Distributed Energy Resources in Ontario – Choice, Cost-competitiveness and Reliability

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Agenda

- About Ontario's Independent Electricity System Operator (IESO)
- Changing Operability Requirements
- Development of Distributed Energy Resources (DERs) in Ontario
- Enabling Customer Choice and Driving Affordability
- Regulatory Enhancements for Net Metering & Virtual Net Metering (VNM)
- Thoughts on VNM
- Market Renewal – opportunities for DER competition

Who We Are and What We Do

The Independent Electricity System Operator (IESO) works at the heart of Ontario's power system and has a broad mandate that includes:

- Planning to meet electricity needs
- Operating the electricity grid
- Administering the electricity market
- Fostering a conservation culture
- Engaging stakeholders and communities
- Enabling innovation
- Acting at the province's Smart Metering Entity

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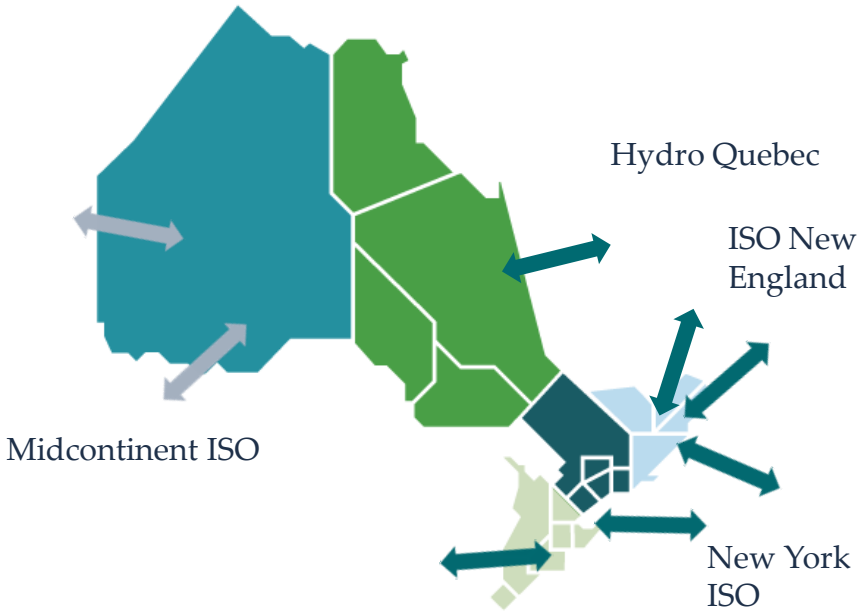
Ontario's System at a Glance

Installed Capacity (December, 2017)	36,853 MW
Record Summer Peak (August 1, 2006)	27,005 MW
Record Winter Peak (December 20, 2004)	24,979 MW
Grid Energy Consumed (2017)	132.1 TWh
Customers	~ 5 million
Transmission Lines	30,000 km
Planning Regions	21
Import/ Export Capability	6,500 /6,100 MW
Interconnections	New York, Quebec, Manitoba, Michigan, Minnesota

The IESO is the Reliability Coordinator and the Planning Coordinator for Ontario and works closely with other jurisdictions across North America to ensure reliability of the interconnected power system.



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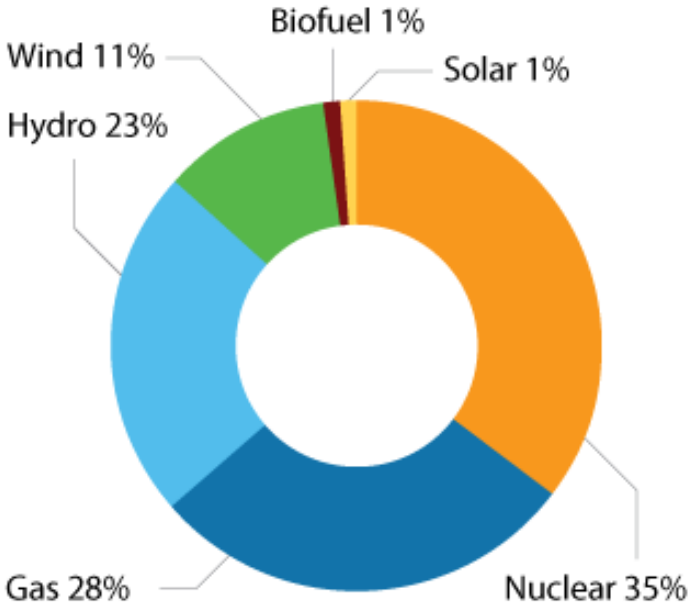
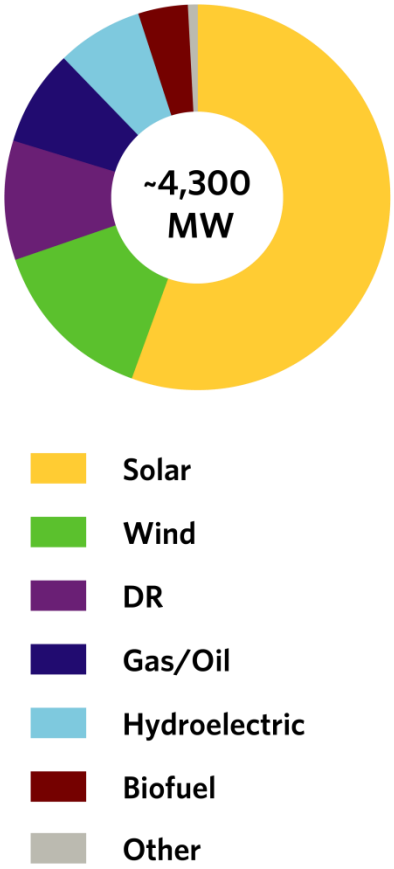
Ontario's Evolving Supply Mix

Transmission-connected



Nuclear	13,009 MW or 35%
Gas/Oil	10,277 MW or 28%
Hydro	8,480 MW or 23%
Wind	4,213 MW or 11%
Biofuel	495 MW or 1%
Solar	380 MW or 1%

Distribution-connected*



* In service or under development

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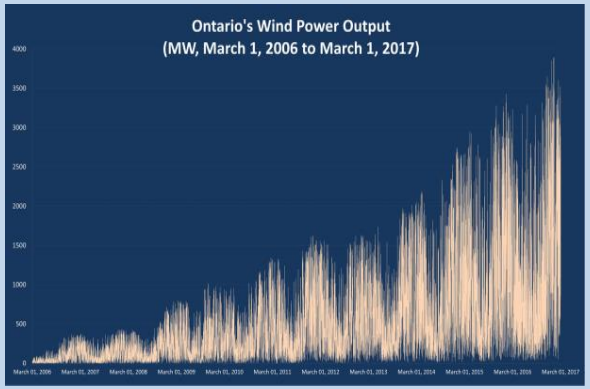
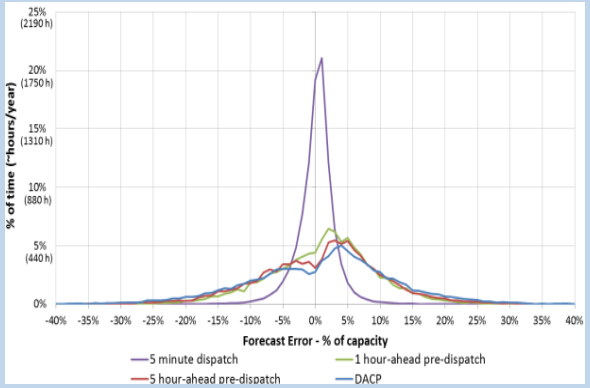
Emerging Operability Needs Associated with Development of Variable Generation Resources

Expansion of variable generation…



…and associated forecast error



Resource shortfalls when variable generation is over-forecast

IESO is addressing near-term operability needs through:

- ✓ Use of 30-minute Operating Reserve (Enabling System Flexibility stakeholder engagement)
- ✓ Expansion of regulation capacity (2017 RFP)

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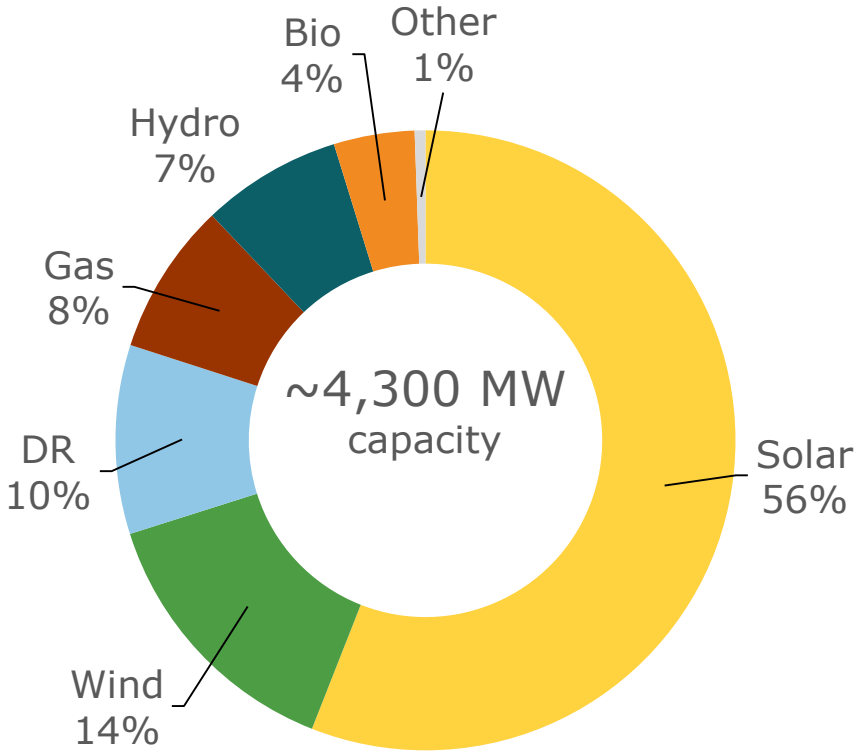
Distributed Energy Resources in Ontario

- Ontario electricity system has 4300 MW of DERs in service or under development, including regulated, contracted, and merchant facilities

- 4,300MW is about 10% of Ontario's installed resource capacity
- Approximately half of DER capacity is solar PV resources
- Most DERs operates autonomously and are not dispatchable



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Impact of Distributed Energy Resources

- DERs increase local supply and reduce the amount of energy required from bulk electric system
- Adoption of DERs is expected to accelerate if costs continue to decline and technical capabilities improve
- DERs are changing the shape of Ontario's demand; midday demand is at times lower than overnight
- Beginning to experience similar challenges as California
  - Forecast uncertainty
  - Low demand
  - Sudden reductions in variable generation output

Drivers for DER Growth in Ontario

- Technology advancement
  - Performance is improving and DER costs have seen rapid decline
  - Smart grid technology advancements are improving visibility and control
- Costs reductions
  - DER adoption is expected to be economic without incentives
- Incentives
  - Driven by government energy policy; Net metering and any GreenON Solar Program
  - ICI program is expected to drive behind-the-meter generation/storage deployment
- Increased Customer Engagement
  - Electricity consumers are increasingly looking at on-site generation to meet all or a portion of their electricity needs or as a way to generate revenue

Considerations for Increased DER Adoption

System Operations	• Lack of visibility and control of DERs presents an operability challenge (i.e. forecast error and unanticipated power flows)
System Planning	• Integrated bulk and distribution system planning to capture system benefits • Ensure DER deployment is driven to where the system benefits most
Distribution-Level	• Transmission and distribution deferral value • DER ownership and operation is not a natural monopoly
Market design	• Enhance competition, facilitate more efficient, multi-service DERs (wholesale and distribution integration)
Regulatory	• Manage risk of stranded assets and equitable cost allocation among customers • As DERs approach "grid parity", need to manage for risk of uncontrolled adoption

Collaboration to Enhance Grid Operability

- Grid - LDC Interoperability Committee (est. 2016)
  - Forum for IESO, LDCs and other stakeholders to identify, learn about and solve emerging system operability challenges
  - Currently developing a risk inventory and work plan targeting interoperability opportunities
- Concept development of distribution markets for electricity services is underway
  - Traditional services (energy, ancillary services)
  - New service concepts to delay or replace traditional wires infrastructure (non-wires alternatives)

Several Forces Create Alternatives to Traditional Electricity Solutions

- Customers seeking alternative supply options
  - System supply mix vs 100% renewable
  - Utility supply, self supply, virtual net metering
- Electricity cost management
  - C&I customers manage demand charges with storage
  - Oversize onsite generation to virtual net meter
- New entrants providing new virtual services
  - Blockchain based energy service trading platforms
  - Transactive energy demonstrations (Ottawa Hydro GREAT DR)

Evolution of Net Metering in Ontario

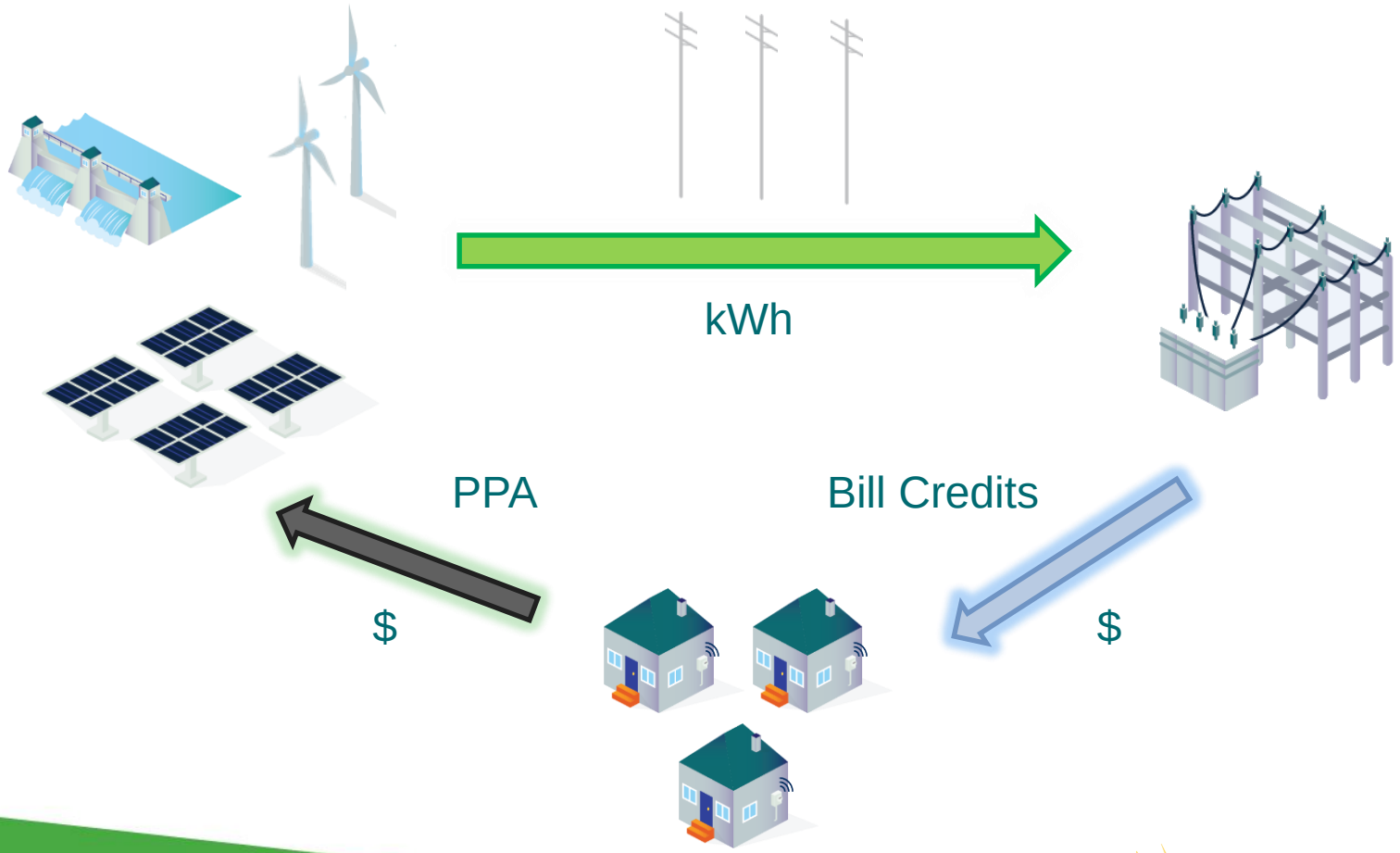
- Ontario's Net Metering Regulation (O. Reg. 541/05)
  - Introduced in 2005
  - Requires electricity distributors to offer net metering to customers crediting energy injection to distribution system at same rates as consumption
  - 500 kW facility size limit
- Net Metering Regulation updated in 2017 (Part 1 Updates)
  - 500 kW size restriction removed
  - Eligibility for energy storage introduced
  - Came into force July 1, 2017
- Additional updates in 2018 (Part 2 Updates)
  - ***VNM enabled through IESO demonstrations programs***
  - Third-party ownership for NEM

Government Legislative/Regulatory Actions

Regulatory changes that enable virtual net metering

1. Enable third-party ownership and VNM demonstration projects (amendment of O. Reg. 541/05)
2. Introduce new and enhanced consumer protections (amendment of O. Reg. 389/10)
3. Ensure that prescribed types of renewable energy generation facilities are sited appropriately (new regulation O. Reg 247/18)

What is VNM and How Does It Work?



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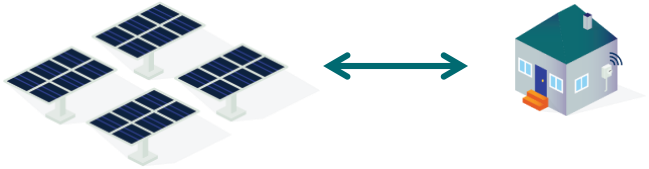
VNM Configurations



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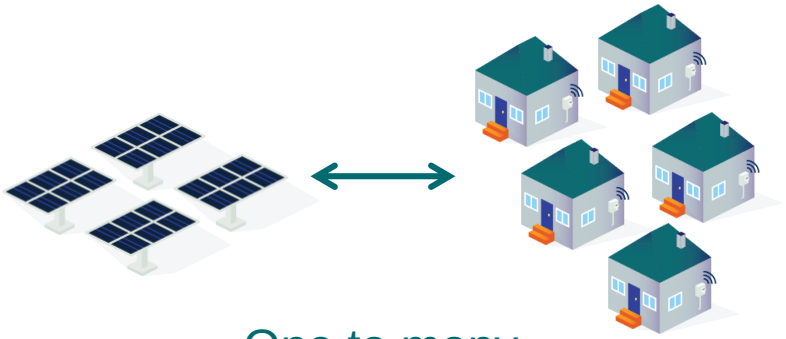

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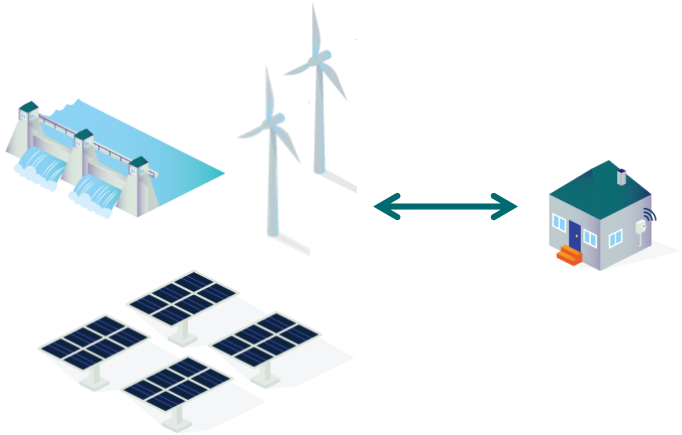

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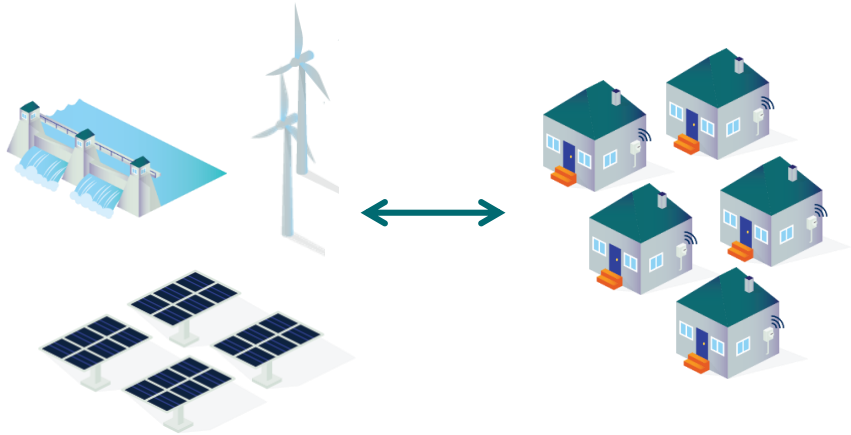

Many to many

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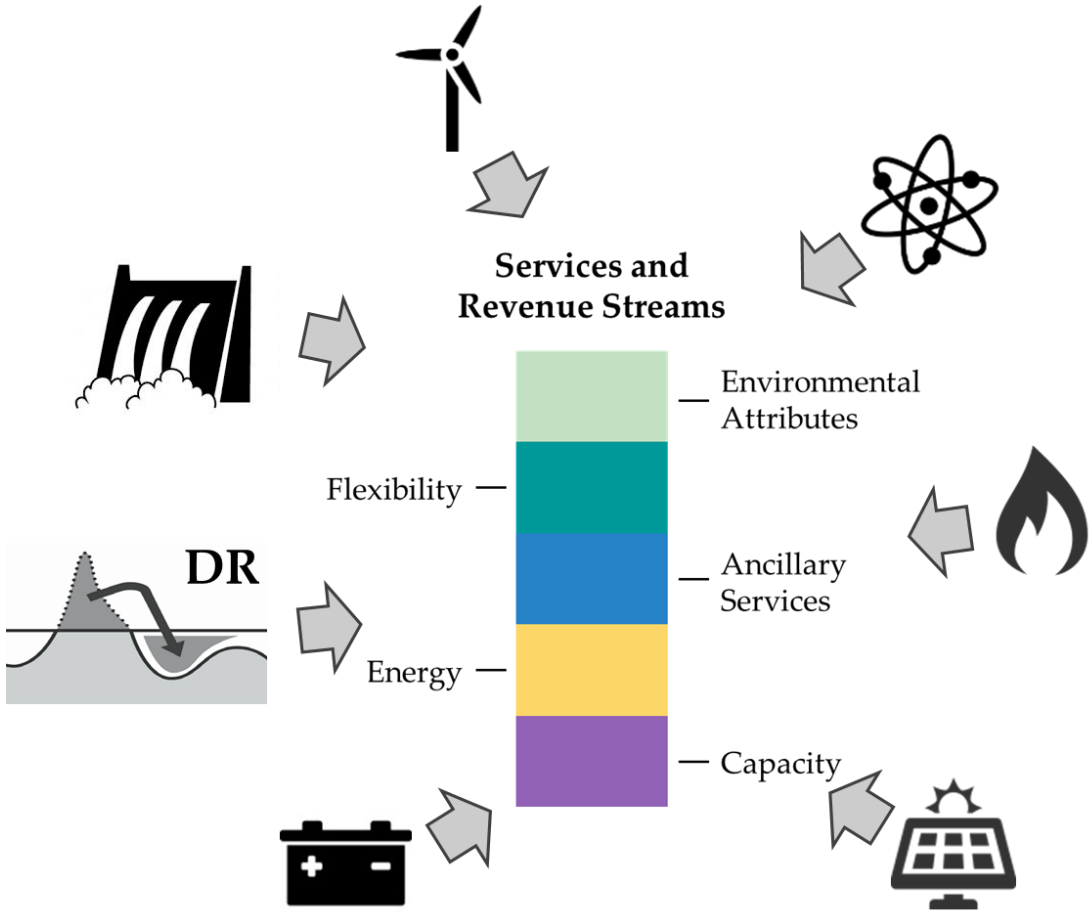
Unanswered Questions About VNM

- VNM models (standard vs exotic models)
- Ownership structures (e.g. private, co-op, LDC, Municipal) and how they work
  - Challenges and opportunities associated with each structure
- Commercial arrangements among LDC, end-customer, and VNM resource and how they operate?
- LDC billing mechanisms, scope of changes required
  - Opportunity for LDC costs to be rate based
- Capability to support regional planning and create local value
  - Methods for identifying local value
  - Valuation techniques
- Cost transfers from VNM participants to non-participants
- Effectiveness of new consumer protection provisions
  - Proposed industry best practices that exceed minimum requirements
- Challenges, constraints, barriers, that the IESO should be aware of

Market Renewal: a Vision for the Future

Address uncertainty by creating a more flexible marketplace based on clearly defined "unbundled" products and services



Questions