Scotland’s Hydrogen Future

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Infrastructure Discussion

- Today’s state of affairs
- The next few years
- Longer term
Air Products and Industry is Focused on Energy

- Clean energy
- Non-conventional oil and gas
- Industrial gases for refining
- Power generation

Today's state of affairs
Air Products
50+ years of hydrogen experience

- Over 5000MT per day H₂ production
- Bulk, liquid, and pipeline distribution
- World’s largest H₂ producer
- H₂ energy projects since 1993
  - > 110 hydrogen stns
  - > 100,000 fuelings/yr
- Stations in 18 countries
- Active in UK hydrogen arena
  - via UKHA, CENEX & SHFCA
- Active in Europe
  - via the JTI and the EHA

Today’s state of affairs
Real advances are being made

Applications that transition to hydrogen, and deliver value today

- Fuel Cell Vehicles
- Mass transit/central fleets
- Material handling networks
- Back-up/stationary power
- Renewable Energy Parks

Today’s state of affairs
Retail-like fueling experience
Hydrogen stations
Auto Companies Continue Development

- MoU signed by most major car companies saying that they will roll out mass produced fuel cell vehicles by 2015

- This will be in limited geographies
  - Germany
  - California
  - Japan

- Public Infrastructure support being delivered
Renewable hydrogen is a must

- Status quo is not an option
- Industry is committed to collaborative programs focused on renewable hydrogen
Infrastructure Transition

- Provide technologies which have utility today while positioning for the future
- Focus on a regional model with abundant H2 and population.
- Focus on mass transit in other urban areas.

Future Hydrogen Infrastructure will include:
- Pipeline delivered hydrogen similar to NG
- Multiple feed sources of hydrogen from:
  - Biomass
  - Geothermal
  - Wind
  - Solar
  - Nuclear
  - Coal
  - Methane reforming
- Delivered or distributed product in the outlying areas
Hydrogen Energy Station Vision

Feedstock Source
- Natural Gas
- Digester Gas
- Landfill Gas
- Agricultural Wastes
- Pyrolysis Products
- Bio-Syngas / Syngas
- Vegetable Oils / Oils
- Other Methane Sources

Renewable hydrogen – for onsite requirements or regional distribution
Municipal Waste Gasification

- Multiple technology options
- Green method of waste destruction which delivers a green syngas – a CO:H2 gas mix
- The key is cleaning of this syngas
- Gas cleaning is a strategic competence of Air Products
- Significant volumes of hydrogen and power can be generated via this route
- Timescale to commercial plant onstream 36 months
Initial Facility Lay Out

"Air Products Confidential – These drawings are not intended for publication and illustrate a conceptual waste to energy facility. Air Products makes no warranty or representation whatsoever in connection with these Drawings nor grants any license or right to use the subject matter of the Drawings. Please consult an Air Products representative to discuss any questions regarding these Drawings."
Plant Details

- 750MT/D waste processed
- 40+MW of power produced
- 70 - 80 long term jobs created
- 700+ construction jobs at peak
- Trial location for fuel cell power train
- Possible upgrading of power train to fuel cells
- Possible further expansion to second train
- Possible sale of hydrogen and/or syngas to chemical companies locally
Hebridean Hydrogen Park
H2seed

Electricity from biogas

H2 production - water electrolysis

Production: 5Nm³/h
Storage (buffer): ~22Nm³ at 30 bar
Storage (high pressure): ~65Nm³ at 420 bar

Application

Fuelling station

Storage
Wind to Hydrogen

- GAS NATURAL: Sotavento wind farm (60 Nm$^3$/h H$_2$ production)
Hydrogen Mini Grid Rotherham

- AP have supplied an S100 hydrogen fuelling system + green hydrogen store for Hydrogen Mini Grid
- Funded by Yorkshire Forward as part of the Objective 1 investment programme
PV to hydrogen

- Hércules project (Spain)
- Located at the site of a solar collector facility
- Transport application
- Converting a diesel car into a hybrid
- 8 companies participating, including Air Products

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TfL, London Bus Supply

- Onstream late 2010
- Fuelling of up to 10 buses for 5 years
- LHY supply via a novel supply concept trailer
Hürth Bus Project Organisation
Central Grocers, Inc.

- Opened March 2009
- 946,000 sft. Warehouse greenfield site
- 140+ MHE fleet, largest under one roof. Expanding to 240 MHE units.
- 3 indoor dispensers, 2 more in a year
The Bottom Line

- The use of Hydrogen as a fuel continues to make strides globally in many markets
- Industry looks for political leadership
- Commercial benefits exist today in some geographies which will drive FC cost reduction
- Car company commitment to role out mass produced vehicles by 2015
- Hydrogen is the only fuel that over the long run, has the ability to meet objectives regarding energy independence, greenhouse gas emissions and sustainability
- Methods of large scale green hydrogen production are just around the corner
Thank you

tell me more

www.airproducts.com/H2energy