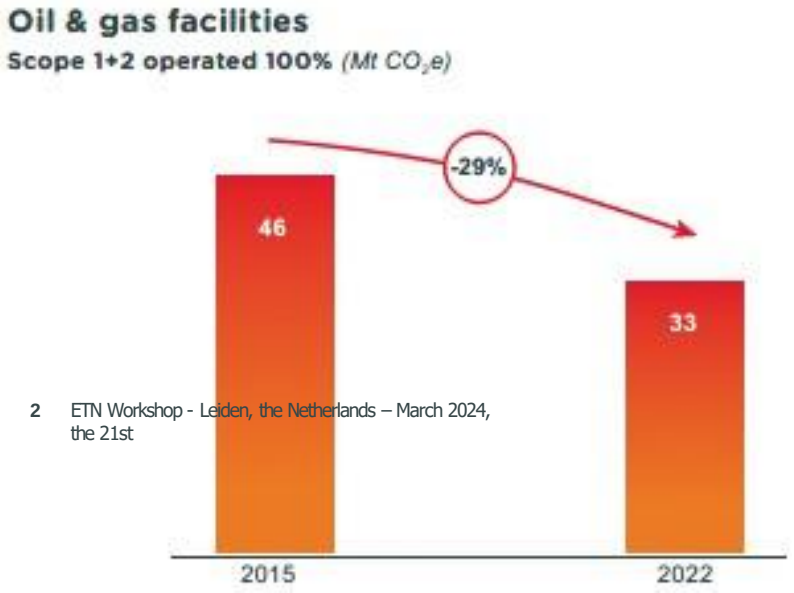
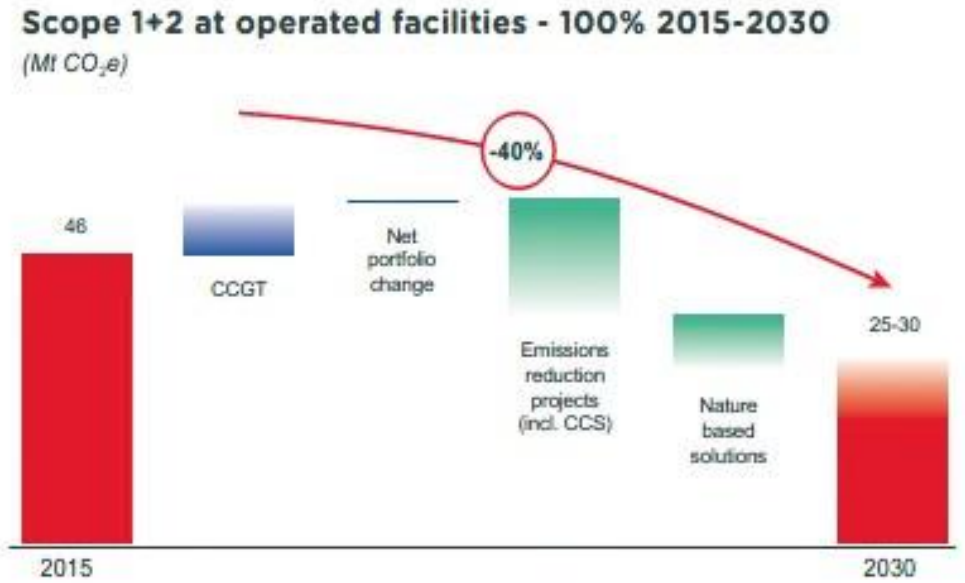
Operation Flexibility and Performance Enhancement - Oil & Gas Turbomachinery - Projects and R&D Developments Overview

Dominique ORHON - TotalEnergies

ETN Workshop - Leiden, the Netherlands – March 2024, the 21st

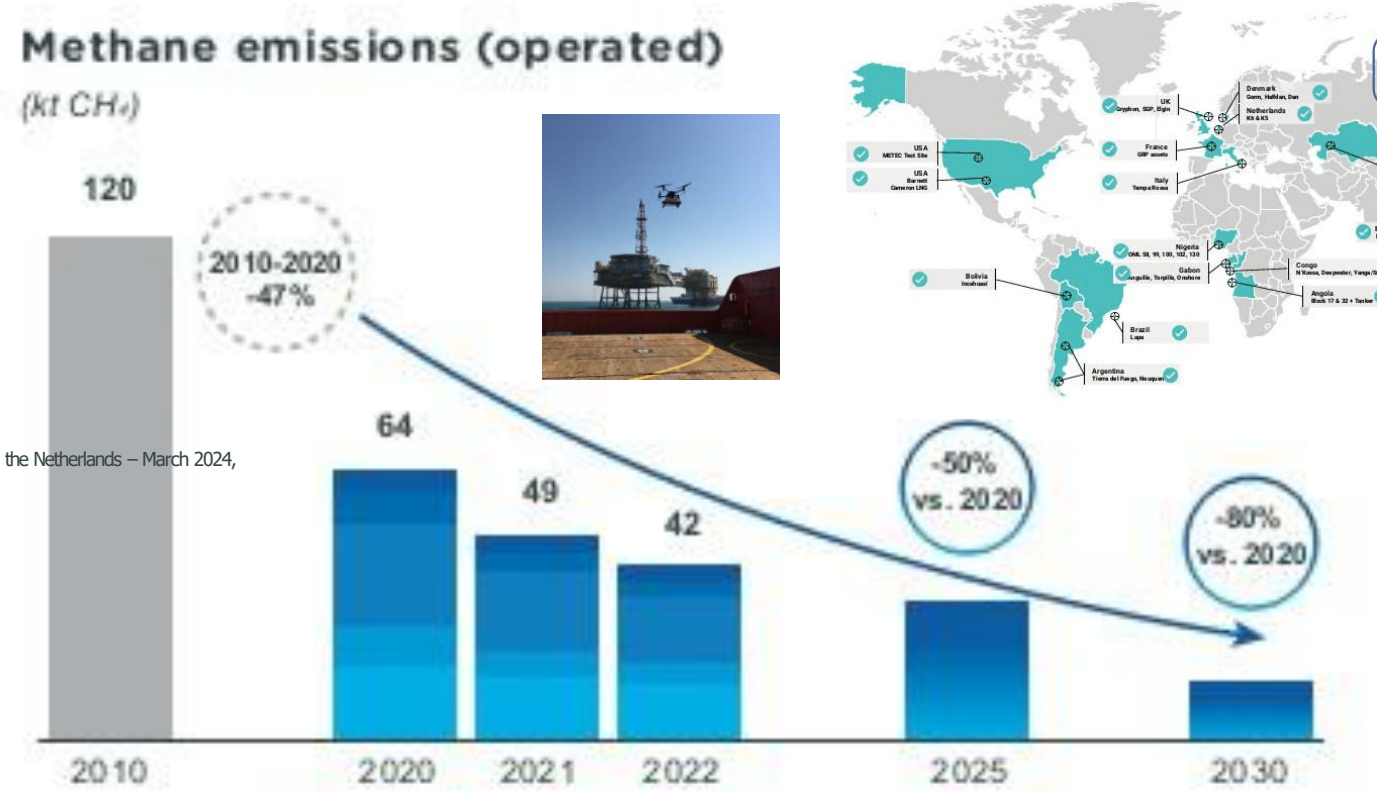
TotalEnergies Trend – CO2 Emissions

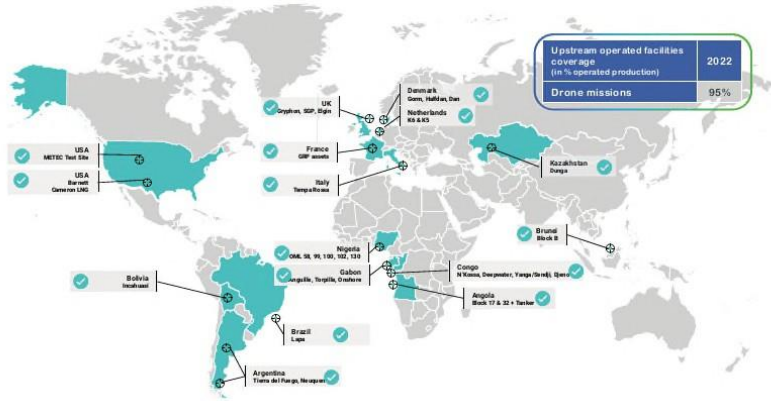




Source: TotalEnergies Universal Registration Document Including Annual Financial Report, 2022

TotalEnergies Trend – Methane Emissions





Source: TotalEnergies Universal Registration Document Including Annual Financial Report, 2022

R&D Roadmap - Four Acting Principles for Enhancement

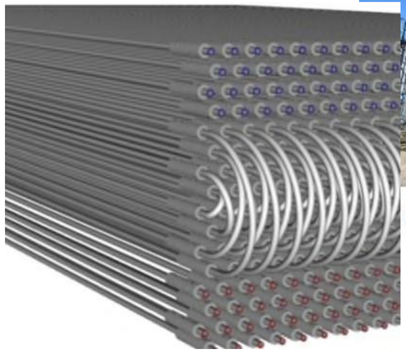
- Decarbonize Gas Turbines
- Lowering Power Demand for Operations
- Reduce Residual Emissions
- Operate Zero Carbon Power on or near Sites

Decarbonize Gas Turbine

Use of CCGT for New Projects and Systematic Evaluation of Existing Open Cycle Assets

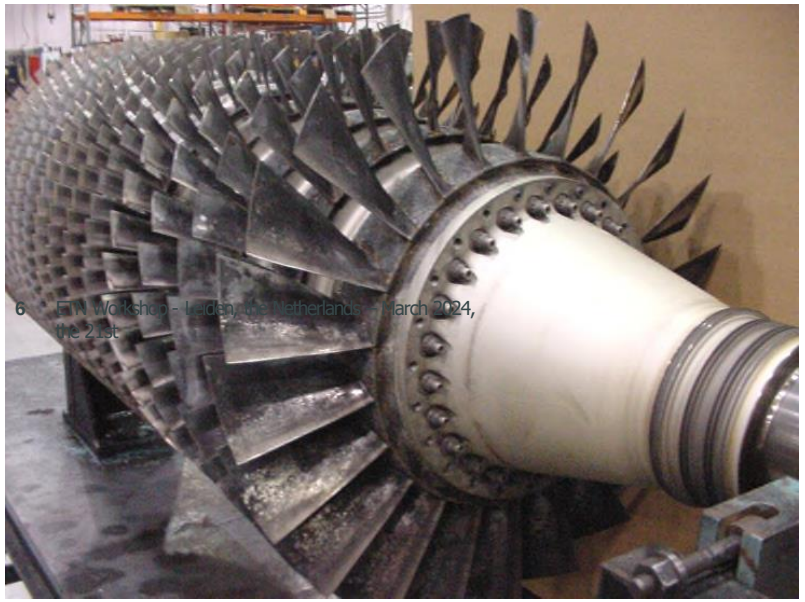
- Steam
  - Use HRSG and CHP for LNG and onshore plant => Engineering SOLUTION
  - Use and develop OTSG for offshore, lower performance BUT lighter weigth => Engineering SOLUTION
- sCO_2
  - Thorough analyses of weigth and footprint for different architectures => R&D Studies
  - Analyses of best architecture => R&D Studies
  - More specific analysis for hot ambient temperature => R&D Studies
- Focus on HRSG/OTSG
  - Reduce Weight and Footprint for Better Offshore Integration
    - Compact OTSG => R&D Studies
    - Different Tubes / Different Fins => R&D Studies
    - Pilot Test at Reduced Scale (1/5), lighter bundle => R&D Test Campaign (including Oil&Gas pairs)

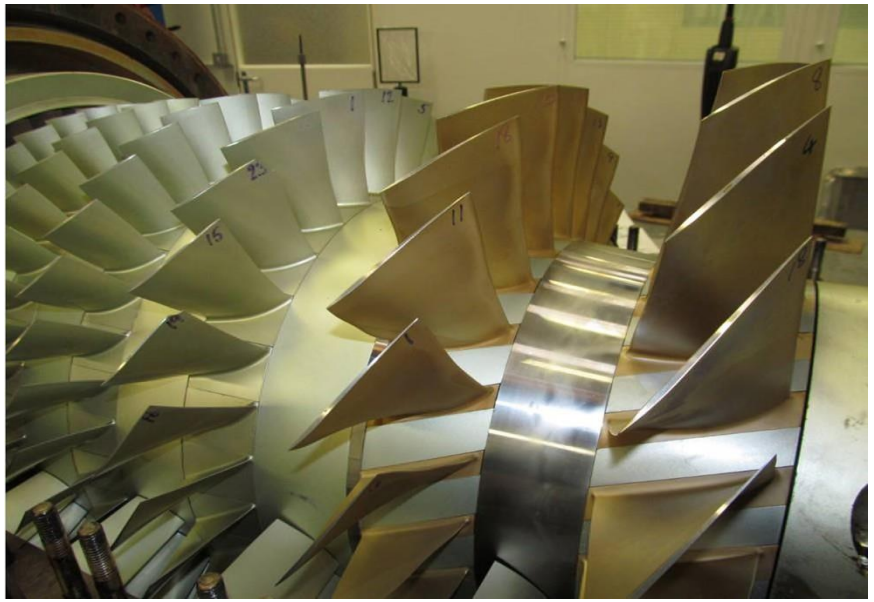
Combustion & Environment Research Centre



Decarbonize Gas Turbine

Upgrade for EPA E12 Air Filtration => Implementation On-going Worldwide





Decarbonize Gas Turbine

Consider CCS, Carbon Capture & Sequestration

- Offshore Power Barge => R&D Studies
- Offshore Power Platform => R&D Studies
- LNG Power Generation => R&D Studies
- TotalEnergies CHP Upgrade Projects => On-going Studies

Consider EGR, as CCS Enabler

- EGR => R&D Studies
- Selective EGR => R&D Studies
- EGR with H2 Pilot Flame => EU R&D Project TRANSITION

Consider Lighter Capture Technologies for CCS

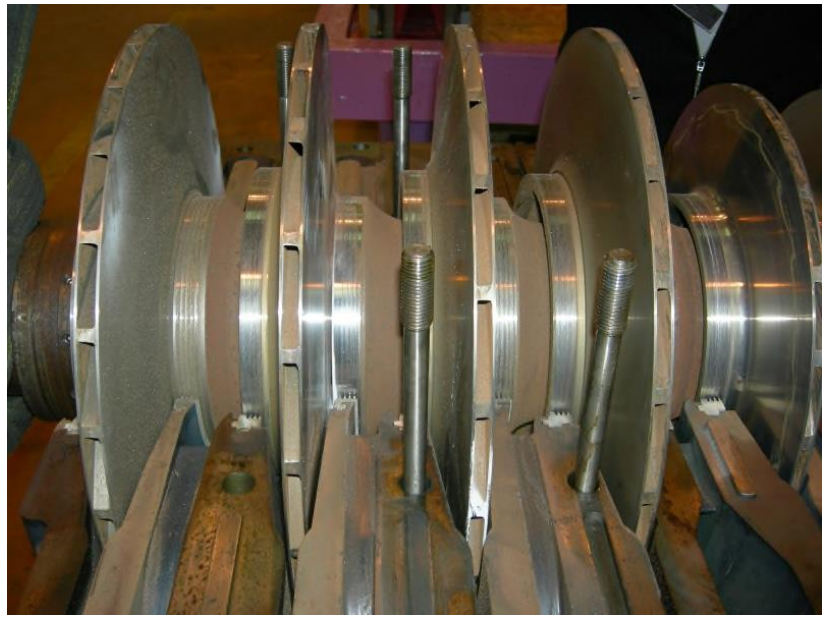
Decarbonize Gas Turbine

Introduce Decarbonized Fuel

- **H2/CH4 Fuel Flexible**
  - 100% H2 in 2028 with Premix Burners => EU R&D Project HyPowerGT
  - TotalEnergies CHP Upgrade Projects => On-going Studies
- **H2/NH3/CH4 Fuel Flexible**
  - Partial cracking => R&D Studies
  - Combustion => R&D Studies
    - PhD, with CERFACS
    - Project under Definition
  - Offshore Power Barge => R&D Studies

Reduce Power Demand

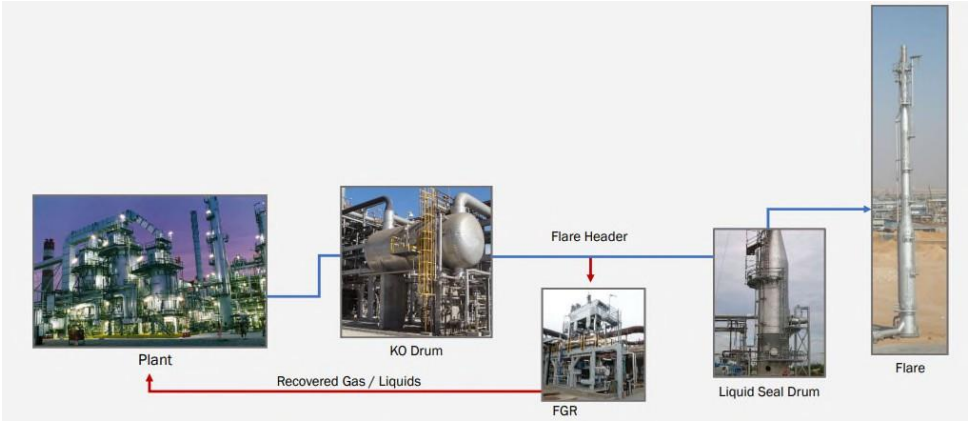
Centrifugal Compressor Re-bundling => Implementations On-

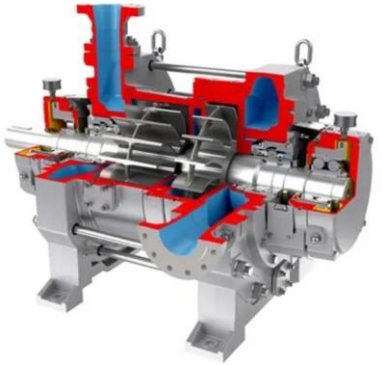


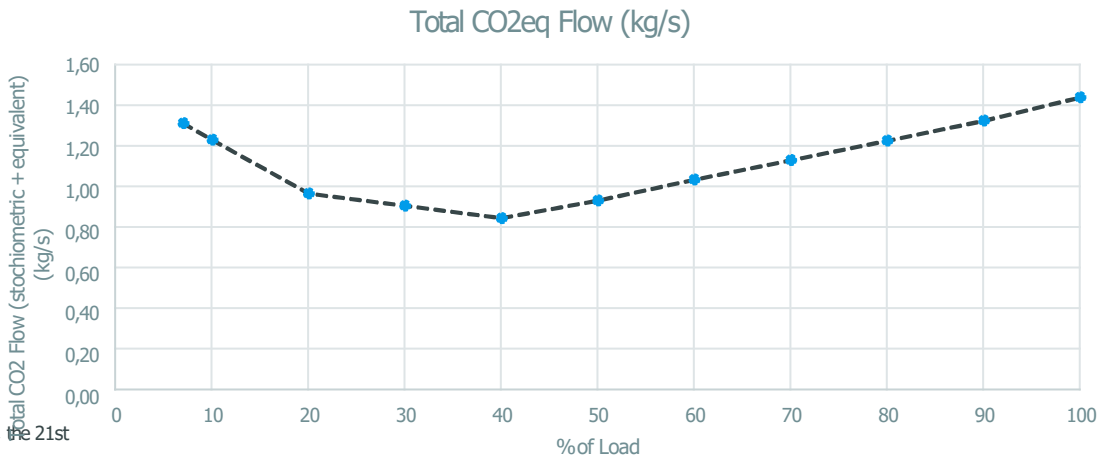
Reduce Residual Emission

FGRS, Flare Gas Recovery System installation ⇒ Implementation On-going

Avoid PREMIX combustion engine running lower than 40% load ⇒ Operation Philosophy







Operate Zero Carbon Power on or near Sites

- Cable from shore with low carbon electricity => On-going Projects
- Offshore Wind farm connection to assets => On-going Project
- Hybridization with on-shore wind farm => On-going Projects
- Hybridization with Solar panels => On-going Projects

TotalEnergies Objectives

Climate targets of the Company

2030 worldwide targets (Scope 1+2)

- Reduce GHG emissions (**Scope 1+2**) from operated facilities from 46 Mt CO_2e in 2015 to less than 38 Mt CO_2e by 2025. By 2030, the target is a reduction of at least 40% of net emissions[1] compared to 2015 for its operated activities, i.e., 25 to 30 Mt CO_2e
- Improve the **energy efficiency** of operated facilities by 1% per year since 2010
- Reduce **methane emissions**[2] from operated facilities by 50% between 2020 and 2025, and by 80% between 2020 and 2030
- Maintain the **methane emissions intensity** below 0.1% of commercial gas produced at operated gas facilities
- Reduce **routine flaring**[3] at a level below 0.1 Mm^3/d by 2025, with the goal of eliminating it by 2030

2030 worldwide targets (Scope 3)

- Maintain **Scope 3**[4] GHG emissions related to its customers' use of energy products to less than 400 Mt CO_2e by 2025 and 2030
- Reduce **Scope 3** GHG emissions related to its customers' use of petroleum products sold worldwide by more than 30% compared by 2025 compared to 2015; by 2030, the objective is a reduction of at least 40%

Source: TotalEnergies Universal Registration Document Including Annual Financial Report, 2022

Becoming Neutral 2050

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Annexes

Drone coverage for Methane Emissions Evaluation

Merci.