Sweden Task 1 presentation

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Swedish Energy Agency

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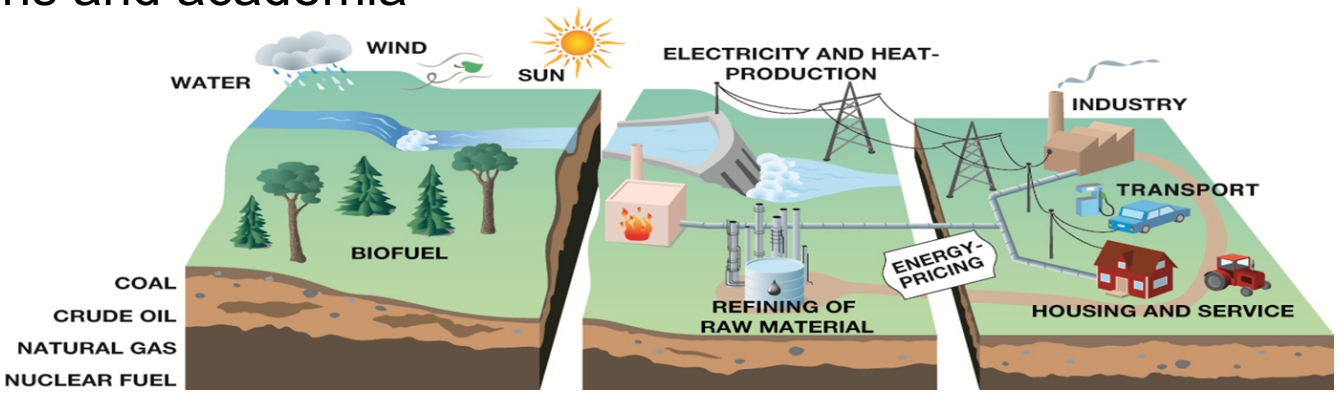
Swedish Energy Agency

What is the Swedish Energy Agency and what is their function?

- Authority which is under the Ministry of the environment
- Supporting the Government with analysis and statistics in the field of energy
- Allocate a large part of the Swedish State research funding in the field of energy (ca 150 million euro/year)
- Approximately 1/3 of the funds goes to the transport area
- Has virtually no own research but support research at industry, institutions and academia



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Political visions and goals related to the transport sector

- Vision to become a GHG emissions neutral country by 2050
- A vehicle fleet that is independent from fossil fuels 2030 (-70%) and fossil-free 2045 (-100 %)
- Goal to ensure the economic efficiency and long-term sustainability of transport provision for citizens and enterprise throughout Sweden
- Investments in research and innovation should be targeted so they can contribute to the established energy and climate goals, the long-term energy and climate policy, the energy-related environmental policy goals and to strengthen the Swedish business

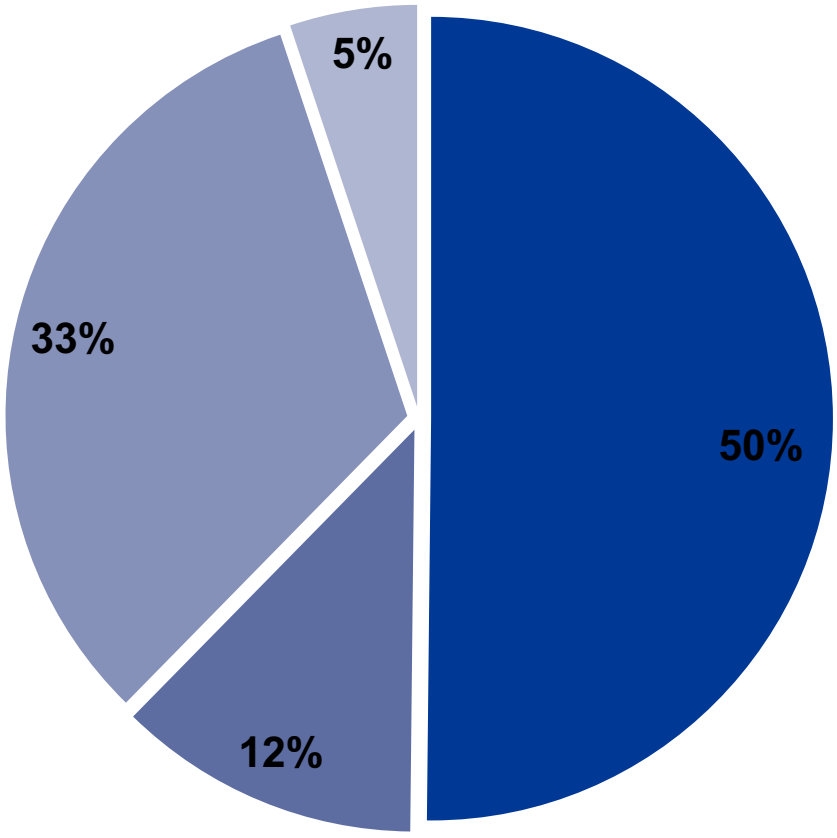
Grant receivers vehicle R&D

Universities 50%

Trade organisations/institutes 12%

Business sector 33%

Public organisations 5%



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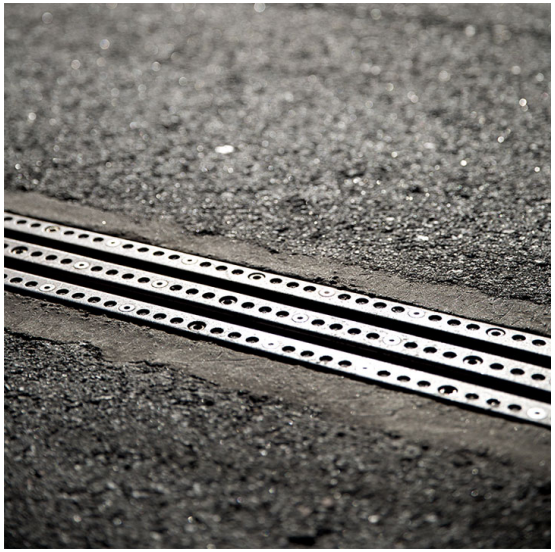
The world first electric highway road



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The electric site

A gravel pit where the vehicles are hybrids or pure electric and the load carriers run autonomously

Company Northvolt planed to built a green battery factory in Sweden

- 32 GWh (4 X 8 GWh) Gigafactory 35 GWh)
- Start in spring 2018
- Production from end 2020
- Full production in 6 year
- Total cost 4 billion Euro
- Factory in Skellefteå

- Demonstration plant in Västerås (The power and automation company ABB is partner)
- CEO is Peter Carlsson (former purchasing manager at Tesla)

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Governmental initiatives for EVs and charging infrastructure in Sweden

Carbon Dioxide Based Vehicle Tax

Super Green Car Bonus

Preferiental Taxation

Electric Bus Bonus

The Climate Step

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Coordination of charging infrastructure

The new electric bus bonus

Electric bus bonus is depending on the emission class of the electric bus and the transport capacity, the sum of the standing and sitting passengers as evidenced by the registration certificate for the respective electric bus. Premium paid one time for each bus. The following premium classes applied to an electric bus according to the emission category electricity:

1. who is registered for more than 130 passengers:
700 000 SEK. = ca 70 000 Euro

2. who is registered for the 111-130 passengers: 600 000 SEK.

3. who is registered for 91-110 passengers: 500 000 SEK.

4. who is registered for the 71-90 passengers: 400 000 SEK.

5. who is registered for the 51-70 passengers: 300 000 SEK.

6. who is registered for 31-50 passengers: 200 000 SEK.

For an electric bus that is included in the source category plug-in hybrid is based on 50% of above

LCA on lithium-ion batteries for light vehicles – CO2 and energy in production

Lisbeth Dahllöf and Mia Romare, IVL

Funded by Swedish Energy Agency and Swedish Transport Administration

http://www.ivl.se/english/startpage/top-menu/pressroom/press-releases/press-releases---arkiv/2017-06-21-new-report-highlights-climate-footprint-of-electric-car-battery-production.html

1. How much energy use and GHG emissions for li-ion battery production?

Largest reason for variation

- Cell production at the cell producer

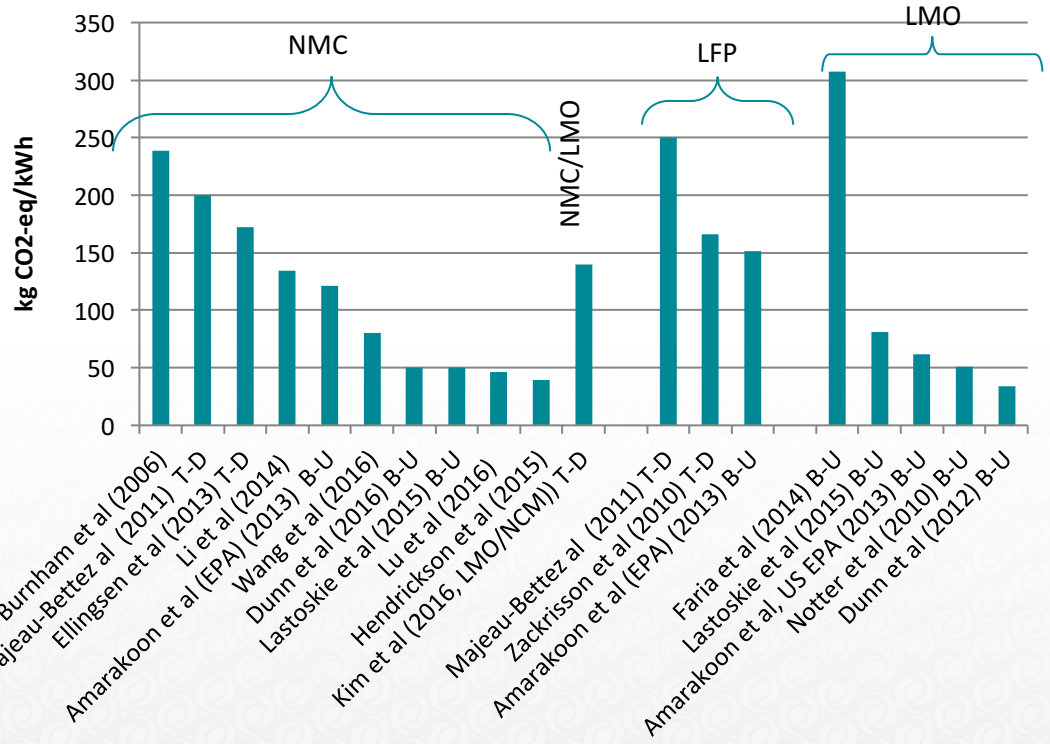
Less important for variation

- Material production
- LCI data choice for material production
- Amount of materials in the batteries
- Electronics data

Of small importance for variation

- Chemistry (/kWh)

(but if one calculates /kg or how long they last, or resource scarcity, ecotox: then it is important)



Most of the articles/reports are to more or less extent not transparent

Energy use cell prod: 3-2300 MJ/kWh (average 1000 MJ/kWh)

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2. GHG emissions per production step for NMC

Component	GHG, kg CO2-eq/kWh raw material	CO2-eq/kWh Cell material production (including raw material!)	CO2-eq/kWh Cell/pack assembly	Recycling
Anode	5-14	7-25		
Cathode	4.5-11	20-115		
Electrolyte	Approx 1	4-13		
Separator	Approx 1	Approx 1		
Cell case	Approx 1	Approx 1		
Battery case		10-25		
Cooling		2-6		
BMS	-	4-30		
Total		55-216	20-110	(-12) - +15

3. Specify how results differ between production countries , and if so, how much and why?

- Elecricity mix is important. Example calculated with the Ellingsens LCA-result (172 kg CO2-eq/kWh bat, 62% of this is due to cell manufacturing, 586 MJ for cell manufacturing assumed)

Electricity mix	g CO2-eq/ kWh el	kg CO2-eq/kWh batt	kg CO2-eq/ 200kWh battery	% of Ellingsen manufacturing	% of Ellingsen total
Sweden	50	7	1400	7%	42%
Brazil	300	46	9213	43%	65%
Ellingsen ref		107	15400	100%	100%
USA	700	112	22496	105%	103%
China	1000	159	31774	149%	130%
Poland	1050	169	33858	159%	136%
India	1400	226	45252	212%	170%

- Metals are usually globally sources. And regarding CO2 they have no major effect anyhow especially if Cu, Co and Ni are recycled.

4. How is energy use and GHG emissions increasing (kWh/gram CO2/kWh)(is it linear?)

Answer: it is nearly linear, but data for BMS in the study was on the lower edge

Vehicle application	kWh energy storage	CO2/ kWh		kWh increase (previous pack as ref)	CO2 total increase	100% incr. kWh -> x% incr. CO2
PHEV	15	270		-	-	-
PHEV	40	266		167%	163%	98%
PHEV/BEV	80	258		100%	94%	94%
BEV	200	254		150%	146%	97%
BEV	250	253		25%	25%	98%

Ambrose and Kendall 2016.

8. Which materials are possible to recycle technically or economically?

- Economically: Cu, Co, Ni. But usually the customer has to pay for recycling. Also electronics are usually recycled

- Technically
  - Pyrometallurgical (+leaching, hydrometallurgical) Co, Ni, Cu, partly Fe
  - Hydrometallurgical: Cu, Co, Al, C, Li (all metals can be recycled)
  - Dismantling before and combinations are possible

- It is possible to get most of the materials back, maybe it is not CO2 efficient, but resource efficient regarding the materials in the batteries.

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SLUT and thank you

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