

U.S. DEPARTMENT OF  
**ENERGY**

Office of Electricity

# ***Promise of Technology: Unlocking the Power of Collaboration to Realize Our Energy Future***

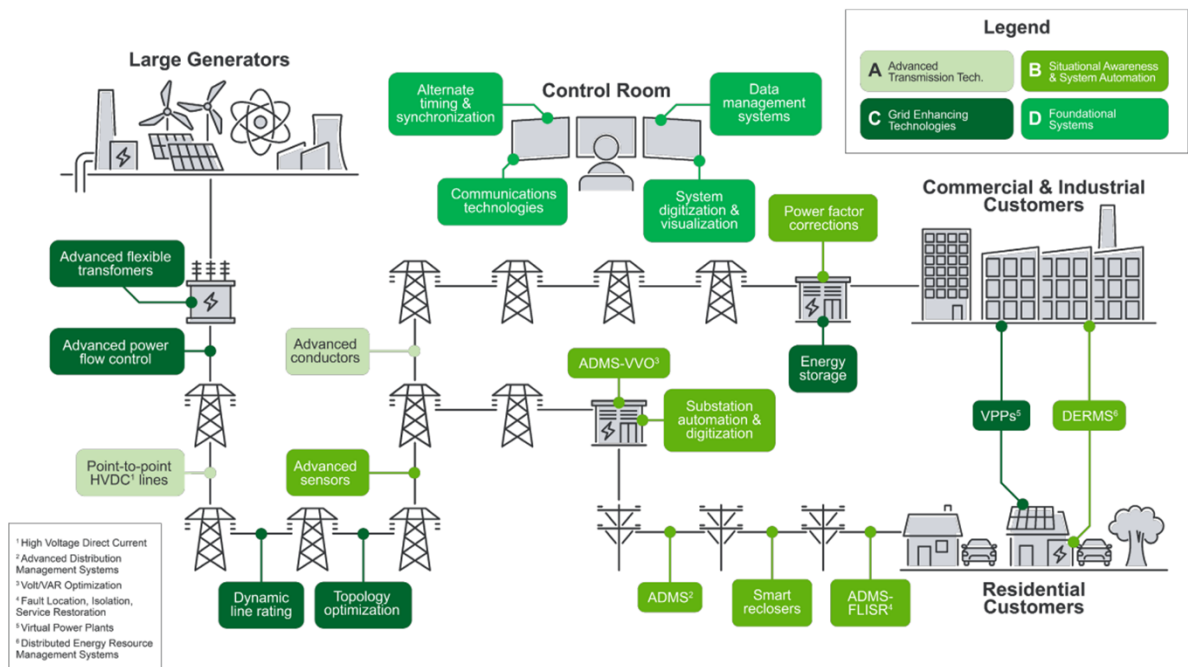
**Gil Bindewald**

*Principal Deputy Assistant Secretary,  
Office of Electricity*

April 2024

# Illustrative Overview of Advanced Technologies and Application in Liftoff Report

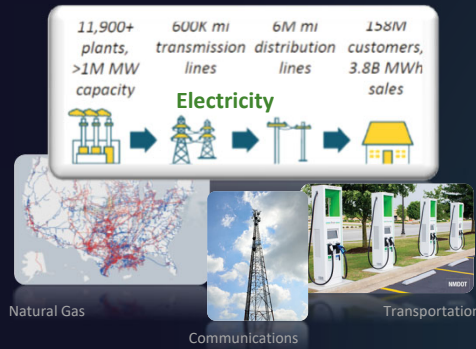
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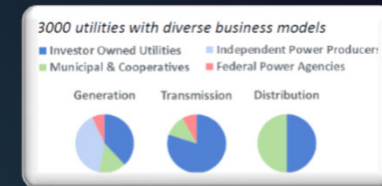
[https://liftoff.energy.gov/wp-content/uploads/2024/04/Liftoff\\_Innovative-Grid-Deployment\\_Final\\_4.15.pdf](https://liftoff.energy.gov/wp-content/uploads/2024/04/Liftoff_Innovative-Grid-Deployment_Final_4.15.pdf)

# The Grid Reality

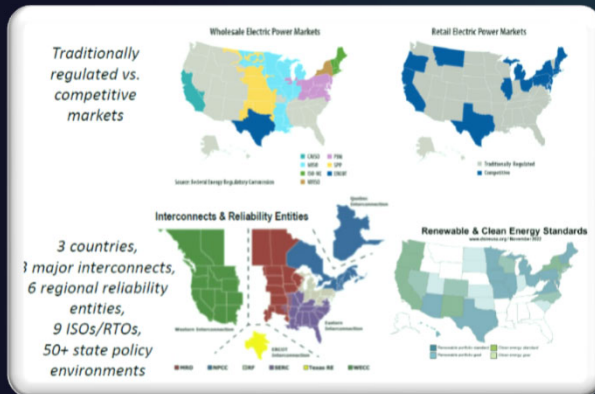
## Infrastructure environment



## Institutional environment



## Regulatory, governance, and market environment



## Threat environment



## Role of customers

- Evolving convergence of utility, 3rd-party, and customer systems and priorities
- New, rapidly emerging types of participants offering grid services and technologies which need to coherently integrate with the legacy system

# + Voices of Experience: A Peer-to-Peer Exchange on Influence of Next Generation Technologies

To maintain forward momentum, regulators are having to evaluate a new class of “next-generation technologies” proposed by utilities. **These innovative technologies are not one-for-one replacements of aging infrastructure.** Technological advancements and evolving societal and customer preferences are driving changes that are raising more complex and fundamental questions for regulators.

[https://www.energy.gov/sites/default/files/2022-05/A%20system%20in%20transition\\_5.13.22\\_web.pdf](https://www.energy.gov/sites/default/files/2022-05/A%20system%20in%20transition_5.13.22_web.pdf)



## Regulatory Wish List

The one thing all regulators could agree was that more information is imperative and always appreciated. Whether it comes from stakeholders, reports, DCM subject matter experts, or cases before other commissions, knowledge, expertise, and new perspectives are always welcome. From the insights participants shared during the conversations, and in response to the challenges commissions are facing, regulators expressed a desire for the following:

- Actionable information to evaluate utility investment value and feasibility, as well as cost recovery during these changing times.
- Access to more specifics about the technologies, their costs, uses and capabilities, and requirement for integration with other systems from trusted experts to help alleviate the increased burden on regulators.
- Support for processes on standards development.
- More information about non-utility solutions or alternatives to investments in the distribution system.
- The ability to understand the need, timing, and phasing for future investments, and how to plan for them while also ensuring they are not deployed so far in advance as to be unused for years.
- More support on evaluating transparent, open distribution planning practices and processes.
- Access to best practice approaches for standards and interoperability and their benefits in order to shorten implementation timelines.
- Information on new regulatory metrics and strategies that other state commissions are using to establish conditions for utility investment approvals, create metrics, or provide direction to utilities.
- Help developing or access to examples of alternatives to traditional cost benefit assessments.
- Support for the development of innovative rate designs for new technologies and tailoring these to specific applications or objectives.
- Opportunities for cross-commission forums that facilitate peer-to-peer engagement.
- Examples of the range of potential uses of technologies and their data.
- Support in establishing regional benchmarking measures to provide an open, public, and transparent accounting of the technologies, costs, and expected benefits.
- Input from private actors to gain a more comprehensive understanding of the opportunities for new technologies to provide solutions and private capital.
- Frameworks for developing policies that encourage innovation and growth for new utility programs or services and for market innovation and growth.
- Assistance in developing practices and frameworks related to privacy, data access, and customer autonomy that balance customer interests and utility planning and operations.
- National level frameworks that could assist in evaluating existing rules and their applicability to new technologies, and that could be used to develop regulations in their state.
- Forums to engage with other state agencies to identify common or overlapping goals, to determine technology investment needs, and to establish communication strategies about policy initiatives.
- Tools and expertise to develop EV readiness that can be used to prepare and inform infrastructure investment needs.
- More information about the interactions of EVs and DERs with wholesale markets and opportunities for grid services.

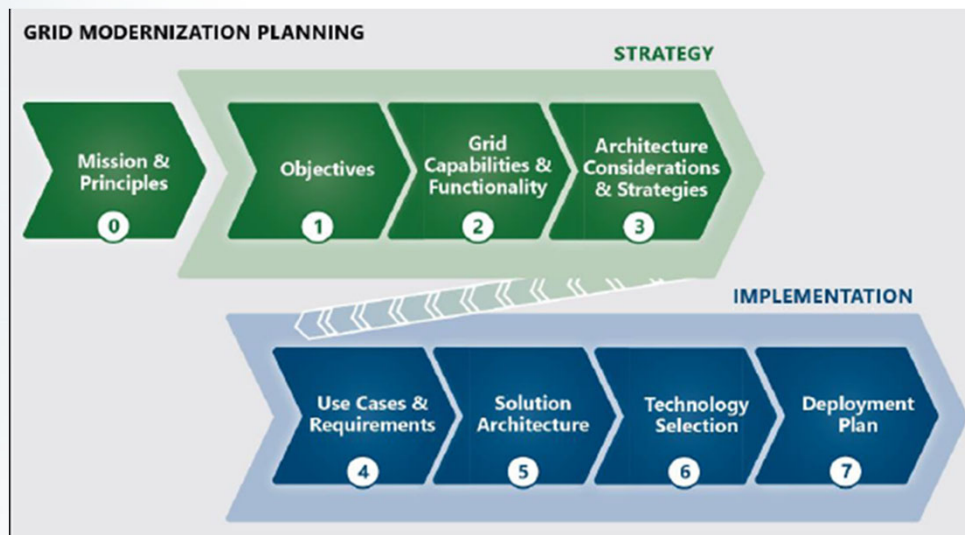
## Questions Commissions Are Asking

- ◇ What is the vision for the state regarding the electricity system?
- ◇ What is the role of the distribution utility in the vision for the state?
- ◇ What investments are required to achieve the vision?
- ◇ What opportunities exist to encourage innovations and market solutions?
- ◇ How do these technologies meet current and future customer needs and preferences?
- ◇ What is the appropriate pace of implementation to manage impacts to ratepayers?
- ◇ How are risks and benefits of investing in technologies balanced between ratepayers, shareholders, and other market participants?
- ◇ Should there be different approaches to cost benefit assessments and cost recovery?

# + Grid Modernization Strategy & Implementation Planning

**Resist the temptation to start with technology choices** --- Community/state policy objectives, metrics, and priorities, combined with customer demand and DER/EV forecasts, are key inputs into the formulation of grid modernization strategies. These strategies should holistically address both functional and structural capabilities needed over time.

Such strategies can then inform decisions on the selection and staged deployment of technology.



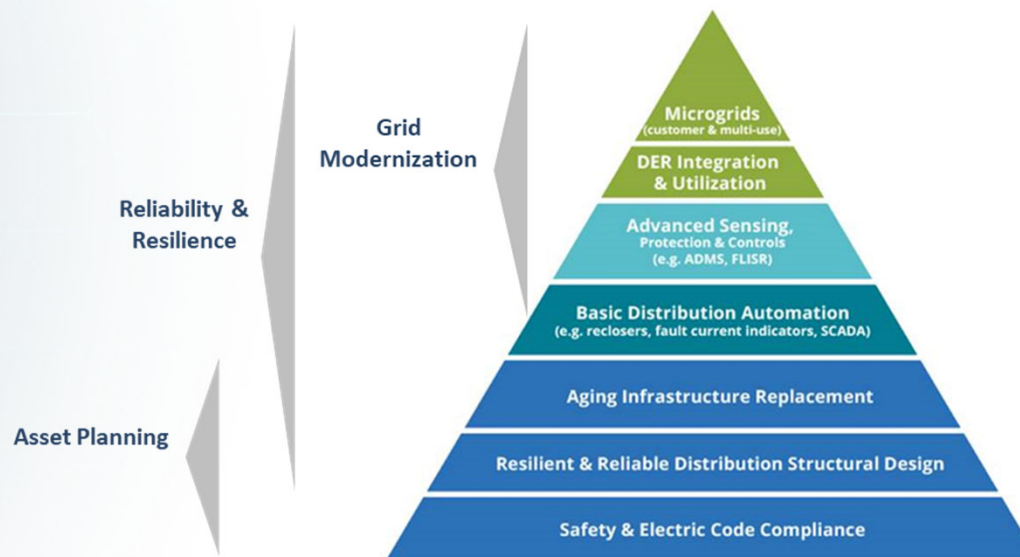
*“To the man who only has a hammer, everything he encounters begins to look like a nail.”*

— Abraham Maslow

Source: *Modern Distribution Grid Guidebook, Strategy & Implementation Planning Guidebook*, Version 1.0 Final Draft, DOE Office of Electricity, June 2020; [Modern-Distribution-Grid Volume IV v1\\_0 draft.pdf \(pnnl.gov\)](#)

# + Distribution & Modernization Investment Categories

Grid modernization technologies **layer on top of & integrate with** foundational physical grid infrastructure. Foundational investments are required to ensure reliability and resilience while enabling more advanced grid operations.

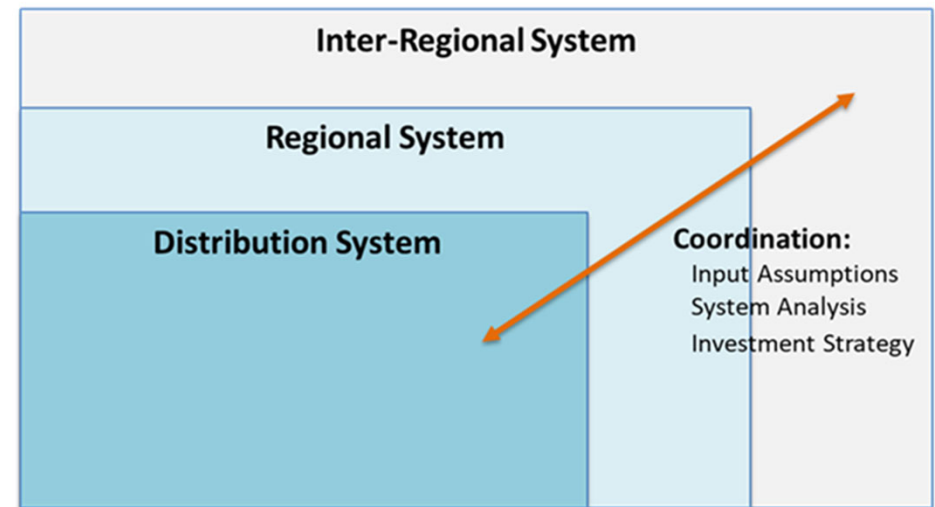


Source: De Martini

# + Comprehensive Energy Planning

**We are moving towards a regional, multi-state planning paradigm:**

- DERs are becoming part of the resource mix
- Reliance on DERs may become more pronounced to satisfy load growth requirements (electrification) given transmission system constraints
- Strategic deployment of energy storage should be considered to address flexibility requirements.
- Resilience planning will require a combination of community, state, and regional investments, with comprehensive assessments of resource adequacy.
- Understanding interdependencies between the electricity and natural gas infrastructures



***Assuming interoperability and scalable staged investment characterize our pathway forward, technologies can be either bridges or barriers to our collective energy future.***

## Additional Resources

### Distribution Grid Transformation

The U.S. Department of Energy works closely with the electricity industry to identify challenges and proactively address grid transformation issues. Policies, changing customer preferences, and innovative technologies are all transforming power system planning and operations, particularly at the distribution grid.

#### Integrated Distribution System Planning

This framework helps decisionmakers to develop holistic grid investment strategies that address community and state policies and increasing complexity at the grid edge

#### Operational Coordination

The integration and utilization of distributed energy resources owned by multiple entities requires standard processes for coordinating grid operations

#### Distribution System Design

Determining future distribution system designs will require a holistic understanding of needed functional and structural requirements.

<https://www.energy.gov/distribution-grid>



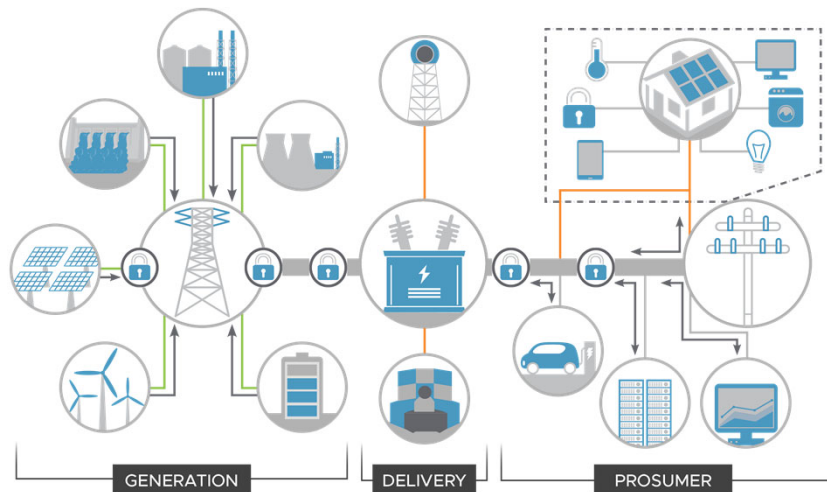


# DOE Grid Modernization Initiative (GMI)



History: Beginning in 2015, GMI has leveraged the expertise of multiple DOE Offices, National Labs, and other partners to collaborate on cutting-edge research and development and technical assistance on grid modernization topics.

The GMI focuses on developing new architectural concepts, tools, and technologies that will better measure, analyze, predict, protect, and control the grid, as well as enable the institutional conditions that allow for rapid development and widespread adoption of these tools and technologies.

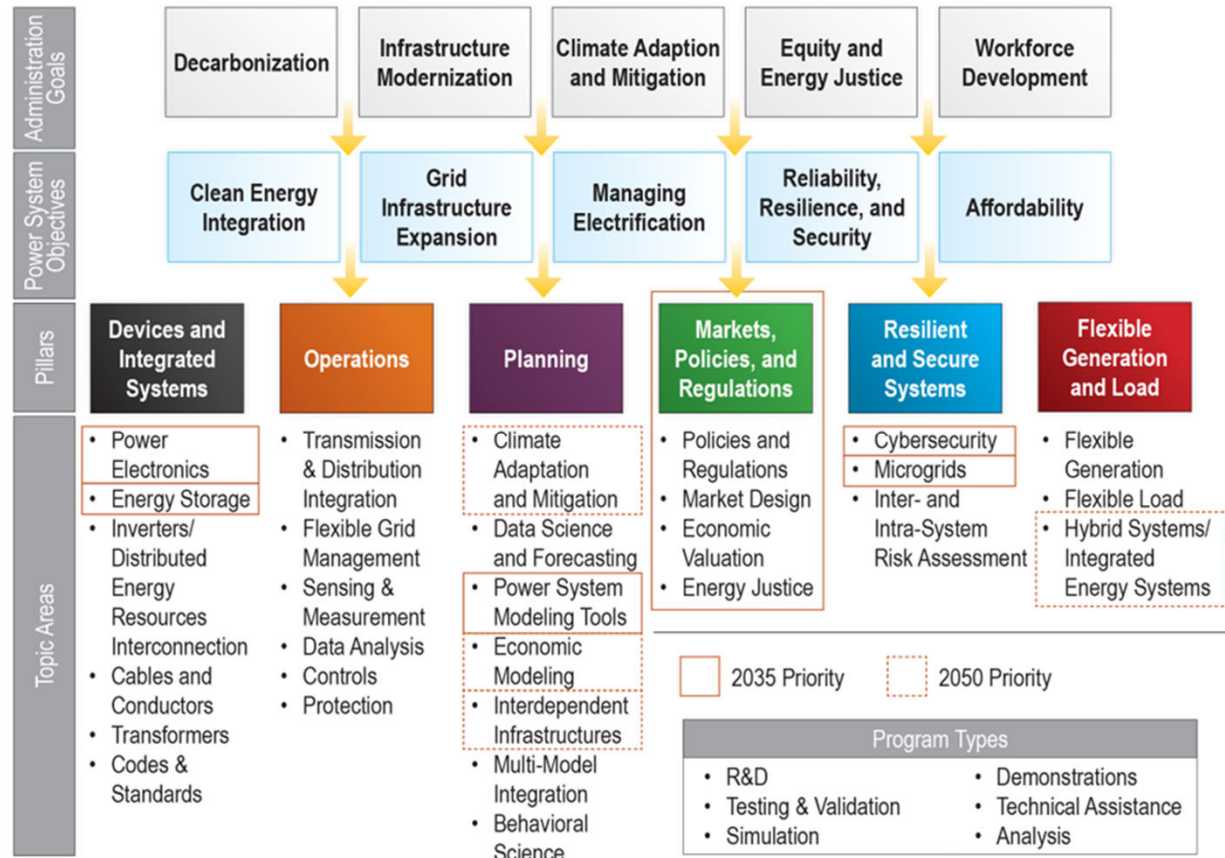
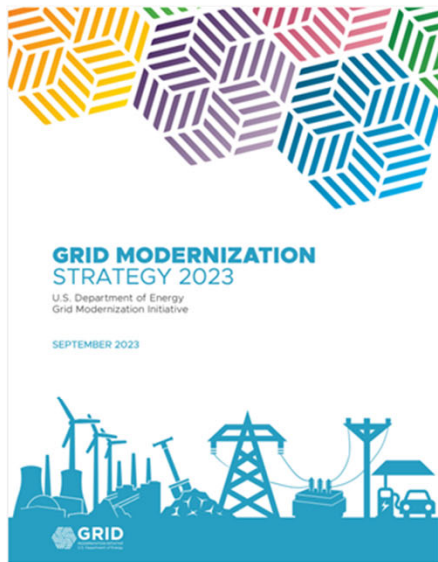


Since 2016, over \$300M has been invested in over 120 projects across the National Laboratories, industry, and academia.

Many of these advancements (e.g. transmission modeling; resilience framework; state-based technical assistance) support advanced energy infrastructure implementation.

Integration required across a complex electricity delivery system to support changing energy demands

# GMI Priorities & Six Strategic Pillars – Overview



# 2023 Topics



Topic Area 1:  
Power and Controls Electronics (PACE),  
in the Power Electronics area of the *Devices and Integrated Systems* Pillar

Topic Area 2:  
Cybersecurity for Architectures, Standards and Practices (CASP),  
in the Cybersecurity area of the *Resilient and Secure Systems* pillar

Topic Area 3:  
Quantum Facilities for Computing, Sensing, and Security (qFACSS),  
in the Power System Modeling Tools area of the *Planning* pillar

Topic Area 4:  
Equitable System Operation and Planning (ESOP),  
in the Energy Justice area of the *Markets, Policies, and Regulations* pillar

Topic Area 5:  
Climate Impact on Energy Resources (CIER),  
in the Climate Adaptation & Mitigation area of the *Planning* pillar

# GMI 2023 Lab Call Selected Projects - Details



	Project Title	National Labs	Industry and Academia Partners
1	Medium Voltage Resource Integration Technologies (MERIT) (\$13.65M)	ORNL   NREL   PNNL   SNL	Eaton   Southern Company   Viridi Parente   OPAL-RT   Florida State University   University of Arkansas   Virginia Tech   University of Colorado
2	Assessment and Coordination of Electric Vehicle Supply Equipment (EVSE) Cybersecurity Standards (\$2.4M)	SNL   ANL   NREL	University of New Mexico   FM Approvals
2	Assessment and Coordination of DER Cyber Security Standards (\$2.4M)	NREL   INL   SNL	UL Solutions   SolarEdge
2	Assessment of Communication Architectures for Energy Systems (ACAES) (\$2.52M)	PNNL   INL   NREL   ORNL	EPRI
3	Grid Research, Integration, and Deployment for Quantum (GRID-Q) (\$3.75M)	ORNL   ANL   LANL   LLNL   NETL	University of Denver   University of Southern California   University of Pittsburgh   Resilient Entanglement   IonQ
4	Advancing Equity in Grid Planning and Operations (\$1.7M)	LBNL   PNNL	National Association of Regulatory Utility Commissioners (NARUC)   National Association of State Energy Officials (NASEO)   Clean Energy States Alliance (CESA)   Northwest Energy Efficiency Alliance (NEEA)
4	Enhanced Modeling to Ensure Equitable Power System Operations and Planning (\$2M)	ANL   NREL	Carnegie Mellon University
5	Aligning Climate Analysis for Power Systems (ALCAPS) and Climate Resilient Equitable Resource Planning (CRERP) (\$6.75M)	NREL   ORNL   ANL (iustCRERP)   LANL (iustCRERP)	Tennessee Valley Authority   Electric Power Research Institute   City University of New York   Colorado State University   Evolved Energy Research   University of Connecticut   Southern Company
5	Critical Analysis of Severe Climate Events (CASCDE): A Framework to Determine Power System Impacts to Enhance Resilience (\$3.6M)	ANL   LBNL   NREL	Baringa   Jupiter   Rutgers University   University of Wisconsin

► Strong collaboration across the labs | Strong partnership with industry and academia

# GMI Pillar Team Leads



GMI Member Office	GMI Leadership Team Member
OE	<b>Gil Bindewald</b>
EERE*	<b>Kevin Lynn</b>
CESER	<b>Jessica Perry</b>
FECM	<b>Jose Benitez</b>
GDO	<b>Molly Roy</b>

ED	<b>Michael Reiner</b>
OTT	<b>Rima Oueid</b>
NE	<b>Alison Hahn</b>
SC	<b>Bill Spatz, Victoria DiStefano</b>
S4	<b>Jen Arrigo, Julien Caubel</b>

GMLC Chair (Acting): Jud Virden (PNNL)  
 GMLC Vice Chair: Juan Torres (NREL)

GMI Pillar	DOE Pillar Lead	GMLC Pillar Lead
Devices and Integrated Systems	<b>Andre Pereira (OE)</b>	<b>Teja Kuruganti (ORNL)</b>
Operations	<b>Sandra Jenkins (OE)</b>	<b>Jim Follum (PNNL)</b>
Planning	<b>Patrick Harwood (GDO)</b>	<b>Jean-Paul Watson (LLNL)</b>
Markets, Policies, and Regulations	<b>Paul Spitsen (EERE)</b>	<b>Mark Petri (ANL)</b>
Resilient and Secure Systems	<b>Cheri Caddy (CESER)</b>	<b>Bobby Jeffers (NREL)</b>
Flexible Generation and Load	<b>Meegan Kelly (EERE)</b>	<b>Ning Kang (INL)</b>

# Questions

NMSU Current Issues 2024

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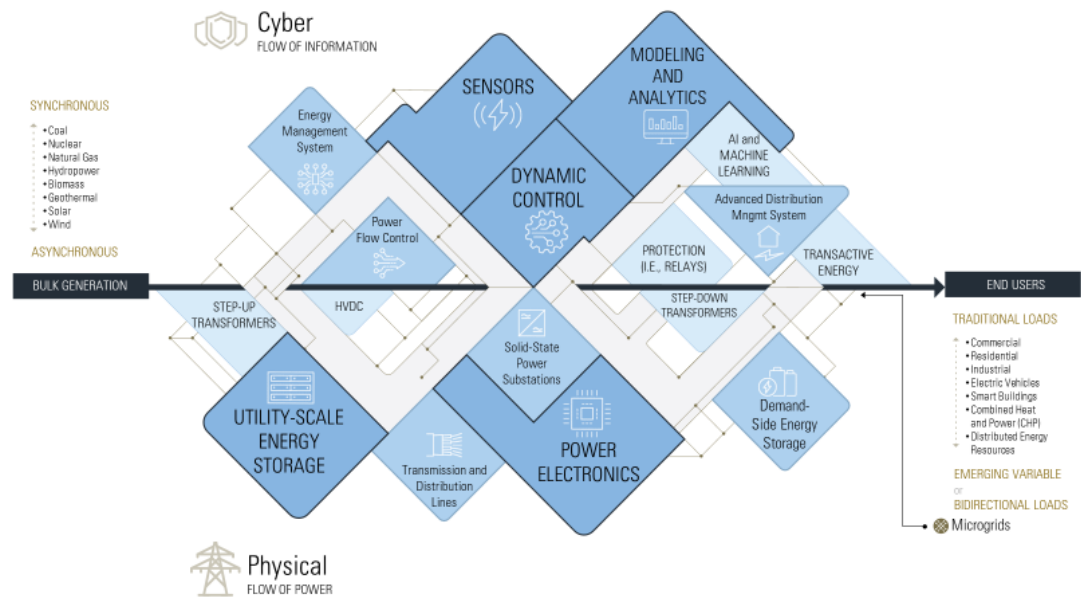
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# + Office of Electricity

- Reliability, Resilience, Security, Affordability**

The Office of Electricity leads the Department of Energy's **research, development, and demonstration** programs to **strengthen and modernize our nation's power grid** so that our nation maintains a **reliable, resilient, and secure electricity delivery infrastructure**.

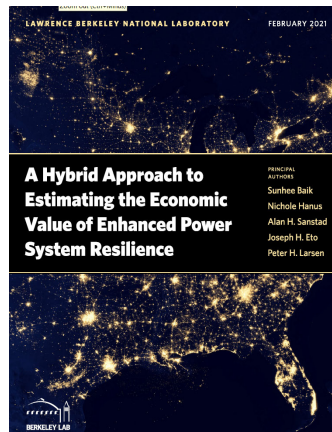
Working closely with industry and other stakeholders, we drive **technological and operational advancements** that ensure that every American home and business has reliable access to **affordable energy**, and that the U.S. sustains its **global leadership** in the clean energy transformation.



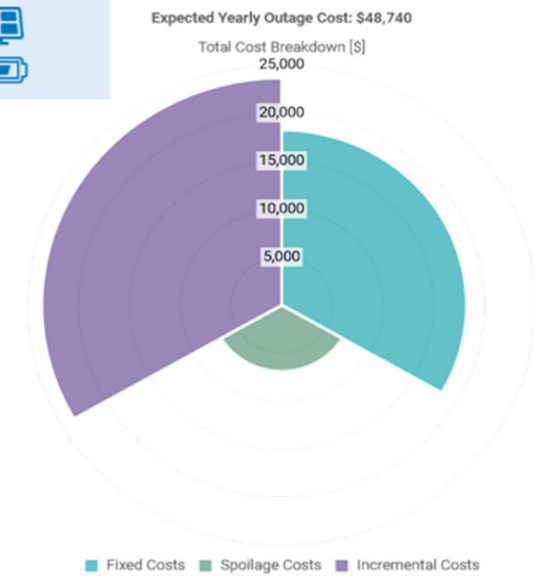
# Metrics for resilience planning - economic



The DOE-funded **ICE Calculator** allows users to estimate the direct costs to customers from power interruptions lasting 24 hours or less—or the value of investments in power system *reliability*



**POET** will allow users to estimate the direct and indirect economic impact of widespread, long duration power interruptions—or the value of investments that enhance power system resilience



The **Customer Damage Function calculator** allows a more granular estimate of economic losses for individual facilities or customers.



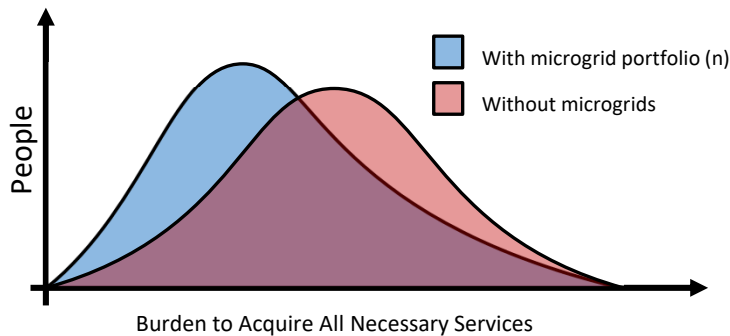


# Metrics for resilience planning - social

DOE has invested in quantifying the performance of society, developing a novel “social burden” metric and quantification approach:

- How hard must people work to **maintain wellbeing** during disruptions?

Aligns DHS FEMA “Community Lifelines” and the Social Justice “Capabilities” theory relating infrastructure availability to human wellbeing



While we have resilience metrics, we have **not validated** these metrics at the appropriate scale - Limited by data

Based on the capabilities framework, Sen and Nussbaum, later applied to energy by Day et al. (2016); Nussbaum, [Capabilities as fundamental entitlements: Sen and social justice](#), 2003; Sen, [Human Rights and Capabilities](#), 2005; Day, R., Walker, G., Simocck, N. Conceptualising energy use and energy poverty using a capabilities framework. Energy Policy. 2016.



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## EVGrid Assist: Accelerating the Transition

*Comprehensive VGI Technical Assistance Initiative*

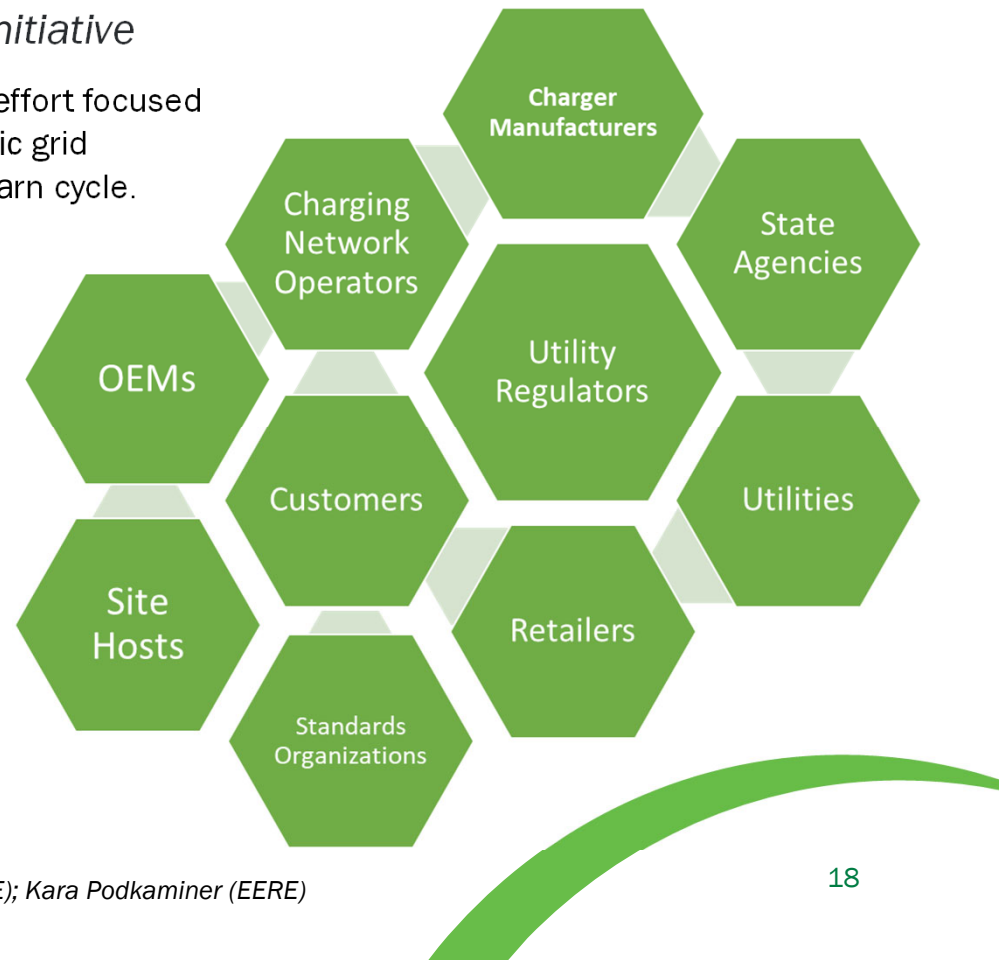
A new cross-DOE coordination and technical assistance effort focused on the interface between vehicle charging and the electric grid considering the full spectrum of the R&D, deploy, use, learn cycle.

**Purpose:**

- Increase stakeholder knowledge
- Drive actions to resolve VGI challenges and barriers
- Provide pathways for stronger VGI coordination

**Objectives:** Activate the community to

- Prioritize challenges to solve
- Accelerate planning and decision making
- Enable proactive infrastructure investments and supporting markets, rates and regulations
- More quickly achieve decarbonization goals



POCs: Chris Irwin (OE); Kara Podkaminer (EERE)