The added value of time-sensitive energy efficiency valuations

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Why does the timing of energy efficiency savings matter?

- Peak demand
  - Makes a few hours very costly
- Selection of demand-side resources
  - Interplay of efficiency measures and demand response
- Resource planning
  - Efficiency is one of many resources in an evolving grid
- Cost-effectiveness screening
  - Avoided system costs are important input

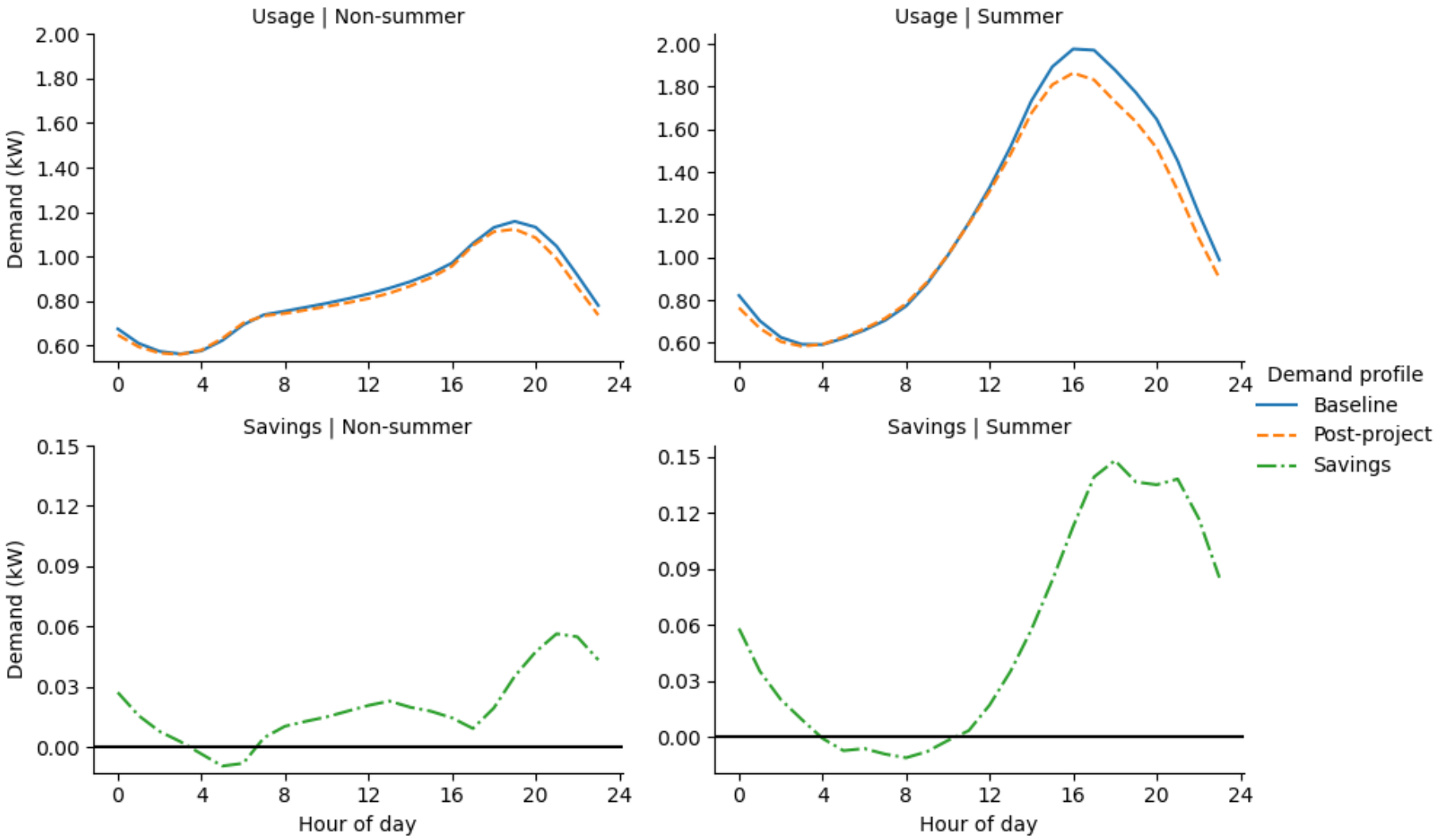
Time-sensitive value of efficiency – electricity savings

- Estimated electricity savings from efficiency projects in 18,000 CA households
  - Installed space conditioning measures through a Property Assessed Clean Energy program between 2009 and 2017
    - HVAC
    - Windows, doors, and skylights
    - Other envelope measures
- Savings are hourly and at the *household level*
  - Savings are the difference between pre- and post-project usage, controlled for weather
  - Estimated with normalized metered energy consumption methods (NMEC)
  - Illustrate how savings and value change over time with savings shapes

Time-sensitive value of efficiency – grid value

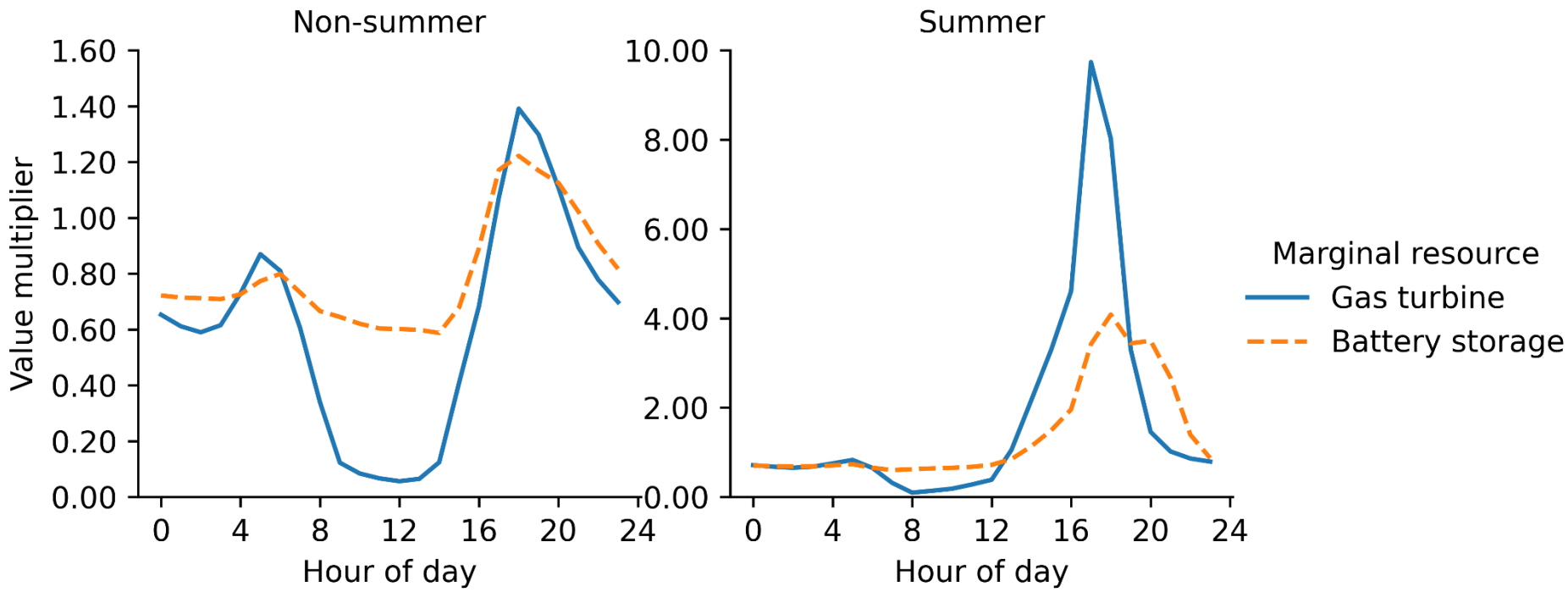
- Calculated the grid value of usage reductions for each measure category
  - Grid value ($2019) = Electricity Savings (kWh) x Avoided Costs ($/kWh)
- Avoided costs are the cost electricity system incurs if usage reductions did not occur
  - Hour-of-year (8760) by utility service territory
  - From California Public Utilities Commission (CPUC) Avoided Cost Calculator (ACC)
- Compared grid value for two scenarios:
  - Existing grid – gas turbine as marginal resource (2019 CPUC ACC)
  - Future grid – battery storage as marginal resource (2020 CPUC ACC)
- Compared grid value based on *hourly savings* with grid value based on *annual savings*
  - Indicates how time-sensitive valuation

Seasonal demand savings for all space-conditioning measures combined



- Summer (Jun-Sep), non-summer (Oct-May)
- Savings align well with peak period
  - 4-5PM in summer
  - 7-8PM in non-summer
- Savings highest in summer
- Savings remain high past peak period into late evening

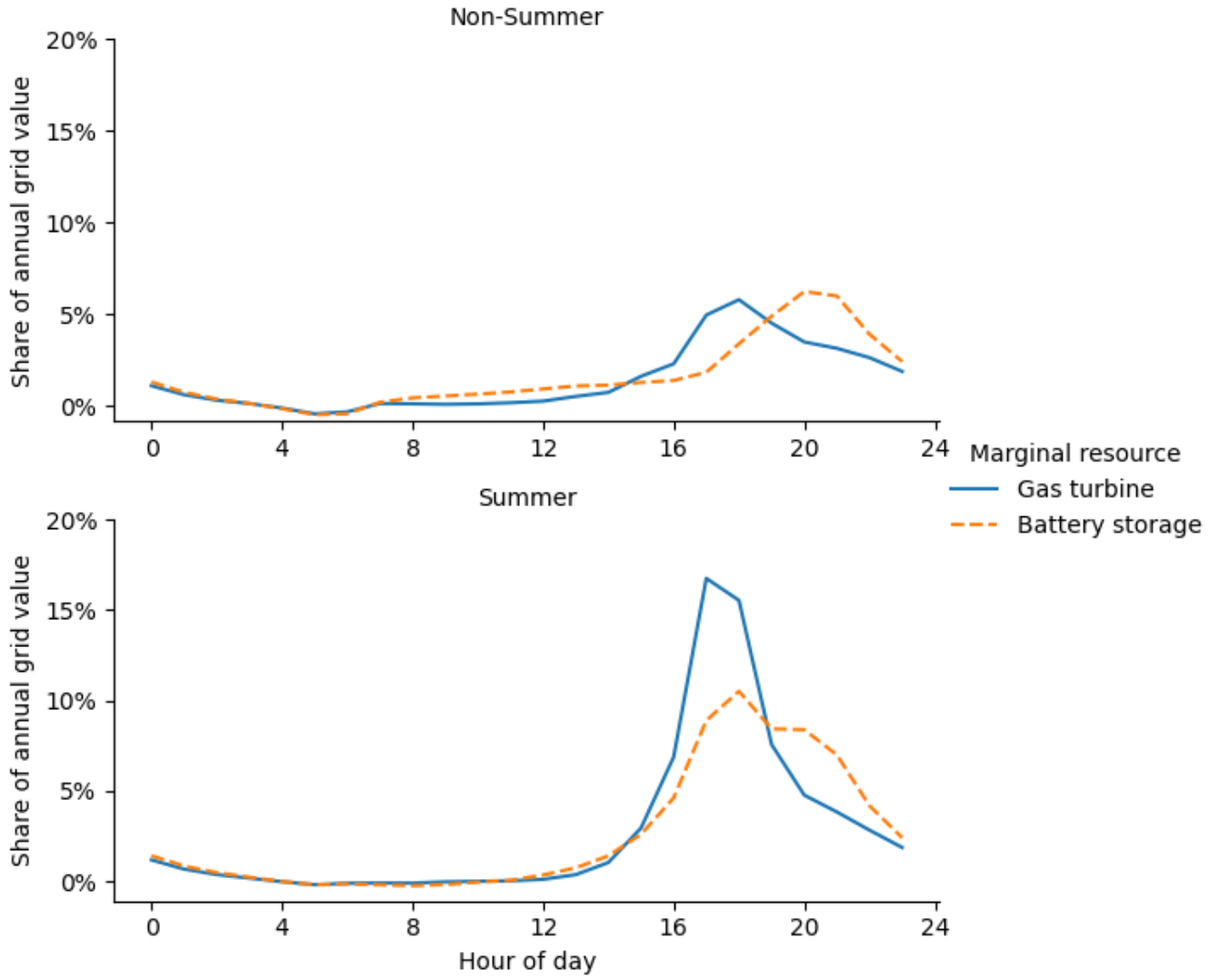
Marginal resource affects avoided costs



- Summer (Jun-Sep), non-summer (Oct-May)

- Value of energy efficiency changes with battery storage as marginal resource
  - Less value in summer *early* evenings
  - More value in summer *late* evenings
  - More value in non-summer mid-day

Grid value is concentrated in summer evenings



- Significant share of annual grid value results from summer savings 4PM-8PM
  - 47% with gas turbine as marginal resource
  - 32% with battery storage as marginal resource
- Larger share of value is in late evenings with battery storage as marginal resource

Comparing grid value

- Time-sensitive project grid value
  - Savings and avoided costs are both hourly
  - Add up value (savings x avoided cost) in each hour

- "Naïve" project grid value
  - Annual electricity savings x hourly annual avoided cost
  - Assumes savings are evenly distributed across year

- Value multiplier
  - Ratio of the time-sensitive project grid value to "naïve'" project grid value
  - Indicates how much more valuable projects are due to timing of usage changes

Value multipliers demonstrate time-sensitive value of efficiency

- Combined space conditioning value multipliers:
  - 1.53 with gas turbine as marginal resource
  - 1.37 with battery storage as marginal resource
- Multipliers are above 1.0 for all measures individually
- More value accounted for when hourly savings are used
- Value multipliers *are not:*
  - ranks
  - measures of absolute impact
  - cost-effectiveness screens

Key takeaways

- Space-conditioning savings align well with CA peak demand
- Timing of savings matters
  - 40-50% more grid value with time-sensitive approach
- Accurate estimates of peak demand savings important for cost-effectiveness
  - Significant share of annual grid value results from summer evening savings
- Evolving grid changes value of efficiency
  - Summer peak period less valuable, but still most valuable time for savings
  - Late summer evenings more valuable

The Time-Sensitive Value of Energy Efficiency Calculator

- Publicly-available tool that estimates the time-sensitive value of up to six EE measures using hourly cost estimates for five value streams:
  - Avoided generation, transmission, and distribution costs
  - Avoided GHG emissions costs
  - Avoided electric energy costs

- Output includes
  - Net present value of selected EE measures over their lifetime
  - Annual benefits by measure and value stream over the analysis period
  - Average hourly benefits by measure and value stream

Contact information and related work

- Email: smurphy@lbl.gov
- Related work from Berkeley Lab
  - Time and locational-sensitive value of efficiency series
  - Cost of Saved Energy series