HEVs Aligned for a Future Global Sustainable Electro-Mobility Existence

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HEV's – Hybrid electric vehicles

Abstract

HEVs ALIGNED FOR A FUTURE GLOBAL SUSTAINABLE ELECTRO-MOBILITY EXISTENCE

Eduardo Velasco, Research Engineer - Autonomous University of State of Mexico & Development Engineer - General Motors of Mexico

This presentation will discuss a simulation study dedicated to define future plans for the next decade oriented to a global sustainable electro-mobility environment. Energy and fuels are diversifying and the role of HEVs on the roads around the globe is growing; they are capable of meet CO_2 and FE regulations and they are considered - the bridge for electro-mobility, - the next generation of drives and a potential main contributor to accelerate the introduction of REs. The review will provide results of the most innovative sustainable drive technologies to keep developing for decades to come based on the optimization of vehicle cost, WTW efficiency analysis and CO_2 emissions.

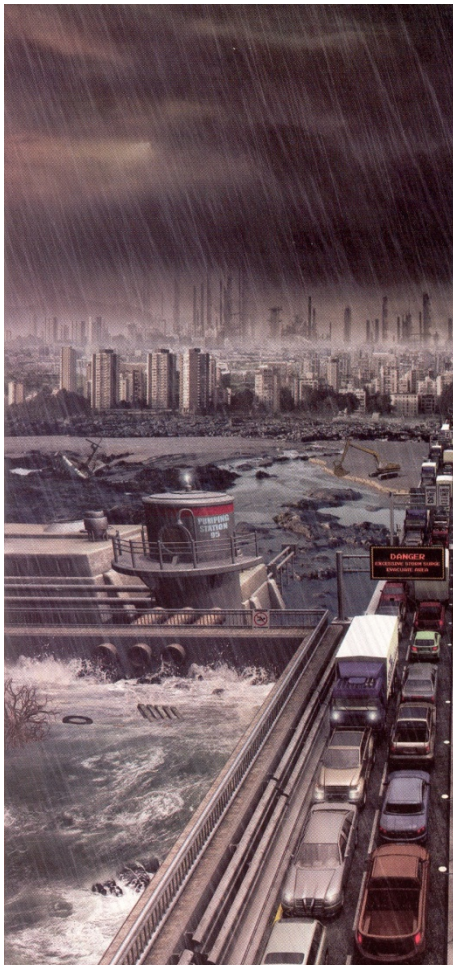
HEVs – Hybrid Electric Vehicles

FE – Fuel Economy

REs – Renewable Energies

WTW – Well to Wheel

Global Sustainable Mobility Vision



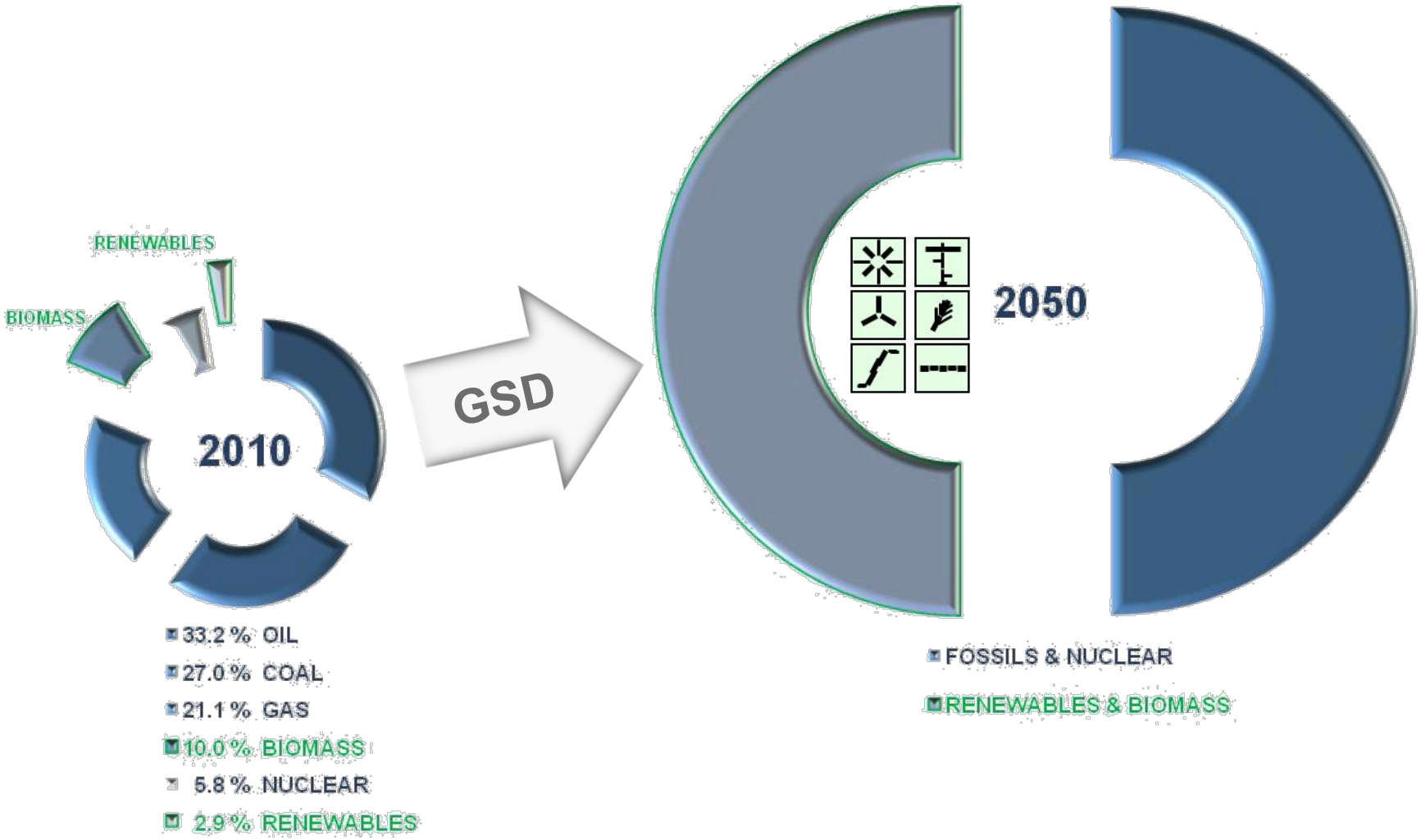
Sustainable drive

- No question about safety.
- Free of harmful emissions.
- Completely recyclable.
- Built from intelligent materials.
- Design at the molecular level.
- Powered by energy from RE's.
- Extensive use of biological sensors.

Change in mindset necessary for sustainable growth

Source: Scientific American Sep06

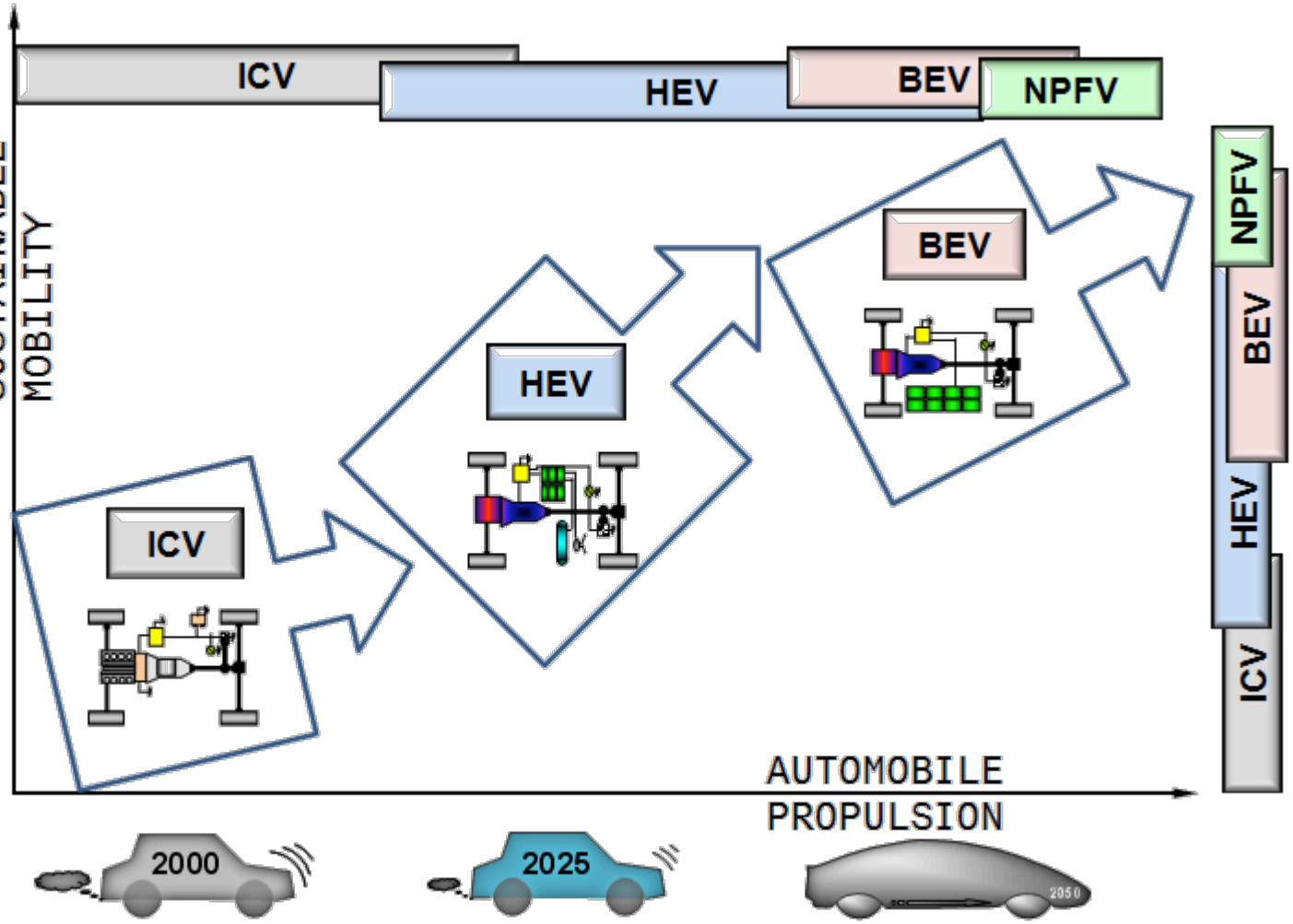
Global Energy Supply target



IEA - 2010 Key World Energy STATISTICS

Technology transformation

Source: Scientific American Sep08



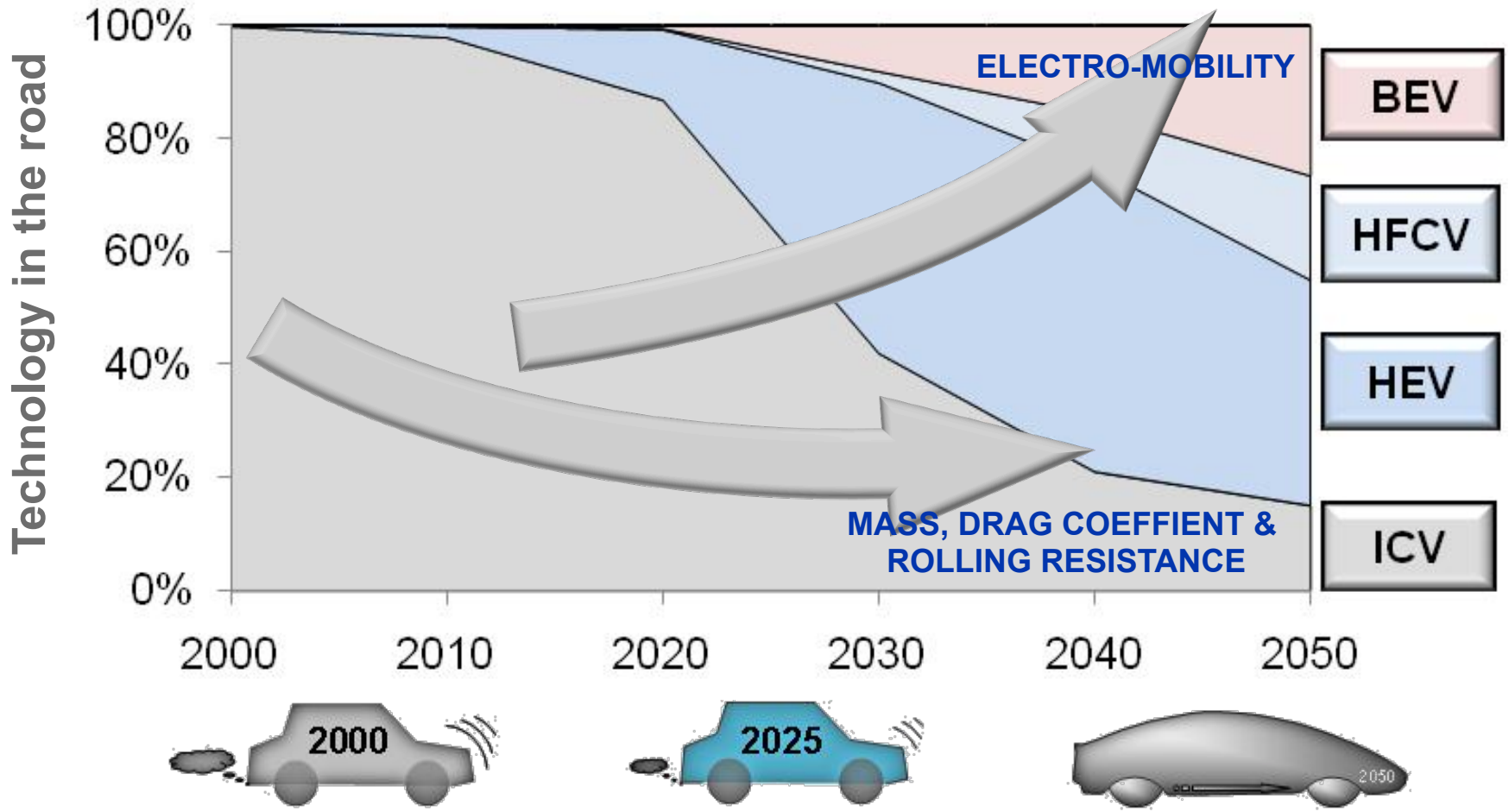
ICV – Internal Combustion Vehicle

HEV – Hybrid Electric Vehicle

BEV – Battery Electric Vehicle

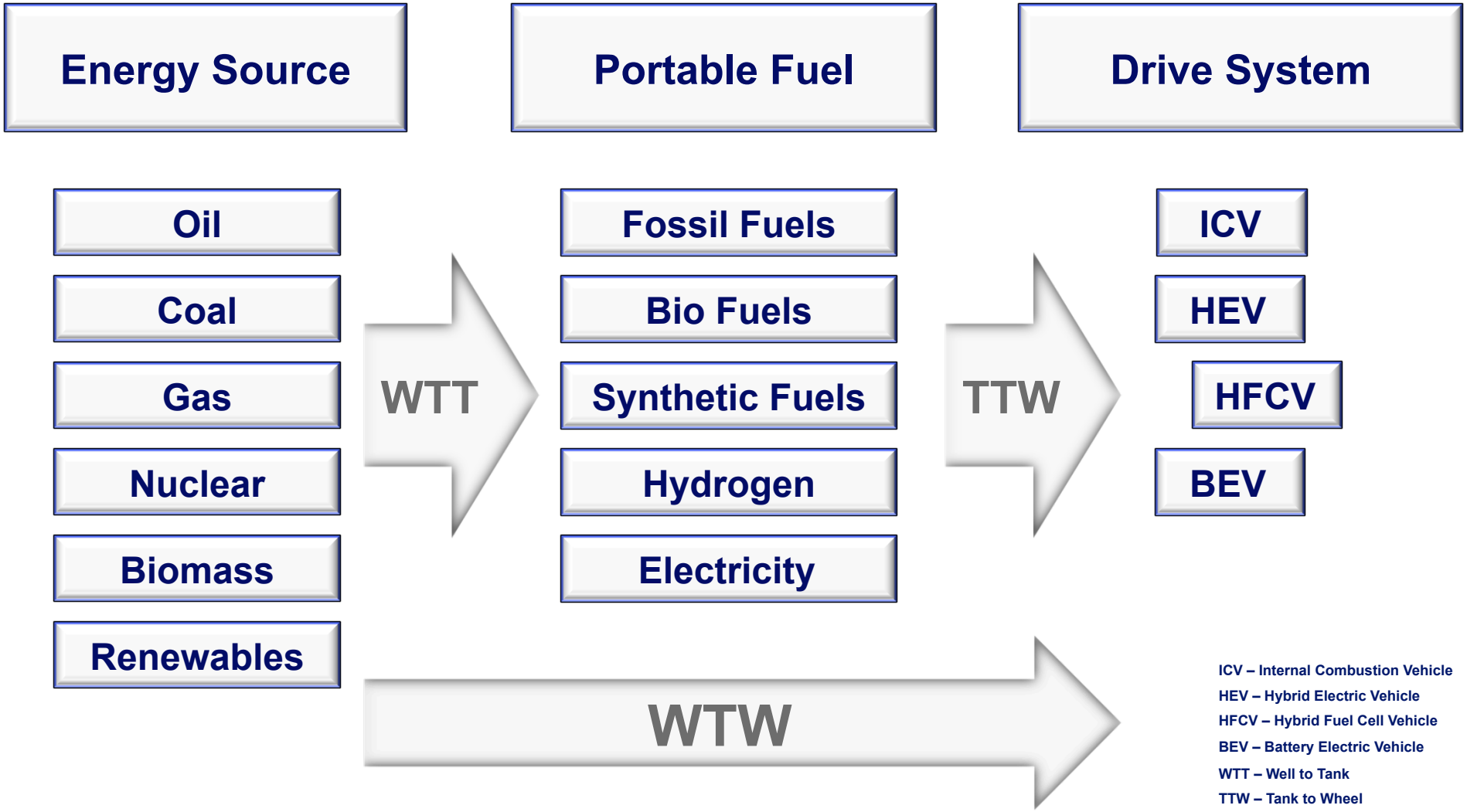
NPFV – Non Portable Fuel Vehicle

Future Propulsion System



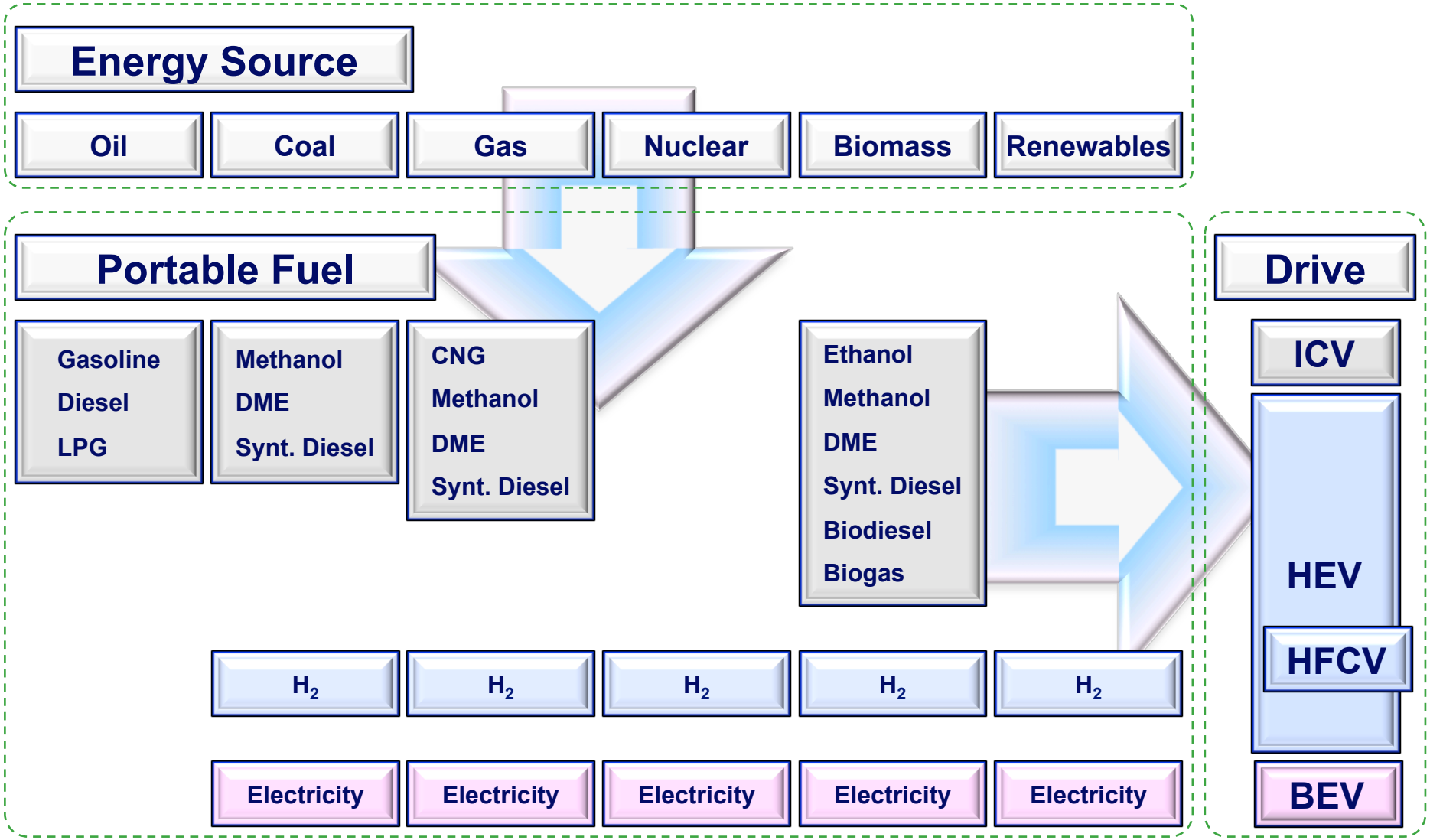
HFCV – Hybrid Fuel Cell Vehicle

Powering Vehicles



ICV – Internal Combustion Vehicle
HEV – Hybrid Electric Vehicle
HFCV – Hybrid Fuel Cell Vehicle
BEV – Battery Electric Vehicle
WTT – Well to Tank
TTW – Tank to Wheel
WTW – Well to Wheel

Portable Fuel Diversity



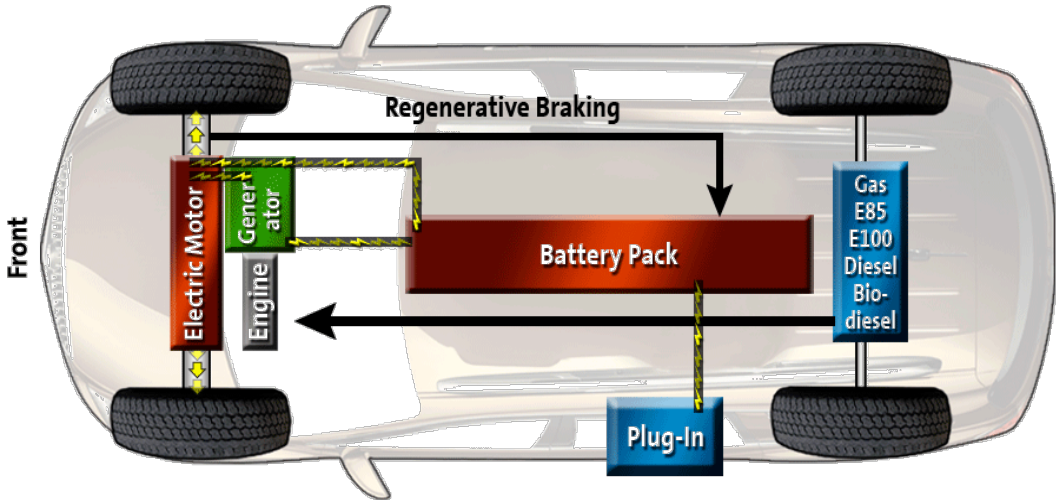
Hybrid Electric Vehicles

ICV	PISI	Gasoline, CNG, LPG, Ethanol, H_2, Biogas		
	DISI	Gasoline, Ethanol		
	DICI	Diesel, DME, Synthetic Diesel, Biodiesel		
HEV	PISI + Battery		Fossils, Biofuels, Synthetics	Ni-MH, Li-Ion, Na-NiCl
	DISI + Battery			
	DICI + Battery			
	ICE + FC + Battery			
	Reformer + PEMFC	Methanol, H_2		Ni-MH, Li-Ion, Na-NiCl
	PEMFC	H_2		Ni-MH, Li-Ion, Na-NiCl
BEV	Electrical			Ni-MH, Li-Ion, Na-NiCl

PISI – Port injection Spark Ignition
DISI – Direct Injection Spark Ignition
DICI – Direct Injection Compression Ignition
ICE – Internal Combustion Engine
FC- Fuel Cell
PEMFC – Proton Exchange Membrane Fuel Cell

AICE – Advanced Internal Combustion Engine
BAT – Battery
FC – Fuel Cell
GHG – Green House Gases
HFCV – Hybrid Fuel Cell Vehicle

Electro-Mobility



ICE + BAT

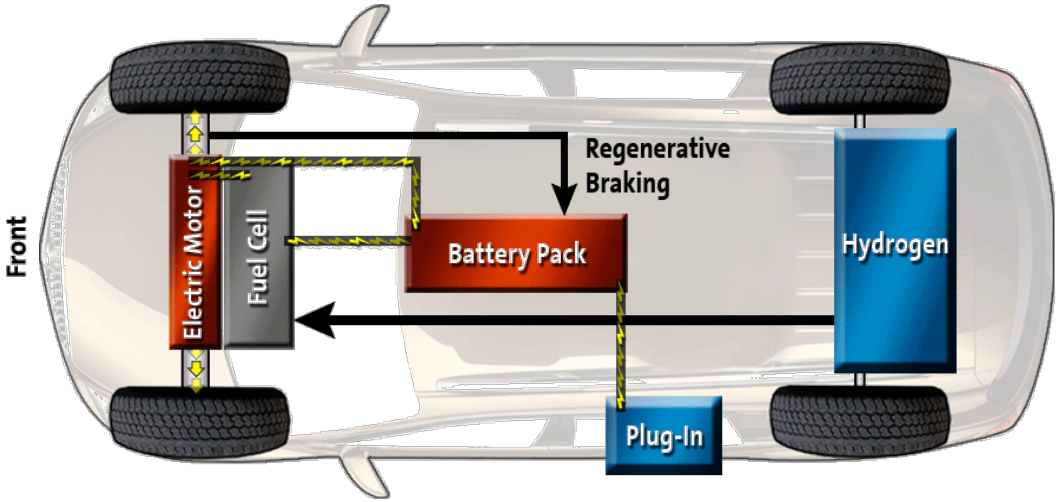
- AICE, idle off & regen
- Fuel diversity
- BAT size & recharge
- Fossil fuels
- GHG emissions
- Extended range
- Full electric drive

BEV

FC + BAT

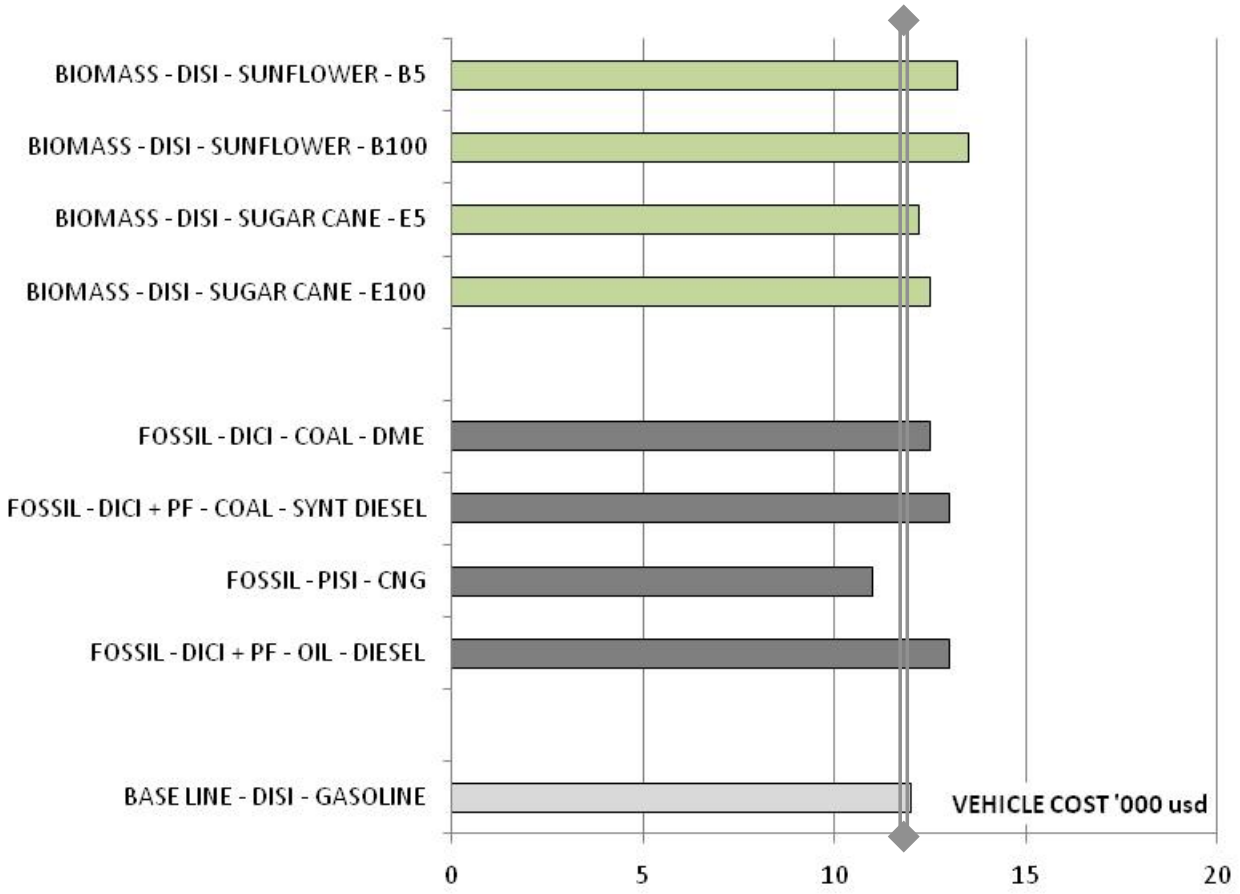
- AICE, idle off & regen
- Pt content
- BAT size & recharge
- GHG emissions
- Extended range
- Full FC drive + aux bat

HFCV



Vehicle – Estimated Cost

ICV



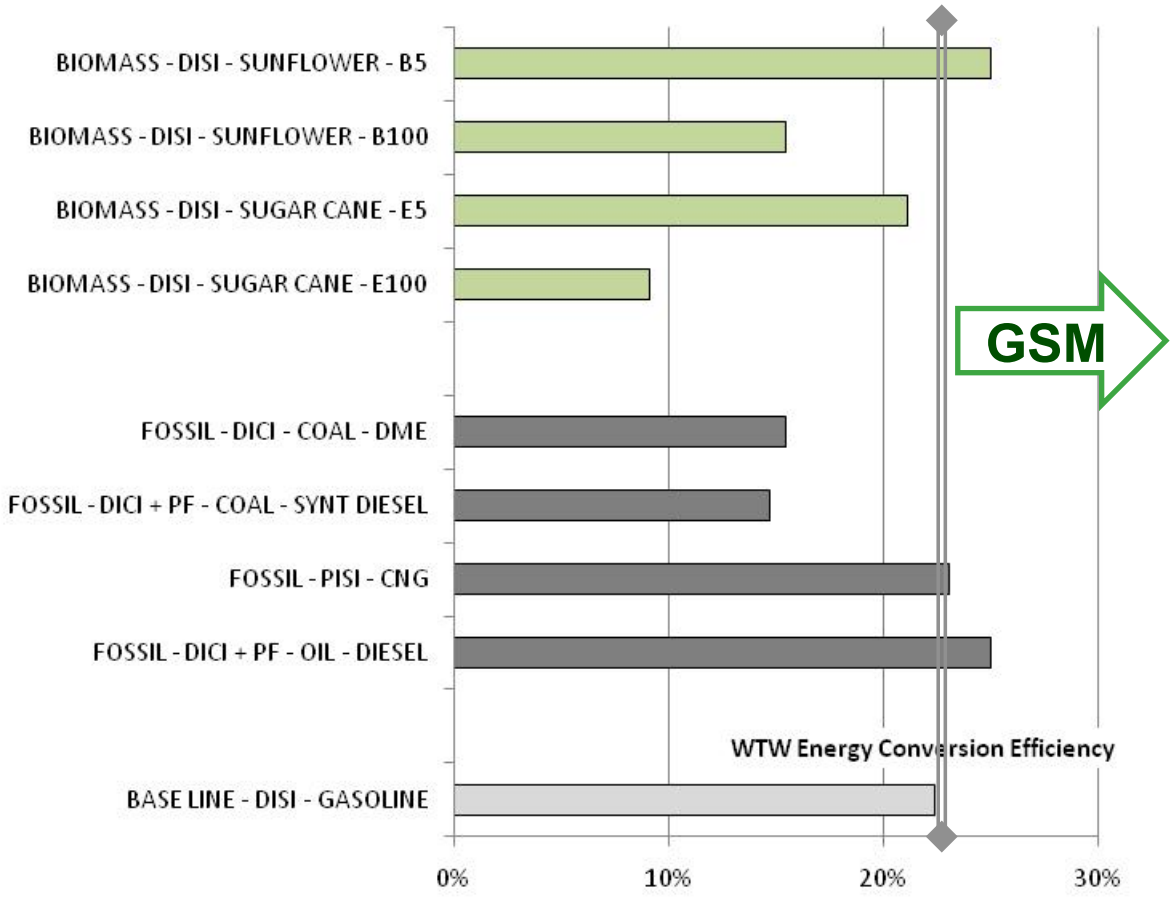
$ - CPSI

Conventional drive technology

CPSI – Continuous Positive Sustainable Impact

WTW - Efficiency

ICV

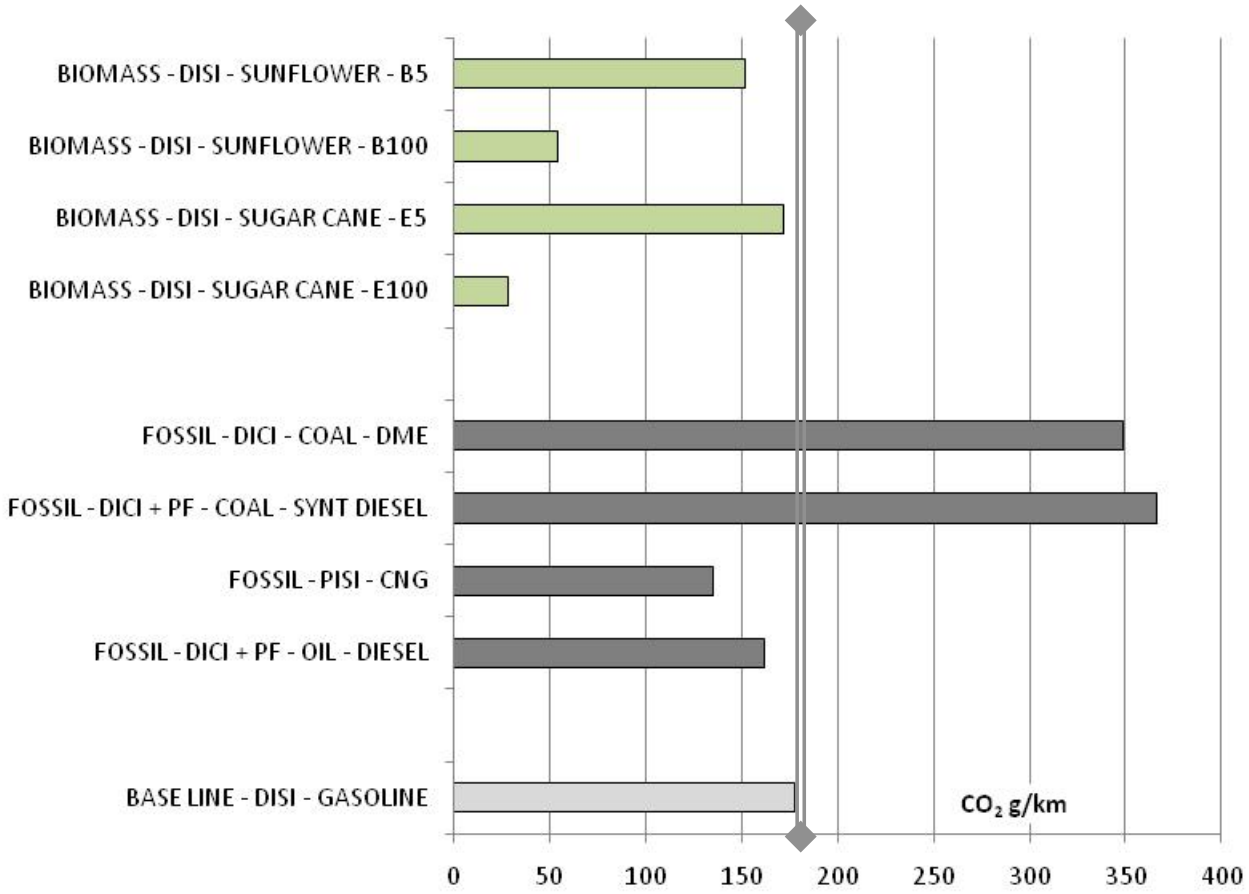


Conventional drive technology

GSM – Global Sustainable Mobility

WTW – CO_2 emissions

ICV



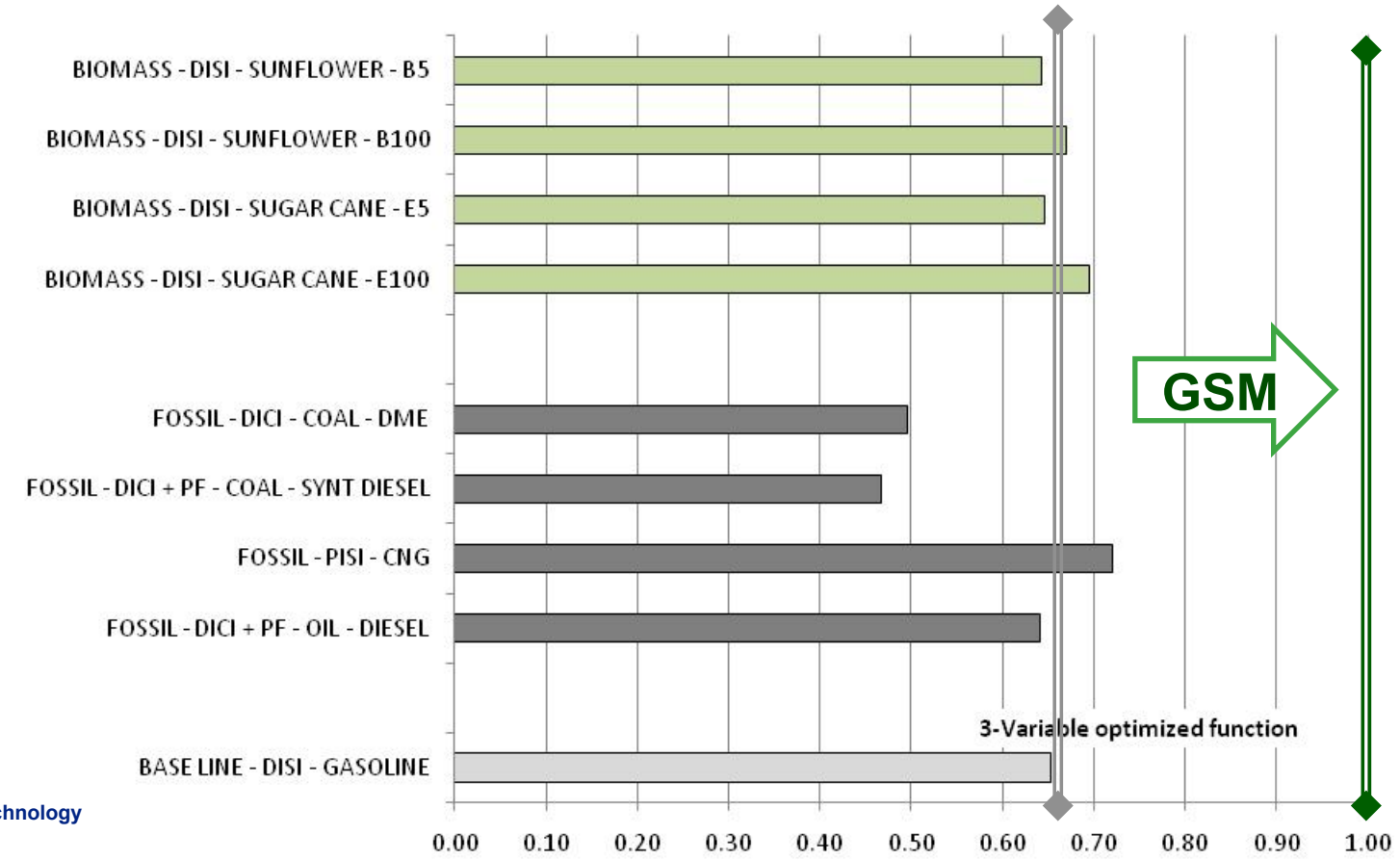
GSM

Conventional drive technology

GSM – Global Sustainable Mobility

3-Variable – Optimization function

ICV

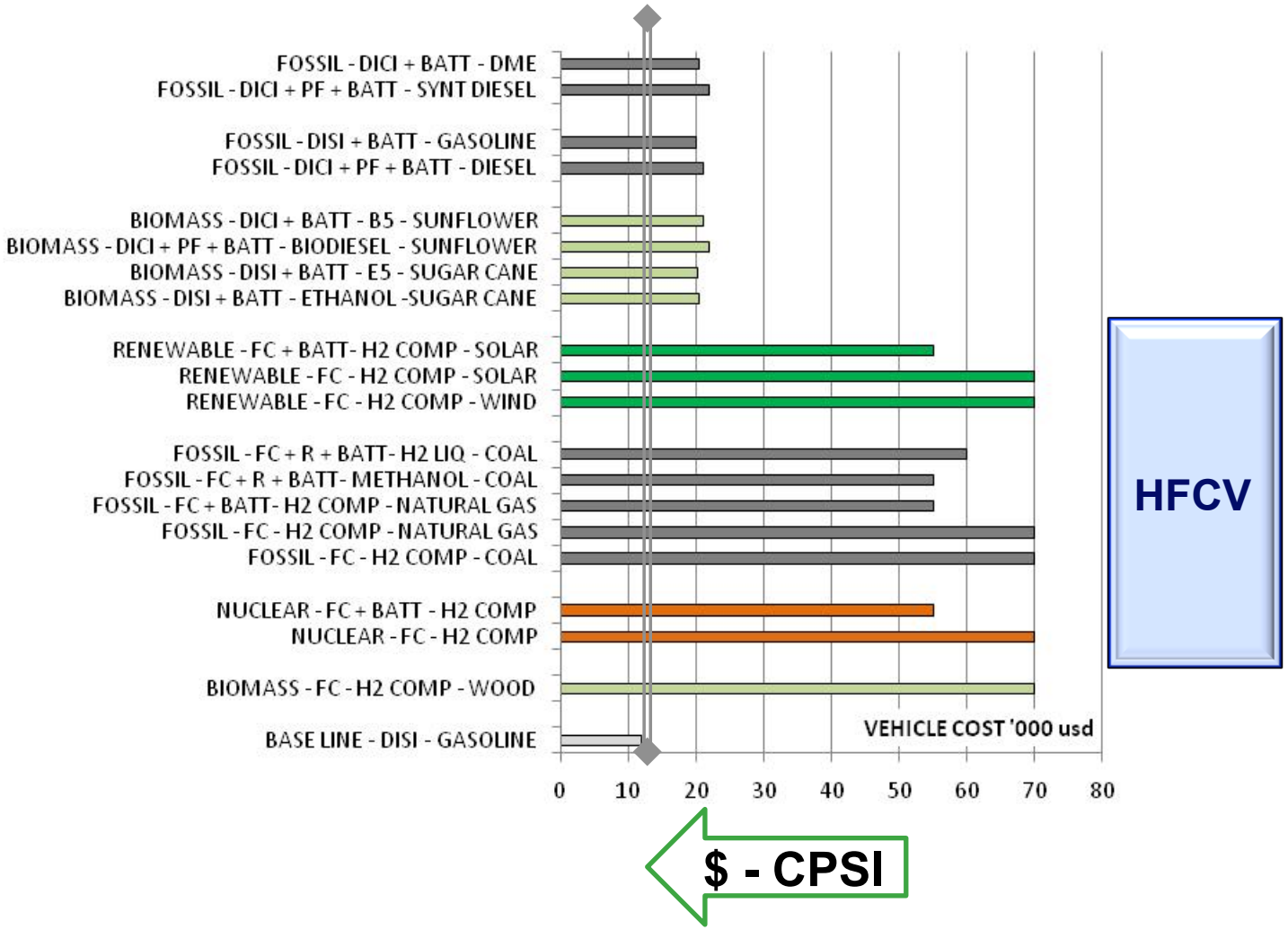


Variable weights
- 40 % Vehicle cost
- 30 % WTW Efficiency
- 30 % WTW CO_2 emissions

Road blocks
- Tighten emission regulations
- Increasing society pressure for greener cars
- AICE dev. truncated by HEV results

Vehicle – Estimated Cost

HEV

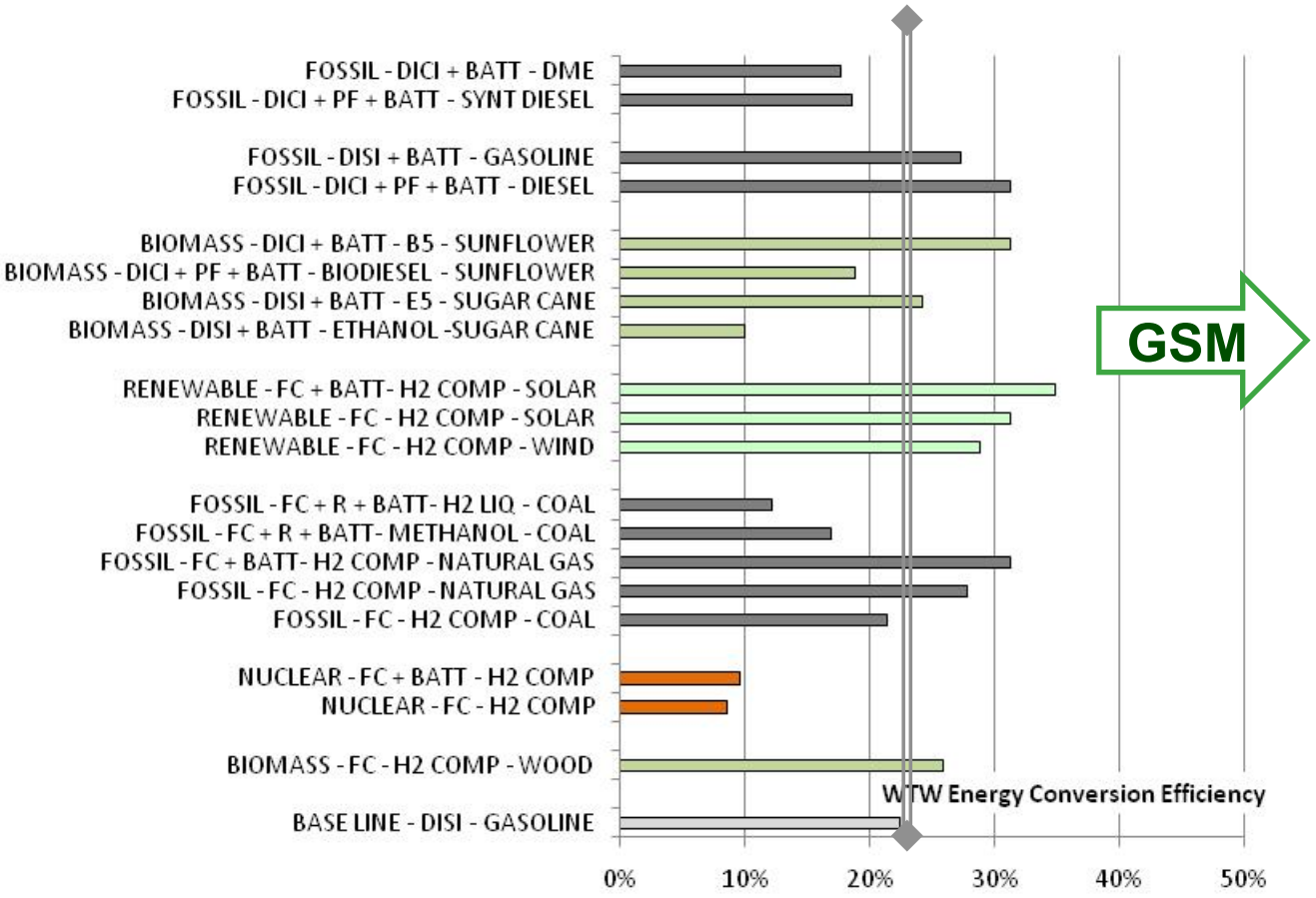


Conventional drive technology

CPSI – Continuous Positive Sustainable Impact

WTW - Efficiency

HEV

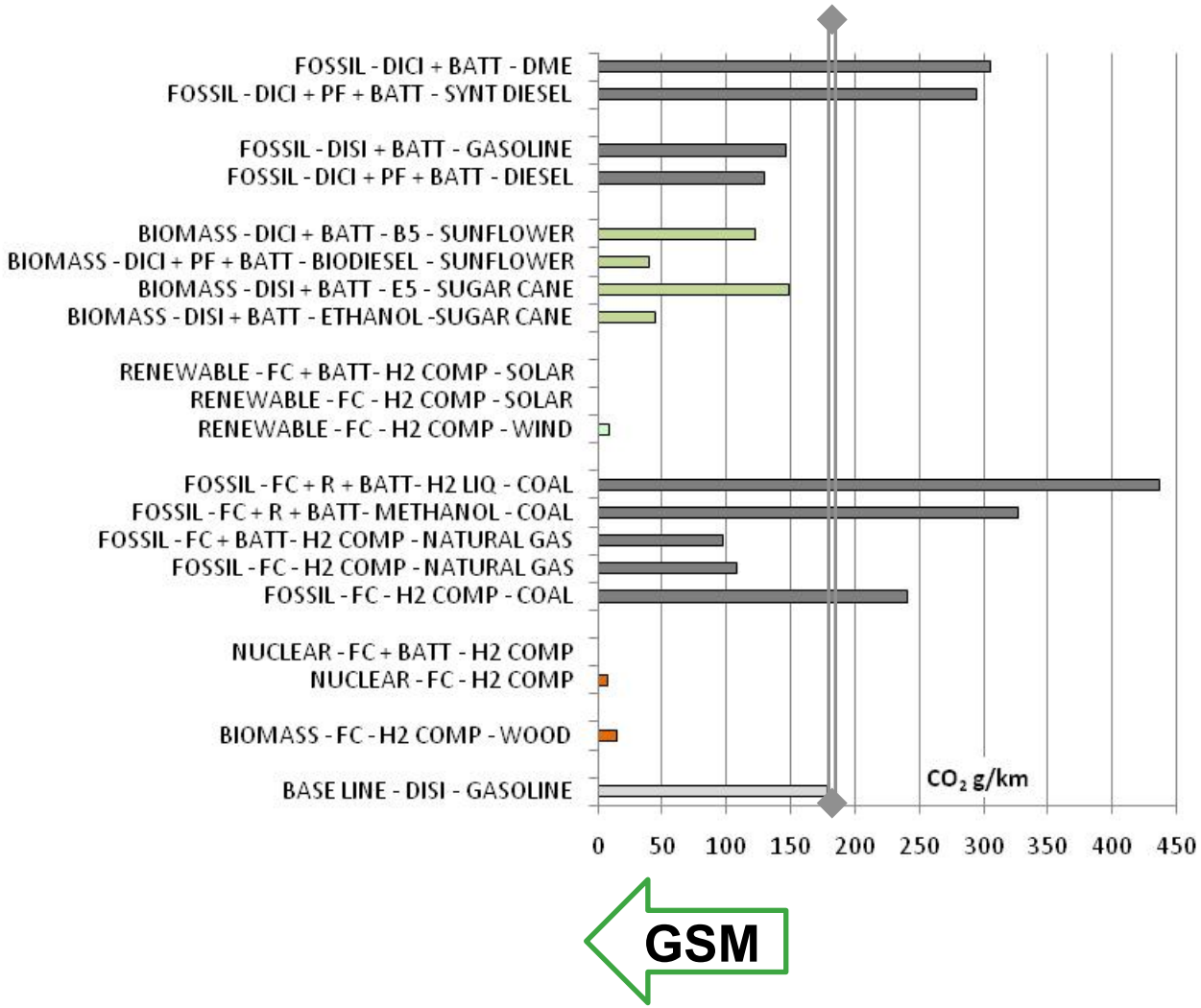


Conventional drive technology

GSM – Global Sustainable Mobility

WTW – CO_2 emissions

HEV



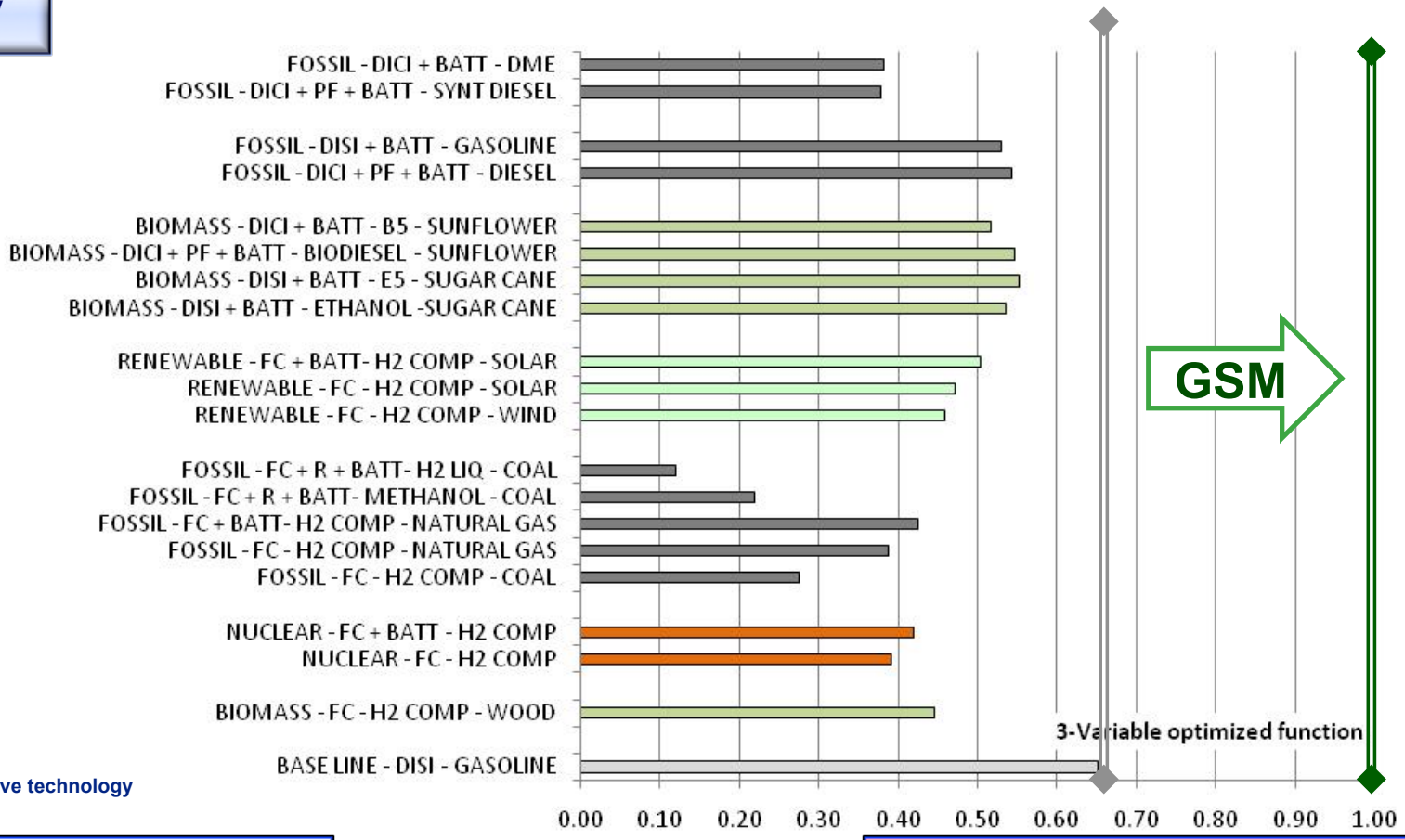
GSM

Conventional drive technology

GSM – Global Sustainable Mobility

3-Variable – Optimization function

HEV

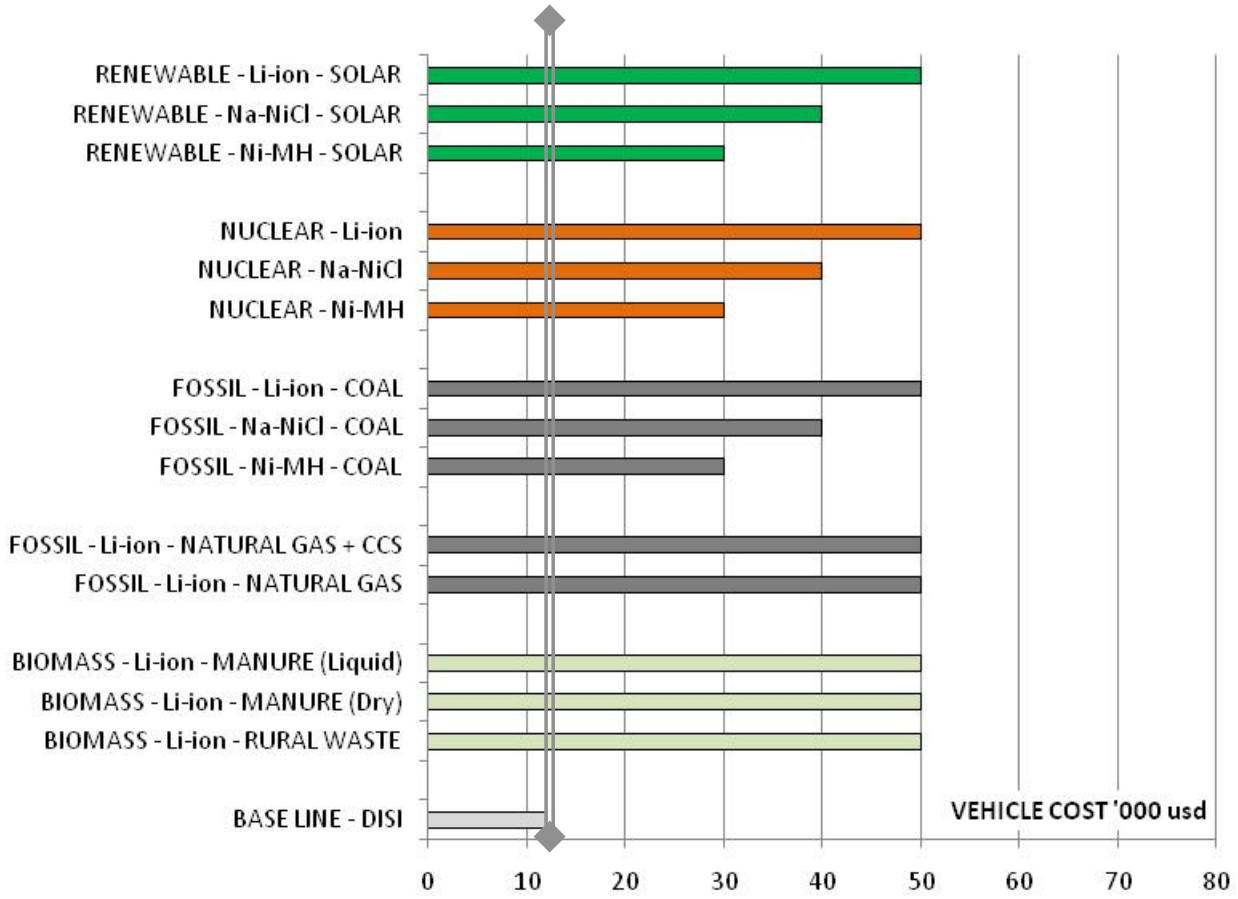


Variable weights
- 40 % Vehicle cost
- 30 % WTW Efficiency
- 30 % WTW CO_2 emissions

Road blocks
- Low demand & high cost
- Easy to meet current FE & CO_2 regulations
- Mature complex controls

Vehicle – Estimated Cost

BEV



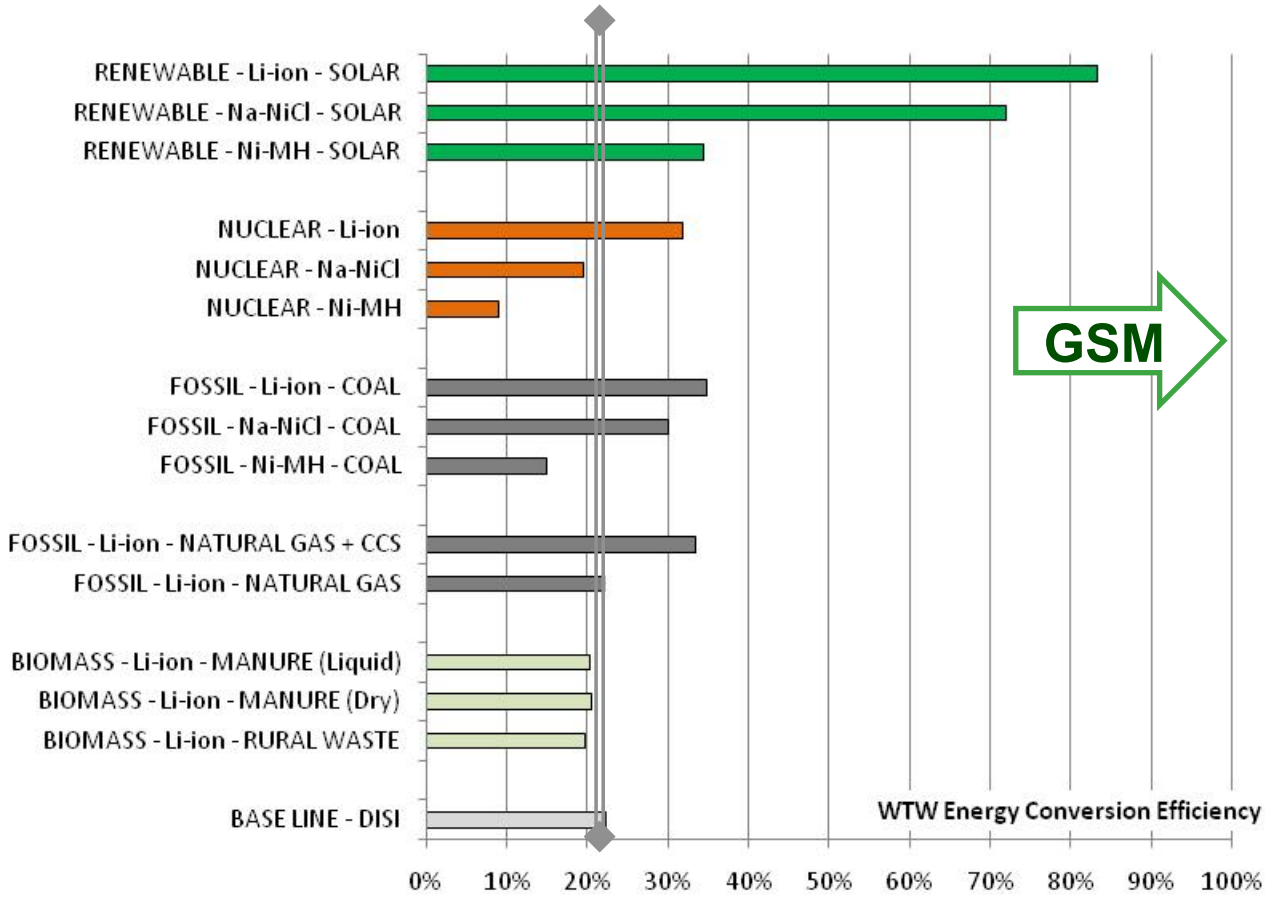
$ - CPSI

Conventional drive technology

CPSI – Continuous Positive Sustainable Impact

WTW - Efficiency

BEV

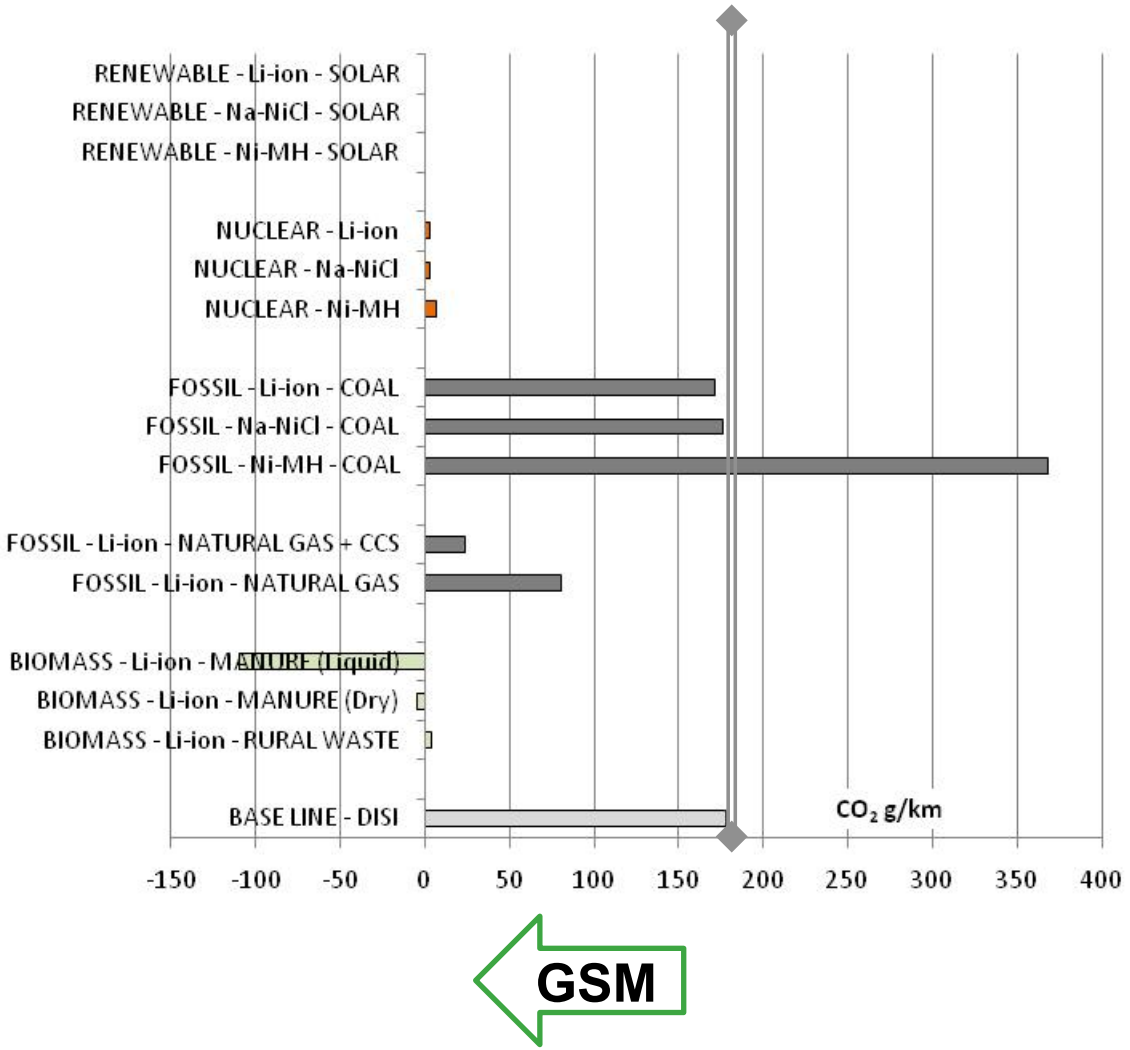


Conventional drive technology

GSM – Global Sustainable Mobility

WTW – CO_2 emissions

BEV



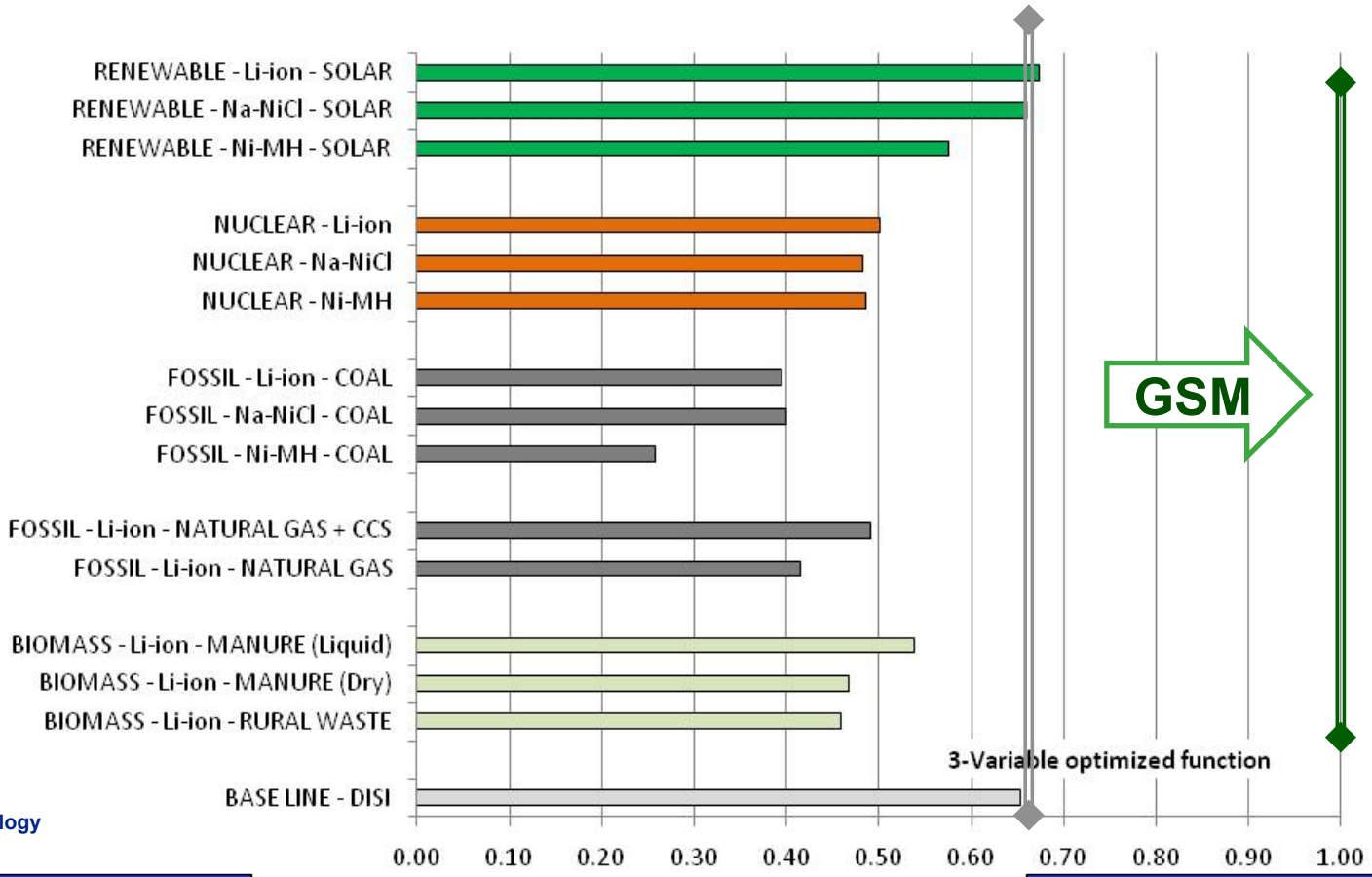
GSM

Conventional drive technology

GSM – Global Sustainable Mobility

3-Variable – Optimization function

BEV



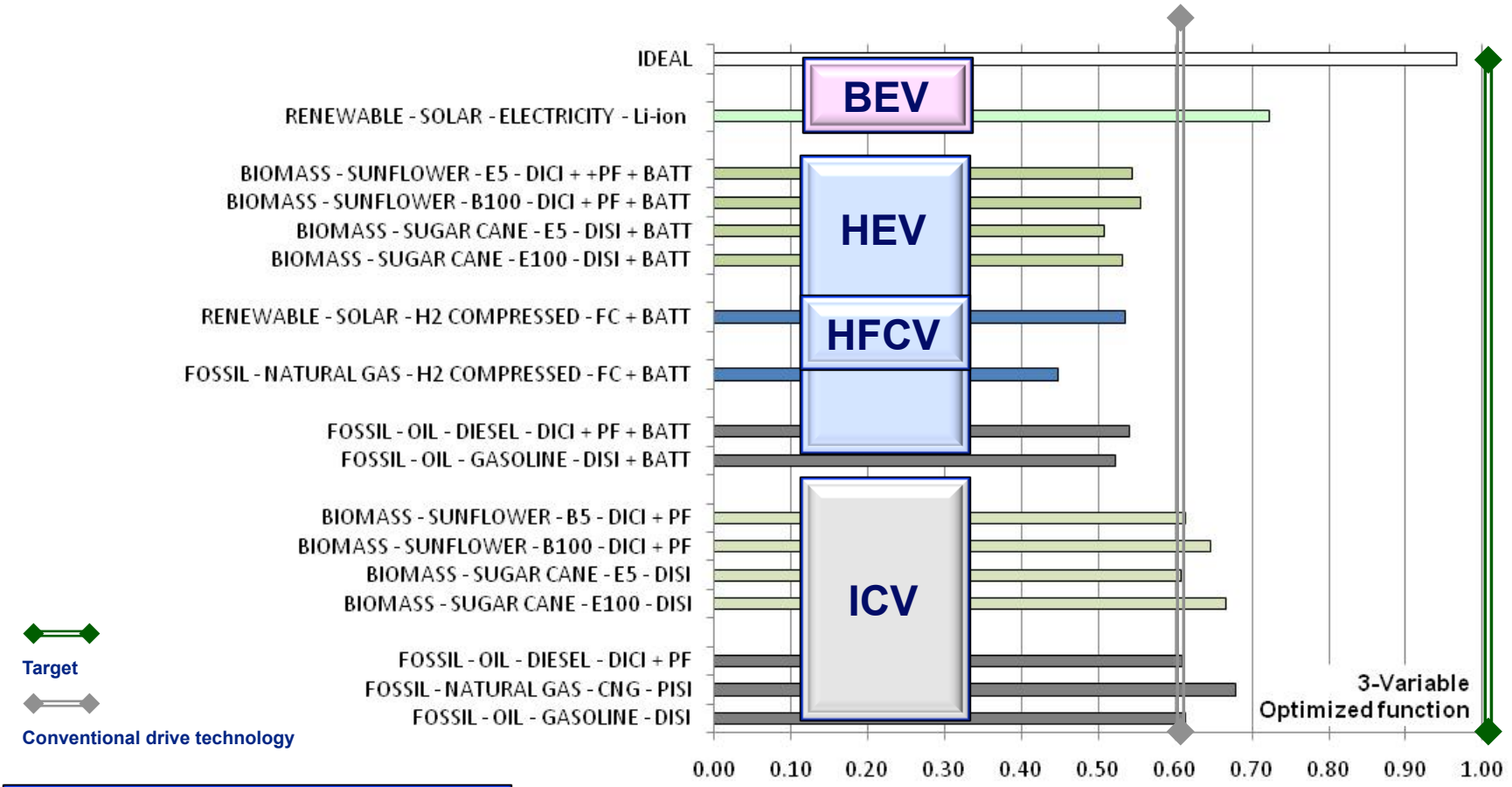
Target

Conventional drive technology

Variable weights
- 40 % Vehicle cost
- 30 % WTW Efficiency
- 30 % WTW CO_2 emissions

Road blocks
- Mature battery and controls
- Wait for greener grid
- HEV as bridge for BEV

Most Feasible & Sustainable Drives



Variable weights
- 33.3 % Vehicle cost
- 33.3 % WTW Efficiency
- 33.3 % WTW CO_2 emissions ~ GHG

GSM

Lower cost
Higher FE
Lower GHG

Conclusions

- A GSM mindset change of the present and future generations is fundamental for a GSD vision.
- Because of lower WTW efficiency and higher GHG's, limit the development of HEV's based on portable fuels made of coal; Methanol, Liquid H_2, DME and synthetic diesel.
- Optimize the use of biomass fuels and higher blend rates with the advanced ICE developments for lower WTW GHG emissions and better WTW efficiency.
- HEV's based on high power split of H_2 and/or electricity are considered main contributors to accelerate the introduction of RE's.

Conclusions

- Based on the WTW analysis (Cost, Efficiency and CO_2 emissions) the sustainable immediate action to follow is the optimization of the HEV's.
- Move in the direction of variable hybridization in order to operate ICE's and/or FC's nearer its best efficiency when batteries are incorporated to solve each other's weaknesses.
- Extended range of electro-mobility for HEV's and the market of BEV's considered sustainable solutions once the electricity comes from greener sources tie-in to the electrical grid.