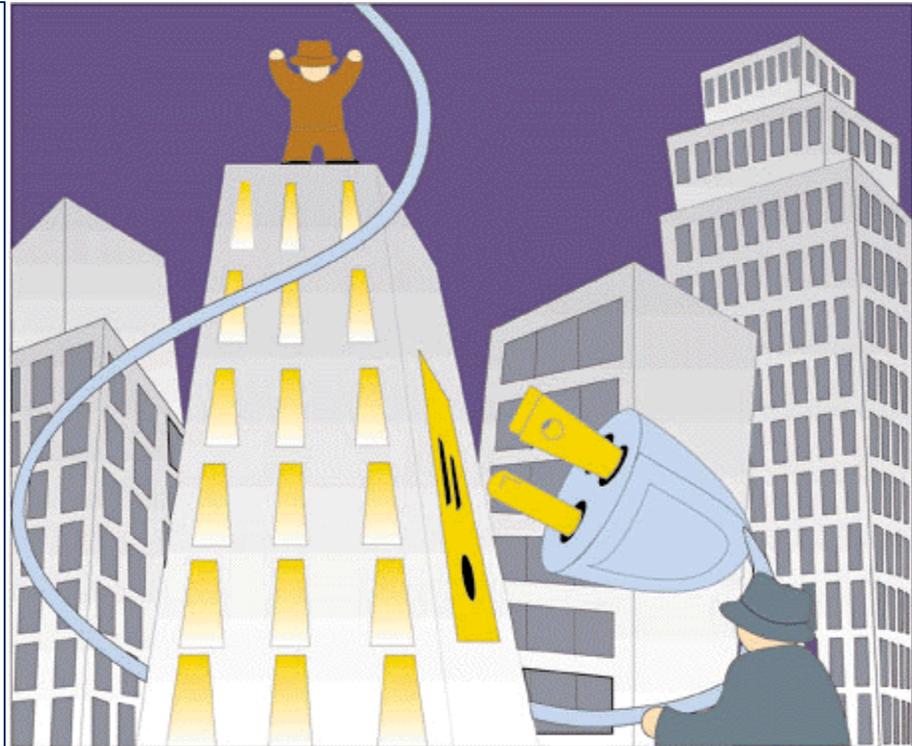


# Distributed Power Hybrids: Technical & Regulatory Barriers - Domestic

DOE Natural Gas/Renewable  
Energy Hybrids  
Session II  
National Renewable Energy  
Laboratory  
Golden, CO  
August 21-22, 2001



Presented by N. Richard Friedman  
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# *Background*

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# Distributed Generation Technologies

- Renewables
  - Wind
  - Solar
  - Biomass
  - Other
- Non-Renewables
  - Reciprocating Engines
  - Turbines
  - Microturbines
  - Fuel Cells
- Efficiency Improvement/Storage

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# The Dominant Myths of Distributed Generation

- Myth 1 - Lots of money is being made in the DG market
- Myth 2 - DG can be installed for <\$500/kW
- Myth 3 - DG will replace central station generation

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# DP Applications

Application	Description
<b>Continuous Power</b>	Requires power on a nearly continuous basis, typically at least 6,000 hours per year.
<b>Combined Heat and Power (CHP)</b>	Applications utilize waste heat as useful thermal output, and typically operate 6,000+ hours annually.
<b>Peak Shaving</b>	Units typically operate 200-3000 hours per year during periods when high demand charges apply.
<b>Standby/ Emergency Generation</b>	Applications typically driven by the reliability (perceived or real) of the grid, or code requirements.
<b>Mechanical Drive</b>	Units drive shaft-driven equipment such as gas compressors, air compressors, refrigeration units, chillers, and pumps.
<b>Grid Support</b>	Applications may use DG to defer transmission or distribution system upgrades, reduce transmission losses, or provide voltage support.
<b>Emerging Applications</b>	Premium power, “green” power or DC applications.

# *Technical Barriers*

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# Technical Barriers

- Integrated Controls & Protective Relaying
- Full-Scale Remote/Unattended Operation
- Production Cost Certainty
- Fully Commercialized Products
- After Sale Support/Warranties

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# Key Issues Driving R&D Needs (from Systems Integration Workshop)

- Functionality of interconnection package
- Grid vs. customer standards
- (generator controls, etc.)
- Interface standards between DER and interconnection package
- Issues of scaling to different power levels
- Lower cost, better performance issues

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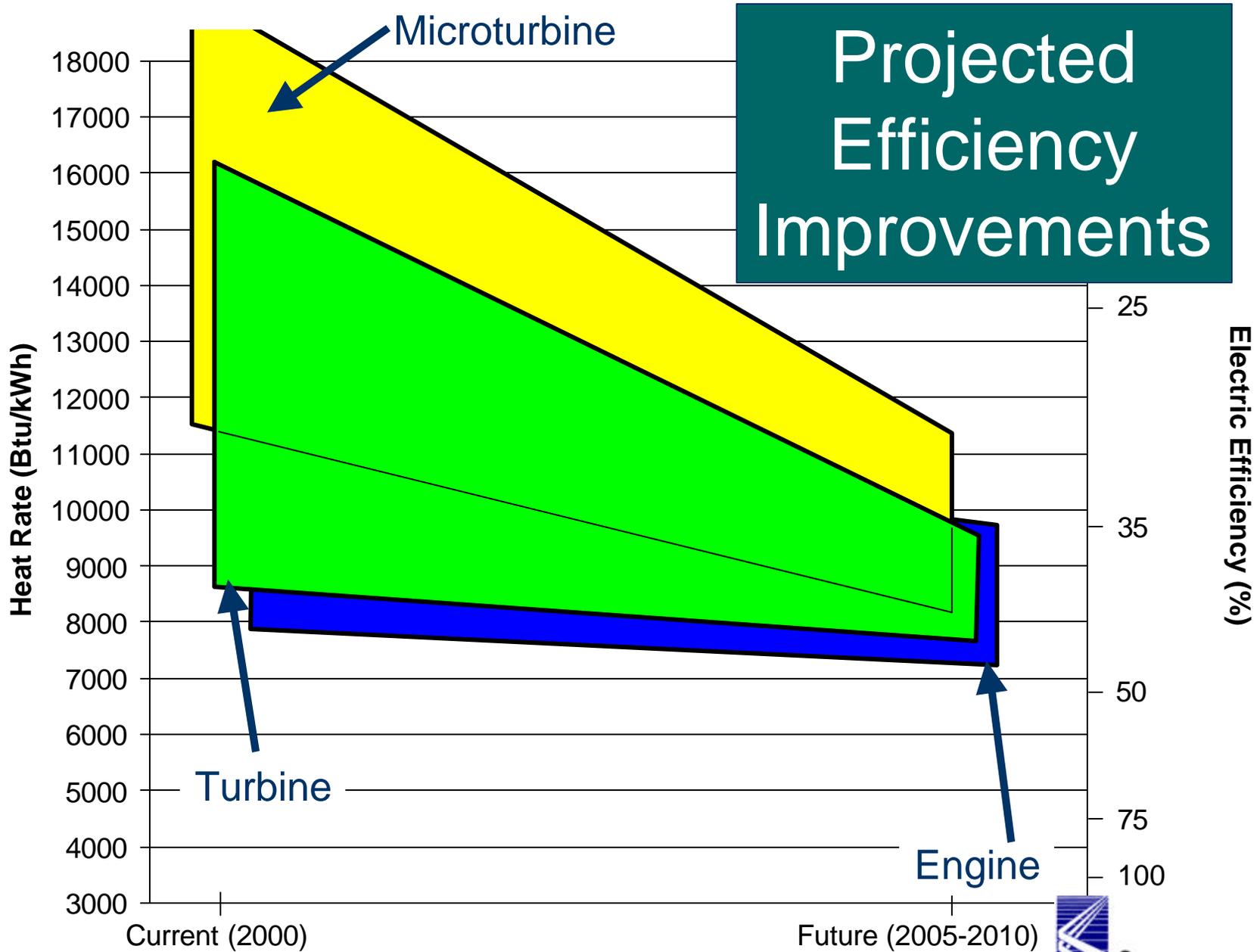
# Relays - Vendor Comparison

Function	Sync Check	Under/Over Voltage	Reverse Power	Negative Phase Sequence Current	Negative Phase Sequence Voltage	Neutral Under/Over Voltage	Directional Overcurrent	Instantaneous Phase Overcurrent	Neutral Overcurrent	Phase Overcurrent w/Voltage Restraint	Under/Over Frequency
Supplier	25	27/59	32	46	47	27G/59G	67	50	50/51N	51V	81 U/O
Basler 951	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
Beckwith M3520	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available	Available
Beckwith M3410	Available	Available	Available	Available	Available	Not Available	Not Available	Not Available	Available	Available	Available
Encorp GPC	Available	Available	Available	Available	Available	Not Available	Not Available	Not Available	Not Available	Available	Available
Schweitzer SEL-351	Available	Available	Available	Available	Available	Available	Available	Available	Available	Not Available	Available
Cutler-Hammer Bkr Trip Unit	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Available	Available	Not Available	Not Available

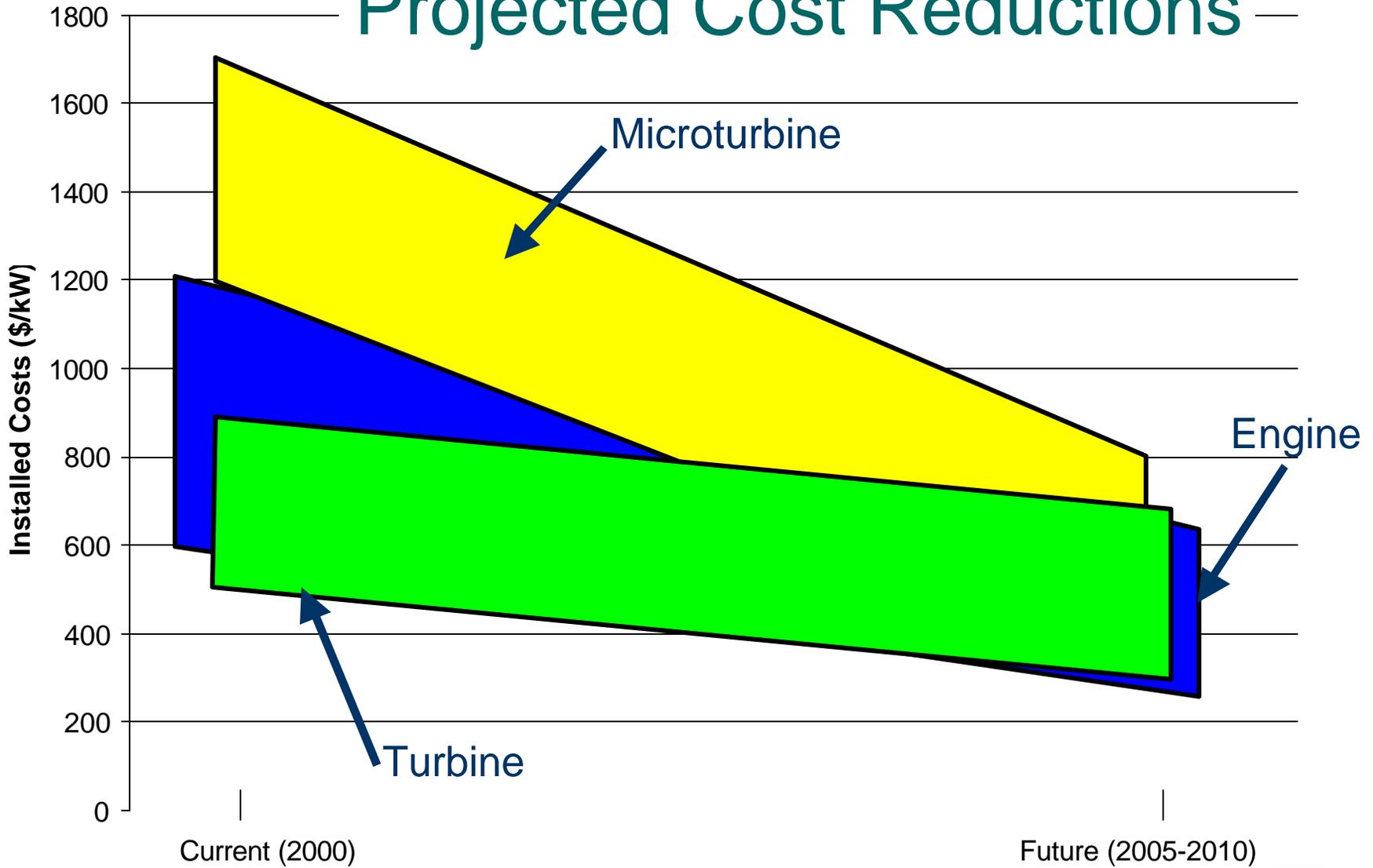
 = available       = not available

Note: This chart does not show all features in the protective relay. Only those we have been asked to supply are shown.

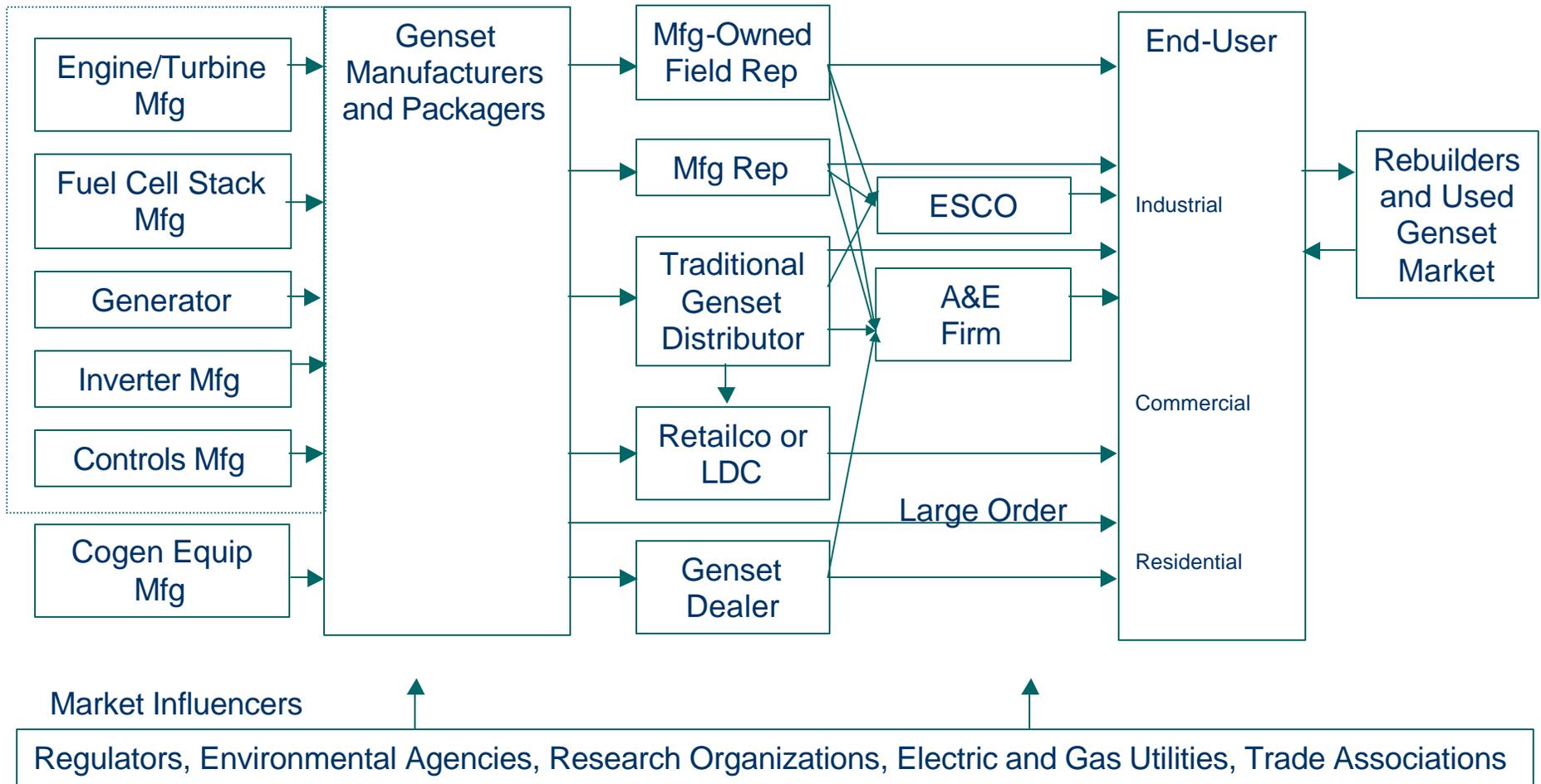




# Projected Cost Reductions



# DG Market Distribution Channels



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# *Regulatory Barriers*

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# Regulatory Barriers

- Interconnection
- Recognition of DP Hybrid Benefits
- Exit Fees/Standby Charges
- ISO Requirements
- Natural Gas Pricing
- DP Ownership

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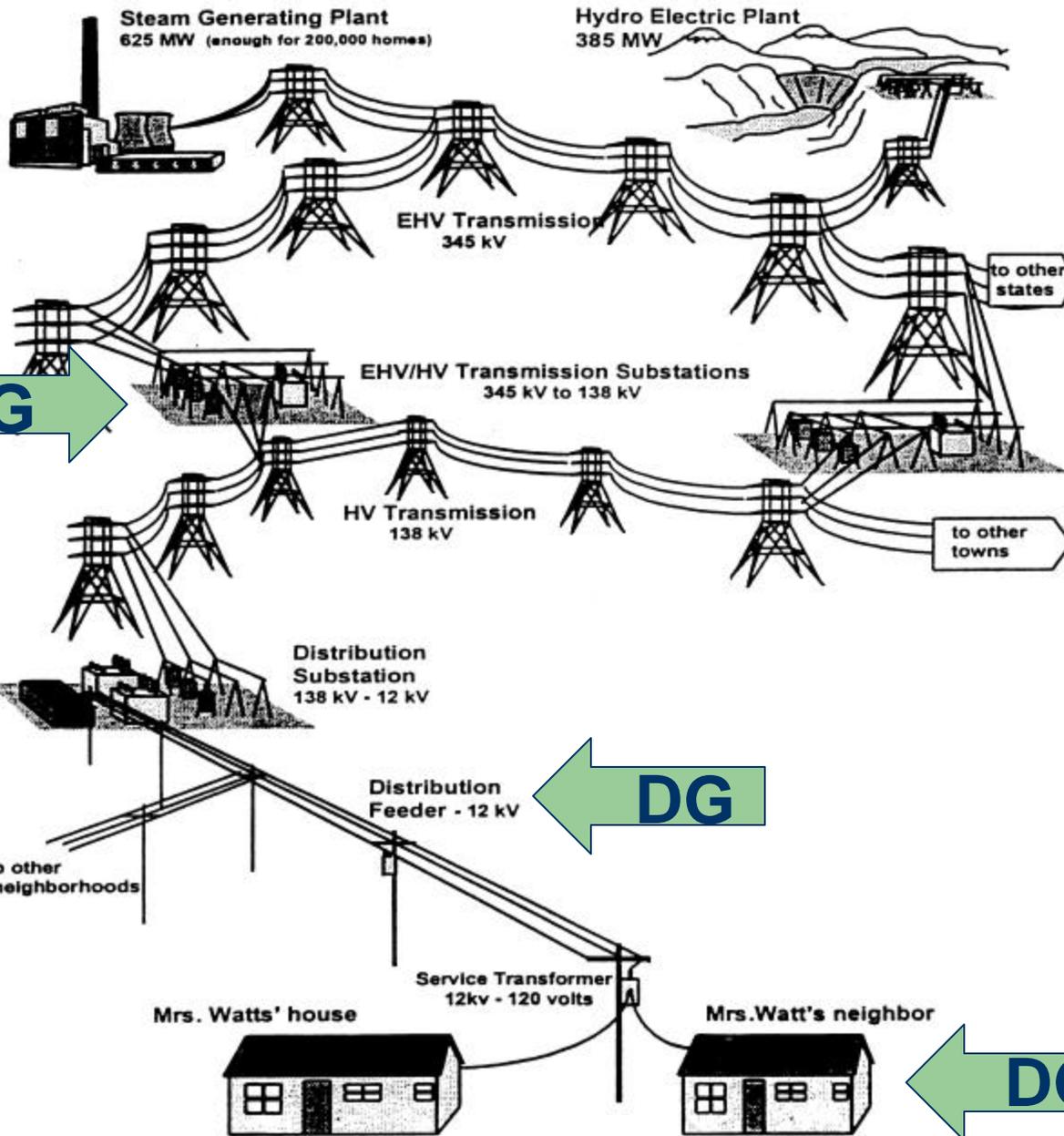
# *Impacts of Interconnection*

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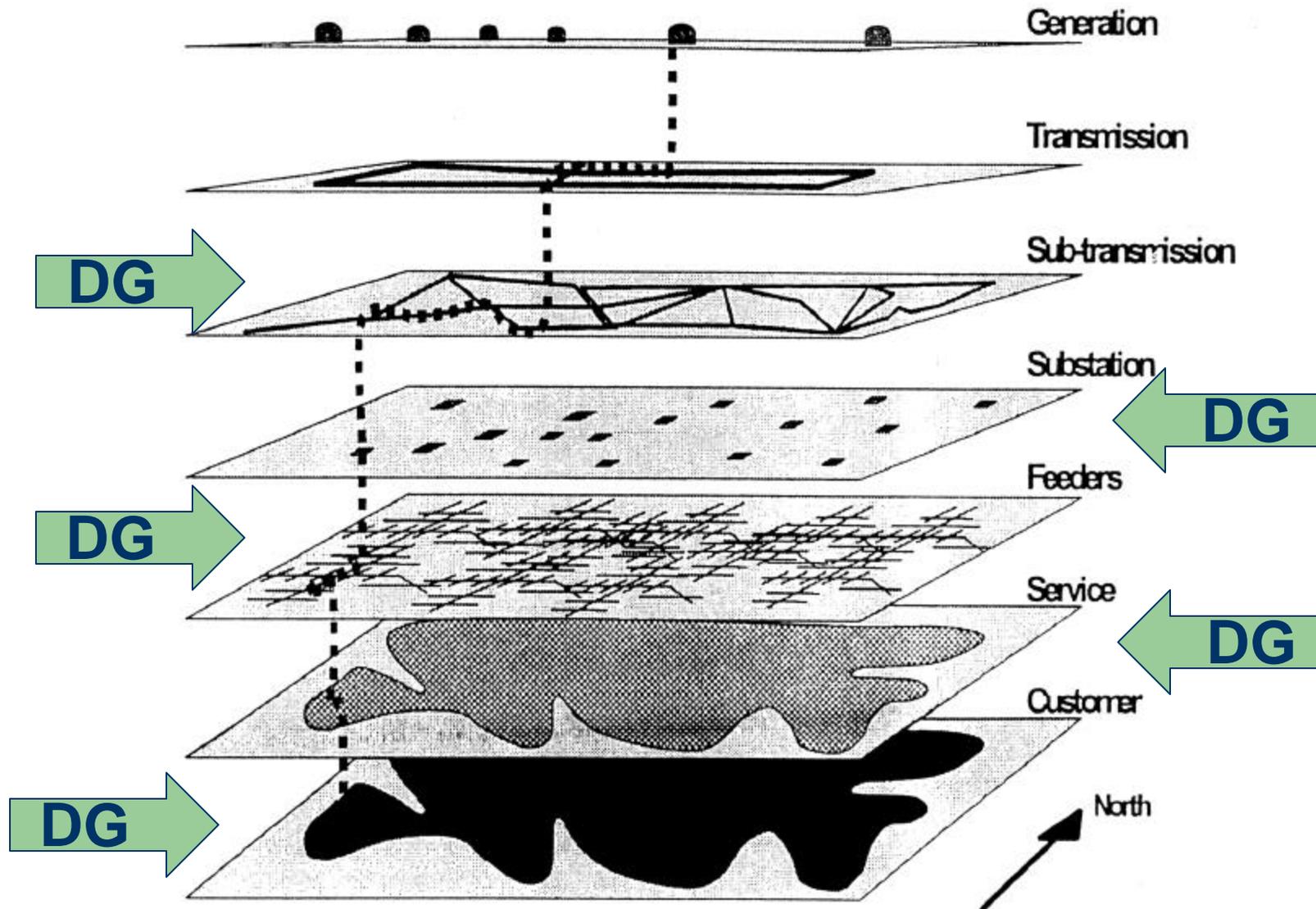
DG

DG

DG

DG

# Layers of Service - Power Gen System



# IEEE 1547 Interconnection Standard

- *Title:* Standard for Interconnecting Distributed Resources With Electric Power Systems
- *Purpose:* Provide a Uniform Standard for Interconnection of Distributed Resources With Electric Power Systems, and Requirements Relevant to the Performance, Operation, Testing, Safety Considerations, and Maintenance of the Interconnection

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# Interconnection Concerns Covered in Standard

- Safety
- System and Equipment Protection
- Power Quality and Reliability

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# Technical Requirements Fall Into Several Categories

- General
- Response to Abnormal Conditions
- Power Quality
- Islanding

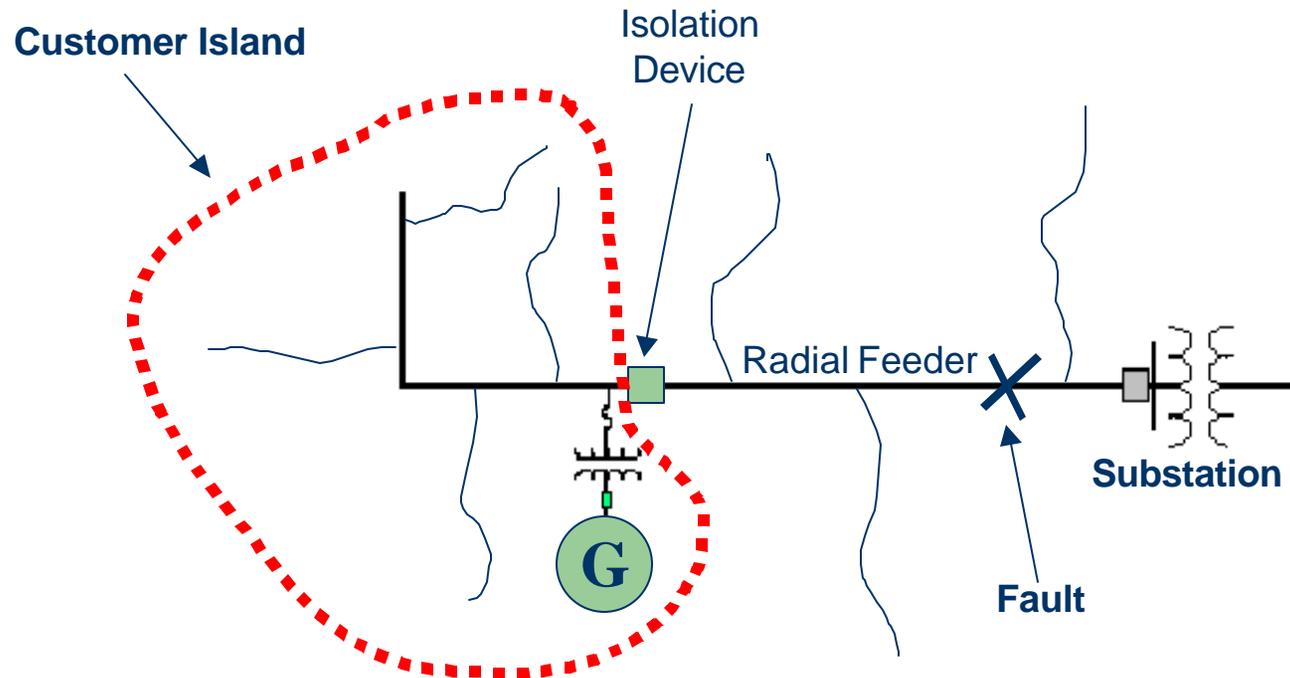
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# Island Situation



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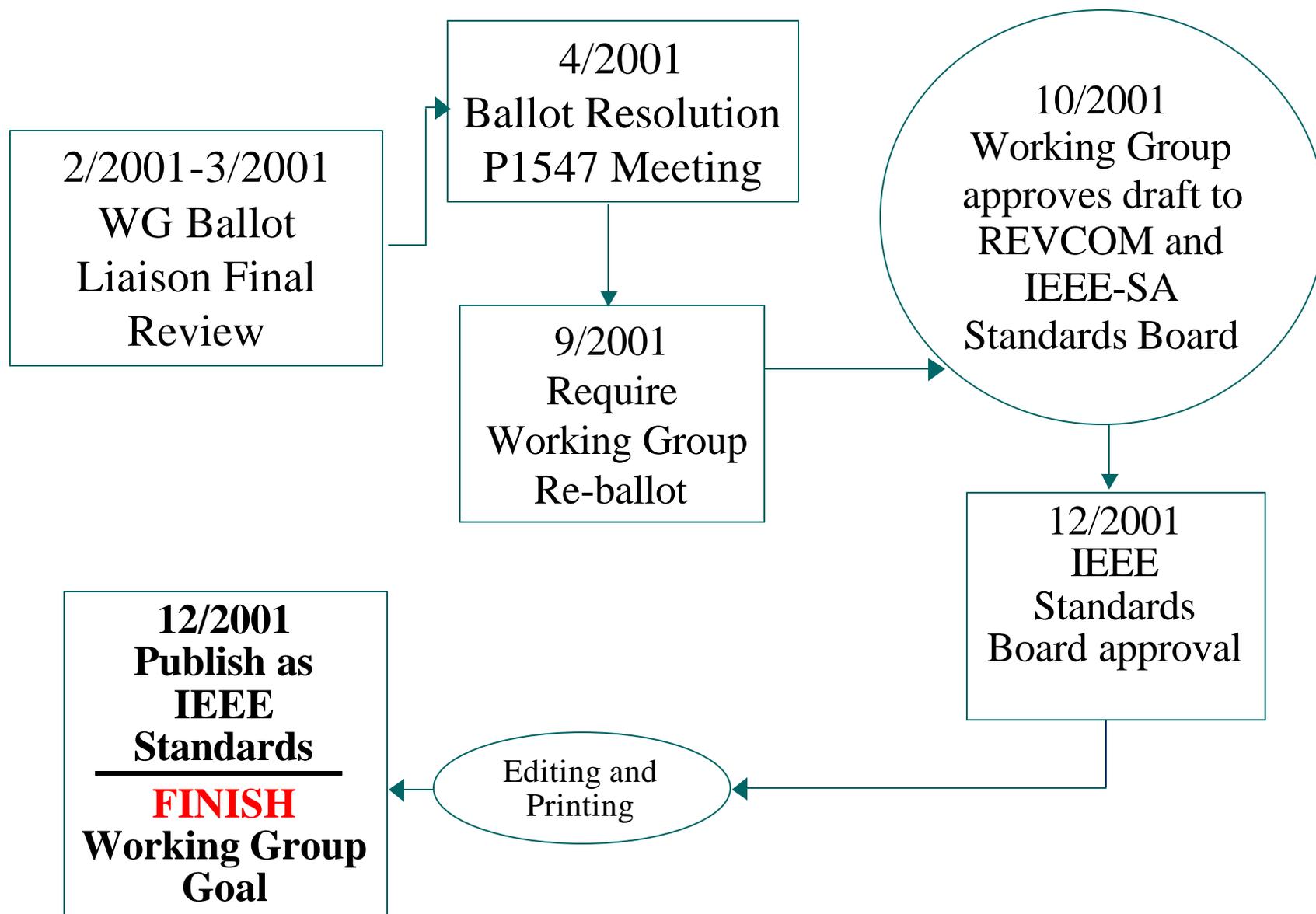
# Future IEEE SCC21-P1547 Activities

- Draft 7 Failed First Ballot - Recirculation Shortly
- Next Meeting - October 16-19, 2001, Las Vegas
- Several New 1547 Projects Initiated
  - Applications Guide
  - Testing
  - Communications
  - Others

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**Proposed Timeline for IEEE SCC21 Standards Development Project  
P1547-Standard for Distributed Resources Interconnected with Electric Power Systems**



# The Bottom Line for DP Hybrids

- Deregulation and Increasing Reliability Concerns Will Accelerate Interest
- Limited Primary Power Market
- Meeting Technology & Regulatory Challenges Still a Wild Card
- Need Other Applications (e.g., transportation) to Build Volume and Establish Service Infrastructure
- Pricing & Reliability Still Need Attention

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# What might the power system of the future look like?

- Large central station generation
- Other central station generation
- Micro-turbines and Micro-grids (Isolated & Parallel)
- Local large and medium DR (rotating)
- Fuel cells
- PV shingles

