

Transport breakout group

IEA workshop
Re-defining climate ambition to “well-below 2°C”

20 June 2016

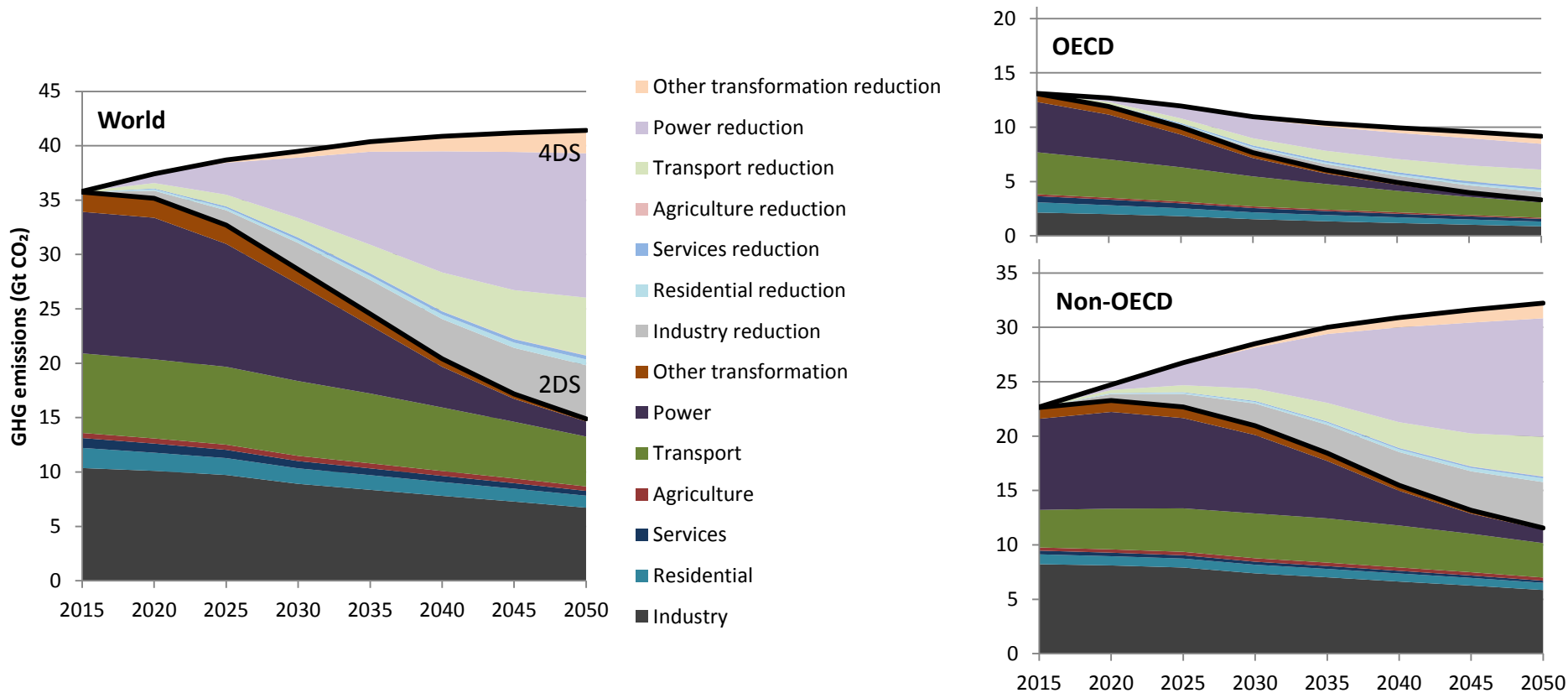
Pierpaolo Cazzola



International
Energy Agency
Secure
Sustainable
Together

GHG emission projections

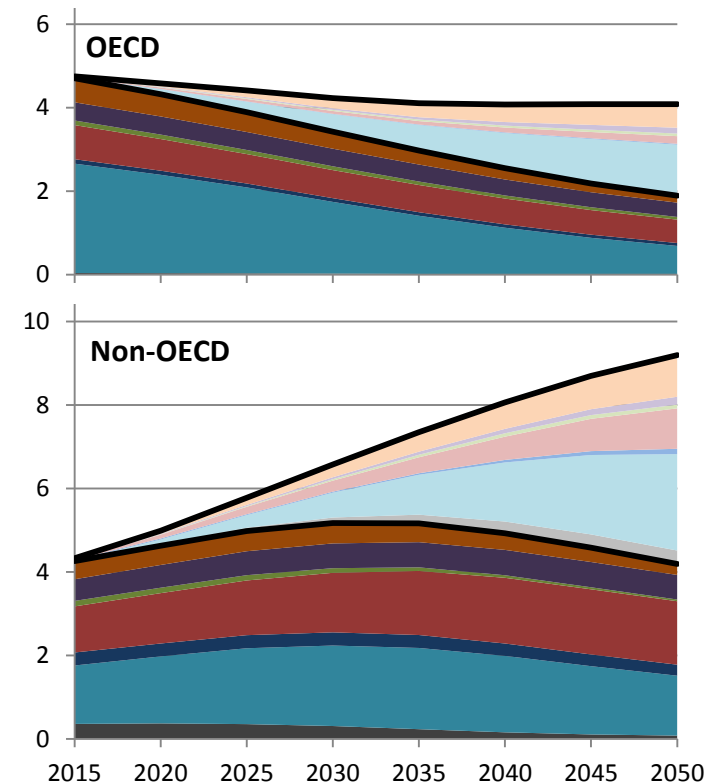
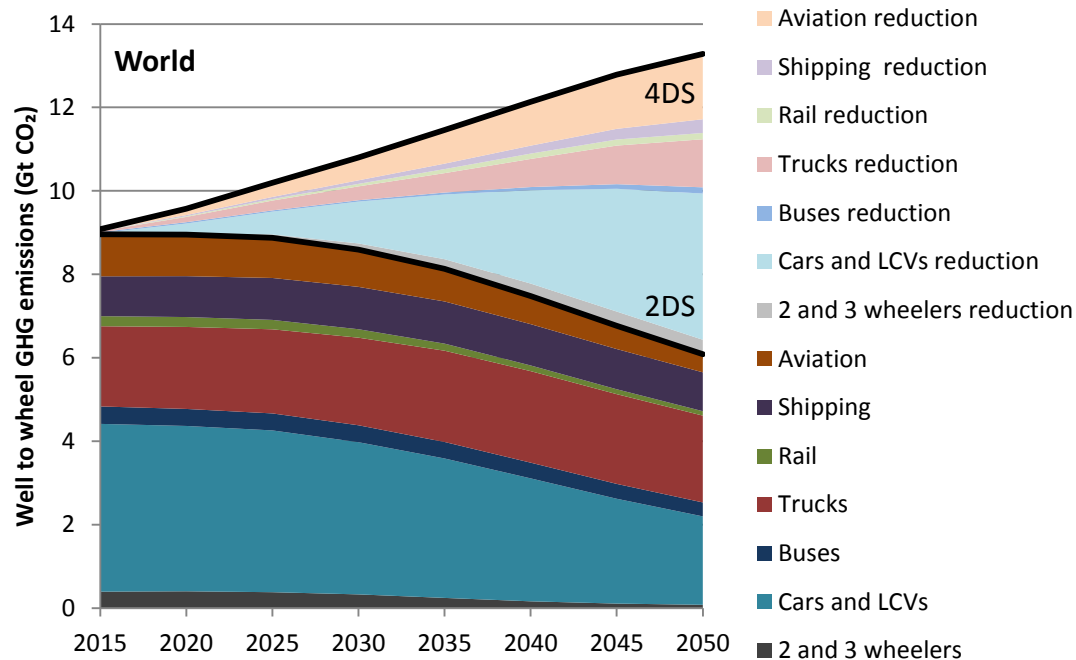
Current ETP scenarios



- Strongest cuts in power generation (fully decarbonized in OECD)
- Major contributions remain in transport and industry
- 800 Gt budget (2DS scenario is based on 1000 Gt) suggests that 2050 emissions should be halved

GHG emission projections

Current ETP scenarios - Transport



- The most energy intensive modes (cars & LCVs, aviation and trucks) experience significant cuts
- The same modes plus shipping account for most of the 2050 emissions
- A 50% reduction in transport emissions has to affect all these modes

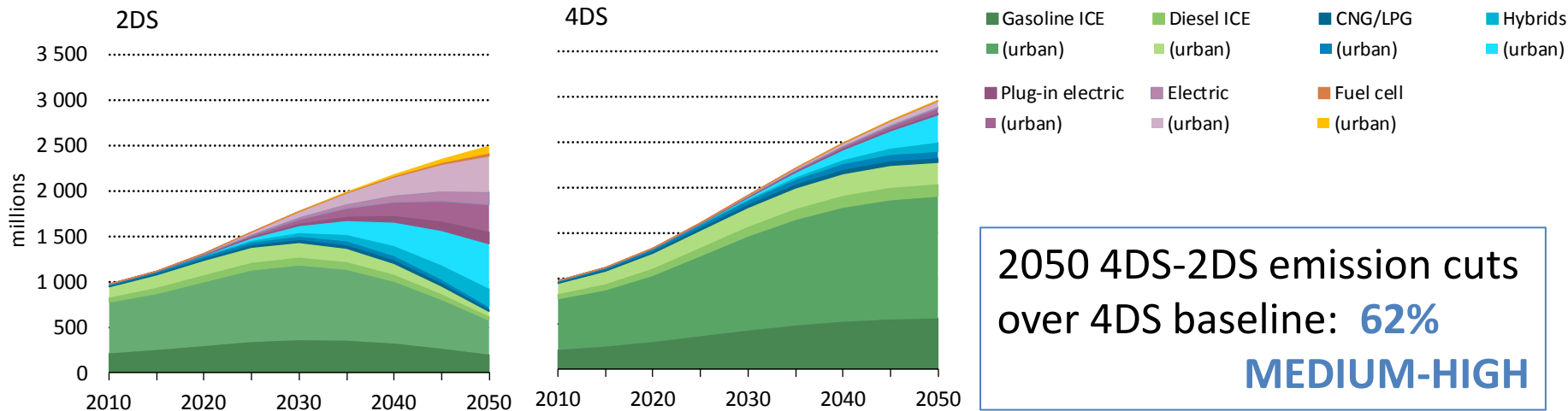
Proposal to frame the discussion

- It is clear that we need to identify ways to move beyond the changes envisaged in 2DS scenario
- The roadmap proposed by Patrick Oliva is fairly aligned with 2DS developments
- We would like to show you basic elements of our considerations for 2DS in each mode (as well as biofuels) and ask you questions on
 - Wrong assumptions, vision, understanding
 - Suggested changes to go beyond 2DS
- We are suggesting some ideas, but the discussion shall not be restricted to those
- **We will get started from the main modes where plus biofuels and behavioural aspects**, and then eventually cover the rest (less controversial), to maximize benefits of having you all here
- The idea is to prioritize least cost options with the highest capacity to increase the sustainability of transport (win-win solutions for local pollution and noise work best)
- We want you to talk, not us...

Going beyond the IEA 2DS

Cars and LCVs

1/2

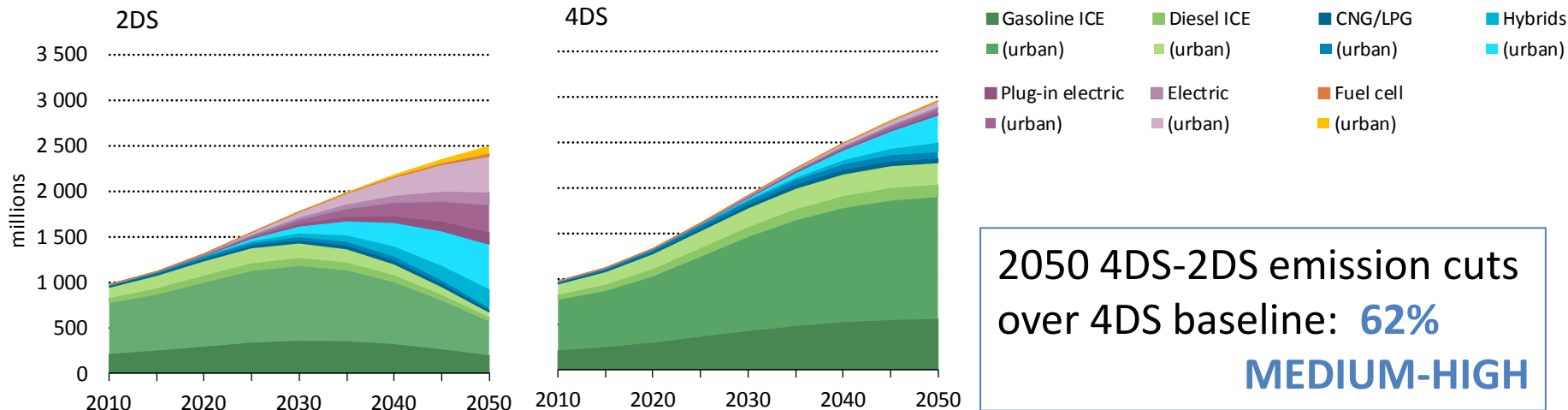


- Stock growth contained by avoid and shift policies
- Technologies deliver fuel economy savings compatible with GFEI targets
- 150 million EVs on the road by 2030, nearly one billion by 2050, boosted by encouraging signs and taking advantage of the PHEV flexibility
- Hydrogen market penetration limited
 - Need for curtailed electricity for production via electrolysis
 - Need for centralized production to contain costs
 - Need to build distribution infrastructure: unlikely without a systemic change in all sectors)
 - Much higher investment risks

Going beyond the IEA 2DS

Cars and LCVs

2/2

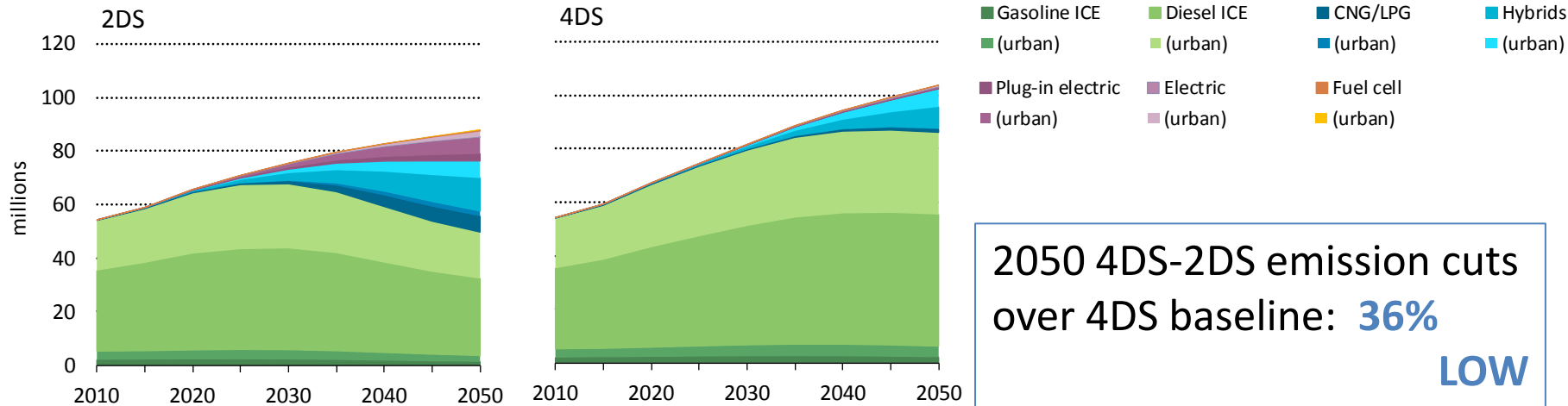


- Role of EVs in a scenario beyond 2DS?
 - No cap? Synergies (slow chargers) with smart energy systems and DSM, but also risks (fast chargers)
 - Battery costs? Range limitations? Charging infrastructure? e-vkm % for PHEVs?
 - Long-term impacts on governmental revenues & changes in taxation of transport?
- Hydrogen?
- Role of shared mobility?
 - Higher mileage, lower stock, quicker stock turnover, faster technology penetration... What shall be the market share? Impacts on shares of public transport? Complementarity? Policy suggestions?
- Role of autonomous driving?
 - Counterproductive (increased car travel, detrimental for public transport)? Useful (ecodriving, technology uptake)?
- More modal shift?

Going beyond the IEA 2DS

Trucks

1/2

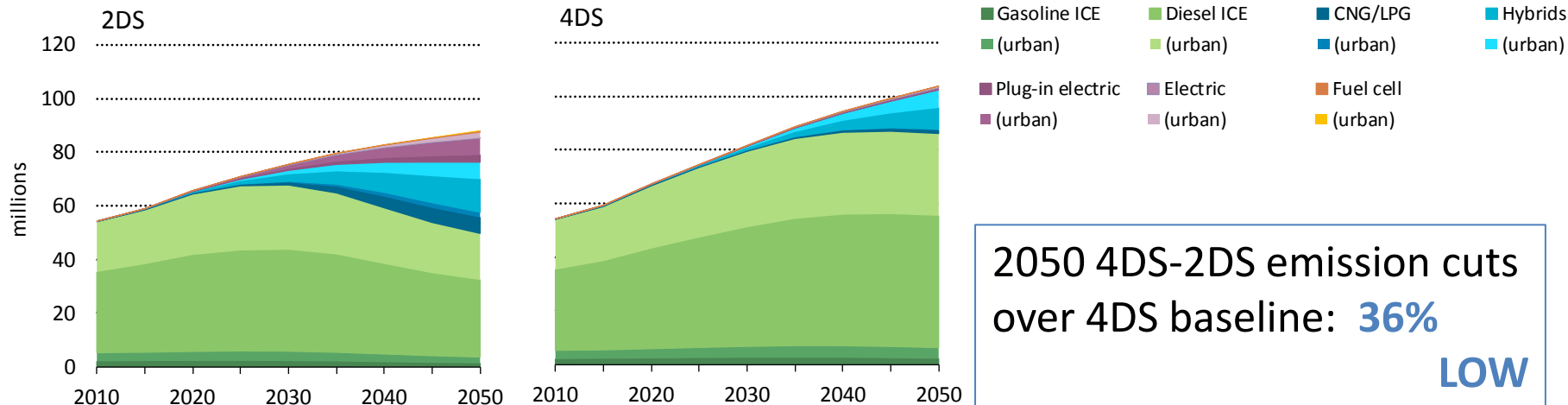


- Stock growth contained by avoid and shift policies
 - Baseline freight activity and hence stock growth may be underestimated (we are working on this)
- Fuel economy improvement does not exceed 35% in OECD (catch up in Non-OECD)
 - Improved diesels, some hybridization in both medium and heavy trucks
 - PHEVs for medium trucks (urban)
- No major technology shift currently assumed
 - Limited electrification, given the high range
 - Very limited use of hydrogen, given risks and need for systemic change to justify investment and cost reductions for fuel cells and hydrogen distribution infrastructure costs
- Need for biofuel for decarbonization
 - Diesel pool: high risk with respect to cost reductions

Going beyond the IEA 2DS

Trucks

2/2

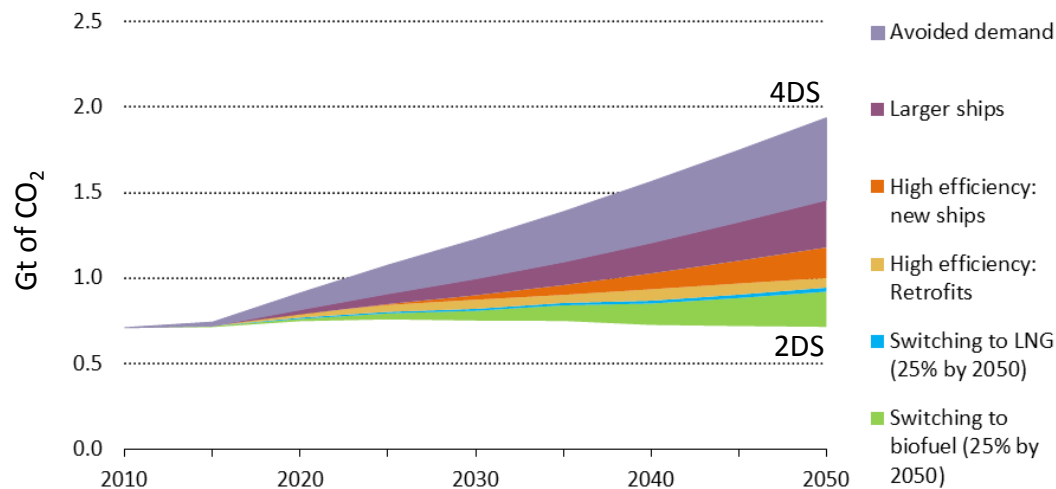


- Role of EVs in a scenario beyond 2DS?
 - Battery costs? Power requirements bring them up?
 - Range assumptions (especially PHEV)? e-vkm % for PHEVs? Charging infrastructure?
 - Catenary lines and PHEV heavy duty trucks? Prospects? Is this a priority?
 - Long-term impacts on governmental revenues & changes in taxation of transport?
- Hydrogen?
- Role of logistics?
 - Urban freight innovations
- Modal shift?
 - We would like to improve our assessment of change in the stock growth
- Role of autonomous driving? Platooning? Eco-driving?

Going beyond the IEA 2DS

Maritime transport

1/2



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

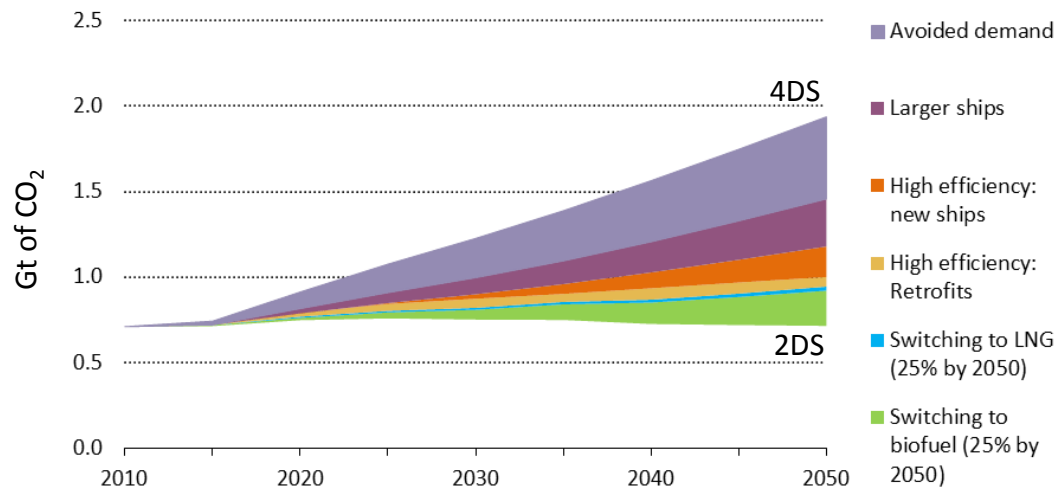
2050 4DS-2DS emission cuts over 4DS baseline: **63%**
MEDIUM-HIGH

- 4DS activity projections based on trade growth projections from OECD
- 4DS projections account for IMO EEDI improvement to 2030
- Changes in the 2DS energy system reflected in lower trade of fossil fuels
- 2DS accounts for increasing size of container and other ships (no oil tankers)
- 2DS projections way more aggressive on efficiency improvements (new ships and retrofits): all potential available (new and retrofits) exploited by 2050
- Fuel switching (LNG) primarily driven by considerations on pollution and sulfur content: assumptions reflect latest IMO assessment report
- Biofuels complement other measures to reach stabilization

Going beyond the IEA 2DS

Maritime transport

2/2



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

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

- Our current assumptions are rather radical on energy efficiency (especially retrofits): are we off track on this?
- Increased use of biofuels to go beyond 2DS?
- Role of electrification and hydrogen? We excluded both options for long-distance shipping in 2DS
 - Electrification seems viable for passenger (e.g. ferries) and short sea shipping only. Correct?
 - Hydrogen may be viable for longer distances (synergies for centralized production and contextual use by road vehicles serving ports). Estimates on costs? Losses of carrying capacity? Storage? Liquid? Life cycle efficiency?
- Role of renewables (wave power, kite sails, or solar)?
 - Partly already accounted for in energy efficiency

- We have a fairly good understanding of some of the mechanisms leading to modal shifts in urban passenger transport, as well as the potential impacts of policy tools stimulating these changes
 - Modal shifts tend to lead to cost savings due to lower road transport infrastructure requirements and declines in the total car stock
 - Other behavioural changes may have similar impacts:
 - Shifting to smaller/lighter vehicles for personal mobility, for instance, would entail lower vehicle purchase and usage costs
 - Sharing vehicles (car sharing) rather than owning them leads to changes in mileage, stock and turnover
 - Sharing rides leads to higher load factors and is likely to be associated with lower ownership and higher mileages
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- To which extent shall we attempt to grasp these changes?
 - Do you have suggestions on the estimation of potentials/impacts suitable for the type of analysis we need to undertake?
 - Which behavioral change shall we consider with priority? Why?
 - Freight? Any suggestion on the way to assess modal shift potentials?

- Biofuels are at the centre of the debate because of sustainability issues
 - Advanced biofuels supply chains can achieve significant reductions in well-to-wheel emission factors, do not compete directly for land with food, and have low LUC impacts. Even in these circumstances, they do not seem likely to get to net zero, due to residual emissions from processes and agriculture)
 - 2DS results suggest that biofuels are required to substitute for diesel, but economic assessments suggest that the prospects for cost reductions are poorer
 - Biosyngas could be of interest, but the potential for its supply seems more limited than for other biofuels
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- What are your views on the statements above? How about grasses and soil carbon sequestration?
 - How do the cost prospects for biodiesel compare with those of alternative technologies (e.g. catenary lines in truck electrification) – which seems to be a more viable decarbonisation pathway?
 - Are residual emissions for advanced biofuels a showstopper for a scenario beyond 2DS? Are these one of the areas where we should think about offsets?

Going beyond the IEA 2DS

Aviation

1/2



“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.

Source: <http://www.atag.org/facts-and-figures.html>

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

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

HIGH

- CO₂ taxation for aviation fuels (210 USD/t by 2050), reducing activity growth
- Significant shifts to HSR, thanks to rail investments
- Major efficiency improvements for airplanes
 - In 2DS, planes consume 70% less fuel per km (current value based on IEA and ICAO data)
 - According to the IATA roadmap, this could be achieved with operational improvements, material substitution (carbon reinforced plastics), flying wings and open rotors* (all together)
- 55% advanced biofuels would still be needed to meet the 2050 50% mitigation goal from ATAG

* Open rotors lead to noise issues, limiting win-win opportunities to address all externalities



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

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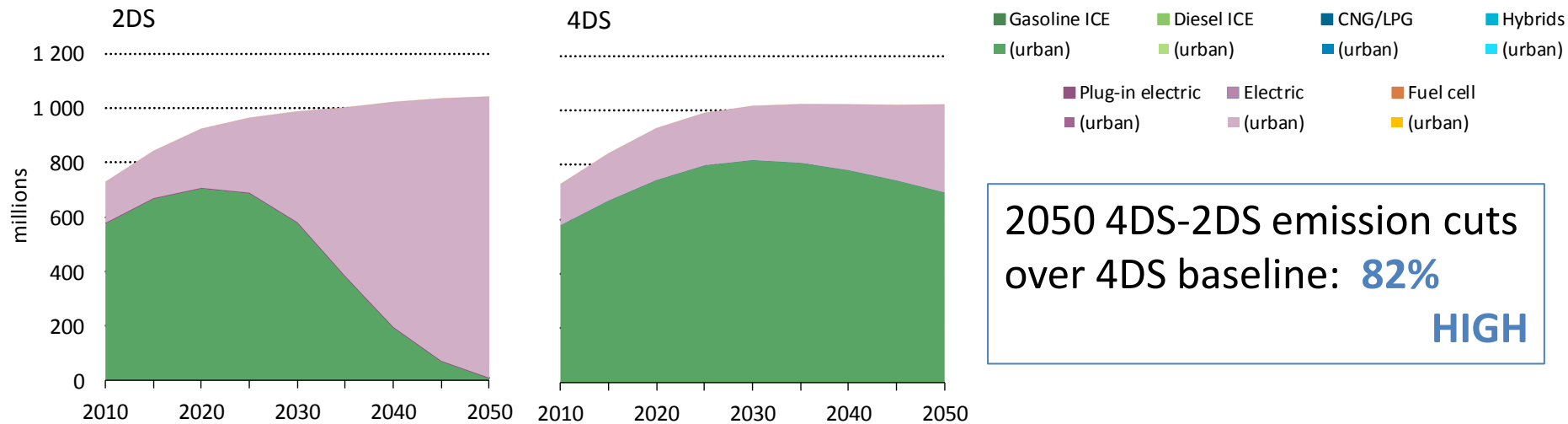
2050 4DS-2DS emission cuts over 4DS baseline: **78%**

HIGH

- Our current assumptions are rather radical in all areas (modal shift, energy efficiency, biofuel use). Is it too much?
- Role of electrification and hydrogen?
 - We excluded both options in 2DS
- Role of offsets?
 - Aviation is probably the transport mode where the decarbonization of the last tonne would be extremely expensive, and therefore the mode that is more likely to need offsetting from other areas of the energy system (e.g. power generation from biomass with CCS) or other sectors (e.g. afforestation)

Going beyond the IEA 2DS

2-3 wheelers



- Already quasi-decarbonized in 2DS, thanks to electrification
 - China ahead of any other region today, with about 200 M electric two-wheelers on the road (more than 40% of the total stock)
 - Costs: electric two wheelers already very cheap in Asia (premium scooter models cost 500 EUR)
 - Significant challenge on the regulatory side (successful introduction in China spurred by bans for conventional 2-wheelers), but major benefits (GHG, local pollution, noise)
 - Win-win solution to address other externalities local pollution and noise, need to address recyclability, not an improvement for safety (and related health issues)
-
- What are your views on the above? Shall we account for anything else?

- Not central in the IEA technology analysis due to limited fuel and GHG emission saving potential
 - Relevant mostly for modal shifts
 - Now subject to significant commitments to reduce carbon intensity (e.g. hybridization, electrification)
 - High mileages and start-stop driving cycles justify technology deployments to move away from ICEs
 - Electrification seems to be one of the preferred deep decarbonization options by operators
 - BEVs emerging in China, Latin America (BYD), and elsewhere
 - Trolleybuses widely used in the past and still in use in European cities
 - Interest from UITP
 - Included in narrative by C40 (contributor to the Paris declaration in 2015)
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- Do you share the views above?
 - Are we missing something important (hydrogen, biofuels, other)?

Going beyond the IEA 2DS

Implementing actions

- What do you see as key policies allowing to reach 2DS and beyond?
- In ETP 2016 we recommended a policy portfolio including different types of instruments

Scope	Policy category	Impact		
		Avoid/Shift	Vehicle efficiency	Low carbon fuels
Local	Pricing (congestion charges, tolls parking fees)	Green	Possible	Red
	Regulatory (access & parking restrictions, low emission zones)	Green	Possible	Minor
	Public transport investments	Green	Possible	Red
	Compact city	Green	Red	Red
National	Fuel taxation	Green	Green	Possible
	Fuel economy regulations	Red	Green	Possible
	Vehicle taxation, feebates	Possible	Green	Possible
	Low carbon fuel standards	Red	Red	Green
	Alternative fuel mandates	Red	Red	Green
	RD&D support	Red	Green	Green

- Do you agree with this? Are we off track?
- Which other actions do you think are necessary to mobilize the change?