# SMART POWER GENERATION – FLEXIBILITY AND EFFICIENCY

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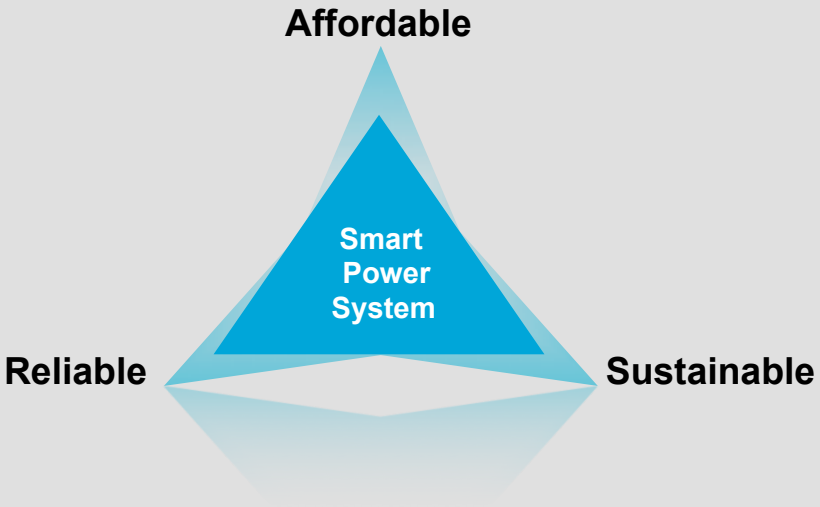
12 Capital Markets Day HELSINKI FINLAND

WÄRTSILÄ

# The world demands

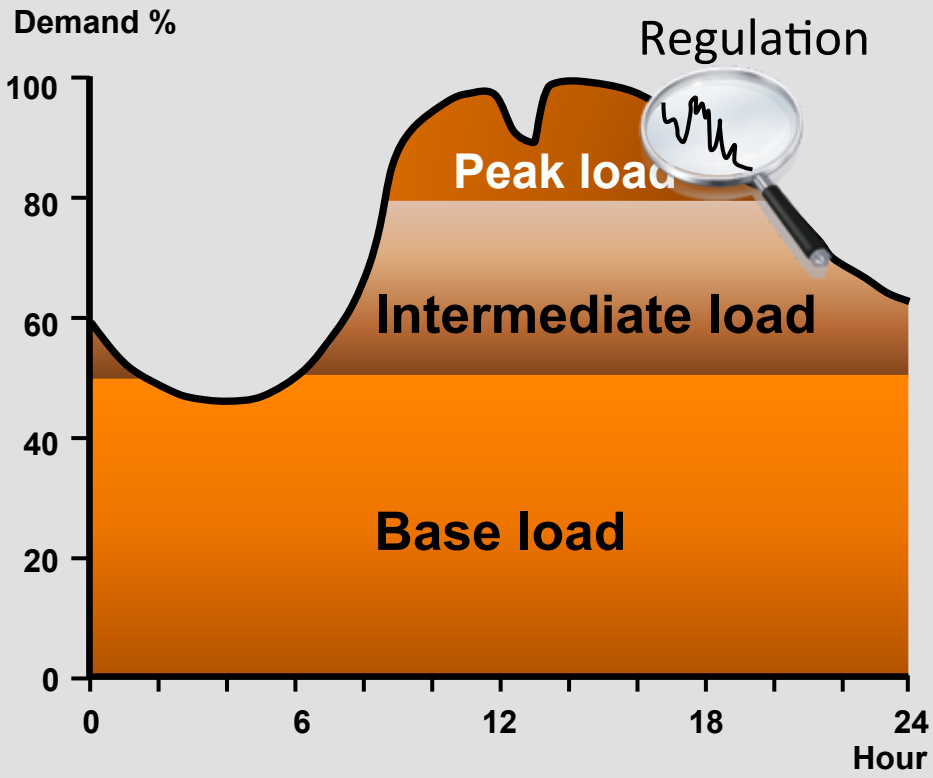
## DESIRED FUTURE OF POWER SYSTEMS




# Load variations in power systems

- **Base load**
  - Constant generation 24/7/365
  - Nuclear and coal plants
- **Intermediate load**
  - Normal daily load variations
  - Increase of wind and solar power introduce uncertainty which leads to large generation variations
- **Peak load**
  - Covering high demand hours
- **Regulation**
  - Balancing the system (frequency & voltage)
- **Reserves**
  - Contingency situations

## DAILY LOAD CURVE

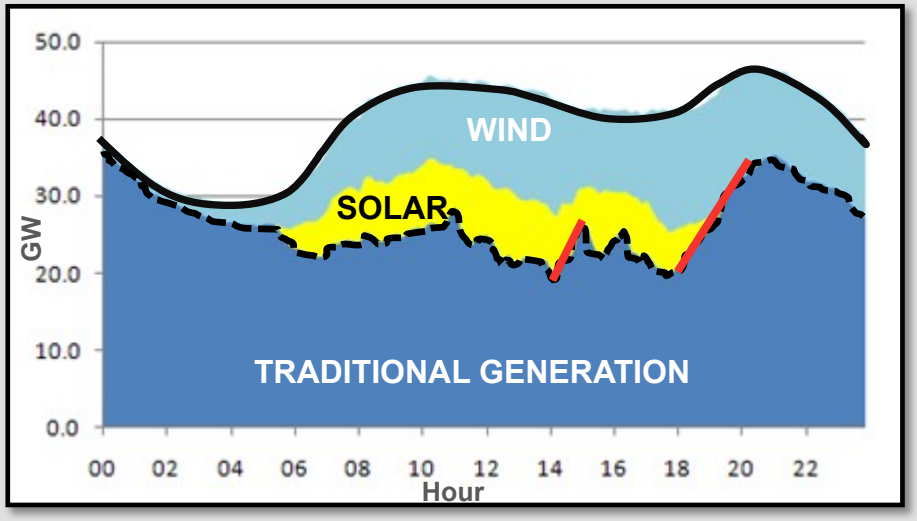


# Growing challenges for power systems

- **Variability of generation, intermittency**
  - Increasing wind and solar production
- **Forecasting error**
  - Intermittent generation
- **Increasing demand variations**
  - Electricity intensity and less industrial production
- **Power plant commitment**
  - Inflexible generation

**INCREASING DEMAND FOR FLEXIBLE POWER GENERATION**

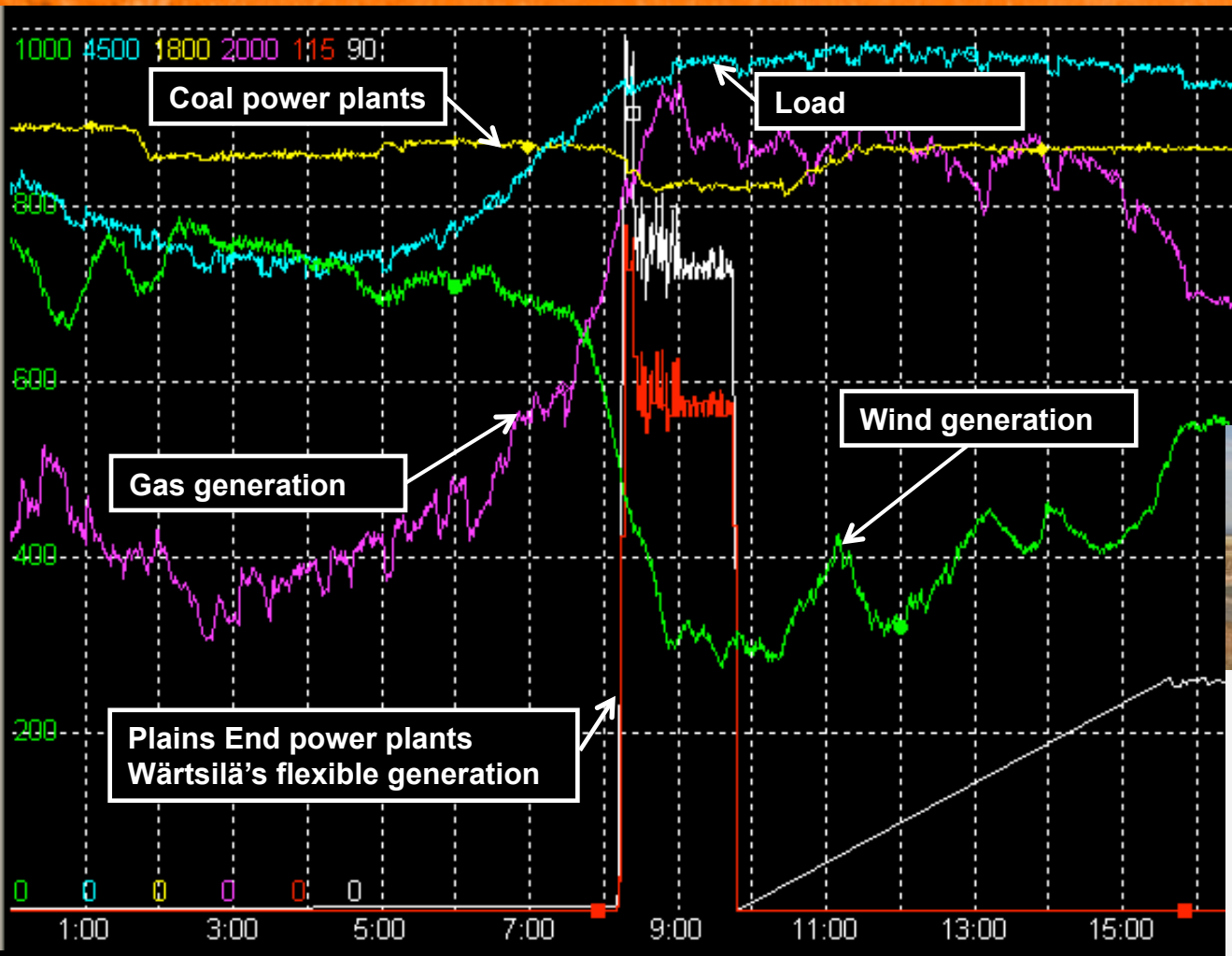
**DAILY LOAD CURVE**



# The perfect match

## Case study: Smart wind chasing in Colorado, US





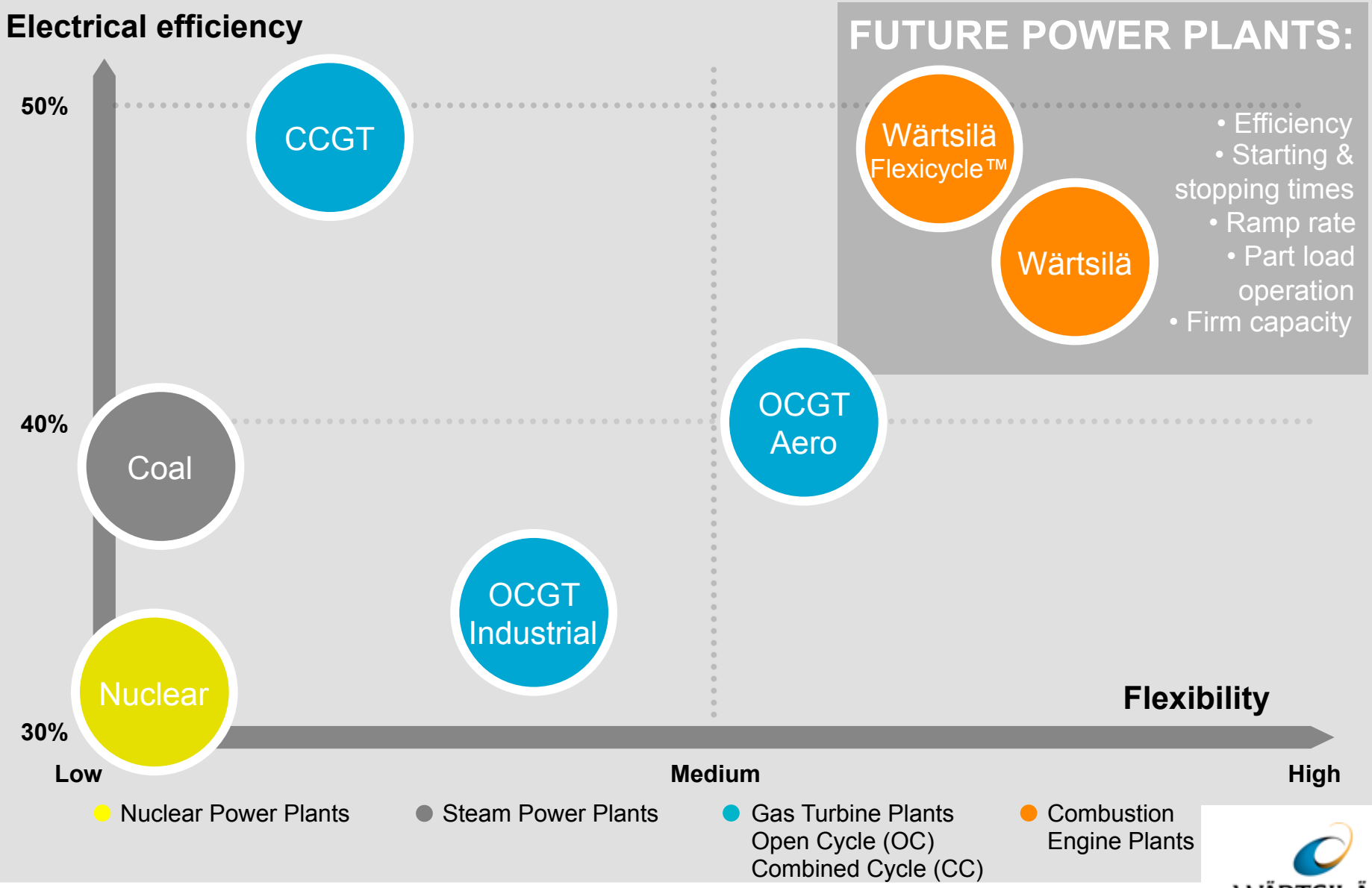

**Screen shot from Colorado Dispatch Center, Xcel Energy, USA**
**3 May 2008**

**PLAINS END POWER PLANT, COLORADO, USA**

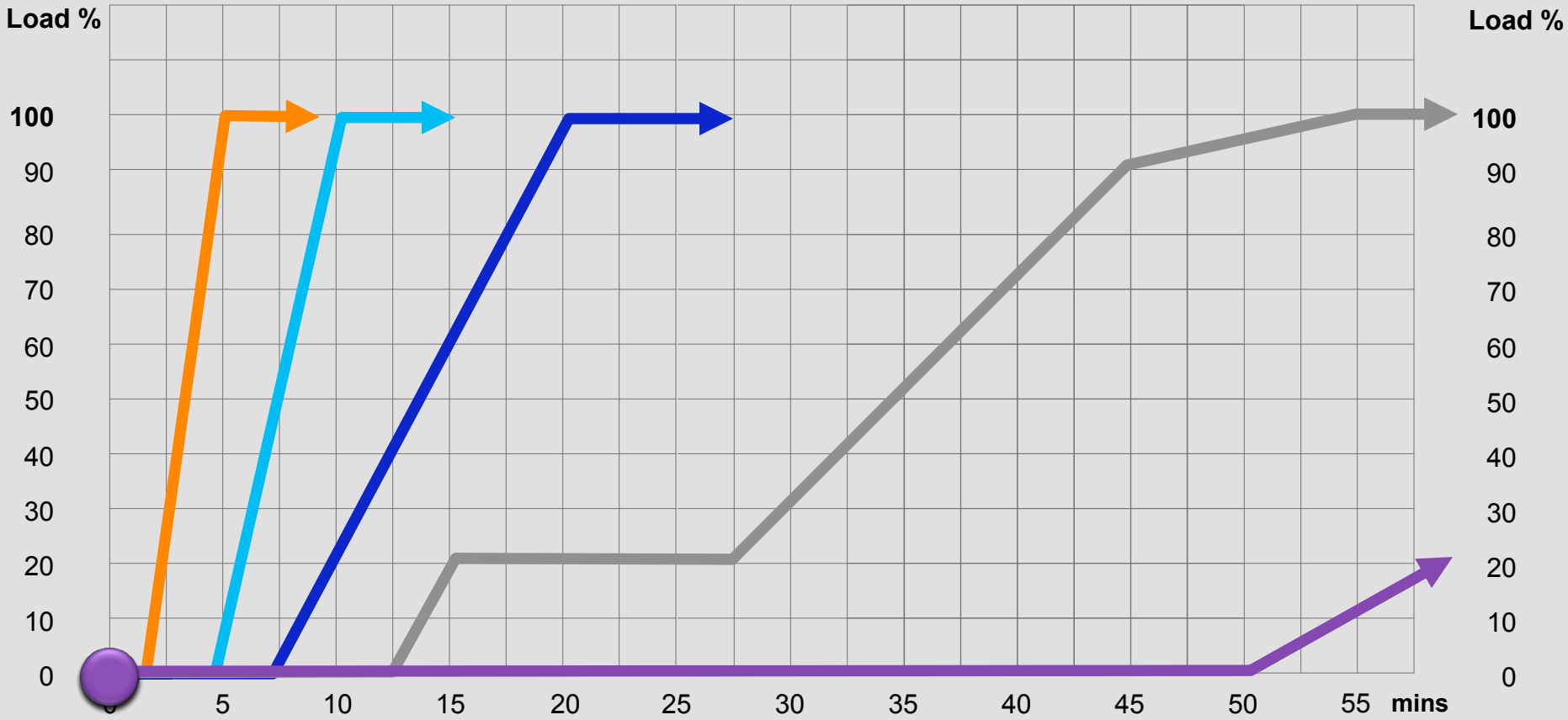
| | |
|---|---|
| Type: | Grid stability |
| Engines: | 20 x Wärtsilä 18V34SG |
| | 14 x Wärtsilä 20V34SG |
| Total output: | **227 MW** |
| Fuel: | Natural gas |
| Installed: | 2002 and 2008 |

Remote controlled from Colorado Dispatch Center

# Operational flexibility AND electrical efficiency



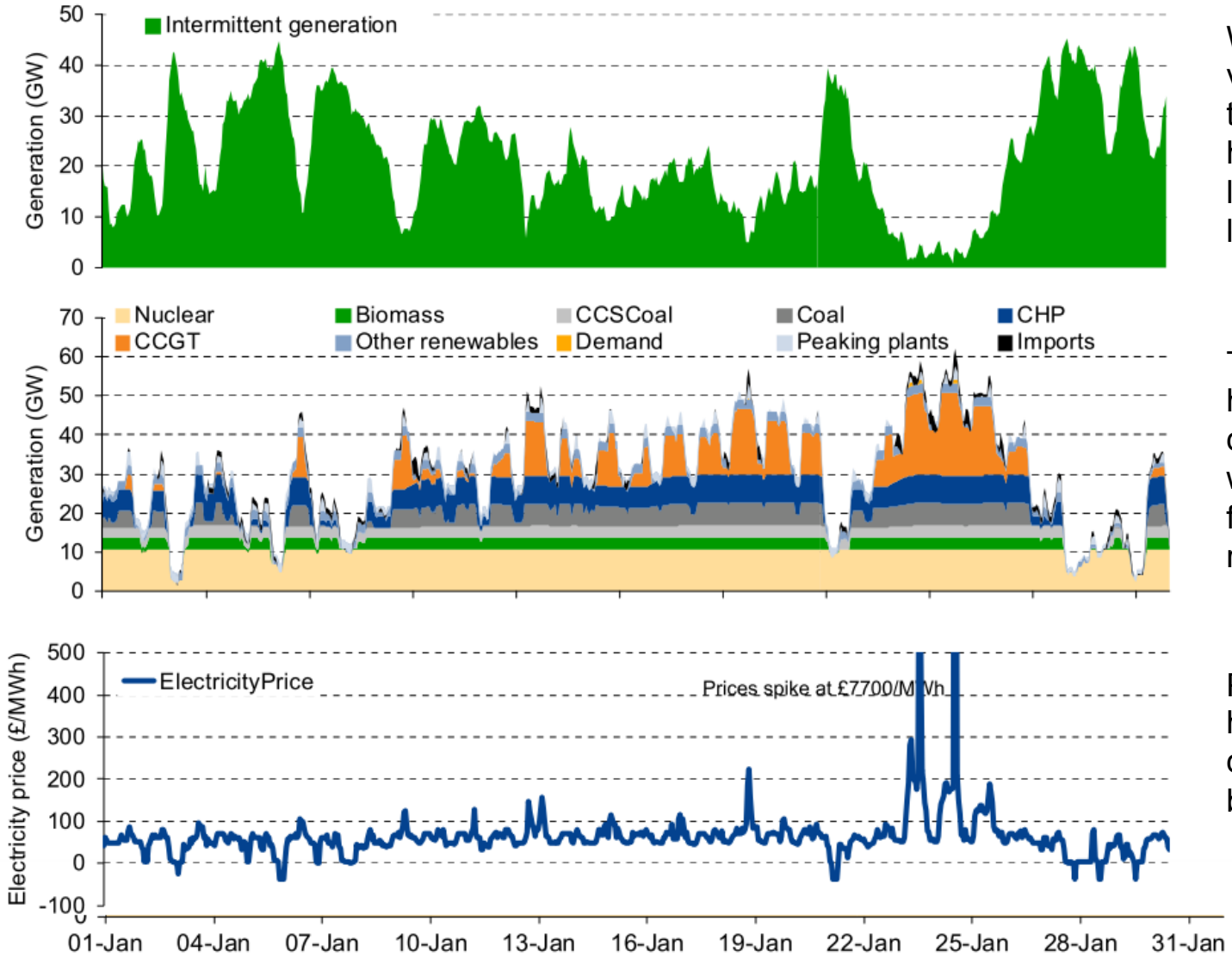
# Fastest loading by Combustion Engine




**POWER PLANTS:**

- Wärtsilä Combustion Engine
- Open Cycle Gas Turbine (OCGT), aeroderivative
- Open Cycle Gas Turbine (OCGT), industrial
- Combined Cycle Gas Turbine (CCGT)
- Coal Fired

# Wind will impact the whole system




Wind generation is very variable, leading to periods of very high generation and low periods of very low generation

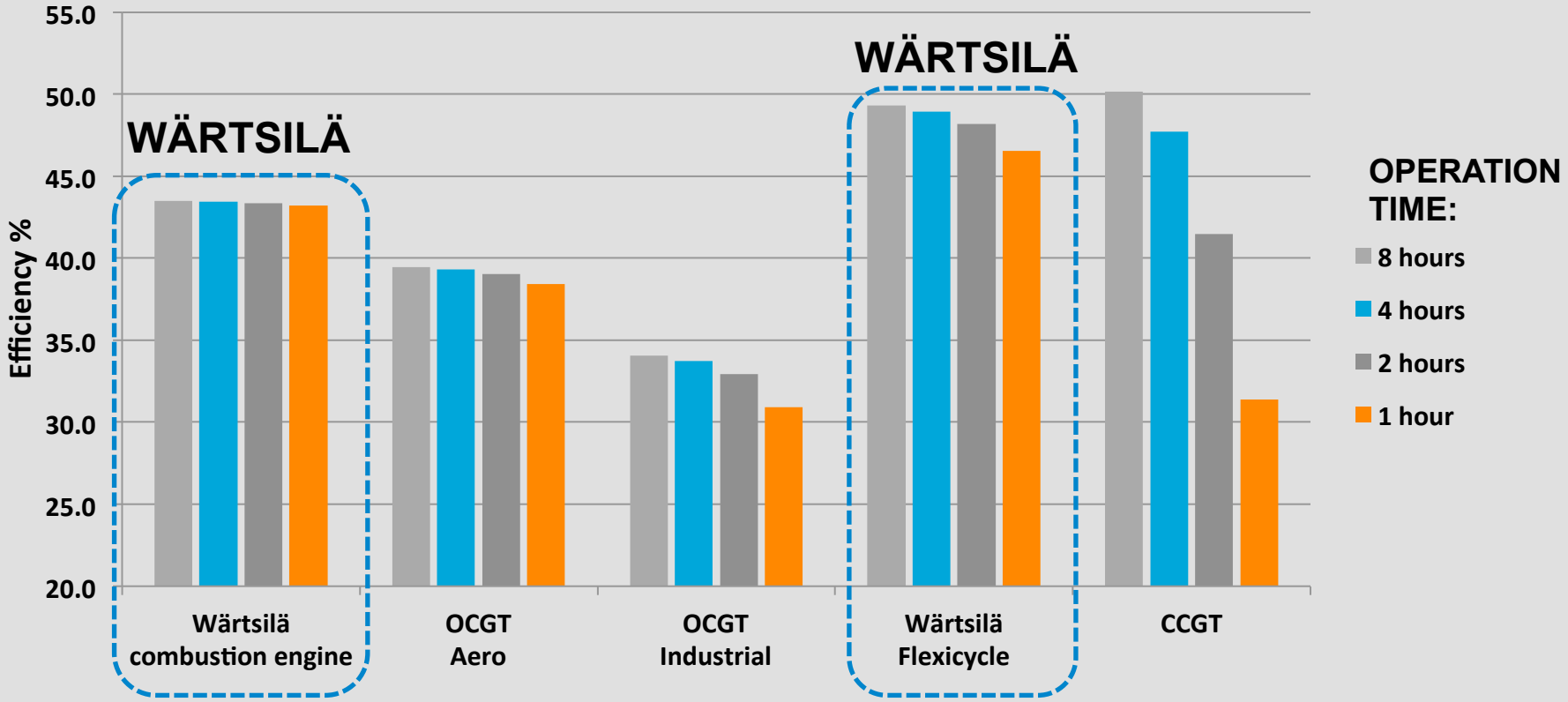
Thermal plants will have to operate in a different manner, with lower load factors and higher risk

Prices may become highly volatile and driven increasingly by wind generation

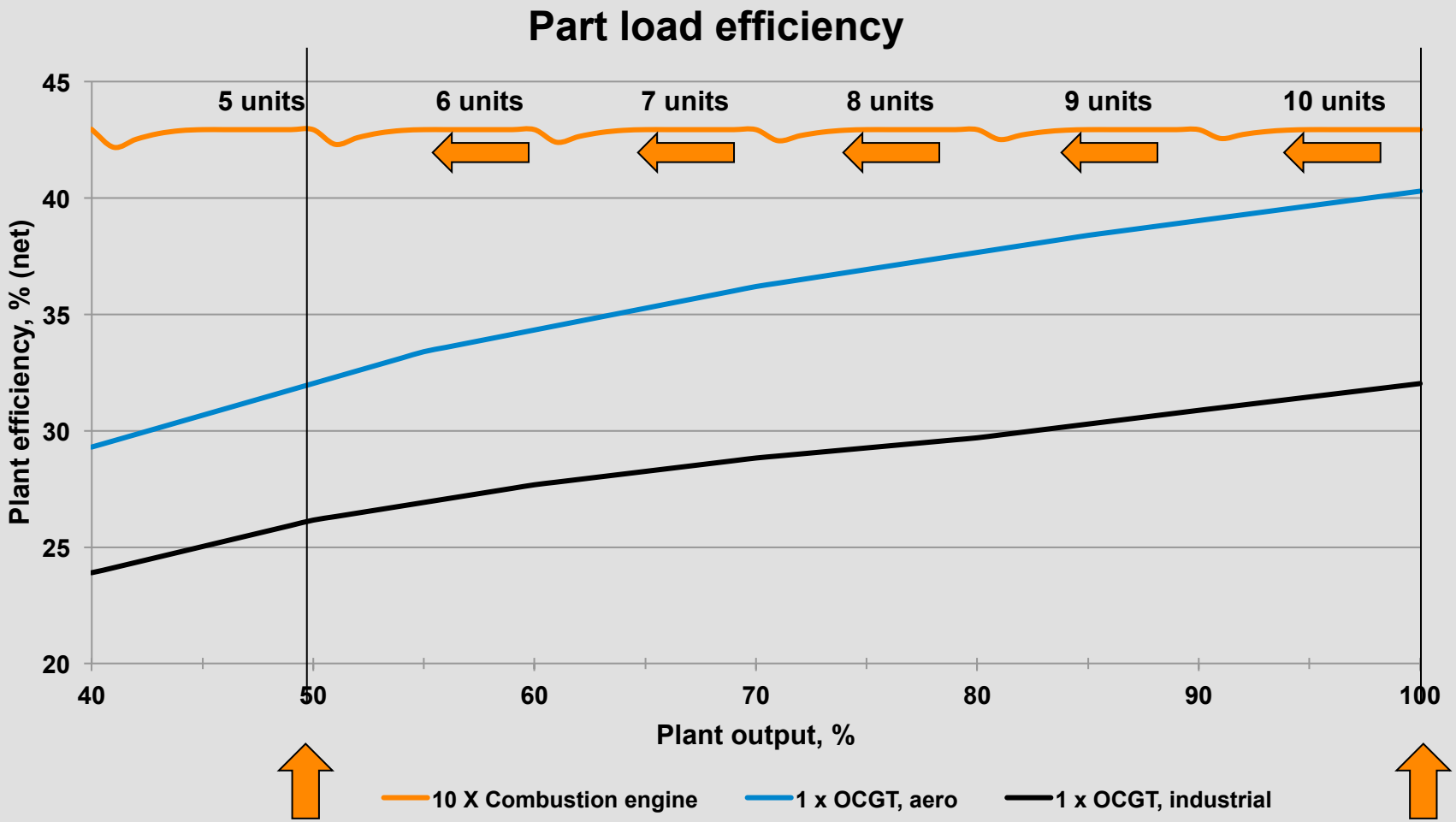
*Source: Impact of Intermittency: How wind variability could change the shape of the British and Irish electricity market, July 2009*

# Engines are more efficient across the operation range

## Average efficiency, start to stop

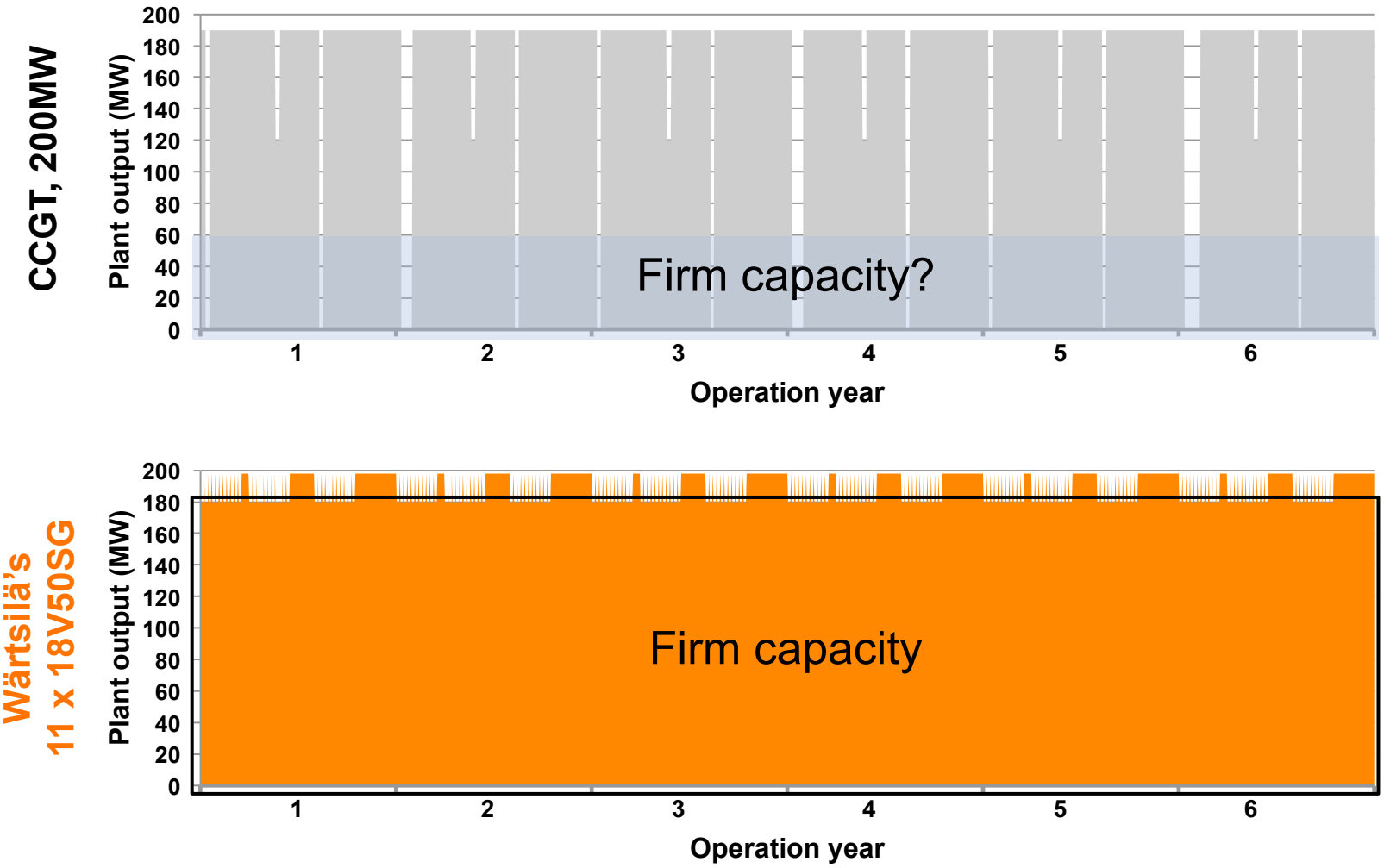


# High efficiency due to multiple units

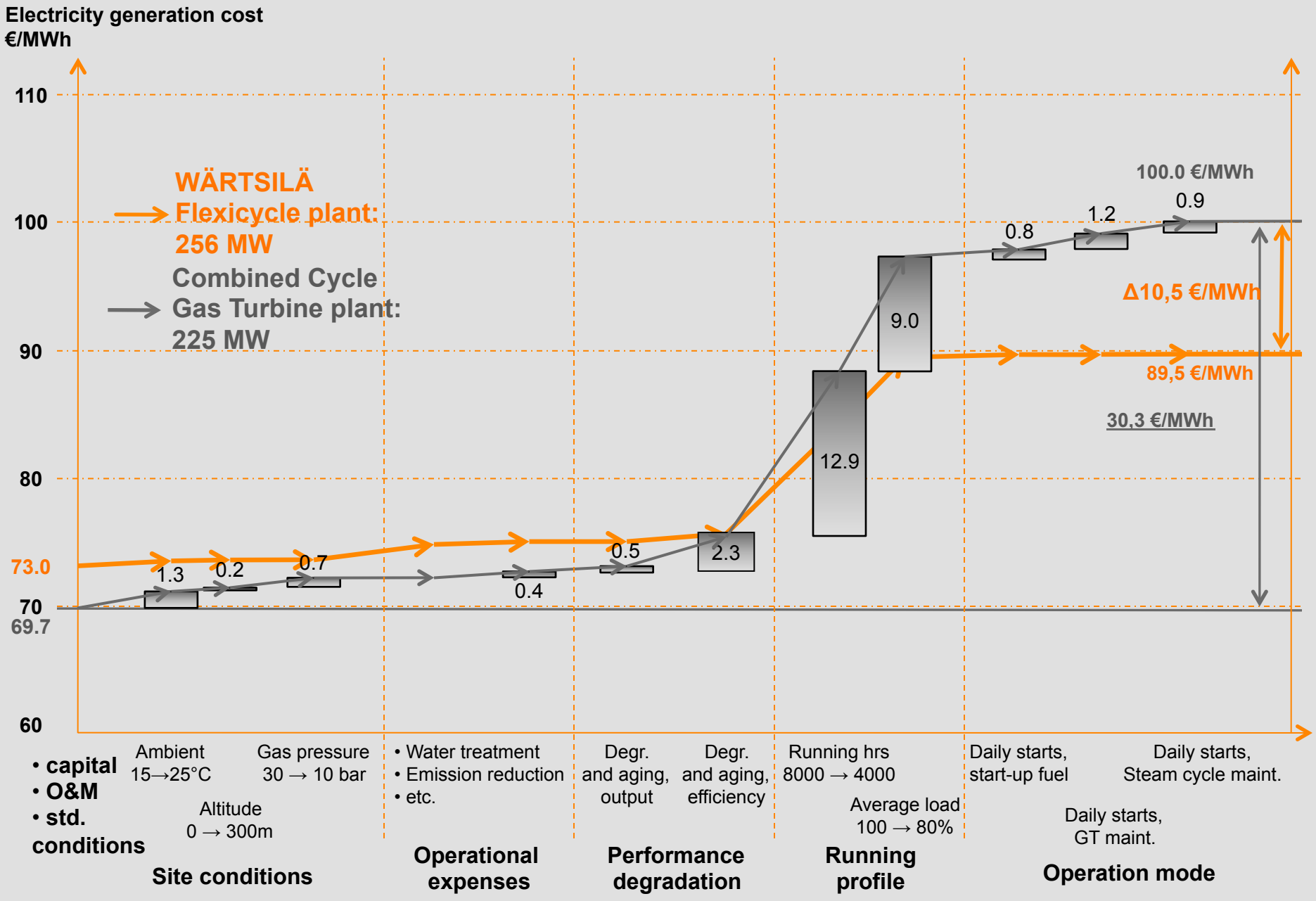



GT performances: GTPro by Thermoflow

# High reliability due to multiple units

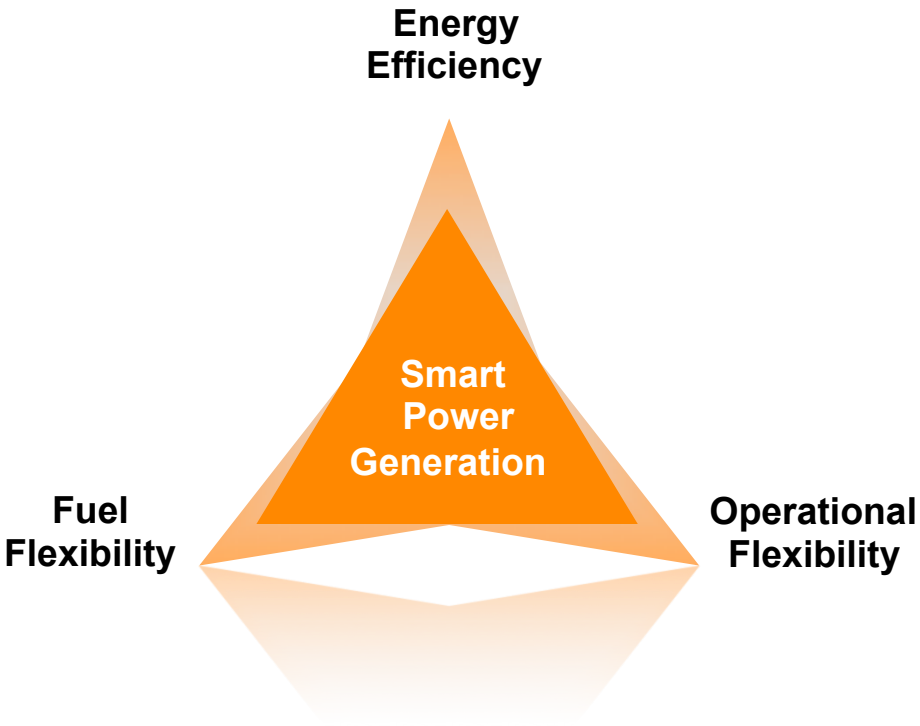


# True and lower cost of generation



# Benefits to power producers

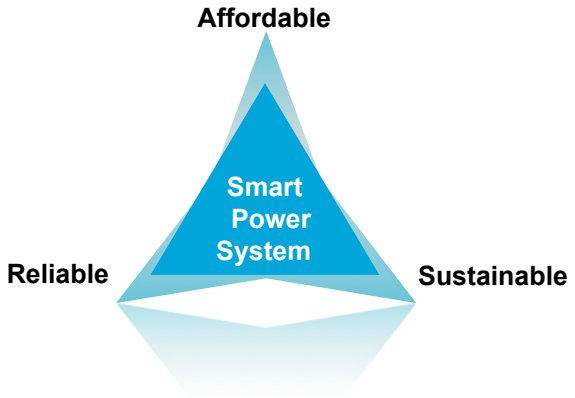
- **Operation in different generation modes**
- **High efficiency**
- **Fuel flexibility**
- **Dependable and committable**
  - Multiple generating units
- **Operate on multiple markets**
  - Energy markets
  - Capacity markets
  - Ancillary services markets
- **Optimum plant location close to consumers**
- **Fast access to income through fast-track project delivery**
- **Competitive O&M costs**

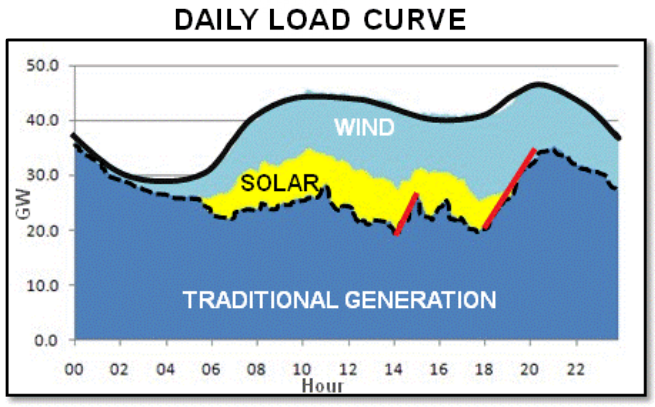


# Benefits to power systems

- **Secures the supply of affordable and sustainable power**
  - Enable highest penetration of wind and solar power capacity
  - Maximising the use of wind power capacity by minimising wind curtailment
  - Ensure system stability in wind variability and contingency situations

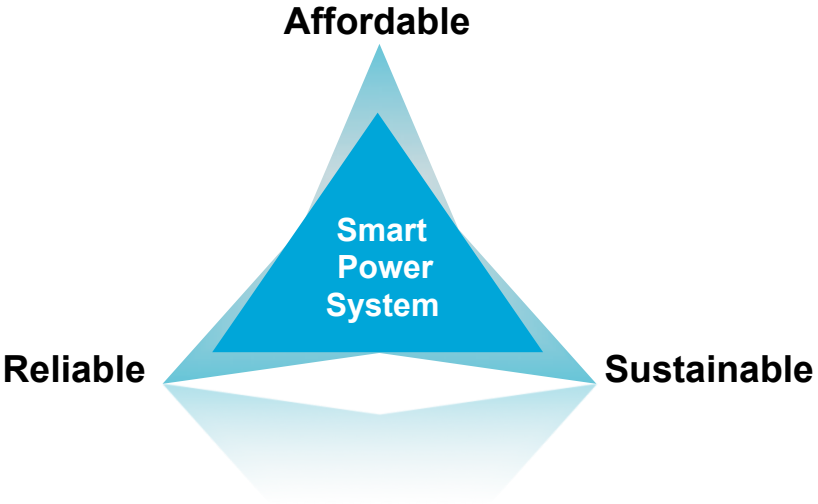
- **Ensures true optimisation of the total power system operation**
  - Remove the abusive starts and stops, and cyclic load from baseload plants that are not designed for it
  - Improves the total system efficiency



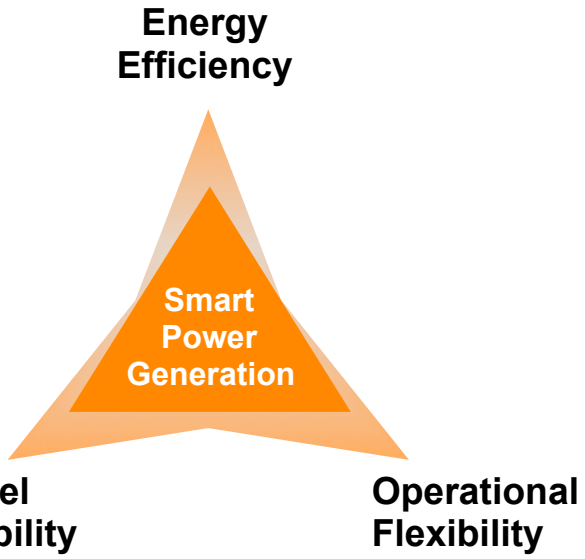



# Matching changing requirements

## DESIRED FUTURE OF POWER SYSTEM




## WÄRTSILÄ'S OFFER





WÄRTSILÄ