2022 NARUC Annual Meeting and Education Conference
CONNECTING THE DOTS
Innovative/Disruptive Technology and Regulation

Yoga for the Distribution Grid:

Demand Flexibility for Customers, Utilities, and System Stability

2022 NARUC Annual Meeting and Education Conference

CONNECTING THE DOTS

Innovative/Disruptive Technology and Regulation

Moderator

Hon. Matt Schuerger, *Commissioner – Minnesota Public Utilities Commission*

Speakers

Ryan Hledik, *Principal – The Brattle Group*

Teresa Ringenbach, *VP of Business Development – Armada Power*

Lon Huber, *SVP, Pricing and Customer Solutions – Duke Energy*

Natalie Mims Frick, *Program Manager – Lawrence Berkeley National Lab*

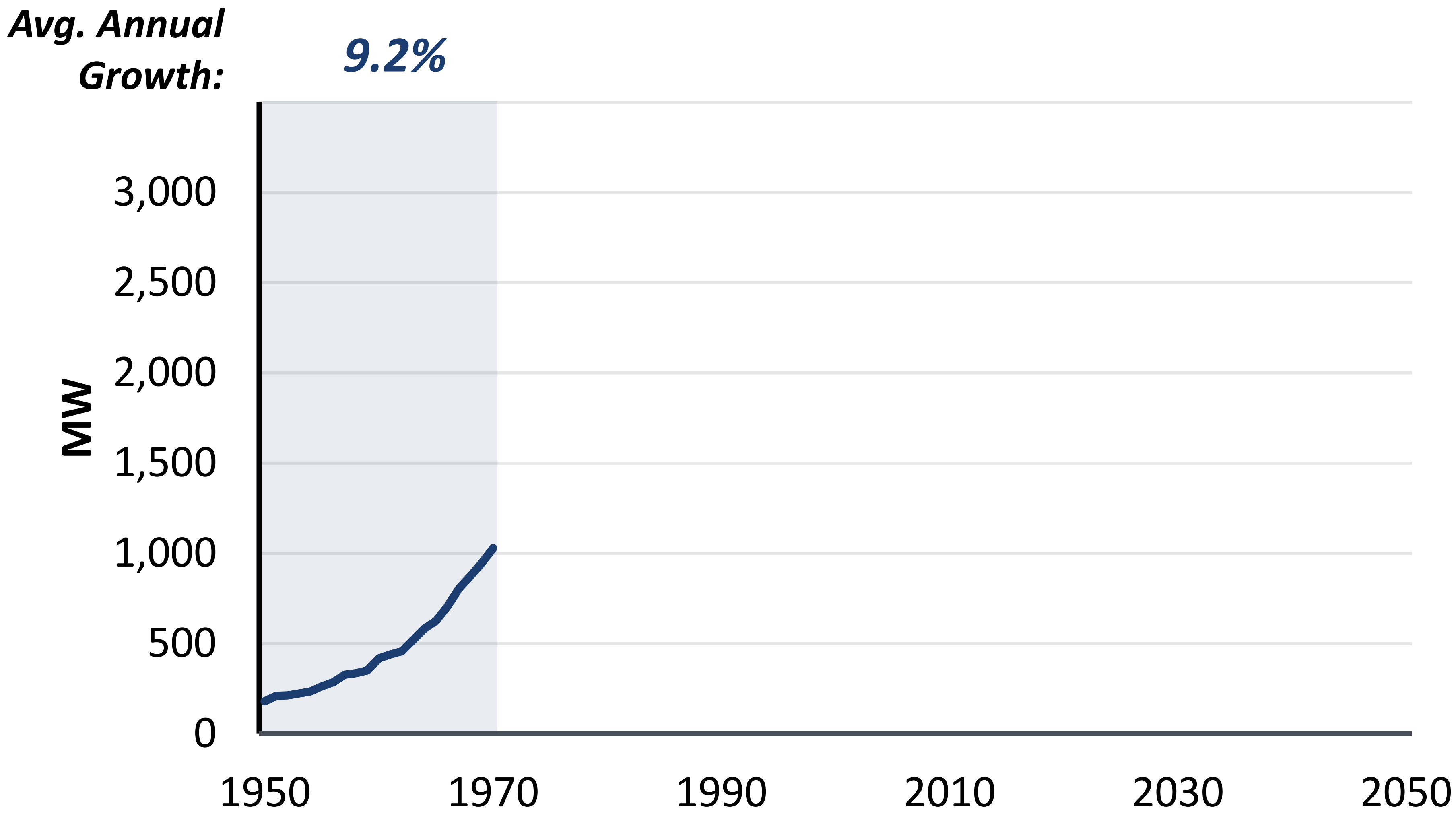
Yoga for the Decarbonized Power Grid

Presented by
Ryan Hledik

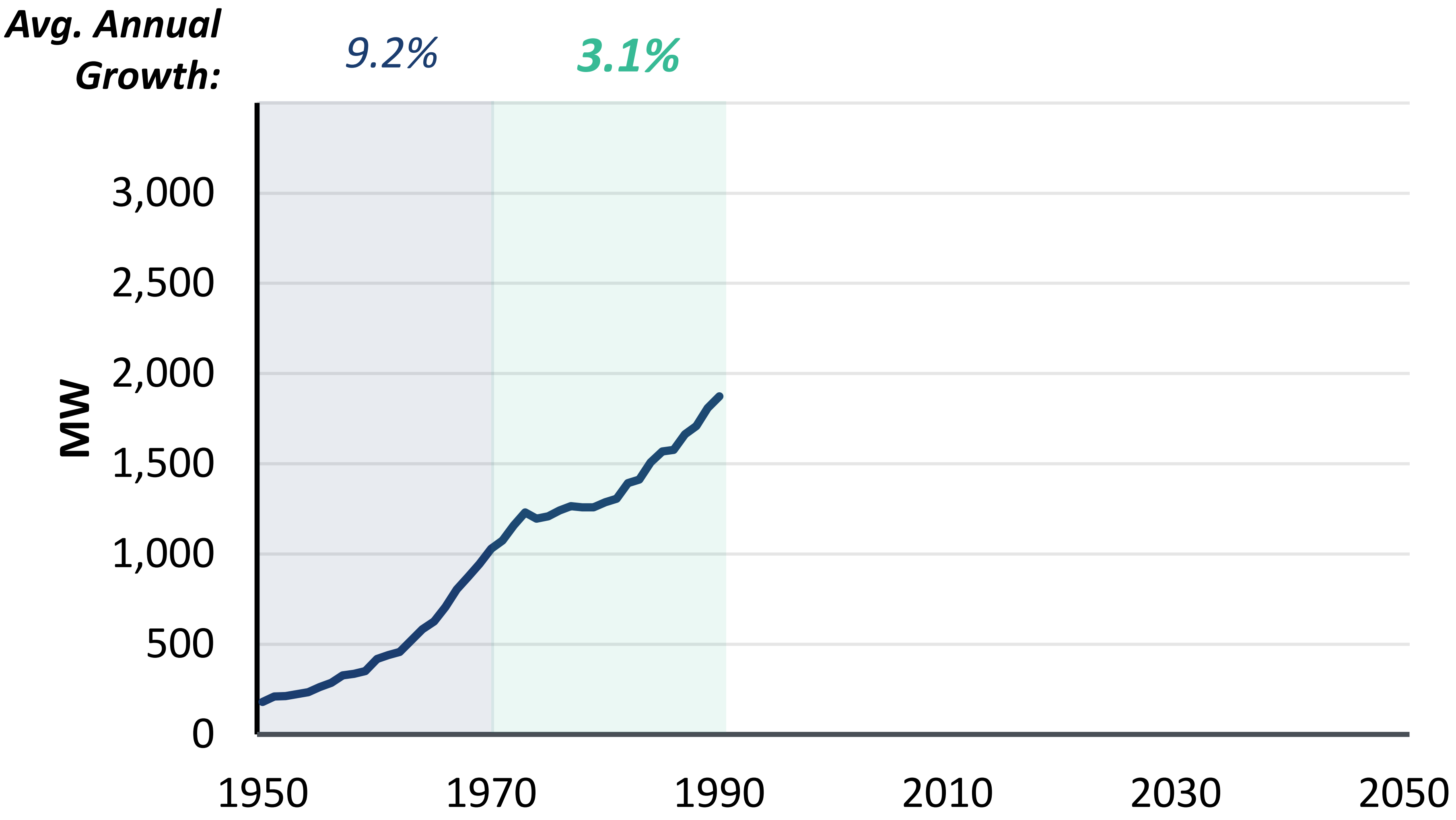
NARUC ANNUAL MEETING
NOVEMBER 15, 2022
NEW ORLEANS, LA

Brattle

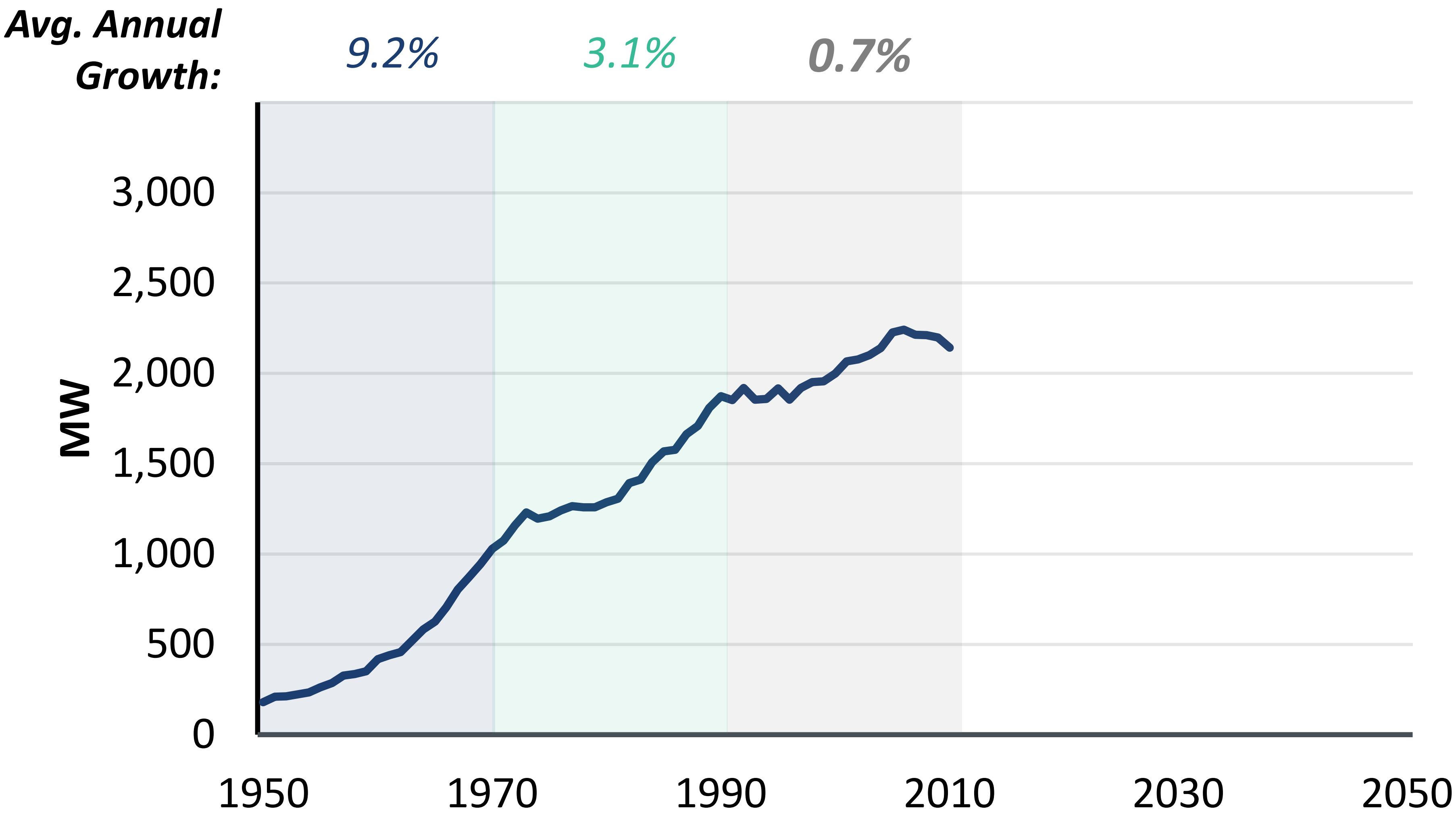
Pepco DC System Peak Demand
1950 to 1970: Rapid Growth



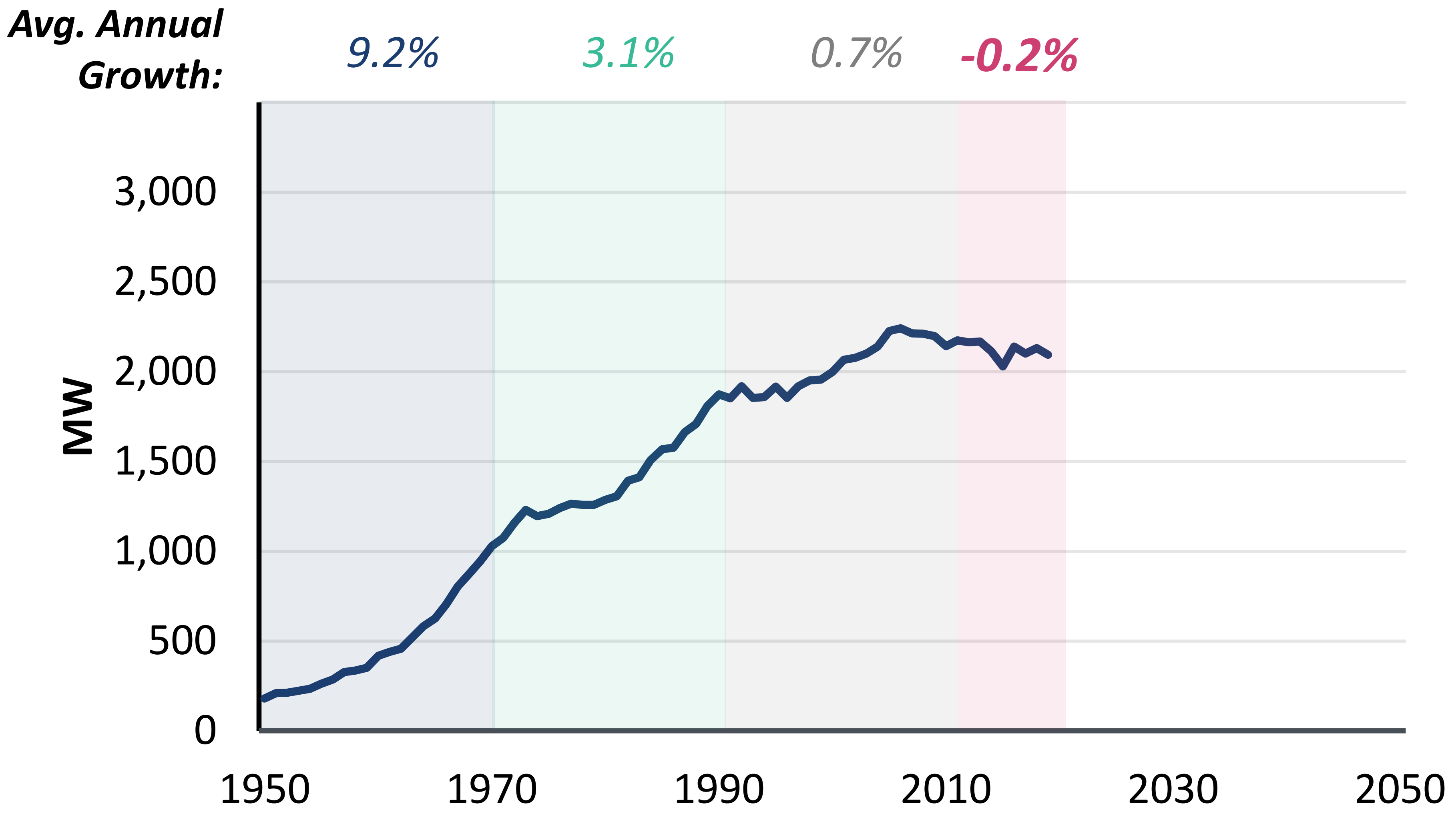
Pepco DC System Peak Demand
1970 to 1990: Persistent expansion



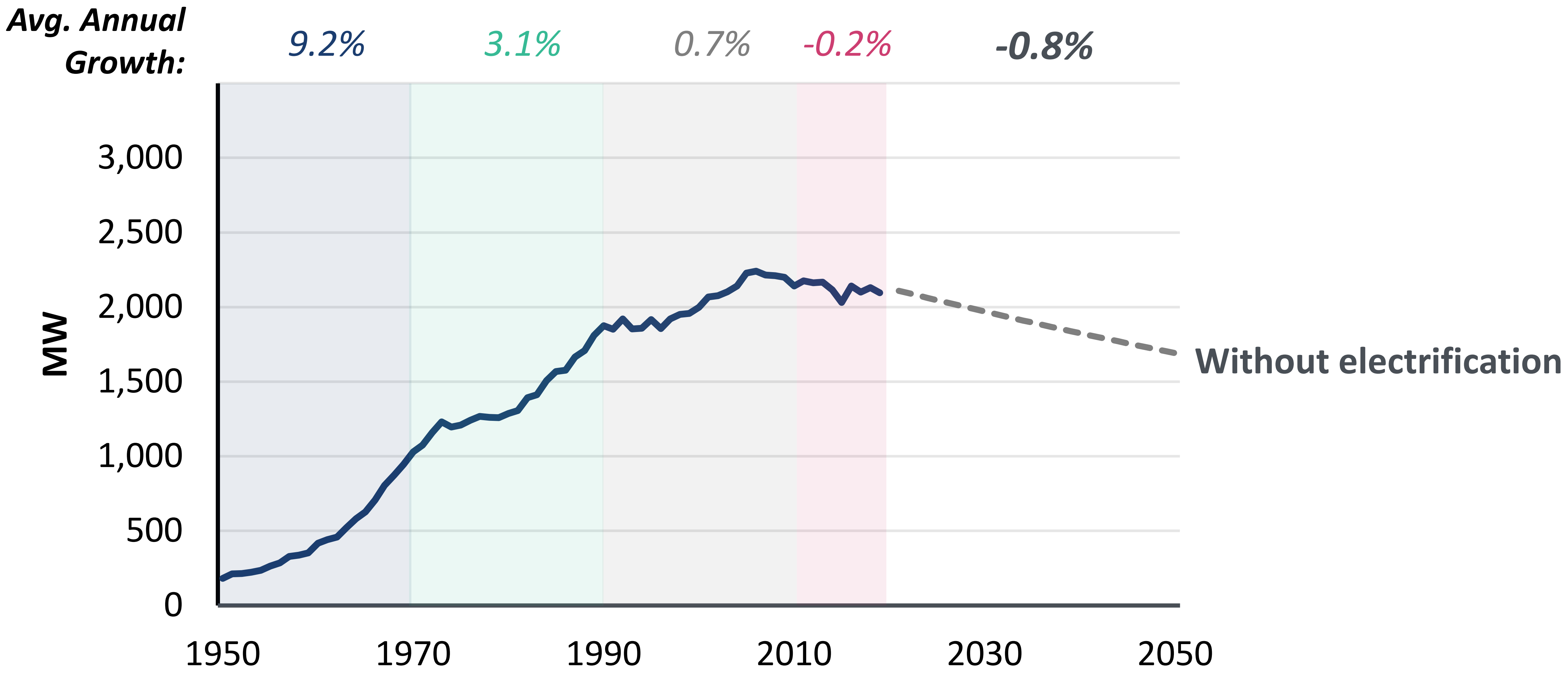
Pepco DC System Peak Demand
1990 to 2010: Slowing Growth



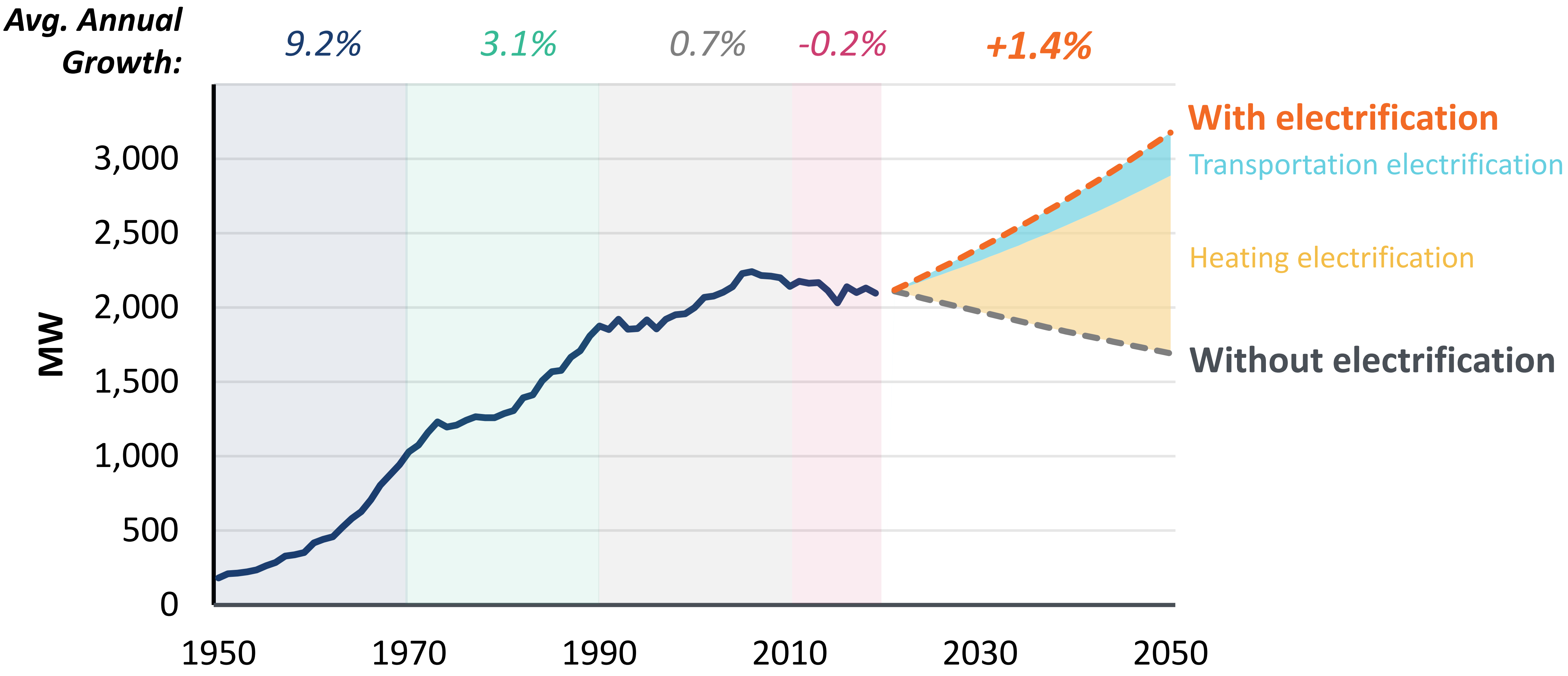
Pepco DC System Peak Demand
2010 to 2019: Multi-year decline



Pepco DC System Peak Demand
To 2050, without electrification: Continued decline



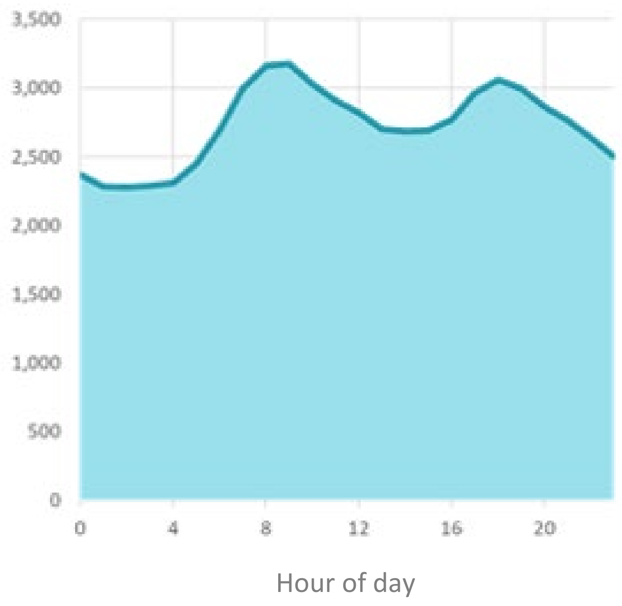
Pepco DC System Peak Demand
To 2050, with electrification: Reversing the trend



Load flexibility: Yoga for a decarbonized power grid

2050 Peak Day Hourly System Load, After Electrification

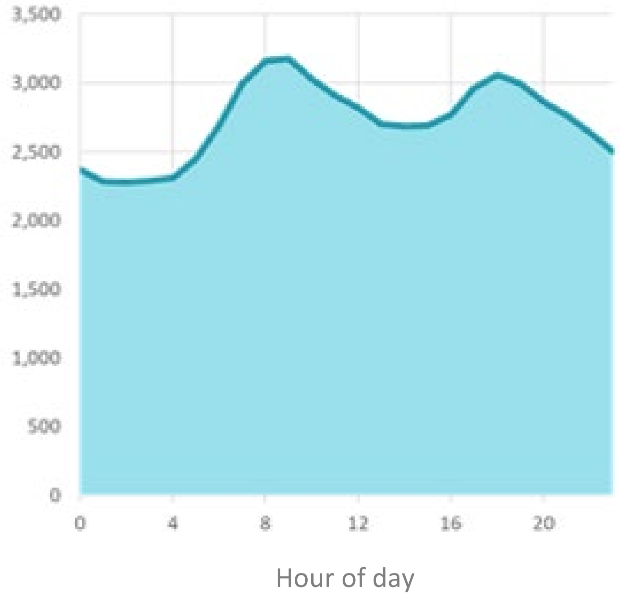
Unmanaged load



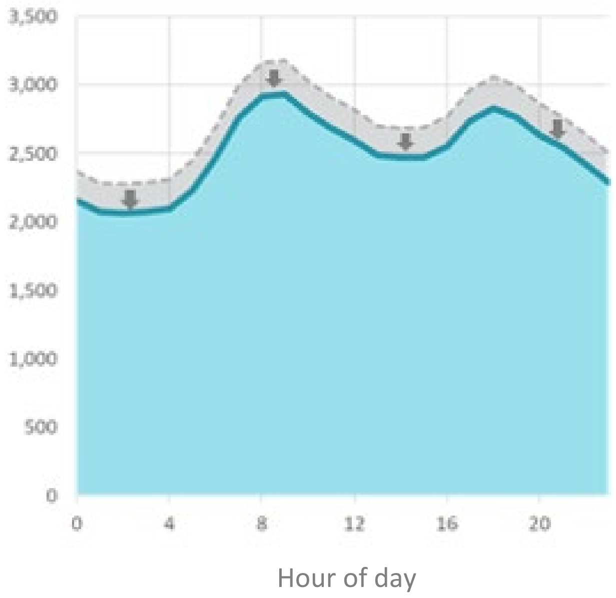
Load flexibility: yoga for a decarbonized power grid

2050 Peak Day Hourly System Load, After Electrification

Unmanaged load

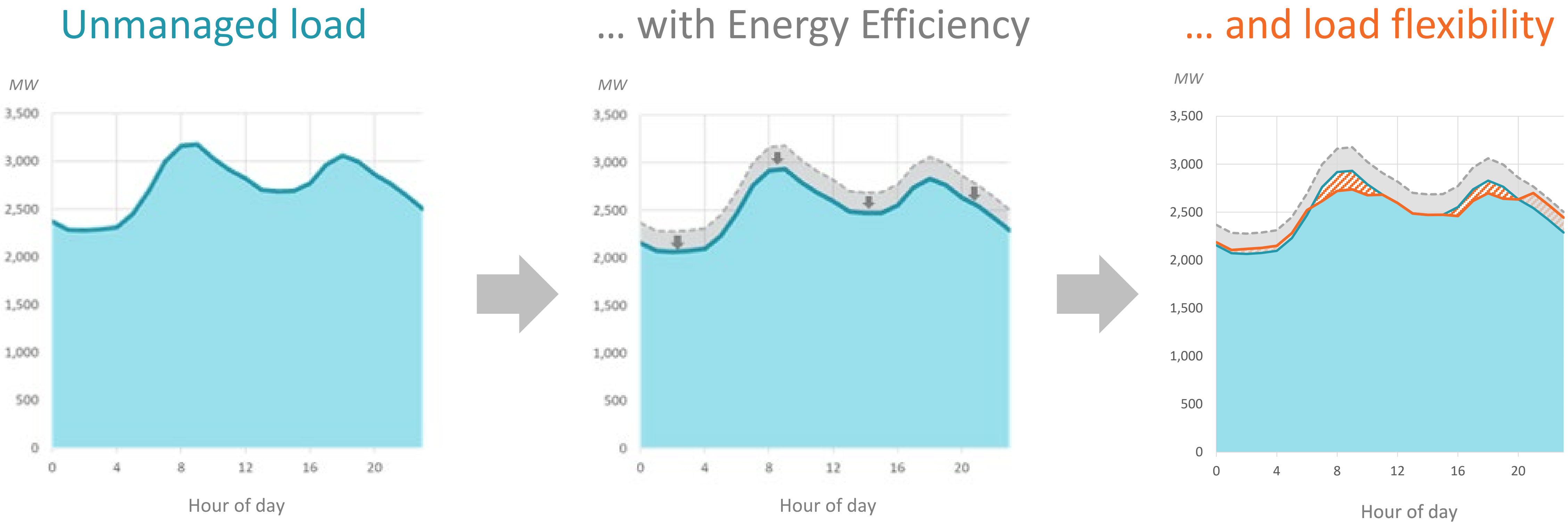


… with Energy Efficiency

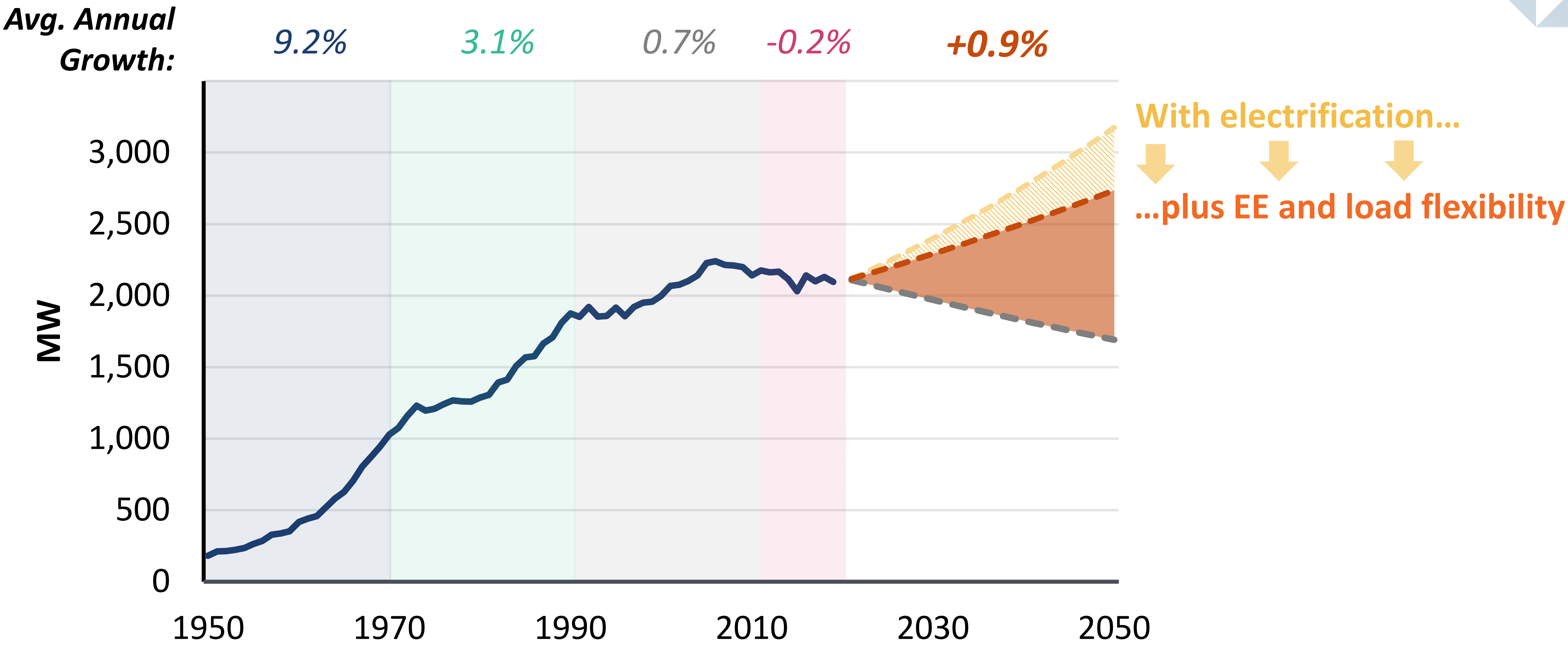


Load flexibility: yoga for a decarbonized power grid

2050 Peak Day Hourly System Load, After Electrification



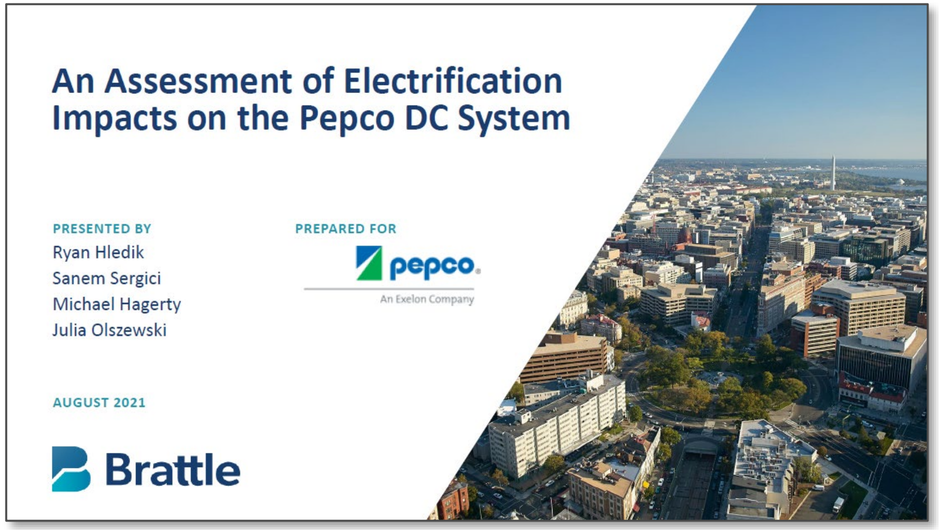
Pepco DC System Peak Demand
To 2050, with EE and load flexibility: Sustainable growth



Takeaways

- Electrification is an **extraordinary opportunity** for electric utilities and society
- Load flexibility and EE are keys to **affordable and sustainable electrification**
- Load flexibility will **enable** capital investment, **not compete** with it
- **Innovative regulatory models and business strategies** can make this work for utilities, market participants, and consumers

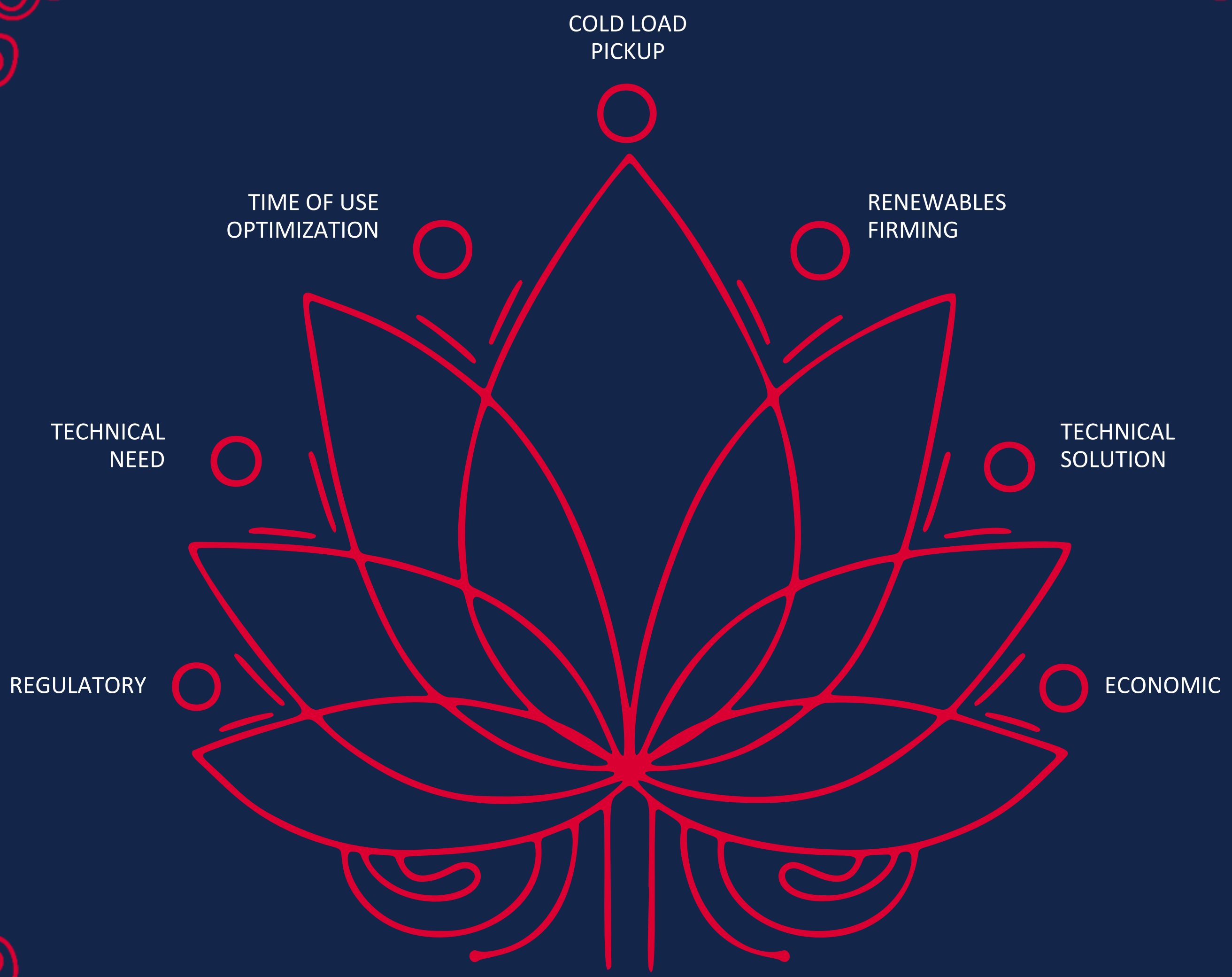
For more information, download from: DC PSC Website



Teresa Ringenbach

VP of Business Development – Armada Power

Demand response is many things which keep the grid in balance.



Armada Power in real life.

DEMAND RESPONSE

# Events	2019 DR Savings	# of Devices	Savings per Device
4	$5,330.12	502	$10.62

TIME OF USE

TOU Events	2020 TOU Savings	# of Devices	Savings per Device
252	$183.87	100+	$183.87

COLD LOAD PICKUP

# Events	CLP Event Savings	# of Devices	Savings per Device
1	$33,367.12	282	$118.32

True grid support requires flexible regulatory approaches.

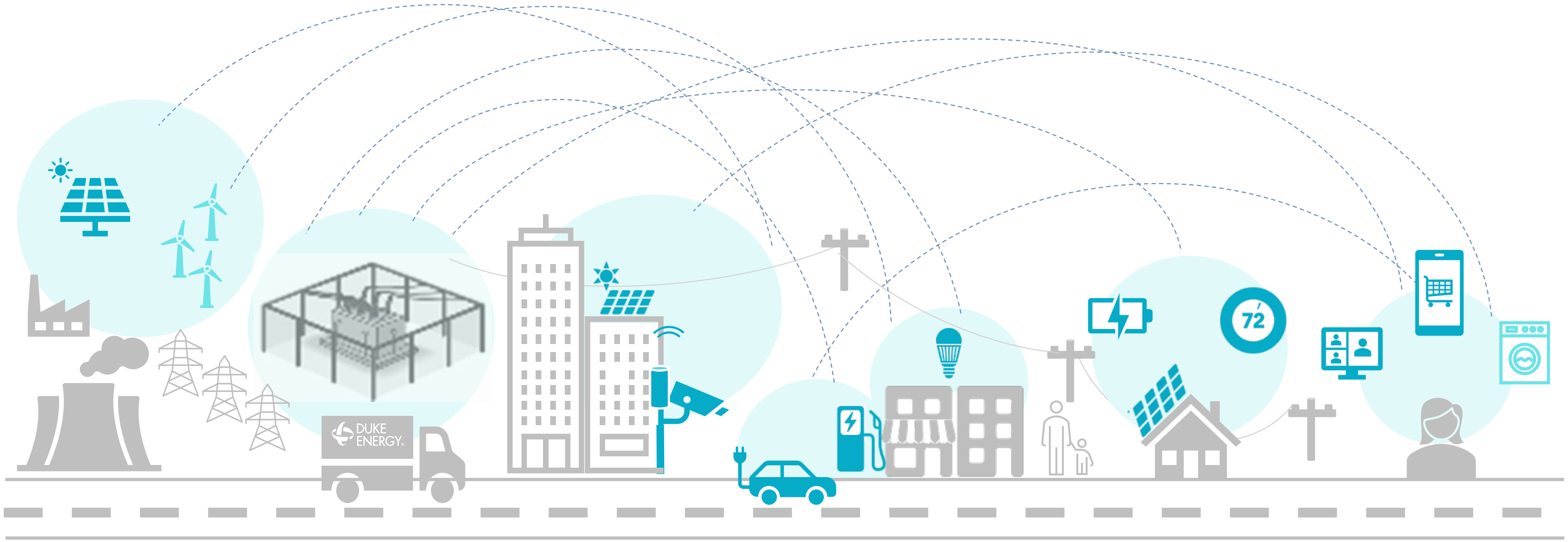
Regulatory Approaches for Advancing Demand Flexibility

Lon Huber – SVP, Pricing & Customer Solutions

Pricing & Customer Solutions

The How and the Why

- Customers receive financial incentives to participate in DR programs; all customers experience downward pressure on rates overtime due to avoided utility capital investments and power purchases to ensure system reliability
  - DR programs are included in integrated resource plans and utilities that operate in organized electric markets can utilize DR to meet Firm Resource Requirements and monetize the resource for the benefit of customers by participating in capacity auctions



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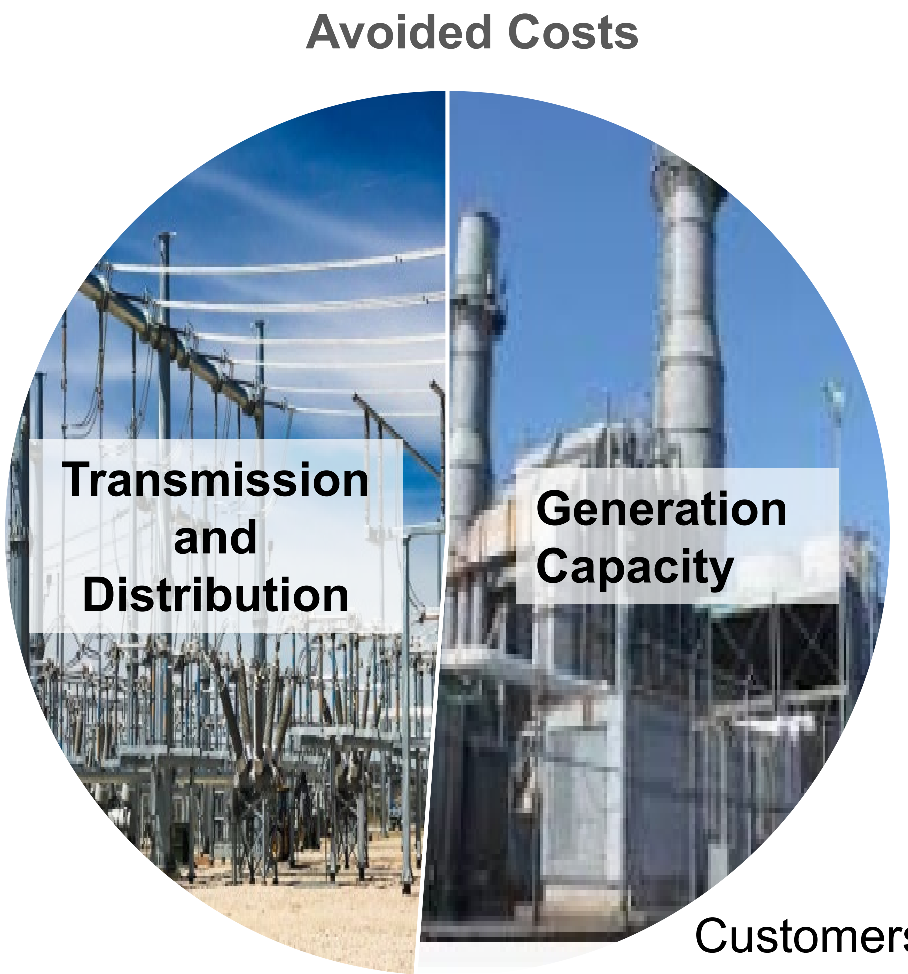
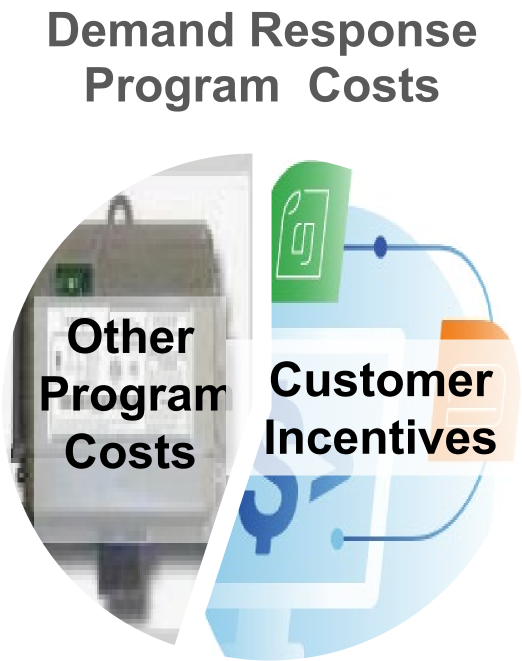
Constructive Regulatory Mechanisms to Foster Demand Response

- Need complimentary business models to promote utility DR programs and investments not accommodated by the traditional utility business model
  - Attract top talent
  - Gain allocation of internal support and resources

- There are several solutions with various combinations to advance demand flexibility
  - Return on expenses
  - ROE adders
  - Incentive bonuses
  - Rapid prototyping
  - Innovative pricing mechanisms
  - Shared savings

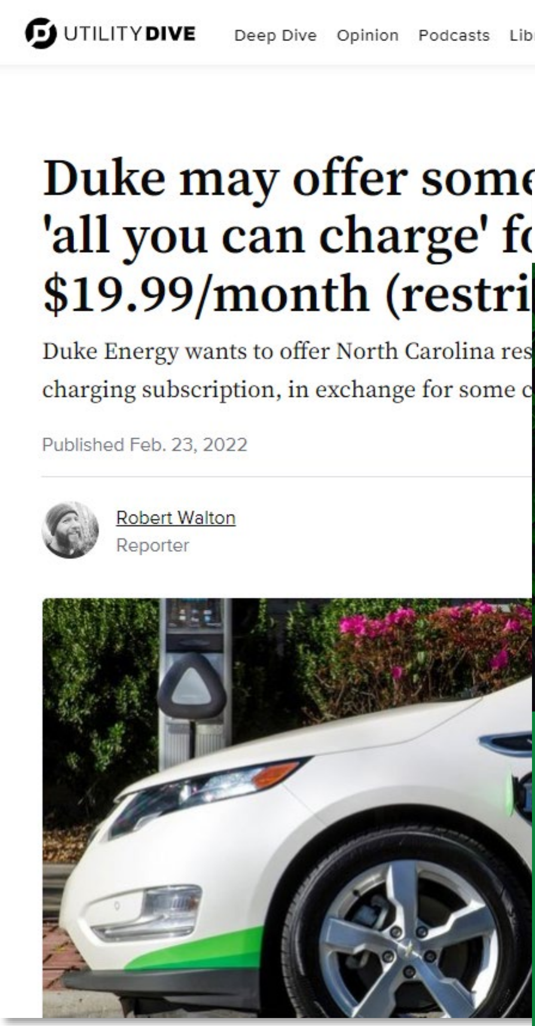
Shared Savings Economics

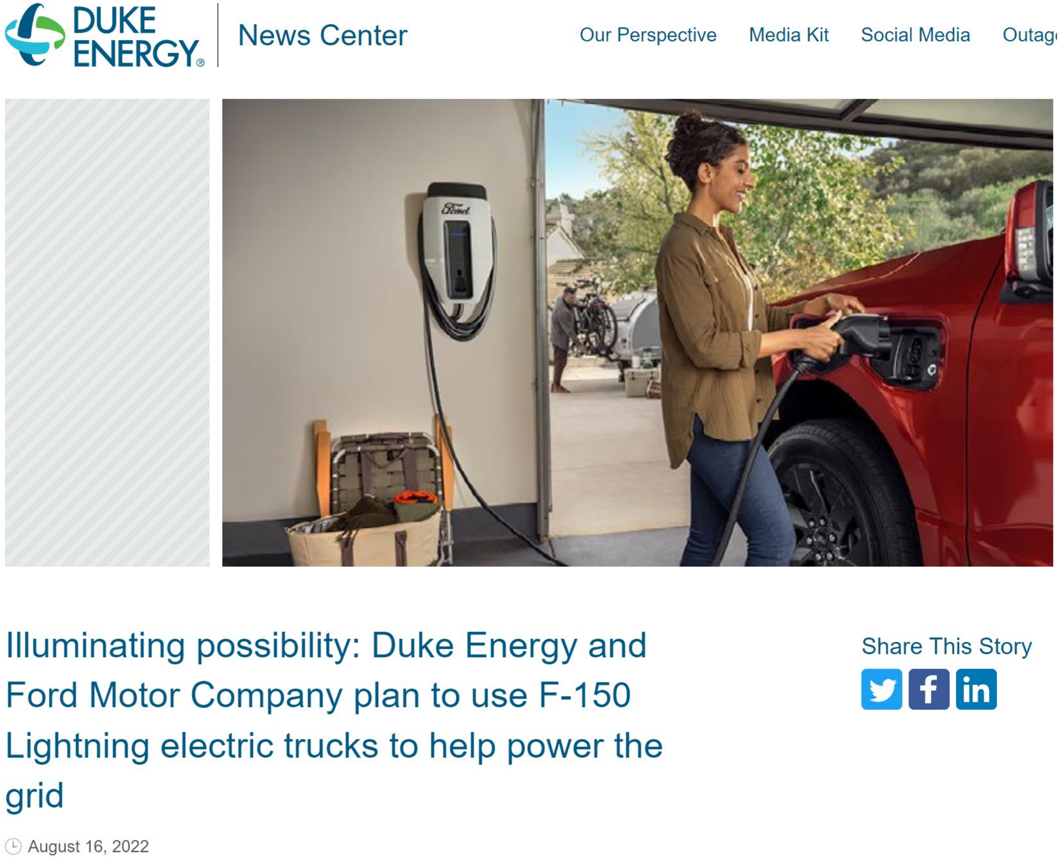




Customers retain approximately 90% of the net benefits realized (Avoided costs less costs of demand response program costs

Innovative pricing mechanisms





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Pricing & Customer Solutions

Innovation | Strategy | Sustainable Solutions

Regulatory Options to Promote Efficiency & Demand Flexibility

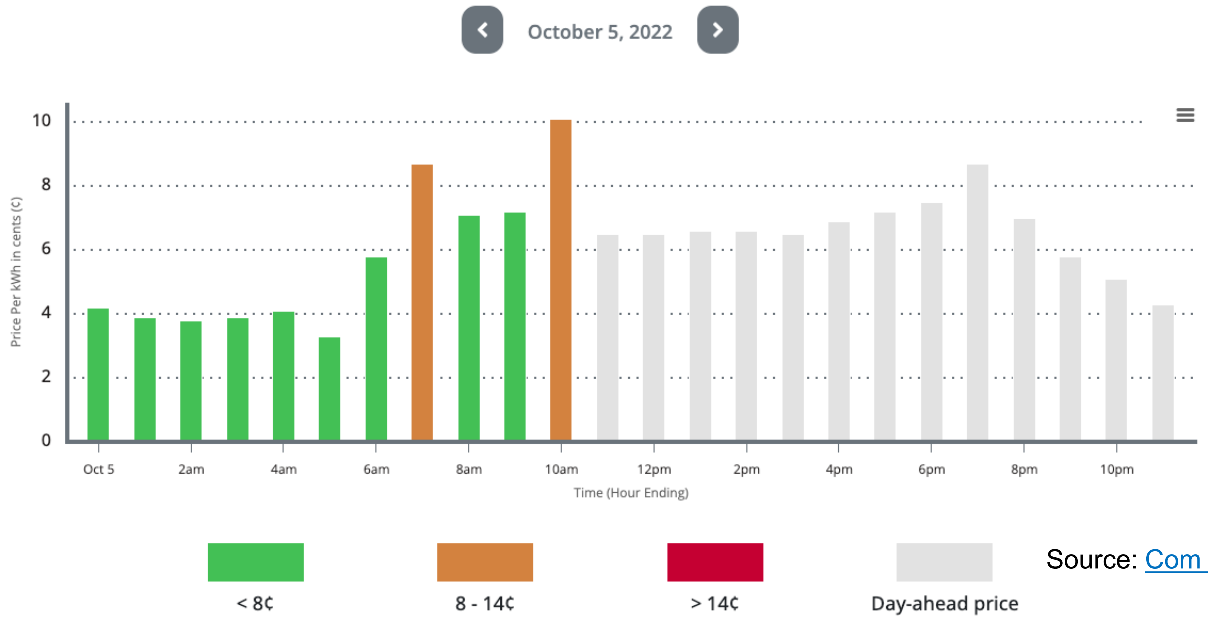
National Association of Regulatory Utility Commissioners Annual Meeting
November 14, 2022

Presented by Natalie Mims Frick
Contributions by Lisa Schwartz

This work was funded by the U.S. Department of Energy's Building Technologies Office, under Contract No. DE-AC02-05CH11231.

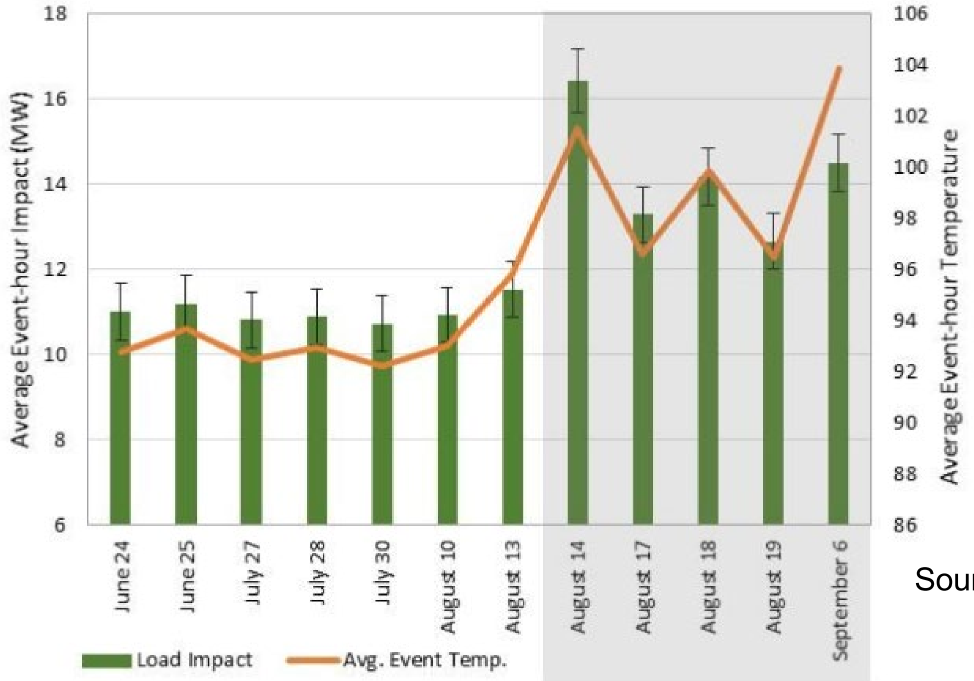
Rates that are reflective of hourly system cost

- Illinois: Commonwealth Edison offers a Residential Real Time Pricing rate that provides participants with day-ahead and real-time prices.



Source: Com Ed

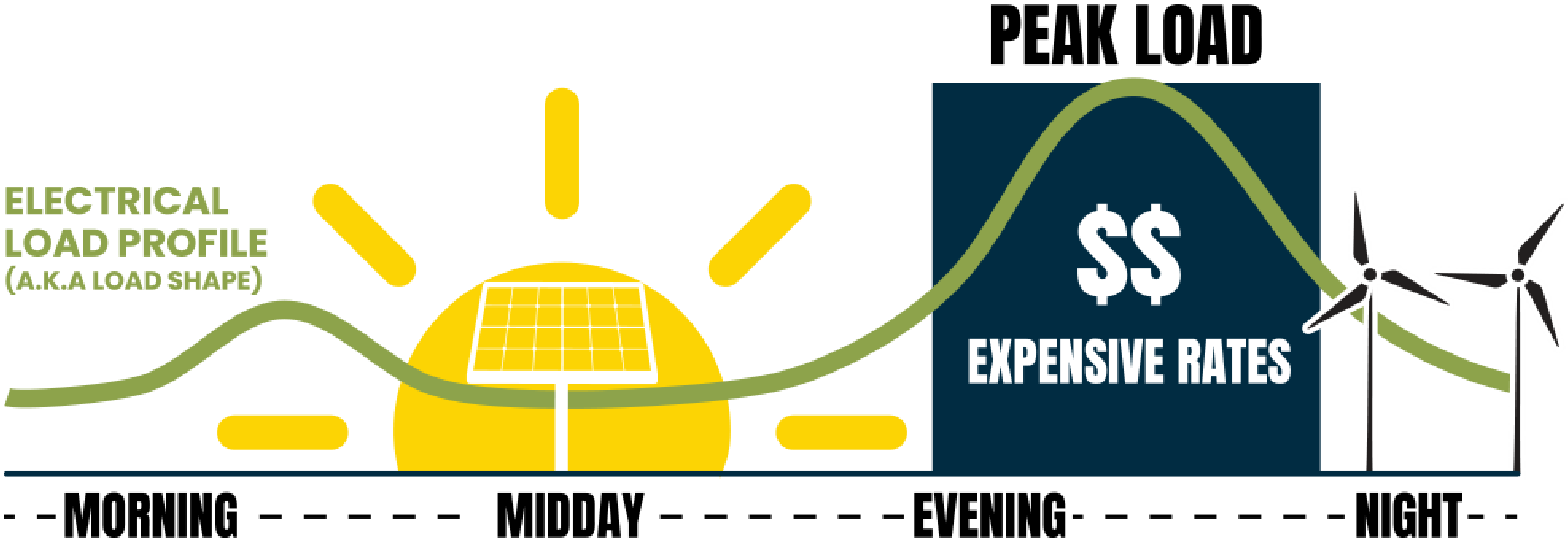
- California: PG&E offers residential customers a *voluntary* critical peak pricing program that overlays a customer's electric rate and is designed to lower summer electricity costs for customers and conserve California's power grid.



Source: PG&E

Load management standards

- Load management is any utility program or activity that is intended to reshape deliberately a utility's load duration curve" (Public Resources Code, section 25132).
- California adopted amendments to load management standards that will increase statewide demand flexibility.



Utility planning related to demand flexibility includes equity strategies

- Washington (SB 5116, 2019) requires utilities to file reports demonstrating how "all customers are benefiting from the transition to clean energy."

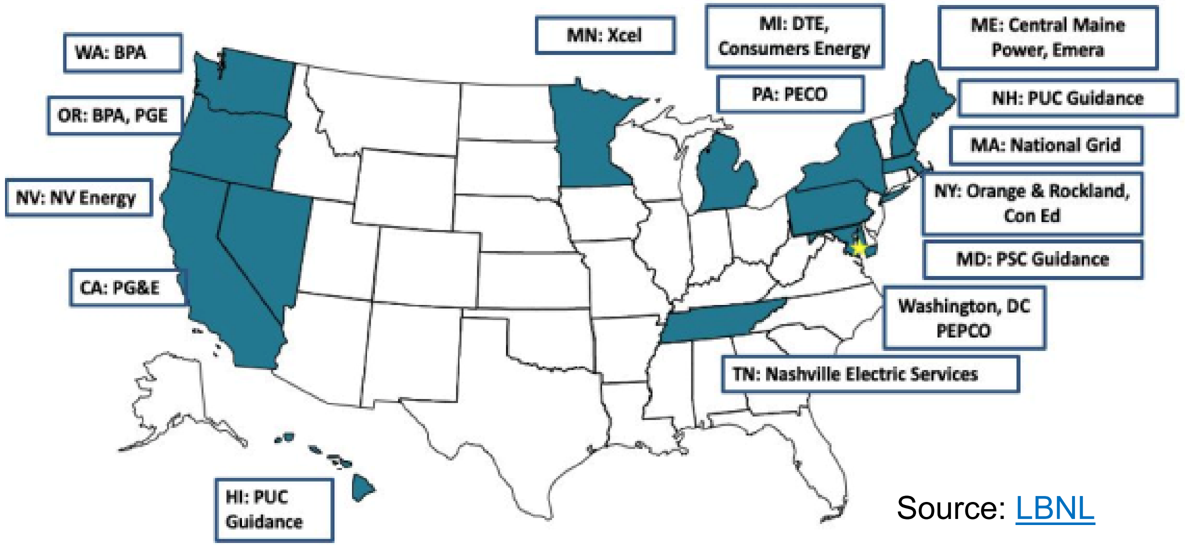
Other state equity policies affecting utility regulation (beyond planning)

- **Massachusetts** Department of Public Utilities is required to include equity as a priority for meeting statewide GHG emission limits
- **Colorado** PUC is required to adopt rules for "all of its work" to "…consider how best to provide equity, minimize impacts, and prioritize benefits to disproportionately impacted communities and address historical inequalities"
- **Oregon** PUC may consider for classifying utility services for retail rates: "differential energy burdens on low-income customers and other economic, social equity or environmental justice factors that affect affordability for certain classes of utility customers"
- **Maine** PUC is required to incorporate equity considerations in decision making at the PUC and other state agencies

Photo by Harley Mac, Flickr CC

Distribution planning

- Distribution system plans
- Grid modernization plans
- Hosting capacity analysis/maps
- Non-wires solutions/locational value



Source: LBNL

For more information see:

- Integrated distribution planning overview (2022)
- State regulatory approaches for distribution planning (2022)
- Berkeley Lab's Integrated Distribution System Planning page

DER Compensation

Arizona Corporation Commission required Arizona Public Service to file a tariff for demand-side resource aggregation and compensate aggregators for a wide range of benefits.

Financial incentives for achieving or exceeding peak demand reduction targets

- Minnesota (HF 124, 2021) authorizes incentive plans for utilities to encourage investments in load management as well as EE; addresses net benefits from integrated load management/EE actions.
- Also in Minnesota, Xcel filed a DR financial incentive for Commission consideration (Docket 21-101).
- Michigan provides utility financial incentives for DR based on non-capitalized costs for achieving DR capacity growth targets and demonstrating DR for NWA solutions (e.g., see Case No. U-20164 and Case No. U-21080).
- New Hampshire provides incentives for utilities that achieve ≥65% reduction in summer or winter peak demand through EE and "Active Demand Savings" (see recent settlement).

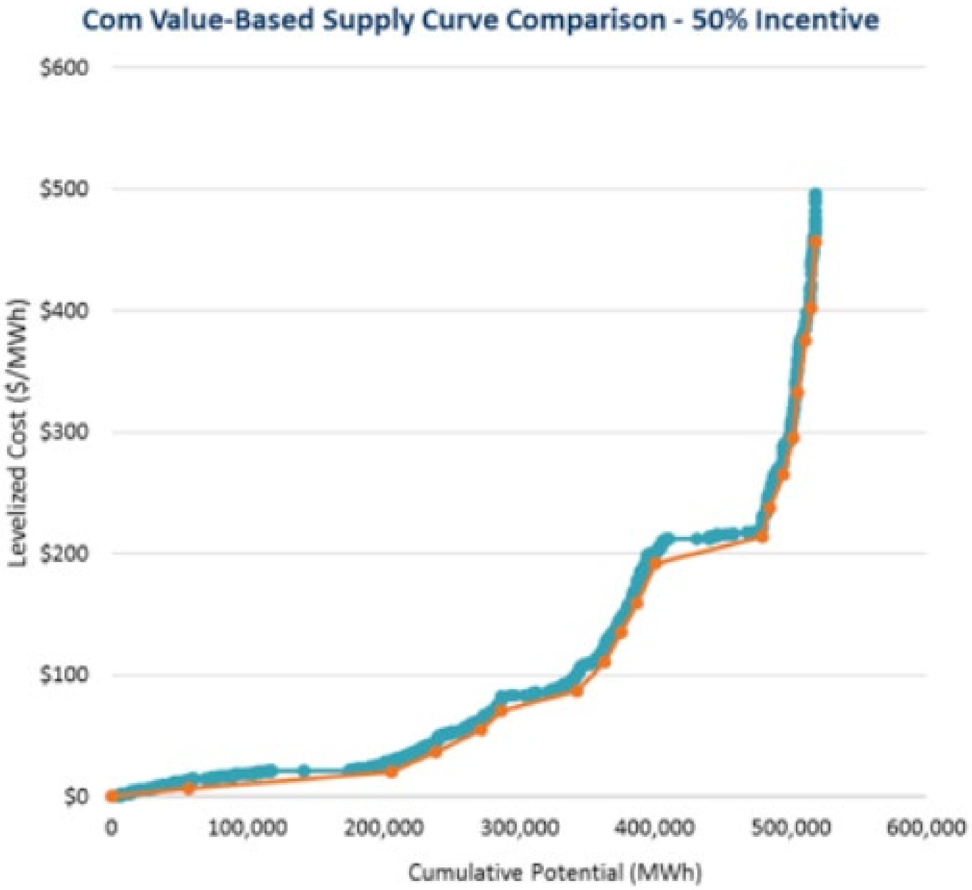
Xcel Energy's Cost Effective Alignment of Generation and Load Performance Metrics

Demand response, including (1) capacity available (MWh) and (2) amount called (MW, MWh per year)
Amount of demand response that SHAPES customer load profiles through price response, time varying rates, or behavior campaigns.
Amount of demand response that SHIFTS energy consumptions from times of high demand to times when there is a surplus of renewable generation.
Amount of demand response that SHEDS loads that can be curtailed to provide peak capacity and supports the system in contingency events: a. For available load b. For actual load reduction c. Metrics that measure the effectiveness and success of (a & b) individually and in aggregate

Docket 17-401

Integrated resource plans (IRP) consider efficiency and demand flexibility on par with other resources

- Oregon PUC requires modeling EE and DR on a par with other resources (Order 07-047)
- Georgia PSC required Georgia Power to include a sensitivity case where DR and EE are modeled "head-to-head" with supply side options in the Company's next IRP (Docket No. 41160)
- Hawaii PUC requires demand-side resources to be treated on a consistent and comparable basis with supply-side resources, in part by developing supply curves for EE; modeling supply curves as portfolio options that compete with supply-side options; and explicitly analyzing cost and risk (Order 37419; Order 37730)
- Xcel Energy modeled EE and DF as bundles that were treated as supply side resources rather than adjustments to load in their most recent IRP (Docket E002/RP-19-368)



Source: Georgia Power

Contact information

Natalie Mims Frick nfrick@lbl.gov, 510-486-7584

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Appendix

Energy Efficiency and Demand Flexibility Typology (1)

States can use this typology to assess their status and consider paths to enable greater building demand flexibility and energy efficiency to meet their own goals. Each policy category includes examples of actions states are taking today

Building codes	Appliance and equipment standards	Resource Standards	Utility Planning	Utility Programs	
Value EE measures based on when savings occur	Include provisions for equipment capable of automated load management in response to a signal from the utility, aggregator, or regional grid operator	EE resource standards (EERS) include peak demand targets or a multiplier for energy savings during peak demand hours	Integrated resource planning considers DF measures and time-sensitive value of EE	EE program goals include peak demand reduction	Programs for utility customers address equity
Provide credit for DF measures through compliance paths		States requiring utilities to acquire all cost-effective EE account for the time-sensitive value of EE	Electricity system planning accounts for interactions between DERs and between DERs and other resources	Cost-effectiveness assessments of EE programs consider time-sensitive value of savings	Pay for performance programs reduce peak demand through EE + DF
Include grid-interactive requirements and open standards for communication and automated load management		DR is included in EERS or is eligible to meet clean energy standards	Distribution system planning considers EE, DR, and other DERs as non-wires alternatives	EE program performance metrics include carbon emissions	DR programs regularly tracked and evaluated
Allow use of a carbon emissions-based metric for compliance, based on predicted energy consumption and CO_2 emission factors		Load management standards encourage shifting electricity use to times with lower carbon emissions	Utilities provide access to system level data to support customer and third-party solutions	Requirements for DR programs include DR/DF potential studies	Locational value informs incentive rates for EE and DR
Incorporate new ASHRAE standards (e.g., 90.1, 189.1)		Storage requirements include thermal technologies	Planning for DR is coordinated with the regional grid operator	DR program goals include significant increases in peak demand savings over time	Programs address multiple DERs to achieve DF
			Utility planning related to DF includes equity strategies	Requirements are established for new utility programs to reduce peak demand	Utility programs are coordinated with state and local government programs and electricity markets

Source: Schwartz, Nemtzow and Frick

Energy Efficiency and Demand Flexibility Typology (2)

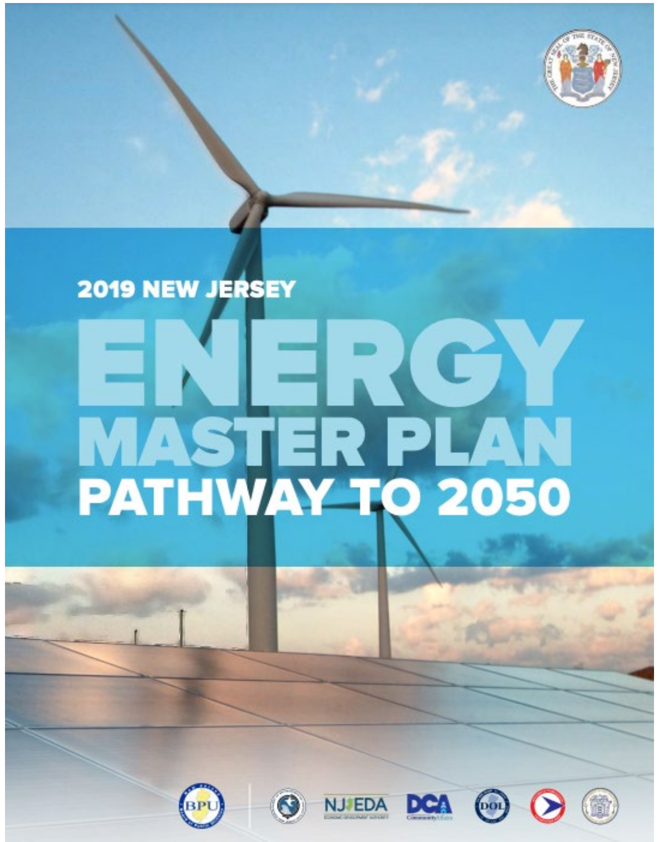
Advanced metering infrastructure and metering data	Rate Design	State Programs	State Energy Planning	Related State Policies and Regulations
Grid modernization plans provide a business case for AMI deployment, with costs and benefits monetized to the fullest extent possible	Demand charges for commercial customers are applied only to peak demand periods, or charges are higher during peak demand periods	State EE incentive and financing programs incorporate DF or new DF mechanisms are established	DF is included as an explicit means to reach broader state energy goals in state master energy plans, resilience plans, renewable energy goals, decarbonization goals, and electrification plans	Utilities and other program administrators have an opportunity to earn financial incentives for achieving or exceeding peak demand reduction and DF targets
AMI is in place, or deployment has been approved, for most utility customers	Time-based rates provide strong price signals for peak demand reductions	State lead by example programs demonstrate enabling technologies for DF and widely share results		Revenue decoupling is in place for electric utilities
Customers and their designated third party have granular and timely access to meter data	Retail rates are more reflective of hourly system costs and location	Benchmarking and transparency programs track and report on metrics for energy use, energy savings, peak demand reduction, and DF		Climate change policies consider the role of DF in reducing GHG emissions from buildings
Utilities provide energy management tools on web portal or customer mobile devices	Robustness of approved programs is regularly tracked and evaluated	Home energy rating programs include DF measures		Grid modernization policies and regulations consider DF
		State RD&D programs test approaches for increasing DF and quantifying benefits and costs		

Source: Schwartz, Nemtzow and Frick

Examples of States Action on Key Indicators

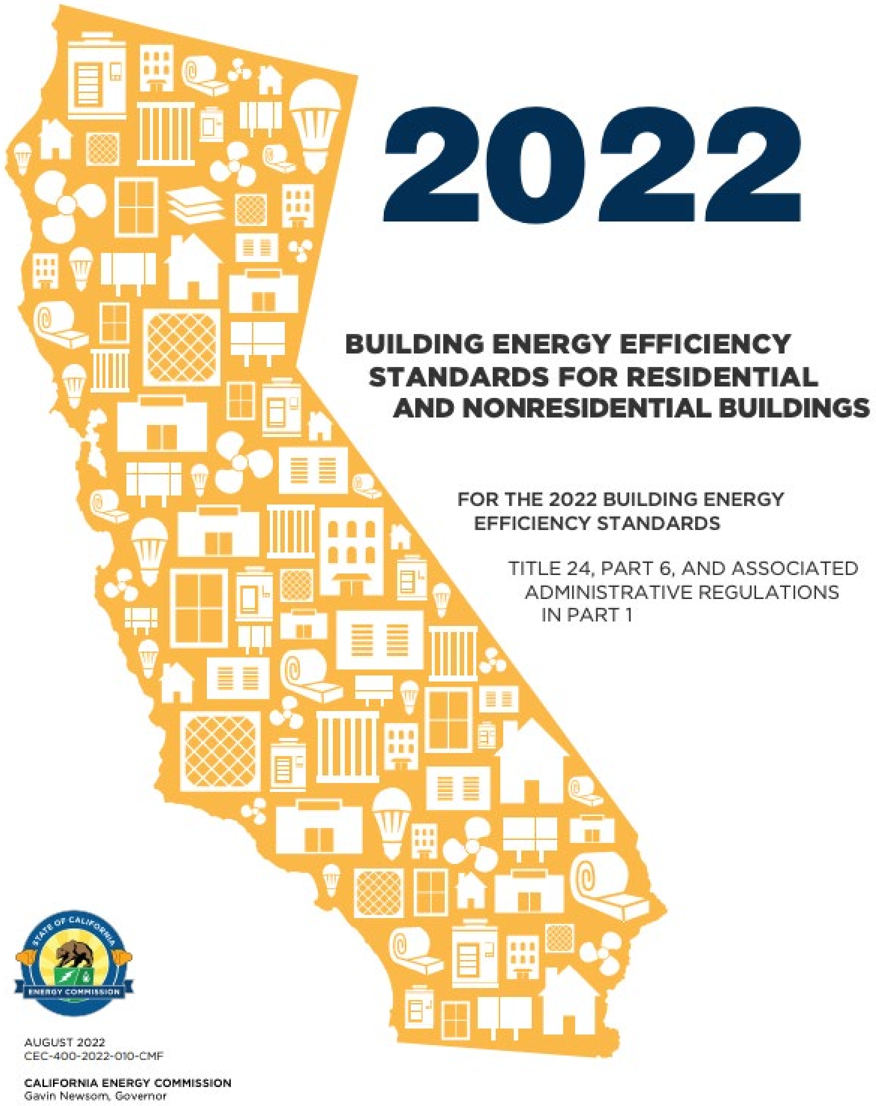
Demand flexibility is an explicit means to reach broader state energy goals

- Executive Order 28 required the New Jersey Board of Public Utilities (BPU) to update New Jersey's Energy Master Plan to achieve 100% clean energy by 2050. The plan includes DF strategies:
  - Pilot alternative rate designs to manage EV charging and encourage customer controlled DF
  - Pilot and implement modified rate design to encourage customer-controlled DF, manage EV charging, and support DR programs
  - Develop DR-ready building codes for new multi-unit dwellings and commercial construction
  - Explore establishment of distribution-level retail DR programs that can complement wholesale electricity markets



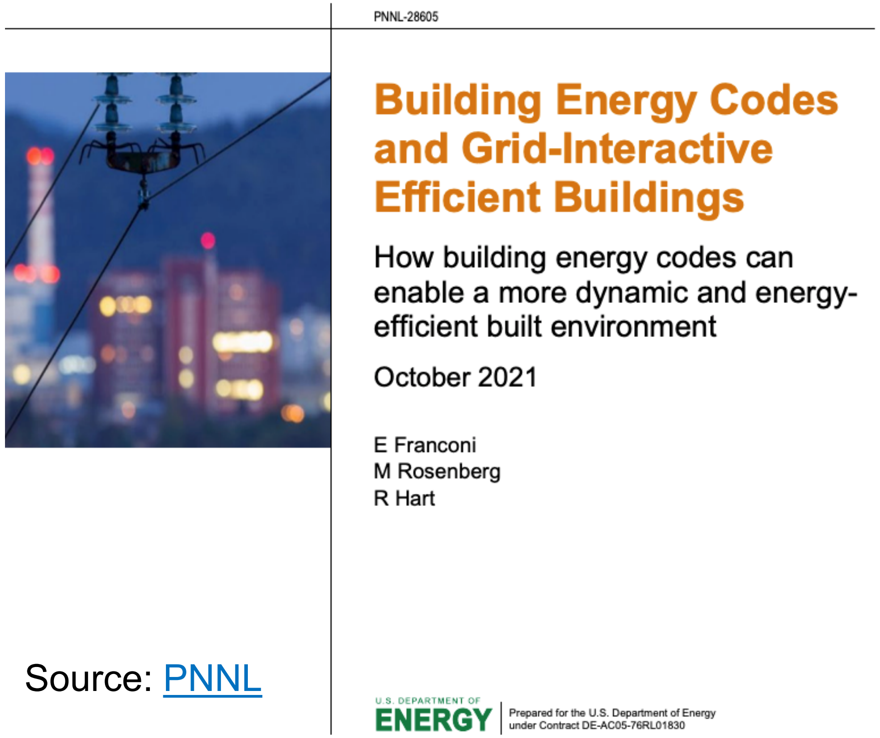
Code values efficiency measures based on when savings occur

- California's Title 24 building energy code includes a Time Dependent Valuation (TDV) compliance metric (section 100.2).



Code includes grid-interactive requirements and open standards for communication and automated load management

- Appendix D of California's 2022 nonresidential code requires that certain types of buildings are DR capable.
- Additional Title 24 standards:
  - Occupant Controlled Smart Thermostats (Appendix JA5)
  - Heat Pump Water Heater Demand Management Systems (Appendix JA13)


PNNL-28605

Building Energy Codes and Grid-Interactive Efficient Buildings

How building energy codes can enable a more dynamic and energy-efficient built environment

October 2021

E Franconi
M Rosenberg
R Hart

U.S. DEPARTMENT OF ENERGY | Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

Source: PNNL

Equipment capable of automated load management in response to a signal

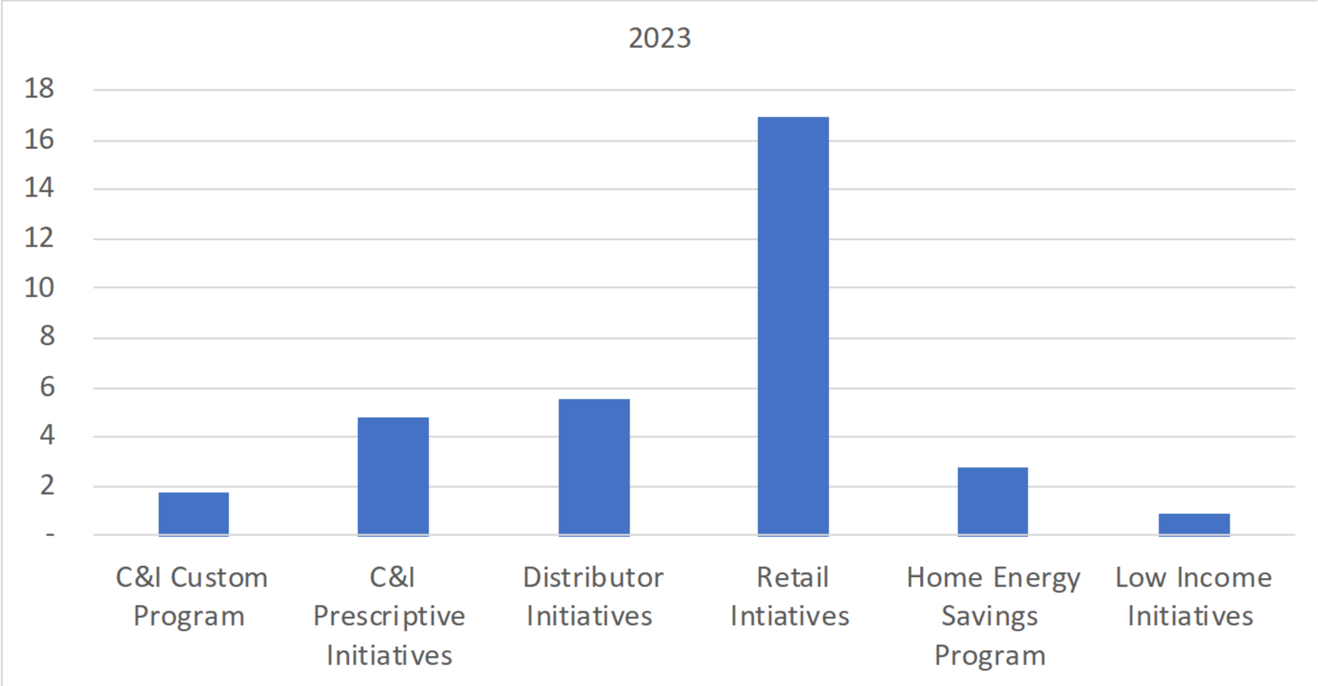
- Washington requires new electric storage water heaters to include a grid-communications port that meets CTA-2045 or similar communication standards.

- Oregon adopted a similar requirement, pursuant to an executive order to establish new appliance standards that promote load management strategies. The CTA-2045 standard is now in statute (HB 2062, 2021).

EE resource standards (EERS) include peak demand target

Resource Standards

- Colorado (HB 1227, 2017) required the Public Utilities Commission (PUC) to set goals for DSM programs to achieve ≥5% peak demand reduction from 2019-2028, compared to a 2018 baseline
- Efficiency Maine is required to reduce "peak-load demand for electricity by the maximum achievable cost-effective amount" (MRS 35-A §10104 (4)).



Efficiency Maine Summer Peak Electric Load Reduction (MW)