IEEE Education- ISUW 2023 MASTER CLASS

Dispatching Grid Scale DER's in drive to Net Zero

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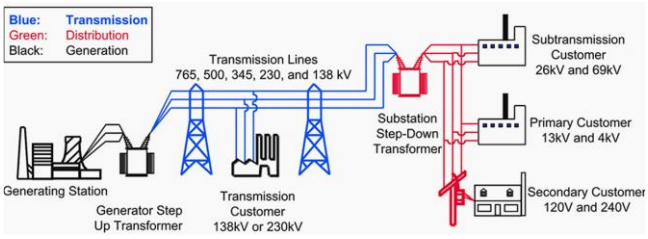
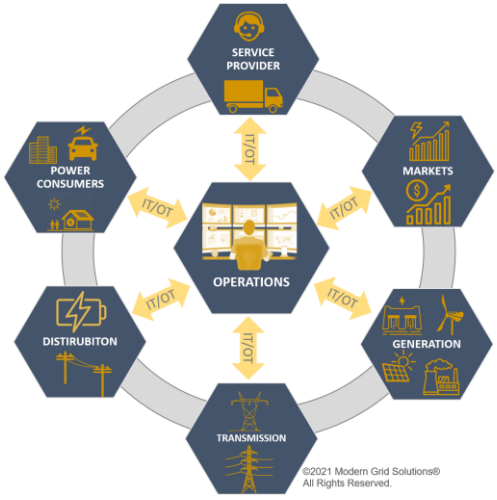
1

Power Delivery Mechanism is changing





From **To**

2

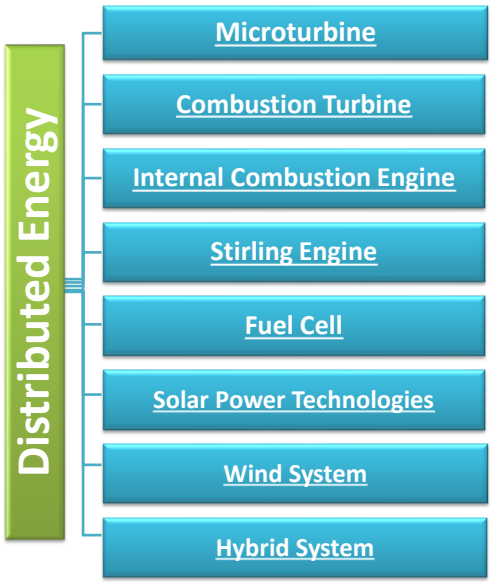
Distributed Generation's key characteristics

Distributed Generation is the set of small-scale power generation technologies located close to the load being served, capable of lowering costs, improving reliability, reducing emissions and expanding energy options.

- **Small**: Output in kW
- **Distributed**: Close to loads
- **Modular**: Flexible deployment
- **Less polluting**: Renewables or NG
- **Quieter operation**: On-site installation
- **Simple or complex**: Stand-alone or Grid-tied
- **Ownership**: Consumer or utility

3

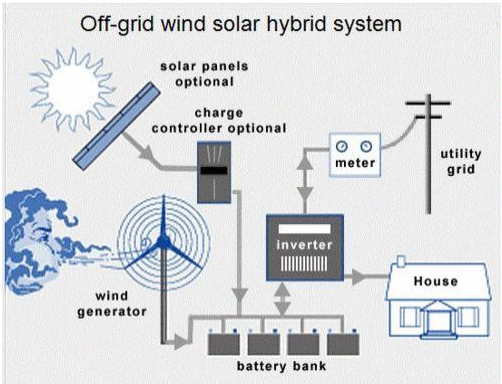
Distributed Generation technologies



4

DG technology: Hybrid system

- Developers and manufacturers of DER are looking for ways to combine technologies to improve performance and efficiency of distributed generation equipment.
- Several examples of hybrid systems include:
  - Wind and solar hybrid power system
  - Solid oxide fuel cell combined with a gas turbine or microturbine
  - Stirling engine combined with a solar dish
  - Wind turbines with battery storage and diesel backup generators
  - Engines (and other prime movers) combined with energy storage devices such as flywheels



Characteristics:

Benefits	Drawbacks	Fuel Source	Size (kW)
• Can run directly on any available heat source (solar, geothermal, biological, etc.) • Can be very efficient when combined with heat recovery	•Require large temperature differentials for efficient operation •Cannot start instantly, needs warm-up time	An inert gas such as helium or hydrogen	1-25

5

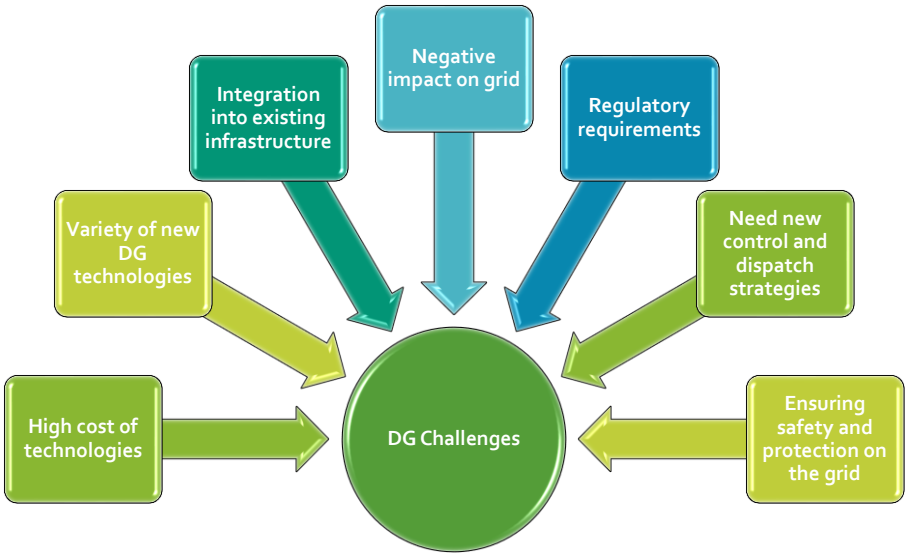
DG key benefits to utilities

		Benefit Categories							
		Energy Cost Savings	Savings in T&D Losses and Congestion Costs	Deferred Generation Capacity	Deferred T&D Capacity	System Reliability Benefits	Power Quality Benefits	Land Use Effects	Reduced Vulnerability to Terrorism
DG Services	Reduction in Peak Power Requirements	✓	✓	✓	✓	✓	✓	✓	✓
	Provision of Ancillary Services –Operating Reserves – Regulation – Blackstart –Reactive Power	✓	✓	✓	✓	✓	✓	✓	✓
	Emergency Power Supply	✓	✓			✓	✓		

T&D= transmission and distribution.

6

Distributed Generation challenges



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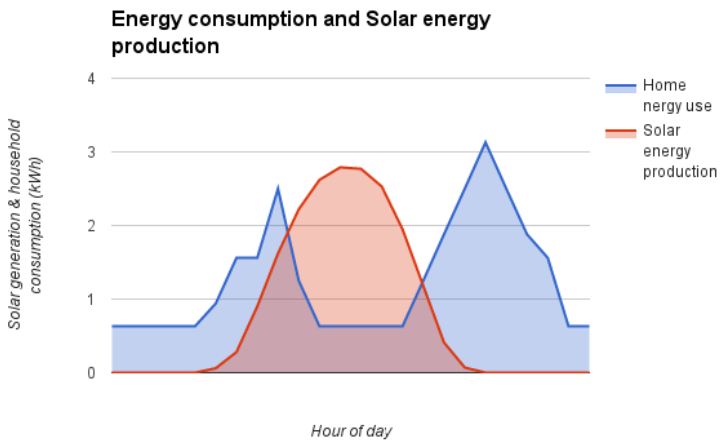
A Case for Dispatching DERs

- Dispatchable generation is needed to handle the energy needs of the population before and after solar generation – and to be balanced with wind.
- When solar ramps up, dispatchable generation is ramped down to the lowest level.
- Beyond that – solar/wind will need to be curtailed and/or dispatched (setpoint control) to ensure that there is enough standby generation ready for action after the sun goes down.



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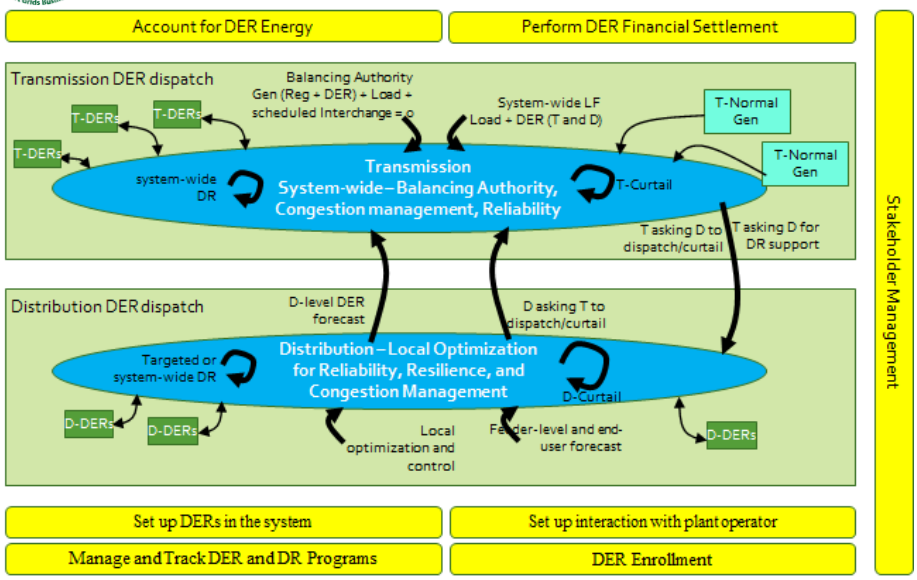
Model, Forecast, safely Dispatch and Settle

- New Opportunities & Needs Require New Solutions
- New Opportunities - Path to Net Zero
  - All DER investment does not need to be from the utility
  - Combination of solar, wind, solar/wind + storage, stand-alone storage
- New Needs
  - Balancing Authority with Supply Across Transmission & Distribution
  - Optimizing Renewables in Distribution to Deliver Multiple Objectives:
    - Congestion
    - Voltage Support
    - Planned and Unplanned Outages
    - Fault Location Isolation & Service Restoration

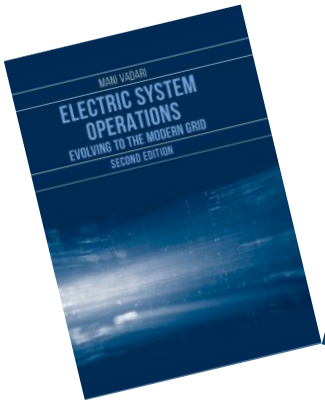
An operating model for how to dispatch DERs



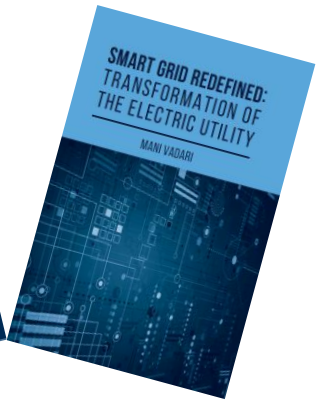
This is an enterprise operating model and is in sharp contrast with the existing operating model – where every business unit / department / jurisdiction has their own operating model

Dr. Mani Vadari is an electric industry leader and visionary, with over 30 years of experience delivering business and technical solutions for transmission, distribution, and generation operations, wholesale markets, Smart Grid, and Smart Cities. Mani has a multi-year track record of delivering value on a wide range of technology and business solutions.

Dr. Mani Vadari leads a team of experts to deliver complex and innovative technology, business, regulatory, and finance solutions. Mani brings over 35 years of experience delivering business and technical solutions. Mani is also an Affiliate Professor at the University of Washington, and an Adjunct Professor at Washington State University. Mani has published two popular books, "Smart Grid Redefined: Transformation of the Electric Utility" and "Electric System Operations – Evolving to the Modern Grid, 2nd edition", and has authored over 100 industry papers, articles and blogs.



Check out the book at www.amazon.com



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