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UK Future Energy Scenarios Consultation



February / March 2012

Agenda

- Consultation process
- 2020 Target Assessment
- Scenario Introduction
- Demand
  - Power Generation
  - Electricity Demand
  - Electricity Smart Meters (optional)
  - Gas Demand
  - Energy Efficiency (optional)
  - Green Technology Rollout (optional)
  - Demand Side Management (optional)
- 2011/12 Winter Review
- Gas Supply
  - Global Drivers
  - Storage and Security
  - UK Supply
- 2050 Story

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2012 Consultation Process

2012 Consultation Process

- 2011 Network Document Publications
  - May: Electricity Seven Year Statement (ESYS)
  - September: Offshore Development Information Statement (ODIS)
  - November: UK Future Energy Scenarios (UKFES)
  - December: Gas Ten Year Statement (GTYS)
- March/April: Future Energy Scenarios Consultation
  - UKFES Workshops
  - 1-2-1 Meetings
- **April/May: Publication of Feedback**
  - Summary Document
- **27th September: Publication of Scenarios & Forecasts**
  - Event: One Great George Street
- **2012 Documents published using consistent scenarios for electricity/gas**

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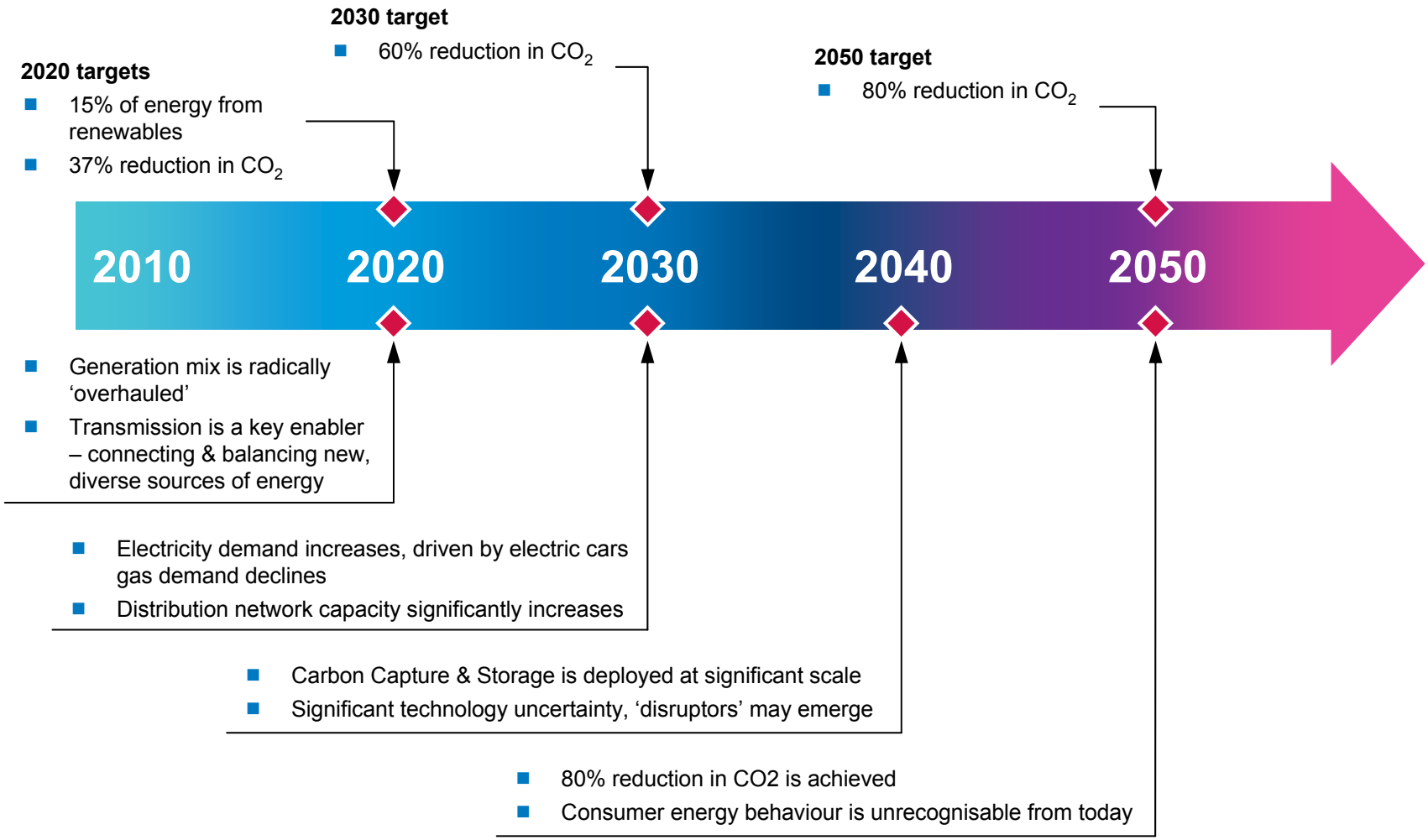
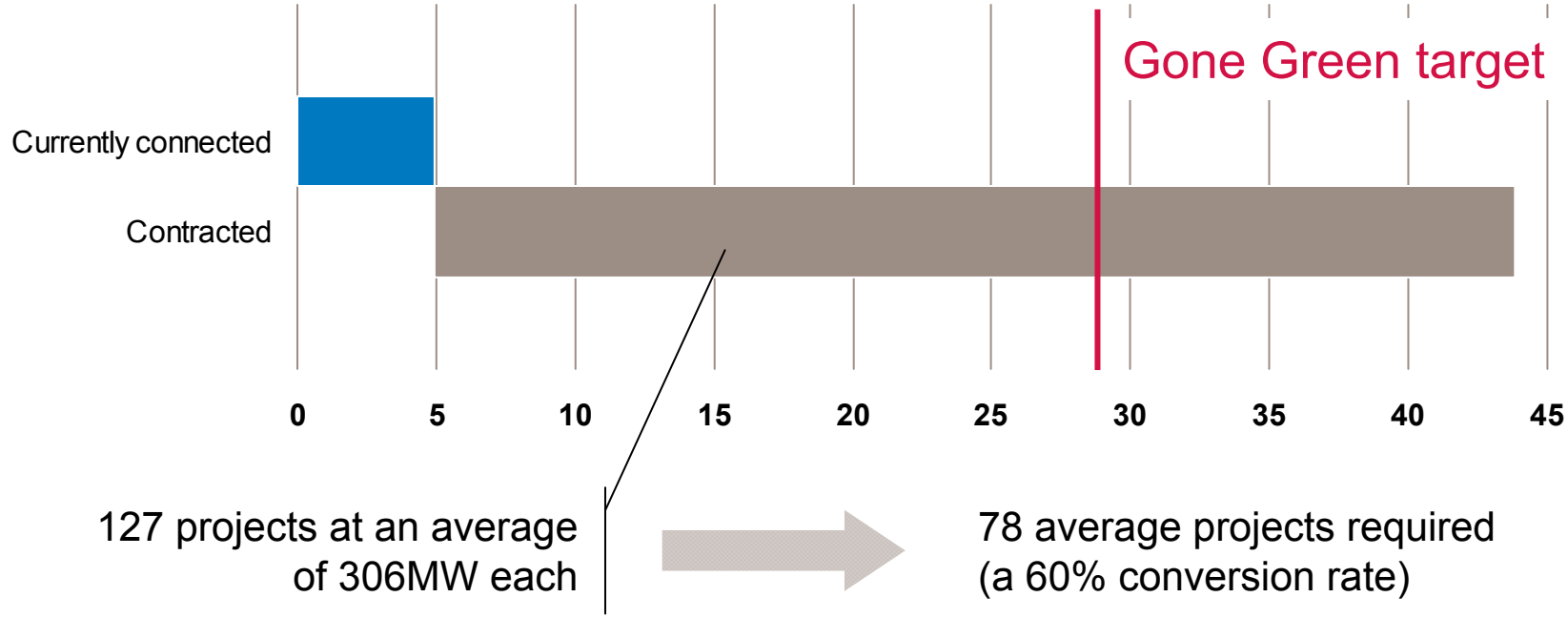
2020 Target Assessment

Gone Green: some key themes



Are the 2020 targets achievable?

2020 Transmission connected renewable generation (GW)



2020 renewables target is challenging, but achievable

Data source: National Grid TNQCU – November 2011; National Grid 2011 SYS. Connected renewable generation excludes pumped storage.

A line of sight to achieving the 2020 renewables target

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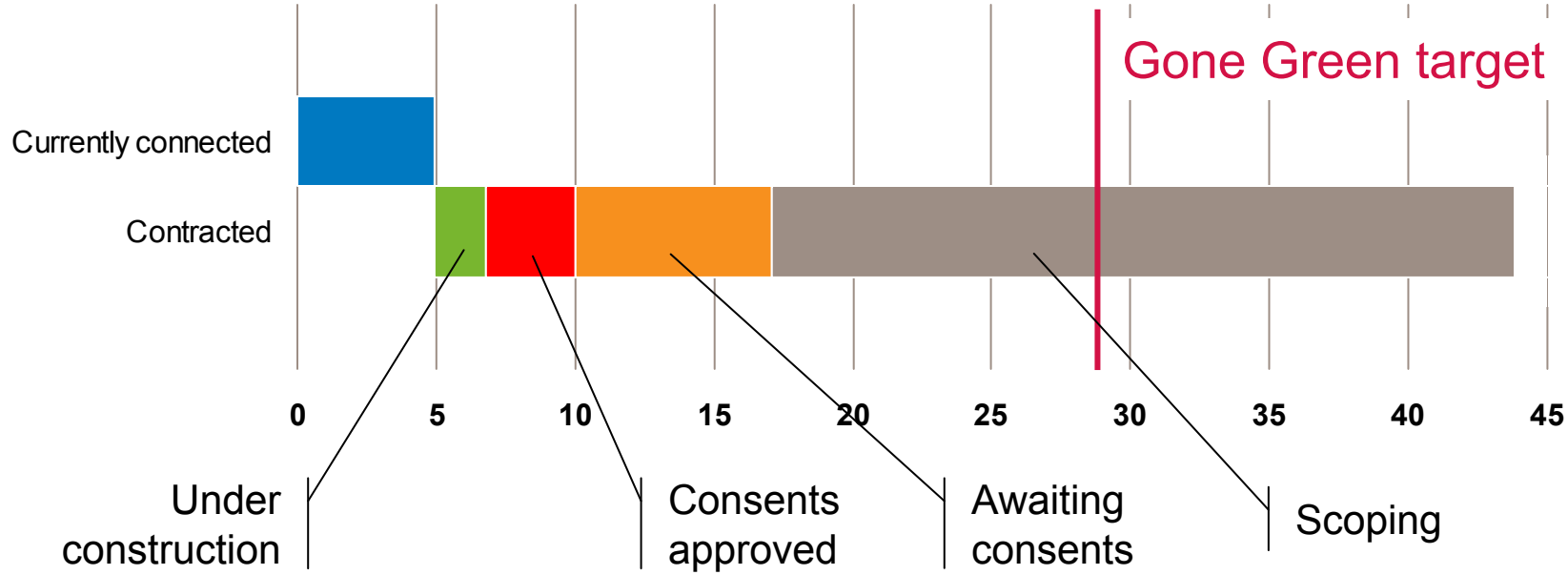
2020 Transmission connected renewable generation (GW)



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A line of sight to achieving the 2020 renewables target

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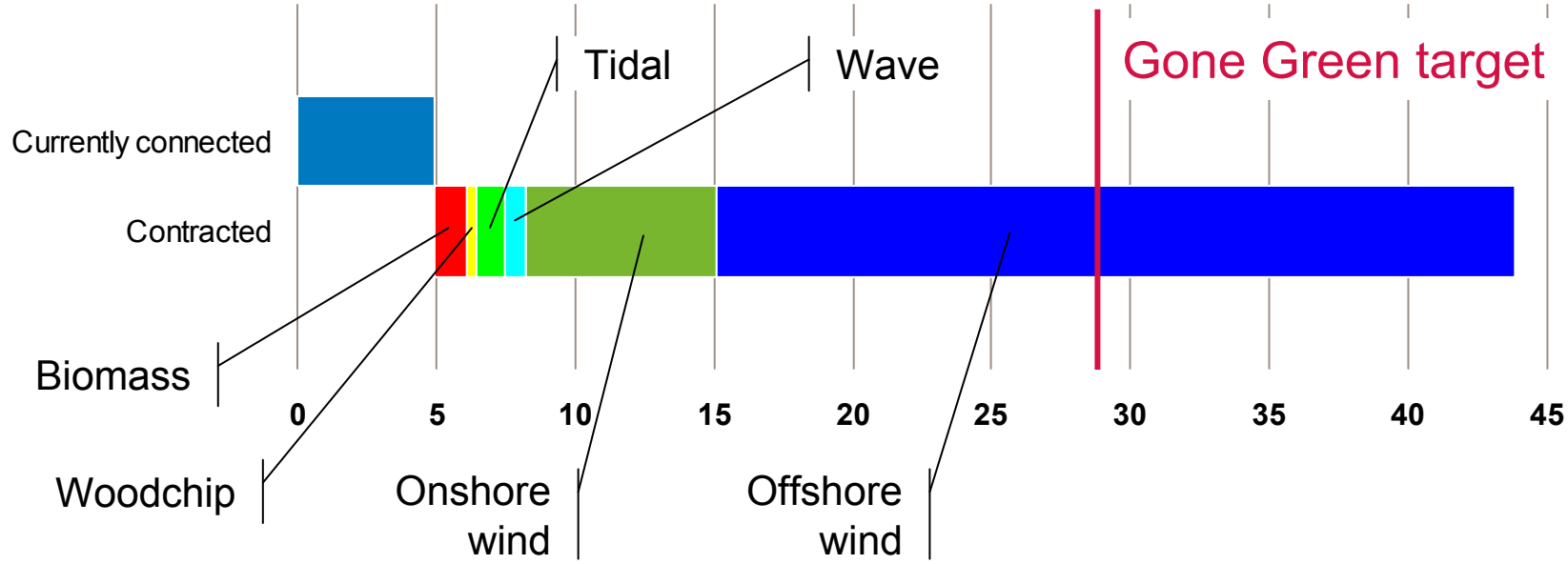
2020 Transmission connected renewable generation (GW)

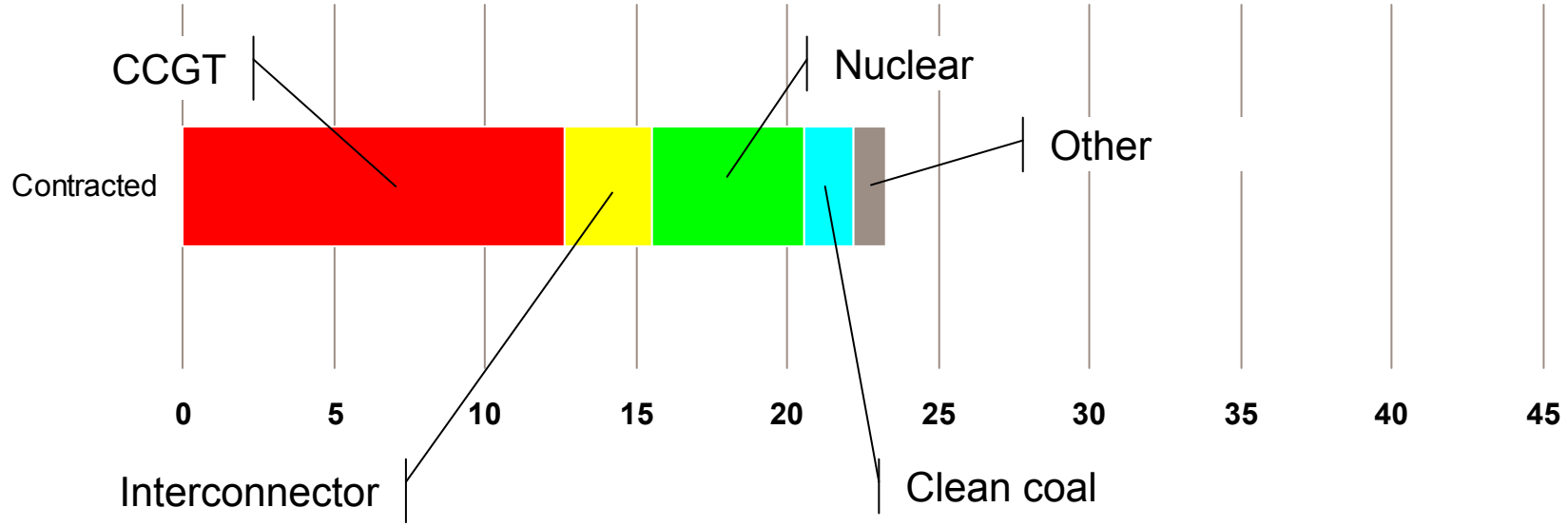


Securing offshore wind, particularly round 3, is critical

Data source: National Grid TNQCU – November 2011; National Grid 2011 SYS. Connected renewable generation excludes pumped storage.

Plus significant new non-renewable generation connections

2020 Transmission connected non-renewable generation (GW)



Data source: National Grid TNQCU – November 2011; National Grid 2011 SYS. Connected renewable generation excludes pumped storage.

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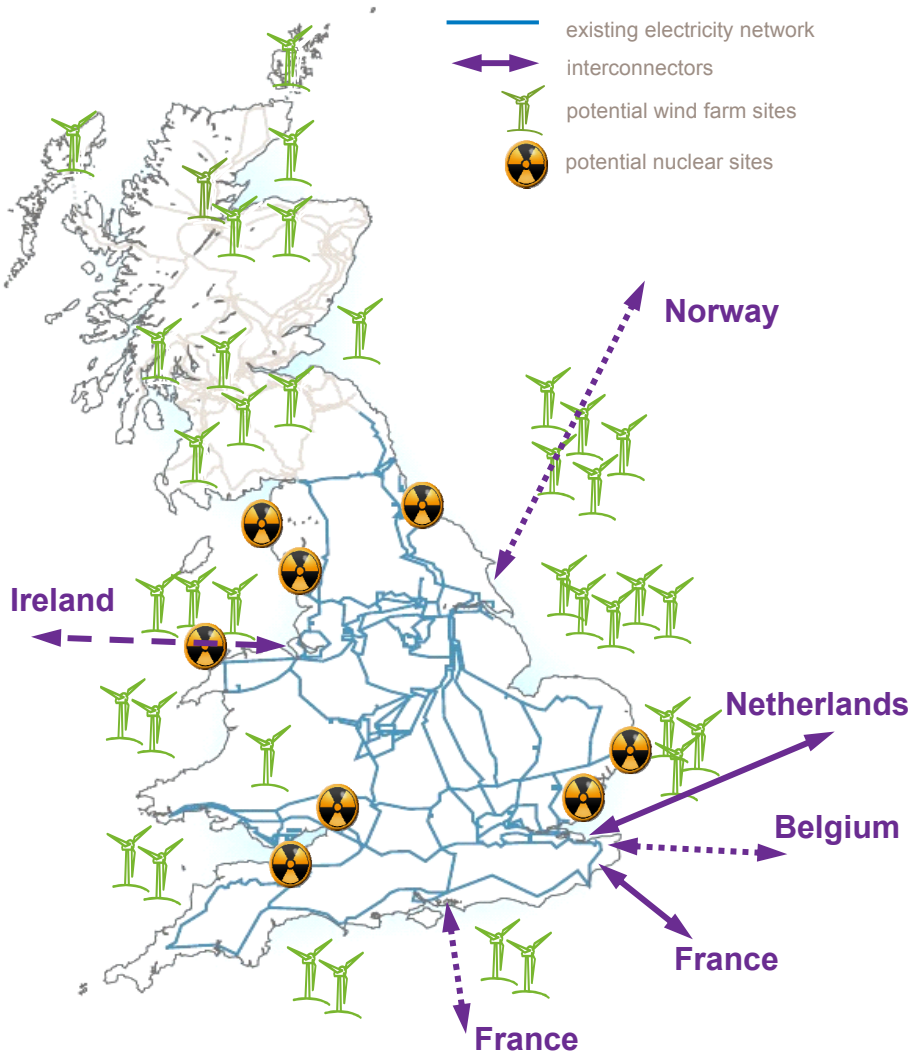
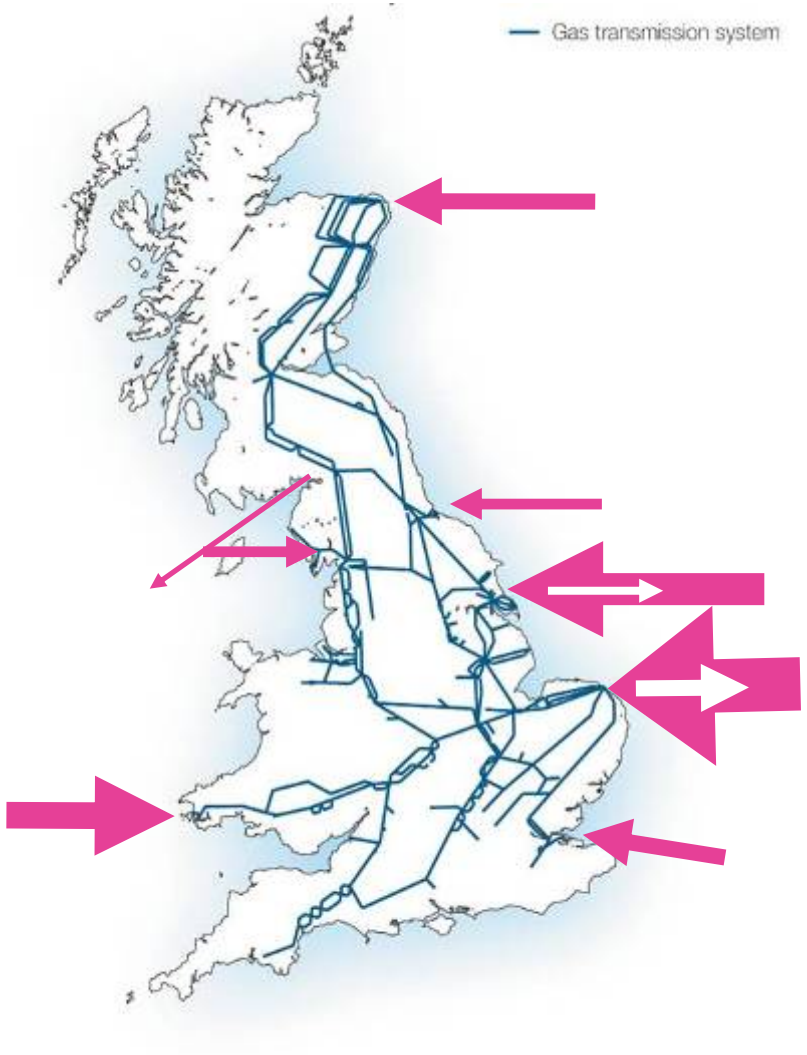
The transmission delivery challenge





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Scenario Introduction

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Future Energy Scenarios

- **Slow Progression**
  - 2020 targets met by 2026
- **Gone Green**
  - All CO_2 and renewable targets met on time
  - Balanced approach, Action needed in all sectors
- **Accelerated Growth**
  - Faster development of offshore generation
  - Targets exceeded

Future Energy Scenarios

Do you think our range of scenarios is sufficiently broad?

Do you think there are alternative technologies we should explore more?

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Demand

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Power Generation

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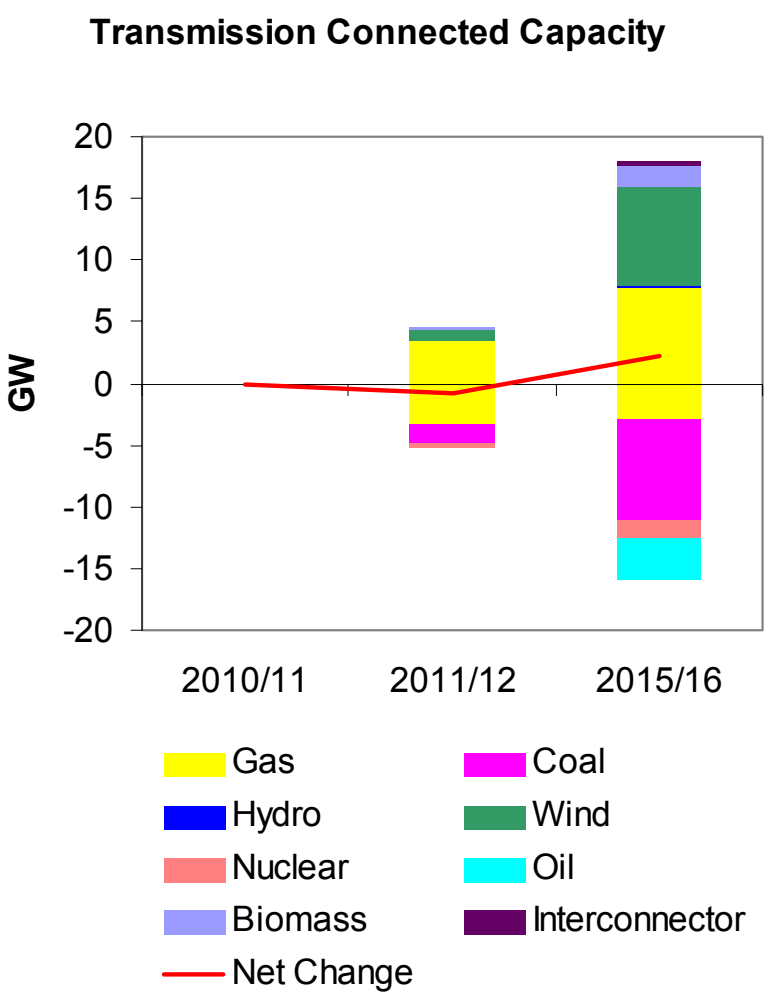
Power Generation

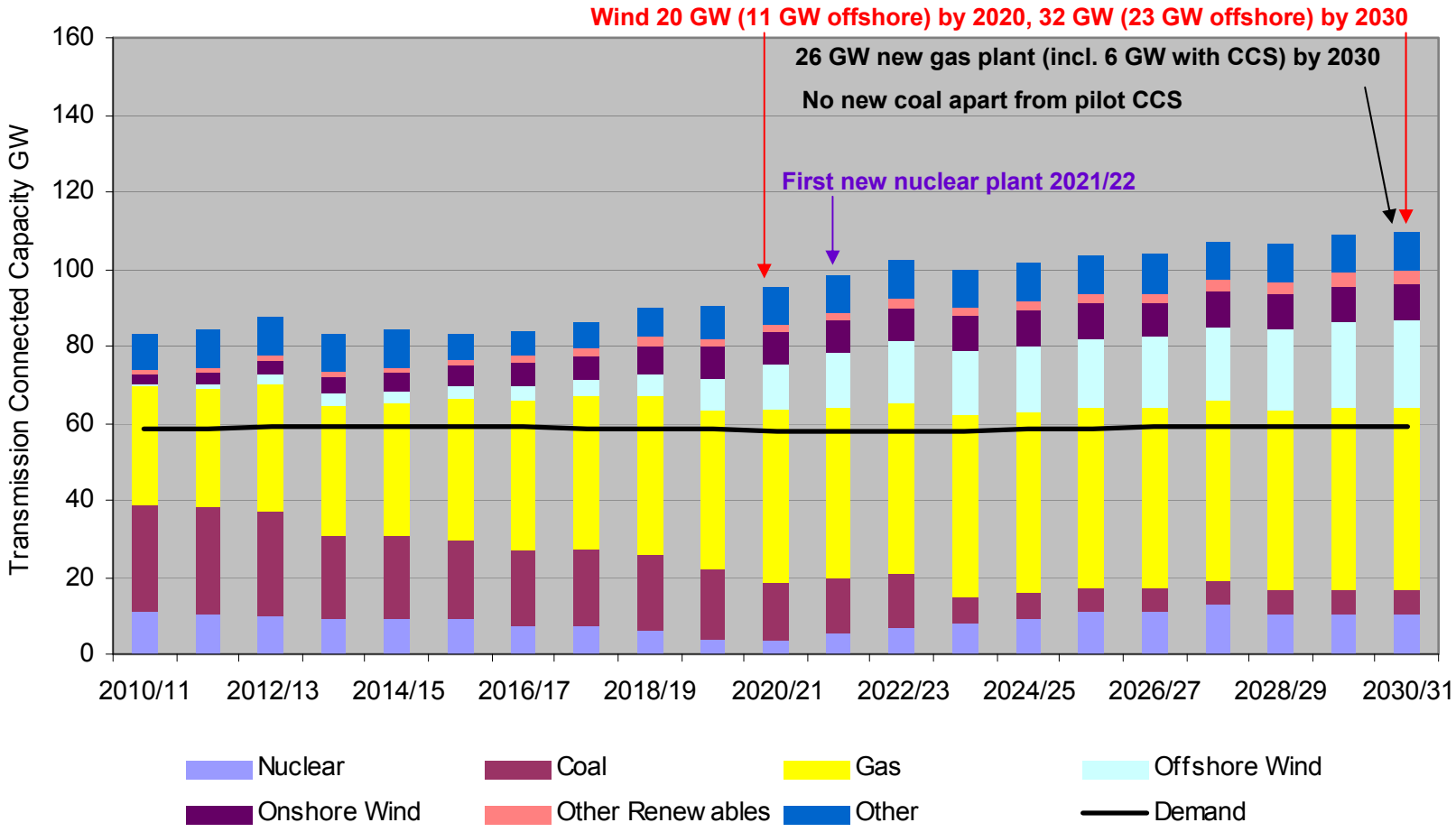
How will the power generation mix evolve over the next 20 years?

Change in generation mix over next 4 years



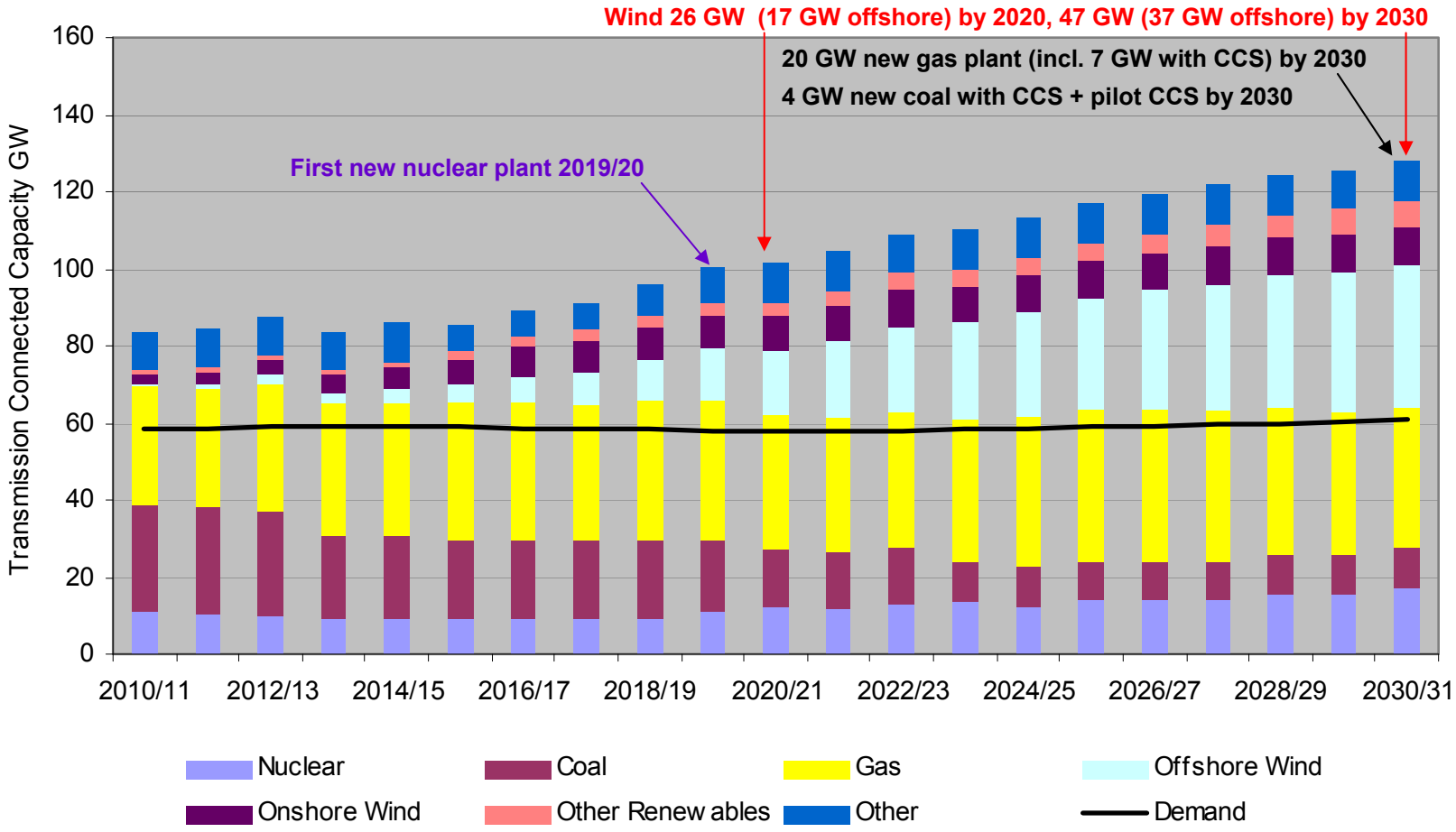
- Some certainty over next 4 years.
- 11 GW of LCPD - opted out plant (8 GW coal, 3GW oil) to close.
- Remaining 1.4 GW Magnox nuclear plant scheduled to close over period.
- 2-3 GW gas plant mothballed / closed?
- Additional capacity consists mainly of plant under construction or about to start. Main additions from 2010/11:
  Gas ~ 8 GW
  Wind ~ 8 GW
  Biomass incl. conversions 1-2 GW
- Additional capacity roughly balances out closures over this period.
- Considerable uncertainty in generation mix after next 4 years, particularly in 2020s – we welcome your views.

Slow Progression 2011



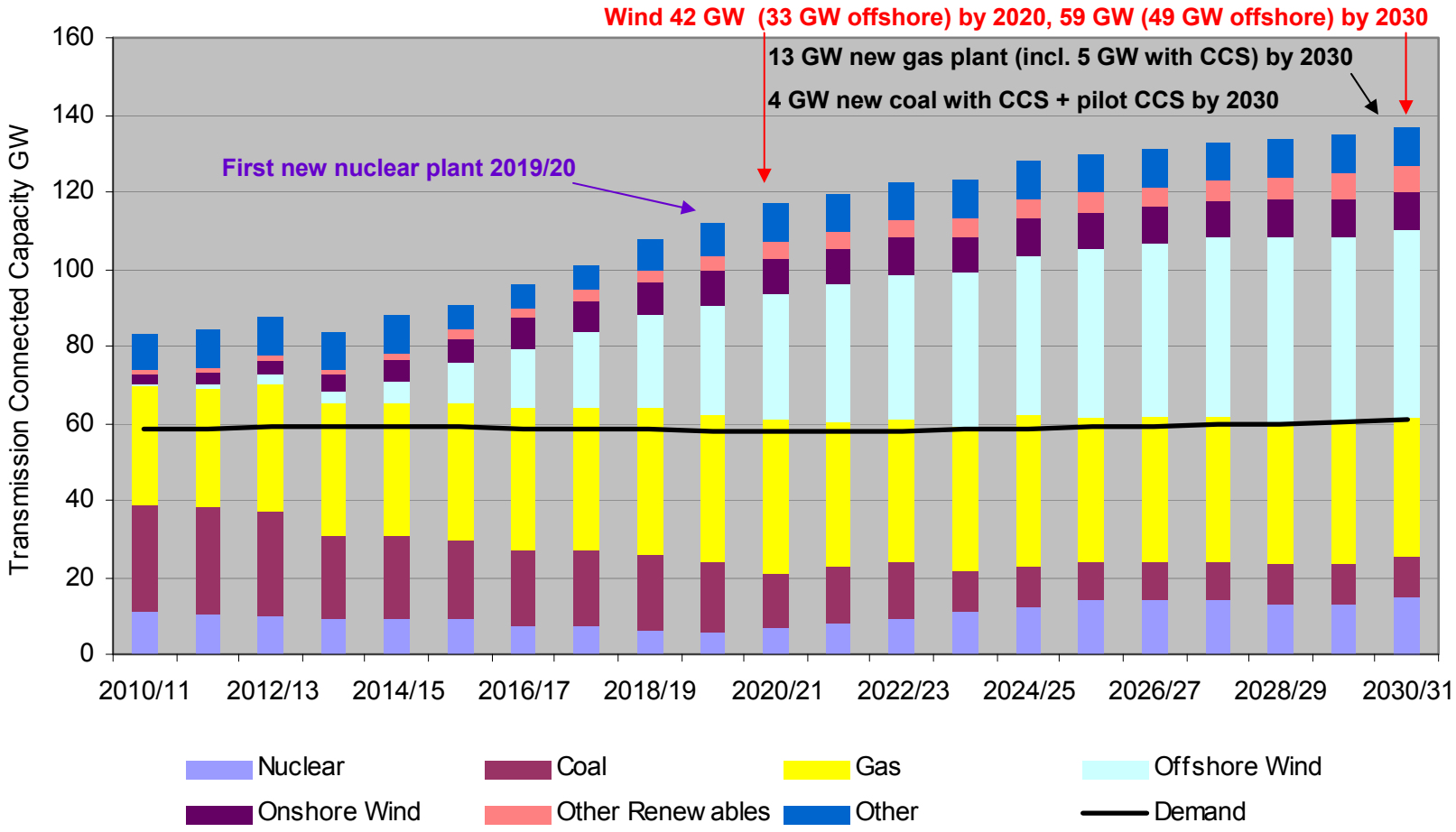
- Slow progression towards EU 2020 renewable / carbon targets and UK carbon budgets

Gone Green 2011



- Meets EU 2020 renewable / carbon targets and UK carbon budgets.

Accelerated Growth 2011



- Meets renewable / carbon targets earlier than Gone Green, mainly via offshore wind

2012 Power Generation Scenarios
Possible Assumptions

	Slow Progression	Gone Green	Accelerated Growth
Nuclear 	Average additional 10-year AGR life extensions First new plant in 2025	Average additional 7-year AGR life extensions First new plant in 2020	Average additional 5-year AGR life extensions First new plant in 2020
Gas 	Significant new build over scenarios period	New build predominantly in period to 2020	New build predominantly in period to 2020
Coal 	Majority of plant closed by 2023 due to age and emissions legislation. Different phasing of closures and different assumptions on new coal CCS between scenarios (see CCS below).		
Wind 	Slower build up. Round 3 mainly post 2020	Capacity to meet target in 2020. Supply chain maintained post 2020	Significant, rapid build up of capacity in this decade
Marine 	Minimal development by 2030	Stronger build up of capacity, mainly post 2020.	Stronger build up of capacity with larger lagoon projects.
Biomass 	Limited new build due to subsidy cost / fuel source restrictions	Stronger development with focus on conversion	Stronger development with focus on conversion and new build
CCS 	Pilot project in 2030 with commercial deployment following	Pilot project in 2025 with commercial deployment following.	Pilot project in 2020 with commercial deployment following.
Interconnection 	Limited new interconnection due to lower RES capacity	Increased interconnection with growing RES capacity	Significant new interconnection with focus on Supergrid

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Power Generation

What do you consider to be the main factors affecting the generation mix over the current and next decades ?

What are your views on the levels of renewable generation that will be connected by 2020 and 2030 ?

What do you consider to be the future for other forms of low carbon generation e.g. CCS and nuclear ?

What role do you see for fossil fuel plant (new and existing) in the generation mix ?

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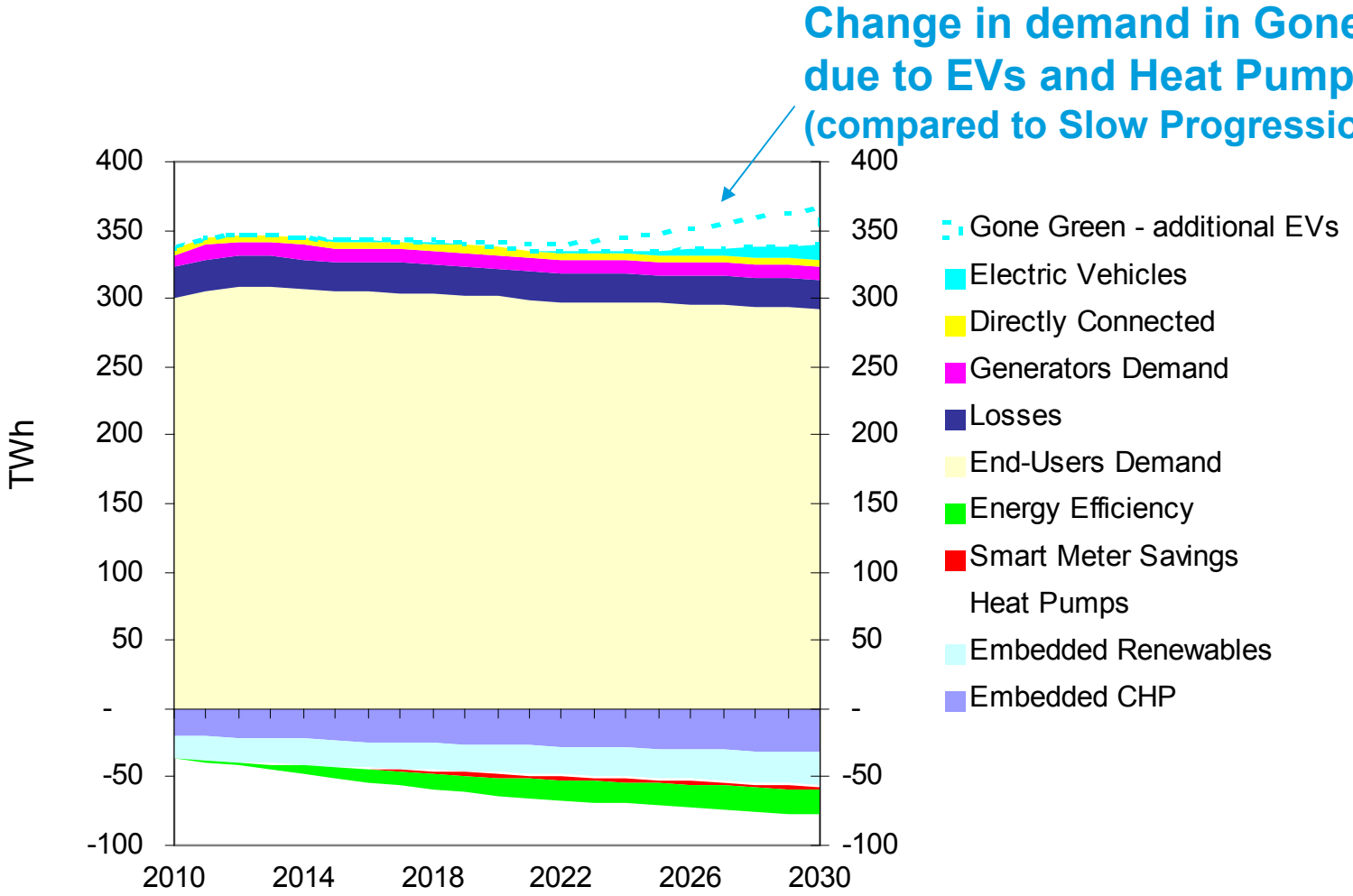
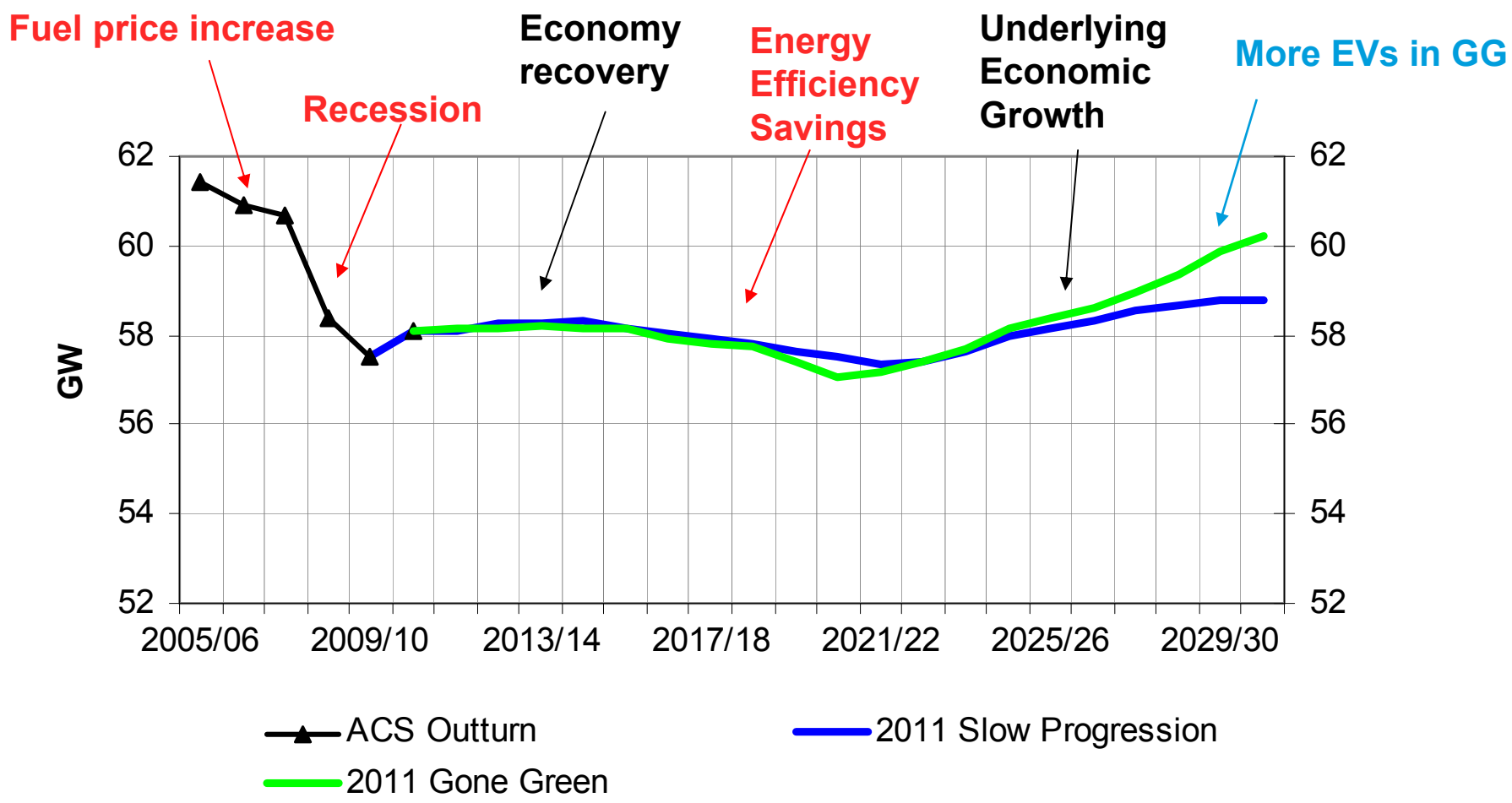
Electricity Demand

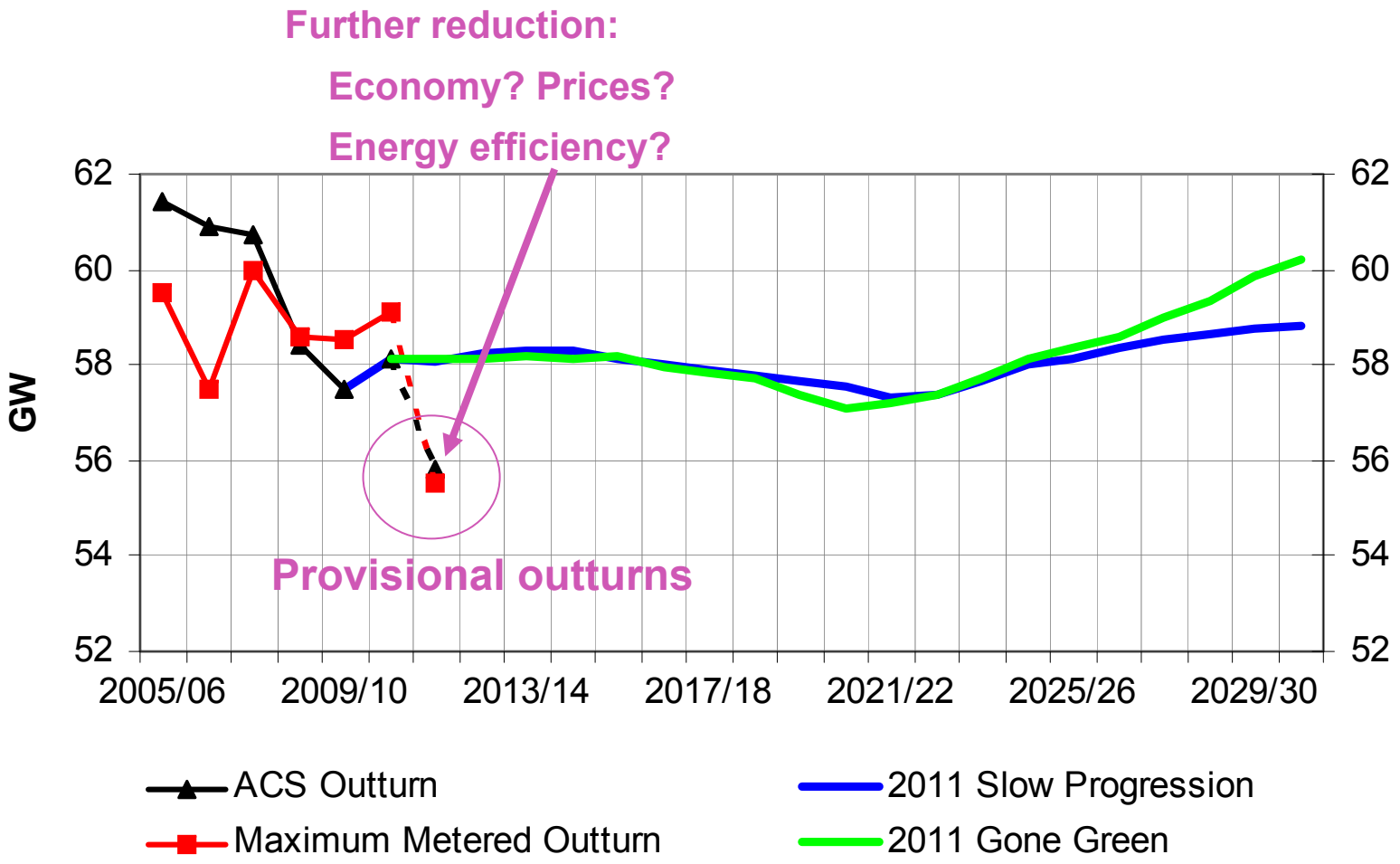
2011 Annual Electricity Consumption



2011 Electricity Peak Demand; ACS Peak



2011 Electricity Peak Demands; ACS Peak and Metered Outturn



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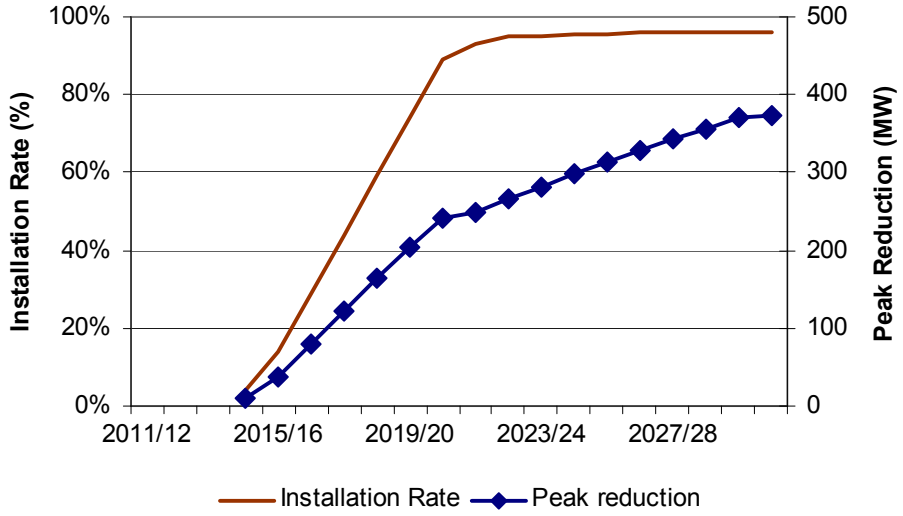
Electricity Smart Meters

Smart Meters

- Smart meter is an **enabler** with interventions such as an electronic real-time display, time of use tariffs, energy efficiency advice.
- In our 2011 scenarios, smart meter savings for domestic electricity sector was based on DECC's impact assessment report:

Annual Savings per household	**2.8%**
Peak Reduction per household	**6.7%**

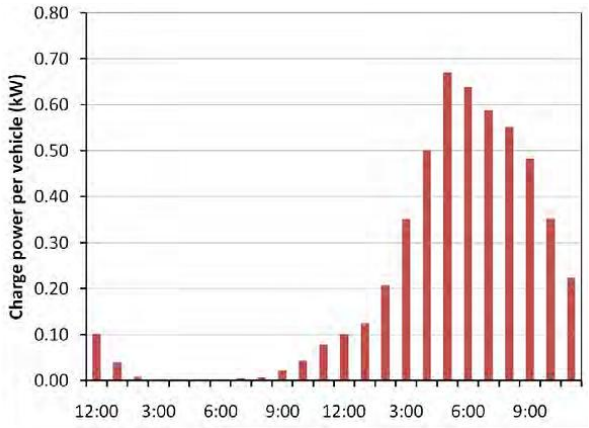


- Peak reduction/shifting is based on DECC's assumptions that:
  - 20% of peak load is shift-able
  - Consumers may only shift 1 out of every 3 times (increasing to 1 of 2 times in the long-run)
  - 20% take-up of time of use tariffs

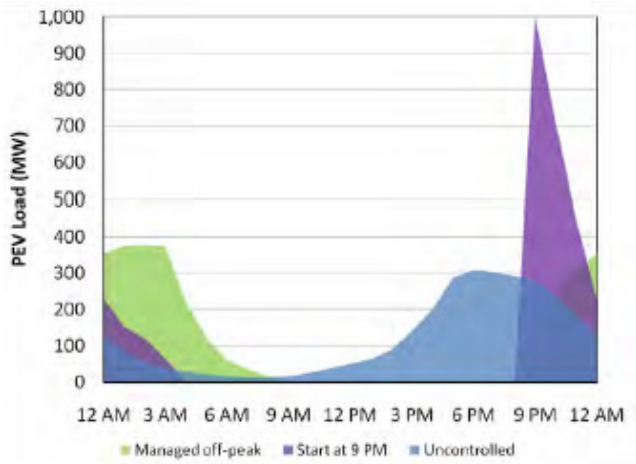
The Smart meter is an important facilitator in managing peak demand

EV Charging;
An illustrative example

EV uncontrolled charging profile:



Different charging profiles:



- Example from EPRI report (US)
- 13% of EV charging occurs during 5-6pm if charging is uncontrolled.
- Applying this rate to our Gone Green EV forecast, charging at peak could be:
  - 2010: 0.001 GW
  - 2020: 1.4 GW
  - 2030: 13.8 GW

A need for additional generation?

- Blue profile – uncontrolled (as above)
- Purple profile – set-time charge control
  - Could cause system control issues:
  - EV charging load could ramp-up quickly from 0 GW to 13.8 GW (GG11 for 2030)
  - Current largest 'TV pick-up' is 2.8GW (World Cup semi-final West Germany v England (after penalty shoot-out) – 4 July 1990

Source: Electric Power Research Institute (EPRI)

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Smart Meter – 2012 Domestic Electricity

- Reduction in energy consumption from different trials on smart meter installation (+ other interventions):

Annual Savings	**2.8% - 8.5%**
Peak Reduction/ Peak demand shift	**4.7% - 10.25%**

Note: Trials have shown minimal effect on gas consumption

What is your view on these results?

When will time-of-use tariffs be implemented to complement smart meters?

What percentage of households will have a smart meter installed by 2020?

What percentage of households will reduce/shift their demand at peak?

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Gas Demand

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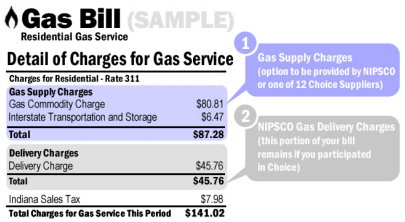
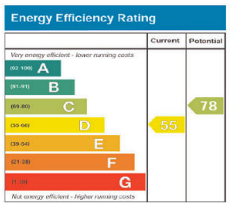
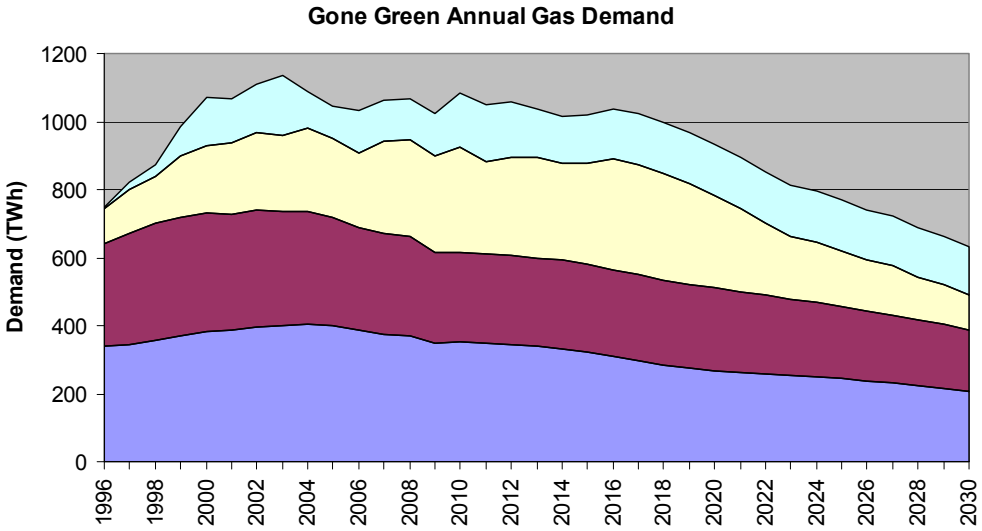
Gas Demand

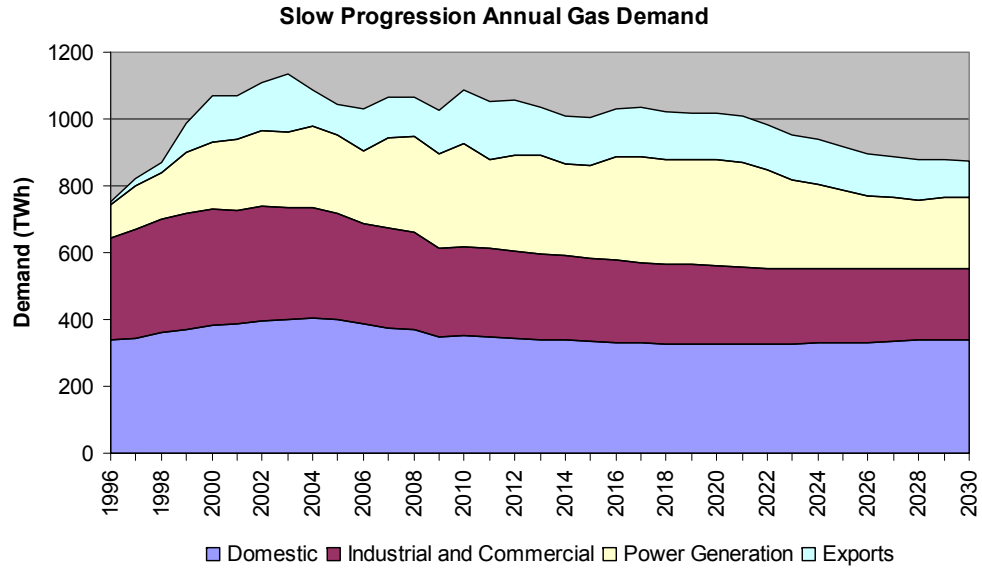
What do you think are the main drivers to gas demand over the next 10- 20 years?





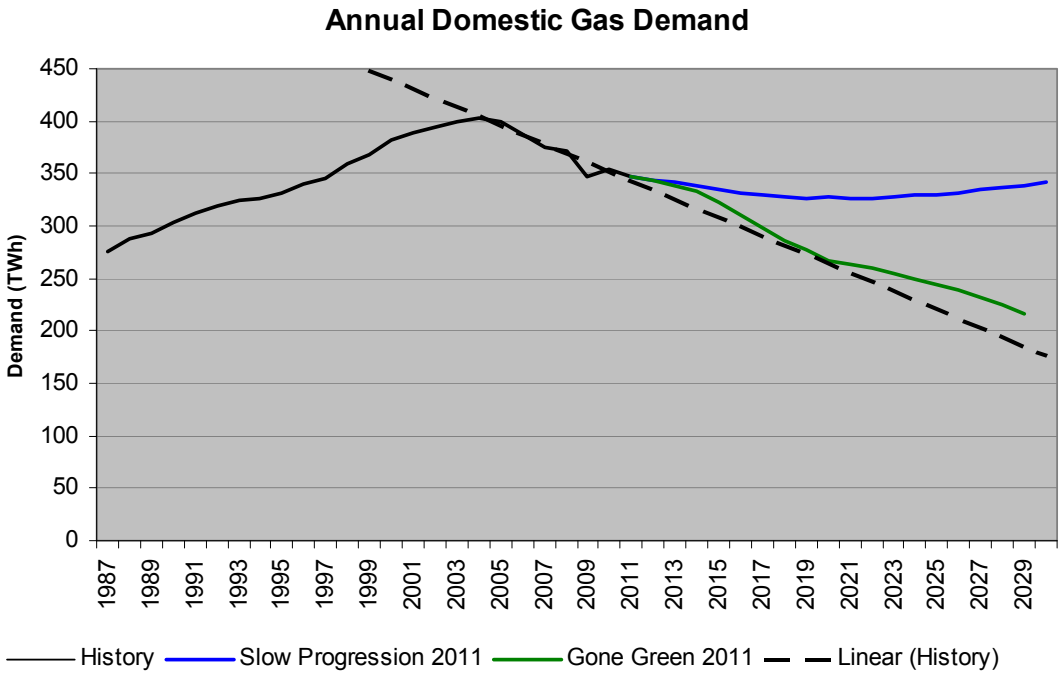
Annual Gas Demand





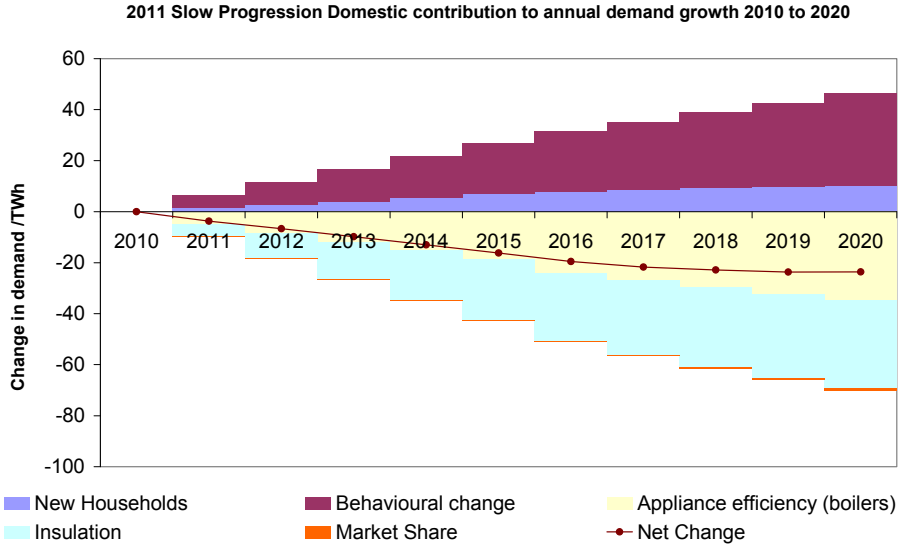
- 2011 Scenarios
- Total gas demand for both scenarios relatively flat until around 2018 when they diverge:
- Gone Green reduces significantly from around 2018
  - domestic demand
  - power generation demand
- Slow Progression reduces post 2021
  - power generation demand
  - Domestic demand remains relatively stable as lesser efficiency gains are offset by demand from new houses.

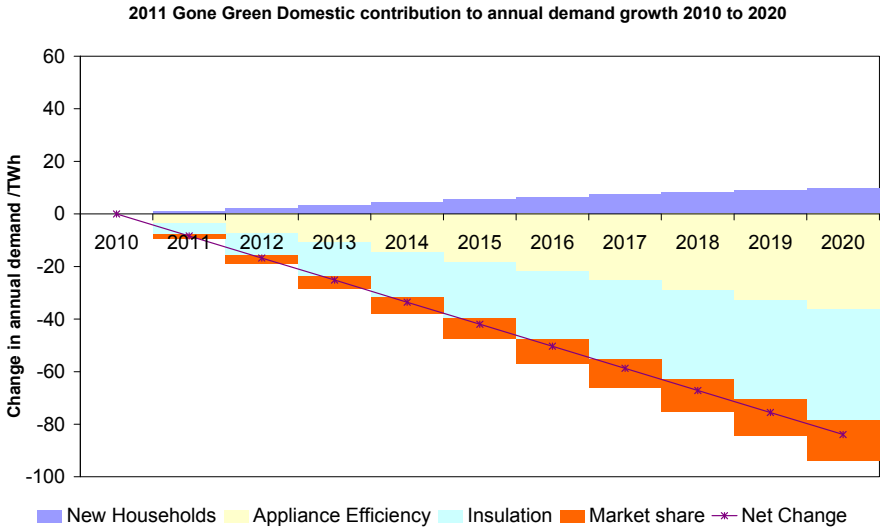
Domestic Demand



- Since 2004 gas demand has reduced year on year due to:
- Gas Prices & Economic Factors
- Energy Efficiency

Domestic Demand





- Differences are due to assumptions on:
  - Comfort levels
  - New house demands
  - Electrification of heat
  - Slightly more insulation

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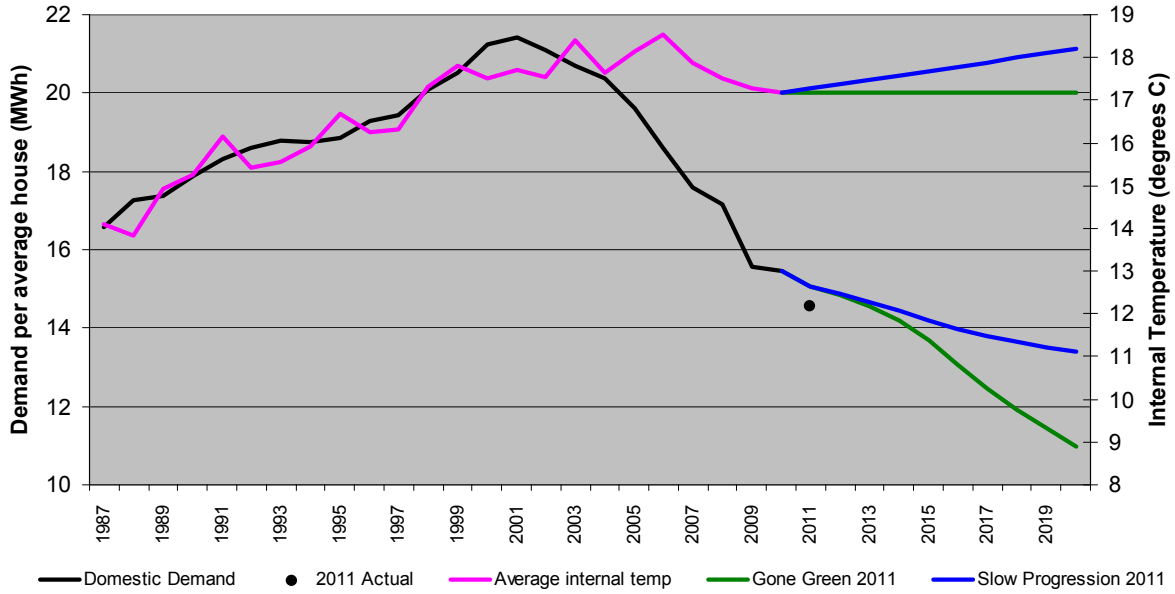
Domestic Internal Temperatures



- Since 2005 (when gas prices increased significantly) internal temperatures reduced year on year
  - GG assumes temperature will remain the same.
  - SP assumes they will increase roughly 1deg in the next decade

Do you think comfort levels will increase, decrease or remain the same?

What effect will this have on demand?

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Energy Efficiency

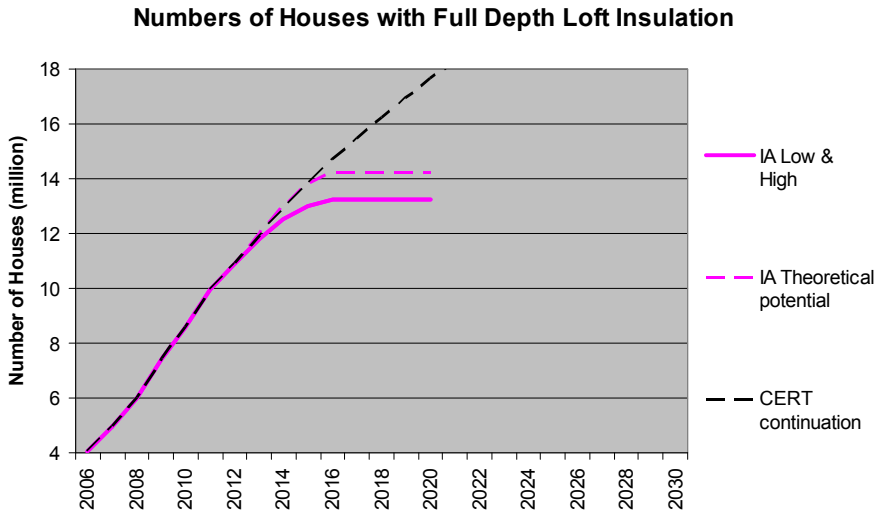
Energy Efficiency; What will Green Deal Deliver

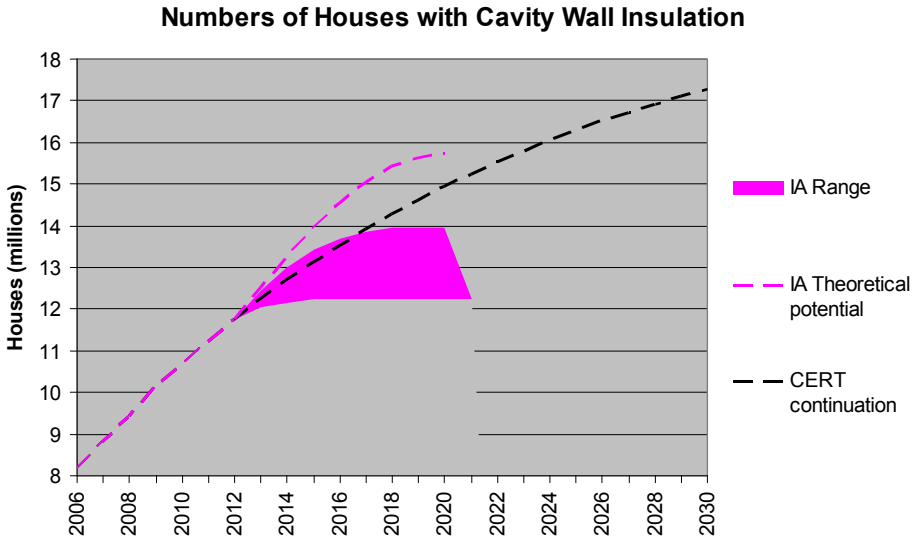
- Since 2006 CERT (& EEC2) delivered insulation:
  - Loft ~ 1m houses / year
  - Cavity wall ~ 0.5 m houses / year
- CERT being replaced by Green Deal in October 2012.
  - IA payback for measures ~ 5 years.

How will this affect insulation take up?

Does IA range appear reasonable?

Where in the range do you think it will be?

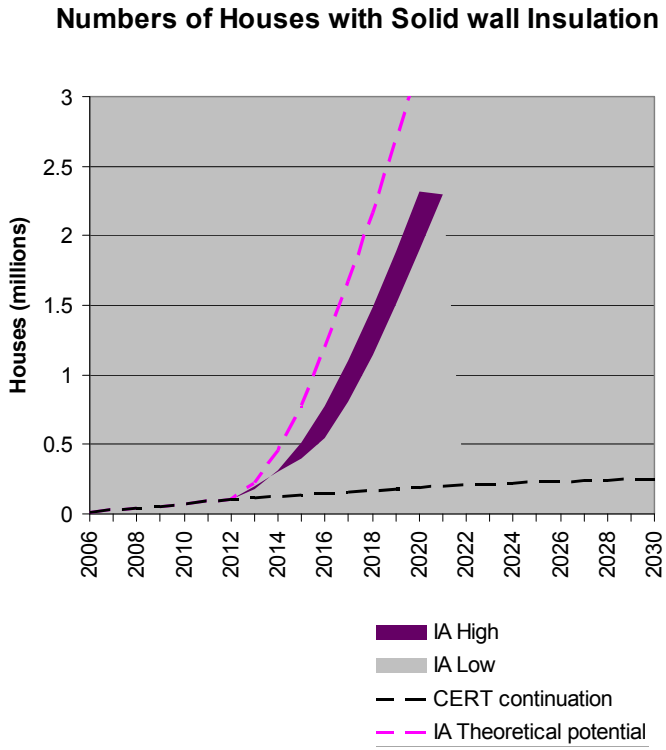




Energy Efficiency – Green Deal 2

- Green Deal what will it deliver?
  - Since 2006 CERT, EEC2 Warm Front and CESP delivered:
  - Solid wall insulation to ~ 15,000 houses per year

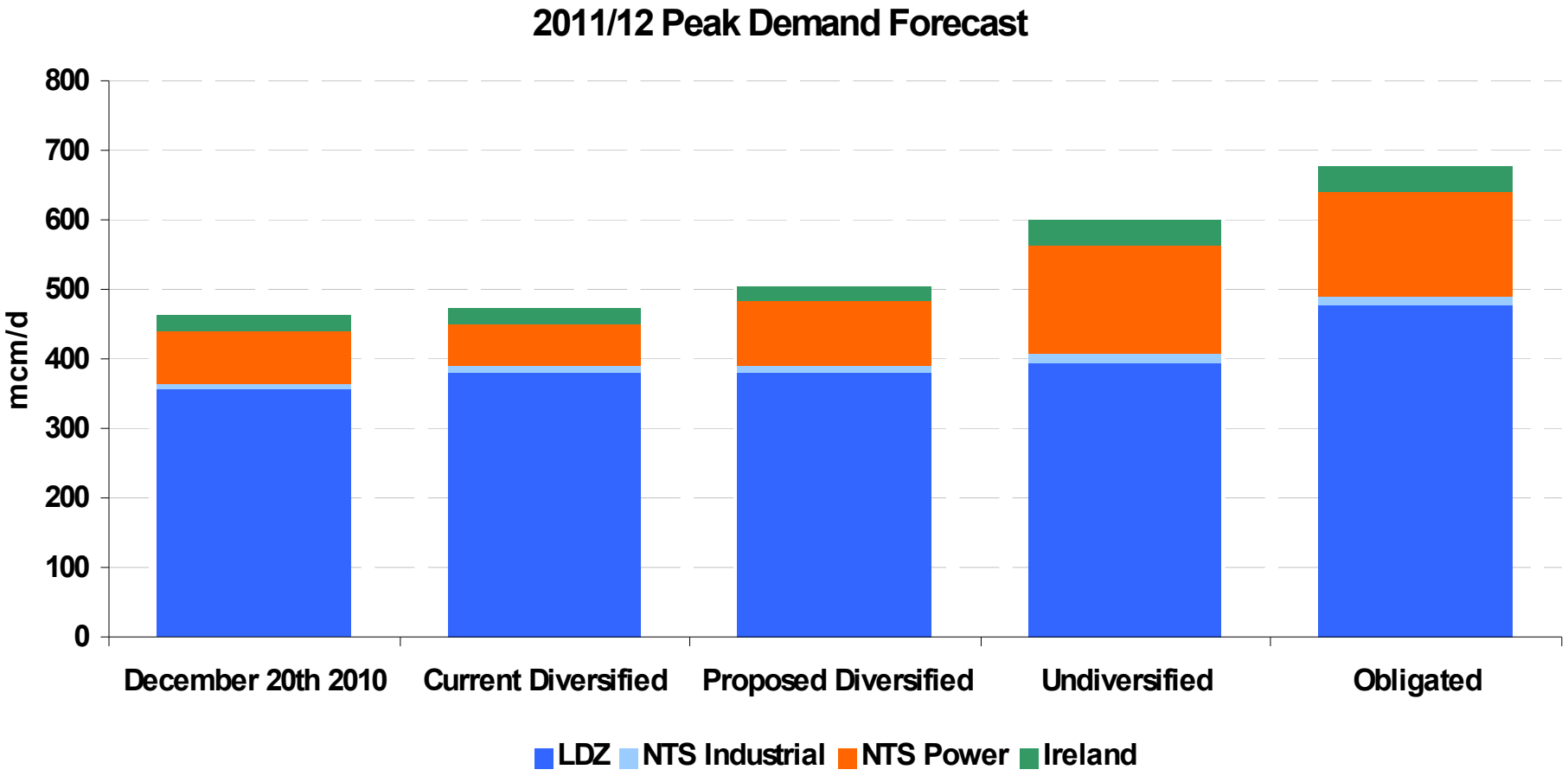
- Green Deal IA assumes Solid Wall Insulation take up will increase significantly as ECO incentivises:
  - Hard to treat homes
  - Lower income groups.
  - Cost around £7k per house



Do you see significant increase in SWI?

New 1 in 20 definition

Do you have any comments about the different peak day definitions?



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Green Technology Rollout

Electric Vehicles and Heat Pumps

Green Technology - Context

- **Government policy drivers**
  - **Pathways 2050 / smart & super grids**
  - **Micro-generation consultation**
  - **FIT's** – supports embedded generation
  - **RHI Premium Payment** – one year support for primarily off-grid renewable heat
  - **RHI** – supports renewable heat (850 million) commercial phase 1 live with domestic phase 2 due Oct 2012
  - **Green Deal** – energy efficiency improvements to homes & businesses at no upfront cost (includes renewable heat e.g. heat pumps)
  - **Electric Vehicle Incentive** (confirmed to 2015 now includes vans)

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Which technologies?

- We are focused on technologies which could have the *largest impact* on domestic energy demand
  - Electric vehicles (pure EVs, plug-in hybrid & range extended)
  - Air source heat pumps (i.e. air-to-water)

- Scenarios developed from a UK wide perspective
- But... on a local scale the picture could be very different
- How could this affect the network?

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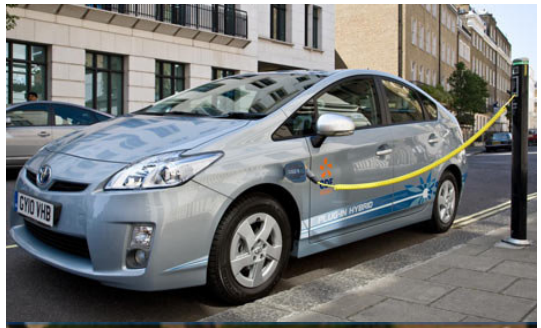
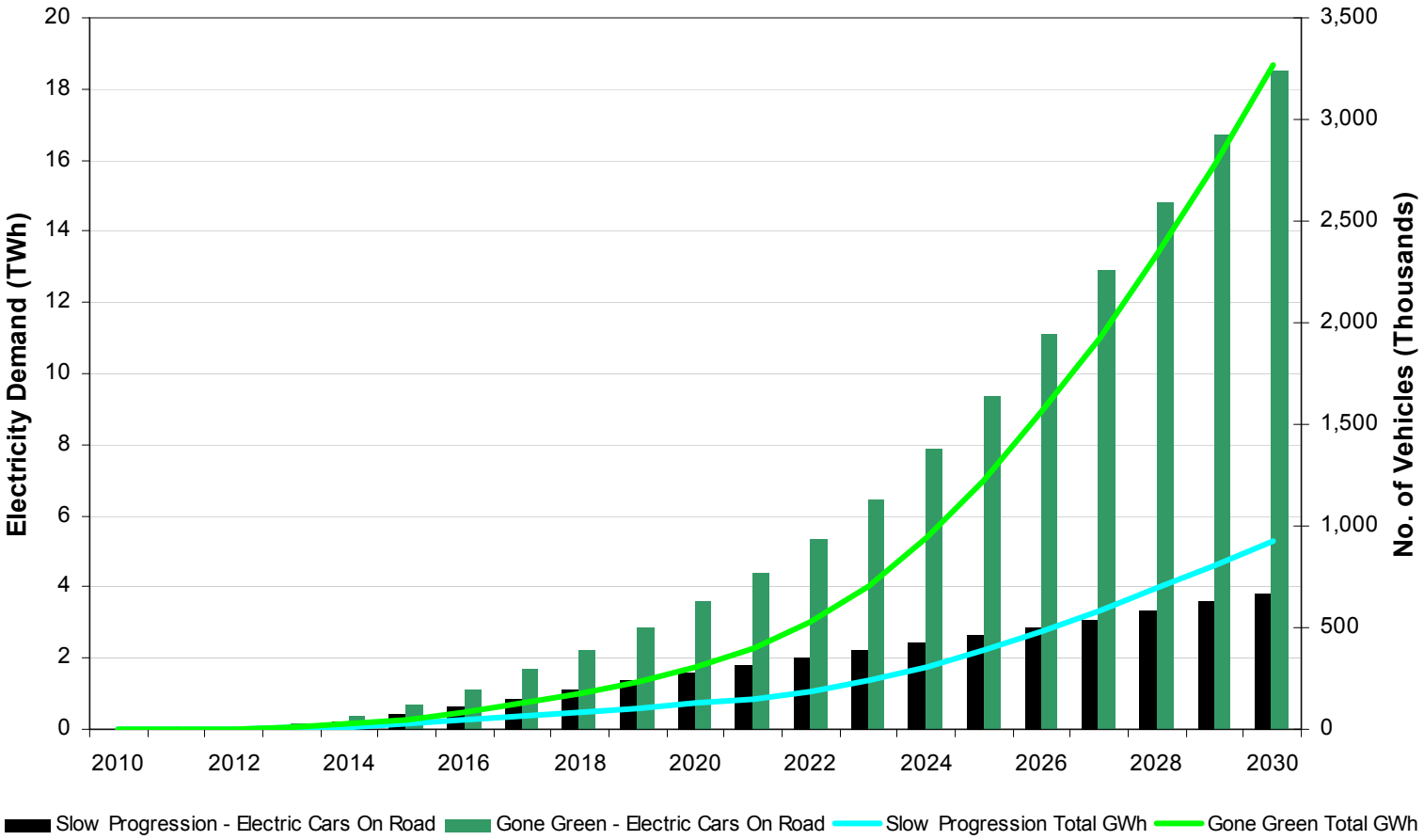
Heat Pumps & Electric Cars

- **Air Source Heat Pumps (Air to Water)**
  - Straight forward retrofit technology
  - 290% Efficient - MCS Standard (can be up to 500%)
  - Reduced heating bills
  - Zero Emissions (at point of heat delivery)
  - SMART Compatible

- **Electric Cars & Plug In Hybrid / Range Extended**
  - Electric Motor 90% Efficient
  - Zero Emissions (at tail pipe when running on electric)
  - Low running costs



Electric Car Scenarios (2012 – provisional scenarios)



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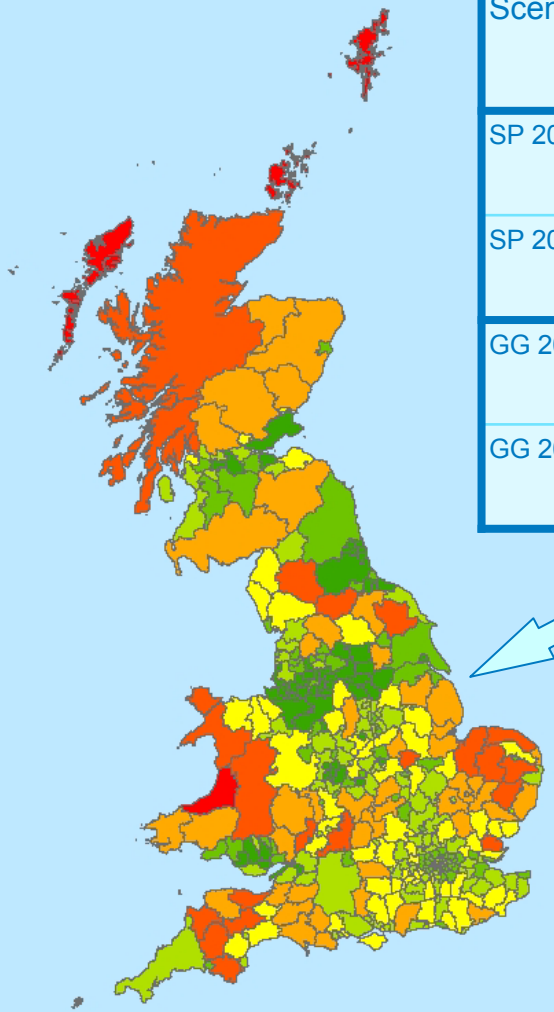
Heat pumps and Electric cars

Heat pumps

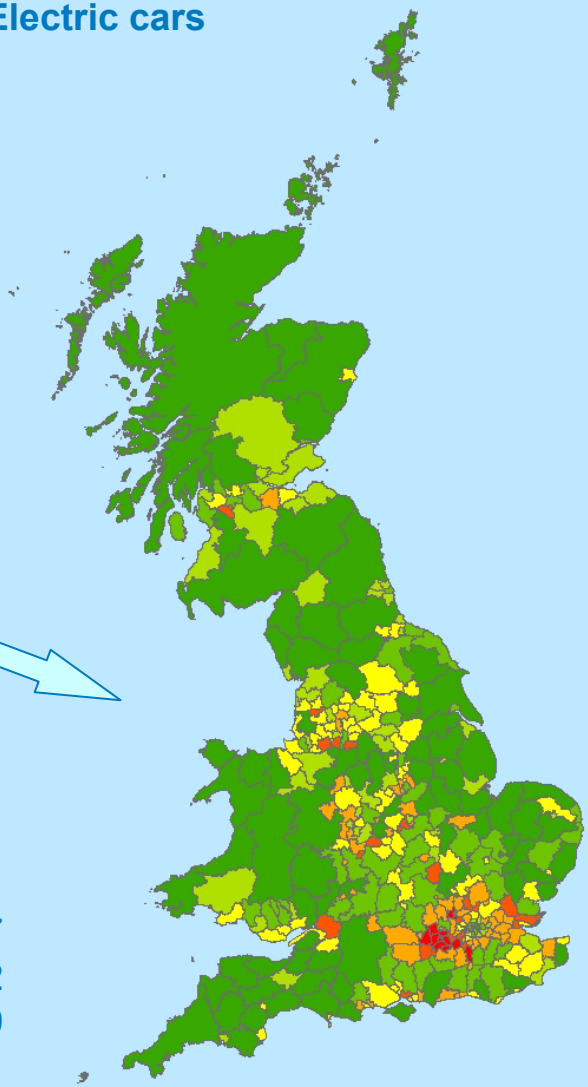


UK totals Scenario	Heat pumps	Electric cars
SP 2020	**390,000** -0.54TWh	**280,000** 0.72 TWh
SP 2030	**420,000** -0.46TWh	**670,000** 5.3 TWh
GG 2020	**1.2m** -1.6TWh	**620,000** 1.7TWh
GG 2030	**7.7m** -8TWh/h	**3.2m** 19TWh/y

Penetration under Gone Green 2030 (% houses)

Heat pumps	Electric cars
0-20	0-5
20-30	5-8
30-40	8-12
40-50	12-17
50-60	17-22
60-70	22-30
70-90	30-41

Electric cars



Electricity Distribution Networks
Gone Green 2030

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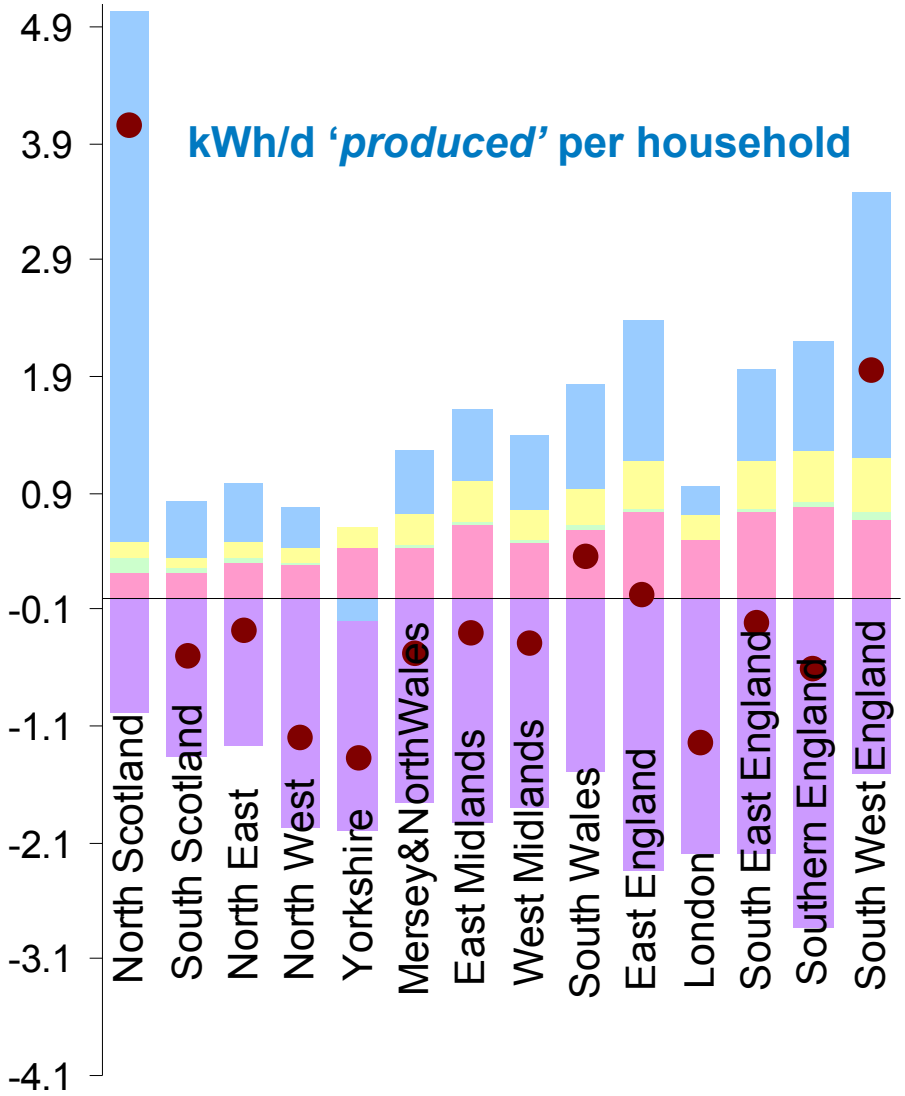
Generally…

Rural areas demand decrease

Urban areas demand increase



Heat pumps and electric cars have much larger impact than other technologies

Extra generation or demand reduction (switching from electric resistive heating to heat pump)

Increase in demand

(EV charging, switching mainly from Gas fired heating to electric heat pump)

- Electric vehicles
- Air-source heat pumps
- Solar hot water
- Wind
- Photovoltaics
- Net

Electricity Distribution Networks
Gone Green 2030

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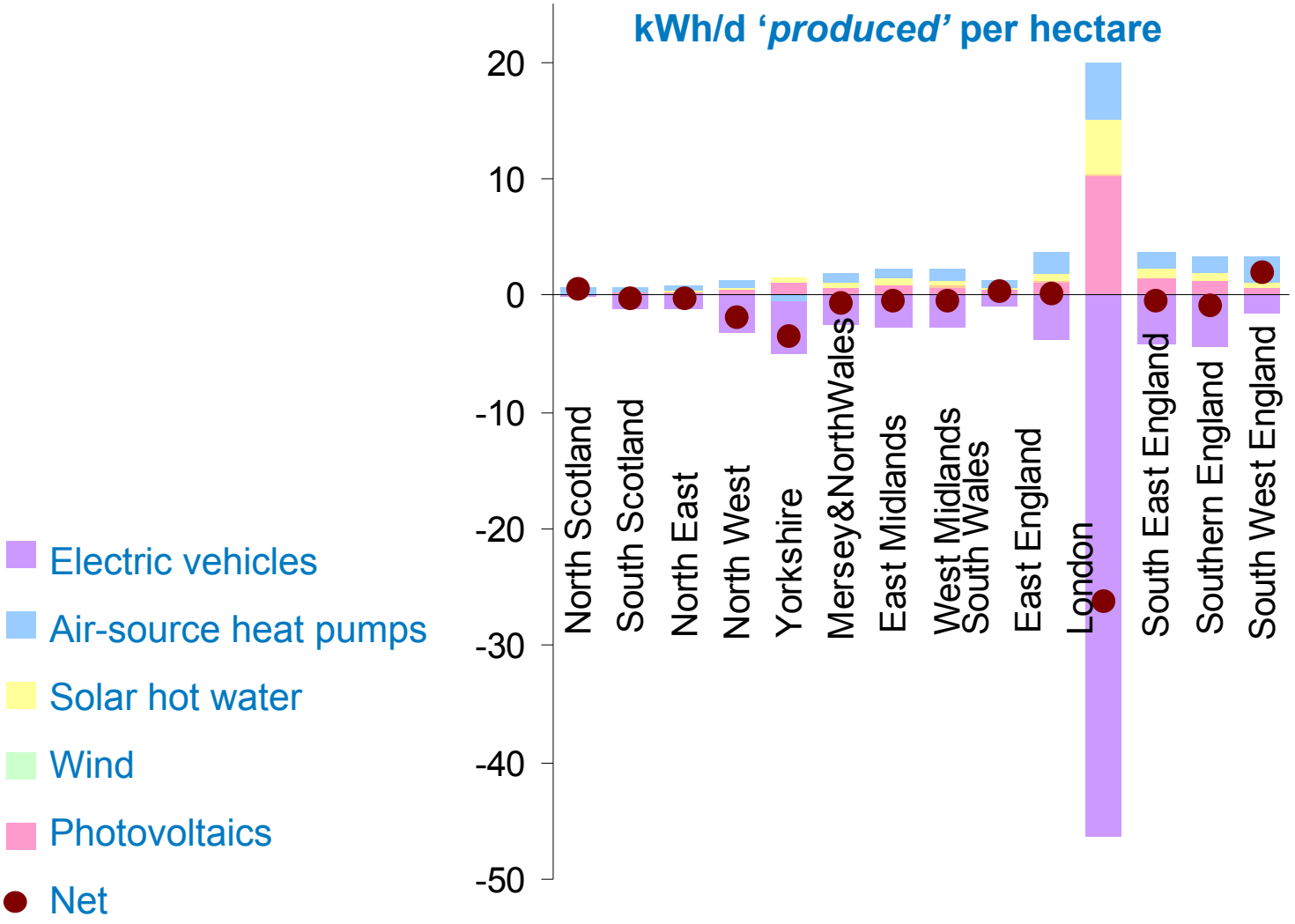

London has by far the highest population density, so bigger change on an area basis

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Domestic green technology roll-out

- Does anything *surprise* you in our results?
- Do you see any other domestic technologies having a large variance by location and large energy impact?

- What is your view on Electric Vehicle numbers ?
- Growth profile? Market saturation level? Barriers?
- When do you think most people will charge cars ?
- At night? In the day? As soon as they get home from work?
- More pure EV's, PHEV or E-REV?
- We see ratios of around…. X:y:z – what do you think?

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Domestic green technology roll-out

Main drivers / barriers affecting people who could buy green technology…..

Socio-economic drivers
Keeping up with the Jones's
Education level
Disposable Income

Photovoltaics
Sunny area / latitude
Cost- FiT?
South facing roof space

Heat pumps
heating & hot water
Insulation
Costs
Green Deal ?
Temperature levels

Home
Home-owner, tenant, landlord, council house tenant
new build home

Vehicle i.e. EV / PHEV / E-REV
Urban, suburban, rural
Range / Cost
Fill-up speed/ charging points
Model availability / Desirability

Which do you think are most important?

Should any others be added?

How would you assess their impact?

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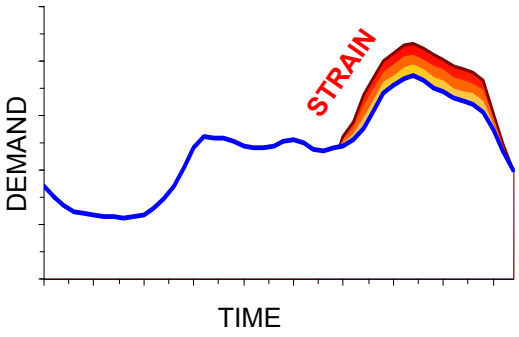
Demand Side Management

Coping with future demand

In the future, National Grid sees that demand side management will become a more and more prominent tool for system balancing.

But is this feeling shared with the whole community?



Domestic Property Demand Curve

Current System Management

- National demand forecasted to increase
  - Additional 'green' technologies being added to the grid
    - (Large) GW of heat pumps being added by 2030
    - (Enormous) GW of electric vehicles to being added by 2030
- Grid is maintained to manage 95% of possible demand peaks
- System balancing is performed by regulating supply to meet demand

Primary methods to address potential demand increases are:

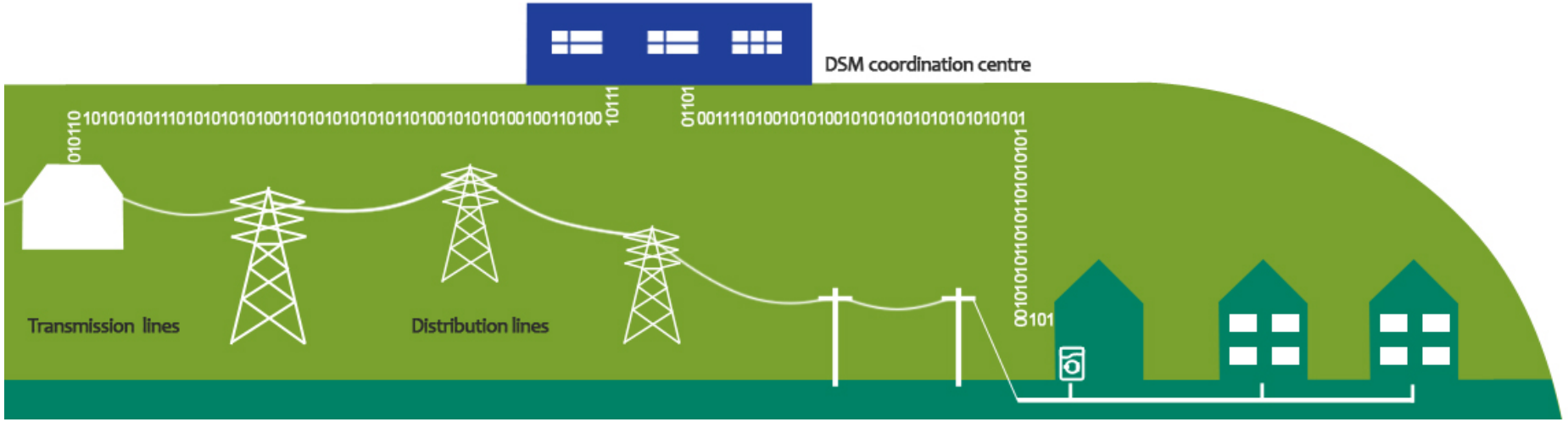
Increase Supply > **Reduce Demand** > **Shift Demand**

Demand Side Management

- DSM is a system in which the direction of the load is passed from the owner to an external coordination centre (DSM Coordination Centre)
  - The coordination centre has a view of the present status of the gird system, the potential for supply and the system demand

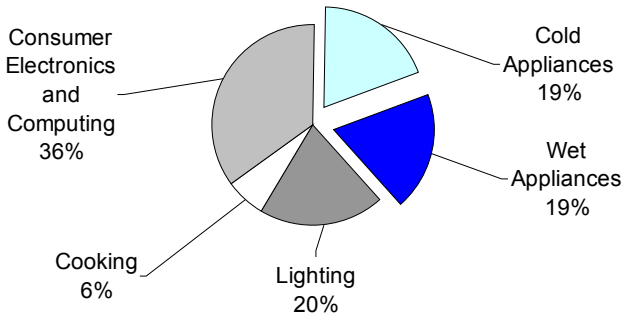
- Direct control of the appliance will either be with the DSM Control Centre (DSMCC) or the consumer
  - Automatic system: DSMCC has direct appliance control
  - Manual System: Advisement sent to household and decision to act made by consumer

- DSMCC must have a whole system view to correctly manage the balance of demand and supply



Domestic Demand Side Management

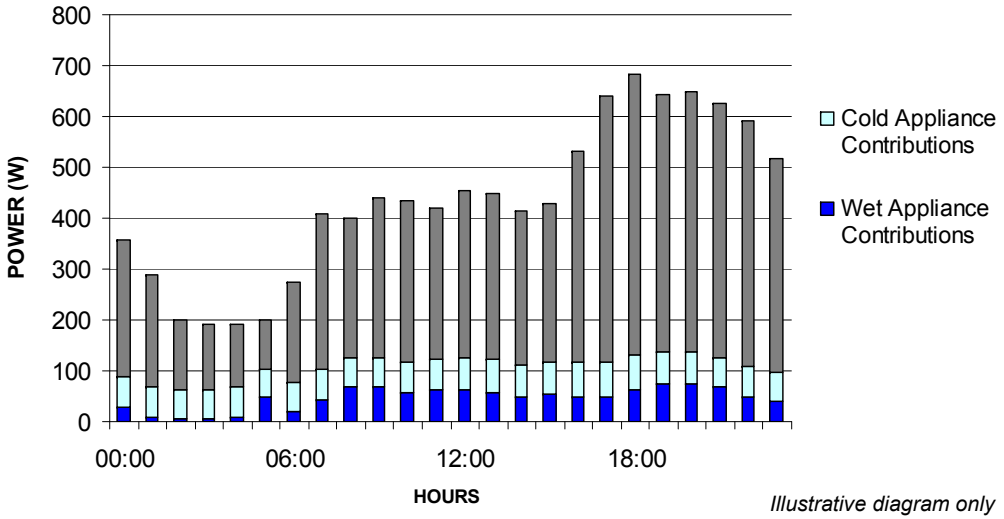
2010 Domestic Electrical Demand



Excludes heating and transport
Total domestic demand 119,041 GWh

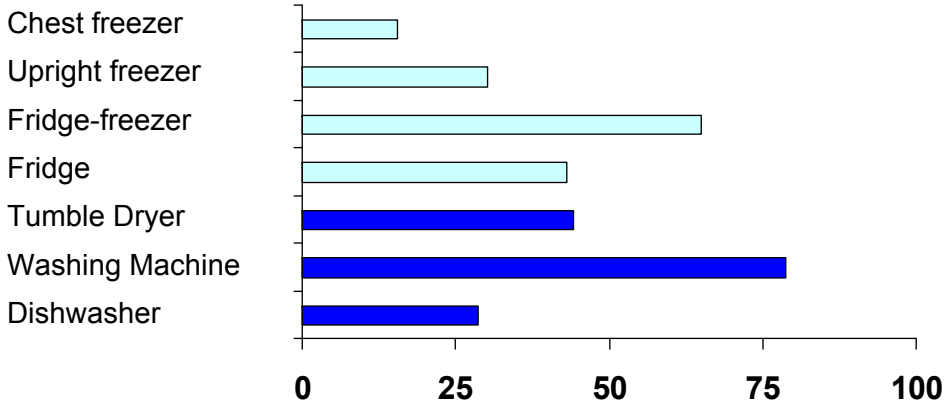
Source: Dukes 2011

Average GB Family Daily Load



Illustrative diagram only

% GB Household Ownership 2010



Source: Defra, Market Transformation Program

Key

- Average lifetime of cold appliances is 15.6 years
- Average lifetime of wet appliances is 14.0 years
- Cold and wet appliance demand peaks between 1600 – 2100

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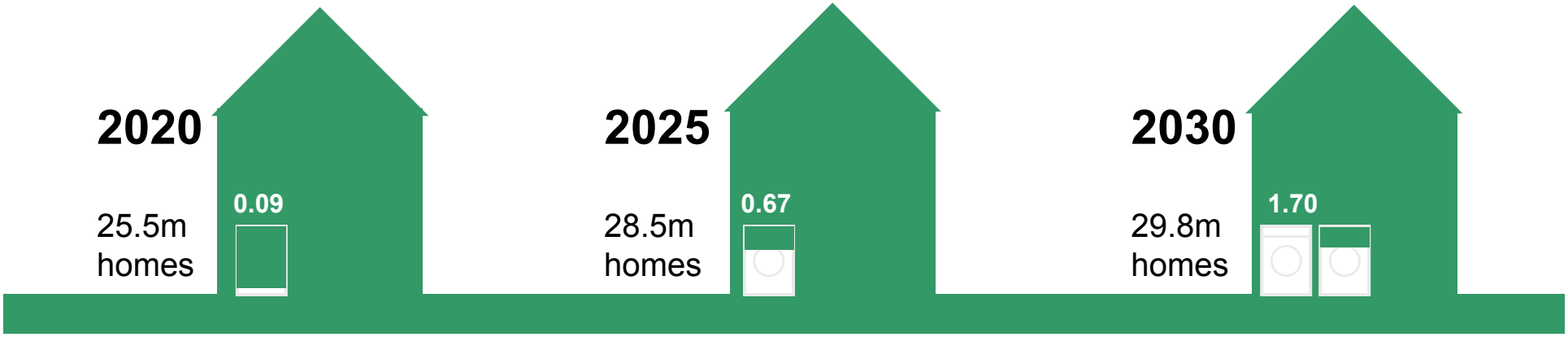
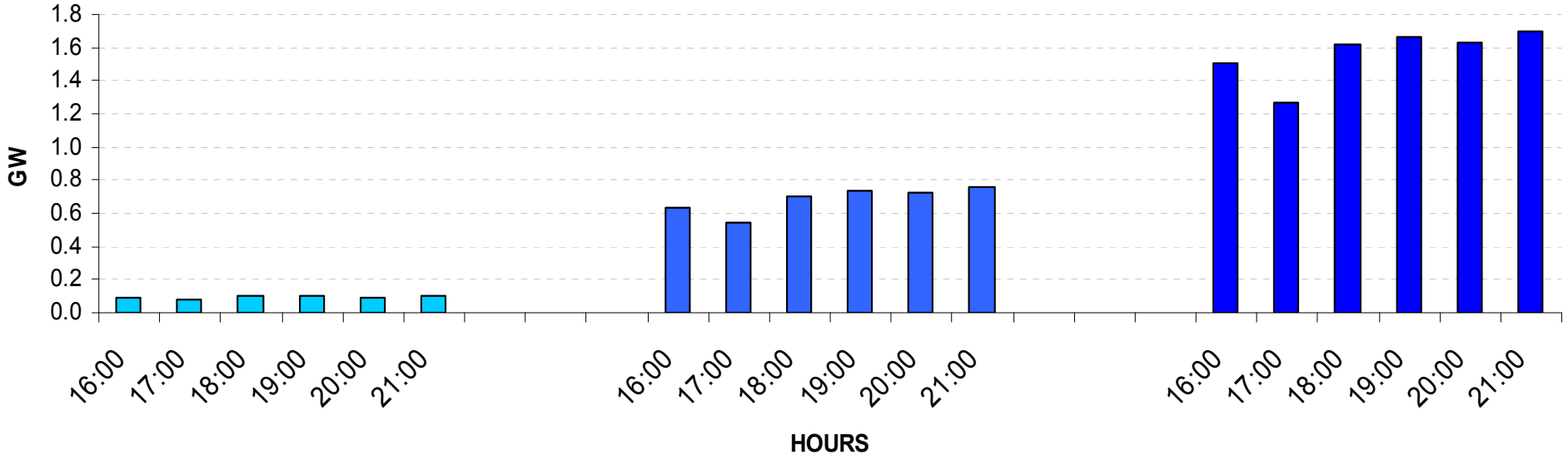
Peak time shiftable demand





Demand Side Management

DSM Highlights

- Wet and Cold Appliances provide the best opportunity for domestic DSM
- Early start date for rollout of this technology is required to overcome large inertia in markets
- No significant effects from shiftable demand before 2030
- DSM Coordination Centre must have holistic view of system

What is the view of DSM as a balancing tool for the network?

Are there any incentives planned to promote domestic load shifting? e.g. TOU tariffs

Does the potential peak reduction, by demand shifting, provide enough incentive for this sector to be developed?

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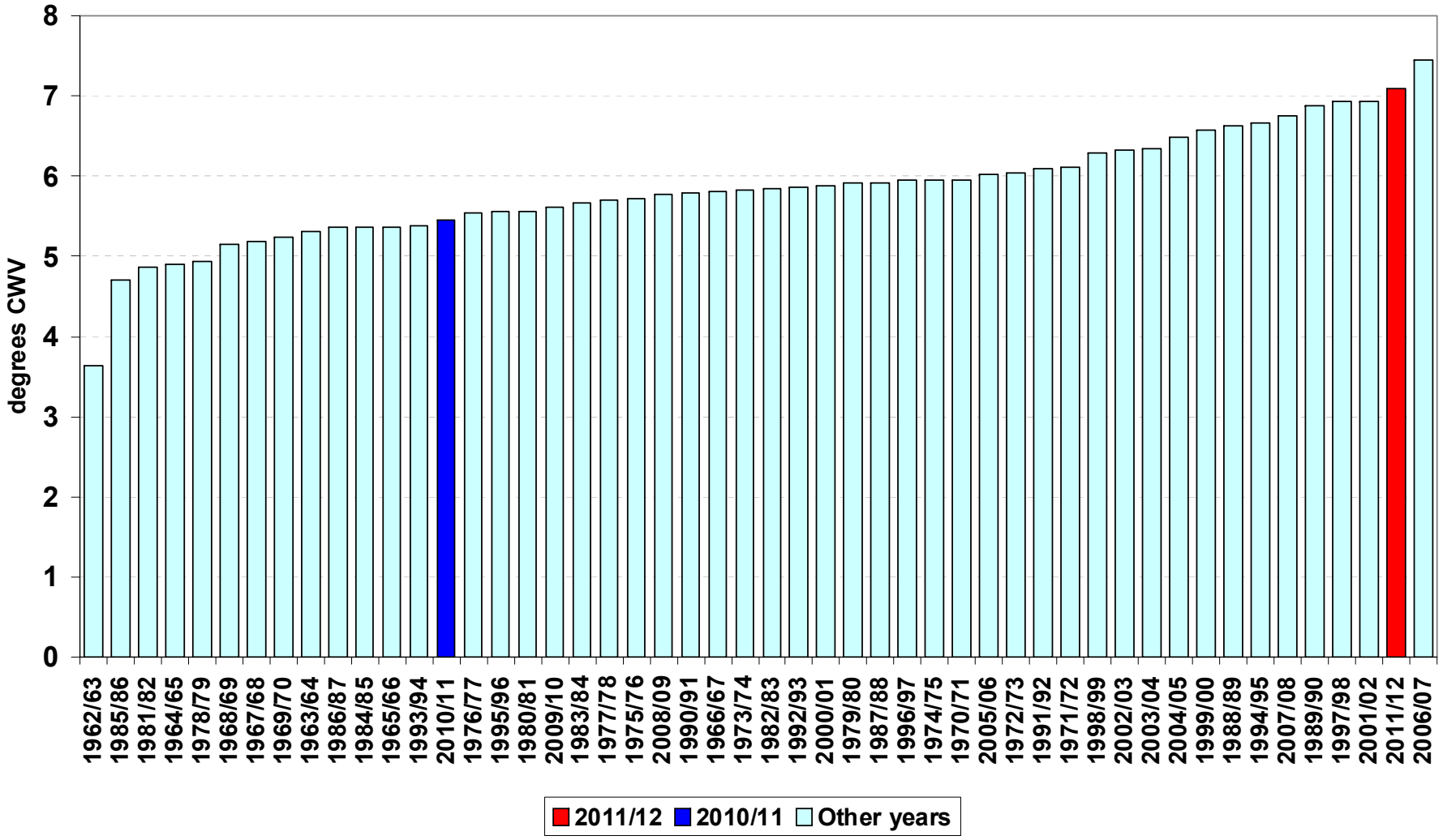
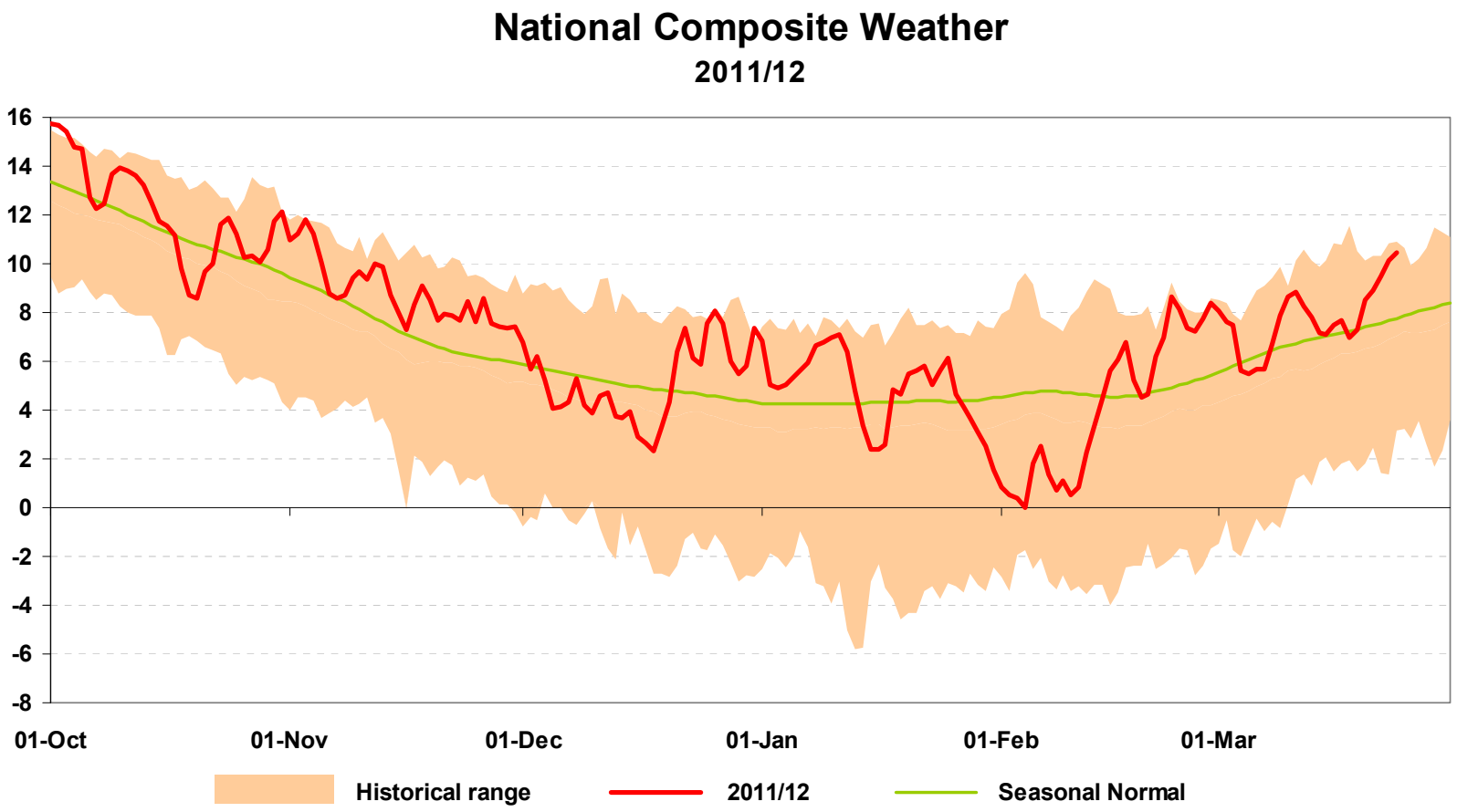
2011/12 Winter Review

Mean Composite Weather Variables

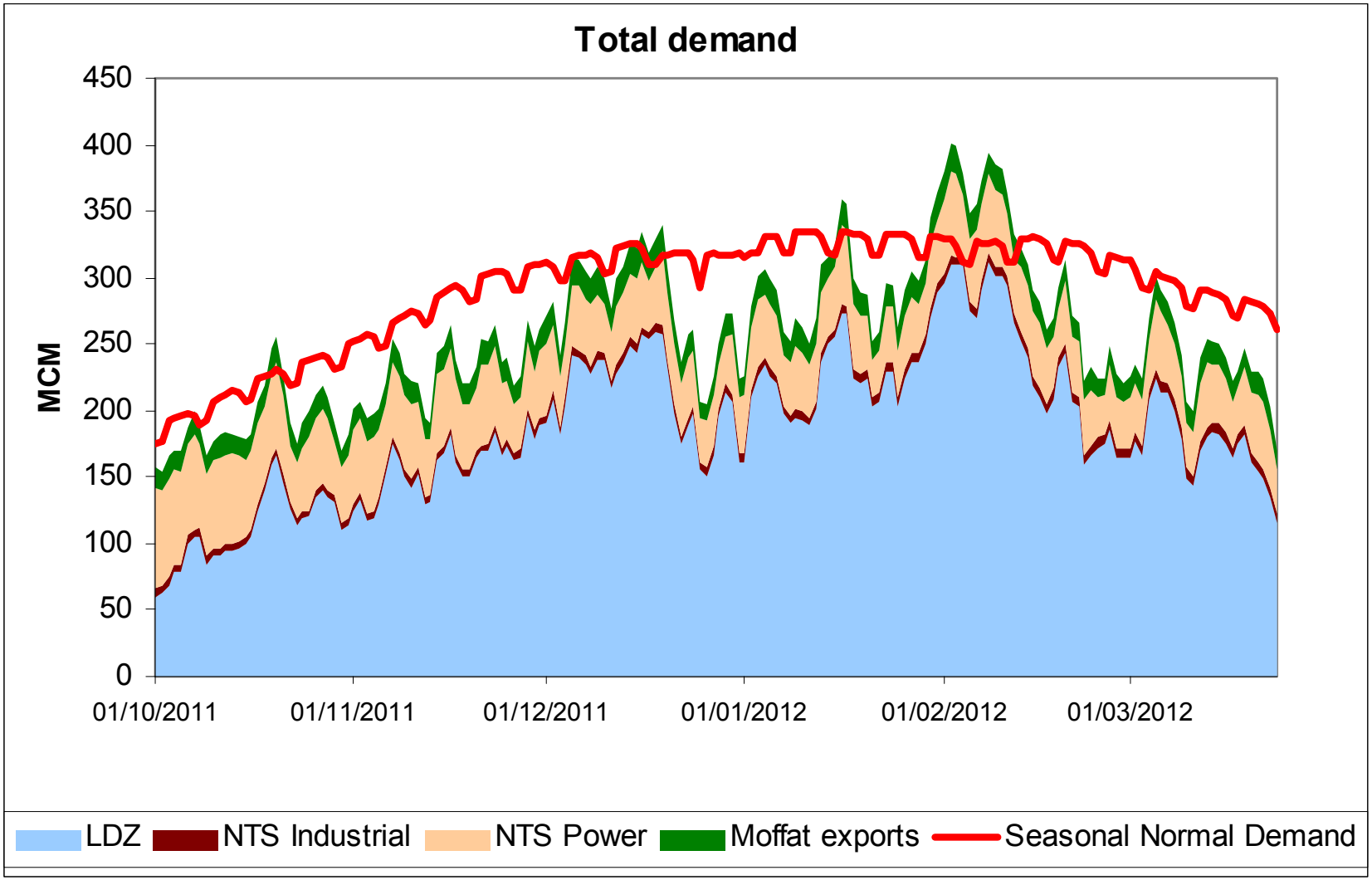
Oct 2011 to March 20th 2012 Vs Previous Yrs.



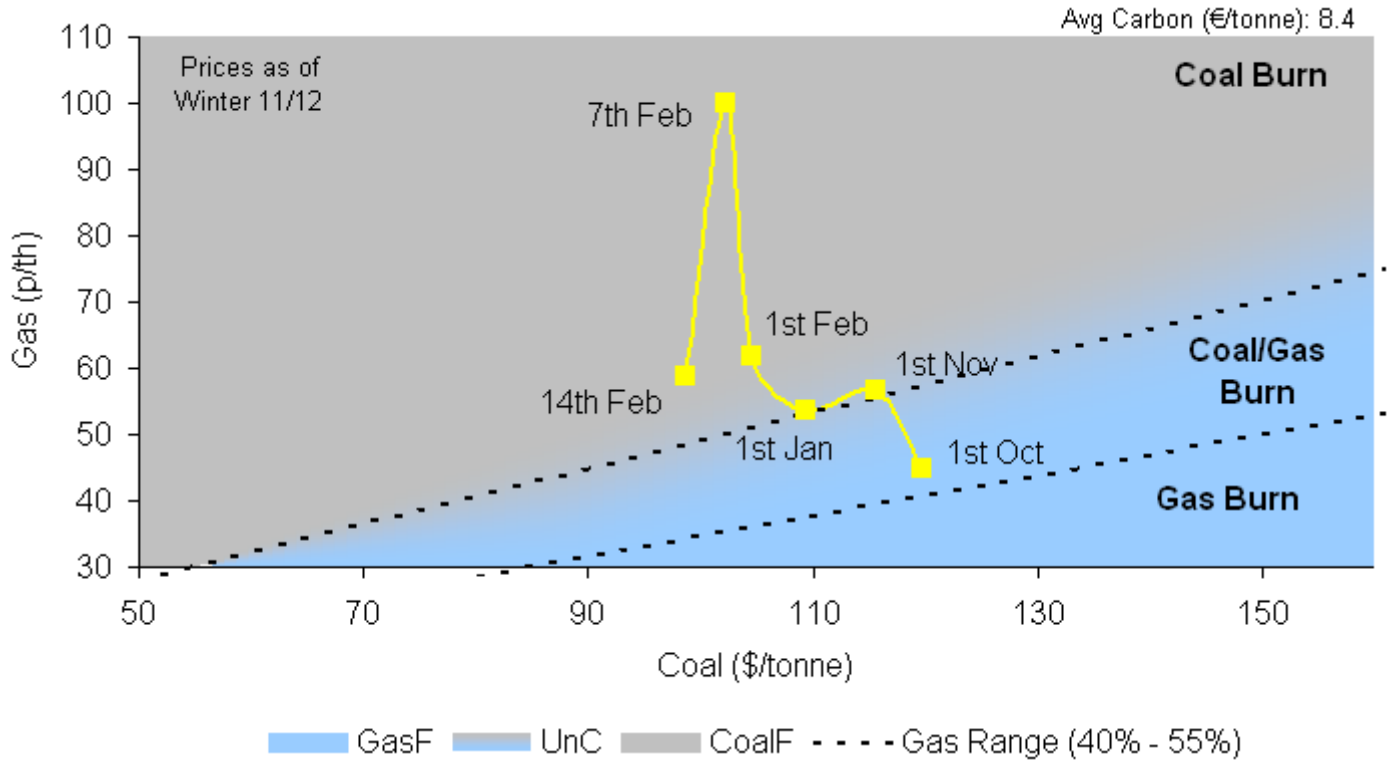
Weather


National Composite Weather
2011/12
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
01-Oct
01-Nov
01-Dec
01-Jan
01-Feb
01-Mar
Historical range
2011/12
Seasonal Normal

Winter 2011/12 gas demand

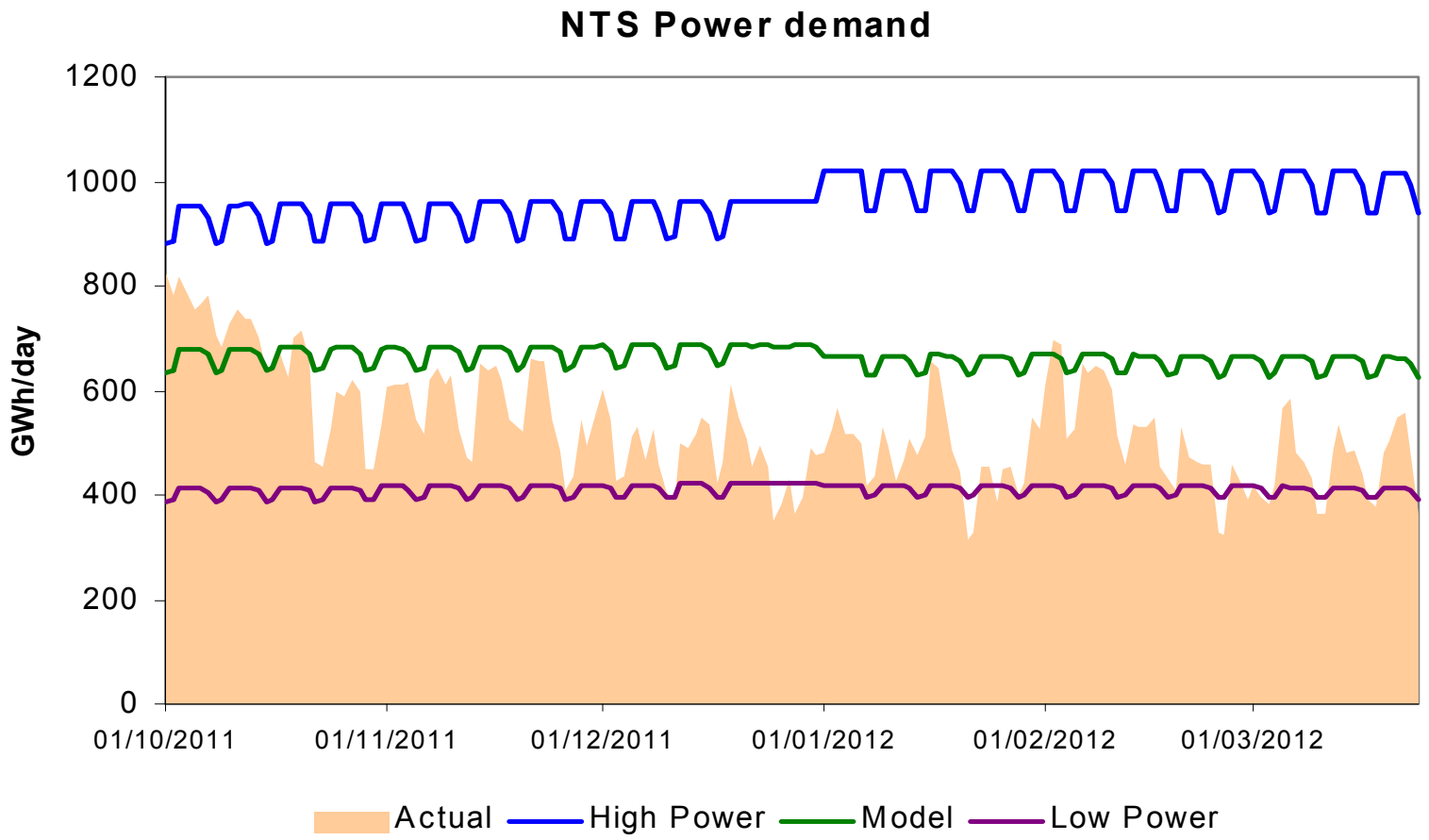


Coal / Gas price; Winter History

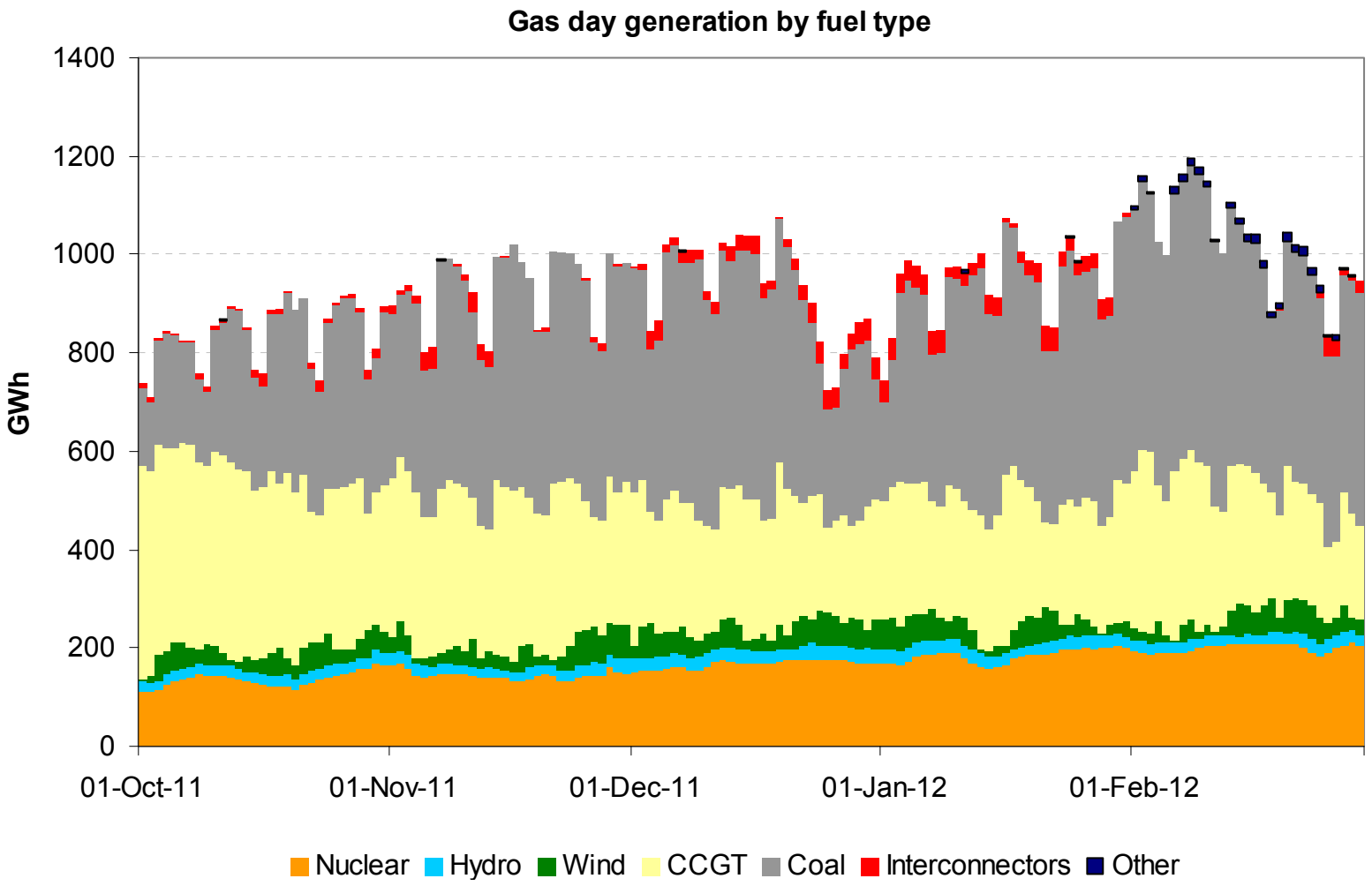


NTS power generation

With low LDZ demands why has there been no fall in gas prices so that more gas is used in power generation?



Winter 2011/12 power generation



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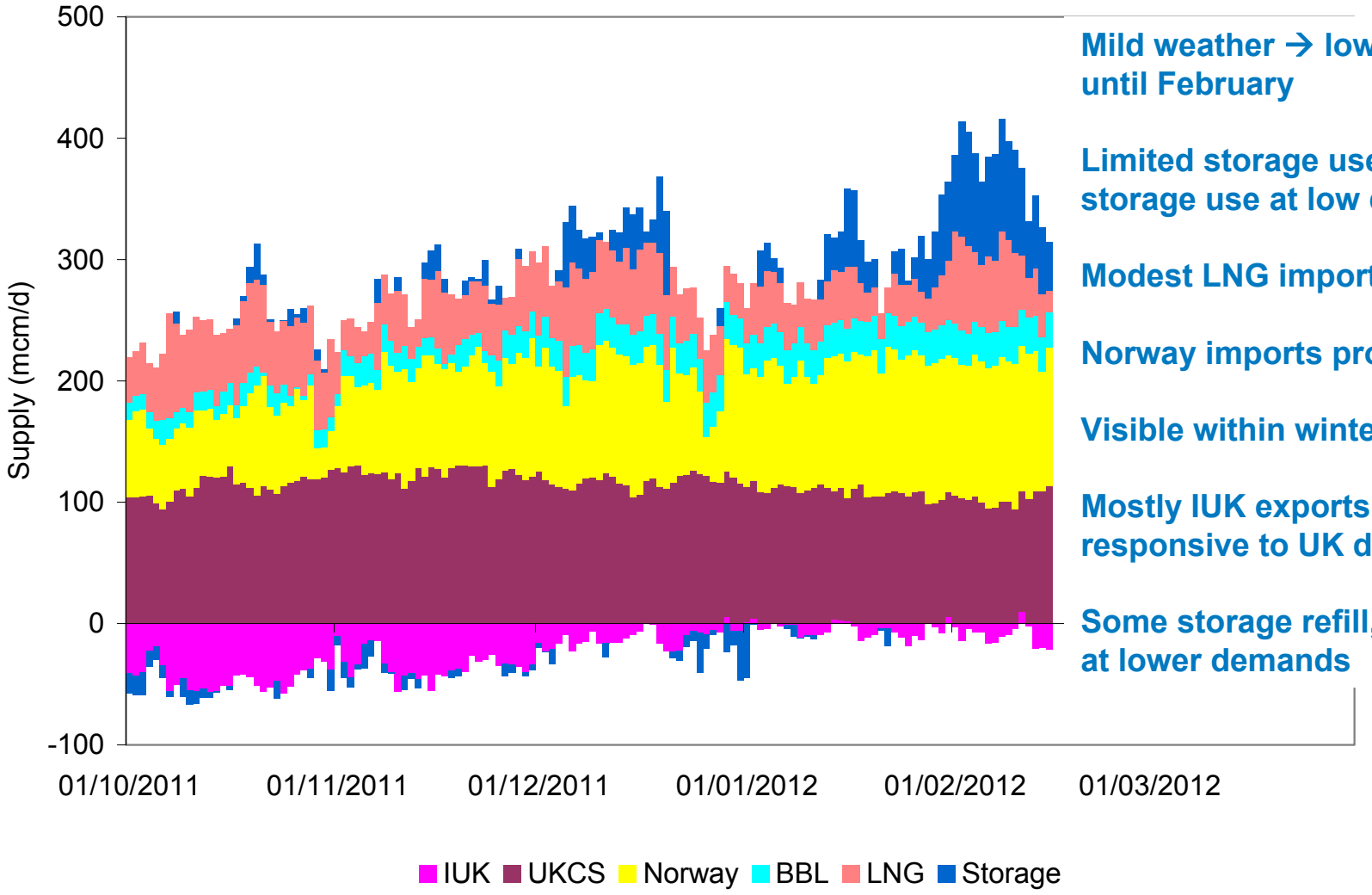
Winter 2011/12 supplies



Mild weather → low demands until February

Limited storage use despite storage use at low demands

Modest LNG imports

Norway imports provide 'swing'

Visible within winter UKCS decline

Mostly IUK exports, though responsive to UK demand

Some storage refill, notably at lower demands

‘What if’ Winter 2011/12 analysis

- Consequences of higher gas demand through colder weather or more gas burn for CCGTs
- Starting position based on observed relationships for this winter:
  - Swing provided mostly from storage, Norway and lower IUK exports
  - Limited / No demand response from UKCS, BBL and LNG
- Optimised position:
  - Storage use reserved for higher demands
  - LNG more responsive to demand (no more cargoes)
- How much extra demand could have been met?
  - NDM demand associated with severe weather
  - Or high power generation
  - **BUT NOT BOTH TOGETHER!**

Options to meet higher demands

- Need to attract more LNG
  - Higher UK gas prices to compete with Far East
  - More contracted gas
- Higher IUK imports / lower exports
  - UK gas prices above those on Continent (above oil indexation)
- Demand Side Response (DSR), notably from power sector

Longer term needs?

More storage

More import capacity

Supply diversity

More contracts

What if UK Demands had been higher?

Could the UK have attracted more LNG?

Would IUK behaviour have different?

How much Demand Side Response could there have been?

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Gas Supply

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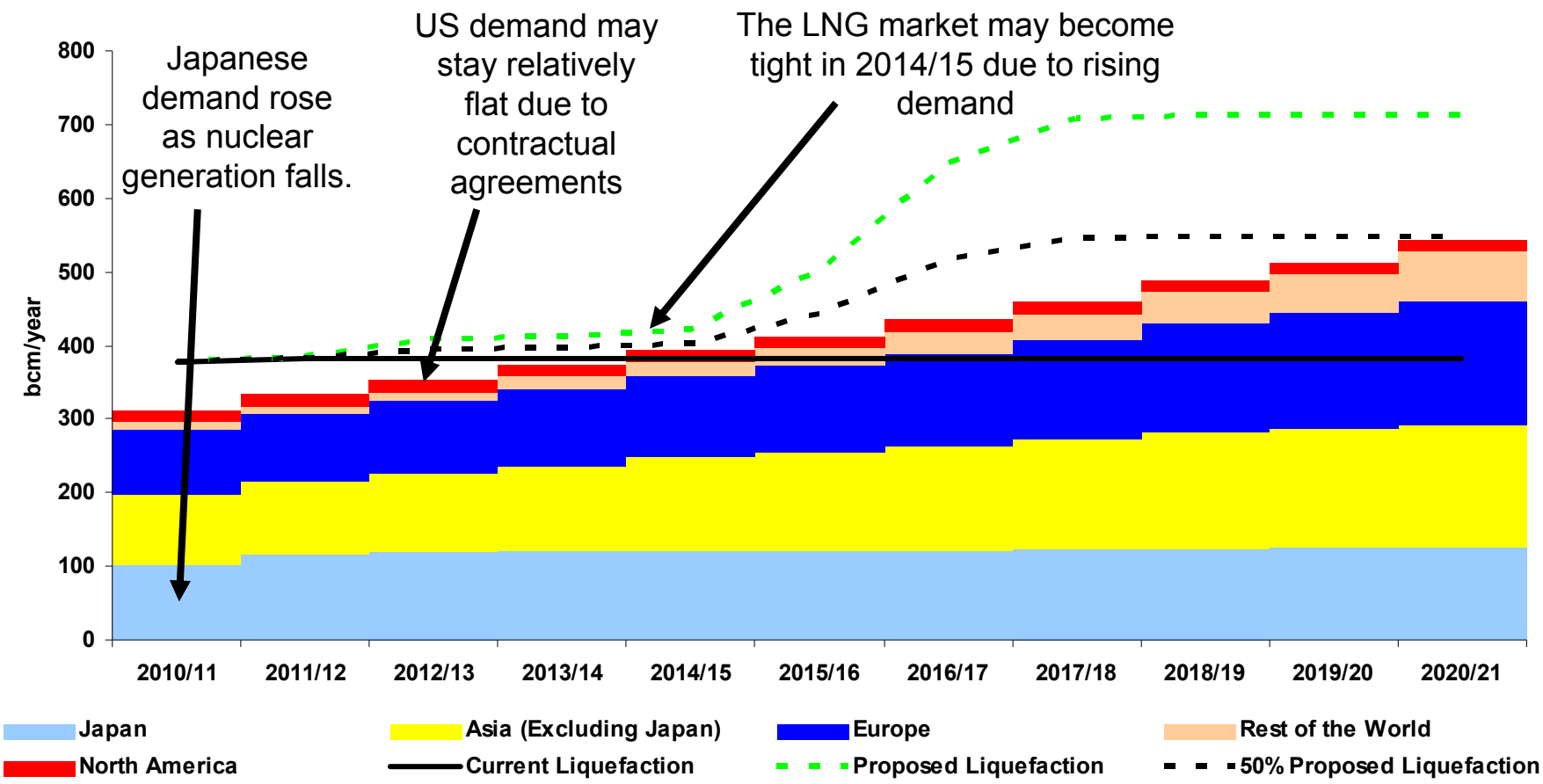
Future LNG Supply and Demand



What are the key influences on future global LNG demand?

Where do you expect future liquefaction capacity to be built?

LNG Supplies to the UK by Country of Origin

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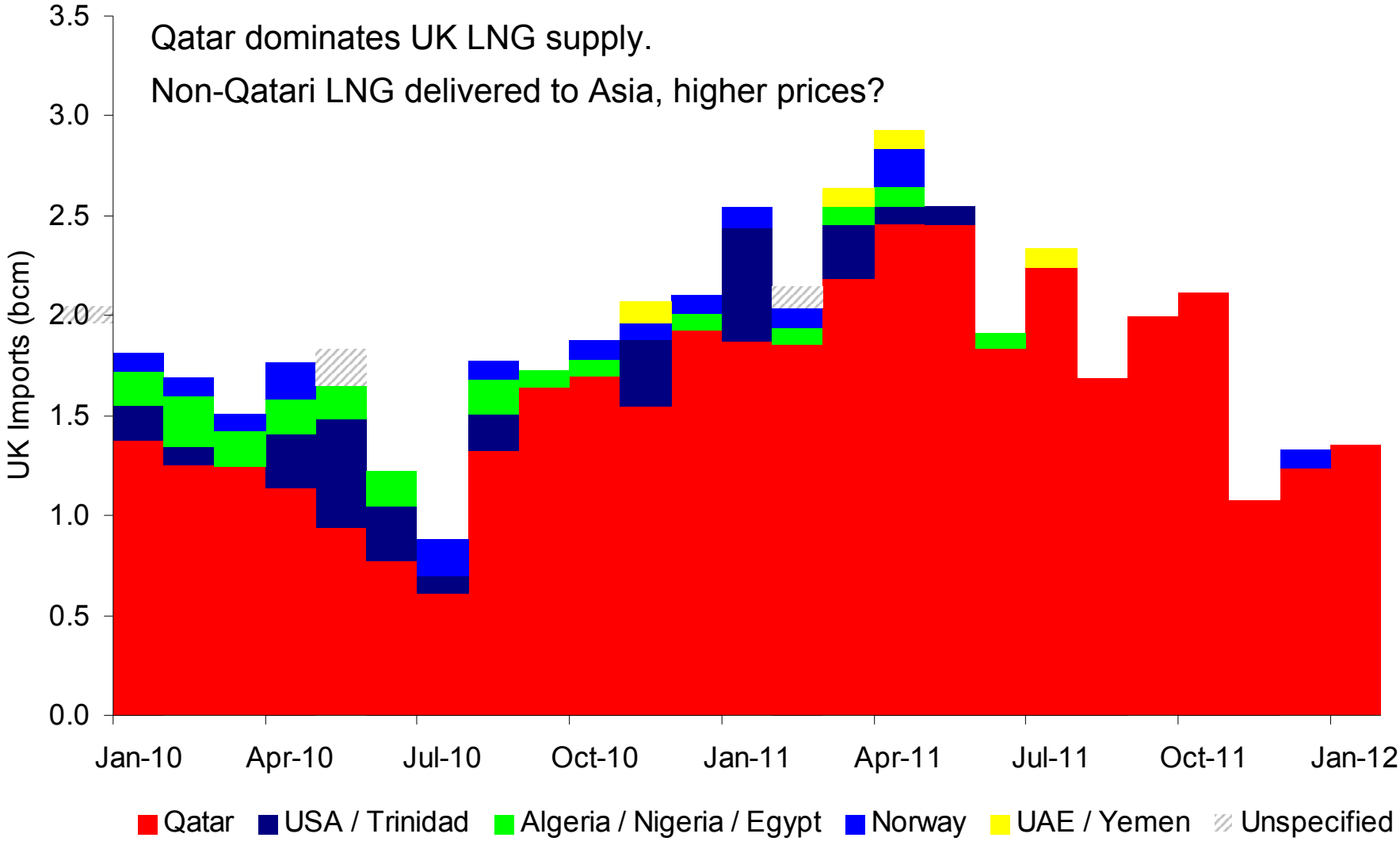

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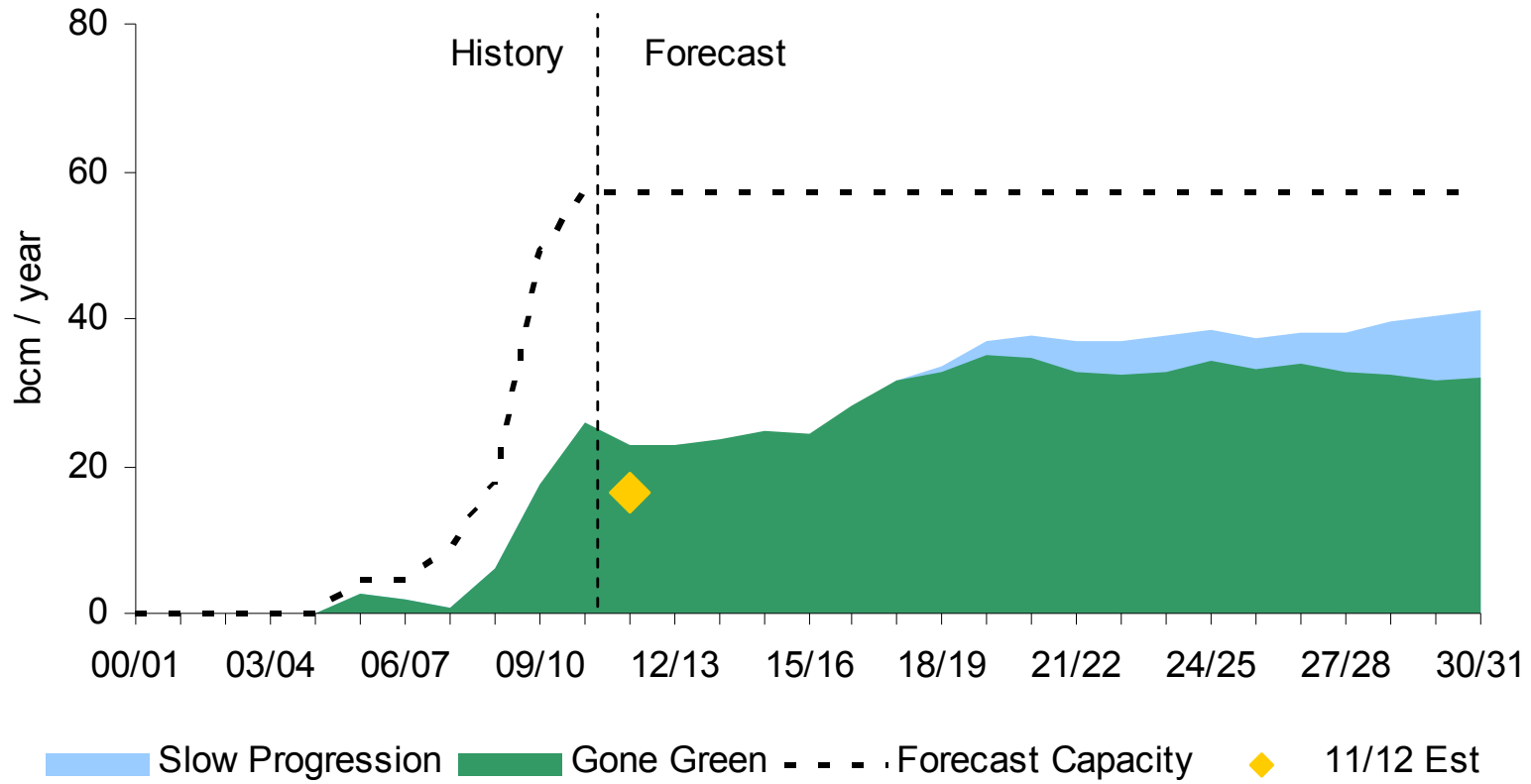
UK LNG Import Scenarios



Can the UK import the required LNG without long term contracts?

How can the UK compete against Asia for spot LNG cargos?

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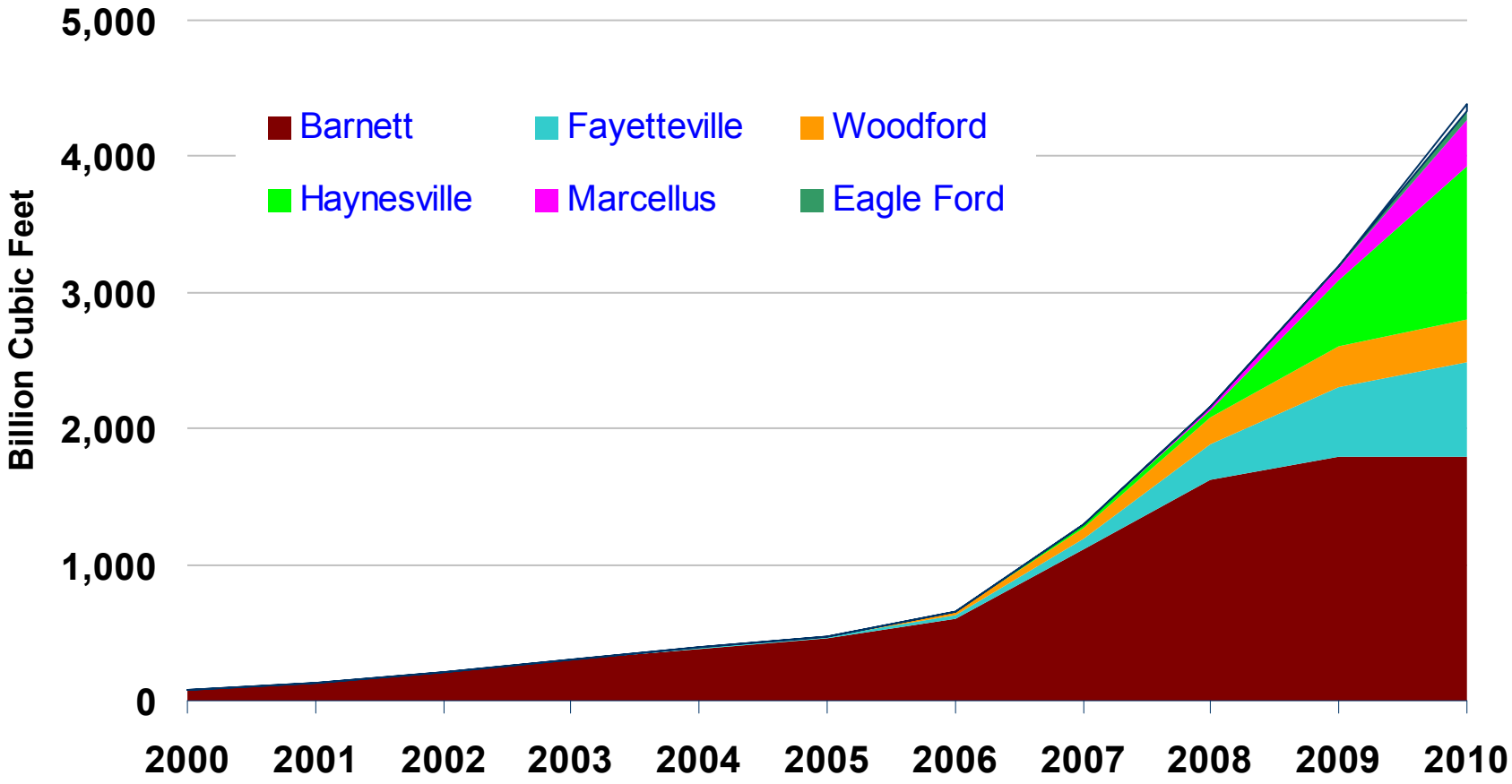
US Shale Production



Source: EIA, Lippman Consulting (2010 estimated)

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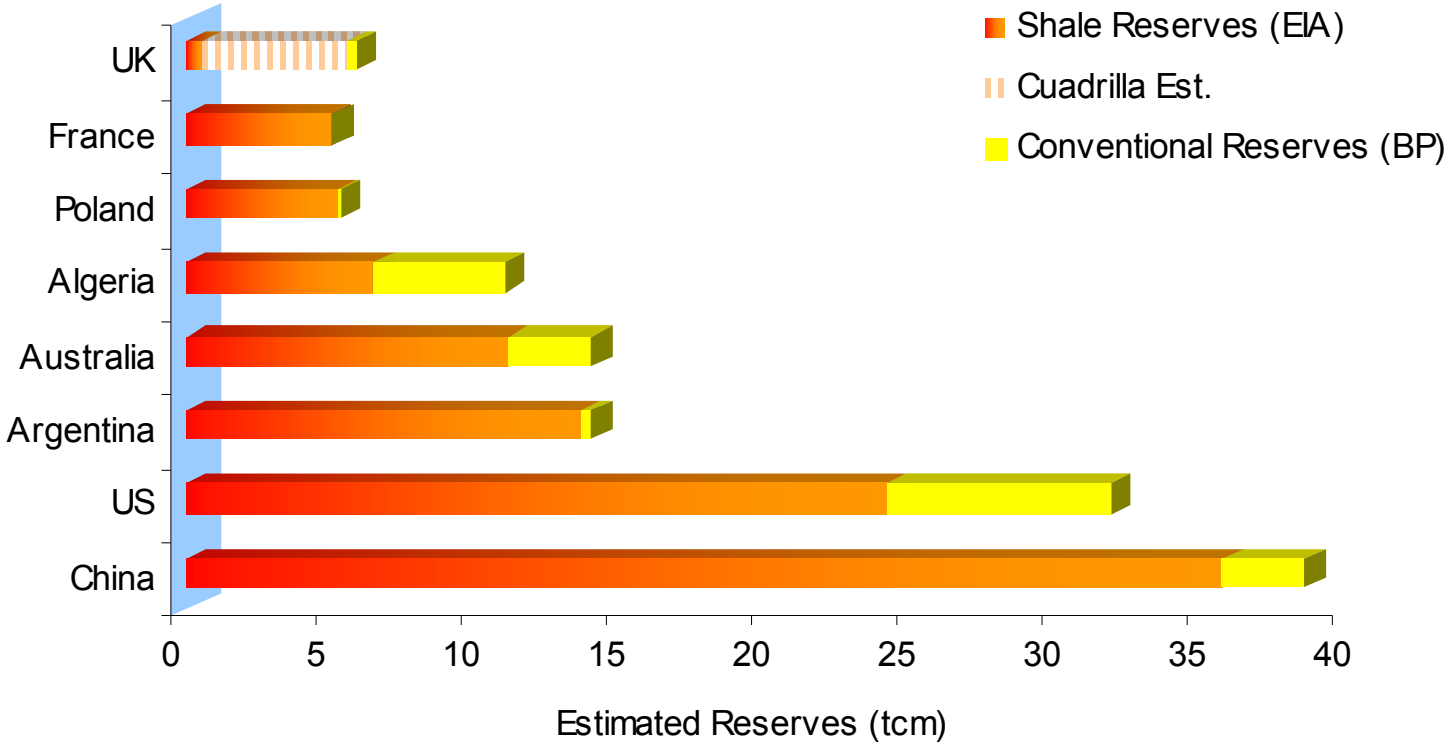
Global Shale Reserves

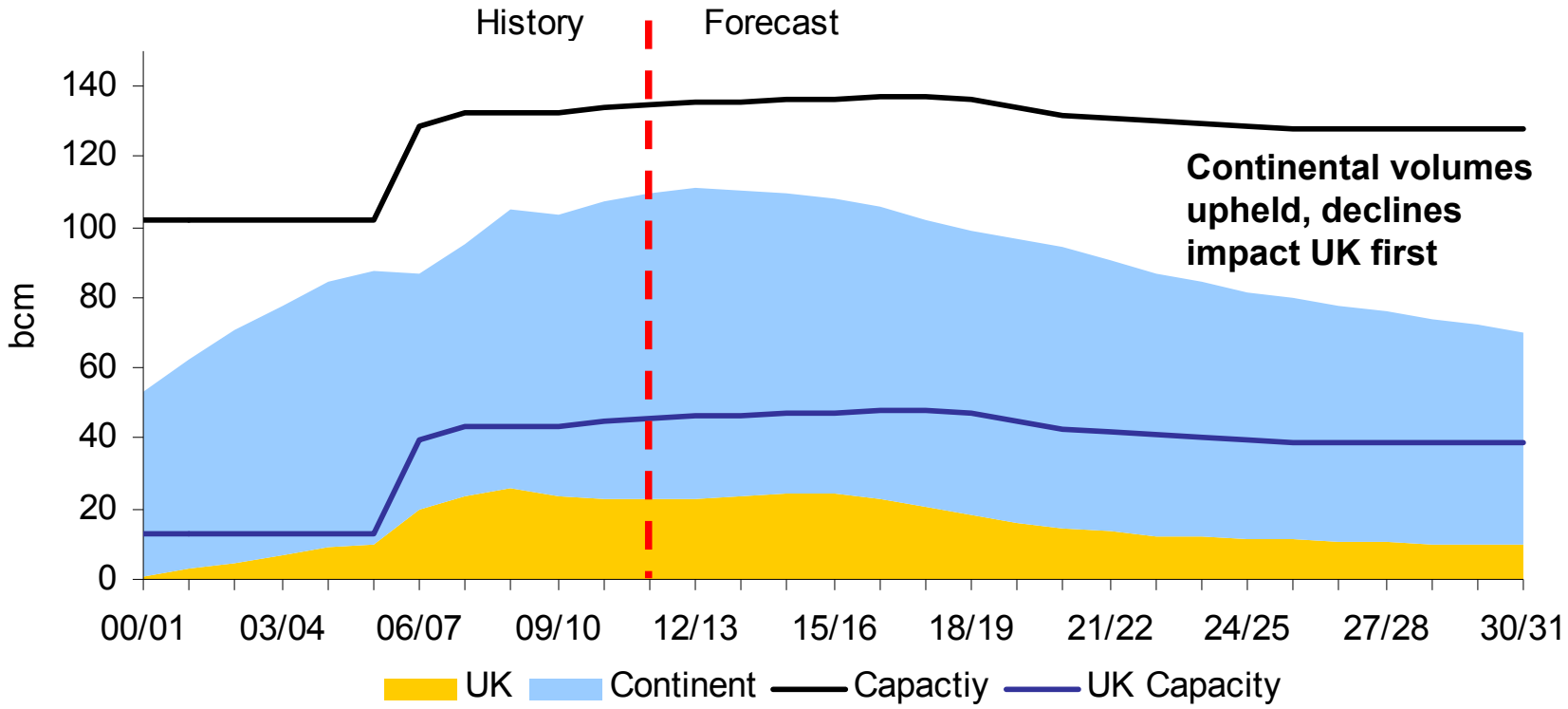


Source: EIA & BP

Besides the US which country or countries do you see producing significant levels of shale gas?

How influential do you see unconventionals being on the European gas market?

Norwegian Supply Forecast



Do you agree with our forecast of a plateau followed by a gradual decline for Norwegian production?

Do you agree that the lack of contracts will see the UK flows reduce more quickly as production declines?

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Continental Supplies

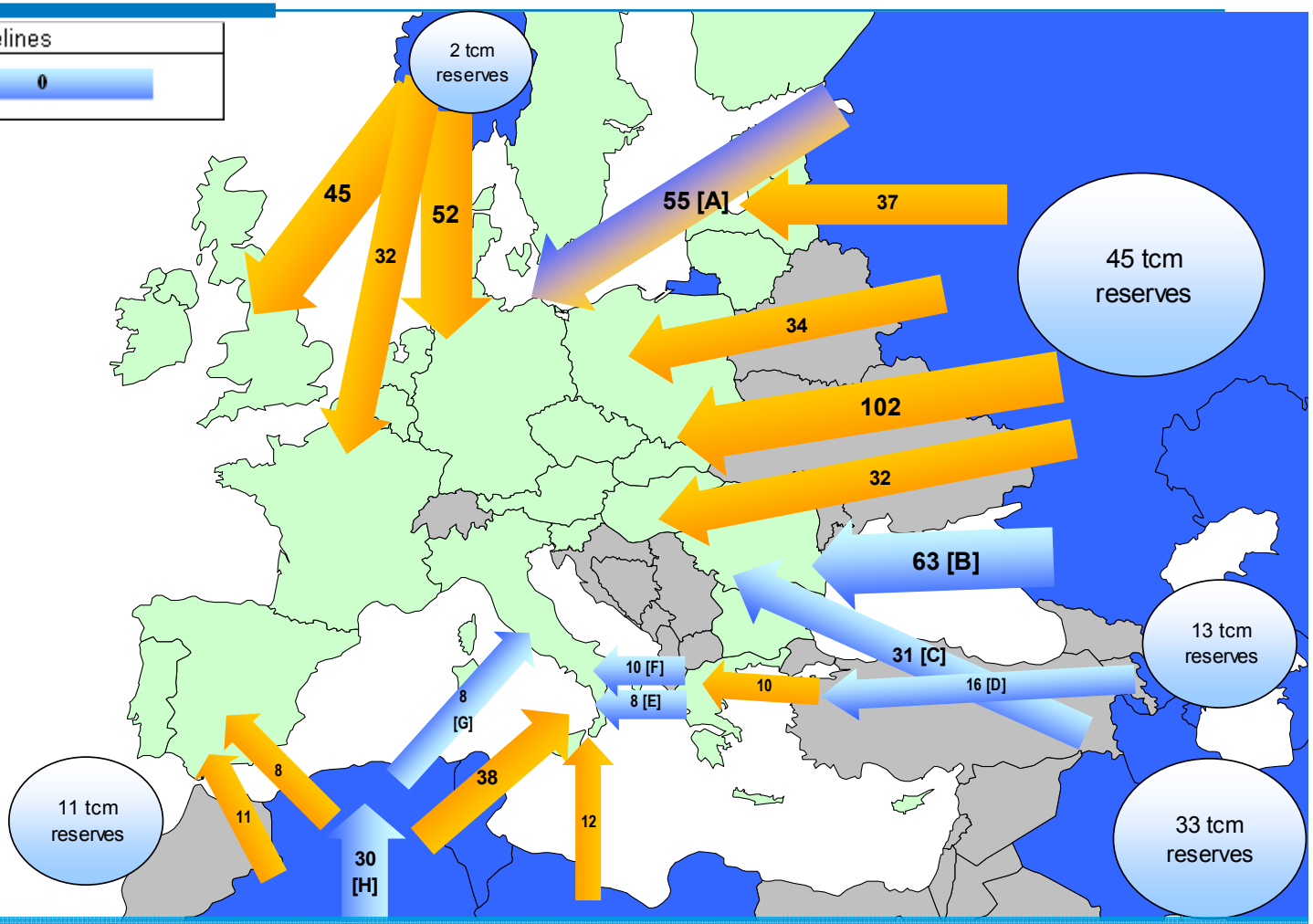
Existing Routes	New Pipelines
0	0

Norway: No new projects expected

Russia: Nord Stream completed end 2012, South Stream FID 2012?

Caspian: Shah Deniz Export route decision 2013

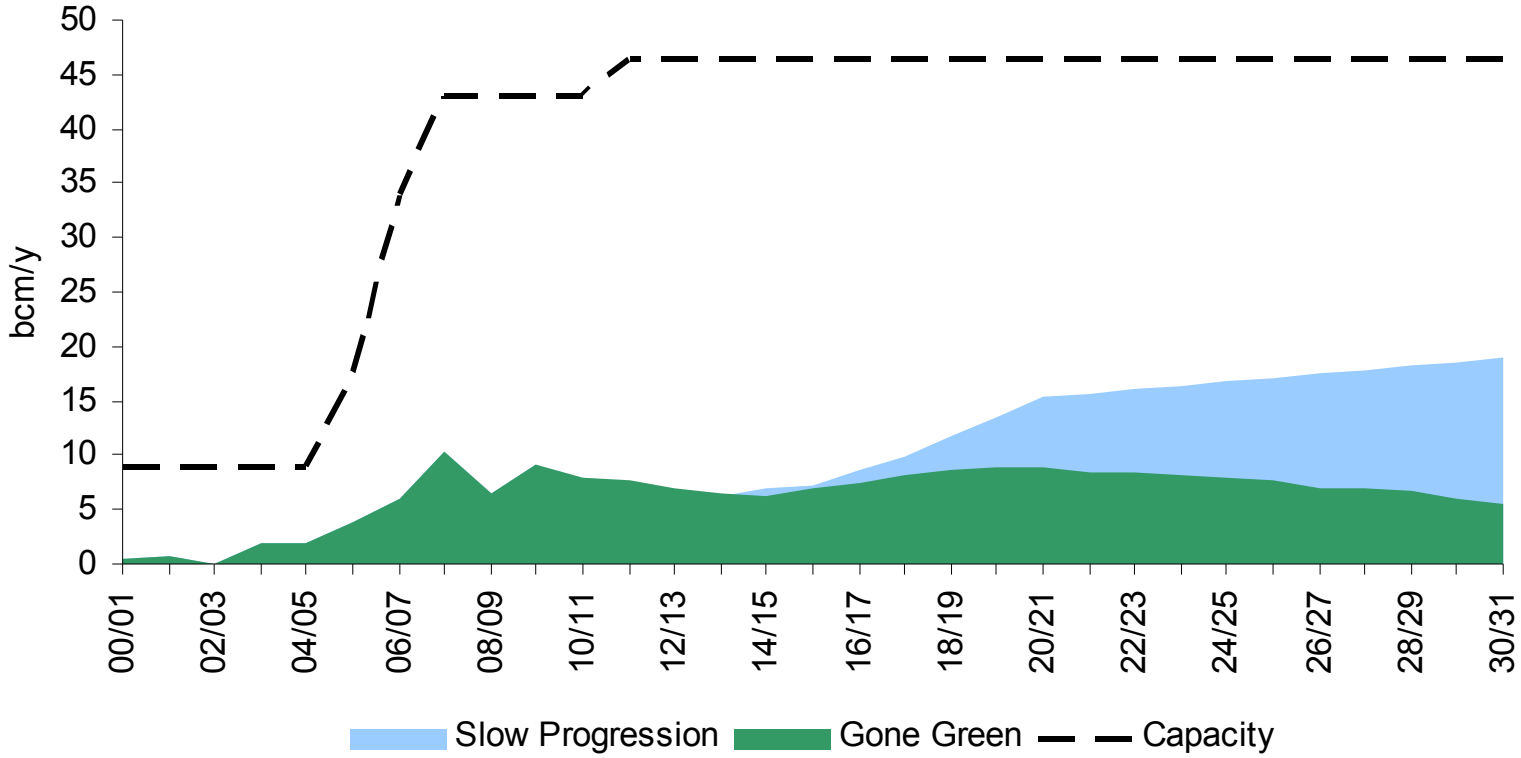
North Africa: Uncertainty over additional routes



Which of the proposed import projects do you see as most likely to proceed?

To what extent do you see continental supply/storage markets liberalising?

UK Continental Supply Scenarios



Volumes dominated by BBL flows

Exports reduce over period but IUK remains net exporter

How can the UK obtain higher volumes from Continental Europe?

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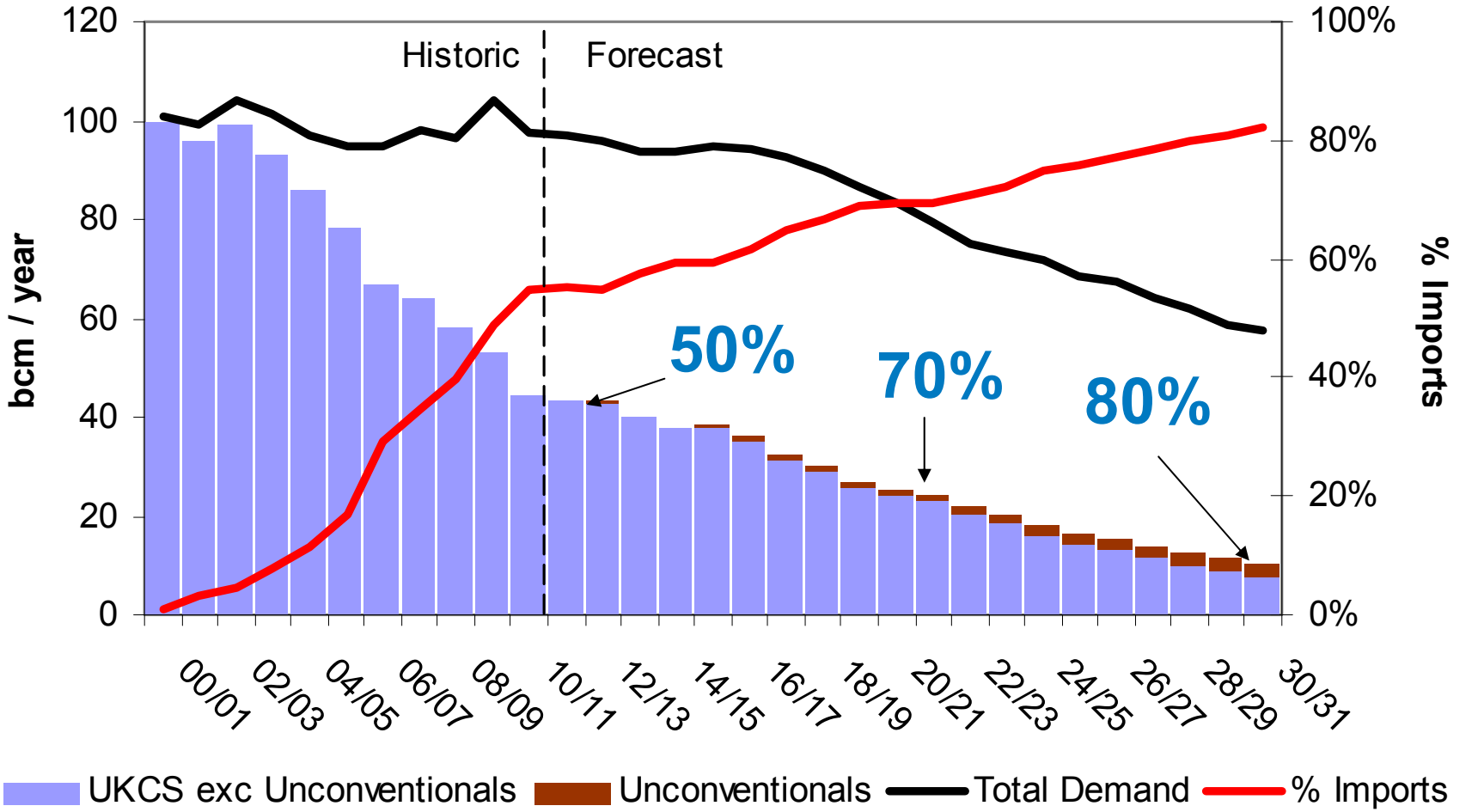
UKCS Forecast

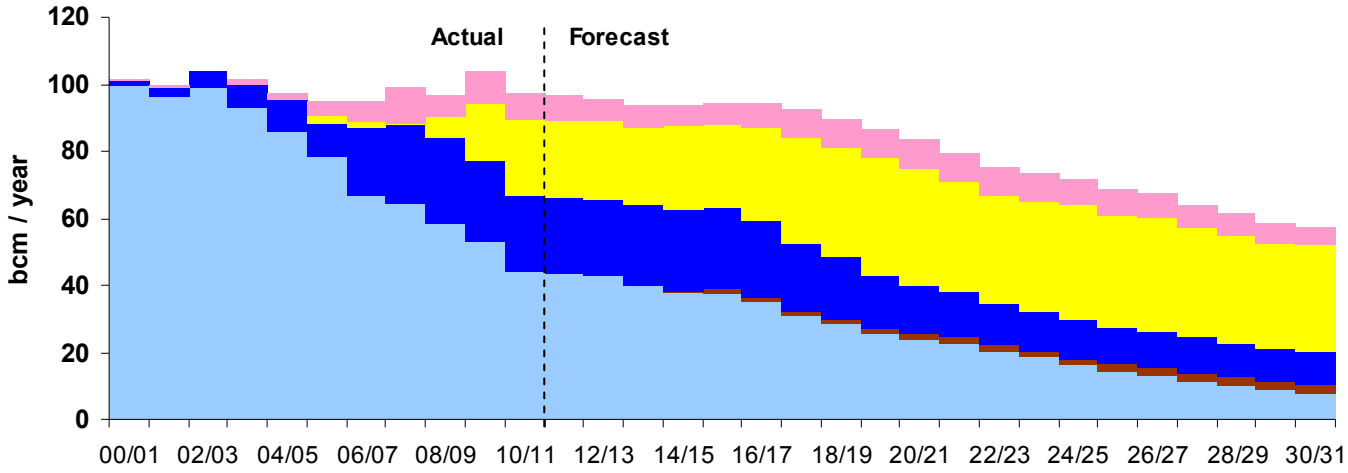


Does our overall UKCS decline story seem reasonable?

What are your views on UK unconventional gas? (CBM/Biogas/Shale)

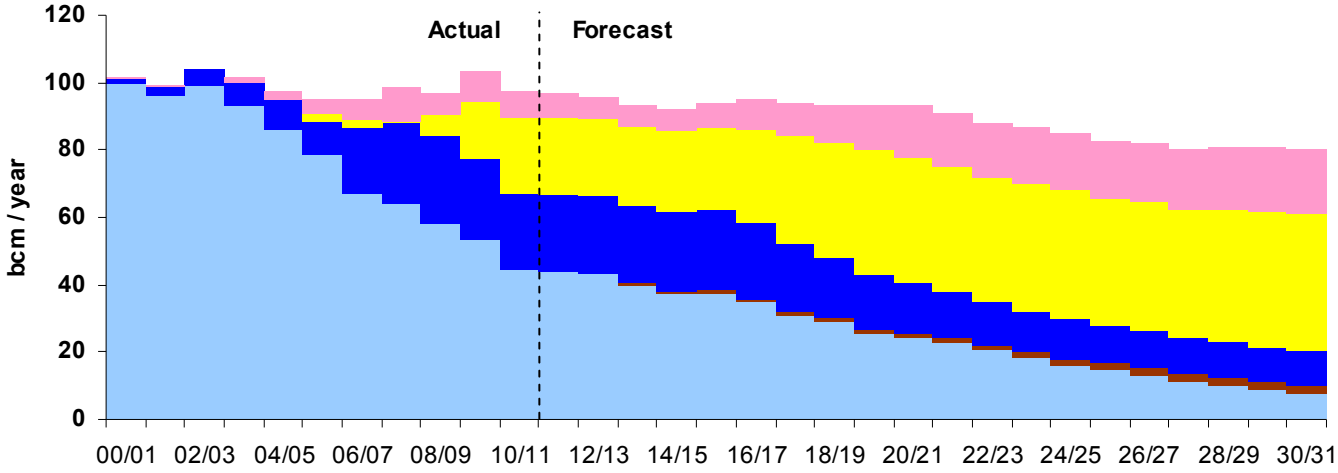
Supply Forecasts

Gone Green



Gone Green

Slow Progression



Slow Progression

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Overall (only for light version)

Is LNG is the most likely source to fill the supply gap?

Could unconventional gas make a bigger contribution to UK supply in the forecast period?

Overall (only for light version)

Is LNG is the most likely source to fill the supply gap?

Could unconventional gas make a bigger contribution to UK supply in the forecast period?

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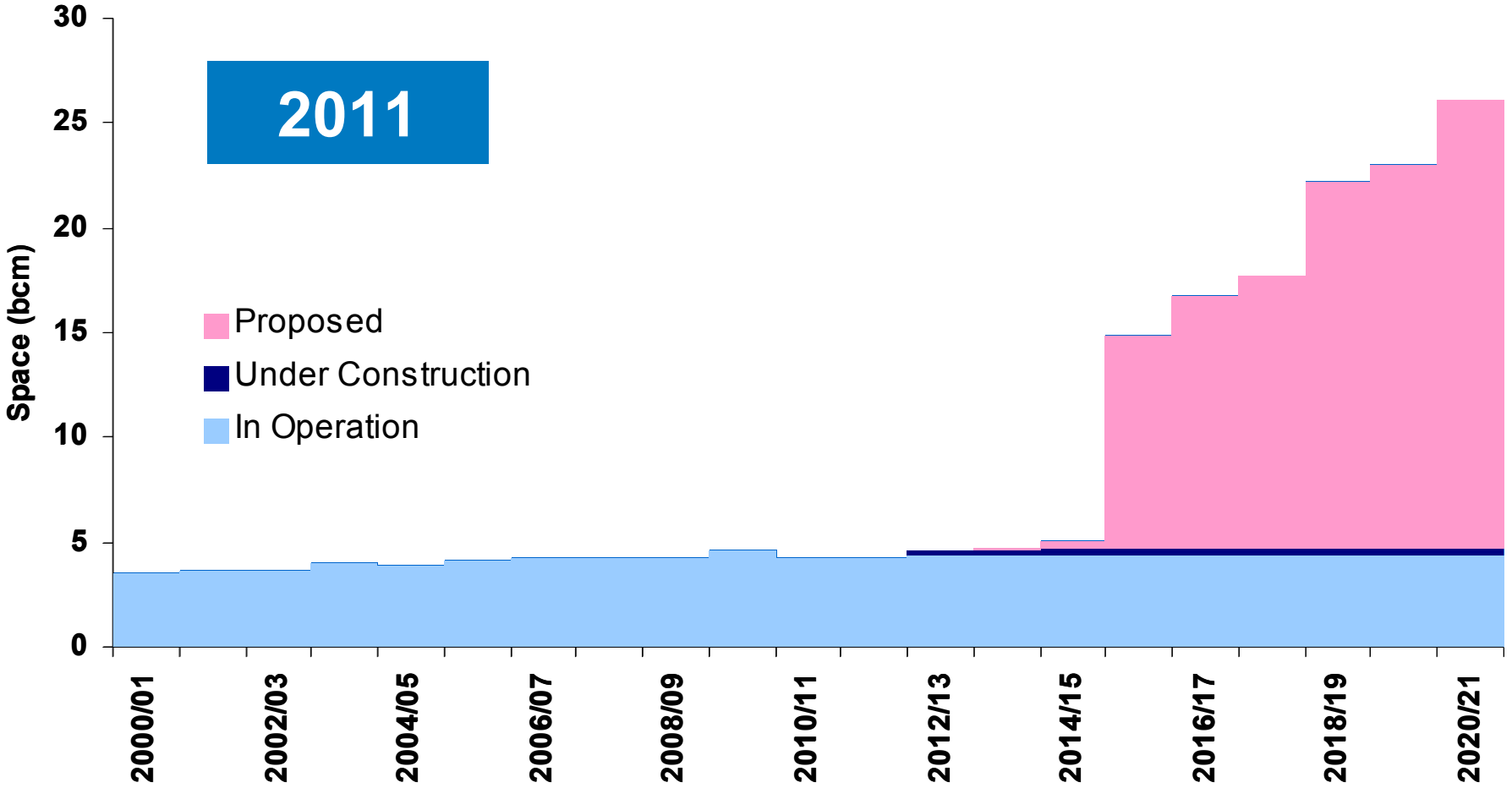
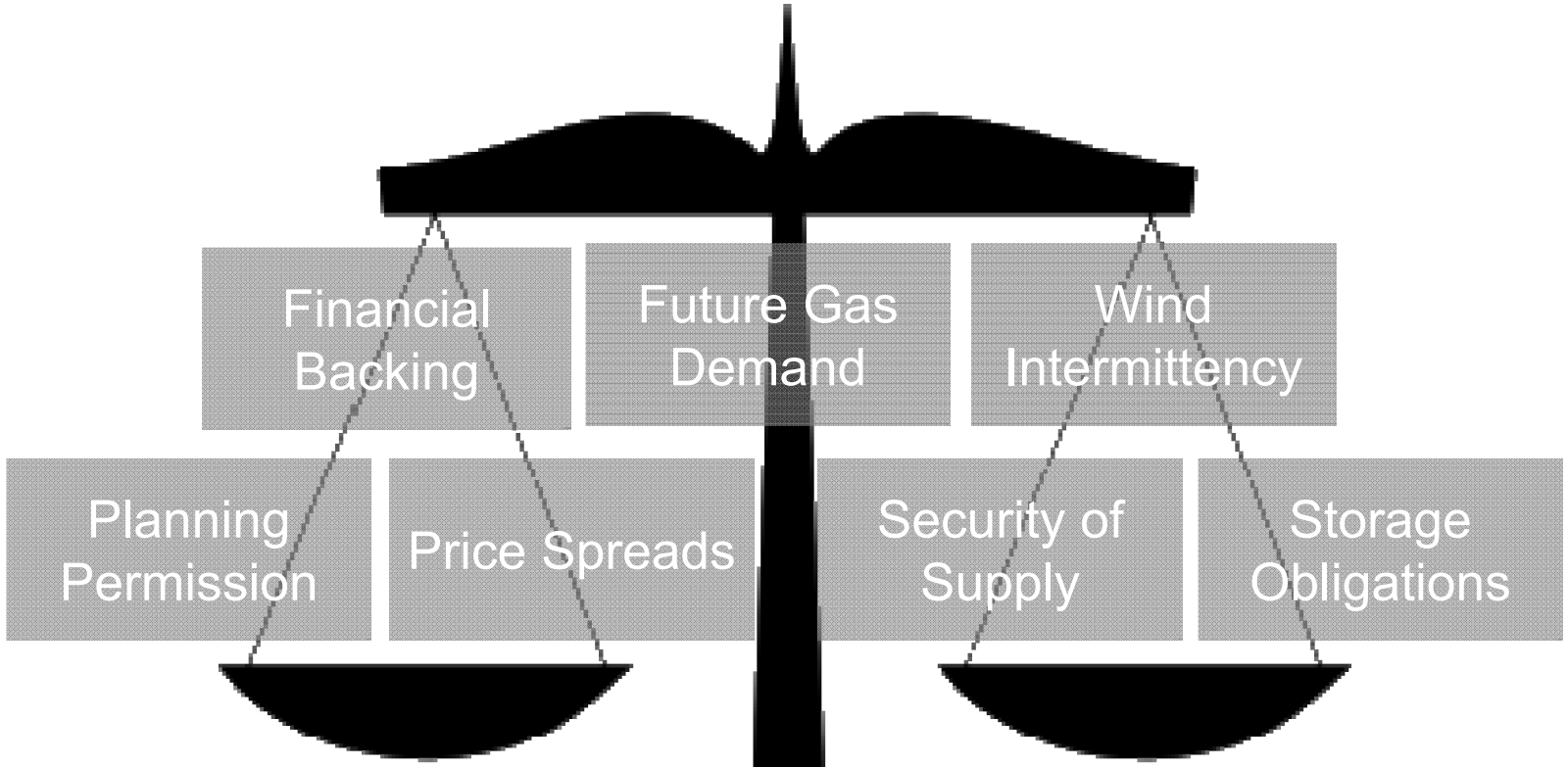
Gas Storage

Proposed Storage



Factors affecting new storage



What are the main drivers that will lead to more UK storage developments?

How important will the role of storage be to cover for wind intermittency?

Should there be storage obligations on the UK gas market?

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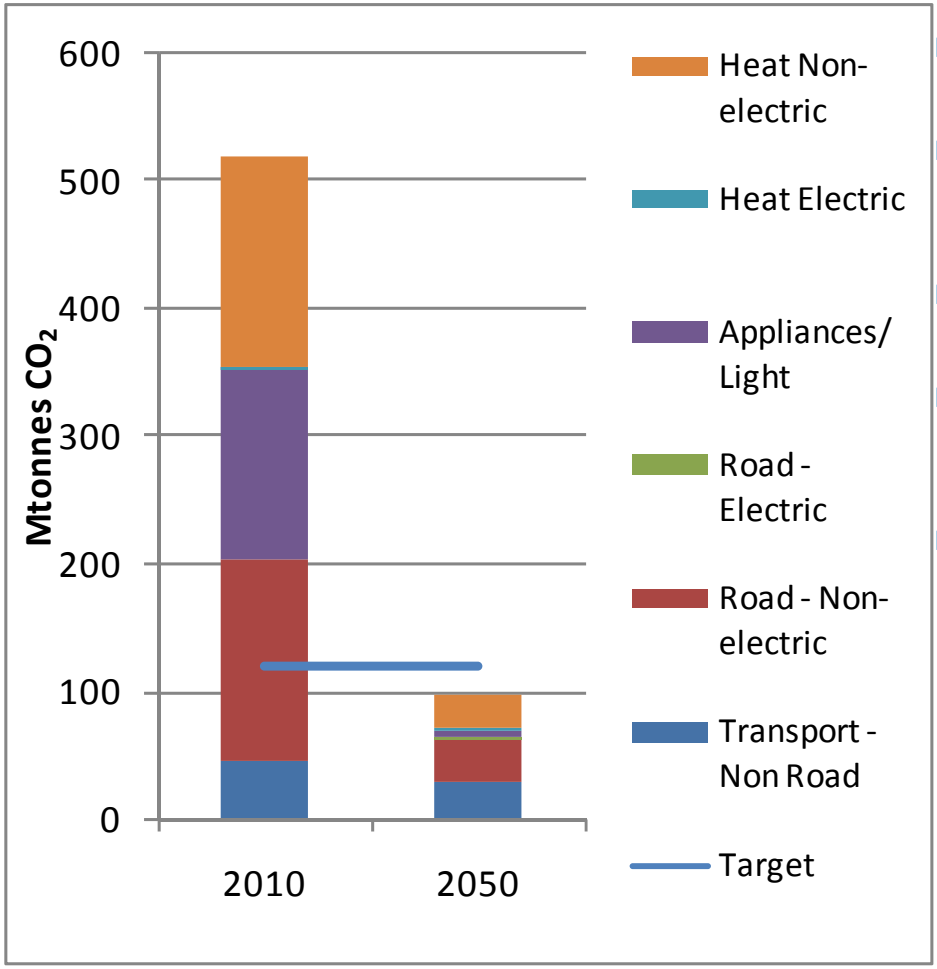
2050 Story

The 2050 Challenge



- Aim is to reduce emissions from 505M tonnes to 118M tonnes
- Aviation emissions drop slightly as biofuel is diverted to air as electricity replaces petrol in cars and LGVs.
- All sectors emissions greater than 118M tonnes – need to take action on all.
- Emissions reduce to 96Mtonnes in Gone Green scenario as agricultural emissions are not modelled
- Some consumption reduction is assumed but can hit target if don't reduced consumption – but at additional cost

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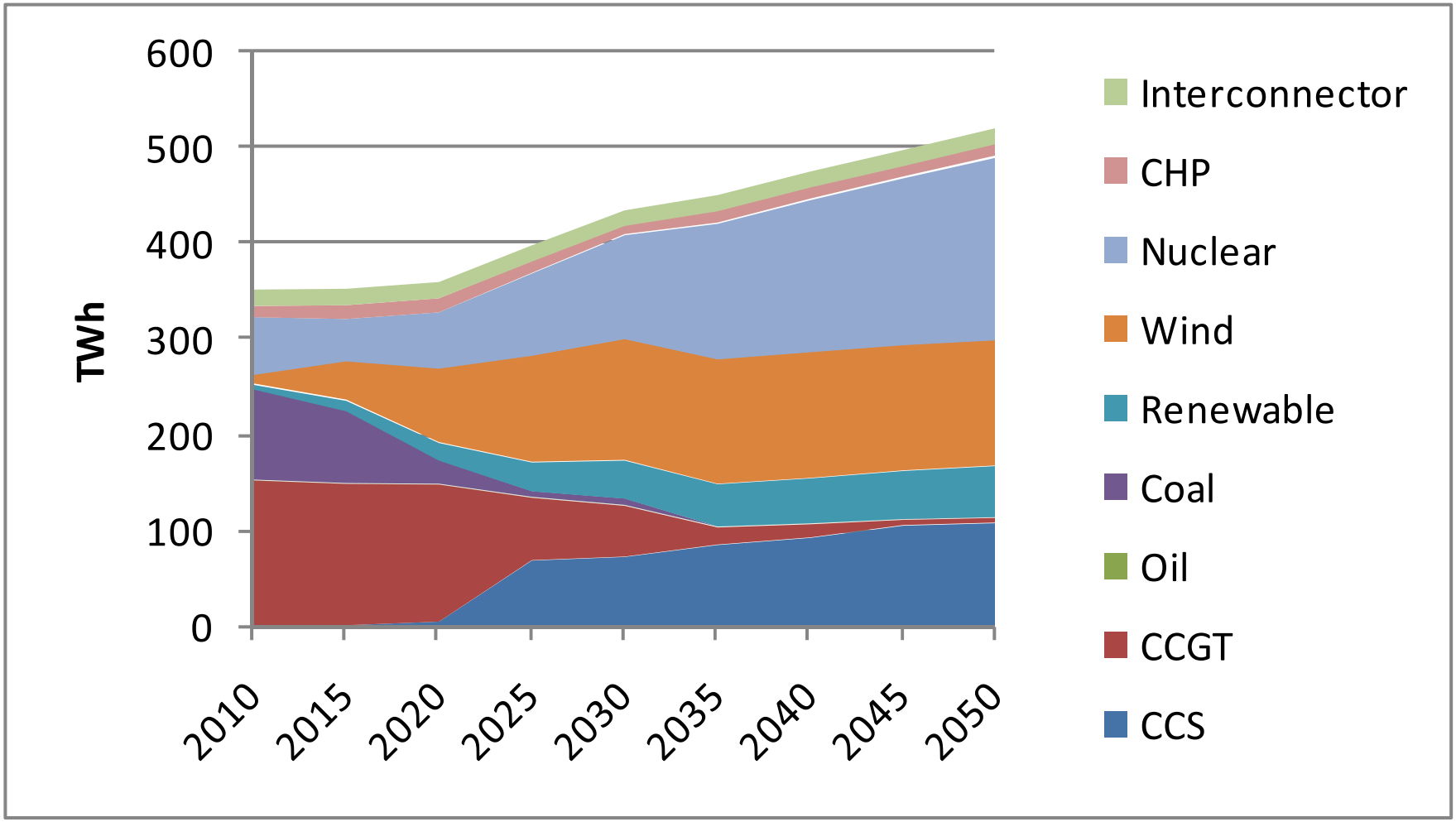
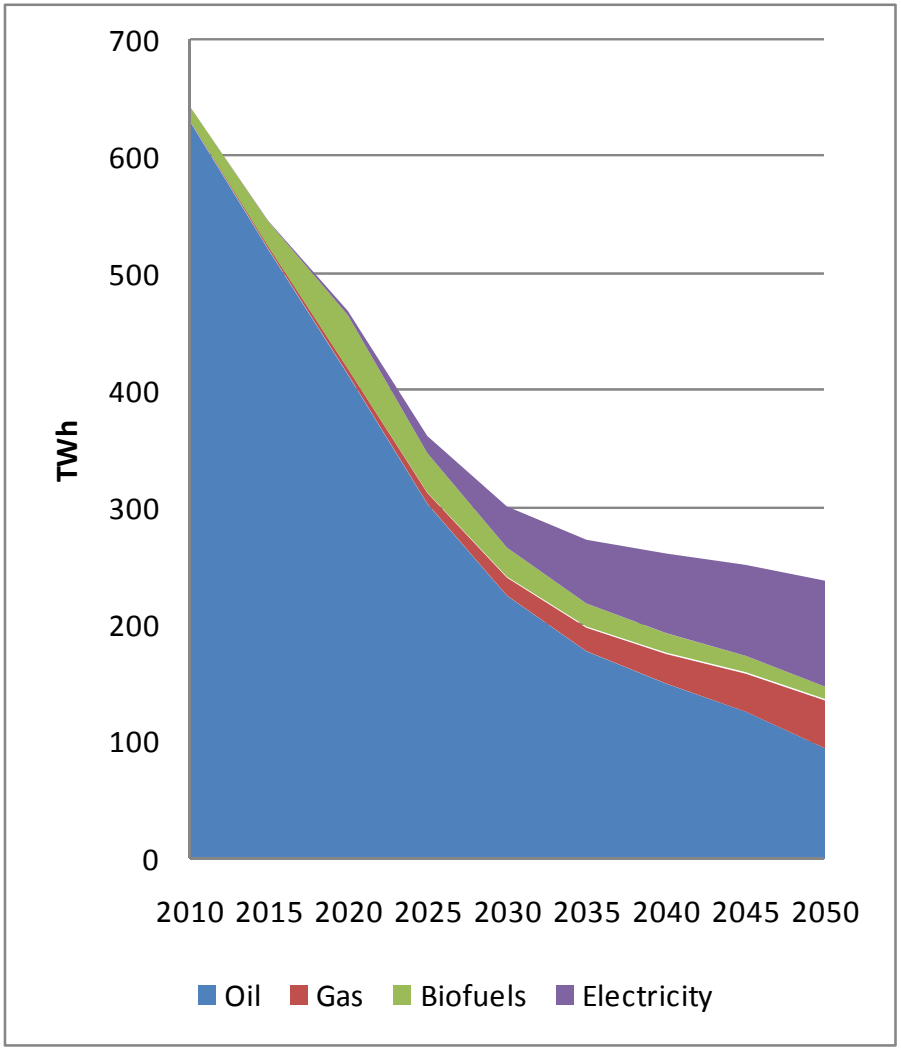
Electricity Profile 2010-2050

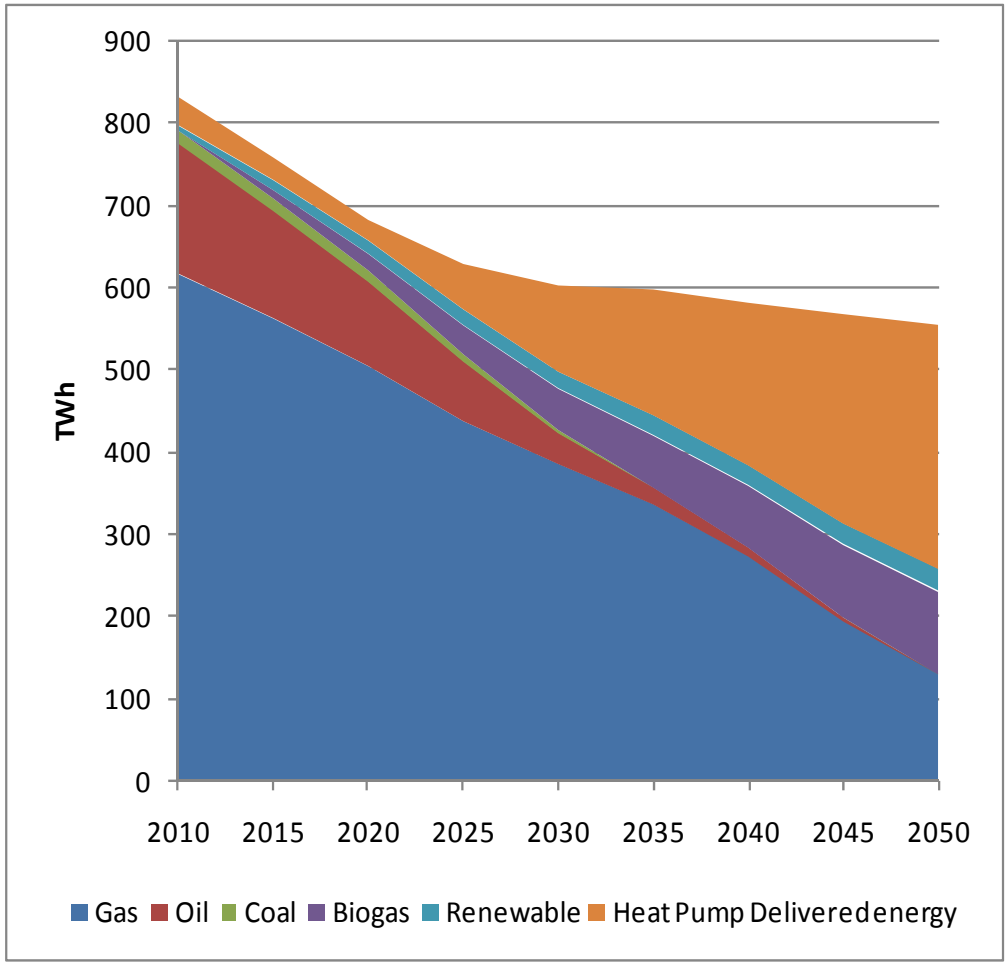


Road Transport – Fuel Supply



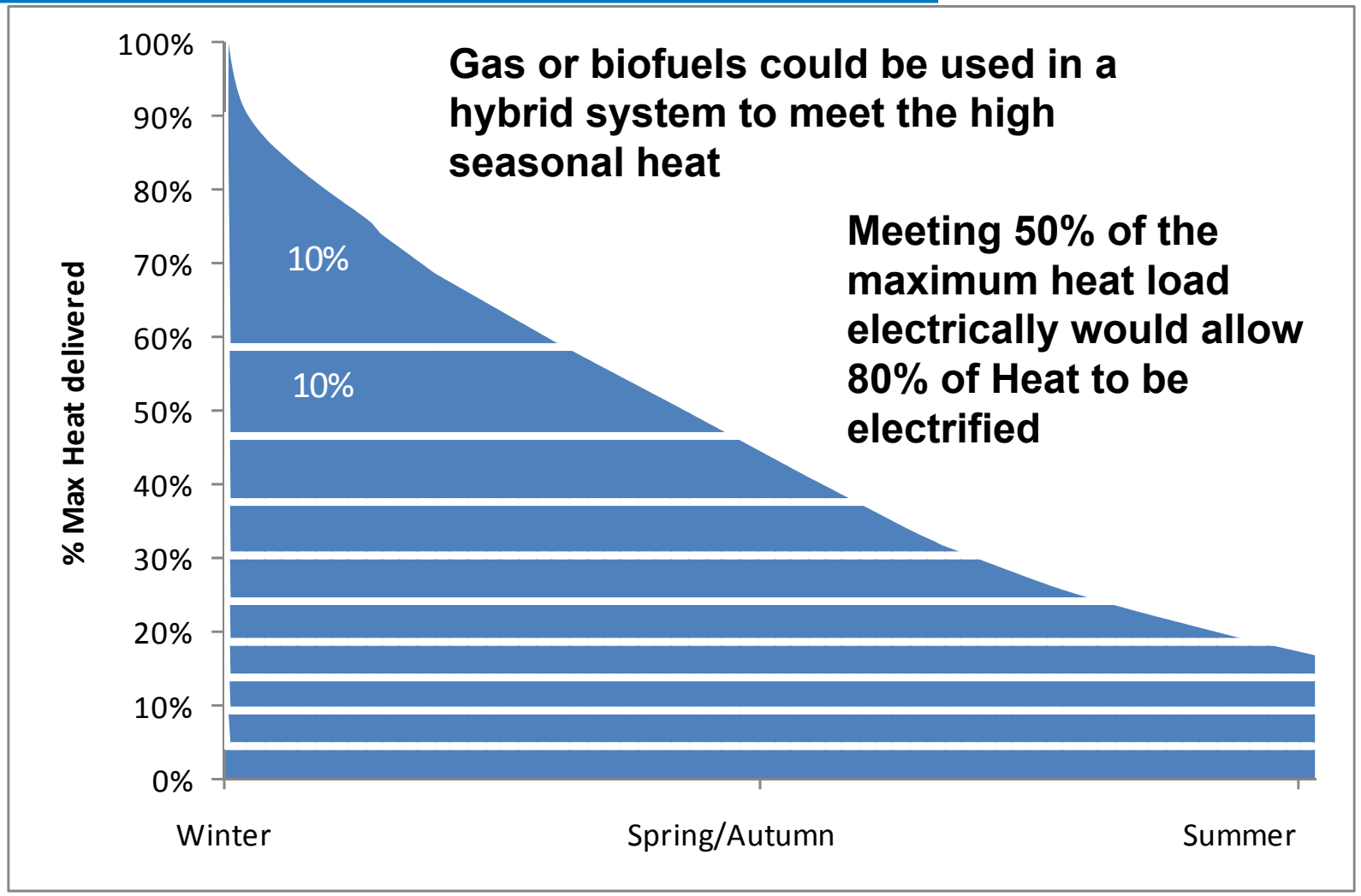
- Petrol use declines as Vehicle engines become more efficient and with increasing hybridisation
- Biofuels make up 10% of Petrol from 2020
- Electric vehicles make up 6% of cars by 2020 and 40% by 2030
- CNG use for HGVs driven by large firms converting fuelling stations

Heat Supply



- Oil and Coal largely eliminated
  - Replaced mainly by electric heat pumps
  - Gas absorption heat pumps could also play a role
- Increased use of electric heating and hybrid heating and carbon intensity drops below gas
- Increasing Biogas in gas network
- Gas required for HT in industry
- Solar Thermal and Biomass supplying small amounts of heat load

Providing secure heat for the winter



Public Attitudes 2050

To what extent can the public be persuaded to act in a more sustainable manner?

- Travelling less
- Cars vs. public transport
  - EVs vs fossil fuel vs Hydrogen fuel cells
- Flying less
- Turning down the thermostat and wearing a jumper
  - Investing in energy efficient homes: HP and Insulation
- Consuming less 'Stuff'

Overall strategy in 2050

Is the Gone Green balance of technologies still appropriate?

Should there be a greater emphasis on…

- **Renewables?**
  - **Wind, Bio, Imports**
- **Nuclear?**
- **CCS?**
- **…or any other new technology?**

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Questions……..

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Future Energy Scenarios

Do you think our range of scenarios is sufficiently broad?

Do you think there are alternative technologies we should explore more?

Power Generation

How will the power generation mix evolve over the next 20 years?

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Power Generation

What do you consider to be the main factors affecting the generation mix over the current and next decades ?

What are your views on the levels of renewable generation that will be connected by 2020 and 2030 ?

What do you consider to be the future for other forms of low carbon generation e.g. CCS and nuclear ?

What role do you see for fossil fuel plant (new and existing) in the generation mix ?

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Smart Meter – 2012 Domestic Electricity

- Reduction in energy consumption from different trials on smart meter installation (+ other interventions):

Annual Savings	**2.8% - 8.5%**
Peak Reduction/ Peak demand shift	**4.7% - 10.25%**

Note: Trials have shown minimal effect on gas consumption

What is your view on these results?

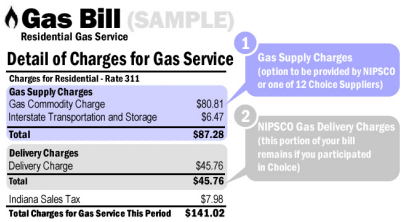
When will time-of-use tariffs be implemented to complement smart meters?

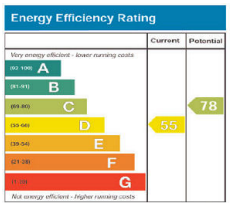
What percentage of households will have a smart meter installed by 2020?

What percentage of households will reduce/shift their demand at peak?

Gas Demand

What do you think are the main drivers to gas demand over the next 10- 20 years?





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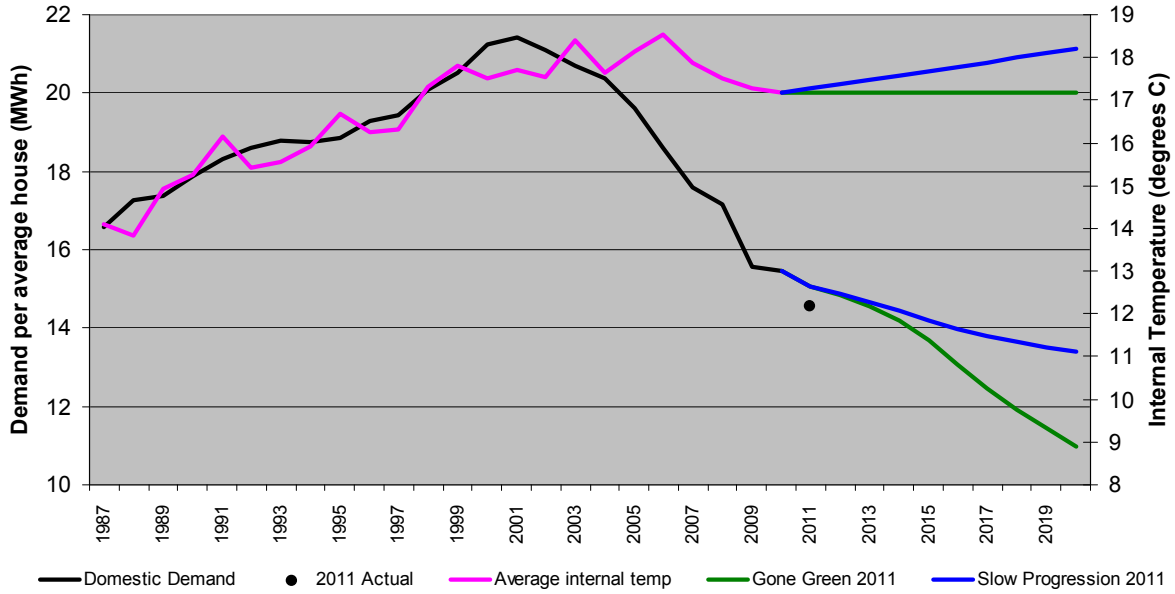
Domestic Internal Temperatures



- Since 2005 (when gas prices increased significantly) internal temperatures reduced year on year
  - GG assumes temperature will remain the same.
  - SP assumes they will increase roughly 1deg in the next decade

Do you think comfort levels will increase, decrease or remain the same?

What effect will this have on demand?

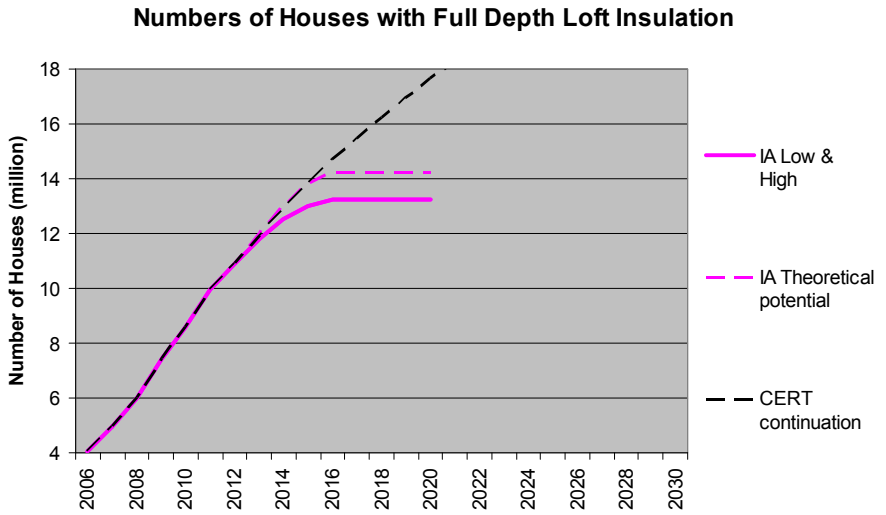
Energy Efficiency; What will Green Deal Deliver

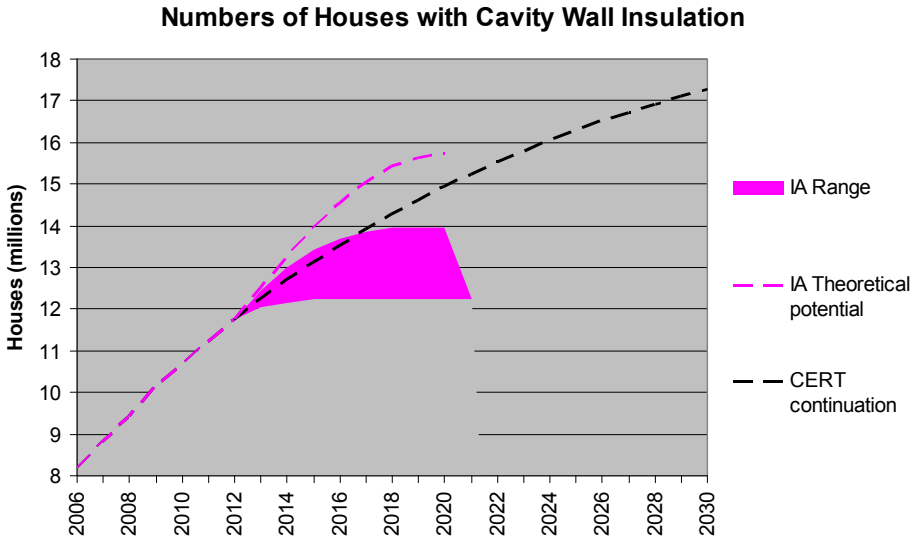
- Since 2006 CERT (& EEC2) delivered insulation:
  - Loft ~ 1m houses / year
  - Cavity wall ~ 0.5 m houses / year
- CERT being replaced by Green Deal in October 2012.
  - IA payback for measures ~ 5 years.

How will this affect insulation take up?

Does IA range appear reasonable?

Where in the range do you think it will be?

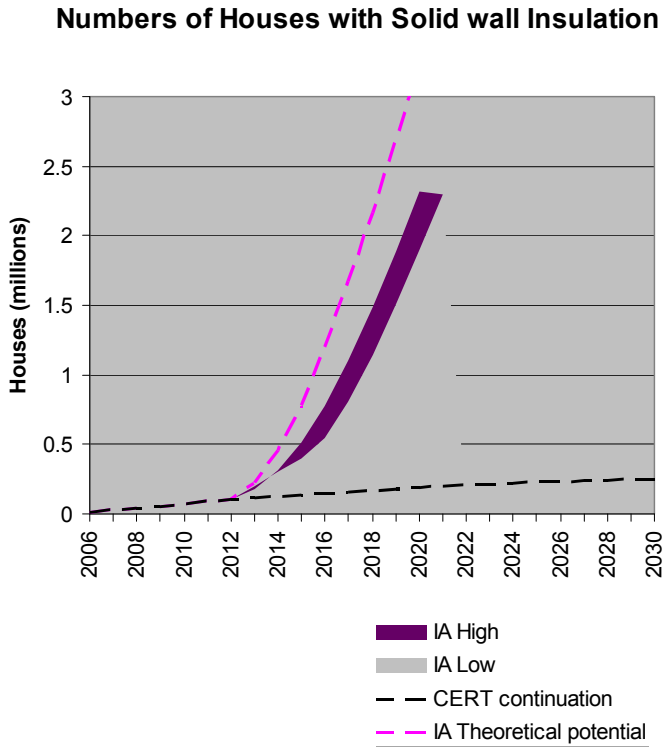




Energy Efficiency – Green Deal 2

- Green Deal what will it deliver?
  - Since 2006 CERT, EEC2 Warm Front and CESP delivered:
  - Solid wall insulation to ~ 15,000 houses per year

- Green Deal IA assumes Solid Wall Insulation take up will increase significantly as ECO incentivises:
  - Hard to treat homes
  - Lower income groups.
  - Cost around £7k per house



Do you see significant increase in SWI?

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Domestic green technology roll-out

- Does anything *surprise* you in our results?
- Do you see any other domestic technologies having a large variance by location and large energy impact?

- What is your view on Electric Vehicle numbers ?
- Growth profile? Market saturation level? Barriers?
- When do you think most people will charge cars ?
- At night? In the day? As soon as they get home from work?
- More pure EV's, PHEV or E-REV?
- We see ratios of around…. X:y:z – what do you think?

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Domestic green technology roll-out

Main drivers / barriers affecting people who could buy green technology…..

Socio-economic drivers
Keeping up with the Jones's
Education level
Disposable Income

Photovoltaics
Sunny area / latitude
Cost- FiT?
South facing roof space

Heat pumps
heating & hot water
Insulation
Costs
Green Deal ?
Temperature levels

Home
Home-owner, tenant, landlord, council house tenant
new build home

Vehicle i.e. EV / PHEV / E-REV
Urban, suburban, rural
Range / Cost
Fill-up speed/ charging points
Model availability / Desirability

Which do you think are most important?

Should any others be added?

How would you assess their impact?

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Demand Side Management

DSM Highlights

- Wet and Cold Appliances provide the best opportunity for domestic DSM
- Early start date for rollout of this technology is required to overcome large inertia in markets
- No significant effects from shiftable demand before 2030
- DSM Coordination Centre must have holistic view of system

What is the view of DSM as a balancing tool for the network?

Are there any incentives planned to promote domestic load shifting? e.g. TOU tariffs

Does the potential peak reduction, by demand shifting, provide enough incentive for this sector to be developed?

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What if (last winter) UK Demands had been higher?

Could the UK have attracted more LNG?

Would IUK behaviour have different?

How much Demand Side Response could there have been?

Options to meet higher demands

- Need to attract more LNG
  - Higher UK gas prices to compete with Far East
  - More contracted gas
- Higher IUK imports / lower exports
  - UK gas prices above those on Continent (above oil indexation)
- Demand Side Response (DSR), notably from power sector

Longer term needs?

More storage

More import capacity

Supply diversity

More contracts

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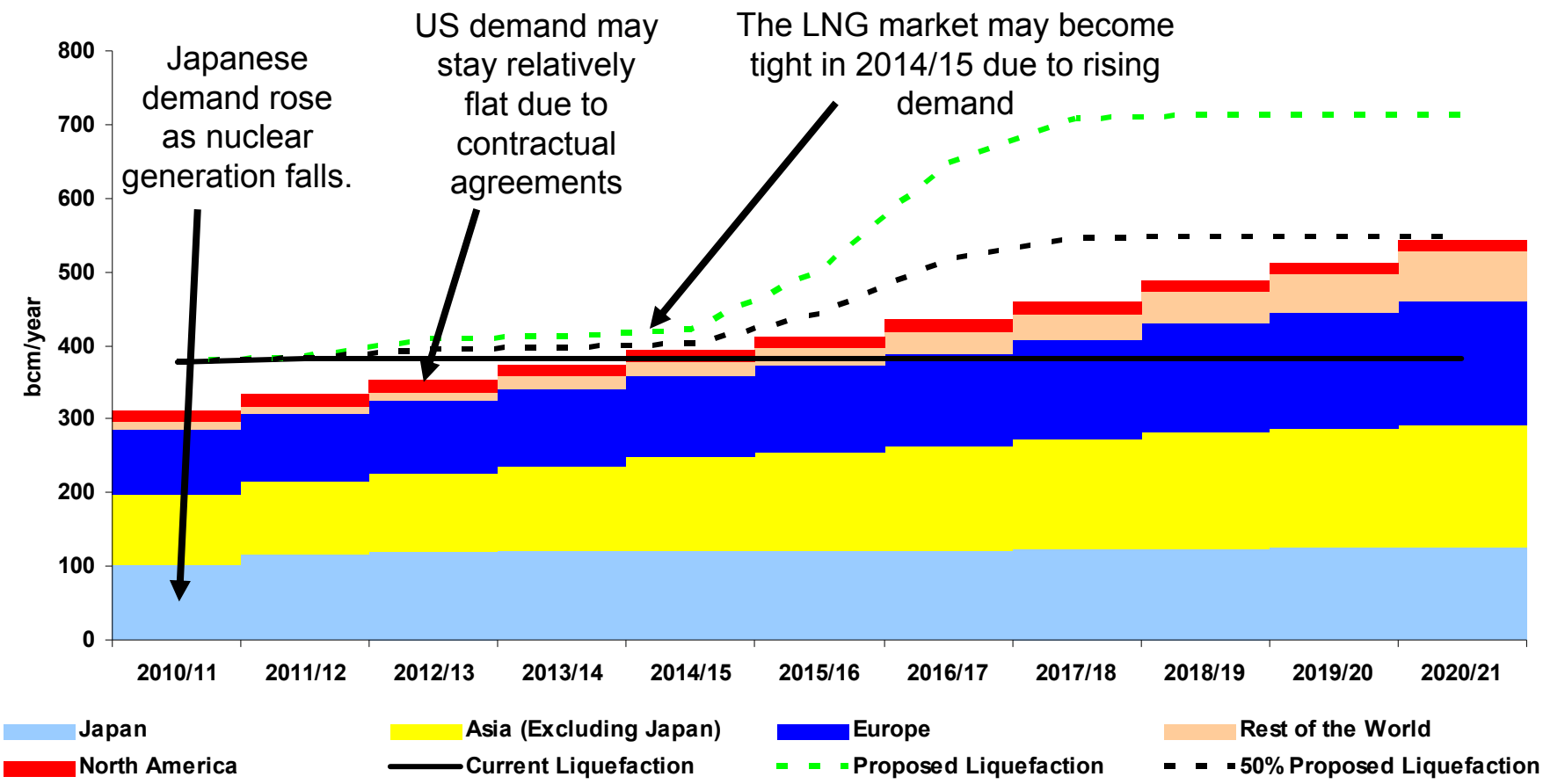
Future LNG Supply and Demand



What are the key influences on future global LNG demand?

Where do you expect future liquefaction capacity to be built?

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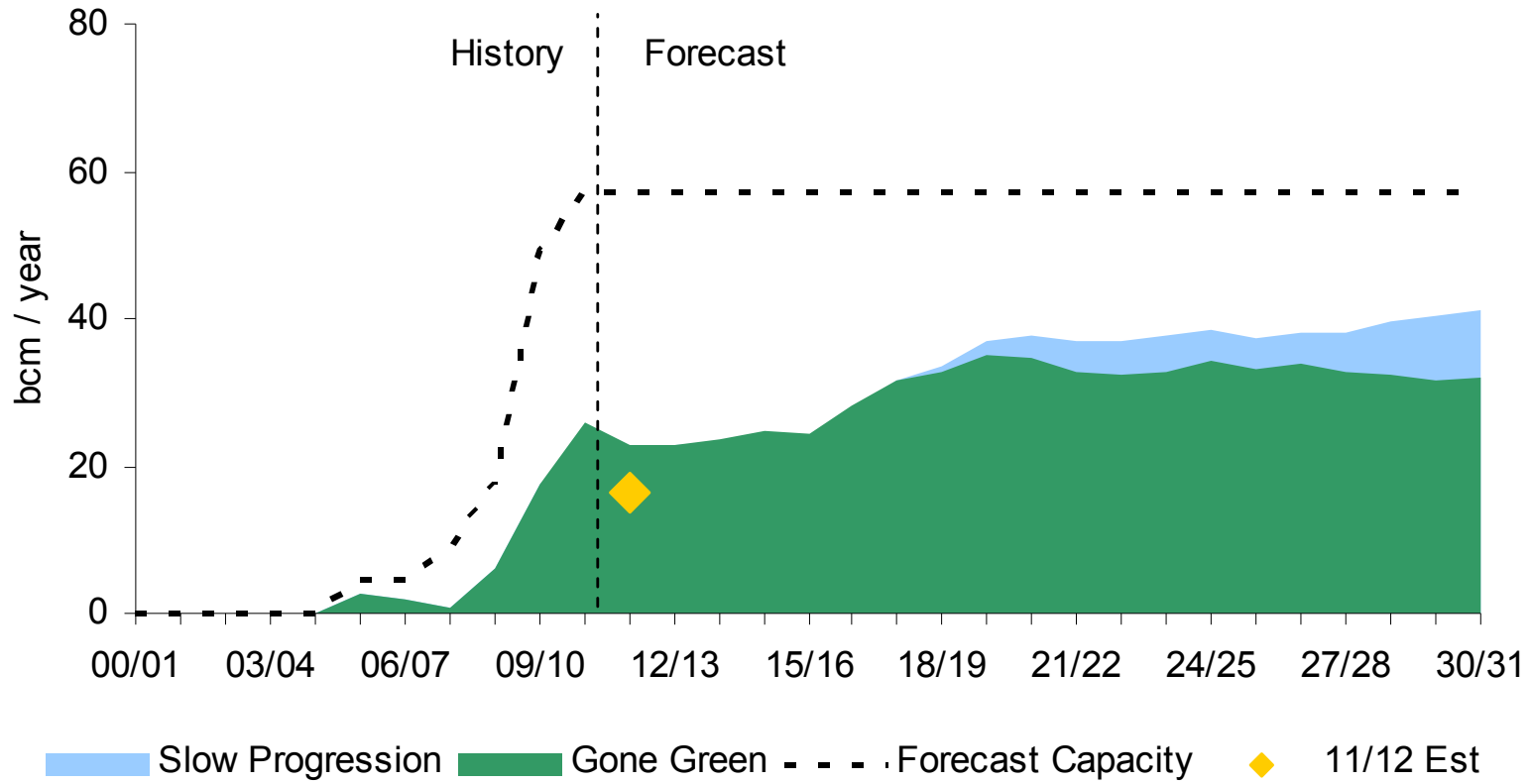
UK LNG Import Scenarios



Can the UK import the required LNG without long term contracts?

How can the UK compete against Asia for spot LNG cargos?

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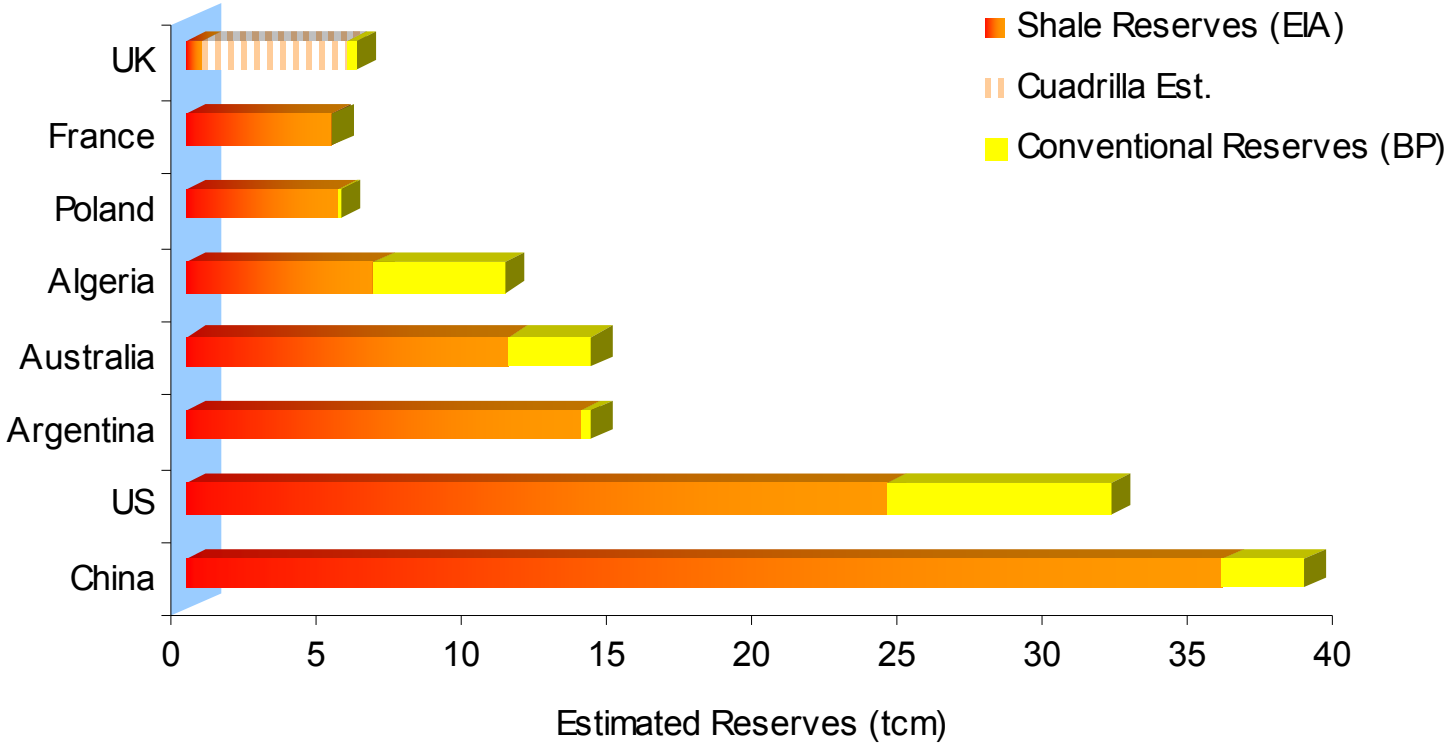
Global Shale Reserves

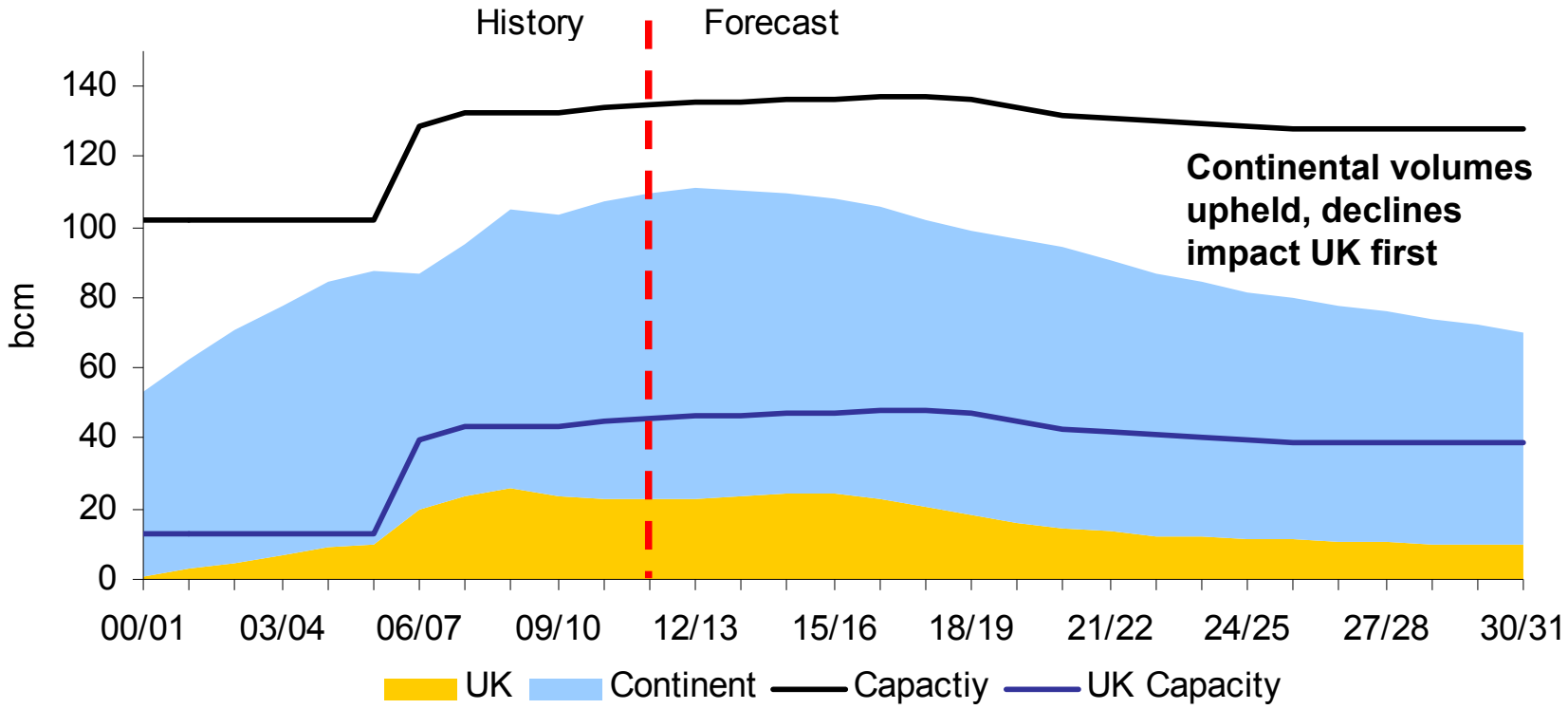


Source: EIA & BP

Besides the US which country or countries do you see producing significant levels of shale gas?

How influential do you see unconventionals being on the European gas market?

Norwegian Supply Forecast



Do you agree with our forecast of a plateau followed by a gradual decline for Norwegian production?

Do you agree that the lack of contracts will see the UK flows reduce more quickly as production declines?

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Continental Supplies

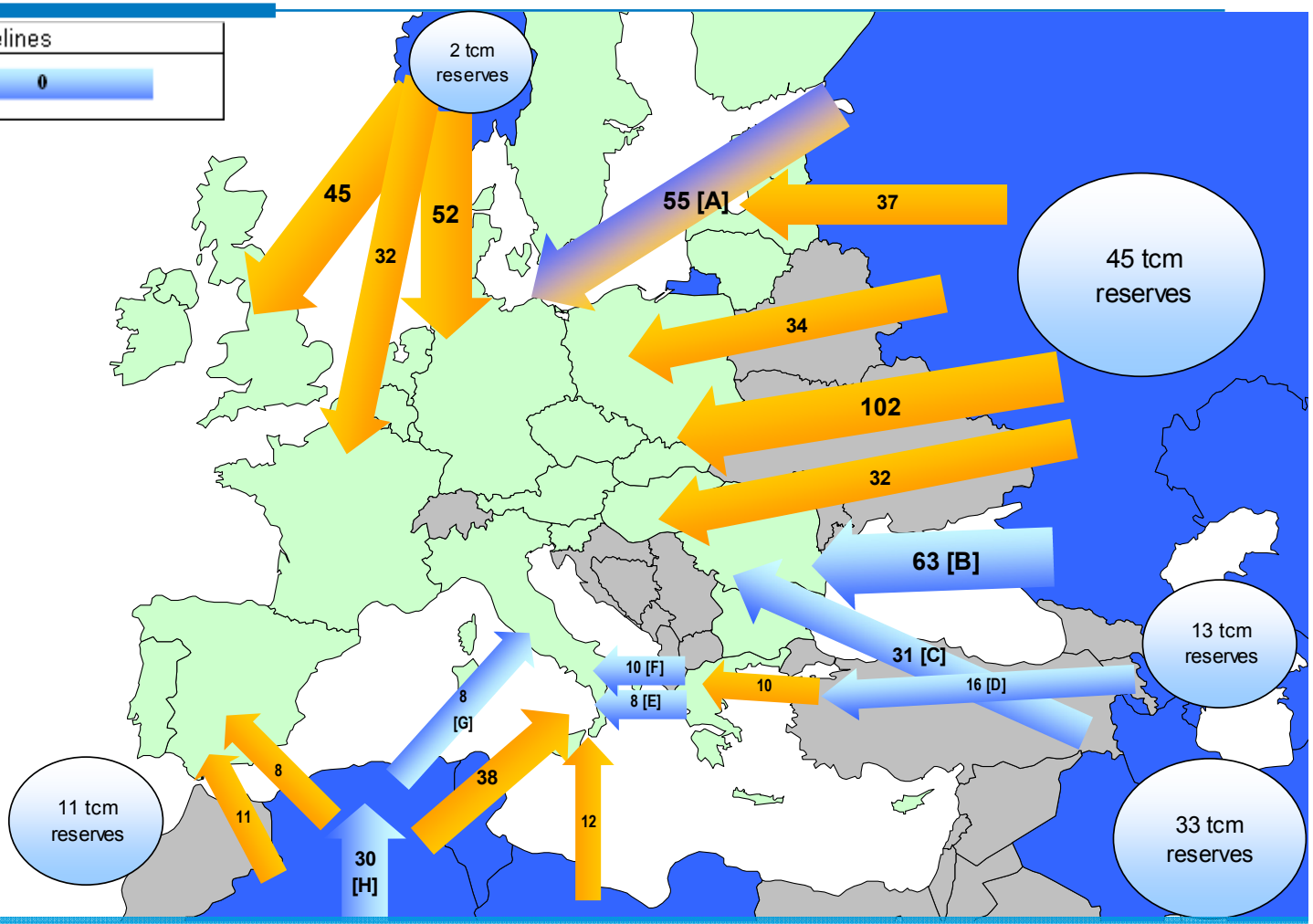
Existing Routes	New Pipelines
0	0

Norway: No new projects expected

Russia: Nord Stream completed end 2012, South Stream FID 2012?

Caspian: Shah Deniz Export route decision 2013

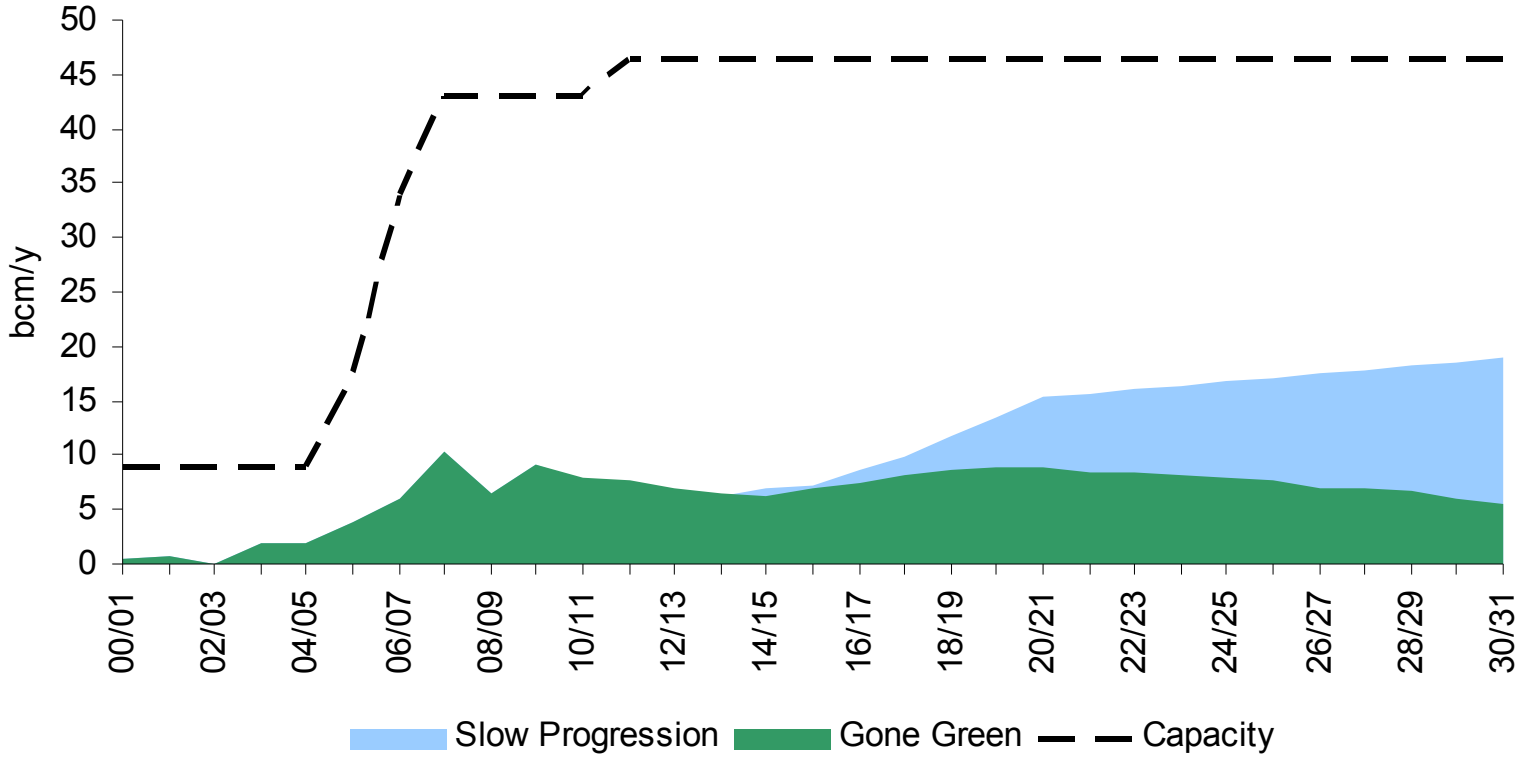
North Africa: Uncertainty over additional routes



Which of the proposed import projects do you see as most likely to proceed?

To what extent do you see continental supply/storage markets liberalising?

UK Continental Supply Scenarios



Volumes dominated by BBL flows

Exports reduce over period but IUK remains net exporter

How can the UK obtain higher volumes from Continental Europe?

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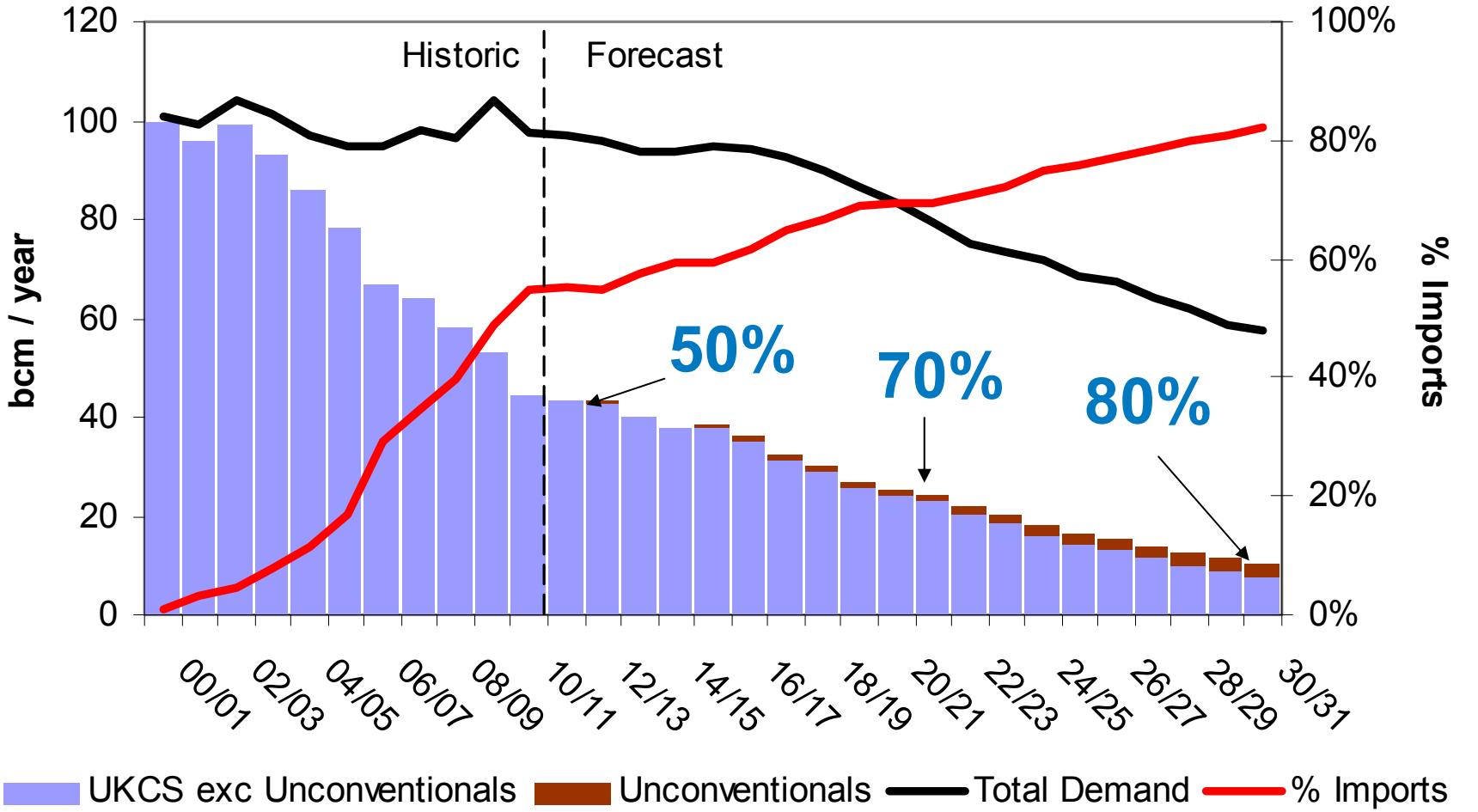
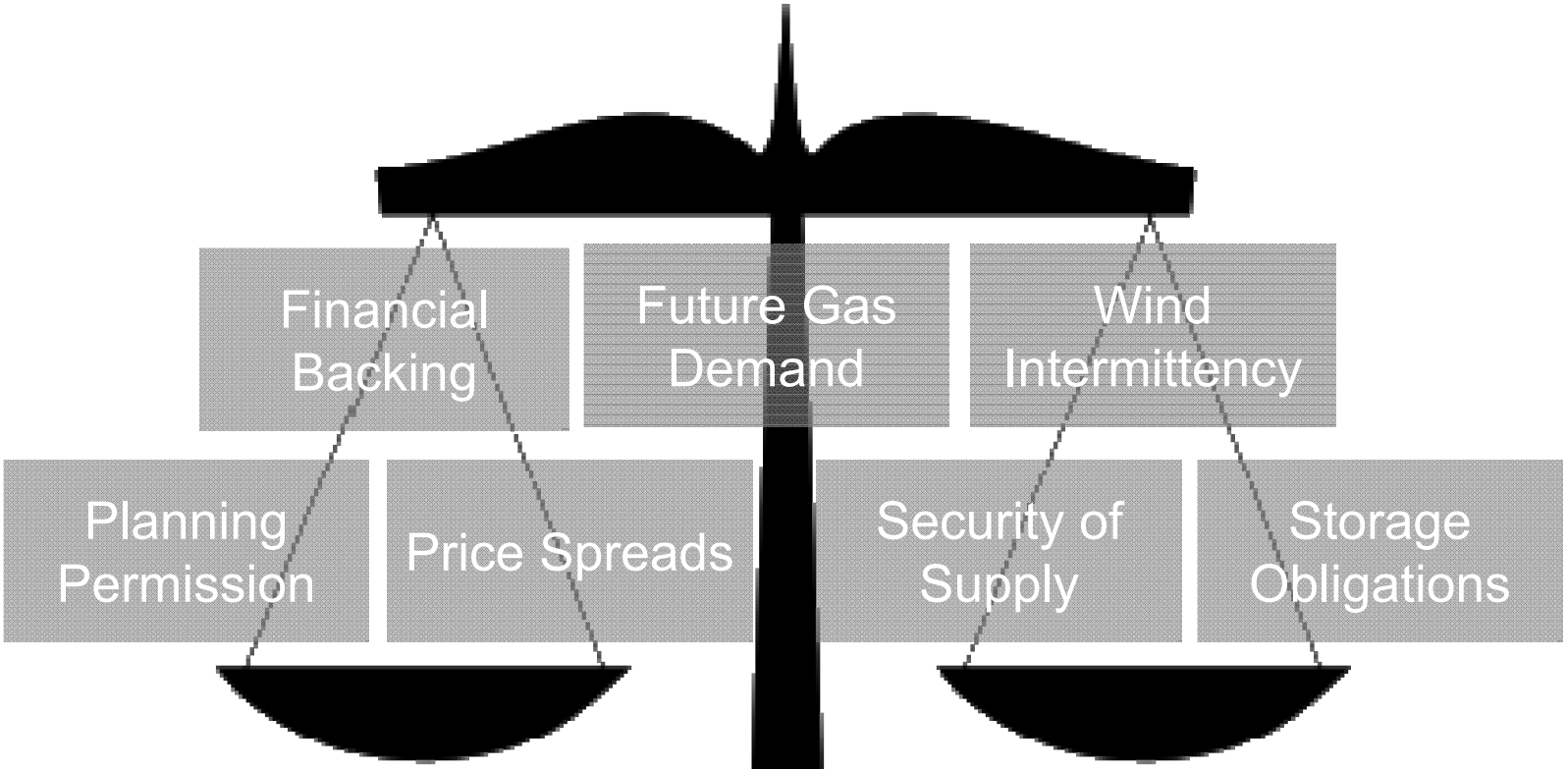
UKCS Forecast



Does our overall UKCS decline story seem reasonable?

What are your views on UK unconventional gas? (CBM/Biogas/Shale)

Factors affecting new storage



What are the main drivers that will lead to more UK storage developments?

How important will the role of storage be to cover for wind intermittency?

Should there be storage obligations on the UK gas market?

Public Attitudes 2050

To what extent can the public be persuaded to act in a more sustainable manner?

- Travelling less
- Cars vs. public transport
  - EVs vs fossil fuel vs Hydrogen fuel cells
- Flying less
- Turning down the thermostat and wearing a jumper
  - Investing in energy efficient homes: HP and Insulation
- Consuming less ‘Stuff’

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Overall strategy in 2050

Is the Gone Green balance of technologies still appropriate?

Should there be a greater emphasis on…

- **Renewables?**
  - **Wind, Bio, Imports**
- **Nuclear?**
- **CCS?**
- **…or any other new technology?**