IEA ETP Transport Analysis
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Alex Körner
International Energy Agency
alexander.koerner@iea.org
Content

- ETP modeling framework
- IEA mobility model (MoMo)
- IEA transport database
- Emission mitigation policy analysis
Motivation – 2DS

To reach a 2 degree Celsius trajectory energy related emissions needs to be halved by 2050.
ETP modelling framework

- **Supply side:**
  - TIMES – Energy system least cost optimization, perfect foresight, high technology resolution, until 2050 (2075)
  - The 2DS is climate change driven – Constraint on emissions

- **Demand side**
  - Split into three sectoral models: Transport (MoMo), Industry and buildings
  - All demand side models are technology rich simulation tools which allow for sectoral projections energy use and policy analysis until 2050
IEA mobility model

- Spreadsheet model of global transport, energy use, emissions, safety, and materials use
  - Analysis of multiple scenarios with time horizon until 2050
  - Projections of future transport demand and vehicle stock based on hypotheses on GDP and population growth
  - Broad set of techno-economic parameters: fuel economy, technology costs, mileage, vehicle and fuel market shares, emission factors etc...

- World divided in 29 regions, incl. a good number of specific countries
  - USA, Canada, Mexico, Brazil, France, Germany, Italy, UK, Japan, Korea, China, India
  - The model is suitable for handling regional and global issues

- Based on a large amount of data on technologies and fuel pathways
  - Full evaluation of the life cycle GHG emissions
  - Cost estimates for new light duty vehicles
  - Estimates for fuel costs and taxes as well as fuel distribution infrastructure
  - Module on material requirements for LDV manufacturing

- It is based on the "ASIF" framework:
  \[ \text{Activity (passenger travel)} \times \text{Structure (travel by mode, load factors)} \times \text{Energy Intensity} = \text{Fuel use} \]
MoMo – Analytical capabilities

- For LDVs and trucks:
  - Technology uptake based on a stock model
  - Tracking of activity, intensity, energy use
  - GHG emissions (on a WTW, a TTW basis)
  - Pollutant emissions (CO, VOCs, PM, lead and NO\(_x\))
  - Fuel and vehicle costs (only for LDVs)

- For buses, 2/3 wheelers, stock, tkm, stock efficiency, energy use and emissions are tracked

- For rail and air total travel activity (in pkm or tkm), stock efficiency, energy use and emissions are tracked

- For shipping, so far just energy use and emissions are tracked

- Material requirements and emissions have been integrated in the model
  - Analysis of future vehicle sales (e.g. fuel cells) and how they impact materials requirements (e.g. precious metals, Li) is possible
  - Full life-cycle analysis for GHG emissions from LDVs (including manufacturing);
  - Tailpipe emissions of various pollutants for road modes
Coverage of transport modes

- 2-3 wheelers

- Light duty vehicles (PLDV, LCV, minibuses)
  - Internal combustion (gasoline/diesel/CNG/LPG)
  - Hybrids (gasoline/diesel)
  - Plug-in hybrids (gasoline/diesel)
  - Fuel cell vehicles
  - Electric vehicles

- Heavy duty vehicles
  - Passenger
    - Buses
    - BRT systems
  - Freight
    - Medium freight trucks
    - Heavy freight trucks

- Rail (passenger, freight)
  - High-speed rail (to be added in 2013)

- Air (only passenger, new module under dev.)

- Water transport (only freight, new module under dev.)
- Transport database covers 33 single countries and 8 aggregate regions
- Stock, sales, travel, mileage, fuel economy are tracked by road vehicle mode, type, power-train and energy source
- Transport database and ESD energy balances allow for bottom-up vs. top-down comparison of fuel use data
The combination of the transport database and ESD fuel use allows for robust fuel split.

Oddities in ESD tracking can be spotted via plausible transport assumptions on uncertain data.
Basic indicators

- **Input data for tracking and scenarios:**
  - Activity data & structure data – transport demand and structure data
    - Vehicle stocks
    - Mileage
    - Mode shares, load factors
    - Travel data – pkm/tkm
    - Bottom up (pkm/tkm)
  - Intensity data – specific fuel consumption of different transport modes (l/100km, mls/gal etc. converted to energy based on LHV of fuels)
  - Fuel data – specific carbon content of different transport fuels (well-to-tire, well-to-wheel)
  - Cost data – Specific vehicle purchase costs, fuel costs for various fuel pathways

- **Incomplete, inconsistent, not available for all countries**
- **Hard to measure: Gap factor between tested and on road FE**
- **Very fuel and region specific, big uncertainties e.g. ILUC emissions**
- **Very region specific: e.g. size classes**
Sources

- IEA data: Energy Balances (Beyond 2020), Energy Indicators
- Official data – National/international stats, government/ministries
  - Eurostat, BTS, EPA, EEA, MLIT, NRC, Transport ministries, RosStat, UNECE, IEEJ...
- Associations
  - JAMA, OICA, ACEA, ANFAVEA, ACEM, FCAI, NAAMSA, IRF, KAMA...
- Public & private research institutes
  - ORNL, TREMOVE, NIIAT, Tsinghua University, ANL, DLR, ARAI, ITS, UC Davis...
- Industry/consulting
  - Marklines, POLK, Walsh, car and truck manufacturers...
The CV subsector is very diverse

Fuel use of CVs highly depend on mission profile and load

In the analysis the proper balance of detail vs. data availability needs to be found

- 68 individual countries to be pulled out
- 33 pulled out as individual files at the end of 2012
World’s mobility habits are diverse

- Most regions and countries increasingly relying on energy intensive transportation modes
Transport energy demand doubled in the last thirty years
Going back to 2000 CO$_2$ levels in 2050

- Pushing technology to its maximum potential is not enough to meet the 2DS target for transport
- A three-pillar strategy is needed: Avoid/Shift/Improve
Avoid/Shift/Improve – Energy use

- By 2050 approx 20% reduction of energy use due to avoid/shift
PLDV sales: Tripling until 2050

- Growth takes mainly place in non-OECD countries
- Technology portfolio need to substantial evolve to reach 2DS
A low carbon future may save money

- More than USD 60 trillion saved over the next 4 decades by saving fuel, and also reducing vehicle and infrastructure spendings.
Tackle Fuel Economy Now!

- Traditional powertrains biggest saving potential
- 2020 Target: 5.6 Lge/100km on average worldwide
- Policy options: FE standards, taxation, monetary incentives e.g. feebate systems
EVs need to come out of age

- *EV sales need to be doubled each year until 2020*
- *In the (very) short term we are on track: 120,000 EVs sold in 2012*

Each production/sale shown here is assumed to be constant after the year OEM announced/reported.
IEA initiatives: GFEI & EVI

- **Global fuel Economy Initiative**: How can we maximize the benefits of fuel efficiency in LDVs on a global scale, given the projected expansion of the global fleet?
  
  GFEI target: reducing new vehicle fuel consumption by 50% until 2030

- **EVI**: Announced at the Clean Energy Ministerial July 2010
  
  - 15 countries: China, Denmark, Finland, France, Germany, India, Italy, Japan, Netherlands, Portugal, South Africa, Spain, Sweden, United Kingdom, United States

- Three primary objectives:
  
  - Common data collection/analysis efforts
  - Greater RD&D collaboration
  - City forum that links cities within EVI countries
GFEI – target and progress tracking

- New vehicles in OECD almost achieve the GFEI annual fuel consumption reduction target
- New vehicles in Non-OECD show a slight annual fuel consumption reduction over the last three years
- The global reduction rate is still far off the target due to a shift in market from OECD to non-OECD

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<td>OECD average</td>
<td>8.1</td>
<td>7.6</td>
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<td>-2.3%</td>
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<td>Non-OECD average</td>
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<td>GFEI target</td>
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GFEI – Data, analysis and outreach

- **Data work** - Global and regional fuel economy baseline
- **Analysis and progress tracking** - Effect of FE policies in OECD countries
- **Outreach**: Attracting Non-OECD countries to implement FE policies
Already published & transport related

- Transport, Energy and CO₂ (2009)
- Energy Technology Perspectives (2010)
- Technology Roadmap on Electric Vehicles (2011)
- Energy Technology Perspectives (2012)
- EV City Casebook (2012)
- Railway Handbook (2012)
- Nordic Energy Technology Perspectives (2013)
- Global Electric Vehicle Outlook 2013
Transport publications 2013/2014

- ETP 2014
- Technology Roadmap on Hydrogen
- IEA Featured Insights Paper on Fuel Costs
Who supports this work?

Now 13 partner institutions; 6 have been financing the project development since the end of the SMP

Institute for Transport Policy Studies (ITPS - a Japanese research institute) joined the project in 2009, after VW in 2008.

US DoE also joined in 2010, and UITP / ICCT in 2011, UC Davis and Volvo in 2012.
Thanks!