



1 – Introduction

- 1 Introduction to the course

2 – Introduction to sector coupling

- 1 Definition of sector coupling
- 2 Opportunities and challenges associated with sector coupling
- 3 Emissions intensity of power generation
- 4 Direct versus indirect use of electricity – definition and processes
- 5 Direct versus indirect use of electricity – comparison of overall efficiency in different sector coupling technologies
- 6 Electrification versus technology mix

3 – Direct electrification in the heating and cooling sector

- 1 Technologies and applications – overview
- 2 Electric heat pumps – description of technologies
- 3 Electric heat pumps – main cost drivers
- 4 Levelised cost comparison: sector coupling versus conventional technologies and future developments
- 5 Electric heaters – description of main technologies and cost parameters
- 6 Demand profiles and flexibilization strategies

4 – Direct electrification in the transport sector

- 1 Technologies and applications – overview
- 2 Passenger cars – description of technologies
- 3 Passenger cars – main cost drivers and expected future developments
- 4 Passenger cars - Cost comparison: sector coupling versus conventional technologies
- 5 Passenger cars – infrastructure requirements
- 6 Passenger cars – infrastructure requirements
- 7 Light trucks, buses, taxis, and 2- and 3-wheelers – technology description & infrastructure requirements
- 8 Demand profiles and flexibilization strategies

5 – Indirect use of electricity

- 1 Renewable synthetic fuels and their applications
- 2 Production of hydrogen from renewable electricity
- 3 Electricity generation in fuel cells
- 4 Relevant cost drivers for renewable hydrogen production
- 5 Production processes for synthetic methane and synthetic liquid fuels and expected cost developments

6 – Renewable hydrogen in steel production

- 1 Decarbonisation of metallurgical processes
- 2 Direct reduction of iron (DRI) process
- 3 Technologies and scale of DRI (H₂-SF-EAF)
- 4 Hydrogen demand (specific consumption) and requirements for a global green steel industry
- 5 Economics: Cost of green steel and market opportunities
- 6 Risk and competition

7 – Renewable methanol

- 1 Introduction to methanol and its applications
- 2 Physical and chemical characteristics of methanol
- 3 Renewable methanol production pathways
- 4 Decarbonisation of maritime shipping with renewable methanol
- 5 Drivers for CAPEX and OPEX

Power-to-X: applications and cost developments

8 – Regulatory framework

1 Supporting the profitability of sector coupling & incentivising flexibility

9 – PtX supply chain examples

1 PtX supply chains

2 Upstream supply chain: renewable energy, water, and transport

3 Hydrogen production: inputs, outputs, and energy required by electrolysis

4 Downstream supply chain, Product X: Electricity from green methane stored in long-term storage facilities

5 Downstream supply chain, Product X: long-distance flight using fuel produced with green hydrogen

6 Downstream supply chain, Product X: steel produced with green hydrogen

7 Downstream supply-chain, Product X: ammonia fertilizer produced with green hydrogen

8 Downstream supply chain, Product X: warm rooms in a building heated via district heating networks

10 – Summary of the course

1 Summary

2 References

3 Further reading