# THE CLEAN ENERGY TRANSITION

## Balancing the Pace of a Clean Energy Transition... Affordably, Reliably, and Responsibly For All

**Morgan Scott**
Director - Climate READi, Sustainability & Ecosystem Stewardship | EPRI

# CLEAN ENERGY TRANSITION = OPPORTUNITY!

**2-3x**

GROWTH IN
ELECTRICITY SALES

**20-30%**

IMPROVEMENT IN
ENERGY AFFORDABILITY

**Choice**

CUSTOMER
OPTIONS

**DONE RIGHT…CLEAN ENERGY TRANSITION SHOULD BE AFFORDABLE TO ALL**

## 2030 STRATEGIC IMPERATIVES

# NEW THINKING, NEW APPROACHES

**Accelerate Energy Supply Innovation**

**Advance Load Forecasting, System Operations; Integrated Planning**

**Reimagine Shared Customer Resource**

# MANAGING INTERMITTENCY

## *Emerging Low-Carbon Dispatchable Technologies will be Required*

Wind & Solar

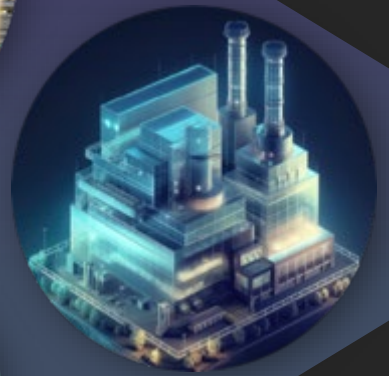
+

Carbon Capture, Usage & Storage

Advanced Nuclear

Hydrogen

Long Duration Battery Storage



Virtual Powerplant

**PACE of CHANGE IMPACTS AFFORDABILITY, RELIABILITY and RESILIENCY**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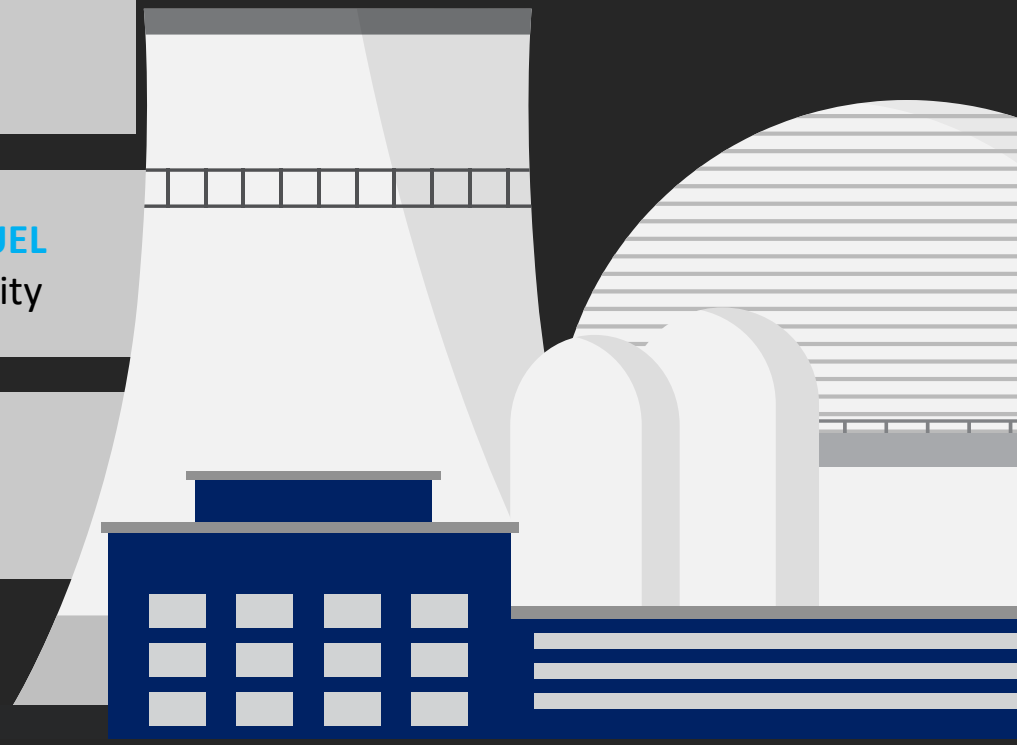
# Benefits of Advanced Reactors

Advanced reactors integrate with renewable energy and improve the utilization of secure energy resources

- Increased **FLEXIBILITY**
- **NEW DESIGNS** can load-follow closer, faster, and more flexibly
- More conducive to **DECARBONIZATION** goals
- Ability to reach **UNIQUE** communities
- Ability to convert more **FUEL ENERGY** to usable electricity
- Many designs are small: **≤300 MWe**



*(Source: Resources for the Future, Advanced Nuclear Reactors 101, March 2021)*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# BALANCING SUPPLY AND DEMAND REQUIRES ADVANCES IN…

Load Forecasting

Resource Adequacy

System Operations

Integrated Planning

# Key Challenges with the Changing Grid

**Electric Vehicles, Data Centers, Crypto mining, $H_2$ Production,** New Manufacturing, Heating Electrification, …

**Wind and Solar Generation, Aging Transmission Infrastructure, Climate impacts …**

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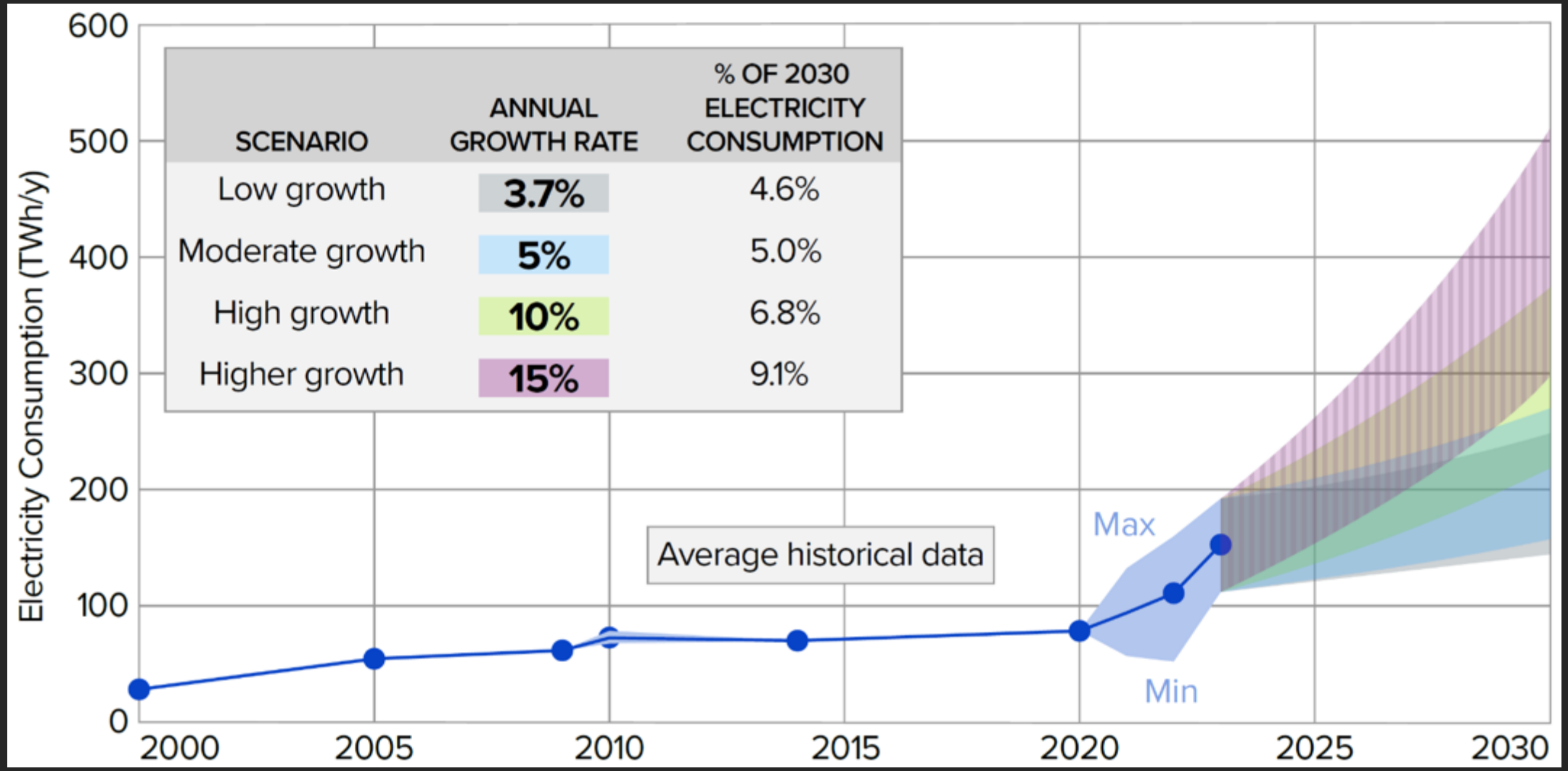
# The AI Race has now become a powering AI Race…





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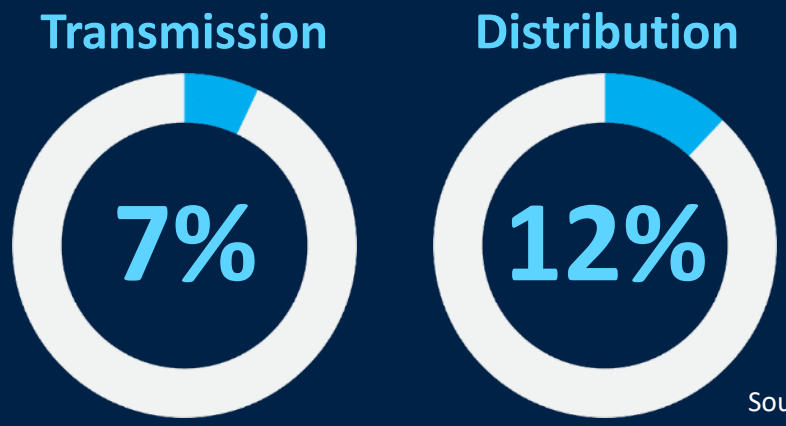
# Grid Enhancing Technologies (GETs)

## Today's T&D Investments

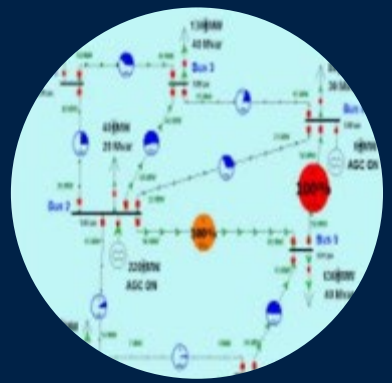



Source: EEI Business Analytics 2022 surveys.

**Advanced technologies will have a much greater portion of tomorrow's T&D Investments**

Dynamic Line Ratings & Advanced Conductors

Power Flow Controllers



Topology Optimization

Bulk Energy Storage

Virtual Power Plants

**Ubiquitous Comms Systems & Cyber Underpin GETs**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## 2030 STRATEGIC IMPERATIVES

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## FAST FORWARD TO 2030

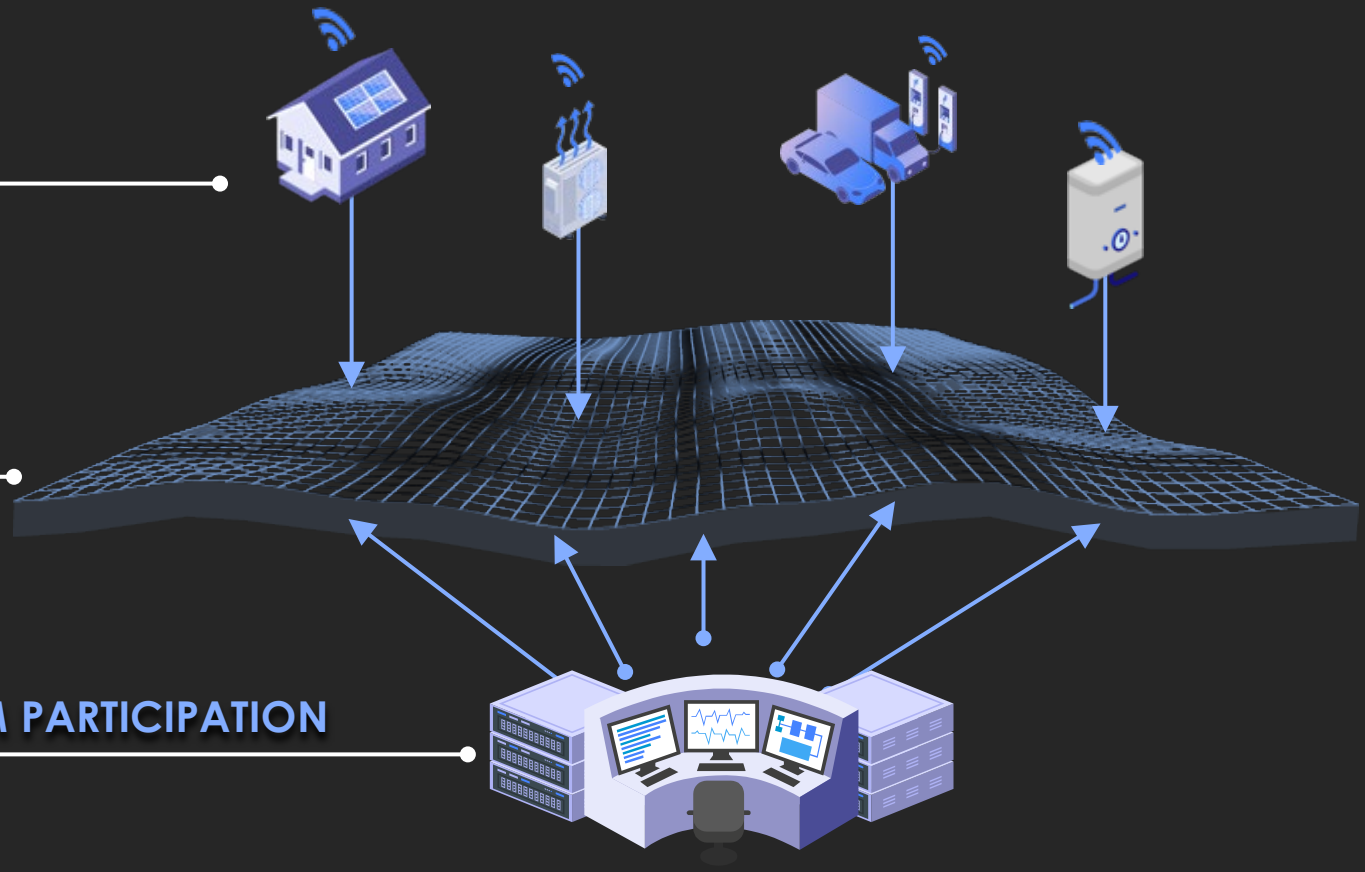
# WHAT IF…

In this future, each customer brings

**2-11 kW**

of controllable load.

- CUSTOMER-OWNED APPLIANCES ARRIVE GRID-CONNECTED
- EV CHARGERS ARE CONTROLLABLE FROM DAY ONE
- EVERY NEW WATER HEATER AND A/C INCENTIVIZES DEMAND-RESPONSE PROGRAM PARTICIPATION



**REALIZING THIS VISION BY 2030 REQUIRES A COMPREHENSIVE STRATEGY NOW**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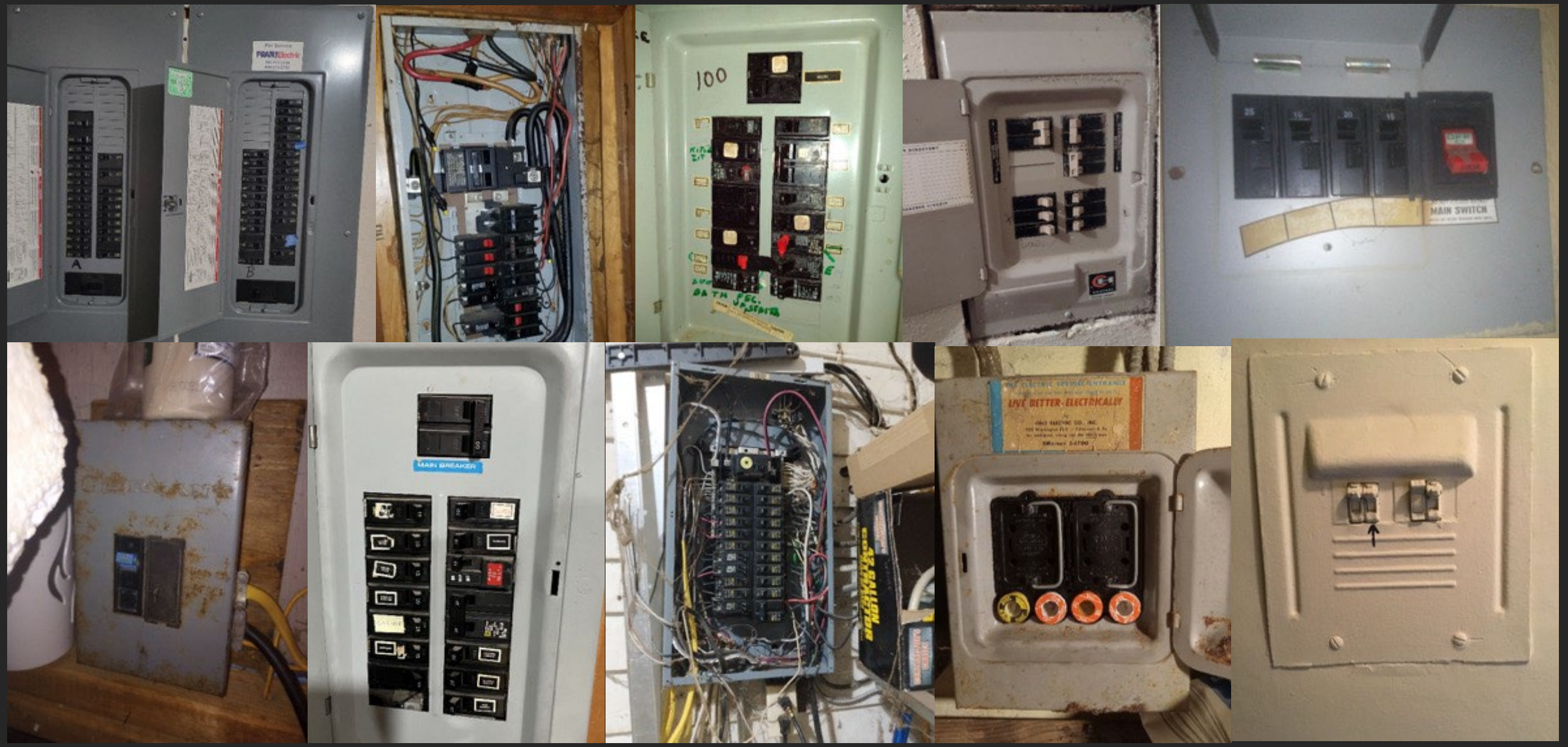
# Electric Panel Survey Project





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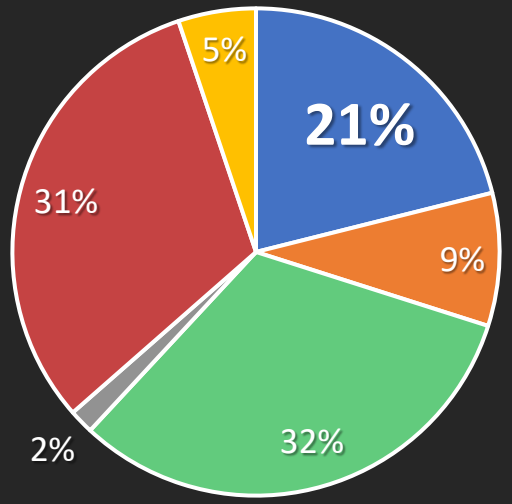
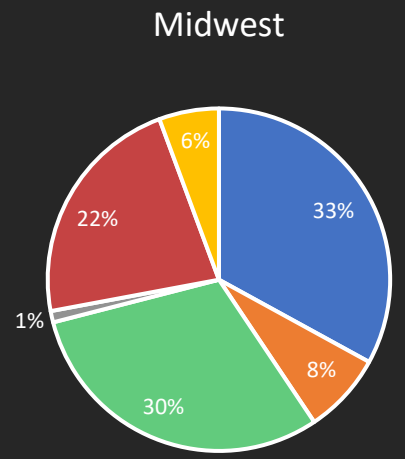
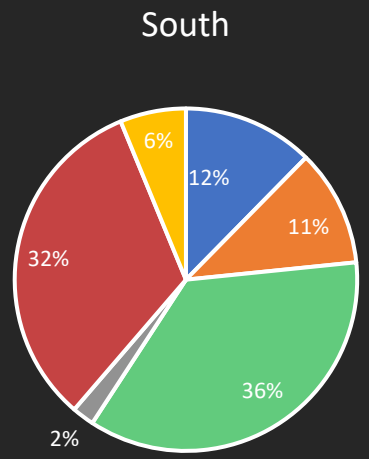
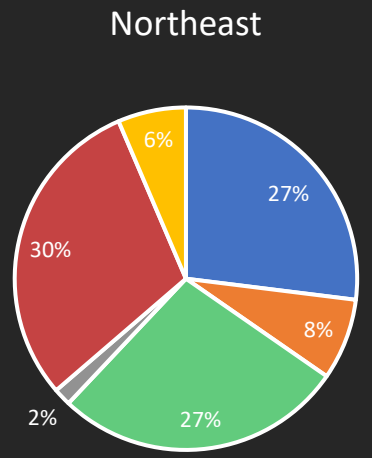
# What is the amperage of your main breaker?

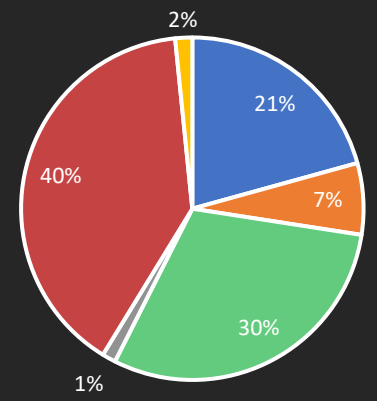
*n=2,950*




100 Amps or Less
101-150 Amps
151-200 Amps
201+ Amps
I couldn't find the main breaker
I don't see a label

- 100 Amp or less least likely in the South, most likely in NE and MW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# Possible Alternatives to Panel Upgrades

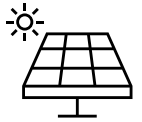
## Amp Diet

Minimizing the size of the electric loads – no backup strip heat, smaller appliances, slow charging

## Load Switches

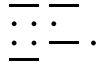
Manually switch between two large electric loads (e.g., dryer and EV charger)

## Smart Panels



Potentially mitigate the service upgrade with automated load balancing in the home

## Code Changes



National Electric Code is a safety code first. May inadvertently hinder whole-home electrification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# Heat Pump Impacts on Grid Peak Demand

**Single-speed all-electric heat pumps**

01 Normally sized for peak cooling plus safety factor

02 For mixed and cold climates, compressor heating capacity often insufficient to meet peak heating loads

03 Inefficient electric resistance provides supplemental heating

04 Electric resistance strains electric grid during winter peak

**Variable capacity all-electric heat pumps**

01 Can be sized to meet most or all of the peak heating load

02 Reduces or eliminates electric resistance auxiliary heat

03 Reduces strain on electric grid during peak

04 Variable speed allows compressor to slow down to meet peak cooling load


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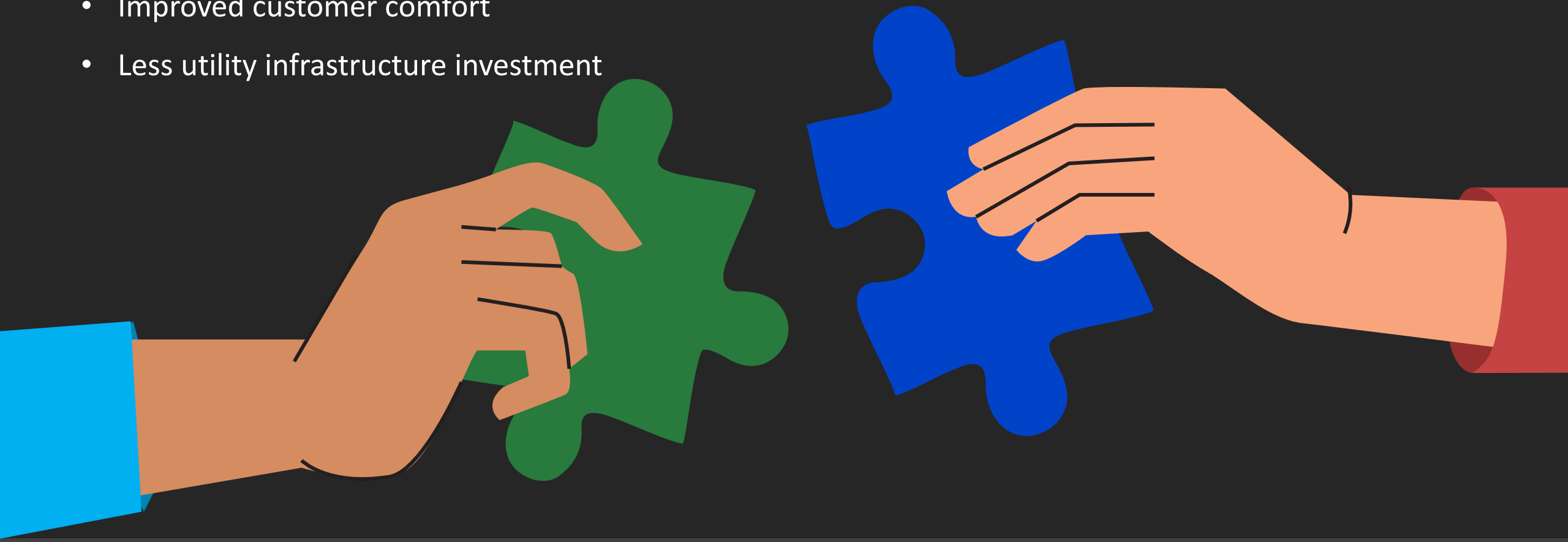
# Opportunity

Variable capacity heat pumps can provide:

- Lower peak demand
- Lower customer bills
- Improved customer comfort
- Less utility infrastructure investment

Funding and tax credits can help adoption

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# A PERFECT STORM

## This Decade Represents a Perfect Storm of Challenges and Opportunities.

# Key Takeaways

### *Central Role of the Electric Sector*

Electrification and power sector $CO_2$ reductions are key strategies for reaching targets

### *Reliability*

Advances in operational practices and grid technologies to ensure reliability; firm capacity is key asset

### *Customer Impacts*

Decarbonizing the economy requires redirecting customers' energy equipment choices and changes in expenditures

### *Accelerated Electrification*

Aggressive deployment is key to meeting the targets especially in transport

### *Regional Deep Dives*

Pathways will likely vary significantly by region; more detailed studies can examine potential bottlenecks, opportunities, and impacts

***Great opportunity for the energy sector & societal priorities to intersect***


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