



Funded by  
the European Union

## Alternative powertrains for road vehicles

---

### Hybrid and electric powertrains

*"Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them."*

**Radoje Vujadinović**  
**Milanko Damjanović**  
**Boško Matović**



**Partnership for Promotion and Popularization of Electrical Mobility through Transformation and Modernization of WB HEIs Study Programs/PELMOB**

Call: ERASMUS-EDU-2022-CBHE-STRAND-2

Project Number: 101082860

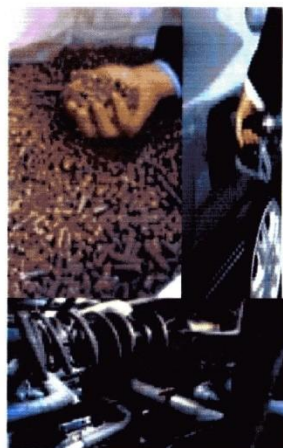
## Prospects for the use of alternative fuels (EU)



### Assessment

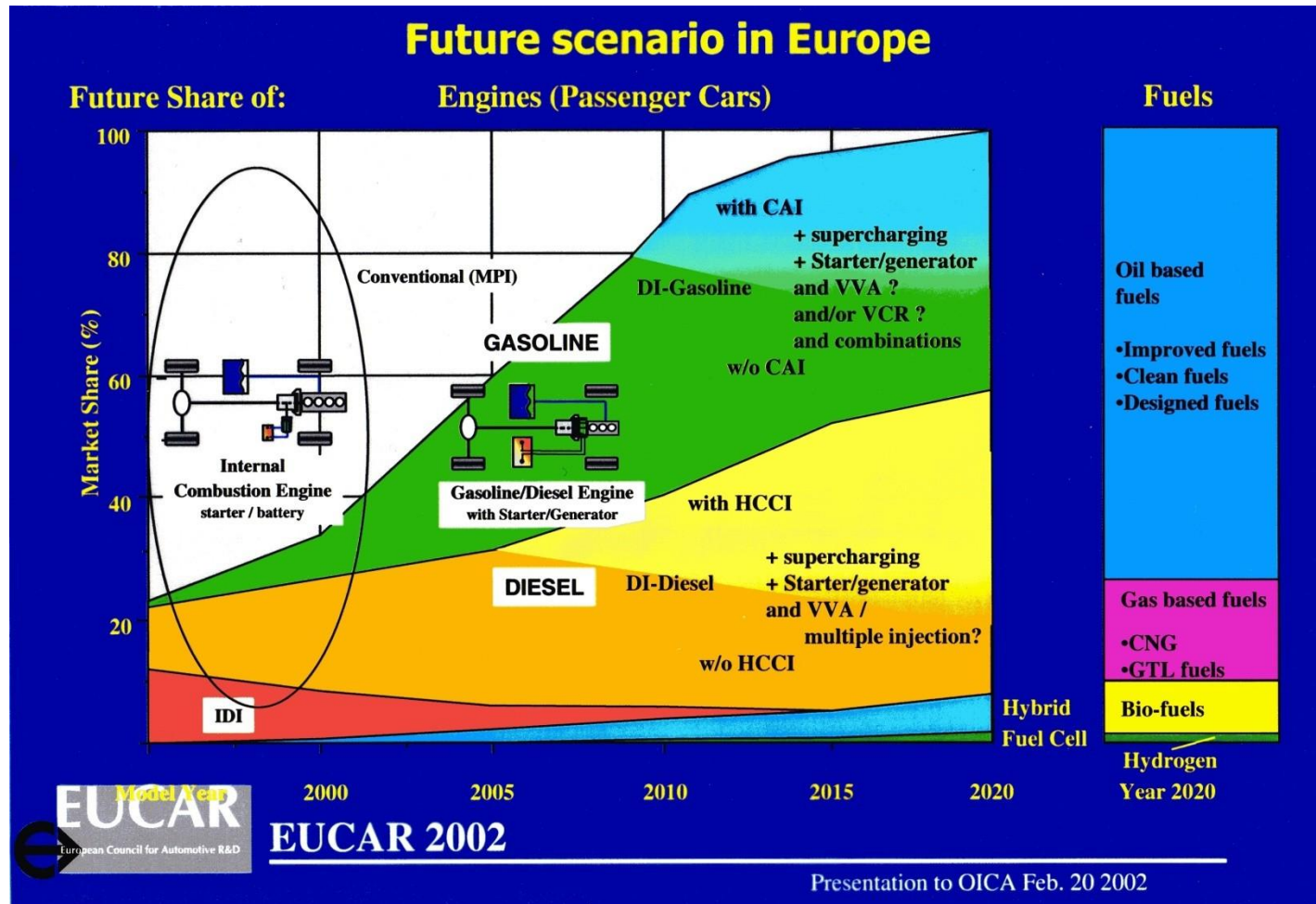
#### Options with potential over the next 20 years

Only three options appear to have a volume potential of more than 5% fuel consumption. If **active policy** is decided to promote them, their **optimistic** development scenario is (% fuel consumption):



	Biofuel	Natural gas	Hydrogen	Total
2005	2			2
2010	6	2		8
2015	(7)	5	2	14
2020	(8)	10	5	(23)

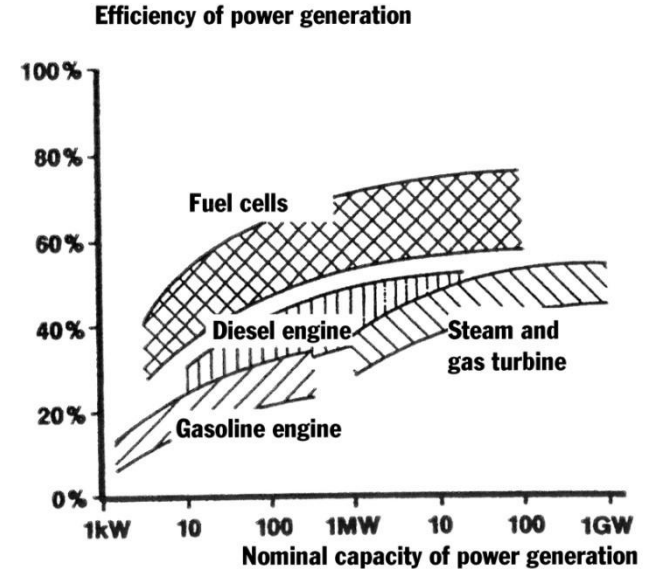
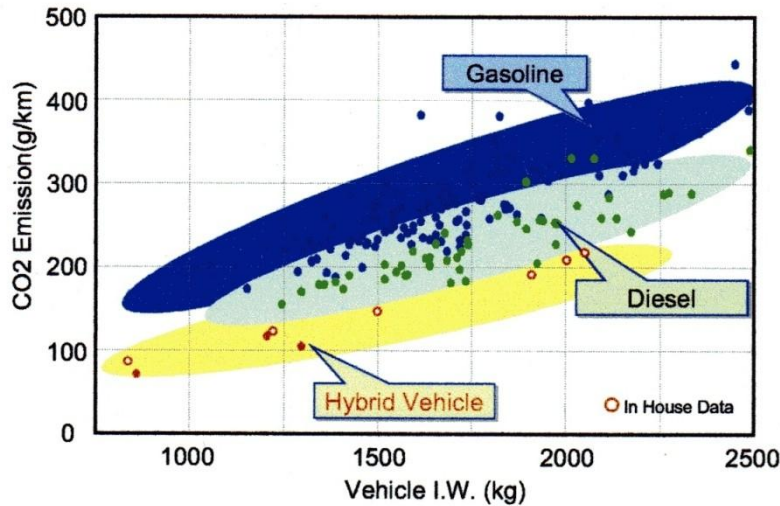
## Perspectives on the application of alternative fuels and powertrains



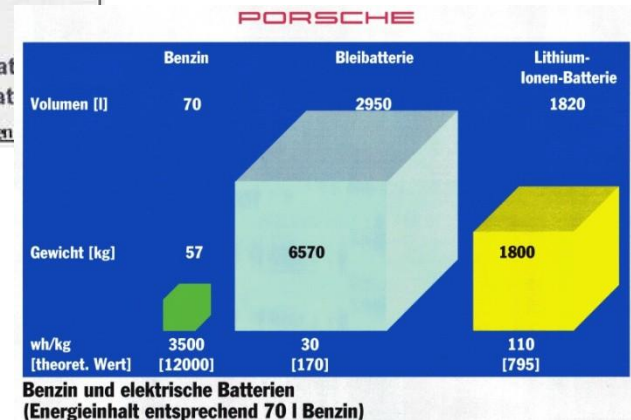
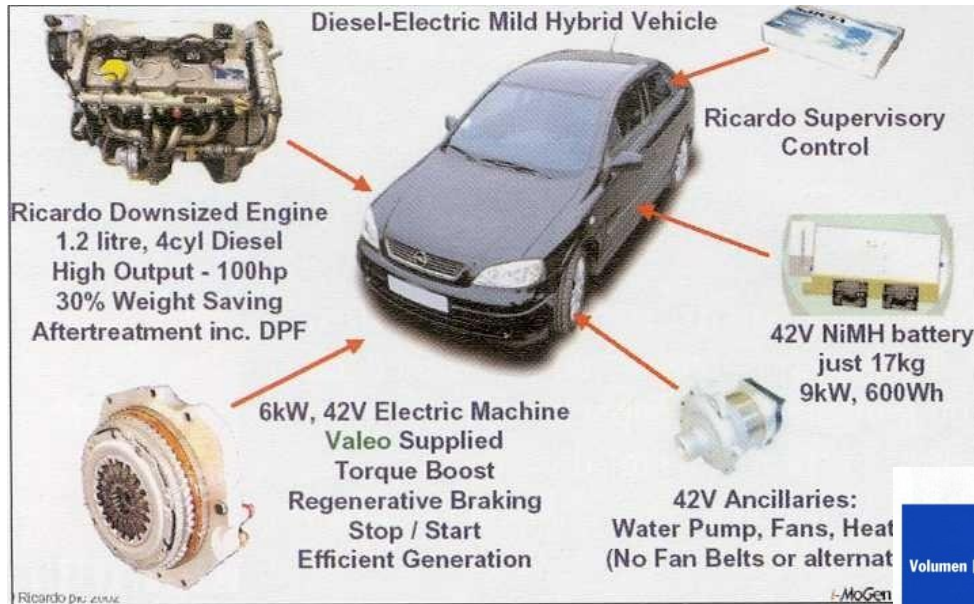
# Hybrid technologies



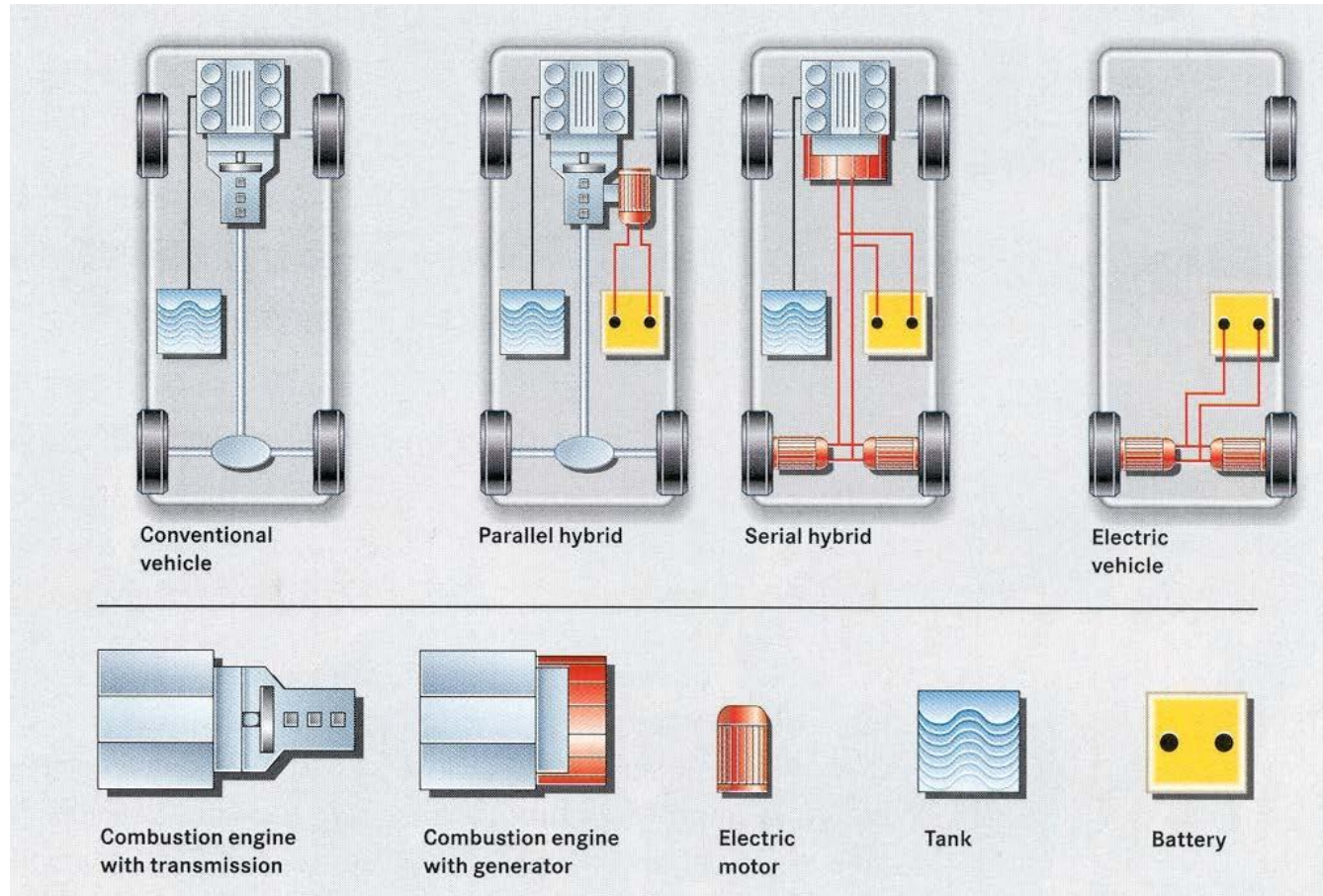
# Environmental and energy advantages of hybrid technologies



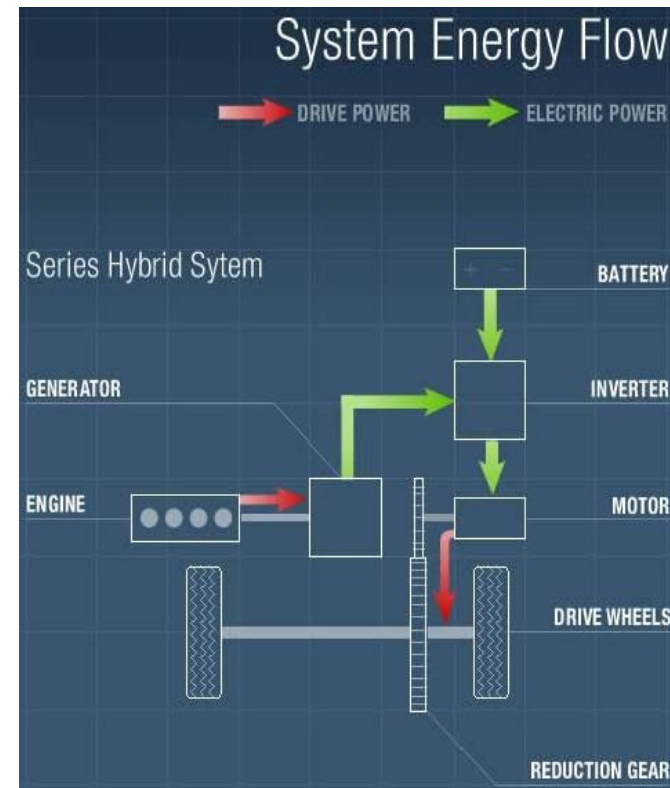
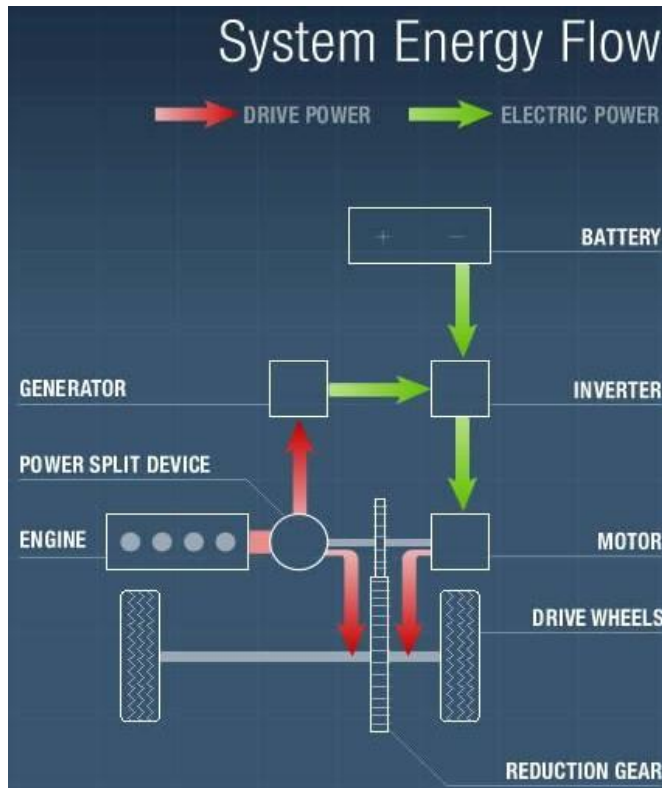
## Mild hybrid vehicles



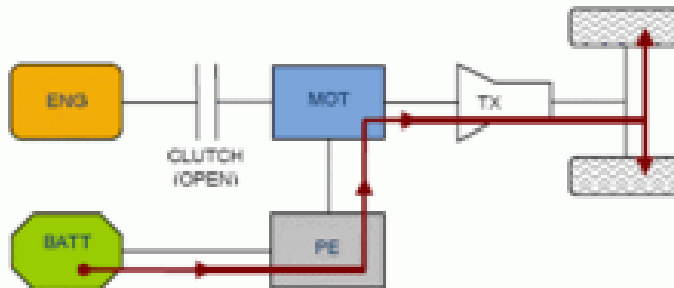
## Alternative powertrains - configurations



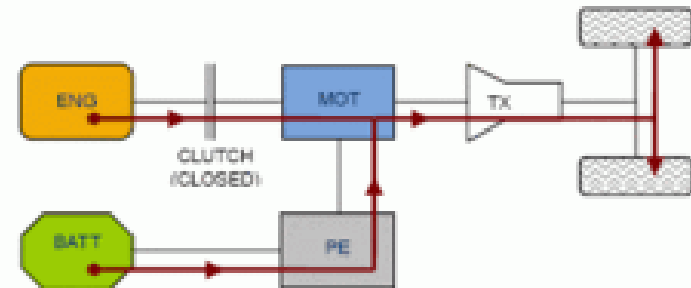
# Hybrid Vehicles - Parallel and Series Hybrids



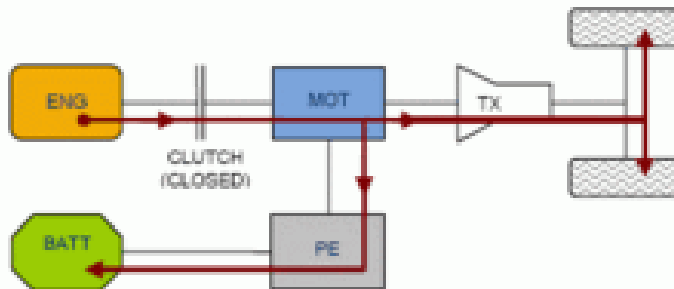
## Modes of Operation of Parallel Hybrid Vehicles



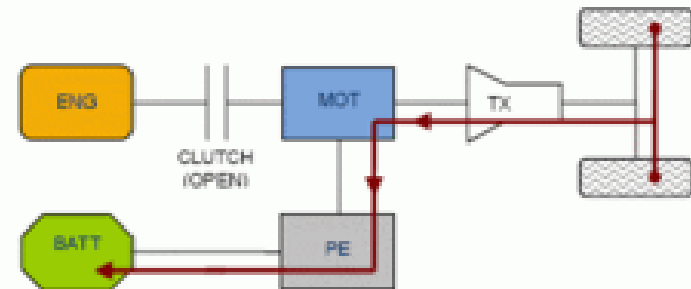
(a): electric only.



(b): hybrid / electric assist.

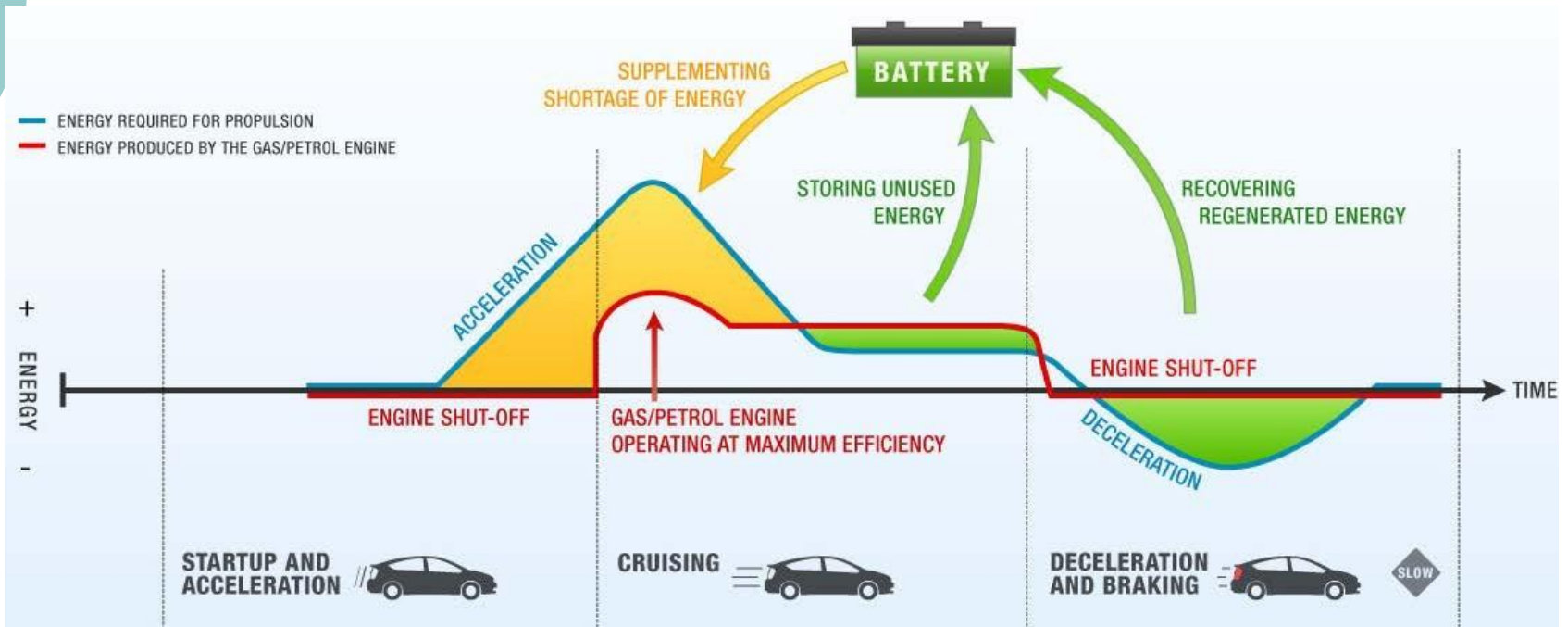


(c): battery charging.



(d): regenerative braking.

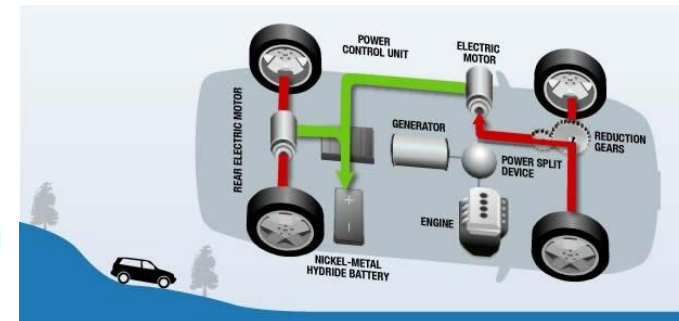
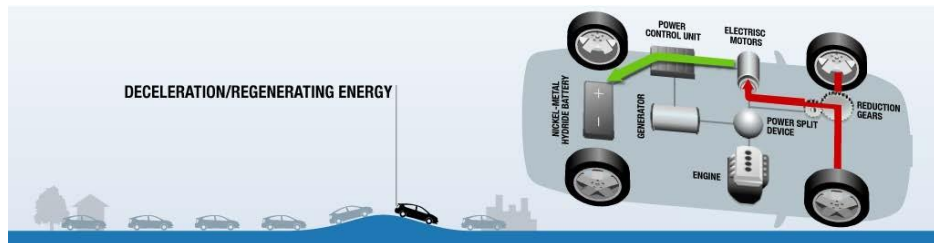
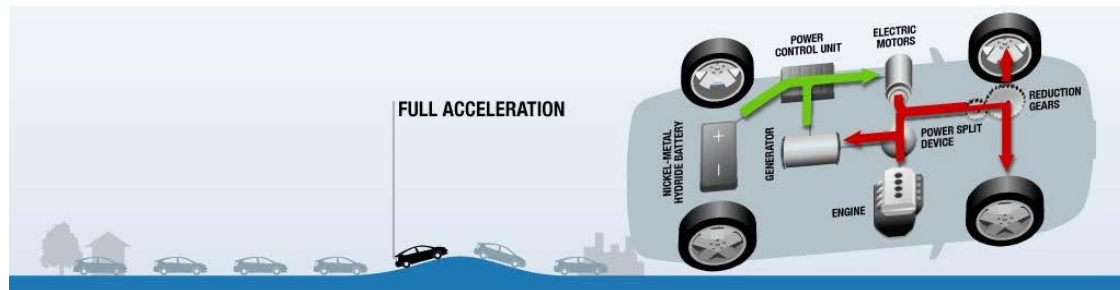
## Full hybrid vehicles - operating principle



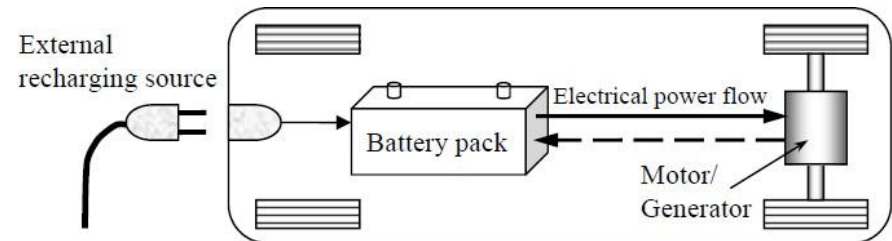
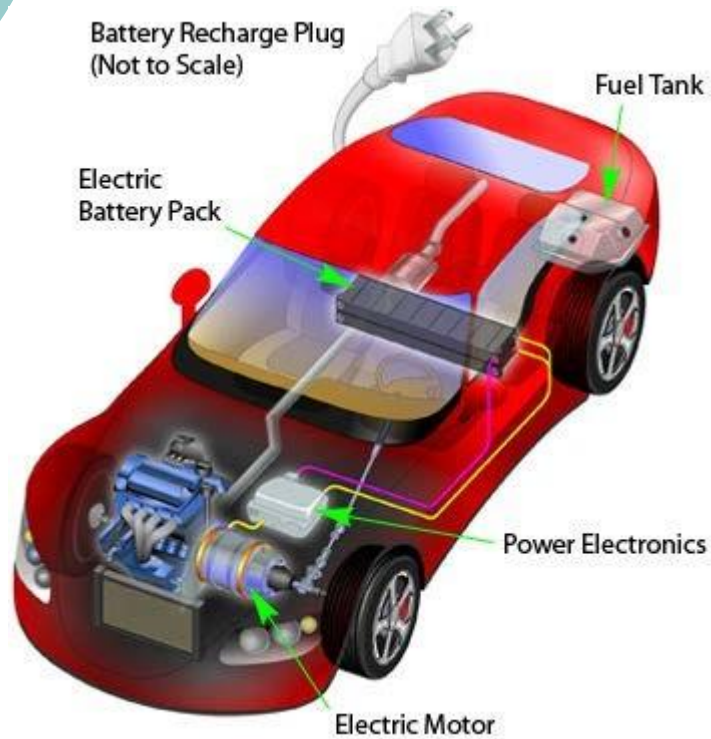
## *Full hybrid vehicles- modes of operation (1)*



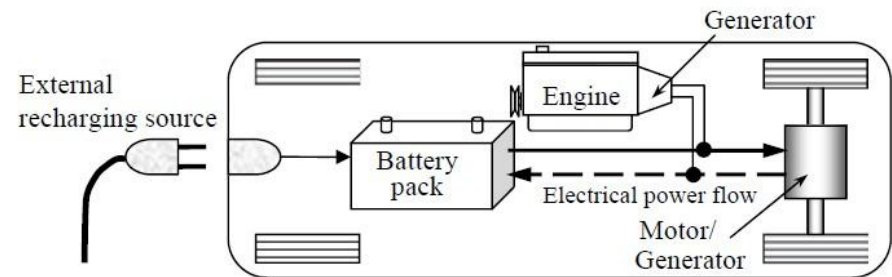
## Full hybrid vehicles - modes of operation (2)



## *Plug-in electric hybrid*



(a) Plug-in electric vehicle



(b) Electric vehicle with range extender and plug-in facility