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Issues and options with regard to the renewables target in the context of the 2030 EU Climate and Energy Package

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RENEWABLES – A CONTESTED SUCCESS STORY OF THE 2008 PACKAGE

The renewables target in the current package has leveraged significant growth in renewables. The share of renewables in final energy consumption increased from 9.7% in 2007 to 13% in 2011; in electricity from 15.8% to 21.7%. Unit costs have fallen as well. However, the renewables targets have also generated significant conflict. The synthetic indicator used to distribute EU targets (GDP/capita) has meant that some Member States must make significant efforts, in the final analysis possibly in excess of their economic potential and preferences. Top-down targets have unleashed policy innovation and capacity expansion in Member States; but in some cases effective appropriation in Member States' policy approaches has lagged behind.

WHY DO WE NEED A FRAMEWORK FOR RENEWABLES IN THE FUTURE PACKAGE?

Nonetheless, there are still strong arguments for a framework for renewables in the future package. Firstly, these technologies will be vital to any long-term, decarbonisation scenario. Secondly, there are still significant cost cuts that must be achieved in many renewables technologies, *via* technological and systemic learning driven by controlled capacity expansion and enhanced R&D. Thirdly, coordinating policy and infrastructure planning, as well as market integration and state aid policy all require that we have a clear idea of the direction of the EU energy mix and Member State policy efforts.

OPTIONS FOR A RENEWABLES FRAMEWORK

In this context, this paper explores options to include renewables in the 2030 climate and energy package. These include binding, top-down targets, non-binding targets, and binding, bottom-up targets negotiated within an EU framework. Whatever approach is taken to the options discussed in the paper, it appears that a key role of the 2030 package should be to strengthen planning and policy processes within Member States, and in turn its integration at EU level.

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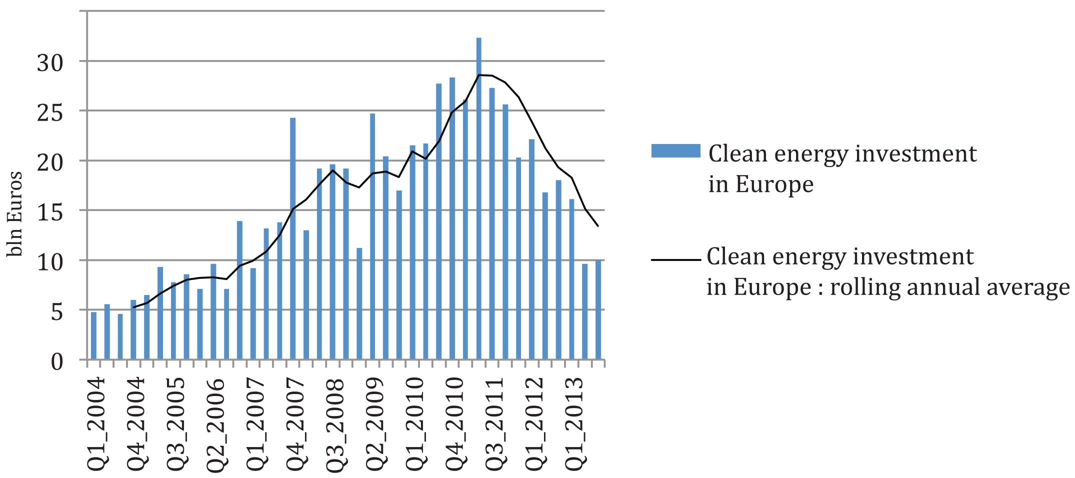
Figure 1. Clean energy investments in Europe



Source: Underlying data from Bloomberg New Energy Finance.

INTRODUCTION

This note sets out the issues and options with regard to the role of renewables in the next EU climate and energy package. Part one summarizes the current approach under the 2008 package, as well as the role of renewables in post-2020 energy sector scenarios at EU and Member State level. The second part presents some structured options for considering the role of renewables in the future package.

1. THE CURRENT APPROACH AND FUTURE PERSPECTIVES

1.1. Renewables in the current package

The renewables target in the current package has leveraged significant growth in renewables. The share of renewables in final energy consumption increased from 9.7% in 2007 to 13% in 2011; in electricity from 15.8% to 21.7%.[1] Granted, this evolution was underway in some Member States well before the renewables directive (Germany, Denmark for example), but the adoption of EU wide targets has helped to broaden and accelerate this trend, in particular in Member States without established renewables policies, such as the New Member States. Targets have given visibility to industry and policymakers; in the electricity sector they have formed a key focal point for infrastructure planning and market coordination between Member States.[2] They have also driven innovation and technology learning: between 2008 and 2012, module costs for PV fell 80%.[3] Smaller but still significant cost reductions have been achieved in onshore wind (about 30%). Global dynamics have certainly contributed, but EU policy has also been important.

Renewables have also been the main driver of structural decarbonisation investments, given the weak signal coming from the EU ETS as a result of the economic crisis and larger than expected quantities of offsets entering the ETS. There has been much discussion of the impact of renewables on the EU ETS cap. Faster than expected growth of renewables may be responsible for a small share of the surplus built up over the period 2008-2012. To get a sense of the order of magnitude: supposing *all* the increment of renewables in electricity from 2007 to 2011 was not taken into account in the setting of the cap, this additional abatement would equate to about 10% of the surplus that built up over the period 2008-2012. This underscores the importance of having a minimum of clarity on complementary policies in setting the EU ETS cap.

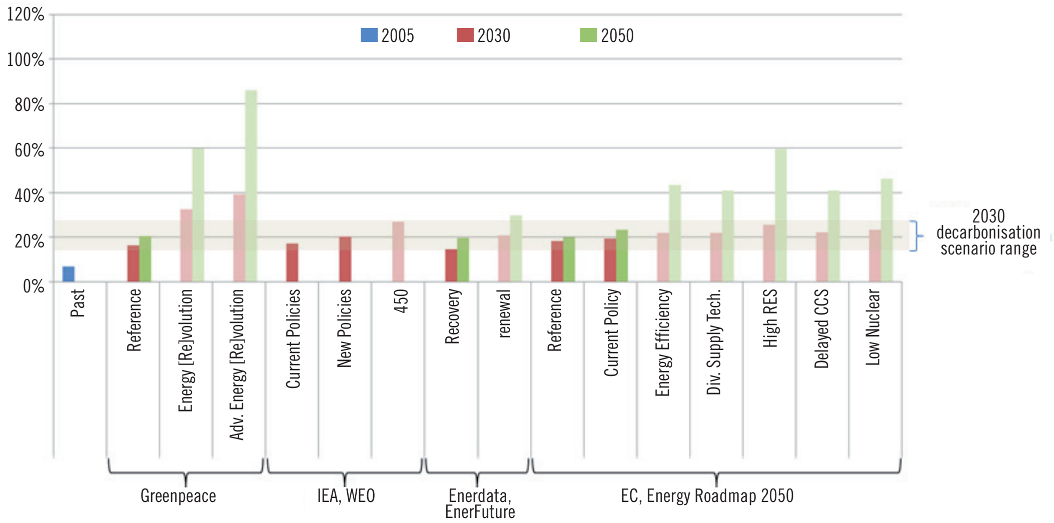
The EU targets have also brought some difficulties. The synthetic indicator used to distribute EU targets (GDP/capita) has meant that some Member States must make significant efforts,

1. Eurostat.

2. See for example, European Network of Transmission System Operators for Electricity (2012), "Ten Year Network Development Plan".

3. Joint Research Commission (2013), "PV Status Report 2013".

Figure 2. Share of renewables in primary energy in EU decarbonisation scenarios



Source: IDDRI analysis based on published scenarios.

in the final analysis possibly in excess of their economic potential and preferences. Top-down targets have unleashed policy innovation and capacity expansion in Member States; but in some cases effective appropriation in Member States' policy approaches has lagged behind, leading to poorly controlled policy rents, sub-optimal system integration, and limited industrial development. Finally, in some cases the EU has not been able to capitalize on hoped-for industrial and trade benefits.

The reaction to these difficulties has brought risks to the sector, such as retroactive policy changes. This can be clearly seen in clean technology investment figures in the EU (Figure 1). Clearly the exogenous shock of the crisis has also played a role here, reducing demand, decreasing the financial capacity of utilities, commercial banks, and governments, and the capacity of household to bear short-term incremental costs. In the long-run, cost-effective policy will be key to ensuring the sustainable expansion of renewables.

Table 1. Renewable electricity in FR, UK, PL and DE 2020 and 2030

Country	2020 renewable electricity (TWh)	2030 renewable electricity (TWh)	2020-2030 growth (%)
FR[2]	112 - 113	194 – 242	73 – 114%
DE[3]	235-237	351-364	49 – 54%
UK[4]	107.11 - 119.7	187 – 258	84 – 116%
PL[5]	19.4	32.4	67%

2. FR figures taken from the Rapport du groupe de travail du conseil national sur la transition énergétique, groupe 2, "Quelle trajectoire pour atteindre le mix énergétique en 2025 ? Quels types de scénarios possibles à horizons 2030 et 2050, dans le respect des engagements climatiques de la France ?". N.B. The scenarios taken are DIV and EFF, as these reflect more closely the Hollande administration objectives of reducing the share of nuclear in the electricity mix to 50% by 2025, and reducing the share of non-fossil fuel energy by 30% by 2030.

3. DE figures taken from the Langfristszenarien und Strategien für den Ausbau der erneuerbaren Energien in Deutschland bei Berücksichtigung der Entwicklung in Europa und global, BMU, 2012, scenario variations A, B and C.

4.UK figures are taken from the Climate Change Committee Review of the Fourth Carbon Budget, 2013, underlying data for figures 2.7 and 2.9.

5.PL figures taken from Agencja Rynku Energii (2011), "Aktualizacja Prognozy zapotrzebowaniana paliwa i energię do roku 2030", Polish Ministry of Economy. [Updated energy projections to 2030]

1.2. Renewables in EU and Member States decarbonization scenarios

Renewables remain a central decarbonisation option to 2030 in almost all EU scenarios. Figure 2 shows the renewables share in primary energy in decarbonisation scenarios from a wide range of actors: Greenpeace, the IEA, energy consultancy Enerdata, and the Commission. It should be noted that this figure presents renewables in primary energy and so is not comparable to any potential 2030 renewables target expressed in final energy. What's important for the argument here is the presence of a continued role for renewables growth in a diverse range of post 2020 decarbonization scenarios, not the particular level represented in the scenarios.

The same is broadly true of Member State scenarios. Table 1 presents a range of potential renewable electricity scenarios for France, the UK, Poland and Germany to 2030. Again it is neither the absolute numbers nor the comparison between countries that is important for the argument here, but rather the direction and consistency of a growth trend across Member States and scenarios. These scenario figures have a different "normative" status in each country, although each is taken from a domestic scenario exercise which was intended to support future policy.

Several elements come out of this analysis:

- Renewables will remain a central decarbonisation option after 2020. The debate around a renewables target it is not therefore a question of whether renewables will play a role, but rather what is the most effective means to support them, at the most appropriate level of subsidiarity.

This also underscores the importance of exploiting EU economies of scale to ensure least cost implementation at a national and EU level, as well as ensuring sufficient coordination to avoid distortions to the internal market and other policy areas (ETS cap setting, infrastructure planning, market design and integration).

- There are clearly differences of potential and preferences between Member States. This can be seen in the greater diversity of scenario ranges for renewable electricity in France and the UK in 2030, compared to Germany. The large spread of scenario figures for the UK and France relates to uncertainties regarding the role of other technologies (nuclear and CCS), and in the level of overall demand. The low figures for Poland reflect the low level from which Poland is starting, a greater projected reliance on nuclear and CCS, and a much lower level of total electricity generation than in the other three Member States. Poland's total electricity consumption is projected to be around 209 TWh in 2030.
- The renewables targets have helped to focus Member State policy and create certainty. This can be seen in the small range of projected renewable electricity in 2020.

2. RENEWABLES IN THE NEW PACKAGE

2.1. Challenges in the decade 2020-2030 - objectives for policy

In 2005 renewables made up 6.84% of EU27 primary energy consumption. By 2030, under a decarbonisation scenario, this is projected to more than double to between 21.87 and 25.64%.[4] Renewables go from a niche, immature technology to an integral part of the EU energy system. When considering the role for policy in the decade 2020-2030, it is necessary to consider the relevant learning curve, market failures, and systemic characteristics technology by technology. Table 2 presents this information for a selection of low-carbon technologies in the electricity sector, taken from the POLES modelling framework. The projected costs here are not given to benchmark the projected performance of the technologies against each other: all projections are uncertain, and those given here are certainly open to discussion. Rather, the table is given to provide a framework for thinking about the relevant industrial challenges for each technology, and the role of policy in overcoming them.

Several elements come out of this analysis:

- There is a diversity of low-carbon technologies facing a range of development challenges, from the CO_2 externality, progress down the learning curve, market integration, industrial-scale demonstration, and effective project delivery of large-scale investments in CCS and nuclear.
- There are a number of technologies, exemplified here by PV and off-shore wind, that still have large progress to make down the learning curve, based on controlled capacity expansion and R&D. For other technologies, the innovation process is different. For CCS, it involves project delivery of large-scale integrated projects, in order to prove the technology at a commercial scale.
- High carbon prices are needed to drive structural abatement options like CCS, nuclear, and offshore wind. In the simulation in Table 2, the carbon price reaches 50 Euro/ton in 2025, sufficient to drive the projected price of nuclear and CCS below that of coal, assuming that other non-CO_2 related development barriers can be overcome. In the Commission's impact assessment for the 2030 package, under a 40% GHG target by 2030 the carbon price reaches 40 Euro/ton by 2030.

In sum, there are two broad considerations for post-2020 EU renewables policy:

- Continued cost-effective capacity expansion, in order to achieve cost effective decarbonisation with available mature technologies. For this, well-designed support schemes are important, as is an effective ETS which can reduce and progressively obviate the need for additional support for mature technologies. Equally important is visibility and coordination for the industry and policy-makers (e.g. in the area of infrastructure coordination), in order to enable economies of scale, coordinate industrial anticipations, facilitate effective market integration, and ensure coherence with the internal market.
- Innovation and learning for less mature technologies. For some technologies, learning will

4. EC, Energy Roadmap, 2011.

Table 2. Projected performance in the POLES modelling framework and key challenges for decarbonized electricity technologies

Technology	Learning rate 1980-2010 (% per year)	Projected levelized cost of electricity (Euro/MWh)			Key development issues 2020-30 & comments on projected performance
		2010	2025	2050	
Onshore wind	6%	77	61	55	Effective market integration Integration of CO_2 externality Availability of high-wind locations Supply chain and cost of raw materials
Offshore wind	3%	153	110	96	Learning through capacity expansion and R&D Effective market integration Supply chain and cost of raw materials
Photovoltaic	19%	178	106	67	Learning through capacity expansion and R&D Effective market integration Development and deployment of radical new technology options (thin film cells, etc)
Nuclear (III generation)	-24%	47	71	66	Integration of safety/decommissioning externalities in the price Integration of CO_2 externality Effective project delivery Current projects are significantly above projected prices given here; there are large uncertainties about cost
Pulverized coal + CCS	n/a	n/a	77	87	Industrial scale demonstration Integration of CO_2 externality Construction and management of pipeline network Social acceptability
Combined cycle gas + CCS	n/a	n/a	99	115	Industrial scale demonstration Construction and management of pipeline network Integration of the CO_2 externality Social acceptability
Pulverized coal	16%	52	81	193	Future carbon prices Future load factors in a system with increasing variable renewables and overcapacity
Combined cycle gas	10%	60	88	151	Future carbon prices Future gas prices Future load factors in a system with increasing variable renewables and overcapacity

Assumptions	2010	2025	2050
CO_2 price (Euro/ton)	10	50	200
Coal price (USD/ton)	110	115	120
Gas price (USD/Mbtu)	10	14	18

Source: Data from the TechPOL lab, CNRS-UPMF.

need to be by controlled capacity expansion, in order to generate incremental gains. For CCS and nuclear, large-scale industrial demonstration of complex, innovative projects will require appropriate risk sharing frameworks. For these technologies, capacity expansion *per se* should not be seen as an appropriate tool of innovation policy at this stage.

2.2. Variables for the consideration of renewables targets

There are a number of variables to consider with regard to design of potential EU targets.

Top-down *versus* bottom-up negotiation: the 2008 renewables directive used a top-down negotiation method. The EU target was agreed politically at the March 2007 Council, and divided between Member States using a highly synthetic indicator (GDP/capita, plus a flat-rate increase for all Member States). Subsequent negotiations did not change the target levels proposed by the Commission, but focused rather on various flexibility mechanisms for target implementation.

By contrast, other policies have involved a more bottom up negotiation of Member State objectives, often framed by a collective objective and Commission analysis. This was the case for the EU burden sharing arrangements to implement the Kyoto Protocol, for example. In 1997, the Dutch Presidency proposed an analytical framework (the "triptych" approach), in order

Table 3. Member State targets during the EU burden sharing negotiations under the Kyoto Protocol

Country	Triptych proposal	Informal pledges to the February meeting of the Ad-Hoc Group meeting 1997	Final Burden Sharing Agreement
Austria	-4.3	-25	-13
Belgium	-15.8	-10	-7.5
Denmark	-14.4	-25	-21
Finland	-7	-5	0
France	-12.9	-5	0
Germany	-21.7	-25	-21
Greece	3	10	25
Ireland	-3.3	10	13
Italy	-9.4	-5	-6.5
Luxembourg	-20.8	-30	-28
Netherlands	-9.4	10	-6
Portugal	19.4	25	27
Spain	9.6	15	15
Sweden	21	5	4
United Kingdom	-19.9	-10	-12.5
EU	-12.9	-11	-8

Source: Triptych proposal from Blok et al, 1997; informal pledges presented in Ringius, L., 1997, table 6; final Burden Sharing Agreement from COUNCIL DECISION 2002/358/CE of 25 April 2002.

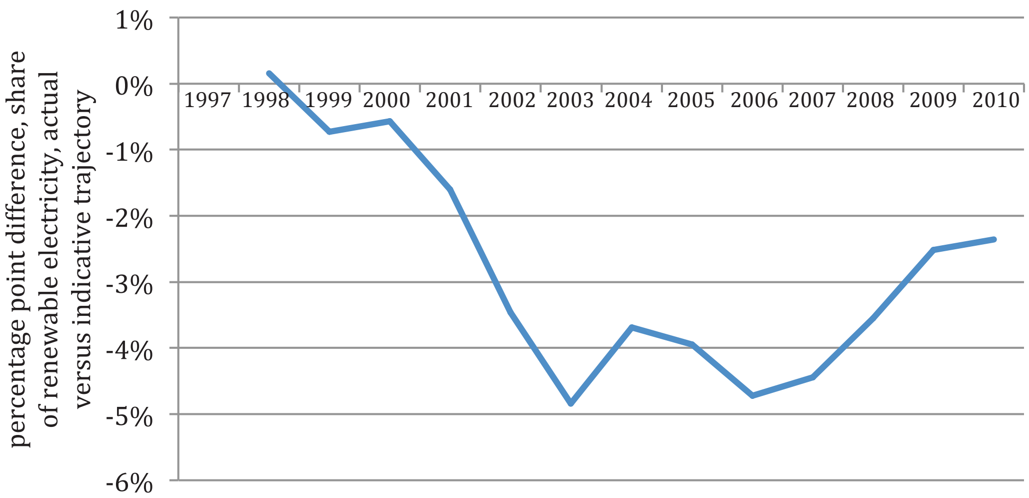
to define Member State targets under the Kyoto burden sharing arrangement. Subsequent negotiations did address the target level and significant changes were made to the initial analytical proposal tabled by the Dutch Presidency (see Table 2). It should be noted in this regard, however, that even this more bottom up negotiation method did not prevent some Member States (Luxembourg, Austria, Spain) from significantly exceeding their allocated targets, before taking into account the use of Kyoto flexible mechanisms.[5] Interestingly, these countries received adjusted targets during the political negotiations on the proposed framework of the Dutch Presidency (loosened for Spain, tightened for Luxembourg and Austria). This suggests that, at least in this instance, more bottom-up negotiations do not *necessarily* guarantee targets that are closer reflections of national preferences and potential, nor their more effective appropriation in national policy, nor their sufficiency relative to collective objectives. This point underscores the importance of framing any potential bottom-up discussion on renewables in the context of a long-term decarbonisation strategy at Member State level, to ensure that Member States' proposals would be coherent internally, and with the EU's long-term decarbonisation goals.

5. European Environment Agency (2013), "Trends and projections in Europe 2013: Tracking progress towards Europe's climate and energy targets until 2020", ff. 50.

Target scope: the current renewables target covers all renewable energy sources in all sectors. Both a reduction and expansion of the scope could be envisaged. The first would involve limiting the target to certain sectors (electricity, for example), or certain renewable technologies. An increase in the target scope would mean expanding it to include other low-carbon technologies, such as CCS and nuclear.

Target bindingness: over the years, different approaches to bindingness have been used. For example, the 2001 Renewable Electricity Directive (2001/77/EC) set out indicative national targets, as well as guiding principles on the evaluation of administrative procedures and grid access. The Directive also required Member States to regularly report progress to the Commission. It is difficult to assess whether these targets did induce policy outcomes in Member States. Figure 3 shows the average performance of the EU15 in terms of the share of renewable electricity since 1997, relative to a linear trajectory needed to meet their individual indicative renewable electricity targets to 2010, under Directive 2001/77/EC. A difference of 4 percentage points means that on average the share of renewable electricity in the EU15 was 4 percentage points below the share given by an indicative trajectory towards the indicative national targets for 2010. It can be seen that for much of the period, the EU15 Member States lagged behind this trajectory, and only began to catch up around 2007/2008.

Figure 3. Comparison between actual trajectory for renewable electricity and an indicative trajectory required to reach indicative national renewable electricity targets in 2010 under Directive (2001/77/EC), percentage point difference, average EU15



Note: Indicative trajectory extrapolated from indicative targets given in Directive (2001/77/EC), actual renewable electricity share derived from Eurostat. N.B. Portugal's actual renewable electricity share varies greatly with seasonal variation in hydropower production. Therefore Portugal has been removed from this data set, which represents the EU15 minus Portugal. The aggregate effect is to generally slightly reduce the gap between the actual and indicative shares across the period.

In contrast to the Renewable Electricity Directive, the 2009 Renewables Directive (2009/28/EC) contains mandatory national targets (Article 3). It also contains biennial reporting requirements (Articles 4, 19, 20). It lacks, however, any sanction mechanism in case of non-compliance.[6] Hildingsson *et al.* (2011) summarize the bindingness of the 2009 Directive as follows:

> "…The targets are legally binding, implying that infringement proceedings can be initiated against Member States that fail to fulfil them. The informal norm of negotiated enforcement (see Chapter 2), however, suggests that non-complying Member States will most likely simply be obliged to submit amended plans to remedy any shortfall in the previous period. Thus, although the Directive reduces the scope for negotiated enforcement, it lacks really stringent enforcement mechanisms such as financial penalties (unlike the revised EU ETS)…"[7]

Flexibility mechanisms: the 2008 Climate and Energy Package contained a number of flexibility mechanisms, in order to increase assurances to Member States that they could achieve their targets. In the case of renewables, these included state-to-state trading mechanisms involving statistical transfer, joint projects or joint support schemes (Directive 2009/28/EC, Articles 7, 8, 9 and 11).

The "software" elements of renewables policy: this relates to qualitative guidelines on the implementation of whatever quantitative targets could be negotiated: state aid guidelines, rules regarding grid access, electricity market design and market integration.

3. THOUGHT EXPERIMENTS AROUND POSSIBLE DESIGN OPTIONS

This section sets out three thought experiments based on variations in the above-listed parameters.

3.1. No EU renewables targets

In this scenario, Member States agree not to implement renewables targets at EU level in the 2030 package. The divergence of potentials and preferences is felt to be insurmountable. Member States wish to give a level playing field to all decarbonisation options, to which renewables targets are perceived to be a potential obstacle. Likewise, the principle of cost effectiveness suggests that decarbonisation should be driven by a harmonized CO_2

6. For example, these do exist in the Effort Sharing Decision (article 7).

7. Hildingsson, R. *et al.* (2011), "Renewable Energies: A Continuing Balancing Act?", p. 118, in Jordan, A. *et al.*, eds, (2011), *Climate Change Policy in the European Union: Confronting the Dilemmas of Mitigation and Adaptation*, Cambridge: CUP.

price from the ETS. In thinking through this scenario, a number of issues arise:

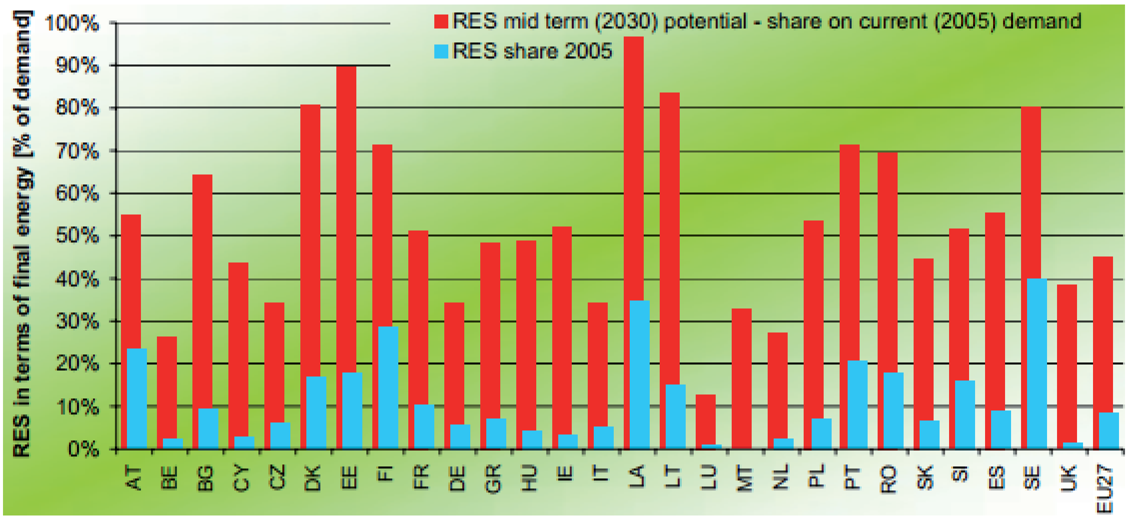
- Investment in structural decarbonisation options: under the EU Reference Scenario, the ETS price rises to 35 Euro/ton by 2030. Under a 40% GHG target, this rises to 40 Euro/ton by 2030.[8] Both figures are insufficient to leverage investments in large-scale structural decarbonisation options, as discussed above (CCS, nuclear, more immature renewables, transport decarbonisation, etc.). In the PRIMES modelling framework, these are achieved by very high carbon prices late in the period to 2050, and perfect anticipation of these prices among agents in the model. However, real world market participants are not blessed with perfect foresight of uncertain policy and exogenous conditions to 2050. The inclusion of such second-best factors such as imperfect foresight and inertia in decarbonisation options in modelling frameworks leads to higher efforts in the short-term in order to generate sufficient structural decarbonisation investment.[9] The presence of renewables targets and CCS policy in the 2008 package can be seen as a reflection of this effect: policy makers wished to start the structural transformation of the EU energy sector and knew that a CO2 target and price alone would be insufficient to do so.
- In the post-2020 framework, the Co_2 target and price will have to increasingly drive structural decarbonisation, but in the continued absence of credible long-term signals to 2050 it may be insufficient to do so, particularly for less mature technologies. Yet long-term decarbonisation and energy security objectives require that these technoogies be brought to maturity. However, the carbon prices required are prohibitive in the short-term, and it is difficult to create a robust expectation of such prices in the long-term to 2050. Alternatives such as explicit price targeting (price floors/caps, or flexible supply) could also be considered to strengthen the ETS. This would imply explicit agreement that the purpose of the EU ETS is to drive structural low-carbon investment via a high, predictable and long-term price signal. This is in opposition with the interpretation that the purpose of the EU ETS is to meet the next cap at lowest cost, and that therefore what matters is the quantity of emissions rather than the price. Achieving significant ETS reform requires a common vision on the role of the ETS – so far difficult to achieve in the EU. Every effort should indeed be made to strengthen the ETS, but in a second best world it seems unlikely that sufficient stringency and long-term certainty could be created to drive deployment and innovation in the technologies needed to implement long term targets. Physical and innovation inertia means that this process needs to start now if low-carbon goals are to be met at acceptable cost, which implies complementary policies to drive innovation and deployment in the required immature technologies.
- *Coherence of Member States' response to the structural decarbonisation challenge*: conscious of the above point, in this scenario Member States implement their own complementary policies to drive the structural decarbonisation of their economies. To a certain extent, the UK's electricity market reform and price floor is an example. This situation could raise a number of concerns. Firstly, the scope and ambition of these uncoordinated complementary policies will have a material impact on the EU ETS cap and price. Secondly, such policy has implications for infrastructure build-out, market design and integration, and intra-EU competitiveness. Fragmentation could raise concerns in all of these areas: e.g. state aid to industry and the energy sector, infrastructure planning, and the compatibility of national electricity market designs. It would be difficult to develop the appropriate policy "software" such as state-aid, infrastructure planning and electricity market design without a minimum degree of clarity around the future energy mix and relevant uncertainties in that regard. Paradoxically, in this scenario of a harmonized EU carbon price and a decentralized approach to technology innovation and deployment, a proliferation of uncoordinated national policies could risk undermining the original ideal of a market-based decarbonisation and the EU level playing field.
- *Economies of scale and least cost implementation*: a harmonized EU framework for renewables has generated economies of scale and coordinated industry expectations, allowing for lower cost implementation at Member State level. A more fragmented approach may impact on industrial anticipations, supply chains and the availability and cost of financing.

8. Figures from the 2030 Impact Assessment, box on page 49.
9. See e.g. the modelling comparison in Edenhoffer, O. *et al.* (2009), "The Economics of Decarbonization. Report of the RECIPE project", Potsdam Institute for Climate Impact Research.

3.2. Top-down and binding

In this scenario, Member States agree to an aggregate target at EU level. Member State targets are then derived from this EU level target using one

Figure 4. Projected 2030 resource potential for renewables



Source: Hoefnagels, R. et al. (2011), "Long Term Potentials and Costs of RES". http://www.reshaping-res-policy.eu/

or several quantitative indicators. As with the 2008 package, subsequent negotiations do not focus on the level of the Member State targets. Several considerations arise:

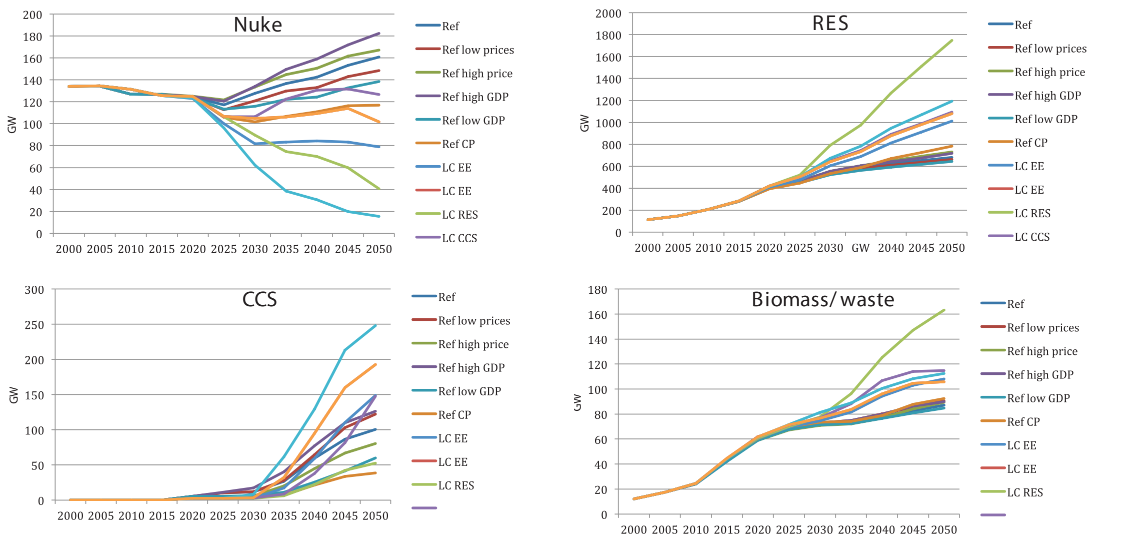
Target allocation: target allocation would involve decisions on the appropriate balance between fairness, efficiency and national preferences. It also involves an assessment of the probability of other policy and energy sector evolutions at Member State level, particularly as regards the evolution of nuclear, CCS, and energy demand. Regarding decisions on appropriate indicators, it seems unlikely that target allocation based solely on GDP/capita would be politically feasible this time, given concerns about economic efficiency at the aggregate level, and different potentials and preferences at the Member State level. However, a greater consideration of efficiency would require an appropriate indicator, such as resource potential. The EU does possess harmonized assessments of resource potential in the PRIMES modelling framework (Figure 4). This framework could potentially be used to derive estimations of national resource potential on which to base the allocation of renewables targets. However, the complexity of deriving such estimates of resource potential would make them more open to contestation than a simple and transparent indicator such as GDP/capita. Finding an acceptable combination of indicators between efficiency and fairness would likely be a difficult balancing act.

Flexible mechanisms: the experience with top-down target allocation in the 2008 package suggests that flexible mechanisms would be an important "safety valve" for Member States in a scenario with a top-down allocation of targets. The discussion on flexible mechanisms reflects a number of, not necessarily synergistic, objectives:

- Redistribution to bring the implementation of renewables targets closer to the "economic optimum" and share the effort between Member States (i.e. a "safety valve" for Member States with high effort, and a funding mechanism for poorer Member States).
- As a step to more harmonized national support schemes, in order to ensure greater cost-effectiveness and coherence with the internal market.
- The desire of Member States to preserve sovereignty over their energy sectors. Member States with steep renewables supply curves are still keen to preserve national support schemes and develop national benefits of renewables development; Member States with flat supply curves are keen to keep renewables to a manageable level given their implications for cost, stability and infrastructure in the national electricity sector.

In the current package, flexible mechanisms for renewables are largely ineffective. Member States rejected the original Commission proposal of a harmonized scheme of guarantees of origin operating at the company level, and put in place state-to-state flexible mechanisms. Given that renewable energy can pose negative externalities to the stability of the electricity system when not well managed, governments were keen to preserve sovereignty over their energy sectors. However, governments are likely to be poorly placed to overcome the transaction costs and information asymmetries of state-to-state trade in a good like

Figure 5. Electricity capacity by technology in EU decarbonisation scenarios



Source: Data from European Commission (2011), "Energy Roadmap".

renewable energy. There are few indications that Member States will significantly avail themselves of these mechanisms.

In the current context, the clash of interests is similar: Member States are keen to preserve sovereignty over their energy sectors, but cost effectiveness and coherence of renewables schemes are also key priorities. One option could be a hybrid scheme, with a certain percentage of Member States' targets coming from a common EU pool implemented via guarantees of origin devolved to the company level. Given the diversity of national support schemes and Member State desire to preserve sovereignty over their energy sector, this could pose political and technical difficulties and might therefore play a marginal role in terms of harmonizing costs and policies.

Scope of targets: the first issue of scope relates to technologies (renewables, CCS, nuclear). A decarbonisation target may seem attractive to Member States who plan to make use of nuclear and CCS. However, nuclear and CCS are lumpy investments, characterized by high social, technological and economic uncertainties. There is also a strong divergence of preferences regarding these technologies both between and in some cases within Member States. This combination of social and technological uncertainty leads to a wide diversity of scenarios regarding the future role of CCS and nuclear (Figure 5).

A decarbonisation target would not by itself give much greater certainty to CCS and nuclear, above that given by the ETS. In which case, it is difficult to see decarbonisation targets as adding value, beyond the ETS, to policy efforts to deploy CCS and nuclear, above establishing rhetorical parity between nuclear, CCS and renewables. Nor would a quantitative decarbonisation target really address the barriers to these technologies, insofar as learning by doing via controlled capacity expansion is not a relevant development strategy for these technologies (although it may be more so for CCS once it reaches the commercialization phase probably after 2030—see Figure 5). There may be more effective ways of supporting these CCS and nuclear:

- Ensuring a strong price signal from the ETS, which means ensuring a degree of clarity on the level of abatement delivered by potential complementary policies, including renewables, and setting the cap accordingly. It should be noted that the projected price of 40 Euro/ton in 2030 under a 40% GHG would be largely insufficient in itself to support the deployment of nuclear and CCS.
- Ensuring a framework conducive to the exploitation of these technologies for those wishing to do so, potentially through the EU state aid framework and national complementary policies.[10] At a political level it could also be important to ensure a recognition of the importance of CCS and nuclear to the EU's decarbonisation efforts.
- Continued efforts to demonstrate CCS on an industrial scale.

Then there is the issue of sectoral scope:

10. Cf. DG Competition (2013), "Paper of the Services of DG Competition containing draft Guidelines on environmental and energy aid for 2014-2020", EC,

electricity, heat and transport. The current approach effectively sets national targets for the electricity and heat sector, plus a mandatory EU wide target for the transport sector, based on the logic that there exists an EU wide market for transport fuels. It can be argued that the electricity sector displays significant EU spillovers, and therefore should be addressed via harmonized targets. It is also the sector, however, where national sovereignty concerns are high due to local spillovers of some technologies, as well as greater technological divergence of starting points and preferences between Member States. Moreover, there are significant potentials in the heat sector, in particular in Eastern Europe, and policy should also promote Member State action in these sectors. It is therefore difficult to see how a restriction in sectoral scope would usefully reduce the difficulty of determining Member State targets at EU level.

3.3. Top-down and non-binding

In this scenario, Member States decide to adopt non-binding renewable energy targets. This is based on the perception that adjusting the bindingness of renewable energy targets is the best (only) way to respect the different potentials and preferences of Member States, and the equality of treatment of different decarbonisation options (renewables, CCS, nuclear). There are a number of considerations which arise:

Degrees of bindingness: legal bindingness relates to three parameters:[11]

- *Legality*: are commitments mandatory or indicative?
- *Substance*: do the commitments require a substantial deviation from the *status quo ante*? How are they negotiated, top-down or bottom-up? Are they precise, or do they contain flexibilities and ambiguities?
- *Structure*: does the legal instrument contain provisions for monitoring and enforcing compliance?

These parameters offer a continuum of options to nuance the bindingness of commitments. The 2008 Climate and Energy Package did so by adjusting the parameter of substance: top-down negotiation of targets, a substantial deviation from the *status quo ante*, but including the option to use flexibility mechanisms. It also nuanced the parameter of structure by including monitoring mechanisms but excluding sanction mechanisms. In this scenario, Member States decide to address the issue of bindingness via the parameter of the legality of renewables targets: the targets are indicative, not mandatory.

Target allocation: even in a situation in which targets are indicative, there will be the issue of how to allocate targets. Indicative targets will still carry a degree of normative force. Thus the issue of the appropriate balance between issues of fairness and efficiency in target allocation will likely remain, albeit with arguably lower stakes than if the targets were mandatory.

Target achievement and implications for other policy areas: non-mandatory targets would immediately raise the question of the risks and likelihood of their non-achievement. This would have implications for other policy areas, as outlined in the first scenario above of no EU renewables target.

3.4. Bottom-up and binding

In this scenario, Member States decide that the most salient concern is not the *form* of targets as such, but rather their *substance*. Member States have different resource potentials and policy preferences, which may be difficult to reflect in frameworks where the substance of targets is decided top-down at EU level. However, they recognize, in this scenario, that there is value in having a harmonized form for renewables targets, i.e. the same legal framework in order to address the concerns outlined above: industrial economies of scale, incentives for structural decarbonisation, and a harmonized and credible legal basis for policy planning and the internal market. Therefore the option is taken to negotiate targets in a more bottom-up manner, but to render the final form legally binding at EU level. A number of concerns arise:

Target negotiation: clearly the key question would be how to render the negotiation process sufficiently timely and ambitious to make it worthwhile at all. There are some basic parameters that could help structure a negotiation process around future renewables targets:

- *The 2050 GHG target*: given the long lead in times for energy infrastructure and its high level of ambition, the EU's indicative 2050 target, if respected, imposes immediate constraints on EU and Member State policy.
- *Power sector decarbonisation*: almost all scenarios show that the power sector needs to be well on the way to decarbonization by 2030. In

11. See e.g. Raustiala, K. (2005), "Form and Substance in International Agreements", *American Journal of International Law*; and Abbott, K. and D. Snidal (2000), "Hard and Soft Law in International Governance", *International Organization.*

2030 the carbon intensity of electricity needs to be reduced by 60% compared to 2010 levels, under a decarbonisation scenario.[12]

- *Limited substitutability between decarbonisation options*: a lesser effort on renewables will require greater effort elsewhere, for example in nuclear, CCS, gas or energy efficiency.
- *The ETS and sectoral policies*: we argued above that the ETS alone was insufficient by itself to ensure structural decarbonisation, at least to 2030. Nonetheless, it can serve to ensure an (increasing) share of abatement, and to make up for gaps in the negotiation and implementation of potential renewables targets by ensuring that the EU reaches its short-term carbon targets in the ETS sector. In which case, the EU ETS cap would need to be adjusted to reflect the level of Member States' negotiated renewables targets, in order to ensure a robust price signal. The process for ensuring a coherent interaction between the EU ETS and complementary policies would be more difficult in a framework of bottom-up renewables targets than in a centrally agreed package. But it may ultimately give more clarity than in a case in which there were no or non-binding renewables targets.

In this scenario, the Commission could play the role in structuring a negotiation around renewables targets. The Commission could put forward a series of principles and indicators, as well as quantitative analysis, to suggest possible targets, or target ranges for Member States. This was the role that the Commission played in the negotiation of National Allocation Plans (NAPS) under Phase II of the ETS. Annex III of the ETS Directive (2003/87/EC) gave the Commission scope to assess Member States' NAP proposals, requiring NAPS to be coherent with i) Member States' obligations under the Kyoto Protocol and the EU Burden Sharing Arrangement; ii) technical potential; iii) EU and Member State policies. In addition, the Commission was granted the competence to reject NAPS on that basis that they were incompatible with the criteria of Annex III.[13] The Commission did so on a number of occasions.

Member States could be required to submit national low-carbon scenarios to 2030, and to show the intended split between abatement options. This would help to give context and substance to Member States' proposed trajectories for renewables, to ensure that they are coherent with an overall trajectory towards structural decarbonization. It may also help the policy appropriation of the decarbonisation agenda in more reluctant Member States. It could also help "level the playing field" between decarbonisation options, although in this scenario only the proposed renewables targets are rendered binding at EU level, for the reasons outlined above. Clearly, there would be concerns about the timeliness, ambition and administrative burden of such a bottom-up negotiation process. Political agreement on benchmarks, timelines, and the role of the Commission would likely be necessary to ensure that this negotiation and adoption would happen in an expeditious way.

4. CONCLUSION

On the basis of this discussion, a number of conclusions can be put forward:

1. *On the rationale for EU policy on renewables*: renewables will continue to be a central decarbonisation lever. There are a number of rationales for a coordinated EU approach: overcoming relevant market failures beyond the CO_2 externality; ensuring industrial economies of scale; ensuring incentives for structural decarbonisation, and a harmonized and credible legal basis for policy planning and the internal market. Other decarbonisation options such as nuclear and CCS are also crucial, and the EU framework should ensure that Member States can exploit them. There is a strong argument for policies to support the demonstration and deployment of CCS, and enable the exploitation of nuclear for those Member States wishing to use it.

2. *On the interaction between carbon price and complementary policies*: this paper has argued that complementary policies will continued to be required, notably to deliver learning through controlled capacity expansion of some technologies. Other types of innovation policies will be needed for technologies such as CCS, where learning depends not on incremental improvement through capacity expansion but rather large-scale integrated demonstration. At the same time, decarbonisation needs to be driven by increasingly market-based signals, in order to ensure the cost-effectiveness and thus sustainability of policy. It is important to underscore: **in order to calibrate the required market signals, it is necessary to know *ex ante* the scope and ambition of complementary policies.** Thus providing an EU framework for complementary policies should not be posed as in opposition to an effective market-based framework.

3. *On the interaction of policy software and hardware*: policy soft-ware refers to elements such as

12. European Commission (2011), « Energy Roadmap ».

13. See Directive 2003/87/EC, Article 9.3.

Table 4. Possible variations of renewable target design

	Legality	Substance	Structure
No renewables targets	None at EU level	Member State policy	Potential monitoring mechanism of Member State policy
Top-down and binding	Mandatory	Quantified targets negotiated top-down Flexibility mechanisms	Precise and regular reporting and monitoring mechanisms No sanction mechanisms
Top-down and non-binding	Indicative	Indicative, quantified targets derived top-down	Precise and regular reporting and monitoring mechanisms No sanction mechanisms
Bottom-up and binding	Final negotiated targets are mandatory	Structured, bottom up negotiation of quantified targets Potential Commission competence to offer analytical support to negotiation, and possibly to arbitrate on Member States' proposals based on agreed criteria	Precise and regular reporting and monitoring mechanisms No sanction mechanisms

state-aid, market design, infrastructure planning and policies for market integration. Policy hardware refers to the physical landscape for which this policy will need to be designed. What kind of energy mix? What level of demand? How much infrastructure, what type and where? It is clear that policy software will play a key role in delivering cost-effective decarbonisation. State aid is a good example: the state aid framework will need to be designed to provide an appropriate balance between cost-effective decarbonisation and innovation, and calibrate innovation policies according to the nature of the technology. However, in order to design such policy software, it is crucial to have a minimum understanding of the hardware elements. This holds at Member State level, and particularly for those aspects having EU spillovers.

4. *On the interaction between Member States and EU level:* Whatever approach is taken to the questions discussed here, it appears that a key role of the 2030 package should be to strengthen planning and policy processes within Member States, and in turn its integration at EU level. Undoubtedly, this can happen through the adoption of EU policies: the 2008 renewables targets have led to a tremendous growth in renewables in the Central and Eastern European Member States, which would not have happened to the same extent in the absence thereof. The EU ETS can also play this role of galvanising Member State policy through a robust price. However, top-down policies can also risk obscuring the nuances of Member States' circumstances and preferences, as well as creating insufficiently broad and deep policy appropriation. A productive dialogue needs to be constructed between Member States and the EU regarding individual and collective decarbonisation trajectories. One means to promote this might be requiring Member States to develop long-term decarbonisation plans as part of the 2030 framework. This could inform policy formulation at EU level (for example on renewables, infrastructure, the ETS), and support policy appropriation at Member State level.

5. *On the level of bindingness*: Member States have different potentials and preferences regarding renewables. This and the experience of the 2008 package have created tensions with regard to the existence of new renewables targets in the 2030 package. Any eventual renewables targets need not be the same as in 2008, however. Member States could adjust the parameters of legality, substance and structure, in order to find an acceptable combination. The options discussed above offer different variations along these parameters (see Table 4).