



Integrated and Decentralized Control in Electric Power Systems

Eugene A. Feinberg

**Department of Applied Mathematics and Statistics
and
Advanced Energy Center
Stony Brook University**

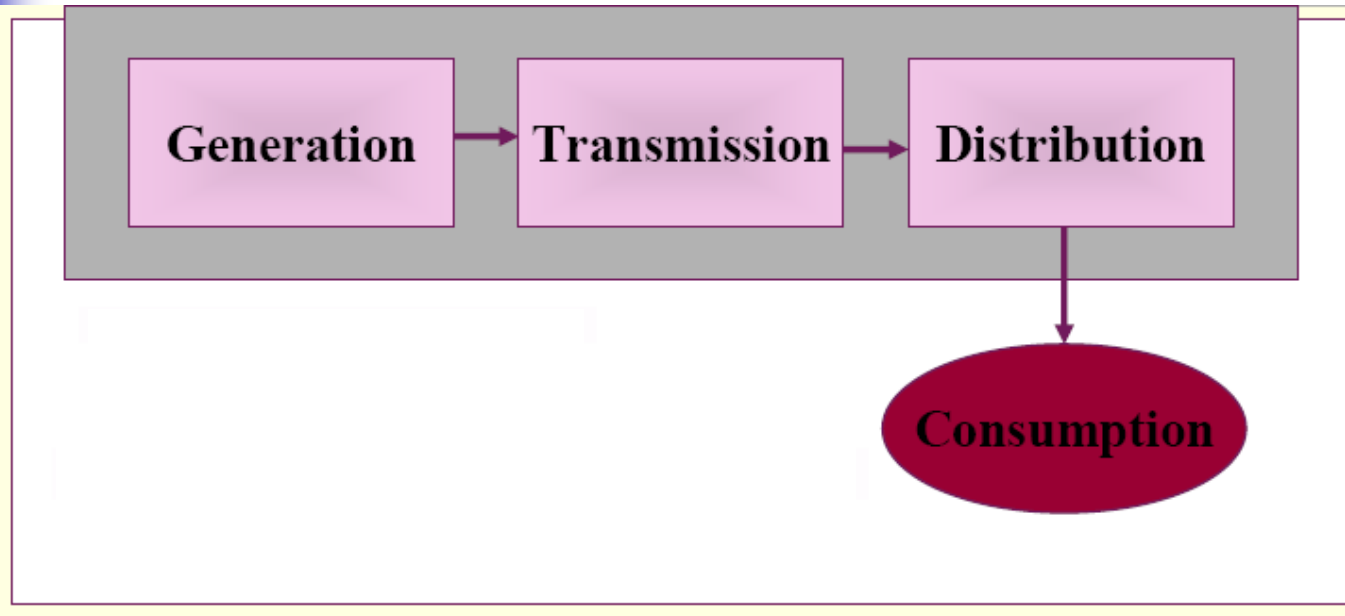
**Workshop on Energy Business Opportunities in NY State
Center of Excellence in Wireless and Information Technology (CEWIT),
Stony Brook, October 5, 2017**



Plan of the Talk

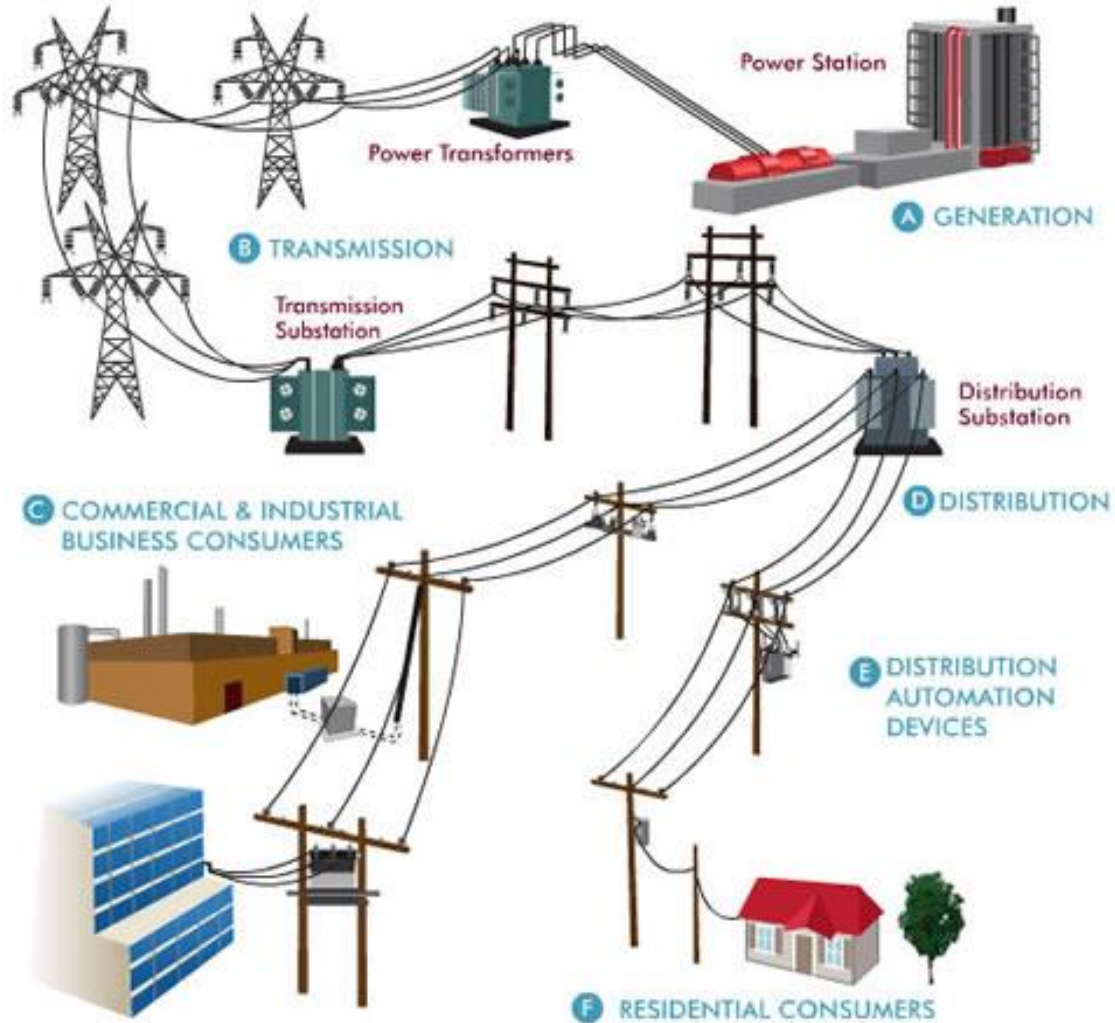
1. Transition in the electric industry, REV program in NYS
2. Traditional components of electric systems
3. The reasons for changes
4. Smart grids, microgrids
5. Local issues
6. Control challenges

Electric Power System Components



Although not normally owned or controlled by the power utility, consumption devices are part of the **Electric Power System**.

Power Grid

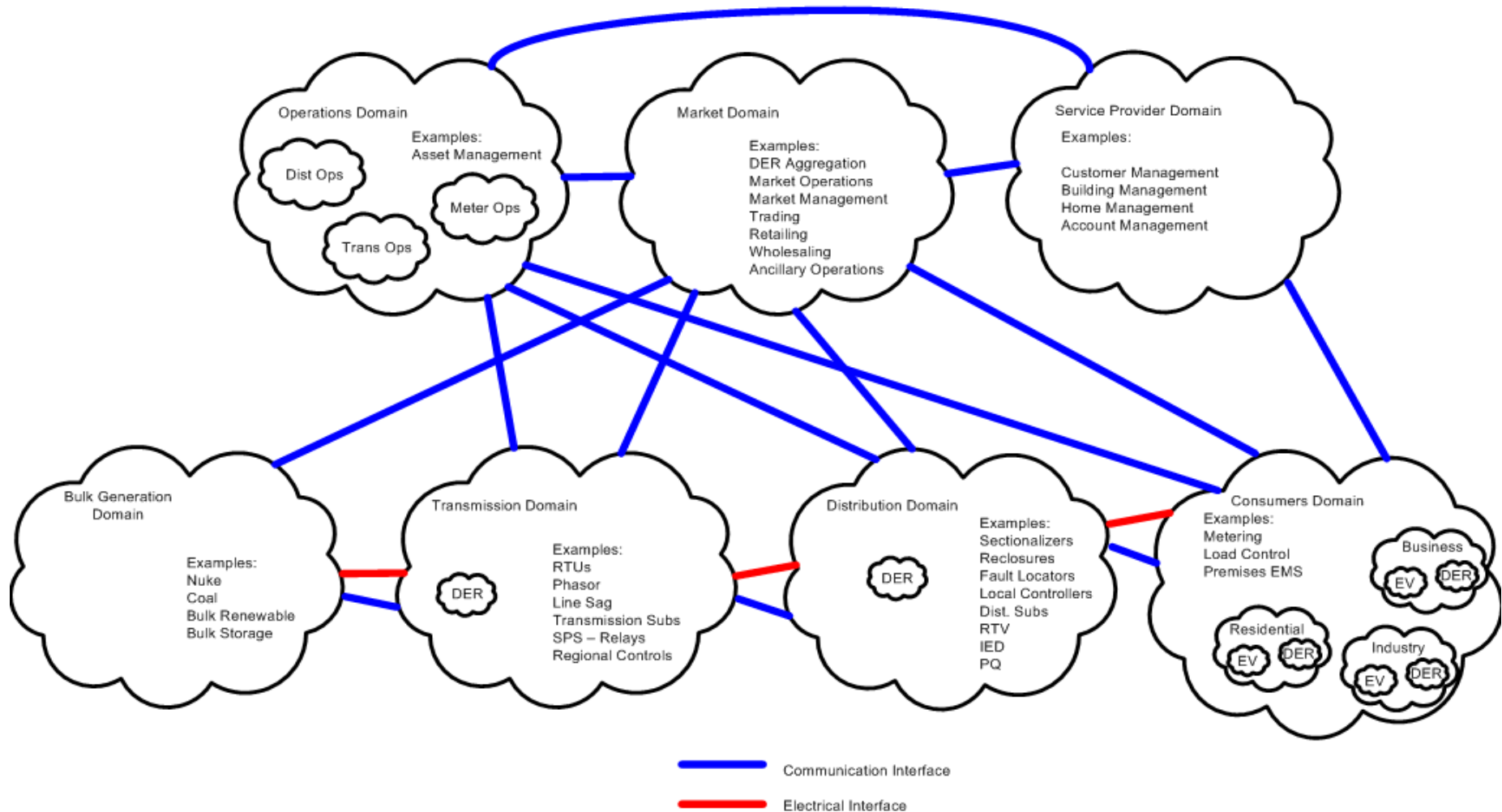




Historical and Current Reasons for Changes

- Physical limitations and technological progress
- AC vs DC
 - For AC systems: active and reactive power; generation and cogeneration
- Regulatory changes, Market deregulation, ISOs
- Financial and informational networks

Electric and Communication Network

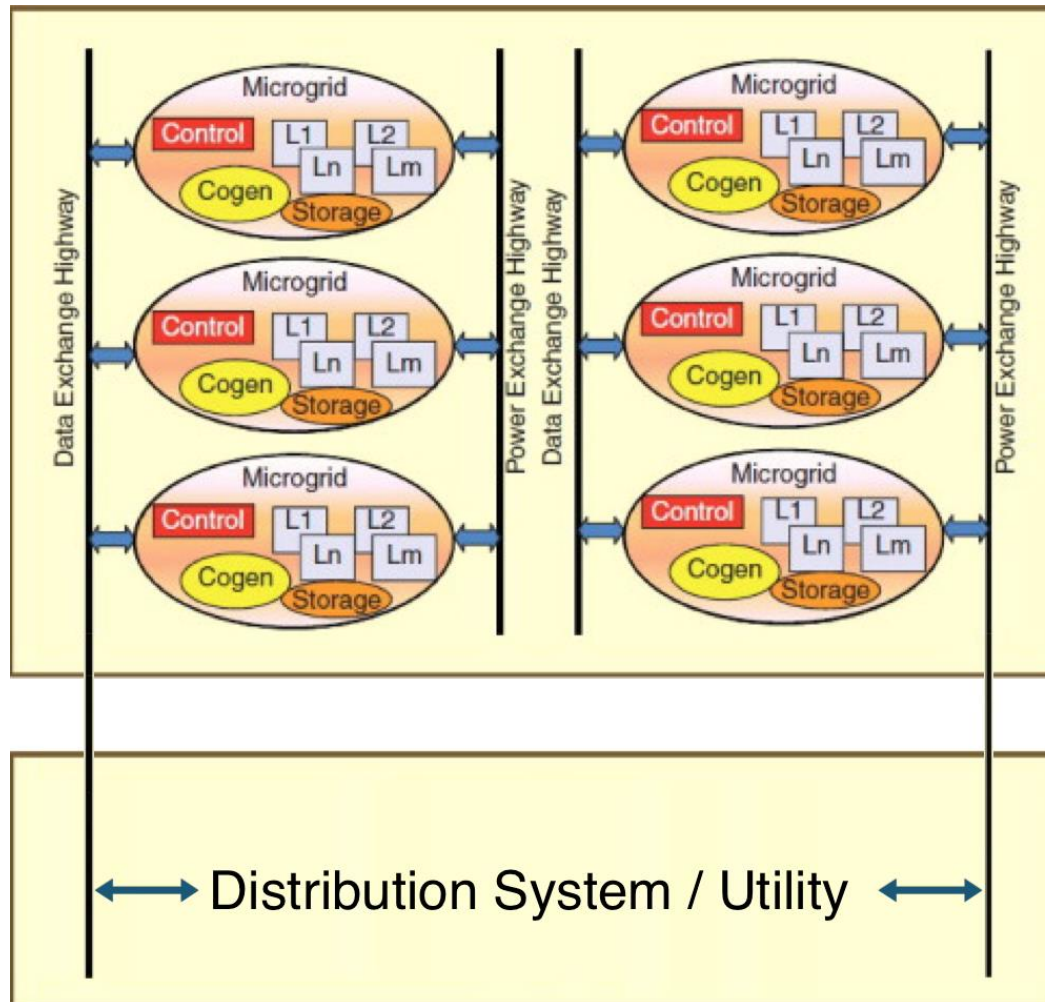




Smart Grid

- Renewable energy
- Storage
- Electric vehicles
- Microgrids
- Combining electric and information networks
- Intelligent control

Network of Microgrids



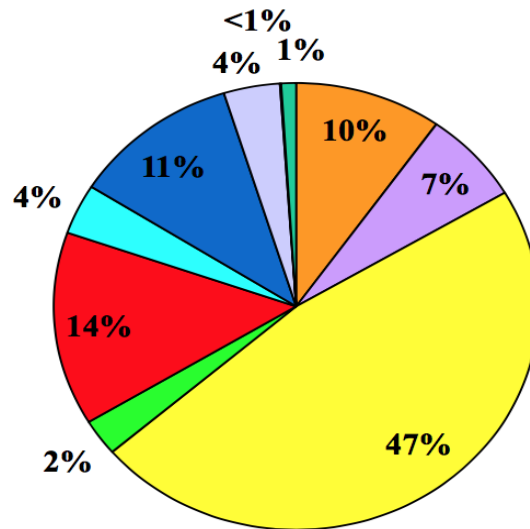


Local Issues

- Renewable generation
- Developments of microgrids

2016 NYCA Summer Capability by Fuel Type (source: NYISO report)

Summer 2016 = 38,576 MW



MW (1)

- GAS - 3,788 (10%)
- OIL - 2,578 (7%)
- GAS & OIL - 18,211 (47%)
- COAL - 1,017 (2%)
- NUCLEAR - 5,402 (14%)
- PUMPED STORAGE - 1,406 (4%)
- HYDRO - 4,315 (11%)
- WIND (2) - 1,446 (4%)
- SOLAR - 32 (<1%)*
- OTHER (3) - 381 (1%)

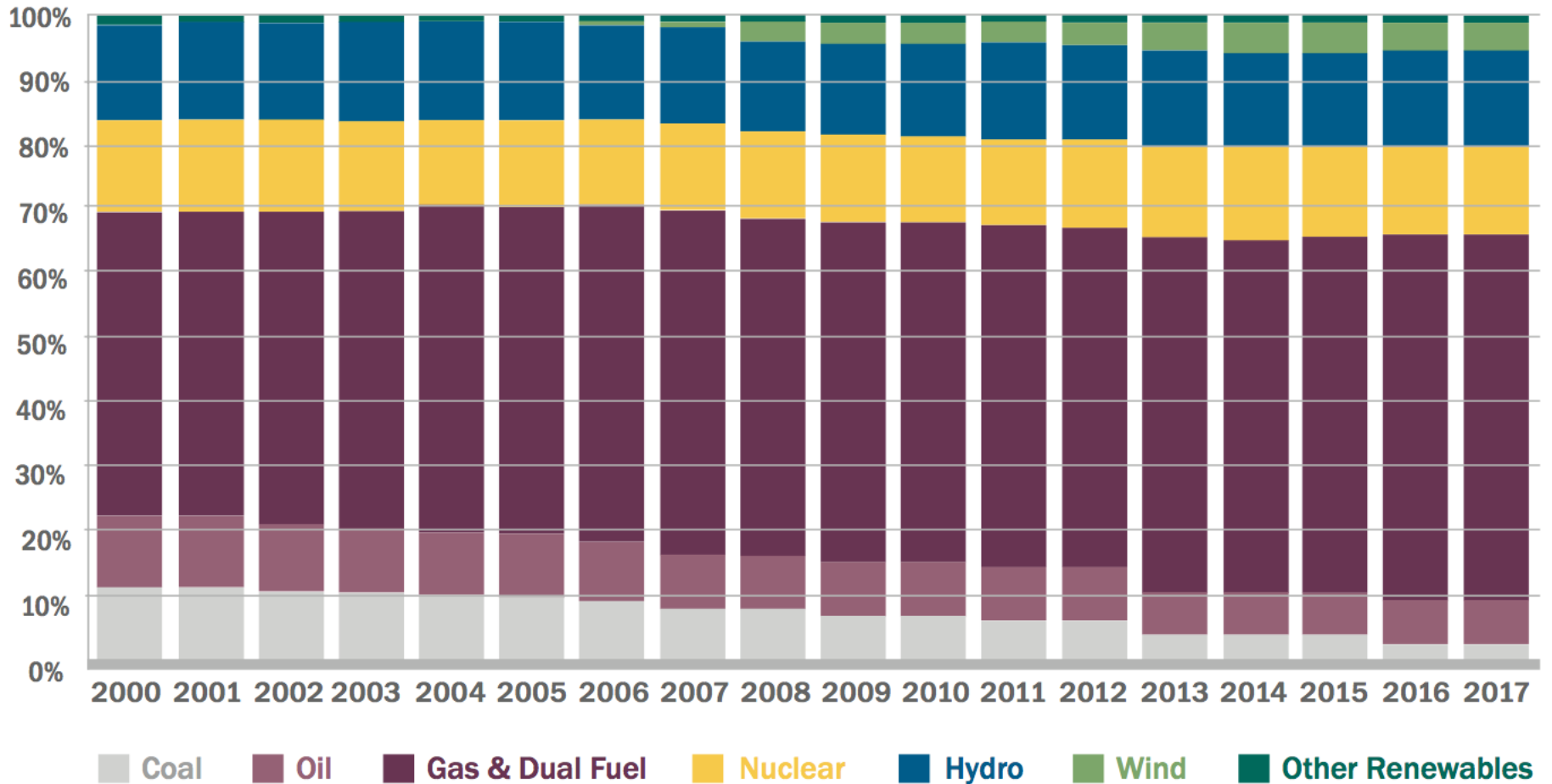
(1) - All values are from the Summer Capability column in Table III-2 and are rounded to the nearest whole MW.

(2) - While there is a total of 1754 MW of Installed Nameplate, 308 MW do not participate in the Installed Capacity market.

(3) - Includes Methane, Refuse & Wood.

* Large-scale solar PV
Actual number: 926 MW

New York State Fuel Mix Trends: 2000-2017 (source: NYISO report)





Control Challenges

- Importance of decentralized control
- Game theoretic methods vs optimization