150th New England Electricity Restructuring Roundtable Gala
May 18, 2016, Seaport Hotel, Boston
First Panel Speakers Respond to the Question:
"Electricity Restructuring: Successes, Failures and Where We Go Next?"

Professor William W. Hogan, Kennedy School of Government, Harvard

Examples of successes, failures and new directions for discussion and debate.

Successes

1. Spot-Market Design. Integrating market design and system operations to provide good short-run operating incentives, support forward markets, and facilitate long-run investments. Under the combined requirements for economic efficiency, open access and non-discrimination, there is only one way to organize the electricity market: Bid-based, security-constrained, economic dispatch with locational prices and financial transmission rights.

2. Scarcity Pricing. New England was one of the first to recognize and incorporate some degree of scarcity pricing integrated with the energy market.

3. Capacity Market. The problematic evolution of the New England Capacity Market has been moving in the direction of better integration with market operations. In the pay-for-performance initiative, New England addressed an important defect in earlier market designs.

4. Cape Wind. Avoiding expensive mistakes can be among the most important successes.

Failures

5. Clean Energy Supports. The RGGI caps are too high, the price of carbon dioxide emissions is too low, and other renewables supports have little or no economic justification.

6. Scarcity Pricing and Capacity Market. The pay-for-performance reform is designed to replicate better scarcity pricing for supply but not to send the same signal to demand. This is one-hand clapping. When the pay-for-performance penalties kick in, there will be some very odd conditions with high prices for generators and low prices for load. Expect inventive arbitrage initiatives.

7. Out-of-Market Uplifts. Any time a plant or action is used to relieve problems in real-time, but is not reflected in the locational prices for energy, real costs are being socialized. This interacts with inadequate scarcity pricing to increase the "missing money" and create the need for more market interventions that compromise investment signals.

8. Transmission Cost Allocation. The history in New England is largely consistent with the FERC fudge on the principles of beneficiary-pays. This provides poor signals to the markets and reinforces the need for ever more intervention to overcome the market failure which socialized cost allocation creates or exacerbates.

Where We Go Next

9. Green Energy Agenda. The challenges for addressing climate and other environmental issues are enormous. Current technologies and policies are not up to the task. Bill Gates says we "need an energy miracle." The primary focus should be on R&D. The market design challenge is to provide conditions and opportunities for entry and innovation. The need is increasing for good electricity market design. The practice is constantly pushing for smart grids with dumb prices, cost socialization, and underinvestment in R&D.

10. Wholesale Market Reforms. Continue to implement to get spot-prices more in line with real opportunity costs. Look to ERCOT for a workable and working model of better scarcity pricing. Make the "missing money" decline or go away. Get the prices right.

11. Utility of the Future. See the forthcoming MIT project, the Reforming the Energy Vision conversation in New York, or related conversations in other states. The visions are to expand the market design to go down to the distribution level and finally get active demand participation and any cost-effective distributed energy resources. A necessity is to create the foundations defining the core energy products and prices, and build the new markets on that firm foundation. A danger is trying to implement markets that skip this necessary step.

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May 10, 2016

To: Jonathan Raab
New England Electricity Restructuring Roundtable

From: **Sue Tierney**
Senior Advisor, Analysis Group

Re: 150th Roundtable gathering:
"Successes," "Disappointments," and "Where We Go Next" in New England's electric industry

In anticipation of our panel discussion at the 150th Roundtable on May 18th, you've requested that each of the panelists comment on various topics: Successes, Disappointments/Shortcomings/Failures, and Where We Go Next? You asked us to provide our lists of successes and disappointments (which I prefer to the notion shortcomings and failures), and then explain why we think of them that way. Here are my offerings on each topic.

Successes

1. **Managing transitions with the lights on, through thick and thin**. Ever since the earliest discussions about the possible restructuring of the electric industry, concerns have periodically been raised regarding the implications of one or another change for the ability of the electric system to provide reliable supply to consumers. This concern was raised during the design and at the time of the start-up of the markets administered by ISO-NE. It was raised when non-utility companies took on ownership of power plants. It was raised with the initial discussions about the Regional Greenhouse Gas Initiative, with the entry of non-dispatchable wind and solar resources on to the grid, and with the system's reliance on demand response. Throughout it all, the various players in the industry took their public-service/'keep-the-lights-on" roles very seriously – by raising questions, doing assessments, adjusting to new realities, and adhering to impeccable level of performance in grid operations. This has been essential to consumers, the region's economy, public officials, and the workforce of people involved in maintaining a reliable system. Nice job.

2. **Designing policies based on market principles**. Restructuring discussions began over two decades ago when various economic and technological forces opened up the possibility that large industrial customers had choices (such as self-supply through installation of cogeneration) besides just buying power from the local utility. From the start, policy makers attempted to create value through building policies based on market principles: by allowing customer choice; by auctioning generation facilities to reduce stranded costs; by designing a bid-based wholesale energy market; by evolving siting processes to entertain non-utility project proposals; by designing a cap-and-trade program into RGGI; by relying on at-risk capital to bring thousands of megawatts of new generation into the system since 2000; by establishing mechanisms to allow non-supply-side alternatives to compete with generation; and on and on. As a former utility regulator who experienced the difficulties and challenges of traditional cost-of-service regulation with torturous after-the-fact prudency reviews of major investment decisions, I learned the wisdom of the old adage that imperfect competition is often times better than imperfect regulation. And I am heartened with the many examples of ways that the New England states and their electric industries have incorporated market principles into the operation of

and investment in the grid. We have relied on private markets in so many ways to absorb investment risks that previously had been shouldered by electric customers. Based on many analyses I and others have performed, I think this has provided real value to consumers and the region's economy.

3. **Increasing the economic productivity of our electricity dollars**. For many years, regulators, utilities and other stakeholders in New England had recognized the value afforded by investments in energy efficiency. Our electricity rates may be relatively high, but we make very good use of each dollar spent on electricity. We've accomplished that not only through consumers' response to price signals, but also through a concerted effort to use public policies to support the provision of cost-effective energy efficiency services and programs. Today, average electricity expenditures as a share of median income is relatively low in the six New England states, compared to so many states which tout their low electricity rates. Massachusetts and Connecticut, in particular, rank among the highest states in terms of their "electricity productivity" (the relationship of dollars of gross state product per dollar spent on electricity). Kudos to the New England states for investing the proceeds from RGGI's auction of carbon allowances into energy efficiency measures, thus keeping dollars within the region and lowering overall demand for power.

4. **Increasing the share of "clean generation" and lowering air emissions that affect human health and global warming**. For various reasons, the New England states have had to clean up their portfolio of generating resources (not only in an absolute sense, but also compared to other parts of the country) over the past two decades. This has helped us meet air quality standards, improve public health, and made Massachusetts and other states leaders in addressing climate change. We have dramatically lowered emissions of sulfur dioxide (helping to address acid rain) and nitrogen oxides (helping to address smog). As we have shifted from coal-fired power production to natural gas and renewable energy, we have addressed particulate emissions (and the health impacts related to them), and lowered carbon emissions. Too often, we forget these benefits as we focus on electricity rates; but we have invested in public health and making a small dent in emissions and costs related to climate change.

<u>Disappointments</u>

5. **Politicizing all things energ**y. I was lucky to have been a utility regulator in the days when politicians liked to distance themselves from regulatory decisions. That's one of the reasons why independent, or quasi-independent, regulatory agencies were set up: politicians could let the regulators make the tough decisions, point out that those were "their" decisions, and then try to get distance from them. Those days are over, for better or for worse. One of the consequences is a political tendency to react to the latest problem with a short-term fix, without a longer-term vision about how things should work, and without sufficient attention to whether the fix is likely to lead to unintended and problematic consequences. An example of this is the chain reaction that has taken place in the region as a result of periodic spikes in electricity prices as a result of periodic spikes in the price of natural gas. The proposed solution of putting a wires charge on all electricity customers to pay for expanded pipeline capacity as the way to address generation-related commodity costs seems fundamentally inconsistent with the structure of the electric system in New England, and seems a blunt and uneconomic approach of shifting risk in ways that will likely lead to some unfortunate unintended consequences.

6. **Pursuing packages of inconsistent policies affecting the electric industry.** As I suggest in my second bullet on "success" ("Designing policies based on market principles"), I have been a supporter

of the many ways that our policy makers have adopted market-based approaches as they've attempted to achieve an efficient, reliable and clean energy system. That's why it's disappointing to me to observe the many proposals that have come forward in recent years to introduce policies and programs that run counter to competitive markets, and which would, in fact, undermine them. A good example is the proposal to have all electricity customers pay for new high-voltage transmission lines to Canada, to enter into an enormous long-term contract for hydroelectric power to be delivered into (and literally flood) New England's electric market, and to suggest that it will reduce risk and provide low cost power. I have previously written about my concerns about the implications of such a program. http://nepga.org/2015/09/tierney-report-on-ma-emissions-cost-of-hydro-contracting/. Although this proposal would provide a low-carbon supply of electricity, it would neither be cheap, nor would it be consistent with the direction the Commonwealth is going in other respects, to encourage distributed energy systems. Putting a large, long-term cost on the wires charges on customers' bills strikes me as something that will help drive customers off the grid and undermine the economics of the existing asset base in the region. There are alternative policy designs for clean energy that would better align with the structure of the region's electric and other energy markets, such as a technology-neutral clean energy standard that focuses like a laser on carbon (as I have recently proposed in New York State (http://www.analysisgroup.com/uploadedfiles/content/news_and_events/news/entergy_proposes_alternative_to_cuomo's_clean_energy_standard.pdf), or a program to introduce a meaningful price on carbon (http://commonwealthmagazine.org/opinion/carbon-pricing-is-smart-policy/).

7. **Letting nuclear plants go away too soon.** As I have explained in an OpEd I wrote last summer (http://thehill.com/opinion/op-ed/247858-dont-let-nuke-plants-go-too-fast): "I never thought I'd be writing this sentence: It would be penny unwise and pound foolish to allow safely operating nuclear power plants to retire too soon. That statement constitutes a big turnaround for me. I started my professional career at a time when scores of new nuclear power plants were under development. That was eons ago, when there were promises of "power too cheap to meter" and realities of huge cost overruns and local protests. As a graduate student, I studied these controversies. As a state utility regulator in the 1980s, I grilled nuclear plant owners about those cost overruns and whether consumers should have to pay for them. I watched as less than half of the roughly 250 nuclear units originally proposed eventually went into commercial operation. The rest were cancelled or otherwise didn't go forward. Let's just say I wasn't a fan of nuclear power.
Fast forward to 2015: 99 nuclear units are still in operation in the U.S. Most have approval to operate for several more decades. A fifth of U.S. electricity comes from these plants. In the wholesale competitive power markets in parts of the eastern U.S., where "merchant" nuclear units are owned by non-utility companies, nuclear units provide a third of the power supply. Their operations help to keep electricity prices lower than they would otherwise be. They routinely generate power at levels of output far exceeding other types of power plants. They provide almost two-thirds of zero-carbon electricity.

   So what's the problem? Some of the nation's best-performing nuclear units are financially distressed. Many have not been able to cover their costs in recent years, largely due to competition from low natural gas prices and flat electricity demand. Economic pressure also results from the reality that these power markets routinely fail to compensate nuclear units for many of the important attributes – especially that valuable carbon-free, around-the-clock generation – they contribute to the electricity system. For example, public policies that aim to bring low-carbon energy resources into the system categorically exclude existing nuclear generators from receiving revenues that would help them stay in the market.

Premature loss of safely-operating nuclear plants, due to these market failures, risks leaving the nation's electric resource mix much less diverse, with much higher costs and much higher carbon emissions. That's why I worry about letting safely operating nuclear power plants retire too soon. To me, it's all about the threat of climate change and the urgent need to reduce carbon emissions from electricity production. That's what changed my mind about the near-term fate of U.S. merchant nuclear reactors. Even assuming continued operation of today's existing nuclear plants, it will be hard enough to reduce U.S. CO2 emissions from the power sector (almost forty percent of U.S. emissions). …I want to see the nation's power sector reduce its carbon footprint, not increase it because of premature closure of existing nuclear units….In the near term, any time a nuclear unit retires, its output is replaced by plants that burn coal, natural gas or oil. In the near term, every new wind and solar project displaces output at those fossil-fuel units, but the pace of adding those renewable energy projects doesn't offset (much less more than compensate for) the zero-carbon output that would be lost if nuclear units retire soon. Given the long-lived nature of greenhouse gases in the atmosphere, retaining zero-CO2-emitting power plants currently in operation is as important as introducing new clean generation resources in the future.

We cannot wait any longer to attend to the urgent challenges now facing nuclear units. Investors have little patience for financially struggling assets in the absence of signals that there will be action to address market failures. More importantly, the health of our planet depends upon urgent action to reduce emissions that lead to climate change. We need to make sure that our safety regulations are strong, that our wholesale power markets compensate power plants for their provision of carbon-free electricity, and that upcoming carbon regulations treat existing nuclear plants fairly relative to other carbon-free power sources, like wind and solar energy. Otherwise, we will likely see more premature nuclear retirements and it will be significantly more costly to make progress toward reducing carbon emissions from the U.S. power system. That would be plenty foolish.

What's Next?

1. **Addressing carbon with a meaningful economic signal:** Massachusetts has been a leader in recognizing the realities of climate change, and has put in place policies that aim at an economy and energy system with a much lower carbon footprint. I'd like to see even stronger policies to address the urgent problem of climate change. Massachusetts could take further steps to internalize carbon into prices in all of the fossil-fuel markets (e.g., through a carbon fee-and-dividend policy) and to compensate suppliers of clean energy resources for the service they provide in helping to decarbonize energy systems (e.g., through a fair clean energy standard that puts all technologies on an equal footing).

2. **Maintaining market-based discipline in electric industry, please!** There are many forms that this could take:
   - By resisting the focus on lowering electric commodity costs (e.g., natural gas, large-scale hydro imports) without telling the whole story about total costs (i.e., socializing the cost of related delivery infrastructure);
   - By evolving utility planning processes, tariffs, pricing models, and utility business models to recognize customer-driven (and policy-driven) interest in clean and distributed energy resources;
   - By developing a vision/pathway(s)/role(s) for natural gas in a decarbonizing energy system, and then aligning policies to accommodate a transition; and
   - By adopting genuinely complementary policies in careful ways so that they can work with and not undermine markets.

Peter Fox-Penner, BU's Institute for Sustainable Energy (& Brattle Group)

150th Roundtable Query

	What	Why
Success	• Short-term LMP markets • Electricity still affordable and reliable	• Clever means of creating a locational "tight pool" • Checks and balances, diverse mix, regulation worked
Shortcoming	• Harmonizing climate and other policy goals with electric markets • Capacity markets • Optimal, timely transmission	• Electricity markets not originally designed to achieve policy goals other than efficient coordination • No carbon price or shadow price • These are very hard problems!
Next	• See shortcomings • The transactive distribution grid prosumer future	• Obvious and inevitable – but a 30-year project that will still retain much of legacy system and will include vertical integration/ESU business model (Smart Power)

To: Jonathan Raab
New England Electricity Restructuring Roundtable

From: **Richard Cowart, Director, Regulatory Assistance Project**
Brussels, May 11, 2016

Re: Thoughts on "Successes," "Disappointments," and "Where We Go Next" in New England's electric industry

Jonathan, thanks very much for the opportunity to reflect on the progress made in the power sector across New England over the past twenty years. Compared to my esteemed fellow panelists, I am much less up-to-date on recent policy debates in New England, as I have been working extensively in Europe for the past few years. On the other hand, working closely on these issues across a diverse set of nations and power systems in Europe provides a perspective that might be useful as we consider how well we are doing in New England.

Restructuring Successes in New England

1. Achievements that we tend to take for granted:
The restructuring process in New England has created the basic conditions, institutions, and operational rules for well-functioning power markets and reliable operations, and both the markets and the system security rules have performed well over a period of fairly dramatic structural change. This is a significant accomplishment, and should be counted as a real success. By comparison, while the European Union is committed to the goals of market liberalization and market integration, and a lot of work is going on in Europe to accomplish that, the truth is that many of the conditions for effective competition function much better in New England than in most of Europe. For example:

- ISO-New England was created as an ***independent* system operator**, with ability and responsibility to manage security-constrained, competitive markets without the conflicts of interest prevalent among European TSOs, and which slow down progress and impede competition. We now take this structure for granted, but back when the restructuring process began, the independence of the ISO was not at all assumed. Among other voices, a number of NARUC commissioners came together to issue something we called the "Declaration of Independence" calling for market and system operators who could make tough choices without any real or perceived biases due to corporate ownership of generation or transmission assets. In New England we have demonstrated that this kind of independence works.

- The New England markets employ **locational pricing** – it's not perfect, but again, something that we now assume as a sensible market characteristic. By comparison, in Germany today there is no locational pricing despite significant congestion constraints, and this has created real barriers to the market and adds to the cost of the carbon reduction in a nation that really wants to succeed at lowering its emissions.

- New England has a well-functioning process for **market monitoring** to control for and correct market abuses, which creates the conditions in which competition can be permitted to exist. Independent market monitoring is something most European markets simply do not have, and as a consequence it is much more tempting for decision-makers to intervene in markets, and much more difficult for them to allow prices to fluctuate to reveal scarcity and reflect real-time market conditions.

- Another key achievement that is mostly taken for granted in New England, but apparent to anyone working in Europe, is that the New England power market operates almost seamlessly **across state lines** – we have regional markets, regional balancing, grid integration, regional resource adequacy rules, and regional policy-making processes. And we have managed to do all of this while reserving to each state a great deal of authority over siting, renewable resource standards, retail rates, and all the rest. Each and every one of these topics is the source of endless debate today among European Member States, as they struggle to find the right balance between national sovereignty and regional cooperation to mobilize the benefits of integrated power systems and markets.

- Finally – the **lack of drama** in recent years over system security and reliability should be noted. Even though the power system in New England has gone through a period of rapid change, in our Roundtable today we are NOT talking about power crises. There are a lot of people to be congratulated for this lack of drama, and of course we know that they have gone through periods of real worry – but the system has worked reliably while folding in a lot of new players, changing the generation mix, and rolling out a series of increasingly competitive market rules. That is a success.

2. Carbon Emission Reductions and RGGI

One of the signal accomplishments throughout the period of restructuring has been the successful design, launch, and operation of the Regional Greenhouse Gas Initiative. In one sense, RGGI is a modest success – the system was always over-allocated, carbon prices have been low, and its coverage has been limited. But in other ways, it has been a globally-leading initiative. It was a significant accomplishment to secure the enrollment of nine independent jurisdictions (I count New Jersey's withdrawal as a mistake by New Jersey rather than a failure of RGGI). In addition, the decisions by the RGGI states to dedicate a large fraction of their carbon auction revenues to low-cost carbon abatement investments, principally through energy efficiency, is a globally-significant action. RGGI has demonstrated that **carbon revenue is just as important as carbon pricing and carbon trading** to achieve deeper carbon reductions at acceptable cost to citizens, businesses, and economies.

As nations, states, and provinces struggle with the challenges of achieving ever-deeper carbon reductions, the RGGI model should continue to provide a useful example of how to get there without exhausting the public's willingness to pay for climate progress.

3. Demand Response and Energy Efficiency

When electric industry restructuring was first being considered across the nation, many state regulators, including myself, were supportive. We had come through a period of rate cases, prudence reviews, and cost overruns by traditional utilities, and were convinced that a competitive model would place risk and management authority in the same place, and would promote innovation in services and pricing. However, we were also deeply concerned that the move to competition would cause utilities and states to "toss overboard" the hard-won public interest programs that states and utilities had designed to deliver energy efficiency, demand management, renewable power, and consumer protection. Indeed, as debates about restructuring unfolded nationally, utility investments in energy efficiency were initially cut in half.

It is a significant achievement in New England across the past twenty years that: (a) investments in energy efficiency in the region have gone forward at robust levels (in most states, and most of the time), and (b) demand response resources have been integrated into virtually all, if not all, of the region's energy, capacity, and ancillary service markets. Together, the suite of policies and markets that mobilize savings at customer locations has saved consumers billions of dollars, helped to lower emissions and the cost of fuel imports, improved system reliability, and improved the functioning of the market.[1]

In addition to the benefits we enjoy at home, New England's success in delivering energy efficiency and demand response resources provides a variety of models to power systems and governments across the US and around the world – something we aren't often aware of or think about. For example, based in large measure on the success of utility-sector demand-side programs in the US, and notably in New England, the European Parliament in 2012 adopted the **Energy Efficiency Directive**, mandating efficiency savings of 1.5% per year across the EU. To date, 16 European nations have adopted Energy Efficiency Obligations on energy companies similar to many of the programs in effect in our region.

Restructuring Disappointments

1. The problem of socialized transmission

One of the consequences of creating a strong ISO with the ability to socialize costs through tariffs is the opportunity to address perceived problems through out-of-market solutions. Sometimes these solutions are addressing persistent market failures and reliability problems, sometimes they are not. When ISO-New England first proposed socialized treatment for "Pool Transmission Facilities" estimated costs were in the low hundreds of millions of dollars. But since socialization for reliability became the norm,

[1] These demand-side achievements have not come easily, but rather have been the result of many people and institutions working together across the region over more than two decades. One prominent example of collaboration was the New England Demand Response Initiative (NEDRI), which in 2002-03 brought together federal and state utility and environmental regulators, ISO-NE, utilities, and consumer and environmental advocates to consider the many ways that demand response and efficiency could improve outcomes in the power sector. They did not find any "silver bullets" to deliver DR and EE, but did develop 38 distinct recommendations. Another example is the collaborative work of the Northeast Energy Efficiency Partnerships (NEEP), which is an agent for continuing improvement in the efficiency programs across the broader US Northeast. These examples and others in New England underscore the point that progress on the demand side has required numerous policy reforms, a spirit of innovation, and persistent attention from policy-makers. Because it has not been easy or simple, New England's progress on the demand side throughout the restructuring era is a notable accomplishment.

transmission investment costs have risen dramatically. Since 2002 a total of 677 project components with an investment cost of about $7.6 Billion have been placed into service, and the project list still contains over 170 active projects with budgets that could cost $4.2 Billion more by 2020.[2]

There is a case to be made for some degree of regional cost-sharing for transmission investments that serve regional reliability needs but face market barriers to implement. However, it seems apparent that easy access to socialized cost recovery has supported a form of "log-rolling" among utilities and states to justify ever-increasing transmission investments. Meanwhile, cost-effective Non-Transmission Alternatives that could promote distributed resources and meet reliability challenges more cheaply, do not qualify for regional support. This problem has become obvious in Vermont, where state law requires utilities to pursue non-wires solutions when they are less expensive than transmission upgrades. The problem is that under current ISO practice, Vermont ratepayers would have to pay for 100% of the costs of a non-wires solution, but would pay less than 5% of the costs of a PTF-eligible transmission project. Notwithstanding this imbalanced policy, the Vermont transmission utility (VELCO) recently removed about $400 million in previously planned transmission projects from the region's project queue, stating that efficiency and demand response investments had made or could make those projects unnecessary.

The VELCO story is just one example of what is potentially a much larger problem. As New England contemplates adding several billion dollars in new transmission and pipeline projects, our failure to fully account for, and equally pay for, non-transmission alternatives continues to be a market flaw.

2. Mixed success with capacity markets

While New England's market has been a leader with respect to day ahead and spot market design, our approach to ensuring adequate reserves through long-term capacity payments has been less successful. As a former regulator I can easily understand and have always supported the ISO's strong interest in ensuring that adequate reserves will always be available when needed. However a broad-brush long-term capacity mechanism has the problem of interfering with energy price signals that would reveal more sharply the value of resources when margins are tight, and undervaluing highly flexible demand- and supply-side resources that will increasingly be needed to deliver quickly in a power system more reliant on variable renewable generation.

On the plus side the successful inclusion of demand response and energy efficiency resources in New England's capacity markets was a very positive step that delivered substantial savings to the market and allowed demand-side resource providers to prove their reliability. Moreover, more recently, the pay-for-performance reform has created additional performance incentives to capacity resources. However, this is unlikely to deliver the robust price signals that will be needed to call forth the deeper levels of flexible load, storage and generation that are going to be needed in a power supply system that has a greater fraction of variable renewables. A more price- and time- sensitive reserve pricing mechanism, (for example, similar to the system used in ERCOT) would deliver stronger price signals on the value of

[2] These data are from the ISO website. The ISO website does not give a ratio, but presumably at least some of these projects provide local non-reliability benefits so not all of these costs will be shared regionally.

reserves, and is more in line with the price signals needed by both supply and demand in the more agile power system we now need.

My perspective on this topic is influenced by the robust debates in Europe now over claims from generators that American-style capacity markets are needed to replace the "missing money" that is alleged to be the result of "too much renewables." However on the whole, EU power systems are overloaded with capacity, much of it inflexible legacy coal plants. Capacity payments that would artificially extend their operating lifetimes just perpetuate the oversupply/low price problem, while interfering with the needed transition to a low-carbon mix.

3. Whatever happened to innovation in retail services?

During the restructuring debates, many participants, myself included, argued that retail competition would not only lower costs to consumers, but it would unleash creativity in the energy service world and open up a host of new options that traditional utility managers and regulators could not even dream of. Analogies to creative new telecommunications services were often made. Many also believed that competition would unleash consumer demand for "green power" and help drive the generation mix towards renewable electricity.

What have we seen instead? In New England, we have of course seen substantial benefits from wholesale competition, but retail competition has not delivered the "game changing" service innovations that many had hoped for. Exceptions can certainly be found on the edges of some markets, but for the most part retail competition has been based on price alone. And as for green pricing, while it is clear that as citizens, New Englanders strongly support renewable power, they prefer that it be delivered to and paid for, by everyone, not just to those who choose to pay. Renewable power in the region has not been driven by retail competition, but instead by renewable portfolio requirements, and more recently by PV net metering policies. It looks like the long-awaited transformation of retail energy services may now be possible, but it has taken a long time to get going.

Looking Ahead – the "Electric Restructuring Roundtable" becomes the "Energy Transition Roundtable"

Over the past twenty years global climate change has gone from being something that we thought about only in the background, as we tried to "get competition right," to a policy challenge that must now be a primary organizing principle for power policy decisions. Fortunately, we have the advantage today in New England of a strong platform on which to build the needed transition. For the next twenty years, I suggest that the "Electricity Restructuring Roundtable" think of itself as a forum for advancing the next, essential, *energy* transition. Electricity remains in the center, but the circle is much wider.

The elements below are listed in no particular order, because they are all intertwined, and because they are all needed:

- **"Efficiency First" –** The New England region has been a leader in proving that investments in end use efficiency and demand response can provide multiple benefits to the power system and to

society. But we have much more to do. The IEA's recent report on the challenges of meeting global climate targets concludes that energy efficiency will be called on to deliver half of the total GHG reductions needed globally. Meanwhile, demand response is essential to delivering the renewable energy supplies that can provide a large fraction of the remainder. Redoubling our efforts on efficiency and demand response will have to be a hallmark of our work in coming years.

- **Getting beyond natural gas** – Electric restructuring in New England has been accomplished in large measure due to our dramatic increase in reliance on natural gas for generation. But natural gas has to be seen as a bridge, not a destination – especially if we are going to meet the goals for climate stability committed to in Paris last winter. Since our nation has abundant supplies of low-cost gas, it will take discipline to leave it in the ground. Lets hope that the lessons we are learning about how to keep coal in the ground can be applied to gas as well. This will be the challenge of a generation for the power sector in New England.
- **Utility-scale and distributed renewable energy** - None of us has the crystal ball to reveal which electric power resources will prevail in coming decades, but I think the debate over "centralized" vs "decentralized" systems is a distraction. We are going to need both, which means we need transmission, and we need smarter grids and more distributed low-carbon generation too.
- **Electrification** – Rapid advances in end-use technologies now offer the hope that low-carbon, affordable electricity can drive down costs and emissions from other sectors of the economy. Electric vehicles and high efficiency heat pumps are principal examples, but there are others. The good news is that these end uses, deployed sensibly, can help to manage load curves and take advantage of variable renewable generation.
- **Intelligent and responsive load** – The market rules and rate designs that we have in place today at both the wholesale and retail levels in New England were designed for a system based largely on delivering dispatchable central station power to customers with fairly predictable load patterns. Systems with much greater fractions of variable renewables present instead the problem of "net load" (the difference between demand and renewable generation at any point in time), and net load is much more variable and less predictable. Reliability and power quality will depend on actuating flexible, responsive resources on both the supply and demand side.
- **Rate designs that are "fit for purpose" in a renewables world** – As we envision a power system that includes a high fraction of variable renewable generation, together with a high fraction of controllable load and storage, we need to keep our eyes on the market rules and rate designs that will deliver price signals in real time to match demand and supply efficiently. This does not mean that individual customers have to face volatile and unpredictable prices, simply that load-serving entities have to face them and have the means to respond. But we are today increasingly seeing rate proposals that remove time-varying price signals from the generation side (e.g., fixed capacity payments), and from the customer side (e.g., high fixed customer charges for distribution). We will need pricing mechanisms that much more directly connect system conditions with price signals for responsive load, storage, and reserve services.

Electric industry restructuring in New England has ushered in a number of notable changes in an electric power sector that was for decades known as slow-moving and resistant to change. But now we do not have the luxury of perfecting the current regime. It has been just over 35 years since the passage of PURPA, and we have less than 35 years between now and 2050. The pace of change we have dealt with during the period of restructuring will seem fairly modest compared with the pace of change required in the power sector as we seek to build a low-carbon economy in a fast-changing world.

Electricity Market Restructuring in New England:
Successes, Failures and Future Challenges

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Two decades of experience operating under a competitive market framework have yielded important successes in New England. Despite progress on many fronts, though, there remain huge challenges and obstacles as we adapt our regional energy system to meet the imperatives of the 21st century. A few observations on key successes, failures and remaining challenges:

1. Successes

Overall Market Structure – Speed of Implementation. New England's transition to a modern, competitive electricity market structure was – especially by comparison with the rest of the US – relatively speedy, complete and irreversible. This was made possible by core elements of the new structure including functional unbundling, full divestiture of generating assets from stand-alone distribution companies, balanced treatment of pre-existing stranded cost commitments, and establishment of an independent transmission system operator. Implementing this new structure quickly necessitated compromises. While imperfect at the outset, it allowed for gradual perfection over time while maintaining reliable operations. New England's heritage (the pre-existing NEPOOL system of centralized dispatch) greatly facilitated the formation of a stand-alone ISO and associated elements of the transition.

This early launch and rapid transition proved fortunate when the industry was struck by a series of disruptive events nationwide. The 1998 Midwest price spikes, a spate of urban distribution blackouts, the 2000-01 California power crisis, the March 2001 repudiation of the Kyoto Protocol and, finally, the September 11 attacks all caused turmoil, and sapped political support for restructuring. The reform process stalled in many regions, with costly and environmentally damaging consequences. In New England, the ship had already left port. Market participants and regulators had little choice but to work through the problems that arose. As a benefit, New England has cemented its role as a national leader in modern, efficient electricity market design.

Leadership in Demand Response. The inefficiencies revealed by restructuring led to shocking price spikes, sometimes reaching $10,000/MWH (the limit of billing systems). Many state commissions recoiled and sought to insulate consumers from these effects. In New England, these spikes were recognized as symptoms of inefficiency and an entrepreneurial opportunity to work out new demand response (DR) contracting models. This model has now become well-established and withstood legal challenge at the US Supreme Court. The growth of DR has created a reservoir of system flexibility, causing price spikes to become less frequent and severe. In the future, the role of DR is certain to expand as the energy system evolves from reliance on dispatchable fossil fuels to renewables-based generation. While the coming "electrification of everything" (EVs, ultra-efficient HVAC, the "Internet of Things") will place new burdens on the system, many of these uses are especially well-suited for DR and we can confidently expect this reservoir of system flexibility to grow even further.

Leadership in Energy Efficiency. In addition to DR, New England has been a leader in energy efficiency which is now firmly accepted as our region's "first fuel." The revenue decoupling initiative addresses the perverse regulatory incentive to increase energy sales and/or distribution system throughput. Four New England states have been ranked in the top 10 nationally for their energy efficiency programs by ACEEE. Massachusetts, the region's most populous state, has ranked #1 for five years running. Massachusetts ranks second only to much-larger California on the Clean Edge index of the Clean Energy Economy. On a per-capita basis, Massachusetts has established the largest clean energy technology sector in the country; the cleantech sector is recognized as an important engine of growth.

Commitment to Environmental Improvement. The initial restructuring process in the 1990s provoked acute concern within the environmental community about a "race to the bottom" in standards. This proved unfounded. Overall, our region's environmental ethic has remained strong and the environmental impacts of the power system have been reduced. Longstanding commitments to retire old, inefficient coal and oil fired generators have been fulfilled, with the role of oil and coal-fired generation reduced from 40% to 6%. The New England region's renewable portfolio standards (RPS) rank among the most ambitious outside California. Five of the six New England states joined – and Massachusetts led – the landmark 2005 lawsuit against the U.S. EPA that led to the Supreme Court's decision affirming EPA's obligation to regulate CO2 emissions as a pollutant.

Use of Natural Gas as a "Bridge to the Future." Natural gas has played an indispensable role as the region's "bridge fuel" during this period. Rapid uptake of gas was possible due to a happy confluence of circumstances unique to the mid-1990s. Gas use for power generation was below 10%, allowing room for growth without threatening system reliability and security. The new gas plants were much cleaner and more fuel-efficient than legacy coal and oil-fired generators, and, represented the cleanest form of generation ready for deployment at large scale. Their flexibility, scale and dispersed ownership made them ideally-suited for a market-based system based on merit-order dispatch. Gas prices were generally low and stable, and conventional natural gas extraction was reasonably clean. For a time, New England's "dash to gas" offered a win-win-win for competition, consumers and the environment. These circumstances have changed, though, and New England now faces the challenge of finally "crossing the bridge."

2. Failures and Challenges for the Future

Carbon pricing. The overriding failure of energy policy during this era – not by any means unique to New England – has been our continuing failure to impose a price on carbon pollution. The scientific and global consensus is unequivocal: to avert climate catastrophe, we must drastically scale back our use of fossil fuels. The single most effective step we can take to make energy markets work and fulfill the central, original goal of restructuring – namely, lower costs over time for electricity consumers – is to ensure that consumers pay the costs of their energy use on their energy bills, rather than on their (and each other's) tax bills, insurance bills, medical bills, or on bills left unpaid for the next generation. There is no more pressing imperative than to find solutions to this problem of massive cost shifting at the national level. Workaround alternatives are bound to be imperfect substitutes.

Siting of Renewable Energy Facilities. It is time for brutal honesty about the scale of land use that will be required if we are to come close to meeting regional energy needs in a post-fossil fuel era, with acceptable levels of service (let alone replicate today's "always on, everywhere for all uses" grid). We have clearly failed to gain social acceptance for siting procedures that will enable development of the requisite capacity in a timely fashion. This is an epic challenge.

Consider that today's energy system, of comparatively recent vintage (well into the industrial revolution), is based on "burning time" profligately (i.e., fossil fuels). Barring unforeseen breakthroughs, we are destined to migrate toward a future energy system that – as in humanity's past – will be based on harnessing energy flows in real time, but across physical space. There is good news: today's renewable energy technologies (principally, wind and solar) are vastly more land-efficient than the traditional sources that predated the industrial revolution. But the space needs will still be significant. Expert analyses suggest that, at today's population levels and living standards, we may need to dedicate 1-2% of our nation's land mass to energy production. Here in New England we will face an even stiffer challenge, given our higher population density and less favorable climate.

It will be necessary to forge greater social acceptance of energy production as a legitimate large-scale use of land. While daunting, this challenge is not impossible when one considers the scale of other land uses (agriculture, grazing and forests together represent close to 50% of the US land mass; paved areas alone represent somewhat more than 1%). But the need is likely to go far, far beyond what can be achieved on a limited number of favorably-oriented rooftops. Large-scale community "solar gardens" will be needed, as will non-peaking land-based wind energy and storage to maintain well-distributed, diverse production profiles. Undoubtedly, communities will continue to diverge widely in their tolerance for siting energy infrastructure. Perhaps consideration should be given to market-based mechanisms akin to cap-and-trade. Communities could be assigned responsibility for energy production based on local demands. These obligations could be traded with other communities that may be less population-dense or more willing to host, and derive economic benefit from, energy infrastructure development.

The Future Role of Gas-Fired Capacity. In a world of severe carbon constraints, it will not be possible to rely on gas as a bulk generation fuel for a large fraction of total energy needs. At the same time, we will not be able to dispense with gas-based generation in the near term, given its much greater capacity value. Today's market structure – however well-suited it was to the circumstances of the 1990s – is simply not well-suited to support this evolving role for gas. We must continue to search for workable ways to keep an adequate level of gas generation available and reliably supplied, but principally in reserve. In the long run, this may necessitate a new form of regulation that treats gas-fired generators akin to other critical public services such as police, fire protection or ambulance services.

As always, a market-driven electricity system is not a fixed destination. It is an ongoing voyage!

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