

IESO Market Renewal Project

Proposed Approach to the Benefits Case Analysis

PRESENTED TO

Independent Electric Systems Operator
IESO Market Renewal Working Group

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THE **Brattle** GROUP

Agenda

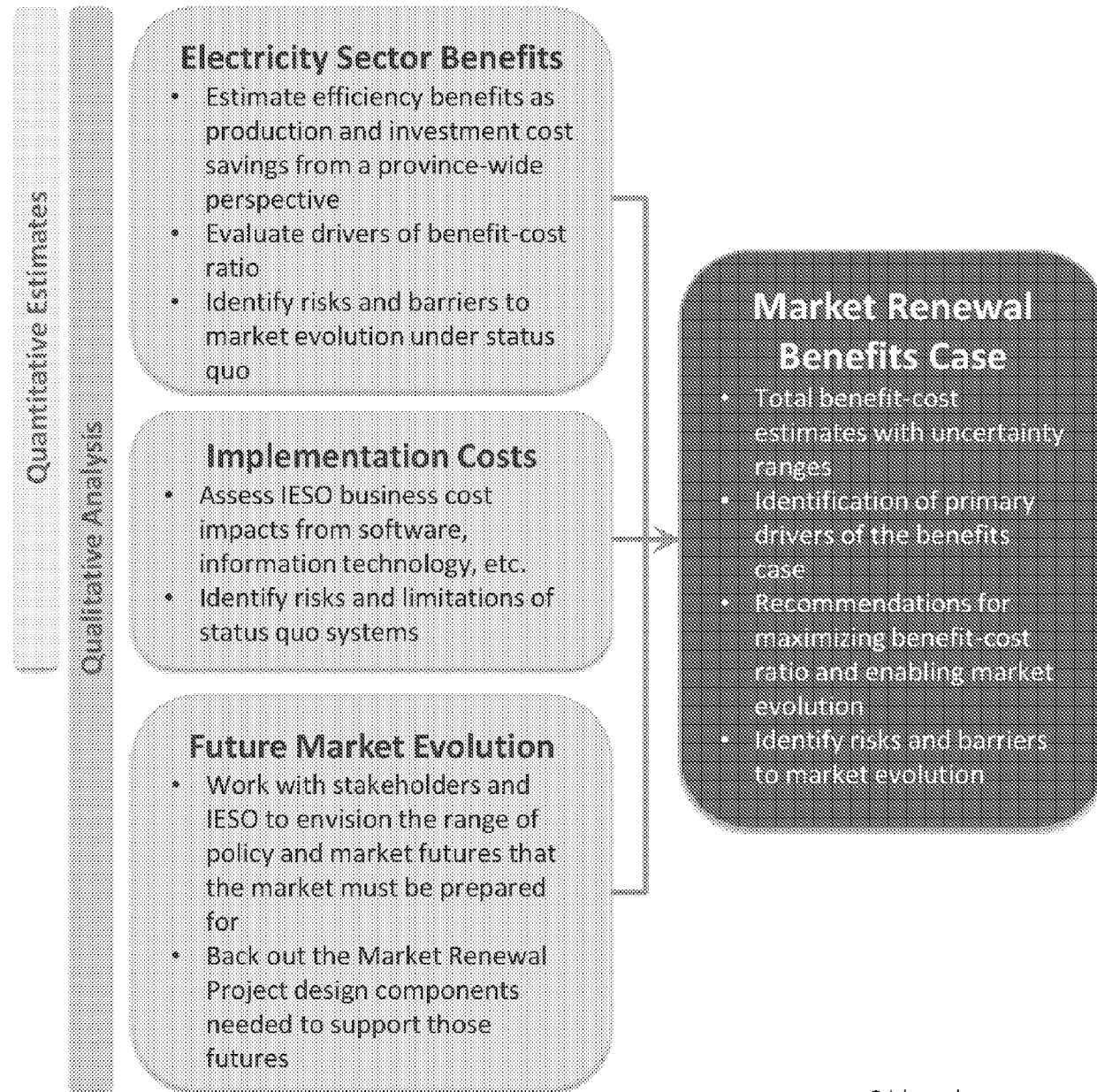
- Overview
- Estimating Sector Benefits
- Estimating Implementation Costs
- Enabling Future Market Evolution
- Next Steps

Study Motivation and Primary Questions

- The IESO and stakeholders have begun the Market Renewal Project that is intended to enhance the efficiency and performance of the wholesale electricity market design in three work streams:
 - Energy Market
 - Capacity Auction
 - Operability
- IESO, policymakers, and stakeholders need a clear understanding of the **benefits case** from the Market Renewal Project to assist in:
 - Planning and sequencing design and implementation
 - Focusing efforts in the most cost-beneficial areas
 - Ensuring that the new design will support public policy and market evolution
- **Primary questions** we were asked to evaluate include:
 - What are the potential benefits and costs? What are the major uncertainties?
 - What are the costs and risks of doing nothing?
 - How will the Market Renewal Project support future market evolution?
 - What opportunities are there for enhancing the benefit-cost ratio?

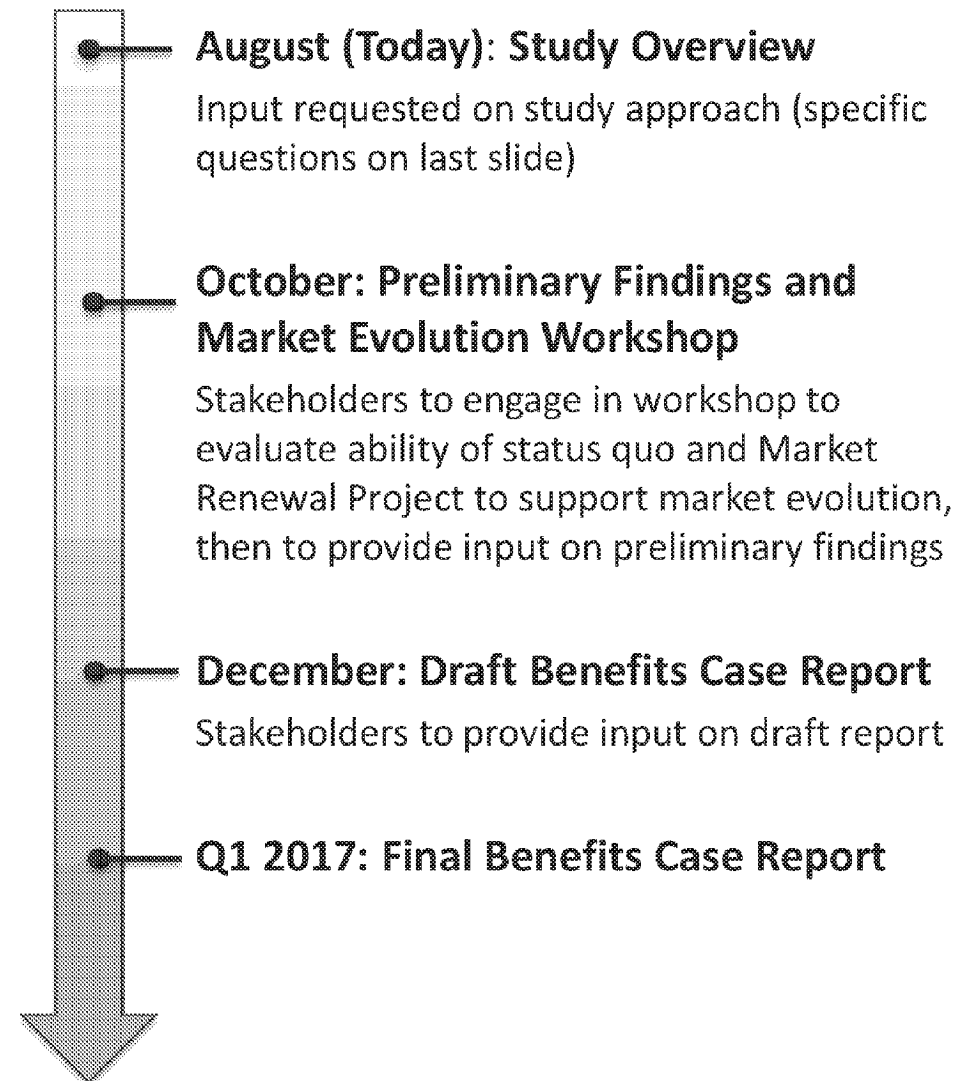
Approach to Evaluating the Benefits Case

- We will evaluate three primary components of the benefits case:
 - Electricity Sector Benefits
 - Implementation Costs
 - Enabling Future Market Evolution
- **Benefits and Costs** derived from prior analysis of Ontario and other markets
 - Qualitative Analysis will be our primary focus, with basic intent to support design efforts with actionable information
 - Quantitative Estimates will provide high-level indicative estimates to inform planning and design efforts for IESO, policymakers, and stakeholders
- **Enabling market evolution** to support continued efficiency gains, policy goals, and sector innovation under a range of plausible futures are a core component of the benefits case



Study Timeline and Requested Stakeholder Input

- Indicative timeline for study results
- We hope to have a collaborative engagement with stakeholders:
 - Working Group to be deeply involved in study approach and providing iterative input to the study
 - Broader Stakeholder group will be engaged at periodic touch points
- IESO will establish specific meeting dates and format for input
- We request input on specific prompting questions today (last slide), but open door communication is requested with the Working Group



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Methods for Evaluating Sector Benefits

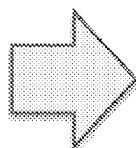
Approaches

Use three different approaches to evaluate benefits from each component of the Market Renewal Project

Previous IESO Studies

Studies from Other Markets

Bottom-Up Indicative Estimates if Needed



Benefits to Identify

Compile range of estimated overall, efficiency-driven benefits by type

Efficiency Benefits

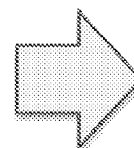
- Production cost savings
- Investment cost savings

Non-Quantified Benefits

- Reliability
- Renewable integration
- Utilizing demand-side resources

Market Evolution

- Risks and barriers
- Lessons learned and emerging challenges



Results

Summarize range of potential benefits over time, and document primary drivers of benefits

Sector Benefits

- Indicative estimates of gross benefits and range over time
- Non-quantified benefits
- Qualitative insights
- Description of the primary uncertainties and drivers of the gross benefits

Building on Prior Studies of the IESO Market

Prior studies identify specific issues and needs for improvement

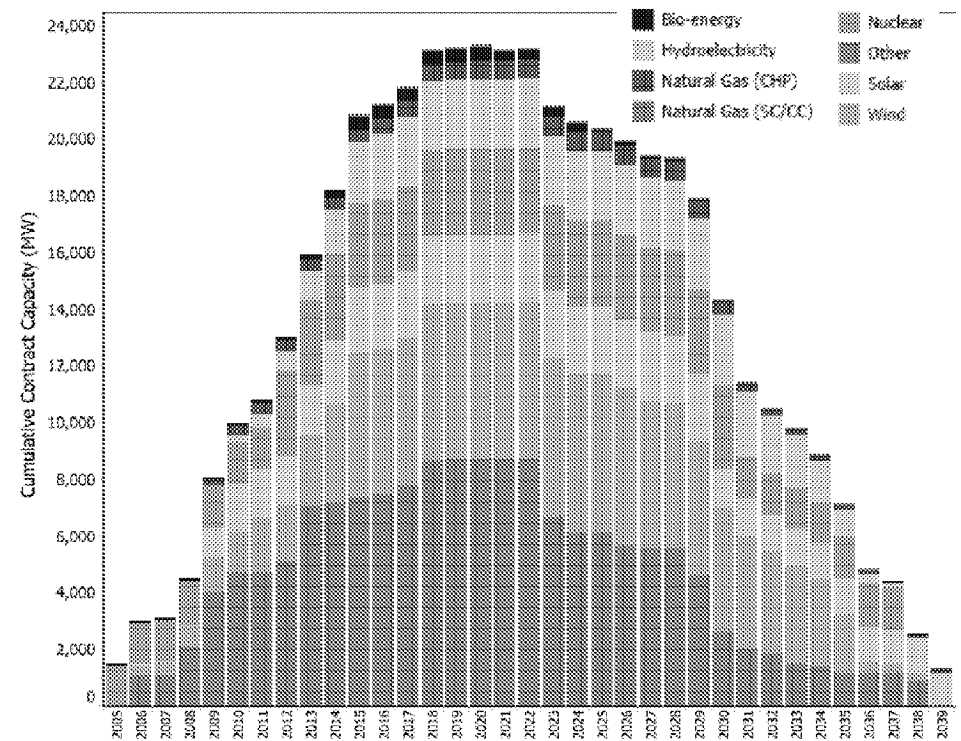
- Our initial scan indicates that most studies reflect conservative benefits estimates (not all types of efficiency enhancements included in scope)
- Need stakeholder input on the insights and limitations of each study that might be useful for our analysis

Study	Scope
Review of Generation Guarantee Programs SE-111 (ongoing)	Impact of RT-GCG and DA-PCG programs on cost, operational effectiveness, and economic efficiency
Energy Market Pricing System Review SE-114 (Market Reform, 2015)	Impact of improved real-time pricing and scheduling on settlements
Benefits of Ontario Capacity Auction (IESO, 2014)	Impact of enabling competitive capacity auction and interchange with neighboring systems
Review of the Efficiency of the HOEP SE-105 (FTI Consulting, 2013)	Impact of current pricing framework on uplift costs
More Frequent Intertie Scheduling SE-115 (IESO, 2013)	Impact of 15-minute (vs. hourly) intertie scheduling
Day-Ahead Market Evolution SE-21 (IESO, 2008)	Impact of day-ahead market enhancements

Interactions with Supply Contracts

- The financial structure, resource types, and duration of supply contracts may influence the benefits case
- We will examine how the efficiency-driven benefits interact with existing and future contracts in:
 - Energy market reforms
 - Capacity auction reforms
 - Operability reforms
- We are working with IESO staff to capture primary drivers in each category of contracts

Outlook for IESO Contracted Capacity



Source:

<http://www.ieso.ca/Documents/Supply/Progress-Report-Contracted-Supply-C43015.pdf>

Drawing from Benefits Studies in Other Markets

- We will also draw on benefit-cost studies of similar design enhancements in other markets
- Studies pose several challenges that we will address in our review:
 - Translating benefits into the Ontario context
 - Prospective studies tend to under-estimate benefits compared to retrospective studies (because prospective simulations do not capture many real-world system conditions)
 - Many studies reflect the value of multiple design enhancements at the same time (such as full RTO expansion)
 - In some cases, the studies provide metrics or indicators of efficiency that come in some form other than overall “societal” benefits
 - Many studies done at a time before there were high levels of intermittent renewable resource penetration, which amplifies the need for efficient market design

Market Renewal Design Enhancement	Analogous Changes in Other Markets
Single Schedule Market and Real-Time Unit Commitment	Introduction of nodal markets in MISO, SPP, CAISO, and ERCOT
Enhanced Intertie Scheduling	Coordinated transaction scheduling in NYISO-ISO-NE, MISO-PJM; European “market coupling”
Day-Ahead Market	Day-ahead market introduction in SPP, MISO, and ERCOT
Capacity Auctions	PJM, ISO-NE, and NYISO capacity markets
Operability	Ancillary service enhancements in MISO and ERCOT; wind integration studies in the U.S. and in some international markets

Sector Benefits

Energy Market Benefits from Other Studies

Recent study of CAISO expansion to a WECC-wide RTO with nodal day-ahead and real-time markets included a meta-study of other benefits studies, which are a useful starting point (only a subset are analogous to the Market Renewal)

Type of Benefit		Estimated Savings as % of Total Production Costs
Savings Captured by Real-Time Energy Imbalance Markets	[1]	0.1% – 1%
Other Production Cost Savings Estimated by Prospective Studies	[2]	0.9% – 2%
Total Production Cost Savings Estimated by Prospective Studies	[3]	1% – 3%
Plant Efficiency and Availability Improvement	[4]	2% – 3%
Additional Real-Time Savings (Considering Daily Uncertainties)	[5]	1% – 2%
Additional Operational Savings with High Renewables	[6]	0.1% – 1%
Total Additional Production Cost Savings Estimated by Some Studies	[7]	3.1% – 6%
Load Diversity Benefits (Generation Investment Cost Savings)	[8]	1% – 1.4%
Renewable Capacity Cost Savings	[9]	1% – 4%
Total Investment Cost Savings (Expressed as Equivalent to % of Production Costs)	[10]	2% – 5.4%
Total Overall Savings as Share of Total Production Costs	[11]	6% – 13%

Source:

Based on the California Senate Bill 350 study analyzing the benefits of a WECC regional transmission organization expansion, summary results from 16 studies of implementing LMP, regional markets, and/or day ahead markets.

<http://brattle.com/news-and-knowledge/news/study-co-authored-by-brattle-economists-examines-impacts-of-a-regional-power-market-in-the-western-u-s-for-california-iso>

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Examples of Particularly Relevant Studies

- Other markets' transitions to enhanced energy markets have achieved 2–8% savings in production costs (but scope of enhancements are not necessarily the same as contemplated in Ontario)
- Investment cost savings are additive to those reported here

Benefits Studies of Introducing Enhanced Energy Markets

Study	Metric	Savings
MISO Retrospective Study (2009)	Production Cost Savings	1.4% Implementing a regional, de-pancaked bilateral market + 2.6% Consolidating BAs and implementing nodal DA, RT, and AS markets = 4.0% Total
SPP Integrated Marketplace Retrospective Study (2015)	Production Cost Savings	3.2% Implementing a de-pancaked regional imbalance energy market + 4.8% Consolidating BAs and implementing nodal DA, RT, and AS markets Markets), = 8.0% Total
Wolak CAISO Nodal Study (2011)	Production Cost Savings	2.1% Moving from de-pancaked zonal Day-2 market to full nodal DA, RT, and AS markets
ERCOT Nodal Study (2014)	Wholesale Power Price Reductions	2.0% Moving from de-pancaked zonal Day-2 market to full nodal DA, RT, and AS markets

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Approach to Estimating Implementation Costs

Utilicast will perform a detailed bottom-up cost estimate for IESO start-up and annual operating costs

Approaches

Analyze IESO estimates on staff and materials requirements for Market Renewal Project; leverage prior work and experiences in other markets to benchmark and identify best practices

Previous IESO Studies

Experience in Other Markets

- Uncertainties, risks
- Best practices and lessons learned
- Benchmarking

Market Participant Feedback

IESO Functional Scope

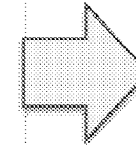
- Identify IESO's incremental market and non-market functions
- Define the scope of each function

Implementation Options

- Define timing of setup, "go live," and transitions to steady state
- Identify potential outside services

IESO Resource Needs

- Organizational requirements
- IT systems, facilities, equipment
- Capital vs. ongoing costs
- Perceived uncertainties and risks



Results

Summarize range of potential costs over time, and document primary drivers of costs and risks

IESO Start-Up Costs

IESO Operating Costs

Participant Costs (Indicative/Directional)

California ISO Introduction of Nodal Market

CAISO moved from three zones for pricing without integrated day-ahead market to a full nodal day-ahead and real-time market. Initial design effort began in 2002, with market go-live on March 31, 2009

California ISO (2009)

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| Market Landscape | <ul style="list-style-type: none">• 54,000 MW generating capacity• 3,000 nodes• US\$6.4 billion value of annual energy traded |
|-------------------------|---|

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|------------------------|---|
| Design Elements | <ul style="list-style-type: none">• Locational Marginal Pricing• Full Network Model• Day-Ahead Market• Hour-Ahead Scheduling• 5-minute dispatch• Local mitigation measures |
|------------------------|---|

- | | |
|---------------------|---|
| Cost-Benefit | <ul style="list-style-type: none">• US\$199.5MM capitalized spend over 2006-09 (not including costs over 2002-05)• Wolak study: 2.1% production cost savings = hundreds of millions of dollars <u>per year</u> |
|---------------------|---|

Forces Affecting Cost

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|-------------------------------|--|
| Regulatory Environment | <ul style="list-style-type: none">• High-level design elements published March 2002• Formal regulatory approval granted 2006• Lengthy litigation/regulatory proceedings over assignment of costs and requests for carve outs |
|-------------------------------|--|

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| Vendor Investment | <ul style="list-style-type: none">• Market System vendor had limited baseline platform.• Significant investment in customization of an “off-the-shelf” product |
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| Implementation Planning | <ul style="list-style-type: none">• Go-live date shifted between 1-Feb-08 to 31-Mar-09.• Testing and simulation results were unreliable |
|--------------------------------|--|

Texas Move Introduction of Nodal Market

Regulatory mandates required ERCOT to migrate from a zonal to nodal market when intra-zonal congestion exceeded US\$100 million annually. This threshold was met six-months after zonal go-live, and the nodal market design and implementation took nearly 8 years to implement

ERCOT (2010)

Market Landscape	• 75,000 MW available capacity • 11,000 LMP nodes • ~600 settlement points
Design Elements	• Locational Marginal Pricing • Full Network Model • Day-Ahead Market • Co-optimized Ancillary Services • FTR auction and allocation • Ex-ante credit and mitigation
Cost-Benefit	• Board approved US\$643.8MM • Actual spend ~US\$515MM • 2008 market monitor report: Nodal could have saved up to US\$175MM per year in congestion alone (in 2008)

Forces Affecting Cost

Regulatory Environment	• Development began before detailed requirements were approved • Governance structure evolved from stakeholder Board to hybrid with independent reps
Vendor Investment	• Move from fixed price prime contractor to best-in-breed with time and materials
Leadership	• 3 CEO changes, and multiple key project and executive positions rotated

Key Drivers of Implementation Costs

- **Information technology and software** will be the primary implementation cost driver:
 - Scope of design and information technology upgrades required is a key driver, e.g. can the current energy management system and network model be maintained?
 - How much customization is needed from the vendor? (Note: No such thing as “off the shelf” market capability, but level of customization needed will vary.)
 - If a “best in breed” vendor approach is used rather than a single-source vendor, it can enhance system capability overall but introduces greater cross-platform integration costs (as in ERCOT)
- **Timing and sequencing of platform upgrades:**
 - Ideal case is to have a clear real-time market design prior to initiating vendor work on this component, including real-time unit commitment, dispatch, pricing and intertie market design requirements
 - Day-ahead market is a natural extension and next step, general approach to design can be understood
 - Capacity auction largely separable from a design and implementation perspective, and much lower cost than energy market enhancements
- **Biggest opportunity for reducing implementation costs** is to avoid major change-orders in the midst of vendor development

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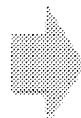
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Approach to Testing Support for Market Evolution

- We propose to engage the Working Group and IESO leadership in a workshop process that uses a scenario-based approach to identify plausible future market evolution cases test the capability to of the proposed market design to support that evolution
- Start by teeing up the questions today, and asking participants to come prepared for a deeper discussion in the next workshop

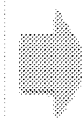
Envision a Range of Possible “Futures”

- Drawn from known industry trends and Ontario policy goals
- Qualitatively different futures designed to “stress test” the nature and performance of the wholesale markets
- No particular relationship to the scenarios used in the Ministry’s Energy Plan (constructed for a different purpose)
- **Example:** Distributed Grid



Ask How Wholesale Markets Need to Support that Future

- How are wholesale prices formed?
- What market and technology platforms are needed to bring supply and demand together?
- What business models might evolve?
- What role might IESO play?
- **Example:** IESO supports bids/offers/settlement at the distribution customer level

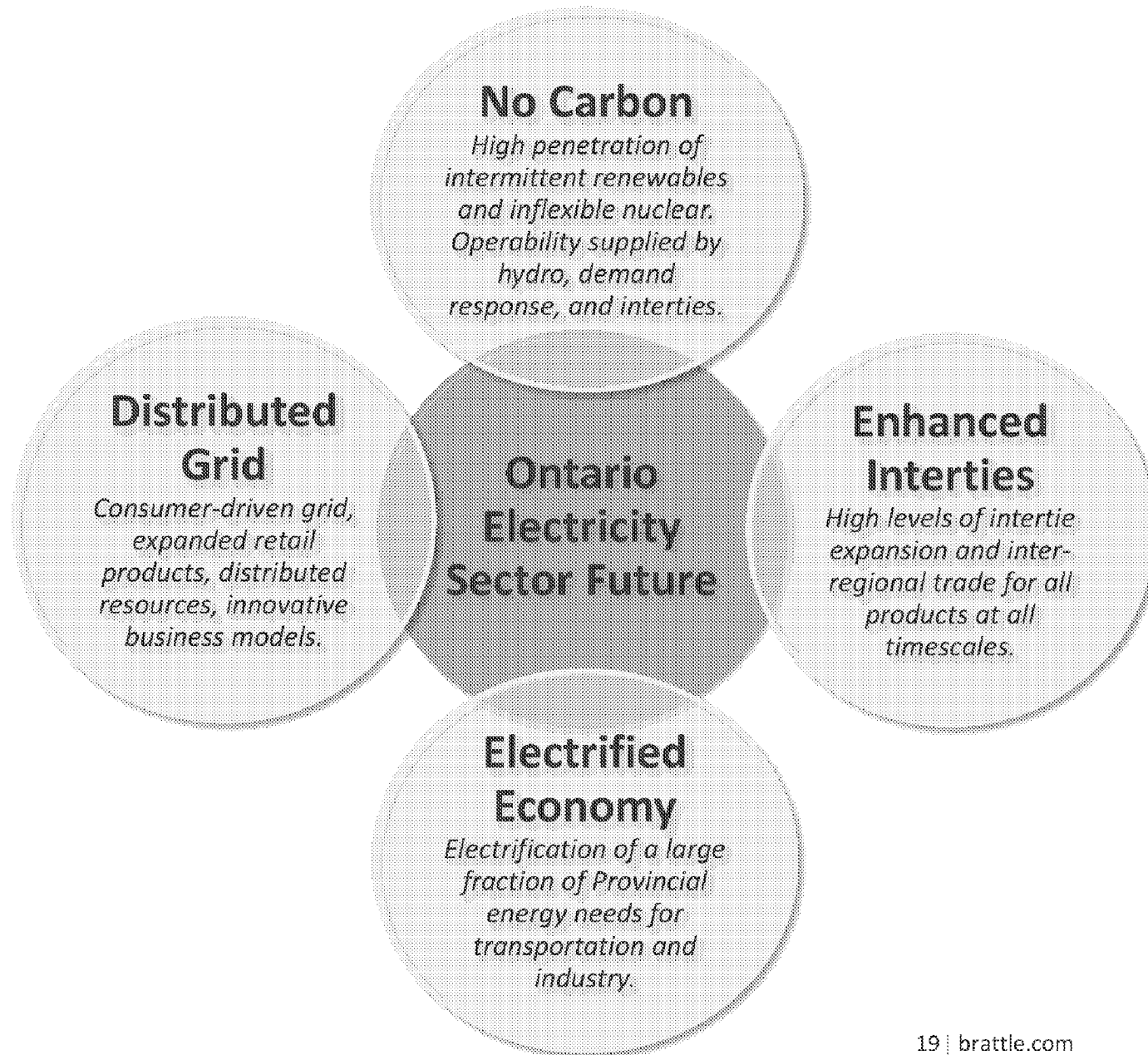


Map Into Market Design Requirements

- Would upgrades to the current market design be needed to support this future?
- How can the Market Renewal Project be targeted to support this potential market evolution path?
- What parts of the market design are likely to “break” in this future?
- **Example:** Price formation and commitment software must support substantial levels of customer response (if not participation)

Preliminary Scope of “Futures” to Examine

- The futures that will be most helpful to examine represent:
 - Known policy objectives
 - Industry trends
 - Plausible scenarios that will “stress test” the market design
- Actual market evolution path is likely to share some characteristics from each future
- Input requested from working group on the most useful “futures” to examine



Draw On “Visioning” Exercises in Other Markets

- We also plan to draw on the market visioning and redesign efforts ongoing or completed in other markets
- Effort to help stimulate discussion regarding what is different and similar in Ontario

Visioning Effort	Scope
New York Renewing the Energy Vision	Examine the retail market options for enabling distributed resources, and interactions with utility business model and wholesale markets
ISO-NE, PJM, NYISO Intersection of Markets and Public Policy	Identify solutions to meet public policy goals such as deep decarbonization through market-based mechanisms
MISO Market Vision	Start with fundamental goals of efficiency and reliability, and determine focus areas for design enhancements

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Next Steps

- We hope to engage with the working group in a series of meetings to gather input on market evolution paths, and findings as we develop the benefits case
- Several working group meetings and broader stakeholder meetings (exact schedule to be determined by IESO), indicative timeline is as follows

Date	Milestones
August 24	Study Overview
October	Preliminary Results
December	Draft Benefits Case Report
Q1 2017	Final Benefits Case Report

Questions for the Working Group

We request input on this proposed benefits case approach and our specific questions as a starting point to the study, future questions will start broad (in the visioning exercise) and then become more specific as we narrow the focus of our study.

■ **Sector Benefits:**

- Which design enhancements or studies of IESO system other markets will be most informative for our study and why?
- What indicative estimates or analyses would be most helpful for informing the benefits case?
- What do you see as the primary benefits drivers?
- What design elements should be considered to maximize market renewal benefits?

■ **Implementation Costs:**

- What specific design upgrades or other experience from other markets will be most useful to inform implementation costs?
- How will the market renewal project affect your business costs? How should we qualitatively or quantitatively assess these costs? Can you provide specific cost estimates?

■ **Market Evolution:**

- Are there other, very different “futures” that the market needs to be prepared for?
- What initial input do you have regarding why the market design does or does not need to change to support market evolution?

Contact Information



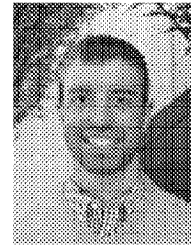
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