

To Gas or Not To Gas: The Quest for Sustainable Energy

# Outline – Not to Gas

- Background
- Climate Perspective
  - Natural gas as a ‘bridge fuel’
  - Impact on 1.5-2 deg target
- Technical Perspective
  - Limitations of renewables
  - Role of storage and batteries
- Economic Perspective
  - Cost comparison
  - Virtuous Cycle
- Geo-political Perspective
  - Energy Security
  - Decentralization





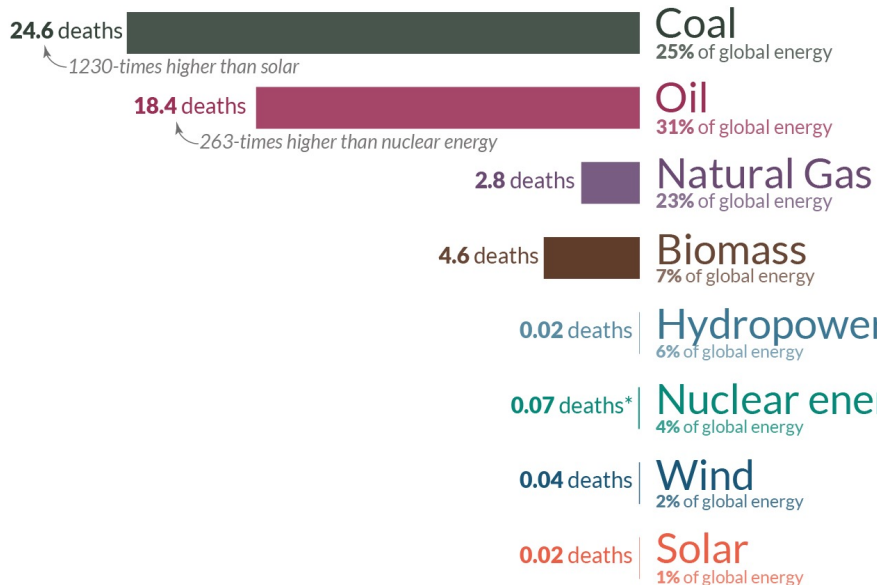
# What is Natural Gas?

- Natural Gas is a **fossil fuel** which is much cheaper, and emits lesser carbon emissions than other fossil fuels
- ‘Bridge fuel’ that supports energy transition

# What are the **safest** and **cleanest** sources of energy?

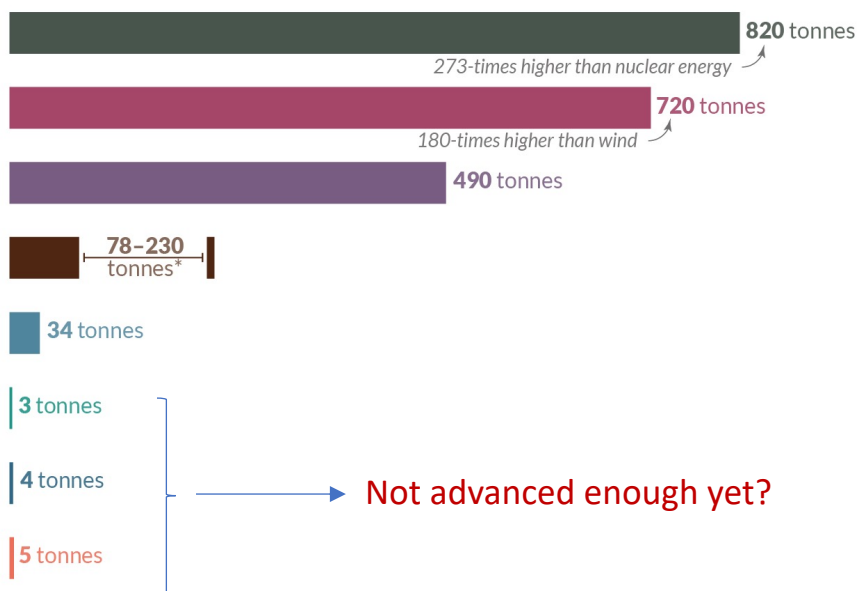
## Death rate from accidents and air pollution

Measured as deaths per terawatt-hour of energy production.  
1 terawatt-hour is the annual energy consumption of 27,000 people in the EU.



## Greenhouse gas emissions

Measured in emissions of CO<sub>2</sub>-equivalents per gigawatt-hour of electricity over the lifecycle of the power plant.  
1 gigawatt-hour is the annual electricity consumption of 160 people in the EU.



Not advanced enough yet?

\*Life-cycle emissions from biomass vary significantly depending on fuel (e.g. crop residues vs. forestry) and the treatment of biogenic sources.

\*The death rate for nuclear energy includes deaths from the Fukushima and Chernobyl disasters as well as the deaths from occupational accidents (largely mining and milling).

Energy shares refer to 2019 and are shown in primary energy substitution equivalents to correct for inefficiencies of fossil fuel combustion. Traditional biomass is taken into account.

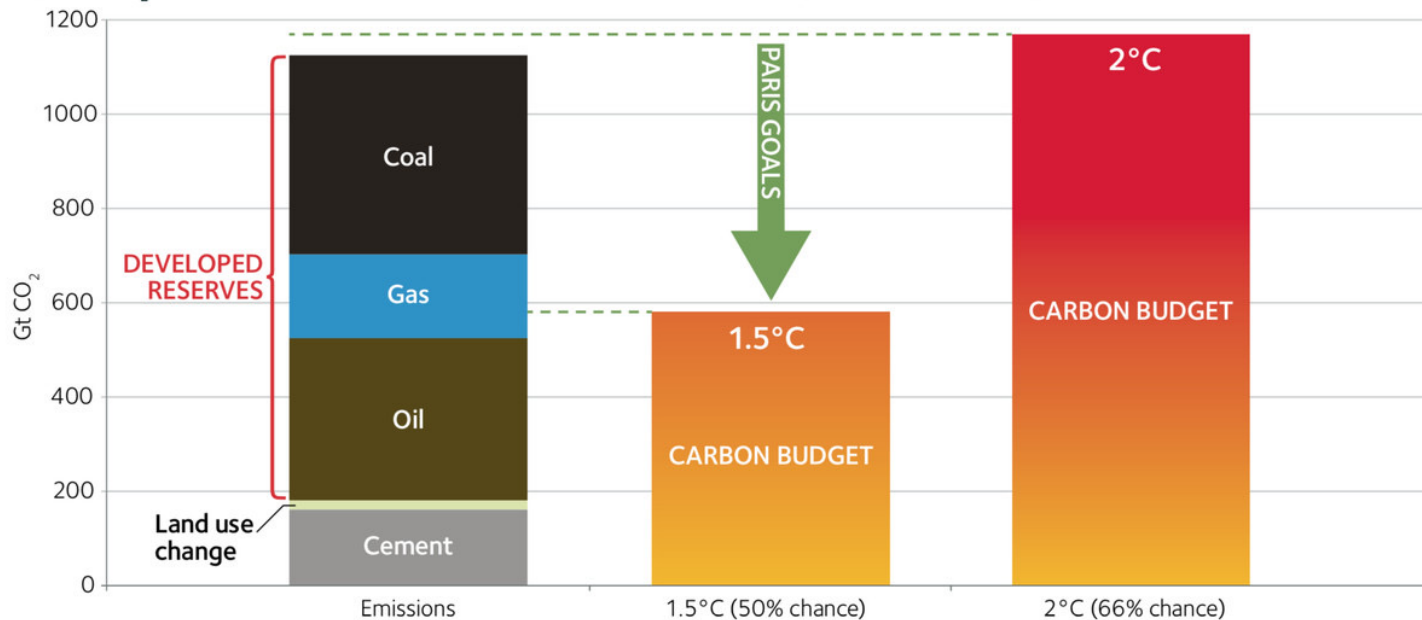
Data sources: Death rates from Markandya & Wilkinson (2007) in *The Lancet*, and Sovacool et al. (2016) in *Journal of Cleaner Production*;

Greenhouse gas emission factors from IPCC AR5 (2014) and Pehl et al. (2017) in *Nature*; Energy shares from BP (2019) and Smil (2017).

# Natural Gas as 'bridge fuel'

Do we have time for a 'bridge'?

Figure 1: CO<sub>2</sub> Emissions from Global Developed Fossil Fuel Reserves, Compared to Carbon Budgets within Range of the Paris Goals



Source: Rystad Energy, IEA, World Energy Council, IPCC, OCl analysis<sup>23</sup>

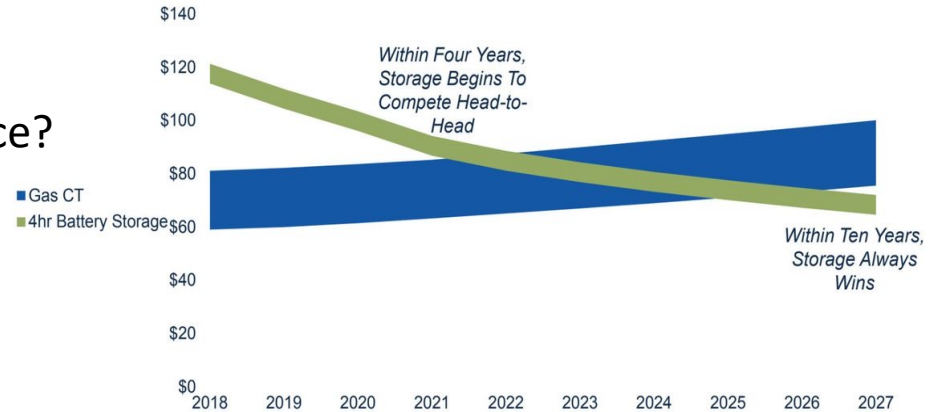
# Technical Perspective

## Main limitation of Renewable sources

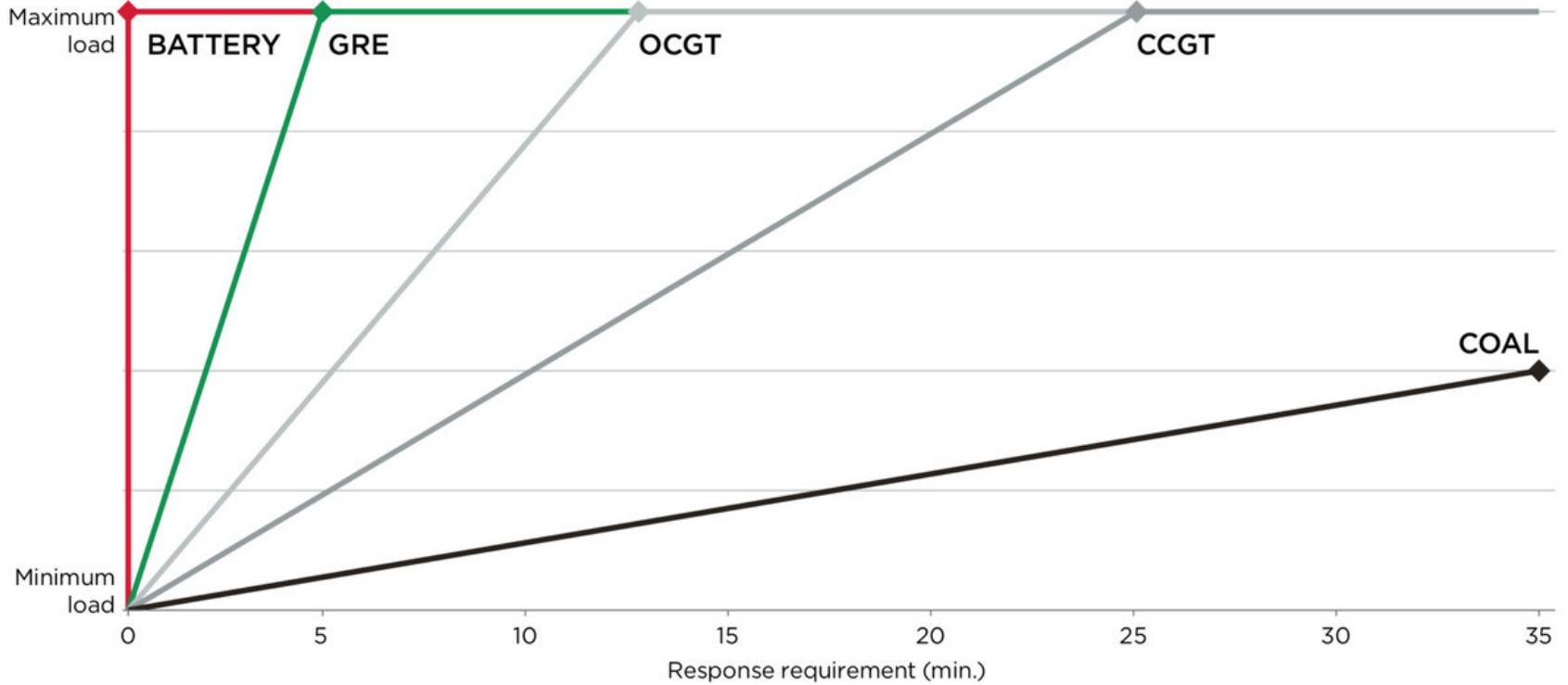
- Intermittency
- Reduced reliability, flexibility and resilience?
- Is Natural Gas the 'only' solution?

## Role of Storage and Batteries

- A cleaner alternative
- Solar and wind coupled with batteries already compete with natural gas in cost
- Batteries offer higher flexibility as they can ramp up/down faster than natural gas plants



**Figure 7: Ramp-up Times for New Power Plants**



Source: Bloomberg New Energy Finance, 2H 2018 LCOE Update<sup>m</sup>

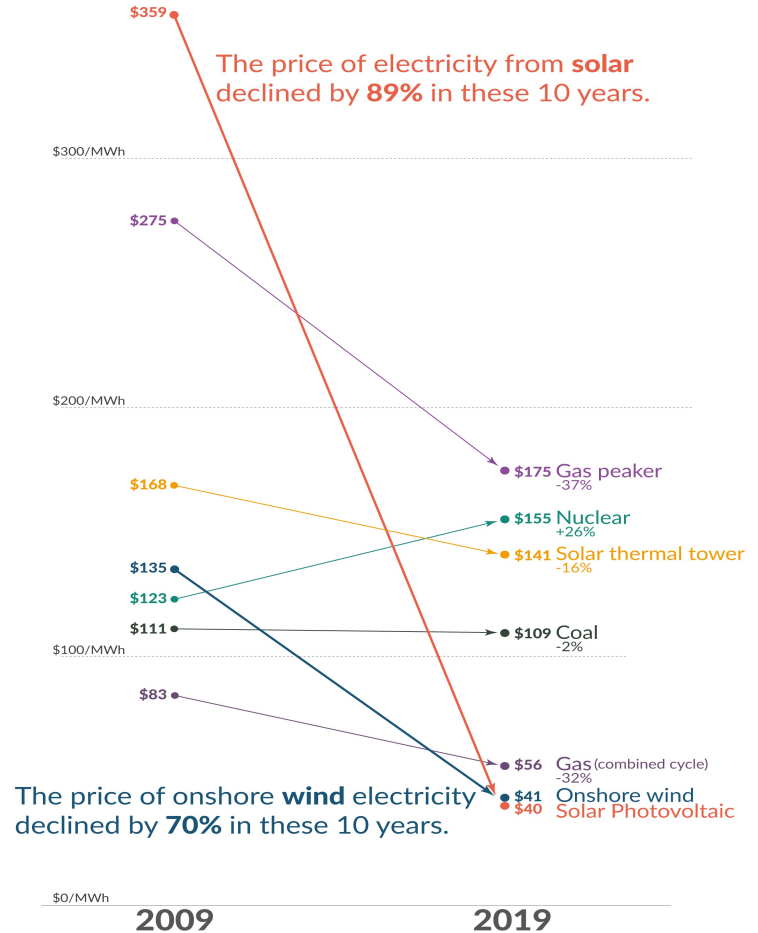
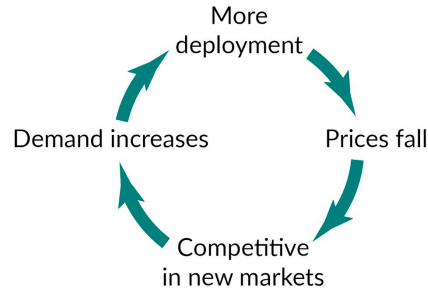
<sup>m</sup> Ramp-up times assume a hot start.

# Economic Perspective

Levelized Cost of Energy (LCOE) includes both Installation and Operational Costs

## Virtuous Cycle

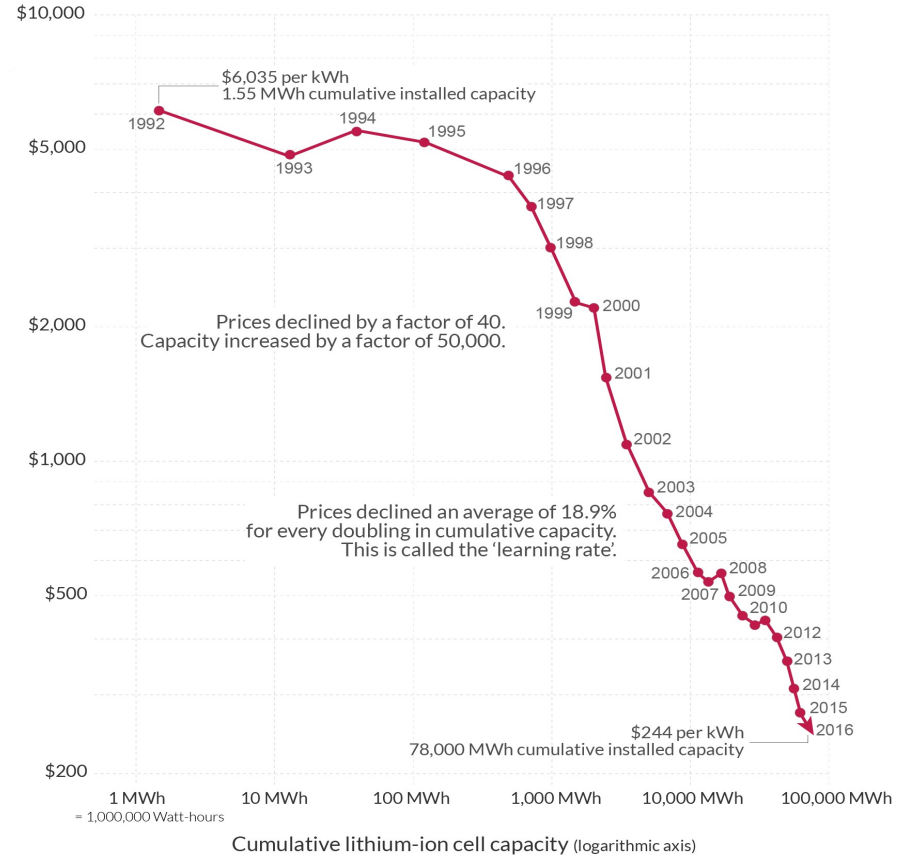
Technologies that become cheaper with increasing production enter a virtuous cycle





## Price and market size of lithium-ion batteries since 1992

Price per kilowatt-hour; kWh (logarithmic axis)



- Batteries and Electricity Storage follow virtuous cycle too
- New deployments of natural gas plants would result in avoidable carbon emissions and infrastructure costs

Prices are adjusted for inflation and given in 2018 US-\$ per kilowatt-hour (kWh).

Source: Micah Ziegler and Jessica Trancik (2021). Re-examining rates of lithium-ion battery technology improvement and cost decline.

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# Geopolitical Perspective

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graph TD; A[Geopolitical Perspective] --> B[Energy Security]; A --> C[Decentralization]; B --> D[Reduced reliance on fuel rich nations]; B --> E[Lower supply chain disruptions (pandemics)]; C --> F[Benefits developing nations]; C --> G[More resilient];
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## Energy Security

Reduced reliance on fuel rich nations

Lower supply chain disruptions (pandemics)

## Decentralization

Benefits developing nations

More resilient



“There is no room for new fossil fuel development — gas included — within the Paris Agreement goals.”  
-Oil Change International (OCI)