

NISMOD Transport model overview and application

DAFNI Roadshow – focus on Transport Research
24th March 2021

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Presentation summary

- The ITRC approach using NISMOD
- Transport model overview
- Recent applications
 - Regional assessments:
 - Oxford-Cambridge Arc
 - England's Economic Heartland
- NISMOD visualisation on DAFNI



**NISMOD: National
Infrastructure
Systems Model**



The ITRC approach

Scenario-based assessment of future infrastructure options

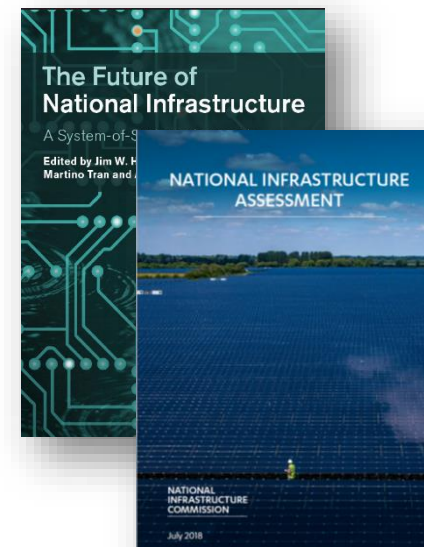


From 2011 the EPSRC-funded Infrastructure Transitions Research Consortium (ITRC) led by the University of Oxford has developed:



- The NISMOD national system-of-systems model (energy-transport-digital-water-waste) for long-term infrastructure planning in Britain
- National modelling of climate risks to infrastructure networks
- MISTRAL's multi-scale approach
- Assessment of the Oxford-Cambridge Arc

More information available at www.itrc.org.uk

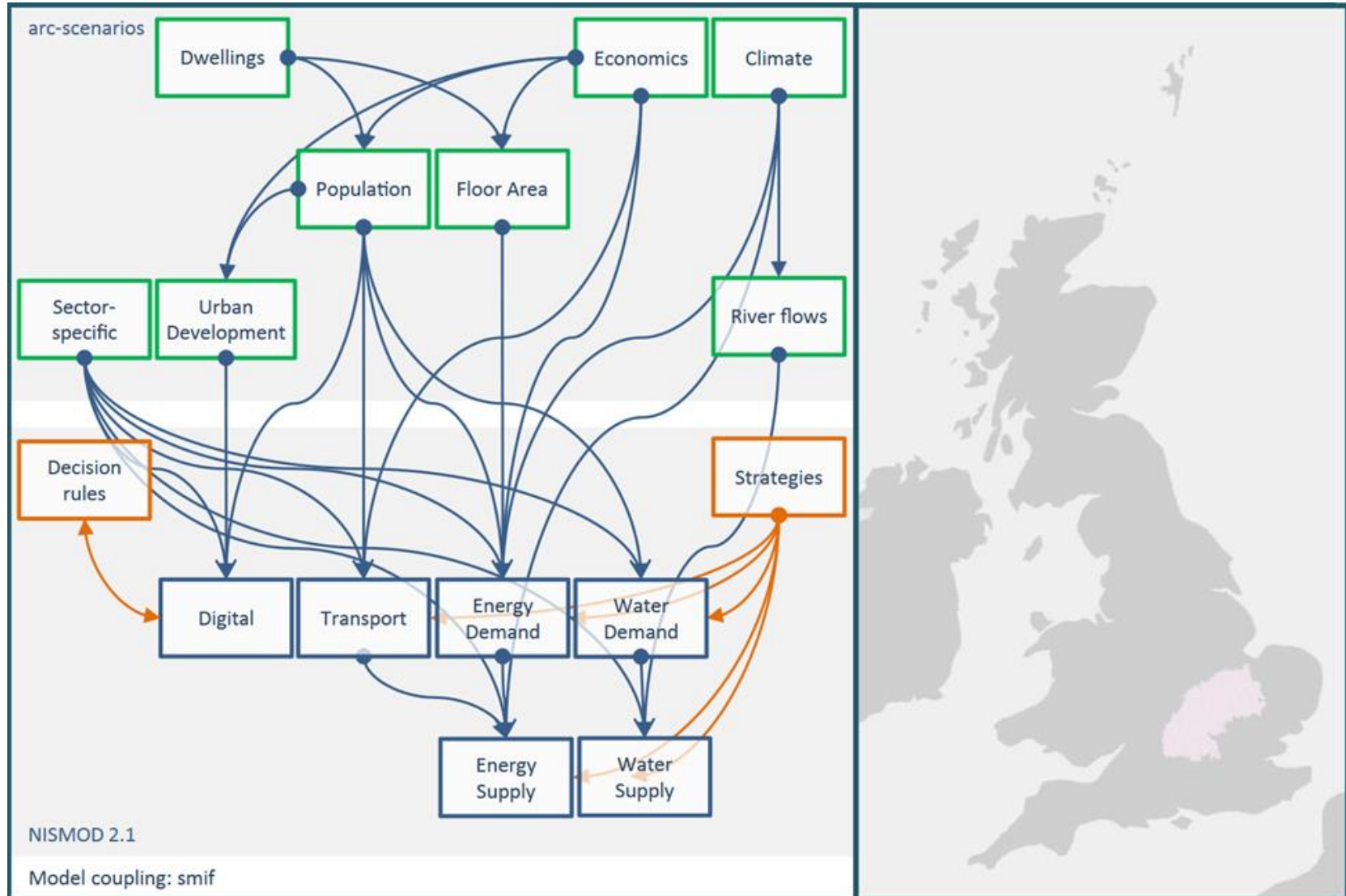


ITRC's data and open source codes are being migrated to DAFNI: the Data and Analytics Facility for National Infrastructure



ITRC's NISMOD

Scenario-based assessment of future infrastructure options



NISMOD Transport Model

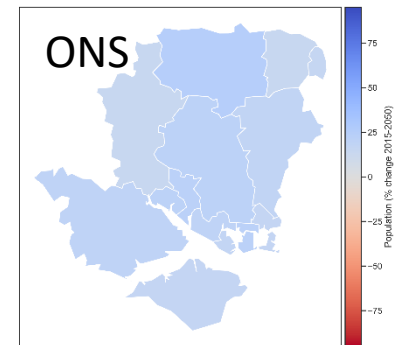
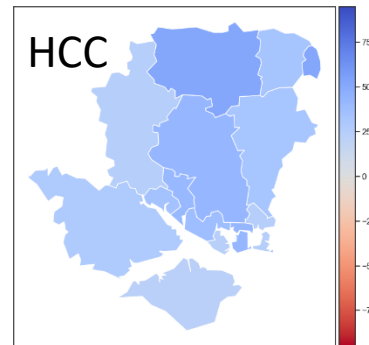


Road demand and capacity

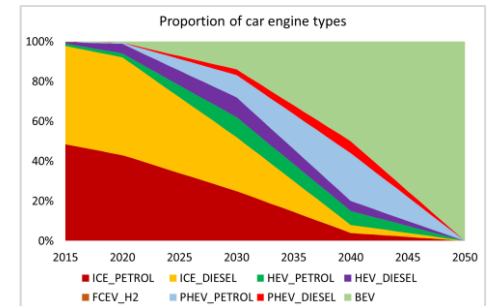
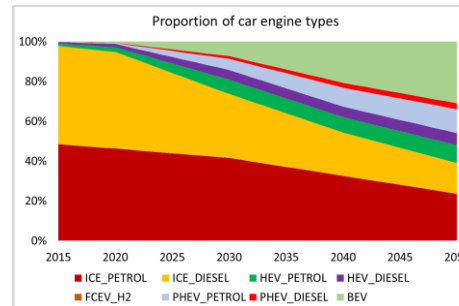
- Major road network (GB) (A-roads and motorways)
- 380 LADs / 7700 TEMPro
- OD Matrix (AADF count data)
- Calibrated with vehicle kilometres, trip length distribution, total number of car trips
- Offline route set generation

Input variables

- Population



- Changes to the fleet



- Changes to the network
- Congestion charging zones

NISMOD Transport Model

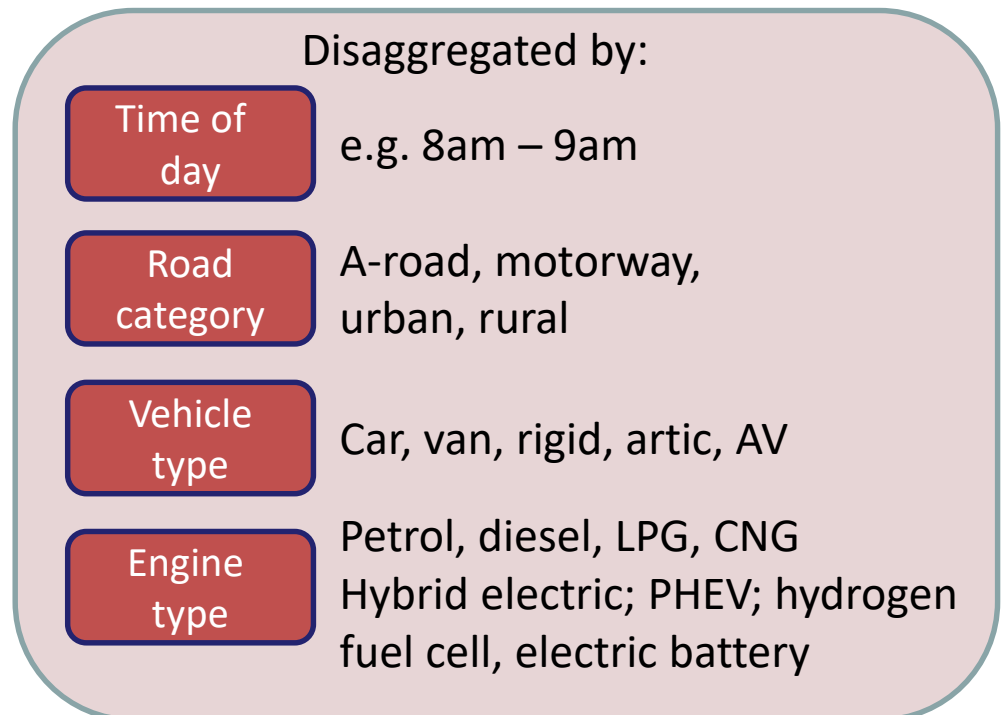
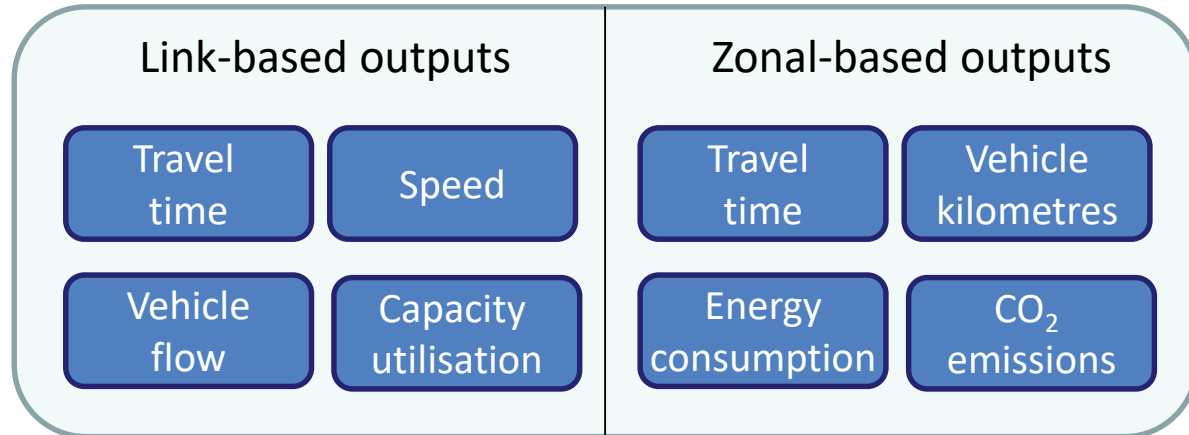


Road demand and capacity

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Railway station demand

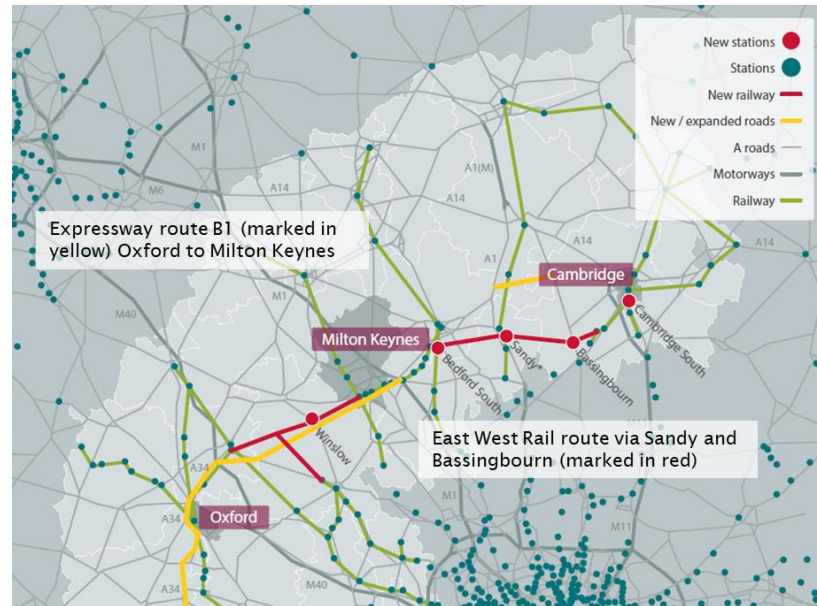
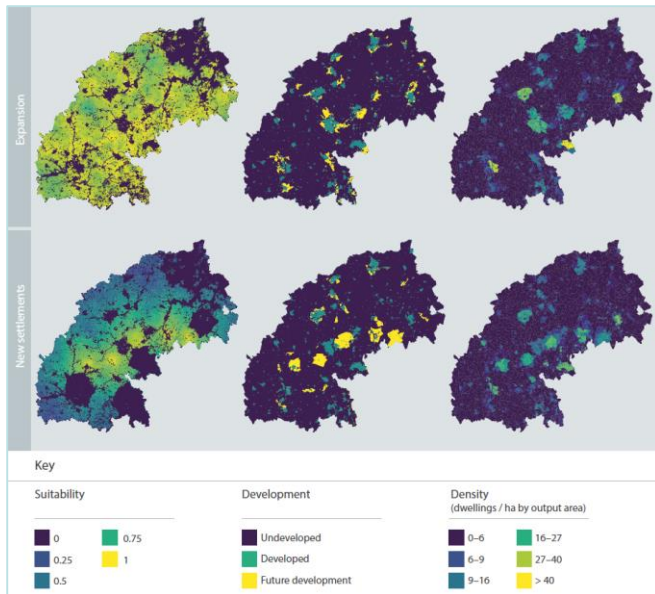
Airport demand and capacity



Recent applications: regional assessments

Oxford-Cambridge Arc

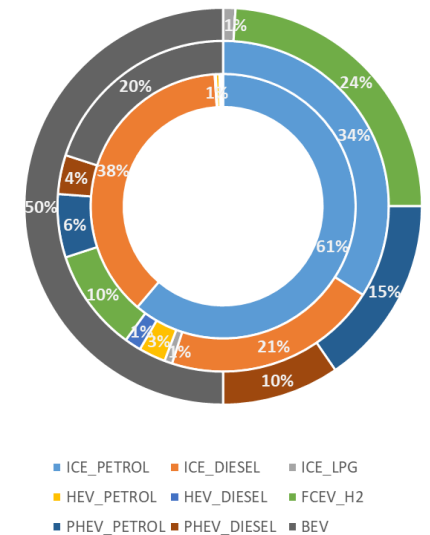
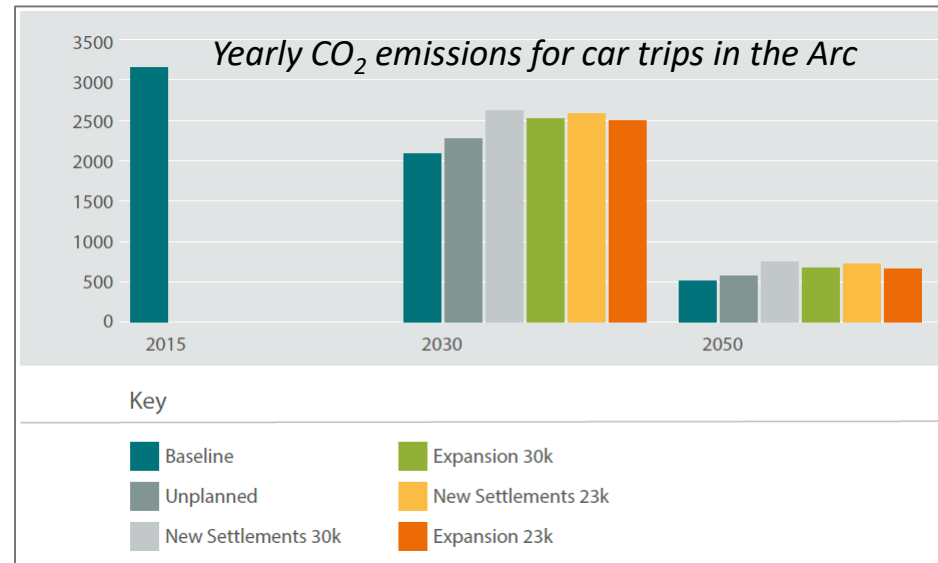
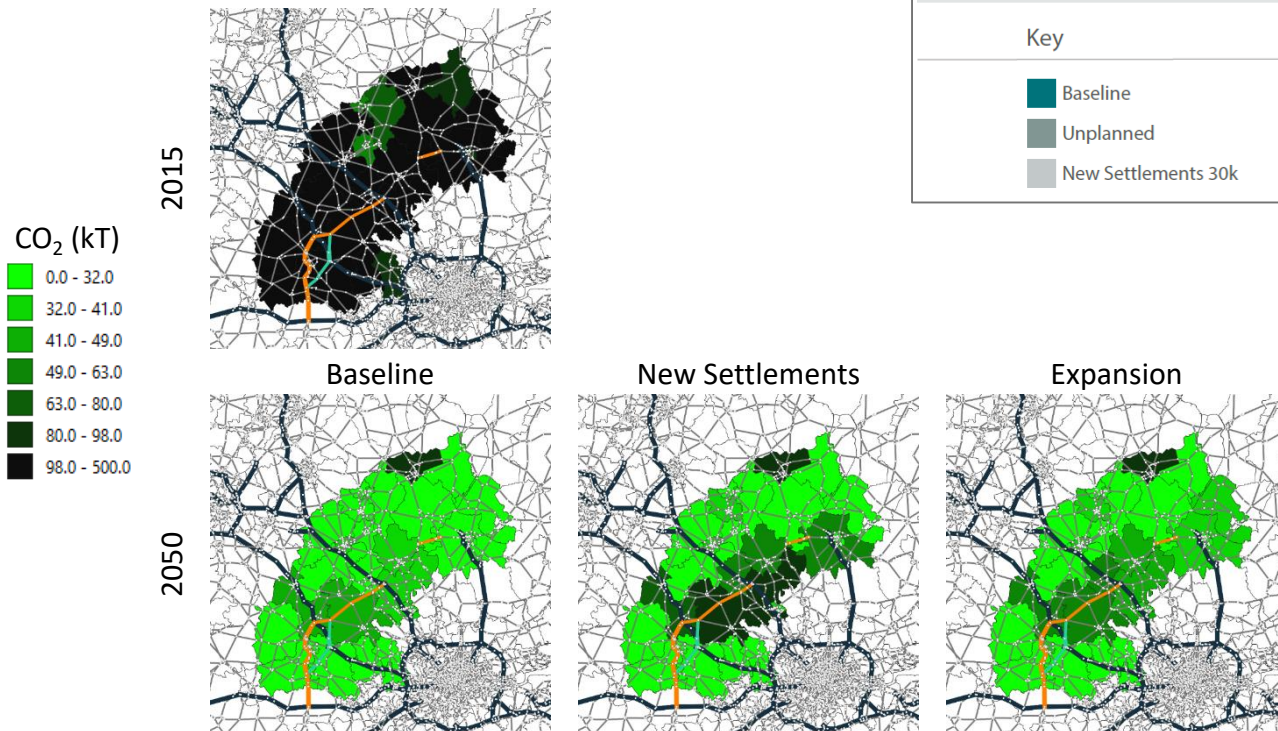
- Multiple growth scenarios, based on alternative approaches to development of new dwellings (23,000 – 30,000 per annum)
- Multi-sector analysis demonstrating all NISMOD capabilities
- Not implicitly strategy-based, although assessed transport options and decarbonisation of domestic heating



Recent applications: regional assessments

Selected results for road transport *Vehicle electrification and carbon footprint*

Despite population growth, conversion to electric vehicles would result in a sharp decrease in carbon emissions and other air pollutants by 2050, but would lead to substantial new electricity demand from the transport sector.

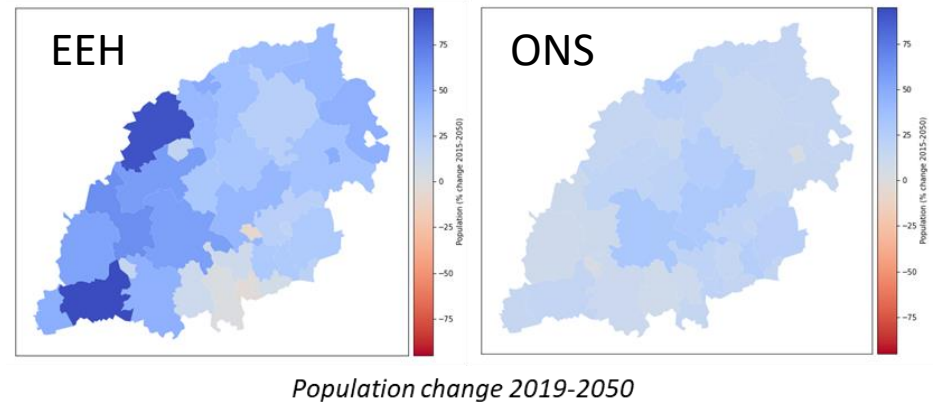


Vehicle electrification scenario with market shares of passenger car engine types (inside: 2015, middle: 2030, outside: 2050)

Recent applications: regional assessments

England's Economic Heartland (EEH)

- Single growth scenario, based on planned development to 2050
- Single sector assessment (transport)
- Multiple strategic approaches ('Pathways') to decarbonise transport to meet UK 2050 net-zero emission targets



Pathways to decarbonisation

All Pathways (except BaU) assume 100% zero-emission vehicles in 2050

- **Business as Usual (BaU)** – pre-Covid 'baseline'
- **Highly Connected (HC)** – ICT and embedded technologies
- **Adapted Fleet (AF)** – rapid technological development
- **Behaviour Shift (BS)** – more intensive use of fewer vehicles, modal shift.

Recent applications: regional assessments

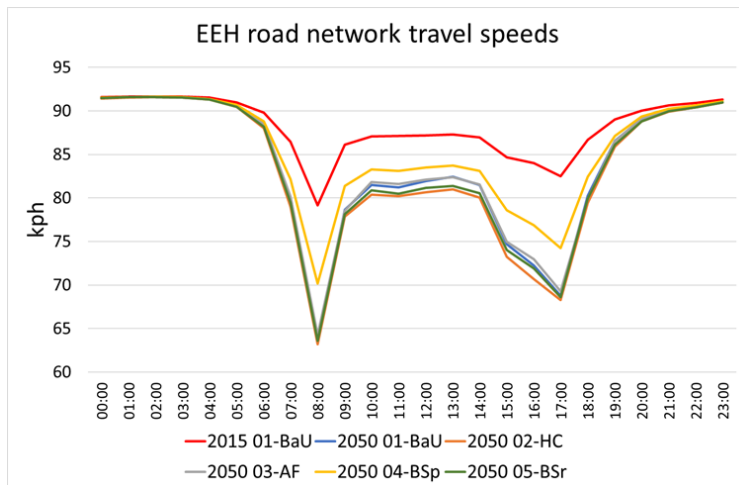
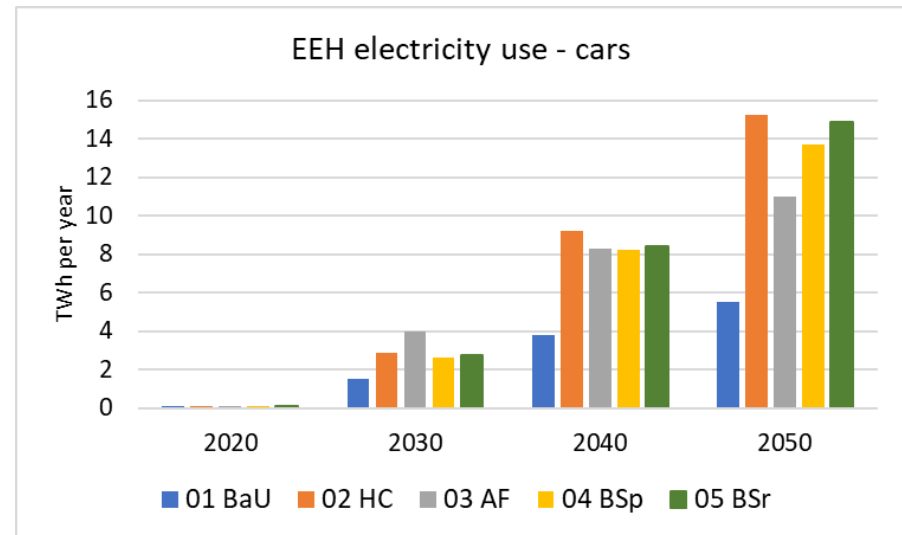
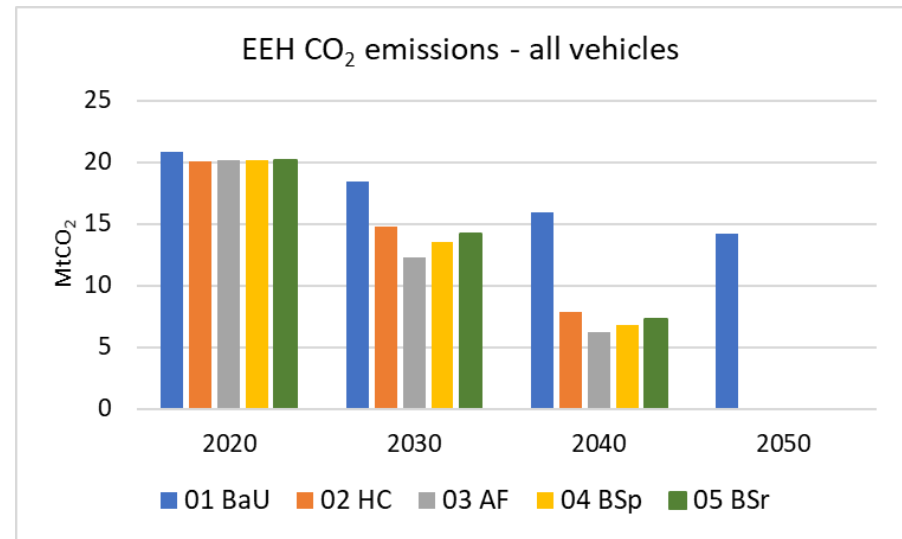
Selected results for road transport

Vehicle electrification and carbon footprint

Carbon emissions drop for all Pathways, but impact of more rapid conversion to electric vehicles is seen for 'Adapted Fleet', where technological improvements help limit electricity demand.

Congestion and traffic speeds

All Pathways have reduced network speeds in 2050, but the road pricing regimes in Behaviour Shift result in less congestion.



Transport model on DAFNI

NISMOD model run setup

The screenshot displays the DAFNI Workflow Status page. The workflow consists of the following steps: nismod2-..., decision, energy-2015, adaptor-2015, transport-2015, energy-transport..., publish, and End. The 'transport-2015' step is highlighted, and its details are shown below.

Step name: transport-2015

Model name: NISMOD - Transport (model v2.3.0 build 2)

Steps to include data from
adaptor-2015.

Parameters

Parameter	Value
Transport Sector Model	transport
Model Run	nic_ed_st_tr
Part of SOS Model	true
Use generated scenario	false
Timestep	2015

Dataslots

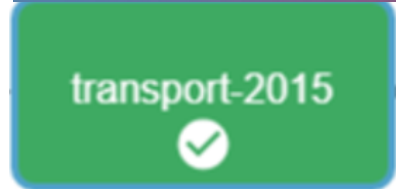
Name	Path to data	Datasets
Scenario Data	scenarios/	NISMOD Scenario data pack
Transport Model Data	transport/	NISMOD Transport data pack
LAD boundaries	lads/	Local Authority Districts (December 2016) Boundaries Local Authority Districts (December 2016) Ultra Generalised Clipped Boundaries in the UK

Step status: Succeeded

Status	Number of processes
Failed	0
Pending	0
Running	0
Succeeded	1



IRIDIS
High
Performance
Computing



Transport model on DAFNI

EEH analysis on DAFNI

☰ DAFNI
HELP

what is your input data?
csv eehCO2Emissions.csv ↓

Geometries

Add layers to plot

- line — ▾
- point ⚙️ — ▾
- + Add new geometry ▾

Aesthetics

Map columns to visual properties

- x year — ▾
- ↑ y CAR — ▾
- size Add
- color scenario — ▾
- + Add new aesthetic ▾

Columns

Drag columns to an aesthetic

- scenario — ▾
- year — ▾
- CAR — ▾
- ARTIC — ▾
- RIGID — ▾
- + Add new field ▾
- + Calculate new field

Filter data

for example: "datum.fieldName > 60" ([syntax](#))

Plot

SAVE PLOT
SAVE TEMPLATE

EEH CO₂ emissions - all vehicles

Transport model on DAFNI

EEH analysis on DAFNI

The screenshot displays the DAFNI web interface for EEH analysis. The top navigation bar includes the DAFNI logo and a 'HELP' link. Below the navigation bar, there are four dropdown menus for file selection: 'what is your input data?' (set to 'csv + topojson'), 'csv file' (set to 'eehLinkTravelTimes.csv'), 'csv id field' (set to 'edgeID'), 'topojson file' (set to 'eehNetwork.topojson'), and 'geometry id field' (set to 'EdgeID').

The interface is divided into several panels:

- Geometries:** A panel for adding layers to the plot. It shows 'geoshape' as the selected geometry and an 'Add new geometry' button.
- Aesthetics:** A panel for mapping columns to visual properties. It shows 'shape' mapped to 'geo', 'color' mapped to 'MIDNIGHT', and 'detail' mapped to 'edgeID'. There is an 'Add new aesthetic' button.
- Columns:** A panel for dragging columns to an aesthetic. It lists 'geo', 'year', 'edgeID', 'freeFlow', 'MIDNIGHT', and 'ONEAM'. There are buttons for 'Add new field' and 'Calculate new field'. A 'Filter data' section is also present with an example: 'datum.fieldName > 60' (syntax).
- Plot:** A visualization of the network graph. It features a 'SAVE PLOT' button, a 'SAVE TEMPLATE' button, and a legend for 'MIDNIGHT' with a color scale from 0 to 13. The plot shows a complex network of edges colored according to the 'MIDNIGHT' aesthetic.
- Vega-Lite Specification:** A panel for editing the Vega-Lite specification. It shows a JSON snippet:

```
{
  "data": {
    "url": "eehLinkTravelTimes.csv",
    "name": "table",
    "format": {
      "type": "csv"
    }
  },
  "mark": {
```

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with thanks to Milan Lovric, Simon Blainey and John Preston
for their inputs into previous work

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