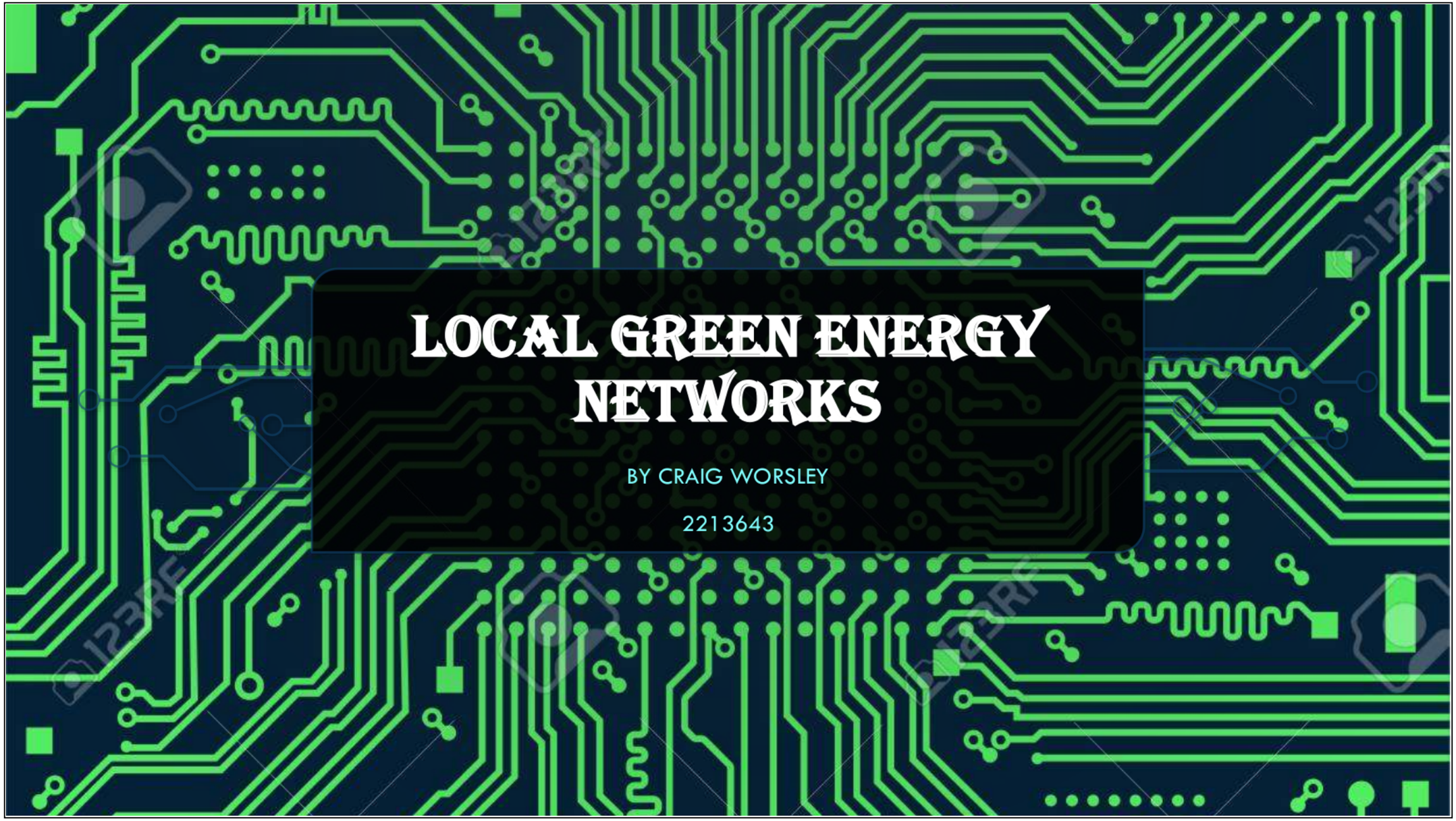
Local Green Energy Networks

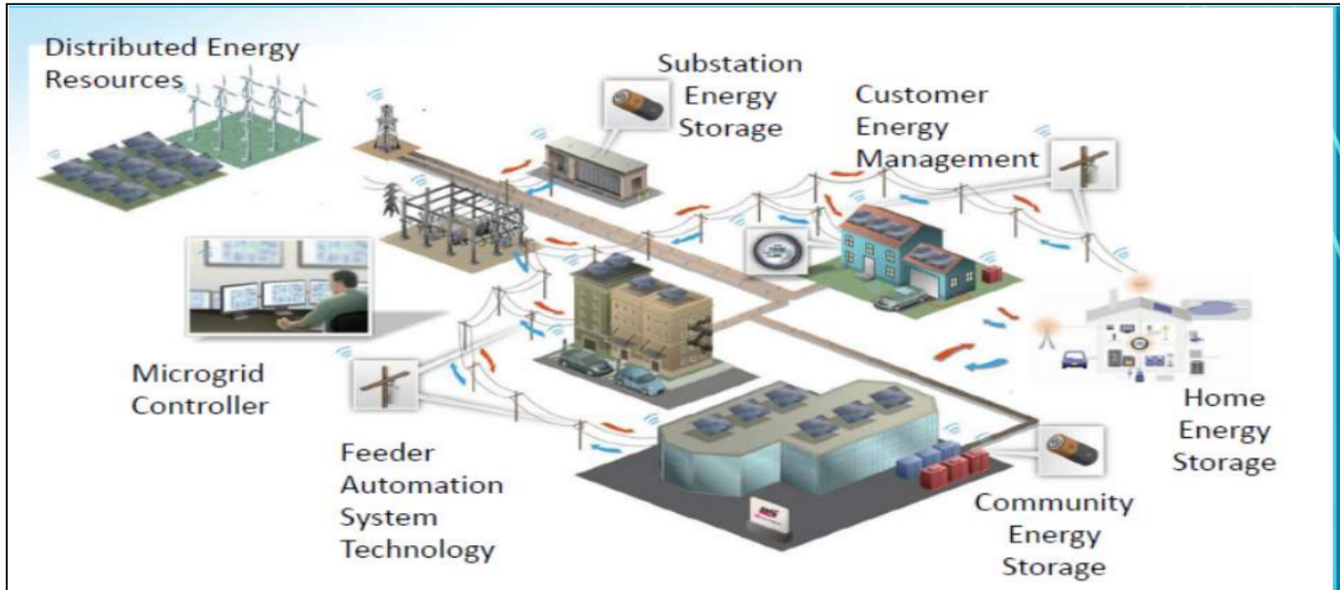
by Craig Worsley

Submission date: 24-Apr-2023 02:24PM (UTC+0100)
Submission ID: 203198739
File name: 41022_Craig_Worsley_Local_Green_Energy_Networks_494134_1455374105.pptx (12.62M)
Word count: 751
Character count: 4112


LOCAL GREEN ENERGY NETWORKS
BY CRAIG WORSLEY
2213643

OVERVIEW

- Identifying the problems
- Issues and challenges
- Identifying the solution
- Giving structure to the solution by means of a flow design
- Breaking down the technologies
- Identifying the parameters of the system
- Implementation and target audience
- Expected cost and profit of the system
- Ideas on expansion and progression possibilities





A PROJECT ON LOCAL GREEN ENERGY GENERATION AND ENERGY STORAGE



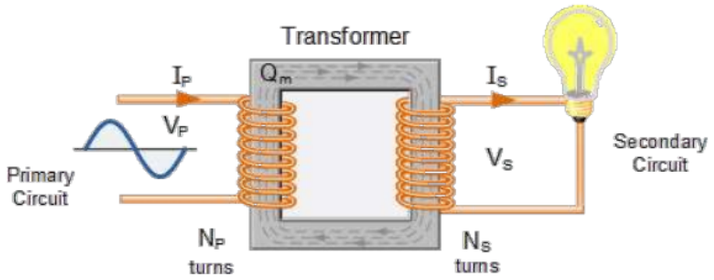


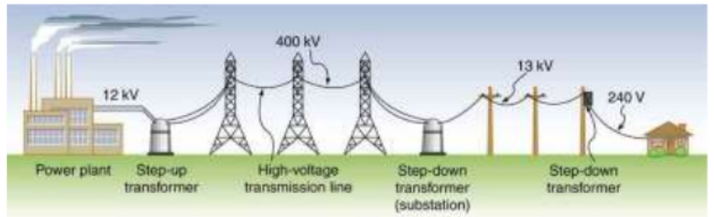


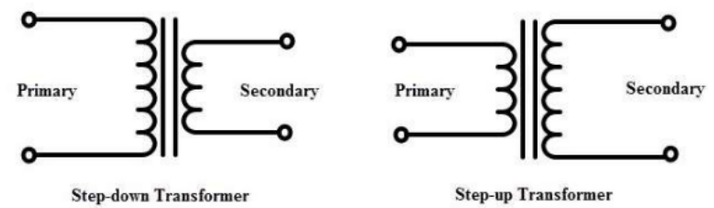
IS A GREEN ENERGY NETWORK WITHIN REACH BY MEANS OF WASTE REDUCTION, LOCAL ENERGY SUPPLY AND HYDROGEN STORAGE

Energy Waste Through Transportation

- Energy created needs to be converted to reduce losses and create safe transport.
- This conversion and transportation still incurs losses
- Around 8-15% which considering national demand is huge!









IN TODAY'S ENERGY INFRASTRUCTURE EFFICIENT ENERGY STORAGE IS ONE OF THE BIGGEST CHALLENGES

A few types of energy storage in use

- Hydro dams
- Liquid Air
- Compressed Air
- Thermal
- Hydrogen





Batteries and Energy Storage

Pumped Hydro is a fantastic energy storage system unfortunately

- Impact on agriculture.
- Geographical locations.
- Construction of dams.
- Not a scalable option.

Lithium-ion is the dominant energy storage choice.

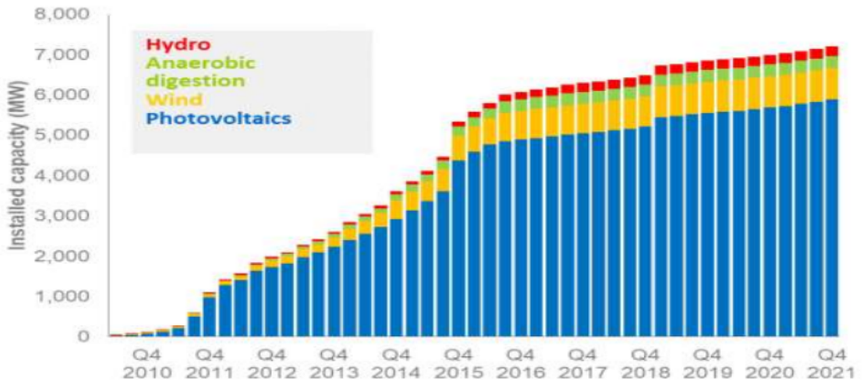
- 85% increase in 2018 in capacity
- Lithium-ion batteries have a life of around 10 years and cost around £2000 for 9kWh

New technologies like the air battery are under development

CAPABILITIES OF RENEWABLE ELECTRICAL SUPPLY IN THE NATIONAL GRID

RENEWABLES

Small scale renewable capacity, 2010 to 2021

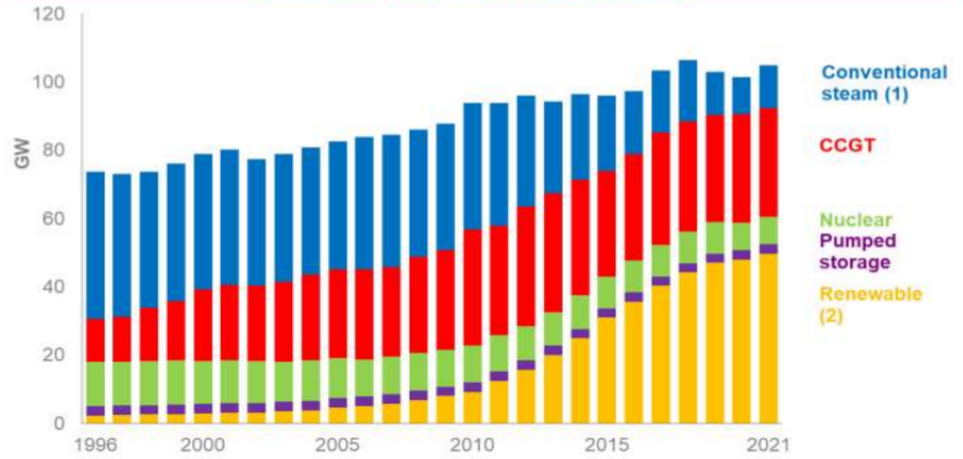


Cumulative Installed Capacity (FITs and MCS) – GB only MW

	2010	2012	2014	2016	2019	2020	2021
Micro CHP	0	1	1	1	1	1	1
Anaerobic Digestion	5	50	151	292	296	296	296
Hydro	12	41	78	183	230	236	236
Wind	21	167	449	702	770	776	776
Photovoltaics	79	1,728	2,928	4,896	5,551	5,684	5,897
Total	**117**	**1,986**	**3,607**	**6,074**	**6,848**	**6,992**	**7,206**

ELECTRICITY

Electricity capacity, 1996 to 2021



HAVE NEW DEVELOPMENTS IN HYDROGEN ENERGY CONVERSION TECHNOLOGIES CREATED A SOLUTION TO ENERGY STORAGE?





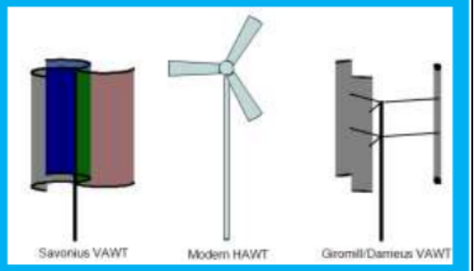


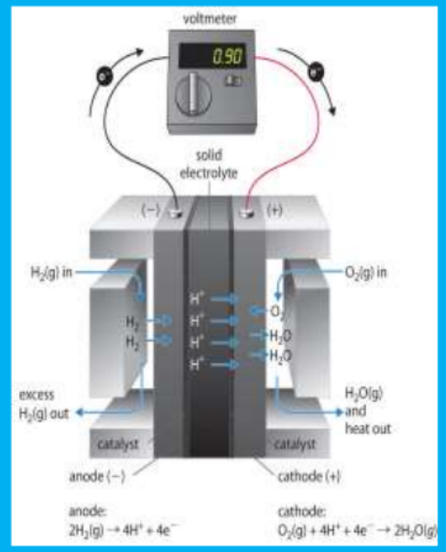
HYDROGEN ENERGY IN COMPARISON TO ENERGY FUELS IN USE TODAY

A Visual Break Down of the System Design Flow





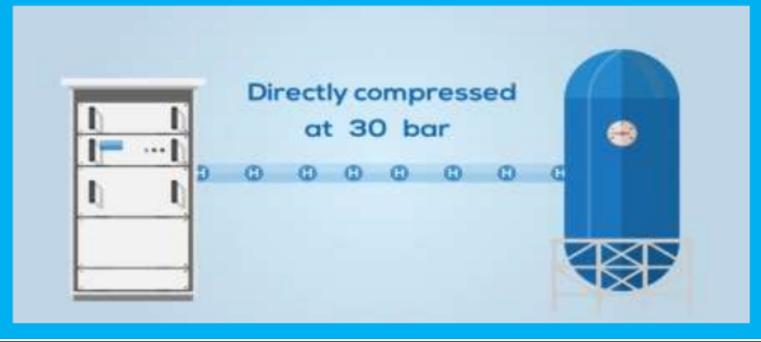


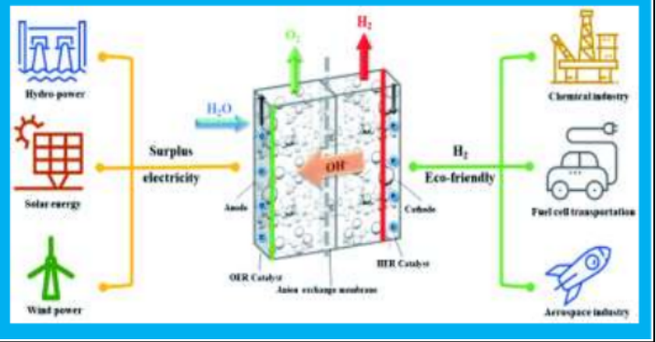












DESIGN COMPONENTS, RENEWABLE ENERGY FARMING AND NEWLY DEVELOPING TECHNOLOGIES

PEER TO PEER ENERGY BUYING AND TRADING STRUCTURES

ENERGY TRADING NETWORKS, SYSTEM UPGRADES AND PROGRESSION.

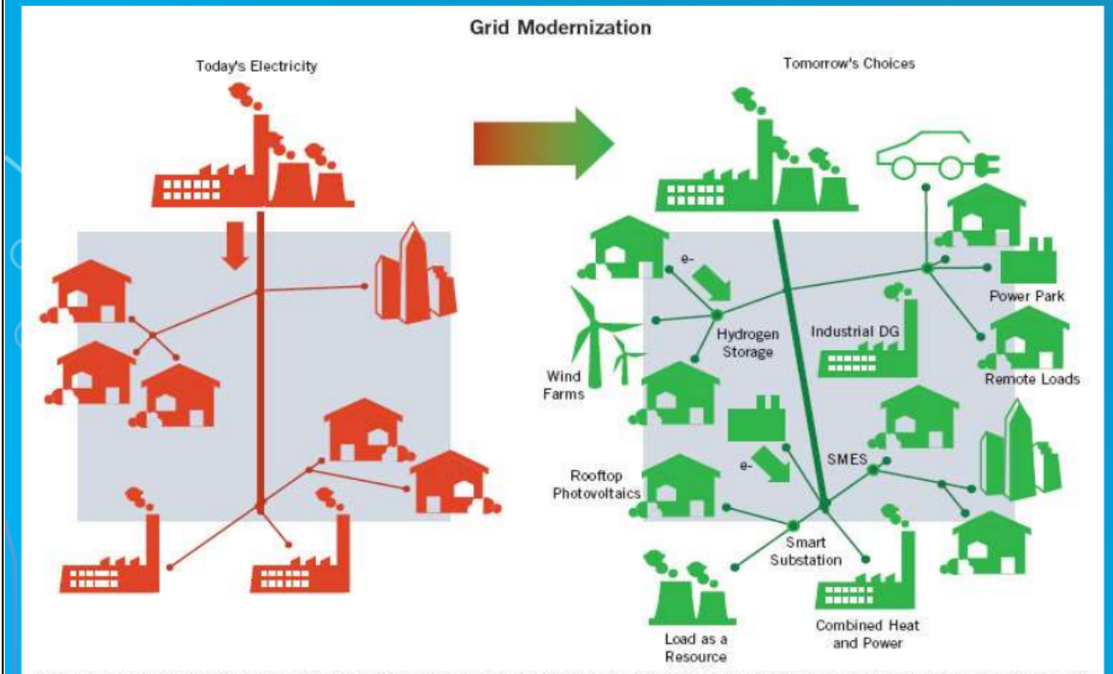
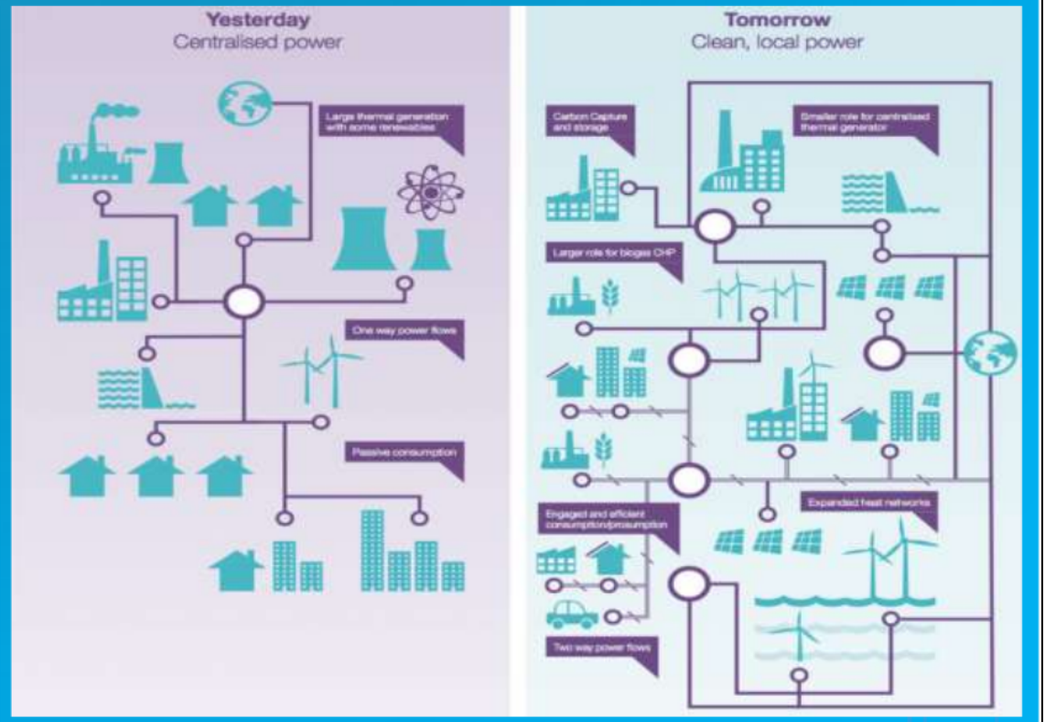


Fig. 1. The IEEE's version of the Smart Grid involves distributed generation, information networks, and system coordination, a drastic change from the existing utility configurations.



PHOTOVOLTAICS

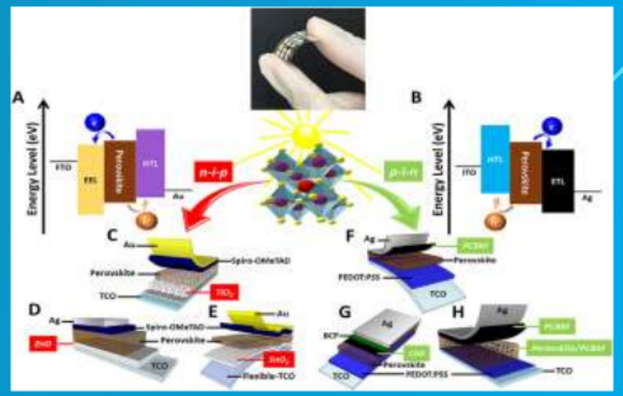


Solar cells have an efficiency of around 22% but are restricted to 31% which is known as the Shockley-Queisser limit.



There are three spectrums of light

- ✓ Ultraviolet
- ✓ Visible
- ✓ Infrared





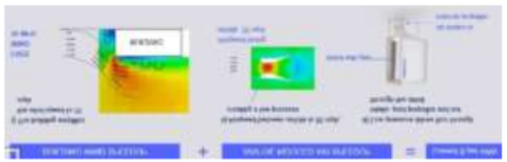
However, a crystalline structure from a mineral called perovskite (CaTi03)

- ✓ Can use more of the light spectrum,
- ✓ is more efficient
- ✓ cheaper to produce
- ✓ can be created from relatively cheap materials in a lab
- ✓ And can be 5 microns thick

COMMERCIAL WIND TURBINES







Through the laws of aerodynamics, the unit manipulates air

Driving a low vibration blade, this generates electricity.

The F1 inspired design can produce around 10-15 MWh annually with a 5-kW turbine

All this with only one moving part

COMPUTER MANAGEMENT SYSTEMS







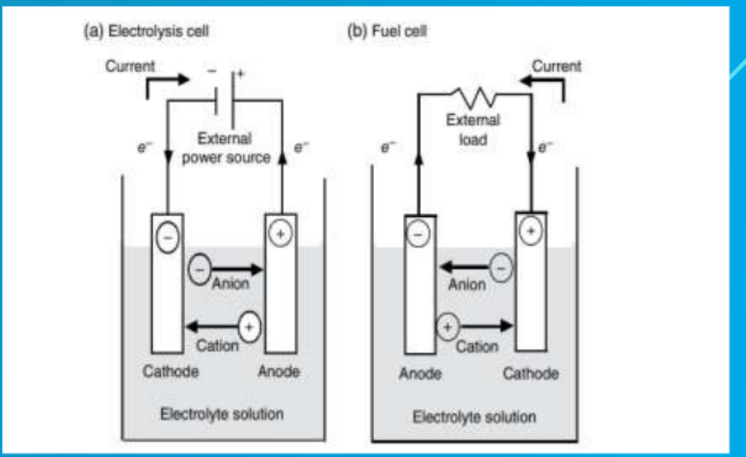
HYDROGEN ENERGY PRODUCTION AND STORAGE SYSTEM

- Electrolysers work with intermittent power supplies.
- H is monitored through a variety of sensors.
- Data acquisition software needs to control valves and read sensors.
- A dedicated module would control the H network.
- Emergency purge system for O2 and H tanks.

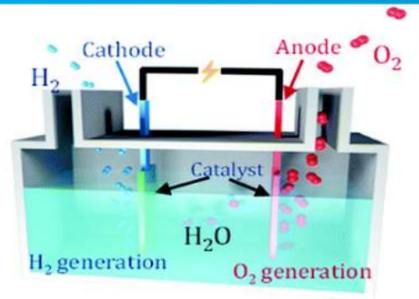
ELECTRICAL CONTROL SYSTEM

- A smart monitoring system at each home.
- Smart monitoring system communicating with the LGEN control centre.
- Monitoring system reduces waste.
- By selling energy directly reduces unnecessary production of H.

HYDROLYSIS, HOW IT WORKS AND THE COMPLICATIONS THAT HAVE BEEN RESOLVED THROUGH ADVANCEMENTS IN AEM TECHNOLOGIES.



A



B

Equations for electrolysis

In acidic solution:

$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$ $E^\theta = 1.23$ V

$4H^+ + 4e^- \rightarrow 2H_2$ $E^\theta = 0.00$ V

$2H_2O \rightarrow 2H_2 + 2O_2$ $E^\theta = 1.23$ V

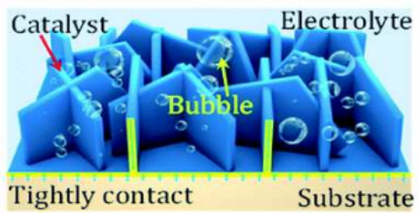
In alkaline solution:

$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ $E^\theta = 0.40$ V

$4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$ $E^\theta = -0.83$ V

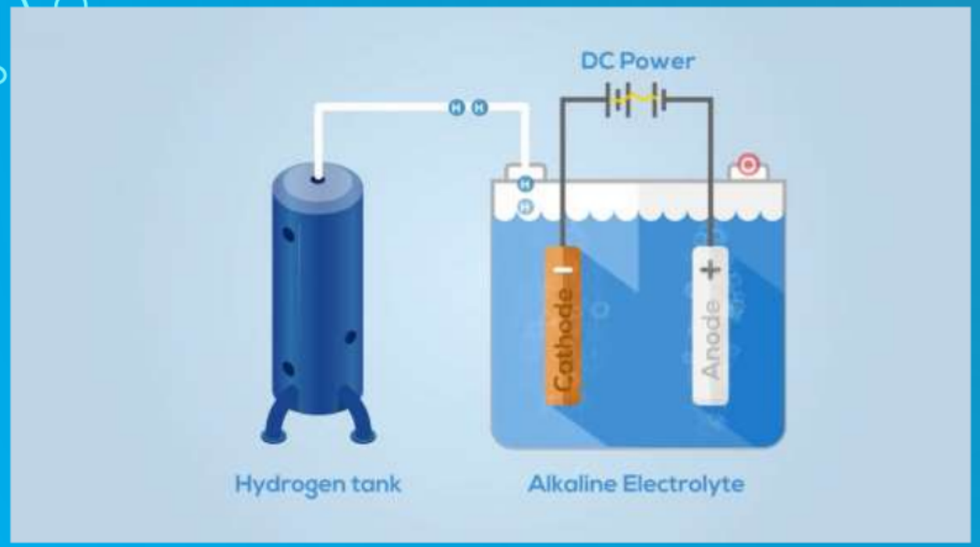
$2H_2O \rightarrow 2H_2 + 2O_2$ $E^\theta = 1.23$ V

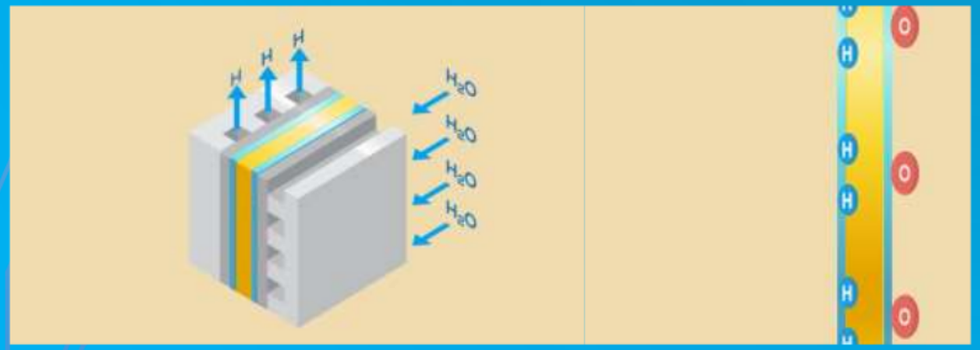
C





ELECTROLYSER CAPABILITIES AND HOW THEY WORK

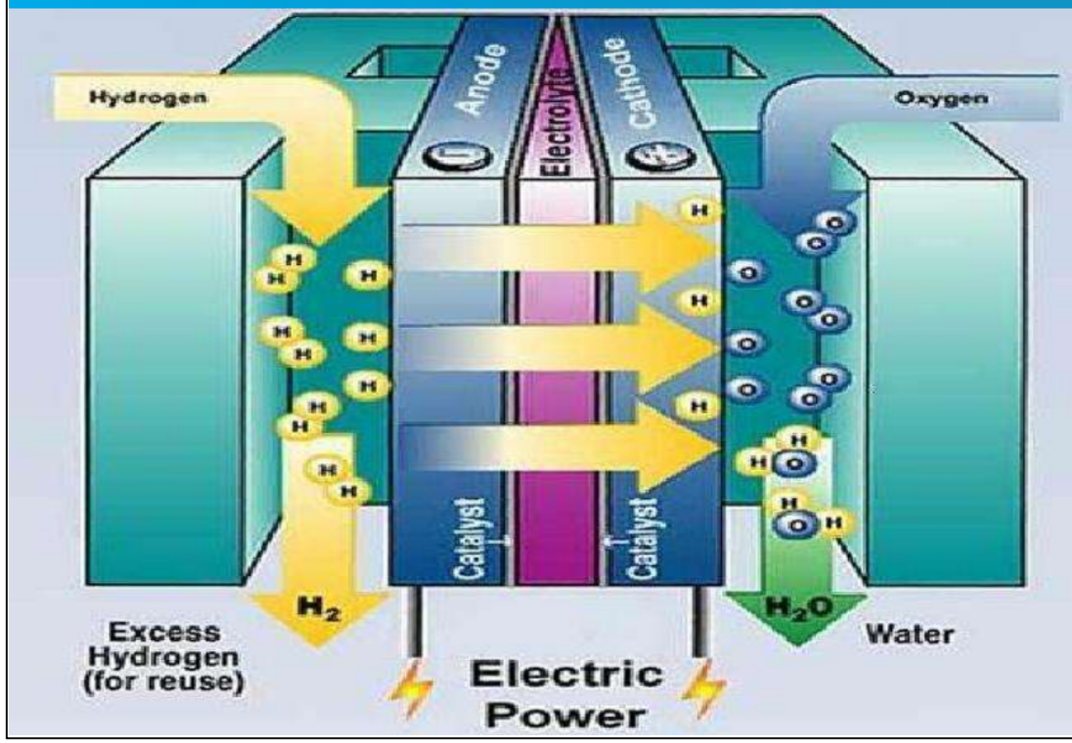






Production rate	Up to 500 NL/h, up to 1.0785 kg/24 h
Hydrogen output purity	35 barg: 99.9% (1,000 ppm H_2O) at 25 °C 8 barg: 98,8% (~ 12,000 ppm H_2O) at 25 °C
Output pressure	Up to 35 barg
Nominal power consumption per Nm^3 of H_2 produced	4.8 kWh/Nm^3, beginning of life
Operative power consumption	2.4 kW, beginning of life
Peak power consumption	3 kW
Heat dissipation **Max heat dissipation**	0.6 kW, beginning of life 0.9 kW, end of life
Standby power consumption[1]	0.3 kW
Power supply	220 – 230 V (AC), 50/60 Hz
Maximum water input conductivity	20 µS/cm at 25 °C
Water consumption	~ 420 mL/h at 25 °C
Water input pressure range	1 – 4 barg
Ambient operative temperature range	5 °C – 45 °C
Ambient operative humidity range	Up to 90% humidity, non-condensing
IP rating	IP 20
Dimensions	W: 482 mm × D: 635 mm × H: 266 mm
Weight	42 kg
Space inside cabinet	6 U
Control and monitoring	Fully automatic with Enapter's EMS via 2.4 GHz Wi-Fi and Bluetooth, Modbus TCP over Ethernet
Conformity	CE mark according to the machine directive 2006/42/CE[2] UKCA mark according to Supply Machinery (Safety) Regulations 2008[3]

FUEL CELLS, PROTON EXCHANGE MEMBRANE AND ANION EXCHANGE MEMBRANE



Disadvantage of PEM

High Cost



Anion Exchange Membrane



Anion Exchange Membrane



DIFFERENT FUEL CELL DESIGNS AND POWER CAPABILITIES

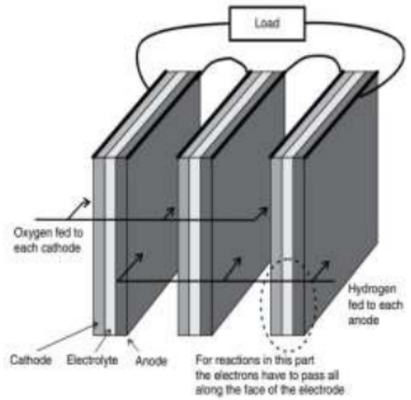


Figure 1.7 Simple edge connection of three-planar fuel cells in series. When the electrolyte is a membrane, the cathode–electrolyte–anode unit is generally known as a membrane–electrode assembly (MEA).

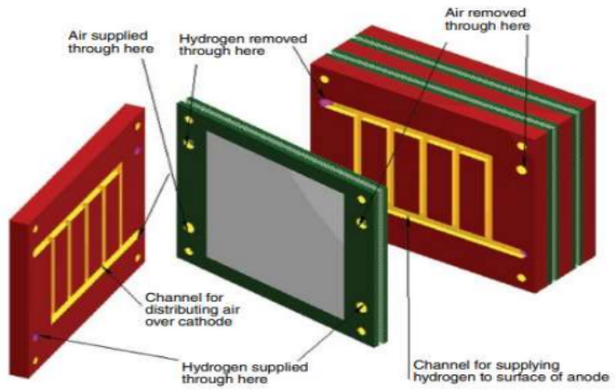


Figure 1.12 Internal manifolding. A more complex bipolar plate allows reactant gases to be fed to electrodes through internal tubes. (*Source*: Courtesy of Ballard Power Systems.)

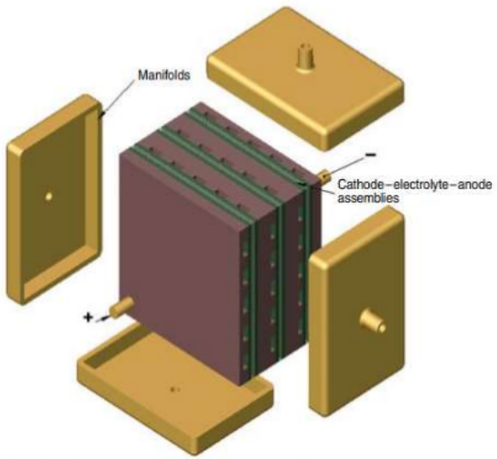


Figure 1.11 Three-cell stack, with external manifolds. Unlike the stack shown Figure 1.9, the electrodes now have edge seals.

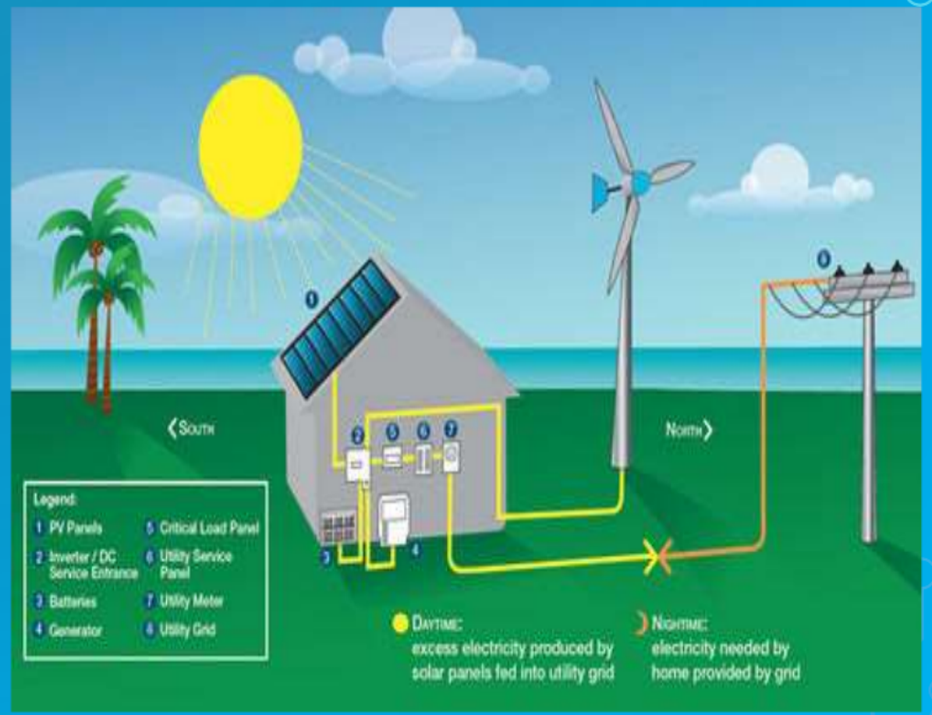
Figure 1.12 Internal manifolding. A more complex bipolar plate allows reactant gases to be fed to electrodes through internal tubes. (*Source*: Courtesy of Ballard Power Systems.)



Figure 1.13 A 96-cell, water-cooled PEMFC stack that produces up to 8.4 kW and weighs 1.4 kg. (*Source*: Courtesy of Proton Motor GmbH.)

IMPLEMENTATION AND TARGET AUDIENCE

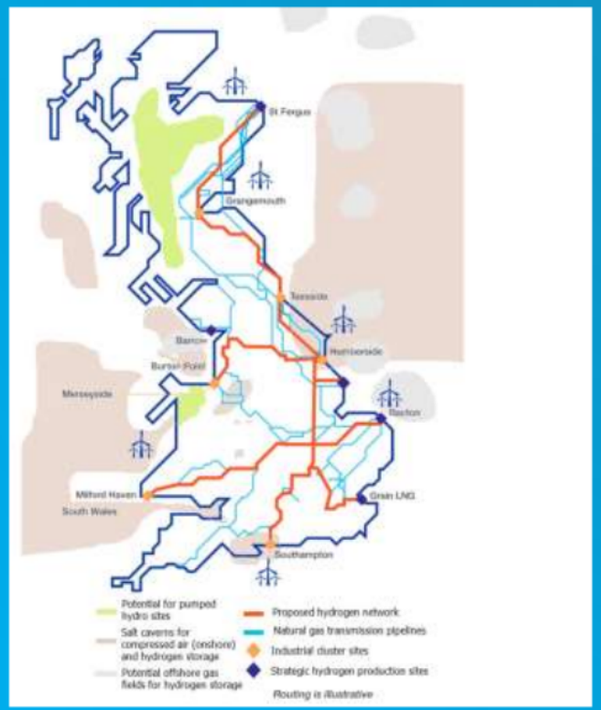
- Lowest cost highest yield is when land and properties are owned in volume.
- Local housing associations are the best target audience.
- By investing in PV for each property.
- Having land to build the LGEN building and reducing land rental cost.
- Using the NG's infrastructure to collect electricity locally reducing transmission waste.
- Bolton at home was used to predict price and cost as a guide.
- 18,000 homes supplying energy to 45% of Bolton during the day.
- A 20 year scale figure is produced on the next slide



CALCULATIONS ON A 20 YEAR SYSTEM

Hydrogen storage system cost 20 year Facility	Conversion loss	System cost	
computer system		-£50,000	
Electrolyser	-£304,472.00	-£913,306.45	
Storage Tanks		-£92,924.32	
Fuel Cell	-274,398	-£483,957.66	
Totals Cost	-£578,870.00	-£1,540,188.43	
	Cost	Production	Value
PV Production Value 8kWh System	-£180,000,000	180,000,000kWh	£2,988,000,000
Wind Generation Value	-£60,000	180,000kWh	£2,988,000
Totals	-£180,060,000	180,180,000kWh	£2,990,988,000
Cost and Profit of the System	Cost	Profits	Total
	-£182,179,058.43	£2,990,988,000	£2,808,808,941.57

GREEN HYDROGEN NETWORK IDEAS ON EXPANSION OPPORTUNITIES





- LGEN buildings are upgradable quite easily.
- H pipeline network not in place.
- Filling stations could be located in close proximity.
- Supplying H directly reducing H pipeline cost.
- The supply of the full Town is also easily added into the system.
- H boilers would require an extensive piping network but supply is possible.
- The LGEN building is designed with expansion in mind.
- Storage tanks are at 25% calculated need.
- EL are easily added to the system.
- Fuel cells are also added easily.

Independent Hybrid Systems

- Hybrid independent systems cost nearly double a LGEN pp.
- Small scale systems do not operate with H alone efficiently.
- An independent system would be at an advantage with a H boiler.





I would like to conclude my presentation by answering any questions you may have?

Local Green Energy Networks

GRADEMARK REPORT

FINAL GRADE

90 /100

GENERAL COMMENTS

Instructor

The project that is interesting and of required quality at this level

has been very well presented in teams.

Introduction to Problem Statement – 9

Problem statement are very well defined and clearly presented

Literature review -20

The literature review is comprehensive including relevant approaches and existing solutions.

Discussion & findings- 9

An in depth analysis of the solution has been provided.

code/Design/prototype - 8

The design and development of the project is well defined. The prototyping solutions are presented.

Project plan-1

Project life cycle represents your working towards the solutions and should have been explicitly included in the presentation

Response to questions -15

The student has engaged in interesting discussions

Presentation in teams -20

The student has confidently presented in teams engaging in discussions

Quality of presentation -8

The slides were well structured and designed

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