

Design Challenges of Solar Integration in BEV



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Pearl PV Seminar: “Designing with Photovoltaics”



Summary

- You said SEV ?
- The engineer point of view
- The designer point of view
- Exploring the range of possibilities

You said SEV ?



You said SEV ?

What is PV ?

Photovoltaics (PV) is the conversion of light into electricity using [semiconducting materials](#) that exhibit the [photovoltaic effect](#), a phenomenon studied in [physics](#), [photochemistry](#), and [electrochemistry](#). The photovoltaic effect is commercially utilized for electricity generation and as [photosensors](#).

A [photovoltaic system](#) employs [solar modules](#), each comprising a number of [solar cells](#), which generate electrical power. PV installations may be ground-mounted, rooftop-mounted, wall-mounted or floating. The mount may be fixed or use a [solar tracker](#) to follow the sun across the sky.

Source: Wikipedia



You said SEV ?

Are SEV a new concept ?



1955: Baker Solar Electric car



1977: Blue Jay Solar Car



1980: the Citicar



1981: The Quiet Achiever



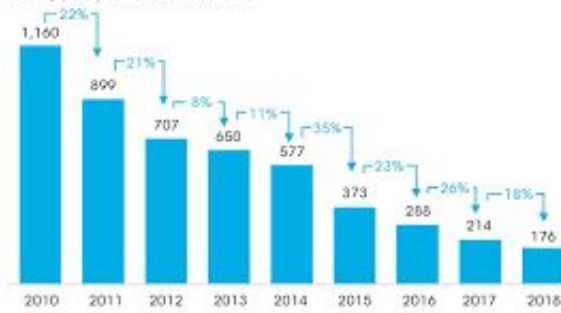
1986: The Sunraycer

You said SEV ?

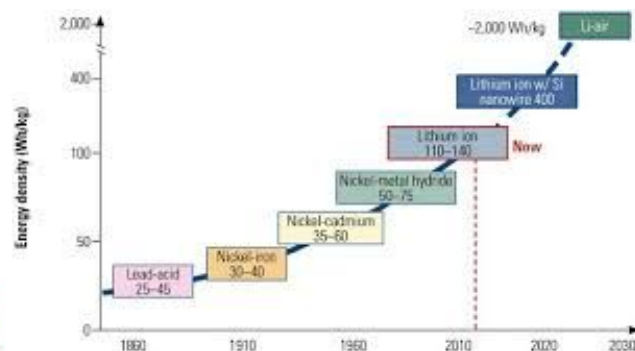
Why this new interest ?

Lithium-ion battery price survey results: volume-weighted average

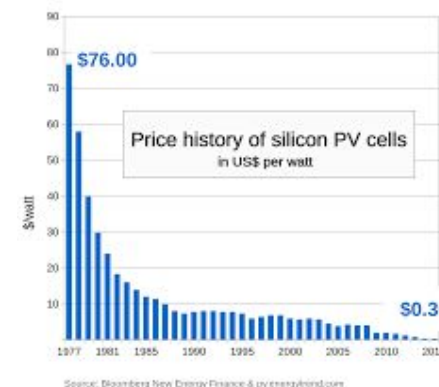
Battery pack price (real 2018 \$/kWh)



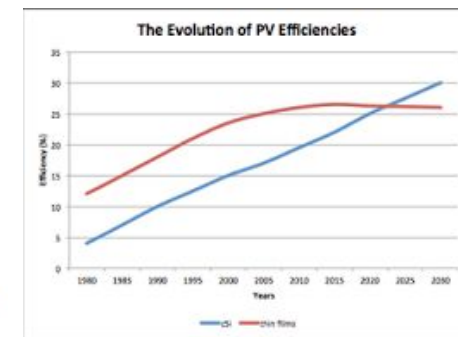
Source: BloombergNEF



Battery prices went down
 Battery energy density went up
 → You can have more km for less money
 → EV get close to the ease of use of ICE



Source: Bloomberg New Energy Finance & pvenergyinsight.com

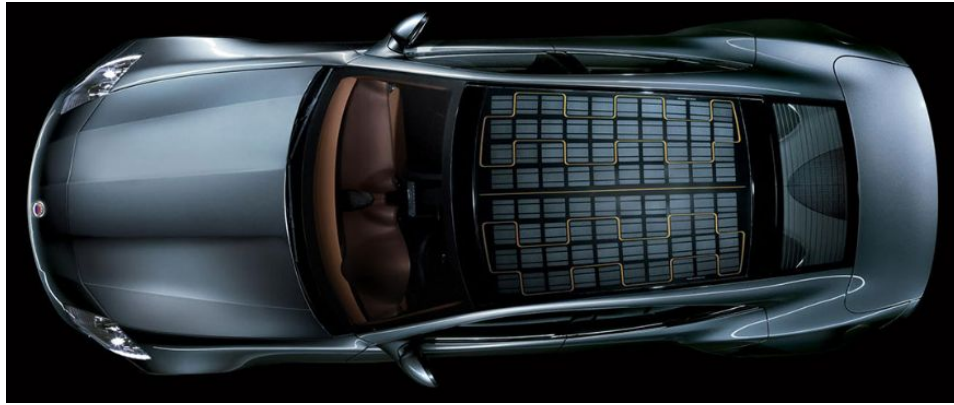


Solar cell prices went down
 Solar cell efficiencies went up
 → You can have more energy for less money
 → You can have more energy from less area

The emergence of SEV as a realistic concept

You said SEV ?

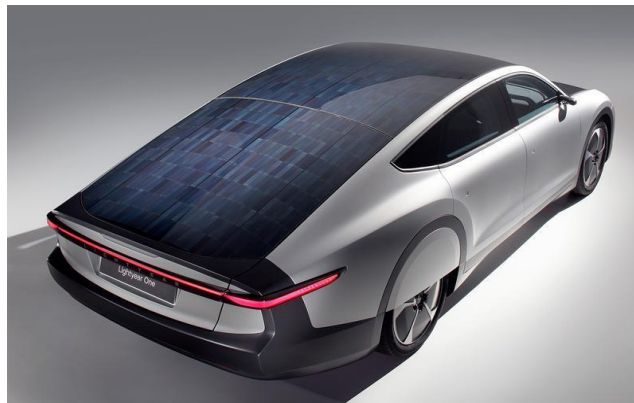
And some design appears ...



2012: Fisker Karma



2018: The Toyota Prius Concept



Soon: The Lightyear One



Soon: The Sion



The engineer point of view



The Engineer point of view

Technical Constraints

1. Solar cells must see the light of the sun to work (sorry !)



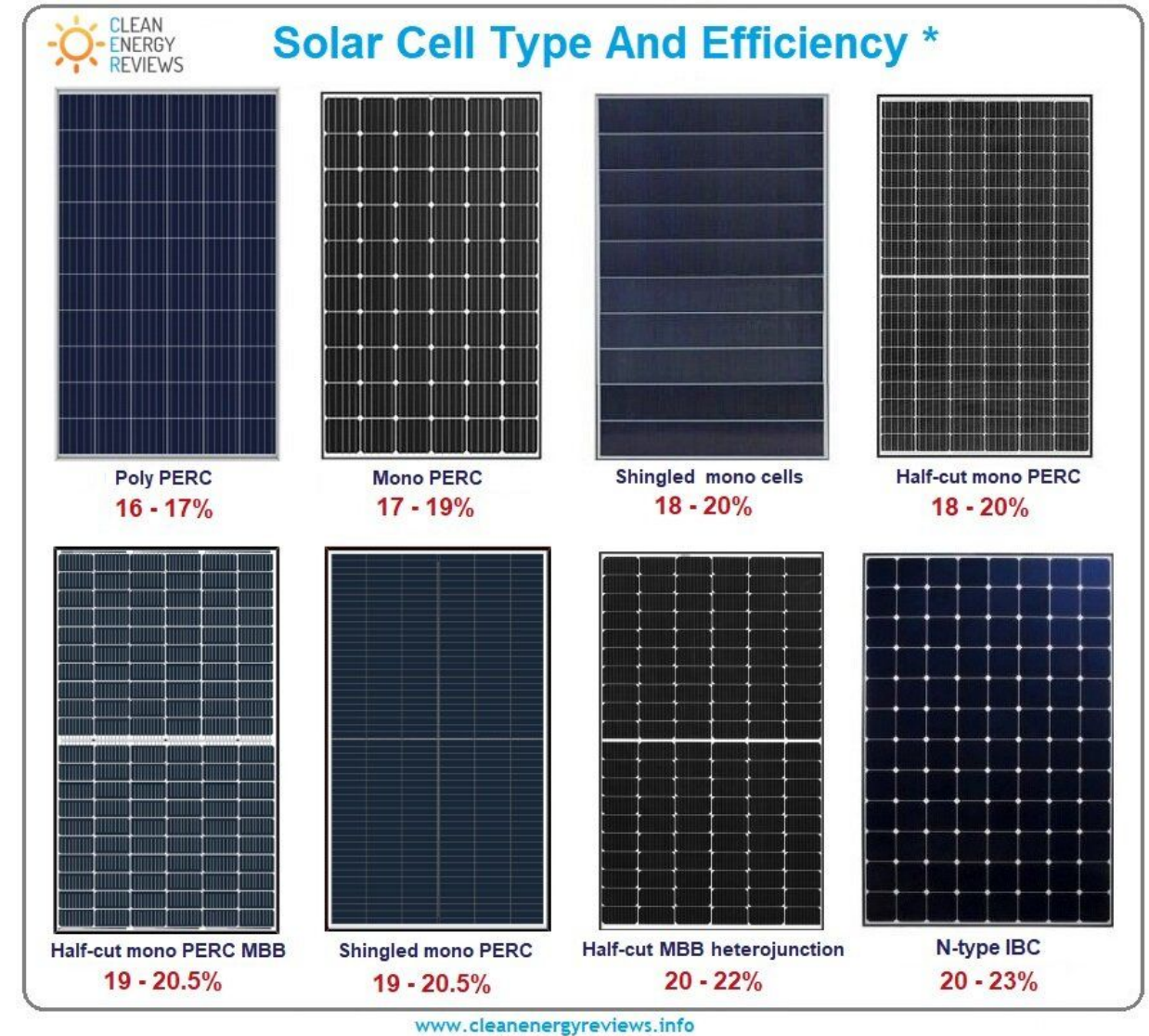
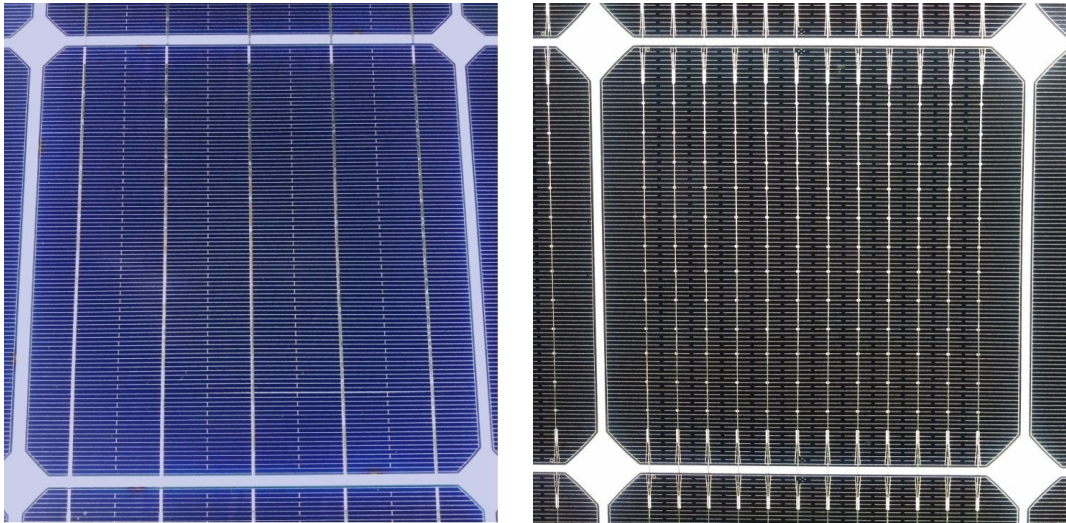
2. Some technologies are not very bendable



3. They are mostly dark to be efficient absorb sunlight

The Engineer point of view

How solar cells look like



Performance is beautiful, and important for a product



The Engineer point of view

Technical Freedom

Colored solar cells are coming, but less performant



Bending possible below a limit



Our core PV integration technology



Cost-efficient polymer exterior



Lighter than regular solar modules



Complex geometries/forms feasible



Replaces metal sheet exterior



Very short production cycle times



Automotive-grade materials





Design

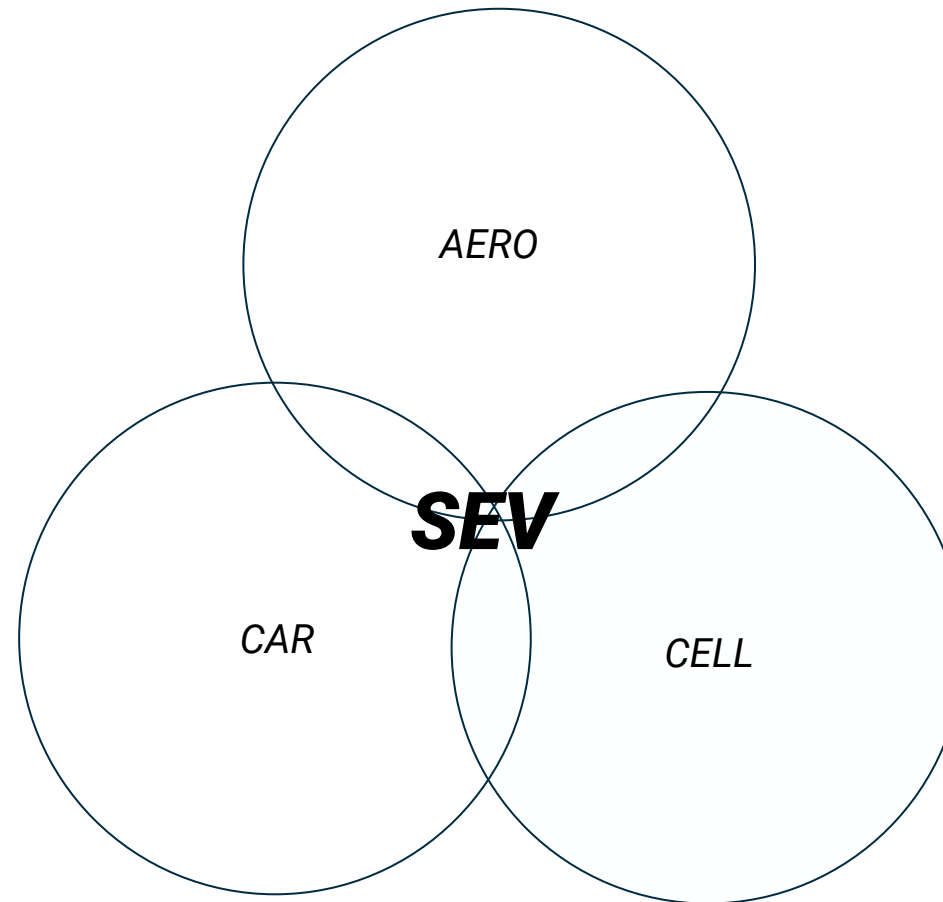




Design

Impacts on Design

SEV Exterior Design is more restricted than you think



Design

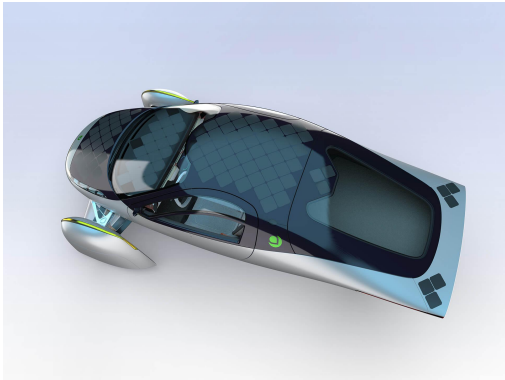
Solar vs. Design

Solar (Aero) Efficiency vs. traditional car design

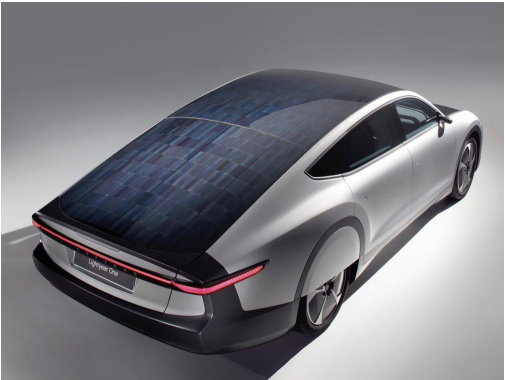
Tokai Challenger



Aptera



Lightyear



Humble Motors



efficiency

car design



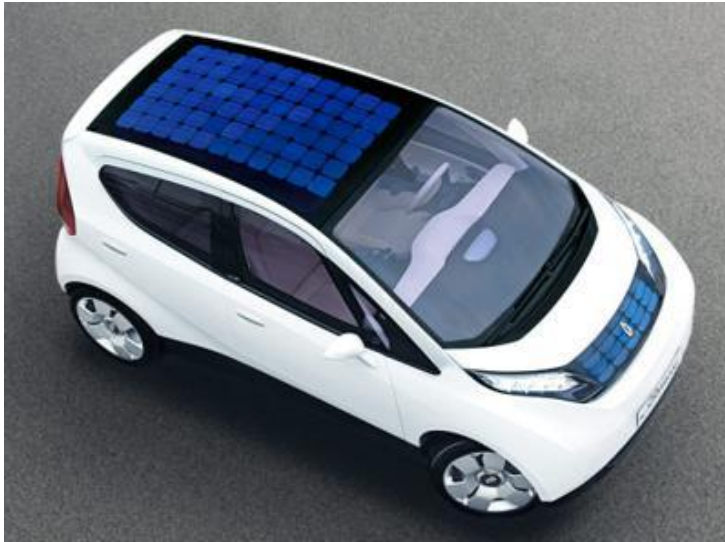


Design

Solar vs. Design

Solar Efficiency vs. traditional car design

/



Stella Vie

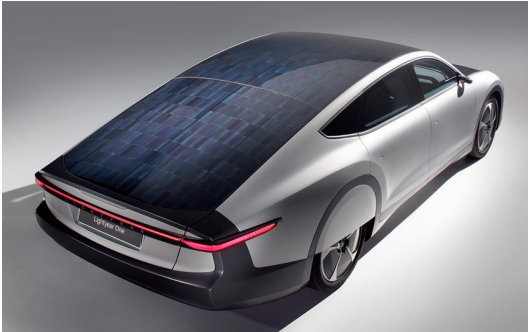


Design

Monolithic Design

traditional car design vs. radical / monolithic design

Lightyear



Arrival



Tesla



Sono Motors



Canoo



Canoo





Design

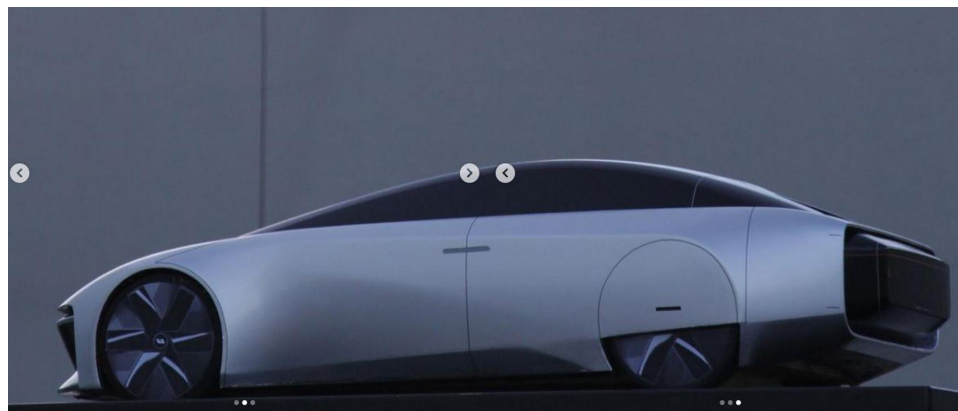
Aero Minimalism

Electric cars require aero-efficiency

Lightyear



Aptera



Li Auto





Design

Invisible Integration

The Sion

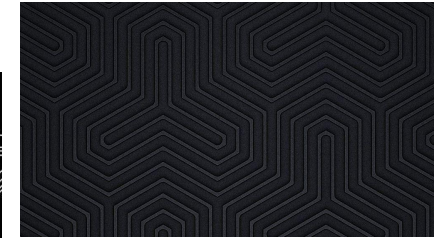
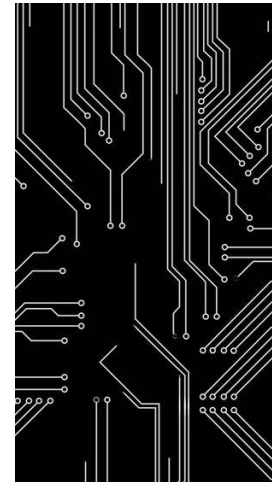
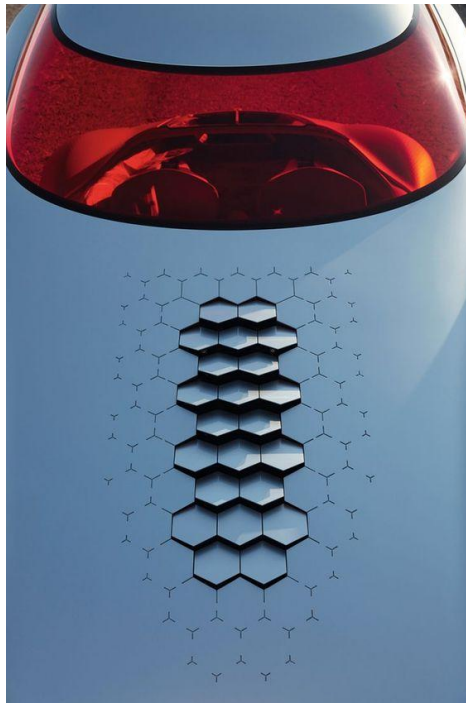




Design

Visible Integration

Make technology visible!





Exploring the range of possibilities



Conclusions

Designing with solar is possible:

- from a designer point of view
- from an engineering point of view

But both expertise are need to work together, **on a daily basis**, to design a nice and commercially viable product (solar as a product Vs green washing)

Technically, many progress has been made on solar to allow integration, from a designer and a engineer point of view.