DOE Grid Modernization Initiative

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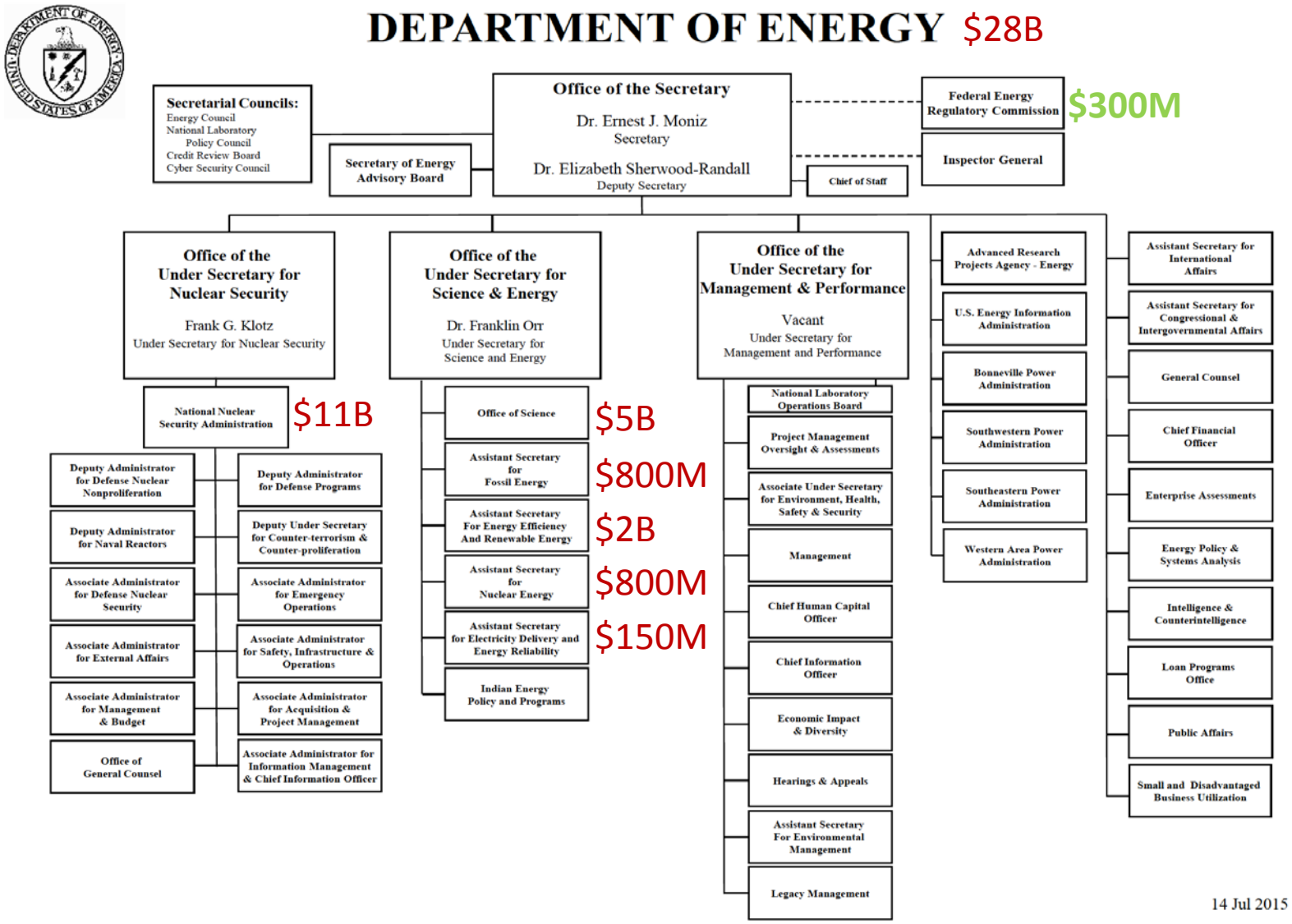
DOE Organization Chart



DOE National Laboratory Complex

Office of Science Laboratories

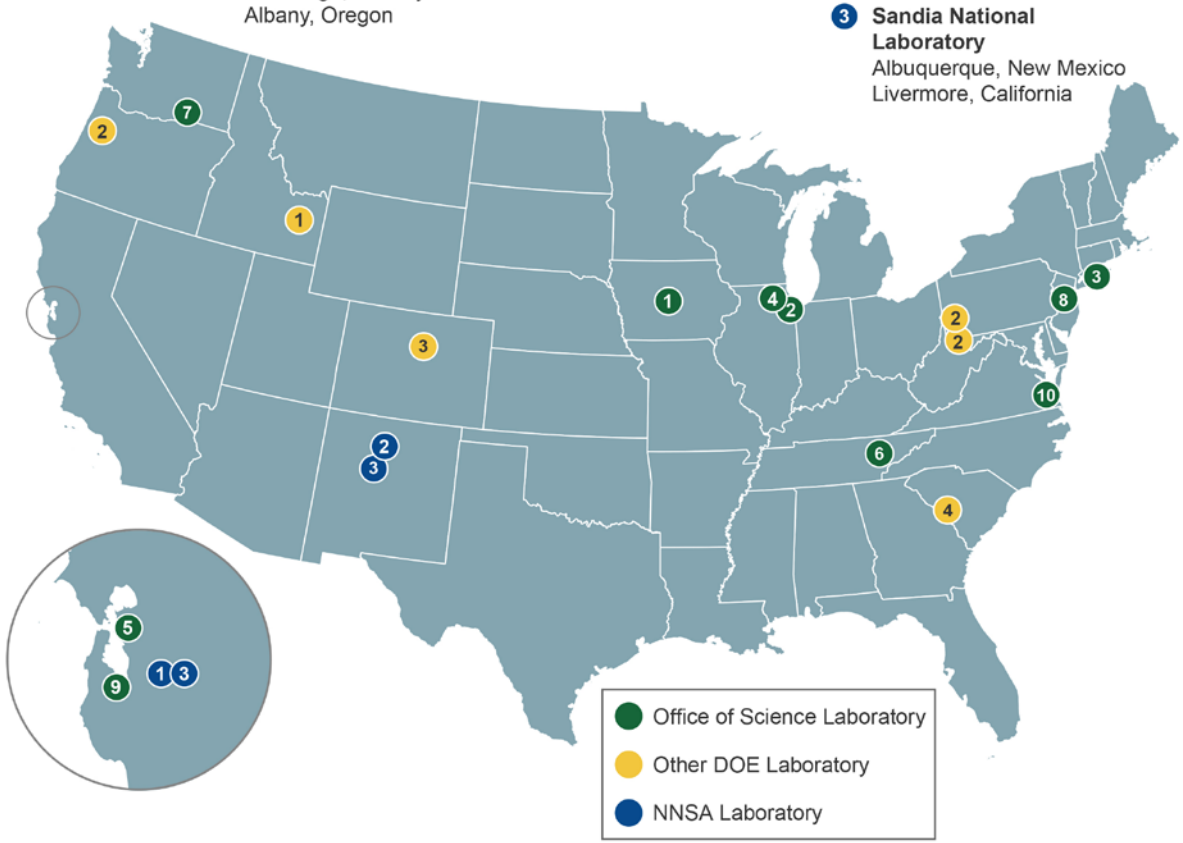
1. **Ames Laboratory**
   Ames, Iowa
2. **Argonne National Laboratory**
   Argonne, Illinois
3. **Brookhaven National Laboratory**
   Upton, New York
4. **Fermi National Accelerator Laboratory**
   Batavia, Illinois
5. **Lawrence Berkeley National Laboratory**
   Berkeley, California
6. **Oak Ridge National Laboratory**
   Oak Ridge, Tennessee
7. **Pacific Northwest National Laboratory**
   Richland, Washington
8. **Princeton Plasma Physics Laboratory**
   Princeton, New Jersey
9. **SLAC National Accelerator Laboratory**
   Menlo Park, California
10. **Thomas Jefferson National Accelerator Facility**
    Newport News, Virginia

Other DOE Laboratories

1. **Idaho National Laboratory**
   Idaho Falls, Idaho
2. **National Energy Technology Laboratory**
   Morgantown, West Virginia
   Pittsburgh, Pennsylvania
   Albany, Oregon
3. **National Renewable Energy Laboratory**
   Golden, Colorado
4. **Savannah River National Laboratory**
   Aiken, South Carolina

NNSA Laboratories

1. **Lawrence Livermore National Laboratory**
   Livermore, California
2. **Los Alamos National Laboratory**
   Los Alamos, New Mexico
3. **Sandia National Laboratory**
   Albuquerque, New Mexico
   Livermore, California



Context for Grid Modernization

- Time of opportunity, time of transition
  - Changing mix of types and characteristics of generation
  - Emergence of interconnected electricity information and control systems - system observability and controllability transitioning rapidly
  - Growing supply and demand side opportunities for customer participation
  - Need/demand for increased grid resilience/reliability
- Public / private partnership viewed as fundamental to grid modernization
  - Grid viewed as central to clean energy future; DOE and White House understand importance in delivering solutions at regional level in partnership with industry and states.
  - Industry increasingly challenged regarding R&D and long-term focus
  - Regulators challenged to innovate the traditional regulatory utility model
  - National Labs able to aim mid and long-term; support DOE leadership in fundamental policy considerations
- Vendors, utilities, and universities are key stakeholders for guiding the translation from discovery to commercial implementation
  - Key partners in regional demonstrations and channel for national benefit
  - Important to DOE and Lab advisory groups to guide strategy

Grid Modernization Vision

The future grid provides a critical platform for U.S. prosperity, competitiveness, and innovation in a global clean energy economy. It must deliver ***reliable, affordable,*** *and* ***clean electricity*** *to consumers where they want it, when they want it, how they want it.*

Enhance the Security of the Nation

- Extreme weather
- Cyber threats
- Physical attacks
- Natural disasters
- Fuel and supply diversity
- Aging infrastructure

Sustain Economic Growth and Innovation

- New energy products and services
- Efficient markets
- Reduce barriers for new technologies
- Clean energy jobs

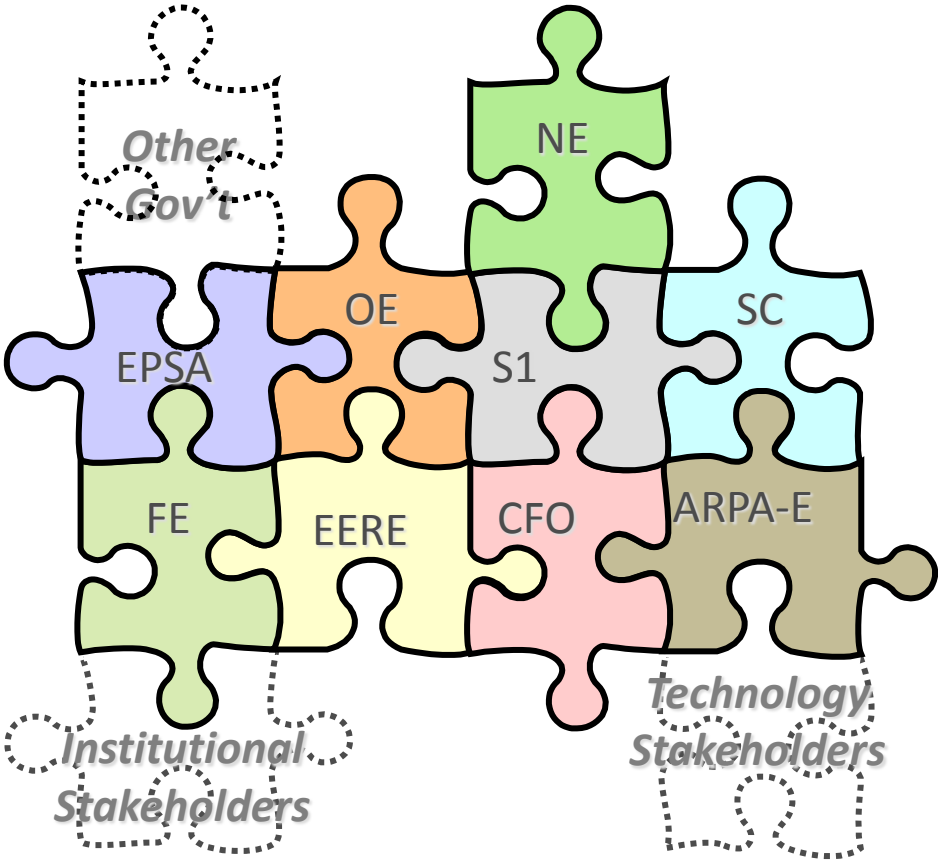
Achieve Public Policy Objectives

- 80% clean electricity by 2035
- State RPS and EEPS mandates
- Access to reliable, affordable electricity
- Climate adaptation and resilience

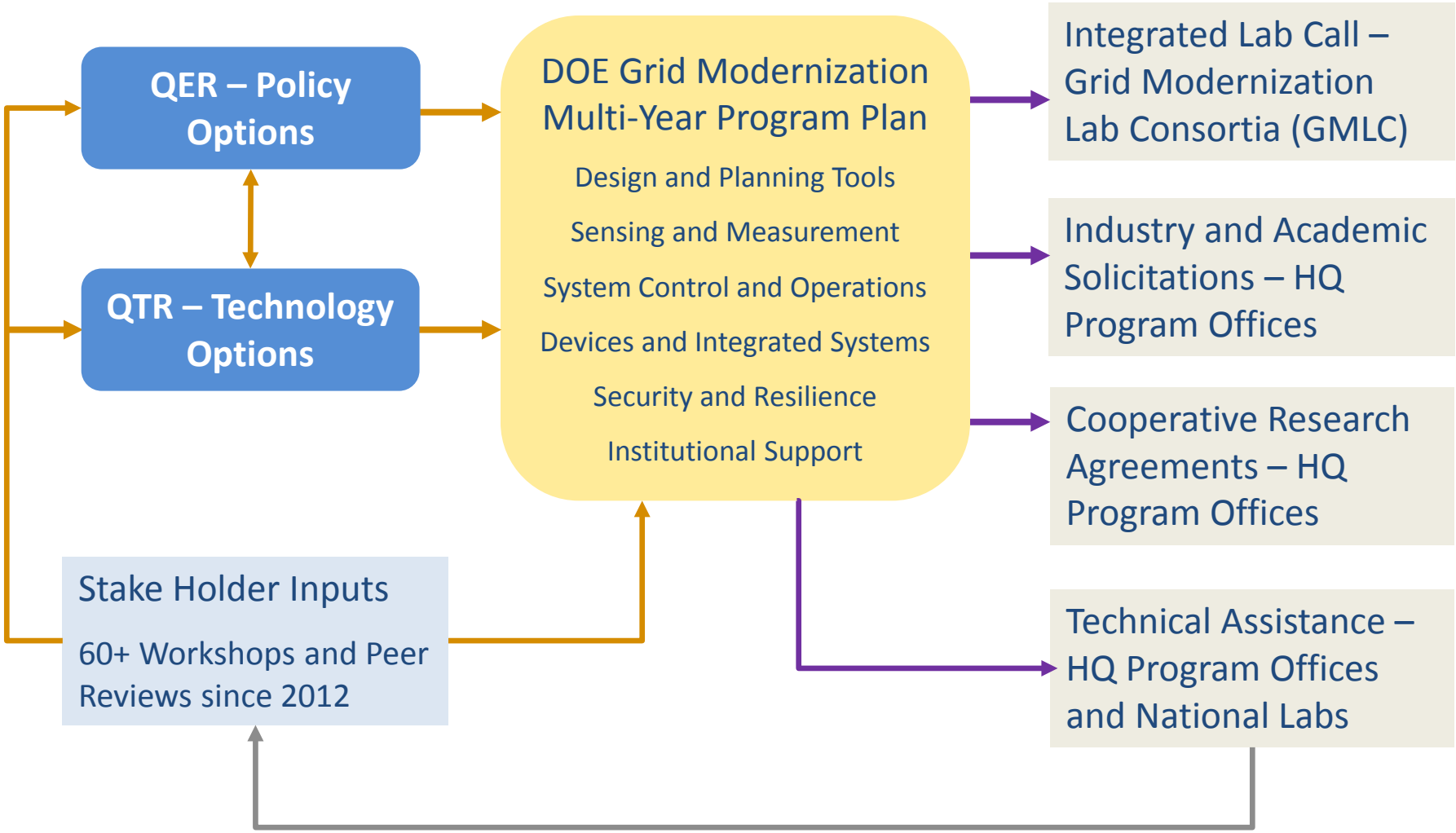
Grid Modernization Initiative

An aggressive five-year grid modernization strategy that includes

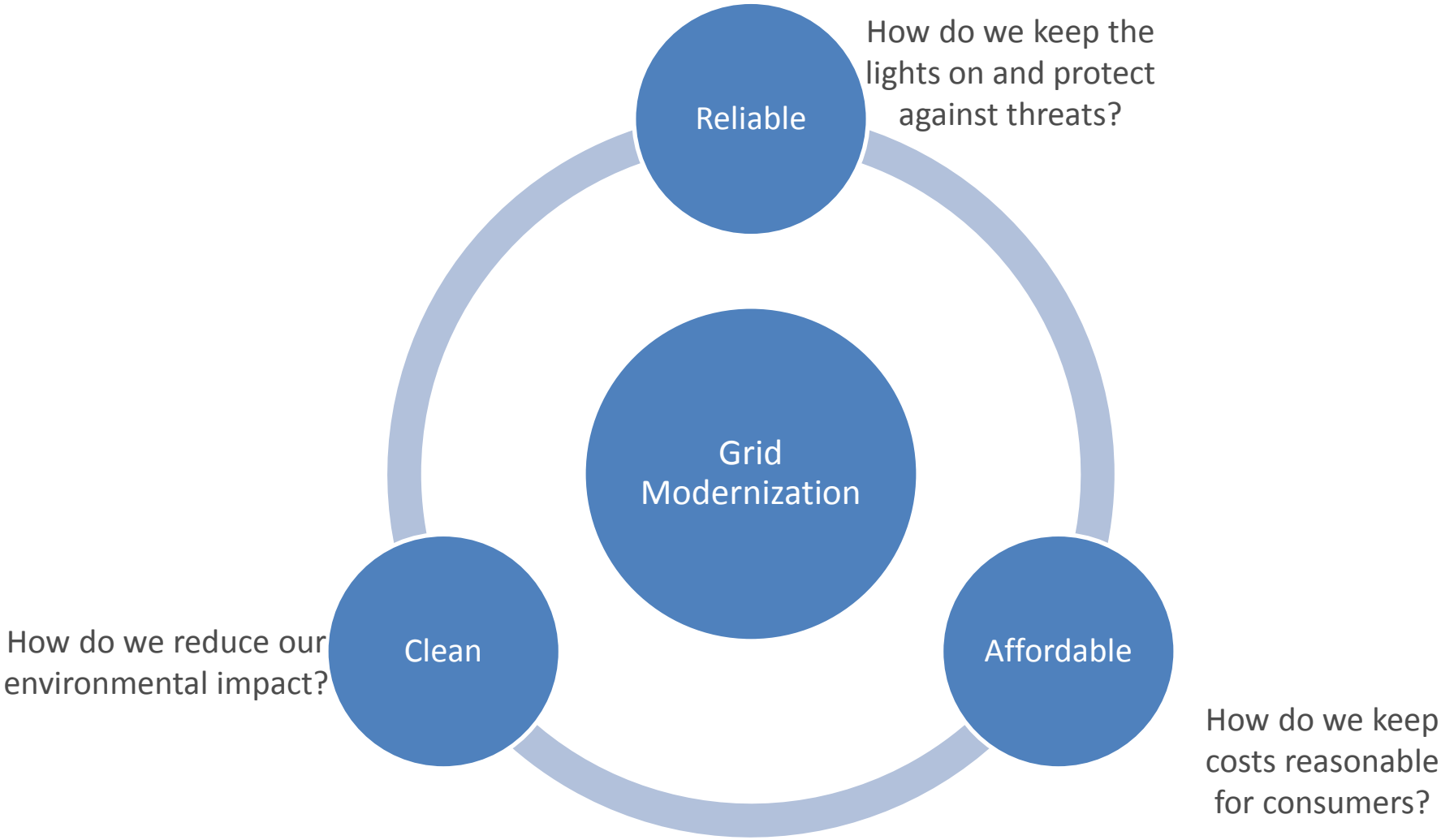
- Alignment of the existing base activities among the Offices
- An integrated Multi-Year Program Plan (MYPP)
- New activities to fill major gaps in existing base
- Development of a laboratory consortium with core scientific abilities and regional outreach



Connectivity to Other DOE Activities



Key Attributes of a Modernized Grid



National Goals and Outcomes

- This new crosscutting effort will build on past successes and current activities to help the nation achieve at least three key outcomes within the next ten years:
  - > **Reliability:** *10% reduction in the economic costs of power outages*
  - > **Affordability:** *33% decrease in cost of reserve margins while maintaining reliability*
  - > **Clean:** *50% cut in the costs of Distributed Energy Resources integration*

- If achieved, these three key outcomes would yield more than $7 billion in annual benefit to the U.S. economy

- In addition, our efforts will ensure the future modernized grid is a flexible platform for innovation by entrepreneurs and others who can develop tools and services to empower consumers and help them make informed energy decisions.

DOE Major Achievements

- **Major Achievement #1 – Lean Bulk Power Systems**
  - **Reliable**: Maintain reliable operations with <=10% reserve margin;
  - **Clean**: Systems include >33% variable energy resources;
  - **Affordable**: New capability for grid operators to leverage and manage distribution-level grid services will require less generation reserve
- **Major Achievement #2 – Clean Distribution Systems**
  - **Clean, Reliable**: Demonstrate reliable and affordable feeder operations with >50% DER penetration
  - **Reliable**: Coordinated microgrid(s) control for resilience (20% fewer outages, 50% shorter recovery time)
  - **Affordable**: Distributed, hierarchical control for clean energy and new customer-level innovation for asset utilization
- **Major Achievement #3 – Grid Planning and Analytics**
  - **Reliable**: Use coupled T&D grid planning models with 500x speed-up to address specific grid issues
  - **Clean**: Develop with stakeholders new data-driven approaches to DER valuation and market design
  - **Affordable**: Work with States to more rapidly evaluate new business models, impacts of policy decisions

Building on our integrated technical thrusts

Technology Innovation

Institutional Alignment	•Evaluate regulatory and policy options and implications of various grid ownership and operations models – support utility and regulatory reform through technical assitance
Design and Planning Tools	•Develop planning tools that integrate transmission and distribution and system dynamics and can use high performance computing platforms - deliver 500x speed-up
System Control and Power Flow	•Increase ability to coordinate and control up to millions of devices and integrate with energy management systems – coordinate millions of devices; enable one-minute contingency analysis at the interconnect scale
Sensing and Measurements	•Develop sensors, analytics, and visualizations that enable 100% observability of generation, loads and system dynamics across the electric system – develop low cost sensors at all scales, handle 1000x data volumes, visualization tools, dynamic accuracy
Devices and Integrated Testing	•Develop advanced grid control and integration devices and validate integrated systems that can optimize operations at high variable RE penetrations and provide high reliable service – validate 50-100% DG penetration scenarios on feeders
Security and Emergency Response	•Develop advanced security (cyber and physical) solutions and real-time incident response capabilities – capable of identifying cyber events in real-time and analyzing within 12 hours.
Risk Mitigation through Multi-scale Pilots	•Develop megawatt-scale demonstrations that show transfer of the technologies developed through R&D activities into the field linked to policy and market decision tools

Institutional Support

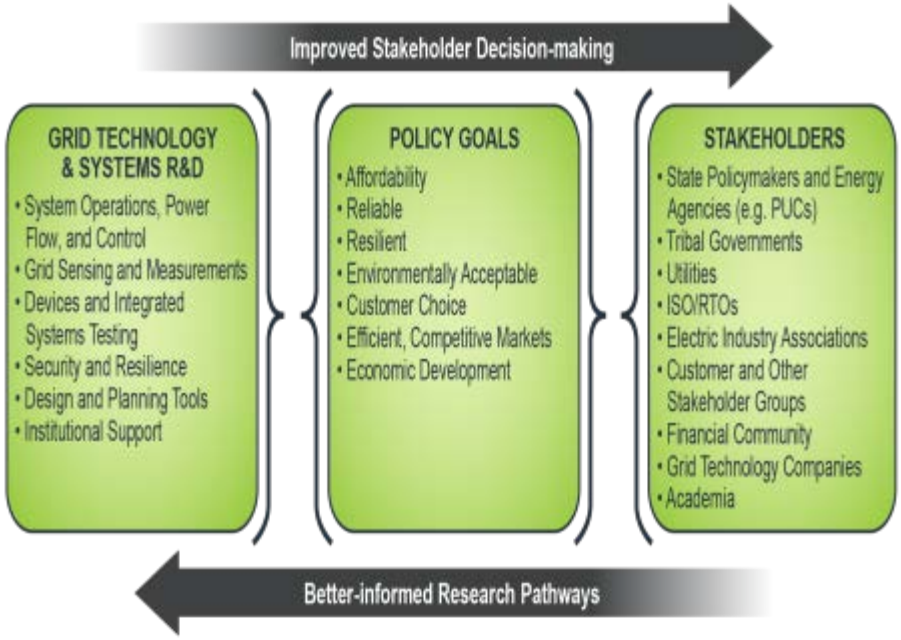
Enable regulators and utility/grid operators to make more informed decisions and reduce risks on key issues that influence the future of the electric grid/power sector

Expected Technical Achievements by 2020

- Accelerated state & federal policy innovation due to enhanced State and Regional technical assistance
- Methods for valuation of DER technologies and services are defined and clearly understood by stakeholders and enable informed decisions on grid investments and operations
- 3-5 states have adopted fundamental changes and 8-10 states have adopted incremental changes to their regulatory structure that better aligns utility interests with grid modernization and clean energy policy goals

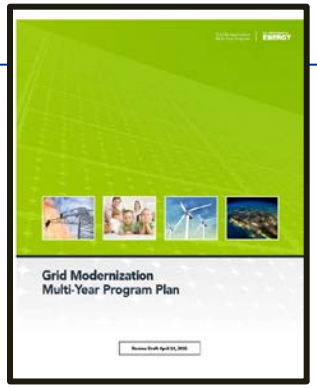
Federal Role

- Provide independent, unbiased technical assistance (e.g., information and analysis tools)that address key grid-related policy, regulatory, and market issues
- Create an over-arching stream of grid-related "institutional" analysis, workshops, and dialogues to raise awareness of the need for grid modernization



Engaging with Stakeholders

Status and What's Next?



- Regional discussions held with stakeholders thru December 2015
  - Strategy input
  - Frame regional priorities for grid modernization
  - GMLC advisory groups for each of six technical areas formed 2015
  - GM Multi-Year Program Plan Developed
- FY16 DOE Budget Initiative for Grid Modernization (84% increase proposed!)
- Funding modalities:
  - Industry and academia access to DOE grid research continues via traditional pathways
  - National Lab engagement will be blend of competitive FOAs, GMLC calls and AOP pathway.
- GMLC Laboratory Call for proposals completed 9/30/15
  - Spontaneous self organization of labs to meet challenges (matching capabilities, expertise, regional connections…)
  - BNL and partners LBNL, PNNL, and INL proposed regional initiative in support of REV

END