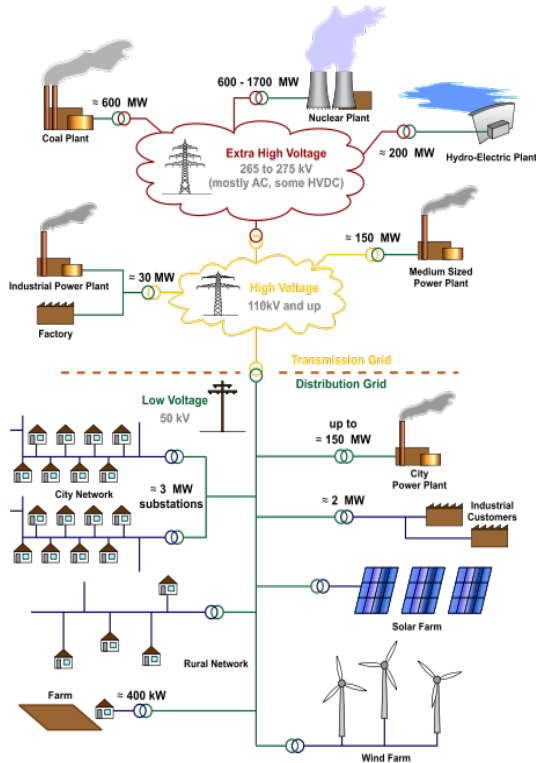


# Resilience of Cyber-Physical Energy Systems

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# Cyber-Physical Energy System

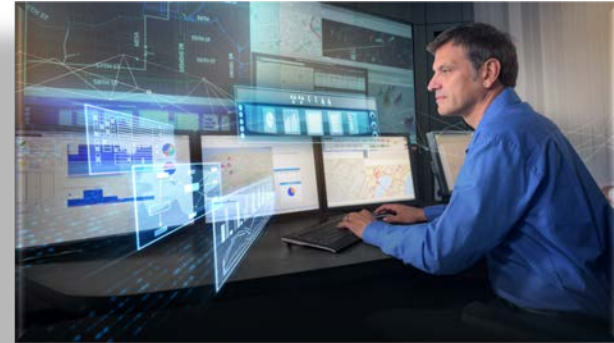


## Cyber

- ICT infrastructures for real-time monitoring and control

## Physical

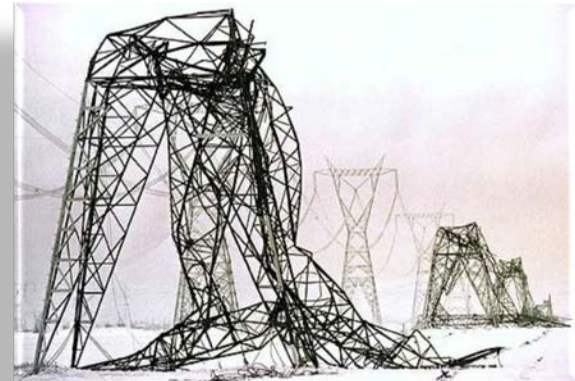
- Power grids



# Resilience to Natural Disasters

Earthquakes, flooding, fire, hurricanes & storms can damage CPS

- **Hurricane Maria** in Puerto Rico (September 20, 2017)
- Power grid destroyed – millions without electricity
  - One month later, 88 % of the island was without power
  - Three months later, 45 % still had no power



# Resilience to Cyber Attacks



Cyber attacks can damage power equipment & lead to a blackout

- **Cyber attack on power grid** in Ukraine (December 23, 2015)
  - Attackers intruded into IT & SCADA of 3 electricity distribution companies
  - 7 x 110 kV & 23 x 35 kV substations disconnected from power grid for 3 hours
  - Cyber attack resulted in several power outages that affected 225,000 customers





# Research and Education

Assess and improve CPS resilience to natural disasters

- Computational methods and AI
- Anticipate, absorb shock, adapt & recover

Cyber security investigations & enhancement for power grids

- Model CPS and system-of-system dependencies
- Security controls & secure OT infrastructures
- Cyber attacks modelling & simulation
- Mitigation of cyber attacks
- Power system defence and restoration

## DeSIRE

- Resilient business information systems
- Resilient asset management and maintenance
- Flood resilience

