Meeting the Challenges for Tomorrow’s Power Generation
Using Variable Intake Valve Train for Gas Engines
The role of the gas engine in power generation

Source:
Content

- Challenges for tomorrow’s gas engines
- Variable intake valve timing as a key technology
- Summary
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Challenges for tomorrow’s gas engines
Gas quality issues

Fossil Resources
- Natural Gas

Biomass
- Biogas
- H₂
- CH₄
- Methanation

Renewable Gases
- PowerToGas
- Solar
- Wind
- Biomass
- Natural Gas

Gases
- Flare Gas
- BFG
- Waste Gases

Engine

Electric Grid

Source:
Challenges for tomorrow’s gas engines

Gas quality issues

- Harmonization process for European gas grid has started
  - European Association for the Streamlining of Energy Exchange
  - European Standard 16726

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**EASEE Gas**

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Challenges for tomorrow’s gas engines
Volatile renewable energy

Source:
Challenges for tomorrow’s gas engines

Volatile renewable energy – stabilize grid

Source: Energy Matters, Did Portugal run for four days on renewables alone? (http://euanmears.com/did-portugal-run-for-four-days-on-renewables-alone)
Challenges for tomorrow’s gas engines

Transient response requirements

- **ENTSO-E** (Type C 1MW < P < 50MW)
  - 30 seconds to synchronize to the network
  - 10% loading in 4 seconds as spinning reserve
  - Stay connected to the network in a frequency band of ±10%

- **ISO 8528-5** (Class G3)
  - Tolerated frequency drop 15%
  - Tolerated voltage drop 15%
  - Recovery time 3s
Challenges for tomorrow’s gas engines

Emission limits

• Lower emission limits up ahead

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<tr>
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<th>NOx mg/m³ Norm @ 5% O2</th>
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* Proposal
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Variable intake valve timing as a key technology

ABB’s Valve Control Management – VCM®

- Electro-hydraulic valve train system
- Variation of timing and lift of the intake valves

Operating principle:

1. **Solenoid valve CLOSED**
   - Valves follow cam profile

2. **Solenoid valve OPEN**
   - Oil pressure drops
   - Springs close the valve

3. **Brake ramp**
   - Hydraulic brake reduces seating velocity

Source:
Variable intake valve timing as a key technology

ABB’s Valve Control Management – VCM®

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- Variation of timing and lift of the intake valves

**Advantages:**
- Cylinder individual control
- Cycle-to-cycle variable adjustment of IVC
- Closes much faster than a mechanical valve train
- Soft landing due to hydraulic brake

**Main components**

- Intake valves
- Oil chamber
- Rocker arm
- Brake unit
- Solenoid valve
- Pump unit
- Push rod

**Source:**
Variable intake valve timing as a key technology
Increased engine efficiency

Variable intake valve timing as a key technology
Increased flexibility to boundary conditions

Changing the engine's power control strategy

Different valve timing (compared to mechanical valvetrain) → more aggressive Miller

Cooler cylinder charge

Reduced knock tendency

Increased engine efficiency

→ +25°C MAT or
→ +20 points MN

Increased knock margin

Source:
Variable intake valve timing as a key technology
Improved transient response

ISO 8528-5 Class G2

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Volatile renewable energy – stabilize grid

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TA Luft 2017*
Summary

VVT as a key technology

Variable intake valve timing as a key technology

Increased engine efficiency

Variable intake valve timing as a key technology

Increased flexibility to boundary conditions

Changing the engine’s power control strategy

Increased engine efficiency

Variable intake valve timing as a key technology

Improved transient response

Cooler cylinder charge

Reduced pumping losses

ISO 8528-5 Class G2
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