

**Proposal of Paul Centolella and Associates, L.L.C.**

**With Support from Tabors, Caramanis, Rudkevich**

**For Expert Testimony on Performance Based Rate Plans for  
Hydro Quebec Transmission and Distribution**

**Provided to Fédération canadienne de l'entreprise indépendante**

**July 15, 2015**

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## **Introduction**

Paul Centolella and Associates, L.L.C. welcomes the opportunity to independent expert advice and testimony to the Fédération canadienne de l'entreprise indépendante (FCEI) and any associated parties (hereafter referred to as "FCEI") in Phase 1 of the current Hydro Quebec Transmission (HQT) and Hydro Quebec Distribution (HQD) cases on Performance Based Rates (PBR). Mr. Centolella will be the primary expert, supported in this matter by staff from Tabors Caramanis Rudkevich (TCR).

We have previously reviewed and provided advice to FCEI counsel on the Elenchus Research Associates report, *Performance Based Regulation: A Review of Design Options as Background for the Review of PBR for Hydro Québec Distribution and Transmission Divisions*.

This proposed mandate addresses tasks related to Phase 1 of the PBR proceedings as described in the Régie's June 30, 2015 procedural decision.

We have participated in and supported the development of performance based regulation and the development of advanced methods for establishing performance based rates in other jurisdictions and look forward to providing expert testimony before the Régie in this matter.

## **Background**

These cases will implement a 2013 Act that mandates:

"The Régie shall establish a performance-based regulation to ensure efficiency gains by the electric power distributor and the electric power carrier.

The regulation must pursue the following objectives:

- (1) Ongoing improvement in performance and service quality;
- (2) Cost reduction that is beneficial to both consumers and the distributor or carrier; and
- (3) Streamlining of the process by which the Régie fixes or modifies the rates the electric power carrier and the electric power distributor charge consumers or a class of consumers."

In the prior HQT and HQD rate cases Mr. Centolella provided expert testimony for FCEI. He testified regarding the information asymmetry between the utilities and the regulator, the cost-of-service framework that up to now has been used to set HQT and HQD rates, and the earnings history and specific circumstances of the utilities, including:

- A history of earnings in excess of authorized returns, including excess earnings from 2008 to 2012 of \$422 million by HQT and \$516 million by HQD;

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- The weakened incentives for pursuing efficiency improvements and achieving cost savings that result from the use annual cost of service rate cases;
- The use in these cases of the companies' forecasted costs, which permits the companies to mitigate their downside risks; and
- The lack of performance incentives that provides management additional flexibility to achieve desired levels of earnings.

In that case, Mr. Centolella supported a transition to PBR. The Régie adopted Mr. Centolella recommendations and the specific ESM mechanism that he proposed to better protect customers.

### **Summary of Qualifications**

Paul Centolella is a respected former regulator. He served as a Commissioner on the Public Utilities Commission of Ohio from April 2007 to April 2012. As a Commissioner, he participated in the development and implementation of the State's 2008 electricity legislation that authorized multi-year rate plans with limits on significant excess earnings and additional performance incentives.

Mr. Centolella has testified and advised a range of clients regarding performance based rates, other alternative regulatory models, and investigations comparable to that being undertaken by the Régie. His analysis of regulatory models in a whitepaper on Results-Based Regulation has helped frame the discussion of performance based regulation in the United States and was cited in the New York Public Service Commission's proposal in its Reforming the Energy Vision (REV) proceeding. Mr. Centolella and his TCR colleagues are currently advising the New York Commission staff on aspects of the REV proceeding. Mr. Centolella currently serves on:

- The Advisory Committee for the Massachusetts Institute of Technology (MIT) Utility of the Future Study that is evaluating alternative regulatory frameworks and utility business models. One of the first products of the MIT study was a white paper that addresses advanced PBR structures.
- The U.S. Secretary of Energy's Electricity Advisory Committee, where he led the development of this Federal Advisory Committee's recommendations that the Department of Energy develop information and tools to assist regulators in implementing performance based regulatory frameworks.
- The U.S. National Academy of Sciences Committee on the Determinants of Market Adoption of Advanced Energy Efficiency and Clean Energy Technologies, where he is the principal author of the draft study's chapter on utility regulation that includes an analysis of advanced PBR mechanisms. The draft report is currently in the Academy's review process and will be released upon the completion of the review process.
- The U.S. National Institute of Standards and Technology Smart Grid Advisory Committee, a Federal Advisory Committee that focuses on modernization of the electric transmission and distribution grid.

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He is frequently invited to speak on alternative regulatory models at industry and regulatory conferences in the United States and Europe.

Mr. Centolella has received national recognition for his contributions to utility regulation, served on a broad range of regulatory committees and boards, was a member of the U.S. delegations to the 2009 and 2012 World Forums on Energy Regulation in Athens and Quebec respectively, was a member of the U.S. delegation to the 2011 Asia Pacific Economic Cooperation (APEC) Senior Officials Meeting, and a co-chair of the 2012 APEC forum on utility regulation in Quebec.

Mr. Centolella is President of the firm, Paul Centolella and Associates, L.L.C. and a Senior Consultant at Tabors, Caramanis, and Rudkevich (TCR), an economic consulting firm with advanced analytical and modeling capabilities. A CV for Mr. Centolella is attached.

### **Approach**

PBR can provide utilities incentives to reduce their costs; achieve efficiency improvements; and, if accompanied by appropriate incentives, pursue reliability, customer service, public policy objectives, and on-going performance improvement.

A central component of PBR in this case would be the *ex ante* specification of a multi-year plan. Such a plan specifies a formula for determining and/or sets levels of allowed revenue or rates that will govern how rates may change during a multi-year period. The multi-year plan creates efficiency and cost savings incentives by permitting the utility to share in any savings relative to its authorized revenues.

In developing a plan, it will be essential to account for the unique characteristics of HQT and HQD. HQT and HQD are crown corporations. Experience in other jurisdictions with government owned utilities suggests that large efficiency improvements may be achievable when such utilities become subject to significant incentives to reduce costs. Given the asymmetry of information available to the regulator compared to the information available to the utilities, it may be difficult for the Régie to estimate the extent of the cost saving and efficiency improvement opportunities available to HQT and HQD.

The key challenge for this case is the presence of a greater than normal degree of uncertainty regarding the extent to which the utilities' recent costs and their cost projections reflect their efficient costs. There are three primary avenues available to address this uncertainty:

- The first is the review of the utilities' cost of service studies. While it may be possible to further improve the review of HQT and HQD cost projections, the recent over earning of allowed returns indicates the limitations of this approach.

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- Second, comparisons with other utilities can provide information regarding efficient costs and performance. A multi-factor productivity study, which the regulator is considering as a second phase for this proceeding, would include such comparisons. As described in the text box below, this case presents unique challenges for the application of the statistical methods commonly used in PBR cases. Given these challenges, statistical comparisons may be treated as a complement to structural incentives. Detailed consideration of productivity studies has been deferred to the second (and third) phase of this proceeding.
- Third, such uncertainty can be addressed by structural incentives for the utility to reveal information on its efficient costs. The characteristics of a PBR structure are the primary focus of this first phase of the case. Based on our expertise in advanced PBR frameworks, we will evaluate mechanisms that could provide an incentive for HQT and HQD to disclose information on their expected efficient costs, achieve efficiency improvements and ongoing performance improvements, minimize the risk of future over earning, and address the unique circumstances of this case.

The structural incentives provided in PBR are a function of multiple components in the plan. In this case, characteristics of the following components will be important in the design of PBR and may have a significant role in providing structural incentives for beneficial cost reduction and ongoing improvements in performance and service quality:

- Structure of Multi-year Plans, including:
  - Earnings Sharing Mechanisms;
  - Potential Off-Ramps;
  - End of Period Reviews;
- Use of a Menu of Contracts in setting Allowed Revenue;
- Cost Recovery Components, including:
  - Attrition Relief Mechanisms;
  - Expenditure Capitalization;
  - Treatment of Large Investments;
  - Cost Trackers;
- Revenue or Rate Caps (Decoupling); and
- Reliability, Service Quality, and On-going Performance Incentives, including incentives related to the cost and performance of autonomous networks.

These PBR components are discussed in sections below. We will develop expert testimony that provides the Régie a balanced view of the implications of different options.

### Relationship to Phase 2: Multi-factor Productivity Study

The Régie has deferred its decision on whether to undertake the Multi-factor Productivity Study that it initially had proposed as a second phase of this proceeding. The regulator's deferral of this decision may reflect the unique challenges of this case and differences between this case and other PBR proceedings.

The uncertainty regarding a potential differential between current and efficient costs impacts the evidentiary value of statistical comparisons often used in PBR cases. An index based PBR rate or revenue cap typically adjusts rates based on a formula (an Attrition Relief Mechanism or ARM) that combines an inflation index and a statistical analysis of productivity trends observed at other utilities. However, this approach does not address uncertainty regarding the differential between HQT's and HQD's current costs and the efficient expenditure levels that they might achieve under PBR. If their initially allowed revenue is high relative to their efficient costs, a standard index based formula would tend to produce overly favorable results for HQT and HQD as they implement additional efficiency improvements. In such a case, productivity trends in regulated, investor-owned utilities could understate the potential for HQT and HQD to reduce their costs.

Other jurisdictions have addressed such concerns, in part, by benchmarking one utility's costs against those of comparable companies. This approach has been accepted in jurisdictions where multiple distribution companies are subject to the jurisdiction of the same regulator, such that the regulator has sufficient information on each company to ensure an accurate comparison. Given Hydro Quebec's size, the lack of comparable utilities in the province, its reliance on DC transmission, dispersed service locations, and other differences, benchmarking in this case would require more challenging cross-jurisdictional cost comparisons for which the number of comparable utilities may be limited.

Case studies of other government owned utilities that have made a transition to PBR with stronger efficiency incentives provide another source of information on the potential for a differential to exist between recent and efficient costs. Although no single case study will necessarily be representative of potential HQT or HQD efficiency gains, such studies might provide indications of the extent of the uncertainty regarding the potential for efficiency improvements.

Recognizing the issues that are unique to this case, the Régie may well treat a productivity study as a complement to structural incentives. In that instance, any such study should seek to identify a target productivity improvement range that can be used in developing structural incentives and not just a point estimate to be included in an index based formula. The development and application of such analyses would occur primarily in subsequent phases of this case.

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*A. Multi-year Plans and Earnings Sharing Mechanisms*

A multi-year plan provides the utility the incentive to pursue efficiency improvements by creating an opportunity for the company to retain a portion of any cost savings achieved over at least the remaining duration of the plan. The duration of a rate plan may reflect the experience of a given jurisdiction and facts of a specific case. Three to five year PBR plans are common. However, the U.K. Office of Gas and Electric Markets (Ofgem) extended the period covered by its PBR mechanisms for network utilities from five to eight years to better align with utility planning horizons and more closely approximate the incentives provided by competitive markets. Extending the time a plan remains in place increases the likelihood that allowed revenues may diverge from actual costs and that the utility may significantly over earn (or under earn) its authorized rate of return. Moreover, a longer plan duration could mean that customers wait longer before fully realizing in lower rates the benefit of any cost savings achieved by the utility. PBR plans can address such concerns in a multi-year plan with an Earnings Sharing Mechanism (ESM) and potential off-ramps for factors that could not have been anticipated when the plan was established.

An ESM enables customers to share in firm-wide cost savings during the term of the plan. The ESM may be a multi-tiered plan with different sharing percentages depending the deviation of actual earnings from authorized levels. Adopting Mr. Centolella's recommendations in the last HQT and HQD rate case, the Régie implemented a two-tier ESM. An ESM should balance providing an incentive for the utilities to pursue cost savings with the timely return of a portion of such savings to customers. Its structure should consider uncertainty regarding efficient costs and the incentives that would be provided by effective competition, if such competition were feasible. Mr. Centolella will consider the precedents in Quebec and the use of ESMs in other PBR proceedings when considering characteristics of an ESM for this case.

Additionally, it may be appropriate to consider incentives for the utilities to pursue longer-term efficiency improvements and needed investments to replace aging infrastructure. One way to encourage such improvements is to authorize a regulatory review of long-term improvements and based on such reviews permit end of period adjustments that allow the utility to carry forward recognition of a portion of the cost savings or reliability enhancements from major improvements into their next PBR plan. Such a review also can help ensure that costs are not unduly shifted between periods covered in different rate plans.

*B. Using a Menu of Contracts to Set Allowed Revenue*

As Mr. Centolella testified in the prior HQT and HQD rate case, the ability to identify HQT's and HQD's costs for providing service in an efficient manner is limited by information asymmetry, e.g. the regulator and external parties are seldom in a

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position to evaluate opportunities for efficiency improvements that have not been pursued by the utility. Such information asymmetry can be mitigated by the use of a menu of contracts in setting allowed revenue. A menu of contracts structure is an efficient means for structuring a principal – agent relationship in contracting and in regulation. In this approach, the regulator offers the utility a set of options that have been structured with varying fixed and performance based revenue components so as to provide an incentive for the utility to select the regulatory contract that best reflects its expected cost for efficient operations. And, once a specific option has been selected, the selected option also provides the utility an on-going incentive to operate efficiently. This approach has been used by Ofgem for several rounds of PBR regulation and adopted by the water utility regulator in the U.K. Our colleagues in the MIT Utility of the Future Study have specified the mathematical formulas for implementing menu of contracts regulation. This is an option that we regularly review with clients who are evaluating PBR models. Mr. Centolella would evaluate use of a menu of contracts based approach and how such an approach might best be implemented taking into consideration how to avoid undue complexity.

*C. Cost Recovery Components: Attrition Relief, Expenditure Capitalization, Large Investments, and Cost Trackers*

Over the course of the PBR plan, authorized revenue requirements or rates may change based on either stair steps set by the regulator in its initial decision or an Attrition Relief Mechanism (ARM) formula. The typical index based ARM includes the following elements:

- An inflation factor that may be based on general economic price index or, where available, indices of increases in specific utility input costs;
- A productivity or “X” factor;
- “Y-factors” for items that are recovered outside of the PBR mechanism, these may involve trackers for specific expenditure categories or the recovery of known sunk costs;
- “Z-factors” for extraordinary or unanticipated events, subject to provisions that may specify and limit the classes of events that could qualify for “Z-factor” treatment, e.g. changes in law or tax rates;
- Off-ramps or reopeners that provide a backstop allowing regulators to step in to address extraordinary events; and
- Reliability, Customer Service, and other Performance Incentives, which we discuss separately below.

We anticipate a general discussion of the ARM structure in the current phase of the proceeding. However, an ARM formula needs to be considered as a whole including detailed review of inflation, productivity, allowable adjustments extraordinary or unanticipated events, off-ramps and reopeners. This detailed review may require information that would not be available until subsequent phases of the proceeding.

There are three structural issues that may be discussed generally during the current phase of this proceeding:



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- Capitalization of Expenditures (TotEx caps);
- Recovery of Large Investments (Targeted Revenue Adjustments); and
- Cost Trackers

How utilities pursue their objectives can be influenced and in some circumstances distorted by their ability to earn a return on capital investments. A multi-year rate plan provides an opportunity to address this effect and provide the utility greater flexibility to pursue efficiency improvements and cost savings. In its recent PBR proceedings, the U.K. regulator, Ofgem, has introduced a Total Expenditure (TotEx) cap in which the percentages of the utility's expenditures that will be capitalized (slow money) and expensed (fast money) are fixed up front without regard how the utility will actually spend its allowed revenue. This permits utility management to shift spending over time and between what would otherwise be considered capital or operating expenses to meet their performance metrics in the most cost effective manner. The utility does not have to come back to the regulator before changing its capital expenditure plan. We will examine whether such an approach might provide additional opportunities for HQT and HQD to make beneficial cost reductions, ongoing performance improvements, or service quality enhancements.

In certain cases, it may be appropriate to consider revenue adjustments outside of an index based formula for large, one time investments. However, such adjustments generally require a strong showing that an extraordinary investment is in customers' best interests.

Although the use of cost trackers and other forms of *ex post* cost recovery can be appropriate in certain circumstances, a common presumption in PBR is that the utility should be responsible for managing variations in costs that are subject to its influence or control, particularly if an analogous cost would not be treated as a simple pass through in a competitive market. In this case, cost trackers may be appropriate to ensure the recovery of costs for specific public policy programs (e.g. innovation or efficiency programs) that improve long-term performance or service quality. In this phase of the proceeding, we can address factors that might justify, characteristics, and procedures for recovery for such items outside of a general rate adjustment formula.

*D. A Cap on Revenue or Rates*

PBR mechanisms can be structured as a cap on allowed revenue or on rates. And, in either case there are different ways in which the cap can be specified.

A cap on revenue removes the incentive for the utility to underestimate its forecasted sales, leaves the utility neutral with respect to customer investments in energy efficiency, and reflects the fact that a large portion of the costs recovered through PBR may be costs that do not vary directly with sales. However, a revenue cap would introduce an additional, relatively straightforward, annual adjustment to

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rates to true up revenue to allowed levels when actual sales differ from forecasted levels.

Revenue caps, which decouple revenue from actual sales, can be structured in different ways. For example, a revenue cap might fix total allowed revenue, set allowed revenue per customer such that the utility retains an interest in attracting and retaining customers, or create a formula by which revenue can grow as a function of customer growth or other factors.

Price caps also can be structured in different ways to provide marketing flexibility or specify how rates for particular customer classes can change over time.

Based on our experience in the prior rate case, our current view is that a revenue cap that decouples revenues for sales may be appropriate in this case. We would provide the Régie a general analysis of different options, the impacts of using a revenue or rate cap, and how rate design could effect the operation of a revenue cap.

*E. Incentives for Reliability, Service Quality, and Ongoing Performance Improvement, including the treatment of autonomous networks*

Experience with PBR suggests that in the absence of incentives to maintain reliability and service quality utilities may reduce operating and maintenance costs and reliability can suffer. We have followed the development of strong output based incentives by Ofgem in the U.K., the Ontario Energy Board's performance scorecard, and metrics and incentive mechanisms in other jurisdictions. Mr. Centolella has developed approaches for estimating the value of uninterrupted service to customers, recognizing that the value of uninterrupted service can vary significantly for different types of customers. And, he has supported the development and use of such values in planning and performance incentives.

Mr. Centolella's experience in key studies, federal advisory committees, and international forums provides him insights into technological and practice developments that will be important to the ability of utilities to achieve ongoing improvements in service quality and performance. Ongoing improvement is, in part, a function of innovation including incorporating third party innovations; maintaining affordability by enabling responsive demand and efficiency that improves asset utilization and reduces costs; accurately accounting for the time- and location-specific value; and addressing system resilience.

Identifying outputs that can be important to customers, we will provide testimony on the development of metrics and incentives related to service reliability and the value of uninterrupted service, the quality of service experienced by customers, and performance improvement.

The Régie has asked parties to address conceptually whether PBR should address the presence of autonomous networks. These networks are areas served by HQD on islands

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and in areas not connected to the larger grid. These networks face specific issues because HQD provides (largely oil fired) generation to serve these areas and their lack of interconnection with the larger grid can give rise operational and reliability issues. In this proceeding, we will examine whether HQD should have specific performance metrics and incentives to address issues that are specific to such autonomous areas.

**Deliverables, Hourly Rates, and Budget Estimate**

We anticipate providing testimony on the following topics:

- Structure of Multi-year Plans;
- Use of a Menu of Contracts in setting Allowed Revenue;
- Cost Recovery Components;
- Revenue or Rate Caps (Decoupling); and
- Reliability, Service Quality, and On-going Performance Incentives, including the treatment of autonomous networks.

Work will be performed on a time and materials basis. Mr. Centolella’s hourly rate will be discounted from the rates previously approved by the Régie to \$425 (U.S.) to take into consideration changes in the exchange rate. At the current Bank of Canada exchange rate this equals \$550 per hour (Canadian). Expenses charged at actual costs. Mr. Centolella may be supported during this engagement by TCR staff. Standard ranges for TCR hourly rates presented in Table 1.

**Table 1: TCR Hourly Rates for Consulting Services**

<b>Personnel Category</b>	<b>Hourly Rate U.S. \$</b>
Principal and Partner	\$475-675
Senior Economist/Consultant	\$400-525
Senior Associate	\$275-350
Senior Analyst	\$275-375
Analyst	\$150-250
Assistant	\$100-150

Working within the available budget for expert testimony, the estimated total cost for this engagement including Paul Centolella and Associates and TCR time and expenses is \$99,900 (Canadian).

This proposal would be subject to the following standard terms:

Our invoices, which will payable upon receipt or if required by the regulator upon approval of costs by the Régie, will show our professional services charges and will provide details concerning the nature of the work performed, by whom, their hourly rate, and the time spent. The invoices will show, separately, our expense charges. Any invoice that remains unpaid

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more than forty-five (45) days after it becomes payable will, at our option, accrue interest at the rate of one percent (1%) per month.

Paul Centolella and Associates' and TCR's aggregate liability, whether in tort, contract or otherwise, shall be limited to the amount paid for the services set forth in this mandate.

Paul Centolella and Associates is not restricted from working on specific engagements, including unrelated engagements involving the parties in this matter; however, all confidential information gained in this matter will be kept confidential.

This agreement is deemed to be made under and shall be interpreted in accordance with the laws of the Commonwealth of Massachusetts, excluding its conflict of laws provisions.

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Mr. Centolella has more than 35 years of experience as a practitioner, policy maker, and innovator in energy and environmental economics, market design and analysis; energy technology and standards development; utility regulation; and public utility and environmental law. His work has contributed to the development of environmental and electric power markets, modernization of power systems, and the evolution of utility business and regulatory models. Mr. Centolella was a Commissioner on the Public Utilities Commission of Ohio (PUCO) and has been nationally recognized for his contributions as a utility regulator. He has served on a range of expert committees and task forces, including the Secretary of Energy's Electricity Advisory Committee, the National Academy of Sciences Committee on the Determinants of Market Adoption of Advanced Energy Efficiency and Clean Energy Technologies, Massachusetts Institute of Technology Utility of the Future Study Advisory Committee, the Electric Power Research Institute's Advisory Council, and the Governing Board and Board of Directors for the Smart Grid Interoperability Panel (SGIP).

### Professional Experience

*President, Paul Centolella and Associates, Brookline, MA (2014 – Present) and Senior Consultant, Tabors Caramanis Rudkevich, Boston, MA (2015 – Present)*

Mr. Centolella provides expert advice and testimony for a range of clients on regulatory policy, energy, and environmental issues affecting the future of utilities and the electric power industry. He focuses on emerging utility business and regulatory models, energy and environmental market design, efficient pricing, innovation in the energy sector, and the application of smart devices and clean energy technology.

Key accomplishments:

- Advising clients on: emerging electric utility business models including the distribution system operator and network platform models for integrating distributed energy technologies; alternative regulatory frameworks including cost-of-service regulation, formula rates, and results-based regulation; and opportunities to provide adjacent value added services to customers.
- Led preparation of Federal Advisory Committee recommendations for U.S. Department of Energy on the development of information and tools to support use of alternative regulatory models in electric utility regulation.
- Developed an assessment of the future of demand response, including the use of smart technologies to automate responsive demand, provide virtual energy storage, reduce wasted energy, and facilitate new business models. The report also addressed dynamic pricing and how to preserve demand participation in wholesale markets consistent with potential limits on Federal Energy Regulatory Commission jurisdiction.
- Participating in and developing portions of the analysis for a National Academy of Sciences study on the determinants of market adoption of advanced energy efficiency and clean energy technologies. The report, which is currently in review, examines approaches for strengthening

the energy innovation system and applying cleaner technologies to mitigate climate and environmental risks without compromising economic competitiveness.

*Vice President (2012 – 2014) and Affiliate (2014 – 2015), Analysis Group, Boston, MA*

Mr. Centolella led consulting engagements and provided expert testimony and advice to utilities, power market participants, technology companies, industry organizations, and other stakeholders on electricity and natural gas markets, utility regulatory economics and policies, emerging utility business and regulatory models, grid modernization, regulation of and governance practices related to cyber security, and power sector investments.

Key accomplishments:

- Led assessments of challenges facing electric utilities, financial impacts of various frameworks for utility regulation, and alternative regulatory frameworks.
- Provided expert testimony on grid modernization including the adoption of new technology, cost recovery, and the development of metrics.
- Provided expert testimony and quantitative analyses on alternative regulatory models including performance based regulation and earnings sharing mechanisms.
- Analyzed the regulation of utility cyber security and opportunities for enhancing cyber security governance.
- Evaluated impacts of environmental regulation on natural gas development and markets.
- Assessed options to more efficiently price retail electricity supply and the potential of price responsive demand to reduce costs.

*Commissioner, Public Utilities Commission of Ohio (PUCO), Columbus, OH (2007 – 2012)*

As a PUCO Commissioner, Mr. Centolella oversaw a broad range of utility services, including electric, natural gas, telephone, water, pipeline safety, and transportation, ensuring consumers access to reliable utility services at reasonable and competitive prices.

Key accomplishments while a Commissioner, included:

- Implementing Ohio's 2008 electricity legislation that created a glide path to market pricing; included energy efficiency, peak demand reduction, advanced and renewable energy standards; required the establishment of distribution reliability standards; and led to the development of multi-year rate plans.
- Accelerating replacement of aging natural gas infrastructure and the development of trackers for recovery of related costs.
- Aligning Commission positions on wholesale power market issues with competition policy and securing capabilities for the PUCO to become the only commission in the region able to model power markets and forecast electricity prices.
- Development of the PJM Interconnection's Price Responsive Demand (PRD) tariff proposal that would integrate dynamic retail pricing into PJM's markets and operations, based on a foundational paper co-authored with PJM's Senior Vice President for Markets.
- Advancing Commission policies on grid modernization through workshops and Commission initiated proceedings on distribution reliability, advanced metering, customer access to energy usage data, privacy, cyber-security, distribution voltage optimization, dynamic retail

pricing, on-bill financing, and a residential real-time pricing and distribution level energy market pilot program.

- Creating Ohio's Smart Grid Cluster that connected research and workforce development activities at major universities and research centers with electric utilities and technology companies.
- Helping guide the development of SGIP, a public-private partnership initiated by the National Institute of Standards and Technology, which has accelerated standards development by as much as 80% and created an authoritative catalog of smart grid standards.

*Senior Economist, Science Applications International Corporation (SAIC), McLean, VA (1992 – 2007)*

Managed major projects and cases in the energy practice and advised clients in the areas of:

- Energy and environmental market design, modeling, and market analysis for electric power, gas, coal, and environmental markets;
- Economic analysis related to utility regulation, cost allocation, electric restructuring, and energy policy; and
- Power system operations including grid modernization and deployment of real-time information systems.

Key client relationships and related accomplishments include:

- *Adoption and implementation of Midwest Independent Transmission System Operator (MISO) Energy and Ancillary Service Markets (2003 - 2007):* Advised MISO senior management regarding the development of MISO's energy and ancillary service markets and MISO's resource adequacy plan. Led the economic analysis and litigation support team for MISO to secure FERC and state commission approval of its energy markets, including modeling and market analysis of MISO and interconnected systems. Served as the senior advisor to MISO's Operational Process Review assessing MISO implementation of its FERC tariff, developing integrated process maps and databases, addressing stakeholder concerns, and recommending operational improvements and metrics.
- *Development and management of TVA's Power System Optimization Project (PSOP) (2002 - 2003):* Led the economic analysis for a strategic initiative to enhance operating systems and provide enterprise wide access to real time data, resulting in more than \$400 million in operational benefits. Supported the program management office through the first year of PSOP implementation, ensuring that project activities were aligned with the achievement of anticipated net benefits.
- *Management consulting for various clients (1999 - 2001):* Led projects for making process and operational improvements based on the application of information systems and transfer of knowledge through organizational learning. These included projects to optimize the economic operation of power generation facilities and transfer lessons learned from an asset sale by a large power company.
- *Development of the U.S. Department of Energy's policies supporting electric industry restructuring (1994 - 2000):* Was principal economic consultant advising the Department's

Policy Office and led one of the first major studies demonstrating that Locational Marginal Pricing (LMP), as subsequently implemented in the organized markets, is associated with significantly lower production costs and prices. Led an assessment of the market power potential of generation suppliers in competitive power markets including an analysis of ownership patterns, the implications of transmission constraints, and potential mitigation measures.

*Senior Energy Policy Advisor and Senior Utility Attorney, Office of the Ohio Consumers' Counsel (OCC), Columbus, OH (1982 – 1992)*

Represented Ohio on issues related to the 1990 Clean Air Act Amendments, led analyses of alternative cap-and-trade and command-and-control regulatory models, was among the initial proponents of using a cap-and-trade approach for sulfur dioxide control, testified before Congress on the development of environmental markets, and served on the U.S. Environmental Protection Agency's Acid Rain Advisory Committee. Led collaborative initiatives with utilities to design and implement energy efficiency programs. Contributed to the development of state policy on a range of energy issues including utility resource planning, review of utility investments, and the opening of natural gas supply markets for retail competition. Represented municipalities and residential consumers in more than seventy state and federal utility rate and regulatory policy proceedings and in more than one hundred municipal negotiations to set utility rates.

*Attorney in private practice, Washington State and California (1977 – 1981)*

Focused on natural resources law and commercial litigation.

## **Education**

1977	J.D., University of Michigan Law School
1973	B.A., Economics, Oberlin College, with honors

## **Selected Committees, Boards, & Delegations**

Nominee, National Institute of Standards and Technology Smart Grid Advisory Committee (Nominated to become a Member at the Committee's next meeting in 2015)

Member, Massachusetts Institute of Technology Utility of the Future Study Advisory Committee (2014 – Present)

Member, National Academy of Sciences Committee on the Determinates of Market Adoption of Advanced Energy Efficiency and Clean Energy Technologies (2013 – Present)

Member, Secretary of Energy's Electricity Advisory Committee (2012 – present), Smart Grid Subcommittee and Transmission Subcommittee



Member, Varentec Advisory Committee (2012 – present)

Member, Advisory Group to Bipartisan Policy Center, Cyber Security Governance across Multiple Agencies: The Electric Power Sector (2013 – 2014)

Member, Board of Directors, Smart Grid Interoperability Panel 2.0 (2012 - 2013), Board Executive Committee and Board Technical Committee

Member, Governing Board, Smart Grid Interoperability Panel (2009 - 2012); Home Area Network Task Force; System and Device Integration Working Group; Communications, Marketing and Education Working Group

Member, Advisory Council, Electric Power Research Institute (2009 - 2012); Advisory Council Executive Committee (2010 - 2012)

Member, Board of the Organization of PJM States, Inc. (OPSI) (2007 - 2012); Vice President (2010 - 2011); Secretary (2009 - 2010)

Co-convenor of 2012 Asia-Pacific Economic Cooperation (APEC) Workshop on Regulatory Approaches to Smart Grid Investment and Deployment

U.S. delegation to 2011 APEC Senior Officials Meeting

U.S. delegation to 2012 World Forum on Energy Regulation, Quebec City, Canada

U.S. delegation to 2009 World Forum on Energy Regulation, Athens, Greece

Member, Energy Resources and Environment Committee, National Association of Regulatory Utility Commissioners (NARUC) (2007 - 2012)

Member, FERC / NARUC Smart Grid Collaborative and Demand Response Collaborative (later known as the Smart Response Collaborative) (2007 - 2012)

Member, NARUC Smart Grid Working Group (2010 - 2012)

Member, NARUC Climate Change Task Force (2007 - 2010)

Member, Technical Advisory Committee, Ohio Coal Development Office (2007 - 2012)

### **Selected Publications**

*Next Generation Demand Response: Responsive Demand through Automation and Variable Pricing* (March 2015).

*Recommendations Regarding Emerging and Alternative Regulatory Models and Modeling Tools to Assist in Analysis* (Working Group Chair for U.S. Department of Energy Electricity Advisory Committee) (September 2014).

“Results-Based Regulation: A More Dynamic Approach to Grid Modernization,” *Public Utilities Fortnightly* (with D. Malkin) (March 2014).

“Understanding the Value of Uninterrupted Service,” *Proceedings of the CIGRE 2013 Grid of the Future Symposium* (with M. McGranaghan) (November 2013)

*Results-Based Regulation: A Modern Approach to Modernize the Grid*, General Electric (with D. Malkin) (October 2013).

“Reexamining Rate Regulation: 1-2-3,” *Utility Horizons Quarterly* (March 2013).

“Smarter demand response in RTO markets: The evolution toward price responsive demand in PJM,” (with S. Bressler, S. Covino, and P. Sotkiewicz) *Energy Efficiency: Towards the End of Electricity Demand Growth*, Fereidoon P. Sioshansi, Editor (February 2013).

“Incentive Regulation for Grid Reliability,” *Electroindustry Magazine*, National Electrical Manufacturers Association (November 2012).

“A Pricing Strategy for a Lean and Agile Electric Power Industry,” *Electricity Policy* (September, 2012)

“The Smart Grid Needs Smart Prices to Succeed,” *Harvard Business Review Blog* (October 14, 2010).

“The integration of Price Responsive Demand into Regional Transmission Organization (RTO) wholesale power markets and system operations” *Energy*, Vol. 35, No. 4 (April 2010).

*Integration of Price Responsive Demand into PJM Wholesale Power Markets and System Operations*, (with A. Ott) (March 2009).

“The Future of Demand Response in RTO Energy Markets: Midwest ISO Studies on Resource Adequacy,” (with R. McNamara) *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy (August 2006).

*Estimates of the Value of Uninterrupted Service for the Midwest Independent System Operator*, Midwest Independent Transmission System Operator (April 2006).

“Energy Services in the Information Age: The Convergence of Energy, Communications, and Information Technologies,” *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy (August 1998).

*The Structure of Competitive Power Markets*, U.S. Department of Energy, Electricity Policy Office (January 1997).

“Making Performance-Based Ratemaking Consistent with Market Transformation,” *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy (August 1996).

*The Organization of Competitive Wholesale Power Markets and Spot Price Pools* (The Electric Industry Restructuring Series), National Council on Competition and the Electric Industry (1996).

“Safeguarding the Environment amid a Competitive Power Market” (with B. Hobbs), *IEEE Spectrum*, 32(3), 1995, pp. 8.

“Environmental Policies and Their Effects on Utility Planning and Operations,” *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy (August 1994).

“Applying Cost Allocation Principles to Demand-Side Resources: A Case Study of Industrial Opt-Out Proposals,” *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy (August 1994).

*Public Utility Commission Treatment of Environmental Externalities* (with K. Rose and B. Hobbs), National Regulatory Research Institute, Columbus, OH, 1994.

*Cost Allocation for Electric Utility Conservation and Load Management Programs*, principal author, National Association of Regulatory Utility Commissioners (November 1992).

*Energy Efficiency and the Environment: Forging the Link* (with E. Vine and D. Crawley), American Council for an Energy-Efficient Economy in cooperation with University-wide Energy Research Group, University of California, 1991.

### **Testimony and Technical Conference Comments**

*Presentation of Paul Centolella on Behalf of National Grid, Panel 2 New Technology Adoption*, Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid, Before the Massachusetts Department of Public Utilities (February 2014).

*Presentation of Paul Centolella on Behalf of National Grid, Panel 4 Cost Recovery*, Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid, Before the Massachusetts Department of Public Utilities (February 2014).

*Presentation of Paul Centolella on Behalf of National Grid, Panel 6 Metrics*, Investigation by the Department of Public Utilities on its own Motion into Modernization of the Electric Grid, Before the Massachusetts Department of Public Utilities (February 2014).

*Prepared Direct Testimony of Paul Centolella On behalf of the Fédération canadienne de l'entreprise indépendante and Summary of Direct Testimony of Paul Centolella*, Proceeding on the Hydro Quebec Request for Approval of Rate of Return on Own Capital and The Mechanism of Treatment of Deviations of Performance, Before the Quebec Régie de l'énergie (October 2013).

*Direct Testimony of Paul Centolella, Vice President of Analysis Group on behalf of Environmental Defense Fund*, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service, Docket No. 13-E-0030 (May 2013).

*Comments of Commissioner Paul A. Centolella Supplementing his Technical Conference Remarks*, Demand Response Compensation in Organized Wholesale Energy Markets, Docket No. RM10-17-000 (October 2010).

*Remarks of Commissioner Paul A. Centolella*, FERC Technical Conference on Demand Response Compensation in Organized Wholesale Energy Markets, Docket No. RM10-17-000 (September 2010).

*Testimony of the Honorable Paul A. Centolella, Commissioner Public Utilities Commission of Ohio on Energy Efficiency Resource Standards*, U.S. Senate Energy and Natural Resources Committee (April 2009).

*Prepared Remarks of Commissioner Paul A. Centolella*, FERC Technical Conference on Capacity Market Design (May 2008).

*Testimony of Commissioner Paul A. Centolella on SB 221*, Ohio House of Representatives, Public Utilities Committee (March 2008).

### **Selected Conference Presentations**

*Innovation and Policy: Challenges and Strategies*, IEEE Power Engineering Society Innovative Smart Grid Technologies Conference (February 2015).

*Next Generation Demand Response: Responsive Demand through Automation and Variable Pricing*, New England Electricity Restructuring Roundtable (November 2014).

*Critical Issues: Fundamental Transformations in Grid 3.0*, National Institute of Standards and Technology Electric Sector Issues Roundtable: Grid 3.0 and Beyond (November 2014).

*Information & Tool Development to Support Consideration of Future Regulatory Models*, U.S. Department of Energy Electricity Advisory Committee (July 2014).

*A Future for Demand Participation in Organized Markets*, FERC – NARUC Collaborative (July 2014).

*The Utility Industry of the Future*, NYU Environmental Law Society and Environmental Law Journal, 2014 Environmental Law Seminar (March 2014).

*Electric Grid Modernization: Regulatory Challenges and Opportunities*, LSI Transmission in the Northeast Conference (February 2014).

*Modern Regulatory Frameworks for a Flexible, Resilient, and Connected Grid*, CIGRE Grid of the Future Symposium (November 2013).

*Developing a Twenty-First Century Model for Regulating Electric Utilities*, National Governors' Association Policy Institute (September 2013).

*Efficiently Powering Smart Cities: A Case for Price Transparency*, Presentation to National Town Meeting on Demand Response and Smart Grid (July 2013).

*Powering the Future: Advancing Regulatory Reforms*, Presentation to the Energy Future Coalition Steering Committee (June 2013).

*Reframing Regulation of Electric Utilities: The Pursuit of Value*, Presentation to IEEE EnergyTech Conference (May 2013).

*Grid Modernization: Creating a Coherent Strategy*, Presentation to the National Governors' Association Experts' Roundtable on Modernizing the Electric Grid (April 2013).

*Preparing for Disruptive Events: Developing an Economic and Regulatory Framework*, Presentation to Electric Light & Power Conference (January 2013).

*Demand Side Management & Next Generation Grid Modernization: Markets, Regulation & Business Case*, Presentation to DistribuTECH Course –A Primer on the Next Generation in Integrated Demand Side Management: Applications, Challenges, Regulation, Markets, Technology and Policy for the Next Generation in Grid Modernization (January 2013).

*Aligning Ratemaking and Grid Modernization*, Presentation to the Massachusetts Department of Public Utilities Grid Modernization Working Group Steering Committee (December 2012).

*Beyond Order 745: A Demand Optimization Strategy*, Presentation to *Restructuring Today* Order 745 Webinar (October 2012).

*Overview of Utility Regulatory Policy and Development of a Smart, Secure, Sustainable Grid*, Presentation to the Secretary of the Navy's Advisory Panel (September 2012).

*Future Directions in Regulatory Policy*, Presentation to Southern California Edison Futures Workshop (September 2012).

*Dynamic Pricing: Lean and Agile Strategy for Electricity*, Presentation to the National Association of Regulatory Utility Commissioners (July 2012).

*Efficient & Resilient Power: Changing Approaches to Regulation and Electric Utility Business Models*, Kentucky Smart Grid Workshop Series (June 2012).

*The Impact of Environmental Law: Utility Regulation and PUC Governance*, Workshop on the Role of Public Utility Commissions in Climate and Energy Policy (June 2012).

*Dynamic Pricing Done Right: Building an Efficient and Resilient Power System*, Smart Grid Today Webinar (June 2012).

*Electricity Markets and Technology: Changing the Role of Regulation*, John Glenn School of Public Policy, The Ohio State University (January 2012).

*An Obligation of Transparency: Providing Opportunities for Retail Demand Response*, Conference on the Law of Demand Response, George Washington University Law School (October 2011).

*Opportunities for Innovation: New Technologies and Smart Grid Implementation*, Organization of PJM States, Inc., Annual Meeting (October 2011).

*Regulatory Reform Efforts and Emerging Business Models*, White House Forum on Grid Modernization (June 2011).

*Utility Regulation, Innovation, and Collaborative Federalism*, American Academy of Arts & Sciences, Social Science and the Alternative Energy Future (May 2011).

*Regulatory & Policy Approaches to Smart Grid Interoperability Standards: U.S. Collaborative Federalism*, ARCAM Dialogue on Smart Grid Interoperability Standards, Asia Pacific Economic Cooperation Senior Officials Meeting (May 2011).

*Placing Electric Vehicles and Battery Storage in a Regulatory Context*, National Alliance for Advanced Technology Batteries, Annual Meeting (December 2010).

*Consumer Engagement: Lessons Learned from Early Deployments*, World Economic Forum Smart Grid Workshop (November 2010).

*Smart Pricing: The Key to Smart Grid Benefits*, GridWeek 2010.

*Smart Grid Consumer Policies: Moving Toward Consensus*, International Energy Agency, Smart Grid – Smart Customer Workshop (September 2010).

*Engaging and Protecting Consumers: Key Issues for Regulators*, Mid-Atlantic Conference of Regulatory Utility Commissioners (June 2010).

*Regulatory Policy & Smart Pricing*, Connectivity Week (May 2010).

*Planning and Policy in a Time of Uncertainty: Expanding Available Options*, Midwest Independent Transmission System Operator Annual Stakeholders Meeting (April 2010).

*Smart Grid Architecture: Opportunities, Vision, & Choices*, Utilities Telecom Council Policy Summit (April 2010).

*Ohio's Energy Future and the Smart Grid*, University of Toledo College of Law Conference on Climate Change and the Future of Energy (March 2010).

*An Essential Attribute: Facilitating a Transition to Efficient Markets*, PJM Long Term Capacity Issues Symposium (January 2010).

*Low Carbon Technologies: A Smart Energy Path*, World Forum on Energy Regulation IV (October 2009).

*Distributed Coordination in the 21<sup>st</sup> Century Power Grid: Emerging Business Models*, GridWeek (September 2009).

*Public Interest Research at an Inflection Point*, Electric Power Research Institute Advisory Council (August 2009).

*Price Responsive Demand in Wholesale Electricity Markets*, Energy Bar Association Webinar (July 2009).

*Creating a 21<sup>st</sup> Century Grid: Distribution and Demand Response*, Aspen Institute Energy Policy Forum (July 2009).

*Price Responsive Demand: A Third Generation of Demand Response*, Demand Response & Energy Efficiency World Conference (May 2009).

*Scarcity Pricing in a Smart Energy Future*, Harvard Electricity Policy Group (March 2009).

*Integrating Price Responsive Demand into Regional Power Markets and System Operations*, FERC-NARUC Demand Response Collaborative (February 2009).

### **National Honors & Awards**

GridWeek Leadership Award for advancing policies for modernizing the electric power system, 2011

Smart Grid Leadership Award, Demand Response Coordinating Council, 2010

Gridwise Applied Award, Gridwise Architecture Council, for development of regulations and policies advancing the principles of technology interoperability, 2010

SGIP Appreciation Award, Smart Grid Interoperability Panel, for ensuring access to information about smart grid standards, 2010

### **Memberships**

Institute of Electrical and Electronics Engineers, Power Engineering Society (2015)

Energy Bar Association (2014 – present)

International Association for Energy Economics (2005-present)

American Economics Association (2001-present)

Ohio State Bar Association (1982-present)

California State Bar Association (1979-present)

Washington State Bar Association (1978-present)