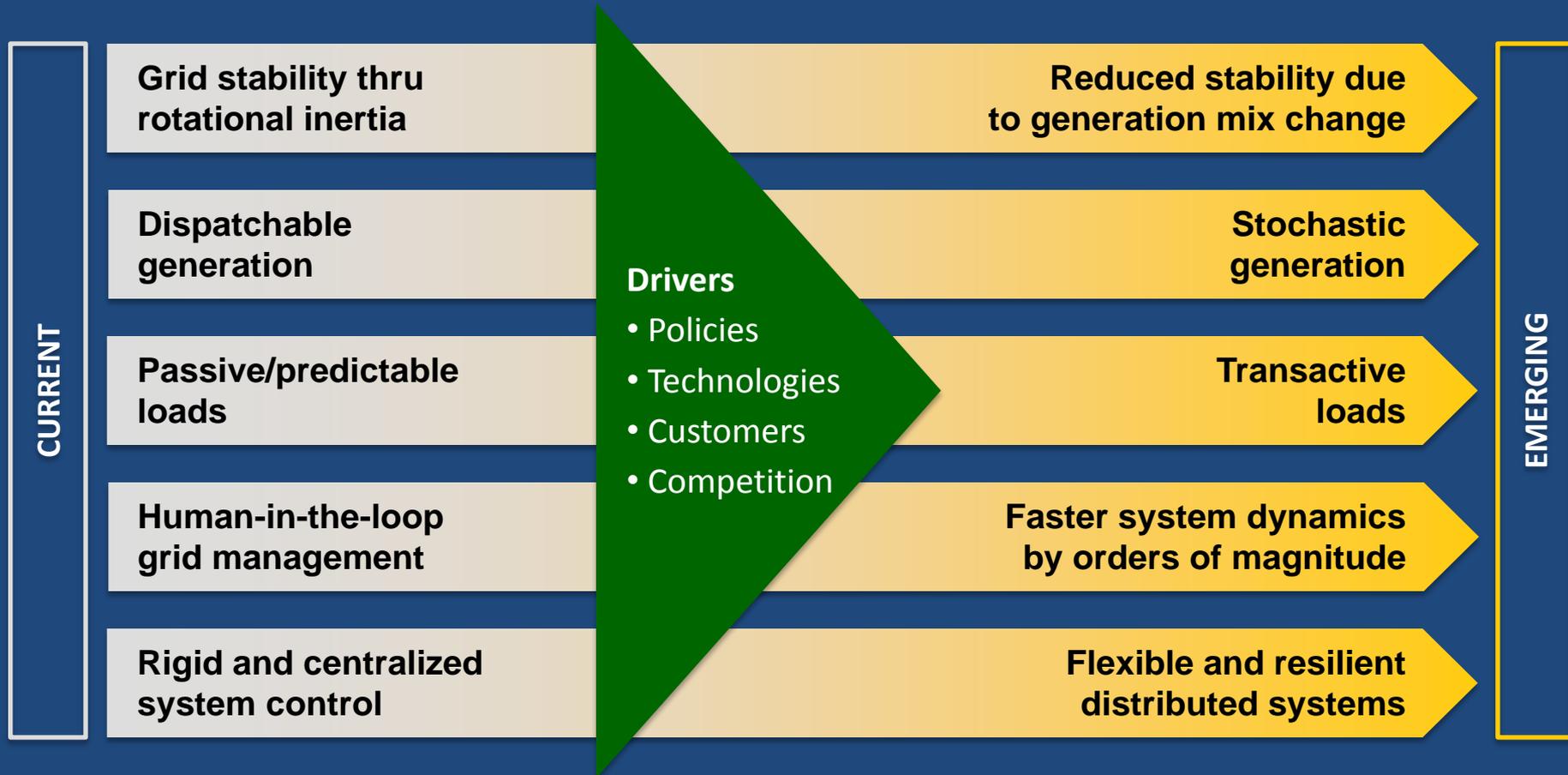




SCE's Advanced Technology Labs

Design Considerations for highly inter-connected
Smart Grid Test Beds

The electric utility system is facing fundamental changes



A common and holistic understanding of grid modernization is needed to thrive in this complex future



Smart Grid Test Beds coordinating efforts can accelerate grid modernization

- Define and prioritize problem spaces to be addressed
- Inter-connect and share
 - Resources, capabilities, services
 - Methods, tools, calibration observations and findings
 - Testing, management and safety processes and procedures
- Technology maturity findings and associated reliability and resiliency considerations
- Common Knowledge Base

Shared practices around a structured approach can shorten research to reality timeframes

Investigation

- Selection of projects based on various SCE organizations' inputs
- External collaboration with Tech Advisory Boards, research organizations, VCs, universities, standards bodies, utilities

Modeling/ Laboratory Evaluation

- Testing prototypes
- Building predictive models
- Assessing market entrants
- Systems integration
- Evaluating grid impacts

Demonstration

- Integrating devices and systems in a real world environment
- Evaluating cost/benefits

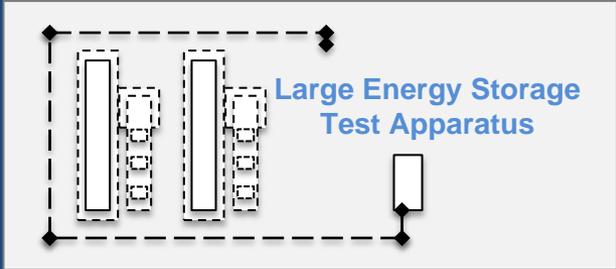
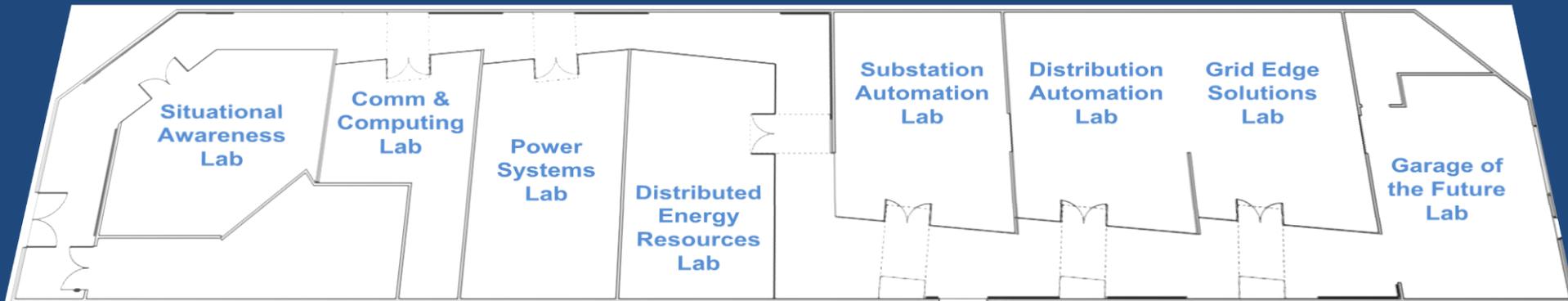
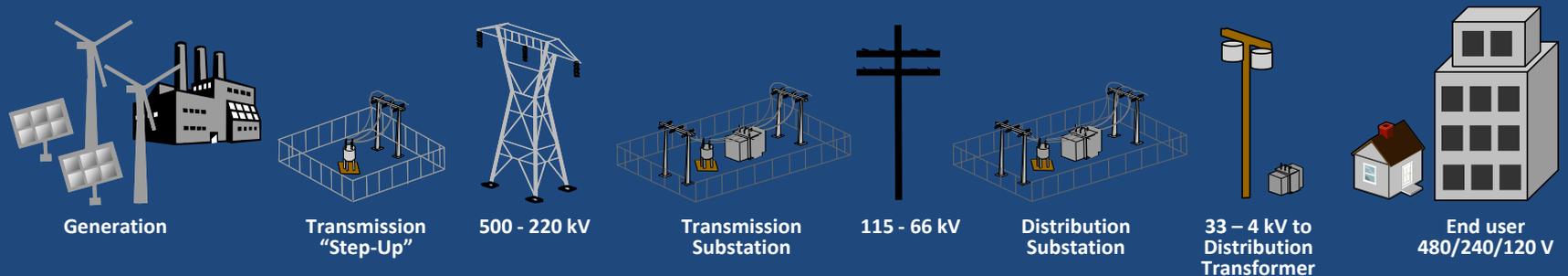
Pilot

- Standards process
- Training development
- Performance validation and verification
- Support capital decision process

Deployment

- SCE standard
- Project support
- Knowledge transfer
- Ongoing consultation

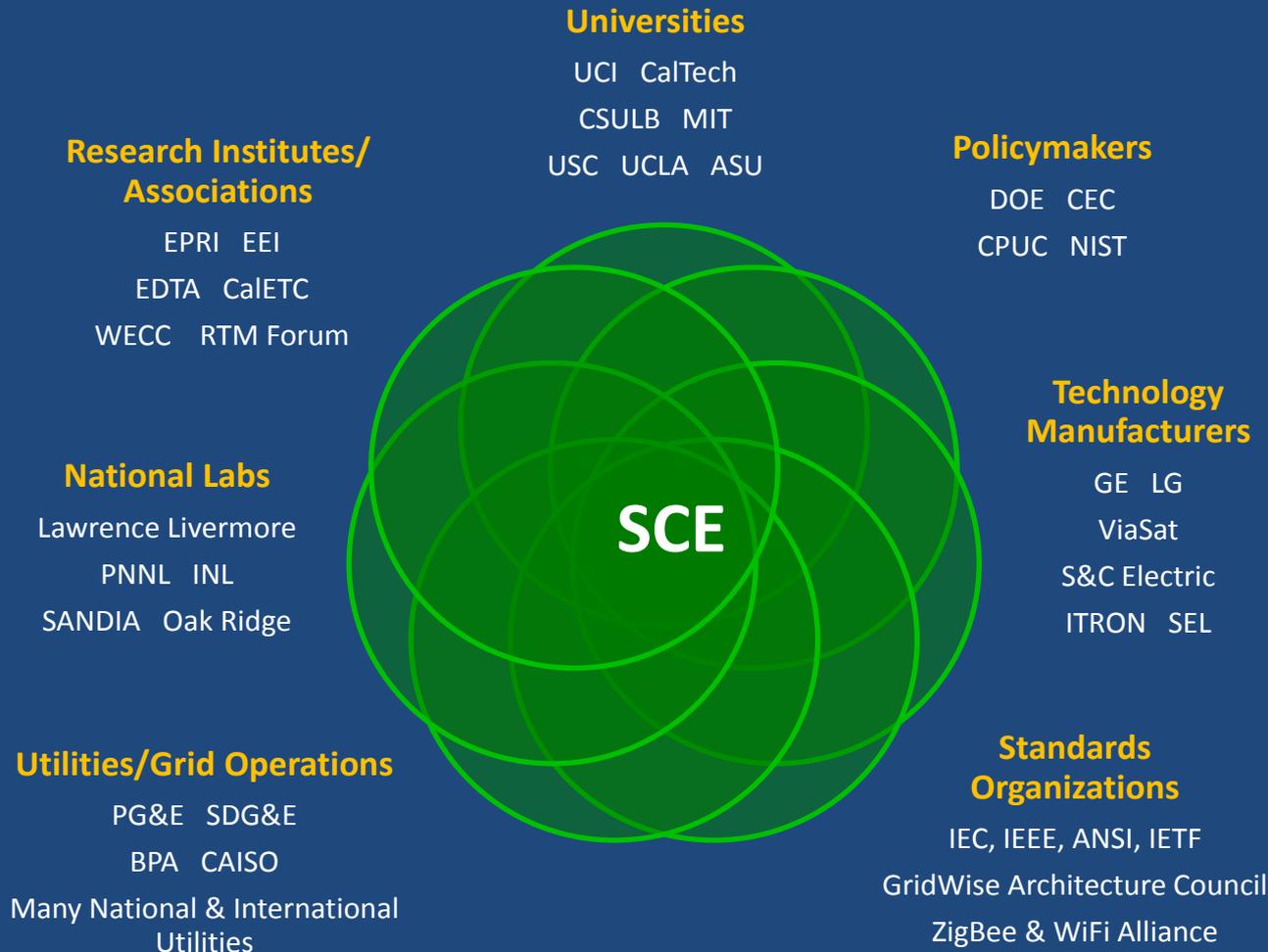
Inter-connected labs can provide an integrated platform for evaluating system of systems designs



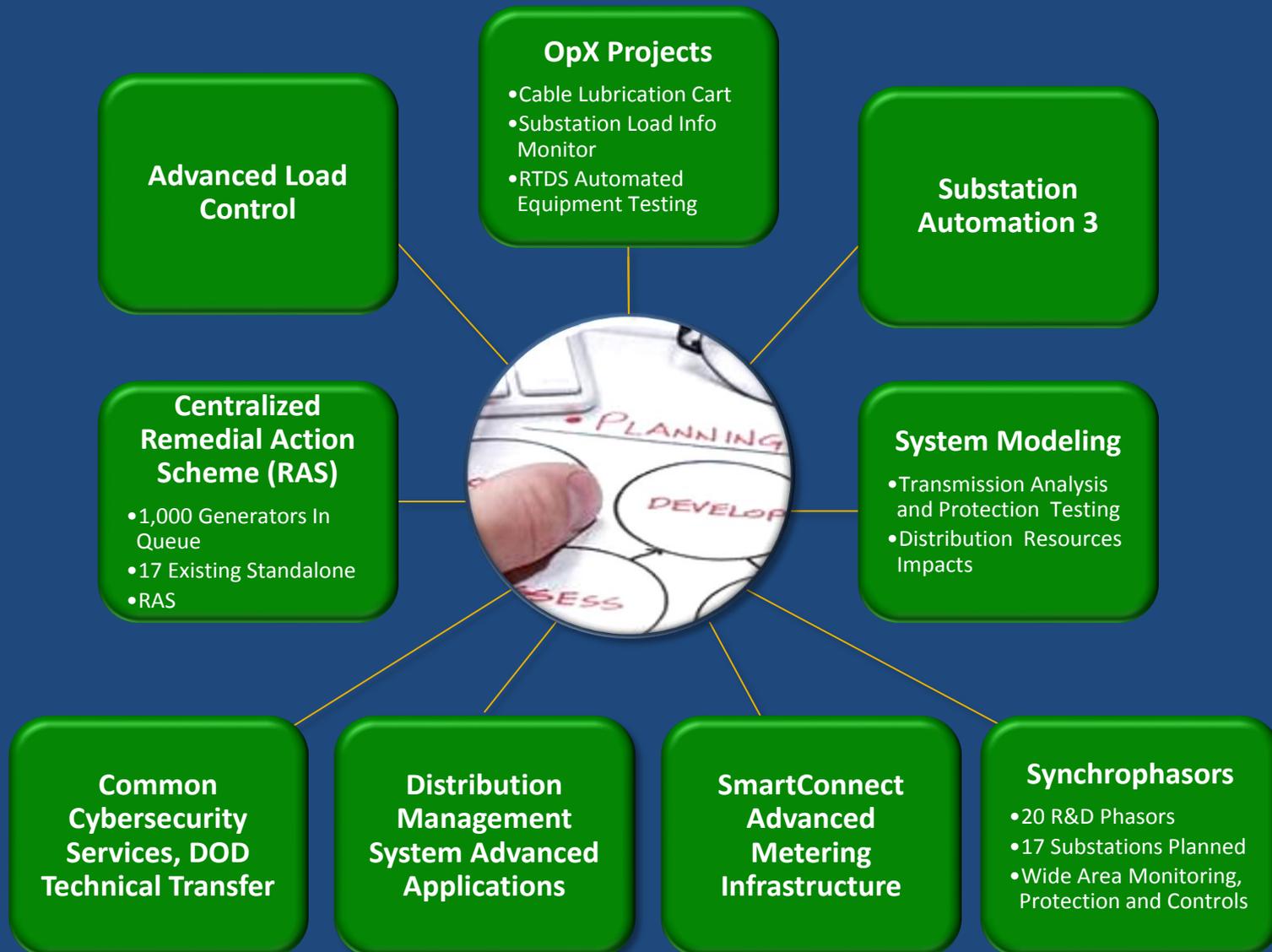
Technical Design Considerations for Inter-connected Smart Grid Test Beds

- Rapid Network Connectivity, Segmentation, VLAN Conventions, Protocol support (IP & Non-IP)
- Virtualization and test environment creation
- Model portability and platform constraints (i.e. RTDS vs. HPC)
- Common cyber-security and asset management services
- Configuration management
- Tolerance in terms of time and costs associated with system integration and vendor interoperability when conducting system tests

Collaboration across the industry and with other Smart Grid stakeholders is required to maximize the value of a network of Smart Grid Test Beds



SCE's SG lab operationalized these projects, imagine what a network of labs could yield



Technology demonstrations in real-world situations provides feasibility, costs and benefits of potential solutions

Irvine Smart Grid Demonstration (ISGD)



Description: An end-to-end demonstration of numerous smart grid technologies which will test the interoperability and efficacy of key elements of the grid, from the transmission level through the distribution system and into the home.

Total Cost: \$80 million

Department of Energy (DOE) Funds: \$40 million

Project Schedule: Lab testing, construction, and field testing began in 2013. Testing will continue into 2015.

Tehachapi Wind Energy Storage Project (TSP)



Description: Build one of the world's largest battery energy storage systems (BESS) (8MW for 4hr/32MWh), near Tehachapi wind farms to demonstrate 13 operational uses for energy storage including intermittent resource integration, operation and transmission benefits.

Total Cost: \$57 million

Department of Energy (DOE) Funds: \$25 million

Project Schedule: Construction began at Monolith in 2012. Pre-commissioning is scheduled to commence in late 2013.

SCE's Advanced Technology Labs

Creating a Smarter, Safer, More Reliable Energy Future



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