Distribution and Microgrid Platforms that Integrate High-Penetration of Beyond the Meter Intermittent Renewables

ASIA Clean Energy Forum 2015

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Trends that are driving the utility of the future

Customer Relationships

Aging Infrastructure

Deliver affordable utility services to customers reliably, cleanly, and safely

Climate Change

Revenue/Costs/ Profitability

Conservation and Sustainable Growth

Source: www.bullittcenter.com

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Renewable distributed generation integration & operations

- **Growth** – renewable distributed generation solar photovoltaic, wind, and storage
- **Increase** – growth of data & field devices
- **Real-Time Analytics**- technology

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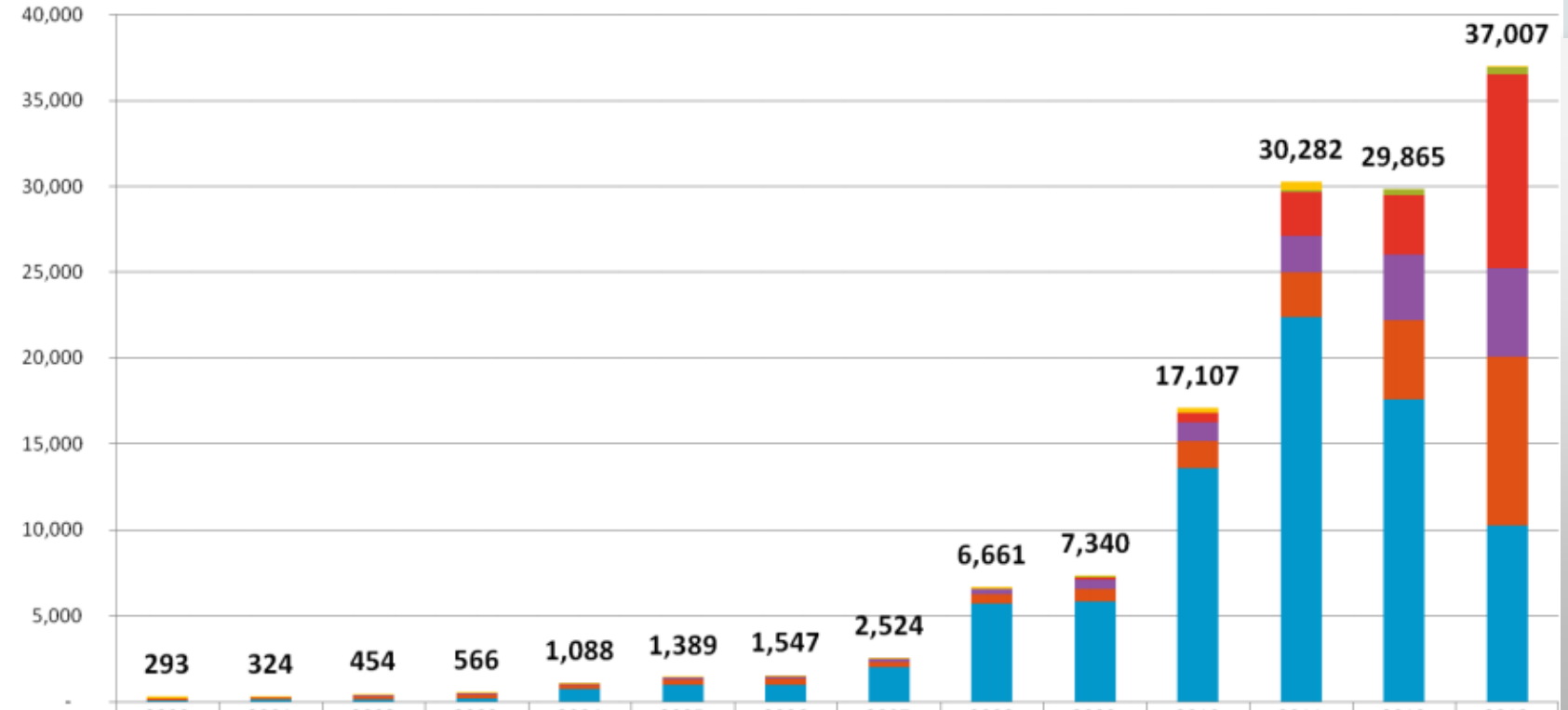
Rooftop Solar Photovoltaics

Potential for massive impact on utility revenue & network stability

Source: EPIA

Global Solar PV Installations (MW)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
ROW	88	56	80	77	29	10	105	42	76	80	284	508	-	85
MEA	-	-	-	-	1	0	0	1	1	22	46	125	365	383
China	19	5	19	10	10	8	10	20	40	160	500	2,500	3,500	11,300
AMERICA	2	3	30	48	61	82	110	166	306	500	1,082	2,181	3,774	5,153
APAC	126	128	190	230	282	304	325	271	530	745	1,578	2,562	4,646	9,833
Europe	58	133	134	202	705	985	997	2,023	5,708	5,833	13,616	22,407	17,580	10,253
TOTAL	293	324	454	566	1,088	1,389	1,547	2,524	6,661	7,340	17,107	30,282	29,865	37,007

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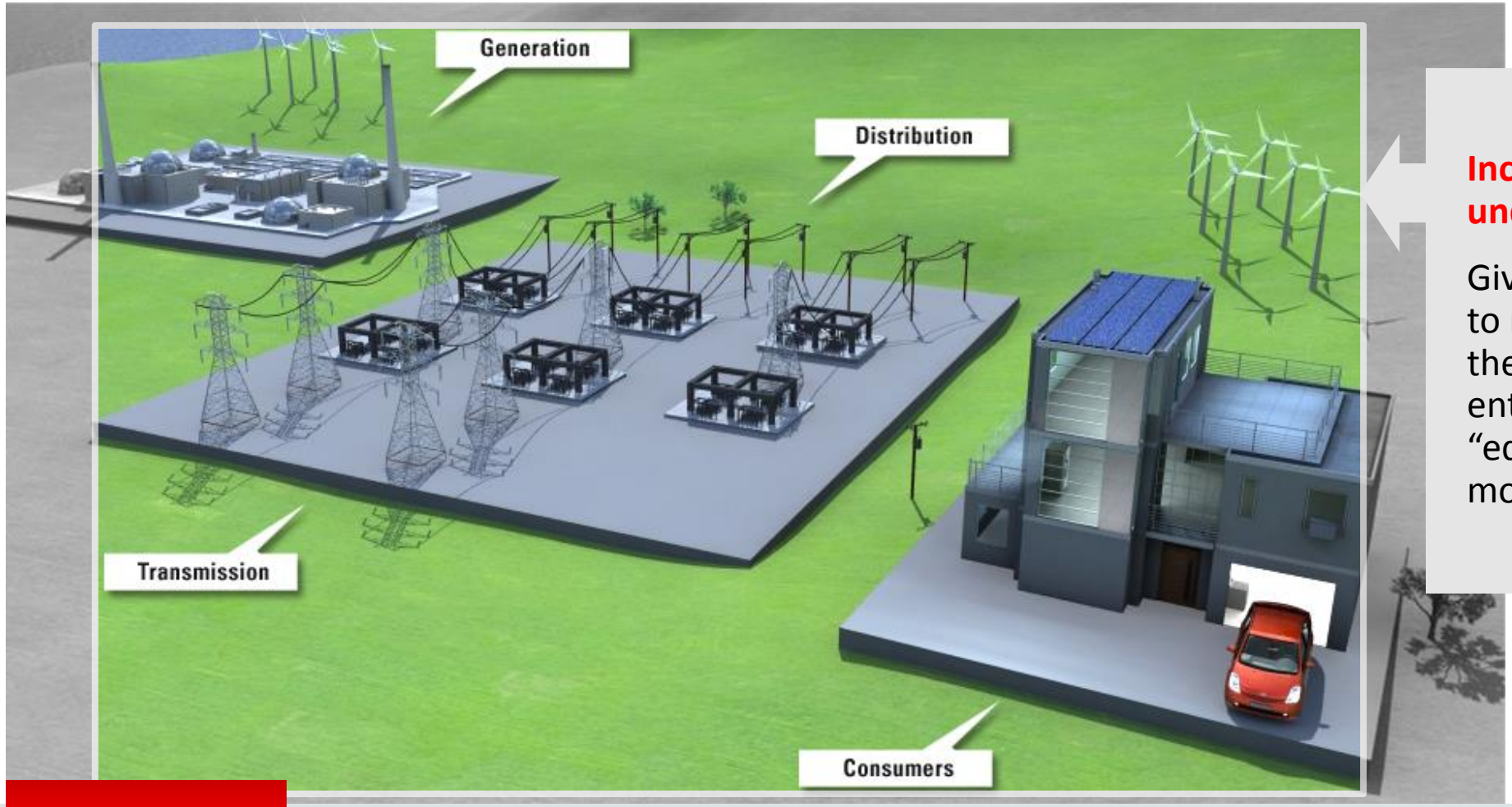
Renewables and SmartGrid Visibility at the Edge of the Grid



Incorporating the whole grid under one control

Gives the full view necessary to model the grid, provides the means to control the entire grid through to the "edge". Better, more efficient, more reliable, and complete.

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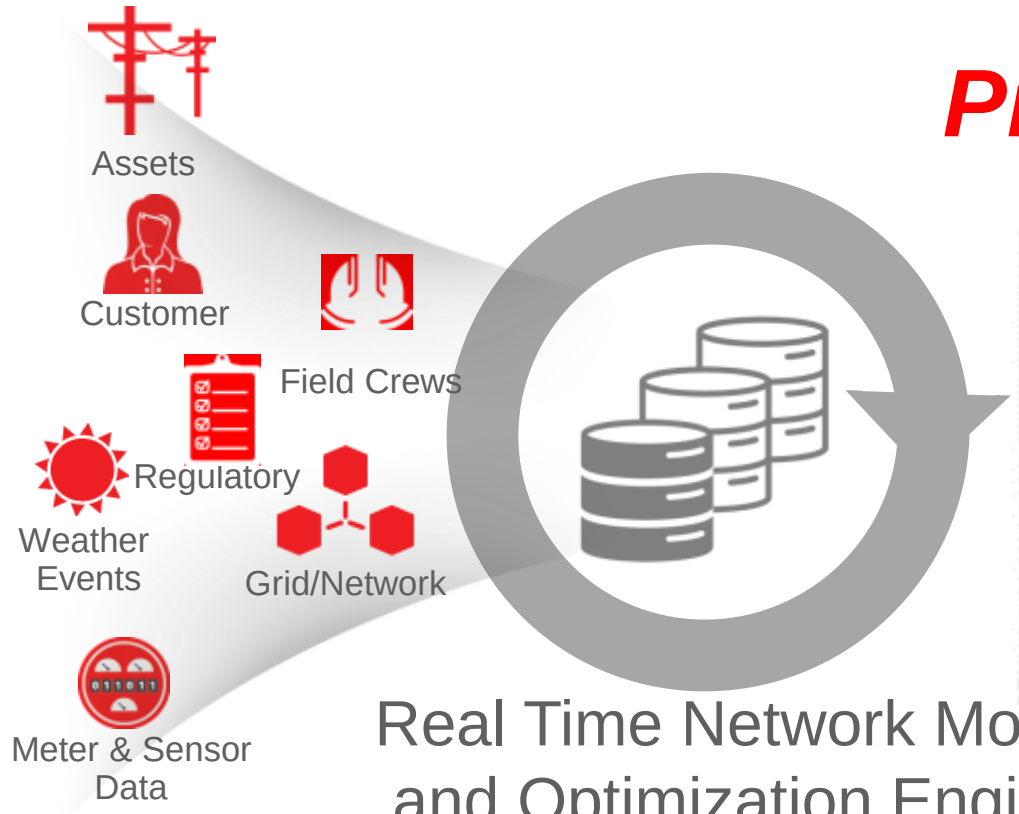
Utilities of TOMORROW: Real-time model drives optimization



Proactive & Prescriptive

- Optimized workflow
- Exceptional service
- Prevents cost & error
- Mitigates operational risks

TAKE AWAY **Accurate model and scalable optimization engine are the key to problem solving**

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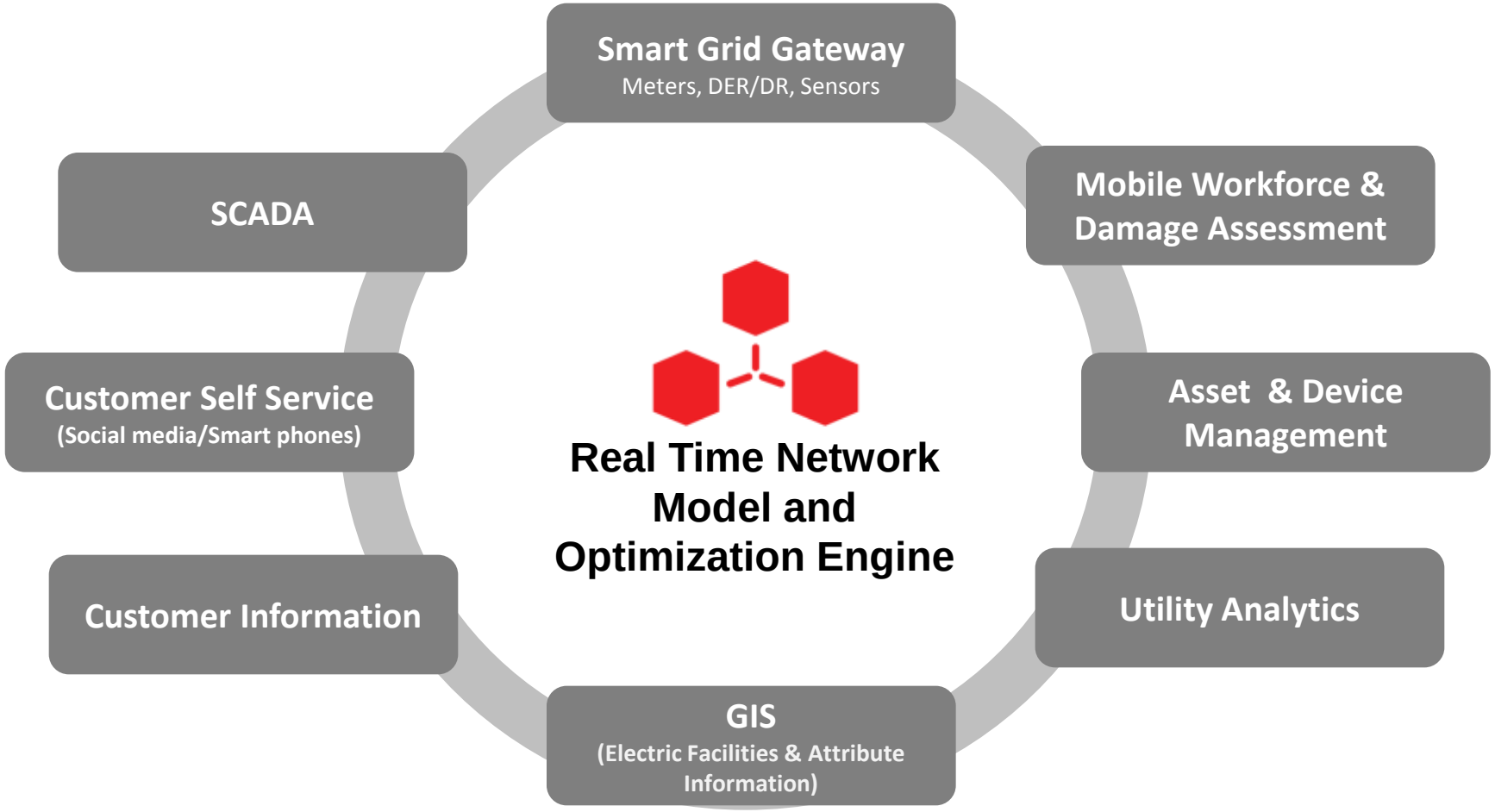
Grid/Network operations & IT/OT convergence



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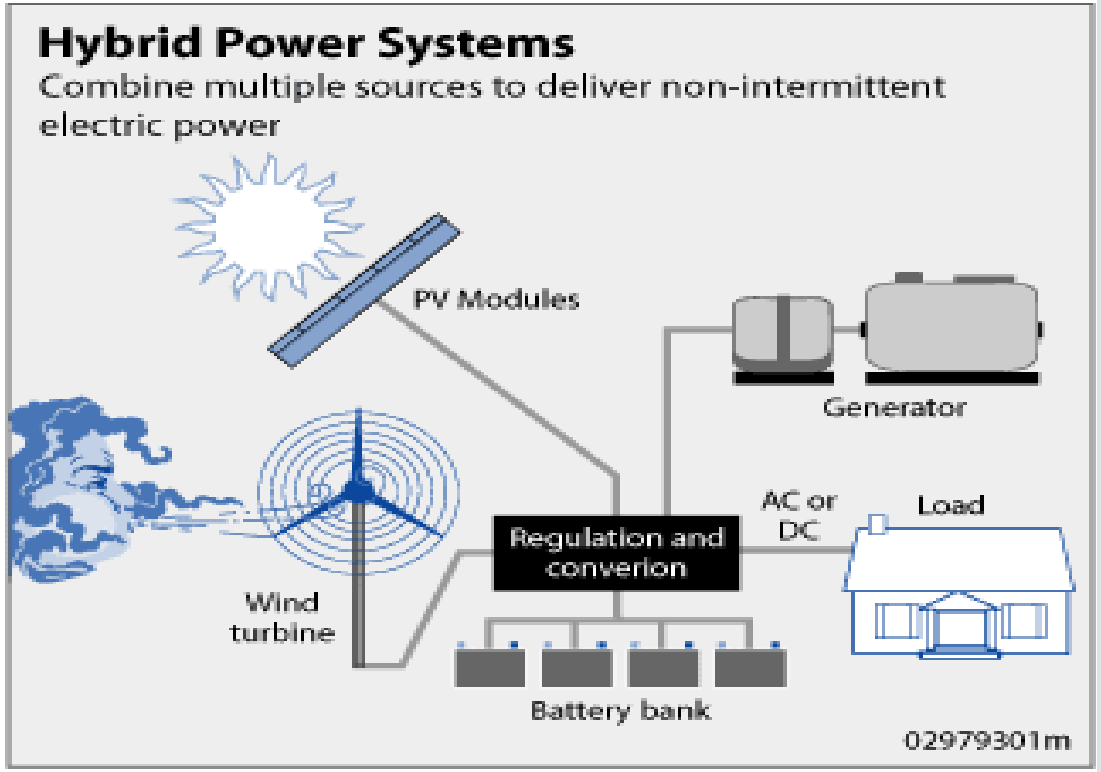
Modeling the Edge of the Grid

Support Consumer Distributed Energy Resources (DERs)

- New technologies require new mathematical models
  - Advanced battery storage
  - Wind and photovoltaic
  - Batteries, Smart Thermostats, etc.
- Requires new parameters for distributed functionality
- Integrations of distribution-based sensors (SCADA) and non-SCADA sensors & gateways for monitoring the edge of the grid



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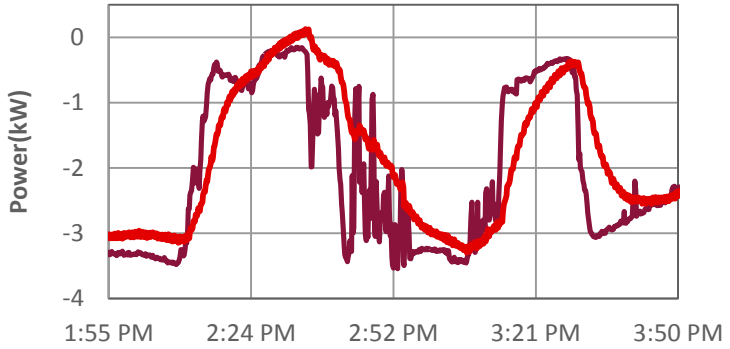
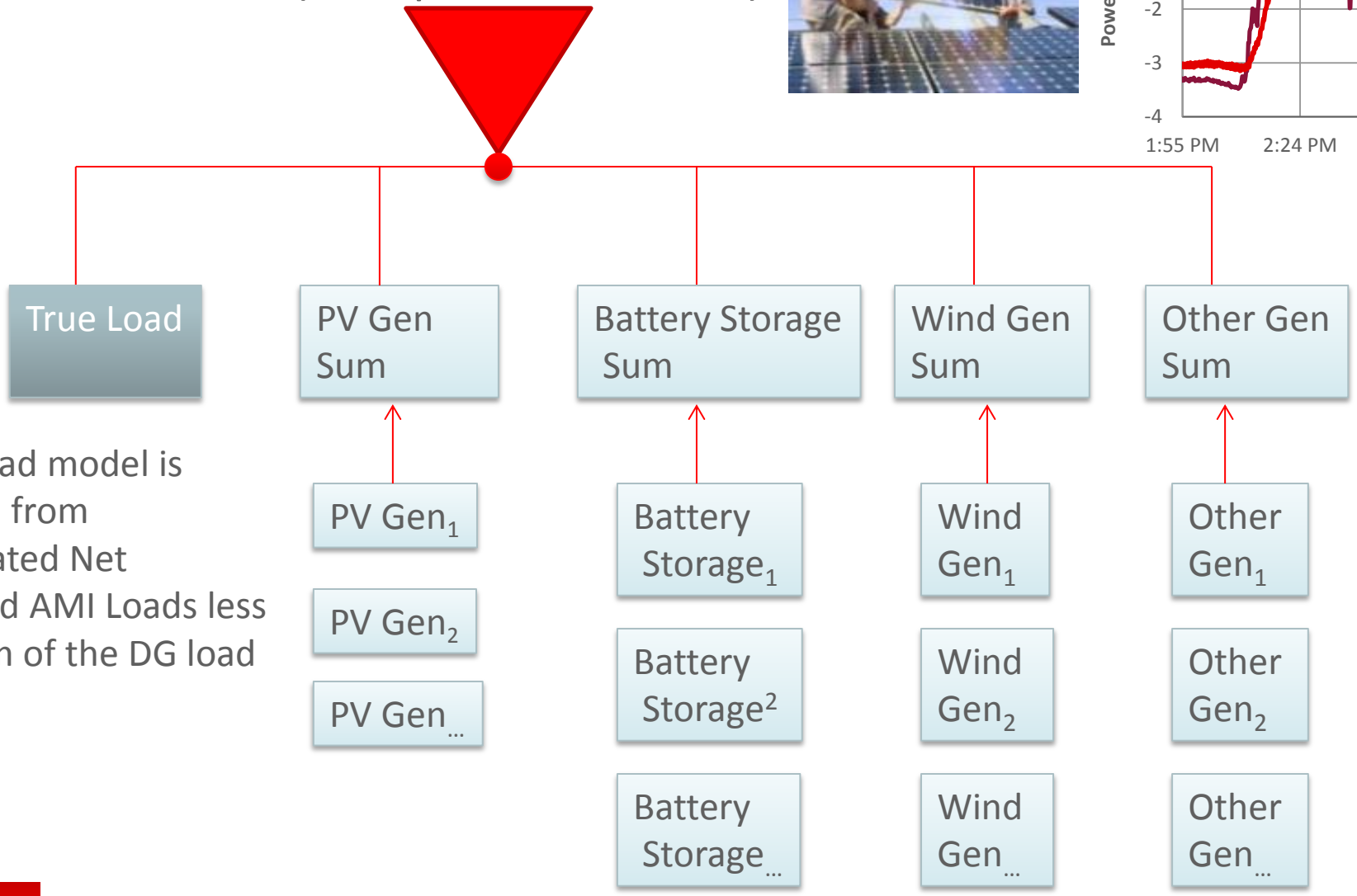
Advanced DG Modeling

At every LV Feeder Point (load point/customer)





True Load model is derived from aggregated Net Metered AMI Loads less the Sum of the DG load shapes

Each type of DER has it's own Generation Model/Schedule Derived from Customer DER Records and specific class models

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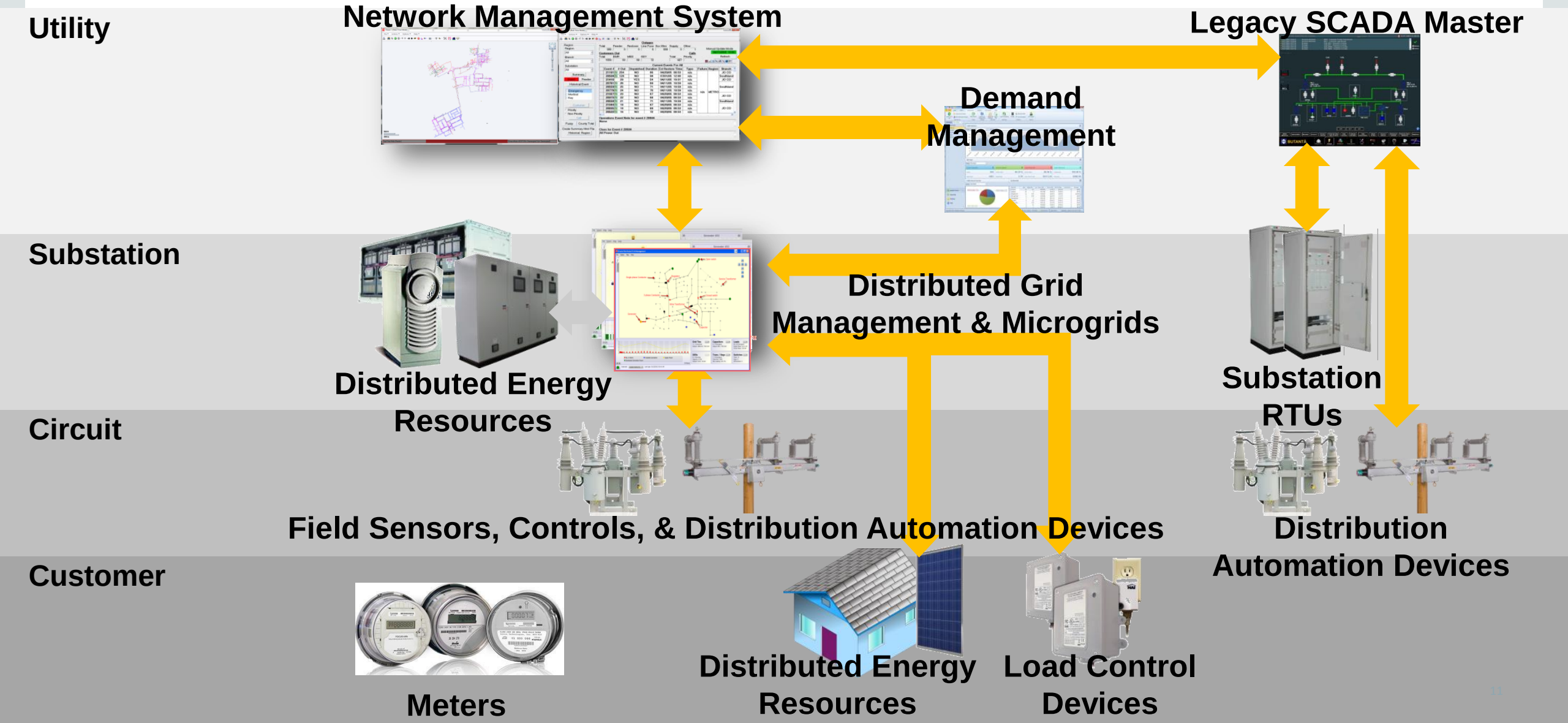
Distributed Processes to support Distributed Generation

Increasing the Value of Utilities Smart Grid Investments



The Road Ahead for Utilities with Distributed Generation…

Develop long-term strategy of what the utility would look like with large penetration of renewables

Create a plan for leveraging lots of real-time information to

- drive safe, reliable, and cost-effective utility performance
- engage customers with consumer energy choices that improves overall satisfaction and performance

Engage technology providers to demonstrate scalable and proven solutions that will leverage existing investments.

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Questions

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