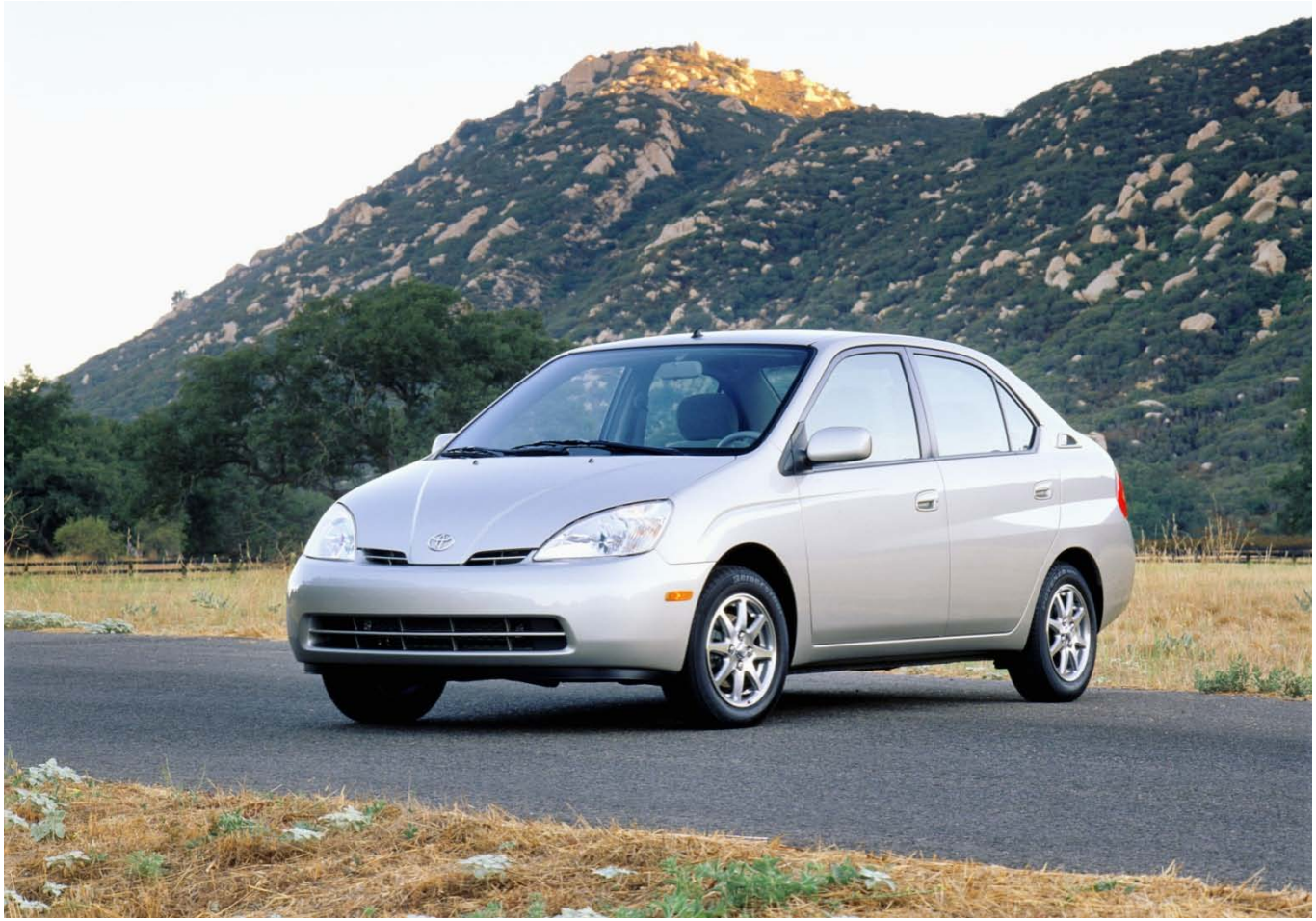
The Automotive Trends Call for Transformative Technology

(*or* why the status quo won't remain so)

by Gary S. Vasilash
Editorial Director

AUTOMOTIVE DESIGN and PRODUCTION

Sacrifice



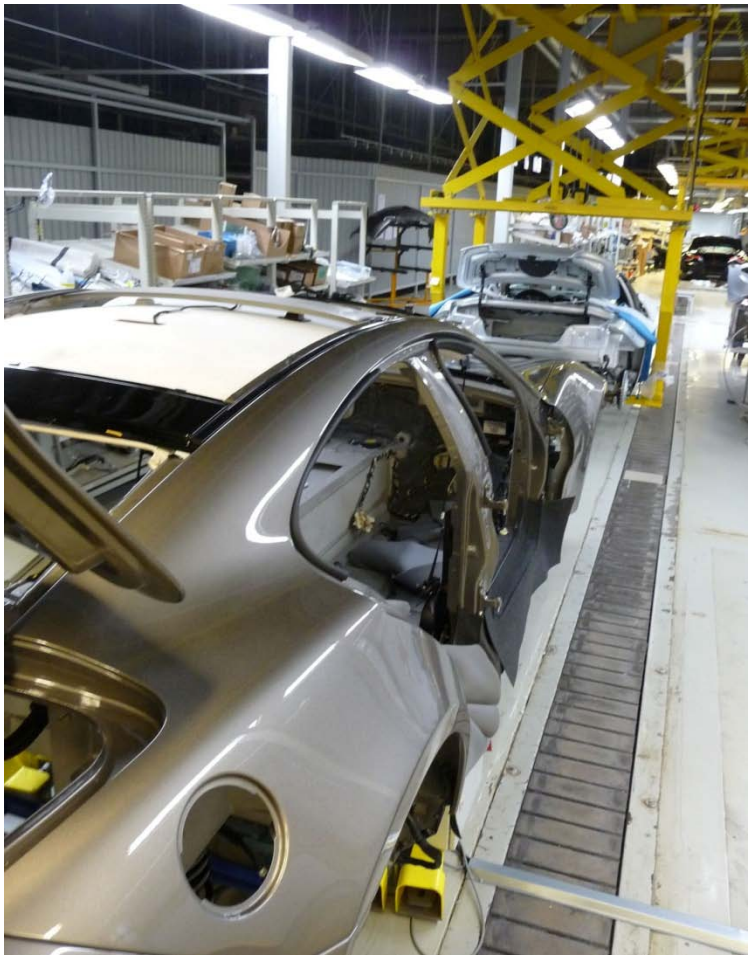
Seduction

Welcome to the world of Environmental Vehicles 2.0

It’s not just about looking good

Alison Brie & Chevy Volt

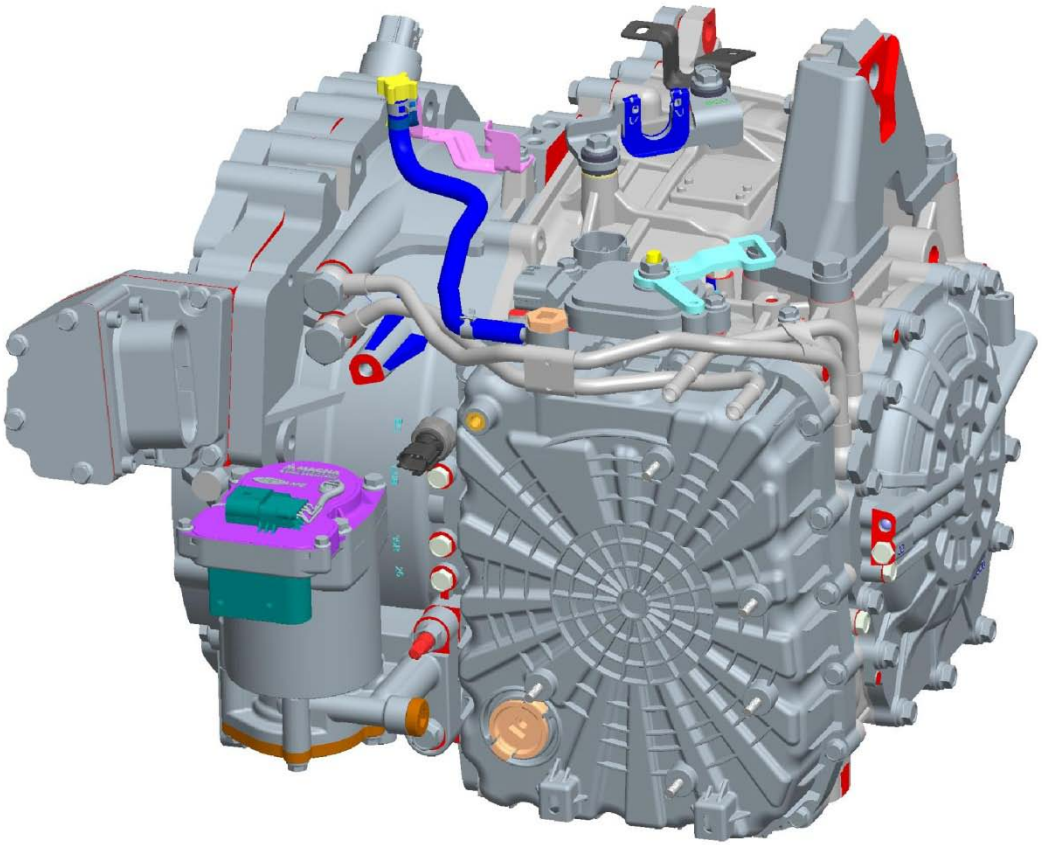
But manufacturing, too



Well, the former is more intriguing

This is serious stuff

Sonata Hybrid Transmission

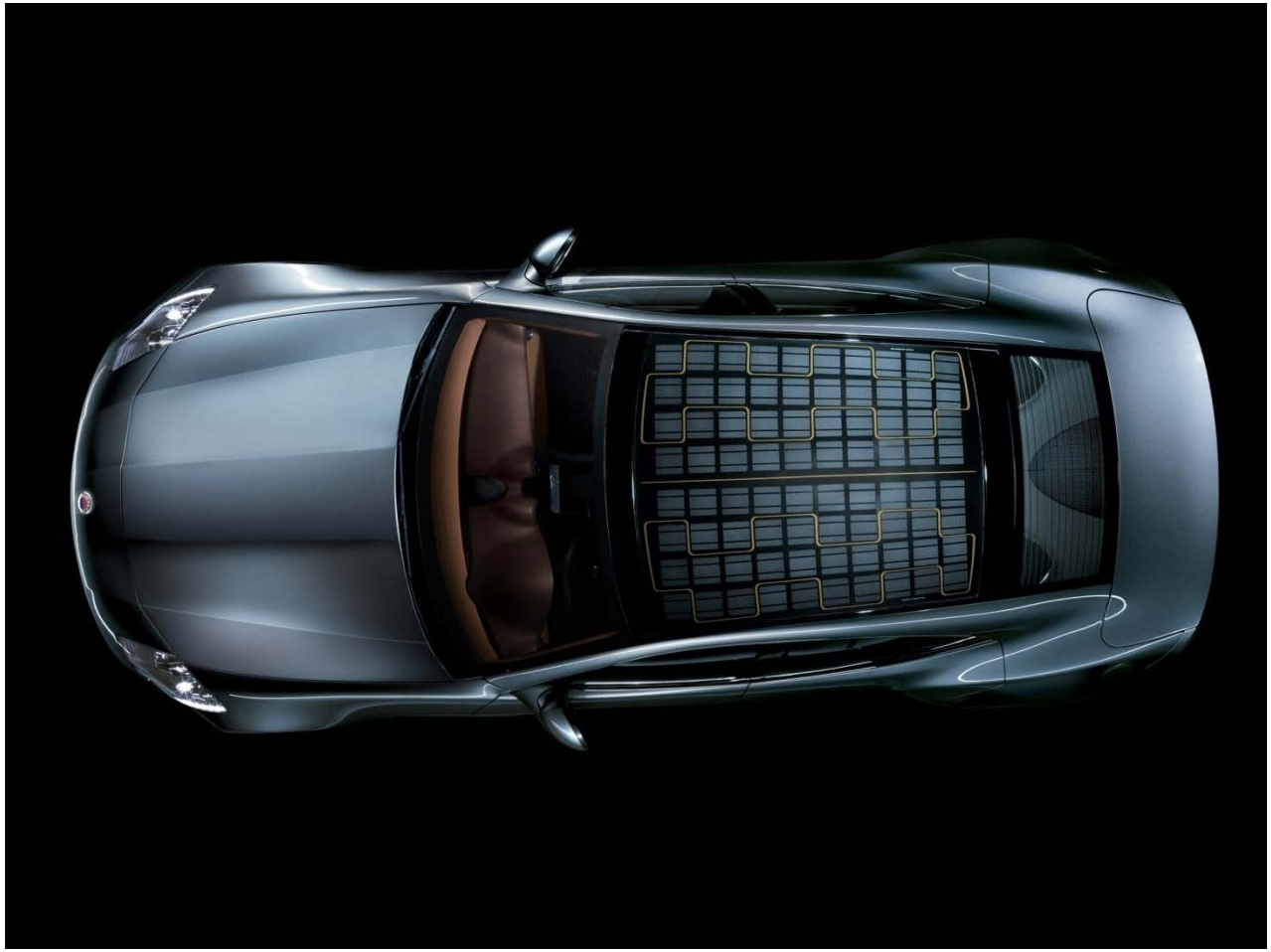


You need this

To get this

KARMA

To make this



Which is done here:
Valmet factory in Finland
(also builds Porsche Boxster)

Fisker Karma

- 0 to 60 mph—5.9 seconds
- 125 mph
- 67 mpg
- Two 201.5-hp electric traction motors
- 2.0-liter, 260-hp GM Ecotec engine (generator)
- 50 miles EV; total 300

Fisker, incidentally, got a $528.7-million loan from the Department of Energy

So, how relevant are the alternatives?

Cadillac

Toyota Prius

Cadillac sales through April:
53,639 —Autodata Corp.

Prius sales through April:

55,256 –Autodata Corp.

Lutz on EVs

"How could we, the world's largest and, arguably, the most technologically capable car company in the world, declare the lithium-ion battery not feasible for motor vehicles when some outfit run by a couple of dot-com billionaires was making it work?"

Car Guys vs. Bean Counters

Lutz was talking Tesla

BATTERY PACK IN PRODUCTION / PALO ALTO, CA

Tesla makes this

The Lotus Elise-based Roadster

And it will be making this

Tesla Model S

Tesla Factory
Fremont, California

"Everything from body panel stamping to final quality testing will take place at the Tesla Factory."--Gilbert Passin, VP, Manufacturing

Tesla photo

May 20, 2010

Tesla & Toyota

- Tesla buys the NUMMI plant in Fremont, CA—former GM/TMC jv
- Toyota invests $50-million
- Companies sign cooperative agreement

Akio Toyoda on Tesla

"I've felt an infinite possibility about Tesla's technology and its dedication to *monozukuri*."

Monozukuri?

Skills & spirit for making things.

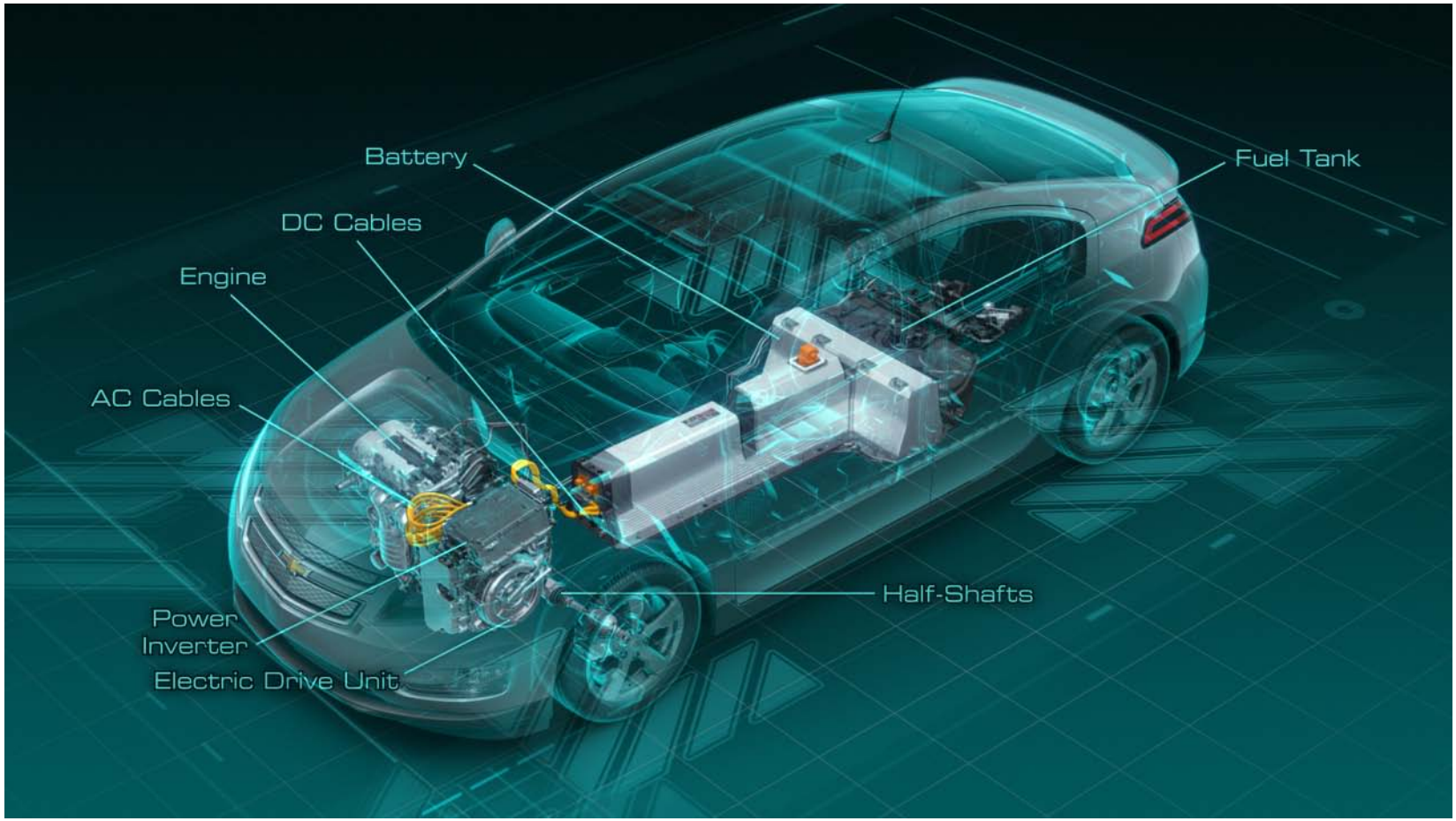
Yes, even dot-com billionaires
impressed him with their ability

BTW: Fisker bought the GM Wilmington Assembly plant ($18 m) to produce the Project NINA ($39,900 after tax credits)

Isn’t it curious that two non-trad builders own major plants?

So What Did Lutz (GM) Do? This: The Volt

A tech tour de force



But Nissan has brought the LEAF

The LEAF: 2010
100-mile range

Parent company Renault is serious, too

VÉHICULE ÉLECTRIQUE : LES ORGANES SPÉCIFIQUES
ELECTRIC VEHICLE: CHARACTERISTIC COMPONENTS

1. **BATTERIE LITHIUM-ION**
   LITHIUM-ION BATTERY
2. **ONDULEUR ET TRANSFORMATEUR**
   POWER INVERTER AND TRANSFORMER
3. **BOÎTIER D'INTERCONNEXION ET CHARGEUR**
   JUNCTION BOX AND BATTERY CHARGER
4. **MOTEUR ÉLECTRIQUE ET RÉDUCTEUR**
   ELECTRIC ENGINE AND REDUCER
5. **PRISE DE CHARGE BATTERIE (LENTE/RAPIDE)**
   SLOW/QUICK BATTERY CHARGE SOCKET
6. **AFFICHAGE TABLEAU DE BORD**
   DASHBOARD DISPLAY

Renault-Nissan Alliance. . .

- . . .and the People's Government of Wuhan
- The Irish Government, the ESB, the nation's largest electricity utility, and. . .
- Madrid City Council and. . .
- The municipality of Sao Paulo and. . .
- Milton Keynes Council and. . .
- . . .and All Japan Ryokan Association

All working to deploy EVs and installing EV infrastructure (a.k.a., charging stations)

Because movie starts love EVs, here's the Renault Fluence Z.E @ Cannes

And Ford is bringing this by 2013—Focus Electric

VW Milano Taxi Study

“Electric mobility is the task of the century for the automotive industry. . . . Manufacturers, suppliers, energy providers, scientists, and politicians—everyone must step up to the plate here.”

--Martin Winterkorn, VW Group Chairman, 5/6/11

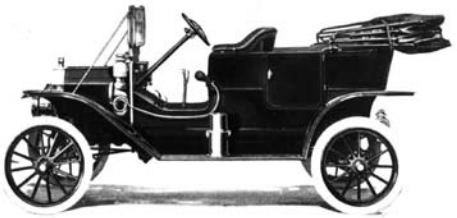
So it is about the diffusion of tech.
And some people are concerned.

Some people are always concerned.

“If I asked people what they wanted, they’d say a better horse.”—Henry Ford

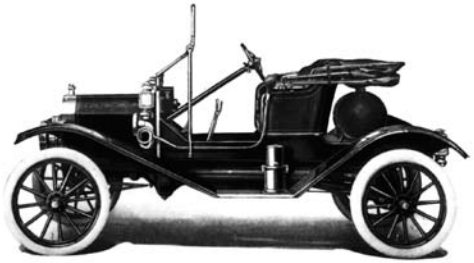
Good thing he didn't listen.

A Complete Line of Model T's to Choose From



5-Passenger Touring Car, Fully Equipped

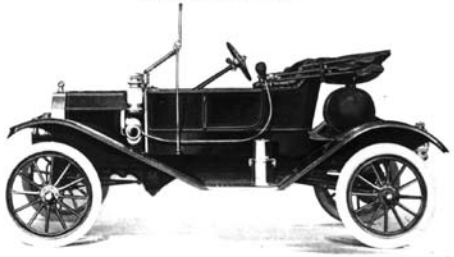
3-Passenger Roadster, Fully Equipped



2-Passenger Open Runabout, Fully Equipped

Ford Car Models Supply Every Demand

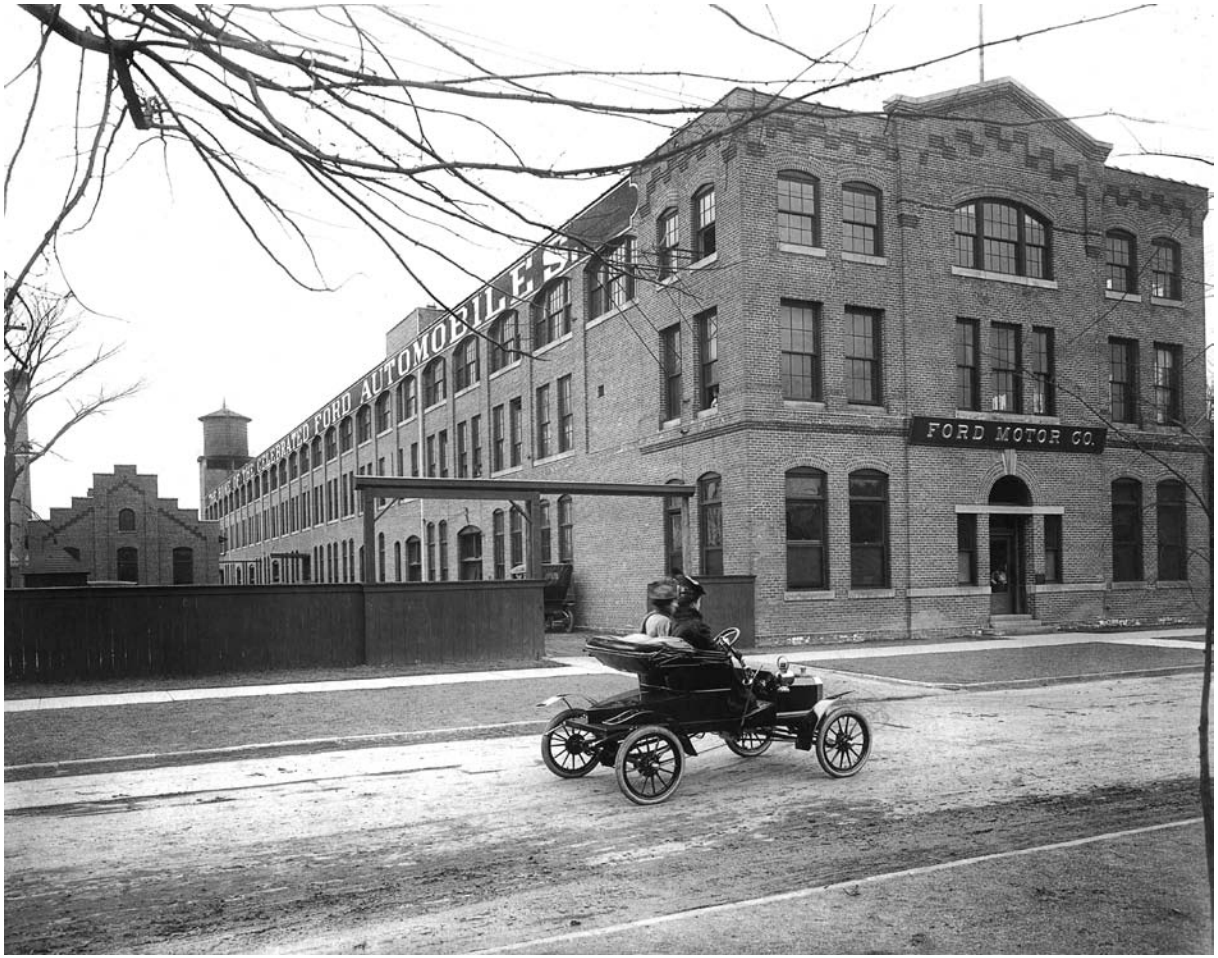
2-Passenger Coupé, Equipped with 3 Oil Lamps, Tubular Horn and Kit of Tools



2-Passenger Torpedo Runabout, Fully Equipped

6-Passenger Town Car, Equipped with 3 Oil Lamps, Tubular Horn and Kit of Tools

Still, the early automobile had issues.



Consider circa 1900

- No gas stations
- No paved roads
- No traffic signs
- No traffic signals
- No AAA
- No headlights
- No roofs
- No self-starters
- No lease programs

Deloitte Consulting's 6 EV barriers

(2010)

1. Familiarity
2. Brand
3. Range
4. Charging
5. Infrastructure
6. Price & ownership cost

Deloitte Consulting's 6 EV barriers
Applied to early cars

1. Familiarity—Who owned a car?
2. Brand—Ford?
3. Range—No gas gauge until 1922
4. Charging—Not many pumps
5. Infrastructure—Not many roads
6. Price & ownership cost--$850 for '08

So as we move to this, we've got to keep things in perspective

China drives past US as world's No.1 auto market

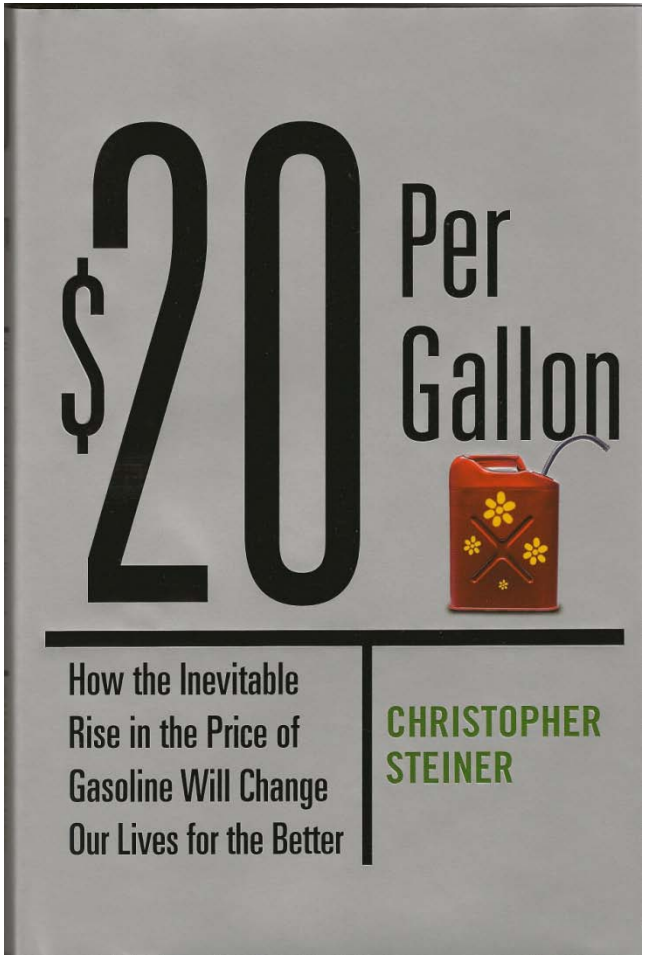
BEIJING, April 21, 2010 (Reuters) - China's auto market, which overtook the United States as the world's largest last year thanks to a raft of policy incentives, has been a major bright spot amid a global industry downturn.

On the one hand, this means plenty of opportunity for vehicle manufacturers in China—nice, for them, but not necessarily helpful here

On the other hand, this means that when the Chinese—who have significant money because of things like this:

--start buying more things like this

How long will it take to get to this?



“The U.S. has 750 cars for every 1,000 people. China. . .has 4 cars for every 1,000 people. If China gets to only half the ownership rate of the U.S., it means an additional 400 million cars on the road. . .like adding another two U.S.’s worth of cars to the world.”—Christopher Steiner

$20 Per Gallon (2009)

And let’s not forget about this:

CAFE

CAFE for Cars

2008: 30.3 mpg

2016: 37.8 mpg

↑ 25%

CAFE for Trucks

2008: 22.2 mpg

2016: 28.8 mpg

↑ 30%

U.S. May Require Up to 7% Annual Fuel-Efficiency Boost for Cars

By Angela Greiling Keane - May 11, 2011

The U.S. may require annual fuel- efficiency improvements of 2 percent to 7 percent from 2017 to 2025 for cars and light trucks, according to the National Highway Traffic Safety Administration.

The agency said in a May 10 Federal Register notice it will evaluate the costs and environmental effects of boosting fuel efficiency in the proposed rule it's scheduled to publish in September.

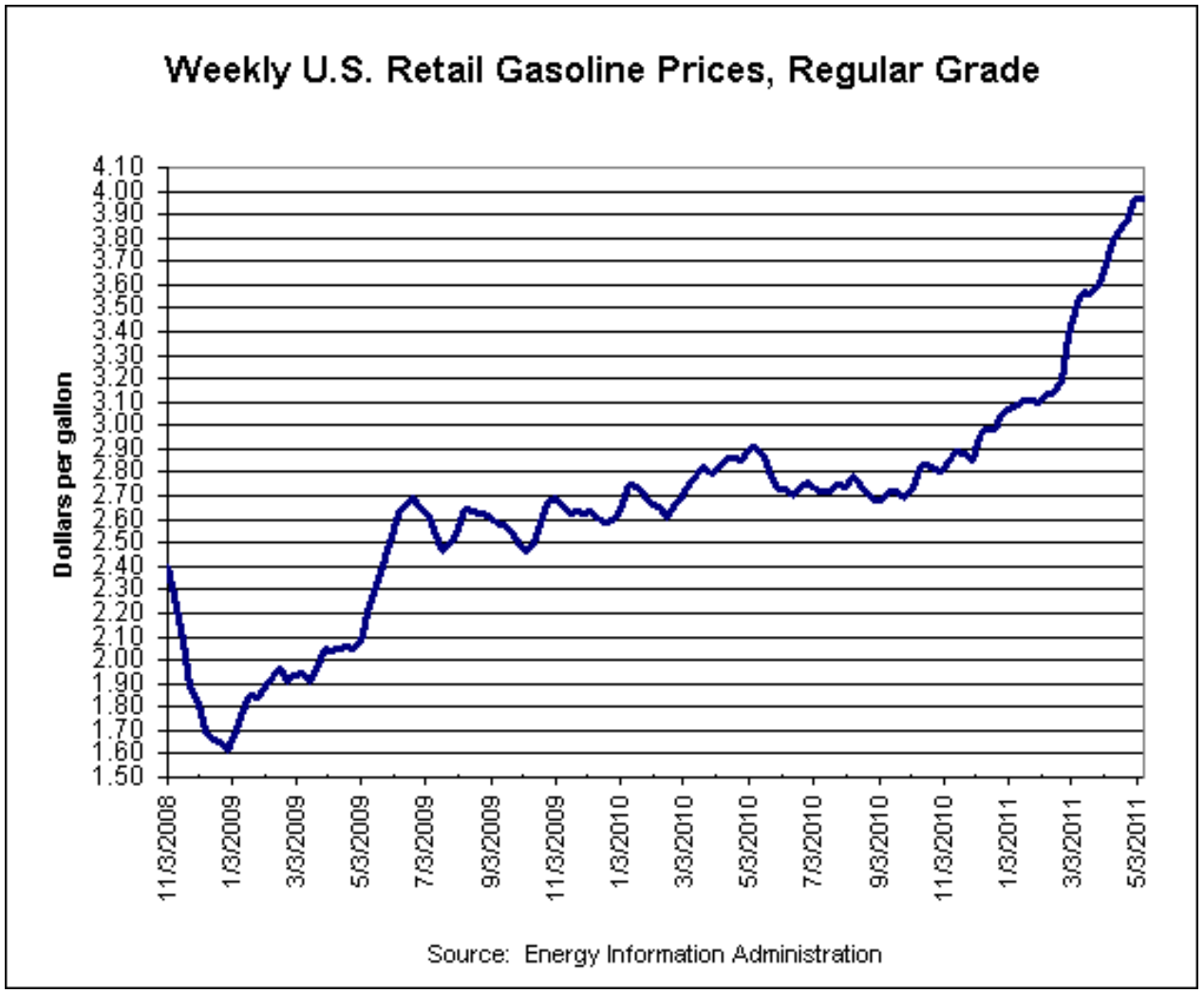
Automakers must have a fleet-wide average of 34.1 miles per gallon, according to the existing fuel-economy rule that applies through model-year 2016 vehicles. NHTSA is developing the next rule with the Environmental Protection Agency and California's Air Resources Board.

The U.S. said last year automakers selling cars in the U.S. may be required to almost double fuel economy to as much as 62 miles per gallon by 2025 models with annual fuel-economy increases of as much as 6 percent.

"Over the next few months, regulators are scheduled to set the next round of U.S. fuel economy standards for manufacturers. Among the proposals under consideration is one that would lift average fuel economy under the law to as much as 62 mpg by 2025."

Peter Whorisky, *The Washington Post*, "Obama administration set to raise fuel efficiency standards, but by how much?", May 12, 2011

And there is this



According to Energy Information Administration, during the week of 5/9/2011
regular gas cost $1.06/gallon more than a year earlier

And let’s not forget about this

So is it all smalls, hybrids, or EVs?

Nope.

These are not going away anytime soon

Chevrolet Tahoe

2010 Vortec 5.3L V-8 VVT (LC9)

But they need to get more efficient.
(Remember those CAFE numbers?)

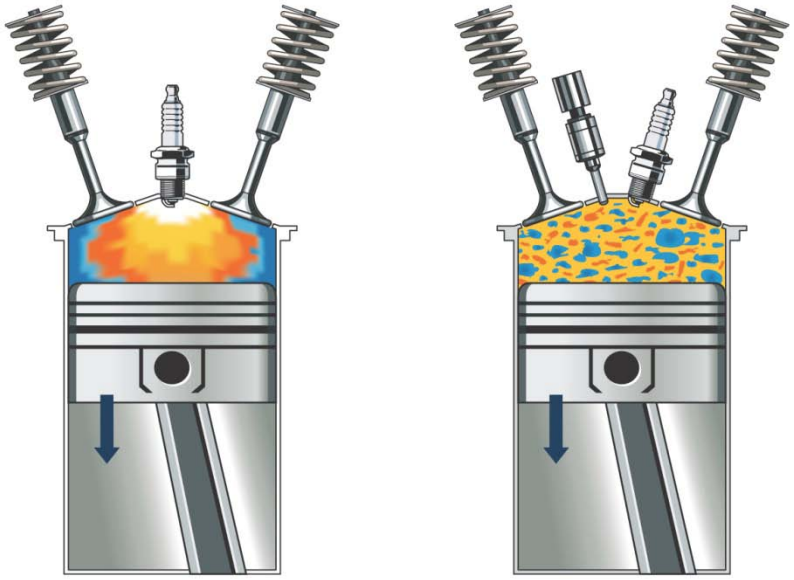
So here's how to build a better engine: what you get & what it costs (data from John German, then with American Honda, now with International Council on Clean Transportation)

Buick Enclave

2010 GM 3.6L V-6 VVT DI (LLT)

Homogeneous charge compression ignition (HCCI)

cost: $233-606 benefit: 10-12%



Camless valve operation

cost: $336-673 benefit: 2.5% Valeo

Lean Burn Direct Injection

cost: $500-750 benefit: 9-16% GM

GMC Terrain

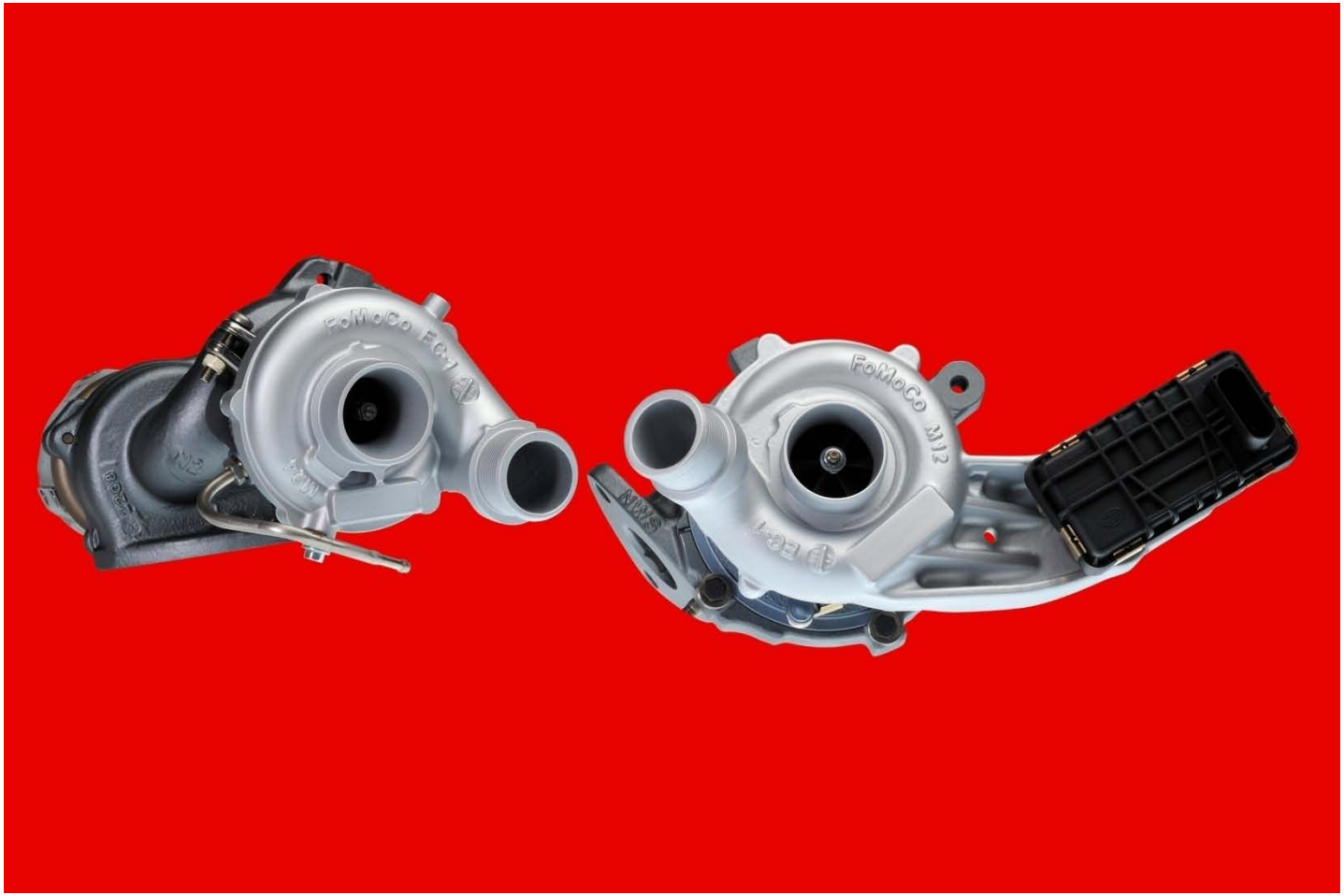
2010 Ecotec 2.4L I-4 VVT DI (LAF)

Piston w/oil cooling jet for DI

2010 Ecotec 2.4L I-4 VVT DI (LAF)
Piston Head and Oil Cooling Jet

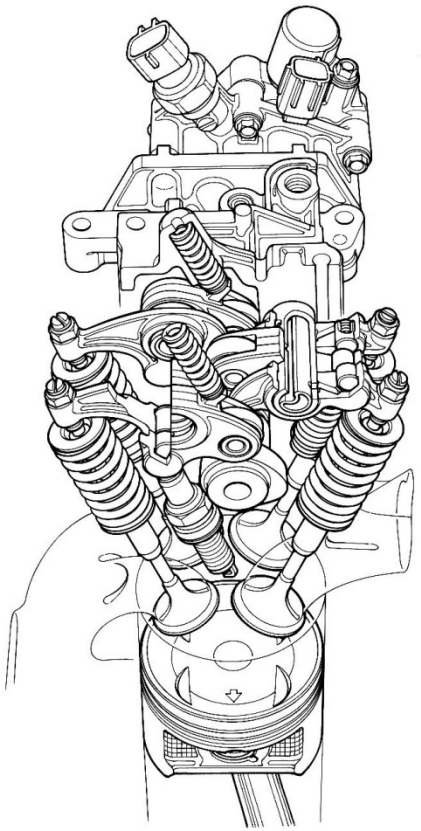
Turbocharging

cost: $120-690 benefit: 5-7% Honeywell



Cylinder deactivation

cost: $203-229 benefit: 4.5-6% Honda



Start-stop systems

Cost: $563-600 Benefit: 7.5% GM

Multivalve DOHC with variable valve timing and lift

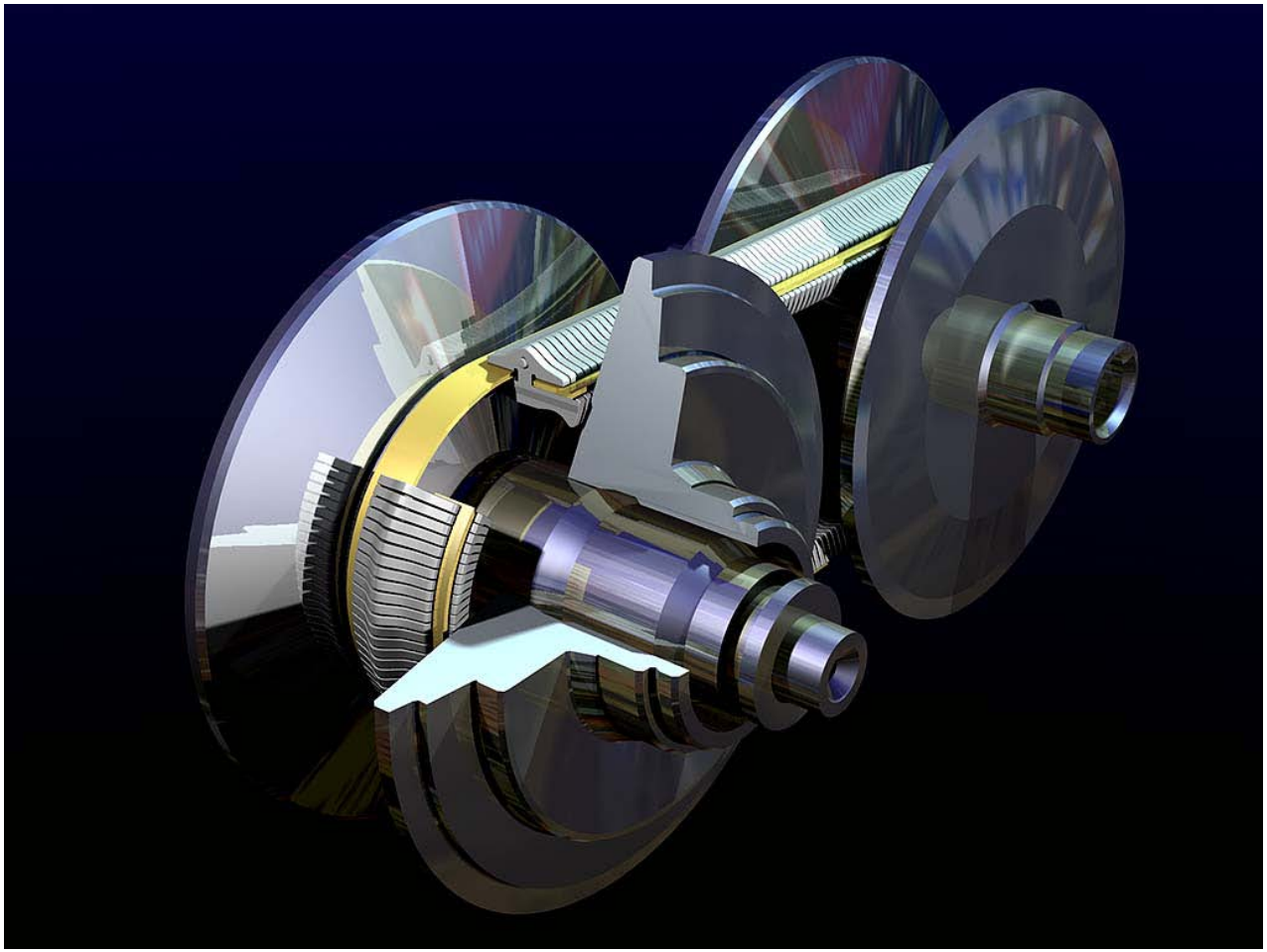
cost (6 cyl): $1,262 benefit: 1-4%

Electric Power Steering

cost: $118-197 benefit: 1.5-2% Nexteer

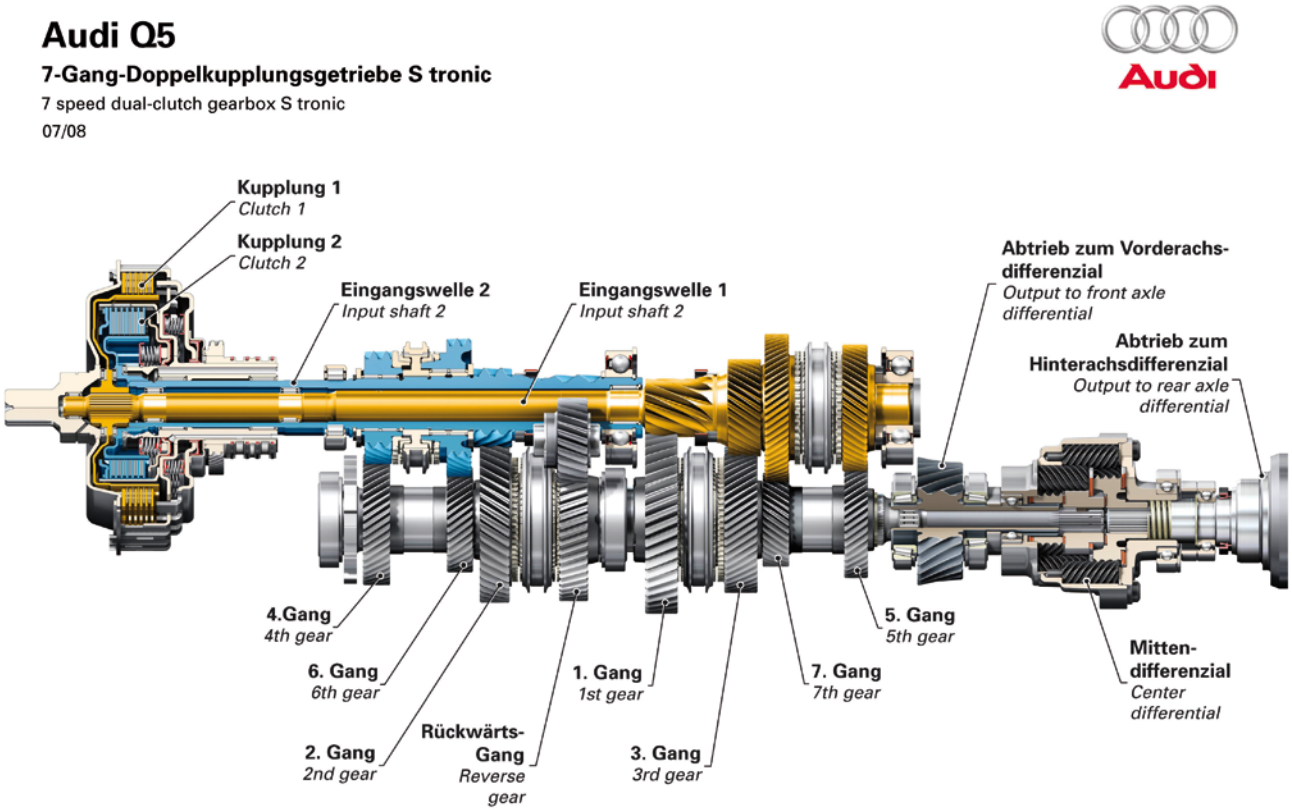
Continuously variable transmission

cost: $100-139 benefit: 3-5% Nissan



Dual-clutch AT

cost: $141 benefit: 4.5-7.5%



H.E. Alternator & electrification

cost: $124-166 benefit: 1-2% Denso

Bottom line

Internal combustion engines have to get much better. It will take new tech. And new manufacturing processes.

Think smaller. Simpler. More efficient. More elegant.

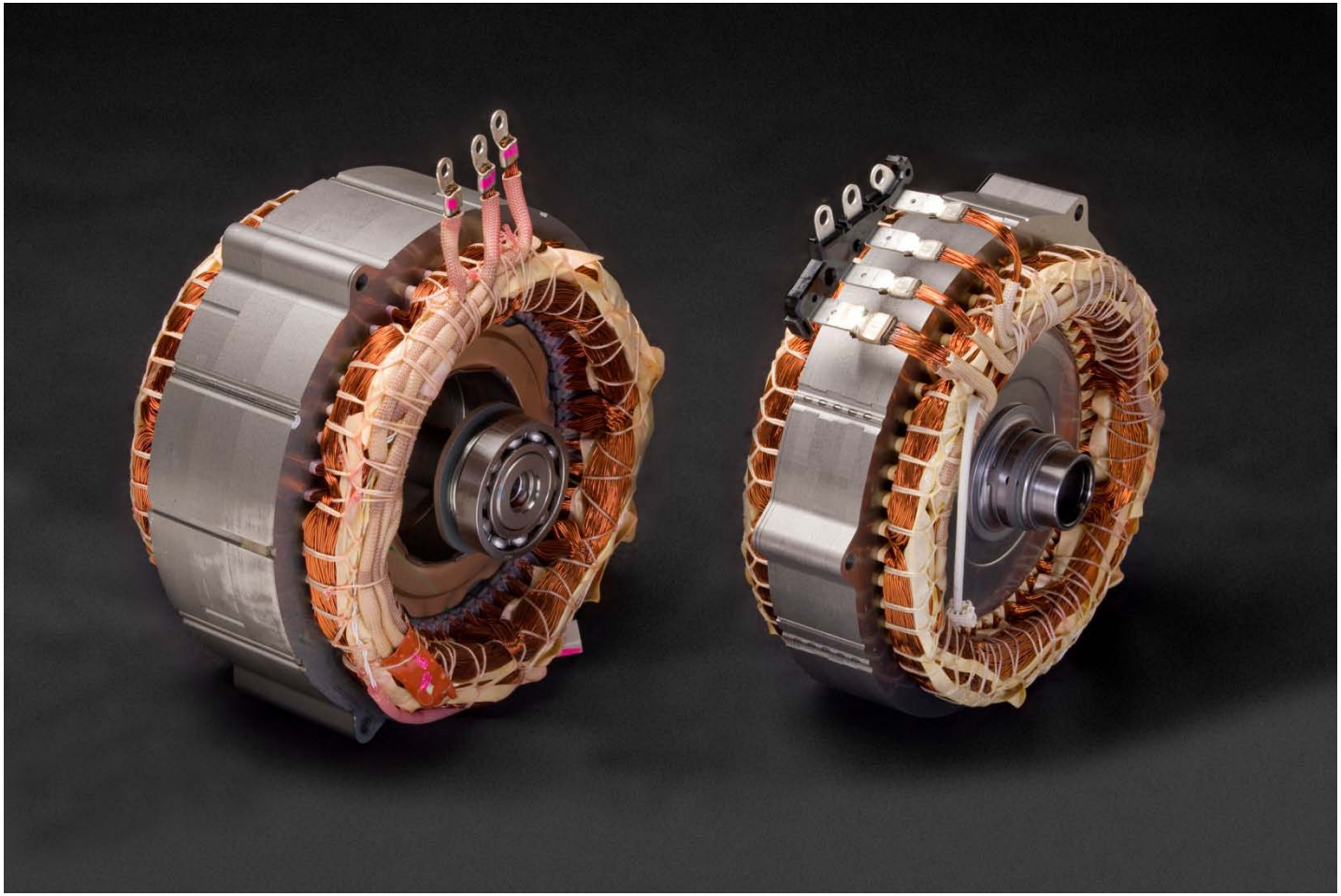
Cases in point:

The changes to the Prius hybrid system.

Changes: 2nd & 3rd gen Prius inverters

Changes: 2nd & 3rd gen Prius MG1

Changes: 2nd & 3rd gen MG2



Changes: 2nd & 3rd gen Prius transaxles

Changes: 2nd & 3rd Gen Prius power split device

No auto company is getting here without all that

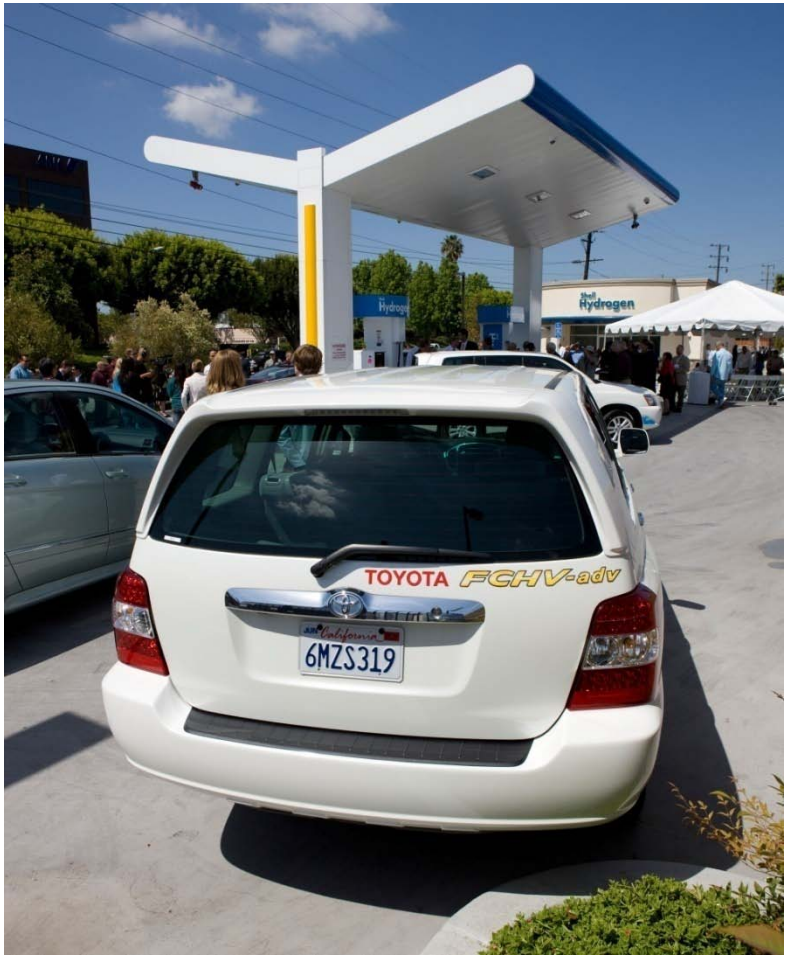
CAFE for cars:

2008: 30.3 mpg

2016: 37.8 mpg

↑ 25%

And there is the Hydrogen future



Toyota, Air Products, Shell, DOE, and South Coast Air Quality Mgmt. District open 1st pipeline-fed station in Torrance, CA May 10, 2011

“We plan to bring a fuel cell vehicle to market in 2015, or sooner.”

Chris Hostetter, group vp, Product & Strategic Planning, Toyota Motor Sales

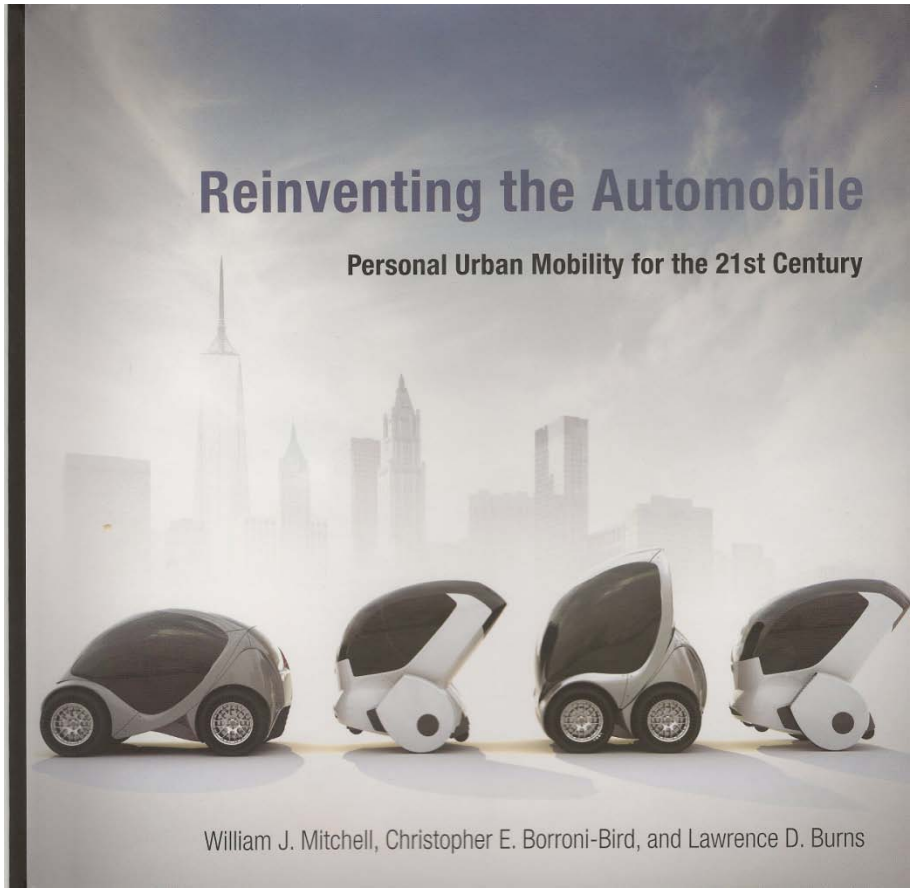
Honda FCX Clarity driver likes it, too

Shai Agassi: Making a Better Place

Better Place has signed partnerships with:

- Israel
- Denmark
- Australia
- California
- Hawaii
- Ontario, Canada
- Japan

“Importantly, the new DNA transforms the automobile from simply a means to get from point A to point B to a node in a global network that integrates the flows of vehicle, information, and power.”



Shanghai World Expo Rolling in GM ENVI vehicles

GM & Segway: 2030

Bottom Line: How many people thought this was feasible?

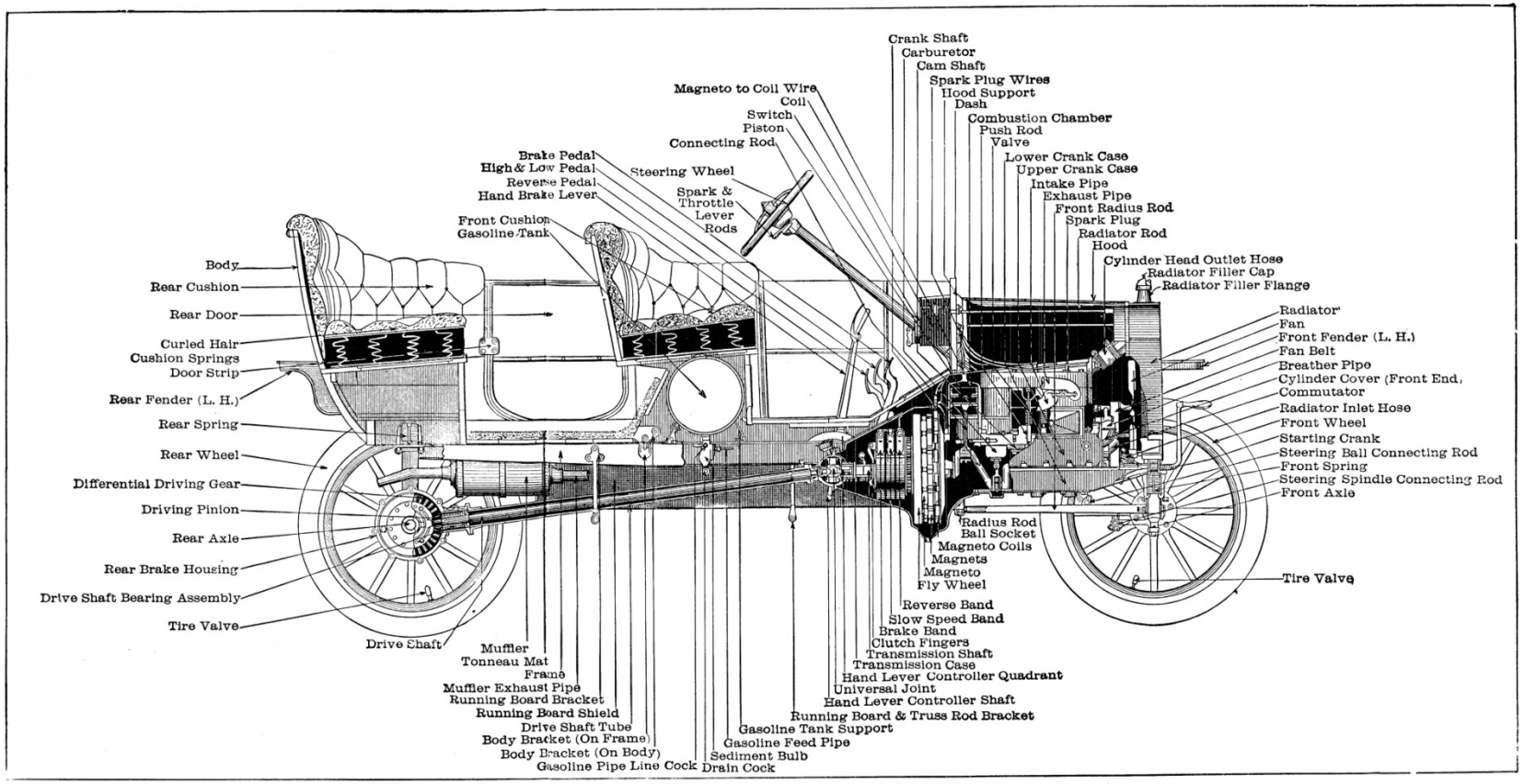
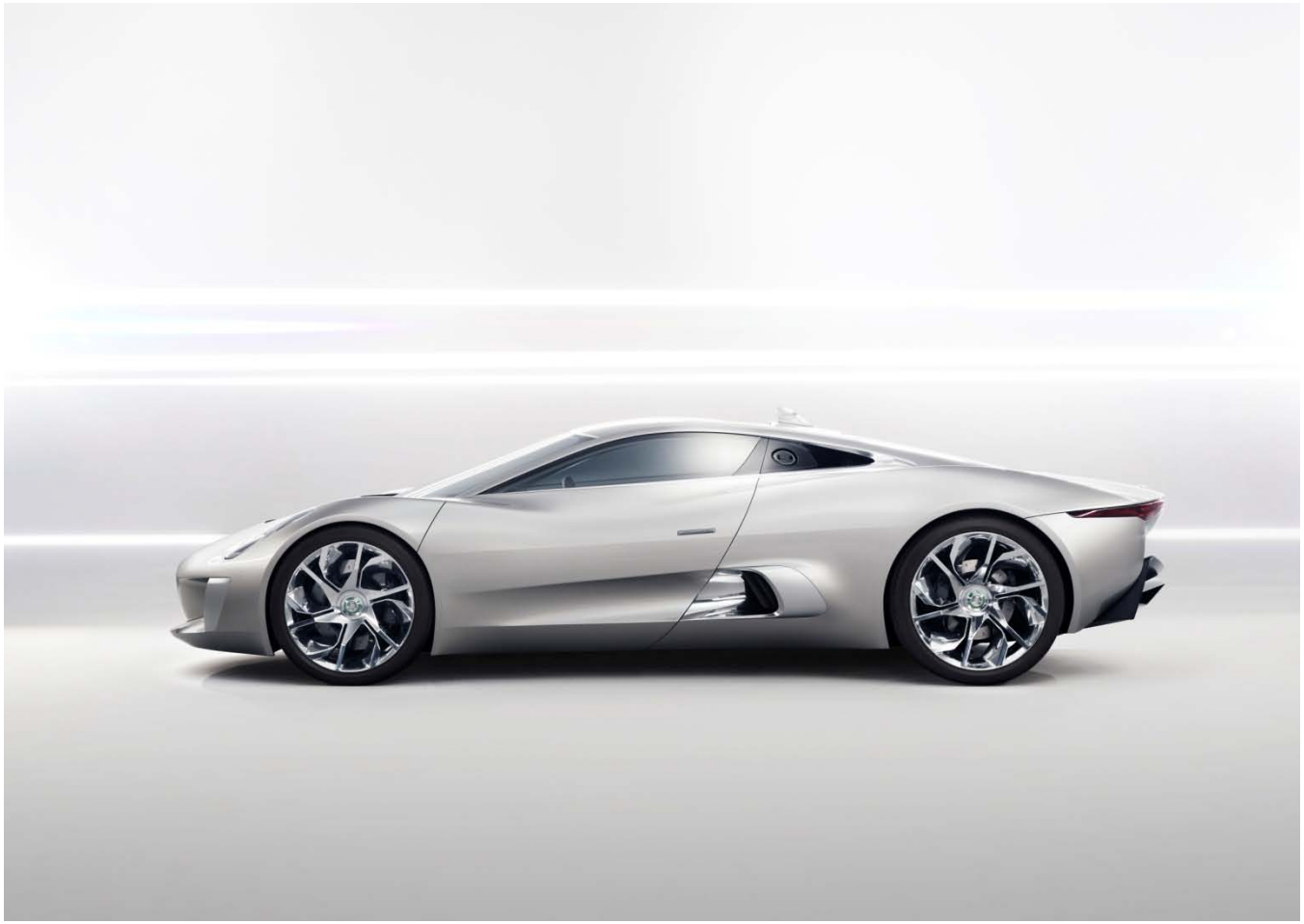


Fig. 468.—Side Sectional View of the Ford Model T Motor Car, the Most Widely Used Automobile in the World.

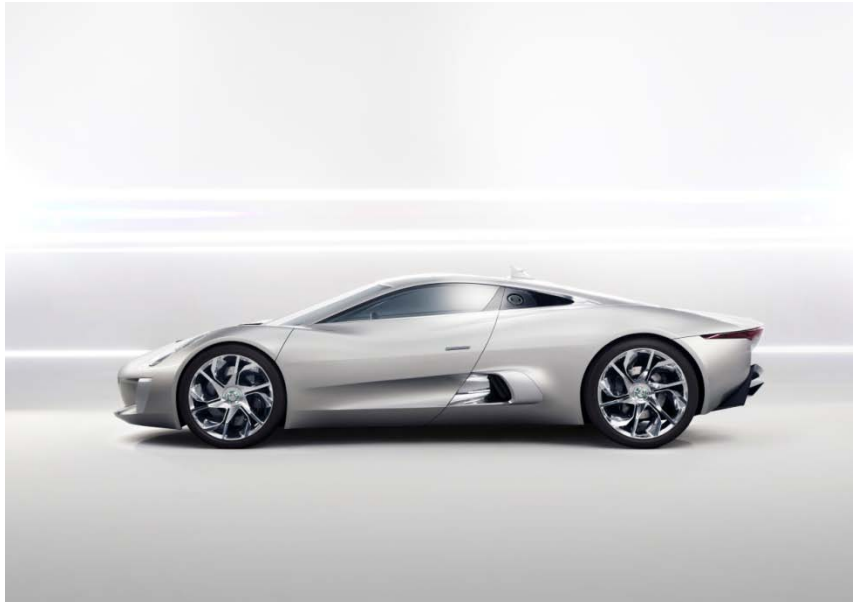
So maybe. . .

Seduction



Jaguar C-X75

- 205 mph
- 0 to 62 mph in 3.4 seconds
- Four 145-kW electric motors at each wheel
- Two 80K rpm micro turbines
- 560-mile range



Jaguar C-X75

- “There is a clear business case for this exclusive halo model. No other vehicle will better signify Jaguar’s renewed confidence and excellence in technological innovation than this.” --Adrian Hallmark, Jaguar Brand Director
- 250 to be produced
- Price starts at £700,000

Remember: Back in the day (1912) this was exotic, too

But I’m guessing rather than the Jag, most of us will get something like this

Thanks