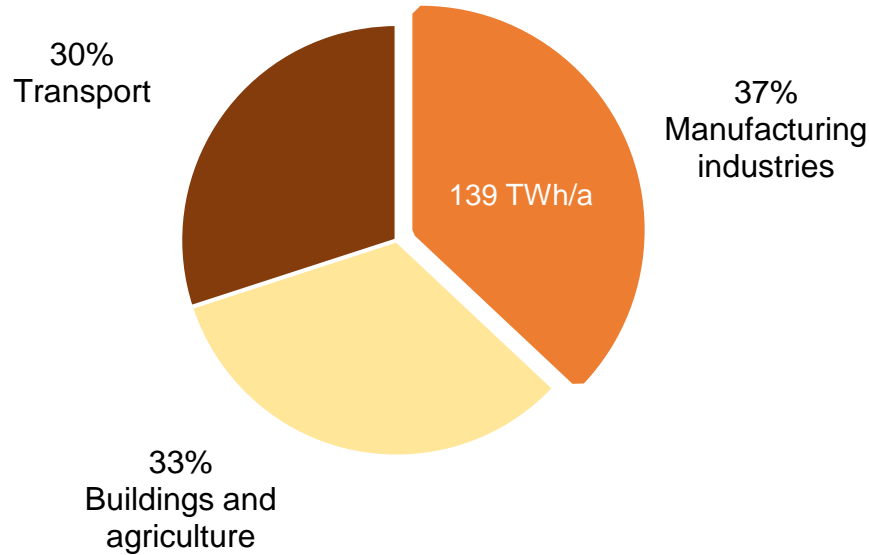


# NEW ENERGY FOR INDUSTRY

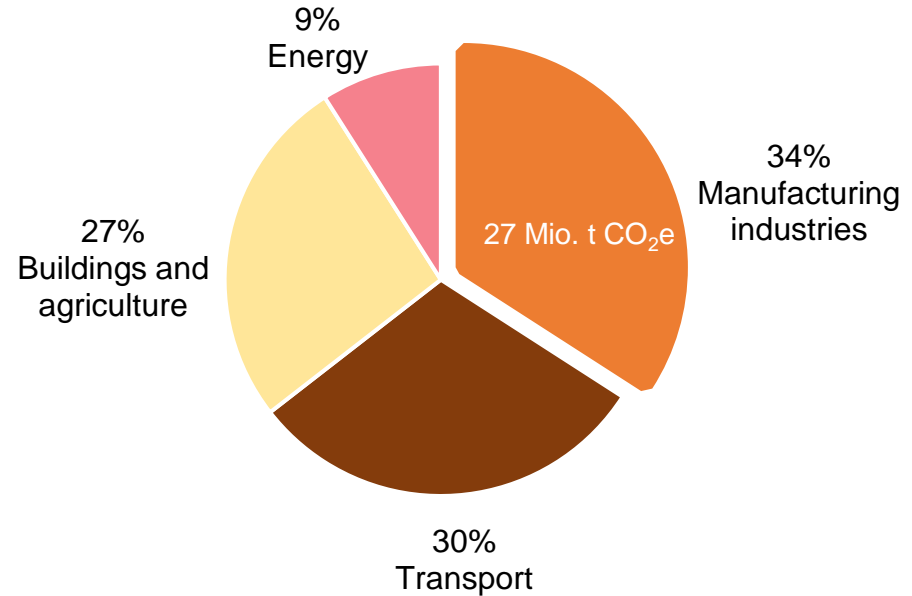
The NEFI innovation network of science, technology providers and companies demonstrates a pathway towards the decarbonisation of industry

# 1/3 OF GHG EMISSIONS IN AUT FROM MANUFACTURING INDUSTRIES

Primary energy demand by sector<sup>[1]</sup>



GHG-emissions by sector<sup>[2]</sup>



1) Sejkora et al., „Exergy as Criteria for Efficient Energy Systems – A Spatially Resolved Comparison of the Current Exergy Consumption, the Current Useful Exergy Demand and Renewable Exergy Potential“, *Energies*, 2020

2) Austrian Federal Environment Agency, „National Inventory Report 2021“

# MOTIVATION FOR SCENARIO DEVELOPMENT

## ENERGY SCENARIOS CAN BE A VALUABLE TOOL FOR ATTAINING CLIMATE GOALS

### Strong drivers:

- Industrial climate neutrality goals
- European Green Deal / Austrian government goals / etc.

### Previous energy scenarios:

- End-energy resolution of industrial demands
- Industrial aggregate; no industrial subsector focus

*Clear target.  
Yet, the road is very much unclear!*

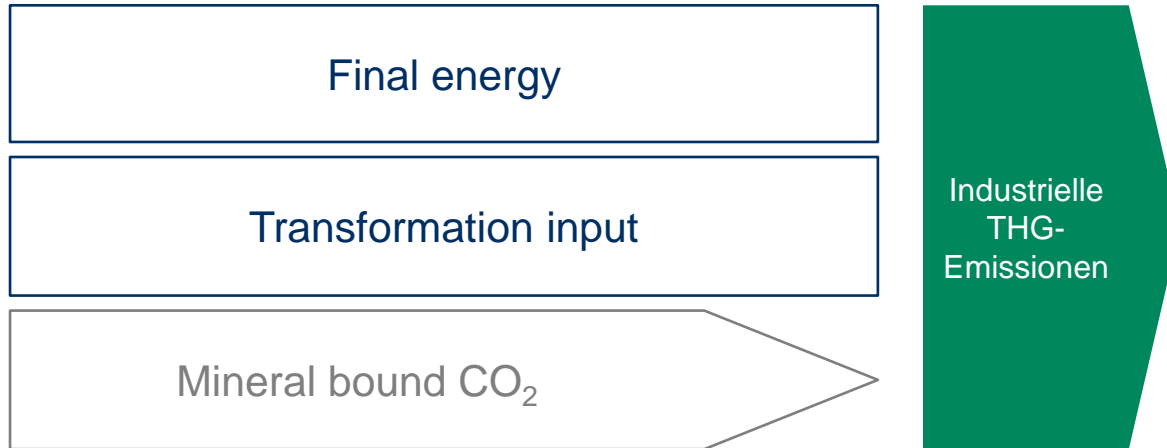
# THE NEFI SCENARIOS

## WHAT'S ON THE PLATE TODAY

- What balance border in industry is necessary for these scenarios?
- What scenario narratives were chosen?
- What technology groups constitute the road to climate neutrality?
- Core results

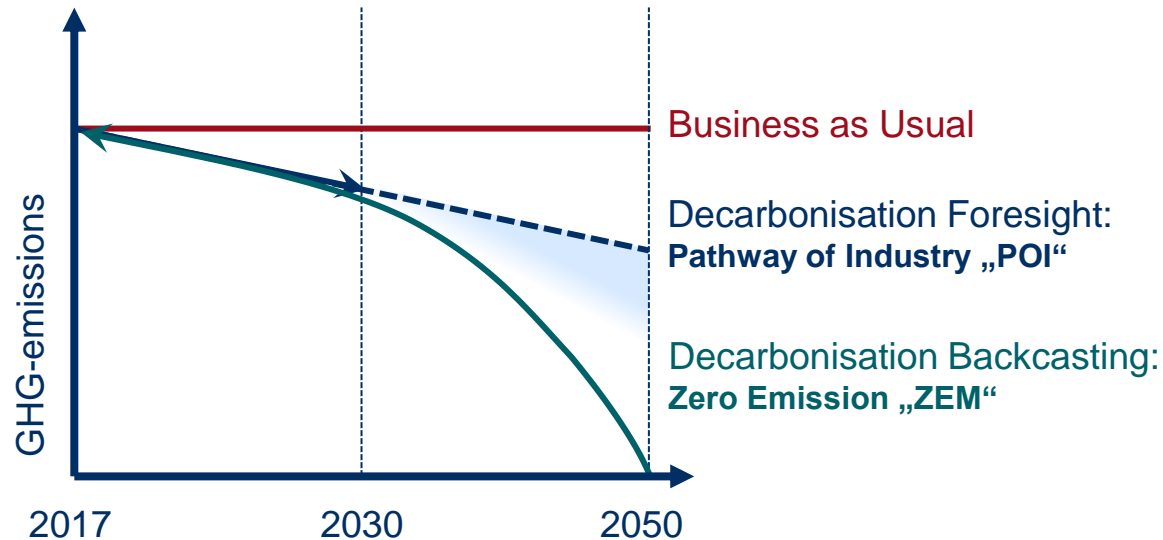
# ENERGY AND EMISSIONS BALANCE OF INDUSTRY

## THREE GHG-SOURCES EXIST



# THE NEFI SCENARIOS

THREE SCENARIOS OPEN UP A BANDWIDTH OF DEVELOPMENT POSSIBILITIES



# CLASSIFICATION OF DECARBONISATION STRATEGIES

## FOUR TECHNOLOGY FAMILIES CAN BE DISTINGUISHED

### Electrification

- Heat pumps
- Stationary engines

### Use of CO<sub>2</sub>-neutral gases and biomass combustion

- Hydrogen
- Bio-CH<sub>4</sub> and synthetic CH<sub>4</sub>
- Solid biomass

### Carbon Capture

- Especially for the sequestration of geogenic emissions
- Requires additional energy

### Circular Economy

- Increased use of end-of-life products
- Substitution of primary resources

# CLASSIFICATION OF DECARBONISATION STRATEGIES

## INITIAL FOCUS LIES ON THREE OPTIONS:

### Electrification

- Heat pumps
- Stationary engines

### Carbon Capture

- Especially for the sequestration of geogenic emissions
- Requires additional energy

### Use of CO<sub>2</sub>-neutral gases and biomass combustion

- Hydrogen
- Bio-CH<sub>4</sub> and synthetic CH<sub>4</sub>
- Solid biomass





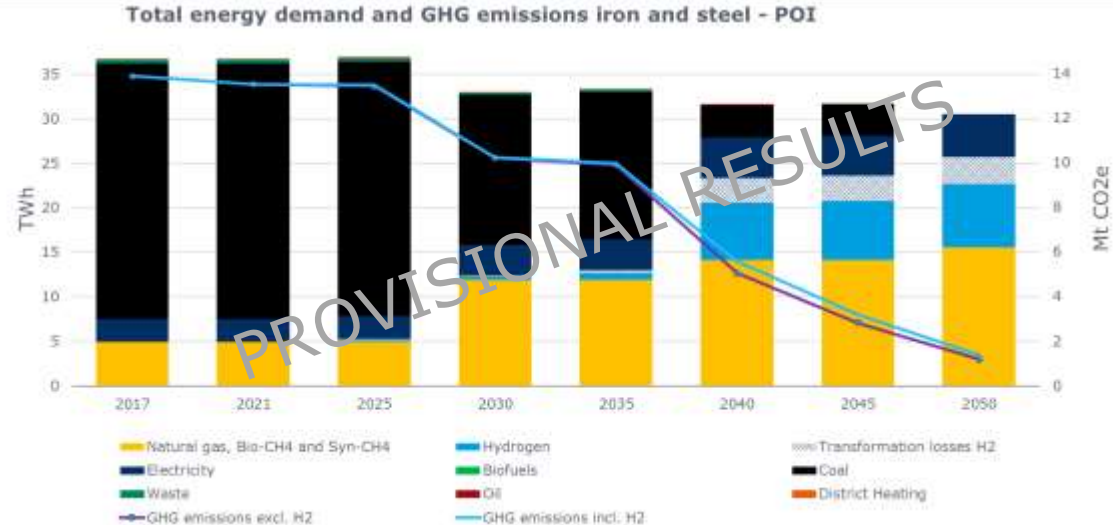
## Scenario Pathway of Industry

Exemplary results

# IRON & STEEL

## CH<sub>4</sub>-BASED DIRECT REDUCTION AND EAF

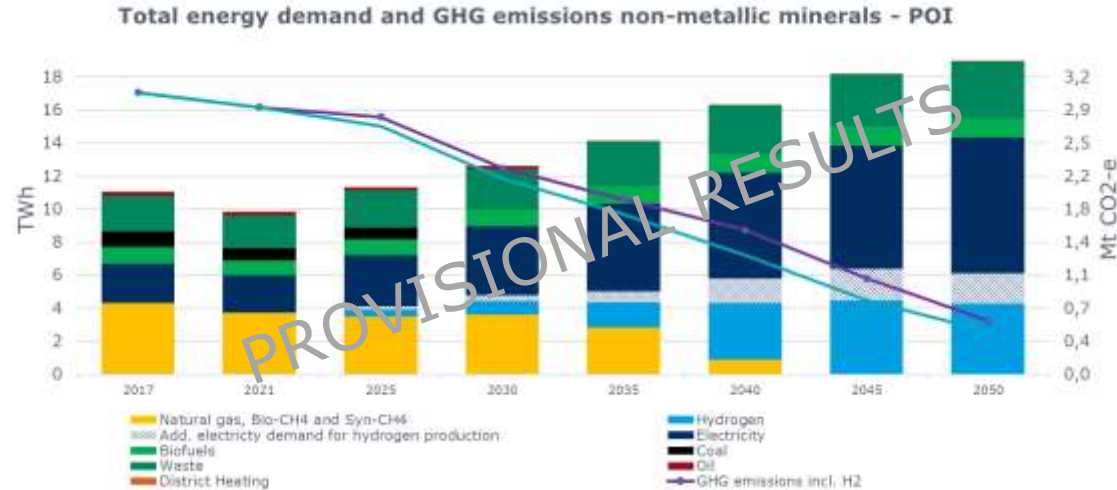
- Increasing usage of CH<sub>4</sub>-DR/EAF incl. 30% H<sub>2</sub> per unit
- Substitution of 29 TWh coal/coke with 22 TWh of green gases
- Electricity demand for electrolysis can sit in- or outside the industrial balance border



# NON-METALLIC MINERALS

## AMINE SCRUBBER REQUIRES ADDITIONAL ENERGY

- Carbon Capture by amine scrubbing
  - Readily available technology
- No investigation of further usage/storage after sequestration
- Required energy provided through heat pumps (@130°C)

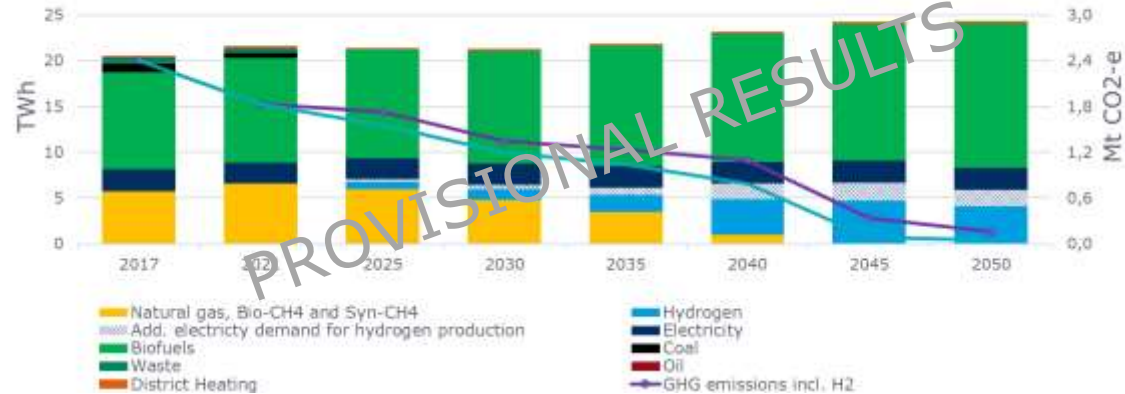


# PULP, PAPER & PRINT

## INTENSIFIED BIOMASS COMBUSTION

- Extension of current supply routes for biomass for combustion
- Retention of current plant structure
  - e.g. CHP-plants

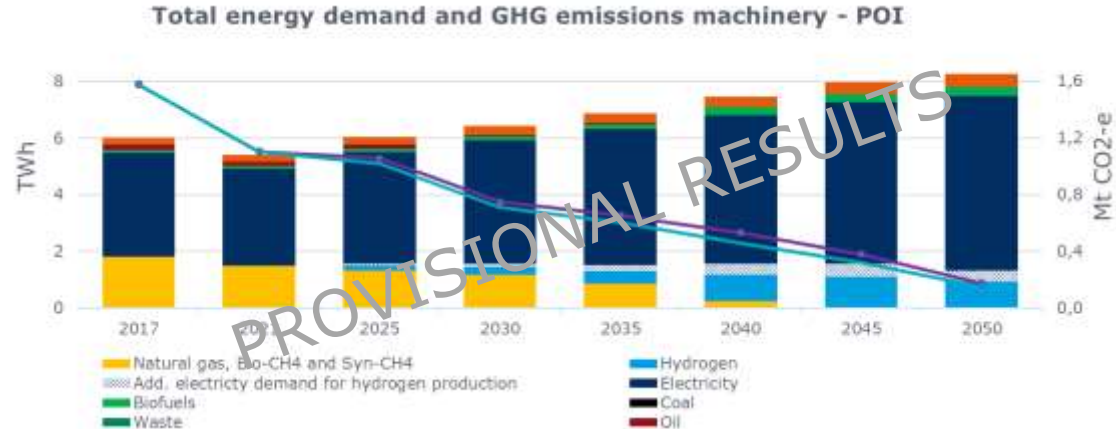
Total energy demand and GHG emissions pulp, paper and print - POI



# MACHINERY

## EXTENSIVE ELECTRIFICATION OF PROCESS HEAT

- Lower temperature levels provided by heat pumps
- Higher temperature levels (>150°C) provided by direct heat
- Energy efficiency cannot compensate fully for production increase (approx. 50%)



# „PATHWAY OF INDUSTRY“ SUMMARY

## CO<sub>2</sub>-NEUTRAL ENERGY SUPPLY IS KEY

- Two fuel-based decarbonisation solutions are visible
  - CO<sub>2</sub>-neutral gases and biomass
  - Electrification
- **GHG-emission reduction of 84%** is possible (comp. to 2017)
- **GHG-neutral supply of electricity and CO<sub>2</sub>-neutral gases is key!**
  - 50 TWh electricity: +92%
  - 90 TWh CO<sub>2</sub>-neutral gases (>130 TWh of electricity, if provided through H<sub>2</sub>)
  - 36 TWh solid biomass: +110%





NEW ENERGY  
FOR INDUSTRY

THANK YOU!