2019 Achievable Potential Study Public Webinar #3

December 11, 2018

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Agenda

Topic	Lead
Welcome & Introductions	Bronwen Smith (IESO)
Recap of Project Objectives & Governance	Valerie Bennett (OEB)
APS Project Updates	Navigant
Thank You	Bronwen Smith (IESO)
Q&A	All

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Webinar Objectives

- Recap APS project objectives and study governance.
- Provide updates on APS progress since August 20 webinar.
- Provide an opportunity for questions and discussion.

Achievable Potential Study Recap

APS Recap – Ministerial Directives

- The Independent Electricity System Operator (IESO) and the Ontario Energy Board (OEB),("Project Team") are currently conducting an integrated electricity and natural gas conservation achievable potential study (APS) to be completed by June 2019.
- The Achievable Potential Study is a requirement of:
  - March 31, 2014 Direction to the former Ontario Power Authority (OPA) now IESO

    "**conduct an achievable potential study** for electricity efficiency in Ontario **every three-years**… to inform electricity efficiency planning and programs. The achievable potential study should, where appropriate, **be coordinated with the natural gas efficiency achievable potential study…**"
  - March 26, 2014 Direction to the OEB

    "an achievable potential study for natural gas efficiency in Ontario should be **conducted every three-years**… to inform natural gas efficiency planning and programs. The achievable potential study should, as far as is appropriate and reasonable… be **coordinated with the [former OPA now IESO]…**"

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APS Recap – Study Objectives

- The main objective of the APS is to identify and quantify energy savings (electricity and natural gas) and GHG emission reductions and associated costs from energy efficiency and conservation for the period of 2018-2038.
- The APS will provide data and analysis to inform:

  - the development of future conservation policy and/or frameworks;
  - program design, implementation and evaluations;
  - long-term resource planning and system operations.

- Being the first integrated APS in Ontario, the study aims to capture the dynamic relationship between electricity and natural gas use in order to better support emerging whole home and business multi fuel measures and programs.

APS Recap – Study Governance

Group	Responsibility	Members
Project Team	• Provide day-to-day oversight and direction for the project including consultant procurement, project delivery and management and stakeholder engagement .	IESO, OEB
Third Party Consultant	• Develop study methodology and undertake study in accordance with industry best practices.	Navigant
Advisory Group	• Provide advice on development of the project as well as review of all project milestones.	**Members:** Local Distribution Companies, Natural Gas Utilities, Consumers, Consultants/Delivery Agents **Observers:** Ministry of Energy, Northern Development and Mines; Ministry of Environment, Conservation and Parks; Environmental Commissioners Office **Project team:** IESO, OEB
Expert Panel	• Review consultant materials and provide technical guidance ensuring work is conducted in accordance with industry best practices. • Where relevant to Advisory Group discussions, Expert Panel input will be shared and communicated in written form in addition to conference calls as required.	Chris Neme, Energy Futures Group Christine Gustafson, Harbourgreene Consulting Danielle Sass Byrnett, National Association of Regulatory Utility Commissioners Dave Shipley, Posterity Group

INTEGRATED NATURAL GAS AND ELECTRICITY CONSERVATION ACHIEVABLE POTENTIAL STUDY (APS)

PUBLIC WEBINAR

2018-12-11

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AGENDA

1 PROJECT OVERVIEW

2 SCHEDULE AND STATUS UPDATES

3 TASK 02: BASE YEAR DISAGGREGATION

4 TASK 03: REFERENCE FORECAST (COMPATIBILITY ANALYSIS)

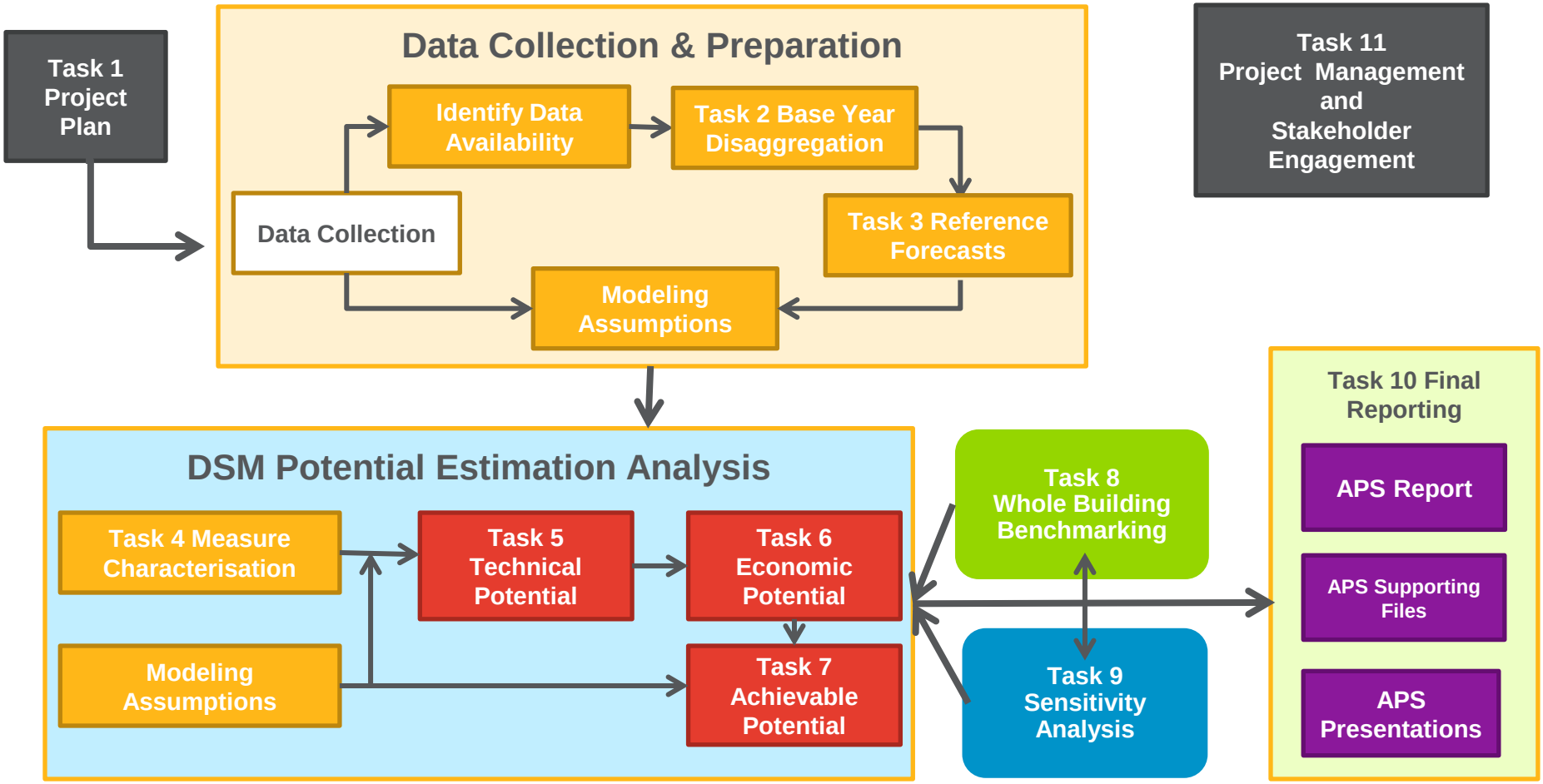
5 TASK 04: MEASURE CHARACTERISATION

6 TASK 05: TECHNICAL POTENTIAL

7 ACHIEVABLE POTENTIAL STUDY OUTLOOK – NEXT STEPS

SCHEDULE & STATUS UPDATES

PROJECT OVERVIEW



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SCHEDULE & STATUS UPDATES

PROJECT TIMELINE

Task	% Complete	Start Date
01 – Project Plan	100%	2018-08-01
02 – Base Year Disaggregation	95%	2018-09-01
03 – Reference Forecast	35%	2018-09-01
04 – Measure Characterisation	30%	2018-09-01
05 – Technical Potential	5%	2018-10-26
06 – Economic Potential	0%	2018-11-20
07 – Achievable Potential	10%	2018-09-27
08 – Whole Building Analysis	15%	2018-09-10
09 – Sensitivity Analysis	0%	2019-01-21
10 – Final Report	0%	2018-11-15

- **Task One: Project Plan**
  - Project Plan updated to incorporate feedback from Expert Panel, Advisory Group (AG) and the public.
  - Revised Plan posted on September 18 on APS engagement webpage.
- **Task Two: Base Year Disaggregation**
  - Segments and end-uses selected in consultation with AG and Project Team (PT).
  - Natural Gas (NG) and electricity base year disaggregation completed and under review by PT.
- **Task Three: Reference Forecast**
  - Compatibility analysis completed in consultation with the AG and PT – determined that IESO and NG utilities' forecast assumptions are compatible for the purposes of the APS.
- **Task Four: Measure Characterisation**
  - Final measure list developed in consultation with the AG and PT.
  - Measure characterisation currently under way.

SCHEDULE & STATUS UPDATES

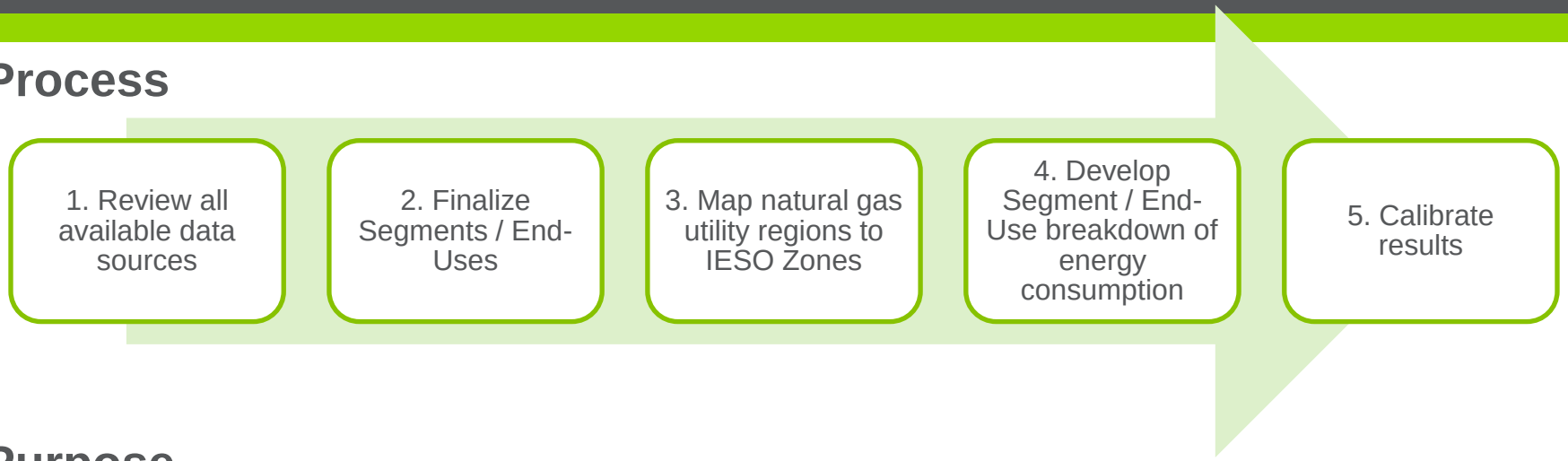
SUMMARY OF ACTIVITIES UNDERTAKEN SINCE LAST PUBLIC WEBINAR (AUGUST 2018)

- **Task Five Technical Potential**
  - Model logic updated for Ontario-specific requirements.
- **Task Six: Economic Potential**
  - Task under development. Cost-effectiveness metrics to be selected in consultation with PT and AG.
- **Task Seven: Achievable Potential (Delphi Panel)**
  - Delphi Panel candidate list and questionnaire under development.
- **Task Eight: Whole Building Benchmarking**
  - Investigating data sets available to support this analysis; recommended segment will be presented to AG.

TASK 2: BASE YEAR DISAGGREGATION

OVERVIEW

Process



Purpose

- The **base year disaggregation** (BYD) delivers a detailed profile of electricity and natural gas consumption, by sector, segment, and end use. The BYD process ensures a consistent base set of assumptions (e.g., consistent geographic assumptions) from which the reference forecast can be developed.
- The **selection of segments** affects the granularity of reported potential, and the **selection of end uses** affects the load profiles applied to projected potential (avoided costs and peak demand reduction potential).

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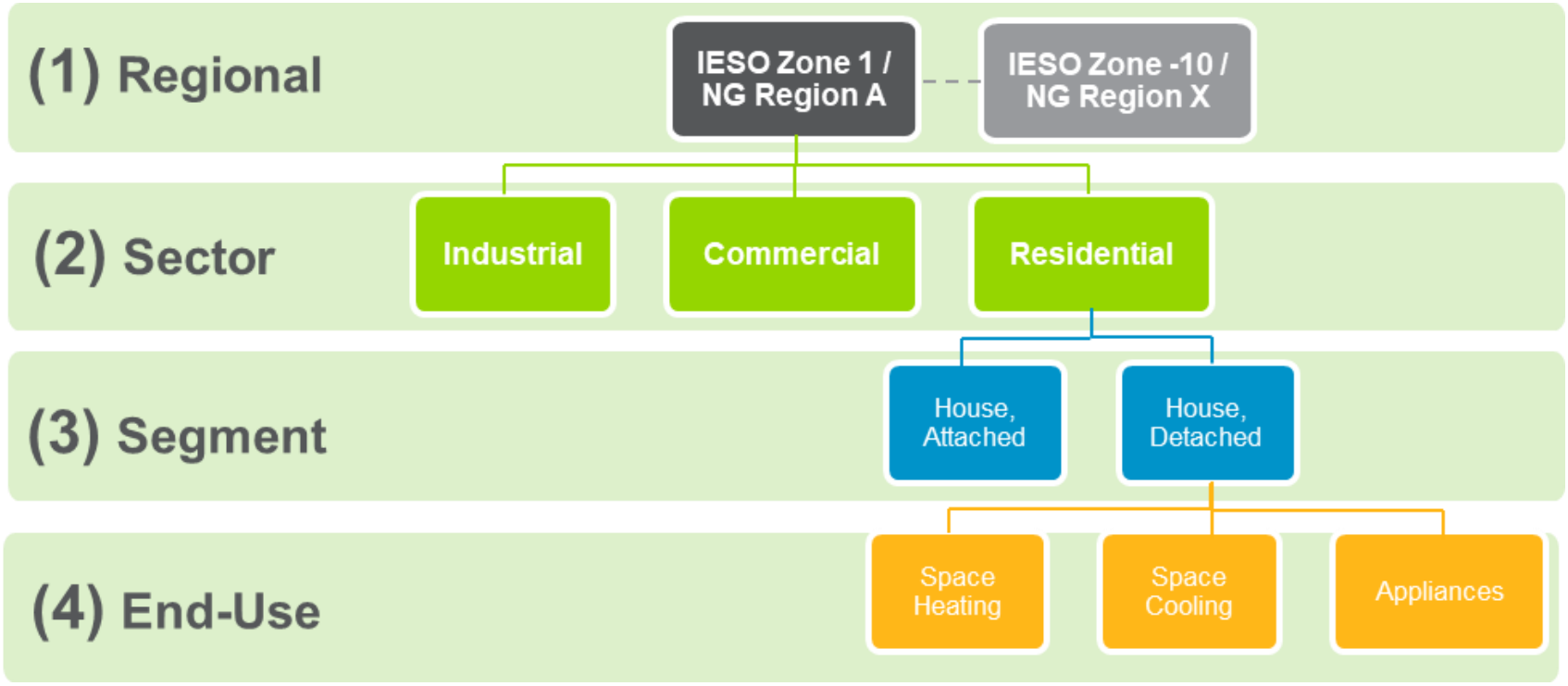
TASK 2: BASE YEAR DISAGGREGATION

OVERVIEW

The **base year** (2017) represents a detailed profile of electricity and natural gas consumption

- Electricity and natural gas consumption will be disaggregated by customer sector, segment, and end-use



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Navigant selected end-uses and segments based on three criteria.

<table>
<tr><th>End-Uses</th><th>Segments</th></tr>
<tr><td colspan="2">1. Availability of data to support disaggregation into a distinct end use or segment.</td></tr>
<tr><td colspan="2">2. Energy use is (or is expected to become) a material proportion of sector total.</td></tr>
<tr><td>3. Meaningful differences in load profile.</td><td>3. Meaningful differences in end use intensities & technology densities.</td></tr>
</table>

TASK 2: BASE YEAR DISAGGREGATION

SEGMENTS

The final list of segments that will be used was developed in consultation with the AG and the PT.

Residential (6)	Commercial (16)	Industrial (13)
Detached House	Large Hotel	Chemicals Mfg
Attached / Row House	Other Hotel/Motel	Fabricated Metals Mfg
Multi-Res High Rise	Large Office	Primary Metals Mfg
Multi-Res Low Rise	Other Office	Mining, Quarrying and Oil & Gas Extraction
Low Income, SF	Large Non-Food Retail	Transportation and Machinery Mfg
Low Income, MF	Other Non-Food Retail	Non-metallic Minerals Product Mfg
	Food Retail	Food and Beverage Mfg
	Hospital	Petroleum Mfg
	Long Term Care	Plastic and Rubber Mfg
	Restaurant	Pulp, Paper, and Wood Products Mfg
	School	Agriculture
	University/College	Water & Wastewater Treatment
	Warehouse	Other Industrial
	Data Center	
	Other Commercial	
	Street Lighting	

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TASK 2: BASE YEAR DISAGGREGATION

SEGMENTS

The final list of end-uses that will be used was developed based in consultation with the AG and the PT.

Residential (10)	Commercial (10)	Industrial (10)
Space Heating	Space Heating	Compressed Air
Space Cooling	Space Cooling	HVAC
Ventilation and Circulation	Ventilation and Circulation	Lighting
Lighting	Lighting	Motors - Fans/Blowers
Water Heating	Water Heating	Motors - Pumps
Washing/Drying Appliances	Cooking	Motors - Other
Cooking	Refrigeration	Process Cooling
Refrigeration	Computer Equipment	Process Heating (Direct)
Other Plug Load	Other Plug Load	Process Heating (Water/Steam)
Misc Residential	Misc Commercial	Other Process

Next Steps

1. Review Task Two outputs with Project Team
2. Present results of Task Two to AG (February AG meeting)
3. Draft report chapter

Process

Purpose of Task 3

- The **Reference Forecast** is a 20-year forecast of electricity and natural gas consumption by: sector, segment, and end use, based on reference consumption forecasts provided by the NG utilities and IESO, as well as the outputs of Task 2.
- The end use forecast is a key input to the DSMsim™ model that delivers projected achievable potential.
- The electricity and NG forecasts can be used together without modification only if their assumptions are consistent. Navigant has **assessed the compatibility of the natural gas and electricity forecasts**. This assessment will be reviewed and reconfirmed when the updated IESO forecast assumptions are finalized.

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The primary goal of the compatibility analysis is:
To ensure that IESO and NG utility planners have a *broadly consistent view of the future*, acknowledging that:

- They are forecasting different commodities that have different end-uses
- They are forecasting over different geographies and different groups of customers.

Challenge of Comparing Forecasts

Forecast Element	Enbridge	Union	IESO
Service Territory	Central Ontario, Ottawa region	South-Western Ontario, Eastern Ontario, narrow strip of Northern Ontario	Province
Forecast Approach	Top-down		Bottom-up
Major End-Uses	Space, water, and process heat. Cooking.		Lighting, plug loads, space heating/cooling, motors, pumps,

"Apples-to-apples" comparison is impossible

What does "compatibility" mean in the context of this Potential Study?

Forecasting assumptions should be directionally the same and have the same overall magnitude. "Compatibility" **does not mean an unqualified perfect alignment in forecast assumptions**.

Example Assessment:

Forecast A's Assumptions	Forecast B's Assumptions	Assessment
Increasing GDP forecast	Decreasing GDP forecast	**Not compatible** – inconsistent directional view.
GDP forecast of 2%	GDP forecast of 10%	**Not compatible** – overall magnitude inconsistent.
GDP forecast of 2%	GDP forecast of 2.5%	**Compatible** – overall magnitude is consistent.
Explicitly uses some GDP forecast	Does not explicitly include GDP forecast	**Compatible** if underlying assumptions about future economic performance are similar.
EGD 10 year average projected GDP growth rate: 1.97%	IESO 10 year average projected GDP growth rate: 2.09%	**Compatible.** The two visions of the future are reasonably consistent.

Global Assumptions I

	Enbridge	Union	IESO	Comments
Existing CDM/DSM (Persistence)	Embedded in historical trend.	Embedded in historical trend.	Explicitly accounted for.	Compatible- all forecasts account for historical CDM/DSM
Codes and Standards	Existing embedded in historical trend, new explicitly accounted for.	Embedded in historical trend.	New & existing explicitly accounted for.	Compatible- all forecasts account for codes and standards.
Natural Conservation	Embedded in historical trend.	Embedded in historical trend.	Embedded in historical trend.	Compatible

Global Assumptions II

	Enbridge	Union	IESO	Comments
Carbon Pricing	Federal Carbon Floor	Cap & Trade	*Assumptions not yet final.*	Impact of differing carbon pricing assumptions is very small.
Fuel Switching	Embedded in historical trend.	Embedded in historical trend.	*Assumptions not yet final.*	IESO assumptions likely to reflect historical trends.
Weather Effects	Weather Normalized	Weather Normalized	Weather Normalized	Compatible.

Sectoral Assumptions

	Enbridge	Union	IESO	Comments
Residential	Projected customer growth rate: 1.32%	Projected customer growth rate: 1.1%	Projected household growth rate: 1.43%	Compatible
Commercial	Employment forecast consistent with recent history (slightly optimistic).	Unemployment rate consistent with recent history (slightly optimistic).	Employment forecast consistent with recent history.	Compatible
Industrial	Customer and segment specific assumptions.	Customer and segment specific assumptions.	Segment specific assumptions.	Compatible

Key Finding: The IESO, Enbridge, and Union's forecasts reflect a vision of the future that is sufficiently consistent for them to be considered compatible.

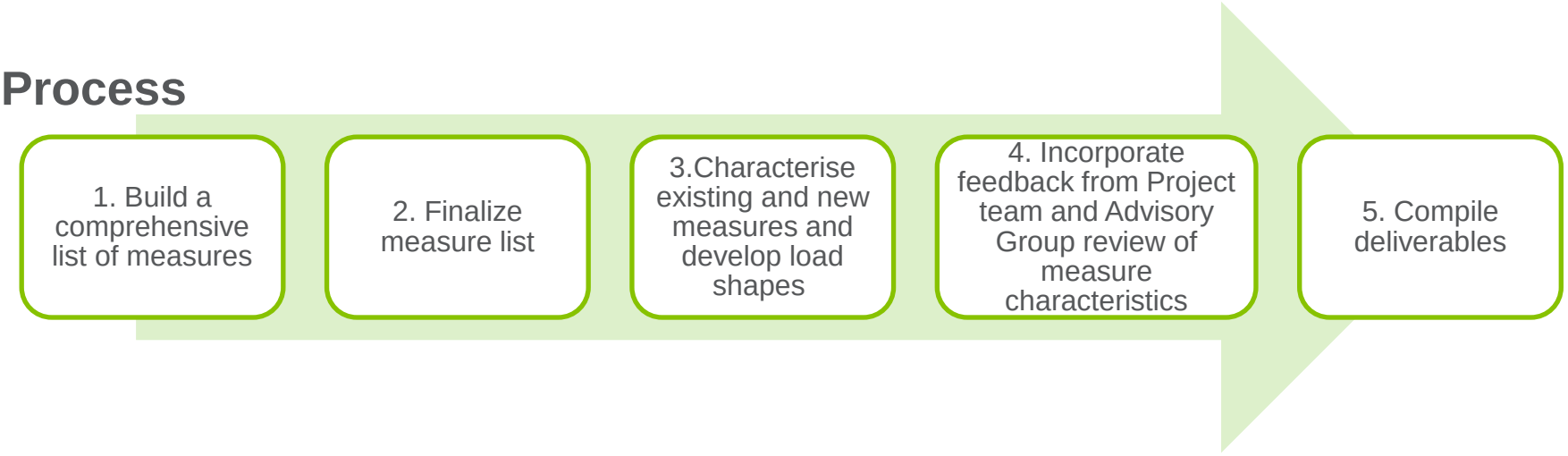
	Forecast Element	Compatible?
Global Drivers	Historical/New DSM and CDM	✓
	Codes and Standards	✓
	"Natural" Conservation	✓
	Carbon Pricing	✓
	Weather Effects	✓
	Fuel Switching	✓
Sector-Specific Drivers	Households (**RES**)	✓
	Employment (**COM**)	✓
	GDP/Output & Consumer Information (**IND**)	✓

Next Steps

1. Develop modeling reference forecast based on:
   a) Base Year Disaggregation outputs
   b) IESO reference forecast
   c) NG utilities' reference forecasts
2. QC reference forecast outputs using DSMSim™ QC utilities
3. Draft report chapter

TASK 4: MEASURE CHARACTERISATION
OVERVIEW

Process



Purpose

- The DSMSim is a bottom-up model. Aggregated potential by end use and segment is derived from individual measure potential.
- Measure characterisation is the process of specifying the key characteristics of each energy efficiency measure included in the model (savings, cost, density, saturation, etc.)
- The **prioritized final measure** list determines both what measures will be characterised, and what level of effort will be applied to individual measures.

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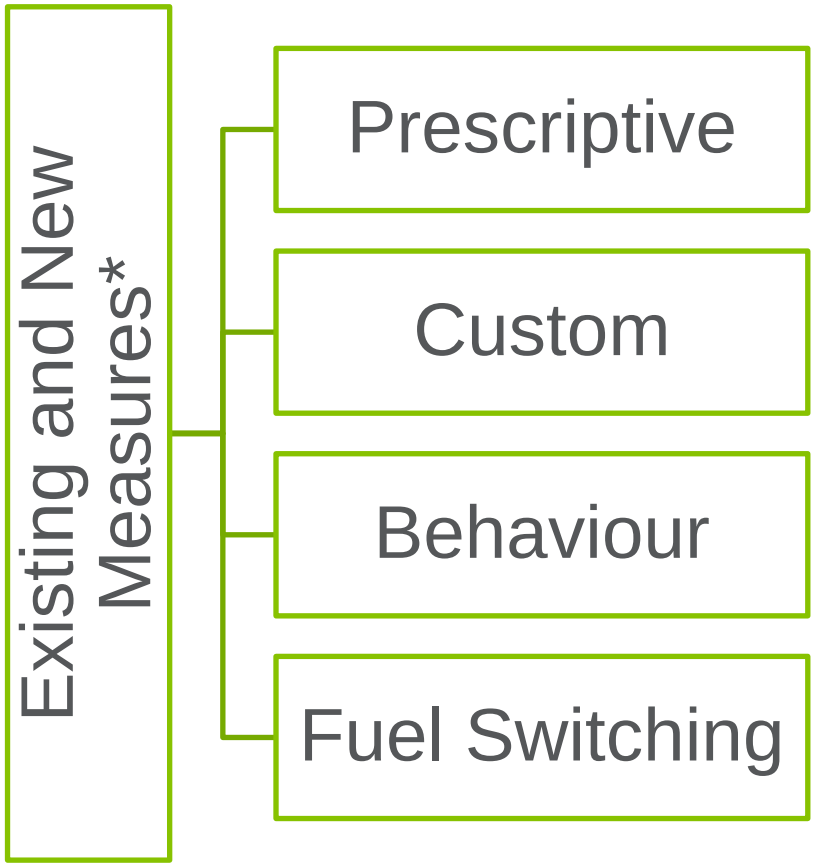
TASK 4: MEASURE CHARACTERISATION
OVERVIEW

Measure characterisation encompasses both identification and characterisation of electricity and natural gas energy efficiency measures to be used.



Energy Efficiency solutions met by upgrading equipment where measure savings (per unit) can be defined.

Custom commercial and industrial measures where per unit savings for a measure are not defined.

High-value behavioural and activity-based measures (example: residential home energy reports).

Energy efficiency solutions where the measure changes from one fuel to another (example: gas furnace to air-source heat pump).

*Majority of the measures will be taken from existing sources—Navigant will add up to 20 new measures to existing measure list

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Navigant has developed a comprehensive measure list for existing (pre-defined) measures by sector based on the following sources:

Illustrative Example

Sector	End Use	Base Measure	Measure Name	Source
Res	Space Heating and Cooling	Programmable or Non-Programmable Thermostat	Adaptive/Smart Thermostat	IESO MAL 2018/OEB Potential Study
Res	Appliances	ENERGY STAR Clothes Washers	Standard Clothes Washer	2016 IESO APS / 2018 MAL / 2016 OEB APS
Res	Space heating	Baseline mix (incandescent/halogen and CFL)	ENERGY STAR A Line, PAR, MR Lamps	2018 IESO MAL/2016 IESO APS

Note: Navigant is working with the Project Team to harmonize baselines for measures that could save both electric and gas savings. Ex: Insulation measures.

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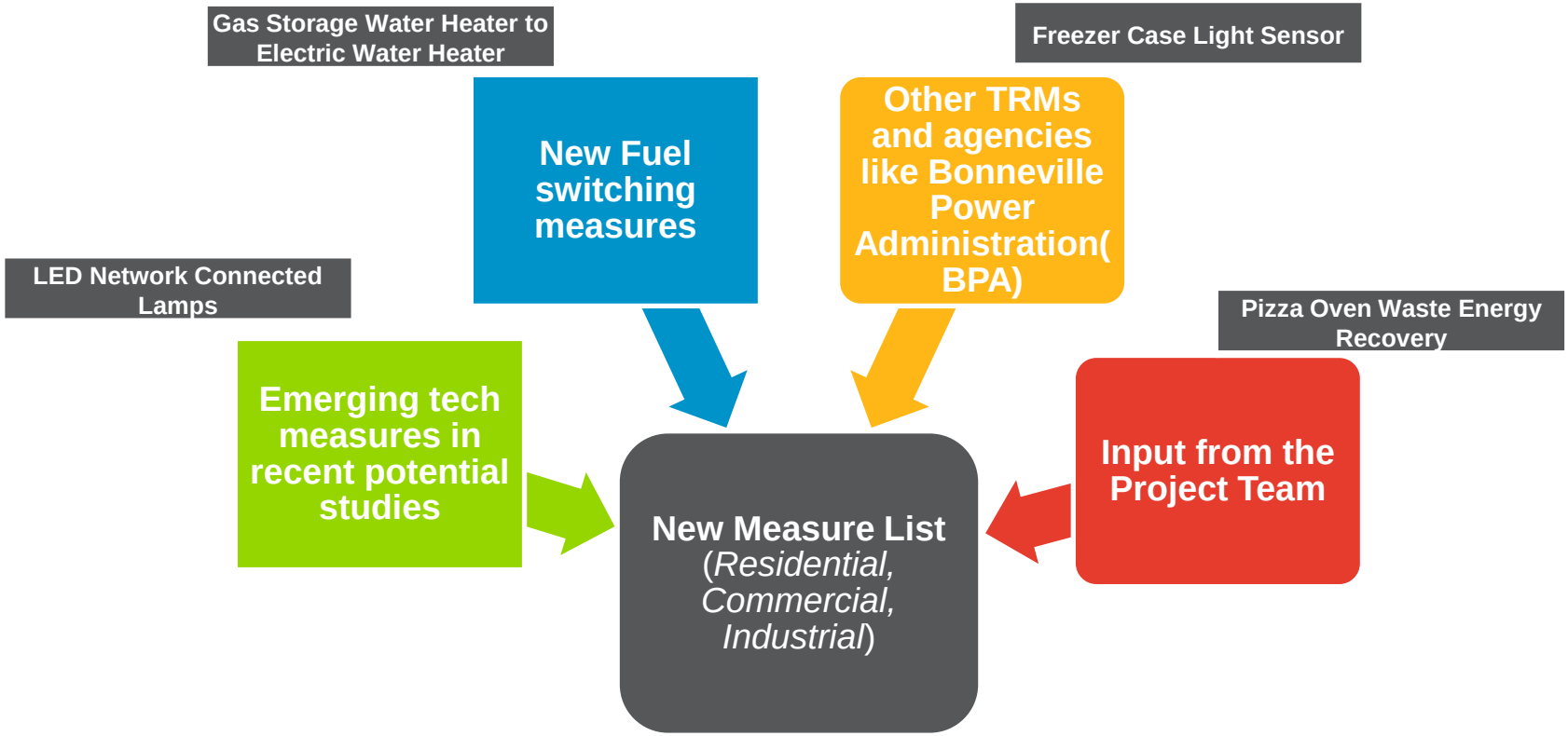
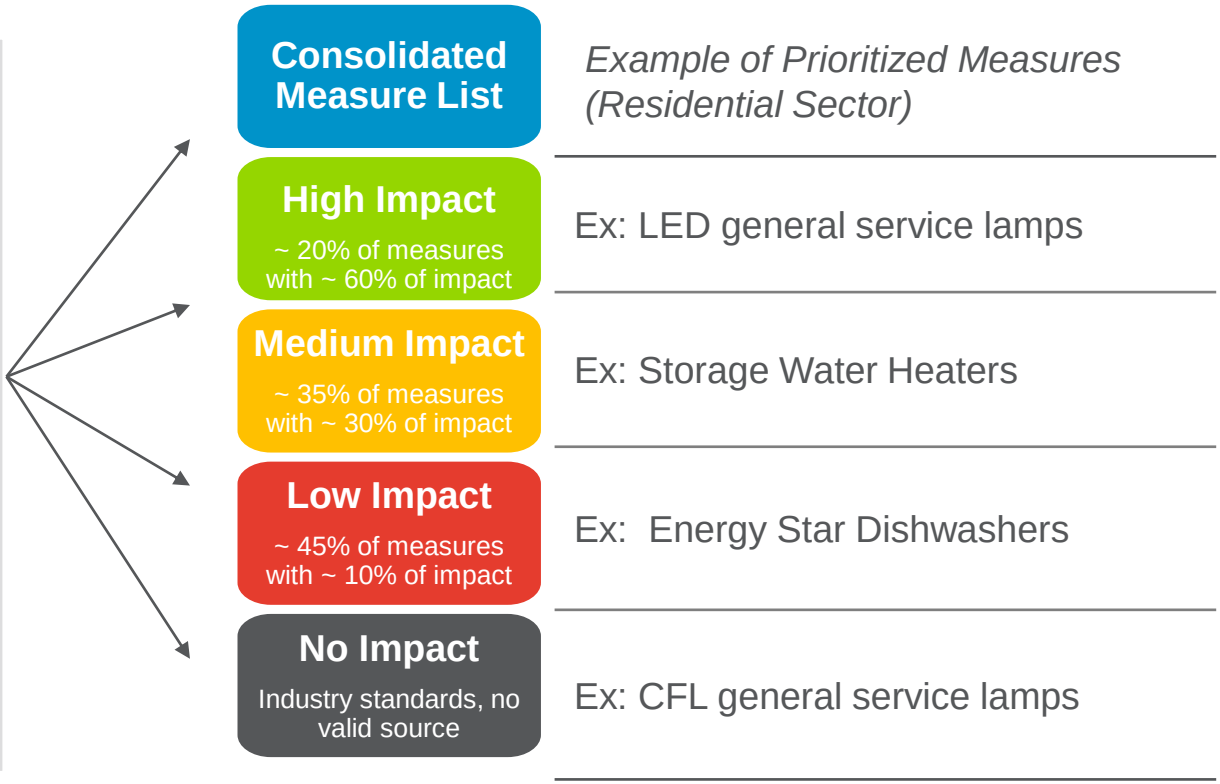
Navigant developed a measure list for **new measures** by sector based on the following sources:



Navigant has assigned a **priority** level to each measure based on the sources detailed below.

Sources for priority assignment:

- Other Recent Canadian and US Potential Study Results
- ON specific EM&V Reports
- 2016 IESO / OEB Potential Study
- Engineering Assumptions
- Input from the Project Team and the Expert Panel
- AG Input



The priority level assigned determines Navigant's level of effort in reviewing and validating measure input assumptions (e.g., costs, savings, useful life, etc.).

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TASK 4: MEASURE CHARACTERISATION

APPROACH AND PARAMETERS

Each measure will be vetted and fully characterised in terms of savings, costs, lifetime, and applicability to different segments.

Characterisation will include:

- Measure description
- Baseline Assumptions
- Measure replacement methodology
- End-use
- Sector
- Segment
- Measure Lifetime (Remaining Useful Life and Effective Useful Life)
- Measure costs
- Simple Payback and ROI
- Savings estimations (electric, gas, water, carbon, demand savings from end use load shapes)
- Technical Suitability
- Measure saturations
- Measure densities
- Data Sources

Next Steps

1. Post final measure list on 2019 APS webpage
2. Complete measure characterisation
3. Work with measure characterisation review subcommittees (IESO, OEB, utilities, sector-specific technical experts) to finalize characterisations
4. Draft report chapter

TASK 5: TECHNICAL POTENTIAL
OVERVIEW

Process

Purpose

- The **Technical Potential** is an estimate of energy efficiency and fuel-switching potential that delivers two parallel tracks of results:
  - **Upper bound of technically feasible conservation** potential that could be attained if all baseline measures were replaced by the technology with the highest unit savings, regardless of economics.
  - **Upper bound of technically feasible gas-to-electric fuel-switching potential** that could be attained if all technically feasible gas-to-electric fuel-switching considered by the study took place, regardless of economics.
- This output provides users of the APS with valuable context for evaluating the magnitude of its ultimate output: achievable potential.

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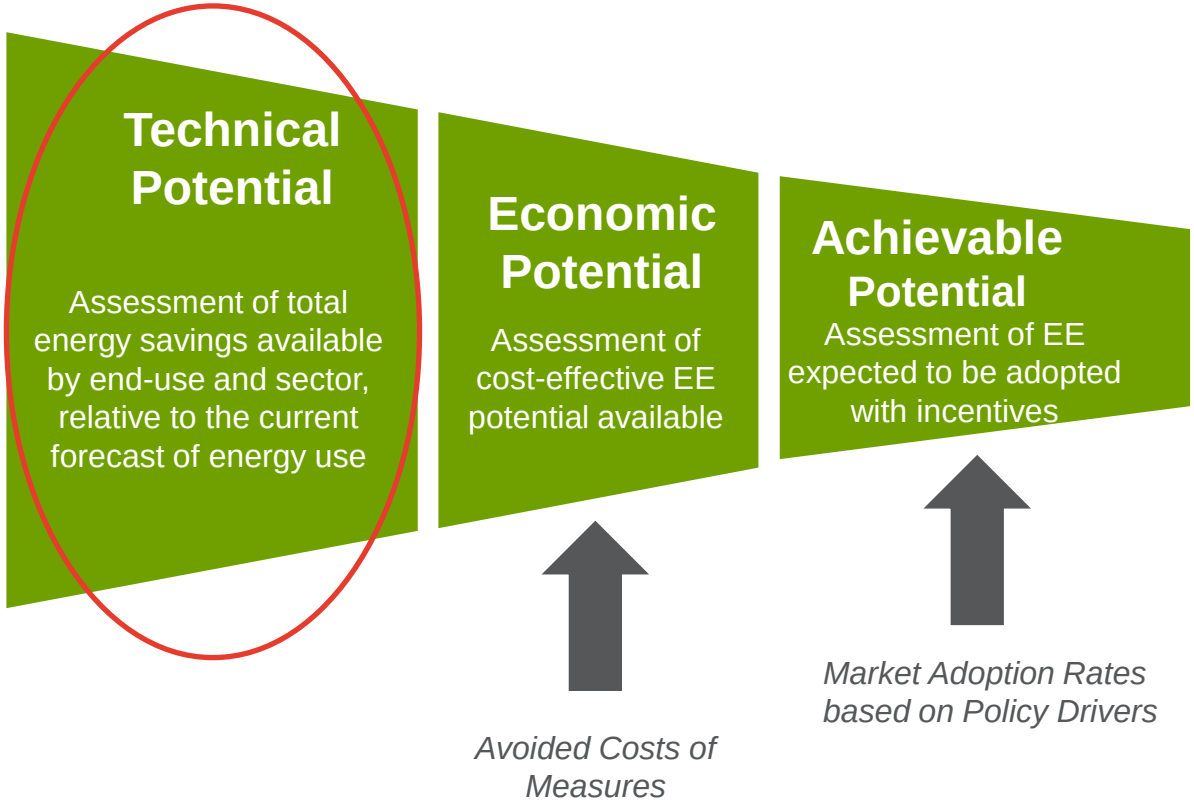
What is Technical Potential? How does it compare to Economic and Achievable?



Energy efficiency measures interact with one another in a variety of ways that can affect overall savings potential.

Interactive Effects

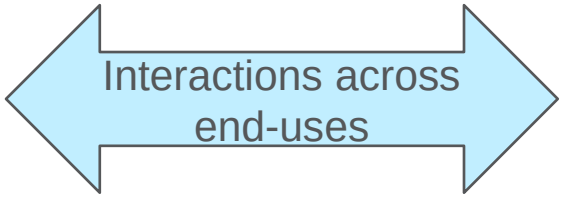
One measure's savings affect another end-use's consumption.

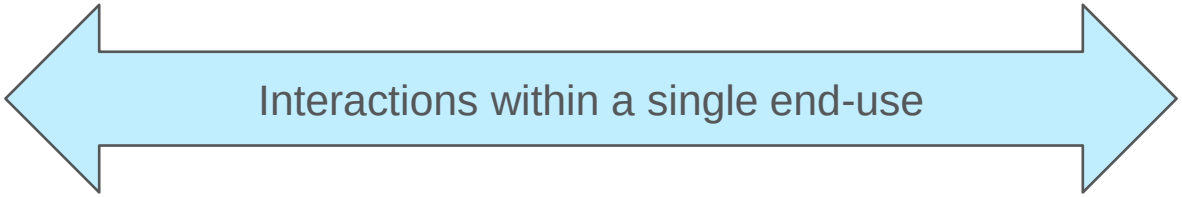
Competing Measures (Competition Groups)

Measures are mutually exclusive – only one or the other can be installed.

Measure Stacking

Measures can be installed together, but total savings are less than the sum of individual savings.





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Measure Interaction Type 1: Interactive Effects

What it is:
"Interactive Effects" refers to the fact that a given measure affects consumption in another end-use.

Example:
LEDs replacing incandescent bulbs:

- Decrease lighting consumption (intended effect)
- Increase space-heating consumption (interactive effect)
- Decrease space-cooling consumption (interactive effect)

How it is addressed in the APS:
Interactive effects are captured as part of the measure characterisation. Assumptions about scale of interactive effects are drawn from the same source as the measure savings (e.g., TRMs, measure substantiation documents, etc.).

Measure Interaction Type 2: Competing Measures

What it is:
Some measures are mutually exclusive, and thus compete for market share; in any given application only one can be adopted. When competition exists which measure is adopted?

Example:
Cold-climate air-source heat pump
VS
Ground-source heat pump

How it is addressed in the APS:
For Technical Potential, the measure with the highest absolute estimated energy savings is assumed to be adopted.

Measure Interaction Type 3: Measure Stacking

What it is:
The combined savings of some measure-pairs, when installed together, will be less than the sum of their individual savings if they were installed separately.

Example:
Cold-climate air-source HP. Savings = X
Attic insulation. Savings =Y

Combined Installation Total Savings < X + Y

How it is addressed in the APS:
After Technical Potential is estimated, an adjustment is applied at the segment and end-use level to account for this effect.
The magnitude of the adjustment is a function of individual adopted measures' savings.

Results will be subject to Navigant's QC modules, and benchmarked against studies in comparable jurisdictions and to previous studies in Ontario to ensure accuracy.

Comparison to previous Ontario studies will allow strong comparison of potential in the early years. Comparison to similar jurisdictions will help guide understanding of results and trends over the entire study period.

Studies for Comparison

nationalgrid

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BC hydro

Pacific Northern Gas Ltd.

FORTIS BC

Standard Metrics for Comparison:

- Sector-level technical and economic potential over time
- Technical potential as percent of end use consumption
- Incremental (annual) achievable potential as a percent of sales
- Cumulative (total at end of study period) achievable potential as percent of sales

Next Steps

1. Update model to reflect selected segments and end-uses
2. Input:
    a) Reference forecast
    b) Characterised measures
4. Estimate and benchmark Technical Potential
5. QC Technical Potential
6. Draft report chapter

Next Steps

The next steps presented below cover activities anticipated to take place between now and the next Public Webinar (Q1 2019).

Task Two – Base Year Disaggregation

1. Review Task Two outputs with Project Team
2. Present results of Task Two to AG (February AG meeting)
3. Draft report chapter

Task Three – Reference Forecast

1. Develop modeling reference forecast based on:
    a) Base Year Disaggregation outputs
    b) IESO reference forecast
    c) NG utilities' reference forecasts
2. QC reference forecast outputs
3. Draft report chapter

Next Steps

Task Four – Measure Characterisation

1. Post final measure list on 2019 APS webpage
2. Complete measure characterisation
3. Work with measure characterisation review subcommittee (IESO, OEB, utilities, sector-specific technical experts) to finalize characterisations
4. Draft report chapter

Task Five – Technical Potential

1. Update model to reflect selected segments and end-uses
2. Input:
   a) Reference forecast
   b) Characterised measures
4. Estimate and benchmark Technical Potential
5. QC Technical Potential
6. Draft report chapter

Next Steps

Task Six – Economic Potential

1. Collect input data (e.g., avoided costs)
2. Confirm cost-effectiveness thresholds
3. Estimate Economic Potential
4. QC Economic Potential and measure costs

Task Seven – Achievable Potential

1. Finalize Delphi Panel candidate list and submit questionnaire to Delphi Panel
2. Process and analyze questionnaire outputs
3. Conduct virtual discussion with Delphi Panel

Task Eight – Whole Building Analysis (WBA)

1. Select segment for analysis
2. Finalize quantitative approach
3. Recruit WBA working group (tentative)
4. Use WBA data to benchmark Technical Potential

Thank You

- Thank you for your engagement.
- For more information about the APS, including AG meeting materials and interim APS deliverables visit the APS engagement webpage.
- The next public webinar will be held in Q1 2019.

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Questions/Discussion

- Questions on the material presented today?
- Comments on how the project is progressing or how the methodology is being implemented?
- Comments on how the Project Team can better share information and updates between webinars?