UCL Institute for Sustainable Resources

Energy and Climate Policy in the EU

A presentation to the Third Annual Conference of the
Italian Association of Environmental and Resource Economists

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Structure of presentation

- The challenges of energy and climate change
- Possible developments in the global energy system
- EU policy responses
- Results from CECILIA 2050: Combining Policy Instruments to Achieve Europe's 2050 Climate Targets

The Energy Trilemma

The objectives of energy policy for many countries are basically three:

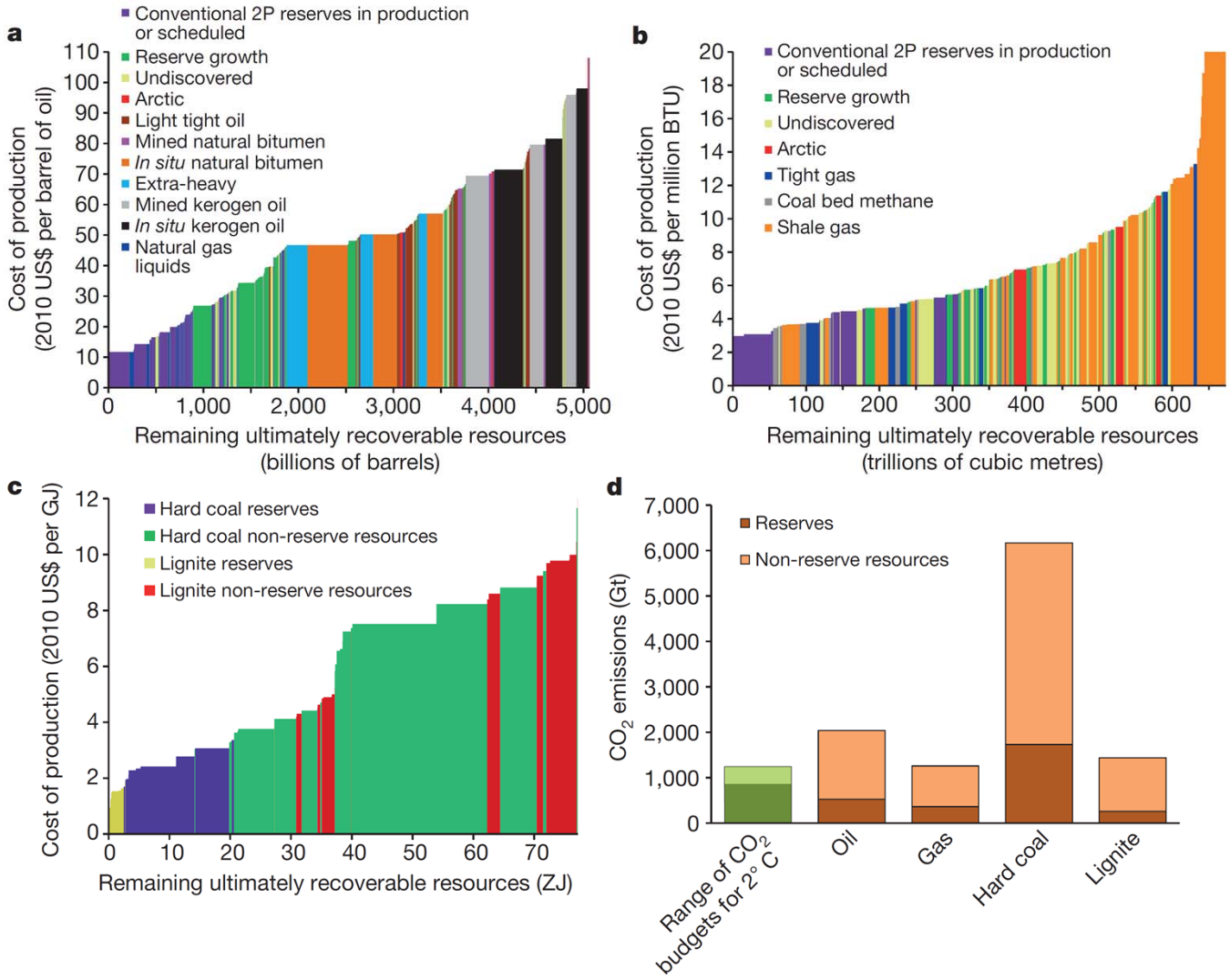
- Transition to a low-carbon energy system (involving cuts of at least 80% in greenhouse gas (GHG) emissions by 2050, which will require the almost complete decarbonisation of the electricity system), and a wider 'green economy'
- Increased security and resilience of the energy system (involving reduced dependence on imported fossil fuels and domestic system robustness against environmental, economic, social and geo-political shocks)
- Affordability
  - For businesses: need for competitiveness (some sectors will decline as others grow – allow time for the transition) and cost efficiency (ensuring that investments, which will be large, are timely and appropriate and, above all, are not stranded by unforeseen developments)
  - For vulnerable households: need to be able to pay energy costs

Energy security: avoiding 'shocks' to the energy system

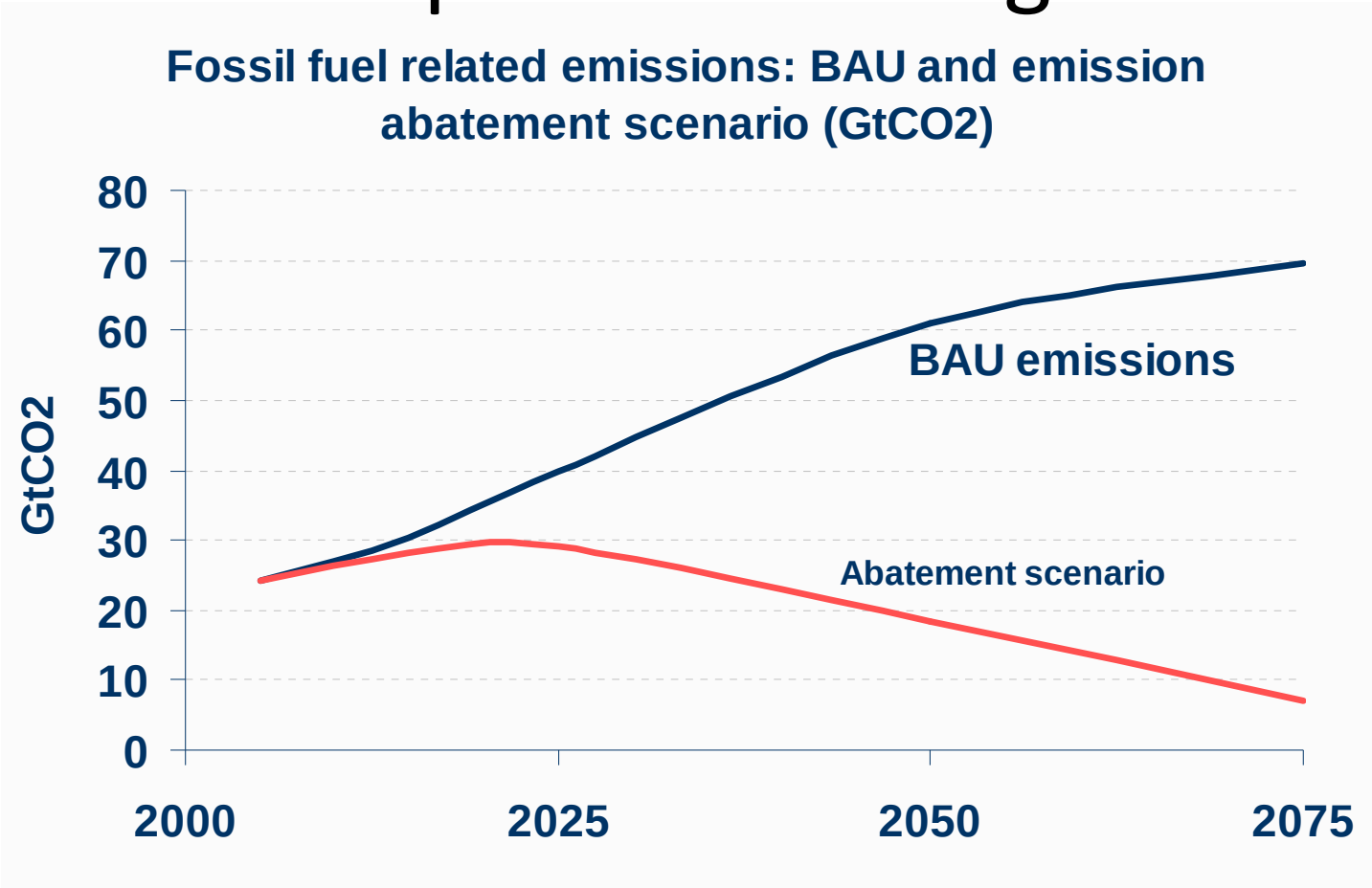
- Concerns:
  - Transformation, conversion, storage and distribution systems that deliver energy services (adequacy of investment in electricity generating capacity - 'keeping the lights on'), intermittency of renewables
  - The availability and cost of primary energy supplies (fears of politically motivated interruptions to supplies of oil and gas), e.g. Russian gas
- Evidence:
  - Many of the "shocks" to the gas and electricity systems relate to equipment failures or weather-related events, rather than politically motivated or other deliberate interventions.
  - The duration of impacts differs according to which part of the energy system is affected. Electricity shocks have tended to last for hours-days, gas shocks for weeks-months, and oil shocks for months-years in some cases.
  - The nature, timing and extent of 'shocks' are characterised by incertitude

The carbon challenge: reserves, resources and carbon budgets

McGlade, C. and Ekins, P. 2015 'The geographical distribution of fossil fuels unused when limiting global warming to 2°C' *Nature*, pp.187-190



Emissions trajectory to limit temperature change



Source: Stern Review, Part III, Chapter 9

The framework of climate policy

- UN Framework Convention on Climate Change (UNFCCC), 1992, Kyoto Protocol, annual COP/MOP meetings, post-Durban process
- G20 processes and discussions
- The EU 20/20/20 by 2020 Programme and associated policies
- National policies and programmes
- State (US)-level policies and programmes
- Regional/city/local roll-out ambitions/ obligations

(global and EU levels discussed here)

The UNFCCC (1)

- The Kyoto Protocol (1997)
  - Entry into force 2005, first commitment period, 2008-2012; 192 signatories, including EU
  - Crucial issue of ‘common but differentiated responsibility’
  - Distinction between Annex 1 (industrial, binding targets) and non-Annex 1 countries (no commitments)
  - Flexible mechanisms: emissions trading, Joint Implementation (JI), Clean Development Mechanism
  - Adaptation Fund for developing countries

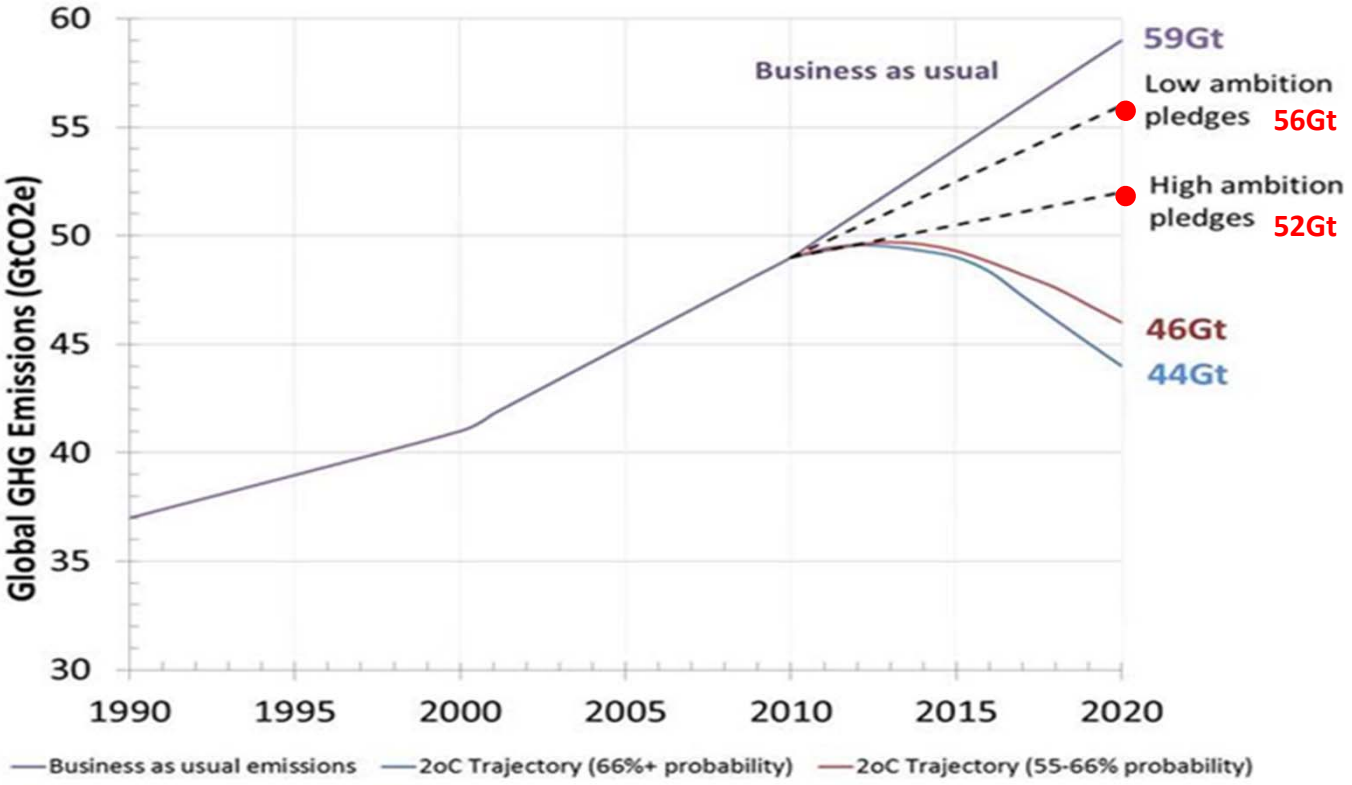
- Copenhagen (2009)
  - The Copenhagen Accord: voluntary commitments to emission reduction by all countries (now called Intended Nationally Determined Contributions – INDCs)
  - Global recognition of the 2^{o}C ‘guardrail
  - Commitment to Green Climate Fund ($30 bn 2013; $100 bn 2020)

The UNFCCC (2)

- Cancun (2010)
  - Accord incorporated into Treaty
  - Commitments from all industrial countries and major developing countries (90% global energy-related emissions), but nowhere near enough for 2^{o}C guardrail

- Durban (2011)
  - The launch of an Ad Hoc Working Group on the Durban Platform for Enhanced Action, which will seek to adopt an agreement for long-term emissions reductions by 2015, to come into effect no later than 2020.
  - Agreement will include all countries, which will make commitments to emissions reduction, and will have legal force
  - All countries are now committed to the prospect of legally binding emissions reduction
  - This could provide a major impetus for the development and adoption of low-carbon technologies, but only with prospect of global deal

The 2°C 'emissions gap'



BAU in 2030
68Gt

2°C cost-effective trajectory in 2030

47Gt
(50% chance of 2°C)

42Gt
(66% chance of 2°C)

Objectives for Paris

- **Paris (2015) needs agreement a global, legally binding deal, applicable to all**
  - **Legal Form**: Should be a Protocol, with legally binding elements
  - **Continued commitment** to 2°C 'guardrail' and carbon budget
  - **Mitigation Ambition**: Commitments should
    - Be nationally determined, but subjected to international scrutiny
    - Keep below 2 degrees goal within reach,
    - Be complemented with a regular review process on a five year cycle, and if possible a Long Term Goal
    - Envisage 'Deep Decarbonisation Pathways' and technological explicitness
    - Involve carbon pricing by at least some countries
  - **Differentiation**: All Parties should contribute 'fair' share, along a spectrum
    - Different types of commitment, different levels of ambition. Major and developed economies to lead the way
  - **Rules**: Internationally agreed rules base for MRV and accounting
  - **Adaptation and Finance**: All countries should be responsible for mobilising finance. Adaptation needs to be core part of Agreement

The international state of play in summary

- Curbing global warming requires international cooperation and agreement to reduce emissions of greenhouse gases

BUT

- Developing countries will not accept emission control if they think it will impede their development

SO

- Committed industrial countries (like the EU) will need to show that deep emissions control is compatible with continued economic growth and development
- Best hope for emission control is the emergence of a ‘green race’ for low-carbon technologies: ‘green economy’
- ‘Green growth’ is now the strategic economic imperative
- What developments in the energy system could drive ‘green growth’?

Major possible, but uncertain, developments (1)

Energy Demand: determines *how much* supply, and *what kind of* supply, is required

- **Demand reduction:** efficiency (rebound effect), lifestyles
- **Demand response:** smart meters/grids, load smoothing, peak/back-up reduction, storage, leading to implications for
- **Network design**
- **Key demand technologies:** most importantly likely be *electric vehicles* (with or without fuel cells), which could also be used for electricity storage/load smoothing, and *heat pumps*, both of which would use the decarbonised electricity. However, both technologies are in substantial need of further development and their mass deployment raises important consumer/public acceptability, as well as infrastructure, issues.

Major possible, but uncertain, developments (2)

- **Decarbonisation of electricity** (and its use for personal transport and residential heat). This depends on the development and deployment of four potentially important low-carbon options:
  - *Large-scale renewables*: issues of incentives, deployment, supply chain, storage technologies, intermittency, market design (zero marginal cost)
  - *Small-scale renewables*: issues of planning, institutions (distribution networks)
  - *Nuclear power*: issues of demonstration, cost, risk (accident, attack, proliferation, waste, safety, decommissioning), public acceptability
  - *Carbon capture and storage (CCS)*: issues of demonstration, feasibility, cost, risk (storage, liability)

Major possible, but uncertain, developments (3)

Bioenergy - thorny issues related to**:**

- *Carbon reduction*: how is biomass produced?
- *Environmental sustainability*: issues of land use, biodiversity
- *Different uses of biomass*: competition between bioenergy and food
- *Social issues*: issues of power, livelihoods, ownership and control

Major possible, but uncertain, developments (4)

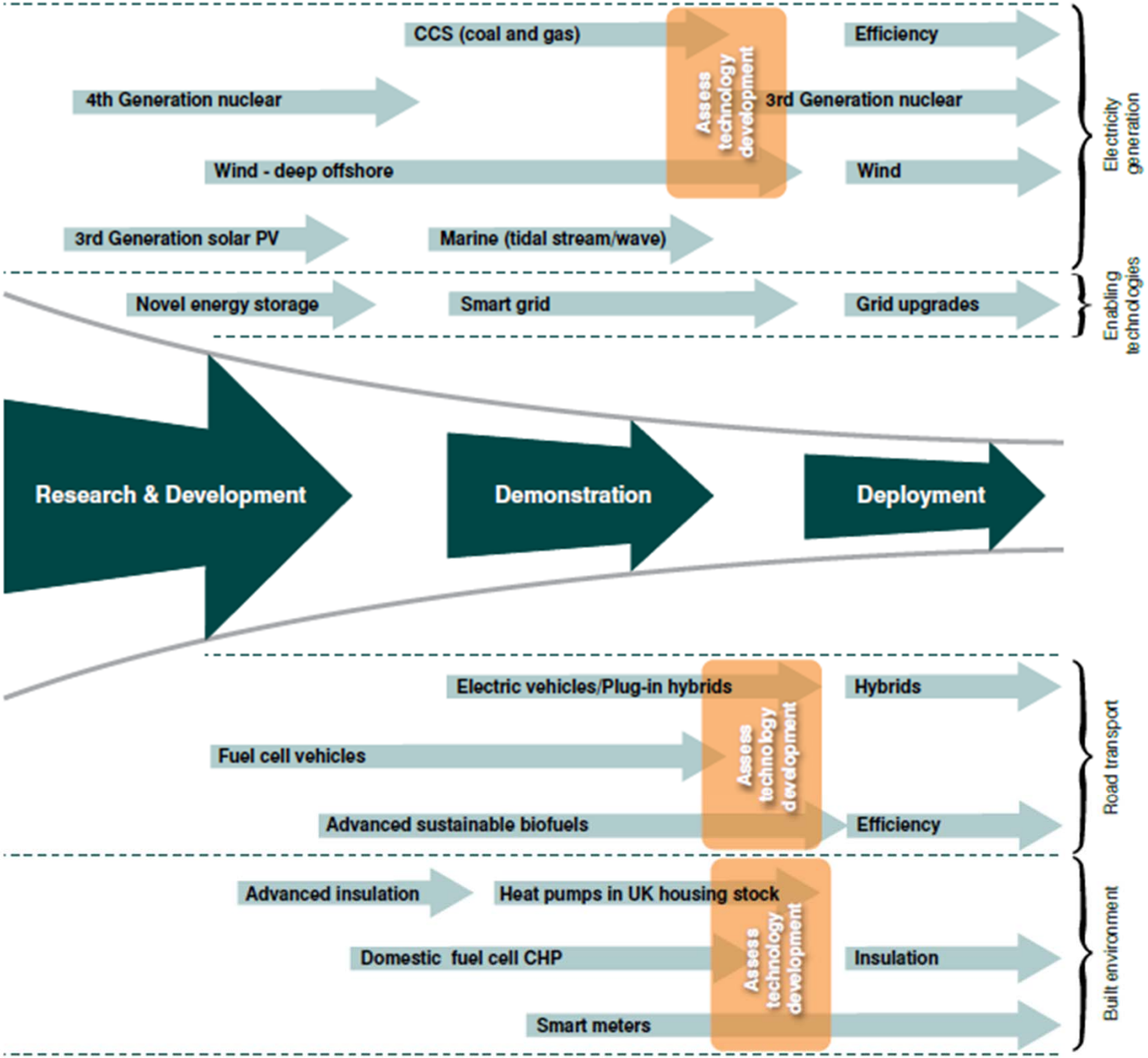
Internationalisation in relation to:

- *Technology*: e.g. global research, innovation, technology transfer. Balance between competition and co-operation
- *Trade*: e.g. bioenergy, electricity, carbon, border taxes
- *International integration*: grids (e.g.high-voltage DC electricity), markets (European Roadmap 2050)

Pipeline of selected energy technologies showing progress required by 2020

Source: Energy Research Partnership 2010 *Energy innovation milestones to 2050*, March, ERP, London

www.energyresearchpartnership.org.uk/tiki-download_file.php?fileId=233

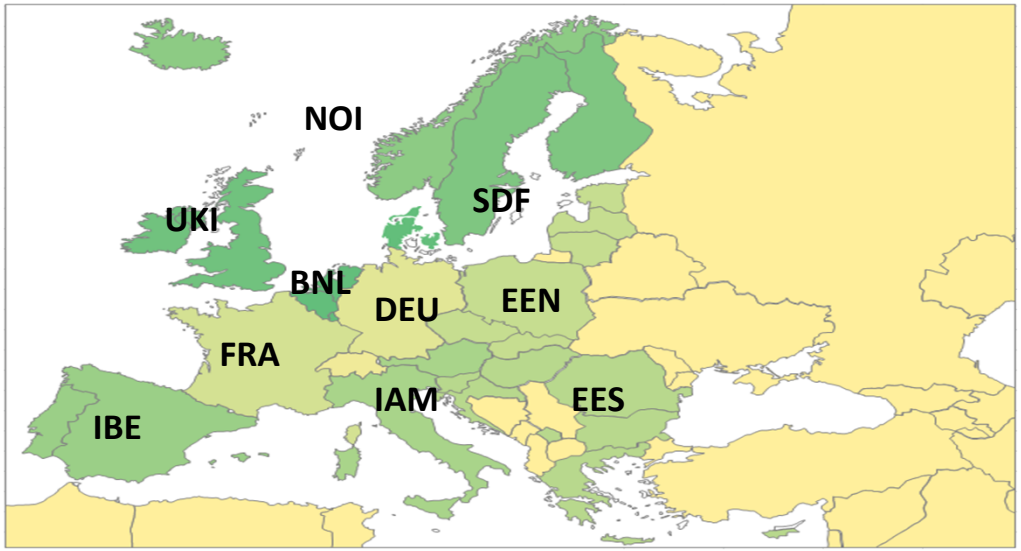

CCS (coal and gas)
Efficiency
4th Generation nuclear
3rd Generation nuclear
Wind - deep offshore
Wind
3rd Generation solar PV
Marine (tidal stream/wave)
Assess technology development
Electricity generation
Novel energy storage
Smart grid
Grid upgrades
Enabling technologies
Research & Development
Demonstration
Deployment
Electric vehicles/Plug-in hybrids
Hybrids
Fuel cell vehicles
Advanced sustainable biofuels
Efficiency
Assess technology development
Road transport
Advanced insulation
Heat pumps in UK housing stock
Domestic fuel cell CHP
Insulation
Smart meters
Assess technology development
Built environment

Options and choices

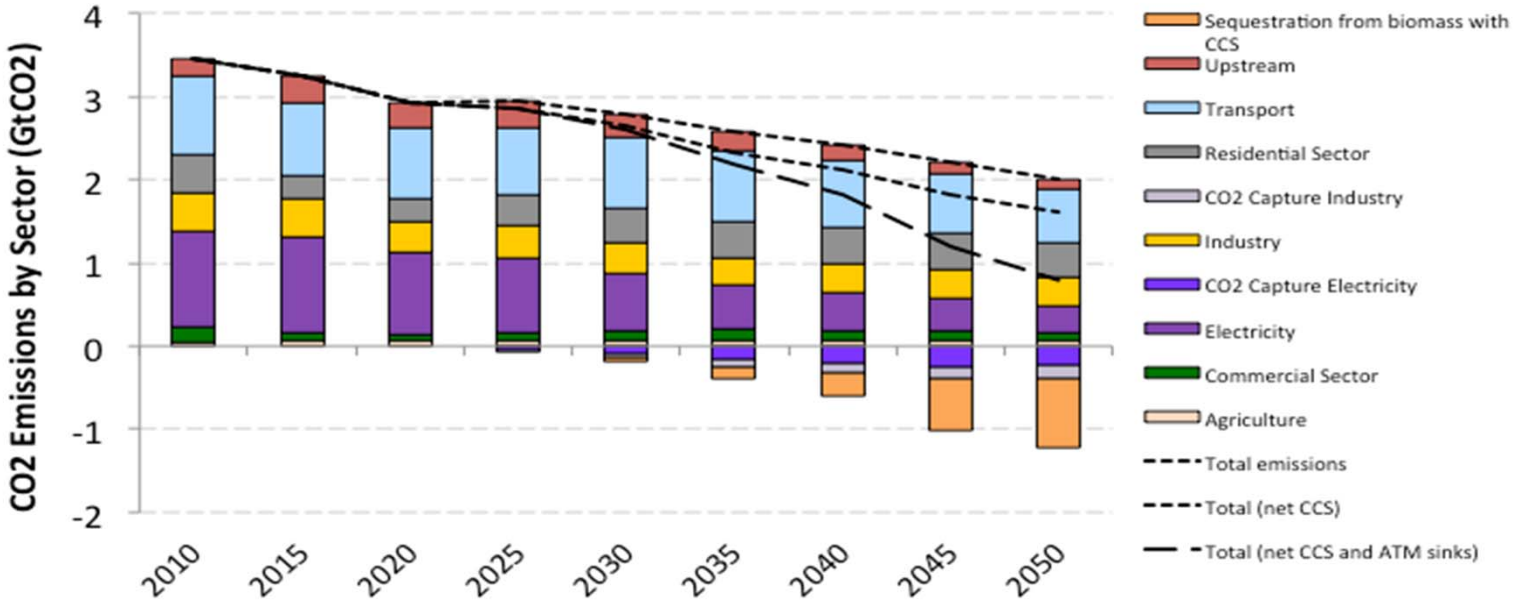
- Different countries have different options and are likely to make different choices across all these dimensions, depending on their energy history, culture, resource endowments and international relations.
- Choices are essentially political (though industry will be inclined to argue that the country concerned 'needs' their favoured option).
- The options will play out differently in terms of energy security and cost
- The economic and political consequences of making the wrong choices are potentially enormous
- Balance between developing portfolios (diversity) and going to scale (picking winners – economic as well as energy).
- Importance of demand side (historically supply needs have been substantially over-estimated)
- Need for immediate decarbonisation and avoidance of future carbon lock-in

Decarbonising the European Energy System: European TIMES Model (ETM-UCL)

- Technology-rich, bottom-up dynamic partial equilibrium model with inter-temporal objective function minimising total discounted system costs.
- Supply and demand use sectors modelled, with energy service demand projected using exogenous drivers such as GDP and population projections. 2010 base year.
- 11 European regions, linked through trade in crude oil, hard coal, pipeline gas, LNG, petroleum products, biomass and electricity. 'Global' region acts as 'basket of resources' from which energy products (except electricity) may be imported.

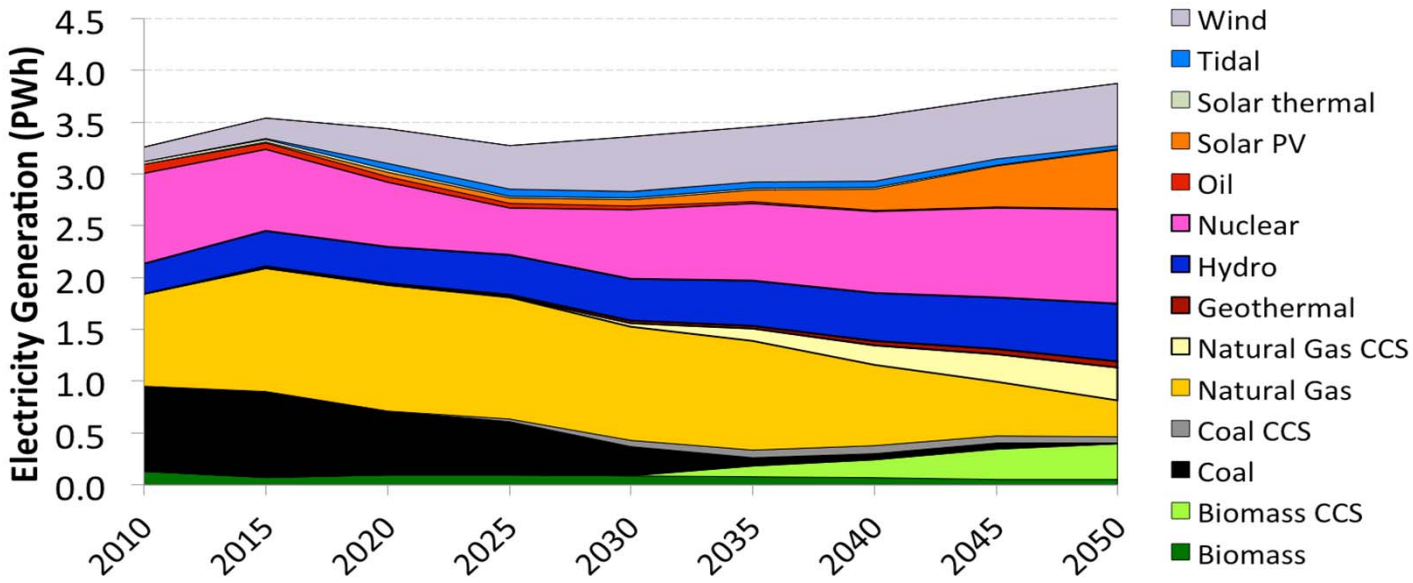


CO_2 Emissions



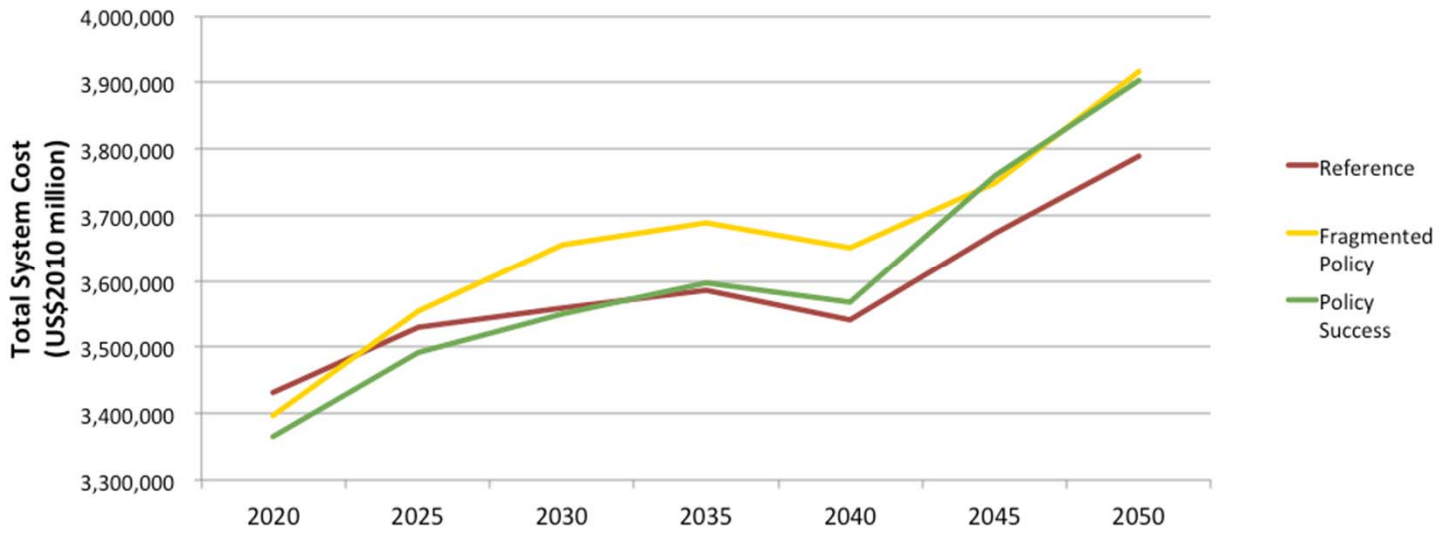
- 3 Scenarios – 'Reference', 'Fragmented Policy' and 'Policy Success'
- 'Policy Success' scenario – CO_2 80% below 1990 levels by 2050
- Power sector largest contributor to abatement (producing net negative emissions by 2050) (152% reduction from 1990 levels)

Power Generation Projection



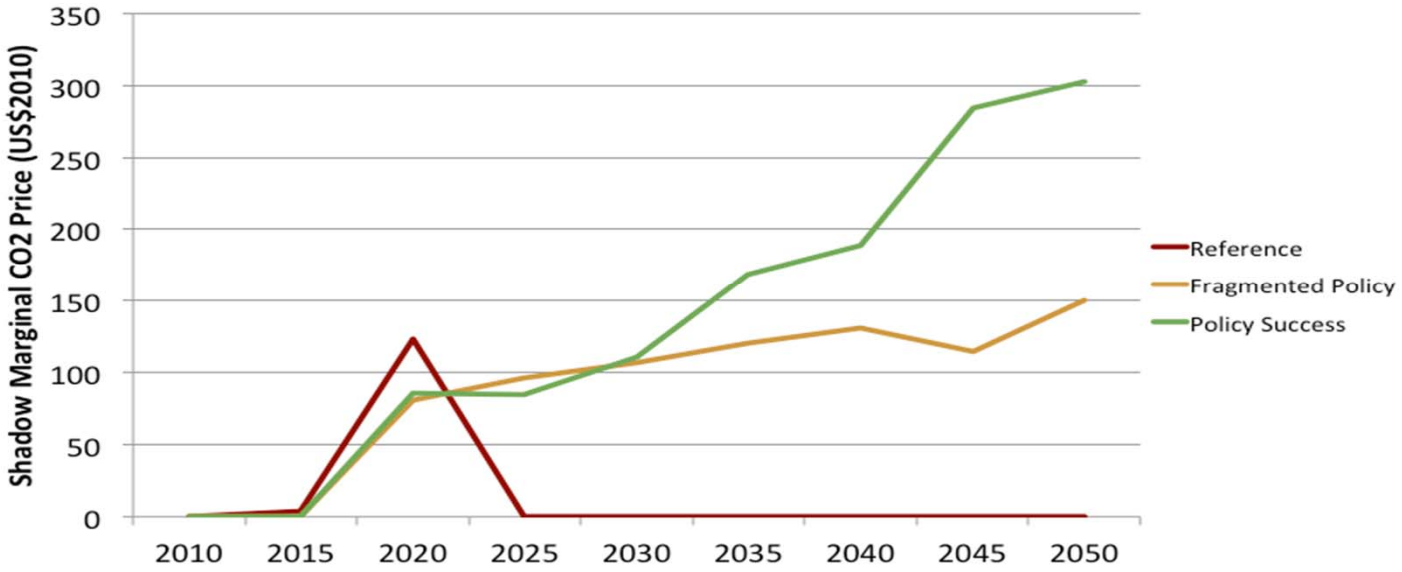
- Renewables grow to 45% by 2050 – including use of biomass with CCS
- Nuclear retains roughly constant capacity (and generation) – exogenous constraint
- Fossil fuel (mainly gas) retains ~15% share (half with CCS)
- CO_2 intensity from 350gCO_2/KWh in 2010 to -50gCO_2/Kwh in 2050

Total System Cost



- Net Present Value (NPV) of 'Policy Success' Scenario = $33.2tn
- 14% higher than Reference scenario, equal to 1.26% projected GDP between 2010 and 2050

Average Marginal CO_2 Abatement Cost



- Peak in 2020 (~\$100/tCO_2), to meet 2020 obligations
- Policy Success reaches €300/tCO_2 by 2050 (€150/tCO_2 in 'Fragmented Policy')

An unprecedented policy challenge

The Stern Review Policy Prescription

- Carbon pricing: carbon taxes; emission trading
- Technology policy: low-carbon energy sources; high-efficiency end-use appliances/buildings; incentivisation of a HUGE investment programme
- Remove other barriers and promote behaviour change: take-up of new technologies and high-efficiency end-use options; low-energy (carbon) behaviours (i.e. Less driving/flying/meat-eating/lower building temperatures in winter, higher in summer)
- Carbon pricing will support the other two two policy dimensions

The rationale for environmental taxation

- Market failure leading to excessive pollution and environmental destruction
- More efficient than regulation; more effective than voluntary agreements and information
- The tax rate needs be set according to one of three aims:
  - Internalise external costs (Pigouvian tax 1932, need to know damage costs)
  - Achieve standards set on the basis of science and political feasibility (standards and pricing approach, Baumol and Oates, 1978)
  - Need to stimulate investment in desired alternatives (e.g. low-carbon, waste management technologies, cf UK Landfill tax)

The rationale for energy taxation

- Energy demand increases with income (income elasticity +0.5)
- Energy demand decreases with price (industry elasticity -0.6)
- Market failures for some energy efficiency technologies
- Improvements in energy efficiency lead to a rebound effect, and therefore save less energy than anticipated (up to 70%)
- Humans are extremely ingenious at finding new ways to use energy (heating drives, gardens, making artificial snow etc.)

The EU 20/20/20 by 2020 Programme

- 20% cuts in carbon emissions (30% with international cooperation)
- 20% of renewable energy in final energy demand
- 20% reduction in energy use (below what it would otherwise be)
- Targets rolled out to Member States
  - E.g. UK 15% renewable energy by 2020; 16% cuts in GHG emissions from 2005 level from non-traded sector

EU energy and climate policy instruments

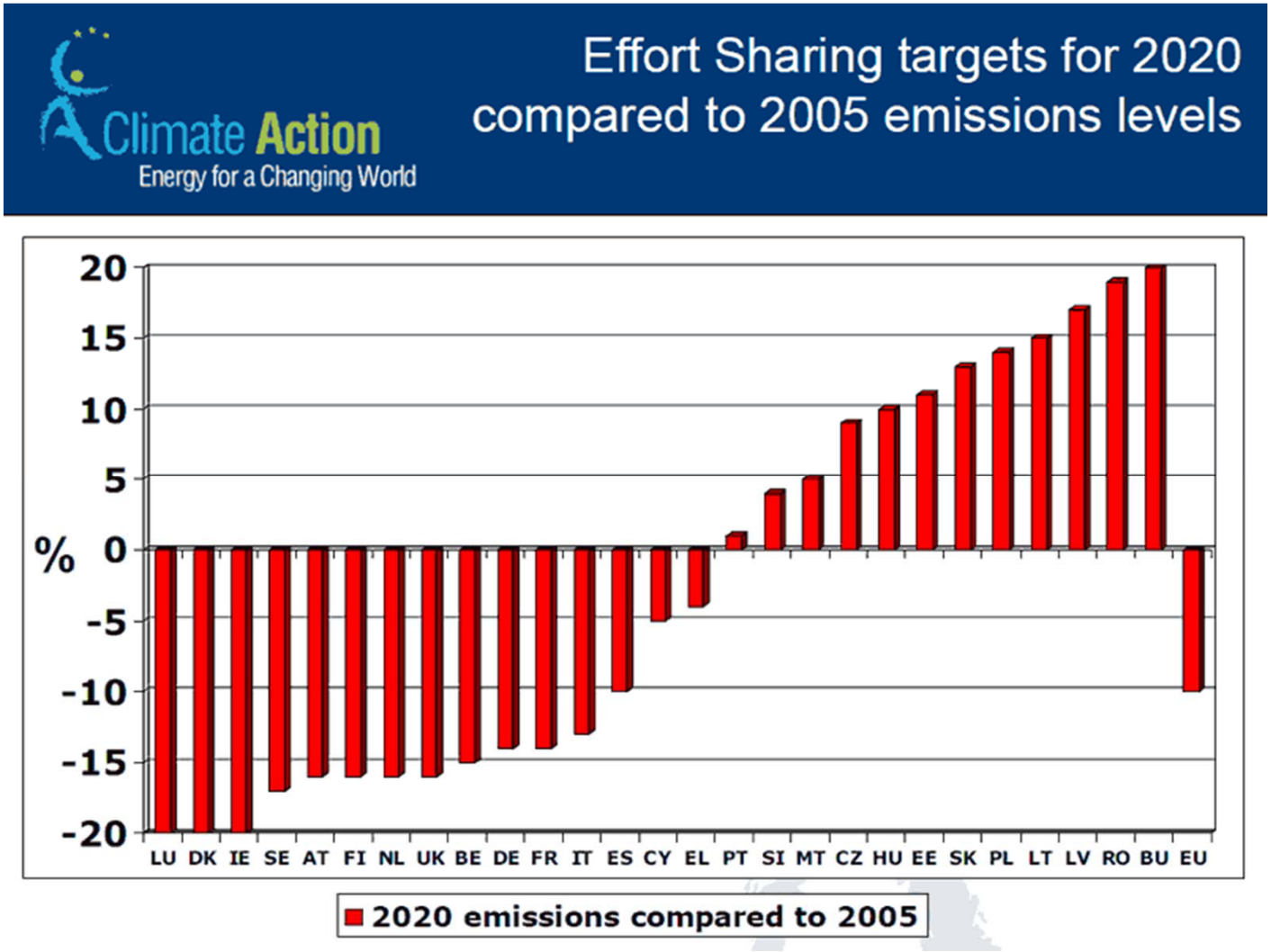
	Policy Landscapes			
Policy Instrument	**Carbon Pricing**	**Energy Efficiency and Energy Consumption**	**Promotion of Renewable Sources of Energy**	**Non-Carbon Dioxide GHGs**
EU ETS	✓	✓	✓	✓
Energy taxation Directive	✓	✓		
Effort Sharing Decision		✓	✓	✓
Energy Performance of Buildings Directive		✓	✓	
Ecodesign Directive		✓		
Energy Labelling Directive		✓		
Energy Efficiency Directive		✓		
Emission Standards for Passenger Cars		✓	✓	
CO2 Labelling for Passenger Cars		✓	✓	
Renewable Energy Directive			✓	
CCS Directive			✓	
F-Gas Regulations				✓
Landfill Directive				✓
Nitrates Directive				✓
LULUCF Accounting Rules				✓

Source: Drummond, P. 2013 'The European Union', report in the CECILIA2050 project ('Choosing efficient combinations of policy instruments for low-carbon development and innovation to achieve Europe's 2050 targets')

IPPC also seeks to promote energy efficiency

ESD (Effort Sharing Decision on energy efficiency)

Source: http://ec.europa.eu/clima/policies/effort/index_en.htm)



The EU 2030 Proposals

- 40% cuts in carbon emissions (perhaps more with international cooperation)
- 27% of renewable energy in final energy demand EU-wide, 27% target for energy efficiency BUT
- No targets for Member States (so 27% purely aspirational and close to business-as-usual anyway)
- ‘Backloading’ EU ETS emission permits in an attempt to support the EU ETS price; further reform post-2020

Economic instruments: Green Taxes and Emissions Trading in the EU (1)

- Carbon-energy taxes:
  - Tax is a Member State (MS) competence, unanimity required
  - Differences in MS environmental taxation undoubtedly distort the single market
  - European Commission initially favoured a carbon-energy tax, but infeasibility led it to adopt EU ETS in order to have an EU instrument in response to Kyoto Protocol
  - Energy Taxation Directive (2003) – low minimum energy taxes – was ultimately agreed
  - Unanimity on further EU stand-alone green tax initiatives in EU28 seems unlikely
  - Might be a case for more limited agreement, or for relaxing the unanimity requirement, if there is a case for EU-wide green taxes
  - Possible revision of Energy Taxation Directive – carbon and energy components

Economic instruments: Green Taxes and Emissions Trading in the EU (2)

- **EU Emissions Trading Scheme (EU ETS)**
  - Phase 1: 2005-2007
  - Phase 2: 2008-2012
  - Phase 3: 2013-2020
  - Speedy introduction of EU ETS a remarkable achievement; widely regarded as path-breaking, essential foundation for global emissions trading for climate change mitigation
  - Nevertheless, not without problems
  - Emissions reduction policies affect the permit price, not emissions, once the cap has been set

Economic instruments: Green Taxes and Emissions Trading in the EU (3)

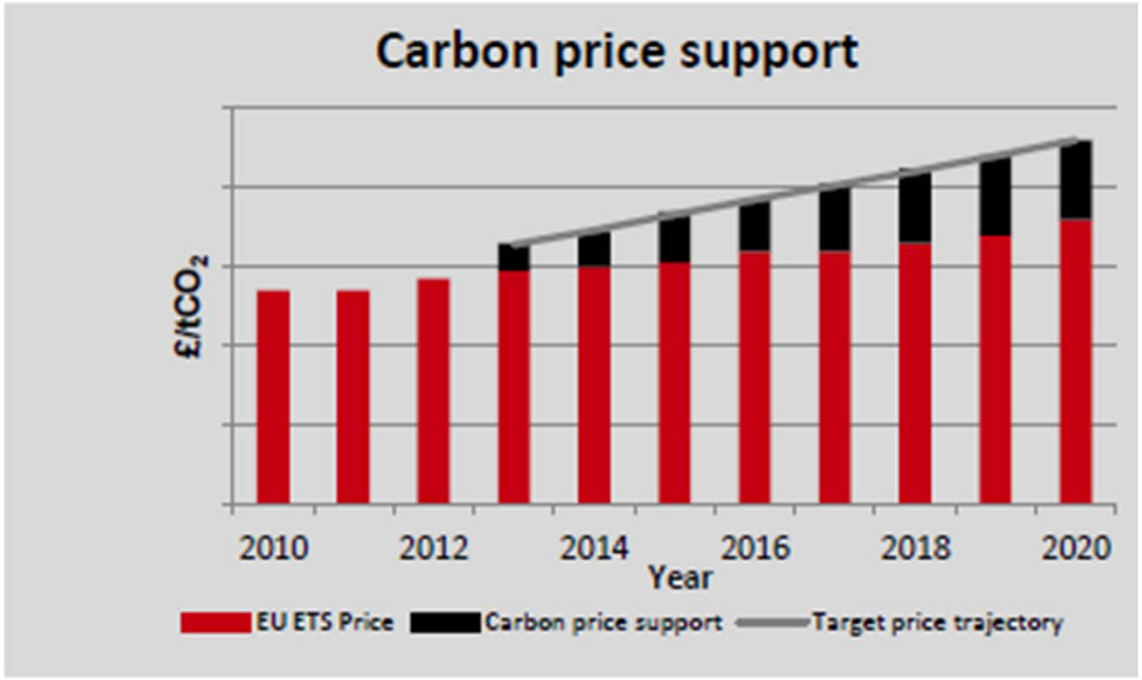
- Emissions trading – issues and problems:
  - New sectors (aviation)
  - Interactions with other schemes
  - Different MS National Allocation Plans distort competition in EU markets
  - Volatile allowance market and low carbon prices give little assurance for low-carbon investment
  - Calls from business for ‘predictable carbon price’ (although full predictability incompatible with trading)
  - Permit price pass through - evidence of ‘windfall profits’, especially in power generation
  - Widespread agreement that more allowances need to be auctioned

The price of CO_2 under the EU ETS

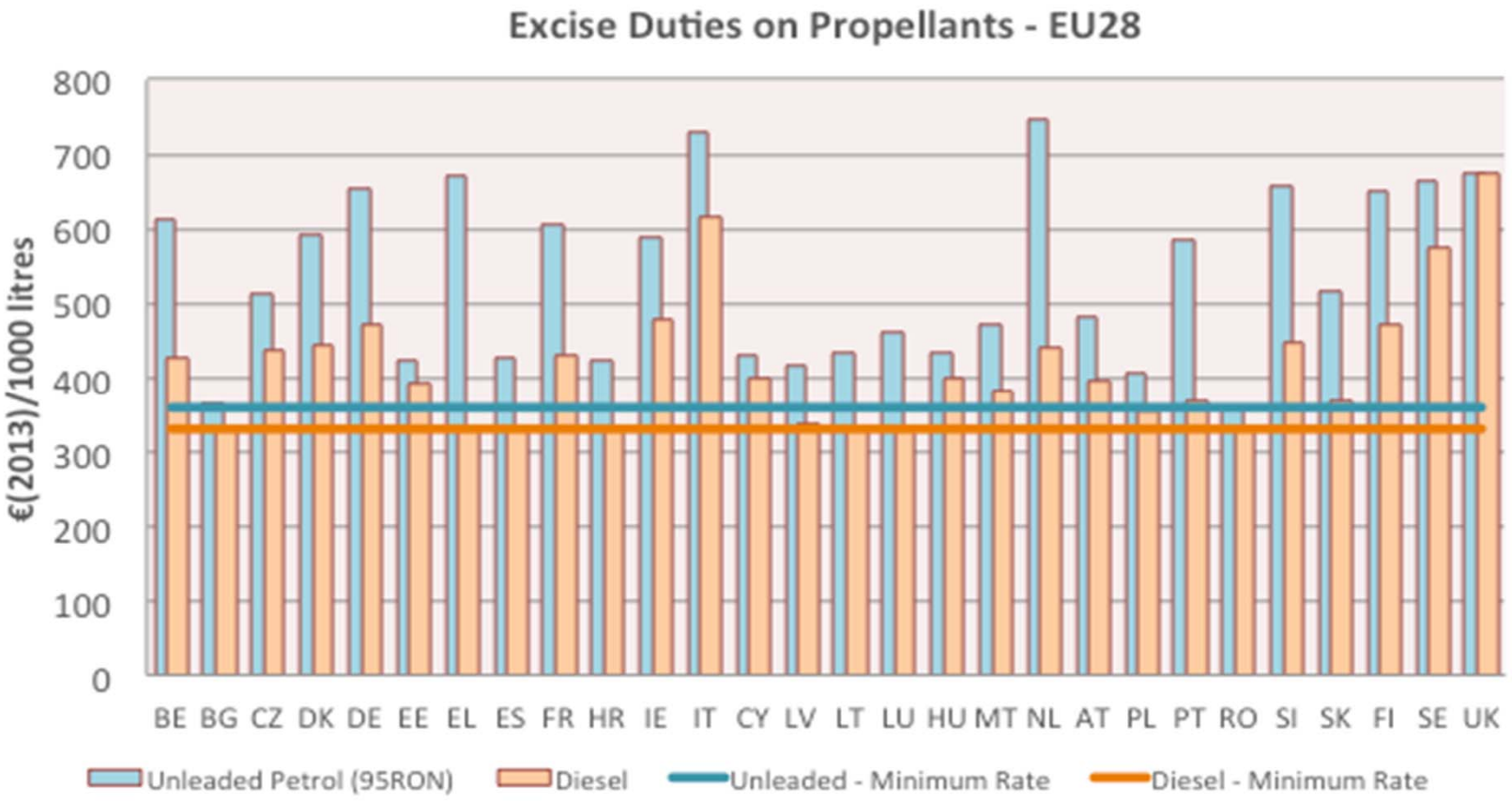
Source: Environment Agency and Intercontinental Exchange, http://daily.sightline.org/2014/07/02/four-carbon-pricing-pitfalls-to-avoid/eu-carbon-prices-have-been-low-since-2008-chart-courtesy-of-european-environment-agency-and-intercontinental-exchange-used-with-permission/

Carbon price policy (UK)

- Carbon price support (£16/tCO2 in 2013, £30/tCO2 in 2020)
- Why not at EU level? Energy Tax Directive



Energy Taxation Directive (ETD) – minimum and actual rates applied on gasoline and diesel



Proposal to revise the Energy Tax Directive

- Split the tax into two components: carbon (€20/tCO2) and energy (€9.6/GJ motor fuels; €0.15/GJ heating fuels, inc. electricity)
- Green Budget Europe et al. critique
  - Rates too low (would require 23% increase just to account for inflation since 2004)
  - Link to EU ETS price too weak – carbon tax component will need to increase faster to achieve necessary emissions reduction
  - Removal of voluntary exemption of household fuels
  - Include aviation/shipping, nuclear fuel, biofuels as appropriate
  - Inclusion of all East European MS
- Prospects for agreement? Slim, given the politics and unanimity decision requirement
- Proposal now withdrawn

What are the obstacles to carbon taxes in Europe?

- Required unanimity on taxation in the EU Council
- Differences in national contexts and tax cultures
- Desire in some member states to keep taxation at exclusively national level
- Political opposition to green taxes in some MS
- Perceived competition with EU ETS

Prospects for environmental taxation in the EU

- The future of environmental taxation in the EU depends on a number of factors
  - International agreement/commitment to emissions reduction – there is a limit to how long or how far the EU will go it alone
  - The rise or decline of Euroscepticism in countries like the UK – greater harmonisation of environmental taxes at an EU level is clearly rational, but this may make little difference to Eurosceptic politics
  - The playing out of the Eurozone crisis – greater fiscal coordination in the Eurozone may open the door to greater harmonisation of environmental taxes in the seventeen countries of the Eurozone
  - Agreement around the Energy Tax Directive, but very unlikely given unanimity requirement
  - A small group of EU countries, coming to the conclusion that environmental taxation is the best way for them to meet their own environmental policy objectives, may coordinate their policies informally, e.g. the Green Growth Group of EU countries

CECILIA2050 Conclusion 1:

The EU climate policy mix is uneven, lightly co-ordinated and difficult to define…

- **Deep divides between sectors (and sub-sectors) and Member States** concerning number of instruments, design, scope, implementation and level of ambition

- **Instruments most coherent across power and industry sectors** (with EU ETS), but still with significant variation between MS (e.g. RES-E support scheme design). Road transport subject to a number of instruments, whilst international shipping and aviation largely excluded.

- **Agricultural emissions have no explicitly targeted climate policy at EU level**. MS level instruments largely recent, focus on information dissemination and R&D, and voluntary. **Common Agricultural Policy** and **Nitrates Directive** probably had largest policy-related impact on emissions

CECILIA2050 Conclusion 2:
…however, it has been effective in producing CO_2 abatement

- EU ETS, RES-E support mechanisms and Environmental Tax Reforms (ETRs) introduced by Member States since 1995 **reduced CO_2 emissions in 2008 by up to 12-13% below the counterfactual in some Member States**

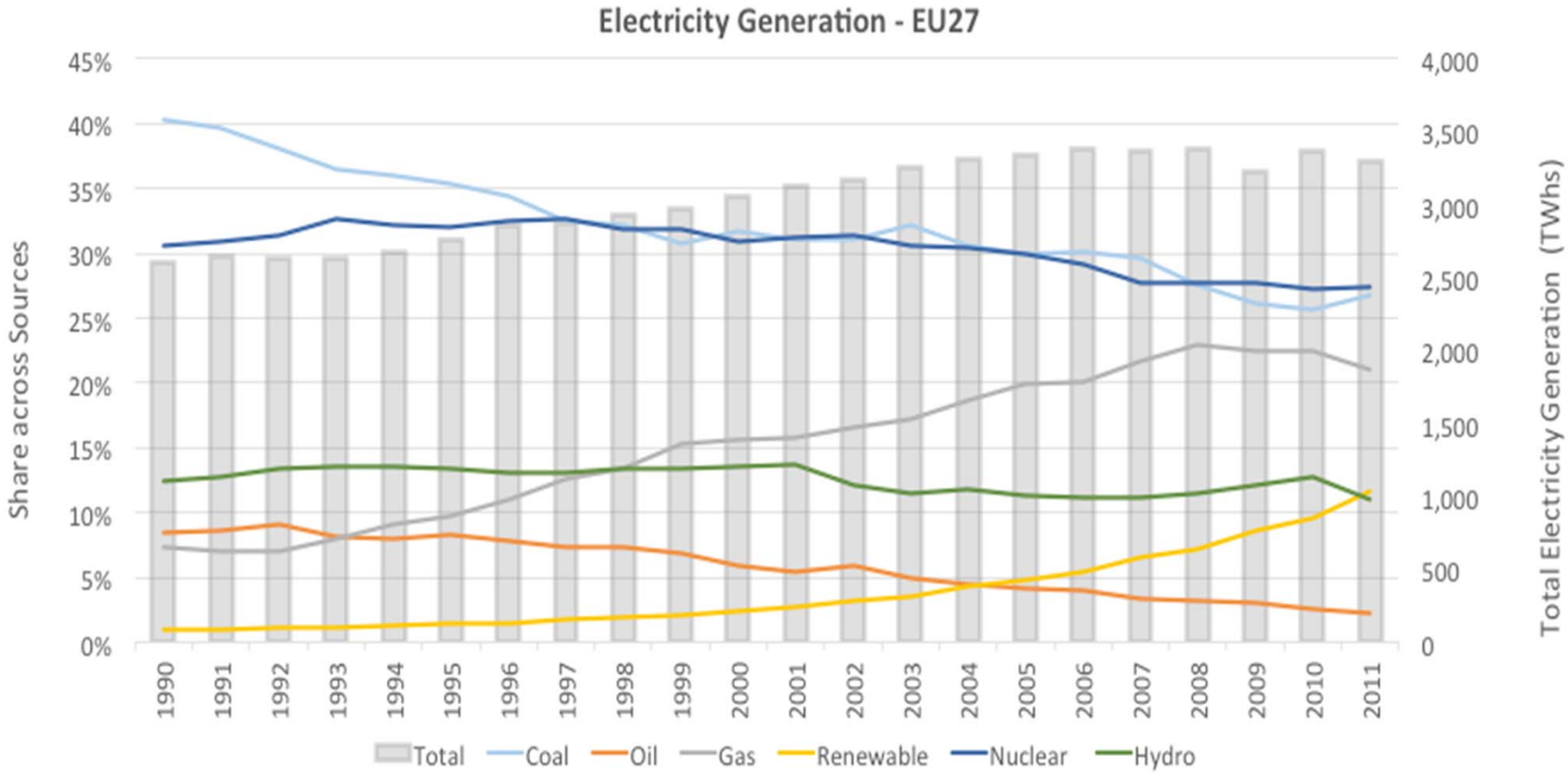
- Impact of other instruments (explicitly and non-explicitly climate policy) likely increases this value significantly

CECILIA2050 Conclusion 3:
Economic instruments are key, but not sole drivers of policy-induced CO_2 abatement

- **EU ETS** produced abatement between **1-3%** in 2008
  - Principally via **fuel-switching** from coal to gas in power sector. This effect is likely to have varied significantly over time due to lack of ability of instrument to adapt sufficiently to unexpected developments (e.g. financial crisis, initial over-allocation)
  - The EU ETS is likely to have triggered only minor technological innovation, due to low and volatile prices and relative unpredictability. Although, induced **organisational innovation has likely been more substantial**, particularly surrounding the introduction of emissions monitoring and management systems.
- **RES-E support mechanisms** produced abatement at an average of between **3.2% and 3.9%** across MS in 2008
  - Value depends on assumptions surrounding the additionality of RES-E investment
  - Dedicated RES-E support mechanisms almost entirely responsible for RES-E deployment, with EU ETS having minimal if any effect. Significant variation between MS (up to 7.88% abatement in Germany)
  - RES-E support/deployment produced significant incremental product innovation, particularly around generation efficiency of renewable technologies

CECILIA2050 Conclusion 3:

Economic instruments are key, but not sole drivers of policy-induced CO_2 abatement



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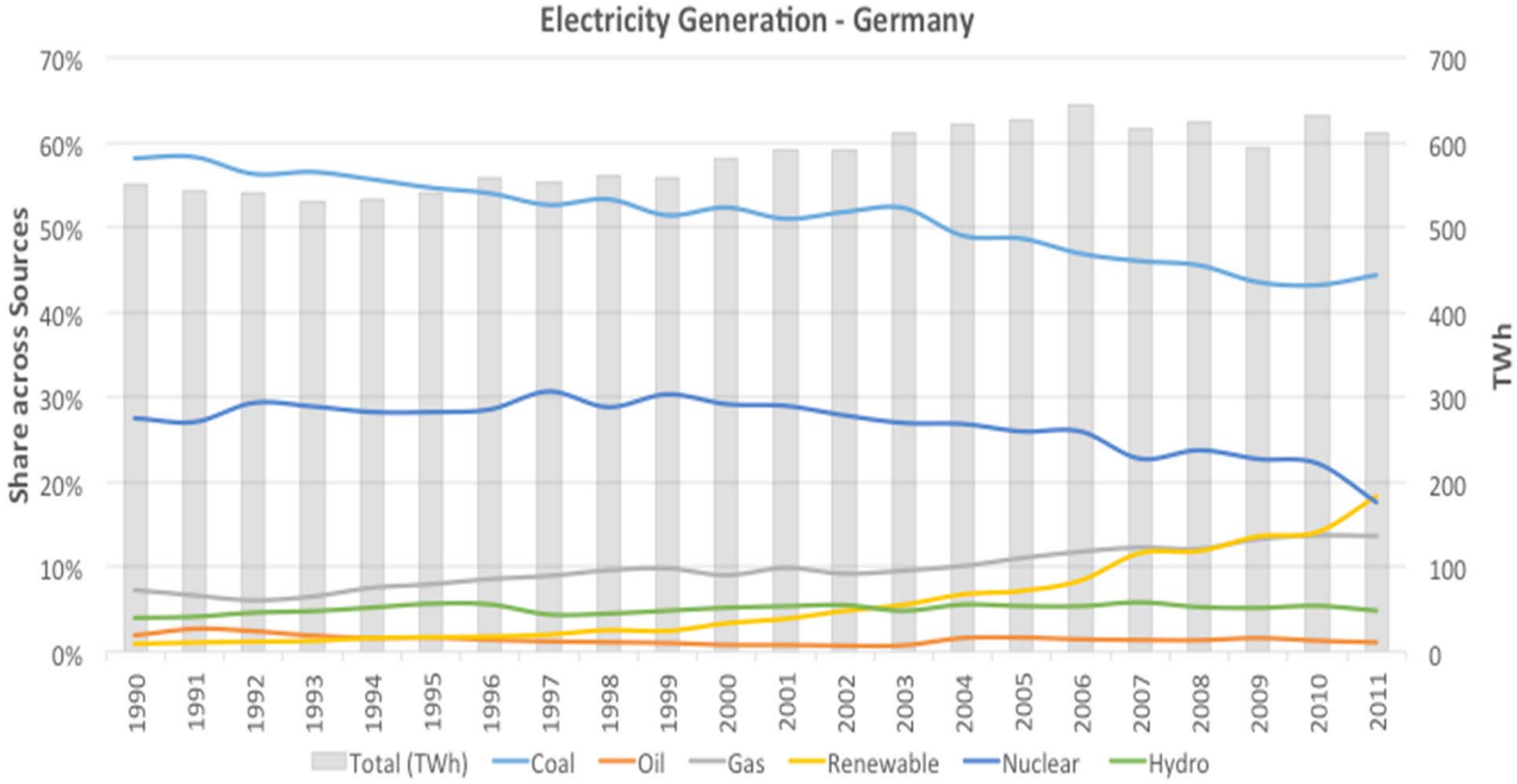

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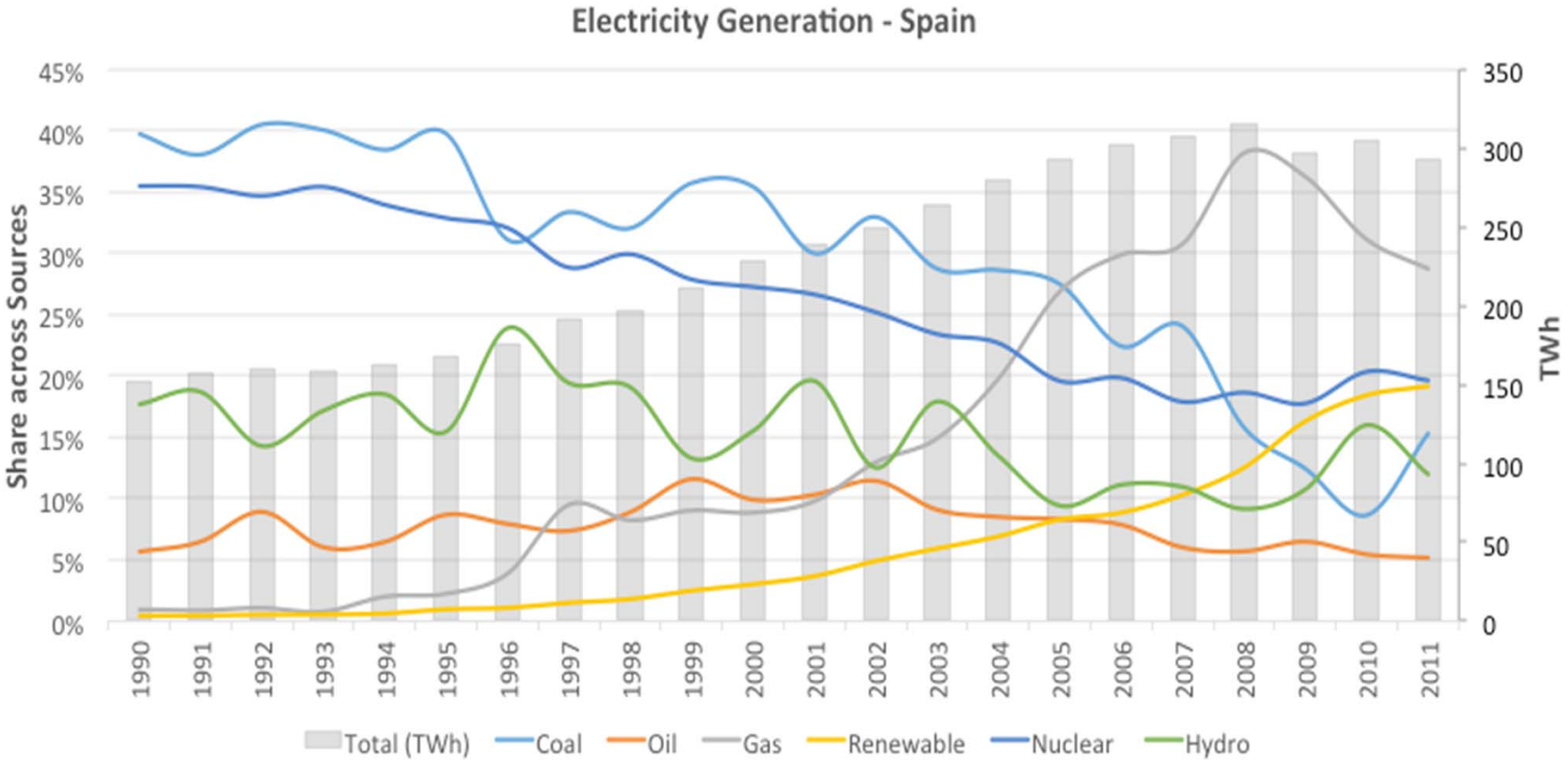

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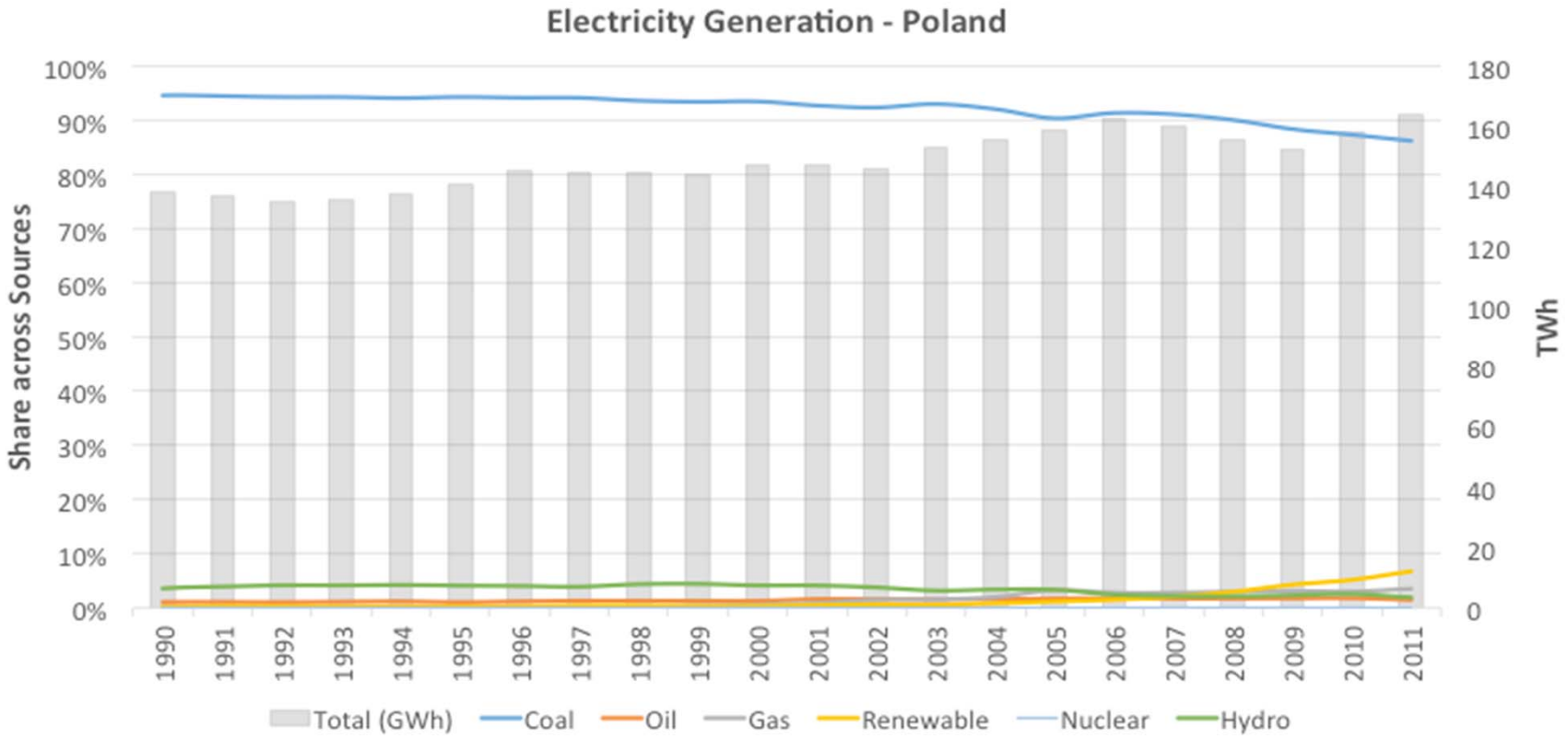

CECILIA2050 Conclusion 3:

Economic instruments are key, but not sole drivers of policy induced CO_2 abatement

- **EU ETS/RES-E interaction** – It is unlikely that the use of RES-E support instruments and deployment has depressed EU ETS prices (in addition to other factors). RES-E deployment was considered during EU ETS cap setting, suggesting only overachievement of targets would produce this effect. In 2010, 15 MS missed their (indicative) RES-E deployment target (set by 2001 Renewable Electricity Directive)

- **Road Transport** – fuel taxation effective in reducing demand, but less so in influencing vehicle purchase decisions. CO_2 intensity regulations for passenger cars (Reg. 443/2009) most effective policy driver for encouraging introduction of less CO_2-intensive vehicles onto the market. (target of 130gCO_2/km for fleet-average for new cars for 2015 already achieved). Impact again likely varied by MS

- **Economic instruments are often subject to distortions less applicable to regulatory approaches** – such as split incentives, environmentally harmful subsidies or company car taxation arrangements.

CECILIA2050 Conclusion 4:
There is no evidence that 'carbon leakage' from the EU has occurred

- Whilst **ex-ante** assessment suggested leakage rates of **5-25%** (higher for some industries) from the introduction of the EU ETS and other climate policies, **ex-post** assessment finds no evidence this has occurred (for 'operational' leakage, at least)
- The difference in findings may be explained by various factors:
  - **Free allocation of EU ETS allowances** in Phases 1 & 2, effectively removing the cost burden, and potentially actively incentivising against abatement/leakage in order to receive higher allocations in future years/phases
  - **Lower, more volatile and less predictable carbon price evolution than projected**. Also, many Energy Intensive, Trade Exposed (EITE – those at risk of carbon leakage) hold long-term electricity supply contracts, shielding them from carbon price fluctuations
  - Many EITE sectors receive **significant protection from renewable electricity levies** (i.e. the EEG in Germany)
  - **Non-consideration, or inadequate representation of other factors** such as capital abundance, labour force qualification, proximity to customers, but also first-mover advantages, 'spillover' effects and the 'Porter Hypothesis' (policy-induced diffusion and innovation of practices/products that reduce costs more than regulatory compliance costs)

CECILIA2050 Conclusion 5:

From a broad perspective, key EU climate policy instruments were economically neutral at worst – and probably beneficial

(extensive literature but no time to review arguments and evidence here)

CECILIA2050 Conclusion 6:

Policy mix 'optimality' is inconsistent with the politics of implementation, but improvements are possible

- **Trade-offs** between the three aspects of 'optimality' ('effectiveness', static and dynamic 'efficiency' and 'feasibility'), is unavoidable in practice
- Effectiveness and cost-efficiency of an instrument or instrument mix is often determined, along with the ability to introduce an instrument in the first place, by **political feasibility**.
- **Political feasibility** (at all levels) is subject to rapid change – options must be on the table ready for introduction when circumstances are favourable
- No reason for thinking that EU climate policy has put EU economy at a competitive disadvantage

Thank you

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