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Information >> Integration >> Intelligence

Software Engineering Institute | **Carnegie Mellon**

SGMM
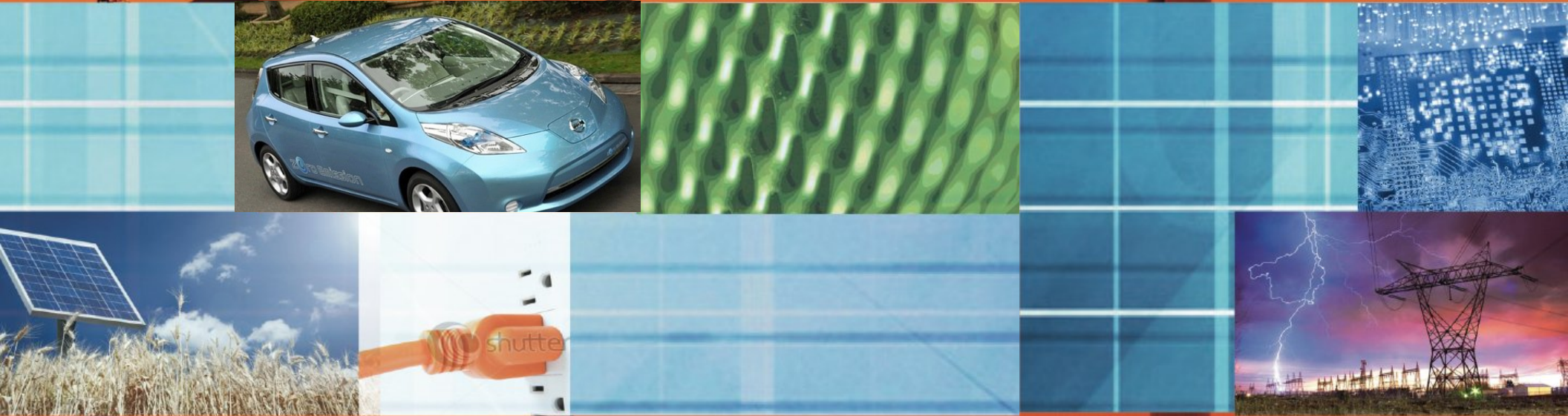## Smart Grid Maturity Model

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SGMM Candidate Navigator

December 8, 2011

Grid-Interop 2011

A major power grid transformation is underway.

How can utilities

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

SGMM was developed to address these concerns

Contents / Agenda

A Word About EBiz Labs

SGMM Overview

A. **History**

B. **Software Engineering Institute (SEI)**

SGMM Process

A. **Domains**

B. **Maturity Levels**

C. **Compass Survey**

D. **Aspirations Workshop**

SGMM Community

About EBiz Labs

❑ Management and Technology Consulting

❑ Focused on Electric T&D Utilities

❑ Subject Matter Expertise in:

  ▪ System Operations
  ▪ Market Design
  ▪ SCADA/ Real Time Systems
  ▪ Control Center Automation

❑ Software Engineering Institute Partner Organization

What Is the Smart Grid Maturity Model?

SGMM is a

MANAGEMENT TOOL

that provides a

COMMON FRAMEWORK

for defining key elements of

SMART GRID TRANSFORMATION

and helps utilities develop a

PROGRAMMATIC APPROACH
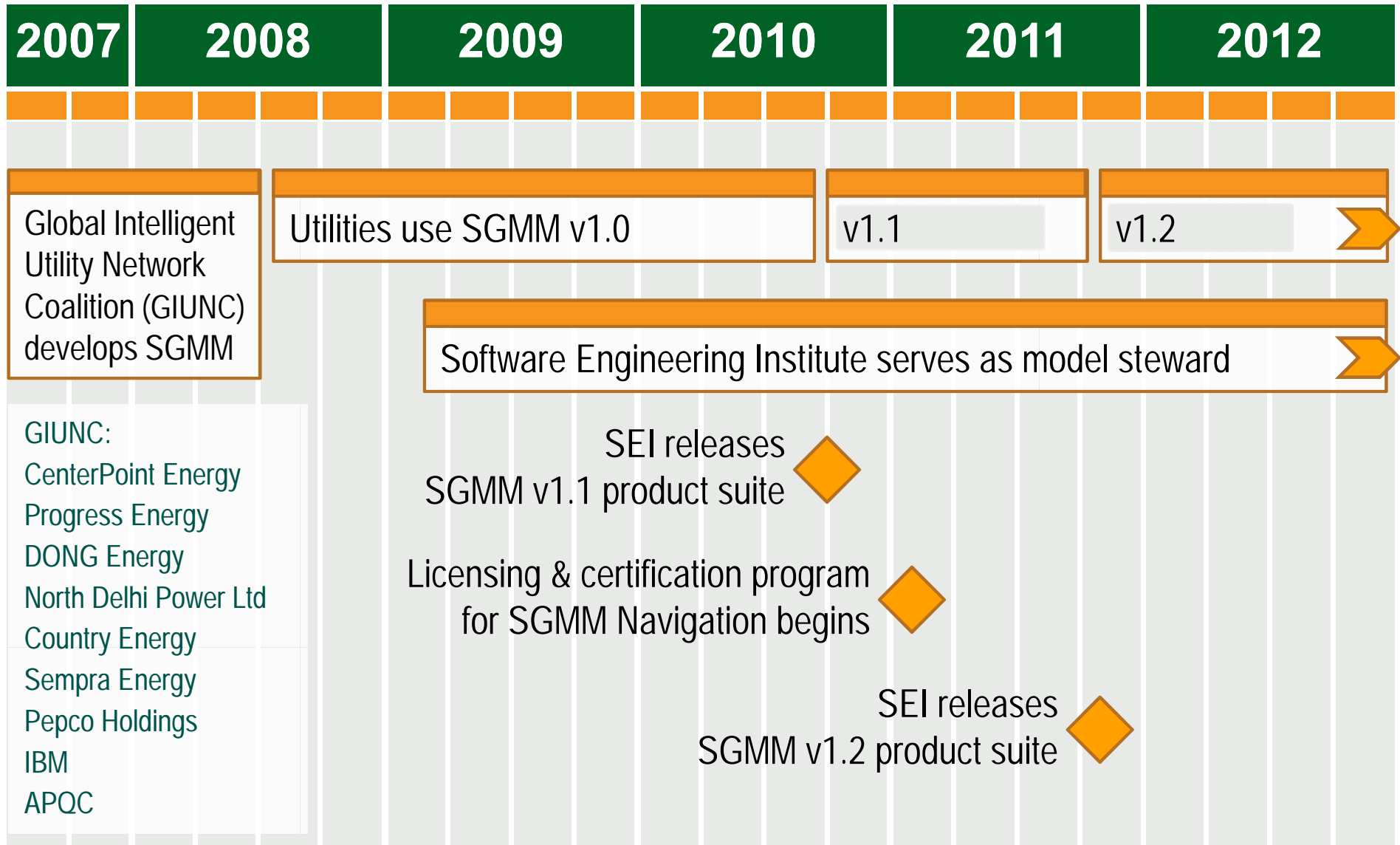
and track their progress.

How Is the SGMM Used?

SGMM is used to help organizations

- Identify where they are on the smart grid landscape

- Develop a shared smart grid vision and roadmap

- Communicate using a common language

- Prioritize options and support decision making

- Compare to themselves and the community

- Measure their progress

- Prepare for and facilitate change

SGMM timeline

2007	2008	2009	2010	2011	2012

Global Intelligent Utility Network Coalition (GIUNC) develops SGMM

Utilities use SGMM v1.0

v1.1

v1.2

Software Engineering Institute serves as model steward

GIUNC:
CenterPoint Energy
Progress Energy
DONG Energy
North Delhi Power Ltd
Country Energy
Sempra Energy
Pepco Holdings
IBM
APQC

SEI releases SGMM v1.1 product suite

Licensing & certification program for SGMM Navigation begins

SEI releases SGMM v1.2 product suite

Developed by utilities for utilities

The Software Engineering Institute

SEI is a federally funded research and development center based at Carnegie Mellon University, a global research 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

Grid-Interop 2011

SGMM at a Glance

8 Domains: Logical groupings of smart grid related capabilities and characteristics

SMR	OS	GO	WAM	TECH	CUST	VCI	SE
5 PIONEERING							
4 OPTIMIZING							
3 INTEGRATING							
2 ENABLING							
1 INITIATING							
0							

175 Characteristics: Features you would expect to see at each stage of the smart grid journey

6 Maturity Levels: Defined sets of characteristics and outcomes

The Smart Grid Maturity Model – Domains

SMR

Strategy, Mgmt & Regulatory

Vision, planning, governance, stakeholder collaboration

TECH

Technology

IT architecture, standards, infrastructure, integration, tools

OS

Organization and Structure

Culture, structure, training, communications, knowledge mgmt

CUST

Customer

Pricing, customer participation & experience, advanced services

GO

Grid Operations

Reliability, efficiency, security, safety, observability, control

VCI

Value Chain Integration

Demand & supply management, leveraging market opportunities

WAM

Work & Asset Management

Asset monitoring, tracking & maintenance, mobile workforce

SE

Societal & Environmental

Responsibility, sustainability, critical infrastructure, efficiency

The Smart Grid Maturity Model – Levels

Level

PIONEERING

5   Breaking new ground; industry-leading innovation

OPTIMIZING

4   Optimizing smart grid to benefit entire organization; may reach beyond organization; increased automation

INTEGRATING

3   Integrating smart grid deployments across the organization, realizing measurably improved performance

ENABLING

2   Investing based on clear strategy, implementing first projects to enable smart grid (may be compartmentalized)

INITIATING

1   Taking the first steps, exploring options, conducting experiments, developing smart grid vision

DEFAULT

0   Default level (status quo)

SGMM
Smart Grid Maturity Model
V 1.2 Product Suite

Model	**Fully described in the Model Definition document**
Compass Survey	**Questionnaire-based assessment yields maturity ratings and comparisons**
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**

SGMM Navigation: five-step, expert-led process

| PREPARATION **1** | SURVEY WORKSHOP **2** | ANALYSIS **3** | ASPIRATIONS WORKSHOP **4** | WRAP UP **5** |

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

SGMM Compass Survey

WAM — Work and Asset Management

PIONEERING 5	1 The use of assets between and across supply chain participants is optimized with processes defined and executed across the supply chain. 2 Assets are leveraged to maximize utilization, including just-in-time asset retirement, based on smart grid data and systems.
OPTIMIZING 4	1 A complete view of assets based on status, connectivity, and proximity is available to the organization. 2 Asset models are based on real performance and monitoring data. 3 Performance and usage of assets is optimized across the asset fleet and across asset classes. 4 Service life for key grid components is managed through condition-based and predictive maintenance, and is based on real and current asset data.
INTEGRATING 3	1 Performance, trend analysis, and event audit data are available for components of the organization's systems. 2 CBM programs for key components are in place. (7) Modeling of asset investments for key components is underway.
ENABLING 2	1 An approach to track, inventory, and maintain event histories of assets is in development. 2 An integrated view of GIS for asset monitoring based on...
INITIATING 1	...into approved business cases. 2 Potential uses of remote asset monitoring are being evaluated. 3 Asset and workforce management equipment and systems are being evaluated for their potential alignment to the smart grid vision.
DEFAULT 0	

WAM-3.2 Condition-based maintenance programs for key components are in place.

WAM-2.1 An approach to track, inventory, and maintain event histories of assets is in development.

Contains

- One question for each expected characteristic in the model and
- Attribute and performance questions

Example questions:

WAM-3.2 For what percentage of key components have you implemented condition-based maintenance that uses real-time data from asset monitoring to drive maintenance and replacement decisions?
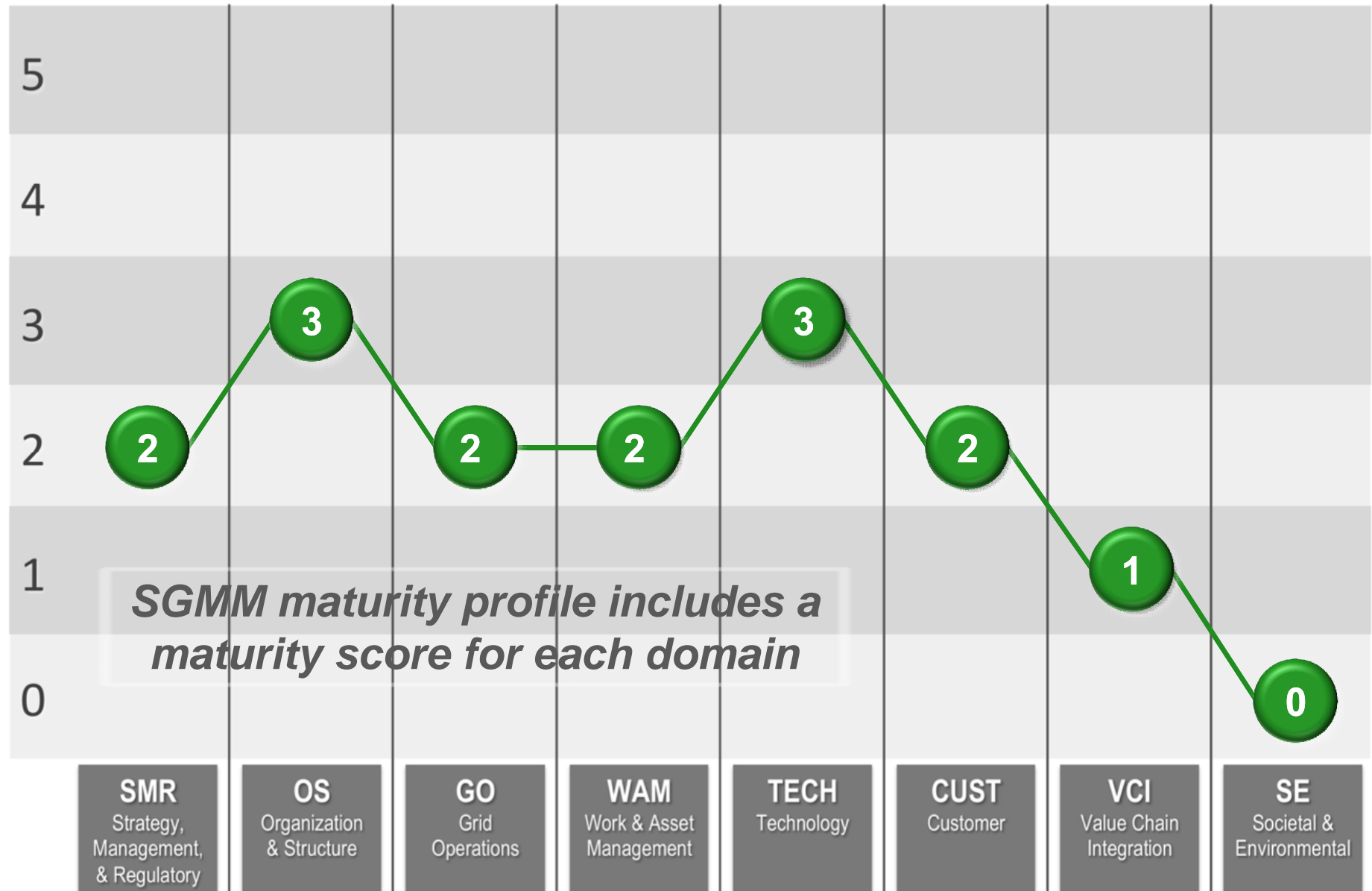- A. 0%
- B. 1 - 25%
- C. 26 - 50%
- D. 51 - 75%
- E. 76 - 100%

WAM-2.1 Have you established an approach to track, inventory, and maintain event histories of assets using smart grid capabilities?
- A. No
- B. In documented plan including committed schedule and budget
- C. In development
- D. Being piloted
- E. Completed

Compass results: maturity profile

example results

SGMM maturity profile includes a maturity score for each domain

SMR Strategy, Management, & Regulatory	OS Organization & Structure	GO Grid Operations	WAM Work & Asset Management	TECH Technology	CUST Customer	VCI Value Chain Integration	SE Societal & Environmental
2	3	2	2	3	2	1	0

Compass results: dashboard
example results

Level	Strategy, Management & Regulatory		Organization & Structure		Grid Operations		Work & Asset Management		Technology		Customer		Value Chain Integration		Societal & Environmental	
Sample Results																
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
(green)	≥ 0.70	Green reflects level compliance within the domain
(yellow)	≥ 0.40 and < 0.70	Yellow reflects significant progress
(red)	< 0.40	Red reflects initial progress
(grey)	= 0	Grey reflects has not started

Compass results: peer community comparison
example results

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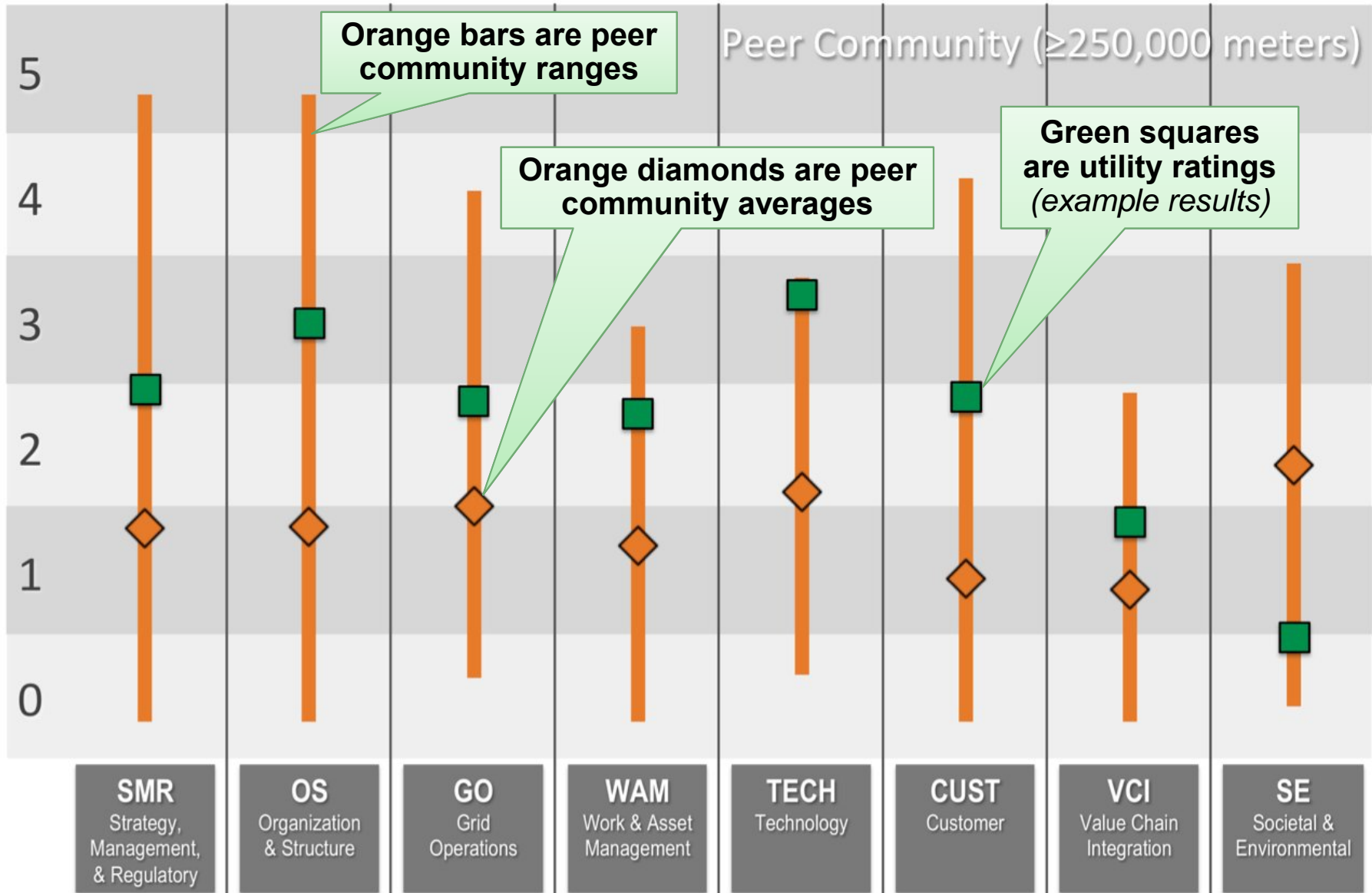
Community data as of September 2011

Legend: ➕ Top 10-30%   ⬇ Bottom 30%   ⭐ Top 10%

Example results
Fictitious organization

Strategy, Mgmt, & Regulatory

5
- 5.3 New business model opportunities emerge as a result of smart grid capabilities and are i...
- 5.2 Smart grid business activities provide sufficient financial resources to enable continued i... sustainment and expansion.
- 5.1 Smart grid strategy capitalizes on smart grid as a foundation for the introduction of new services and product offerings.

4
- 4.3 Smart grid strategy is shared and revised collaboratively with external stakeholders.
- 4.2 Smart grid is a core competency throughout the organization.
- 4.1 Smart grid vision and strategy drive the organization's strategy and direction.

3
- 3.4 Required authorizations for smart grid investments have been secured.
- 3.3 Smart grid leaders ... effective implementa...
- 3.2 A smart grid go...
- 3.1 The smart grid visio...

2
- ➕ 2.6 There is support an...
- 2.5 There is collaboratio... sion and strategy.
- ⬇ 2.4 Budgets are establis...
- 2.3 Operational investm...
- 2.2 A common smart grid vision is accepted across the organization.
- 2.1 An initial smart grid strategy and a business plan are approved by management.

1
- ⭐ 1.3 Discussions have been held with regulators about the organization's smart grid vision.
- 1.2 Experimental implementations of smart grid concepts are supported.
- 1.1 Smart grid vision is developed with a goal of operational improvement.

Aspiration setting:

1. Model characteristics are sequentially reviewed, discussed, and considered for levels that have not yet been achieved.

2. Consensus on relevance and importance to organization for achieving characteristics is used to set aspiration.

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Grid-Interop 2011

Strategy, Mgmt, & Regulatory

5

4

3 ← Aspiration

2 ← Current

1

0
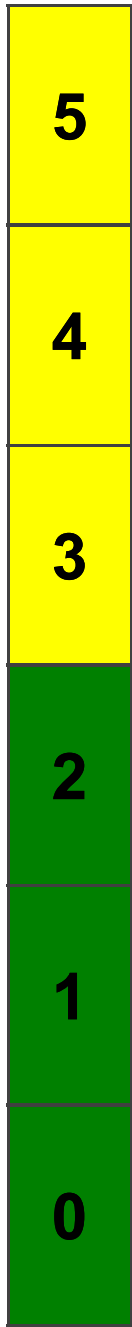
What motivates this aspiration?

-
-
-
-

What actions must happen to achieve this aspiration?

-
-
-
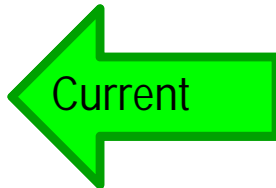
What are the obstacles that must be overcome to achieve this aspiration?

-
-
-
-

Grid-Interop 2011

Navigation results: consensus aspirations

example results

This is where we aspire to be in X years

This is where we are today

NOTE: There is no "correct" target profile implied in the model; the optimal profile will vary by utility.

SMR	OS	GO	WAM	TECH	CUST	VCI	SE
Strategy, Management, & Regulatory	Organization & Structure	Grid Operations	Work & Asset Management	Technology	Customer	Value Chain Integration	Societal & Environmental
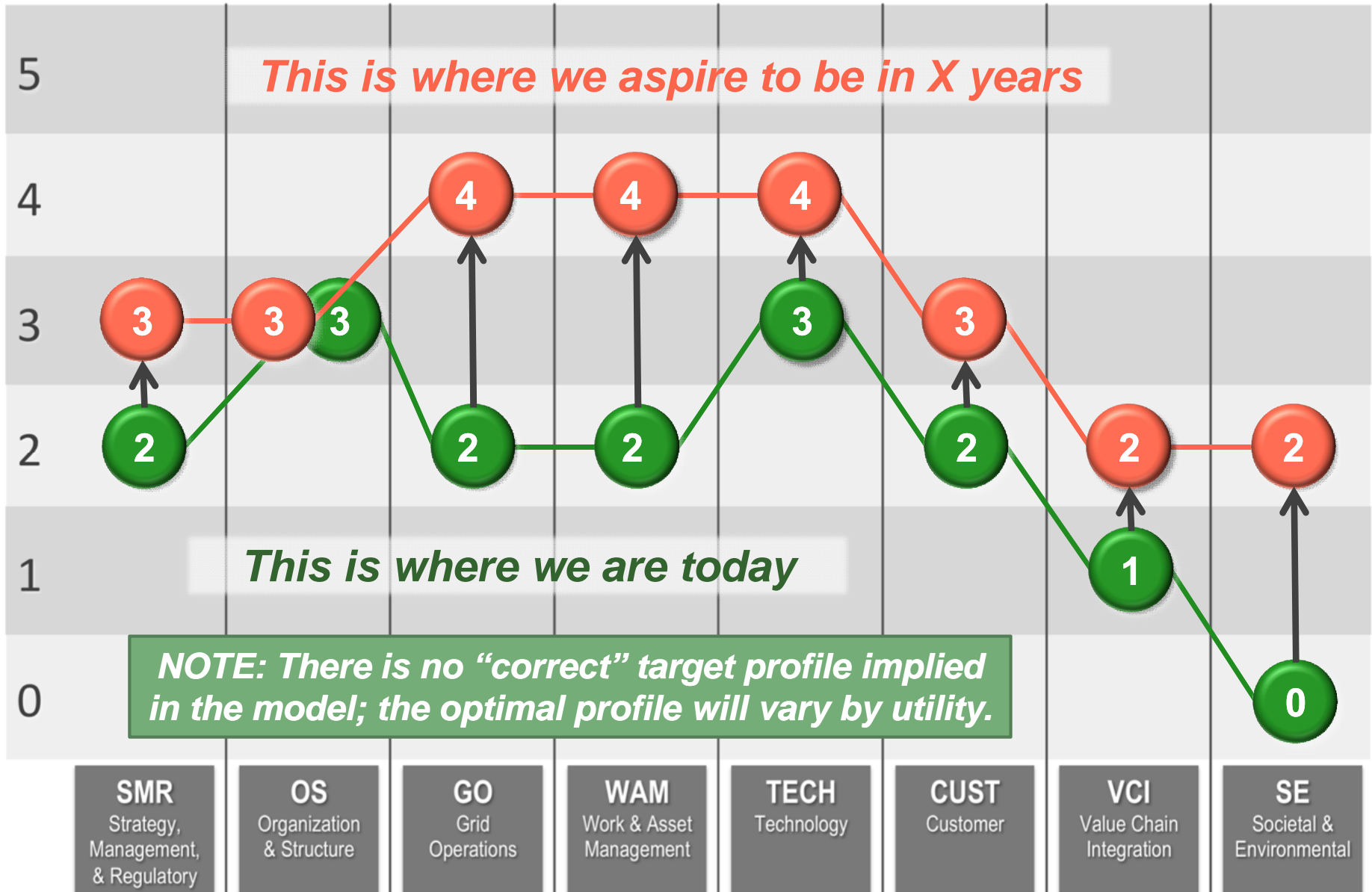
SGMM community: 119 utilities in 21 countries

USA	70	Netherlands	2	Japan	1
Canada	10	Belgium	1	Philippines	1
India	9	Denmark	1	Poland	1
Australia	5	France	1	Spain	1
Brazil	4	Hong Kong	1	Sweden	1
China	3	Ireland	1	Switzerland	1
Mexico	3	Israel	1	UK	1

Other 13%
Asia/Pacific 16%
EMEA 11%
United States 60%
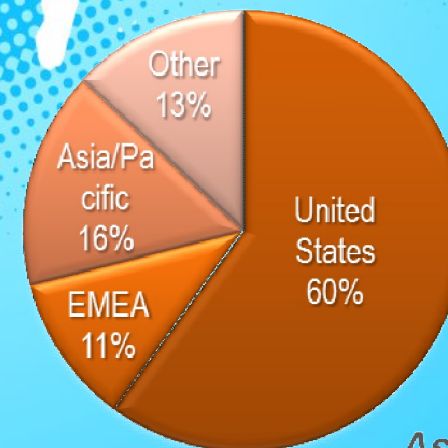
As of September 2011

Grid-Interop 2011

SGMM Community – 119 utilities as of September 2011

AES Electropaulo	City Of Palo Alto	Enexis	Manila Electric Company	Redding
Alameda Municipal Power	City Of Piqua Power System	Entergy	Manitoba Hydro - T&D	Sacramento Municipal Utility District
Allegheny Power	City of Riverside Public Utilities	EPCOR Distribution & Transmission	Marietta Board of Lights and Water	Salt River Project
Alliander	City Of Wapakoneta	Ephrata Borough	MSEDCL	SDG&E
Ameren Illinois	City Of Westerville	ERDF	NB Power	SCANA
Ameren Missouri	CLP Power	ESB Networks	NDPL	SIG Geneva
American Electric Power	Coldwater Board Of Public Utilities	Exelon/ComEd	NOIDA Power Company Ltd	Silicon Valley Power
APCPDCL	Country Energy	Exelon/PECO Energy	Oberlin Municipal Light & Power System	SMEPC - International Cooperation Dept.
ATCO Electric	CPFL Paulista	FirstEnergy	Pasadena Water and Power	Snohomish
ATCO Gas	Dominion Virginia Power	Fortum	Pepco Holdings/PHI	Southern Company
Ausnet	DONG Energy Sales & Distribution A/S	Glendale Water & Power	PG&E	Tata Power
Austin Energy	DPSC Limited	Guandong Power Co.	PGN Progress Energy	Tokyo Electric Power Co.
AZUSA Light and Water	DTE Energy	Hydro One	PGN Carolina	Toronto Hydro Electric System
BC Hydro	Duke Energy	Hydro One - Distribution	PGN Florida	Town Of Front Royal
BESCOM	Eandis	Hydro Ottawa Limited	PNM	Tucson Electric Power
Bonneville Power Admin.	East Miss EPA	IEC	Portland General Electric	UGVCL
BSES	EDF Energy Networks	Imperial Irrigation District	Powercor	Unión Fenosa Distribución
Burbank Water and Power	EDP - Energias do Brasil	Integral Energy	PPL Electric Utilities	Vattenfall Distribution
CELPE	EnergyAustralia	Intergys	Princeton Electric Play Board	VELCO
CenterPoint Energy		Los Angeles Department of Water and Power	Puget Sound	Village Of Carey
CFE (Mexico) Corporativo				Village Of Clinton
CFE (Mexico) Gulfonorte				Village Of Oak Harbor
CFE (Mexico) Jalisco				Village Of Yellow Springs
CFE (Mexico) Peninsular				Wadsworth Electric
City of Anaheim				Wyandotte Municipal Service
City Of Columbus				Xcel Energy
City Of Danville				Zhejiang Jiaxing Electric Power Bureau
City Of Dover				
City Of Hamilton				
City Of Hudson				
City Of Jackson				
City Of Napoleon				
City Of Painesville				

**22 US States
5 Canadian Provinces**

21 Countries

Grid-Interop 2011
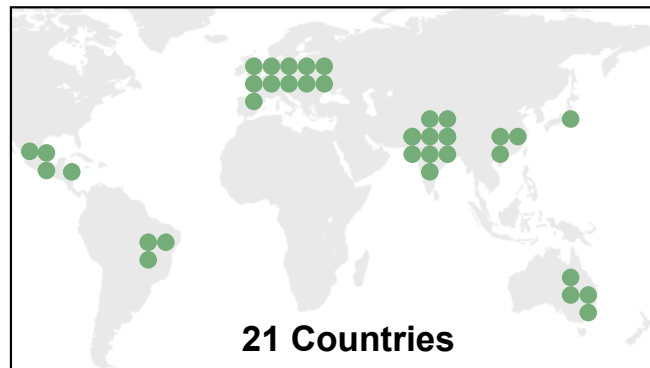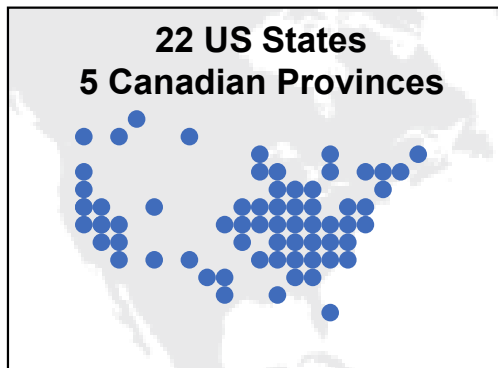
SGMM community – meter count

Largest: 34,000,000 Meters

Median: 1,000,000 Meters

Community segmentation breakpoint: 250,000 meters

Smallest: 40 Meters

Meter Count

SGMM Community

100,000,000
10,000,000
1,000,000
250,000
100,000
10,000
1,000
100
10
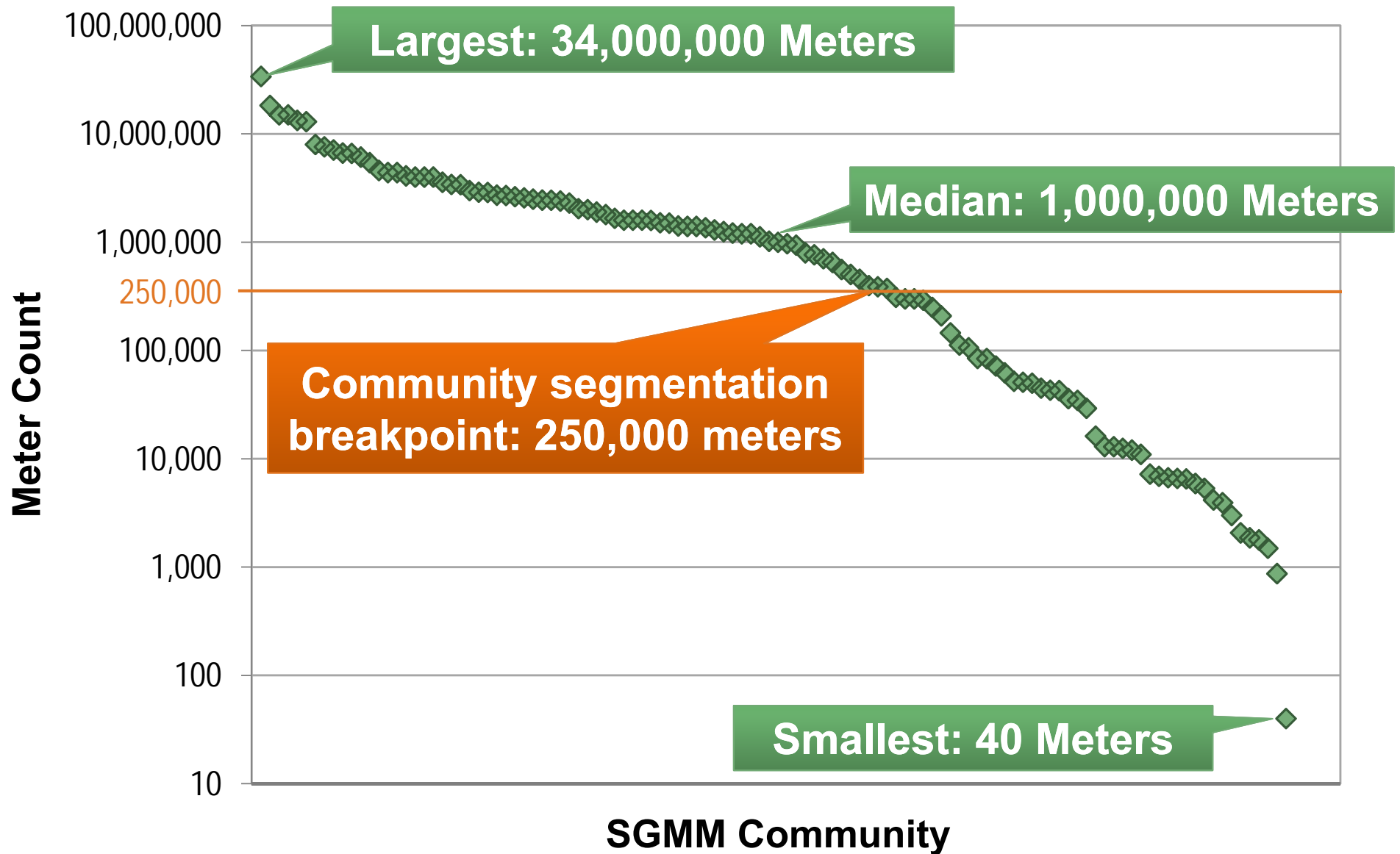
SGMM community – utility type

SINGLE FUNCTION

0.9%
Retail Only

25.5%
Distribution Only

1.8%
Transmission Only

30%
Generation, Transmission,
Distribution, Retail

FULLY INTEGRATED
4 Functions

PARTIALLY INTEGRATED
2 Functions

1.8%
Generation, Transmission

1.8%
Generation, Distribution

7.3%
Transmission, Distribution

11.8%
Distribution, Retail

4.5%
Generation, Distribution,
Retail

10%
Transmission, Distribution,
Retail

4.5%
Generation, Transmission,
Distribution

PARTIALLY INTEGRATED
3 Functions

87.5% Distribution
59.4% Transmission
51.6% Retail
40.6% Generation
21.9% Other

As of September 2011

SGMM community: all participants
average and range maturity scores as of September 2011

SGMM community: < 250,000 meters
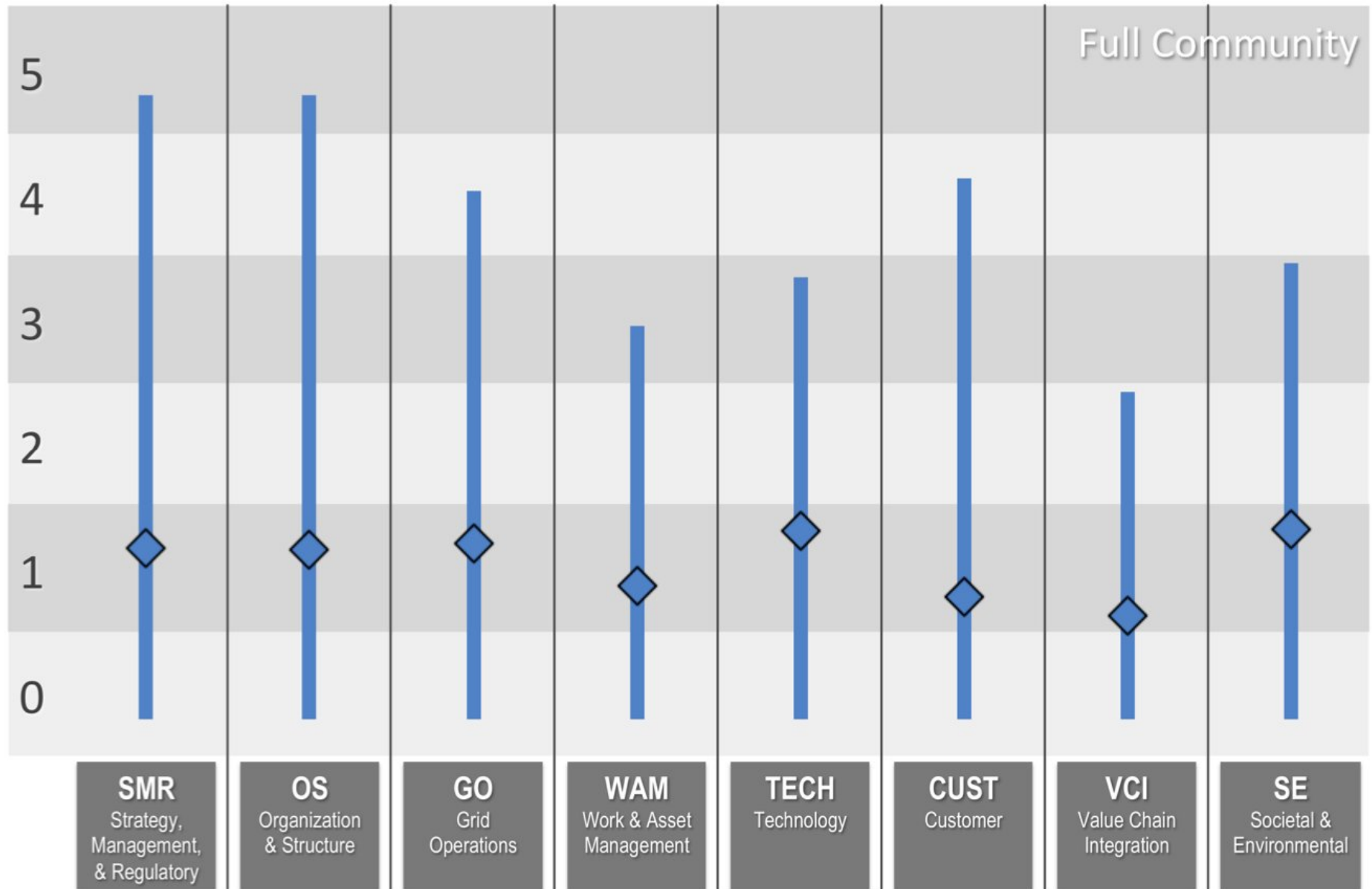## *average and range maturity scores as of September 2011*
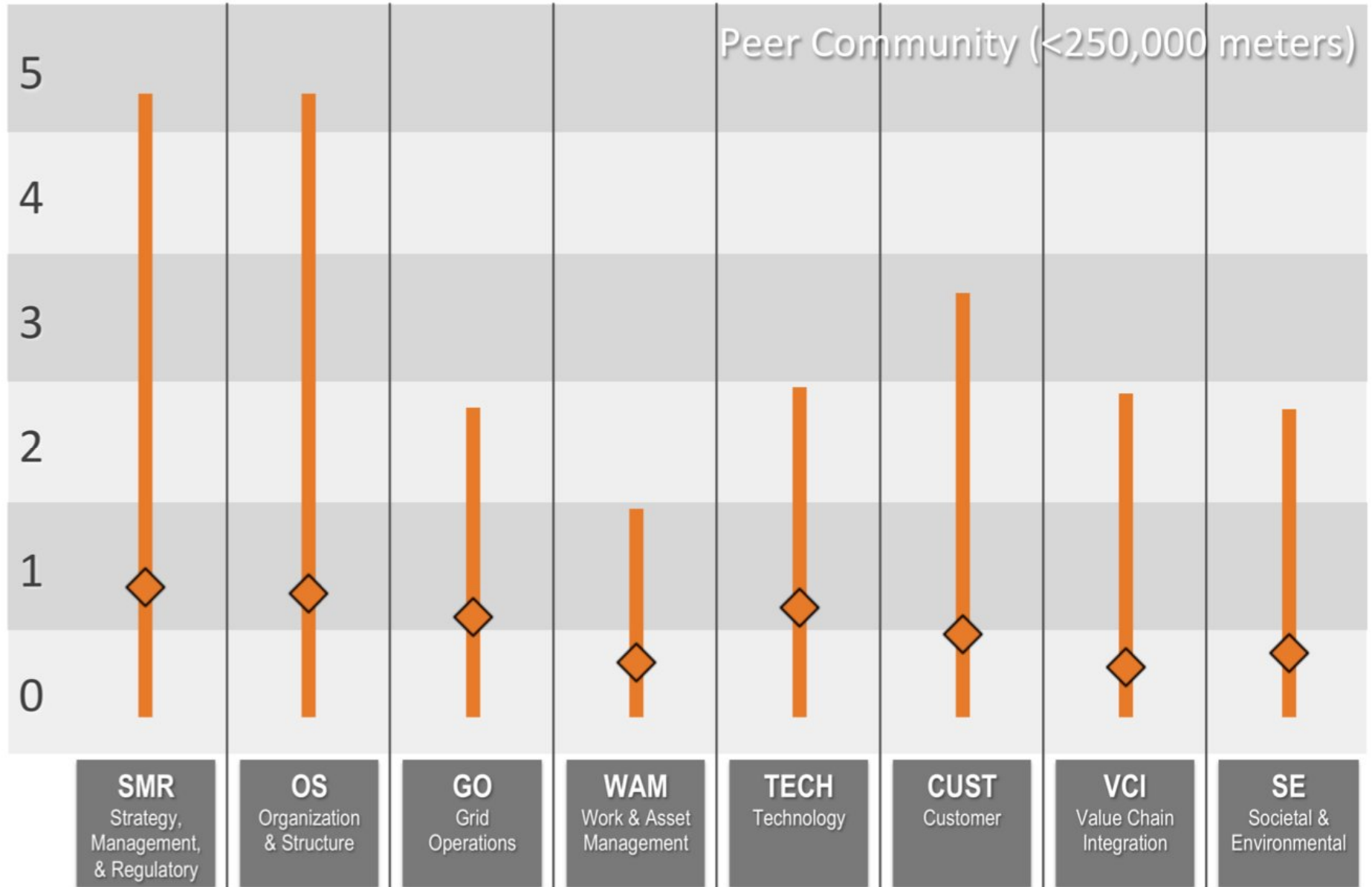
Peer Community (<250,000 meters)

SMR Strategy, Management, & Regulatory	**OS** Organization & Structure	**GO** Grid Operations	**WAM** Work & Asset Management	**TECH** Technology	**CUST** Customer	**VCI** Value Chain Integration	**SE** Societal & Environmental

SGMM community: ≥ 250,000 meters
average and range maturity scores as of September 2011

Peer Community (≥250,000 meters)

SMR	OS	GO	WAM	TECH	CUST	VCI	SE
Strategy, Management, & Regulatory	Organization & Structure	Grid Operations	Work & Asset Management	Technology	Customer	Value Chain Integration	Societal & Environmental

Grid Interop 2011
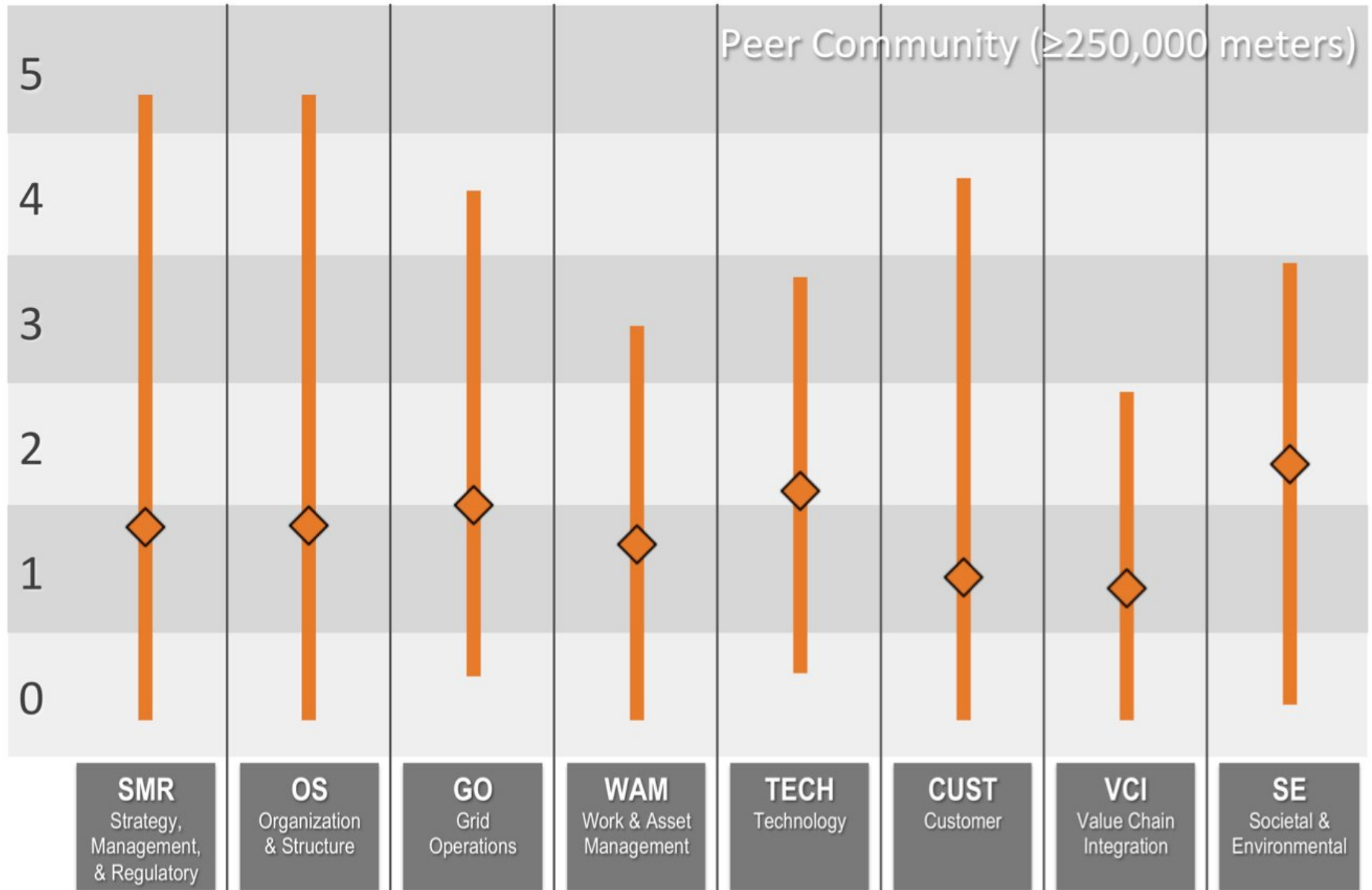
SGMM benefits – a community view

Use of SGMM by utilities

Utilities	Guidance, common language, & means to track progress

SGMM Partners	Product to help customers and participation in roadmap development

DOE	Another mechanism to support grid modernization

SEI	Maturity & Performance Data

"What works" patterns to inform strategies, services, & programs.

Demonstrations of the value of grid modernization.

Improvements to SGMM product suite.

Correlations of performance to maturity patterns and other analyses

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