

Chemistry for a Sustainable Future

Dr. Han Yu
Asia Sales Team Lead Energy Storage
BASF New Business





Our purpose:

We create
chemistry for a
sustainable future

BASF Corporate Commitments

Our Corporate Commitments cover every part of our value chain and operations to deliver long-term business success.

Suppliers

BASF operations

Customers

And along the way...

We source responsibly



We produce safely for people and the environment



We produce efficiently

We drive sustainable solutions



We value people and treat them with respect



Climate Protection Goal

We aim to achieve net zero CO₂ emissions¹ by 2050.

We want to reduce our absolute CO₂ emissions¹ by 25 percent by 2030.

¹ The goal includes Scope 1 and Scope 2 emissions without emissions from sale of energy to third parties. Other greenhouse gases are converted into CO₂ equivalents according to the Greenhouse Gas Protocol.

Our way to net zero 2050

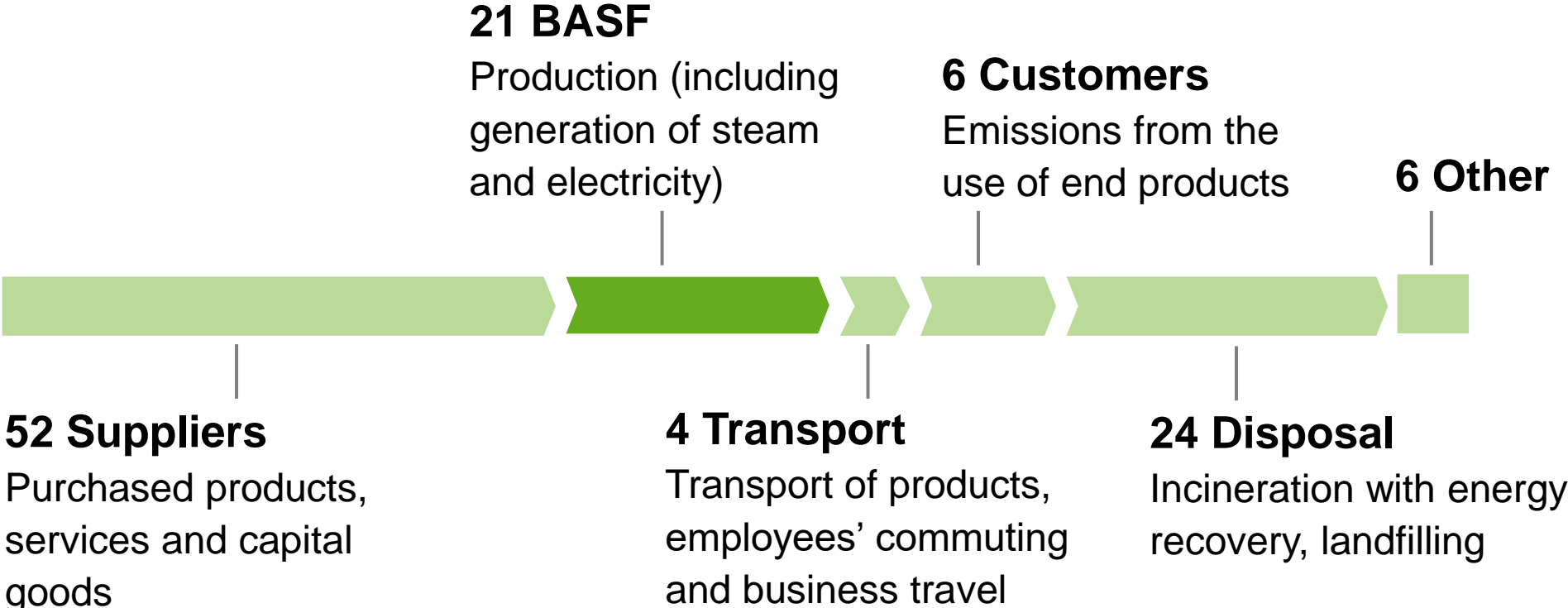
- We are a **key enabler** in the net zero transformation of base chemicals and downstream value chains
- Globally, we want to reduce our absolute CO₂ emissions **by 25% by 2030 compared with 2018**
- This means that, **compared with 1990**, we aim to reduce our global **CO₂ emissions by 60% by 2030**
- We aim to achieve **net zero CO₂ emissions at BASF by 2050**
- We are a **front-runner** in offering customers a portfolio of **products with lower carbon footprints** to enable their decarbonization



We assume responsibility along the entire value chain

Greenhouse gas emissions along the BASF value chain in 2020*

(in million metric tons of CO₂ equivalents)

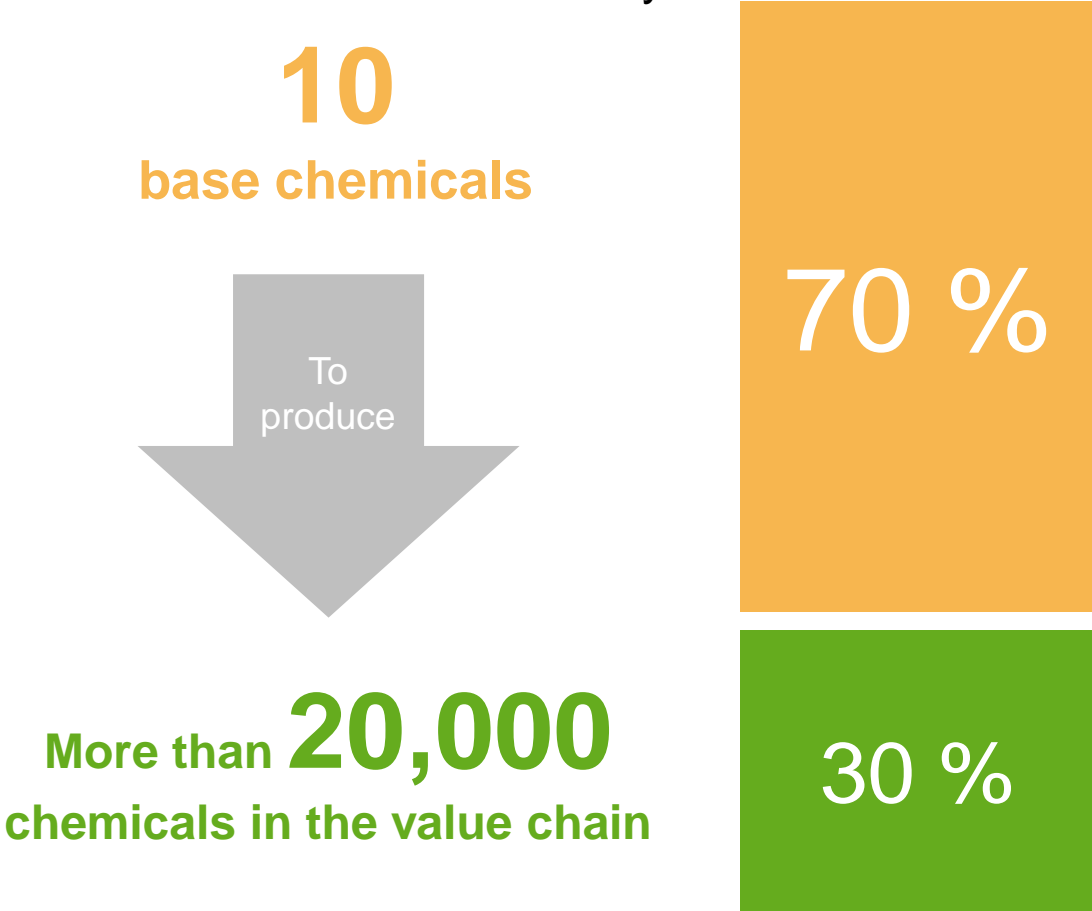


* Excluding polyamide business acquired from Solvay

Carbon Management

Carbon Management R&D Program: Base chemicals are in the focus of our research

Greenhouse gas emissions of the chemical industry
in Europe



Source: JRC study : Energy efficiency and GHG emissions: Prospective scenarios for the Chemical and Petrochemical Industry 2017, Boulamanti A., Moya J.A.

Carbon Management R&D Program: Breakthrough process technologies for key petrochemicals

Examples:



**Methane pyrolysis for
CO₂-free hydrogen**

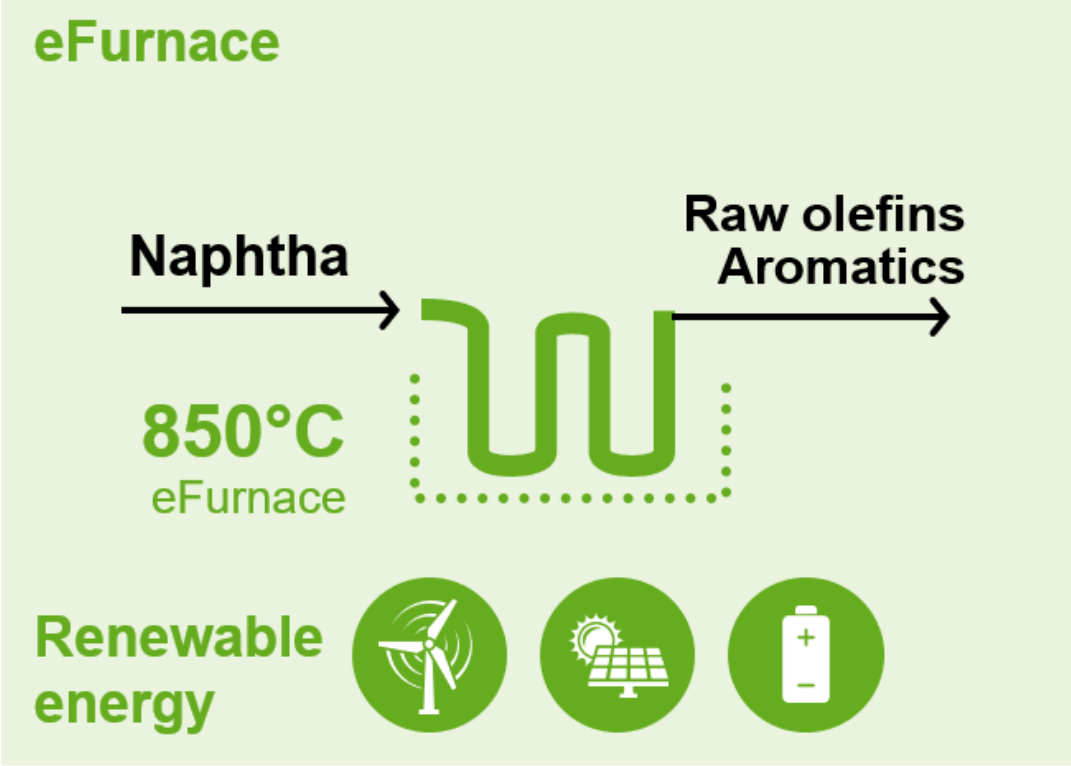
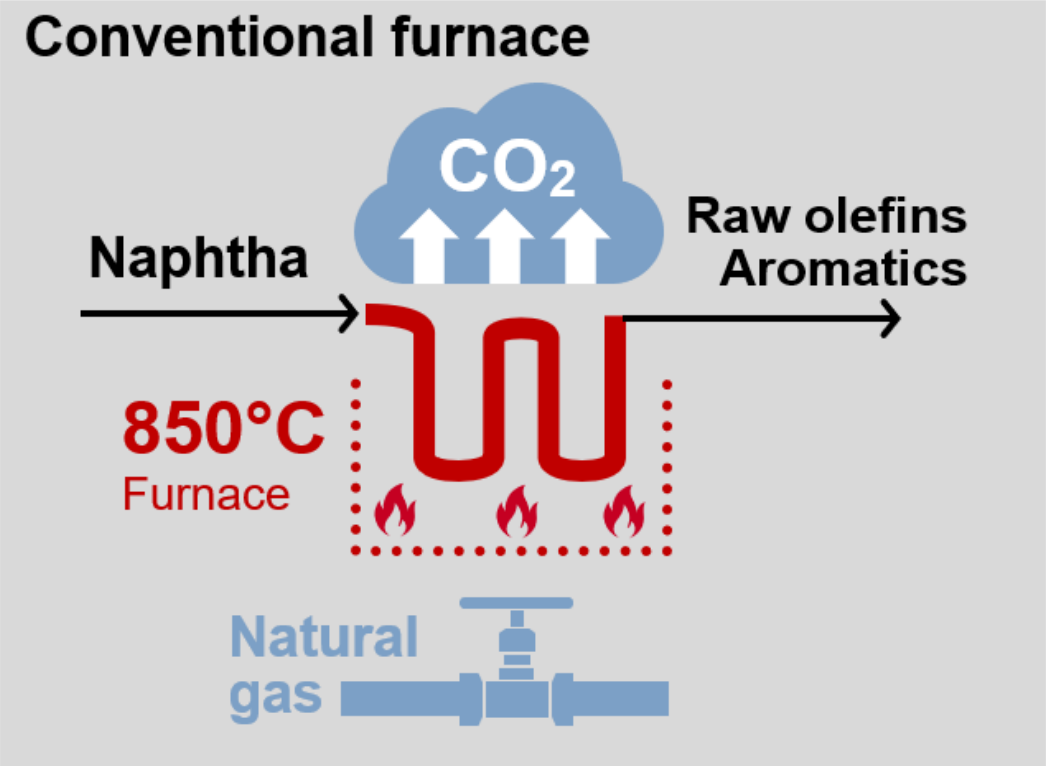


**eFurnace for electrification
of steam crackers**

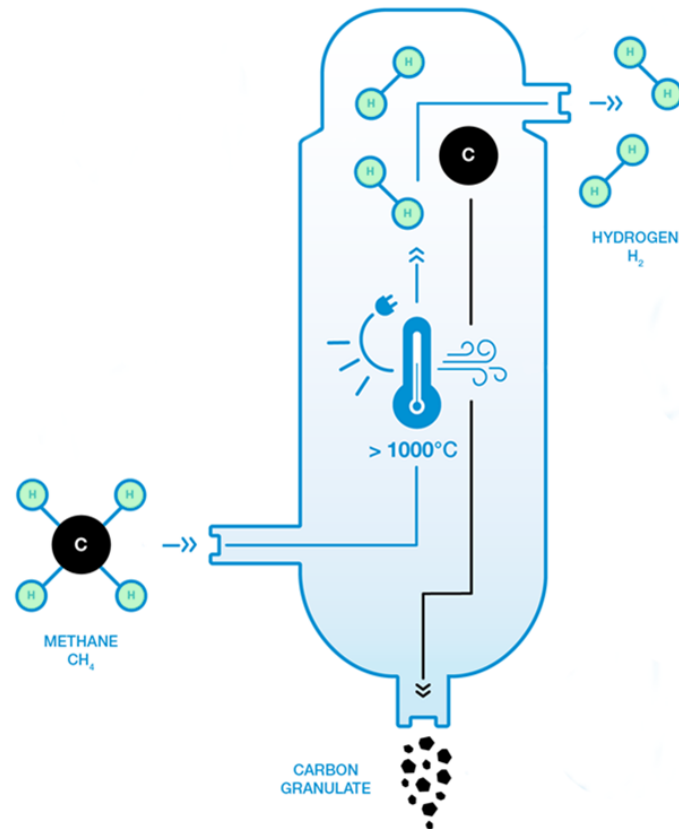


**Dry reforming to produce syn-
gas from methane and CO₂**

Carbon Management R&D Program: Electrification of steam cracker furnace



Carbon Management R&D program: Methane pyrolysis*



- We are continuously optimizing processes, gradually replacing fossil fuels with renewable energy and developing new low-emission technologies to further reduce our overall CO_2 footprint.
- Methane pyrolysis is a low-emission technology. Electricity is used to heat methane and split it into its components: hydrogen gas and solid carbon.
- Methane pyrolysis requires around 80% less electricity than the alternative method of producing hydrogen using water electrolysis.
- Test plant at the Ludwigshafen site is being started up.
- If this energy comes from renewable sources, the process could be made carbon-free.

* Project sponsored by the Federal Ministry of Education and Research

Green Hydrogen Projects in South Korea

- P2G Projects to produce green hydrogen from renewables. NAS[®] battery is used as energy buffer between wind turbines and electrolyzers.
- 500kW P2G Project, Jeju Island, Korea (2020): one NAS battery system (250kW/1.45MWh)



Wind turbine connected 500kW P2G system

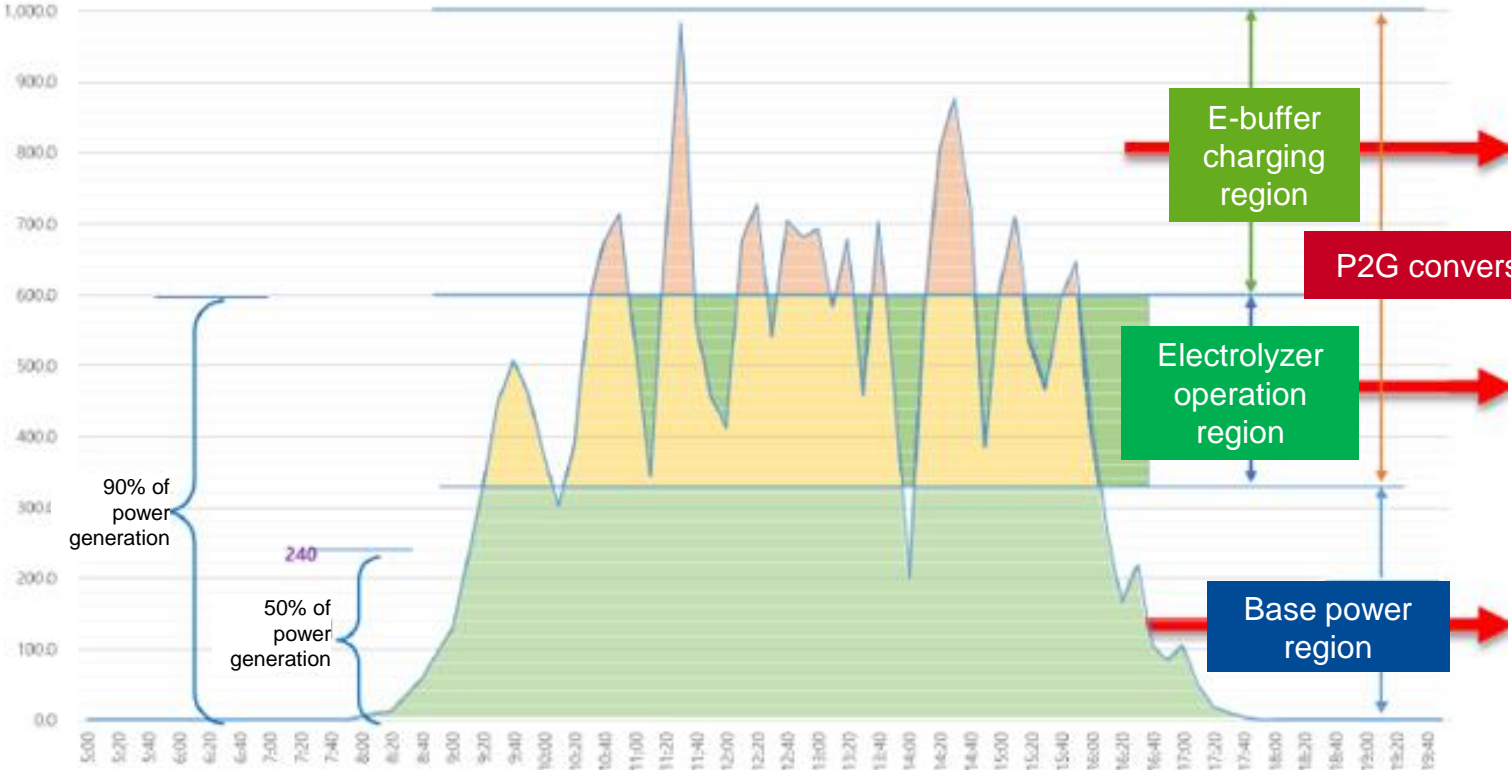
System Operation



- Surplus power = 0
- System standby

- Surplus power detected
- E-buffer discharge for power variation compensation

- Surplus power > electrolyzer capacity
- E-buffer charge



- Maximize system efficiency

- Responsive to instability of power generation
 - Constant electrolyzer operation: less on-off stress to electrolyzer

- Minimize power feed fluctuation
 - Grid stability ↑

Wind turbine connected 500kW P2G system

: Jeju Island, South Korea (2020)

■ System configuration

- ▶ Wind turbines: 21 MW (7 x 3 MW)
- ▶ P2G system: 500kW
- ▶ E-buffer (NAS battery): 1.2 MWh
- ▶ Electrolyzer: 52 Nm₂/h
- ▶ Fuel cell: 10 kW
- ▶ Control: P2G-PMS by G-Philos

■ NAS battery for P2G system

- ▶ Large storage capacity
- ▶ Safety: battery system next to H₂ tank



Increasing importance of renewable energy



- In 2020, internally generated power in the BASF Group had a carbon footprint of around 0.24 metric tons of CO₂ per MWh of electricity and was below the national grid factor at most BASF Group locations (purchased electricity: around 0.41 metric tons of CO₂ per MWh)
- We are continuously optimizing processes, gradually replacing fossil fuels with renewable energy and developing new low-emission technologies to further reduce our overall CO₂ footprint.
- In 2020, 19 BASF sites in Europe, North America and Asia already source partially or fully emission-free electricity from suppliers.
- Availability and price of renewable power as critical success factors.
- BASF is investigating different options for renewable power supply.



We create chemistry