**Transport emissions: modelling and analysis**

T&E's advocacy for greater ambition in emissions targets and reduction in greenhouse gas emissions is informed by its transport emissions modelling tools. Transport modelling provides a framework for comparing the effect of technological change and policy levers on energy use, activity, and greenhouse gas emissions in the sector. For road transport, we use the European Union Transport Roadmap Model (EUTRM). For aviation and shipping, we have developed modelling tools in-house.

**Road transport**

The EUTRM was originally based on the ICCT Global Transportation Roadmap Model (GTRM). In 2017 it was adapted to include the 27 EU member states plus the United Kingdom, Switzerland and Norway, adding the functionality of second-hand sales flows between member states. The upgrade was undertaken by Cambridge Econometrics (see User Guide here), but T&E constantly improves it. The EUTRM makes use of the most recently available data as well as detailed European-specific data. These data are kept up to date and as better data become available, they are updated.

In 2018, Cambridge Econometrics was commissioned to convert the passenger cars module into a full stock model. The stock model enables much more granular outputs with yearly resolution from the year 2000 to 2050. In 2021, T&E pythonised the spreadsheet models, extending the stock model to all road transport modes. During this process, a more accurate calibration procedure was developed. Converting the model to python allows us to develop tools based on hundreds of scenarios and to give greater flexibility for future development, for example adding vehicle segments (e.g. different truck categories), company cars, or second hand vehicle sales flows that are not constant in time.

The EUTRM is a demand driven model. All transport demand is then met with the required transport capacity through the sales of vehicles. Besides changing the composition of the new vehicle sales, we are able to implement pricing or modal shift policies to reduce demand and investigate the impact on energy and greenhouse gas emissions.

**Shipping**

T&E has developed in-house capabilities for the analysis and projection of shipping emissions. We started by analysing automatic identification system (AIS) signals from cruise ships to

determine pollution in ports. We have analysed and reported on the monitoring, reporting and verification (MRV) data, to assess the performance of different ship types and companies. T&E has purchased vessel characteristics databases and codified the emissions calculation as used in the IMO's Fourth Greenhouse Gas Study (2020). Combined with access to global AIS data from 70,000 ships, this capability enables us to analyse global shipping movements and their associated emissions. We have developed an in-house stock model of the European shipping fleet. This tool allows us to determine the emissions savings potential from operational and technological measures as well as the uptake of green fuels, to the end of better guiding law makers to implement the best possible policy for decarbonising the shipping sector, as we discuss in our 2021 report. Finally, our optimisation model allows us to predict how shipping companies would behave when faced with different regulatory constraints, incentives, fuel prices or other factors. This allows us to project the uptake of fuels in the shipping fleet for example under the FuelEU maritime regulation.

**Aviation**

T&E has several tools at its disposal for the analysis of European aviation emissions. We have a yearly update on ETS emissions that combines databases and data filling to give an accurate picture of the intra-EU aviation sector, both in terms of emissions and carbon pricing. We have purchased data from OAG on scheduled flights, which has enabled us to look at flights and their emissions to the granularity of airlines, airports, countries and individual routes. OAG also provides data on passenger journeys, giving information on the origin airport, stopover airport(s) if any, and destination airport, as well as the airline operating each leg and the cabin of the passenger. Both datasets have been combined to estimate the Tax Gap, or the current lost revenues from the aviation sector's poor taxation, and to model future potential emissions saving from better taxation. T&E has developed an in-house aviation model that has policy levers such as demand management, technology and e-fuel fuel uptake rates, which was used to elaborate T&E's Roadmap to climate neutral aviation in Europe.