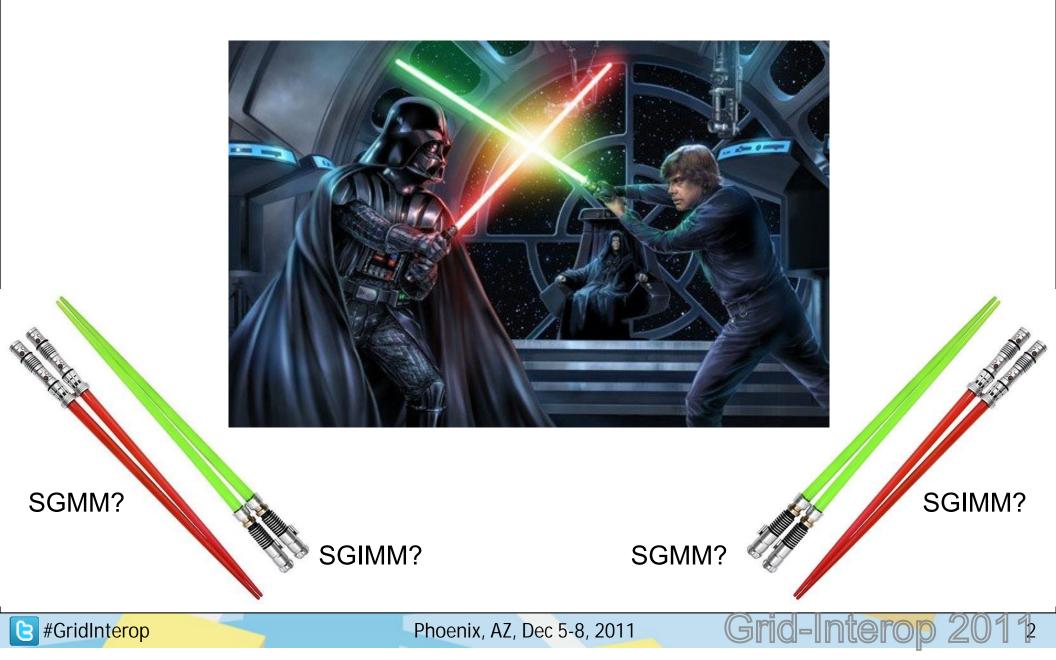


#### The Smart Grid Maturity Model & The Smart Grid Interoperability Maturity Model





#### Maturity Models – Dueling or Complementary?



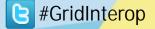


- Technology has been evolving ever since the industry was born
- Technology today is moving faster than our ability to respond to it
- To achieve Smart Grid will require interoperability across a wide spectrum of participants and systems
- In systems of systems this large, we need to focus on:
  - Human
  - Organizational
  - Policy
  - Hardware and
  - Software components
- So where do SGMM and SGIMM fit into this?



#### SGMM and SG IMM

- The SGMM and SG IMM have different but potentially complementary purposes and uses
  - SGMM
    - Is a management tool to support utility smart grid planning and implementation;
    - It references interoperability as a key element of smart grid maturity
    - It does not focus on how to achieve it
  - SG IMM
    - Is specifically designed to assist stakeholders in achieving interoperability between devices and systems that support smart grid capabilities
- The SGMM and SG IMM teams are exploring ways to collaborate for the benefit of users of the two tools





#### BUSNESS PROCESS & OPERATIONS

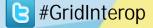
# DATA, INFORMATION, & SYSTEMS INTEGRATION

Grid-Interop

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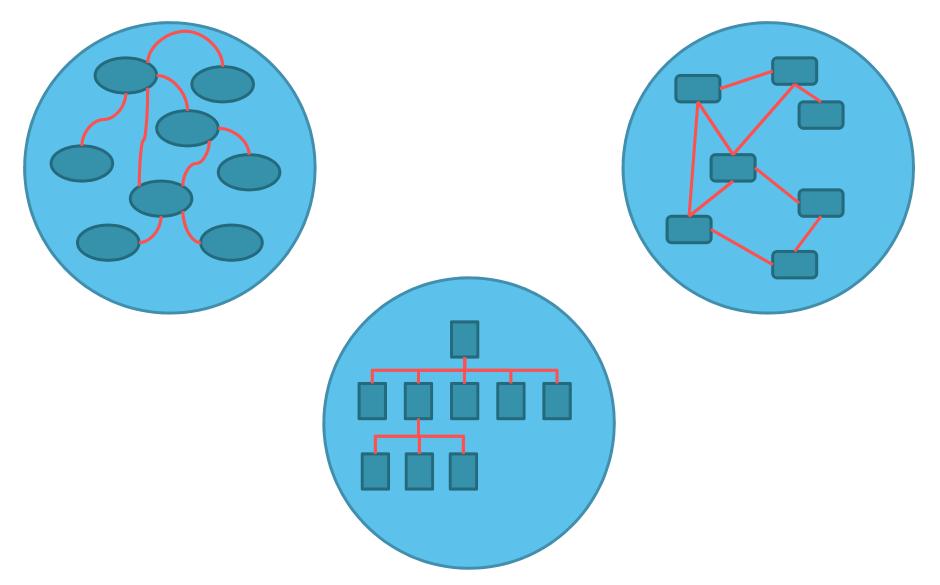
# ORGANIZATION, STRUCTURE, & REGULATION

Several key elements referenced in SGMM and SGIMM





Grid-Interop 201%

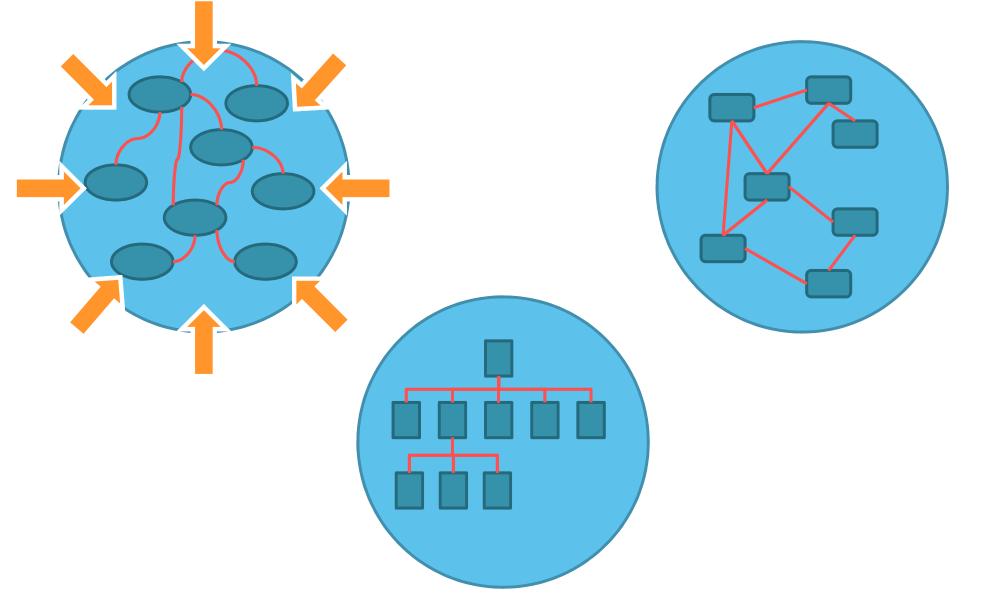


Several key elements referenced in SGMM and SGIMM



11

Grid-Interop 20

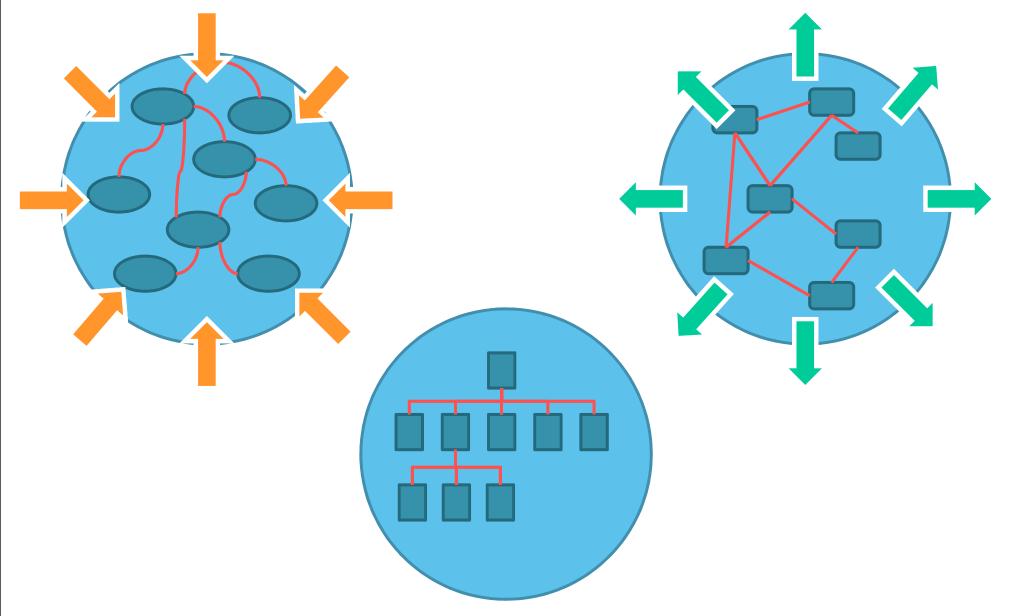


SGMM can be viewed largely as an internal focus

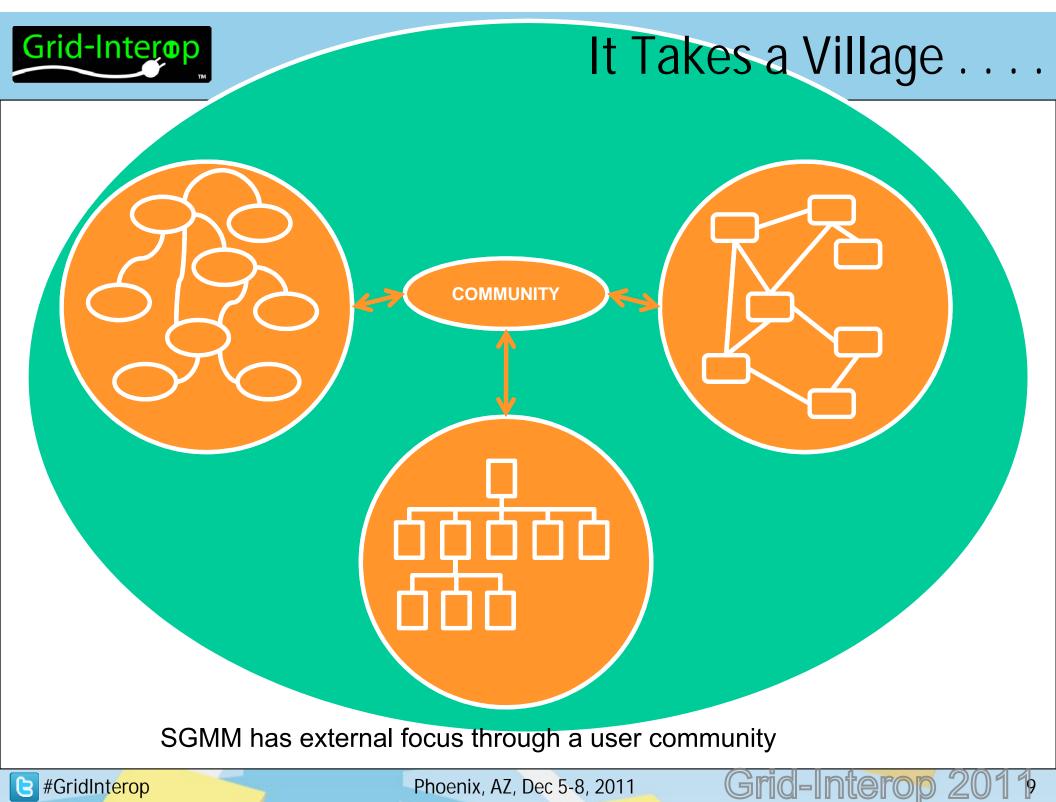


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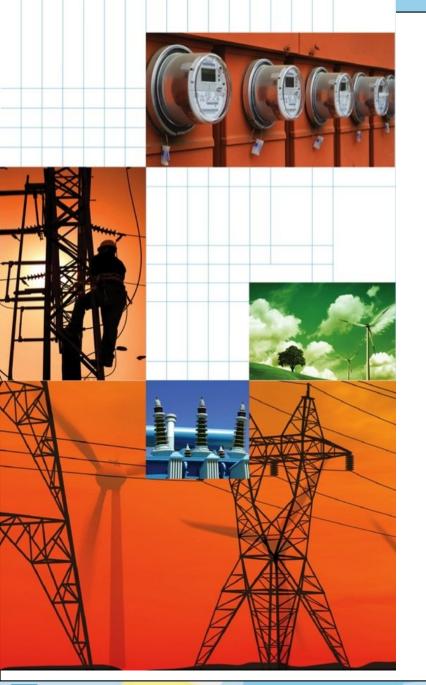


SGIMM can be viewed largely as an external focus



#GridInterop B

## Smart Grid Maturity Model



#### How can utilities

- Develop effective roadmaps?
- Track progress?
- Understand their posture in comparison to peers?

The Smart Grid Maturity Model was developed by utilities to address these concerns



A management tool that provides a

common language and framework for defining key elements of smart grid transformation and helping utilities develop a programmatic approach and track their progress





## SGMM timeline

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2007 20	08 2	2009 2		2011	2012
Global Intelligent Utility Network Coalition (GIUNC) develops SGMM GIUNC: CenterPoint Energy Progress Energy Progress Energy DONG Energy North Delhi Power Ltd Country Energy Sempra Energy Pepco Holdings IBM APQC	SG	oftware Engi SE MM v1.1 pro	neering Institu I releases oduct suite fication progra avigation begin		

Developed by utilities for utilities



#### Software Engineering Institute

SEI is a federally-funded research and development center at Carnegie Mellon University, a global university recognized worldwide for its energy and environmental research initiatives.

A trusted, objective source of best practices, methods and tools to organizations worldwide, SEI is a global leader in software and systems engineering, process improvement and security best practices – all critical elements of smart grid success.

SEI collaborates in public-private partnership with government and industry on important cyber security, architecture, and interoperability challenges of the smart grid.







## SEI's Role as Steward of the SGMM





- Provide **governance** working with multiple stakeholders
- Enable widespread availability, adoption, and use of the model for the benefit of the community
- Evolve the model based on stakeholder needs, market developments, user feedback, and interactions with domain experts
- Develop transition mechanisms education, training, awareness, research collaboration to support the model
- Grow the SGMM community of users
   worldwide



#### SGMM at a glance

#### 6 Maturity Levels: Defined sets of characteristics and outcomes

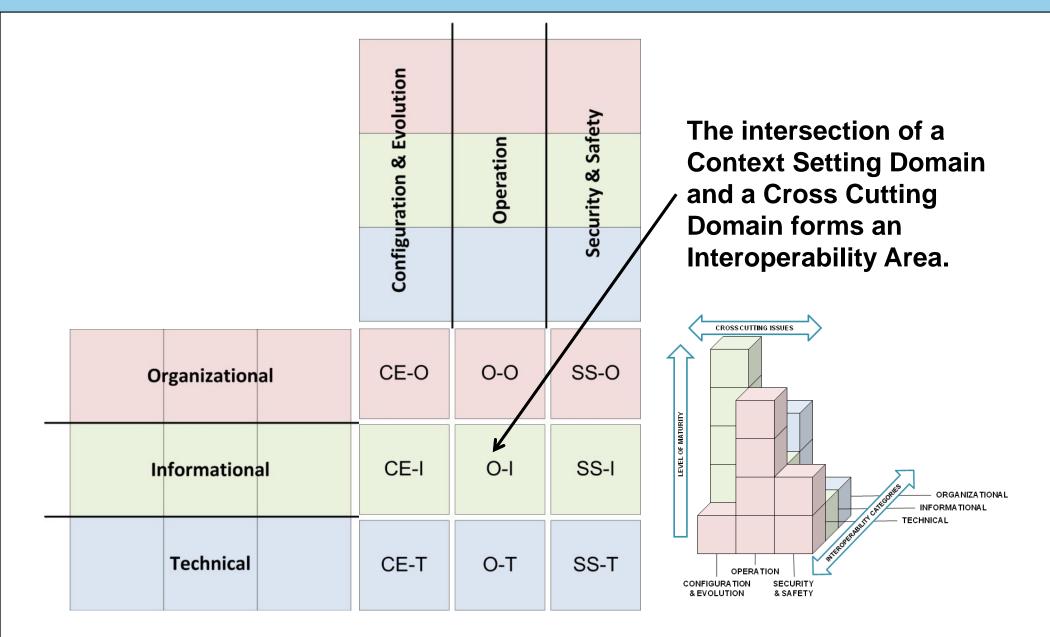
5	<ol> <li>Smart grid strategy: capital-less or smart grid as a foundation for the strated.ction of new services and packar, of derings.</li> <li>Smart grid barness activities provide sufficient financial resources to suble contracted mestment in smart grid sublemment and expension.</li> <li>New barness model opportunities emerge as a result of smart grid capabilities and are implemented.</li> </ol>	The organizational structure analyses polisiblication with other grid sublabilities to optimitic ownall grid population and health.     The organization is able to madily adder to apport, their winnurses, products, and services that menges is a stand of smart grid.     Oramedia are algoritication themself stand, theory from and logistic products, and taking hitsma shareses in process, workforce compreferences, and technology.	1 Self-having capabilities are present. 2 System-web, analytics-based, and autometed prof decision making is in place.	<ol> <li>The use of assists between and access supply chain participants is optimized with processes defined and executed access the supply chain.</li> <li>A losses are liveraged to maximize solication; including user-traine access retrements; based as smart grid date and lystems.</li> </ol>	Automone comparing and nucleum learning are implemented.     Zhe enterprise information infractionary an automatically identify instrume, and nucleum fram cyber incidents.	Lostomer can manage ther end-to-end energy supply and usage levels     There is submark catage detection of perivace or divice livel     They and-pair, continue categories catagories     Sub-grand-pair, continue categories     Sub-grand-pair, for all contines data is assured     Sub-grand-pairs	The optimulation of alreagy lastest is automated across the full easier chain.     Teleconcers are adducatively opportunitable and controllable is that the organization can be advectage of granular market options.     So the organization is automated control and across optimulation achieves consider and across the spanial and/or neticonal grid optimulation.	Ingle bottom line goals align with local, regional, and hadronil abjectives.     2 Outcomest potential free regio-based environmental forcements through automatics of these end-ta-end energy scaply and usage level levels possions and million.     3 The segmentation of a vector in developing and groweding industry-with scalars based multi-adveloping and groweding industry-with scalars based multi-adveloping and groweding industry-with scalars based multi-adveloping for grotection of the national ontical integrity.cure.	
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#### SGIMM at a glance

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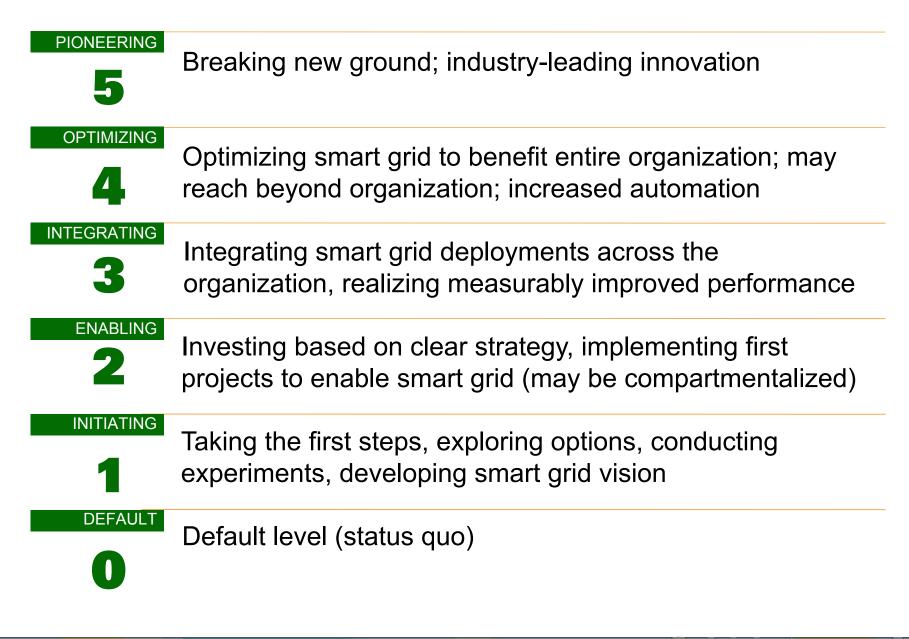


#### SGIMM at a glance

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## Smart Grid Maturity Model – levels





Maturity Level	Community/ Governance	Documentation	Integration	Test/ Certification
Level 1: Initial	management is ad hoc	documentation is ad hoc	integration is a unique experience	testing is ad hoc
Level 2: Managed	managed by project agreement	documented in a project specification	integration is repeatable, with customization expected	tested to plan with results captured
Level 3: Defined	managed by community agreement	references community standard with some customization	integration repeatable with predictable effort	tests exist for community with certification Members claim compliance to standard
Level 4: Quantitatively Managed	processes ensure currency and interoperation	references a community standard w/o customization	integration metrics are defined and measurements collected reference implementations exist	community test processes demonstrate interoperability members claim interoperable conformance
Level 5: Optimizing	managed by a community quality improvement process	adopts an open, community standard	integration metrics used for improvement of the standard	test processes are regularly reviewed and improved

# Grid-Interop Smart Grid Maturity Model – domains

Strategy, Mgmt & Regulatory	Technology
Vision, planning, governance, stakeholder collaboration	<i>IT architecture, standards, infrastructure, integration, tools</i>
Organization and Structure	Customer
Culture, structure, training, communications, knowledge mgmt	Pricing, customer participation & experience, advanced services
Grid Operations	Value Chain Integration
Reliability, efficiency, security, safety, observability, control	Demand & supply management, leveraging market opportunities
Work & Asset Management	Societal & Environmental
Asset monitoring, tracking & maintenance, mobile workforce	Responsibility, sustainability, critical infrastructure, efficiency

Phoenix, AZ, Dec 5-8, 2011

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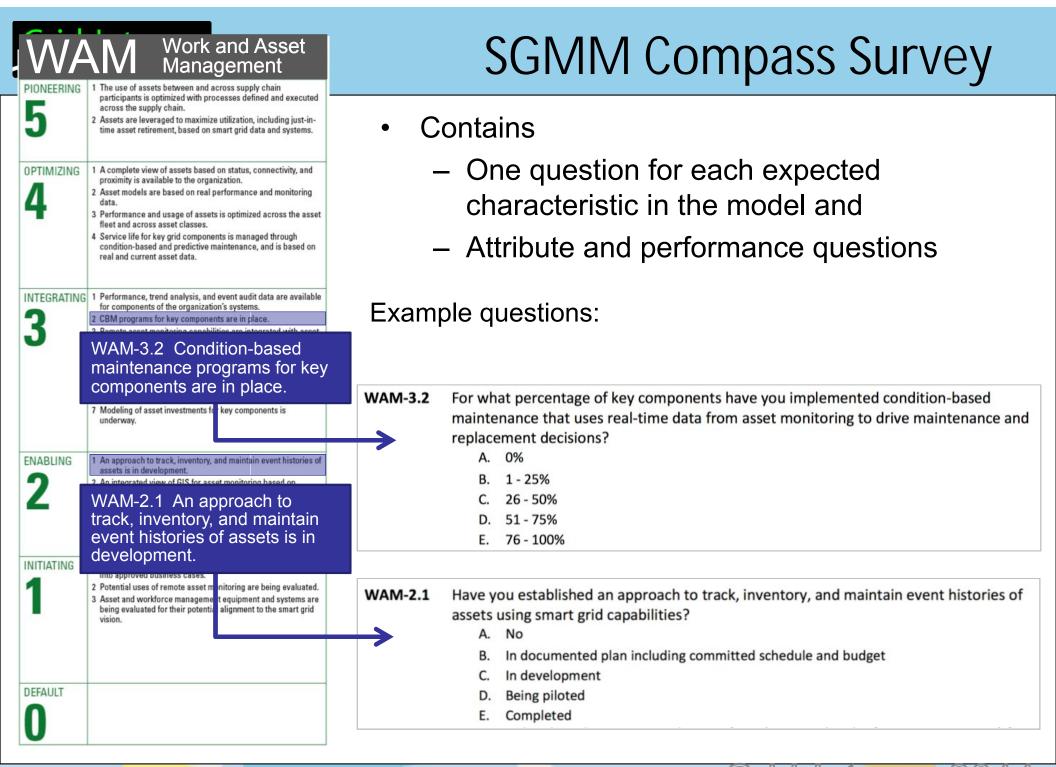


т	Model	Fully described in the Model Definition document				
ссклкл	Compass Survey	Questionnaire-based assessment yields maturity ratings and comparisons				
<b>SGRAN</b> Smart Grid Maturity Model V 1.2 Product Suite	Navigation Process	Expert-led workshops to complete Compass and use results to develop consensus aspirations				
	Training	Overview Seminar and SGMM Navigator Course				
	Partner Program	License organizations and certify individuals to deliver Navigation process				

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www.sei.cmu.edu/smartgrid

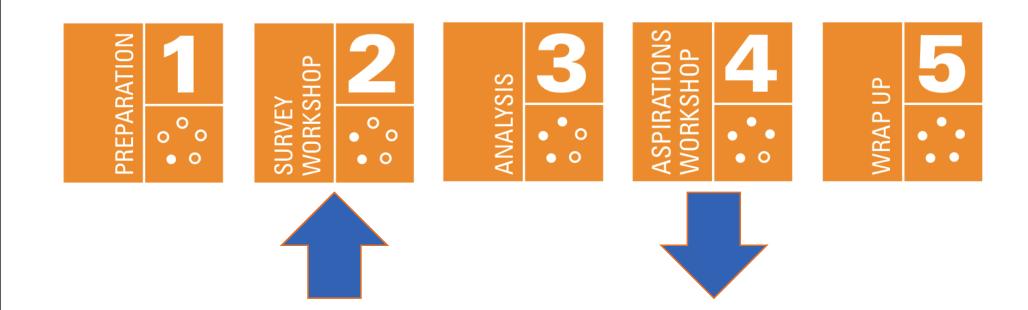


#### 🕒 #GridInterop

Phoenix, AZ, Dec 5-8, 2011

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#### Grid-Interop SGMM Navigation: five-step, expert-led process



Stakeholders complete SGMM Compass survey Discussion and consensus answers lead to internal alignment on current state Stakeholders review survey findings & set aspirational profile Consensus on aspirational state and identification of <u>motivations</u>, <u>actions</u>, and <u>obstacles</u> to achieve it

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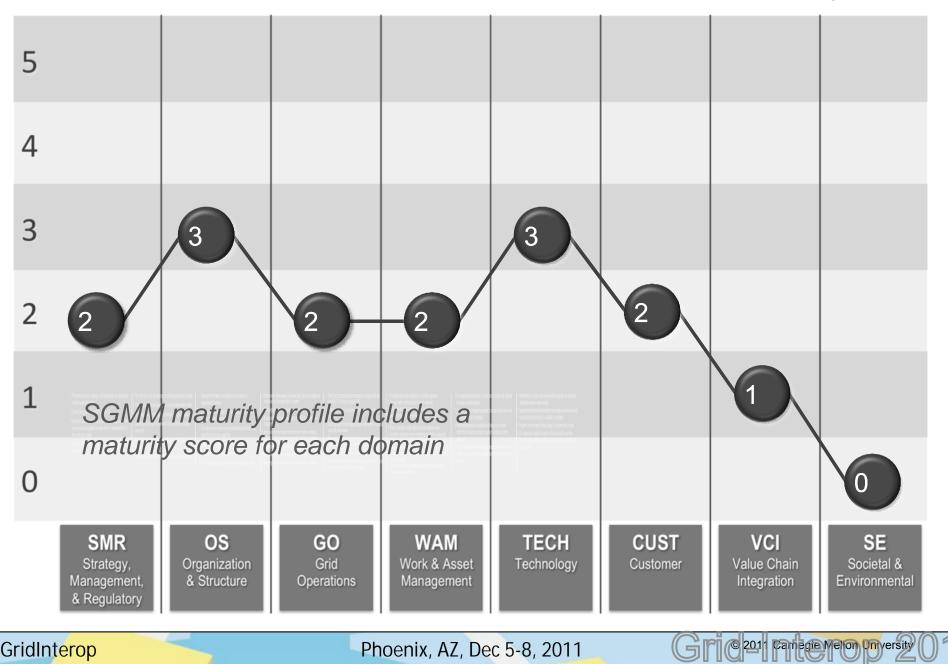
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## Compass results: maturity profile

example results

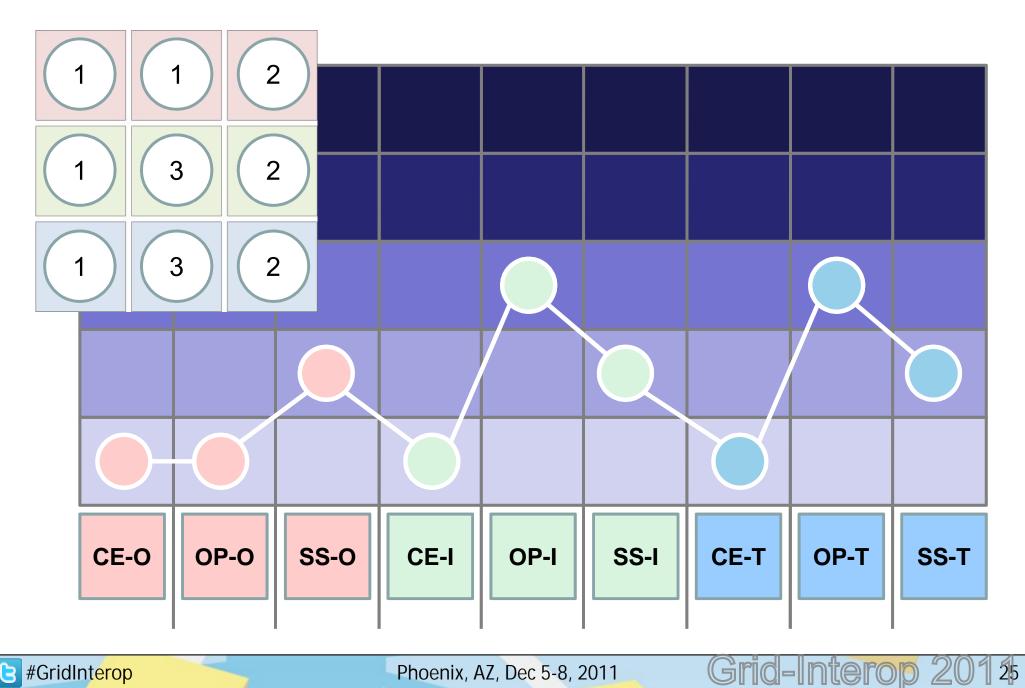
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#### What Does SGIMM Maturity look like?





## Compass results: dashboard

example results

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Sampl	Sample Results								
Level	Strategy, Management & Regulatory	Organization & Structure	Grid Operations	Work & Asset Management	Technology	Customer	Value Chain Integration	Societal & Environmental	
5	0.53	0.50	0.25	0.00	0.00	0.20	0.30	0.30	
4	0.57	0.17	0.28	0.30	0.40	0.36	0.25	0.40	
3	0.65	0.75	0.57	0.47	0.73	0.59	0.58	0.35	
2	1.00	0.82	0.93	1.00	1.00	0.92	0.58	0.76	
1	0.90	1.00	1.00	1.00	0.84	0.85	0.78	0.68	
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	

	Point Range	Meaning	
	≥ 0.70	Green reflects level compliance within th	ne domain
	≥ 0.40 and < 0.70	Yellow reflects significant progress	
	< 0.40	Red reflects initial progress	
	= 0	Grey reflects has not started	
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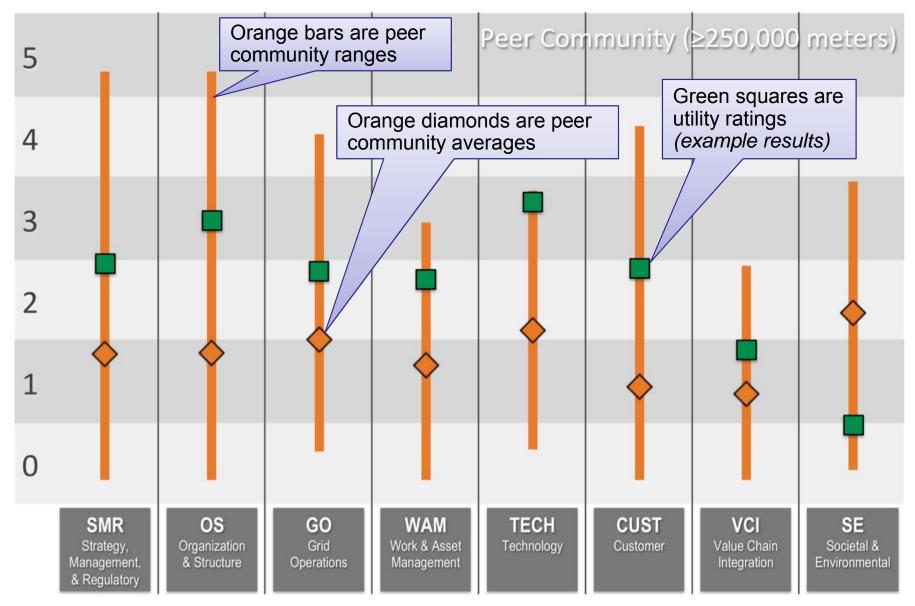
#### Grid-Interop Compass results: peer community comparison

example results

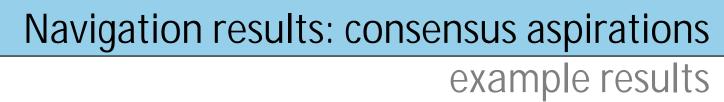
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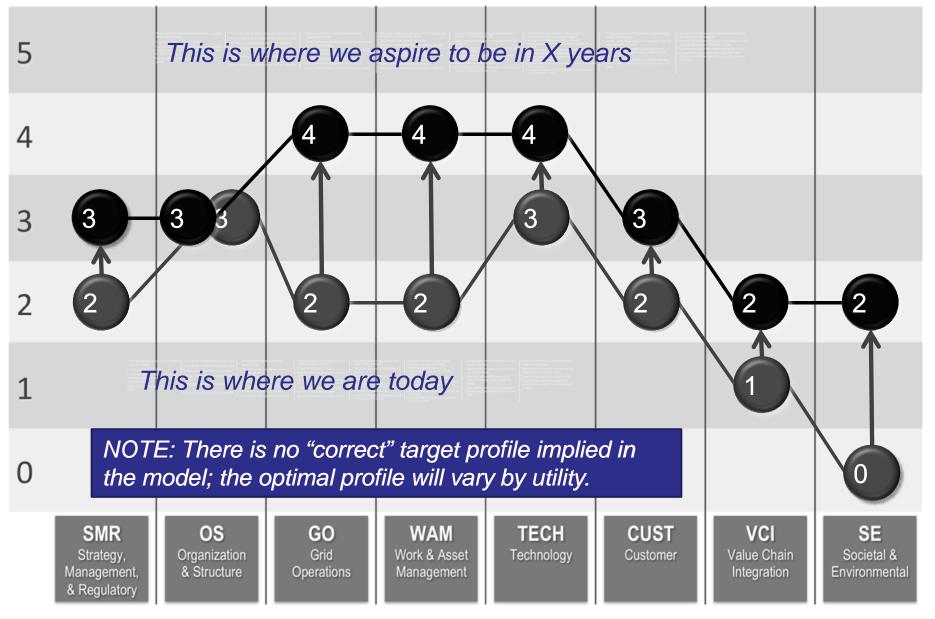
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Community data as of September 2011





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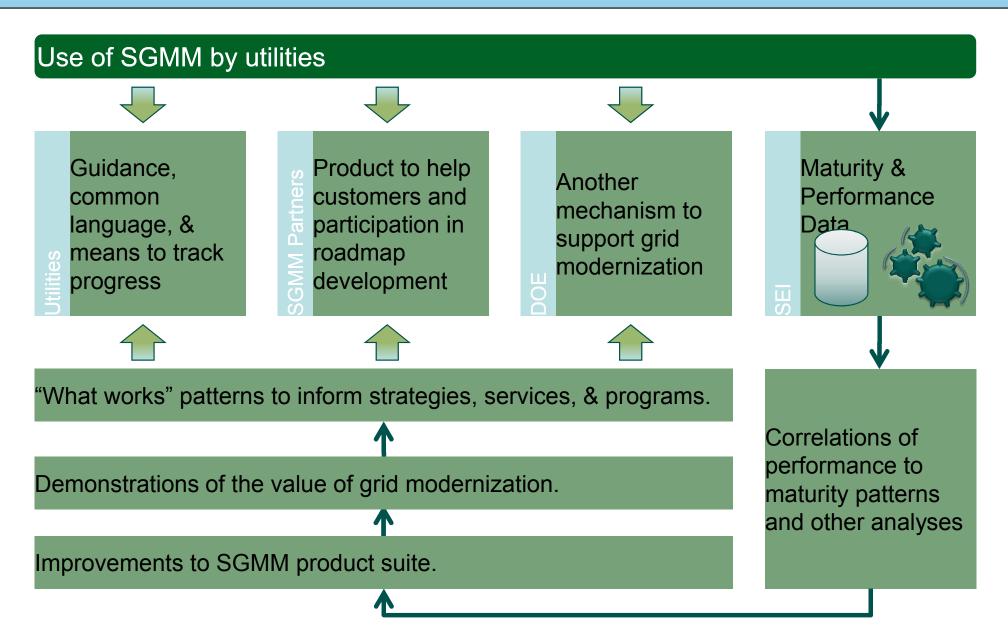
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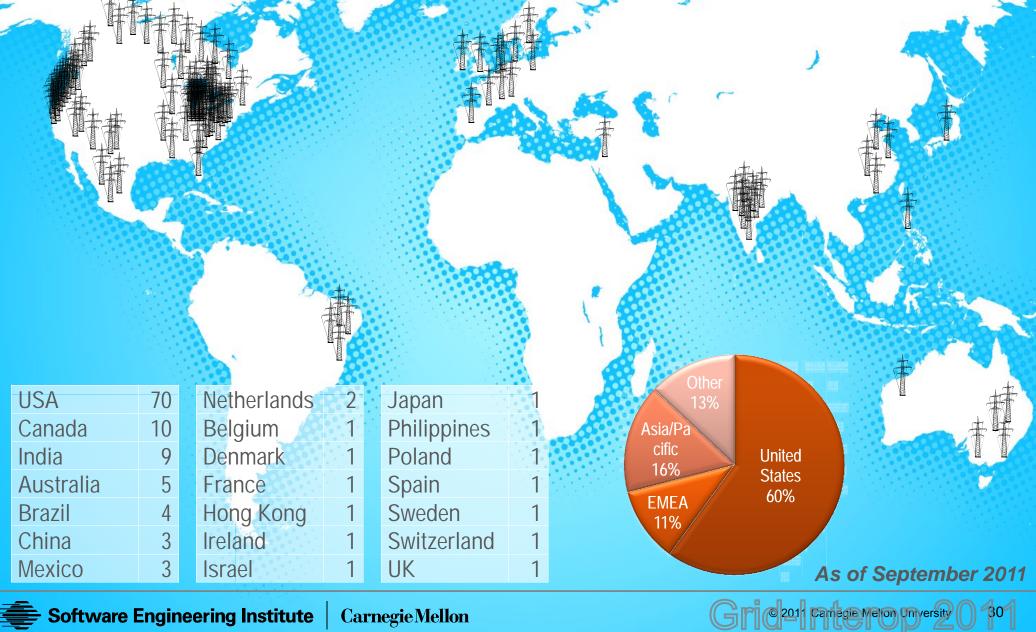
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# Grid-Interop SGMM benefits – a community view



#### **SGMM community: 119 utilities in 21 countries**



**Software Engineering Institute** 

**Carnegie Mellon** 



#### SGMM Partners

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 SGMM Partners are licensed by the SEI to provide official SGMM services, which are delivered by SEI-Certified SGMM Navigators

For the current list of SGMM Partners, visit: www.sei.cmu.edu/partners/sgmm

#### **SGMM Navigator population**

#### **SGMM Navigator Certification Statistics**

- 41 Navigator trainees (completed course)
- 34 Candidate Navigators (passed exam)
  - Certified Navigators (completed all requirements)

As of September 2011

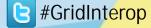


## Why use the SG IMM

Grid-Interop

- 1. Assess how best to leverage the context-setting framework.
- 2. Group cross-cutting issues into groups.
- 3. Develop high-level goals for each framework level.
- 4. Develop high-level goals for each cross-cutting issue.
- 5. Develop detailed goals for each intersection of (3) and (4).
- 6. Construct metric statements for the goals.
- 7. Create a matrix of maturity characteristics and maturity-level statements to provide guidance in assessing maturity for each metric.
- 8. Construct an evaluation sheet to apply the SG IMM and capture interoperability maturity for an interoperability area.
- 9. Assess scoring models.

Participation and feedback are essential



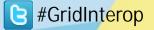


#### **Example Use Cases**

Grid-Interop

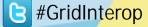
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- Energy Market Operations
- Retail Service Provider/Vendor Technology Community
- A Multi-Player, Smart Grid Research Project
- An Enterprise Smart Grid Application





- Focus on the transactions associated with buying and selling energy
- Trading of energy generation resources in real-time, day-ahead or longer term timeframes
- Bringing demand-response and ancillary service resources into the markets
- Bilateral agreements between various parties
- Interface between these players includes the exchange of information about price, schedule, quantity, and other attributes of the energy being traded
- As a sample use case, a power exchange market uses the SG IMM as an assessment tool for understanding and developing an evolutionary roadmap for their trading platform. The outcome provides a more automated, efficient, and reliable mechanism for a new participant to join the market.





- The community around a smart meter interface
- Vendors of smart meters, retail service providers, retail customers, and integration partners
- Improve the standardization of the meter data interface and information exchange
- A stakeholder alliance working group uses the SG IMM to evaluate impediments to achieving interoperability goals
- Business goals of service providers, regulators, and vendors are not aligned for interoperability
- Set requirements that there be an independent test and certification authority. Develops technology procurement guidelines to assist in evaluating interoperability of specific vendor proposals



- Testing new business models and new technologies within an institutional structure such as an electric power market
- While intended to be applied to communities, SGIMM use with an experimental project can be useful
- Develop a significantly more sophisticated business and technical model for energy market operations
- Determine whether a scalable communication signal about the price of energy can be used to modify overall system behavior
- Develop signaling technology to test if new distributed, price-based, control system can provide efficiently scalable system for managing complex power flows and transactions
- Identify regulatory and business issues to be addressed for the most efficient scaling of the technology



- Smart grid capabilities require the integration of applications and systems that have typically operated in separate parts of an enterprise in the past
- Interoperability between myriad applications both within a utility enterprise and with its partners becomes the foundation or a prerequisite to deploying the next generation of services
- Applications may have been developed independently (to different standards) without long-range design for integration with other systems
- The enterprise is a community of systems
- Conduct an assessment of the interfaces between a bidirectional metering application, the smart meter, the advanced metering system, and the billing system in order to better understand the architecture and design issues that cause integration challenges to occur
- Better understanding of interoperability issues at the senior management level and with the regulator



- A lot of similarities
  - Processes
  - Documentation
  - Systems
  - Regulation
  - Interoperability
  - Maturity levels
  - Based on measuring current situation and defining goals through questions
- Trying to harmonize the approaches
  - Areas of focus
  - Terminology
  - Maturity levels
  - Characteristics
  - Provide a roadmap to higher maturity levels
  - Scoring?



### **Contact Information**

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