



**US Department of Energy  
Hydrogen Technology Advisory Committee  
November 4, 2009 Meeting**

## **International Status of Fuel Cells and Hydrogen Technology**

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Fuel Cell Today**





## Fuel Cell Today

### *An Independent Resource*

**FCT Consulting**

**Website**

**Fuel Cell Today  
Annual Review**

Three main types of analysis undertaken:

1. Can we use a fuel cell to power product 'X'?
2. We want to use fuel cells but what are our risks?
3. What are the future markets going to look like?

[www.fuelcelltoday.com](http://www.fuelcelltoday.com) :

1. 15+ free reports - analysis on developments in the industry over the past year
2. Reports on potential future developments in the industry (application and region)
3. News, directory etc. etc.





## Global Overview (2008): Industry Coming of Age

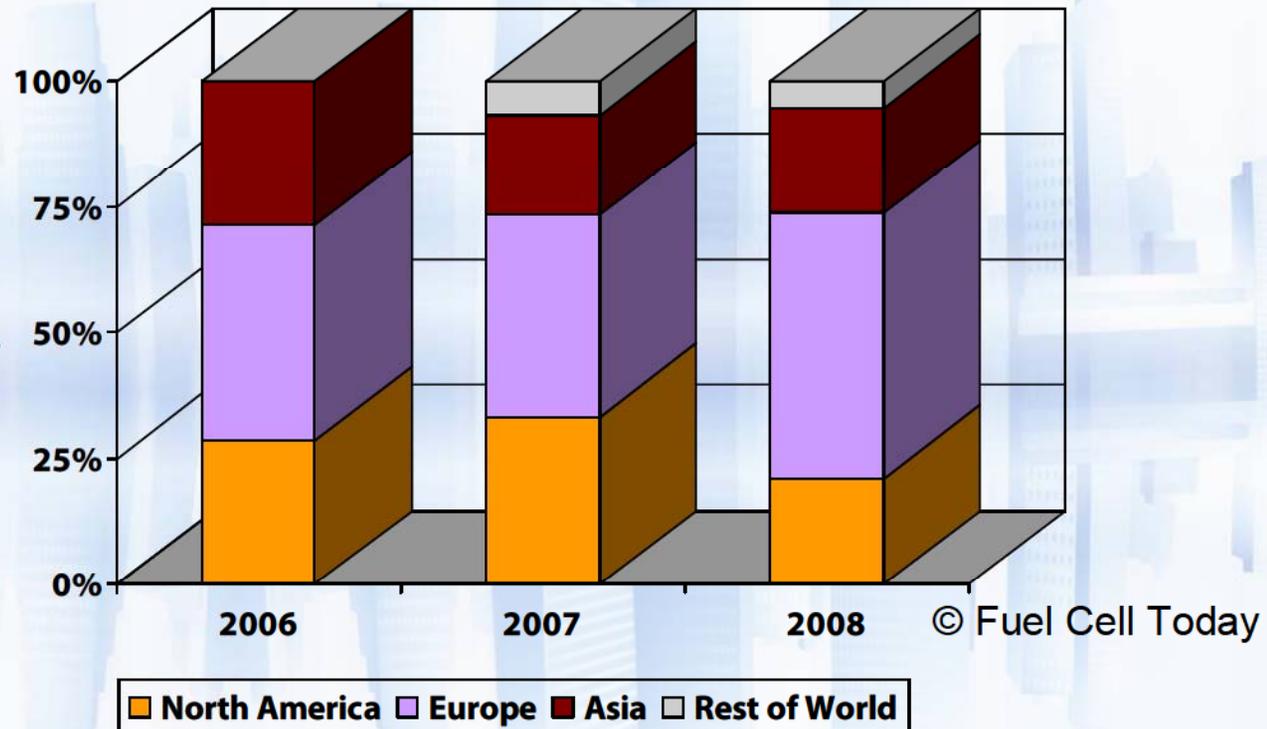
- 2008 shipments of fuel cells increased to almost 18,000
- Since 2007, every year has seen new products become commercially available – marks the year that commercialisation began.
- Worldwide manufacturing capacity is up significantly over the past two years.
- 2009 is showing that some markets are “recession proof” and some are not...with government support a key factor





## Global Overview (2008) – Development of All Applications by Region

- Europe saw biggest gain in 2008, while North America saw slight drop
- For Asia, 2008 was year of building stock for 2009 delivery

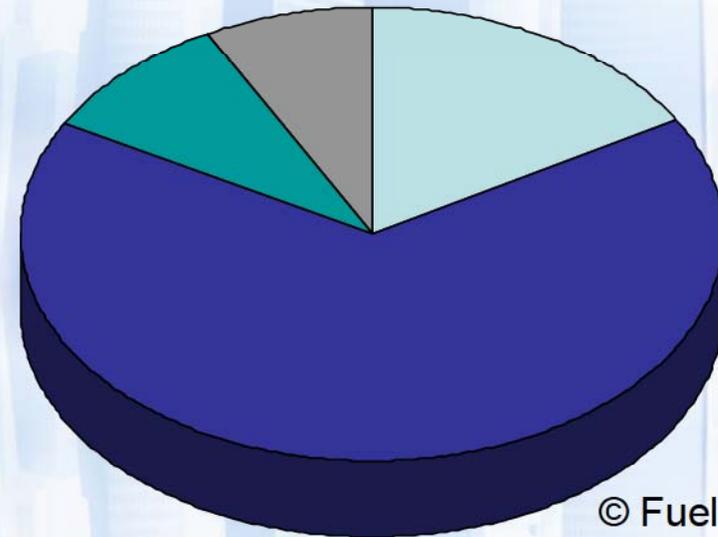




## Global Overview (2008) –Development of All Applications By Fuel

**Key Message: Reformer availability means that fuel use has seen a shift from direct hydrogen to a variety of fuels types now available.**

- Increase in Direct Methanol Fuel Cell sales is major factor in shift from hydrogen dominance over last 3 years
- Fuel diversity also dependent on reformer technology
- (“Other” predominates in Japan where Kerosene and City Gas are widespread in the home)



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Hydrogen Methanol Natural Gas Petrol / Diesel Other



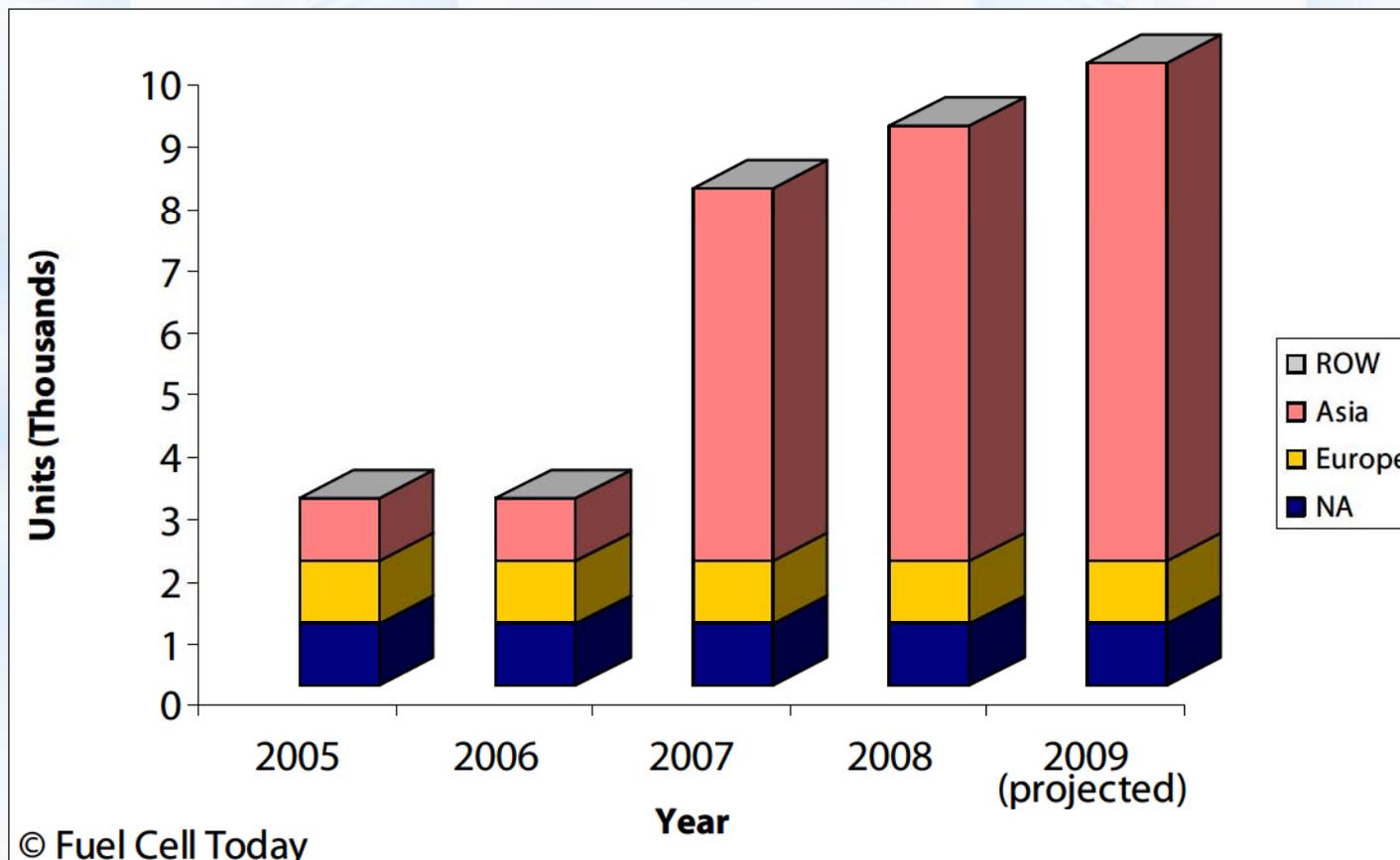
## Portable

Any fuel cell that is designed to provide power to portable objects





## Portable Market – Shipments 2005-2009 (projected)





## Portable Market – Key Developments 2008 - 2009



- Small consumer electronics / Micro fuel cells:
  - Commercial launch of Toshiba Dynario DMFC charger is the big 2009 story
  - Produces 0.2 W and holds 14ml methanol
  - Priced at \$325, with 5 cartridges



### Skid mounted generators:

- Commercial introduction PEM generator from the Bredenoord & Nedstack (Holland)
- 4 kW output, runs for 30 hours on a single set of hydrogen tanks





## Key Developments 2008 - 2009:

- Laptops and mobile phones: Asian companies leading this sector, especially Japan, South Korea – with Taiwan showing supply chain potential

	<b>Integrated Fuel Cell</b>	<b>External Fuel Cell Charger</b>
<b>Mobile Phone</b>	<b>Motorola</b> <b>Toshiba</b>	<b>Lilliputian</b> <b>Horizon</b> <b>MTI Micro</b> <b>Panasonic</b> <b>Sony</b> <b>Toshiba</b>
<b>Laptop</b>	<b>Samsung</b>	<b>CMR Fuel Cells</b> <b>Horizon</b> <b>Nan Ya*</b> <b>Panasonic</b>
<b>Other CE</b>	<b>Coretronic*</b>	<b>Syspotek*</b>

**Selected companies in the mobile phone and laptop sector.**

**Blue denotes OEM, Red denotes ODM, Orange denotes fuel cell stack/system manufacturer. \* Stacks by Antig**



**Stationary Sector:**  
Any permanently fixed fuel cell.



**UPS /  
backup  
power**



**mCHP**

**CHP, CCP**

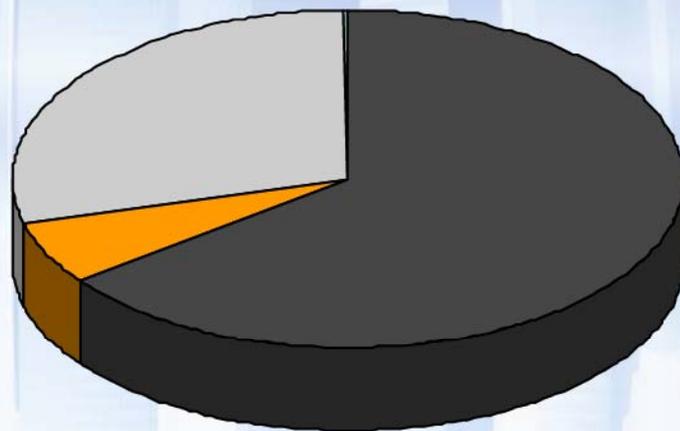




## Stationary Applications: Annual Shipments by Region of Manufacture (2008)

Note: Stationary covers around 9 market segments, ranging from 1 kW to multi MW

This chart shows shipments by unit, not MW



■ NORTH AMERICA   ■ EUROPE   ■ ASIA   ■ RoW

- US focused on UPS/backup
- Asia focused on residential
- EU is looking at both

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## **Mobile telecoms backup power: India as key early market**

It is estimated that over 500,000 new telecoms backup sites will be required before 2011, with many of these located in rural areas.

- Other factors driving market: Imminent construction of natural gas infrastructure and “reverse import substitution”
- Acme Telepower, Ballard and IdaTech signed supply agreement for up to 30,000 5 kW fuel cell systems to be delivered by March 2013
  - Idatech reports significant cost reductions due to new supply chain partners in India, China, North America and Europe
  - Company missed deadline for delivery of natural gas unit. Status update expected in mid-November.



## **Prime Power: Key Developments 2009**

- Plug Power received an order from Wireless-TT Infoservices, the telecoms arm of Tata Teleservices Ltd (TTSL), for 200 GenSys systems to be installed at TTSL cell tower sites in India
  - LPG fuelled 6kW PEM prime power unit to be installed by early 2010
- Further order followed on
- Hindustan Petroleum Corporation Limited (HPCL) will provide LPG fuel for the initial 200 installations



## CHP -- Key Developments 2009

Sector is still pre-commercial with installations driven by policy.

EU has around 10 companies working in the mCHP sector:

- German Callux program: First phase (to 2012) testing the technology. 17 units have been installed to date.
- Denmark testing thermal load following fuel cells in retro fit homes. Units tested are mix of Low Temp PEM, High-Temp PEM and SOFC.

Japan: As of 2008 over 3000 residential fuel cells were installed and tested.

- Launch of "Ene Farm", five stack manufacturers selling home-use fuel cells.
- Osaka Gas selling Toshiba systems, with pricing around \$30,000.

South Korea:

- Implementing subsidy programme for the adoption of fuel cell powered residential mCHP



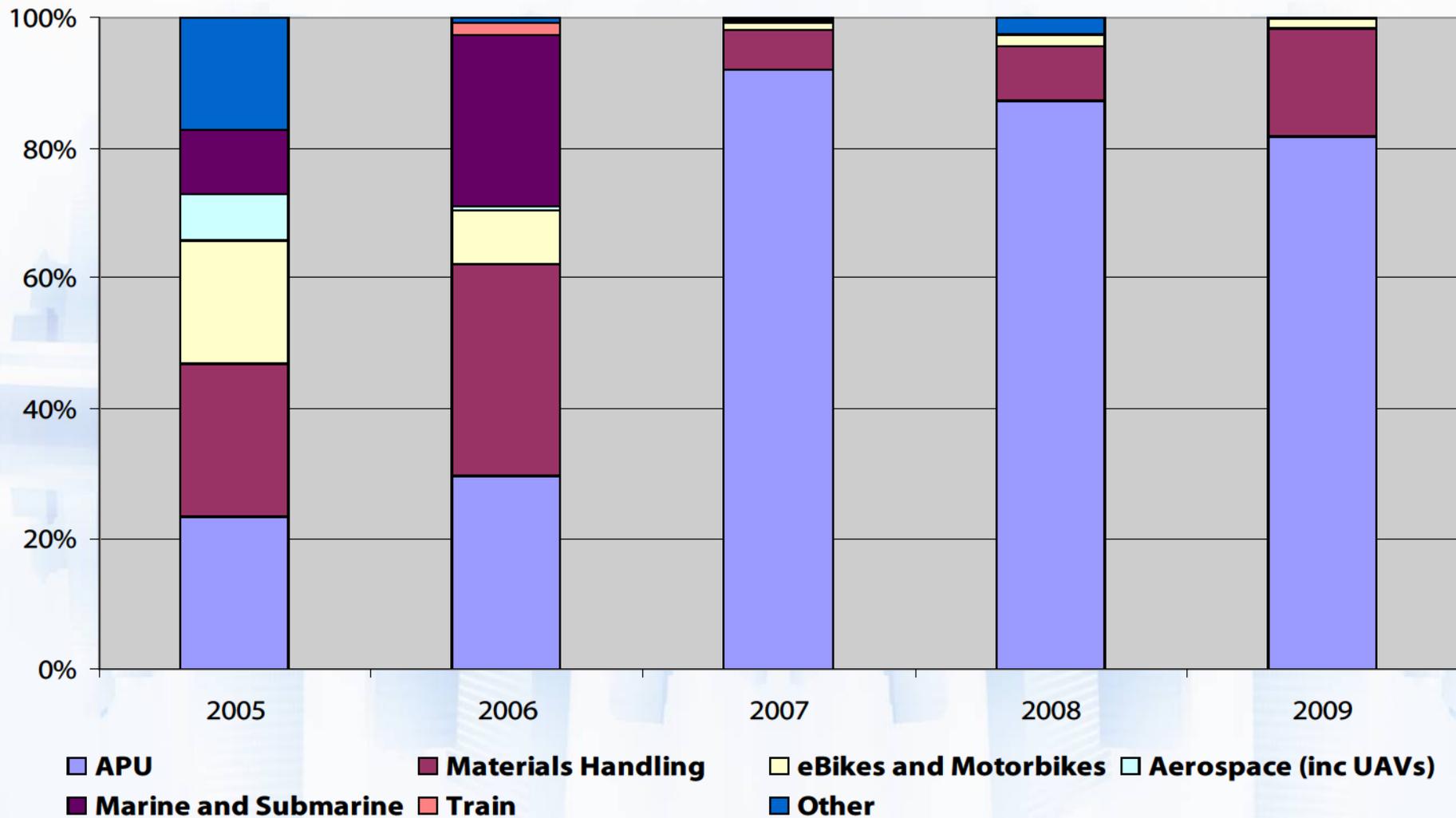
## Transport

Any unit that is included in a vehicle whether for direct propulsion or on-board power.





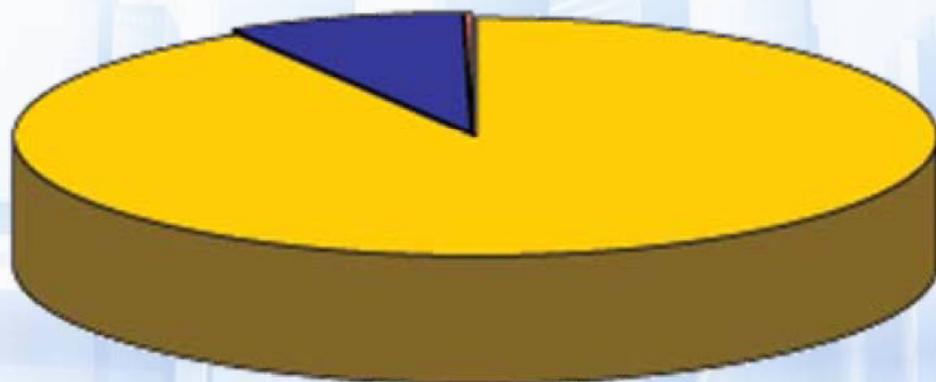
## Niche Market: Annual Shipments by Application, 2005 – 2009 (projected)





## Niche Transport: Region of System Manufacture, 2008 and 2009 (projected)

2008



2009



© Fuel Cell Today

■ EU ■ NA ■ Japan ■ Asia ■ RoW

- This shows region of system manufacture and shipment from, not region of adoption



## Auxiliary Power Units (APUs) – Early Breakout Market

- First of the niche markets to become commercial
  - Market is focused in the EU, with leisure shipments leading the way
1. Leisure: Small APUs for RVs and yachts have been commercial for two years
    - Non subsidised market
    - Lead by SFC Smart (Germany, DMFC) leads market – five commercial APUs, from 25 - 90 W output
    - This space suffering somewhat from downturn – Voller (UK) ceased operations





## Auxiliary Power Units (APUs): Other Developments

Trucking – Small APU for electricity, heat for trucks at stops.

- Volvo subsidiary Powercell has 5 kW PEM APU with fuel converter (diesel, gasoline, bio fuels such as ethanol, DME, biogas, methanol and biodiesel)
- Targeting commercial introduction (for Volvo trucks) by 2011
- Just announced – SEK 60m (US\$8.6m) to be invested in Powercell by Swedish government's automotive venture capital company. In addition to \$3m announced earlier this year.





## **Marine: APUs and Propulsion**

### APUs:

- Only commercial shipments from SFC Smart – sub kW fuel cells
- More attention being given to large (>200 kW) for cruise ships
- Danish SOFC manufacturer Topsoe working on APUs for marine, trucks and defense
  - Working with Wartsila to develop 200-250 kW units for container ships
  - Denmark announced 30 million DKK to develop commercial SOFCs, with first market APUs (electricity, heat) in trucks, boats, campers



## Marine: APUs and Propulsion

- Marine propulsion still in the R&D phase, few shipments to date
- EU is particular focus due to regulatory environment
- ZEMships project: Launched in 2008
  - Two 50 kW PEM hybrid systems from Proton Motor (Germany) for propulsion and hotel loads
- Nedstack (PEM, Holland)
  - Contract with Australian system integrator for Australian trawler
  - In 2009, delivered two fuel cell systems for Amsterdam's first hydrogen-operated canal boat





## Materials Handling

- Due to subsidies and operational drivers, this market is US-focused, but a few players are looking to the EU:
- H2Logic, Danish PEM manufacturer
  - Class 1 and 2, replacing LPG or diesel forklifts
- Oorja Protonics, US DMFC manufacturer
  - 1.5 kW DMFC APU for Class 3 & 5 forklifts
  - Looking at the UK market
- Proton Motor has demonstrated forklifts, little activity in the past year
- Little activity in Asia





## Buses and Light Duty Vehicles

- New bus prototype introductions, deployments and orders announced from:

- Daimler
- Proton Motor and Skoda
- Nedstack
- Brazil's Marcopolo bus
- Hyundai



- In September Daimler, Ford, GM/Opel, Renault, Nissan, Hyundai-Kia, Honda and Toyota all signed Letter of Understanding on development and market introduction of FCVs and encouraging infrastructure development.
- Linde, Daimler, EnBW, OMV, Shell, Total, Vattenfall and NOW signed MOU on planned roll out of hydrogen infrastructure around Germany



## Summary and Key Points

- The fuel cell industry is not ten years away – it is now
- Commercialisation has been underway since 2007, with consistent growth in annual shipments
- Some early breakthrough markets are APUs for RVs, backup power, forklifts, residential mCHP
- Government support is still a key factor for some, but other markets are experiencing non-subsidised growth (APUs in EU, UPS in India)
- Asia shipments dominated by portable market, with Toshiba charger the breakout application for this year
- EU shipments focused on residential CHP, APUs and other transport
- North America is more evenly divided



## ***Sources and More Information:***

### **FCT Annual Market Surveys:**

2009 Portable Survey

2009 Small Stationary Survey

2009 Niche Transport Survey

2009 Light Duty Vehicle Survey

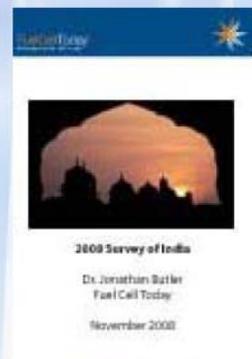
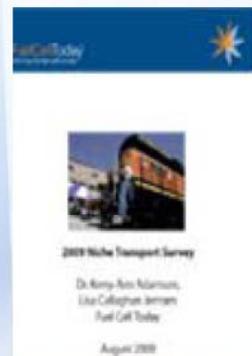
2008 Large Stationary Survey

Survey of Denmark, 2009

Survey of India, 2008

Go to:

[www.fuelcelltoday.com/online/surveys](http://www.fuelcelltoday.com/online/surveys)

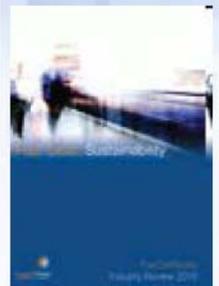


### **2009 FCT Industry Review:**

<http://www.fuelcelltoday.com/events/industry-review>

### **2010 FCT Industry Review:**

To be published in January 2010





***Thank You***

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