POTENTIAL FOR PEAK DEMAND REDUCTION IN INDIANA

IRP Contemporary Issues Technical Conference

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What is an “Advanced Energy Economy?”

A prosperous world that runs on secure, clean, affordable energy

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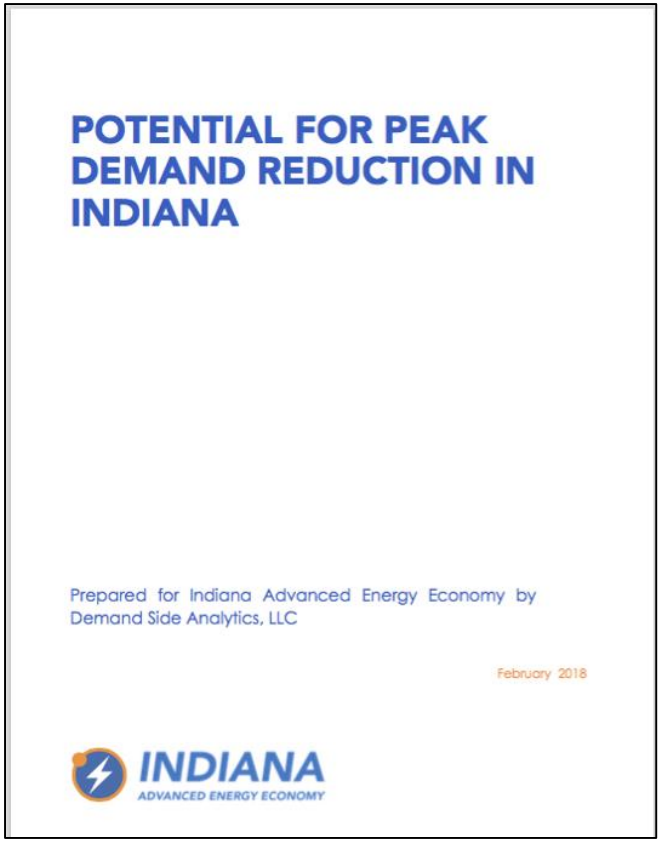
Indiana DR study purpose and scope



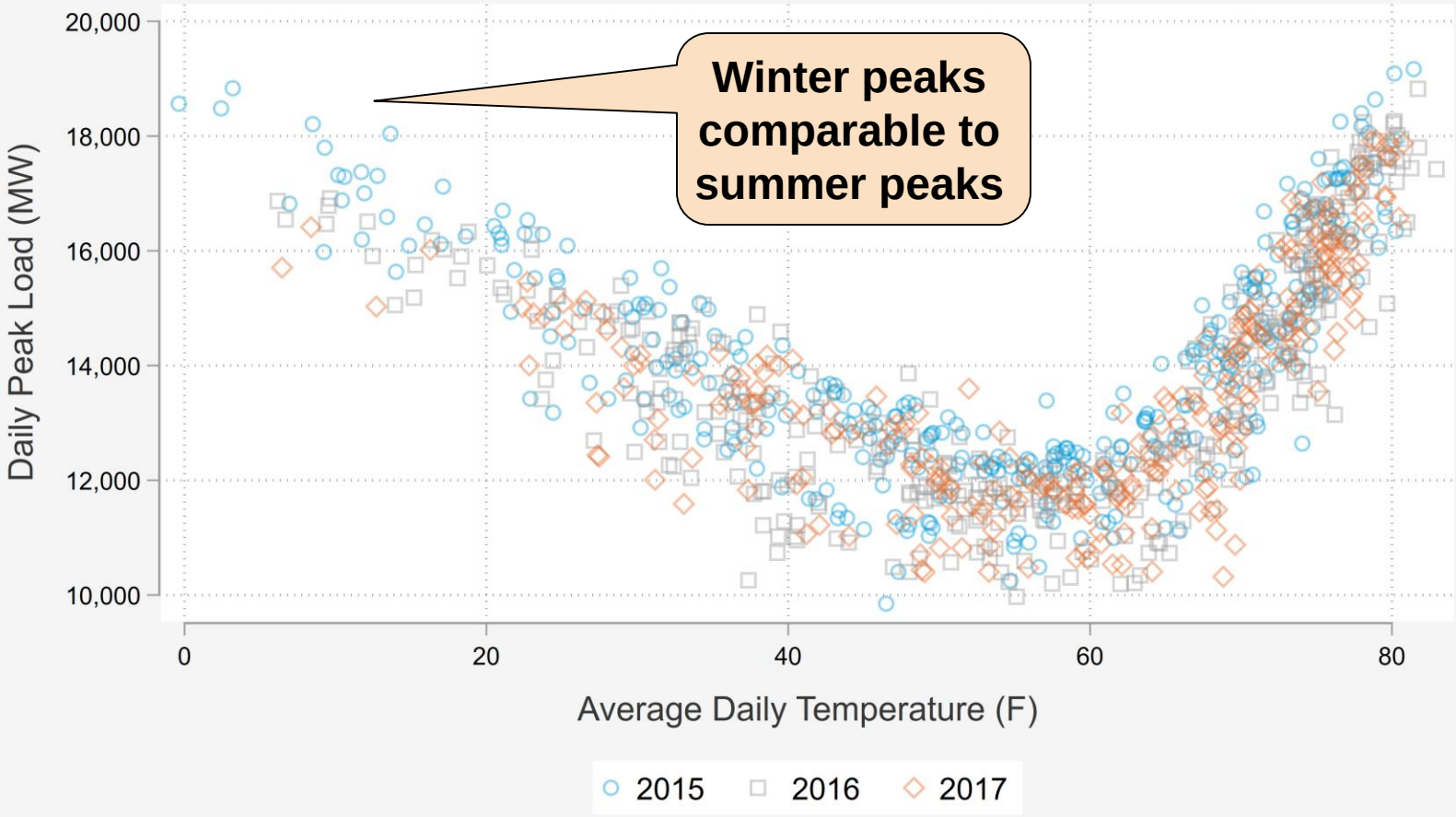
- Estimate cost-effective demand response (DR) potential in Indiana
  - Capacity (MW)
  - Net benefits (NPV of cost savings)
- Three market segments
  - Commercial & Industrial (C&I)
  - Residential - smart thermostats
  - Grid-sited energy storage
- Ten-year time horizon (2018-2027)

- Acknowledgements
  - Study conducted by Demand Side Analytics LLC
  - Residential smart thermostat data provided by ecobee's "Donate your Data" program

https://info.aee.net/2018-peak-demand-reduction-for-indiana

Indiana's peak loads are driven by weather

Weather Sensitivity of Indiana Loads

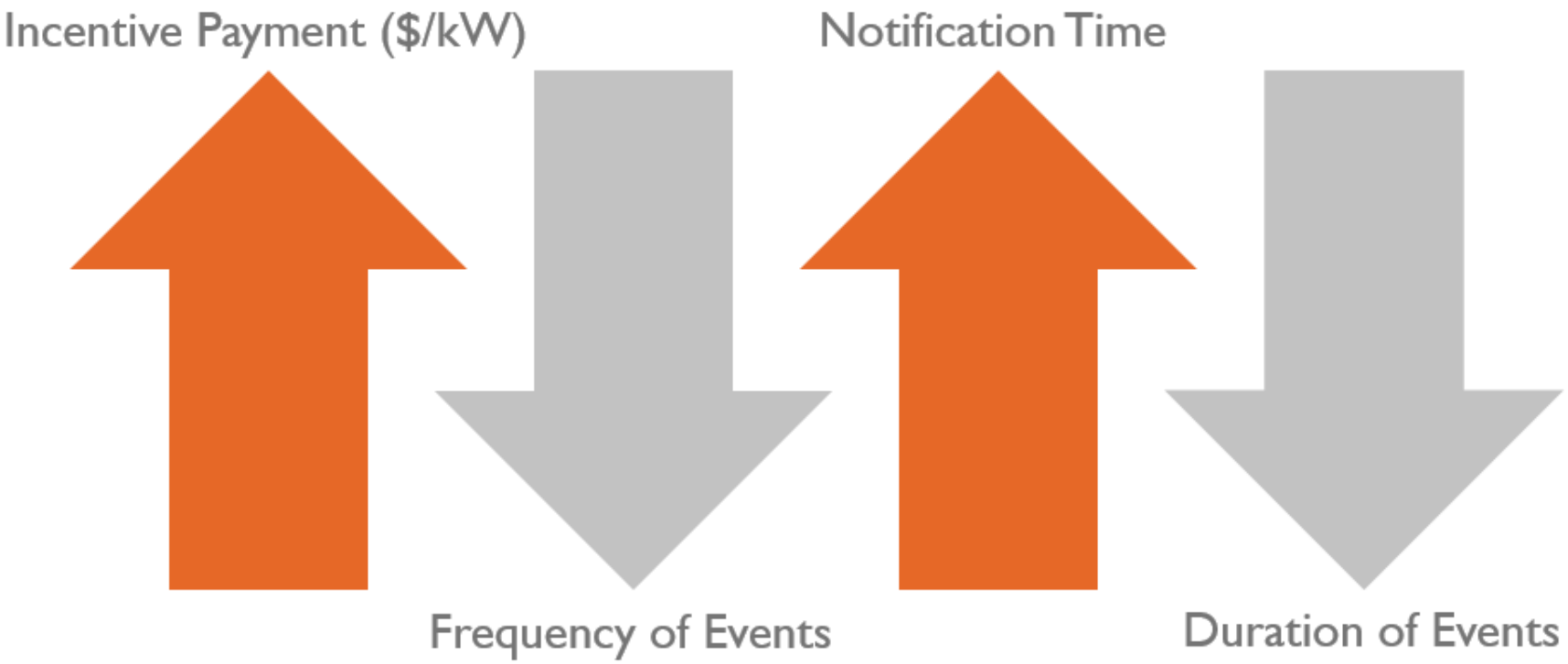


Study methodology (simplified)

- Develop annual peak demand forecast
- Develop avoided cost scenarios (L, M, H)
  - Capacity
  - T&D
  - Energy
- Define characteristics of the DR program
- Assess cost-effectiveness
  - Utility Cost Test
  - Market potential estimates based on maximizing net benefits (typical UCT ratio >1.6)
- For grid storage: include locational benefits
- Estimate economic potential*

* Inclusive of current DR capacity.

Drivers of demand response program participation

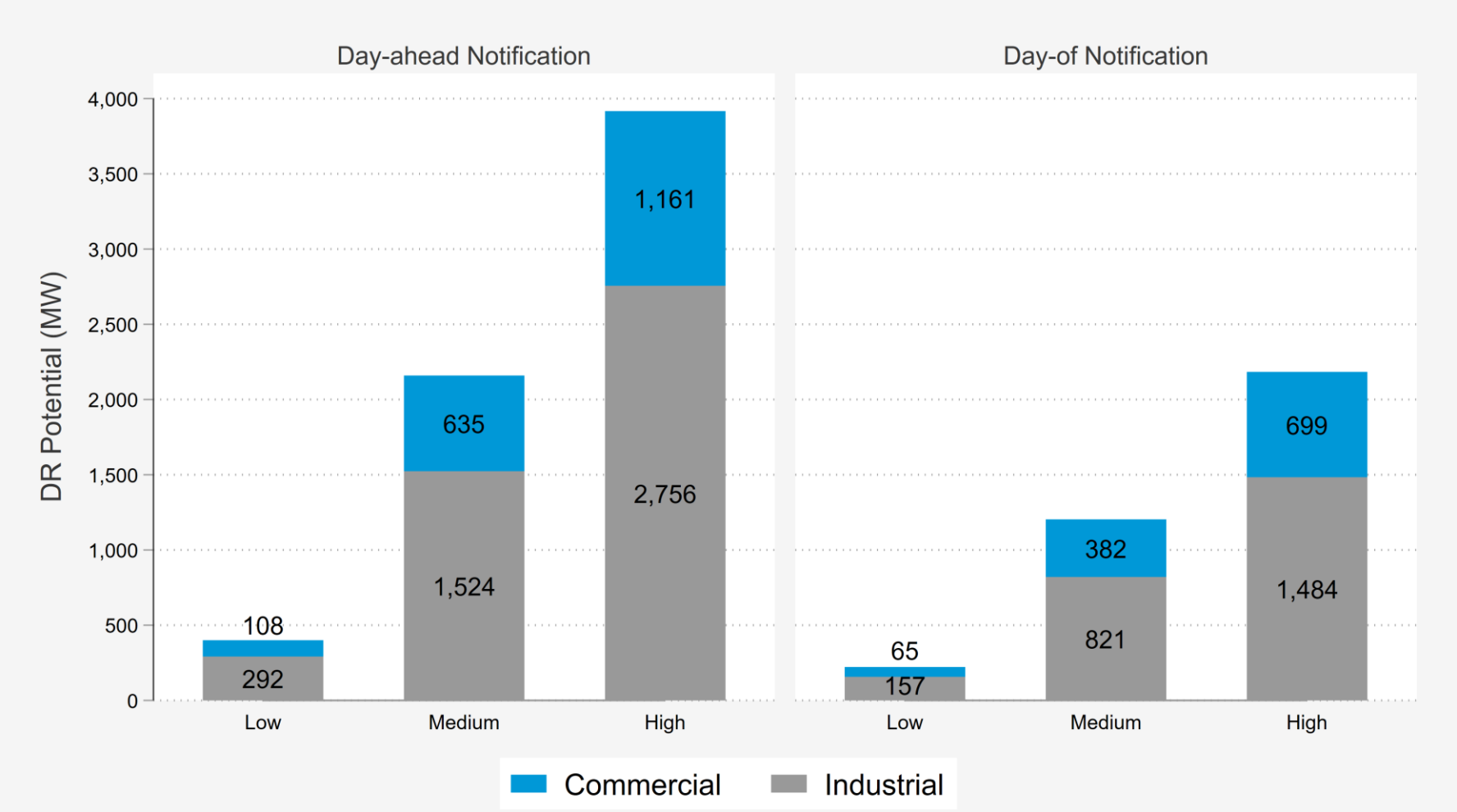


Avoided costs are a key driver of DR cost-effectiveness ($/kW-yr)

Avoided Cost Scenario	Avoided Generation Capacity	Avoided Transmission	Avoided Distribution
Low	$14	$0	$0
Medium	$56	$10	$10
High	$99	$20	$20

- Energy peak to off-peak differential assumed to be $20/MWh
  - DR assumed to shift usage from peak to off-peak hours
- Based on recent available IRPs, IN avoided costs appear to be between the Medium and High scenarios
- Battery storage assumed to be deployed only in constrained areas of the grid, with higher avoided T&D costs.

C&I DR potential in 2027 – as much as 4 GW



C&I DR costs savings (10-year NPV of net benefits - $ million)

Avoided Cost Scenario	Day-Ahead Notification	Day-of Notification
Low	$15	$8
Medium	$485	$272
High	$1,615	$907

- C&I DR is highly cost-effective in all scenarios
  - UCT ratios range from 1.61 to 1.94

Residential connected thermostat market potential and cost-effectiveness in 2027

Avoided Cost Scenario	2027 Enrollment (# thermostats)	2027 MW Impacts	Net Benefits ($ million)	UCT Ratio
Low	67,000	84	< $1	1.01
Medium	214,000	229	$73	2.44
High	515,000	553	$344	2.74

- Costs to establish program are relatively low
  - Customers already buying smart thermostats
- Today, about 1.5% of IN households (~36,000) have connected thermostats

Energy storage is cost-effective where there are locational T&D benefits

Avoided Cost Scenario	MW	NPV Benefits ($ million)	NPV Costs ($ million)	Net Benefits ($ million)	UCT Ratio
Low	0	$0	$0	$0	N/A
Medium	139	$353	$250	$103	1.41
High	329	$917	$606	$311	1.51

- Low Scenario assumed no T&D benefits
- Medium Scenario assumed locational T&D benefits across 5% of system; High Scenario assumed 10%.

Conclusions

- There is significant remaining DR potential in the C&I sectors
- With air conditioning a primary driver of summer peak demand, connected thermostats represent a significant opportunity to reduce residential energy use and provide savings
- The potential for cost-effective battery storage to produce savings grows as battery costs decrease
- Cost-effective DR and energy storage in Indiana have the potential to generate net benefits ranging from $448 million to $2.3 billion over 10 years, in scenarios representative of expected avoided costs in Indiana.

Thank you!

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