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The INTEGRATED GRID: Realizing the Full Value of Central and Distributed Energy Resources

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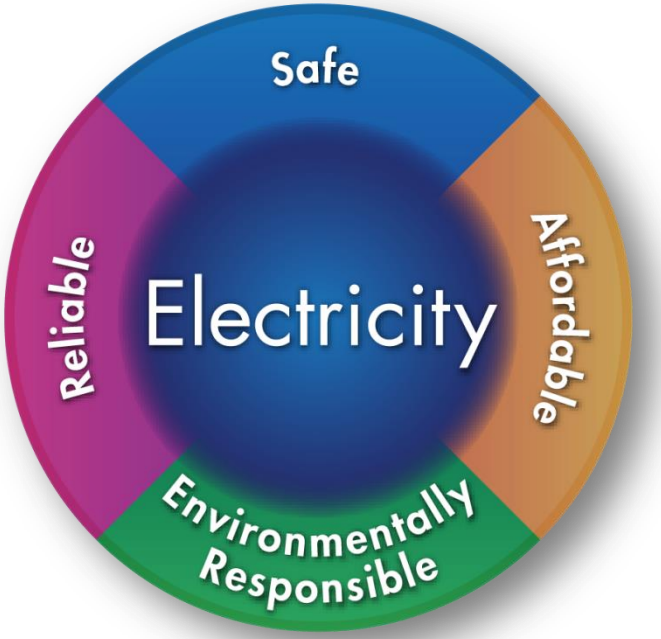
Consulting Executive, EPRI

Presentation to SENAI, Santa Catarina
November 18, 2014

EPRI's Mission

Advancing safe, reliable, affordable and environmentally responsible electricity for society through global collaboration, thought leadership and science & technology innovation



Our Collaborative Members…

- 450+ members from more than 30 countries.
- Research portfolio of $380 Million USD
- EPRI members generate approximately 90% of the electricity in the United States.
- International members from Europe, Asia, Latin America and other parts of the world contribute to the research and development knowledge base.

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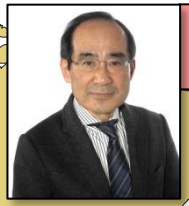
EPRI Country Managers

Locally based throughout the world…

Kevin East
International Director

Jong Kim
South Korea

Vaclav Vyskocil
Central Europe &
Scandinavia



Michio Matsuda
Japan

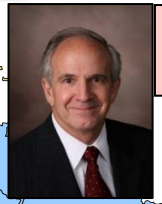
Jose Delgado
Southern Europe

- Croatia
- Czech Republic
- Finland
- Norway
- Poland
- Slovenia
- Slovakia
- Sweden
- Switzerland

- UK
- Germany
- Belgium
- India
- South Africa
- UAE

Warren Frost
Canada

- Spain
- Italy
- Greece



David Eskinazi
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H. T. Tang
Taiwan

Shanshan Liu
China

Maria Martin & Acher Mosse
Latin America

- Argentina
- Brazil
- Mexico

Des McInnes
Australia, New Zealand,
Thailand, Malaysia

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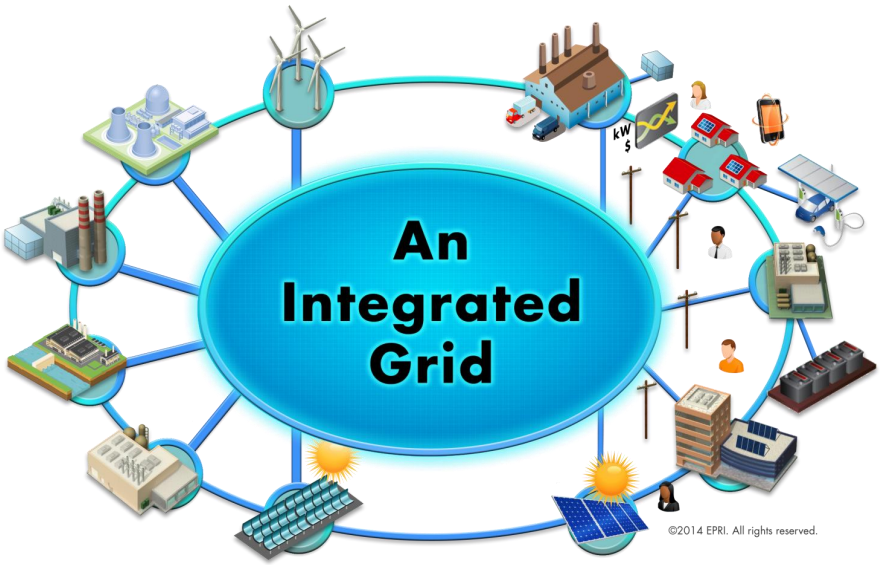
Global Energy Challenges

Renewable Energy



Energy Utilization & Efficiency

Flexible & Clean Plant Operations

Sustainability

Water Management

Technology Roadmaps Guide Key Initiatives

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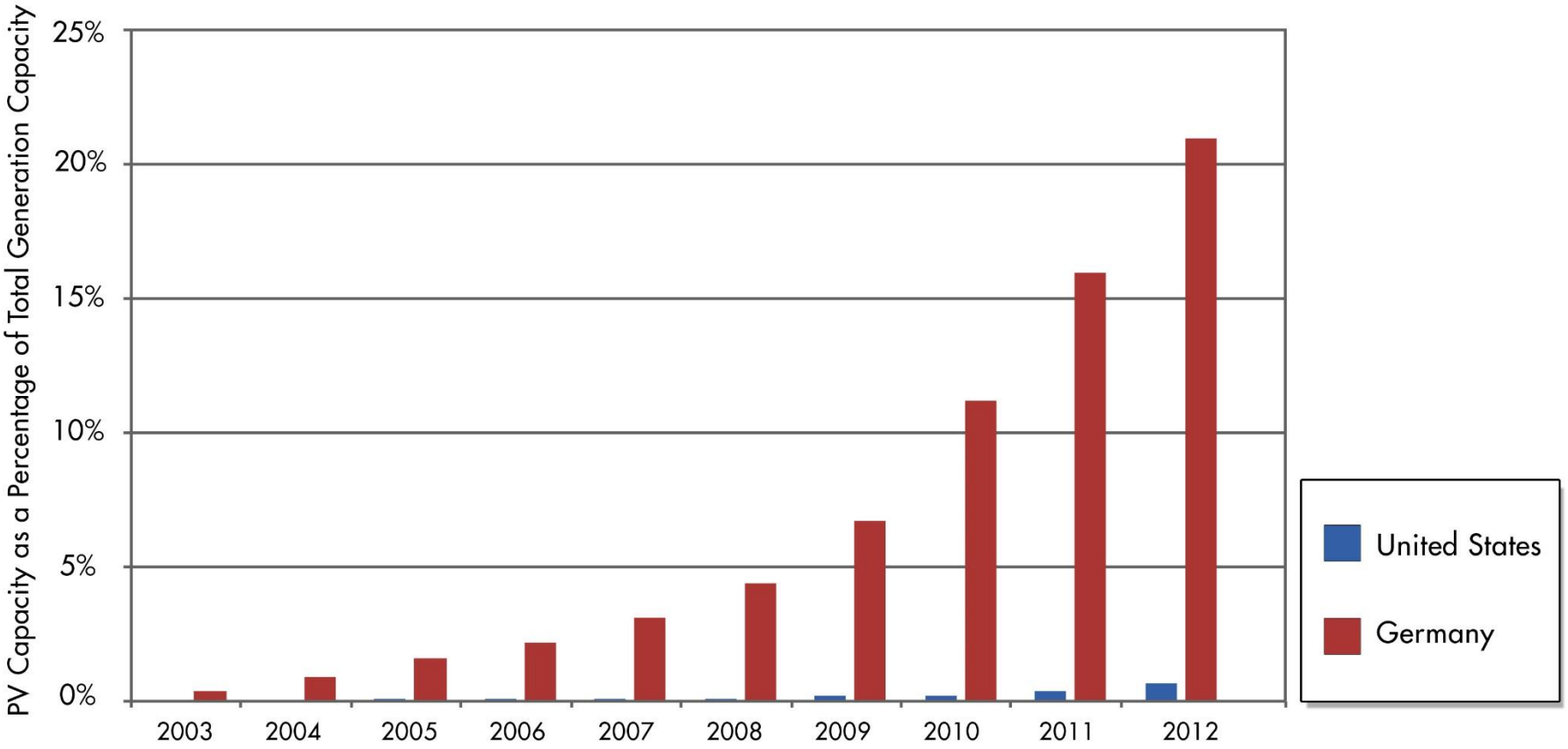
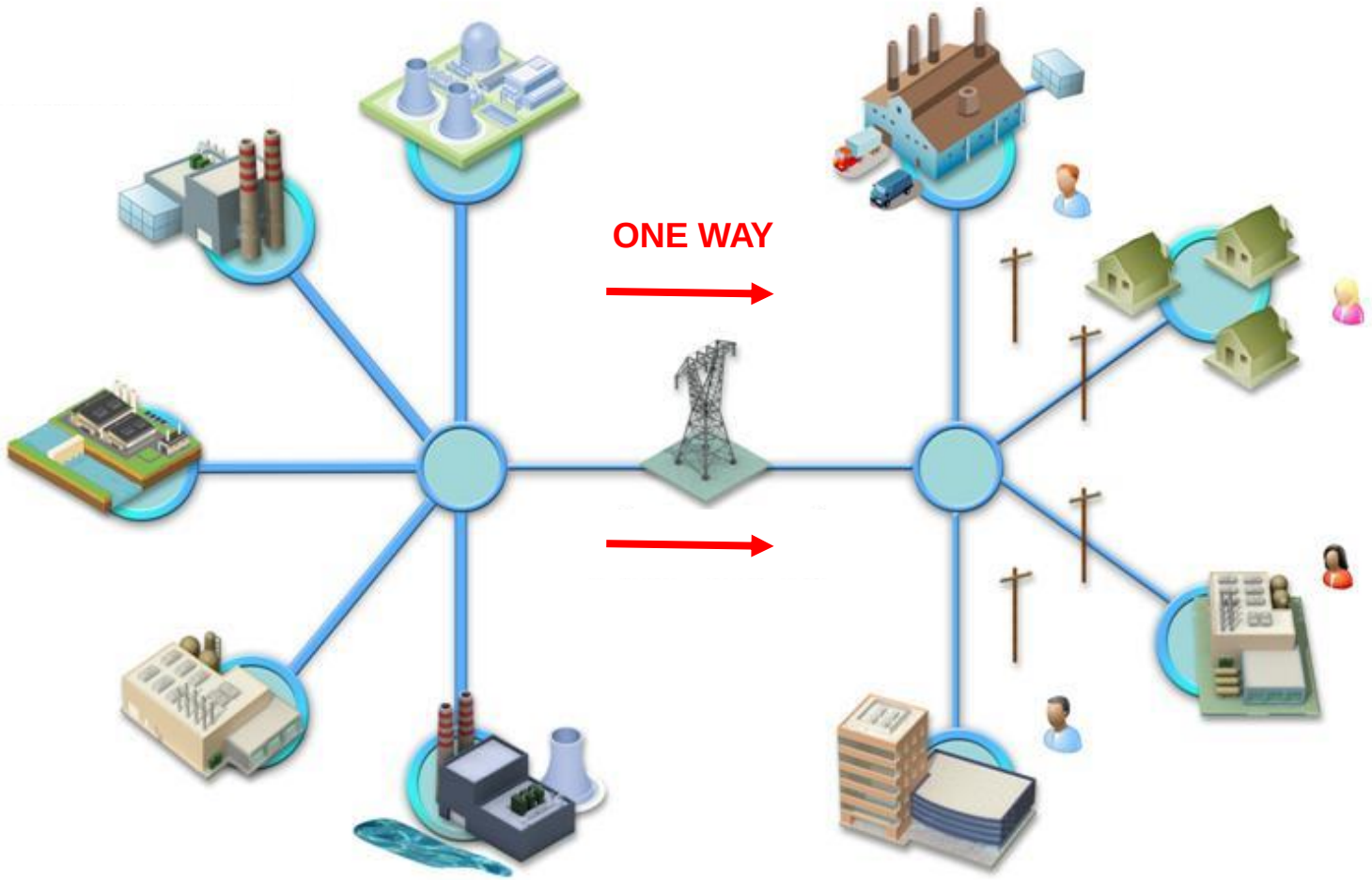
The Pace of Change



Exponential growth in solar photovoltaic (PV)

The Electric Power System



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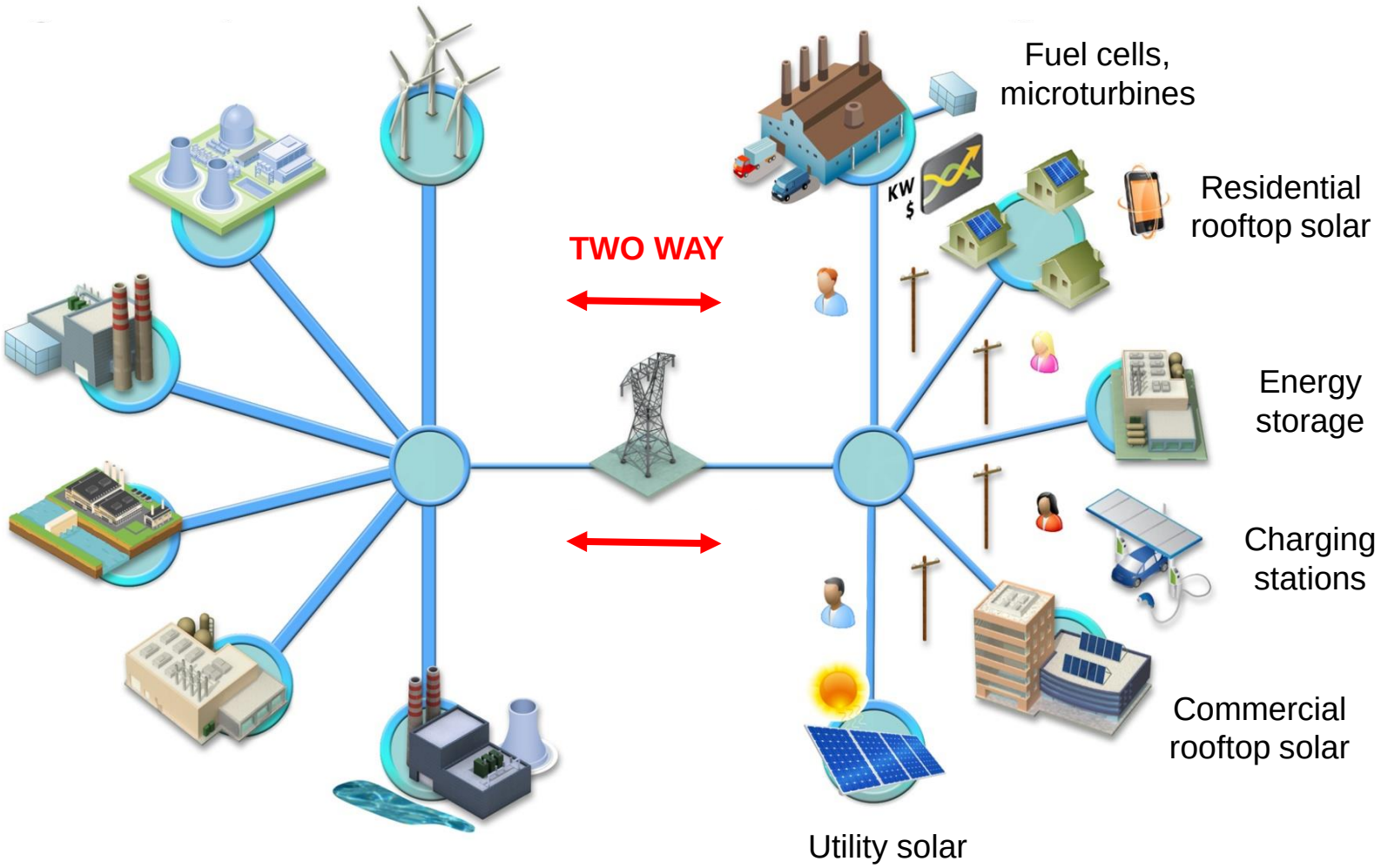
Looking Forward



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Capacity and Energy

Central Station Generation

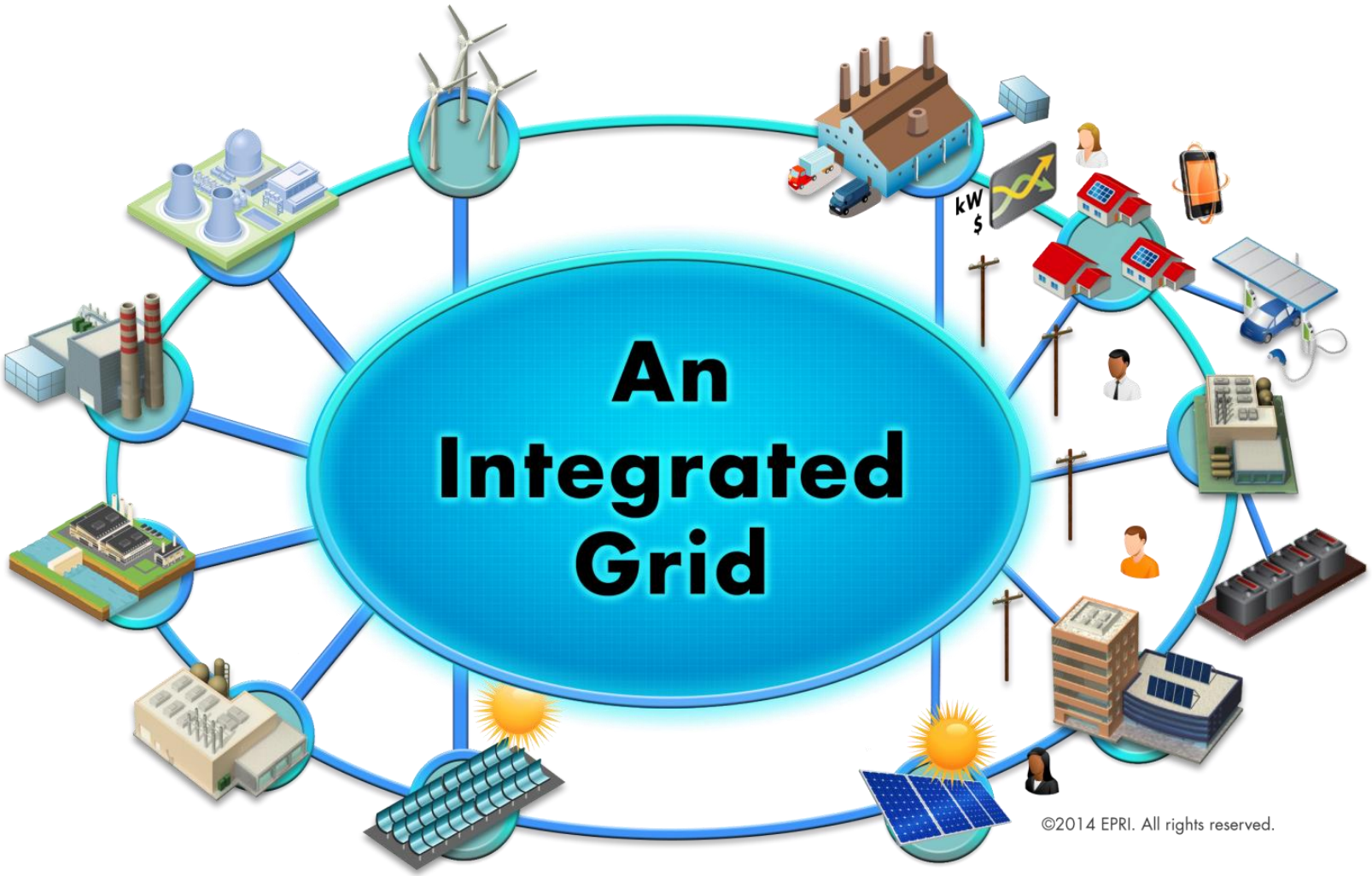
Variable Generation

Energy Storage & Demand Response

Energy

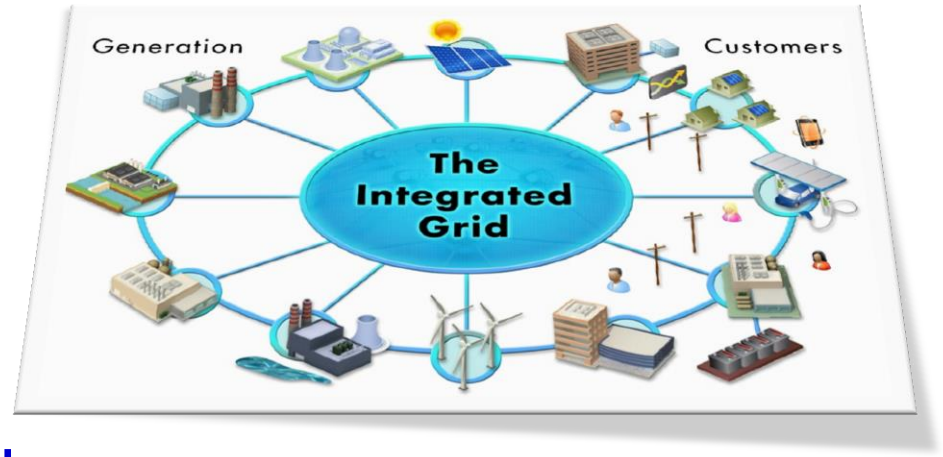
Capacity

Meeting the Challenges

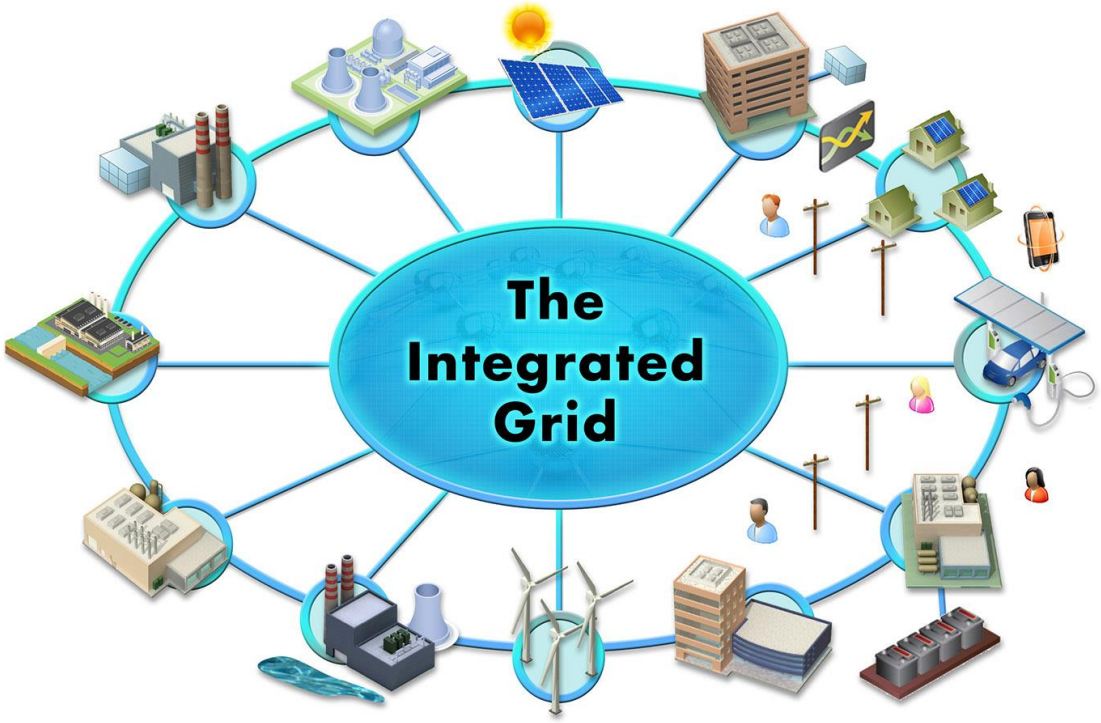


Foundation of An Integrated Grid

1. Grid Modernization
2. Communication Standards and Interconnection Rules
3. Integrated Planning and Operations
4. Informed Policy and Regulation



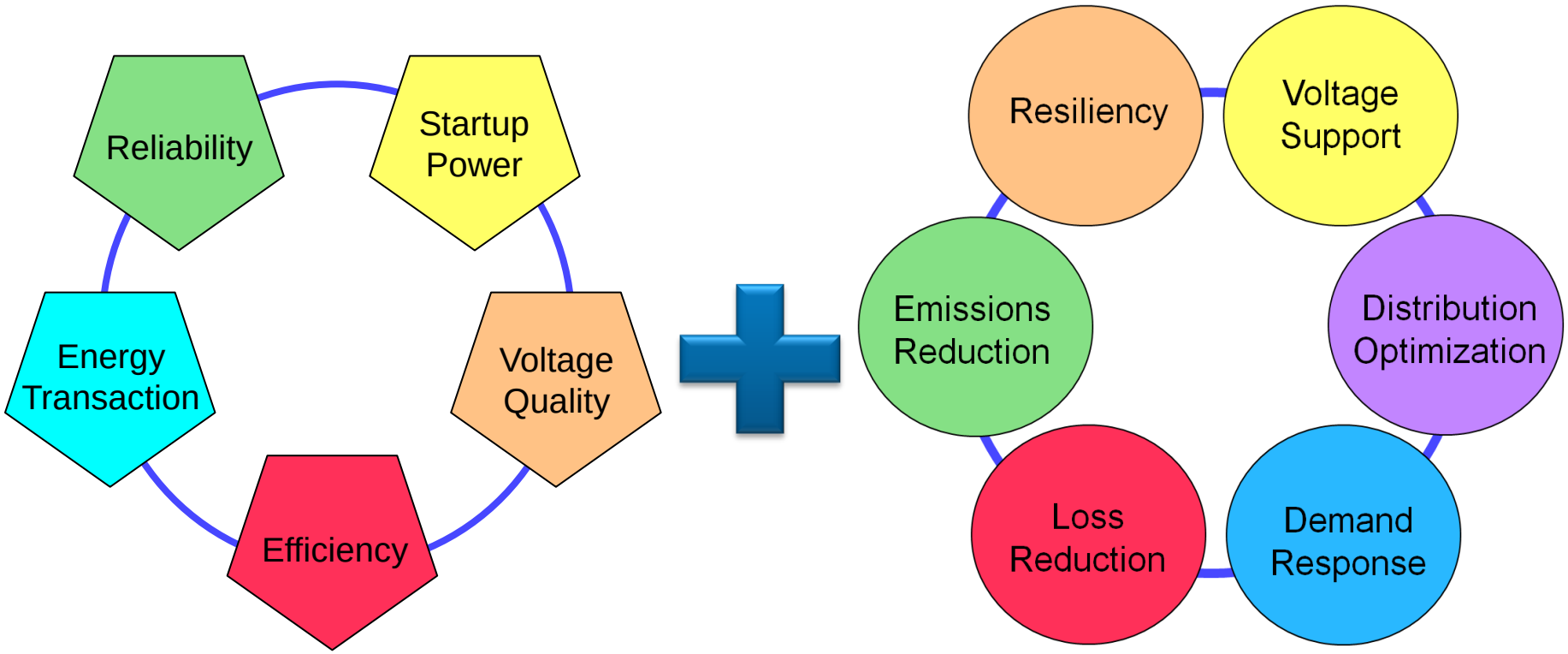
Value of Integrated Grid to Society



Value of Integrated Grid to Power System

Interconnected
Value of Grid Connectivity

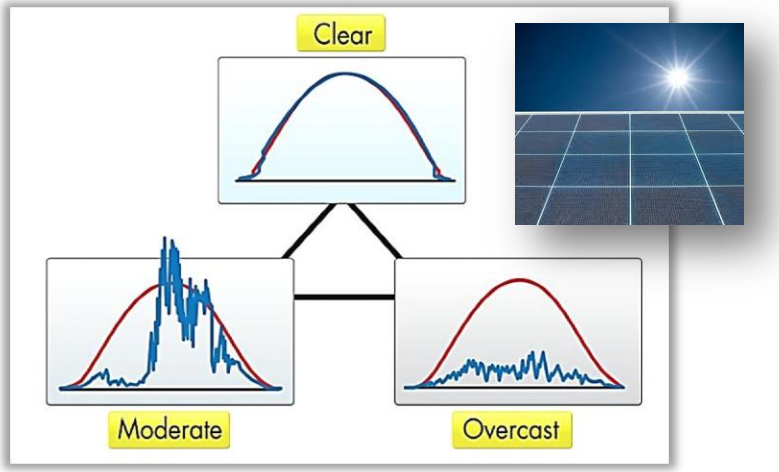
Integrated
Value of DER and Grid



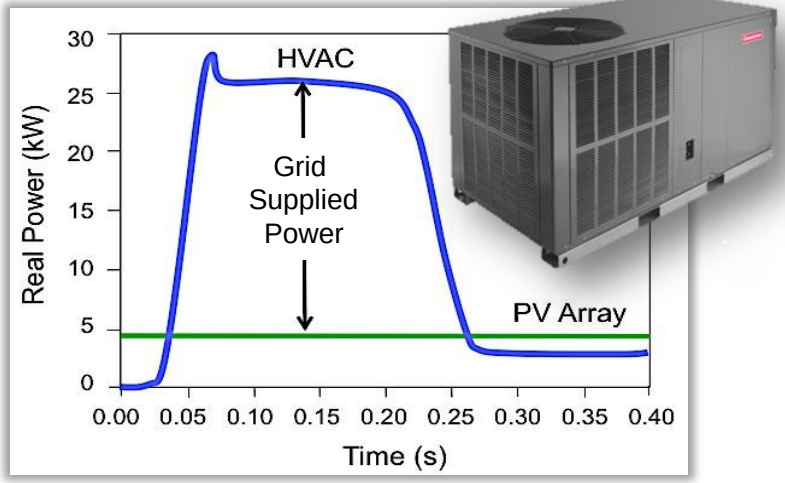
Integration Enables Values of all Resources

Value of Grid Connectivity

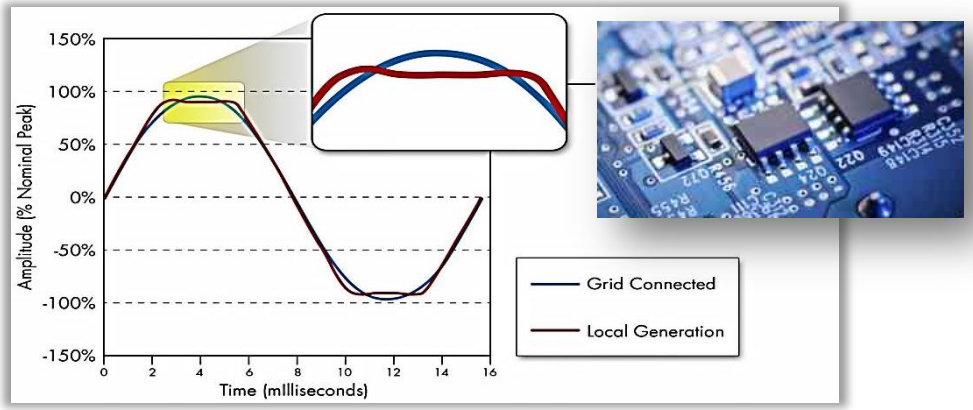
24 by 7 Electricity



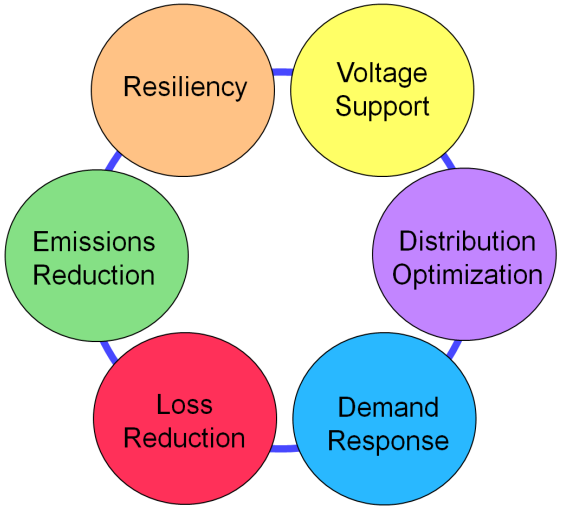
Startup Power

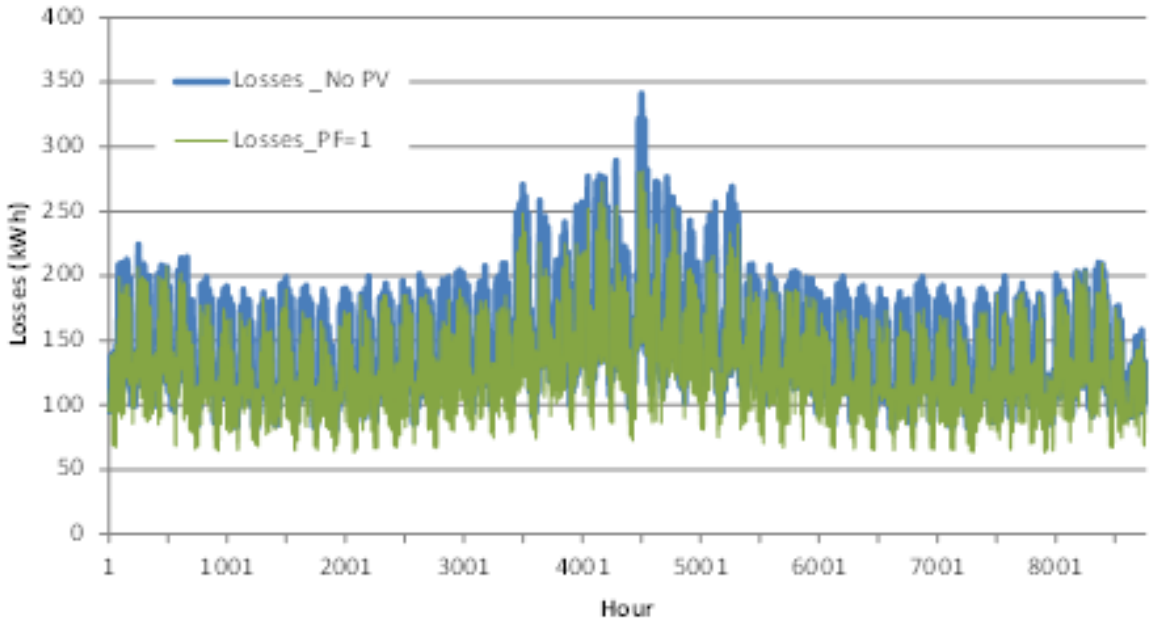


Voltage Quality



Value of Distributed Energy Resources





Scenario	Average Losses*
No PV	4.98%
With PV	4.24%

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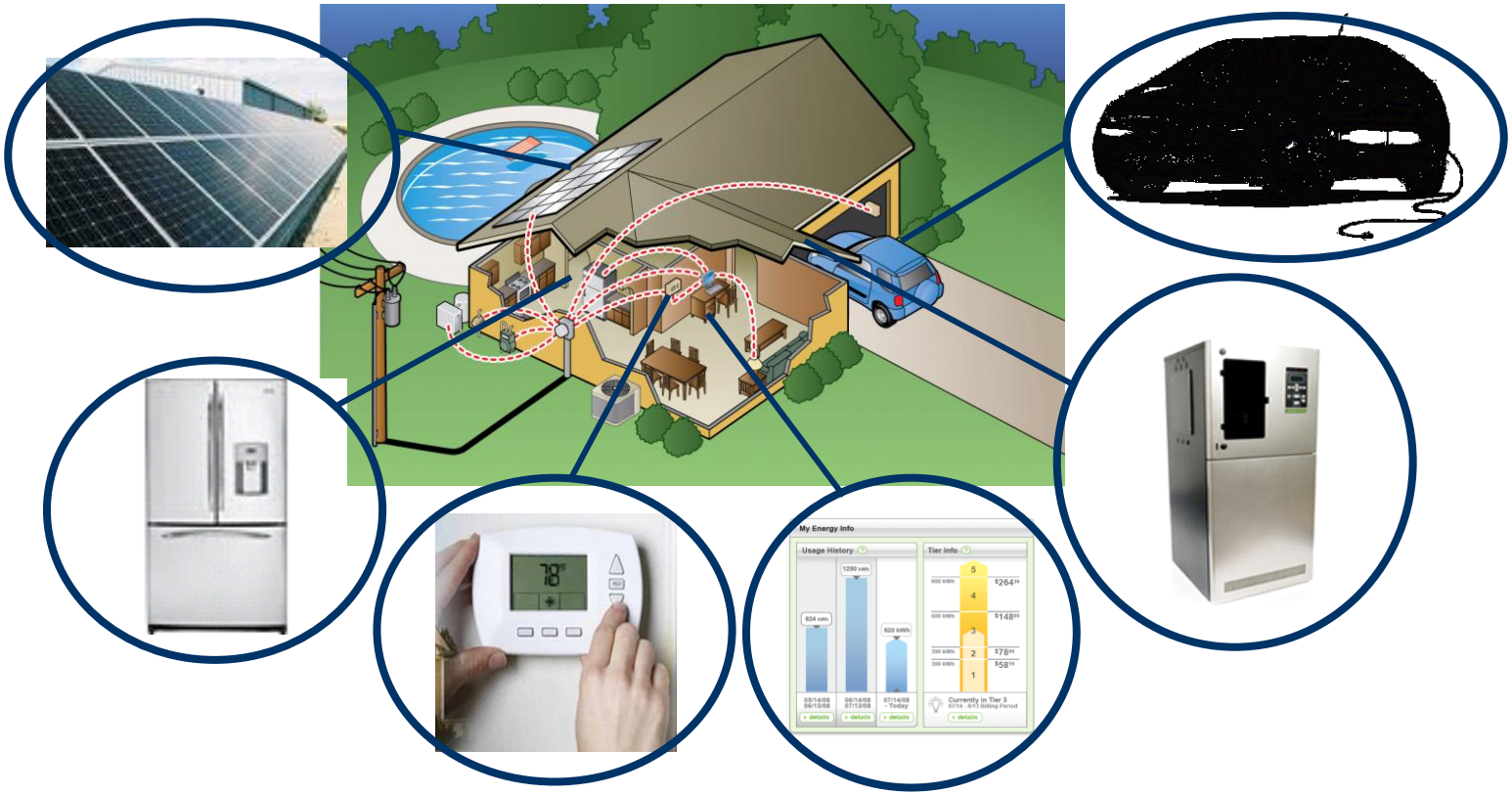
Energy Utilization and Efficiency



The Integrated Grid can enable a closer tie between a customer and the utility

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Renewable Energy and Integration

- Fundamentally changing the strategic landscape
- EPRI has an extensive knowledge base on technology cost, performance and impacts
- The electricity grid must continue to be highly reliable as variable generation technologies achieves high penetration
- High penetration creates the need to understand and minimize environmental impacts

How Might the Grid Evolve?

Grid Defection	Connected, but not Integrated **Where we are today**	Partially Integrated	A Fully Integrated Grid

Policy, Regulation, Markets, Interconnection Rules and Technology will Drive the Transformation of the Grid

Next Steps

3 Key Areas & Research Challenges In Addition to EPRI's Existing Research Portfolio

Benefit/Cost Framework

Interconnection Technical Guidelines

Grid Planning & Operations

Collaboration with All Stakeholders Including Regulatory/Policy

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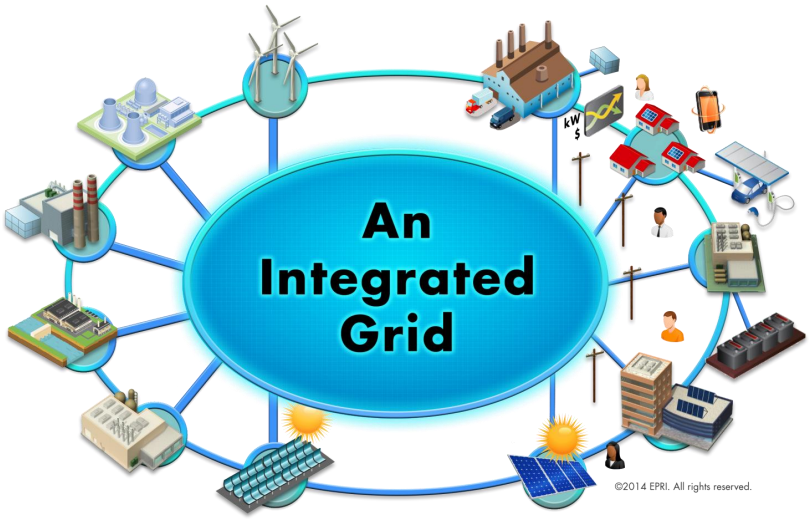
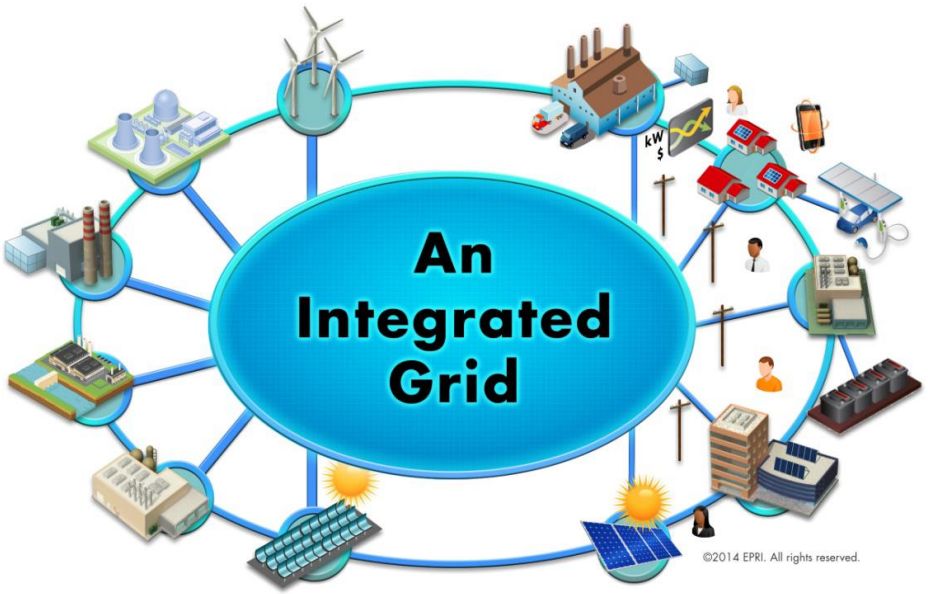
The Integrated Grid

Utilities will play the lead role in designing, building, and operating the grid of the future by:



- Providing the backbone distribution system
- Creating a ‘plug and play’ system capable of 2-way electricity flows
- Facilitating integration of distributed energy resources, including solar PV and storage
- Ensuring grid reliability and power quality

Proposed Pilot Projects…



1. ***Solar PV with Storage***
2. ***Micro-grids***
3. ***Distributed Storage***
4. ***Large Scale PV***
5. ***Electric Vehicle Infrastructure***
6. ***Customer Side Technologies***

EPRI is developing pilot projects around the world

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Together…Shaping the Future of Electricity