Electric & Hybrid Electric Vehicles – History, present and future Based on Debate Articles in Ny Teknik spring 2020

SAAB-veteranerna at SAAB Car Museum – November 17, 2022, at 2:00 p.m.

Urban Kristiansson

- 1963 to ~1992
- ~1993 to ~2022

• 2022

- Public opinions Threats Challenges
 - ~2023 to ~2063
 - Electric cars The only solution?
- Updated Bonus/Malus that minimizes CO₂ and is tax neutral
 - Hydrogen as Fuel Are lead times realistic?
 - Powertrains vs. Traffic safety & environmental impact
 - Future milestones
- Serie-HEVs & EVs reduce CO₂ the most while supporting mass market customers best

Birds view 1963 – 2063

<u>1963 to ~1992</u>

Focus on reduction of tailpipe emissions; HC, NO_x, CO & particles

From carburettor to electronic injection & ignition

~1993 to ~2022

Focus on zero tailpipe emissions; ZEVs (Zero Emission Vehicles)

Technology development and market acceptance of electrified propulsion

~2023 to ~2063

Focus (hopefully) on eliminating CO₂ based on LCA (Life Cycle Analysis)

Reduce CO₂ from Well-to-Wheel: i.e. during production-operation-scrapping

1963 – ~1992 : Regulation of Tailpipe Emissions







2022, page 2(3) Examples of Threats

Acceleration vs. Road safety & Environmental care

- Electrified cars easily accelerate twice as fast as today's cars.
- How many more fatalities will the increased acceleration cause?
 How many more particles from tire wear will the increased acceleration generate?

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Large batteries vs. Energy efficiency & Child labour

- A 100 kWh battery weights 500 kg and a 10 kWh battery weights 50 kg.
- How much more energy is needed just to move the large battery compared to the small battery?

. . .

How many more children need to crawl into the mine for the large battery compared to the small battery?

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Most threats will be reduced if regulated CO₂–reduction is based on Life Cycle Analysis, and even better, if regulation also take road safety into consideration.

2022, page 3(3) Challenges			
Recent years' Swedish Bonus/Malus:	EU: New petrol/diesel car sales prohibited from 2035.		
Achieved results:	 Fuels: Bio-fuels, electricity and hydrogen Powertrains: ICE, Parallel-HEV, Serie-HEV & Electric 		
Premium segment has accepted electrified cars.	How realistic is it?		
 Volvo Cars was given a free ticket to develop competitive powertrains. 			
	Wanted focus for a future Bonus/Malus:		
Weaknesses:	The primary goal must be to minimize CO ₂ based on LCA;		
 Does not primarily focus on reduction of CO₂. 	and at the same time ensure:		
 Supports over-powered heavy cars creating reduced road safety and increased environmental load 	Mass market acceptance of electrified cars		
(accelerations, battery production, road wear,).	Cars for rural areas & continuous operation		
 Will possibly mean a higher price picture for cars when Bonus/Malus is removed. 	That there will not be a price shock on new cars		

~2023 to ~2063 Analysis & Synthesis of Potential Future

- Electric cars The only solution?
- Updated tax neutral Bonus/Malus that minimizes CO₂
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~2023 to ~2063 Electric cars – The only solution, page 1(2)?

Exaples of basic data for the Analysis

Fuel	WTW	[Unit]	
Gasoline 95%	2,850	[kg CO2e/liter]	
Diesel MK1	2,730	[kg CO2e/liter]	
Etanol E85	1,120	[kg CO2e/liter]	
Vehicle gas	0,433	[kg CO2e/liter]	
FAME	1,060	[kg CO2e/liter]	
HVO - Swedish Mix	0,300	[kg CO2e/liter]	
Biogas HBK	0,034	[kg CO2e/liter]	
FC-H2 - Swedish Mix El	0,022	[kg CO2e/kWh]	
Electricity - Swedish Mix	0,013	[kg CO2e/kWh]	
Electricity - EU Mix	0,260	[kg CO2e/kWh]	
Electricity - Global Mix	0,475	[kg CO2e/kWh]	
Electricity - From Solar Cells	0,050	[kg CO2e/kWh]	
Electricity - From Windmills	0,012	[kg CO2e/kWh]	
Electricity - From Nuclear power - Global mix	0,016	[kg CO2e/kWh]	
Electricity - From Nuclear Power - Ringhals	0,006	[kg CO2e/kWh]	
Electricity - From Fossil gas	0,469	[kg CO2e/kWh]	
Electricity - From Cool	1,001	[kg CO2e/kWh]	
Pure gasoline	2,901	[kg CO2e/liter]	
Pure diesel	2,730	[kg CO2e/liter]	
Natural Gas	0,483	[kg CO2e/liter]	
Cert.gas	0,438	[kg CO2e/liter]	
Pure ethanol	0,688	[kg CO2e/liter]	
Methangas - Renewable	0,025	[kg CO2e/kWh]	
Methanol - Renewable	0,189	[kg CO2e/liter]	

Prime Mover	
ICE	
Parallel Hybrid	
Pure electric	
Serial Hybrid with ICE	
Serial Hybrid with FC	
Fuel	
Gasoline / Diesel	
HVO - Swedish Mix	
Electricity - Swedish Mix	
Electricity - Global Mix	
Hydrogen - Green	
and info about:	
 Traffic Vehicles 	
Components	
Cost / Price / Profit / Tax	
 Bonus / Malus 	

Customer / OEM / State

Guidelines for the Analysis

- Regulate reduction of CO₂ based on LCA
- Keep it simple, e.g. charging infrastructure
- Technology used shall be known today, i.e. at least be in low volume production, e.g. Fuel Cells
- Ignore the wait and see argument type "There will come a component that is God's gift to humanity"
- Do not accept shameful arguments like that today's mining for cobalt is good for the livelihood of poor families, invest in serious mining
- Be sceptical to automotive CEO's communications
 - No revolution evolution

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~2023 to ~2063 Electric cars – The only solution, page 2(2)?

Note: Battery replacement is not included in electrified cars' CO₂ load.

CO₂ for different Energy Mixes Annual mileage 14,500 km, of which 50 days with longer mileage than 100 km. Cars lifespan 17 years.





~2023 to ~2063 Updated Bonus/Malus that minimizes CO₂ and is tax neutral, page 1(2)









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~2023 to ~2063 Serie-HEVs & EVs reduce CO_2 the most while supporting mass market customers best





Thank You for Listening

