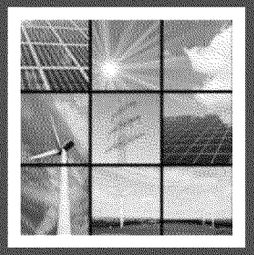

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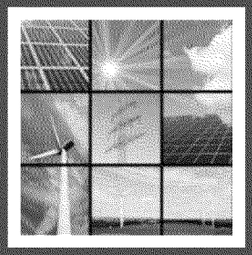
California Energy Systems for the 21st Century CPUC Review and Comments

November 15, 2013



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CES-21 Briefing Agenda

Welcome & Introductions – 5 minutes

- CES-21 Joint Utilities:
  - SCE: Glenn Haddox, Michael Hoover, John Minnicucci
  - SDG&E: Scott King, William Blattner, Corey McClelland
  - PG&E: Steve Knaebel, Antonio Alvarez, Erik Jacobson
- LLNL -- John Grosh

Note on Public Disclosure

Overview - 10 minutes

- Definition of "Cyber Security" and "Grid Integration"
- Joint Report

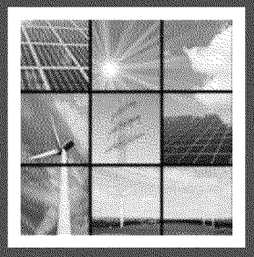
Research Area Presentations + Q&A - 30 minutes

- Cyber Security
- Grid Integration

Next Steps - 15 minutes

- Schedule and Cost Approach
- Governance Structure and Research Partnerships

Adjourn



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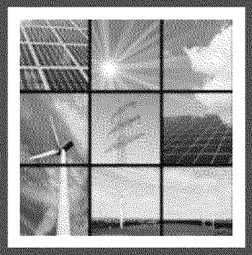
Note on Public Disclosure

The CES-21 Cyber Security R&D effort is focused on the protection of critical infrastructure, therefore a secure process for reporting and a secure process for deliverables will need to be maintained. Detailed tactics, techniques, and procedures developed for use by the IOUs will be marked and handled as

"For Official Use Only (FOUO)"

and not open to the public.



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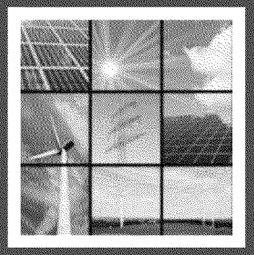
Definition of "Cybersecurity" and "Grid Integration"

Cyber Security
Fundamental research in industrial control systems (ICS) cybersecurity is a young science. Valuable research topics include:

- detection of advanced threats
- detection of previously unknown threats ("zero-day vulnerabilities")
- automated response to threats
- operating ICS infrastructure in the face of constant attack (how to build a "resilient" grid)
- modeling and simulation of threats and response scenarios
- vulnerability assessments / supply chain analysis of grid components

Grid Integration is a "cross cutting" research category.

The challenges of grid integration, particularly with respect to the integration of renewable resources, is an important area for further research to facilitate the integration of 33% renewables by 2020.



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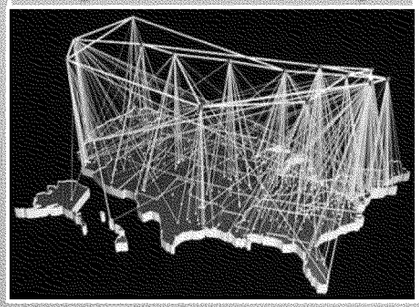
CES-21 is built around areas of collaboration

The joint IOU report will address:

- the scope of all proposed research projects
- how the proposed project may lead to technological advancement
- potential breakthroughs in cyber security and grid integration
- the expected timelines for concluding the projects

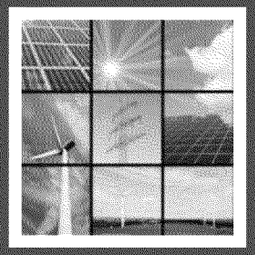
Cyber Security



- Advanced analytics and situational awareness of the grid
- Integrated algorithms to effectively capture, analyze, and share data on demand
- Machine to Machine Advanced Response Capability

Grid Integration

- Weather uncertainty affecting customer load, and intermittent renewable generation
- Operating flexibility metrics /standards and evaluation tools to facilitate the reliable and cost-effective integration of new energy policies



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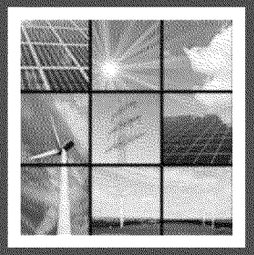
Cyber Security Research Overview



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Cyber Security Proposed Project

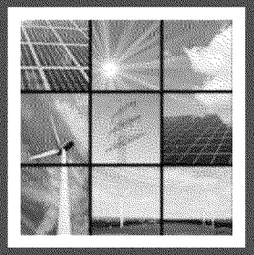
Non-duplicative efforts folded in

- Advanced Threat Analysis Capability
  - Develop tools and algorithms to analyze large amounts of the IOU network data to detect advanced emerging cyber attacks and improve situational awareness
- Modeling and Simulation
  - Build a computational simulation codes that couples the industrial controls systems communication infrastructure with generation, transmission and distribution networks, storage, and loads to simulate cyber attack and defense.

- *Machine to Machine Automated Threat Response (MMATR)*
  - The proposed research is intended to develop automated response capabilities to protect critical infrastructure against emerging cyber-attacks. Due to the time criticality of these cyber-attacks, the only way to effectively protect the critical infrastructure will be through automated response capabilities.

Required ModSim included

Preliminary



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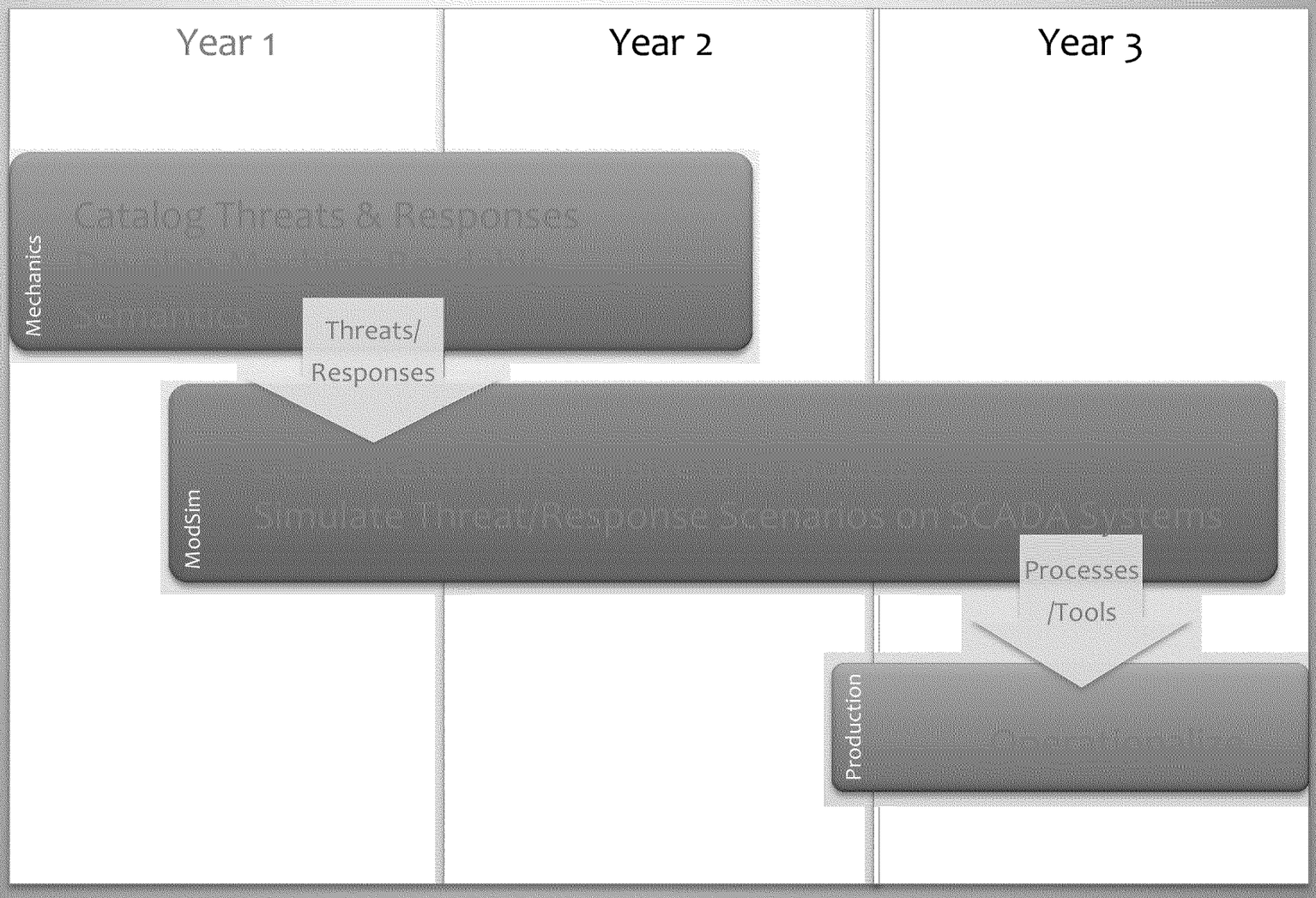
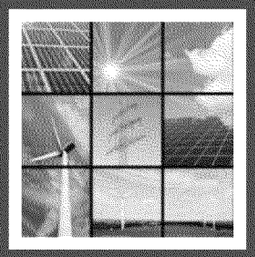
Cyber Security

Preliminary

MMATR Timeline – 3 phases over 3 years





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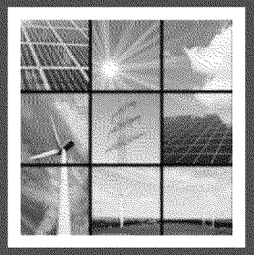
Grid Integration Research Overview



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CES-21 Grid Integration Proposed Project

- The utilities are reviewing the **Flexibility Metrics and Standards** project for inclusion in revised CES-21
- This project as previously adopted anticipated benefits to customers in excess of costs through improved long term resource planning metrics and tools.

Flexibility Metrics and Standards (about $2M, 2 years)

Need:

Integrating high levels of intermittent renewable generation requires the system to be operationally flexible.

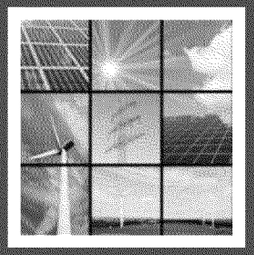
We require new planning metrics and tools to: 1) assess the system requirements for flexible capacity, 2) measure the contribution of existing and new resources to meeting these requirements, 3) quantify the residual system need for new resources with different operating attributes, and (4) evaluate the cost-effectiveness of resources alternatives with different operating attributes to meet residual system needs.

Objective:

The proposed project will build on previous work done by CAISO/E3, SCE, EPRI, and LLNL for the CEC incorporating weather uncertainty affecting customer load, and renewable generation to:

1) Propose operating flexibility metrics based on probabilities of flexibility requirements, such as regulation, net load following, and ramping up/down requirements,
2) Test candidate operating flexibility metrics and requirements (standards) in simulations of weather forecasts,
3) Develop new methodologies and improved tools for unit commitment and economic dispatch able to measure the contribution of resources to meeting these requirements, quantify the residual system need for new resources with different operating attributes, and evaluate their cost-effectiveness.

Preliminary



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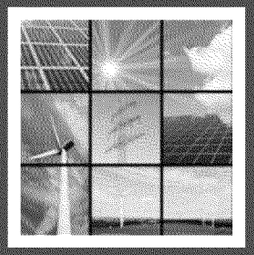
Next Steps

- Schedule and Cost Approach
- Governance Structure and Research Partnerships



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Timelines and annual cost for projects in *Cyber Security and Grid Integration*

Machine to Machine Automated Threat Response

Total Estimated Project Cost:

$28M

YR1	YR2	YR3	YR4	YR5
$11M	$9M	$8M		

Grid Integration

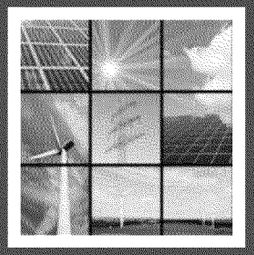
Total Estimated Project Cost:

$2M

YR1	YR2	YR3	YR4	YR5
$1.2M	$0.8M			

$5M (14.3% of total $35M) held in reserve for future efforts or expansion of current efforts based on need

Preliminary



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Cyber Security and Grid Integration

IOU Program Management and Governance Structure

Program Management

1. Each IOU will have a Program Manager for CES-21
2. The three (3) Program Managers will rotate as Chair each year and will be responsible to all program related management
3. The Program Managers will report to a Joint IOU Steering Committee for internal IOU reporting, review and strategic direction

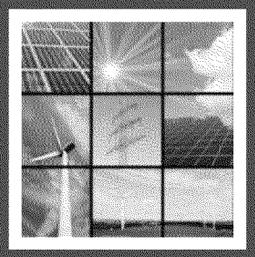
Program Governance

1. CES-21 will report to CPUC as directed in SB96 Legislative Language
   - Joint IOU Report Due 1Dec13
   - Final Report at 60 Days after conclusion of all R&D
   - Propose semi-annual status reports to CPUC
2. Milestones and deliverables will be determined upon authorization of business case

Contract Vehicle

1. Joint IOU/LLNL Contract Vehicle will be a DOE Cooperative Research and Development Agreement (CRADA)

Preliminary



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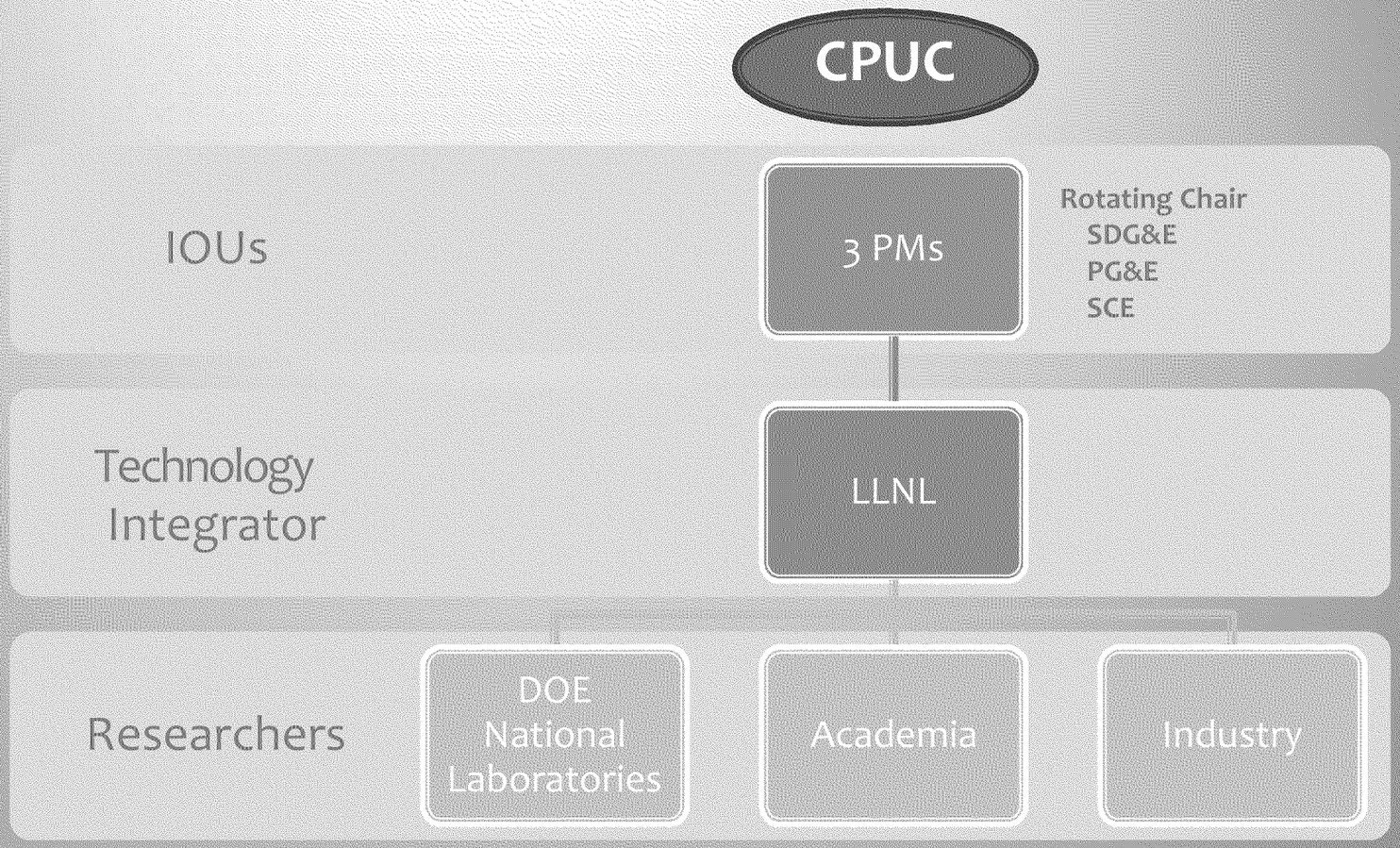
Governance Structure



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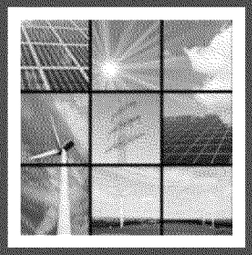

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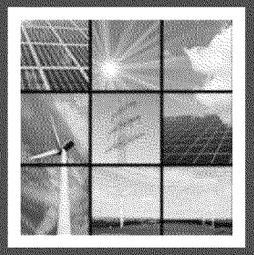
Appendix



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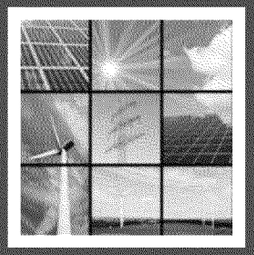
Cyber Security

Historical Perspective

The joint IOUs believe that the legislature acknowledged the two original business cases labeled ATAC and ModSim when wording SB96. Those business cases were inter-related and together sought to analyze grid-connected cyber systems and develop a defense against cyber threats that would be pervasive throughout a more thoroughly integrated grid.

The evolving nature of the threat has matured thinking on how best to accomplish the goals set forth by ATAC and ModSim. In the past year efforts have been undertaken by both DoE and DHS to categorize and share threat data among utilities, however this is still a completely human-in-the-loop operation AND there has been almost no research into how best to respond to an attack.

For these reasons the joint IOUs have combined the ATAC and ModSim business cases, removed the duplication with other ongoing efforts and oriented a new business case towards quicker, machine-to-machine threat recognition and response.



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Cyber Security
Modeling and Simulation

Potential customer benefits

1. Ability to develop detection and mitigation strategies to emerging vulnerabilities before they can be exploited
2. Explore and evaluate incident response scenarios in advance of need, to improve the time to respond and recover
3. Capability to replay cyber incidents, with variations, to understand the range of risk exposures in similar situations, and the possible consequences of response strategies other those utilized at the time of incident
4. As a planning tool in assessing operational benefits and risk reduction that could be realized by future grid improvement proposals. Such information would enable rapid quantitative assessment of potential benefits as part of developing future rate cases
5. Provide training and exercise capability for incident detection and response
6. Evaluation of disaster response, recovery and restoration plans at the IOU and CALISO level, enabling all stakeholders to understand drivers and consequences outside their own domain