable Potential Studies*
- SEEAction: *Energy Efficiency Program Impact Evaluation Guide*
- Alliance to Save Energy: Utility Rate Decoupling

What are current best practices when it comes to feed-in-tariff (FIT) policy design?

At the beginning of 2015, feed-in tariffs were in place in 73 countries around the world, and were the most predominant national-level incentive globally. FITs were first enacted in Europe in the 1980s and have since evolved to encompass many different policy designs as they have diffused internationally and changed over time.

FITs typically guarantee renewable generators specified performance-based cash payments ($/kWh) that are set by regulators, rather than through competition. Beyond establishing payment levels, FIT policies may also include rules related to:

- **Interconnection.** FIT regulations can include interconnection guarantees, streamlined or priority interconnection rules, and/or special rules for how interconnection costs are allocated and recovered.
- **Transmission rules.** Utilities may be required to give priority to renewable electricity on the transmission systems.
- **Electricity transactions.** FIT policies may require that utilities (or other entities) purchase renewable electricity.
- **Contractual and administrative rules.** These include rules regarding the term of the contract, the extent to which the contract must be simplified and standardized, and/or the contract currency, etc.

FIT best practices will vary based on the objectives that policymakers are attempting to accomplish. A FIT that is attempting to encourage energy access, for example, will likely require a different design from a FIT that is attempting to diversify the national portfolio.

FIT best practices have historically been associated with policy designs that increase investor confidence and unlock rapid a market growth across a portfolio of technologies. Such best practices include, for example: payments calculated to provide specific technologies with reasonable returns, long-term contracts available on a standard offer basis, and rules guaranteeing interconnection, dispatch, and power purchase. These fundamental best practices for attracting investment remain largely unchanged.

Although best practices such as these continue to serve as a useful benchmark, countries are introducing a range of innovations in response to specific national objectives and changing market conditions.

- **Payment adjustments.** In many countries, FIT payment levels have been steadily reduced in response to declining renewable energy costs (e.g. solar PV). These reductions have been made using automatic adjustments and/or periodic review. The choice of adjustment approach may depend on factors such as, e.g. administrative capacity in the case of detailed reviews or global market power in the case of automatic adjustments.
- **Parallel policies.** Some countries are now deploying FITs in parallel with other policy types in order to achieve different policy goals. Countries such as France and Taiwan, for example, are using FITs to support smaller scale renewable energy systems and competitive bidding to support larger-scale systems.
- **Revised rate setting.** Historically, FIT payments were often set as an incentive above retail or wholesale energy prices. In jurisdictions with high energy prices (e.g. island jurisdictions), and/or low renewable energy costs, some policymakers are pegging FIT payments to, for example, the avoided cost of conventional generation or the energy, environmental, and societal value created by renewables. This rate setting approach represents a departure from the cost-based rate setting that prevailed in the 2000s.

See Also

- Clean Energy Solutions Center: Policy Brief: Feed-in Tariffs: Good Practices and Design Considerations
- Clean Energy Solutions Center: Resource Library: Feed-in Tariffs
- Clean Energy Solutions Center: Instrument Summary: Feed-In Tariffs
- UNEP: *Feed-in tariffs as a Policy Instrument for Promoting Renewable Energies and Green Economies in Developing Countries* (PDF
- Clean Energy Solutions Center: *The Next Generation of Renewable Electricity Policy: How Rapid Change is Breaking Down Conventional Policy Categories*
- NREL: *A Policymaker's Guide to Feed-in Tariff Design*
- Deutsche Bank Climate Change Advisors, Paying for Renwable Energy: *TLC at the Right Price – Achieving Scale through Efficient Policy Design.*

What is the best choice of regulatory instruments/tools for renewable energy promotion based on efficiency and effectiveness of reaching policy targets (FIT versus Green Certificates versus Central Procurement and others)?

There has been vigorous debate during the past several decades about the inherent efficiency and effectiveness of different policy mechanisms for reaching renewable energy targets. In Europe, for example, policymakers argued about the merits of competitive bidding and feed-in tariffs in the late 1990s before migrating to a debate between feed-in tariffs and credit trading in the mid-2000s. Although these debates have been well-documented and oft-repeated, they are of diminishing relevance to international policymakers because policy definitions are increasingly fluid and the distinctions between "traditional" labels have become blurred as policymakers have introduced new innovations. Instead of revisiting broad arguments about policy type, it can be more helpful to focus on specific policy design issues and considerations. At the core of the efficiency and effectiveness debate, for example, is the issue of how payment levels are set: administratively, through competitive bidding, or through short-term trading:

- **Administrative rate setting.** Regulators, or other authorized entities, calculate and specify the rate for a class of generators based the cost of generation or other benchmark values (e.g. the avoided cost of conventional power, etc.). Administrative rate setting is typically associated with feed-in tariffs, but is also utilized for, e.g. tax credits, rebates, etc.
- **Competitive rate setting.** Generators are invited to submit bids to supply electricity (and/or other commodities). The winning bids are typically selected based on a price criteria (e.g., the lowest price bid or all bids lower than a ceiling price), although other non-price criteria may be factored into selection. Auctions are a type of competitive rate setting structure.
- **Short-term trading.** The payment level is set in a short-term or spot market, as determined by the balance of supply and demand under a policy target. Short term trading was initially used to set the price for renewable energy credits under renewable portfolio standard policies in the US starting in the late 1990s.

The primary tradeoffs between these payment setting approaches relate to investor security and policy access.

- **Investor security.** Policies that provide a long-term, certain revenue streams can lower investor risk and lower the cost of capital. Polices that expose investors to revenue uncertainty can raise the cost of capital and increase overall policy cost. Administrative rate setting and competitive rate setting approaches typically provide longer-term price certainty than short-term credit trading and are therefore considered to be lower risk, lower cost, and more efficient.
- **Policy access.** Administrative rate setting approaches typically make payments available to generators on a standard offer, or "first come, first served," basis. Competitive rate setting and short-term trading, on the other hand, may require higher transaction costs in order to participate. As a result, it has been argued that administrative rate setting approaches allow for a broader and more inclusive range of market participants, whereas competitive and short-term trading approaches encourage a narrower field of more sophisticated developers.

There are other arguments that have been made to support different policy types, but these design considerations tend not to be policy specific. Competitive bidding has been criticized for creating markets that boom and bust, whereas feed-in tariffs have helped countries achieve significant market scale-up. Similarly, it has been argued that feed-in tariffs, competitive bidding, and short-term trading each have the highest (or lowest) policy costs. These observations are more a function of policy design in specific countries than of inherent policy traits. The frequency of competitive bidding rounds, for example, can be increased to sustain market momentum, whereas feed-in tariffs have created boom and bust cycles in many markets when they have been capped. The policy cost of each approach can also be mitigated (or exacerbated) through a range of different design choices. Rather than attempting to unravel the often confusing debates that focus on broad policy labels, policymakers may find it more useful to benchmark individual policy design decisions against well-articulated objectives and priorities.

See Also

- Clean Energy Finance Solutions Center: Instrument Summary: Tradable Renewable Energy Certificates

- UNEP: *Feed-in Tariffs as a Policy Instrument for Promoting Renewable Energies and Green Economies in Developing Countries*
- Clean Energy Solutions Center: *The Next Generation of Renewable Electricity Policy: How Rapid Change is Breaking down Conventional Policy Categories.*

What is the role of off-grid DG in increasing energy access? How can we encourage private investment?

An estimated 1.2 billion people do not have access to modern energy services including electricity and lighting, globally. Access to affordable, modern forms of electricity is essential for spurring social and economic development and meeting key development goals associated with income generation, health, education, gender equality and environmental protection, among others. Approximately 95% of individuals who live without electricity live in Sub-Saharan Africa and developing Asia, with 84% concentrated in rural areas. For populations living in rural areas, off-grid distributed generation is often the most economical solution for providing access to modern energy services as extending the electric grid to sparsely populated rural areas can be costly.

Off-grid distributed generation can provide a range of energy services: An individual's basic lighting and charging needs through solar powered lanterns and cell phone chargers; household lighting, electricity or heating needs through solar home energy systems; and community or business energy needs through renewable energy (solar, wind, hydropower, biomass) or conventionally powered (diesel) or hybrid (renewable energy and dieseil) mini-grids.

According to the IEA, it is estimated that nearly $1 trillion ($979 billion) is required to achieve universal access to energy by 2030, with an average cost of $49 billion per year (from 2011-2030). Meeting this financial need will require participation and partnership between the public and private sector. The private sector has a key role to play in helping to achieve universal energy access by providing its ingenuity, business model innovation, supply chains and much needed capital. Fortunately, the private sector recognizes the huge market opportunity that un-electrified and under-electrified populations present. The majority of the un-electrified population is part of the close to 4 billion people making up "base of the pyramid"(BoP) market with 80%of the population living on incomes of less than US$ 3 per day. However, even with low incomes, the BOP segment has major market power with an estimated US$37 billion per year being spent to meet basic energy needs.

Despite this burgeoning multi-billion dollar industry, it can still be difficult to attract private sector investment at the scale required into the off-grid energy access market. Many private sector actors still find it difficult to overcome existing barriers including high upfront investment costs and risks, lack of information about market opportunity, market fragmentation, limited availability of proven and innovative business models, lack of familiarity or experience in new markets, and high expectations for short-term returns.

The public sector can help ensure an effective enabling policy environment to support investment in energy access by undertaking:

- Transparent planning and coordination on electrification planning including on and off-grid plans.
- Designing and implementing effective regulations and business enabling policies that support large and small to medium sized enterprises and domestic financial institutions; permitting and designing effective business-enabling mechanisms such as power purchase agreements, concession contracts and schemes, grants and subsidies, concessional loans and risk mitigation instruments; and facilitating reliable access to mobile services and business model flexibility to support , pay as you go services, lease schemes, and community partnerships, etc.
- Strengthening the capacity of financial institutions, business owners and communities to better understand the benefits and lessen the risk perception associated with off-grid renewable energy technologies.

The private sector and public sector can also work together to develop cross-sector collaborations that build off the strengths and weaknesses of both sectors to address many of the current market barriers. According to a recent study by the World Economic forum and PWC, an effective framework for cross-sector collaboration includes to following elements:

- Bringing together private sector companies (with operations of significant size, and multi-country presence) with local partners to ensure investment power is combined with local market knowledge and BoP-ready solutions
- Aligning interests and competencies of different private sector partners to leverage synergies
- Building on an anchor load demand as a primary market for energy and securing energy beneficiary co-investment in the business model

- Focusing on decentralized, renewable or hybrid solutions which provide adequate levels of energy for productive energy use
- Providing a scalable and replicable base for business models for country-wide and global impact.

See Also

- IEA: World Energy Outlook 2012: *Measuring Progress Towards Energy for All: Power to the People?*
- World Economic Forum: *Scaling Up Energy Access through Cross-sector Partnerships*
- Clean Energy Solutions Center: *Policies to Spur Energy Access: Volume 1. Engaging the Private Sector in Expanding Energy Access to Electricity*
- Clean Energy Solutions Center: *Policies to Spur Energy Access: Volume 2. Case Studies of Public-Private Models to Finance Decentralized Electricity Access.*