POWER.HOUSE Feasibility Study Results

May 26, 2017

Assumption Framework

- The technology selected is the residential solar, storage used for PowerStream's POWER.HOUSE pilot projects at 20 homes.
- The study is geographically focused on Markham, Richmond Hill and Vaughan.
- Two configurations of the technology solution assumed: Single homes: 5 KW Solar/11.4 kWh Battery; Semi, Row homes: 3 kW Solar/ 7.7 kWh battery.
- Utility owned and operated ownership model is selected.
- Customer assumed to pay upfront amount and a recurring monthly payment in lieu of benefits from the system. The balance of the cost is expected to be funded by TBD.
- The time frame for the report is over next 15 years (2016-2031).
- Forecast based on known and measurable policy changes, public sources and results from POWER.HOUSE pilot.

Study Highlights

✓	High degree of involvement and collaboration with IESO, Alectra, and other supporting staff
✓	POWER.HOUSE can feasibly reach meaningful uptake within the study period (2016-2031) - 30,000 units and 140 MW of dependable capacity
✓	POWER.HOUSE could defer at least 2 years of local transmission/distribution investment in late 2020 timeframe
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Collaborative Process

High degree of involvement and collaboration with IESO, Alectra, and other supporting staff

- IESO operations staff involved early on to ensure technical tests appropriately reflected current services and potential future needs
- IESO planning staff involved in helping frame the mechanisms to assess the value to the electricity grid and validate assumptions, approach and results
- IESO and Alectra planning staff worked together to estimate the value of transmission/distribution deferral

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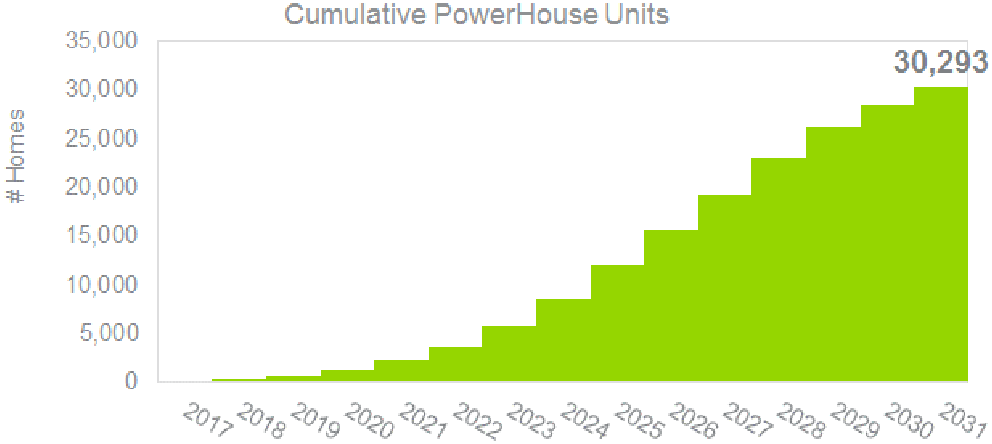
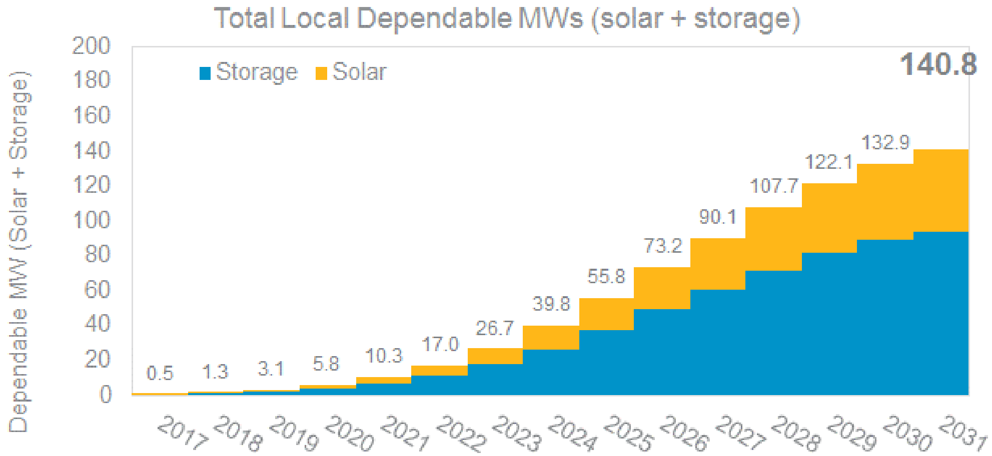
Program Structure and Uptake





Program Offer:

Single Family Home

- 5 kW Solar/11.64 kWh battery
- 8 – 10 MWh average annual load
- $4,500 up front
- $80/month for 10 years
- Average nominal bill savings + reliability benefit of $1,800/year
- Payback between 4 and 5 years

Semi/Row Home

- 3 kW Solar/7.7 kWh battery
- 4 – 6 MWh average annual load
- $3,500 up front
- $55/month for 10 years
- Average nominal bill savings of $1,100/year
- Payback between 5 and 6 years

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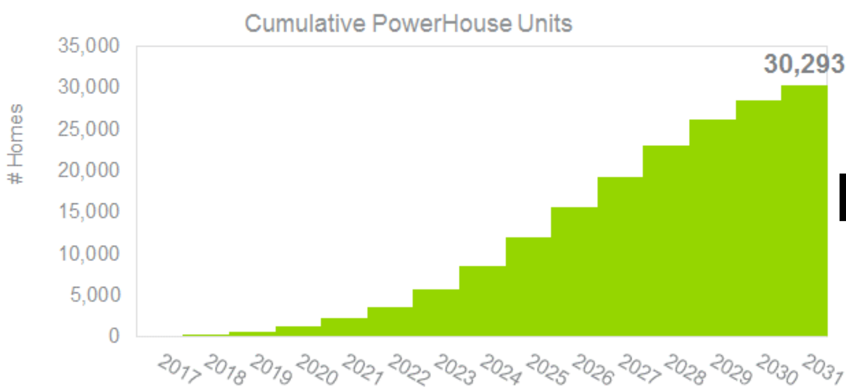
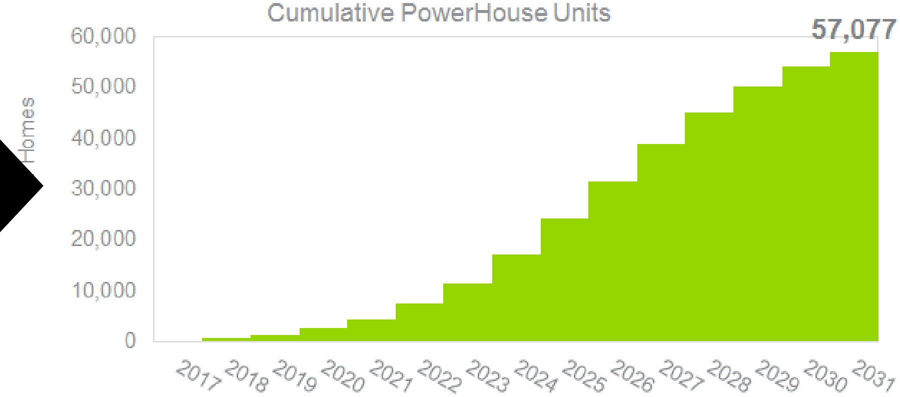
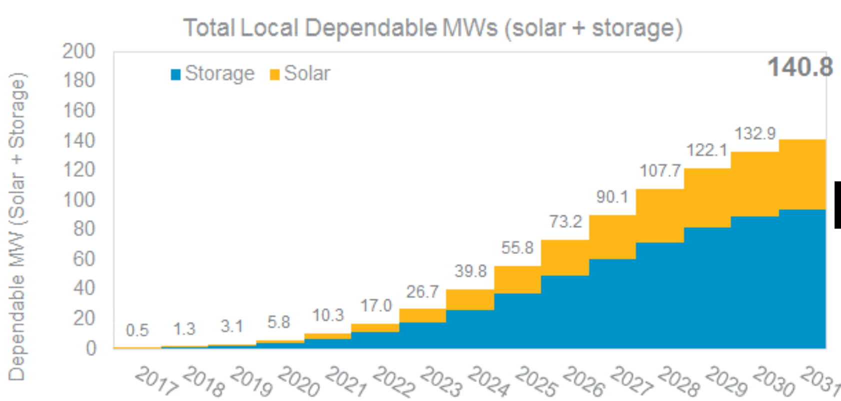
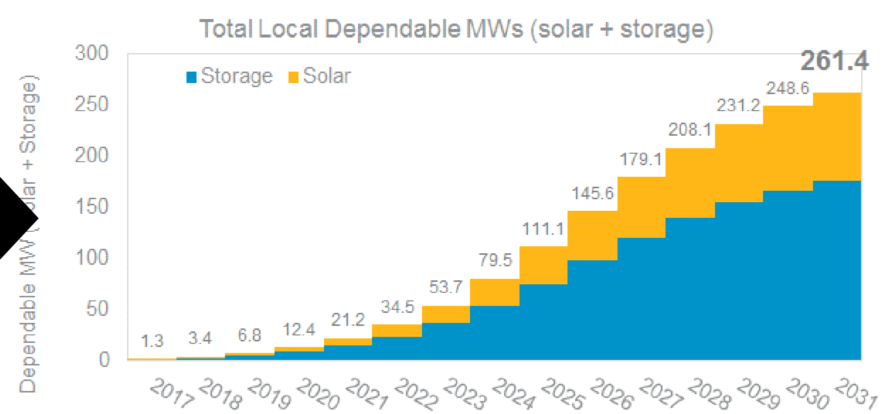
Program Uptake Increases under a Deep De-carbonization Scenario









Aligned with IESO OPO **Outlook B** **Outlook D**

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TX/DX Deferral Assessment

- Tx/Dx deferral was assessed by Alectra and IESO planning staff
- A measure of the system's effective nameplate capacity by year was determined based on a combination of solar and storage capacity factors during peak system demand (i.e. a 3 hour period during summer). This was compared against the local needs for Markham/Richmond Hill and Vaughan
- Analysis concluded that, without considerably lower load growth Markham/Richmond Hill is not feasible to defer in time to meet capacity needs
- Infrastructure deferral in Vaughan was, however, possible under current load growth assessments for 2026 and 2027, and represented an additional $12M in overall value

Vaughan	2026 (No Deferral)	Defer Tx Reinforcement								
		2027	2028	2029	2030	2031	2032	2033	2034	2035
Toal Deferral Value ($M)	-	6	12	17	22	27	32	37	41	45

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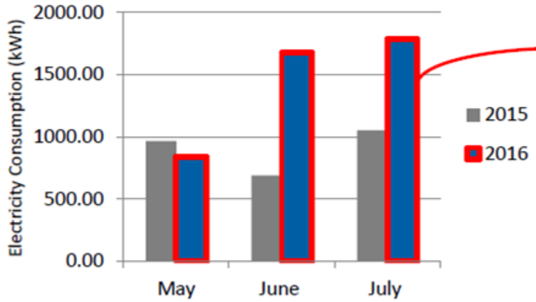
Technical slide

Although only demonstrated over a short period of time, our testing showed that these systems have the potential to provide a number of reliability services.

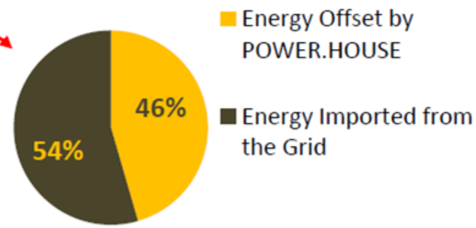
Capability Tested	Result
Automatic signal following (regulation)	✓
Trigger response (operating reserve)	✓
Scheduled response (demand response, flexibility product)	✓
Outage protection	✓
Response to system voltage drop	✓
Local sensing and prediction (TOU arbitrage)	✓

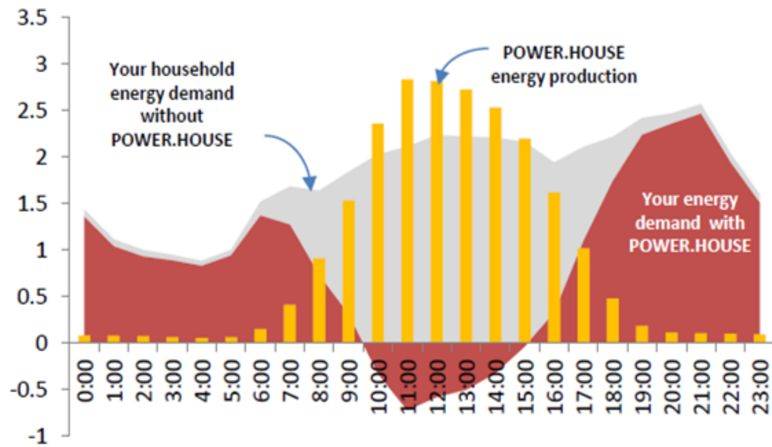
Actual Savings for a POWER.HOUSE Customer from May to July 2016

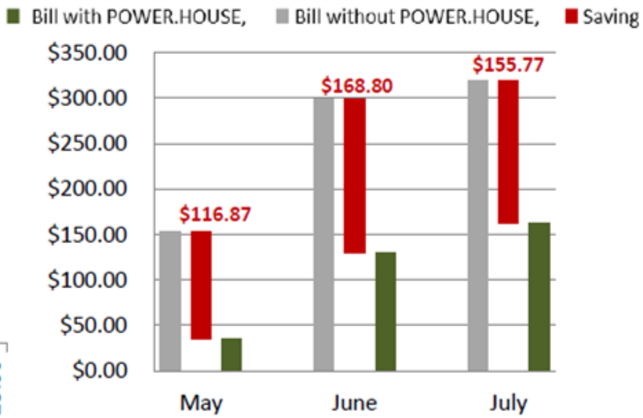
This graph compares your household consumption pattern for the same quarter last year (2015).



This graph breaks down your household consumption into what is imported from the utility grid vs. what was offset by your POWER.HOUSE unit.







Your total saving in this quarter = 441.44 $ (57.3 %)

This quarter, POWER.HOUSE Program participants enjoyed a total of 20.87 hours of power outage protection. *

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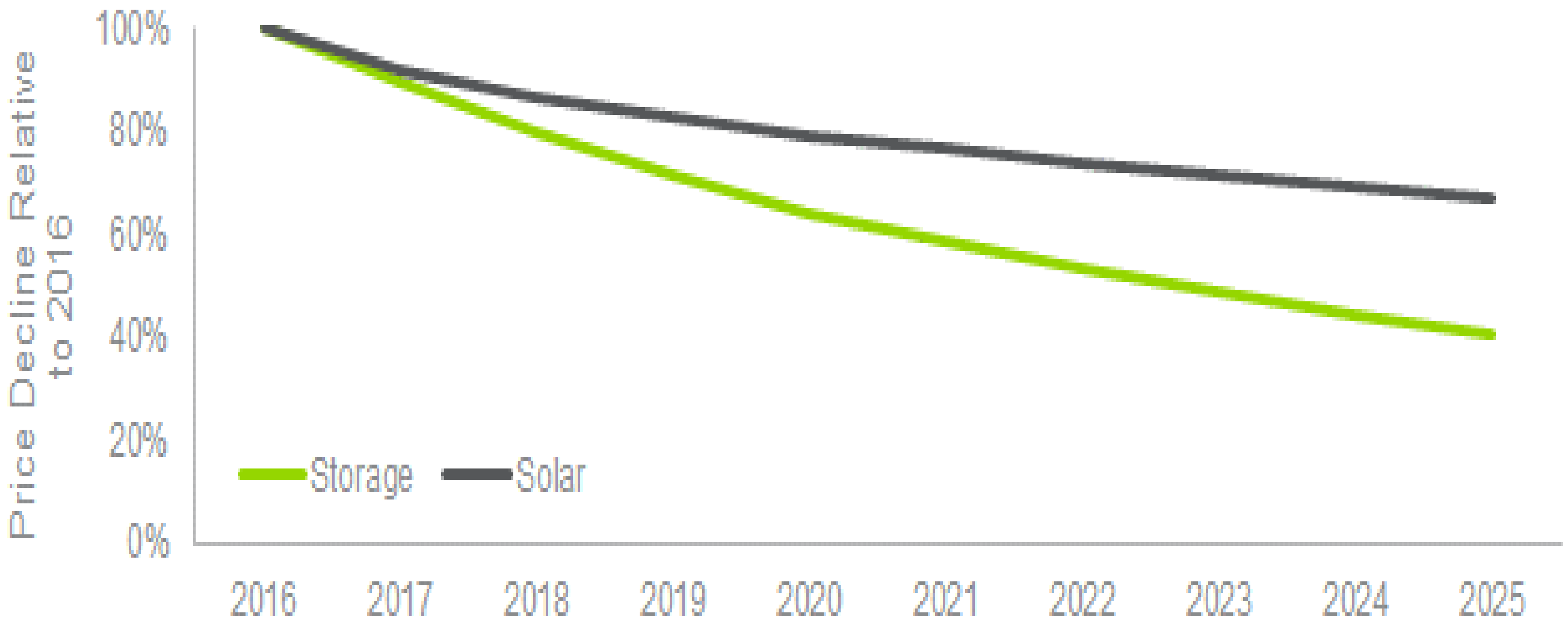
POWER.HOUSE Unit Costs

Costs are anticipated to decline significantly over the program feasibility study period



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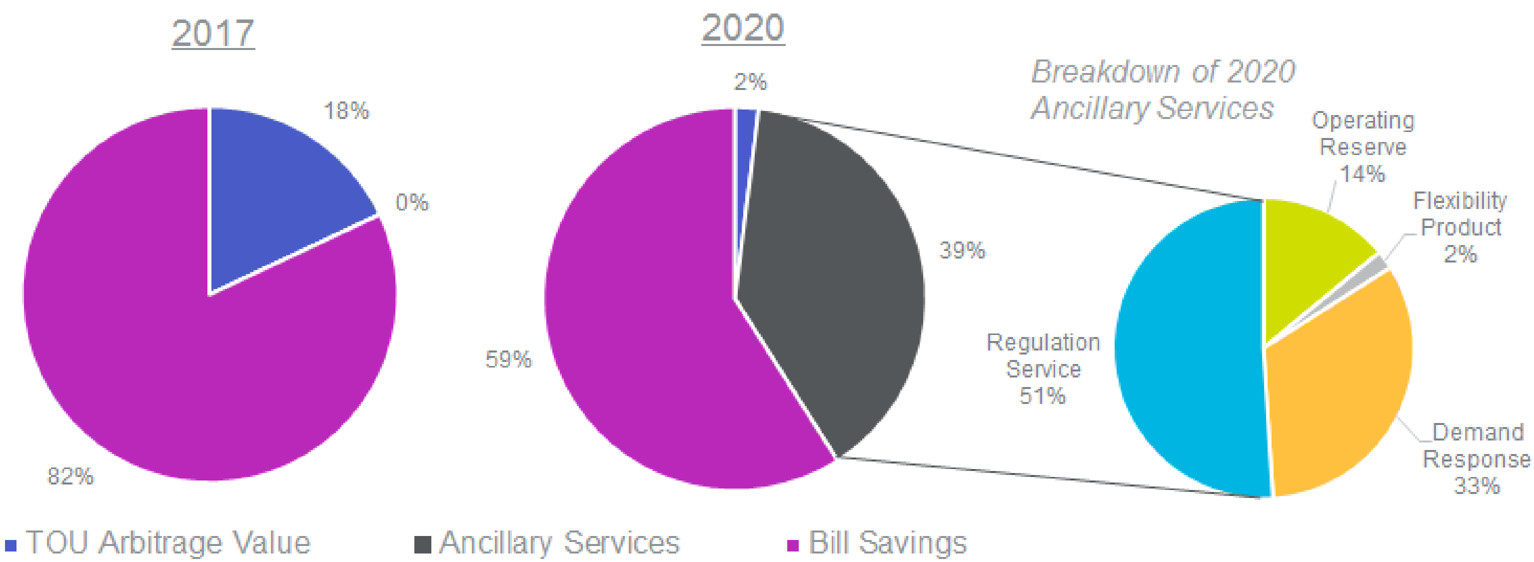
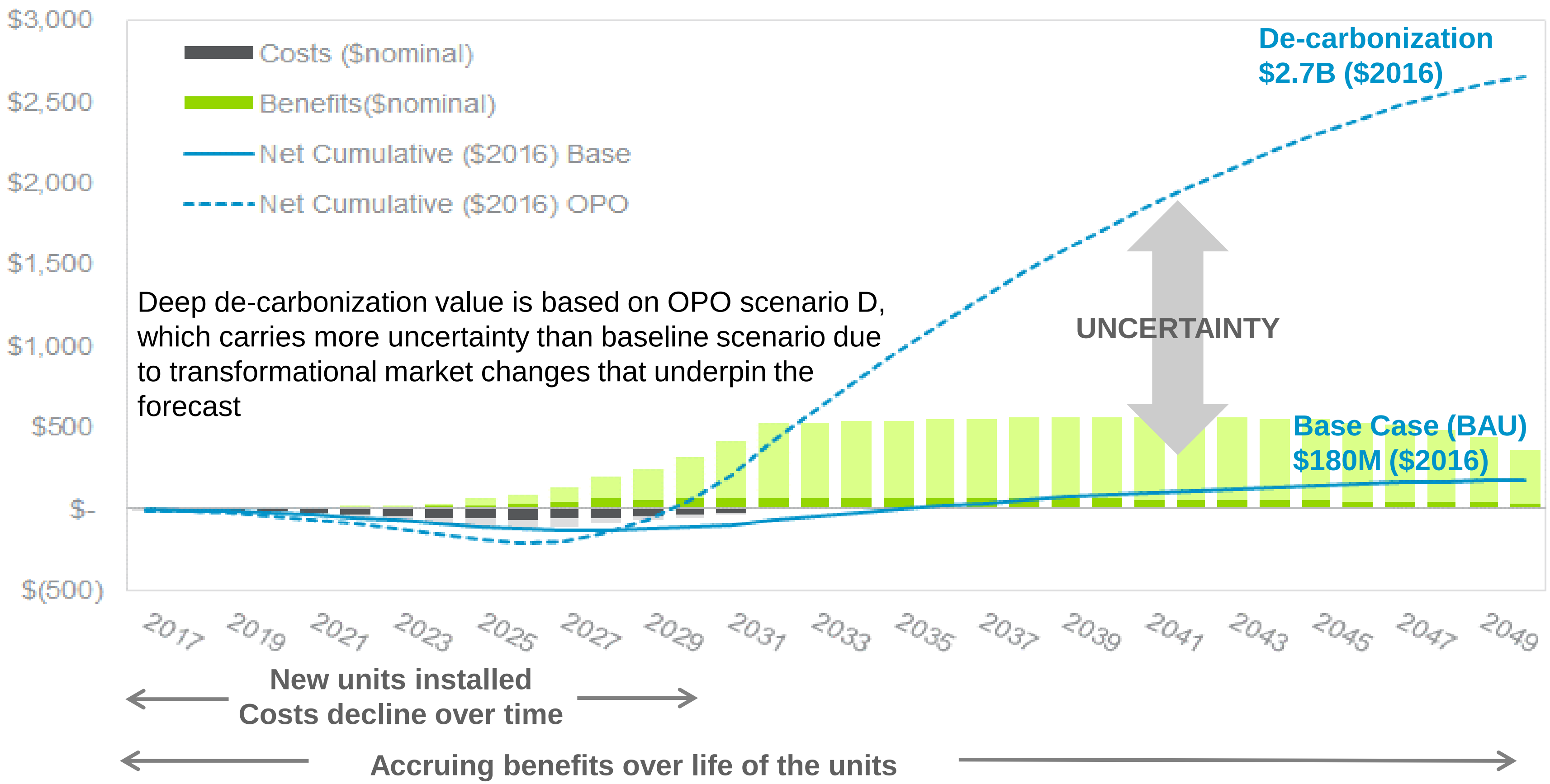
Proportionate Benefit



Breakdown of value derived by the system changes over time as new Ancillary Services become available and as the value of various services changes according to system need.

Cumulative Net Benefits

Based on the anticipated adoption rates there is a positive cumulative net benefit over time under both outlooks



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Key Enablers

- **Ancillary Services Market Timing** – revenues are highly dependent on access to A/S markets within the next 2 years. Products, procurement mechanisms and participation requirements would have to be defined, all of which would have to consider cost impacts
- **Net Metering Regulation** – key regulation changes including permissions for third party ownership and recognition of storage as a renewable asset would have to be incorporated into the next NM/SC regulation. MDM/R would also require upgrade to accommodate NM on TOU
- **Utility and Regional Planning**– Processes for incorporating DER integration into traditional utility and regional planning to mitigate locational capacity issues (transformer loading, etc.) would have to be formalized, along with billing integration.

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Questions?