

Renewable Energy & Smart Grid Interactions

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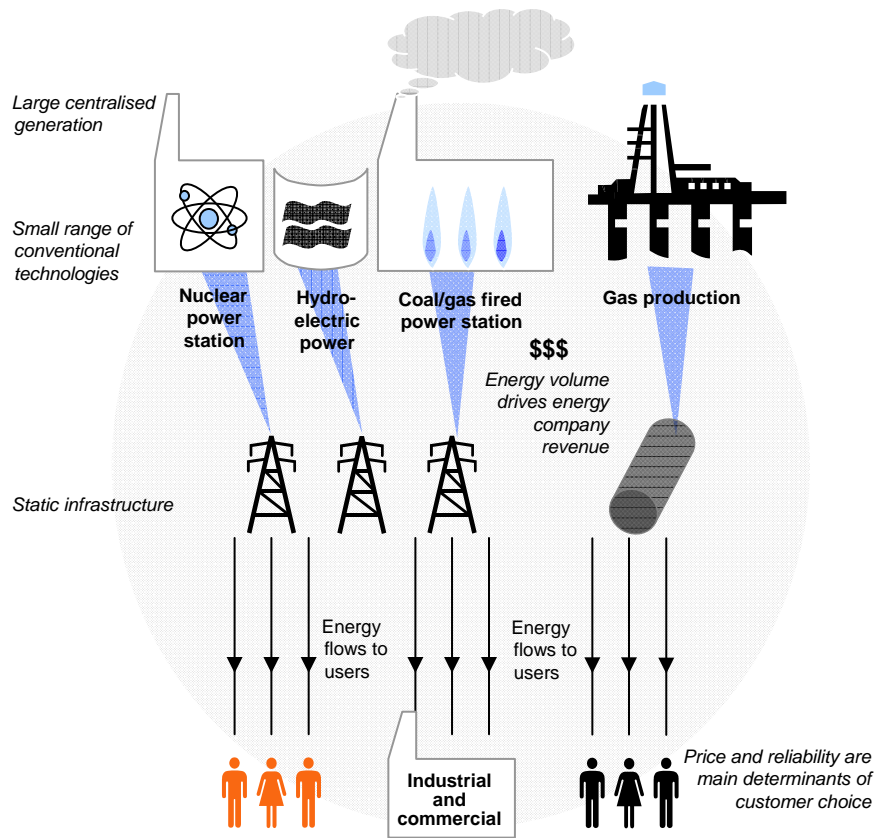
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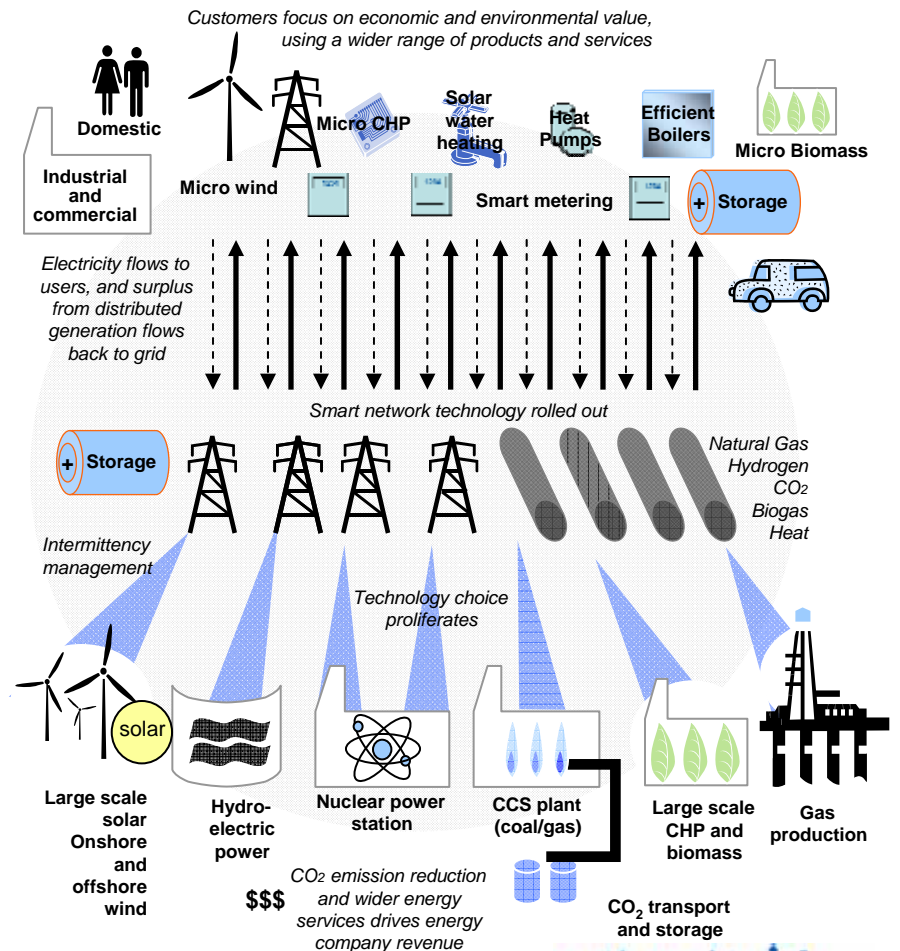
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The Smart Grid is an Essential Part of the Evolution of the Energy Industry

Traditional Energy Market - supply driven



Today's Evolving Market - customer driven



The Energy Industry Must Adapt

The deployment of Smart Grid technologies will enable the shift in customer behavior towards more widespread installation of renewable energy systems, energy storage systems and unique devices like electric vehicles with V2G capabilities

With increasing volatility in energy prices, and climate change becoming a more prominent public concern, customer needs are changing.

Customers need the “tools” to play their part in the shift towards a new energy future.

The trend to increased consumer choice and control will be different for customers dependent upon their circumstances and needs – more segmentation will occur.

The “one ratepayer” approach to serving residential and small business customers must evolve, we will have to be more innovative in developing home-generation tariffs and distribution system power management procedures to satisfy customers going forward.

Smart Grid Technology can Accommodate Rapid Load Changes

Smart Technology Definition

Technology that provides advanced information, automation and control capabilities to help us distribute, measure and use energy more efficiently, reliably, safely and sustainably – all the way from the point of bulk power generation of various types to consumer-owned generation and appliances

What is Smart Technology?

Meter

- ♦ Meter that records interval data
- ♦ 2-way communications, remote configuration
- ♦ Informative display
- ♦ Load Control and Energy Storage Management

Grid

- ♦ Sensors & measuring devices
- ♦ Energy Storage to provide or absorb kWh
- ♦ Faster & two-way Voltage Regulators
- ♦ Feeder management systems to deal with highly variable customer energy sources

Home

- ♦ Customer portal & Home Area Network
- ♦ Automated controls for PHEV and EV Chargers
- ♦ More advanced control for customer-owned generation and energy storage (ES)

What does it allow you to do?

- ♦ Automatic meter reading
- ♦ Enable customer choice and control
- ♦ Choice of tariffs e.g. time of use – peak shifting
- ♦ Remote management of selected house loads and home energy sources via inverter inputs
- ♦ Accommodate Variable Distributed generation
- ♦ Remotely detect, diagnose, predict and correct network problems & faults
- ♦ Maintain feeder voltage within desired range despite widely varying loads and generation
- ♦ Automatically optimize selected home appliances
- ♦ Allow premium kWh sales from renewable and ES systems

Renewable Energy and Advanced Technology

Energy technologies to be integrated (not inclusive):

- Electric Vehicles (EVs) and Plug-in Hybrid EVs (PHEVs)
- Energy Storage
- Wind turbines
- Photovoltaic (PV) Systems
- Geothermal
- Biomass
- Combined Heat and Power (CHP)

Solutions to Challenges Associated with Distributed Energy Resources

A coordinated and collaborative approach among stakeholders

Focus on optimization – find the right mix of options

Optimize opportunities presented by diversification of resources

Analytics and software tools

Effective communication – do not create false expectations

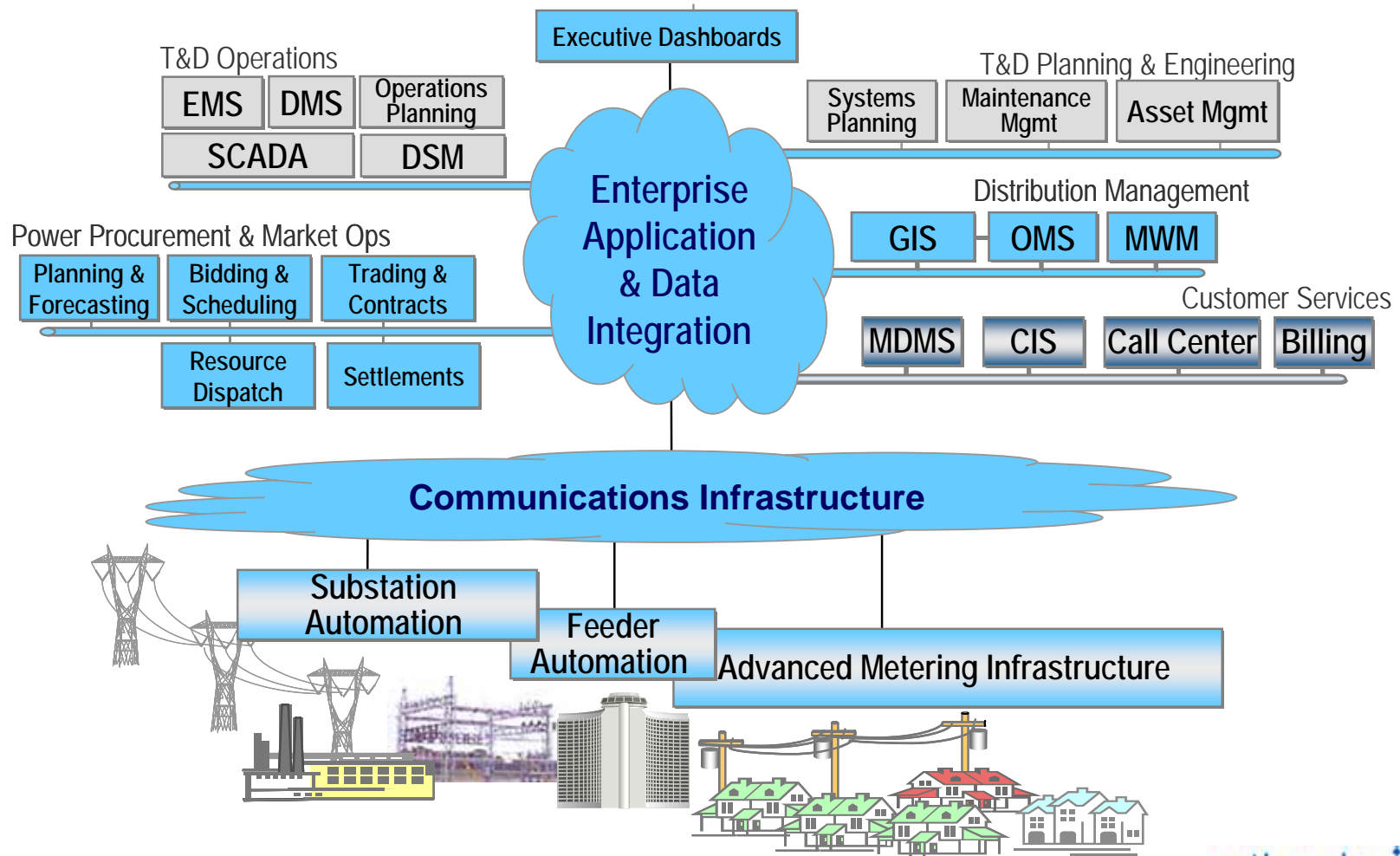
Increase focus on efficiency and encourage customer participation

Effective load management – real and reactive power

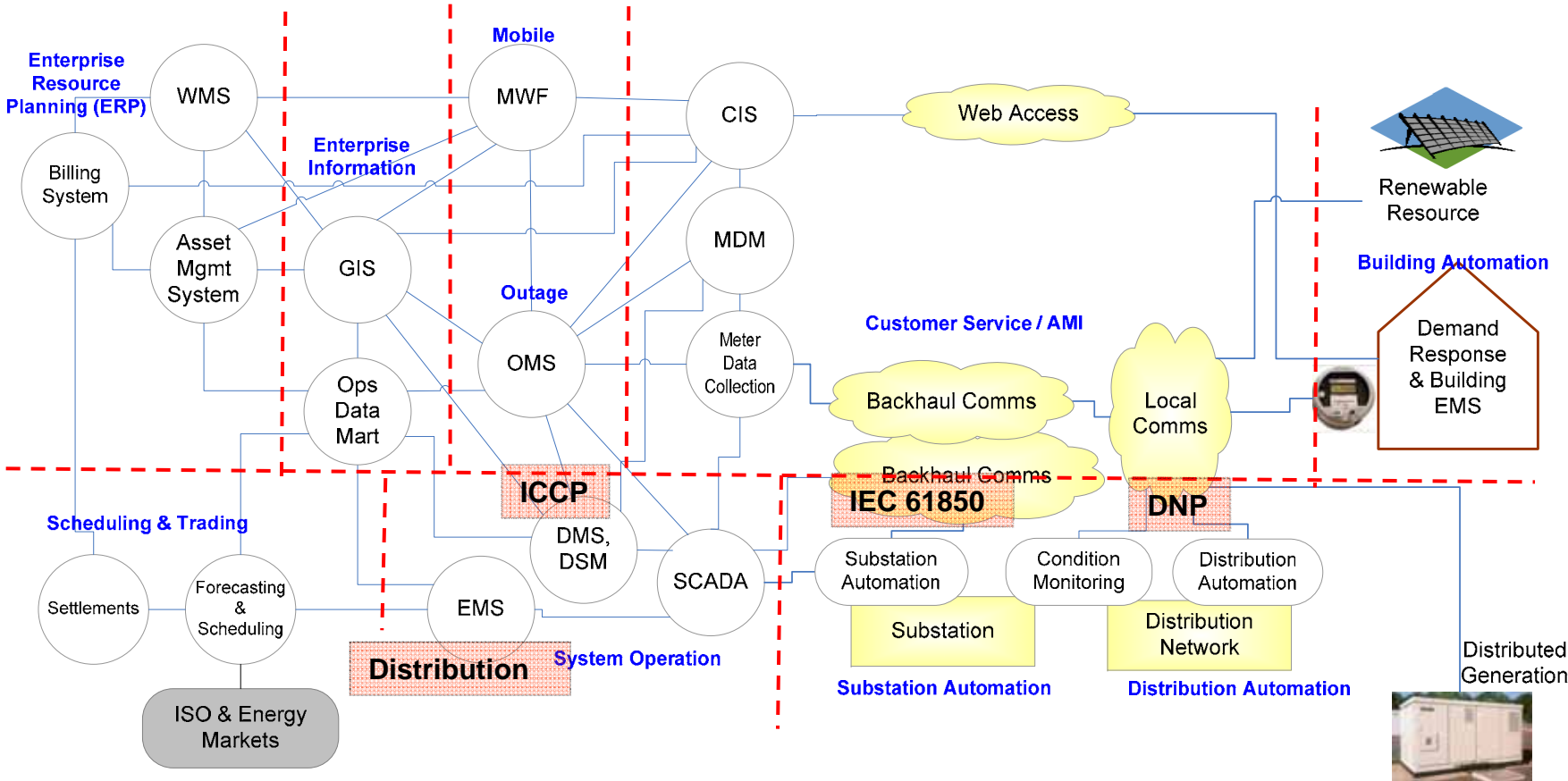
Develop workable micro-grid concepts – interoperability

The Smart Grid can interact automatically with the wide range of assets that make up the energy delivery infrastructure as well as energy sources inside homes and businesses

Smart Grid is about Infrastructure

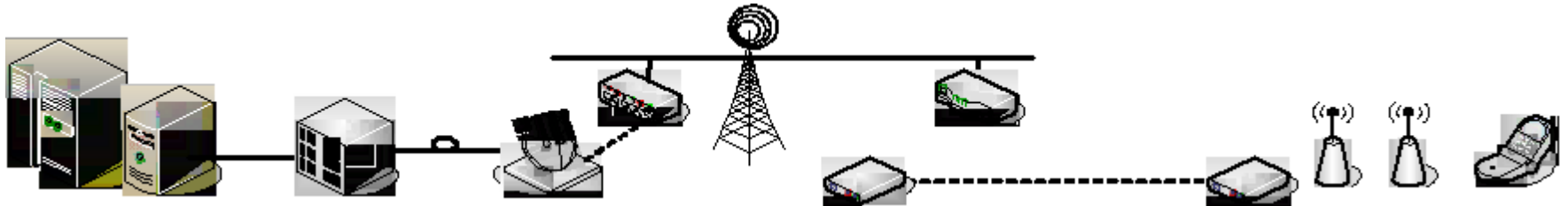


Smart Grid is about Interoperability



Smart Grid is about Enabling Distributed Energy Resources

The Smart Grid Infrastructure and Interoperability will enable the seamless integration of numerous and diverse distributed generation resources.



Communication Media: BPL, Wi-Max, Satellite, Fiber, DSL, Wi-Fi, RF Mesh, etc.

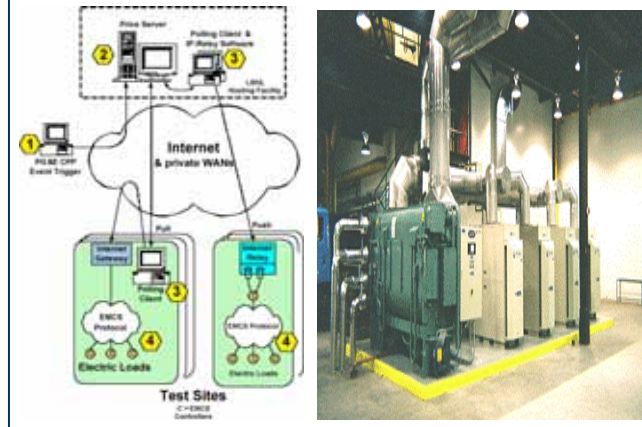
Smart Grid Infrastructure: Software/database, network communication and monitoring and control architecture



Substation/Feeder DER Integration



C&I Customer Demand Response & DER Integration



Residential Customer Demand Response & DER Integration



Integrating Distributed Power Generation, Storage and Demand Response Technology into a Demand-Side Virtual Power Plant

Conclusion

A coordinated strategy and approach by stakeholders is absolutely essential to the successful deployment of distributed energy resources

Effective education of consumers, stakeholders and energy participants is critical

Smart Grid will enable new services and relationships between market participants and their customers – beneficial to both

An enhanced regulatory model may be necessary to fully realize the benefits of a Smart Grid

Ultimately, it is about optimizing the use of our resources – we all need to adapt

Smart Grid will redefine the way the electric system operates and the way energy is managed and consumed, but the basic laws of physics have not changed