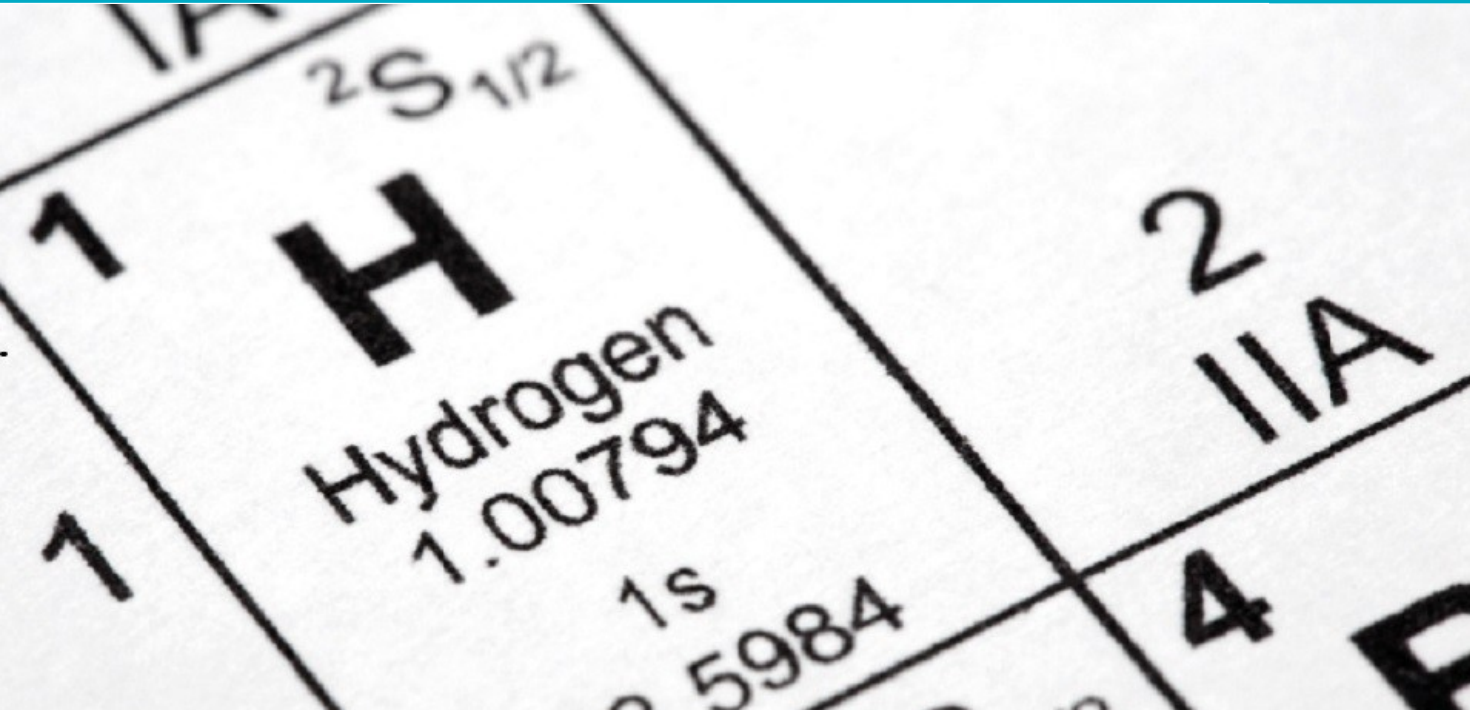


Zero Carbon Heat - Storage and Innovation

Iain Summerfield

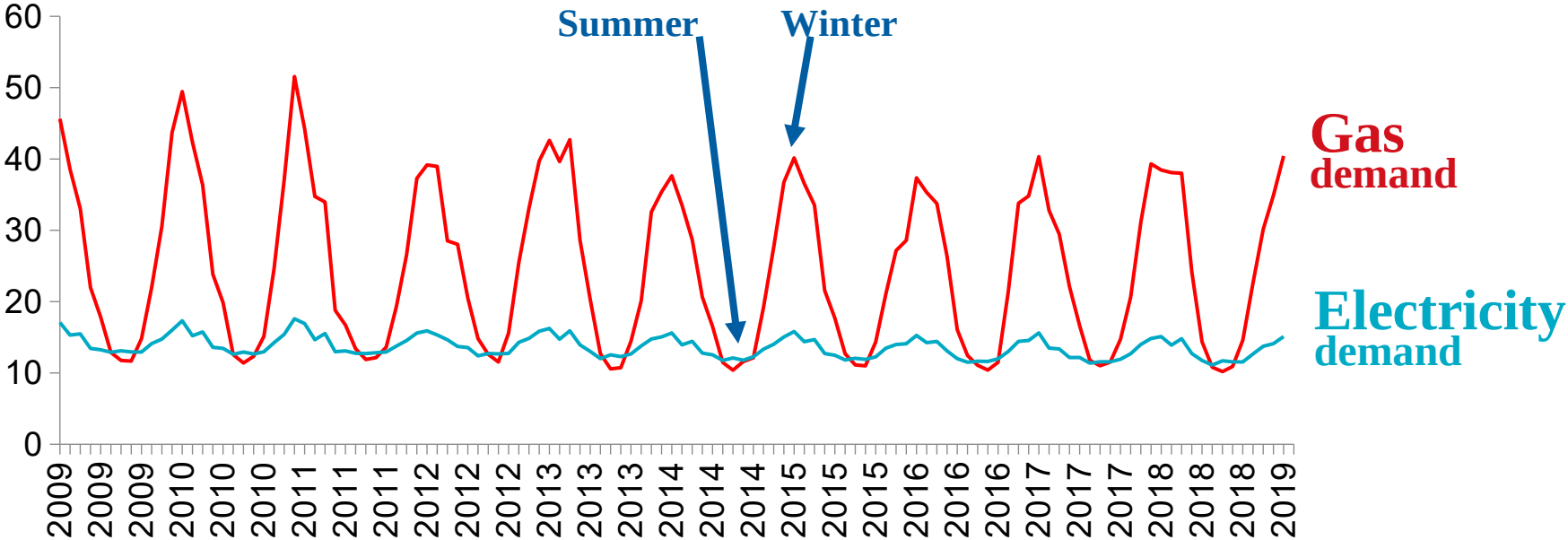


Kiwa Gastec

**Trust
Quality
Progress**

UK inter-seasonal variation in energy demand

Daily energy per person (kWh)



Options for energy vectors include:

- Electricity
- Hot water / Steam
- Methane with a biologically derived carbon atom
- Ammonia etc
- Hydrogen - liquid & gas

Hydrogen storage

Compressed underground hydrogen storage is entirely proven and new sites are under construction today eg PRAXAIR in Texas

Hydrogen caverns are operated in

- Teesside, UK by Sabic Petrochemicals (3 X 70,000 m³)
- Clemens Dome, Lake Jackson, Texas, USA by ConocoPhillips (580,000 m³)
- Moss Bluff salt dome, Liberty County, Texas, USA by Praxair (566,000 m³ – maximum permitted capacity)

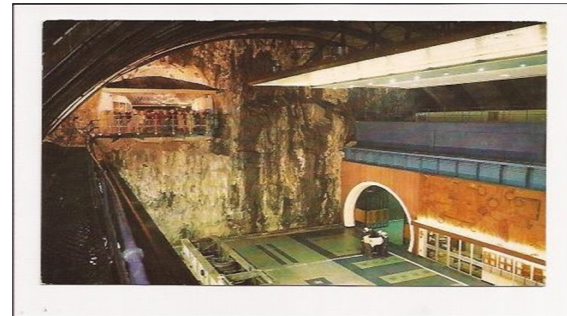
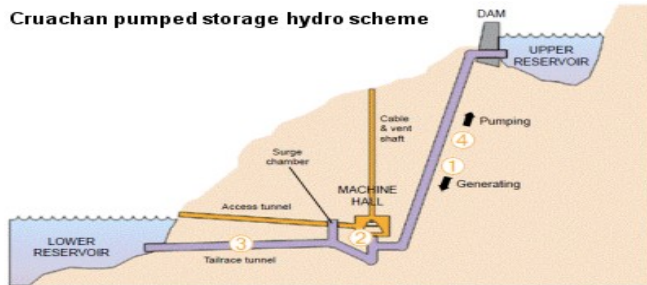
This last facility has the capacity of about 4mboe or 2.5% of UK annual energy demand or 50 Cruachan pumped storage stations

Hydrogen storage

Hydrogen storage cavern for Air Liquide at the Spindletop Dome nr Beaumont in SE Texas

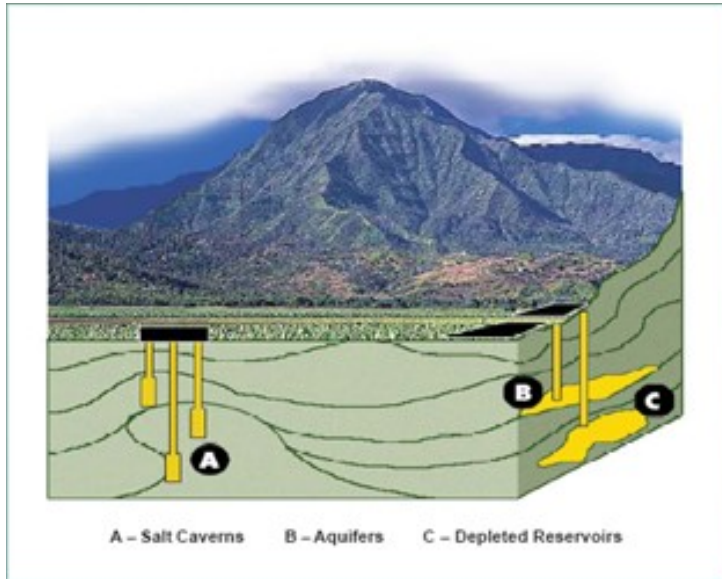


Cruachan pumped storage hydro scheme



Indicative costs of storage

The surest route to reducing energy production cost is to increase operating hours of the producer and/or not restrict output, hence the value of storage is to disconnect (in time) production from use.



Federal Energy Regulatory Commission

Storage capacity	GWh	8052
CAPEX		£1,991,000,000
Depreciation	years	40
ROI	%	6
Annual charge		£169,235,000
OPEX		£63,000,000
Total costs		£232,235,000
Cost storage /kWh		£0.029

Discussion

Iain.Summerfield@Kiwa.com

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