



## *Quo(ta) vadis, Europe?*

A comparative assessment of  
two recent studies on the future  
development of renewable  
electricity support in Europe

*(EWI and futures-e)*

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The core objective of the RE-Shaping project is to assist Member State governments in preparing for the implementation of Directive 2009/28/EC and to guide a European policy for RES in the mid- to long term. The past and present success of policies for renewable energies will be evaluated and recommendations derived to improve future RES support schemes.

The core content of this collaborative research activity comprises:

- Developing a comprehensive policy background for RES support instruments.
- Providing the European Commission and Member States with scientifically based and statistically robust indicators to measure the success of currently implemented RES policies.
- Proposing innovative financing schemes for lower costs and better capital availability in RES financing.
- Initiation of National Policy Processes which attempt to stimulate debate and offer key stakeholders a meeting place to set and implement RES targets as well as options to improve the national policies fostering RES market penetration.
- Assessing options to coordinate or even gradually harmonize national RES policy approaches.

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## *This report*

*serves as a background document for the  
forthcoming model-based RE policy analyses  
conducted within the European research project*

# *RE-Shaping*

*Shaping an effective and efficient  
European renewable energy market*

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## Abbreviations

BAU .....	Business-As-Usual	$p_c$ .....	electricity price
CS .....	consumer surplus	PS .....	producer surplus
EC .....	European Commission	PV .....	photovoltaics
ETS .....	emission trading system	Q .....	quota
EU-27 .....	European Union comprising 27 Member States	$q_{el}$ .....	quantity of electricity generation
FIT .....	feed-in tariff	S .....	supply curve
GC .....	generation costs	SNP .....	Strengthened National Policies
HPS .....	Harmonised Premium System	$p_o$ .....	penalty
HQS .....	Harmonised Quota System	RE .....	renewable energy
MC .....	marginal cost	RES-E .....	electricity generation from renewable sources
MS .....	Member State	TGC .....	tradable green certificate

## Summary

The new renewable energy (RE) directive (Directive 2009/28/EC) lays the ground for the RE policy framework until 2020, prescribing binding national targets for RE, while the choice of policies to achieve these given targets is left to the Member States themselves. However, discussions on the possible harmonisation of RE support which have been a central element in the European renewable energy (RE) policy debate since years have been prolonged. Of highlight, in April 2010 the *Institute of Energy Economics at the University of Cologne (EWI)* published a study titled *“European RES-E Policy Analysis - A model based analysis of RES-E deployment and its impact on the conventional power market”* (Fürsch et al., 2010). This study which has been discussed quite prominently throughout Europe analysed possible efficiency gains arising from a harmonisation of national RE support schemes. The EWI-study estimates that a harmonised European certificate trading scheme (*HQS, Harmonised Quota Scheme*) would result in cumulative cost savings for achieving the European 20 % RE target of about 174 billion €.

A *comparison to our own assessment*, which has been pursued within the recently completed European research project *future-e* (see [www.future-e.org](http://www.future-e.org)), *shows that the efficiency gains through a move from national RE support schemes to an EU wide harmonised certificate trading as calculated in the EWI study seem largely overestimated.*

*The key findings can be summarized as follows:*

- *The EWI study is not based on an adequate reference case which considers the present European policy situation.* The EWI study does not define a reference case in line with current realities. The underlying “Business as Usual” scenario used

by EWI, which serves as a benchmark to assess harmonization gains, ignores the implementation of the Directive (2009/28/EC) especially with regard to the cooperation mechanisms contained therein which aim to contribute to an optimised resource allocation all over Europe.

- *The EWI-study overestimates the exploitable potential of best resources across Europe* since it does not adequately consider the limiting effect of non-economic barriers. Particularly it does not consider obstacles regarding grid expansion. This leads to unrealistic assumptions for RE deployment at preferable site conditions. For example, EWI assumes that the RE share of Ireland could increase from currently 9 % (2007) to 92 % by 2020 or that the RE share of Estonia could increase from 1 % (2007) to 79 % by 2020. In comparison, the *future-e* study, while taking non-economic barriers into account, arrives at an estimated RE share by 2020 of only 30 % for Ireland and 20 % for Estonia.
- *The EWI Study does not adequately consider that technological learning of RE technologies needs to be financed.* Technology learning effects seem to “fall from heaven” - i.e. it appears not to be correctly correlated to “actual” (i.e. projected) RE deployment. In the scenario calculated in the EWI Study also currently high-cost technologies such as photovoltaics are needed in the last years up to 2020 in order to achieve the 20% RE target. Nevertheless, the RE certificate price is assumed to be only 51 €/MWh. This would not be sufficient to finance PV deployment at current PV costs which results in the assumption that technological learning was modelled exogenously, and, consequently, the overall investment and generation costs as well as the required

support in the harmonised quota scheme are calculated too low.

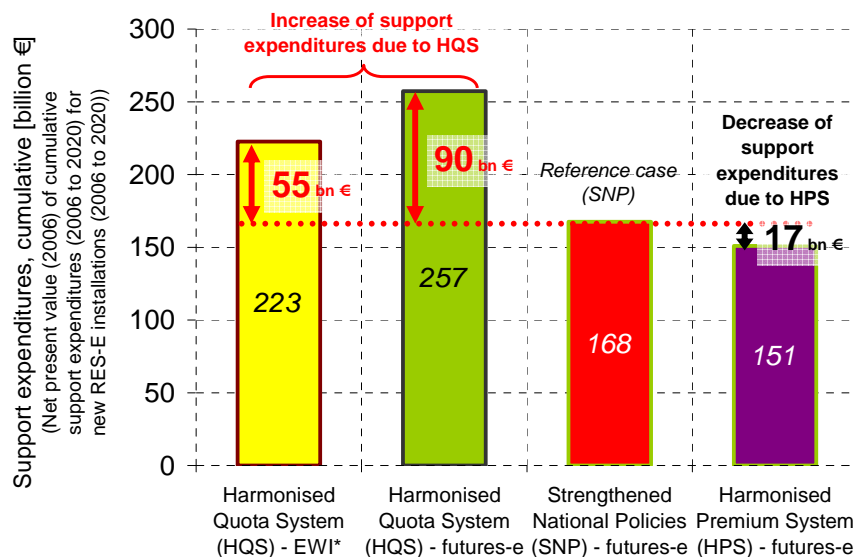
- All in all, *EWI's calculated savings of generation costs due to a switch to the harmonised quota system (HQS) seem to be largely overestimated.* The EWI study arrives at lower generation costs of 174 billion € (cumulative until 2020) for reaching the 2020 RE targets compared to their reference case of national RE support. In contrast to EWI, the futures-e-study shows cumulative savings in terms of generation costs for a harmonised technology-neutral RE support of only 7 to 28 billion €, depending on the national policy case being compared to (see Table 1).
- More importantly, *the EWI Study only reflects on investments and generation costs - the decisive policy costs for consumers are ignored.* If the EWI study had taken into account the producer surplus in a harmonised quota scheme and, thus, the resulting policy costs - i.e. the support expenditures that need to be borne by consumers, this would probably

have led to quite different results.

*We can conclude from this comparative assessment that a switch to the harmonised quota system based on technology-neutral RE support would result in an increase of support expenditures compared to the adequate reference case of strengthened national RE support (complemented by cooperation mechanisms). As shown in Figure 1, the cumulative "efficiency losses" resulting from that simplified harmonisation range from 55 to 90 billion €, depending on which study (EWI or futures-e) to rely on.*

Consequently, a harmonization of RE support based on simplistic policy options offering uniform support e.g. via a uniform RE certificate trading cannot be recommended. Thus, considering the possibilities offered by the new RE directive one can conclude that *a further strengthening and fine-tuning of national RE support instruments appears preferable*, whereby a focus needs to be taken on the removal of currently prevailing non-economic constraints which hinder an accelerated RE diffusion.

Figure 1: Comparison of cumulative support expenditures for new RES-E technologies (installed 2006 to 2020) at EU level according to the assessed policy cases (in line with the 2020 RE targets)



Note: \*Estimated based on expressed certificate prices in 2020

Source: futures-e & own calculations based on EWI



## 1 Introduction

A possible harmonisation of RE support has been forming a central element in the European renewable energy (RE) policy debate. The new RE directive (Directive 2009/28/EC) lays the ground for the RE policy framework until 2020, prescribing binding national targets for RE while the choice of policies to achieve given targets was left to the Member States themselves.

However, the discussion on harmonisation has been prolonged and several studies have discussed possible efficiency gains arising from that. Of highlight, in April 2010 the Institute of Energy Economics at the University of Cologne (EWI) has published a study named "European RES-E Policy Analysis - A model based analysis of RES-E deployment and its impact on the

conventional power market" (Fürsch et al., 2010), which has been discussed quite prominently all over Europe.

This paper analyses method of approach, assumptions, key results and recommendations of the EWI-study. For this purpose a comparison to an own assessment in this topical context is undertaken which has been pursued within the recently completed European research project futures-e (see [www.futures-e.org](http://www.futures-e.org)).

We start with a concise representation of both studies, focusing on central results and recommendations. Next, a quantitative comparison of key results is undertaken, followed by a discussion of related findings and conclusions.

## 2 Two studies on the future development of RE support in Europe with conflictive findings and recommendations: EWI versus futures-e

### 2.1 The EWI study "European RES-E Policy Analysis"

Aim of EWI's "European RES-E Policy Analysis" - a study supported by among others the German Federal State Nordrhein-Westfalen, BDEW, Eurelectric, E.ON, RWE and Vattenfall - was to assess possible efficiency gains arising from a harmonization of RE support at the European level. Thereby, the following questions were in the center of analysis:

- What is the level of cost differences between a national and an EU wide harmonized RE support?
- In particular, how high are possible savings arising from a switch from technology-specific national to EU-wide harmonized uniform RE support?

For this purpose EWI has developed the LORELEI (Linear Optimization Model for Renewable Electricity Integration in Europe) model which optimizes the capacity expansion within Europe's

renewable electricity sector according to the underlying policy framework. Besides, a comprehensive database was developed containing more than 2,200 geographically and technologically diversified RES-E expansion options as well as the currently implemented policy framework at Member State level. Based on above three scenarios were assessed: A scenario applying an EU-wide harmonized technology-neutral RES-E quota (HQS), a Business-As-Usual (BAU) scenario, extrapolating the current schemes in the Member States, and a hybrid scenario in-between these two.

The EWI-study concludes that *significant cost savings appear feasible through a harmonization based on a uniform quota system*. The net present value of total RES-E cost savings in the period 2008 to 2020 associated with a switch from BAU to the auxiliary HQS amounts to 174 billion €. These cost savings arise from two effects, first due to the change from a national to an EU wide harmonized support, and secondly due to the change from a

mainly technology-specific to a technology-neutral support of RES-E in Europe whereby the majority of them refers to the former harmonization gains (118 billion €) due to an EU-wide optimized allocation of RES-E deployment. *As targeted recommendation it is concluded that a switch to an EU-wide harmonized technology-neutral (uniform) RES-E support should be pursued.*

## 2.2 An alternative assessment within the European research project futures-e

Within the scope of the European research project „futures-e - Deriving a future European Policy for Renewable Electricity“<sup>1</sup> a first assessment of the new policy framework as defined by the RE directive (2009/28/EC) was conducted. Thereby, besides qualitative analyses an independent in-depth model based assessment of various policy options for renewable energies in general, and renewable electricity in particular, to meet Europe's commitment on 20 % RE by 2020 was undertaken. A broad set of policy scenarios conducted with the Green-X model<sup>2</sup> were thoroughly analysed, illustrating the consequences of policy choices for the future RE evolution and the corresponding cost within the EU as well as at country level. Feasible policy

pathways were identified and targeted recommendations provided in order to pave the way for a successful and in the long-term stable deployment of RE in Europe.

A possible harmonisation of RE support deserved also key attention in this policy analysis. In addition to the default cases of national RE support (i.e. business-as-usual (BAU)<sup>3</sup> and strengthened national RE support<sup>4</sup>) three different policy options were assessed with respect to a (fully) harmonised RE support within the EU: Similar to EWI a harmonised uniform support (based on a uniform RE trading scheme) (HQS - futures-e) has been assessed together with two alternative variants of harmonised technology-specific support (based on either a quota with banding or a premium feed-in system).

The finally compiled scenario work represents the outcome of an intensive feedback process established via lively debates at the national and the European level. A broad set of regional workshops had been held all over Europe within the futures-e project throughout 2008. Thereby, policy makers and key stakeholders provided essential inputs on draft outcomes and recommendations, facilitating to improve and reshape the performed work by better taking into account national specifics.

Key conclusions drawn from the assessment within the futures-e project comprise:

- Besides proactive RE support, both an accompanying (strong and) effective energy efficiency policy to reduce overall demand growth and a removal of non-economic barriers for RE are necessary to meet the 2020 RE commitment. In this context, efforts are needed in all Member States and a broad set of RE technologies has to be supported.

<sup>1</sup> For further information on the European research project futures-e which has been supported by the European Commission's research programme "Intelligent Energy for Europe" and coordinated by TU Vienna / EEG we refer to [www.futures-e.org](http://www.futures-e.org) and the concise final report (Resch et al., 2009a). A detailed discussion of the quantitative impact assessment comprising all policy options is given in "20 % by 2020 - Scenarios on future European Policies for Renewable Electricity" (Resch et al., 2009b).

<sup>2</sup> Green-X is a simulation model for RE policy instruments which has been developed by the Energy Economics Group at Vienna University of Technology. The core strength of this tool lies in the detailed RE resource and technology representation accompanied by a thorough energy policy description, which allows assessing various policy options with respect to resulting costs and benefits. Further details on the model and its application are accessible at [www.green-x.at](http://www.green-x.at).

<sup>3</sup> National RE policies were applied as currently (2008) implemented (without any adaptation).

<sup>4</sup> In this case a continuation of national RE policies until 2020 was conditioned, assuming a further optimization of current support schemes with regard to their effectiveness and efficiency. In particular the further fine-tuning of national support schemes would require in case of both (premium) feed-in tariff and quota systems a technology-specification of RE support.

- The realisable domestic RE potentials are large enough to achieve the national 2020 RE targets in almost all countries - from an economic viewpoint intensified cooperation is however recommended.
- *RE targets can be achieved either by improved (strengthened) national support systems or by a harmonized EU-wide support system, as long as support that is offered is technology-specific.*
- *RE targets cannot be achieved by a harmonized, technology-neutral support system, because such a system fails to trigger immediate deployment, development and cost reduction of technologies which are currently still more expensive but whose contribution is needed in the mid- to long-term.*
- *The (support) costs of achieving 20% RE by 2020 are significantly lower in case of technology-specific support compared to technology-neutral support.* In the latter case huge producer rents have to be borne by the consumer.

### 3 Comparison of key results from both studies

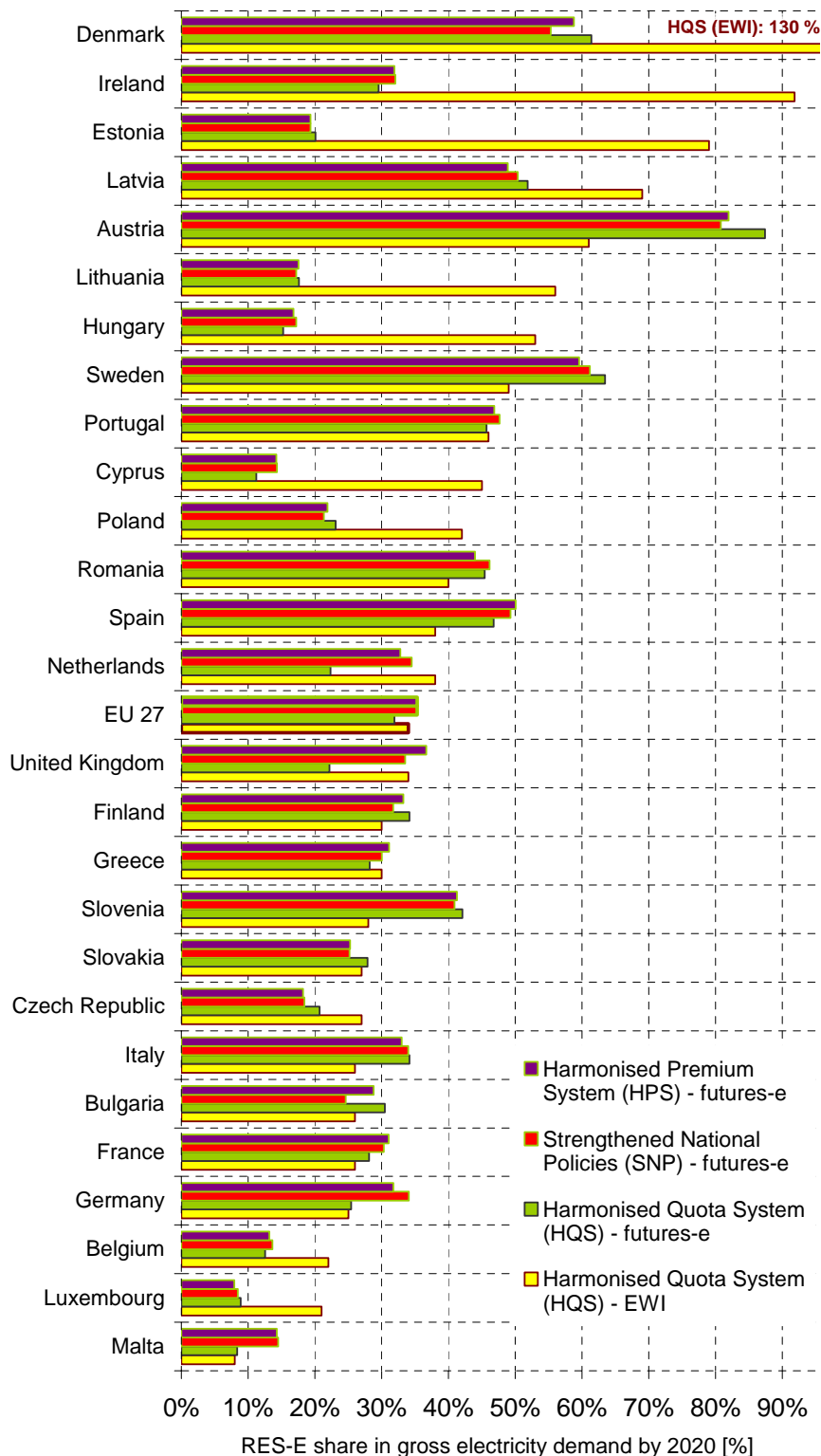
Subsequently, the key outcomes of both studies are compared, aiming to identify similarities as well as differences. Consequently, explanations shall be provided why such diametric different conclusions and recommendations were derived. We start with a comparative assessment of RE deployment according to the underlying assumptions on future RE policy approach and design. Finally, indicators on the associated costs and expenditures are assessed. Please note that similar to the EWI study the subsequent comparison is constrained to the electricity sector.

#### 3.1 The feasible RE deployment up to 2020

We start with a comparison of the RE deployment by 2020 between the *EWI* case of a *harmonised quota system (HQS - EWI)* based on uniform RE support with futures-e variants in line with the 2020 RE commitment, comprising the following policy options:

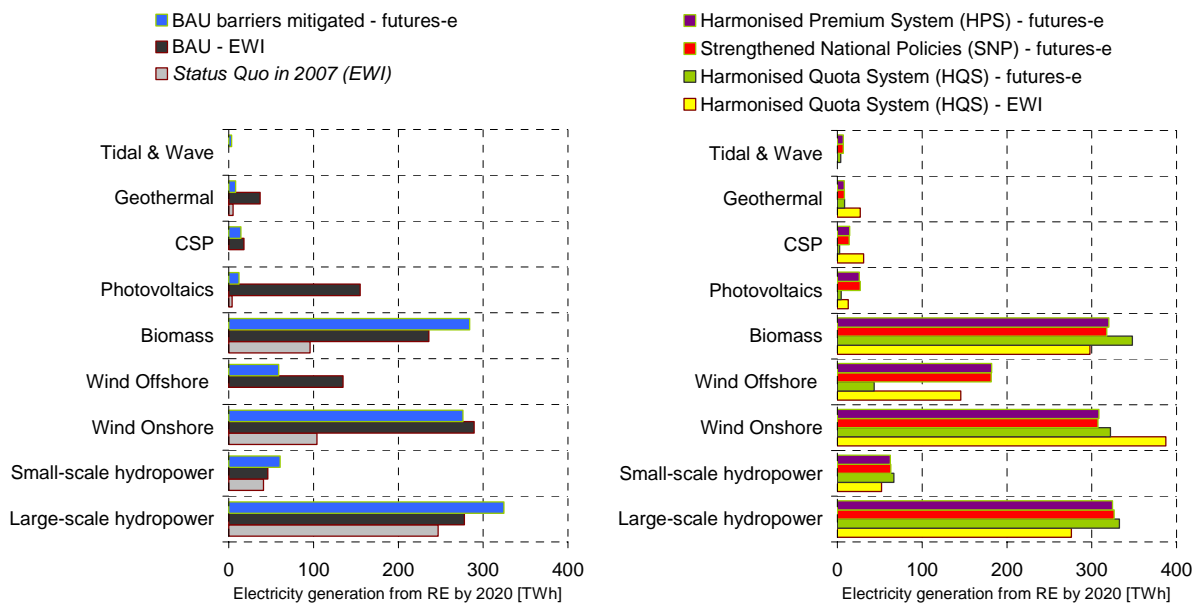
- *“Harmonised Quota System” (HQS - futures-e):* This case represents the futures-e pendant to EWI’s HQS case where uniform RE support is preconditioned by means of technology-neutral certificate trading.
- *“Harmonised Premium System” (HPS - futures-e):* An alternative variant of harmonized RE support where EU-wide equal but technology-specific premiums are conditioned for the forthcoming period up to 2020.
- *“Strengthened National Policies” (SNP - futures-e):* This case represents the reference case within futures-e whereby a continuation of national RE policies until 2020 in line with the new policy framework as given by the RE directive (2009/28/EC) is assumed. Moreover, the assumption is taken that these policies would be further optimised in the future with regard to their effectiveness and efficiency. In particular the further fine-tuning of national support schemes will require in case of both (premium) feed-in tariff and quota systems a technology-specification of RE support. In the case that a MS would not possess sufficient potentials that can be economically exploited, cooperation between the MSs would serve as a complementary option.

Figure 2: Comparison of the resulting RES-E share in gross electricity demand by 2020 at EU level and by Member State for the assessed policy cases in line with the 2020 RE targets



Source: EWI & futures-e

Figure 3: Comparison of electricity generation by RE technology in 2020 at EU level for the assessed policy cases - i.e. BAU cases (left) and policy variants in line with the 2020 RE targets (right)



Source: EWI & futures-e

Figure 2 (previous page) offers a comparison of the resulting RES-E share by 2020 in gross electricity demand at EU level as well as by Member State for all assessed cases in line with 20 % RE by 2020. Complementary to this, Figure 3 indicates the corresponding RE technology portfolio in 2020 at EU level, whereby also several variants referring to the BAU-case are included.

The following differences and similarities between both studies are becoming apparent:

- Notable, within both studies similar assumptions are taken with respect to future electricity demand. Besides, in all discussed variants a mitigation of non-economic barriers which currently limit an accelerated RE expansion is conditioned, although within the EWI-study technology diffusion goes far beyond what is frequently classified as feasible and, consequently, a substantial RE deployment can be achieved at short notice.
- At EU level differences between both studies are generally less significant. In EWI's HQS case a RES-E share of 34 % is achieved by 2020, which is according to EWI's approach for the sector target allocation consistent with meeting the overall RE target by 2020. In contrast to EWI, according to futures-e

under a harmonised uniform RE support as conditioned by a quota system based on technology-neutral support (HQS - futures-e) the EU would fail to meet its 2020 RE obligation. I.e. a RES-E share of 32 % appears feasible under the assumed boundary conditions, and the corresponding RE share in overall gross final energy demand is only 18.9 %. Within futures-e a slightly higher RES-E share (35 %) is achieved in the case of strengthened national policies (SNP -futures-e) as well as in the case of harmonised premium tariffs (HPS - futures-e).

- More significant deviations between both studies are observable at country level. Focussing on the direct comparison of both cases of uniform RE support ("HQS - EWI" vs. "HQS - futures-e") it is becoming apparent that in general the EWI study draws a far more optimistic picture of the feasible RE deployment, specifically at preferable site conditions. The largest deviations are observable for Denmark, Ireland, Estonia, Lithuania, Hungary and Cyprus - in these countries the difference is above 30 percentage points. E.g. for Ireland futures-e assumes an increase of the RES-E share from currently (2007) 9 % to 30 % (HQS - futures-e) as feasi-

ble, which can be further increased to 32 % with improved policy support (SNP and HPS - futures-e). In contrast to above, EWI projects an increase to 92 % in 2020 for Ireland. Another striking example represents Estonia, where EWI postulates a feasible increase from currently (2007) 1 % to 79 % in 2020, while according to futures-e only a share of 20 % appears realistic under the underlying framework conditions. Both examples underpin that within the EWI-study besides other non-economic barriers grid constraints are totally neglected. This is also explicitly stated therein - the added value of such an approach for the researched policy topic appears however highly questionable. In contrast to that, within the Green-X model applied within the futures-e study a "pragmatic optimism" is conditioned - a mitigation of such constraints is assumed, but the timely feasibility of such long-term infrastructural investments appears adequately reflected.

- In contrast to above, the Green-X model indicates a more optimistic appraisal than EWI's LORELEI model for countries like Austria, Sweden, Slovenia, Spain and Italy - whereby with the exception of Austria the deviation is generally of much lower magnitude.
- A high level of consistency between both models is notable for Germany, Malta, Slovakia and France. For these countries the deviation is lower than two percentage points.
- A closer look on the technology-specific deployment as illustrated in Figure 3 indicates which technology options are expected to provide the additional deployment within EWI's HQS: A significantly higher deployment is expected for wind energy, specifically for wind offshore. Of interest, also other comparatively more expensive RE technologies such as photovoltaics (PV), CSP and advanced geothermal electricity are expected to provide a substantial contribution in later years close to 2020 according to EWI's HQS case while within futures-e the underlying policy framework (of uniform RE support) would not allow that. This indicates that within EWI's LORELEI model tech-

nological learning is not endogenously modelled. In other words, EWI expects that these technologies achieve a substantial market entrance in later years at significantly lower cost than today - whereby the cost and performance improvements would rather have to "fall from heaven" than to be a consequence of a stable and continuous policy intervention. This is underlined by EWI assuming a certificate price of only 51 €/MWh by then, which is not sufficient to finance e.g. PV deployment at current costs.

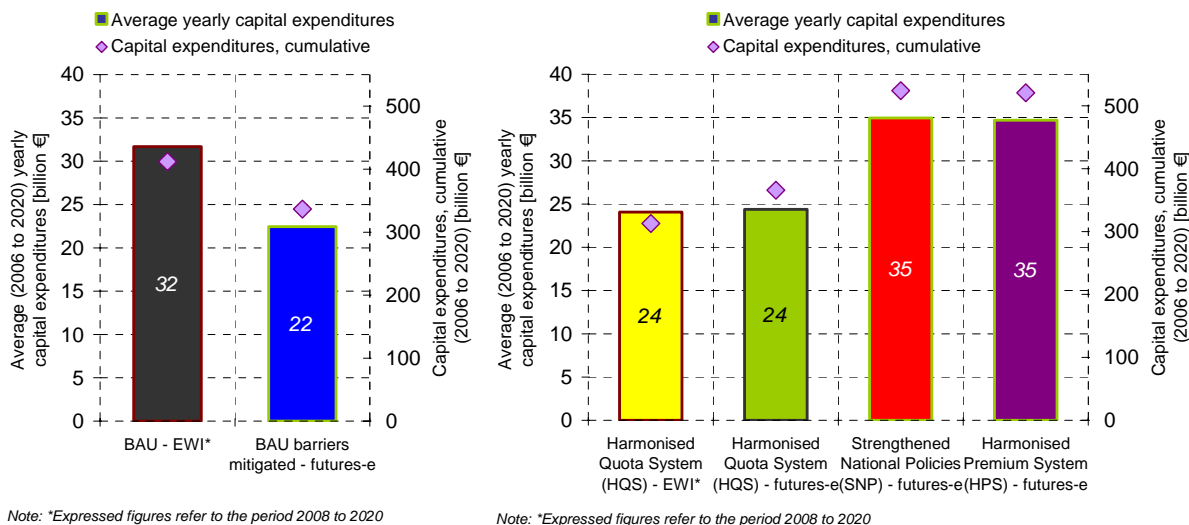
A closer look on the BAU cases, i.e. assuming a continuation of current RE support, indicates more significant differences between both studies also at EU level. According to EWI with current RE support an increase from currently (2007) 15 % to 32 % appears feasible until 2020. In contrast to that, in the default BAU case (BAU - futures-e) of the futures-e study only a RES-E share of 23 % is achieved by 2020. It has to be noted that thereby a higher electricity demand is conditioned, following to a baseline trend.<sup>5</sup> With similar assumptions related to future electricity demand growth<sup>6</sup> and assuming a mitigation of current non-economic RE barriers a share of 29 % is projected for 2020 (BAU barriers mitigated - futures-e, see Figure 3). Similar to above, this suggests that within the EWI study non-economic deficits which limit the diffusion of the various RE technologies are ignored. Moreover, at country level more significant differences between both studies are apparent. The largest deviations (i.e. above 20 percentage points) are observable for Estonia, Cyprus, Hungary, Greece, Latvia and Portugal, whereby EWI tends to draw a more optimistic, but from a pragmatic viewpoint unrealistic picture.

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<sup>5</sup> For ensuring consistency with existing EU scenarios and projections the key input parameters of the scenarios presented in the futures-e study are derived from PRIMES modeling, specifically the baseline demand trend is taken from the European Energy and Transport Trends by 2030 / 2007 / Baseline (NTUA, 2007).

<sup>6</sup> Based on the PRIMES scenario on meeting both EU targets by 2020 - i.e. on climate change (20 % GHG reduction) and renewable energies (20 % RE by 2020) / 2008 / Reference (NTUA, 2008).

Figure 4: Comparison of average yearly and cumulative capital expenditures for RES-E technologies at EU level for the assessed policy cases - i.e. BAU cases (left) and policy variants in line with the 2020 RE targets (right)



Source: EWI & futures-e

### 3.2 Resulting costs and expenditures

The previous discussion of future RE deployment has helped to identify differences and similarities between both studies. With similar assumptions on RE support different results with respect to RES-E deployment were gained. Apart from that the comparison provided first insights on the usability of assumed policy measures for reaching the 2020 RE commitment. Differences were less significant at EU level, while at country and technology-level different expectations became apparent. Next we focus on the economic assessment, starting with capital expenditures and concluding with the resulting cost related to the enhanced RES-E deployment (i.e. generation cost, support expenditures).

#### 3.2.1 Capital expenditures / Investments

Firstly, it should be noted that an indication of the required investments does not provide insights on the resulting costs - it simply depicts the need for adequate financing, but per se it is impossible to prejudge if such impulses in the economic system lead to positive or negative overall impacts.

An overview on the required capital expendi-

tures for RES-E technologies at EU level is provided by Figure 4 (above). The cumulative capital expenditures at EU level as expressed in both reports differ significantly from case to case, ranging from 337 to 524 billion €. Besides policy assumptions this is also caused by a differing underlying time perspective.<sup>7</sup> Consequently, for the comparative assessment a closer look on the average yearly expenditures appears adequate.

Among both BAU cases quite significant differences are observable. This results from different assumptions related to the feasible technology diffusion - i.e. the difference of yearly 10 billion € between "BAU barriers mitigated - futures-e" and "BAU - EWI" is caused by the higher RE deployment according to EWI's BAU case, specifically due to the significantly increased PV expansion.

A closer look on the policy cases in line with the 2020 RE commitment offers a clear distinction: Both variants of harmonized uniform RE support ("HQS - EWI" and "HQS - futures-e") show lower capital expenditures than the alternative cases

<sup>7</sup> EWI expresses capital expenditures for the period 2008 to 2020, while within the futures-e study the years 2006 to 2020 are in focus.

based on technology-specific RE support as assessed within futures-e - i.e. at EU level average yearly investments into RES-E technologies vary from 24 (HQS) to 35 billion € ("SNP - futures-e" and "HPS - futures-e"). At first glance, one may suppose that this is caused by the limitation to low-cost technologies within a technology-neutral support system. However, in EWI's HQS case also currently intermediate and novel technologies such as CSP or photovoltaics are expected to deploy in later years close to 2020. This clarifies that within EWI the future cost reduction of the various RE technologies is not modelled endogenously - in other words, there is no linkage between the projected future RE deployment and the assumed cost reduction which contradicts the concept of technological learning. In reality these technologies would only be applicable at higher cost and, consequently, corresponding capital expenditures are clearly underestimated.

### 3.2.2 Generation costs

The EWI-study prominently debates efficiency gains associated with a harmonization of RE support at the EU level. This is done for capital expenditures as well as generation costs and results from the comparison of the researched policy cases (HQS versus BAU, HQS versus national quota systems). While as discussed above the first indicator (i.e. capital expenditures) appears inadequate for a discussion of cost savings, the latter (i.e. generation costs) represents one of the feasible indicators for a cost assessment and a discussion of efficiency gains. However, with respect to generation cost

neither brief nor detailed figures by scenario are applicable in EWI's report. Consequently, we can only repeat the expressed efficiency gains resulting from the comparative scenario assessment: The net present value of total RES-E (generation) cost savings in the period 2008 to 2020 associated with a switch from BAU to the auxiliary HQS amounts to 174 billion €. These cost savings may be subdivided artificially into gains resulting firstly from the switch from a national to an EU wide harmonized support (118 billion €), and secondly due to the change of policy design, i.e. moving from a mainly technology-specific to a technology-neutral support of RES-E in Europe (56 billion €).

Within futures-e the comparison of the resulting generation costs was not in focus. However, data is applicable in the futures-e reports allowing a comparison to the findings of the EWI-study. More precisely, in the futures-e study not the total but the additional generation costs of RE technologies are discussed. That is "the levelized cost of renewable energy minus the reference price for conventional energy supply whereby the levelling is done over the lifetime" (Resch et al., 2009b).

Table 1 lists the possible savings in terms of (additional) generation costs resulting from the implementation of a harmonised quota system (HQS - futures-e) instead of an alternative policy case according to futures-e. More precisely, this table expresses the net present value of cumulative (2006 to 2020) savings in terms of additional generation costs for new RES-E installed in the period 2006 to 2020.

**Table 1: Comparison of possible savings in terms of (additional) generation costs due to the implementation of a Harmonised Quota System (HQS) according to futures-e calculations**

Scenario comparison	BAU - futures-e	BAU barriers mitigated - futures-e	Strengthened National Policies (SNP) - futures-e	Harmonised Premium System (HPS) - futures-e
HQS (futures-e): Savings* in terms of (additional) generation costs compared to other policy cases [billion €]	-0.1	6.8	27.9	27.0

*Note: \*Net present value of cumulative (2006 to 2020) savings in terms of additional generation costs for new RES-E installed in the same period (i.e. 2006 to 2020).*

*Source: based on futures-e*



Although the assessed time period differs slightly among both studies, an indicative comparison appears feasible and reasonable. The results, however, differ substantially: According to futures-e cost savings associated with a switch from national policies to a harmonized RE support occur only if (similar to all other cases) non-economic barriers are mitigated. Moreover, these savings are of significantly lower magnitude compared to EWI's calculations: Cumulative (2006 to 2020) savings of generation costs range from 7 (BAU barriers mitigated - futures-e) to about 28 billion € (Strengthened National Policies - futures-e) instead of 174 billion € as expressed by EWI. In general, savings in terms of generation cost arise only if a harmonisation based on uniform RE support is pursued (HQS - futures-e). This results from the fact that within this policy case only low-cost RE technologies deploy on the market while in all other harmonization variants also a substantial deployment of intermediate and novel RE technologies is expected. Consequently, this is associated with higher generation costs in the short term<sup>8</sup>, but, as stated above, they are significantly lower compared to EWI's figures. Besides, it also has to be taken into account that in contrast to all other harmonized or strengthened policy options in futures-e's HQS case RE deployment lacks behind the given target.

### 3.2.3 Support expenditures

Finally, the *key indicator for a comparative assessment of the efficiency of RE support* is discussed - i.e. the resulting *support expenditures*.

In general, support instruments have to be *effective* in order to increase RE deployment and *efficient* with respect to *minimising the resulting public costs* - i.e. the transfer costs for consumer (society) due to RE support, subsequently named support expenditures - over time. The criteria used for evaluating the

various policy instruments are based on two conditions:

- *Minimise generation costs*. This objective is fulfilled if total RE generation costs (GC) are minimised. In other words, the system should provide incentives for investors to select technologies, scales and sites so that generation costs are minimised.
- *Reduce producer profits to an acceptable level*. Once such cost-efficient systems have been identified, the next step is to evaluate various implementation options with the aim of minimising the transfer costs for consumer / society. This means that feed-in tariffs, investment incentives or RE trading systems should be designed in such a way that support expenditures are also minimised. This implies lowering generation costs as well as producer surplus (PS).

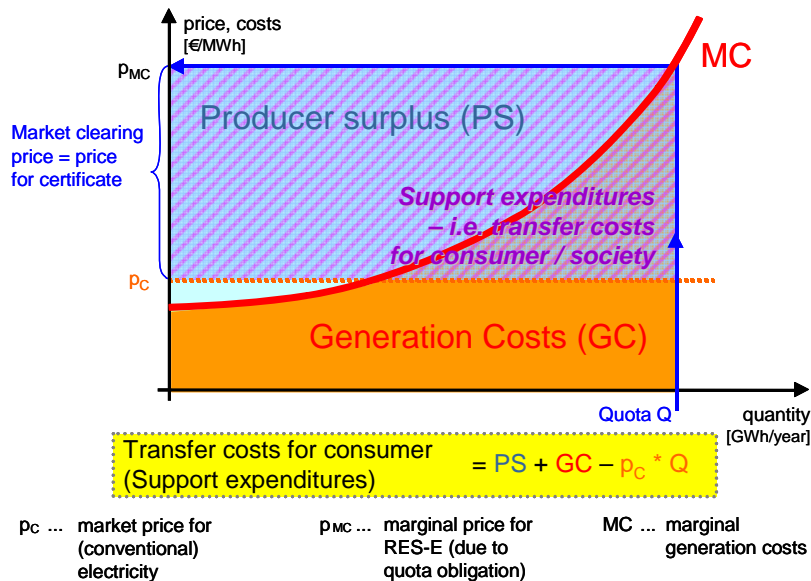
In some cases it may not be possible to reach both objectives simultaneously - i.e. minimise generation costs and reduce producer surplus - so that compromises have to be made. For a better illustration of the cost definitions used, the various cost elements are illustrated in Figure 5 (next page).

Next, we aim to provide clarification on the level of resulting support expenditures according to the policy cases examined in both studies. The EWI-study aims for a comprehensive RES-E policy analysis and discusses prominently efficiency gains associated with a harmonization of RE support but avoids any discussion of resulting support expenditures. An estimation of the resulting support expenditures for EWI's recommended policy case of a harmonized quota system based on technology-neutral certificate trading (HQS) can be conducted, based on the certificate price in 2020 as published in the EWI-report, which amounts to 51 €/MWh.<sup>9</sup> Assuming that this price remains constant over the assessed period - i.e. the forthcoming years

<sup>8</sup> Obviously, investments in innovative technologies are a necessity to "ride down the learning curve" - i.e. to achieve corresponding cost reductions in future years. Hence, this increases the dynamic efficiency of the policy.

<sup>9</sup> A graphical illustration of certificate prices by 2020 according to various policy cases is shown in Figure 9-2 on page 119 of the EWI-study. From that we conclude a certificate price of 51 €/certificate, corresponding to 51 €/MWh.

Figure 5: Basic definitions of the cost elements (illustrated for a RE trading system)



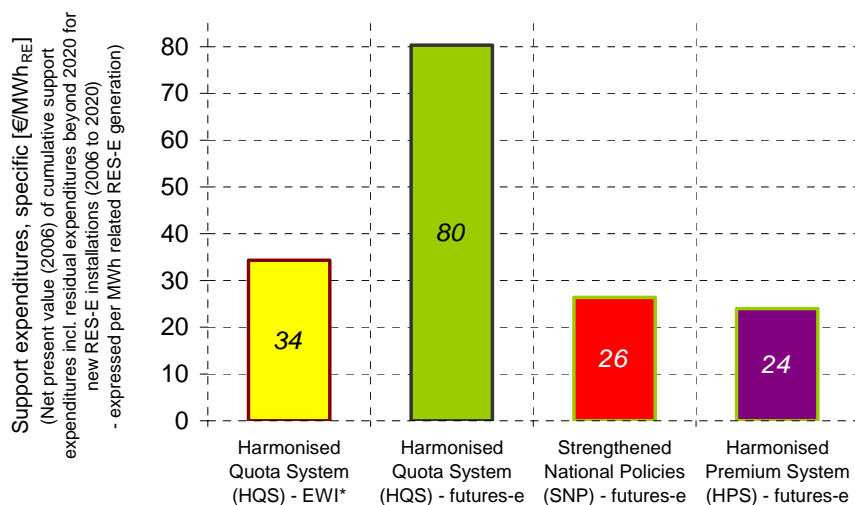
Source: based on Huber et al. (2004)

up to 2020 - support expenditures can be calculated following the approach as examined in futures-e. For EWI's BAU case such an estimation was however not feasible due to the broad portfolio of policy variants involved (i.e. 27 national support schemes) and no applicable information on the associated costs. Consequently, the subsequent comparison is constrained to EWI's HQS case and all corresponding alternative policy options assessed within futures-e and discussed above. In this context, Figure 6 (next page) provides a depiction of specific support expenditures for new RES-E installations for the scenarios assessed. As the corresponding RES-E deployment differs to a certain extent from case to case, a comparison of specific support expenditures appears more adequate. More precisely, this figure is derived by expressing cumulative support expenditures (including also possible residual cost beyond 2020) for new RES-E installations in relation to their corresponding electricity generation. The following overview can be gained: In specific terms the most cost-efficient policy option represents the case of harmonized premium system where EU-wide equal but technology-specific premiums are conditioned for the forthcoming period up to 2020 (HPS - futures-e) with specific support costs in size of 24 €/MWh<sub>RES-E</sub>.

Marginally higher support costs (26 €/MWh<sub>RES-E</sub>) occur in the case of strengthened national RE support (accompanied by cooperation mechanisms) (SNP - futures-e) which is in line with the policy framework defined by the new RE directive (2009/28/EC). Significantly higher support costs are applicable for both cases of harmonized technology-neutral RE support (HQS), ranging from 34 (HQS - EWI) to 80 €/MWh<sub>RES-E</sub> (HQS - futures-e)<sup>10</sup>.

<sup>10</sup> As noted previously, within Green-X's HQS-variant also the 2020 RE commitment cannot be met - i.e. by 2020 a RES-E share of 32 % is achieved (instead of 35 %). The corresponding RE-share at the aggregated level (including besides electricity also RE deployment in the heat and transport sector) is 18.9 % instead of 20 %.

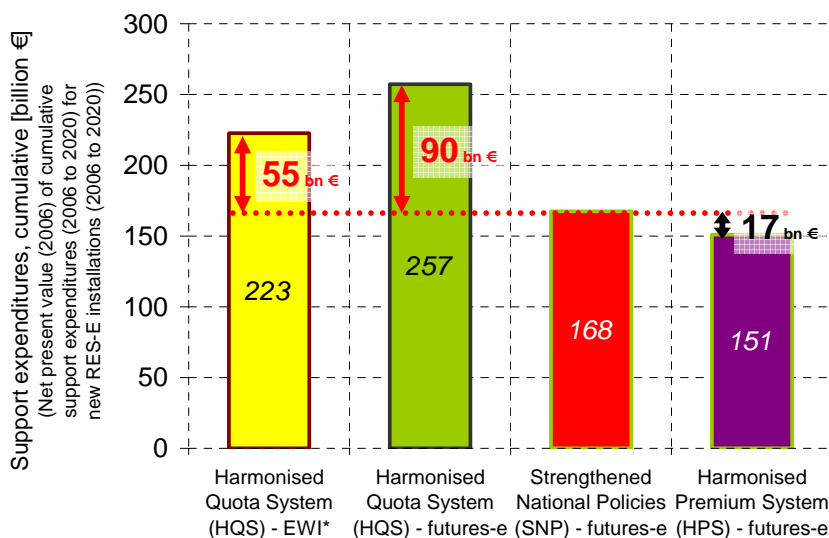
Figure 6: Comparison of specific support expenditures for new RES-E technologies (installed 2006 to 2020) at EU level according to the assessed policy cases (in line with the 2020 RE targets)



Note: \*Estimated based on expressed certificate prices in 2020

Source: futures-e & own calculations based on EWI

Figure 7: Comparison of cumulative support expenditures for new RES-E technologies (installed 2006 to 2020) at EU level according to the assessed policy cases (in line with the 2020 RE targets)



Note: \*Estimated based on expressed certificate prices in 2020

Source: futures-e & own calculations based on EWI

Following the approach examined in the EWI-study by expressing efficiency gains in cumulative terms<sup>11</sup>, we can conclude that the

implementation of a harmonized uniform quota system (HQS) would obviously not cause a de-

<sup>11</sup> More precisely, we compare the net present value of support costs arising in the period 2006 to 2020, that are associated with new RES-E installed

in the same period. Similar to EWI's approach as used in this paper also for the comparison of generation costs we hereby ignore residual costs beyond 2020.

crease of support expenditures, see Figure 7 (previous page). In comparison to the “least cost” policy variant of harmonized premium feed-in tariffs (HPS - futures-e) a switch to the quota solution (HQS) would cause an increase of expenditures according to both studies, ranging from 72 (EWI) to 106 billion € (futures-e). Compared to the national policy option of strengthened national RE support (SNP - futures-e) the cost difference decreases but remains significant - i.e. a switch to the HQS-case would result in an increase of support expenditures in size of 55 (EWI) to 90 billion € (futures-e). Conse-

quently, a harmonization of RE support based on simplistic policy options offering uniform support e.g. via a uniform certificate trading cannot be recommended. Thus, from a pragmatic viewpoint - i.e. considering the possibilities offered by the new RE directive - one can conclude that a further strengthening and fine-tuning of national RE support instruments appears preferable, whereby a focus needs to be taken on the removal of currently prevailing non-economic constraints which hinder an accelerated RE diffusion.

## 4 Key findings and conclusions

The key findings from the comparative scenario assessment as well as the detailed analysis of the approach and methodology applied in the EWI-study can be summarized as follows:

- *The EWI study is not based on an adequate reference case which considers the present European policy situation.* The EWI study does not define a reference case in line with current realities. The underlying “Business as Usual” scenario used by EWI, which serves as a benchmark to assess harmonization gains, ignores the implementation of the Directive (2009/28/EC) especially with regard to the cooperation mechanisms contained therein which aim at optimum resource allocation.
- *The EWI study does not consider existing non-economic obstacles limiting RE diffusion - or does so only insufficiently.* These involve, e.g. obstacles regarding grid expansion. For instance, directly comparing the HQS scenarios of both studies shows that an extremely optimistic expansion of RE is forecast by EWI compared to futures-e in a majority of Member States. The biggest differences result for (in decreasing order) Denmark, Ireland, Estonia, Lithuania, Hungary and Cyprus. In these countries, the RE share achieved in 2020 differs by more than thirty (!) percent. For example, EWI identifies a RE share of 92 % for Ireland in the HQS case, while futures-e considers it feasible

that this could increase from the current 9 % (2007) to 30 % by 2020 under the assumed frame conditions. There is a similar picture for Estonia, where futures-e predicts a RE-share of 20 % for the HQS case, while EWI believes it realistic that RE could grow in the electricity sector from 1 % (2007) to 79 % by 2020. Both results underline the fact that grid restrictions were disregarded in the EWI study. It has to be asked what contribution the insights gained by EWI can make to the current policy discussion since ignoring these realities causes the possible growth of RE to be massively overestimated in a series of Member States and consequently also any possible harmonization gains. In contrast, futures-e is based on “pragmatic optimism” - these kinds of obstacles are indeed assumed to be dismantled, but the time required to implement such long-term infrastructure measures is also taken into account.

- *The cost reduction in the future due to technological learning was not sufficiently integrated in the model used by EWI;* in particular, the connections between the growth in renewable energies and technological learning were not properly accounted for. This is why learning advances are overestimated for a series of innovative technologies, especially in the harmonized quota scenario where technologies like PV do not deploy on the market in early years due to insufficient support while costs are as-

sumed to continuously decline. In the years close to 2020 then out of a sudden deployment takes place due to the previous cost reduction “falling from heaven”. Thus, the costs of this scenario underestimated which leads, in turn, to overestimating harmonization gains.

- *Modelling the development of renewable energies, which was conducted by EWI only for the electricity sector, ignores possible flexibility due to the greater use of renewable energies in the heat and transport sectors.* Limiting the scope to electricity from renewable energies also results in failing to depict the interaction of the increased demand for biomass in one energy sector with other sectors' demand and the resulting impact on price structure.
- All in all, *EWI's calculated savings of generation costs due to a switch to the harmonised quota system (HQS) seem to be largely overestimated.* The EWI study arrives at lower generation costs of 174 billion € (cumulative until 2020) for reaching the 2020 RE targets compared to their reference case of national RE support. In contrast to EWI, the futures-e-study shows cumulative savings in terms of generation costs for a harmonised technology-neutral RE support of only 7 to 28 billion €, depending on the national policy case being compared to (see Table 1).
- *The use of the term costs in the study is limited to investments and generation costs. This seems incomplete and insufficient to answer the questions examined.* An analysis of the overall policy cost, specifically the support expenditures associated with a certain policy intervention that have to be finally borne by the consumers / society, would have been of central importance, especially taking into account the producer surpluses occurring in the scenarios examined. This would probably have led to different conclusions concerning the evaluation of the scenarios since the EU-wide harmonized quota system is likely to result in

obvious cost increases for consumers for supporting renewable energies even within the scope of the calculations presented by EWI.

The above comments are clearly illustrated by a comparative cost analysis: A harmonized quota system based on uniform support (HQS) leads to a technology portfolio with comparatively low generation costs in both the EWI and the futures-e study - due to the fact that such a simplified policy approach would not stimulate the deployment of currently intermediate to novel RE technologies. Connected with this, however, are also high producer surpluses (“windfall profits”) among power generators. *Compared to strengthened national support policies (plus cooperation mechanisms) (SNP - futures-e) in the reference case used by futures-e, both HQS scenarios show an increase of support expenditures. The cumulative “efficiency losses” resulting from that simplified harmonisation range from 55 to 90 billion €, depending on which study (EWI<sup>12</sup> or futures-e) to rely on. In contrast to this, a harmonization based on technology-specific feed-in premiums is shown to be the marginally more cost-effective variant with regard to support expenditures compared to strengthened national policies. Thus, a harmonization of RE support based on a quota system with technology-neutral certificate trading as recommended in the EWI-study would not lead to cost savings from the consumer / societal perspective. Contrarily, as examined in this comparative analysis this would cause a significant increase of support expenditures which would be also accompanied by a stop of successfully launched innovation processes of intermediate to novel RE technologies.*

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<sup>12</sup> Estimating the cumulated support expenditures required according to EWI's HQS case is based on the certificate price given for 2020 - for a detailed explanation of the derivation, please refer to the related passage in the previous section of this paper.

Apart from high effectiveness, the primary objective of an efficient support policy for renewable energies should be to minimize the corresponding support expenditures and thus the burden on society. This is achieved by minimizing both generation costs and producer surplus. No doubt, minimizing generation costs through an optimised resource allocation across Europe, as postulated in the EWI study, should also be taken into consideration in the medium to long term. In this context, however, it must be clarified which policy approach, and specifically which instrument, is capable of providing the technology portfolio for a cost-effective generation structure in the long term (beyond the 2020 targets). In any case, the necessary conditions for intensified cooperation, coordination or even harmonization have to be created to start with.<sup>13</sup> The current policy framework as defined by the new RE directive (2009/28/EC) provides already a suitable basis for exploiting favourable potentials through cooperation while continuing with stable national RE policies, which however need to be strengthened in forthcoming years to meet the agreed RE targets. Which policy framework at European level would alternatively result in minimizing support expenditures depends among other aspects on how the marginal costs of the technology options develop over time and deserves further analysis. Previous observations have shown, however, that making a support instrument technology-specific has proven to be an efficient design criterion for avoiding excessive support.

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<sup>13</sup> These include, for example, a comprehensive unbundling on Europe's electricity markets, developing (cross-regional) grid capacity, dismantling current non-economic barriers for RE, integrating the electricity markets and implementing best practice policies in the field of RE.

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*This report*

*serves as a background document for the  
forthcoming model-based RE policy analyses  
conducted within the European research project*

***RE-Shaping***

*Shaping an effective and efficient  
European renewable energy market*