LOW CARBON COMMUNITIES
H₂ & FUEL CELL OPPORTUNITIES

Community Energy Scotland Conference
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John Lidderdale
Chairman, SHFCA
What’s this all about…

• Energy Challenges
  • Local Energy Storage
  • Community Transport
  • Low Carbon Heat
  • Energy Self-sufficiency

• Hydrogen & FC can deliver in all areas
SHFCA & Our Member Activities

Key SHFCA activity areas include

• Fuel Cell distributed CHP with natural gas
• Hydrogen and Fuel Cells for Sustainable Transport
• Energy Storage with Hydrogen, Small to Large scale

SHFCA Membership includes:

• Energy companies & delivery partners
• Researchers & Developers
• Early Adopters & Project Partners

70+ members: largest European H&FC Association
Scotland’s Ambitions for Renewables & CO₂

• 42% reduction in CO₂ emissions by 2020

• Generate 100% of Scotland’s power* from Renewables

• 500MW Community Owned Renewables

In 2013 Scotland generated 47% of its annual electrical demand from Renewables
Scotland’s Renewable Energy – Wind is Dominant

Renewables power generation increasingly dominated by wind…

Wind = 65.7% of renewables

2013 ELECTRICITY OUTPUT BY TECHNOLOGY (GWh)

(2013 Total Scottish Annual Power demand = 36GWhr)

TOTAL = 16,974 GWh
But what happens if local grid is constrained?

• More local generation
• Grid may have limitations
• Wind & PV intermittent
• What next?

Do you have these:

Or this…
Water + Power = Hydrogen

- Pass DC electricity through water (electrolysis)
- Produces Hydrogen – from kW to MW scale
- Allows balancing of wind energy
- Buffers energy production to use
- Hydrogen uses include
  - Local Heating
  - Local Transport
  - Power – with Fuel Cell

Hydrogen from Renewables = ‘Green Hydrogen’
Local Hydrogen from Renewables

- Happening in Scotland
  - PURE, Unst
  - SEED, Lewis
  - Hydrogen Office
  - Aberdeen
Hydrogen fuel with ICE Conversions

Using the hydrogen refueller in Stornaway: Transit petrol/H2 flex-fuel conversion
Local ‘Agri-Renewables’ with Hydrogen

- 20kW wind turbine
- 48kW photo-voltaic
- Hydrogen production & storage
- Hydrogen boiler
- Hydrogen fuel cell
Localised Energy Storage & Uses

- Capture ‘surplus’ renewables
- Use power to electrolyse water
- Produce and store hydrogen
- Use for back-up critical power
- Heat and low carbon transport

Revolve Transit flex-fuel diesel-H2
Link: [http://www.revolve.co.uk/](http://www.revolve.co.uk/)
Why are Fuel Cells more Efficient?

Conventional Power Plant:
- Fuel
- Combustion
- Hot Gas or Steam
- Turbine/Generator
- Electricity

Fuel Cell Power Plant:
- Fuel
- Direct Fuel Cell
- Electricity

Direct energy conversion without combustion provides high efficiency with negligible emissions, from domestic and renewable fuels.

http://www.afcenergy.com/#!prettyPhoto/0/
Low Carbon Heat with Micro-CHP

- Fuel cells now also being used for domestic CHP
- 50,000 units to be installed in Japan in 2014
- Uses natural gas supply, about 1kW power, 1kW heat
Transport with Fuel Cell Vehicles

Toyota ‘Mirai’ production FCV, launched 18\textsuperscript{th} Nov 2014
Key Attributes of Mirai FCV

- Zero CO$_2$, NOx, SOx, PM10 emissions at tailpipe
- Efficient (regen braking)
- Range & Quick refuelling
- Easy to use
- + Back-up Power!

Mirai can also deliver 240 AC power to household using built-in supply powered from the hydrogen fuel cell
FCVs now Coming to UK

• First six Hyundais arrived recently

• Only clean water from the exhaust…

In October 2013 Hyundai teamed up with Something & Son to unveil the world’s first urban aquaponic farm ‘powered’ by a hydrogen car! Located outside of the London Design Museum, Hyundai’s Fuel Cell Farm seeks to educate the public on the benefits of hydrogen fuel cell technology. The aquaponics farm filters water produced by a ix35 fuel cell vehicle and then uses the H2O to sustain an aquarium full of fish and an edible garden.
Clean Energy for Ferries

CMAL’s diesel-electric hybrid – built in Port Glasgow
Putting Renewables into Transport
Summary – Local Benefits

- Hydrogen can provide local Energy Storage
- Maximise local benefit from Renewables
- Can help overcome local grid constraints
- Bring benefits of Renewables into Transport
- Use existing Gas Grids for decarbonised Heat
- Supports low-carbon communities
- Produce transport fuel locally – self-sufficient
Hydrogen & Fuel Cell Solutions for Local Energy Challenges

Thanks for listening - Any Questions?

Remember - our SHFCA members can help deliver your local H$_2$ energy projects:
- Technical design & delivery
- Project planning & advice