Modelling of very low Carbon Transport Pathways

Transport Day
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IEA supports the low-carbon transition

IEA: the global energy authority

- Part of the OECD family
- Founded in 1974 to co-ordinate a response to oil supply disruptions
- 2015: IEA Modernisation grounded on three main pillars
  - global energy security
  - energy cooperation and global dialogue
  - promoting an environmentally sustainable energy future
- Build on a decade of analysis on what we need to do to keep temperature increase below 2°C
- Now developing analysis on faster and deeper energy-sector decarbonisation
Sizing the scale of the challenge... ... and its solutions

The carbon intensity of the global economy can be cut by two-thirds through a diversified energy technology mix.
But the challenge increases to get from 2 degrees to “well below” 2 degrees.

Energy- and process-related CO$_2$ emissions by sector in the 2DS

- Agriculture 2%
- Buildings 8%
- Industry 33%
- Transport 24%
- Other transformation 4%
- Power 29%

Industry and transport account for 75% of the remaining emissions in the 2DS in 2050.
Systems thinking and integration

Today’s energy system paradigm is based on a unidirectional energy delivery philosophy.
A sustainable energy system is a smarter, multidirectional and integrated system that requires long-term planning for services delivery.
ETP model finds cost-effective investment and operation of energy technologies to meet energy demands from now to 2050
Looking at interactions between energy technologies

Flexible uses in conversion sector

Energy storage

Fuel costs

Potentials

Flexibility generation

Technical and economic characteristics

Demand side management

Fuel demand

Electricity and heat demands

Load curves

Transport DSM

Rail

EV/PHEV

Buildings DSM

Elec. appliances

Elec. water boiler + storage

Heat pumps

Industry DSM

Chloralkali electrolysis

Aluminium electrolysis

Electric arc furnace

Compressed air

Electricity storage

Pumped storage

CAES

District heat storage

Process heat storage

Elec. DH boilers

H2 electrolysis + storage

Fuel supply

Flexible generation

Transmission and distribution

District heat grid

Electricity prices

Average generation costs

Generation mix

New capacities

Emissions
Understanding transport impacts: Mode matters

Well-to-wheels GHG emissions in 2015, by mode

Transport is the least diversified energy demand sector
Solutions need to be adapted transportation modes
Passenger transport activity: Mode matters

National passenger transport activity (pkm) in 2015, by mode

While activity is almost 50% higher in China than in the US...
While China’s activity is almost 50% higher than in the US... Its total energy use is only a bit more than half that of the US
Need to decouple activity & emissions
Avoid/shift, vehicle efficiency, low carbon fuels

GHG Emissions in the 2DS, 4DS, and 6DS – 2010 to 2050

OECD transport emissions have peaked, while Non-OECD transport emissions can be brought back to current levels in 2050.
Transport energy demand projections

Policy and technology have great potential

Global Energy for Transport in 2015 & in 2050 in the ETP Scenarios

2DS sees a net global decline in transport energy demand, but not in all regions
Moving below 2DS reductions in transport will require action in all transport modes.
IEA 2DS level of ambitions – How can we move beyond?

### Cars and LCVs

**2DS**

- Gasoline ICE
- Diesel ICE
- CNG/LPG
- Hybrids

**4DS**

- Gasoline ICE
- Diesel ICE
- CNG/LPG
- Hybrids

2050 4DS-2DS emission cuts over 4DS baseline: **62%**

**MEDIUM-HIGH**

### 2-3 Wheelers

**2DS**

- Gasoline ICE
- Diesel ICE
- CNG/LPG
- Hybrids

**4DS**

- Gasoline ICE
- Diesel ICE
- CNG/LPG
- Hybrids

2050 4DS-2DS emission cuts over 4DS baseline: **82%**

**HIGH**
IEA 2DS level of ambitions – How can we move beyond?

**Trucks**

<table>
<thead>
<tr>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
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<tbody>
<tr>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
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</tbody>
</table>

- Gasoline ICE (urban)
- Diesel ICE (urban)
- CNG/LPG (urban)
- Hybrids (urban)
- Plug-in electric (urban)
- Electric (urban)
- Fuel cell (urban)

2050 4DS-2DS emission cuts over 4DS baseline: **36%**

**Maritime transport**

- Avoided demand
- Larger ships
- High efficiency: new ships
- High efficiency: Retrofits
- Switching to LNG (25% by 2050)
- Switching to biofuel (25% by 2050)

Preliminary results of updated projections (higher 4DS, stabilization in 2DS)

2050 4DS-2DS emission cuts over 4DS baseline: **63%**

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IEA 2DS level of ambitions – How can we move beyond?

**Aviation**

“the only global industry-wide body to bring together all aviation industry players so that they can speak with one voice”

**Stabilise**

From 2020, net carbon emissions from aviation will be capped through carbon neutral growth.

50%  
By 2050, net aviation carbon emissions will be half of what they were in 2005.


IEA 2DS reflects ATAG goals without taking into account of any offset

2050 4DS-2DS emission cuts over 4DS baseline: **78%**

**Cross-cutting Technologies**

- Biofuels
- Hydrogen

**Non-Technology Options**

- Modal Shifts
- Urban Design/Logistics
### Implementing actions

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<thead>
<tr>
<th>Scope</th>
<th>Policy category</th>
<th>Impact</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Avoid/Shift Vehicle efficiency Low carbon fuels</td>
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<tr>
<td>Local</td>
<td>Pricing (congestion charges, tolls parking fees)</td>
<td>Possible</td>
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<tr>
<td></td>
<td>Regulatory (access &amp; parking restrictions, low emission zones)</td>
<td>Possible Minor</td>
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<tr>
<td></td>
<td>Public transport investments</td>
<td>Possible</td>
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<td></td>
<td>Compact city</td>
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<tr>
<td>National</td>
<td>Fuel taxation</td>
<td>Possible</td>
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<tr>
<td></td>
<td>Fuel economy regulations</td>
<td>Possible</td>
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<td></td>
<td>Vehicle taxation, feebates</td>
<td>Possible Possible</td>
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<td>Low carbon fuel standards</td>
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<td></td>
<td>Alternative fuel mandates</td>
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<td></td>
<td>RD&amp;D support</td>
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Sustainable Transport Systems analysis: the IEA Mobility Model and ETP

- Foundation of transport-related analysis in the IEA
- Projections to 2050+, 29 global regions (including most of G20), all transportation modes except pipelines
- Assess urban and non-urban activity, energy use, emissions (GHG, pollutants), infrastructure and materials demand
- Shared with OECD Directorates (TAD), ITF
- Developed in the framework of a partnership with major industrial and governmental stakeholders, some academic institutions and NGOs (MoMo partnership)
Sustainable Transport Systems analysis: the IEA Mobility Model and ETP

- **ETP uses ASIF** (activity–structure–intensity–fuel) methodology
  - **Activity** = Distance travelled
  - **Structure** = Vehicle Stock
  - **Intensity** = Fuel Economy

- Sustainable Transport Systems analysis: the IEA Mobility Model and ETP
IEA data coverage and transparency – Understanding energy use patterns

Fuel use in Argentina

![Graph showing fuel use in Argentina from 1970 to 2009. The graph includes data for Energy Use (ktoe), Gasoline, Diesel, CNG, and ESD official Stats.]
IEA data coverage and transparency – Understanding energy use patterns

Fuel use in China
The IEA works around the world to support an accelerated clean energy transition that is enabled by real-world **SOLUTIONS** supported by **ANALYSIS** and built on **DATA**.
Thank you

Explore the data behind ETP

www.iea.org/etp

www.iea.org/statistics