HEV's as a technological impetus for a more global sustainable mobility in decades to come

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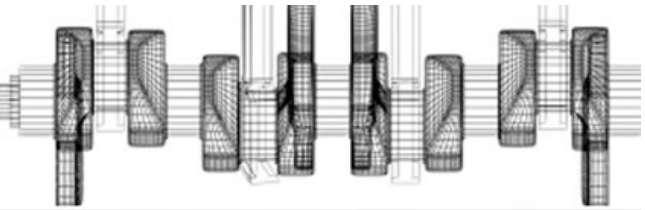
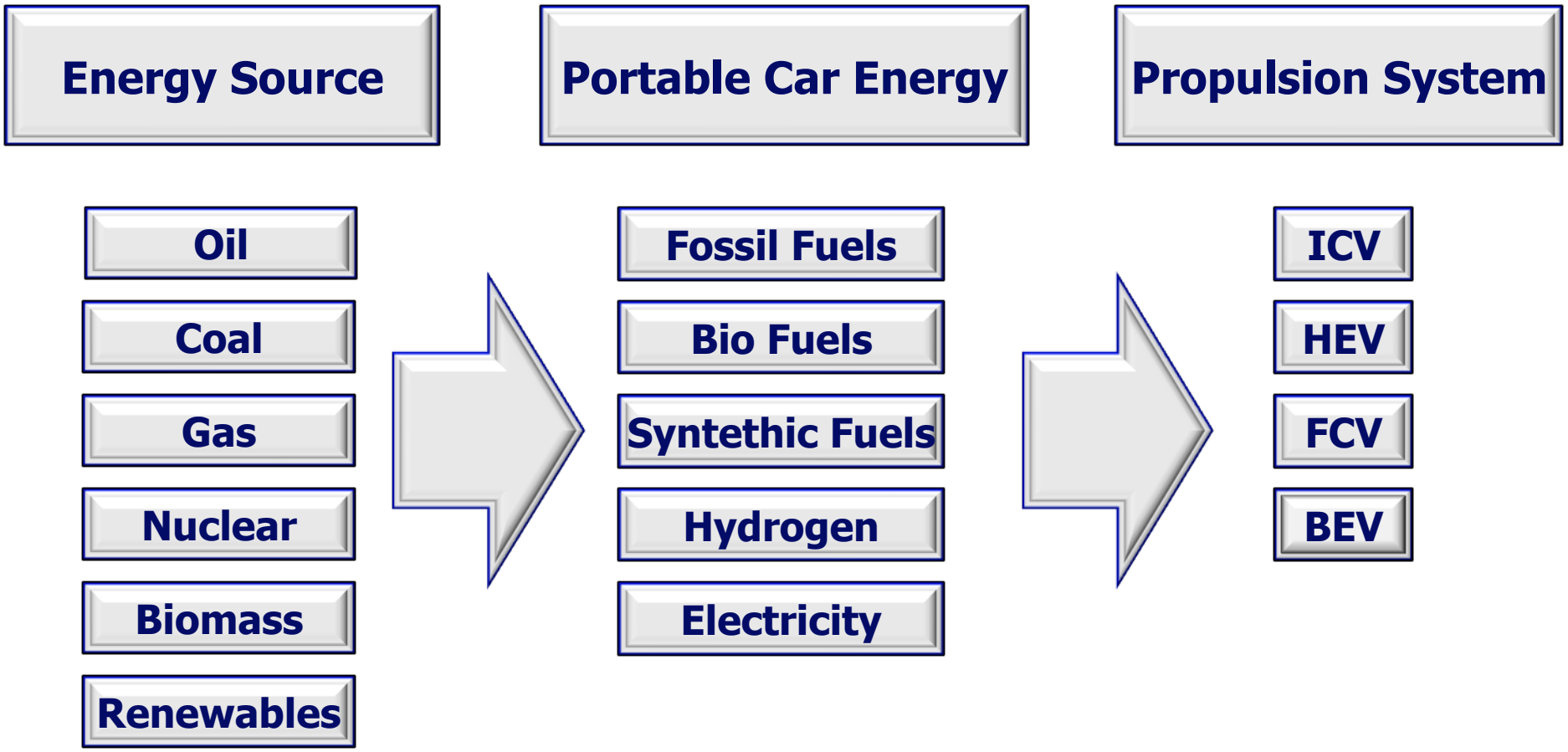


Abstract

Hybrid electric vehicles (HEVs) have the potential to meet short-term stringent regulations as well as fuel economy (FE) and CO_2 goals, and can therefore be considered as the first step forward into global sustainable mobility (GSM). In addition, efficient use of energy and fuel diversity is destined to emerge in the near future, allowing significant use of renewable energy (RE) sources in the transportation sector.

I will briefly discuss an analysis of the future vehicle propulsion systems to meet a potential GSM as a long-term thinking that might produce better short-term decisions.

Powering Vehicles



ICV – Internal Combustion Vehicle
HEV – Hybrid Electric Vehicle
FCV – Fuel Cell Vehicle
BEV – Battery Electric Vehicle

Portable Fuels

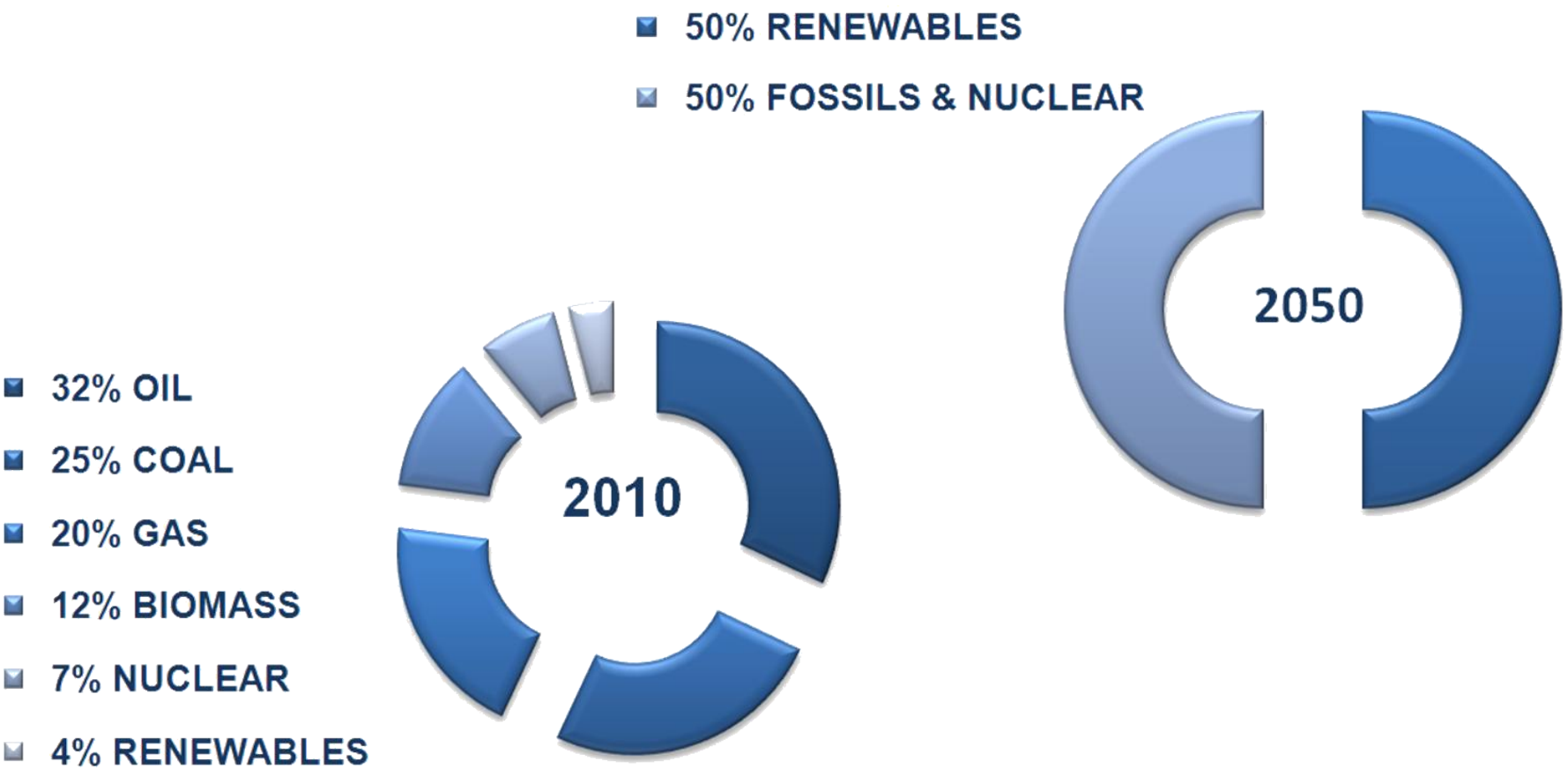
Energy Source

Oil	Coal	Gas	Nuclear	Biomass	Renewables

Portable fuel

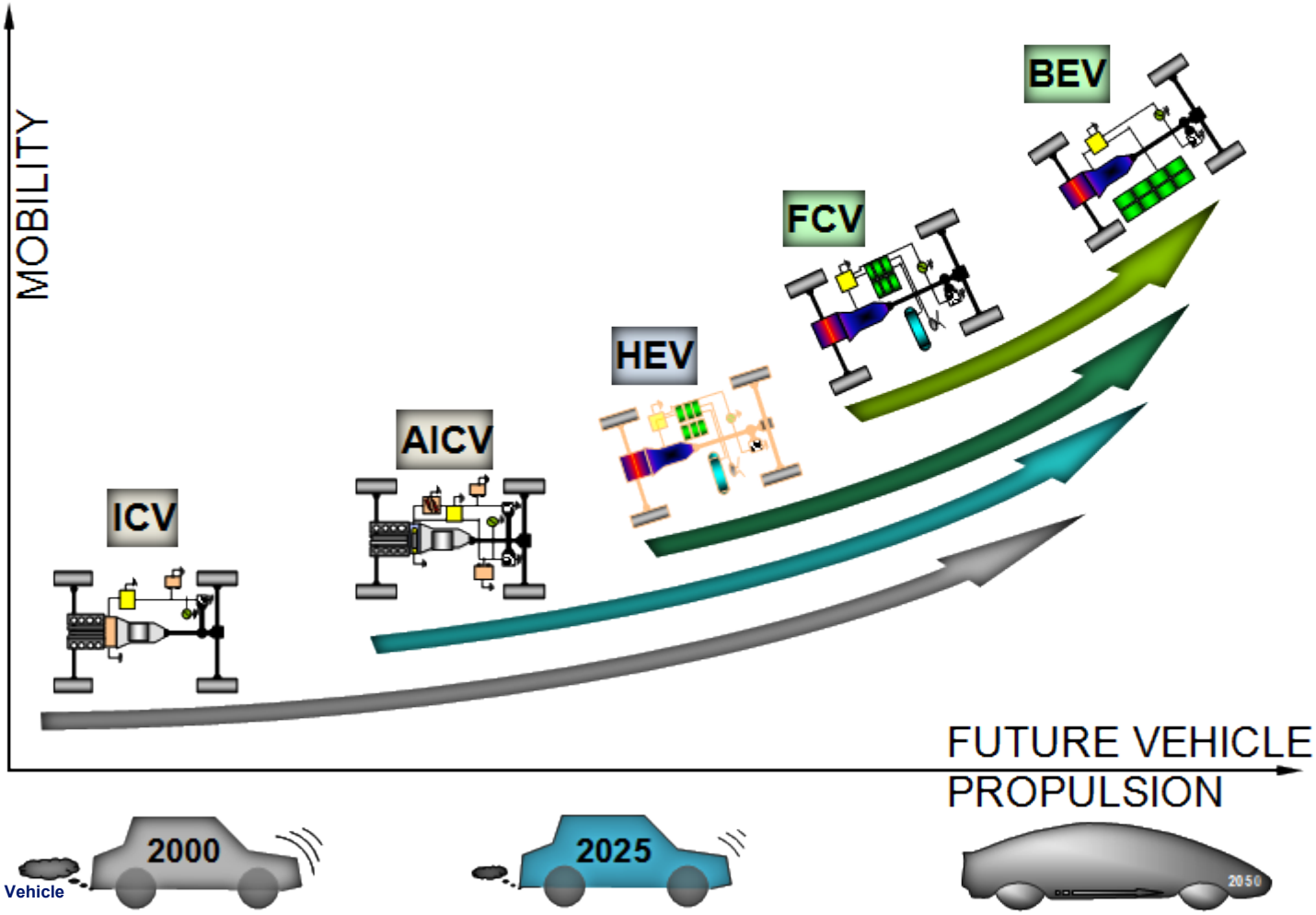
Gasoline Diesel LPG	Methanol DME Synt. Diesel	CNG Methanol DME Synt. Diesel	H_2	Ethanol Methanol DME Synt. Diesel Biodiesel Biogas	H_2
	H_2	H_2	Electrical	H_2	Electrical
	Electrical	Electrical		Electrical	

Energy consumption - Global target



Future Vehicle Propulsion System

Source: Scientific American Sep08



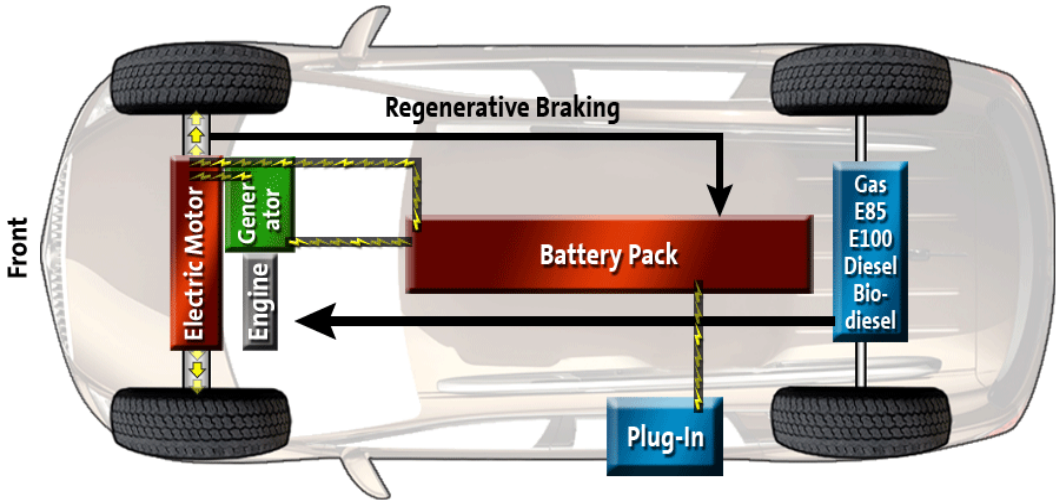
ICV – Internal Combustion Vehicle
AICV – Advanced Internal Combustion Vehicle
HEV – Hybrid Electric Vehicle
FCV – Fuel Cell Vehicle
BEV – Battery Electric Vehicle

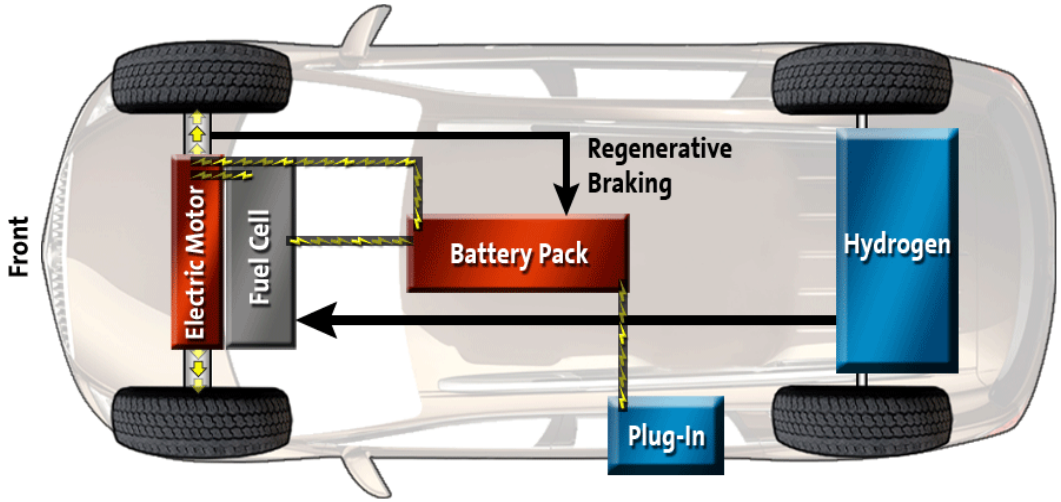
Hybrid Electric Vehicles

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			
FCV	Reformer + PEMFC	Methanol, H_2	Ni-MH, Li-Ion, Na-NiCl	
	PEMFC	H_2		
BEV	Electrical	Ni-MH, Li-Ion, Na-NiCl		

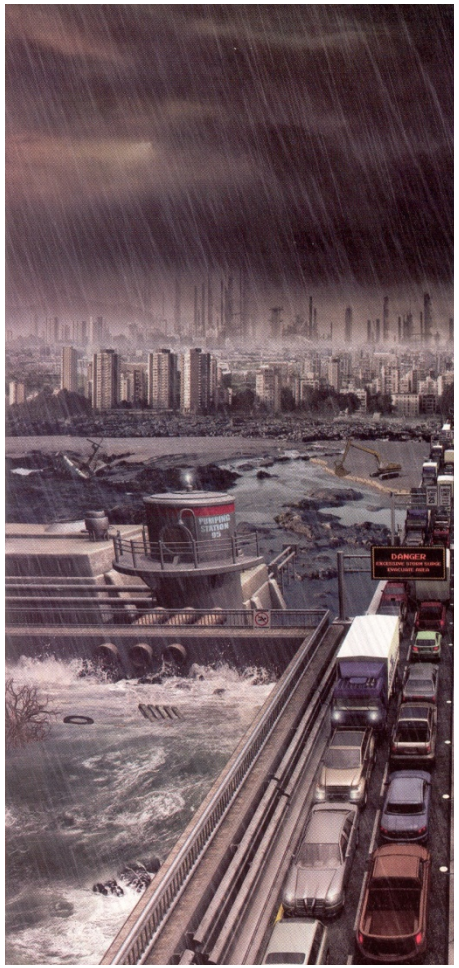
PISI – Port injection Spark Ignition
DISI – Direct Injection Spark Ignition
DICI – Direct Injection Compression Ignition
ICE – Internal Combustion Engine
FC- Fuel Cell
PEMFC – Proton Exchange Membrane Fuel Cell

Hybridization and Electro-Mobility



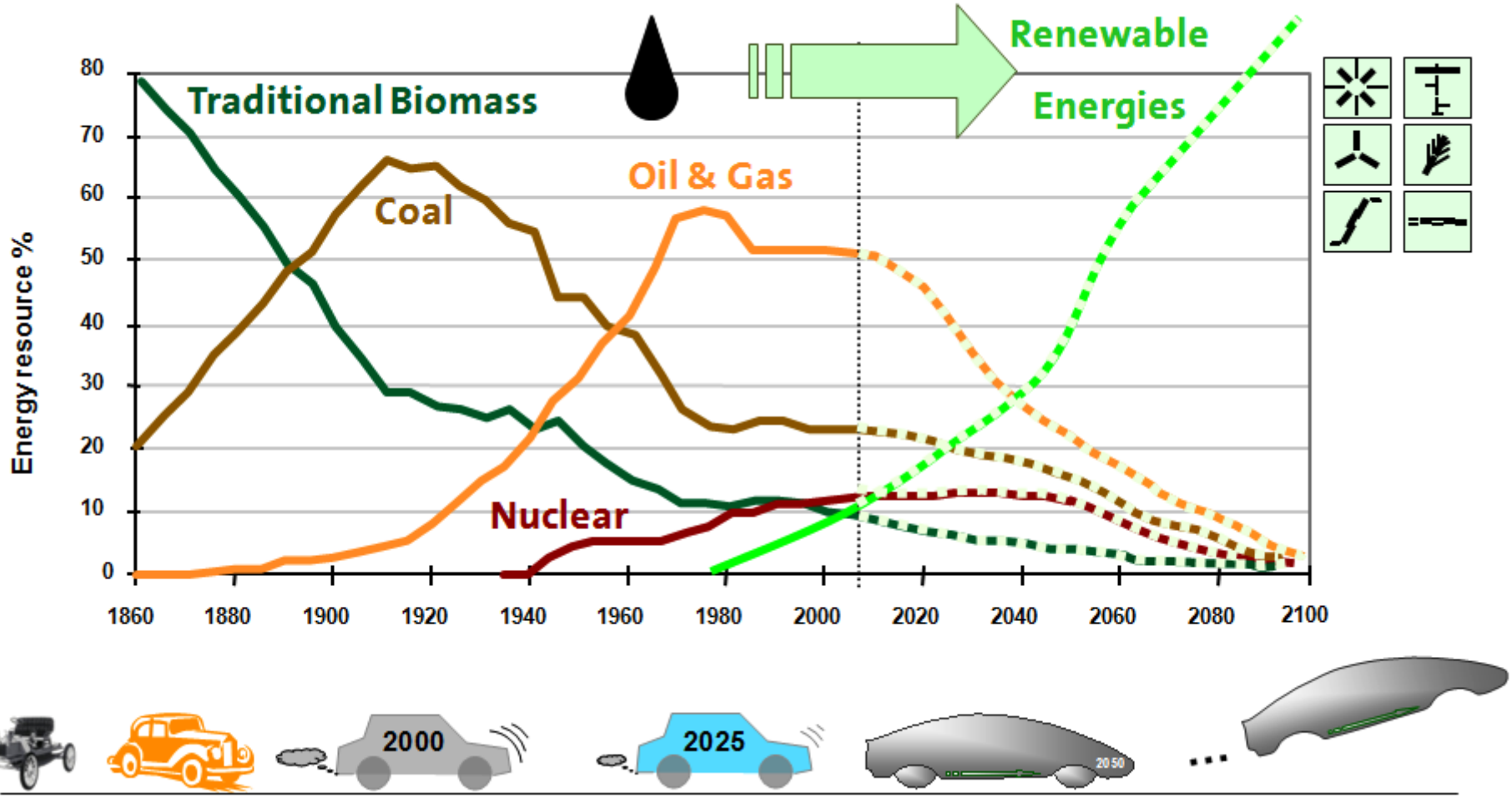


Global Sustainable Mobility Vision

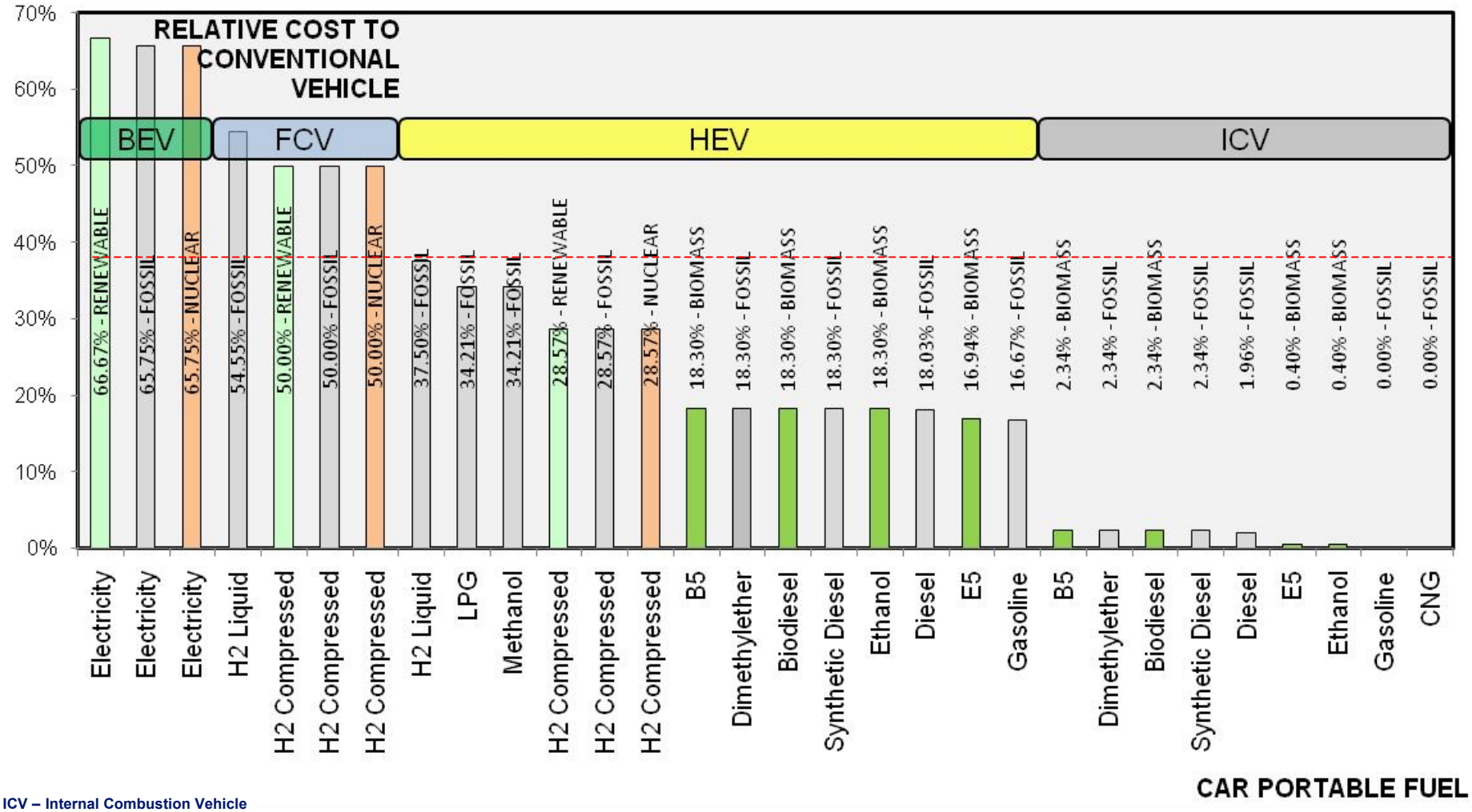


Source: Scientific American Sep06

Renewable Energy Transition



Vehicle - Relative Cost



ICV – Internal Combustion Vehicle

HEV – Hybrid Electric Vehicle

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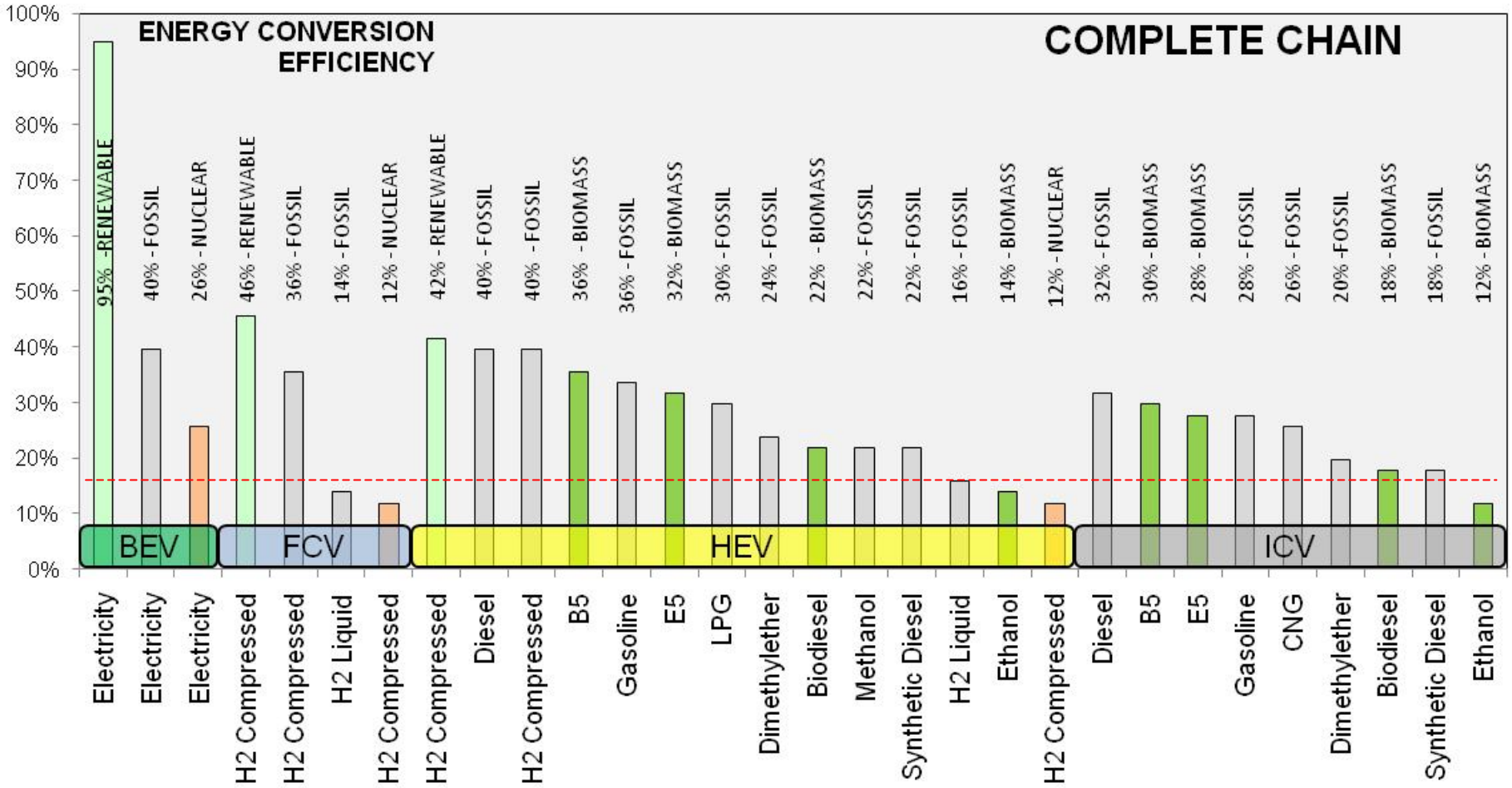
BEV – Battery Electric Vehicle

WTW – Energy Efficiency



ICV – Internal Combustion Vehicle

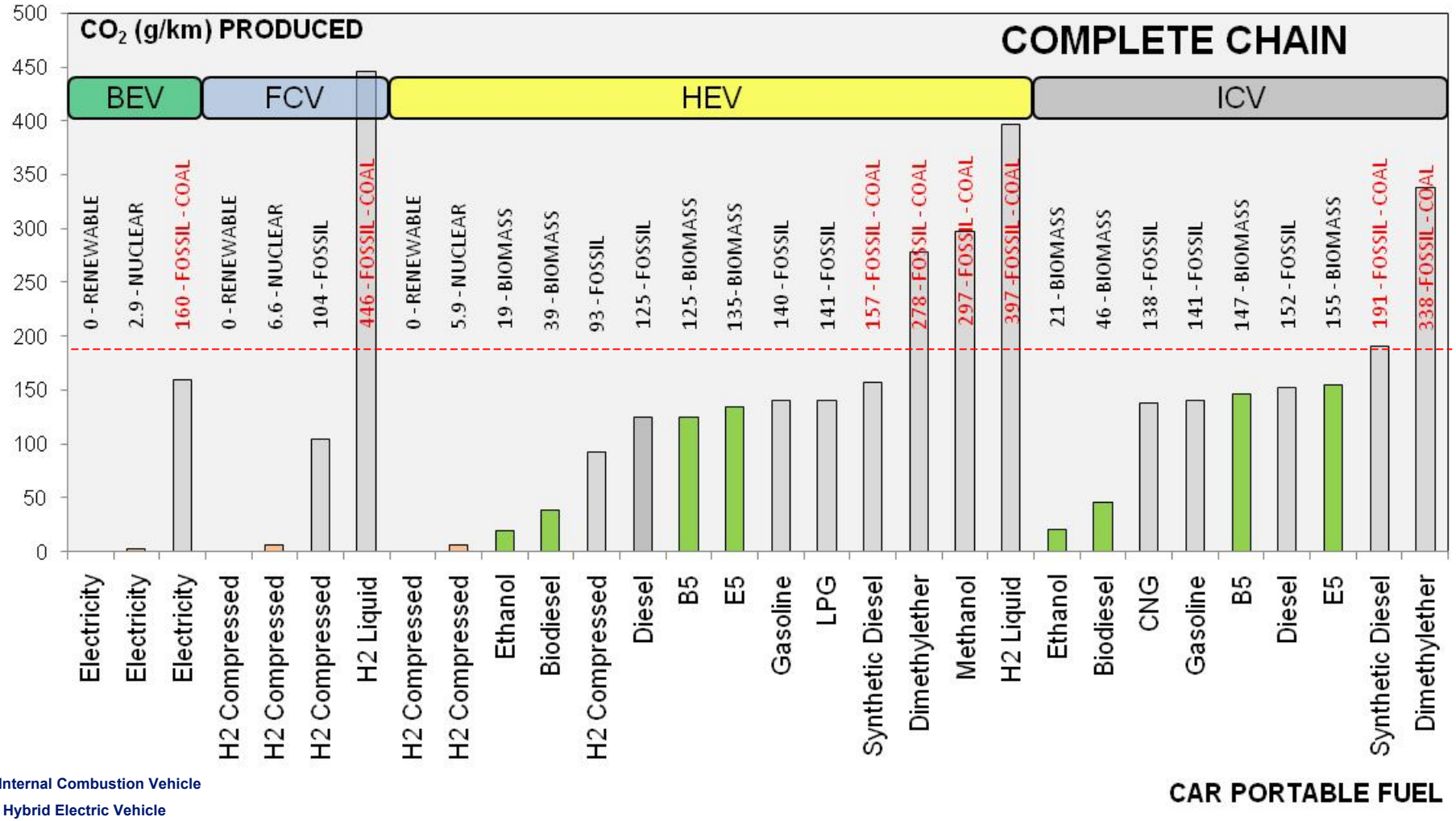
HEV – Hybrid Electric Vehicle

FCV – Fuel Cell Vehicle

BEV – Battery Electric Vehicle

WTW – Well to Wheel

WTW – CO_2 Emissions



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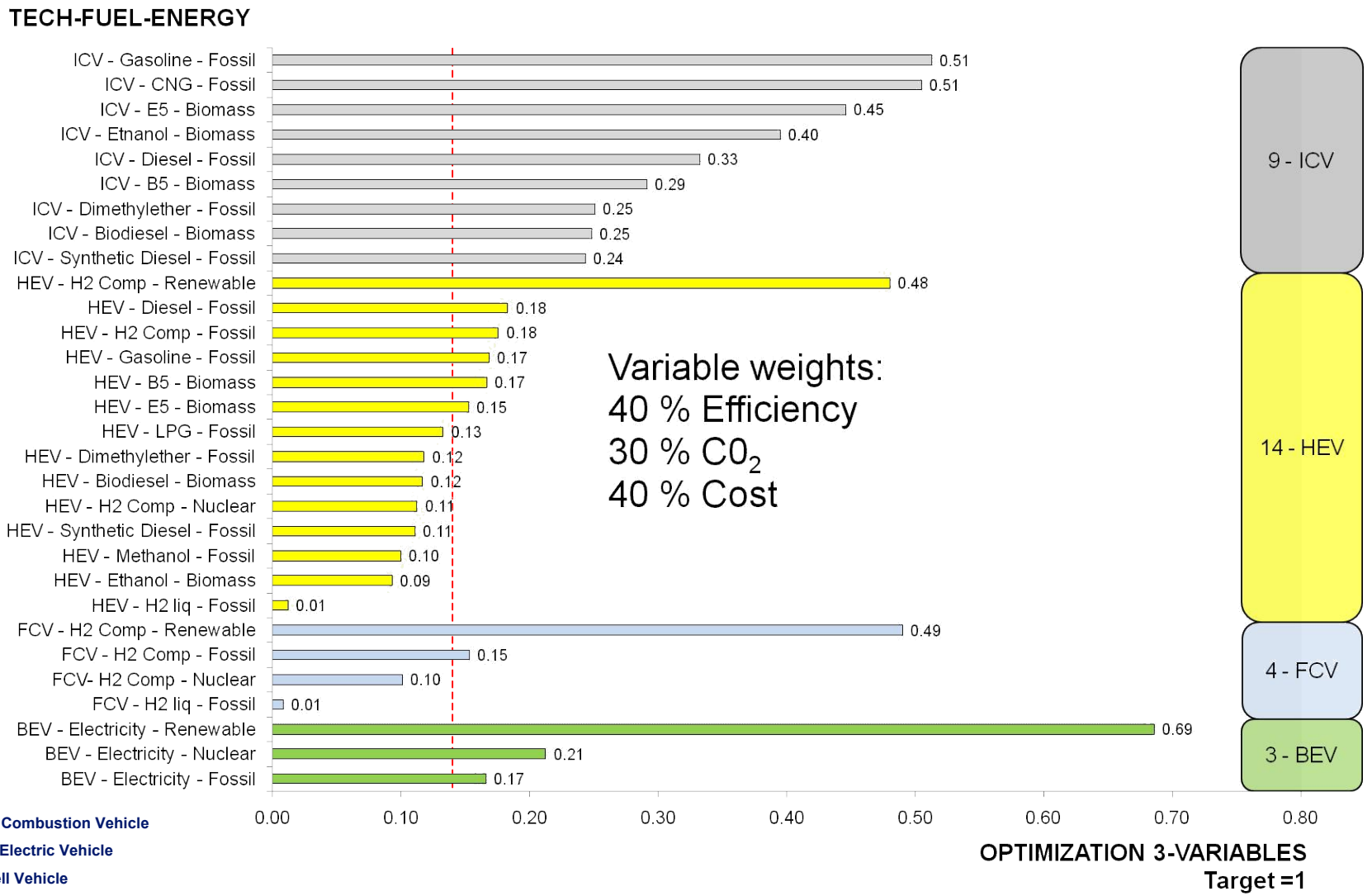
Vehicle Propulsion Optimization



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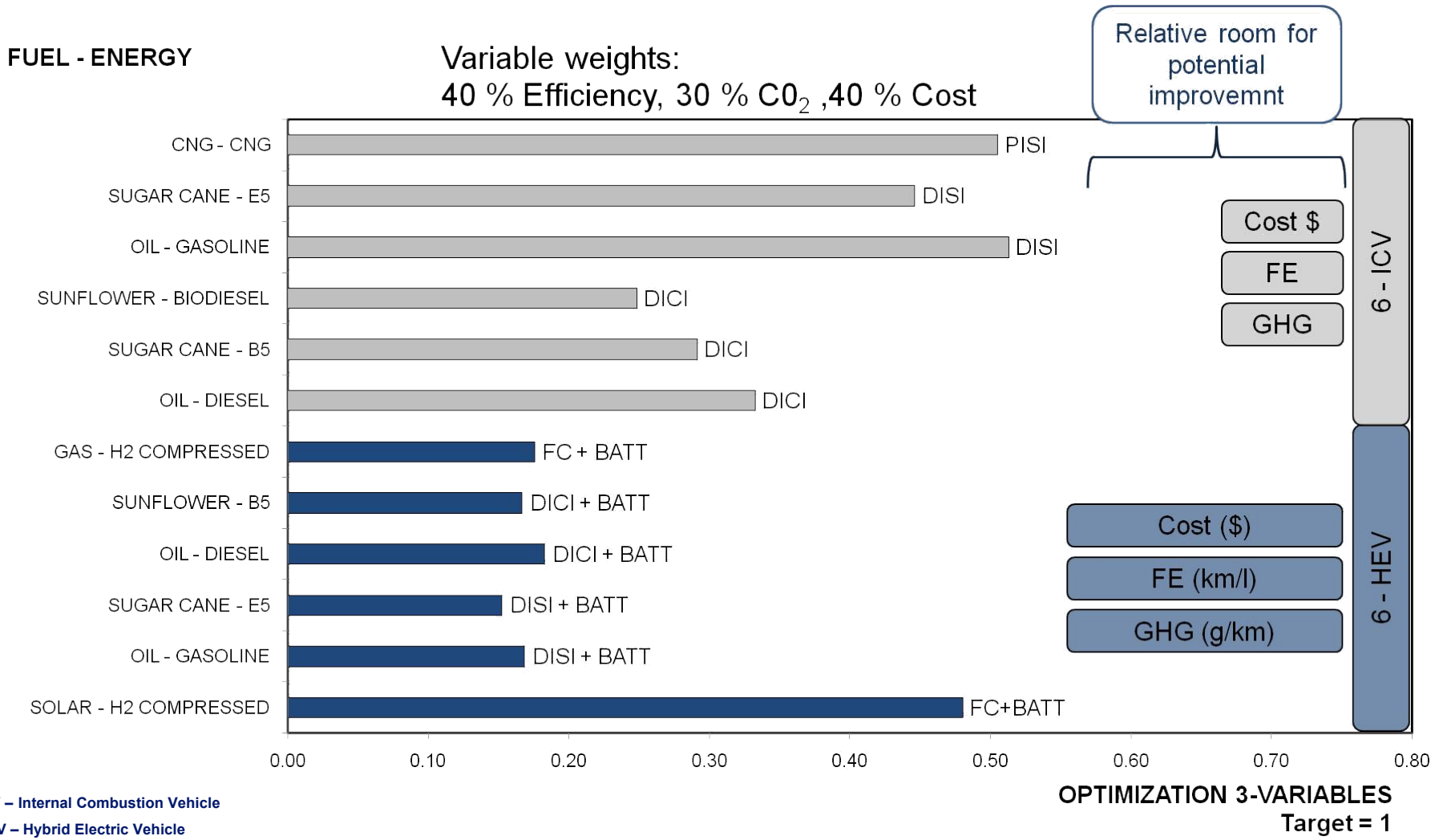
Most Feasible & Sustainable VPS's



ICV – Internal Combustion Vehicle
HEV – Hybrid Electric Vehicle
FE – Fuel Economy
GHG – Green House Gases

Results

1) From the 30 VPS's analyzed the most sustainable technologies recommended to keep development in decades to come are the following:

ICV's

- Powered by gasoline or diesel from oil. E5, B5 and biodiesel from biomass and the potential for blend rate increase.
- AICV's to mature on variable features for best energy conversion efficiency.

VPS's – Vehicle Propulsion Systems
ICV's – Internal Combustion Vehicles
AICV's – Advanced Internal Combustion Vehicles

Results

HEV's

- Powered by an ICE and fuels previously described along with a certain level of hybridization as the technology on batteries permit in terms of mature, cost and durability.
- Optimization and control to operate ICE, FC and batteries nearer its best efficiency.
- FC's powered by compressed H_2 from gas and best from Solar energy.

ICE – Internal Combustion Engine

FC – Fuel Cell

Results

2) Additional considerations for next generation of FVPS's in the direction of a GSM;

- Less use of coal for fuel production.
- Avoid liquid H_2 as a portable fuel.
- Start using renewable energy for H_2 production.
- Biomass as a renewable converter to produce E5, B5, biodiesel and all blend rates to deliver a CPSI.

FVPS's – Future Vehicle Propulsion Systems
GSM – Global Sustainable Mobility
CPSI – Continuous Positive Sustainable Impact

Conclusions

- To continue the GSM journey a mindset change of the present and future generations is fundamental.
- PHEV's, FCV's and BEV's technologies to wait for greener energy (tie-in to the electrical grid).
- The GSM vision provides the long-term thinking to produce better short-term decisions.
- Next vehicle propulsion systems are the hybrids.
- HEV's, H_2 and electro-mobility are considered the main contributors to accelerate the introduction of RE's.

GSM – Global Sustainable Mobility
PHEV's – Plug-In Hybrid Electric Vehicles
FCV's – Fuel Cell Vehicles
BEV's Battery Electric Vehicles
RE's - Renewables