Scenarios for Future CO2 Emissions in Transport: The Role of the Car as a Constraint or Challenge?

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Precourt Energy Efficiency Center
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• A research and analysis institute at Stanford
• Established in October 2006
• Initial funding: $30 million pledge by Jay Precourt
• Mission
  – To improve opportunities for and implementation of energy efficient technologies, systems, and practices, with an emphasis on economically attractive deployment
  – Focus on the demand side of energy markets
  – Energy efficiency: economically efficient reductions in energy use (or energy intensity)
Outline of this Presentation

• Broad Approach to Saving Carbon from Cars
  – Background
  – Developed Countries
  – Developing Countries

• Conclusions: the Challenge is to Act Now, Keep Acting

• Background Material

• References:
  – Millard Ball and Schipper, 2010. Are we Reaching Peak Travel? Transport Reviews (in press) (also US TRB)
  – Schipper and Fulton 2009. Daunted by Diesel. Transport Research Record 2139
  – Schipper, Banerjee and Ng (2009). CO2 Emissions from Land Transport in India. Transport Research Record 2114
Transport Most Rapidly Rising CO2 Emission Source
CO2 Not the Worst Externality Transport Faces

[Graph showing CO2 emissions from different transport sources over time]
Traditional Approach
“ASIF” Decomposition of Transport Impacts (incl CO2)
Note Technology and Other Factors too in New Approach

Lesson: Challenges and Opportunities in Each Component
Transport- CO2 Links:
Avoid and Shift, but also Improve/Mitigate

Avoid CO2-Intensive Development:
Singapore Land Use Planning, Congestion Pricing

Shift and Strengthen:
Mexico City Metrobus

Improve and Mitigate:
Efficient Vehicles

Improve and Mitigate:
True Low Carbon Fuels
A New Opportunity and Challenge
COBENEFITS OF GOOD URBAN TRANSPORT

• **Avoid** – Saving Carbon Through Urban Development
  – Land Use: Building a city or differently (Singapore, Curitiba, Seoul)
  – Internalizing costs of transport at an early stage of development
  – Shifting the balance away from high-carbon transport

• **Switch**: Co-benefits of Transport, Development
  – Bus Rapid Transit and other improvements to transport system
  – Careful transition from smaller to larger, better managed transit vehicles
  – Congestion pricing and other strategies to reduce externalities

• **Improve by Operations, Technology**
  – Lower fuel use/km with improved traffic flow
  – Higher vehicle occupancy
  – Efficient vehicles, low carbon fuels – Mostly national initiatives, count

*Solve Transport Problems and Gain Reduce CO2
*Necessary Complement to Improvements of Vehicles*
CO2 Emissions from Cars
Key Messages from Developed Countries

- Providing 80-85% of all travel, LDV/car use in IEA countries has stagnated since the early 2000s. Causes include higher fuel prices, ageing populations, congestion, modest switch to other modes.
- On road LDV fuel economy has shown some improvement since the 1990s, even if voluntary goals for new vehicles (EU/Japan) were not met. Cars dominate CO2 emissions from transport in developed countries.
- Stronger fuel economy standards in US, EU and Japan in Europe and Japan will yield about a 30% reduction in CO2/km on road by 2030-5, with the US by then achieving Eu’s present level. The main differences among the regions are car power/weight and traffic conditions.
- Analysis of new diesel cars (their use and on-road fuel economy) shows only marginal energy and CO2 savings a large shift to diesel of vehicle purchases in Europe. This suggests that cheap fuel (diesel, CNG, LPG, biofuels) or green car programs (incentives such as in the UK) are counterproductive unless backed by strong fuel price signals.
- Advanced biofuels may work at modest scale (a few % of global LDV fuel) but as the Biofuels Roundtable and others warn, we are far from having truly environmentally benign low CO2 fuels at the scale needed.
- Electrification might offer low carbon alternatives, but only in a context where CO2 is taxed in all sectors and electricity is priced according to its cost when used to charge batteries. Since electric cars are likely to be small, the first step to them is to shrink fueled cars.
Trends in On-Road ("real") Fuel Intensity

"Gasoline Equivalents"
Fuel Consumption - Curb Weight For MY2005 Vehicles

Source Prof. John Heywood, MIT

The Challenge – Small and Safe, not Fast Cars

![Graph showing the relationship between curb weight (kg) and fuel consumption (L/100km)].

Fuel consumption (L/100km)

Curb weight (kg)

Fuel economy (mpg)

CO₂, gm/km

On Road Fuel Intensity, l/100 km

US (test x 1.24) | JAPAN (test x 1.33) | EU (test x 1.195)

Fleet On Road 1990 | Fleet on road 2007 | New Vehicles Sold 2007 on road | Present New Standard/VA 'On Road' | Proposed/ Strengthened New, on Road | Needed, new 'on road' by 2030[FIA]
Diesels Close to 50% of New Car Market in Europe: Yet Savings of CO2 from Diesel Small or Absent

- Nine Countries Show Little Savings (Counting emissions, not gallons!)
  - On road diesel fleet emissions (gm/km) slightly (<5%) lower than gasoline
  - New vehicle test diesel emissions slightly (<5%) lower than gasoline
  - Diesel cars driven 50-100% more per year than gasoline cars

- Huh?
  - Cheaper diesel in Europe raises use, backfires on diesel policies
  - Diesels more powerful than gasoline equivalent, buyers choose bigger cars
  - Liter of diesel has 12% more energy, 18% more CO2 than gasoline

- But Diesel Drivers Are Different -- That’s the Point
  - Long distance drivers buy more expensive diesels with lower fuel costs
  - Increased switching to diesel stimulated by price – switchers drive more
  - Diesel SUVs increase attractiveness of SUVs (“Gelaendewagen”)

Avoid Subsidizing “Winners” or Creating Loopholes like Flexfuel Vehicles, HOV Exemptions for Hybrids, Cheap LPG or CNG
The CO2 and Oil Impact of EEV‘s
Not a Simple Matter of Calculation Even for Bio Fuels

Electric Cars: EEV’s*?

Plug In Hybrid:
When to gas, when to charge?

Swedish Car on Brazilian Ethanol: How do we scale up by a factor of 100?
Fuel cycle, land use implications

*”Elsewhere Emissions Vehicles”
The Challenge for Developed Countries
Present Steps Important, but More Needed

• Fuel Economy Standards and Energy – FIA 50 in 50 good start but...
  • Keep pressure on all parties – consumers, governments, industry
  • Accept a new paradigm for small, safe, and slower
  • End company car and other subsidy schemes – the driver responsible

• Avoid Subsidy and Incentive Traps
  • Only Bonus/Malus (feebate) works – Incentives with edges always backfire
  • Earmarks: hybrids, diesel, EV, Cash for clunkers lead to mischief and misery
  • Low carbon fuels yes – but only with carbon taxes

• The Larger Picture – Sustainable Transport Policy
  • Larger challenge is internalizing costs of all vehicles (not just cars)
  • Cars are indispensible, but new balance is necessary
  • For wealthy countries, the challenge is one of slow but steady change

Squeezing Carbon out of Cars not a Constraint if Manufacturers and Fuel Companies Lead
Less Car Travel Than Today

Cars 3 l/100 km and 1/3 less carbon/l
CO2 Emissions from Cars
Key Messages from Developing Countries

- Cars provide roughly 10-15% of trips and 20% of travel in the developing world, yet are the principal cause of congestion keeping the overwhelming majority of people and goods tied up in traffic. Something is out of balance.
- Projections for future car ownership and use in the developing world are staggering, but profound congestion and air pollution problems likely will slow growth in car use much more than higher fuel prices or taxes alone will.
- Developing country authorities can unfreeze mobility and access by strengthening collective and non motorized transport and removing the subsidies to fuels and individual car ownership before these trends become politically irreversible.
- This broad approach to sustainable transport will mean fewer cars and less car travel than otherwise yet result in more access than present trends in car use. CO2 savings from improved transport will rival that from more efficiency and lower CO2 fuels, and as such is a necessary part of future development strategies.
- Recognition of the real constraints on car use is important for the vehicle industry so it can adjust its strategies accordingly and prosper in a crowded world.
- Financing “low carbon transport” is perhaps an oxymoron: truly sustainable transport is built mostly on low emission collective modes that better utilize road and rail capacity than individual vehicles. What is needed is balanced set of transport prices and taxes that reflect the real costs of the whole system including externalities from congestion accidents barriers to mobility and access as well as the smaller (but still important concerns of CO2 and oil security.
Montezuma’s Revenge in Mexico City?
ITPS CO2 Scenarios for Latin America 2050:
Less Challenge than Change of Course
More Driving than Today, But Much Less than BAU
A Broader View: Mobility, not Fuel or CO2
Cheap Two Wheelers, but No Sidewalks

The Peoples’ Car: Which People?
Sustainable Transport? Yes
What Needs To Happen Everywhere

• Present Goals (US, EU, Japan) Too Timid
  – Start with FIA “50 by 50” or IEA 50% by 2030
  – Work now on even bolder goals
  – Reverse the decline in share of other modes

• What Has To Happen in Policy?
  – Realistic pricing of transport, not just energy
  – Reorientation of urban and rural development - more wealth, less motion
  – Stronger integration of CO2 concerns into development

• The Vehicles and Fuels Industries
  – Help reverse engineer the problem – rather than reversing progress
  – Stake out realistic R&D needs now
  – Re-work ‘Sustainable Mobility’ to get it right the next time

The Present Transport System Doesn’t work for Most People
Whoops: the Transport System is Unsustainable
You Can’t Fix Carbon without Fixing Transport.

- **Wide Consensus System Out of Balance**
  - Continual EU White Papers
  - Three US Bipartisan Studies
  - Countless World Bank and National Studies

- **Little Action on Taxes or Regulation**
  - Few Politicians willing to stake positions
  - Consumer opposition
  - Vehicle, road industry often in opposition

- **Advances in Sustainable Transport**
  - Sweden, UK congestion pricing
  - Singapore, Curitiba on problem avoidance
  - Mexico, Colombia, India correcting neglect
The Ultimate Clunker? – Absorbs its own CO2 but Does not Fix Transport Policy

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Dieselization in Europe: Where are the Savings? Relative to Gasoline, Diesel Shows Little Energy or CO2 Savings Moreover, Driving Distances Larger Where to put the Prius? PHEV? BEV? LPG and CNG (Schipper and Fulton TRR 2009)
CO2 Emissions from Cars

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• Cars provide roughly 10-15% of trips and 20% of travel in the developing world, yet are the principal cause of congestion keeping the overwhelming majority of people and goods tied up in traffic. Something is out of balance.

• Projections for future car ownership and use in the developing world are staggering. But the profound congestion and air pollution problems in the same countries may slow growth in car use much more than higher fuel prices or taxes on their own. Developing country authorities can only meet this prospect of frozen mobility by strengthening collective and non motorized transport and removing the subsidies to fuels and individual car ownership before these trends become politically irreversible.

• Taking this broader approach to sustainable transport will mean fewer cars and less car travel than otherwise yet result in more access and mobility than present trends in car use. CO2 savings from improved transport will rival that from more efficiency and lower CO2 fuels, and as such (the three legged stool) is a necessary part of future development strategies.

• Recognition of the real constraints on car use is important for the vehicle industry so it can adjust its strategies accordingly and prosper in a crowded world.

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Motorization and Economic Growth: Do 2 Billion Cars Make Us Better Off?

Key Question: Is this path of motorization good? Inevitable or avoidable?
CO2 Emissions from Road Transport in Latin America – The Dominating Role of Light Duty Vehicles

*Source: This study based on SMP/WBCSD and IEA/MOMO estimates by mode 2005*
Future Latin America Passenger Road Transport CO2
Driving Force is LDV Ownership and Use
(Source: WBCSD Sustainable Mobility Project)

- Emissions in 2000
- Emissions in 2030, no fuel economy improvements
- Emissions in 2030, w fuel economy improvements

CO2 Emissions, Mn Tonnes

Cars, Motorcycles

All Buses
Future CO2 Emissions from Transport in Asia
Even After 20% Reduction in Fuel/km, Still Out of control
(Source: WBCSD Sustainable Mobility Project)

LDVs out of control

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