HYBRID AND ELECTRIC VEHICLES

In media and in practice

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Mika Kauppila
Manager of sustainable energy solutions

VALMET AUTOMOTIVE

CONTENT

BACKROUND

WHAT YOU NEED TO UNDERSTAND

- There are no yes or no answers
- Changes are fast
- 90% of media articles are deliberate BS
  - Both positive and negative
  - Money and ideologies involved
  - Overoptimistic, overpessimistic
  - Myths
  - Outdated data
- I support EV growth, but I try to be neutral

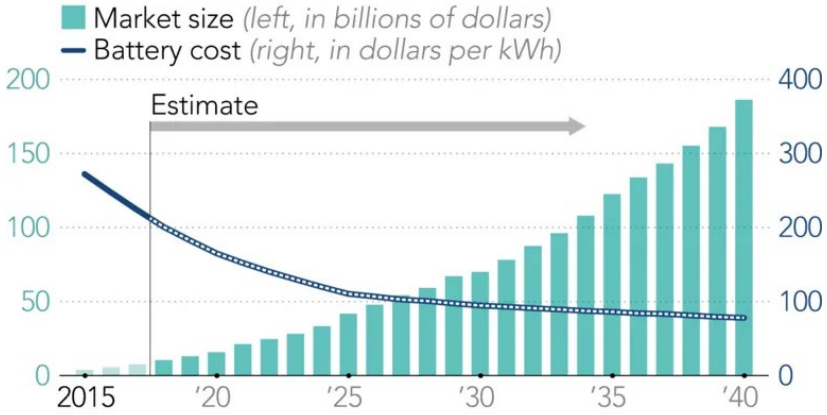
WHY EV?

MANUFACTURER POINT OF VIEW

- **Increasing demand**
- **Technology development**
  - Cost decrease
  - Range increase
- **Competitor pressure**
  - What if we are late?

    => Constant strategy changes

EV battery demand to rise, costs to fall



Source: Goldman Sachs Global Investment Research, company data

- **Laws and regulations**
  - Manufacturers must meet certain average fleet emission level
    - => Green series
    - => Artificial collaboration between manufacturers for ”emission trading”
- **Politics**
  - ICE bans
  - Green incentives
  - Pollution bans in cities

POSITIVE SIDES

WHAT IS BETTER WITH EVS

- Simplicity
  - Reliability
  - Maintenance
- Performance
- Incentives
- Local emissions
- Global emissions
- TCO?

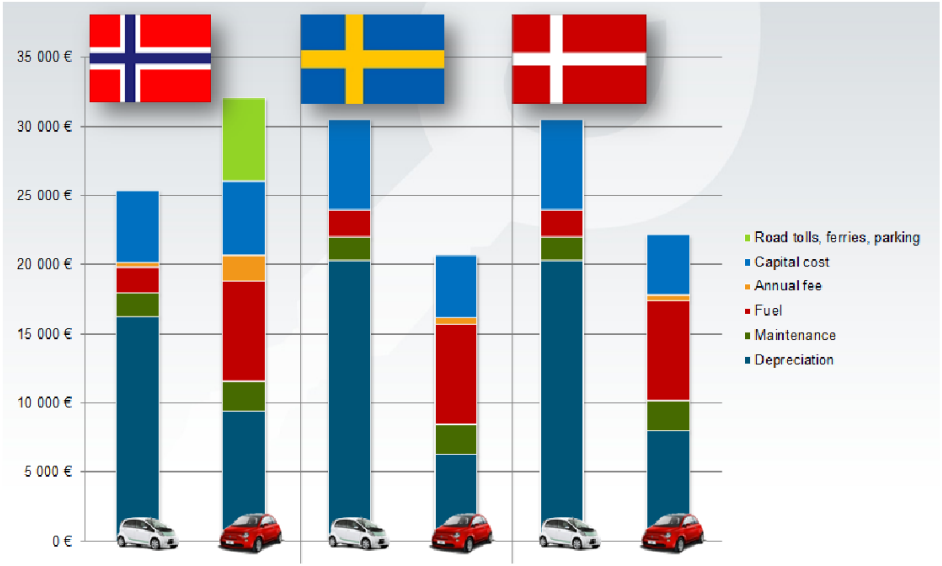
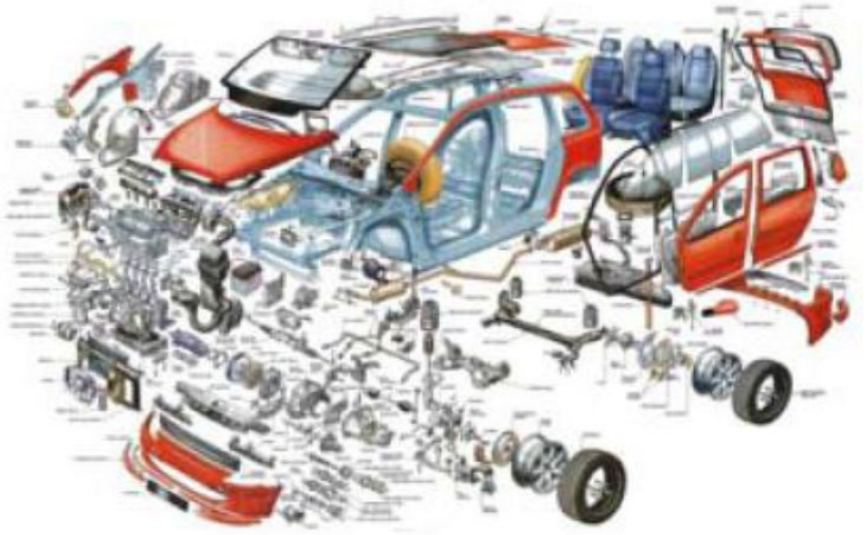


Figure 5: TCO for mitsubishi i-MiEV vs Fiat 500. 2012 pricing. 5 years of ownership, 15.000 km / year. Es



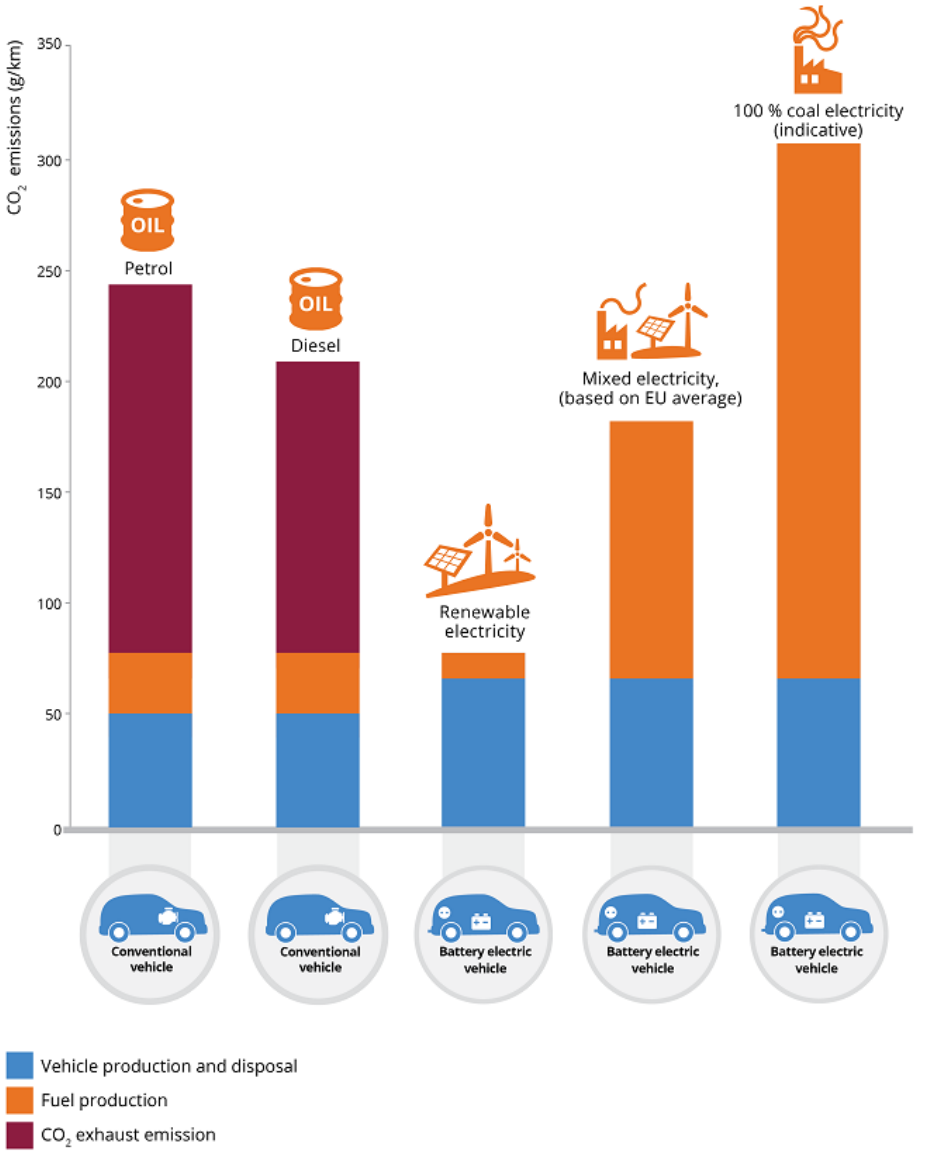
CHALLENGES

WHAT MUST BE SOLVED

HOW GREEN IS IT?

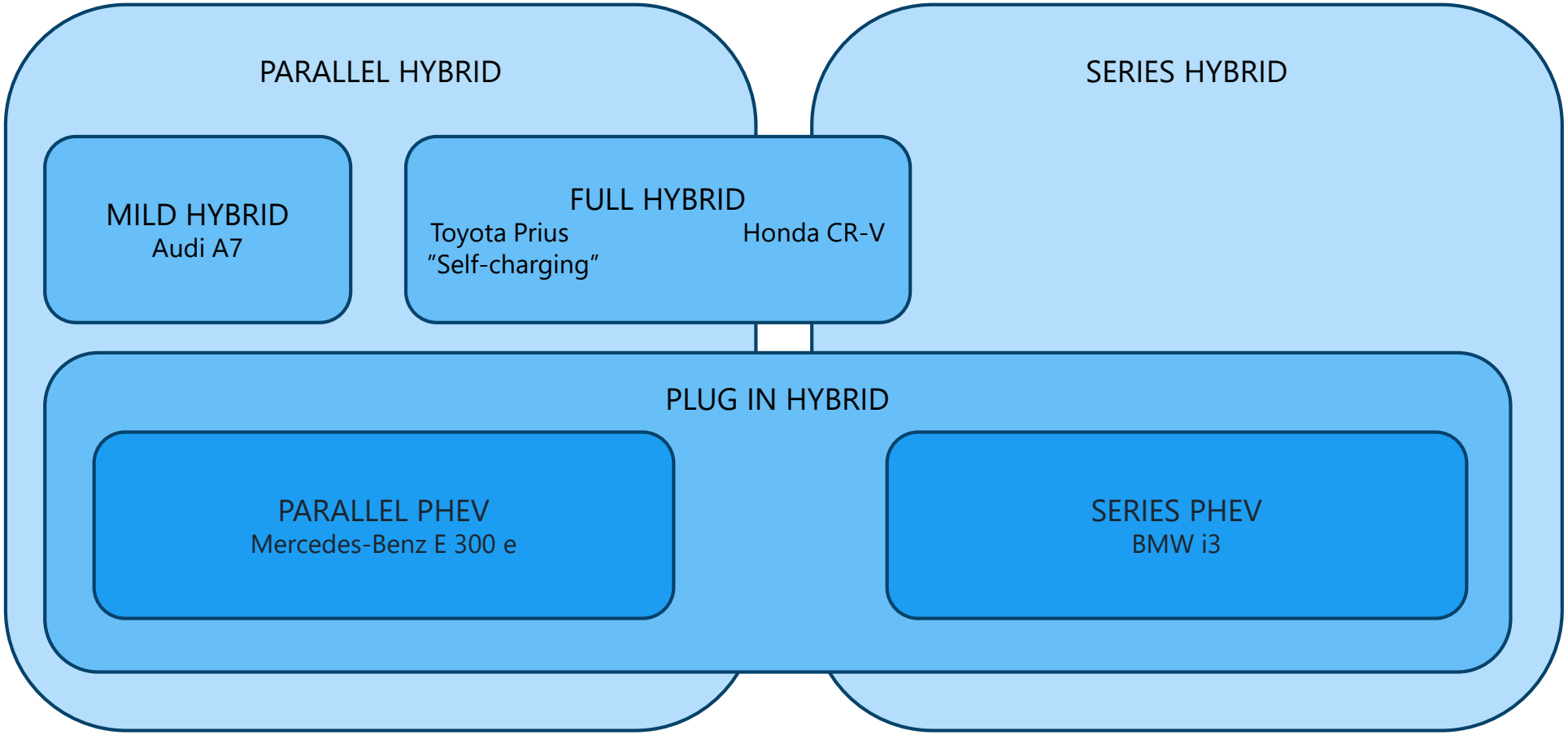
LIFECYCLE CO2 EMISSIONS

- **Lifecycle emissions are hard to estimate**
  - Denmark is different from Poland
  - Manufacturer data not public
  - Technologies are very different (plastic bag vs. paper bag)
  - 2nd life battery usage
  - Recycling is still emerging
- **Typical mistakes (against EVs)**
  - EV = car + battery
  - Percentage of coal is overestimated
  - Recycling data is based on old data
  - Renewables used on battery production neglected
- **Typical mistakes (pro EVs)**
  - Renewables considered zero polluting
  - Skip recycling and/or manufacturing



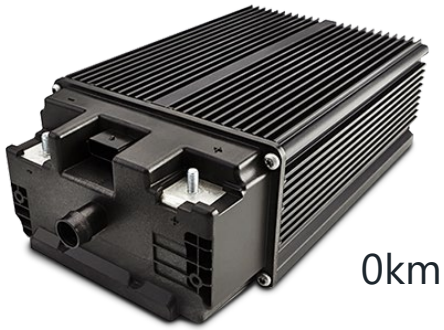
HYBRID VEHICLE TECHNOLOGIES

HEV COMPARISON



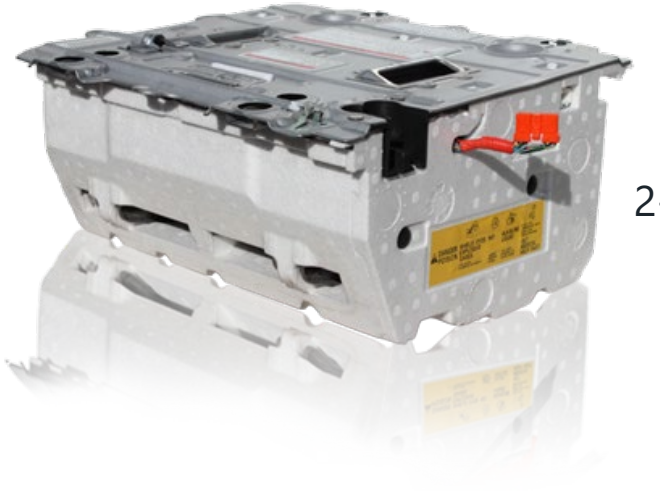
BATTERIES

FROM MILD HYBRID TO FULL EV



0km

200-400km



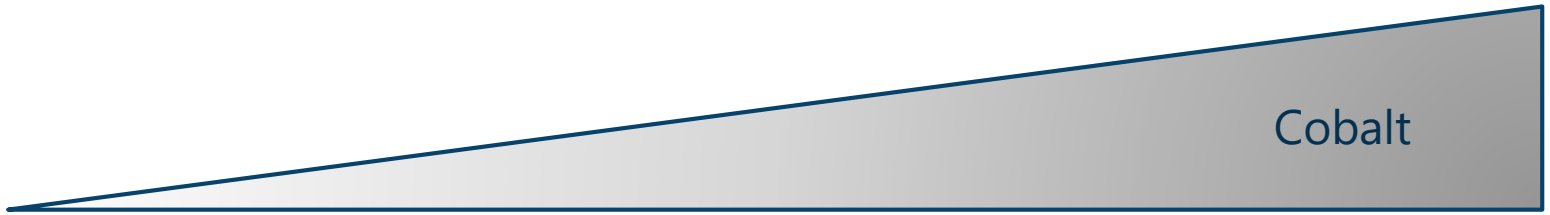
2-4km

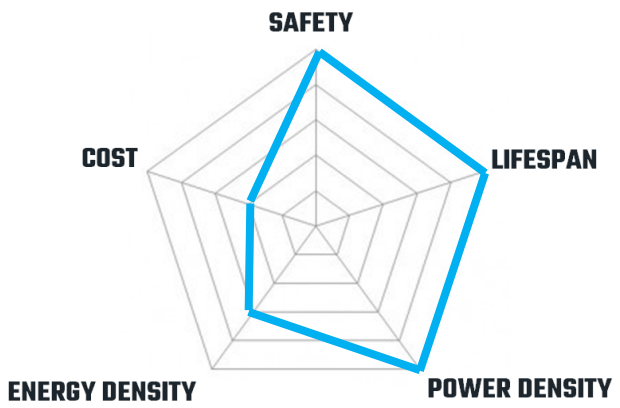
20-40km

BATTERY CHEMISTRIES

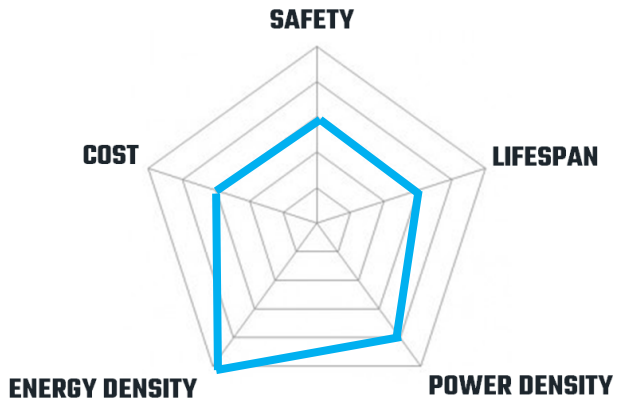
OVERVIEW

- Material availability
- Ethicalness
- Manufacturability
- Recycling

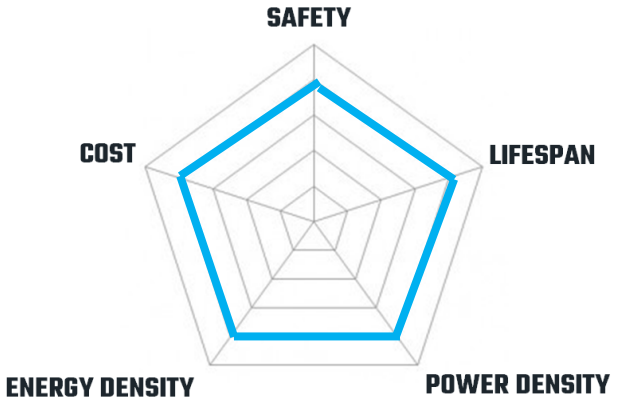




LTO



NCA



NMC

BATTERY LIFETIME

LIMITATIONS & HOW TO MAXIMIZE

Kills the battery

- Fast charging
- Cold charging
- Full cycles
- Harsh temperatures

EV Express 150 kW
can charge a GM Bolt
in 24 minutes

”Cannot kill the battery” -Metallica

- Slow charging
- Charging when warm
- 25-75% State of charge
- Steady temperatures

BATTERY SWAPPING VS CHARGING

COMPARISON

Swapping

Possibilities

- No fast charging
- No waiting
- No range anxiety

Issues

- Investment costs
  - Storage, robotics?
- Standardization
- Safety
- Cost

Charging

Possibilities

- Low investments
- Infrastructure ready
- Low standardization

Issues

- Need for fast charging
- Waiting
- Range anxiety

COLD BEHAVIOR

- ICE
  - Starting battery might ”die”
  - Lubrication not sufficient
- EV
  - Battery will not die
  - Capacity and power will decrease
  - Motor will work
- Both might suffer from other failures, like electronics and measurements

ELECTRIC GRID INTERACTION

THREATS AND OPPORTUNITIES

- ”Charging at 5pm”
- Grid buffering
  - Charge when cheap
  - Sell your capacity
  - Microgrids
  - 2nd life usage

CONCLUSIONS
=OPINIONS

- Future or not? Definitely future.
- Will everyone drive EVs soon? Hardly, nor is it necessary. Many will, maybe most.
- When are EVs competitive in cost? Sooner than most estimate.
- Are all issues solved soon? Many are getting better all the time, but all are not solved.
- Are future batteries safe, fast charging, energy dense, power dense and cheap? Not for a long time.
- Incentives or force? Incentives, always.
- Fuel cells, hybrids, full electric, bio diesel or better gasoline cars? All of them.

CONTACT

Mika Kauppila
Manager, sustainable energy solutions
Product development

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THE FAST LANE TO FUTURE VEHICLES
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