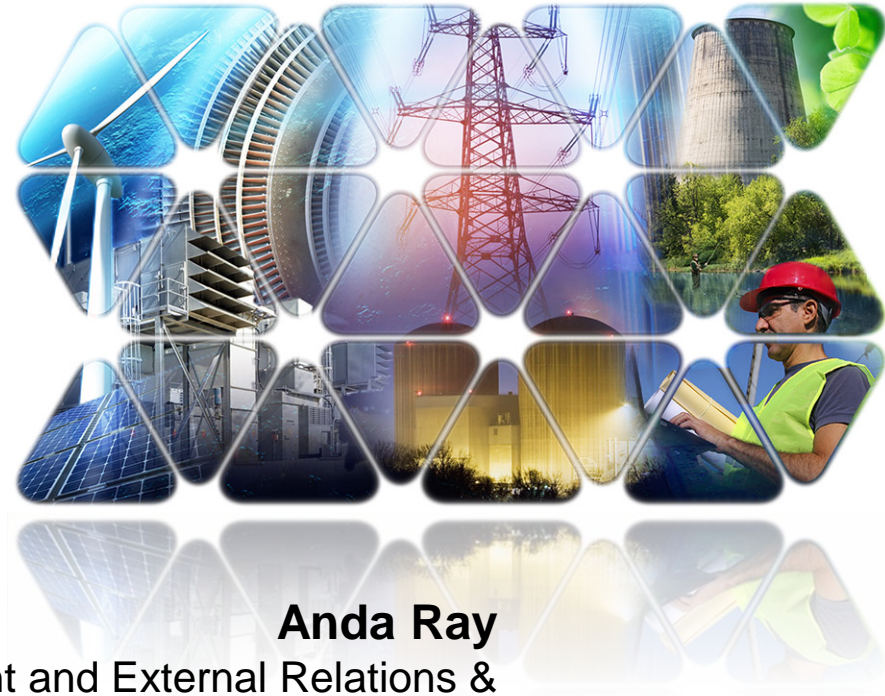


The Integrated Energy Network and Sustainable Energy



Anda Ray
Senior Vice President, Energy, Environment and External Relations &
Chief Sustainability Officer
Electric Power Research Institute

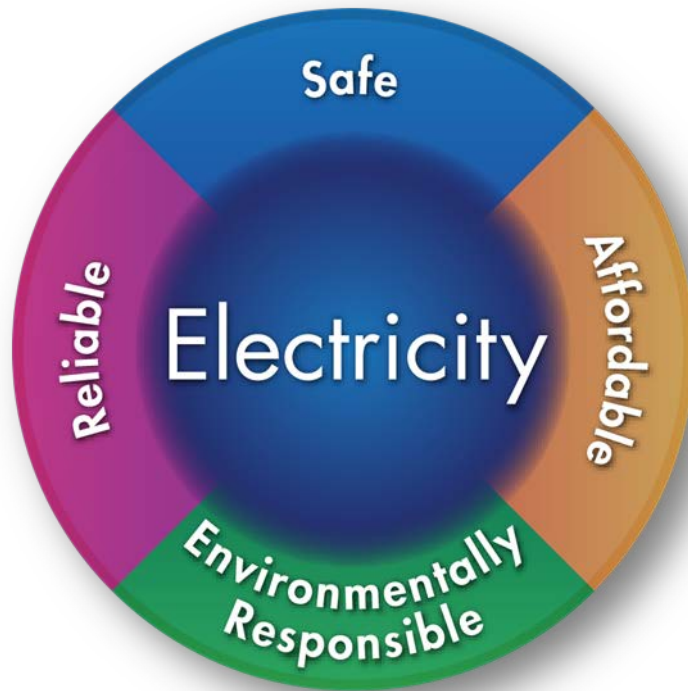
2016 Sustainable Energy Conference

April 2016

Today's Discussion Objectives



- 1. EPRI's Electric Power Research**
- 2. The Integrated Energy Network**
- 3. Defining Sustainable Energy**



■ World-wide Members

- 450+ participants in more than 30 countries
- 90% of the electricity in the United States generated by EPRI members
- 30% of research, development and demonstrations international funding

Spans the Entire Electricity Sector

Generation



Nuclear



Transmission & Grid Operations



Environment



Distribution & End Use



Three Dimensions of EPRI's Value

To provide value to the public, our members, and the electricity sector

Thought Leadership



Industry Expertise



Collaborative Model



Today's Discussion Objectives



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Energy and Emission

- Reducing emission will remain a long-term global issue
- Overall global energy demand will grow – flat/declining in OECD; growth in non-OECD



Efficiency and Renewables

- Energy use and GDP will continue to decouple as efficiency gains across all energy use
- Renewable technology cost will decrease and global penetration level will continue to increase



Customer Expectations

- Choice, control, comfort, and convenience will be primary drivers
- The internet of things will digitally connect every customer with every thing
- Increased dependence on electricity will demand higher reliability and quality and higher energy infrastructure resiliency against physical/cyber/natural disaster



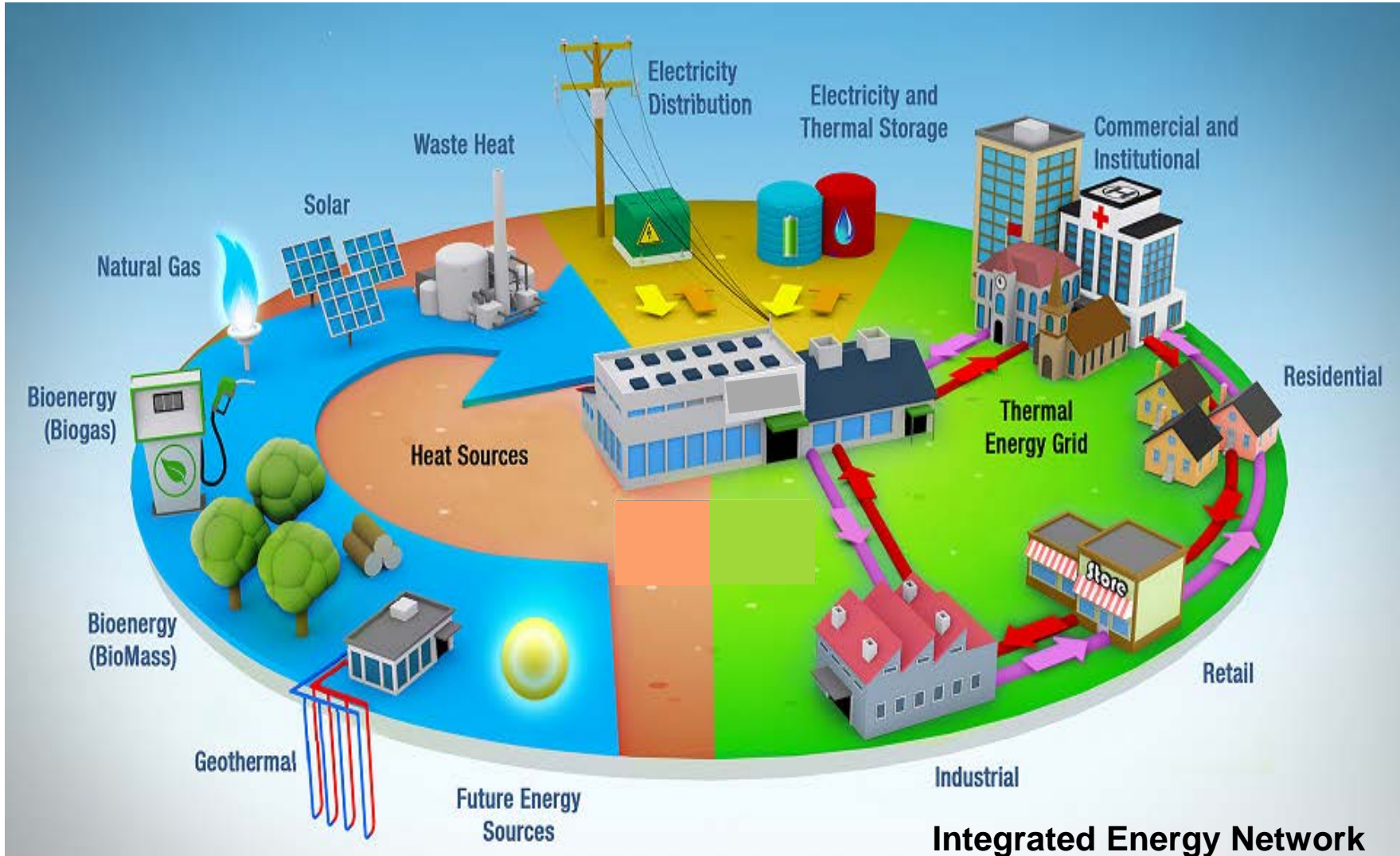
Water

- Increasingly water-constrained future over the long term
- Water energy interfaces will continue to expand

**Black and White Swans...
Expect the Unexpected**



Global Points of View – Leads to a Vision of the Future



Integrated Energy Network: Three Evolving Infrastructures

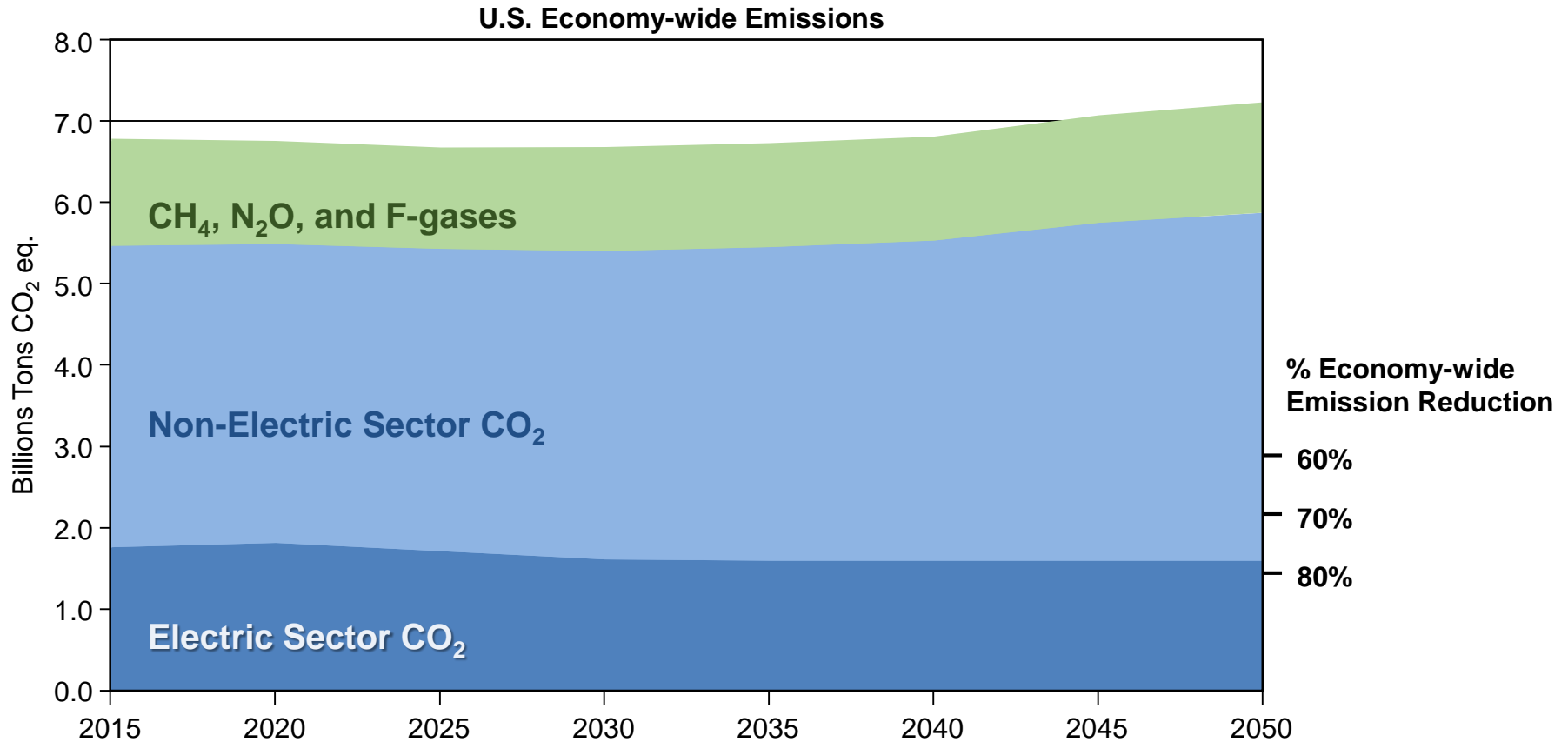


Integrated Energy Network

A Network of Infrastructures that enable the customer to use energy in a way that:

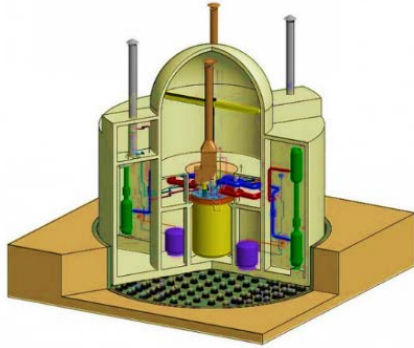
- ***Optimizes:***
- ***Reliability***
- ***Security***
- ***Efficiently***
- ***Increased Economic and Environment Performance***

Clean Electric Sector Enables Economy-wide Emission Reduction



Source: US-REGEN data; Energy Modeling Forum 24

Pathway to Producing Cleaner Energy 2050



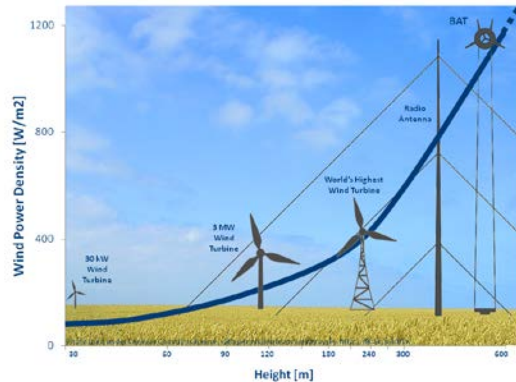
Generation IV Nuclear
(co-production – electricity, hydrogen steam)



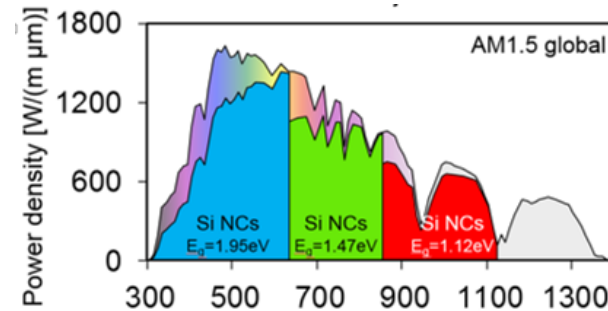
Large-Scale Storage
(e.g., Regenesys Flow Battery)



Coal and Gas Carbon Capture and Sequestration



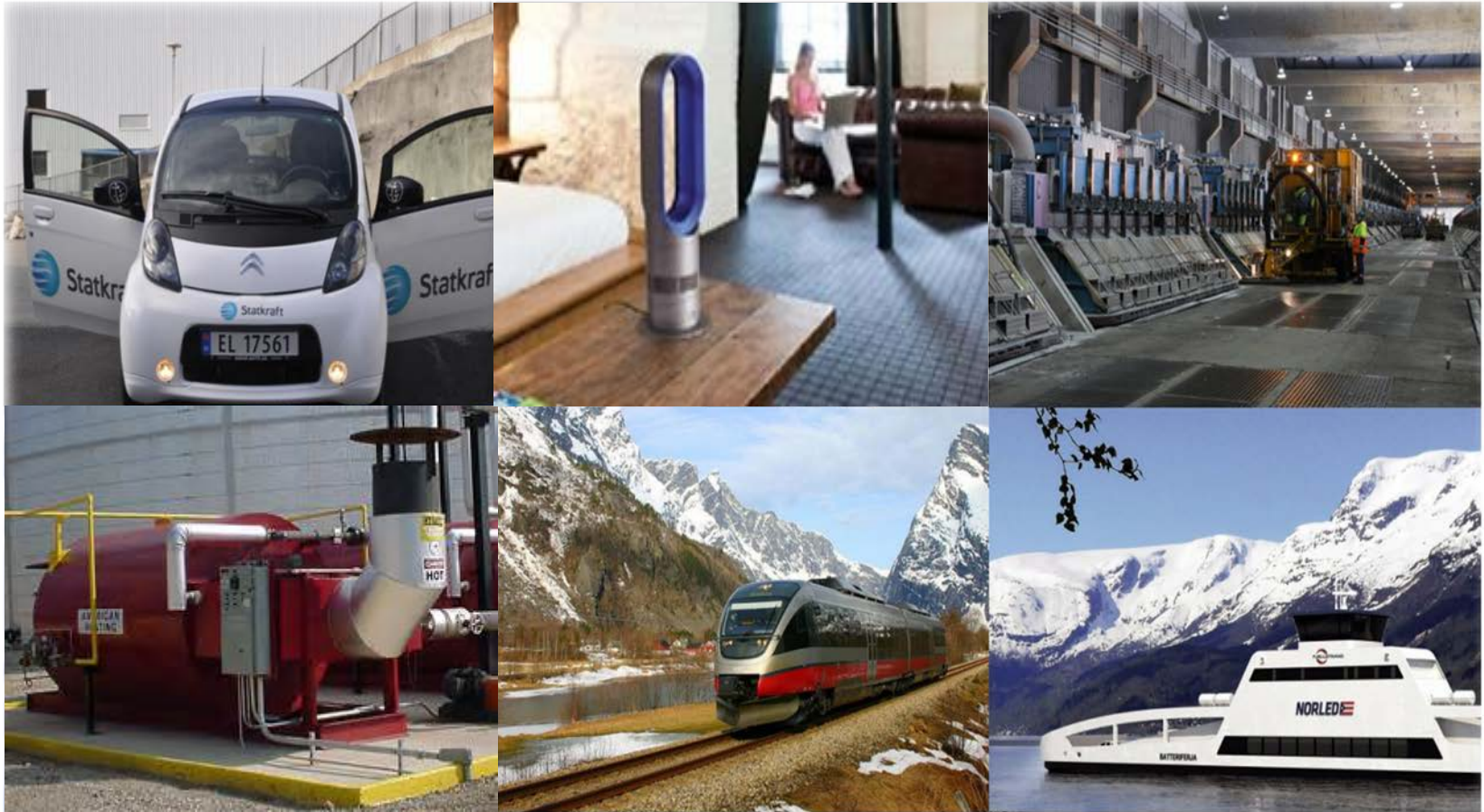
High-Altitude Wind



Gen III Photovoltaic (PV)
(e.g., High power density PV cells)

Source: Carbon Capture Image – htcco2systems.com; Gen IV Image – KAERI

Electrification is the Pathway to Economy-wide CO₂ Reductions



Increasing Interface with Gas and Water Infrastructure



■ Natural Gas and Electricity

- Pipeline and gas compression/electric generation station
- Electric/gas markets
- Power to gas (H_2) and gas to power (fuel cell)

■ Water and Electricity and Energy

- Water for electricity and electricity for water transportation
- Electricity for water treatment, e.g., desalination
- Electrotechnology for reducing water use, e.g., microwave drying

Integrated Energy Network: Three Evolving Infrastructures



Integrated Energy Network

A Network of Infrastructures that connects customers with clean energy production and use

Today's Discussion Objectives



- 1. EPRI's Electric Power Research**
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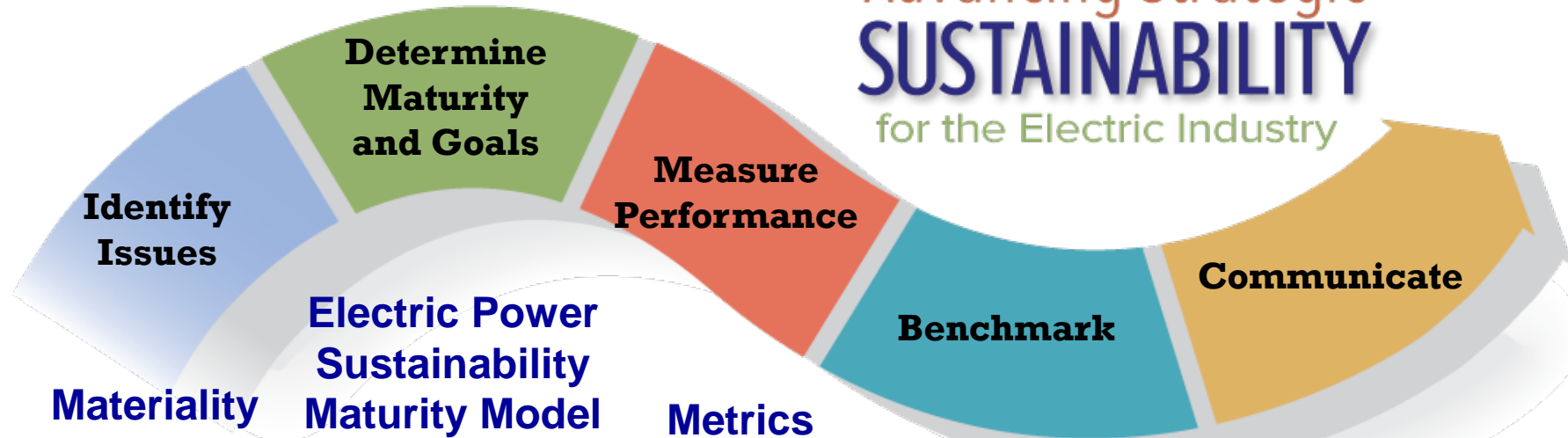
Attributes of the Sustainable Electric System – From the Sustainable Consumers' Perspective



- 1. Sustainable:** It is environmentally, socially, and economically responsible from generation, delivery through to utilization of electricity.
- 2. Functional:** Enables reliable delivery of safe and secure electricity at the quantity and quality desired.
- 3. High Valued Energy Services:** Consumers can manage costs within their means while having the ability to exercise choice and connectivity.

What is EPRI's role?

Advancing Strategic SUSTAINABILITY for the Electric Industry



Materiality Study



Electric Power Sustainability Maturity Model

	GHGs	Affordability	Water Availability	Reliability
5 Achieving economic	<ul style="list-style-type: none"> Strategy is continuously improved and re-integrated Diversifying, innovative solutions to new and future challenges Measured progress of metrics supports sustainability, is achieved Achieving benefits of shared value both internally and externally 			
4 Optimizing for sustainability	<ul style="list-style-type: none"> Strategy is implemented and optimized, as necessary Actions and activities are integrated across the business units Measuring integrated results Realizing net positive benefits of shared value 			
3 Managing shared sustainability	<ul style="list-style-type: none"> Implementation of strategy is well underway Actions and activities are tracked to relevant business units Engaging to address stakeholder needs Integrating specific shared value activities 			
2 Initiating sustainability	<ul style="list-style-type: none"> Developing vision, strategy and setting objectives Assessing and testing positive actions or solutions Establishing metrics for measuring progress Planning for shared value 			
1 Assessment of the issue	<ul style="list-style-type: none"> Acknowledgment that there is an issue (bearing a strategy) Compiling credible actions or solutions Collecting data to understand current performance Considering opportunities for shared value 			

Metrics

Pillar	Material Issue	# of Metrics
Environmental	Greenhouse gas emissions	76
	Reductions of other air emissions	35
	Water quality	24
	Water availability	54
Social	Habitat protection and biodiversity	17
	Waste management	31
	Public safety and health	24
	Employee safety and health	20
Economic	SO ₂ collection	12
	Community support and economic development	20
	Engagement and collaboration	10
	Energy readiness	11
	Energy affordability	2
	Skilled workforce availability	8
	Economic vitality of electric utilities	32
	TOTAL	648

Sustainability Benchmarking for Utilities

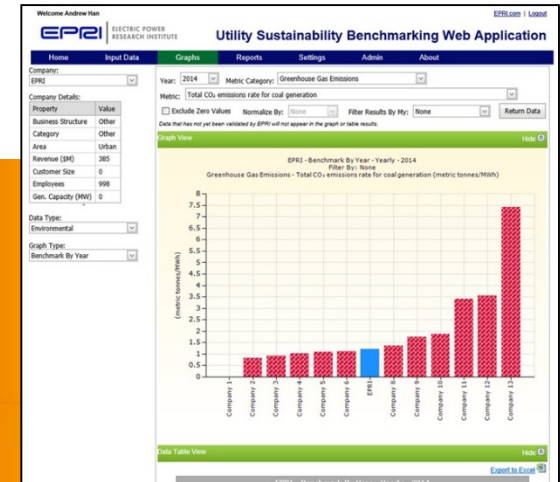
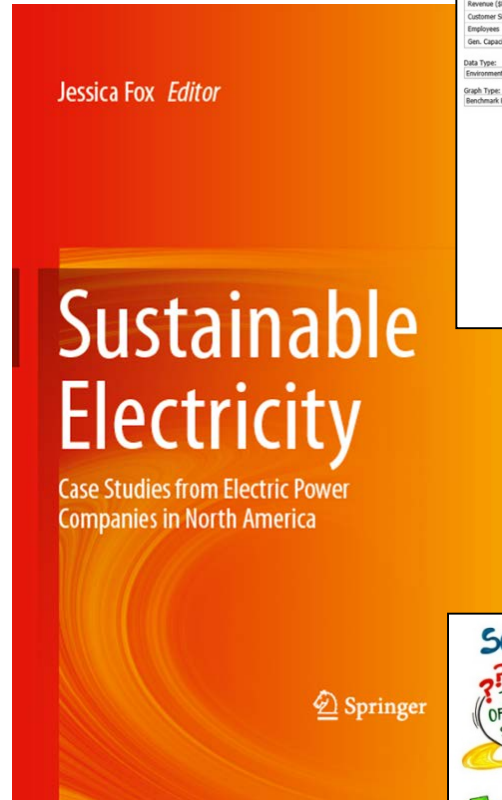


Energy Sustainability Interest Group (ESIG)



The Next Decade of Sustainability Science

- Advancing a multi-stakeholder “shared understanding.”
- Defining “sustainable electricity/energy” via models, tools, metrics, and communication.
- Forecasting future position through development of leading metrics and decision making tools.



What can Utility Officers do?

Roles of Company Officers

CEO

Explain that sustainability is a key mega-trend of the 21st century that will profoundly affect the business

CFO

Explain the financial benefit of sustainability initiatives

HR + Unions

Explain how sustainability affects employee satisfaction and workplace attractiveness

Marketing and Sales

Explain how sustainability affects customer and consumer brand perception, trust and loyalty

Operations

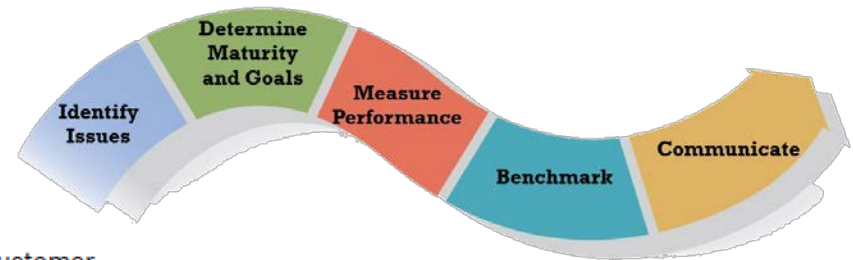
Explain how sustainability can improve efficiency and resource productivity, and reduce business risks

Business Manager

Explain how sustainability will affect profit and loss, and how sustainability performance is seen by CEO

Commun. and Gov't Affairs

Explain the company's sustainability efforts in relevant terms to the public, regulators, policy makers and employees



Get clarity on roles and commitment –

Then identify the important issues, determine maturity level and define goals

2016 Energy Sustainability Interest Group



Business Drivers for Corporate Sustainability

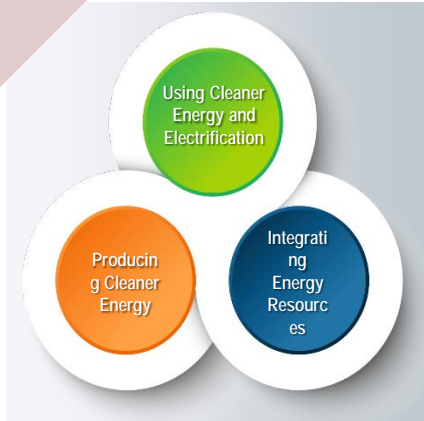
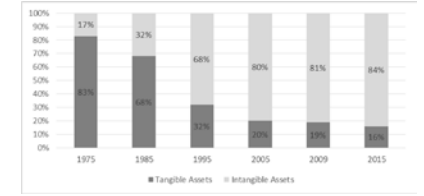


Enhances Market and Financial Performance

Improves Business Reputation

Reduces Costs & Enhances Employee Engagement

Fosters Innovation





Together...Shaping the Future of Electricity