Integrated Transport and Energy Modelling
Decarbonising the transport sector

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Integrated Transport and Energy Modelling

01 Introduction

02 Modelling on local level

03 From local to national level
Norway: Transition to low emission

2015: 10 ton/capita

2050: 2 ton/capita

2050: 1 ton/capita
How can we reduce the transport emissions?

Three options:
- Avoid
- Shift
- Improve

Source: Statistics Norway
Norwegian government has rather ambitious targets for the market uptake of zero and low emission vehicles

- By 2025, all new passenger cars and all new urban buses acquired are to be zero emission vehicles (BEVs or FCEVs)
- By 2030, all new light commercial vehicles, to three quarters of all new inter-urban buses, and to half of all new heavy duty freight vehicles acquired are to be zero emission vehicles
- Strong incentives have been implemented:
  - The most important one is the CO₂-differentiated vehicle purchase tax, payable upon first registration of any passenger car or cargo van equipped with an ICE. This purchase tax is a sum of four independent components (curb weight, ICE power, and type approval CO₂ and NOₓ emission rates)

How will this impact the energy and power system?
New research project: Integrated Transport and Energy Modelling (ITEM)

Research Question:
What are the prerequisites and implications in terms of energy supply, power generation, local and regional grid distribution of fast charging and hydrogen production?

Project Goal: Determine policies and measures best suited to reach carbon neutrality in the transport sector
Aim of the ITEM project

- Improved modelling of zero emission transport infrastructure
- Policy advise to government
- Investment support to energy and industry
The project involves two levels of energy system modelling - and linking to transport demand models

1. Development of local energy and power system model for transport corridors. Utilization of the capacity in the electricity grid for fast charging and hydrogen production

2. Further development of the energy system model TIMES-Norway to include detailed modelling of the heavy duty vehicle sector including the infrastructure (fast charging, catenary and hydrogen)

3. Development of a hybrid modelling framework integrating energy system models with vehicle, travel and freight demand models
Modelling of transport

- Analysis of alternative transport corridors between major cities in Norway: Oslo ↔ Trondheim/Bergen

- Local conditions taken into account:
  - Future transport demand
  - Need for grid investments?
  - Challenges with fast charging?
  - Hydrogen production and storage

- Localization of new energy stations
  - How many & where?
Modelling local energy and power system

- Development of **local energy and power system** model for transport corridors
- Utilization of the capacity in the electricity grid for fast charging and hydrogen production
Modelling of the local grid and power hub

- We have simulated a part of the grid (data from DSO)
- The figure shows part of the simulation file in MATLAB.
- Simulate the behavior of the grid close to the charging station
- How does the amount of electrical power the charging station needs affect the current and voltage of the grid
- Three main concerns:
  - The maximum current that the cables can handle
  - Voltage loss in the cables maybe affect some loads
  - The generator may not be able to handle power needed, so the frequency decreases and the grid shut down
Modelling of hydrogen infrastructure

Need to improve the modelling of the hydrogen value chain in TIMES-Norway
From local level to national level

• National analysis with the energy system model TIMES-Norway
• Future transport demand (from Institute for transport economics):
  • Transport corridors and national level
  • Divided by transport modes
• How do we aggregate?
  • Local power hub ⇒ new technology?
  • Potentials in different cost classes?
    • Dependent on capacity in local grid
    • Need for grid extension?
    • Need for stationary batteries?
    • Storage capacity for H2

Fast chargers (22 kW, 50 kW, 120 kW)
https://www.ladestasjoner.no/
Further work
Integrated Transport and Energy Modelling

• Recently started research project (2018-2021)

• Discuss with those of you who have ideas and experience in this kind of modelling

• What is a useful methodology going from local scale power/grid modelling to national TIMES-models?

• Hopefully, a new/interesting methodology and results will be presented in a later ETSAP WS
Thank you

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