ENERGY & CONTSTRUCTION BEST PRACTICES SUMMIT

Energizing America's Workforce for Tomorrow

Lighting the Way to a Smarter Grid

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June 21, 2012

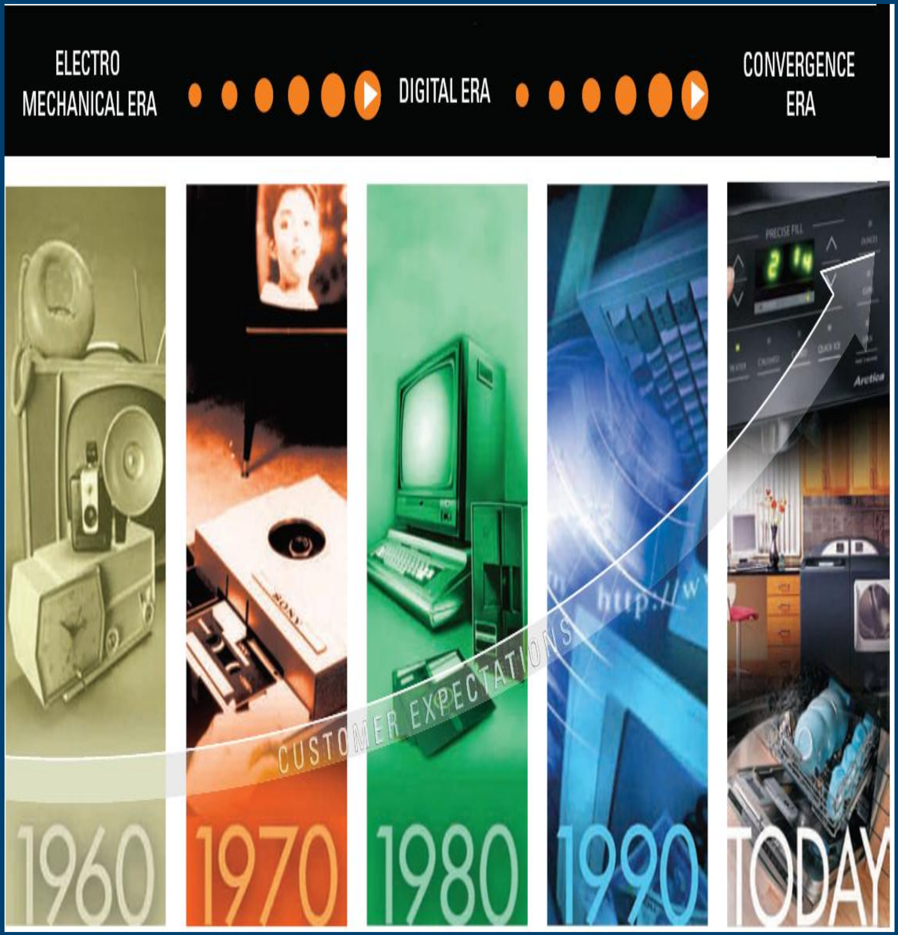
Overview

- Electric demand and need for power
- Major investment in US and globally
- Smart grid realities
- Business is changing
- Significant workforce attrition
- IEEE PES Scholarship Plus to attract the best
- Managing the workforce transition

Electricity Demand is Increasing

Recognizing the Need for Power

- Consumer electronics represent the largest single use for domestic electricity
- Computers and gadgets will account for 45% of electricity used in the home by 2020
- Increases demand for near-perfect power quality and uninterrupted power availability

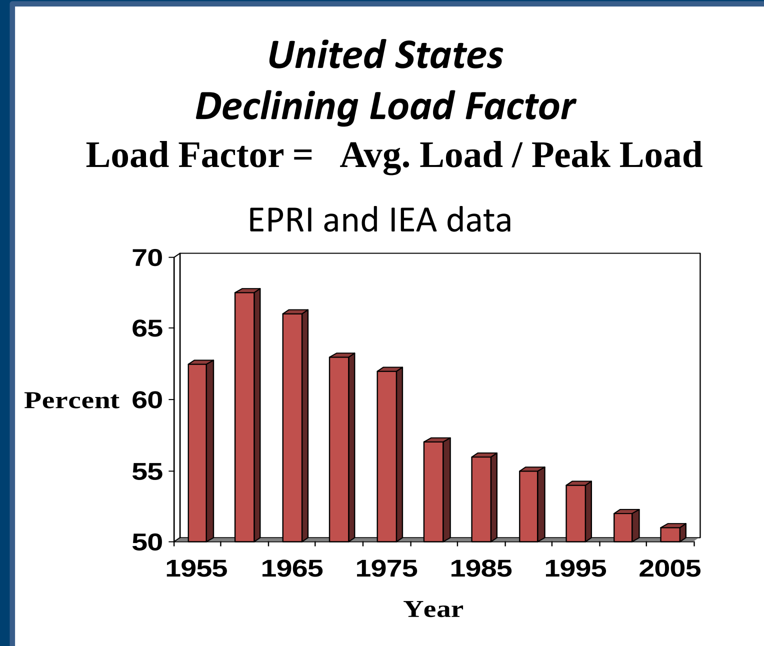


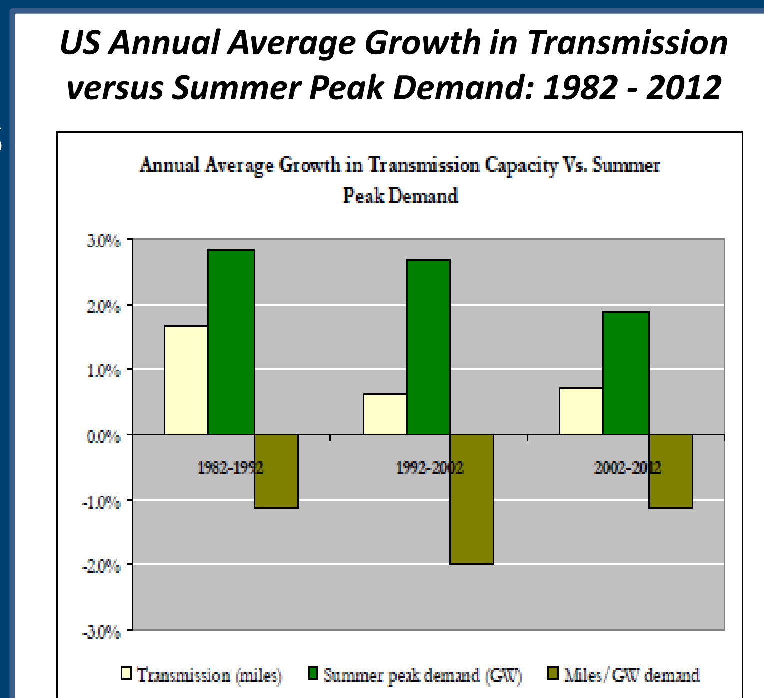
Sources: "The Ampere Strikes Back: How Consumer Electronics Are Taking Over The World," Energy Saving Trust, June 2007; "The Rise of The Machines: A Review of Energy Using Products In The Home From The 1970s to Today" Energy Saving Trust, June 2006; "Electric Power – The Next Generation: The Intelligent Grid," Center Point Energy, April 2007

And, the Response

- Declining load factor
- Assets are aging
- Investment lags peak growth
  - Peak conditions < 1% of time
  - Operating risk, vulnerability
- R&D spending is limited
- US outages up over last 15 years

- Grid modernization is inevitable
- Need to invest “intelligently”

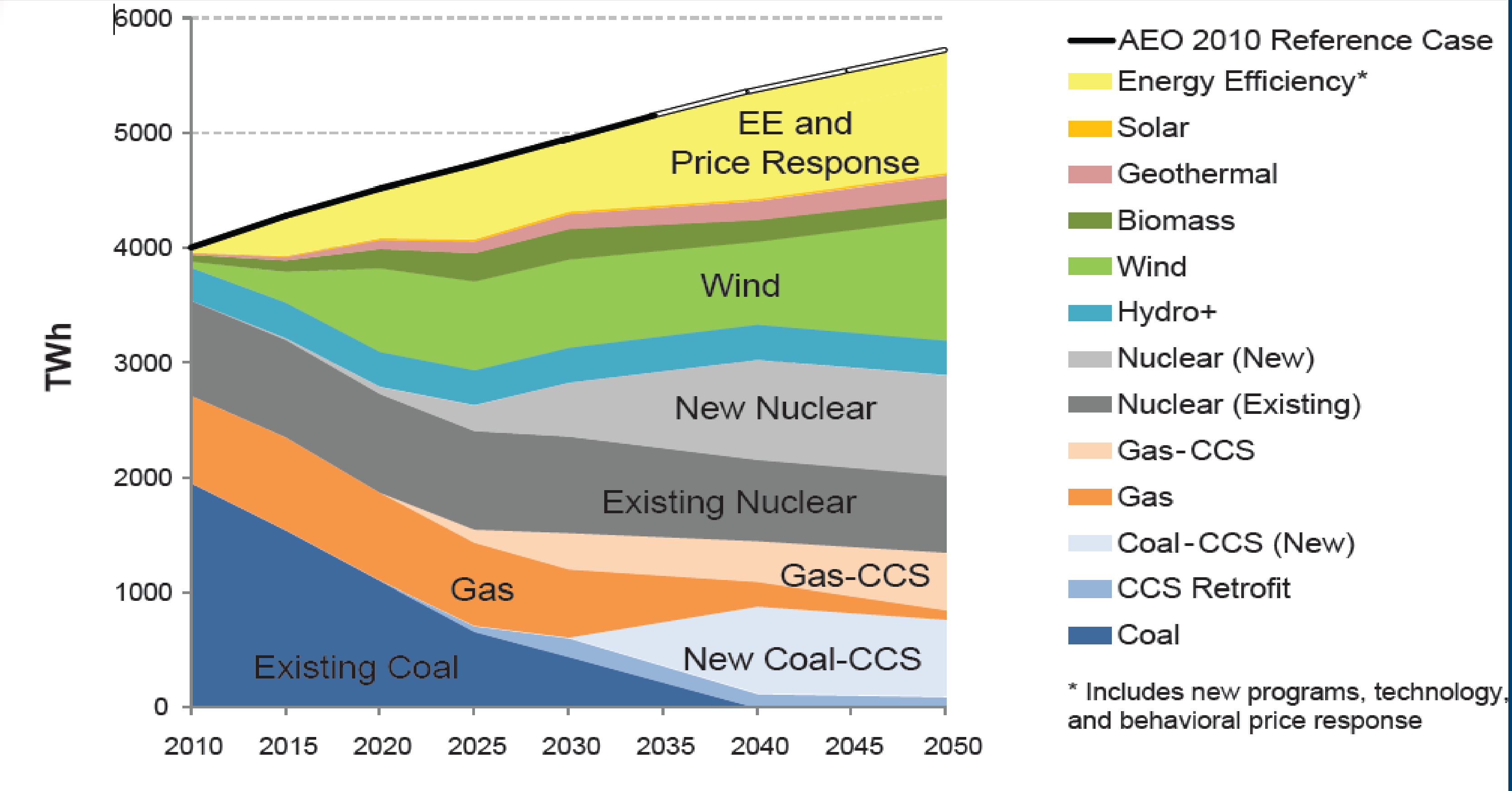




United States Generation Trend

EIA 2011 Annual Energy Outlook: 2010 - 2050

Broadening portfolio of ways of meeting the need



Preliminary Insights from EPRI’s Regional Model." August 2, 2010.

Changing Power & Energy World

Growing Population, More Electronics

Rising Cost of Energy

Increasing Environmental Requirements

Escalating Security Concerns

Heightened Investor Demands

Driving Technology:

- Carbon Management
- Electric Transportation
- Sustainability
- Distributed Sources
- Efficiency
- Modernization
- Reliability

The Opportunity

- **36.8% -** Projected growth global energy demand by 2030
- **170 Billion kWh -** Wasted each year by consumers due to insufficient power usage information
- **25% -** Worldwide CO_2 emissions from power generation

↓

- **15% Reduction in peak loads –** Projects have shown consumers peak load can be reduced by 15%, saving 10% in electricity bills
- **$70 Billion -** The U.S. could save in infrastructure spending over the next 20 years through better management of existing assets
- **14% Lower emissions -** Smart Grid technology as the potential to reduce power sector's CO_2 emissions 14% by 2020

Source: IBM, "Plugging In the Consumer"

Major Investment is Anticipated

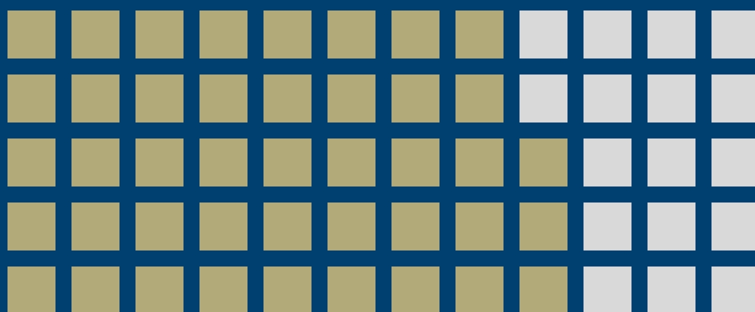
Adoption Rate Factors:

- Economy
- Policy
- Technology
- Consumer Acceptance
- Reliability Needs

SGIG Spending

$7.9 billion with cost share to be spent through 2015

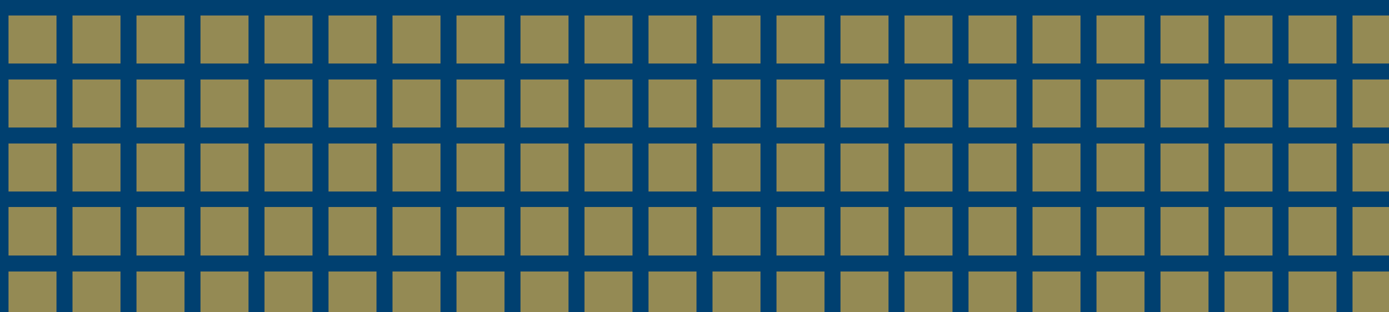
EPRI Estimate



$338 - $476 billion needed through 2030

EPRI. Estimating the costs and benefits of the smart grid: A preliminary estimate of the investment requirements and the resultant benefits of a fully functioning smart grid. EPRI, Palo Alto, CA; 2011.

Brattle Group Estimate



$880 billion needed through 2030

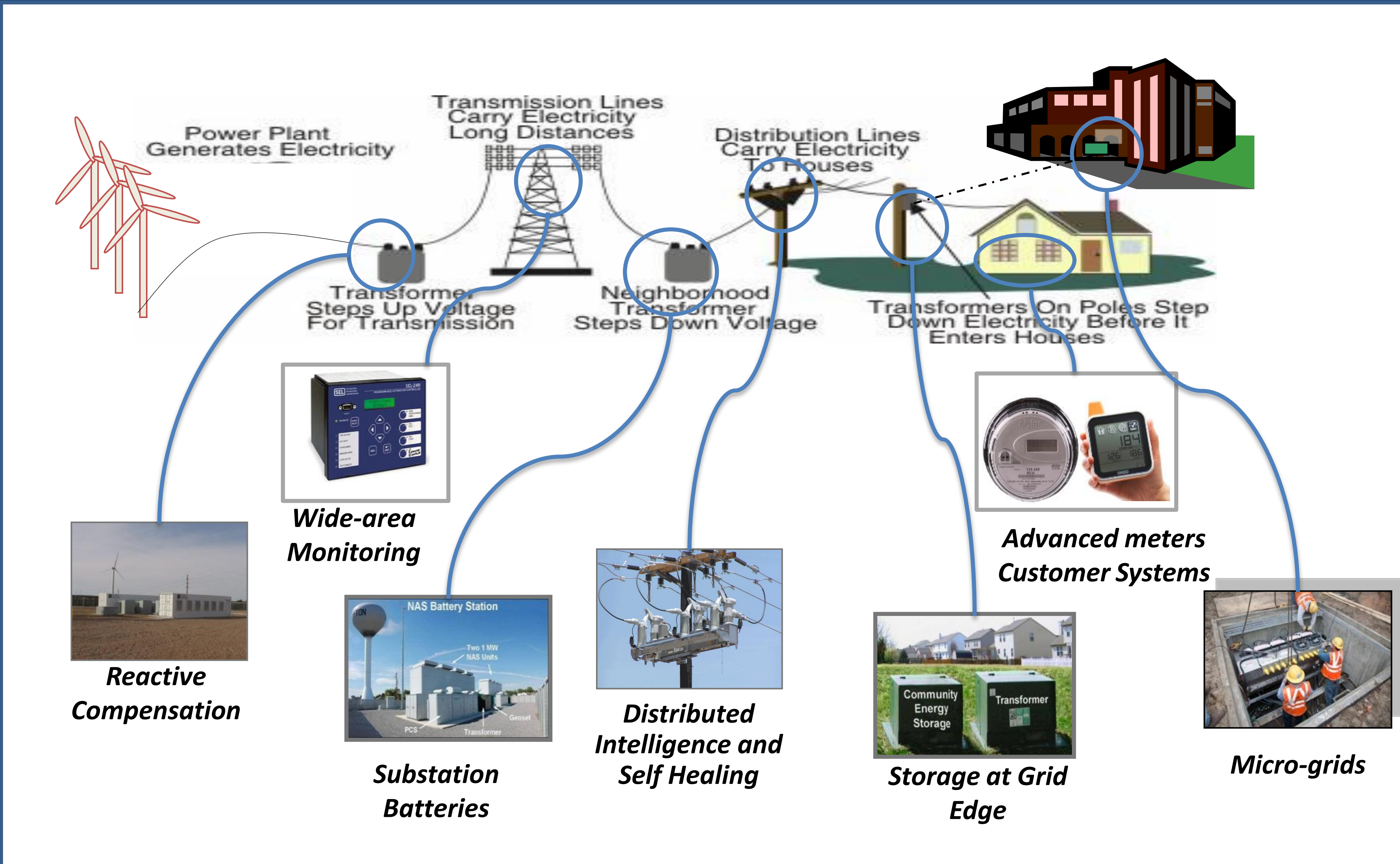
Chupka, M.W. Earle, R., Fox-Penner, P., Hledik, R. Transforming America's power industry: The investment challenge 2010 – 2030. Edison Electric Institute, Washington D.C.,: 2008.

Graphics adapted from a US DOE Office of Electricity Presentation on ARRA Smart Grid Projects

Smart Grid Around the Globe

United States	South Korea
• Investing ~$7 Billion	• Investing nearly $1 Billion
• Standards framework in development	• $65M pilot for 6000 homes on Jeju island. Nationwide deployment by 2030
China	Brazil
• Investing $7.3 billion; will spend $96 billion by 2020	• Forecasting 60% growth in electricity consumption between 2007 and 2017
• Energy needs double by 2020	• 16-34% increase in renewables
• Will account for 18.2% of the global smart grid appliance spending by 2015	

Smart Grid Realities



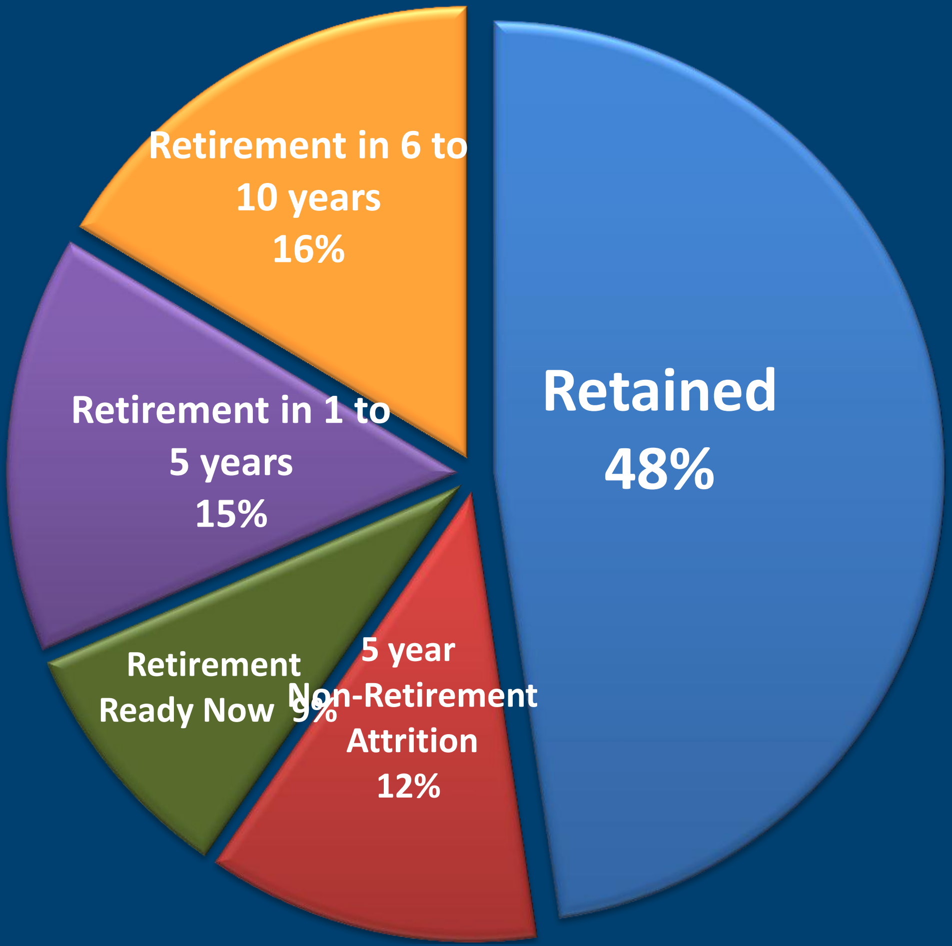
Graphics adapted from an EPRI Presentation


Efficient
Building
Systems
Utility
Communications
Renewables
Internet
PV
Consumer Portal
& Building EMS
Advanced
Metering
Control
Interface
Dynamic
Systems
Control
Distribution
Operations
Plug-In Hybrids
Smart
End-Use
Devices
Distributed
Generation
& Storage
Data
Management

Business is Changing

Our Past	Our Future
Regulated business models	Emerging “customer choice”
Large generation stations	Distributed & green resources
Centralized dispatch	Distributed intelligence
Minimal constraints	Pressures for “green power”
Outages “tolerated“	Less tolerance of outages
Grid “over designed”	Infrastructure exhausted
Radial distribution	Looped or meshed distribution
Homogeneous technology	Mixing old with new
Slow distribution operations	Near real-time micro-grids
Uni-directional power flow	Multi-directional power flow

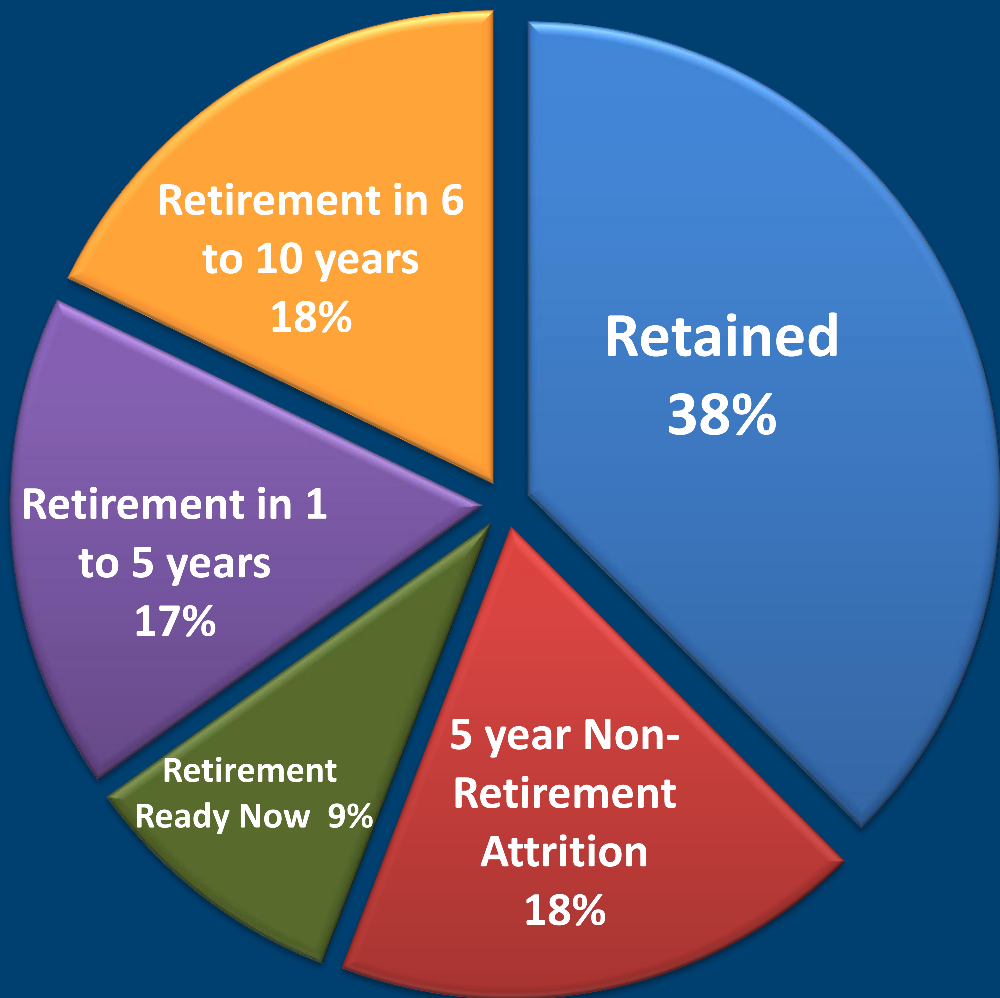
Retirement and Non-Retirement Attrition



52 % of skilled technicians and engineers may need to be replaced in the next 10 years

[Gaps in the Energy Workforce Pipeline: 2011 CEWD Survey Results]

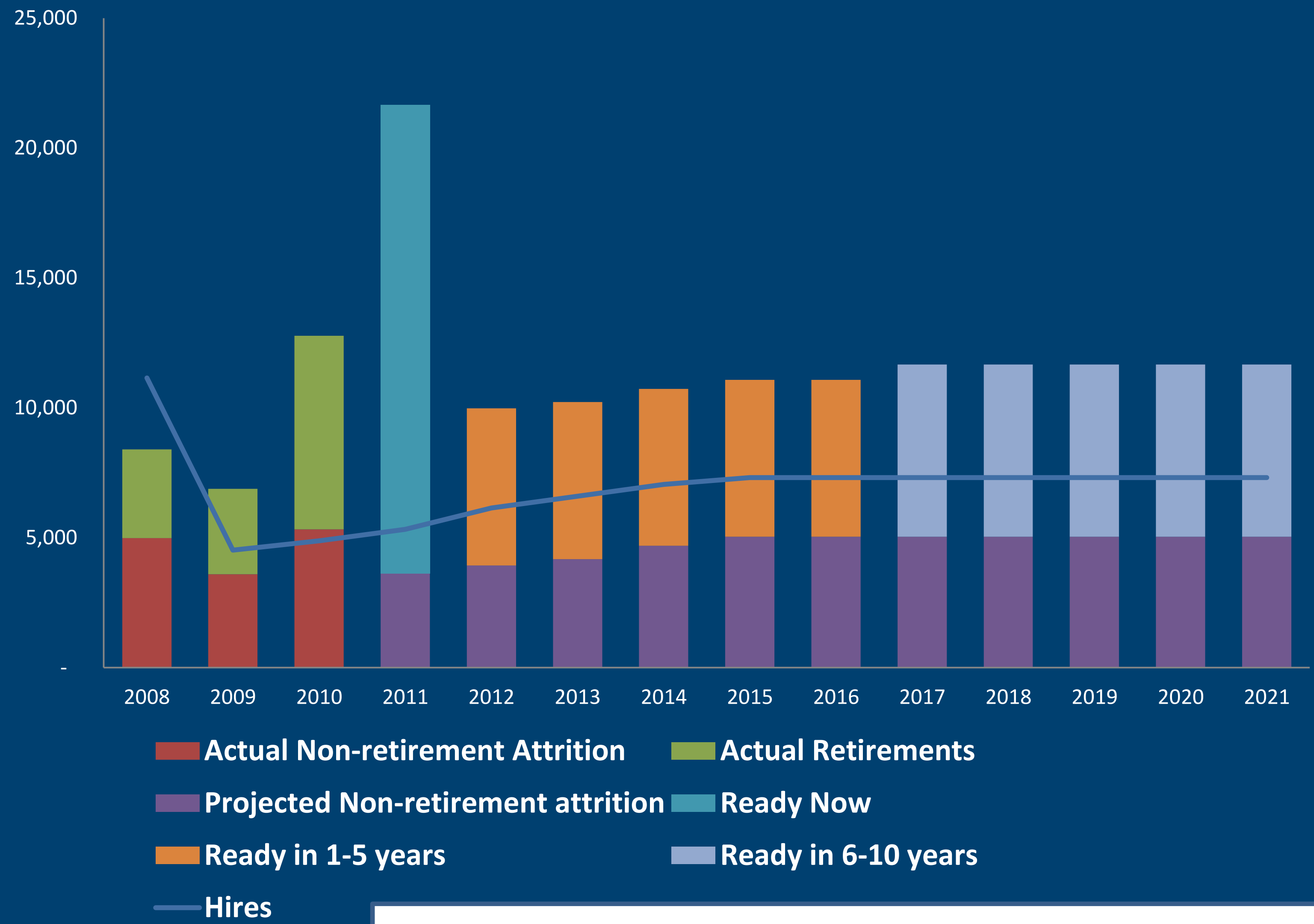
Total Industry Potential Replacement Impact on Retirement and Non-Retirement Attrition



62 % of the workforce may need replaced in 10 years

[Gaps in the Energy Workforce Pipeline: 2011 CEWD Survey Results]

Key Jobs Retirement Projections Based on Age and Years of Service



Gaps in the Energy Workforce Pipeline: 2011 CEWD Survey Results

Potential Replacements for Key Jobs

	Potential Replacements 2010 - 2015		Potential Replacements 2015 - 2020	
Job Category	Potential Attrition & Retirement	Estimated Number of Replacements	Potential Retirement	Estimated Number of Replacements
Lineworkers	32%	22,100	15%	10,300
Technicians	39%	28,500	19%	13,500
Plant Operators	37%	12,400	17%	5,800
Engineers	38%	10,600	15%	4,100
Total	**36%**	**73,600**	**16%**	**33,700**

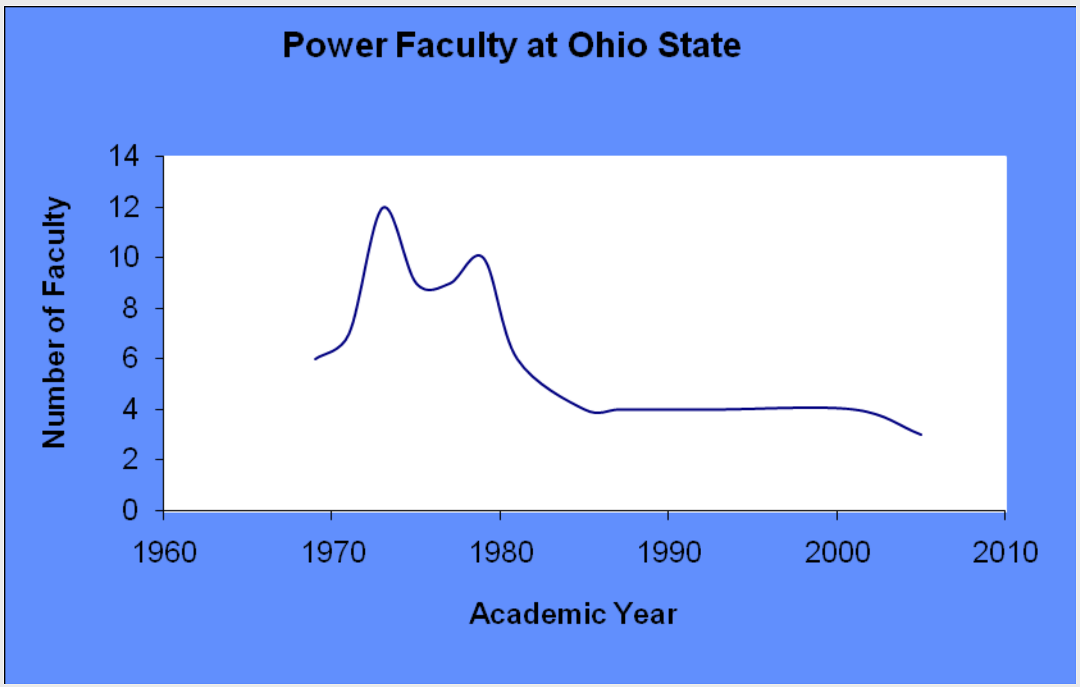
Gaps in the Energy Workforce Pipeline: 2011 CEWD Survey Results Center for Energy Workforce Development. Based on 535,000 est. of employees in electric utilities and integrated electric and gas utilities. Due to delayed retirement plans, the Task Force on America's Energy Jobs postulated a "silver tsunami" may occur when retirements actually occur.

The Education Dilemma

- Undergraduate specialization is becoming less prevalent
  - More power electives are needed
  - The average age of faculty is increasing
  - Funds are limited for recruiting new faculty
  - The reduction in elective credit hours further challenges ability to graduate with a power emphasis
- A need for more:
  - “Power” faculty for teaching and research
  - Frequent monitoring of academic supply and demand

Power Systems Engineering Programs

- Weakening programs: Of 48 university programs surveyed in 1987/8 and 2005/6, 50% declined and 15% grew in number of major faculty members.
- Former strong programs declining or ending



<u>Power Engineering Faculty</u>

Carnegie Mellon University:
1975: 8 faculty; 2007: 1

Cornell University:
1975: 7 faculty; 2007: 1

University of Michigan*:
1971: 5 faculty; 2007: 0

UC Berkeley:
1971: 4 faculty; 2007: 1

Univ. of Missouri-Columbia:
1975: 8 faculty; 2007: 0

* Recent decision to rebuild program

Source: IEEE Power Engineering Education Committee Survey Results for Various Academic Years.

IEEE Power and Energy Engineering Workforce Collaborative

1. Double the number of power graduates

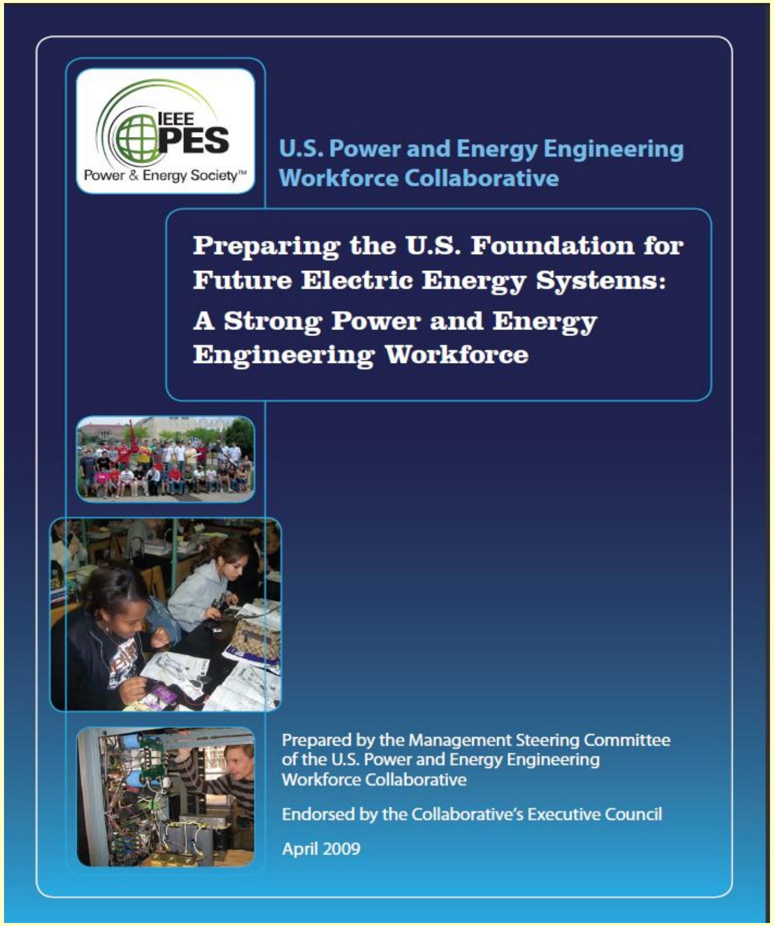
2. Provide $4 million undergraduate power engineering scholarships

3. Create 2,000 internship opportunities

4. Hire 80 new power faculty members in the US over the next five years

5. Raise annual university research funding to $50 million per year

6. Create five University Centers of Excellence to conduct power research and education



In easy-to-reference lists, the report outlines specific steps needed to meet these goals.

www.ieee-pes.org/workforce/workforce-collaborative

Published April, 2009

IEEE PES Scholarship Plus Initiative ™

- Scholarship: $2000, $2000 and $3000 in year 1, 2 and 3
- Up to two years of career experience
- For US citizen or permanent residents with one year of completed undergraduate study
- Attending ABET accredited school with undergraduate power classes

IEEE

IEEE Power & Energy Society
SCHOLARSHIP PLUS INITIATIVE™
Preparing the Next Generation of Power & Energy Engineers

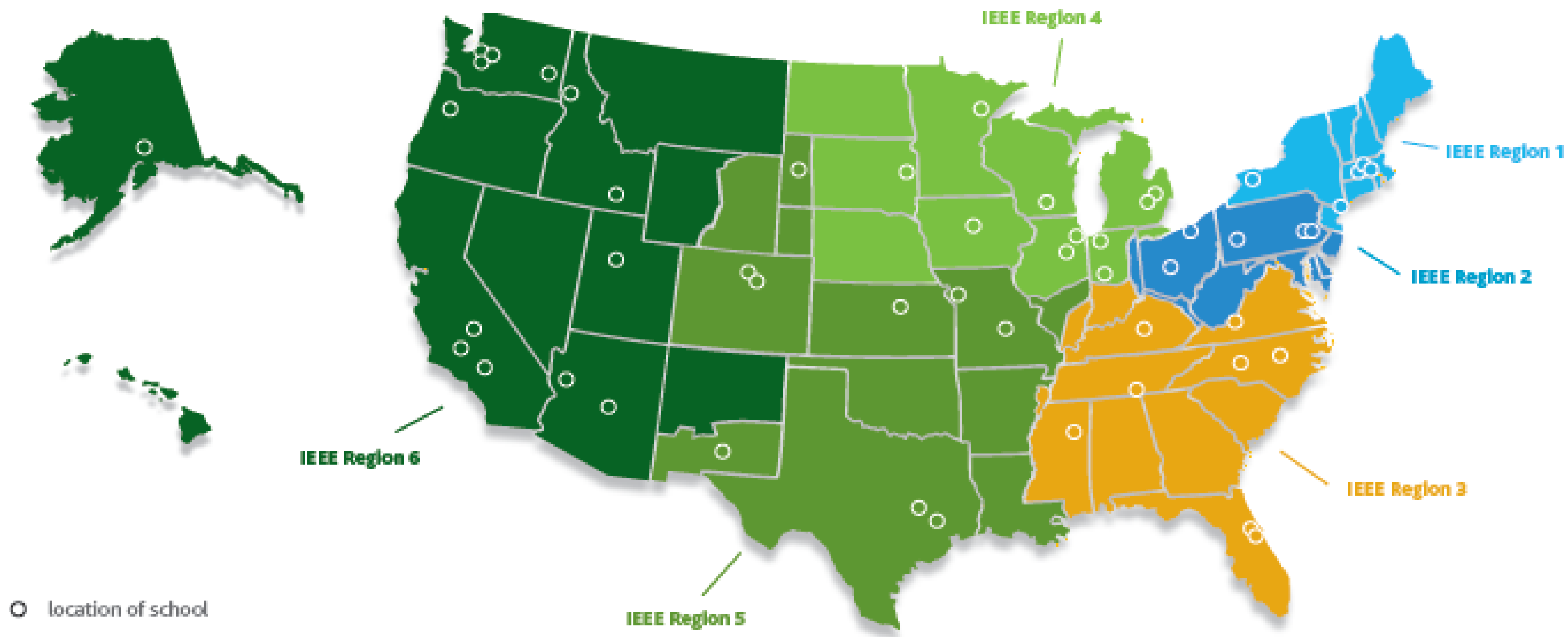
Awarded scholarships to 93 undergraduate students at 51 universities across the U.S. in 2011

Online application:

- www.ee-scholarship.org

PES SCHOLARSHIPS AWARDED 2011-2012

IEEE Region 1	IEEE Region 2	IEEE Region 3	IEEE Region 4	IEEE Region 5	IEEE Region 6
12 Scholarships Awarded	12 Scholarships Awarded	18 Scholarships Awarded	18 Scholarships Awarded	13 Scholarships Awarded	20 Scholarships Awarded
5 Schools	5 Schools	8 Schools	10 Schools	9 Schools	14 Schools



Total national percentage: 77% Male Students 23% Female Students

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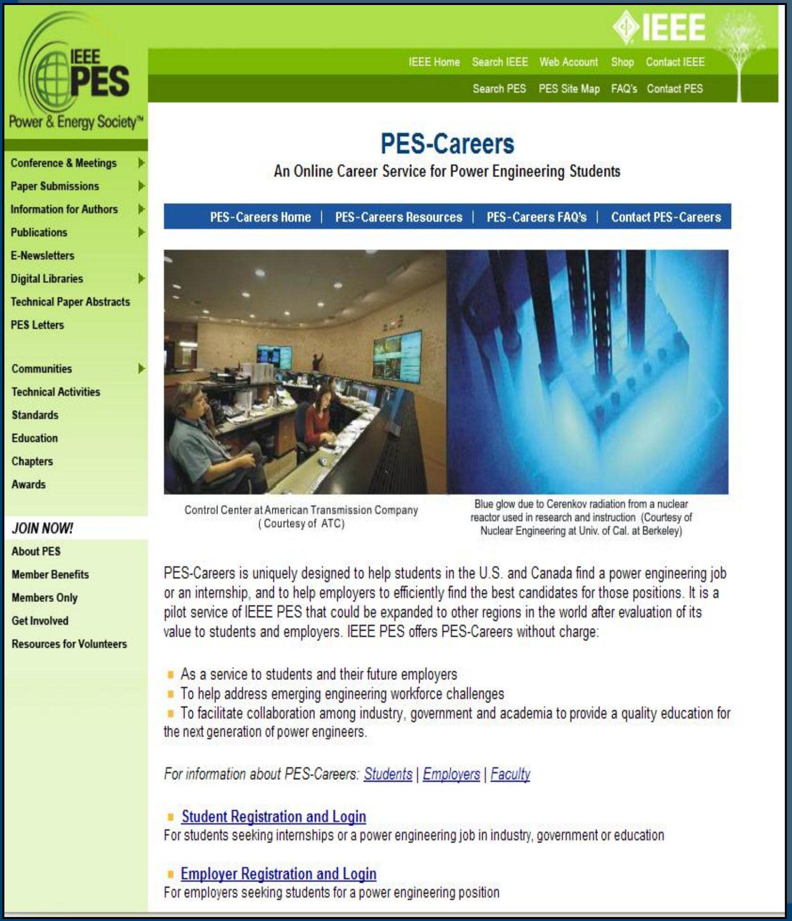
Career Experience

- Required for renewal
- Can be arranged by awardee or through PES-Careers platform
- PES-Careers is an online resource with subscribers
  - Students us it up to one year after graduation
  - Employers post employment opportunities and provide mentors
  - It's free!



www.ieee-pes.org/workforce/pes-careers

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PES Scholars

"This scholarship has helped me feel empowered by having more resources available to me to seek experience through internships, and comforted me by lessening my educational costs. Being a PES Scholar makes me feel "chosen" to enter the power and energy field."

"Being a PES Scholar has deepened my dedication to my chosen career. It got me even more interested and excited about being a power engineer."

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Financial Support

Thank You For Your Generous Support!

You have made the IEEE PES Scholarship Plus Initiative™ possible.

Presidential Level

S&C SEL

Gold Level

The Grainger Foundation

Silver Level

ALSTOM doble

Mentorship Level

COOPER   Southern California EDISON (An EDISON INTERNATIONAL® Company)   ISO new england

Regional Level

Autodesk   PSEG   Ulteig   Westinghouse

Scholar Level

MidAmerican Energy Foundation   NSTAR   pjm

Friend of PES Scholarship Plus Initiative

GE Foundation

John W. Estey, Chief Executive Officer - *S&C Electric Company*
Wanda Reder, Chairwoman - *IEEE PES Scholarship Plus Initiative*
Jackie Peer, Regional Sales and Service Director - *SEL*

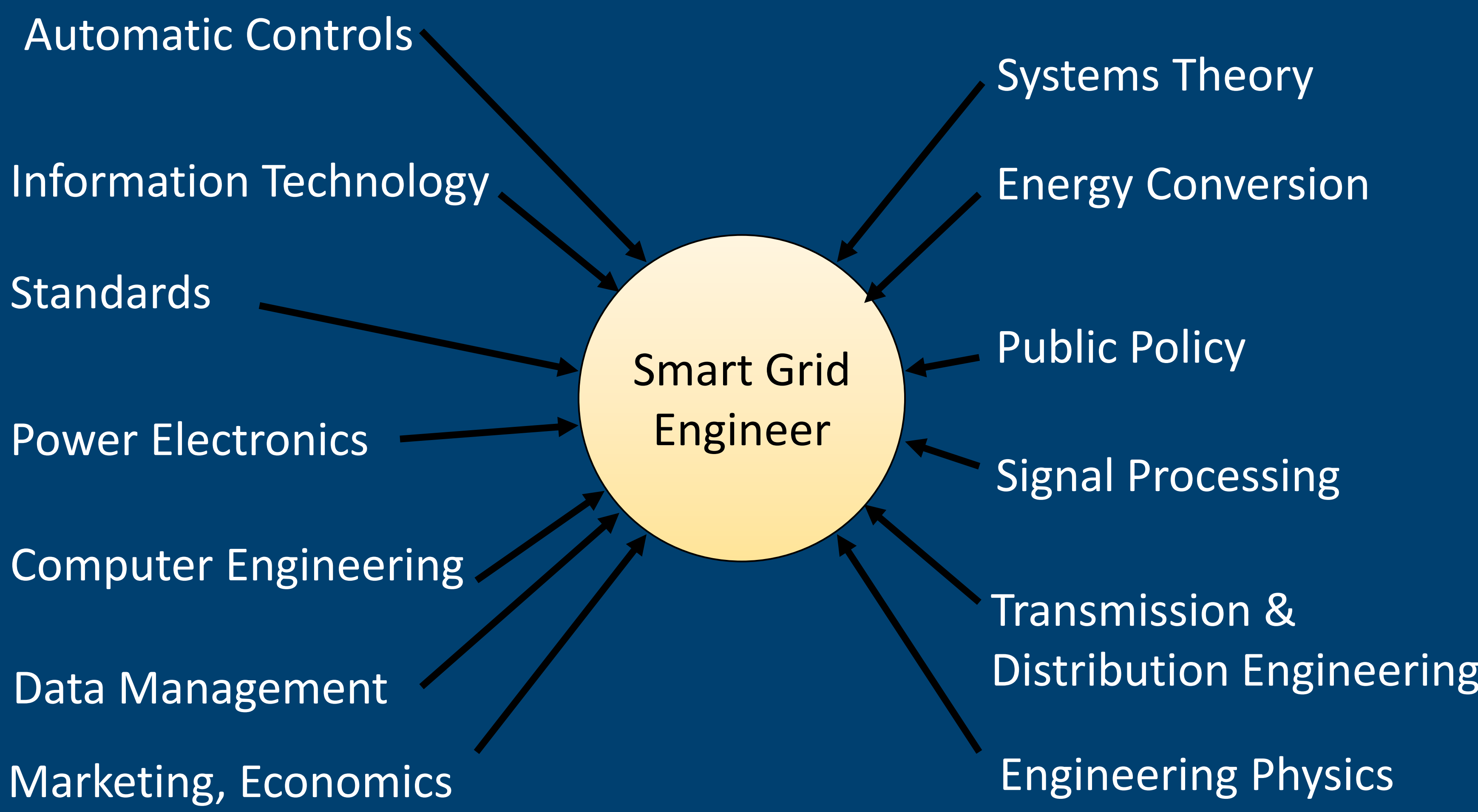
Transitioning the Workforce

- Requires succession planning
  - Tribal knowledge is associated with legacy systems
  - Knowledge transfer in anticipation of attrition
  - Technologies require new competencies, processes,
- Broad implications:
  - Recruitment, retention
  - Knowledge transfer
  - Training and development
  - Increased diversity

Workforce Strategy Matrix

	Legacy Assets	New Assets
New Employees	*Mentorship*	*Curriculum Development*
Existing Employees	*Knowledge Transfer*	*Employee Development*

Smart Grid is Multi-Disciplinary



Source: Professional Resources to Implement the "Smart Grid"
Gerald T. Heydt and others
2009 IEEE Power & Energy Society General Meeting

The New Leader is a Coach

Leader As Coach

- More Ideas - Faster
- Buy-in for Change
- Employee Development
- Results-oriented Teams

Leader As Commander

- New Ideas Limited to Low Hanging Fruit
- Change Met with Resistance
- Compliance Mentality

– Ask for future suggestions
– Listen without judging
– Think before reacting
– Be thankful for ideas, respond positively
– Involve people in the change process
– Follow-up to ensure long-term results
– Establish results-oriented teams and disband

Workforce Diversity for Change

- Embrace it!
  - Promotes creativity
  - Provides a distinct advantage when flexibility is needed
  - Shown to produce better solutions to problems and a higher level of critical analysis
- Can develop a reputation as an employer of choice to attract and retain the best from a shrinking labor pool
- Vital to manage through change
- More workforce diversity is inevitable

Conclusion

- Societal needs are changing
- Electric demand growing, infrastructure is aging
- Grid modernization is attracting investment
- Business is changing
- Significant pending attrition from retirements
- Participate in the IEEE PES Scholarship Plus Initiative to attract the best and brightest
- A new day, a new workforce: manage the transition

Are you doing enough?