Electricity Committee

Gas Committee

Committee on Consumers and the Public Interest

NARUC Summer Policy Summit

Another Outlet for Discussion:

The Effects of *Electrification* on the Electric and Natural Gas Industries, the Environment, and Consumers

NARUC Summer Policy Summit

Moderator:

- Hon. Judy Jagdmann, Virginia

Panelists:

- Tom Wilson, EPRI
- Phil Jones, Alliance for Transportation Electrification
- Chris McGill, American Gas Association
- Elin Katz, Connecticut Consumer Counsel

NARUC Summer Policy Summit

EPRI's US National Electrification Assessment: Key Insights

Tom Wilson
Principal Technical Executive

NARUC Session on the Effects of Electrification on the Electric and Natural Gas Industries, the Environment, and Consumers
July 16, 2018

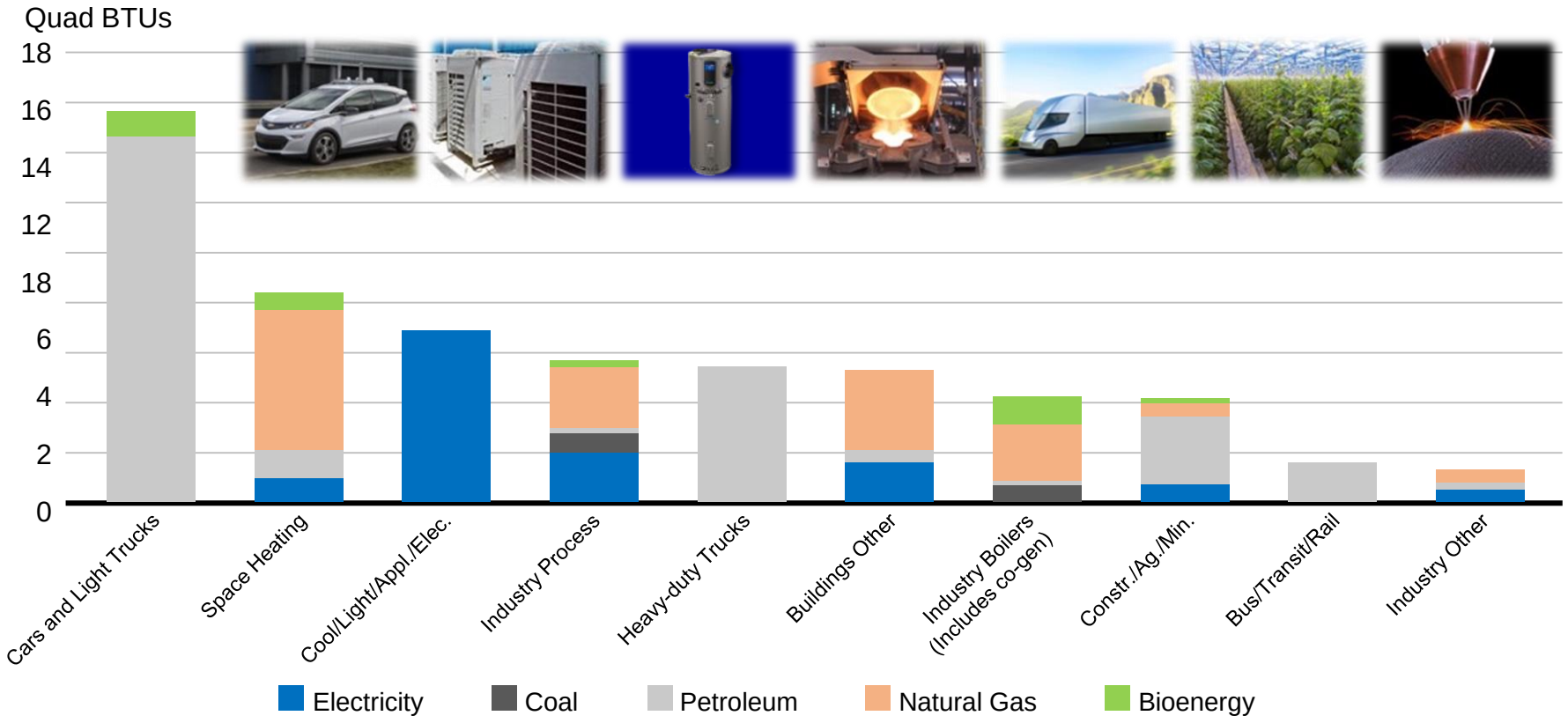
U.S. National Electrification Assessment (USNEA)

- Economy-wide assessment:
  - Residential, commercial, industrial and transport
- Customers have broad technology choices and control
- Customer decisions integrated with detailed electricity supply model

- Just the beginning … kickoff to EPRI's Electrification Initiative

For more information on EPRI's Efficient Electrification Initiative:
https://www.epri.com/#/pages/sa/efficientelectrification

End Use (Final) Energy Use By Sector

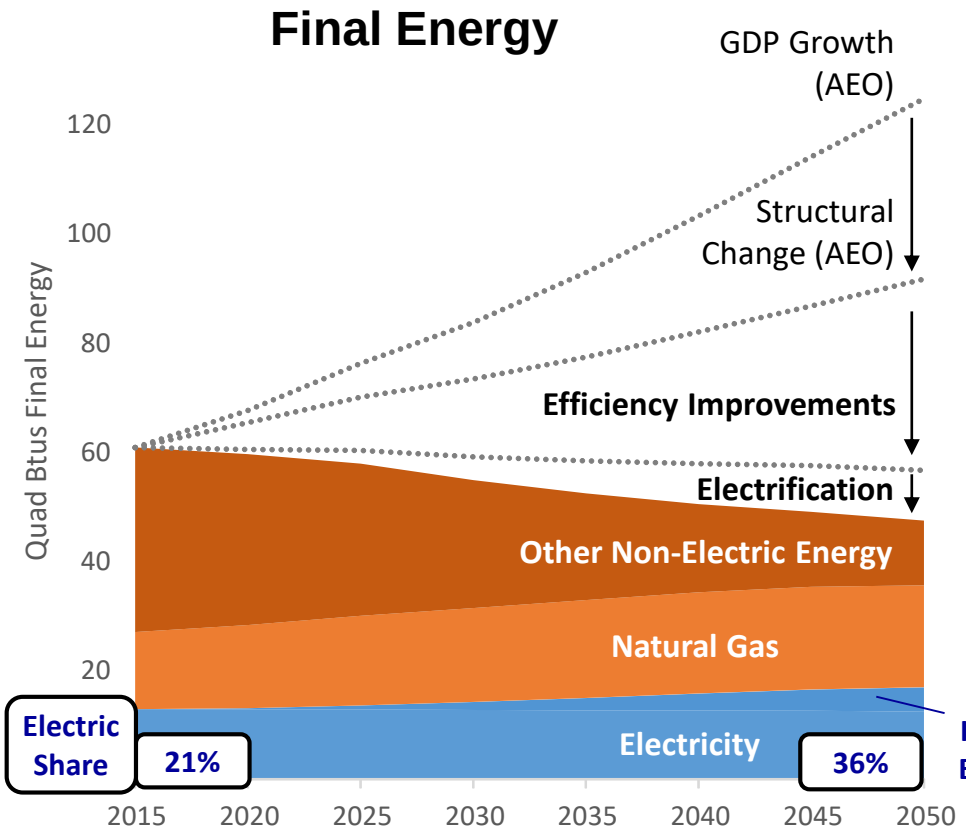


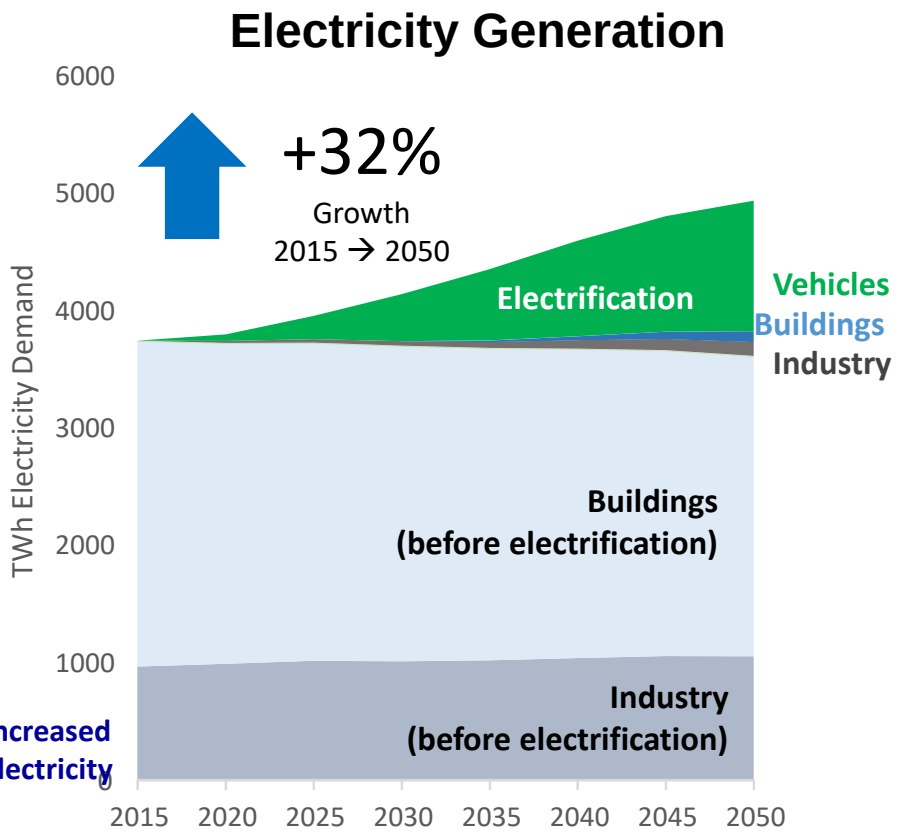
** Excludes upstream and midstream energy use, e.g., power generation, oil and gas extraction, refining, and pipelines*

EPRI's US National Electrification Assessment Scenarios

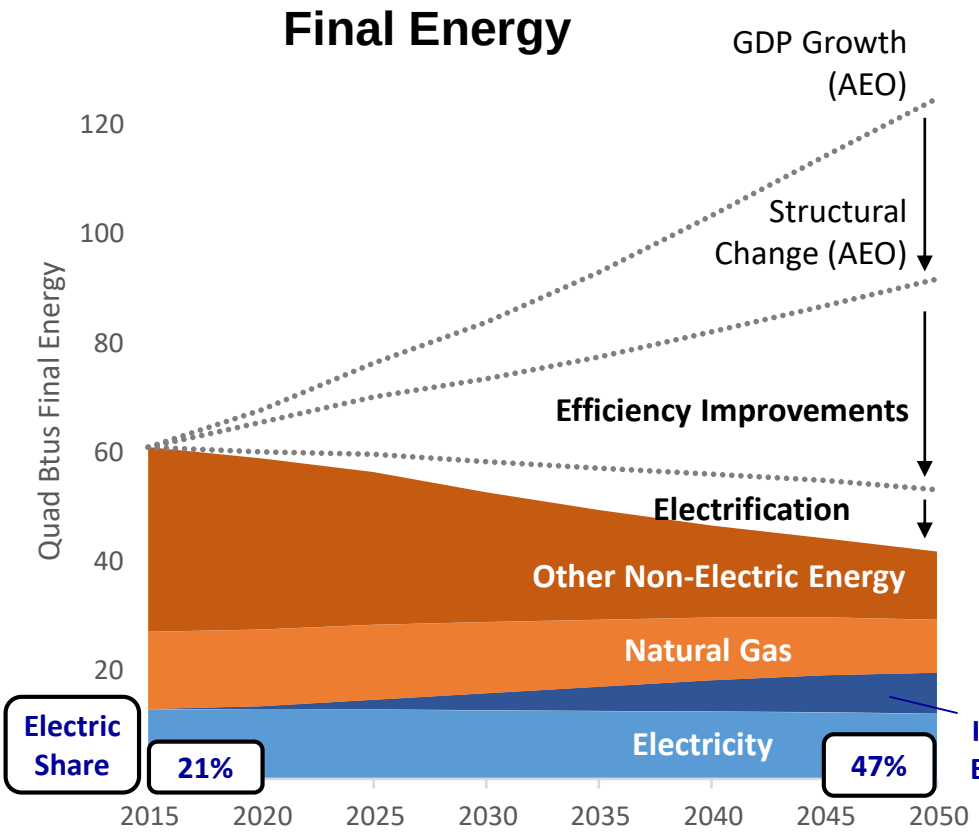
CONSERVATIVE	Slower Technology Change	• AEO 2017 growth path for GDP and service demands, and primary fuel prices • EPRI assumptions for cost and performance of technologies and energy efficiency over time • Existing state-level policies and targets
REFERENCE	Reference Technology	
PROGRESSIVE	Reference Technology + Moderate Carbon Price	
TRANSFORMATIO N	Reference Technology + Stringent Carbon Price	

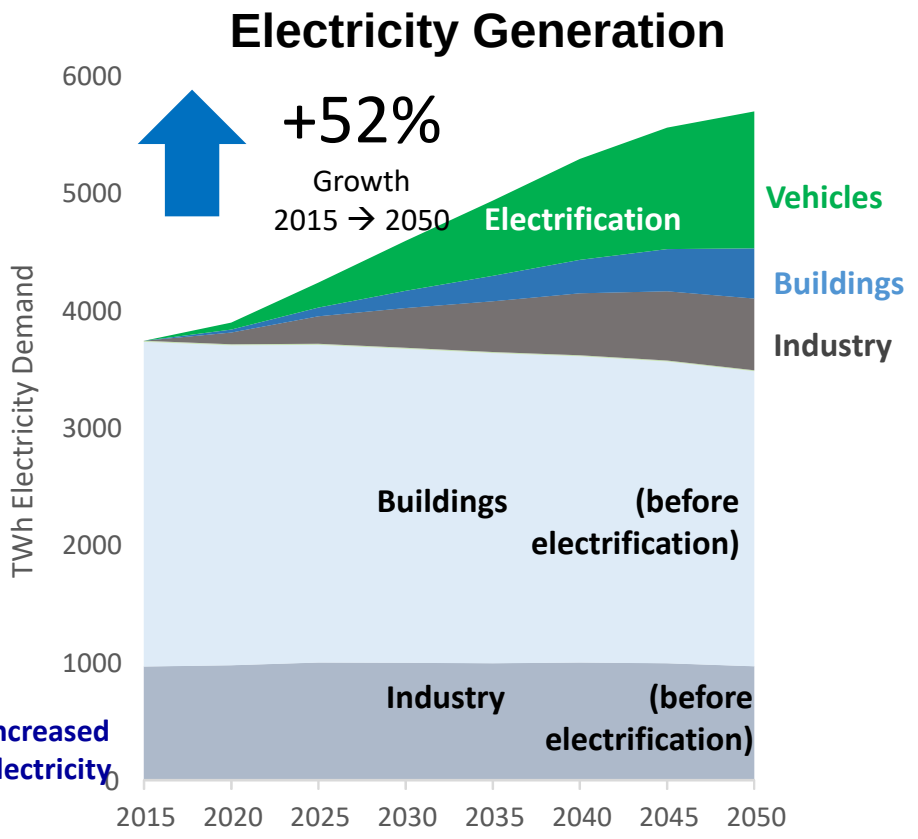
Efficient Electrification: Reference Scenario



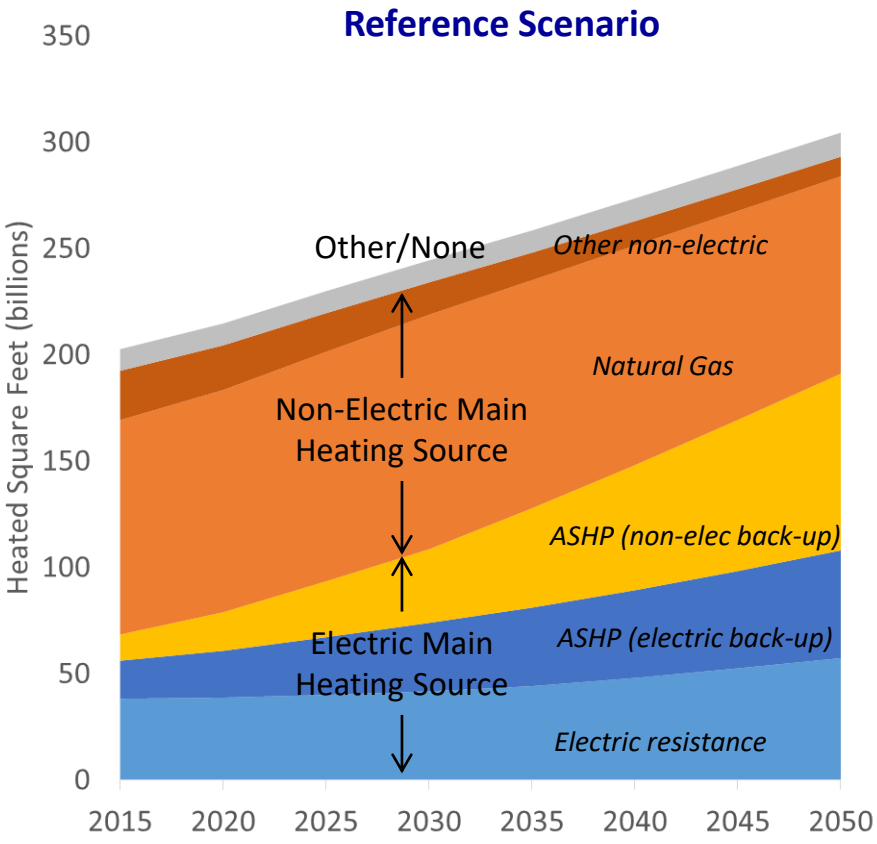


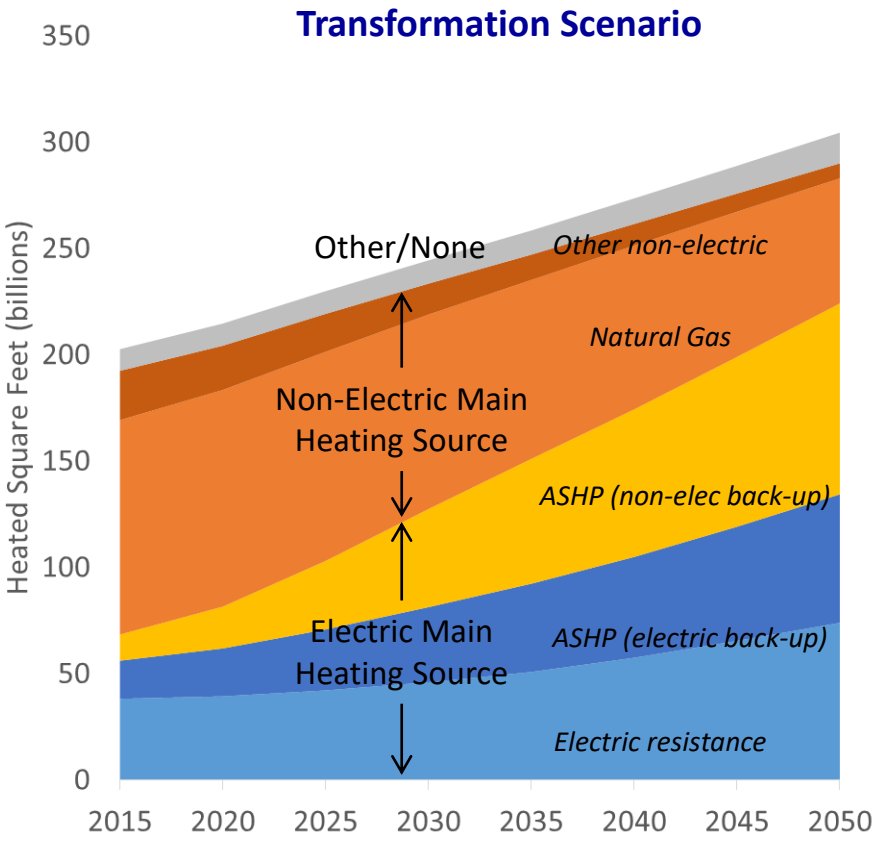
Efficient Electrification: Transformation (tight carbon target)



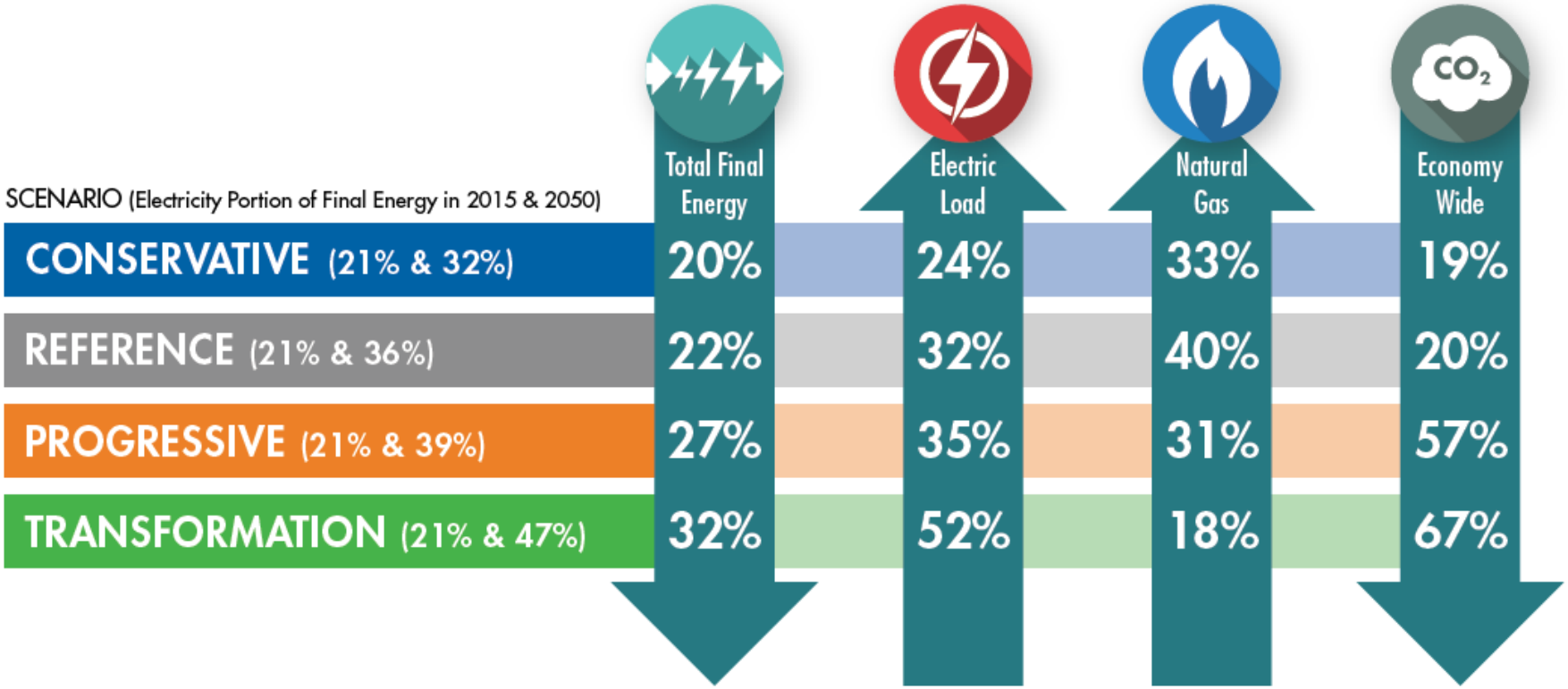


Projections for US Residential Space Heating Services

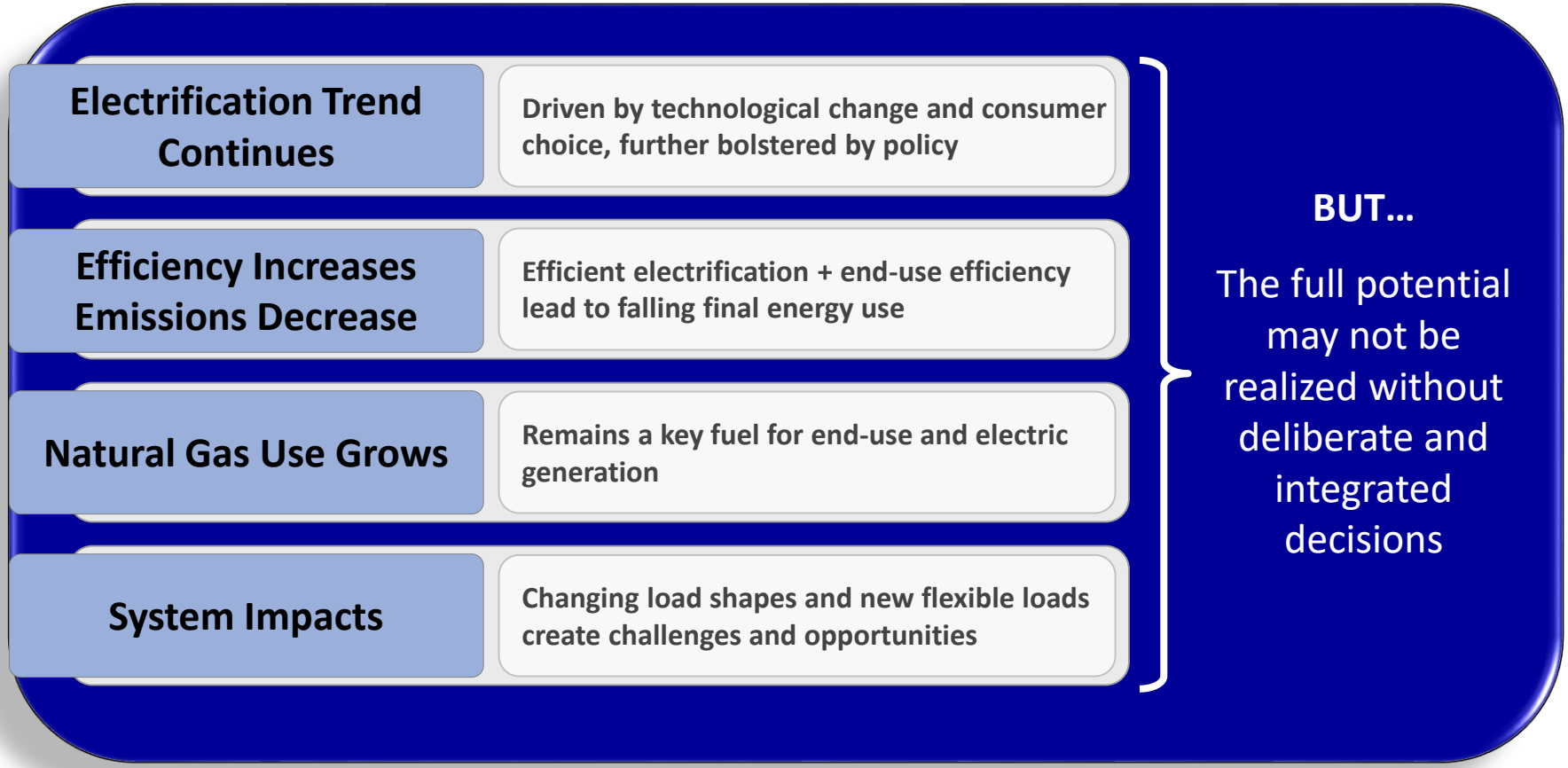




U.S. National Electrification Assessment (USNEA) - Results

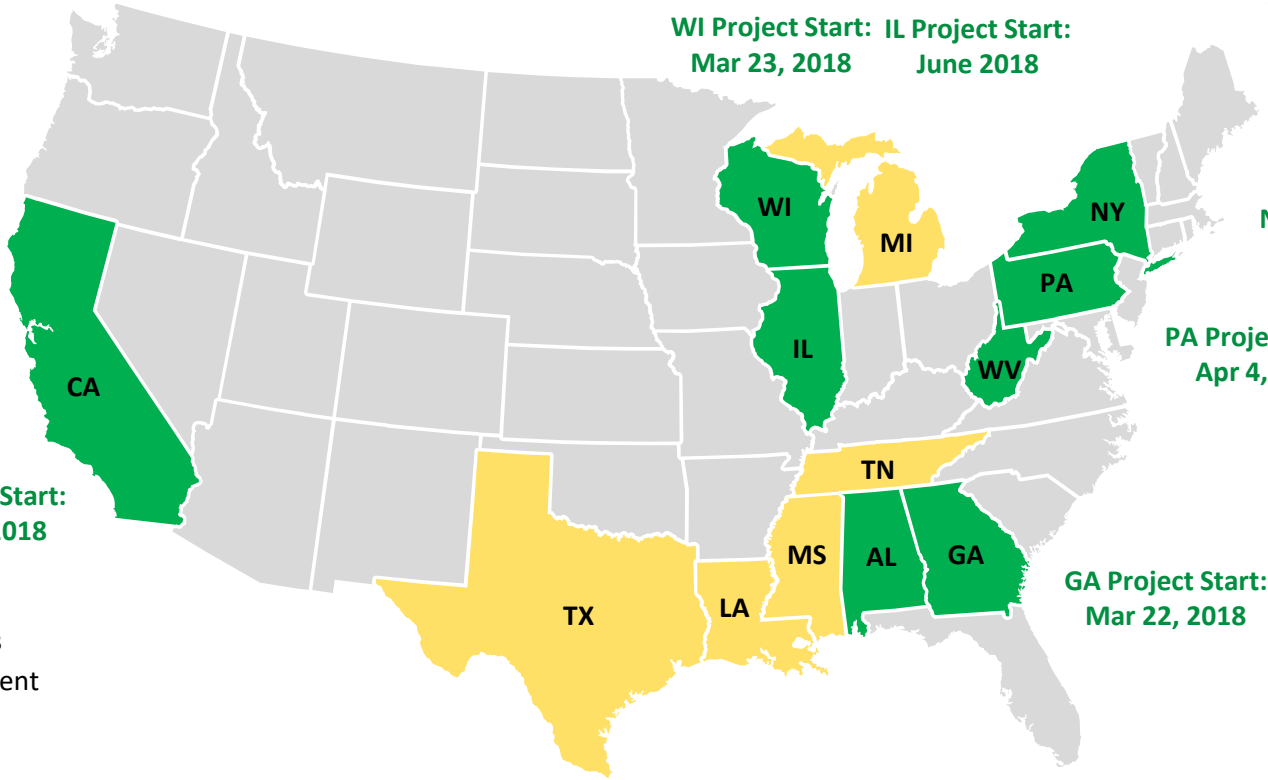


Key Take Away Messages from National Electrification Assessment



State and Utility Electrification Projects in Development

FOCUS:
- Economics
- Air Quality
- Grid Impact
- Implementation

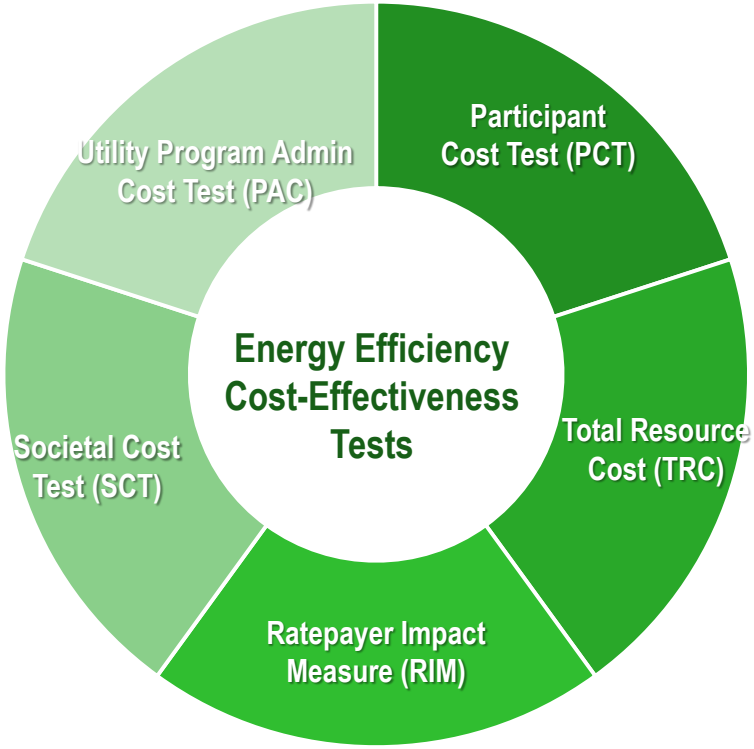


Key – State Project Status
- Funding Commitment
- Interested

State-wide level of Electrification Assessment

June 30, 2018

Efficient Electrification Benefits/Cost Framework… Leveraging Efficiency Cost-Effectiveness Tests...



KEY QUESTIONS

- IS THE PARTICIPANT BETTER OFF? (PCT)
- IS RESOURCE EFFICIENCY IMPROVED? (TRC)
- ARE RATES LOWERED (RIM)
- ARE SOCIETAL COSTS LOWER? (SCT)
- ARE REVENUE REQUIREMENTS LOWERED? (PAC)

LEVERAGE EFFICIENCY COST EFFECTIVENESS TESTS…FOCUS ON REGULATORY SUPPORT

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

ELECTRIFICATION 2018

INTERNATIONAL CONFERENCE & EXPOSITION

www.electrification2018.com

SAVE THE DATE

AUGUST 20-23, 2018 LONG BEACH, CALIFORNIA

- To gain an understanding of the quantifiable customer and environmental benefits of efficient electrification
- To learn about best practices for implementing efficient electrification programs to maximize customer benefit
- To experience the latest electrification-related technologies in action
- To collaborate with industry, government, and academic leaders

For more information, contact Info@Electrification2018.com

Scan here for the latest EPRI Efficient Electrification newsletter

Together…Shaping the Future of Electricity

Thoughtful Pathways

Examining Natural Gas and the Cost Implications of Policy Driven-Residential Electrification

Chris McGill
VP Energy Markets, Analysis and Standards
NARUC, July 2018

Progress in technology and market developments for all energy sources need to be understood and acknowledged but what problem is *policy-driven* electrification of the natural gas residential space and water heating sector trying to solve?

Main Questions the Study Addresses

AGA Study

- Will residential electrification actually reduce emissions?
- How will residential electrification impact natural gas utility customers?
- What are the impacts on the Power Sector and Transmission infrastructure?
- What is the overall cost of residential electrification?
- https://www.aga.org/research/reports/implications-of-policy-driven-residential-electrification/

Initial Findings from Study

1. **Natural gas is a critical residential energy source: Residential natural gas demand in January is more than twice electricity demand in July**

2. **Total GHG reduction potential from policy-driven residential electrification is small: Ranging from 1.0 to 1.5 % of U.S. GHG emission in 2035.**

3. **Policy-Driven Electrification will be burdensome to customers: average residential household energy costs (utility bills and equipment/renovation costs) increase by 38 to 46 %.**

Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Initial Findings from Study

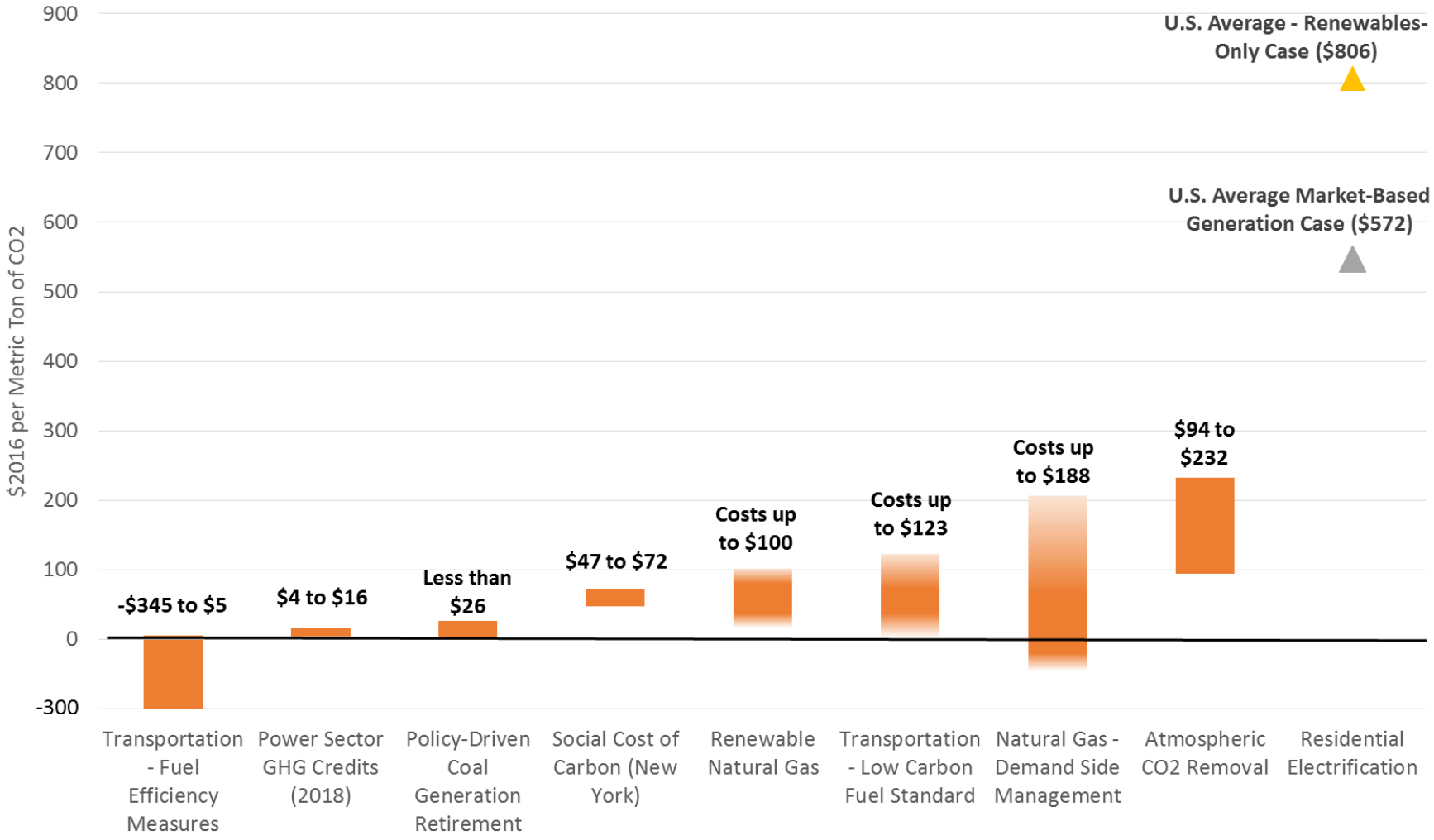
4. A policy-driven residential space and water heating strategy is expensive to the economy - $590 Billion to $1.2 Trillion in total incremental energy costs.

5. Such a policy may require infrastructure investments of $150 to $425 Billion for generation capacity and transmission.

6. Policy-driven electrification of the residential sector is an expensive tool for greenhouse gas emissions reductions - $572 to $806 per ton CO2.

Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Emissions Reductions Costs for Alternative Approaches to Reducing CO2 Emissions



Source: Implications of Policy-Driven Electrification of Residential Gas Use, AGA, July 2018.

Emerging gas technologies can make substantial and cost-effective contributions to GHG reduction goals

~100	25-40%	60-80%
Innovative Gas Technologies for Residential / Small Commercial identified in our global search	**GHG reduction potential on a customer basis by integration of these technologies and other efficiency practices**	**GHG reduction – sufficient to meet COP 21 goals – with inclusion of future CHP technologies and Renewable Gas**

- Policy goals for sustainable energy can be achieved at significantly lower consumer cost through integrating innovative gas solutions into long-term resource planning, while offering customers more choice and improved affordability, reliability and comfort.
- Gas technologies can enhance energy system reliability (system-wide and as a local backup) and efficiency, while reducing the need for new electric generation and T&D infrastructure and preserving the future value of gas infrastructure.
- Electric technologies will also improve, and are supported by incentives, but their GHG impacts depend on the generation fuel mix. In some regions electrification may increase GHG emissions through the 2030s.

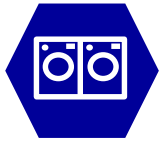
Enovation Partners, May 2018.

Innovative technologies were assessed, prioritized and aligned with relevant end use pathways

High priority technologies by major end use, Enovation Partners, May 2018

- Low-cost residential gas absorption heat pump (GAHP) combination
- Condensing furnace
- Transport Membrane Humidifier (TMH)

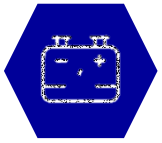
- Tankless water heater - Maintenance-free approaches for tankless water heaters
- Solar-assisted heating - PV assisted domestic hot water heater (potable)
- Unplugged power burners - Two-Phase Thermo-Syphoning (TPTS) technology
- Combined Space and Water Heating Systems*



- Ozone and cold water washing

- High production fryers
- Boilerless steamer - Multistacked convention steamer for high volume cooking
- Combination steam and heat oven

- IoT thermostats (i.e. Nest, Honeywell)
- Building envelope (insulation, windows, building materials)
- Demand controls for HW systems
- Thermostatically controlled low flow shower head



- Solid oxide fuel cells*
- Micro CHP – gas recip, sterling engine*

- Fuel cell electric vehicles (hydrogen)
- Commercial CNG vehicles

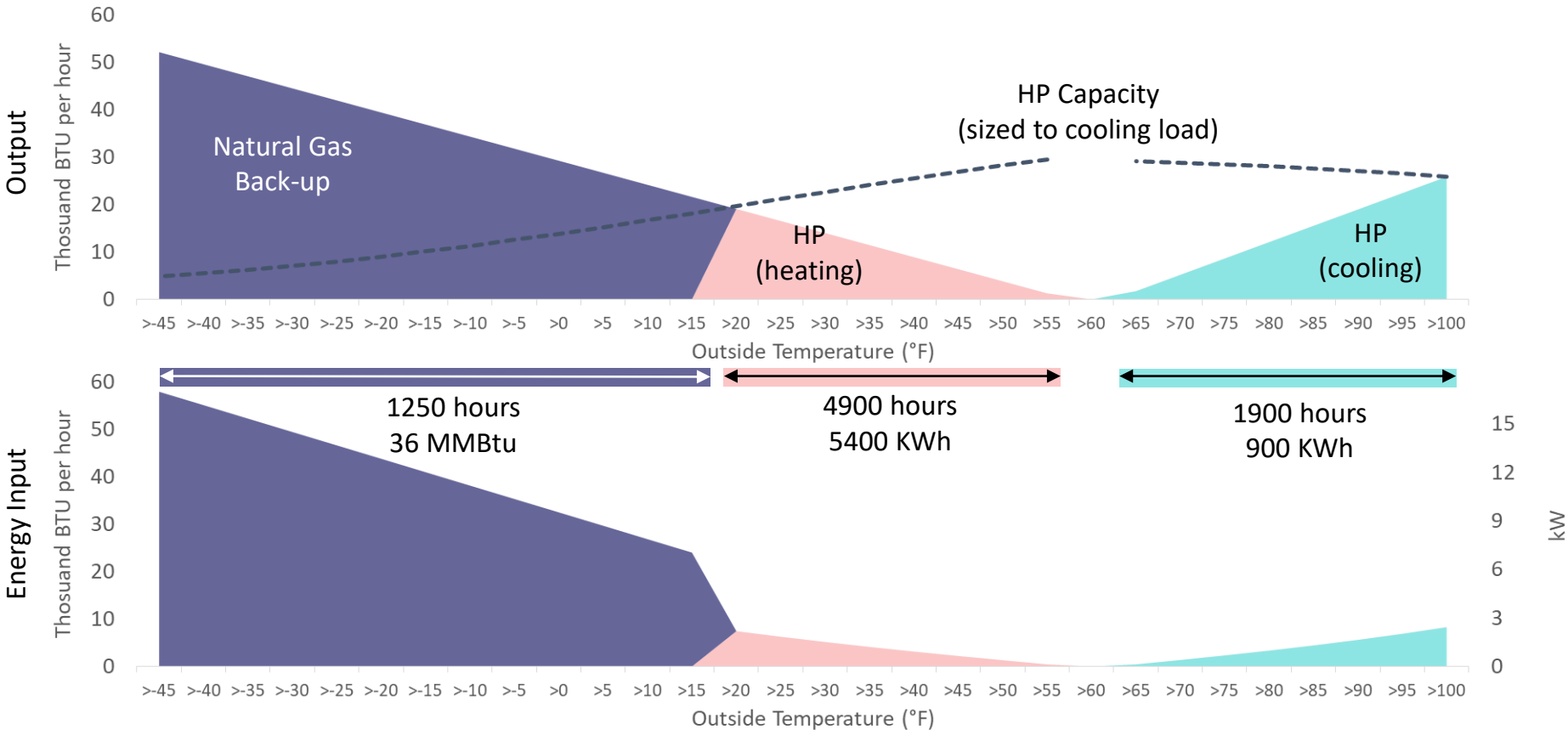
Note: All technologies were independently evaluated and scored by several SMEs; evaluation criteria primarily considered GHG impact and time to market; aggregated scores were consistent among experts and robust against multiple weightings; * designates technology with multiple end-uses, but listed only once

Questions?

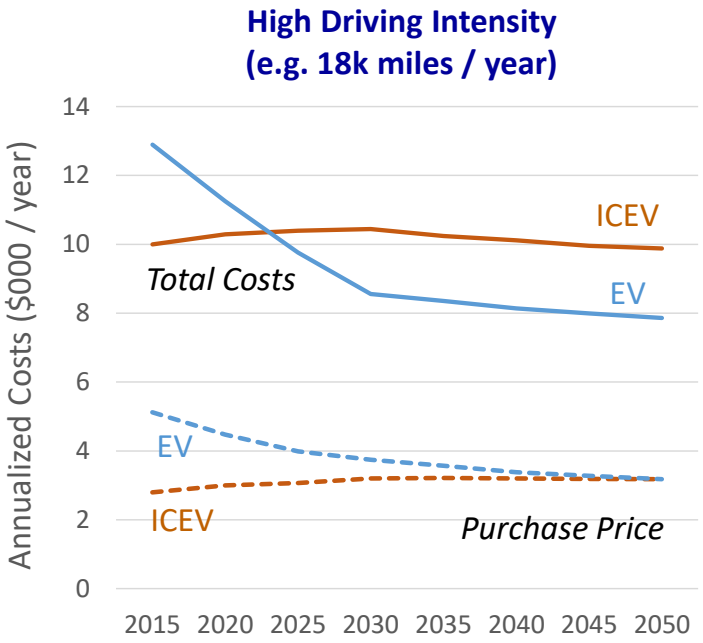
Chris McGill
VP Energy Markets, Analysis and Standards
American Gas Association
cmcgill@aga.org

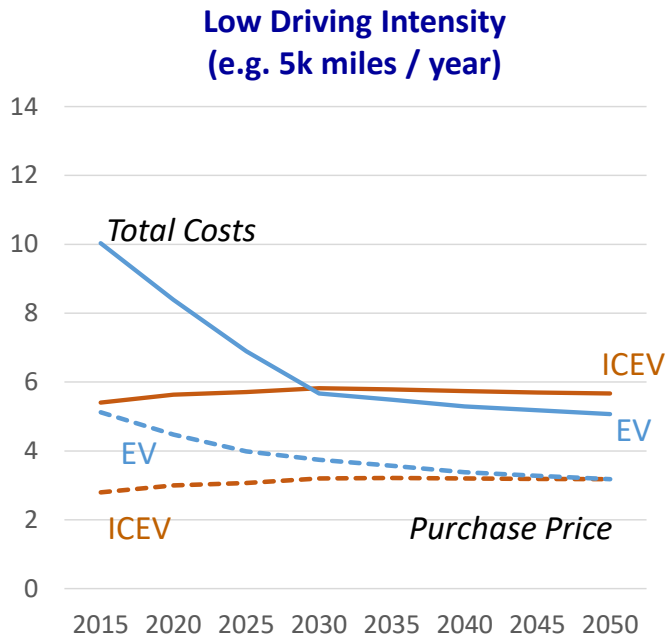
EPRI Backup Slides

Hybrid Gas-Electric Heat Pump System Potentially Attractive (e.g., Northern Wisconsin)



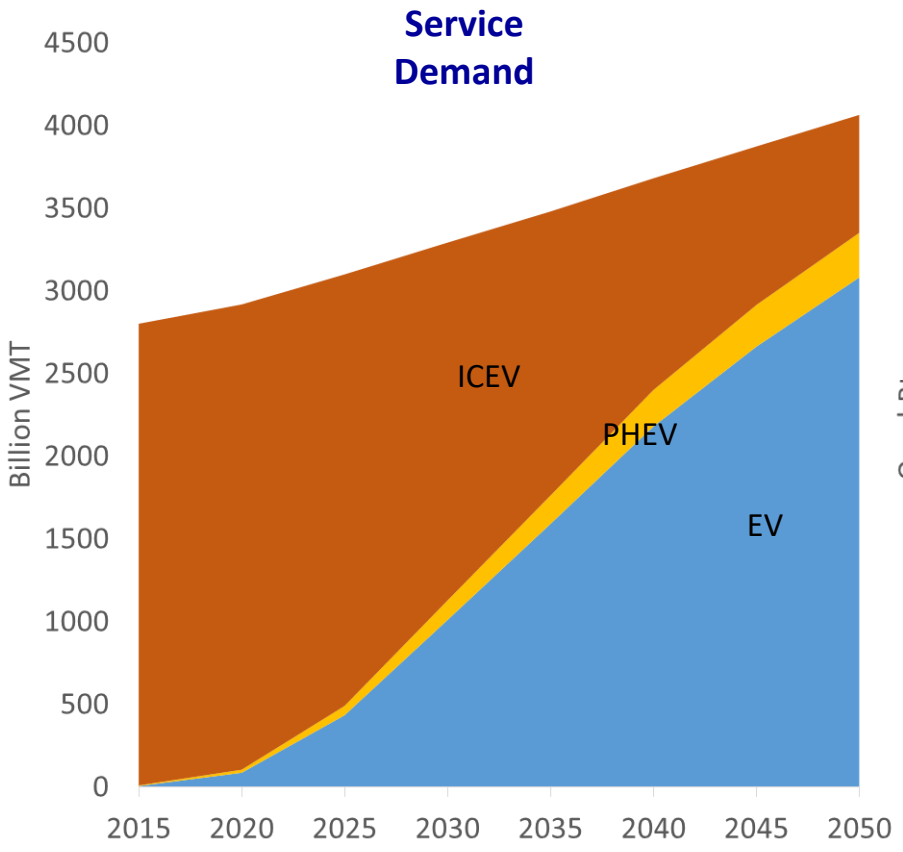
Passenger Vehicle Cost Assumptions for Representative Household

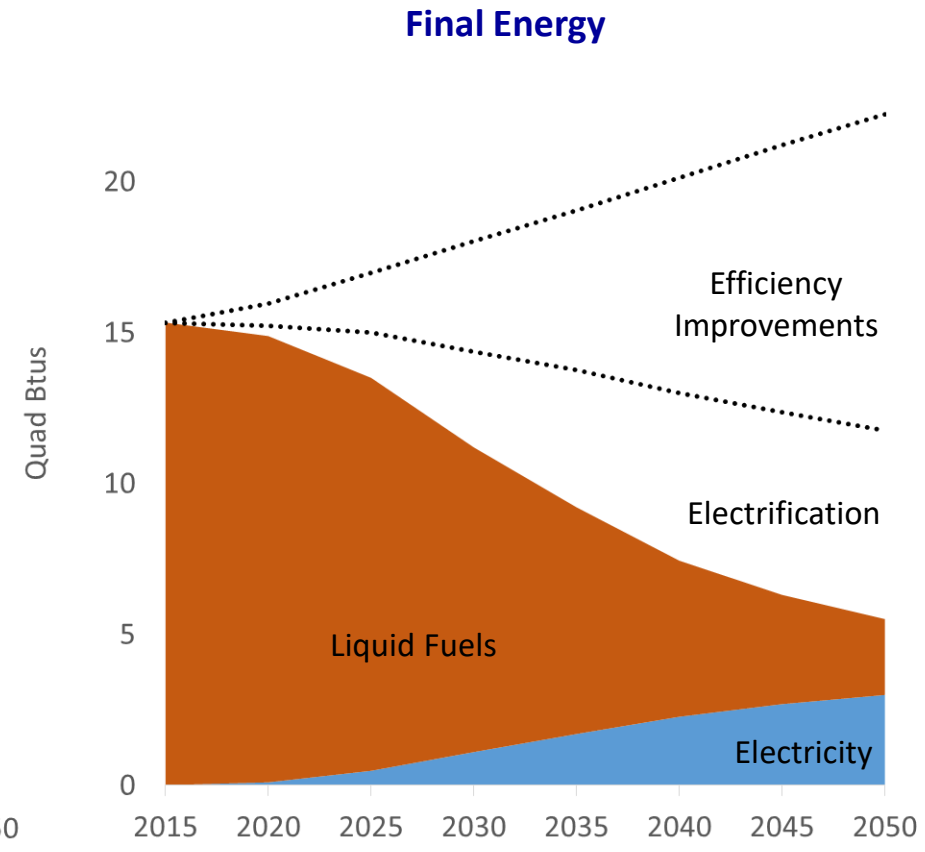




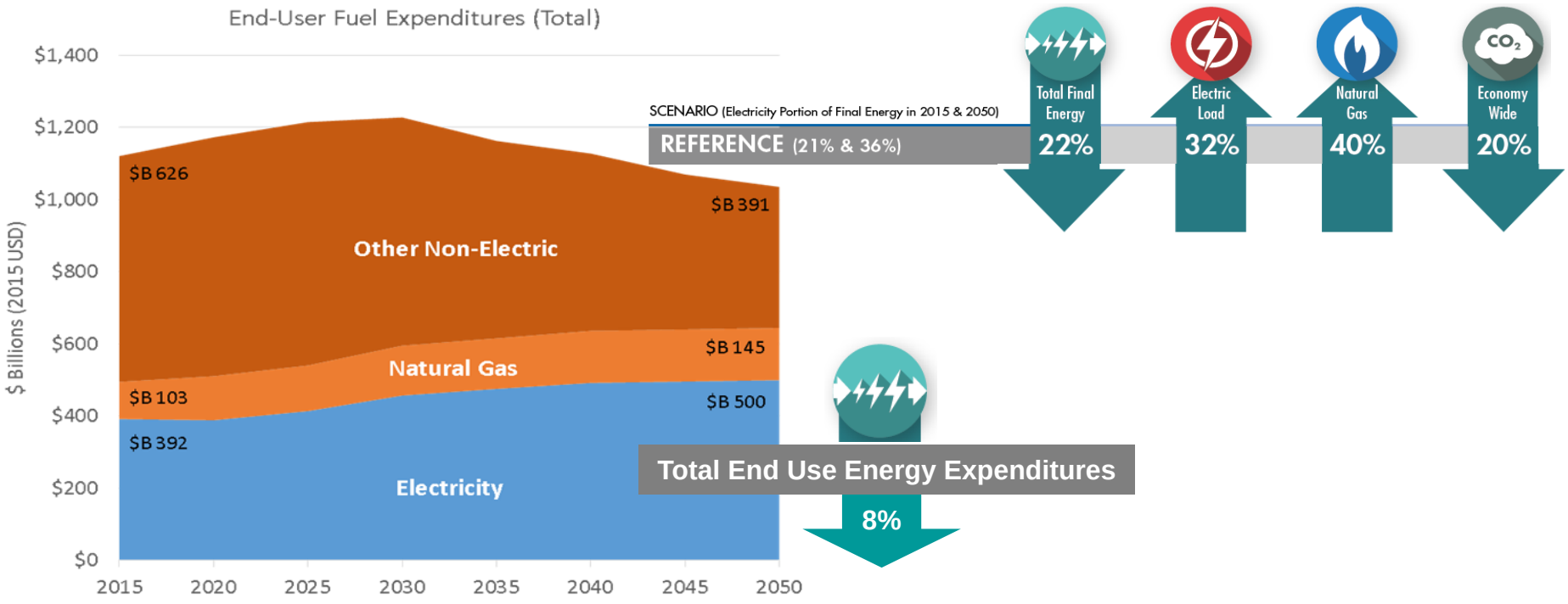
Based on suburban household in NE-Central model region

Reference Projections for US Light-Duty Vehicles





End-User Fuel Expenditures – Reference Case



Total Energy Expenditures Decline

EPRI ELECTRIC POWER RESEARCH INSTITUTE

UP NEXT…

MAXIMIZING THE BENEFITS OF TECHNOLOGY THROUGH CUSTOMER ENGAGEMENT

NARUC Summer Policy Summit

Electricity Committee

Innovation Task Force

NARUC Summer Policy Summit

MAXIMIZING THE BENEFITS OF TECHNOLOGY THROUGH CUSTOMER ENGAGEMENT

NARUC Summer Policy Summit

Moderator:

- Hon. Ann Rendahl, Washington

Panelists:

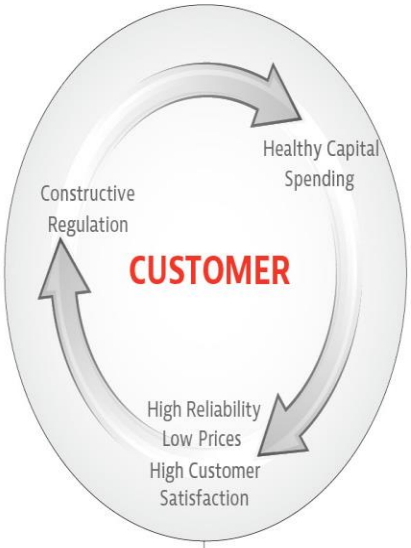
- Latanza Adjei, Georgia Power
- Rick Counihan, NEST
- Tim Stojka, Agentis Energy
- Juliet Shavit, SmartMark Communications

NARUC Summer Policy Summit

Georgia Power

Maximizing the Benefit of Technology through Customer Engagement

Latanza Adjei
VP of Sales & Marketing



Reliability | Service | Price

Intelligence
Solutions
Relevant
Innovative
Beyond the Meter
Digital
Insights
Analytics
Experience
Data
Options
Resilient
Personalization

Strategic Drivers and Expectations

Deeper Insights and Intelligence

- Deepen knowledge of each customer well beyond energy consumption
- Understand needs, wants, behaviors both past and present
- Communicate and engage with only timely and relevant messaging
- Provide multiple channels and methods for engagements, intuitively understand which needs are best in each space

Enhanced Customer Experience

- Establish and consume big data derived from both the meter and the market
- Integrate key data sources using robust analytics methodologies
- Leverage analytics and market intelligence to provide real time information which empowers consumers to make smart choices
- Integrate new technologies into traditional operational practices to drive more advanced outcomes

Expand Offerings and Solutions

- Educate and inform regarding alternative energy options
- Serve as the energy expert who can manage energy issues well beyond the meter
- Play an expanded role beyond reliable service to resiliency solutions
- Leverage traditional infrastructure to support technology evolutions and emerging markets

Maximizing Technology to Drive Customer Engagement

Software Enablement
SiteView • Smart Cities

Self Service Platforms
Customer Portals • APLs • PrePay

Website Personalization
Online Customer Care Center

E Commerce Platforms
Marketplace • Customer Rewards

Digital Marketing Strategy
Outage Communication

Guided by CULTURE

Lead by STRATEGY

Focused on CUSTOMER

Informed by DATA

Enabled by TECHNOLOGY

Optimized for RESULTS

DATA

TECHNOLOGY

Utility of the Future

Customer Engagement of the Future

- Agent Desktop
- Next Best Offer
- Channel Preferences
- Personalized Messaging

Interaction Management

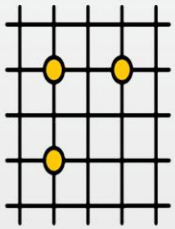
- 360º View of Customer
- Relevant Communication
- Integrated Systems
- Effortless Experience

Expand Solutions Beyond the Meter

- Trusted Provider
- Energy Expert
- Deliver more advanced outcomes

Grid Modernization

- Sustainability
- Resiliency
- Offer Infrastructure for Adjacent Markets

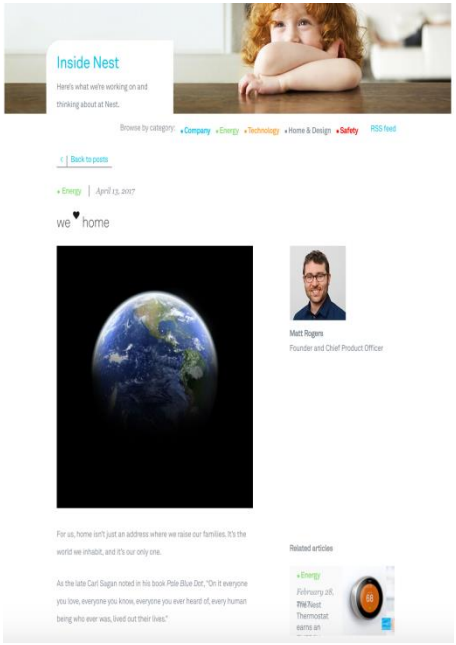



Georgia Power

Project Eclipse

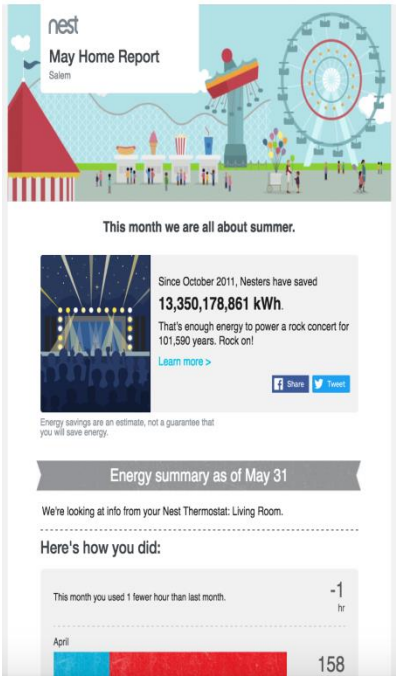
The customer experience

Home Report mention to all customers
Aug 10/11



Blog Post - What are we doing and why
Aug 10/11

Device opt-in messaging to qualified customers
Aug 19



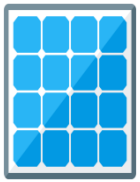
Home Report event recap & RHR recruitment message
Sept 11/12

Nest will also provide marketing assets for partners to co-promote

Nest’s Solar Eclipse Rush Hour

By the numbers - how we did!

774,000 Devices participated



MW of power

699 Issues with Grid or Nest Service

0

AGENTIS

NARUC Presentation

July 2018

Company Overview

- Technology company helping utilities engage business customers since 2009
- Digital engagement software
- 1.7 million business customers
- 25 billion meter reads annually
- Strengths:
  - Understanding business customer needs
  - Developing technology to fit those needs through data science, premier user experience, data visualization

Understanding Business Customers

Lessons learned:

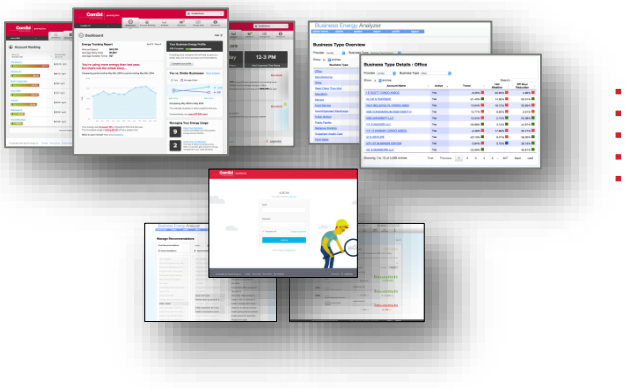
- Businesses are different than residential
- One size does not fit all

- Just because you build it, doesn't mean they will come

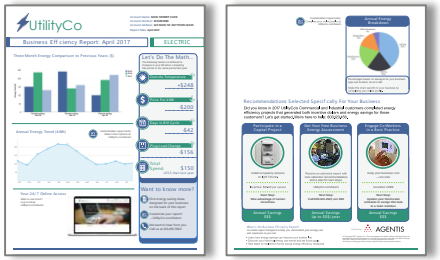
Where They Want The Data

How businesses interact:

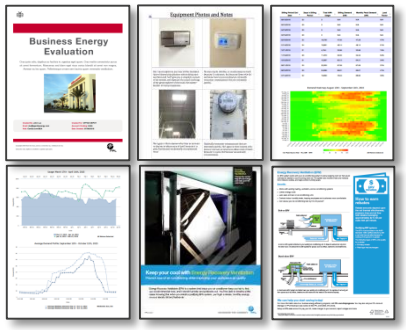
Opt-In



Push



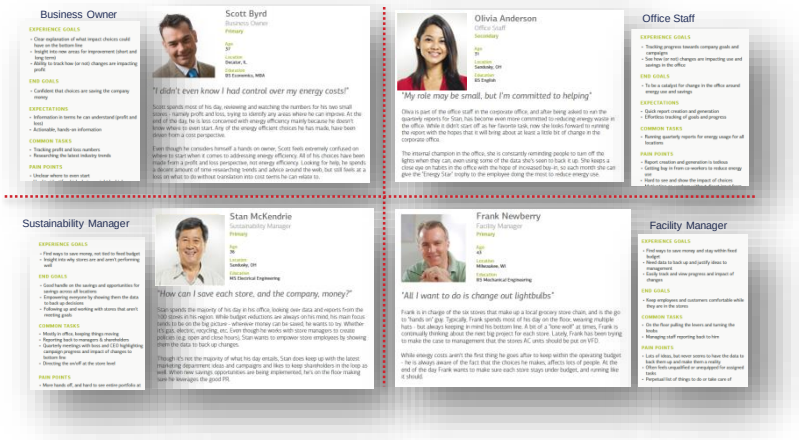
Field Activity



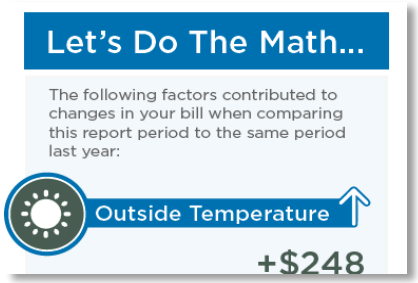
Understanding Their Needs

Customer research:

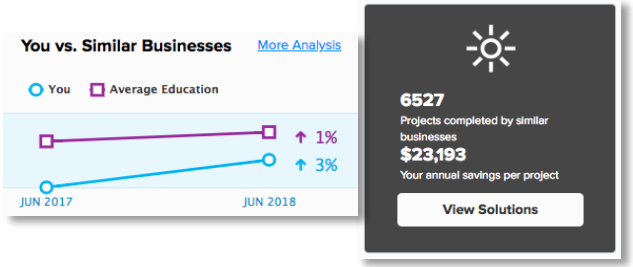
- Persona-based development/product
- Voice of customer research
- Commonly asked questions



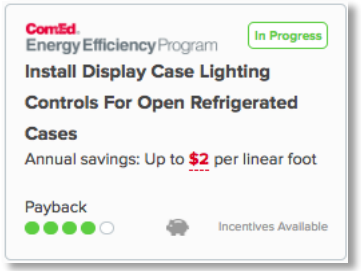
"Why is my bill up?"



"What are my peers doing?



"What do I do next?"



Positive Results

94%
SATIFIED WITH AGENTIS PLATFORM!

1.5%
ENERGY SAVINGS –A first in the C&I sector!

77%
BUSINESS CUSTOMERS ARE INTERACTING with their utility programs.

51%
FEEL MORE POSITIVE ABOUT UTILITY

78%
BUSINESS CUSTOMERS ARE MANAGING their energy differently.

34%
LESS CALLS to business customer call centers.

Thank You

Tim Stojka, CEO

tstojka@agentisenergy.com

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The Importance of Innovation and the Customer Experience

Juliet Shavit, SmartEnergy IP™

A Division of Smartmark Communications, LLC

Thomas Edison invented the Lightbulb and the Phonograph

Both changed life forever

What is *not* innovation?

- Something with an “on/off” button
- Something that has wireless capabilities
- Voice activation
- A smart meter
- The word “smart”

What is innovation?

- A coffee maker that shuts off when I forget about it
- The ability to video chat with my family when I travel
- The ability to turn all electric devices on and off by saying “Alexa, turn on (or off) my house”
- The utility knowing when my power is out so that I do not have to call and my power can be restored faster after an outage
- A city that is connected so that it can be proactive about being secure and making my life more safe and convenient—and respond immediately when something goes wrong

What is innovation?

- These days the word innovation seems to be linked to smart because technology has transformed it
- But smarter still means that it is a *better* way to do things
- Similarly, innovation is not a switch added to a device. *It's using a device to solve a problem in a way we could not solve it before*
- Innovation is AMI, smart city, solar, electric vehicles, etc.
- But innovation is also attaching wheels to a cart so we can carry around groceries. Or to a chair, so we can travel when we are impaired
- What separates innovation from just cool technology, are the problems you solve

Innovation in the energy sector

- Thanks to tremendous advancements in technology we can modernize our grid
- Save energy
- Restore energy faster
- Protect our critical infrastructure

But understanding where to invest money when it comes to technology innovation is the tricky question

Questions to ask around technology innovation investment

- Will the application improve the lives of customers?
- What benefits will this long term investment have on consumers?
- A smart city is not smart if it doesn't make our lives better
- A modern grid can be automated, but will it improve our lifestyle, safety or security?
- Developing a business case around technology investment starts with the consumer –

Because consumers are the core components of communities, cities, countries, and regions. These are the things we talk about when we discuss benefits of technology innovation

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a Division of SmartMark Communications

The lightbulb

- So why did I begin this conversation with a lightbulb?
- How do you engage today's consumers in the energy conversation?
- How do you make energy relevant?
- What will empower people to make a difference?
- What will make people care about the lights who don't care about anything at all?
- It's what comes out of this lightbulb. What song inspires you?
- What can you do with the future of electric delivery?

What to remember?

- Innovation is the application of technology to solve problems
- Investing in innovation must have the consumer as the focus
- What is the point of modernizing our grid and utilizing advanced technologies if we all cannot benefit
- How do utilities articulate these customer benefits
- Are they considered in the design of the business cases
- Utilities should not be afraid of creative innovation – lightbulbs helped us live a better quality of life, but record players help us enjoy life more.

Thank You!

Juliet Shavit

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a Division of SmartMark Communications

UP NEXT…

SMART MONEY:

ASSESSING THE VALUE AND PERFORMANCE OF INVESTMENTS IN THE MODERN GRID

NARUC Summer Policy Summit

Electricity Committee

NARUC Summer Policy Summit

SMART MONEY:

ASSESSING THE VALUE AND PERFORMANCE OF INVESTMENTS IN THE MODERN GRID

NARUC Summer Policy Summit

Moderator:

- Hon. John Rosales, Illinois

Panelists:

- Erin Erben, EPRI
- Paul Alvarez, Wired Group
- Tim Woolf, Synapse Energy Economics

NARUC Summer Policy Summit

Synapse
Energy Economics, Inc.

Benefit-Cost Analysis For Investments in the Modern Grid

Recent trends in how to determine whether grid modernization investments will deliver value to customers

July 16, 2018

Smart Money Panel
NARUC Summer Policy Summit
Scottsdale, Arizona

Overview

- Increasing demand for benefit-cost analysis (BCA):
  - Grid modernization
  - Distributed energy resources (DERs): energy efficiency, demand response, distributed solar, storage, electric vehicles, strategic electrification.
  - IRP, distribution planning, iDER assessments.
- Very different practices are being used:
  - Across technologies
  - Across states
- Benefit-cost analyses show very different results.
  - Creates challenges in how to interpret the results
- Some positive trends are emerging.
- Much more progress is needed.

California Standard Practice Manual

- The CA Manual has been universally used for energy efficiency
  - But most states apply it differently.
- Describes five standard cost-effectiveness tests:
  - Utility Cost test: impacts on the utility system
  - Total Resource Cost test: impacts on the utility system and program participants
  - Societal Cost test: impacts on society
  - Participant test: impacts on program participants
  - Rate Impact Measure test: impacts on rates
- These tests are increasingly being used to assess grid modernization, DERs, and related initiatives.
- But the CA Manual does not address current needs:
  - Does not address energy policy goals
  - Does not address rate impacts well
  - Has been interpreted inconsistently
  - Does not address some key DER issues

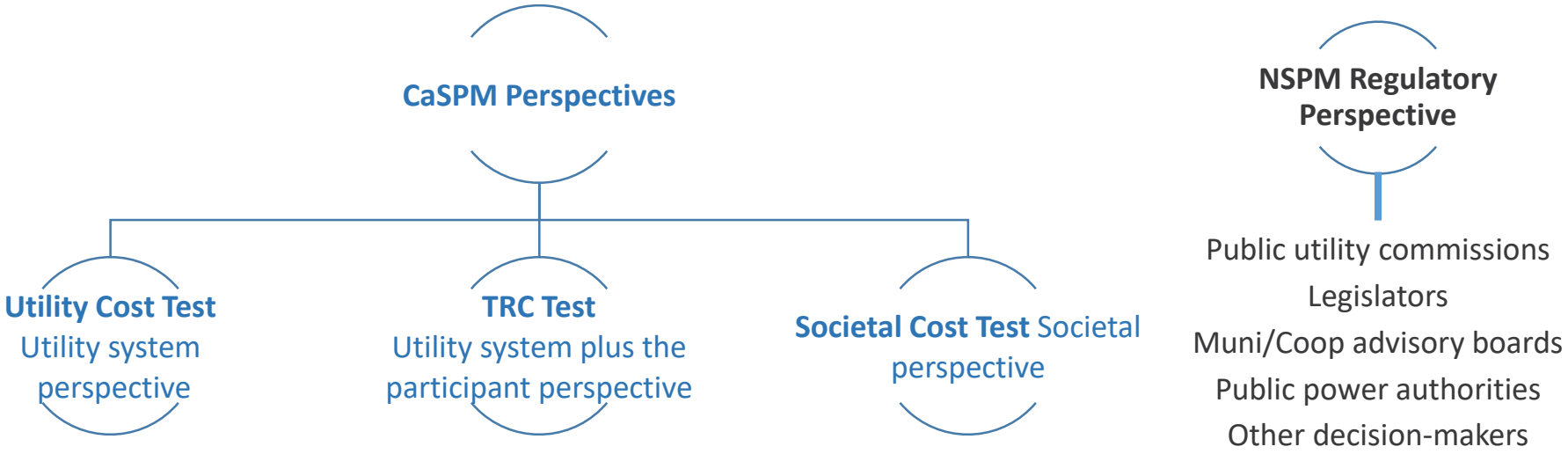
National Standard Practice Manual

- Designed to update, improve, and replace the CA SPM.
- Includes a set of fundamental BCA principles.
- Acknowledges the importance of policy goals in BCAs.
- Provides an framework for determining a state BCA test.
- Distinguishes between primary and secondary tests.
- Provides guidance on whether and how to include participant impacts.
- Provides guidance on key BCA inputs:
  - Discount rates
  - Avoided costs
  - Study period
  - End effects

NSPM: Principles

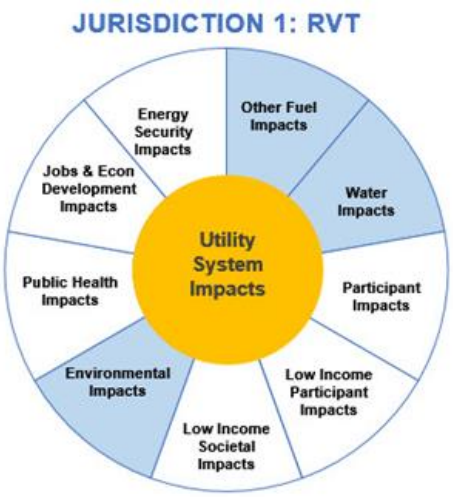
Efficiency as a Resource	EE is one of many resources that can be deployed to meet customers' needs and therefore should be compared with other energy resources (both supply-side and demand-side) in a consistent and comprehensive manner.
Policy Goals	A jurisdiction's primary cost-effectiveness test should account for its energy and other applicable policy goals and objectives. These goals and objectives may be articulated in legislation, commission orders, regulations, advisory board decisions, guidelines, etc., and are often dynamic and evolving.
Hard-to-Quantify Impacts	Cost-effectiveness practices should account for all relevant, substantive impacts (as identified based on policy goals,) even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value.
Symmetry	Cost-effectiveness practices should be symmetrical, where both costs and benefits are included for each relevant type of impact.
Forward-Looking Analysis	Analysis of the impacts of resource investments should be forward-looking, capturing the difference between costs and benefits that would occur over the life of the subject resources as compared to the costs and benefits that would occur absent the resource investments.
Transparency	Cost-effectiveness practices should be completely transparent and should fully document all relevant inputs, assumptions, methodologies, and results.

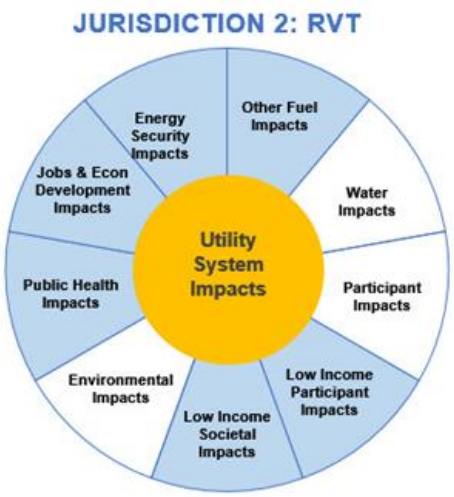
NSPM: Cost-Effectiveness Perspectives

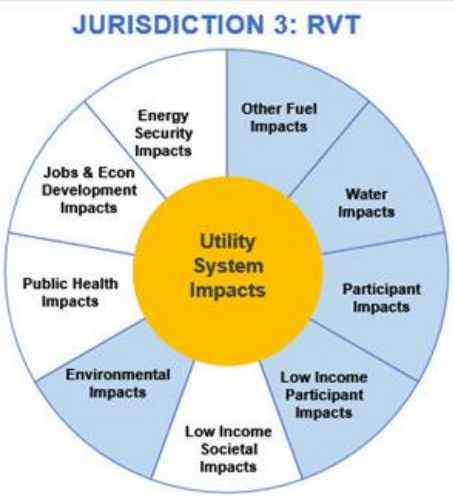


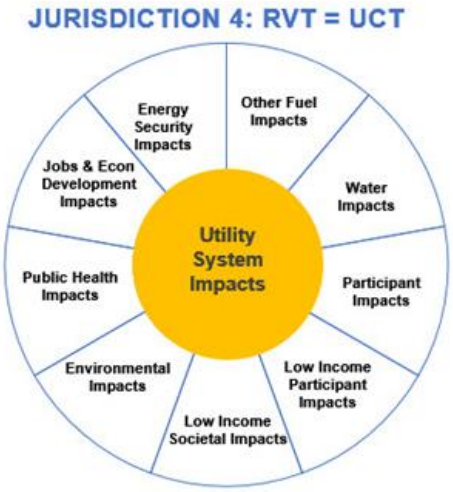
- California Standard Practice Manual (CaSPM) – test perspectives are used to define the scope of impacts to include in the 'traditional' cost-effectiveness tests
- NPSM introduces the 'regulatory' perspective, which is guided by the jurisdiction's energy and other applicable policy goals

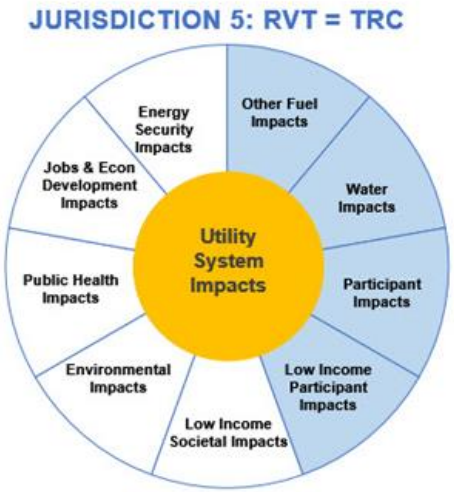
NSPM: Relationship Of Different Tests

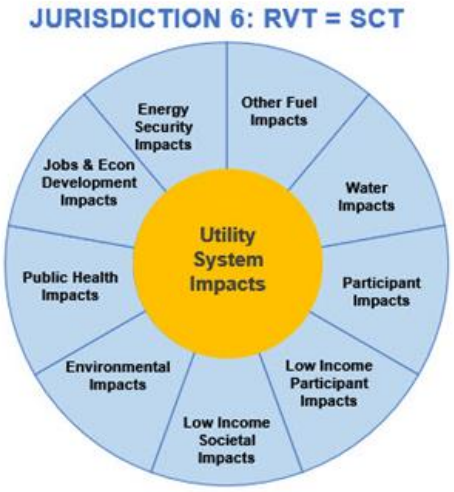




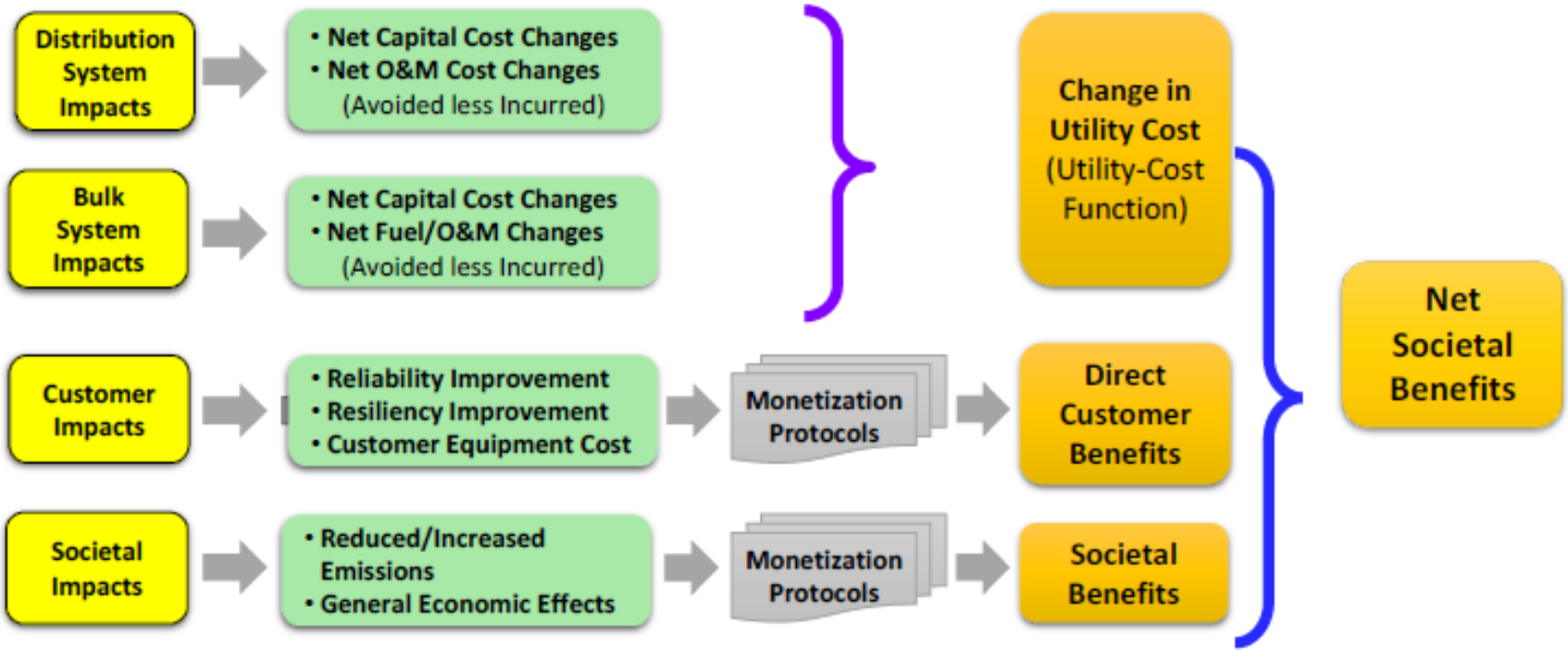








EPRI: Benefit-Cost Framework for the Integrated Grid



Source: Electric Power Research Institute, The Integrated Grid: A Benefit-Cost Framework, February 2015, page 9-3.

EPRI report explains the rationale for the utility and societal perspectives.
No mention of a Total Resource Cost test.
No mention of lost revenues or a RIM test.

General Trends in BCA for DERs

- Increased interest in accounting for policy goals.
- Increased flexibility in choice of tests/perspectives.
- General emphasis on:
  - Utility system impacts
  - Societal impacts
- Less emphasis on:
  - Participant impacts
  - The Rate Impact Measure test
- Lack of consistency
  - Different tests for different DERs
- Increased complexity
  - Especially for optimizing across DERs

U.S. Department of Energy: Modern Distribution Grid

DOE divides modern grid expenditures into four types:

1. Expenditures to replace aging infrastructure
   - Apply a least-cost/best-fit approach or the Utility Cost test
2. Expenditures to maintain reliable operations
   - Apply a least-cost/best-fit approach or the Utility Cost test
3. Expenditures to enable public policy or societal benefits
   - Apply the Societal Cost test
4. Expenditures that will be paid for by customers
   - No need to analyze because they do not require regulatory approval

Source: US Department of Energy, Modern Distributed Grid, Decision Guide, Volume III, June 8, 2017, pages 39-44.

No mention of a Total Resource Cost test.
No mention of lost revenues or a RIM test.

New York Reforming Energy Vision (REV) BCA Order

- The Societal Cost test should be the primary test.
- The Utility Cost test should play a subsidiary role.
- The RIM test should play a subsidiary role.
  - But a more sophisticated rate and bill impact analysis is needed
- The Societal Cost test should include environmental externalities.
  - Based on the EPA Social Cost of Carbon
- Non-energy benefits:
  - Should be monetized on a location-specific or project-specific basis, where possible
  - NEBs that cannot be monetized should be considered on a qualitative basis

California Trends

- Regarding energy efficiency cost-effectiveness
  - In 2017 commission staff proposed a partial societal cost test
  - Accounts for the benefits of reducing GHG emissions
  - Reflects aggressive state energy policy goals to reduce GHG emissions
- Regarding grid modernization

  In 2017 commission staff proposed several options:
  - Option 1: develop a BCA methodology by individual technology
  - Option 2: develop a BCA methodology for grid modernization
  - Option 3: apply a least-cost/best-fit approach for grid modernization
  - Option 4: assess ratepayer benefits as a sensitivity in IRP optimization

Contact Information

Synapse Energy Economics is a research and consulting firm specializing in energy, economic, and environmental topics. Since its inception in 1996, Synapse has grown to become a leader in providing rigorous analysis of the electric power and natural gas sectors for public interest and governmental clients.

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CA Manual: Traditional Tests

Test	Perspective	Key Question Answered	Summary Approach
Utility Cost	The utility system	Will utility system costs be reduced?	Includes the costs and benefits experienced by the utility system
Total Resource Cost	The utility system plus participating customers	Will utility system costs plus program participants' costs be reduced?	Includes the costs and benefits experienced by the utility system, plus costs and benefits to program participants
Societal Cost	Society as a whole	Will total costs to society be reduced?	Includes the costs and benefits experienced by society as a whole
Participant Cost	Customers who participate in an efficiency program	Will program participants' costs be reduced?	Includes the costs and benefits experienced by the customers who participate in the program
Rate Impact Measure	Impact on rates paid by all customers	Will utility rates be reduced?	Includes the costs and benefits that will affect utility rates, including utility system costs and benefits plus lost revenues

California Manual:

Components of the traditional tests in the California Standard Practice Manual

	UCT	TRC Test	SCT	Participant Cost Test	RIM Test
EE Costs:					
Efficiency Program Costs	Yes	Yes	Yes	---	Yes
Efficiency Portfolio Costs	Yes	Yes	Yes	---	Yes
Financial Incentive Provided to Participant	Yes	Yes	Yes	---	Yes
Participant Financial Cost of Efficiency	---	Yes	Yes	Yes	---
Participant Non-Financial Cost of Efficiency	---	Yes	Yes	Yes	---
Participant Increased Resource Consumption	---	Yes	Yes	Yes	---
Societal costs (environmental, health, etc.)	---	---	Yes	---	---
Lost Revenues	---	---	---	---	Yes
EE Benefits:					
Avoided Energy Costs	Yes	Yes	Yes	---	Yes
Avoided Generation Capacity Costs	Yes	Yes	Yes	---	Yes
Avoided T&D Capacity Costs	Yes	Yes	Yes	---	Yes
Avoided T&D Losses	Yes	Yes	Yes	---	Yes
Wholesale Market Price Suppression Effects	Yes	Yes	If applicable	---	Yes
Avoided Environmental Compliance Costs	Yes	Yes	Yes	---	Yes
Avoided RPS Compliance Costs	Yes	Yes	Yes	---	Yes
Avoided Credit and Collection Costs	Yes	Yes	Yes	---	Yes
Participant Resource Savings (fuel, water)	---	Yes	Yes	Yes	---
Participant Non-Resource Benefits	---	Yes	Yes	Yes	---
Reduce Low-income Energy Burden	---	---	Yes	---	---
Environmental Benefits	---	---	Yes	---	---
Jobs and Economic Development Benefits	---	---	Yes	---	---
Societal Health Care Benefits	---	---	Yes	---	---
Increased energy security	---	---	Yes	---	---
Customer Bill Savings	---	---	---	Yes	---

Using Peer Comparisons in Distributor Performance Evaluation

Wired Group

Unleashing Latent Value in Distribution Utility Businesses

Electricity Committee “Smart Money” Panel

NARUC Summer Policy Meetings

July 16, 2018

Paul J. Alvarez, President, Wired Group

Wired Group Background

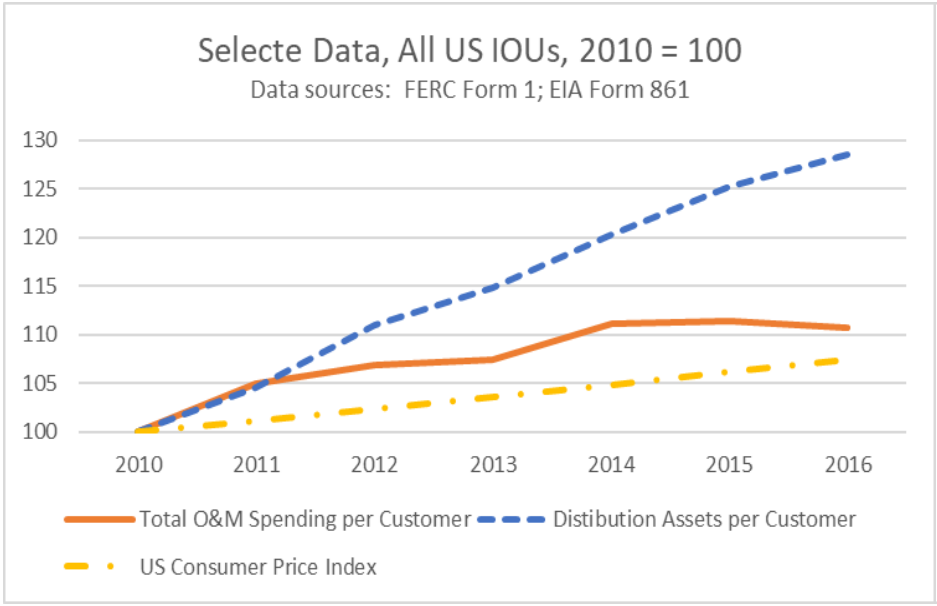
- Leading experts on grid modernization plans & performance for Advocates

- Comprehensive, objective evaluations of smart grid deployments
  - SmartGridCity™ for Xcel Energy (2010)
  - Duke Energy Ohio for the Ohio PUC (2011)
  - (California DRA, Southern California Edison, smart meters only, 2012)

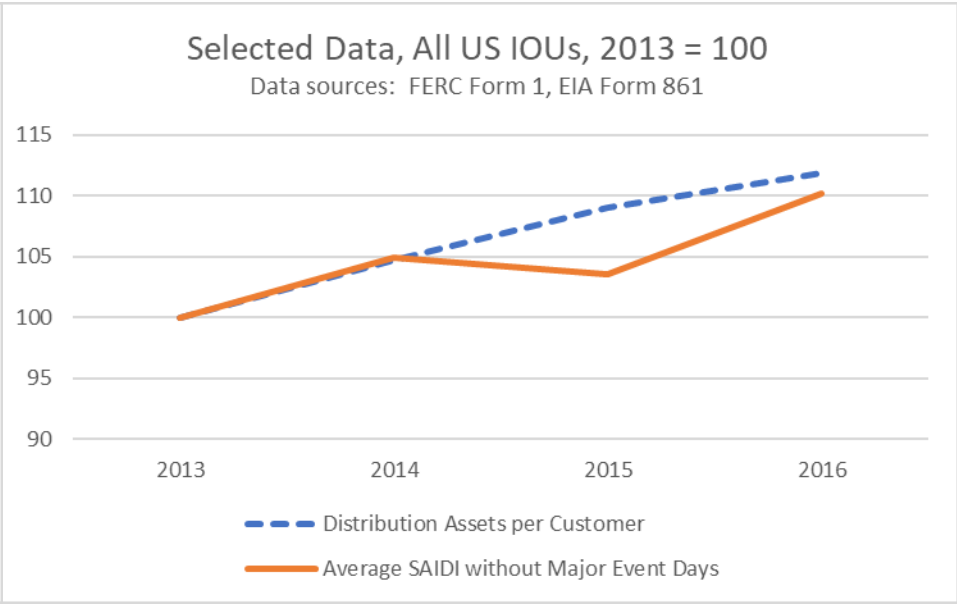
- Findings:
  - Securing benefits in excess of costs is extremely difficult and rare
  - Variation in post-deployment customer benefits is very high

What Are Customers Getting for Their Money?

Despite grid investment,
O&M spending is increasing



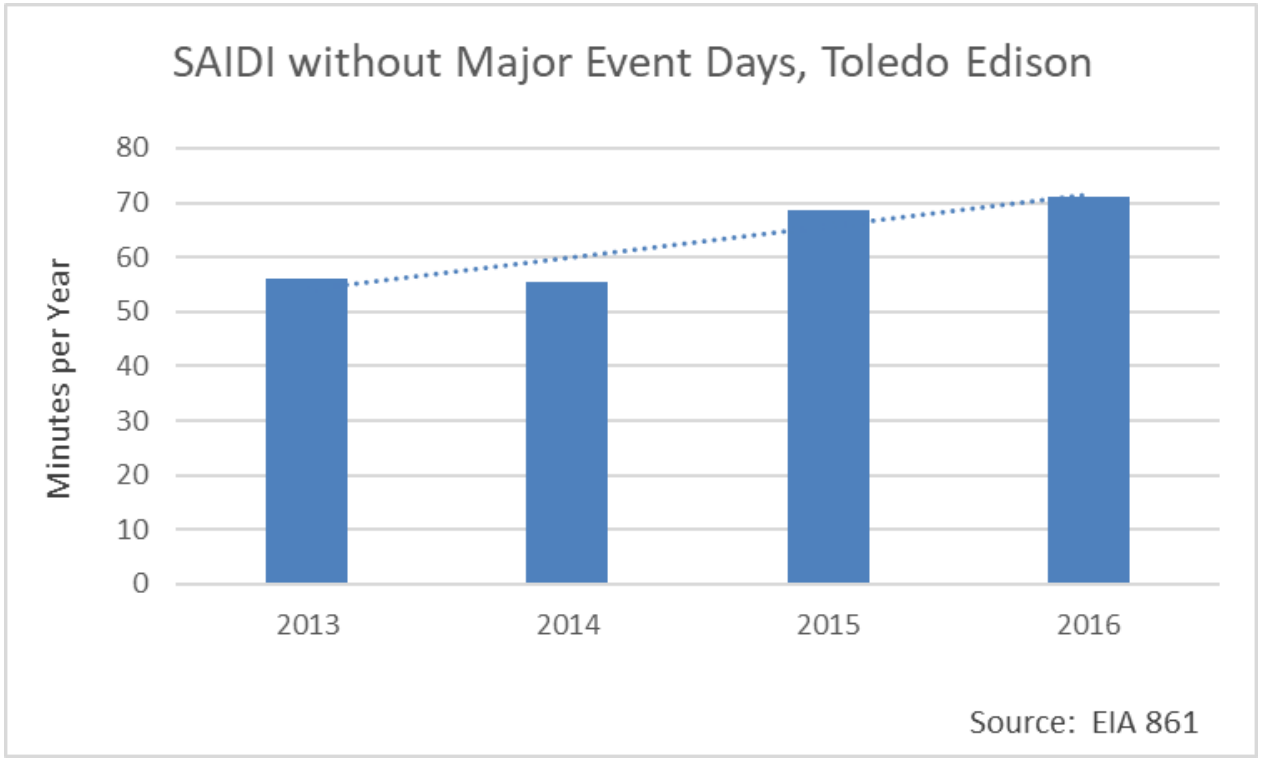
Despite grid investment,
SAIDI is increasing



Performance measurement is essential to securing benefits from grid investments

Charts courtesy of the Utility Evaluator™.
For more information visit utilityevaluator.com.

Setting/Prioritizing Targets: Historical Comparison



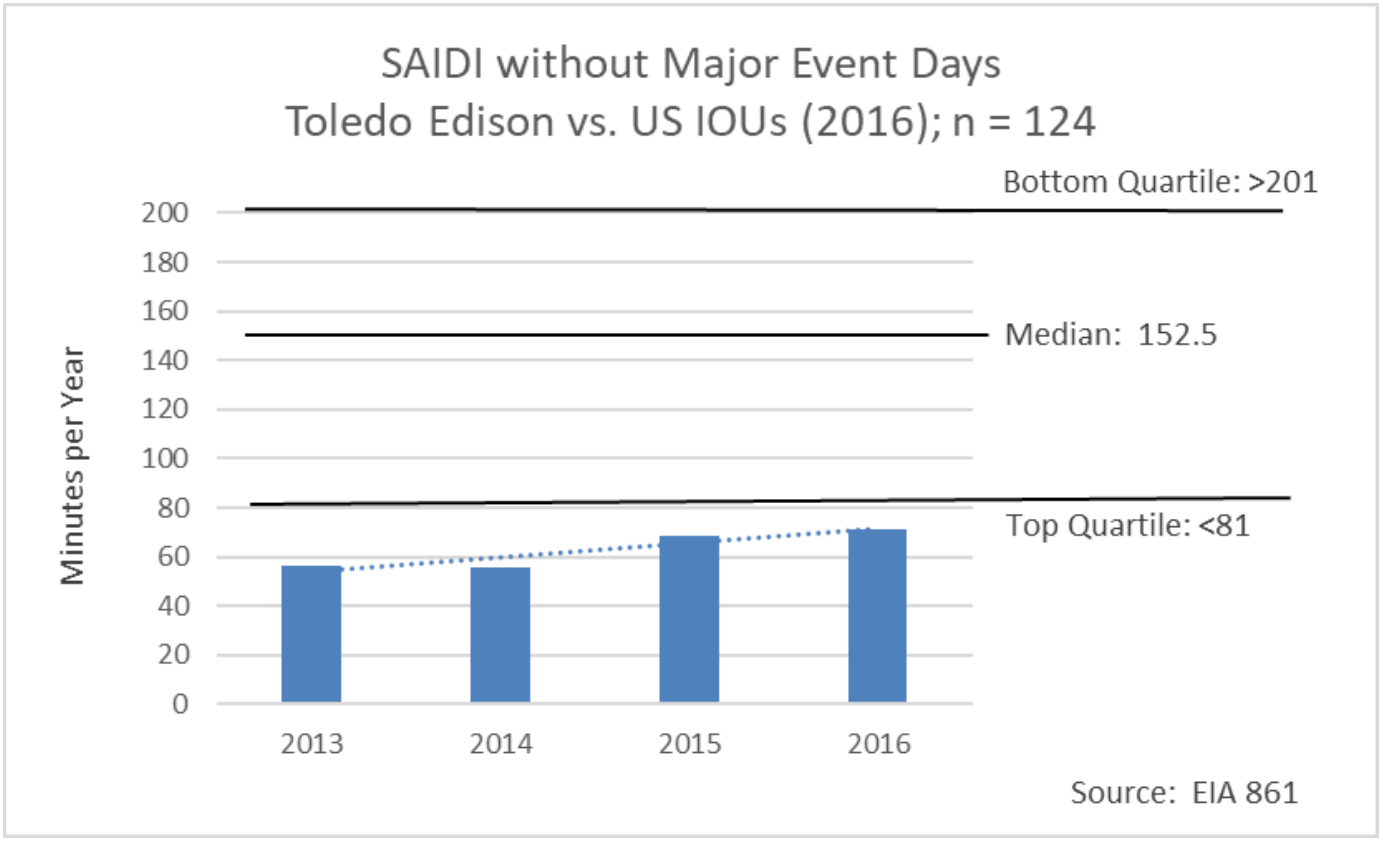
Optional metric: "Achieve 60-minute SAIDI by 2019"

Is SAIDI performance problematic for Toledo Edison?

Chart courtesy of the Utility Evaluator™. For more information visit utilityevaluator.com.

Setting/Prioritizing Targets: Peer Comparison

Synapse Energy Economics, Inc.

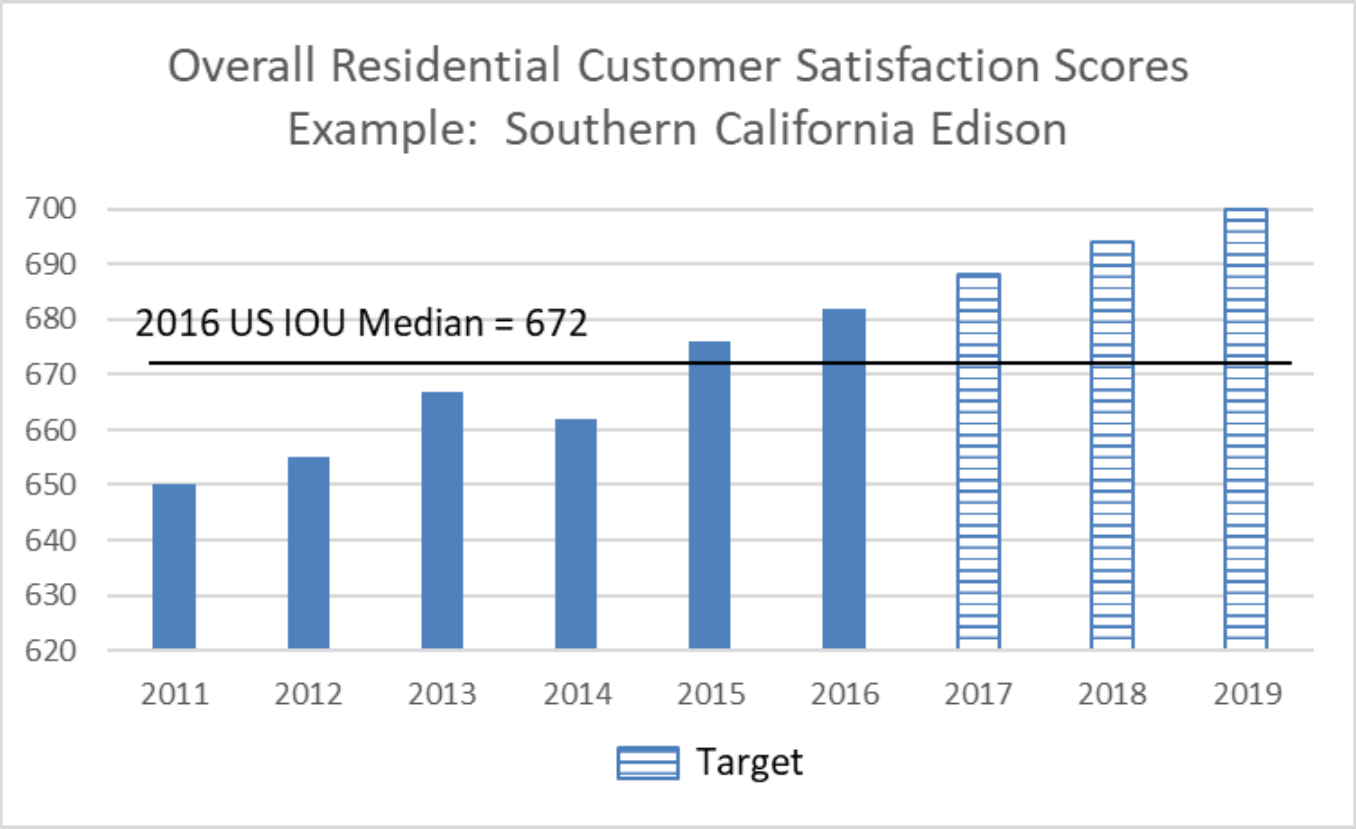


Better metric: "Remain Top Quartile in SAIDI through 2019"

Is SAIDI problematic for Toledo Edison in light of peer performance?

Chart courtesy of the Utility Evaluator™.
For more information visit utilityevaluator.com.

History-based Targets: Do Not Remain Relevant in Changing Circumstances

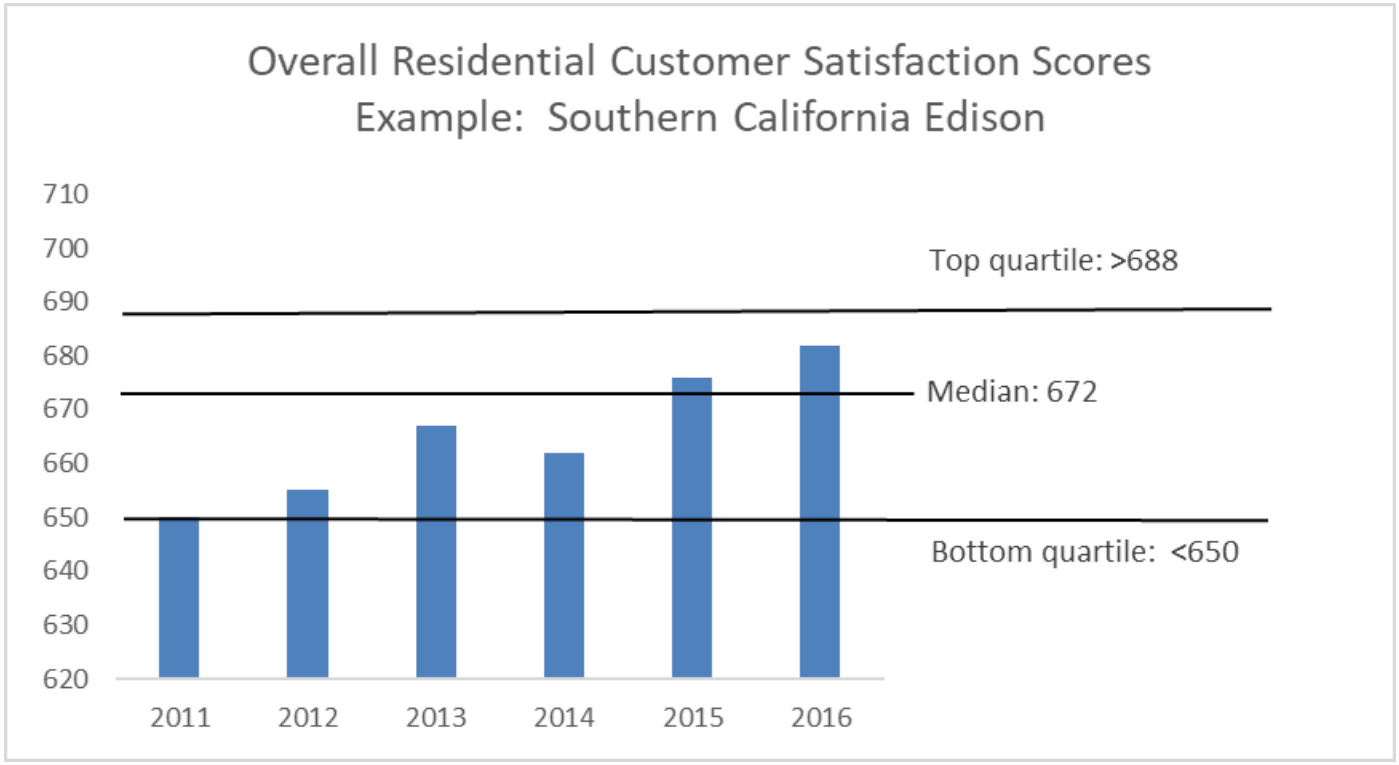


Optional metric: "Achieve 700 JDPA Satisfaction Score by 2019"

Will a target score of 700 by 2019 remain relevant if Natural Gas prices double?

Chart courtesy of the Utility Evaluator™.
For more information visit utilityevaluator.com.

Peer-based Targets DO Remain Relevant in Changing Circumstances

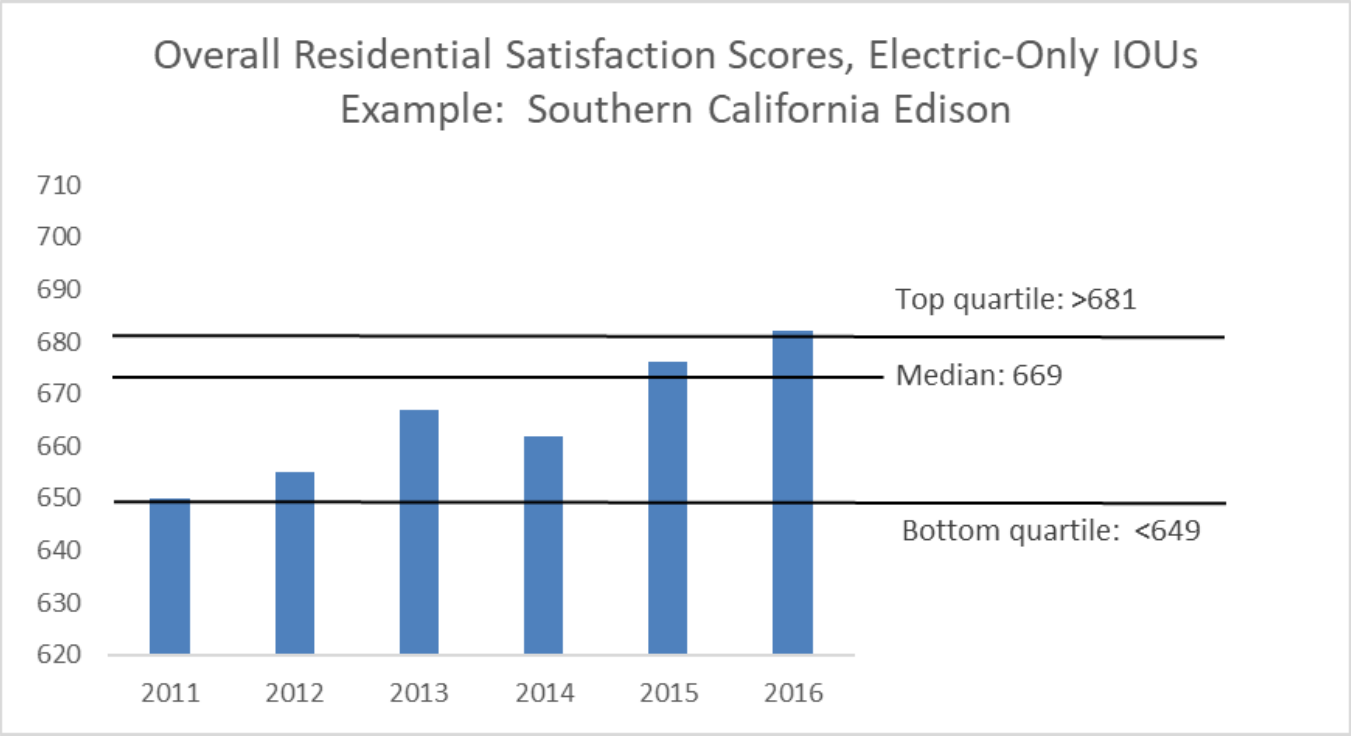


Better metric: "Achieve Top Quartile JDPA Satisfaction Score by 2019"

By expressing target as a quartile relative to peers, target will remain relevant even if Natural Gas prices double

Chart courtesy of the Utility Evaluator™.
For more information visit utilityevaluator.com.

Peer-Based Targets Can Accommodate Differences in IOU Characteristics



Even better metric: "Maintain Top Quartile JDPA Satisfaction Score among Electric-only IOUs through 2019"

Using characteristics to define a peer group results in more relevant targets.

Chart courtesy of the Utility Evaluator™.
For more information visit utilityevaluator.com.

Other Benefits to Peer Comparisons for Setting Targets, Measuring Performance

- Reduces performance manipulation opportunities
- Improves administrative efficiency
- *Broad adoption will raise all IOU's performance over time in a manner similar to competition*

Sample Metrics for Peer Comparisons

Focus: affordable, reliable electricity

- Capital investment per customer
- Capital investment per distribution line mile
- O&M spending per customer (Dist, B&CS, A&G)
- Overall residential customer satisfaction (JD Power)
- CAIDI/SAIDI (with or without Major Event Days)
- CAIFI/SAIFI (with or without Major Event Days)
- Demand Response (MW) as % of system peak
- DR program admin $ per MW of callable Demand

Utility Evaluator™ development plan: Natural Gas version; OSHA safety data.

Thank You!

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UP NEXT…

THE PROMISE AND CHALLENGES OF ENERGY STORAGE:

ORDER 841 AND THE STATES' ROLE

NARUC Summer Policy Summit

Electricity Committee

Energy Resources and the Environment Committee

NARUC Summer Policy Summit

THE PROMISE AND CHALLENGES OF ENERGY STORAGE:

ORDER 841 AND THE STATES' ROLE

NARUC Summer Policy Summit

Moderator:

- Hon. Edward S. Finley, Jr., North Carolina

Panelists:

- Jeff Burleson, Southern Company
- Judy Chang, Brattle Group
- Kelly Speakes-Backman,
  Energy Storage Association
- Charlie Bayless, NCEMC

NARUC Summer Policy Summit

The Storage Story

WHAT CAN STATES DO TO CONSIDER STORAGE RESOURCES?

PRESENTED TO

NARUC Summer Policy Summit

PRESENTED BY

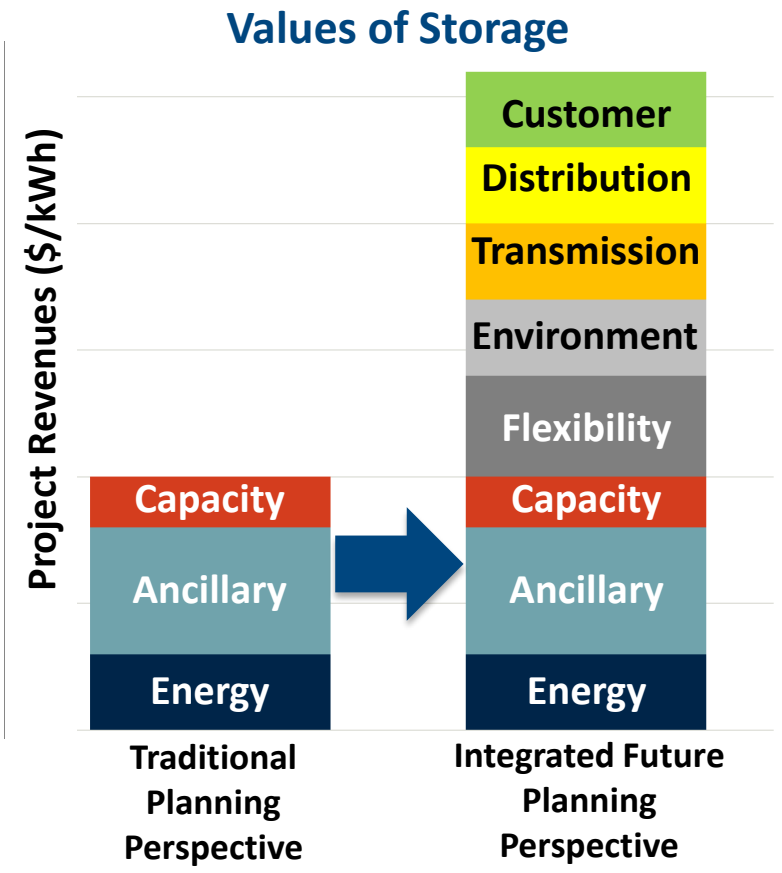
Judy Chang

July 16. 2018

THE Brattle GROUP

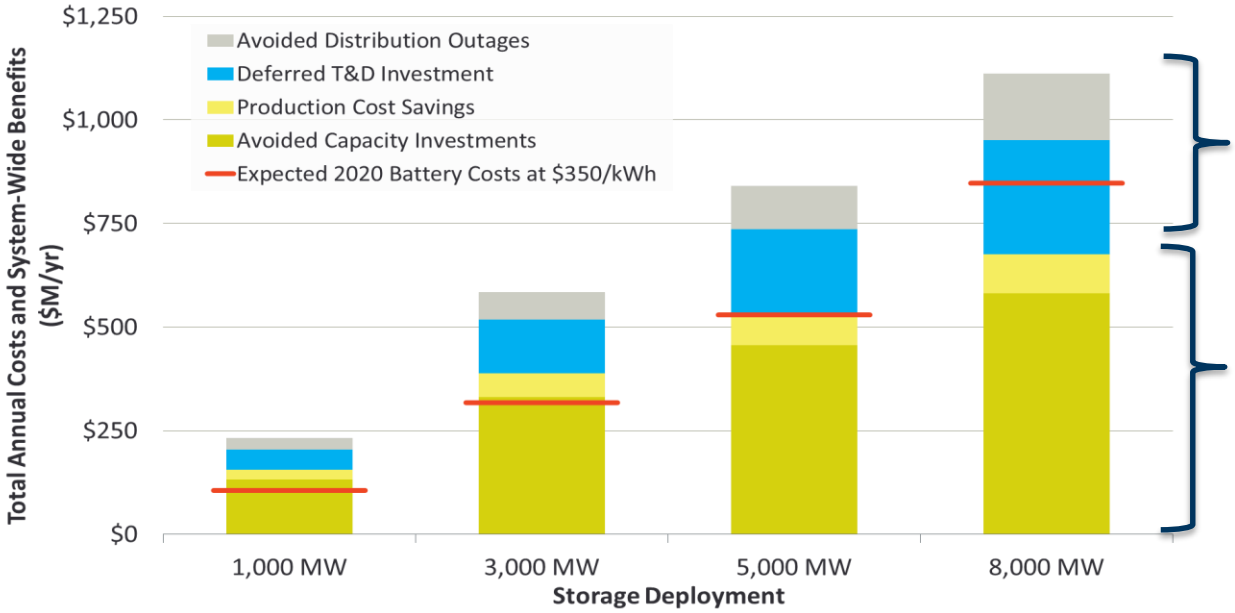
Considering the Value of Storage

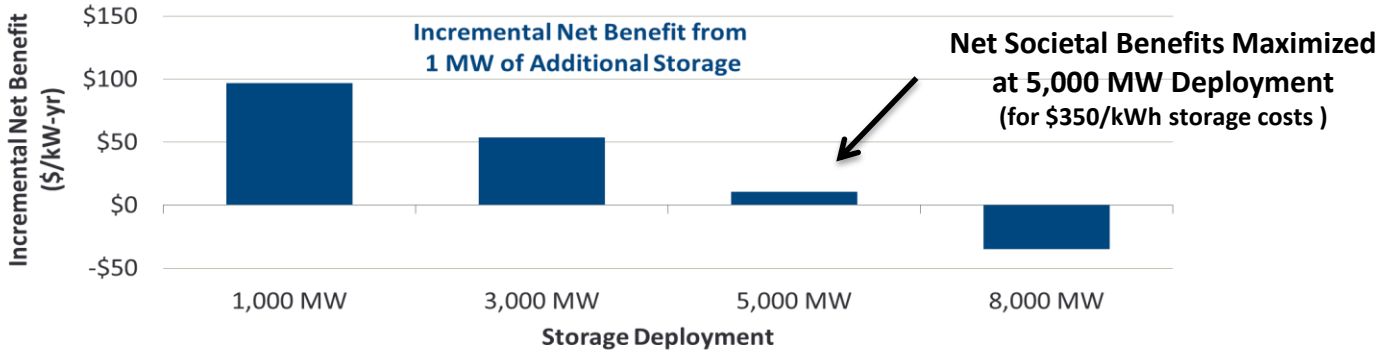
- Storage provides a **variety of potential benefits**
  - Utilities do not yet consider in traditional resource planning framework
  - Considering all of the benefits is essential
  - May require new modeling paradigm and tools to capture benefits
- **Traditional services:** energy arbitrage, fast-response capabilities, and avoided capacity
- **Clean energy support:** additional value from higher-quality ancillary services, other flexibility and clean energy products
- **Deferred or avoided investments in transmission and distribution** infrastructure
- **Additional reliability** to specific customer groups or sites



Quantifying Values of Storage in Texas

Incremental system-wide benefits exceed incremental costs for up to 5GW. ~40% of benefits from T&D deferral and improved reliability.





T&D and Customer Value

- Highest value opportunities if targeted to underperforming T&D circuits and customers with high outage costs

Merchant Value

- Highest-value opportunities (in particular ancillary services) saturate quickly as deployments rise

Source: Chang, et al., The Value of Distributed Electricity Storage in Texas: Proposed Policy for Enabling Grid-Integrated Storage Investments, Prepared for Oncor, March 2015. Based on analysis with Brattle's bSTORE modeling platform.

States' Role and Objectives in Storage

State plans that include storage should clarify objectives and goals.

Are there reliability goals that storage is uniquely positioned to provide?

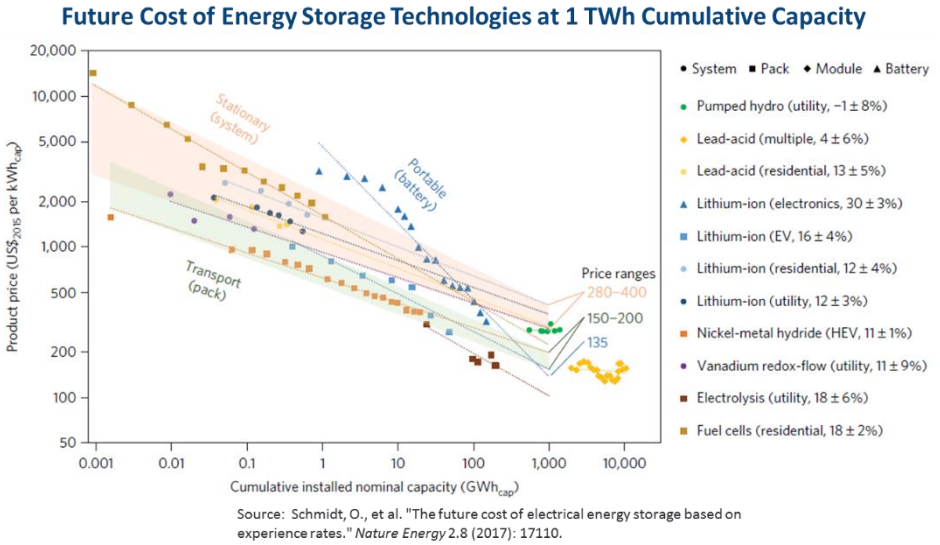
Regulators could ask:

- "How does storage fulfill the need?"
- "Why renewable + storage?"
- "What are the alternatives?"
- "How do the cost of the portfolio change with storage?"

Various Use Cases for Storage

Storage can provide wholesale and retail market values, increase utilities efficiency, and improve reliability.

- Storage + renewable energy resources can efficiently integrated renewable generation
- Distribution-level storage initiatives can increase system and customer reliability
- Transmission-level storage investment can help reduce congestion
- Behind-the-meter storage investments can reduce customer costs, but may create challenges for utilities



Source: Schmidt, O., et al. "The future cost of electrical energy storage based on experience rates." *Nature Energy* 2.8 (2017): 17110.

Difficult Questions for Regulators

How can states help advance storage investments?

- Openly discuss the potential value of storage in terms of states' energy infrastructure and environmental goals
- Identify state's objectives in advancing storage
- Clarify the roles of the utilities in meeting the objectives
- Consider customers' storage investment potential when designing retail rates and programs
- Set future trigger points to update the roles of utilities and state targets

Brattle Experience in Storage Analyses

Asset Valuation	• Valuing and sizing renewables + storage facilities • Valuing storage across multiple value streams • Developing bid/offer strategies to maximize value • Accommodating storage into IRPs • Supporting due diligence efforts of investors
Market Intelligence	• The state and federal policy landscape • Electricity market fundamentals and opportunities • Storage cost and technology trends • Current and emerging business models
Policy, Regulatory, and Market Design	• Wholesale market design • Market and regulatory barriers • Utility ownership and operation models • Retail rate implications of distributed storage • Implications of storage on wholesale markets

PRESENTED BY

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Ms. Judy Chang is an energy economist and policy expert with a background in electrical engineering, and has over 20 years of experience in advising energy companies on regulatory and financial issues, with a focus on power sector investment decisions in clean energy, electric transmission, and energy storage. Ms. Chang has submitted expert testimonies to the U.S. Federal Energy Regulatory Commission, and U.S. state and Canadian provincial regulatory authorities on topics related to resource planning, power purchase and sale agreements, and transmission planning, access, and pricing. She has authored numerous reports and articles on the economic issues associated with generation and transmission investments, clean energy development, energy storage investments, and systems planning. In addition, she has led teams of energy company executives and board members in comprehensive organizational strategic and business planning.

Ms. Chang holds a Bachelor of Science in Electrical Engineering and Computer Science from University of California, Davis and a Master of Public Policy from Harvard Kennedy School. She is a former board member of the Massachusetts Clean Energy Center.

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