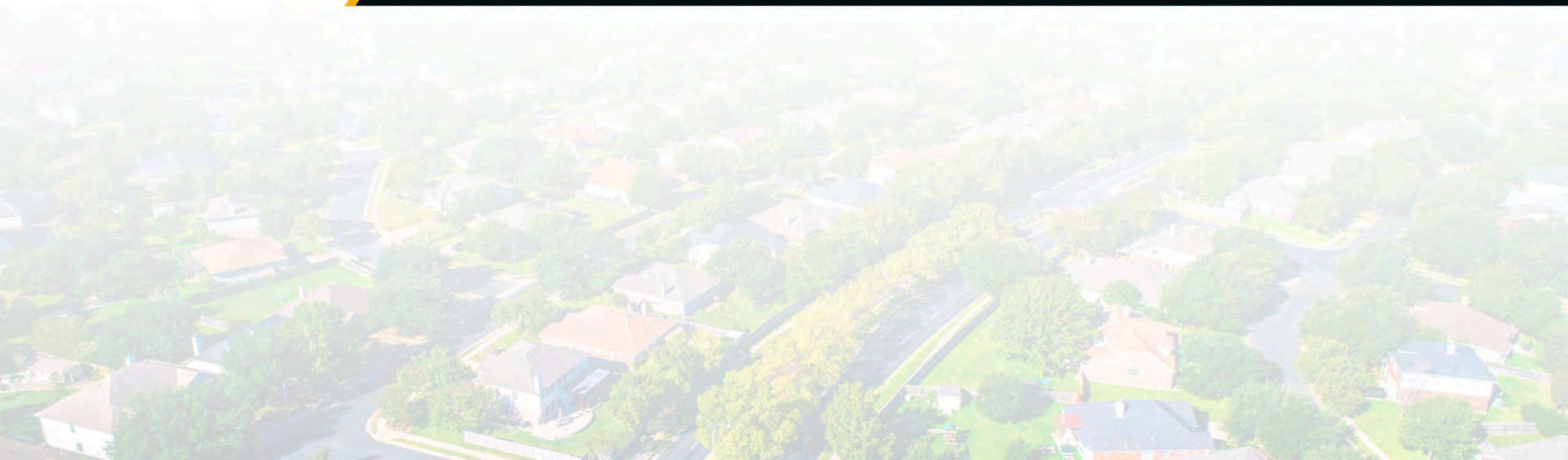




Beneficial Electrification! The Future Is Electric!



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Introduction!



Electrification Futures Study (EFS) Overview



Goal: explore potential & impact of electrification of U.S. economy; power sector focus



EVOLVED
ENERGY
RESEARCH



Multi-year research effort with development of a series of publications, tools, and data, to be released and finalized as the project continues.
Electrification is a Global Megatrend!

Key Research Questions



Technologies

- What end-use electric technologies are available for the highest energy-consuming services today, and how might the technologies advance over time?

Energy Consumption

- How might widespread electrification impact national and regional electricity demand and consumption patterns?

Power Sector Evolution

- How would the U.S. electricity system need to transform to meet changes in demand from an electrified economy?

Flexibility

- What role might demand-side flexibility play to support reliable operations of a clean electricity grid?

Impacts

- What are potential costs, benefits, and impacts of mass electrification?

Scenario Descriptions



Reference

- **No dramatic technological, societal, or policy changes**
- **Electro-technology adoption follow current trends**
- **(EIA AEO Reference Case)**

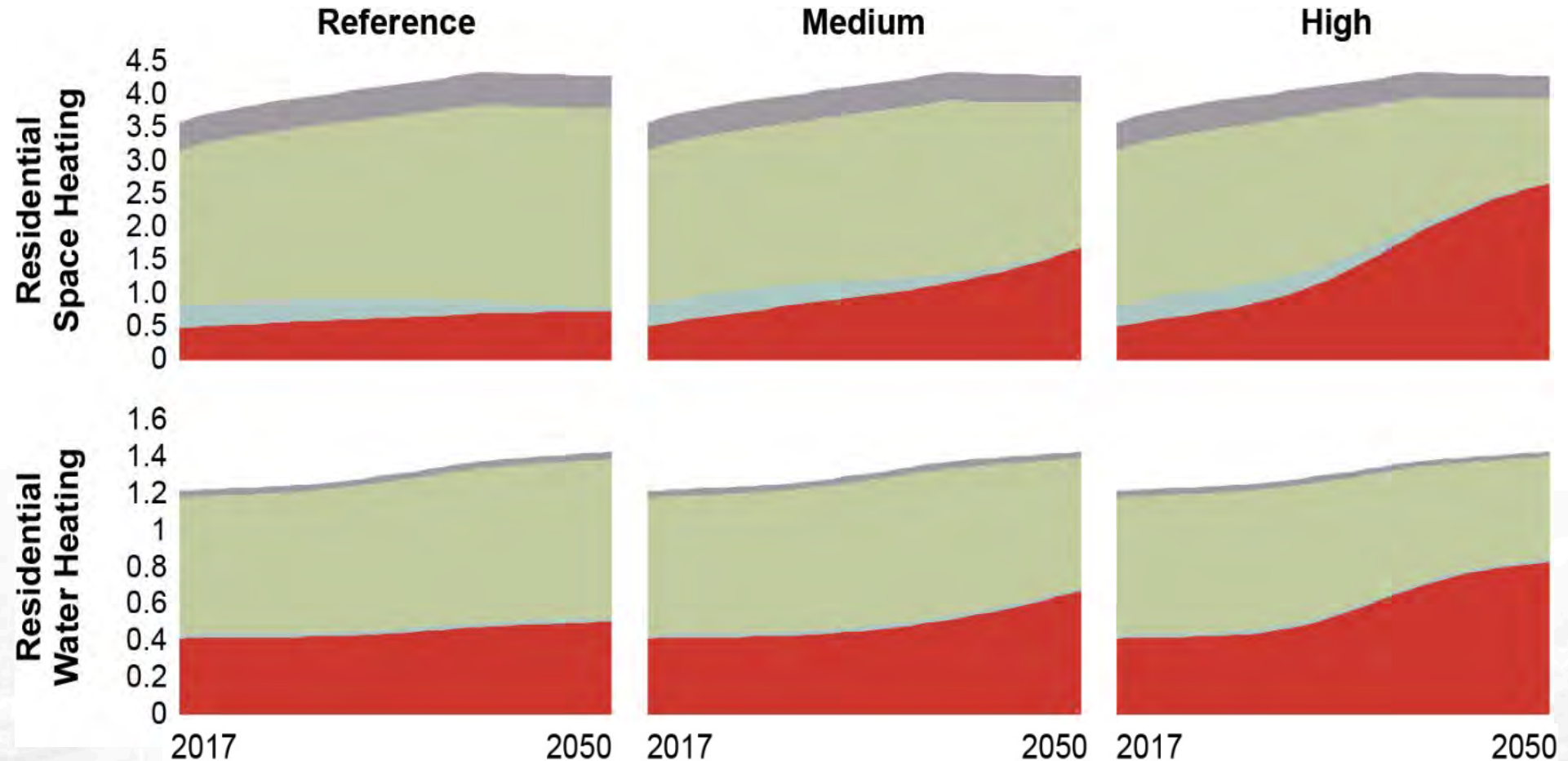
Medium Electrification

- **Plausible but not transformational changes**
- **“Low-hanging fruit” end-uses see accelerated adoption**
- **Limited, niche market adoption elsewhere**
- **Technical, economic, and consumer preference barriers remain**

High Electrification

- **More favorable set of conditions for electrification**
- **Aggressive adoption where many barriers are overcome**
- **Not a “technical potential”**

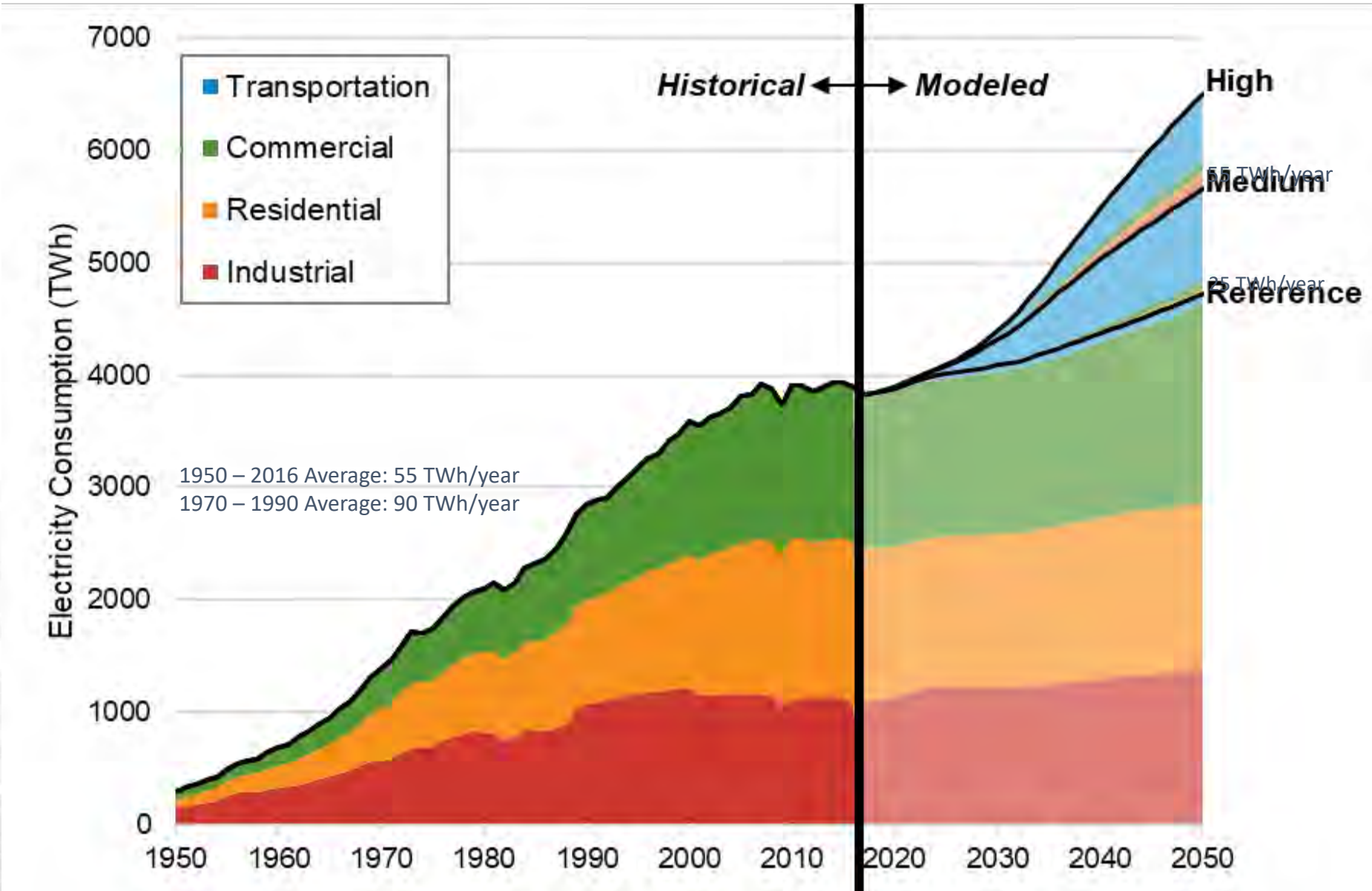
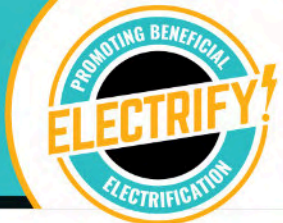
Residential Service Demand



Space and water heating offer largest electrification opportunities, making air source heat pumps a key technology; 2050: 61% space heating, 52% water heating

Cold climate heat pumps, new vs. retrofit, and consumer acceptance are key unknowns

Dramatic increase in demand led by transportation Unprecedented 80-110 TWh/year growth rates

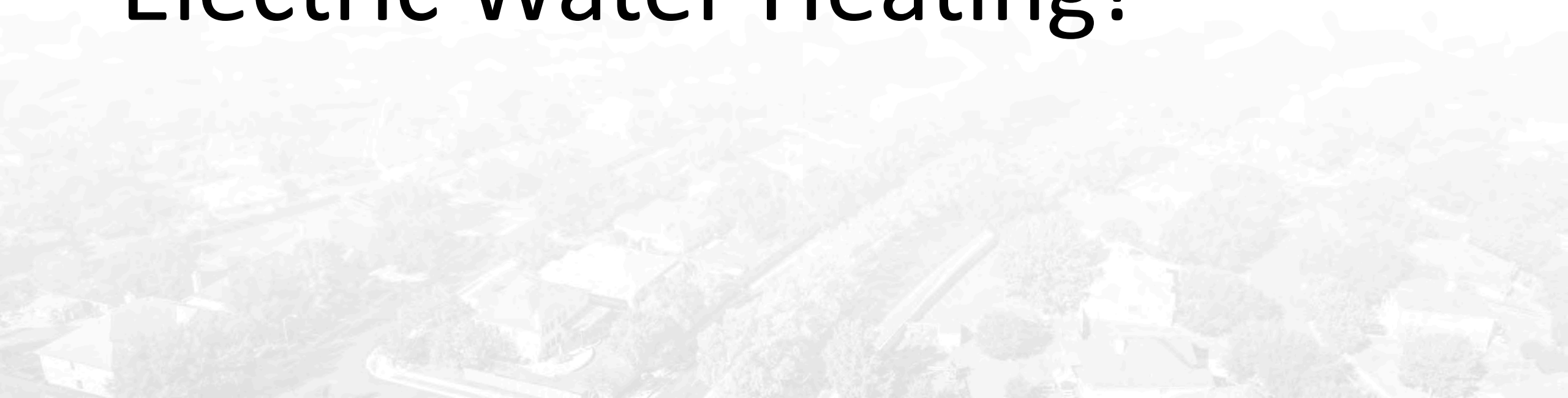


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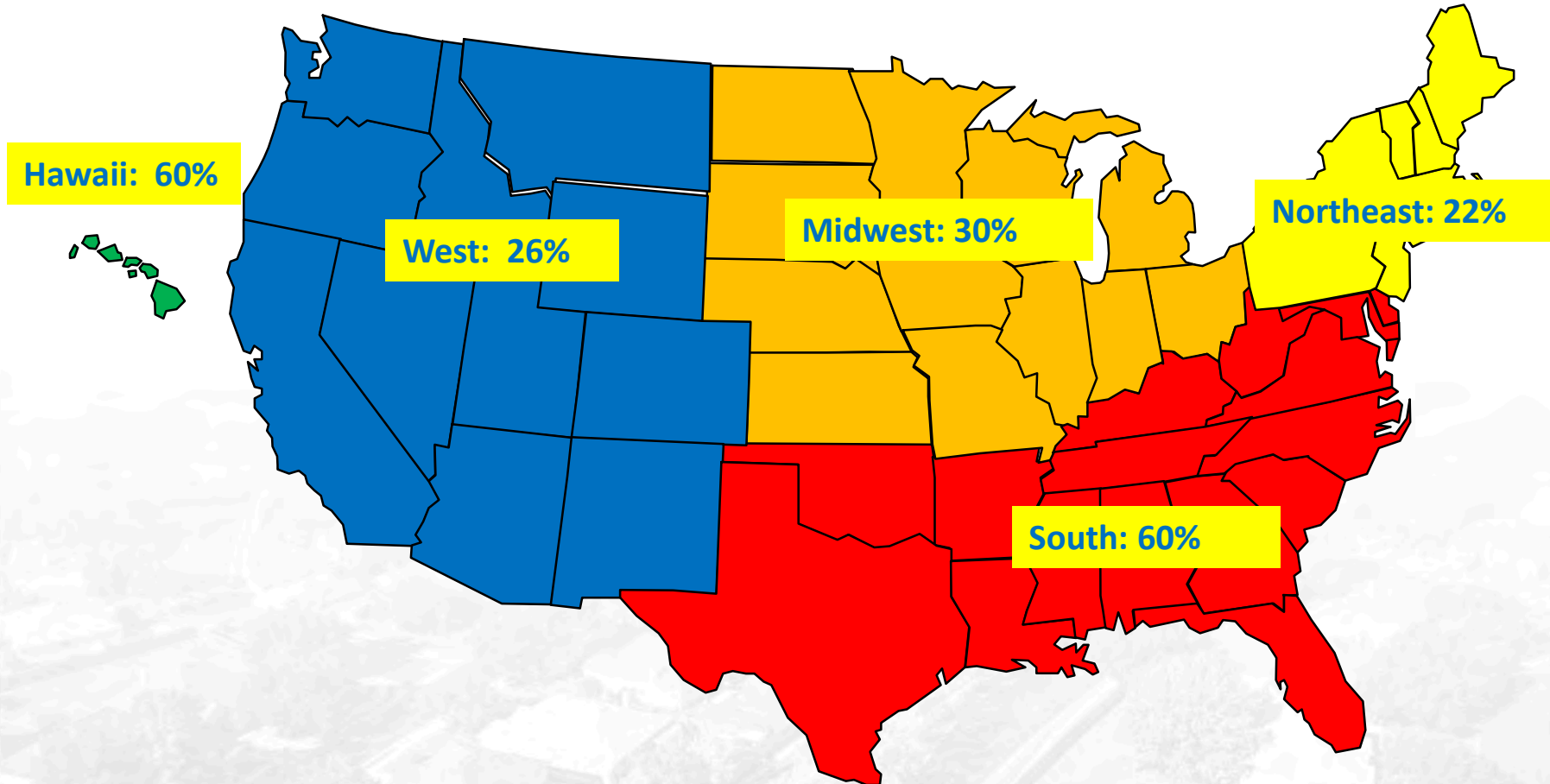
It Started With Electric Water Heating!



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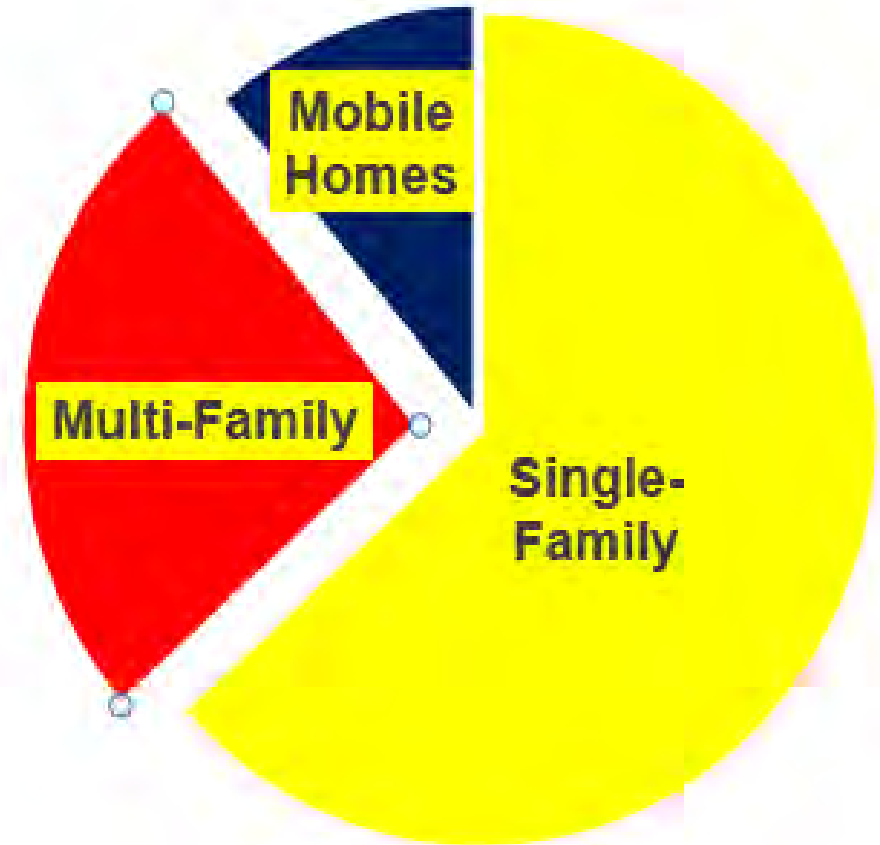
Electric Water Heating Market Share



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45 Million Water Heaters		Total
Capacity	4.5kW/ea.	202.5 gW
Energy Storage Capacity	12kWh	540 gWh
Annual Energy	3800kWh/ea.	171 tWh



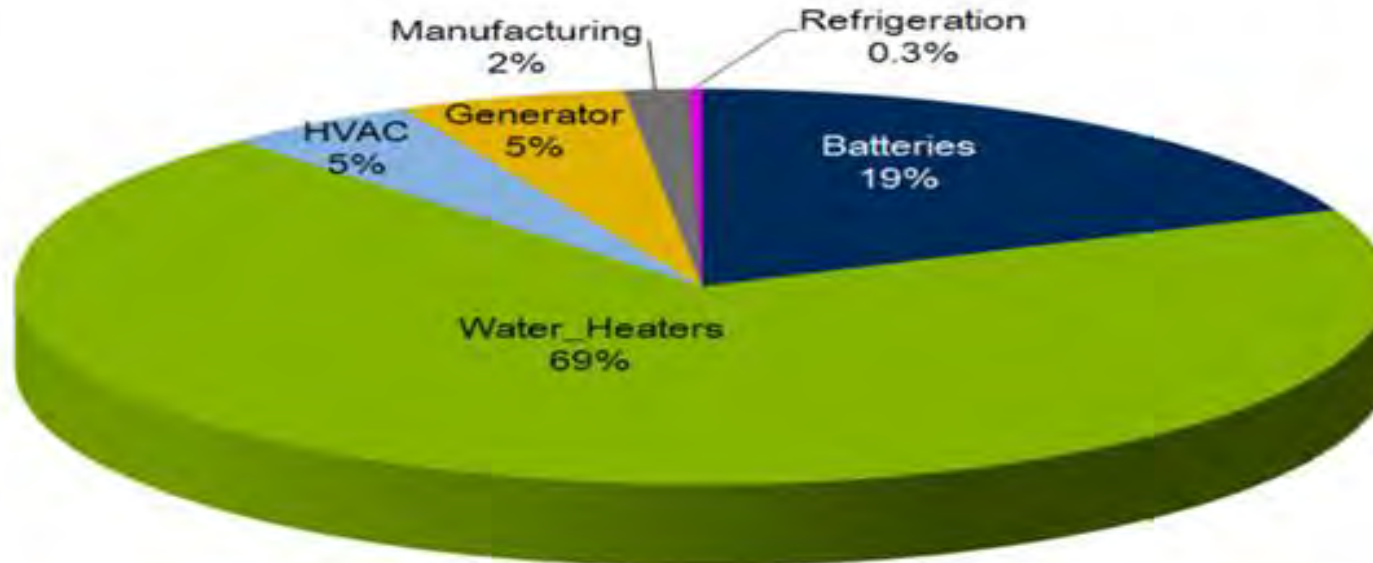
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Regulation	Zone	Jan	Feb
Locations	RTO	414	428
Average Number of Unique Participating Locations per Month:		421	
MWs	RTO	64	65
Average MWs per Month:		65	

Capability represents total amount that may be offered. Actual offered and cleared volume may be significantly lower and is represented in subsequent figures/tables in report

Figure 10: 2017 PJM Demand Response Confirmed Regulation Registrations Load Reduction Methods





It Started With

Electric Water Heating!

- Grid-Interactive Water Heating (GIWH)
- DOE HPWH Rulemaking
- ACEEE Hot Water Forum
- PLMA GIWH Interest Group - Webinars & Workshops
- 'The Hidden Battery' – NRECA/NRDC/PLMA
- NRECA Organized Stakeholder Group > Amendment Language
- Congressional Testimony > Bi-Partisan Support
- Energy Efficiency Act of 2015 > Grid-Enabled Product Category



Riding the Storage Wave!

- Load Management > DSM > DER Integration
- PLMA Grid-Interactive Behind-the Meter Storage Interest Group
- GIWH / Thermal Storage (Hot/Cold) / Batteries / Etc.
- ACEEE HWF – GIWH > Community Storage > Beneficial Electrification
- The Community Storage Initiative



The Community Storage Initiative!

- The Community Storage Initiative – NRECA/NRDC/EEI/APPA/PLMA
- 2016 Community Storage Leadership Forum – Univ. of MN
- Website/Resources - www.communitystorageinitiative.com
- PUF Article on Community Storage
- Congressional Briefing on Community Storage
- Great River Energy – Community Storage Demonstration Project
- Community Storage – The Foundation of Beneficial Electrification



Beneficial Electrification!

- Environmentally Beneficial Electrification – Nov. 2015, July 2016
- ‘Beneficial Electrification’ RAP Whitepapers & Webinars
- PLMA ‘Beneficial Electrification’ Webinars & Workshops
- EPRI ‘Electrification 2018’ Conference
- CSI Beneficial Electrification Leadership Forum
- Website & Resources – www.beneficialelectrification.com
- Electrify Minnesota! The Future Is Electric!
- Beneficial Electrification League – BEL
- Beneficial Electrification Ambassador (BE-A) Program

Beneficial Electrification



The application of electricity to end-uses that would otherwise use fossil fuels and where doing so satisfies at least one of the following conditions, without adversely affecting the others:

- *Saves consumers money over time*
- *Benefits the environment and reduces green house gas emissions*
- *Improves product quality or consumer quality of life*
- *Fosters a more robust and resilient grid*

Beneficial Electrification League – BEL!



Recognizes:

- Electricity is getting cleaner, less carbon intensive
- Electricity production is becoming more intermittent and variable
- The electric grid is more sophisticated, more efficient, and more resilient
- Consumers are more sophisticated and expect more
- End-use technologies are more advanced, more efficient, and more wide-spread
- Climate change goals are not going away

Beneficial Electrification League – BEL!



Background:

- BE is the most effective and inclusive GHG reduction strategy
- To be successful, BE requires a collaborative effort
 - Utilities
 - Environmental and consumer advocates
 - Manufacturers and technology providers
 - Policymakers
- Immediate opportunities include:
 - Electric vehicles
 - Electric space and water heating
 - Commercial/industrial, and agricultural applications

Beneficial Electrification League – BEL!



Structure:

- Outgrowth of a 6+ year partnership
- A 501(c)3 org. with rules, bylaws, and advisory board
 - Gary Connett – Retired
 - Carla Frisch – Formerly with DOE, currently with RMI
 - Keith Dennis – NRECA
 - Ruth Calderon – Golden Spread Electric Cooperative
 - Robin Roy – Consultant to NRDC
 - Steve Koep – HTP/Westinghouse
 - Chuck Foster – Legal Counsel, Consultant to EEI



Key Activities:

- Create a broad stakeholder coalition
- Establish definitions and goals for stakeholders
- Build strategic partnerships
- Provide stakeholder engagement opportunities
- Identify policies that support / hinder BE
- Support BE market development
- Seek additional sponsorship and grant opportunities



Measurements and Metrics:

- Hosting regional “Listening” meetings
- Engaging in speaking opportunities
- Creating state/regional BE Leagues
- Promote BE Ambassador Program
- Providing input on policy requests
- Establishing a national presence



Public Policy & Market Development!

$$EE + RE = BE$$

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**“In this age, in this country,
public sentiment is everything.
With it, nothing can fail;
against it, nothing can succeed.”**



The Times They Are A-Changin'

[Bob Dylan](#)

Come gather 'round people wherever you roam,
And admit that the waters around you have grown,
And accept it that soon you'll be drenched to the bone
If your time to you is worth savin'
Then you better start swimmin'
Or you'll sink like a stone
For the times they are a-changin'!



Thank You!





The Win-Win-Win of Beneficial Electrification!

