July 16, 2020

VERMONT PUBLIC SERVICE DEPARTMENT

RATE DESIGN INITIATIVE / DISTRIBUTED ENERGY RESOURCES STUDY
STAKEHOLDER ENGAGEMENT MEETING #5

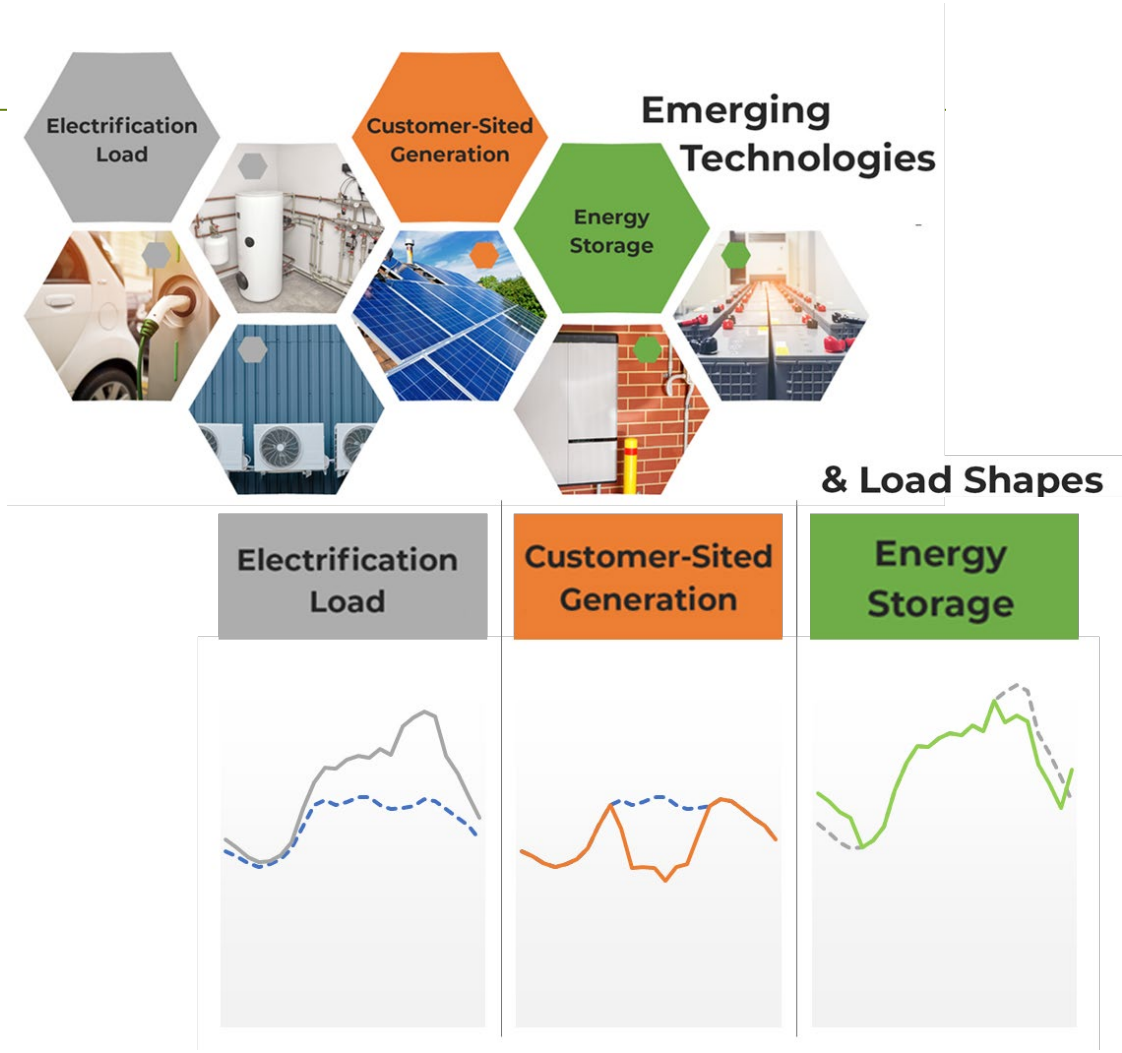
NewGen Strategies & Solutions

PRESENTATION OUTLINE

- Introduction
  - Vermont's Energy Vision, Technology Adoption and Load Shapes
  - Load Control Programming
  - Quantitative Results
- Problem Statement
- Recommendations

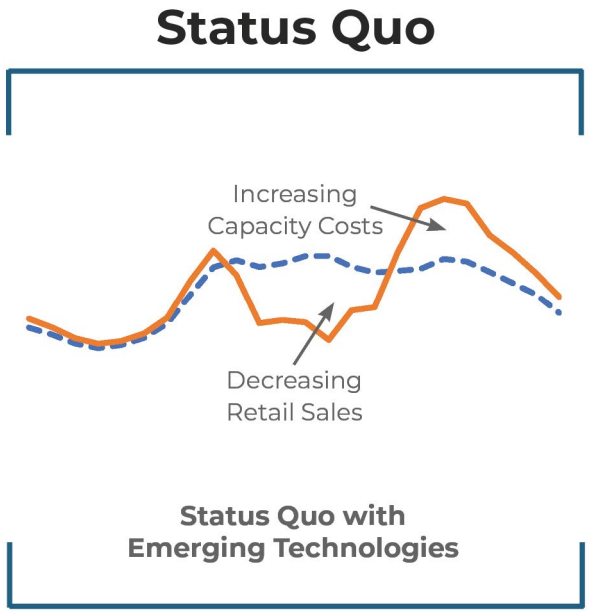
ELECTRICITY USAGE IS EVOLVING AS A FUNCTION OF TECHNOLOGY ADOPTION

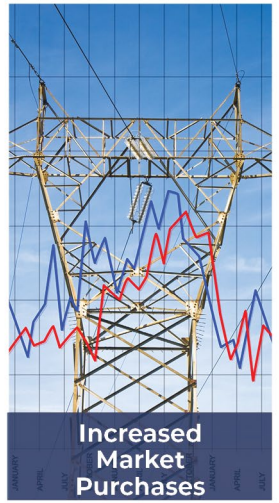
- For the purposes of this Study, we have focused on:
  - Electrification Load:
    - Electric Vehicles (EV)
    - Cold Climate Heat Pumps (CCHP)
    - Heat Pump Water Heaters (WH)
  - Customer-Sited Generation (solar PV)
  - Energy Storage / Controllable Loads
- Focus here due to adoption rates, inherent load flexibility, and policy support
  - Comprehensive Energy Plan, and electrification as decarbonization



INCREASING LOAD WILL DRIVE CAPACITY-RELATED COSTS

- Absent management, Emerging Technologies' load will likely be largely coincident
  - Increasing peak demand during times of existing peak demand
    - Weather impacts + behavioral patterns from 9-5 workday
- A "Status Quo" case is established estimating cost of "purchasing" capacity from the "market"
  - ISO-NE Forward Capacity Market
  - Regional Network (Transmission) Service (RNS)
  - Incremental Distribution Capacity

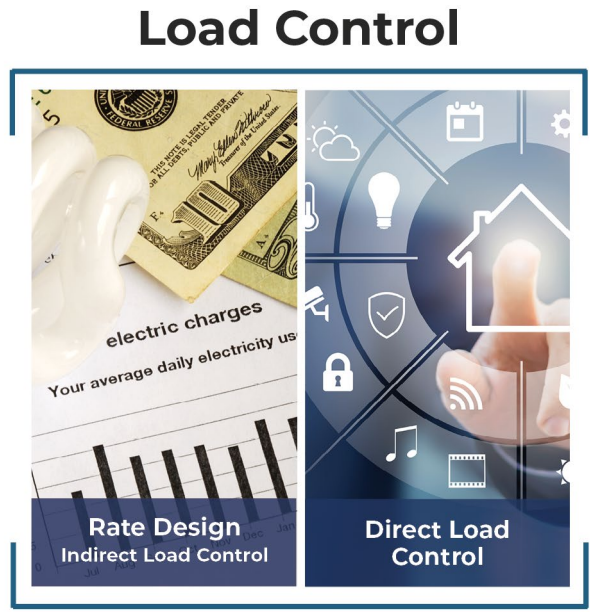




STRATEGIC LOAD CONTROL CAN AVOID OR DELAY INCREASED CAPACITY COST

- Strategic Load Control Programming can avoid or delay increased costs
- Load Control Programming can entail:
  - Indirect Load Control
    - Rate Design and customer response
  - Direct Load Control
    - Direct control of end-use electric consumption by utility and/or 3rd party

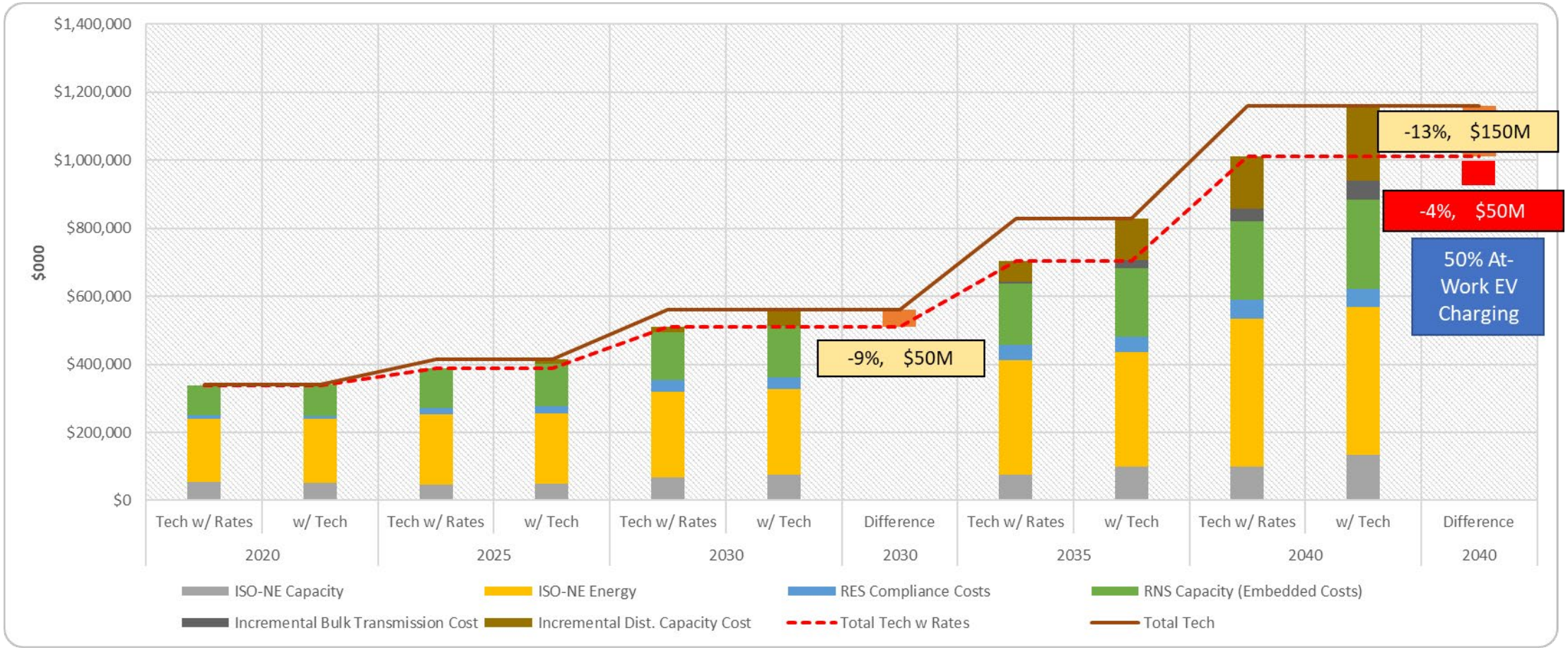
The purpose of this Study is to assess the potential for and implementation challenges of Load Control Programs



The Value of Load Control Programs

COMPARISON BETWEEN MODELED SCENARIOS

TECHNOLOGY ADOPTION FUTURE VS. TECH W/ RATES, AT-WORK EV - 2040

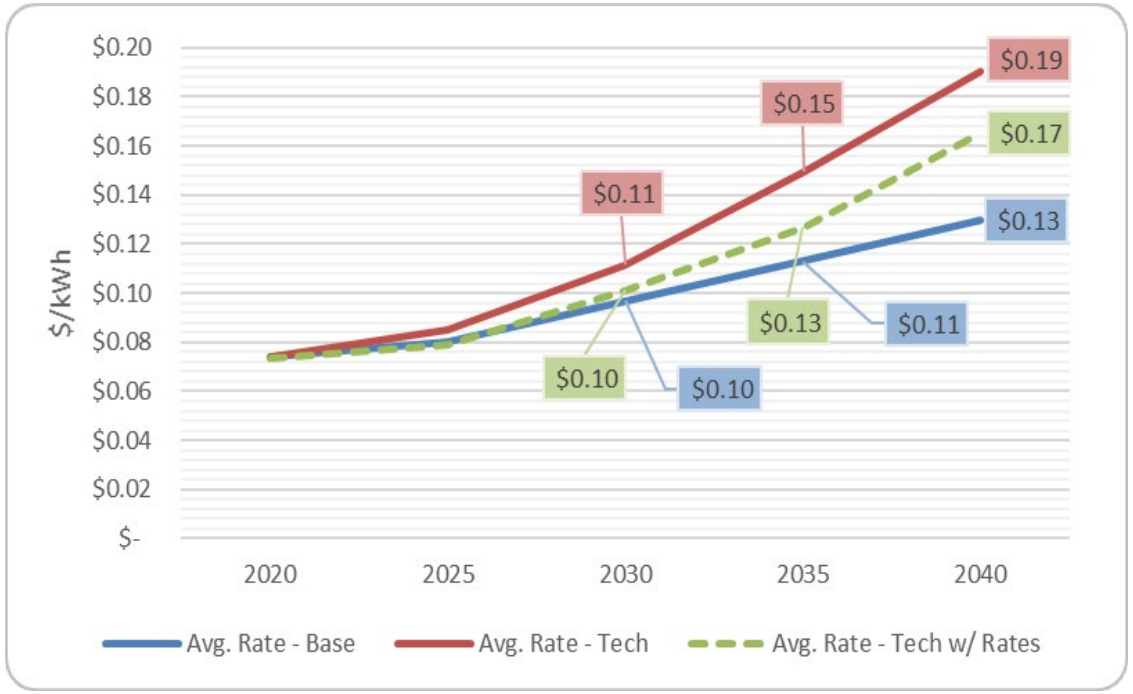


Downward Pressure

LSAM MODELED RATE PRESSURE

BEFORE AND AFTER STRATEGIC RATE DESIGN

- Electric market evolution will exert upward rate pressure
  - CAGR of 4.8% vs. 2.8% (Base)
- Load Control Programs can manage load and costs
  - Modeled savings $150M-$200M
  - Upward rate pressure is nearly avoided in 2030
  - Nearly cut in half by 2040



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LOAD CONTROL PROGRAM DESIGN

IMPLEMENTATION AND ENROLLMENT

- To improve efficacy in managing load shapes:
  - How do you increase enrollment to increase capacity under management; AND
  - How do you improve customer responsiveness or efficacy in managing load?
- Options include:
  - Program Structure (mandate, opt-out vs. opt-in, etc.)
  - Strategic targeting of loads
  - Marketing
  - New business models

"Time-differentiated rate design is not a new concept . . .

We've had a TOU rate for years and nobody's on it"

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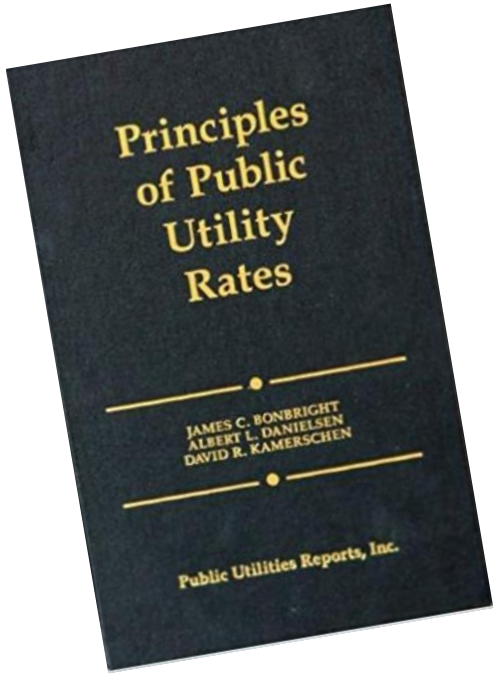
INDIRECT LOAD CONTROL PRICING (RATE DESIGN)

HOURLY AND MARGINAL VS. EMBEDDED COST OF SERVICE

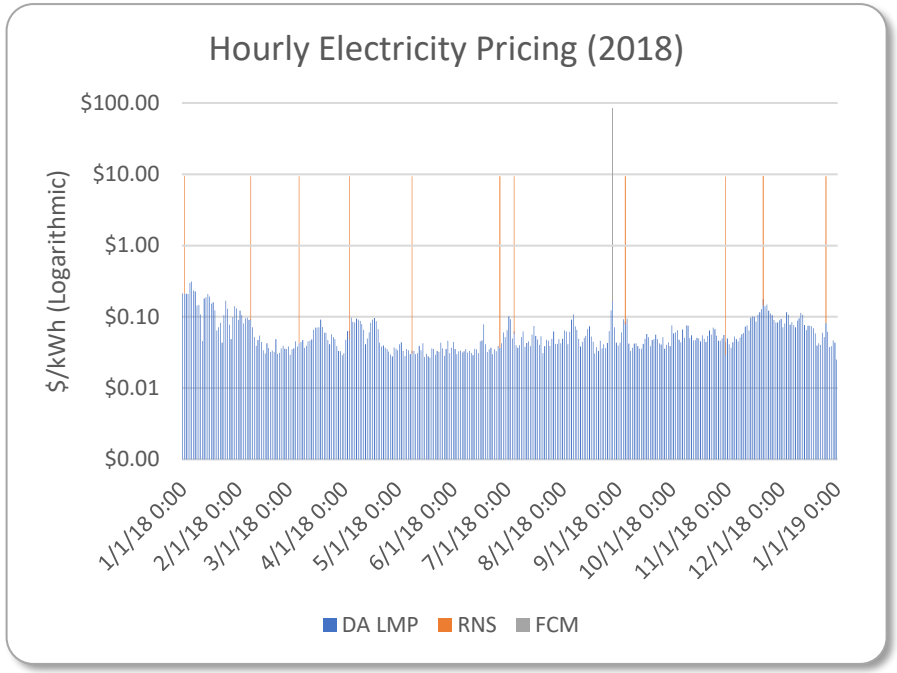
- Electric rates should promote stability, equity, and recover costs
- Allocated cost of service is important in aligning cost-drivers with cost recovery
- Data collection and management is paramount even in embedded COS



INDIRECT LOAD CONTROL PRICING (RATE DESIGN)

HOURLY AND MARGINAL VS. EMBEDDED COST OF SERVICE

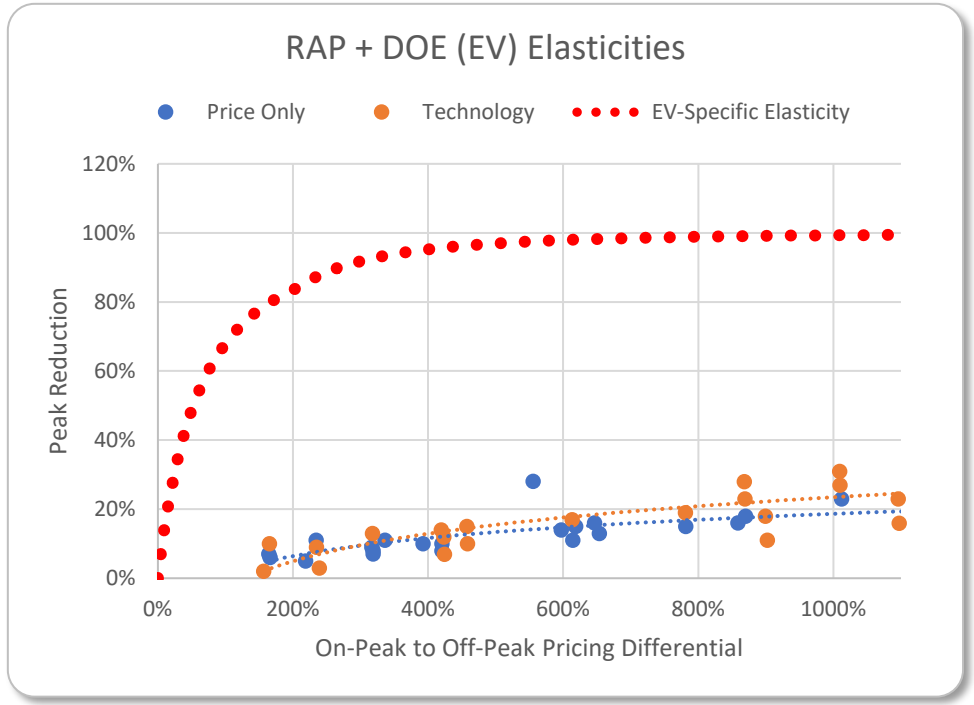
- Electric system costs are a function of electric consumption during all hours
  - But some hours are more costly than others
- Innovative rate design informed by marginal costs serves a dual purpose:
  - Improves equity in aligning with cost causation
  - Signals the customer to change usage patterns
- Marginal cost analyses can inform incentives for customer behavior change



INNOVATIVE ELECTRIC RATE DESIGN

END-USE DIFFERENTIATED ELECTRIC RATE DESIGN

- Certain loads can be "turned down"* with minimal impact to customer
  - EV charging
  - Heat pump water heaters
  - Others (commercial opportunities?)
- Importance of "consumer comfort"
  - Will a targeted change to usage be "felt" by the customer?
    - Turning down heating/cooling during the coldest/hottest hours of the year



* By the customer and/or directly by the utility

LOAD CONTROL PROGRAM DESIGN

INNOVATION IN TECHNOLOGIES AND BUSINESS MODELS

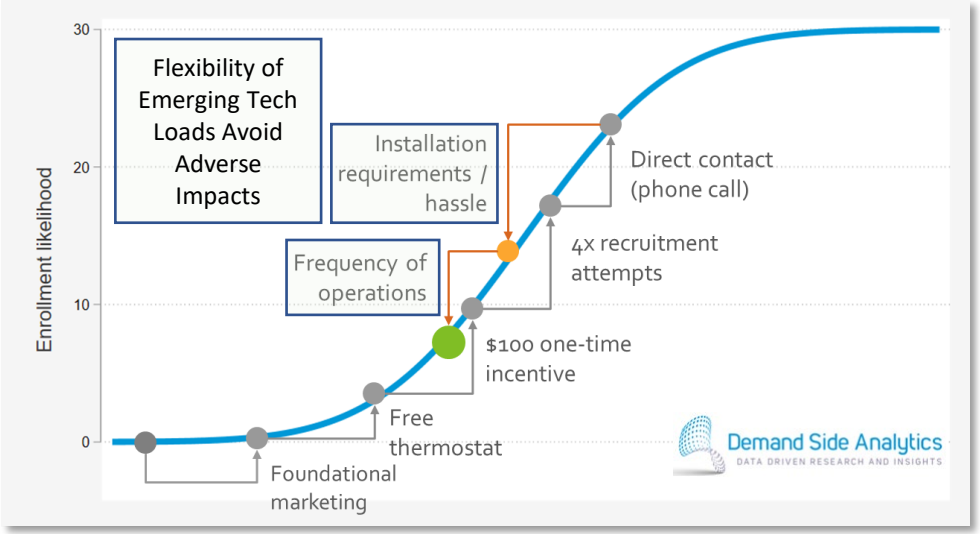
- Technology innovation
  - Increased automation of existing devices
  - Newly connected devices
- Business model innovation
  - 3rd party offerings
  - Utility offerings
    - Fixed fee(s) for service with utility direct control of inefficient energy use

Recommendation: Continued innovation will spur additional opportunities both in automation technology, new flexible loads, and business models

LOAD CONTROL PROGRAM DESIGN

IMPLEMENTATION AND ENROLLMENT CHALLENGES

- Program Structure (e.g., mandates, opt-out, opt-in)
- Program design and pricing to increase enrollment
  - Voluntary enrollment in Load Control Programs is deterred by
    - Increased frequency of behavior change; and/or
    - Risk of higher electric bills deter enrollment
  - Emerging Technology loads are flexible
    - Change electric usage patterns without frequent behavior change
    - Without sacrificing performance
- Proactive and increased marketing
  - Partnerships with device vendors offering programs that save the customer money
  - Incentives in exchange for enrollment
    - Mandatory or opt-out



CONCLUSION

- Emerging Technologies will drive increased costs
  - Offset by decreased fossil fuel purchases
- Load Control Programs can manage costs
- Load Control Programs face implementation challenges, that can be mitigated based on some combination of:
  - Program enrollment structure
  - Program design and pricing based on targeted end-use
  - Increased marketing
  - Continued innovation of technology and business models

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PROJECT WRAP-UP AND ACKNOWLEDGEMENTS

- The electric market is evolving at an unprecedented pace
  - Technology advances in communications, metering, and automation have expanded being provided to a more engaged customer
  - The future looks to continue to offer opportunities for Load Control Programs to bring value in avoiding future capacity costs
  - Billing, metering, data management, communications systems, etc. take time to build out
  - Transmission planning (in particular) has a long on-ramp

Now is the time to plan for a future with more electric sales and to develop programs to manage evolving load shapes

PROJECT WRAP-UP AND ACKNOWLEDGEMENTS

- As part of the initial steps of this project, NewGen conducted a survey of innovative rates/programs
  - There are many long-running static TOU programs, largely with limited enrollment
  - There are not many direct load control programs
    - Specifically, Vermont is a leader in EV and BTM-storage Direct Load Control programming
  - Vermont should be commended for leading in this space
    - Continue to innovate, and share best practices internally between utilities that have implemented Load Control Programs and those that are in development

PROJECT WRAP-UP AND ACKNOWLEDGEMENTS

- NewGen thanks the diverse and well-informed stakeholders, provided below in alphabetical order

▪ Aegis Renewables	▪ Greenlots	▪ Sun Run
▪ Burlington Electric Dept. (BED)	▪ JouleSmart	▪ University of Vermont
▪ DC Energy Innovations	▪ MMR LLC	▪ Vermont Electric Cooperative (VEC)
▪ Demand-Side Analytics	▪ Norwich Technologies	▪ VEIC
▪ Dynamic Organics	▪ Oracle	▪ Vermont Electric Power Company (VELCO)
▪ Energy Action Network, Vermont	▪ Packetized Energy	▪ Vera Renewables
▪ Energy Futures Group	▪ Peck Electric	▪ Vote Solar
▪ Efficiency Vermont	▪ Public Service Department	▪ Vermont Public Power Supply Authority (VPPSA)
▪ Green Mountain Power (GMP)	▪ Regulatory Assistance Project	▪ Washington Electric Cooperative
▪ Grassroots Solar	▪ Renewable Energy Vermont	

- In addition, NewGen would like to thank the Vermont Public Service Department and the U.S. Department of Energy