Why we need electric mobility

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Why we need electric mobility

1. Oil products have been the ideal transport fuels: energy-dense, portable, readily available, inexpensive, relatively safe.

2. Oil products can only fuel internal combustion engines (ICEs), which are inefficient and polluting but tolerated because oil is so good.

3. Electric traction is much better: efficient, quiet, strong, and clean (unless coal-fired generation).

4. But, fuel systems for electric traction are inadequate: either low energy density and/or expensive at vehicle (batteries, fuel cells), or inflexible and expensive infrastructure (grid-connected).

Why we need electric mobility

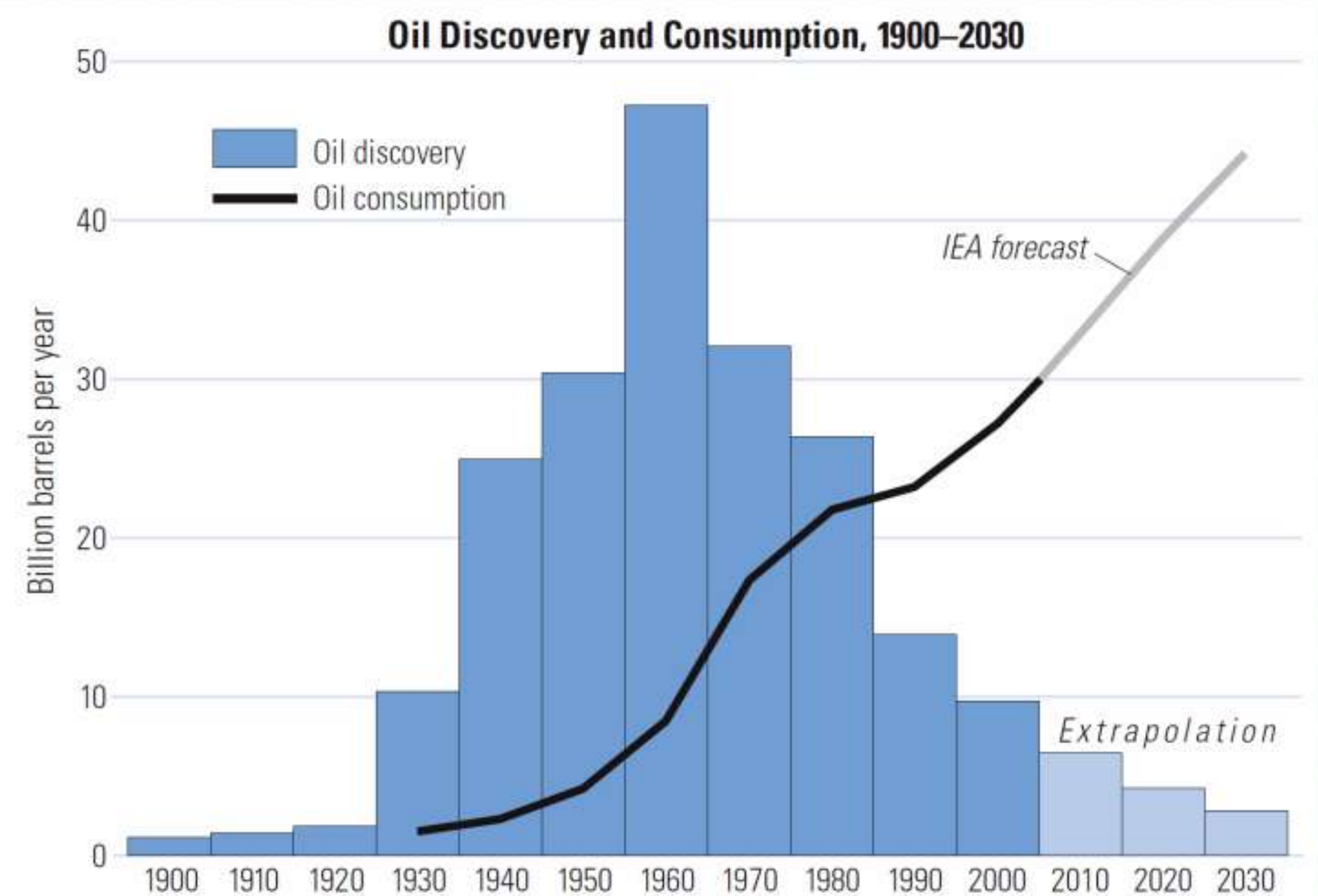
5. Soon (~5 years) oil supply will likely not keep up with potential demand; prices will rise steeply forcing reduced use of oil and thus ICEs.

6. If oil supply does keep up with demand, concerns about climate change could force reduced use of oil and thus ICEs.

7. Biofuels for ICEs, especially biodiesel, can help a little, but land issues will limit scope (displacement of food production, soil degradation).

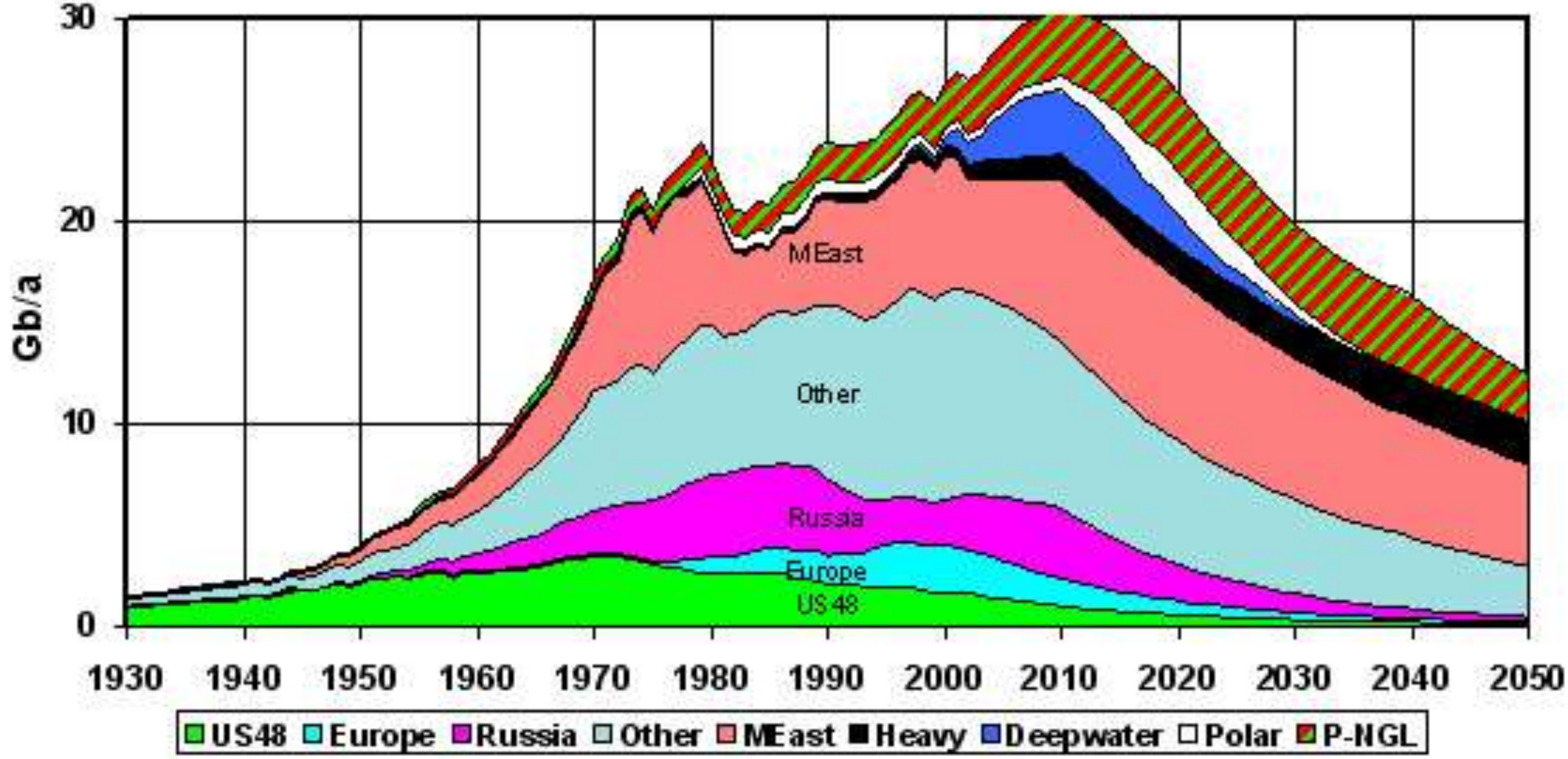
8. Without readily available liquid fuels, the intrinsic superiority of electric traction will become more evident, especially if there is strong interest in the use of renewable energy sources.

Here's the nub of the oil problem: discoveries are not keeping up with consumption



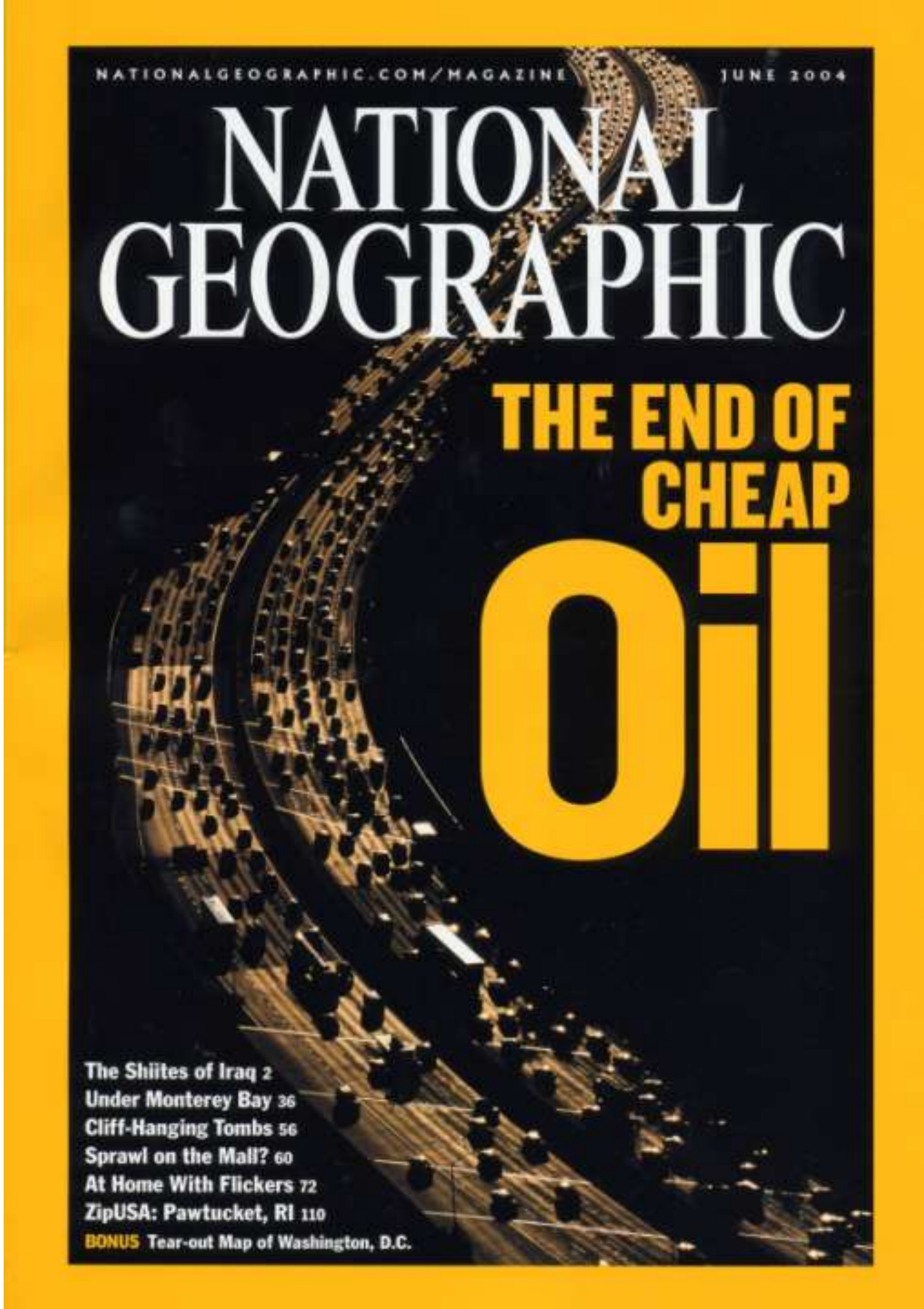
Source: Kjell Aleklett, Oil: a bumpy road ahead. *World Watch*, 19(1), 10-12, 2006

Here's the best estimate of when the world peak in liquid hydrocarbon production will occur: about 2012 (black area is oil sands)



Source: Uppsala Hydrocarbon Depletion Group

It's not a secret! The National Geographic cover of June 2004 echoed the title of a 1998 *Scientific American* article by geologists Colin Campbell and Jean Laherrère that was initially dismissed as yet another oil scare but is now seen as a seminal step in our understanding of the future availability of oil (and natural gas).



Even the US Army Corps of Engineers is concerned about peak oil

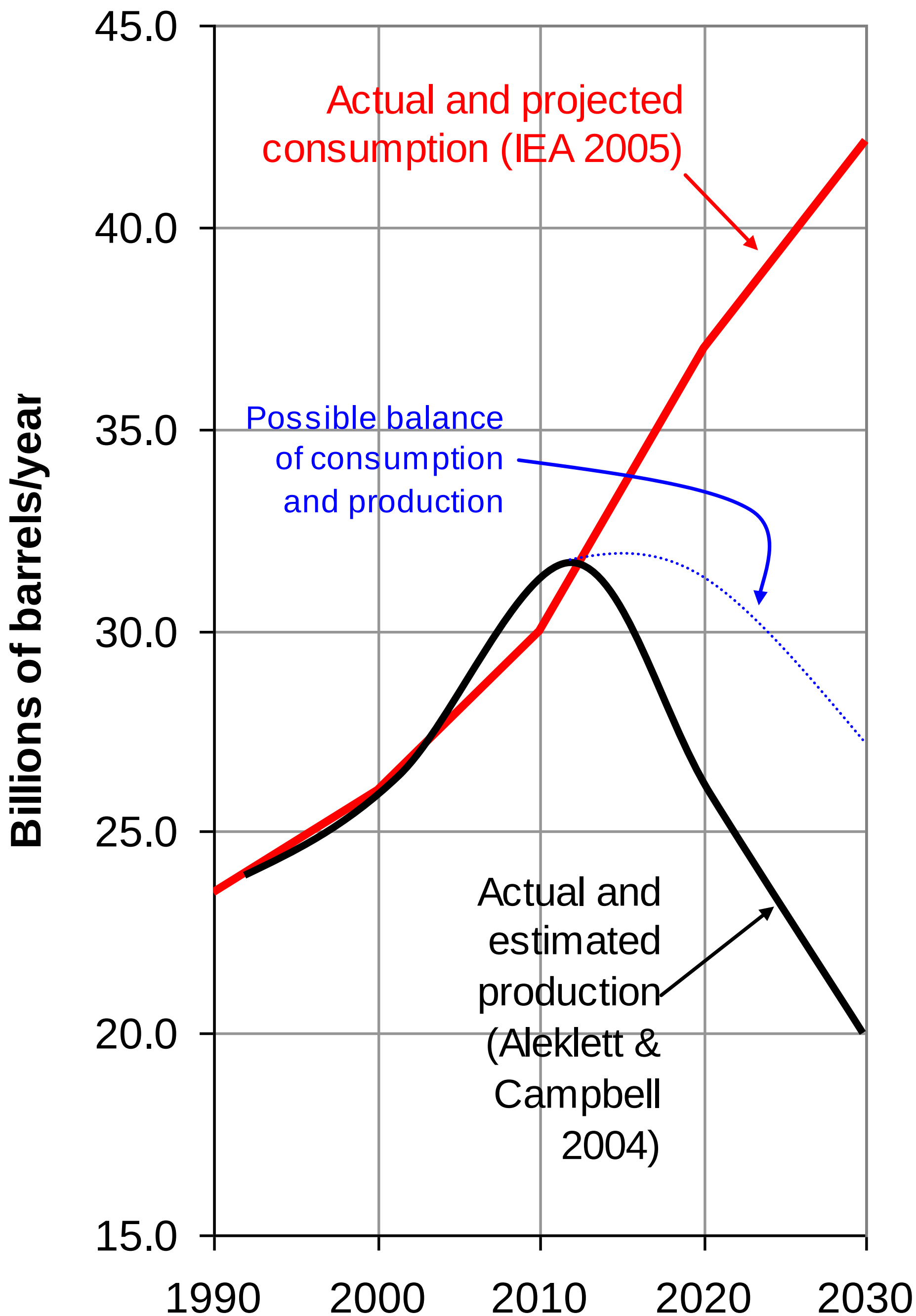
US Army Corps of Engineers®
Engineer Research and Development Center

Energy Trends and Implications for U.S. Army Installations

Eileen T. Westervelt and Donald F. Fournier — ERDC/CERL TN-05-1 — September 2005

"Peak oil is at hand … Once worldwide petroleum production peaks, geopolitics and market economics will result in even more significant price increases and security risks. … Oil wars are certainly not out of the question. Disruption of world oil markets may also affect world natural gas markets as much of the natural gas reserves are collocated with the oil reserves."

Balance of oil production and consumption after 2012 (30% mismatch by 2020)



Small shortfalls can mean big price increases (two analyses)

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Based on analysis for the U.S. by the Brookings Institution

	Shortfall in crude oil supply			
	0%	5%	10%	15%
Resulting increase in crude oil price	0%	30%	200%	550%
Crude oil price per barrel (US$)	$50	$65	$150	$320
Resulting gasoline pump price (Can$/litre)	$0.85	$1.00	$1.50	$2.50

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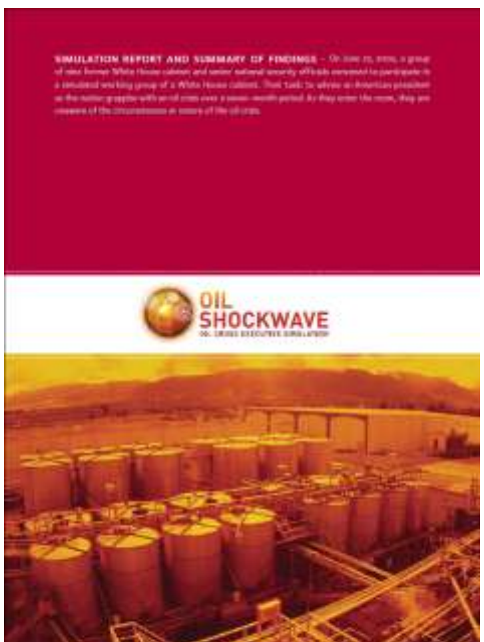


The U.S. National Commission on Energy Policy concluded in June 2005 that a "4 percent global shortfall in daily supply results in a 177 percent increase in the price of oil" (from $58 to $161 per barrel).

Why biofuels may not fill the liquid transport fuels gap

1. Ethanol and biodiesel may have some role as substitutes for present transport fuels.

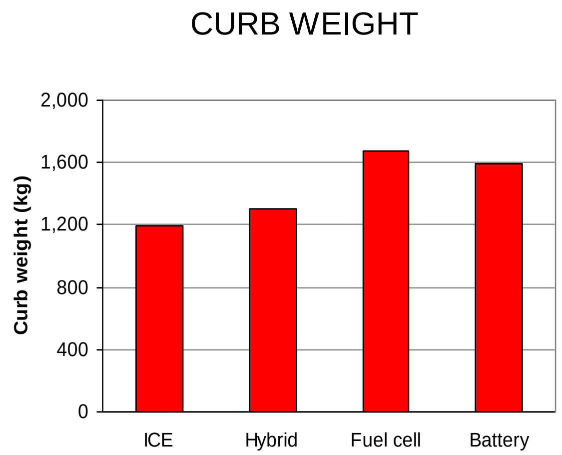
2. Ethanol production raises questions about required energy inputs and land requirements. E.g., the new Goldfield plant in Iowa uses about 100,000 tonnes of coal [!] a year to produce about 200 million litres of ethanol from about 600,000 tonnes of corn—harvested from about 1,000 square kilometres of land. The energy in the coal is about 60% of the energy in the ethanol, and more energy is required for farming and transporting the corn.

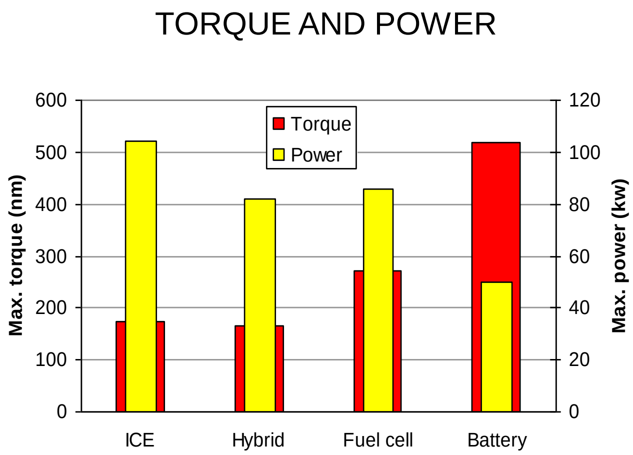
3. There are fewer questions with production of ethanol from cellulose rather than sugar (Iogen is a world leader), allowing use of wood, corn and other wastes.

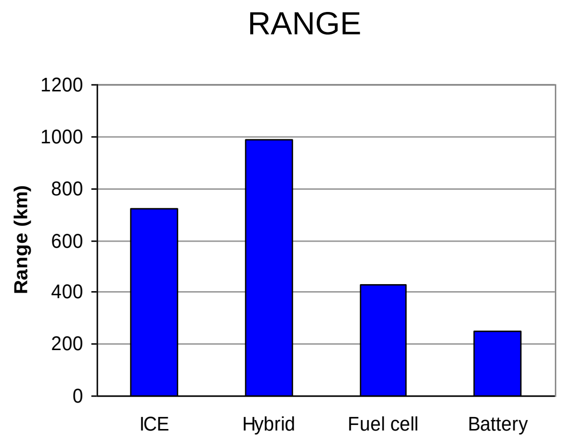
4. But still the land requirement question remains, and a new question: in an energy-constrained world, in which fertilizer production is a major challenge (oil and natural gas are major feedstocks), will not waste materials be needed to replenish land?

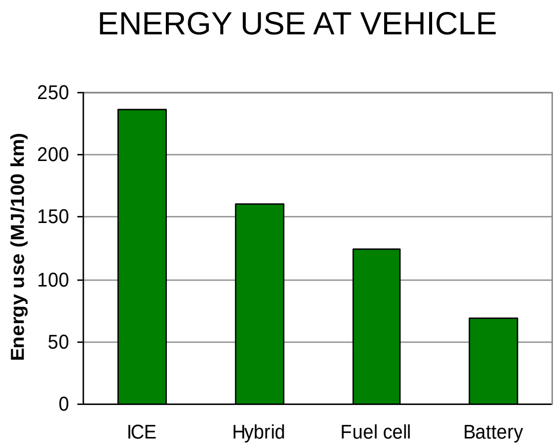
5. It will usually make more sense to use biofuels to cogenerate electricity.

Comparable ICE, hybrid, fuel cell, and battery vehicles
(Honda Civic DX, Honda Civic Hybrid, Honda FCX, Mitsubishi Lancer Evolution MIEV)







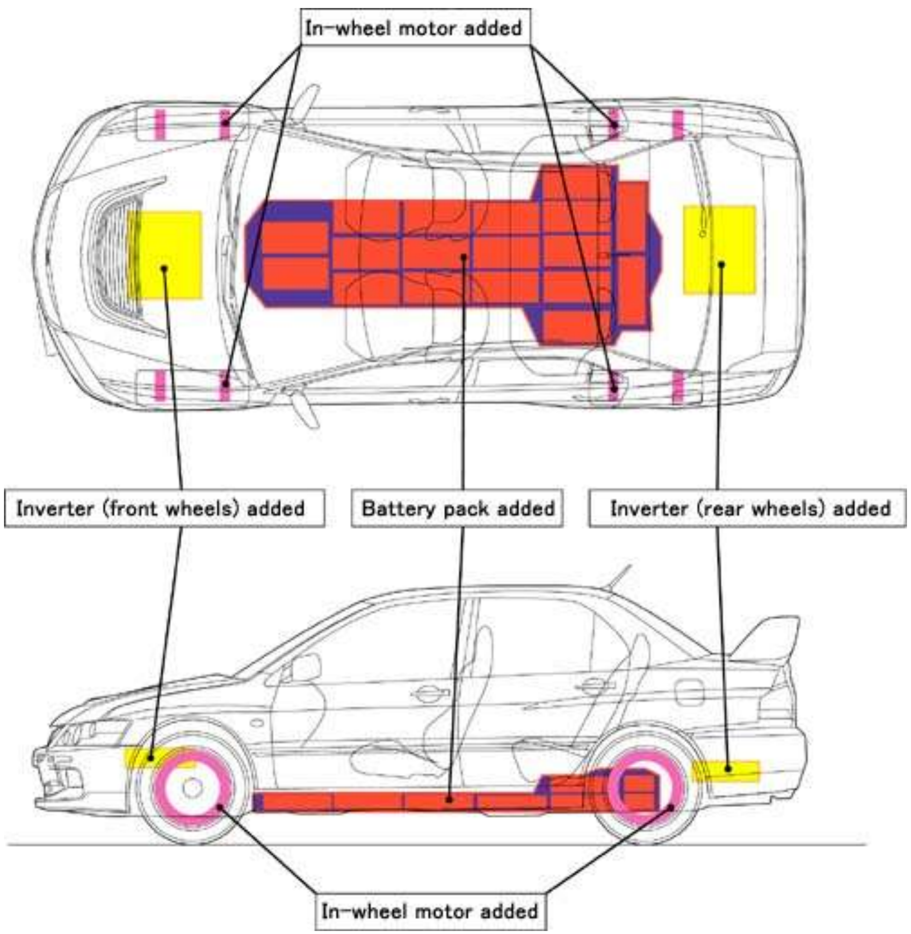


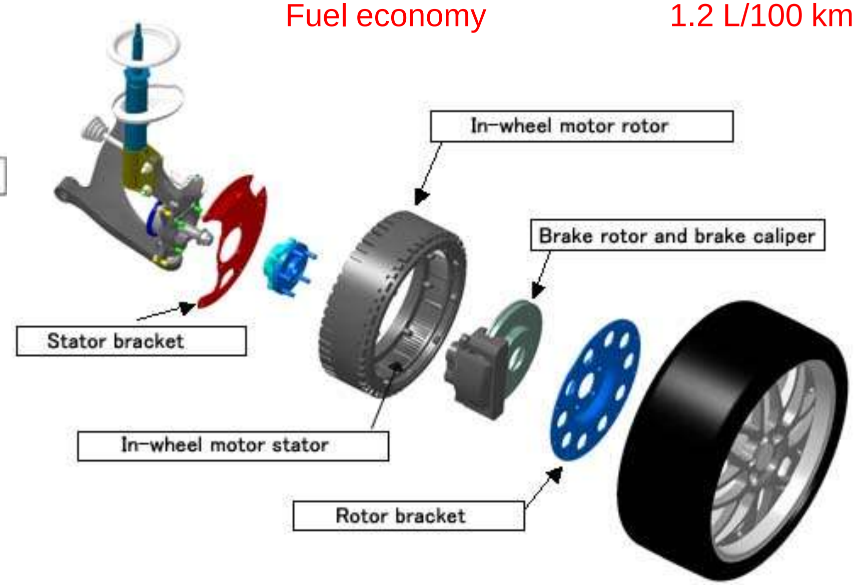
Sources: US EPA (2006); Honda (2006); Mitsubishi (2006); Bossel (2005)

Electric cars are coming

Mitsubishi Lancer Evolution MIEV:

Length	4490 mm
Width	1770 mm
Curb weight	1590 kg
Seating	5
Max. Power	4 x 50 = 200 kW
Max. speed	180 km/h
Range/charge	250 km
Lithium-ion	90Ah at 14.8 V
No. of batteries	24
Max. energy stored	32 kWh
Gasoline equivalent	3 Liters
Fuel economy	1.2 L/100 km





Source: Mitsubishi Corporate press release, August 24, 2005

Prevalence of Electric Mobility 1

- Nearly all vehicles with on-board generation are hybrids (ICE-electric).

- Most battery vehicles are now off-road (although this may be about to change).

- Today, almost all electric mobility involves grid-connected vehicles.

Prevalence of Electric Mobility 2

- In 1900, electric automobiles were as popular as ICE automobiles.
- In Europe and Japan, most rail systems are electrified.
- In Canada, five of the six largest cities provide electric transit, responsible for almost half of the trips in those cities.

Prevalence of Electric Mobility 3

Jurisdiction	Transit vehicle	Annual trips (millions)	Annual PKM* (millions)
City of Toronto	All vehicles	418.1	
	Subway and SRT**	173.6	
	Streetcars	42.5	
	Electric share (%)	52%	
Greater Montreal	All	437.8	
	Electric train	7.5	
	Subway	217.5	
	Electric share (%)	51%	
Greater Vancouver Regional District	All	155.6	1,851.6
	Skytrain	36.6	435.6
	Trolley buses	39.2	466.0
	Electric share (%)	49%	49%
City of Calgary	All	80.6	1,024
	Light rail	34.7	440
	Electric share (%)	43%	43%
City of Edmonton	All	84.0	
	Light rail	11.7	
	Trolley buses	6.5	
	Electric share (%)	22%	

Final points

1. The remarkable efficiencies of grid-connected systems will be especially advantageous in an energy-constrained world.

2. A large variety of generating sources can be used, including renewable sources, without changing anything at the vehicle.

3. Much more electric-mobility research and development are required, especially on battery systems and on light-vehicle, grid-connected systems (personal rapid transport).

4. Canada can be an electric mobility powerhouse. We have renewable electric in every region and the prospect of much more, and we will soon have much unused vehicle manufacturing capacity.

5. Electric Mobility Canada will help make it happen.