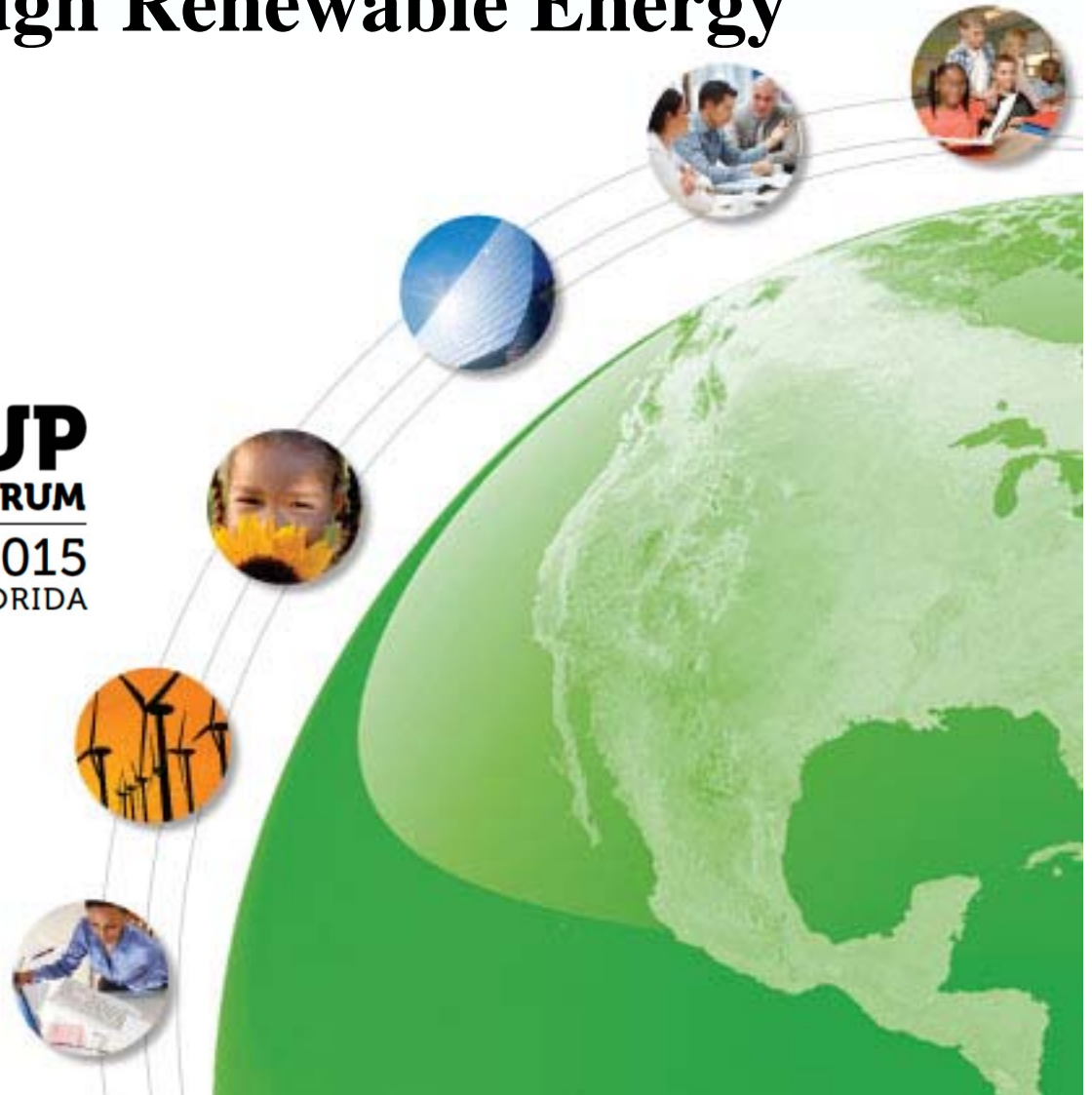


Grid Security Through Renewable Energy



POWER UP
DEFENSE ENERGY FORUM
OCTOBER 28, 2015
FT. WALTON BEACH, FLORIDA

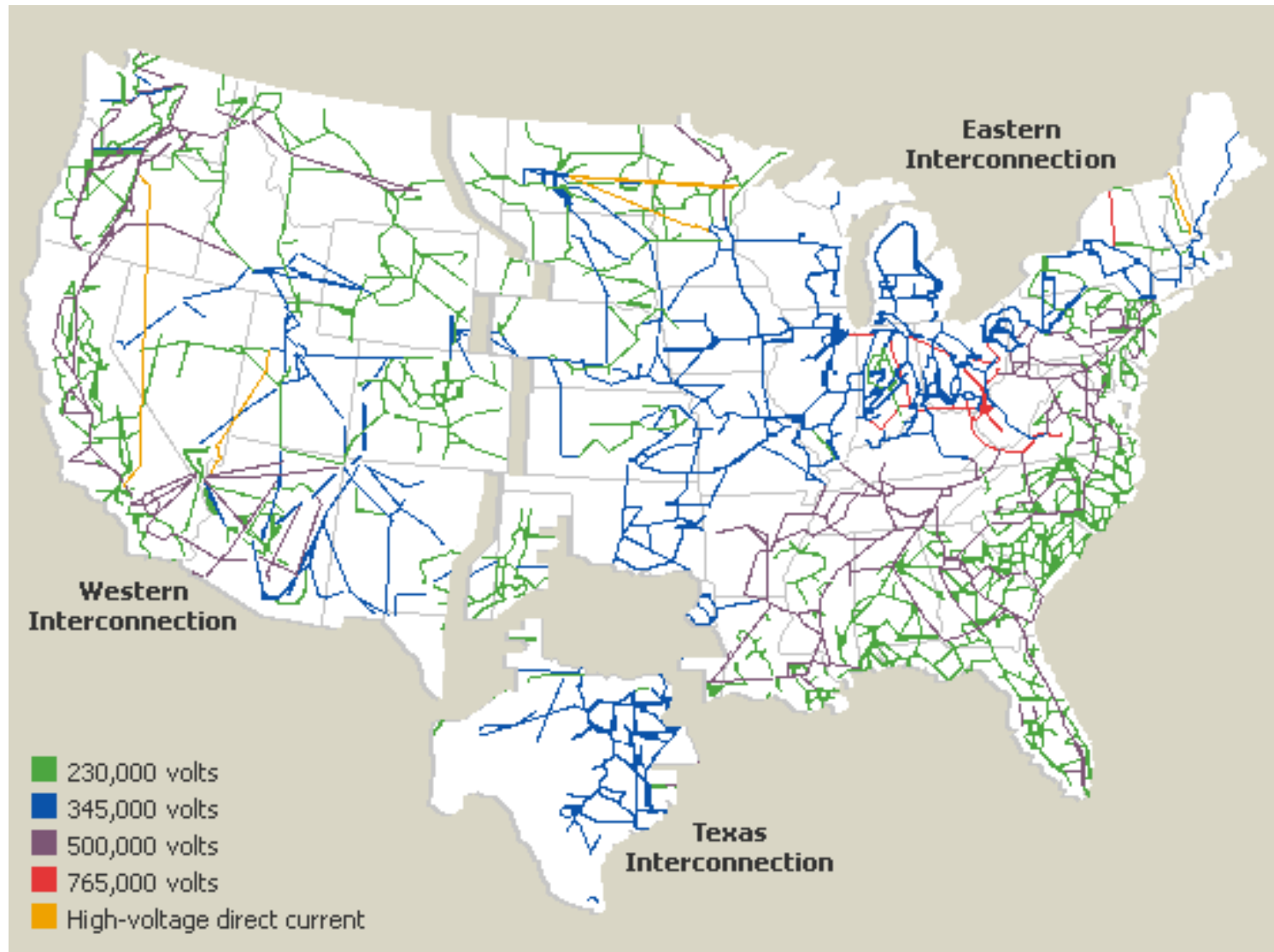


Current Grid Design

- Design concept based on.....
 - 150 year old thinking
 - Vision of energy as a luxury, not a necessity
- Transmission infrastructure.....
 - Open air metal conductors
 - Non-shielded, non-hardened
- Substations.....
 - Typically secured by a fence
 - Limited video surveillance

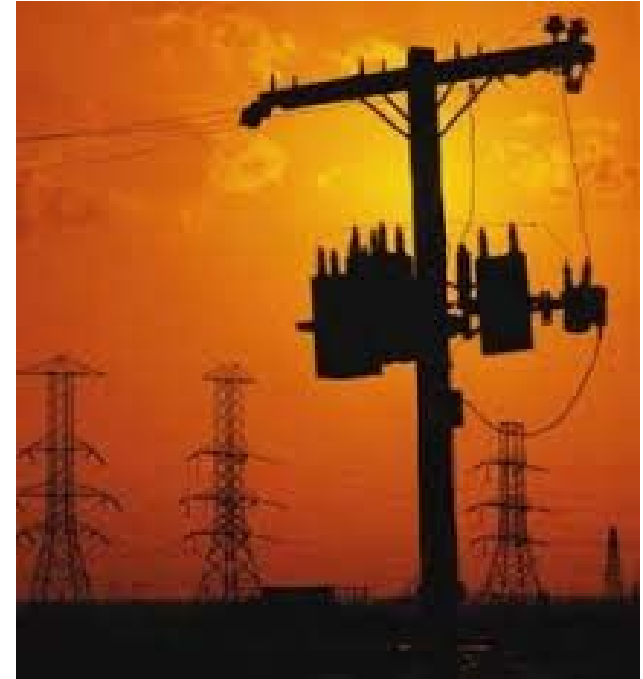


Current Grid Design



Current Grid Vulnerabilities

- System Overload
 - Demand based event
 - Greater impact on generation than transmission
- Grid Congestion
 - Traffic based event
 - Restricts energy delivery
 - Negatively impacts system efficiency due to elevated conductor temperature
- Lack of Data
 - Analog systems



Current Grid Vulnerabilities

- Weather/Natural Disaster Event
 - Hurricane Sandy was great learning event for ConEd.....
 - Generation capacity largely unaffected
 - Demand was laying on the ground due to loss of local transmission grid



Current Grid Vulnerabilities

- Weather/Natural Disaster Event
 - Earthquakes



Current Grid Vulnerabilities

- Weather/Natural Disaster Event
 - Solar flares/storms
 - Solar Storm of 1859 – Carrington Event
 - Coronal plasma mass traveled to earth in 17.6 hours
 - Telegraph communications stopped
 - Transmission wires burned and melted



Current Grid Vulnerabilities

- Human Intervention
 - Maintenance Failure
 - Vegetation program
 - Switch failure – moving parts
 - Control Error/Manipulation
 - Generation capacity
 - RTO interconnection switch



Current Grid Vulnerabilities

- Human Intervention
 - Direct Attack/Terrorism
 - Cyber attack on grid control
 - Remotely executed
 - Relatively low cyber security technologies



Current Grid Vulnerabilities

- Human Intervention
 - Direct Attack/Terrorism
 - Bombing RTO hub locations
 - Coordinated military action
 - Regional impact



Current Grid Vulnerabilities

- Human Intervention
 - Direct Attack/Terrorism
 - Electric Magnetic Pulse
 - Low cost ballistic missile
 - Capable of effecting entire national grid
 - Similar impact as 1859 Carrington Event
 - Life as we now know it ends



Grid Challenges of Renewable Energy

Advocates attempt to make the case that distributed renewables pose no issue for grid reliability, however that's narrow vision of the reality.....just ask Germany

Grid Challenges of Renewable Energy

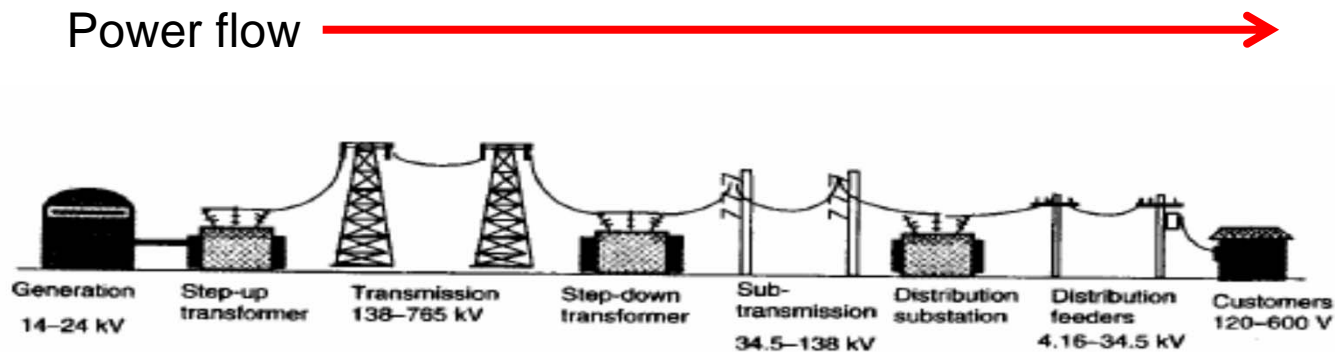


Figure 3.1 Conventional power generation, transmission, and distribution system.

Tradition Grid Dynamics

Grid Challenges of Renewable Energy

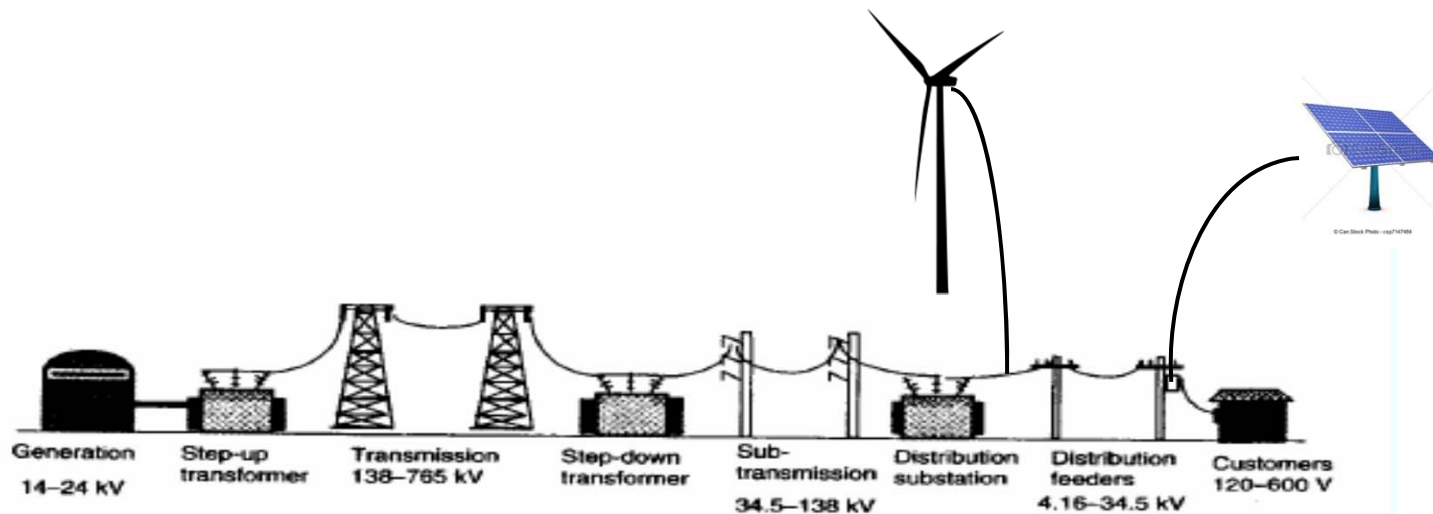


Figure 3.1 Conventional power generation, transmission, and distribution system.

Power flow ← → Power flow

Renewable Grid Dynamics

Grid Challenges of Renewable Energy

- Intermittent Power Resources
- Power quality issues
- Multiple unbalanced entry points
- Difficulty for grid planners
- Push to retire existing assets



Current Grid Vulnerabilities

DoD Grid Security = Base Power Source Security

Renewable Energy Mix

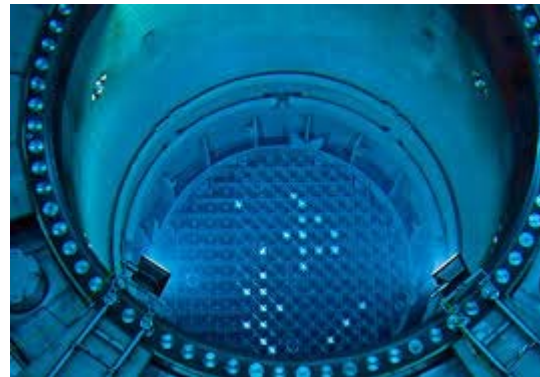
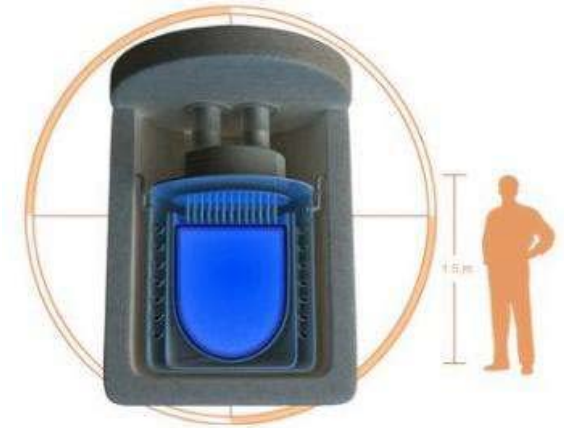
- Solar PV
- Wind
- Biomass/Cogeneration
- Waste to energy
- Fuel cell
- Battery storage
- Tidal flow
- Others yet to come



- Distributed generation....distributed risks

Essential Elements

- Reliable power source...
 - Sun and Wind are obvious
 - Proximity to feed stock
 - Tidal flow
- Redundant technology
- Distributed footprint
- Micro-grid automation



Risk Analysis

- Make sure to defend against the “right” risk
 - Pearl Harbor 1941



Leaders felt the “risk”
was sabotage....



Risk Analysis

- Make sure to defend against the “right” risk
 - Pearl Harbor 1941



History tells us we
were wrong....



Risk Analysis

- Avoid singular technology fixation
- Design around “plug and play” methodology
- Allow for technology advances
- Distribute generation regardless of technology
- Invest in micro-grid & data acquisition
- Leverage public/private partnerships

Who is ConEdison?

- ConEdison has powered New York City since 1823
- Oldest continuously listed company on the NYSE:ED
- \$14+ billion in annual revenues
- \$41+ billion in total assets
- Ranked #1 “greenest” utility in the US (Newsweek Magazine 2014)
- 680 MW owned renewable portfolio
- 1.1 GW total renewable portfolio

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