DTU Management Engineering
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Energy system modelling and integrated future scenario analysis of the Nordic transport system through TIMES

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*The **transport sector** is widely considered the most complicated energy sector to decarbonise. It is the sector that experienced the **highest growth in emissions** since 1990, and presents the **least diversified portfolio** of energy supply sources, relying mainly on **petroleum products**. Policy makers need a **better understanding** of how the transport and the energy system interact with each other, and with broader economic, innovation, social and political systems **to capture opportunities and overcome potential barriers**.*

Context and PhD project in brief

This PhD is part of the **SHIFT** ("Sustainable Horizons for Transport") project, aiming at:

- **Developing and applying tools** that integrate poorly understood factors as: modal shifts, fuel options, and consumer behaviour into scenario modelling.
- **Carrying out in-depth analysis** of future **transport policies** within the **Nordics up to 2050**.

Specific objectives

The PhD will provide

I. Support in building up a **novel Nordic energy system model (TIMES)** that better represents transport technologies, **national and international passenger and freight transport**, and modal shift as endogenous elements.
II. Enrichment of the developed model with **cutting edge and forefront transport technologies** and potential game changers as **car-sharing and car-pooling**, **electrified highways** and **autonomous cars** incorporated in a sophisticated way.
III. A **long-term scenario analysis** that takes into account the variable and optimizable nature of these elements, to assess how different **future transport policies** will impact the Nordic energy system under different assumptions, ending up with recommendations for policy makers.

Research Questions

How can we model the transport sector in TIMES models in order to carry out innovative future scenario analysis?

- *What is the best approach for incorporating emerging phenomena such as car-pooling, car-sharing, autonomous cars and electrified highways within the modelling framework?*
- *What is the best structure for including freight transport and urban logistic in a TIMES multi-regional energy model?*

Methodology

The modelling part is contextualized in a **linear optimization partial equilibrium modelling framework**, all the tasks with this respect will be carried out within a TIMES model describing the whole Nordic energy system.

At the first stage, the PhD will focus on building the **backbone** of the aimed model, structuring the different sectors composing the entire society from an energy perspective. **Background energy scenarios** will be implemented according to what outlined within the **Nordic Energy Technology Perspectives** (**NETP**) **2016**.

Then **the model will be enriched** with **forefront transport** technologies and **emerging phenomena** as **car sharing**, **car pooling, autonomous cars** and **electrified roads**. The vast experience in transport and in technology innovation held by the partnerships will support the modelling part when assessing **potentials and barriers** for the emerging technologies diffusion, besides providing data and **foresighted developments**.

The implementation of **these new elements** requires a revised transport sector structure compared to traditional TIMES models, which necessitates a vast amount of new data. Data will be collected from sources such as **transport surveys**, **transport experts workshops**, **National Transport models** (e.g. LTM in the case of Denmark).

The developed model will be applied for **future scenario analysis**, aiming at assessing the impact of specific selected transport policies on the whole Nordic energy system, tracking possible **synergies** or conflicts across sectors while reducing **energy-related CO_2** emissions in the whole **Nordics**.

Expected Outcomes

This PhD will provide a **Nordic TIMES model with a novel transport sector description**, such tool will be used within the SHIFT project to carry out future scenario analyses supporting smarter energy policies, ending up with **recommendations for policy makers**.

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Shift
Sustainable Horizons in Future Transport