



ANNUAL CONFERENCE

SCOTLAND'S ENERGY EVOLUTION

21 & 22 MARCH 2017 **EDINBURGH**

HEADLINE
SPONSOR



Evolving Businesses: The Next Chapter for the Energy Sector

Chair

Jenny Hogan, Scottish Renewables

Speakers

Ivor Catto, Renewable Energy Systems (RES) Group

Paul Winkle, Torness Power Station, EDF Energy

Ivor Catto
Chief Executive Officer
Renewable Energy Systems (RES) Group



Paul Winkle
Scottish Business Development Director and Director
Torness Power Station
EDF Energy

WELCOME



EVOLVING BUSINESSES: THE NEXT CHAPTER FOR THE ENERGY BUSINESS

PAUL WINKLE, SCOTTISH BUSINESS DIRECTOR, EDF ENERGY



Today, EDF Energy is Britain's leading electricity supplier and generator

Number

1

• Electricity supplier

- Largest electricity supplier by volume^[1] (16% market share, more than 45 TWh)
- Delivering on customer commitments on fair value, better service and simplicity, so improving trust with customers and other stakeholders

[1] Source: Cornwall Energy Associates, 31 October 2016

Number

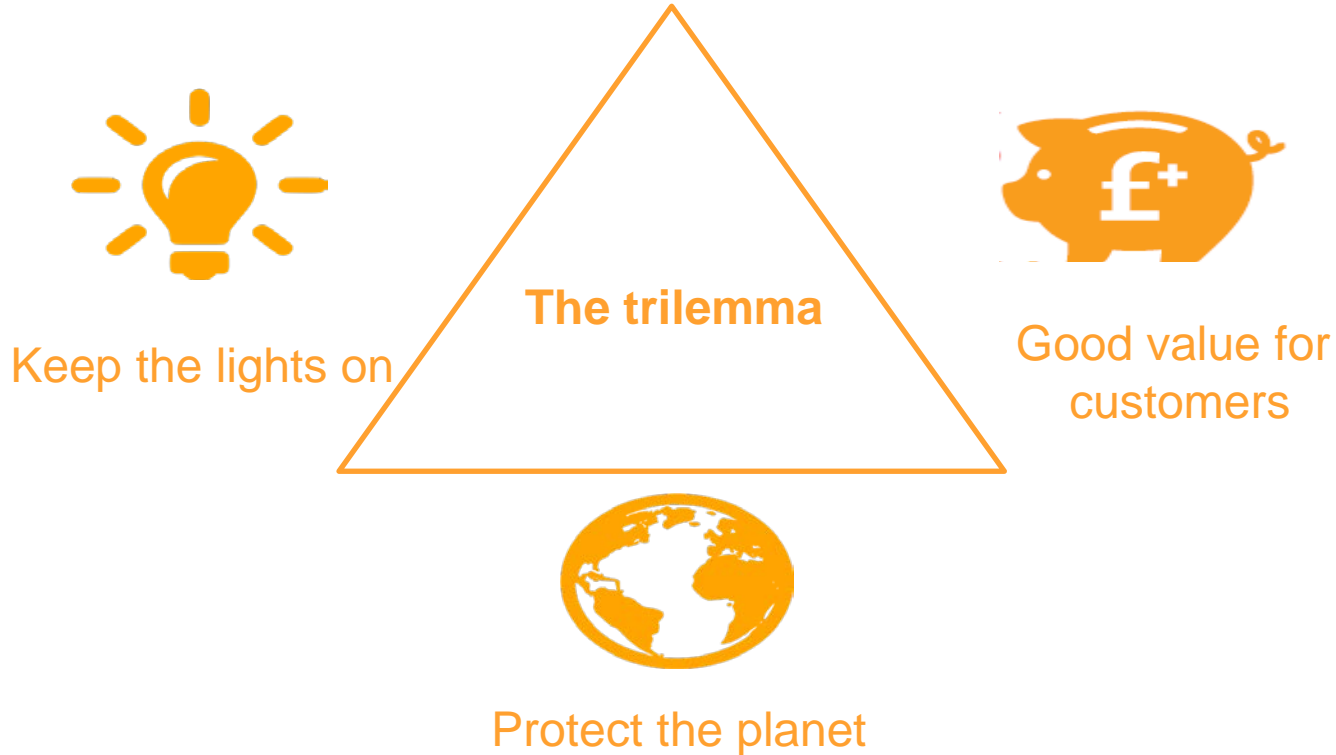
1

• Electricity generator

- Leading nuclear generator operating all UK nuclear power reactors comprising 14 advanced gas cooled reactors (AGR) and one pressurised water reactor (PWR)
- Operating two coal stations (2 x 2.0 GW) and a new CCGT (1.3 GW)
- Joint venture EDF Energy Renewables operates more than 600 MW of wind farms



We all have a responsibility...



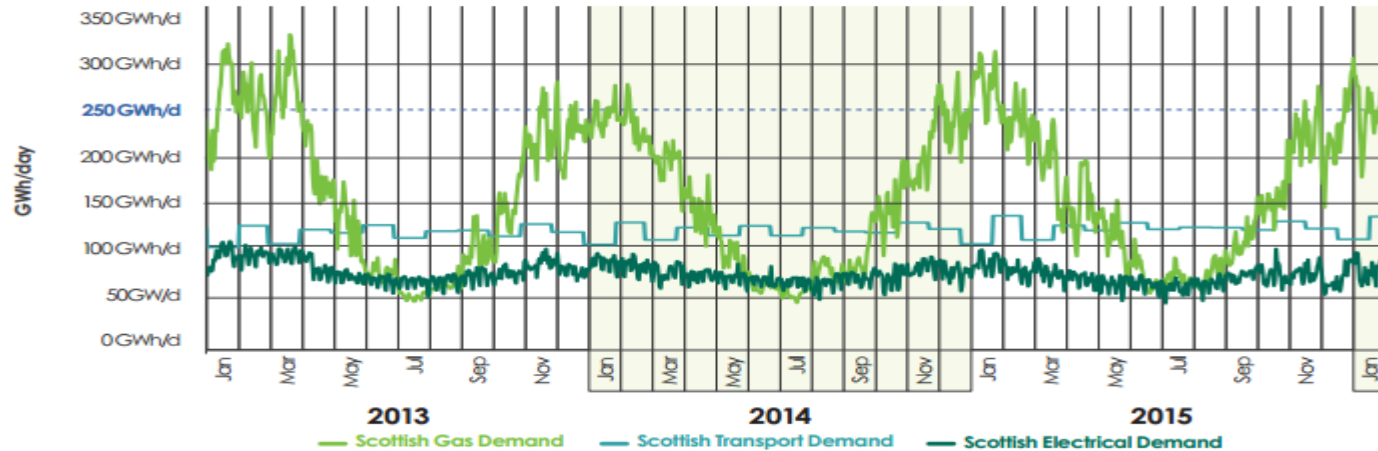
How do we solve the trilemma?

It depends who you ask...



Scotland's energy demands

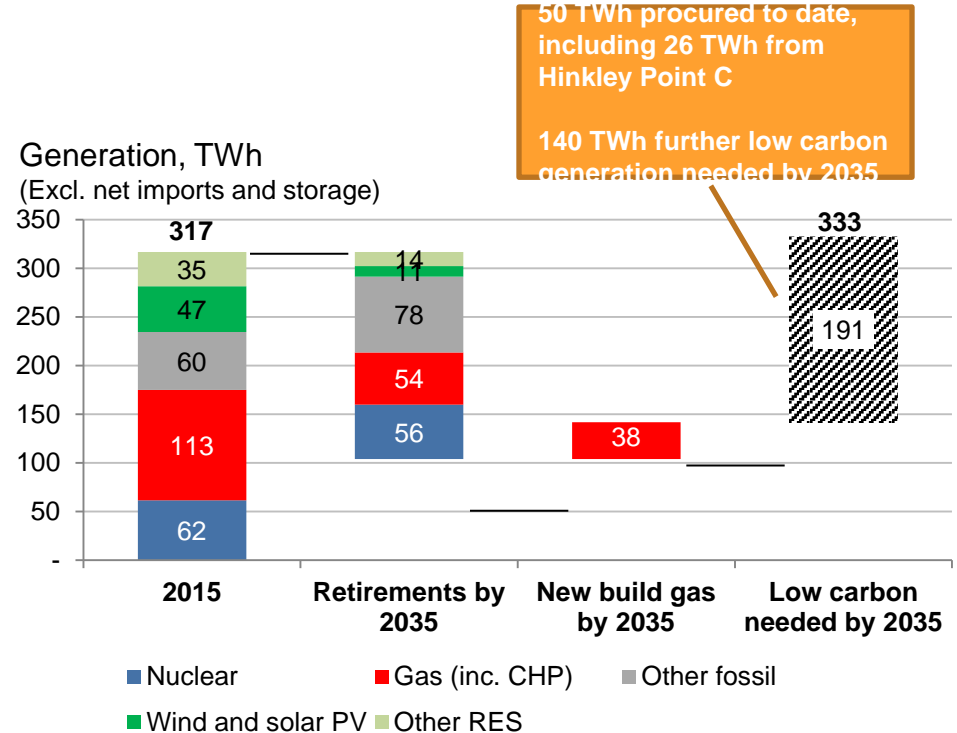
Diagram 10: Yearly Pattern of energy consumption



Source: Scottish Government, Draft Energy Strategy. Published, Jan 2017.

What will energy demand be like in 2035?

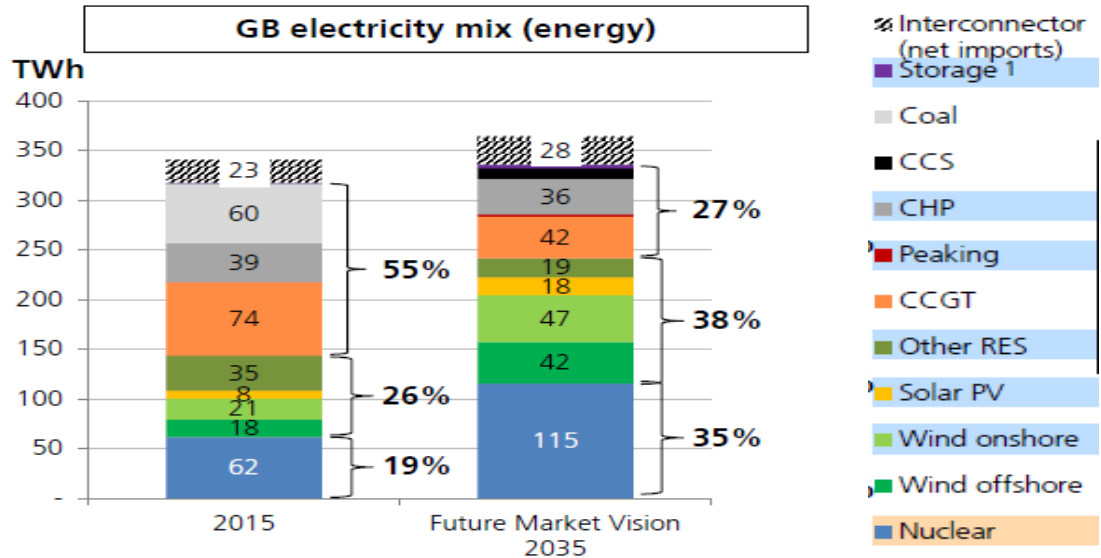
- Electricity demand will be higher – by around 20TWh.
- This will be driven by more households, growth in economic activity, and electrification of heat and transport.
- We will need around 190TWh of new low carbon generation by 2035.
- 140TWh of this is still to be procured – this is an opportunity!



Source: A Vision for the UK's Future Power Market © 22 March 2017 EDF Energy plc. All rights Reserved

Finding a balanced mix

- For EDF Energy the question isn't: "which single option will win out?"
- The question is: "what's the right mix so that we have a fair, affordable and robust low carbon electricity system which works best for customers?"
- Our view is that a diverse mix is needed to satisfy the main requirements:
 - Match demand, day and night, summer and winter
 - Deliver new services to customers
 - Bring forward new, cheap and previously untapped distributed energy resources
 - Maintain the system quality that keeps the Grid stable
 - Move away from relying on unabated fossil fuels
 - Be affordable



Source: A Vision for the UK's Future Power Market © 22 March 2017 EDF Energy plc. All rights Reserved

What is EDF Energy doing?



We are building capacity



What is EDF Energy doing?

We are investing in education and skills



EDINBURGH INTERNATIONAL
science
festiva



What is EDF Energy doing?



We are helping customers better manage their energy use



A few key questions...

How do we encourage customers to make the most of Smart meters?

How do we successfully manage the electrification of heat and transport?

What do our customers want – technologies sparring or technologies working together to complement each other to meet their needs?

THANK YOU





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Evolving Customers

Chair

Jenny Hogan, Scottish Renewables

Speakers

Rob Williams, BT

Nick Boyle, Lightsource Renewable Energy



Rob Williams

General Manager, Procurement –
Utilities, Power & Cooling

BT





Evolving Customers

Climate action-
implementation and ambition

BT's climate action journey

2015
BT announces goal for 100% renewable electricity worldwide by 2020 at CWNYC



2015
Global Goals launched and BT maps how its work supports them



2008

BT announces goal to cut its net global carbon intensity by 80% compared to 1996/97 (achieved 2016)



2016

BT investigates what a 1.5°C global carbon target would mean for its business

2012

BT announces ambition to purchase 100% renewable electricity in UK

Meaningful goals

Using Science Based Targets provides guidance for setting clear, measurable goals



1992
BT measures corporate carbon footprint and sets its first carbon reduction targets

2012

Better Future Supplier Forum launches to share environmental best practice and encourage sustainable innovation across BT's supply chain

#go100percent

Using renewable energy has a big impact and drives the creation of a global market for renewable energy



2016

BT tops Carbon Clear's annual ranking of carbon reporting performance of FTSE 100 companies for third year in a row



2014

BT is a founding member of the campaign for leading companies committed to using renewable energy

2014

Introducing spring out feet on BT Home Hub helps its 'through letter box' design save customers' carbon



2013

Introducing the BT Design Checklist highlights sustainability as a driver for product innovation

2016

BT achieves seven consecutive years of energy reduction



2016

Newsweek ranks BT as the third greenest company in the world



2013

BT introduces ambition to help customers cut their carbon emissions by at least three times its own end-to-end carbon impact



2015

BT launches web-based Sustainability Assessor Tool for suppliers

Holistic thinking

Measuring our end-to-end carbon impact and using the Global Goals as a framework, encourages collaboration, helps effective planning and demonstrates the difference our work makes in the world



2012

BT publishes world's first communications services carbon footprint for Olympic and Olympic Games

2013

BT introduces climate action policies for suppliers



2011

BT Home Hub is among the first products to have its carbon footprint published to the GHG Protocol Product Standard



What have we learned?



Meaningful goals

Using Science Based Targets provides guidance for setting clear, measurable goals



#go100percent

Using renewable energy has a big impact and drives the creation of a global market for renewable energy



Holistic thinking

Measuring our end-to-end carbon impact and using the Global Goals as a framework, encourages collaboration, helps effective planning and demonstrates the difference our work makes in the world

Raising the ambition - what's next for BT

- Develop a 1.5°C pathway for BT
- Drive the agenda forward on the Sustainable Development Goals
- Scale our supply chain sustainability performance
- Use our influence to extend beyond our own ambition to purchase 100% renewable energy globally

Thank you

bt.com/sustainability

@BTGroup



Nick Boyle
CEO
Lightsource Renewable Energy





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Evolving Technology and Challenges for the Energy System

Chair

Gordon MacDougall, Scottish Renewables

Speakers

Arnout de Pee, McKinsey & Company

Phil Doran, ITM Power

Arnout de Pee
Partner
McKinsey & Company



Opportunities & Challenges in the Energy transition

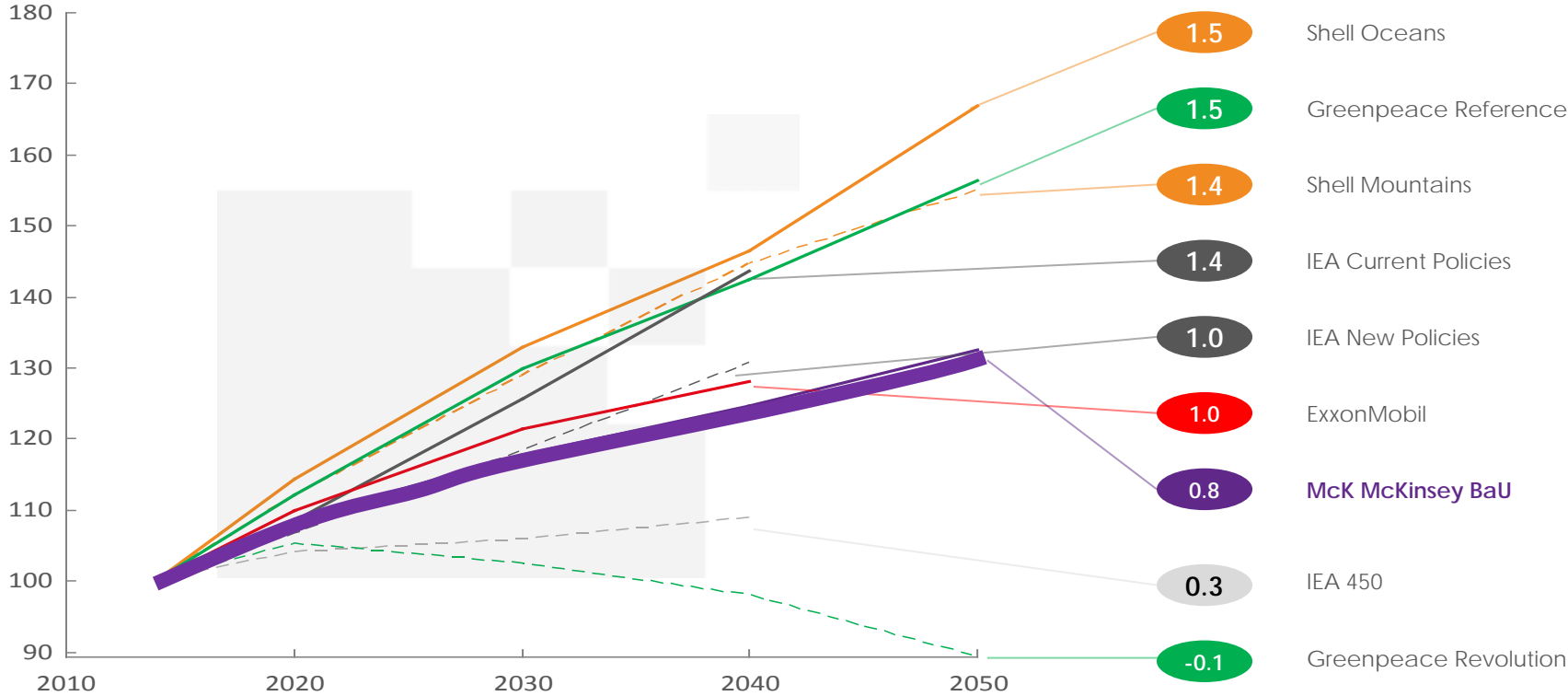


scottish
renewables

Scottish Renewable Conference

Energy demand growing, but at lower pace

Primary energy demand^{1,2}, Index, 2014 = 100



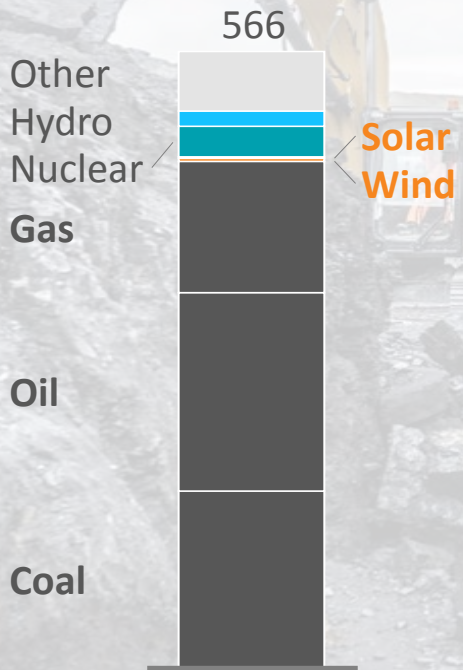
1 Primary energy consumption is fuel into power generation and other transformation activities, fuel used in energy sector, and final consumption excluding electricity/heat

2 Base years for forecasts; GEP, IEA 2013, Shell 2012, Greenpeace, ExxonMobil 2010. Indexing assumes linear growth between base year and 2013

Fuel mix is reliant on fossil fuels

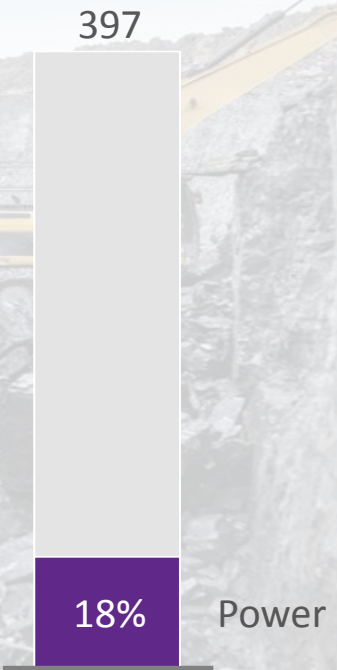
Primary energy demand

Million terajoules, 2014



Final energy demand

Million terajoules, 2014

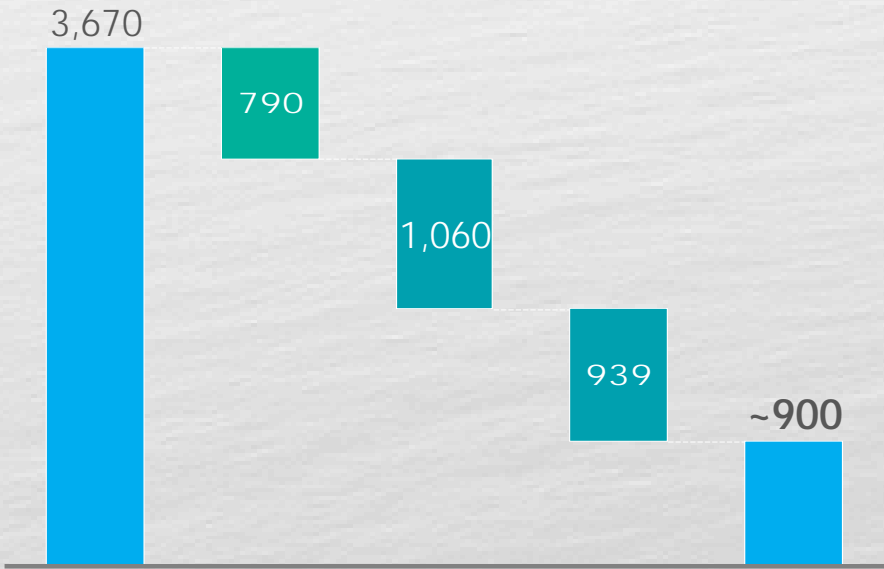


1 Other includes Biomass, Geothermal and Marine

We are constrained by a CO2 budget

Carbon budget emissions to 2100

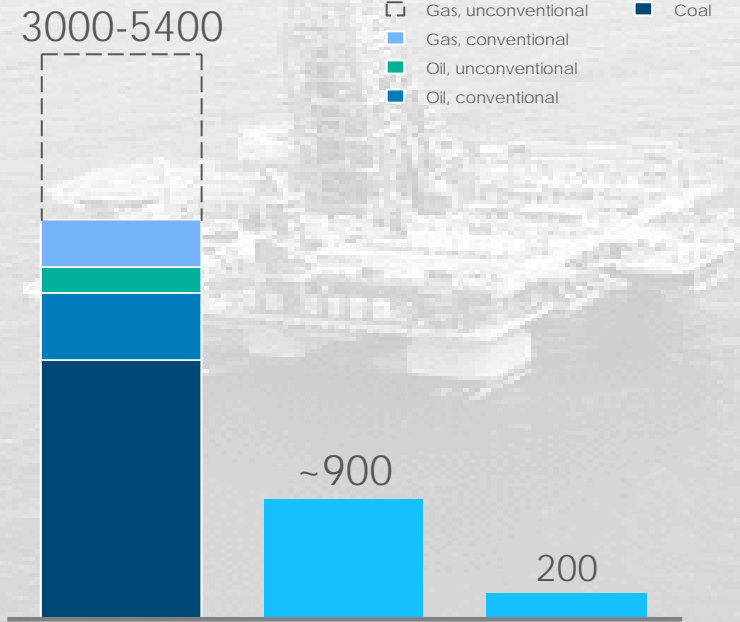
Billion tonnes of CO₂-eq.



2C carbon budget	Non-CO ₂	1750-1985	1985-2016	2016 carbon budget

Emissions implied by fossil fuel reserves

Billion tonnes of CO₂-eq.



Reserves	2° C carbon budget	1.5° C carbon budget

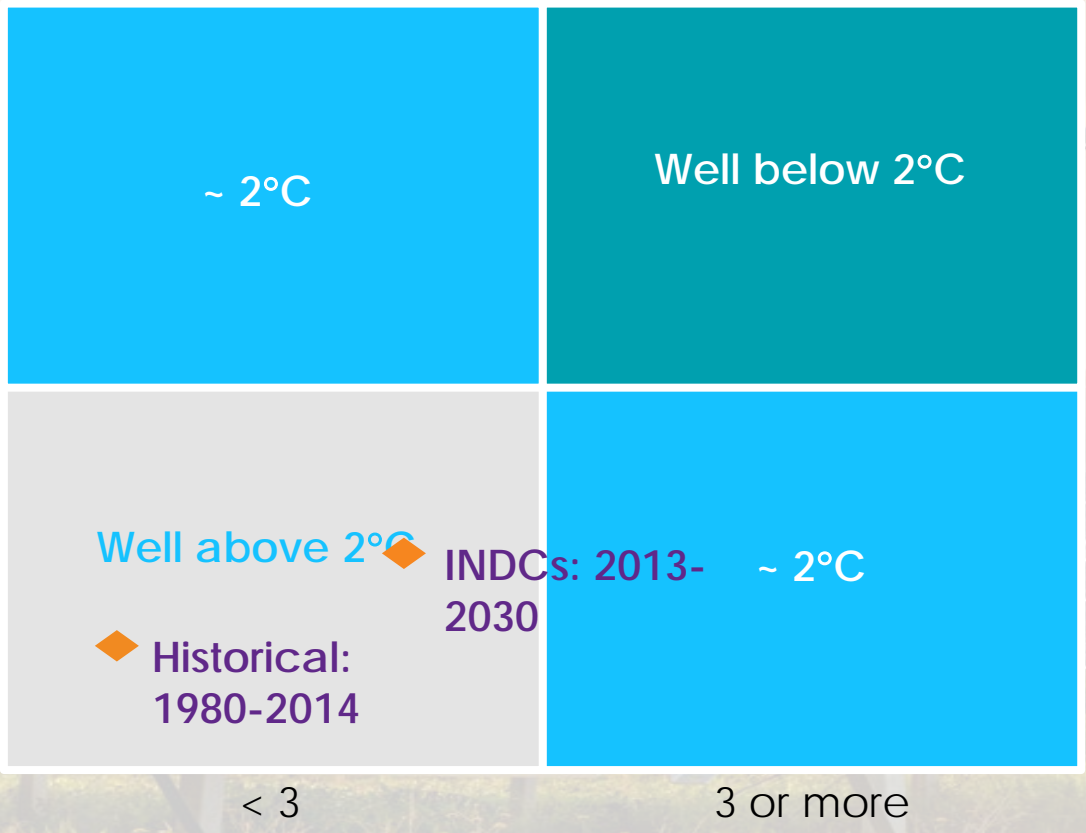
- Gas, unconventional
- Gas, conventional
- Oil, unconventional
- Oil, conventional
- Coal

Current actions are not enough yet

Increase in share of zero-carbon¹ energy % points p.a.

1 or more

< 1



Improvement in energy productivity, % p.a.

¹ We include here renewables, nuclear, biomass and fossil fuels if and when their use can be decarbonized through carbon capture and use or storage (CCS/CCU). However, if a large share of the increase is from the latter, a higher share is required since this does not reduce emissions to zero completely

4 simultaneous transition strategies

2 sets of enablers

4 transition strategies

A

Coherent and stable policy framework



B

Investment and financing shifts

① Decarbonization of power combined with extended electrification

② Decarbonization of activities which cannot be easily electrified

Country-specific transition pathways

③ Acceleration in the pace of energy productivity improvement

④ Optimization of fossil fuels use within overall carbon budget constraints

Transition to low carbon energy systems providing energy access for all

Our system challenges ahead

Sources of energy



Backbone of energy system



End uses



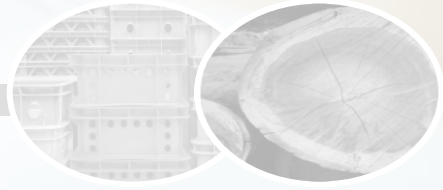
Increasing renewables share leading to imbalances of power supply & demand



Infrastructure needs to go through a major transformation



Global buffering capacity based on mostly fossil sources



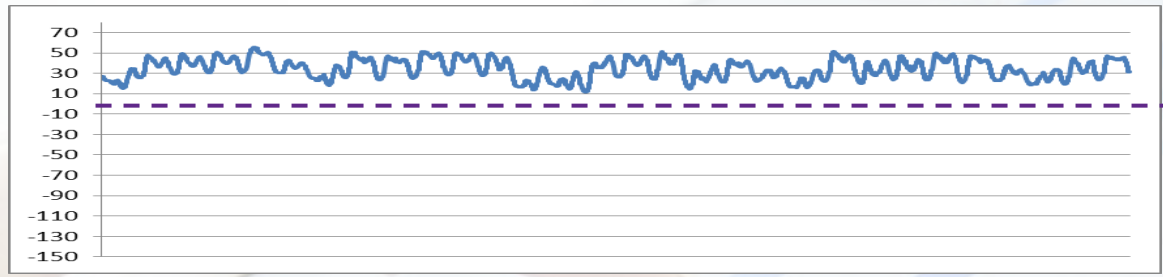
Some energy uses are hard to electrify via the grid or with batteries

Carbon needs to be reused to decarbonize feedstock

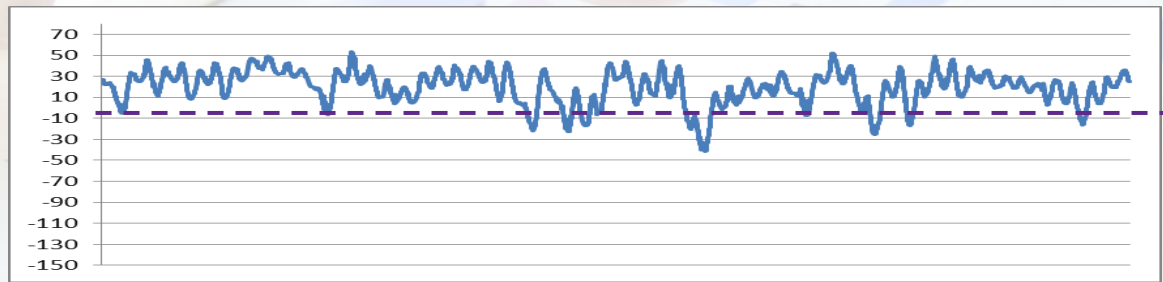
System imbalances will require new solutions

Germany, residual load in GW, 1-month sample

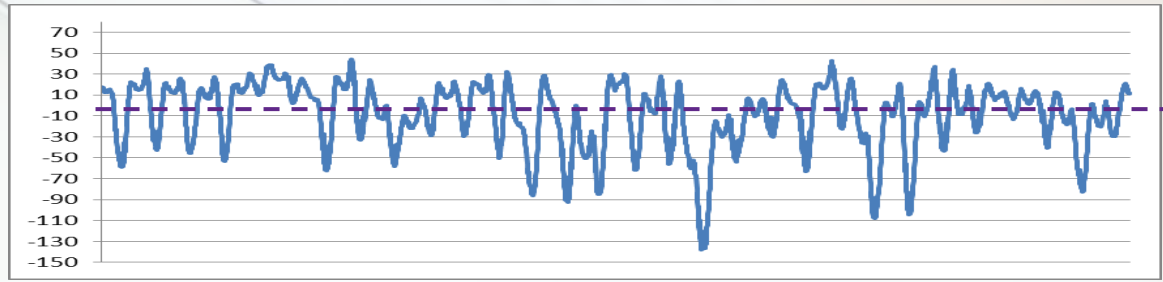
2013



2030



2050



Our system challenges ahead

Sources of energy



Backbone of energy system



End uses



Increasing renewables share leading to imbalances of power supply & demand



Infrastructure needs to go through a major transformation



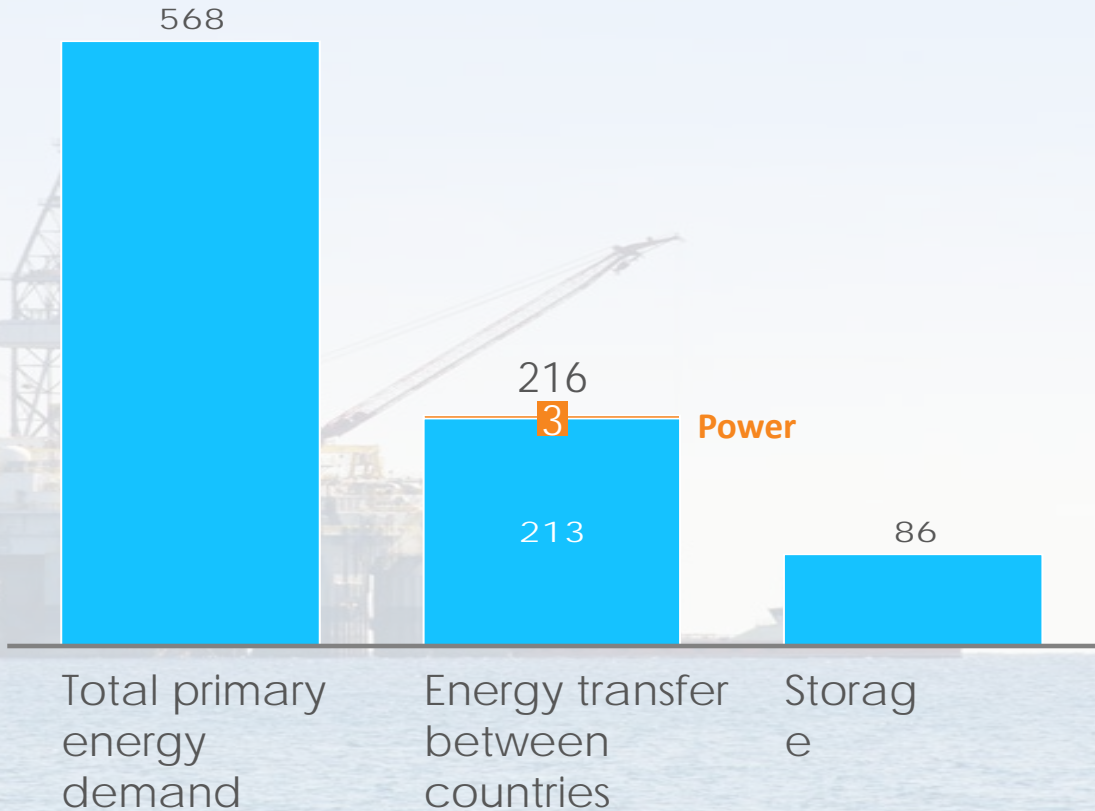
Global buffering capacity based on mostly fossil sources



Some energy uses are hard to electrify via the grid or with batteries:

Carbon needs to be reused to decarbonize feedstock

Energy mismatches – between countries, and in storage



1 EGIS/ENTSO

SOURCE: McKinsey, expert interviews, cedigaz; IGU wrld LNG report, DoE Global energy storage database, CIA

Our system challenges ahead

Sources of energy



Backbone of energy system



End uses



Increasing renewables share leading to imbalances of power supply & demand



Infrastructure needs to go through a major transformation



Global buffering capacity based on mostly fossil sources



Some energy uses are hard to electrify

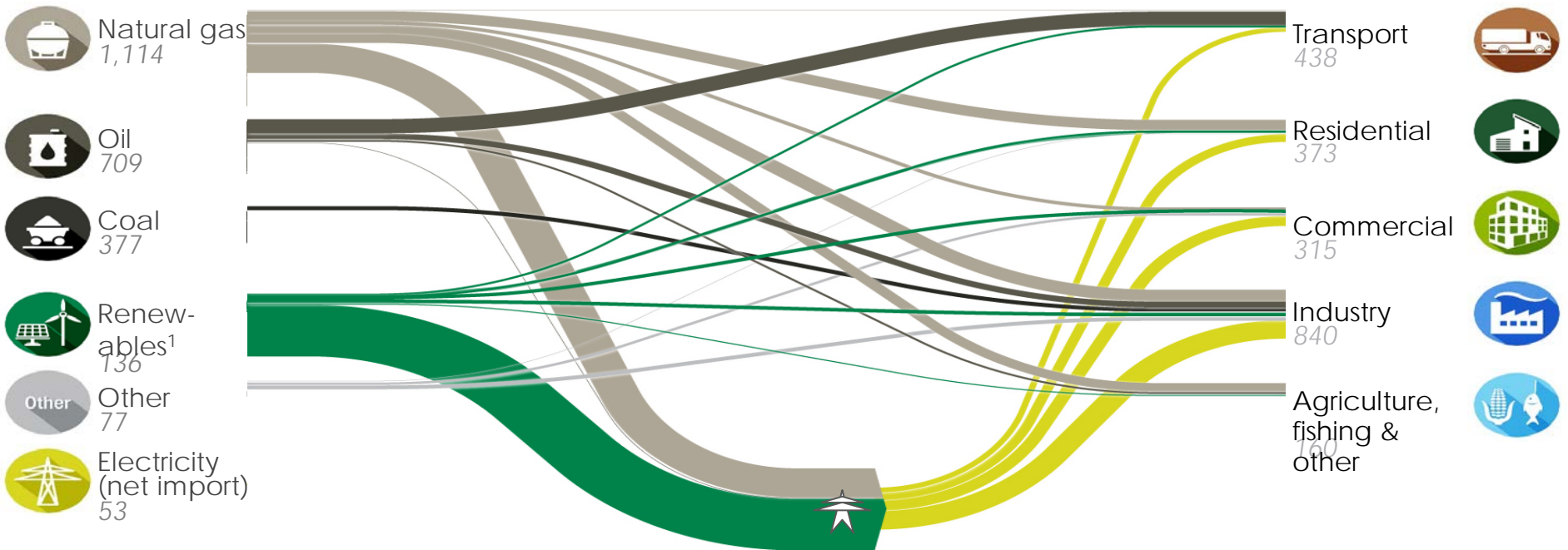
Reuse carbon to decarbonize feedstock

An 2040, Ex 60% ple tra 2004 itation, the system is largely would depea de n on fossil fue s differently

Netherlands energy demand in 2040; flow between energy sources and sectors, PJ

Energy sources

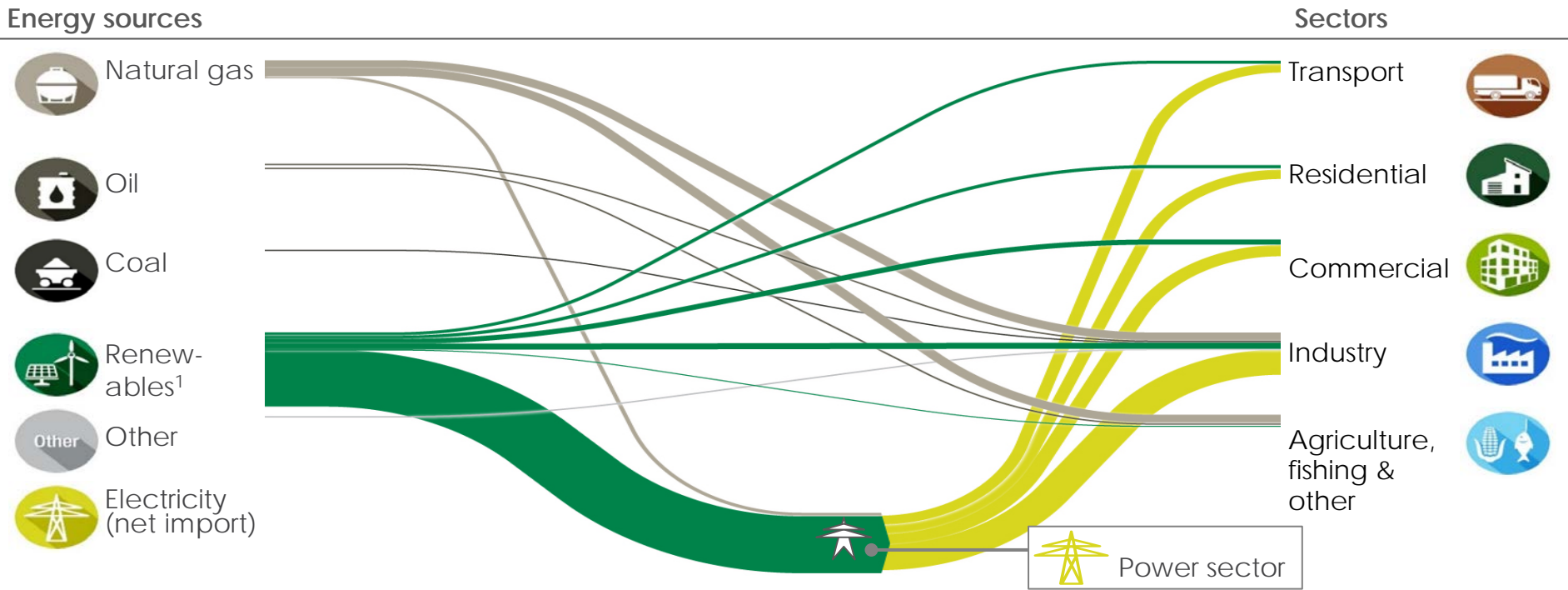
Sectors



¹ Includes: hydro, geothermal, solar, wind, and biomass. ² Only includes net use for central power production (220 PJ) and transmission and distribution losses (23 PJ); energy sector own use (e.g., oil consumption in refining is included in industry)

When striving for 80% reduction by 2040 the role of renewables increases further

Netherlands energy demand in 2040; flow between energy sources and sectors, PJ



¹ Includes: hydro, geothermal, solar, wind, biomass, and hydrogen
² Includes net biomass use (94 PJ), gas use (37 PJ), and own use and transmission and distribution losses

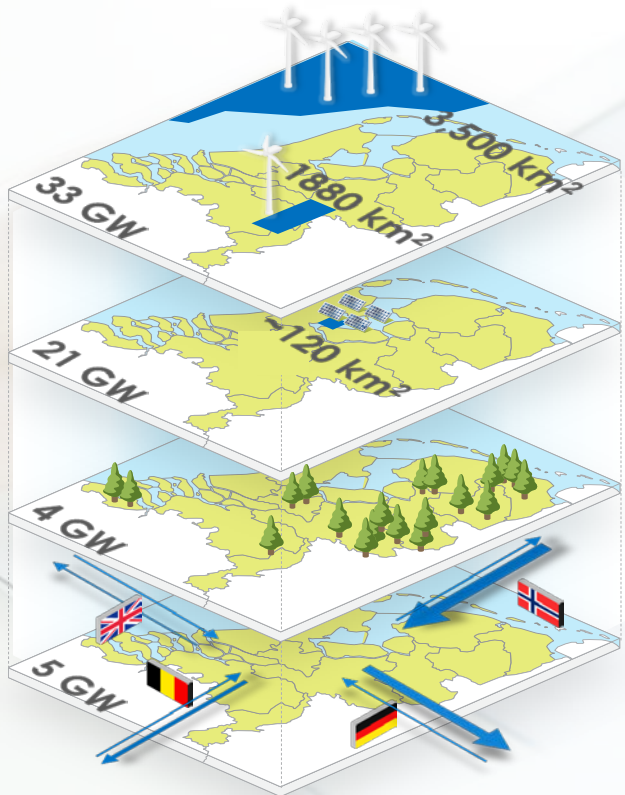
An example of such a power system

Wind
62% of production

Solar
12% of production

Biomass
8%

Flexibility measures



~11 thousand turbines¹

- 6% of Dutch North Sea

~63 million solar panels²

- Third of current roof area

8,500 kton dry biomass³

- Conversion of existing coal plants to biomass
- 5 GW of (seasonal) storage

¹ 1.45% capacity factor, turbines of 3 GW

² 1.65 m² per solar panel, 235 kW

³ 17 MJ/kg biomass, 2 ktons/km²

Implications



Energy transition is an economic transition – think value



Don't just focus on supply – rethink the system and demand



Take a long term perspective on regulation, technology

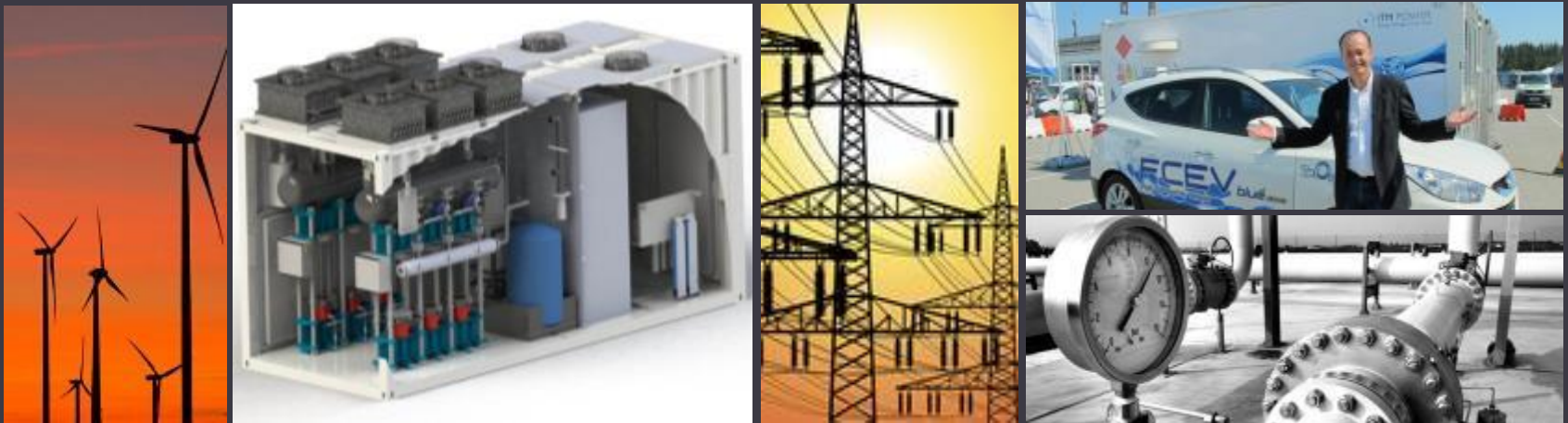
Phil Doran

ITM Power



GRID BALANCING AND SUPPORT: POWER-TO-GAS ENERGY STORAGE

21ST MARCH 2017 | SCOTTISH RENEWABLES ANNUAL CONFERENCE



PHIL DORAN
BDM - SCOTLAND

GRID BALANCING AND SUPPORT: POWER-TO-GAS ENERGY STORAGE

21ST MARCH 2017 | SCOTTISH RENEWABLES ANNUAL CONFERENCE

Contents:

- ITM Power company background
- Energy storage background, grid balancing and demand side management
- The role that hydrogen can play in improving the utilisation of renewable power
- Power-to-gas energy storage

ITM Power | History

- First AIM listed fuel cell & hydrogen company
- 2004 IPO | £10m | ITM.L
- 2006 Secondary | £30m
- 2012 -16 Expansion | £22m
- 2015 Strategic investment from JCB | £5m
- 2017 Secondary | £5.6m
- Two facilities in Sheffield | 70 staff
- Subsidiaries in Germany & California
- Manufacturing business model

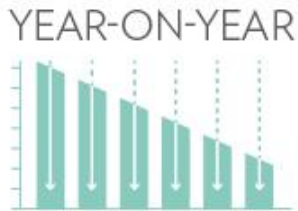
ORDERS OF
£15.68m
OVER THE LAST
12 MONTHS



DEAL PIPELINE OF
£21m



LOSSES
DECREASED
BY
20%



HEAD COUNT
UNCHANGED



ACHIEVED

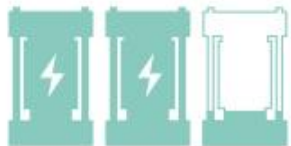


LONG RUN
COST TARGET
€1m/MW



SOLD

5.25MW



OF LARGE SCALE
ELECTROLYSERS

1st
UK

POWER-TO-GAS
CONTRACT WITH

nationalgrid



OPENED **THREE**
NEW REFUELLING
STATIONS IN UK



AND **ONE** IN USA

FUEL CONTRACTS
WITH



TOYOTA



HYUNDAI



COMMERZBANK

GROUP



ARCOLA
energy



ARVAL
BNP PARIBAS GROUP

Europcar



ANGLO
AMERICAN



Shell



REFUELLING STATION
ON SHELL FORECOURT

ACHIEVEMENTS IN THE LAST 12 MONTHS
HYDROGEN ENERGY SYSTEMS

RAPID RESPONSE ELECTROLYSER

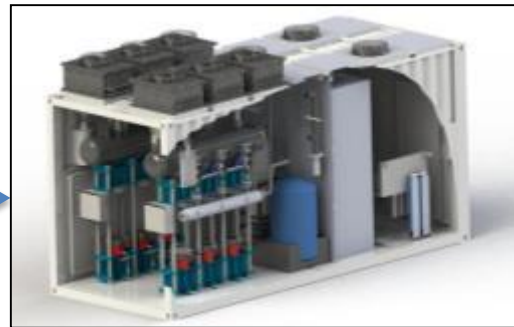
Efficiently convert surplus renewable electricity into chemical energy (hydrogen gas)



Renewable Energy



Grid-balancing
Demand side response



ITM Electrolyser System



Energy Storage



Clean Fuel

ENERGY STORAGE | CLEAN FUEL
HYDROGEN ENERGY SYSTEMS

PRODUCT OFFERING

Rapid Response | High Efficiency | Self Pressurising | Scaleable

- Rapid response: <1s; for primary grid balancing
- High Pressure: self pressurising; for onward compression & direct injection
- High Efficiency: measured by third parties in the field
- MW Scale: modular system design
- Compliant: EU, USA & permits to operate
- Operations: 3yrs in the field



HGAS: INTEGRATED ELECTROLYSER SYSTEMS

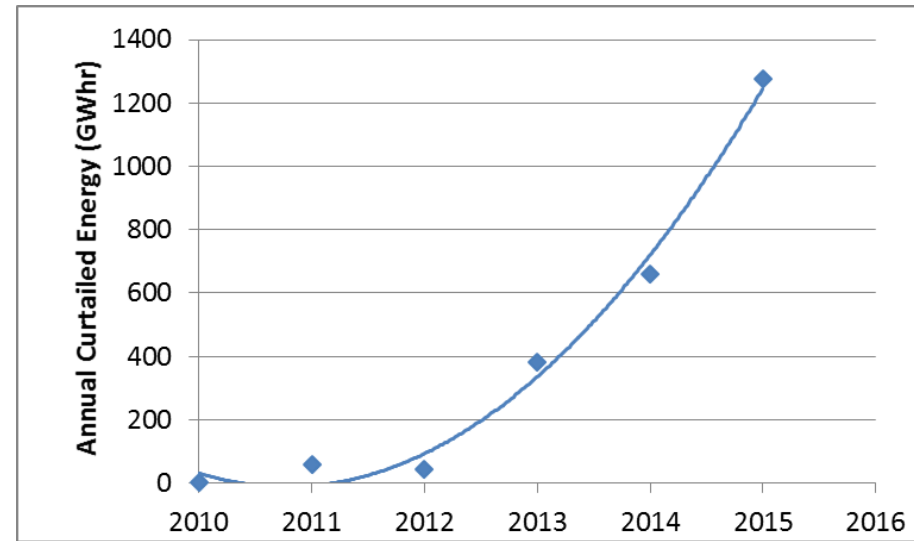
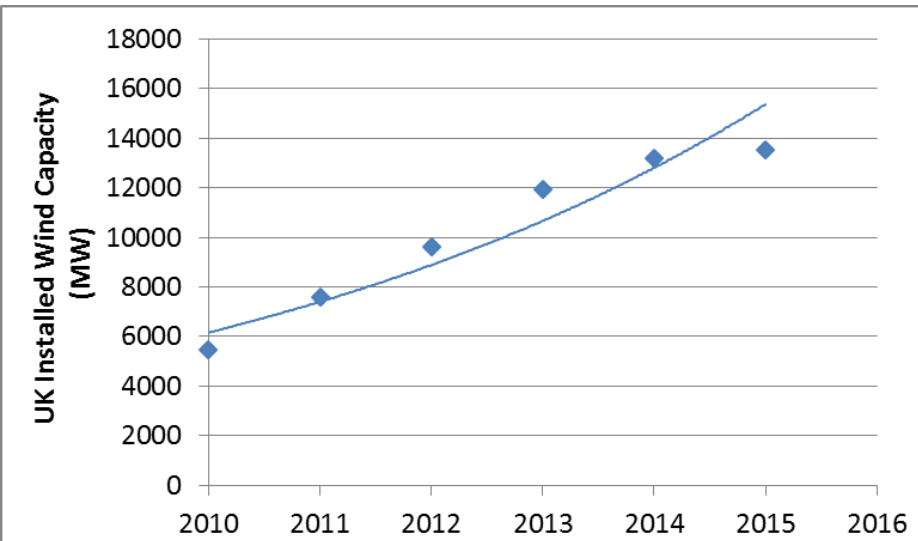
INTRODUCTION

THE NEED
GRID BALANCING
P2G RATIONALE
ENERGY STORAGE



UK WIND CURTAILMENT

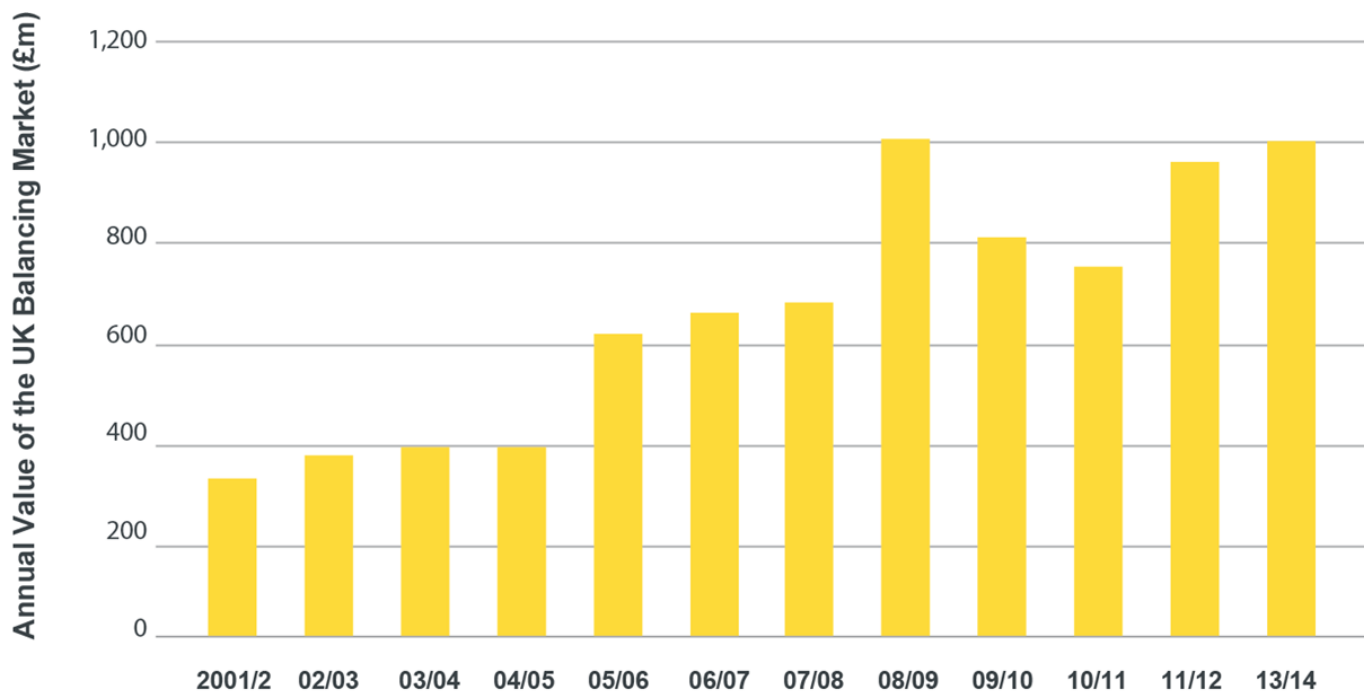
- Evidence of grid balancing problems from Germany and Denmark
- Problems start above ~20% capacity
- UK hit this threshold at the end of 2013
- Wind curtailment is rising faster than wind capacity



ENERGY STORAGE: THE NEED
HYDROGEN ENERGY SYSTEMS

BALANCING SUPPLY AND DEMAND:

- A total of £725m paid for balancing services in 2010–11; £1,100m in 2014/15
- Estimates in 2020 are: circa £1.9bn – £5.9bn pa

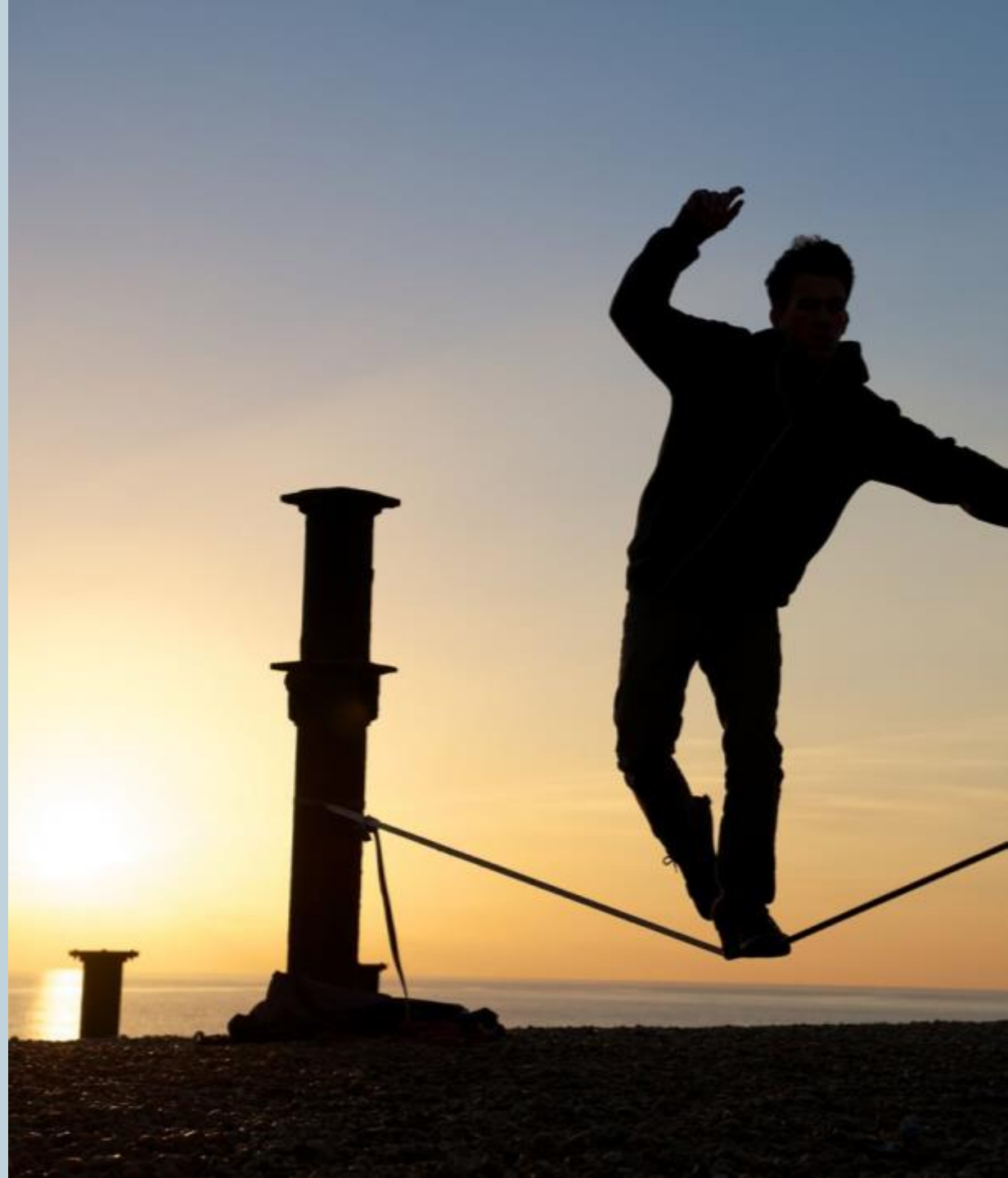


*Source: National Grid: Note: The dip in value reflects the UK's recession

THE NEED: GRID BALANCING
HYDROGEN ENERGY SYSTEMS

GRID BALANCING

FREQUENCY
SUPPLY SIDE
DEMAND SIDE



POWER GRID

Mechanical Inertia | Dynamic Coupling

- 3000 rpm | 50Hz (60Hz USA)
- Max 4% swing 48Hz|52Hz
- 0.5 Hz activates primary balancing action
- Obligation average 50Hz in 1hour



POWER GRID OPERATION
MECHANICAL INERTIA

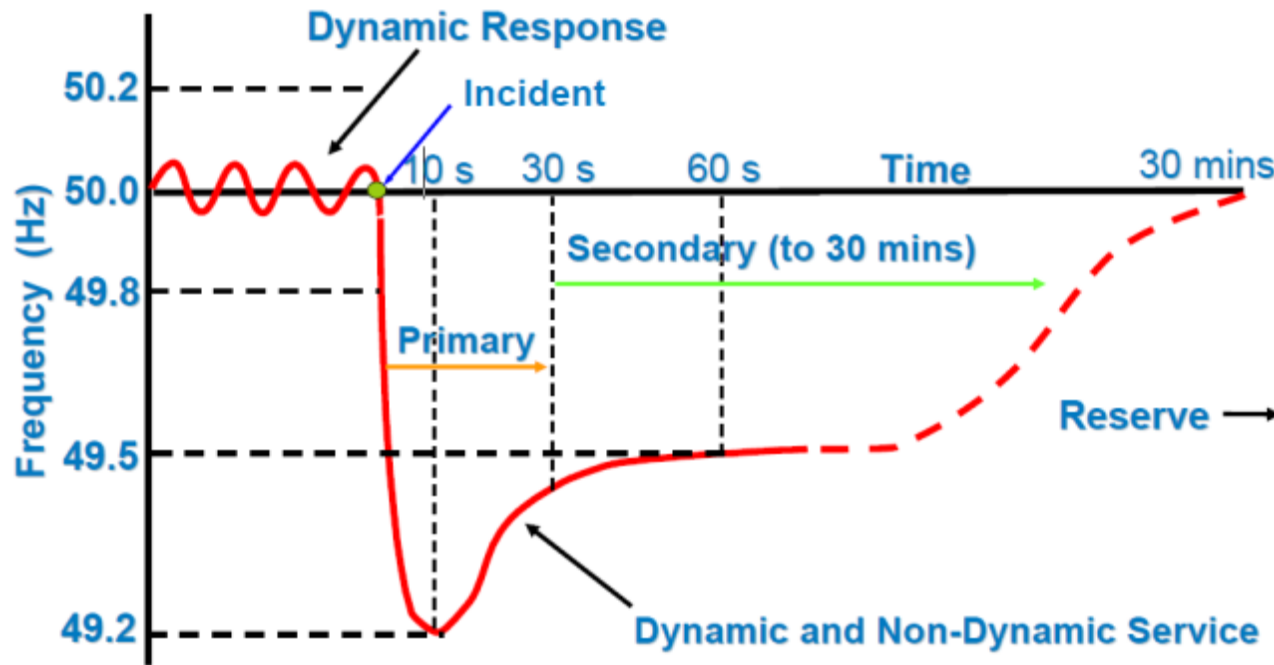
BALANCING SUPPLY AND DEMAND: SECOND BY SECOND



THE NEED: GRID BALANCING
ENERGY STORAGE | CLEAN FUEL

PRIMARY VS SECONDARY RESPONSE

Frequency Control Phases



RAPID RESPONSE ELECTROLYSIS

ENERGY STORAGE | CLEAN FUEL

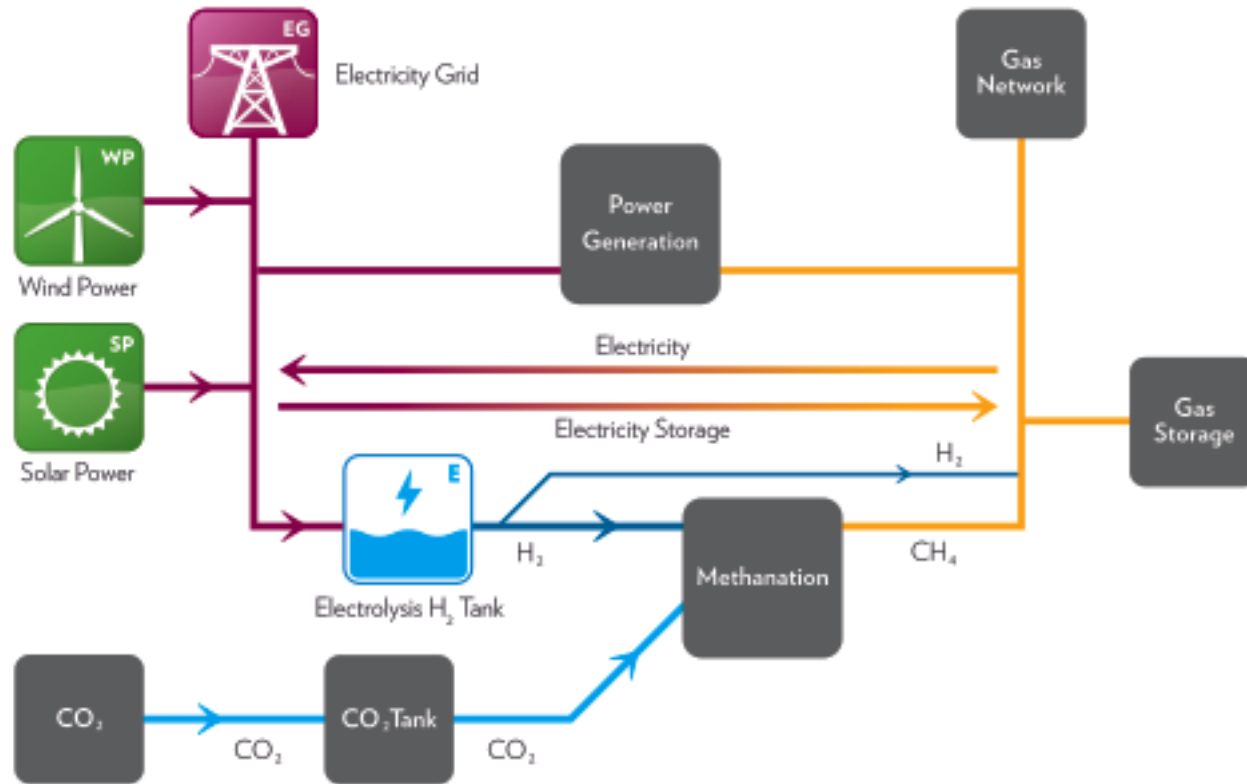
POWER-TO-GAS ENERGY STORAGE

RATIONALE
TECHNOLOGIES
ELEMENTS OF VALUE



WHY POWER-TO-GAS?

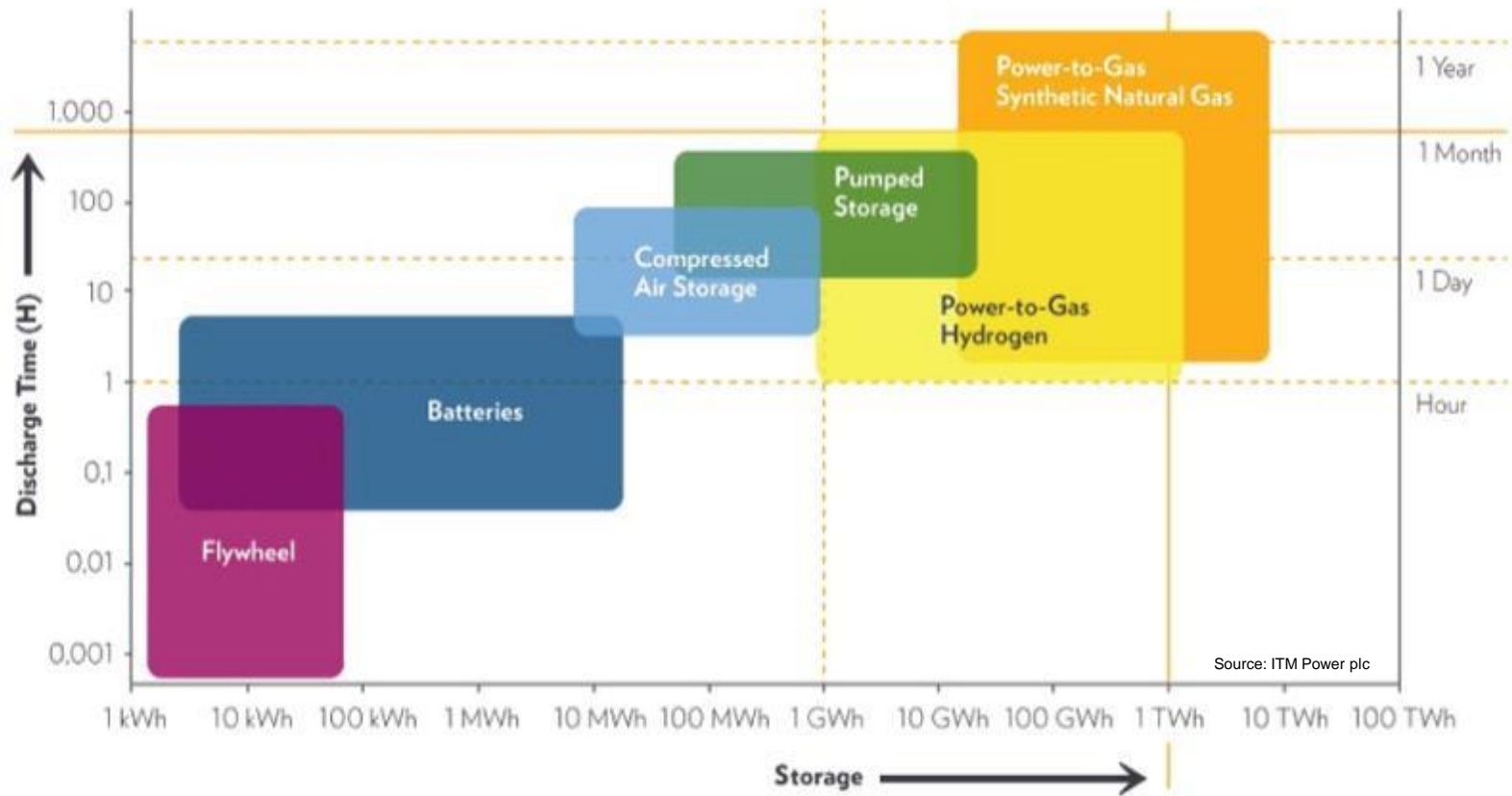
Electricity cannot be stored easily | Hydrogen can be stored easily in the gas grid



POWER-TO-GAS RATIONALE
HYDROGEN ENERGY SYSTEMS

ENERGY STORAGE TECHNOLOGIES

Power-to-gas is efficient | long term | low energy cost



ENERGY STORAGE TECHNOLOGIES

ENERGY STORAGE | CLEAN FUEL

P2G: ELEMENTS OF VALUE

- Value to the power grid
- Value to the gas grid
- Value to the economy

Value to the Power Grid

- Avoided wind curtailment
- Avoided infrastructure upgrades
- Reduced reserve power
- Reduce CO₂ from open cycle GTs

Value to the Gas Grid

- Decarbonising gas
- Providing renewable heat
- Reducing GHG emissions from gas transportation

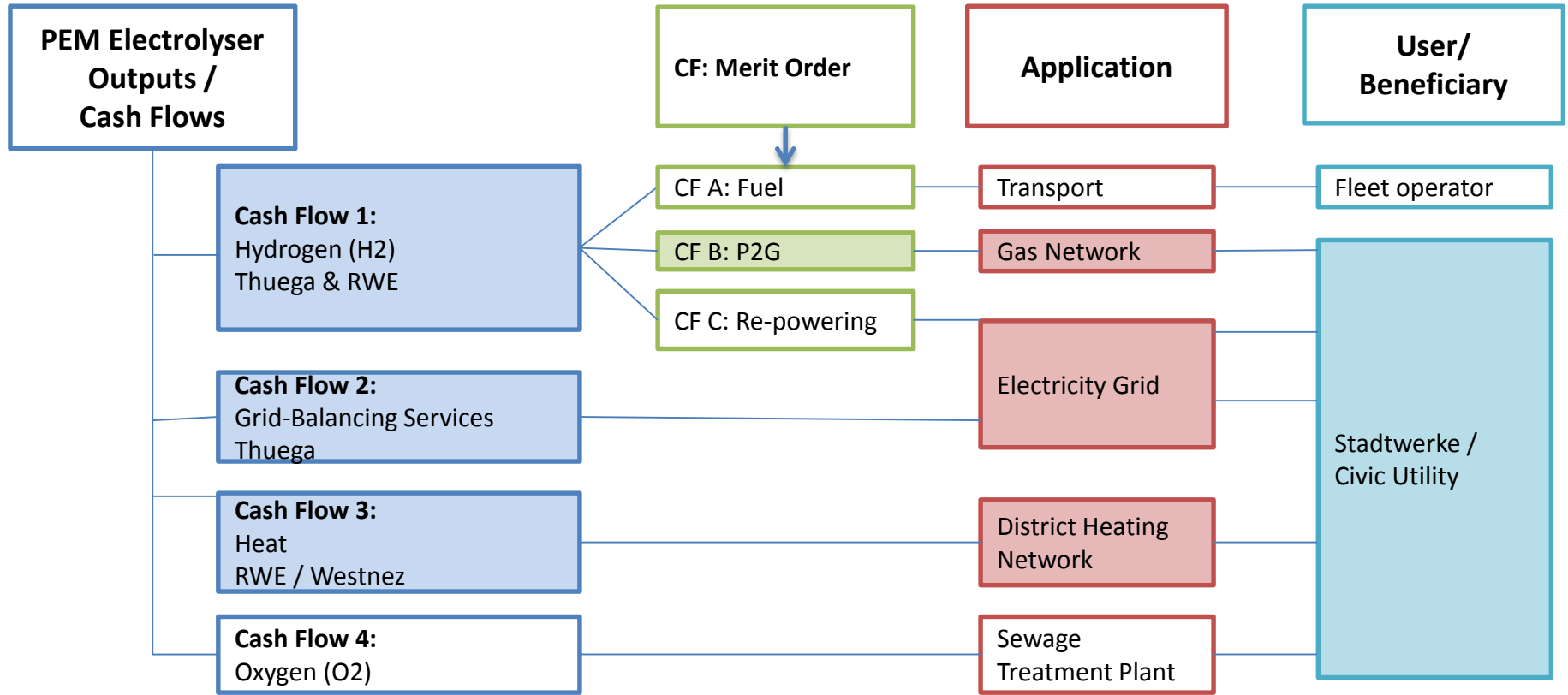
Value to the Economy

- Reducing fuel imports
- Improved energy security
- Creating jobs in manufacturing

P2G: ELEMENTS OF VALUE

ENERGY STORAGE | CLEAN FUEL

PEM ELECTROLYSER: A MENU OF OPERATING OPTIONS

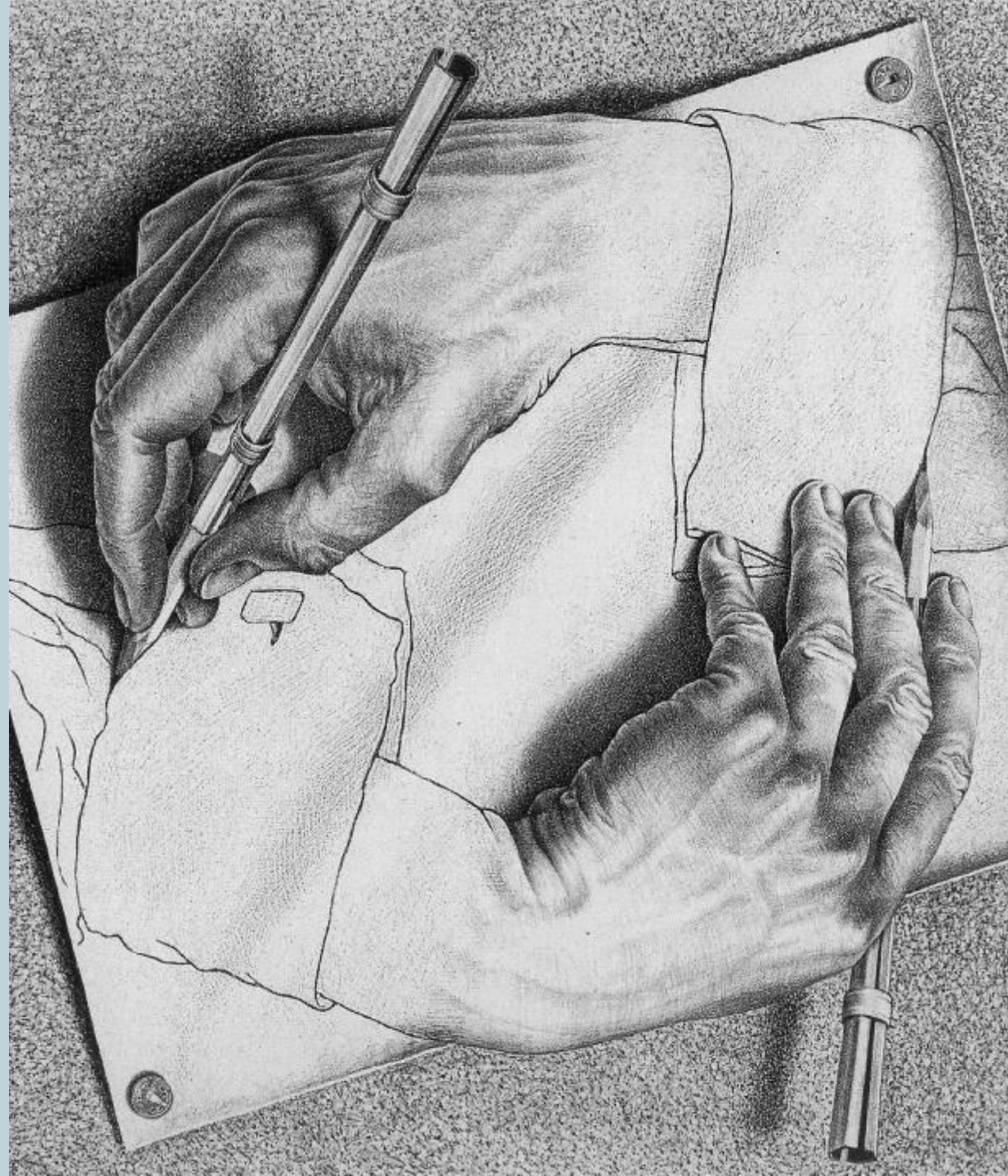


A MENU OF OPERATING OPTIONS

ENERGY STORAGE | CLEAN FUEL

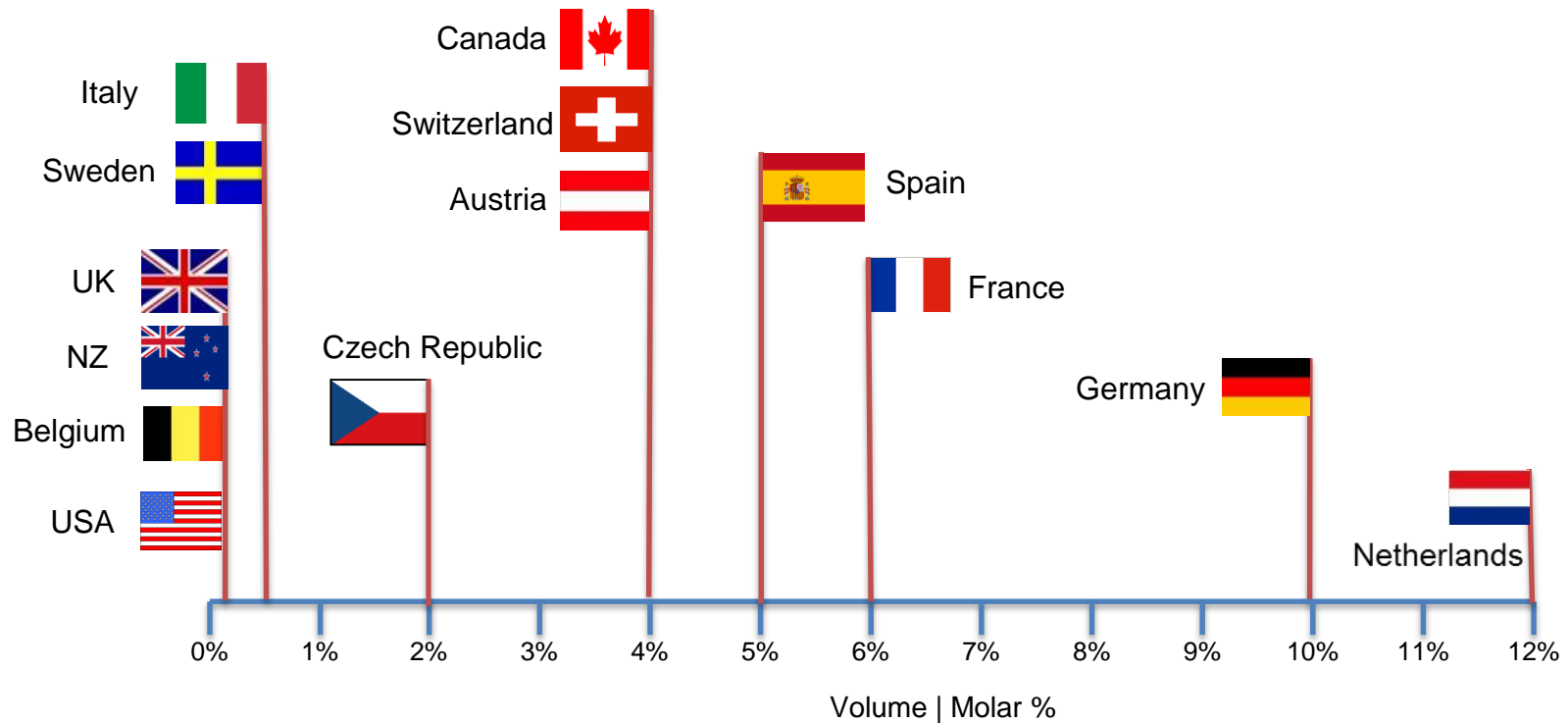
COMPLIANCE

H2 INJECTION LIMITS



Current Hydrogen Limits for Gas Grid Injection

Covered by a range of local laws and directives



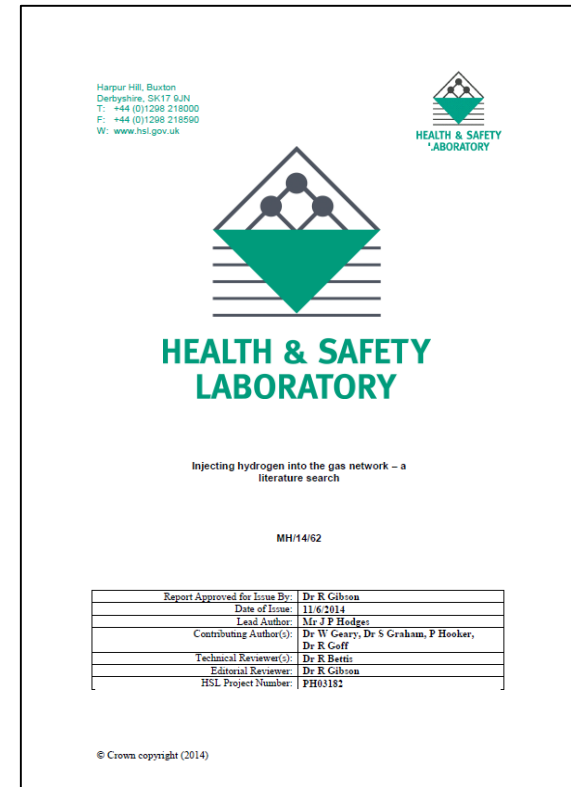
POWER TO GAS ENERGY STORAGE

ENERGY STORAGE | CLEAN FUEL

INJECTING HYDROGEN INTO THE GAS NETWORK: A LITERATURE SEARCH BY THE UK HSL

Examined the effect of natural gas enriched hydrogen on the UK gas network; key findings:

- Injection of hydrogen at concentrations of 20% v/v or less is unlikely to have a deleterious effect on the gas network and most appliances
- There is no evidence that pipes and fittings made from polyethylene (PE) will be adversely affected.
- Modern, CE marked, naturally aerated appliances appear to be able to burn hydrogen-enriched natural gas available in the UK safely at up to 20% v/v without modification
- It is not expected that the fire and explosion hazards arising from the ignition of accumulations of mixtures of natural gas and hydrogen (up to 20% v/v) from unintentional escapes will be significantly more severe than for leaks of natural gas alone.



DEPLOYMENT

THUGA PROJECT
RWE / WESTNETZ
HYDEPLOY - FIRST
P2G IN THE UK



ENERGY STORAGE REFERENCE PLANT



First ever Power-to-Gas using PEM electrolyser

- November 26th, 2013 H₂ injection into Frankfurt gas distribution network
- 3 years of real world operation outside of ITM control
- system partial-load efficiency of 77%
- Prequalified plant for secondary balancing
- Successfully tested the plant for primary balancing
- Thuega investigated various modes of operation



THUGA GROUP – P2G PLANT

POWER 2 GAS

Thüga-Gruppe P2G Project



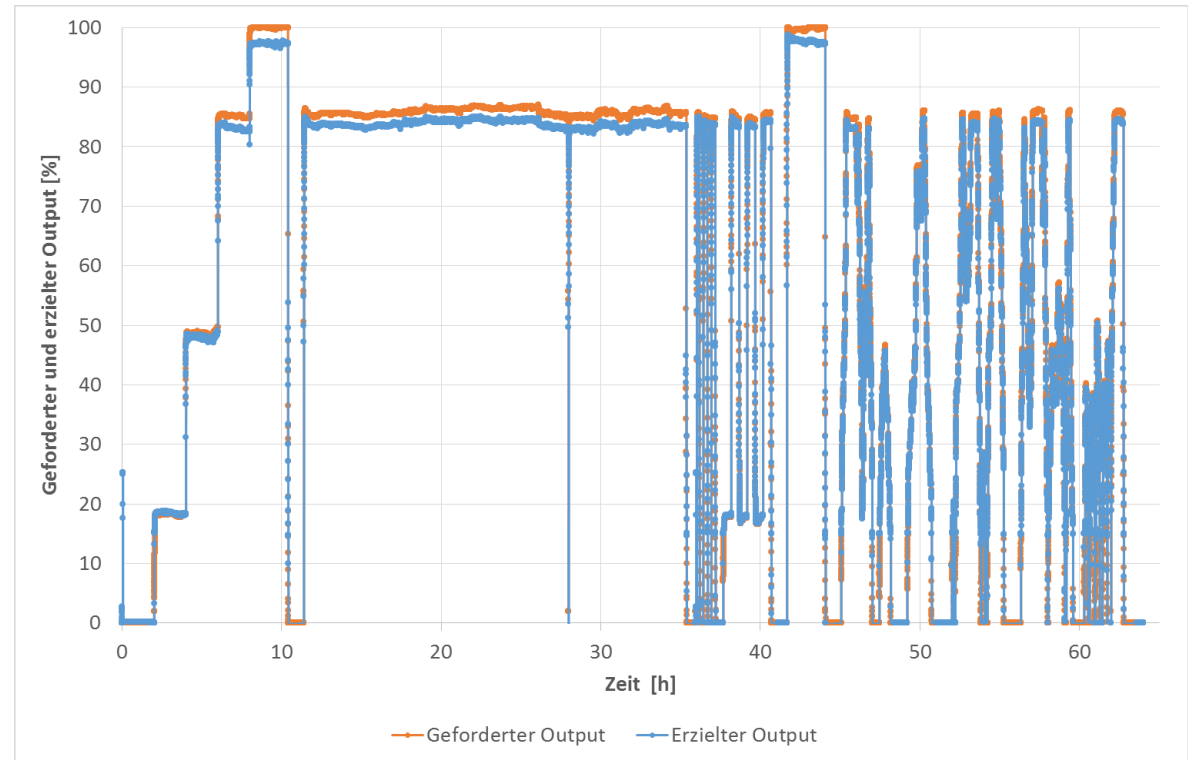
Technologie: PEM – Elektrolyse
Elektrische Anschlussleistung: 300 kW
Erzeugtes Wasserstoffvolumen: 60 Nm³/h

Geplante Betriebsarten für den 3-jährigen Betrieb der Thüga-Demonstrationsanlage:

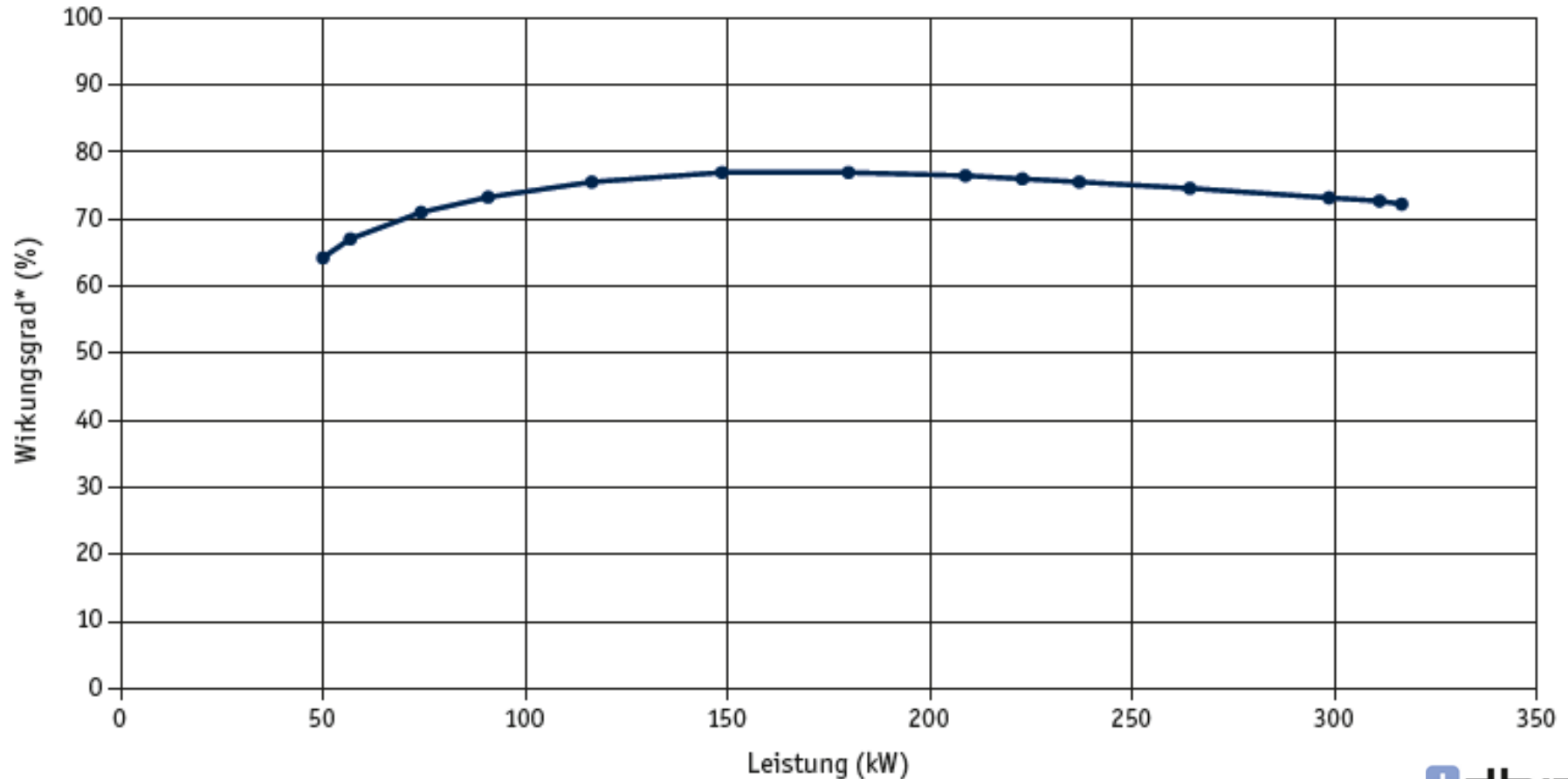
- **Regelleistungsbetrieb** –
Anbieten von negativer Sekundärregelleistung
- **Forschungsbetrieb Anlagentechnik** –
Anlagenparameter für verschiedene Betriebsmodi bestimmen
- **Hybrides Kraftwerk** –
Erneuerbare Energien regelbar machen

Rapid response Electrolysis

- Full system test program
- Set Point v's Actual (blue)
- Multiple start/stop tests
- Load modulation for full range
- Validate system to assimilate intermittent renewable power



SYSTEM EFFICIENCY: ELECTRICAL ENERGY IN, CHEMICAL ENERGY OUT



- Die angegebenen Werte zum Wirkungsgrad sind auf den Brennwert bezogen / Quelle: Thüga:

http://www.szg-energiespeicher.de/fileadmin/media/Strom_zu_Gas/PDF/Pressegrafik_150210_SzG_Wirkungsgrad.pdf



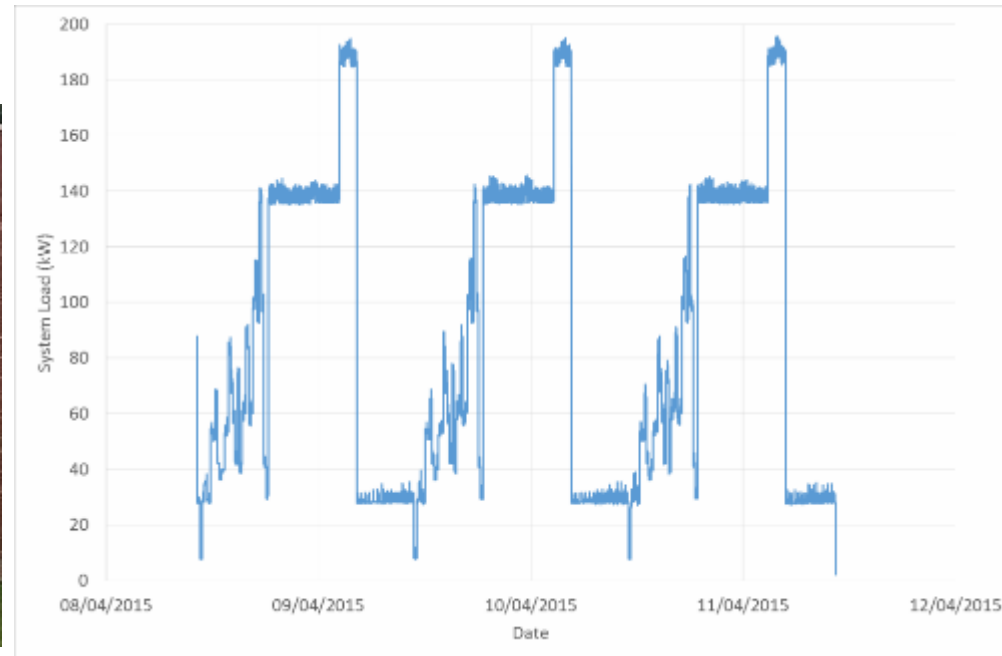
THÜGA P-2-G TOTAL SYSTEM EFFICIENCY



RWE DEPLOYMENT

Highest recorded electrolyser system efficiency

- 2nd generation HGas180 product
- Integration of waste heat recovery
- 86% system efficiency achieved
- Official inauguration 18th Aug 2015



EXAMPLE DEPLOYMENT & SAT

FIRST P2G IN THE UK

HyDeploy Project Scope

- Demonstrate first injection of hydrogen into a representative UK gas distribution network & establish practical operational limits
- Co-sponsored by National Grid Gas Distribution & Northern Gas Networks
- Keele University campus is a closed private network
- 0.5MW electrolyser delivering up to 20% hydrogen into the gas network servicing a population of 9000 people
- Project timeline 30-36 months:
 - Customer engagement & dissemination
 - Network & appliance survey
 - Qualitative Risk Assessment
 - GS(M)R Exemption
 - Primary network field trials



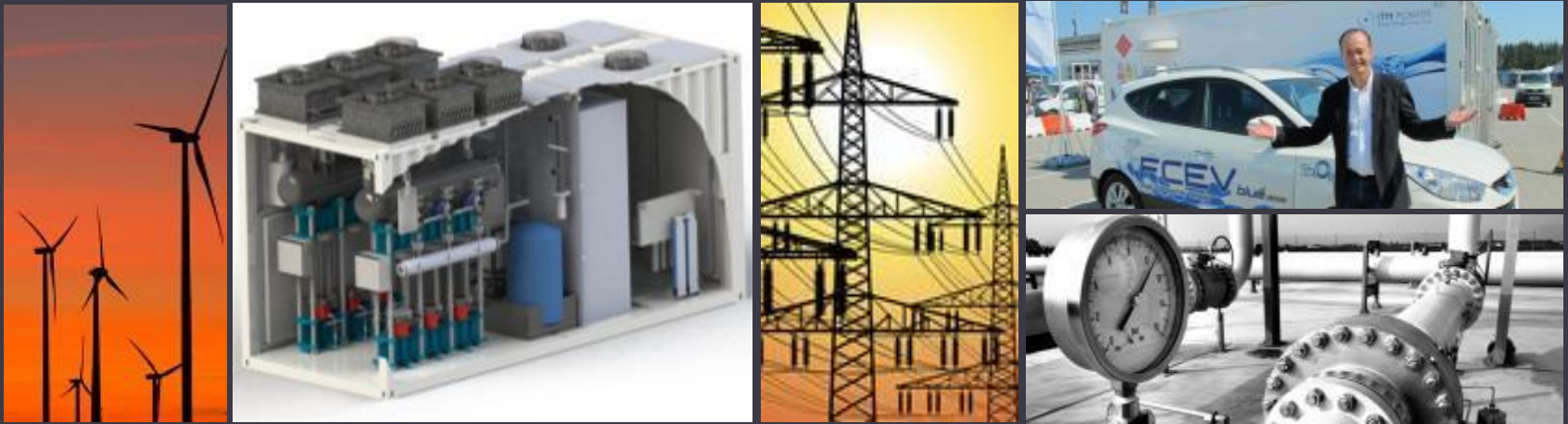
POWER TO GAS

ENERGY STORAGE | CLEAN FUEL



GRID BALANCING AND SUPPORT: POWER-TO-GAS ENERGY STORAGE

21ST MARCH 2017 | SCOTTISH RENEWABLES ANNUAL CONFERENCE



PHIL DORAN
BDM - SCOTLAND



ANNUAL CONFERENCE

SCOTLAND'S ENERGY EVOLUTION

21 & 22 MARCH 2017 **EDINBURGH**

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Evolving Ambitions: Scottish Energy Strategy

Chair

Gordon MacDougall, Scottish Renewables

Speaker

Paul Wheelhouse MSP, Minister for Business, Innovation and Energy



Paul Wheelhouse MSP

Minister for Business, Innovation and Energy





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Leading the Transformation of Scotland's Energy

Chair

Gordon MacDougall, Scottish Renewables

Speakers

Gavin Slater, Glasgow City Council

Mark Vyvyan-Robinson, EDF Energy Renewables

Lindsay McQuade, ScottishPower Renewables

Sam Gardner, WWF Scotland



Gavin Slater

Group Manager – City Energy &
H2020 Ruggedised Lead
Glasgow City Council





RUGGEDISED
Designing smart,
resilient cities for all

Leading the Transformation of Scotland's Energy – The Role of Local Government.

Scottish Renewables Annual Conference 21/03/17





ROTTERDAM . UMEÅ . GLASGOW

BRNO . PARMA . GDANSK



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731198. The sole responsibility for the content of this document lies with the Ruggedised project and does not necessarily reflect the opinion of the European Union.



GLASGOW'S SMART STREET

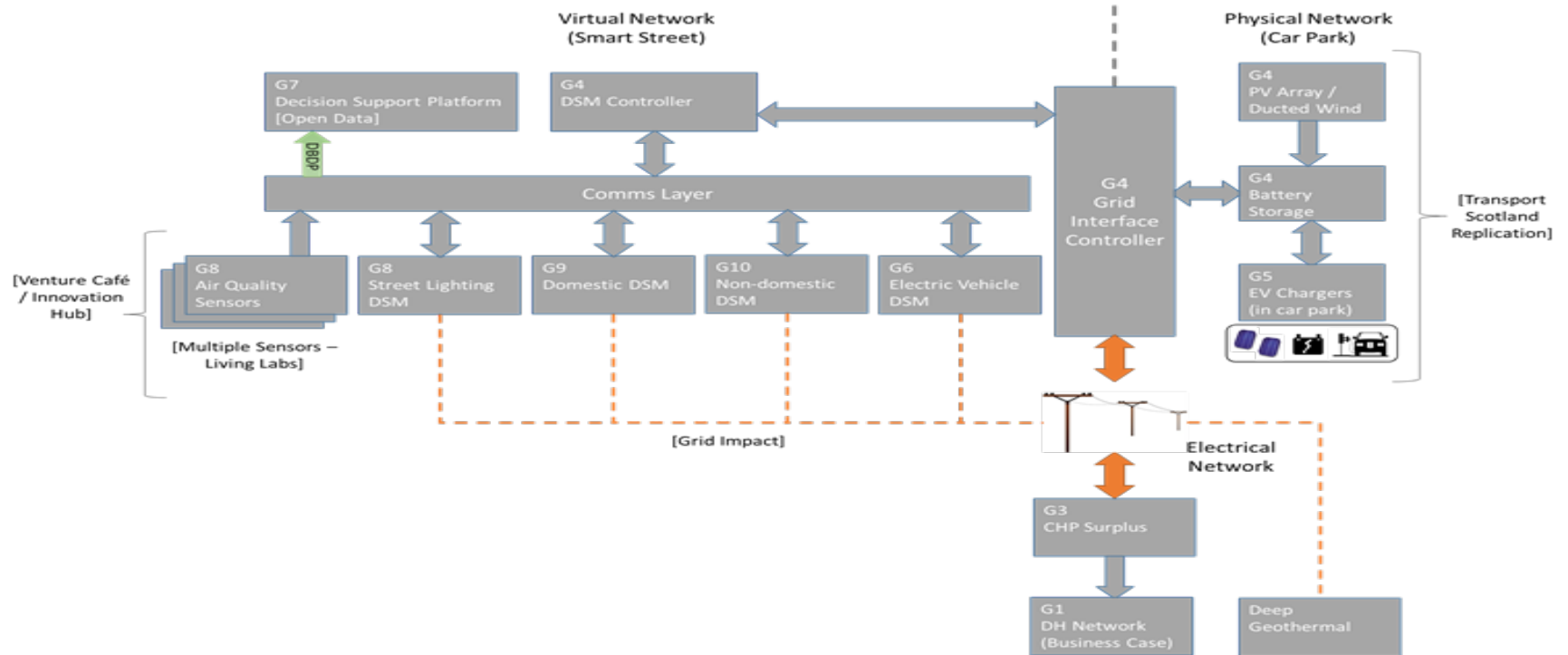
Through **RUGGEDISED**, Glasgow will continue on its journey – transforming from an industrial city to a sustainable, resilient and low carbon city, focused on the future, growing from its past, and





Glasgow's Smart Street.







The Scottish Energy Strategy

- Transforming the energy system
- Increasing the generation of renewable and low carbon energy
- Increasing the flexibility, efficiency and resilience of the energy system as a whole
- Helping energy consumers to manage their bills, harnessing smart technology in the home...
- Supporting the introduction of viable, lower carbon alternatives across all modes of transport
- Smart, local energy systems
- Develop future energy systems in partnership between communities, the private and public sectors



CONTACT

Gavin Slater

Gavin.slater@glasgow.gov.uk

0141 287 8347

FOLLOW

E info@ruggedised.eu

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Mark Vyvyan-Robinson
Director of Development and Investments
EDF Energy Renewables



Mark Vyvyan-Robinson
Director of Development and Investments
EDF Energy Renewables

22 March 2017



EDF ER's new Edinburgh office



Corriemoillie wind farm near Garve in the Highlands – 47.5 MW



Lewis Wind Power Projects

EDF ER is a **50:50 JV partner** in Lewis Wind Power (LWP) - LWP controls the two major Island Wind projects on the Isle of Lewis

The Stornoway and Uisenis wind farms are both **fully consented** and **ready to build**

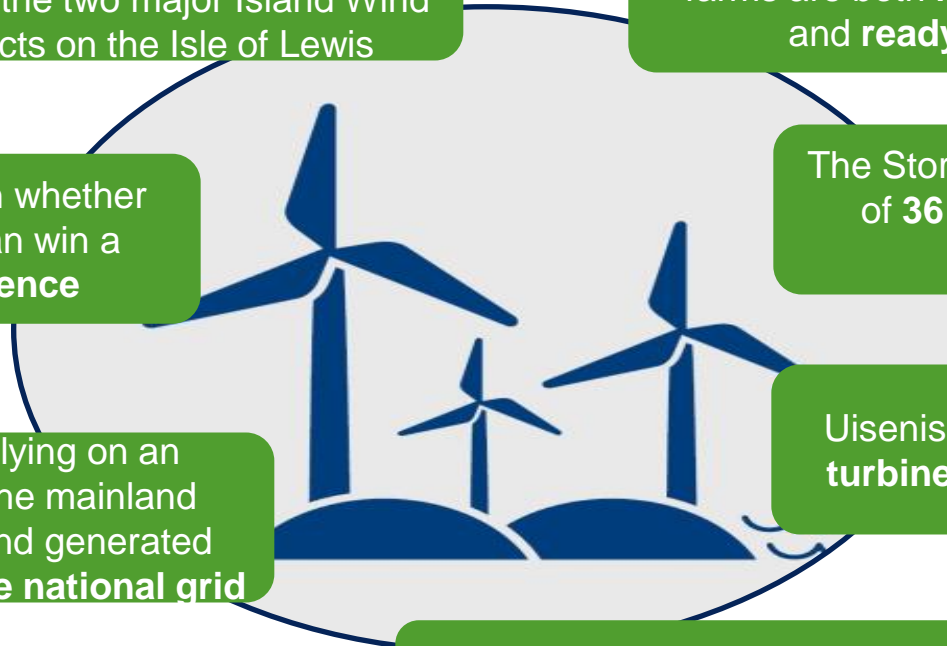
Investment depends on whether remote island wind can win a **contract for difference**

The Stornoway wind farm consists of **36 turbines** and **180 MW capacity**

The projects are relying on an **interconnector** to the mainland being built so that wind generated can be **exported to the national grid**

Uisenis wind farm consists of **45 turbines** and **162 MW capacity**

The two wind farms will have a combined capacity of **342 MW**



Blyth Offshore Demonstrator



Battery Storage at West Burton B





Lindsay McQuade
Policy & Innovation Director
ScottishPower Renewables





SCOTTISHPOWER
RENEWABLES

ScottishRenewables Annual Conference
Edinburgh, March 2017

Our energy transition

Iberdrola – Europe’s largest integrated utility

One of the largest global utilities, with operations in Spain, UK, US, Brazil and Mexico

- Global No.1 in renewables with 14GW of wind
- Iberdrola to reduce CO₂ emissions by 30% by 2030, and carbon neutrality by 2050
- Diverse portfolio of gas, renewables and nuclear



Ready to invest up to £8bn in UK in next 5 years

ScottishPower Renewables



SCOTTISHPOWER
RENEWABLES



2GW
installed
capacity
in UK



Our energy transition

Privatisation

Security of Supply

Decarbonisation

Digitalisation

Decentralisation

Disruption

1991

2017

2021

2041

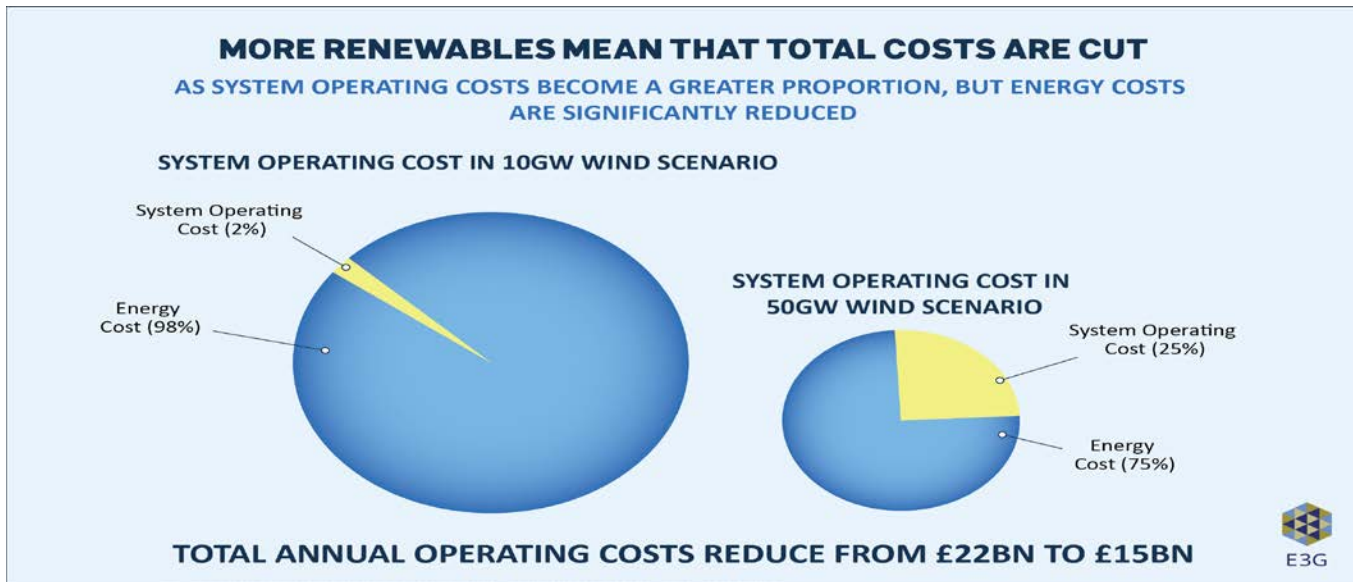
Beginning of a new era...



Clean Energy
Transition

System Integration of Renewables

With increased penetration of renewables and flexibility, overall system costs reduce, with reduction and shift in proportion of energy v system operation costs

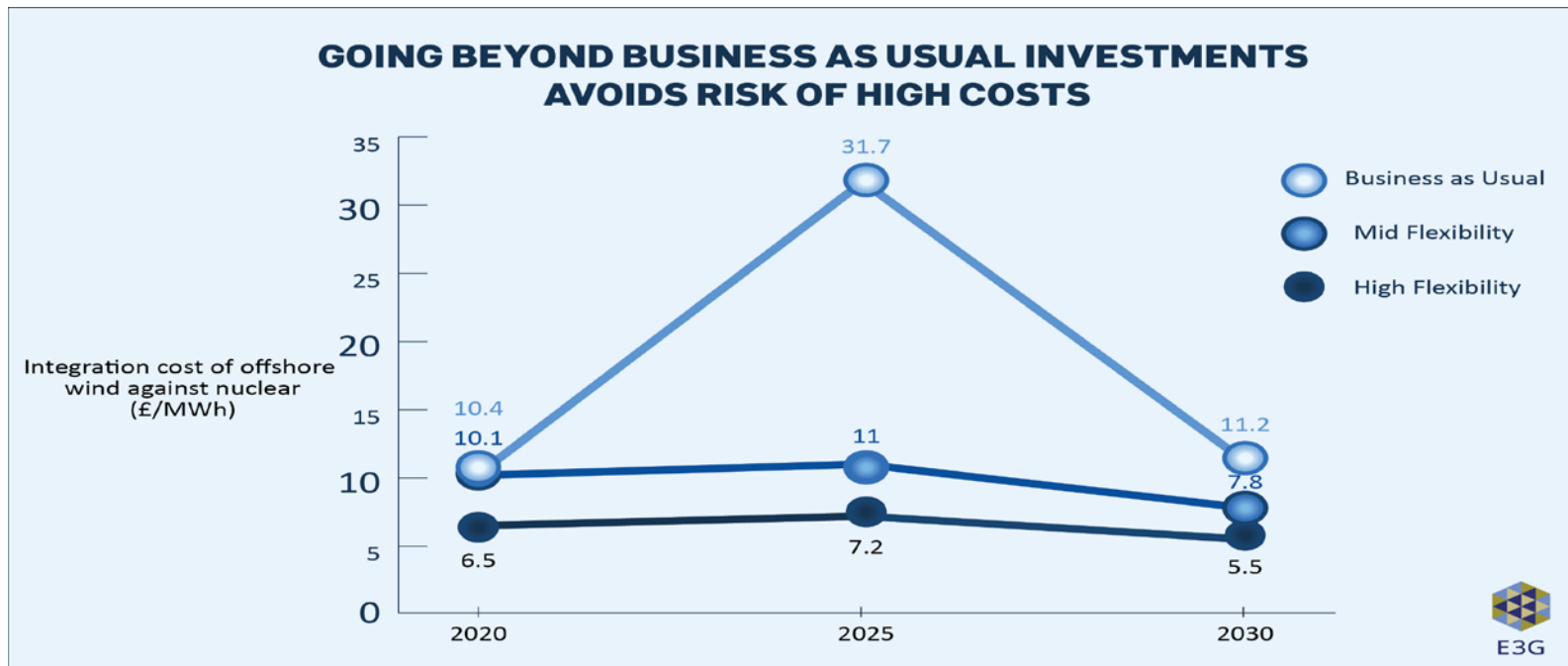


Ref: E3G, "Plugging the Energy Gap", November 2016

Range of services required to provide flexibility – including variable renewable generation taking more active role in the ancillary service markets

System Integration of Renewables

‘Business as usual’ could result in small increase in system costs in 2030, slow progress on flexibility could risk substantial increase in mid-2020s



Ref: E3G, “Plugging the Energy Gap”, November 2016

How do we achieve the transition?

Number of drivers to deliver low carbon energy at least cost...



Energy Policy

- Scotland's Energy Strategy
- Emissions Reduction Plan, LCF...
- CfDs & market stabilisation



Industrial Strategy

- Energy at heart of strategy
- Minimising energy costs
- Low carbon needs renewables



Planning Policy

- Smarter Planning
- Repowering, Life Extn, New sites
- Engaging with communities



Innovation

- Cost reduction
- Flexibility and resilience
- Technology shift - engineering and system level



Markets & Regulation

- Ancillary Service evolution
- Corporate offtake niche
- Capacity Market reform



Consumers

- Energy bills – industry role to play
- Customer's interaction with market: Smart roll-out



Lindsay McQuade
Director of Policy & Innovation

Email:

Lindsay.McQuade@scottishpower.com

Sam Gardner
Head of Policy
WWF Scotland



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Scotland's Energy Strategy: How Can it Deliver?

Chair

Lindsay Roberts, Scottish Renewables

Speaker

Chris Stark, Scottish Government

Panel

Crispin Matson, Ramboll

Colin Taylor, SP Energy Networks

Neil Kermode, European Marine Energy Centre

Jonny Clark, ITP Energised



Chris Stark
Director of Energy and Climate Change
Scottish Government



Scottish Energy Strategy:

The future of energy in Scotland

Chris Stark,
Director of Energy and Climate Change



Scottish Government
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1. A quiet disruption

2. Charting a new course

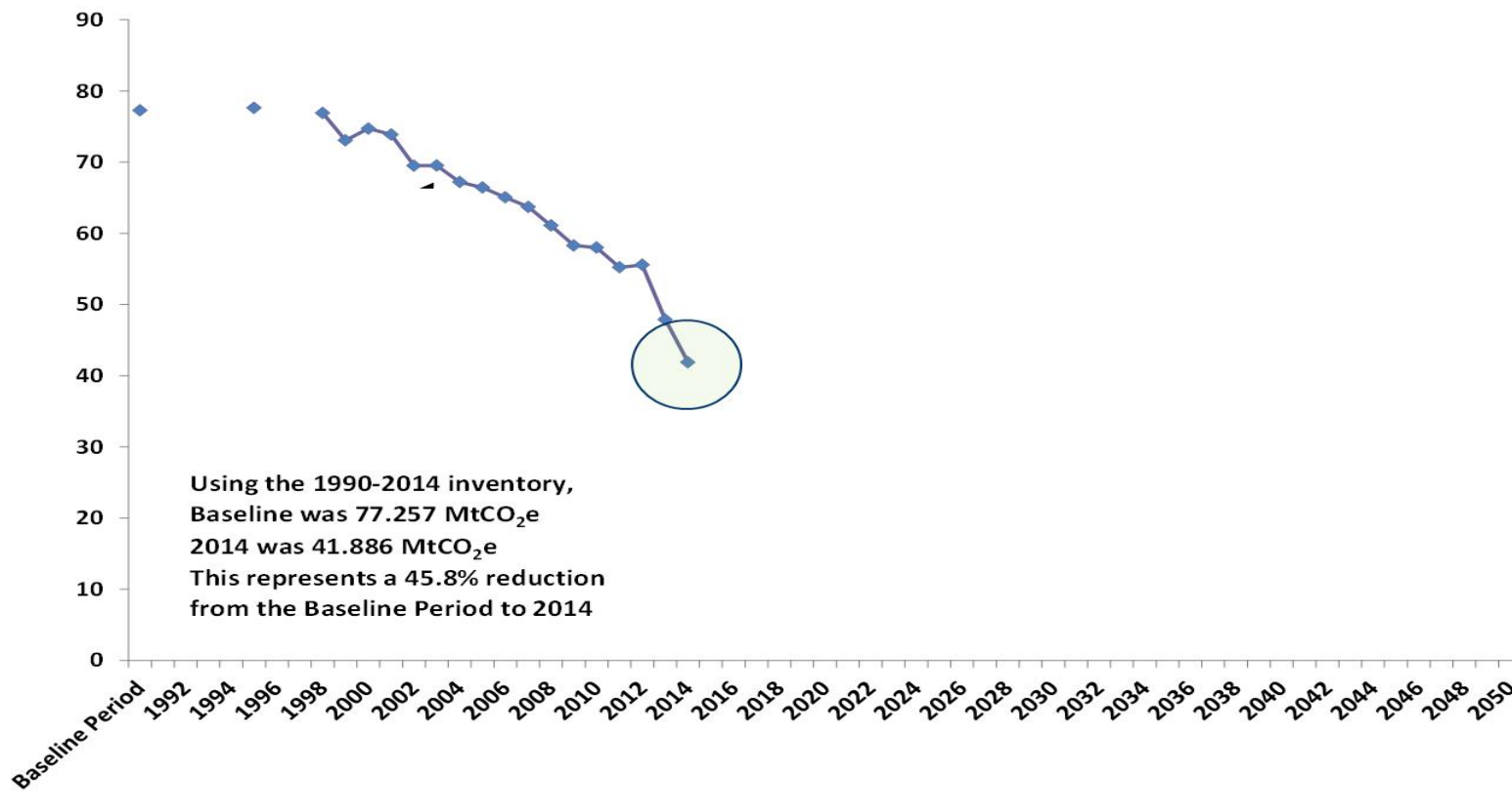
3. Scotland's draft energy strategy

- Transforming energy use
- Meeting our energy supply needs
- Smart, local energy systems
- Delivery, monitoring and engagement



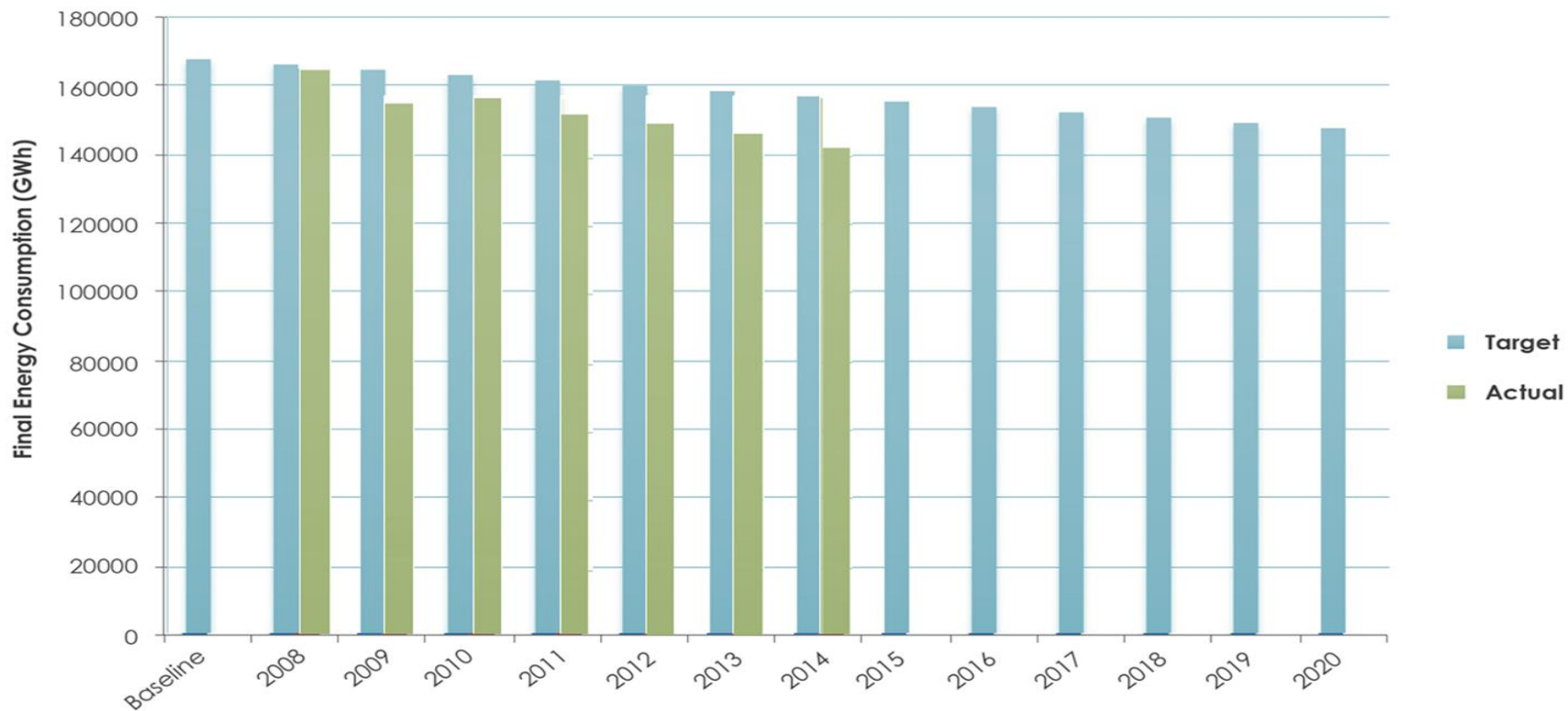
A quiet disruption

Emissions reduction trajectory

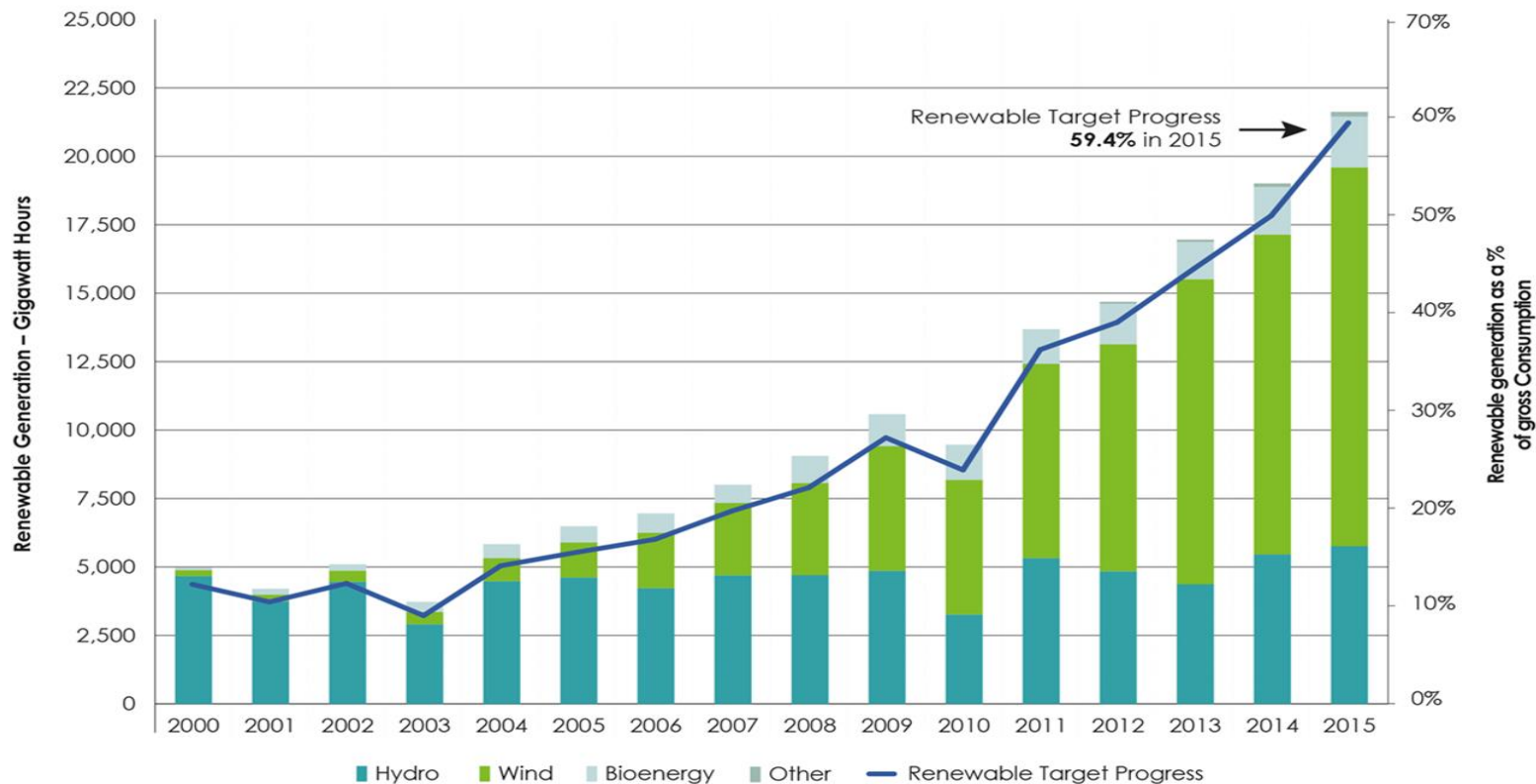


A quiet disruption

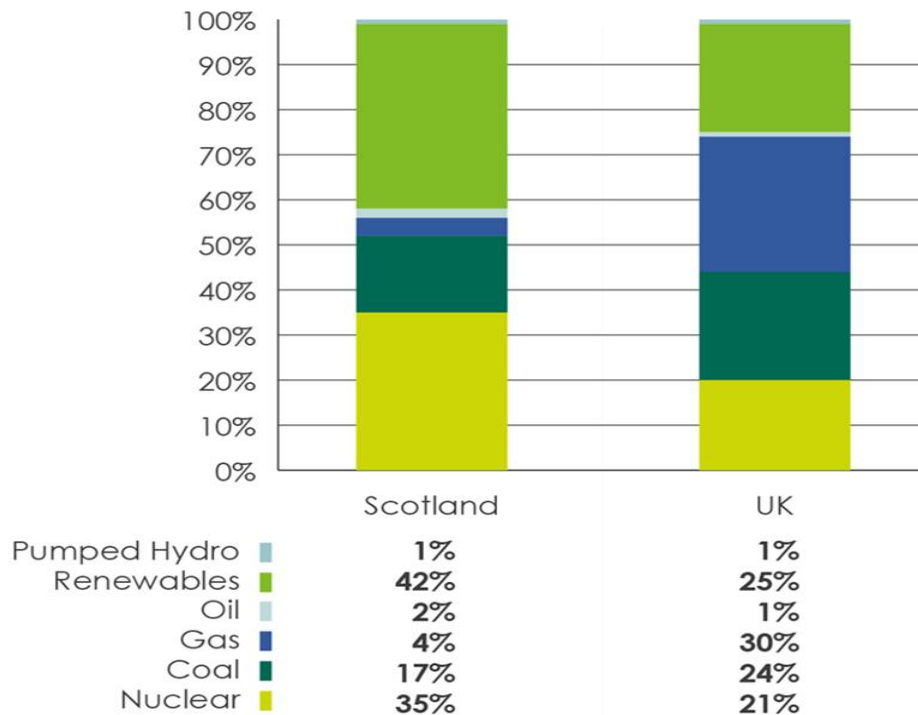
Final energy demand reduction, Scotland, 2005-07 to 2014



Electricity generated (GWh) from renewable sources, Scotland, 2000-2015



Electricity generation in 2015, Scotland and UK



1. A quiet disruption

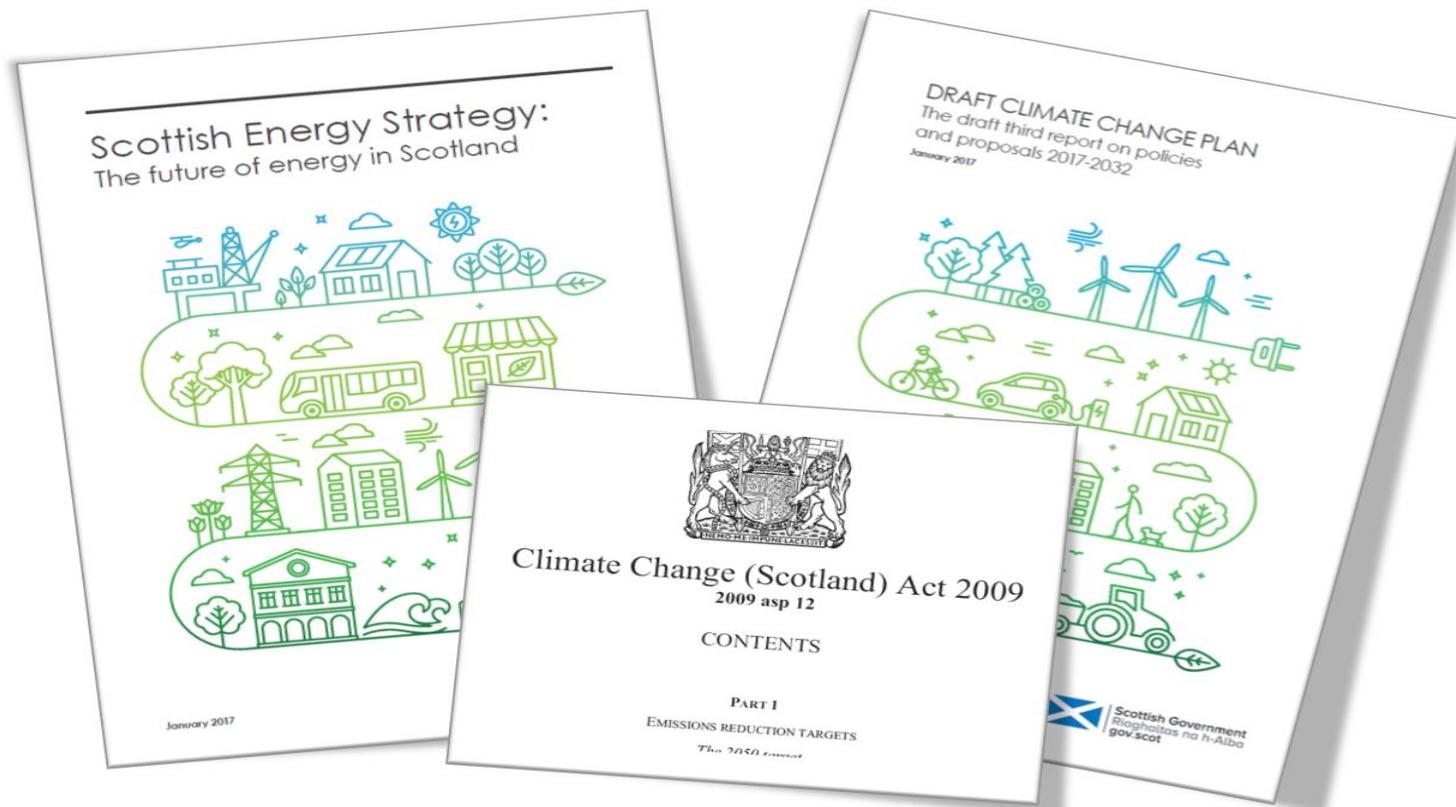
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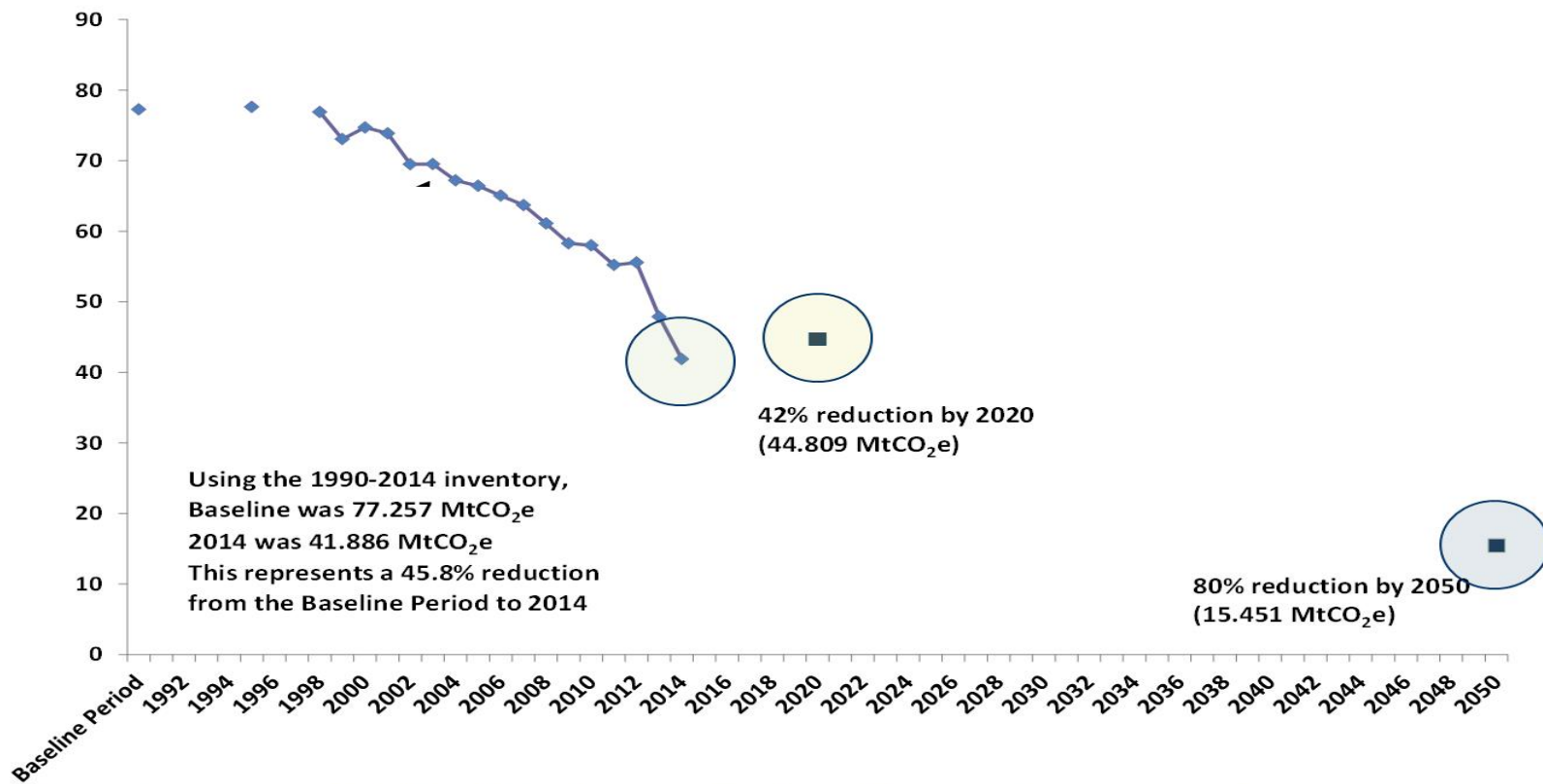


Charting a new course



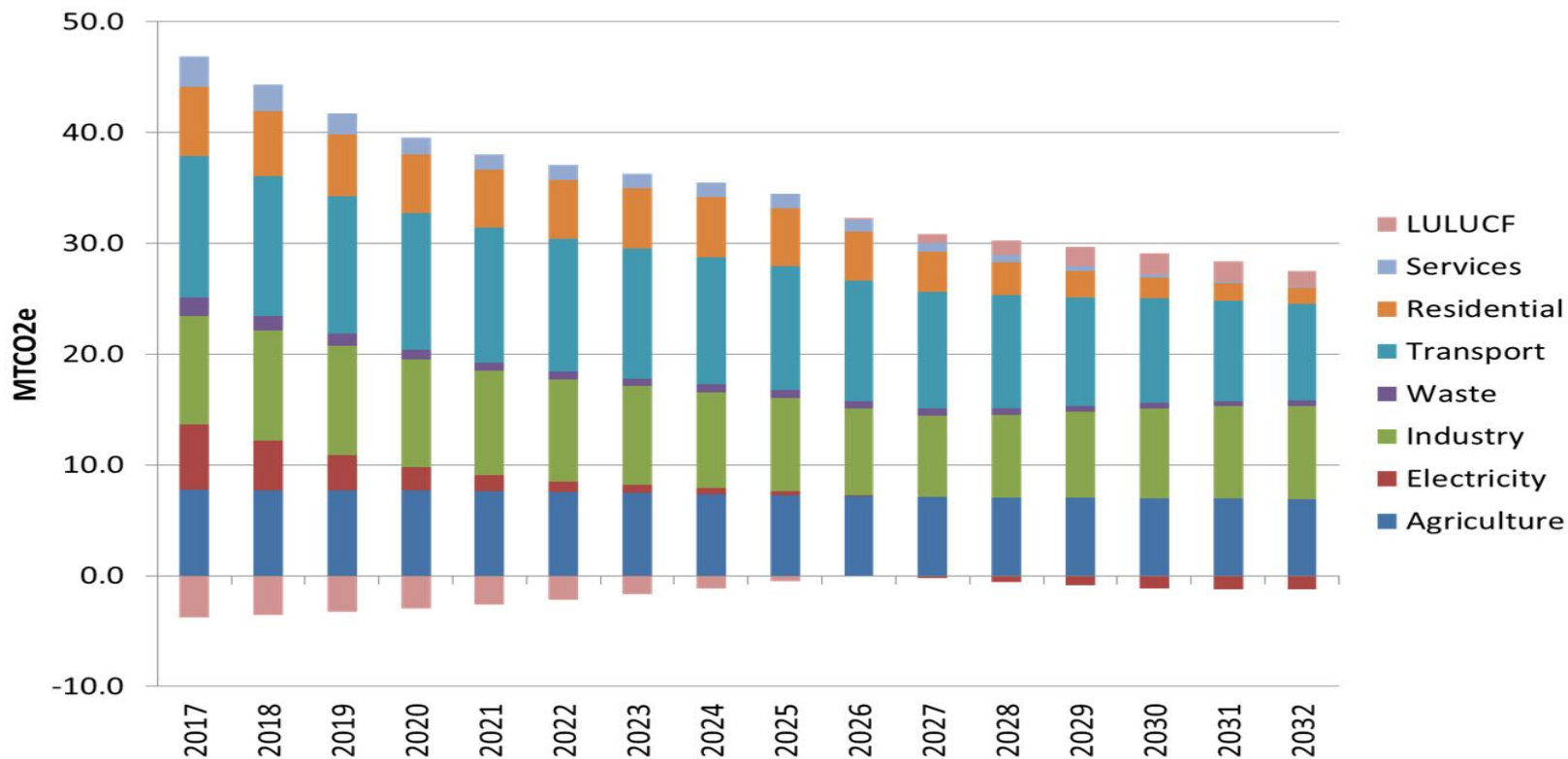
Charting a new course – decarbonising

Emissions reduction trajectory



Charting a new course – developing a ‘whole system’ view

Draft Climate Change Plan



Charting a new course – developing a ‘whole system’ view

Yearly pattern of energy use - Scotland



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Scotland's Draft Energy Strategy



'Whole-system' view

- Economic modelling, informing view of Scotland's future energy supply and demand
- Integrated approach to heat, power and transport
- New 50% 'all energy' 2030 renewables target
- Renewed focus on energy efficiency and energy demand reduction



Stable 2050 energy transition

- Long-term plan, consistent with requirements of the Climate Change Plan
- Flexible to future changes in technology and patterns of energy use
- Managed transition of energy supply, post-nuclear



A smarter model of local energy provision

- Encouragement for new localised models of energy supply and use
- Enhanced role for local planning and local ownership
- New economic opportunities of energy storage and 'smart' energy solutions

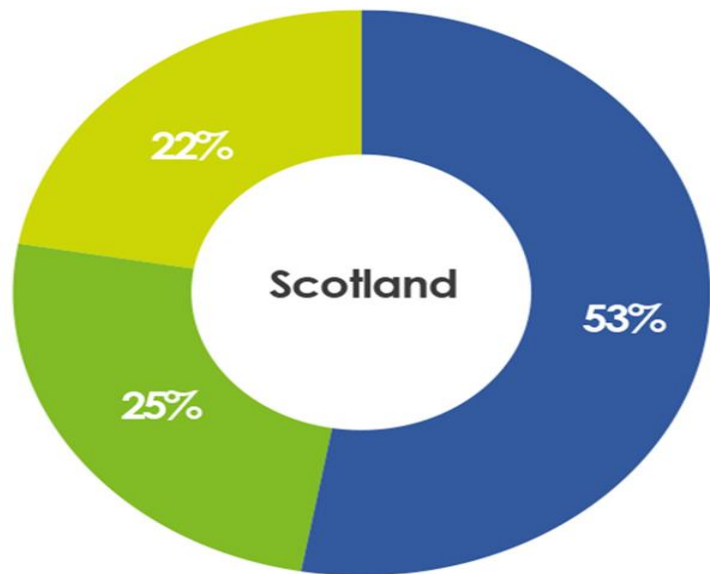


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Final energy consumption

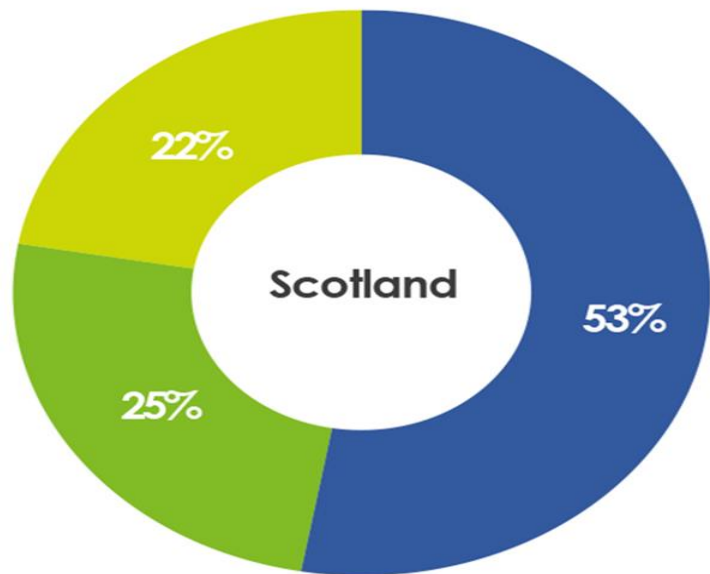


Heat | Transport | Electricity



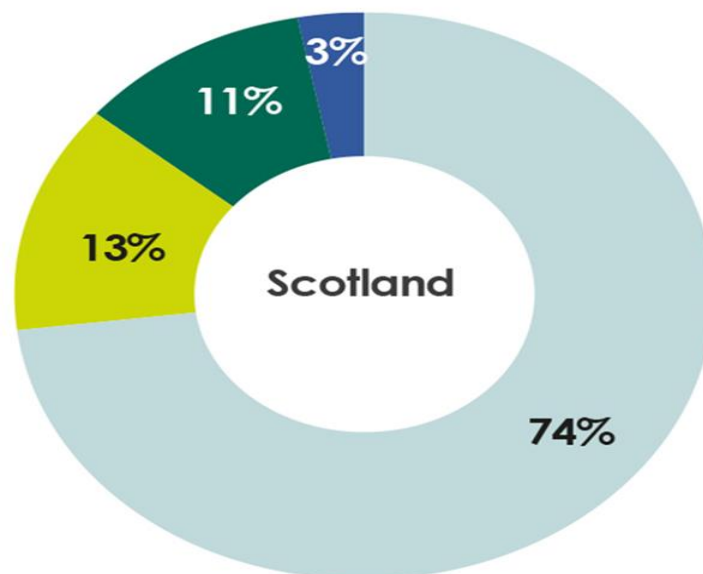
Transforming energy use

Final energy consumption



Heat | Transport | Electricity

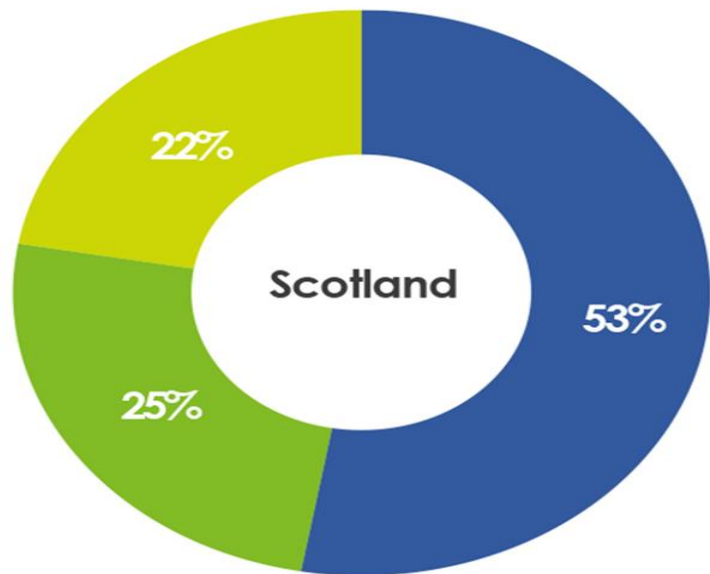
Household energy use in Scotland



Space Heating | Water Heating | Cooking
Lights, appliances and renewables

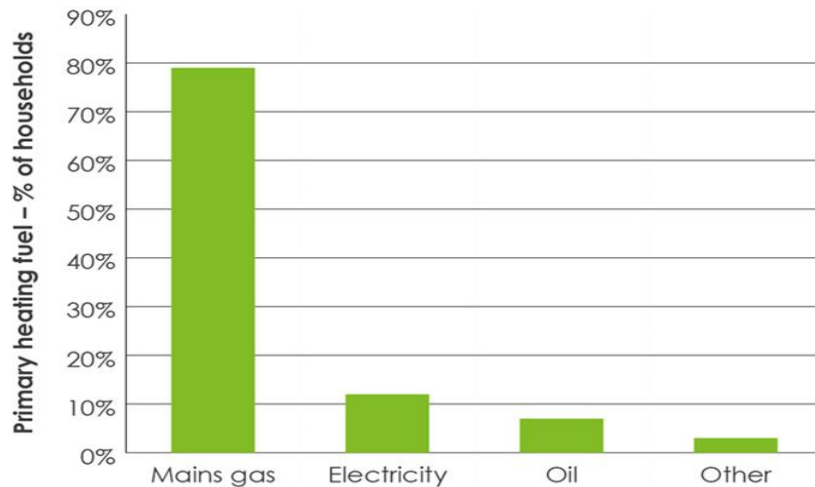


Final energy consumption



Heat | Electricity | Transport

Primary heating fuels in Scotland



2050 Vision

- Scotland's domestic and non-domestic buildings have undergone a low carbon transformation – substantially reducing greenhouse gas emissions and delivering a host of economic, social, health and regeneration benefits
- Scotland has an energy market that delivers fair outcomes for all consumers – and especially those on low incomes and at risk of fuel poverty
- Scotland has successfully managed a widespread shift to a low carbon transport system – by 2032 over 40% of all new cars sold each year are Ultra Low Emission Vehicles
- Scotland has achieved a significant improvement in the efficient use of energy – with substantially improved energy efficiency in our manufacturing and industrial sectors, as a means to improve competitiveness



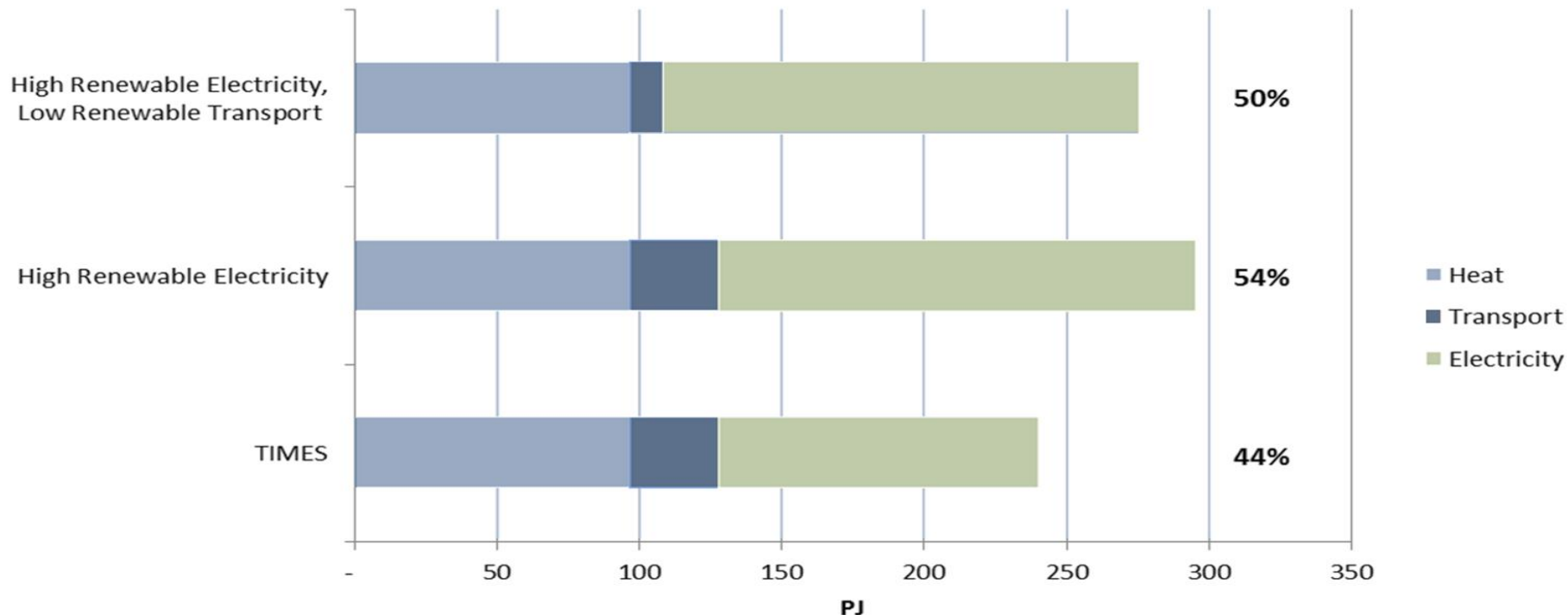
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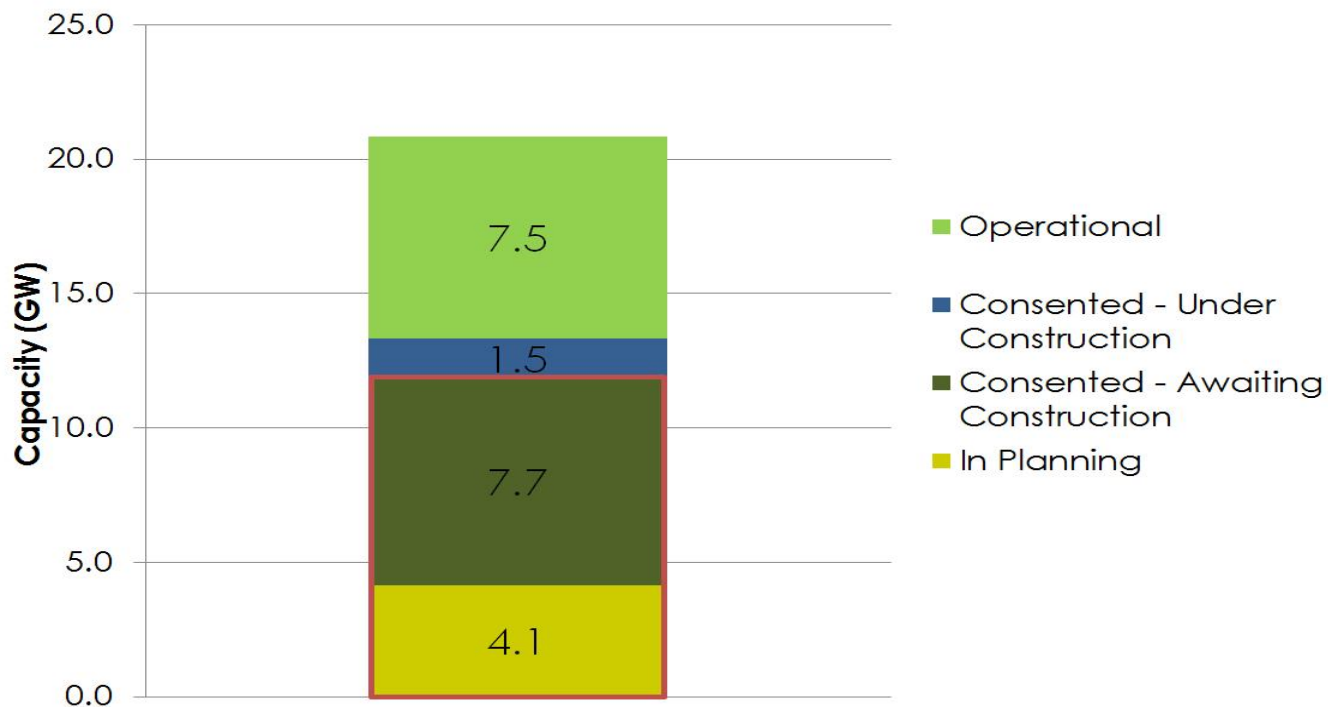


Meeting our energy supply needs

Final energy from renewables – 2030 scenarios



Renewable capacity in Scotland by planning stage, September 2015



2050 Vision

- Scotland has achieved almost complete decarbonisation of the energy system – in line with domestic and international climate change targets
- The equivalent of 50% of all energy consumed in Scotland from renewable sources by 2030
- Scotland is a world-leader in renewable and low carbon technologies and services – and continues to offer technology solutions in oil and gas, and excellence in subsea engineering. This knowledge and expertise is exported internationally
- Urban communities benefit extensively from low carbon heat networks
- Carbon capture and storage is operational at large scale and plays a crucial role in decarbonising Scotland's energy system and industrial processes
- New forms of flexible generation and demand management services are widespread
- Shared ownership of renewables and of local energy systems maximise benefits to Scotland's communities



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2050 Vision

- Scotland is a leader in the development of local energy systems, providing local solutions to local needs with improved consumer benefit
- Expertise in the management of local energy systems, coordinating the supply, storage and use of many devices, has developed to become a significant export industry
- Local communities play an active part in the delivery of innovative, low carbon energy systems, have the opportunity to influence energy planning from the outset, and receive community benefit (in various forms) from energy generation
- Local energy plans, drawing on best data on energy supply and use, are drawn-up in collaboration with local authorities in every region of Scotland, acting as a commercial investment prospectus and coordinating an area-based approach to public investment



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2050 Vision

- Scotland has a thriving energy sector, with public and private sectors working together to deliver the 2050 vision
- Scotland continues to work at the leading edge, adapting and taking advantage of new energy technology and systems
- The Scottish public are informed, helping them shape Scotland's energy future





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Scotland's energy efficiency programme

- Integrated approach to reducing demand, improving energy efficiency – and decarbonising heat
- Consultation on district heating regulations and local heat and energy efficiency strategies
- Consultation on energy efficiency standards for private rented homes
- Proposal for phased regulation and standards for existing buildings
- Consultation on appropriate incentives to secure private investment
- Review of energy performance of non-domestic buildings regulations
- New energy efficiency 2030 target



Improved energy efficiency in manufacturing and industry

- New incentives and packages of business support to help facilitate industrial decarbonisation, through Scotland's Manufacturing Plan and SEEP
- Support for improved business energy productivity through Scottish Enterprise, Highlands and Island Enterprise, Scottish Environment Protection Agency and the Scottish Manufacturing Advisory Service
- Scottish Government pressure to maintain a level playing field on emissions regulation during Brexit negotiations



Low carbon transport alternatives



- Funding for active travel infrastructure and behaviour change programmes
- New roadmap for adoption of plug-in vehicles
- SG negotiation for tighter EU and UK emissions standards for cars and vans – and VED differentials
- Enhance capacity of EV charging network – ChargePlace Scotland
- Interest-free loans, through the Energy Saving Trust, for Evs
- Review of licensing regulations for ULEV taxis with local authorities



Consumers, smart technology in the home, new retail models

- Scottish-specific steps to tackle low levels of consumer engagement with the market
- Support for new participants in retail market – local energy supply companies, not-for-profits, renewable energy-only suppliers, social housing suppliers
- Work with suppliers to explore new routes to support low income households
- Home Energy Scotland work to improve consumers' understanding of consumption patterns and smart meter use
- Support for retail tariff innovation





Increasing the generation of renewable and low carbon energy

- 50% 'all energy' 2030 target
- Call on the UK Government to provide a stable, supportive regulatory environment to provide certainty to renewable investors
- Partner with UK Government to provide adequate incentives are in place for renewable and low carbon heat technologies
- Seek to address distribution and transmission grid constraints on new renewable generation in Scotland
- Ensure at least half of newly consented renewable energy projects have an element of shared ownership by 2020



Exploring the role of new energy sources

- Review of the role of new technologies and energy sources as transitional fuels
- Consideration of how the planning framework can better support new energy sources
- Recognition of hydrogen as a potential low carbon heat solution, with funding for demonstrators
- Collaboration with UK Government, local government, industry and academia on a UK hydrogen routemap, establishing the strategic basis for hydrogen in the future energy system
- Consultation on 'fracking'



Highly regulated north sea oil and gas, a sector in transition

- A balanced approach, reducing our reliance on imported fossil fuels as part of a managed transition
- Work with the OGA to avoid premature cessation of production
- Maximise opportunities for skills transfer to low carbon industries
- Encouragement for the oil and gas industry to produce new, lower-carbon fuels
- Through the Energy Jobs Taskforce, support for industry as it adapts to current economic challenges
- Decommissioning action plan
- Support for the Oil and Gas Technology Centre

Demonstration and commercialisation of CCS and CCU

- Work with industry to assess opportunities for small scale CCS demonstration and CO2 utilisation projects in Scotland
- Exploration of the opportunity to combine bioenergy production with CCS – with a view to maximise the benefits to the energy system as a whole
- Maintain pressure on UK Government to align its CCS strategy with the Scottish Government's
- Work with industry and the OGA to ensure retention of existing critical infrastructure, suitable for CCS





Onshore wind

- A challenge to industry, in partnership with Scottish Government to develop onshore wind in Scotland without subsidy
- Consultation on a range of factors influencing onshore wind development, including steps to bring the efficiency of wind development into consenting procedures
- Consideration of scope for power purchase agreements to support future development, or alternative SG support mechanisms
- Champion the cause of island wind development



Offshore wind

- Improved consenting procedures
- Scottish Government support for innovation and cost reduction, through the Enterprise Agencies and partners such as the Offshore Renewable Energy Catapult and the Carbon Trust
- Support for remaining developments under the Renewables Obligation (Scotland) – supporting floating wind demonstrators



Hydro power

- Reinforced Scottish Government commitment to the encouragement and promotion of hydro within the powers available to it – including pressure on UK Government where necessary
- Consultation on appropriate steps to improve the environment for small scale and community hydro power in Scotland

Marine renewables

- Support for innovation and cost reduction in wave energy, through continued funding for Wave Energy Scotland
- Finance support for marine energy projects through the Renewable Energy Investment Fund – and other financial support mechanisms
- Collaboration with the marine renewable sectors to demonstrate to the public and private investment community the strong industrial potential of marine energy
- Continued pressure on UK Government to offer support for marine renewable technologies



Solar PV

- Consideration of role for solar (and other renewable technologies) as part of a review of energy standards within building regulations
- Ensure that good practice guidance for shared ownership developments fully recognises the opportunities for solar

Bioenergy

- Recognising the rising interest in bio fuels for a range of uses, commitment to develop a 'whole-system' bio energy action plan, following the publication of the final Climate Change Plan





Increasing the flexibility, efficiency and resilience of the energy system

- Scottish Government support for network investment and interconnection to relieve constraint
- Promotion of network flexibility technologies, alongside renewables as basis for a future 'lowest cost' system
- Continued opposition to current transmission charging regime, which discourages new investment – including in system-stabilising thermal generation
- Policy that Scottish nuclear plants should not be replaced with new nuclear, under current technologies
- Invitation of views on repowering large scale thermal generation sites
- Collaboration with UK Government and Ofgem to develop a Smart Energy Plan for the UK, seeking a fair treatment for storage and flexibility mechanisms, including pumped hydro storage, through a 'cap and floor' regime for investment
- Support innovation and demonstration of new forms of storage, including support for the 'Power Networks Demonstration Centre' and work under the Energy Technology Partnership





Supporting the demonstration and growth of innovative projects

- Under the Community and Renewable Energy Scheme (CARES), provide advisory and technical support for community and local renewable energy schemes
- Extensive financial and demonstration support through: the Low Carbon Infrastructure Transition Programme, CARES Local Energy Challenge Fund, CARES Infrastructure and Innovation Fund, Renewable Energy Investment Fund and the District Heating Loan Fund



Partnership between communities, private and public sectors

- Develop strategic approaches to local energy systems, drawing on Scotland's heat map and the Energy Masterplanning approach.
- An enhanced role for local authorities and city regions to deliver new local energy system investment
- Explore potential for a government owned energy company
- Explore the creation of a Scottish Renewable Energy Bond
- Consult on the development of a regulatory framework for local heat and energy efficiency strategies, in conjunction with COSLA and local authorities



Working in partnership to sustain a thriving energy sector

- Refocused Scottish Energy Advisory Board, providing oversight and advice to the First Minister on the themes of this strategy, supported by a network of industry, academic and consumer-led advisory groups
- Collaboration with local authorities and COSLA in the development and implementation of the energy strategy
- Alignment of Enterprise and Skills agencies behind the objectives of the final energy strategy
- Support for the Energy Technology Partnership, promoting collaboration between universities and industry

Monitoring Scotland's Energy Strategy

- Publication of an Annual Energy Statement each summer, taking into account: latest energy statistics, greenhouse gas statistics, wide range of evaluation on the effectiveness of Scottish Government and UK Government energy schemes
- An energy monitoring framework, in line with the framework developed for the final Climate Change Plan



Deepening public engagement

- 18 week consultation on the draft energy strategy
- Consultation will include new approaches to public participation and engagement: raising awareness to improve understanding of choices among citizens, encouraging greater sense of ownership and control amongst communities and individuals, using public participation to codesign and improve programmes
- Development of an engagement plan to be published as part of the final energy strategy





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Scotland's Energy Evolution: Guest Lecture

Chair

Rachelle Money, Scottish Renewables

Speaker

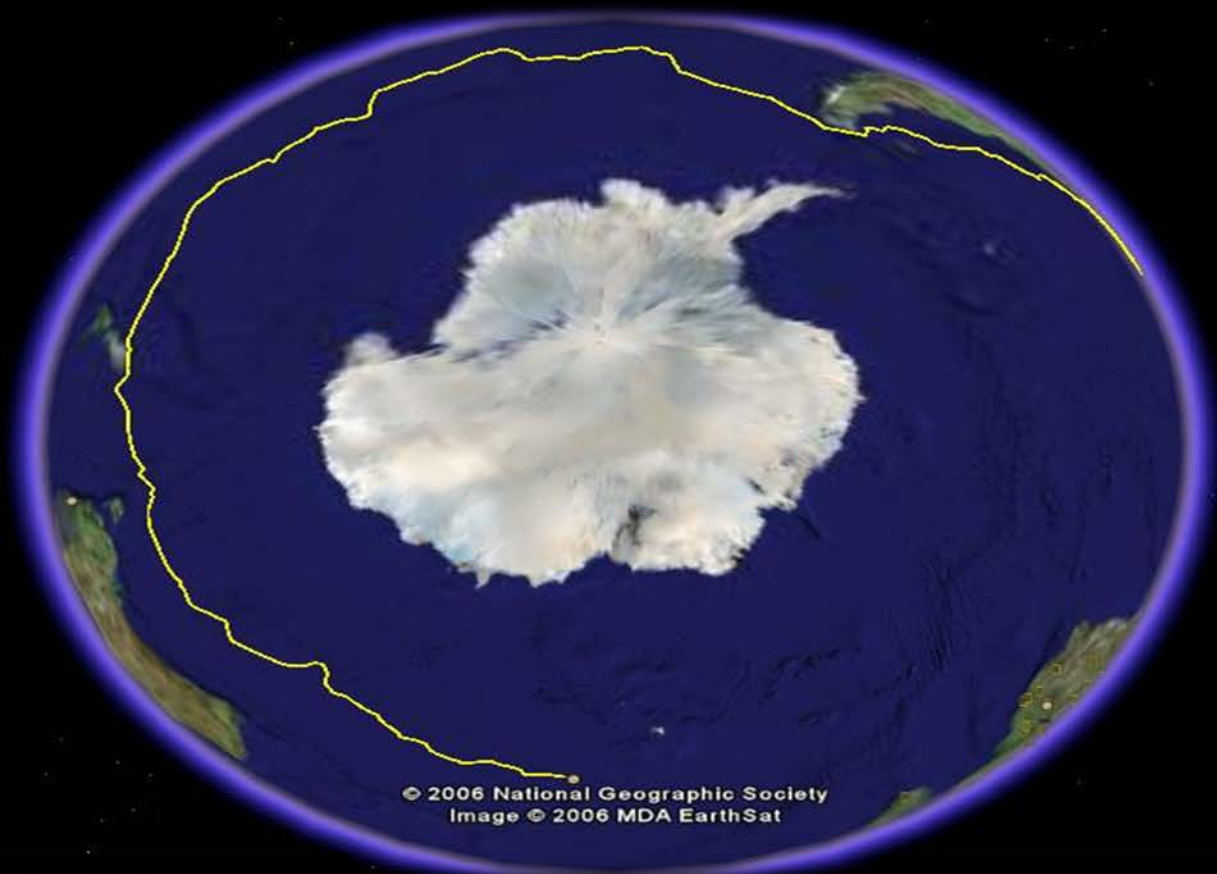
Dee Caffari MBE



Dee Caffari MBE







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Image © 2006 MDA EarthSat

© 2005 Google



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Rural post offices to face closure

Thousands of rural post offices face closure over the next five years as the Royal Mail transforms the network in a £1.3 billion shake-up. The situation where offices have less than six clients a day has been deemed to be "unsustainable". The number of rural offices could be cut by half to just 4,000.

NEWS page 8

Student stabbed

Teachers and pupils watched in horror as a 15-year-old boy was stabbed to death outside the gates of a North London school. Kiyam Prince was a promising footballer.

NEWS page 3

Troops 'at risk'

There is growing concern that the 12,000 British troops fighting counter-insurgency wars in Afghanistan and Iraq are overstretched and may be left exposed.

NEWS pages 6, 7

SU DOKU WIN CHAMPAGNE

Times2

Execution appeal

Margaret Beckett, the Foreign Secretary, has made a dramatic appeal for the life of a British Muslim who faces execution by hanging under Islamic law in Pakistan despite being acquitted of murder.

WORLD NEWS page 30

Arsenal deal

Thierry Henry is understood to have agreed in principle a new four-year contract that would see him commit his future to Arsenal and spurn the advances of Barcelona, the Champions League winners.

SPORT page 96

Why Al would love to beat Hillary for that nomination
GERARD BAKER page 23

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Mind the gap

HOW TO SURVIVE THE DROUGHT AND SUBSIDENCE

BRICKS AND MORTAR

£2.8m award for prisoner who tried to kill himself

By Richard Ford
Home Correspondent

COMPENSATION payments to prisoners have doubled in the last year to more than £4 million, while the total legal bill to the Prison Service has reached £20 million a year, *The Times* has learnt.

The total litigation bill is enough to run one of the large jails in England and Wales.

One prisoner received £2.8 million compensation after a failed suicide attempt, which is equal to the previous prison service record payout in 2002.

The payment was made in an out-of-court settlement to a prisoner who self-harmed and claimed for miscellaneous injury against the Prison Service. The service estimates that the costs alone of the case will be more than £1 million.

It is understood that a large proportion of the cash payout is a recognition that the inmate requires long-term medical care.

A Prison Service spokesman refused to comment on the latest award, saying that as it

was an out-of-court settlement the details of the action and identity of the prisoner and prison were confidential.

Compensation for prisoners is now six times higher than three years ago as the service is hit by a rising number of claims from inmates, including an increase in those alleging that their human rights have been breached.

Among personal injury claims made was one by a prisoner who had had his finger bitten off by a horse.

An inmate in one of the top security jails currently has 15 outstanding claims against the service. Derek Ramsden, head of the Prison Service's operational litigation unit, said that the "litigation culture" in society was reflected in prisons and there were plenty of would-be amateur lawyers in jails encouraging fellow prisoners to bring claims.

He added: "Accidents happen, but now people often look for someone to blame rather than themselves. And that is true of society as a whole, not just within the service."

Mr Ramsden disclosed that more than 1,000 cases are being brought against the Prison Service every year and the figure is on the rise.

"The most common claim is for personal injury," he said. "Personal injury can cover a multitude of sins: slipping or falling down stairs, a chair collapsing, falling off a ladder or through a ceiling — we even had one prisoner that had his finger bitten off by a horse." Mr Ramsden said.

Other previous high awards include more than £1 million given to Gregg Marston, 43, who was left crippled when a doctor failed to send him for an urgent examination.

But the latest figures will fuel public concern about the fairness of the criminal justice and the perception that it is biased in favour of the offender rather than the victim. Many of the claims are for relatively trivial mishaps.

Latest official figures show that overall out-of-court settlements to prisoners in publicly run jails totalled £4,010,233. Continued on page 2, col 3

Dee sails round the world - backwards



Dee Caffari, 31, yesterday became the first woman to finish the "impossible voyage" — navigating solo and non-stop around the world against prevailing winds and currents. She sailed *Arvo* across the finish line in Cornwall after 176 days, during which she battled 12 storms. NEWS



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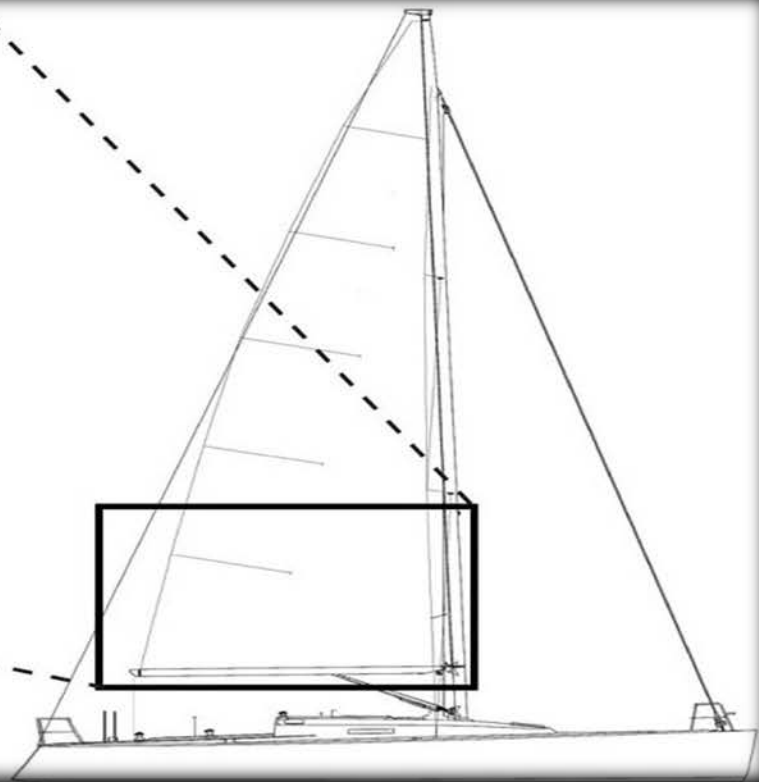














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500 astronauts have voyaged into space

60 people have circumnavigated the globe non stop

3 of those have gone the right way non stop too



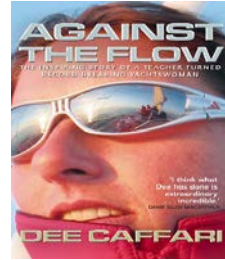
270 people have circumnavigated the globe

5 people have gone the wrong way round non stop

1 of those is a woman



Thank You



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Dee Caffari



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