Supply and Equipment Reliability

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May 2017 Rapid Meeting

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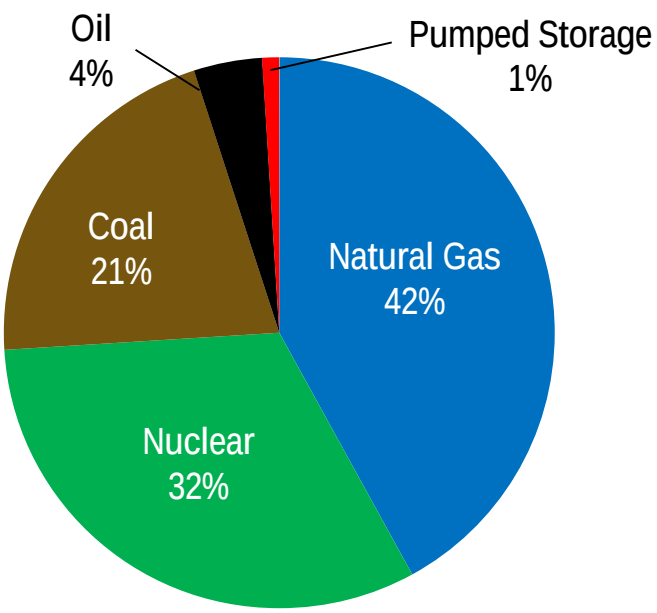
PSEG Power Portfolio

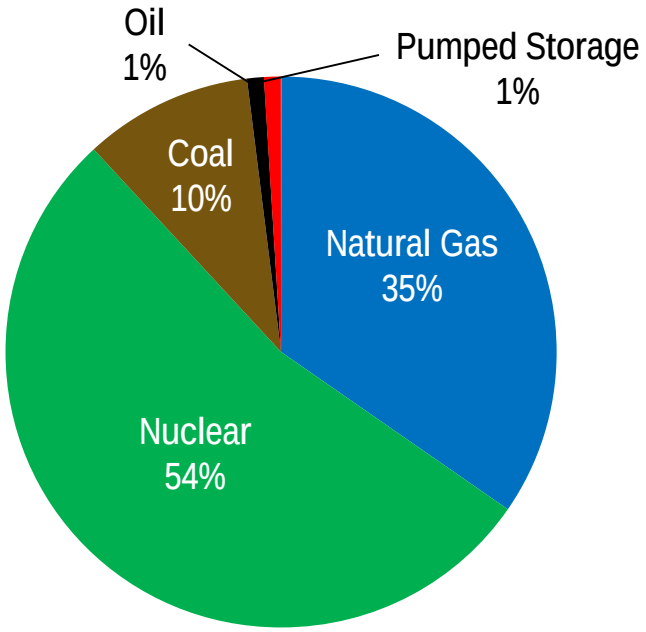
Fuel Diversity

Total MW: 11,678



Energy Produced

Total GWh: 55,213



Coal - includes NJ units that fuel switch to gas**

- Generating assets in five states – New Jersey / New York / Connecticut / Pennsylvania / Maryland (under construction); Solar assets in 11 states
- Announced shut down of 2 large fossil units in 2017
- Building new gas units in NJ, CT, and MD- 1800+ MWe - total staffing for all 3 units = ?
  - Less than 200
  - Less than 150
  - Less than 100

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Salem and Hope Creek Nuclear Generating Stations

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PSEG Nuclear – Salem and Hope Creek

Second largest site in country

- Approximately 3,575 MWe
- Enough electricity for 2.7 million homes

Each unit licensed for 60 years (license renewal completed)

- Salem Unit 1 (PWR, 1180* MW) – August 2036
- Salem Unit 2 (PWR, 1175* MW) – April 2040
- Hope Creek (BWR, 1219* MW) – April 2046

Avoid 14 million tons of carbon emissions per year

- Prevent 26,000 tons of SO_2
- Prevent 11,400 tons of NOX

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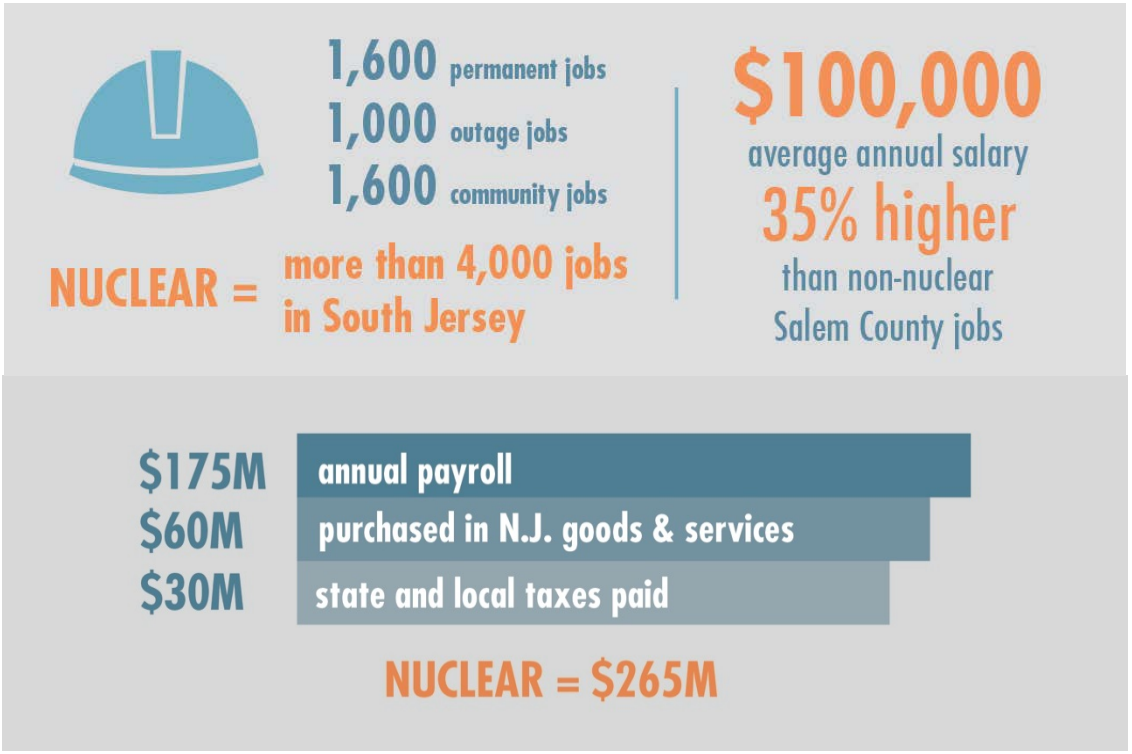
Economic Impact on New Jersey



Shutting down Salem and Hope Creek would have a drastic negative impact on the South Jersey economy and the overall New Jersey economy.

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Three pressures on all nuclear plants

1

Electricity prices have declined dramatically

- Low natural gas prices, coupled with flat demand, have driven down electricity prices.
- In 2016, our nuclear units received $29/MWh compared to $54/MWh in 2011.

2

Increasing regulatory costs

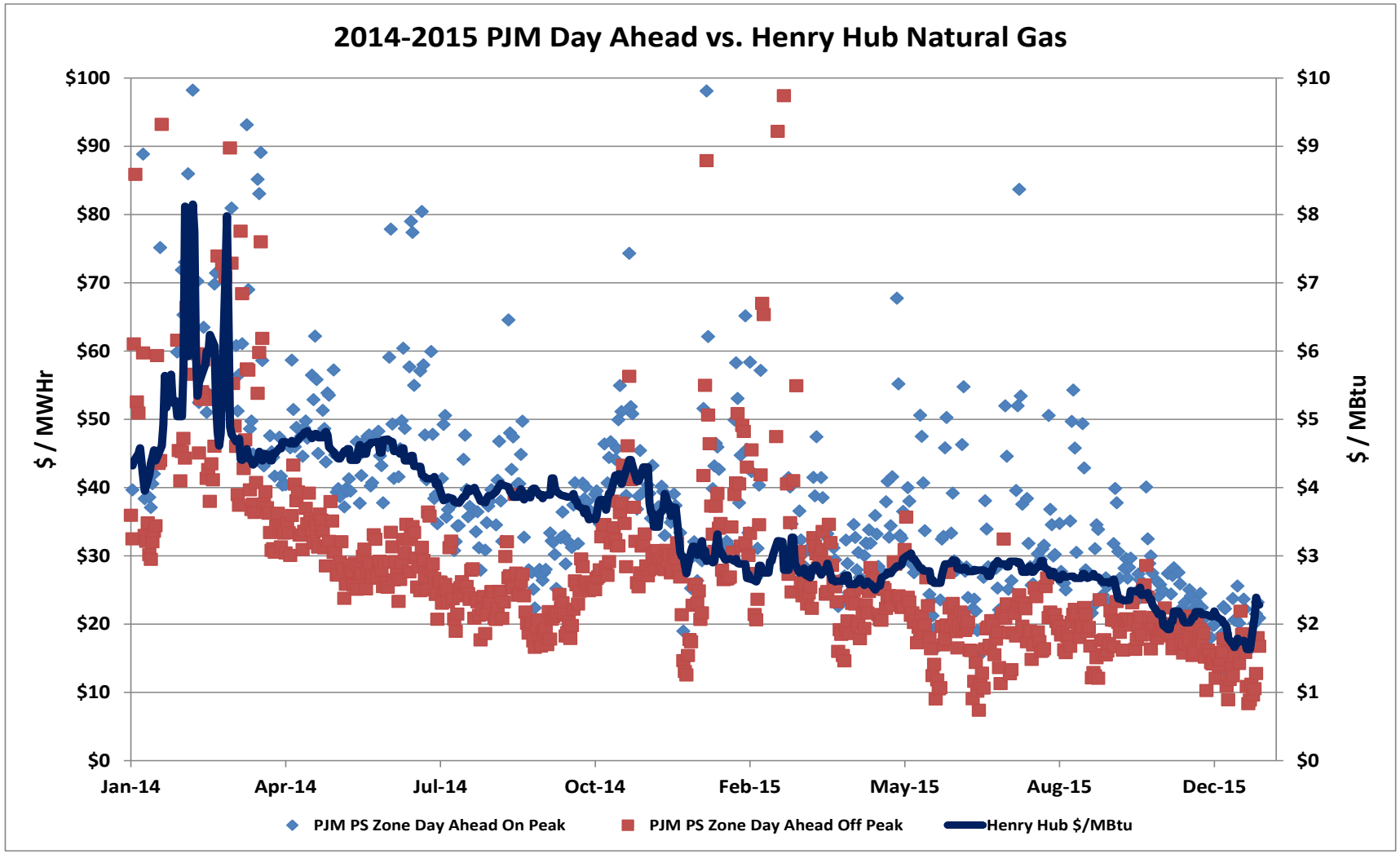
- Fukushima/security investments.

3

Growth in renewables

- Renewables clip the peak and most profitable hours for electric sales.
- Do not provide base load 24/7 energy.

Day Ahead On-Peak and Off-Peak Pricing



Combined Cycle- about $13-15/MWHr,
Nuclear about $25-$40 MWHr

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Area	ERI Sub-Indicator No.	ERI Sub-Indicators	ERI Points Max	HOPE CREEK	SALEM 1	SALEM 2
Electric Generation (Lagging)	1.1	**Online Reliability Loss Factor (ORLF)** (INPO Definition – 18 month Running Average)	8	7	5	0
(Lagging)	1.2	**Unplanned Power Reductions per 7000 hrs Critical** (NRC Indicator)	8	7	3	2
(Lagging)	1.3	**Quarterly Operational Loss Events**	6	6	6	6
Challenge to Ops (Lagging)	2.1	**Unplanned Shutdown LCO Entries** (in last 3 months)	4	4	2	4
(Lagging)	2.2	**Operator Work Arounds**	2	2	2	2
(Lagging)	2.3	**Critical Component Failure Clock Resets** - INPO AP-913 Consequential Failure Events (in last 3 months)	10	10	10	10
System Health (Lagging)	3.1	**Mitigiating System Failure Margin (MSPI)**	5	5	5	5
(Leading)	3.2	**Unmitigated Single Point Vulnerability (SPV)**	8	8	8	8
Maintenance (Leading)	4.1	**Maintenance Rework** (Per Station)	5	5	5	5
(Leading)	4.2	**Deficient Critical Work Backlog** (Online)	5	5	5	5
(Leading)	4.3	**Deferral of Critical PMs** (includes 1st time Critical PM Deferrals)	6	6	6	6
(Leading)	4.4	**Critical PMs Open in 2nd Half of Grace**	6	6	6	6
Work Management (Leading)	5.1	**Work Week Scope Survival** (Average of last 3 months)	8	8	4	6
Long Term Planning (Leading)	6.1	**Plant Health Committee Effectiveness (PHCE)** (Per Station)	7	7	6	6
(Leading)	6.2	**Age of Red & Yellow Systems**	8	8	7	7
Monitoring/Trending (Leading)	7.1	**Chemistry Effectiveness Indicator -R (CEI-R)**	2	2	1	2
AP-913 Process (Leading)	8.1	**PM Change Request Backlog** (Critical and Non-Critical >60 days)	2	2	2	2
91 to 100	**GREEN**	Leading Indicators	**57**	57	50	53
70 to 90	**YELLOW**	Lagging Indicators	**43**	41	33	29
less than 70	**RED**	**ERI Point Total**	**100**	**98**	**83**	**82**
Industry Top Quartile	**98**	ERI Point Total Last Month	Mar-17	98	83	82
		ERI Year-End Projection		98	96	92
		ERI Year-End Goal		98	88	88

Rapid Conference

- Parts quality continues to challenge plant operations
  - NSCSL challenge of industry data is a good effort and helpful
  - But there are impactful quality issues that occur frequently
- Quality issues with both materials and services that are not limited to a specific set of suppliers
  - OEMs
  - Manufacturers
  - Specialty
  - 3rd parties
- Salem and Hope Creek have had significant impacts:
  - Main Power Transformer- Generator Trips/Dual Unit outage
  - Emergency Diesel Safety Related Switches, Breakers- Loss of safety margin
  - Non-Safety Generator Protection Relays- Reactor Trip
- Salem – INPO AFI under ER-3

Equipment is managed to maintain long-term equipment reliability.

- Supply chain personnel work with station organizations to maintain sufficient inventories of equipment and components that support plant reliability and nuclear safety. A spare parts process that defines the criteria for identifying a component as a critical spare should be used to develop a strategy for obsolescence and lengthy lead times that could result in extended out-of-service time.
- Controls are in place such that inventory is available, is accurate, and is maintained in a serviceable condition. Such controls include but are not limited to environmental and shelf-life controls, in-storage preventive maintenance, and traceability strategies.
- Supply chain processes are designed and implementation is coordinated with station priorities to meet station needs (outage, on-line, and emergent tasks). This includes feedback of material and service status to station management to enable alignment with station requirements and commitments. Measures are in place to monitor and improve the quality of delivered items.

- Supply chain processes are established for procured parts, materials, and services. Vendors and suppliers are selected and approved based on qualifications and performance.
- Controls are established to monitor supplier performance, including the proper oversight and intrusiveness at the manufacturing facility, commensurate with the risk significance of the equipment. Performance data and metrics that could have an impact on plant reliability or nuclear safety are trended and promptly communicated back to the supplier to ensure supplier action and continuous improvement.

Salem AFI ER.3

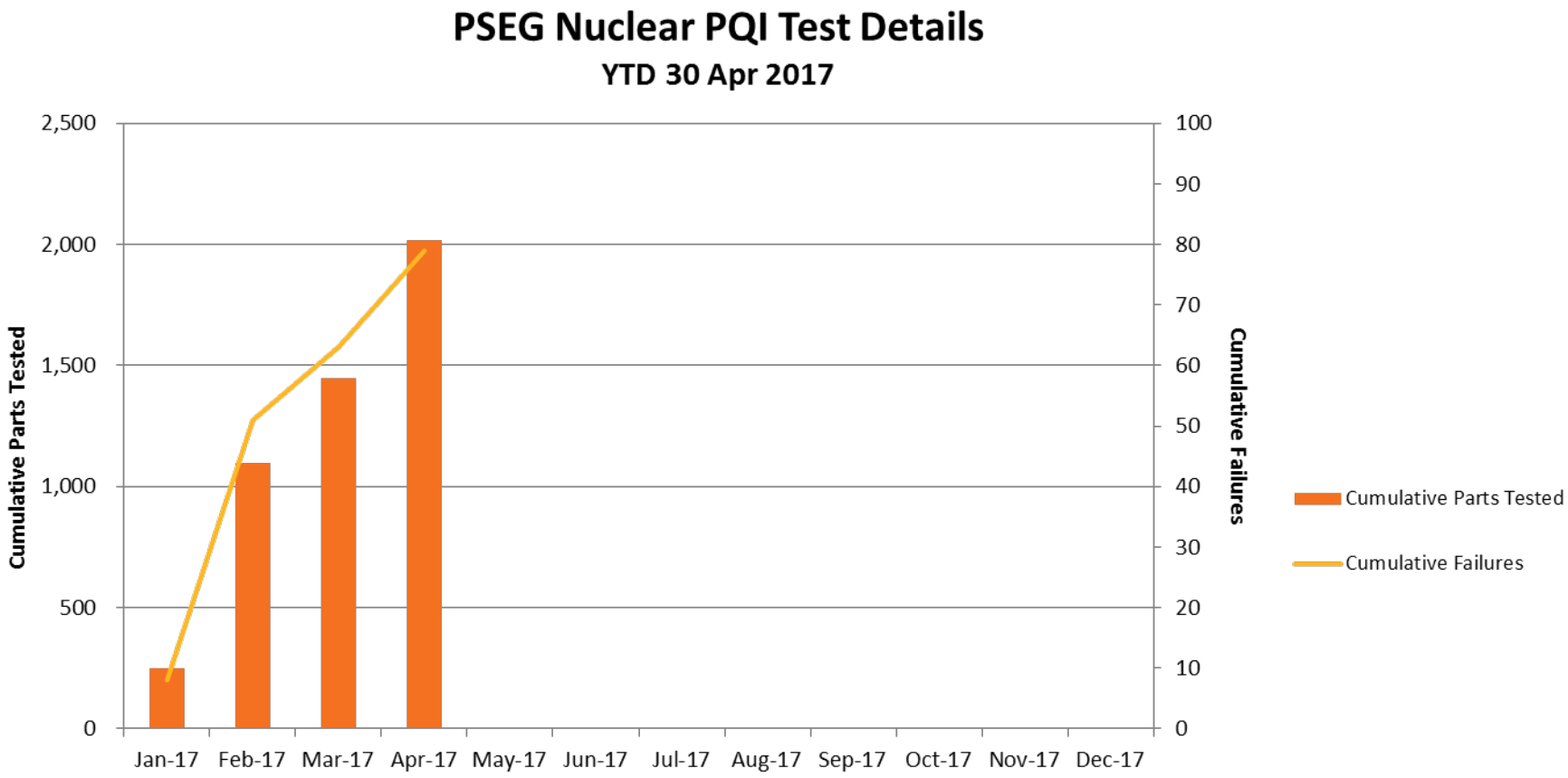
"Supply chain, engineering and maintenance personnel do not validate that reliable parts are received from suppliers. As a result, deficient parts have resulted in two emergency diesel generator failures to start, safety-related relay failures, and reactor trips".

What are we doing

- Implemented a Parts Quality Program - Safety and Non-Safety
  - Addressing existing inventory and new receipts
  - Single Point Vulnerabilities
  - Critical Components
  - Other high failure items as determined by test program data
  - Focus on Outage SPVs and new parts scoped for design changes
  - Expect to have 5000+ parts (stock codes) in program
  - Testing in progress with approx 4% failure rate on first 2000 tested
  - Cost of testing program is significant but cost of not testing is higher

What are we doing- continued

- Enhanced Supplier Performance Monitoring
  - Supply data- OSD&D, Fundamental Management System
  - Installed failures- Corrective Action Process
  - NUPIC results considered in supplier performance
  - Supplier Performance Review Board - quarterly
  - Targeted feedback to Suppliers based on analysis- 3 tier Approach



	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
Cumulative Parts Tested	248	1,097	1,449	2,017								
Cumulative Failures	8	51	63	79								

Failure Comments:

Failures primarily driven by fuses (44 failures) and Masonelian valves (11 failures). Other items with multiple failures include Agastat time delay relays (6), Westinghouse and Hitachi circuit boards (7), GE/Protec potentiometers (3).

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What can the industry and the suppliers do?

Industry

- Risk informed reliability testing of parts prior to install- different from bench testing
- Factor supplier performance into vendor audits - Supply Chain and Quality Assurance share data- Better integration between Supply and NUPIC
- Timely feedback to the suppliers on performance

Suppliers

- Supplier Testing of components – Are supplier test procedures generic or purchase order specific?
- Ensure test sampling plans executed by suppliers are statistically valid
    - Components from sub suppliers are controlled?
- Ensure changes in sub-vendors or manufacturing locations are well controlled with quality plans developed and executed

Conclusion:

- Supply activities directly impact on Equipment Reliability- need to keep the denominator high to lower the cost of production
- Deregulated Plants are in “fight for their lives”- Regulated plants are not exempt from cost pressures either
- Outlook is long term - not changing
- We all (Suppliers and Industry) are in this together - need to look for ways to assist in keeping quality and safety high and wringing out the waste and inefficiencies.

Thank you for allowing me to speak- have a productive conference!!