Advancing Fuel Cell Vehicles

American Honda Motor Co., Inc.

Air Quality –
Zero Emission
Vehicle

- Greenhouse gas reductions
- Use of diverse energy sources
-Use of renewable energy

Stephen Ellis

Manager, Fuel Cell Vehicle Marketing

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1st Customer: City of Los Angeles

December 2, 2002

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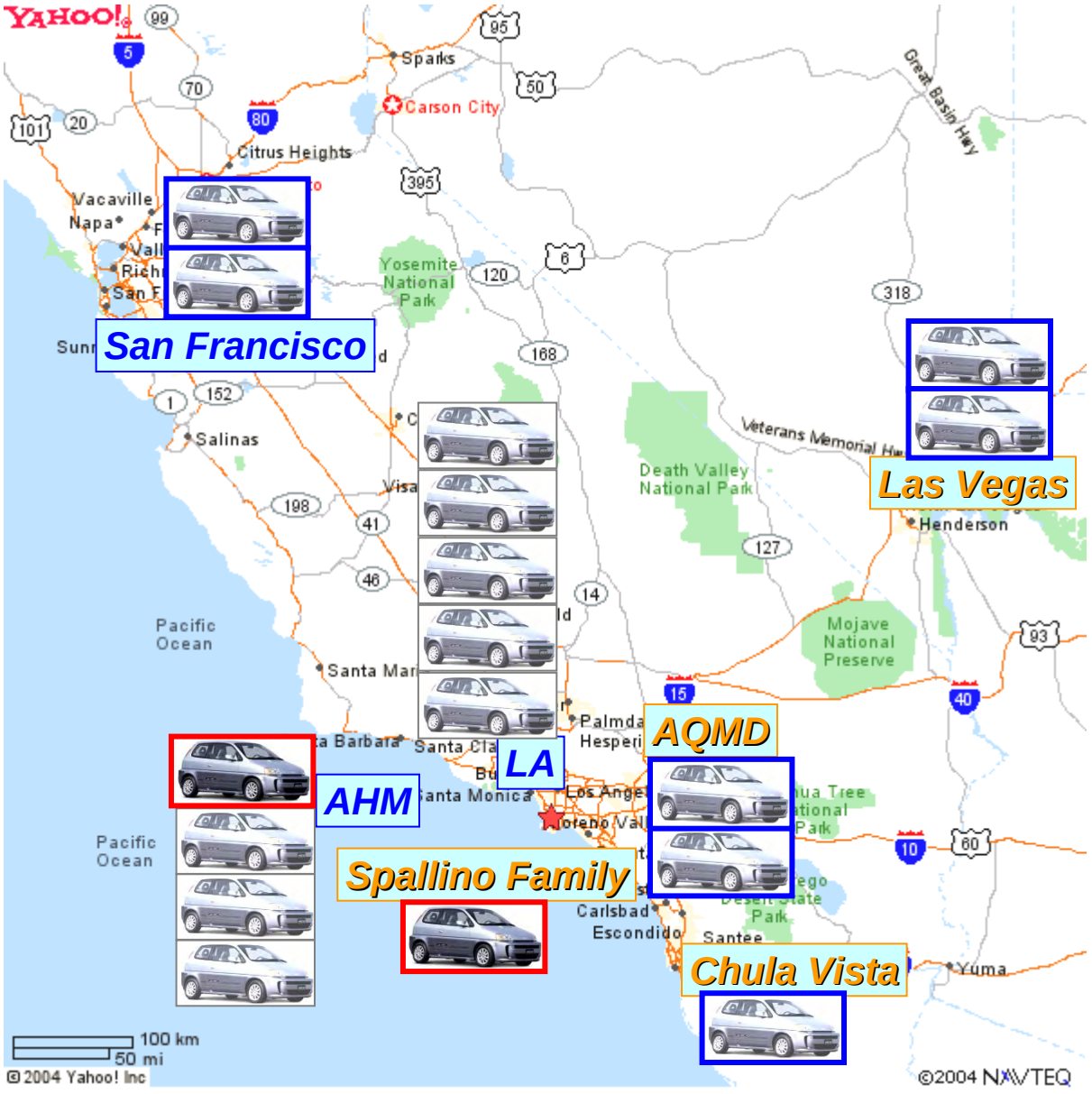
Honda FCX Vehicles in Daily Use

California & Nevada



New York

: 03M FCX

: 04M FCX

: 05M FC

FCV Success: Importance of Approach

Honda's Focus:

1. *Fuel Cell Technology Advancement*
2. *Customer Use & Feedback*
3. *H_2 Infrastructure & Innovation*

& "Co-opetition"

(e.g. CA Fuel Cell Partnership & CA H2 Network)

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Honda's Steps to date:

1. ***Design and deliver FCV for a real customers (Starting with City of LA, 2002)***
2. ***Confirm FCV Freeze-capable performance (New York State Gov't, Winter 2004)***
3. ***Deliver FCV for individual consumer use (Starting in So. California, June 2005)***

Start of Individual Consumer Leases

Consumer use will be the key to AFV commercial success - Effort on vehicle technology and market-based activity, but, where do we go from here?

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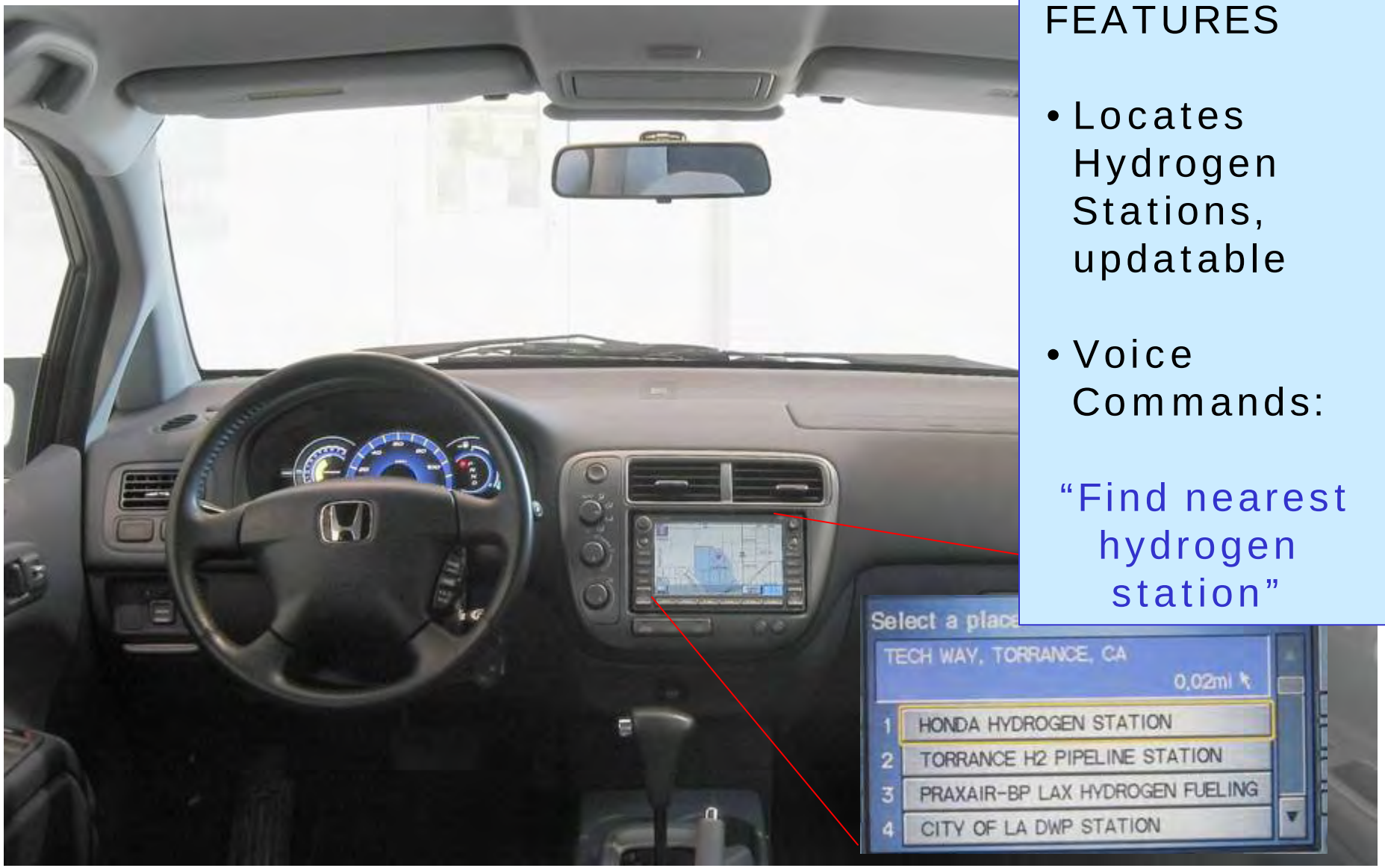
- Honda FCX Navigation System -
Maps Hydrogen Station Locations



FEATURES

- Locates Hydrogen Stations, updatable
- Voice Commands:

"Find nearest hydrogen station"

Honda FC Power Plant Technology Advancements

Honda's New Fuel Cell Stack Material Advancements:

FCV widespread use

Simplified Construction and Materials for Automotive Fuel Cells:

- **Stamped Metal Flow Plates**
  (vs. Carbon and Resin)
- **Hydrocarbon Membranes**
  (vs. Fluorine Compounds)

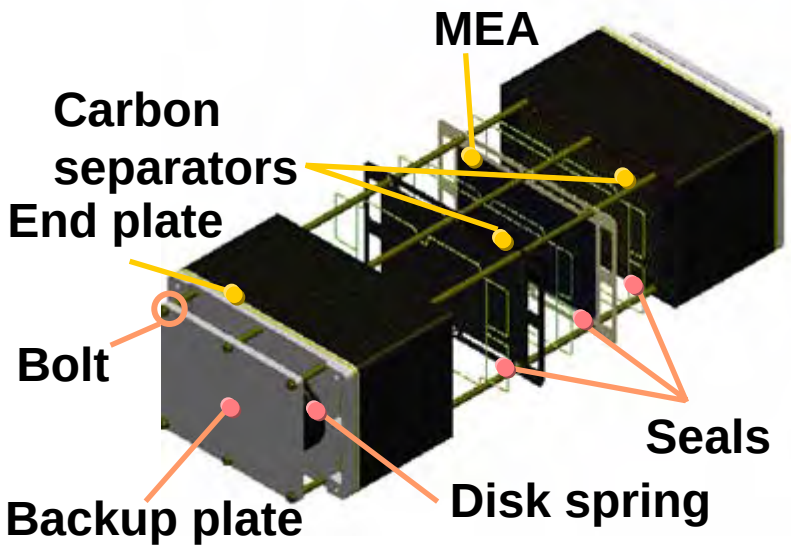
Compact, High output.

Environmental adaptability

for volume production in the future.

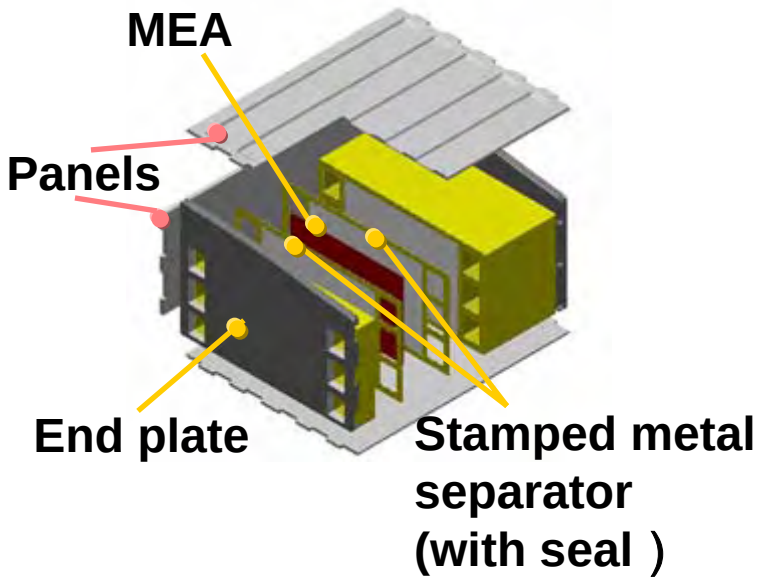
Fuel Cell Engineering

Conventional Fuel Cell :



- Carbon & Resin plates
- Tensioning bolts and springs
- Separate seal parts

Latest Honda Fuel Cell:

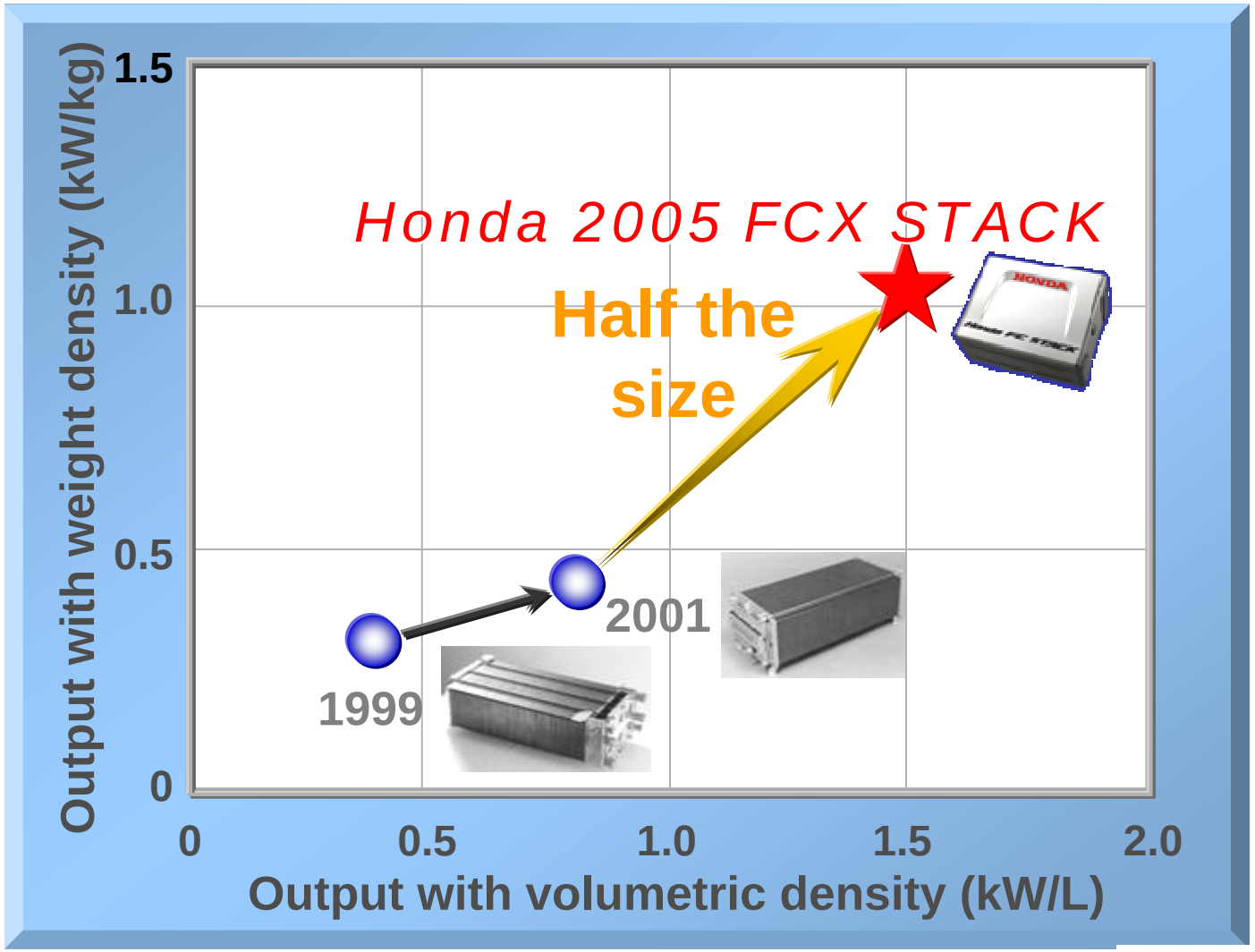


- Stamped metal plates
- No tensioning bolts
- No separate seals

Half the parts!

Fuel Cell Performance

(rapid advances in size & weight reduction)



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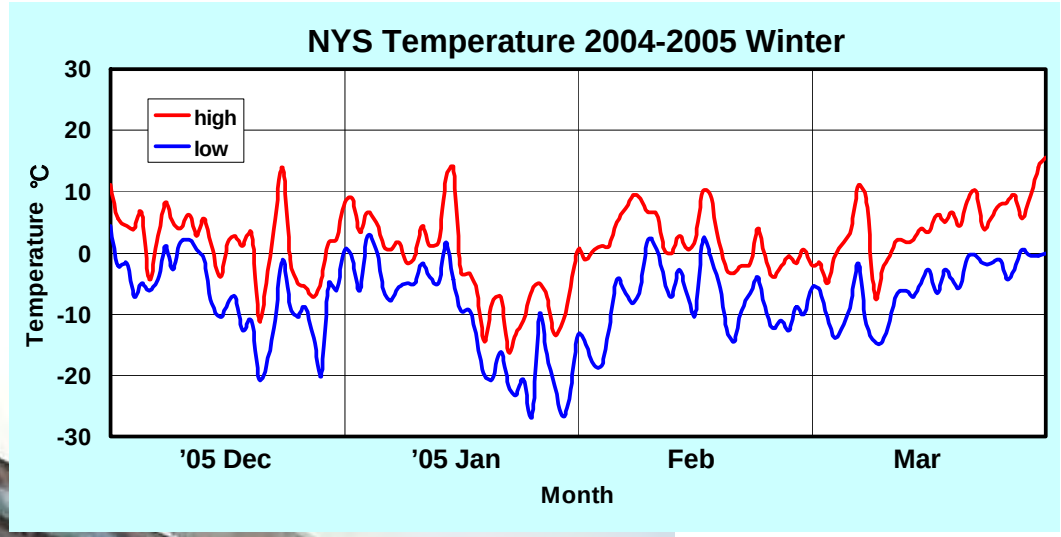
Customer Environment

New York State (Albany)



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Honda Home Energy Station (HES)

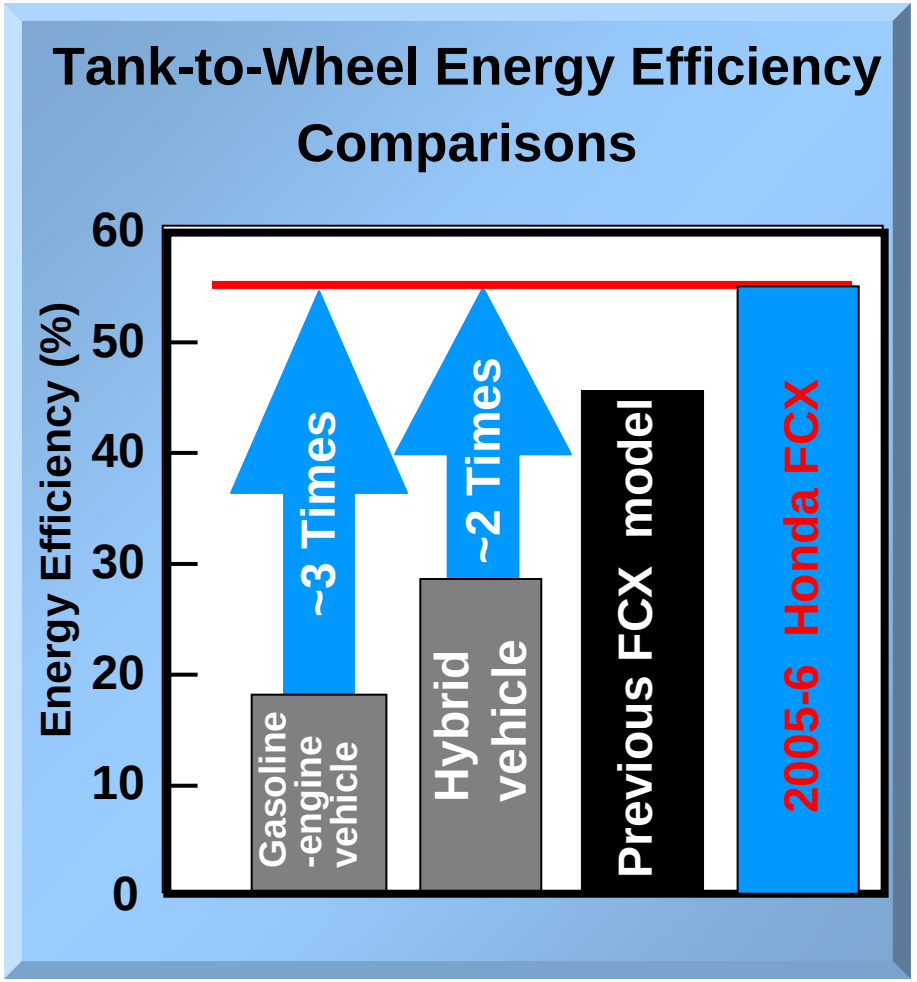
- Third Generation CHP+H2
  - Honda / Plug Power Partnership
  - 30% Smaller Size
  - + 25% Electrical Output
  - + 50% H2 Production & Storage

Fuel Cell Vehicle Energy Efficiency

Efficiency on City Driving Cycle

(Work done at wheels divided by energy consumed from tank)

3 times that of a conventional Gasoline Vehicle on City Drive Cycle



Honda calculations based on production cars, EPA's City driving cycle

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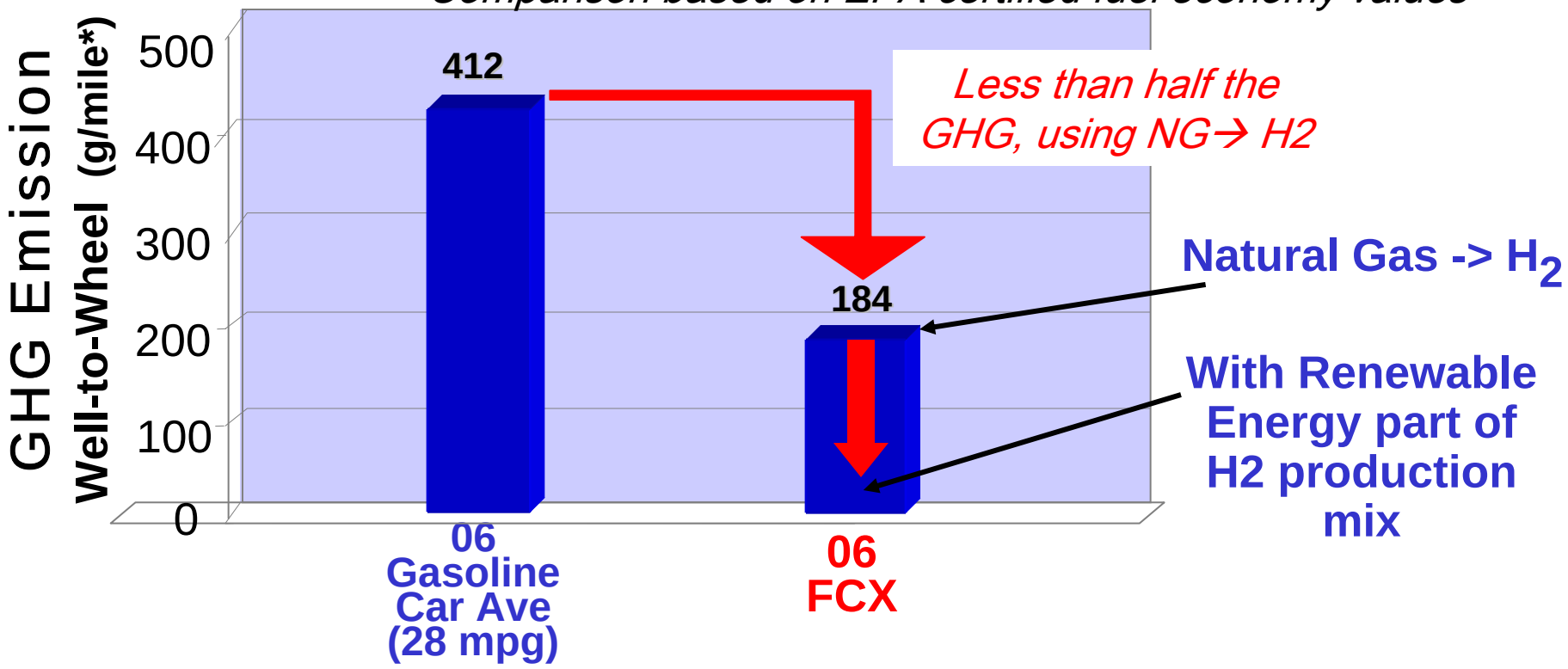
Comparison of Greenhouse Gas
Well-to-Wheel
GREET Model, EPA Combined F.E.

Comparison based on EPA certified fuel economy values



DOE GREET 1.6 model evaluation

Well-To-Wheel analysis using EPA (CAFÉ) Combined Fuel Economy, FRFG, CO2-equivalent GHG

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Comparison of Greenhouse Gas, Well-to-Wheel

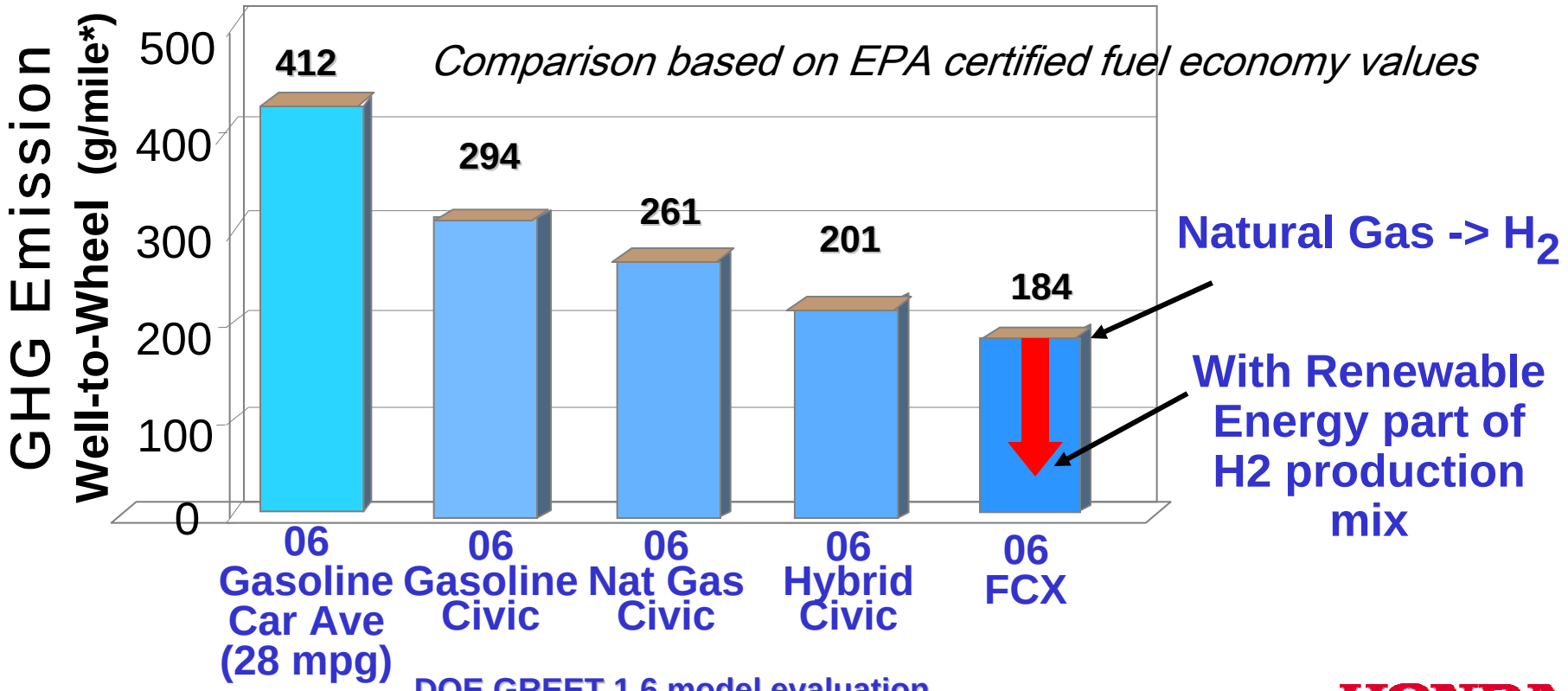
GREET Model, EPA Combined F.E.

FCX less than half the GHG of conventional gasoline sedan of similar weight, even with H2 made from natural gas

Energy Sustainability

Stable Climate (GHG)

Healthy Air Quality



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FCX

Next Honda Fuel Cell Vehicle Concept

Introduction Timing: 3-4 years from now
Drivable prototype later this year (2006)

- 4 Door Sedan Design
- New FC architecture (V-flow)
- Low Floor Height
- Compact FC Stack hidden between seats

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Vehicle and Home-Refueling Combination

- New Value for consumers
- Convenience
- Maximum Energy Efficiency
- Minimize CO2

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Hierarchy of Honda Energy Choices

BENEFITS TO SOCIETY

GOOD

CLEAN GASOLINE

- Ultra Low/Near Zero emissions
- Gasoline will be the dominant "clean" fuel for the short and mid term

BETTER

GASOLINE-ELECTRIC HYBRIDS

- Near zero emissions
- Higher MPG/less CO2
- Decreases petroleum use
- Reduced fuel cost
- Innovative proven technology
- Fueled with gasoline

NO NEW INFRA

BEST

NATURAL GAS VEHICLE

- Near zero emissions
- Domestic fuel
- Displaces petroleum
- Proven technology
- 25% less CO2
- Home refueling
- Best alternative fuel for many decades
- Path to H2

NEW INFRA

ULTIMATE

HYDROGEN FUEL CELL

- Zero emissions
- Cleanest fuel, derived from natural gas or renewable energy
- Displaces petroleum
- Potential for home refueling
- Uses existing natural gas infrastructure

The Fuel Cell Challenge

- The difficult balance is to promote Fuel Cell Vehicle and H2 technology today, without over promising it as a near-term solution.

- Rather Fuel Cell and Hydrogen is an opportunity for sustainable transportation in the future... 10 ~ 20 years from now. The proliferation pathway and rate may be much slower than Hybrids due to higher costs and an all new refueling network.

- Keeping the public interested over this long timeframe will be challenging.

- All economic arguments against hydrogen must be weighed against the question: "What will the price of oil be in 10 ~ 20 years".

- Expensive technologies today may be viable solutions tomorrow...

- Therefore, government can help bridge the financial gap

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