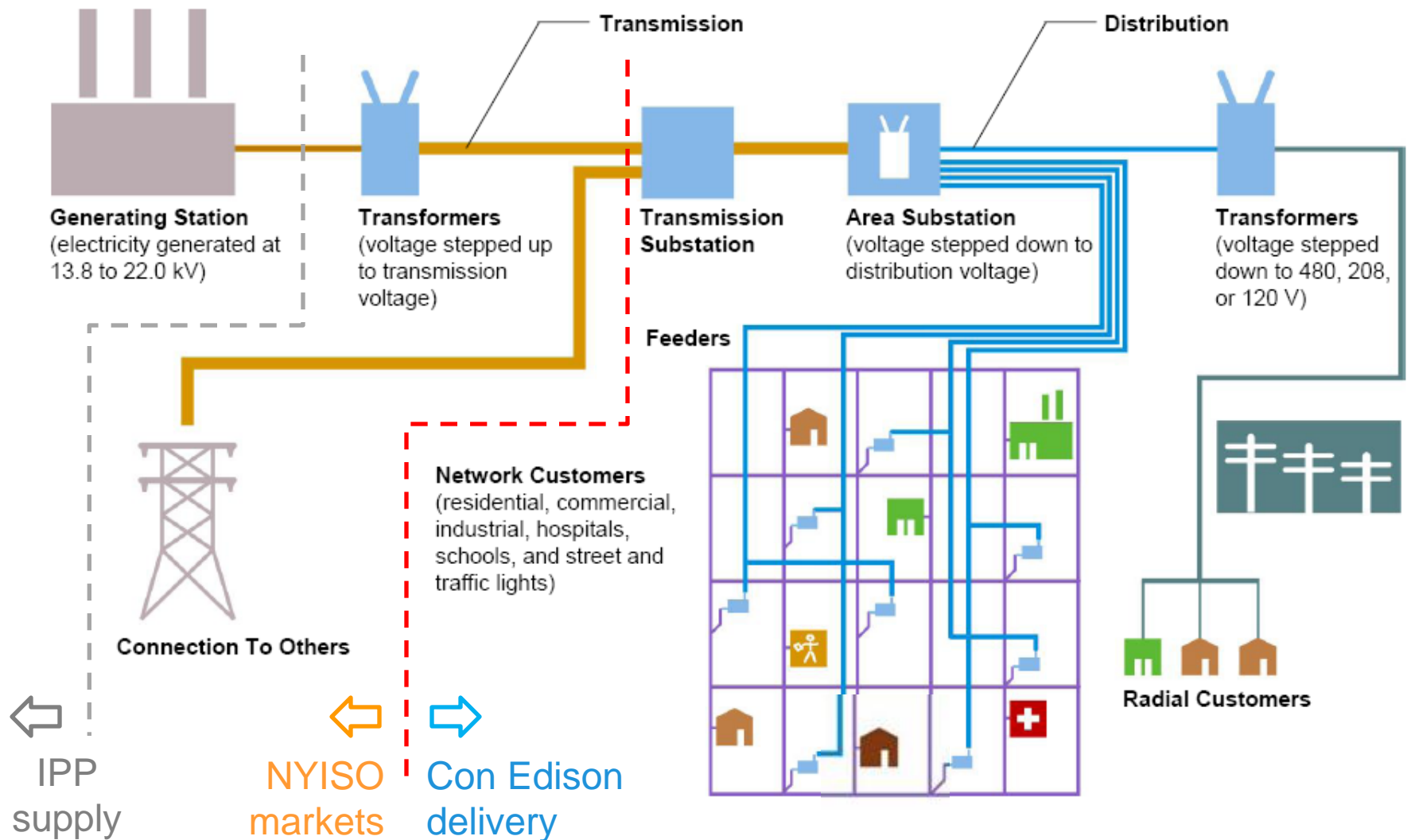


Microgrids

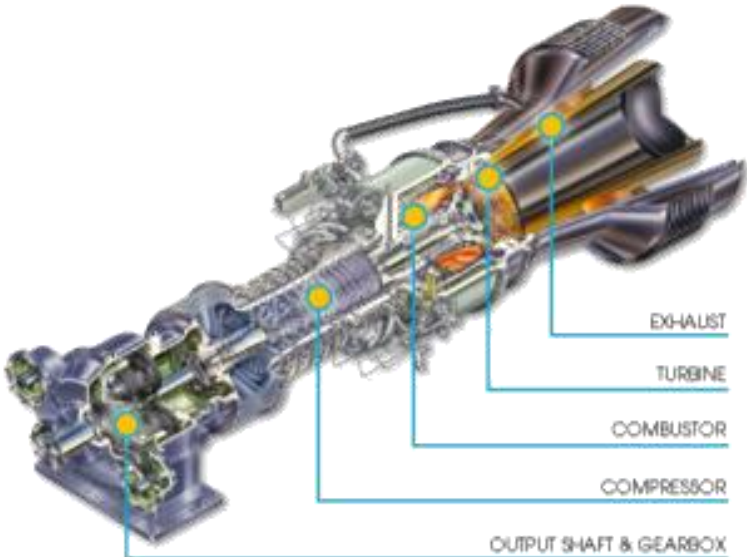
The Devils (and Angels) in the Details

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The Electric System – Supply and Delivery



Distributed Generation Technologies



Traditional System

CHP System



45% Efficiency

80% Efficiency

DG Technology Attributes

	Reciprocating Engines	Gas Turbines	Micro-turbines	Fuel Cells	Solar PV
Capacity	10kW - 5+ MW	500kW – 20MW	30kW – 250kW	5kW – 2MW	< kW-20 MW
Electrical Efficiency	69% – 78%	49% – 66%	47% – 59%	54%–82%	20% – 45%
Capital Cost [\$1000/kW]	1.2 – 2.3	1.5 – 5.5	2.5 – 3.0	5.0 – 7.0	5.0 – 6.5
O&M Cost [\$/MWh]	12 – 29	5 – 14	16 – 35	43 – 51	22 – 25
NO _x [lb/MWh]*	0.05-2.17	0.07-2.4	0.06-0.54	0.02-0.06	–
CO ₂ [lb/MWh]**	1,145-1,360	1,025-1,875	1,375-1,735	775-1,440	–

*New York State: 0.48. East River 1 and 2: 0.04-0.08. NYS 'Clean DG' Standard 1.6. California: 0.07

**New York State: 705. East River 1 and 2: 626.

Managing System Impacts

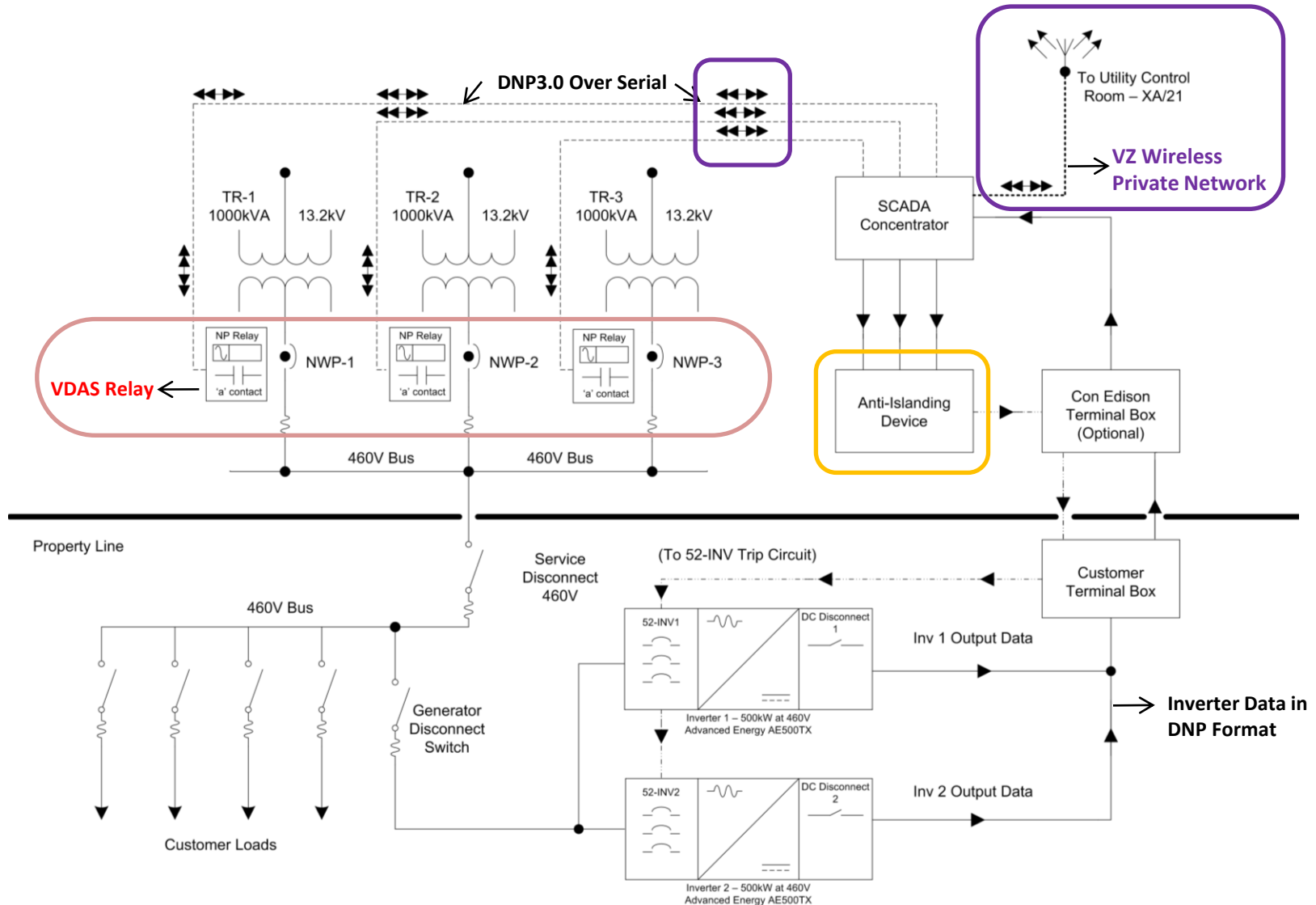
Electric

- Ownership/Operation of utility grade equipment
 - Utility workers work 'live' – NESC/DoB requires more space and isolation equipment
- Fault current increases impacts on Company and Customer equipment
 - Fault current mitigation technology exists, technology solutions desirable
- Impact on network protectors
 - Smart Grid proven technologies allow for great amounts of PV export
- Unintentional islanding
 - Transfer trip solutions are expensive and use space at company S/S, technology solutions under review
- Stand alone operation (for multi-customer microgrid)
 - Isolation switches and operating protocols needed

Gas

- Gas availability
 - Case by case – [coned.com/gasconversions](https://www.coned.com/gasconversions)
- High-pressure gas safety spec (DoB)
 - NYC Rule§50-01 applies to microturbine

Smart grid secure solution allows export, ensures customer stays connected, and provides remote switching



Devils and Angels

- Cautions

- Overpromise of technology capabilities
- Operations only as good as customer's internal infrastructure and operations
- Approach holistically (pursue energy efficiency first!)
- DoT permission to cross public ways
- NESC/DoB code to operate utility equipment
- PSC governs franchise
- Con Edison's network system already highly reliable, redundant, and modular
- High load density in NYC limits ability for DG to support multiple customers
- Who is not in the room (the building community)

- Opportunities

- NYU School, Third Breevort case studies
- New Offset/Microgrid tariff
- Targeted NYSERDA incentives
- Avoided line losses and lowered capacity charges
- Con Edison growing its gas system
- Expedited interconnection process for UL approved microgrid interconnection components
- Leveraging Smart Grid technology
- Upcoming NYSERDA study
- Who is not in the room?

Grid as Energy Platform

Customers and innovators active in energy equation

- Interagency interconnection processes
- Data
 - Management and analytics
 - Communications
 - Monitoring
 - Dynamic transient modeling
 - Scenario planning
- **Industry standards**
- Rates and cost recovery
- Business models



Thank You!

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