



The Electric Car: Solution or Setback for the environment?

Sigal Shusterman and Abraham Kribus
School of Mechanical Engineering
Tel Aviv University



Significance

Transportation: 26% of world energy
>60% of world oil

Cars: ~50% of Transportation energy

Sims et al., Climate Change 2007:
Fourth Assessment Report IGCC.

Electric cars:

- On-board generation (hybrid, fuel cell)
- Plug-in
- Plug-in hybrid





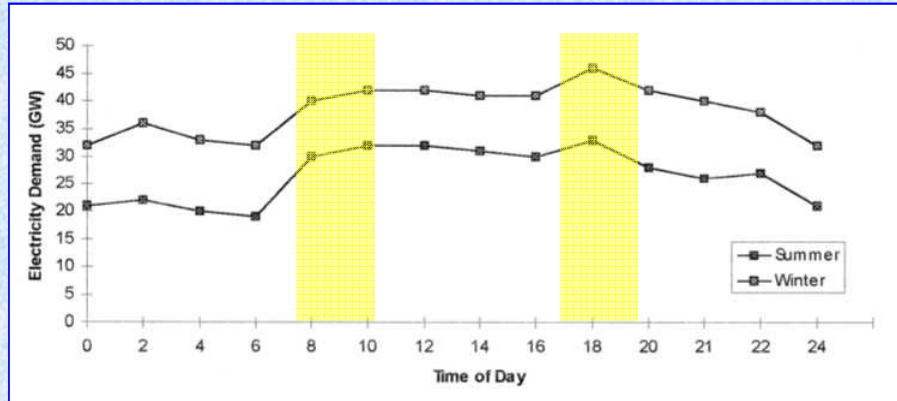
Questions

Range (~100 km)

Battery lifetime

Impact on grid

Typical daily load curve (UK)



Greenhouse gas emissions



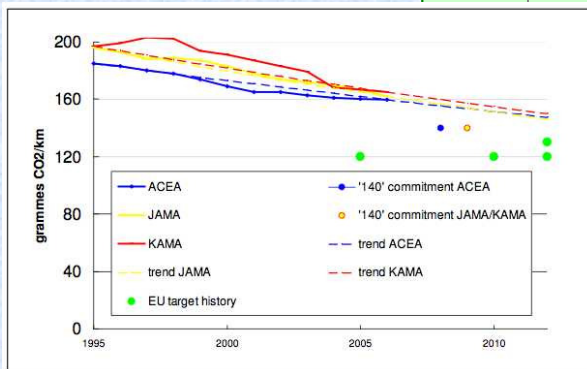
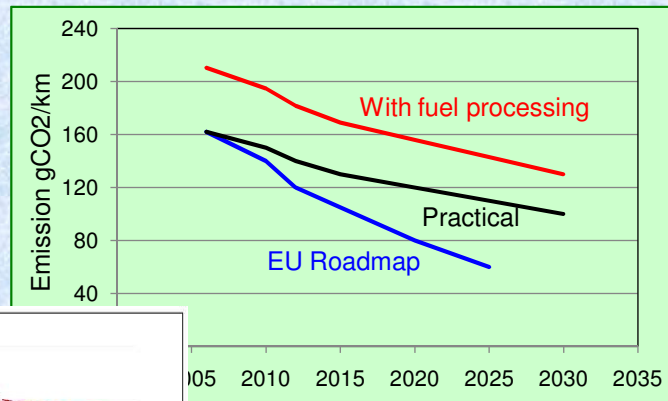


Conventional Cars

Average emissions: 162 gCO₂/km (2006)

Emissions reduction:

- Lighter materials
- Aerodynamics
- Engine efficiency
- Improved A/C



Dings et al., 2007: Reducing CO₂ Emissions from New cars. European Federation for Transport and Environment.



Electric Cars

Tesla Roadster
0.22 kWh/km



Phoenix SUV
0.17 kWh/km

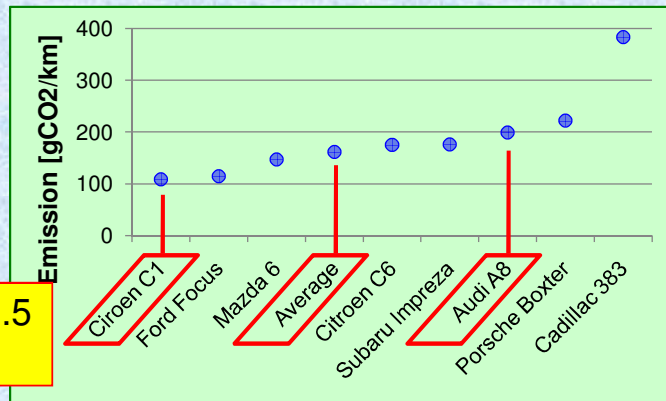




Practical Electric Cars

A reasonable scenario includes larger cars

Conventional cars:



Average = Small × 1.5
 Large = Small × 1.8

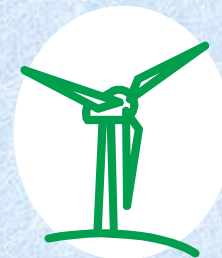
Small electric car: 0.17 kWh/km
 Average: 0.26
 Large: 0.31



Emission from Electricity

Coal: 0.9—1.1 kgCO₂/kWh
 Oil: 0.7—0.9
 Natural gas: 0.4—0.6
 Renewable: ~0

What source of electricity?





No / Reduced Emissions?

“Each Phoenix vehicle offsets 22 internal combustion vehicles even if powered from electricity from a coal plant.”
- *Phoenix Motorcars*

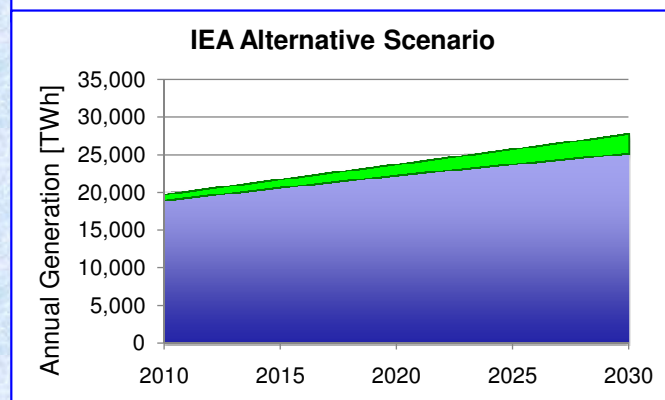
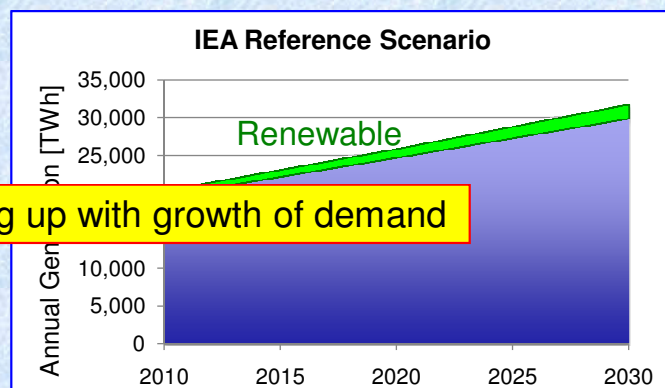
“As the electric car network grows, the market for green energy will grow with it.”
- *Better Place*

“If you really want zero emissions, electric vehicles can be powered from 100 percent renewable energy.”
- *Tesla Motors*



Electricity Scenarios

Renewables not catching up with growth of demand

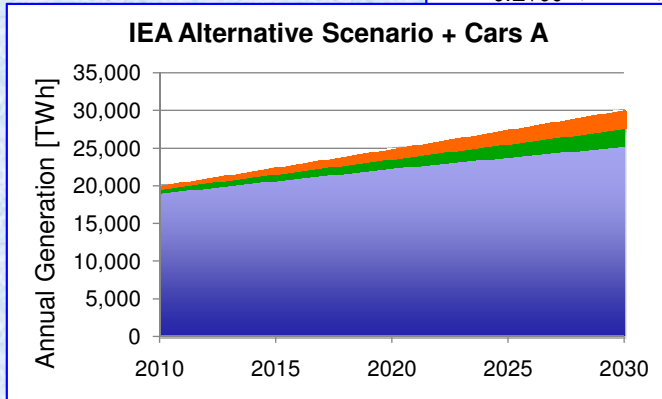
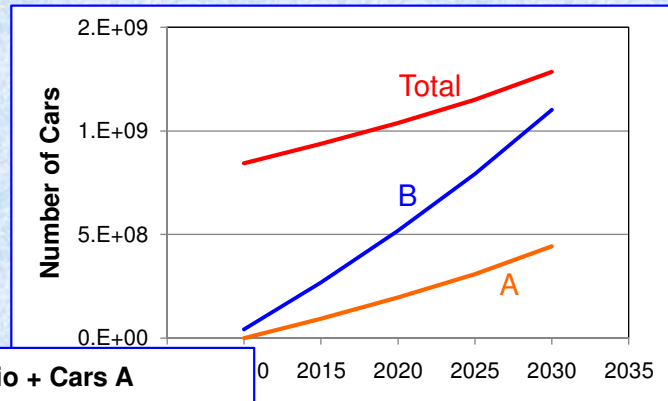




Electric Car Penetration

A: New cars are electric

B: 5% replaced with electric every year



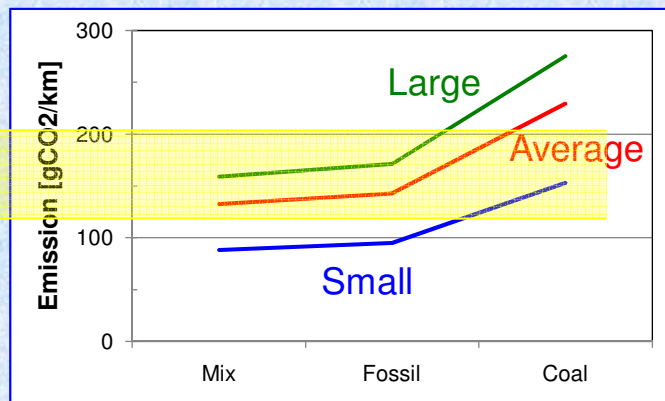
Source Scenarios

Optimistic: Proportional mix 0.52 kgCO₂/kWh

Middle: Fossil fuels mix 0.56

Pessimistic: Coal 0.9

Conventional Car





Conclusions

Electric cars reduce GHG emission if:

- Consume **< 0.17 kWh/km**
- Reduction **only ~20%** from future conventional car

Time of deployment

- **After** sufficient Renewable generation becomes available



Other Solutions?

On-board generation

Prius hybrid: save 10—30%

Aptera: <50 gCO₂/km



Renewable fuels

From waste, marginal land/water