The Technology Enabler

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Group Vice President, Head of Wärtsilä Power Plants
1. Fuelling Power Plants of the Future

2. From Black Box to Crystal Ball
The Energy Discussion

Climate change

• Climate change is being recognised as a fact

• Focus is changing from local emissions to global emissions

• General public wants energy sector to solve the emissions problems with TECHNOLOGY

• Electricity price is going to rise due to higher requirements for emission abatement

Availability of Fuels

• Many names but same subject
  – Sustainable development
  – Independence from oil
  – Domestic energy supplies

• Availability problem is highlighted by the fact that energy consumption is rising at the same times as the sources are diminishing

• Primary energy prices will rise due to availability issues
Greenhouse emissions

- Burning fuel releases energy through the breaking of chemical bonds when fuels react with oxygen.
- In fossil fuels CO2 intensity depends on hydrogen – carbon ratio
  - The more hydrogen, the better
  - Methane (NG) C:H = 1 : 4
  - HFO C:H = 1 : 2.1
  - Coal C:H = 1 : ~1

- Oil & Gas benefit from higher conversion efficiency in pure electricity production
  - Coal is turned to electricity through steam cycle which typically yields 36-38% efficiency
  - Reciprocating engines typically yield 43-45% net electrical efficiency with oil or gas
Forecasted Growth in Global Electricity Use

- Total electricity generation (TWh)
- Year
Wärtsilä Products for the Future

**Fuel flexibility**
- The ability to use fuels which are available
- The ability to use of low cost fuels
- The ability to convert from one fuel to another
- To have backup fuel capability
- Efficient use of fossil fuels
- Technology enabler for renewable fuels

**Competitive capital cost**
- Standardized solutions
- Modularity

**Emission compliance**
- Compliance with all relevant standards

**High electrical efficiency**
- Sustainable power generation must have high efficiency because the share of electricity in energy consumption is increasing

**Reliability & Availability**
- Tried and tested solutions
### Wärtsilä means Fuel Flexibility

<table>
<thead>
<tr>
<th>Fuel Source</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Biomass (Wood based)</td>
<td>Renewable power, Europe/Kyoto</td>
</tr>
<tr>
<td>Liquid Biofuels (LBF)</td>
<td>Base load power, Europe/Kyoto</td>
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<tr>
<td>Natural gas (NG)</td>
<td>Base load power, power islands, grid stability services, compressor drives</td>
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<tr>
<td>Associated gas (AG)</td>
<td>Oil field power, eliminates the need for flaring in oil fields</td>
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<tr>
<td>Light Fuel Oil (LFO)</td>
<td>Stand by &amp; emergency power</td>
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<tr>
<td>Crude Oil (CRO)</td>
<td>Oil field power, Oil pipeline pump sets</td>
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<tr>
<td>Heavy Fuel Oil (HFO)</td>
<td>Base load plants, Power Islands, Back-up power</td>
</tr>
<tr>
<td>Fuel Water Emulsions (FEW)</td>
<td>Oil sands, Oil refinery power based on process residue</td>
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</tbody>
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Agenda

1. Fuelling Power Plants of the Future

2. From Black Box to Crystal Ball
Power Plants: A Black Box?
Poised for Growth

• Business fundamentals strong

• Product Matching Market Needs – Now and in the Future
  – Fuel Flexibility
  – High Efficiency
  – Low environmental impact
  – Competitive cost
  – Tried and tested concepts

• Services package clear differentiator
  – Local Presence Globally
  – Understanding of Customers’ Business
  – Project execution, including planning, site works, erection, logistics
  – Lifecycle management
  – Development and Financial Services
  – Operations and Management
Focus on Segments

Grid Stability & Peaking

• Transition from industrial to services economy
• Increasing interest in renewables increasing instability
• Deregulated markets create increased need for stability services
• Difficulty in installing new transmission
• Increasing demand for high reliability and quality
• Independence from grid instability problems
Focus on Segments

Flexible Baseload Power

- Population growth
- Economic growth
- Baseload efficiency combined with peaking power flexibility
- Fuel flexibility
- Modular expansion as demand increases
- Grids weak or non-existent
Focus on Segments

Industrial Self Generation

- Difficulty in installing new transmission
- Increasing demand for high reliability and quality
- Independence from grid instability problems
Planning

- Utilities have traditionally been poor at planning for future power needs
- Problem accentuated in smaller range of power generation

However
- Market, regulatory and environmental demands are increasing
- Fuel supply and security issues are increasing

- Forces better planning
- Leads to better predictability
VISION 2020 for Power Generation

Clean Energy
• Energy without measurable impact locally or globally

Sustainable source of energy
• Available or Renewable source of energy
• Highest efficiency

emissions sustainable