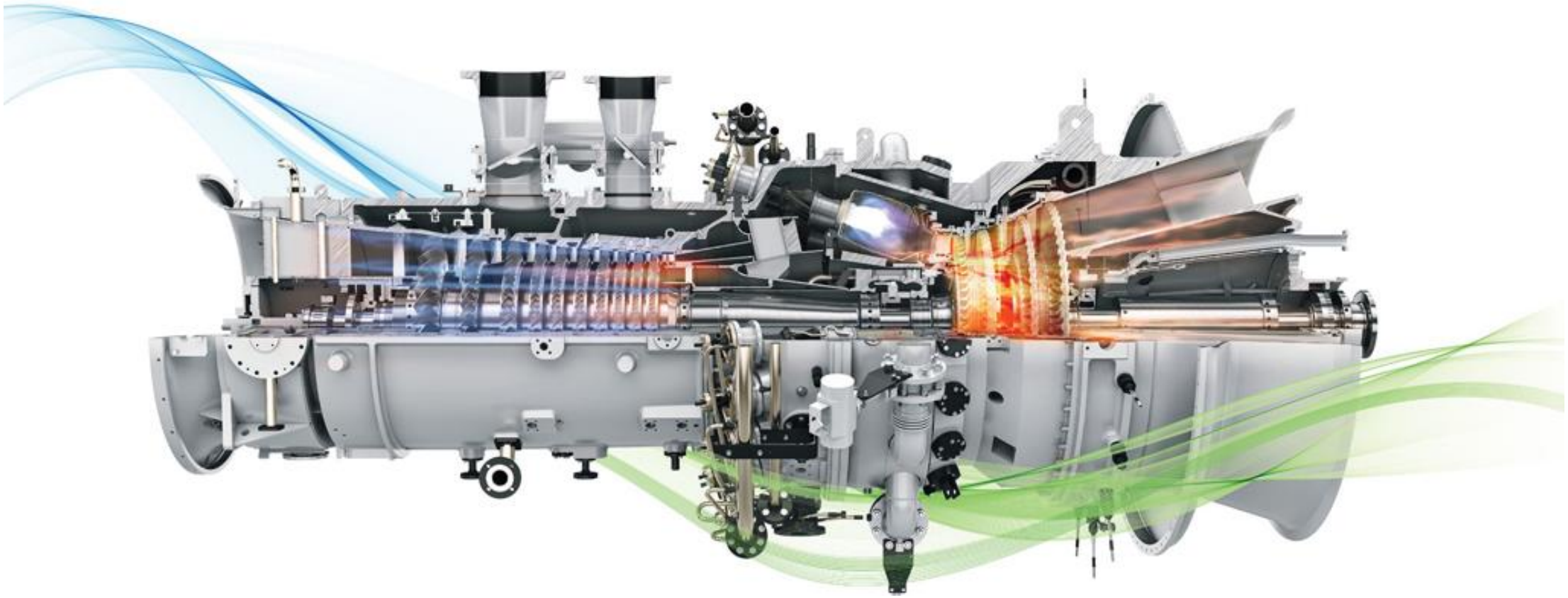


Young Engineers Committee (YEC)

Introduction

Vision, Mission and Objectives

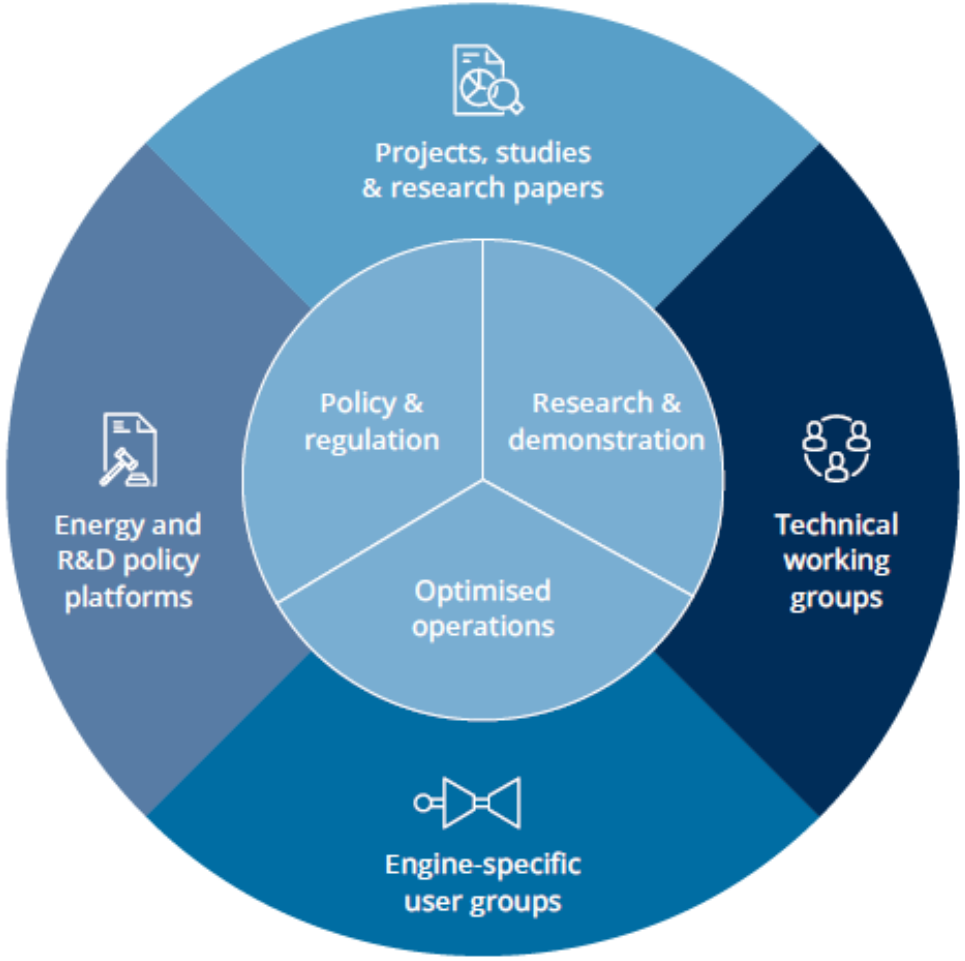
- **Vision:** Facilitate a successful energy transition
- **Mission:** A network of committed young engineers promoting fresh perspectives for a sustainable world and society
- **Objectives:**

  - Provide an opportunity for young engineers to meet colleagues from other companies to exchange market views, innovative ideas, and business cultures
  - Provide a platform to brainstorm new ideas and bring them into projects and proposals

Members

ETN Global

Energy & Turbomachinery Network



Global cooperation for dispatchable, safe, affordable and sustainable energy solutions

Non-profit association with 135 organisation members:

- ✓ Utilities, gas companies, industrial users, gas distribution companies
- ✓ Gas turbine OEMs
- ✓ suppliers and service providers
- ✓ consultancies
- ✓ research institutes and universities

22 countries: Europe, North America & Asia

ETN's Technology Development Platform 2023

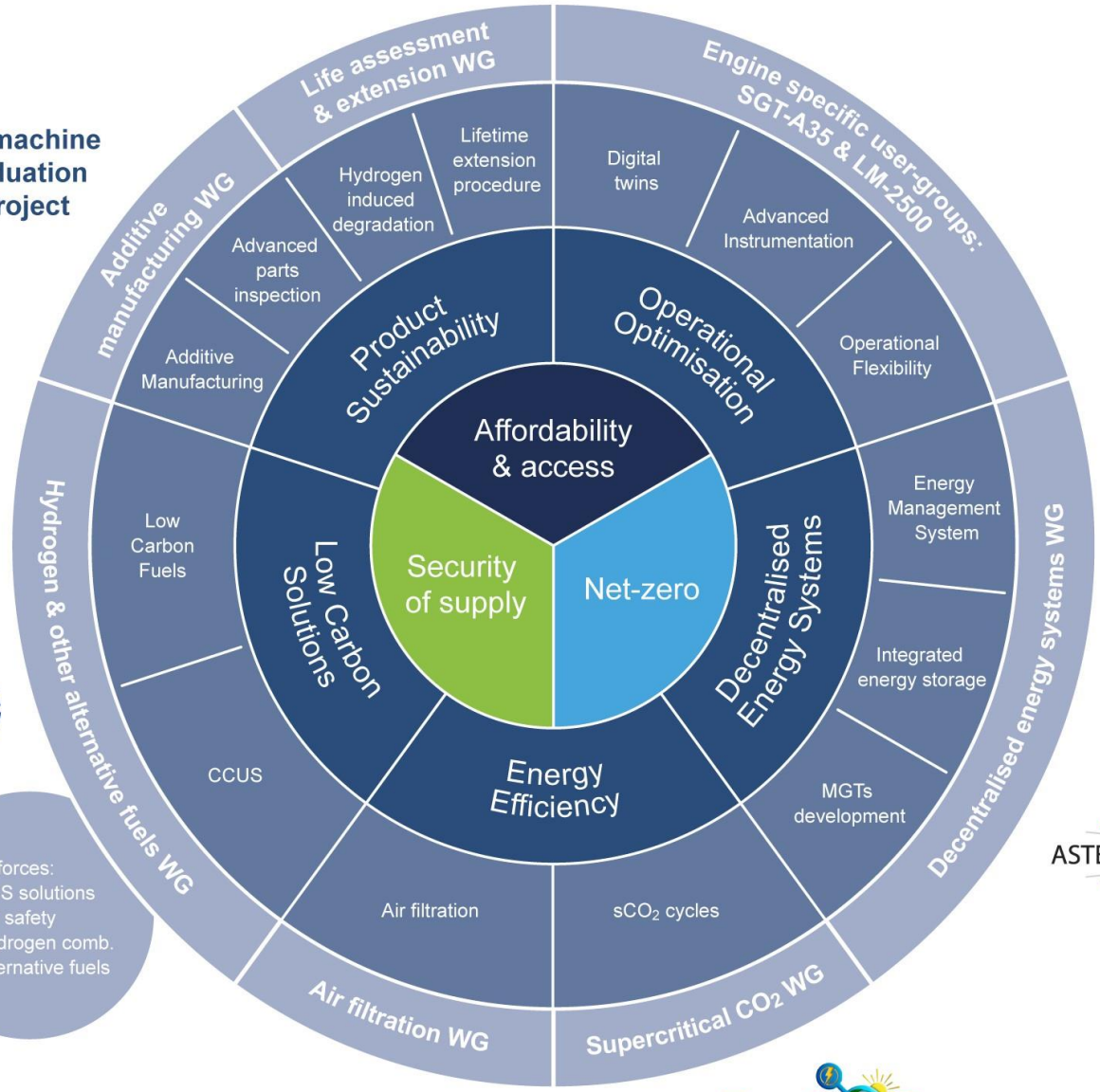
Explore technical solutions in WG's

Pathways explorations

Projects

Accelerate Technology Development

AM machine evaluation project



Taskforces:
- CCS solutions
- GT safety
- Hydrogen comb.
- Alternative fuels

Key objectives

Key topics

Tech. solutions

Working Group's

ETN Projects

“Career Paths in the Turbomachinery Field”

Speakers

Franco Rosatelli
Former CTO
Ansaldo Energia

Karen Thole
Distinguished Professor
Penn State University

Sigrid Gijbels
Thermal Fleet Manager
ENGIE

David Webb
Senior Rotating Equipment Engineer
DNV

Moderator

Antonio Escamilla
Post-doc Researcher
University of Seville
ETN YEC

Christer Björkqvist
Manager Director
ETN

GAS TURBINE APPLICATIONS IN A CARBON-NEUTRAL SOCIETY

ETN GLOBAL'S VISION
Safe, secure, affordable and dispatchable carbon-neutral energy solutions by 2030, implemented globally by 2050

2020

2030

2050 AND BEYOND

GAS TERMINAL

Gas turbines for compression, transport and storage

HARBOUR

Gas turbine providing Combined Heat & Power for industrial hubs

SEA TRANSPORT

Gas turbines for ship propulsion

MOBILITY

Gas turbines for aviation, hybrid electric heavy-duty vehicles and for e-charging stations

H_2 pipeline

HYDROGEN STORAGE

H_2 pipeline

H_2 PIPELINE

Compressor station

POWER PLANT

- Gas turbines as electric power generation units
- Power-to-X solutions

ENERGY INTENSIVE INDUSTRIES

- Gas turbines as mechanical drives
- Power-to-X solutions
- Co/tri-generation

BUILDINGS & RESIDENTIAL

- Gas turbines for distributed generation and microgrids
- Combined Heat & Power and district heating

GAS TURBINE ENERGY SYSTEM SOLUTIONS OF THE FUTURE:

COMPACT POWER DENSITY | DISPATCHABLE | FLEXIBLE | RENEWABLE FUELS | ENERGY STORAGE | COST COMPETITIVE | NET-ZERO SOLUTIONS

Career Paths in the Turbomachinery Field

An industrial perspective

Franco Rosatelli

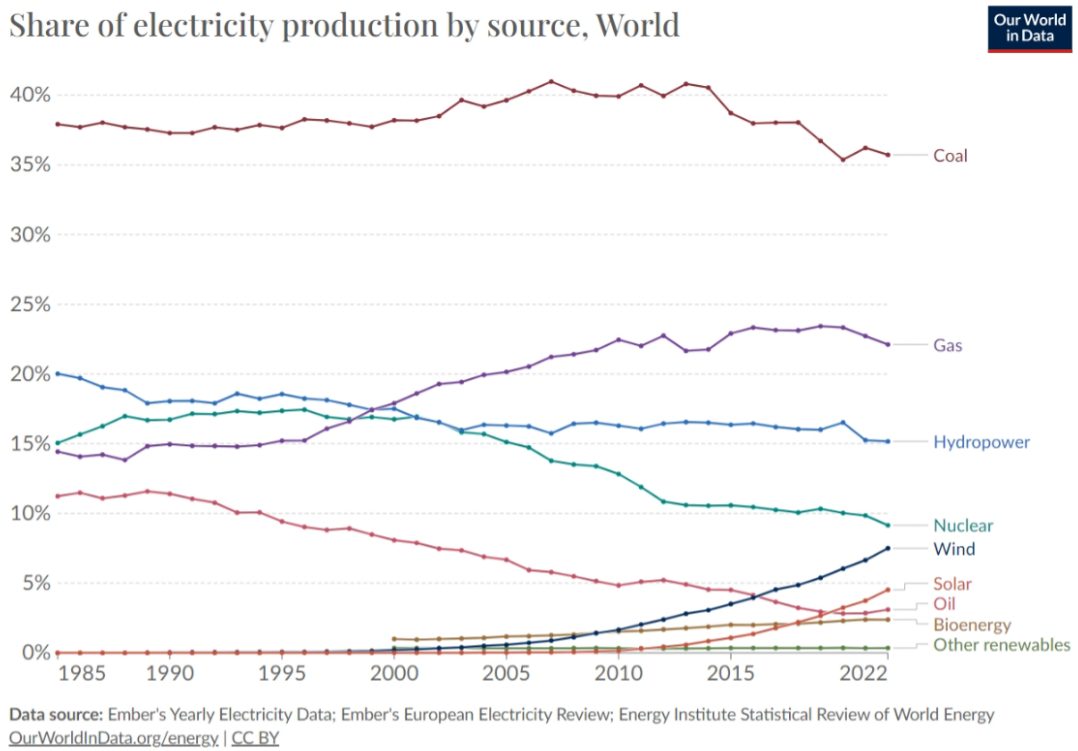
ETN Emeritus Member

Some steps in my personal career path

- *35 years of career (1980 – 2015) with Ansaldo group, developing a broad experience in power generation technologies for nuclear, fossil and renewable power plants*
- *Chief Technical Officer of Ansaldo Energia from 2009 to 2015, in charge of R&D Engineering for all products (approx. 200 engineers and technicians)*
- *Vice-President/Chairman of the Technology Committee of European Association of Gas and Steam Turbine Manufacturers (EUTurbines) from 2008 to 2015*
- *From 2015 to 2019, Vice-president for Technology Development in Russian turbomachinery manufacturer REP Holding (Gazprom group), in charge of localization for production in Russia of two gas turbines licenced from GE-NP (now Baker Hughes)*

Careers in turbomachinery: growing opportunities in Energy Transition era

- *Fundamental role of natural gas for coal substitution in Power Generation*



- *Growing market for turbomachinery in mechanical drive application 480 MTPA Global LNG capacity + 120 MTPA expected in 2023 -2027*
- *Nuclear Power Plants*
- *Small turbines, microturbines for industrial use, distributed generation*

A key role for innovation - 1

- *Technological and process innovation is the true game changer*
- *Some of you are probably aware of the R&D effort deployed during 70's and 80's in alternative technologies (e.g. direct conversion, MHD, high power fuel cells,…) to overcome 60% efficiency in energy conversion*
- *Today's state-of-the-art Combined Cycle Power Plants, based on turbomachinery, can offer guaranteed performance of 63%*
- *Some trends in gas turbine innovation: advanced materials & cooling techniques, hydrogen combustion, digitalization and sensors, additive manufacturing, AI-based engineering/maintenance,…*
- *Availability for discontinuities and changes can be an important acceleration factor in your career path*

A key role for innovation - 2

- *Large organizations (end users, O&G companies, OEM's) are still key players in innovation process with in-house R&D,…*
- *but a growing role is played by supply chain companies and tech-based startups*
- *Also big players are aware about that and developed relevant programs in recent years to stimulate innovation based on small businesses:*

- Baker Hughes Energy Ideas Generation Program

- ENGIE New Ventures

- Siemens Energy Ventures

- ENEL Startup Ecosystem – Open Innovability

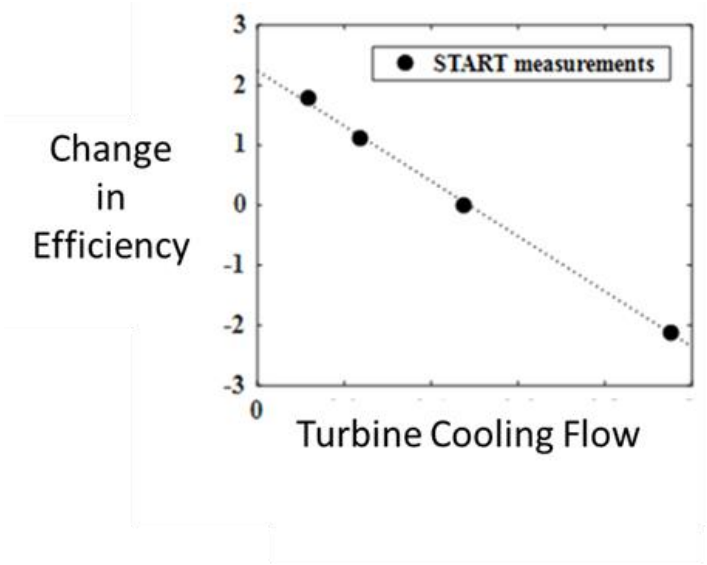
- Equinor Ventures

- SHELL STARTUP ENGINE

- ….

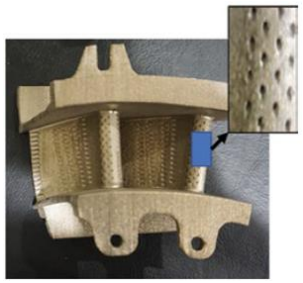
Thank you for your attention

Propulsion and Power Generation Advances in Turbines

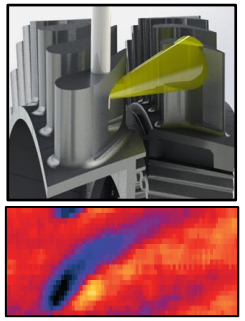


Turbine airfoil cooling

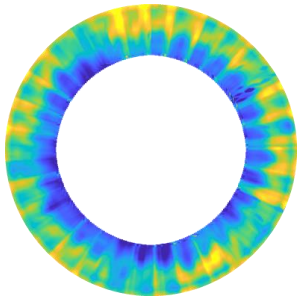
Blade Cooling



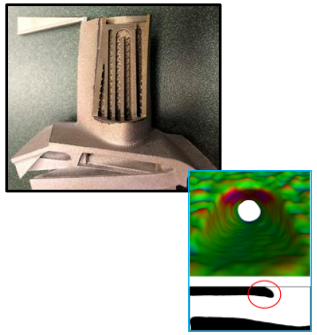
Blade Heat Transfer



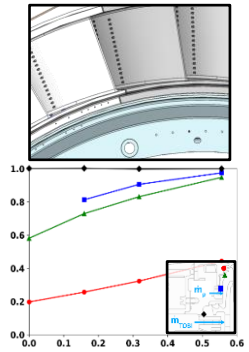
Stage Efficiency



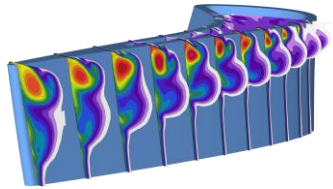
Advanced Manufacturing



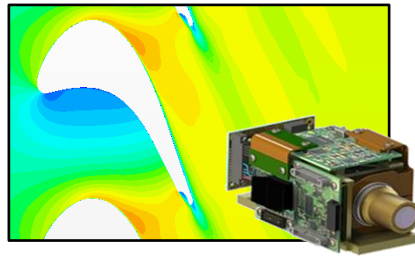
Rim Sealing



Tip Gap Designs



CFD / Measurement Methods



Karen A. Thole, Dept of Mechanical Engineering, Penn State
Kthole@psu.edu

15

My personal journey

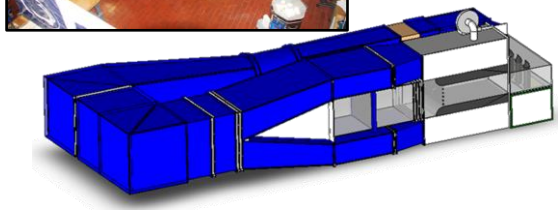
ILLINOIS

THE UNIVERSITY OF TEXAS AT AUSTIN

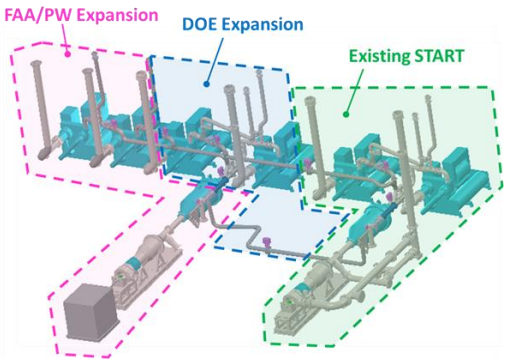
KIT Karlsruhe Institute of Technology

UNIVERSITY OF WISCONSIN MADISON

Virginia Tech



PENNSTATE



$26M START Lab expansion

Karen A. Thole, Dept of Mechanical Engineering, Penn State
Kthole@psu.edu

Propulsion and Power Generation offer amazing opportunities

START students are at Boeing, Blue Origin, GE, RR, PW, Honeywell, Siemens, Solar Turbines…

and Purdue, Penn State, Dept of Energy, NIST….

and also Amazon, formula race team….

START students have positions 1^{+} yr before degree completion; multiple offers;

What makes them standout is closely working with industry, great communication skills, participating in the technical community, and more….

Karen A. Thole, Dept of Mechanical Engineering, Penn State
Kthole@psu.edu

Career Paths in the Turbomachinery Field

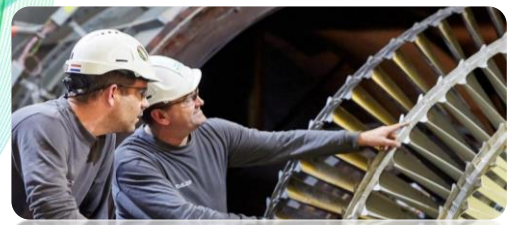
Sigrid Gijbels, Engie

ENGIE, a worldwide organization

ENGIE, we make the transition happen

1.49 min

Many professions in the energy sector



ENERGY GENERATION

- Renewables
- Nuclear
- Flexible GEN

EMS
European Maintenance Support

- Operating and maintaining assets

R&I & ENGINEERING

ENGIE Laborelec

TRACTEBEL ENGIE

GLOBAL ENERGY MANAGEMENT

- providing energy supply solutions and risk management services,
- to support its clients through their decarbonization journey

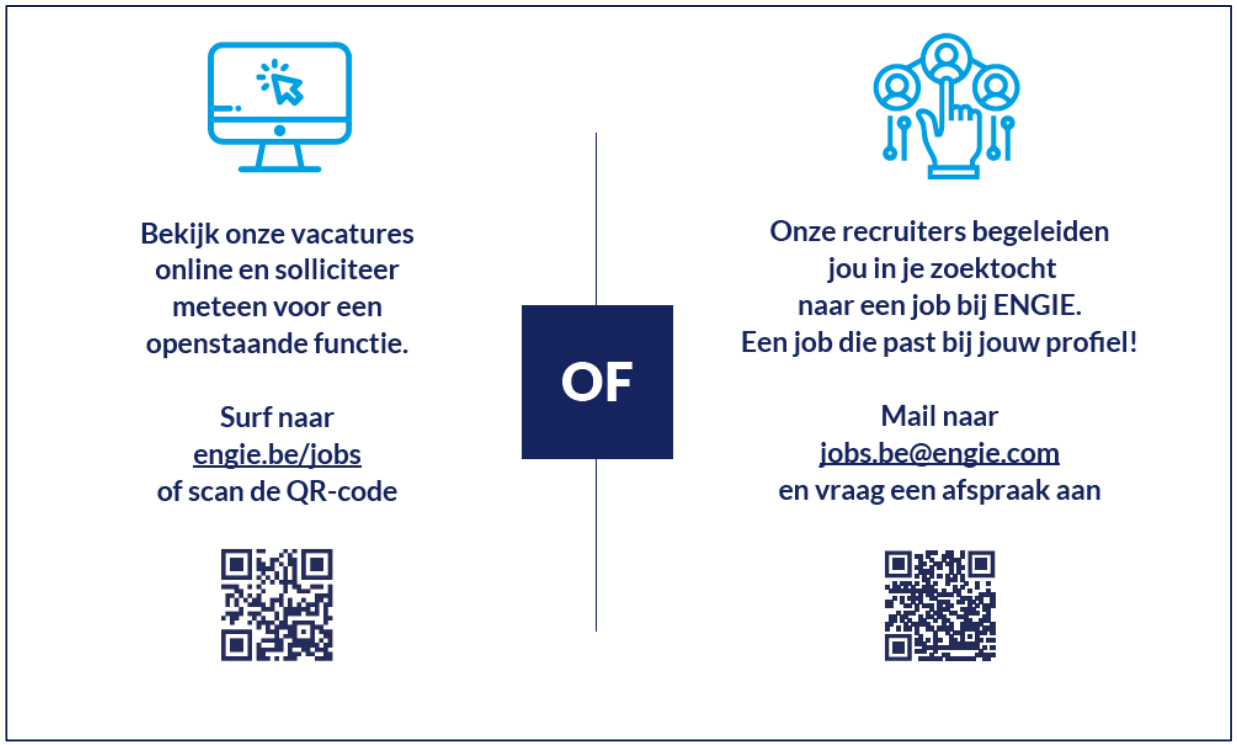
SALES & SUPPLY

- Gas
- Electricity
- Energy services

Ways of joining

- Internships
- Traineeship programs
- Jobs (starter or experienced)

Candidate Care experience



- **ENGIE consider it essential that candidates derive an enriching experience from all interaction.**
- **During the recruiting process, the candidate must be able improve his/her self-knowledge.**

ENGIE Traineeship Program

4.42 min

Thank you for your attention

David Webb

Senior Engineer

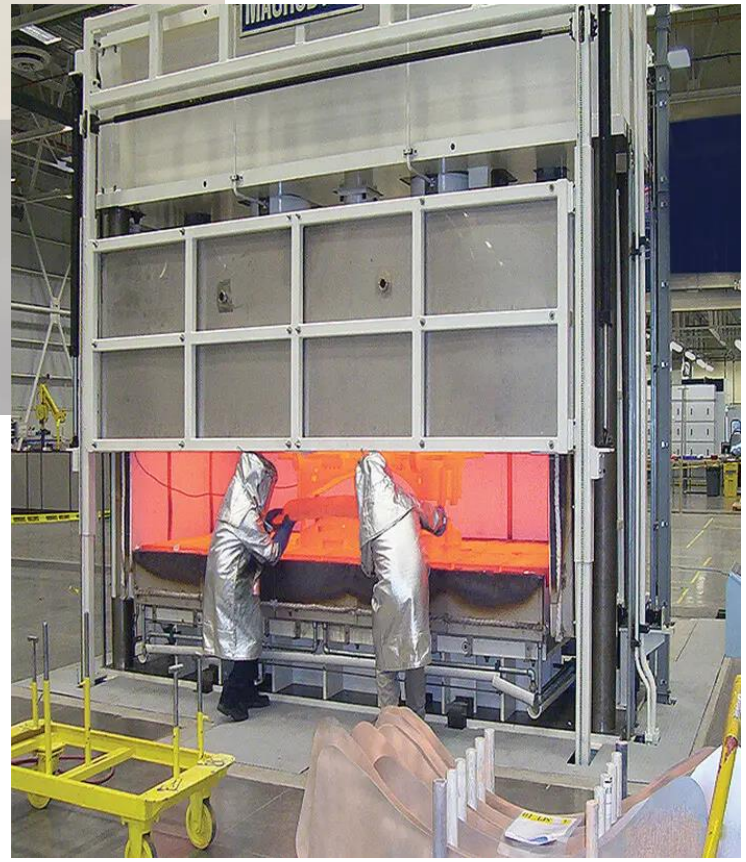
DNV - Rotating Machinery Solutions

Manchester, UK

ROLLS ROYCE

Rolls-Royce

ETN



Typical work

90% office work 10% site work

- Handling the monitoring of emissions, vibration and healthcare for a fleet of 70+ Gas Turbines pushing gas into, around and out of UK
- Emissions testing of Gas Turbines on site
- GT consultancy projects in Hong Kong/Malaysia
- Offshore work

Future opportunities

- Decarbonsiation of the UK energy network (Hydrogen)
  - Hydrogen safety work (explosions) ongoing at out Spadeadam research site