"A New Framework for New York State Renewable Energy Subsidies"

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Summary

New York State has embarked on a number of important initiatives that could have significant implications for its clean energy policies. As New York State considers new programs that will guide the spending of publicly mandated ratepayer subsidies in this area, it should be guided by a set of core principles that includes:

(i) A focus on outcomes rather than the means to an end;
(ii) Evaluating the relative productivity of subsidies for different types of programs in achieving those outcomes ; and
(iii) A strategic approach that shifts a portion of public subsidies now dedicated to subsidizing the deployment of mature renewable energy technologies to research and development of emerging technologies.

Among the important current initiatives is a Public Service Commission (PSC) proceeding regarding the creation of a new "Clean Energy Fund" which will consolidate all existing New York State programs that currently govern the spending of more than $1 billion of ratepayer-funded subsidies annually for renewable energy and energy efficiency initiatives. The Clean Energy Fund proceeding will likely be informed by two other important clean energy initiatives in New York State: the creation of a Green Bank in 2013, which seeks to facilitate the financing of clean energy projects; and the development of a new regulatory framework called "Reforming the Energy Vision," which aims, among other things, to promote the expansion of distributed generation and demand side management measures and to develop an appropriate regulatory response to the significant ramifications of this expansion.

The proposed Clean Energy Fund does not inherently supersede the State's existing Renewable Portfolio Standard (RPS) and Energy Efficiency Portfolio Standard (EEPS). Under existing policies, the amount of ratepayer subsidies available to be spent on renewable energy and energy efficiency projects is dictated by the amount necessary to achieve the RPS and EEPS goals. The RPS and EEPS have played a valuable role in stimulating clean energy policies, but they should no longer be the central organizing principle for determining the amount of ratepayer subsidies for clean energy purposes. Instead, the RPS and EEPS goals would be seen as milestones of progress rather than the determining factors of PSC policy.

[1] The views expressed here are my own and do not represent the views, if any, of the Guarini Center or of New York University.

It is useful to have easily understood numerical targets as the basis for determining state policy. Accordingly, the PSC should establish a targeted reduction in the amount of greenhouse gas emissions. The achievement of this targeted reduction would be the main factor for determining the level of ratepayer subsidies raised for the Clean Energy Fund over time. Within an acceptable budget and consistent with achieving these greenhouse gas emission reduction targets, the PSC should authorize policymakers to assemble a strategic portfolio of initiatives to realize the objective of meeting both short-term and long-term targets for reduction in greenhouse gas emissions, as opposed to a prescriptive set of subsidy policies. The PSC approved such a flexible, strategic approach in authorizing funding for the Green Bank and the same philosophy should apply to the Clean Energy Fund.

The PSC should acknowledge that achievement of its greenhouse gas emission reduction targets is the paramount goal of the Clean Energy Fund. NYSERDA and the PSC have articulated a wide range of energy, environmental and economic development goals that can be advanced by clean energy policies. Both organizations should be commended for identifying quantitative metrics of success and rigorously analyzing progress. There is a risk, however, that the multitude of measures will obscure the forest for the trees. As with the underlying goals of the RPS and EEPS, these metrics should continue to be monitored, but having a common denominator for the multitude of different programs is useful in developing a clear focus.

A "State Subsidy Productivity Calculator" as described below would be useful in comparing the effectiveness of diverse policies and subsidy programs in achieving the paramount goal of a targeted reduction in greenhouse gas emissions. This productivity measure is not intended to be the sole factor in determining policy or resource allocation. New York State's clean energy policies should advance a range of energy, environmental and economic development goals, provided that the target of reduced greenhouse gas emissions can be met within the available budget. Understanding the relative contribution of diverse policies and subsidy programs in achieving that goal (in addition to any internal program metrics) is an important touch point for decision-making.

Background

By way of background, New York State public authorities – mostly the New York State Energy Research and Development Authority (NYSERDA) and the Long Island Power Authority (LIPA) – are on track to spend close to $400 million in ratepayer-funded subsidies for renewable energy in 2015 and another roughly $650 million of ratepayer funds for energy efficiency subsidies. This spending is in addition to low-cost financing provided by the New York Power Authority for energy efficiency projects in public facilities and approximately $250 million annually in extra ratepayer charges to pay for utility-sponsored energy efficiency programs.

The amount of ratepayer subsidies available for renewable energy was established by the PSC based on calculations of the investment that was thought necessary to achieve New York State's current Renewable Portfolio Standard goal of having 30% of the State's energy needs supplied by renewable sources by 2015. Similarly, the PSC has authorized a level of ratepayer surcharges for energy efficiency projects based on the Energy Efficiency Portfolio Standard (EEPS), which calls for the reduction of energy usage in New York State by 2015 to a level that is 15% below what it would have been in the absence of energy efficiency efforts.

Because energy efficiency initiatives produce a positive economic return, both subsidized and unsubsidized energy efficiency efforts are being widely adopted, and New York State is more likely to achieve the 15% EEPS target by 2015. However, New York State will not achieve the RPS target of 30% renewable energy by 2015.

The productivity of renewable energy subsidies has significantly declined since the first procurement in 2005. Because of the declining price of natural gas, the amount of subsidy per megawatt hour of renewable energy produced has more than doubled over the last 7 years – from $14.75 per megawatt hour produced in 2007 to $34.95 per megawatt hour produced in the last Main Tier solicitation.[2] At this rate, it will require the State to spend $1.7 billion to expand the percentage of energy supplied by renewable fuels from the current level of approximately 25% of the total to the RPS target of 30%.[3] This compares to a total cost of approximately $900 million that was needed to expand the total percentage of renewable energy from approximately 20% to approximately 25% since 2005.[4]

New York State policies in this area will have to take into account the proposed new federal EPA regulations that mandate that states adopt policies to reduce the "carbon intensity" of energy generation in their state to targeted levels. Carbon intensity is defined as the amount of greenhouse gas emissions per megawatt hour of designated types of energy generated in the state. The EPA calculation of energy generation excludes energy from hydropower and nuclear (which collectively account for approximately 25% of energy generation in New York State). An implication of the way this definition of energy generation is constructed is that the closing of Indian Point (or New York State's other nuclear facilities) – which would increase greenhouse gas emissions – would not affect the state's ability to meet its reduction in "carbon intensity" target.[5] New York State is required to reduce its carbon intensity from 2012 levels by 44% by 2030, which would result in a reduction in greenhouse gas *emissions* between 2012 and 2030 by approximately 25%, based on NYSERDA's estimate of total energy generation in New York

[2] NYSERDA. "New York State Renewable Portfolio Standard: Annual Performance Report Through December 31, 2013". March 2014. P. 13. https://www.nyserda.ny.gov/Publications/Program-Planning-Status-and-Evaluation-Reports/Renewable-Portfolio-Standard-Reports.aspx>

[3] The MWh target for the RPS Main Tier is roughly 9.5 million MWh generated annually. To date, the RPS has entered into contracts for 4.6 million MWh leaving approximately 4.9 million MWh to be achieved. At the most recent solicitation price of $34.95 per MWh over the 10-year length of the subsidy contract, this amounts to a cost of $1.7 billion.

[4] This spending does not include the significant amount of additional subsidies for "behind-the-meter" customer-sited distributed generation projects, which are mostly comprised of residential solar energy projects. As of 2014, the total amount of spending on customer-sited projects was $454.3 million. The amount of renewable energy produced by these projects is quite small – accounting for only 500,596 megawatt hours of renewable energy production. This results in a reduction of approximately 258 thousand metric tons of CO_2e, or approximately 0.16 % of total carbon emissions in New York State.

[5] The EPA carbon intensity baseline for NY State is based on annual CO_2e emissions of 31.58 MMt, and net generation of 70.85 TWh yielding approximately 983 lbs of CO_2e per MWh. Inclusion of generation from hydroelectric and nuclear sources would increase net generation, and effectively lower the carbon intensity baseline. If a nuclear plant were to be phased out the carbon intensity would increase automatically without any increase in emissions from carbon positive sources.

State in 2030 (and assuming no change in the amount of carbon-free energy generation from nuclear and hydropower sources).[6]

A Proposed New Framework for Clean Energy Policies

The new framework for clean energy policies for New York State, of which the Clean Energy Fund is an important part, should include the following elements:

- First, an explicit target for the reduction of greenhouse gas emissions – technically "CO_2 equivalent" or " CO_2e" emissions. The initial, short-term target could be the same level of reduction in greenhouse gas emissions that would be produced by a 5% increase in renewable energy supply – the amount necessary to reach the 30% RPS goal – which amounts to a reduction of approximately 2.7 million metric tons in CO_2e emissions.[7] The longer-term target (to be achieved not later than 2030) would be a reduction in greenhouse gas emissions sufficient to meet the targeted reduction in carbon intensity required under the proposed new EPA regulations. A wide range of programs should be eligible for subsidies under the Clean Energy Fund, including renewable energy and energy efficiency projects, capital for the Green Bank, and research and development (including market development) of emerging clean energy technologies.

- Second, New York State should track and compare the productivity of subsidies in terms of reducing greenhouse gas emissions of different clean energy programs. The establishment of such a clear outcome measure would create a common denominator that would enable New York State to evaluate the *productivity* of various subsidy and policy programs in achieving this paramount goal. This productivity metric will necessitate the development of more transparent and sophisticated measures of scoring the carbon reduction benefits of programs other than subsidies for renewable energy and energy efficiency, including benefits produced through the contribution of capital to the Green Bank and grants and investments that support research and development such as NYSERDA's Technology and Market Development program.

[6] The EPA released data on energy output and carbon emissions for all 50 states. Their calculations state a current rate of GHG emissions of 983 lbs/MWh of electricity generated (excluding hydropower and the majority of nuclear generation). A 44% reduction in carbon intensity results in approximately 583 lbs/MWh. Using the 2030 electricity forecast determined by NYSERDA in the report titled "New York State Greenhouse Gas Inventory and Forecast: Inventory 1990-2011 and Forecast 2012-2030", NYS anticipates its net generation to be approximately 95 million MWh excluding hydropower, nuclear power, and net imports of electricity. At 583 lbs/MWh, this yields total GHG emissions of roughly 23.5 million tons, a decrease of 25.3% from 2012 emission levels of 31.6 million tons of GHG emissions.

[7] In 2010, NYS PSC stated a static target of 10.4 million MWh to be achieved by New York's Renewable Portfolio Standard. EPA eGrid estimates roughly 0.515 tons of CO_2e per MWh of natural gas generation. Assuming this generation would replace natural gas generation and come from carbon neutral sources, the target of 10.4 million MWh correlates to a reduction of roughly 5.4 million tons of GHG emissions. Approximately 5.1 million megawatt hours will be provided from renewable energy projects funded to date, which reduces CO_{2e} by approximately 2.7 million metric tons. Reducing greenhouse gas emissions by an additional 2.7 million metric tons would reduce total greenhouse gas emissions from Energy generation by 8.5% from 2012 levels and 6.4% from baseline 2030 levels.

- Third, a greater proportion of the Clean Energy Fund should be dedicated to funding of NYSERDA's energy research and development efforts, known as the Technology and Market Development (T&MD) program, and subsidies to support renewable energy projects of strategic value that would not be selected under a strict procurement model. A good example of such a strategic project is the Brookhaven National Laboratory solar project, which was supported by subsidies from LIPA based on strategic considerations as opposed to NYSERDA's competitive procurement process. The Department of Energy recently released a special report on the project, describing it as "an unparalleled resource for solar energy research" and discussed the challenges of funding a project of this sort under New York State's typical procurement process.[8]

The adoption of such a framework does not mean that New York State should abandon subsidies for renewable energy, but it does make clear that policymakers can use a strategic approach in supporting the four types of clean energy investments now authorized by the PSC – subsidies for renewable energy and energy efficiency projects, capital for the Green Bank, and funding for NYSERDA'S T&MD program. It is important to recognize that the RPS has always been a means to an end. The "means" of the RPS makes possible the "ends" of the environmental and economic development benefits.[9]

One obstacle to adopting a framework such as that proposed above is that reforming the RPS in any way is viewed as a retreat from a commitment to address global warming. That perception is fueled by the fact that most critics of RPS programs are seeking to reduce the overall amount of public subsidies for clean energy programs of all types. However, the framework proposed here does not imply a reduction in funding for clean energy initiatives, but rather enables a more strategic use of a finite pool of resources in order to better achieve New York's energy, environmental and economic development goals. Moreover, the rigorous analysis supporting ambitious research and development initiatives such as the federal SunShot Initiative (discussed below) suggests that redirecting some funding that would be spent on the deployment of mature technologies to research and development would have a much greater impact on reducing global warming in the long run by accelerating the time when emerging technologies make renewable energy competitive on a global basis without subsidies.

The framework I am proposing would give policymakers greater flexibility to develop a strategic approach to clean energy policies that would allow the Executive branch to allocate a greater proportion of ratepayer subsidies in accordance with its determinations as to how to most effectively advance its long-term greenhouse gas emissions reduction goals. The advantages of such a flexible approach have been articulated by the PSC in its approval of funding for the

[8] http://apps1.eere.energy.gov/solar/newsletter/detail.cfm/articleId=401

[9] When then Gov. Pataki proposed the RPS in New York in 2002 (the RPS was approved by the PSC in 2004), global warming and the issue of reducing greenhouse gas emissions were not explicitly noted. Instead, Gov. Pataki described the RPS as a program that would:

"[I] mprove our environment and reduce our dependence on imported foreign energy by leading the nation in the development and deployment of renewable energy resources like geothermal, biomass, solar, and wind power. By doing so, we can not only clean our air, but also create new industries, expand markets for New York agricultural products, diversify the state's energy supply, and increase our security."[9]

Green Bank and is consistent with the approach taken by the Obama Administration's new carbon emissions reduction regulations, which sets state-by-state targets but allows states to develop their own policies for achieving that result.

The Productivity of Subsidies

A crucial advantage of basing clean energy policies on a single *outcome* goal of reducing greenhouse gas emissions is that it facilitates the comparison of different programs – such as project subsidies, Green Bank capital and research and development – that serve as the means of achieving that end. This single outcome goal or "common denominator" represents the productivity of subsidies in reducing greenhouse gas emissions under various New York State initiatives by measuring the amount of subsidy dollars required per metric ton reduction in greenhouse gas emissions (in technical terms, CO_2 equivalents). The State Subsidy Productivity Calculator table below shows the productivity of subsidies in reducing greenhouse gas emissions under various New York State initiatives and illustrates the wide range of productivity of subsidies among different programs in achieving the goal of reducing greenhouse gas emissions.

The table below includes two energy efficiency initiatives – the Build Smart initiative designed to reduce energy usage by approximately 20% in facilities owned by New York State and NYSERDA's residential energy efficiency program.[10] The renewable energy initiatives shown in the table represent two types of projects under the Main Tier Solicitation program – wind power (by far the largest category) and biomass – and two examples of subsidized solar power projects – customer-sited solar and LIPA's feed-in-tariff program. The footnotes in the tables for the State Subsidy Productivity Calculator are set forth in the Appendix.

State Subsidy Productivity Calculator

Subsidy per Metric Ton of CO2 Reduction

Guarini Center		State Facility Energy Efficiency Master Plan (1)	2012 NYSERDA Energy Efficiency (2)	Rochester Airport - Combined Heat & Power (3)	Main Tier Solicitation # 8 - Wind (4)	Main Tier Solicitation # 7 - Biomass (5)	Customer Sited Tier - Competitive PV (6)	LIPA Feed-In Tariff - 50 MW (7)
Subsidy	State Subsidy (Present Value) (8)	$54,860,000	$963,400,000	$700,000	$32,178,964	$65,319,951	$209,199,656	$82,853,667
Savings	Annual Energy Generation/Savings (MWh)	(922,091)	2,140,500	10,512	131,089	324,045	300,381	61,320
	Renewable Energy Supply (Annual Production As % of 2012 NYS Retail Electricity Sales)	N/A	N/A	0.006%	0.081%	0.199%	0.184%	0.038%
CO_2 Reduction	CO_2e Reduction in Year 1 in Metric Tons	474,715	1,101,982	2,260	67,488	(316,001)	154,644	31,569
	% Reduction in Statewide CO_2e Emissions	0.300%	0.697%	0.001%	0.043%	(0.200%)	0.098%	0.020%
	Cumulative CO_2e Reduction Over 20 Years in Metric Tons	9,494,304	22,039,643	45,200	1,349,757	(3,728,808)	3,092,871	631,381
Productivity	**State Subsidy Per Metric Ton of CO_2e Reduction Over 20 Years**	**$5.78**	**$43.71**	**$15.49**	**$23.84**	**N/A**	**$67.64**	**$131.23**

[10] For purposes of this analysis, an imputed capital charge related to financing provided by the New York Power Authority for energy efficiency projects in public facilities is treated as a subsidy.

The Productivity Calculator shows that energy efficiency projects require a much lower level of subsidy per ton of greenhouse gas emissions reduced, because energy efficiency projects typically produce a positive return on investment. For this reason, subsidies for the financing of energy efficiency projects will always produce a greater reduction in carbon emissions per dollar subsidy than renewable energy projects, which do not produce a positive return on the overall investment.

This table also illustrates the extent to which subsidies for wind power are more productive than subsidies for solar power. Nevertheless, solar power is a much less mature technology than wind power and holds great promise for very significant cost improvements in the future, which could lead to a more significant contribution to the reduction of carbon emissions in the long run than incremental improvements in wind power are likely to produce. This fact and the central role of solar power in expanding distributed generation are important reasons to continue to invest in solar energy technology and deployment.

The table also illustrates how policymakers could get to different results if clean energy subsidies were based on the outcome goal of reducing greenhouse gas emissions, as opposed to simply increasing the supply of renewable energy. Biomass projects accounted for 71% of the seventh Main Tier Solicitation in 2012. Biomass projects *increase* the amount of greenhouse gas emissions for decades, at a minimum, because the combustion of biomass emits more greenhouse gases than fossil fuels per unit of energy produced. This creates what is referred to as a "carbon debt," which is defined as the excess emissions from the switch to biomass relative to the fossil fuel it displaces for energy generation. The theory is that since carbon accumulation occurs at a faster rate in young, growing forests compared to older ones, clearing forests and generating new tree growth eventually offsets the higher emissions and discharges the carbon debt.

The timeframe for off-setting this "carbon debt" is particularly long when the fossil fuel being replaced is natural gas – which is most likely the case in New York. The Manomet Center for Conservation Studies concluded in a report on biomass sustainability that "When biomass is assumed to replace natural gas electric capacity, carbon debts are still not paid off after 90 years."[11] Since renewable energy in New York State generally displaces natural gas generation, not coal, making biomass eligible for renewable energy subsidies does not make sense in New York State on environmental grounds and could be justified only in terms of economic development benefits.

Because New York State's Green Bank has not yet completed transactions or published its projection models, the Productivity Calculator does not include an estimate of the productivity in terms of reduced greenhouse gas emissions of subsidy dollars contributed as capital to the Green Bank. However, we can estimate this amount based on a generic model for a Green Bank developed by the energy consulting firm The Brattle Group.[12] The Brattle Group model suggests

[11] Manomet Center for Conservation Sciences. "Biomass Sustainability and Carbon Policy Study". June 2010. p 7.

[12] "Overview of Rooftop Solar PV 'Green Bank' Financing Model, Sponsored by The Connecticut Clean Energy Finance and Investment Authority and The Coalition for Green Capital," January 17, 2013, at p. 22.

that $100 million of capital in a Green Bank could support incremental residential solar projects amounting to 220 MW of capacity assuming other subsidy levels remained unchanged. Under this assumption, the "productivity" of the capital contributed to the hypothetical green bank for purposes of increasing the number of residential solar projects would amount to $35.98 per metric ton of reduction in greenhouse gas emissions, which is much more productive than existing subsidy structures for residential solar power.

As noted above, the productivity measure shown in the Calculator is not intended to be dispositive of policy choices, because New York State is wisely using its clean energy policies to advance a range of energy, environmental and economic development interests. For example, New York State has a strong interest in promoting distributed generation of energy for purposes of increased resilience, as well articulated in the PSC's Reforming the Energy Vision statement.[13] This interest in distributed generation places a premium on solar power, for example, compared to wind power (which has a greater subsidy productivity) because wind power is not distributed and therefore does not contribute to increased resilience in the same way that solar power does. In terms of environmental interest, concerns about increased particulate emissions might lead some to reduce the priority of combined heat and power projects. Even if technology and market development projects did not demonstrably reduce greenhouse gas emissions, they could be favored because of the projects' impact on job creation and economic development.

But while the measure of the productivity of subsidies is not dispositive of policy choices, it is an important tool in analyzing various ways of achieving New York State's articulated greenhouse gas emissions reduction goal within a fixed level of funding and timeframe. In effect, the more efficiently (in terms of subsidy dollars) that New York State achieves its greenhouse gas emissions reduction goal, the greater its "open to buy" to pursue its ancillary energy, environmental and economic development goals. Having an outcomes-based goal such as a targeted reduction in greenhouse gas emissions and an objective and common yardstick for analyzing various programs and policies will also be helpful in rebutting the arguments of those who benefit from the status quo and therefore resist any change in existing clean energy policies.

Finally, it is worth noting that estimating the productivity of subsidies in reducing greenhouse gas emissions is not an entirely novel concept – and identifying the *total* cost of mitigation through various technologies is quite common, as popularized by the McKinsey "cost of mitigation" curve.[14] The New York State Climate Action Plan released in 2010 includes a table that shows the cost to government of various strategies for reducing greenhouse gas emissions.[15] The Climate Action Plan does not, however, provide the assumptions behind its cost estimates or explain how the widely varying productivity of such strategies should inform policy. The PSC

[13] New York State Public Service Commission. "Reforming the Energy Vision". April 2014. http://www3.dps.ny.gov/W/PSCWeb.nsf/All/26BE8A93967E604785257CC40066B91A?OpenDocument.

[14] McKinsey & Company. "Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Curve". 2009. http://www.mckinsey.com/client_service/sustainability/latest_thinking/greenhouse_gas_abatement_cost_curves

[15] New York State Department of Environmental Conservation. "Climate Action Plan Intermediate Report". November 2010. PP. OV-20-22. http://www.dec.ny.gov/energy/80930.html.

has the opportunity to make this way of thinking a more important part of clean energy policies in New York.

Directing More Funding to Research and Development of Emerging Energy Technologies

The argument that a clean energy policy organized around the goal of reducing greenhouse gas emissions should shift a portion of State subsidies to the research and development of emerging energy technologies is based on the assumption that it is more productive to spend on reducing greenhouse gas emissions than to spend such funds on a marginal increase in the deployment of mature technologies. By using the tons of greenhouse gas emissions reduced per dollar of subsidy as a common denominator it becomes possible – at least in theory – to test this assumption.

The nature of technological progress makes it difficult to assign credit for a particular outcome to any particular research and development initiative. The process is inherently subjective and can best be estimated for a portfolio of research and development spending, as opposed to the ability to know with some precision the amount of greenhouse gas abatement that a particular renewable energy project will produce. Nevertheless, a rigorous and transparent analysis can produce a "scoring" of the impact of the technological progress made possible by research and development on reducing greenhouse gas emissions.

The Department of Energy's SunShot Initiative, which aims to reduce the total cost for Solar PV and Concentrating Solar Power (CSP) by 75% by the year 2020, can be used to illustrate this point. While the price targets vary based on the scale of use - $1/W for utility-scale PV, $1.25/W for commercial rooftop PV, $1.50/W for residential rooftop PV, and $3.60/W for CSP systems – the targets were set with the goal of reducing the levelized cost of energy (LCOE) for these technologies to be economically competitive with traditional electric generation. The DOE projects that if these milestones are met, solar energy could supply 14% of U.S electricity demand by 2030 and 27% by 2050[16].

The additional deployment of solar technologies resulting from the SunShot Initiative would primarily displace natural gas generation prior to 2030. This would account for 642 million MWh of electric generation annually, with an associated carbon emissions reduction of 181 million metric tons per year below the base case scenario that would occur without accelerated solar R&D initiatives. Over a 20-year timeframe this would account for carbon emissions reductions of over 3.6 billion metric tons.

Funding for the SunShot Initiative over the expected life of the program is not publicly available, but historical expenditures by the DoE's Office of Energy Efficiency and Renewable Energy on Solar Energy Technologies have averaged roughly $270 million per year since the program's inception. Assuming a 10-year funding period (2011-2020) at a static rate of investment, this sums to just below $2.7 billion dollars, without accounting for inflation. The cost of this investment would be $0.75 per metric ton of greenhouse gas abatement. Assuming a 10%

[16] U.S. Department of Energy. "SunShot Vision Study". February 2012. <http://energy.gov/eere/sunshot/sunshot-vision-study>

annual budget increase, the total 10-year spending of $3.25 billion dollars equates to a cost per metric ton of greenhouse gas emissions reduction of $0.90.

Even if this productivity metric of $0.90 is adjusted upward to account for the fact that not all of this technological progress is attributable to the SunShot initiative spending (and the fact that not all energy research and development efforts will be as successful as those dedicated to solar power), the gap between this statistic and the most productive subsidies for the deployment of renewable energy technologies is sufficiently large to directionally support the argument that research and development spending is – at the margin – a more effective way to reduce greenhouse gas emissions.

An examination of outcomes produced through the Technology & Market Development program (T&MD) of NYSERDA produces a more ambiguous conclusion, but mostly suggests the need for a greater focus on scoring the environmental benefits of initiatives funded by the T&MD program. NYSERDA is budgeted to spend $41 million in fiscal year 2014-15 on later stage research and development with the aim of developing innovative technologies, strategies and practices to increase reliable clean energy delivery within New York State. Because most of this spending is on applied technology and market development for emerging technologies, NYSERDA refers to the program as "technology and market development," to distinguish the program from the type of earlier stage research and development funded by the federal government.

NYSERDA's metrics for measuring the success of its T&MD program focus predominantly on the economic benefits that these investments generate – which appear to be significantly greater per dollar spent than the economic development benefits from New York State's spending on deploying renewable energy.[17] Nevertheless, NYSERDA does project the expected electricity and fossil fuels savings for some of their T&MD initiatives, which in turn can be used to calculate a reduction in greenhouse gas emissions given an assumption that the savings are displacing energy generation from natural gas. The table below is based on the savings and NYSERDA's spending on T&MD initiatives over a five-year period.

The table makes clear that changes in energy codes and standards are the most cost effective (at least in terms of government spending) policy for reducing greenhouse gas emissions, while spending on other T&MD initiatives resulting in a reduction in greenhouse gas emissions is comparable to the productivity of subsidies for energy projects.

[17] To its credit, NYSERDA undertakes a rigorous evaluation of the economic development benefits of initiatives TM&D program. NYSERDA. "NYSERDA Research & Development: Impacts, Challenges and Opportunities". October 2013. <http://www.nyserda.ny.gov/Energy-Innovation-and-Business-Development/Research-and-Development.aspx>

State Subsidy Productivity Calculator

Subsidy per Metric Ton of CO2 Reduction

		Guarini Center Frank J. Guarini Center on Environmental, Energy, and Land Use Law at NYU School of Law		
		NYSERDA T&MD On-Site Electricity & Fossil Fuel Savings from Advanced Energy Codes & Standards	**NYSERDA T&MD On-Site Electricity & Fossil Fuel Savings from Advanced Buildings**	**NYSERDA T&MD On-Site Electricity & Fossil Fuel Savings from Clean Energy Infrastructure Market Development**
Subsidy	State Subsidy (Present Value) (8)	$16,679,794	$75,336,160	$70,380,281
Savings	Annual Energy Generation/Savings (MWh)	987,000	40,300	162,000
	Renewable Energy Supply (Annual Production As % of 2012 NYS Retail Electricity Sales)	N/A	N/A	N/A
CO_2 Reduction	CO_2e Reduction in Year 1 in Metric Tons	796,380	38,890	135,823
	% Reduction in Statewide CO_2e Emissions	0.503%	0.025%	0.086%
	Cumulative CO_2e Reduction Over 20 Years in Metric Tons	15,927,607	777,804	2,716,466
Productivity	**State Subsidy Per Metric Ton of CO_2e Reduction Over 20 Years**	**$1.05**	**$96.86**	**$25.91**

In connection with the development of the Clean Energy Fund, NYSERDA should conduct the level of rigorous and transparent scoring of environmental benefits from the T&MD program that it currently applies to examining the economic development benefits. The starting point of this exercise would be an analysis of the success of a portfolio of companies and projects supported by NYSERDA over the last five years. The value proposition of almost every company and project funded through the T&MD program is some kind of measurable clean energy benefit, whether that benefit is an increase in energy efficiency or improving energy storage in a way that makes renewable energy more cost-effective. Starting with the companies that have been most successful financially, NYSERDA could examine the efficacy of the underlying products in producing the promised clean energy benefits. The impact of these benefits could be estimated – albeit subjectively, but also transparently and with a logical foundation – for their impact on reducing greenhouse gas emissions in New York State and beyond.

When NYSERDA conducts this type of analysis, the evidence may well show that the productivity of subsidies in the T&MD program are comparable to that suggested by the SunShot Initiative and worthy of expanded funding on environmental, as well as economic development grants. The development of this type of scoring could also have a profound effect on the total amount of funding for clean energy research and development around the world, thereby having an impact far greater than individual subsidies of projects employing mature technologies could ever have.

Appendix A

State Subsidy Productivity Calculator

Subsidy per Metric Ton of CO2 Reduction

		Guarini Center	State Facility Energy Efficiency Master Plan (1)	2012 NYSERDA Energy Efficiency (2)	Rochester Airport - Combined Heat & Power (3)	Main Tier Solicitation # 8 - Wind (4)	Main Tier Solicitation # 7 - Biomass (5)	Customer Sited Tier - Competitive PV (6)	LIPA Feed-In Tariff - 50 MW (7)
Subsidy	State Subsidy (Present Value) (8)		$54,860,000	$963,400,000	$700,000	$32,178,964	$65,319,951	$209,199,656	$82,853,667
Savings	Annual Energy Generation/Savings (MWh)		(922,091)	2,140,500	10,512	131,089	324,045	300,381	61,320
	Renewable Energy Supply (Annual Production As % of 2012 NYS Retail Electricity Sales)		N/A	N/A	0.006%	0.081%	0.199%	0.184%	0.038%
CO_2 Reduction	CO_2e Reduction in Year 1 in Metric Tons		474,715	1,101,982	2,260	67,488	(316,001)	154,644	31,569
	% Reduction in Statewide CO_2e Emissions		0.300%	0.697%	0.001%	0.043%	(0.200%)	0.098%	0.020%
	Cumulative CO_2e Reduction Over 20 Years in Metric Tons		9,494,304	22,039,643	45,200	1,349,757	(3,728,808)	3,092,871	631,381
Productivity	**State Subsidy Per Metric Ton of CO_2e Reduction Over 20 Years**		**$5.78**	**$43.71**	**$15.49**	**$23.84**	**N/A**	**$67.64**	**$131.23**

(1) State Facility Energy Efficiency Master Plan data is based on information prepared for the SAGE Commission Final Report, February 2013; http://www.governor.ny.gov/assets/documents/SAGEReport.pdf.

(2) 2012 NYSERDA Energy Efficiency data shows the cumulative energy savings and spending for the third System Benefit Charge (SBCIII) through December 31, 2012. NYSERDA. "SBC3 Post-Program Annual Report". June 2013. P. 1-1. http://www.nyserda.ny.gov/Publications/Program-Planning-Status-and-Evaluation-Reports/NYE$-Evaluation-and-Status-Reports.aspx.

(3) Project data for the Rochester Airport - Combined Heat & Power was sourced from the NYSERDA CHP Fact Sheet which can be found at http://chp.nyserda.org/facilities/details.cfm?facility=65. The Renewable Energy Supply for this project is based on the project size of 1.5 MW x an 80% capacity factor x the number of hours in a year (8760).

(4) Main Tier Solicitation #8- Wind Subsidy Amount is based on the total contracted MWh for wind projects in the 8th tier multiplied by the weighted subsidy amount of $34.95 per MWh. NYSERDA. "2014 RPS Performance Report". March 2014. http://www.nyserda.ny.gov/Publications/Program-Planning-Status-and-Evaluation-Reports/Renewable-Portfolio-Standard-Reports.aspx.

(5) Main Tier Solicitation #7 - Biomass Subsidy Amount is based on the total contracted MWh for biomass projects in the 7th Main Tier multiplied by the weighted subsidy amount of $28.70 per MWh – NYSERDA. "2014 RPS Performance Report". March 2014. http://www.nyserda.ny.gov/Publications/Program-Planning-Status-and-Evaluation-Reports/Renewable-Portfolio-Standard-Reports.aspx. The estimate of increased CO2e emissions from biomass facilities is based on information in the recent study –"Biomass Sustainability & Carbon Policy Study" released by the Manomet Center for Conservation Sciences – which estimates that the carbon payoff period (the amount of time before net CO2 reductions occur as a result of biomass projects from the switch to biomass over fossil fuels) is upwards of 90 years if the biomass project is replacing energy generated by natural gas. The estimate shown here assumes that biomass is displacing energy generated by natural gas.

(6) NYSERDA. "2014 RPS Performance Report". March 2014. http://www.nyserda.ny.gov/Publications/Program-Planning-Status-and-Evaluation-Reports/Renewable-Portfolio-Standard-Reports.aspx. Due to a lack of granular data for specific programs within the Customer Sited Tier, subsidy amounts and production totals reflect the program budget and the estimated amount of solar energy these projects are expected to produce.

(7) The LIPA Feed-In Tariff subsidy is adjusted for the value of the energy in MWh received by LIPA. The figure used in the model is based on the expected subsidy of $230 million less the value of energy that LIPA would otherwise have to acquire over the 20 year life of the program. Assuming $60 per MWh for the wholesale value, the subsidy reduces to roughly $156 million and is then discounted at a rate of 7% over the 20 year life of the program to yield the present value subsidy of $82 million. Long Island Power Authority. "Proposal Concerning Modifications to LIPA's Tariff for Electric Service". https://www.psegliny.com/files.cfm/proposal_feedin.pdf. Year 1 CO2 Reduction for Feed-in Tariff assumes that the energy purchases displaced by this program would be fueled by natural gas. The amount of energy required under the program is based on 50 MW of capacity and an Efficiency Factor of 14%. For this and other projects in the table, it is assumed that the energy being generated displaces natural gas. To calculate the avoided emissions, the amount of electricity generated by each project is multiplied by the emissions factor for natural gas of 0.51482465 metric tons per MWh.

(8) State Subsidy (Present Value) represents the calculated expense to the State for each project or program, whether through contracted subsidy payments or imputed financing costs based on a typical capital ratio. The contracted length of subsidies varies by program, but each is discounted at a rate of 7%. For both the State Facility Energy Efficiency Master Plan and the Rochester Airport - Combined Heat & Power project, a capital ratio of 10% is used to reflect the cost of State financing, although the initial capital outlay will be recouped from energy savings.

State Subsidy Productivity Calculator

Subsidy per Metric Ton of CO2 Reduction

		Guarini Center Frank J. Guarini Center on Environmental, Energy, and Land Use Law at NYU School of Law		
		NYSERDA T&MD On-Site Electricity & Fossil Fuel Savings from Advanced Energy Codes & Standards (9)	**NYSERDA T&MD On-Site Electricity & Fossil Fuel Savings from Advanced Buildings (9)**	**NYSERDA T&MD On-Site Electricity & Fossil Fuel Savings from Clean Energy Infrastructure Market Development (9)**
Subsidy	State Subsidy (Present Value) (8)	$16,679,794	$75,336,160	$70,380,281
Savings	Annual Energy Generation/Savings (MWh)	987,000	40,300	162,000
	Renewable Energy Supply (Annual Production As % of 2012 NYS Retail Electricity Sales)	N/A	N/A	N/A
CO_2 Reduction	CO_2e Reduction in Year 1 in Metric Tons	796,380	38,890	135,823
	% Reduction in Statewide CO_2e Emissions	0.503%	0.025%	0.086%
	Cumulative CO_2e Reduction Over 20 Years in Metric Tons	15,927,607	777,804	2,716,466
Productivity	**State Subsidy Per Metric Ton of CO_2e Reduction Over 20 Years**	**$1.05**	**$96.86**	**$25.91**

(9) Energy Savings – NYSERDA."Operating Plan for Technology and Market Development Program". December 2012. P. 38. http://www.nyserda.ny.gov/Energy-Data-and-Prices-Planning-and-Policy/Program-Planning/System-Benefits-Charge.aspx. Corresponding budgets – NYSERDA. "Semiannual Program Report Through June 30, 2013". August 2013. P. 17. http://www.nyserda.ny.gov/Energy-Data-and-Prices-Planning-and-Policy/Program-Planning/System-Benefits-Charge/SBCIV-Documents.aspx.