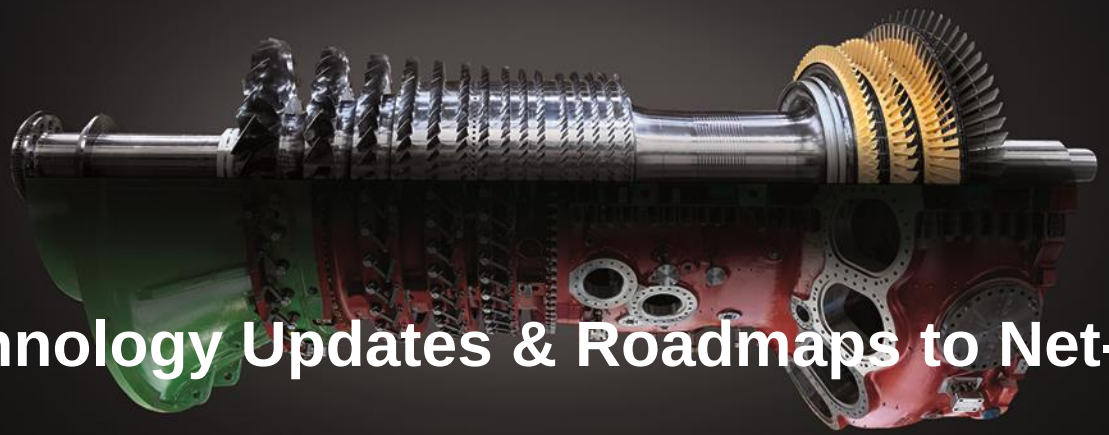
ITALIAN ENERGY

BRIGHTER FUTURE



Technology Updates & Roadmaps to Net-Zero

Federico Bonzani – Product and Technology

IGTC 2023, Brussels

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Our Mission

Ansaldo Energia has always been committed to a sustainable and innovative power generation with the aim to ensure a lower environmental impact and a high flexibility in energy production.

Power Generation Outlook & Decarbonization Challenges

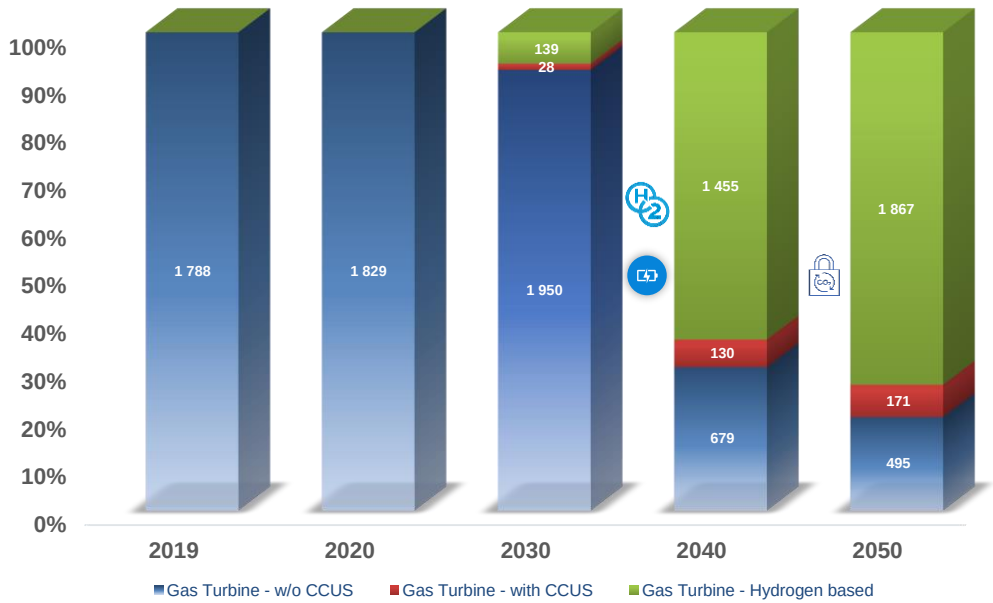
What is expected for GTs in the most aggressive decarbonization Scenario?

Until 2030

- Natural gas will remain the main fuel
- Utilization will remain stable
- Fleet size will grow slightly

- …Then H_2 or net zero fuel based GTs are expected to become predominant

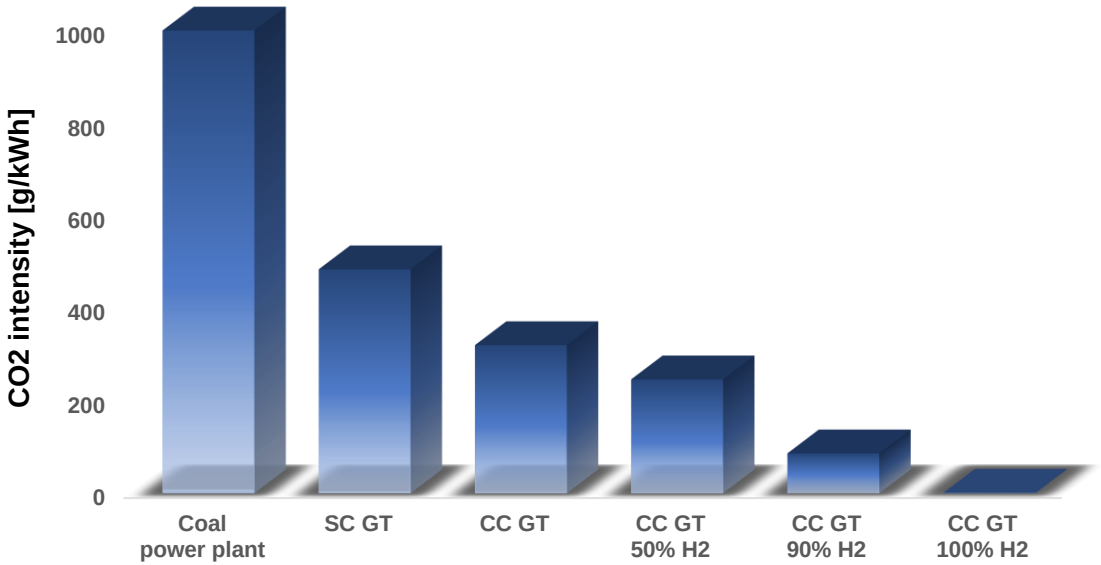
Gas Turbine Capacity in the NZE (GW)



Source: IEA Net Zero Emission Plan, May 2021

Power Generation Outlook – CO_2 Intensity

- GTs already bring a major CO_2 reduction compared to coal power plants
- Firing GTs with H_2 based fuels can further help decarbonization
- For a substantial effect large percentage of H_2 in NG are needed

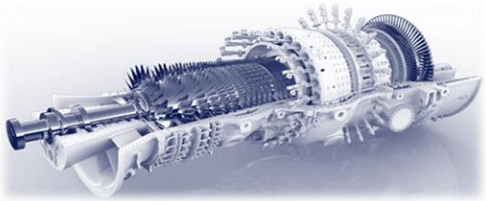


Roadmap to Net Zero

- Increase Sustainability of Existing Assets
- Provide Highly Efficient Gas Turbines Able to Burn Alternative, Net Zero, Fuels

Sustainability: Improving Existing Assets

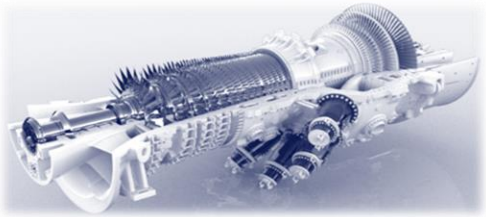
GT26 (F-Class) architecture



- Proven design principles
- Simplification of architecture
- Optimised for maintenance

- Design improvements
- Technology transfer
- Validation experience

GT36 (H-Class) architecture

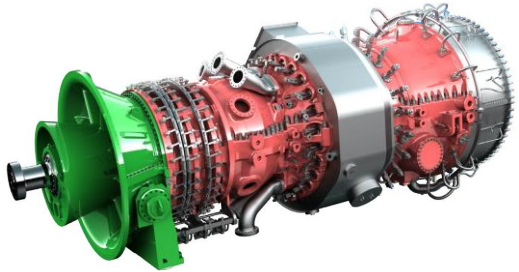


GT26 (R2006) — **GT26 MXL3**

C-inspection Interval

28 kEOH — **40 kEOH**

MXL3 Upgrade Scope Relative to MXL2



- Redesigned first two LP Turbine Stages
- Proven SEV Combustor for enhanced stability & fuel flexibility (<45%vol. H_2)
- Compressor updates for optimized CC performance

Up to **+35MW** and **+1.6% η_{cc}**

(Reference Rating: GT26 Rating 2006)

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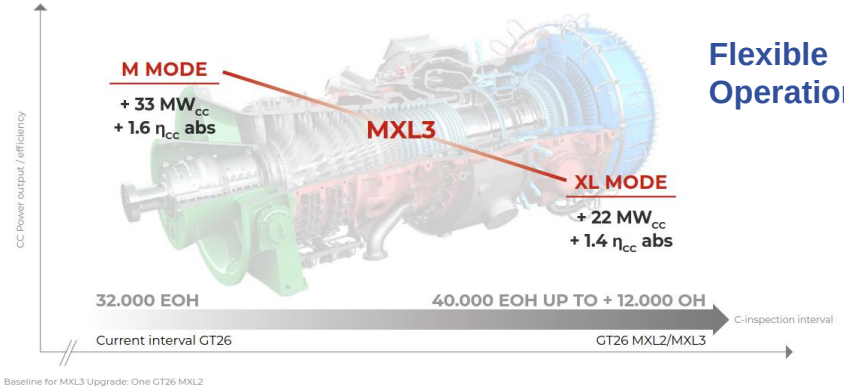
Sustainability: Improving Existing Assets

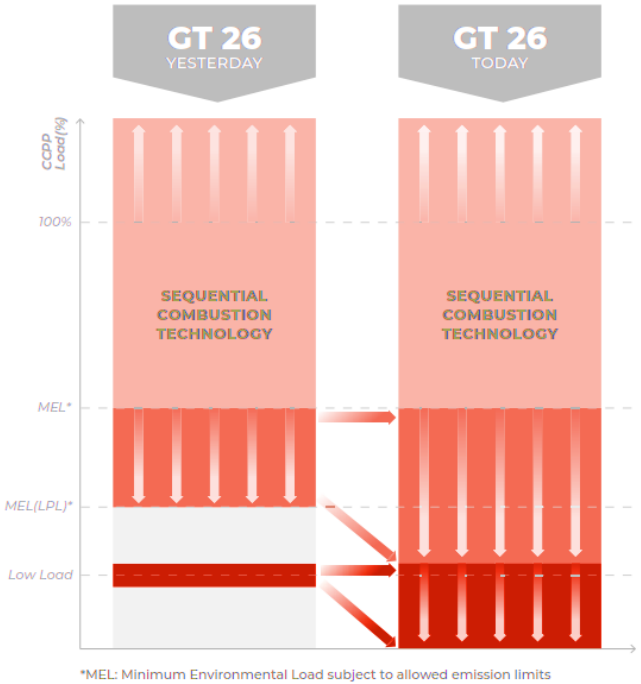


Flexible Operation Modes

REDUCING COST OF ELECTRICITY — MEL down to 15% (minimum environmental load achieved)

LOWERING ENVIRONMENTAL FOOTPRINT — Low CO emissions (thanks to sequential burner switch off)

INCREASING FLEXIBILITY & RELIABILITY — > 80% (load range achieved, maintaining emission and frequency response compliance)

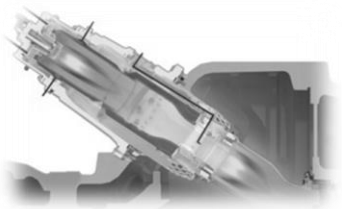


eLPL Features

- Operation window from near zero GT load to full load
- Full NO_x and CO_2 compliance
- Seamless operation range from extended part and low loads
- No preparation time for WSC
- Frequency response capability

Alternative Fuels: Hydrogen Combustion

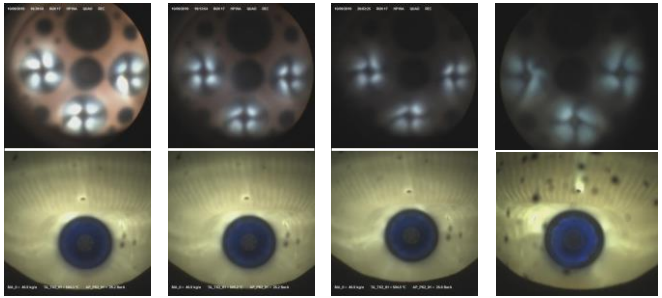
Sequential Combustor



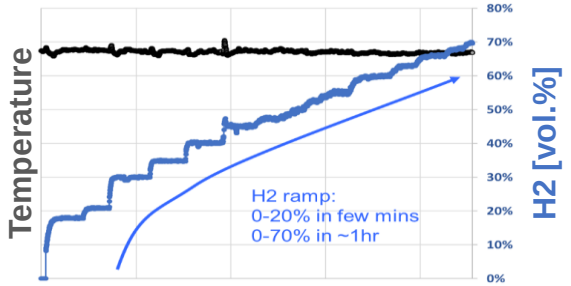
H-Class Temp F-Class Temp

First Stage

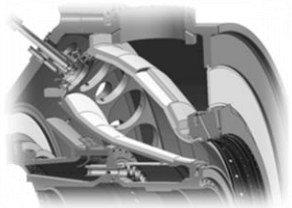
Second Stage (Sequential)

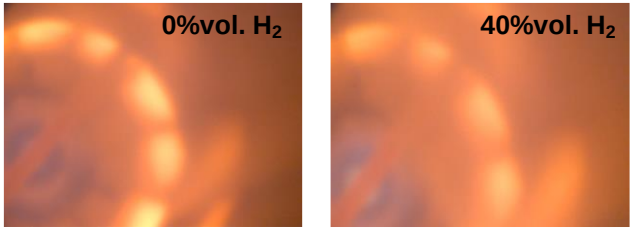


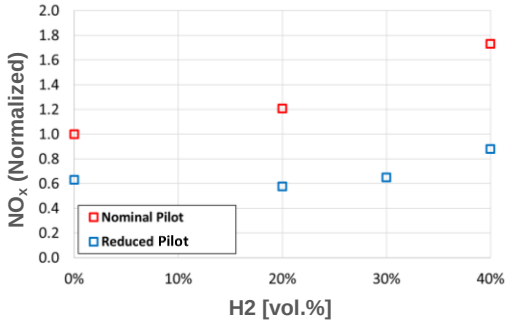
30%vol. H_2 50%vol. H_2 70%vol. H_2 90%vol. H_2



Annular Hybrid Combustor







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Flexibility for Hydrogen (FLEX4H2)

FLEX4H2
Decarbonised Power

Main impacts

New combustor technology
able to handle blends of natural gas with up to 100% of H_2

Re-utilisation of existing infrastructure
enabling investment cost reduction

Contribution to Net Zero pathway
by decarbonisation of the electric power sector

Project Budget:	Approx. EUR 8.7M
Funding EU:	EUR 4,178,517.25
Funding Switzerland:	CHF 4,012,475.00
Duration:	4 years (Jan 23 – Dec 26)
Project Coordinator:	Ansaldo Energia

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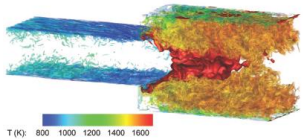
www.flex4h2.eu
FLEX4H2
@flex4h2
info@flex4h2.eu

Sequential Combustion Technology

Testing & Validation

Numerical Modelling



This project is supported by the Clean Hydrogen Partnership and its members Hydrogen Europe and Hydrogen Europe Research (GA 101101427), and the Swiss Federal Department of Economic Affairs, Education and Research, State Secretariat for Education, Research and Innovation (SERI)

Clean Hydrogen Partnership
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Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

GT36 – Marghera Levante

Edison inaugurates the most efficient thermoelectric power plant in Italy: an industrial excellence to support the country's energy transition

Edison's new 780 MW natural gas combined cycle of Marghera Levante consists of a 515 MW class 'H' turbine from Ansaldo Energia - technologically ready for the use of up to 50% hydrogen mixed with natural gas - a heat recovery steam generator (HRSG) with a catalytic system for the reduction of nitrogen oxides (SCR) inside, and a 26 MW steam turbine (TVB).

Edison inaugurates a new latest generation thermoelectric plant in Marghera Levante

"The ... industry to face the energy transition"

EDISON INAUGURATES THE MOST EFFICIENT THERMOELECTRIC POWER PLANT IN ITALY: AN INDUSTRIAL EXCELLENCE TO SUPPORT THE COUNTRY'S ENERGY TRANSITION

The new plant of Marghera Levante is the first latest-generation thermoelectric power plant in Italy and among the most efficient in the world. Thanks to the GT36 turbine, it is able to reduce specific emissions of nitrogen oxides by up to 70% and carbon emissions by up to 30% compared to the current average of the Italian thermoelectric fleet.

The new turbine is also technologically ready for the use of hydrogen mixed with natural gas.

REUTERS

Energy | Sustainable Markets | Renewable Fuels | Grid & infrastructure | Gas

Edison opens 'strategic' hydrogen-ready power plant near Venice

By Giancarlo Navach and Francesca Landini

June 16, 2023 2:18 PM GMT+2 · Updated 3 months ago

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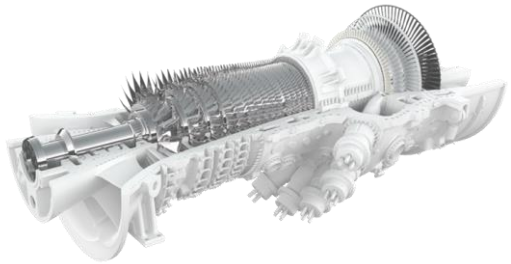
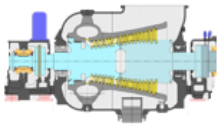
GT36 – Current Status

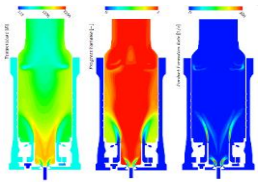


- GT36 in operation in **3 sites**, total 6 orders awarded (**2 GTs 50% vol. H2 ready**)
- Performance are **in line** with expectations with **CC efficiency 62.5% +**
- Environmental friendly: **NOx** below **15 ppm** in the full load range, **MEL** well below **30% GT load**
- Flexible with a ramp rate **up to 100 MW/min**
- Hydrogen capability tested **up to 70% H2 vol.**; commitment to **100% vol. H2 by 2030**

Our Roadmap towards Net Zero

- Increasing sustainability through **repair** and **upgrade** technologies
- **Adapting existing technologies** to support renewable technologies
- Developing **solutions** to progressively replacing natural gas and ensuring that existing and future investments in **gas power plants** are **future-proof**
- Both **Hydrogen** and **Ammonia** represent **viable** gaseous **fuel options** for GTs
- **CPSC technology** offers **unique** advantages for both H_2 and even NH_3 fuels





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Thanks for your attention

Ansaldo Energia: Technology Updates & Roadmaps to Net-Zero

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