Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Transportation in IAMs – A Brief Overview

Steven Smith and the EMF-30 Steering Group

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

UNIVERSITY OF MARYLAND

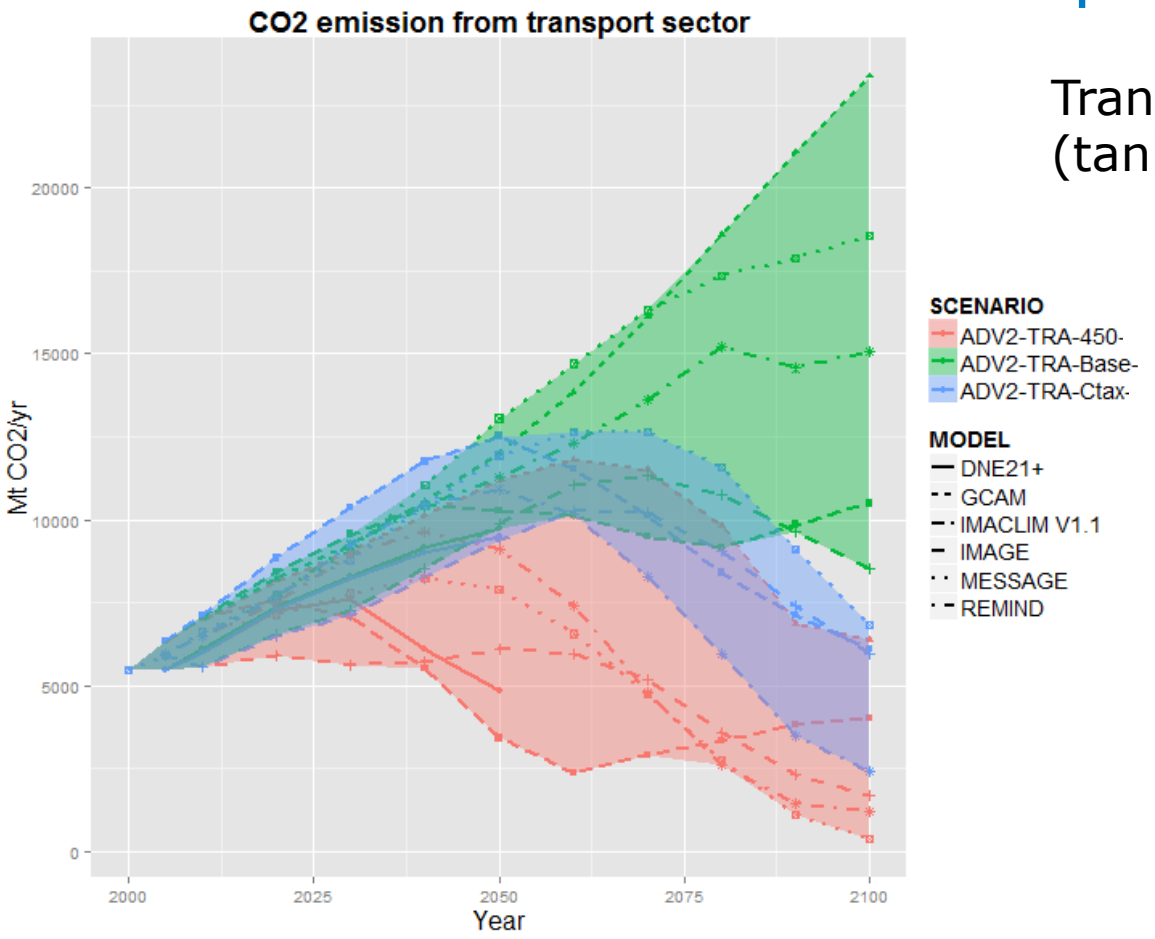
Context – Transportation and Emissions

The transportation sector contributes a large portion of global greenhouse and air pollutant emissions.

Species	Fraction	Uncertainty	
Small Fraction			
CH4	0.5%	NA	
NH3	1.0%	NA	
N2O	1.1%	NA	
Significant Fraction			
BC	16%	Very Large	~ factor of 2
CO	20%	Moderate (?)	~ 10-30%
SO2	12%	Small	~ 10% or less
CO2	20%	Small	
Dominant Sector			
NOx	41.9%	Large	

* Data circa 2000 for direct (downstream) emissions only.

Input and output data

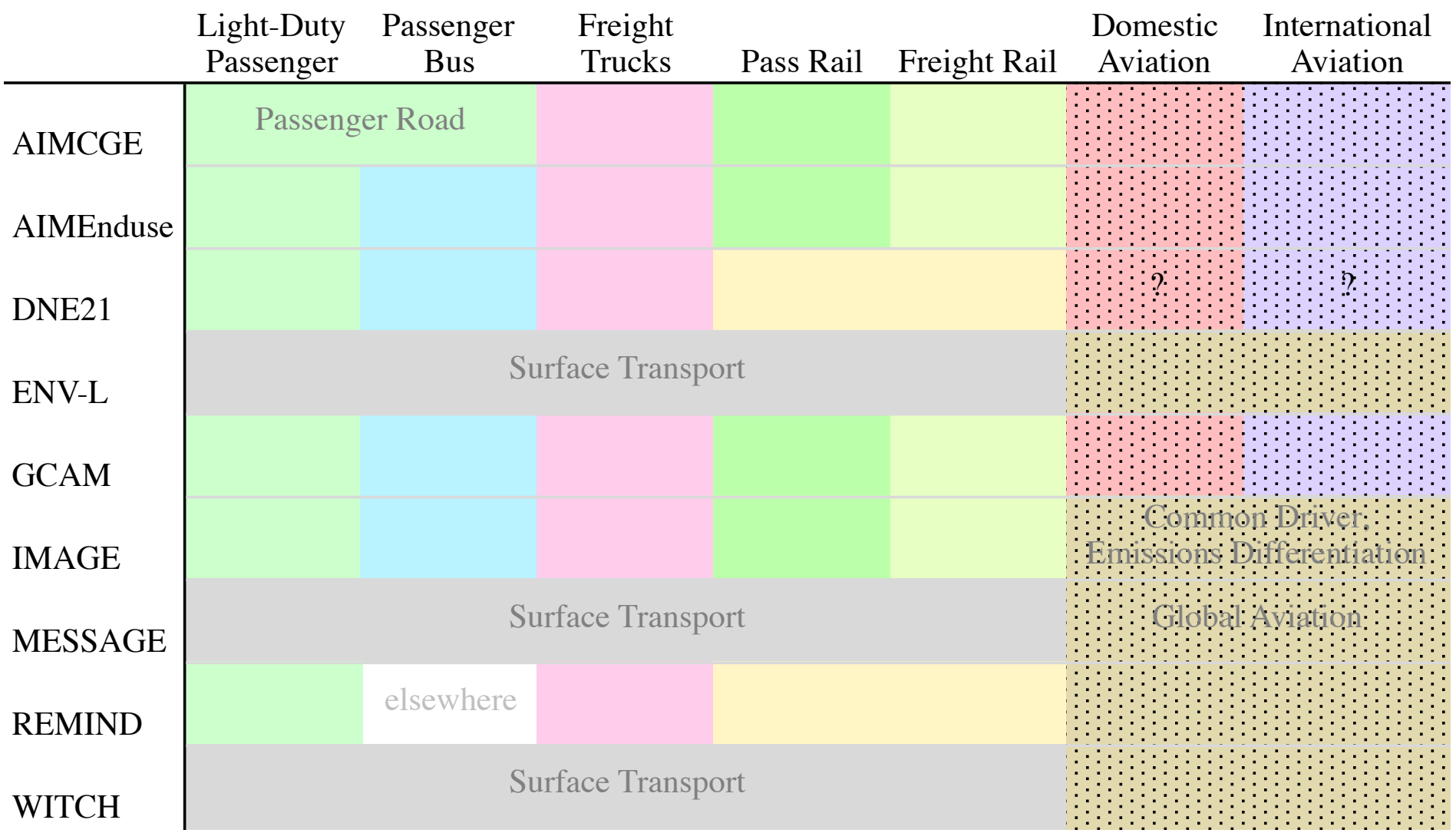


Transport CO2 projections (tank to wheel)

Transportation continues to be a key sector into the future: with results varying substantially between models.

IAMs Vary In Their Transportation Detail

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965



IAMs Vary In Their Transportation Detail

Models also vary in their technology detail

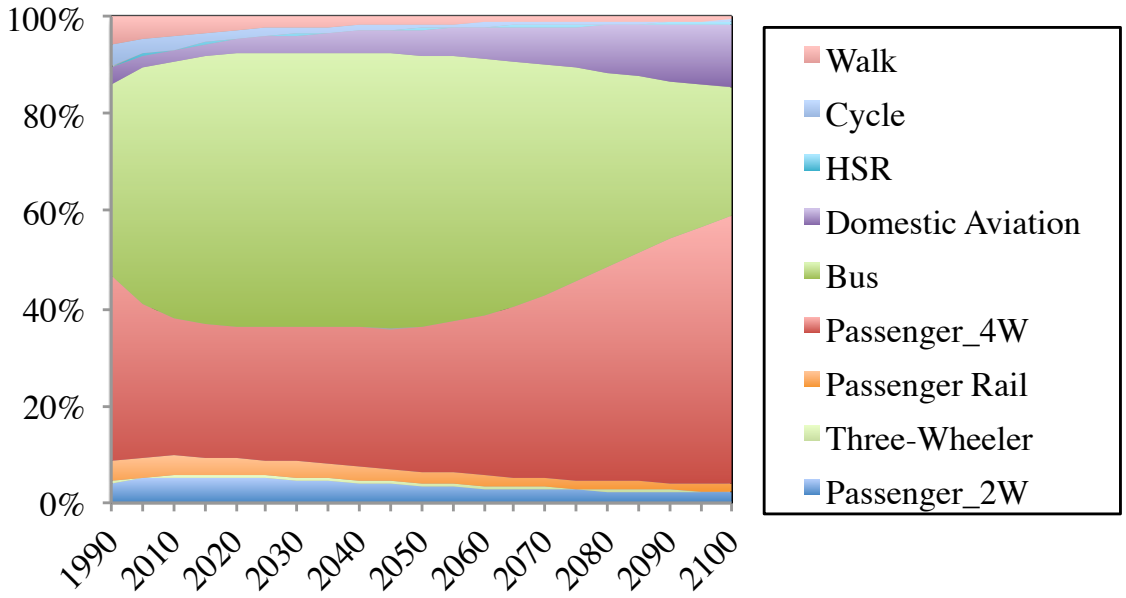
- Some level of fuel switching is generally present (electric, natural gas, hydrogen).
- A few IAMs distinguish between different petroleum fuels (e.g., diesel, gasoline), although the selection is often simplified.

For this sector, non-economic factors (infrastructure, range, convenience, style, etc.) are particularly large drivers for mode switching and also technology choice (e.g., fuel switching, although less so in some cases).

- Can be as much a scenario specification as endogenous modeling.

Distribution of transportation Service vs fuel consumption

Global Passenger Service Fraction (GCAM ref)

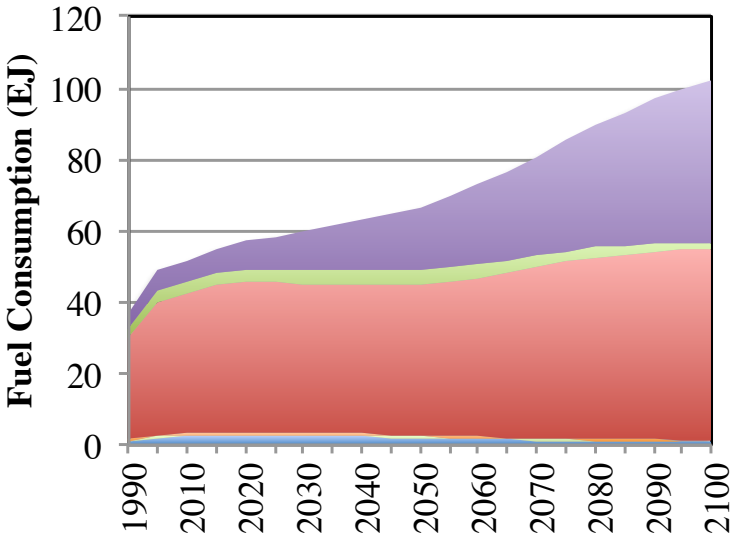


Buses and LDVs dominate transportation service, with both LDVs and higher speed modes (air, high-speed rail) increasing over the century.

However, light-duty vehicles (LDVs) and domestic air dominate liquid fuel consumption.

Service data and fuel use can have substantial uncertainties.

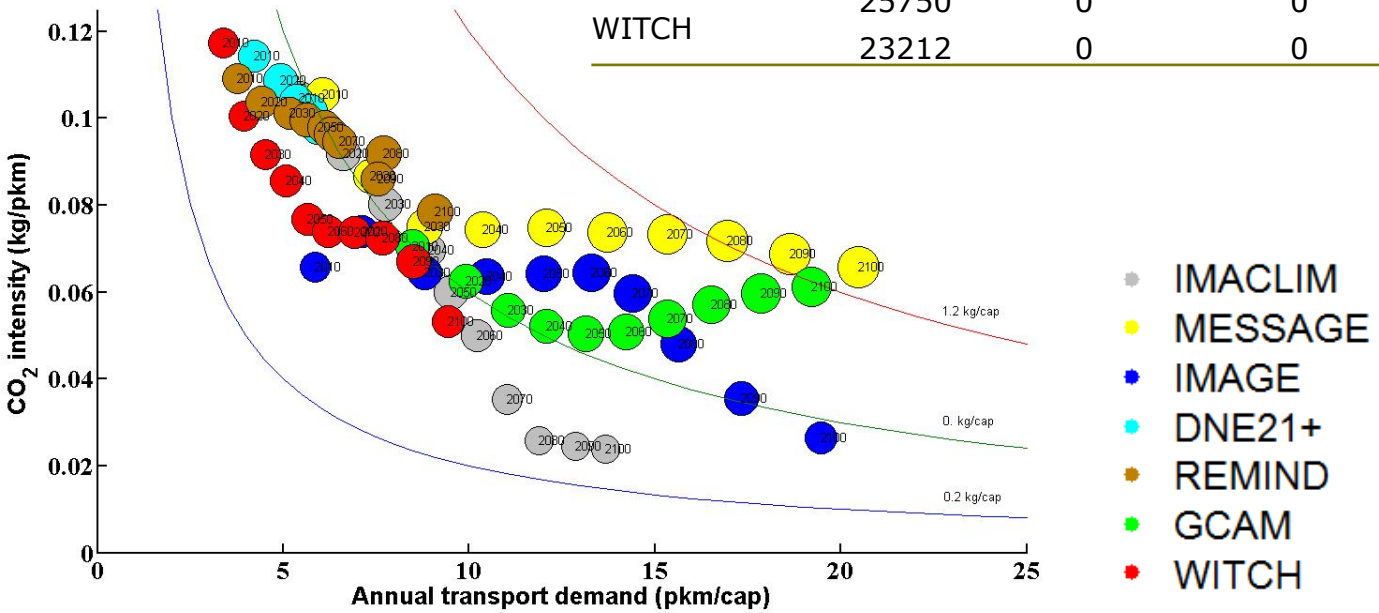
Global Liquid Fuel Consumption



CO2 intensity compared to transport activity

Baseline

Model	Car	Bus	2/3 Wheel	Aviation	Train	Total
DNE21+	19527	9663	0	0	0	29191
GCAM	23878	**22192**	4602	4371	3538	58582
IMACLIM V1.1	25210	10910	0	**1299**	0	37419
IMAGE	20000	12550	0	3710	4282	40542
MESSAGE	23328	8862	2174	4494	3151	42009
REMIND	25750	0	0	0	0	25750
WITCH	23212	0	0	0	0	23212



- IMACLIM
- MESSAGE
- IMAGE
- DNE21+
- REMIND
- GCAM
- WITCH

Ctax scen

Some Points for Pollutant Emissions

Overall scale of transportation demand is a major driver

- Passenger and freight transportation demand have both historically shown a strong, nearly linear, correlation with income.
  - Time is likely to be the long-term limiting factor for passenger demand.
  - Long-term constraints on freight are less clear.

Fuel demand is also a major driver

- The potential for fuel shifts are likely to be more important than mode shifts
  - A number of options for passenger vehicles (electric, CNG, hydrogen)
  - Freight trucks have fewer options (CNG, limited electrification, hydrogen)
- Mode shifts are more difficult to model and will depend on infrastructure and other details (good type , locations of suppliers and receivers, preferences).

Emission controls are a key driver, particularly near-term

- For many pollutant emissions, a small fraction of vehicles can contribute a large portion of emissions (super-emitters).
  - This becomes more important as controls strengthen

END