Modelling alternative fuel production technologies for the future Danish energy and transport system

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Modelling alternative fuel production technologies for the future Danish energy and transport system

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How should we best value residual biomass resources?

The dependence on fossil fuels and lock-in effects in the infrastructure network have for long determined a slow pace in the transition to a transport sector based on renewable sources. While biofuels represent a possible alternative, biomass is a limited resource, which use is restricted by potential social, technical and environmental effects. Because residual biomass, e.g. straw in Denmark, inherently minimizes these negative impacts, it could lend itself to multiple options, including production of alternative transport fuels.

**Methodology**

Optimal scenario Cost-optimal combination of technologies

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**Key Results**

The bottom-up optimization model TIMES-DK covers the Danish energy system, allowing electricity and fuel exports, and it optimizes under the assumption of perfect foresight from 2010 through 2050. No primary imports of biomass are allowed for this study.

- **Objective function**
  
  \[
  \min \sum_{t=2010}^{2050} \sum_{y=0}^{1} \left(1 + d_{y,t}\right)^{(r-2010)} \cdot Cost_{r,y} \text{ subject to} \]

- **Resource bounds**
  
  \[
  \sum_{y=0}^{1} x_{y,C} \geq A_{C,y} \text{ for } Y \in C, R \in Y \]

- **Fulfillment of service demands**
  
  \[
  \sum_{y=0}^{1} w_{y,S} \geq D_{y,S} \text{ for } Y \in S, R \in Y \]

- **Emission targets constraints**
  
  \[
  \sum_{y=0}^{1} E_{y,C} \leq Target_{y,C} \text{ for } Y \in Y, R \in R \]

- **Future work**

  - How does plant location affect the final use of straw?
  - Recovery of process heat in district heating network
  - Geographical and temporal availability of biomass
  - Transportation of biomass from the field

- **How do we measure costs and benefits within the agriculture sector?**

  - Soil carbon stock: direct and indirect land use changes
  - Soil treatment: reutilization of process by-products
  - Future food production and dietary developments

- **What are the policy implications?**

  - Shaping the non-ETS CO2 quota market

**Further work**


**Literature**