

Electric Vehicles - Unplugged



Part 2 – Green on the road, but Grey in the factory?

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1. Recap from Last Time

Last time

Looked at pros and cons of owning and driving an Electric Vehicle (EV)

In summary

- Zero emissions
- Cheaper to service and maintain
- Much cheaper to run per mile, but only if charging at home.
- Quiet
- Responsive - quick from a standing start!
- More expensive to insure
- Very expensive to charge at public chargepoints

This time

Look at the green credentials **before** and **after** an EV takes to the road.

The Lifecycle of an EV



2. Raw materials

Used in
batteries
and motors



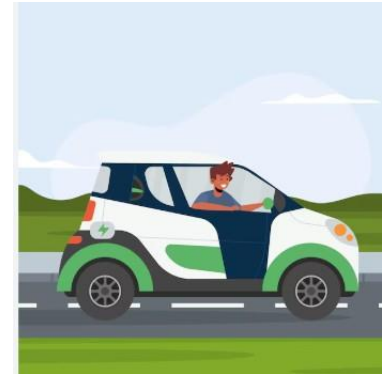
3. Manufacturing



**4. Upstream
emissions**



During



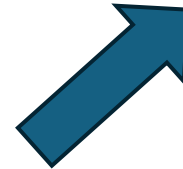
1. On the road



Before



After



Recovery



Re-purpose



5. Recycling

2. Critical Raw Materials for Lithium-ion Batteries

Includes Lithium, Cobalt, Nickel, Graphite
(NB. These are **NOT** “Rare Earth Metals”)

Relatively abundant, but difficult to extract and refine.

Extraction processes include acid leaching, chemical solvents

Associated problems include:

- **Contamination** – toxic waste, water contamination
- **Human rights concerns** (hazardous chemicals, working conditions)
- **Groundwater** - Massive amounts used in lithium mining . So less is available for farming etc
- **Greenhouse gas emissions** – from mining itself and transport to battery factories
- **Land degradation** - scar the landscape and disrupt ecosystems



2. Critical Raw Materials (Batteries)

What can be done to reduce the environmental impact?

- **The industry needs strong regulation to ensure :**
 - Safer leaching methods, including bioleaching
 - Rehabilitation of mined land (including monitoring and long-term management)
 - Treatment of waste water – closed-loop systems, remove impurities
 - Enforce the recovery of Lithium from old batteries (50%+ is recoverable)
- **Battery technology is advancing – less reliance on CRMs, particularly Lithium**
 - eg Sodium-ion - safer and last longer than Li batteries (but can't store as much energy)

2. Critical Raw Materials

.... Compare with the environmental impact of Oil Drilling/Refining

- **Air Pollution** – greenhouse gases, VOCs, flaring emissions
- **Water Pollution** - oil spills, damaged pipelines, produced water
- **Soil and Land Damage** – oil spills, leaks, waste ponds
- **Habitat Damage** - Marine life, the Arctic, rainforests
 - Roads, pipelines, refineries – all impact wildlife.
- **Fracking** - millions of gallons of water, mixed with chemicals / run-off
 - Produced water = Drilling brings up water mixed with oil and other contaminants.*



3. Manufacturing (Electric Motors)

Critical Raw Materials and CO2 Emissions

A) Rare Earth Elements

- used in manufacture of electric motors.
- Crucial for many technologies, not just motors (permanent magnets)

3. Manufacturing (Electric Motors)

Rare Earths in Technology



3. Manufacturing (Electric Motors)

Critical Raw Materials and CO2 Emissions

A) Rare Earth Elements

- used in manufacture of electric motors.
- Crucial for many technologies, not just motors (permanent magnets)
- .
- Same environmental and humanitarian concerns, as for Lithium etc
 - China dominates mining and processing (95%)
 - Environmentally and economically dangerous.



La Rochelle, France

Ways forward:

- Supply needs to be diversified, away from China, with robust regulation.
- Huge refinery being built in France. Aiming to supply 30% of Europe's needs by 2030.
- Solvay will also be able to recover rare earths from end-of-life technology (not just cars)

3. Manufacturing



B) CO2 emissions

- The production of a mid-sized EV creates approx. **10 tons** CO2
- A similar petrol/diesel car creates “only” **6 tons** CO2
- Primary cause = the batteries
- Most battery factories are in China, S. Korea, Japan - powered by fossil-fuel power stations.

Ways forward:

- Battery-producing countries are moving towards renewables.
- Technology : smaller batteries → smaller carbon footprint
- Car manufacturers need to push for cleaner supply chains.

4. Upstream Emissions

The carbon emissions created by the supply of fuel/power for vehicles

Petrol/Diesel - from drilling, refining and transporting.

Electricity - from power stations using gas, coal or renewables



Globally, electricity production is twice as dirty as refining petrol.

Worst offenders are China and Russia - coal-fired power stations

Ways forward:

- Home charging – use of solar panels or green electricity tariffs.
- Many countries are moving towards renewables
- Sadly, some countries are going backwards



5. Battery and Motor Recycling

Up to 95% of key materials can be recovered, which means:

- Less mining
- Lower costs through re-use of materials
- Less waste into landfills and incinerators

BUT

- Recovery processes are energy intensive and generate emissions.

Ways Forward

- Manufacturers need to design EVs to make component recovery easier.
- More battery recycling plants using efficient, cleaner methods for recovering metals.
- More plants like Solvay to recover rare-earths. Japan leading the way.
- **Legislation**
 - Europe and UK – it is illegal to incinerate EV batteries or send to landfill.
 - Manufacturers are required by law to recover and recycle.



5. Battery Re-purposing (second life)

Old EV batteries generally have 60 – 80% of their original capacity left. Can be re-purposed and given a “second life”. 3 main uses are

1. To store off-peak electricity

- Businesses can store cheap electricity and use it during peak rates.

2. To store electricity from renewable sources eg solar and wind

- Home and Commercial use – store power for later use or during power outages

3. Backup Power

- Used in data centres and hospitals etc – as emergency power backup.
- Batteries can kick in instantly – whilst back-up generators start up



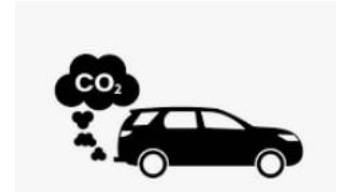
How many? A mid-size storage unit for up to 500kw/h would need about 15 EV batteries.

7. Summing Up – So how green are EVs?

The usual metric for “greenness” is **Carbon Emissions**.

By the time a vehicle comes off the production line:

- An EV - has already produced the bulk of its lifetime emissions
- An ICE car - its exhaust emissions are only just beginning.
- EVs break even within about 2 years of driving.



Over full lifecycle,

- Medium-sized petrol car produces **24** tons CO2 over its life.
 - Equivalent battery EV produces **18** tons
- (Auto Express 2022)*

But, it's not just about carbon emissions

- How green are EVs taking everything else into account?
- E.g. Oil v Lithium Mining

One is burned, the other is partially recyclable – which is worse for the environment?