The Evolution of Alberta’s Energy Markets
September 20th, 2017

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GRID OF THE FUTURE
Broad changes are sweeping through society that will have lasting impacts on the electricity sector

1. **“Technology”**: Technological change in data processing, communications and manufacture are making new technologies available and cost-effective

2. **“Policy”**: Climate change and the need to decarbonize our economy will require the development of massive quantities of low-carbon electricity

3. **“Democracy”**: Consumers are increasingly wishing to take control of their own destiny, decentralizing the focus of decision-making

The role of utilities will need to continue to evolve to respond to these changes in ways that preserve value for their shareholders and ratepayers
“Technology”
Renewables

+ Solar PV costs have declined tremendously in the last decade
+ Wind and solar are now cost-competitive with conventional resources in many markets—**even without subsidies**!
+ Rooftop solar can be installed at below the embedded cost rate in some jurisdictions

Source: [Utility Scale Solar 2014](LBNL, 2014)
There is increasing interest in grid-connected energy storage for renewable integration and investment deferral.

Battery costs are declining rapidly with manufacturing scale-up and technology advances.

Lithium-ion appears to be following the photovoltaic path.
Smart devices and advanced communications networks provide new mechanisms to facilitate customer response.

Improved access to data and control systems will enable response to occur seamlessly and with little effect on consumer experience.
“Policy”
The 2016 Paris agreement committed industrialized nations to 80% reductions below 1990 levels by 2050

- Roughly consistent with IPCC/UNFCCC goal of keeping global average temperature rise within 2°C to avert catastrophic climate change

If current trends continue, 2°C aggregate warming will be exceeded


Source: IPCC Global Assessment Report 5, SPM.07
Economy-wide decarbonization requires four energy transitions:

1. **Efficiency and Conservation**
   - Energy use per capita (MMBtu/person)
   - Emissions intensity (tCO2e/MWh)

2. **Fuel Switching**
   - Share of electricity & H₂ in total final energy (%)
   - Emissions intensity (tCO2e/MWh)

3. **Decarbonize electricity**
   - Emissions intensity (tCO2e/MWh)
   - CCS

4. **Decarbonize fuels (liquid & gas)**
   - Emissions intensity (tCO2/eJ)

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Energy+Environmental Economics
Three Sources of Low-Carbon Electricity

1. Renewable
   - **Hydroelectric**: high-quality, low-carbon resource in the Northwest that can help to balance wind and solar power
   - **Wind**: high quality resources in West, particularly East of the Rockies, intermittent availability
   - **Solar**: high quality resources across the Southwest, intermittent availability
   - **Geothermal**: resource limited
   - **Biomass**: resource limited

2. Nuclear

3. Fossil generation with carbon capture and storage (CCS)
One look at a GHG-compliant Pathway for California

Resources selected by E3’s RESOLVE model to meet electric sector’s share of 2050 GHG abatement goals

- Electric sector reduces emissions to 20 MMT by 2050 while serving higher loads from electrification of transportation, buildings and industry
“Democracy”
Consumer empowerment is resulting in a decentralization of decision-making

+ Restructuring of the electric utility industry in the 1990s invited new entities into the industry
  • Direct access (DA), electric service providers (ESPs), independent system operators (ISOs)

+ Municipalization and community-choice aggregation (CCA) allow local control of energy decisions

+ Rooftop solar and demand response empower small customers

+ More difficult to justify large, centralized infrastructure investments
Utilities have traditionally viewed rate design as a part of the cost allocation/ratemaking process:

- COSA study identifies classes of customers and allocates costs among them.
- Rates are designed to collect the class-specific revenue requirement from the class as a whole.
- Each customer pays a fair share of the utility’s total cost.
- A customer’s bill should generally align with utility’s cost to serve it, but some imprecision is tolerated due to pooled nature of costs, and to keep rate designs manageable for utility and customers.

*Utilities think of rates in the same way politicians think of taxes!*
Utility view is driven by structure of its embedded costs

+ Vast majority of costs in utility rates today are fixed costs

- Utility capital investments form the “rate base”, a portion of which is recovered each year from customers based on depreciation schedules
- Electricity production and delivery requires significant capital investments
  - Power stations
  - Transmission lines and substations
  - Distribution poles, wires and transformers
- Variable costs are only O&M and fuel
Traditional utility view has little room for customer response

+ Rates are set as part of a careful, political process designed to produce equitable outcomes

+ Customer response, also called “bypass”, upsets this balance
  - Customers are motivated to minimize their bills through consumption decisions
  - Direct access and net energy metering are the most extreme examples of this
  - Utilities respond with fixed monthly charges and “ratchet” demand charges

Economists prefer taxes that are non-distortionary, i.e., they do not change behavior of consumers or producers
Why should utilities want customer response?

1. **Because customers want choice!**
   - Customers want to manage their bills and many want rooftop PV

2. **Because there can be cost savings for the utility right now**
   - Utilities can avoid fuel and investment costs
   - DER increasingly cost-effective

3. **Because we will need customer response—a lot of it—in the long term**
   - Renewables integration and greenhouse gas reduction
   - Resilience against major disruptions
   - Innovation from new market entrants
INDUSTRY OF THE FUTURE
Historically, we have planned and operated power systems assuming resources are flexible and load is inflexible.

Technology, Policy and Democracy are driving change through expansion of intermittent generation and enabling customer response.

Utilities are responding in states like California and New York by evolving their markets and business models.
Will customer choice and innovation proliferate?

Historic Electricity Industry

- Relatively homogenous customers within each rate class
- Volatility and uncertainty handled via command-and-control regulation
- Generation mostly centralized
- Majority of costs recovered volumetrically in an era of continual load growth

Tomorrow’s Industry?

- Rise of the prosumer; demand profiles diversify
- Volatility and uncertainty addressed via markets, increased consumer control over demand, and strategic regulation
- Generate a diverse mix of centralized and distributed technology, including storage, microgrids, and solar
- Usage and payment of the electric network/platform an open question
Implications for market participants

Customers: Technology affords increasing opportunities to manage energy services and costs.

Utilities: Continued pressure to become the “utility of the future” as Technology and Democracy make more monopoly services contestable.

Transmission Developers: Increased focus on integration of remote renewable resources and managing new flows and system changes.

Wholesale Markets: Increasing value as a means to manage variable resources and facilitate customer response.

IPPs: Times are tough now, but trend is still toward more competition with potentially more opportunity if the utility of the future is a “skinny” one.
How will the grid of the future be organized?
What Happens to Utilities when Regulated Bundled Rates are used in Competitive Markets?

+ They can experience uneconomic bypass of their monopoly services with increases in costs and rates.

+ At the extreme, unmitigated cost increases lead to a death spiral that eventually leads to rate and market restructuring and the potential for stranded cost recovery proceedings.

+ Electricity deregulation has many similarities to cable industry.

### Natural Gas
- Complete unbundling of both costs and functions created separate Pipelines, Marketers and Buyers.
- Open seasons matched contract terms and anchor tenants with new investments.

### Railroad
- Had inflexible and noncompetitive bundled regulated rates when trucking and airlines industry become deregulated; this created substantial amounts of uneconomic bypass.

### Airline
- Also had highly regulated bundled rates (by distance) prior to deregulation and Sabre system implementation.

### Telephone
- Opened up long distance common carrier service to all providers.
- Implemented multi-part rates, similar to what we are proposing.
Technology, policy and democracy leads to many questions on the future of the grid.

- E3 is active in examining grid modernization, utility business models, and rate reform in many jurisdictions:
  - Most notably in California, Hawai’i, and New York.

- Experience shows there is no one right path forward:
  - Each path must be tailored to a jurisdiction’s unique circumstances.

Source: NC Clean Energy Technology Center
Several jurisdictions are pushing action on rate reform, grid modernization, and new utility business models.

E3 is particularly active in states such as New York, Hawai‘i, and California, but we work in every U.S. jurisdiction.

Top Ten Most Active States of Q1 2017 By Number of Actions

- New York
- Hawaii
- California
- Massachusetts
- Colorado
- Maryland
- North Carolina
- Maine
- Nevada
- Michigan

Most Common Types of Actions Taken in Q1 2017

- AMI Deployment
- Smart Grid Deployment
- Time-Varying Rates
- AMI Rules
- Energy Storage Target
- Grid Modernization Investigation
- Microgrid Deployment
- Energy Storage Deployment
- Rate Reform Study
- Energy Storage Rebate
- Energy Storage Tax Credit
- Integrated Resource Planning
- Microgrid Rules
- Energy Storage Study

Source: NC Clean Energy Technology Center
How will distribution utilities and markets operate in the future?

There are many different and valid ways to think about how the electric distribution system will operate in the future.

1. **DO** = Distribution System Owner/Operator
2. **DSP** = Distribution System Platform
3. **DSO** = Distribution System Operator

- **Virtual vs. Real** = Tariff-based pricing vs. bid-based markets

*Source: New York Joint Utilities Supplemental Distribution System Implementation Plan (SDSIP)*
Pricing and retail market design are key considerations as technology, policy, and democracy advance.

**Fundamental Pricing Signals**

- **seconds**
  - Frequency regulation
  - Volt/VaR regulation
  - Spinning reserves
  - Emissions

- **minutes**
  - Spinning reserves
  - Energy
  - Emissions

- **hours**
  - Energy
  - Emissions

- **months**
  - Capacity
    - Generation

- **years**
  - Capacity
    - Generation
    - Transmission
    - Distribution

**Today’s Utility**

- Regulated Monopoly
- Wholesale Markets
- Limited DER Penetration / Retail Markets

**Future Utility**

- New Business/Operating Model?
- More Active Customers + New Technologies?
- Transformed Markets?

**Average rates and blunted price signals:**

- Average ¢/kWh
- Flat $/kW

**More accurate and dynamic pricing signals:**

- Dynamic ¢/kWh?
- Variable $/kW?
- Other billing determinants?

*Energy + Environmental Economics*
A “smart” multi-part dynamic retail rate or tariff is one pricing solution that also serves to create a virtual retail market.

- Existing rates and tariffs do not effectively encourage dispatchable or high value DERs nor do they allow for efficient recovery of utility costs.
- A multi-part dynamic rate or tariff can work in tandem with other utility or state programs and it can also accommodate various public policy and regulatory goals.
- This offers utilities in jurisdictions like the Pacific Northwest the opportunity to create virtual retail markets based on rates and tariffs rather than entirely new distribution level markets.

Part 1: Embedded Costs
- Customer Charge
  - $/customer? Other?

Part 2: Embedded Costs
- Network/Grid Access Charge
  - $/kW, $/kWh? Other?

Part 3: Marginal Costs
- Value-Based Charge/Payment
  - $/kW, $/kWh? Other?
New York example of dynamic pricing in a distribution constrained area

Hourly prices by component, sub-station capacity limit and loads

Only these components are credited for exports for self-generation

Public purpose and utility embedded costs

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NY Full Value Tariff: Network Subscription Choices

1. Coincident peak at each level of system (distribution, transmission, system)
2. Maximum demand in a peak period that includes the coincident peak (e.g. July 6-9pm)
3. Maximum demand in the peak month
4. Peak period demand in all months
5. Maximum demand in all months
6. Monthly usage in the peak month
7. Rolling maximum monthly energy
8. Average monthly energy
9. Energy
10. Flat fee per customer (size independent)

Easier to Understand

What can a “smart” multi-part dynamic rate do?

A multi-part dynamic rate has several innovations that can serve as tools to achieve diverse goals.

**Enables Smart Grid Technologies**
- Dynamic prices send technology agnostic signals to enable a whole host of DERs
  - More Efficient Appliances
  - Storage
  - Smart EV charging
  - Smart HVAC
  - Smart Water Heaters
  - Smart Inverters

**Innovative Pricing can Capture “D” Value**
- “D” value of utility distribution and sub-transmission translated to customers as “prices to beat” to enable DER participation, enabling equitable and economical management of grid costs
- Sources of value can be communicated in a variety of ways including hourly real-time price signals or utility program payments

**Enables Utility Business Model Change**
- Encourages creation of business models that can lead to greater customer adoption of high value DERs rather than DERs that have low, zero, or negative value
- Utilities can begin to offer new and different products/services

**Rationalization of Rate Design**
- Utilities may have better and more transparent fixed-cost recovery through a multi-part rate that has an explicit mechanism, potentially forestalling future issues with retail rates like net energy metering cost shifts
- The rate or tariff can be implemented rapidly or gradually, e.g. initially opt-in only

E3 has proposed such a rate in New York, which served as the basis for the ConEd Smart Home rate available at: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId= {A0BF2F42-82A1-4ED0-AE6D-D7E38F8D655D}
There are many different and valid ways to think about how utilities and retail markets will be organized and operate in the future.

There is no one-size-fits-all solution and each jurisdiction will have to chart its own path balancing factors like:

- Size and value of potential DER and retail markets
- The costs of grid modernization and foundational investments needed to enable DER and retail markets
- Tailored and implementable transition strategies that address customer impact, utility business models, policy goals, and retail market competition concerns

A good place to start might be what NY is calling virtual retail markets through utility offered dynamic rates/tariffs coupled with more operational control over DERs.
Thank You!

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