



POWER-GEN[®]
EUROPE

NAVIGATING THE POWER TRANSITION

3 – 5 JUNE 2014 | KOELNMESSE | COLOGNE | GERMANY

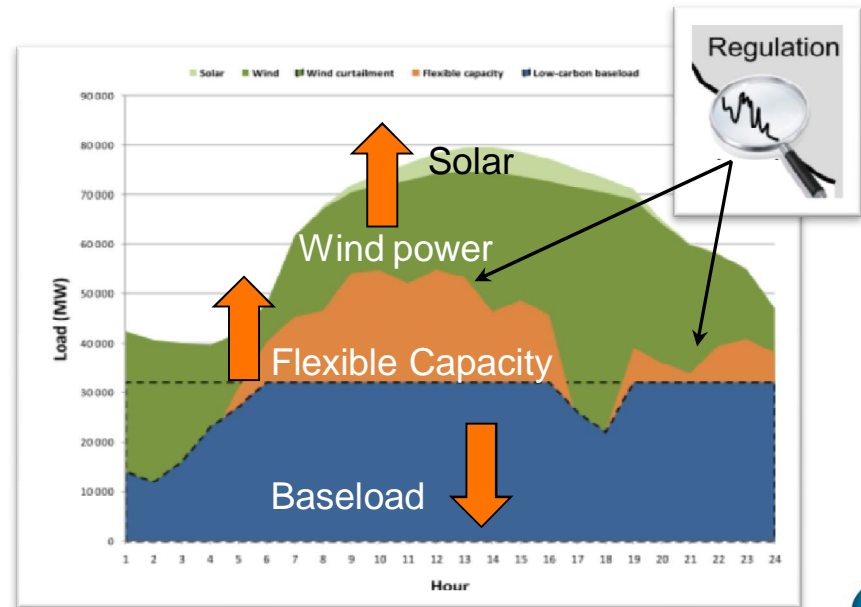
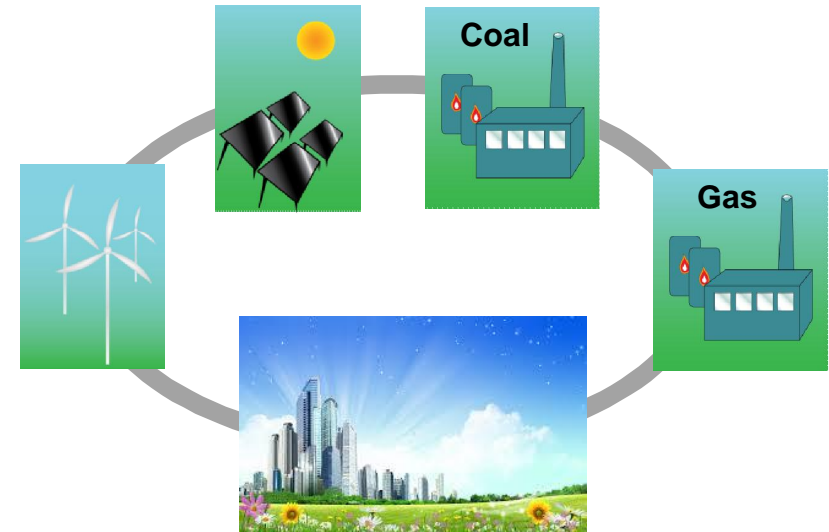
Flexible Power Generation utilizing Combustion Engines

Ulf Åstrand, Director, Research&Development, Wärtsilä Finland Oy

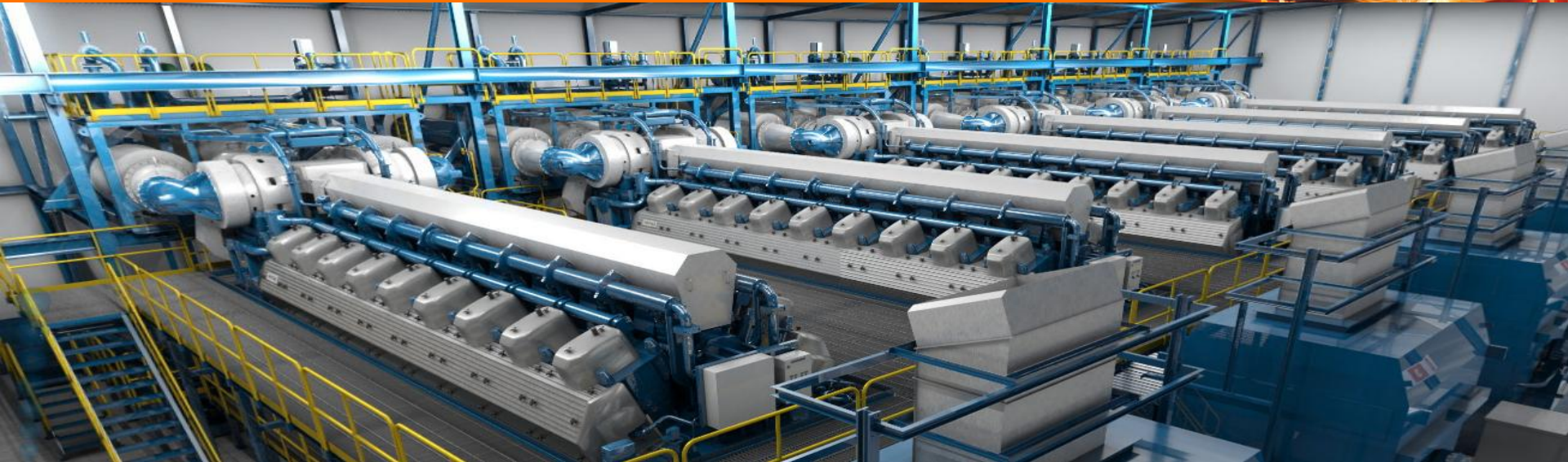


Why is flexibility needed:

- for reducing environmental impact by
 - enabling increased growth of renewable power such as wind and solar
 - enabling optimized efficiency of available power supplies
- for securing reliable power supply
- for enabling adaptation to changes



Flexible Power Generation utilizing Combustion Engines



Low environmental impact:

- High energy efficiency
- High reliability & availability
- Low emissions
- Enabling wind and solar

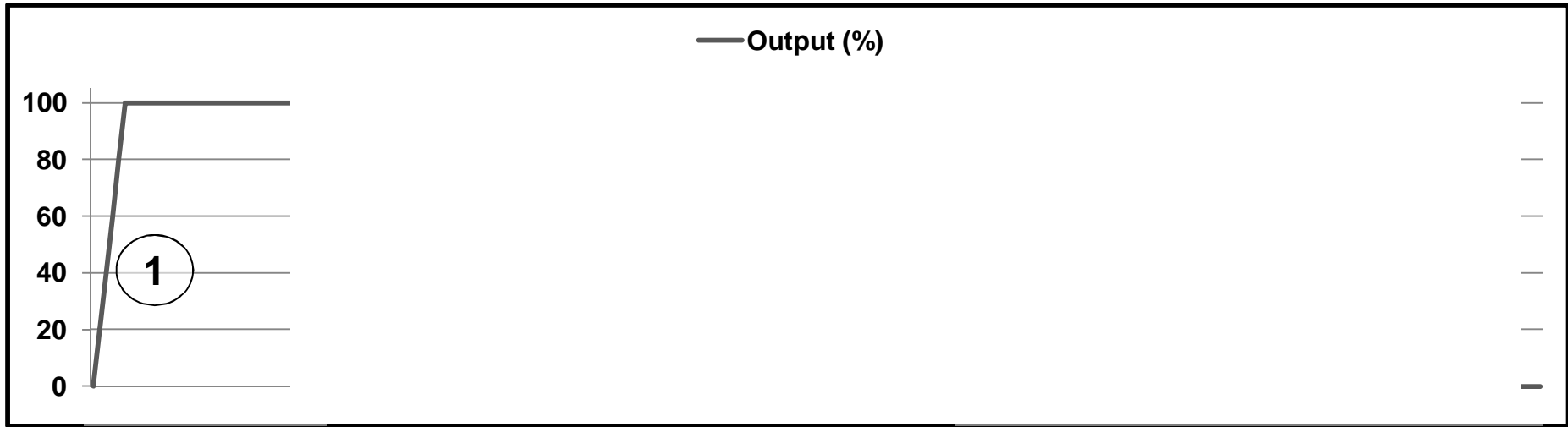
Operating flexibility:

- Fast starting, loading and unloading
- High part load efficiency
- Fuel flexibility

Agility of dispatch for:

- Flexible base load
- Flexible peaking & intermediate load
- Grid stability & ancillary services
- Stand-by reserves

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1 FASTSTART

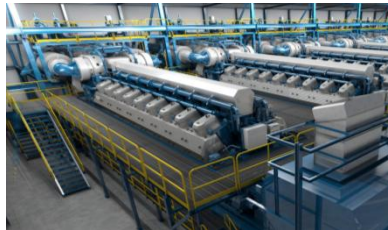
VALUE

- Grid stability & ancillary services
- Stand-by reserves

FEATURES

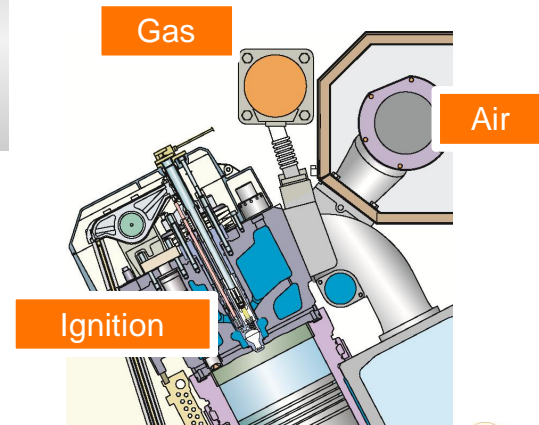
- Power to grid in 30s
- 2 min to full power
- Start up efficiency

POWER GENERATION BY COMBUSTION ENGINES

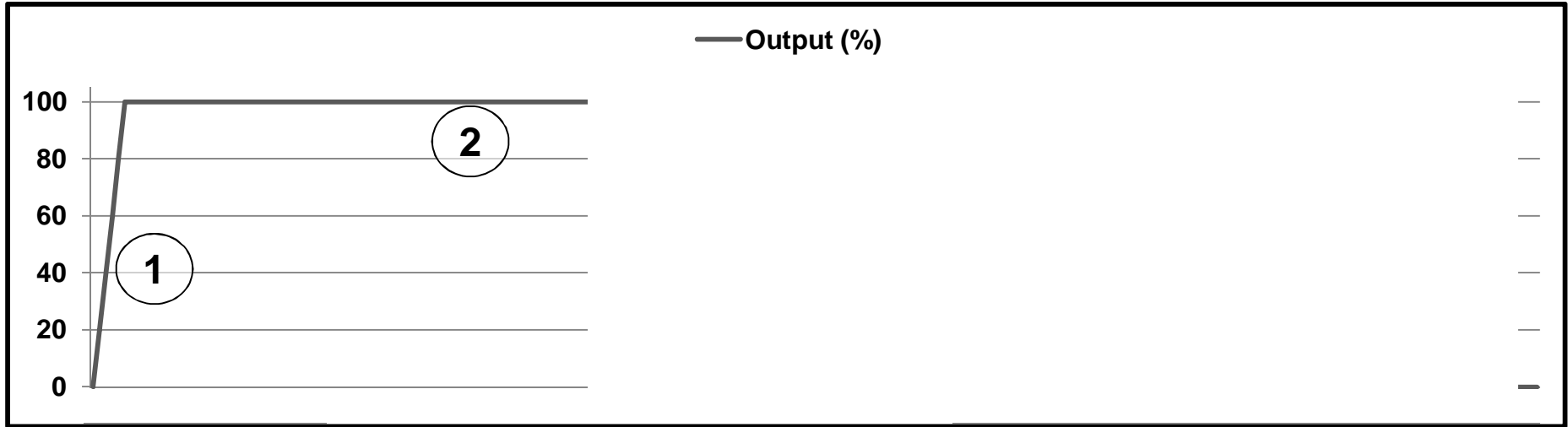


ENABLER

- Fast and accurate gas admission and air-fuel ratio control



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2 BASELOAD

VALUE

- Competitive life cycle generation cost
- Any output, same generation cost

FEATURES

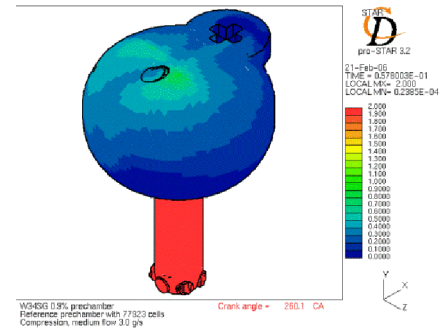
- Highest simple cycle efficiency
- Multi unit -> high firm capacity
- Flexicycle™

POWER GENERATION BY COMBUSTION ENGINES

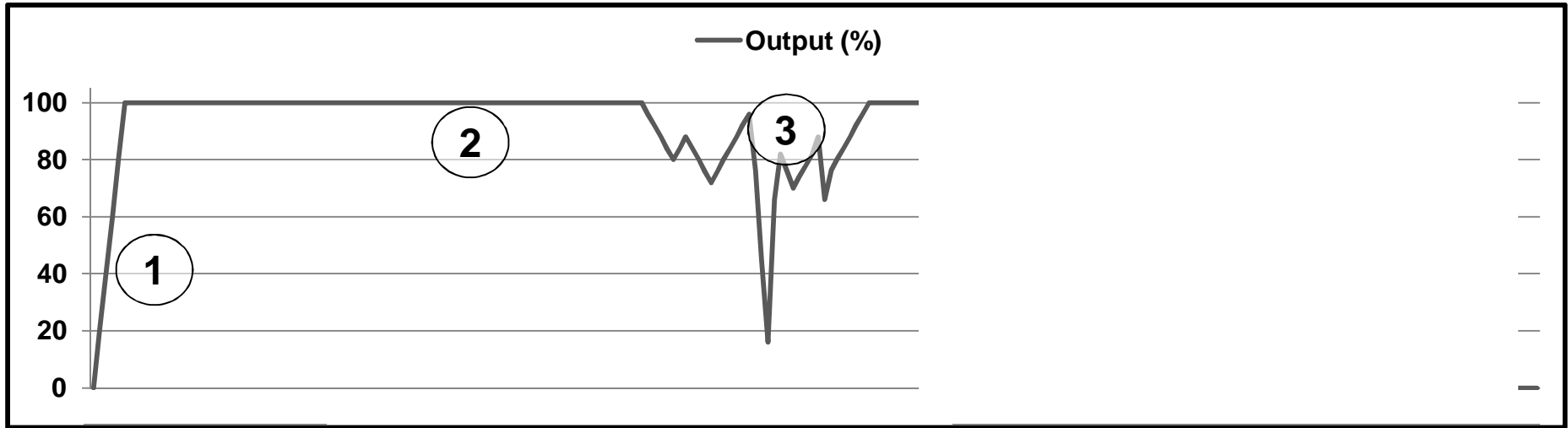


ENABLER

- Efficient combustion utilizing high performance turbochargers and Miller valve timing



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3 LOAD FOLLOWING

VALUE

- Wind balancing
- Ancillary Service market

FEATURES

- Part load efficiency unaffected
- No EOH cost for cycling

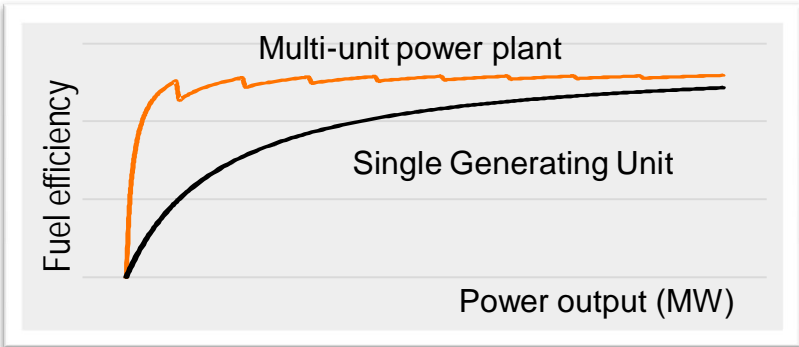
EOH: Equivalent Operating Hours

POWER GENERATION BY COMBUSTION ENGINES



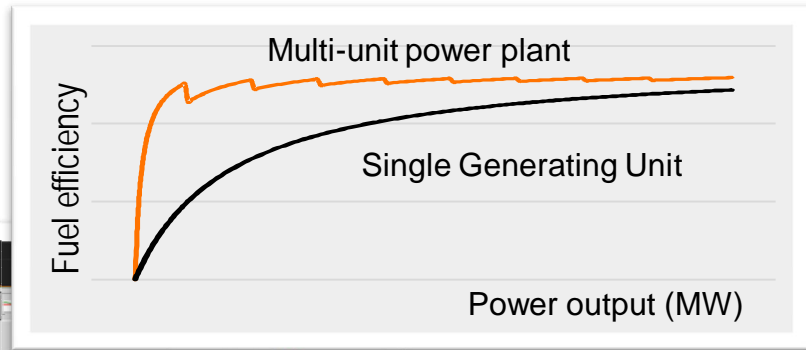
ENABLER

- Fast and accurate gas admission and air-fuel ratio control
- Multi-unit power plant



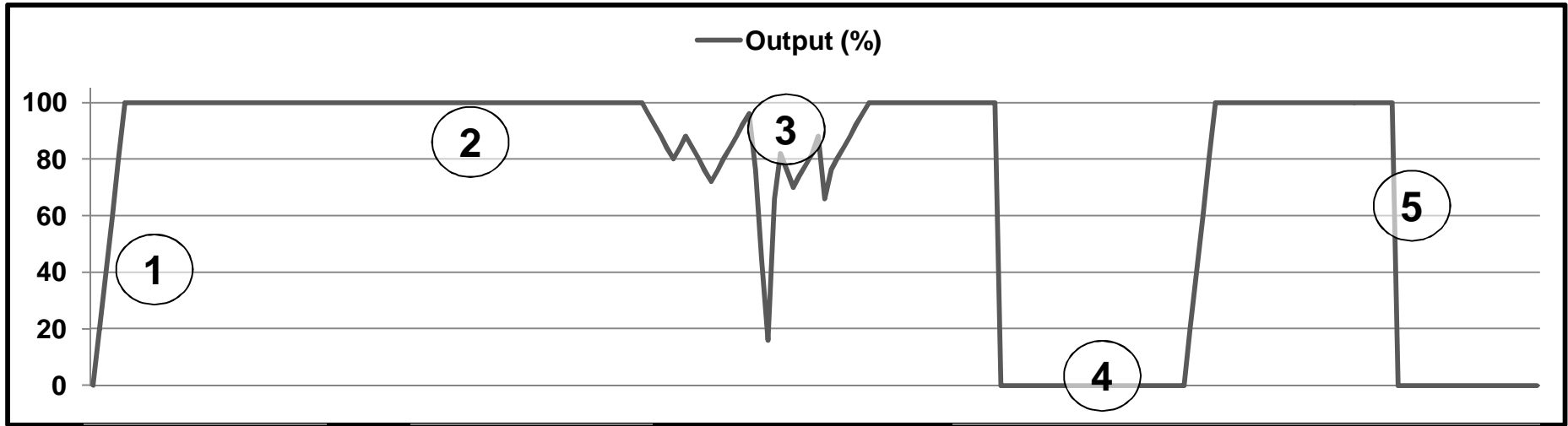
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Load following with multi unit power plant utilizing combustion engines



Gas Engine Power Plant in Turkey, 7x18V50SG, 130 MW, 2 hour trend
Plant setpoint signal from the Grid, TSO TEIAS, typically 40-110 MW
Plant total output in MW, exact setpoint following; 42 MW / Minute !

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4 LOW-LOAD OPERATION

- VALUE**
- "low load" = No load
 - Not running when no revenue

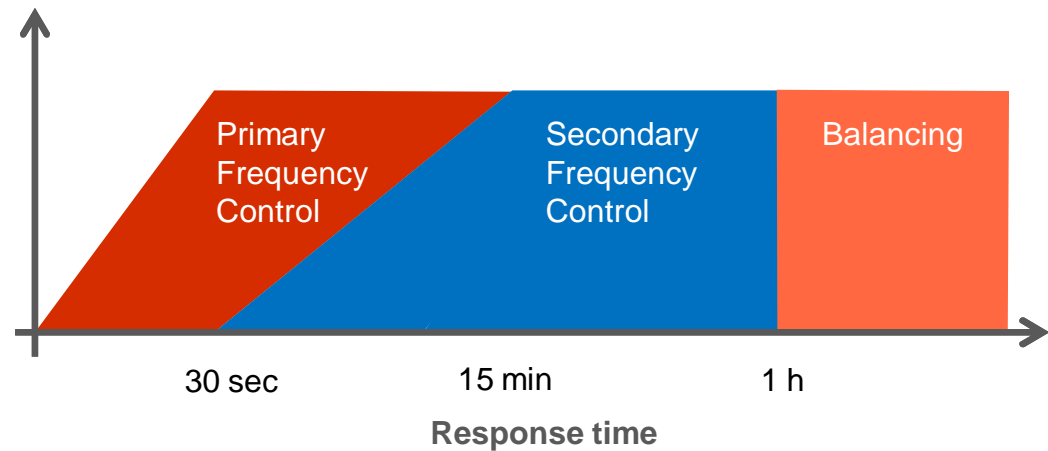
- FEATURES**
- 1min shutdown
 - No minimum down time
 - Zero fuel cost
 - Zero emissions

5 FAST STOP

- VALUE**
- Not running when no revenue
 - PV enabler

- FEATURES**
- 1min shutdown
 - No minimum up time
 - No EOH calculation
- EOH: Equivalent Operating Hours

Potential non-spinning secondary reserve



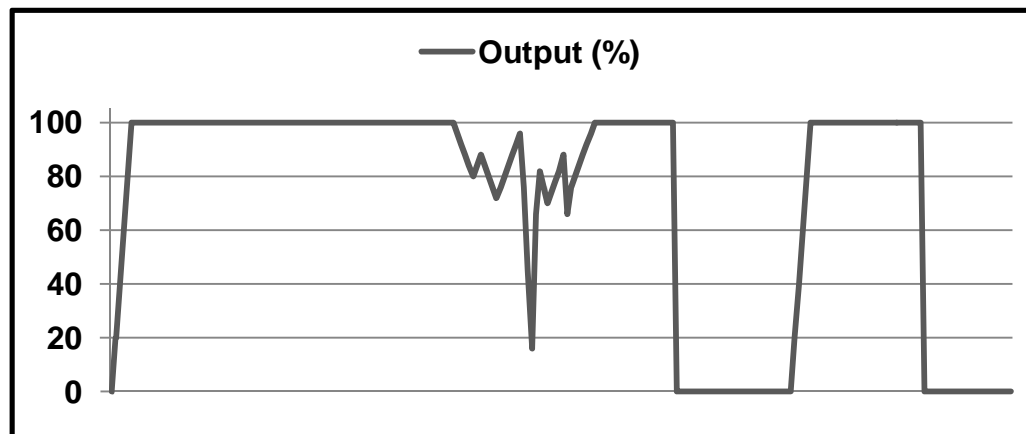
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ALL in ONE!

Agility of dispatch for:

- Flexible base load
- Flexible peaking & intermediate load
- Grid stability & ancillary services
- Stand-by reserves



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Summary and Conclusions:

- **Superior operational flexibility:** baseload, reserve or balancing operation can be selected at any time
- **Reducing environmental impact** by enabling increased growth of renewable power and by maximized efficiency of available power supplies
- **Secures reliable power supply** utilizing superior operation flexibility and by use of multiple engines

