



power to change the world®

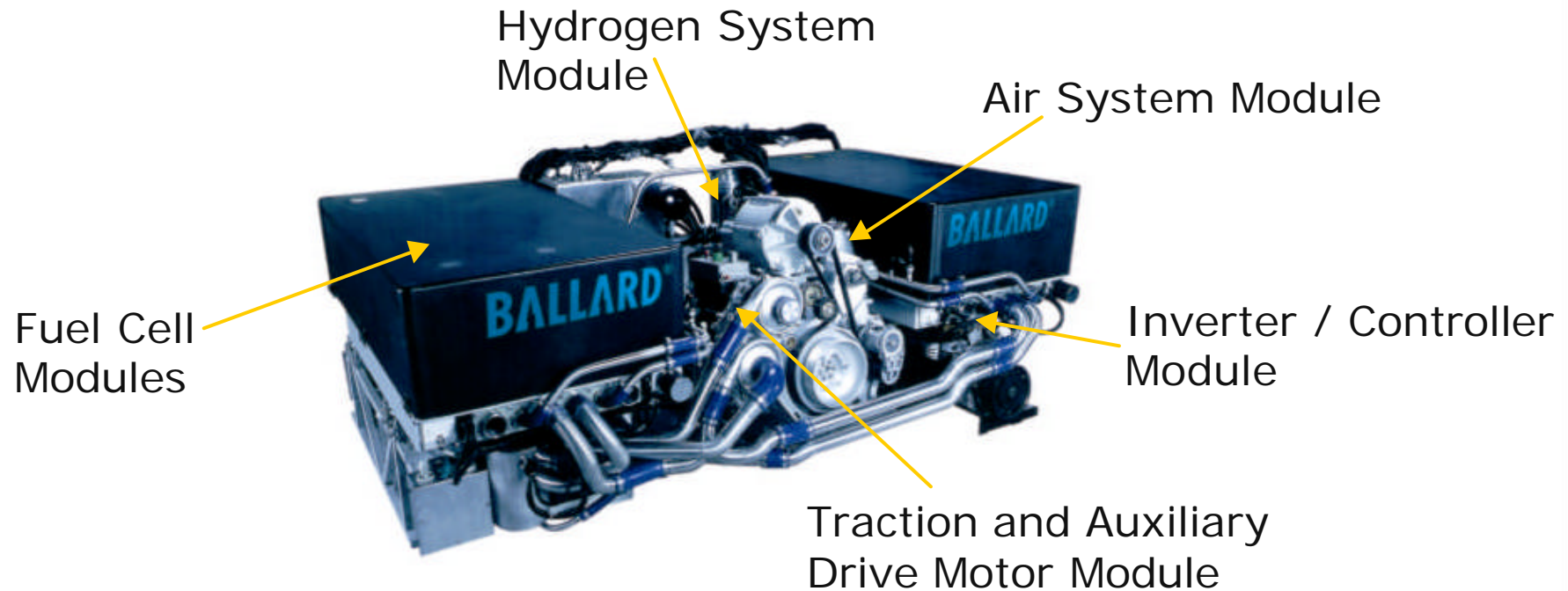
Ballard Power Systems

BALLARD®

Ballard® Heavy-Duty Engines

Xcellsis™ HY-205-4 Fuel Cell Engine

BALLARD®



stack gross power: 250 kW
system net power: 205kW

Buses Equipped With Ballard[®] Fuel Cell Engines



1995



P2 Bus

1997



NEBUS

1998



P3 Buses in Vancouver and Chicago

1999



ZEBUS

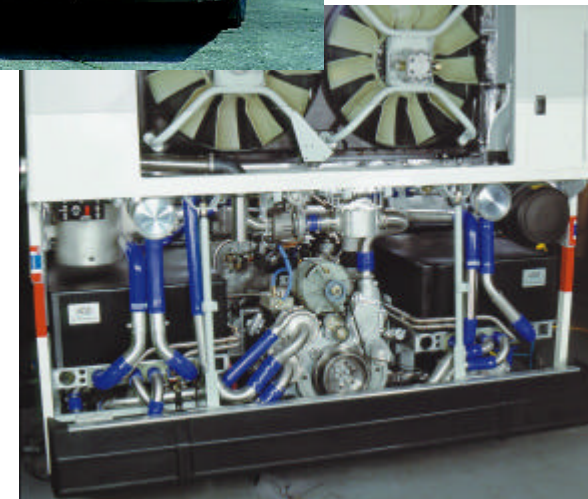
2003



Citaro Fuel Cell Bus

Xcellsis™ ZEBus

BALLARD®

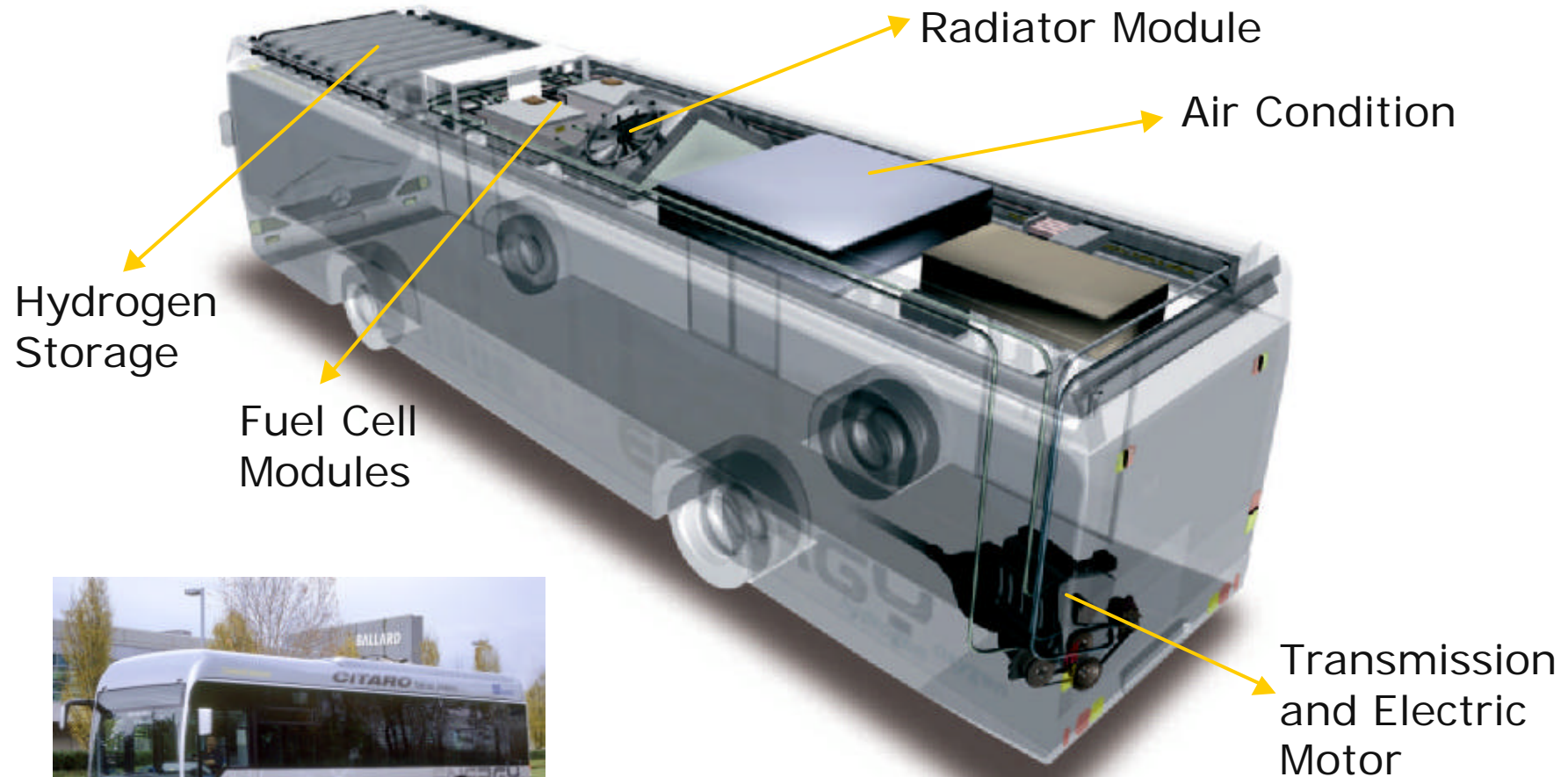


System power: 205 kW

Fuel: Gaseous Hydrogen

Emissions: ZEV

Xcellsis™ HY-205-5 Fuel Cell Engine in a European Transit Bus





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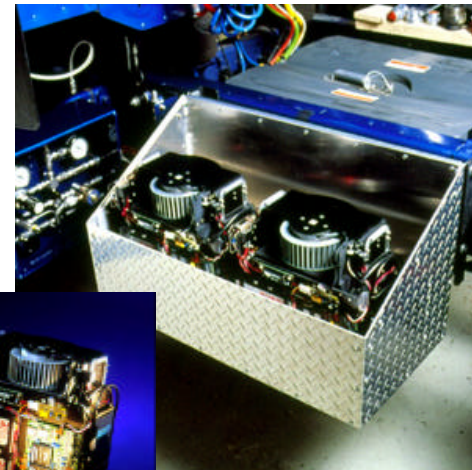
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Ballard® Auxiliary Power Unit - APU -

Hydrogen APU for Freightliner

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Providing a heavy-duty truck with power for comfort and convenience accessories without idling the engine



Fuel Cell System

Power:

1.4 kW

Voltage:

120 VAC / 12 VDC

Stack:

PEM

Fueling system

Fuel:

Hydrogen*

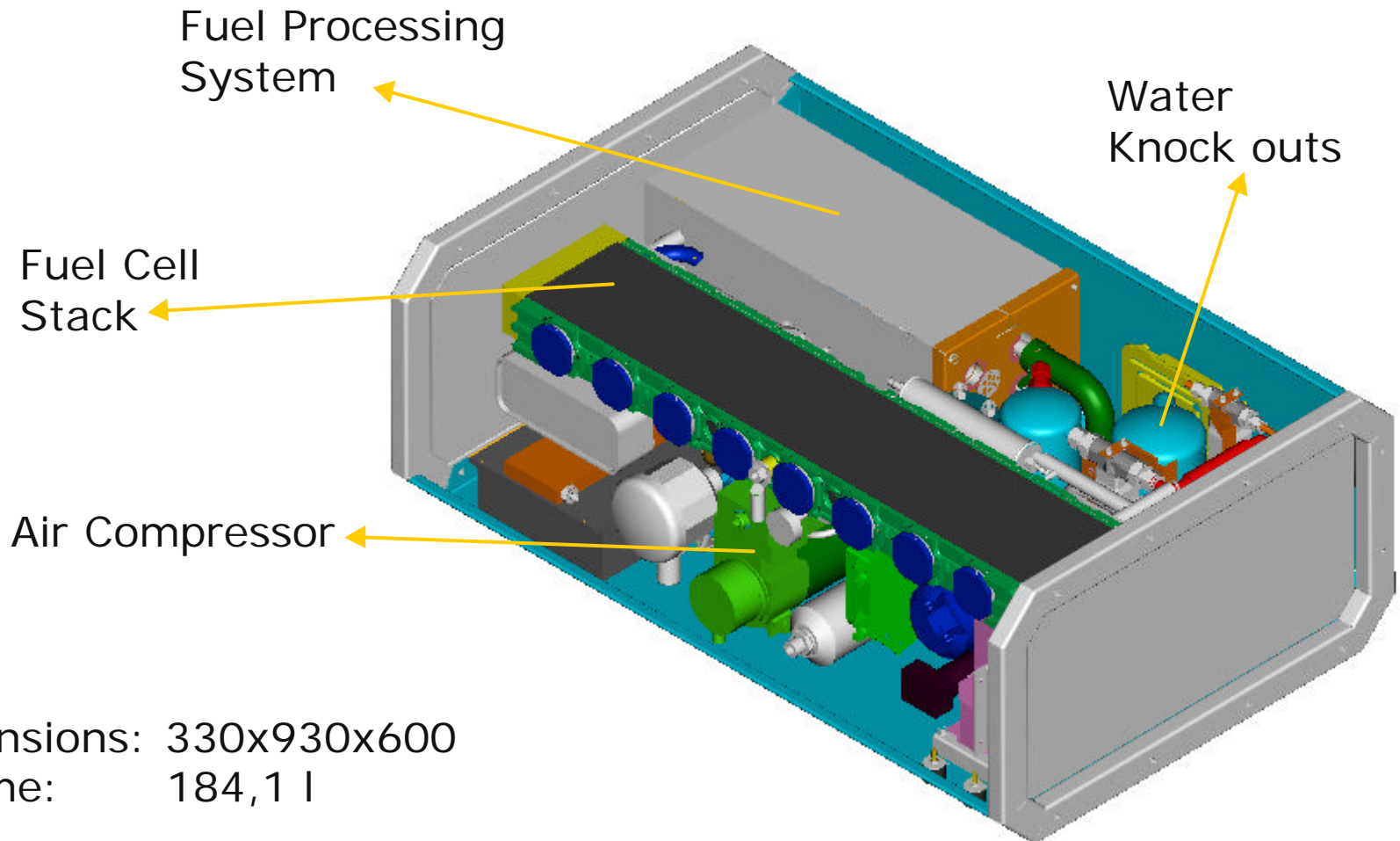
Storage:

liquid

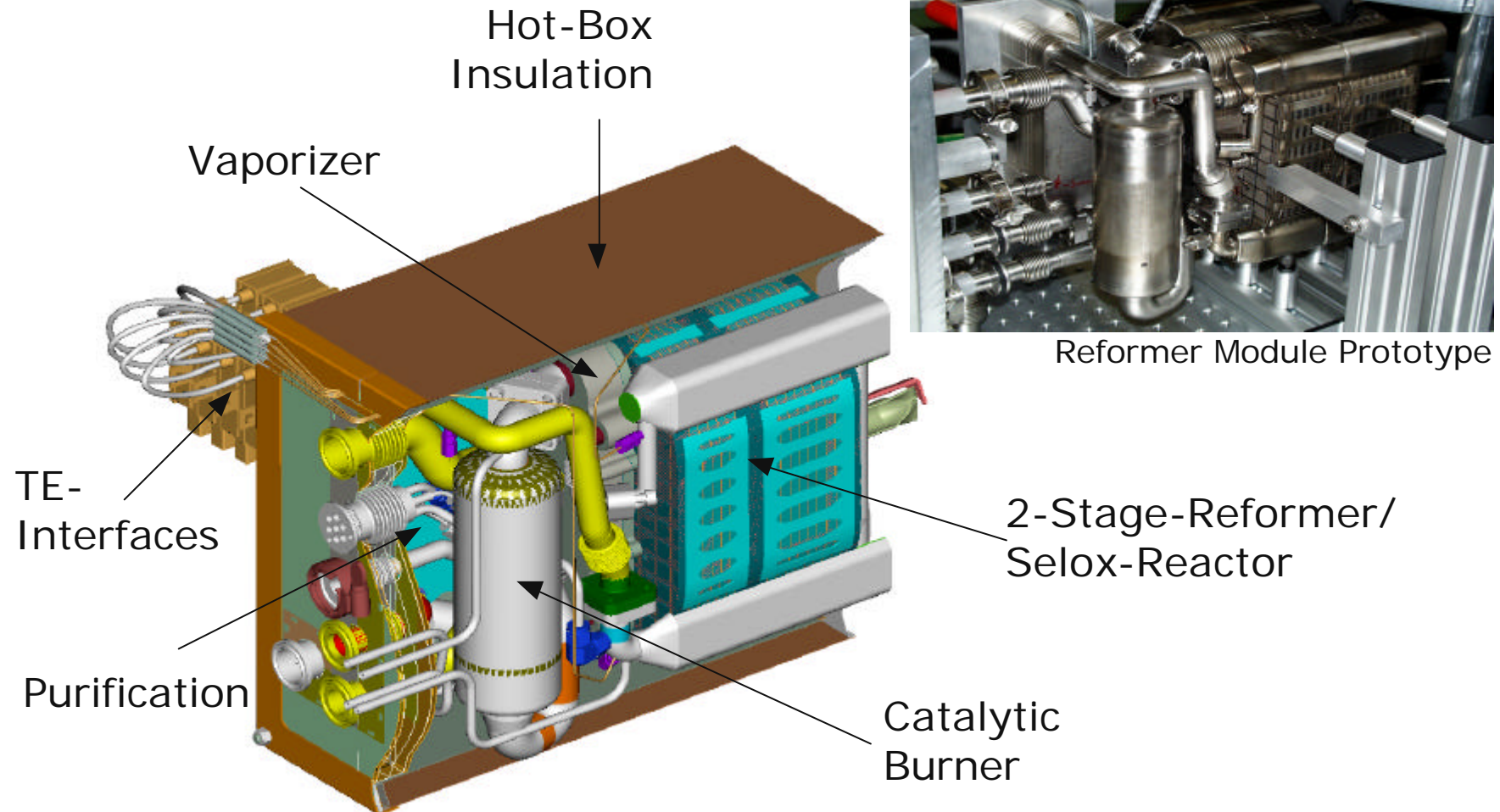
* fuel for commercialization
t.b.d.

Ballard® Auxiliary Power Unit Xcellsis™ ME-5-1

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Xcellsis™ ME-5-1 Reformer Module





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Projects

- CUTE
- CaFCP

CUTE (Clean Urban Transport for Europe) - European Fuel Cell Bus Project

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Joint project of Evobus and Ballard

Timeframe: • market entry end of 2002 / beginning of 2003



Schedule:

- Construction and durability test of a CITARO-based prototype in 2000 and 2001
- Construction of 30 CITARO-based fuel cell buses in 2003
- Two years of fully supported everyday commercial operation starting end of 2002
- different operating conditions and infrastructure options

Participating European Cities

Amsterdam - Netherlands

Barcelona - Spain

Madrid - Spain

Hamburg - Germany

Stuttgart - Germany

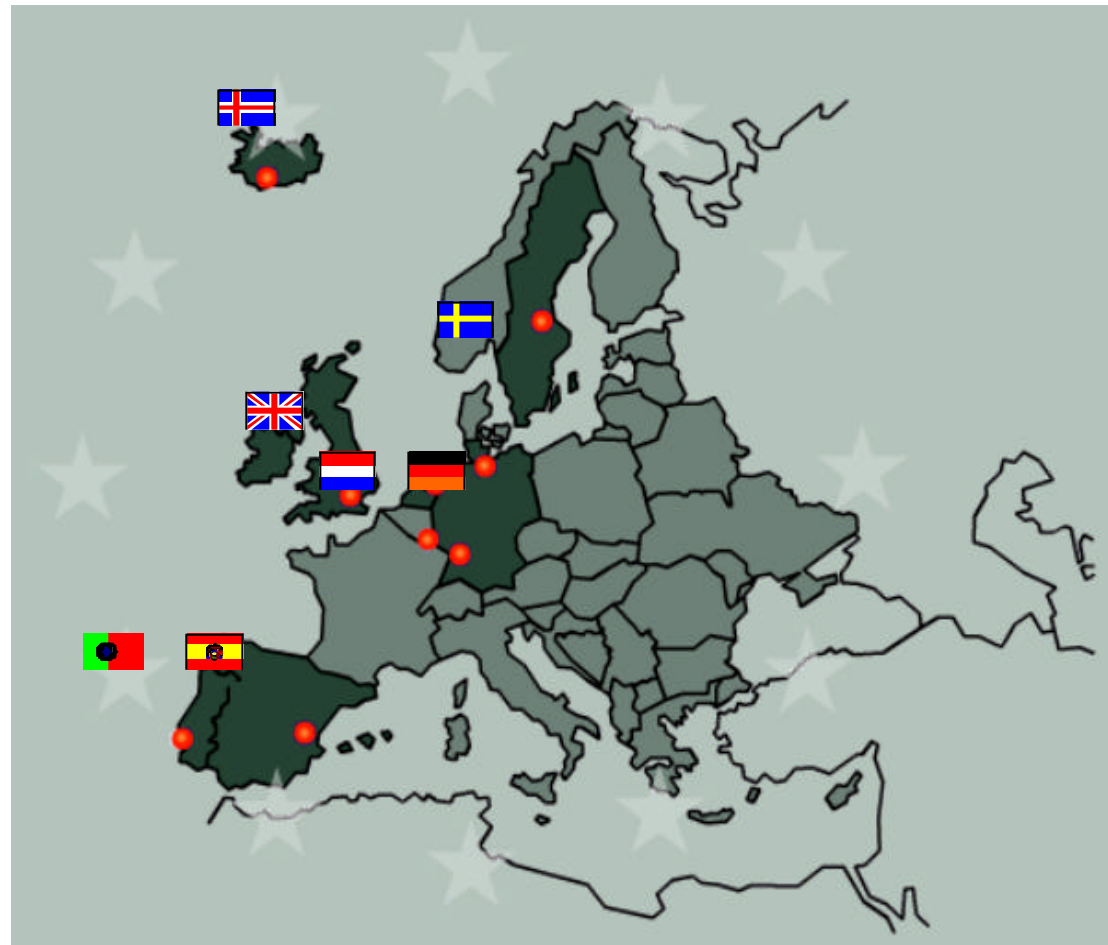
London - Great Britain

Luxemburg - Luxemburg

Porto - Portugal

Stockholm - Sweden

Reykjavik - Iceland



California Fuel Cell Partnership (CaFCP)

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Timeline

April 1999
2000 - 2001

- Project initiated
- Demonstrate first fuel cell vehicle by DaimlerChrysler, Ford and others
- Oil companies will provide the necessary infrastructure for fuel tests

2002 - 2003

- Demonstrate a total of more than 70 fuel cell passenger cars and buses



The California Fuel Cell Bus Project

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- Part of the California Fuel Cell Partnership's demonstration program
- Joint demonstration project of VTA, Gillig Corporation and Ballard Power Systems
- 3 buses in two year operation in revenue service at VTA starting 2004
- Xcellsis™ HY-205 fuel cell engine of Ballard adapted to the design of the Gillig bus construction
- Installation of a refueling station at VTA's Cerone division.

DoD Project

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DUST

- Ballard is currently performing a DUST program funded by DoD with partner Freightliner and University of Alabama
 - Objective is to demonstrate a truck methanol APU and a synthetic hydrocarbon APU at brassboard level
 - Duration 22 months (from may 2001) , 2.3 M\$ project cost

ATTI

- The additional DoD funding NOT COST SHARED have the following objectives connected to the current DUST program and with same Partners:
 - Improvement of Fuel Processor Component and System Design - 66%
 - Catalyst Development / Screening and Long term Stability Testing - 15%
 - Assessment of Noise and Vibration, Thermal Signature and Truck Idling - 6%
 - Analysis of Diesel Fuel and Future Electric Truck Auxiliaries - 13%
- Duration 24 months from BOC
- 1.76 M\$ project cost

DUST = Dual Use of Science and Technology

DoD = Department of Defense, through the TACOM (Tank-Automotive&Armaments Command)- National Automotive Center (NAC)

ATTI = Advance Tactical Transportation technology Initiative



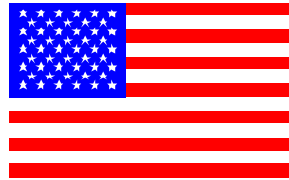
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On the way to Commercialization

Market Preparation Programs



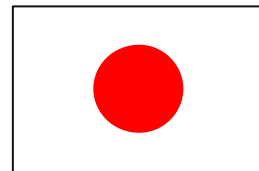
- DoE Program (Demo)
- FreedomCAR (R&D)
- NextEnergy, MI
- California Fuel Cell Partnership



- Clean Energy Partnership (GER)
- European Bus Project (EU)
- Iceland Model of Hydrogen Economy



Fuel Cell Bus
Program in
Emerging Countries



Fuel Cell
Commercialization
Conference of Japan



Sinergy-EDB
Fuel Cell Program
Singapore