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Memorandum

From the office of
Commissioner Andy Tobin
Arizona Corporation Commission
1200 W. WASHINGTON
PHOENIX, ARIZONA
(602) 542-3625

TO: Docket Control

DATE: August 4th, 2016

FROM: Commissioner Andy Tobin's Office

SUBJECT: Docket No. # E-00000J-16-0257

Attached please find Hank Courtright presentation entitled "The Power System of the Future and Managing Peak Demand" for the Reducing System Peak Demand Costs Workshop on August 4, 2016.

Arizona Corporation Commission
DOCKETED
AUG 03 2016
DOCKETED BY

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AZ CORP COMMISSION
DOCKET CONTROL
2016 AUG -3 A 11: 31

CERTIFICATION OF SERVICE

On this 4th day of August, 2016, the foregoing document was filed with Docket Control as a correspondence from Commissioner Andy Tobin, and copies of the foregoing were mailed on behalf of Commissioner Andy Tobin to the following who have not consented to email service. On this date or as soon as possible thereafter, the Commission's eDocket program will automatically email a link to the foregoing to the following who have consented to email service.

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1200 W. Washington
Phoenix Arizona 85007

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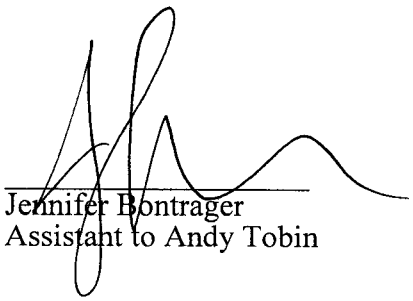
1200 W. Washington St.
Phoenix Arizona 85007

Dwight Nodes
1200 W. Washington
Phoenix Arizona 85007-2927

By: 
Jennifer Bontrager
Assistant to Andy Tobin

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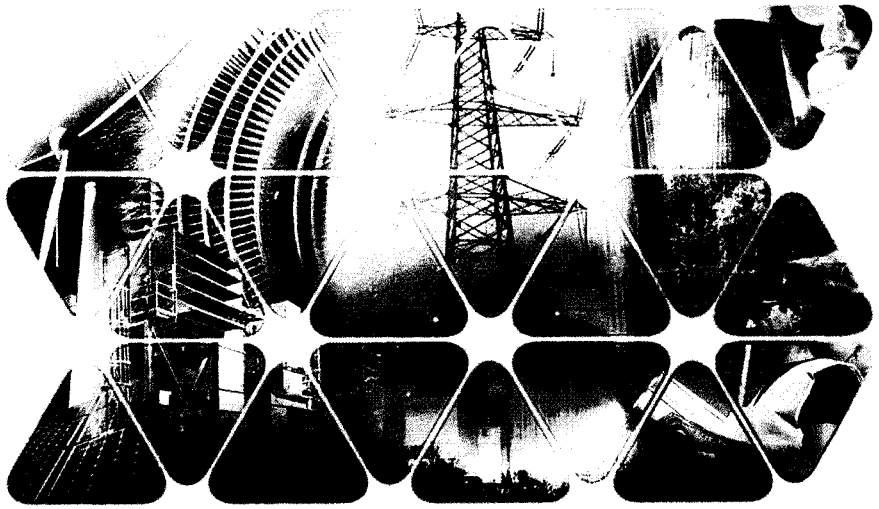
The Power System of the Future and Managing Peak Demand



Reducing System Peak Demand Costs Workshop
Phoenix, AZ
August 4, 2106

Hank Courtright

Electric Power Research Institute (EPRI)

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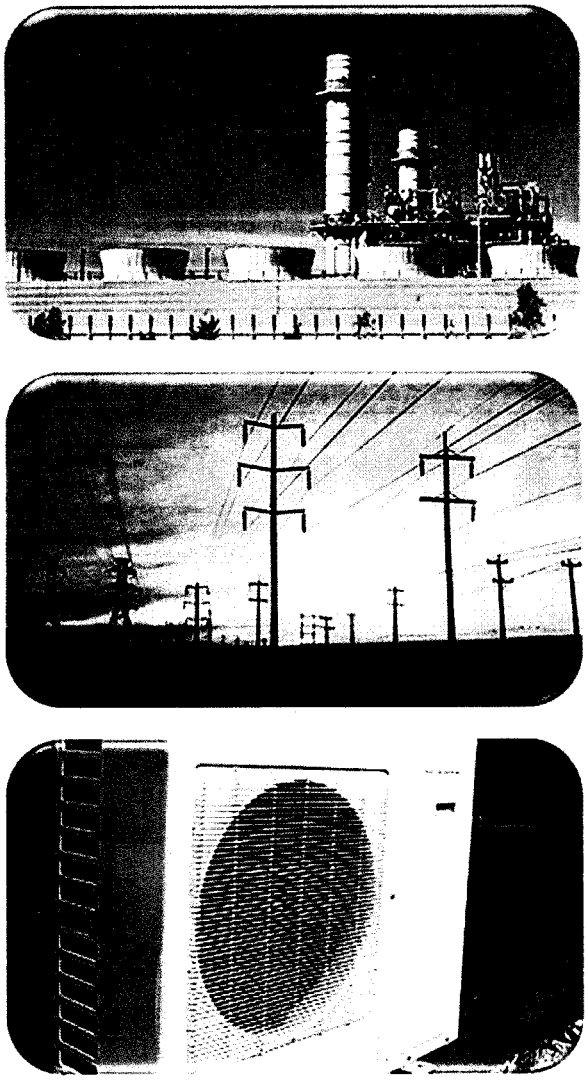
Electric Power Research Institute

- Founded in 1972 by the electricity industry and regulatory community to provide collaborative R&D to serve the public.
- EPRI members provide ~90% of the electricity in the United States.
- 450+ members from more than 30 countries collaborate on the EPRI technology program.
- EPRI's Public Advisory Council, which oversees EPRI's independence and objectivity, includes twelve NARUC state commissioners, plus representatives of the environmental, consumer and academic communities.



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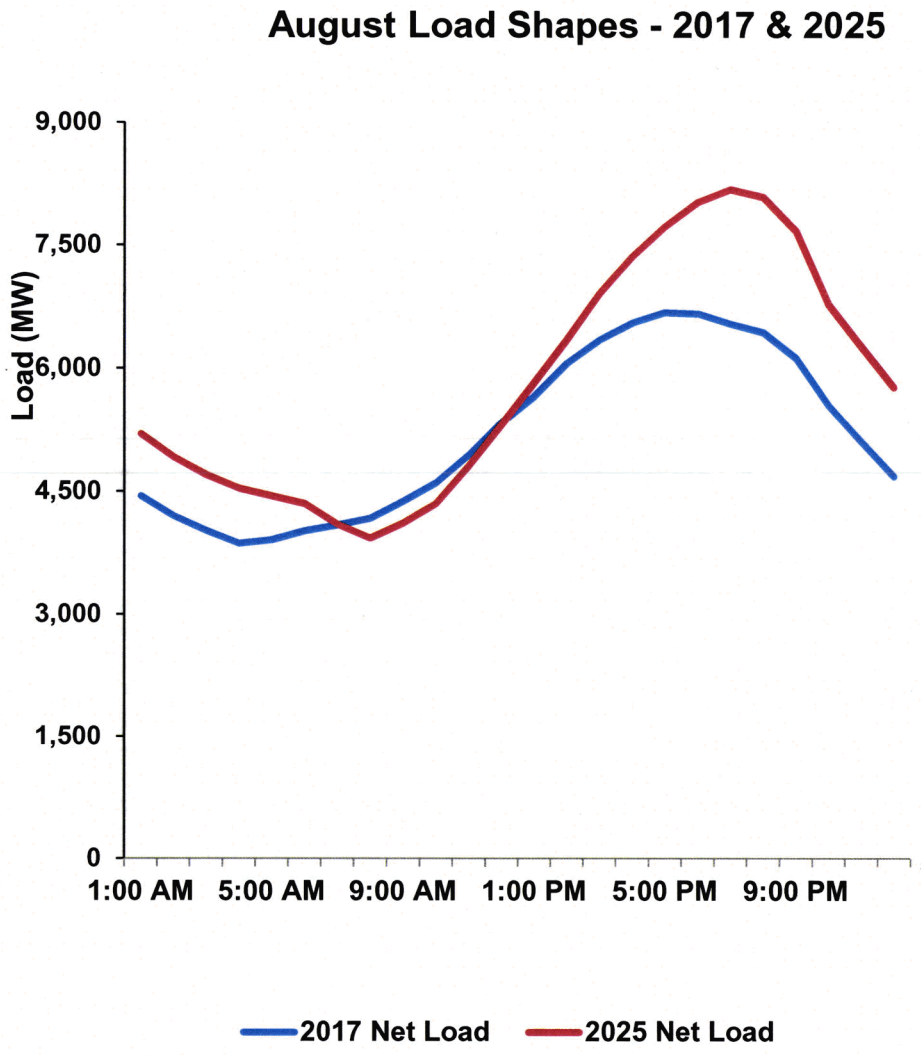
Presentation Objectives

- "Set the Stage" for the Workshop
- Provide a perspective on the transition of the power system and the impact on peak demand management
- Provide insights from other systems around the world and relevance to Arizona
- Discuss ongoing research on "The Integrated Grid" and peak demand cost management



Courtesy: APS – Integrated Resource Planning Workshop – July 2016

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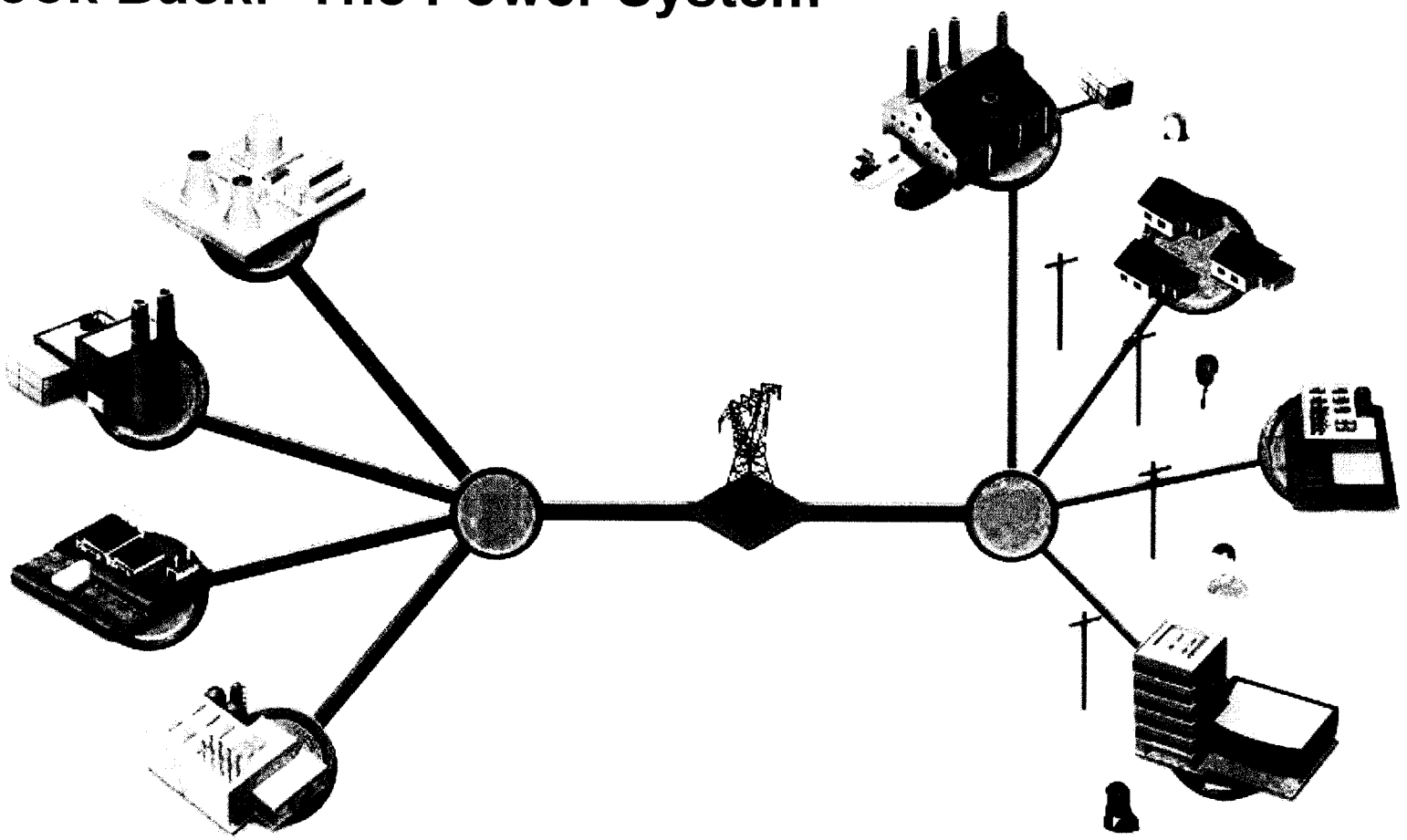
A Look Back: The Power System



Dispatchable ***Forecastable***

Base Load Generation + **Load Following Generation** +/– **Bulk Energy Storage** = **Customer Demand** – **Interruptible Load**

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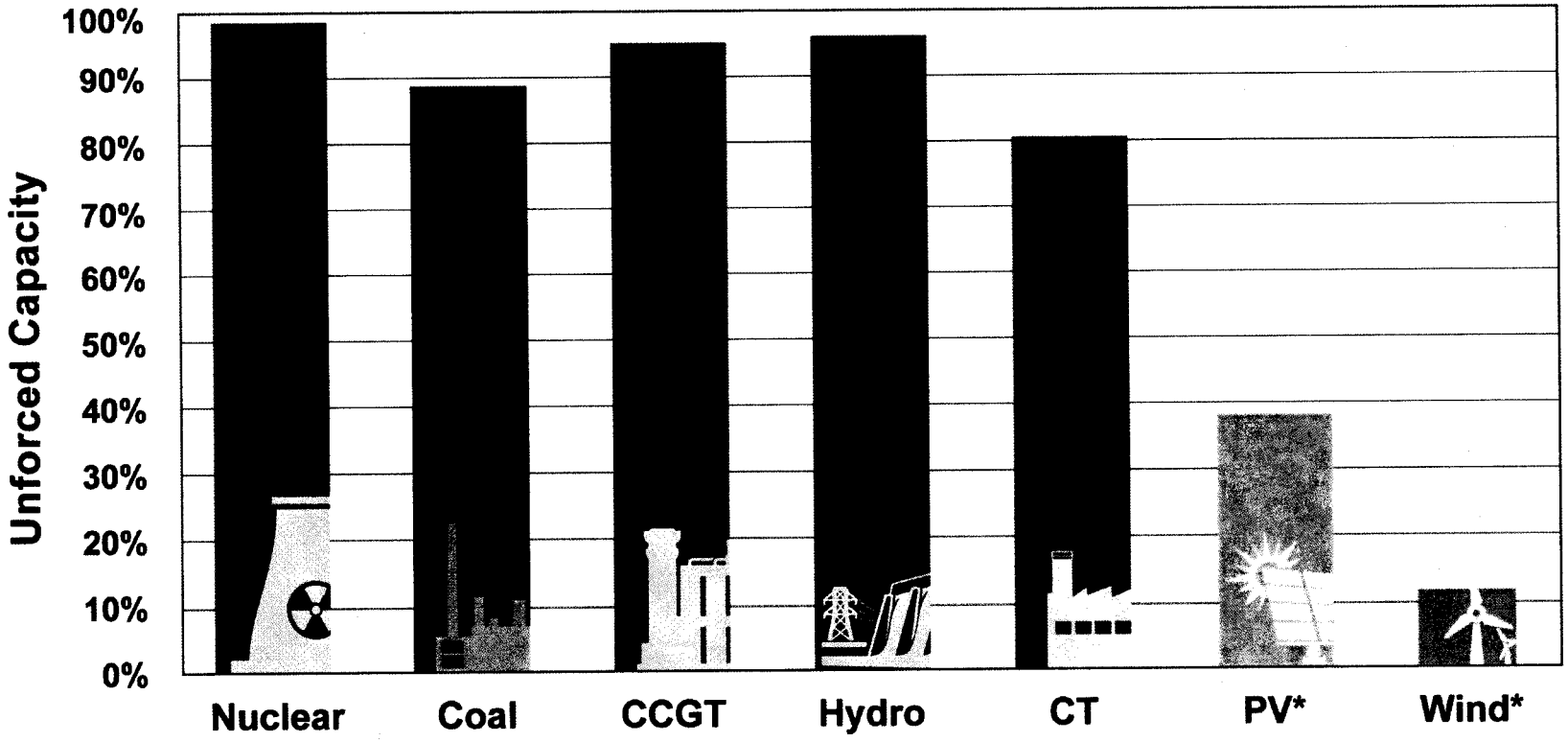
Capacity Contributions of Generation Types



- ***Generation capacity to meet demand is usually a mix of sources, generally dispatched by cost.***
- ***Variable renewable resources can supply energy at low, or zero variable cost, but alone are generally not sources of firmly available capacity.***
- **** Energy storage technologies can help "firm up" renewable resources, however current storage costs are higher than other capacity options.***

***Data Source: PJM** Unforced capacity values for PJM in 2013*

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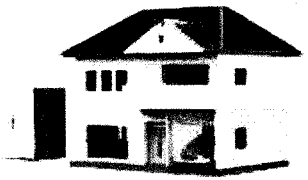
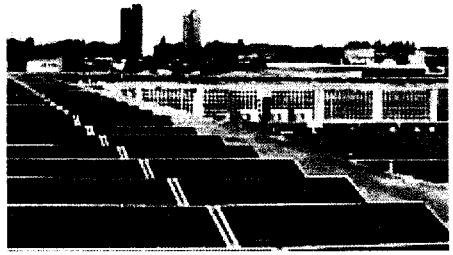
A Look Ahead: Technology Innovation

Automation

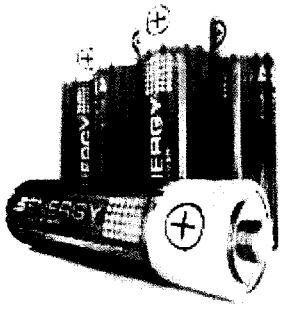
Efficiency

Renewable Energy

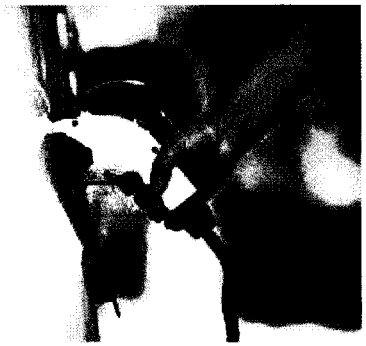




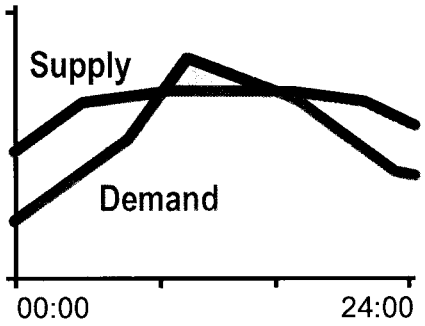
Storage



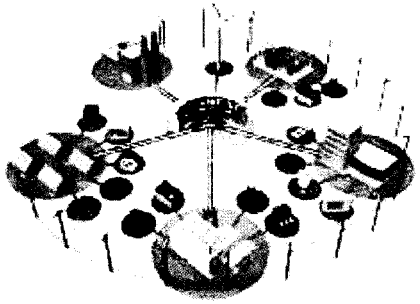
Transportation



Demand-Side Management



Microgrids



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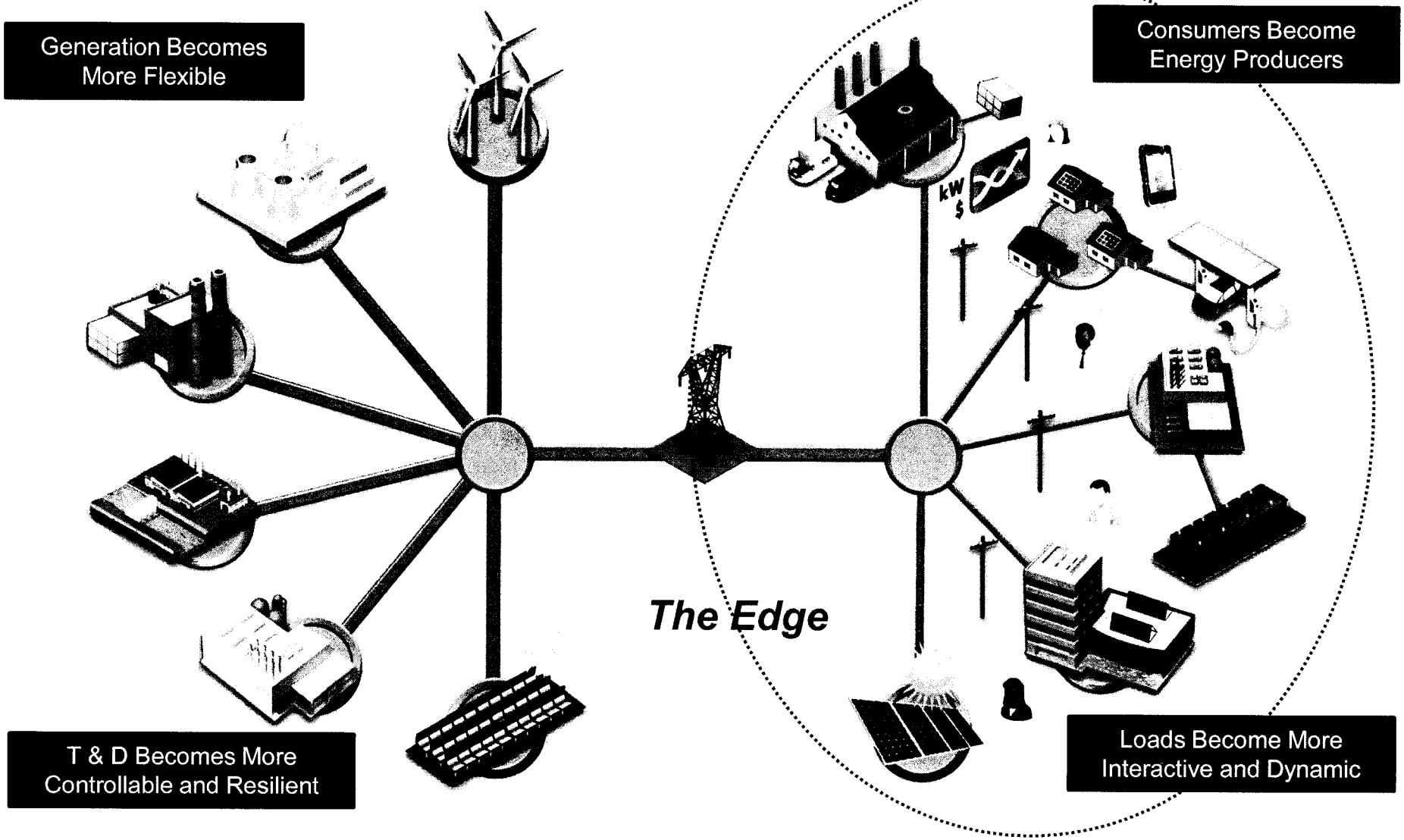
A Look Ahead: The Power System of the Future



Less Dispatchable, Less Forecastable, More Dynamic, More Interactive

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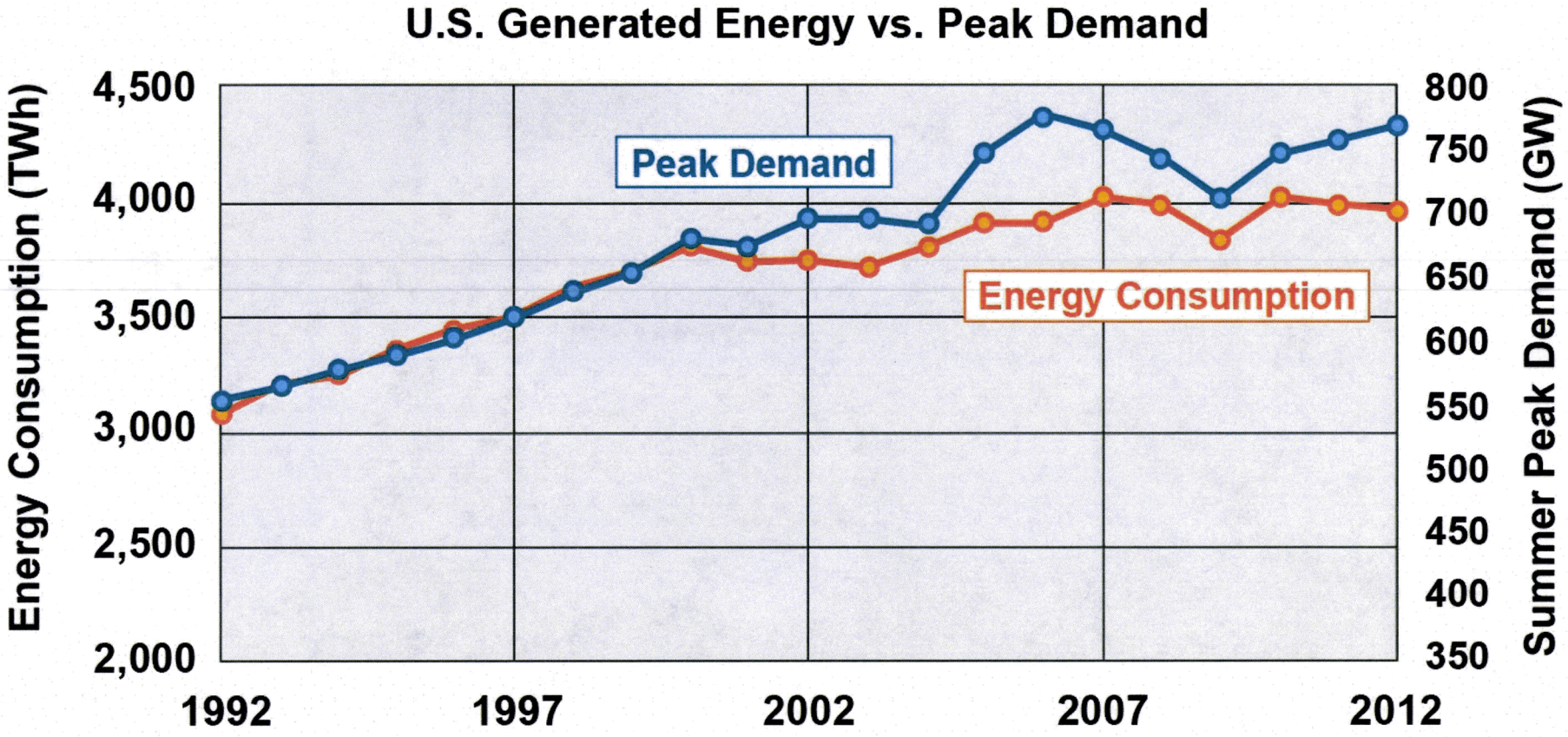
Insight: Energy vs. Demand – Changing Relationship



Source: EIA Form 411

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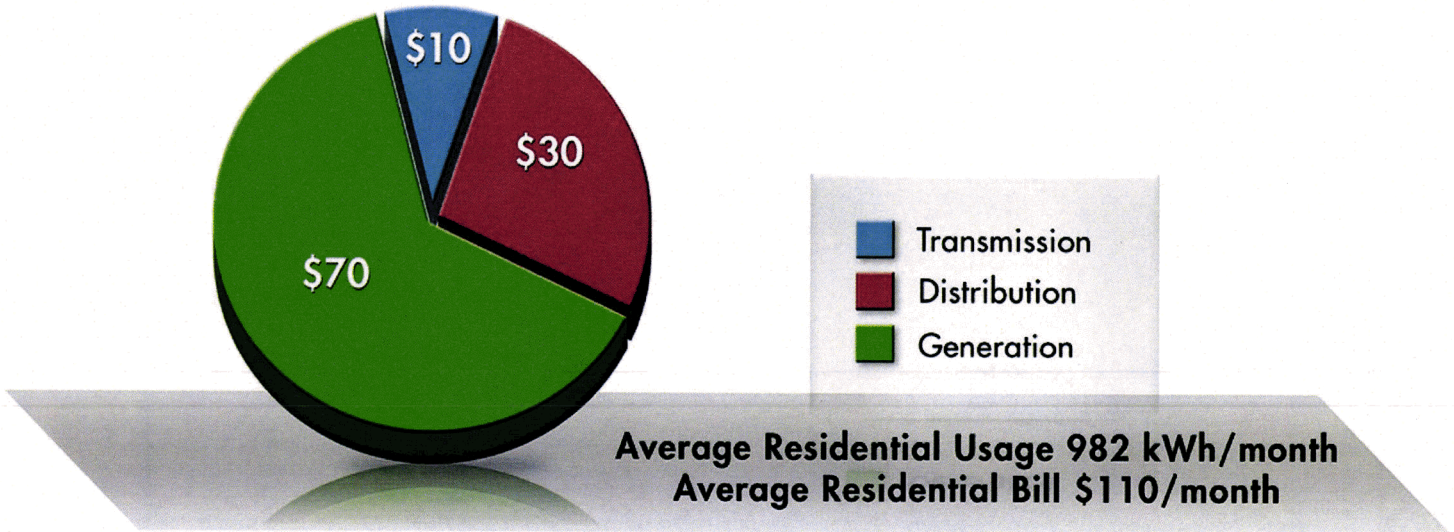
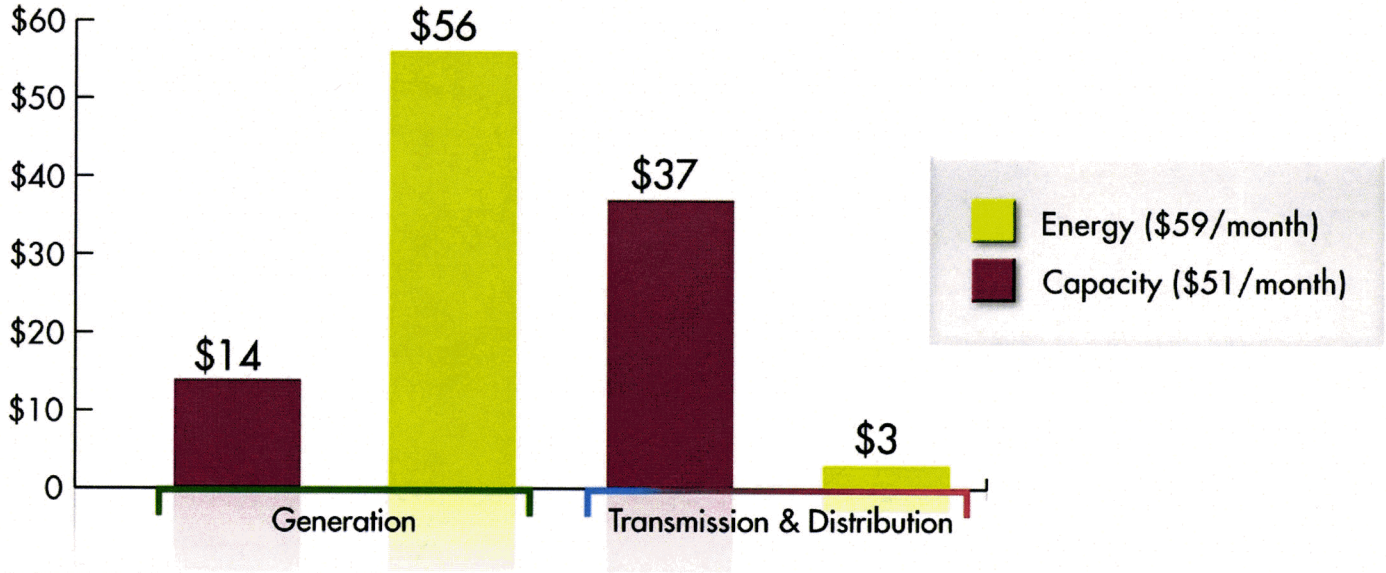
Insight: U.S. Average Cost to Consumers





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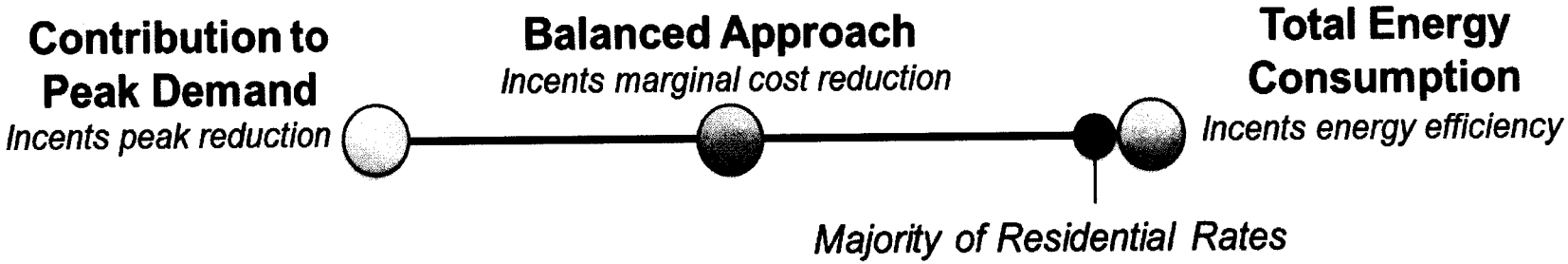
Insight: Rate Design – Current Status in U.S.



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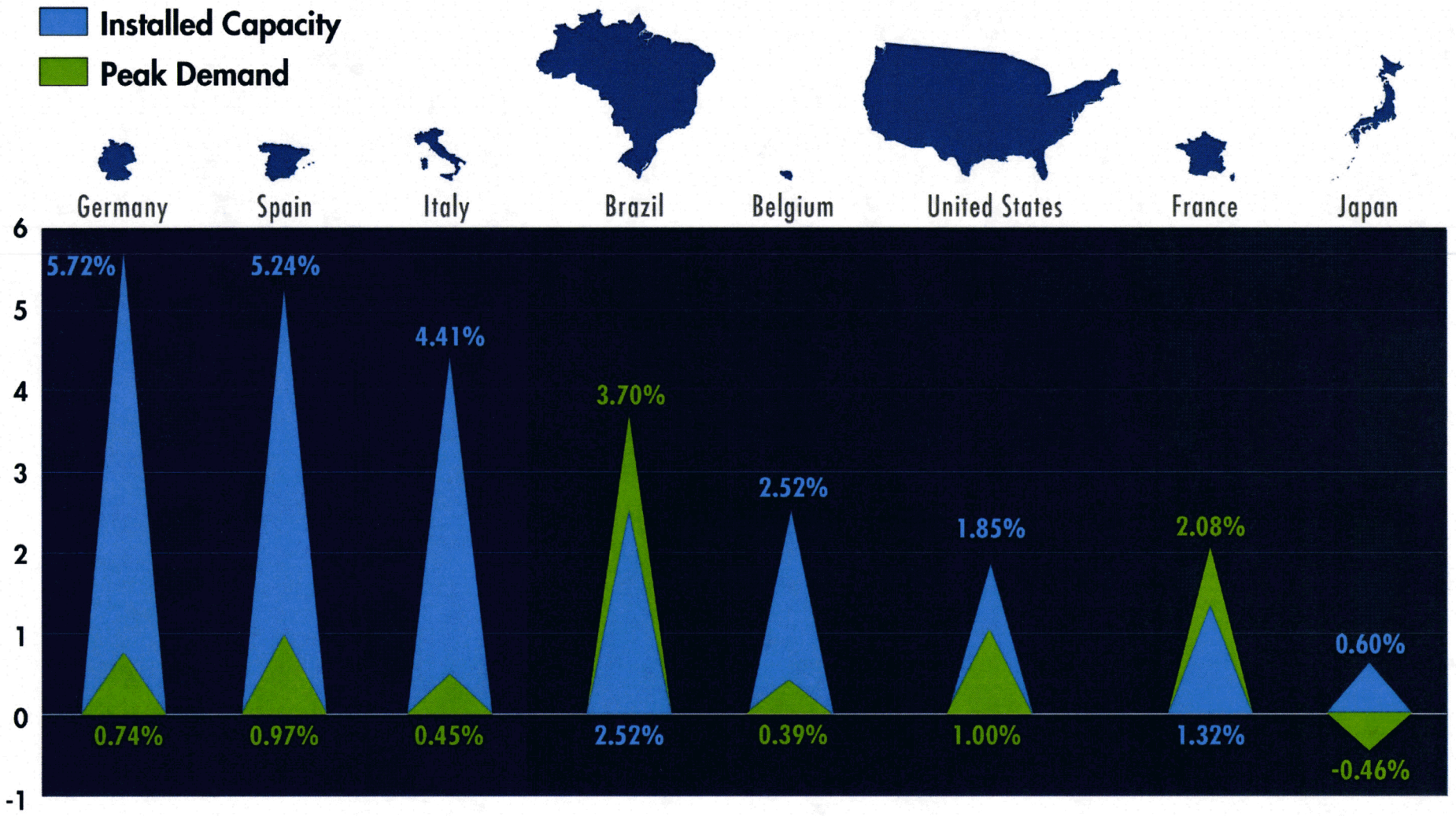
Insight: Installed Capacity vs. Peak Demand Growth

Compound Annual Growth Rate (%), 2003-2013



Source: EIA

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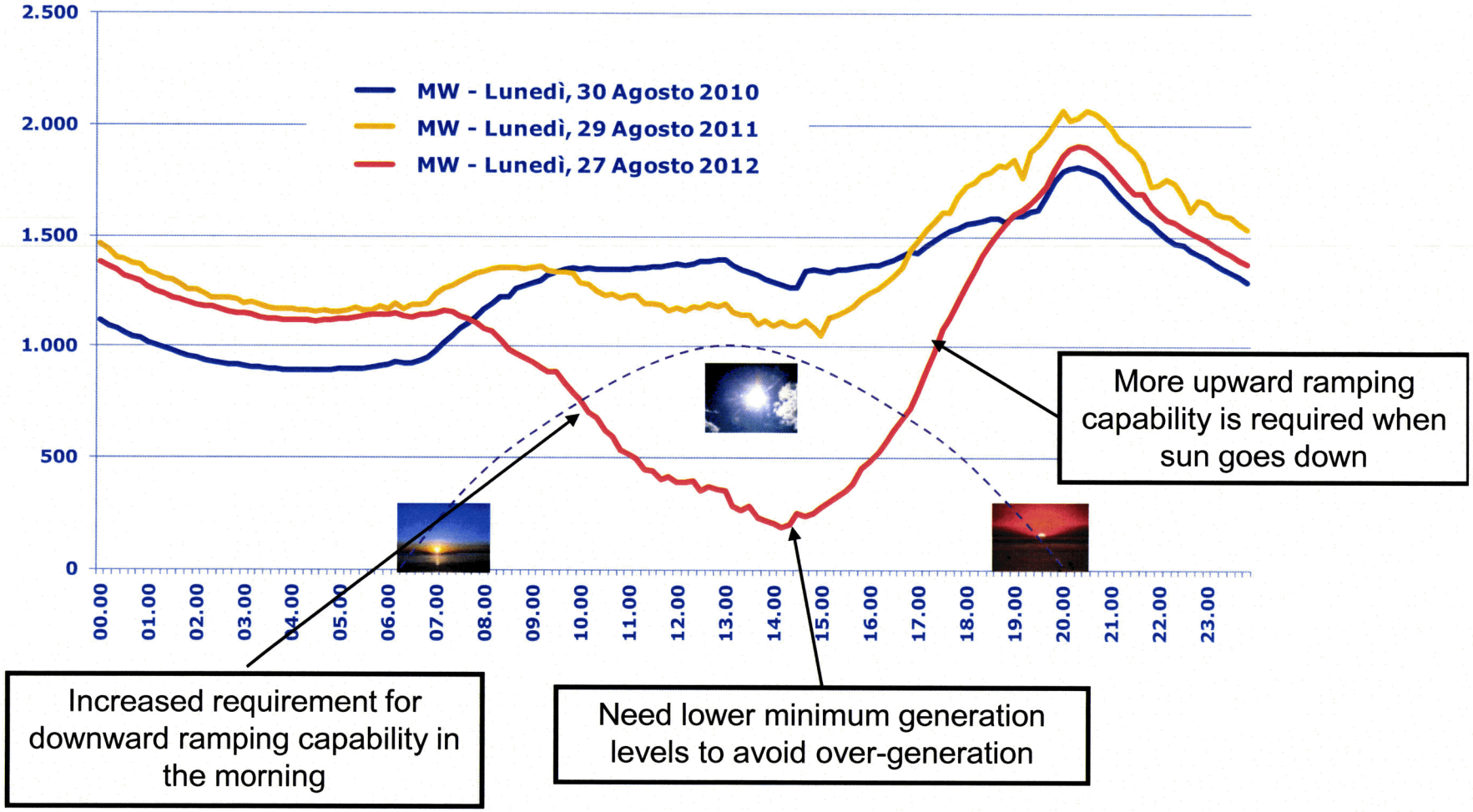
A Look Ahead: Insights from The Italian "Duck" Curve

Not Just Resource Adequacy…but the Adequacy of Resources of the Right Type at the Right Location at the Right Time…



Source: *ENEL – Measured Data from Southern Italy and CAISO analysis*

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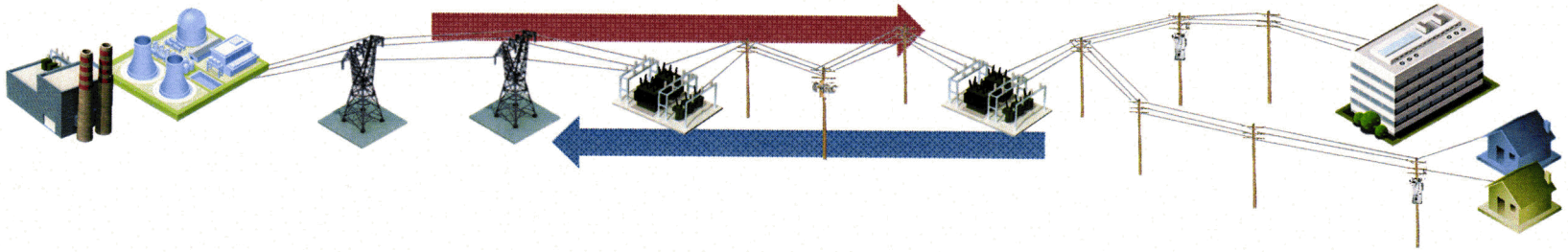
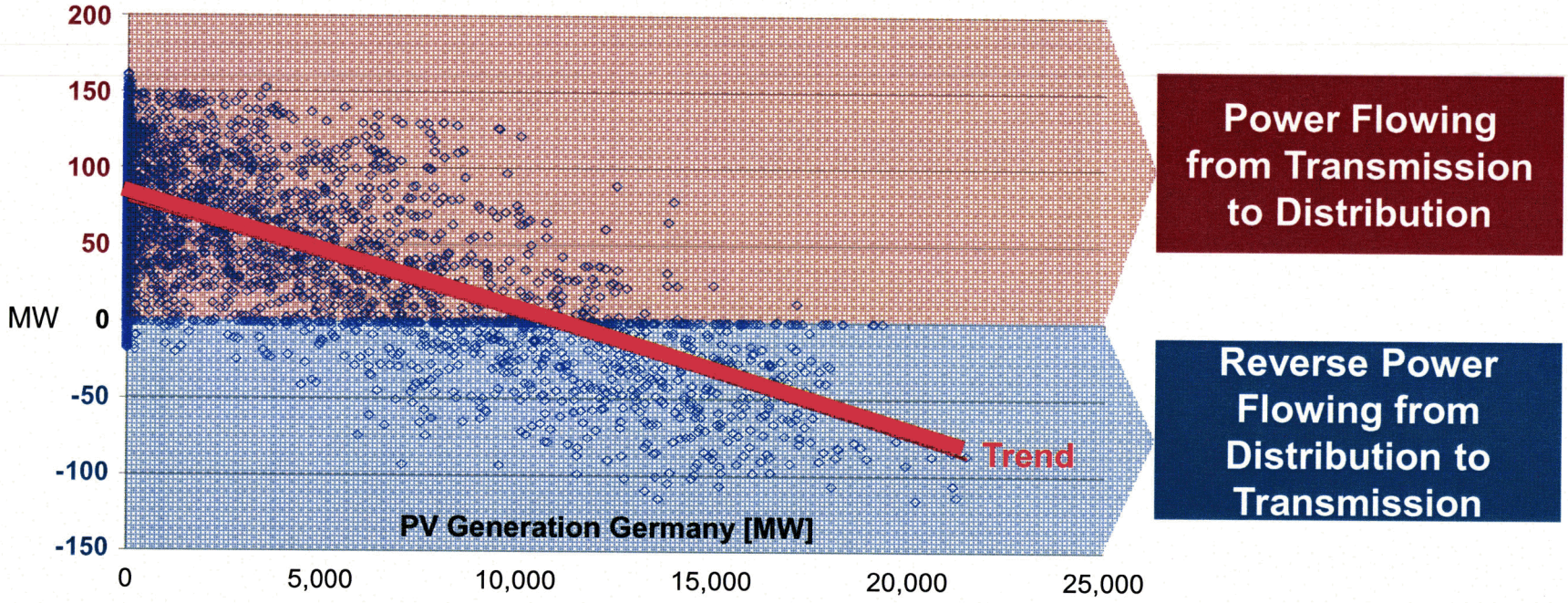
A Look Ahead: Insights from Germany Solar Growth





Source: Klaus Kleinekorte, Amprion, German TSO.

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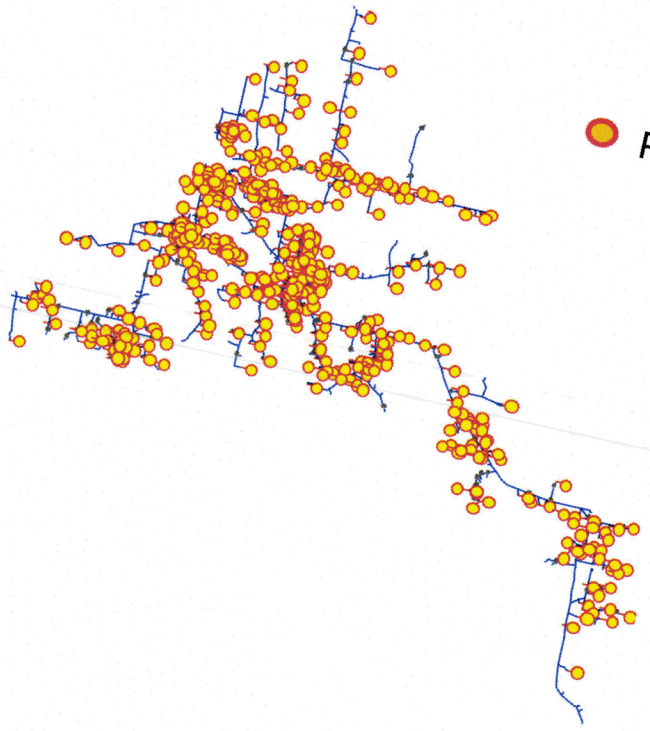
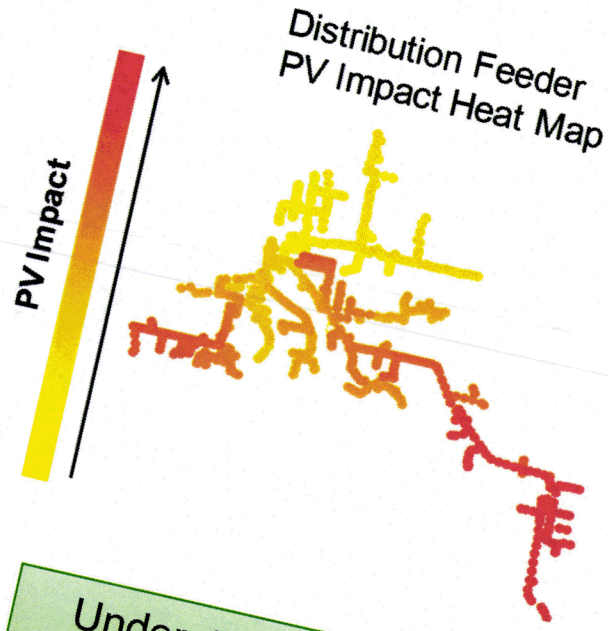
DER Adoption – Peak Loads on Feeders

Feeder Hosting Capacity can affect available energy





Understand Adoption Levels and Where / When "Violations" Occur

- voltage
- protection
- power quality
- thermal

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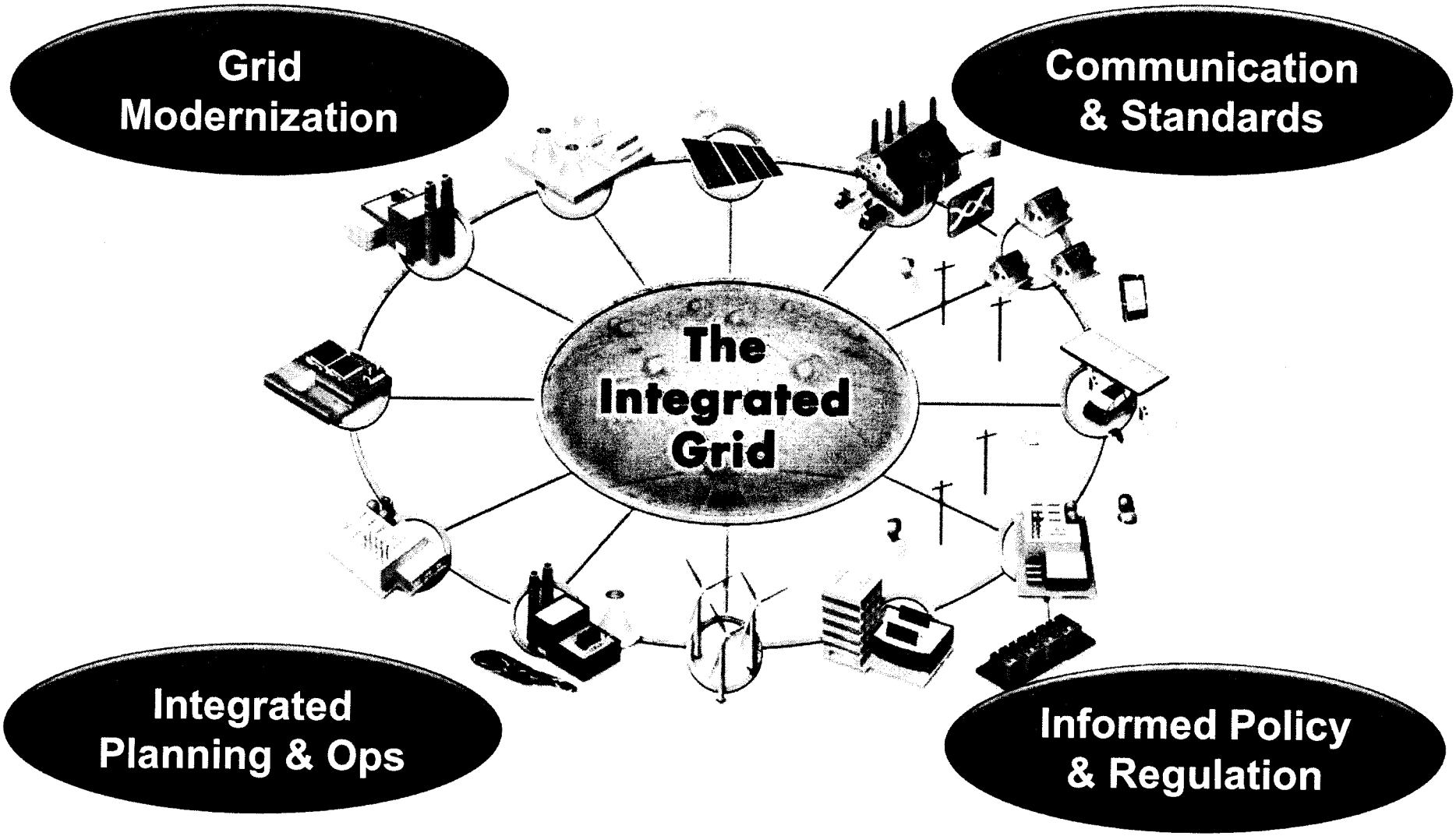
Meeting the Challenge



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Technologies to Address the System Challenges

#3 - INFORMATION AND COMMUNICATIONS PROTOCOLS

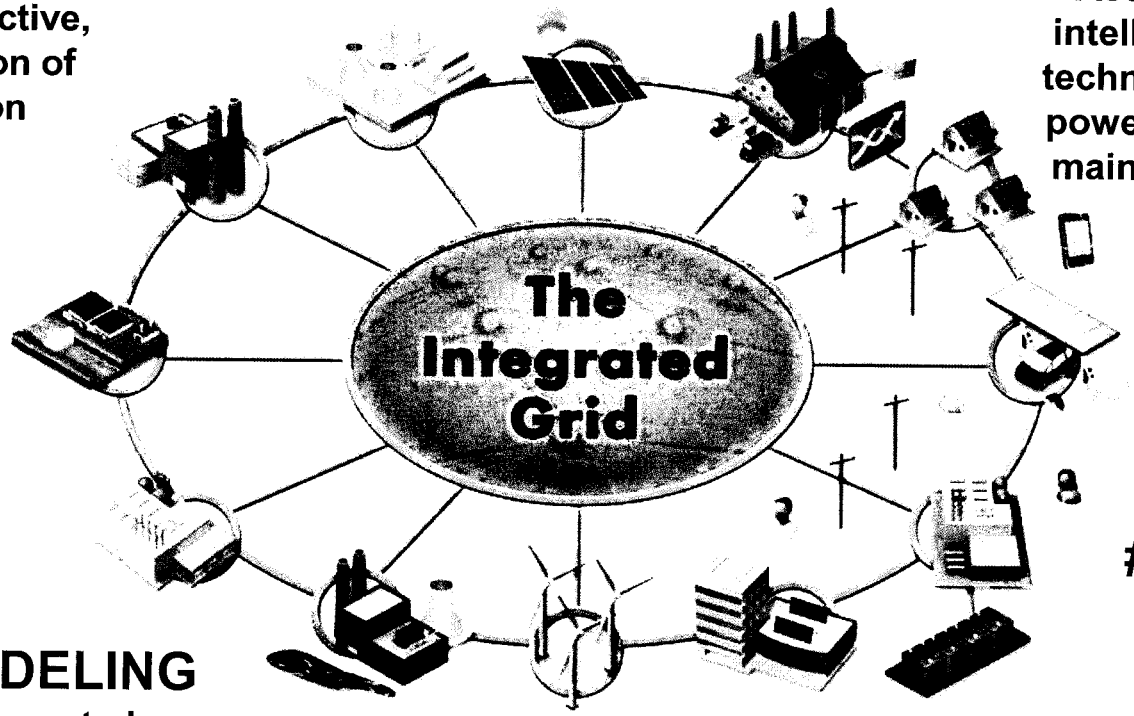
Develop an Integrated Grid platform

#4 - FLEXIBLE OPERATIONS

Enable cost-effective, flexible operation of central station generation

#2 – SENSORS INFORMING ACTIONS

Accelerate adoption of intelligent sensor system technologies for improved power system operations, maintenance, and outage restoration



#5 - MODELING

Develop an integrated power system and environmental modeling framework to support regulatory & policy initiatives

#1 - CUSTOMER RESOURCES

Enable integration of customer resources into the integrated power system

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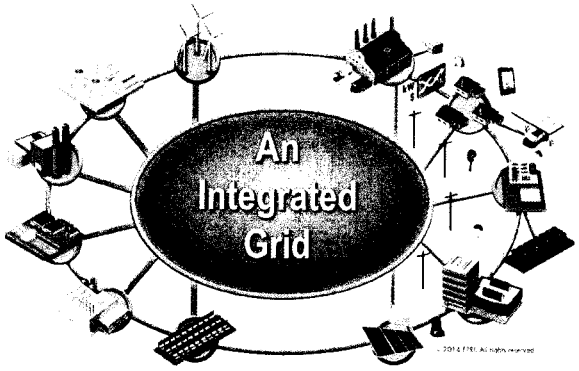
The Integrated Grid Concept

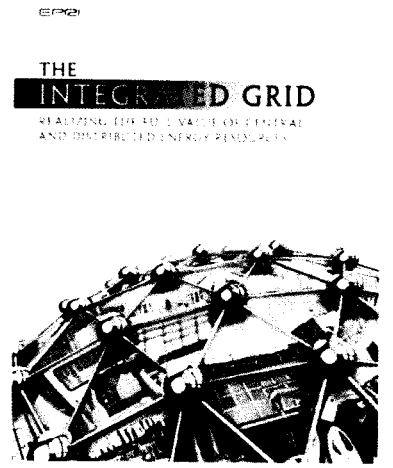
Extensive Electricity Sector Stakeholders Engagement in All Phases

Phase 1	Phase 2	Phase 3
Integrated Grid (IG) Paper	Benefit/Cost Assessment	Integrated Grid Pilots
FEB 2014	FEB 2015	NOW
Report #3002002733	Report #3002004878	



The Board of Directors of the National Association of Regulatory Utility Commissioners (NARUC)...

recognized the contributions of EPRI's "Integrated Grid" for evaluating the value of energy resources and grid connectivity, and commended EPRI for its beneficial analytical framework and communications outreach to stakeholders.



Envisioning the Path Forward

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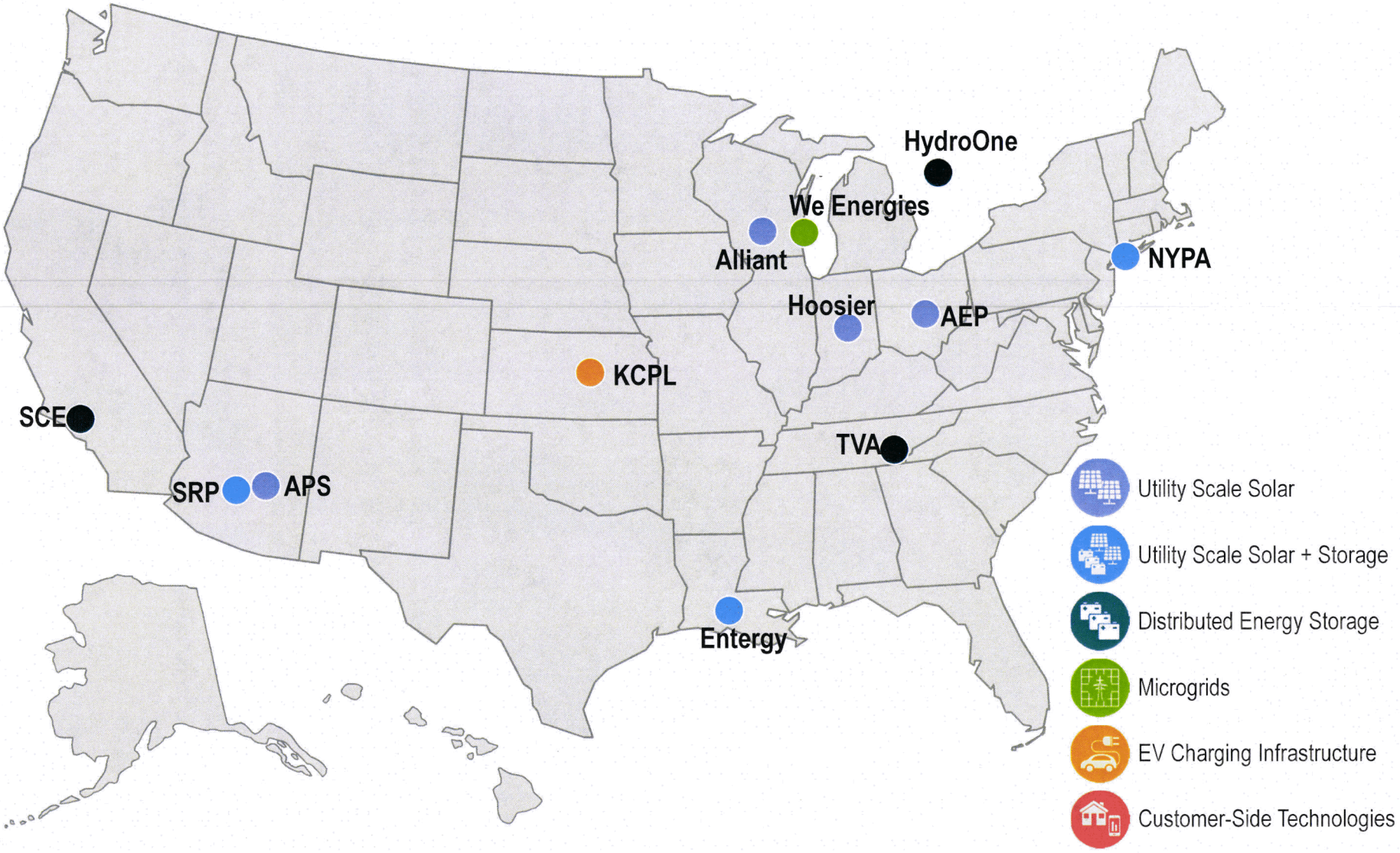
EPRI Integrated Grid Pilots



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Resources – available on epri.com

- The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources (3002002733)
- The Integrated Grid: A Benefit-Cost Framework Final Report (3002004878)
- Integrated Grid Pilot Projects (3002005004)
- Capacity and Energy in the Integrated Grid (3002006692)
- Other information and technical papers available at: integratedgrid.epri.com

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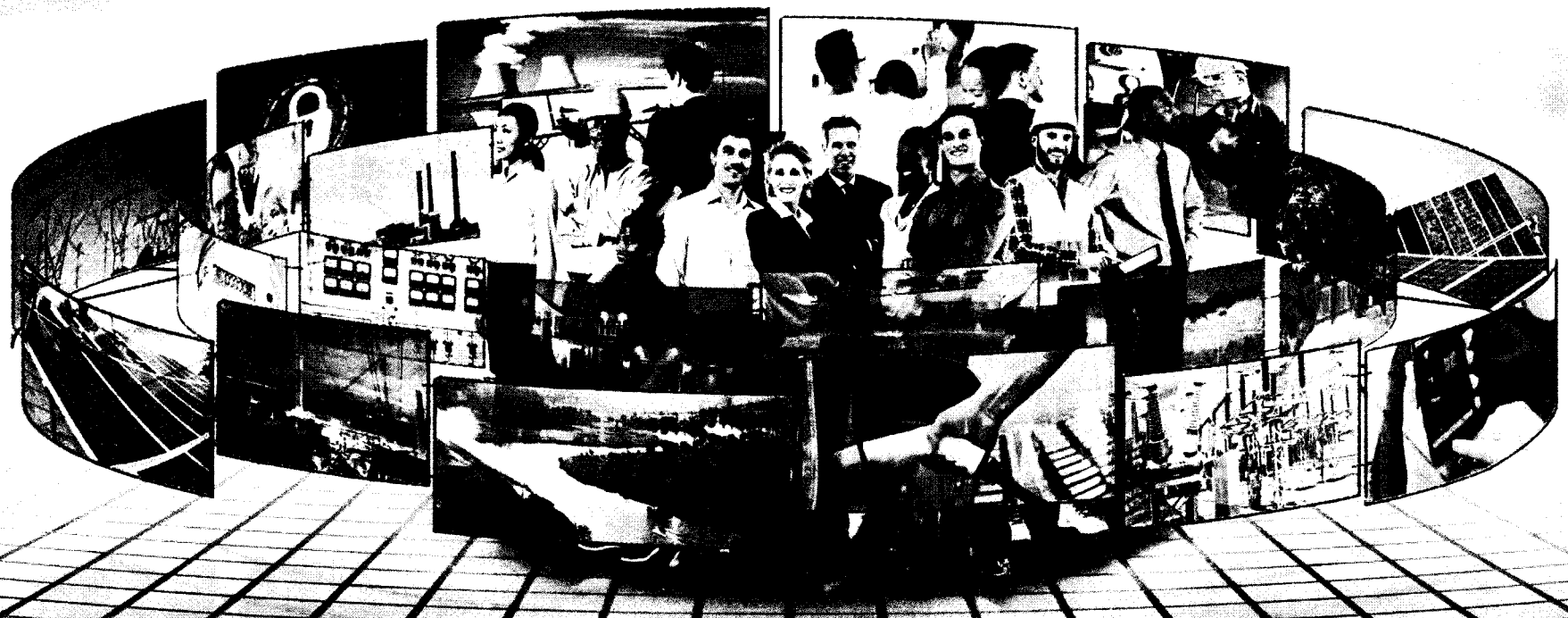
For More Information Contact:
Henry "Hank" Courtright
Executive Advisor, Office of the CEO



Together...Shaping the Future of Electricity

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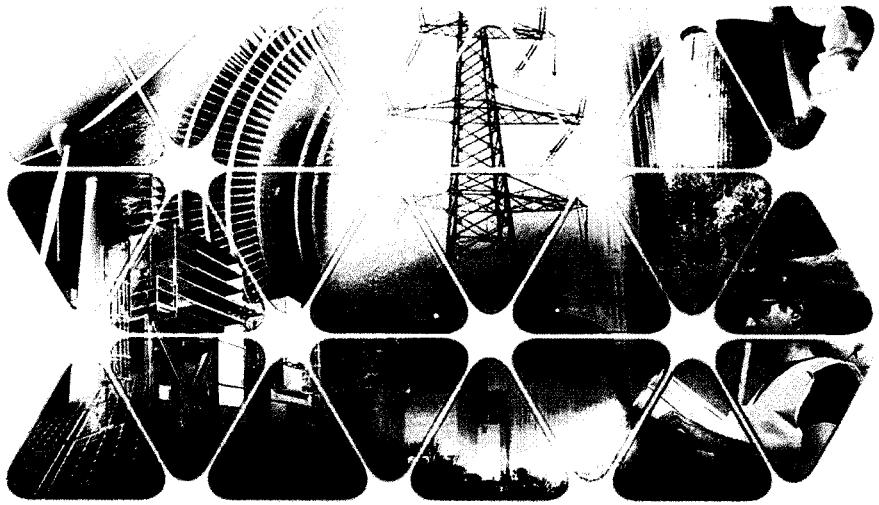
The Power System of the Future and Managing Peak Demand



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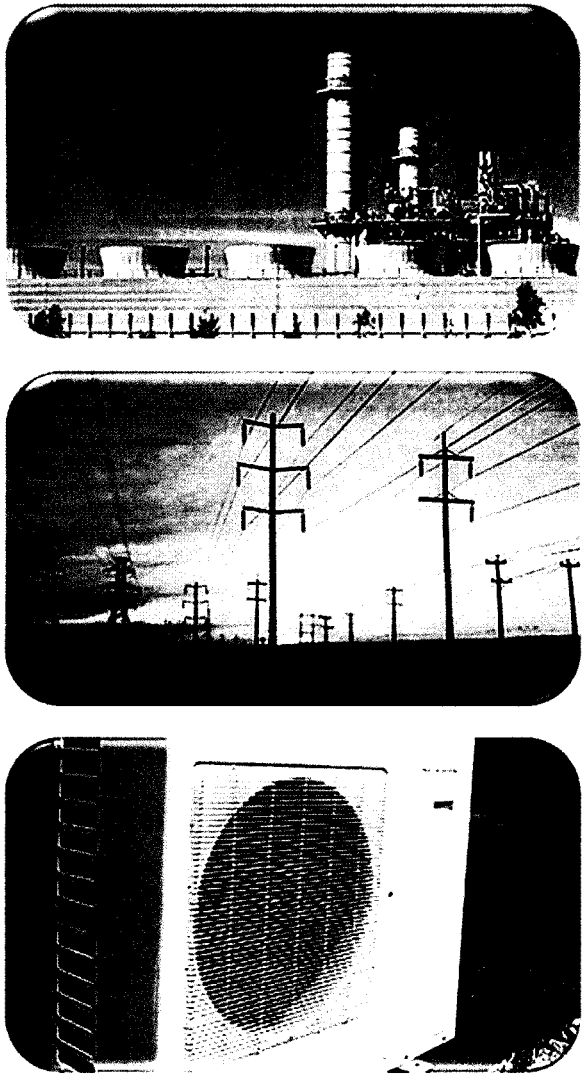

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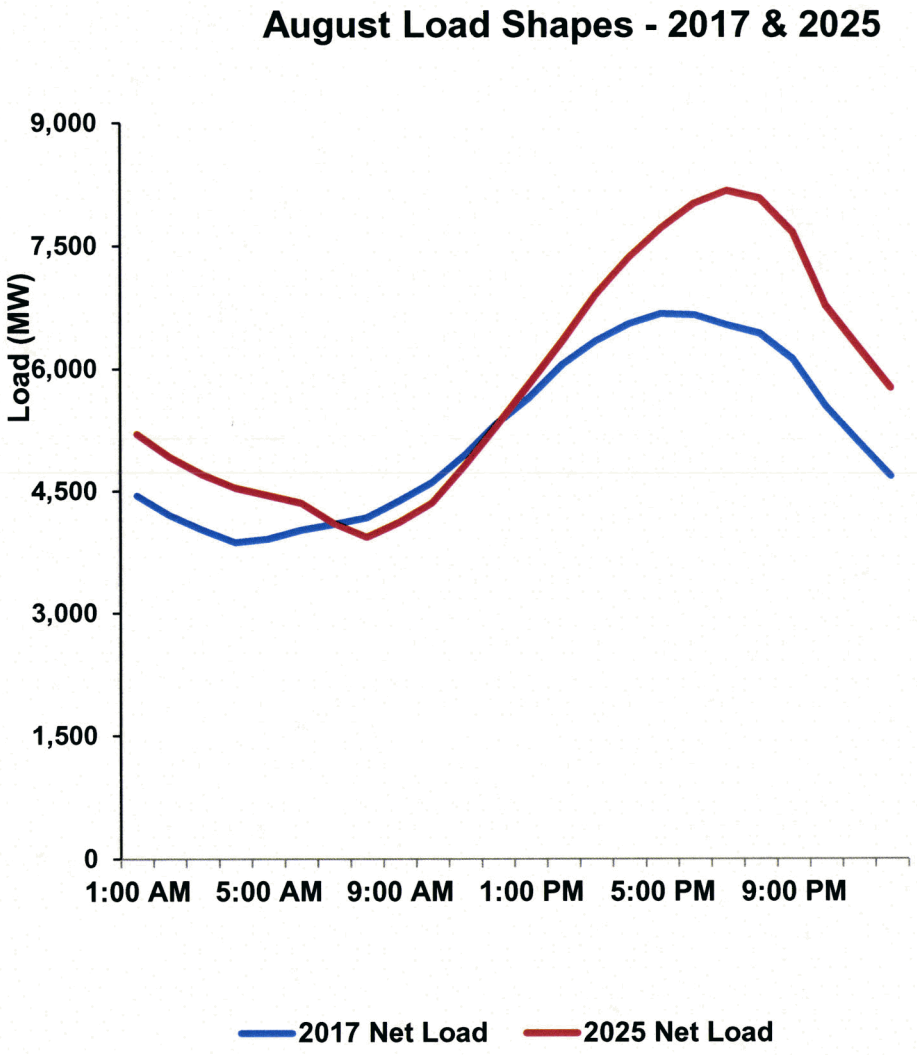

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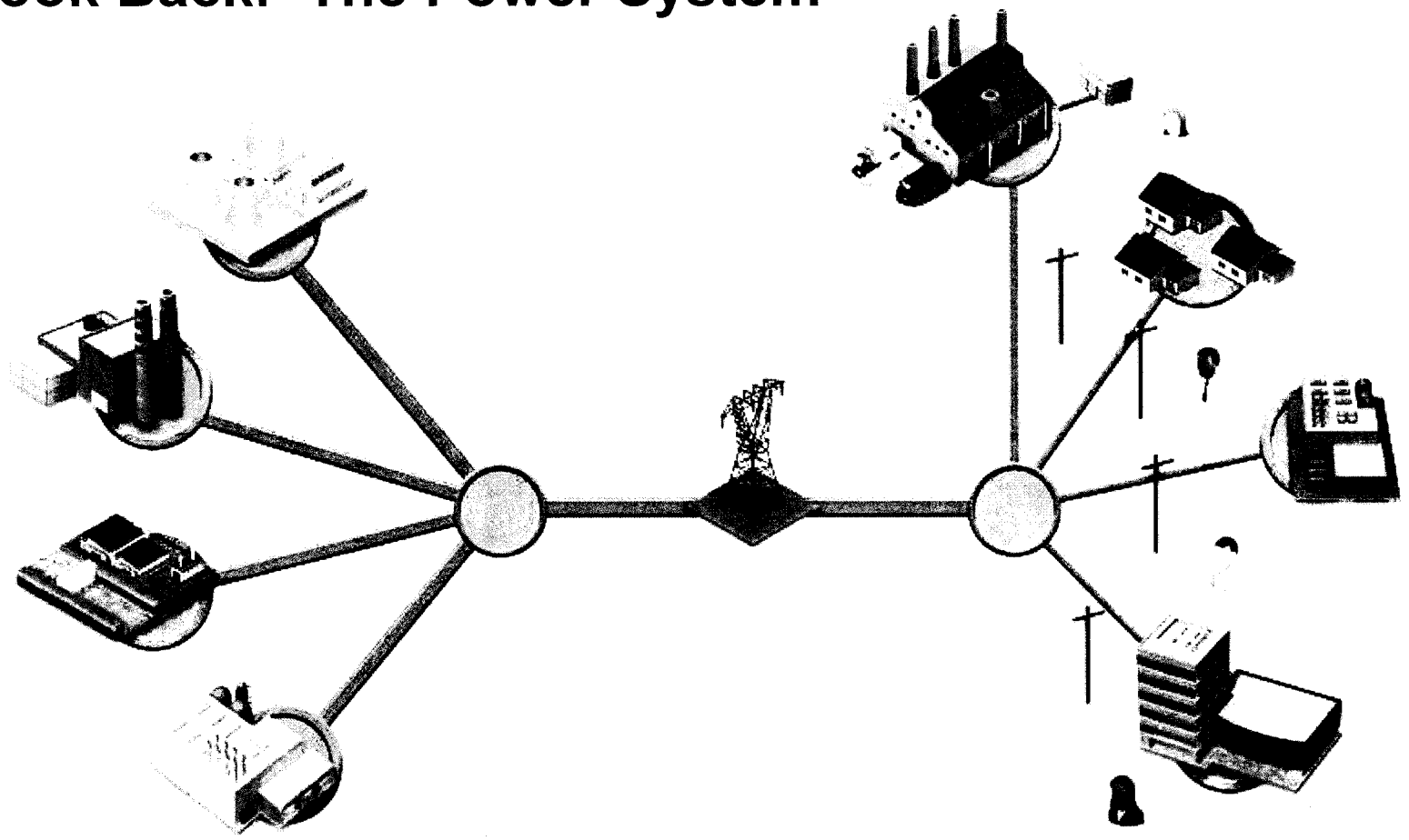

Dispatchable ***Forecastable***

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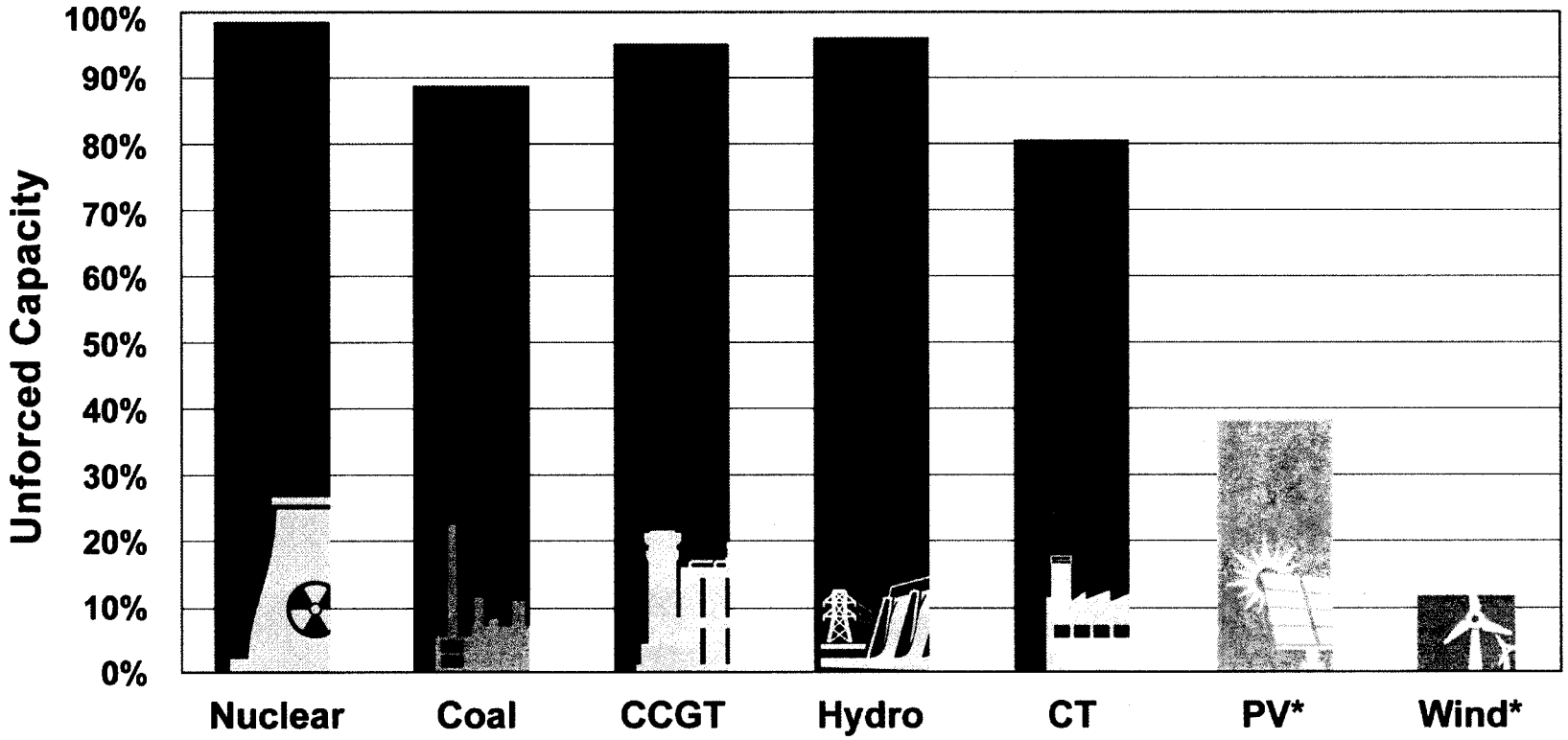
Capacity Contributions of Generation Types



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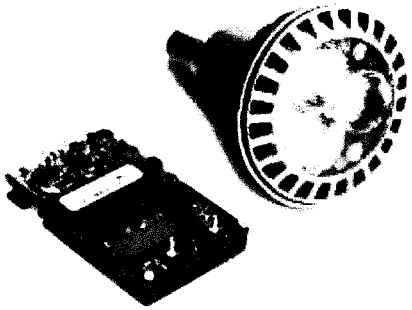
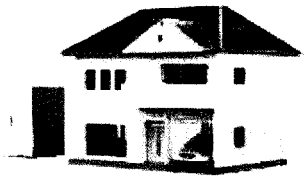
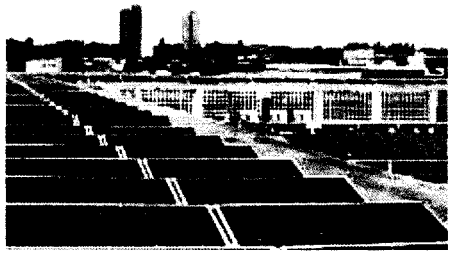
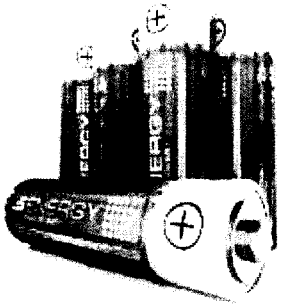


Renewable Energy



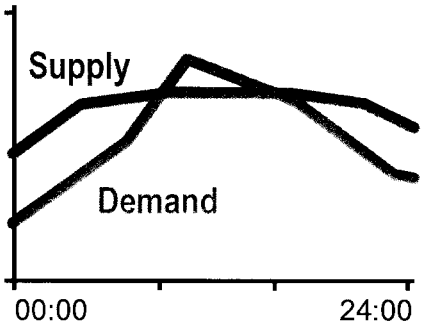


Storage



Transportation

Demand-Side Management



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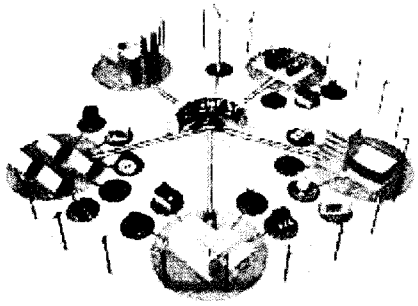

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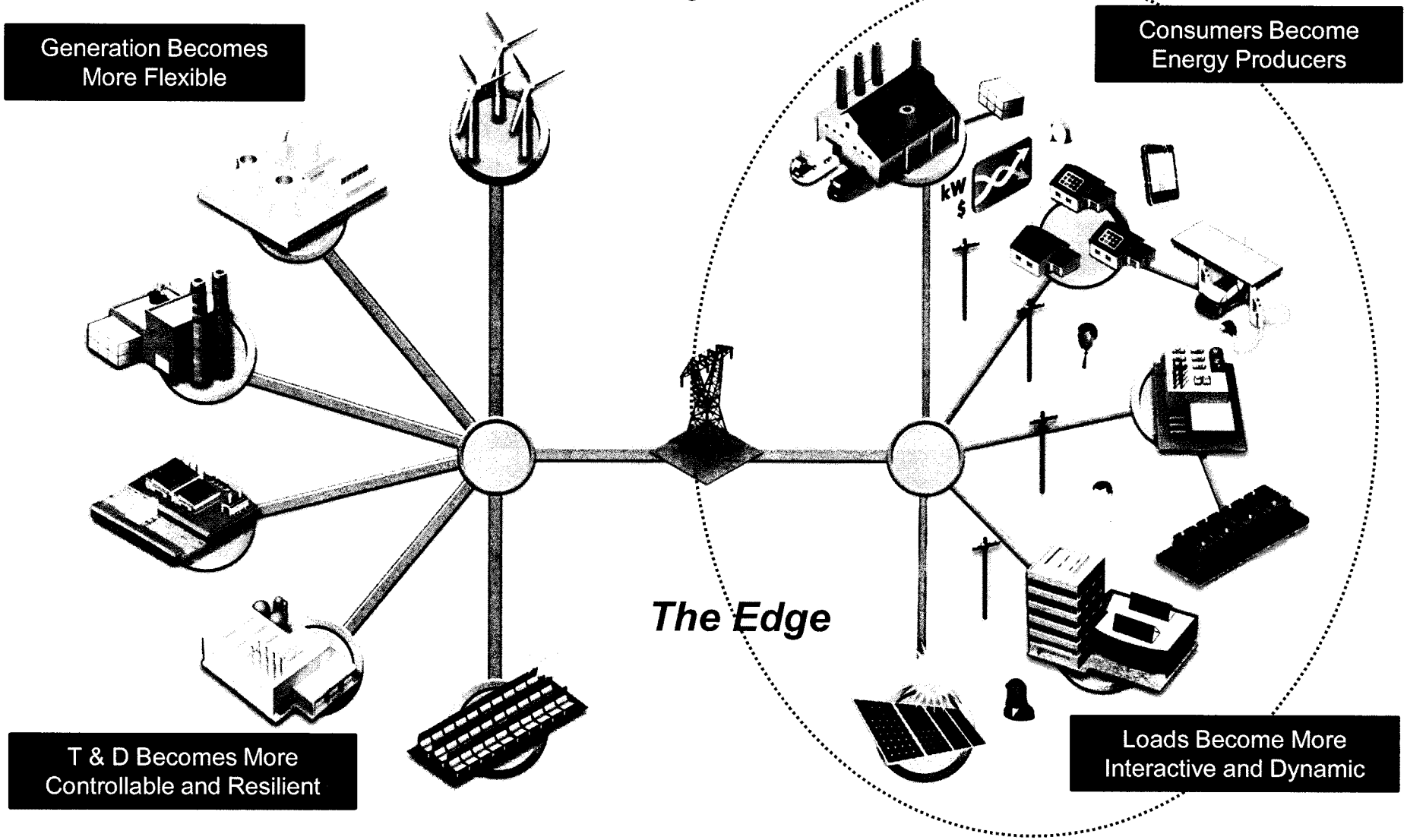
A Look Ahead: The Power System of the Future



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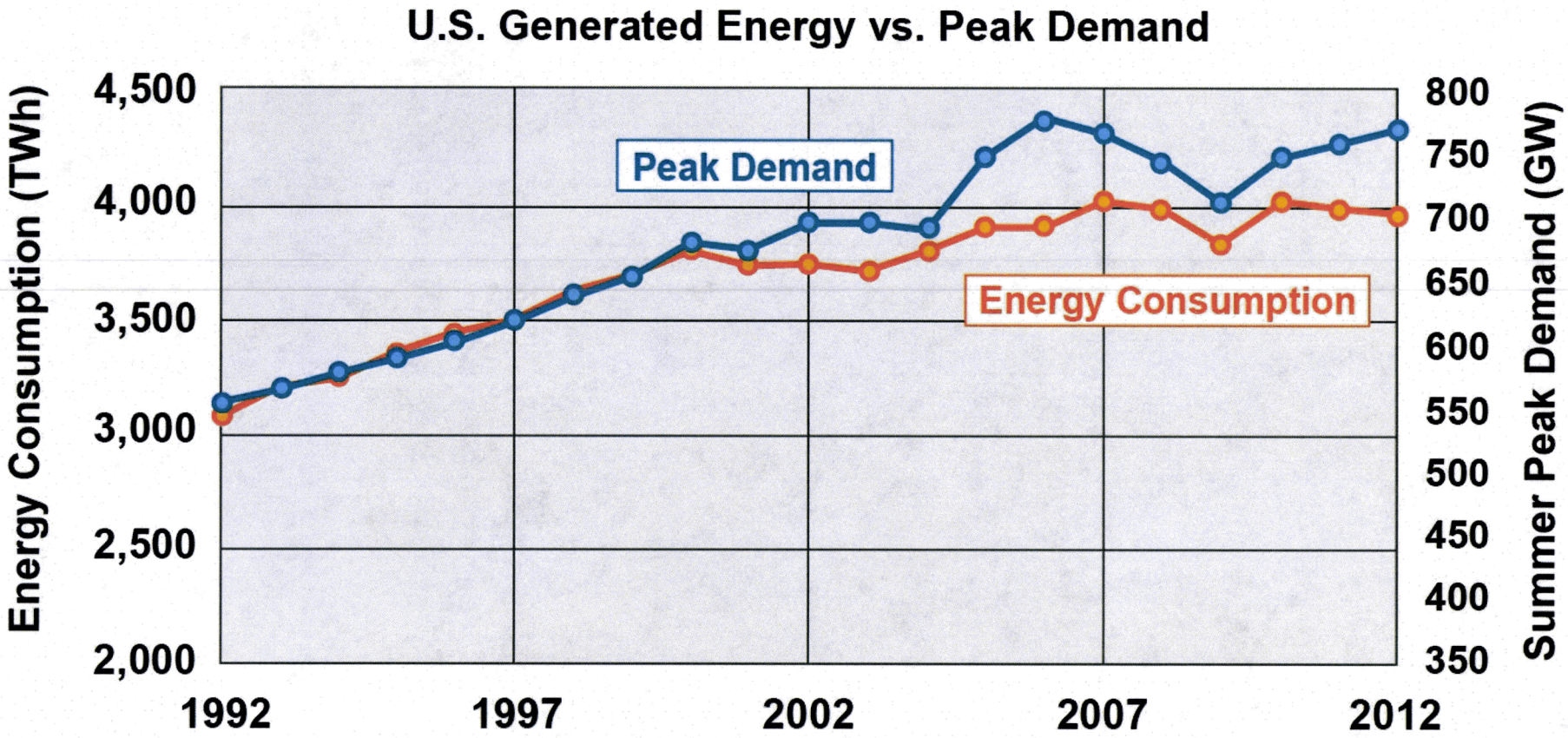

Source: EIA Form 411

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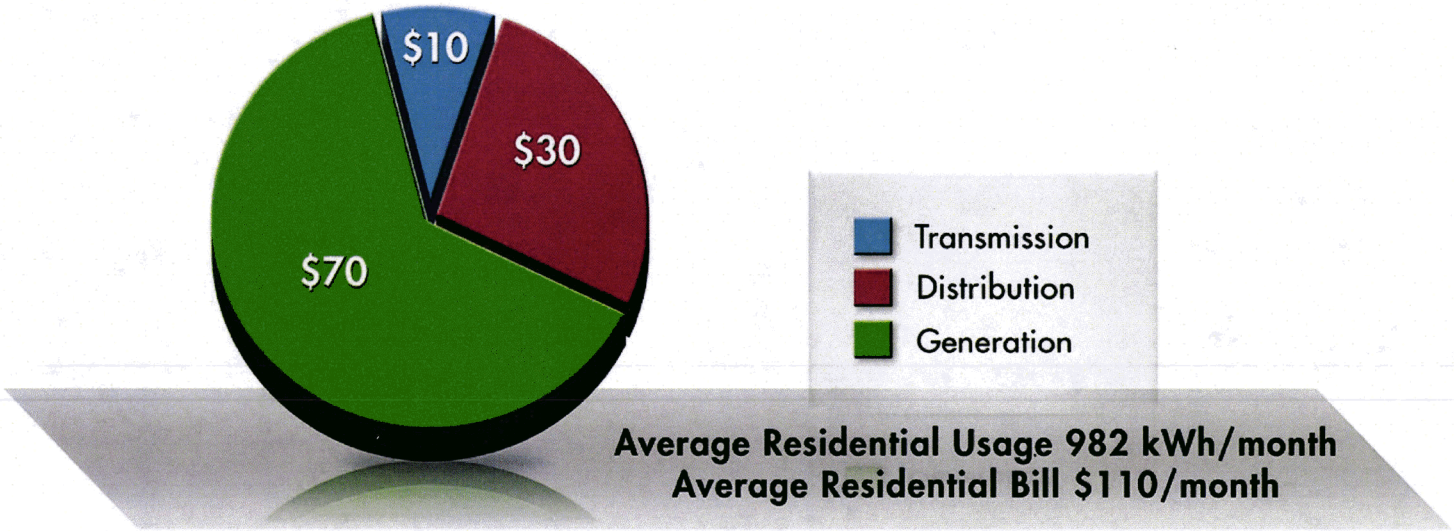
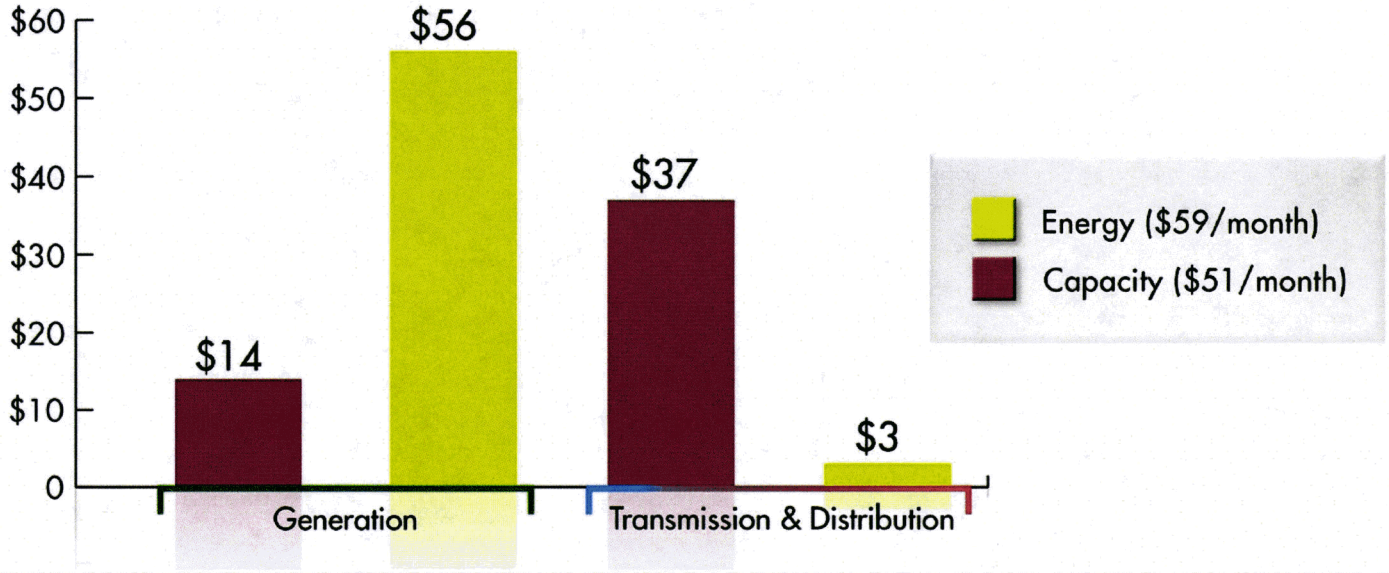
Insight: U.S. Average Cost to Consumers





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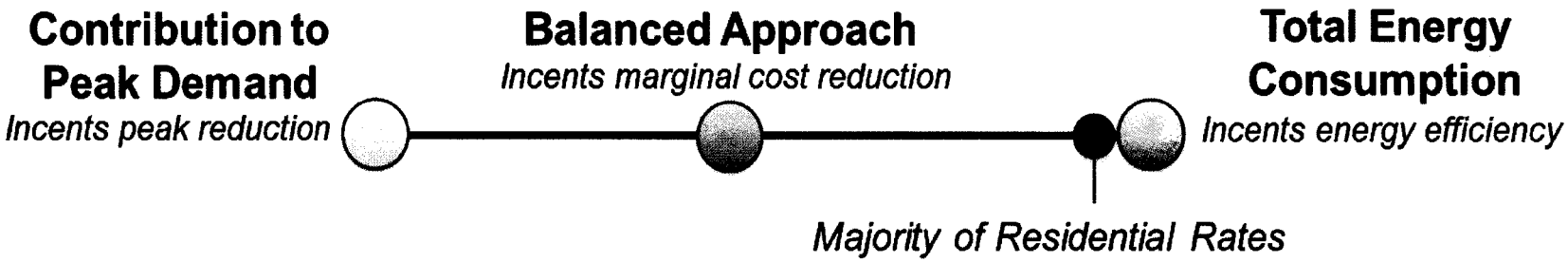
Insight: Rate Design – Current Status in U.S.



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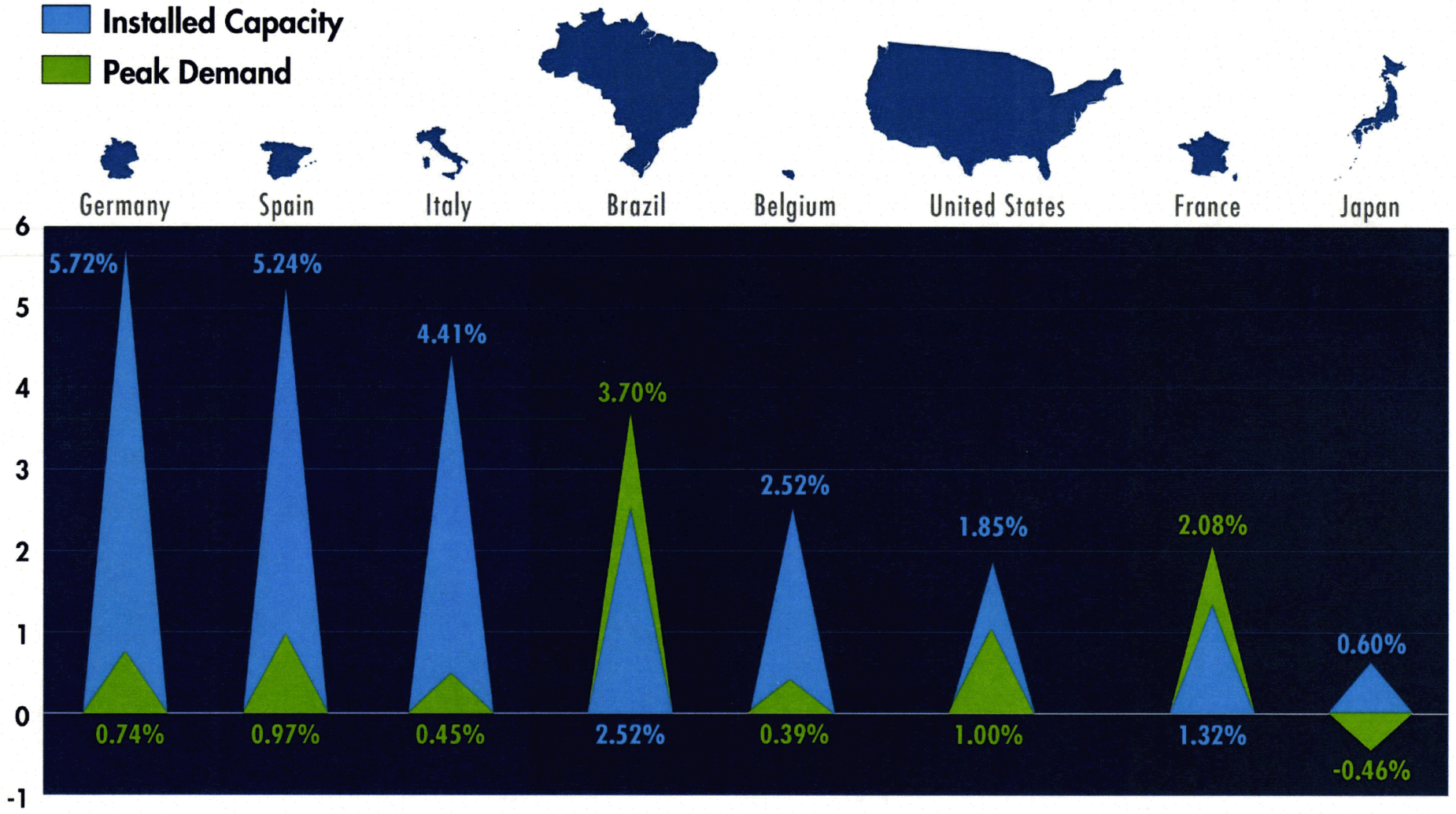
Insight: Installed Capacity vs. Peak Demand Growth

Compound Annual Growth Rate (%), 2003-2013



Source: EIA

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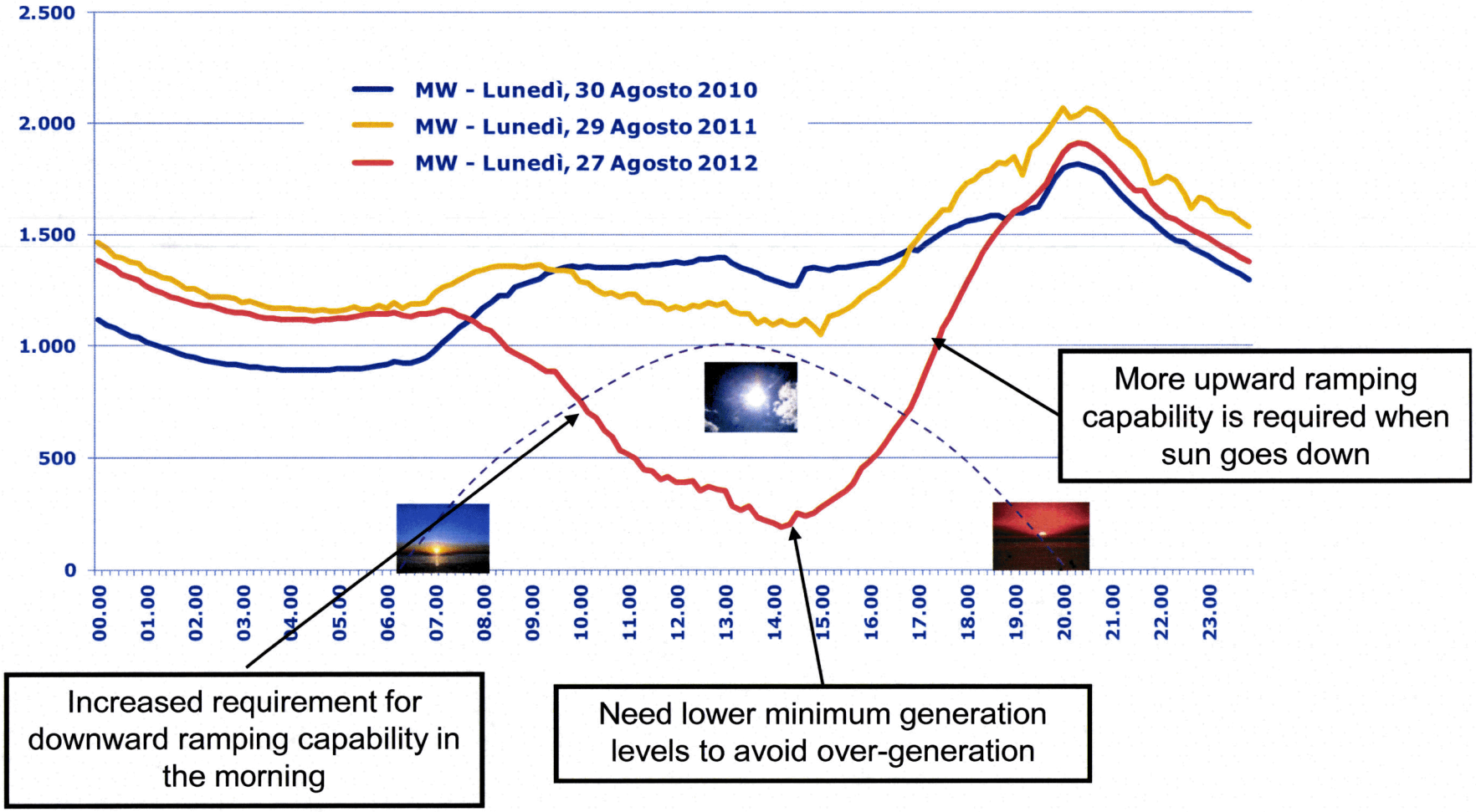
A Look Ahead: Insights from The Italian "Duck" Curve

Not Just Resource Adequacy…but the Adequacy of Resources of the Right Type at the Right Location at the Right Time…



Source: *ENEL – Measured Data from Southern Italy and CAISO analysis*

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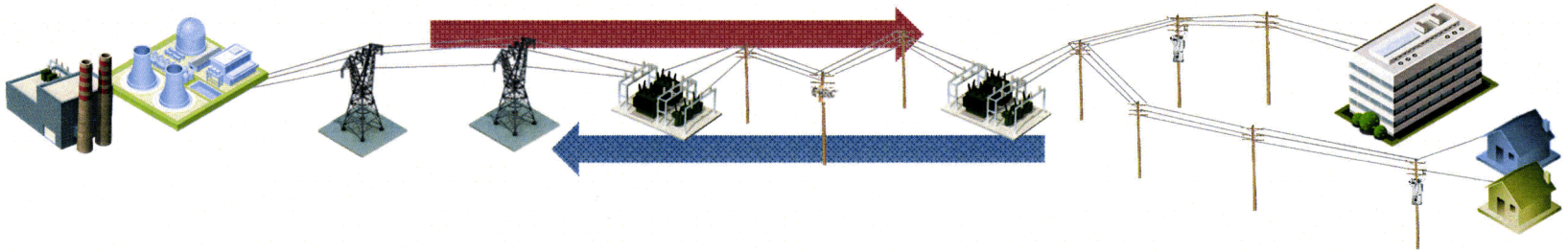
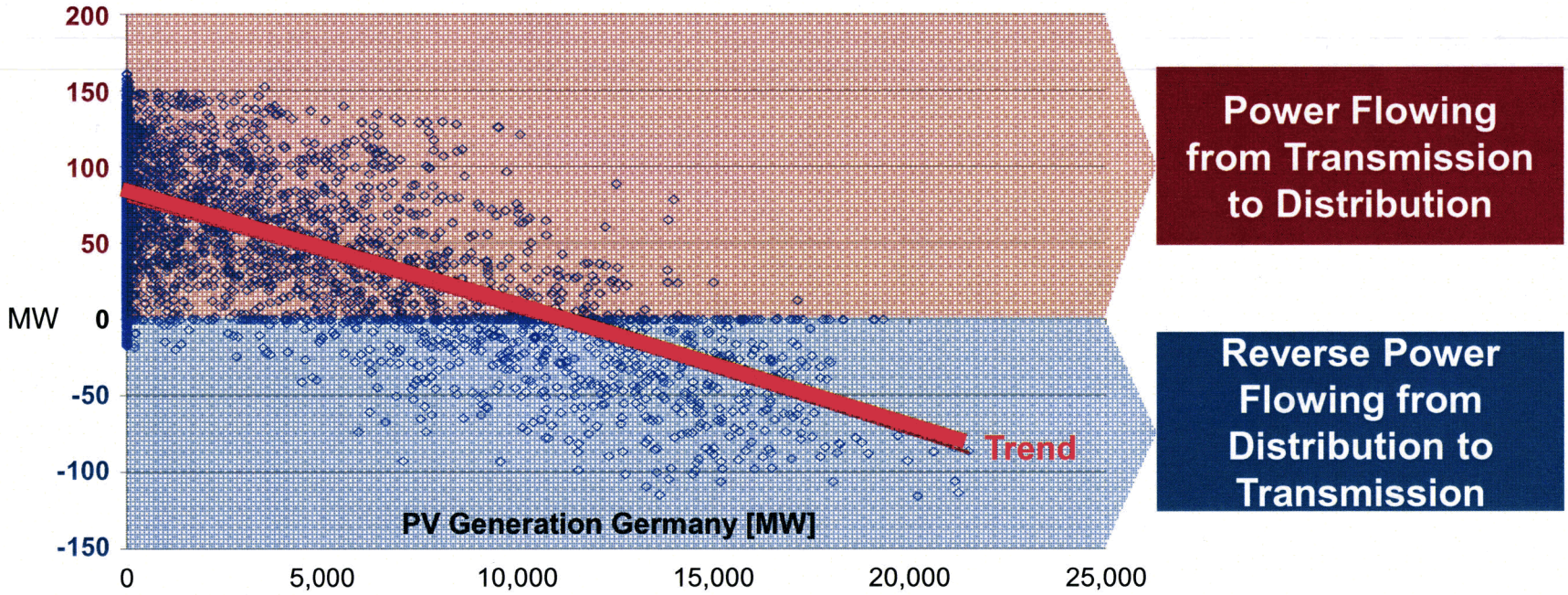
A Look Ahead: Insights from Germany Solar Growth





Source: Klaus Kleinekorte, Amprion, German TSO.

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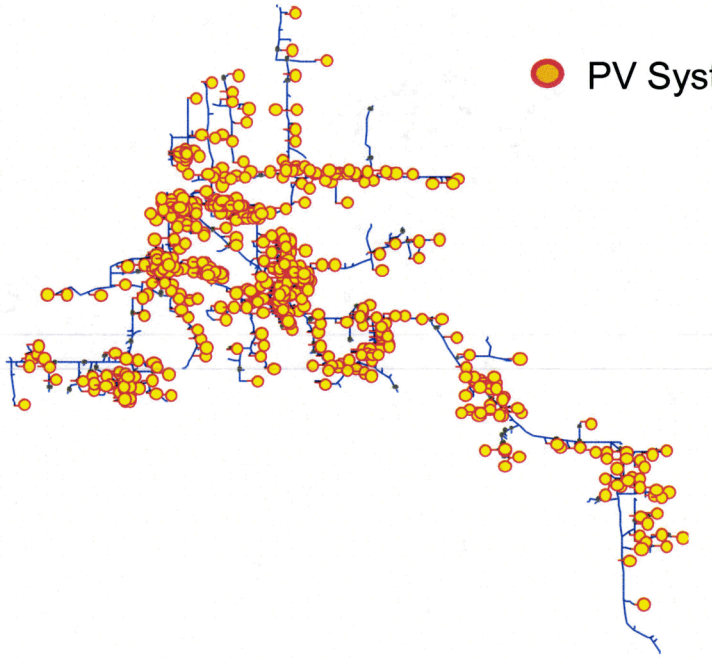
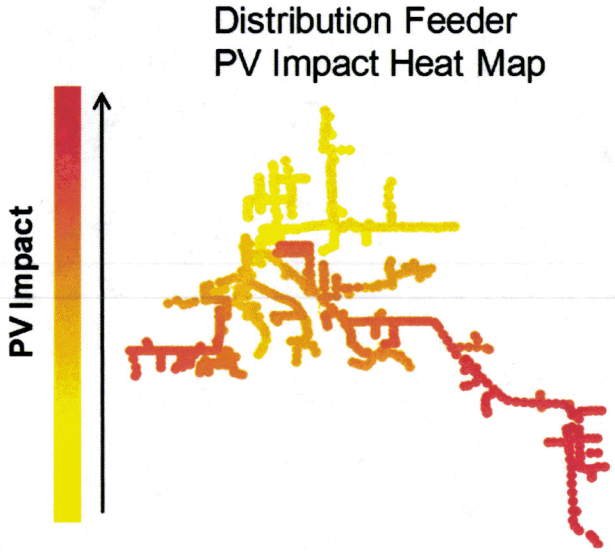
DER Adoption – Peak Loads on Feeders

Feeder Hosting Capacity can affect available energy





Understand Adoption Levels and Where / When "Violations" Occur

- voltage
- protection
- power quality
- thermal

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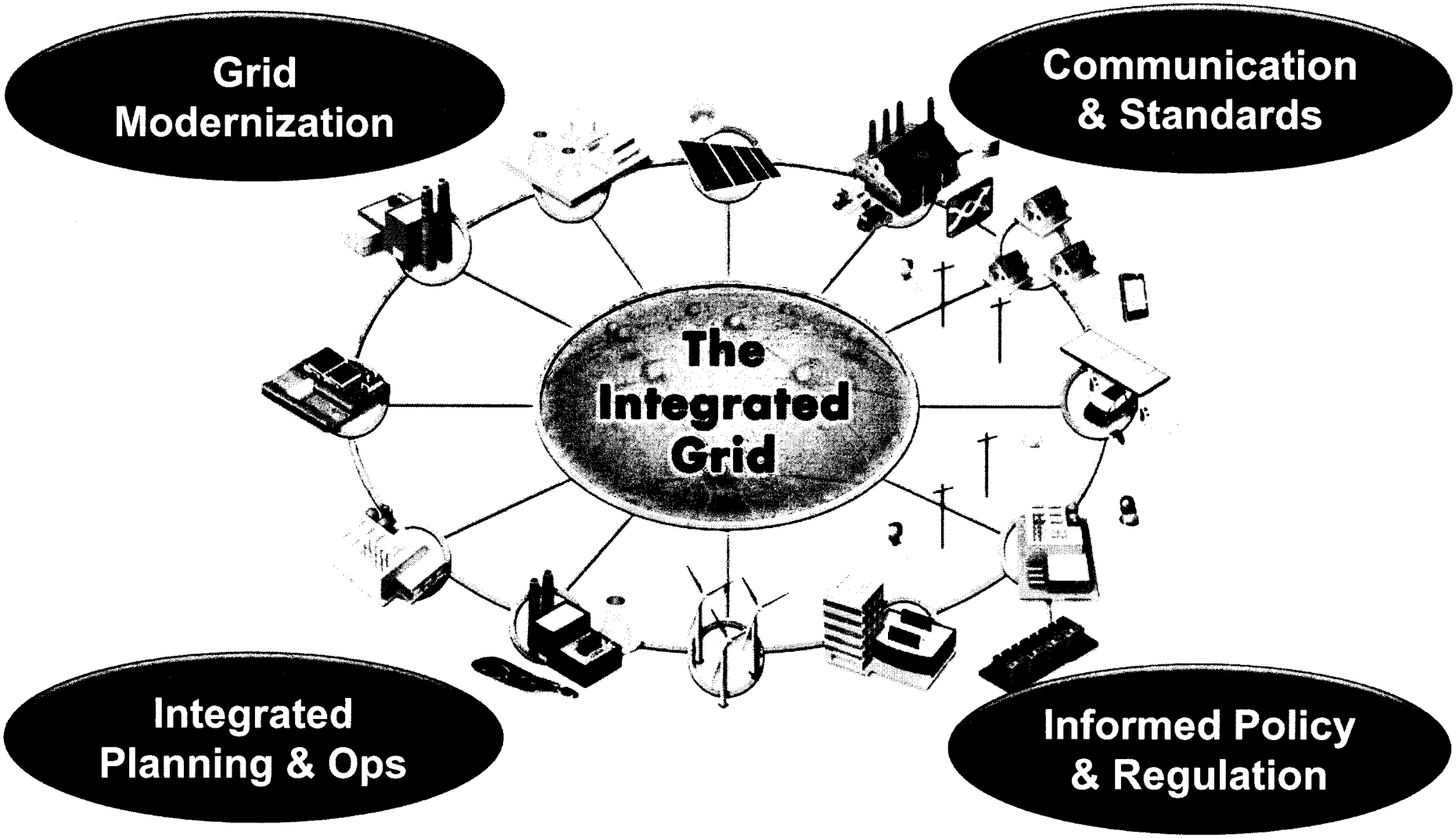
Meeting the Challenge



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Technologies to Address the System Challenges

#3 - INFORMATION AND COMMUNICATIONS PROTOCOLS

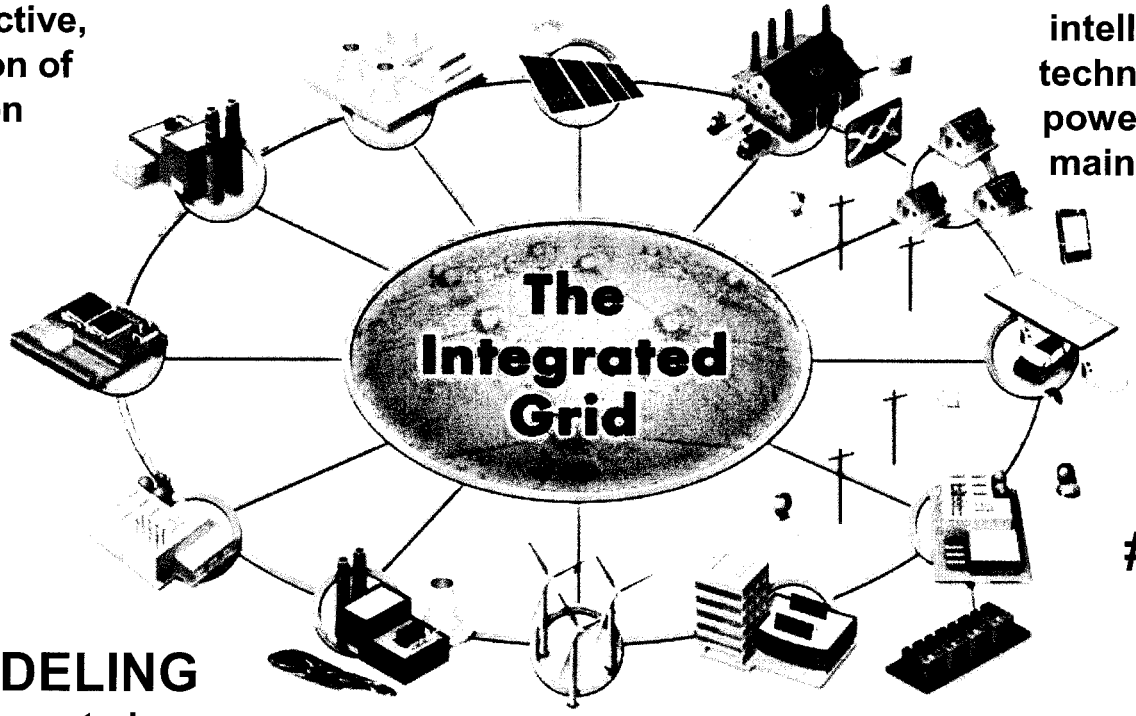
Develop an Integrated Grid platform

#4 - FLEXIBLE OPERATIONS

Enable cost-effective, flexible operation of central station generation

#2 – SENSORS INFORMING ACTIONS

Accelerate adoption of intelligent sensor system technologies for improved power system operations, maintenance, and outage restoration



#5 - MODELING

Develop an integrated power system and environmental modeling framework to support regulatory & policy initiatives

#1 - CUSTOMER RESOURCES

Enable integration of customer resources into the integrated power system

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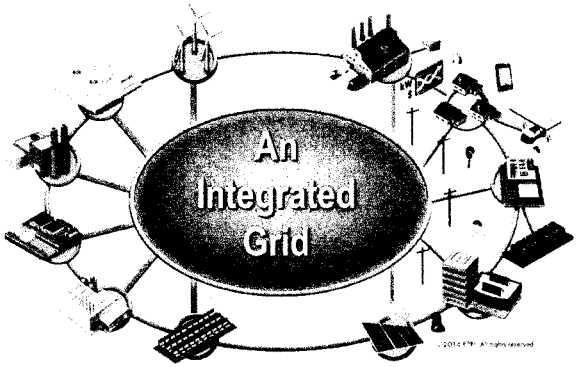
The Integrated Grid Concept

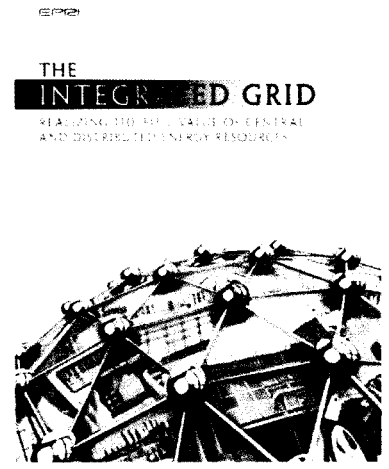
Extensive Electricity Sector Stakeholders Engagement in All Phases

Phase 1	Phase 2	Phase 3
Integrated Grid (IG) Paper	Benefit/Cost Assessment	Integrated Grid Pilots
FEB 2014	FEB 2015	NOW
Report #3002002733	Report #3002004878	



The Board of Directors of the National Association of Regulatory Utility Commissioners (NARUC)...

recognized the contributions of EPRI's "Integrated Grid" for evaluating the value of energy resources and grid connectivity, and commended EPRI for its beneficial analytical framework and communications outreach to stakeholders.



Envisioning the Path Forward

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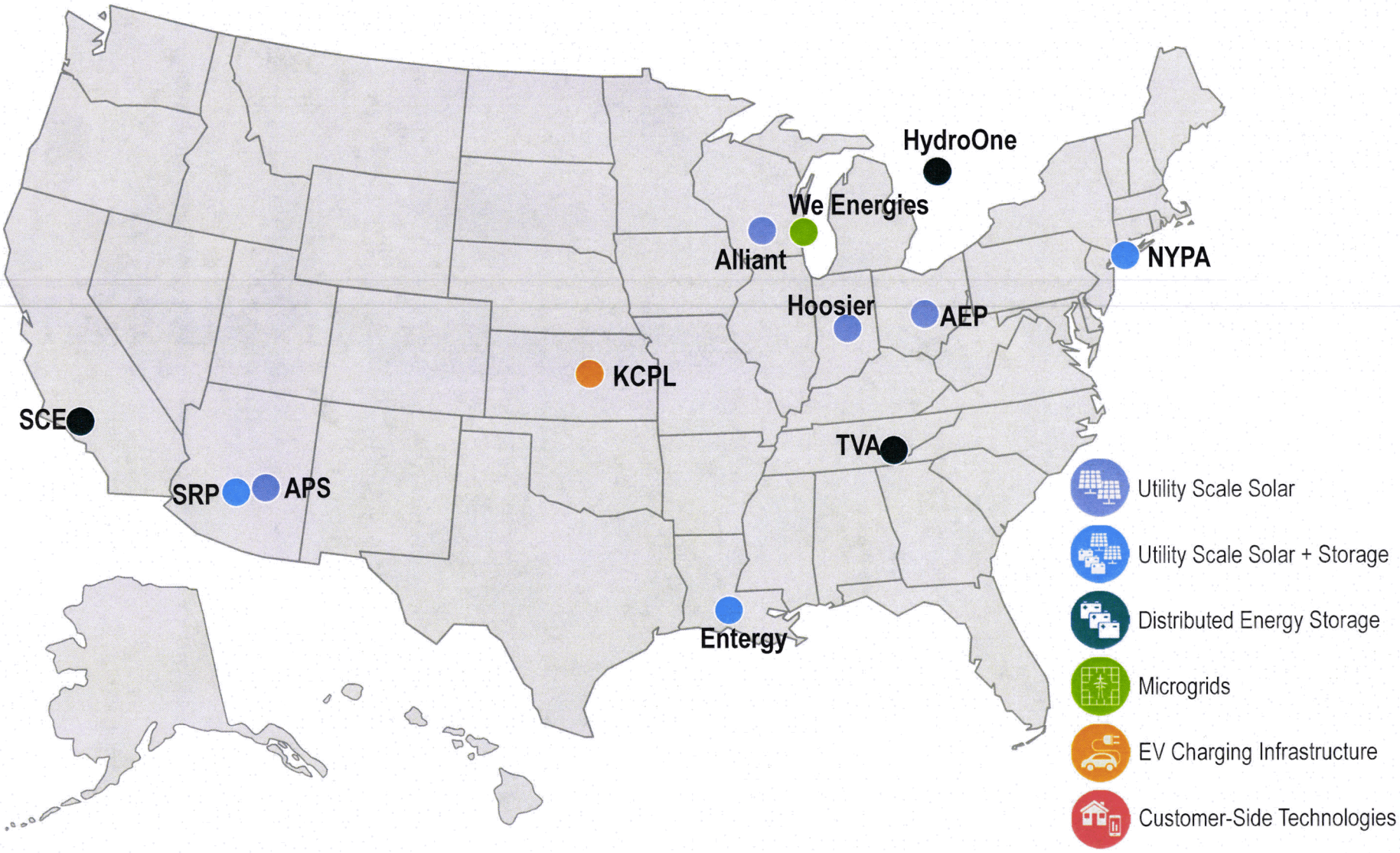
EPRI Integrated Grid Pilots



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Resources – available on epri.com

- The Integrated Grid: Realizing the Full Value of Central and Distributed Energy Resources (3002002733)
- The Integrated Grid: A Benefit-Cost Framework Final Report (3002004878)
- Integrated Grid Pilot Projects (3002005004)
- Capacity and Energy in the Integrated Grid (3002006692)
- Other information and technical papers available at: integratedgrid.epri.com

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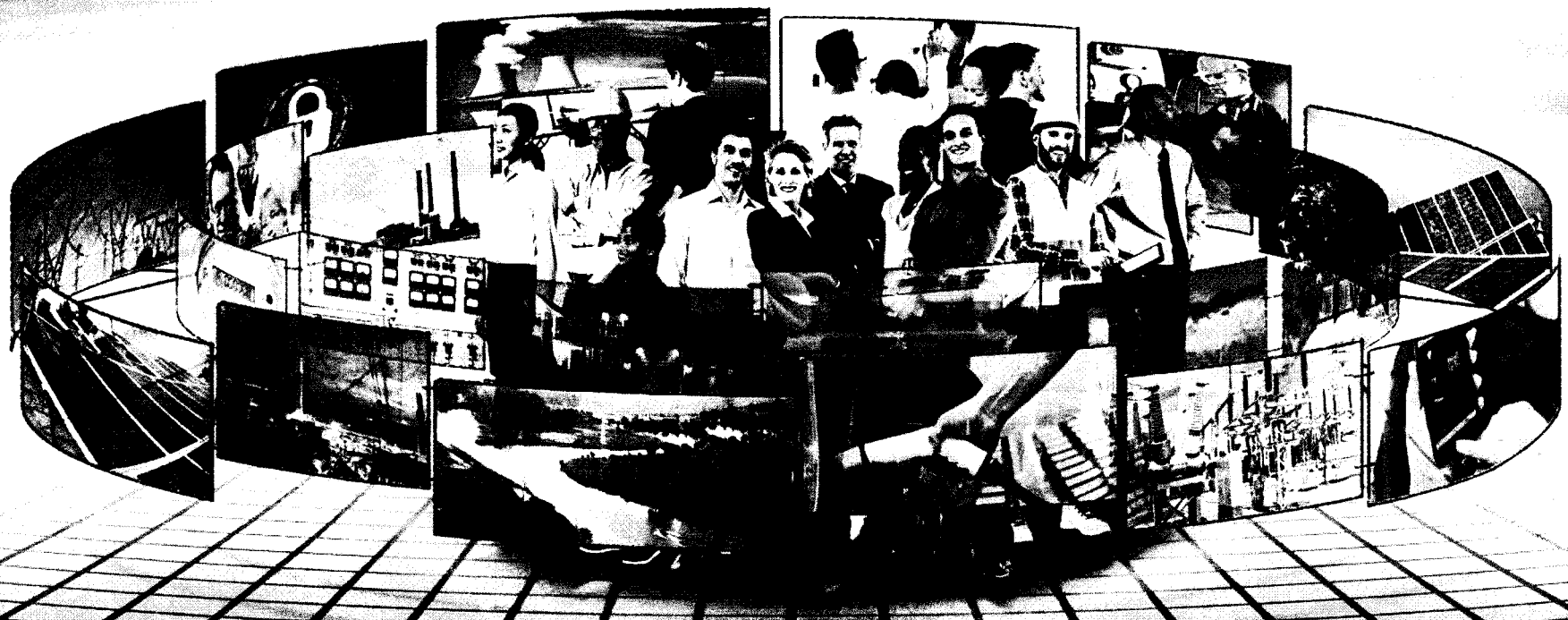

Together...Shaping the Future of Electricity