Soft-Linking a TIMES Model and Sectoral Simulation Model for Individual Policy Measures

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• .... Modelling on the shoulder of giants

• Irish TIMES model development – Alessandro Chiodi

• CarSTOCK model development – Hannah Daly


Overview

• TIMES provides cost-optimal scenarios and technology pathways

• However, the results in certain sectors may be difficult (or infeasible) to achieve

• Simulation models can provide more detail for these sectors and hence can be used to inform individual policies and measures

• Creating a soft-link between these two models can be used to test and inform possible future policies

• A combination of the Irish TIMES model and a model of the Irish private car fleet (CarSTOCK) is presented
CarSTOCK Model

- The CarSTOCK model is a simulation model of the private car fleet in Ireland projected forwards to 2050.

- The model takes inputs of percentage share of car sales and drivers and projects the private car fleet stock and energy on an annual basis to 2050.

- Vehicles are disaggregated into a range of variables with given specific energy consumption for each type.

- This allows for the calculation of total energy and emissions in the private transport sector.
CarSTOCK Model

- The CarSTOCK model provides a higher level of detail of the transport sector than the Irish TIMES model
- Disaggregated by fuel type, engine band and age

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Process

80% GHG Emissions Reduction relative to 1990 by 2050

Irish TIMES Model

Private Transport Fleet

Private Car Fleet Emissions

Simulate Policy Measures

CarSTOCK Model

Higher Level Detail of Private Transport Fleet
The Low Carbon Roadmap – Irish TIMES Private Transport
(80% overall GHG Emissions Reduction by 2050 relative to 1990)

Private Car Fleet Emissions

Times 80% GHG Reduction
The Low Carbon Roadmap
Private Car Fleet

TIMES Private Car Fleet

Percentage Share of Fleet

Year

Diesel Cars
Petrol Cars
LPG Cars
Electric Vehicles
Ethanol
Biogas Vehicles
Plug in Hybrids
Private Car Fleet Emissions

- CarSTOCK BaU
- TIMES 80% GHG Reduction

Year: 2008 to 2050

Emissions in kt CO₂:
- 2008: 6,600
- 2010: 6,000
- 2015: 5,800
- 2020: 6,200
- 2025: 6,600
- 2030: 7,000
- 2035: 7,400
- 2040: 7,700
- 2045: 7,900
- 2050: 7,430

TIMES 80% GHG Reduction
CarSTOCK BaU
BaU Private Car Efficiency
CarSTOCK BaU

Private Car Fleet Emissions

Year

Kt CO₂

2008 2010 2015 2020 2025 2030 2035 2040 2045 2050

170 4,829 7,430

TIMES 80% GHG Reduction CarSTOCK Increased Efficiency CarSTOCK BaU
Only EV Sales from 2030

Private Car Fleet Emissions

- TIMES 80% GHG Reduction
- CarSTOCK Increased Efficiency
- Only EV Sales from 2030
- CarSTOCK BaU
EVs + Smarter Travel

Private Car Fleet Emissions

- TIMES 80% GHG Reduction
- CarSTOCK Increased Efficiency
- Only EV Sales from 2030 and Smarter Travel
- CarSTOCK BaU
CarSTOCK and TIMES Private Car Fleet Comparison

CarSTOCK vs. Irish TIMES Car Fleet

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<tr>
<th>Year</th>
<th>CarSTOCK</th>
<th>Irish TIMES</th>
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- **Petrol**
- **Diesel**
- **EV**
- **Ethanol**
Insights into Individual Policy Measures

• These results can be used to give several insights into individual policy measures:
  • Only selling Electric Vehicles from 2030 onwards
  • Introduction of incentives to create a shift towards public transport use or for better bicycle infrastructure
  • After that, introducing a scrappage scheme may be necessary to meet our 80% GHG reduction by 2050 according to TIMES
  • Otherwise it may be required to change the inputs for Irish TIMES.
Irish TIMES 82% EVs Constraint - Results

TIMES 80% CO₂ Vs. 82% EVs

- Agriculture
- Services
- Electrical generation
- Industry
- Industrial Processes
- Residential
- Transformation
- Transport

CO₂-80 vs. CO₂-80 82% Share RE
Conclusion

• Creating a soft-link between a sectoral simulation model with an optimisation model can provide insights into individual policy measures

• It can test a range of possible policies which could inform on the paths to be taken in reaching given targets

• It also creates an iterative methodology whereby the constraints of the optimisation model can be changed according to the sectoral simulation model

• This soft-linking methodology can be used with any sector in order to create effective policies

Thank You

Energy Policy & Modelling Group

www.ucc.ie/energypolicy
Survival Rates in CarSTOCK

\[ \text{Surv}_t(Y - v) = \text{Avg}_y \left( \frac{\text{Stock}_{t,y-(Y-v)}^{Y} - \text{Stock}_{t,y-(Y-v)}^{Y-1}}{\text{Stock}_{t,y-(Y-v)}^{Y-1}} \right) \]

\[ \text{Stock}_{t,v}^{Y} = \text{Stock}_{t,v}^{Y-1} \times (\text{Surv}_t(Y - v) + 1) \]
TPER in Ireland 2013

Total primary energy demand by sector in 2013

- 33 ktoe (33%) - Industry
- 24 ktoe (24%) - Commercial / Public
- 27 ktoe (27%) - Residential
- 15 ktoe (14%) - Transport
- 2 ktoe (2%) - Agriculture / Fisheries

Source: SEAI
Transport Energy Demand 2013

Share of transport energy demand by mode for 2013

- 1,842 ktoe (43.0%)
- 900 ktoe (21.0%)
- 430 ktoe (10.1%)
- 250 ktoe (5.8%)
- 151 ktoe (3.5%)
- 57 ktoe (1.3%)
- 42 ktoe (1.0%)
- 607 ktoe (14.2%)

Source: SEAI