ELECTRIC AND HYBRID VEHILCES

Stefan Geyer

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ENVIRONMENT AND ENERGY

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1 Electric Vehicles

1.1 General Information

1.1.1 How does an electric vehicle work?

- Replacing the ICE (Inner combustion engine) with an electric motor
- Replace the fuel tank with a battery or multiple battery cells
- Require charging from special charging stations
    - Can be installed at home
    - There are stations similar to standard gas stations

BEV
(Battery Electric Vehicle)

1.1.2 Advantages

- No exhaust or waste is produced while driving
- Motors are quiet and smooth when driving
- Lower costs in certain aspects, because there is no need for gas

1.1.3 Disadvantages

- Production of an electric car also results in a lot of chemical waste in the atmosphere
- Batteries will degrade after 7-8 years and have to be replaced
- Charging stations are very rare and not as simple as gas stations
- Charging can take up to 12 hours

1.2 Economics

- Price
  - Electric cars cost around 30.000$
  - More expensive than regular cars
    - That is because the driver does not pay for gas
  - Higher end electric cars can cost up to 100.000$
- Maintenance
  - New batteries cost around 10.000$
  - Besides that there are hardly any maintenance costs
- Running costs
  - Costs of charging depend on the price per kWh of electricity
    - Some cars are estimated to cost about 600$ per year for charging
      - Regular cars have fuel costs of 2.300$ per year

2 Hybrid Vehicles

2.1 General information

- Hybrid vehicles use two or more power sources to move itself
- Term commonly refers to hybrid electric vehicles
  - Combine an inner combustion engine and one or more electric motors
- A hybrid is a compromise
  - Significant increase in the range of an electric vehicle
  - Reduces the emissions of a gas-powered vehicle
- Power sources for hybrid vehicles include
  - Electricity (and a rechargeable energy storage system)
  - Petrol or Diesel fuel
  - Solar, Wind
  - Coal, Wood for combustion

2.2 Engines

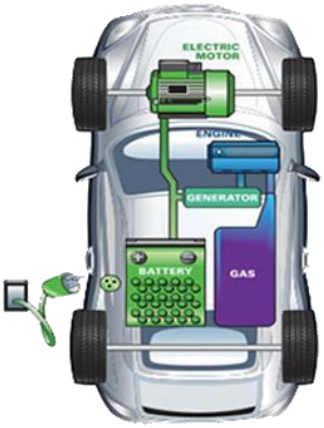
- Hybrid Electric Petroleum Vehicles use
  - Inner combustion engines
    - Usually gas or Diesel engines
  - Electric batteries to power the vehicle
- Batteries can be recharged while the user drives
- Hybrid fuel engines
  - can switch between
    - an onboard diesel engine
    - electric engine
      - Can act as an engine
        - Accelerate the car using energy from the batteries
      - Can act as a generator
        - Can slow down the car and return energy to the batteries
      - Batteries are designed for this concept

- Electric engines can put and draw energy from the storage device

2.3 Types of hybrid vehicles

2.3.1 Series hybrid electric vehicle

- Simplest configuration
- Electric motor is the only way of powering the wheels
  - Motor receives power from
    - Battery pack
    - Generator run by the gasoline engine
  - Computer program decides how much power comes from the battery or the generator
- Perform best during stop-and-go traffic
  - Gasoline engines are inefficient for that
  - The computer can decide to power the motor from the batteries only
    - Saving the gas-engine for situations where its more efficient
- Gas-engine is usually smaller in a series vehicle
  - Only has to produce power for the electric motor
  - Therefore the battery pack is more powerful than in parallel vehicles
    - In order to provide a lot of power
- Because of the larger battery and electric motor and the generator a series hybrid is more expensive than a parallel hybrid



Series PHEV
(Series Plug-In Hybrid Electric Vehicle)

2.3.2 Parallel hybrid electric vehicle

- Gas-engine and the electric motor work together to provide power for the wheels
- Usually use a smaller battery pack than series hybrids
    - Because baking recharges the battery
- When power demands are low the electric motor is used as a generator for recharging
    - Rotation provided by the gas engine is used
- Due to the engine being connected to the wheels
    - Mechanic power (by the gas-engine) does not need to be converted to electrical power
    - And afterwards converted back into rotation (motor)

Parallel PHEV
(Parallel Plug-In Hybrid Electric Vehicle)

2.3.3 Series / parallel hybrid electric vehicle

- Merges both systems
- Gas-engine can
    - drive the wheels directly
    - be disconnected, so only the electric motor provides the power (series)
- Because the gas-only and electric-only options are available
    - System operates at near optimum efficiency more often
    - Lower speed: Series vehicle
    - Higher speed: engine takes over and minimizes energy losses
- More expensive than a pure parallel hybrid because it requires
    - Generator
    - Large battery pack
    - More computing power (for the dual system)
- Yet the series / parallel hybrid is very effective and uses less fuel than the other types

3 Sources

https://plugndrive.ca/whats-the-difference-between-electric-cars-and-hybrids
http://www.ucsusa.org/clean-vehicles/electric-vehicles/series-vs-parallel-drivetrains
https://en.wikipedia.org/wiki/Electric_car
https://en.wikipedia.org/wiki/Hybrid_vehicle