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A Study on the United States Renewable Energy Policy Design and Outcomes

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By

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1. Introduction

Energy is essential for the existence of modern civilization, and the amount of energy consumed by society is constantly growing. In 2015, the United States alone generated about 4 trillion kilowatt-hours of electricity.[1] About 67% of the electricity generated was from fossil fuels (coal, natural gas, and petroleum).[2] The United States' high dependence on fossil fuels leads to numerous problems, such as increased greenhouse gas emissions, urban air pollution, as well as geopolitical and military tensions.[3] There are two primary ways that scholars and politicians are trying to address the problem of fossil-fuel consumption—either by reducing the population's dependence on energy, which would require substantial behavioral and educational changes, or by finding alternative sources of energy, such as renewable energy sources.[4] Because significant behavioral changes would be far more difficult to implement,[5] it is more realistic to reduce our over-dependence on petroleum and coal by increasing our reliance on renewable energy resources.

The United States' transition to renewable energy sources will be one of the major challenges of this century.[6] In 2015, the U.S. Energy Information Administration (EIA) reported that about 13% of total U.S. electricity generation (or 7% excluding hydropower) is attributable to renewable energy.[7] The EIA

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[1] *See* U.S. ENERGY INFO. ADMIN., ELECTRIC POWER MONTHLY WITH DATA FOR OCTOBER 2016 (February 2017).

[2] *Id.*

[3] THE LAW OF CLEAN ENERGY: EFFICIENCY AND RENEWABLES 241 (Michael B. Gerrard ed. 2011).

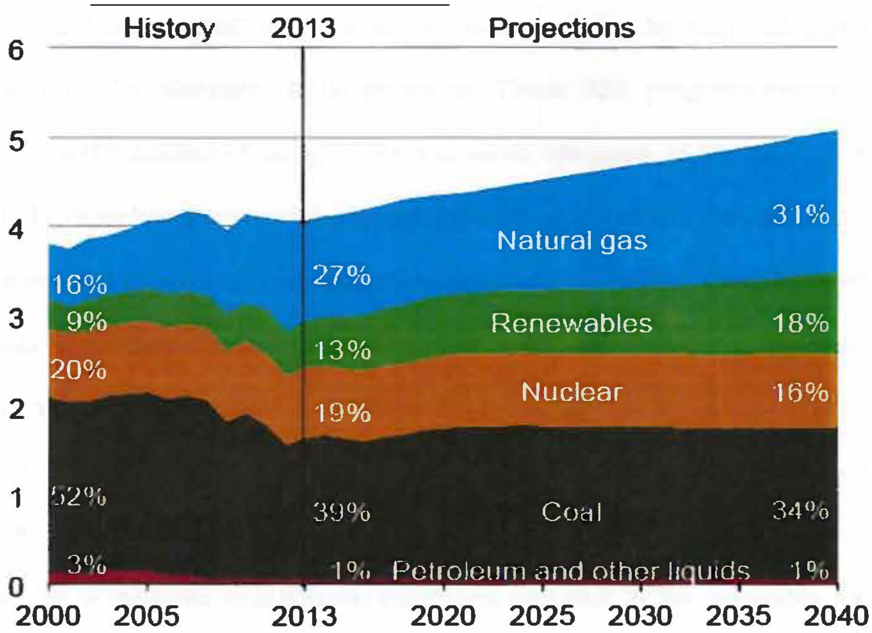
[4] *Id.*

[5] The behavioral changes would be far more difficult to implement than increasing our reliance on renewables because they require a wide range of policy tools from communications and marketing to regulation and environmental and social planning. Professor Robert West and Professor Susan Michie from University College London have developed a Behaviour Change Wheel which describes the basic elements required for behavior change to take place and the range of interventions and policies which can influence behavior. *See* Michie S, van Stralen M, West R. *The Behavior Change Wheel: a multi-system behavior change framework.* PSYCHOLOGY & HEALTH, 25 (2010).

[6] ANDREA S. KRAMER & PETER C. FUSARO, ENERGY AND ENVIRONMENTAL PROJECT FINANCE LAW AND TAXATION: NEW INVESTMENT TECHNIQUES (2010).

[7] *See* U.S. ENERGY INFO. ADMIN., DOE/EIA-0383(2015), ANNUAL ENERGY OUTLOOK 2015 WITH PROJECTIONS TO 2040 (2015) [hereinafter ANNUAL ENERGY OUTLOOK 2015]. U.S. ENERGY INFO. ADMIN., ELECTRIC POWER MONTHLY WITH DATA FOR DECEMBER 2016 (Feb. 2017). *See also Frequently Asked Questions*: *What Is U.S.*

predicted that the renewable share of all U.S. electricity generation would increase from 13% (including hydropower) in 2013 to 18% in 2040 (*see* Figure 1, "Electricity Generation by Fuel, 2000–2040," below).[8]



[Figure 1, Electricity Generation by Fuel, 2000-2040][9]

Renewable energy resources are among the fastest growing sources of new electric power in the United States.[10] Renewable energy is extracted from natural resources, including sunlight, wind, rain, tides, and geothermal heat. Although the most significant disadvantage of renewables is that we have no control over the timing of their availability, the overall amount of obtainable energy is unlimited.[11] However, the development of renewables is inhibited by high costs and insufficient financing, which are both, in part, byproducts of the competitive, low-cost and still subsidized by the government fossil-based fuel industry.

To boost the competiveness and reduce the costs of renewable energy projects, the United States offers economic incentives, such as tax incentives, and imposes command-and-control regulations, which

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Electricity Generation by Energy Source?, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=427&t=3 (last updated Apr. 1, 2016).

[8] *Id.*

[9] *See* U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2015, *supra* note 7, at 24.

[10] Steven Ferrey, *Sustainable Energy, Environmental Policy, and States' Rights: Discerning the Energy Future Through the Eye of the Dormant Commerce Clause*, 12 N.Y.U. ENVTL. L.J. 507 (2004); *see also id.* at ES-7.

[11] *See, e.g.*, Yunita Anwar & Martin Surya Mulyadi, *Income Tax Incentives on Renewable Energy Industry*, 5(31) AFR. J. BUS. MGMT. 12,264 (2011).

generally include legislation that directs a specific activity and determines what is and what is not permitted. In addition to tax incentives and command-and-control regulations, other regulatory initiatives, so called "thinly-disguised command-and-control" regulations, have been launched by state and local governments that offer Renewable Portfolio Standard (RPS) programs. These RPS programs require each energy provider to produce a specific amount of energy from renewable resources. In Europe, for example, feed-in tariffs programs (FiTs) have become increasingly popular as an additional incentive to boost renewables. FiT programs require utilities to purchase renewables at a specified price. These developments come at the same time as increases in the public's awareness of, and in some instances, the public's direct financial participation in, renewable energy projects.

Over the past several years, the public's interest in renewable energy has been reinforced by a growing concern with global warming and the United States' dependence on foreign countries' energy resources.[12] This concern is reflected in numerous incentives provided to the renewable industry by the federal government and state authorities. Given the variety and extent of incentives offered to the renewable industry, one might find it difficult to identify a similar industry that gets such favorable attention from government agencies.[13] However, despite the available incentives, the renewable energy industry still struggles to fully compete with fossil-based and natural gas sources of energy.

The variety and complexity of policy instruments employed in the domestic renewable energy market raise questions about the policies' effectiveness, as well as about their interactions with one another. This dissertation tries to deepen the understanding of these policy instruments and their effectiveness in achieving intended goals.

This dissertation is structured around two central arguments. First, I argue that an increase in governmental support for renewables does not necessarily result in a corresponding increase in the

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[12] It should be noted that United States' dependence on foreign countries' energy resources has significantly decreased. In 2016, domestic energy production is equal to about 91% of U.S. energy consumption. The remaining 9% was imported from foreign countries. *See U.S. Energy Facts,* U.S. Energy Information Administration (EIA), https://www.eia.gov/energyexplained/?page=us_energy_home (last updated May, 19, 2017).

[13] *See supra* note 11.

deployment or generation rate of renewables. In some cases, infusing additional economic incentives into the renewable energy market might have limited to no effect on the production rate of renewable energy. Almost exclusively focusing on economic incentives and renewable energy growth does not take into account a basic concept of "prices" that could offset or even eliminate the intended renewable energy growth.

My second central argument focuses on a synergistically integrated RPS-FiT policy. Widely seen as dichotomous or mutually exclusive renewable regulatory policies, RPS and FiT could work together to potentially achieve better results than either policy alone. This study tries to advance the scholarship in this field by addressing some of the issues left open by prominent scholars who have advocated for a combined RPS-FiT policy.

The first part of this study focuses on domestic renewable energy policy. It presents an *ex post* analysis of how the policy was applied in practice and whether it achieved its intended goals.[14] This analysis is possible only in the late stages of a policy cycle, well after it has been adopted, because the policy outcomes are analyzed based on legal rules, the implementation of the policy, and strategic reactions by businesses to the regulation.[15]

Examining policy outcomes based on the actual data of renewables' deployment and the available data on economic incentives provides important insight into the comparative effectiveness of domestic renewable energy policies. This appraisal can assist policymakers in bridging the gap between conceiving of policies in theory and implementing them successfully on the ground.

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[14] Charles Herrick & Daniel Sarewitz, *Ex Post Evaluation: A More Effective Role for Scientific Assessments in Environmental Policy*, 25 SCI., TECH. & HUM. VALUES 309 (2000).

[15] Kerstin Tews, *The Diffusion of Environmental Policy Innovations*, *in* MULTILEVEL GOVERNANCE OF GLOBAL ENVIRONMENTAL CHANGE: PERSPECTIVES FROM SCIENCE, SOCIOLOGY AND THE LAW 227 (Gerd Winter ed. 2006); Lawrence H. Goulder & Ian W. H. Parry, *Instrument Choice in Environmental Policy*, 2 REV. ENVTL. ECON. & POL'Y 152 (2008).

The last part of this study is an *ex ante* analysis of a proposed RPS-FiT policy. It explores the synergies that could be achieved by combining RPS and FiT. If strategically used together, RPS and FiT could provide enhanced policy outcomes compared to the implementation of either policy on its own.[16]

Despite the importance of this field, many renewable energy policy studies remain very descriptive, focusing on a particular characteristic of a specific policy and very often without references to actual data.[17] This study, on the other hand, proposes models and hypotheses that are tested against actual data from the U.S. Department of Energy, National Renewable Energy Laboratory (NREL), the Budget of the U.S. Government, Estimates of Federal Tax Expenditures by the Joint Committee on Taxation, and other official sources.

In general, renewable energy policies can be divided into two broad classes: the supply-side tools and the demand-side mechanisms. The supply-side tools, often called "Market Push Policies," seek to affect the supply of renewables by increasing the amount of renewable energy technology that is available for commercial use.[18] In the energy context, such policies may include economic incentives, tax credits, grants, or other financial incentives that directly or indirectly reduce the after-tax costs of supplying renewable energy electricity.

The demand-side mechanisms, often called "Market Pull Policies," try to promote renewable technologies by influencing the demand for them. In the energy context, there are two main demand-side policies: quantity-based policies, such as renewable portfolio standards (RPSs), and price-based policies, such as feed-in tariffs (FiTs). These regulatory policies impose a legal obligation on utilities to purchase a specified amount of renewables (RPS) or to purchase renewables at a specified price (FiT).[19] RPSs are the most dominant state-level Market Pull Policies in the United States. As of this writing, twenty nine states

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[16] Michael Howlett & M. Ramesh, *Patterns of Policy Instrument Choice: Policy Styles, Policy Learning and the Privatization Experience*, 12 REV. POL'Y RES. 3 (1993).

[17] Adam J. Newmark, Measuring State Legislative Lobbying Regulation, 1990–2003, 5 ST. POL. & POL'Y Q. 182 (2005); David Popp, *International Innovation and Diffusion of Air Pollution Control Technologies*, 51 J. ENVTL. ECON. & MGMT. 46 (2006).

[18] *See infra* text accompanying note 89.

[19] *See infra* text accompanying note 93.

and Washington D.C., have adopted mandatory RPS programs that collectively apply to 55% of total U.S. retail electricity sales.[20] Since 2000, more than half of all growth in domestic renewable electricity generation (60%) and capacity (57%) is attributable to these state RPS programs.[21] RPSs and FiTs have traditionally been treated as mutually exclusive policy options, and one can see that FiT seems to be more popular in Europe,[22] while RPS has been the preferred choice in the United States.[23]

To appreciate the role of these policies, it is important to understand their complexity, their effectiveness, and the nature of their interactions with each other. This dissertation presents two models to evaluate the effectiveness of U.S. renewable energy policies and suggests new pricing tools for a combined RPS-FiT policy. These models contribute to the literature on renewable energy policy design and effectiveness, by expanding empirical knowledge about prominent, sustainable energy policy instruments.

The structure of this dissertation is organized as follows. Chapter 2 briefly describes the role and historical development of renewable energy in the United States in order to contextualize the present research. This chapter describes market push policies and market pull policies currently implemented in the domestic renewable energy market.

Chapter 3 introduces a new evaluation model for the renewable energy market. The model is intended to be used as a general guide to policy and law. This chapter explains what the model can tell us about the renewable energy market and the mechanism by which it operates. The goal of the model is to advance scholarship in the renewable energy field and to describe the effects of economic and regulatory incentives on the renewable energy market. The model could also be used to make recommendations about an appropriate renewable energy policy.

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[20] GALEN BARBOSE, LAWRENCE BERKELEY NAT'L LAB., LBNL-10055057, U.S. RENEWABLES PORTFOLIO STANDARDS: 2016 ANNUAL STATUS REPORT (2016).

[21] *Id.*

[22] *See Feed-in Tariffs*, NAT'L RENEWABLE ENERGY LAB., http://www.nrel.gov/tech_deployment/state_local_governments/basics_tariffs.html (last visited Apr. 24, 2017); Lincoln L. Davies, *Incentivizing Renewable Energy Deployment: Renewable Portfolio Standards and Feed-in-Tariffs*, 1 KLRI J.L. & LEGIS. 39, 48–52 (2011). Currently, there are six U.S. states that use FiT policies. *See, infra* text accompanying note 210.

[23] *See infra* text accompanying note 154.

Chapter 4 provides a basic microeconomic explanation of how market push policies and market pull policies interact with each other in the renewable energy market. This chapter makes the case for closer integration of two market pull policies—quantity-based policy (RPS) and price-based policy (FiT)—for better allocation of investor and regulatory risk as well as increased efficiency and effectiveness when compared to the use of either tool alone.

The suggestion of integrating the two main market pull policies into a combined RPS-FiT policy is not entirely new. The European Union Directive 2009/28/EC imposed a regulatory obligation on European member nations that has some resemblance to a combined RPS-FiT policy.[24] Further exploration of this relatively recent policy innovation is important. Also, some prominent scholars have suggested detailed analyses as to appropriate policy designs that would combine the best features of RPS and FiT.[25] However, these studies have left questions open for further research and analysis. For example, those analyses did not address some of the design problems of the combined policy, including how to structure the FiT price.

Therefore, in Chapter 5, I address some of these unanswered questions in the hope of further advancing the scholarship in this field. In particular, I offer an integrated pricing model for the combined RPS-FiT policy as a possible solution to some of the policy design issues.

Chapter 6 offers a final discussion of the analysis presented in this dissertation.

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[24] Council Directive 2009/28, 2009 O.J. (L 140) 16 (EC). A June 2015 report from the European Commission shows that EU countries are on track to meet the aggregate 20% goal. *See EU on Track to Meeting 20% Renewable Energy Target*, EUR. COMM'N ENERGY NEWS, https://ec.europa.eu/energy/en/news/eu-track-meeting-20-renewable-energy-target (last updated June 16, 2015).

[25] Lincoln L. Davies, *Reconciling Renewable Portfolio Standards and Feed-In Tariffs*, 32 UTAH ENVTL. L. REV. 311 (2012); Felix Mormann, *Re-Allocating Risk: The Case for Closer Integration of Price- and Quantity-Based Support Policies for Clean Energy*, ELECTRICITY J., Nov. 2014, at 9, 15.

Chapter 2

2. The Renewable Energy Market in the United States

2.1 Historical Development of the U.S. Energy Market

It is imperative to trace the history of the United States' energy regulation in order to understand its current renewable energy policy. Unlike other developed countries, the United States had a long-standing preference for largely private control of natural resources.[26] The U.S. government tried to avoid owning, producing, or delivering energy.[27] When an energy resource was found on government land, the government leased the development rights to private businesses and provided significant tax incentives for those businesses in the form of depreciation deductions, enhanced oil recovery credits and other incentives. Therefore, the United States did not have to initiate a significant privatization process like many other nations in the developed and developing worlds.[28]

However, in the late 19th Century, the free economy in the United States did not operate flawlessly. Some markets that required high initial investment, such as the railroad and energy markets, became fertile ground for monopolies, which could capture the markets and then control the prices within those markets. In the railroad market, anti-trust laws were promulgated to address the monopoly issue. In the energy markets, the beginning of the 20th Century featured the first substantial regulatory initiatives in the U.S. energy market. States and local governments promulgated the first energy regulations that imposed considerable economic regulations on private businesses.[29] For example, some regulations stated that the prices charged to customers should be "just and reasonable".[30]

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[26] John Gulliver & Donald N. Zillman, *Contemporary United States Energy Regulation*, *in* REGULATING ENERGY AND NATURAL RESOURCES 113 (Barry Barton et al. eds., 2006).
[27] *Id.*
[28] *Id.*
[29] *Id.*
[30] *Id.* at 114.

Due to the expansion of the energy market in the 1920s, the federal government decided to intervene by promulgating energy regulations that addressed interstate energy commerce.[31] The federal government was concerned about the risks of creating monopolies in the energy and electricity markets, so it enacted a number of laws that empowered the Federal Power Commission (FPC)—later renamed the Federal Energy Regulatory Commission (FERC)—to regulate prices, prohibit discrimination among customers, and impose other regulations on the private energy sector.[32]

During the period of time between the New Deal and the early 1970s, the United States' energy regulatory structure worked well without considerable changes. However, after Ronald Reagan's election, governmental control over the energy market started to diminish.[33]

The 1973 oil shock was the first push toward developing clean, domestic energy sources. The Public Utility Regulatory Policies Act of 1978 (PURPA) encouraged new utilities and generators of electricity (smaller than 80 megawatts in capacity using renewable technologies and cogeneration processes) to enter the market.[34] The new governmental goal was to open energy markets to competition—from the early stage of exploration, through production, and ultimately to delivery of electricity to the customers. The renewable energy market received a further boost in 1978 with the enactment of the Energy Tax Act, which gave an investment tax credit of 30% of the cost of renewables to residential consumers for installing wind and solar energy equipment and a 10% investment tax credit to businesses for installing renewable energy technologies.[35] The Energy Tax Act substantially lowered the risk of investing in

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[31] *See* Pub. Utils. Comm'n v. Attleboro Steam & Elec. Co., 273 U.S. 83 (1927), *abrogated by* Quill Corp. v. North Dakota *ex rel.* Heitkamp, 504 U.S. 298 (1992); Missouri *ex rel.* Barrett v. Kansas Nat. Gas Co., 265 U.S. 298 (1924).

[32] Gulliver & Zillman, *supra* note 26, at 114; *see also* Hydroelectric project in 1927, Public Law No. 280, 66th Cong, 2nd Sess, ch 285 (10 June 1920); Interstate electricity law, Public Law No. 333, 74th Cong, 1st Sess, ch 687 (16 August 1935); Natural gas crossing state lines law, Public Law No 688, 75th Cong, 3rd Sess, ch 556 (21 June 1938).

[33] Gulliver & Zillman, *supra* note 26, at 114.

[34] *Id.* at 116.

[35] The Energy Tax Act is a law passed by the U.S. Congress as part of the National Energy Act. *See* Energy Tax Act, Pub. L. No. 95-618, 92 Stat. 317 (1978). The tax credits under the Energy Tax Act ended in 1985. *See* Gerald W. Braun & Don R. Smith, *Commercial Wind Power: Recent Experience in the United States*, 17 ANN. REV. ENERGY & ENV'T 97 (1992).

renewable technologies and made distributed generation more attractive.[36] However, a combination of diminishing government funding for renewable-energy research and decreasing fossil-based fuel prices[37] resulted in a downturn during the late 1980s and early 1990s.[38] During this time, the renewable energy market suffered a sharp decline in capacity additions.[39]

The next attempt to promote renewable energy took place in 1992, when Congress created the production tax credit, which offered to investors in renewables 1.5 cents per kilowatt hour (kW/h) of electricity produced from eligible renewable technologies.[40] This tax credit has expired and then been extended and amended several times since its enactment.[41] Every time the tax credit has been extended, new capacity development has jumped, before dropping off again when the credit expired (see Figure 2, "Annual Wind Capacity Additions and PTC," below).[42]

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[36] Sebastian J. Nola & Fereidoon P. Sioshansi, *The Role of the US Electric Utility Industry in the Commercialization of Renewable Energy Technologies for Power Generation*, 15 ANN. REV. ENERGY 99 (1990).

[37] James McVeigh et al., *Winner, Loser, or Innocent Victim? Has Renewable Energy Performed as Expected?*, 68 SOLAR ENERGY 237 (2000).

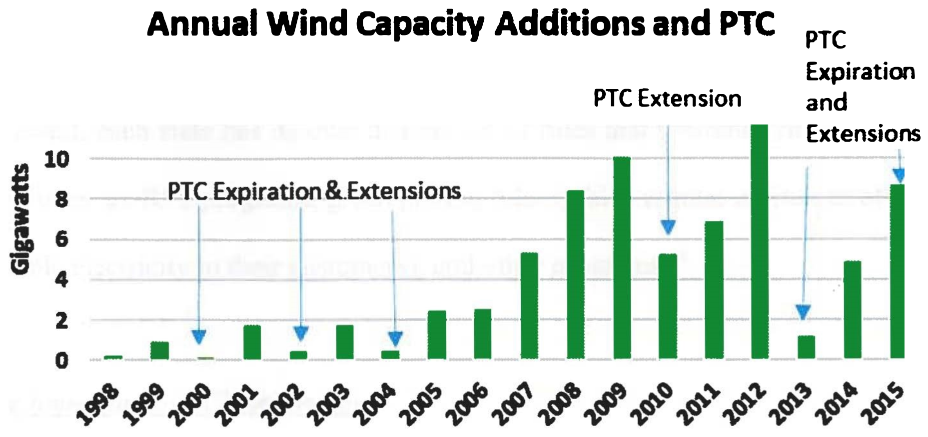
[38] *See generally* Michael K. Heiman & Barry D. Solomon, Power to the People: Electric Utility Restructuring and the Commitment to Renewable Energy, 94 ANNALS ASS'N AM. GEOGRAPHERS 94 (2004).

[39] McVeigh et al., *supra* note 37.

[40] The 1992 Energy Policy Act (102nd Congress H.R.776.ENR, abbreviated as EPACT92) is a United States government act. It was passed by Congress and set goals, created mandates, and amended utility laws to increase clean energy use and improve overall energy efficiency in the United States.

[41] *See infra* Appendix A - "Some of the Main Federal and Local Economic Incentives Available Today".

[42] K. PORTER ET AL., NAT'L RENEWABLE ENERGY LAB., SUBCONTRACT REPORT NREL/SR-550-44508, GENERATION INTERCONNECTION POLICIES AND WIND POWER: A DISCUSSION OF ISSUES, PROBLEMS, AND POTENTIAL SOLUTIONS (2009); Elizabeth J. Wilson & Jennie C. Stephens, *Wind Deployment in the United States: States, Resources, Policy, and Discourse*, 43 ENVTL. SCI. & TECH. 9,063 (2009).



Source: U.S. Department of Energy (DOE)- Electric Market and Policy Group.
PTC= Production tax credit.

[Figure 2, Annual Wind Capacity Additions and PTC][43]

In 2005, President George W. Bush signed the most significant energy legislation enacted in over a decade: the Energy Policy Act of 2005.[44] The Energy Policy Act encouraged domestic production of all forms of energy; provided numerous tax breaks to energy companies, including renewable and alternative sources of energy; emphasized the importance of the private sector with limited governmental regulations; and granted FERC increased authority over complex wholesale energy markets.[45] Current U.S. energy policy is shaped by the Energy Policy Act, which probably accounts for the rejection of traditional "command-and-control" regulatory approaches at the federal level.[46]

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[43] S. Patricia Batres-Marquez, *Recent Developments in U.S. Wind Power* (Sept. 27, 2016), http://www.agmrc.org/renewable-energy/renewable-energy-climate-change-report/renewable-energy-climate-change-report/october-2016-report/recent-developments-in-us-wind-power/; *see also Wind and Solar Data and Projections from the U.S. Energy Information Administration: Past Performance and Ongoing Enhancements*, U.S. ENERGY INFO. ADMIN. TODAY IN ENERGY (March, 2016), https://www.eia.gov/outlooks/aeo/supplement/renewable/pdf/projections.pdf.

[44] The Energy Policy Act of 2005, Pub. L. No. 109-58.

[45] *Id.*; Gulliver & Zillman, *supra* note 26, at 119.

[46] The enthusiastic promotion of renewables during the 1970s and 1980s did not last long and was followed by the "lost" decade for renewable energy. During late 1980s and 1990s, the United States had a policy of reducing the federal government's role in many issue areas, including environmental policy. Consequently, the command-and-control regulations -- which regulations are you thinking of? were put on hold, which gave no incentive for further investment in renewables. Since then, the United States' environmental policy, in comparison with other developed countries, has been less strict. *See* KATRIN JORDAN-KORTE, GOVERNMENT PROMOTION OF RENEWABLE ENERGY TECHNOLOGIES: POLICY APPROACHES AND MARKET DEVELOPMENT IN GERMANY, THE UNITED STATES, AND JAPAN 206 (2011).

Notwithstanding the Energy Policy Act, the absence of a stricter federal environmental policy has made it possible for the states to fill the regulatory gap by enacting state-level renewable energy regulations.[47] As a result, each state has its own distinct set of rules that promote renewables. Prominent among these state policies are RPS programs, green pricing rules (which require utilities to offer voluntary programs for renewable electricity to their customers), and other programs.[48]

2.2 The Importance of Clean Energy

The renewable energy industry has been an issue of considerable importance to the US government for the past several years. The political support for renewables was notable in the energy policies of both Presidents George W. Bush and Barack Obama.[49] The United States Environment Protection Agency (EPA) emphasized the importance of clean energy because it "is a cost-effective way to meet [states'] energy needs while reducing harmful greenhouse gas (GHG) emissions and other air pollutants, lowering energy costs, and potentially improving the reliability and security of the nation's energy system."[50]

Since the 2016 election, there have been varying opinions as to President Donald Trump's policy regarding renewables in the United States.[51] Some say he is bad for renewables;[52] some say he is not bad for renewables and that renewables will do just fine in President Trump's America.[53] Trump has called

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[47] Felix Mormann, *Clean Energy Federalism*, 67 FLA. L. REV. 1621 (2015).

[48] According to DSIREUSA.ORG, there are at least 3,748 different regulatory policies and programs available for renewable energy industry in the United States. Among the state-level renewable energy regulations and programs are the following: Third-Party Solar Power Purchase Agreement Policies, Net Metering Policies, Appliance Efficiency Regulations, Building Energy Codes. For the full list of programs and policies *see Programs*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program (last updated Aug. 19, 2017).

[49] *See* http://www.whitehouse.gov/issues/energy-and-environment, quoted June 15, 2010; George W. Bush, U.S. President, State of the Union Address (Jan. 23, 2007).

[50] EPA, ENERGY AND ENVIRONMENT GUIDE TO ACTION: STATE POLICIES AND BEST PRACTICES FOR ADVANCING ENERGY EFFICIENCY, RENEWABLE ENERGY, AND COMBINED HEAT AND POWER ES-2 (2015).

[51] Earl J. Ritchie, *How Bad Will Donald Trump Be for Renewable Energy?*, FORBES (Dec. 1, 2016; 2:19 PM), https://www.forbes.com/sites/uhenergy/2016/12/01/how-bad-will-donald-trump-be-for-renewable-energy/#2ca93b356af8.

[52] Nick Visser, *It's Official: Donald Trump's First 100 Days Will Be Horrible for the Planet*, HUFFINGTON POST (Nov. 21, 2016; 10:36 PM), http://www.huffingtonpost.com/entry/donald-trump-environment_us_5833a0bbe4b099512f84763a.

[53] James Conca, *Renewable Energy Will Do Just Fine in President Trump's America*, FORBES (Nov. 10, 2016; 2:51 PM), http://www.forbes.com/sites/jamesconca/2016/11/10/energy-in-president-trumps-america/#b46705b69ff8.

climate change a hoax and said he would abolish the EPA including its Clean Power Plan,[54] pull out of the Paris Agreement[55] and boost the coal and natural gas industries.[56] Following his election, President Trump did in fact pull out of the Paris Agreement,[57] however, in other areas, he has largely moderated his positions.[58] Obviously, only time will tell. But renewable energy growth will certainly be affected by numerous policy decisions, including the fate of the Clean Power Plan, Investment Tax Credit, Production Tax Credit, other economic and financial incentives, and the growth of fossil fuel production and consumption.[59]

2.3 Renewable Energy Policy

2.3.1 Introduction

Renewable energy policy involves the use of several regulatory and fiscal instruments, such as tax incentives, funding programs for research and development of new technologies, investment subsidies, RPS, FiT, and other energy-efficiency regulations.

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[54] The Clean Power Plan is a policy aimed at combating anthropogenic climate change (global warming) that was first proposed by the Environmental Protection Agency in June 2014, under the administration of U.S. President Barack Obama. The final version of the Clean Power Plan tries to set a national limit on carbon dioxide pollution produced from power plants. *See Clean Power Plan*, EPA.GOV, https://www.epa.gov/cleanpowerplan (last visited Jan. 16, 2016). On February 9, 2016, the U.S. Supreme Court stayed implementation of the Clean Power Plan pending judicial review.

[55] The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change dealing with greenhouse emissions mitigation, adaptation, and finance. The agreement went into effect on November 4, 2016. The agreement aims at holding the increase in the global average temperature to well below 2 degrees Celsius; increasing the ability to adapt to the adverse impacts of climate change; and making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. *See* Paris Agreement, UN Doc. FCCC/CP/2015/L.9/Rev.1 (Dec. 12, 2015).

[56] Ritchie, *supra* note 51; Karen Yourish, *20 Things Donald Trump Said He Wanted to Get Rid of as President*, N.Y. TIMES (Nov. 14, 2016), http://www.nytimes.com/interactive/2016/11/11/us/politics/what-trump-wants-to-change.html?_r=0.

[57] *See* Michael. D. Shear, *Trump Will Withdraw U.S. From Paris Climate Agreement,* The New York Times (Jun. 1, 2017), https://www.nytimes.com/2017/06/01/climate/trump-paris-climate-agreement.html.

[58] Ritchie, *supra* note 51.

[59] *Id.*

2.3.2 Market Failures and Justification of Governmental Intervention

The most typical justification for governmental intervention in the economy is market failures.[60] Like other markets, the renewable energy market is not immune from market failures.[61] Economic justifications (*i.e.*, market failures) often serve as justifications for government intervention through both economic and social regulation.[62] Government intervention can also be explained by non-economic justifications, such as the desire to reach fair allocations and distributions of resources.[63] The dominant market failures in the renewable energy market are (i) imperfect competition, (ii) externalities, and (iii) information asymmetry.[64]

The first market failure is imperfect competition. Energy and electricity markets are unique, because they often operate in a state of natural monopoly due to high initial investment costs and require long periods of time to generate a meaningful return on investment. For example, building multiple power lines to serve the same customers cannot be economically profitable due to the high initial investment costs. Indeed, it is redundant to build more than one set of electric power lines between a power plant and consumers. Consequently, many investors are reluctant to enter that market, where there is a very high risk

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[60] ROBERT BALDWIN, RULES AND GOVERNMENT 260–63 (1995); HUGH GRAVELLE & RAY REES, MICROECONOMICS 314–20 (2004); JORDAN-KORTE, *supra* note 46, at 22.

[61] *See, e.g.*, Richard Schmalensee, *Evaluating Policies to Increase Electricity Generation from Renewable Energy*, 6 REV. ENVTL. ECON. & POL'Y 45, 46–48 (2011).

[62] STEPHEN BREYER, REGULATION AND ITS REFORM (1982).

[63] JAMES E HICKEY & ENERGY LAW GROUP, ENERGY LAW AND POLICY FOR THE 21ST CENTURY (2000) at 2-31; *see also* RICHARD A. MUSGRAVE, THE THEORY OF PUBLIC FINANCE (1959).

[64] JORDAN-KORTE, *supra* note 46, at 22. *See generally* AMORY B. LOVINS & L. HUNTER LOVINS, BRITTLE POWER: ENERGY STRATEGY FOR NATIONAL SECURITY (1982); AMORY B. LOVINS, SOFT ENERGY PATHS: TOWARD A DURABLE PEACE (1977); JOSEPH P. TOMAIN, ENDING DIRTY ENERGY POLICY: PRELUDE TO CLIMATE CHANGE (2011); A.K. Akella et al., *Social, Economical and Environmental Impacts of Renewable Energy Systems*, 34 RENEWABLE ENERGY 390, 391 (2009); Gary C. Bryner, *The National Energy Policy: Assessing Energy Policy Choices*, 73 U. COLOR. L. REV. 341, 342 (2002); Lincoln L. Davies, *Beyond Fukushima: Disasters, Nuclear Energy, and Energy Law*, 2011 BYU L. REV. 1937, 1975–78 (2011); Ned Farquhar, *Energy, Security, Climate: Converging Solutions*, 29 J. LAND RES. & ENVTL. L. 1 (2009); Irma S. Russell, *The Sustainability Principle in Sustainable Energy*, 44 TULSA L. REV. 121 (2008); Hannah Wiseman et al., *Formulating a Law of Sustainable Energy: The Renewables Component*, 28 PACE ENTL. L. REV. 827 (2011); *Benefits of Renewable Energy Use*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/public-benefits-of-renewable.html#bf-toc-1 (last revised Oct. 12, 2016).

of losing substantial initial capital investment. This creates a natural monopoly where a single investor controls the prices and production in the market. The result is a loss of social welfare.[65]

Therefore, based on the unique monopolistic characteristics of the electricity market, the government in some states has intervened by granting utilities exclusive franchises to produce electricity in exchange for the government's authority to regulate prices.[66] By controlling the price in the market, the loss of social welfare is substantially reduced. However, it should be noted that some states chose the path of deregulation of utilities, which led in some cases to double digit price increase for electricity.[67]

The second market failure is externalities. An externality is a cost or benefit that is not included in the price of a product.[68] When a price is not accurate, it creates inefficient markets where the consumption of a good is over-consumed or under-consumed. Some prominent examples of externalities relate to environmental consequences of production and use, *i.e.* different kinds of pollution.[69] When the costs of pollution are not absorbed by a polluter such as a manufacturer, the manufacturer will produce more goods than it would if it were obligated to install pollution-control equipment.[70] By imposing a legal requirement on the polluter to install proper equipment, the pollution costs are internalized in the market and prices represent the real production costs of goods.[71]

In the renewable energy and electricity markets, there are two main kinds of externalities. The first kind focuses on *environmental externalities* such as the cost of extracting, processing, delivering and

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[65] In a monopoly, a company will set a specific price for a good that is available to all consumers. However, as opposed to free competitive markets, monopolies will set prices higher and produce less than companies in free market which creates a deadweight loss because the company forgoes transactions with the consumers. The deadweight loss is the potential gains (if the market was competitive) that did not go to the producer or the consumers. ROBERT BALDWIN, UNDERSTANDING REGULATION: THEORY, STRATEGY, AND PRACTICE 10 (1999).

[66] HICKEY & ENERGY LAW GRP., *supra* note 63 at 2-33.

[67] Retail Electric Rates in Deregulated and Regulated States: A Ten Year Comparison, AMERICAN PUBLIC POWER ASSOCIATION (March, 2008), http://www.publicpower.org/files/pdfs/10year.pdf.

[68] James M. Buchanan & William Craig Stubblebine, *Externality*, 29 ECONOMICA 371 (1962); HICKEY & ENERGY LAW GRP., *supra* note 63 at 2-34.

[69] There are also positive externalities. For example, an investment in research and development provides positive externalities because society benefits from the research as well as the investors.

[70] It should be noted that internalizing the externalities will increase the costs of goods which might also lead to a decreasing demand for these goods. The consumers will consume less of the goods, the extent of which would depend on the relative elasticities in the market. *See infra* note 127 and accompanying text.

[71] HICKEY & ENERGY LAW GRP., *supra* note 63 at 36.

combusting fossil fuel. These externalities include land and air pollution, and spills and leaks from fossil extracting. Burning fossil fuels causes the accumulation of carbon dioxide and other greenhouse gases in the atmosphere, which negatively affects our climate.[72] The second kind of externality relates to *national and economic security*, especially for countries that strongly depend on imported energy resources.[73] Disruptions in energy resources may negatively affect these countries' economic development. The costs of energy stability and security are not included in fossil fuel prices; consequently, these externalities create a market failure.[74] There are also other negative consequences for countries that have unstable energy resources, such as increased unemployment and inflation due to oil price spikes.[75]

The third major market failure is information asymmetry. A perfectly competitive market assumes open access to relevant information that is available to all the market participants. This way, no one can take advantage of using information that is not available to others.[76] Almost all markets, including the electricity market, have some degree of information asymmetry, which presents a particular problem for renewable energy use. Both innovations and technological development are hampered by lack of complete information. This failure sometimes explains why markets fail to make sufficient investments in economically efficient energy. Key information for investment decisions in the renewable energy market is considered incomplete by market participants. This causes extreme price volatility in spot markets for

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[72] JORDAN-KORTE, *supra* note 46, at 24; Dominique Finon & Philippe Menanteau, *The Static and Dynamic Efficiency of Instruments of Promotion of Renewables*, 12 ENERGY STUD. REV. 53 (2004).

[73] In recent years, the proportion of petroleum consumed in the United States imported from foreign countries has declined. In 2015, about 24% of petroleum consumed in the United States was imported, the lowest level since 1970. *E.g.*, *Frequently Asked Questions*: *How Much Oil Consumed by the United States Comes from Foreign Countries?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=32&t=6 (last updated Oct. 13, 2016).

[74] JORDAN-KORTE, *supra* note 46, at 25; Fredric C. Menz, *Green Electricity Policies in the United States: Case Study*, 33 ENERGY POL'Y 2,398, 2,408 (2005).

[75] *See* James D. Hamilton, *Causes and Consequences of the Oil Shock of 2007–08* (Nat'l Bureau of Econ. Research, Working Paper No. 15002, 2009). Hamilton evaluates the role of the oil shock of 2007–2008 in the succeeding economic recession. *Id.* For discussion about the connection between oil prices and inflation *see* Chad Langager, *What Is The Relationship Between Oil Prices and Inflation?*, INVESTOPEDIA (last accessed Aug. 25, 2017), http://www.investopedia.com/ask/answers/06/oilpricesinflation.asp.

[76] N. GREGORY MANKIW, PRINCIPLES OF MICROECONOMICS 480 (4th ed. 2007); Friedrich A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519 (1945).

electricity and ancillary services that directly affects the future generation costs of renewable energy sources. This market failure further reduces investors' enthusiasm for renewables.[77]

When there are market failures associated with an activity, correcting the economic distortion with a tax (or incentive) or regulation, if designed properly, can improve economic efficiency. If we ignore regulatory policies, a tax (or, alternatively, a subsidy) should be equal to the monetary value of any damages (or, alternatively, any benefits) to third parties imposed by the taxed activity.[78] As a result and depending on the elasticity of the demand and supply curves in a market, the tax would increase the price of the activity, and reduce the volume of the activity. The alternative to imposing a direct tax on fossil-based fuel has been to subsidize energy production from alternative energy sources, such as renewables.

The U.S. government has already addressed some of the above-mentioned market failures through environmental and antitrust laws. The environmental laws aim to require polluters to internalize the negative externalities, which would then be reflected in prices in the energy markets.[79] The antitrust laws try to promote competition and keep prices down.[80] Other energy regulations try to ensure that available energy in the United States is both plentiful and steady.[81]

Some scholars argue that renewable energy laws are not needed because those laws cover the same ground that is already covered by environmental laws, antitrust laws, and energy regulations.[82] They further emphasize that renewable energy policies simply duplicate the environmental restraints that are already in place, such as forcing energy producers to pay for mercury, sulfur dioxide, and other pollutants.[83] These

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[77] JORDAN-KORTE, *supra* note 46, at 30.

[78] Using taxes to correct negative externalities was developed by Arthur Cecil Pigou, and these taxes are often called Pigovian taxes.

[79] Zygmunt J.B. Plater, *From the Beginning, a Fundamental Shift of Paradigms: A Theory and Short History of Environmental Law*, 27 LOY. L.A. L. REV. 981, 982 (1994).

[80] Davies, *supra* note 25, at 317; John B. Kirkwood & Robert H. Lande, *The Fundamental Goal of Antitrust: Protecting Consumers, Not Increasing Efficiency*, 84 NOTRE DAME L. REV. 191 (2008); *see also* Markian M.W. Melnyk & William S. Lamb, *PUHCA's Gone, What Is Next for Holding Companies?*, 27 ENERGY L.J. 1, 7–9 (2006).

[81] Gulliver & Zillman, *supra* note 26, at 113.

[82] Robert J. Michaels, *A National Renewable Portfolio Standard: Politically Correct, Economically Suspect*, ELECTRICITY J., Apr. 2008, at 9, 10.

[83] Davies, *supra* note 25, at 317; Joseph P. Tomain, *The Dominant Model of United States Energy Policy*, 61 U. COLO. L. REV. 355, 375 (1990).

arguments would be convincing if the environmental laws fully internalized the externalities in the energy market. However, based on the environmental scholarship itself, the environmental regulations do not price all pollution properly and therefore the market cost of pollution does not represent its true environmental cost.[84] If this is true, laws that promote renewable energy are not duplicative; the opposite is true—they are essential in that they impose additional costs missed by environmental laws.[85]

In spite of all these efforts, some renewable energy technologies still remain economically uncompetitive with other fossil-based sources of energy, although this situation is changing rapidly in favor of the renewables.[86] Although renewable energy has been closing the gap on the natural gas and coal industries, it is still not fully commercially utilized. Therefore, the main goal for renewable energy policy is to make renewable energy cost-competitive with fossil fuels.[87]

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[84] FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUE OF NOTHING 9–10 (2004) (criticizing "the strange process of assigning dollar values to human life, human health, and nature itself" and challenging assumptions about information limits); RICHARD A. MUSGRAVE & PEGGY B. MUSGRAVE, PUBLIC FINANCE IN THEORY AND PRACTICE 752–53 (3d ed. 1980) (discussing the complexity of pricing benefits and costs of pollution control measures); Matthew D. Zinn, *Policing Environmental Regulatory Enforcement: Cooperation, Capture, and Citizen Suits*, 21 STAN. ENVTL. L.J. 81 (2002) (discussing agency capture in the enforcement of environmental regulation).

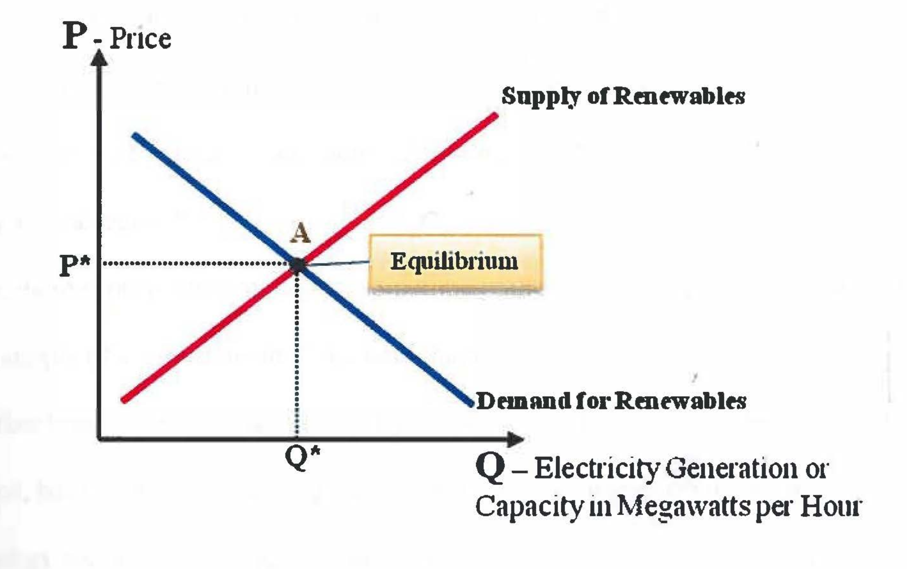
[85] Amy J. Wildermuth, *The Next Step: The Integration of Energy Law and Environmental Law*, 31 UTAH ENVTL. L. REV. 369, 388 (2011) ("Energy law, with its economic focus, ironically leaves the environment largely to the side, viewed as one more cost of doing business. Until we move toward a more integrated legal approach . . . both our energy landscape and our natural landscape will continue to suffer."). Further, some observers note that while any subsidies can distort a market, those that renewable energy receives pale in comparison to those enjoyed by fossil and other nonrenewable fuels. *See, e.g.*, NANCY PFUND & BEN HEALEY, WHAT WOULD JEFFERSON DO?: THE HISTORICAL ROLE OF FEDERAL SUBSIDIES IN SHAPING AMERICA'S ENERGY FUTURE 29 (2011); Sanya Carleyolsen, *Tangled in the Wires: An Assessment of the Existing U.S. Renewable Energy Legal Framework*, 46 NAT. RESOURCES J. 759, 791–92 (2006). Along the same line, others argue that incumbent power sources have been so heavily favored by government for so long that renewable sources deserve public backing until they can "catch up" to fossil fuels and achieve comparable economics of scale. Barry Rabe, *Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards*, 7 SUSTAINABLE DEV. L. & POL'Y 10 (2007). If these views are credited, laws promoting renewable energy are not merely redundant; they are needed to correct market dysfunction that persists, despite other efforts to correct it.

[86] *See* Paul Dowling and Matt Gray, *End of the Load for Coal and Gas? Challenging Power Technology Assumptions*, Carbon Tracker (2016), http://www.carbontracker.org/wp-content/uploads/2016/09/LCOE-report-v7.pdf; Davies, *supra* note 25, at 319; Felix Mormann, *Requirements for a Renewable Revolution*, 38 ECOLOGY L.Q. 903, 908 (2011).

[87] Brad A. Kopetsky, Comment, *Deutschland Über Alles: Why German Regulations Need to Conquer the Divided U.S. Renewable-Energy Framework to Save Clean Tech (and the World)*, 2008 WIS. L. REV. 941, 946–47 (2008); David Zilberman et al., *On the Inclusion of Indirect Land Use in Biofuel Regulations*, 2011 U. ILL. L. REV. 413, 431 (2011).

2.3.3 *Market Push and Pull Policies*

The renewable energy market has characteristics similar to any other economic market, with its own supply and demand curves. The vertical axis shows the price of renewable electricity in megawatts per hour ($/mWh); this is the amount that renewable energy producers receive (and utilities pay) for a given quantity supplied (or demanded). The horizontal axis shows the generation or capacity of electricity produced and demanded, *Q*, which is measured in megawatts per hour.



[Figure 3, Basic Renewable Energy Market]

The renewable energy *supply* slopes upward, because the producers of renewables are willing to produce and sell more electricity as the prices increase. Respectively, the *demand* for renewable energy increases as the prices fall. The intersection between the *supply and demand* represents equilibrium (A) (see Figure 3, "Basic Renewable Energy Market," above).

Renewable energy policies that try to promote or force technologies onto the market can be divided into two broad classes: supply-side tools and demand-side mechanisms.[88]

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[88] Davies, *supra* note 25; Norbert Enzensberger et al., *Policy Instruments Fostering Wind Energy Projects—A Multi-perspective Evaluation Approach*, 30 ENERGY POL'Y 793 (2009).

Supply-side tools seek to affect the supply curve of the renewable energy market by promoting the quantity and diversity of a given type of technology.[89] In other words, the government uses supply-side policies to increase the amount of resources or technologies that are available for commercial use—in our case, renewable energy technologies. In the energy context, such policies may include research, demonstration, and development (RD&D) programs; economic incentives, such as tax credits or tax incentives; and grants or investment subsidies, such as loan guarantees.[90] The economic effect of these policies is to increase production by influencing the supply curve in the market in which they are used (*i.e.*, shifting the supply curve so that equilibrium occurs in a different place). In the case of tax credits and subsidies, these policies would directly and indirectly reduce the after-tax costs of purchasing and utilizing renewable energy technologies.[91]

Together, these supply-side policies are sometimes called "technology-push" policies, because they try to "push" the supply of a certain technology onto the market.[92]

On the other hand, *demand-side policies* try to promote technologies *not* by making them available in the first instance, but rather by influencing the demand for them. For example, by increasing the demand for renewable energy technologies, suppliers would react by providing more of the desired good. In the energy context, there are two main demand-side policies: quantity-based policies, such as RPS programs, and price-based policies, such as FiT programs.[93] Quantity-based regulations (*e.g.*, RPSs) impose a legal obligation to purchase a specified amount of renewable energy and then penalize those who do not comply.

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[89] Mary Jean Bürer & Rolf Wüstenhagen, *Which Renewable Energy Policy Is a Venture Capitalist's Best Friend?: Empirical Evidence from a Survey of International Cleantech Investors*, 37 ENERGY POL'Y 4,997, 4,998 (2009).

[90] Jonathan H. Adler, *Eyes on a Climate Prize: Rewarding Energy Innovation to Achieve Climate Stabilization*, 35 HARV. ENVTL. L. REV. 1 (2011); Daniel R. Cahoy & Leland Glenna, *Private Ordering and Public Energy Innovation Policy*, 36 FLA. ST. U. L. REV. 415 (2009); Lincoln L. Davies, *Incentivizing Renewable Energy Deployment: Renewable Portfolio Standards and Feed-in-Tariffs*, 1 KLRI J.L. & LEGIS. 39, 48–52 (2011); Joseph P. Tomain, *Our Generation's Sputnik Moment: Regulating Energy Innovation*, 31 UTAH ENVTL. L. REV. 389 (2011); Sarah Tran, *Expediting Innovation*, 36 HARV. ENVTL. L. REV. 123 (2012).

[91] ROBERT S. PINDYCK, MICROECONOMICS 267 (3d ed. 1995); David G. Duff, *Tax Policy and Global Warming*, 51 CAN. TAX J. 2063, 2,063–111 (2003); De Jonghe et al., *Interactions Between Measures for the Support of Electricity from Renewable Energy Sources and CO2 Mitigation*, 37 ENERGY POL'Y 4,743, 4,743–52 (2009); *see also* CAROLYN FISCHER & LOUIS PREONAS, RES. FOR THE FUTURE, DISCUSSION PAPER 10-19, COMBINING POLICIES FOR RENEWABLE ENERGY (2010).

[92] Bürer & Wüstenhagen, *supra* note 89, at 4,998; Davies, *supra* note 25, at 320.

[93] Bürer & Wüstenhagen, *supra* note 89.

Priced-based regulations (*e.g.*, FiTs) seek to influence the deployment of renewables indirectly, either by imposing a legal obligation to purchase renewable energy at a certain price or by raising the cost of those that compete with renewables.[94]

Together, these demand-side policies are called "market-pull" policies, because they attempt, through an increased demand for a specific technology, to "pull" that technology into commercialization.[95]

Taking renewable technologies from the "valley of death" into full commercial utilization is the ultimate goal of both market-push and market-pull policies.[96] Bürer & Wüstenhagen divided technological innovation into the following main stages: (a) basic research and development, (b) advanced research and development, (c) demonstration, (d) pre-commercial use, (e) use in niche markets, and (f) full commercial utilization.[97] The technology "valley of death" spans the middle three of the above stages (*i.e.*, demonstration, pre-commercial use, and niche markets), between initial development of a technology and full commercial and market support for it.[98] In order to cross the "valley of death," the technology must enter into a broad-scale commercialization stage, and true economies of scale must be realized. In other words, the production costs per unit (unit means megawatt per hour of electricity) need to decrease to the point where a sustainable profit can be turned.[99]

Some renewable energy technologies, such as algal biofuels, have not crossed the "valley of death" into the full commercial utilization stage.[100] Others, such as wind and solar photovoltaic technologies, have reached a broad-scale commercialization stage and have developed far enough to become truly

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[94] *Id.*

[95] Bürer & Wüstenhagen, *supra* note 89, at 4,999.

[96] Bürer & Wüstenhagen, *supra* note 89, at 4998; Davies, *supra* note 25, at 321; Michael Grubb, *Technology Innovation and Climate Change Policy: An Overview of Issues and Options*, 41 KEIO J. ECON. 103 (2005).

[97] Bürer & Wüstenhagen, *supra* note 89, at 4,998.

[98] *Id.*

[99] Allison S. Clements & Douglass D. Sims, *A Clean Energy Deployment Administration: The Right Policy for Emerging Renewable Technologies*, 31 ENERGY L.J. 397, 407–09 (2010); Davies, *supra* note 25, at 321; Michael Shellenberger et al., *Fast, Clean, & Cheap: Cutting Global Warming's Gordian Knot*, 2 HARV. L. & POL'Y REV. 93, 108–09 (2008).

[100] Nina Chestney, *Aqualia Eyes Large-Scale Algae Biofuel Production*, REUTERS (Mar. 5, 2012), https://uk.news.yahoo.com/aqualia-eyes-large-scale-algae-biofuel-production-181746178.html.

economically competitive with fossil-based technologies.[101] "The challenge is to bring new technologies . . . to market, and to do so while surviving the 'technology valley of death,' namely the middle phase of the innovation chain where successful prototypes have been developed but the commercializing firm is facing the rough challenge of successful market introduction."[102]

It is very important to understand that push-market policies and pull-market policies each focus on different players in the market, and more importantly, on different sides of the "valley." While push-market policies try to help a technology reach the "valley of death," pull-market policies try to "pull" the technology from the "valley of death" into full commercialization.[103] However, it does not mean that both instruments are essential to facilitate a particular technology to reach full commercial utilization. Theoretically, a sufficiently strong push-market policy or pull-market policy, individually, could bring a new technology into a market to its full commercialization. However, since generally a policy embodies compromises between political and economic goals, in practice, implementing a strong policy tool in the renewable energy market might be a challenging task.[104]

2.3.4 Market Push Policies – Economic and Tax Incentives

2.3.4.1 Economic and Tax Incentives – What Do They Include?

Market push policies include any policy that would affect the supply side of the renewable energy market. The U.S. energy tax policy uses one of the government's main fiscal instruments—taxes (both as

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[101] *See* Paul Dowling and Matt Gray, *End of the Load for Coal and Gas? Challenging Power Technology Assumptions*, Carbon Tracker (2016), http://www.carbontracker.org/wp-content/uploads/2016/09/LCOE-report-v7.pdf; Davies, *supra* note 25, at 321; *see also* Mei-Chih Hu & Fred Phillips, *Technological Evolution and Interdependence in China's Emerging Biofuel Industry*, 78 TECHNOLOGICAL FORECASTING & SOC. CHANGE 1130, 1132 (2011).

[102] Bürer & Wüstenhagen, *supra* note 89, at 4,998.

[103] *See infra* Part 3; *see also* Davies, *supra* note 25, at 322.

[104] SHERLOCK & STUPAK, *infra* note 106.

an incentive and as a disincentive[105])—to alter the allocation, or configuration, of energy resources and their use.[106]

Taxation has three main goals.[107] The first, and broadly accepted, goal of the tax system is to raise revenue for governmental activity. The second, and a more controversial, goal of the tax system is to promote a more equitable distribution of wealth. The third goal, which generally creates complexity in the tax system when the tax system is used to regulate behavior, is to regulate the behavior of taxpayers in the private sector either by providing tax incentives or by penalizing undesired activity.[108] It is the third goal of taxation that is used by the government to promote the renewable energy industry. The government offers a broad range of tax incentives to change private sector behavior in the energy market.[109]

As Professor Avi-Yonah notes, "a lot of the trouble people have with the corporate tax system stems from a misunderstanding of its primarily regulatory nature. Once we understand that the main purpose of the corporate tax is to regulate corporate behavior, the issue becomes not how much revenue is raised, or what the incidence of the tax may be, but rather whether the tax is effective in achieving its regulatory goals."[110] Therefore, it is absolutely fine that a corporate entity does not pay taxes, as long as the reason is consistent with Congress' intent to promote the renewable energy industry.

What do we mean when we say tax incentives? Tax incentives often refer to tax expenditures and include tax credits as well as deductions, exclusions, accelerated depreciation deductions, and other

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[105] For example, under the *Omnibus Budget Reconciliation Act of 1993,* P.L. 103-66, President Clinton proposed a Btu tax on fossil fuels (tax on oil, gas and coal based on the British thermal units of heat output), which was dropped in favor of the excise taxes on motor fuels. *See* CORDELL O. LAMPEER (ED.), AMERICAN ECONOMICS, Vol 1 (Nova, NY, 2007) at 95.

[106] MOLLY F. SHERLOCK & JEFFREY M. STUPAK, CONG. RESEARCH SERV. 7-5700 R43206, ENERGY TAX POLICY: ISSUES IN THE 114TH CONGRESS (2016).

[107] Reuven S. Avi-Yonah, *The Three Goals of Taxation*, 60 TAX L. REV. 1 (2006).

[108] *Id.*

[109] *See* R. ALTON LEE, A HISTORY OF REGULATORY TAXATION 212 (1973).

[110] Reuven S. Avi-Yonah, *Taxation as Regulation: Carbon Tax, Health Care Tax, Bank Tax and Other Regulatory Taxes*, ACCT. ECON. & L. 1 (2011).

financial incentives.[111] As defined by the Joint Committee on Taxation, any deviation from a "normative"[112] tax base is a tax expenditure.[113] Accordingly, economic incentives for renewables can be defined as tax expenditures, and the way the government implements its renewable energy policy—whether through the tax system or through other governmental agencies, such as the U.S. Department of Energy—is irrelevant, at least from the renewable energy market perspective.[114]

As Professors Weisbach and Nussim note:

> "[If] the underlying policy is held constant, there are no effects of putting a program into or taking a program out of the tax system even if doing so hurts or enhances traditional notions of tax policy. Welfare is the same regardless of whether the program is formally part of the tax system or is located somewhere else in the government."[115]

Therefore, any economic or tax incentive available to the renewable industry from any governmental source, either directly or indirectly, can be seen as an overall government expenditure for renewables.[116] The ultimate goal of such an incentive is to reduce renewables' high costs and promote financial liquidity of the renewable market.[117]

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[111] *See* STANLEY S. SURREY, PATHWAYS TO TAX REFORM: THE CONCEPT OF TAX EXPENDITURES (1973); STANLEY S. SURREY & PAUL R. MCDANIEL, TAX EXPENDITURES (1985); David A. Weisbach & Jacob Nussim, *The Integration of Tax and Spending Programs*, 113 YALE L.J. 955, 972 (2004).

[112] The definition of a 'normative' tax base is frequently debated in the literature. *See* Charles E. McLure, Jr., *The Budget Process and Tax Simplification/Complication*, 45 TAX L. REV. 25, 54–56 (1989) (noting possible inaccuracies in the actual tax expenditure budget); Edward A. Zelinsky, *The Tax Treatment of Qualified Plans: A Classic Defense of the Status Quo*, 66 N.C. L. REV. 315 (1988).

[113] *See* JCT Tax Expenditure Report, https://www.jct.gov/publications.html?func=select&id=5 (last visited Aug. 19, 2017); Weisbach & Nussim, *supra* note 111.

[114] *See, e.g.*, BORIS I. BITTKER ET AL., A COMPREHENSIVE INCOME TAX BASE? A DEBATE (1968); JOSEPH A. PECHMAN, COMPREHENSIVE INCOME TAXATION (1977); JOSEPH A. PECHMAN, TAX REFORM, THE RICH AND THE POOR 55–64 (1989); Weisbach & Nussim, *supra* note 111, at 955. The governmental funds/budget can be allocated in two general ways. The first, as mentioned above, is through tax expenditures implemented by the IRS. The second is through direct expenditures, which include grants and direct payments implemented by other governmental bodies such as the U.S. Department of Energy, Department of Education, and Department of Agriculture (*i.e.*, not by the IRS). Specifically, the U.S. Department of Agriculture offers the USDA High Energy Cost Grant Program and USDA Rural Energy for America Program, and the U.S. Department of Energy offers multiple funding vehicles and grants.

[115] *See* Weisbach & Nussim *supra* note 111, at 955.

[116] *See* Douglas A. Kahn & Jeffrey S. Lehman, *Tax Expenditure Budgets: A Critical Review*, 54 TAX NOTES 1661 (1992); Eric J. Toder, *Tax Cuts or Spending—Does It Make a Difference?*, 53 NAT'L TAX J. 361 (2000).

[117] Toder, *supra* note 116.

In other words, the overall government expenditures for renewables represents a *market push* measure (*i.e.*, a measure that affects the *supply curve* in the renewable energy market) that aims to help create a supply of renewable energy technology that is capable of reaching and crossing the "valley of death."[118]

One of the main fiscal instruments available to the government is tax incentives. Utilization of tax incentives allows the government to alter the allocation or configuration of energy resources and their use. Tax subsidies are intended by the government either to correct a problem or distortion in the energy markets, or to achieve some economic efficiency or equity objective.[119] The economic rationale for government intervention in energy markets is commonly based on the government's perceived ability to correct market failures.[120] By using tax and economic incentives, the government corrects these market failures.[121] It should be noted, though, that U.S. energy tax policy is made in a political setting where the key players, such as policymakers, special interest groups, and academic scholars, have a substantial influence on the outcome. Therefore, the "enacted tax policy embodies compromises between political and economic goals, which could either mitigate or compound the existing distortions in the energy market."[122]

2.3.4.2 The Effect of Economic and Tax Incentives on the Renewable Energy Market

When economic incentives are infused into the market,[123] their effectiveness depends primarily on the price elasticity of the demand curve in the renewable energy market.[124] For example, let us assume that we are currently at point A in the renewable energy market where the market price is set at a price of P0 and the supply of renewable electricity is set at Q0 (see Figure 4, "Basic Renewable Energy Market,"

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[118] *See supra* note 104 and accompanying text.

[119] SHERLOCK & STUPAK, *supra* note 106.

[120] *See supra* Chapter 2.3.2.

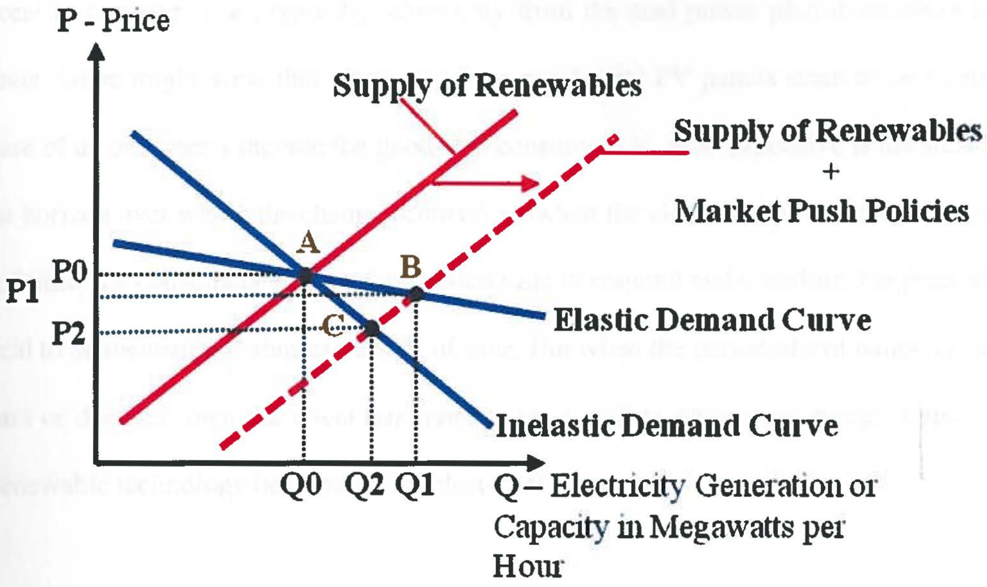
[121] *Id.*

[122] SHERLOCK & STUPAK, *supra* note 106.

[123] *See infra* Chapter 2.3.3 the renewable energy market has the same assumption sand principles as any other microeconomic market (see Figure 3 above)).

[124] *See generally* R. GLENN HUBBARD, MICROECONOMICS 164 (2006); DOMINICK SALVATORE, SCHAUM'S OUTLINE OF MICROECONOMICS 39 (2006).

below). Now, consider how much electricity will be sold if the government implements one of the market-push policies, such as a subsidy or any other financial incentive. In microeconomics, these financial incentives lower production costs, making production more profitable and encouraging existing firms to expand and new firms to enter the market. This will shift the supply curve to the right (see the shift of the red line in Figure 4 below).[125]



[Figure 4, Basic Renewable Energy Market]

Now consider two possibilities: if a demand curve for our market is an elastic demand curve, the production of renewable energy will increase from Q0 to Q1, and the market will have a new equilibrium at point B. The elasticity of the demand curve, in this case, increased the production or capacity of renewable electricity (Q0 → Q1) at a greater degree than the decrease of the price (P0 → P1).

However, if a demand curve for our market is an inelastic demand curve, the production of renewable energy will increase from Q0 to only Q2 (which is less than Q1), and the market will have a new equilibrium at point C. In the second scenario, the governmental infusion of financial incentives or subsidies

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[125] PINDYCK, *supra* note 91 (The logic behind the shift of the supply curve to the right is as follows: since the costs of production decrease, we expect to observe a greater supply of electricity produced if the market price stays constant).

had a greater effect on the price (P0 → P2) than on the production of renewable electricity (see Figure 4 above).[126]

In general, The elasticity of demand for renewables will depend on the four main factors: (1) availability of close substitutes (*i.e.*, if a technology has many available close substitutes, then it will be easier for clients to switch among goods, thus, the demand will tend to be elastic) ; (2) whether the form of energy is a necessity or luxury (*i.e.*, typically, electricity from the coal power plan it necessity and thus inelastic, however, some might view that electricity from residential PV panels seem to be luxury) ; (3) how large a share of a consumer's income the good will consume (*i.e.*, how expensive is the substitute?) ; and (4) the time horizon over which the change occurs (*i.e.*, when the electricity prices increase briefly for a short period of time, the consumers will not have much time to respond and therefore, the price elasticity of demand is said to be inelastic for shorter periods of time. But when the period of evaluation is measured in terms of years or decades, then the client has more time to shift to alternative energy source and the demand for a renewable technology becomes more elastic).[127]

2.3.4.3 Tax Incentives and Subsidies in Particular

Using tax incentives for renewables is advantageous for several reasons. First, since renewable energy is a substitute product for fossil-based fuels, any increase in the production of renewables reduces GHG[128] emissions that are caused by fossil-based industries, assuming the renewables are not used to meet the growing demand for electricity in the energy market (*i.e.*, the demand for overall energy stays constant).[129] Second, subsidies and incentives for renewables stimulate the demand for emission-free

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[126] *See e.g.*, M.A. BERNSTEIN AND J. GRIFFIN, NAT'L RENEWABLE ENERGY LAB., SUBCONTRACT REPORT NREL/SR-620-39512, Regional Differences in the Price-Elasticity of Demand for Energy (2006), https://www.nrel.gov/docs/fy06osti/39512.pdf (last visited August 19, 2017).

[127] *See supra* Note 124.

[128] GHG – Greenhouse Gases are gases that trap heat in the atmosphere such as Carbon Dioxide (CO2), Methane (CH4), Nitrous Oxide (N20) and Fluorinated gases. *See Greenhouse Gas Emissions: Overview of Greenhouse Gases*, EPA (Apr. 23, 2017), https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

[129] CRISTINA E. CIOCIRLAN, DEVELOPING AND TESTING A POSITIVE THEORY OF INSTRUMENT CHOICE: RENEWABLE ENERGY POLICY IN THE FIFTY AMERICAN STATES, A Thesis In Public Administration, The Pennsylvania State University (2006). https://etda.libraries.psu.edu/paper/7340/2610 (April 12, 2013); *see* Duff, *supra* note 91.

technologies and subsequently reduce such technologies' costs over time.[130] Finally, economic incentives for renewables also have an educative function since they prioritize environmentally friendly technologies and products as well as promote an environmentally friendly mindset,[131] although tax incentives are not the main reason people considering investment in renewables.[132]

There is no doubt that tax incentives contribute to the development of the renewable energy industry.[133] Tax incentives reduce tax liabilities, either by providing tax credits directly or indirectly through accelerated depreciation provisions or the funding of energy research and development. And reducing tax liabilities means shareholders or interest holders get more money out of their investment in the corporation or partnership. Incentives for renewable energy reflect the U.S. government's desire to have a diverse energy supply, which coincides with the government's general goal of domestic energy security.[134] Also, incentives for renewables reflect environmental concerns related to the production and consumption of energy using fossil-based resources.[135]

In recent years, tax incentives directed to renewable energy progressively grew. As discussed in further detail below, federal legislation over a three-year period, from fiscal year 2010 through fiscal year 2013, continued to increase tax support for renewables in order to boost the renewable industry. Since 2007, federal tax policy shifted significantly in favor of renewable energy sources. According to the Energy Information Administration (EIA) report, from 2010 until 2013, total federal electricity-related subsidies increased from $11.7 billion to $16.1 billion, an increase of 38% over the three-year period.[136] The largest

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[130] CIOCIRLAN, *supra* note 129.

[131] *Id.*

[132] For example, the main reasons people considering an investment in solar at home are (1) to save money on utility bills (92%); (2) to help the environment (87%); (3) to improve health (67%) and (4) to get a tax credit (59%). *See* Cary Funk and Brian Kenn, *Public Opinion on Renewables and Other Energy Sources*, PEW RESEARCH CENTER (Oct. 4, 2016) http://www.pewinternet.org/2016/10/04/public-opinion-on-renewables-and-other-energy-sources/.

[133] *See* Mark Bolinger et al., *Preliminary Evaluation of the Section 1603 Treasury Grant Program for Renewable Power Projects in the United States*, 38 ENERGY POL'Y 6,804, 6,804 (2010).

[134] *Id*; U.S. DEPARTMENT OF ENERGY, VALUATION OF ENERGY SECURITY FOR THE UNITED STATES, REPORT TO CONGRESS (January 2017) https://energy.gov/sites/prod/files/2017/01/f34/Valuation%20of%20Energy%20Security%20for%20the%20United%20States%20%28Full%20Report%29_1.pdf.

[135] SHERLOCK & STUPAK, *supra* note 106.

[136] U.S. ENERGY INFO. ADMIN., DIRECT FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY IN FISCAL YEAR 2013 (2015) [hereinafter FEDERAL INTERVENTIONS AND SUBSIDIES 2013].

increases in federal energy subsidies were in the renewable energy sector, which increased 54% over that time, from $8.6 billion to $13.2 billion. Total fossil fuel subsidies declined by 15%, from $4.0 billion to $3.4 billion.[137] According to the EIA report, which reflects 2013 data, the federal subsidies and support per unit of electricity production, subsidized solar generation by over 345 times more than coal and oil and natural gas electricity production. The report found that wind was subsidized over 52 times more than conventional fossil fuels on a unit of production basis.[138] However, it should be noted that the EIA report only reflects subsidies over fiscal years 2010 through 2013, and does not reflect the cumulative historical subsidies for energy. From cumulative historical perspective, federal incentives for early fossil fuel production and nuclear industry were much more robust than the support provided to renewables today.[139]

The major tax incentives for renewable energy are Investment Tax Credits (ITC) or Production Tax Credits (PTC). But there are also other incentives, including energy research credits, credits for advanced energy equipment, depreciation rules, and excise tax credits.[140]

A primary effect of tax credits is to reduce tax liability. Therefore, in order to make the most of the credits, a taxpayer has to have tax liability so that an entity will be able to claim the credits. Because the tax credits are not transferrable or tradable, taxpayers create different entities, such as LLCs or partnerships, and the developers of renewable energy projects enter into agreements with investors with substantial tax liabilities to obtain current and future tax benefits.[141]

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[137] *Id.*; *see also* Gilbert E. Metcalf, *Taxing Energy in the United States: Which Fuels Does the Tax Code Favor?*, MANHATTAN INST. (Jan. 10, 2009), http://www.manhattan-institute.org/html/eper_04.htm.

[138] *See EIA Report: Subsidies Continue to Roll In For Wind and Solar*, INST. FOR ENERGY RESEARCH (Mar. 18, 2015), http://instituteforenergyresearch.org/analysis/eia-subsidy-report-solar-subsidies-increase-389-percent/#_ednref2.

[139] Historical Average of Annual Energy Subsidies data provides that oil and gas received on average $4.86 billion, nuclear $3.5 billion, biofuels $1.08 billion and renewables only $0.37 billion. *See* Nancy Pfund and Ben Healey, *What Would Jefferson DO? The Historical Role of Federal Subsidies in Shaping America's Energy Future* (Sep. 15, 2011), http://www.dblpartners.vc/resource/what-would-jefferson-do/.

[140] *See infra* Appendix A.1 – "Some of the Main Federal and Local Economic Incentives Available Today".

[141] *See* Rev. Proc. 2007-65, 2007-2 C.B. 967 (10/19/2007) (Electricity produced from certain renewable resources – wind energy – safe harbor for allocation of credit by partnership); Rev. Proc. 2014-12, 2014-3 I.R.B. 415 (12/30/2013) (Rehabilitation credits – safe harbor for allocation of credit by partnership); Baer, *IRS Guidance on Wind and Biomass Credits: The Regs Are in the Mail*, 122 TAX NOTES 877 (Feb. 16, 2009); Breaks & Blumenreich, *New Guidance on Partner Allocations of Wind Energy Production Tax Credits*, 108 J. TAX'N 95 (2008); Howard A. Cooper, *Tax Credit for Electricity from Renewables—Updated*, TAX NOTES 221, 226 (2009).

However, during financial crises, such as the recent financial crisis in 2008, investors' enthusiasm for investing in renewable energies has been significantly diminished. Many investors simply did not have a use for tax credits because of their own net operating losses.[142] As a result, Congress enacted the American Recovery and Reinvestment Act of 2009 (ARRA 2009) and President Obama signed the legislation, which offered grants in lieu of Investment Tax Credits, to investors to stimulate business operations in the renewable energy industry.[143]

Many energy-related tax provisions are temporary, with a number of provisions that were scheduled to expire at the end of 2016. The Consolidated Appropriation Act of 2016[144] extended several energy tax incentives through the end of 2016. Incentives for wind and solar were given longer term extensions, with credits scheduled to phase out over a multi-year period in the future.[145]

Clearly, energy-related incentives reduce the amount of federal tax revenue collected. Between 2015 and 2019, the Consolidated Appropriation Act of 2016 will reduce governmental revenues from fossil fuels by $21.5 billion and from renewables by $46.5 billion.[146] The total cost of tax expenditures for the renewable energy industry between 2015 and 2019, including the Section 1603 grants in lieu of the tax credits program, is estimated to be $50 billion.[147]

Despite the recent financial crisis, it seems that people have retained their interest in renewables. Even with the difficulties of finding investors and utilizing governmental tax incentives, the renewable energy industry continues to grow.[148]

See infra Appendix A for some of the main federal and local economic incentives available today.[149]

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[142] Brent M. Haddad & Paul Jefferiss, *Forging Consensus on National Renewables Policy: The Renewables Portfolio Standard and the National Public Benefits Trust Fund*, ELECTRICITY J., Mar. 1999, at 68.
[143] American Recovery and Reinvestment Act of 2009, P.L. 111-5 (ARRA 2009).
[144] The Consolidated Appropriation Act of 2016, P.L. 114-113, formerly known as the Protecting Americans from Tax Hikes Act of 2015 (PATH), H.R. 2029.
[145] *Id.*
[146] SHERLOCK & STUPAK, *supra* note 106.
[147] *Id.*
[148] U.S. ENERGY INFO. ADMIN., DOE/EIA-0383(2016), ANNUAL ENERGY OUTLOOK 2016 WITH PROJECTIONS TO 2040 (2016) [hereinafter ANNUAL ENERGY OUTLOOK 2016].
[149] Updated as of October 2016.

2.3.5 Market Pull Policies – Quantity (RPS) and Price (FiT) Based Policies

2.3.5.1 Market Pull Policies – Introduction

Renewable Portfolio Standards (RPS) and Feed-in Tariffs (FiT) are the two major policies that support renewables across the globe.[150] RPS and FiT are both market-pull policies.[151] The goal of both policies is to promote the renewable energy market and to make renewable energy more competitive by affecting the demand for renewable energy technologies.[152] While RPS is a quantity-based regulation that directly targets technology demand, FiT is a price-based regulation that seeks to influence quantity indirectly by imposing mandatory prices in the market.[153] In other words, both policies have the same goal of promoting renewable energy, but they differ in the way they achieve that goal—one through quantities and the other through prices.

RPSs and FiTs have traditionally been treated as mutually exclusive policy options.[154] FiT seems to be more popular in Europe, while RPS has been the preferred choice in the United States. As of February 2017, 29 states and Washington, D.C. have established mandatory RPS requirements.[155] An additional eight states and one territories have adopted non-binding renewable portfolio goals.[156] RPSs are significant policies driving renewable energy development in the United States.[157]

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[150] Marc Ringel, *Fostering the Use of Renewable Energies in the European Union: The Race Between Feed-in Tariffs and Green Certificates*, 31 RENEWABLE ENERGY 1 (2006).

[151] *See supra* text accompanying notes 93–95.

[152] Bürer & Wüstenhagen, *supra* note 89, at 4,998.

[153] Davies, *supra* note 25, at 320.

[154] *See, e.g.*, Davies, *supra* note 25, at 313 (reporting that, between FiT and RPS policies, "states traditionally have chosen one tool or the other"); Ringel, *supra* note 150, at 14 ("Feed-in tariffs on the one side and green certificates on the other side seem promising tools to foster renewable energies . . . . Whether feed-in tariffs or—more likely—green certificates will be chosen is only a first, generic decision."); Kwok L. Shum & Chihiro Watanabe, *Network Externality Perspective of Feed-in-Tariffs (FiT) Instruments—Some Observations and Suggestions*, 38 ENERGY POL'Y 3,266, 3,267 (2010) ("Different governments have attempted to use a price [FiT] vs. quantity approach [RPS] for renewable deployment"). For a critique of FiTs, see Wilson H. Rickerson et al., *If the Shoe FiTs: Using Feed-in Tariffs to Meet U.S. Renewable Electricity Targets*, ELECTRICITY J., May 2007, at 73, 76–78.

[155] EPA, *supra* note 50.

[156] *Id.*

[157] Trieu Mai et al., *A Prospective Analysis of the Costs, Benefits and Impacts of U.S. Renewable Portfolio Standards*, NREL, Berkeley Lab (Dec. 2016) at 1, https://emp.lbl.gov/sites/default/files/lbnl-1006962.pdf; BARBOSE, *supra* note 20.

2.3.5.2 RPS Overview

An RPS is a powerful tool that encourages the use of renewable energy resources. The RPS is a regulation that requires the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal sources.[158]

The RPS system imposes an obligation on electricity providers to produce a specified fraction of their electricity from renewable energy sources. By accomplishing the RPS' requirement, the provider earns a certificate for every unit of electricity produced (*i.e.*, a Renewable Energy Certificate or REC). This certificate indicates that the provider met the conditions of the RPS and that the certificate can be tradable with other electricity providers through a regulatory body. The law typically prescribes sanctions or waivers for those facilities that fail to meet the RPS requirement. If the electricity provider does not comply with the RPS requirements, the provider may be liable for civil fines and penalties. From a renewable-energy-project perspective, an RPS allows renewable power generators to sell both their electricity and the corresponding RECs to earn more than the market rate for electricity alone.[159]

The first attempt to promote electricity production from renewable energy sources came after the enactment of the Public Utility Regulatory Policies Act of 1978 (PURPA),[160] which was part of the National Energy Act. In 2010, PURPA was amended by the Support Renewable Energy Act, which authorized the Secretary of Energy to promulgate regulations allowing electric utilities to use renewable energy to comply with any federal renewable electricity standard. As of this writing, the Secretary of Energy has neither enacted a federal-level RPS nor promulgated such a regulation.[161]

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[158] Each state defines differently what encompasses the term "renewable energy source."

[159] *See* Reinhard Haas et al., *A Historical Review of Promotion Strategies for Electricity from Renewable Energy Sources in EU Countries*, 15 RENEWABLE & SUSTAINABLE ENERGY REVS. 1003, 1014 (2011).

[160] Public Utility Regulatory Policies Act, Pub. L. No. 95-617, (1978).

[161] KRAMER & FUSARO, *supra* note 6.

However, many states decided to stimulate the renewable energy market in their own state by enacting state-based RPS programs.[162] No two states have the same RPS program.[163]

2.3.5.3 Federal Level Renewable Portfolio Standard

More than two dozen proposals have been introduced in Congress since 1996 in order to promote a federal-level RPS system, but none have passed.[164] Some argue that the broad scope of state RPS programs eliminates the need for a federal RPS.[165] Others believe that a national RPS has benefits beyond those obtained through state-level programs.[166]

Supporters say that a federal RPS will broaden compliance by requiring all the states in the United States to comply. A nationwide RPS requirement will increase the amount of renewable energy that a retailer needs to purchase, which will lead to an increase in the demand for renewable energy equipment and facilities.[167] As mentioned below, a federal RPS will create a federal-level market for RECs, further encouraging renewable energy generation. Furthermore, a federal RPS could eliminate jurisdictional problems created by state-RPS systems, including problems arising from the Dormant Commerce Clause.[168] Finally, a federal RPS will reduce environmental harm, stimulate job growth, and improve the United States' energy independence.[169]

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[162] Kevin L. Doran, *Can the U.S. Achieve a Sustainable Energy Economy from the Bottom-Up?: An Assessment of State Sustainable Energy Initiatives*, 7 VT. J. ENVTL. L. 95, 107 (2006).

[163] Each state has its own ratio for the required production of electricity from renewable energy sources. Also, each state includes different kinds of renewable energy sources that qualify for the RPS. *See Database of State Incentives for Renewables & Efficiency*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/tables (last visited on Apr. 23, 2017).

[164] James Montgomery, *Trying Again: Proposing a National U.S. Renewable Energy Standard*, Renewable Energy World (Nov. 1, 2013) http://www.renewableenergyworld.com/articles/2013/11/trying-again-proposing-a-national-u-s-renewable-energy-standard.html; Congress www.congress.gov; Felix Mormann, *Clean Energy Federalism*, 67 FLA. L. REV. 1621, 1625 (2015); Mary Ann Ralls, *Congress Got It Right: There's No Need To Mandate Renewable Portfolio Standards*, 27 ENERGY L.J. 451 (2006).

[165] Ralls, *supra* note 164.

[166] THE LAW OF CLEAN ENERGY, *supra* note 3, at 83; Davies, *supra* note 25.

[167] Davies, *supra* note 25.

[168] U.S. CONST. art. 1, § 8; Davies, *supra* note 25.

[169] THE LAW OF CLEAN ENERGY, *supra* note 3, at 89.

Critics, conversely, want to refrain from applying a federal RPS. One of the arguments is that an RPS is "only one element of a climate conductive to renewable investment" and that there are better ways to promote technology development.[170] Another argument is that a federal RPS will transfer the wealth from renewable poor states to renewable rich states.[171] Professor of Economics Robert Michaels from California State University argues that a federal RPS will reduce emissions at a higher cost. He argues that renewables will not create a "one-for-one" reduction in air pollution, because renewable utilities do not work continually and depend on renewable sources such as sun and wind which are intermittent. He also argues that efficiency improvements and/or energy conservation are more efficient than reducing pollution by the use of renewables.[172]

One of the more recent proposals for a federal RPS would be accomplished by amending the existing PURPA[173] by requiring that retail electric suppliers obtain between 15% and 20% of their energy from renewable sources by the year 2020.[174] To meet the required percentage, the supplier would have to either generate its own electricity from a renewable source or obtain/exchange RECs.

The most recent proposal would create a federal RPS system that coexists with the state RPS systems, as long as the state systems provide greater incentives for renewables than the minimum required by the federal system.

In spite of dozens of proposals to promote a federal RPS, as of this writing, none has passed.

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[170] Robert J. Michaels, *National Renewable Portfolio Standard: Smart Policy or Misguided Gesture?*, 29 ENERGY L.J. 79, 91 (2008).

[171] The Edison Electric Institute, a trade association for America's investor-owned utilities, has taken a stand against a nationwide RPS, saying it would "raise consumers' electricity prices and create inequities among states." *See Renewable Energy Portfolio Standard (RPS) Background and Debate Over a National Requirement*, CRS REPORT FOR CONGRESS (Sept. 6, 2007), https://www.hsdl.org/?view&did=479675

[172] Robert J. Michaels, *supra* note 170, at 91.

[173] Public Utility Regulatory Policies Act, Pub. L. No. 95-617,(1978).

[174] H.R. 969 and 3221, 110th Cong. § 9611(a) (2007).

2.3.5.4 State-Level Renewable Portfolio Standards: The Situation Today

Currently, Twenty nine states and Washington, D.C. have adopted a mandatory RPS (see Figure 5, "Renewable Portfolio Standard Policies," below). The RPS systems across the states have different target RPS percentages, differently define the sources includable as renewables, impose different penalties for failure to comply, as well as other differences. The RPS policies and systems include tiers, or carve-outs for target resources or technologies, as exemplified below. These policies also vary widely in terms of program structure, enforcement instruments, scope, and implementation. No two state policies are exactly the same.[175]

Typically, the RPS programs define an overall target that includes tiers and carve-outs, for example a 20% overall RPS target by 2025 with a 4% carve out for solar or wind. In some cases, state legislation does not include an overall RPS target, so the overall RPS target has to be calculated by combining the separate tiers of RPS. Therefore, in the case specified above, the first tier would include an RPS requirement for all renewables except solar, and the second tier would include only a solar RPS requirement.

For example, Delaware separates its RPS program into two tiers.[176] The first tier includes the main renewable energy requirement, which does not include solar, and the second tier includes a separate RPS requirement for solar power plants.[177]

Massachusetts, as another example, has five tiers in its RPS program. The first tier includes Class I—new renewables installed after December 31, 1997. The second tier includes Class II—existing renewables that were installed prior to December 31, 1997 (except waste-to-energy projects). The third tier is Class II—existing waste-to-energy projects. The fourth and fifth tiers are for solar carve-outs.[178]

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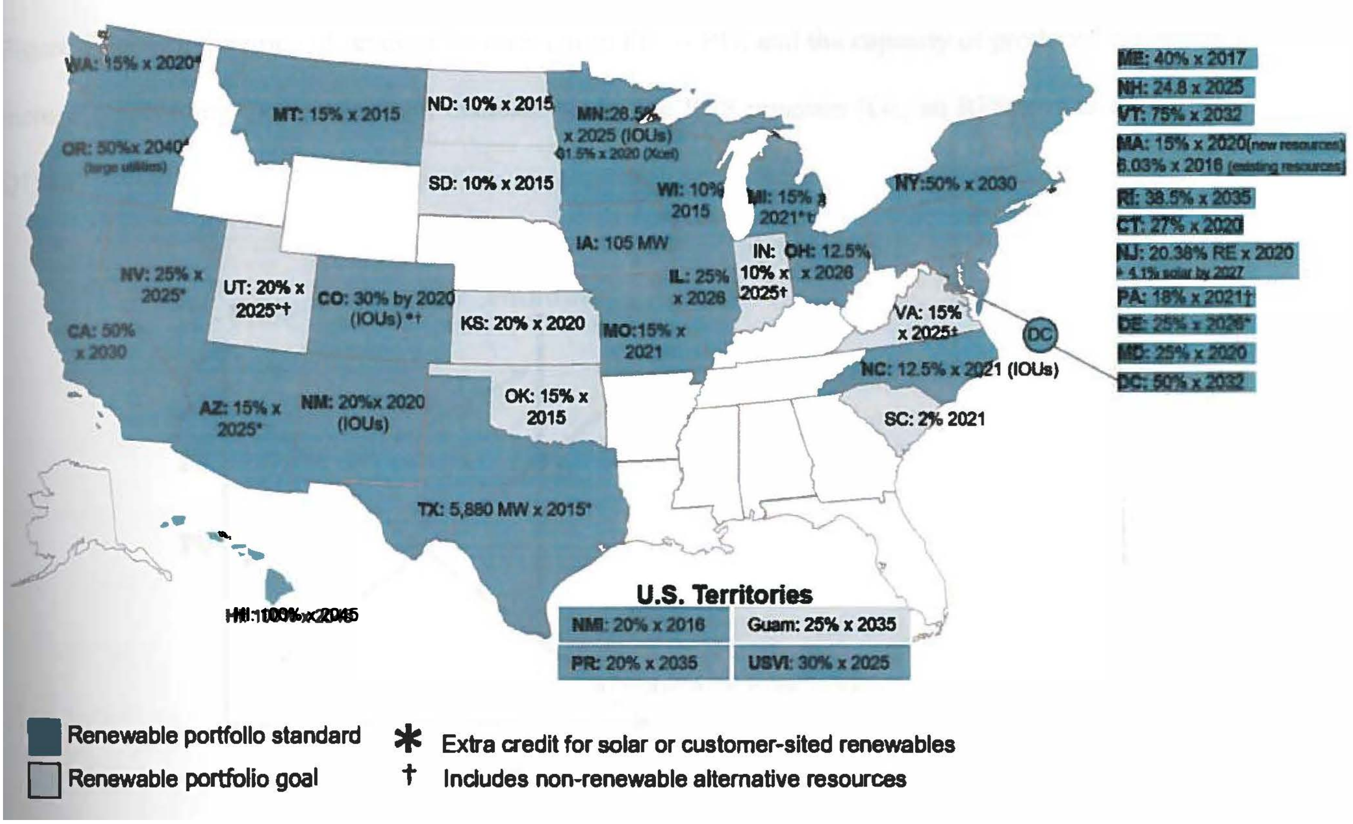
[175] *Energy in Brief: What Are Renewable Portfolio Standards (RPS) and How Do They Affect Renewable Electricity Generation?*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/energy_in_brief/article/renewable_portfolio_standards.cfm (January 28, 2013).

[176] *Renewables Portfolio Standard: Delaware*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/1231 (last updated Jan. 17, 2017).

[177] *Id.*

[178] *Renewable Energy Portfolio Standard (RPS) & Alternative Energy Portfolio Standard Programs (APS)*, MASS. GOV ENERGY & ENVTL. AFFAIRS, http://www.mass.gov/energy/rps (last visited Mar. 23, 2017); *Renewables Portfolio Standard: Massachusetts*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/479 (last updated Dec. 4, 2015).

Another eight states—Utah, North Dakota, South Dakota, Kansas, Oklahoma, Indiana, Virginia and South Carolina—adopted voluntary goals for their RPS systems. A renewable portfolio goal differs from an RPS in that compliance with the objective is voluntary and there are no penalties or sanctions if a retail provider of electricity fails to meet the objective.[179]



[Figure 5, Renewable Portfolio Standard Policies][180]

<u>2.3.5.5 The Effect of an RPS Mandate on the Renewable Energy Market</u>

As described above, an RPS program is a quantity-based system that promotes the development of the renewable market. The government sets a minimum electricity quota for utility companies, which obliges those companies to purchase a specified amount of energy from renewable sources.[181]

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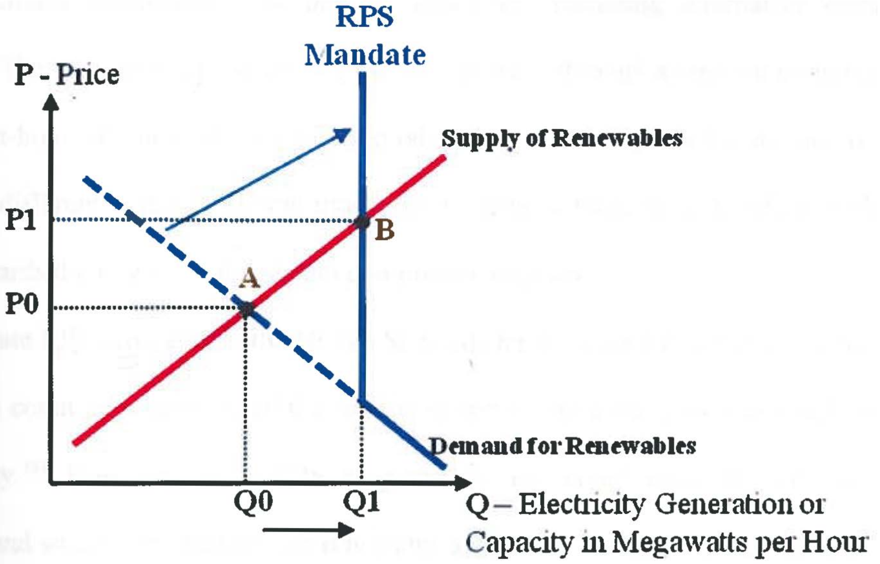
[179] Jocelyn Durkay, *State Renewable Portfolio Standards and Goals*, NAT'L CONFERENCE STATE LEGISLATURES (Dec. 28, 2016), http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

[180] *Database of State Incentives for Renewables & Efficiency*, DSIREUSA.ORG, www.dsireusa.org (last visited Mar. 23, 2017).

[181] JORDAN-KORTE, *supra* note 46.

In economics, the RPS program increases the production of a commodity by setting the demand curve in the market according to the mandate that is set by the program (see Figure 6, "The Effect of an RPS Mandate on Renewable Energy Market," below).

Without any financial incentives for renewables, the new equilibrium shifts from point A to B (see Figure 6 below), the price of renewables rises (from P0 → P1), and the capacity of produced electricity is increased according to the minimum mandate set by the RPS program (*i.e.*, an RPS mandate is equal to Q1).



[Figure 6, The Effect of an RPS Mandate on Renewable Energy Market]

Generally, given a higher cost for generating renewable energy, there is no incentive to produce more than the politically fixed amount in these quantity-based systems.[182] However, the available economic incentives for renewables equalize the competition with fossil-based technologies and provide an additional incentive to produce more electricity from renewable sources beyond the minimum quota.[183]

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[182] *Id.* at 70; *see also* Carlos Batlle et al., *Regulatory Design for RES-E Support Mechanisms: Learning Curves, Market Structure, and Burden-Sharing*, 41 ENERGY POL'Y 212 (2012).

[183] CHRIS HARRIS, ELECTRICITY MARKETS: PRICING, STRUCTURES AND ECONOMICS 434 (2006).

2.3.5.6 RPS Mandate in Practice

Probably not surprisingly, RPS systems in practice are much more complex than the above concept of a single, vertical straight line (*i.e.*, the RPS Mandate line in Figure 6 above) that represents the new demand curve in a renewable energy market.

Typically, RPS programs consist of four major components. First, the RPS sets a target for the percentage of electricity generation or capacity that must be renewable. Second, it directs how quickly that target must be achieved. Third, the RPS defines what sources count as an eligible renewable energy sources. Fourth, it includes compliance and penalty structures (including alternative compliance payment structures).[184] The compliance program is typically enforced through a credit-trading regime of RECs for each megawatt-hour of renewable electricity produced. Accordingly, each state has its own unique RPS program with different targets, different timetables to achieve those targets, different eligible renewables that count towards the targets, and different compliance regimes.

The state RPS programs in the United States differ from each other in many ways.[185] Most of the RPS programs count as renewable all the resources one would expect, such as wind, solar, biomass and hydroelectricity.[186] However, some RPS programs do not count solar thermal, as opposed to solar photovoltaic, and some even include non-renewable sources of energy in the true sense of the word, such as nuclear and even coal.[187]

However, the major difference between the RPS programs is their compliance schedules, which are the driving force of the RPS programs. Figure 7, "RPS Compliance Schedule," below shows the nominal deployment schedule for the 30 states that set a renewable goal as a percentage of all electricity sales. The chart clearly shows that RPS programs require the utilities to purchase a growing amount of renewables

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[184] Davies, *supra* note 25, at 322; Jonathan A. Lesser & Xuejuan Su, *Design of an Economically Efficient Feed-in Tariff Structure for Renewable Energy Development*, 36 ENERGY POL'Y 981, 983 (2008).

[185] Davies, *supra* note 25, at 326.

[186] *Programs*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program (last visited Mar. 23, 2017).

[187] *Alternative Energy Portfolio Standard: Ohio*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/2934 (last updated Feb. 7, 2017); *Voluntary Renewable Energy Portfolio Goal: Virginia*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/2528 (last updated Feb. 8, 2015).

over time.[188] The highest absolute goal is set by Hawaii, at 100% renewable sales to be achieved by 2045.[189] Iowa and Texas have mandated a capacity goal, specifying the construction of a certain quantity of renewable resources.[190]

Also, enforcement of the RPS programs differs among states, varying from the strictest policies, which impose stiff penalties for non-compliance, to relaxed policies that impose none at all.[191] And these are not the only elements that distinguish between various RPS programs. Among other varying design elements are the scope of the RPS program, quotas and subsidies, REC eligibilities and multipliers, and various waivers and exemptions.[192] In other words, each state has its own unique RPS program.

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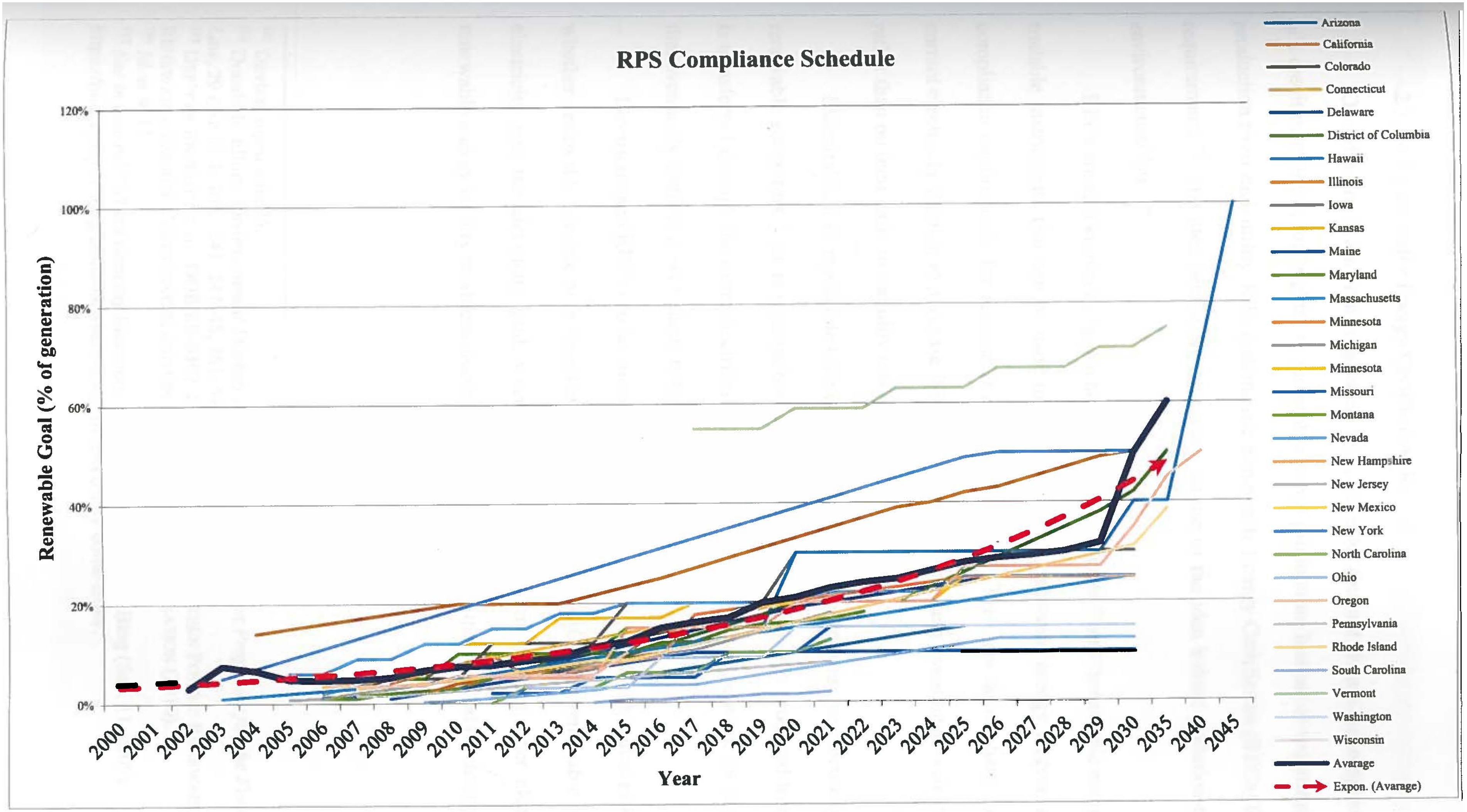
[188] Source: the data was collected from DSIRE website and converted by the author to a chart (*See infra* Figure 7). The data is available at *Programs*, *supra* note 186.

[189] HAW. REV. STAT. § 269-91 (2001, subsequently amended).

[190] IOWA CODE § 476.41(1983, amended 1991, 2003); 16 TEX. ADMIN. CODE § 25.173 (2009); *Alternative Energy Law (AEL): Iowa*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/265 (last updated Dec. 9, 2016).

[191] Davies, *supra* note 25, at 327.

[192] Ryan Wiser et al., *The Experience With Renewable Portfolio Standards in the United States*, ELECTRICITY J., May 2007, at 8.



[Figure 7, RPS Compliance Schedule. States with voluntary and capacity goals are not shown]

2.3.5.6.1 Renewable Energy Certificates (RECs)

One of the most important regulatory tools that often (but not always) accompanies the RPS system is a credit mechanism for "rights" to renewable power production. Instead of requiring renewable energy production from each utility, RPS systems use Renewable Energy Certificates (RECs) for their production requirements.[193] The idea behind RECs is very similar to the idea behind pollution-trading schemes in environmental law.[194]

RECs are also known as "green tags," "green certificates," and "renewable energy credits," and are tradable instruments that can be used to meet voluntary renewable energy targets, as well as to meet compliance requirements for renewable energy policies.[195] Customers do not have to switch from their current electricity supplier to purchase RECs, and they can buy them based on a fixed amount of electricity rather than on their daily or monthly load profile.[196]

Essentially, it is impossible for a customer of green power to consume electricity produced only by renewable generators. That is because both renewable energy and energy produced from coal, oil, and gas is transferred through the same electrical grids (*i.e.*, an interconnected network for delivering electricity) that eventually connect power plants with our homes.[197]

Electricity and RECs can be, and often are sold separately, as an unbundled product. In both cases, whether renewable electricity is bundled or unbundled from RECs, the renewable generator feeds the electricity into the electricity grid, where it mixes with electricity from other electric sources. As a renewable energy facility produces electricity, it creates RECs. If the physical electricity and the associated

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[193] Davies, *supra* note 25.
[194] Donald E. Elliott, *Environmental Markets and Beyond: Three Modest Proposals for the Future of Environmental Law*, 29 CAP. U. L. REV. 245, 247–48, 251–54 (2001).
[195] DEP'T OF ENERGY ET AL., DOE/EE-0307, GUIDE TO PURCHASING GREEN POWER: RENEWABLE ELECTRICITY, RENEWABLE ENERGY CERTIFICATES, AND ON-SITE RENEWABLE GENERATION (2010).
[196] *Id.* at 9–13.
[197] *See in general* "Where does my Electricity Come From?" The EPA Blog (Sep. 11, 2009), https://blog.epa.gov/blog/2009/09/where-does-my-electricity-come-from/.

RECs are sold to separate buyers, the electricity is no longer considered "renewable" or "green," for purposes of meeting the RPS. Therefore, only the REC complies with the requirements of RPS programs.[198]

There are two types of markets for RECs in the United States: compliance markets and voluntary markets.[199] Compliance markets play a significant role in states where mandatory renewable portfolio standards (RPS) are adopted. The electricity providers have to meet a minimum RPS percentage requirement for electricity production from a renewable source, and those who do not meet the minimum requirement can purchase RECs for that purpose. Voluntary RECs are generally created from renewable energy projects that are located in states that do not have in-state requirement for RPS.[200] This voluntary market is driven by corporations, municipalities, and even individuals that decide to purchase RECs for marketing or other purposes.[201] In voluntary markets, customers choose to buy a REC (*e.g.*, renewable electricity/power) by their own will without any state or local requirements.

There are many advantages of tradable RECs in both compliance and voluntary markets, such as alleviation of the strict compliance requirements of some RPS programs; flexibility of RECs purchased through tradable markets, especially when renewable resources unexpectedly fall short in a given compliance period; time to better calculate a utility's investment in its own renewable projects in the future; lower prices for RECs, since some renewable projects might produce more competitive electricity; and obviation of the need for transmission of energy produced from eligible resources, which reduces transmission costs.[202]

Tradable RECs have drawbacks too. RECs are merely pieces of paper, and do not represent the supply of actual green energy to the purchaser of a REC. Consumers might purchase RECs without even getting the benefits of the renewable industry, such as: reduced environmental impacts, a hedge against risk posted by electricity price volatility and fuel supply disruption, and encouragement of new clear energy

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[198] *See generally Green Power Partnership*, EPA, https://www.epa.gov/greenpower (last updated Mar. 25, 2017).
[199] *See infra* Appendix A.2 – "RPS Compliance and Voluntary Markets".
[200] *See infra* Appendix A.2.2 – "Voluntary Markets".
[201] Elec. Mkt. & Policy Grp., *Renewables Portfolio Standards Resources*, LAWRENCE BERKELEY LAB., https://emp.lbl.gov/projects/renewables-portfolio (last visited Apr. 6, 2017).
[202] David Berry, *The Market for Tradable Renewable Energy Credits*, 42 ECOLOGICAL ECON. 369, 371 (2002).

development in the area.[203] This is because the renewable project might be placed in another area or state. Therefore, the clean air benefits and potential job opportunities[204] provided by renewable energy technologies, for example, will not be enjoyed by these consumers. Some state RPS programs do not permit REC trading outside the state, or do not recognize out-of-state RECs to meet the local RPS requirements.[205]

2.3.5.6.2 Prices

Prices in REC markets are subject to demand and supply, which can be influenced by many factors, such as the location of renewable energy facilities, the year the RECs were generated, RPS program compliance, and even the sources from which energy is provided (for example, solar RECs may be more valuable in states that have a separate RPS requirement for solar energy production).[206]

The following pricing charts represent REC pricing in different states. As illustrated below, REC pricing varies by state RPS market and by resource tier or carve-out.

The sales of RECs are an important source of additional revenue for renewable energy generators and the REC pricing is one of the main factors that determine the amount of such revenue. At the same time, it also represents an additional cost of compliance to utilities and customers that are subject to RPS obligations. Figure 8 below focuses on spot market REC pricing trends for RPS states with active REC trading, recognizing that spot market transactions may represent only a portion of total compliance obligations.[207] Since the sales of RECs are an additional source of income for renewable projects, the price volatility in REC market represents one of the challenges the investors in renewables face when they contemplate investing in a renewable energy project.

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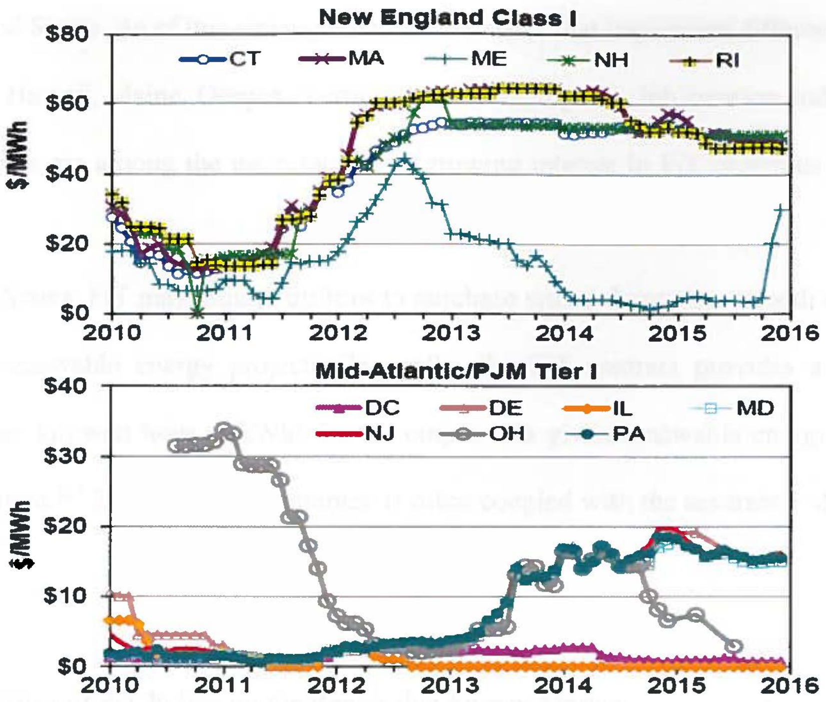
[203] *See generally Guide to Purchasing Green Power, Renewable Electricity, Renewable Energy Certificates, and On-Site Renewable Generation*, EPA (March 2010), at 5. https://www.epa.gov/sites/production/files/2016-01/documents/purchasing_guide_for_web.pdf; *Renewable Energy Certificates, Benefits of RECs*, https://www.nexteraenergyresources.com/what/marketing_rec.shtml (last updated Aug. 21, 2017).

[204] *See infra* note 212. *Also,* according to *U.S. Energy and Employment Report by Department of Energy* (Jan. 2017), The solar workforce increased by 25% in 2016, and wind employment increased by 32%. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf.

[205] *Id.*

[206] *See generally Database of State Incentives for Renewables & Efficiency*, *supra* note 180.

[207] BARBOSE, *supra* note 20.



[Figure 8, REC Trading][208]

2.3.5.7 FiT Overview

A feed-in tariff (FiT) is a policy mechanism designed to accelerate investment in the renewable energy market. FiTs are not "quantity-based" laws (like RPS) but rather are "price-based" measures that influence demand for renewables indirectly (*i.e.*, influencing the generation of electricity through prices).[209] Electricity utilities are obligated under a FiT to buy renewable electricity at above-market rates set by a local government.[210]

FiT policies are implemented in more than 40 countries around the world and are notably successful in Europe.[211] As a result of this success in Europe, a number of states have considered FiT legislation or

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[208] *Id.*

[209] David Jacobs, *Fabulous Feed-in Tariffs*, RENEWABLE ENERGY FOCUS, July–Aug. 2010.

[210] *Feed-in Tariffs*, NAT'L RENEWABLE ENERGY LAB., http://www.nrel.gov/tech_deployment/state_local_governments/basics_tariffs.html (last visited Apr. 24, 2017).

[211] KARLYNN CORY ET AL., NAT'L RENEWABLE ENERGY LAB., TECHNICAL REPORT NREL/TP-6A2-45549, FEED-IN TARIFF POLICY: DESIGN, IMPLEMENTATION, AND RPS POLICY INTERACTIONS (2009); WILSON RICKERSON & ROBERT GRACE, HEINRICH BOLL FOUND., THE DEBATE OVER FIXED PRICE INCENTIVES FOR RENEWABLE ELECTRICITY IN EUROPE AND THE UNITED STATES: FALLOUT AND FUTURE DIRECTIONS (2007).

regulation in the United States. As of this writing, there are six states that implement different kinds of FiT programs (California, Hawaii, Maine, Oregon, Vermont, and Washington). Job creation and effectiveness in promoting renewables are among the main factors of growing interest in FiT programs in the United States.[212]

In the United States, FiT may require utilities to purchase either electricity, or both electricity and RECs from eligible renewable energy projects. Typically, the FiT contract provides a guarantee of payments in dollars per kilowatt hour ($/kWh) for the output of a given renewable energy project for a guaranteed period of time.[213] This payment guarantee is often coupled with the assurance of access to the grid.[214]

2.3.5.8 The Effect of FiT Policy on the Renewable Energy Market

As mentioned above, the government sets a minimum FiT price at which all electricity produced from renewables must be purchased by load-serving entities (or utilities). In economics, the FiT policy increases the production of a commodity by setting the demand curve in the market according to the mandated price that is set by the program (see Figure 9, "The Influence of a FiT Policy on Renewable Market," below).

Without any financial incentives for renewables, the new equilibrium shifts from point A to B, the capacity of renewables rises (Q0 → Q1), and the price of electricity is increased according to the minimum mandate that was set by the FiT program (*i.e.*, Min P1).

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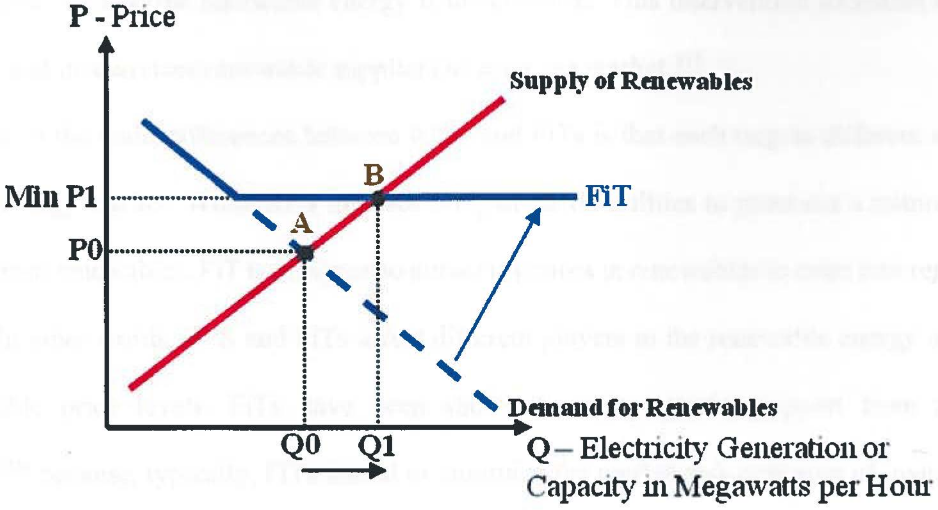
[212] Paul Gipe, *Indiana Rep. Introduces Feed Law Bill & Wisconsin PSC Opens Docket on Renewable Tariffs*, RENEWABLE ENERGY WORLD (Jan. 21, 2009), http://www.renewableenergyworld.com/articles/2009/01/indiana-rep-introduces-feed-law-bill-wisconsin-psc-opens-docket-on-renewable-tariffs-54546.html; *Feed-in Tariffs*, NAT'L RENEWABLE ENERGY LAB., *supra* note 210.

[213] CORY ET AL., *supra* note 211, at 2.

[214] ROBERT GRACE, WILSON RICKERSON & KARIN CORFEE, CAL. ENERGY COMM'N, PUB. NO. CEC-300-2008-009D, CALIFORNIA FEED-IN TARIFF DESIGN AND POLICY OPTIONS (2008).



[Figure 9, The Influence of a FiT Policy on Renewable Market]

Generally, given a higher cost for generating renewable energy, there is no incentive to purchase more electricity from renewable sources than the amount required by the policy.[215]

2.3.5.9 FiT Policies in Practice

Similar to RPS programs, FiT policies in practice are much more complex than the above illustration of a single, horizontal straight line that represents the new demand curve in the renewable energy market.

Typically, FiT policies consist of three major components. First, the FiT sets the minimum price that will be paid for renewable-based electricity. Second, a FiT contract determines how long that price will be offered. Third, a tariff specifies that electricity suppliers must purchase the renewable energy produced.[216] The government intervenes in the renewable energy market by signaling (*i.e.*, setting a minimum price) to the suppliers of renewables that the price for the production of renewable electricity

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[215] It should be noted that the policy design of FiT programs does not include RECs. RECs are an RPS compliance mechanism.

[216] Davies, *supra* note 90, at 68–74.

must be higher because the renewable energy is undervalued. This intervention increases the demand for renewables and incentivizes renewable suppliers to enter the market.[217]

One of the main differences between RPSs and FiTs is that each targets different segments of the renewable energy market. While RPS imposes obligations on utilities to purchase a minimum amount of electricity from renewables, FiT is designed to attract investors in renewables to enter into renewable energy market.[218] In other words, RPS and FiTs affect different players in the renewable energy market.[219] Also, at comparable price levels, FiTs have been shown to enjoy greater support from the investment community[220] because, typically, FiTs intend to minimize the market-risk exposure of investors.[221]

Similar to RPS systems, FiT policies are also diverse. FiT policies can be broken down into four basic policy approaches.[222] The most effective approach is the cost-based approach, which is the most widely implemented approach globally.[223] Furthermore, each FiT policy can be further broken down based on different tariff levels for different renewable technologies (*e.g.*, wind, solar, and photovoltaics).[224] The most challenging issue that FiT policymakers face is setting tariff levels correctly.[225] If a tariff price is set too high, the producers of renewable energy will get a windfall of unjustified profits, which consequently increases the compliance costs of the policy. On the other hand, if a tariff price is set too low, the FiT policy might become ineffective in attracting new investors.[226]

If that is not enough to think about, policymakers also need to determine the tariff's duration and whether it should include caps or other limitations on the tariff rates. If the tariff's duration is too long, the renewable energy producers will receive a windfall benefit, but if its duration is too short, the FiT policy

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[217] Davies, *supra* note 25, at 324; David Grinlinton & LeRoy Paddock, *The Role of Feed-in Tariffs in Supporting the Expansion of Solar Energy Production*, 41 U. TOL. L. REV. 943, 945–56 (2010).
[218] Davies, *supra* note 25, at 325.
[219] *Id.* at 326.
[220] Bürer & Wüstenhagen, *supra* note 89.
[221] See Felix Mormann, *Enhancing the Investor Appeal of Renewable Energy*, 42 ENVTL. L. 681, 701 (2012).
[222] *See infra* Appendix A.3 – "FiT Payment Structures".
[223] *Id.*
[224] CORY ET AL., *supra* note 211, at 9–11.
[225] *See infra* Chapter 4.3.3.
[226] Davies, *supra* note 25, at 329; Lesser & Su, *supra* note 184, at 983.

becomes ineffective in attracting new renewable developers.[227] To limit the costs of a policy, some FiT policymakers have incorporated price caps and price floors.[228] Without these kinds of limitations, FiTs may become over-subscribed and over-funded, which can lead the renewable technology toward a dangerous boom-and-bust cycle.[229] *See infra* Appendix A.3 for some of the most common FiT payment structures and designs.

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[227] TOBY D. COUTURE ET AL., NAT'L RENEWABLE ENERGY LAB., TECHNICAL REPORT NREL/TP-6A2-44849, A POLICYMAKER'S GUIDE TO FEED-IN TARIFF POLICY DESIGN 7 (2010).

[228] *See infra* Appendix A.3 – "FiT Payment Structures" for more detailed discussion of FiT Payment Structures.

[229] Davies, *supra* note 25, at 330; Robin J. Lunt, Comment, *Recharging U.S. Energy Policy: Advocating for a National Renewable Portfolio Standard*, 25 UCLA J. ENVTL. L. & POL'Y 371, 393 N.109 (2007).

Chapter 3

3. New Evaluation Model for the Renewable Energy Market

"Models are at bottom tools for approximate thinking; they serve to transform your intuition about the future . . . . You must start with models and then overlay them with common sense and experience."

-The Financial Modelers' Manifesto by Emanuel Derman and Paul Wilmott[230]

3.1 Introduction to Tax Modeling

When we think about a tax model,[231] one should ask what we can learn from this model about the real world. In this Chapter, I present a tax model that tries to address *how* it is meant to inform us about the world and the *mechanism by which* it teaches us about the world. The real world in our case is the U.S. renewable energy market.

This model is intended to be used as a general guide to policy and law.[232] It is not presented as the basis for specific, detailed economic recommendations, but rather as support for a general approach to renewable energy policy.[233] Sometimes, scholarship that uses economic models does not explain how the model connects to the real world.[234] And sometimes, a model's assumptions are too far from reality, and therefore the model is not useful. As Alex Raskolnikov noted, "economic theory has a much weaker connection to the content of our tax laws and their enforcement than it does to the content and enforcement of many other legal regimes".[235]

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[230] Emanuel Derman & Paul Wilmott, *The Financial Modelers' Manifesto* (Jan. 7, 2009), http://www.uio.no/studier/emner/sv/oekonomi/ECON4135/h09/undervisningsmateriale/FinancialModelersManifesto.pdf.

[231] *See in general* Roberta F. Mann, *Economists are from Mercury, Policymakers are from Saturn: The Tax Policy Implications of Communication Failure*, 5 Wm & Mary Pol. Rev. 1 (2013).

[232] *See, e.g.*, Eric A. Posner, *Law and Social Norms: The Case of Tax Compliance*, 86 VA. L. REV. 1,781, 1,783 (2000) (referring to the statement, and a discussion of its implications, as a model).

[233] Sarah B. Lawsky, *How Tax Models Work*, 53 B.C. L. REV. 1657 (2012).

[234] *See, e.g.*, DANIEL M. HAUSMAN, THE INEXACT AND SEPARATE SCIENCE OF ECONOMICS 221 (1992); Robert Sugden, *Credible Worlds: The Status of Theoretical Models in Economics*, 7 J. ECON. METHODOLOGY 1, 33 (2000) (noting, in a discussion of two prominent models, "on closer inspections of the texts, it is difficult to find any explicit connection being made between the models and the real world").

[235] Alex Raskolnikov, *Accepting the Limits of Tax Law and Economics*, 98 CORNELL L. REV. 523 (2013), at 523.

Nevertheless, I will not only present the mechanics of the proposed model but also apply the model to the real world through data available on the U.S. renewable energy market. In other words, the model, through deductive reasoning, is intended to provide policymakers information about the U.S. renewable energy market. The goal of the model is to advance scholarship in the renewable energy field and to describe the effects of economic and regulatory incentives on the renewable energy market. Also, the model could be used to make recommendations about an appropriate renewable energy policy.[236] Generally, the data collected from the U.S. Energy Information Administration (U.S. Department of Energy),[237] Analytical Perspectives, Budget of the U.S. Government,[238] Joint Committee on Taxation,[239] and Lawrence Berkeley National Laboratory[240] support the mechanics and conclusions of this model. Finally, perhaps as any other model, the proposed model has its assumptions and limitations, which will be discussed in this Chapter.

3.2 Evaluation Model for the Renewable Energy Market

3.2.1 Theory and Hypotheses – Introduction

A renewable energy market has characteristics similar to any other economic market with its own supply and demand curves (see [Figure **10**, "A Basic Renewable Energy Market," below). The demand and supply curves are mapped onto a two-dimensional space; the y-axis captures price (P) of renewable electricity (*i.e.*, \$X per kilowatt per hour) and the x-axis represents the capacity or generation (Q) of renewable energy.

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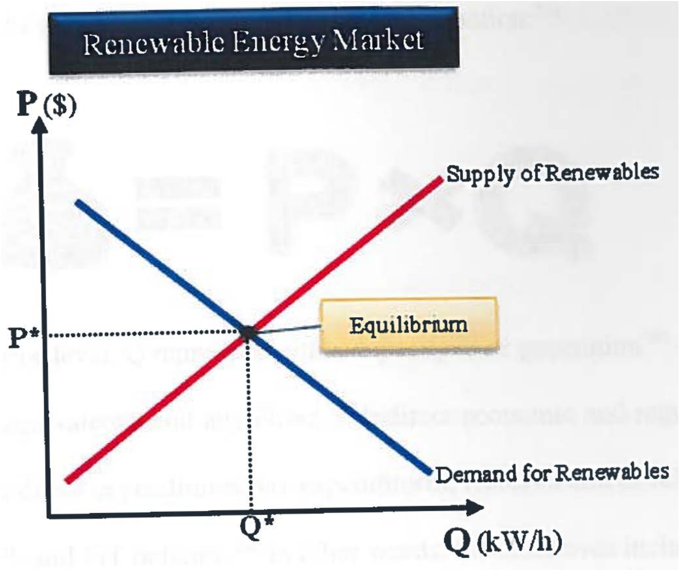
[236] *See e.g.*, Milton Friedman, *The Methodology of Positive Economics*, *in* ESSAYS IN POSITIVE ECONOMICS 3 (1953); Lawsky, *supra* note 233, at 1,691; Richard A. Posner, *The Economic Approach to Law*, 53 TEX. L. REV. 757, 763 (1975); Jeanne L. Schroeder, *Just So Stories: Posnerian Methodology*, 22 CARDOZO L. REV. 351, 355 (2001).

[237] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS AND SUBSIDIES 2013, *supra* note 136.

[238] U.S. Office of Mgmt. & Budget, *Budget of the United States Government – Analytical Perspectives, Fiscal Years 1995–2015*, FED. RESERVE ARCHIVAL SYS. FOR ECON. RESEARCH (FRASER), https://fraser.stlouisfed.org/title/425#7281 (last visited Apr. 8, 2017) (providing annual budget reports for fiscal years 1995–2017).

[239] STAFF OF JOINT COMM. ON TAXATION, 113TH CONG., ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2012–2017 (Joint Comm. Print 2013) [hereinafter FEDERAL TAX EXPENDITURES 2012–2017]; STAFF OF JOINT COMM. ON TAXATION, 111TH CONG., ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2010–2014 (Joint Comm. Print 2010) [hereinafter FEDERAL TAX EXPENDITURES 2010–2014].

[240] Elec. Mkt. & Policy Grp., *Renewables Portfolio Standards Resources*, *supra* note 201.



[Figure 10, A Basic Renewable Energy Market]

The interception point between the supply and demand curves represents equilibrium, *i.e.*, Q* kW/h of electricity will be sold for P* dollars (see Figure 10 above). Consumers pay money ($) in exchange for the value of the electricity provided by renewable energy projects. The value is calculated by multiplying the price for (P) and the quantity of (Q) renewable electricity (PxQ).

In the center of the proposed model is the following equation:[241]

P represents a price level, Q represents either capacity[242] or generation[243] of renewable energy and $ represents cash, cash equivalents, and any direct or indirect economic and regulatory incentives. These incentives might include direct expenditures, tax expenditures, research and development incentives, DOE loan guarantees, and RPS and FiT policies.[244] In other words, the incentives include both market push and pull policies.[245]

It should be noted that the price (P) and capacity/generation (Q) parameters are evaluated from the renewable energy project perspective. Therefore, if the model suggests that the price was increased, it means that the renewable energy project investors received a higher value (in dollars) per kWh that was generated by the project. The price that a utility company pays for renewable energy might not change, but if we take into account indirect incentives and grants infused into the renewable project, the overall price that taxpayers pay per kWh of renewable energy is increased.

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[241] The value of production and sales (PxQ) is one of the basic concepts of classical economists (1800-1940). *See* N. GREGORY MANKIW, MACROECONOMICS (8th ed. 2012).

[242] Generator nameplate capacity is defined as the "maximum rated output of a generator, prime mover, or other electric power production equipment under specific conditions designated by the manufacturer. Installed generator nameplate capacity is commonly expressed in megawatts (MW) and is usually indicated on a nameplate physically attached to the generator." *See Glossary*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/glossary/index.cfm?id=g (last visited Apr. 6, 2017).

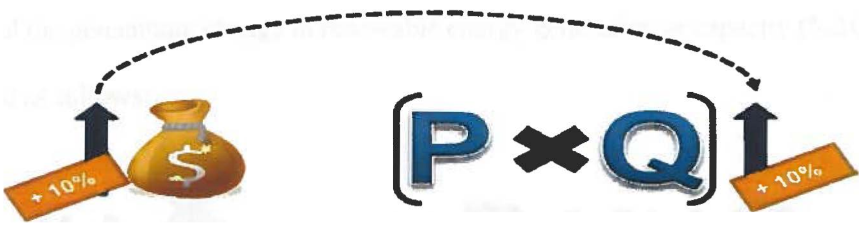
[243] Generation is the amount of electricity a renewable energy project produces over a specific period of time. For example, a generator with 1 megawatt (MW) nameplate capacity that operates at only 50% of that capacity for one hour, it will produce 0.5 MWh of electricity. Many generators do not operate at their full capacity all the time. A generator's output may vary according to conditions at the project, fuel costs, and/or as instructed by the electric power grid operator. *See Frequently Asked Questions: What Is the Difference Between Electricity Generation Capacity and Electricity Generation?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.cfm?id=101&t=3 (last updated Mar. 10, 2017).

[244] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS AND SUBSIDIES 2013, *supra* note 136.

[245] *See supra* Chapter 2.3.3.

For example, if we spend $1,000 ($) in the renewable energy market (the left side of the equation), then the value of the renewable energy produced and sold is on the other side of the equation (P x Q), which is equal to $1,000. When we go to the cash registers or financial statements of the renewable energy projects, we will find $1,000. Therefore, if $1,000 is spent in the renewable energy market, this $1,000 will have to appear in the financial statements of renewable energy projects.

The direction of causation runs from left to right. An increase in $ will lead to an exactly proportionate increase in (P x Q). Therefore, if there is a 10% change in $, then it shows up as a 10% change in PxQ.[246] One of the assumptions is that economic and financial incentives (*i.e.*, an increase in $) can be fully utilized by the renewable energy projects.[247]



When (PxQ) increases by 10%, it will appear either as an increase in P, an increase in Q, or a combination of both P and Q. In our example, if the government increases an economic incentive by $100 (10% x $1,000), the outcome *is not* necessarily an increase in renewable energy capacity (or simply said, a deployment of new renewable energy projects) (Q) by 10%. Many scholars focus on Q, assuming that a

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[246] Similar concepts are used in the money market as part of the quantity theory of money. *See* IRVIN FISHER, THE PURCHASING POWER OF MONEY: ITS DETERMINATION AND RELATION TO CREDIT, INTEREST AND CRISES (1911); Emmanuel I.S. Ajuzie et al., *Import Response and Inflationary Pressures In the New Economy: The Quantity Theory of Money Revisited*, 6 J. BUS. & ECON. RES. 125 (2008).

[247] The author is aware of the fact that not all economic incentives (such as tax credits and depreciation deductions) can be utilized by renewable energy producers. For example, consider a case where a renewable project is not profitable: since there is no tax liability associated with the project, tax credits cannot be utilized to offset that (nonexistent) tax liability. Also, the need to enter into complex transactions to obtain the tax benefits reduces efficiency and drives up the financing charges and transaction costs in the renewable energy market. "In other words, the value of tax credits lies in their capacity to reduce tax liability and lower tax bills." Felix Mormann, *Beyond Tax Credits: Smarter Tax Policy for a Cleaner, More Democratic Energy Future*, 31 YALE J. ON REG. 303 (2014); *Historic Boardwalk Hall, LLC v. Commissioner*, 694 F.3d 425 (3d Cir. 2012), cert. denied, 133 S.Ct. 2734 (2013); Rev Proc. 2014-12, 2014-3 I.R.B 415 (12/30/2013). *See also* STANLEY S. SURREY, PATHWAYS TO TAX REFORM 134 (1973) (discussing the inequities from tax incentives' greater value for high-income as compared to low-income taxpayers); Alvin C. Warren & Alan J. Auerbach, *Transferability of Tax Incentives and the Fiction of Safe Harbor Leasing*, 95 HARV. L. REV. 1752, 1758–59 (1982) (describing the difficulties that start-up and loss companies confront in using tax credits and depreciation deductions).

direct investment in the renewable energy market will necessarily increase Q; however, in reality, the correct analysis takes into consideration both the renewable growth parameter—Q and the price parameter—P. Therefore, theoretically, an economic incentive of $100 in the renewable energy market may also produce a result where Q *will not* increase, or even decrease, due to the corresponding increase in price P (*e.g.*, $100 = 100 (P) x 1(Q); $100 = 10(P) x 10(Q) or $100 = 1(P) x 100(Q)). Clearly, there are many combinations of P and Q that can represent $100. In other words, an increase in governmental expenditures in the renewable energy market, in some cases, might have no effect on the actual deployment of new renewable energy projects (Q).

Thus, a percentage change in economic incentives (%Δ$) equals the sum of the percentage change in price (%ΔP) and the percentage change in renewable energy generation or capacity (%ΔQ). This concept can be represented as follows:

$$\%\Delta\$ = \%\Delta P + \%\Delta Q$$

"%Δ" represents a percentage change (increase/decrease) of: (1) $ – financial incentives; (2) P – price; and (3) Q – renewable energy generation or capacity.

Mathematically, the above equation can be represented by using a natural logarithm[248] as follows:

$$\ln(P \times Q) = \ln(P) + \ln(Q)$$

Accordingly, if we know the percentage change of financial incentives (%Δ$) and the percentage change of renewable energy capacity (%ΔQ), this equation can help us evaluate the percentage change of price (%ΔP).[249]

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[248] Natural logarithm (ln) is defined as the inverse of e^x. *E* and ln are twins – (1) e^x is the amount of continuous growth after a certain amount of time and (2) natural logarithm (ln) is the amount of time needed to reach a certain level of continuous growth. *See* MORRIS KLINE, CALCULUS: AN INTUITIVE AND PHYSICAL APPROACH 337 (unabr. repub., Dover 1998) (2d ed. 1977).

[249] In general, economists use logarithms and percentage changes to approximate the relationships between economic variables (*i.e.*, P and Q). For example: ln(P) + ln(Q) = Percentage change in (PXQ). *See Rules for*

3.2.2 The Proposed Model – Hypotheses

Development of the proposed model was mainly prompted by the following question: If the government decides to increase economic incentives (↑%Δ$) for the renewable energy market, how much is it going to effectuate an increase (if any) in the deployment of new renewable energy projects (↑%ΔQ) and how much is it going to be reflected as an increase in price (↑%ΔP)?

The Budget of the U.S. Government for fiscal year 2015 states the following:

> "The administration is committed to a future where the United States leads the world in research, development, demonstration and deployment of clean-energy technologies . . . . The Budget requests approximately $6.9 billion for clean energy technology programs government-wide . . . . Within EERE [Energy Efficiency and Renewable Energy], the Budget increases funding by 15 percent above 2014 enacted levels for sustainable vehicle and fuel technologies, by 39 percent for energy efficiency and advanced manufacturing activities, and by 16 percent for innovative renewable power projects such as those in the SunHot Initiative to make solar power directly price-competitive with other forms of electricity by 2020."[250]

Clearly, the goal of that budget request was to promote real growth in deployment of new renewable energy projects in the United States (↑%ΔQ). At least with respect to the President Obama's administration, this was the goal of the U.S. government, and through economic incentives (↑%Δ$), the government tries to achieve that goal.[251] Clearly, this goal might undergo significant changes under the President Trump's administration.[252]

Exponents, PITT.EDU, http://www.pitt.edu/~mgahagan/Exponent.htm (last visited Apr. 7, 2017). *See also* ANDREW GELMAN & JENNIFER HILL, DATA ANALYSIS USING REGRESSION AND MULTILEVEL/HIERARCHICAL MODELS 60–61 (2007); James Hamilton, *Use of Logarithms in Economics*, ECONBROWSER BLOG (Feb. 23, 2014), http://econbrowser.com/archives/2014/02/use-of-logarithms-in-economics.

[250] U.S. OFFICE OF MGMT. & BUDGET, FISCAL YEAR 2015 ANALYTICAL PERSPECTIVES: BUDGET OF THE U.S. GOVERNMENT (2014).

[251] *Id.*

[252] *See supra* notes 51 - 59 and accompanying text.

RPS policies have been one of the main drivers for renewable energy growth in the United States.[253] Collectively, 58% of all non-hydroelectric renewable energy capacity built in the United States from 1998 through 2014 is being used to meet RPS requirements.[254] In the aggregate, existing state RPS policies require that by 2025, at which point most RPS requirements will have reached their maximum percentage targets, at least 8.4% of total U.S. generation supply will be met with RPS-eligible forms of renewable electricity, equivalent to roughly 106 gigawatts (GW) of renewable generation capacity.[255] RPS demand could require an additional 60 GW of renewable generation capacity by 2030, roughly a 50% increase from current non-hydro renewable generation capacity (114 GW though 2015).[256]

RPS policies will be used as a reference point in the following proposed model due to their significant contribution to renewable energy development in the United States.

The proposed model is mapped in a two-dimensional space: the y-axis represents the aggregate nameplate capacity or generation of renewable energy (in gigawatts), and the x-axis represents time (in years) (see Figure 11, "The Proposed Model," below).

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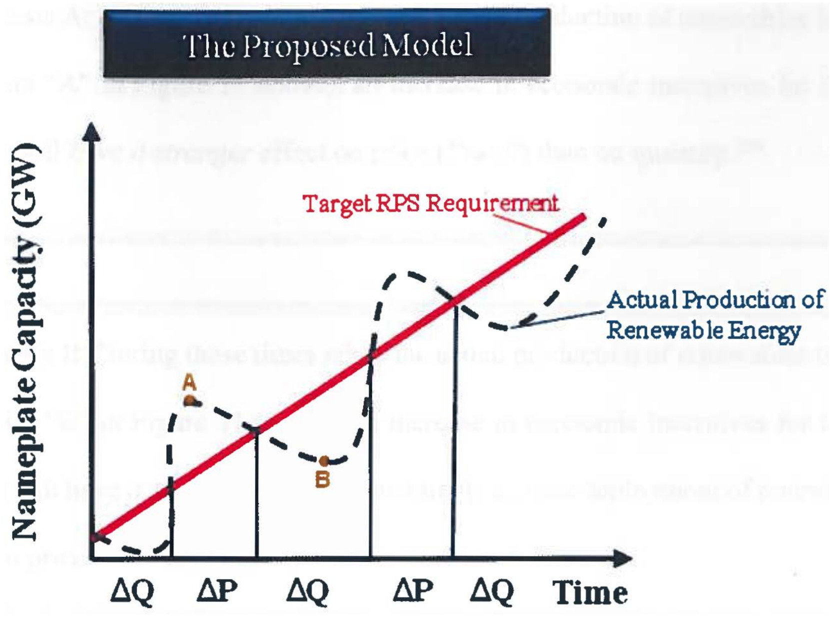
[253] *See supra* Chapter 2.3.5.2.

[254] RYAN WISER ET AL., LAWRENCE BERKELEY NAT'L LAB. & NAT'L RENEWABLE ENERGY LAB., TECHNICAL REPORT NREL/TP-6A20-65005, A RETROSPECTIVE ANALYSIS OF THE BENEFITS AND IMPACTS OF U.S. RENEWABLE PORTFOLIO STANDARDS (2016); Galen Barbose, Address at National RPS Summit: Renewables Portfolio Standards in the United States: A Status Update (2015).

[255] *See* U.S. Energy Information Administration, EIA; https://www.eia.gov/tools/faqs/faq.php?id=427&t=3 (last updated Apr. 18, 2017); RYAN H. WISER & MARK BOLINGER, DEP'T OF ENERGY, LBNL-188167, 2014 WIND TECHNOLOGIES MARKET REPORT (2015).

[256] BARBOSE, *supra* note 20.



[Figure 11, The Proposed Model]

The red line in the model represents the aggregate minimum RPS requirement in the United States. Since the RPS policies require utility companies to meet a *growing* portion of their load with renewables,[257] the aggregate generation or capacity of renewable energy grows over time. The blue dashed line in the model represents actual aggregate production of renewable energy.

Over time, in the renewable energy market presented in Figure 11 above, sometimes the actual aggregate production of renewables is *under* the minimum RPS target (see Point "B" in Figure 11 above), representing under-compliance with the RPS, and sometimes the actual aggregate production of renewables is *above* the minimum RPS target (*see* Point "A" in Figure 11 above), representing over-compliance with the RPS. In other words, under-compliance means that the renewable energy market produces *less* electricity from renewable energy sources than the minimum required under the RPS policies, and over-compliance means that the renewable energy market produces *more* electricity from renewable energy sources than the minimum required under the RPS policies.

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[257] WISER ET AL., *supra* note 254.

Hypothesis A: During those times when the actual production of renewables is *above* the minimum RPS target (Point "A" in Figure 11 above), an increase in economic incentives for the renewable energy market (↑%Δ$) will have *a stronger* effect on price (↑%ΔP) than on quantity.[258]

Hypothesis B: During those times when the actual production of renewables is *below* the minimum RPS target (Point "B" in Figure 11 above), an increase in economic incentives for the renewable energy market (↑%Δ$) will have *a stronger* effect on quantity (*i.e.*, new deployment of renewable energy projects) (↑%ΔQ) than on price.[259]

3.2.3 Methods and Data Collection

To test the above hypotheses, I examined the renewable energy market along with the renewable energy policies in the United States. Market push and pull policies remain the preeminent drivers of renewable capacity deployment.[260] RPS policies and direct and indirect economic incentives are the most widely used policy instruments to encourage the development of renewable resources in the United States.[261]

To analyze the model, I collected data about the target RPS requirement and compared it to the actual production of renewable energy in states that are subject to RPS policies. Most of the data was collected from the U.S. Energy Information Administration (U.S. Department of Energy),[262] National

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[258] It should be noted that this **does not** mean that quantities (Q) are not affected. The hypothesis states that the *degree* of change in price would be higher than the *degree* of change in quantities.

[259] It should be noted that this **does not** mean that price (P) is not affected. The hypothesis states that the *degree* of change in quantities would be higher than the *degree* of change in price.

[260] *See supra* Chapter 2.3.3.

[261] *See supra* Chapters 2.3.3–2.3.5.

[262] U.S. ENERGY INFO. ADMIN., http://www.eia.gov/ (last visited Apr. 7, 2017).

Renewable Energy Laboratory (NREL),[263] Berkeley Lab Electricity Markets and Policy Group,[264] and DSIRE Database of State Incentives for Renewables & Efficiency.[265]

Also, I contacted Galen Barbose from the Lawrence Berkeley National Laboratory, who kindly provided the underlying data that was part of the U.S. Renewables Portfolio Standards 2016 Annual Status Report.[266] The report was funded by the National Electricity Delivery Division of the Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy.[267]

In order to evaluate the direct and indirect economic incentives that are available to the renewable energy market, *i.e.*, market push policies,[268] I reviewed the Budget of the United States Government – Analytical Perspectives for fiscal years 2000 through 2016,[269] Estimates of Federal Tax Expenditures for Fiscal Years 2010-2014 and 2012-2017, Joint Committee on Taxation,[270] the Energy Information Administration (EIA) reports on Federal Financial Interventions and Subsidies in Energy Markets 2007, 2010 and 2013,[271] EIA Annual Energy Outlooks,[272] and other official data sources.[273]

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[263] *State & Local Governments: Renewable Portfolio Standards*, NAT'L RENEWABLE ENERGY LAB., http://www.nrel.gov/tech_deployment/state_local_governments/basics_portfolio_standards.html (last updated July 6, 2015).

[264] Elec. Mkt. & Policy Grp., *Renewables Portfolio Standards Resources*, *supra* note 201.

[265] *Database of State Incentives for Renewables & Efficiency*, *supra* note 180.

[266] BARBOSE, *supra* note 20.

[267] *Id.* A spreadsheet with the data is on file with the author and available upon request.

[268] *See supra* Chapter 2.3.3.

[269] U.S. Office of Mgmt. & Budget, *supra* note 238.

[270] STAFF OF JOINT COMM. ON TAXATION, 113TH CONG., ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2012–2017 (Joint Comm. Print 2013); STAFF OF JOINT COMM. ON TAXATION, 111TH CONG., ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2010–2014 (Joint Comm. Print 2010).

[271] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS AND SUBSIDIES 2013, *supra* note 136; U.S. ENERGY INFO. ADMIN., DIRECT FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY IN FISCAL YEAR 2010 (2011) [hereinafter FEDERAL INTERVENTIONS 2010]; U.S. ENERGY INFO. ADMIN., SR/CNEAF/2008-01, FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY MARKETS 2007 (2008) [hereinafter FEDERAL INTERVENTIONS 2007].

[272] U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2015, *supra* note 148.

[273] *See also* CLEAN ENERGY STATES ALLIANCE, http://cesa.org/ (last visited Apr. 7, 2017); U.S. DEP'T ENERGY, https://www.energy.gov (last visited Apr. 7, 2017).

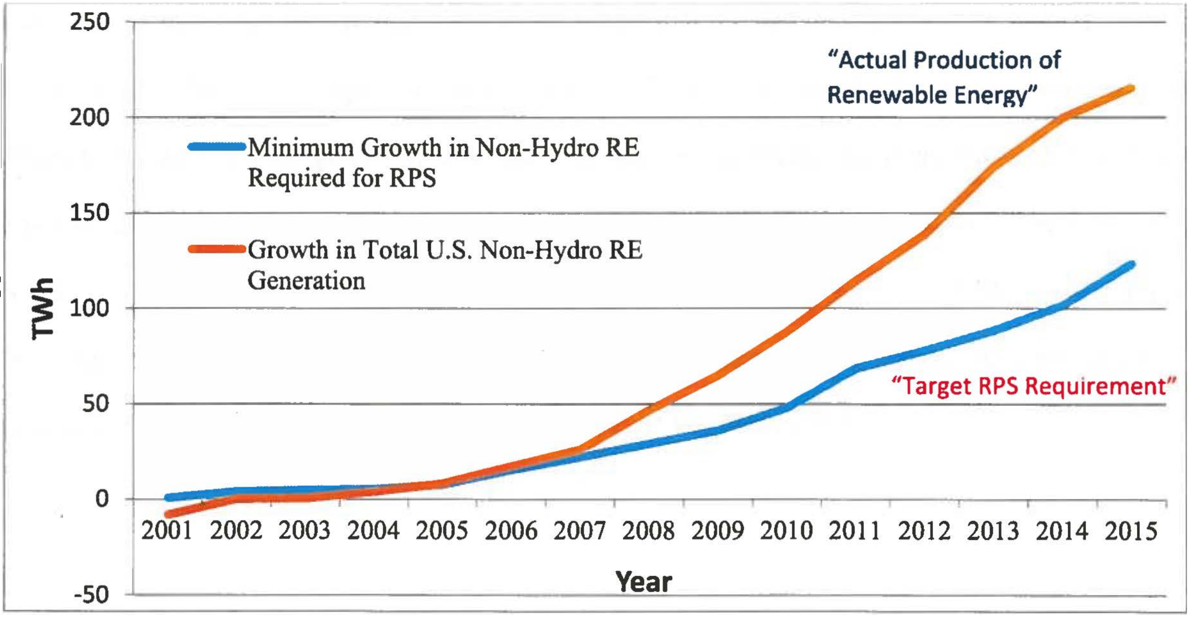
3.2.4 Data Analysis

This section leaps from the theoretical model into the real world of the U.S. renewable energy market.

The first step was to find the Target RPS Requirement and compare it to the Actual Production of Renewable Energy. This way we should learn when the actual production of renewable energy was *above* the target RPS requirement and when it was *below* the target RPS requirement (see Figure 11 above).

According to the U.S. Renewable Portfolio Standards 2016 Annual Status Report,[274] from 2000 until 2005, the growth in Total U.S. Non-Hydro RE Generation (*i.e.*, "Actual Production of Renewable Energy") was *below* the Minimum Growth in Non-Hydro RE Generation (*i.e.* ,"Target RPS Requirement") (see Figure 12, "Growth in U.S. Non-Hydro Renewable Generation (Terawatt-hour/TWh)," below). This is equivalent to point "B" in the proposed model.

However, from 2005 until 2015, the growth in total U.S. Non-Hydro RE Generation was *above* the Minimum Growth in Non-Hydro RE Generation. And this is equivalent to point "A" in the proposed model.



[Figure 12, Growth in U.S. Non-Hydro Renewable Generation (Terawatt-hour/TWh)][275]

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[274] BARBOSE, *supra* note 20, at 11.

[275] *Id.*; U.S. ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2015 (2016).

The "Minimum Growth in Non-Hydro RE" in Figure 12 above, is equivalent to the "Target RPS Requirement" in the proposed model (see Figure 11 above). And "Growth in Total U.S. Non-Hydro RE Generation" is equivalent to the "Actual Production of Renewable Energy" in the proposed model.

The "Minimum Growth in Non-Hydro RE Required for RPS" is estimated by first calculating total RPS-compliance demand for each state, based on historical retail electricity sales and accounting for exempt load, use of RPS credit multipliers, offsets, and other state-specific provisions. Also, the "Minimum Growth" excludes contributions to RPS compliance from pre-2000 vintage facilities and from hydro municipal solid waste and non-renewable technologies, based on the data from state and utility RPS compliance reports. It is possible, though, that a portion of the Minimum Growth could have occurred in the absence of RPS.[276] For reference, see Figure 7, "RPS Compliance Schedule," above, which illustrates state-by-state Target RPS Requirement from 2000 through 2045.[277]

If we compare the rate of annual changes in Actual Growth of renewables to the rate of annual changes in the Minimum RPS Requirement after 2005 (*i.e.*, when the "Actual Production of Renewables" was *above* the "Minimum RPS Requirement"), we notice that the gap between the two rates is shrinking (see Figure 13, "Annual Changes in Growth Rate of Total U.S. Non-Hydro Renewable Generation Compared with Annual Change in Minimum Growth Rate in non-Hydro RE Required for RPS," below). In other words, once the Actual Production of Renewables is *above* the Minimum RPS Requirement, the RPS policy becomes substantially weaker. In fact, according to the U.S. Renewables Portfolio Standards 2016 Annual Status Report, the relative contribution of RPS to renewable energy growth has declined in recent years, from 71% of Annual Renewable Builds in 2013 to 46% in 2015.[278]

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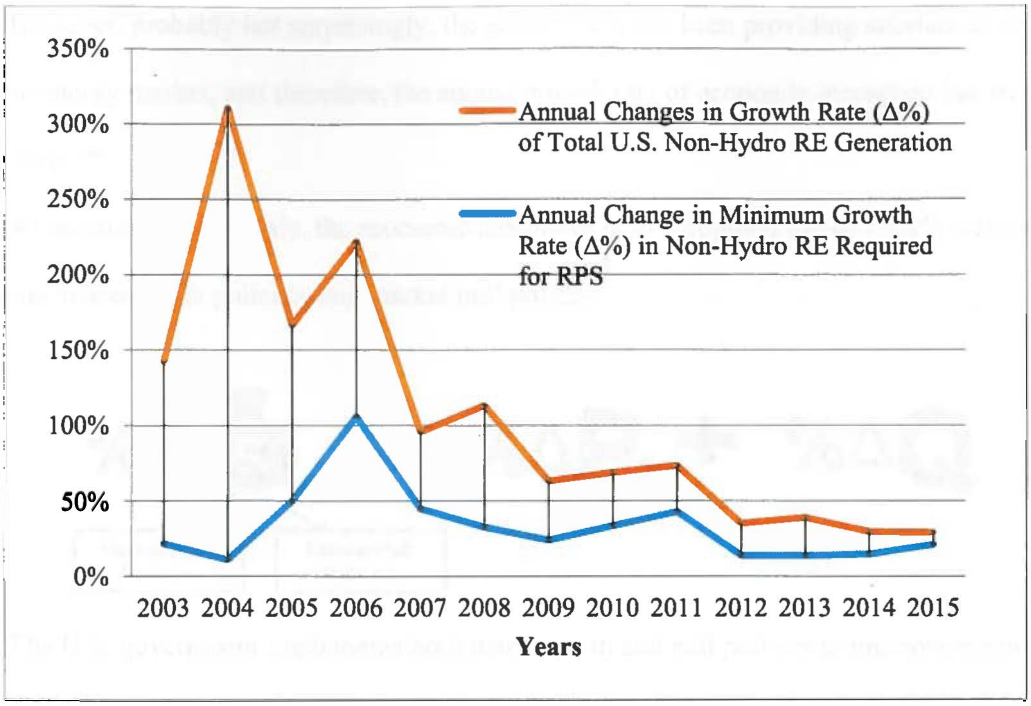
[276] BARBOSE, *supra* note 20, at 41.

[277] *See supra* Chapter 2.3.5.6.

[278] BARBOSE, *supra* note 20, at 12–13.



[Figure 13, Annual Changes in Growth Rate of Total U.S. Non-Hydro Renewable Generation Compared with Annual Change in Minimum Growth Rate in non-Hydro RE Required for RPS]

Based on the proposed model, all else being equal,[279] we can expect the tendency—the *decreasing* rate of Annual Changes in Growth Rate of renewables—to continue at least until the Actual Production of Renewables curve intersects the Minimum RPS Requirement curve once again (see Figure 12 above). If we look at the proposed model (see Figure 11 above), the above-mentioned tendency could be illustrated as if the renewable energy market is moving from point "A" towards point "B".

3.2.5 *A Deeper Dive into the Proposed Model*

So far, I have been focusing on the annual changes in renewable energy generation (%ΔQ), which is only one of three elements of the proposed model (*i.e.*, $\%\Delta\$ \approx \%\Delta P + \%\Delta Q$). Also, I have shown the tendencies (↑/↓%ΔQ) in annual growth rate of renewable energy generation, assuming all else is equal (*i.e.*, that there is no change to the growth rate of economic incentives in the market (*fixed* %Δ$)).

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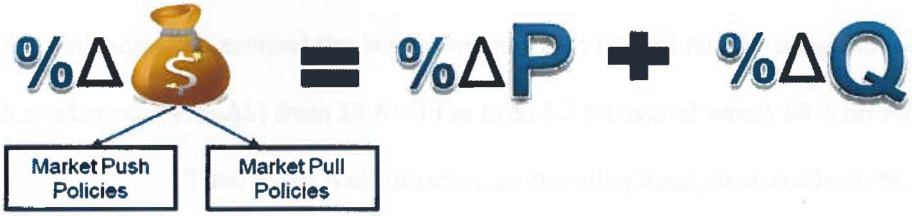
[279] *Id.*

However, probably not surprisingly, the government has been providing substantial support to the renewable energy market, and therefore, the annual growth rate of economic incentives has not been static over the time.[280]

As mentioned previously, the economic incentives in the proposed model (%Δ$) include cash, cash equivalents, market push policies, and market pull polices.



The U.S. government implements both market push and pull policies to promote renewables in the United States.[281]

3.2.5.1 Market Push Policies

First, let us focus on the market push policies. At the request of Congress, the Energy Information Administration (EIA), an independent agency of the U.S. Department of Energy, evaluated the subsidies that the federal government provides to energy producers. The EIA published three reports: for FY 2007, FY 2010, and FY 2013.[282]

For example, over a three-year period, from FY 2007 through FY 2010, total federal energy subsidies increased from $17.9 billion to $37.2 billion, an increase of 108% over the three-year period.[283] Of this increase, renewable energy subsidies increased by 186% (*i.e.*, market push policy, ↑%Δ$) from $5.1 billion to $14.7 billion, which is by far the largest jump in federal benefits. Of the $14.7 billion in FY 2010, $6.2 billion (*i.e.*, 65% of the increase) was related to the economic stimulus law.[284] Wind energy led the

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[280] *See supra* Chapter 2.3.3.
[281] *See supra* Chapter 2.3.3.
[282] *See supra* note 271.
[283] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2010, *supra* note 271.
[284] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 State. 115; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2010, *supra* note 271.

various renewables with more than a tenfold increase in subsidies (from \$476 million to \$4,986 million) followed by solar subsidies that were increased by more than a factor of six (from \$179 million to \$1,134 million).[285]

In 2015, the EIA updated the subsidies report for the three-year period from FY 2010 through FY 2013. During this time, total federal electricity-related subsidies increased from \$11.7 billion to \$16.1 billion, an increase of 38% over the three-year period.[286] Of this increase, similar to previous reports, renewable energy subsidies represented the largest increases in federal energy subsidies, which increased 54% (*i.e.*, push market policy, %Δ\$) from \$8.6 billion to \$13.2 billion, of which \$8.6 billion was related to the economic stimulus act.[287] Total fossil fuel subsidies, on the other hand, declined by 15%, dropping from \$4.0 billion to \$3.4 billion. This time, solar energy led the various renewables with almost a fivefold increase in subsidies, from \$1.1 billion to \$5.3 billion, and also led electricity sector subsidies on a unit of production basis. Wind energy subsidies increased by 9% from \$5.4 billion to \$5.9 billion.[288]

If we focus, for a moment, on only the annual growth of tax expenditures for renewables (%Δ\$ = ITC + PTC only),[289] and compare this growth to the annual growth of RPS-contracted/delivered renewable capacity (%ΔQ),[290] we see how these two growth rates correspond with each other (see Figure 14, "Annual Growth in Tax Expenditures (%Δ\$) Compared with Annual Growth of RPS-Contracted/Delivered RE Capacity (%ΔQ)," below).

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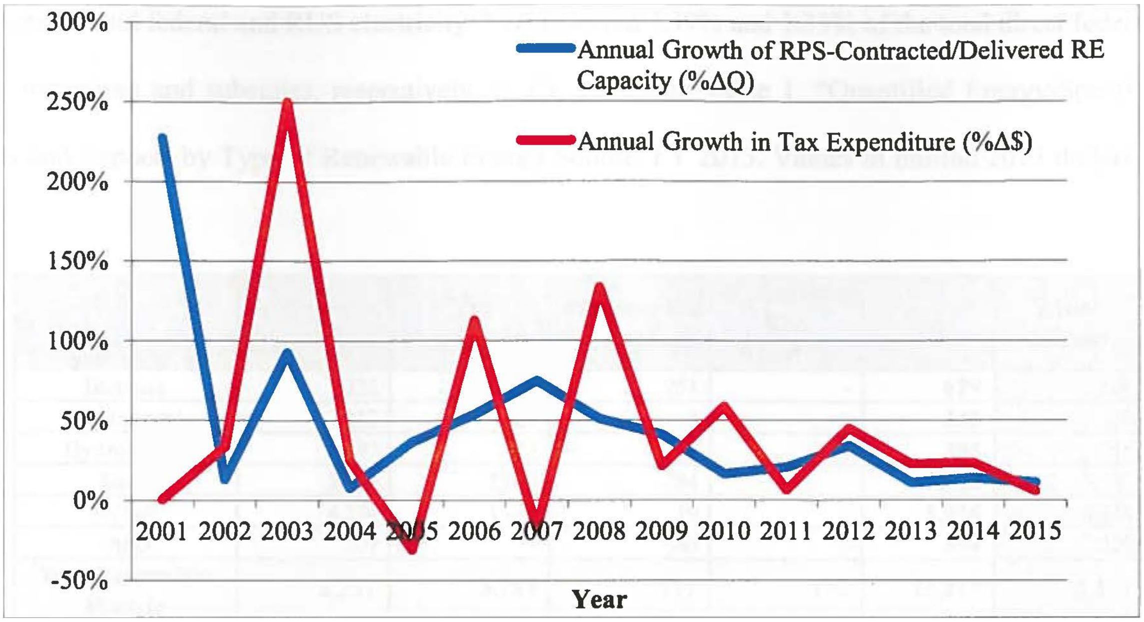
[285] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2010, *supra* note 271.
[286] *Id.* U.S. ENERGY INFO. ADMIN., DIRECT FEDERAL FINANCIAL INTERVENTIONS AND SUBSIDIES IN ENERGY IN FISCAL YEAR 2013 (2015) [hereinafter FEDERAL INTERVENTIONS 2013].
[287] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 State. 115; *see also* Table 1, "Quantified Energy-Specific Subsidies and Support by Type of Renewable Energy Source, FY 2013," below.
[288] *See* Table 1, "Quantified Energy-Specific Subsidies and Support by Type of Renewable Energy Source, FY 2013," below.
[289] Tax expenditures are largely provisions found in the Internal Revenue Code, and they typically reduce the tax liability of the firms who take specified actions that affect energy production, distribution, transmission, consumption, or conservation. *See* U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286.
[290] RPS-contracted/delivered renewable capacity consists of renewable capacity contracted to entities subject to an RPS or sold on a merchant basis into regional RPS markets. *See* BARBOSE, *supra* note 20, at 12.



[Figure 14, Annual Growth in Tax Expenditures (%Δ$) Compared with Annual Growth of RPS-Contracted/Delivered RE Capacity (%ΔQ)][291]

However, tax expenditures represent only part of the financial incentives that are available to renewables (*i.e.*, part of the (%Δ$)). According to the EIA report on Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013, tax expenditures represented only 28.6% of total direct federal financial incentives and subsidies.[292] The largest component of federal incentives (especially after 2009 when the American Recovery and Reinvestment Act of 2009 was enacted) was "direct expenditures,"[293] which represented 62.68% of total direct federal financial incentives and subsidies.[294] Research and

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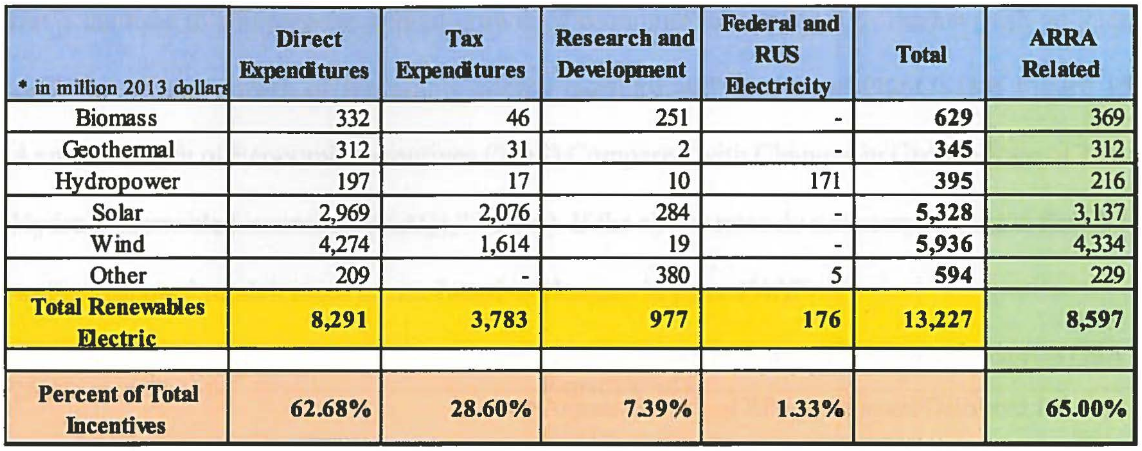
[291] *Id.* (providing "Annual Growth of RPS-Contracted/Delivered RE Capacity" information); *See* STAFF OF JOINT COMM. ON TAXATION, FEDERAL TAX EXPENDITURES 2010–2014, *supra* note 239 (providing "Annual Growth in Tax Expenditures" information for fiscal years 2010–2014); U.S. Office of Mgmt. & Budget, *supra* note 238 (providing "Annual Growth in Tax Expenditures" information in respective budget reports for fiscal years 2001–2015).

[292] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286, at xv.

[293] Section 1603 grant program counts as a "direct expenditure". *See* U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286 at xv ("The changing mix of direct expenditures between FY 2010 and FY 2013 was primarily driven by ARRA's Section 1603 grant program.").

[294] The direct expenditures to producers are federal programs that provide direct cash outlays that financially benefit producers. *See* OFFICE OF MGMT. & BUDGET & U.S. GEN. SERV. ADMIN., 2014 CATALOG OF FEDERAL DOMESTIC ASSISTANCE (2014), available at https://www.cfda.gov/downloads/CFDA_2014.pdf.

development[295] and federal and RUS electricity[296] represented 7.39% and 1.33% of the total direct federal financial incentives and subsidies, respectively, in FY 2013 (see Table 1, "Quantified Energy-Specific Subsidies and Support by Type of Renewable Energy Source, FY 2013. Values in million 2013 dollars," below).



* in million 2013 dollar	Direct Expenditures	Tax Expenditures	Research and Development	Federal and RUS Electricity	Total	ARRA Related
Biomass	332	46	251	-	**629**	369
Geothermal	312	31	2	-	**345**	312
Hydropower	197	17	10	171	**395**	216
Solar	2,969	2,076	284	-	**5,328**	3,137
Wind	4,274	1,614	19	-	**5,936**	4,334
Other	209	-	380	5	**594**	229
Total Renewables Electric	**8,291**	**3,783**	**977**	**176**	**13,227**	**8,597**
Percent of Total Incentives	**62.68%**	**28.60%**	**7.39%**	**1.33%**		**65.00%**

[Table 1, Quantified Energy-Specific Subsidies and Support by Type of Renewable Energy Source, FY 2013. Values in million 2013 dollars][297]

It should be noted that the changing mix of direct expenditures between FY 2010 and FY 2013 was primarily driven by ARRA's Section 1603 grant programs,[298] which represented 65% of total direct federal financial incentives for renewables; totaling $8.6 billion (see Table 1 above).[299]

Having a full picture of U.S. direct federal financial incentives and subsidies for the U.S. renewable energy market (*i.e.*, market push policies), would allow us to more accurately evaluate the proposed model.

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[295] The U.S. government has an extensive program of finding energy research and development activities aimed at a variety of goals, such as increasing U.S. energy supplies or improving the efficiency of various energy consumption, production, and transformation technologies. *See supra* Chapters 2.3.3.

[296] Federal and Rural Utilities Service (RUS) electricity programs are federal programs that help bring to market large amounts of electricity, stipulating that "preference in the sale of such power and energy shall be given to public bodies and cooperatives." Flood Control Act of 1944, 16 U.S.C. § 825s (2012). Also, the federal government supports portions of the electricity industry through loans and loan guarantees made by the U.S. Department of Agriculture's Rural Utilities Service (RUS) at interest rates generally below those available to investor-owned utilities.

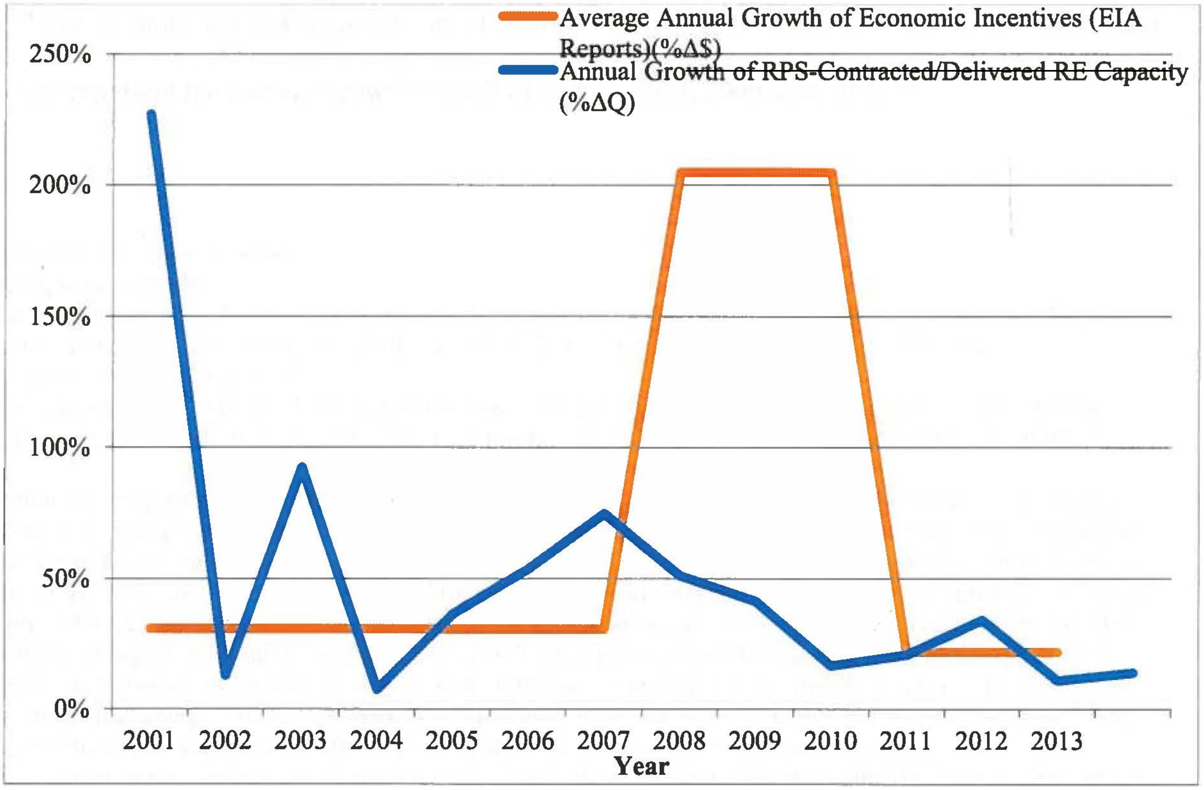
[297] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286, at xv.

[298] *See infra* Appendix A.1.4 - "Section 1603 Grants in Lieu of Tax Credits".

[299] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 State. 115; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286, at xv.

As discussed earlier, the basic equation of the model is %Δ$ ≈ %ΔP + %ΔQ, and one of the hypotheses was that during those times when the actual production of renewables is *above* the minimum RPS target, in our case after 2005–2006 (see Figure 12 above), an increase in economic incentives for the renewable energy market (↑%Δ$) would have *a stronger* effect on price (↑%ΔP) than on quantity (%ΔQ).

Now is the time to compare the annual growth of economic incentives (*i.e.*, market push policies) (%Δ$) against the annual growth of renewable energy capacity and generation (%ΔQ) (see Figure 15, "Average Annual Growth of Economic Incentives (%Δ$) Compared with Changes in Growth Rate of Total U.S. Non-Hydro Renewable Generation (%ΔQ)," below). If the above rates do not correlate, the difference, according to the proposed model, must be attributed to changes in price (%ΔP).[300]



[Figure 15, Average Annual Growth of Economic Incentives (%Δ$) Compared with Changes in Growth Rate of Total U.S. Non-Hydro Renewable Generation (%ΔQ)][301]

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[300] *See supra* Chapter 3.2.1 for a numerical example of how the equation (%Δ$ ≈ %ΔP + %ΔQ) operates.

[301] The data was taken from BARBOSE, *supra* note 20; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2010, *supra* note 271; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2007, *supra* note 271.

In Figure 15 above, the blue line represents the annual growth of renewable energy capacity contracted to entities subject to an RPS or sold on a merchant basis to regional RPS markets. In other words, the blue line represents the annual change in renewable energy capacity in states that are subject to RPS programs (%ΔQ).[302] The orange line represents the annual growth of market push policies (%Δ$) based on the EIA reports on direct federal financial interventions and subsidies in energy.[303]

It should be noted that the market push policies are shown on an average basis (*i.e.*, straight lines) for the years 2001–2006, 2007–2010, and 2010–2013, because EIA published only 3 reports on "Direct Federal Financial Interventions and Subsidies in Energy" that cover FY 2007, 2010 and 2013. The EIA reports do not cover the annual changes in financial incentives for each of the years within the tested periods.[304] For example, the 614% growth rate of financial incentives between 2007 and 2010 was divided by 3 years to represent the average growth in each of years—2008, 2009, and 2010.[305]

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[302] BARBOSE, *supra* note 20.

[303] The data come from U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2010, *supra* note 271; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2007, *supra* note 271.

[304] *See* U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2010, *supra* note 271; U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2007, *supra* note 271.

[305] The author's attempts to receive more accurate data for the annual growth in economic incentives and subsidies directly from U.S. Energy Information Administration were not successful. According to an email from Christopher Namovicz, Team Leader for Renewables Electricity Analysis, U.S. Department Information Administration (one of the authors of the 2007, 2010, and 2013 EIA reports on direct federal financial interventions and subsidies), the most accurate pre-2009 data appears in the sources listed in the EIA reports, *i.e.*, the annual budget reports published by the U.S. Office of Mgmt. & Budget, *see supra* note 238. This paper incorporates the data from these sources. *See supra* Figure 13. However, these sources only provide information regarding tax expenditures (*i.e.*, ITC, PTC, and credits for residential energy efficient properties). This data could be considered viable nonetheless, assuming that the tax expenditures for years prior to 2009 represented the largest portion of the total economic incentives for renewables. In fact, if we compare the average annual change in tax expenditures from 2000 to 2007 [%Δ$=**~35%**] with the average annual change mentioned in the EIA reports for fiscal years 2000 through 2007 [%Δ$=**~30.5%** (244%/8 years)], we see that on average the growth rates are very close. For the average annual change in tax expenditures from 2000 to 2007, see U.S. Office of Mgmt. & Budget, *supra* note 238 (providing annual budget reports for fiscal years 1995–2017) and JOINT COMM. ON TAXATION, https://www.jct.gov/publications.html?func=select&id=5 (last visited Apr. 7, 2017) (providing tax expenditure reports for fiscal years 1972–2017). As for the years after 2009 (after the American Recovery and Reinvestment Act of 2009 (ARRA)), Christopher Namovicz states that the computation of the annual growth rate for financial incentives is very difficult, since most technologies were eligible to receive either the PTC or the ITC (or the 1603 grant). Therefore, the only way to estimate the annual growth of financial incentives for renewables is to divide the total growth between two tested years by the number of tested years, *i.e.*, the average growth per year. The email from Christopher Namovicz is on file with the author.

Looking at Figure 15 above, we can clearly see that a substantial increase in market push policies in years 2008–2011 (↑%Δ$) had a very minimal effect on renewable energy growth (*i.e.*, the incentives had a minimal effect on %ΔQ). That means that most of the incentives for renewable energy market affected the price (↑%ΔP). This outcome supports the hypothesis of the proposed model—that when the actual production of renewables is *above* the minimum RPS target, such as in years 2008–2011, an increase in economic incentives for the renewable energy market (↑%Δ$) will have *a stronger* effect on price (↑%ΔP) than on quantity (%ΔQ).

3.2.5.2 Market Pull Policies

Renewable energy producers receive additional economic incentives through market pull policies. As previously mentioned, one of the major components of RPS programs is the Renewable Energy Certificates (RECs) through which RPS compliance programs are typically enforced.[306] In restructured (*i.e.*, competitive retail) markets, RPS compliance typically occurs through "unbundled" RECs that are sold separately from the underlying electricity, often via spot market transactions or relatively short-term contracts.[307] In regulated markets, the renewable electricity is "bundled" with the RECs, and both are sold as part of Power Purchase Agreements to utilities. REC pricing in restructured markets varies by state RPS market and by resource tier or carve-out.[308] In our case, REC pricing can be viewed as a potentially important source of additional revenue for renewable energy projects (*i.e.*, market pull policy – %Δ$).[309] That means that in addition to the retail sale of electricity in the renewable energy market, a renewable energy project receives additional income from the sale of RECs, which further increases the project's income.

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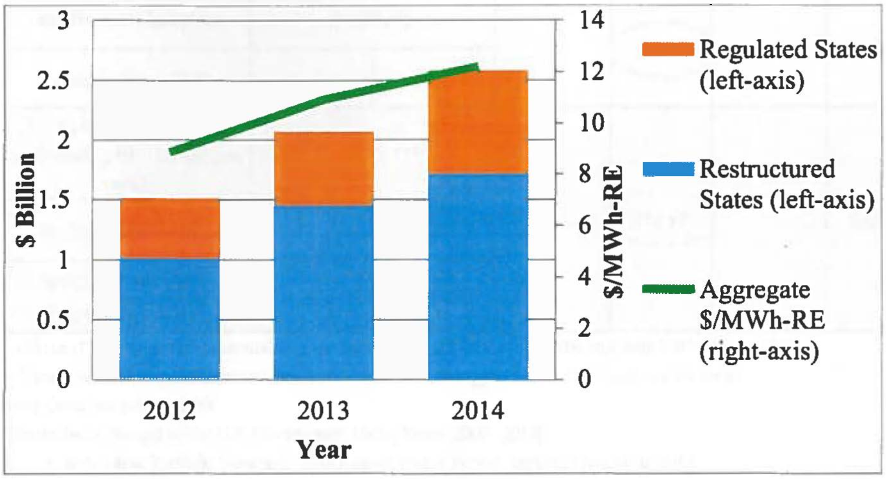
[306] *See infra* Chapter 2.3.5.6.

[307] Restructured markets are electricity markets that have been restructured to introduce as much competition as possible among generators while maintaining strict regulation over the transmission and distribution wires business. Regulated markets are electricity markets that are governed by extensive rules and regulations at both the wholesale and retail levels. For more information *see Deregulated Electricity vs. Regulated Electricity*, UGI ENERGYLINK, http://www.ugienergylink.com/deregulated-electricity-vs-regulated-electricity/ (last visited Apr. 24, 2017).

[308] *See infra* Chapters 2.3.5.6.1–2.3.5.6.4.

[309] BARBOSE, *supra* note 20, at 27.

The aggregate U.S. RPS compliance costs totaled roughly $2.6 billion in 2014, an increase from $2.1 billion in 2013 (see Figure 16, "Total RPS Compliance Costs – "Pull Market Policy" (%Δ$)," below). The compliance costs for restructured states represent REC plus alternative compliance payment (ACP) expenditures.[310] Compliance costs for regulated states are based on utility- or PUC-reported estimates in annual RPS compliance filings and legislative reports.[311]



[Figure 16, Total RPS Compliance Costs – "Pull Market Policy" (%Δ$)][312]

The cost growth of 37.24% and 24.63% in 2013 and 2014, respectively, is associated with increasing RPS targets, shifts toward somewhat higher-cost RPS resources, and increasing REC prices in some states.[313] Unfortunately, Berkeley Lab did not compile data for years before 2012, and according to Galen Barbose, they are not aware of any other sources that may be available to obtain such information.[314]

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[310] Alternative Compliance Payment (ACP) generally caps costs at 5% to 10% of retail rates. Some state's RPS programs contain a mechanism that caps the maximum possible rate impact for the final year in the RPS. For states with an ACP, the maximum possible rate impact corresponds to the scenario in which the entire RPS obligation in the final RPS year is achieved with RECs priced at the ACP. States' ACP mechanisms include rate impact/revenue requirement caps (DE, IL, NM, OH, OR, WA), surcharge caps (CO, MI, NC), renewable energy contract price caps (MT), renewable energy fund caps (NY), and financial penalties (TX). *See Programs*, DSIREUSA.ORG, *supra* note 186; *see also* BARBOSE, *supra* note 20, at 32, 43.

[311] BARBOSE, *supra* note 20, at 32.

[312] *Id.*

[313] *Id.*

[314] *See* email from Galen Barbose, Elec. Mkts. & Policy Grp., Lawrence Berkeley Nat'l Lab., received Nov. 21, 2016 (on file with author).

3.2.6 *Results*

Based on the data collected from different governmental sources about the U.S. renewable energy market from fiscal year 2000 through fiscal year 2013, there is substantial evidence supporting the proposed model and the hypotheses presented therein (see Table 2, "Data Supporting the Proposed Model," below).

Years	**%Δ$**			**≈**	**%ΔP**	**+**	**%ΔQ**	**Comments**
2000 - 2006	**Total Financial Incentives**	**↑~30% *‡**		≈	**↓%ΔP**	+	**↑~72%†**	**Target RPS Requirement Curve is above the Actual Production of Renewable Energy Curve**
	Tax Expenditures Only		↑~36%**					
2007 - 2013	**Total Financial Incentives (not icnluding RPS compliance costs)**	**↑~113% *****		≈	**↑%ΔP**	+	**↑~29%†**	**Target RPS Requirement Curve is bolow the Actual Production of Renewable Energy Curve**
	Tax Expenditures Only		↑~48%**					
	RPS Compliance Costs (for years 2012-2013)		↑~36%‡‡					

Percentage increase (↑%Δ$) or (↑%ΔQ) represents annual average increase from 2000 through 2006 and from 2007 through 2013

* Source: EIA report on Direct Federal Financial Interventions and Subsidies in Energy Markets 2007 (includes biofuels).

‡ Data on RPS Compliance Costs are not available.

** Source: Analytical Perspectives, Budget of the U.S. Government, Fiscal Years [2000 - 2013].

† Source: Galen Barbose, U.S. Renewable Portfolio Standards 2016 Annual Status Report, Berkley Lab (April 2016).

*** Source: EIA report on Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Years 2010, 2013 (not including biofuels).

‡‡ Source: Galen Barbose, U.S. Renewable Portfolio Standards 2016 Annual Status Report, Berkley Lab (April 2016).

[Table 2, Data Supporting the Proposed Model]

In years 2000 through 2006, when the Target RPS Requirement Curve was *above* the Actual Production of Renewable Energy Curve (see point "B" in Figure 11 above), the average annual growth of financial incentives[315] (↑%Δ$ = ↑~30%) had a substantially *stronger* effect on the average annual growth rate of renewable energy generation (↑%ΔQ = ↑~72%) than on price parameter. Through deductive reasoning from the basic equation (%Δ$ ≈ %ΔP + %ΔQ), we can assume that since ↑%ΔQ was higher than ↑%Δ$, to equalize the equation, the price parameter should have decreased during fiscal years 2000 through fiscal year 2006 (↓%ΔP).

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[315] Financial incentives include direct expenditures, tax expenditures, R&D, and federal and RUS electricity programs. *See supra* Chapter 2.3.4. The average annual growth of tax expenditures for fiscal years 2000 through 2006 represented ~36%.

Mathematically, the decrease in the price parameter can be proven with the assistance of a natural logarithm.[316] One of the natural logarithm rules is the product rule:

$$(*)\ \ln(P\text{x}Q) = \ln(P) + \ln(Q)$$

Using the data collected in the study, we find the percentage change of the price parameter (P) as follows:

$$(*)\ \ln(1.3) = \ln(P) + \ln(1.72);$$[317]

$$(**)\ \ln(1.3) = \ln(P*1.72);\ \text{and}$$

$$(***)\ P = 1.3 \div 1.72 = 0.7558.$$

The price equals 75.58%. In other words, the price decreased from 100% to 75.58%, a decrease of 24.42% ($\downarrow\%\Delta P = \downarrow 24.42\%$).[318]

Therefore, hypothesis B is supported, indicating that when the actual production of renewables is *below* the minimum RPS target, an increase in economic incentives to the renewable energy market will have a stronger effect on the quantity parameter ($\%\Delta Q$) than on the price parameter ($\%\Delta P$). This result is hardly surprising, since stricter RPS targets should result in higher rates of deployment of new renewable energy projects when the policy is accompanied with direct and indirect economic incentives.

In fiscal years 2007 through 2013, when the Target RPS Requirement Curve was *below* the Actual Production of Renewable Energy Curve (see point "A" in Figure 11 above), the average annual growth of the financial incentives[319] ($\uparrow\%\Delta\$ = \uparrow{\sim}113\%$(!) (without market pull policy incentives)) had a very limited effect on the average annual growth rate of renewable energy generation or capacity ($\uparrow\%\Delta Q =$ only $\uparrow{\sim}29\%$). That means that most of the financial incentives affected the price side of the equation ($\uparrow\%\Delta\$ \approx \uparrow\%\Delta P +$

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[316] *See supra* Chapter 3.2.1. *See also supra* notes 248–249 and accompanying text.

[317] An increase of 30% in economic incentives for the renewable energy market can be presented as the total value of economic incentives after the increase, *i.e.*, 130% or 1.3.

[318] This result can be verified by a simple example: $\$ = P \text{ x } Q \rightarrow 100 = 10 \text{ x } 10$. Now let us apply the results: $\%\Delta Q = +72\%$, and from the above equation $\%\Delta P = -24.42\%$. We know that the end result should represent an overall increase in $\uparrow\%\Delta\$ = +30\%$. $(10\text{x}1.72) \text{ x } (10*0.7558) = 17.2 \text{ x } 7.558 = 129.9976$. This result is similar to the increase in economic incentives by 30% ($\uparrow\%\Delta\$$), *i.e.*, 130%.

[319] The tax expenditure average annual growth represented ~48%. As noted above, the changing mix of direct expenditures between fiscal years 2010 and 2013 was primarily driven by ARRA's Section 1603 grant programs, which represented 65% of the total direct federal financial incentives for renewables, totaling $8.6 billion. *See* U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286, at xv.

%ΔQ) rather than the quantity side. In addition to the above mentioned ~113% increase in financial incentives, the increase of RPS compliance costs of ~36% further supports the conclusions of this study, because the RPS compliance costs are an additional source of revenue from renewable energy project perspective. Therefore, when we add an increase in financial incentives (~113%) and an increase in RPS compliance cost (~26%), the overall incentive "package" that renewables receive is the sum of financial incentives (market push policies) and RPS compliance costs (market pull policies).

Mathematically, the increase in the price parameter can be also proven with the assistance of a natural logarithm. As mentioned above, the natural logarithm product rule provides as follows:

(*) $\ln(PxQ) = \ln(P) + \ln(Q)$.

Using the data collected in this study, we find the percentage change of the price parameter (P) as follows:

(*) $\ln(2.13) = \ln(P) + \ln(1.29)$;[320]

(**) $\ln(2.13) = \ln(P*1.29)$; and

(***) $P = 2.13 \div 1.29 = 1.6512$.

Since the price equals 165.12%, the price increased from 100% to 165.12%, representing an increase of 65.12% (↑%ΔP = ↑65.12%).[321]

These results support hypothesis A, which predicted that when the actual production of renewables is *above* the minimum RPS target, an increase in economic incentives for the renewable energy market (↑%Δ$) will have *a stronger* effect on the price parameter (↑%ΔP) than on the quantity parameter (%ΔQ). In our case, the price increased by 65.12% while the renewable growth represented only 29%. That means

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[320] An increase of 113% in economic incentives to renewable energy market can be presented as the total value of economic incentives after the increase, *i.e.*, 213% or 2.13.

[321] This result can be verified by a simple example: $ = P x Q → 100 = 10 x 10. Now let us apply the results: %ΔQ = +29%, and from the above equation %ΔP = +65.12%. We know that the end result should represent an overall increase in ↑%Δ$ = +113%.
(10x1.29) x (10*1.6512) = 12.9 x 16.512 = 213.004. This result is similar to the increase in economic incentives by 113% (↑%Δ$), *i.e.*, 213%.

that during fiscal years 2007–2013, only about 30 cents of every dollar spent on renewables actually contributed to renewable energy growth.

3.2.7 *Limitations*

The limitations of this study are mainly related to its assumptions, such as the assumption that governmental incentives in the proposed model can be fully utilized by renewable projects.[322] The present study provides a general picture of the U.S. renewable energy market, the general effects of governmental incentives (*i.e.*, market push and pull policies) on U.S. renewable energy growth, and the effectiveness of these incentives under different conditions in the renewable energy market. This study does not intend to provide exact numerical microeconomic conclusions but rather to describe general interactions between governmental incentives, prices, and renewable energy growth.

Data availability on market pull policy incentives (*i.e.*, RPS compliance costs) was not available for years prior to 2012.[323] However, given the size of the economic incentives ($13.2 billion in 2013[324]) versus the size of the RPS compliance costs ($2.1 billion in 2013[325]), the lack of pre-2012 data should not have a substantial effect on the hypotheses and conclusions of this study. Also, in some cases, the data relating to market push policies was available for certain years (*i.e.*, 2001, 2007, and 2013), so the annual growth had to be calculated on an average growth basis.[326]

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[322] *See* supra note 247 and accompanying text. *See e.g.*, *Historic Boardwalk Hall, LLC v. Commissioner*, 694 F.3d 425 (3d Cir. 2012), cert. denied, 133 S.Ct. 2734 (2013); Rev Proc. 2014-12, 2014-3 I.R.B 415 (12/30/2013). The tax code generally restricts the trafficking of tax attributes and incentives. *See, e.g.*, 26 U.S.C. § 382 (2012). For a discussion of the few tradable federal tax credits, see Clinton G. Wallace, Note, *The Case for Tradable Tax Credits*, 8 N.Y.U. J. L. & BUS. 227, 237 (2011).

[323] *See* Chapter 3.2.5.2 "Pull Market Policies"; *also see* fn 384 and accompanying text.

[324] U.S. ENERGY INFO. ADMIN., FEDERAL INTERVENTIONS 2013, *supra* note 286, at xv.

[325] BARBOSE, *supra* note 20, at 32.

[326] *See supra* Chapter 3.2.5.1.

This study also does not address credit availability and debt financing issues for renewables,[327] deal structures,[328] transmission issues, master limited partnerships and real estate investment trusts proposals,[329] the Clean Power Plan proposal,[330] and other issues that are not expressly taken into account in this study.

Finally, the study did not take into account reductions in renewable energy costs due to technological advances (not attributable to market push policies such as government-funded research and development), which might have contributed to some extent to the growth of renewable generation (see Figures 17–20 below).[331] However, as further discussed below, the data from the U.S. Energy Information Administration on capital costs for wind and solar technologies *do not* contradict the conclusions of this study.[332]

Generally, in microeconomics, technological advances and reductions in capital costs lead to increased economic output over time.[333] In the renewable energy context, reductions in capital costs for

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[327] *See* SCOTT FISHER ET AL., U.S. P'SHIP FOR RENEWABLE ENERGY FIN., TAX CREDITS, TAX EQUITY, AND ALTERNATIVES TO SPUR CLEAN ENERGY FINANCING 2 (2011); Felix Mormann & Dan Reicher, Opinion, *How To Make Renewable Energy Competitive*, N.Y. TIMES (June 1, 2012), www.nytimes.com/2012/06/02/opinion/how-to-make-renewable-energy-competitive.html.

[328] In some cases, renewable energy developers use different deal structures such as partnership flip, the sale-leaseback and the inverted lease, which help attract tax equity investors that have a bigger appetite for tax credits. *See* Roberta F. Mann, THE LAW OF CLEAN ENERGY, *supra* note 3, at 146-147; DIPA SHARIF ET AL., BLOOMBERG NEW ENERGY FIN., THE RETURN—AND RETURNS—OF TAX EQUITY FOR U.S. RENEWABLE PROJECTS 11, 16 (2011); Mormann, *supra* note 247, at 303.

[329] Mormann, *supra* note 247, at 303.

[330] On August 3, 2015, President Obama and the U.S. Environmental Protection Agency (EPA) announced the Clean Power Plan to reduce carbon pollution from power plants, which takes real action on climate change. The Clean Power Plan was designed to strengthen the fast-growing tend toward cleaner and lower-polluting American energy with strong but achievable standards for power plants. The Plan cuts significant amounts of power plant carbon pollution and the pollutants that cause the soot and smog that harm health, while advancing clean renewable energy. Only ten days after the EPA announced the final Plan, 27 states petitioned the U.S. Court of Appeals for the District of Columbia Circuit for an emergency stay. On February 9, 2016, the Supreme Court stayed implementation of the Clean Power plan pending judicial review by the lower Court of Appeals. *See* Adam Liptak & Coral Davenport, Supreme Court Deals Below to Obama's Efforts to Regulate Coal Emissions, N.Y. TIMES (Feb. 9, 2016), http://www.nytimes.com/2016/02/10/us/politics/supreme-court-blocks-obama-epa-coal-emissions-regulations.html?smid=pl-share&_r=0; *Fact Sheet: Overview of the Clean Power Plan*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/cleanpowerplan/fact-sheet-overview-clean-power-plan (last visited Arp. 8, 2017).

[331] It should be noted that some of the cost reductions could have resulted from the government-funded R&D that is part of the Push Market Policies taken into account in the proposed model. *See* U.S. ENERGY INFO. ADMIN., WIND AND SOLAR DATA AND PROJECTIONS FROM THE U.S. ENERGY INFORMATION ADMINISTRATION: PAST PERFORMANCE AND ONGOING ENHANCEMENTS 4 (2016) [hereinafter WIND & SOLAR DATA].

[332] *Id.*

[333] OLIVIER BLANCHARD, MACROECONOMICS (5th ed. 2010); ROBERT M. SOLOW, GROWTH THEORY: AN EXPOSITION (2d ed. 2000).

wind and solar technologies should have some positive impact on the growth of renewable energy generation and capacity.[334]

According to the EIA's report,[335] for years prior to 2008/2009 the annual estimated capital costs for wind and solar technologies were either relatively steady (in solar technologies) or rising (in wind technologies) (see Figures 17 and 18, "Annual Estimated Capital Costs for Wind and Solar Technologies from Various Agencies, 2005–2015," below). For this period of time, solar and wind capital costs did not play a major role in renewable energy growth, simply because there were not substantial technological advances made and, therefore, it can be reasonably concluded that most of the growth is attributable to market push and pull policies.

Figures 17 and 18 below include a comparison of the EIA's annually reported assumption for initial-year overnight costs with other published capital costs for that year. The EIA's report points out that the EIA consistently underestimated capital cost values compared to data later developed by Lawrence Berkeley National Laboratory (LBNL) and others.[336] The EIA further acknowledges that when taking account of actual plant locations, EIA costs are significantly below the values shown in Figures 17 and 18 below; in other words, the more accurate data on renewables' costs are closer to the data of LBNL and Lazard.[337]

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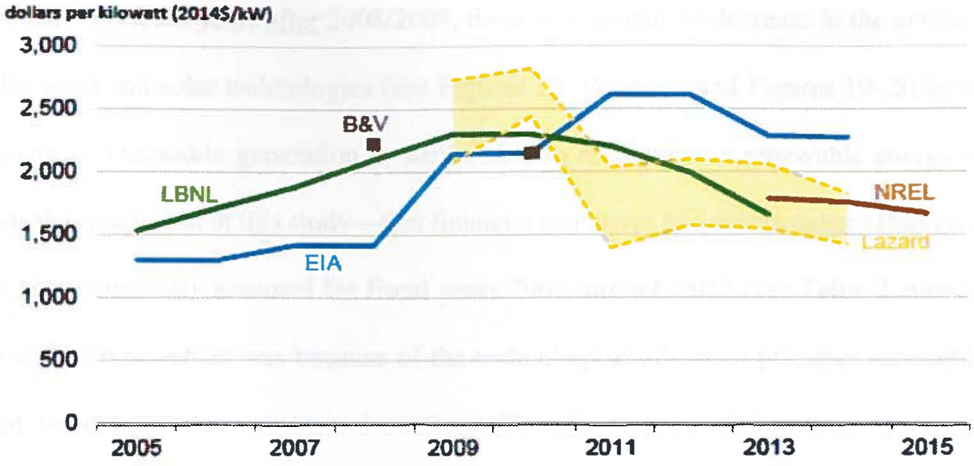
[334] OLIVIER BLANCHARD, MACROECONOMICS (5th ed. 2010); ROBERT M. SOLOW, GROWTH THEORY: AN EXPOSITION (2d ed. 2000).

[335] U.S. ENERGY INFO. ADMIN., WIND & SOLAR DATA, *supra* note 331.

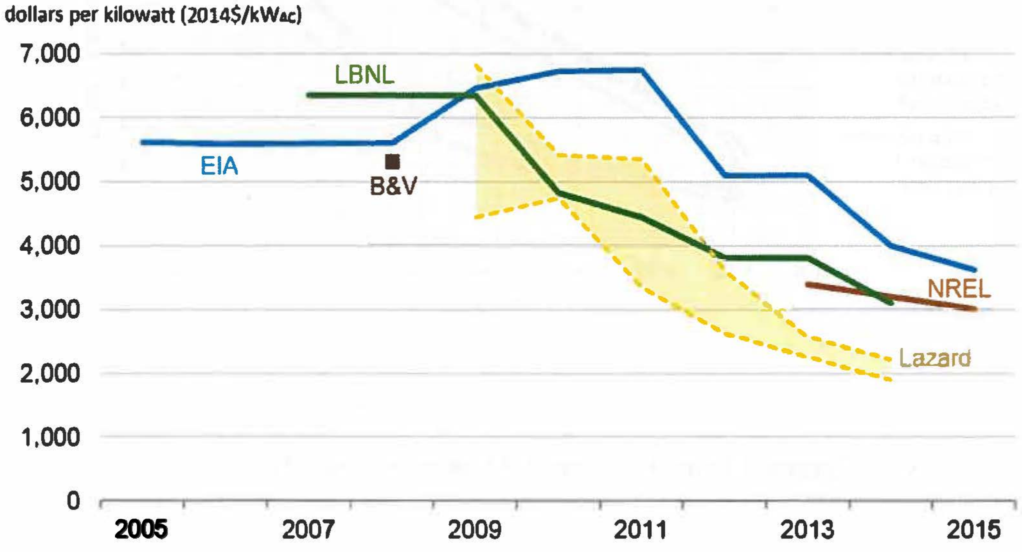
[336] *Id.* at 13.

[337] *Id.*



Source: EIA, *Annual Energy Outlook* (2003-2015); LBNL, Wind Technologies Market Report (2013-2014); Black & Veatch (B&V), Cost and Performance Data for Power Generation Technologies; NREL, Annual Technology Baseline 2014; Lazard, Levelized Cost of Energy (versions 3 through 8).

[Figure 17, Annual Estimated Capital Costs for Wind Technologies from Various Agencies, 2005–2015][338]



Sources: EIA, *Annual Energy Outlook* (2003-2015); LBNL, *Tracking the Sun 2014*; LBNL, *Utility-Scale Solar* (2013-2014); Black & Veatch (B&V), *Cost and Performance Data for Power Generation Technologies*; NREL, *Annual Technology Baseline 2014*; Lazard, *Levelized Cost of Energy* (version 3-8)

[Figure 18, Annual Estimated Capital Costs for Utility-Scale Solar PV Technologies from Various Agencies, 2005–2015][339]

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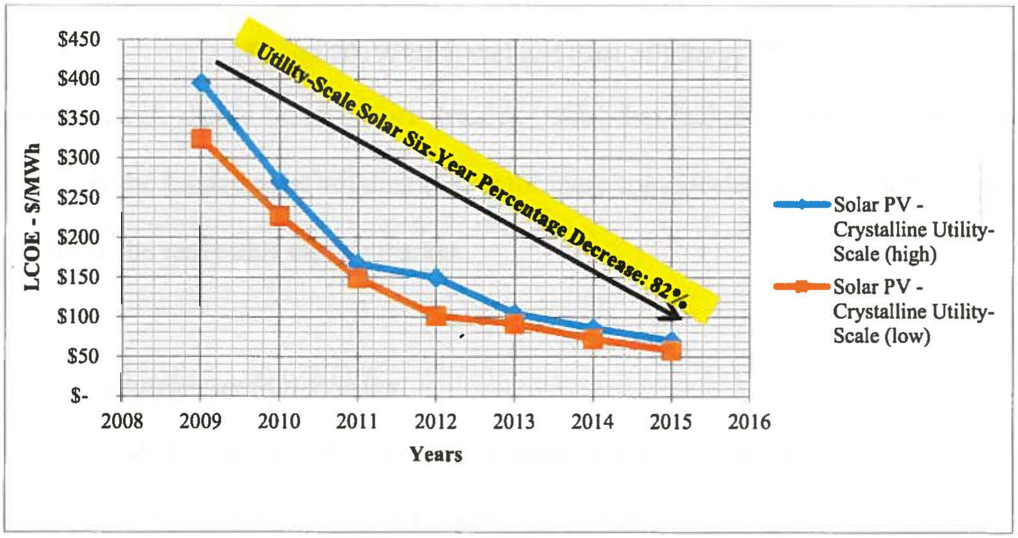
[338] *Id.* at 14 (regarding wind).

[339] *Id.* at 23 (regarding solar).

However, for years after 2008/2009, there is a substantial decrease in the annual estimated capital costs for wind and solar technologies (see Figures 17–18 above and Figures 19–20 below).[340] If some of the growth of renewable generation is attributable to reductions in renewable energy costs, that further supports the conclusion of this study—that financial incentives had even weaker effect on renewable energy growth than previously assumed for fiscal years 2007 through 2013 (see Table 2 above). In other words, the growth of renewables was because of the technological advances (cheaper renewables) in the market and not because of the economic incentives. Therefore, when the government introduced additional incentives after 2008/2009, these incentives did not contribute to the growth of renewables but mainly increased the price for renewables instead.



[Figure 19, Solar PV Levelized Cost of Energy][341]

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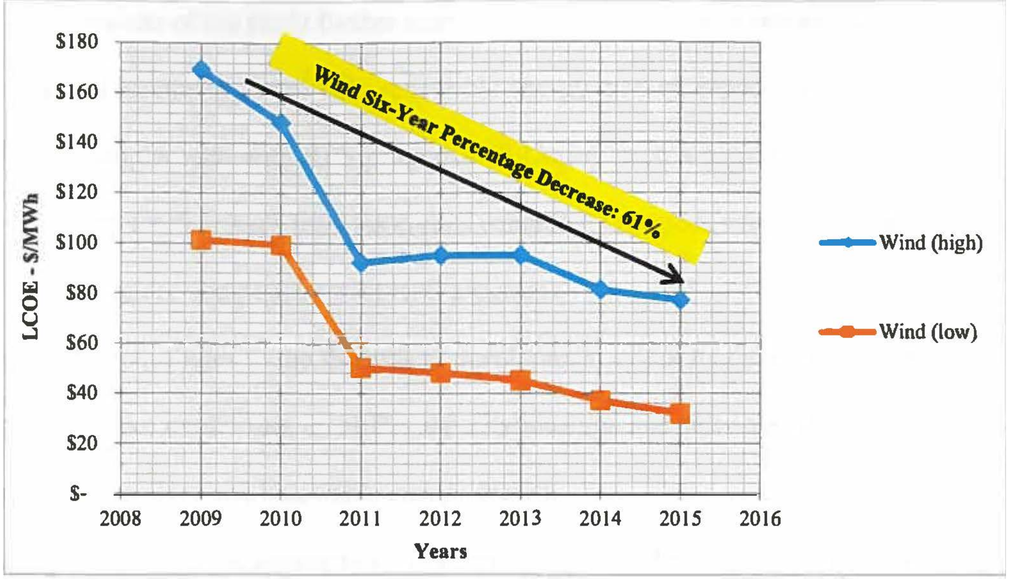
[340] LAZARD, LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS – VERSION 9.0 (2015).
[341] *Id.*



[Figure 20, Wind Levelized Cost of Energy][342]

Future research should build a more detailed model that includes a state-by-state analysis. This study presents only the fundamental building blocks for more complicated analyses of financial incentives and their effects on the renewable energy market.

3.2.8 *Discussion and Conclusion*

The present study has traced the association between market push and pull policies and renewable energy growth in states that have enacted RPS policies. In doing so, it has provided some evidence that when the target RPS requirement curve is *above* the actual production of renewable energy curve, an increase in economic incentives for the renewable energy market has a stronger effect on the renewable energy growth parameter than on the price parameter. Similarly, when the target RPS requirement curve is *below* the actual production of renewable energy curve, an increase in economic incentives for the renewable energy market has a stronger effect on the renewable energy price parameter than on the renewable energy growth parameter.[343] This confirms the hypotheses of this study.

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[342] *Id.*

[343] *See supra* Hypothesis A and Hypothesis B.

The conclusions of the study further emphasize the importance of properly evaluating the need for additional financial incentives in the U.S. renewable energy market, especially when the market is in the position of over-complacence with RPS programs.[344] During such a period of time, taxpayers get fewer renewables deployed for their buck from tax credits compared to periods when the renewable energy market is in the position of under-compliance with RPS programs.

This study contributes to the theoretical development of tax modeling and the policy design field by creating a basic tax model that identifies the relationships and tests associations between direct and indirect financial incentives and renewable energy growth.

Taking into account the assumptions and limitations of its data set, this study provides some support for theoretical models (further discussed below) that predict the responses of renewable energy market to market push and pull policies. More importantly, the study offers theoretical and, in some cases, empirical contributions to the understanding that there are more elements in the equation (*i.e.*, prices and quantities) than just a growth rate of renewables. Specifically, in some cases, a substantial increase in financial support for renewables may have a minimal (if any) effect on renewable energy growth, simply because the financial support affected the price side of the equation.

This study further supports a policy design where more stringent RPS goals (*i.e.*, where the target RPS requirement curve is *above* the actual production of renewable energy curve) are associated with higher market pull and push policy responses.

In sum, the proposed model and its conclusions open up other fruitful areas of investigation and tax modeling. For instance, combinations of different pull market policies, such as RPS and FiT, could be better designed using the proposed model. Such possible combinations are further discussed in the next chapters.

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[344] *See supra* Table 2; *see also supra* Chapter 3.2.5.2 and Figure 11 (Point "B").

Chapter 4

4. Combination of Market Pull Policies – RPS and FiT

4.1 Introduction – Market Push and Pull Policies Do Work Together

The renewable energy market has received considerable attention from the government, as only a few industries have, given the government's efforts to promote the market's development. The record-breaking growth of renewable energy in recent years can be attributed to two primary policies: market push policies[345] and market pull policies.[346]

Market push and pull policies can coexist together in the renewable energy market because each focuses on different players in the market and, more importantly, each affects different microeconomic curves in the market. Market push policies affect the *supply curve*, whereas market pull policies affect the *demand curve*.[347] The following simplified microeconomic model attempts to illustrate the changes and tendencies of prices (P) and commodities (Q) (*i.e.*, electricity generation or capacity) when applying both market push and pull policies to the renewable energy market.

The model shows why market push and pull policies successfully work together to boost the U.S. renewable energy market. It also aims to explain and predict the behavior of the "players" in the renewable energy market. Specifically, the model follows the changes and tendencies of prices and commodities (electricity) when different policies are applied, making it easier to assess the probable outcomes of employing different policies.

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[345] Market push policies seek to affect the renewable energy market by promoting the quantity and diversity of a given type of technology. These policies include research, demonstration, and development (RD&D) programs as well as economic incentives, including tax credits, tax expenditures, grants, and investment subsidies such as loan guarantees. The goal of these policies is to make renewable energy technology more competitive by incentivizing investment in the market and reducing production costs. *See supra* Chapter 2.3.3; *see also supra* notes 89–91 and accompanying text.

[346] Market pull policies try to promote renewable technologies not by making them available in the first instance, but rather by influencing the *demand* for them. These policies include RPS and FiT programs. The goal of market pull policies is to impose legal obligations on utilities or market participants to purchase an increasing amount of electricity from renewable sources. *See supra* Chapter 2.3.3 and 2.3.5; *see also supra* notes 93–94 and accompanying text.

[347] *See supra* notes 88–103 and accompanying text.

4.2 Basic Microeconomic Model – Economic Reasoning Behind Using Both Market Pull and Push Policies

> *"Economics is a study of mankind in the ordinary business of life."*
>
> Alfred Marshall.[348]

4.2.1 Basic Microeconomics and the Renewable Energy Market

Economics is a social science that examines the production, distribution, and consumption of goods and services. Microeconomics deals with the behavior of individual economic units, such as consumers, investors, business firms, and entities. Microeconomics helps to clarify how these economic units interact with one another and how they influence economic decisions.[349]

As with any other scientific theory, microeconomic theories have their limitations and rely on certain assumptions. One of the assumptions is that firms always try to maximize their profits.[350] Another assumption is that people are rational decisionmakers who act to maximize their own utility.[351]

In Figure 21 ("Basic Economic Model") below, the elementary supply and demand curves represent the aggregate amounts that participants will consume or produce at each price level.[352]

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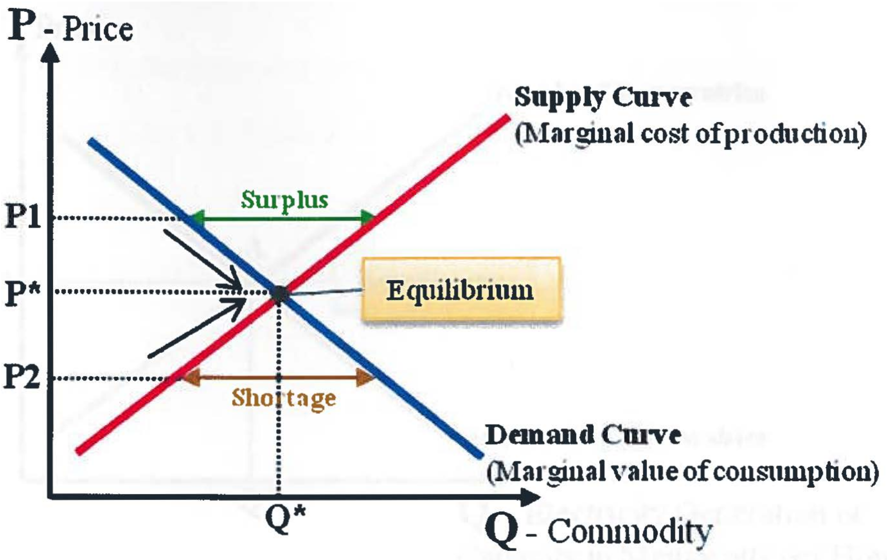
[348] GREGORY N. MANKIW, PRINCIPLES OF ECONOMICS, at ix (6th ed. 2010).
[349] HUBBARD, *supra* note 124; ROBERT S. PINDYCK, MICROECONOMICS (3d ed. 1995).
[350] HUBBARD, *supra* note 124.
[351] *See* MANKIW, *supra* note 76, at 6.
[352] *See* HARRIS, *supra* note 183, at 385; HUBBARD, *supra* note 124.



[Figure 21, Basic Economic Model]

The equilibrium in the above market is set at the price of P* and commodity production of Q* (see Figure 21 above). Equilibrium is characterized by constant supply, demand, and price. Therefore, if the price is set at P1, a surplus will develop in the market, since the supply is higher than the demand. This imbalance between the supply and demand for commodities leads to a decrease in the price and the market's return to the equilibrium. Similarly, if the price is set at P2, a shortage will develop in the market and the excess of demand with respect to supply will force the price to increase; therefore, the quantity will return to the equilibrium point (Q*).[353]

The renewable energy market has characteristics similar to any other market with its own supply and demand curves.[354] See *supra* Chapter 2.3.3 for an explanation of Figure 22 below.

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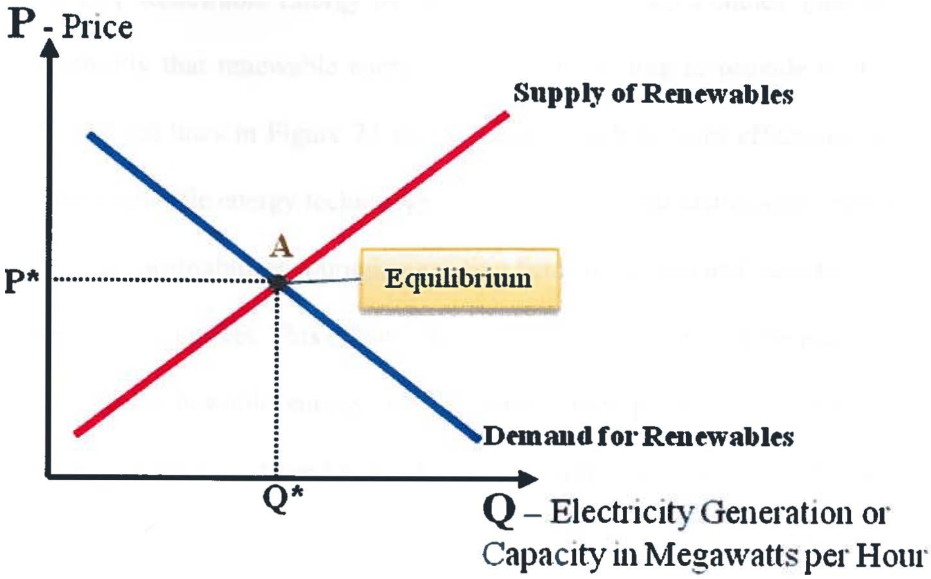
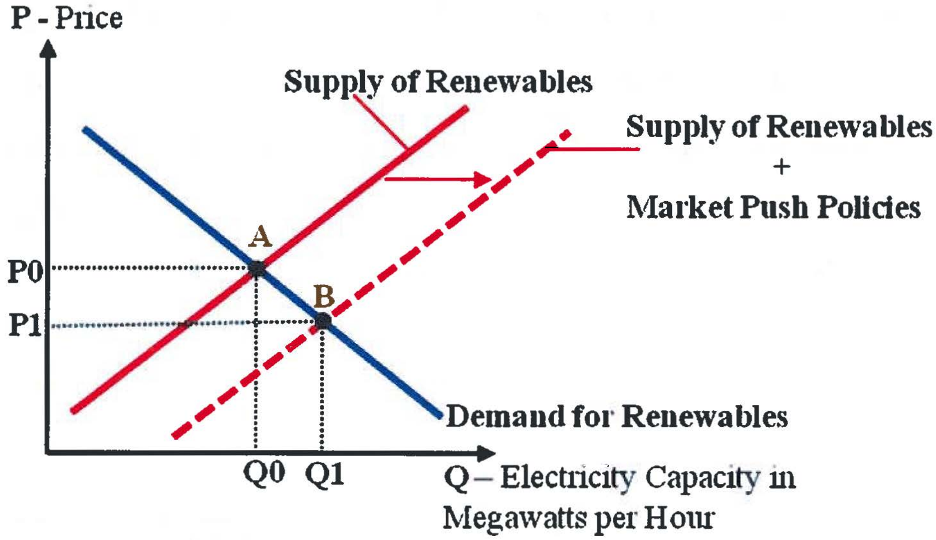
[353] *See* HARRIS, *supra* note 183, at 385; HUBBARD, *supra* note 124.
[354] *See supra* Chapter 2.3.3.



[Figure 22, A Basic Renewable Energy Market]

Market push policies, also known as supply-side tools, typically affect the *supply curve* of the renewable energy market.[355] These tools include incentives that directly and indirectly reduce the costs of renewable energy production.[356]



[Figure 23, Renewable Energy Market with Push Market Policies]

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[355] *See supra* Chapter 2.3.3; *see also* Bürer & Wüstenhagen, *supra* note 89, at 4,998; Davies, *supra* note 25, at 320.
[356] De Jonghe et al., *supra* note 91, at 4,743–52; *see also* FISCHER & PREONAS, *supra* note 91, at 14.

In Figure 23 ("Renewable Energy Market with Push Market Policies") above, the supply curve represents the electricity that renewable energy projects are willing to provide to the marketplace. The supply curves are the red lines in Figure 23 above. Market push policies effectively reduce the after-tax costs of purchasing renewable energy technology.[357] The reduced production costs make the production of renewable energy more profitable, encouraging existing firms to expand and incentivizing new investors to enter into (or invest in) the market. This effectively shifts the supply curve in the market to the right.[358] The new equilibrium of the renewable energy market moves from point "A" to point "B," with a higher renewable electricity output (*i.e.*, from Q0 to Q1) and a lower price (*i.e.*, from P0 → P1) (see Figure 23 above).[359]

Similarly, introducing taxes to the renewable energy market will have the reverse effect of shifting the supply curve to the left because taxes will increase the costs of producing electricity.[360]

Now, let us see what would happen when the government adds market pull policies on top of market push policies.

Market pull policies, such as RPS and FiT programs, are often called demand-side policies; they typically affect the *demand curve* in the renewable energy market.[361] The government sets a minimum electricity quota (in the case of RPS) or a minimum electricity price (in the case of FiT) for utility companies, which obliges the utilities to purchase electricity from renewable sources according to the regulatory mandate.[362]

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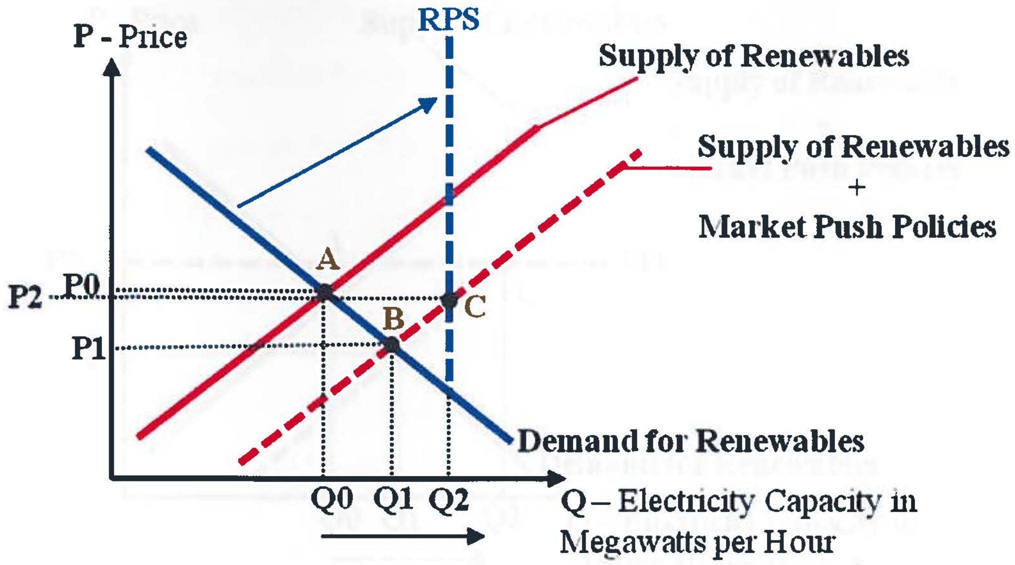
[357] PINDYCK, *supra* note 91, at 267; Duff, *supra* note 91, at 2,063–111.
[358] PINDYCK, *supra* note 91 (the logic behind the shift of the supply curve to the right is that since the costs of production decrease, if the market price remained constant, we could expect to observe a greater supply of electricity produced than before).
[359] *See* PAUL SAMUELSON & MICHAEL NORDHAUS, MICROECONOMICS 53 (17th ed. 2001).
[360] *Id.*
[361] Bürer & Wüstenhagen, *supra* note 89, at 4,998; Davies, *supra* note 25, at 320.
[362] *See supra* Chapters 2.3.4.2, 2.3.5.5, and 2.3.5.8; JORDAN-KORTE, *supra* note 46, at 206.



[Figure 24, Energy Market with Market Push and Pull (RPS) Policies]

In Figure 24 ("Renewable Energy Market with Market Push and Pull (RPS) Policies") above, the demand curve (the blue line) represents the amount of electricity that consumers are willing and able to purchase at any given price.[363] In case of the RPS program, the demand for renewables is set by governmental mandate. In other words, the government creates an artificial demand curve (the blue dashed line), which requires the utilities to purchase a minimum amount of Q2 Megawatts per Hour of electricity from renewable sources of energy.

The new equilibrium of the renewable energy market shifts from point "B" to point "C" with *a higher renewable electricity output* (*i.e.*, Q1 → Q2). The effect on price is unclear and depends on other factors, such as elasticity[364] of the demand and supply curves and the strength (strictness) of the RPS program.[365]

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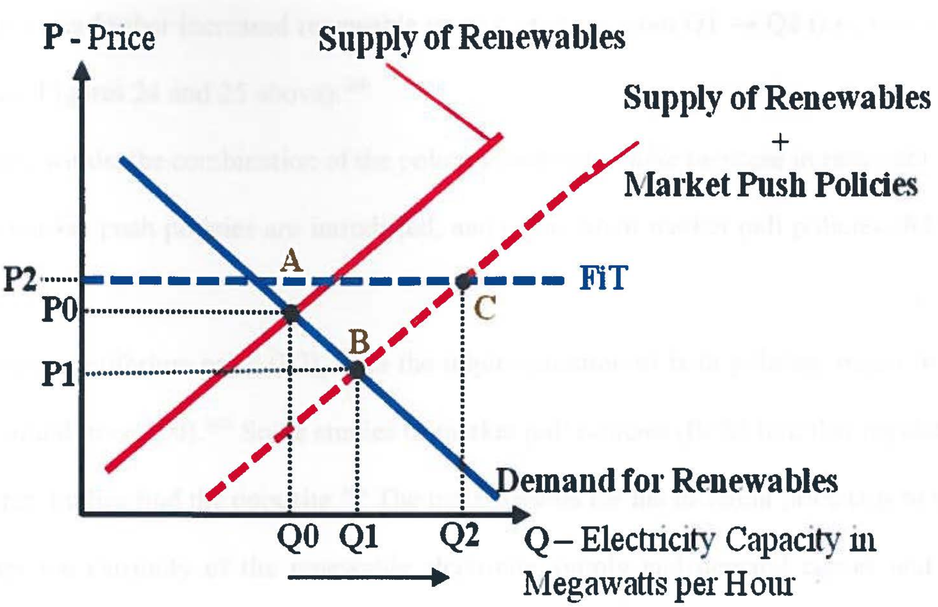
[363] ARTHUR O'SULLIVAN & STEVEN M. SHEFFRIN, ECONOMICS: PRINCIPLES IN ACTION 81–82 (2003).

[364] Price elasticity of demand or supply is a measure of the sensitivity of the quantity variable Q, to changes in the price variable, P. Elasticity answers the question of how much the quantity will change in percentage terms for a 1% change in the price. *See* HUBBARD, *supra* note 124, at 164; JEFFREY M. PERLOFF, MICROECONOMICS: THEORY AND APPLICATIONS WITH CALCULUS 19 (1st ed. 2007); IVAN PNG, MANAGERIAL ECONOMICS (1999); DOMINICK SALVATORE, SCHAUM'S OUTLINE OF MICROECONOMICS 39 (2006).

[365] *See supra* Chapter 2.3.4.2.



[Figure 25, Renewable Energy Market with Push and Pull (FiT) Market Policies]

In case of the FiT program, as illustrated in Figure 25 ("Renewable Energy Market with Push and Pull (FiT) Market Policies") above, the government sets the demand for renewables at a specified price (tariff). In other words, the government creates an artificial demand curve (the blue dashed line), which requires the utilities to purchase renewable electricity at a minimum price set at P2 dollars per Megawatt per Hour.

The new equilibrium of the renewable energy market shifts from point "B" to point "C" with a higher renewable electricity output (*i.e.*, Q1 → Q2) and price (P2) that was set by the FiT program.

4.2.2 *Conclusion – Market Push and Pull Policies Work Hand-in-Hand in the Renewable Energy Market*

The combination of market push and pull policies offers the best chance for increasing and promoting the production of renewable energy. While market push policies managed to increase the renewable energy capacity from Q0 → Q1 (*i.e.*, moving from point "A" to "B"; see Figure 23 above), market pull policies further increased renewable energy capacity from Q1 → Q2 (*i.e.*, moving from point "B" to "C"; see Figures 24 and 25 above).[366]

In other words, the combination of the policies causes a *double increase* in renewable capacity (Q) – once when market push policies are introduced, and again when market pull policies (RPS or FiT) are imposed.

The new equilibrium price (P2), after the implementation of both policies, might be either above or below the initial price (P0).[367] Some studies of market pull policies (RPS) find that regulations increase prices, but other studies find the opposite.[368] The main reasons for the different price tags of renewables in the market are the elasticity of the renewable electricity supply and demand curves and the effective stringency of the RPS mandate.[369]

4.2.3 Limitations of Microeconomic Model

The above microeconomic model is substantially simplified in order to emphasize the general effects of market pull and push policies on the renewable energy market. Microeconomics is a very complex branch of economics that studies the behavior of individuals and firms when making decisions regarding the allocation of resources.[370] Market pull and push policies were also presented in their simplified form. In practice, RPS and FiT programs are substantially more complex than the above concept of a single vertical line (for RPS) or single horizontal line (for FiT) that represents the new demand curve for renewable energy.[371] Each program consists of several components that might affect the way the demand curve is represented in the model.[372]

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[366] *See* Carolyn Fischer & Richard G. Newell, *Environmental and Technology Policies for Climate Mitigation*, 55 J. ENVTL. ECON. & MGMT. 142, 142–62 (2008) (discussing the combination of different policies).

[367] The initial price (P0) refers to the renewable market without market push and pull policies.

[368] Carolyn Fischer, *Renewable Portfolio Standards: When Do They Lower Prices?*, 31 ENERGY J. 101, 101–19 (2010); *see also* Geoffrey Lawrence, *High-Powered Taxation in the Silver State,* NEV. POLICY RESEARCH INST. (Sept. 22, 2011), http://www.npri.org/publications/highpowered-taxation-in-the-silver-state.

[369] *See* Fischer, *supra* note 368; *see also supra* Chapter 2.3.4.2.

[370] *See generally* ROBIN BADE & MICHAEL PARKIN, FOUNDATIONS OF MICROECONOMICS (2001).

[371] *See supra* Chapters 2.3.5.6 and 2.3.5.9.

[372] Some RPS and FiT concepts might include elements of Market Push Policies, such as tradable RECs, which also might affect the representation of the demand curve in the microeconomic model. *See supra* Chapter 2.3.5.6.1.

Nevertheless, the above limitations should not change the conclusions regarding the main effects of market push and pull policies on the renewable energy market[373] and the way these policies can (and do) work together.[374]

4.3 Two Market Pull Polarities – Quantity-Based Policy (RPS) Versus Price-Based Policy (FiT)

4.3.1 Introduction

The microeconomic model suggests that market push policies and market pull policies could be integrated in order to promote the deployment of new renewable energy projects. Market push policies in combination with RPS increase renewable energy capacity (Q). Similarly, market push policies in combination with FiT increase renewable energy capacity (Q). However, a critical observer might correctly notice that RPS and FiT were not tested together with market push policies; rather, they were tested separately.

RPSs and FiTs are both market pull policies. Both policies promote the deployment of renewables, but each takes a different path to achieve this goal—one through a price mandate (FiT)[375] and the other through a quantity mandate (RPS).[376]

Historically, these policies have been treated as competing, mutually exclusive options.[377] Many studies position RPSs and FiTs against each other in order to demonstrate which is more effective and

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[373] Main effects of market push and pull policies refer to shifts of the demand and supply curves as a result of implementing market push and pull policies.

[374] Since market push policies typically affect the supply curve and market pull policies typically affect the demand curve, these policies can be implemented independently and simultaneously. In other words, these policies affect different microeconomic forces.

[375] *See supra* Chapter 2.3.5.7; *see, e.g.*, Pierre Bull et al., *Designing Feed-in Tariff Policies to Scale Clean Distributed Generation in the U.S.*, ELECTRICITY J., April 2011, at 52; Dominique Finon, *Pros and Cons of Alternative Policies Aimed at Promoting Renewables*, *in* 12 AN EFFICIENT, SUSTAINABLE AND SECURE SUPPLY OF ENERGY FOR EUROPE, 110, 115 (Armin Riess ed., 2007); Haas et al., *supra* note 159.

[376] *See, e.g.*, Trent Berry & Mark Jaccard, *The Renewable Portfolio Standard: Design Considerations and an Implementation Survey*, 29 ENERGY POL'Y 263 (2001); Karlynn S. Cory & Blair G. Swezey, *Renewable Portfolio Standards in the Stats: Balancing Goals and Rules*, ELECTRICITY J., Apr. 2007, at 20, 21; Keith Crane et al., The Economic Costs of Reducing Greenhouse Gas Emissions Under a U.S. National Renewable Electricity Mandate, 39 ENERGY POL'Y 2,730 (2011); Wiser et al., *supra* note 192; *see also supra* Chapter 2.3.5.2.

[377] Rickerson et al., *supra* note 154, at 74.

efficient in promoting the deployment of renewable energy projects.[378] Empirical evidence and qualitative analysis suggest that, generally, RPSs prioritize mitigation of regulatory risk over investor risk, while FiTs focus on investor risk mitigation.[379] These studies generally compare the European experience with FiTs against the U.S. experience with RPSs.[380]

4.3.2 Which Market Pull Policy is More Effective and Efficient – RPS or FiT?

In general, studies suggest that FiTs are both more effective and more efficient than RPSs with respect to deploying new renewable energy projects.[381] These studies were based on comparing the overall FiT policies with the overall RPS policies, without breaking them down into their elements.[382] Clearly, some elements of the RPS policies might be more efficient and effective than those of the FiT policies.[383] Even those scholars who have suggested that FiTs are more effective and efficient than RPSs acknowledge that both policies have their respective advantages and disadvantages.[384]

Before getting into detailed analyses, it is important to understand the meaning of an efficient and effective policy. Efficient policy is a policy that achieves its target at a lower cost in comparison to alternative policies.[385] Effectiveness focuses on the extent to which a policy actually achieves its stated

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[378] *See, e.g.*, Lucy Butler & Karsten Neuhoff, *Comparison of Feed-in Tariff, Quota and Auction Mechanisms to Support Wind Power Development*, 33 RENEWABLE ENERGY 1,854 (2008); Philippe Menanteau et al., *Prices Versus Quantities: Choosing Policies for Promoting the Development of Renewable Energy*, 31 ENERGY POL'Y 799, 802 (2003); Ringel, *supra* note 150.

[379] Mormann, *supra* note 25, at 19.

[380] FiTs have been especially popular in Europe, pioneered by countries like Denmark, Germany, Portugal, and Spain. RPSs have been particularly popular at the U.S. state level. *Id.*; Mormann, *supra* note 221. It should be noted that some European nations, such as the U.K. and Sweden, have long histories of implementing RPS-like policies. Similarly, power purchase agreements (PPAs) and purchase requirements for electricity from qualifying facilities imposed by PURPA could be considered a precursor to the European FiT policies. *See* Mormann, *supra* note 25, at 19 n.38.

[381] Davies, *supra* note 25, at 332; Menanteau et al., *supra* note 378.

[382] Adesoji Adelaja et al., *Effects of Renewable Energy Policies on Wind Industry Development in the U.S.*, 2 J. NAT. RESOURCES POL'Y RES. 245, 259 (2010); Haitao Yin & Nicholas Powers, *Do State Renewable Portfolio Standards Promote in-State Renewable Generation?*, 38 ENERGY POL'Y 1,140, 1,149 (2010).

[383] Adesoji Adelaja et al., *Effects of Renewable Energy Policies on Wind Industry Development in the U.S.*, 2 J. NAT. RESOURCES POL'Y RES. 245, 259 (2010); Haitao Yin & Nicholas Powers, *Do State Renewable Portfolio Standards Promote in-State Renewable Generation?*, 38 ENERGY POL'Y 1,140, 1,149 (2010).

[384] Ringel, *supra* note 150, at 12–14.

[385] Menanteau et al., *supra* note 378.

goals.[386] A renewable energy policy might have several goals, such as creating jobs, solving climate change, and attracting industry; however, the major goal of RPS and FiT policies is to promote the deployment of renewables.[387]

4.3.3 *Efficiency and Effectiveness of FiT Policy*

4.3.3.1 Efficiency of FiT Policy

Under a FiT policy, utilities or network operators are required to enter into long-term power purchase agreements (PPAs) at guaranteed above-market rates to ensure investors and developers returns on their investments.[388] Therefore, FiT programs are well-known for the investment certainty they provide.[389] PPAs allow the developers of renewable energy projects to sell electricity directly to the utilities at guaranteed rates outside the open market.[390]

PPAs guarantee a lucrative sales price for renewable electricity as well as a well-funded, creditworthy utility company that will pay the price.[391] As a result, FiTs substantially decrease market risks and investment risks associated with renewable energy projects, which makes these policies appealing to investors and developers.[392]

So, where are the efficiency problems? The above-mentioned risks do not disappear. All the risks associated with trading with unknown counterparts at fluctuating rates determined by the wholesale electricity market are literally shifted and reallocated from the developers of renewables to the government or policymakers and subsequently to consumers.[393]

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[386] Davies, *supra* note 25, at 332.

[387] *See, e.g.*, Deborah Behles, *An Integrated Green Urban Electrical Grid*, 36 WM. & MARY ENVTL. L. & POL'Y REV. 671, 707 n.227 (2012). This goal could be measured either by the amount or percentage of renewable electricity sold to or consumed by the end users (generation) or by the installed capacity of new renewable energy projects (capacity/installations). *See* Davies, *supra* note 25, 3t 334.

[388] *See supra* Chapter 2.3.5.7.

[389] Butler & Neuhoff, *supra* note 378.

[390] *Id.*

[391] Mormann, *supra* note 25, at 11.

[392] *See, e.g.*, Bürer & Wüstenhagen, *supra* note 89, at 4,997; Sonja Luthi & Thomas Prassler, *Analyzing Policy Support Instruments and Regulatory Risk Factors for Wind Energy Deployment – A Developers' Perspective*, 39 ENERGY POL'Y 4,876 (2011).

[393] Mormann, *supra* note 25, at 11.

The risk shifts to the government that determines which FiT rate will allow the renewable projects to recoup their costs and earn reasonable returns on their investments. If the FiT rate is set too low, it will fail to attract developers and investors to enter the renewable energy market, as was the case with Argentina's 2006 FiT policy.[394] Similarly, if the FiT rate is set too high, it will give windfall profits to the developers and investors of renewable energy projects at the expense of ratepayers, as was the case with the Spanish FiT program.[395] The Spanish FiT program was so expensive that it eroded public support for solar energy and eventually forced Spain's government to suspend it.[396]

Therefore, policymakers are exposed to the regulatory risks of setting an incorrect FiT rate (*i.e.*, a risk of making the wrong decision regarding the adequate FiT price) for each renewable technology. The policymaker needs to take into account the projects' sizes, locations, and decreasing costs due to technological advances.[397] On top of these risks, there are additional costs of constant monitoring and modifying FiT rates to make sure that investors and developers receive a reasonable return on their investments.[398]

While RPSs policy administrators can basically set a target and let the market respond, FiT policy administrators need to constantly monitor the tariffs. This requires hiring experts and collecting data on market prices and costs of renewables, which in turn drives up the compliance and administrative costs.[399]

However, while theory and economic logic dictates that RPS policies should be more cost-efficient than FiT policies, a number of recent studies point to FiTs as the more efficient policy tool.[400] Butler & Neuhoff's study noted that although the price paid to wind generation in the first half of the 1990s was

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[394] See MIGUEL MENDONCA ET AL., POWERING THE GREEN ECONOMY: THE FEED-IN TARIFF HANDBOOK 57 (2010).

[395] *Id.* at 58.

[396] *See* Finon, *supra* note 375; *see also* Julieta Schallenberg-Rodriguez & Reinhard Haas, *Fixed Feed-in Tariffs Versus Premium: A Review of the Current Spanish System*, 16 RENEWABLE & SUSTAINABLE ENERGY REVS. 293, 294 (2011).

[397] *See, e.g.*, Patrick Hearps & Dylan McConnell, *Renewable Energy Technology Cost Review* (Melbourne Energy Institute Technical Paper Series, Mar. 2011).

[398] *Id.*

[399] Bull et al., *supra* note 375, at 54; Davies, *supra* note 25, at 338.

[400] *See* TOBY COUTURE & KARLYNN CORY, NAT'L RENEWABLE ENERGY LAB., TECHNICAL REPORT NREL/TP-6A2-45551, *State Clean Energy Policies Analysis (SCEPA) Project: An Analysis of Renewable Energy Feed-in Tariffs in the United States* (2009), at 1,858.

higher in Germany (with a FiT policy) than in the U.K. (with an RPS policy), this pattern changed in the second half of the decade, when the German price fell below the U.K. level.[401] Other researchers reached similar conclusions.[402] FiTs are more complex policy tools from the regulatory perspective, requiring proper checks and tariff adjustments, so they can become very expensive policies. This might be one of the reasons why some of the European countries with FiTs felt compelled to reduce FiT payment levels, which cast some doubt on the superior efficiency of FiTs over RPSs.[403] However, there are other reasons for some of the European countries to cut down their FiT policies, such as the overall market slowdown in the beginning of 2011, technological advances (*i.e.,* falling price of renewables) and political considerations.[404]

4.3.3.2 Effectiveness of FiT Policy

Several studies have suggested that FiT policies are more effective than RPS policies in promoting the deployment of renewables.[405] Studies that focused on European energy markets, comparing countries with FiT policies (Denmark, Germany, and Spain) and countries with RPS policies (the Netherlands and the U.K.), concluded that FiT policies tend to be more effective than RPS ones with respect to incentivizing renewables.[406]

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[401] Butler & Neuhoff, *supra* note 378, at 1,858.

[402] Haas et al., *supra* note 159, at 1031.

[403] CLAIRE KREYCIK ET AL., NAT'L RENEWABLE ENERGY LAB.,TECHNICAL REPORT NREL/TP-6A20-50225, INNOVATIVE FEED-IN TARIFF DESIGNS THAT LIMIT POLICY COSTS 1 (2011); Davies, *supra* note 25, at 340; O. Julia Weller et al., *Committee Report: International Energy Law and Transactions Committee*, 33 ENERGY L.J. 285, 291–92 (2012).

[404] *See* O. Julia Weller et al., *Committee Report: International Energy Law and Transactions Committee*, 33 ENERGY L.J. 285, 291 (2012); Thilo Grau, DIW Berlin, Responsive Adjustment of Feed-in Tariffs to Dynamic PV Technology Development (Feb. 14, 2012), https://www.diw.de/documents/publikationen/73/diw_01.c.392871.de/dp1189.pdf.

[405] C.G. Dong, *Feed-in Tariff vs. Renewable Portfolio Standard: An Empirical Test of Their Relative Effectiveness in Promoting Wind Capacity Development*, 42 ENERGY POL'Y 476 (2012). A similar conclusion was reached by Marc Ringel where he used the production rate rather than installation. *See* Ringel, *supra* note 150, at 14; *see also* Sanya Carley, *State Renewable Energy Electricity Policies: An Empirical Evaluation*, 37 ENERGY POL'Y 3,071, 3,071 (2009).

[406] *See e.g.*, JANET L. SAWIN, INT'L CONF. FOR RENEWABLE ENERGIES, NATIONAL POLICY INSTRUMENTS: POLICY LESSONS FOR THE ADVANCEMENT AND DIFFUSION OF RENEWABLE ENERGY TECHNOLOGIES AROUND THE WORLD 3 (2004); Butler & Neuhoff, *supra* note 378, at 1,858.

However, most of these studies did not take into account the different design elements of each policy, which calls into question the reliability of any conclusions that FiTs are necessarily better than RPSs.[407] Each RPS policy is very distinct with a unique policy design, making it very difficult to compare RPSs to FiTs generally.[408] Therefore, in practice, it is very difficult to reach a concrete conclusion as to an overall effectiveness of RPS versus FiT on a stand-alone basis.

4.3.4 Efficiency and Effectiveness of RPS Policy

4.3.4.1 Efficiency of RPS Policy

RPS policies, as opposed to their FiT counterparts, rely heavily on the free market and therefore have substantially lower regulatory risks and policy costs. RECs, the compliance mechanism of RPSs, are traded on the open market.[409] Also, under RPS policies, renewable electricity competes with other sources of energy in the electricity market.[410]

Therefore, policymaking costs and associated risks are substantially mitigated under RPS policies, because RPS regulators trust the judgment of market participants rather than their own. The policymakers are relieved from setting prices and other parameters, as in FiT policies, and instead focus only on setting the RPS target itself.[411] In other words, RPSs are very cost-effective and naturally cost-limiting because the RPSs have a built-in, market-based brake system, which is influenced by the wholesale electricity market.[412] Furthermore, RPS programs include provisions imposing caps on the overall costs incurred in complying with the RPSs.[413]

The policymaking risks that are mitigated under RPSs are reallocated to the investors in and developers of renewables. Investors and developers are exposed not only to the fluctuating prices of RECs,

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[407] Davies, *supra* note 25, at 336.
[408] *Id.*
[409] *See supra* Chapter 2.3.5.2.
[410] Berry & Jaccard, *supra* note 376.
[411] Mormann, *supra* note 25, at 14.
[412] Davies, *supra* note 25, at 337.
[413] It should be noted that some FiT policy designs include some sort of cost limits such as price caps and price floors. *See supra* Chapter 2.3.5.9.

but also to the fluctuating prices of the wholesale electricity market; in other words, they are exposed to REC market risks and electricity market risks.[414] The direct consequence of these risks is higher transaction costs for renewable energy projects because the contracts require a higher degree of complexity to address bidding processes and hedging strategies against price fluctuations.[415] And in business, a higher degree of risk for developers of and investors in renewable projects means increased pressure on the required returns.[416] Put simply, the riskier the project, the higher return an investor will demand.[417]

However, as mentioned previously, recent studies suggest that FiTs are a more efficient policy tool than RPSs.[418] It was noted in one of the research papers that countries with FiTs generally seem to be more effective at moderate support levels.[419] But even those countries that benefited from a high deployment rate of renewable energy projects, such as Germany, France, Italy and Spain, decided to significantly cut prices under their FiT policies due to high costs.[420] The simple fact that some jurisdictions with FiT policies decided to reduce FiT payment levels casts further doubt on assertions that FiTs are necessarily more efficient than RPSs.[421]

4.3.4.2 Effectiveness of RPS Policy

As noted above, some studies have suggested that FiT policies are more effective than RPS policies at promoting the deployment of renewables.[422] However, some studies have confirmed that the unique design of an RPS policy has a direct impact on that RPS's effectiveness.[423] For example, in the U.S. renewable energy market, there is no single state-RPS program that is similar to another. Each state-RPS

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[414] *See* Mormann, *supra* note 25, at 13; Benjamin K. Sovacool & Christopher Cooper, *Congress Got It Wrong: The Case for a National Renewable Portfolio Standard and Implications for Policy*, 3 ENVTL. & ENERGY LAW POL'Y J. 85 (2008).

[415] *See* Mormann, *supra* note 25.

[416] COUTURE & CORY, *supra* note 400, at 3; DAVID DE JAGER & MAX RATHMANN, ECOFYS, POLICY INSTRUMENT DESIGN TO REDUCE FINANCING COSTS IN RENEWABLE ENERGY TECHNOLOGY PROJECTS (2008) at 127.

[417] COUTURE & CORY, *supra* note 400, at 4.

[418] See *supra* Chapter 4.3.3.

[419] Haas et al., *supra* note 159, at 1032.

[420] *See* KREYCIK ET AL., *supra* note 403; Davies, *supra* note 25, at 340; Weller et al., *supra* note 403, at 291–92.

[421] Davies, *supra* note 25, at 341.

[422] *See supra* Chapter 4.3.3.2.

[423] Adelaja et al., *supra* note 382, at 259; Yin & Powers, *supra* note 382, at 1,149.

program is unique. Without a detailed analysis, a seemingly aggressive RPS policy might provide only weak incentives in practice, and a seemingly weak RPS policy might provide strong incentives in practice.[424] Therefore, the elements of an RPS policy and the way it is designed matter for that policy's effectiveness.

4.3.5 Interim Summary

On the face of it, ignoring the design complexity of each policy, one could conclude that based on the above research and analyses, FiT is an obvious policy choice over RPS for promoting the renewable energy market. Most of the studies suggest that, on a stand-alone basis, FiTs have been held out as more effective and efficient than RPSs.[425]

However, if we mix various design elements of RPS and FiT policies, we might find that RPS and FiT policies are not mutually exclusive but rather have the potential to work together. A policymaker can pick and choose those elements of each that best serve his or her renewable energy policy goals.

RPSs are considered to be market-oriented policies, in that RPS targets can create markets for renewable energy.[426] FiTs, on the other hand, have proven to be investor friendly policies that help attract new investments into the renewable energy market.[427] Combining only these two features into an integrated RPS-FiT policy might create the synergies needed to further boost the renewable energy market.

One of the more detailed analyses on integrated RPS-FiT policies was written by Professor Lincoln Davies.[428] The following Section explains Davies's proposed synergistic policy design that aims to create a successful market pull policy. Davies has left some questions open for further research and analysis with regard to the integration of RPS and FiT policies. Therefore, in Chapter 5 below, I address some of the issues left open and offer an integrated model based on my earlier proposed model (see Chapter 3.2.2 above)

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[424] Adelaja et al., *supra* note 382, at 259; Yin & Powers, *supra* note 382, at 1,149.
[425] *See supra* Chapters 4.3.3–4.3.4.
[426] Mormann, *supra* note 25, at 15.
[427] *Id.*
[428] Davies, *supra* note 25.

as a possible solution to these issues. I hope this integrated model further advances the scholarship in this field.

4.4 Searching for Synergies – Integrated RPS-FiT Policy

Instead of choosing RPS versus FiT, policymakers should be asking how they can combine the best aspects of each policy to create the synergistically best policy to drive renewable energy deployment.[429]

More studies are beginning to show that a FiT policy can be used in conjunction with an RPS as an alternative procurement mechanism to help utilities meet their RPS mandates.[430] Lincoln Davies suggested a detailed analysis of the appropriate policy design that would combine the best features of both policies.[431] According to Davies, "the combined RPS-FiT policy could function as follows: The RPS would establish general RE [renewable energy] and more specific, technology unique regulatory targets. The FiT would then be used to achieve these objectives, by setting an incentive price, creating a purchase obligation, and assuring investors that renewables-produced electricity will have a market."[432]

RPSs define the clear goal of a percentage target that must be achieved in a certain amount of time.[433] Typically, RPSs state annual percentage goals that must be achieved in particular years.[434] Therefore, these policies provide a very clear picture of where the marker is headed, which is a very positive feature from a policy-clarity perspective.[435]

FiTs, by contrast, can offer the primary way to achieve the RPSs' goals, since FiTs have been found to be both more effective and more efficient than RPSs.[436] FiTs are also considered to be more investor-

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[429] RICKERSON & GRACE, *supra* note 211; Davies, *supra* note 25, at 332.

[430] CORY ET AL., *supra* note 211; GRACE, RICKERSON & CORFEE, *supra* note 214; RICKERSON & GRACE, *supra* note 211.

[431] Davies, *supra* note 25, at 332.

[432] *Id.*

[433] *See e.g.*, *Programs*, *supra* note 186 (surveying different RPS goals).

[434] *See supra* Figure 7.

[435] An integrated RPS-FiT renewable energy policy should send a strong signal to the market as to the government's position on renewables. Regulatory commitment and stability constitute a premium in the renewable energy market. *See e.g.*, Davies, *supra* note 25, at 353; Kirsten H. Engel & Scott R. Saleska, *Subglobal Regulation of the Global Commons: The Case of Climate Change*, 32 ECOLOGY L.Q. 183, 219 (2005).

[436] *See supra* Chapter 4.3.3.

friendly than RPSs.[437] Furthermore, based on European experience, FiTs have a strong track record of deploying new renewable energy projects.[438]

An integrated RPS-FiT policy creates stronger policy clarity because it signals governmental support for renewables not only though an overall RPS goal, but also through substantial support for investors through higher prices via FiTs.[439] When the market is transparent as to the overall RPS goal, it is easier to keep track of goal implementation through FiTs. For example, when the renewable energy market is in the position of under-compliance with the RPS program (see Point "B" in Figure 11, "The Proposed Model," above),[440] FiTs could be properly adjusted by increasing the tariff to ensure that the RPS goal is accomplished. Similarly, when the renewable energy market is in the position of over-compliance with the RPS program (see Point "A" in Figure 11 above),[441] tariffs under FiTs could be reduced to make sure that the compliance and policy costs are under control and that the renewable deployment rate meets the RPS target.[442]

Davies's study suggests that with respect to effectiveness, RPSs have comparative advantages in setting the overall goal for the deployment of renewables.[443] FiTs would supplement this goal by assuring the requisite deployment set by the RPSs.[444] When the two policies are combined in an integrated RPS-FiT policy, higher effectiveness can be achieved. RPSs, on a stand-alone basis, *focus on utilities* by requiring them to purchase renewable energy up to a certain goal.[445] FiTs, on a stand-alone basis, *focus on investors* by attracting them to invest in renewable energy markets through incentive prices/tariffs and standardized contracts (PPAs).[446] Combining both policies would target *both utilities and investors*. Not only would utilities be required to purchase renewables, but investors would also be substantially incentivized to enter

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[437] *See supra* Chapter 4.3.3.1.
[438] *See supra* Chapter 4.3.3.
[439] Davies, *supra* note 25, at 354–56.
[440] *See supra* Chapter 3.2.2.
[441] *Id.*
[442] *See infra* Chapter 5 (offering a possible solution for price adjustment under the Combined RPS-FiT Policy).
[443] Davies, *supra* note 25, at 351.
[444] *Id.*
[445] *See supra* Chapter 2.3.5 & Chapter 2.3.5.2.
[446] *See supra* Chapter 2.3.5.7 & Chapter 4.3.3.

into a less risky renewable energy market.[447] Such a combined policy creates greater investment certainty with mitigated market risks, which is one of the essential components necessary to attract new investment in any competitive market.[448]

In terms of efficiency, both RPSs and FiTs can be very cost efficient, though for different reasons. RPSs might be efficient from a policymaker's perspective, because they are market-based policies in which the risks are shifted from the policymakers (*i.e.*, the government/DOE) to the investors.[449] This risk-shifting should diminish the administrative costs of the policy. However, one must take into account the substantial compliance costs of RPSs, which might reduce the overall efficiency of such policies.[450] FiTs might be efficient because based on some studies, they have proven less costly overall, although that has not been definitively established.[451] For example, some studies found that one policy is more efficient than the other but later reversed their conclusion.[452] It seems that researchers reach mix results, and therefore their studies are not definitive.[453] Other studies have found that FiTs have a comparative advantage in reducing transactional costs due to their long-term mandatory purchase obligations (*i.e.*, PPAs) with standardized tariff terms.[454] Therefore, given the virtues of reduced transaction costs, FiTs have a clear advantage over RPSs.[455]

A combined RPS-FiT policy could achieve greater cost-efficiency than either RPSs or FiTs on a stand-alone basis. PPAs, via a FiTs policy, guarantee standardized contract terms and stable investment environments.[456] With a clear RPS goal, PPAs could be used to replace the competitive solicitations and bidding processes of an RPS policy, which could substantially reduce the compliance costs of the combined

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[447] Davies, *supra* note 25, at 354.
[448] Mormann, *supra* note 25, at 16.
[449] *See supra* Chapter 4.3.4.1.
[450] *Id.*
[451] Davies, *supra* note 25, at 351; *see also supra* Chapter 4.3.3.
[452] *See e.g.*, David Toke, *Renewable Financial Support Systems and Cost-Effectiveness*, 15 J. CLEANER PROD. 280 (2007).
[453] Davies, *supra* note 25, at 339.
[454] Davies, *supra* note 25, at 351.
[455] *Id.*
[456] CORY ET AL., *supra* note 211.

policy.[457] Standardized PPA contracts under a combined RPS-FiT policy translate into greater planning certainty and lower financing charges, consequently driving down RPS compliance costs.[458] Also, a combined RPS-FiT policy could eliminate many of the potentially extensive costs involved in assuring that utilities comply with an RPS, including eliminating volatile wholesale electricity and REC market risks, because FiT will be used as a compliance mechanism to make sure the RPS goal is achieved.

One challenge for successfully integrating such a combined policy is figuring out how to treat ownership and transfer of RECs. Felix Mormann suggested the conditioning of tariff payments on the transfer of REC ownership to the local utility company in exchange for FiT payments.[459] In other words, a renewable energy developer would sell renewable electricity at the FiT price in exchange for electricity and all associated RECs, as a bundled product.[460] If renewable energy developers are allowed to sell RECs separately under the combined RPS-FiT policy, it might create windfall benefits to the developers—once when they receive an above-market tariff for the electricity, and a second time when they sell RECs. Therefore, utilities will be able to use RECs as a compliance mechanism for the RPS targets, without the option to resell RECs in the secondary REC market.[461]

Another alternative is to allow utilities to resell the RECs they receive in exchange for their tariff payments for additional profit.[462] This resale would take place in an open market between both in-state and out-of-state utility companies. This approach would allow utilities to further reduce compliance costs under a combined RPS-FiT policy.[463] Although this alternative does not eliminate risks related to volatile REC markets, these risks are shifted to utility companies that are better equipped and experienced with such markets.[464] Therefore, utilities are better situated than investors to bear the REC-market related risks.[465] In

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[457] *Id.*
[458] *Id.*
[459] Mormann, *supra* note 25, at 15.
[460] *See supra* Chapter 2.3.5.6.1.
[461] Mormann, *supra* note 25, at 16.
[462] *Id.*
[463] *Id.*
[464] *See id.*; Bürer & Wüstenhagen, *supra* note 89, at 4,997; Luthi & Prassler, *supra* note 392.
[465] Bürer & Wüstenhagen, *supra* note 89, at 4,997; Luthi & Prassler, *supra* note 392; Mormann, *supra* note 25, at 17.

this case, utilities would be allowed to keep a portion of the profits from REC resales, which offers an additional reason for them to prefer the cost-effective RPS-FiT policy.[466]

Other scholars have suggested using the REC market as a tool to facilitate setting the right FiT price; however, they have not further elaborated on *how* this tool would be used in a combined RPS-FiT policy.[467] Another suggestion is splitting the FiT into two components—one payment for energy, and one payment for capacity.[468] The energy payment would be based on the wholesale electricity market, while the capacity payment would be based on a pricing system, which is very similar to how RECs function today.[469] In the combined RPS-FiT policy, the REC market could be used to set the appropriate FiT price.[470]

Davies summarizes his analysis for an integrated RPS-FiT policy as follows: "The RPS would establish the overall policy objective, including both the general deployment goal and any deployment sub-goals for specifically targeted renewables resources. The FiT would then (1) compel the purchase of produced eligible energy, (2) provide standard terms and conditions, including contract duration, for those purchases, (3) mandate interconnection for new projects, and (4) establish a tariff price and pricing structure, including, if desired, differentiated pricing for different resources."[471]

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[466] *See* Mormann, *supra* note 25.
[467] Davies, *supra* note 25, at 357.
[468] Lesser & Su, *supra* note 184, at 986–90.
[469] *Id.*
[470] Davies, *supra* note 25, at 358.
[471] *Id.* at 353.

Chapter 5

5. Proposed Pricing Model for Combined RPS-FiT Policy

5.1 Introduction

Davies's analysis is very broad and detailed; however, there are some unresolved questions left open.[472] One of the questions is what the pricing structure for FiTs would be in a combined RPS-FiT policy.[473]

In this Chapter, I will address the pricing structure question and propose a simplified theoretical pricing model for FiTs. The model is intended to be implemented in the combined RPS-FiT policy; therefore, the model assumes that the combined RPS-FiT policy is in place. Policymakers could use this model as a general guide to determine and, over time, adjust FiT price in the combined RPS-FiT policy.

The goal of the pricing model is to advance the study on market pull policies in general and on combined RPS-FiT policies in particular.

5.2 The Pricing Model in an Integrated RPS-FiT Policy

5.2.1 'Driving' the Renewable Energy Market

In the integrated RPS-FiT policy, RPS would establish the overall policy objective, such as 30% renewable energy by year 2030. The FiT would then be used to achieve this objective by setting an incentive price and assuring investors that renewables-produced electricity will have a market.[474]

As mentioned earlier, RPSs generally prioritize mitigation of regulatory burden over investor risk, while FiTs focus on investor-risk mitigation.[475] As of this writing, most of the states in the United States implement some sort of RPS policy.[476] RPSs mitigate regulatory burden by relying on free markets—

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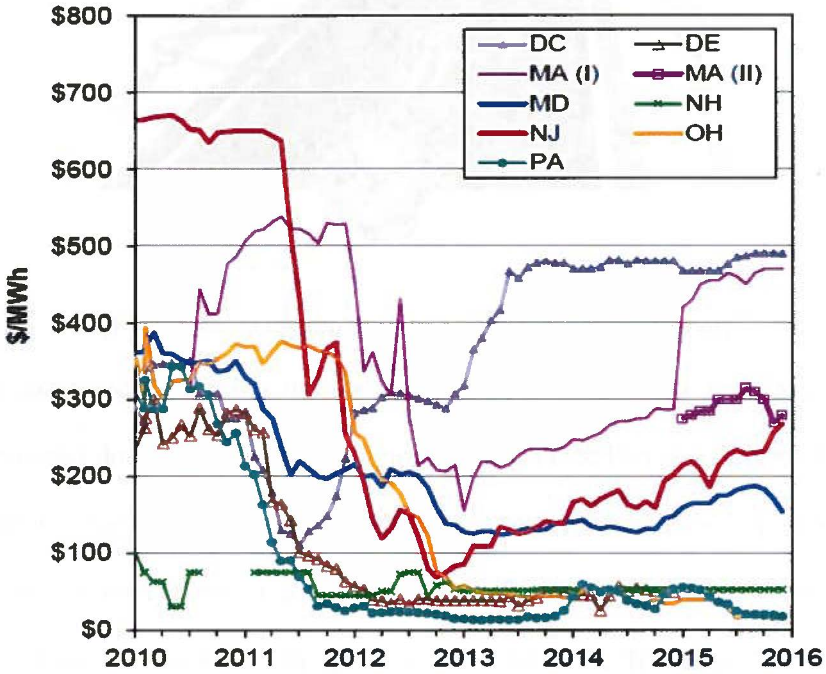
[472] *See supra* Chapter 4.3.5 & Chapter 4.4.
[473] Davies, *supra* note 25, at 358.
[474] *See supra* Chapter 4.4.
[475] *See supra* Chapter 4.3.
[476] *See supra* Chapter 2.3.5.2.

namely, the wholesale electricity market (through a bidding system) and the REC market.[477] Therefore, policymakers need only set the RPS target, and then the market's invisible hand takes care of determining the price of the renewable electricity and the price of the associated RECs. In other words, the burden shifts from the regulators to the investors and developers of renewables, which becomes an investor risk. Price volatility in electricity and REC markets has a negative effect on investments in the renewable energy market (see, for example, Figure 26, "Solar RECs Market Volatility," below).[478]



[Figure 26, Solar RECs Market Volatility][479]

When implementing a combined RPS-FiT policy—by importing some of the features of FiT into an existing RPS policy, such as in the United States—we also shift some of the risks from investors in and developers of renewables back to policymakers.[480] Under the combined RPS-FiT policy, policymakers would need to assume a regulatory burden of determining the FiT price.[481] The most challenging issue that

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[477] *See supra* Chapter 4.3.

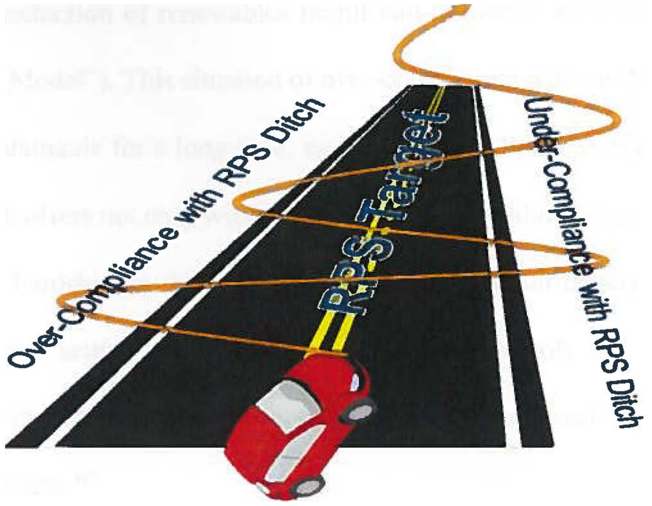
[478] *See supra* Chapter 4.3.3–4.3.3.1.

[479] BARBOSE, *supra* note 20, at 29.

[480] *See supra* Chapter 2.3.5.6, Chapter 2.3.5.9, & Chapter 4.3.4.

[481] *See* Corinna Klessmann et al., *Pros and Cons of Exposing Renewables to Electricity Market Risks—A Comparison of the Market Integration Approaches in Germany, Spain, and the UK*, 36 ENERGY POL'Y 3,646, 3,647 (2008).

faces the policymakers is how to set the tariff/price at a level that will successfully bring the renewable energy market to the RPS target.[482]



[Figure 27, "Driving" the Renewable Energy Market]

Under the combined RPS-FiT policy, it would be the policymakers' responsibility to "drive" the renewable energy market down the road towards the RPS target (see Figure 27, "'Driving' the Renewable Energy Market," above). On one side of the road, there is an "over-compliance with RPS target" ditch, and on the other side of the road, there is an "under-compliance with RPS target" ditch. The job of the policymakers is to "drive" the renewable energy policy "car" down the RPS target "road" without swerving into either ditch.[483] The main problem is that if the policymaker swerves too far in one direction or another, the renewable energy market may find itself in one of the ditches.

Let us assume, for example, that a policymaker is concerned about under-compliance with the RPS target and therefore decides to set the FiT price very high to ensure deployment of new renewable energy projects. In this case, the policymaker might increase the renewable energy deployment (Q) in order to

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[482] *See supra* Chapter 2.3.5.9.

[483] This principle is similar to the Federal Reserve's role in managing the nation's money supply through monetary policy. The Fed, by changing the money supply and interest rates, tries to prevent inflation or recession in order to ensure smooth economic growth over time. *See Monetary Policy*, BD. OF GOVERNORS OF THE FED. RESERVE SYS., https://www.federalreserve.gov/monetarypolicy/default.htm (last updated Mar. 15, 2017); *see* also Governor Ben S. Bernanke, Remarks Before the National Economists Club, Deflation: Making Sure "It" Doesn't Happen Here (Nov. 21, 2002), https://www.federalreserve.gov/BOARDDOCS/SPEECHES/2002/20021121/default.htm.

comply with the RPS target, but in so doing, the policymaker might have increased the prices in the renewable energy market (↑P).[484] An overreaction might even lead to over-compliance with the RPS; in other words, the actual production of renewables might end up *above* the RPS target (see Point "A" in Figure 11, "The Proposed Model"). This situation of over-compliance with an RPS target coupled with too high a FiT price is not sustainable for a long time, as evidenced by Spain's original solar FiT program.[485] A FiT price that is too high offers not only windfall benefits to renewable energy developers and investors, but also imposes an undue hardship on electricity ratepayers who may ultimately undermine public support for renewables.[486] Similarly, setting a FiT price too low would simply fail to make the most of the advantages offered by a FiT policy and, consequently, would fail to attract the necessary investments to new renewable energy projects.[487]

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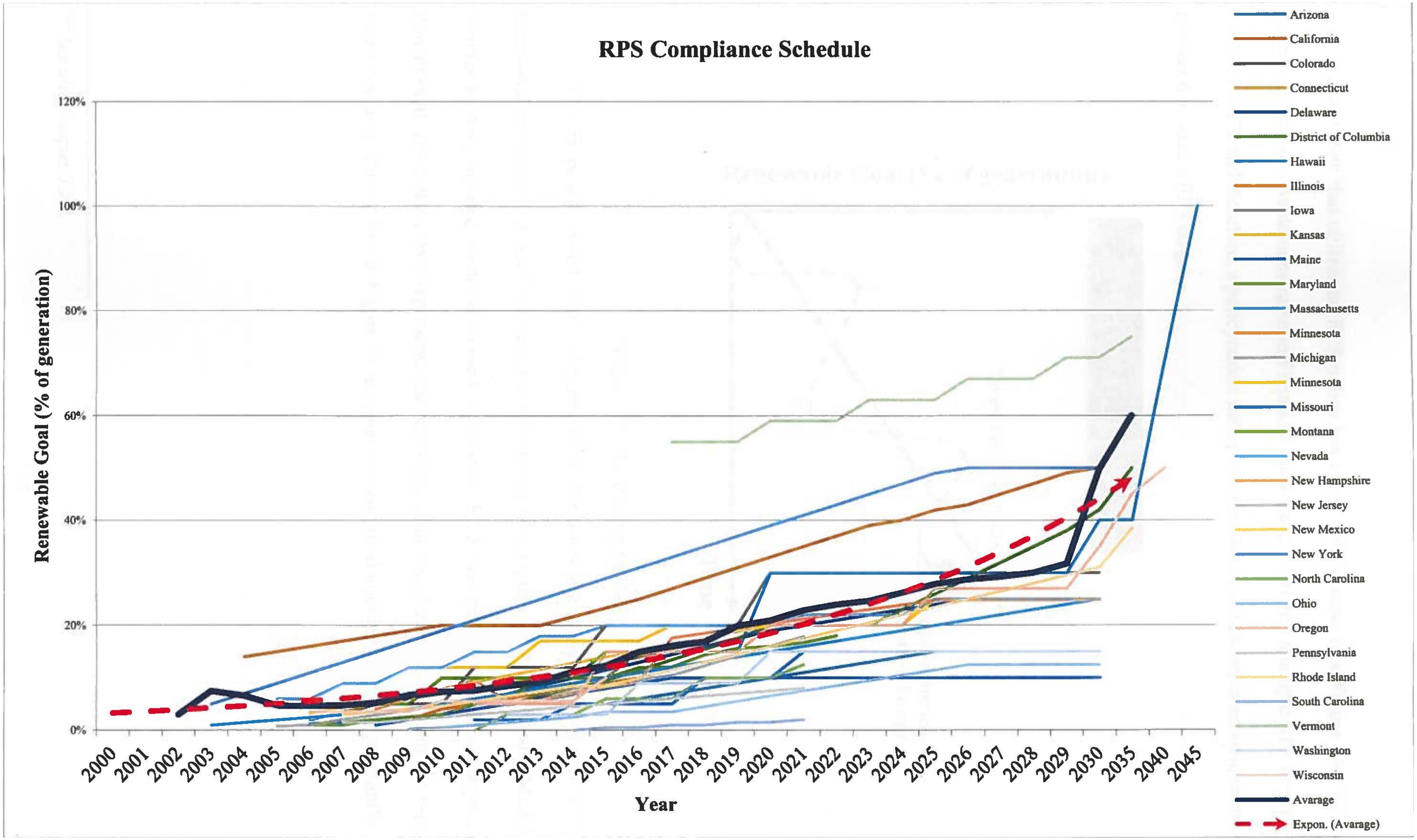
[484] See discussion about the basic concept of economics: $=P*Q in Chapter 3.2.1.

[485] It should be noted that Spain implemented only a FiT policy. *See* Council of Ministers, *The Government Will Temporarily Suspend Premiums for New Special Regime Facilities*, MINISTRY OF ENERGY, TOURISM & DIG. AGENDA (Jan. 27, 2012), http://www.minetad.gob.es/en-US/GabinetePrensa/NotasPrensa/2012/Paginas/npregimenespecial270112.aspx; *see also* MENDONCA ET AL., *supra* note 394, at 57–59; Schallenberg-Rodriguez & Haas, *supra* note 396, at 294.

[486] Schallenberg-Rodriguez & Haas, *supra* note 396.

[487] *See supra* Chapter 4.3.3.



[Figure 28, RPS Compliance Schedule. States with Voluntary and Capacity Goals are not Shown][488]

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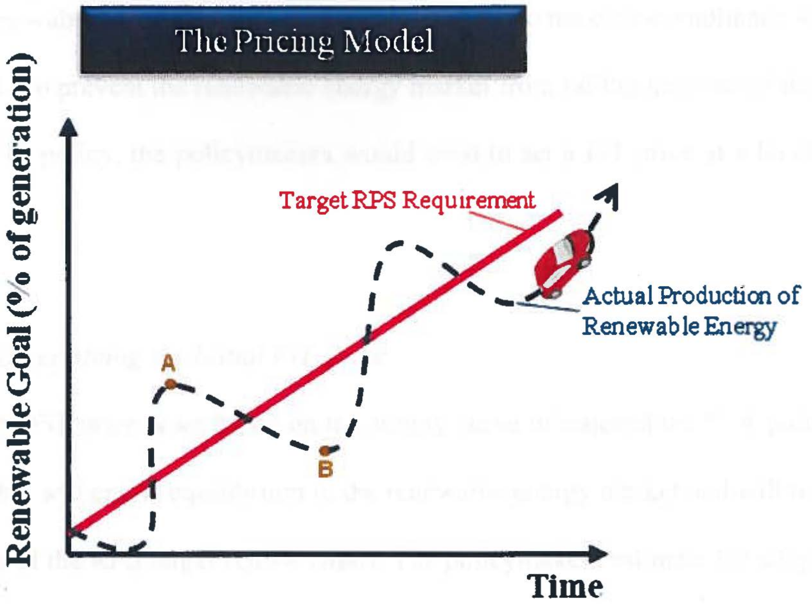
[488] *Presentations and Publications*, DSIREUSA.ORG, http://www.dsireusa.org/resources/presentations-and-publications/ (last visited Apr. 18, 2017).

Each state that utilizes an RPS policy has its own RPS target (see Figure 28, "RPS Compliance Schedule," above). As demonstrated in Figure 28 above, each state has a unique RPS target (*i.e.*, a unique "policy road"), and therefore, a policymaker for a particular state would need to set an appropriate FiT price to meet that state's RPS target.



[Figure 29, The Pricing Model]

The proposed model from Chapter 3.2.2 illustrates the policymaker's job of "driving" the renewable energy policy "car" to meet the RPS target (see Figure 29, "The Pricing Model," above).[489] Similar to the proposed model discussed in Chapter 3.2.2, the pricing model is mapped onto a two-dimensional space: the y-axis represents the renewable goal (% of generation), and the x-axis represents time (in years). The red line in Figure 29 represents a simplified minimum RPS target. Similar to the actual

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[489] *See also* Chapter 3.2.2.

state-RPS targets[490] (see Figure 28 above), the minimum RPS target grows over the time.[491] The blue dashed line in Figure 29 represents the actual production of renewable energy.

At point "A" in Figure 29, the renewable energy market is in the position of over-compliance with the RPS target, because the actual production of renewable energy is *above* the target RPS requirement. At Point "A," the renewable energy market is at risk of falling into the over-compliance with RPS "ditch" (see Figure 27 above). To prevent the renewable energy market from falling into one of the "ditches" under the combined RPS-FiT policy, the policymakers would need to set a FiT price at a level that meets the RPS target.[492]

5.2.2 Determining the Initial FiT Price

Generally, FiT price is set based on the supply curve of renewables.[493] A policymaker determines the price (PFiT) that will create equilibrium in the renewable energy market and will result in production of renewable energy at the RPS target (QRPS Target). The policymakers estimate the supply curve of a certain renewable energy source and, based on that supply curve, they determine the PFiT that will achieve the desired deployment rate of renewables (*i.e.*, QRPS Target) (see Figure 30, "Determining FiT Price in Renewable Energy Market," below).[494] The chosen FiT price would be offered to potential investors in renewables under the PPAs.[495]

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[490] The **red line** could also represent federal- level RPS targets with which each state needs to comply. *See* Chapter 2.3.5.3; "Federal Level Renewable Portfolio Standard"; *see also* Joshua P. Fershee, *Moving Power Forward: Creating a Forward-Looking Energy Policy Based on a National RPS*, 42 CONNONN. L. REVEV. 1,405 (2010); Benjamin K. Sovacool & Christopher Cooper, *supra* note 414*Congress Got It Wrong: The Case for a National Renewable Portfolio Standard and Implications for Policy*, 3 ENVTL. & ENERGY L. & POL'Y J. 85 (2008).

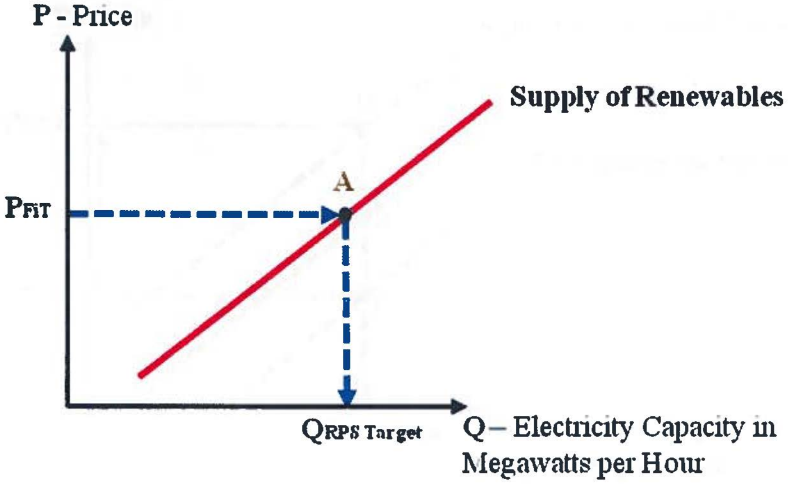
[491] *See supra* Chapter 3.2.2 & Figure 11.

[492] For different types of FiT policies, *see infra* Appendix A.3 – "FiT Payment Structures".

[493] Menanteau et al., *supra* note 378, at 802.

[494] *Id.*

[495] *See supra* Chapter 4.3.3.1.



[Figure 30, Determining FiT Price in Renewable Energy Market]

Figure 30 above represents a snapshot of the renewable energy market at a particular moment. However, markets are not fixed, and the supply curve shifts over time due to different economic forces and activities.[496] There are several factors that may cause a shift in the renewables' supply curve, including changes in prices of other goods, changes in the number of renewable energy projects, changes in the prices of relevant inputs (*i.e.*, the cost of resources used to produce renewable energy, including labor, land, and raw materials), technological advances, and taxes and subsidies.[497] This list is not exhaustive.

For example, if a government decides to phase out tax incentives or alternatively impose new taxes on renewables, the renewables' supply curve would shift to the left (see Figure 31, "Shifts of Supply of Renewables Curve in Renewable Energy Market," below). Since the government imposed a new tax, it would be more expensive to produce renewables; therefore, for each megawatt of electricity produced, the developers of renewables would ask for a higher price from the buyers. In this case, policymakers would need to set a higher FiT Price at the "PFiT B" level in order to meet the RPS target at "QRPS Target" (see Point "B" in Figure 31 below).

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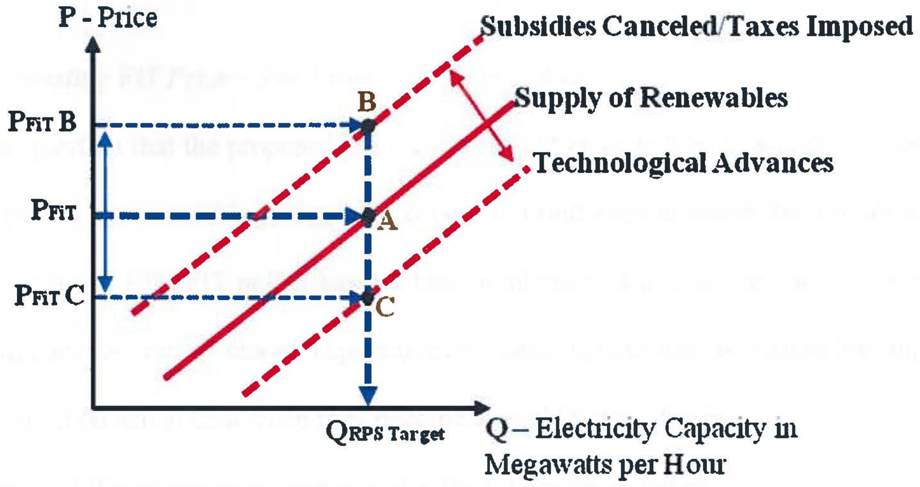
[496] PINDYCK, *supra* note 91. The supply curve shifts to the right, because if the market price stays constant as the costs of production decrease, we can expect an increase in the production and supply of electricity. *See* WILLIAM BOYES & MICHAEL MELVIN, MICROECONOMICS 60 (5th ed. 2002).

[497] BOYES & MELVIN, *supra* note 496; SAMUELSON & NORDHAUS, *supra* note 359, at 53.



[Figure 31, Shifts of Supply of Renewables Curve in Renewable Energy Market]

Take another example: if a renewable energy market experiences a technological advancement in production of renewables, then the supply curve for renewables will shift to the right (see Figure 31, "Shifts of Supply of Renewables Curve in Renewable Energy Market," above). The technological advancement makes it possible for producers of renewables to sell each megawatt of electricity at a lower price than before. In this case, policymakers would need to set a lower FiT price at "PFiT C" level in order to meet the RPS target at "QRPS Target" (see Point "C" in Figure 31 above).

It is the policymakers' task to keep track of such shifts in the supply curve for renewables, meaning they need to set and later adjust the FiT price that will eventually meet the RPS target. This way, the government achieves price stability in the renewable energy market as well as investment certainty and compliance with the RPS goal, each of which promotes the deployment of new renewable energy projects.[498]

The following proposed pricing model addresses the issue of how to properly adjust the FiT price so that it neither leads to the over-production of renewables (by setting the FiT price too high) nor the under-production of renewables (by setting the price too low), either of which would reduce incentives to invest in the renewable energy market.

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[498] *See generally supra* Chapter 4.4.

5.2.3 *Adjusting FiT Price – The Proposed Pricing Model*

The main question that the proposed pricing model addresses is how to properly adjust FiT price over time to ensure that the renewable energy market does not find itself in one of the figurative ditches.[499]

Since a combined RPS-FiT policy has not been implemented in practice, the following model is theoretical. As with any theoretical model, experience and learning over time will allow for improvements and adjustments based on actual data when they become available in the future.

In the center of the proposed pricing model is the following equation:

$$P_{FiT} = \$X + \alpha * \$X * (\text{Push Instruments Gap \%}) + \beta * \$X * (\text{RPS Gap \%})$$

Where:

PFiT	is the FiT price after the adjustment.
$X	is the initial FiT price determined based on the renewables supply curve (see Figure 30, "Determining FiT Price in Renewable Energy Market," above).
Push Instruments Gap %	is equal to: 100 * (Actual Supply of Renewables – Potential Supply of Renewables) ÷ Potential Supply of Renewables.
RPS Gap %	is equal to: 100 * (Target RPS Requirement – Actual Production of Renewable Energy) ÷ Target RPS Requirement.
α , β	are coefficients that determine the strength or weakness of the resulting effects of the Push Instruments Gap % and RPS Gap % on the PFiT.

The left side of the equation (PFiT) is the result of the operation of the right side of the equation.

Push Instruments Gap % is created as a result of a difference between an expected supply of renewables curve and an actual supply of renewables curve. The difference between actual and expected

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[499] *See supra* Chapter 5.2.1.

supply curves may be a result of shifts in the supply of renewables curve due to changes in market push policies, technological advances, or other economic activities that affect the supply curve for renewables (see Figure 31 above).

For example, if there were a shift in the supply of renewables curve to the left due to a phase-out of a tax credit for renewables (see Point "B" in Figure 31 above), that would create a gap between the initial supply of renewables curve, point "A", and the new supply of renewables curve, point "B" (see Figure 31 above). In the equation, this would create a positive gap percentage that consequently would require increasing the FiT price from "PFiT" to "PFiT B" (see Figure 31 above).

RPS Gap % is created as a result of a gap between the target RPS requirement line and the actual production of renewable energy line (see Figure 32, "Proposed Pricing Model – Overview," below). For example, if a renewable energy market is in the position of over-compliance with the RPS target (see Point "A" in Figure 29, "The Pricing Model," above), that would create a gap between the target RPS requirement line and actual production of renewable energy curve. In the equation, this would create a negative gap percentage that consequently would require decreasing the FiT price to bring the market towards the RPS target.

α and β are coefficients that determine the strength or weakness of the resulting effects of the Push Instruments Gap % and the RPS Gap % on the PFiT. These are fixed figures that would be determined based on a microeconomic study once the RPS-FiT policy is in place and actual data become available.

5.2.4 Mechanics of the Equation

The following examples will describe the mechanics of the equation. If there were no shifts in the supply of renewables curve and the renewable energy market was in compliance with the RPS target, then the Push Instruments Gap % and RPS Gap % would equal zero and the PFiT should equal $X.

$$\text{PFiT} = \$X + \alpha * \$X * \underbrace{(\text{Push Instruments Gap \%})}_{0} + \beta * \$X * \underbrace{(\text{RPS Gap \%})}_{0}$$

$$\Downarrow$$

$$\text{PFiT} = \$X$$

Now let us assume that the government passes a resolution requiring that renewable energy tax credits be phased out gradually over time.[500] The resolution would affect the supply of renewables curve by shifting it to the left gradually over time.[501] Without the tax credits, the production of renewable energy for developers of renewables becomes more expensive. This shift would create a gap between an initial or expected supply curve and the new supply curve after the application of the credit phase-out (see point “B” in Figure 31, “Shifts of Supply of Renewables Curve in Renewable Energy Market,” above).

$$\uparrow \text{PFiT} = \overline{\$X} + \alpha * \$X * \underbrace{(\text{Push Instruments Gap \%})}_{\uparrow \text{Positive Gap \%}} + \beta * \$X * \underbrace{(\text{RPS Gap \%})}_{0}$$

$$\Downarrow$$

$$\uparrow \text{PFiT} = \overline{\$X} + \alpha * \$X * (\uparrow \text{Positive Gap \%})$$

Push Instruments Gap % equals 100 * (Actual Supply of Renewables – Potential Supply of Renewables) ÷ Potential Supply of Renewables. Since the actual supply curve is above the initial supply curve, the gap % would generate a positive percentage number (see the line between points “A” and “B” in Figure 31 above). Inserting this result into the equation results in a positive adjustment of FiT price, from “PFiT” to “PFiT B” (*i.e.*, ↑ PFiT). α would eventually determine to what extent the Push Instruments Gap % would affect the PFiT. Therefore, according to the equation, a policymaker would need to increase the FiT price in order to improve the attractiveness of the market during the energy credit phase-out period.

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[500] *See infra* Appendix A.1.3–A.1.4 - “Credit for Advance Energy Property – IRC Sec. 48C” and “Section 1603 Grants in Lieu of Tax Credits”.

[501] *See supra* Figure 23 & Figure 31.

Now let us assume that renewable energy is in the position of over-compliance with the RPS target (see point "A" in Figure 29 above). What happens if the market produces more renewable energy than the RPS target?

$$\downarrow P_{FiT} = \overline{\$X} + \alpha * \$X * \underbrace{(\text{Push Instruments Gap } \%)}_{0} + \beta * \$X * \underbrace{(\text{RPS Gap } \%)}_{\downarrow \text{Negative Gap } \%}$$

$$\Downarrow$$

$$\downarrow P_{FiT} = \overline{\$X} + \beta * \$X * (\downarrow \text{Negative Gap } \%)$$

In this case, the RPS Gap is equal to: 100 * (Target RPS Requirement – Actual Production of Renewable Energy) ÷ Target RPS Requirement. Point "A" in Figure 29 is above the target RPS requirement, and therefore, the actual production of renewables number would be higher than the target RPS requirement number. Inserting this result into the equation results in a negative adjustment of FiT price (*i.e.*, ↓ PFiT) (see negative and positive RPS Gaps in Figure 32, "Proposed Pricing Model – Overview," below). β would eventually determine to what extent the RPS Gap % affects the PFiT. A microeconomic study would be needed to determine the value of β in a particular renewable energy market. Therefore, according to the equation, a policymaker would need to decrease the FiT price in order to avoid the situation in which the market falls into the "over-compliance with RPS" ditch.[502]

Figure 32, "Proposed Pricing Model – Overview," below provides an overview of the proposed pricing model. It shows how different economic activities in the renewable energy market might affect the adjustment to FiT price over time.

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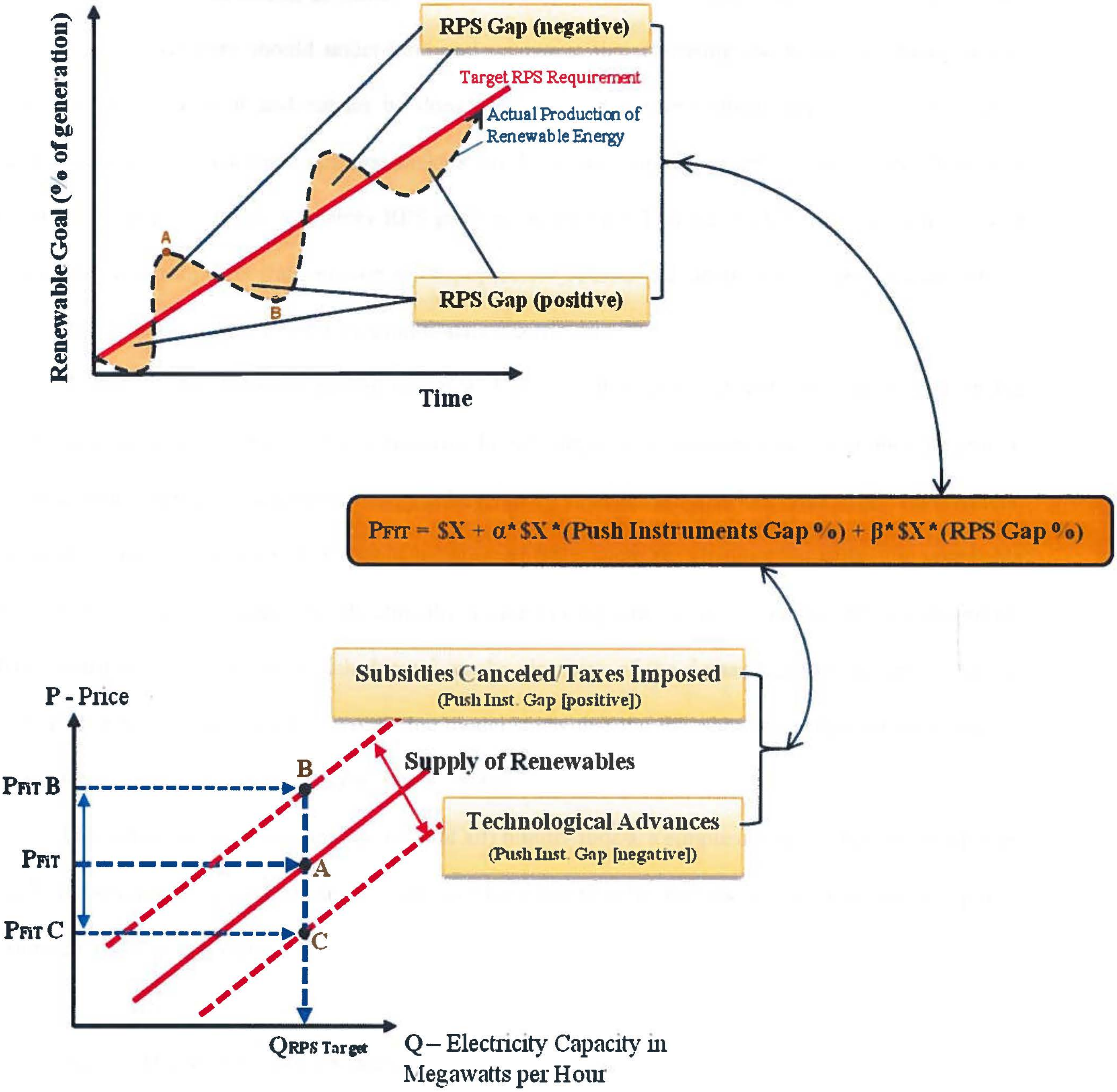
[502] *See supra* Figure 27.



[Figure 32, Proposed Pricing Model - Overview]

5.2.5 *Policy Rules and Their Use in Practice*

Policy rules, such as the proposed pricing model, need not be pure mechanical formulas that are implemented without discretion. A policy rule can be operated more informally by policymakers who understand the economic effects of market push and pull policies on the renewable energy market. At the same time, policymakers should understand and recognize that operating the proposed pricing model requires human judgment and cannot be done only by a computer without any supervision.[503] It is reasonable to assume that these decision-makers would be non-political electricity operators whose goal would be to comply with the regulatory RPS goals by adjusting FiT in the market. This position could be compared to electric power transmission system operator (TSO) or an independent system operator (ISO) who coordinates, control and monitors a multi-state electric grid.[504]

Therefore, the proposed pricing model will allow policymakers to make judgments to keep the actual renewable energy capacity or generation on the RPS target. The proposed model describes the general principles that underlie the renewable energy policy, but the final discretion is left with the decision-makers. The model states only that the FiT should be adjusted when there are changes that affect the renewable energy market. The model provides the direction of the FiT adjustment but not necessarily the magnitude of the adjustment (*i.e.*, α , β), which depend on the elasticity of the demand and supply curves in the renewable energy market. In other words, the model states that the FiT should be adjusted when market push policies change and when an RPS Gap is created.

In practice, decision-makers rarely (if at all) blindly follow a simple algebraic formula as a policy rule.[505] However, having the proposed pricing model as a tool in policymakers' toolkit could improve policy performance and policy clarity.

5.2.6 Discussion and Conclusion

This chapter has attempted to address the issue of determining the FiT price in a combined RPS-FiT policy. This issue has been left unaddressed or unresolved by many scholars in the field. Therefore, I

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[503] *See e.g.*, John B. Taylor, *Discretion Versus Policy Rules in Practice*, 39 CARNEGIE-ROCHESTER CONF. SERIES ON PUB. POL'Y 195 (1993).

[504] *See Glossary*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/glossary/index.php?id=I (last visited Aug. 23, 2017).

[505] *Id.* at 213.

made an effort to create a rule-like pricing model that could potentially improve policy performance in the renewable energy market once a combined RPS-FiT policy is in place. A simple algebraic formula proposed under the pricing model takes into account different economic activities that affect the renewable energy market and suggests that decision-makers adjust the FiT price in order to keep the renewable energy market on RPS target. Although the algebraic formula is not intended to be mechanically followed by policymakers, it could be used to as a valuable tool to improve the renewable energy policy performance.

Chapter 6

6. Conclusion

This dissertation has described and evaluated the U.S. renewable energy policy, offering a model to evaluate the effects of policymakers' decisions on the deployment rate of renewables in the United States. The study not only makes the case for a combined RPS-FiT policy design that offers a number of advantages, which neither policy design provides by itself today, but also addresses some of the hybrid policy's thorniest problems such as the pricing structure issue.

Chapter 2 of the study provides a wealth of detail on market push and pull policies implemented in the U.S. renewable energy market. It also describes the historical development of renewable energy policy in the United States along with market failures and justifications of governmental intervention in energy markets.

Underlying Chapter 3 of the study is the idea that evaluating policy decisions more carefully and accurately is essential to understanding their effect on policy outcomes. The study offers a model to evaluate probable policy outcomes under different economic conditions of the renewable energy market as a result of policymakers' decisions. To test the hypotheses that were presented in Chapter 3, I collected and analyzed data on the U.S. renewable energy market from different official sources and applied the data to the proposed model.

From an empirical standpoint, the data reveals that there is substantial evidence supporting the hypotheses of the study. Indeed, in years 2000 through 2006, when the Target RPS Requirement Curve was above the Actual Production of Renewable Energy Curve, the economic incentives that were infused into the renewable energy market had a substantially stronger effect on the deployment rate of renewables than on the price rate of renewables. Similarly, the data substantially supports the second hypothesis of the study. Namely, in years 2007 through 2013, when the Target RPS Requirement Curve was below the Actual Production of Renewable Energy Curve, the economic incentives that were infused into the renewable energy market had a very limited effect on the deployment rate of renewables. In particular, Chapter 3 highlights the importance of proper evaluation of the necessity to introduce additional financial incentives to the U.S. renewable energy market when the market is over-compliant with the RPS targets. Furthermore, the study supports a policy design where more stringent RPS goals are associated with higher market pull and push policy responses.

Chapters 4 and 5 are prospective in nature. They propose a policy design that would include the combination of RPS and FiT policies. Specifically, Chapter 4 provides a basic microeconomic explanation how different policies, such as market pull and push policies, work together. Then, Chapter 4 elaborates the benefits of the combined RPS-FiT policy. Under the combined policy, the RPS would set the renewable energy target or destination that the policymakers are trying to reach on our collective energy landscape, whereas FiT would be used as the primary incentive or the engine that can drive us towards that destination. The combined RPS-FiT policy could offer several advantages. First, the combined policy sends a stronger signal to the market than either policy on a stand-alone basis that the government is committed to promotion of renewables. Second, the combined policy will target a broader audience – RPS targets utilities while FiT seeks to attract investors. Finally, the combined policy offers synergies by making renewable energy simpler and more efficient by eliminating redundancies and adopting the most efficient and effective aspects of each policy.

Chapter 5 addresses one of the renewable energy policy's thorniest problems: what pricing structure to use and how to effectively adjust the price in the combined RPS-FiT policy once it is in place. A rule-like pricing model is created to potentially improve policy performance in the renewable energy market. The model facilitates the policymakers; adjustments of the FiT price in order to keep the renewable energy market on RPS target.

The line of inquiry presented in this dissertation could offer an opportunity for future research in the field of the renewable energy and electricity pricing. Renewables are the fastest growing energy source, and their falling costs are making them competitive with fossil fuels. Therefore, it is no longer far-fetched to think that the world is entering an era of clean and cheap power. However, to get there requires huge amounts of investment over the next few decades. Normally, investors like investing in electricity because of the reliable return; although this might change due to President Trump's deregulation agenda in the energy market. In the case of renewables, the return is even harder to estimate than that of the fossil-based energy market. The more that renewables are deployed, the more that the price of power from any source declines, which makes it hard to estimate a reasonable return on investment. A possible solution could be offered through an elaborated system of renewable energy pricing. This system can be based on and further developed from the pricing model that was presented in Chapter 5.

This dissertation highlights the importance of examining policies in more detail and gives the utmost attention to policy design and its effect on prices (ΔP) and deployment rates (ΔQ) of renewables. Obviously, no single energy policy offers the best option for a sustainable future; however, policymakers could adopt a more efficient and effective policy, such as the combined RPS-FiT policy, that would bring us closer to an era of clean, unlimited, and cheap power. Overall, this policy research attempts to create evidence-driven support upon which future policy debates could be built. It provides important insights on the outcomes associated with changes in the market push and pull policies. Also, it provides a potentially useful pricing tool that could be used by policymakers in the combined RPS-FiT policy.

Appendix A

A.1 - Some of the Main Federal and Local Economic Incentives Available Today[506]

Today, the federal tax subsidy mechanisms related to renewable energy are included in several sections of the Internal Revenue Code of 1986 (IRC).[507] The IRC provides two main tax credits, the Investment Tax Credit (ITC) and the Production Tax Credit (PTC).[508]

A.1.1 Investment Tax Credit – "Energy Credit" – ITC

Investment Tax Credits (ITCs)[509] were first introduced by the U.S. Congress in 1962 as a part of a major program to stimulate the economy and protect U.S. businesses from foreign competition. Since then, ITCs have also been used in support of energy protection, pollution control, and other economic goals.[510] Today, the ITC is one of the government's main tools for subsidizing and incentivizing the production and installation of renewable energy projects.[511] The ITC is an indirect subsidy provided by the government to incentivize individuals and businesses to invest their capital in specific types of business property. The tax credits are claimed on an income tax return, in which each credit offsets tax liability dollar-for-dollar[512] without reducing the tax liability below zero.[513]

The energy credit is granted in exchange for placing Energy Property (as defined in IRC Sec. 48(a)(3)) in service.[514] This credit is calculated by multiplying the basis of the property put into service (*i.e.*, the cost of the eligible project) by either 10% or 30% depending on the type of property. Energy

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[506] Updated as of October 2016.
[507] *See, e.g.*, KRAMER & FUSARO, *supra* note 6, at ch. 25.
[508] Historically, the primary tax incentive for renewable electricity has been the production tax credit. *See* MOLLY F. SHERLOCK, CONG. RESEARCH SERV. 7-5700 R43453, THE RENEWABLE ELECTRICITY PRODUCTION TAX CREDIT: IN BRIEF (2015).
[509] I.R.C. § 48 (2012); *see also* Consolidated Appropriations Act, 2016 H.R. 2029.
[510] *See also* Energy Tax Act of 1978, Pub. L. No. 95-618, 92 Stat. 3174 (the first act to establish the investment tax credit for renewables).
[511] MICHAEL J. NOVOGRADAC, RENEWABLE ENERGY TAX CREDITS HANDBOOK (2010).
[512] As opposed to tax deductions that are less attractive to provide incentives to taxpayers.
[513] Elliott, *supra* note 194, at t 247–48, 251–54.
[514] I.R.C. § 48 (2012).

Percentage equals 30% for IRC Sec. 48(a)(2)(A)(i) property (*i.e.*, solar, wind, and converted PTC facilities) and 10% for all other Energy Property (*i.e.*, geothermal energy, microturbine, or combined heat and power methods). After 2019, the credit rate for solar electric begins to decrease over time to 10% for projects that begin construction after 2012 or that are not placed in service before 2024.[515] The ITC is expected to reduce federal revenues by $10 billion between 2015 and 2019.[516]

A.1.2 Production Tax Credit – PTC

The Production Tax Credit (PTC),[517] first introduced as part of the Energy Policy Act of 1992,[518] provides tax credits for the production of energy from a qualified renewable energy facility.[519] Similar to the ITC, the PTC offsets taxes dollar-for-dollar from taxpayers' tax liability and cannot be reduced below zero. The PTC was enacted under Sections 45 and 38 of the IRC.[520]

Under IRC Sec. 45, taxpayers are allowed a credit for producing and selling renewable electricity, refined coal, and Indian coal.[521] The credit amount is generally 2.3 cents per kW/h for electricity produced from wind, closed-loop biomass, and geothermal energy in 2015; it is generally 1.2 cents per kW/h for electricity produced from open-loop biomass, small irrigation, landfill gas, trash combustion, qualified hydropower, and marine and hydrokinetic sources in 2015. The tax credit is available for 10 years after the date the facility is placed in service.[522]

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[515] Consolidated Appropriations Act, 2016 H.R. 2029. The Consolidated Appropriations Act, signed in December 2015, included several amendments to this credit which apply to solar technologies and PTC-eligible technologies. Notably, the expiration date for these technologies was extended, with a gradual step down of the credits between 2019 and 2022.

[516] SHERLOCK & STUPAK, *supra* note 106, at 15.

[517] I.R.C. § 45 (2012); I.R.S. Notice 2013-29 (04/15/2013); I.R.S. Notice 2013-60 (09/20/2013); I.R.S. Notice 2014-46 (08/08/2014), I.R.S. Notice 2014-36 (05/22/2014); I.R.S. Notice 2015-25 (03/11/2015); I.R.S. Notice 2016-31 (05/05/2016).

[518] Energy Policy Act of 1992, Pub. L. No. 102-486, 106 Stat. 2776.

[519] For details regarding the legislative history of the production tax credit, see CONG. RESEARCH SERV., 109TH CONG., TAX EXPENDITURES: COMPENDIUM OF BACKGROUND MATERIAL ON INDIVIDUAL PROVISIONS (Comm. Print 2006).

[520] *See supra* note 517.

[521] I.R.C. § 45(a) (2012); *see also* I.R.C. § 38(b)(8) (2012).

[522] *See* I.R.C. § 45(a) (2012).

In order to take advantage of the PTC, construction must begin before December 31, 2019. The credit has phase-out provisions beginning after December 31, 2016.[523] The PTC is expected to reduce federal revenues by $19.9 billion between 2015 and 2019.[524]

A.1.3 Credit for Advanced Energy Property – IRC Sec. 48C

Under the ARRA 2009, Congress provided funds for a credit for advanced energy property.[525] Consequently, the manufactures of renewable energy equipment also became eligible for tax credits.[526]

This credit provides an ITC of up to 30% of qualified investment[527] in a qualifying advanced energy project that produces or manufactures renewable energy equipment, such as fuel cells, microturbines, and electric grids for renewable projects. To qualify for the credit, the IRS must certify a project in advance.[528] A total of $2.3 billion was allocated for advanced energy property investment tax credits, which were competitively awarded by the Department of Energy and the Treasury.[529]

A.1.4 Section 1603 Grants in Lieu of Tax Credits

The Section 1603 program offers renewable energy project developers cash payments in lieu of ITCs.[530] The amount of the grant equals 30% or 10% of the relevant qualified facility's basis.[531] To be eligible for the grant, a renewable property must be placed in service during 2009, 2010, or 2011, or after 2011 if construction began on the property during 2009, 2010, or 2011.[532] According to IRC Sec. 48(d)(3),

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[523] *Renewable Electricity Production Tax Credit (PTC)*, *supra* note 48.

[524] SHERLOCK & STUPAK, *supra* note 106, at 14.

[525] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 State. 115.

[526] KRAMER & FUSARO, *supra* note 6, at ch. 25.

[527] ITC provides 30% for solar, fuel cells, small wind and PTC-eligible technologies, and 10% for geothermal, microturbines and CHP.

[528] I.R.C. § 48C (2012).

[529] SHERLOCK & STUPAK, *supra* note 106, at 14.

[530] American Recovery and Reinvestment Tax Act of 2009, Pub. L. No. 111-5, 123 Stat. 115, *amended by* Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010, Pub. L. No. 111-312, § 707 (§1603 provides rules for coordinating such grants with the I.R.C. § 48).

[531] I.R.C. § 45(d) (2012).

[532] *1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, U.S. DEP'T OF TREASURY (Sept. 30, 2016), https://www.treasury.gov/initiatives/recovery/Pages/1603.aspx; *see also* U.S. TREASURY DEP'T,

the grant is not includible in the gross income of the taxpayer, but the grant will be taken into account in determining the basis of the property to which the grant relates.[533]

As of July 31, 2016, the total number of projects funded was 105,178, with total funding of $24.9 billion. Total estimated private, regional, state, and federal investment in Sec. 1603 projects equals $90.2 billion, which added 33.3 GW of installed capacity from renewable-funded projects and 88.8 TWh of total estimated annual electricity generation from funded projects.[534]

A.1.5 Federal Tax Incentives for Consumers

The IRC includes not only incentives directed to renewable energy manufacturers, producers, and distributers, but also incentives provided to renewable energy consumers. For example, IRC Sec. 25C provides a 30% energy property credit based on the cost of qualified energy-efficiency improvements in a taxpayer's principal residence.[535] IRC Sec. 25D provides a 30% credit based on the cost of certain property that either generates electricity, heats water, or both heats and cools a residence. The tax credit for solar technologies is subject to a phase-out schedule. Fuel-cell power plants receive a 30% credit, limited to $500 for each 0.5 kilowatt of capacity.[536]

A.1.6 Modified Accelerated Cost Recovery System (MACRS) and Bonus Depreciation

Sec. 168 of the IRC was updated under the authority of IRC Sec. 48 and provides a modified accelerated cost-recovery system (MACRS) and bonus depreciation from 2008 through 2012 for the renewable energy projects.[537]

PAYMENTS FOR SPECIFIED ENERGY PROPERTY IN LIEU OF TAX CREDITS UNDER THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 (2011), https://www.treasury.gov/initiatives/recovery/Documents/GUIDANCE.pdf.

[533] *1603 Program: Payments for Specified Energy Property in Lieu of Tax Credits*, *supra* note 532.

[534] *Overview and Status Updated of the Sec. 1603 Program*, U.S. DEP'T OF TREASURY (July 31, 2016), https://www.treasury.gov/initiatives/recovery/Documents/STATUS%20OVERVIEW.pdf.

[535] Energy efficiency improvements include insulation, exterior doors, metal roofs, and exterior windows.

[536] Consolidated Appropriations Act, 2016, H.R. 2029; I.R.C. § 25D (2012).

[537] I.R.C. §§ 168, 48. Generally, the federal tax code allows for the annual depreciation of capital investments over the useful life of the respective asset. *See* I.R.C. § 167 (2012). For a general discussion, see PHILIP BROWN & MOLLY F. SHERLOCK, CONG. RESEARCH SERV. 7-5700 R41635, ARRA SECTION 1603 GRANTS IN LIEU OF TAX CREDITS FOR RENEWABLE ENERGY: OVERVIEW, ANALYSIS, AND POLICY OPTIONS 4 (2011); *see also* I.R.S.,

Under MACRS, renewable energy businesses are eligible for recovering investments in renewable projects through accelerated depreciation deductions. Eligible renewable projects, such as solar, geothermal, and wind projects/properties (defined under IRC Sec. 48(a)(3)(A)[538]), are classified as five-year properties under MACRS.[539] Other renewable energy projects, such as biomass or marine and hydrokinetic properties, are classified under MACRS as seven-year properties. Both of these classifications are substantially lower than the actual life of the corresponding projects.[540] The five-year cost recovery for renewable energy is a permanent part of the tax code, and it is estimated to reduce federal revenues by $1.3 billion between 2015 and 2019.[541]

The bonus depreciation was first introduced by the Federal Economic Stimulus Act of 2008, which included a 50% first-year bonus depreciation provision for eligible renewable energy equipment that was acquired and placed in service in 2008.[542] This provision was extended by the ARRA 2009[543] for the entirety of 2010.[544] In December 2010, the bonus depreciation was extended once again by The Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010[545] through 2012; however, this Act reduced the basis for the deduction from 100% to 50%.[546] Following the enactment of the American Taxpayer Relief Act of 2012, the 50% first-year bonus depreciation was further extended for property placed in service during 2013.[547] The latest extension was introduced by the Tax Increase Prevention Act of 2014,[548] which extended the 50% first-year depreciation allowance through December 31, 2014.[549] The

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Publication 946 Cat. No. 13081F, *How to Depreciate Property* (Feb. 27, 2017), https://www.irs.gov/pub/irs-pdf/p946.pdf.

[538] The eligible property includes: solar-electric and solar thermal technologies, fuel cells and microturbines, geothermal electric, direct-use geothermal and geothermal heat pumps, small wind (100KW or less), combined heat and power (CHP) and other ITC eligible technologies.

[539] I.R.C. § 168(e)(3)(B)(vi), 48(a)(3)(A) (2012).

[540] *See Modified Accelerated Cost-Recovery System (MACRS)*, ENERGY.GOV, http://www.energy.gov/savings/modified-accelerated-cost-recovery-system-macrs (last visited Oct. 22, 2016).

[541] SHERLOCK & STUPAK, *supra* note 106, at 15.

[542] *See* Emergency Economic Stabilization Act of 2008, Pub. L. No. 110-343, 122 Stat. 3765.

[543] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115.

[544] *See id.*; I.R.C. § 168(k) (2012).

[545] Job Creation Act, Pub. L. No. 111–312, H.R. 4853, H.R. 4853 (2010).

[546] *Id.*

[547] *See* American Taxpayer Relief Act, Pub. L. No. 112-240, 126 Stat. 2313 (2012).

[548] H.R. 5771, § 125.

[549] *See Modified Accelerated Cost-Recovery System (MACRS)*, *supra* note 540.

Consolidated Appropriations Act, signed in December 2015, extended the "placed in service" deadline for bonus depreciation. Equipment placed in service before January 1, 2018 can now qualify for 50% bonus depreciation; equipment placed in service during 2018 can qualify for 40% bonus depreciation; and equipment placed in service during 2019 can qualify for a 30% bonus depreciation.[550]

A.1.7 Clean Renewable Energy Bonds (CREBs) – IRC Sec. 54, 54A, and 54C

The Energy Tax Incentives Act of 2005 is codified in IRC Sec. 54.[551] This provision created Clean Energy Renewable Bonds (CREBs), and it allows states and local governments to sell bonds to finance public renewable energy projects and certain qualified private activities. CREBs carry a lower interest rate than comparable corporate bonds. Nonetheless, in order to make these bonds attractive to the public, they are typically tax-exempt bonds. Also, according to IRC Sec. 54, CREBs provide credits to taxpayers who hold renewable energy bonds. The credit amount is determined by multiplying the bond's credit rate by the face amount of the holder's bond.[552]

Generally, the borrower who issues the bond pays back only the principal of the bond, while the bondholder receives federal tax credits, which equals the market interest.

CREBs are typically issued by government entities (*e.g.*, states, cities, counties, or any other local governments) and electric cooperatives.[553] Qualifying technologies that are eligible to receive funds through CREBs are generally similar to the technologies that are eligible for PTCs.

In order to be a qualified CREB, the bond has to satisfy four conditions:[554] (1) it must be issued by a qualified issuer (a mutual or cooperative electric company, or a governmental body); (2) more than 95% of the funds collected must be used for qualified projects; (3) the bond must be in registered form; and (4)

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[550] *See* Rev. Proc. 2011-26, 2011-16 I.R.B. 664 (03/29/2011); I.R.C. §§ 48, 168 (2012); *Modified Accelerated Cost-Recovery System (MACRS)*, *supra* note 540.
[551] Energy Tax Incentives Act of 2005, Pub. L. No. 109-58, § 1301, 119 Stat. 594.
[552] JOINT COMM. ON TAXATION, JCX-60-05, DESCRIPTION AND TECHNICAL EXPLANATION OF THE CONFERENCE AGREEMENT OF H.R. 6, TITLE XIII, THE "ENERGY TAX INCENTIVES ACT OF 2005" (2005).
[553] Entities qualified to issue CREBs include mutual or cooperative electric companies, "clean renewable energy bond lenders," and certain governmental bodies.
[554] I.R.C. § 54(d) (2012).

the issuance of the bond must meet special rules specified in IRS Sec. 54(h).[555] The bondholder receives federal tax credits in lieu of a portion of the market bond interest, resulting in a lower effective interest rate for the borrower. The issuer remains responsible for repaying the principal on the bond.

Participation in the program is limited by the volume of bonds allocated by Congress for the program. Participants must first apply to the IRS for a CREBs allocation and then must issue the bonds within a specified time period.[556]

IRC Secs. 54A and 54C, enacted under the Energy Improvement and Extension Act of 2008 and later improved under the ARRA 2009,[557] provide *New* Clean Renewable Energy Bonds (New CREBs). Congress limited the volume of bonds available for renewable facilities to $2.4 billion, of which no more than one-third can be allocated each to public power providers, governmental bodies, or cooperative electric companies. The IRS is responsible for the New CREBs allocation and requires that bonds must be issued within three years after the applicant receives notifications of an approved allocation.[558] According to IRS Announcement 2010-54,[559] the IRS stopped accepting applications for New CREBs as of November 1, 2010, because the entire bond volume was fully allocated by the end of 2009.

As opposed to the (old) CREBs, which provide dollar-for-dollar credit to offset the tax liability of the bondholder, the New CREBs reduced the credit to 70%. However, the tax credit may be applied against both the regular and alternative minimum tax liability in New CREBs.[560]

IRS Notice 2015-12 announced the availability of close to $1.4 billion in remaining volume for New CREBs. On March 5, 2015, the IRS opened the rolling volume-cap application window for

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[555] KRAMER & FUSARO, *supra* note 6, at ch. 25.

[556] I.R.S. Notice 2009-33 (04/06/2009); *see also Clean Renewable Energy Bonds (CREBs)*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/2510 (last updated Apr. 16, 2015).

[557] American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115.

[558] The expiration date for New CREB applications under this solicitation was August 4, 2009. Further guidance on CREBs is available in I.R.S. Notices 2006-7 and 2007-26 to the extent that the program rules were not modified by 2008 and 2009 legislation.

[559] *Applications from Cooperative Electoral Companies for Authority to Issue New Clean Renewable Energy Bonds Now Being Accepted by the IRS*, I.R.S. ANNOUNCEMENT 2010-54, http://www.irs.gov/pub/irs-drop/a-10-54.pdf (last visited Mar. 20, 2017).

[560] *See* I.R.S. Notice 2009-33, 2009 C.B. 865; KRAMER & FUSARO, *supra* note 6.

governmental bodies and cooperative utilities, as well as a closed-end application period for public power providers.[561]

A.2 – RPS Compliance and Voluntary Markets

A.2.1 Compliance Markets

A compliance REC market is an essential element of mandatory RPS programs. Mandatory RPS programs differ state by state in their compliance requirements.[562] Each state has its own REC regulations, which, among other things, determine the types of renewable energy facilities that qualify for RECs.[563]

RECs can be traded directly between a buyer and seller, though more often the trading mechanism is achieved through third-party marketers such as brokers, asset managers, or local/state governmental authorities.

There are two primary methods to verify the ownership of a REC: through contract-path auditing and through tracking systems. Today, tracking systems are becoming the preferable method because they can be highly automated, contain broad information about each REC, and be easily accessible through the Internet. In the tracking system, each REC receives a unique number for each MWh that has been generated by a renewable facility. Anyone can open an account in the tracking system and transfer RECs from one account to another, much like transferring money in a bank account.

A.2.2 Voluntary Markets

In addition to the REC's role in meeting minimum RPS in-state requirements, a voluntary cross-national market for RECs has also developed. Voluntary RECs are generally created from renewable energy projects that do not have in-state requirement for RPS. This voluntary market is driven by corporations,

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[561] *See Clean Renewable Energy Bonds (CREBs)*, *supra* note 556.

[562] KRAMER & FUSARO, *supra* note 6, at ch. 5.

[563] *See id.*; Elec. Mkt. & Policy Grp., *Renewables Portfolio Standards Resources*, *supra* note 201.

municipalities, and even individuals that are incentivized to purchase RECs for marketing or other purposes.[564]

In voluntary markets, customers choose to buy a REC (*e.g.*, renewable electricity/power) by their own will without any state or local requirements. These RECs are often traded at a substantial discount in comparison to compliance RECs. Due to increasing concerns about the environment and carbon emissions in the atmosphere, there is a growing demand for voluntary RECs.[565]

The main problems associated with voluntary markets are the difficulty in ensuring that RECs are not double counted and verifying the eligibility of renewable projects. One of the programs that tries to address these problems is the "Green-e" program. The mission of the Green-e program is to strengthen customer confidence in the reliability of RECs, expand the retail REC market and the demand for new renewable energy generation, provide customers with clear information about retail clean energy products, and minimize air pollution.[566] Under the Green-e program, buyers and sellers are required to submit RECs to an annual Verification Process Audit to ensure that the RECs meet the requirements for certification. There are other smaller entities that also certify voluntary RECs in different regions across the United States.

A.3 – FiT Payment Structures

One of the major design challenges for FiT policymakers is determining the actual FiT price awarded to project developers for the electricity they produce.[567] There are four basic FiT policy approaches that determine the FiT payment level.

The first is based on the actual levelized cost of renewable energy generation. This is the most successful European FiT policy, which resulted in quick and substantial renewable energy capacity

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[564] Elec. Mkt. & Policy Grp., *Renewables Portfolio Standards Resources*, *supra* note 201.
[565] *Id.*
[566] *See About Green-e*, GREEN-E, http://www.green-e.org/about_miss.shtml (last visited Apr. 6, 2017).
[567] COUTURE ET AL., *supra* note 227, at 7.

expansion.[568] According to the levelized cost approach, the payment level is based on the levelized cost of renewable energy generation, plus a stipulated return that is set by policymakers, regulators, or program administrators.[569] This approach ensures that project investors obtain a reasonable rate of return, while creating conditions that are more conductive to market growth.[570]

The second policy approach is based on the "value" of the renewable energy generation to the utility and/or society, generally expressed in terms of "avoided costs." Avoided costs include the value of climate mitigation, health and air quality impacts, etc. This is a "value-based" approach, as opposed to the above-mentioned levelized "cost-based" approach, and it is used in California and Portugal.[571] The major challenge of this approach is appropriately evaluating the value of a renewable energy project, which potentially leads to a high degree of administrative complexity. If the value does not match the actual renewable energy generation costs (*i.e.*, it is too high or too low), the FiT policy becomes less effective. In other words, if the payment level is set too low, the FiT will not stimulate rapid market growth. Alternatively, if the payment level is set too high, it will lead to cost-inefficiency.[572]

The third policy approach offers a fixed-price incentive without regard to levelized renewable generation costs or avoided costs.[573] This approach is used by certain utilities in the United States.[574]

Finally, the fourth policy approach is based on an auction or bidding process, which reveals the price structures in the renewable energy market by appealing to the market directly. An auction-based mechanism is a variant on the cost-based approach and can be adjusted to different types of renewable energy projects.[575]

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[568] ARNE KLEIN, ET AL., ENERGY ECON. GRP., FRAUNHOFER INST. SYS. & INNOVATION RESEARCH, EVALUATION OF DIFFERENT FEED-IN TARIFF DESIGN OPTIONS: BEST PRACTICE PAPER FOR THE INTERNATIONAL FEED-IN COOPERATION (2d ed. 2008).

[569] *Id.*

[570] *Id.*

[571] GRACE, RICKERSON & CORFEE, *supra* note 214; Energy Division Resolution E-4137, CAL. PUB. UTIL. COMM'N, ITEM 29 I.D. 7150 (Cal. 2008); *LADWP – Feed-in Tariff (FiT) Program: California*, DSIREUSA.ORG, http://programs.dsireusa.org/system/program/detail/5685 (last updated Feb. 2, 2017).

[572] *See* GRACE, RICKERSON & CORFEE, *supra* note 214.

[573] COUTURE & CORY, *supra* note 400.

[574] RICKERSON &GRACE, *supra* note 211.

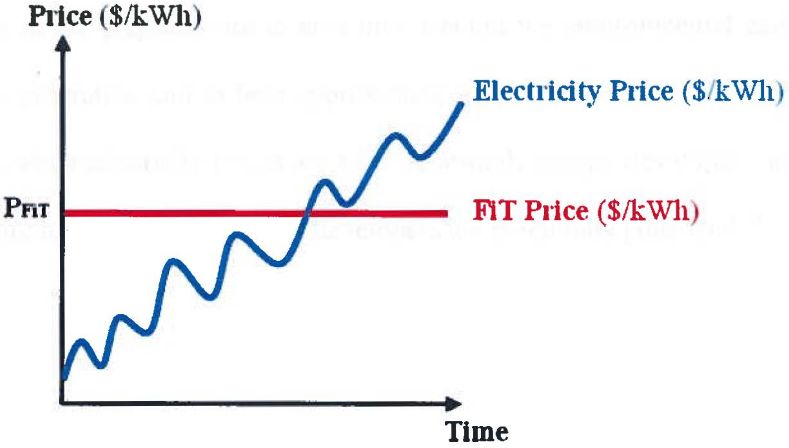
[575] COUTURE ET AL., *supra* note 227, at 7.

The most successful approach is the levelized cost-based approach because, at least based on the European experience, it results in quick and substantial renewable capacity expansion.[576] The other value-based approaches are currently used in some U.S. states and, so far, have been unsuccessful at driving rapid growth in renewable energy.[577]

Since the cost-based approach has proven to be the most effective, the following discussion on FiT payment structures is limited to the FiT cost-based approach.

A.3.1 FiT Payment Structure 1 – Fixed-Price

In a fixed-price FiT policy structure, the total FiT payment level is fixed independently from the market price (see Figure 33, "Fixed-Price FiT Policy Structure," below). This structure ensures a stable, low risk, and known return for investors, which consequently lowers the project-financing costs.[578]



[Figure 33, Fixed-Price FiT Policy Structure]

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[576] KLEIN, ET AL., supra note 568.
[577] Staffan Jacobsson &Volkmar Lauber, *The Politics and Policy of Energy System Transformation—Explaining the German Diffusion of Renewable Energy Technology*, 34 ENERGY POL'Y 251, 256–57 (2006).
[578] COUTURE ET AL., *supra* note 227, at 22; DE JAGER & RATHMANN, *supra* note 416.

This is the most widely implemented structure and is in use in more than 40 countries around the world, including Germany, France, Switzerland, and Canada.[579] In these countries, fixed-price structures have demonstrated a higher level of cost efficiency as compared to premium-price structures (discussed below) and have created, on average, lower risk and more transparent market conditions for renewable energy development.[580]

A.3.2 FiT Payment Structure 2 – Premium-Price

In a premium-price FiT policy structure, the renewable energy project owner receives payment for the total electricity generation (at market prices) as well as an additional fixed premium on top of the market prices (see Figure 34, "Fixed Premium-Price FiT Policy Structure," below). This is in contrast to the fixed-price structure, where a purchase guarantee is typically included and separates renewable energy generation from spot market dynamics.[581]

The goals of the premium are to take into account the environmental and societal attributes of renewable energy generation and to help approximate renewable generation costs. Since it is a market-dependent model, when electricity prices are high, renewable energy developers are rewarded, but when electricity prices are low, renewable energy developers are potentially penalized.[582]

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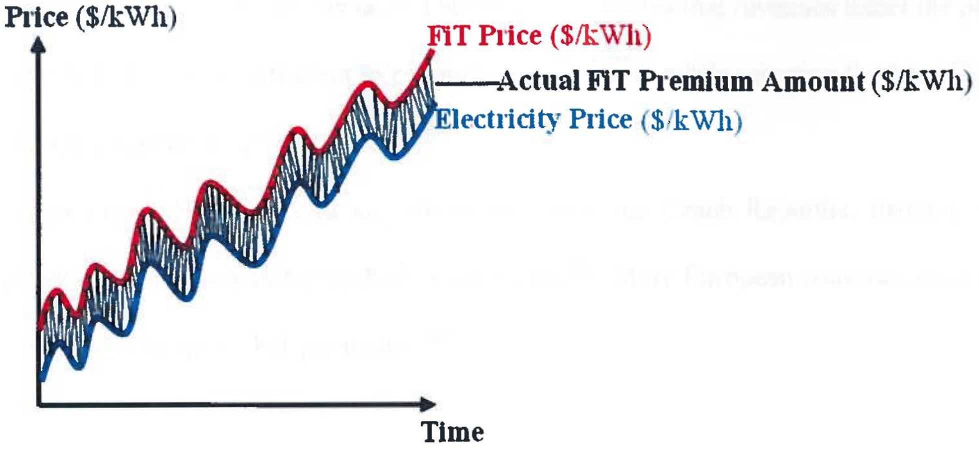
[579] RENEWABLE ENERGY POLICY NETWORK FOR THE 21ST CENTURY (REN21), RENEWABLES GLOBAL STATUS REPORT: 2009 UPDATE (2009).

[580] ARNE KLEIN, FEED-IN TARIFF DESIGNS: OPTIONS TO SUPPORT ELECTRICITY GENERATION FROM RENEWABLE ENERGY SOURCES (Saarbrucken, Germany: VDM Verlage Dr. Müller 2008).

[581] COUTURE ET AL., *supra* note 227, at 50.

[582] *Id.* at 22.



[Figure 34, Fixed Premium-Price FiT Policy Structure]

The additional premium in the premium-price FiT policy structure does not have to be fixed. Policymakers can design a FiT policy with a variable premium, where the premium varies as a function of the spot-market electricity price. This design would address the potential issue of windfall profits for developers if spot-market prices for electricity increase significantly. Similarly, if electricity prices fall, the investors' returns would be at-risk and therefore the premium would need to be increased accordingly in order to decrease the pressure on project-financing costs.[583]

The premium-price structures try to address the challenges of over- or under-compensation of renewable energy producers. In Spain, for example, a premium-price FiT policy includes a price cap and a price floor.[584] These limitations were introduced in Spain, where both the fixed-price and premium-price were tied directly to the spot-market price. The old structures led to rapidly increasing policy costs whenever electricity spot prices increased unexpectedly. In addition, the premium payments declined as

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[583] CORY ET AL., *supra* 211, at 5; MENDONCA, M., FEED-IN TARIFFS: ACCELERATING THE DEPLOYMENT OF RENEWABLE ENERGY (EarthScan, London 2007).

[584] Spain Royal Decree 1578/2008 for photovoltaic installations and Spain Royal decree 661/2007 for other renewable technologies injecting electricity to the public grid; On 27 January 2012 the Spanish government temporarily stopped accepting applications for projects beginning operation after January 2013. Construction and operation of existing projects was not affected. The country's electrical system had a €24 billion deficit and FiT payments added significantly to that deficit. In 2008 the FiT was expected to result in 400 MW of solar being installed. However, it was so high that over 2600 MW was installed. Andrew, *Solar Power Is Alive and Kicking in Spain, But Flawed Electric Power Act Needs Correcting* (June 28, 2012), https://cleantechnica.com/2012/06/28/solar-power-alive-kicking-spain-flawed-electric-power-act-needs-correcting/.

electricity prices increased and vice versa.[585] This structure ensures that revenues under the premium price option remain within a range sufficient to encourage investment, while securing the benefit of renewable energy resources if electricity prices increase.[586]

Premium-price FiT structures are offered in Spain, the Czech Republic, Estonia, Slovenia, the Netherlands, as well as Denmark for onshore wind energy.[587] More European countries choose fixed-price structures over premium-price FiT payments.[588]

A.3.3 FiT Payment Structure 3 – Spot-Market Gap Model

The Netherlands implements the spot-market gap model (see Figure 35, "Spot-Market Gap Model," below).[589] This is a hybrid approach that combines the fixed-price and the premium-price models. According to this structure, the government guarantees that projects will receive a predetermined minimum total payment, which is very similar to a fixed-priced structure (see Figure 33, "Fixed-Price FiT Policy Structure," above). However, instead of paying a fixed price through a FiT payment, the renewable project receives its payment through two separate revenue streams. The first is the prevailing spot-market price of electricity. The second is a variable FiT payment that covers the real-time difference between a minimum total payment guarantee and the spot-market price.[590] Since the FiT payment covers the difference between the spot-market price and the required FiT price, the actual FiT payment fluctuates over time, covering the "gap" between the two. If the spot-market price for electricity rises above the minimum FiT payment, then the FiT premium drops to zero.[591]

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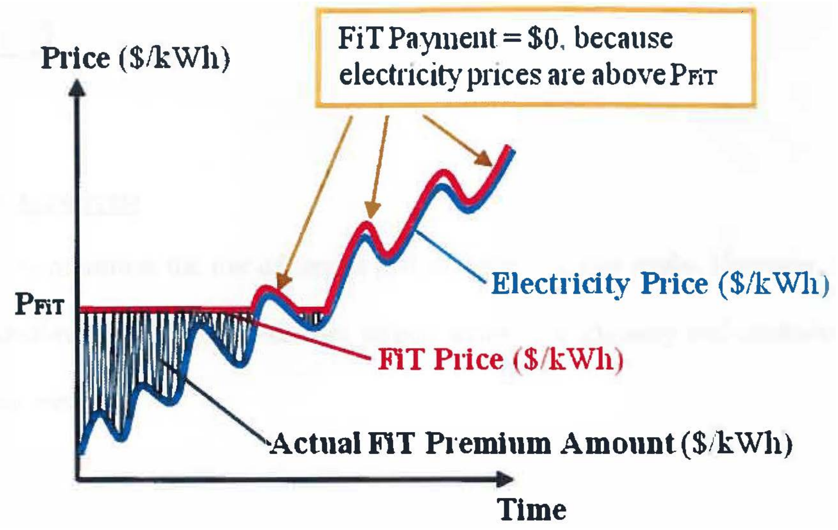
[585] *Id.*
[586] *Id.*
[587] KLEIN, *supra* note 568.
[588] *Id.*
[589] R. van Erck, Presentation at the Feed-in Cooperation's 6th Workshop in Brussels, Belgium: Update National Feed-in Schemes: The Netherlands (Nov. 2008).
[590] *Id.*
[591] *Id.*; CORY ET AL., *supra* 211, at 6.



[Figure 35, Spot-Market Gap Model]

The Netherlands and Switzerland use variations of this model.[592] The Netherlands does not guarantee a minimum revenue stream. In other words, if the electricity price drops below two-thirds of the expected electricity market price, the tariff level drops as well.[593] Switzerland applies the spot-market gap model, which is based on an average of the previous month's exchange price, and the gap is calculated as the difference between this average and the posted technology-differentiated FiT price.[594]

This Swiss structure has several benefits. First, it ensures a minimum payment to investors by offering a guaranteed minimum price for the electricity sold. Second, the investors receive an upside benefit of any upward price movements. Third, it provides a clearer method for calculating policy costs of implementing this structure. Finally, the policy costs are limited once the spot-market price for electricity is above the minimum FiT price.[595]

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[592] COUTURE ET AL., *supra* note 227, at 54; *Feed-in Remuneration at Cost*, SWISS FED'L OFFICE OF ENERGY, http://www.bfe.admin.ch/themen/00612/02073/index.html?lang=en (last updated June 22, 2015).
[593] COUTURE ET AL., *supra* note 227, at 54.
[594] COUTURE ET AL., *supra* note 227, at 55; *Feed-in Remuneration at Cost*, *supra* note 592.
[595] COUTURE ET AL., *supra* note 227, at 56.

Appendix B

Glossary and Acronyms

I tried to minimize the use of jargon and acronyms in this study. However, this cannot always be achieved. Therefore, this appendix defines jargon terms in a glossary and contains a table of acronyms along with their meaning.

B.1 Glossary

- **Command and control** – An environmental policy that uses regulation (*e.g.*, permits, quotas, etc.) instead of financial incentives.
- **GHG** – Greenhouse gases are gases that trap heat in the atmosphere such as carbon dioxide (CO2), methane (CH4), nitrous oxide (N20) and fluorinated gases.
- **Investment Tax Credit** or **ITC** – The ITC is an indirect subsidy provided by the U.S. government to incentivize individuals and businesses to invest their capital in specific types of business property. This credit is calculated by multiplying the basis of the property put into service by either 10% or 30% depending on the type of property.
- **Feed-in Tariff** or **FiT** – A price-based regulation that guarantees a premium payment on every unit of renewable energy produced.
- **Production Tax Credit** or **PTC** – The PTC provides tax credits for the production of energy from a qualified renewable energy facility.
- **Push market policies** – Push Market Policies include: research, demonstration, and development (RD&D) programs; economic incentives, such as tax credits or tax incentives; and grants or investment subsidies, such as loan guarantees.
- **Pull market policies** – Pull Market Policies include: quantity-based policies, such as RPS programs, and price-based policies, such as FiT programs.

- **Renewable portfolio Standard** or **RPS** – A quantity-based regulation that imposes a legal obligation on utility companies to purchase a specified amount of renewable energy and then penalizes those utilities that do not comply.

B.2 Acronyms

Acronym	**Meaning**
ACP	Alternative Compliance Payment
CO2	Carbon dioxide
EIA	Energy Information Administration
EPA	Environmental Protection Agency
GWh	Giga Watt-hour
kWh	kilo Watt-hour
ITC	Investment tax credit
kWh	Kilo Watt-hour
MW	Mega Watt
MWh	Mega Watt-hour
PTC	Production tax credit
PUC	Public Utility Commission
PURPA	Public Utility Regulatory Policies Act of 1978
RPS	Renewable portfolio standard
REC	Renewable energy certificate
TWh	Terra-Watt-hour