



Migration of Manufacturing to the Information Age

Presented by Dr. J. Patrick Kennedy

Empowering Business in Real Time
PI Infrastructure for the Enterprise

What Is Happening to the Economy?

- Fundamental Shift to Information Age
 - Alvin Toffler - Revolutionary Wealth
- Parallels to Telecom
 - Rise of the Stupid Network
 - Rise of the Stupid Grid
- Enabler of “Intelligence at the Edge” Telecom
 - Voice over IP, Distributed ACD, Telepresence, SMS, Remove Land Line, Personal Call Bridges, Personal Info Web Sites
- Better Place - New Business Model

Desynchronization

- **Competitive Business - 100**
- NGO's - 90
- Family - 60
- Unions - 30
- **Government and Regulators - 25**
- School System - 10
- Political Structure (Rich Countries) - 3
- Courts and the Law - 1

Source: Revolutionary Wealth, Alvin & Heini Toffler

Smart Grid – the Enabler

- www.oe.energy.gov
- Kurt Yeager and Robert Galvin - Perfect Power
- Enabling New Business Models
- New Technology 30-50 yr adoption
- Example Microturbine
- “Load” (as in Load Management) is You
- Drives Adoption of MicroGrid

Benefits of a Microgrid

- ***Reduced O&M Costs*** - Increased information peer to peer allows common O&M desk
- ***Enhanced security and fault monitoring*** - require by NERC Critical Infrastructure Program.
- ***Increased Efficiency of Power Delivery*** - distributed generation, non-traditional sources and CHP or fuel cells are much more efficient if they can sell their heat output. It also can manage intermittent sources at the local, low voltage level.
- ***Improved Electrical System Security*** - Common security for the power, water, sewer and physical assets.
- ***Consumption Management*** - Access to the wholesale prices of power is possible in some states.
- ***Automation*** - Billing, environmental and other reports are automated. ERP and real time information services could be offered as much of the information is already in the Microgrid.

Benefits of a Microgrid

- **Peak Load Reduction** - Any demand/peak charges are monitored carefully and manages with the resources on site as allowed by contract. This could include, in addition to Distributed Energy Resources (DERs) (e.g. turbines, engines, PV, geothermal, hydro, PV, wind turbines) and storage (e.g. batteries, flywheels, plug in vehicles, high energy process materials) it can implement strategies that use alternate sources of energy such as switching from electrical drives to steam turbines or using stored refrigerant instead of compressors.
- **Convenience of Microgrid** - There is value for documentation of energy conservation project since the detailed sub-metering is already in place thereby allowing the facility to determine where improvements could be achieved. This would include interfaces to loads from building systems, SCADA, EMS, DMS, DCS or PLC systems.
- **Energy Conservation and Reduced Costs** - The measurements and procedures defined above are those needed to support the proposed ISO type improvement process mandated by the Energy Independence and Security Act of 2007, Section 1304.
- **Convenience** - The convenience of having information readily available are numerous. The Microgrid can supply detailed analytics of a user's utility situation along with sufficient information to change their operation,

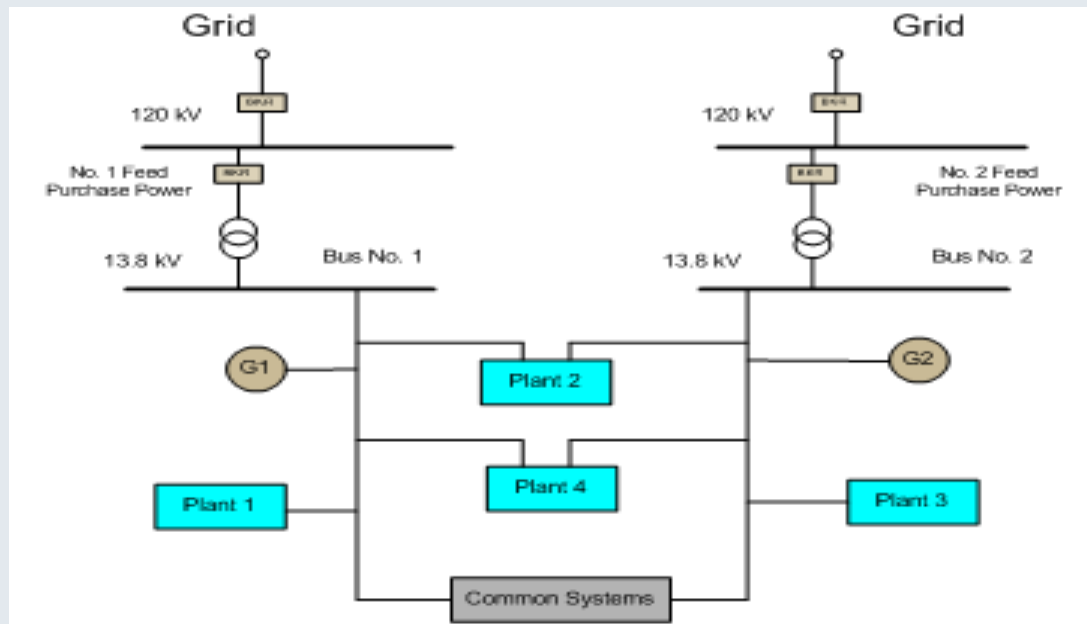
Benefits of a Microgrid

- **User M&O** - We spoke of the Utility M&O, but there is an equivalent on the user side that might require information exchange.
- **Enhanced Customer Support** - Microgrid provides both much greater data set in real time (not daily like many smart meters), real time analytics to aggregate the information, find the problem, notification by exception and ad hoc trouble shooting.).
- **General Functions** - Real-time access, historian, event management, visualization, and notification are part of the Microgrid.
- **Advanced Functions** - Detection of grid instability required the implementation of synchronous phasors. In the domain of a Microgrid it also includes reasonable sized battery storage and ultra capacitors and steam turbines for seamless island and resynchronize actions. For grid connected systems, the Microgrid can monetize surplus power and certificates (renewable, carbon). For “green” users, the Microgrid could manage panel carports for employee parking of Plug In Hybrid Electric Vehicles (PHEV) or Plug In Electric Vehicles (PEV).

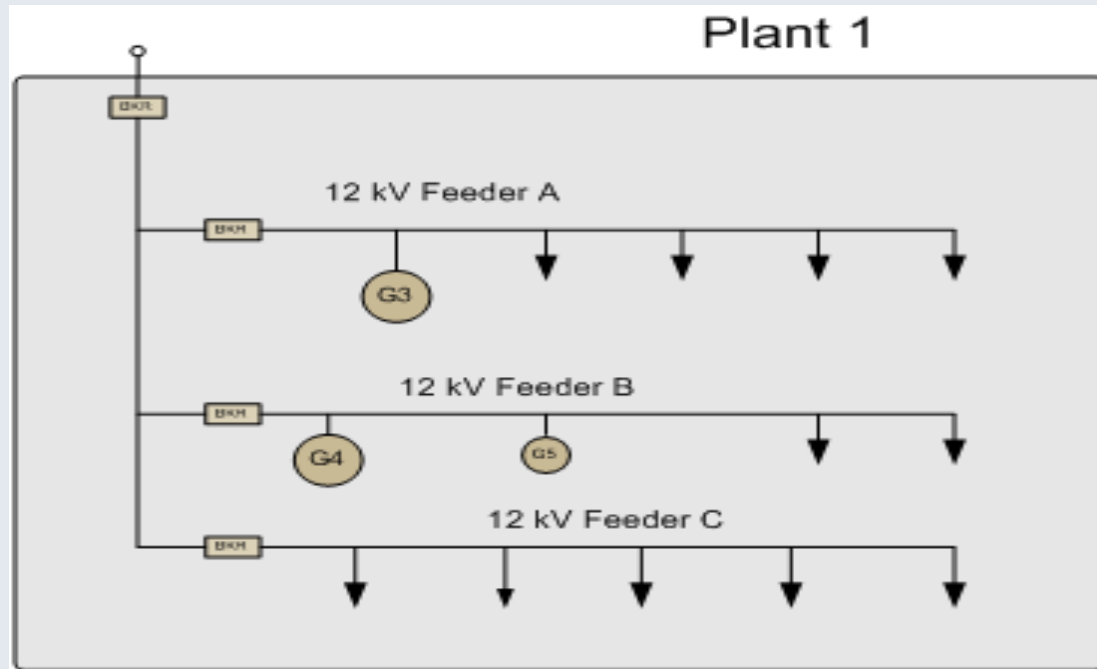
What is Microgrid?

- Natural Evolution of the Smart Grid (Smart Load?)
- Ability to Island
- Internal Load Balancing
- Managed Curtailment
- Ancillary Products (Standby, Reg Up, Reg Dn)

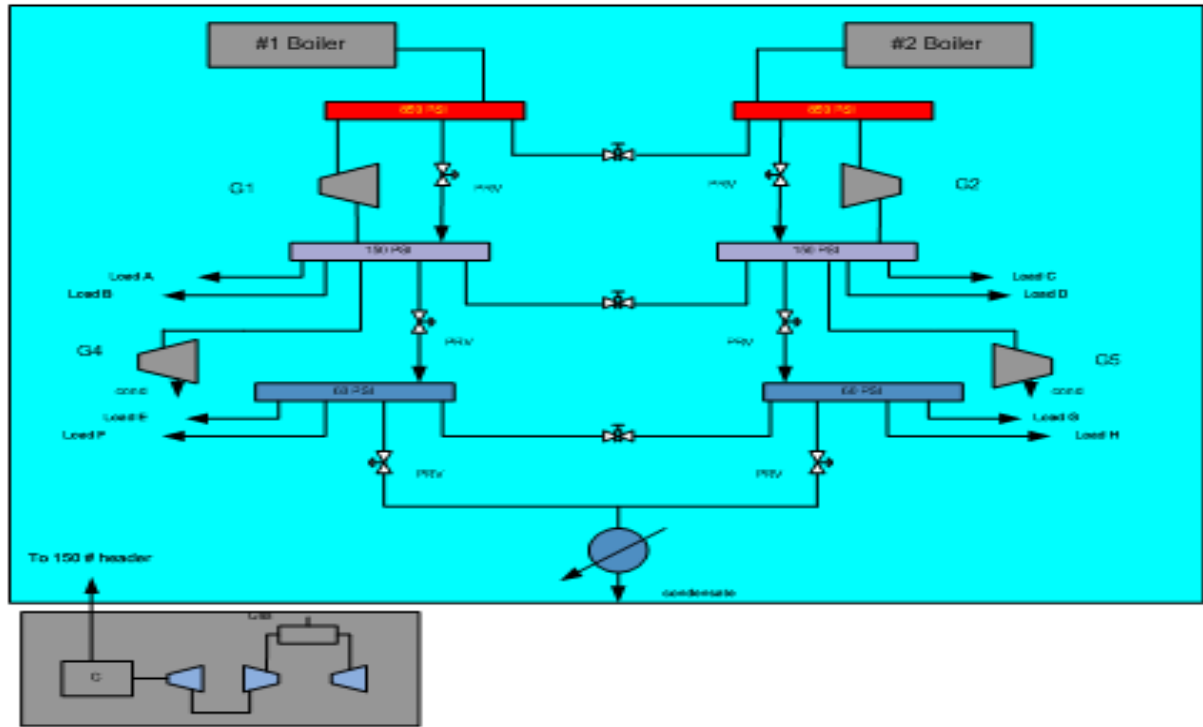
Simplified Microgrid



Feeders



Steam System



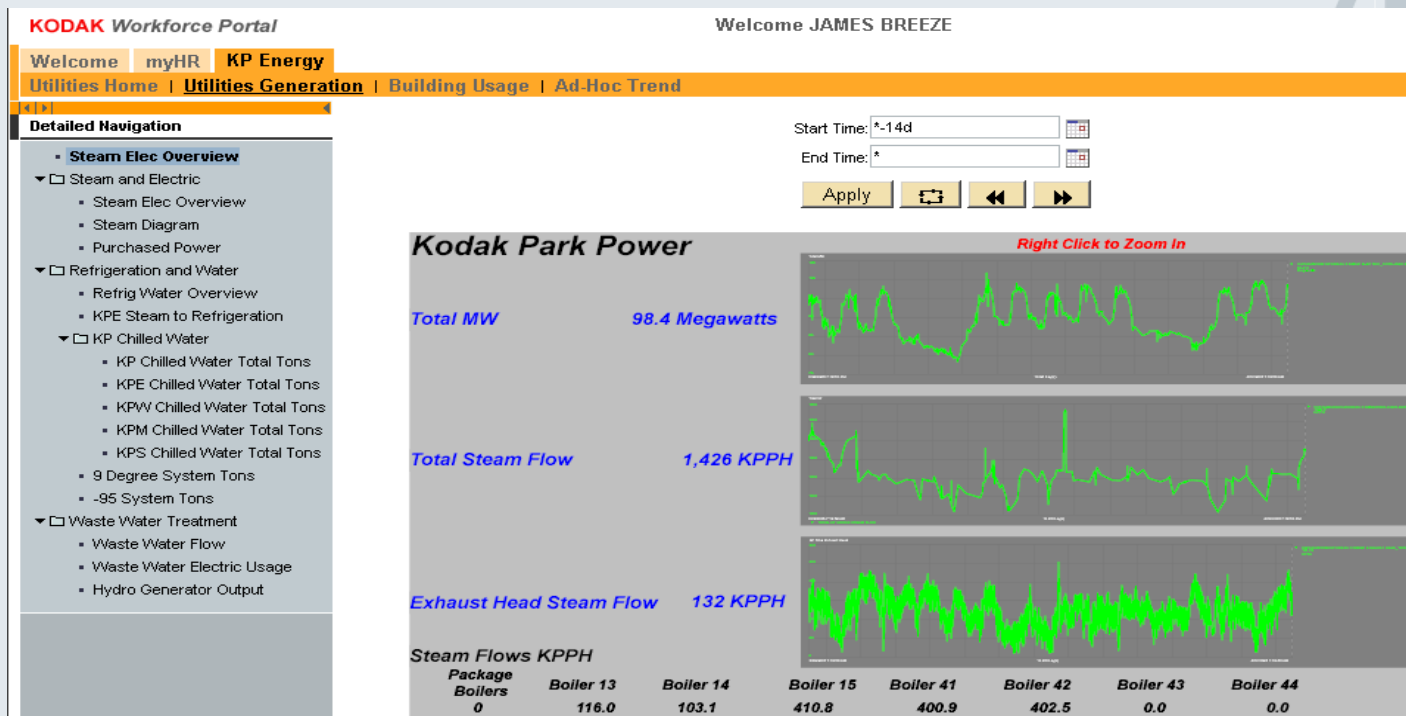
Paper Mill



Example 2 - Kodak Park



Power at Kodak Park



Eastman Business Park

- (www.eastmanbusinesspark.com).



Manufacturing as a Service



- Offer as Services in a Business Park
 - Utilities
 - Energy Audits
 - ERP/PI
 - Auditorium, Security, Parking Lot

Eastman Business Park - Utilities

- **STEAM** - 1,500,000 pounds per hour firm capacity from utility-grade boilers with emergency backup boilers. Steam is generated at 1400 psig/900°F and used to generate electric while supplying steam to customers at different nominal pressure levels of 260 psig, 140 psig, 70 psig and 5 psig.
- **ELECTRIC** - 130,000 kilowatts firm capacity of co-generation by-product from steam reduction with backup inter-connections with the public utility. Electric is generated at 13,800 volts and distributed throughout the Park on a small grid with underground redundant feeds to double-ended load centers/substations for highest reliability and quality of power. Double-ended load centers are designed to provide full load with either feeder out of service. Typical delivery to customers is a nominal 480 volt, three phase alternating current.

Eastman Business Park

- **CHILLED WATER** - 50,000 ton-days capacity of tri-generation by-product utilizing steam optimizing system costs. Nominal supply temperature is 40°F with a nominal gauge pressure of 95 psig.
- **9°F REFRIGERATION** - 2,400 ton capacity, nominal supply is 9 degrees F. Ready access to central refrigeration systems which are operated as a part of the site cogeneration plant, and contain approximately 69,000 tons of installed refrigeration capacity, which provide chilled water and brine service ranging from 9 to 40 degrees F.
- **COMPRESSED AIR** - 47,000 standard cubic feet per minute installed capacity with a nominal gauge pressure of 75 psig and a maximum dewpoint of 55°F.
- **NITROGEN** - 148,000 standard cubic feet per hour installed capacity with backup liquid vaporizers. Purity of 99.999%, nominal gauge pressure of 70 psig and a maximum dewpoint of -100°F.
- **KODAK PROCESS WATER** - 50,000,000 gallons per day installed capacity of treated Lake Ontario water with backup inter-connections with Monroe County Water Authority and City of Rochester Water Department. The Kodak Water system is a non-transient non-community public water system regulated by New York State Department of Health. Water quality meets all Department of Health regulations.

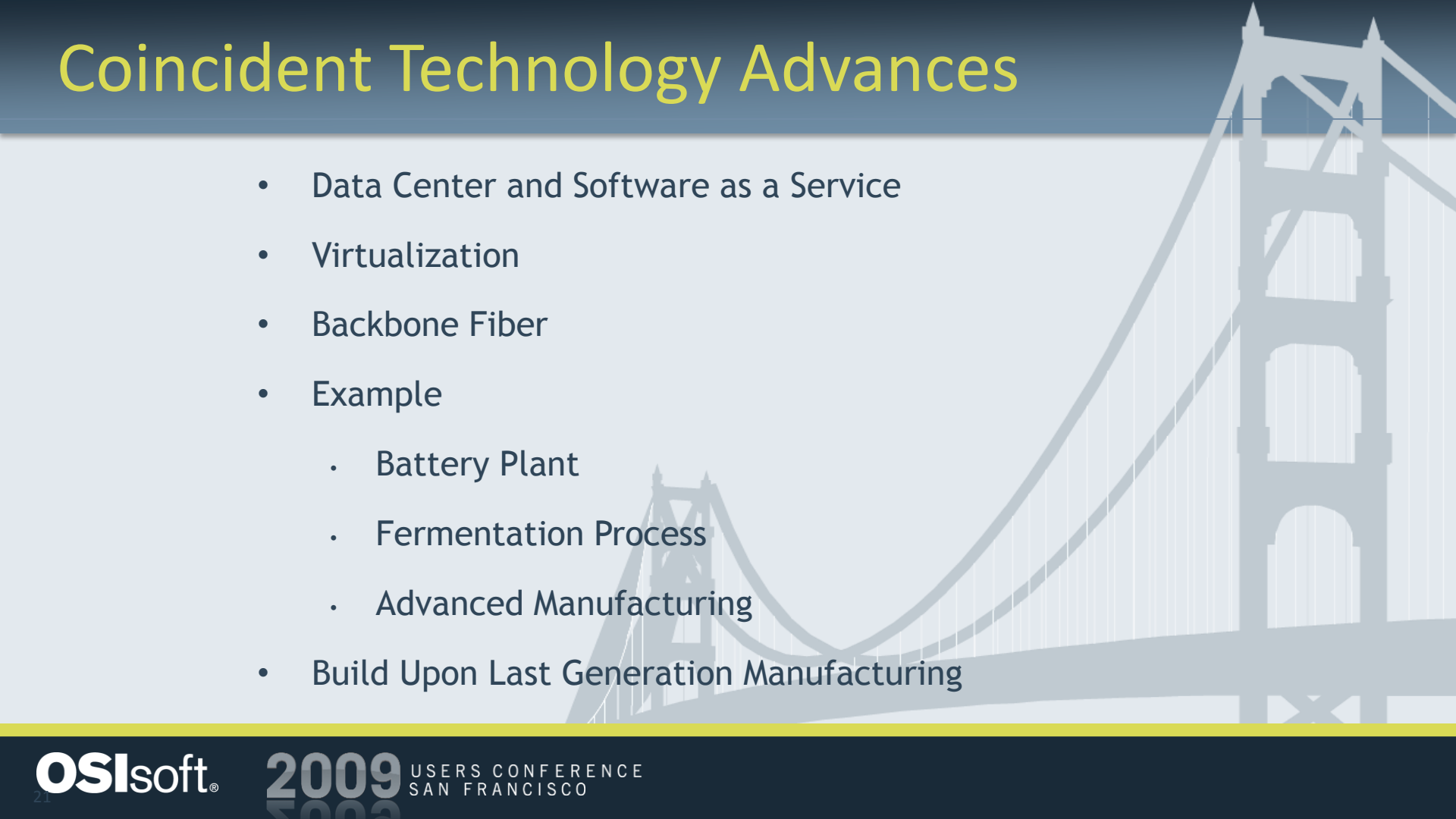
Eastman Business Park

- **DEMINERALIZED WATER** - Treated process water using anion and cation exchangers with maximum conductivity of 4 micromhos.
- **HIGH-PURITY WATER** - 300 gallons per minute firm capacity of reverse osmosis deionized water with a minimum resistivity of 2 megohms.
- **INDUSTRIAL WASTEWATER TREATMENT** - 54,000,000 gallons per day rated hydraulic capacity. The state-of-the-art facility uses physical, chemical and biological treatment processes to remove both organic and inorganic contaminants. Plant discharges must meet requirements imposed by the Federal and State regulatory agencies as stipulated by the plant's State Pollutant Discharge Elimination System (SPDES) permit. A hydroelectric turbine rated for 500 kilowatts installed at the head of the facility removes the kinetic energy built-up by the head pressure producing additional electric power for the Park.

What This Has to Do with PI

- Microgrid - All About Better Knowledge of Environment
- Driving Force for Industrial Migration
- Could have Picked
 - Wind Farms
 - Remote Maintenance
 - Companies Like ICE Energy or Nalco

Coincident Technology Advances



- Data Center and Software as a Service
- Virtualization
- Backbone Fiber
- Example
 - Battery Plant
 - Fermentation Process
 - Advanced Manufacturing
- Build Upon Last Generation Manufacturing



Thank you

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