Here goes your presentation title.

- Introduction - Project Objective, Team Roles
- Section 1 - Concept and Design - Modelling
- Section 2 - Viability - Class Concepts and Solar Science
- Section 3 - Emissions and Cost Comparison
- Section 4 - Real-World Applications and Case Studies
- Section 5 - Final Evaluation and Group Opinion

Project Objective, Team Roles

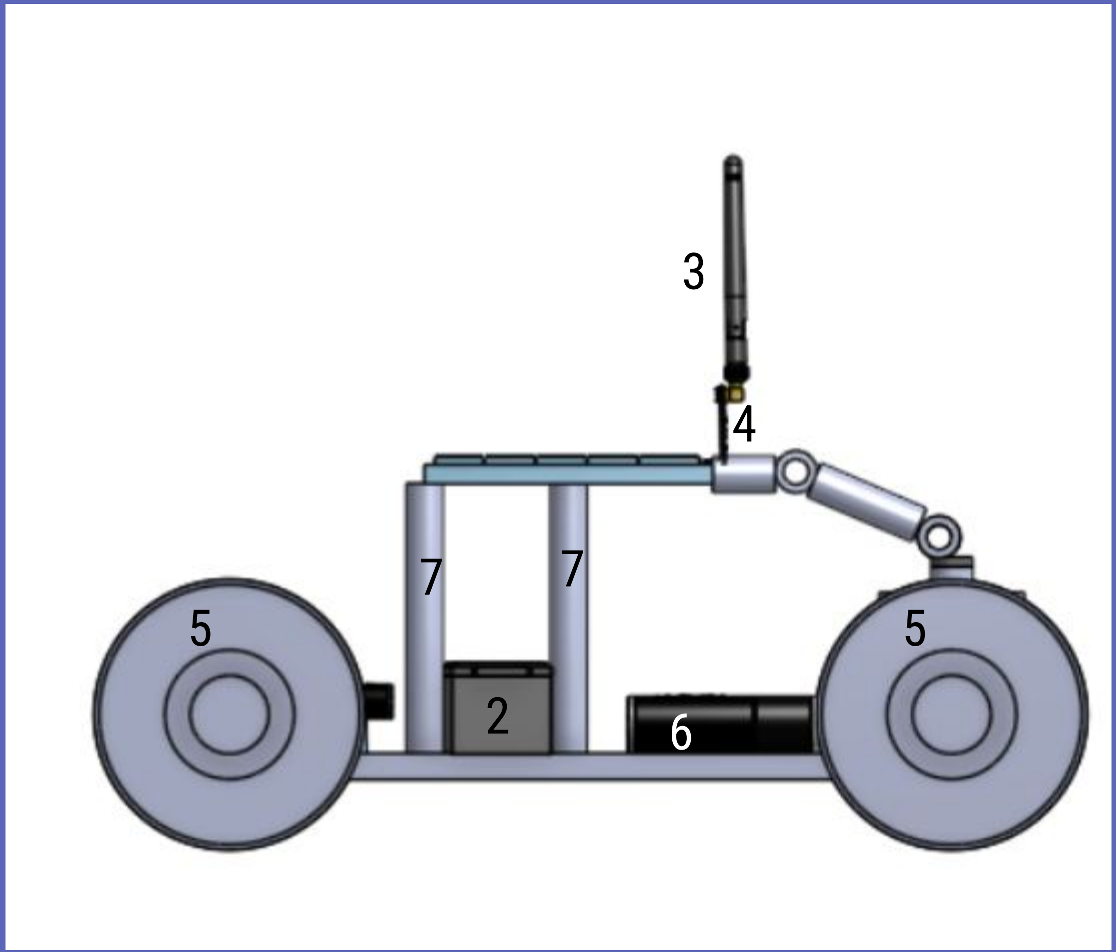
Title

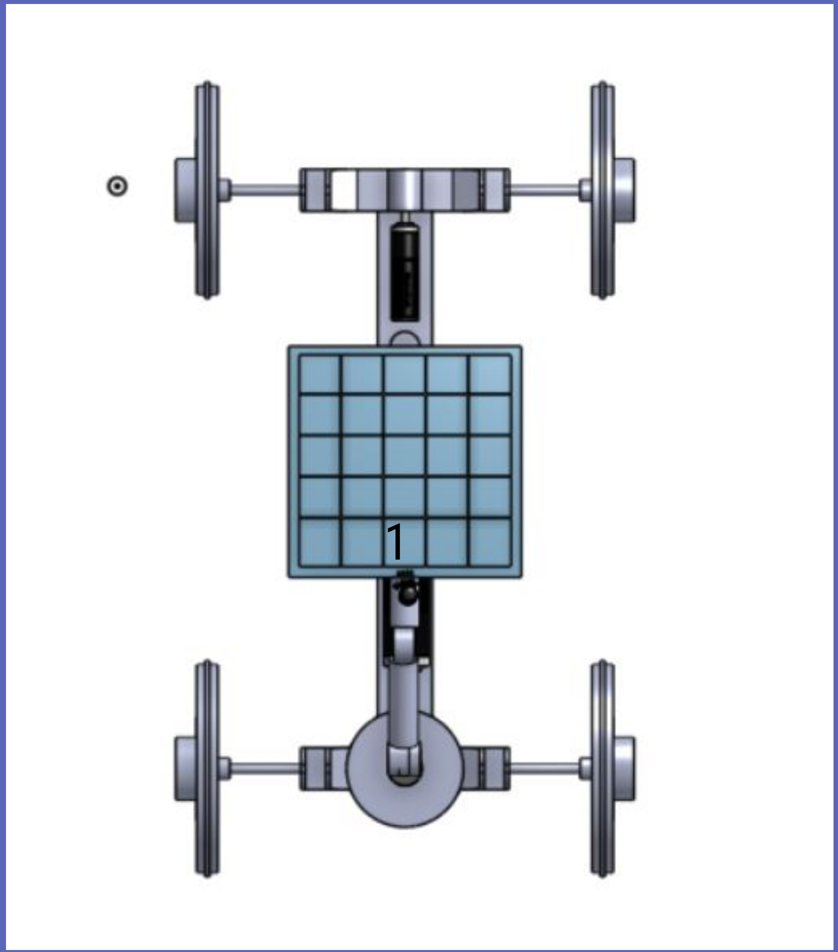
Concept and Design - Modelling

Cad Model Components - Solar Powered Car Small Scale Internal Model

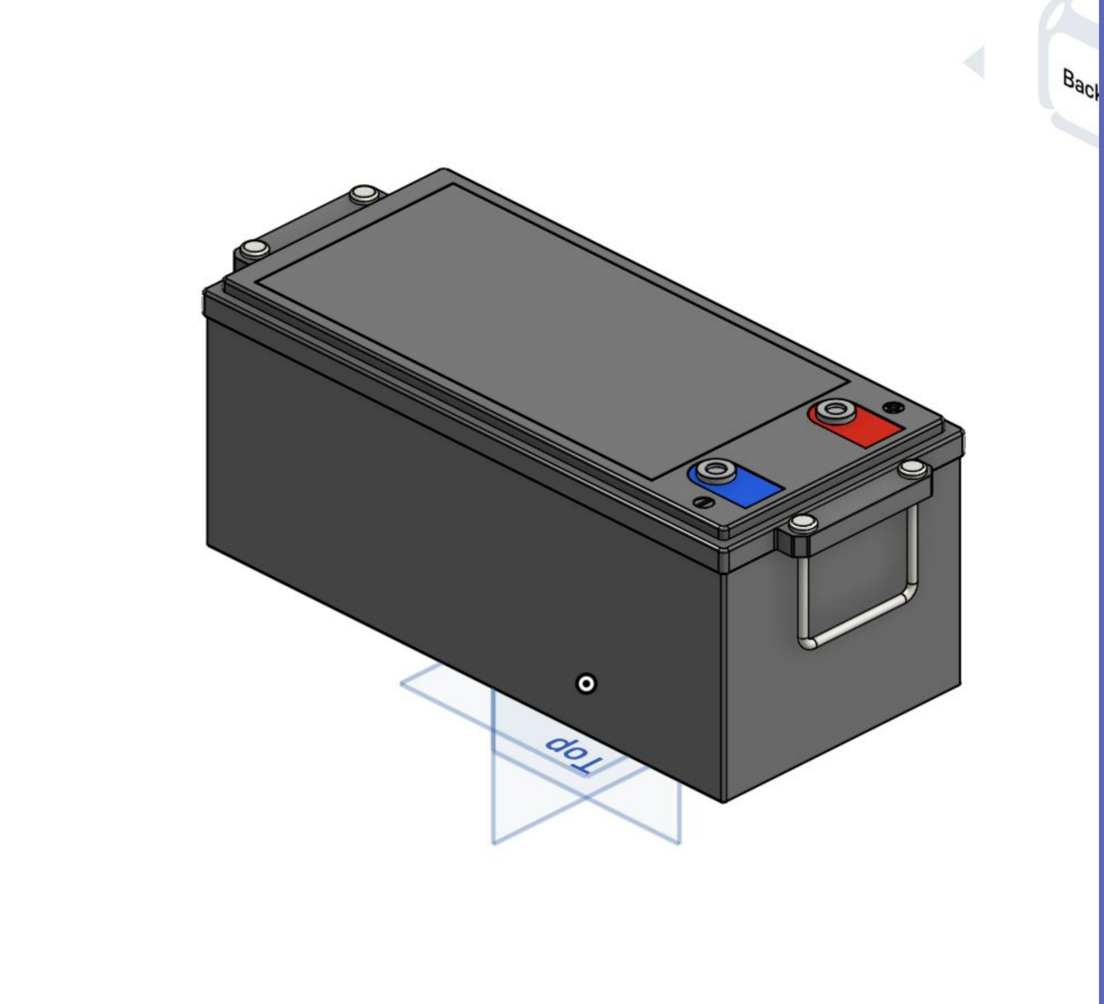
1) 400 square inch solar paneling
2) Solar-compatible rechargeable battery
3) Radio antenna receiver
4) Microcontroller
5) Main chassis, wheels, and axles
6) Brushless DC motor
7) Solar panel supports
8) Internal wiring

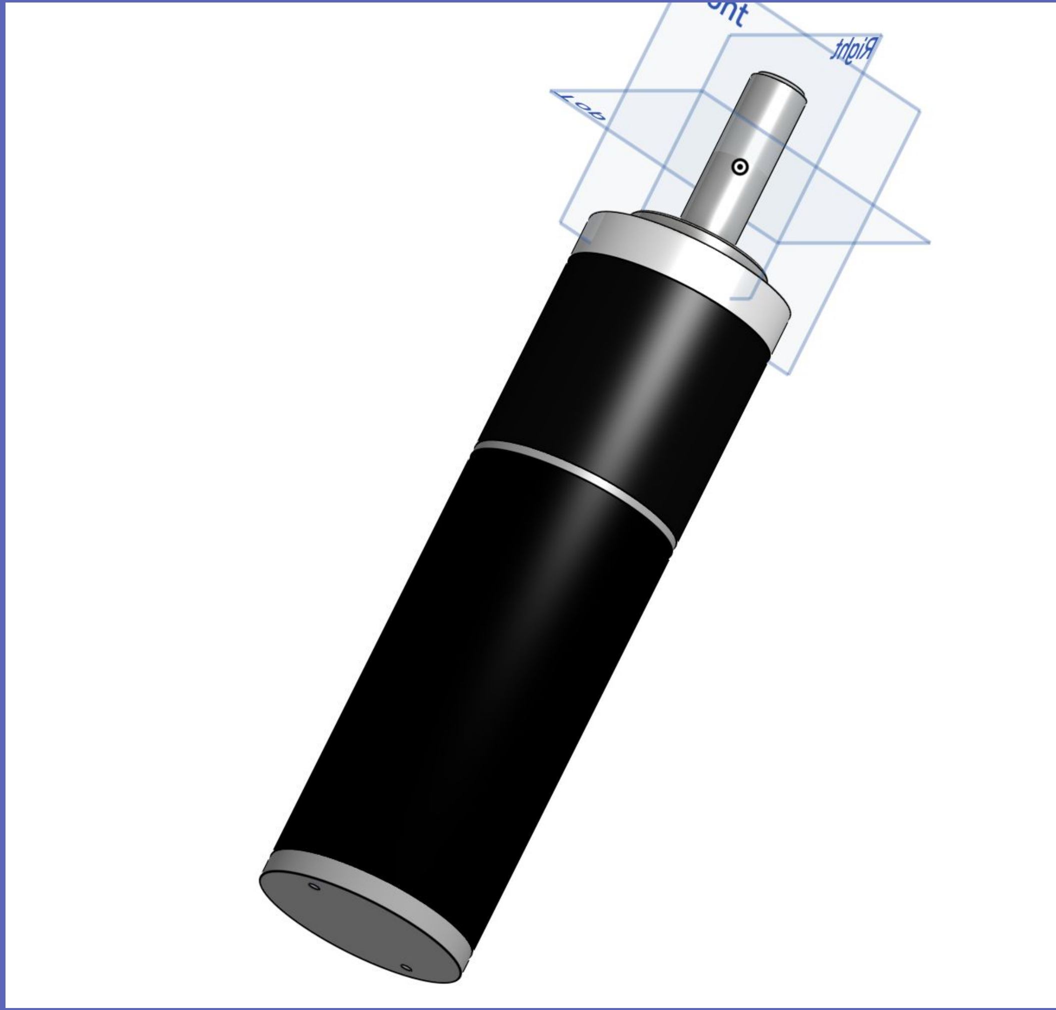
Cad Model





Cad Model Individual Components

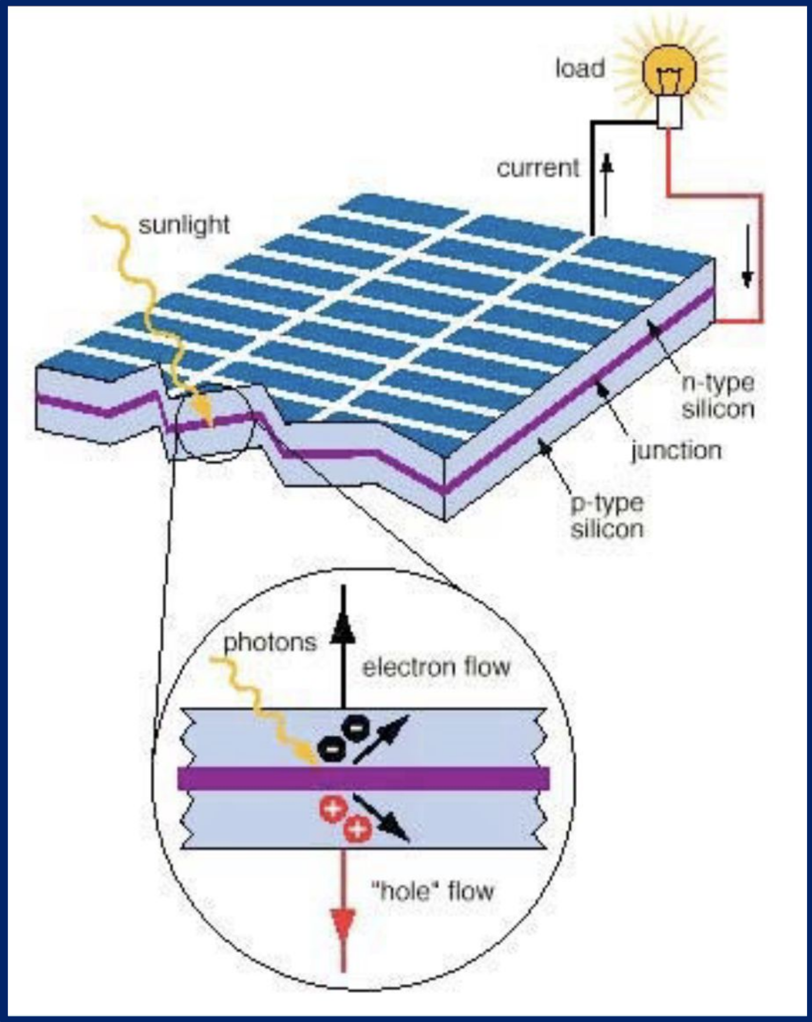




Viability - Class Concepts and Solar Science

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:

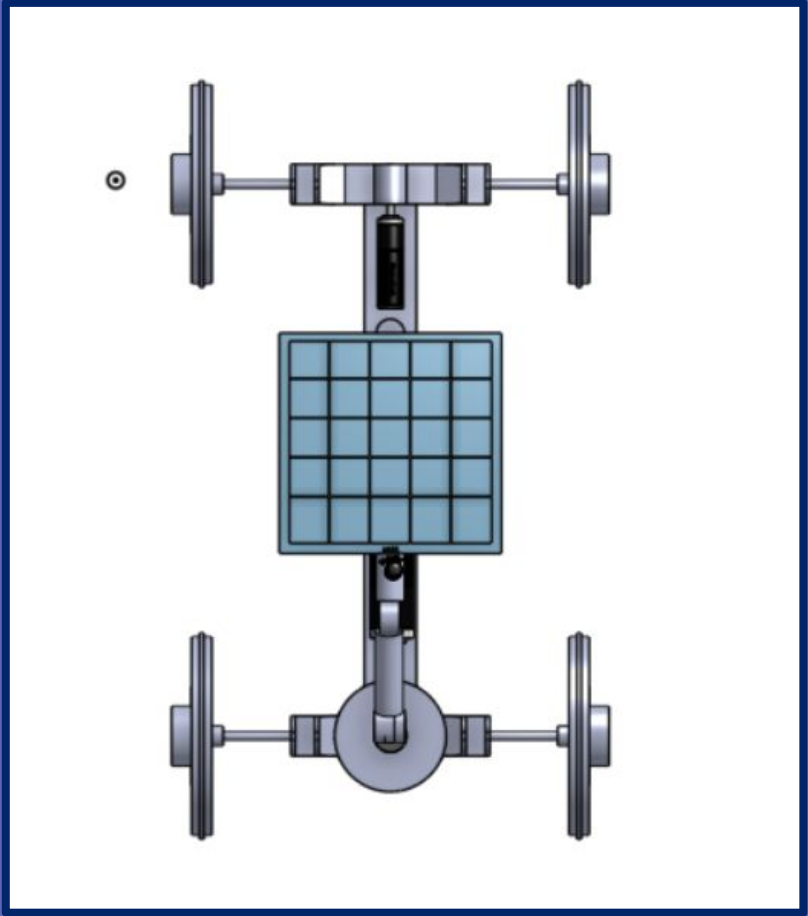
- solar energy → flow of electrons → electrical energy (in our case, to be used in an electric motor)

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**.

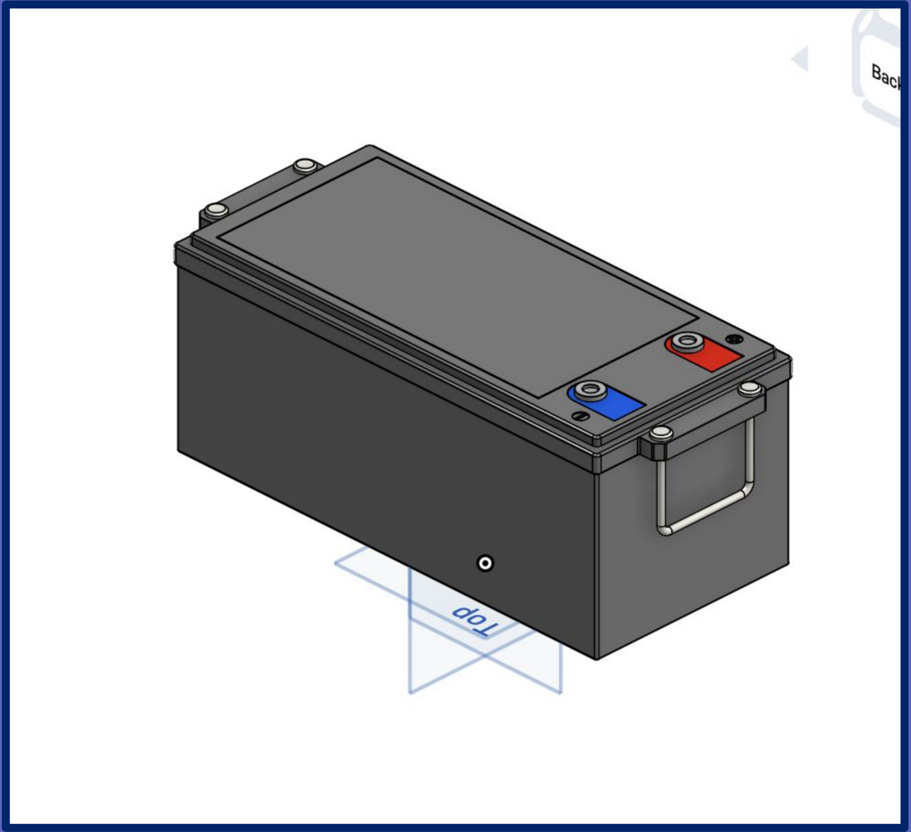
The **solar panels** need to be both **durable** and **flexible**. The panel **cost/m²** ranges from **\$200–\$300** (prices from companies **SunPower**, **Maxeon**, and **Renogy**), so for our model with a surface area of **10 m²**, the cost would be **\$2000–\$3000**.

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.)

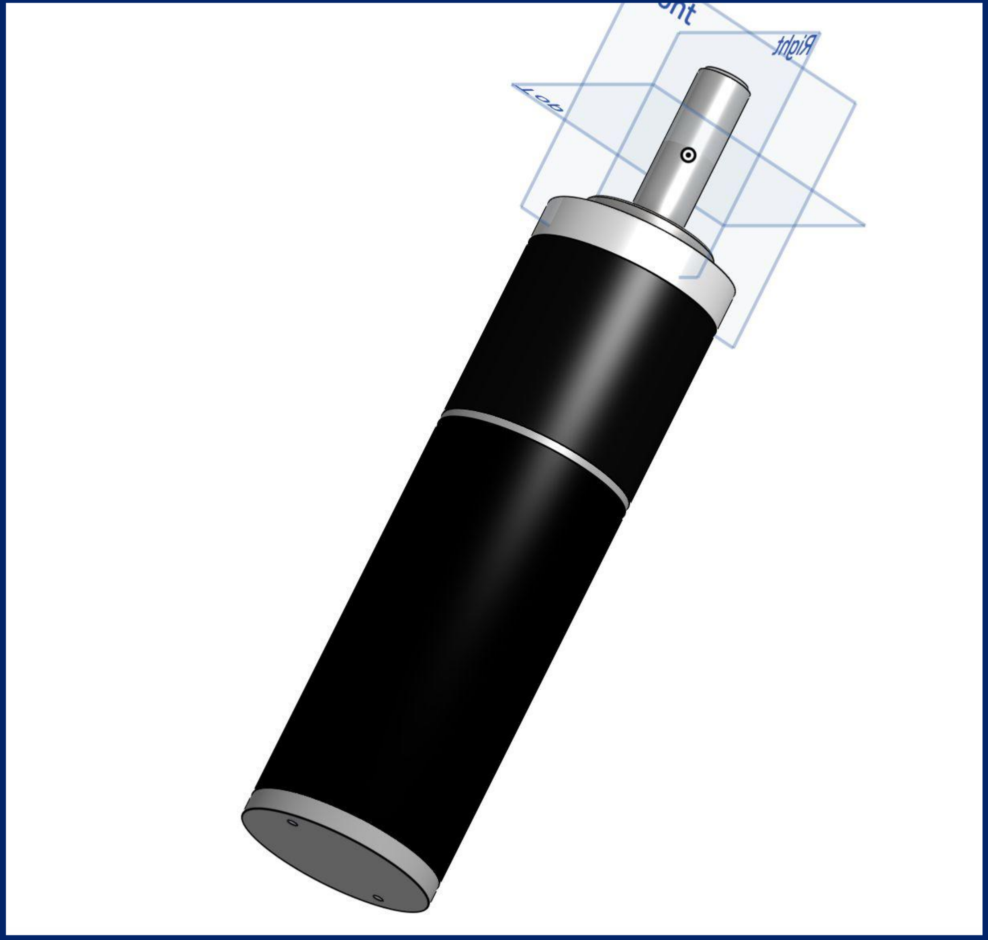
Motor **costs** depend on the **type**. The two types of motors serviceable for EVs are **light-duty DIY systems** or **performance-grade (OEM level)** motors.

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.



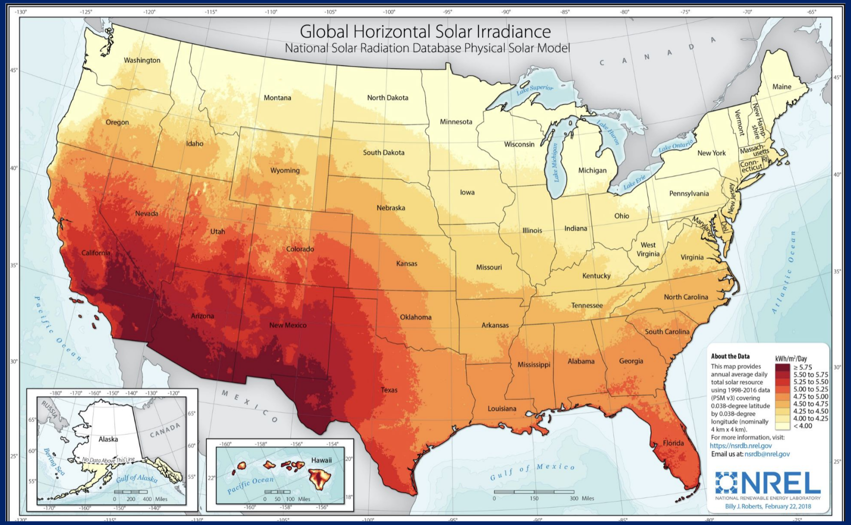
Infrastructure Requirements

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**.



Scaled Emissions and Cost Comparison

Title

Competitive Landscape

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

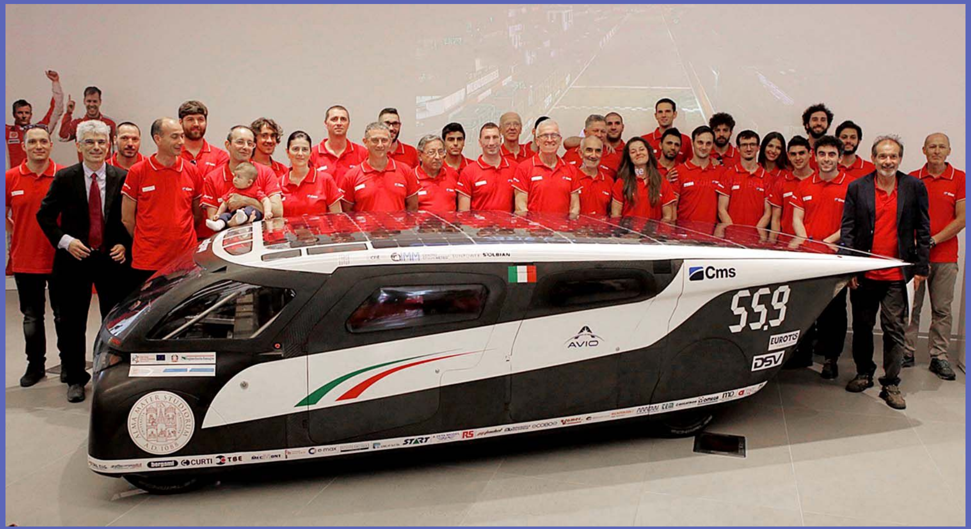
- 782 solar cells over 54 sq ft solar array, in addition to traditional charging, powering 60 kWh battery
- 4-wheel, practical-first design with in-wheel motors
- Price range: $35,000-$75,000
- Practical and seats 5, comparable to Civic
- Recorded lowest drag coefficient of 0.175

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

Key Takeaways 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 costs
- A hybrid design, combining solar with traditional EV technology may be more practical
- No major market demand for solar vehicles



Lifecycle Emissions Comparison

Vehicle Manufacturing Emissions

- For Honda Civic:
  - ~5.7 metric tons CO_2 per vehicle (2019 Honda Environmental report)
- For Lightyear 0:
  - Battery Pack (60 kWh): ~ 4.1–4.6 metric tons CO_2
    Calculated using a median value of 69–77 kg CO_2 per kWh for battery production (Nature)
  - Solar Panels (5 m²): ~0.5–1.0 metric tons CO_2
    Estimated based on emissions of 41 g CO_2 per kWh generated over panel's lifetime (source)
  - Vehicle Manufacturing (excluding battery and solar): ~5.7 metric tons CO_2 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 ≈ 4,688 gallons.
  - Combustion CO_2 Emissions: 4,688 gallons * 8.89 kg CO_2/gallon ≈ 41.7 metric tons CO_2 (EPA)
  - Upstream Emissions: 4,688 gallons * 1.24 kg CO_2/gallon ≈ 5.8 metric tons CO_2 (EPA)
  - Total Operational Emissions: ~47.5 metric tons CO_2
- For Lightyear 0:
  - Energy Consumption: 10.5 kWh per 100 km (62 miles) ≈ 0.169 kWh/mile (source)
    => for 150,000 miles: 150,000 miles × 0.169 kWh/mile ≈ 25,350 kWh.
  - Assuming 40% solar charging, solar energy required ≈ 10,140 kWh.
  - Assuming remaining 60% grid charging, energy required ≈ 15,210 kWh.
  - Assuming grid emissions 200 g CO_2e per kWh, emissions = 0.2 3.04 metric tons CO_2.
  - Total Operational Emissions: ~3.0 metric tons CO_2e.

Operational Emissions

- For Honda Civic
  - Recycling Emissions: Approximately 1.0–2.0 metric tons CO_2e. Estimation: Based on typical vehicle recycling processes.
- For Lightyear 0
  - Battery Recycling: Emissions can vary; pyrometallurgical processes emit about 5.11 kg CO_2e per kWh. Calculation: 60 kWh × 5.11 kg CO_2e/kWh ≈ 0.31 metric tons CO_2e. Solar Panel Recycling: Recycling 1,000 kg of silicon PV waste produces approximately 446 kg CO_2e. Estimation: Assuming 5 m^2 of panels weigh around 100 kg, emissions ≈ 0.045 metric tons CO_2e. Vehicle Recycling: Approximately 1.0–2.0 metric tons CO_2e. Total End-of-Life Emissions: ~1.4–2.4 metric tons CO_2e.

Category	Honda Civic	Lightyear 0

Final Evaluation and Group Opinion

Lasting 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.

Thank you!

Do you have any questions?

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