Low carbon GT operation

“Expanding the solutions portfolio of new energy systems”

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Low Carbon Technologies: a review

Focus area #1

Pressure Gain Combustion: A new engine concept to enhance the fuel economy of gas turbines

Focus area #2

Innovative Combined Cycles for reduced Cost of Ownership: new solutions to reduce the TCoO of Combined cycle Gas Turbines in a low Capacity Factor scenario

Focus area #3

Meeting more stringent environmental regulations: Making Carbon Capture, Utilisation and Storage (CCUS) possible to meet increasingly stringent environmental regulations

Stakeholders Engagement

OEMs

EPCs

Users

FOCUS AREA #1
Pressure Gain Combustion

What is it?

Conventional gas turbines operate on Brayton cycles with heat addition at constant pressure

- *Total pressure decreases during combustion*

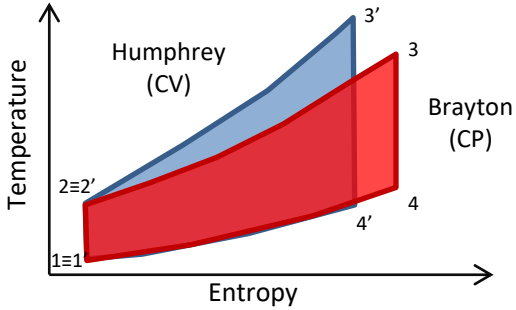
PGC refers to different combustion technologies approaching heat addition at constant volume

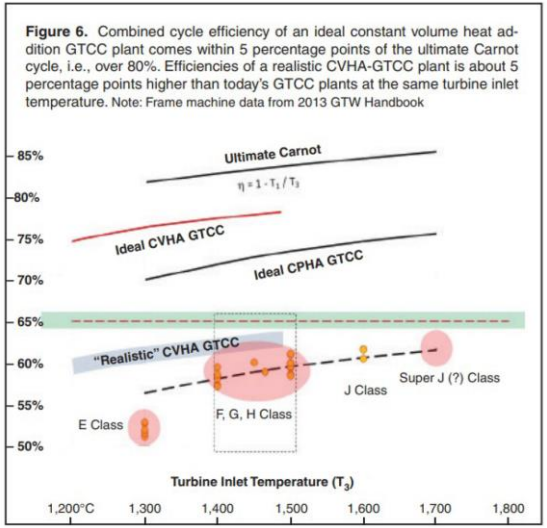
- *Total pressure increases during combustion*

What are the potential benefits?

Simple cycle: *Cycle efficiency gains as high as 8-10%*

Combined cycle: *Cycle efficiency gains as high as 4-5%*





Source: J. Gulen, 2013, Constant Volume Combustion, the ultimate gas turbine cycle, Gas Turbine World

FOCUS AREA #2
Innovative Combined Cycles for reduced Cost of Ownership

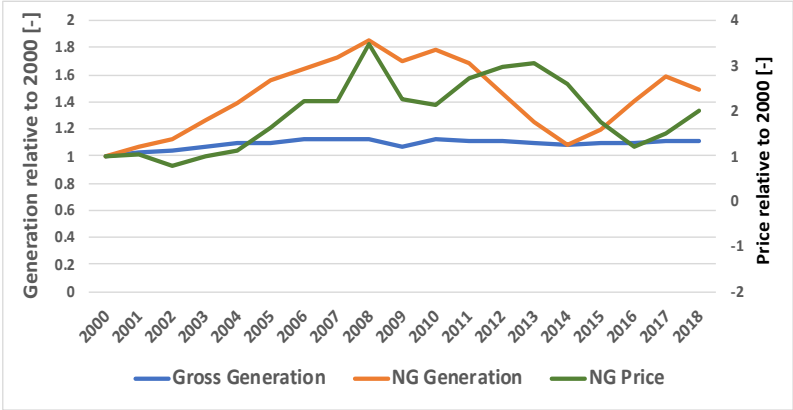
Background

- *High capacity factors: 2000-2010*
  - *Cost of ownership (CoO) driven by OpEx*
- *Target market is base load –> flexibility a secondary feature*
  - *Low capacity factor from 2010*
- *Cost of ownership driven by CapEx*
  - *Target market is peaking capacity and load control –> flexibility a primary need*

RE drive

What is it?

- *Simplify bottoming cycle technology*
  - ✓ *Simpler steam cycles*
  - ✓ *Organic Rankine Cycles*
  - ✓ *Supercritical CO_2 cycles*
- *Benefits*
  - ✓ *CapEx reduction larger than OpEx rise –> reduce CoO*
  - ✓ *Enhanced flexibility –> market opportunities*



FOCUS AREA #3 Meeting more stringent environmental regulations

Background

- *Pledge to achieve carbon neutrality by 2050*
- *CO2 emissions removal technologies needed to achieve target*

What is it?

A net-zero energy system requires a profound transformation in the way we produce and use energy that can only be achieved with a broad suite of technologies. Carbon capture, utilisation and storage (CCUS) is the only group of technologies that contributes both to reducing emissions in key sectors directly and to removing CO2 to balance emissions that are challenging to avoid – a critical part of "net" zero goals.

After years of slow progress, new investment incentives and strengthened climate goals are building new momentum behind CCUS.

"A Clean Plant for All" , EC strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050