

Solar Powered Car: Viability and Application

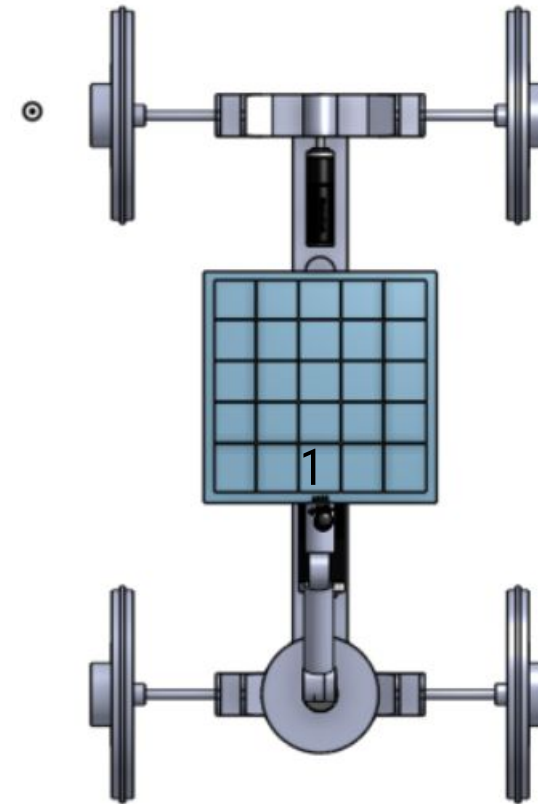
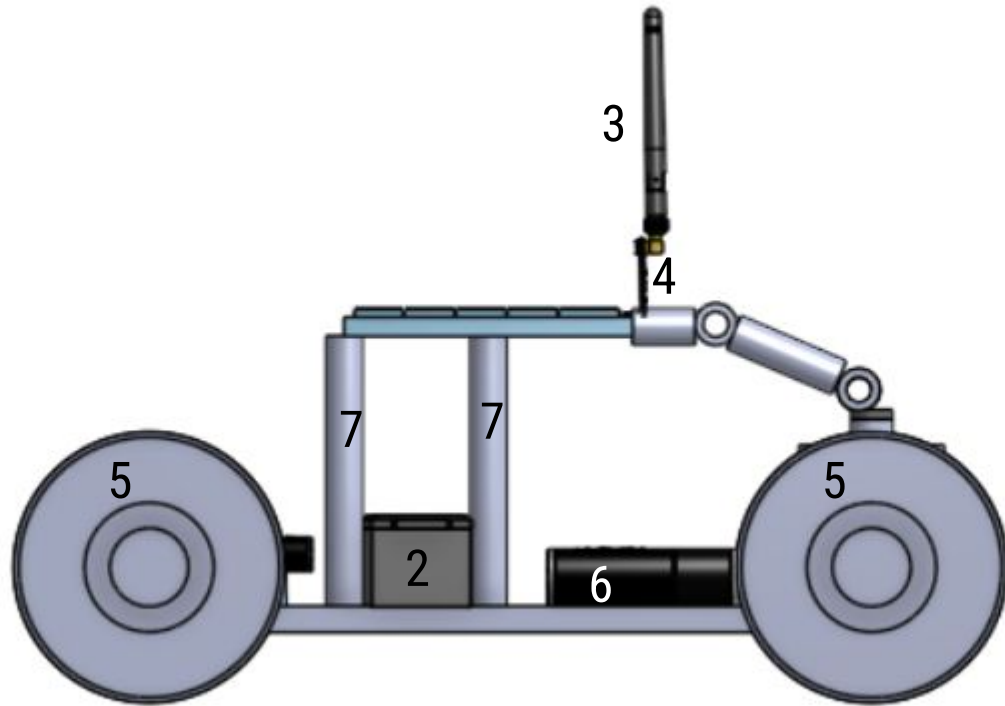
- Section 1 - Concept and Design - Modelling
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Concept and Design - Modelling

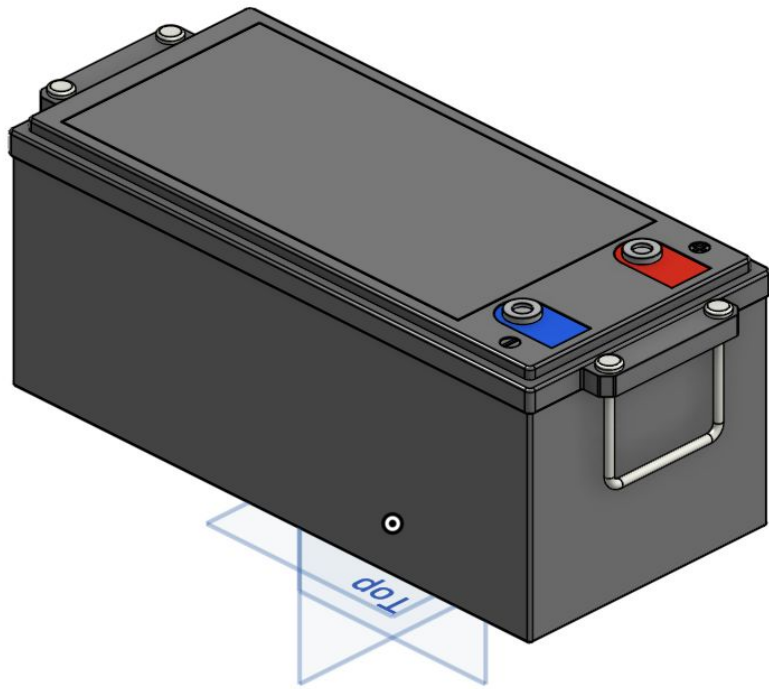
Cad Model Components - Solar Powered Car Small Scale Internal Model

- 1) 400 square inch solar paneling
- 2) Solar-compatible rechargeable battery
- 3) Radio antenna receiver
- 4) Microcontroller
- 5) Main chassis, wheels, and axles
- 6) Brushless DC motor
- 7) Solar panel supports
- 8) Internal wiring

Cad Model



Cad Model Individual Components



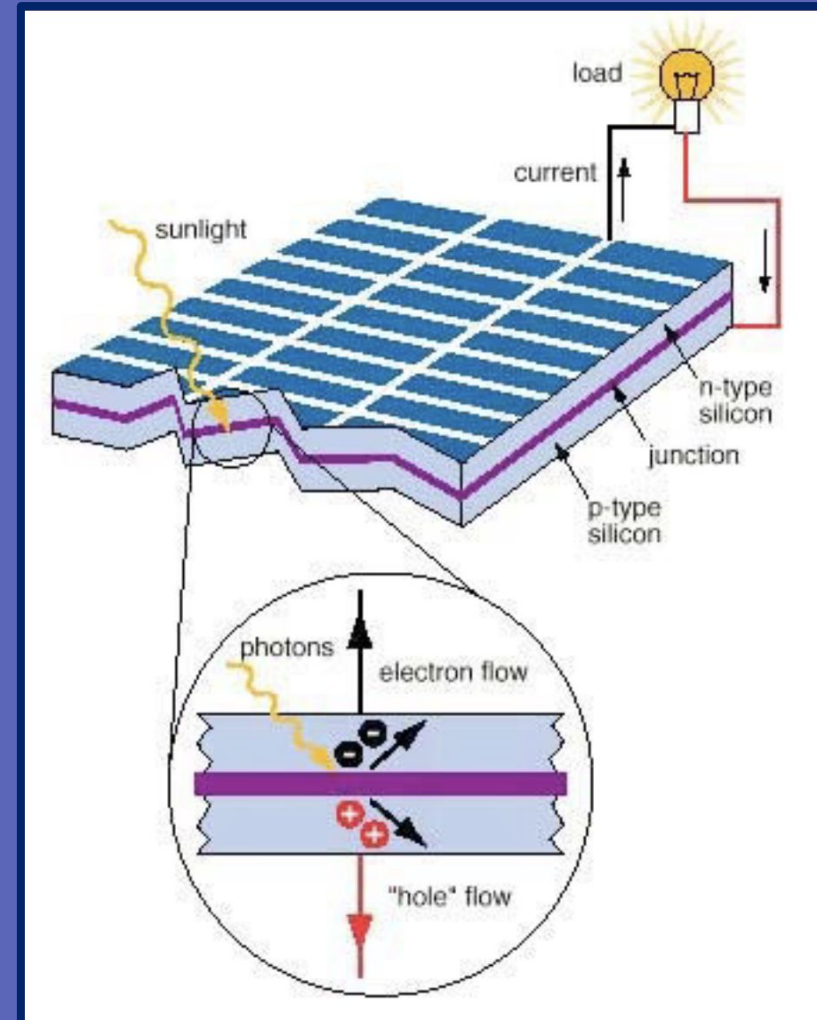
Viability - Class Concepts and Solar Science

Scientific Principles

Through the **photovoltaic effect**, **photons** that hit the a solar cell **increase the energy of electrons** such that the electrons move from the **valence band** to the **conduction band**, creating a **voltage** between the two electrodes attached.

Thus, the **energy transfer process** is as such:

- solar energy → flow of electrons → electrical energy
(in our case, to be used in an electric motor)

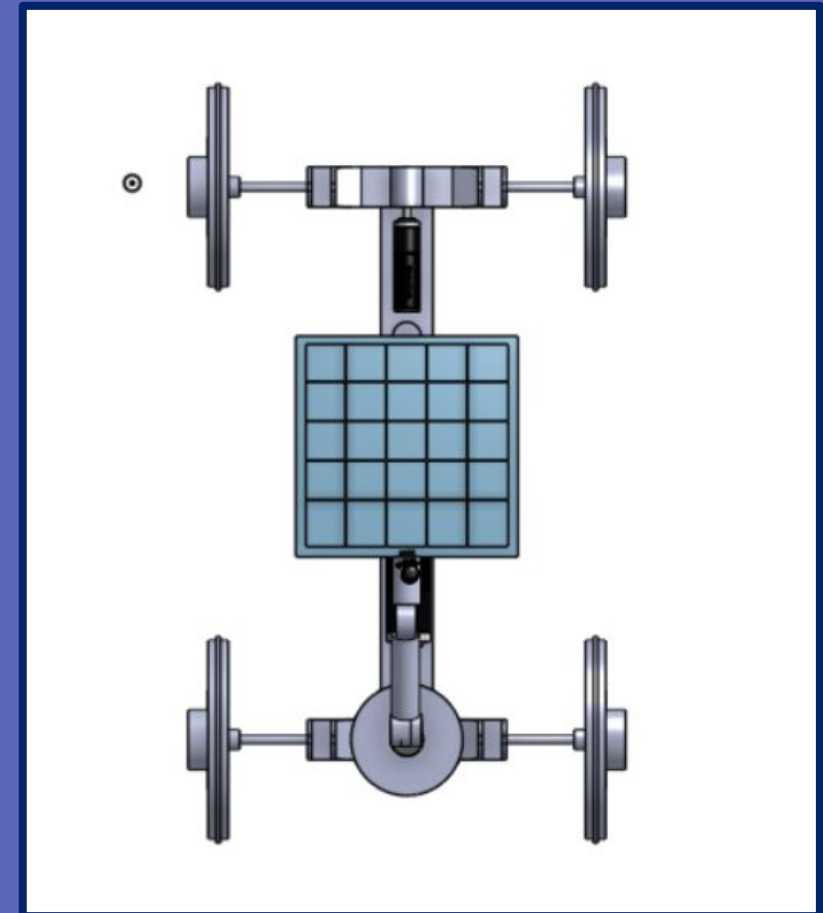


Technological Limitations

The average **energy density** of **commercially available** solar panels is **180–220 W/m²**, and it would take about **17–20 kWh/100 km** to power the vehicle **only on solar energy**.

For our model, the **surface area** (top-down “solar area”) is **10 m²**. Assuming **200 W/m²** and **10 m²** of surface area, the solar output would be **1000 W** under **full sun**. If left charging for **5 hours**, it would generate **10 kWh/day**.

A typical **round-trip efficiency** of a **well-designed** lithium solar battery system is about **80–90%**, meaning **10-20% of the energy is lost** from the panel to usable power via the battery system, lowering our estimate on the car’s ability to generate electricity to **8-9 kWh/day**.



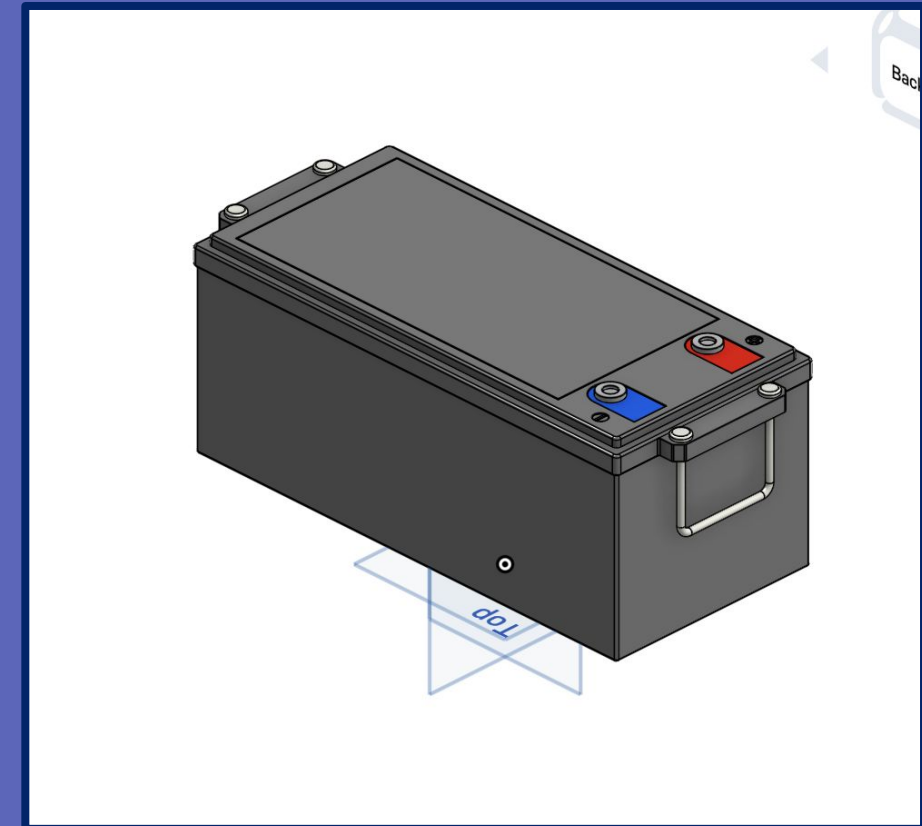
Cost and Materials Analysis

Necessary components: **solar panels**, **battery**, and **motor**.

The **solar panels** need to be both **durable** and **flexible**. The panel **cost/m²** ranges from **\$200–\$300** (prices from companies **SunPower**, **Maxeon**, and **Renogy**), so for our model with a surface area of **10 m²**, the cost would be **\$2000–\$3000**.

Battery costs depend on the **capacity**:

- Assuming **30–60 kWh**
- **30 kWh:**
 - estimated range of **150–200 km**
 - **\$3,600–\$4,500** for **\$120–\$150/kWh**
- **60 kWh:**
 - estimated range of **300–400 km**
 - **\$7,200–\$9,000** for **\$120–\$150/kWh**



Cost and Materials Analysis (cont.)

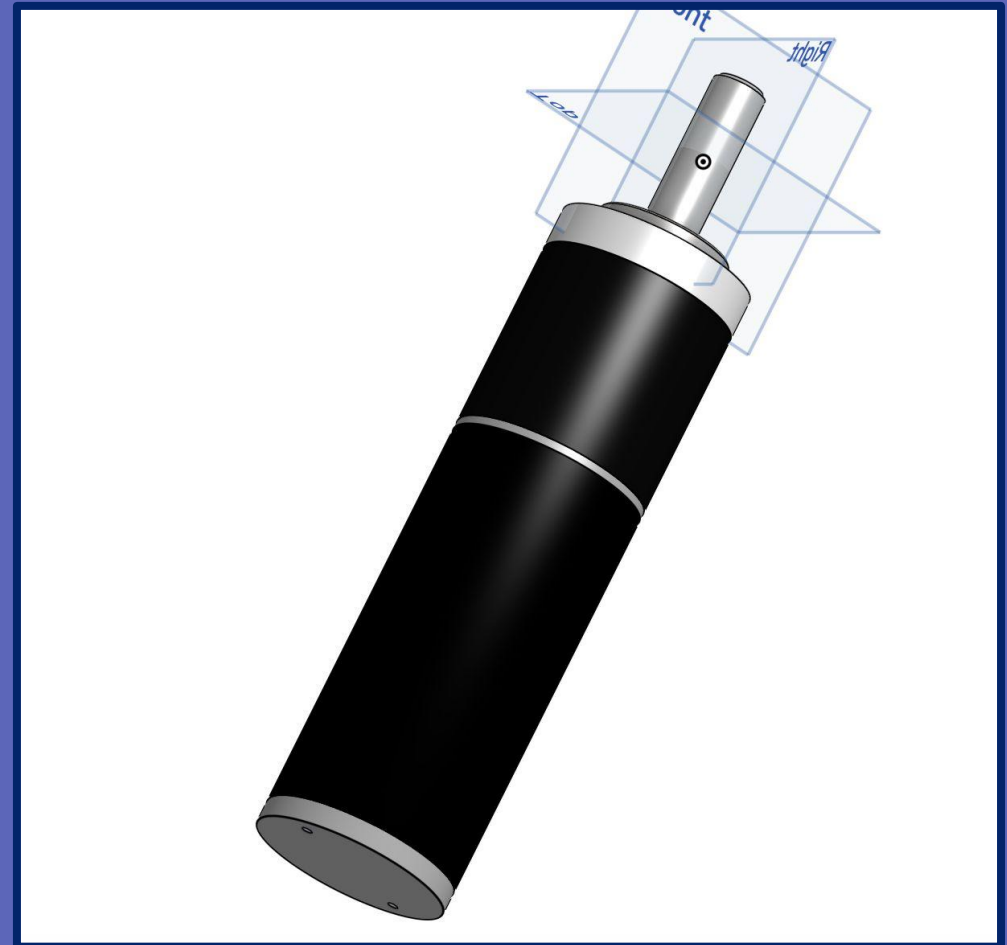
Motor **costs** depend on the **type**. The two types of motors serviceable for EVs are **light-duty DIY systems** or **performance-grade (OEM level)** motors.

A **light-duty motor** would cost between **\$1,500–\$3,000**. A **performance-grade motor** would cost between **\$4,000–\$7,000**.

Total cost of the needed materials (outside of the chassis, wheels, etc.):

- **\$14,700** on the low end
- **\$22,000** on the high end

Depends on the specific components used.

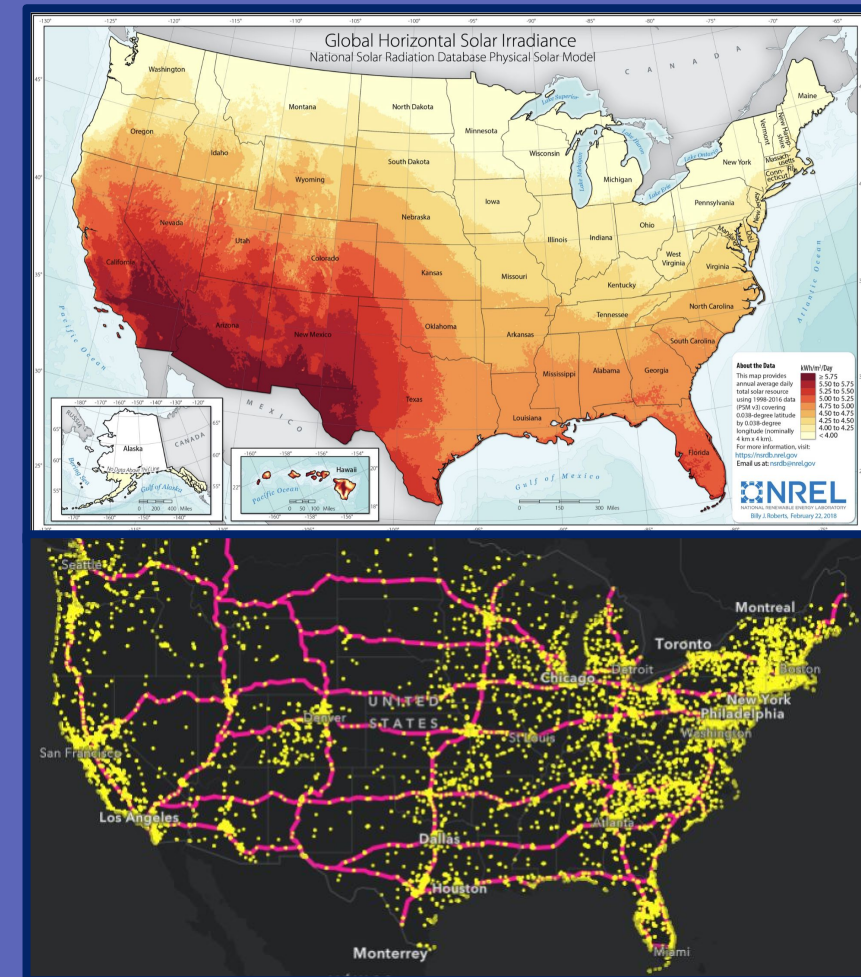


Infrastructure Requirements

General requirements to make a car like this feasible:

- An area with **more than adequate sunlight exposure**
- areas with **current EV infrastructure** to act as **backup charging options** where adequate sunlight is not available

Perhaps the use of solar cells **need not stop at the cars**, but can be used to make **more, smaller-scale solar farms** that act as **charging stations for EVs**.



Competitive Landscape Analysis

Competitive Landscape: Aptera

Aptera: longest-existing market participant

- 700W integrated solar cells, about 40 miles of daily range
- 3-wheel, aero-first design with in-wheel motors
- Price range: \$40,000-\$50,000
- R&D phase over 10 years, production beginning 2026
- Eliminates any kind of stop for charging or refueling

Critical challenges halt progress

- Design optimizes solar capacity, not practicality
- Difficult funding environment, especially climate field
- Battery storage is key issue, adding weight when that is last thing needed
- Market shift away from sustainable cars: e-bikes,



Competitive Landscape: Lightyear

Lightyear: longest-existing market participant

- 782 solar cells over 54 sq ft solar array, in addition to traditional charging, powering 60 kWh battery
- 4-wheel, practical-first design with in-wheel motors
- Price range: \$35,000-\$75,000
- Practical and seats 5, comparable to Civic
- Recorded lowest drag coefficient of 0.175

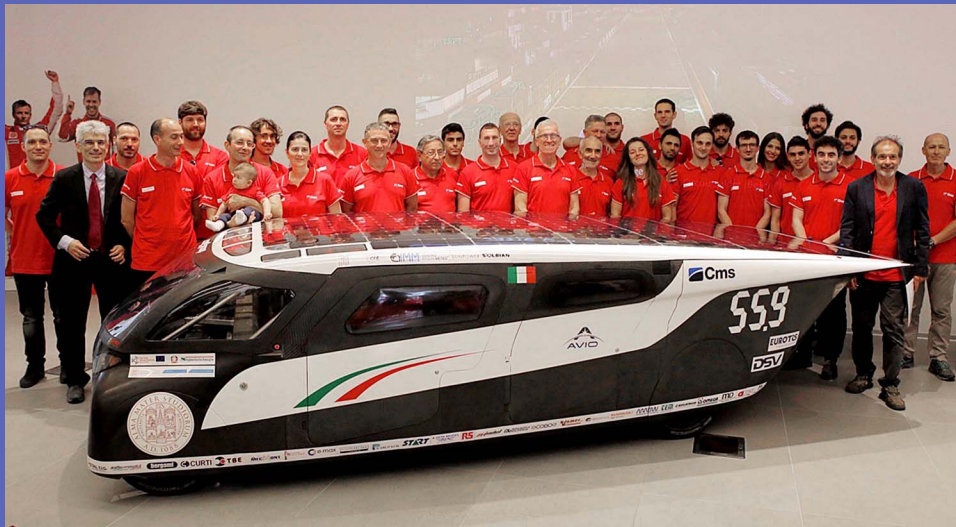
Critical challenges halt progress

- Extremely expensive materials (\$250,000 TC)
- Overly complex system with too many breakdowns
- Real world car & driver test: 4 miles of purely solar range
- Abandoned solar car plans for now, focusing on solar EV charging instead



Lessons Learned for us from Competitive Landscape

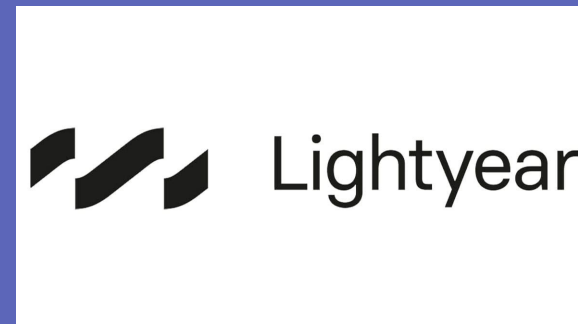
- Maximizing surface area for solar panels lends to impractical vehicle shape
- Solar-powered vehicles are incredibly dependent on weather conditions
- While cost of solar panels are coming down, cost of lightweight materials including carbon fiber and magnesium increase total cost
- A hybrid design, combining solar with traditional EV technology may be more practical
- No major market demand for solar-powered cars. Good news is that we can adapt our solar-powered technology to fit smaller vehicles like golf carts.



Lifecycle Emissions Comparison

Vehicle Manufacturing Emissions

- For Honda Civic:
 - ~5.7 metric tons CO₂ per vehicle (2019 Honda Environmental report)
- For Lightyear 0:
 - Battery Pack (60 kWh): ~ 4.1–4.6 metric tons CO₂
Calculated using a median value of 69–77 kg CO₂ per kWh for battery production (Nature)
 - Solar Panels (5 m²): ~0.5–1.0 metric tons CO₂
Estimated based on emissions of 41 g CO₂ per kWh generated over panel's lifetime (source)
 - Vehicle Manufacturing (excluding battery and solar): ~5.7 metric tons CO₂ Assuming similar to Honda Civic's manufacturing emissions



Operational Emissions

- For Honda Civic:
 - Fuel Efficiency: ~32 mpg (city).
 - Total Fuel Used: 150,000 miles / 32 mpg \approx 4,688 gallons.
 - Combustion CO₂ Emissions: 4,688 gallons * 8.89 kg CO₂/gallon \approx 41.7 metric tons CO₂ (EPA)
 - Upstream Emissions: 4,688 gallons * 1.24 kg CO₂/gallon \approx 5.8 metric tons CO₂ (EPA)
 - Total Operational Emissions: ~47.5 metric tons CO₂
- For Lightyear 0:
 - Energy Consumption: 10.5 kWh per 100 km (62 miles) \approx 0.169 kWh/mile (source)
=> for 150,000 miles: 150,000 miles \times 0.169 kWh/mile \approx 25,350 kWh
 - Assuming 40% solar charging, solar energy required \approx 10,140 kWh
 - Assuming remaining 60% grid charging, energy required \approx 15,210 kWh
 - Assume grid emissions 200g CO₂/kWh=> emissions = 0.2kg/kWh* 15,210 kWh = 3.04 mtCO₂
 - Total Operational Emissions: ~3.0 metric tons CO₂

Summary of Emissions

Category	Honda Civic	Lightyear 0
Manufacturing	~5.7 tCO ₂	~10.3–12.1 tCO ₂
Operation (150k miles)	~47.5 tCO ₂	~3.0–5.3 tCO ₂
Total Emissions	~53.2 tCO ₂	~14.3-17.4CO ₂

While the Lightyear 0 has far higher emissions from manufacturing, the Honda Civic has far greater operational emission due to its internal combustion engine. Overall, the Lightyear 0 has far lower emissions over its life cycle.

Final Evaluation and Group Opinion

Key Takeaways

- RC model proves viability of solar cars in terms of size and space constraints.
- Company focuses on scalability, with tech to better transfer and store solar energy for EV charging
- Material costs are high, but expected to decrease with innovation and manufacturing efficiency.
- Growing EV infrastructure and demand in the U.S. creates opportunity for solar-powered vehicles.
- Current competitive landscape struggles with practical vehicular design while incorporating solar panels
- Market lacks demand and funding for solar-powered cars. Consider applying our technology to solar-powered golf carts, crowd management vehicles, or other small vehicles.
- While solar powered cars have higher manufacturing CO2 emissions, they theoretically emit far less operationally than conventional ICE cars
- However, various practical issues such as weather conditions could greatly impact the emissions calculations

Thank you!

Do you have any questions?

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