

The logo for Econ, featuring the word "econ" in a dark blue, lowercase, sans-serif font. The letter 'o' is stylized as a dark blue circle with a white ring inside, and a solid green circle is positioned in the center of the white ring.

MEMBER OF THE PÖYRY GROUP

Renewable energy in Europe

October 8, 2008
Gry Hamarsland

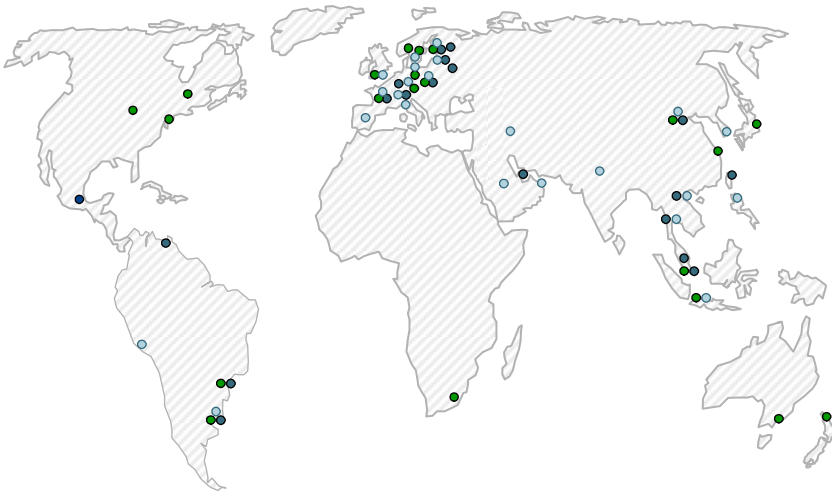
Agenda

- 1 What is renewable energy in a 2020-perspective?
- 2 Political driver: RES directive proposal
- 3 Instruments for national compliance to the target
- 4 Projections of the compliance costs

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European leader in energy engineering and consulting
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Leading position worldwide

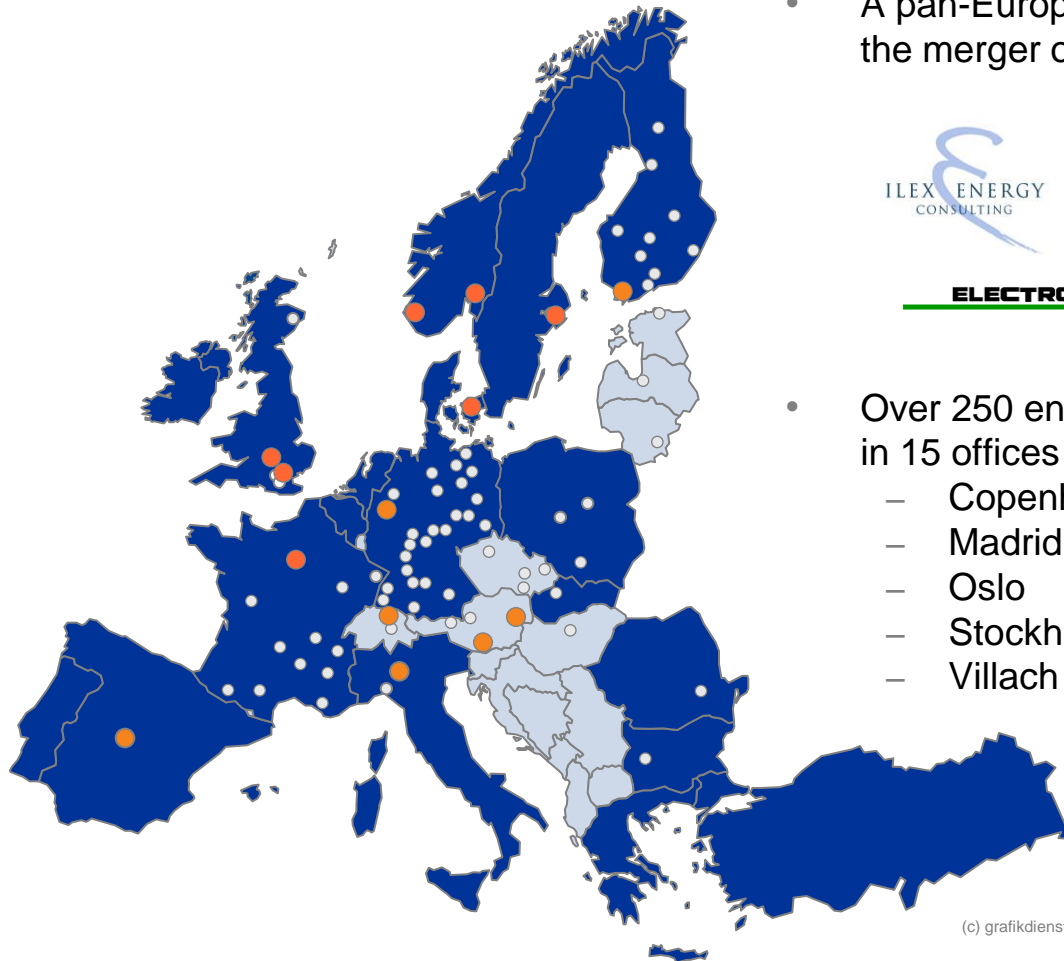


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Agenda

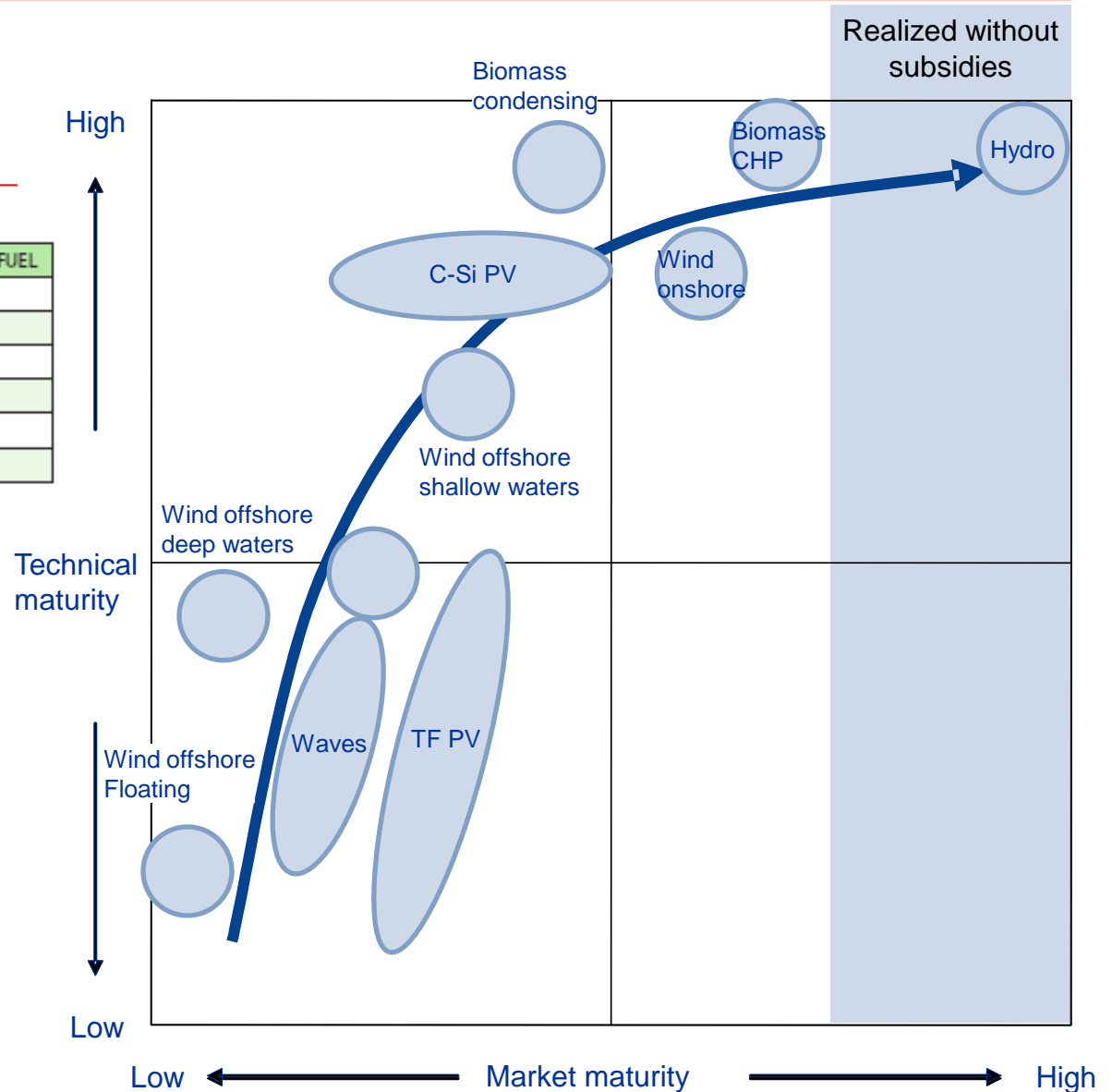
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Renewable energy and Renewable electricity

Uses of different types of renewable energy

	ELECTRICITY	HEAT	TRANSPORT FUEL
BIOENERGY	✓	✓	✓
SOLAR	✓	✓	
GEOHERMAL	✓	✓	
WIND	✓		
OCEAN	✓		
SMALL HYDRO	✓		

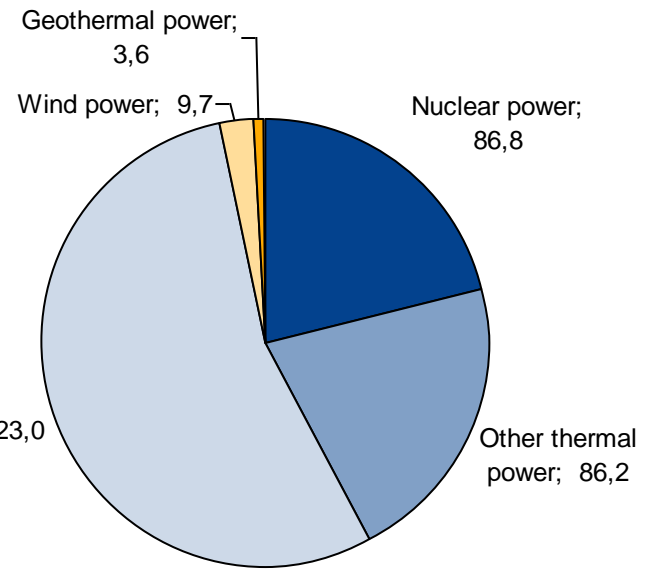
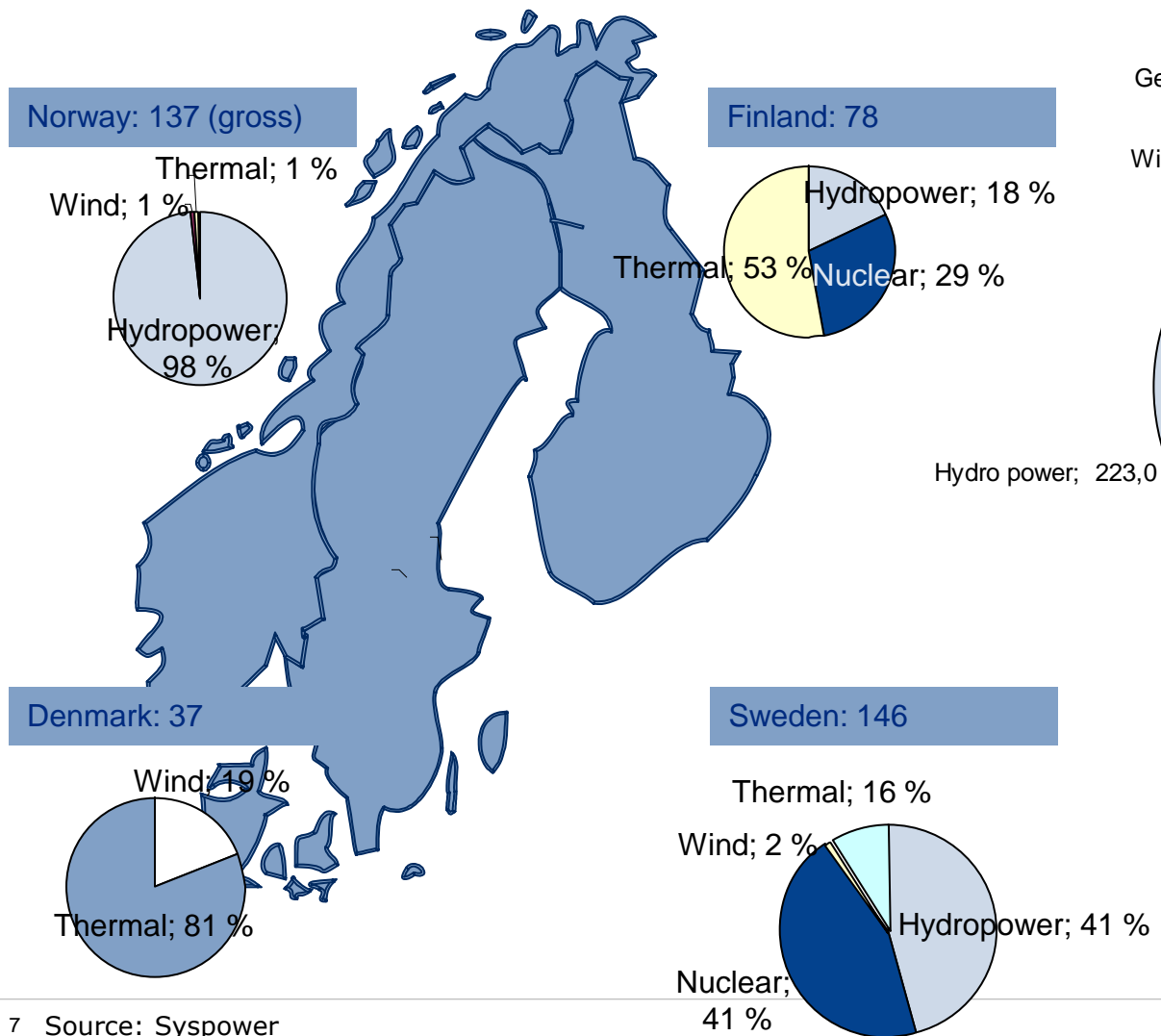
Source: EC



Diversified generation capacity, electricity generation 2007 (TWh)

Nordic production: 400 TWh

Distribution Nordic production



Source: Nordel

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European Union '20:20:20' energy and environment package

- **20%** reduction in EU greenhouse gas emissions, as compared with 1990 levels, or 30% if other nations, specifically the U.S., China and India agree to similar action
- **20%** of all energy consumed to come from renewable energy (including electricity, heat and transport)
 - Binding minimum target for each member state to achieve at least 10% of their transport fuel consumption from biofuels, with certain caveats such that the binding character of this target is 'subject to production being sustainable' and to 'second-generation' biofuels becoming commercially available
- **20%** increase in energy efficiency

The Directive on Renewable Energy (RES Directive proposal)

- Sets mandatory **national targets for the overall share of energy from renewable sources** in energy consumption: overall EU target of 20% in 2020
 - And suggests an indicative **trajectory** to meet these targets
- Require national action plans
- Sets a mandatory **target of 10% for the share of energy from renewable sources in transport** by 2020 ("biofuel" target)
 - Establishes environmental sustainability criteria for biofuels and other bioliquids
- Standardizes guarantees of origin (GO), certifying the renewable origin of electricity, heat and cooling
 - Enables transfer of GOs to provide flexibility between MS's
- Requires reduction of barriers:
 - Administrative, regulatory, information and improves renewables' access to the electricity grid

Current discussions in Parliament

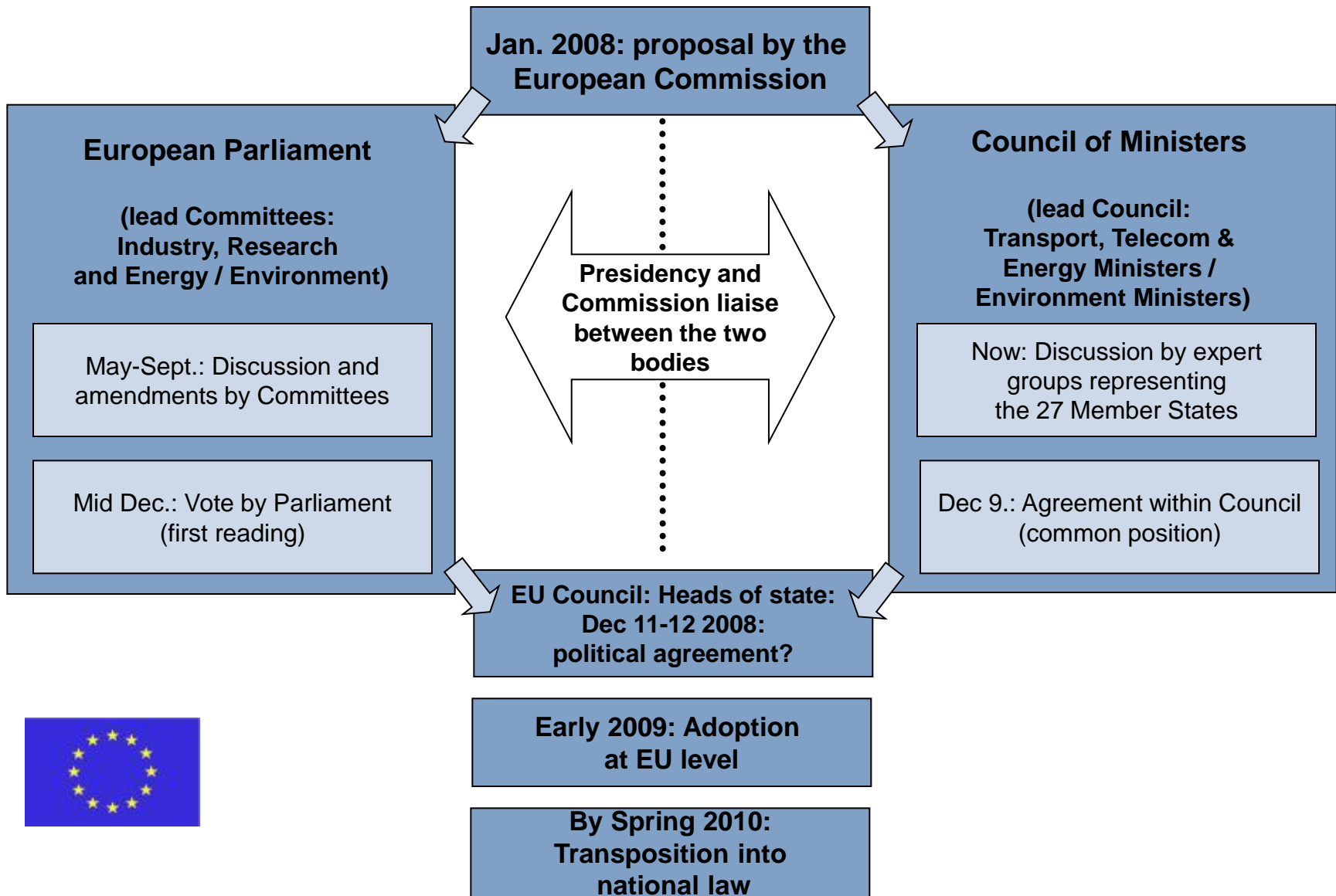
•Compulsory?
•Bonus/malus-system?

•Energy effi.
•Redefined: 40% from not 1st gen
•Sub-target
•Review in 2014

45-60%
carbon
emission
savings

Omitted

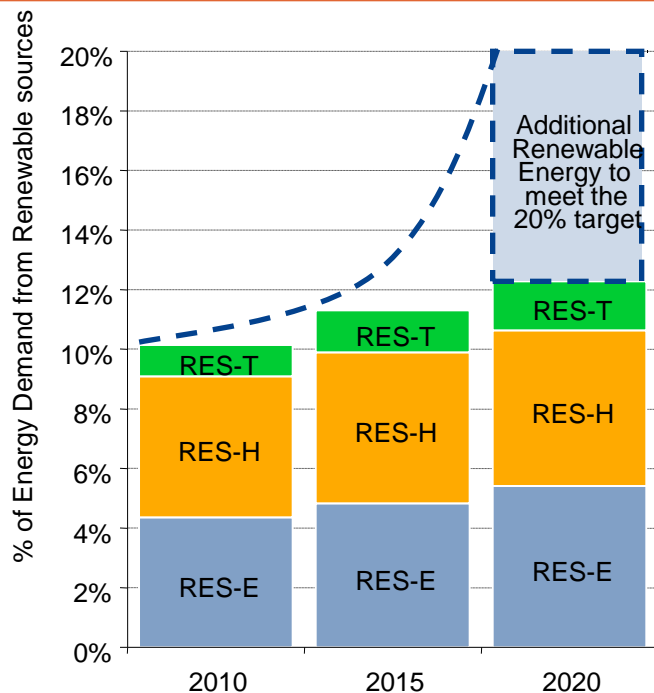
Where do we stand?



What the 20% by 2020 renewables target represents for the EU

- By 2020, under a BAU situation renewable energy supply (RES) is expected to account for around 12% of EU final energy demand
- Use of renewable energy needs to increase by 67% above BAU growth

EU baseline renewable energy supply



Main challenges

Existing support mechanisms inadequate to meet the target deliver the targets

Existing supply chain may need to grow at compound annual rate to meet demand for renewable assets and supporting infrastructure

Commission estimates of renewable resource very reliant on untapped biomass, biogas and biofuel potential

Commission estimates of compliance costs assume a lot of cost-effective renewable heat can be developed

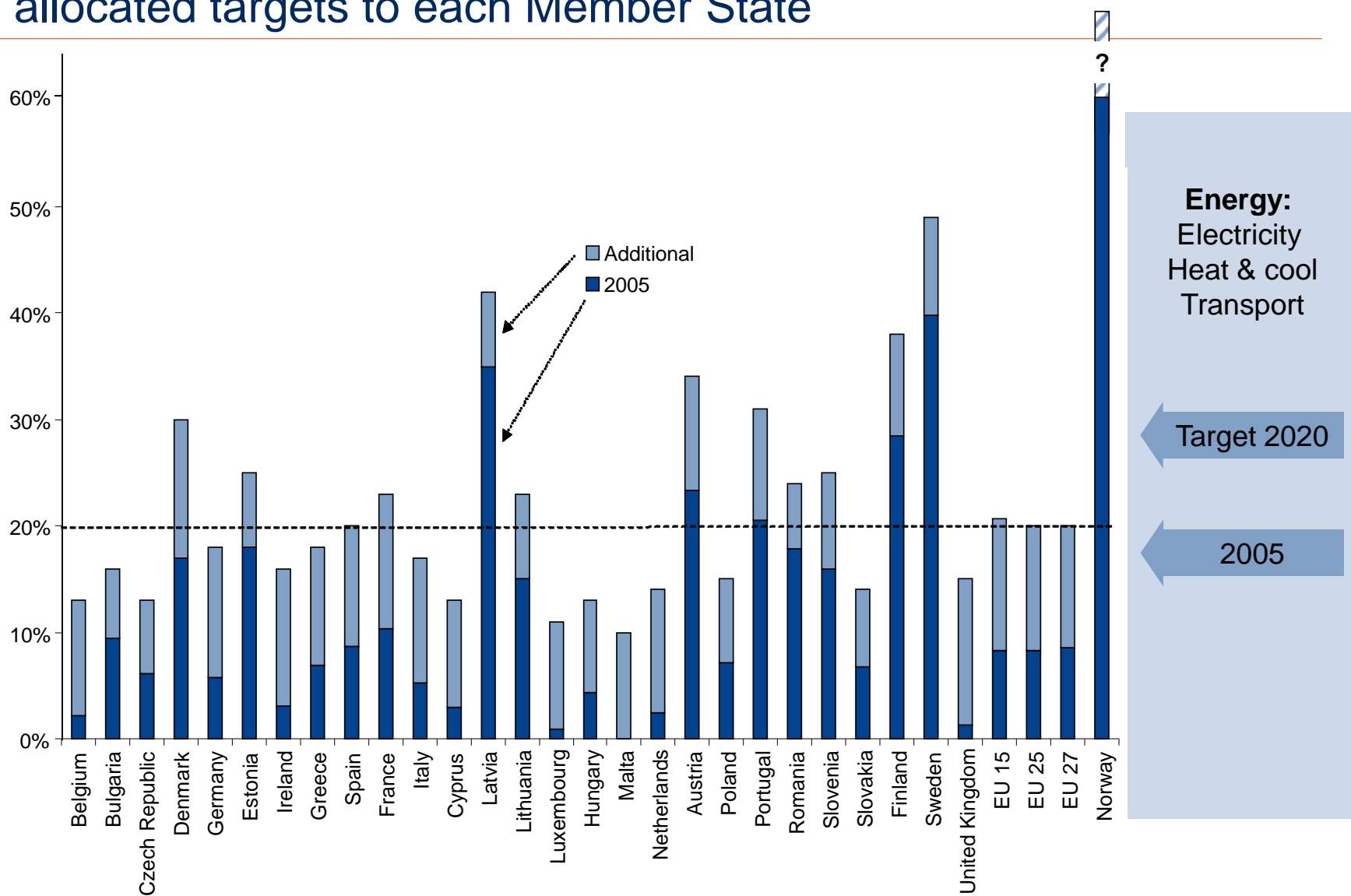
Agreement on trading mechanisms may be difficult to achieve

- Increasing compliance costs for some MS significantly

Is non-compliance a viable option?

Draft Renewables Directive published in January 2008

- allocated targets to each Member State







Targets set on combination of economic renewable potential and GDP

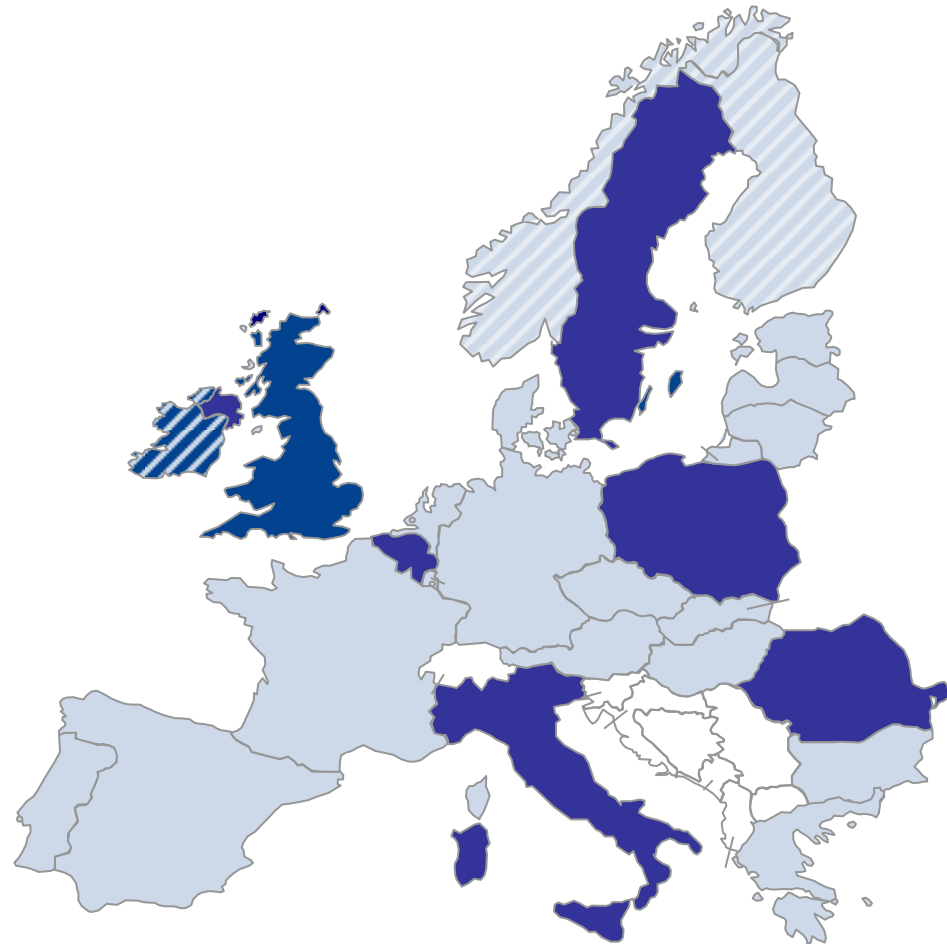
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Supply of Renewable Energy: Overview of Support Schemes

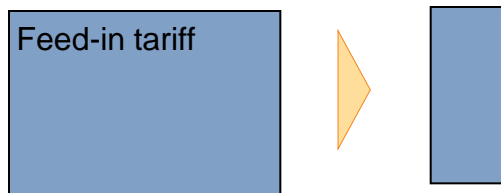
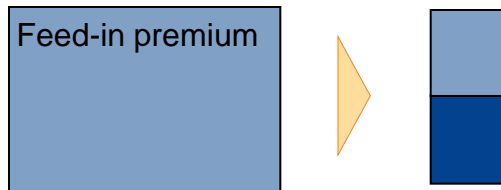
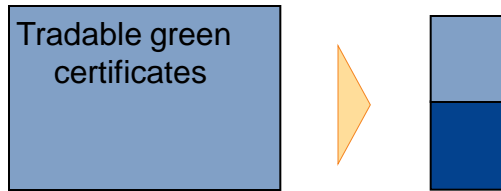
Dominating subsidy scheme



-  Feed-in tariff (guaranteed price)
-  Certificate systems
-  Investment support/tax incentives
-  Tender

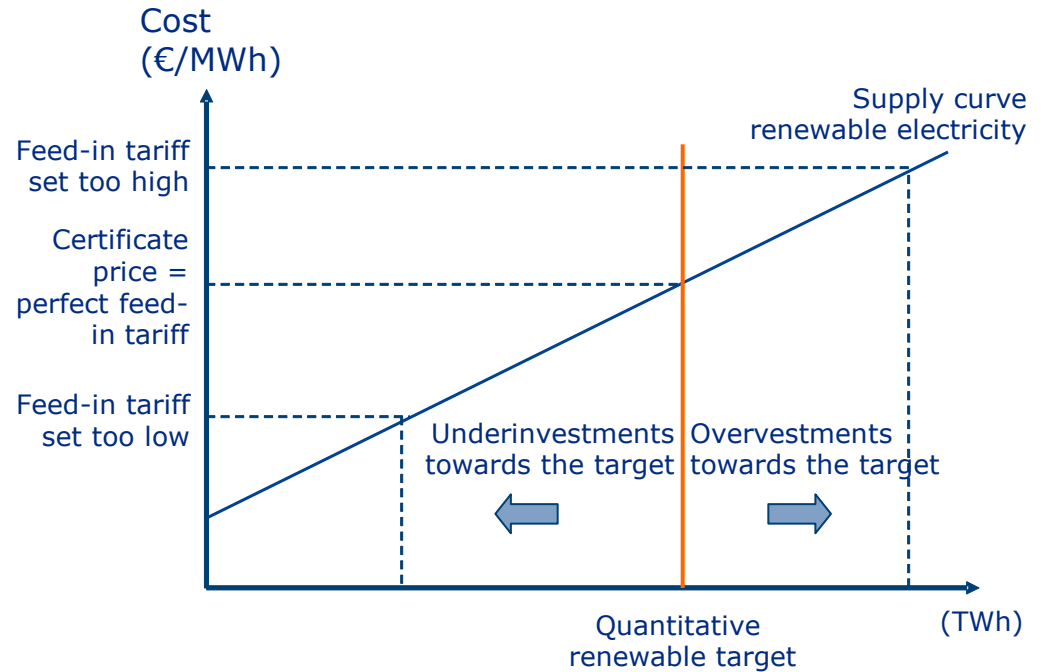


- Renewable energy is subsidised
- Support schemes vary a lot across Europe

Feed in-tariffs, certificates and quantitative targets



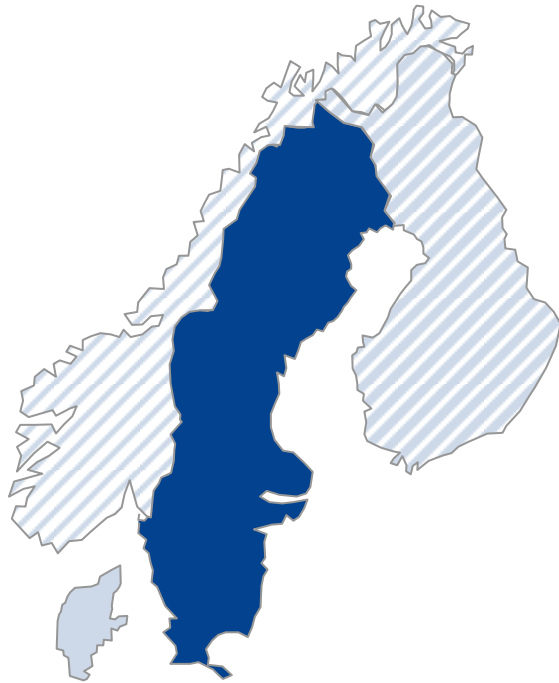
 Governmental support
 Power price







And remember:

- Who is financing the support scheme and
- Who is taking the risk

Each Nordic Country currently applies a different national support system for renewables




-  Certificates
-  Investment support/Tendering
-  Fiscal incentives
-  Feed- in tariffs/Tendering

- Support level for different fuels and technologies also vary within countries. In feed-in systems, the technology choice is made by politicians, whereas in the certificate system the technology choice is based on most economic technologies.
- The needed support level (premium) changes with changes in the power price. Oil, gas, coal and carbon prices vary over time.
- Target levels are mostly set in TWhs (amount of electricity produced), not as percentages of consumption.

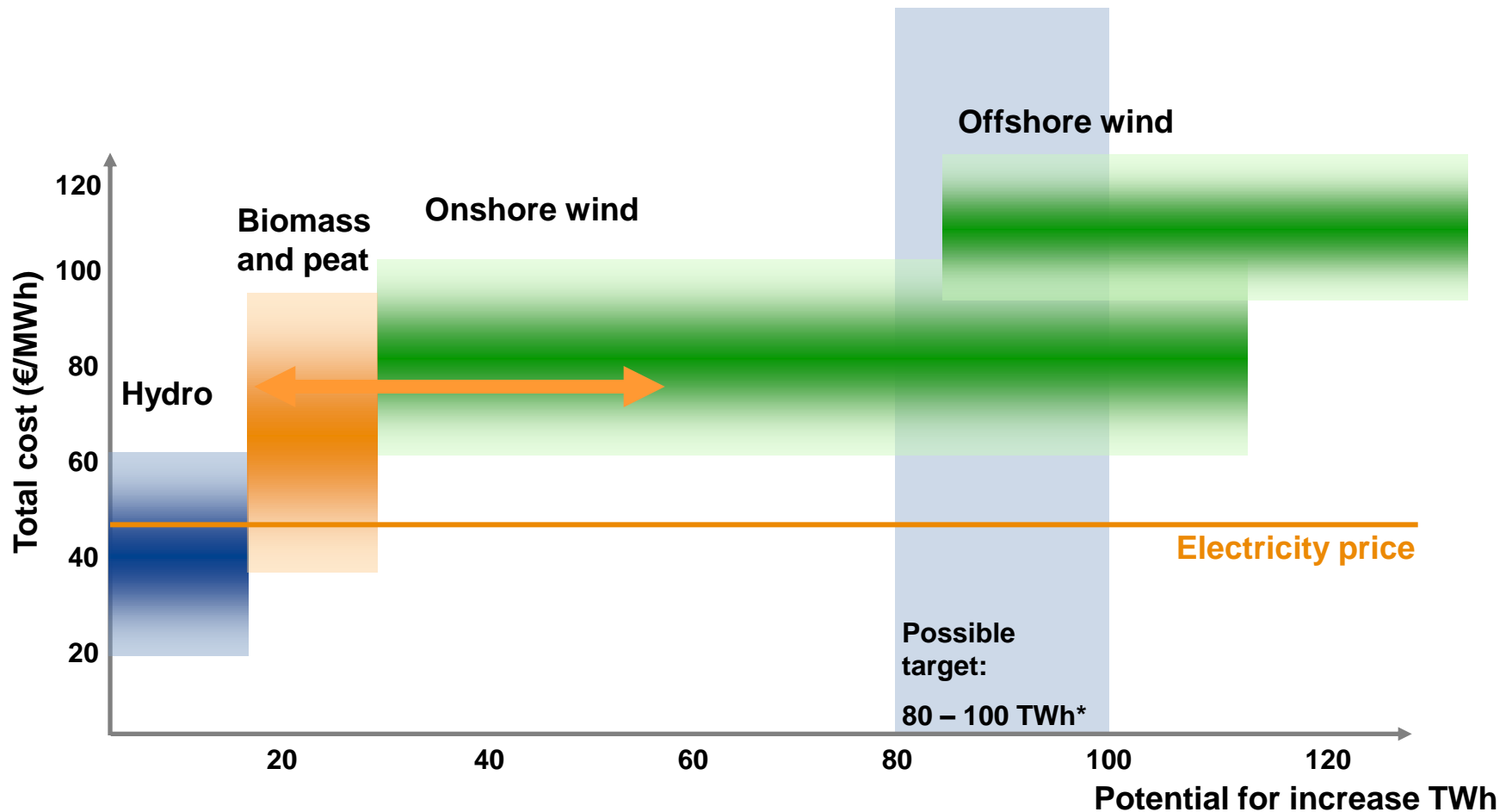


- National schemes can lead to sub-optimal investment decisions based on support level. Limited national support funds can limit the support only for the first projects
- For the companies planning investments, uncertainties about developments in market fundamentals are not as costly as policy/administrative uncertainty
- In general, market-based systems are more transparent and correspond to changes in the market and especially in technology development.

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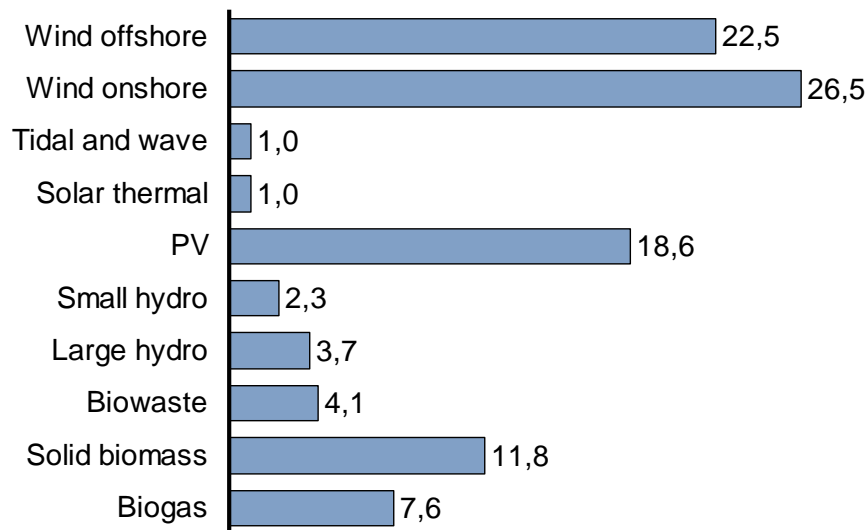
Possible renewable electricity potential in Finland, Sweden and Norway towards 2020



*Based on Econ Pöyry's estimates

Compliance costs estimate – renewable electricity

Breakdown of cumulative investment needs for new RES-E capacity (2005-2020), per cent



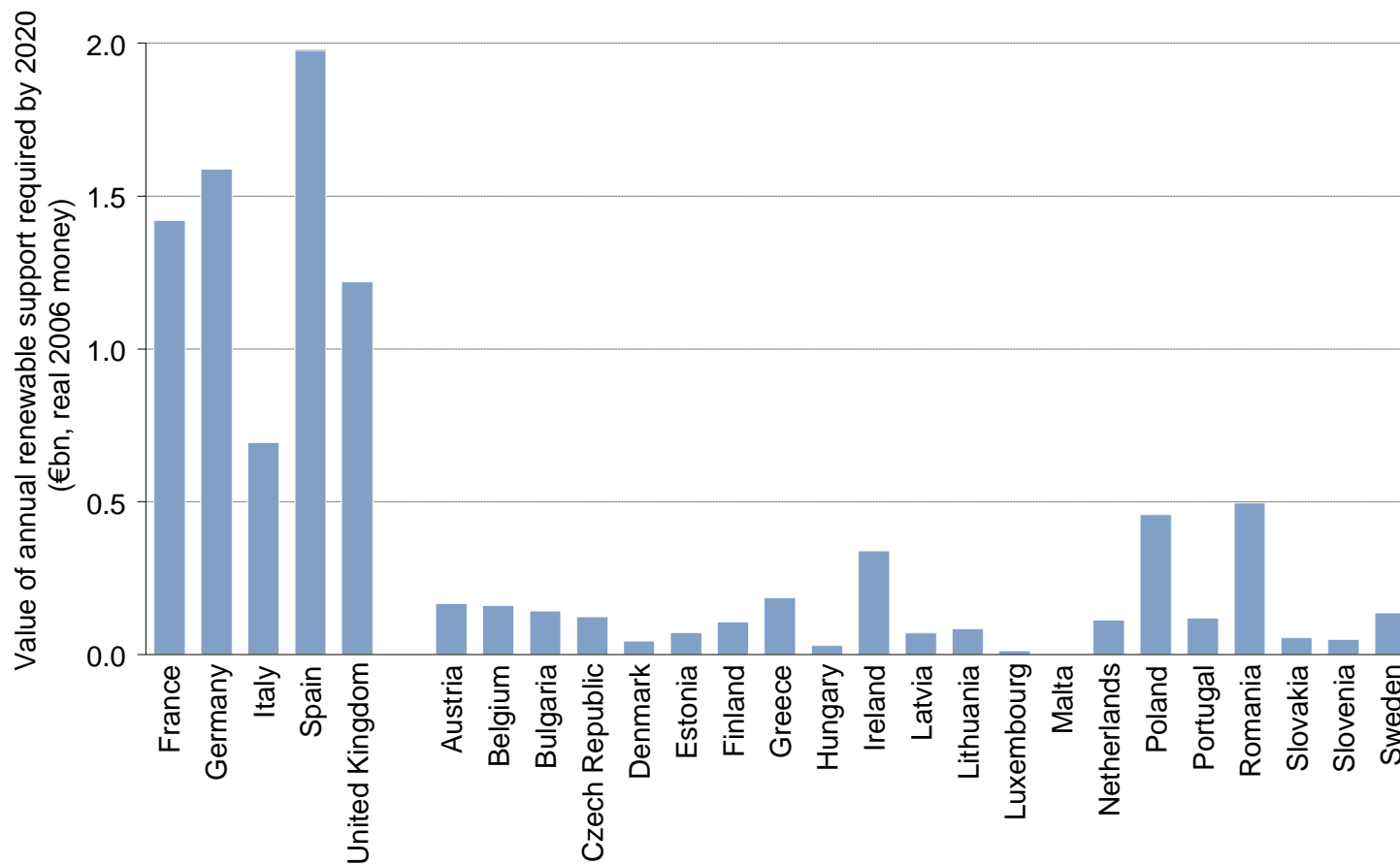
Total investment needs:

€ 330 bn

Source: OPTRES, 2007

Compliance costs vary across member states

Cost of renewables support in a fully traded renewables market





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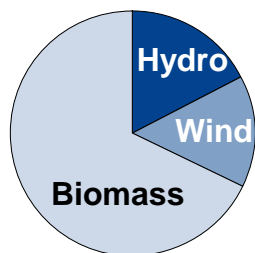
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Examples of Sweden's effort in reducing CO₂ emissions in the energy sector



Produce more renewable energy

Examples:

- Renewable electricity
- Instrument: Electricity Certificate scheme
- 6.2 TWh increase in renewable electricity production from 2002



Energy efficiency

- Passive buildings
- 11 already built, 7 planned
- Highly isolated buildings; utilizes energy already existing in the building and external energy sources (solar)



Getting new technologies on to the market

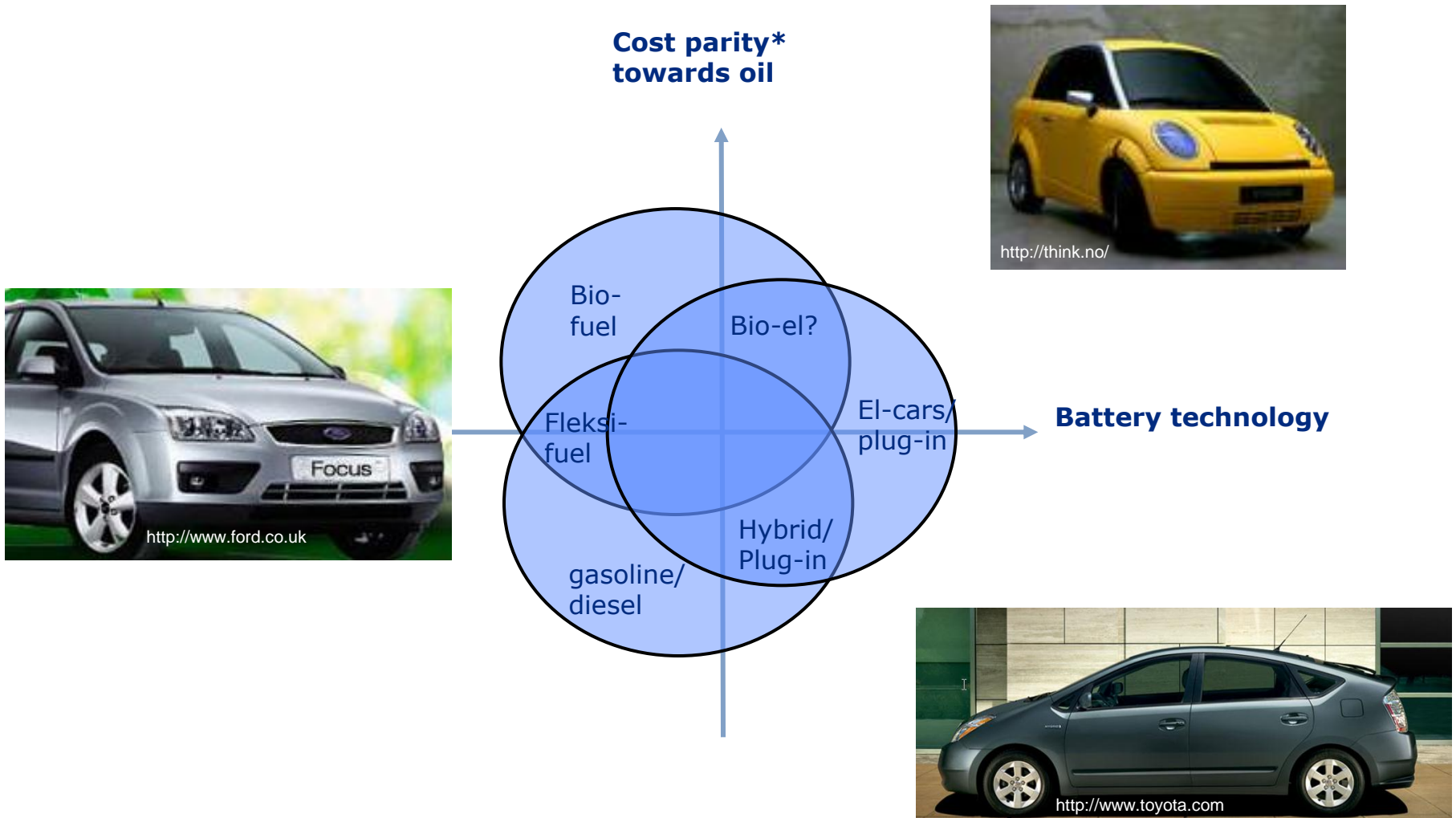
- Lillgrund in Öresund (2007)
- 48 turbines, 110 MW
- Instrument: Pilot support and environmental support (Electricity Certificates)



Technology development

- Vattenfall: Schwarze Pumpe in Germany (2008)
- 30 MW thermal pilot plant (Lignite and hard coal)
- The captured CO₂ will be stored underground as soon as a suitable site has been identified and the necessary permit processes are completed

Coexisting of different technologies and fuels within the transport sector towards 2020

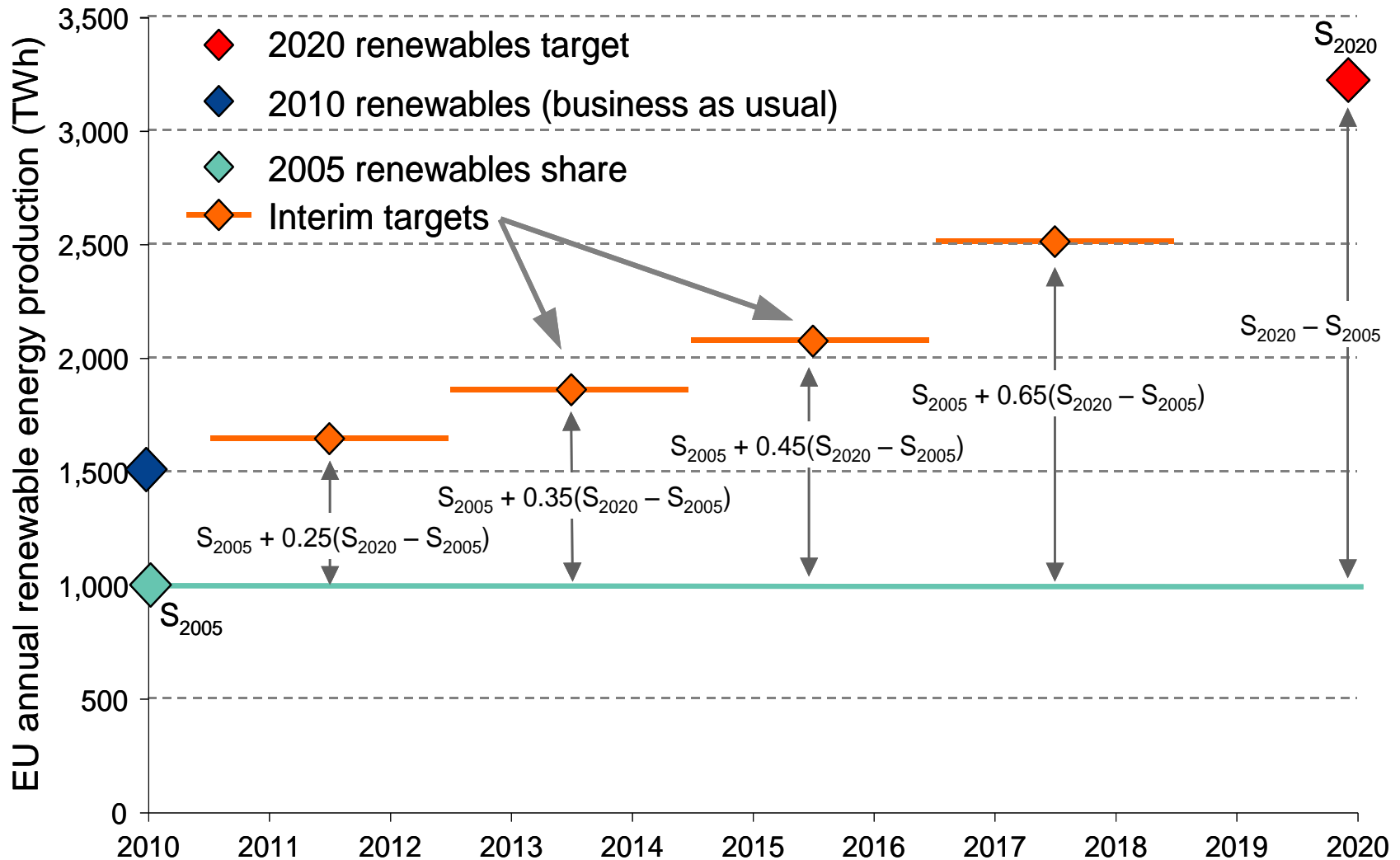


*Assumption: equal quality

Annex 1 - Targets set by the draft RES Directive (COM proposal)

	Share of energy from renewable sources in final consumption of energy, 2005 (S2005)	Target for 2020 (S2020)
Belgium	2.2%	13%
Bulgaria	9.4%	16%
The Czech Republic	6.1%	13%
Denmark	17.0%	30%
Germany	5.8%	18%
Estonia	18.0%	25%
Ireland	3.1%	16%
Greece	6.9%	18%
Spain	8.7%	20%
France	10.3%	23%
Italy	5.2%	17%
Cyprus	2.9%	13%
Latvia	34.9%	42%
Lithuania	15.0%	23%
Luxembourg	0.9%	11%
Hungary	4.3%	13%
Malta	0.0%	10%
The Netherlands	2.4%	14%
Austria	23.3%	34%
Poland	7.2%	15%
Portugal	20.5%	31%
Romania	17.8%	24%
Slovenia	16.0%	25%
The Slovak Republic	6.7%	14%
Finland	28.5%	38%
Sweden	39.8%	49%
United Kingdom	1.3%	15%

Annex 2 - Illustrative total EU trajectory to achieve the 2020 target: same formula for each Member State (COM proposal)

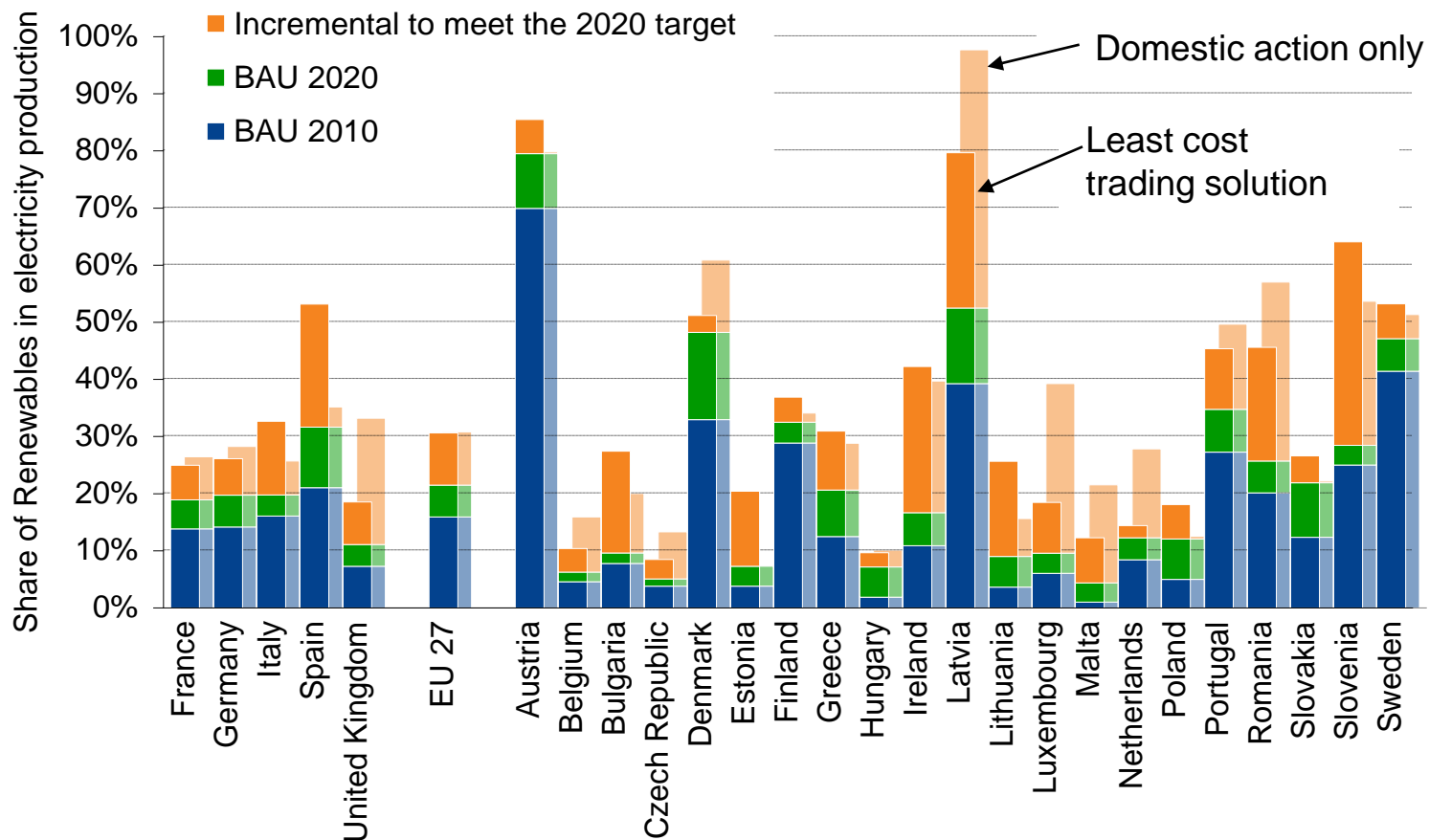


Annex 3 - the draft RES Directive: key milestones

Milestone	Who does what?	COM dates	Agreed dates
Agreement / adoption	European Parliament and Council		By end 2008 / early 2009
Entry into force	Following adoption, publication in the EU Official Journal gives legal effect	Early 2009	?
Transposition	Each Member State (+ NO) should have transposed the directive into national law	By 31 March 2010	?
Indicative trajectory	To meet their 2020 target, each MS should steadily increase their share of renewables through a standard formula	Averages over a two-year period (2011-2012, etc.)	?
National Action Plans	Each MS should notify their first national action plans to the Commission (including overall strategy, targets and key measures)	By 31 March 2010	?
Reporting on progress	Each MS should report regularly on progress (+ COM assessment)	By 30 June 2011 and every 2 years thereafter	?
Review of rules for GO transfer	The Commission will re-assess the costs and benefits of the provisions related to the transfer of GOs between MS	By 31 Dec. 2014	?

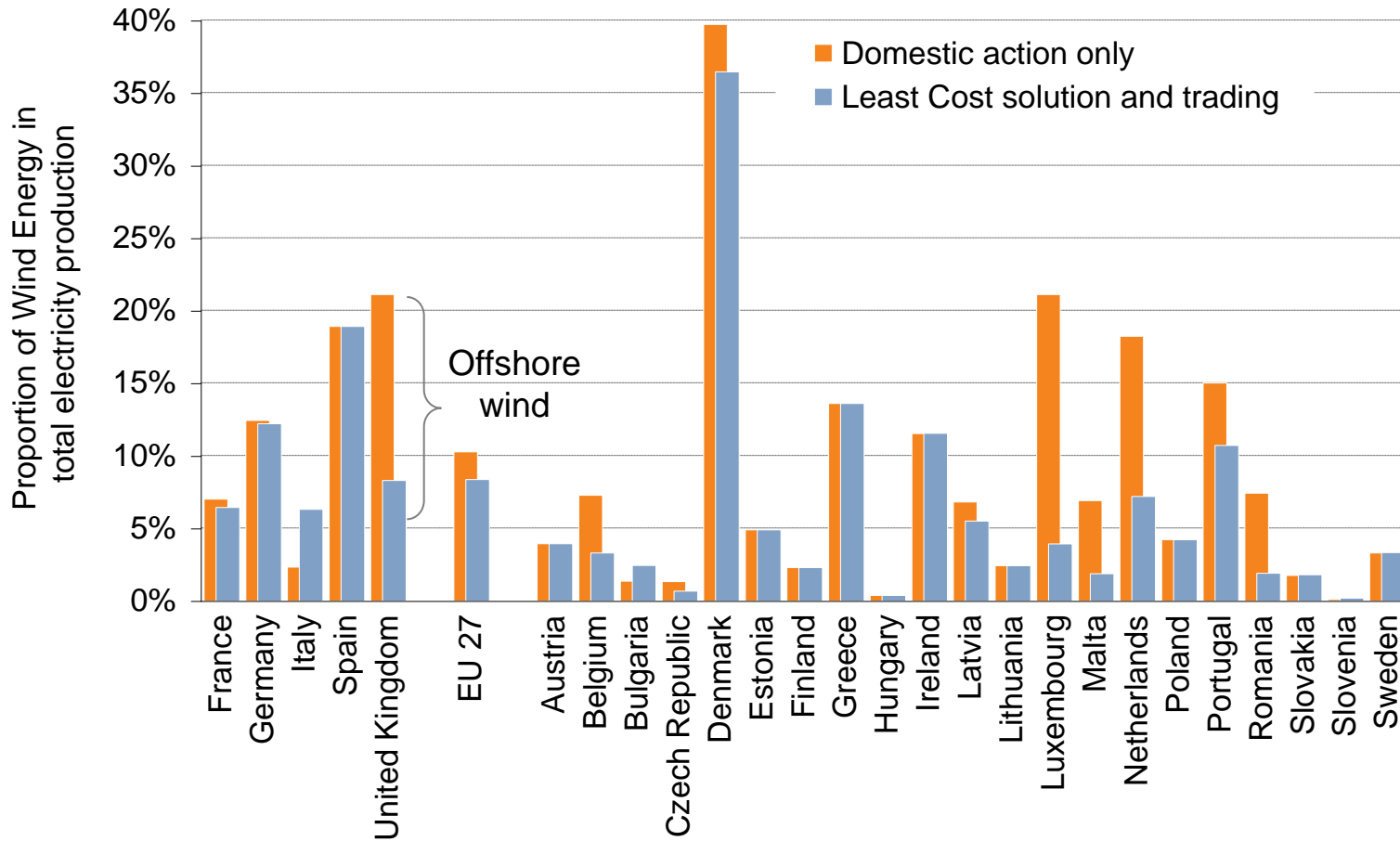
Estimation of proportion of renewable electricity supplied

The extent of trading could be a significant determinant of the proportion of renewable electricity in the generation mix



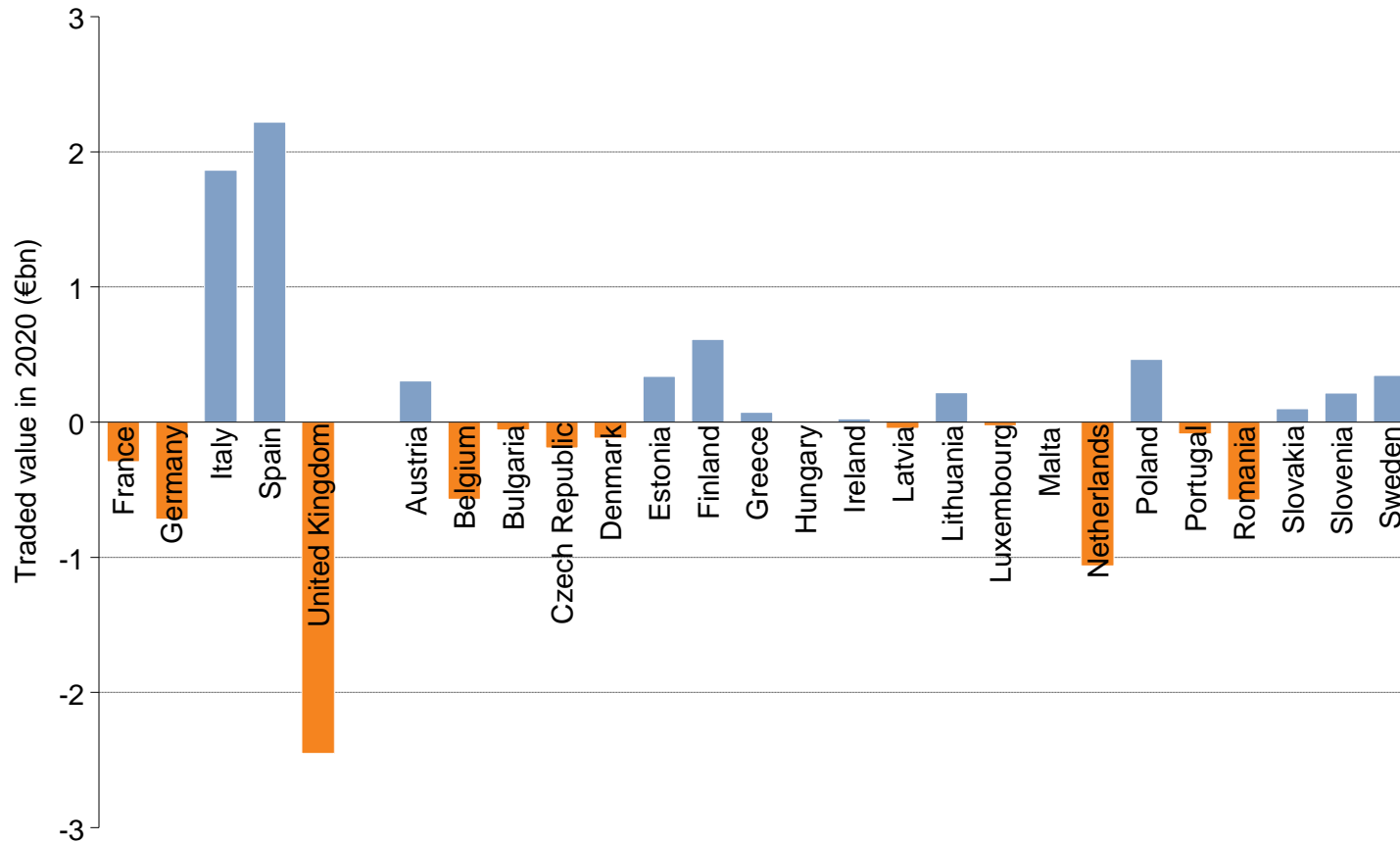
Estimates of wind power development

- Proportion of wind power on the system varies significantly by Member State and by compliance route
- Growth in wind required to meet the targets could test the ability of System Operators to balance the system



Trading volumes in green certificates

Trading in green certificates could range from €8bn (EC estimate) to €13bn (Pöyry estimate) annually by 2020



Green certificate scheme is more cost effective and flexible support system compared to feed-in tariffs

	Effectiveness	Cost efficiency	Dynamic efficiency	Flexibility	Predictability
Tradable green certificates (long-term targets)	+++ Set volume target – price adjusts Penalty level must be high enough	+++ Market prices pass on information on (expected) long-run marginal cost for renewables	++ Do not favour infant technologies	+++ Prices adjusted for new market information (Fuels, techn., EUAs, taxes, ...)	++ (Known) market uncertainty Negative correlation power/TGC)
Feed-in premium -as uniform right	+ Imprecise. Depends on information about and slope of supply curve	+++ Power price pass on info. about conventional power	++ Do not favour infant technologies	+ FT set for regulation periods	+ Power market uncertainty Premium changed by authorities
Fixed feed-in tariff -long-term contract	++ Imprecise. Queue mechanism? Auctions: Winner's curse?	+ Incentive to overestimate costs Weak incentive for best projects first	+++ Room for tailor-made contracts	++ Can be changed from contract to contract. Fixed per contract for agreed period	++ Full when contract is signed Main criteria may be changed prior to contract.

Other criterias:

- Ease of introduction – to existing managerial, legal and technological systems
- Ease of monitoring and enforcement – reliable compliance monitoring an enforcement implemented
- Diversification – lead to a diversified electricity system
- Equity or Fairness – disproportional burdens or benefits
- Acceptability – understood by the public, acceptable to generators and sellable to government

Tradable green certificate scheme is a market based support mechanism for renewables

- In the certificate system, each producer of eligible renewable production receives a certificate for each MWh of electricity produced. The certificates can be sold in the market separately from the electricity.
- The electricity users or retailers have an obligation to purchase renewable energy according to an ambition level set by authorities - for example 10% share of electricity purchase. This sets the demand for certificates.
- Price of certificates reflects the last renewable production unit needed to fulfil the total renewable target. The certificate is tradable in the market like any other securities

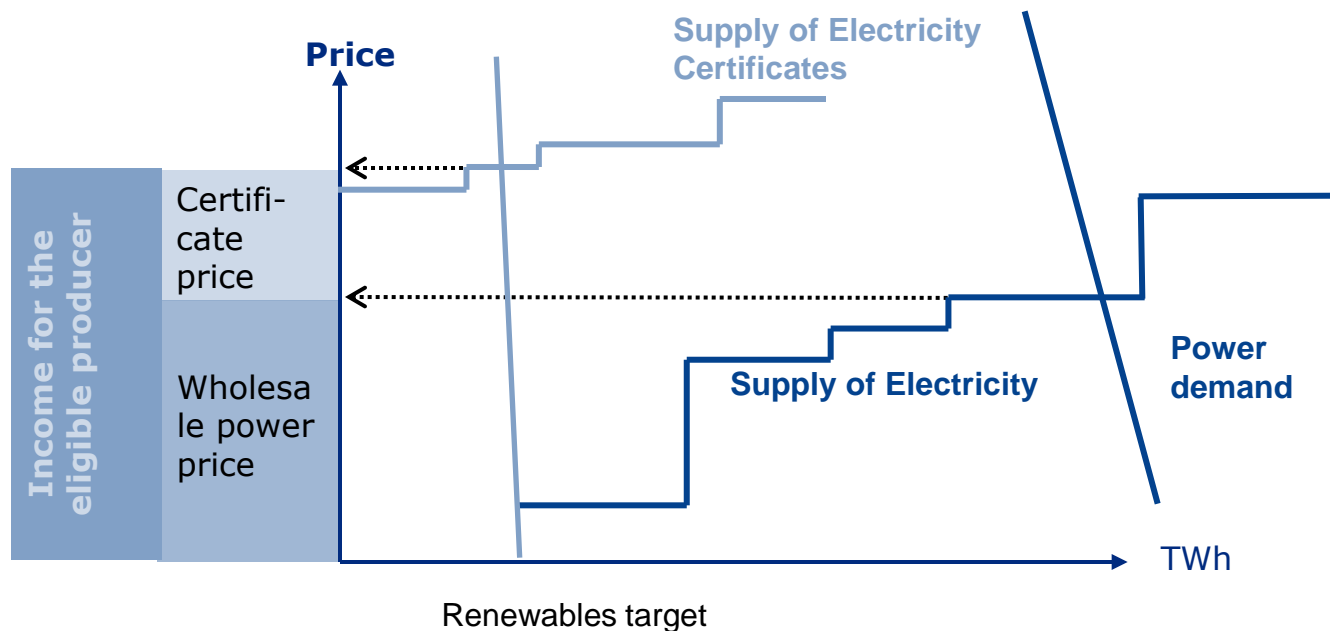
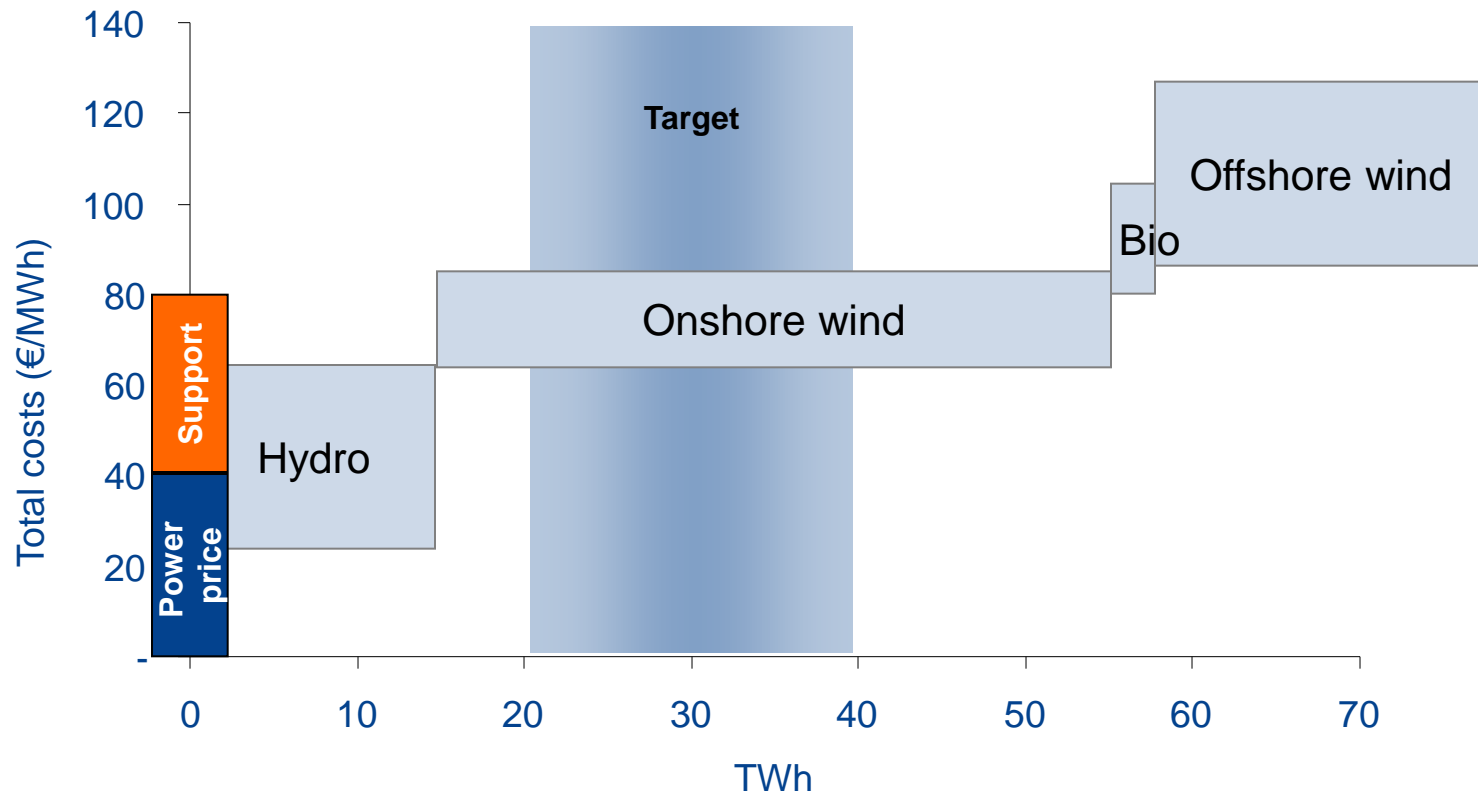
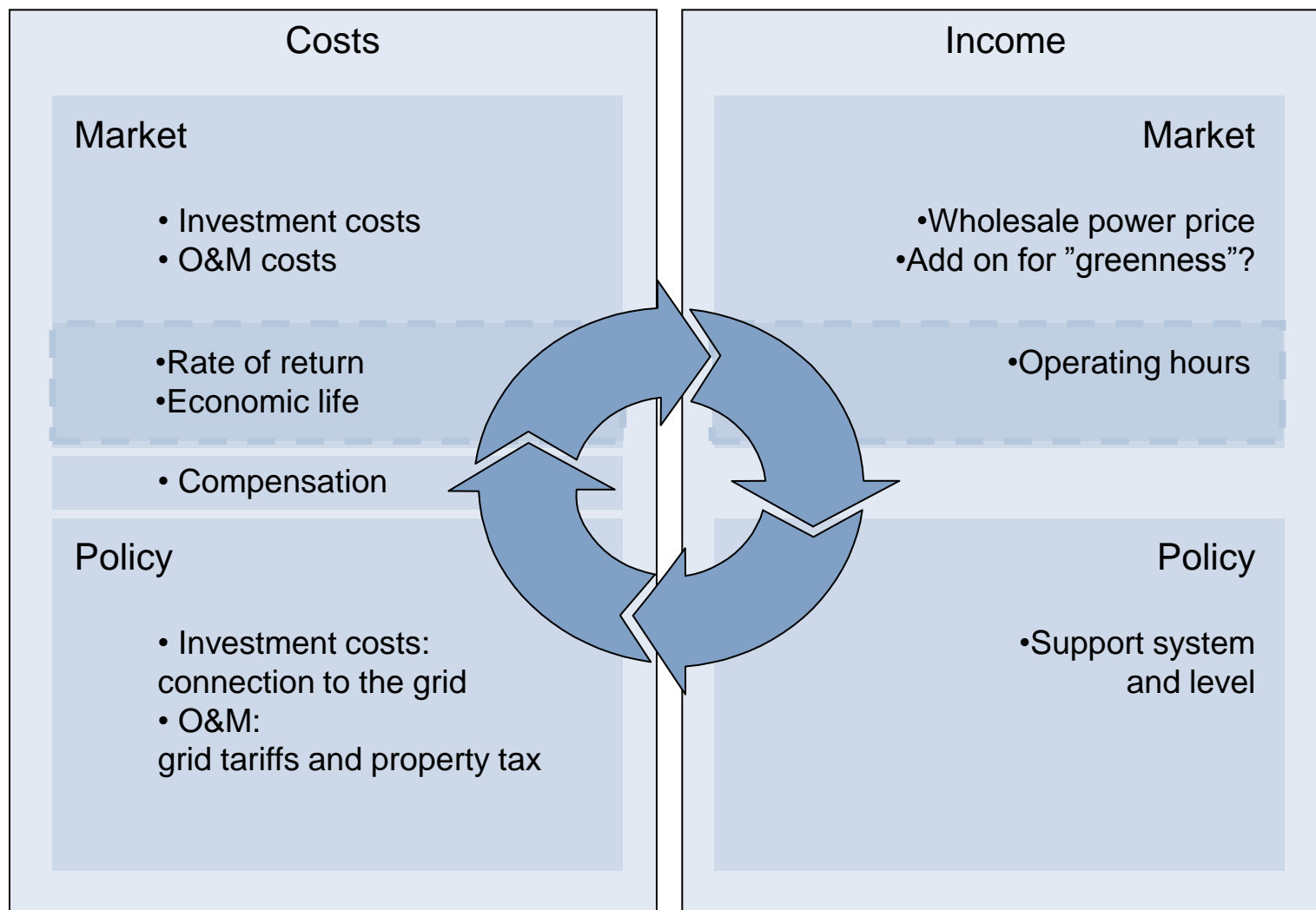


Illustration of possible consequences for the Norwegian electricity sector

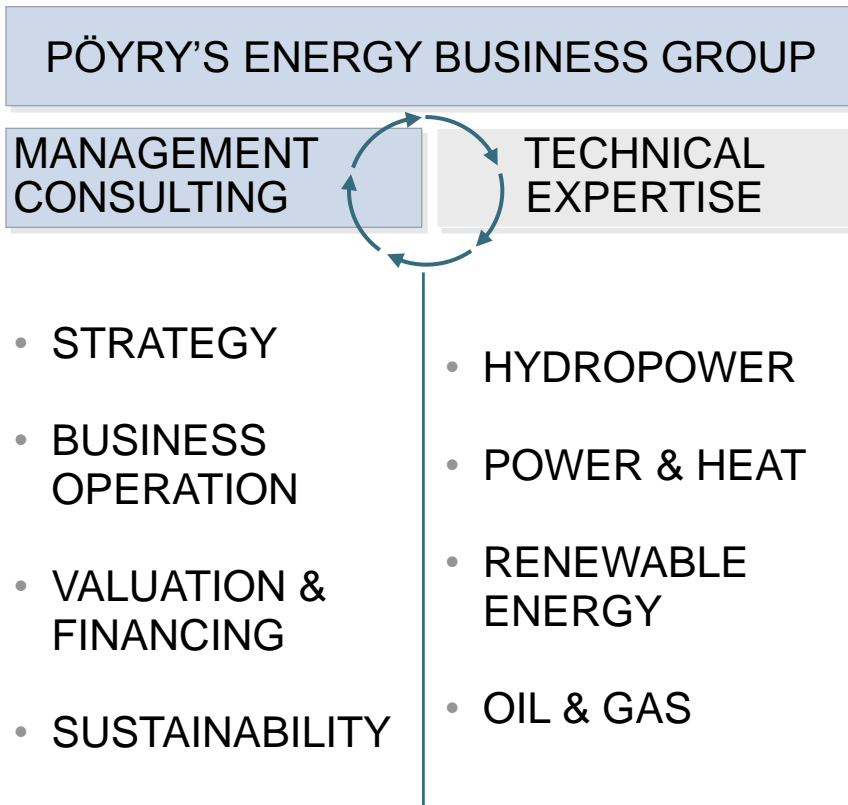


Aggregated supply curve for renewable electricity in Norway (2020)

The profitability in renewable investments is influenced by market and policy



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