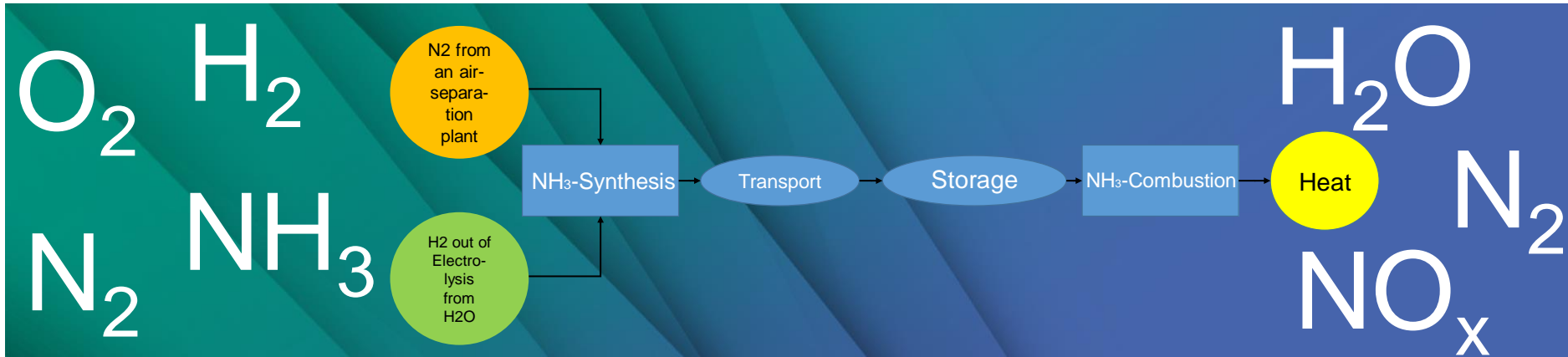
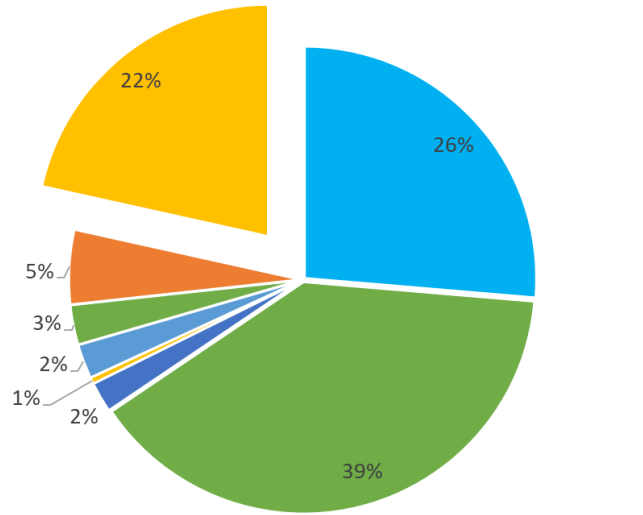


# Nitrogen oxide reduction in the oscillating combustion of ammonia as a carbon-free energy carrier

Janine Wiebe<sup>1</sup>, Dr. Hans-Joachim Gehrman<sup>1</sup>, Dr. Krasimir Aleksandrov<sup>1</sup>, Dr. Hartmut Mätzing<sup>1</sup>, Prof. Dieter Stapf<sup>1</sup>, Dr. Anne Giese<sup>2</sup>, Dr. Jörg Leicher<sup>2</sup>, Dr. Tim Nowakowski<sup>2</sup>



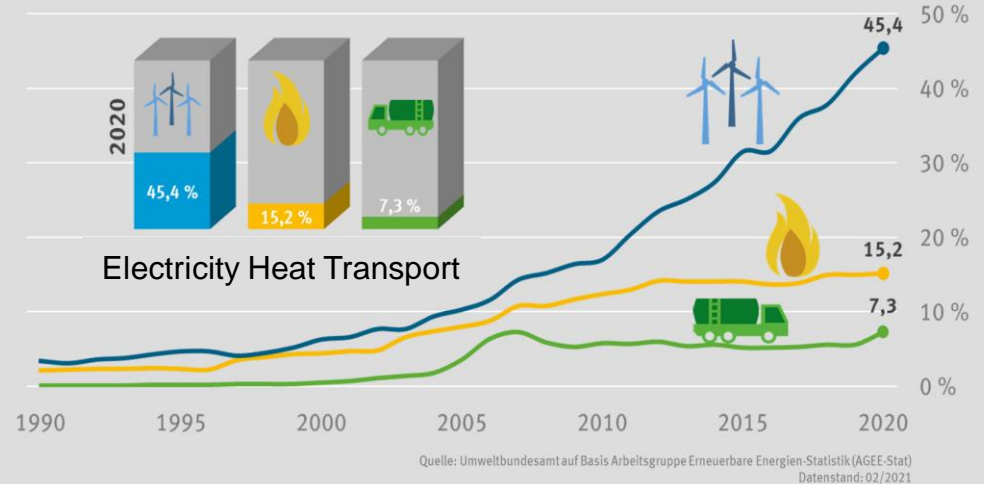
# Final energy use and development of renewable energies in different sectors in Germany



In GE (2019) - 9.329 PJ

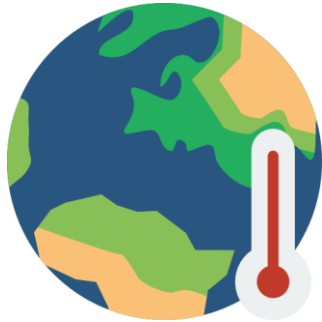
- room heating
- Climate cooling
- Warm water
- Mechanical energy
- IKT
- Process heat
- Process cold
- Lighting

## Renewable energies: Share in the electricity, heat and transport sectors

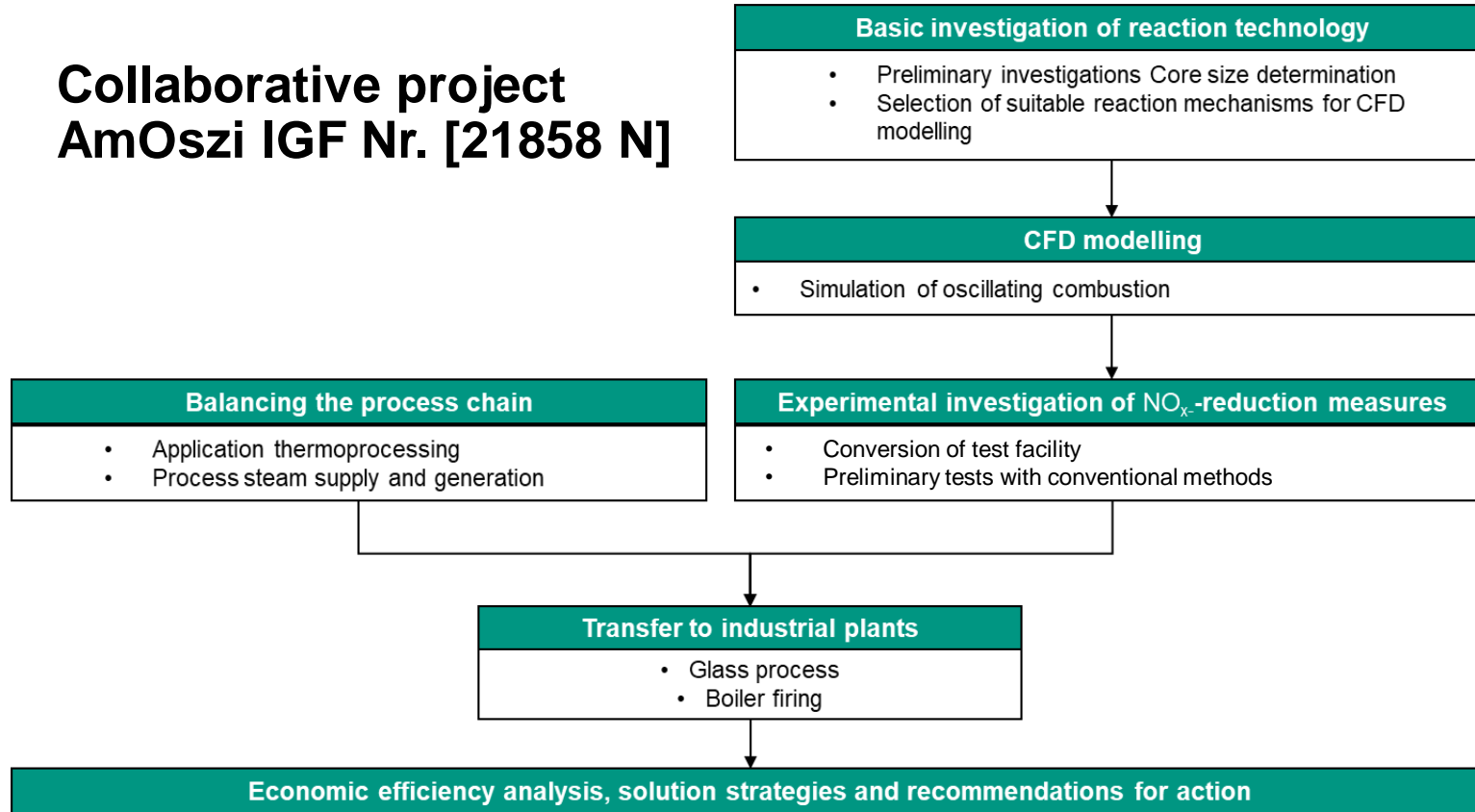


Source: BMWi, AGEB (2020)

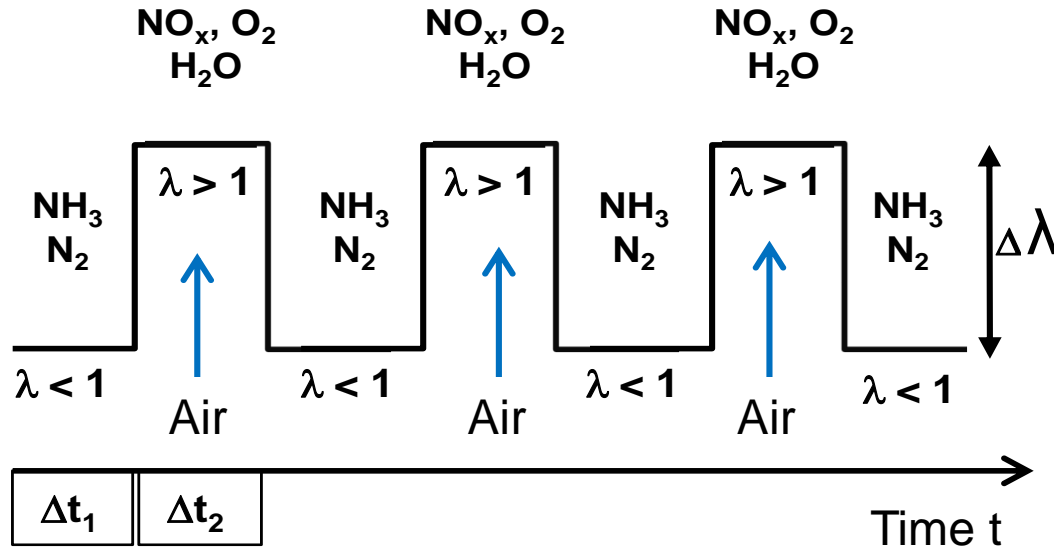
# Industrial heat demand and decarbonisation



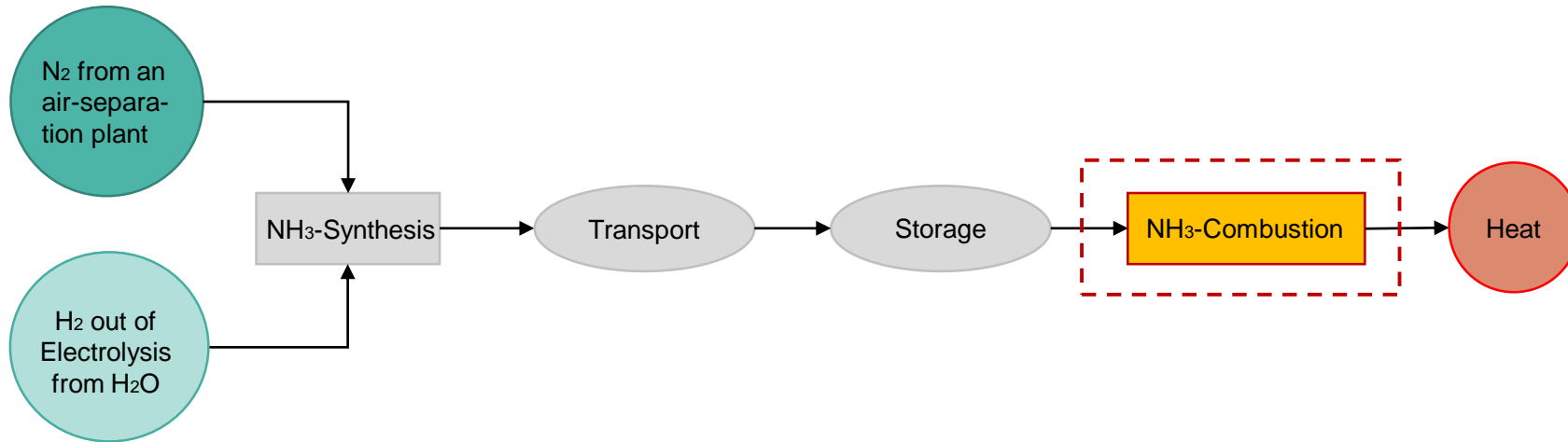
# Collaborative project AmOszi IGF Nr. [21858 N]



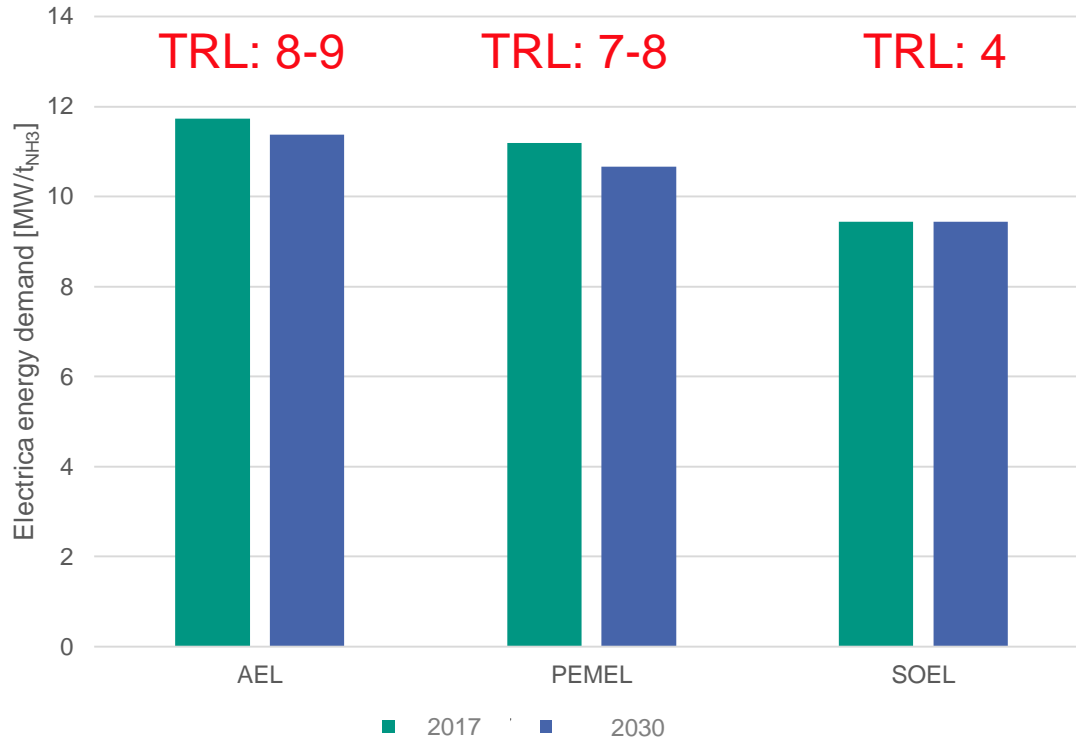
# NO<sub>x</sub>-reduction through oscillating combustion



# Balancing the process chain



# Energy demand - ammonia production as a function of the H<sub>2</sub> extraction from electrolysis



AEL:	Alkaline electrolysis
PEMEL:	Polymer electrolytes Membrane electrolysis
SOEL:	Solid oxide electrolyser

Source: Low carbon energy and feedstock for the European chemical industry, Dr. Alexis Michael Bazzanella, Dr. Florian Ausfelder,

\*TRL: TECHNOLOGY READINESS LEVEL

# Experimental Approach

## Operating conditions

26,1 m<sup>3</sup>/h NH<sub>3</sub> with 1,7 m<sup>3</sup>/h CH<sub>4</sub>, 111 m<sup>3</sup>/h Total Air  
 Without oscillation



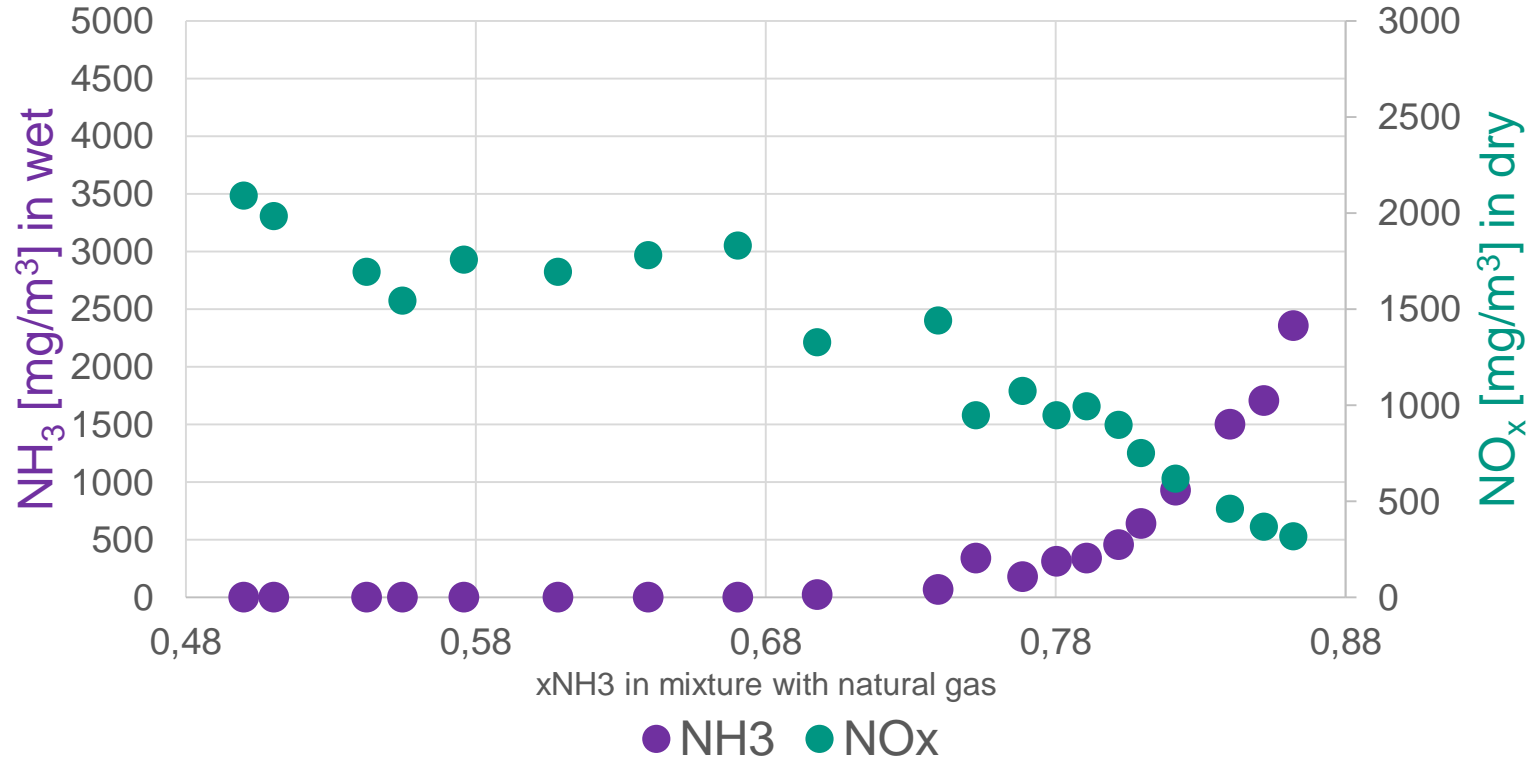
### Exhaust gas

NO <sub>x</sub>	20 mg/m <sup>3</sup>
NH <sub>3</sub>	22685 mg/m <sup>3</sup>
N <sub>2</sub> O	21,06 mg/m <sup>3</sup>
CO <sub>2</sub>	3,86 Vol.-%
H <sub>2</sub> O	27,22 Vol.-%
O <sub>2</sub>	1,34 Vol.-%





# Experimental Approach



# Comparison of oscillating combustion with normal combustion



Without oscillation



With oscillation

# Outlook

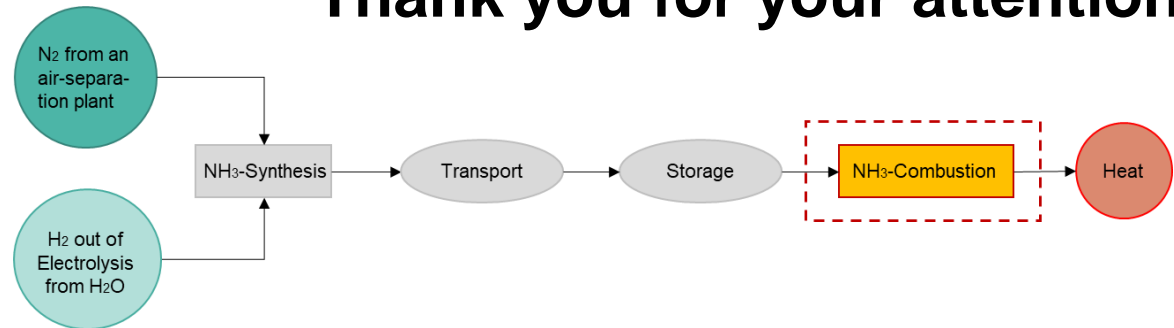
- Economic efficiency analysis of the process chain
- Further experimental trials in August

# Outlook

- Economic efficiency analysis of the process chain
- Further experimental trials in August

## Janine Wiebe

Karlsruhe Institute of Technology,  
Institute for Technical Chemistry  
Combustion technology  
Hermann-von-Helmholtz-Platz 1,  
76344 Eggenstein-Leopoldshafen  
+49 721 608-24374  
Janine.Wiebe@kit.edu



**Thank you for your attention!**