ZEP NWT
LOW-CARBON ENERGY INTENSIVE INDUSTRIES

EnII | Filip Neele

TNO innovation for life

MISSION STATEMENTS

1. **Scope**
   - Consider those energy-intensive industries that are currently unavoidable CO_2 sources
   - All pathways, solutions and concepts towards a significant reduction of CO_2 emission to be considered: technology openness
2. **Cost**
   - Technologies openness is needed to arrive at lowest-cost solutions
   - The earlier CO_2-reducing technologies are applied, the lower the costs for the low-carbon energy-intensive industries will become.
3. **Competitiveness**
   - Many EnII exposed to global markets: create level playing field by considering carbon footprint of „well to final product“

ENERGY-INTENSIVE INDUSTRIES

Scope

- Power industry
- Steel industry
- Aluminium industry
- Cement industry
- Chemical and petro industry
- Glass and ceramic industry
- Recycling industry
- …

MOTIVATION

- Background
  - COP21 agreement emphasises key role of CCS throughout power and industry sectors
  - Decarbonising EnII will rely heavily on CCS – but other options available, e.g., CCU
  - Some EnII products tend to have small margin
  - EnII tend to be exposed to world trade
- Goals
  - Collect data on feasibility and cost of decarbonising EnII sectors through CCS and CCU
  - Emphasise cost efficiency through clusters and hubs
  - Products made by CCS/CCU with high margins to be identified
  - Low-carbon or decarbonized economy is to be (remain) competitive
  - Conclude / advise on regulations or mechanisms to introduce CCS and CCU in EnII
  - Assessment of CCS and CCU → decision of what-where-when to apply

CURRENT STATUS OF CCU

- Increase of renewable energies in several EU member states → focus on decarbonizing the energy sector
- CCU to be combined with Power-to-X, i.e Power-to-Gas, Power-to-Fuel, Power-to-Liquids, Power-to-Chemicals (and Power-to-Heat but not being part of this scope of work)
- Studies of CCU and Power-to-X for EnII recently done (examples)
  - ULCOS – Steel, 2013
  - ECRA – Cement, 2012
  - IEAGHG - Pulp & paper, expected Q3 2016
  - CONCAWE – refineries, expected Q1 2017
  - Global CCS Institute – The Global Status of CCS 2015 (includes also CCU)
  - ChemCoast – H_2 from wind power in North German chemical and refinery sites to replace conventional H_2, 2015
  - German Umweltbundesamt (Federal Environmental Agency) – Integration of Power to Gas/Power to Liquids into the ongoing transformation process, 2016
- Other relevant work
  - ZEP CCU – Carbon Capture and Utilization, 2015

MULTI-PURPOSE STRATEGY
CCS AND CCU AS PARTNERS

- CCS and CCU to be considered as complementary possible technological pathways
- CCS as final storage but also as intermediate storage for carbon resource to be considered (similar to a „filling station“ for later processing)
- CCU as option for CO_2 conversion into valuable products → chance to substitute gas/oil imports and to increase regional economy (value chain)
- CCS as 100% instantaneous CO_2 reduction vs. CCU as time-shifted CO2 emission but at significant lower level

MULTI-PURPOSE STRATEGY
CCS AND CCU AS PARTNERS

- Feasibility and commercial application depend on several key criteria
  - total potential available for CO_2 reduction
  - realization time
  - economics
  - lock-in impacts
  - total system efficiency
  - political and public acceptance
  - availability of transport and storage capacities in case of CCS
  - legislation
  - consideration of regional boundary conditions

SECTOR COUPLING AS NEXT STEP

- Sector coupling as one pathway for a high system efficiency
  - high integration of all industrial, private and mobility sectors with optimized processes
  - integration of renewable energies into the world of ‘fossil’ processes
- CO_2 as multi-talent resource recognized instead of being bad waste only
- Maximum of flexibility when applied in different sectors and in different final applications
- Usage of existing infrastructure reduces costs (compatibility of technology and its products), otherwise new infrastructure to be established
- Sector coupling to generate scale effects → technologies and products to become more economic
- Sector coupling to support the change into a low-carbon economy requiring some time

ESTABLISHING OF TWG

- Potential members (*all to be (re-)confirmed*)
  - Chair – *tbd* Arthur Heberle (MHPS-EDE)
  - Sigmund Størset (SINTEF)
  - Isabelle Czernichowski (BRGM)
  - Wilfried Maas (Shell)
  - Tim Peeters (Tata)
  - Stanley Santos (IEAGHG)

Proposal: start topic in Q3 2016

- Collect studies cited above into ZEP review report
- Conclude on feasibility and cost of CCS and CCU in EnII
- Discuss mechanisms to address cost of CCS and CCU, unit cost and impact on trade
- Highlight cost reduction through hubs and clusters
- Operate jointly with NWPE