ETN's 20th Annual General Meeting & Workshop

"Accelerating turbomachinery pathways to net-zero"

19-21 March 2024, Leiden, the Netherlands

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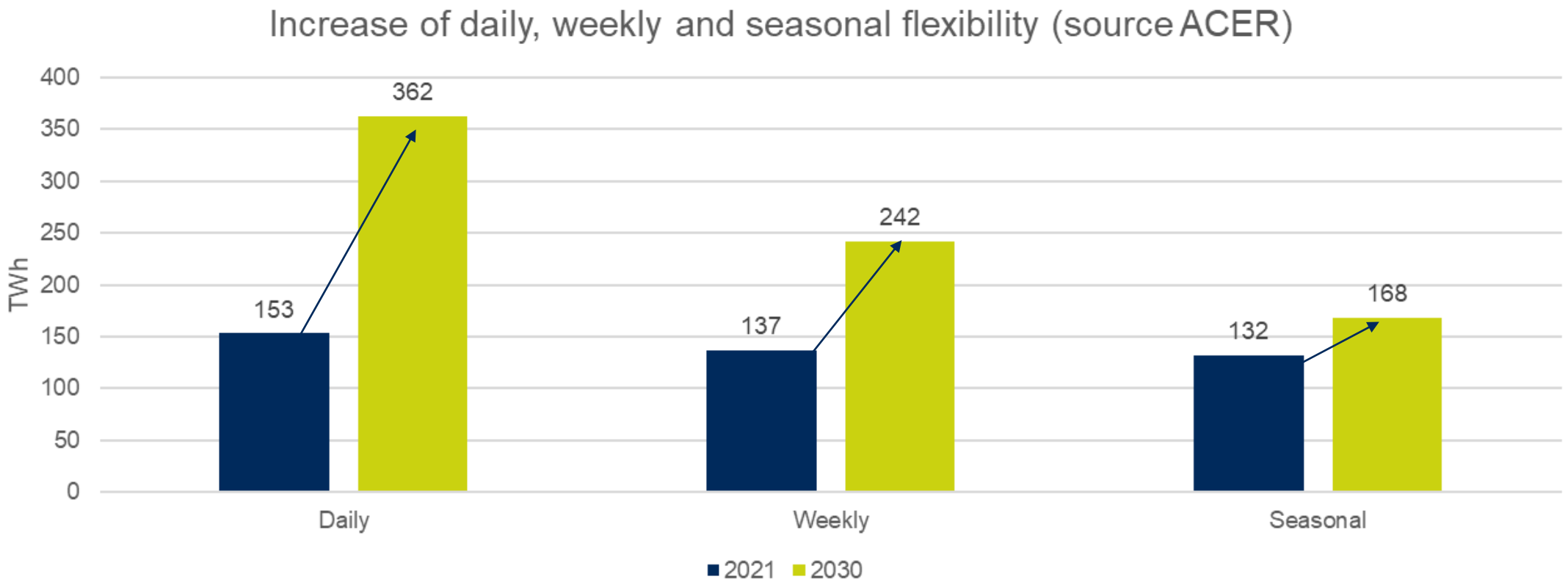
Global market overview and GT sector needs – ETN white paper

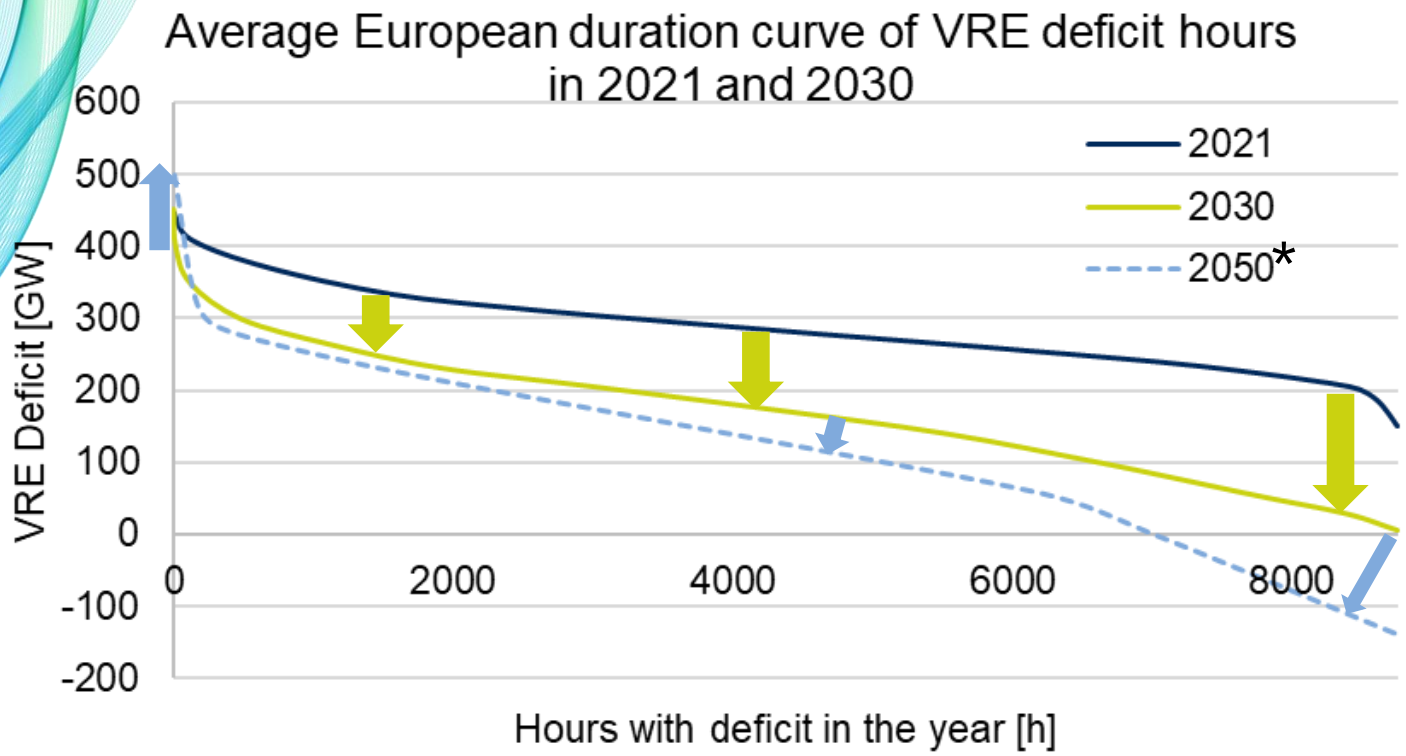
Pedro Lopez, ETN President & Peter Jansohn,
ETN Project Board member

Increasing demand for dispatchable energy



Note: The analysis was performed by for interconnected ENTSO-E member countries

Required dispatchable power capacity



Note: The analysis was performed by for interconnected ENTSO-E member countries
Source: ACER, ETN Global adaptation.
* Theoretical scenario (extrapolation)

Requirement for dispatchable power:

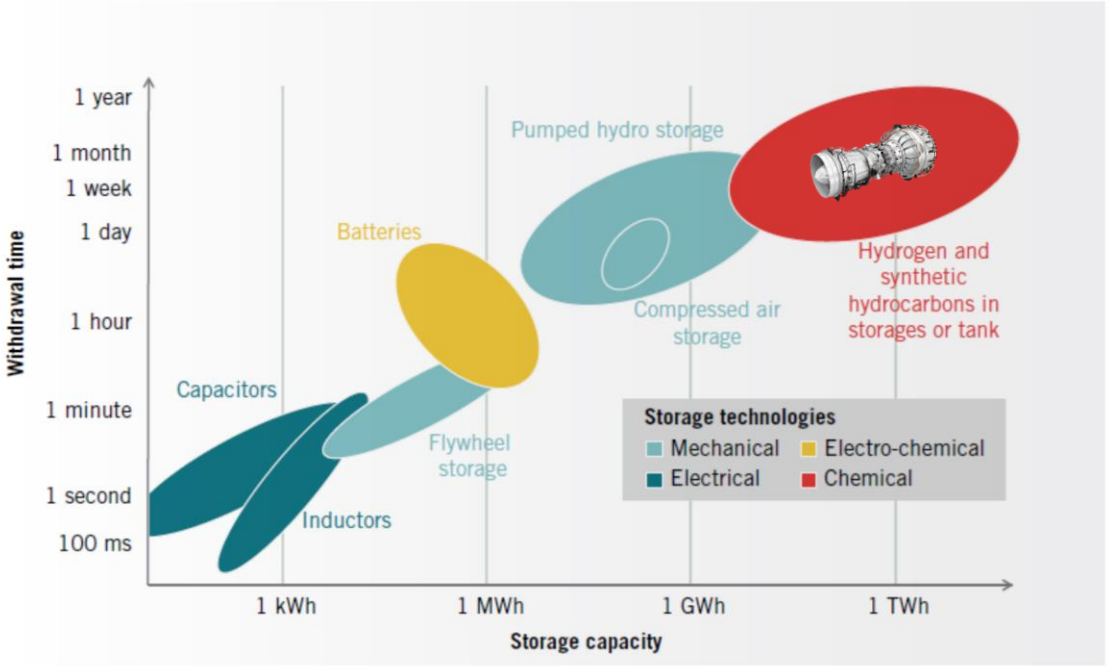
- 2021: High-capacity / high-volume
- 2030: High peak capacity / lower-volume
- 2050: reduced operating hours

Need to preserve dispatchable capacity to be progressively converted into carbon-free

Characteristics of GT operations

Flexibility: Gas turbines vs. complementary technologies

Energy Storage Solutions



Source: Arteiys

Demand Side Flexibility

	Seconds	Minutes	Hourly	Daily	Weekly	Seasonal
Fuel Cell	●	●	●	●	●	●
Flywheel	●	●	●	●	●	●
Batteries	●	●	●	●	●	●
Capacitors	●	●	●	●	●	●
(Pumped) Hydro	●	●	●	●	●	●
GT	●	●	●	●	●	●
Nuclear/Coal	●	●	●	●	●	●

Capacity limited geographically

Suited to provide flexibility:

● Yes (best) ● Yes (conditionsl) ● No

Characteristics of GT operations

Gas turbines are mandatory for future energy systems

Gas turbines are a fundamental element to support the power sector:

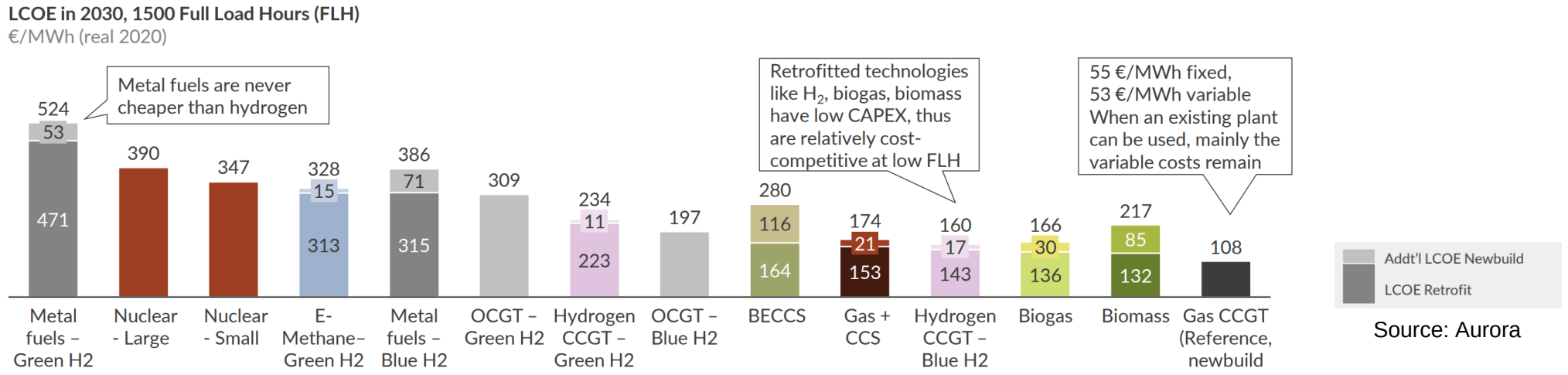
- Balance of Supply-Demand (Load following, peaking and back-up capacity)
- Provide grid services (inertia, frequency control)
- Enable medium-to-long-term storage solutions for a wide range of power scales (in combination with future low carbon fuels)

Characteristics of GT operations

Long term energy storage solutions via fuel flexibility

Energy storage via electrolysis and re-electrification via gas turbines :

- Low emission characteristics (low NOx, CO, UHC) for a multitude of alternative fuels (H2 & derivatives like NH3, CH3OH, synfuels)
- High round trip efficiencies (e.g. power-to-H2-power)
- Competitive capital and operating costs



Source: Aurora

Development roadmap

Required capacity

Piloting and demonstration

Market conditions /policy framework

Call to action: showcase of solutions

Hydrogen POWER

European Project Launches to Demonstrate High-Volume Hydrogen Gas Turbine Combustion

POWER

Hydrogen

Ansaldo Energia Reports Hydrogen Breakthrough for Gas Turbine Sequential Combustion Technology

Fast-ramping peakers support solar... and bridge the way to net zero

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REUTERS

Tecnicas Reunidas, Ansaldo Energia to develop RWE hydrogen plant in Germany

POWER

MHI, Mitsubishi Power Report Breakthroughs for Hydrogen Combustion, Ammonia Burners