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FOR SUSTAINABLE ENERGY
Stanford University

NEWPORT
CONSULTING GROUP

The Smart Grid Ecosystem

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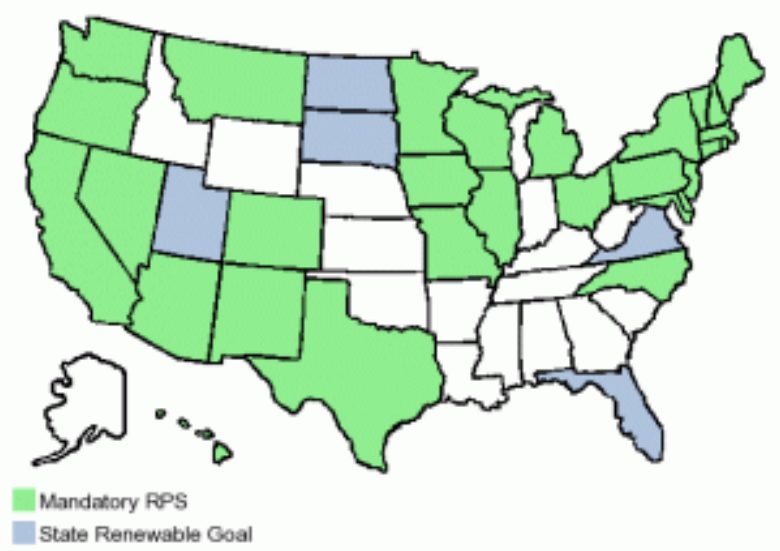
Policy is Spurring DER Adoption

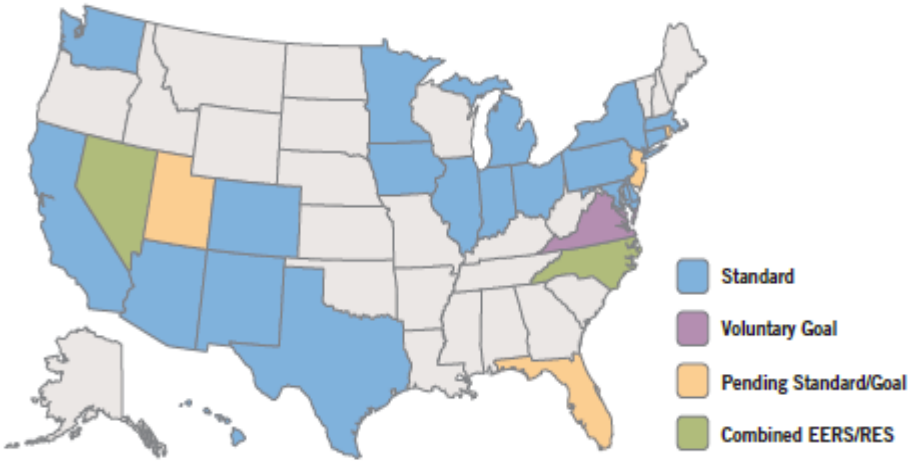
Combined with accelerating improvements in DER technology price & performance are creating opportunities for electric system efficiencies

2011 US State Renewable Policy



Source: EIA

2010 US State EE Policy

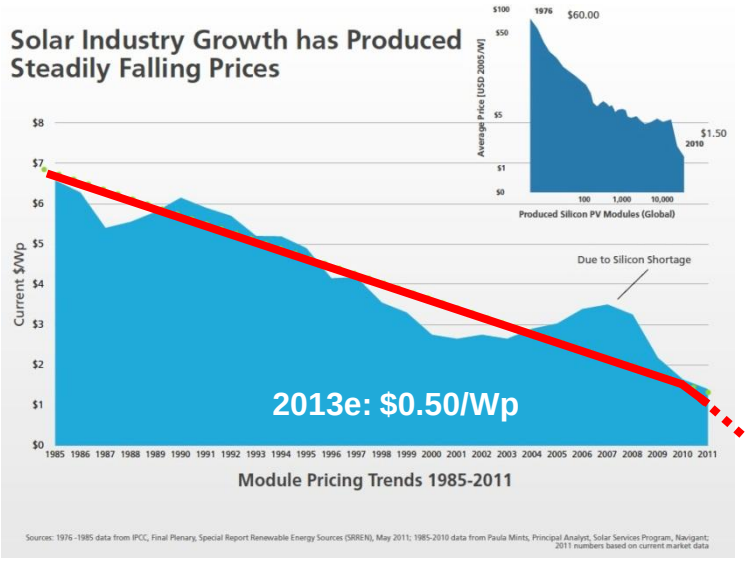


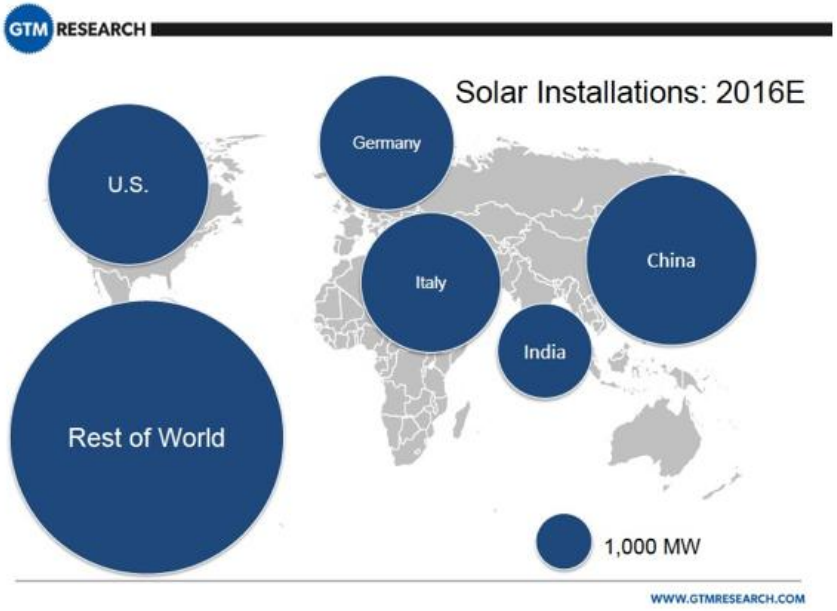
Source: ACEEE

Solar PV is Reaching Retail Parity

"In the last two years, the delivered cost of energy from PV was cut in half. NRG expects the cost to fall in half again in the next two years, which would make ***solar power less expensive than retail electricity in roughly 20 states****"*

David Crane, CEO NRG Energy Nov. 2011





Transformational Trends

"The future is already here, it's just not evenly distributed"

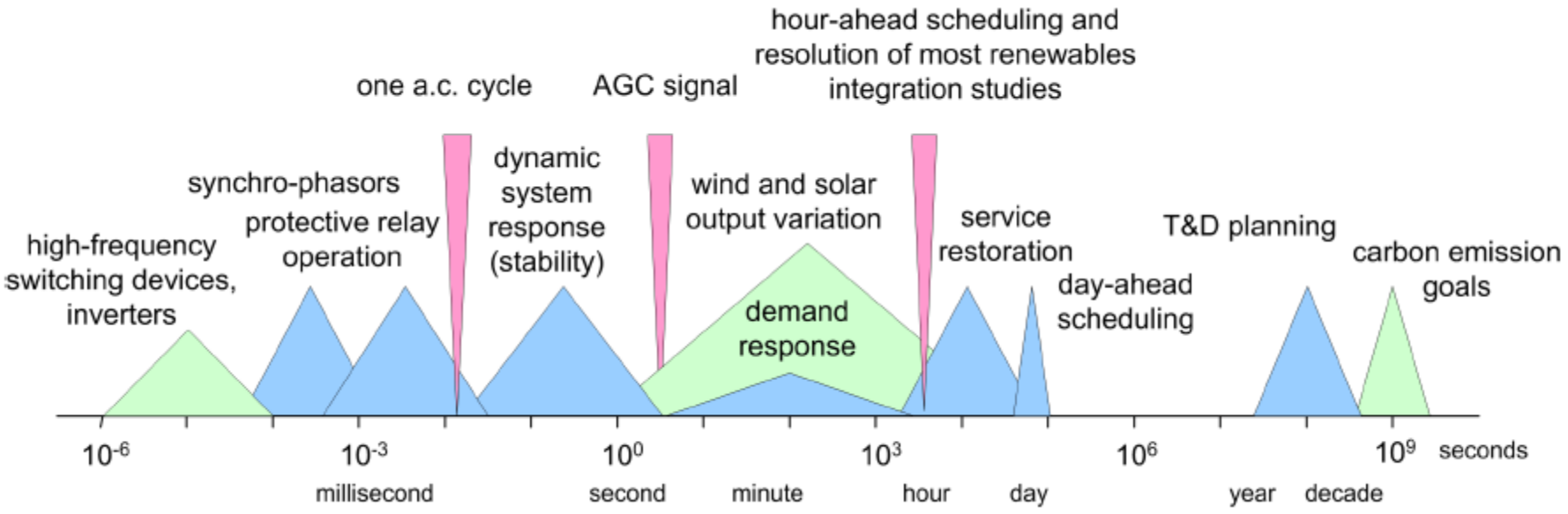
William Gibson, Author

Sensing and Response	Clean Generation	Enernet	Prosumerization
▪ **Smart Monitoring:** sensor networks, AMI ▪ **Demand Management:** bldg control systems, HEM, DR aggregation, time differentiated pricing	▪ **Solar / Wind:** clean generation integration and transmission ▪ **Distributed Generation:** commercial and residential renewable DG and clean fuels DG	▪ **Electric Vehicles:** rapid growth in PEV via smart distribution solutions and smart endpoints ▪ **N-Way Smart Grids:** any-to-any smart grid enabling automated, optimized power flows and resiliency	▪ **Virtual Power Plants:** integrated distributed generation, storage and smart endpoints for increased reliability ▪ **Active Customer Participation:** large scale participation of customers via M2M interfaces in wholesale markets and grid operations

Source: Cisco

Grid Temporal Dimensions

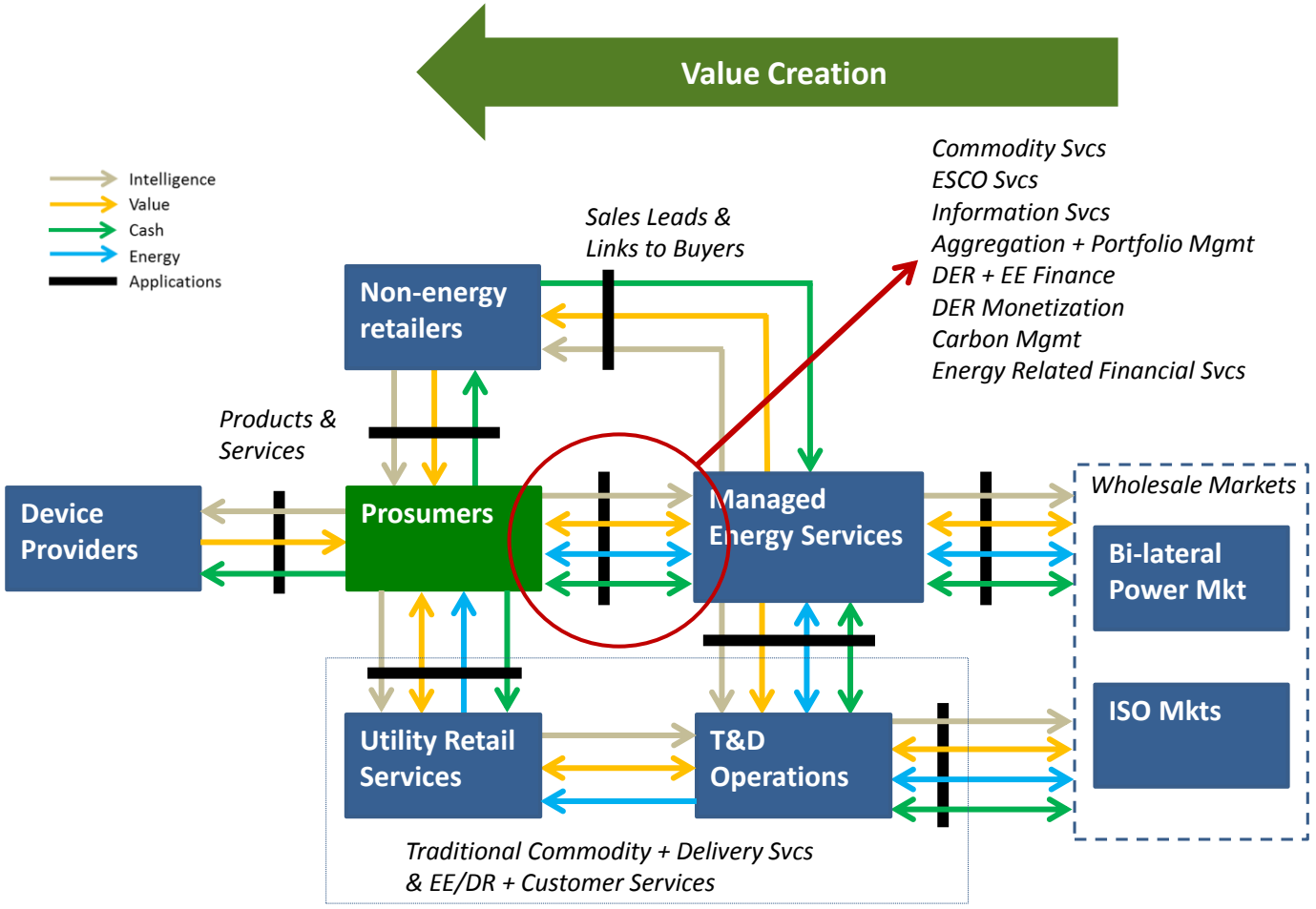
Engineering & Economic Aspects of these Dimensions Will Need to Reconcile More Dynamically thru Closed-loop Systems



Source: CIEE/ A. von Meier

Emerging Electricity Industry Ecosystem

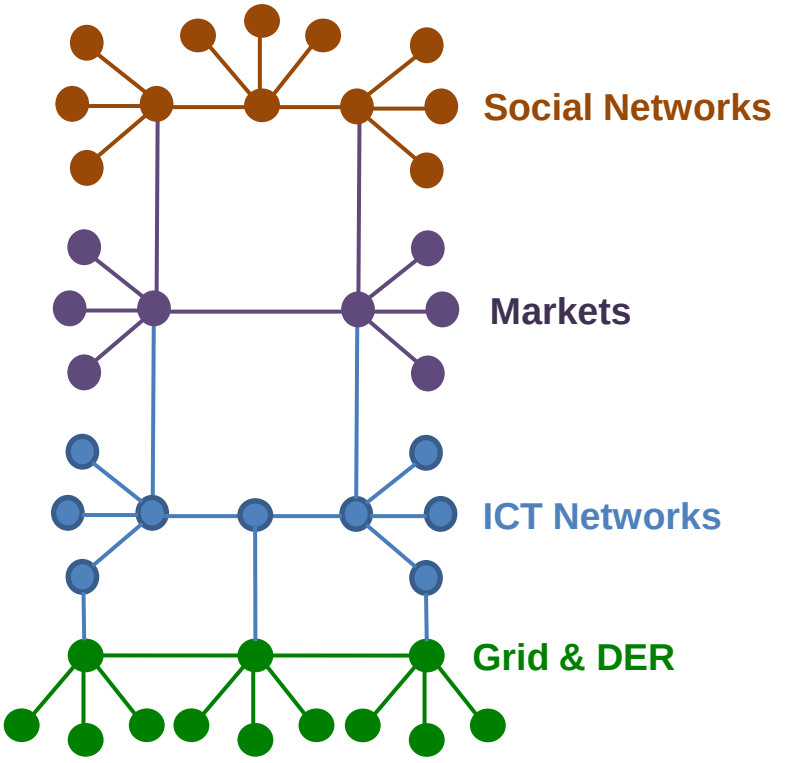
Transformation of roles and relationships and respective value creation & provision



Implications of Ecosystem Convergence

Smart Grid Facilitates Convergence of Markets with Social and Electric Networks

- The convergence of markets, social, cyber and electricity networks as envisioned by smart grid and public policy makers also creates multi-dimensional value and operational considerations
- Distribution system role is evolving and the engineering designs and control systems also need to evolve
- Data and information management are critical components of emerging applications/control systems
- Markets will continue distributed evolution and will need to reconcile DER stakeholders' objectives– not just wholesale objectives



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