



2011 World Materials Summit



Vehicle and Transport (Cars, Buses)

2011 World Materials Summit & Student

Report of the Vehicles and Transportation Panel Chairs

Bernard Frois and Yusheng Zhao

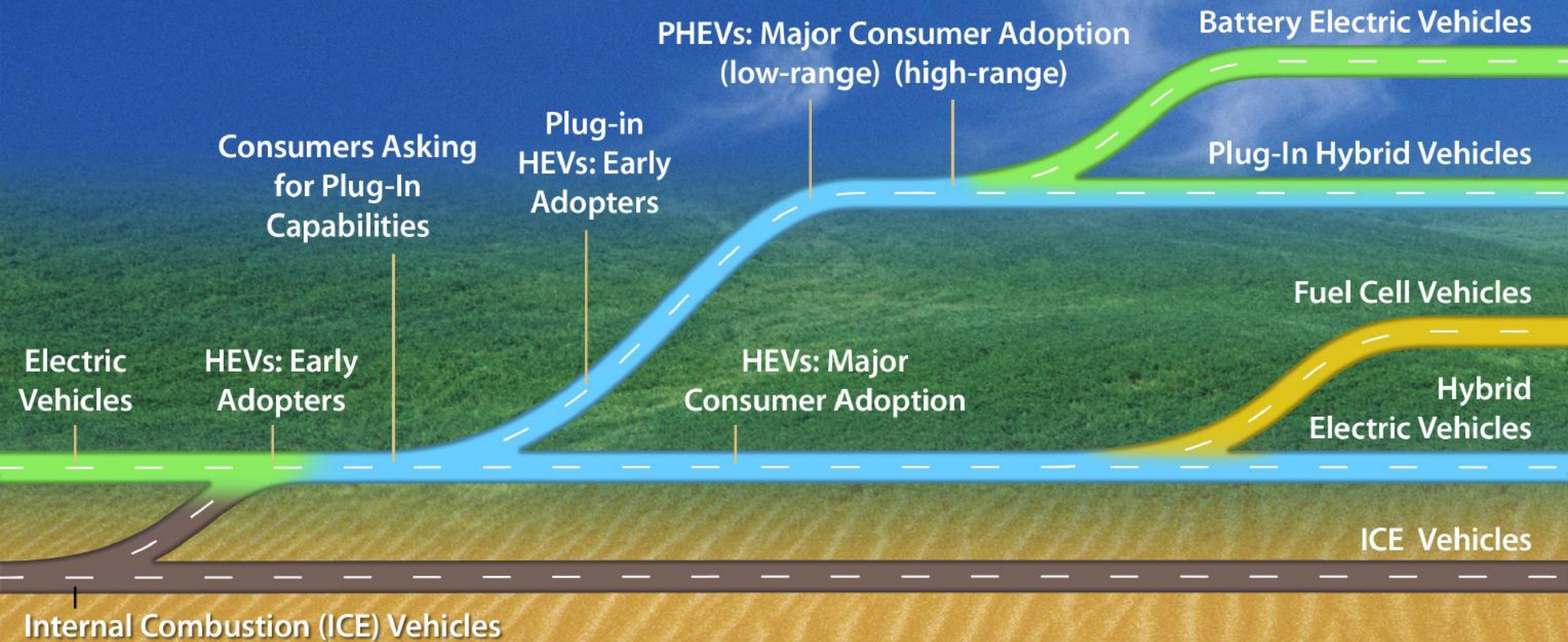
- Current and Future Technologies
- Vision 2030
- Roadblocks
- Recommendations



Vision of Future Transportation



National Renewable Energy Laboratory • Concept - Ahmad Pesaran • Illustration - Dean Armstrong • NREL/GR-540-40698



Battery Advancement

High Power ▶

Affordable High Power ▶

Affordable High Energy ▶

Fuels

Gasoline, Ethanol Blends, Natural Gas ▶

E85, Cellulosic Ethanol ▶

Diesel, Biodiesel Blends ▶

B20, Biodiesel ▶

Electricity ▶

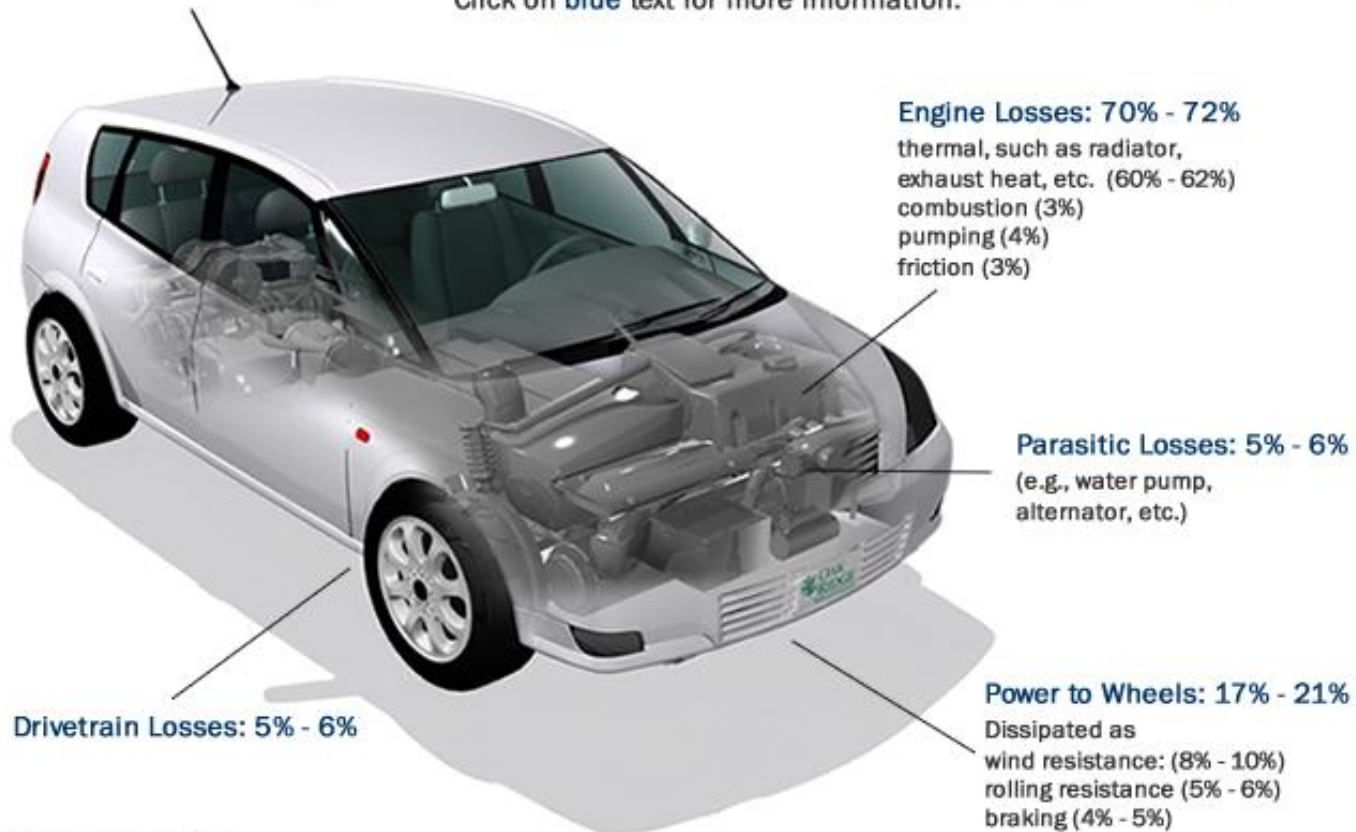
Hydrogen ▶

Time ▶

Only about 15% of the fuel consumed is actually used to propel the vehicle and support the accessory loads.

Energy Requirements for Combined City/Highway Driving

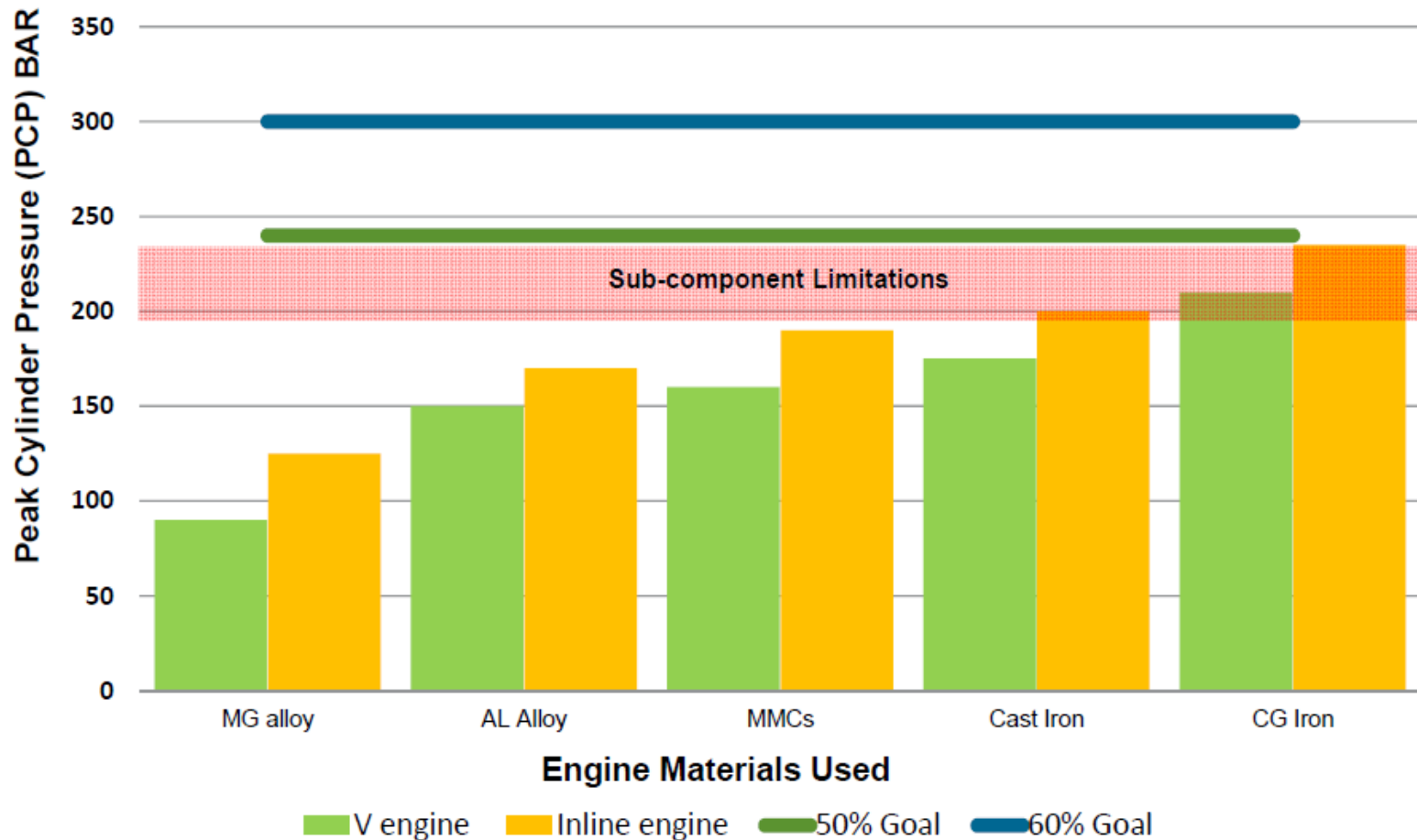
Click on blue text for more information.



Idle Losses: 3%

In this figure, they are accounted for as part of the engine and parasitic losses.

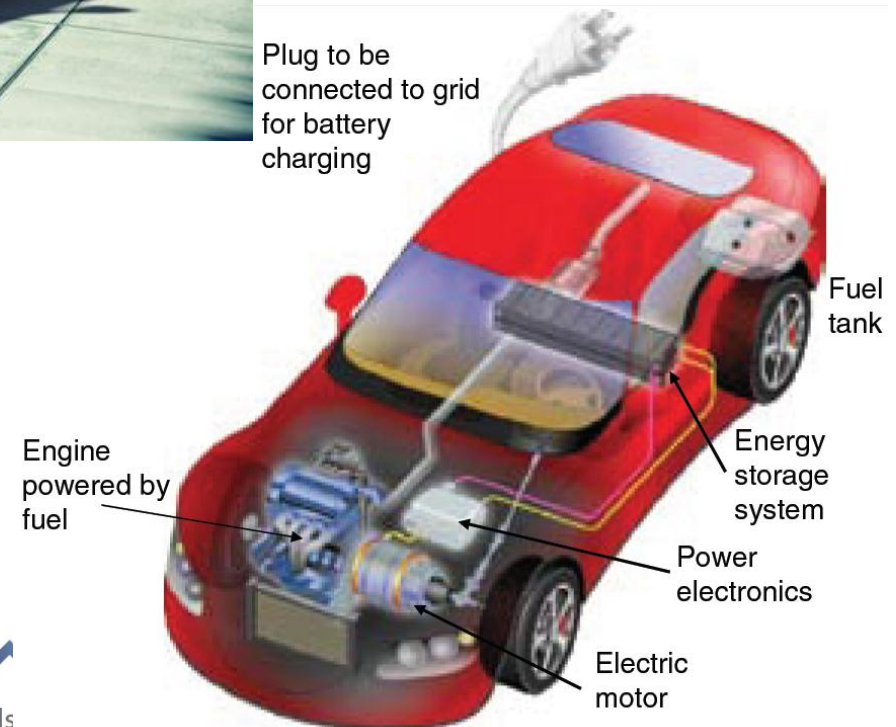
Current Material Limits



Based on 1999 study

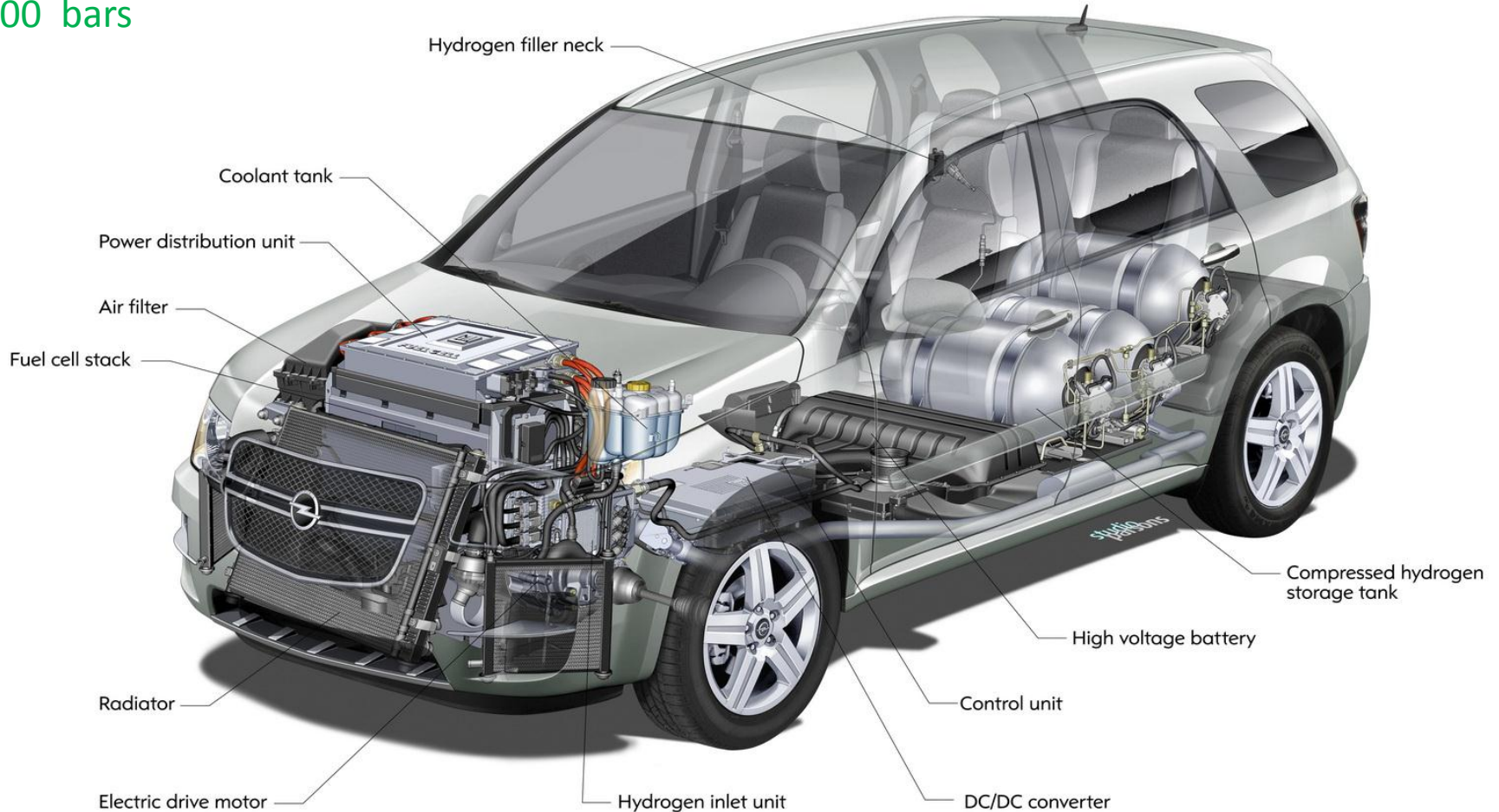


Plug to be connected to grid for battery charging



93 kW
320 km
12s
160km/h
700 bars

OPEL (GM) Hydrogen4



Vision 2030

- **De-carbonization of transport**
- **Smart road, smart car, smart networking**
- Durability and long-term reliability of batteries,
- Sustainability
- Economical
- Market deployment of high efficiency cars



Developments towards Vision 2030

- High efficiency ICE: decrease fuel consumption
- High energy density and high power capacity batteries
- Fuel cell: cheap catalyzers, better membrane,
- Reduce weight by using composite materials
- Optimization of power management systems
- Sensors and real-time information
- IT networking



International Collaboration

- **Facilitate scientific exchanges**
- Develop an agreement on long term vision.
- Share concepts and best practices
- Agree on codes and standards
- Focus on technological research and technology transfer



Roadblocks

- Competition slows information flow of exchange
- Patents and IP protection prevent technology transfer
- Public acceptance may delays market deployment
- Long term availability of materials
- Access to strategic materials (REE, Li, Rubber, Transition Metals,



Policy, Industry, Outreach and Education

- National/Central government policy
- Regional/Local policy development
- Industry should be involved at early stage
- Regulations and standards
- Risks and liabilities
- Incentives
- Public awareness and involvement
- Education and training of next generation of scientists and engineers



Recommendations

- **Expand dialogue with policymakers and Industry**
- **Develop road map** and update it every two year in Summit
- Study specifics of buses and trucks (heavy duty vehicles)
- Link with aircraft industrial needs, battery and fuel cell
- Analyze materials needs for high speed train
- Develop new architectures in power electronics (powertrain management). Link with Intelligent technologies



ENERGY

SOCIETAL CHALLENGES



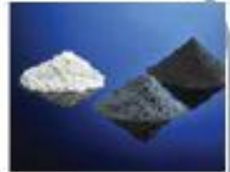
De-carbonisation of transport

ELECTRIC VEHICLE



Tyres

Advanced materials



Nanopowder for batteries

Microelectronics



Power MOSFET

Nanotechnologies



Sensor

Photonics



LED's

Biotechnologies



Lotus effect windscreen

the case of the electric vehicle