European Research Roadmaps

On the road to a more Efficient Transport System

ERTRAC's Research Roadmaps for the Decarbonization of Road Transport

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ERTRAC's Strategic Research Agenda 2010

EUROPEAN ROAD TRANSPORT RESEARCH ADVISORY COUNCIL

Societal challenges

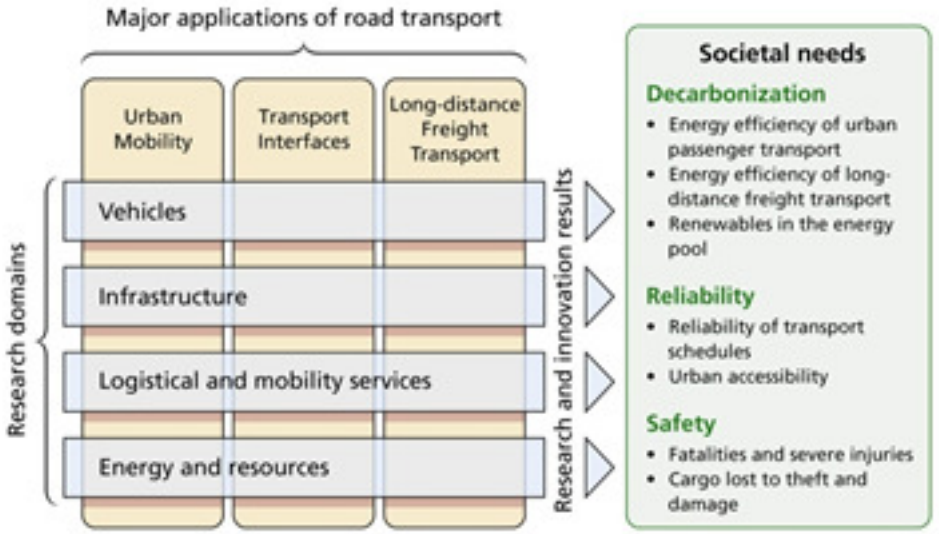
- Decarbonisation
- Reliability
- Safety & Security
- Global Competitiveness

Outcome

- Sustainable Growth
- Green Jobs

➢ Involving all stakeholders

➢ Following a system approach



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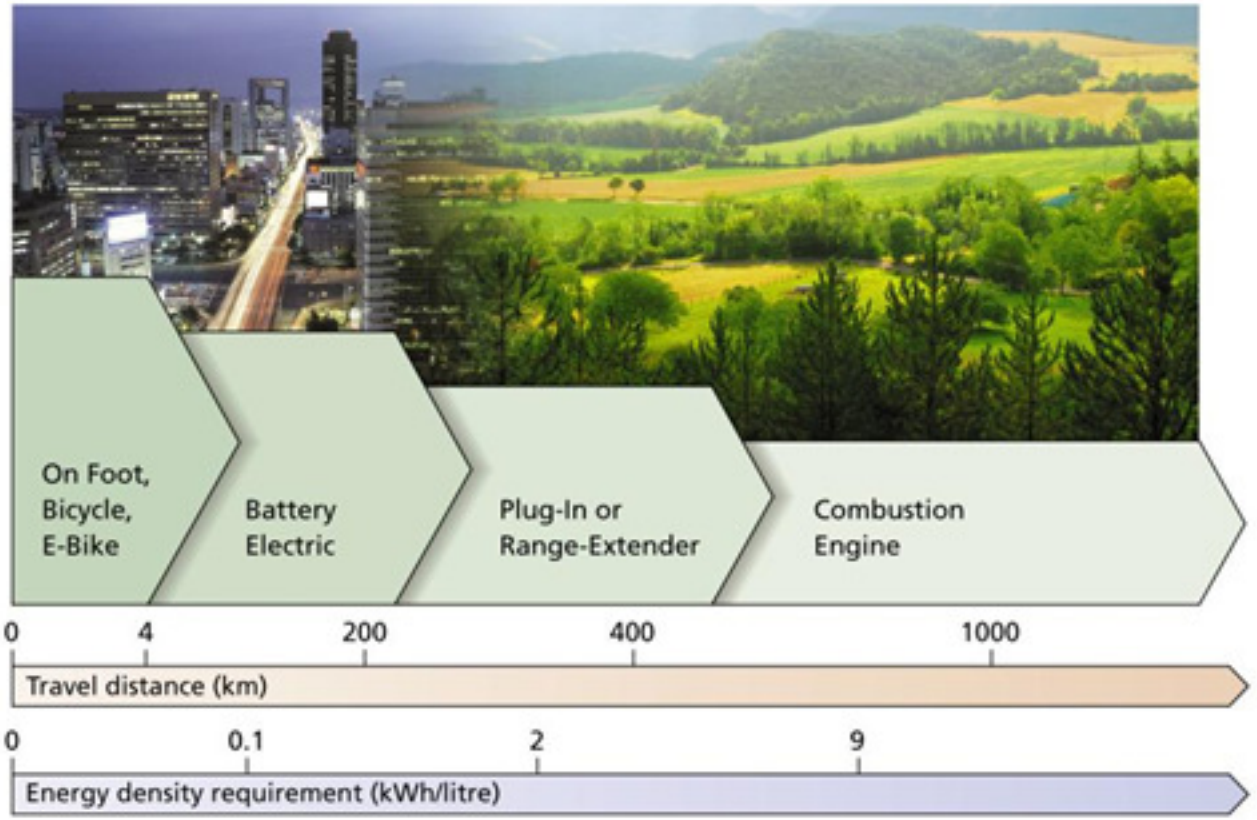
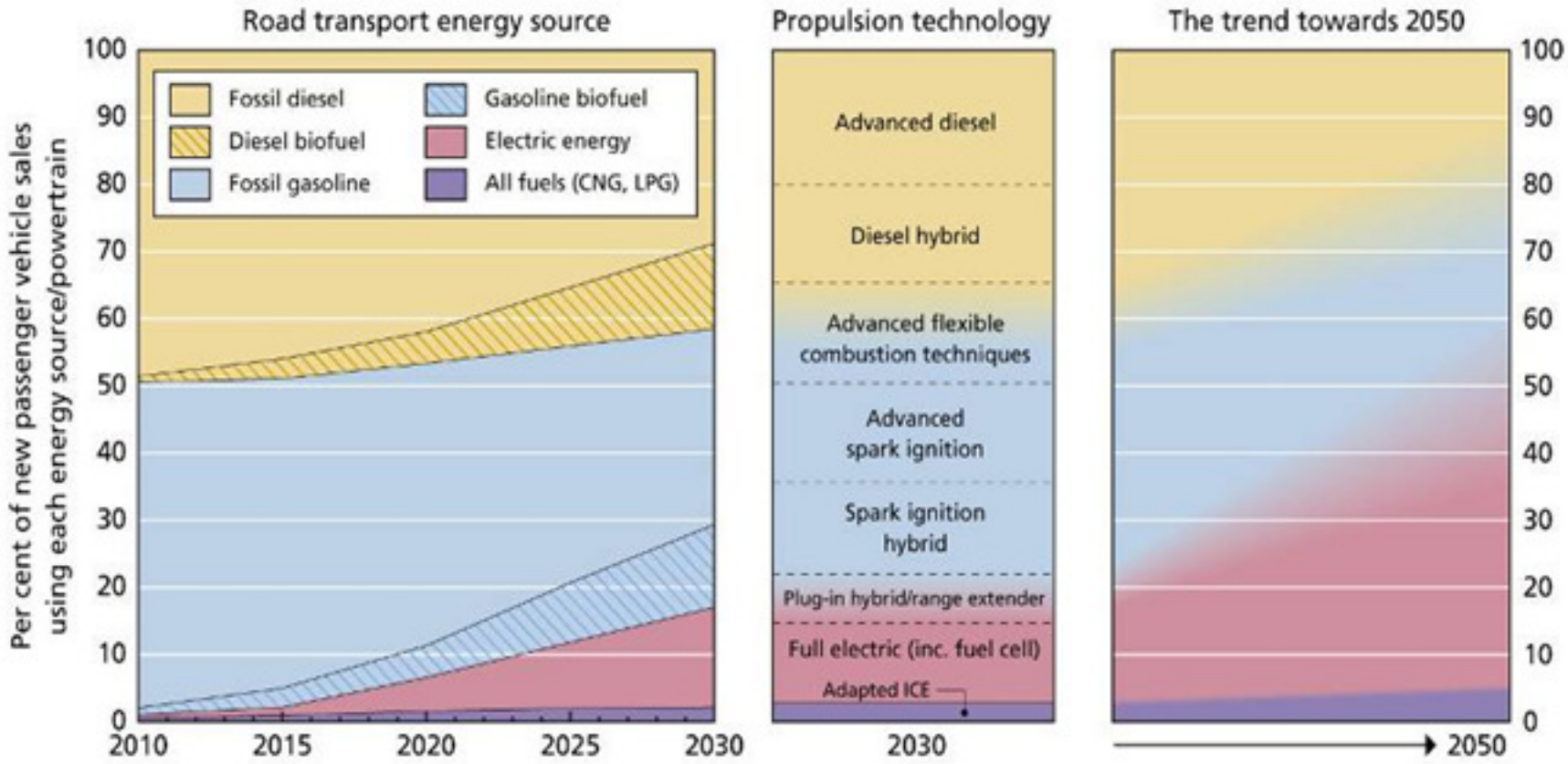
Affordable sustainable mobility solutions for both urban and long distance transport



Evolution of Light-duty Powertrains and Fuels Through 2050



Following an Integrated Approach is Paramount

Guided by clear and ambitious objectives for a 50% more efficient European Road Transport System by 2030

Achieving the objectives requires collaborative and synchronised action by public and private partners

	Indicator	Guiding objective
Decarbonization	Energy efficiency: urban passenger transport	+80% *
	Energy efficiency: long-distance freight transport	+40% *
	Renewables in the energy pool	Biofuels: 25% Electricity: 5%
Reliability	Reliability of transport schedules	+50% *
	Urban accessibility	Preserve Improve where possible
Safety	Fatalities and severe injuries	-60% *
	Cargo lost to theft and damage	-70% *

* = versus a 2010 baseline

Decarbonisation of Road Transport: Significance & Guiding Objectives

Decarbonisation of Road Transport	Energy efficiency: Urban transport	+80%
	Energy efficiency: Long-distance freight transport	+40%
	Share of renewables	25% Biofuels* 5% Electricity

- SRA2010 focuses on Decarbonisation of Road Transport by:
  - Substantially improving the energy efficiency of road transport
    - Greater fuel efficiency of engines, vehicles, and transport systems
    - Greater use of alternative transport modes, especially in urban areas
    - Greater use of Information Technology (V2V, V2I, and V2G)
  - Substantially increasing the share of renewables in road transport
    - Greater use of biofuels in road fuels
    - Greater use of renewables in electricity generation

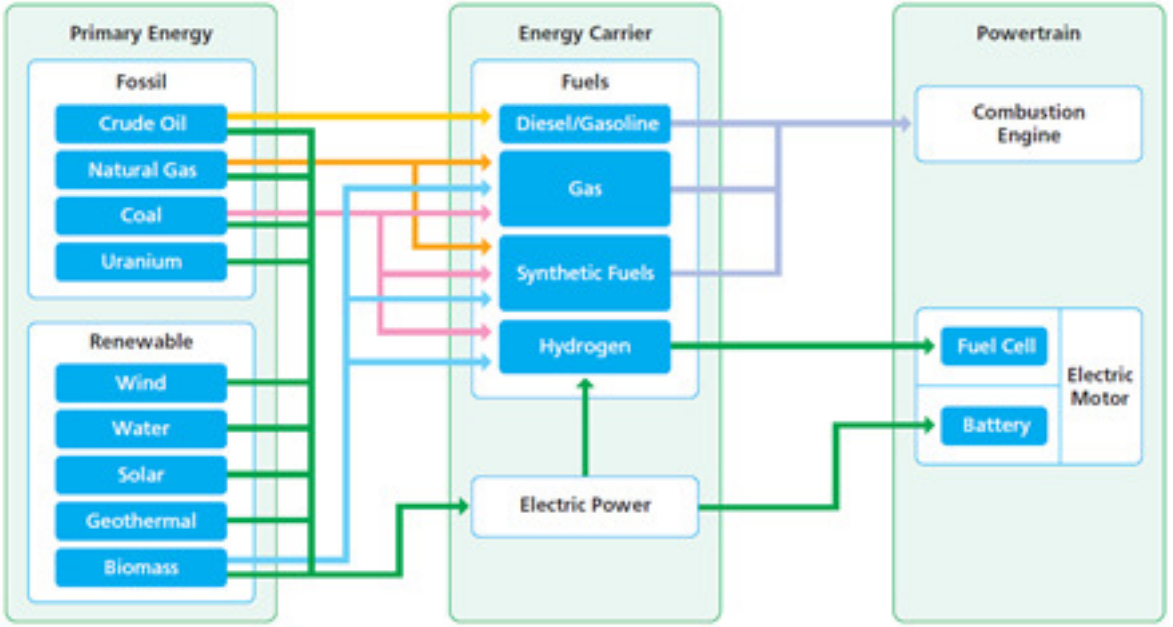
** Aligned with the European Biofuels Technology Platform*

Outlook for 'Future Powertrains and Fuels'

- **Vehicles:**
  - Internal combustion engines (ICEs) expected to dominate road transport through 2030, especially in long distance transport modes
  - Greater diversification of vehicles and fuels in urban environments
  - Growing transport electrification with the pace of implementation dependent on energy storage capacity and cost
- **Energy & Resources:**
  - Increasing diversification in biofuel/fossil fuel blends and other renewables
  - Continuous improvement in road transport noise and vehicle emissions
- **Infrastructure:**
  - Availability and effective management of existing transport infrastructure
  - Search for new, durable, and lightweight materials for diverse applications
- **Services:**
  - User-friendly, integrated, and efficient information and logistics services

Decarbonisation: Key Research Priorities

- **Powertrains: Electric and Advanced Internal Combustion Engines**
  - Integrated Drivelines
  - Battery and Energy Storage Systems
  - Energy Management
  - High Performance from More Abundant Materials

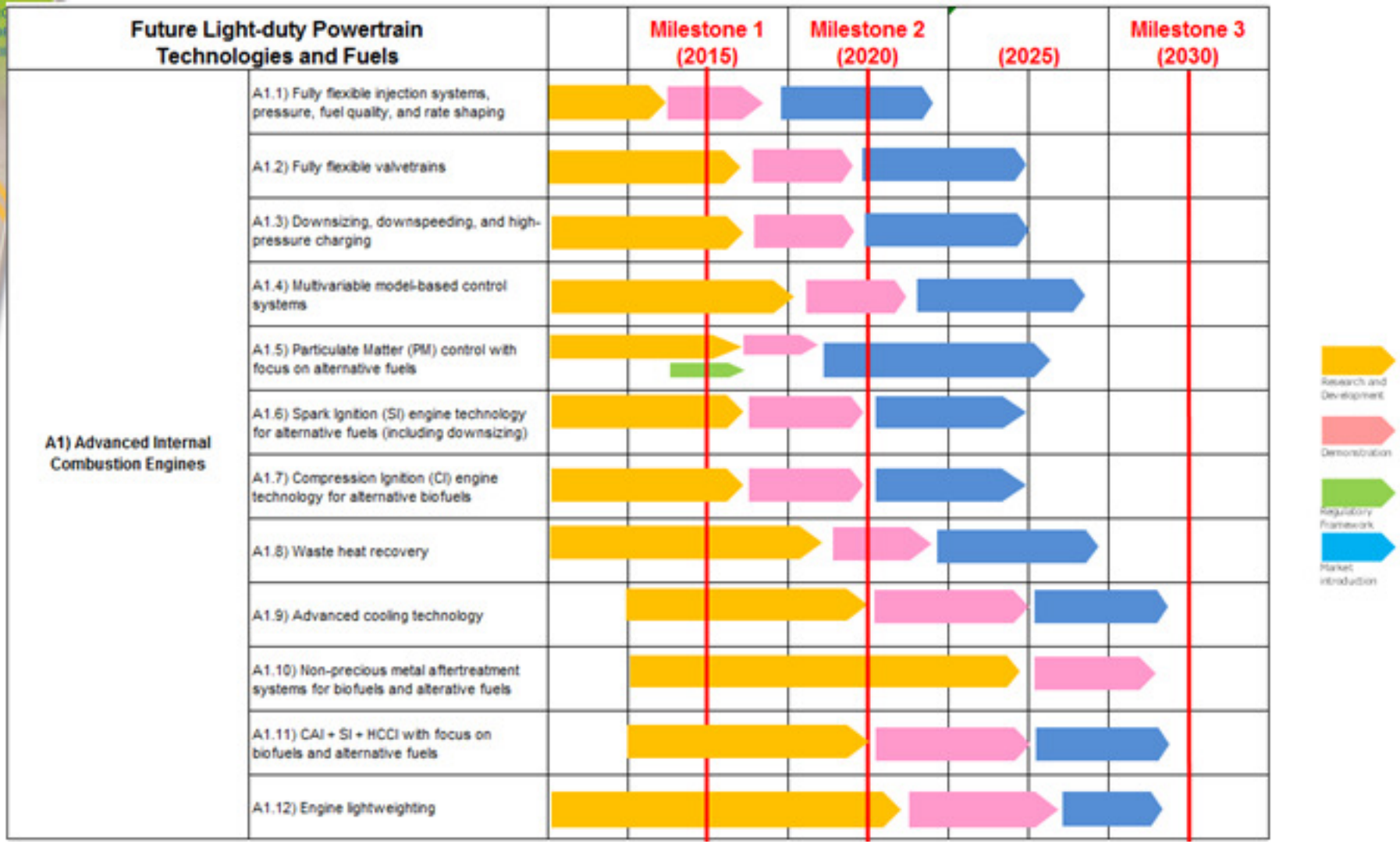


- **Biofuels and Advanced Fuels Production**
- **Integrated information and Communication Technologies**
  - Vehicles, Infrastructure, and Services

Future Light-duty Powertrain Technologies and Fuels Roadmap Milestones

- **Milestone 1 (2015) – Market: 2020-2025**
  - Adapting existing technologies to impact decarbonisation challenges
- **Milestone 2 (2020) – Market: 2025-2030**
  - Integrating implemented technologies to impact decarbonisation challenges
- **Milestone 3 (2030) – Market: 2030+**
  - Optimising performance from implemented technologies to impact decarbonisation challenges

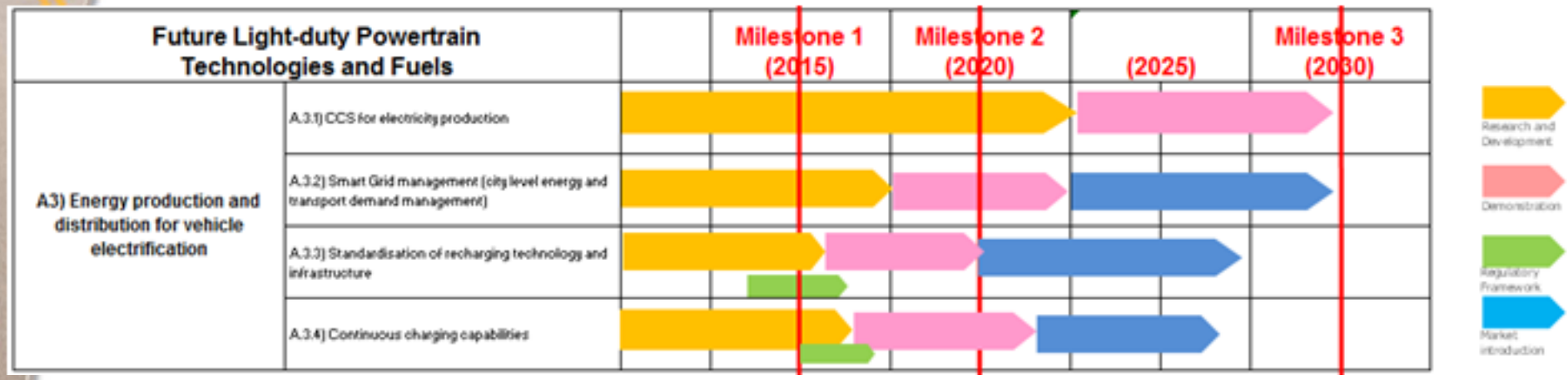
A1) Advanced Internal Combustion Engines



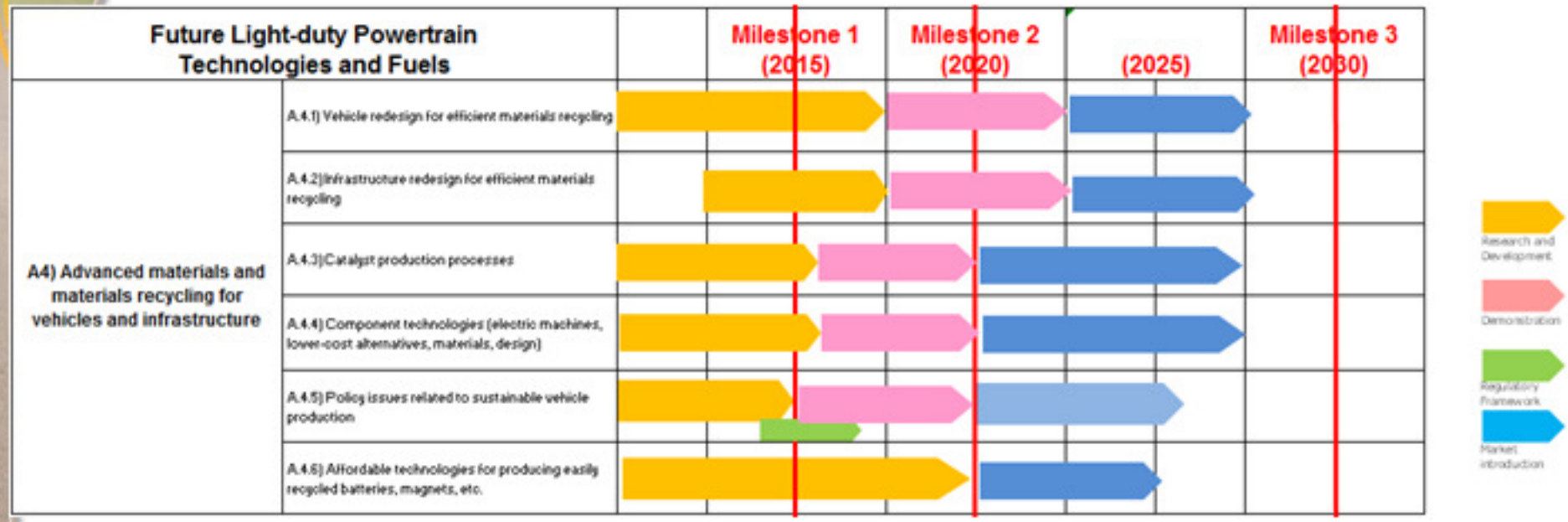
A2) Production & Storage of Fuel Products

Future Light-duty Powertrain Technologies and Fuels		Milestone 1 (2015)	Milestone 2 (2020)	(2025)	Milestone 3 (2030)
A2) Production, distribution, and storage of biofuels and advanced fuel products	A.2.1) Improve process and catalyst technology in order to improve WTT efficiency of fuel production				
	A.2.2) Meet current fossil fuel properties using advanced biofuel products (HVO, BTL, LC Ethanol, Biomethane, DME, Hydrogen) and adapt engine technology to meet regulated limits				
	A.2.3) Long-term biofuel storage systems				
	A.2.4) Additive technology for enabling enhanced performance				

A3) Energy Production for Electrification



A4) Advanced Materials and Recycling



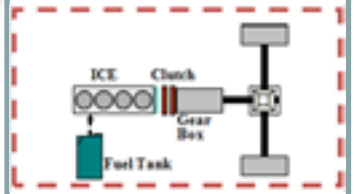
A5) Assessment Tools (WTW, LCA)

European Roadmap Hybridisation of Road Transport

Surroundings of Hybrids

The challenge of decarbonisation of transport at acceptable costs, could not be solved without Hybrids

Conventional Vehicles



Hybrid Electric Vehicles

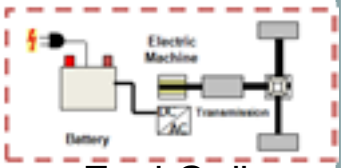
Micro Hybrid	Mild Hybrid	Full Hybrid (Parallel /Power-Split / Serial)	Plug-In Hybrid Range Extender

+ Pure Electric Drive
+ Electric Take-off
+ Engine Assistance
+ Kinetic Energy Recovery
Start - Stop

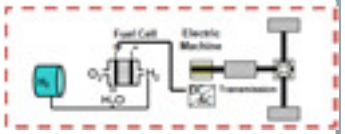
Hybridisation aiming at assisting the combustion engine

Hybridisation aiming at running the vehicle by electric propulsion

Battery Electric Vehicles



Fuel-Cell Electric Vehicles



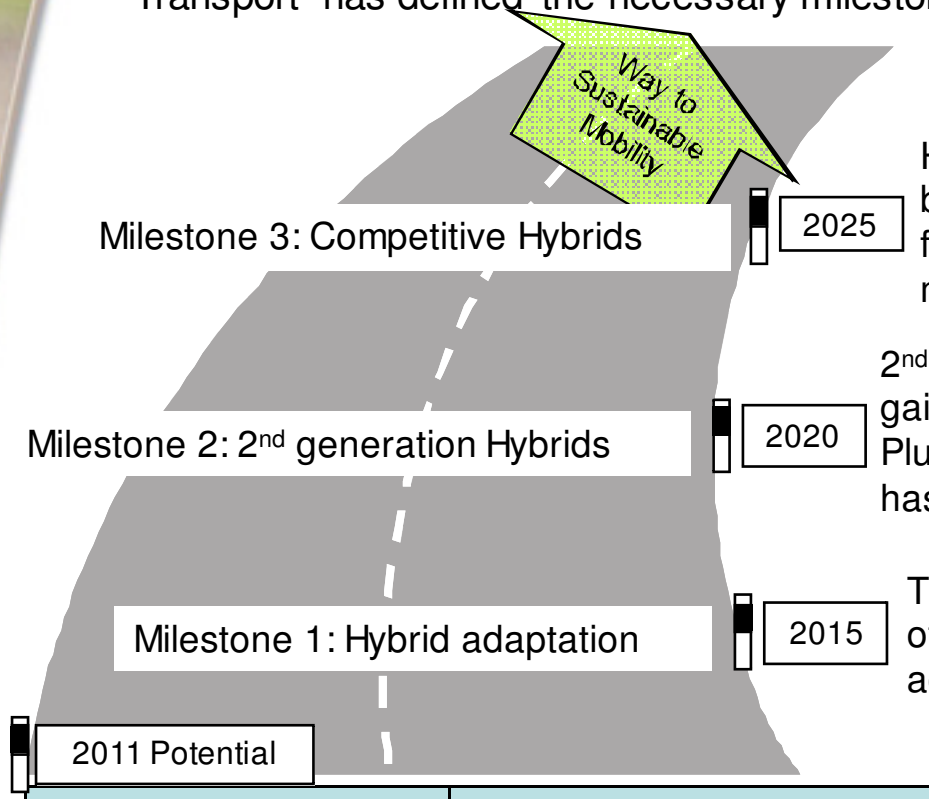
⇨ Hybrid Electric Vehicles combine the advantage of two different propulsion systems:
To drive with zero emission and to drive more efficient on long distances

⇨ Hybrids suit a lot of vehicle configurations:
Small city cars, long distance family cars, delivery vans, city-buses

European Roadmap Hybridisation of Road Transport

Milestones

In order to strengthen and extend the competitiveness of European auto-motive industry in the field of Hybrid Vehicles, the 'European Roadmap Hybridisation of Road Transport' has defined the necessary milestones and recommendations



Hybrid Vehicles competitive regarding costs and benefits will conquer the market. Modular and flexible Hybrid Vehicle designs will make the market more interesting.

2nd generation hybrids will provide efficiency gains for all consumers. Mass production of Plug-In Hybrids and Range Extender Hybrids has started.

The already started and ongoing introduction of hybrids into the market is based on the adaptation to existing vehicles.

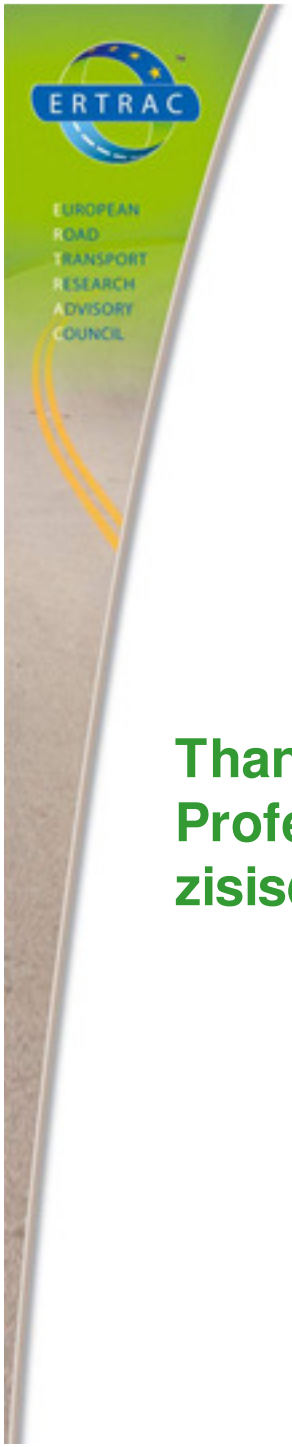
	Application	ZEV range (km)	CO_2 reduction potential
Plug-In Hybrid	Best application for 'All-Round' cars	20 km – 80 km	15% - 90%
Range Extender Hybrid	Proper solution for city traffic	80 km-120 km	10% - 95%

European Roadmap Hybridisation of Road Transport

Main Recommendations

Future challenges for the Hybrids will be surely:

- ⇨ The relation costs vs. benefits. The question will be which additional Hybrid costs will be accepted by the customer, which (cost) benefits can be achieved during a reasonable time of operation
- ⇨ To enlarge the ZEV range, to adapt the ICE to Hybrid demands, to make Hybrids lightweight, safe and more robust
- ⇨ To overcome those challenges, research efforts must be undertaken mainly for the following fields:
  - ⇨ Energy Storage Systems
    Batteries smaller, cheaper, lightweight, safe, more robust,
    long life time and with high power & energy density
  - ⇨ Drive Train technologies
    New concepts for electrical machines & electro mechanical
    technologies, low-cost, lightweight
  - ⇨ System Integration & Modular Hybrid Architecture
    To build robust, small, integrated and efficient hybrid configurations
  - ⇨ Grid Integration
    Fast, contact-less, bidirectional charging infrastructure
  - ⇨ Safety Aspects
    Crashworthiness of lightweight / small cars
  - ⇨ Integration into the Transport system
    Development of solutions capable for high number of pieces (mass production)



Thank you for your attention!

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