World Outlook for Transport-Related GHG Emissions

Summary of and Personal Reflections on the WBCSD's Sustainable Mobility Project

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The World Business Council for Sustainable Development (WBCSD)

- **“A coalition of 170 international companies united by a shared commitment to sustainable development via the three pillars of economic growth, ecological balance, and social progress”**
- **WBCSD members are drawn from more than 35 countries and 20 major industrial sectors**
- **WBCSD issues reports that are the responsibility of the entire membership; also provides logistical support and structure for member-led sector projects**
- **The Sustainable Mobility Project (SMP) was a member-led sector project**

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Sustainable Mobility Project Members

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The SMP's Final Report: *Mobility 2030*

- **Defines "sustainable mobility" and provides indicators for measuring it**
- **Provides a frank assessment of outlook if present trends continue**
- **Proposes seven goals for improving outlook**

Report and supporting material available at www.sustainablemobility.org

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Goal 2: Limit transport-related GHG emissions to sustainable levels

"We accept that society's long-term goal should be nothing less than to eliminate transportation as a major source of greenhouse gas emissions. Yet even under the most favorable circumstances, achieving this goal will take longer than the time frame of this report"

***Mobility 2030 Overview*, p. 21.**

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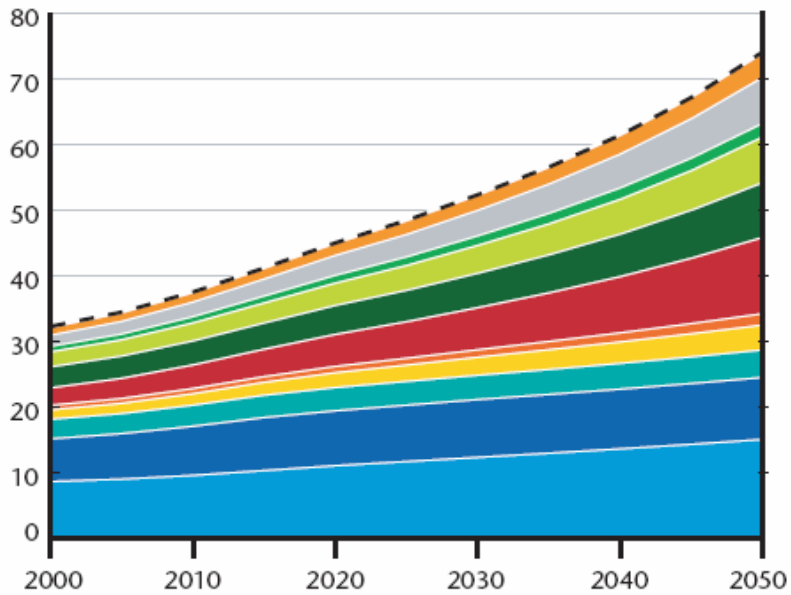
SMP's reference case projection of transport-related GHG emissions

- **Inputs required**
  - Volume of transport activity and modal composition
  - In-use fleet average energy consumption per unit of transport activity for each mode
  - Mix of fuels employed and well-to-wheels GHG emissions characteristics of these fuels
- **Need credible and transparent way to make projections**
  - IEA/SMP Spreadsheet Model (Lew Fulton)

Projected personal transport activity by region



	Average Annual Growth Rates 2000-2030	2000-2050
Total	1.6%	1.7%
Africa	1.9%	2.1%
Latin America	2.8%	2.9%
Middle East	1.9%	1.8%
India	2.1%	2.3%
Other Asia	1.7%	1.9%
China	3.0%	3.0%
Eastern Europe	1.6%	1.8%
Former Soviet Union	2.2%	2.0%
OECD Pacific	0.7%	0.7%
OECD Europe	1.0%	0.8%
OECD North America	1.2%	1.1%

Source:
Sustainable Mobility Project calculations.

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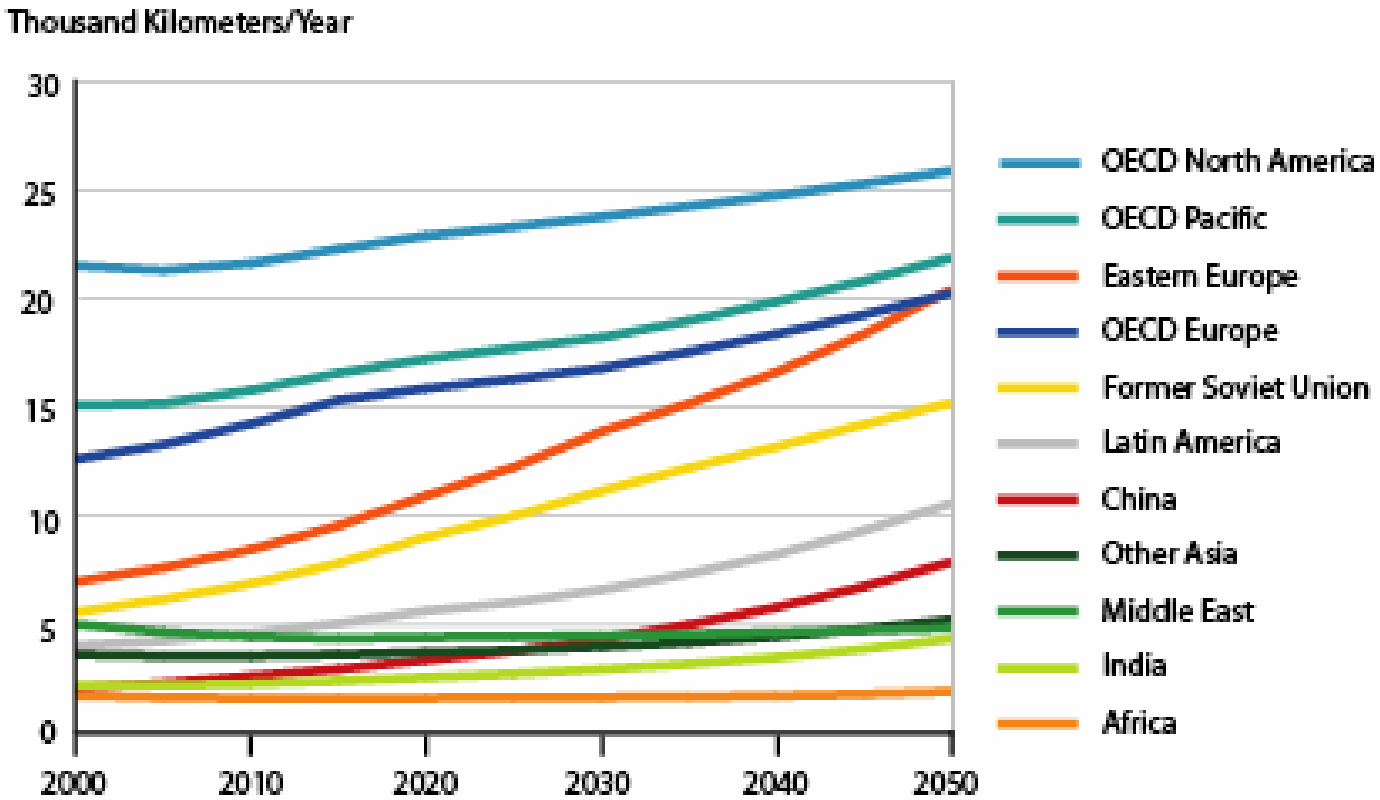
Projected per capita personal transport activity



Source:
Sustainable Mobility Project calculations.

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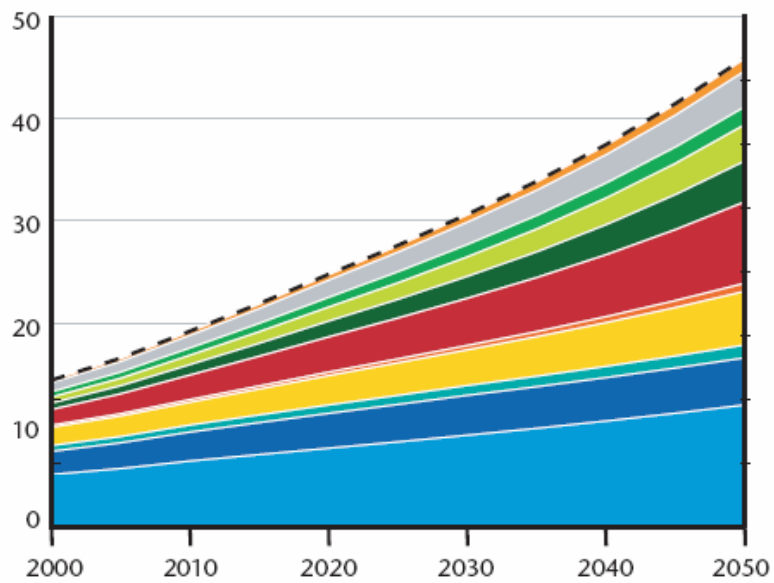
Projected road and rail freight activity by region



	Average Annual Growth Rates 2000-2030	2000-2050
Total	**2.5%**	**2.3%**
Africa	3.4%	3.1%
Latin America	3.1%	2.8%
Middle East	2.8%	2.4%
India	4.2%	3.8%
Other Asia	4.1%	3.7%
China	3.7%	3.3%
Eastern Europe	2.7%	2.8%
Former Soviet Union	2.3%	2.2%
OECD Pacific	1.8%	1.6%
OECD Europe	1.9%	1.5%
OECD North America	1.9%	1.7%

Source:
Sustainable Mobility Project calculations.

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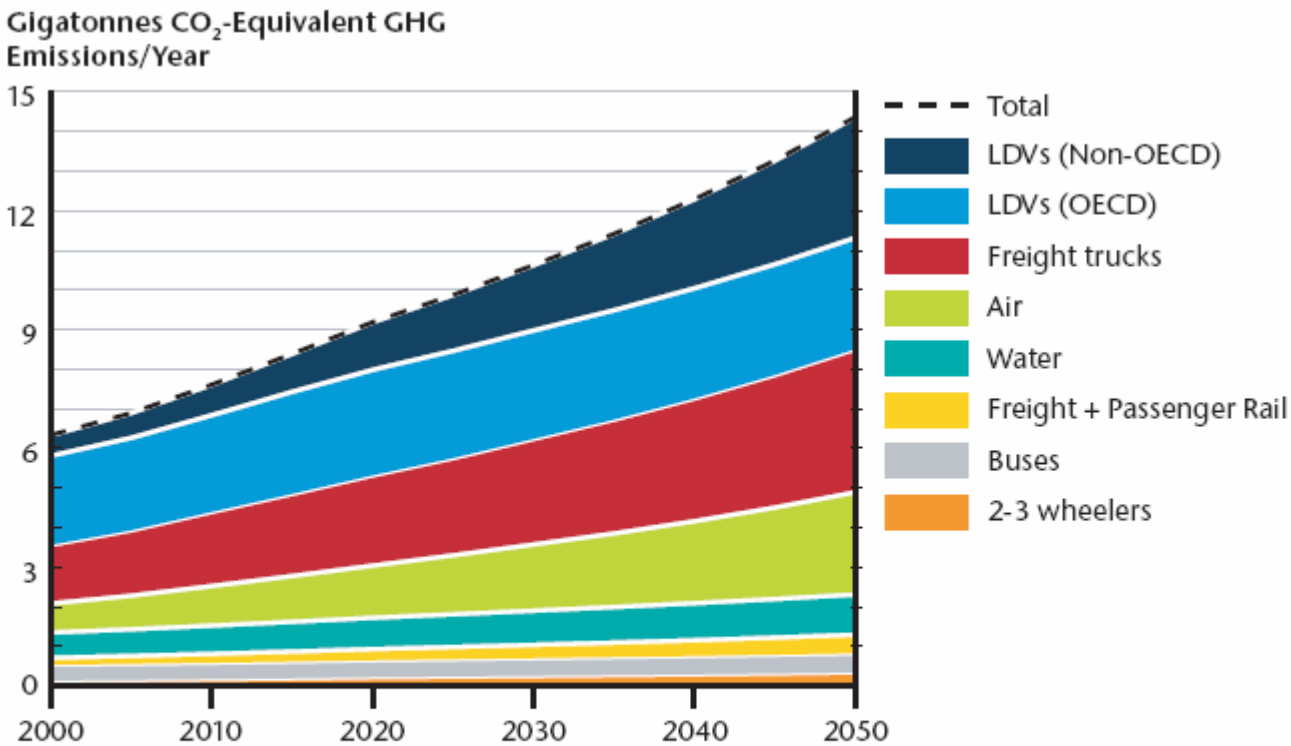
Competing trends

- **Average fleet in-use energy consumption per unit of transport activity declines for each transport mode:**
  - LDVs – 18%
  - Heavy-duty trucks – 29%
  - Air transport – 29%

But,

- **Transport activity increases**
  - LDVs – 123%
  - Heavy-duty trucks – 241%
  - Air transport – 400%

World transport-related GHG emissions by mode



Source:
Sustainable Mobilty Project spreadsheet calculations

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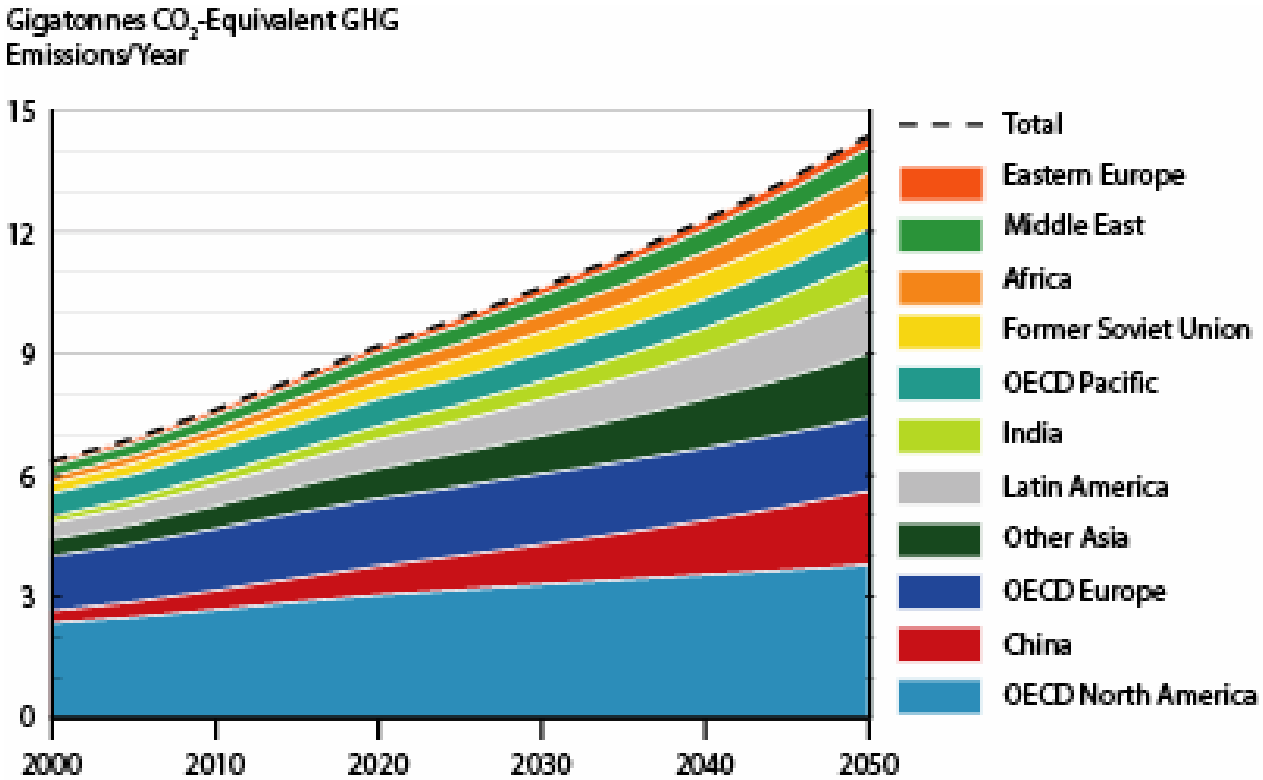
Transport-related WTW GHG emissions by region



Source:
Sustainable Mobility Project calculations.

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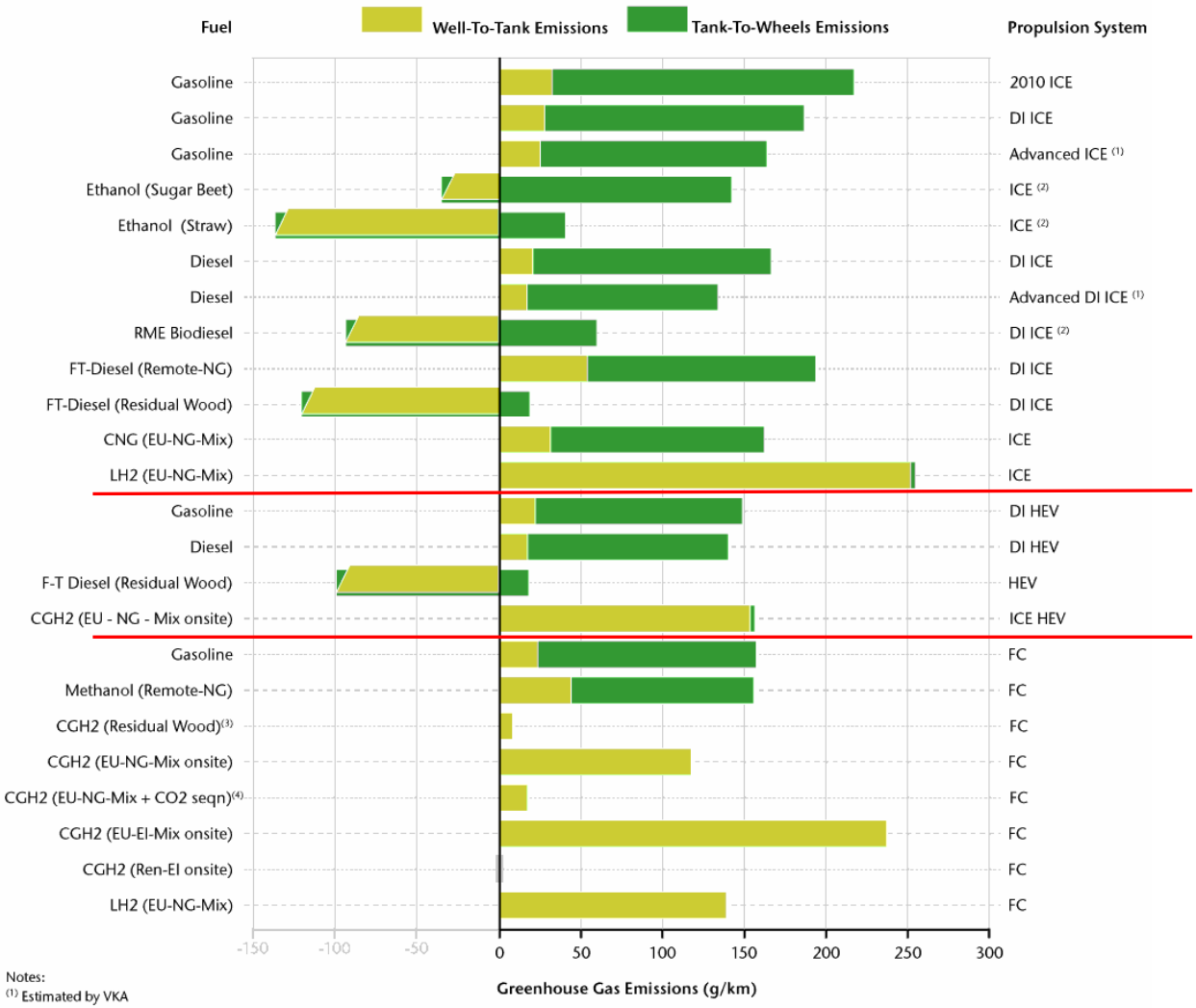
Hypothetical potential of individual technologies and fuels to reduce WTW GHG emissions from transport

- For diesels and advanced hybrids, 100% sales penetration (worldwide) reached by 2030 in light-duty vehicles and medium-duty trucks
- For fuel cells,100% sales penetration (worldwide) reached by 2050; hydrogen produced by reforming natural gas, no carbon sequestration)
- For “carbon neutral” hydrogen, change WTT emissions characteristics of the hydrogen used in fuel cell case above
- For biofuels, assumed that would be used in a world road vehicle fleet similar in energy use characteristics to the SMP reference fleet
- Diesel ICE technology (using conventional diesel fuel) was assumed to have an 18% fuel consumption benefit versus the prevailing gasoline ICE technology during the entire period
- Fuel consumption benefit relative to gasoline ICE technology assumed to be 36% for diesel hybrids, 30% for gasoline hybrids, and 45% for fuel-cell vehicles.

Well-To-Wheels (Well-To-Tank + Tank-To-Wheels) greenhouse gas emissions for various fuel and propulsion system combinations



ICE's

Hybrids

Fuel Cells

Notes:
(1) Estimated by VKA
(2) Estimated by BP, from GM data
(3) Net output from energy use in conversion process
(4) Based on Hydro figures

Source:
Sustainable Mobility Project calculations.

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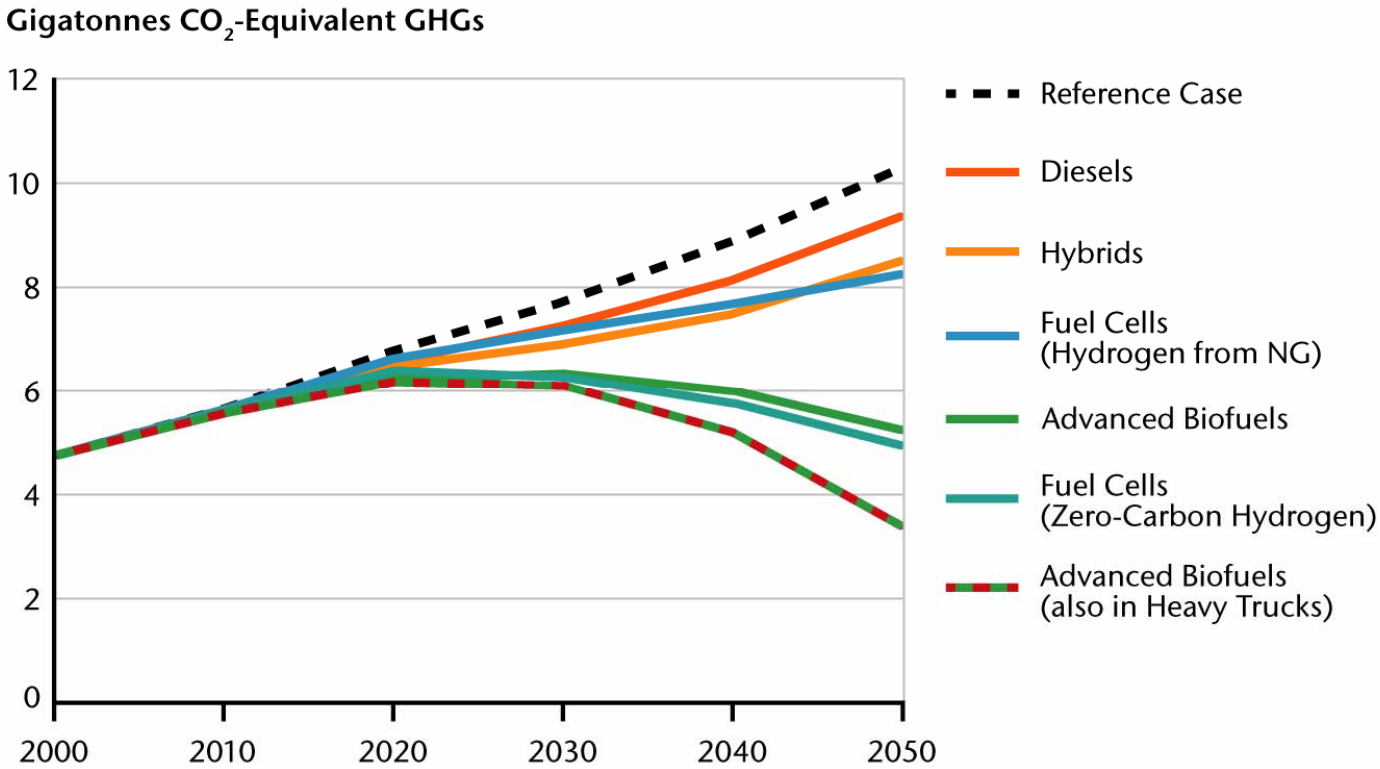
Hypothetical potential of individual technologies to lower road transport Well-To-Wheels CO2 emissions



Note:
The cases represent very high hypothetical levels of technology penetrations, thus they cannot be added together.

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The fundamental challenge/dilemma

"*Even if implemented worldwide*, diesels and hybrid ICEs fueled with conventional gasoline and diesel fuel, or fuel cells fueled by natural gas-derived hydrogen, can no more than slow the growth in road transport CO_2 emissions during the period 2000-2050. Only the use of carbon-neutral hydrogen in fuel cells and/or advanced biofuels in ICE-powered vehicles can largely or totally offset the growth in CO_2 emissions produced by the growth in road travel during the period 2000-2050."

***Mobility 2030*, p. 114**

Personal Reflections on Sustainable Mobility Project

- **Major satisfactions**
  - Obtaining consensus among diverse group of companies on some very important issues affecting their businesses – and the world's future
  - Willingness of companies (in many, but not all, cases) to have their preconceptions challenged by data
    - Requires ability to generate (and defend) good data
  - Extent to which some companies are using insights generated by project
- **Major disappointments**
  - Unable to get companies to provide data on (and, in some cases, even discuss) certain issues
    - Fuel economy potential and costs (even though had done so in EUWTW study)
    - Potential of various transport demand "channeling" measures
  - Unable to reach consensus on "a way forward"
    - Became clear that if continued to work as a group, the pace would be set by the slowest/most reluctant

Backup slides

Mobility 2030's seven goals for improving the outlook for sustainable mobility

- **Reduce conventional emissions from transport to levels where they do not constitute a significant public health concern anywhere in the world**
- **Limit GHG emissions from transport to sustainable levels**
- **Reduce the number of transport-related deaths and injuries worldwide to levels well below those projected by our reference scenario**
- **Reduce transport-related noise**
- **Mitigate traffic congestion**
- **Narrow "mobility opportunity divides"**
- **Preserve and enhance mobility opportunities available to the general population**

How significant are transport GHG emissions?

(Data for 2000)

IEA total CO_2 emissions, all sectors	**22.6 Gt**
IPCC total anthropogenic emissions (CO_2 equivalent)	**c. 32 Gt**
Vehicle (TTW) CO_2 emissions (including international marine bunkers)	**5.4 Gt**
Total transport (WTW) CO_{2eq} emissions (incl. bunkers)	**6.3 Gt**
Vehicle (TTW) share of IEA total CO_2 emissions, all sectors	**24%**
Total transport (WTW) share of IEA total CO_2 emissions, all sectors	**28%**
Total transport (WTW) share of IPCC total anthropogenic emissions	**c. 18% - 20%**

Source: IEA WEO 2002; SMP calculations

Impact of timing of developing world implementation

Developing countries- Assumed technology implementation time lags in the cases

	Reference Case	Combined Technologies Case	... with Additional 5 Year Lag	... with Additional 15 Year Lag
Diesel Sales Reach 50%	5 years	no lag	5 years	15 years
Hybrid Sales Reach 50%	10 years	5 years	10 years	20 years
Fuel Cell Sales Reach 50%	n.a.	10 years	15 years	25 years
Biofuels Blend Levels Reach 33%	5 years	5 years	10 years	20 years
Biofuels Low-GHG Share Reaches 80%	n.a.	no lag	5 years	15 years
Hydrogen Low-GHG Share Reaches 80%	n.a.	no lag	5 years	15 years
Additional 10% Fuel Economy Improvement	no lag	no lag	5 years	15 years

Source: Sustainable Mobility Project

SMP's definition of sustainable mobility

"The ability to meet the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values today or in the future."

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SMP's indicators of sustainable mobility

1. Access to mobility 2. User costs 3. Travel time 4. Reliability and comfort 5. Safety 6. Security 7. Greenhouse gas emissions 8. Impact on environment and public well-being	Mobility users
9. Resource use 10. Impact on public revenues and expenditures 11. Equity Implications 12. Prospective rate of return to private business	Society as a whole
	Mobility providers

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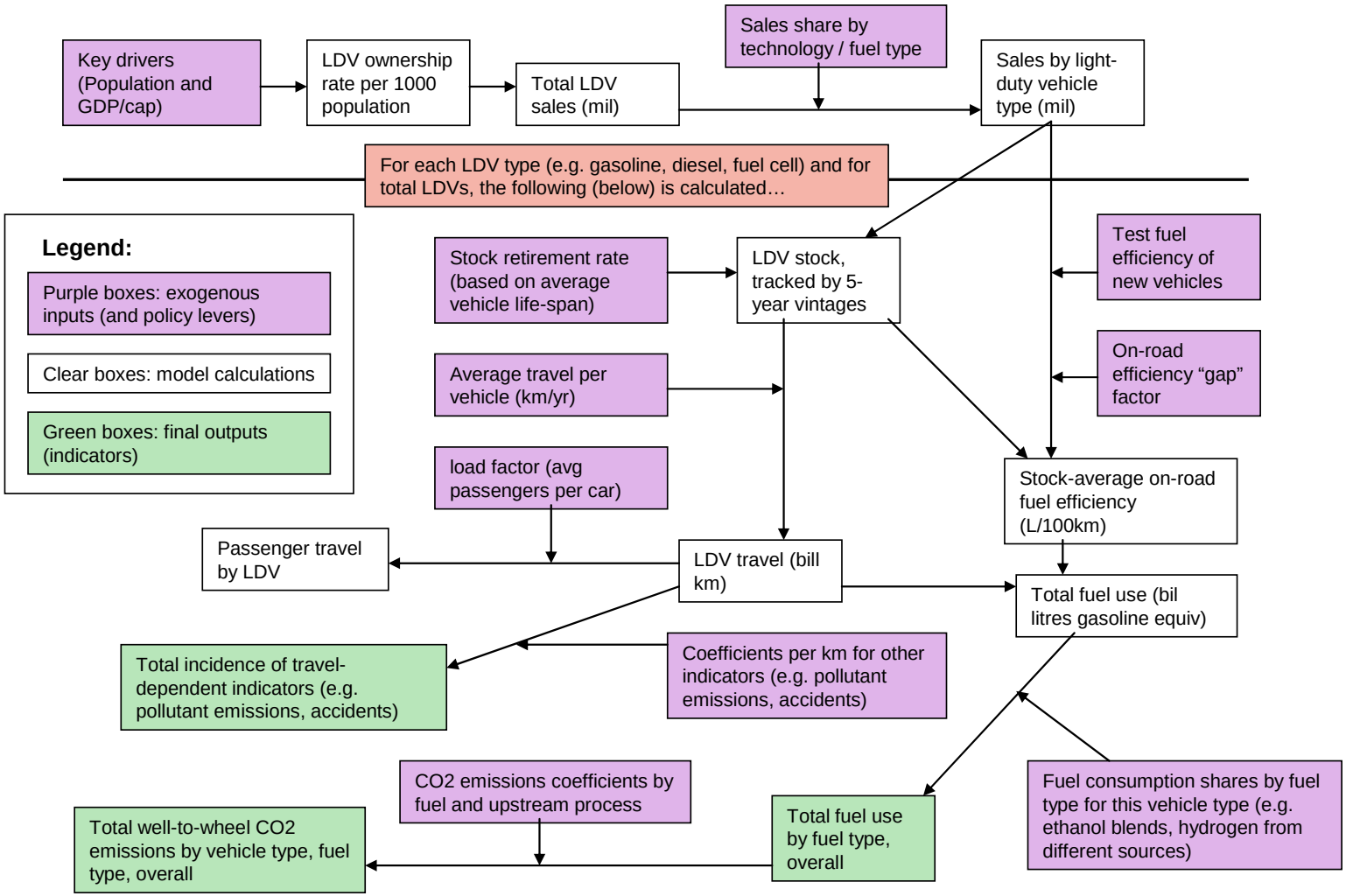
IEA/SMP Transport Spreadsheet Model Flowchart – Light-duty Vehicles



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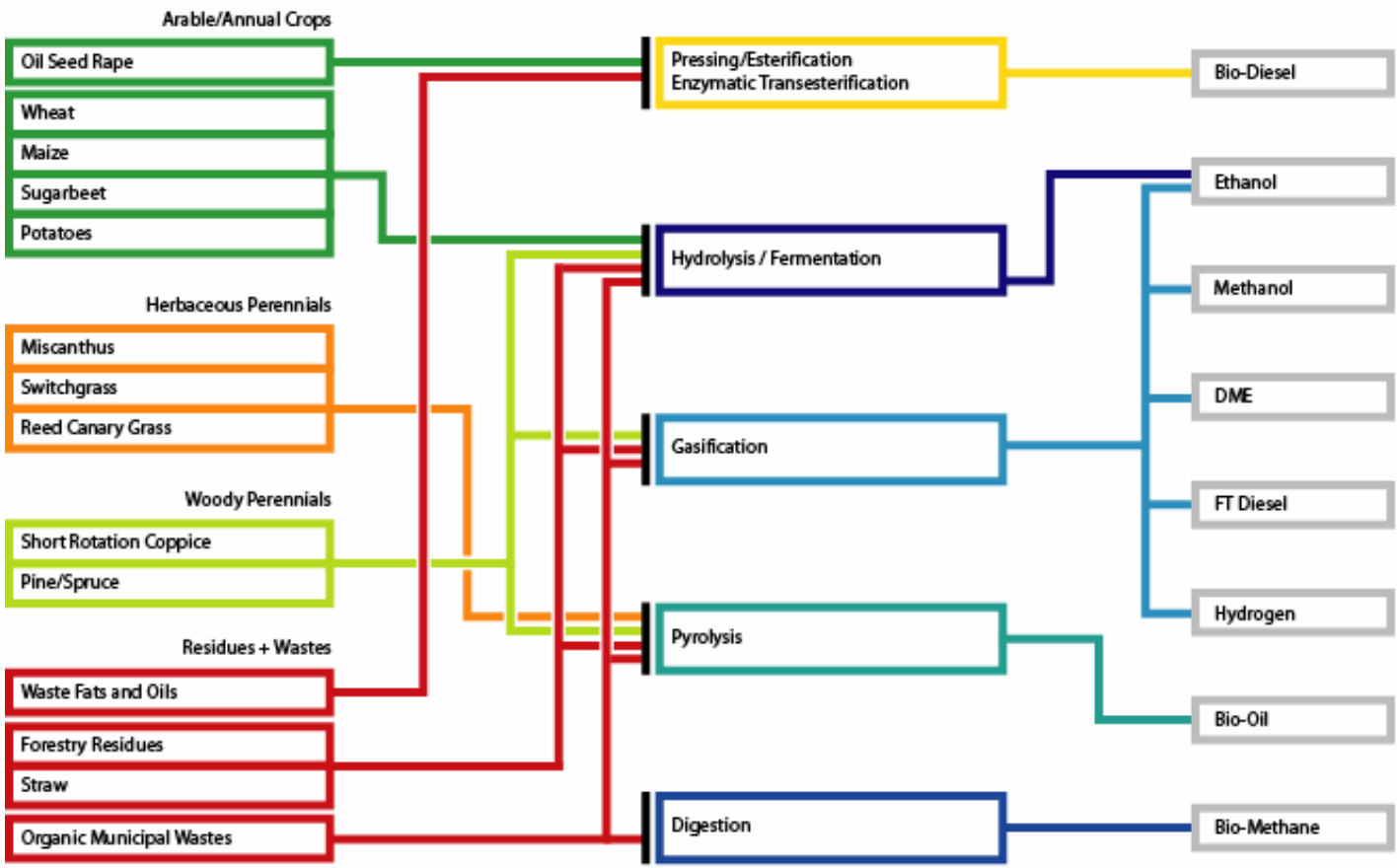
Possible Advanced Biofuel Pathways



Source:
Adapted from E4tech 2003

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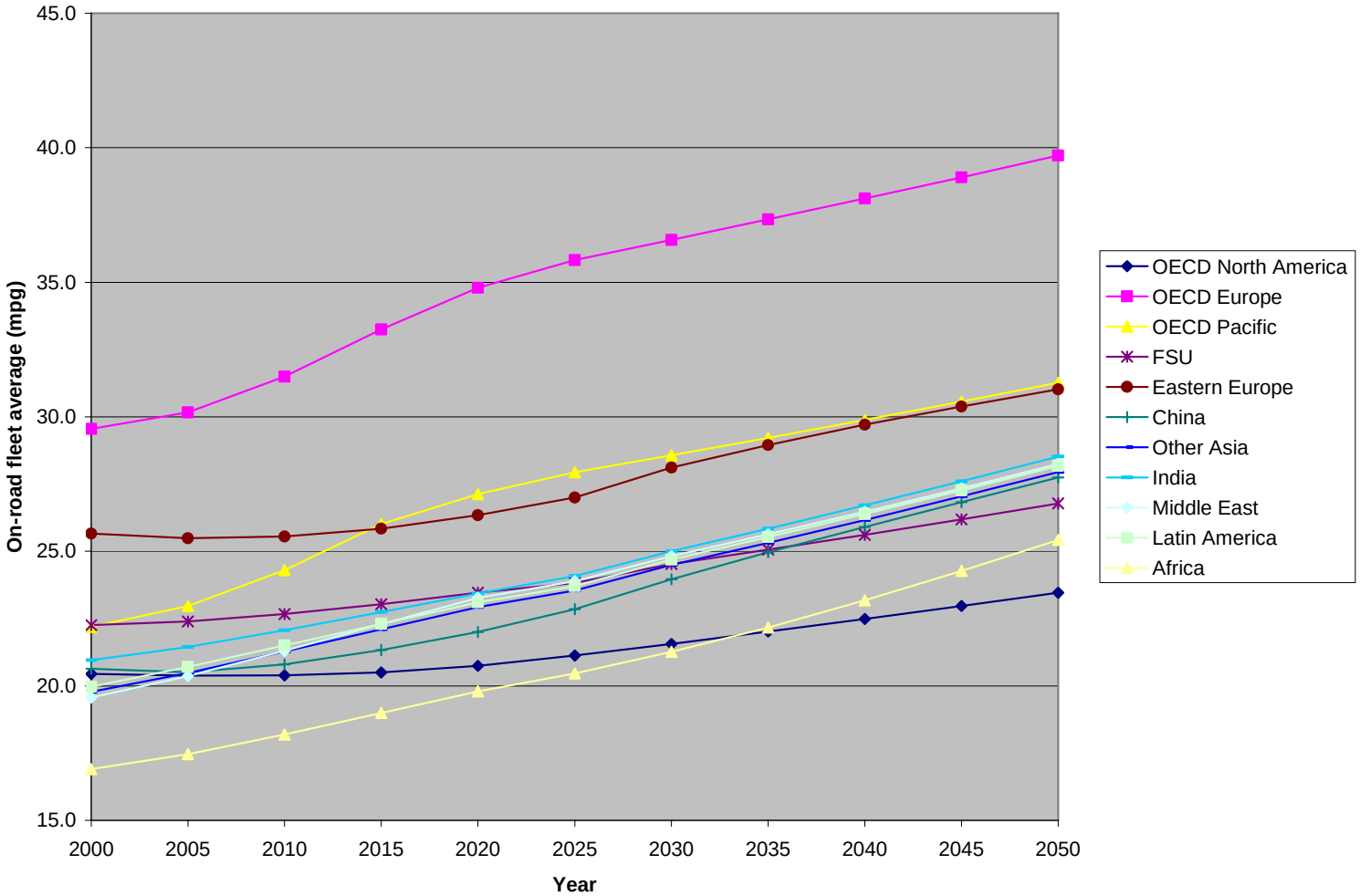
On-road average fleet fuel economy (mpg)



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Assumption regarding fuel consumption policies

- "In general, no major new policies are assumed to be implemented beyond those already implemented in 2003. An exception to this is where there is clear evidence of what might be called "policy trajectories" – future policy actions that are either explicit or implicit in other trends. For example, a clear trend is emerging in the developing world to adopt vehicle emissions standards of a form similar to those already implemented in OECD countries. We assume this "policy trajectory" will continue in the future. In contrast, no such policy trajectory is evident for reduced light-duty vehicle (LDV) fuel consumption; we therefore only incorporate existing fuel consumption programmes through the year they currently end; we assume a return after that date to historical (non-policy-driven) trends in fuel consumption."

***IEA/SMP Model Documentation and Reference Case Projection*, p. 5**