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R&D/New Technologies for Utilities: Some Things to Know

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Three Takeaways

- Research and development (R&D) is critical for economic growth, the survival and long-term prosperity of individual companies, and the attainment of public-policy goals for energy utilities
- Many observers have expressed a concern over deficient R&D for both the country as a whole and individual industries, including energy public utilities
- State utility commissions might want to revisit their policies and practices that affect utilities' willingness and ability to invest in R&D

The Importance of R&D

- Innovation (e.g., technological change) is a key element for economic growth and long-term prosperity
  - It can spawn new products, improvement of existing products, or higher efficiency of production processes
  - Economists have long held that technological change is critical for economic growth
- A *precursor* to innovation is investments in R&D
- Demand for R&D is therefore a derived demand for improved products/processes that are profitable or achieve some public benefit more effectively or at a lower cost
- R&D is also critical for advancing long-term policy objectives

R&D 101

- There are 3 distinct stages of R&D: basic research, applied research and demonstration
- Public benefits are a major reason for using taxpayer monies for R&D
- For many companies, survival depends on keeping a technological edge over competitors
- Utilities are more often users of new technologies than creators
- Major technological breakthroughs are essential for making the transition to a low-carbon future at reasonable cost
- Basic research by definition is not directed at solving an immediate problem or inventing a particular product
- R&D intensity varies widely across different industries
- Innovation requires the right incentives and trial and error
- The majority of R&D efforts become "dry holes"
- R&D is also critical for advancing long-term policy objectives, like safety, reliability, cheaper energy, cleaner environment

R&D 101 – *continued*

- Both the public-good nature of R&D, its distant returns, and its uncertain outcomes are major obstacles to innovation by the private sector
- Several minefields lie between basic research and the wide acceptance of a new technology or other innovations
- Because of the risk of R&D, companies are unlikely to innovate unless the payoff from successes is high

Some Concerns over Energy R&D

- Utilities, which include power generation, transmission, and distribution, natural gas distribution, water supply and sewerage treatment, spent just 0.1% of revenues on R&D
- Federal government energy R&D as a percentage of GDP has dropped since the 1970s
- The federal commitment to energy R&D is less than 0.5% of the annual nationwide energy bill
- While U.S. expenditures for energy R&D has risen in recent years, they are only about one-half the level in real dollars of R&D in late 1970s during the oil crisis
- DOE receives about 7% of the total federal budget for R&D (Defense gets 50% with Health and Human Services receiving 25%)
- In responding to increased competition, utilities cut back on internal R&D in addition to reducing their support for collaborative research managed by EPRI and GTI/GRI
- R&D intensity for utilities is much less than for U.S. industries as a whole
- Awe have seen particularly drastic cutbacks in R&D for the natural gas sector

R&D Intensity for Different Industries (2013)

Industry	R&D Intensity
All industries	3.3%
Manufacturing	3.8
Chemicals	4.5
Pharmaceuticals and medicines	10.3
Automobiles, trailers and parts	2.4
Computer and electronic products	10.6
Electrical equipment	2.9
Non-manufacturing industries	2.7
Software publishers	9.0
Computer systems design	8.4
Finance and insurance	0.7
Utilities	0.1

Source: National Science Foundation

What to Know about New Technologies

- Different factors account for the emergence of new technologies in the utility sector:
  - Public policy
  - Customer demands
  - Favorable supply-side developments
  - Rent-seeking
  - Undue favoritism by a company or government
  - Ideology
  - Synergy where one technology development spawns others.

What to Know about New Technologies – *continued*

- Contrary to the beliefs of some industry observers, a bright line between good and bad new technologies rarely exists
- We have seen new technologies in both the energy and non-energy sectors that appear promising but, as of today, are unproven
- The effect of new technologies will generally depend not only on their inventors but also on the creativity of the eventual users of the new technologies
- Some new technologies may not survive in the absence of subsidies
- New technologies often take decades before they become widely dispersed
- Many if not most major technologies were not projected to have a disruptive effect (think of the airplane, television, the steam engine, the computer, the laser, the mobile phone)
- Overall, policy makers including public utility regulators should proceed with caution in taking positions on specific new technologies funded by taxpayers or utility customers, or in predicting, for example, what the electric utility industry will look like in 20 years, 10 years, or even 5 years

The Effect of Utility Regulation

- Regulation affects: (1) the amount utilities spend to innovate, (2) the pace at which they innovate, (3) the nature of innovative activities, and (4) the management of those activities
- A *core question* relates to the regulatory incentives for innovative activities by utilities
  - Economists have criticized traditional rate-of-return (ROR) regulation for providing utilities with less-than-robust incentives
  - Incentives for utilities to invest in R&D/innovation depend on two broad factors influenced by public utility regulation, *regulatory lag* and *cost recovery*
  - The standard narrative, buttressed by observation, is that regulation causes utilities to be cautious about innovating and taking risks
  - Traditional regulation tends to socialize both the benefits and costs of innovations, or worse
- Two major issues facing regulators are: (1) incentives for R&D/innovation by utilities and (2) incentives by potential entrants, vendors and manufacturers

Features of Utility Regulation Affecting R&D/Innovation

Feature of Regulation	Effect on R&D/Innovation
Entry restrictions for new companies	▪ Reduces competitive pressure on utility to innovate ▪ Natural monopoly structure favors large-scale technologies
Regulatory lag	▪ As to costs, deters innovation because it takes longer for utility to recover its costs ▪ As to benefits, encourages innovation because utility can retain benefits longer
Cost-of-service rates	▪ Diminishes utility's benefits from innovation ▪ Diminishes customer incentive to purchase certain technologies
Benefits allocated largely to customers	▪ Diminishes utility incentive to under R&D and innovate
Risk allocated largely to customers	▪ Increases utility willingness to innovate ▪ Unfair to customers if utility captures most of the benefits ▪ Creates a "moral hazard" situation
Ratemaking treats cost savings from conventional and new technologies the same	▪ Utility finds conventional technologies are relatively more attractive (i.e., the less risky technology)
Book depreciation	▪ Can diminish utility incentive to under R&D and innovate ▪ Can jeopardize utility's ability to recover fully the costs of existing assets
Prudence and "used and useful" tests	▪ Can deter utility from investing in high-risk innovations ▪ Can discourage utility pilot programs ▪ Protects customer against subpar utility management performance or unexpected outcomes
Emphasis on reliability and safety	▪ Shifts interest away from cost-saving innovations
Favoritism toward certain innovations	▪ "Jump starts" potentially socially desirable innovations ▪ Risks choosing the wrong technology

Regulatory Tools to Bolster R&D/Innovation

- Modified ROR regulation (e.g., economic depreciation)
- Price caps
- Focused incentives
- Profit or benefit sharing
- Regulatory lag
- Benchmarking
- Planning (prospective) process
- Regulatory commitment
- Explicit rules
- Policy guidance (e.g., guidelines on pilot programs)

Major Regulatory Matters

- Incentives for utilities to innovate (i.e., utility demand for innovation)
- The effect of a new business model on creating new demand for innovation by utilities, customers and third-parties
- Parties carrying out innovation (utilities, third-parties, e.g., Google): Why should utilities get involve with the development of new technologies; can't other entities better serve this role?
- Regulatory objectives for R&D (e.g., improve the long-term performance of the utility)
- The benefits of collaborative research
- Role of state commissions in accommodating and supporting innovation (including those created by third parties) that is in the public interest
- Regulatory guidelines or principles on utility R&D

Illustrative Regulatory Principles for R&D

- Sustained and stable funding
- Funding levels sufficient for achieving regulatory/policy goals
- *Portfolio approach* for selecting projects within broad programs (challenging because of uncertainty and multiple policy/company objectives)
- Allowing utilities to assume reasonable risks, and encouraging innovation by willing to pass at least some costs of failure to customers
- Picking winners can easily lead to unfavorable technology lock-in
- *Articulated FERC criteria*: "R&D projects should be well-defined, clearly explained and with consumer benefits, targets and justification"
- Selection of ratepayer-funded projects based on the public interest
- Well-managed R&D projects
- Measurable outcomes
- Retrospective and prospective analyses

The Benefits of Collaborative Research

- Avoids duplicative efforts and inefficiencies
- Avoids the “free rider” problem
- Exploits economies from pooling company resources to undertake R&D
- Results in a more diversified portfolio of research projects
- Allows companies that lack funds to participate in R&D activities that otherwise they would not have
- Spreads the costs of high-risk projects
- Helps participants stay on top of the latest technology developments
- Overall, enhances the industry’s capability to leverage R&D investments for addressing common needs

NATIONAL RENEWABLE ENERGY LABORATORY

Superior Energy Performance – Research and Development

Barbara O'Neill

Grid Integration Manager

May 24, 2016

Presented to the Western Conference of Public Service Commissioners of the National Association of Regulatory Utility Commissioners

Lake Tahoe, Nevada

NREL Scope

Sustainable Transportation

- Vehicle Technologies
- Hydrogen
- Biofuels

Energy Productivity

- Residential Buildings
- Commercial Buildings

Renewable Electricity

- Solar
- Wind
- Water: Marine Hydrokinetics
- Geothermal

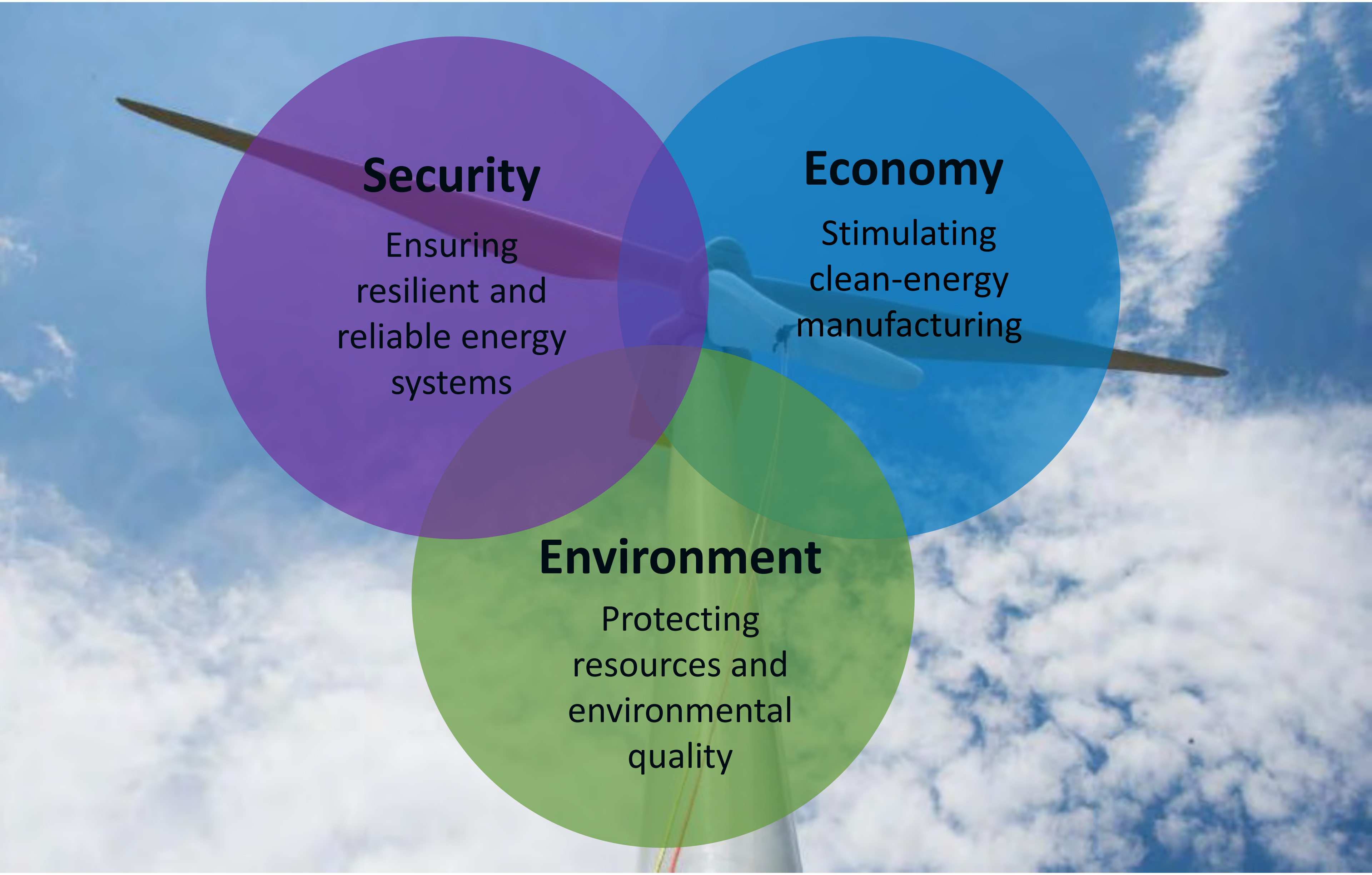
Systems Integration

- Grid Integration of Clean Energy
- Distributed Energy Systems
- Batteries and Thermal Storage
- Energy Analysis

Partners

- Private Industry
- Federal Agencies
- State/Local Government
- International

National Energy Imperatives



NREL's Solutions Role

Reducing Investment Risk

- Integrating technology at scale
- Enabling basic and applied clean energy technology innovation
- Accelerating technology market introduction and adoption
- Encouraging collaboration in unique research and testing partnering facilities
- Providing analysis and expertise to inform decisions and catalyze market adoption

Wind Turbine Research

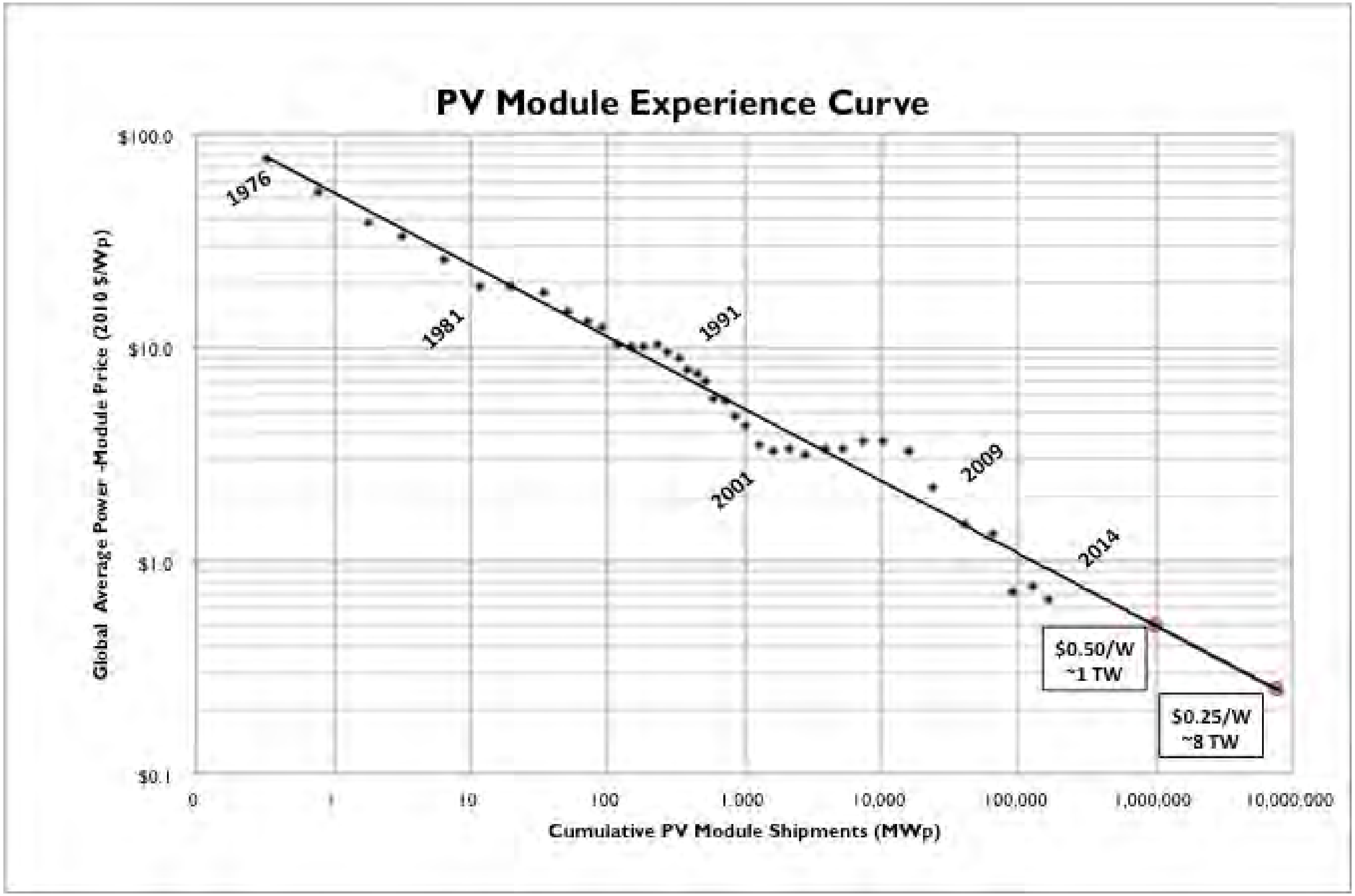
- Patented airfoil designs improved blade efficiency and simplified controls
- Drivetrain and blade testing improved turbine reliability and lowered costs
- Aerodynamic and structural models guided U.S. industry product development
- On-going research in reliability, efficiency, and controls for entire wind farms
- Developing offshore wind and water power technologies
- Dynamics testing analyze interactions with transmission grid
    - ~8 MW dynamometers
    - 7-MW controllable grid interface
    - ~10 MW wind turbines
    - Capable of utility-scale storage

Sustainable Transportation

NREL's transportation R&D accelerates adoption of efficient vehicles and clean alternative fuels:

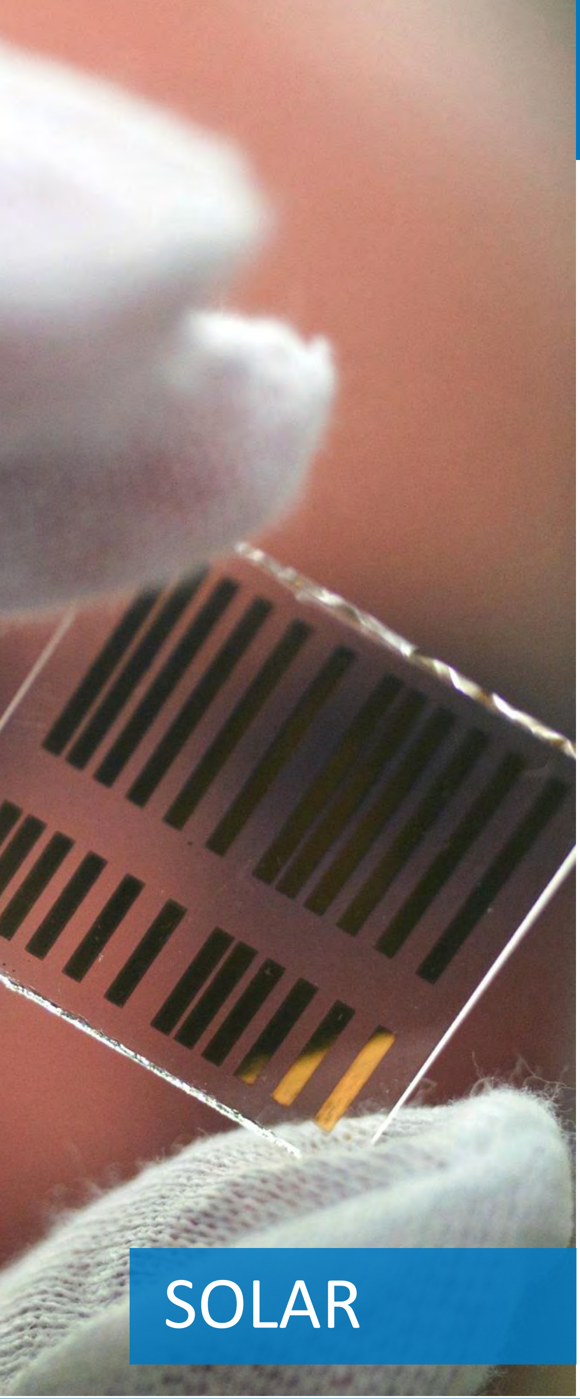
- Computer-aided engineering tools to design better electric vehicle batteries faster
- Platooned trucks that demonstrate ~6.4% fuel savings
- Recruitment of more than 200 businesses for the Workplace Charging Challenge
- Climate control configurations to reduce electric vehicle energy use by ~66.5%
- R&D 100 Award-winning calorimeters that provide the most accurate measurement of battery thermal performance

Photovoltaic Pioneer



Sources: For 1999-2014:SPV Market Research, Photovoltaic Manufacturer Shipments: Capacity, Price & Revenues 2014/2015, Report SPV-Supply2. For 1984-1998: Navigant ConsulMng (2010), Photovoltaic Manufacturer Shipments, Capacity & CompeMMve Analysis 2009/2010, Report NPS-Supply5 (April 2010). For 1980-1984: Navigant ConsulMng (2006), Photovoltaic Manufacturer Shipments 2005/2006, Report NPS-Supply1 (August 2006). For 1976-1980: Strategies Unlimited (2003), Photovoltaic Manufacture Shipments and Profiles, 2001-2003, Report SUMPM 53 (September 2003).

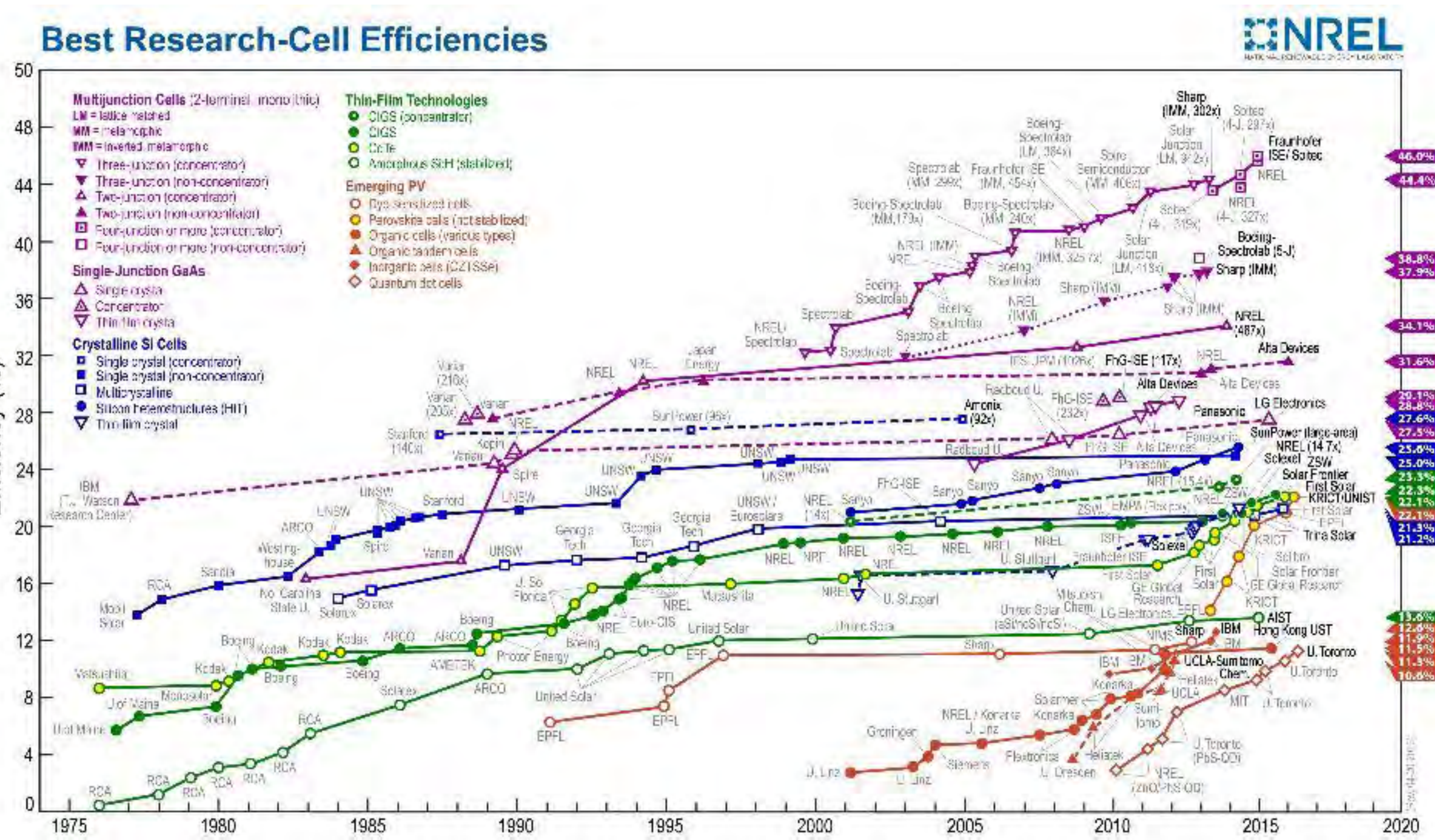
Next-Generation PV Power



SOLAR

- Quantum-dot (QD)-based solar cells
  - QDs are nanoscale spheres of semiconducting material
  - QDs have the potential to dramatically increase cell efficiency
  - NREL built the first all-QD solar cell
- Plastic solar cells may incorporate QDs
- Perovskite solar cells have rocketed to high efficiencies during research

Photovoltaic Strides



Helping Solar Manufacturers

- U.S. market share slipped from 30% to about 2% (2000-2014) ---> manufacturers need to cut costs
  - Developed a simple chemical etch that causes silicon to absorb more light and avoids expensive antireflection coatings
  - Devised a tool to measure detailed PV performance in less than a second; test every cell on a manufacturing line
  - Optical Cavity Furnace uses light during processing to heat cells, leading to higher efficiencies and uniform temperatures

Consolidated Utility Base Energy (CUBE) Project

Photo by Dennis Schroeder, NREL

- Diesel, PV and Battery System Optimized
- 31% Fuel Savings
- 1/3 of savings due to battery as regulating reserve
- Partners: NREL, U.S. Army Mobile Electric Power (MEP), Wyle, U.S. Army Rapid Equipping Force (REF)

- 60 kW Load
- Two 30 kW TQGs
- Four 5 kW PV Arrays
- One 30 kW Battery Bank
- One spare 30 kW Battery Connection

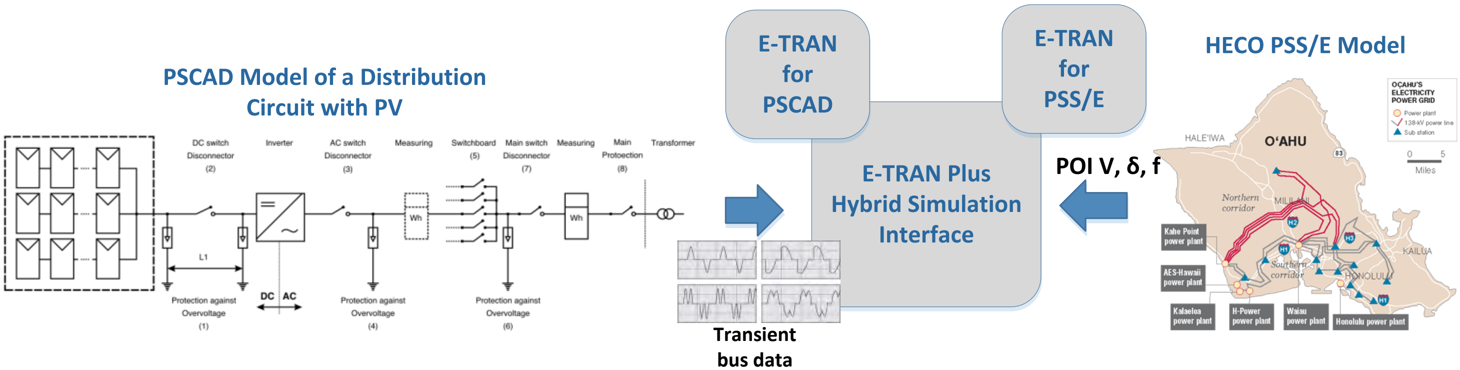
Upcoming Work: NREL, Hawaii Electric, and partners

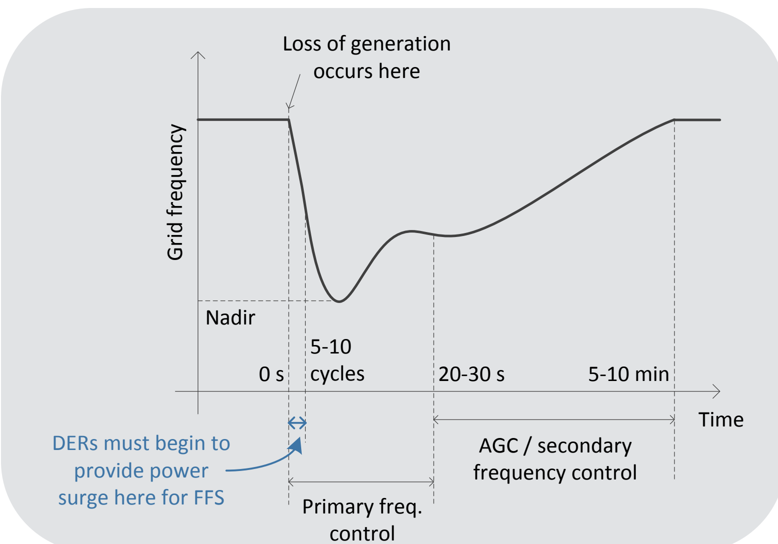
TECHNOLOGY ADDRESSED

Problem: Degraded grid **frequency stability** (power outages) due to high levels of PV. Solution: Control PV and storage to autonomously help stabilize grid.

WORK and IMPACT

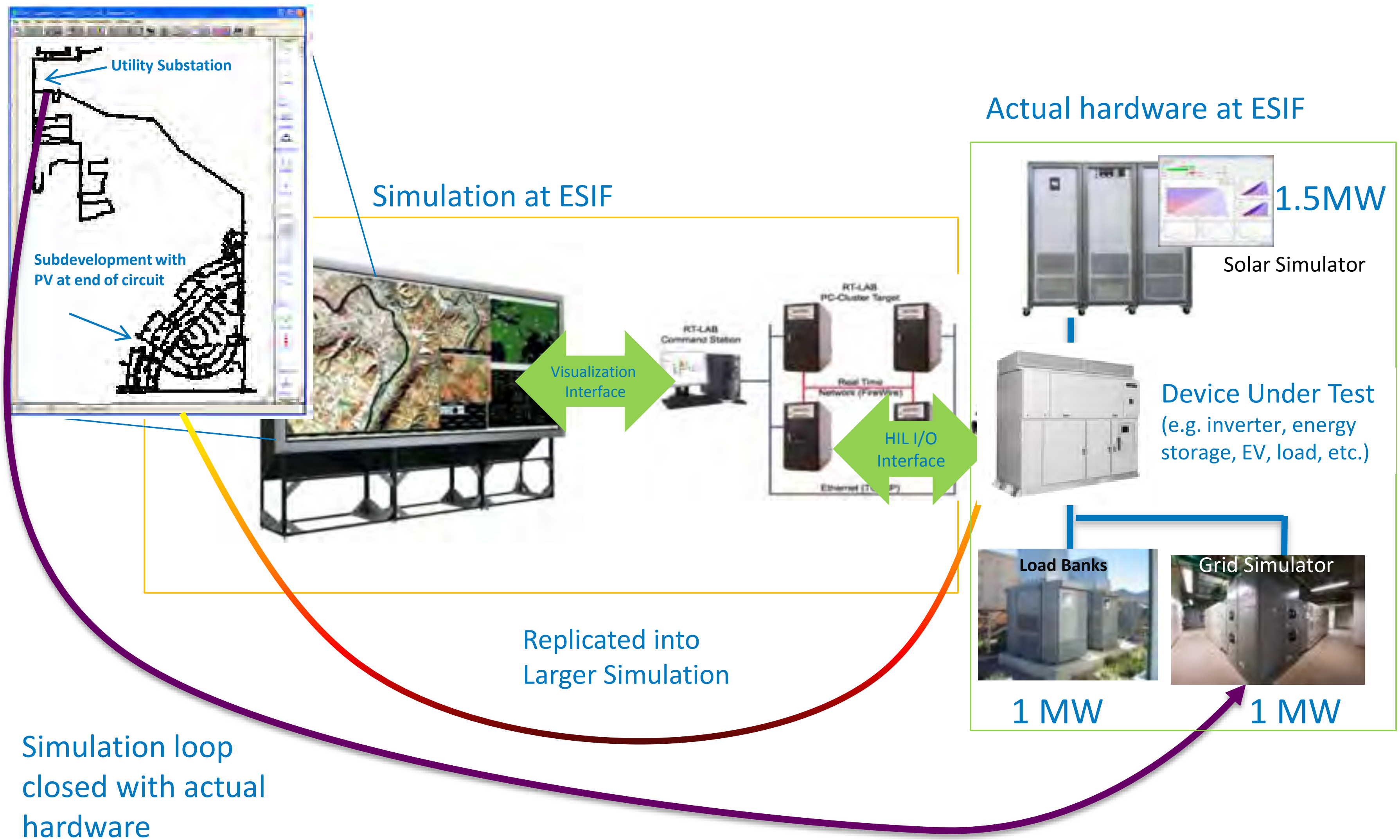
Develop distributed inverter-based controls, validate in the lab, and demonstrate in the field. Result will help maintain a stable, reliable grid as Hawaii moves towards 100% renewables.





- Broad regional partnership led by NREL: HECO, Sandia, Enphase, Fronius, FIGII, and Energy Excelerator
- DOE funded ($1M) as part of Grid Modernization Lab Call (GMLC)
- Help pave a path to a sustainable reliably-powered future for the rest of the US
- Officially started April 1. First phase will test existing **frequency-Watt function**.

Power Hardware-in-the-Loop: Experiments to Simulations

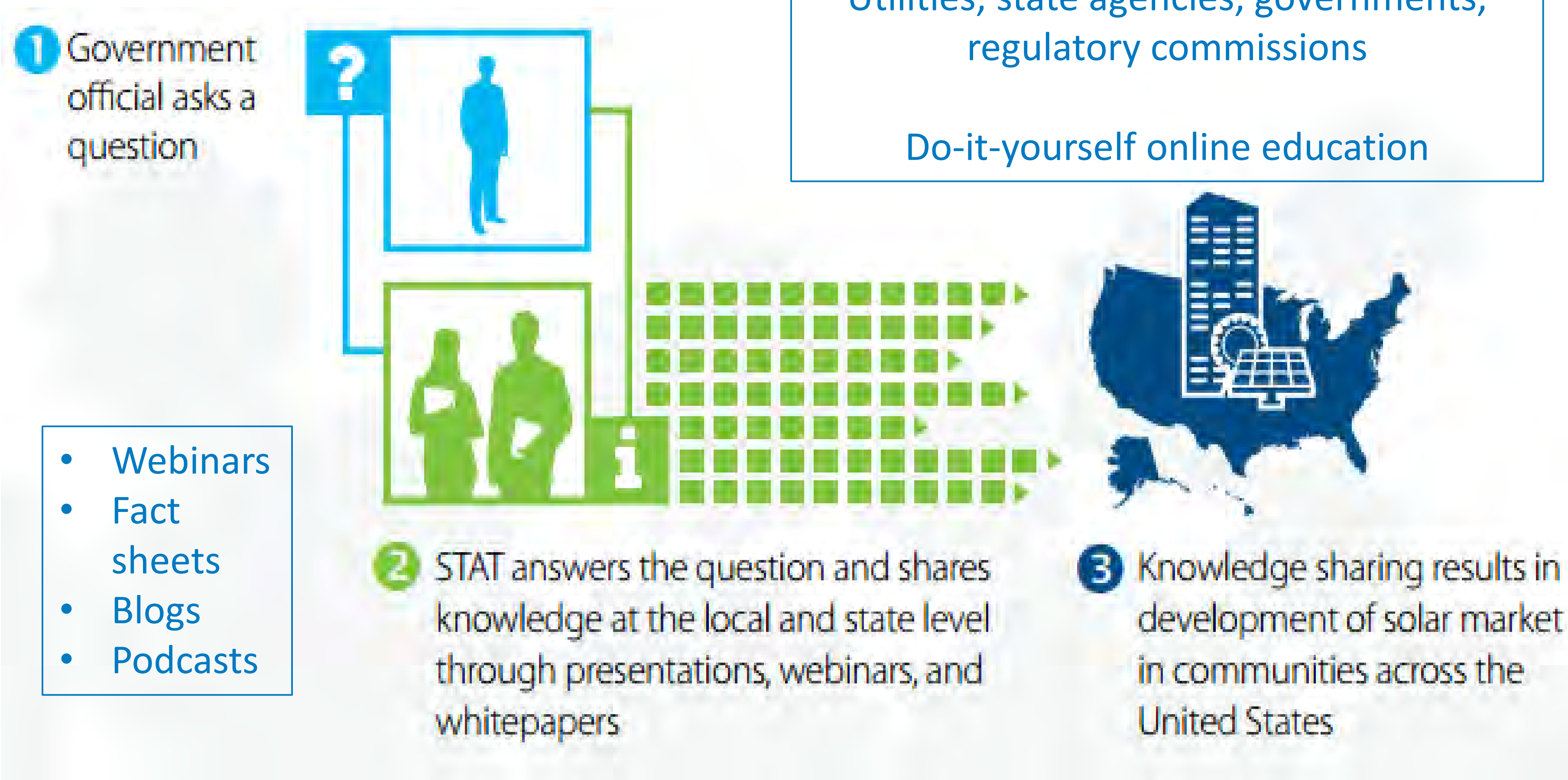


*This is an overview of NREL/ESIF's capabilities; Details of actual HECO tests will differ

NREL's Solar Technical Assistance Team (STAT)

Utilities, state agencies, governments, regulatory commissions

Do-it-yourself online education



- Webinars
- Fact sheets
- Blogs
- Podcasts

Source: NREL, 2016

http://www.nrel.gov/tech_deployment/state_local_governments/stat.html

STAT Partnerships with States

Illinois Office of Energy & Recycling

How can solar PV deployment can stimulate economic development in Illinois?
Explore solar policy scenarios by employing NREL's Distributed Generation and Market Demand (dGen) and Jobs and Economic Development Impact (JEDI) models.

New York State Energy Research and Development Authority (NYSERDA)

How to better understand soft costs related to financing in NY?
Provide a summary of solar financing models available to residential and commercial solar markets: loans, power purchase agreements, and cash purchase.

Nevada Governor's Office of Energy

How can we learn from other state programs?
Review a "Green Bank" study, summarizing findings from feed-in-tariff analyses and renewable portfolio standards trends, participate in Task Force meetings.

State Technical Assistance: Direct, Quick Response

Applicants	Topic
City & County of Denver, Office of Economic Development	Solar contribution to NZE community, strategies
City of Camden, New Jersey	Solar on contaminated lands
City and County of Denver, Mayor's Office	Solar Benefits technical support
Montana Senate District 33	Solar Ready Design presentation
Delaware Public Service Commission	Technology – Inverter accuracy
County of Kauai, Hawaii	RFP Assistance
City of Chicago	Airport project technical support
Louisiana PSC	Net metering caps presentation
City of Tucson	Financing Options for PV
Ranson, WV	Policy Options
Austin Electric Utility Commission	Value of solar methodology

Program Structure

- Rolling application throughout the year
- Short online application
- Quick turnaround time on request approval
- Up to 40 hours per request

Apply Online:
http://www.nrel.gov/tech_deployment/state_local_governments/stat.html

Any questions?

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www.nrel.gov

NREL

NATIONAL RENEWABLE ENERGY LABORATORY

Superior Energy Performance®
U.S. DEPARTMENT OF ENERGY

Western Conference of Public Service Commissioners
Lake Tahoe, Nevada
Tuesday, May 24, 2016

Alice Napoleon
Synapse Energy Economics

What is Strategic Energy Management?

SEM: A Strategy for Continuous Improvement

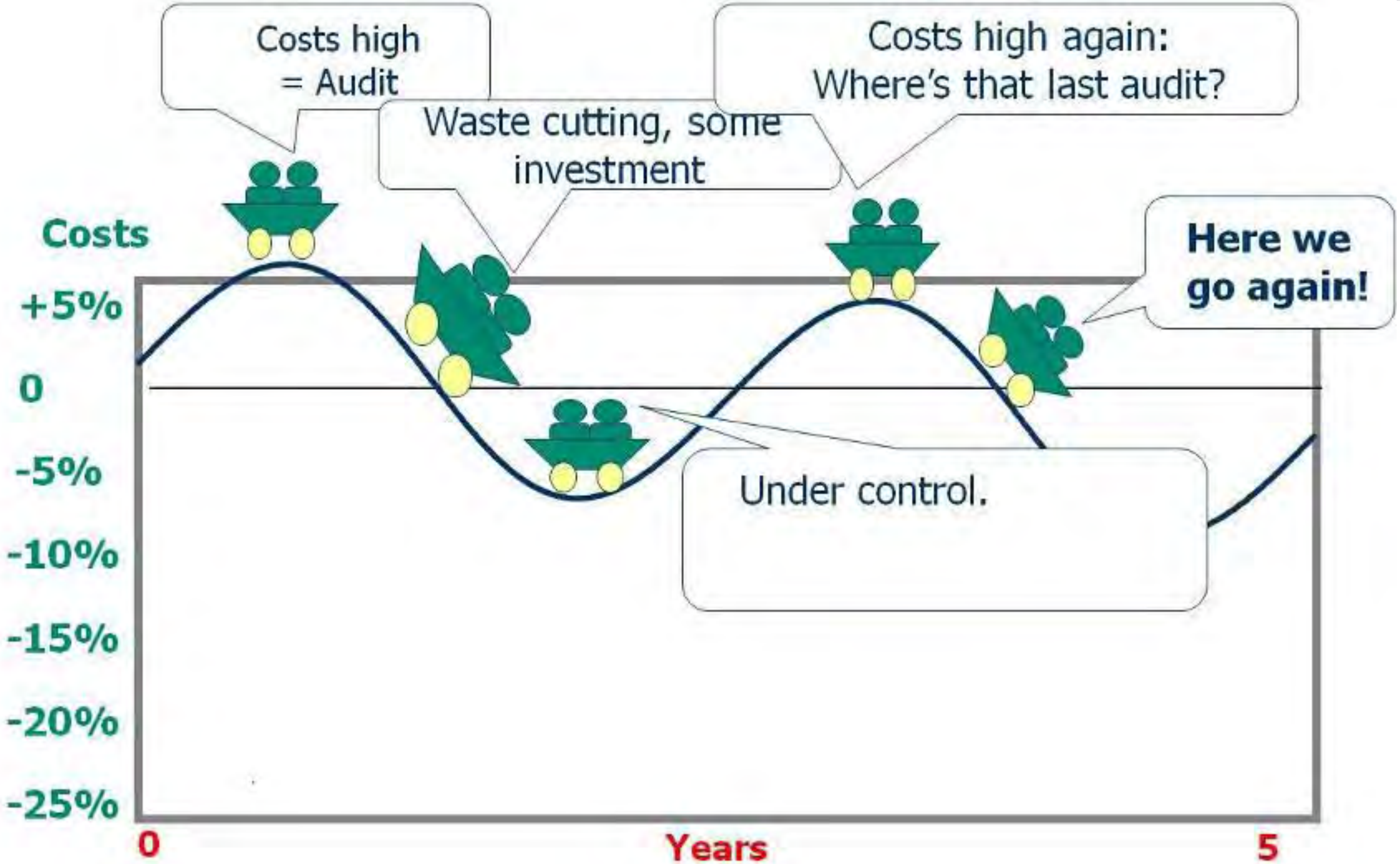
- A holistic approach to managing energy use in order to continuously improve energy performance and achieve energy and cost savings over the long term.
- Focuses on business practice change from senior management through shop floor staff, affecting organizational culture to improve energy performance.
- Also referred to as
  - Continuous energy improvement (CEI)
  - Energy management systems (EnMS)
  - High performance energy management (HPEM)

Source: Consortium for Energy Efficiency, 2014

Energy Management *Program* vs. *System*

- Typical energy *program*
  - Management decides energy cost and use are too high
  - Energy manager tries different tactics to reduce consumption
  - Issues are tackled one at a time, on a project-by-project basis
  - The tactics may or may not be effective or sustainable
- Energy management *system*
  - System versus project orientation
  - Sustained and continuous improvement
  - Cross-organizational involvement

Program Approach to Energy Management



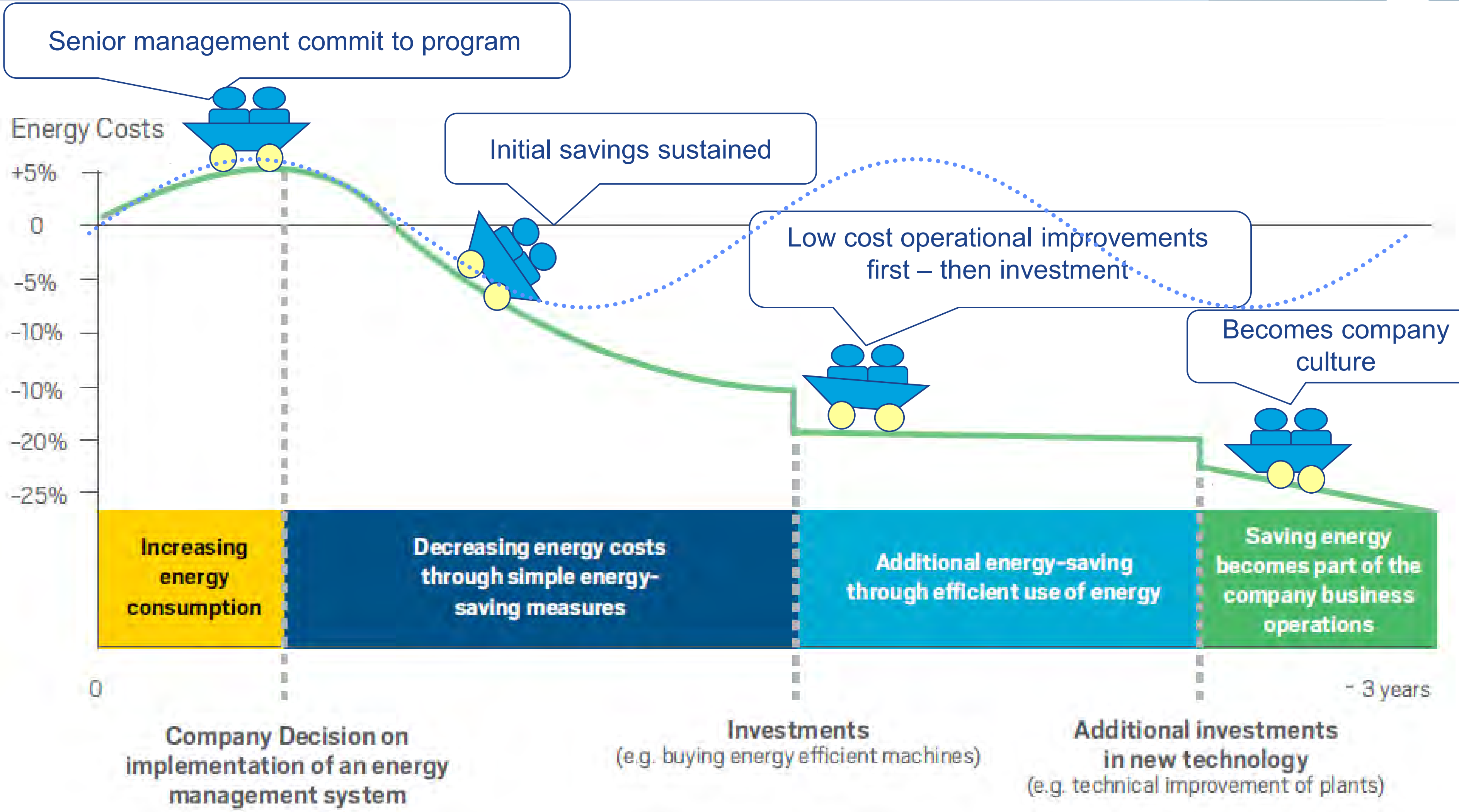
Source: UNIDO 2010

Ask Yourself…

Do your utilities' energy management programs

- Ask what's working and what's not?
- Build feedback opportunities into their design?
- Document processes so others can follow/replicate them?
- Provide a role for a variety of people with varied responsibilities?
- Include a leadership role for top management?
- Consider how the energy program affects other programs?
- Align energy goals with organizational goals?
- Respond to both internal and external events?
- Drive continuous improvement?

Strategic/System Approach to Energy Management



SOURCE: Kahlenborn et al. (2012), based on Lackner & Holanek (2007).

The Business Case for Strategic Energy Management

Why Are Utilities Supporting SEM?

- Sustainable, continuous improvement over time
- Efficiency and cost-effectiveness of delivery
- Improved capacity for load management
- Customer relationships
- Reputation

Making the SEM Business Case to the Customer—Benefits of SEM

- Lowering energy costs = lower production costs = more competitive
- Lowering exposure to energy cost volatility = lower risk
- Focus on energy = enhanced process control
- Investor interest
- More engaged workforce
- Customer image and reputation
  - Smarter, responsible, more efficient supplier
  - Superior quality product or service

The Strategic Energy Management Continuum

Foundational Energy Management

New to energy management?
Looking to develop a more *systematic* approach?

Foundational Energy Management **(e.g., ENERGY STAR For Buildings & Plants)**

Fundamental approach to developing a systematic energy management program based on industry best practices and benchmarking tools

- ▶ Re-assess
- ▶ Evaluate progress
- ▶ Implement plan
- ▶ Create action plan
- ▶ Set goals
- ▶ Baseline energy performance
- ▶ Establish energy policy

ISO 50001

Already familiar with ISO 9001 or 14001?
Looking for external verification of an EnMS?

ISO 50001

Standard Energy Management System (EnMS) framework for global industrial operations

- ▶ Receive ISO 50001 certification
- ▶ Achieve ISO 50001 EnMS
- ▶ Management reviews
- ▶ Conduct internal EnMS audit
- ▶ Formally document EnMS

Foundational Energy Management (e.g., ENERGY STAR For Buildings & Plants)

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ISO 50001 Background

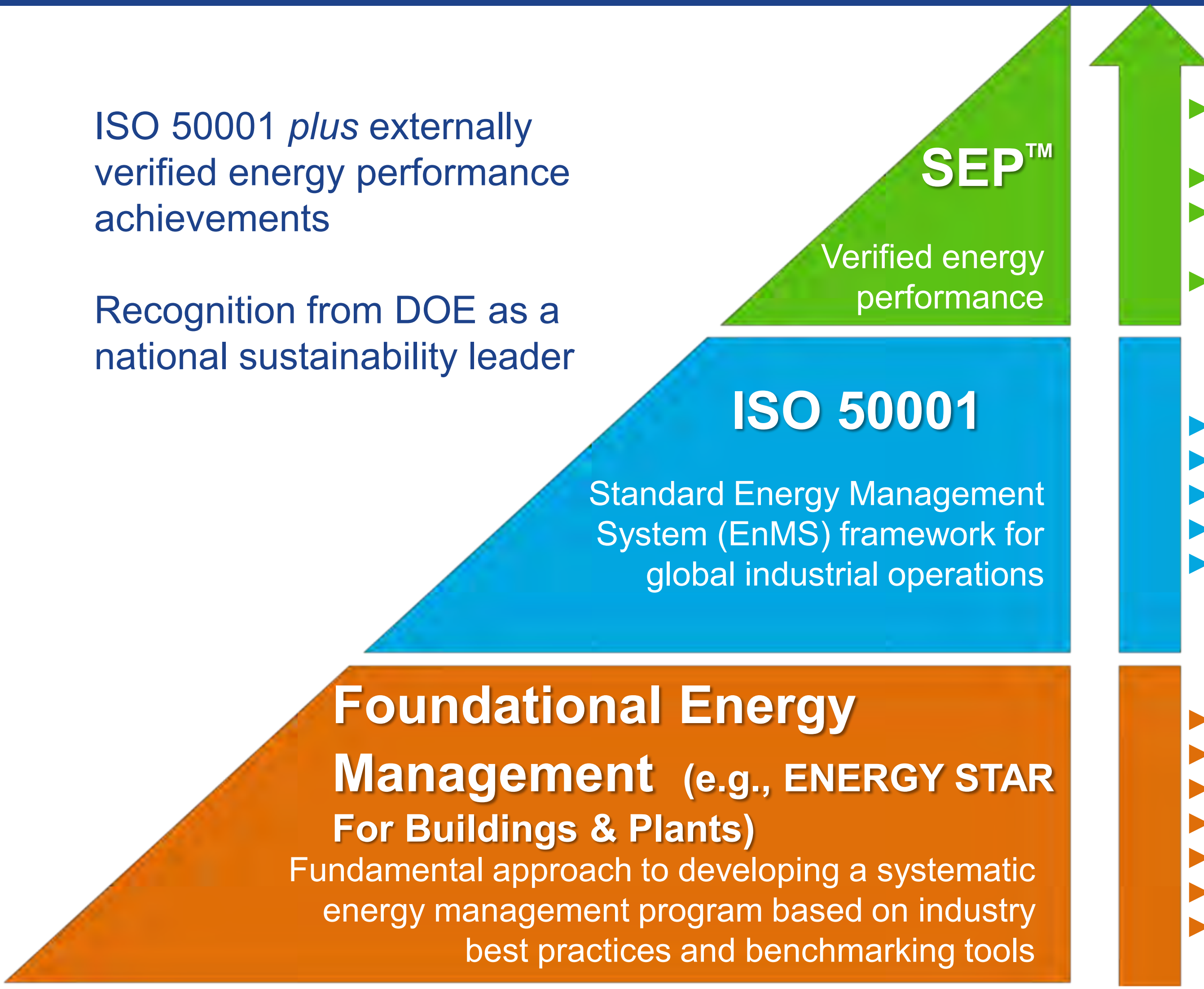
- International consensus-based standard, published 2011
  - U.S. represented by ANSI
- Defines the elements of an effective energy management system
  - Does not set performance requirements; not an energy code
- Follows Plan-Do-Check-Act approach
- Continual improvement of the *system* → continual improvement in *performance*
- Compatible with ISO 9001-2008 (quality management systems) and ISO 14001-2004* (environmental management systems)
  - Similar structure, similar processes
- Organizations can choose to have their systems reviewed and “registered” to the standard

* ISO 14001:2015 published October 2015

Superior Energy Performance (SEP)

ISO 50001 *plus* externally verified energy performance achievements

Recognition from DOE as a national sustainability leader



- Receive SEP™ certification (includes ISO 50001 certification)
- Obtain third-party verification
- Achieve energy performance improvement targets
- Conduct rigorous measurement & verification of energy performance

- Receive ISO 50001 certification
- Achieve ISO 50001 EnMS
- Management reviews
- Conduct internal EnMS audit
- Formally document EnMS

- Re-assess
- Evaluate progress
- Implement plan
- Create action plan
- Set goals
- Baseline energy performance
- Establish energy policy

SEP Certification Requirements

SEP requires plants to meet the ISO 50001 energy management standard and verify the savings they achieve.

ISO 50001

Components in place:

- Top management
- Energy team
- Policy
- Planning
- Baseline
- Performance metrics

Superior Energy Performance

Builds on ISO 50001 to help organizations achieve deeper, more sustained energy and cost savings.

- **ISO 50001 certification**
- **Verified energy performance improvement**

"External verification and validation is critical. Certification adds to the confidence in calculations and savings."

Nissan, Smyrna, TN

SEP Certified Facilities and Verified Energy Performance Improvement

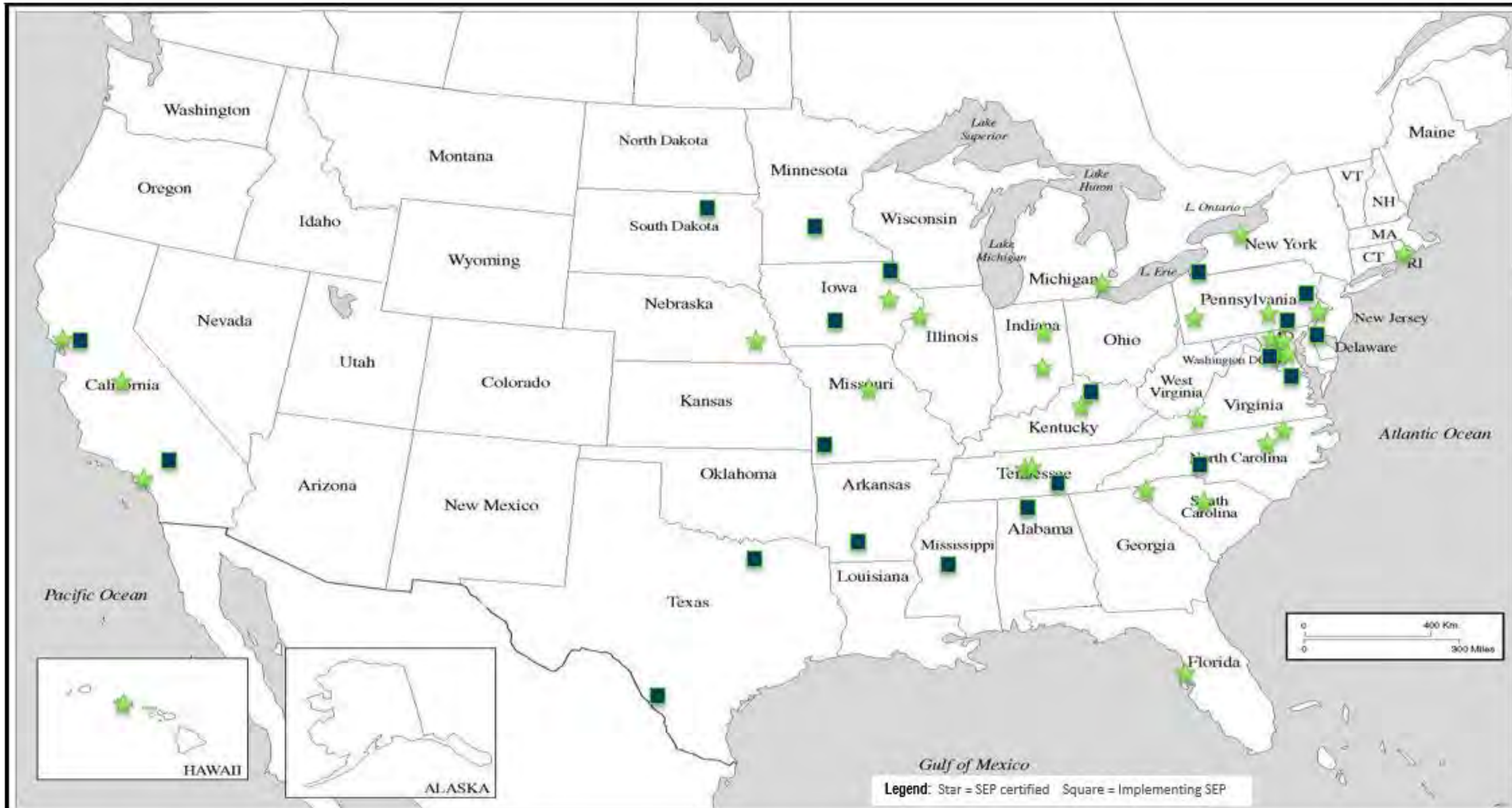
Schneider Electric	Saanichton, BC Canada	**30.6%**
	Smyrna, TN	**23.1%**
	Clovis, CA	**16.7%**
	Seneca, SC	**15.6%**
	Hopkins, SC	**10.2%**
	Tijuana, Mexico	**10.2%**
	Peru, IN	**24.9% over 10 years**
	Cedar Rapids, IA	**8.8%**
	Lexington, KY	**6.9%**
	Lincoln, NE	**6.5%**
	Rojo Gomez, Mexico	**5.9%**
Volvo	Mack Trucks, Macungie, PA	**41.9% over 10 years**
	Dublin, VA	**28.4% over 10 years**
	Hagerstown, MD	**20.9%**

Improvement over 3 years unless stated otherwise

3M	Brockville, Ontario Canada	**21.4% over 7 years**
	Cordova, IL	**5.6%**
Nissan	Smyrna, TN	**17.7%**
Harbec	Ontario, NY	**16.5%**
Cummins	Whitakers, NC	**12.6%**
Coca-Cola	Dunedin, FL	**12.2%**
General Dynamics	Scranton, PA	**11.9%**
Cooper Tires	Texarkana, AR	**10.1%**
Bridgestone	Wilson, NC	**16.8% over 10 years**
Olam	Gilroy, CA	**9.8%**
MedImmune	Gaithersburg, MD	**8.5%**
Curtiss Wright	Cheswick, PA	**7.6%**
Land O'Lakes	Carlisle, PA	**5.7%**

Last updated: September 1, 2015

SEP: Certified and In-Progress Facilities in the U.S., April 2016



Roles for Utilities in SEM and SEP

Market barriers exist preventing customers from adopting SEM or SEP on their own. A role exists for energy efficiency program engagement

- Training in understanding value of SEM and SEP
- Technical assistance
- Financial assistance
- Energy management/organizational assessments

 Source: Consortium for Energy Efficiency (CEE^{SM}). 2014. 2014 CEE SEM Program Case Studies Report.

SEP Tools for Ratepayer-funded Program Administrators

DOE produced a toolkit to help utilities and PAs develop SEP offerings. The toolkit provides SEP program information, cost-effectiveness tools, and guidance and tools for program plans and reports.

Resources in this toolkit:

1. **Cost Effectiveness Screening Tool** to estimate SEP benefits & costs
2. **Program Transition Tables** for info on level of effort moving between SEM, ISO 50001 and SEP, from perspectives of PA and customer
3. **SEP Guide for the Development of Energy Efficiency Program Plans** ("Program Planning Guide")
4. **SEP Program Planning Template**
5. **SEP Presentations**: general, for PAs, and for customers
6. **Utility EM&V Resources** (under development)

www.energy.gov/eere/amo/utilities

SEM – Case Studies

Case Study: Sierra Pine

Leading manufacturer of fiberboard and particleboard

SEM Improvements

- Adopted an energy policy, established an energy team, engaged employees in energy saving actions and tracked progress
- Adjusted equipment schedules to minimize idle operation
- Shut down an underused and unneeded 350-horsepower hog system
- Increased water injection rate on refiner plates

Case Study: Sierra Pine

SEM Estimated Savings

- 11.3 million annual kWh per year
- $588,700 in annual energy costs

“Strategic Energy Management helped us set aside time to give energy efficiency more attention. Doing that paid off by reducing our annual energy costs by $588,700.”

— **Wayne Ralph**
Electrical Supervisor

Source: Energy Trust of Oregon
http://assets.energytrust.org/api/assets/success-stories/SierraPine_CS_1508.pdf

Case Study: Bonneville Power Administration Energy Smart Industrial Program

- Since 2009, the program has collaborated with 112 retail utilities to complete more than 800 energy efficiency projects resulting in 750 GWh savings.
- Of the 750 GWh saved, nearly 50 GWh are the result of behavior change improvements.
- Lesson learned
  - Engaging participants for a 3-5 year period increases both the magnitude and reliability of energy savings.

Source: Promoting Reliability of Industrial SEM Savings Through Multi Year Engagements
http://aceee.org/files/proceedings/2015/data/index.htm

Case Study: Harbec, Inc.

- Specialty plastics manufacturer
- Implements a rigorous (SEP) energy management system producing lasting benefits
  - Validated by an independent 3rd party
- Three-person energy team
- No capital investment needed
  - Costs largely include energy management system implementation, training, and related labor costs

Source: DOE
http://energy.gov/sites/prod/files/2015/05/f22/SEP_HARBEC_case_study.pdf

Case Study: Harbec, Inc. (continued)

- SEM improvements
  - Reducing unnecessary run time at CHP plant
  - Using excess chill capacity to cool process water
  - Adding automatic sequencing so no excess CHP microturbines are operating
- Annual energy cost savings of $52,000 per year
  - Equivalent of 16.5% improvement in energy performance over 3 years

SEM – Wrap-up

Wrap Up

- SEM is accessible to any facility or organization
- Start with a basic system and move up from there
  - Foundational SEM
  - ISO 50001
  - SEP

Wrap Up

- Compared to traditional energy management, SEM is
  - Top-driven
  - Strategic
  - Integrated
  - Data focused
  - Continual

Wrap Up

- SEM does more than just save energy
  - Productivity
  - Quality
  - Cost
  - Morale
  - Reputation
  - Market value

Extra slides

How SEM Can Help – Engage Management

Pitfalls of current energy programs

- Little direction from above
- One person's job – he/she may leave or be overtaken with competing projects
- Little or no input from key players

How SEM can help

- Commitment from top management – evidenced with policy
- Appointed lead representative with defined role
- Creation of energy team

How SEM Can Help – Plan for Energy Management

Pitfalls of current energy programs

- How energy is used at the site is not clearly understood
- Energy usage is not quantified, so best improvement opportunities are difficult to identify
- Tendency toward one-off projects (utility incentives)
- No clear plan for moving forward

How SEM can help

- Process in place for learning how energy is used at the site
- Opportunities with the best outcome are prioritized
- Low-cost/no-cost opportunities can be identified (e.g., set backs versus new chiller)
- Objectives, targets, and clear actions plans to implement change are identified

How SEM Can Help – Implement Energy Management

Pitfalls of current energy programs

- Identified projects not completed
- New equipment installed but not used or maintained properly

How SEM can help

- Allocate resources to a specific action plan with dates
- Communicate and train on new equipment or process to sustain savings

How SEM Can Help – Measure Results

Pitfalls of current energy programs

- Uncertainty about project achieving desired results
- Failure to meet corporate goals at year's end
- Poor understanding of spikes – ("must be the weather")

How SEM can help

- Measure against metrics
- Analyze routinely to know how you are doing before you report to corporate
- Investigate unexpected results

How SEM Can Help – Review for Continual Improvement

Pitfalls of current energy programs

- Start over next year

How SEM can help

- Get feedback from top management
- Communicate how you did versus objectives
- Communicate results to get continued support for program
- Look for ways to keep improving

Case Study: AEP Ohio's Continuous Energy Improvement (CEI) Program

- A multi-year program that offers comprehensive SEM delivery to large industrial companies throughout Ohio.

Program Results from 2013-February 2015

	Months in Program	Number of Participants	2014 MWh Savings	2015 MWh Savings to date	Total MWh Savings to date	Average Savings as a % of load
Cohort 1	24	14	21,100	20,700	41,800	8.6%
Cohort 2	20	7	7,000	10,000	17,000	7.5%
Cohort 3	17	7	4,000	2,600	6,600	4.2%
Cohort 4	16	9	8,000	4,400	12,400	2.4%

AEP Ohio Customer Testimonials

"CEI has also given us metrics we have not had before. In the past all we had is our bills and now we have a model to predict our usage."

"I appreciate the discussion from different companies. Very open, and we all realize we are on the same journey."

"Looking forward to working with AEP on engaging management & staff to realize additional energy savings."

"A great process for developing our Energy Management Program."

Source: The Second Generation of Strategic Energy Management Programs, *http://aceee.org/files/proceedings/2015/data/index.htm*