IESO Non-Energy Impacts

2016 Results and Next Steps

19 October 2017

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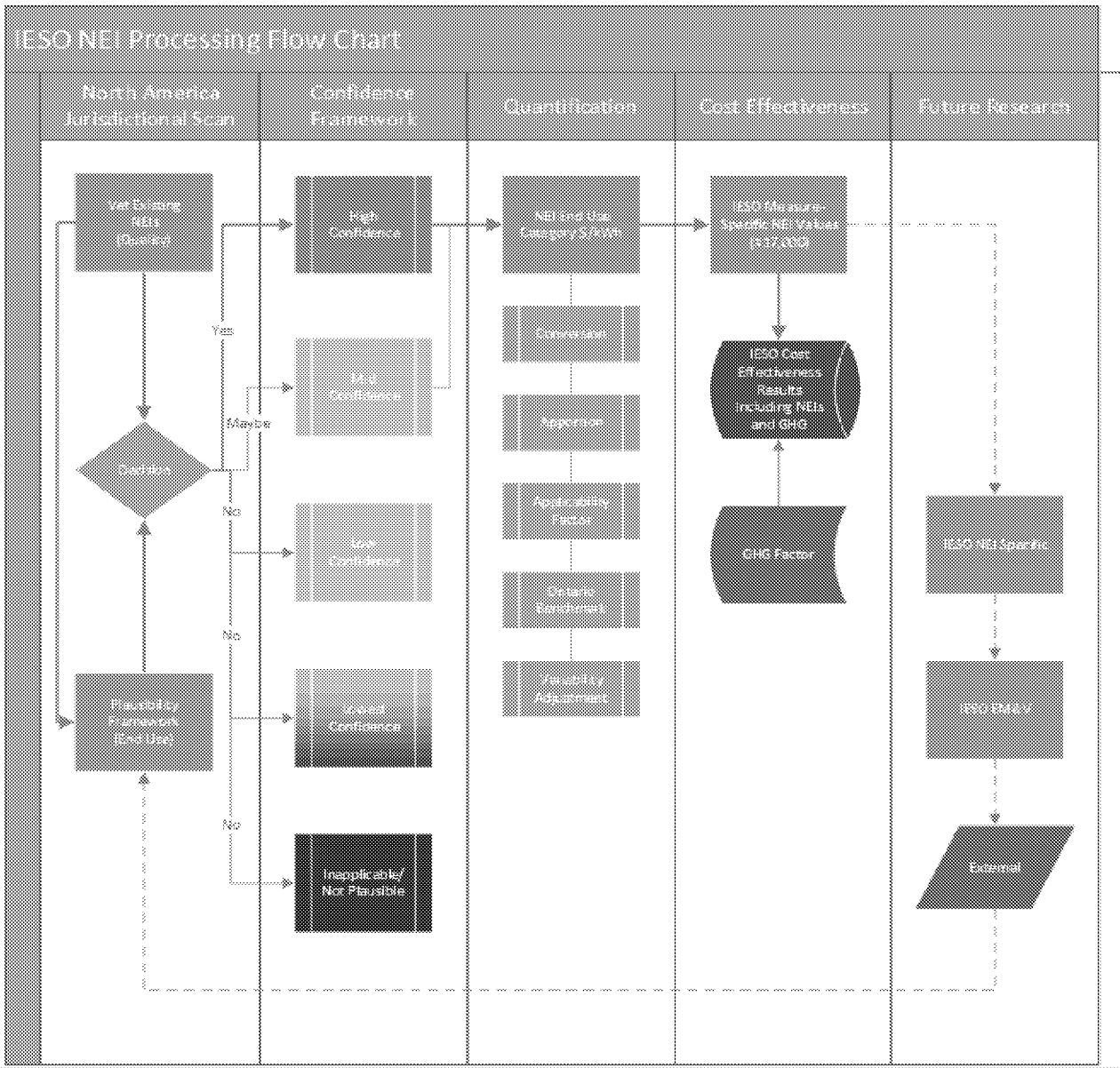
Agenda

- Overview of IESO's NEI quantification process
- Results applying quantified NEIs to 2016 Program Results
  - Overall NEI Impact on TRC
- What Next?
  - Options for application of NEIs
  - Future Research

Overview of IESO NEI Quantification Process

Overview



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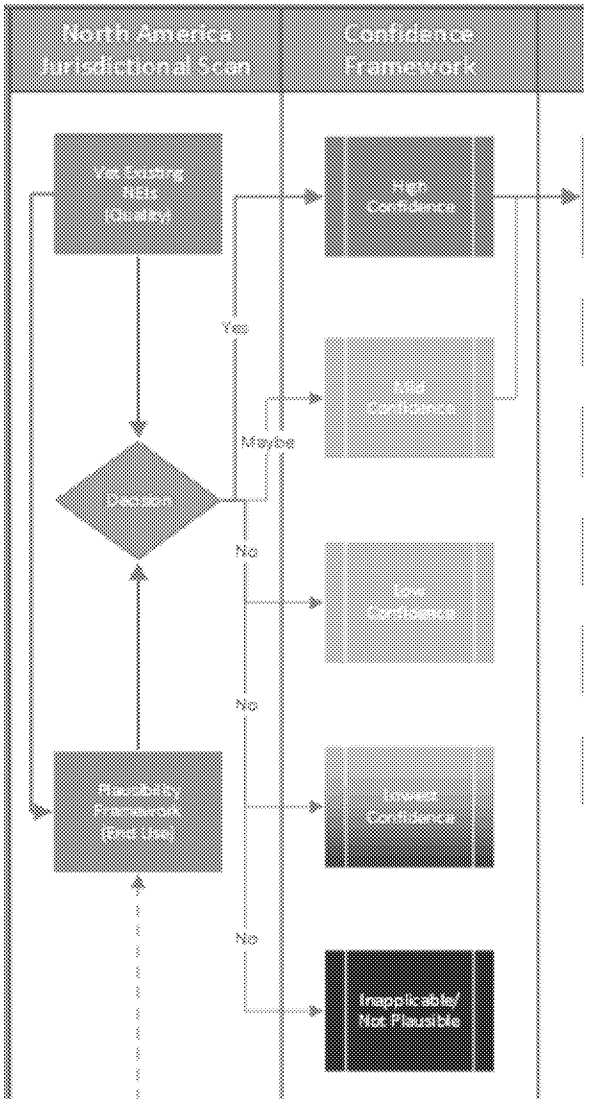
Overview (continued)

- Reviewed 62 jurisdictions (10 provinces, 1 territory, 50 states and 1 district)
- Existing research vetted for study quality and credibility and then also for plausibility
  - Plausibility is applicability to IESO end uses and measure categories (CO poisoning example)
- The combination of vetting for quality and plausibility landed each NEI in a confidence category
  - For this analysis, only High Confidence research results were utilized

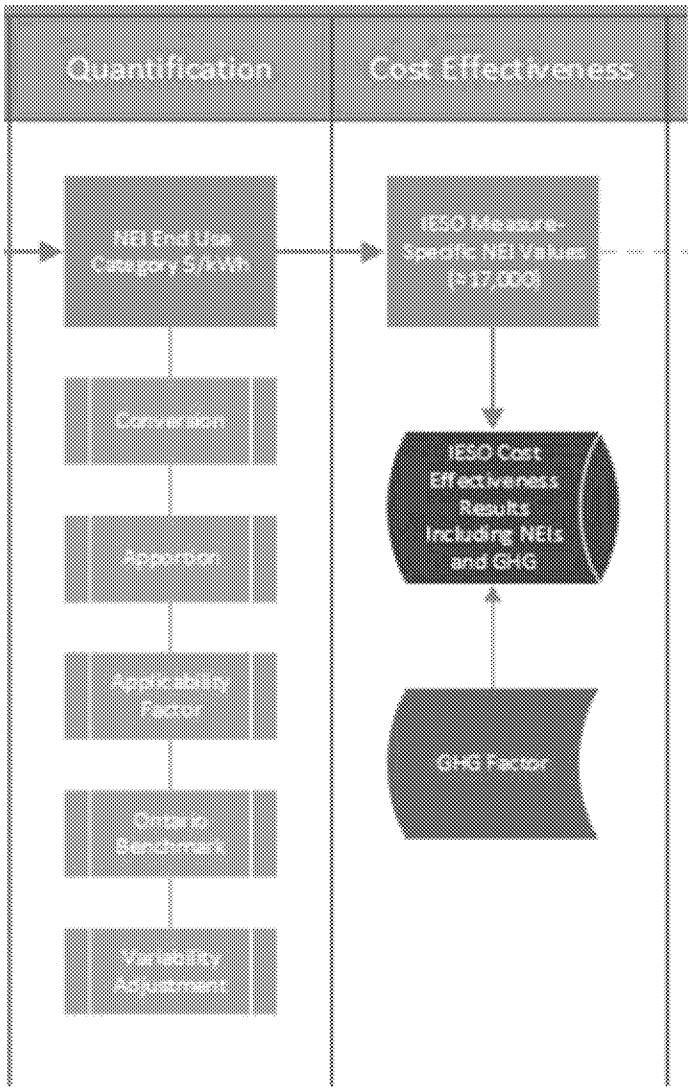


Overview (continued)

- A systematic approach was developed and applied to convert original research assessed by program, household, facility, individual, treatment, etc., into consistent measure-level $/kWh compatible with the IESO Cost Effectiveness Tool

- An algorithmic summation of the appropriate and applicable Participant, Utility and Societal NEIs are applied at the measure level
  - Each of the 17,000+ measures in the system are categorized by sector, measure group, NEI type, NEI category, etc.

- The GHG factor is applied to the tool in a similar manner, except it is a universal $/kWh



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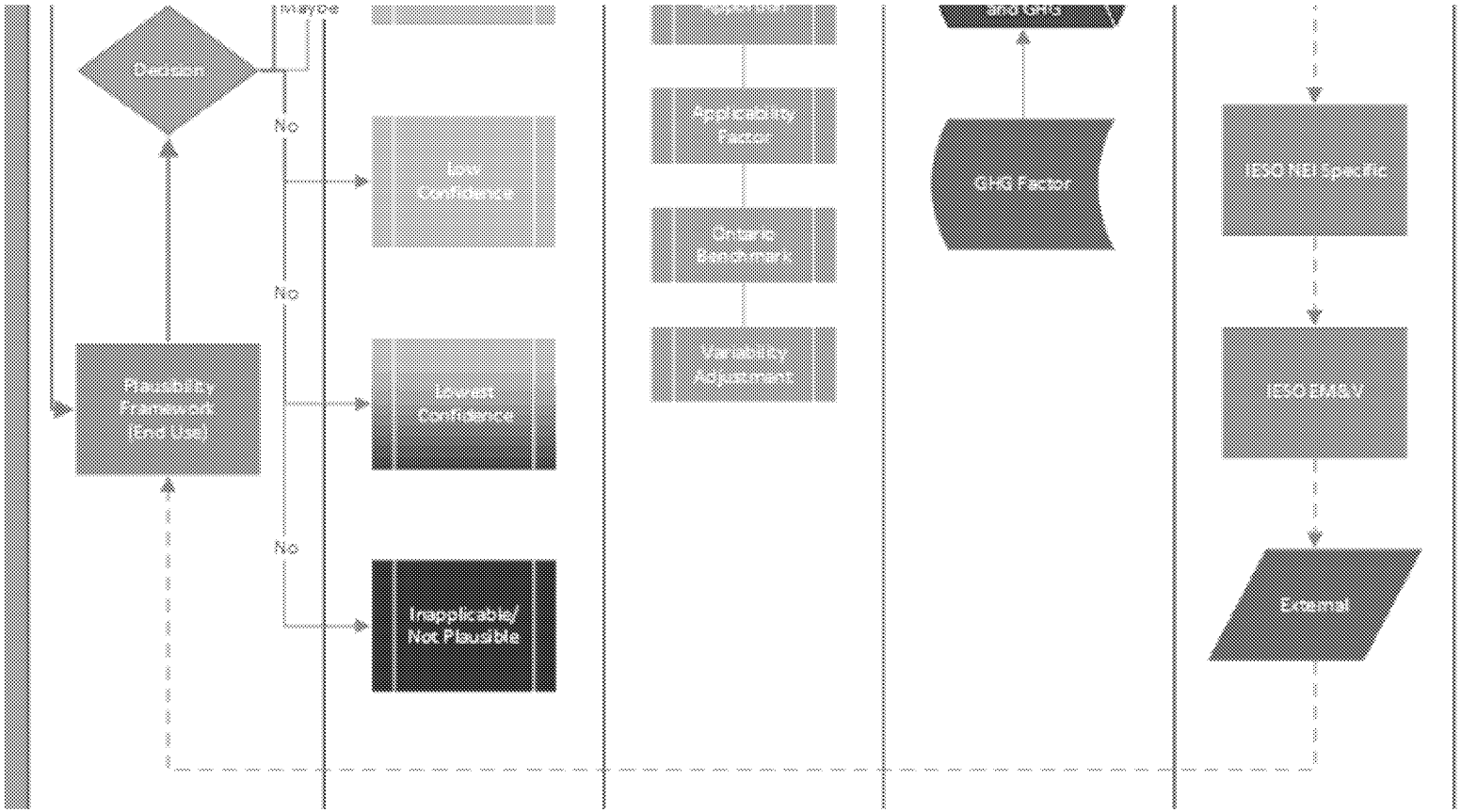

- The NEI Tool as built provides a "processing engine" for all future NEI research, whether that is specific studies or supplements to EM&V processes by IESO or new research available from other jurisdictions

Process to Results

- By design, DNV GL took the most conservative approach
  - Started with researched NEIs, not the universe of all possible or plausible NEI's
  - Drew circle even smaller by vetting for high quality of research

- Ontario is atypical in terms of few/low Societal NEIs
  - Societal NEIs usually comprise a significant proportion of an overall NEI adder
  - Reduced GHG emissions now already accounted for in avoided costs
  - Comparatively clean supply mix (coal phase-out combined with substantial nuclear and hydro) means avoided costs of air pollution effects are minimal
  - NEIs for economic development category is mixed
    - Job creation already captured in some evaluations
    - Possible opportunity to collaborate with Ministry of Finance on multiplier effect that could be added to TRC calculation

Overall NEI Impact on TRC

Defining the CE Tool NEI Scenarios

Scenario	Model settings
Scenario TRC (w/NEI)	NEI switched on, GHG off NEBs Adder set to 0%
Scenario TRC (w/GHG)	GHG switched on, NEI off NEBs Adder set to 0%
Scenario TRC (w/NEI+GHG)	NEI and GHG switched on NEBs Adder set to 0%
Baseline TRC (w/existing 15% Adder)	GHG and NEI switched off NEBs Adder set to 15%

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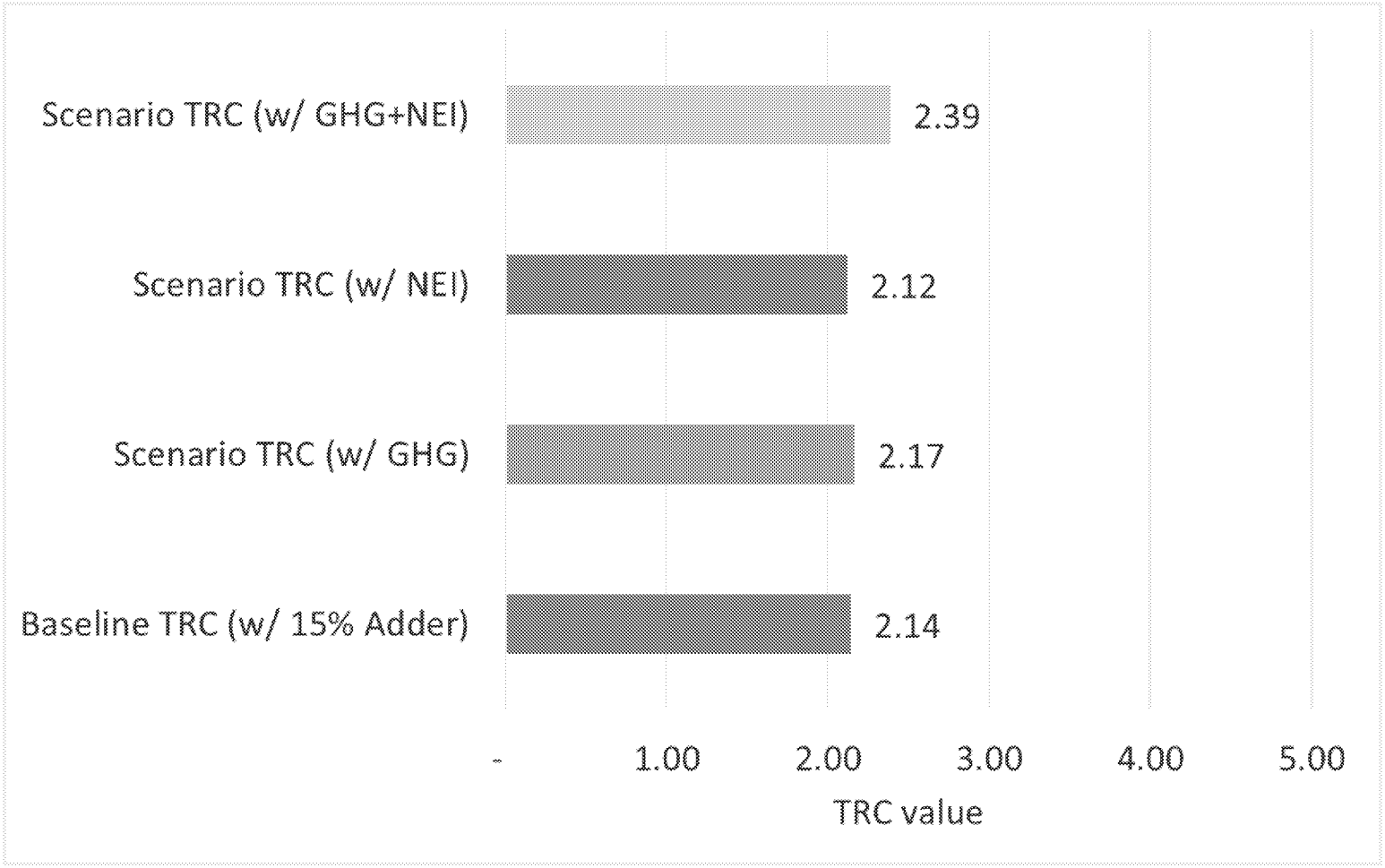
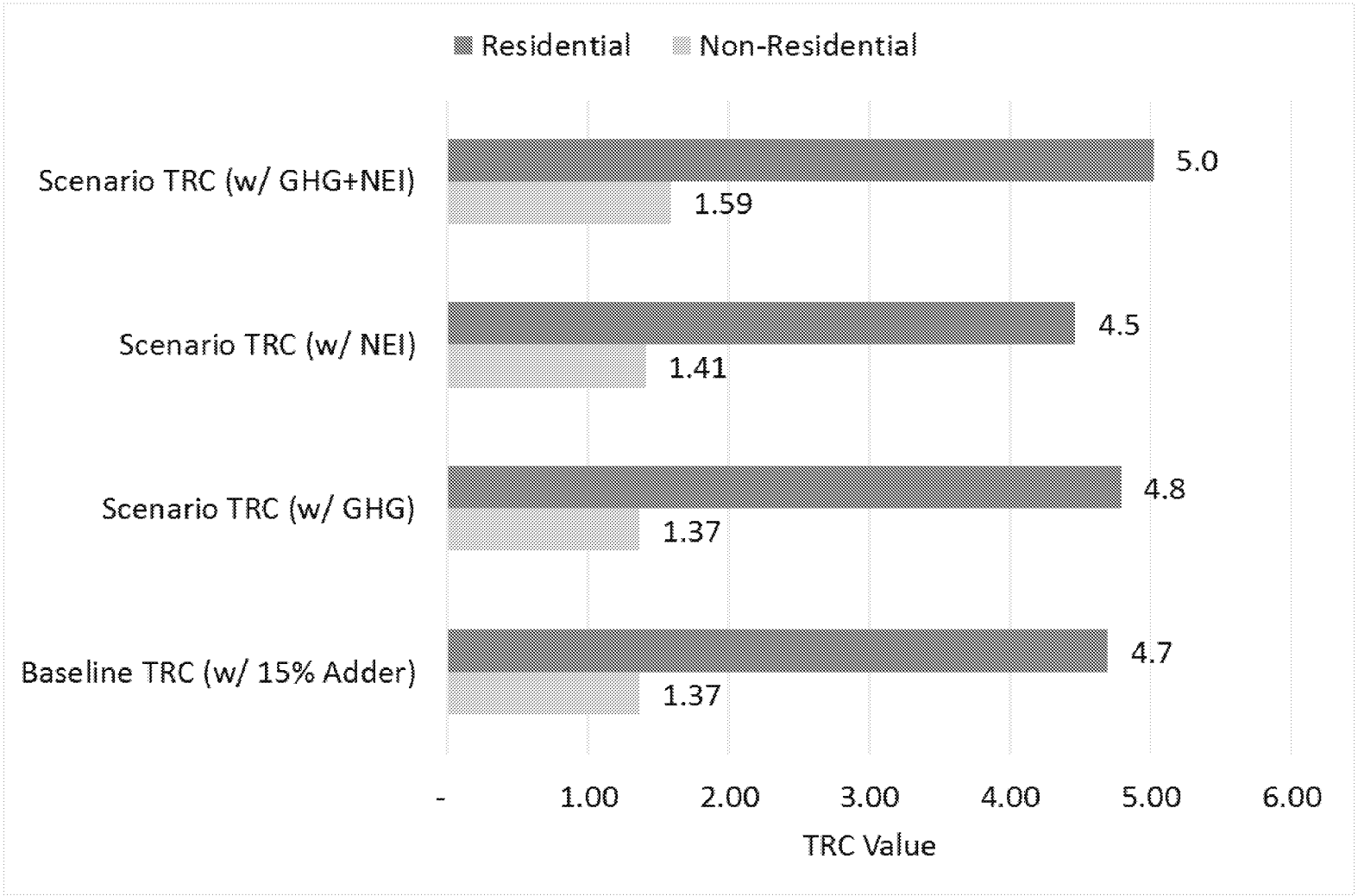
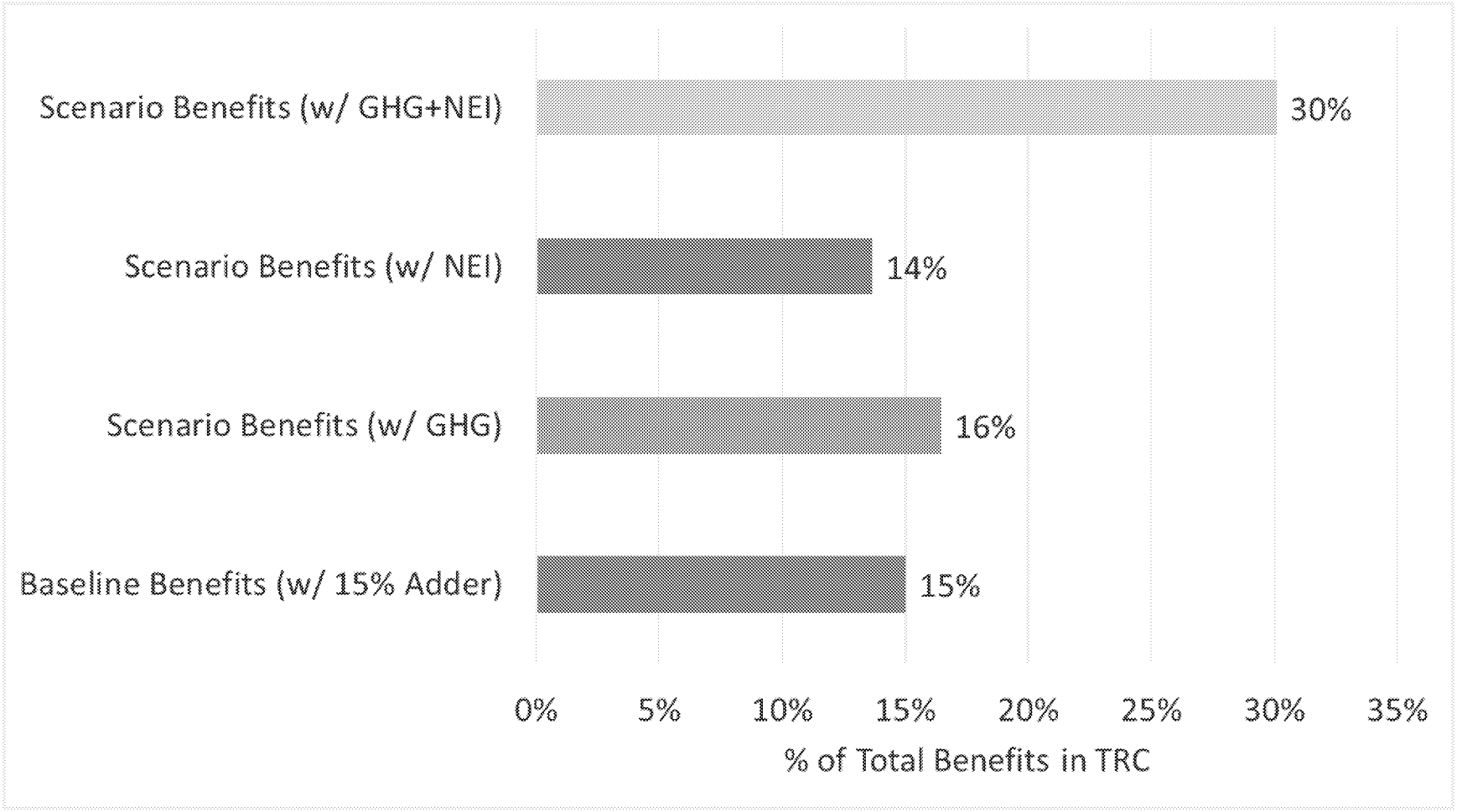
Higher TRC Impact of NEI and GHG Adders Versus Existing 15% Adder on TRC for 2016 Programs



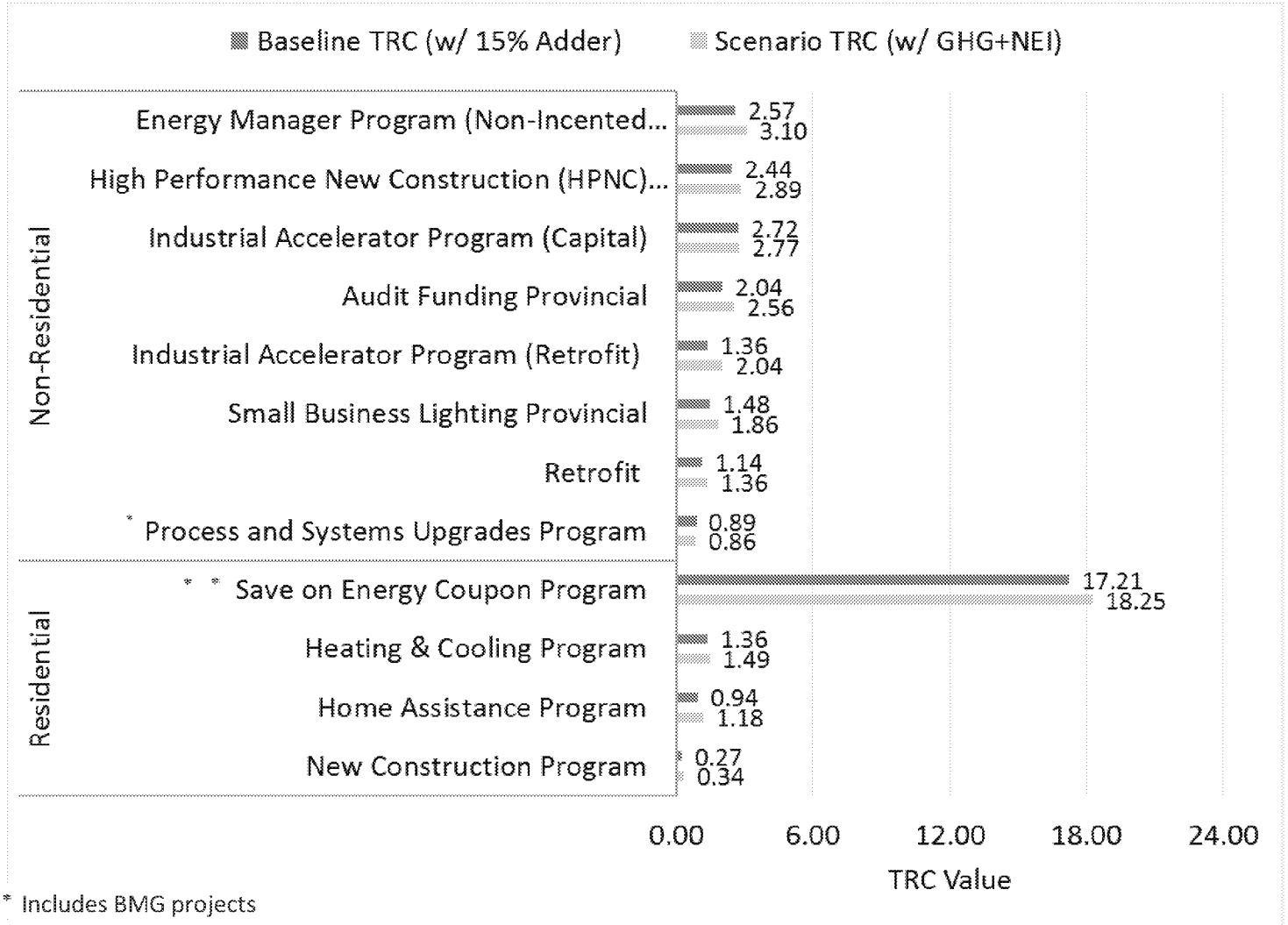
Residential Province-wide Programs Have Higher TRC Impact than Non-Residential Programs in all Scenarios



Province-wide Scenario Benefits as % of Total Benefits in TRC



Typically Higher Impact on TRC for Province-wide Programs



* Includes BMG projects

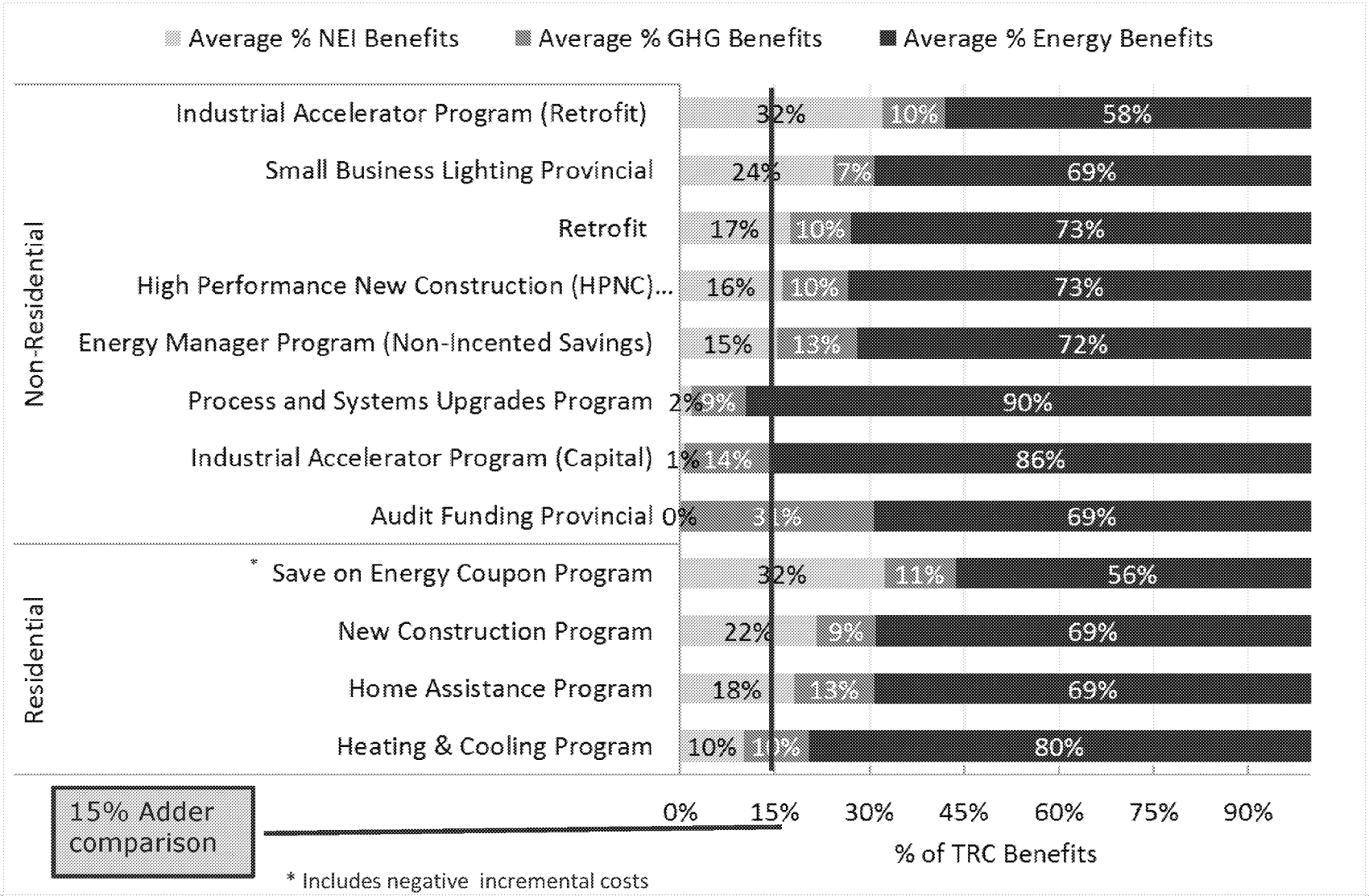
* * Includes negative incremental costs

GHG Factor and NEI Factor are Similar to the Existing 15% adder

- The new GHG factor is approximately equal to the existing 15% adder
  - A value commonly defined as a social cost of carbon required to effect climate change is often quoted at €80/t (approx. Cdn$115)
  - IESO is currently using a more conservative value of $43
    - Some jurisdictions (many US states) use a significantly lower value
    - BC's carbon tax is $30/t ($35 in 2018 and scheduled to reach $50 by 2021)

- The NEI factor is just slightly smaller than the existing 15% adder
  - NEI quantification is likely to rise significantly if new and better research emerges
  - Currently, the most conservative values are used, based only on the best results from the small pool of existing research
  - Negative NEIs are possible and more will emerge as additional research is performed, but all indications point to a favourable balance of overall benefits

Energy Benefits still Represent Greatest Proportion of Benefits in Scenario TRC (w/ GHG+NEI)



Next Steps

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How to Apply NEI Values in the Future

- The jurisdictional scan revealed that many places are using percentage adders as a substitute for quantifiable values
  - Adders contain different components depending on the regulatory and program context
  - Various mixtures of proxy values for Societal versus Participant impacts

- This research reveals that the existing 15% adder is likely too conservative given that the IESO's GHG value alone comprises a 15% equivalent value

- Options:
  1. Retain the existing 15% adder
  2. Increase the existing adder to account for current NEI and GHG research
  3. Move to a bottom-up measure-level approach to NEI and GHG
  4. Adopt a hybrid approach, using bottom-up values from #3, but add another global percentage to account for unknowns

Options Under Consideration

- Option 1 – Retain current 15% adder
  - Higher certainty that 15% is not an overstatement of benefits
  - Simpler to administer
  - Applies the same values to all measures and programs even though impacts are not uniform or consistent

- Option 2 – Increase 15% adder to reflect current research
  - 30% would seem to be the appropriate value
  - Simpler to administer
  - Applies the same values to all measures and programs even though impacts are not uniform or consistent

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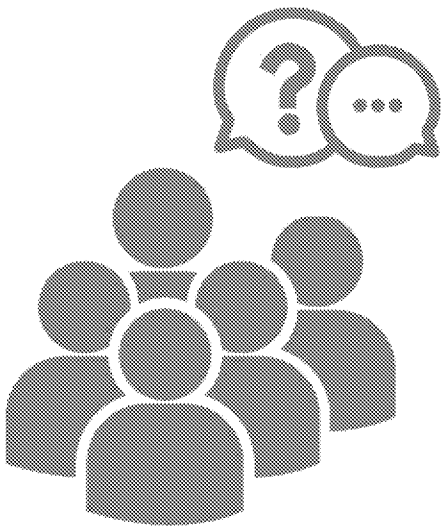
Options

- Option 3 – Switch to bottom-up measure-specific NEI calculation
  - Even current conservative value is almost as large as previous entire 15% adder (that presumably included carbon/GHG as well)
  - Increased confidence and accuracy in applying different NEIs to measures for cost effectiveness and program design considerations
    - May be important for marketing and outreach purposes
  - Future research will continuously improve the knowledge base of NEIs
  - Measure-level impacts are consistent with the rest of the IESO reporting framework has been developed
  - IESO has already funded the research and development of the CE calculator

- Option 4 – Hybrid of Option 3 plus an additional percentage
  - Additional percentage difficult to justify because research only quantified the available credible values

Questions/Discussion

- What are other considerations for the 4 options?
- What is the preferred option?
- Could the application of NEI adders be applied at the measure, program and sector-level? How else may it be used?



Sustainable Energy Use

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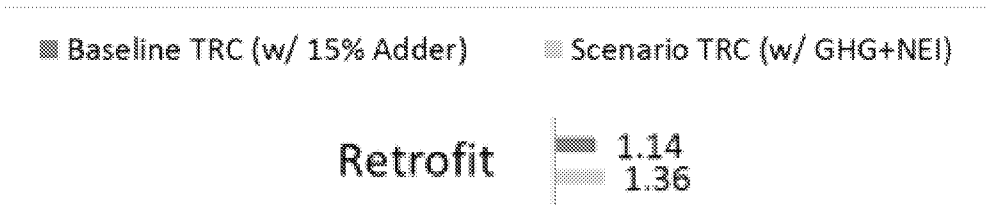
Extra Material

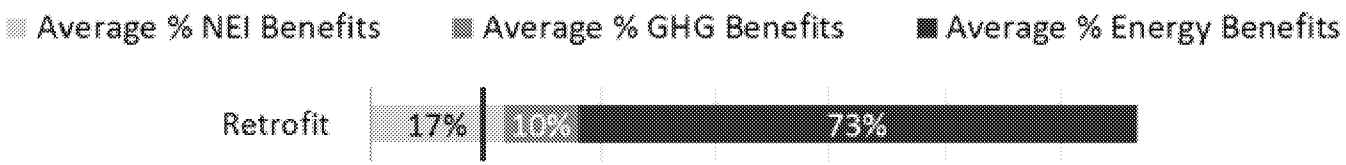
Unpacking NEIs

What Drives the Program NEIs (which NEI_IDs)?

- Example: Non-Res Retrofit program had a TRC that increased from 1.14 to 1.36

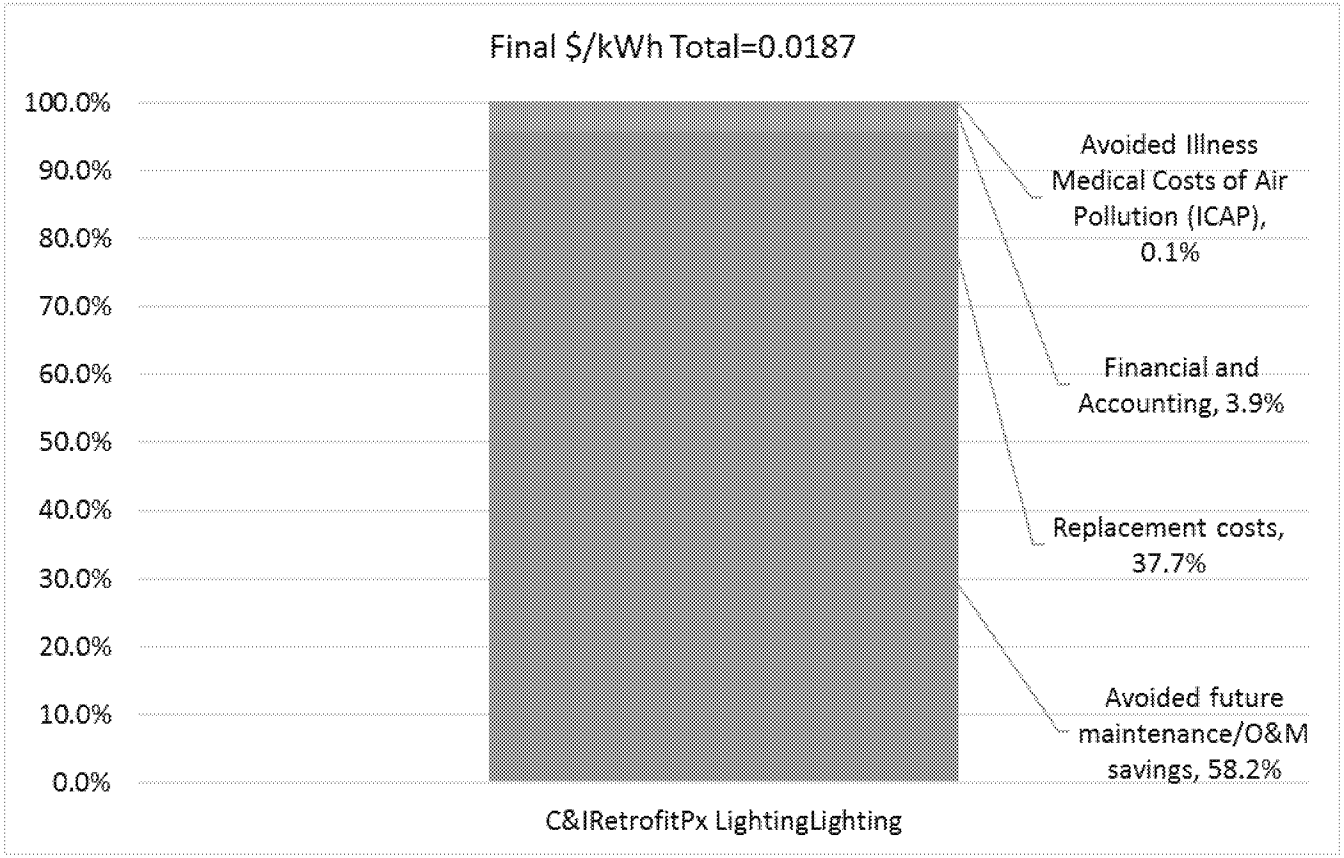


- 17% of the benefits that made up this calculation TRC came from NEIs

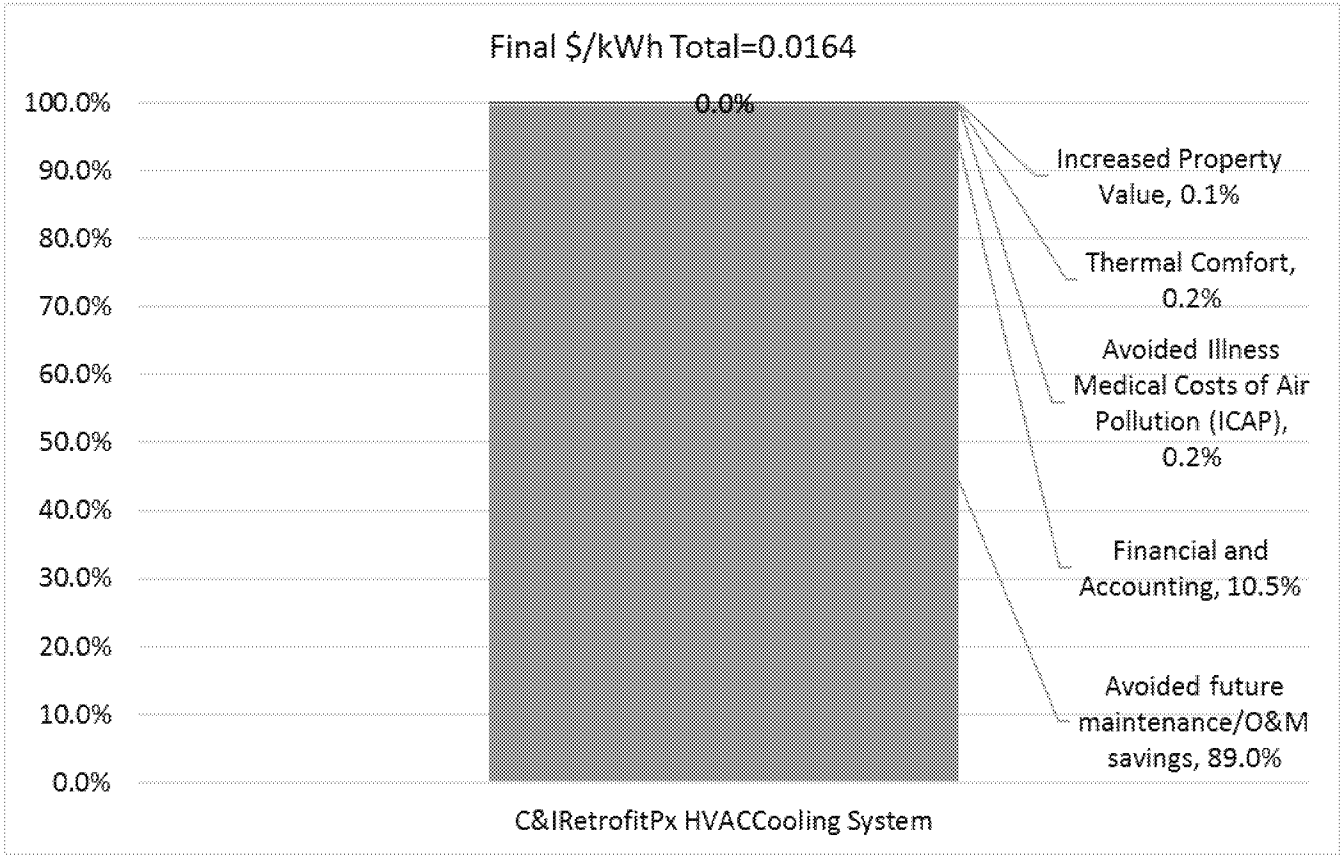


- What sub-categories of NEIs are driving this?

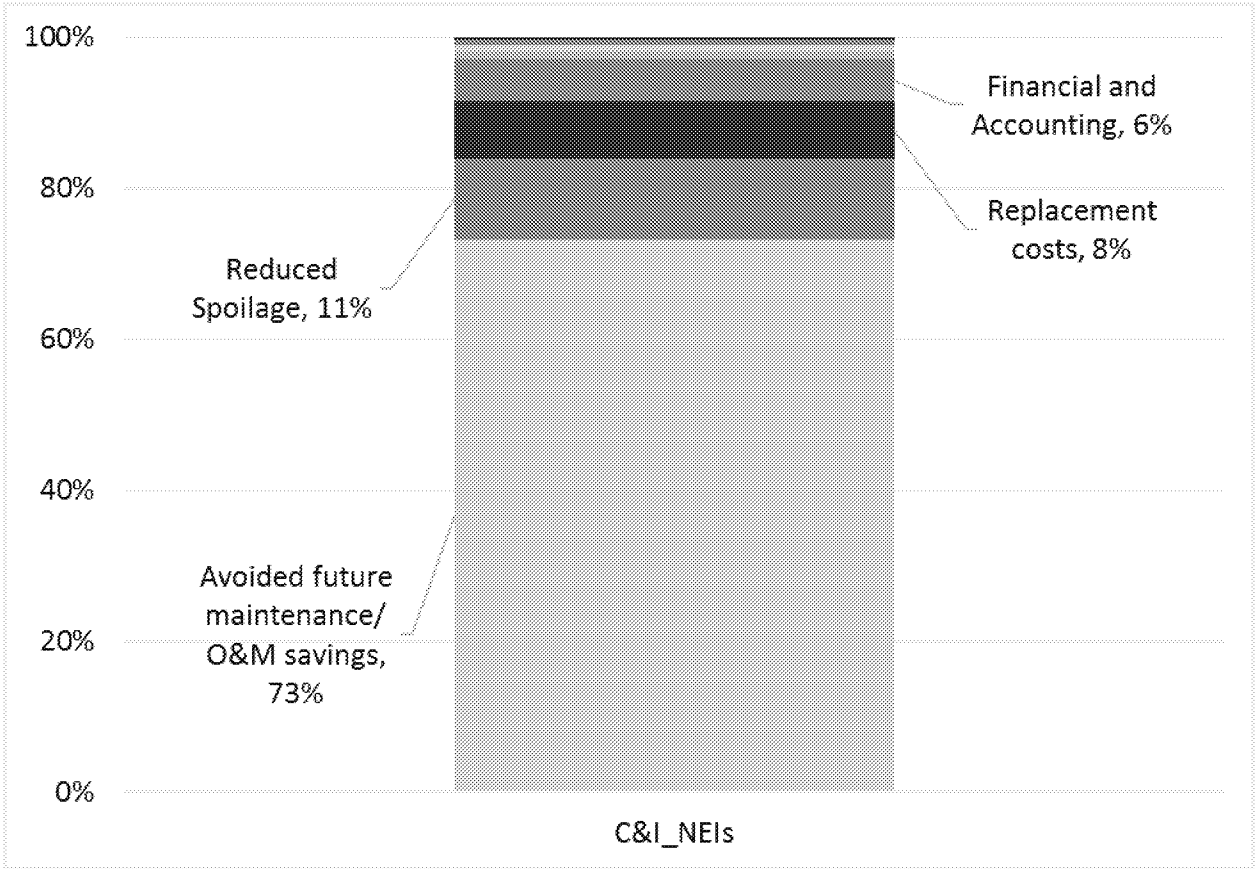
Example: NEI ($/kWh) breakdown for a lighting end-use in the Non-Residential Retrofit program



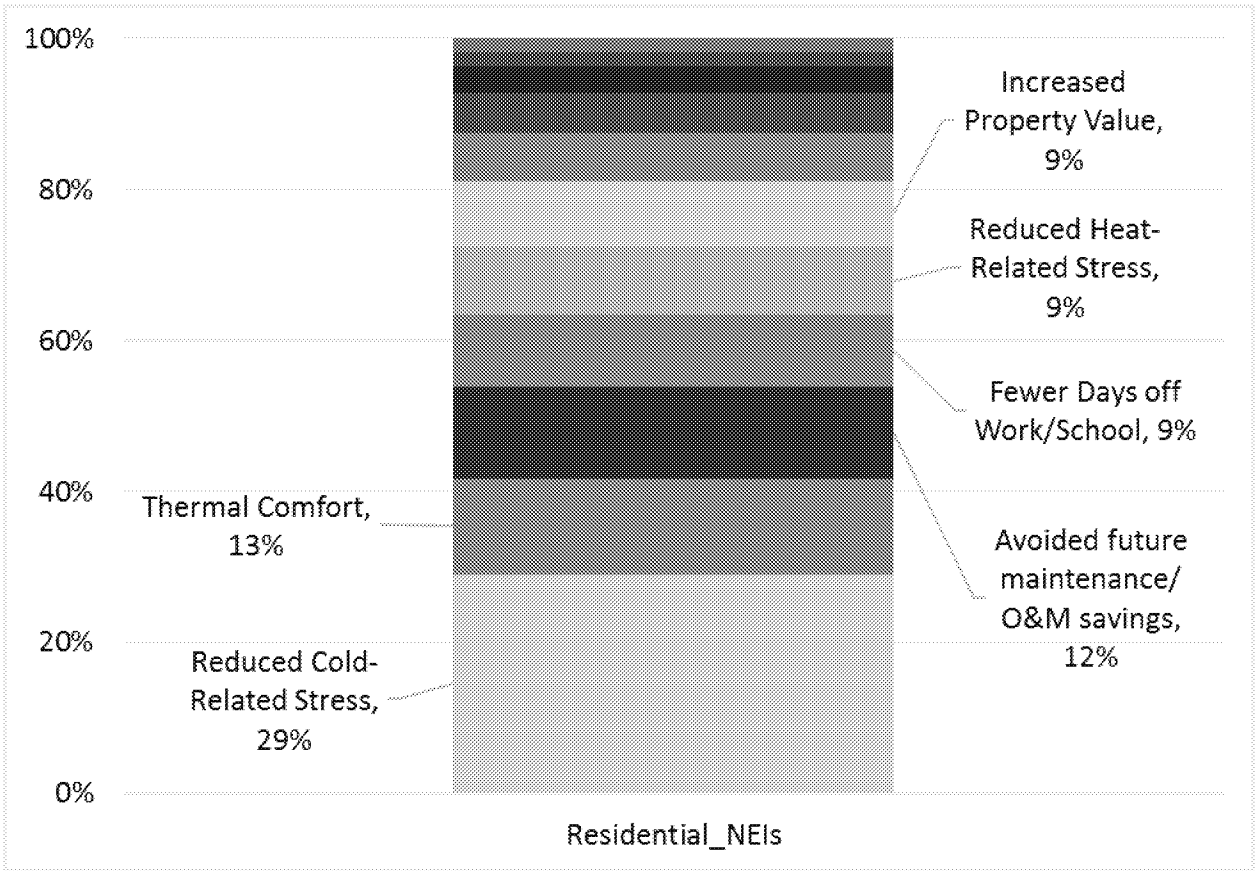
Example: NEI ($/kWh) breakdown for a HVAC cooling end-use in the Non-Residential Retrofit program



Breakdown of Average NEIs for C&I Programs



Breakdown of Average NEIs for Residential Programs



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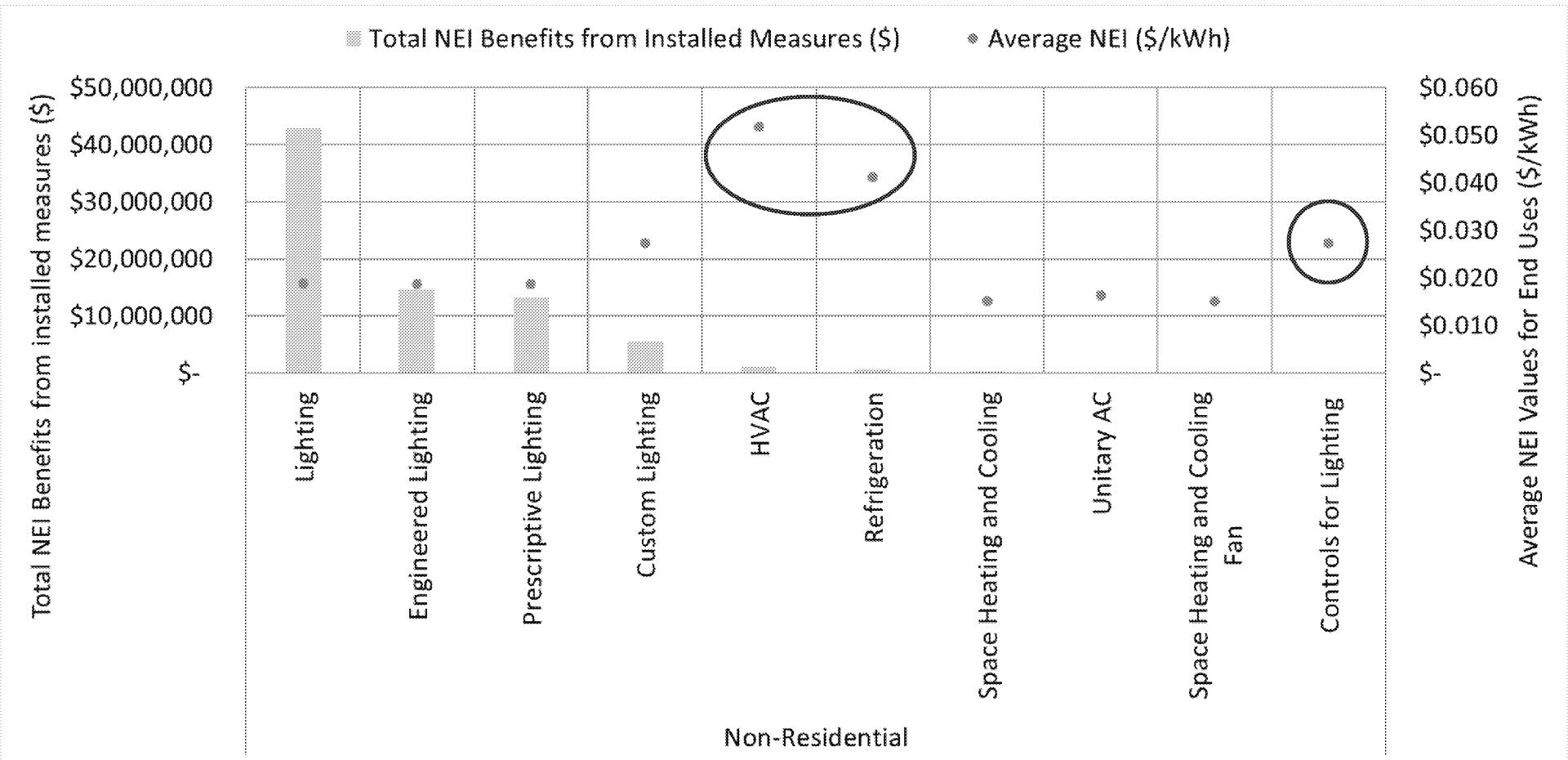
Opportunities vs. Current Practices

Opportunities

- High NEI benefit values ($) typically reflect large uptake volumes, which may or may not be accompanied by high NEI values ($/kWh)

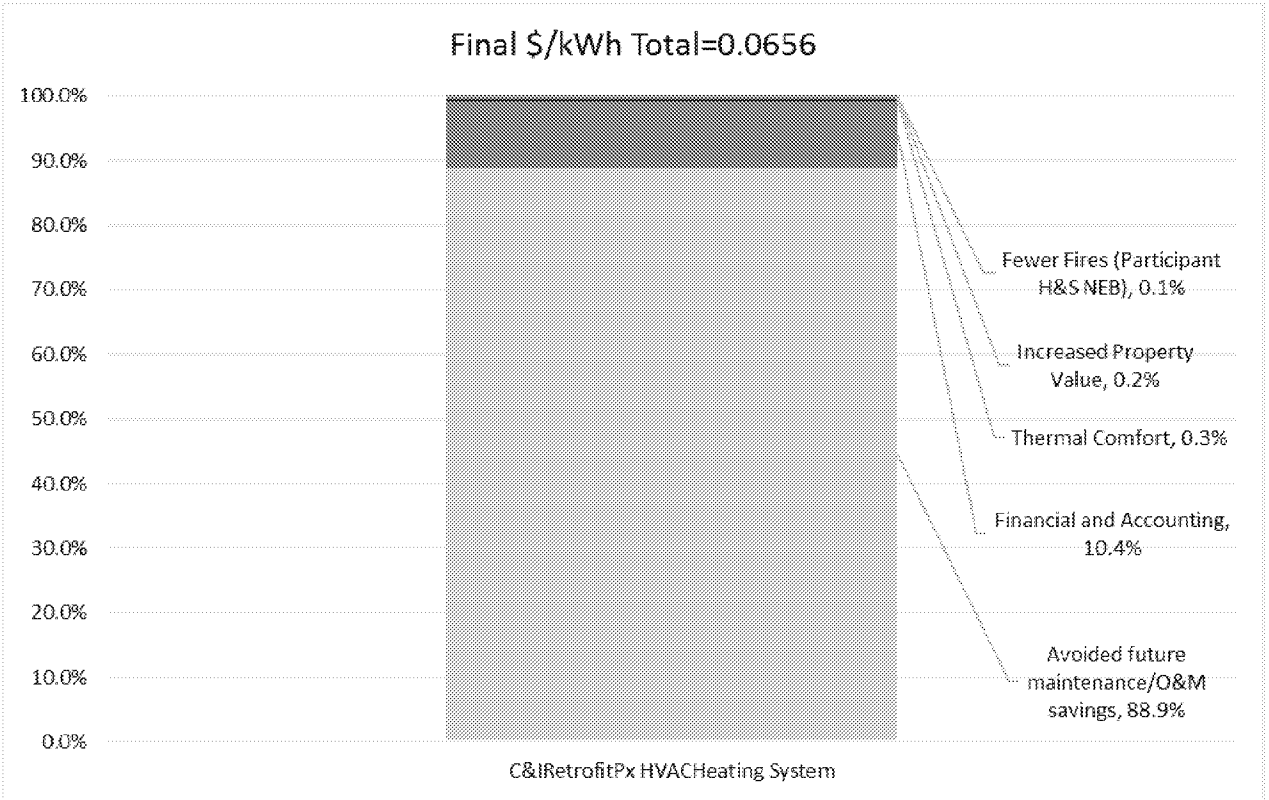
- The farther apart the dots are from the tops of the bars suggests either:
  - Large potential NEIs have been identified in measures or programs of less emphasis today
    - E.g., Non-Res HVAC and Refrigeration
  - Programs with more modest NEIs are dominant, so NEIs will not be able to help or "save" them in the future if trends change
    - E.g., Lighting, with energy savings that will be diminished by market transformation

Comparing Installed End Uses to $/kWh NEI Potential - Non-Residential

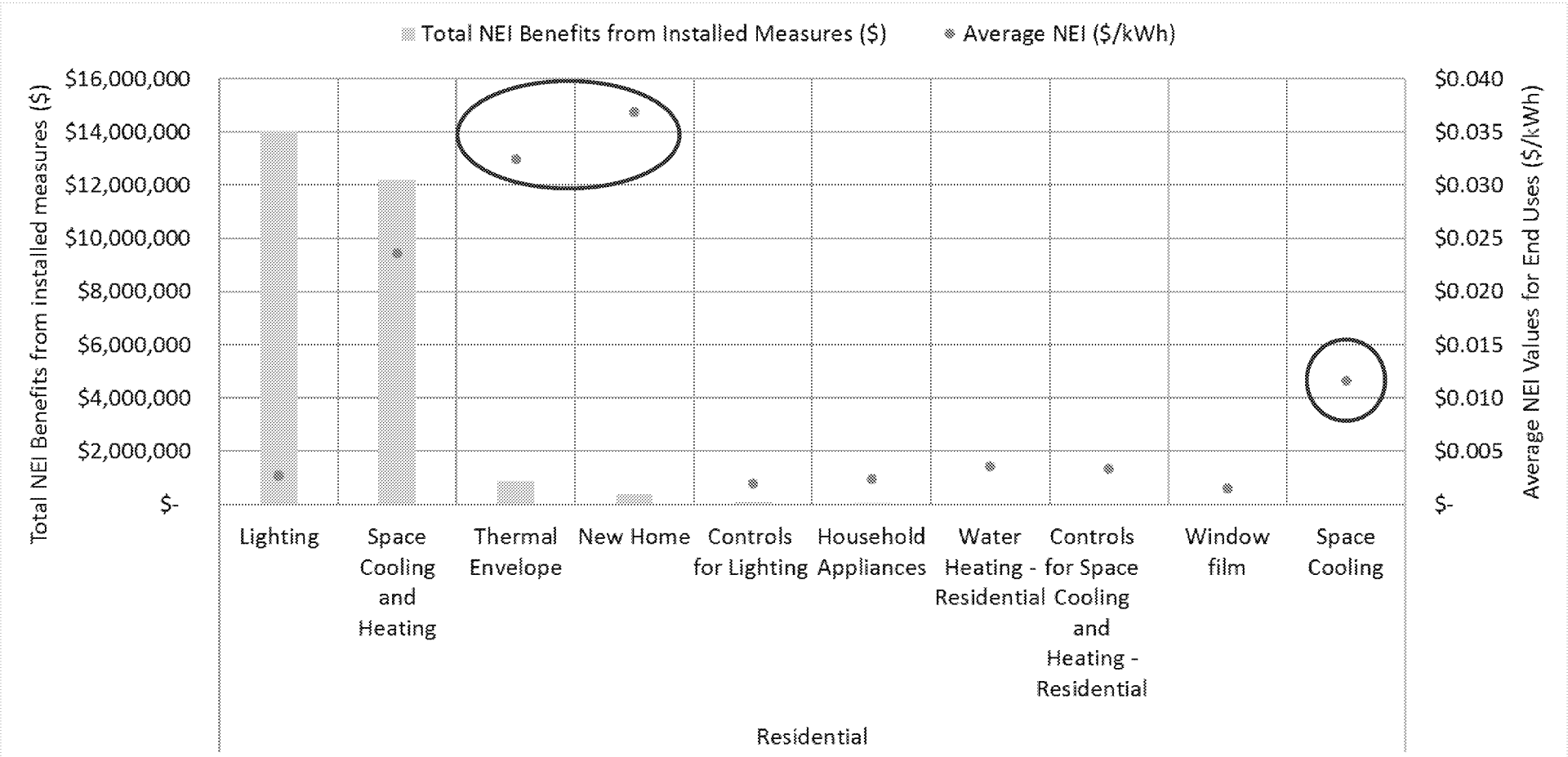


Non-Residential Opportunities to take Advantage of NEIs

- HVAC (Heating systems), see graphic below
- Refrigeration
- Controls for Lighting

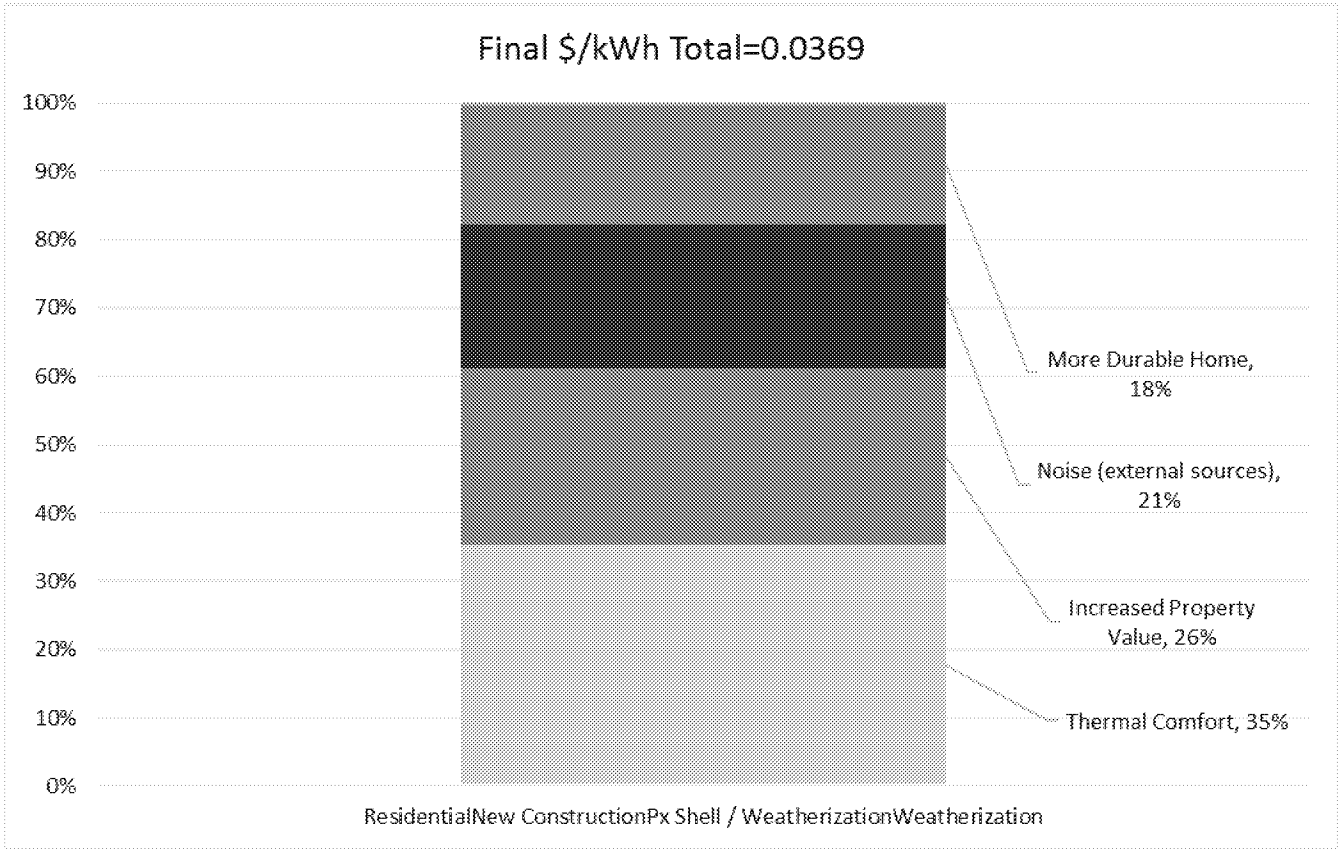


Comparing Installed End Uses to $/kWh NEI Potential - Residential



Residential Opportunities to take Advantage of NEIs

- New Home (Shell/Weatherization), see graphic below
- Thermal Envelope (Shell/Weatherization)
- Space Cooling



Glossary (1)

Term	Definition
IESO Cost Effectiveness (CE) Tool	The Excel spreadsheet used to calculate measure-level cost effectiveness, which now can include avoided costs for GHGs and NEIs
Non-Energy Benefits (NEBs)	A common term for NEIs that implies all NEIs are benefits
Non-Energy Impacts (NEIs)	A wide range of benefits (and some costs) that accompany the energy savings inherent in energy conservation measures
NEBs 15% Adder	An across-the-board 15% benefits boost employed by IESO (and similarly by other jurisdictions) as a proxy for NEIs
Total Resource Cost (TRC) Test	The most common energy efficiency benefit-cost test; used in the analysis presented here to assess the influence of NEIs on cost effectiveness; one of five or six established cost tests used in North American DSM/CDM
Avoided future maintenance/O&M savings	Newer, better technology may require less ongoing maintenance and/or bring lower operating costs (besides the energy component)
Financial and accounting	Fewer purchases, fewer service calls, fewer invoices to process

Glossary (2)

Term	Definition
Thermal comfort	Better temperature, humidity and drafts control
Increased property (/business) value	Significant efficiency retrofits may bring increase resale value of a home, facility, or in some cases of a business operation
Increased productivity	Better lighting, thermal comfort, noise abatement, or other improvements result in increased productivity for employees, students
Reduced cold or heat stress	Improvements that control extreme temperatures in certain business areas exposed to outdoor temperatures (e.g., parts of warehouses) or some extreme low income residential scenarios
Durability	Home/facility energy retrofit results in overall durability improvement
Sales revenue	More attractive showcases increase product sales; office space easier to lease; apartments easier to rent
Reduced spoilage	From better quality refrigeration; better lighting in industrial context
Reduced waste	From reduced spoilage; more efficient industrial production
Fewer fires	HVAC equipment and some lighting major source of household fires
Reduced illness costs of air pollution	Reduced use of (especially peaking) fossil fuel-based power plants reduces a variety of quantifiable health care costs and illnesses

Sustainable Energy Use

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