# Integrated Fuels and Vehicles Roadmap to 2030+

## Study results

Utrecht, January 27, 2017

# Summary Integrated Fuels and Vehicles Roadmap to 2030+

> On the basis of a detailed EU 28 road fleet model developed by Roland Berger it appears that extending **existing policy** measures to 2030, the road transport sector **can reduce TTW emissions by ~29% to 2030** (vs. 2005) reaching almost the 2030 aspiration – Compared to today, 2030 WTW GHG emissions should reduce by 238 Mton, thereof 191 Mton reduction are direct emissions

> Abating ~1,100 Mton $CO_2$ emissions cumulative in passenger cars 2010 to 2030 reflects **cost to society** of an estimated **~200 EUR/ton $CO_2$e** this includes significant cost incurred by vehicle manufactures and fuel suppliers

> Identified cost-efficient abatement **pathways** (fuels with higher biofuel shares, hybridization in passenger cars and highly efficient truck concepts) would allow **additional** GHG abatement of estimated **34 Mton $CO_2$e until 2030**

> Additional policies are needed to address obstacles to the deployment of low-carbon pathway technologies such as
  - supporting development of advanced **biofuels via price signal** to the biofuel/fuel industry
  - an **adjusted fuel and vehicle taxation** (e.g. excise duty exemption or taxation bonus/malus on advanced bio-components in fuels in combination with a $CO_2$ taxation component)
  - **adjusted** regulations regarding **biofuel's TTW emissions** (set tailpipe emission to zero for the renewable part of the fuel that the vehicle is compatible with, above 2020 levels and define reference fuels accordingly) to accelerate the penetration of vehicles that are compatible with higher concentrations of biofuels
  - adjusted regulations of **truck length and weight limits** to improve aerodynamics and transport efficiency by increased payload levels
  - making technology benefits more **transparent to the customer**

> **Market-based mechanisms** (MBM) are an option to complement policy to vehicle $CO_2$ standards, fuels and infrastructure policies which would provide Member States with funds to support new ultra-low-carbon vehicle and fuel technologies – In the **long term** MBM can become **primary** GHG reduction policy

# Roland Berger was appointed by Auto Fuel Coalition to conduct an independent study on EU road transport decarbonization

## Overview of Auto Fuel Coalition and Roland Berger

### Auto Fuel Coalition

Auto Fuel Coalition is a group of international vehicle and fuel companies


- Roland Berger is one of the world's **leading top management consultancies** of German heritage and **European origin**
- Roland Berger provides of **comprehensive experience and knowledge** in both automotive industry and fuel industry
- In recent years, Roland Berger conducted **several studies** in both industries, for example:
  - "Chemicals 2035 – Gearing up for growth"
  - "Are we running out of oil?"
  - "Powertrain 2020 – The Future Drives Electric"
  - "Fuel cells – A realistic alternative for zero emission?"
  - "Roland Berger E-Mobility Index" with FKA

Source: Roland Berger

# In July 2016, EU Commission confirmed overall objective to reduce GHG emissions by at least 60% in 2050 compared to 1990 levels to be firmly on path towards zero

## The regulatory framework proposed in July 2016 is based on 3 levers and a desire for EU, member states and cities to work together

### Key levers for transport decarbonisation

**Optimizing the transport system and improving its efficiency** through: Digital mobility; Fair and efficient pricing in road transport: Promotion of multi-modality

**Scaling-up the use of low-emission alternative energy sources** through: An effective framework for low emission alternative energy; Roll-out of infrastructure for alternative fuels; Interoperability and standardization for electro-mobility

**Moving towards zero-emission vehicles** through: Improvements in vehicle testing; setting post – 2020 vehicle efficiency strategy for cars and vans; setting post – 2020 vehicle efficiency strategy for lorries

### EU 2030+ decarbonisation targets

**EU 2030 Energy and Climate Package** agreed by Heads of States in 2014 sets a **40% reduction target** for GHG emissions in 2030 (-30% for non-ETS sectors versus 2005 level)

Commissioner for Transport Bulc during the press conference on the launch of the **Communication "A European strategy for low-emission mobility"** in July 2016 confirmed that transport should achieve a 20% decrease of GHG emissions by 2030 compared to 2008 levels.

Source: European Commission, Roland Berger

# The RB study proposes an optimized pathway and policy measures towards GHG reduction in road transport for 2030

## Objective of the Integrated Fuels and Vehicles Roadmap to 2030

**Opportunity for integrated policy in the communication on "A European strategy for low-emission mobility"**

> Actions to be based on concept of technology neutrality and subject to better regulation principles and processes so as to ensure any measures proposed will be evidence-based, effective, efficient, proportionate and in full respect of subsidiarity.

> Holistic approach requiring actions from all stakeholders including member states, cities, industry and services and researchers.

> Success will be finally delivered by choices made by mobility users.

### Objective of the study

> Develop an **integrated fuels and vehicle roadmap** for road transport decarbonization that includes:
  - Estimation of **GHG emissions of road transport sector in 2030**
  - A clearly identified and **suitable pathway** for cost-optimal GHG reduction in the EU to 2030 and beyond
  - Propose and implementable **policy measures** required to deliver the identified pathway

Source: Roland Berger

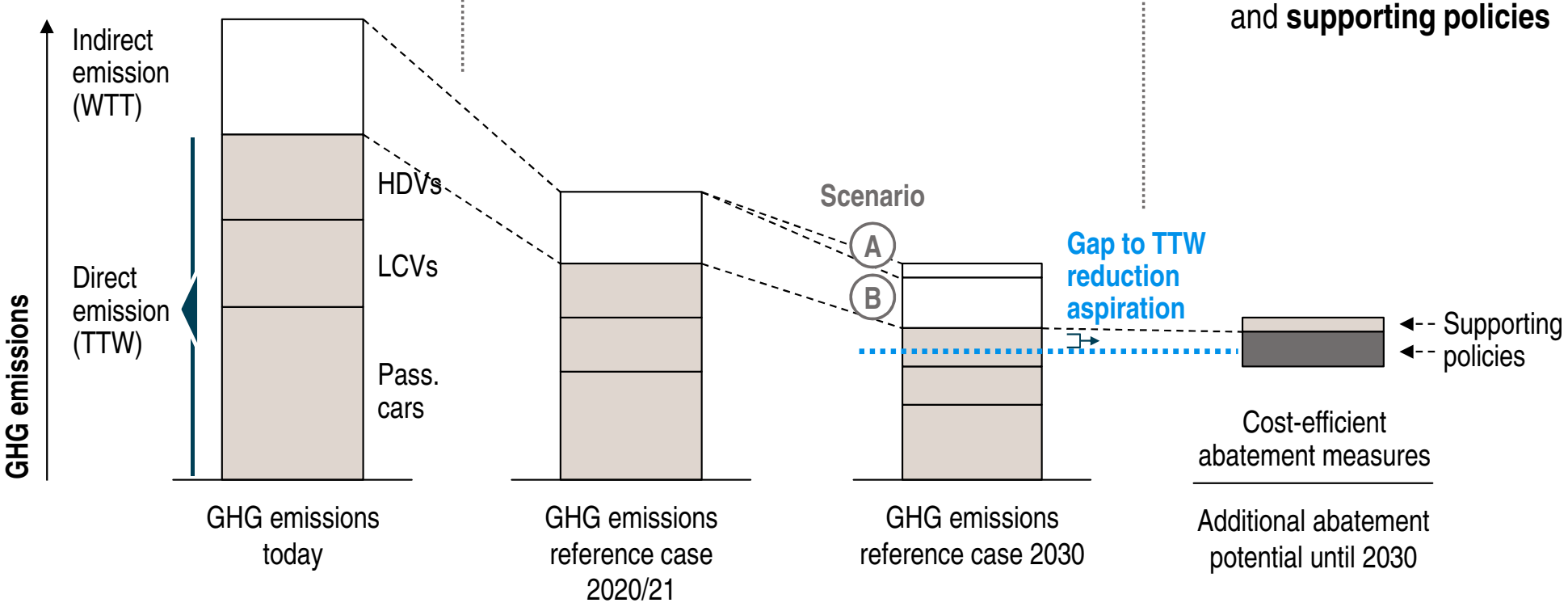
# We assessed GHG reduction with current policies – Additional cost-efficient reduction measures and supporting policies selected

## Approach for development of integrated roadmap

**1** **Vehicle fleet and fuel model** for EU28

**2** **Reference case GHG emission reduction** (2 scenarios within current regulatory framework)

**3** **Additional cost-efficient** GHG emission **reduction** until 2030 (and beyond) and **supporting policies**



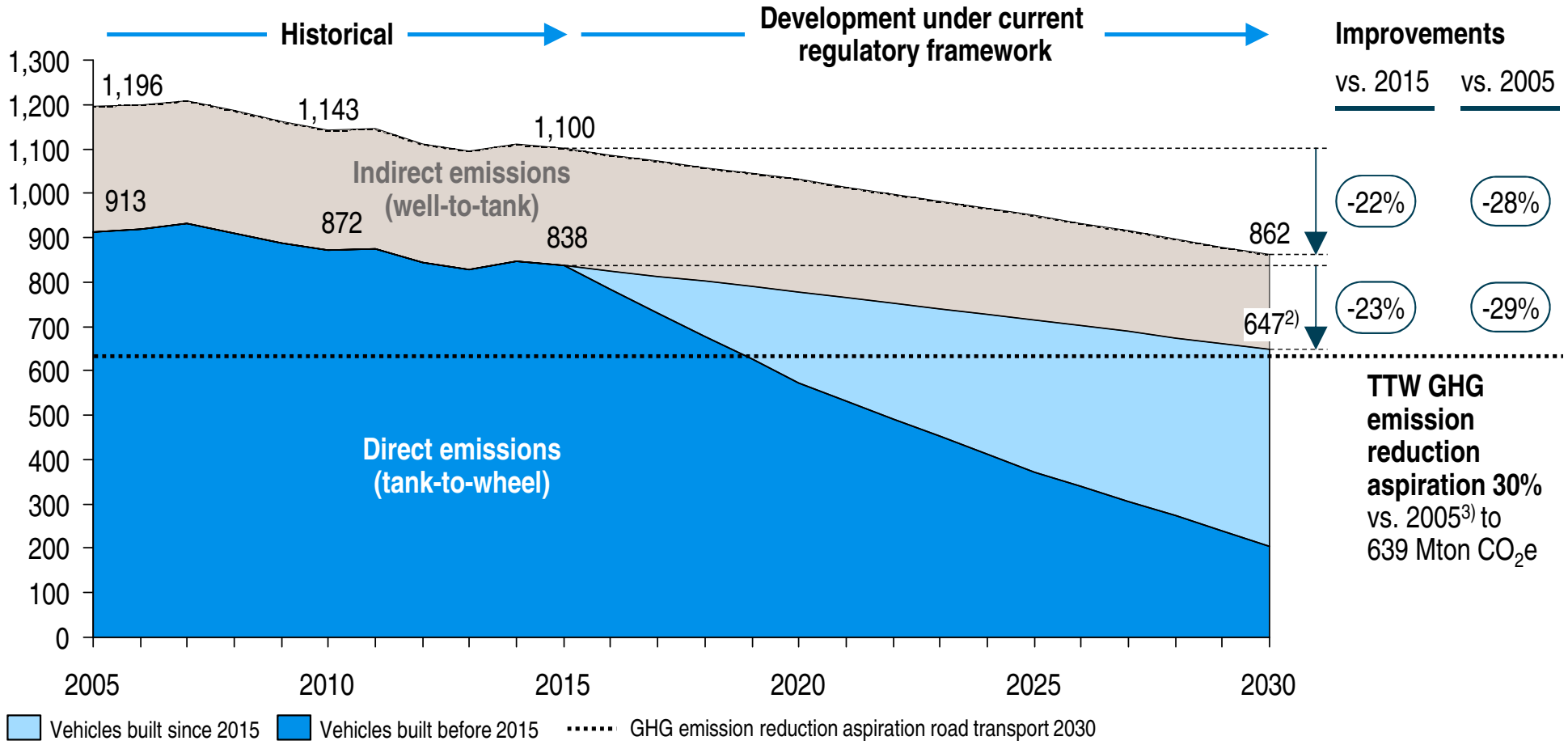

EU 2030 Energy and Climate Package (2014) aspiration of -30% GHG emission vs. 2005

1) EU 2030 Climate & Energy Policy Framework (2014) Scenario A: low oil price, high battery cost Scenario B: high oil price, low battery cost

Source: Roland Berger

# In current policy framework, road transport sector will reduce TTW emissions by ~29% vs. 2005 – Almost achieving aspired 2030 levels

## EU28 road transport sector GHG emissions[1] in reference case[2] [Mton $CO_2e$]

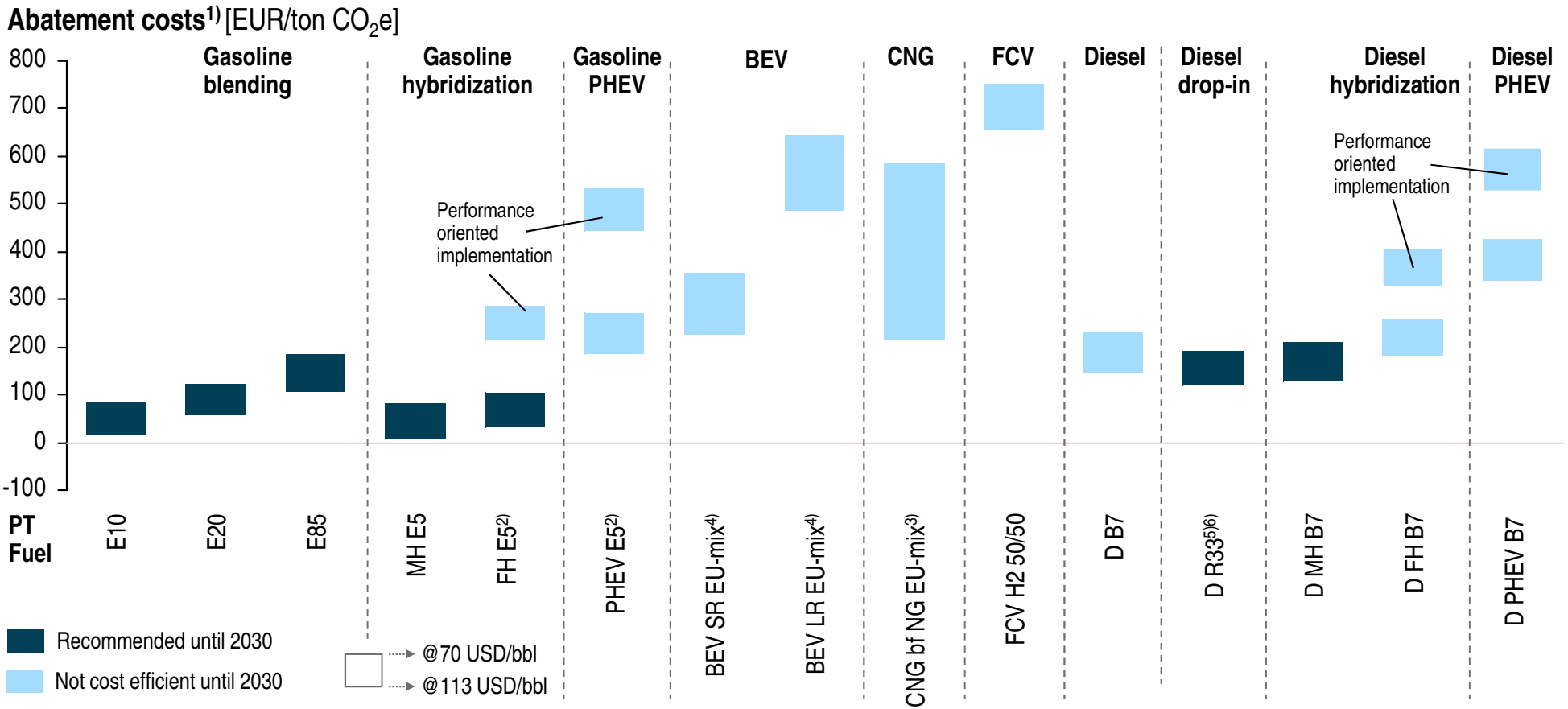



1) Fleet emissions of passenger cars and commercial vehicles, excluding two-wheelers, biofuels considered TTW carbon-neutral
2) Scenario A: low oil price, high battery cost 3) Based on EU 2030 Climate & Energy Framework (2014) reduction aspiration for non-ETS sectors

Source: UNFCCC/EEA; EU 2030 Climate & Energy Framework; Roland Berger

# The pathway technologies biofuel and hybridization allow additional cost efficient abatement in passenger cars until 2030

## WTW GHG abatement costs for society, new C-segment PC 2030 [EUR/ton $CO_2$e]

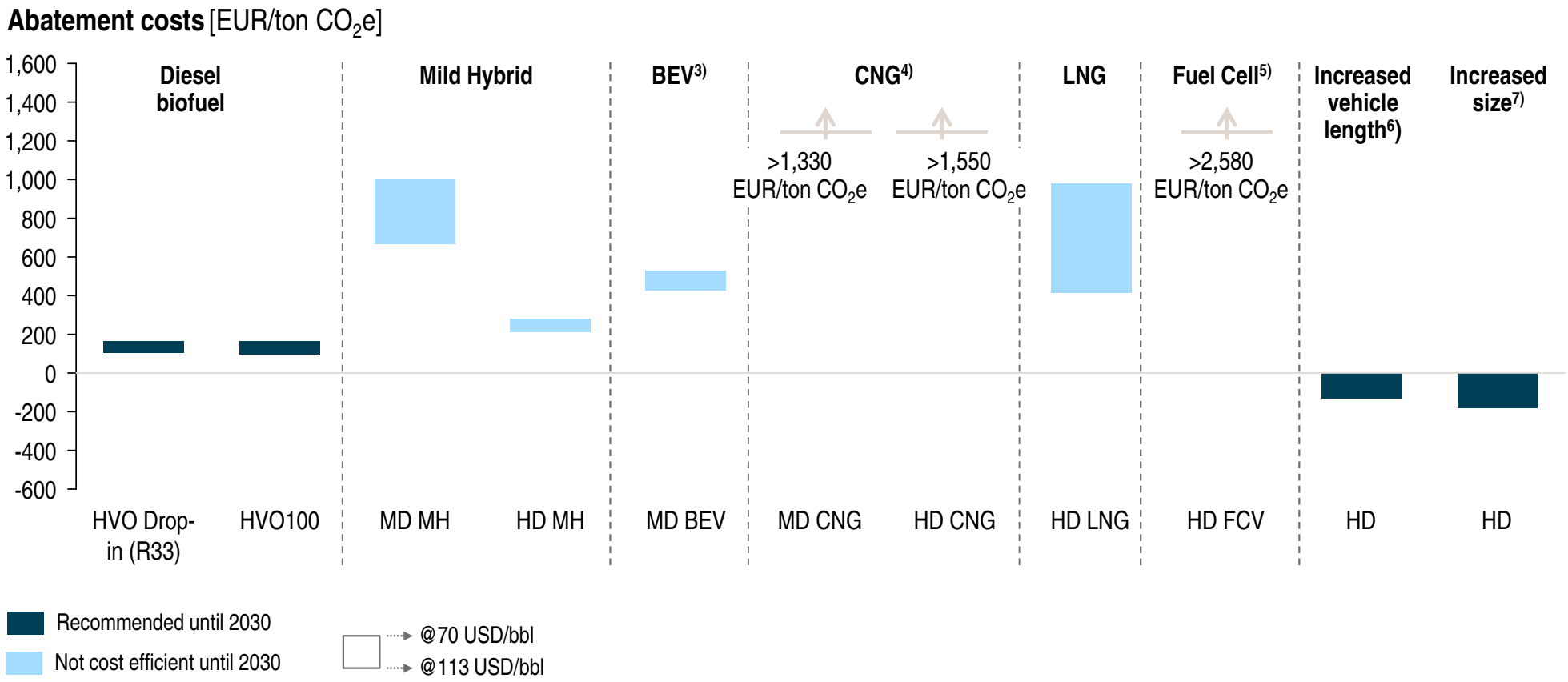



1) Compared to optimized Gasoline powertrain 2030 using E5, all technologies with 250,000 km lifetime mileage 2) 30% e-driving, higher e-driving share reduces abatement costs
3) Large range between scenarios driven by decoupling effect of natural gas price 4) Risk of higher abatement costs due to need of second battery over lifetime,
SR – short range with 35 kWh battery capacity, LR – long range with 65 kWh battery capacity, both using 2030 EU mix electricity, 5) Diesel fuel with 7% FAME and 26% HVO
6) Abatement cost in existing vehicle: -67 EUR/ton $CO_2$ (high oil price), 7 EUR/ton $CO_2$ (low oil price)

Source: Roland Berger

# In trucks, pathway technology high biofuel drop-ins is cost efficient – Larger trucks could have negative abatement cost

## WTW GHG abatement costs of MD[1] and HD[2] commercial vehicle 2030 [EUR/ton $CO_2$e]

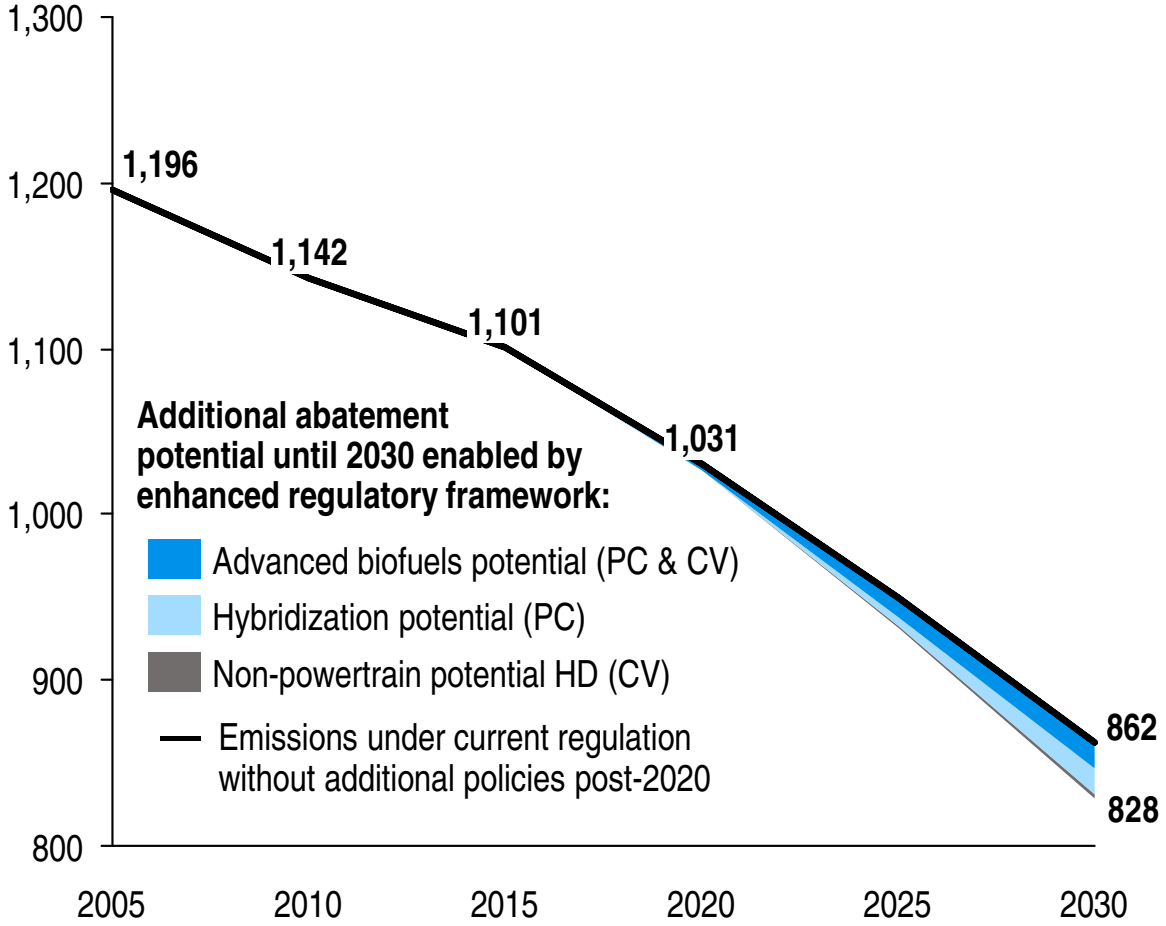



1) Medium duty 2) Heavy duty 3) Exclusion of HD BEV due to incompatibility of BEV range with long haul requirements 4) High $CO_2$ abatement costs for CNG and LNG within MD/HD/City Bus s result from low quantities of vehicles (missing economies of scale) and $CO_2$ abatement potential compared to Diesel is small (<5% savings/km) 5) High system cost and low lifetime mileage in medium duty trucks causes very high abatement cost , therefore incompatibility 6) Increased efficiency due to aerodynamic measures to reduce drag 7) Length and gross vehicle weight increase, increased transport efficiency by 10%

Source: Roland Berger, Expert interviews, IKA $CO_2$ study

# The identified cost-efficient abatement technologies will allow >30 Mton $CO_2$e additional WTW GHG emission reduction in 2030

## Road transport sector WTW GHG emissions, 2005-2030, EU 28 [Mton $CO_2$e]




- Under **current regulation**, the transport sector will significantly reduce GHG emissions to 862 Mton $CO_2$e
- Additional measures (biofuels, HEVs, new truck concepts) allow **additional reduction** to 828 Mton $CO_2$e
- **Advanced biofuel measures**
  - **Full** coverage of **E10**[1)]
  - Introduce **E20** on fuel and vehicle[2)]
  - Increase **HVO drop-in** share[3)]
- **Hybridization**
  - Increase **MH** uptake in new passenger car sales (assuming **~40%** sales share in new car sales 2030)
  - Increase **FH** uptake in new passenger car sales (assuming **~20%** sales share in new car sales 2030)
- **Non-powertrain measures for HD CV**
  - increased vehicle length/weight (assuming 5% share in new truck sales 2030)

1) In reference case a 36% E10 coverage is assumed 2) Assuming full E20 compatibility from MY 2025 onwards, 7% cap for conventional biofuel remains
3) In reference case full B7 coverage is assumed, assumed feedstock restriction 4% advanced HVO drop in ("R11")

Source: Roland Berger

# Prioritized policies address obstacles of cost-efficient abatement technologies from all perspectives

## Overview policy recommendation to member states[1] until 2030

| | **A** Fuel with high biofuel share | **B** MHs/FHs power-trains for PC | **C** Highly efficient trucks |
|---|---|---|---|
| | **Existing supportive policies** at fuel supply side (e.g. transport RED targets, provision within DAFI/AFID) and vehicle side **kept unaltered** | | |
| **Additional financial instruments** | > Introduce **additional fuel taxation components** enabling a price advantage for fuels with high advanced biofuel share, e.g.<br>– Biofuel bonus/malus + $CO_2$ component<br>– Biofuel tax exemption + $CO_2$ component<br>> Support the use the Innovation Fund for invest-ments in innovations in low carbon technologies | > **Change existing vehicle taxation towards a $CO_2$ based taxation**, e.g.<br>– $CO_2$ based vehicle registration tax<br>– $CO_2$ based annual vehicle tax<br>– $CO_2$ based vehicle usage tax | |
| **Add. regulation/ liabilities** | > Set **tailpipe emission to zero** for the renewable part of the fuel that the vehicle is compatible with, above 2020 levels – define reference fuels accordingly | | > Adjustments in truck **length and weight regulation** |
| **Additional other policies** | > Introduce **$CO_2$ labeling for fuels**<br>> Offer/support "**customer education**" for biofuels<br>> Make fuel **taxation transparent** to customer (e.g. at gas station) | > Introduce **cost/TCO labeling** for vehicles | |

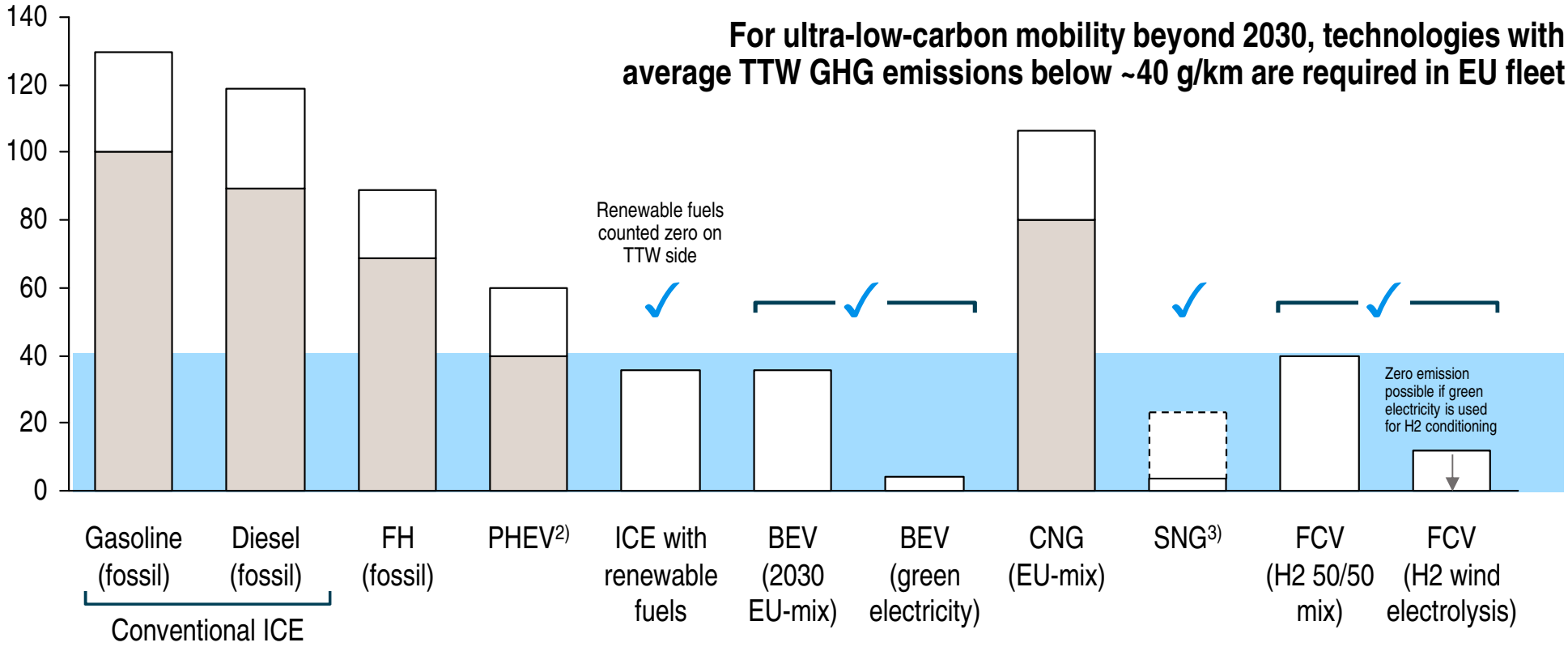
1) Taxation as powerful financial instrument is in responsibility of member states, additional regulation and liabilities can be introduced on EU level

Source: Roland Berger

# Beyond 2030, pathway technologies renewable fuels, BEVs and FCs are potential technologies for an ultra-low-carbon mobility

## WTW GHG efficiencies by technology[1], average C-segment 2030 [g/km]

Indicative




✓ = Potential vehicle/fuel combination for low-carbon economy

In all technologies significant vehicle efficiency improvements are included

Well-to-tank | Tank-to-wheel | Allowed average vehicle $CO_2$ emission in fleet in 2050 for compliance with reference emissions

1) Biofuel adjusted 2) With 30% electric driving 3) If NG is produced via power-to-gas from renewable electricity TTW = 0

Source: Roland Berger

# Market-based mechanisms are an option to raise funds for low carbon technologies and a long-term primary GHG reduction policy

## Market-based mechanisms as future policies for long-term GHG emission reduction

### Long-term policy requirements

- The required additional GHG emission abatement beyond 2030 **require additional supporting policies**[1)]
- Market-based mechanisms (**MBM**) are an option **as complementary policy** to vehicle $CO_2$ standards, fuels and infrastructure policies
- Initially, MBM should be used to **generate revenues** to fund new low carbon vehicle and fuel technology to reach market competitiveness
- Once low carbon vehicle and fuel technologies are competitive, MBM can become the **primary GHG reduction policy** replacing other vehicle efficiency, fuels related policies

### Design principles for a market-based mechanism

The following design principles ensure cost-effective and transparent GHG emissions reduction

- **Fuels suppliers** should be the **obligated party**
- **All** emissions **allowances** need to be **purchased** and can be traded
- Only **direct $CO_2$** emissions (TTW) should be included in the **cap**
- **Biofuels** (meeting sustainability criteria) should be accounted for as **zero TTW** $CO_2$ emissions

1) EC White Paper (from 2011) suggests a 60% GHG emission reduction by 2050 with respect to 1990

Source: Roland Berger


Roland
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