An Chomhairle Náisiúnta Eacnamaíoch agus Shóisialta
National Economic & Social Council

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Options for Reducing Emissions from Freight

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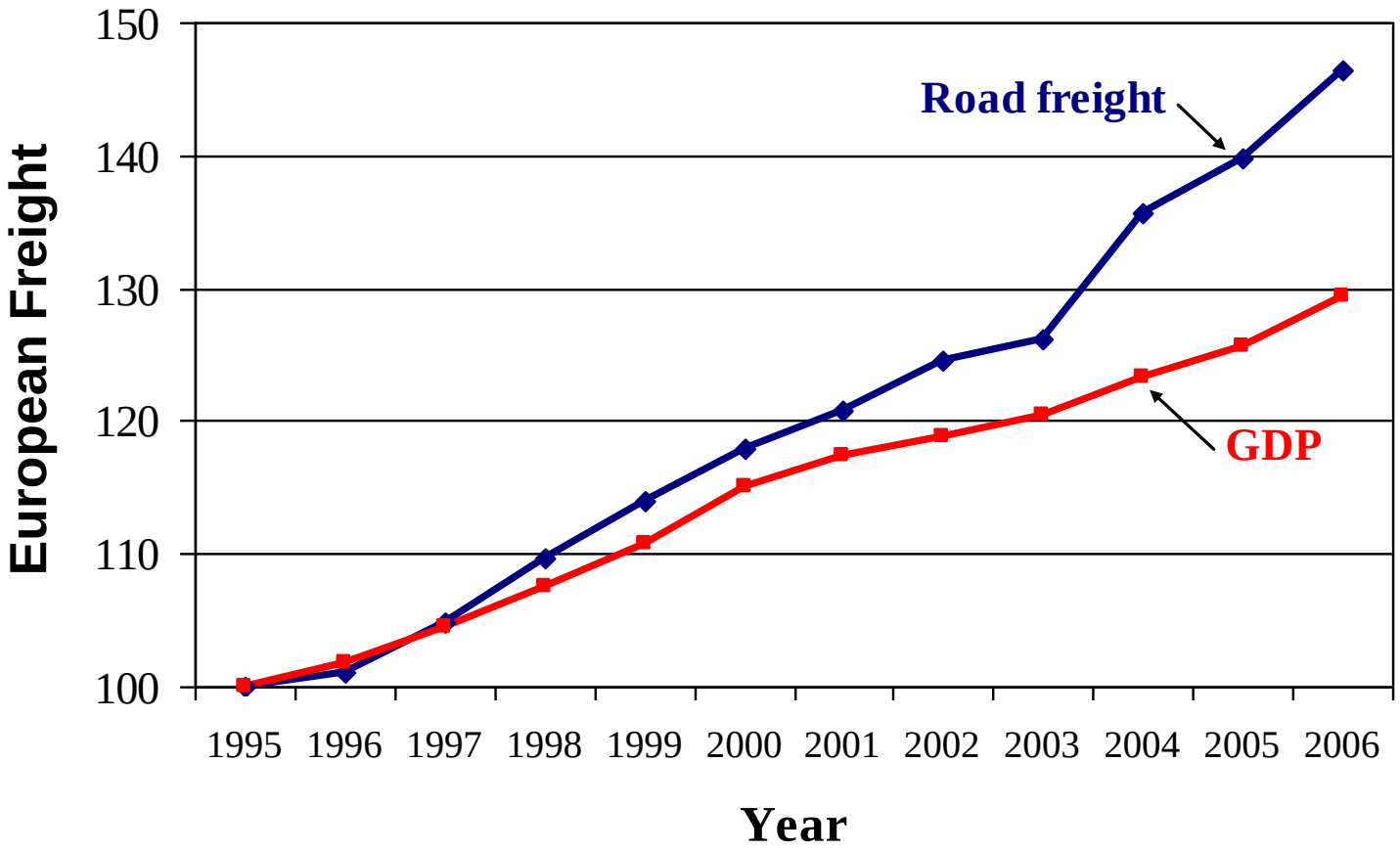
Reducing Emissions – Really?

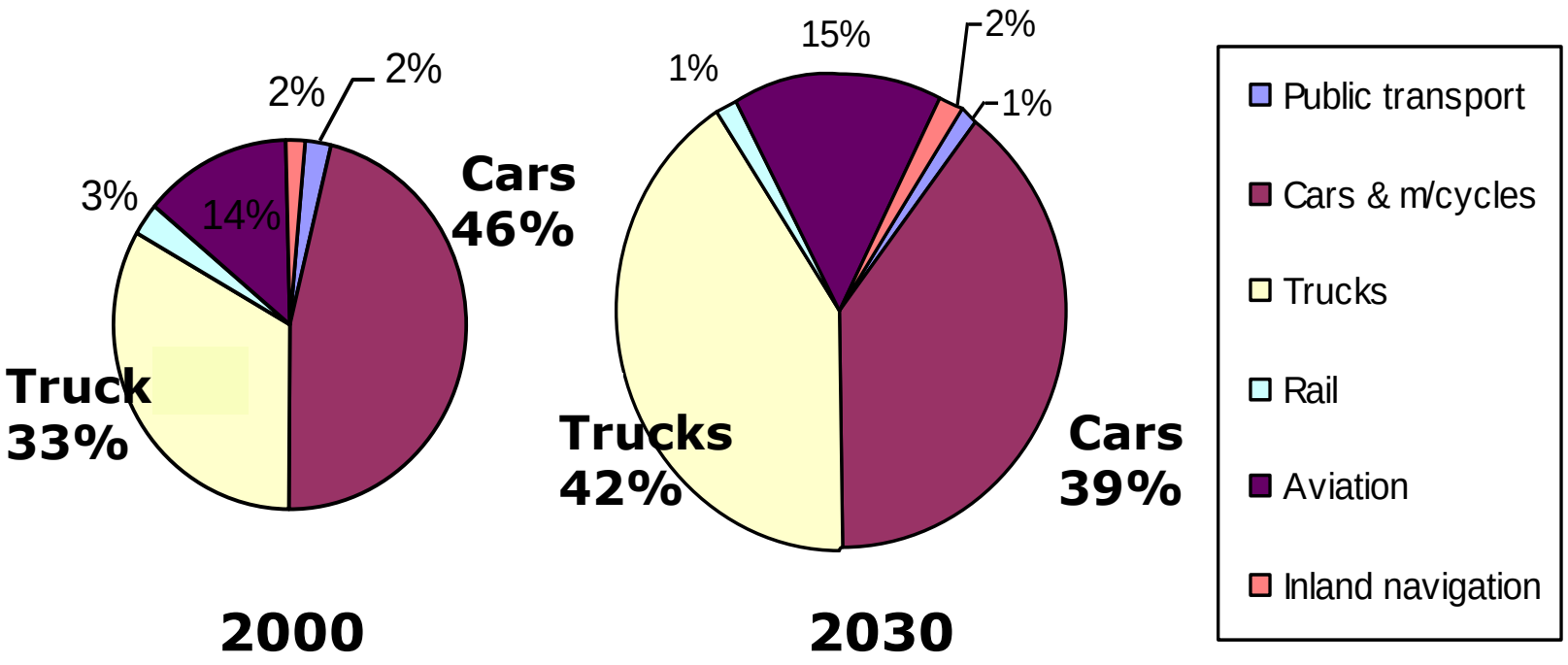
Before thinking about how to reduce emissions …… consider how we can prevent GROWTH in emissions!

Growth in Freight Demand

- Tonne-km growth in EU27 is exceeding economic growth
- Freight grew 46% in 11 years – doubling every 25 yrs



Freight Transport – a big polluter



Trucks will grow from second largest polluter in the transport sector in 2000 (EU-30) to the largest in 2030

Growth in Freight - Choices

Reducing Carbon Footprint of Freight

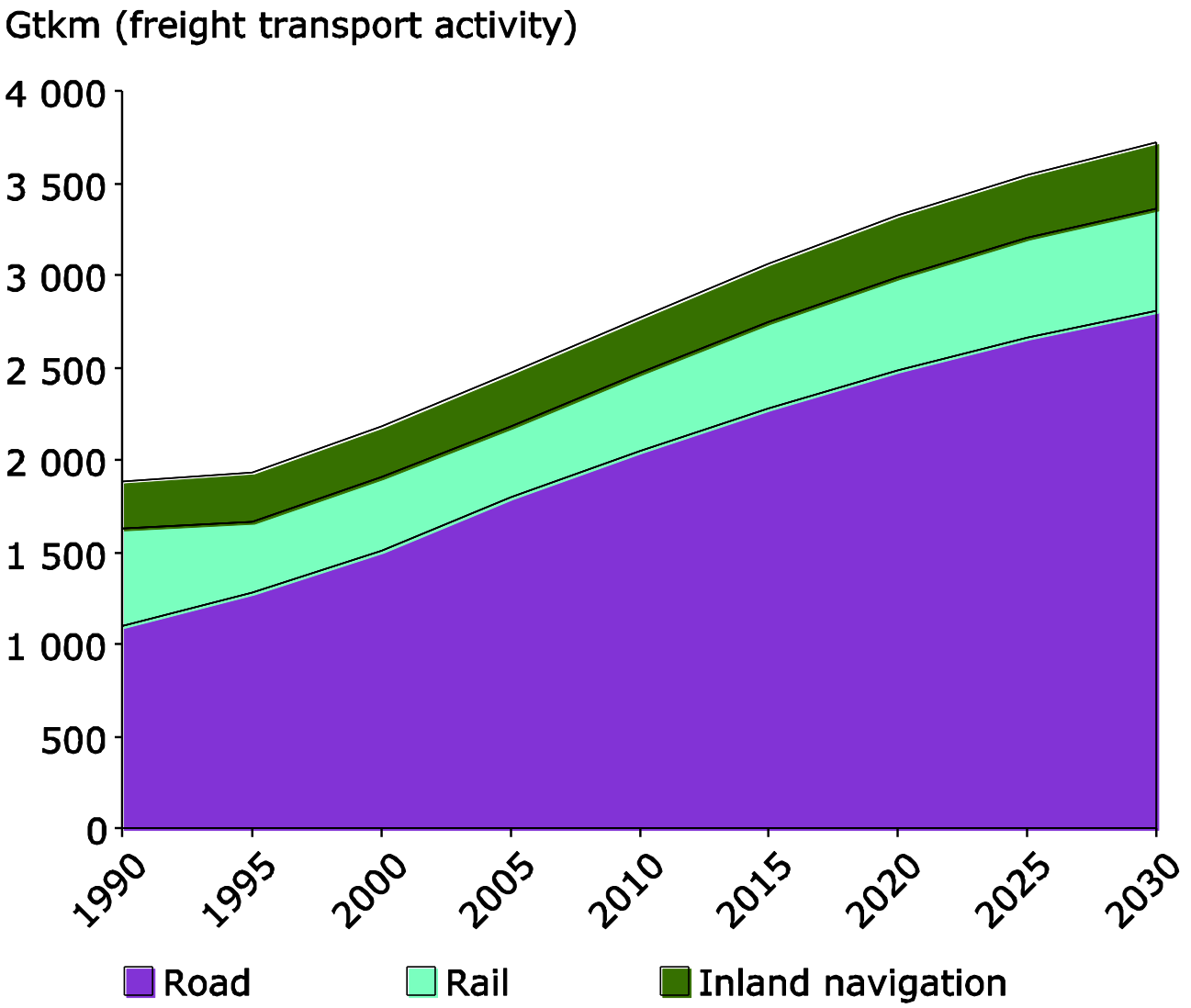
Decouple freight growth from carbon emissions growth

- What are our options?
- Will the future be,
  1. Rail or
  2. Road?

1. Rail & (Renewable) Electric Power

- **Mainline power is changing from fossil fuels to nuclear, wind and maybe wave**
- **Trains can use mains electricity**
- **Hence, rail could provide a Carbon-neutral solution but.....**

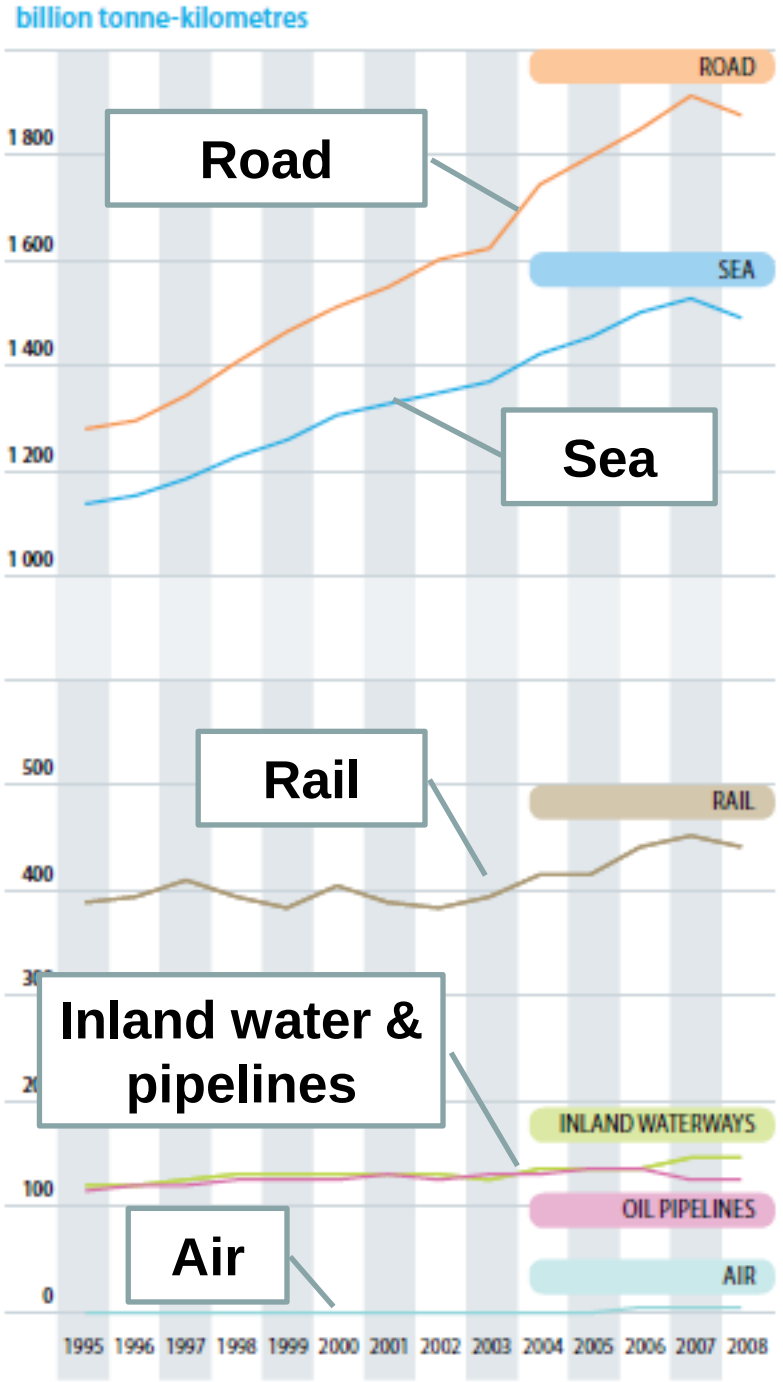
Rail vs Road



EU 25. The TERM report (EEA, 2009)

EU freight by Mode

- Rail is small and a diminishing % - seems unlikely to be the solution
- Inland water & air not significant
- Most European freight is by road or short sea shipping



Rail & (Renewable) Electric Power

- Only 4% growth in European rail in ten years – rail is not currently providing the solution in the EU
  - competition between national authorities inhibiting efficiency
  - some growth in rail freight where it is deregulated
  - batch process – not efficient

Rail freight in Ireland

- Ireland is an island – our distances are relatively short …. makes it harder to compete with road

- Ireland has not implemented the separation of functions: track from rolling stock

Rail freight in Ireland

- **Ireland is an island – our distances are relatively short …. makes it harder to compete with road**

- **Ireland has not implemented the separation of functions: track from rolling stock**

13th March, 2012: “Today's Cabinet meeting agreed not to seek a further derogation from EU rules on rail market access, at the suggestion of Transport Minister Leo Varadkar”.

Rail freight in Ireland

- Ireland is an island – our distances are relatively short …. makes it harder to compete with road

- Ireland has not implemented the separation of functions: track from rolling stock
- Irish Rail is the only company in Ireland offering a rail freight service (the market is small)
- Irish Rail appear to have prioritised passenger transport over freight
- Irish railways are not yet electrified!

Rail freight in Ireland

- Transferring between road/rail is expensive logistically
- Most freight will start and end its journey in a truck

Rail freight in Ireland

- Rail could be made more attractive to transport operators if incentivised financially or through the tax system.
- However, the fact remains that in a small country, significant modal shift from road freight to rail freight is not likely.
- Other ways of reducing emissions from road freight must be sought.

2. Road Freight Solutions

- If future freight is to be carried by road, how will we decouple growth from carbon emission?

- ERTRAC is the European Road Transport Research Advisory Council
- ERTRAC's subcommittee on Long Distance Freight prepared a research roadmap for green, safe and efficient freight corridors

ERTRAC on Long Distance Freight – Research Roadmap:

	Indicator	Guiding objective for 2030
Decarbonisation	Energy Efficiency: Urban Passenger	**+80%**
	Energy Efficiency: Long Distance Freight	**+40%**
	Share of Renewables	Biofuels: **25%** Electricity: **5%**
Reliability	Reliability of transport times	**+50%**
	Urban Accessibility	Preserve Improve where possible
Safety	Accidents with fatalities and severe injuries	**-60%**
	Cargo Lost to Theft and Damage	**-70%**

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ERTRAC on Long Distance Freight – Research Roadmap:

- Vehicle technologies
- Driver environment
- Logistics & intermodality
- Infrastructure
- ICT in corridors

- Standardised, modular dimensions;
- Longer & heavier vehicles
- Optimised; aerodynamic design
- Reduced rolling resistance & friction;
- Will use new fuels/electric.

ERTRAC on Long Distance Freight – Research Roadmap:

- Vehicle technologies
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- Eco-driving (10-12% fuel saving);
- Advanced HMI supporting the driver;
- Smart loading (intelligent goods);
- Automated cargo handling.
- Anti-idling
- Air con./heating

Best practice in reducing GHG in road freight (from Frey and Kuo, 2007)

Type of best practice	Name of Best Practice
Anti-idling	Off-board truck stop electrification Truck-board stop electrification Auxiliary Power Units Direct Fired heaters Direct Fired heaters with thermal storage units
Air conditioning system improvement	Enhanced air-conditioning system (1) for direction emissions, (2) for indirect emissions Alternative Refrigerants
Aerodynamic drag reduction	Vehicle profile improvement for (1) Tractor, (2) Truck side and underside (3) for van Pneumatic Aerodynamic drag reduction Planar boat tail plates on a tractor-trailer Vehicle load profile improvement
Tyre rolling resistance improvement	Automatic tyre inflation system Wide=base tyres Low-rolling resistance tyres Pneumatic blowing to reducing rolling resistance

Best practice in reducing GHG in road freight (from Frey and Kuo, 2007)

Hybrid propulsion	Hybrid trucks
Diesel engine improvement	Engine friction reduction through low-viscosity engine lubricants Increase peak cylinder pressures Improved fuel injectors Turbocharged, direct injection to improved thermal management Thermoelectric technology to recover waste heat
Accessory load reduction	Electric auxiliaries Fuel cell-operated auxiliaries
Driver operation improvement	Truck driver training programme
Alternative Fuel	Biodiesel fuel

SOURCE: Best practice guidebook for GHG Reductions in Freight Transportation, Final report for the US Dept of Transportation.

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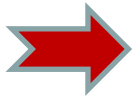

- Optimised use of all transport modes;
- Green hubs and corridors;
- Connections between corridors and cities.
- Changing buyer behaviour (pass on carbon cost of goods)

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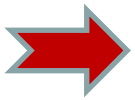
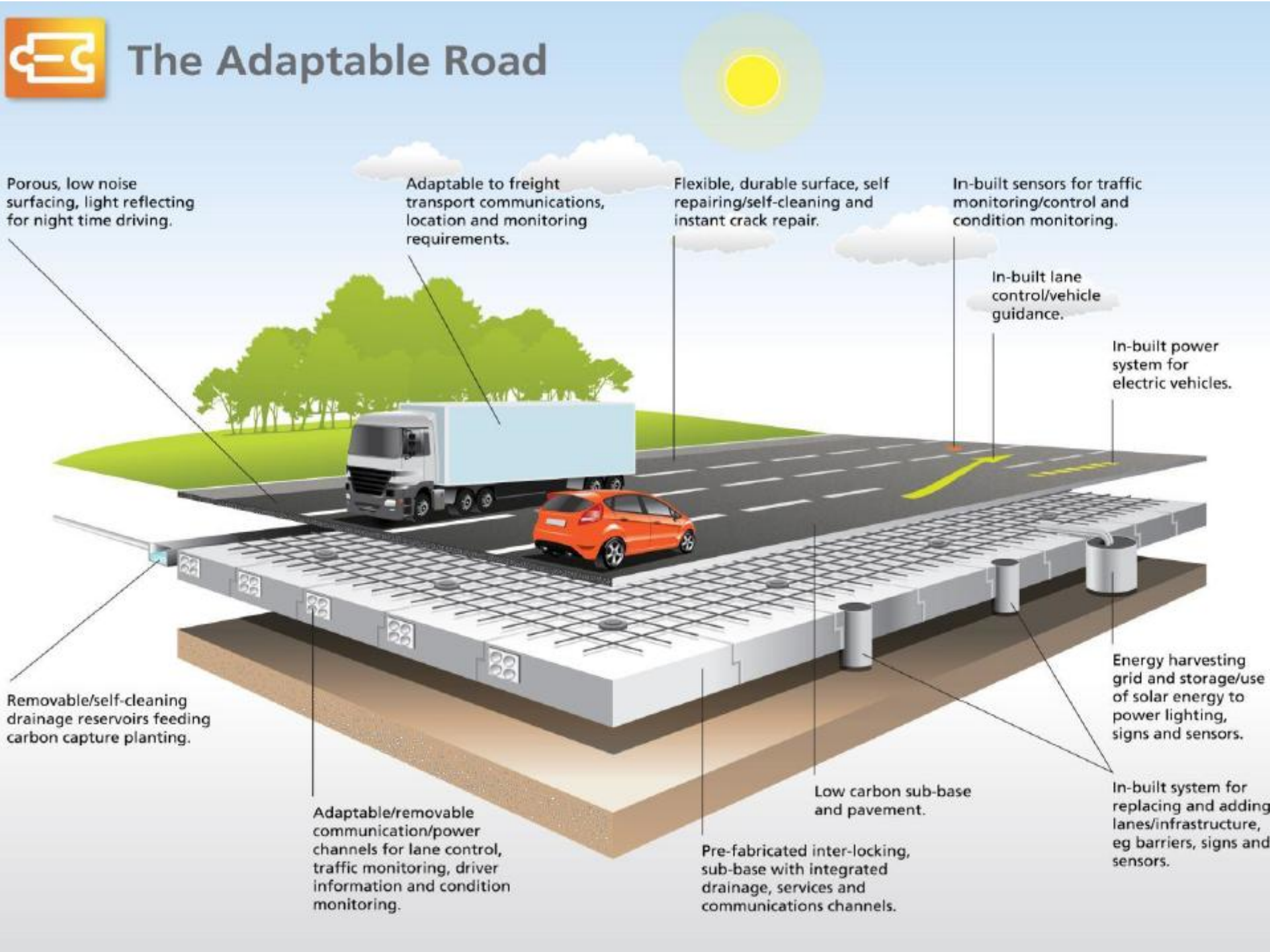


Roads will be:

- **Adaptable;**

The Adaptable Road



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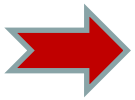
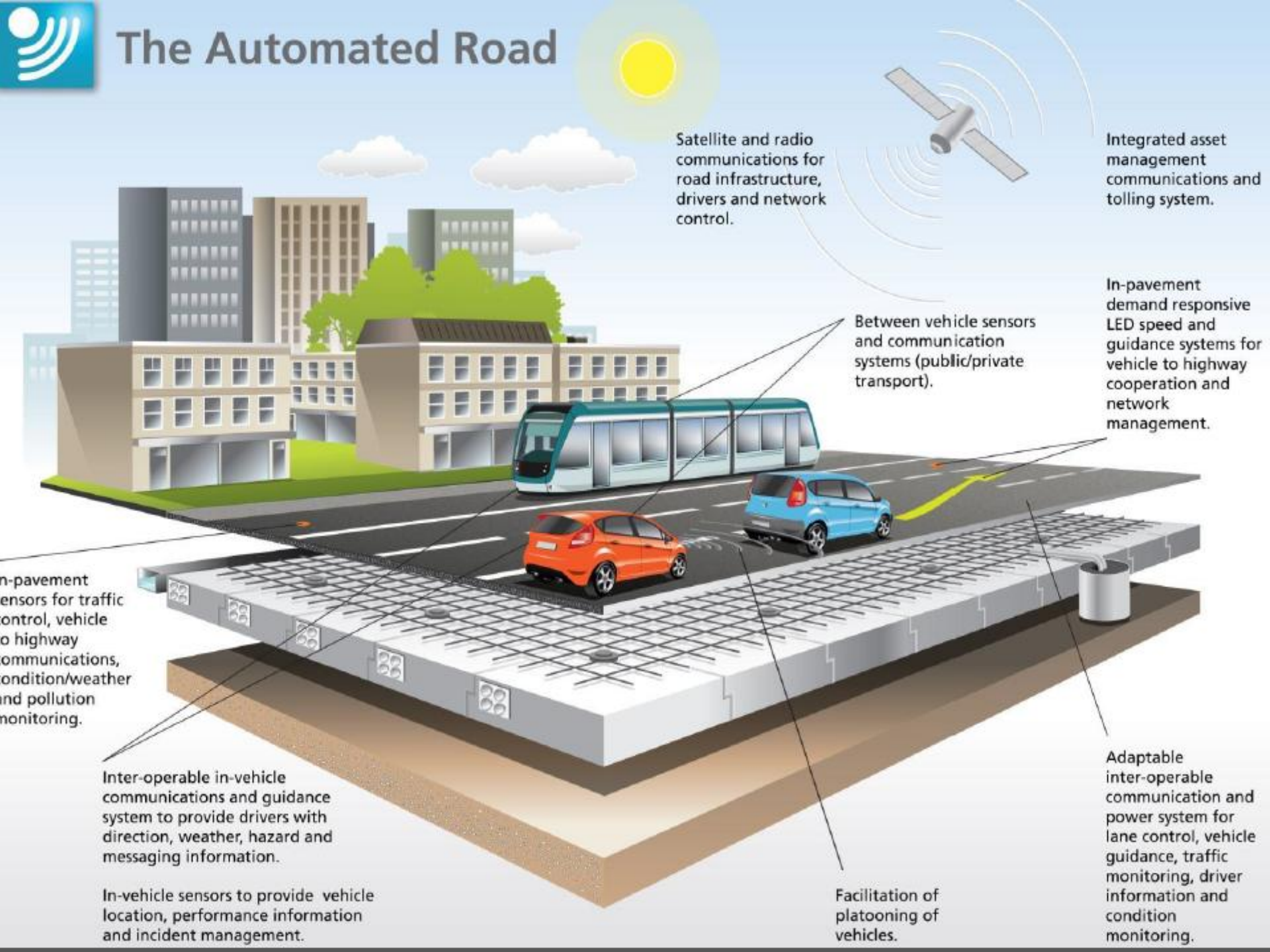


Roads will be:

- **Adaptable;**
- **Automated**

The Automated Road



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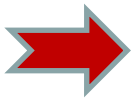
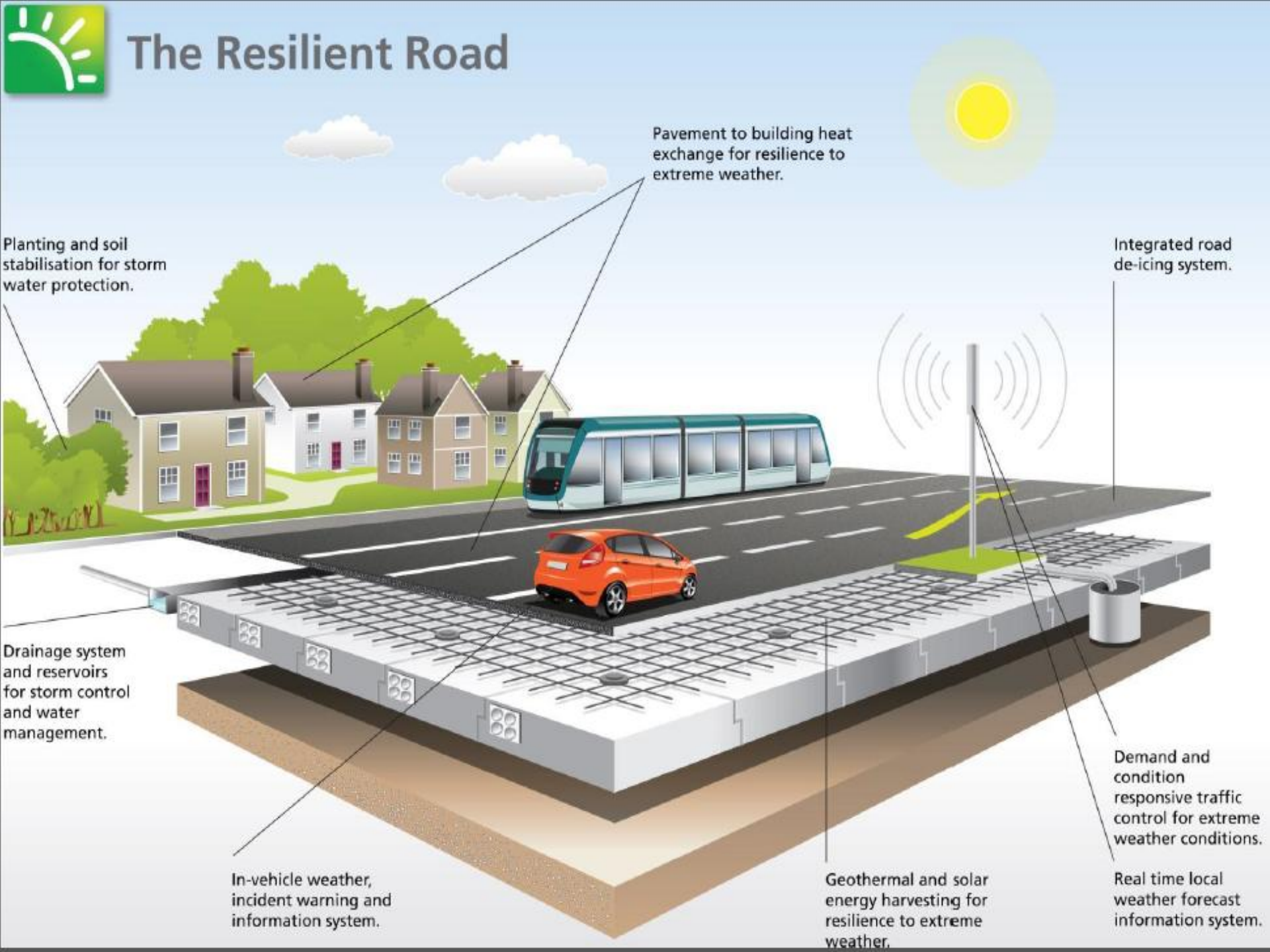
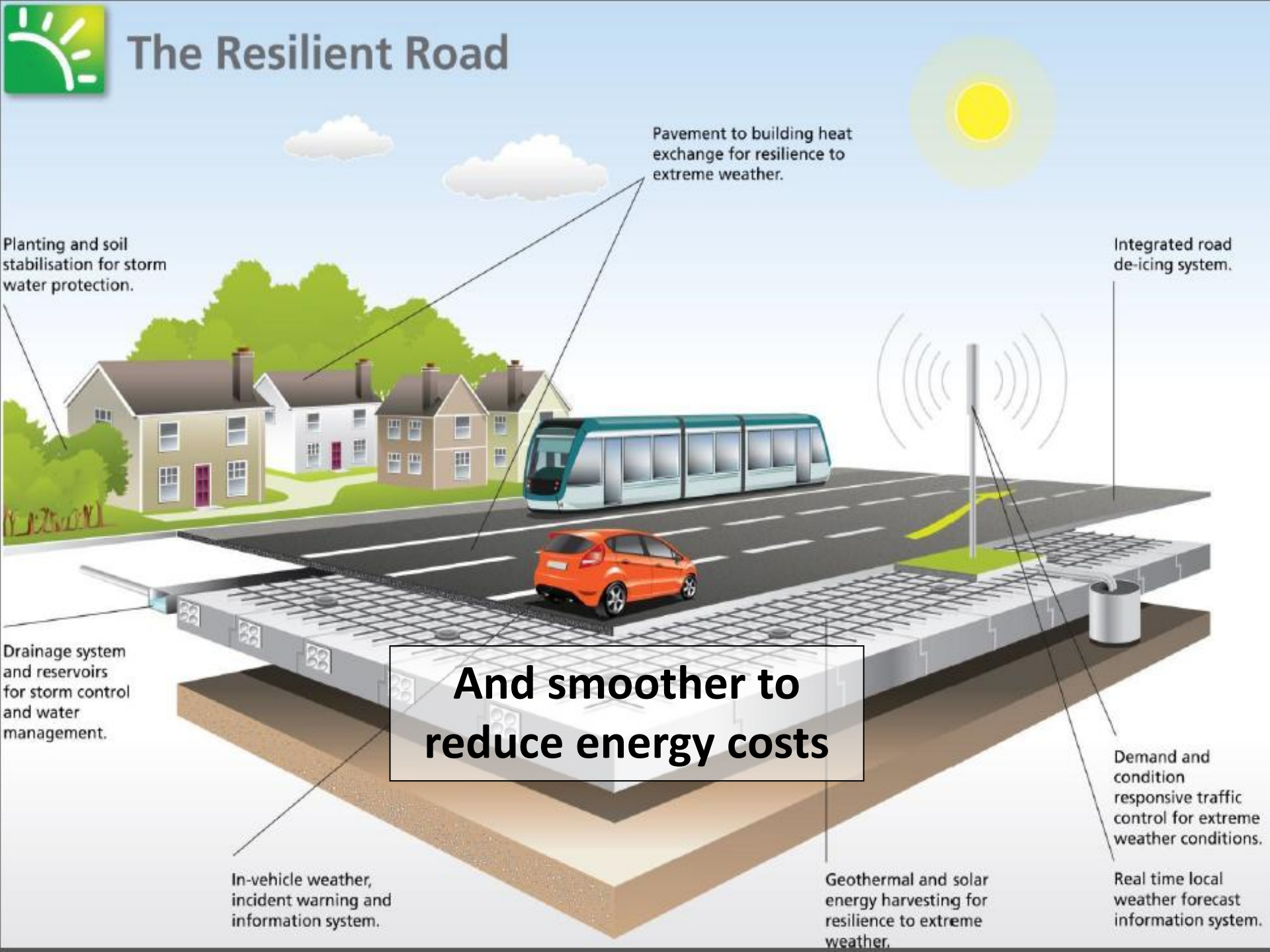


Roads will be:

- **Adaptable;**
- **Automated and**
- **Resilient.**

The Resilient Road




The Resilient Road
Pavement to building heat exchange for resilience to extreme weather.
Planting and soil stabilisation for storm water protection.
Integrated road de-icing system.
Drainage system and reservoirs for storm control and water management.
And smoother to reduce energy costs
Demand and condition responsive traffic control for extreme weather conditions.
In-vehicle weather, incident warning and information system.
Geothermal and solar energy harvesting for resilience to extreme weather.
Real time local weather forecast information system.

ERTRAC on Long Distance Freight – Research Roadmap:

- Vehicle technologies
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V2V, V2I and I2V communications:

- Vehicle tells infrastructure that road needs repair
- Car tells next car that road is frosty
- Vehicle convoying technologies

Vehicle Technologies - Fuels

a) Biodiesel

b) Fuel cell

c) Electric

(a) Biodiesel

Biodiesel has many advantages:

- **It can be produced domestically, reducing dependency on importing of fuel and providing farmers with an alternative income generator.**

- **Ireland is particularly well-suited to the production of biomass for energy.**

(a) Biodiesel

- **Biodiesels MAY result in lower carbon emissions, decreased hydrocarbons and lower particulate emissions at the exhaust pipe.**

- **Plants producing biodiesel absorb carbon dioxide – which can be offset against carbon that is produced when biodiesel fuels are made.**

(a) Biodiesel

BUT:

- **Does biodiesel really result in lower carbon emissions? As many researchers have pointed out, we can only answer this definitively following a life stage analysis of the production of biodiesel, including its transportation and refining.**
- **Some researchers are sceptical of the ability of biodiesel to reduce carbon emissions.**

(a) Biodiesel

- Its performance is dependent of the blend used – higher blends (>20%) achieve better results in terms of lower carbon emissions.

- Biodiesel MAY result in higher NOx emissions, especially at higher blends.

(a) Biodiesel

Conclusion:

- **We need Irish studies to explore more fully how biodiesel production and biodiesel use might impact upon carbon emissions in Ireland.**

(b) Fuel Cell

- **Fuel cell electric vehicles, as with biodiesel, have significant advantages:**
- **The only by-product is water so there are no GHG emissions, no noise and no particulates.**
- **Hydrogen is also the most plentiful element in the universe so we are not going to run out.**

(b) Fuel Cell

- **Fuel cells can be used to power auxiliary power units (to run heating, air conditioning etc when the truck is stopped), reducing idling of vehicles, and hence reducing GHG emissions.**

(b) Fuel Cell

BUT:

- **Expensive to produce. More expensive that producing diesel? But perhaps not in the future?**
- **Expensive to transport as hydrogen is bulky.**
- **If vehicles were to be allowed to refuel with pure hydrogen, infrastructure would need to be developed to enable this.**

(c) Electric Vehicles

- Mainline power is changing from fossil fuels to renewables
- Power for transport is a particular challenge
- Future cars will be electric but what about trucks?

(c) Electric Trucks

- Trucks require too much energy to run on batteries
- Hybrid electric/diesel truck with mains electricity is technically feasible
- Already made by Siemens
- In use in quarries
- Currently use diesel & use electricity for ‘boost’ on steep climbs

(c) Electric Trucks

- So future could be trucks using biodiesel on side roads
- And tapping into mains electricity when they get to the highway
- Big infrastructural cost to put in overhead wires but road infrastructure is only about 9% of total freight transport cost – the only issue is recovering the initial investment

ERTRAC on Long Distance Freight – Research Roadmap:

- Vehicle technologies
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But most of this is not Ireland-specific – more efficient vehicles, etc, will arrive on Ireland's roads. How is it relevant to us?

Ireland-specific Research Challenges

- Vehicle technologies
- Driver environment
- Logistics & intermodality
- Infrastructure
- ICT in corridors

- Standardised, modular dimensions;
- Longer & heavier vehicles
- Optimised; aerodynamic design
- Reduced rolling resistance & friction;
- Will use new fuels.

Bigger Trucks & Road Trains

- Road Trains are cheaper to operate (one driver for more freight)
- Much more freight in much less road space
- Much less energy usage per tonne carried

- It may be difficult to gain acceptance in Europe

Long-Combination Vehicles (LCV's)

- Could be a compromise acceptable in Europe
- 25.5 m trucks are already allowed in Sweden & Finland
- Dutch 'test' programme has been extended
- Plans for trials in Germany
- Going to be tested in Norway

25.5 m truck

Claimed Benefits of Long-Combination Vehicles (LCV's)

Performance Measure	Reduction due to LCVs
Freight movements and overall truck-kms	44%
Overall shipping costs	29%
Fuel consumption / greenhouse gas emissions	32%
Road wear	40%

2 LCV's carry freight of 3 semi-trailers

Source: Woodrooffe, J. and L. Ash, *Economic Efficiency of Long Combination Transport Vehicles in Alberta*. 2001

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Long Combination Vehicles

We are ‘land-locked’!

Research Challenges – Bridge Loading

- **Bigger trucks, road trains and convoys, all represent potential problems for Ireland's bridges**
  - **they were not designed for such heavy concentrations of loading**
  - **many bridges (especially in minor roads) are old and not designed for modern traffic**
  - **there may be problems of dynamics from regular patterns of loading**
- **The 'bridge issue' is being used as an argument to prevent the introduction of larger trucks**
- **Need research on accurate assessment of the traffic loading on bridges**
  - **and the implications of new concepts**

Conclusions – We Have a Problem

- Overall, in the EU, freight is tracking GDP – doubling every 25 years
- Our freight transport carbon footprint is more likely to grow than reduce
- Rail takes a small & reducing % in EU
  - And even less in Ireland

Conclusions – Road Freight

- Vehicle technologies will help
  - Improved fuel efficiencies
- Eco-driving will help
- Roads can be smoother with reduced carbon footprint
- Fuels:
  - Biodiesel – yes
  - Fuel cell – maybe
  - Electric – good idea but …..

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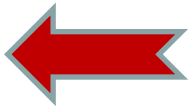
Conclusions – Bigger Trucks

Longer & heavier vehicles are the 'low hanging fruit' of freight transport



- **Much improved fuel efficiency**
- **Inexpensive to implement**
- **Reduced transportation costs**