Evaluating the current EU energy efficiency policy framework and its impact until 2020 and 2030

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Abstract
The current state of achieving the 20 % energy saving target by 2020 as well as the realization of the EU 2030 target adopted in October rank very high on the EU energy policy agenda. Scenario-based analysis using bottom-up simulation models provides information on the impact of implemented policies as well as future saving potentials. Our analysis has two main objectives: (i) to assess the contribution of implemented policies towards achieving the 2020 energy efficiency target of 20 %; (ii) to assess energy efficiency potentials beyond implemented policies until 2020 and 2030. For both objectives, we apply a bottom-up modelling approach using detailed sector models covering residential and non-residential buildings, industry, residential and tertiary appliances as well as transport. In order to assess the different policy options and saving potentials, we define several scenarios including a baseline (with and without early action and with planned measures), a scenario with additional measures not yet implemented and three scenarios representing saving potentials (from very cost-effective to "near economic"). Our results show that the scenario including early action misses the 20 % energy saving target by 2020 by about 2.3 %. Including additional measures (and intensifying existing measures) it is possible to reach the 20 % target. Regarding the new 2030 targets of the EU, our modelling approach shows that primary energy consumption can be reduced by 41 % compared to the PRIMES 2007 baseline by fully exploiting the economic energy savings potentials. This is considerably more than the reduction by 27 % as decided by the European Council. The resulting decrease of GHG emissions amounts to more than 45 % in this scenario (assuming a share of renewable of 27 %). The detailed modelling of policies and technologies allows a sector-specific analysis of the contribution of individual policy instruments and technologies towards the above mentioned targets. Only such detailed models allow simulating the different types of energy-efficiency policies (e.g. standards, taxes, ETS, audits, information programs, subsidies).

Introduction
In 2008, the European Union launched a system of climate and energy targets for 2020 including headline targets for greenhouse gas (GHG) emissions, renewable energy sources (RES) and energy efficiency (EE) (EC 2008a). The latter was defined as a reduction of primary energy consumption by 20 % compared to the trend up to 2020.[1] The 2020 EE target was further specified in Article 3 of the Energy Efficiency Directive (EED; European Parliament and Council 2012) stating that "the Union's 2020 energy consumption has to be no more than 1,474 Mtoe of primary energy or no more than 1,078 Mtoe of final energy".[2] There was, however, some evidence that the EU may miss its 2020 energy savings target (EEA, 2013; Harmsen et al., 2014). On the other hand, it is well documented that there is a huge potential for energy efficiency and reduced use of energy which is often cost-effective from a social perspective, and

1. The trend was set by the PRIMES 2007 projections (EC 2008b) and does not include impacts of the financial and economic crisis from 2008 onwards.

2. Later on Croatia was included as a new EU Member State and the figures increased to 1,483 respectively 1,086 Mtoe.

even that of an individual private investor (Fraunhofer ISI et al., 2009; Ecofys and Fraunhofer ISI, 2010; IEA, 2012; Fraunhofer ISI, 2012; Eichhammer, 2013). Finally, in October 2014, the European Council (2014) adopted its Climate and Energy Package for 2030 including a binding EU target of an at least 40 % domestic reduction in greenhouse gas emissions compared to 1990, a target of at least 27 % for the share of renewable energy which is only binding at EU level, and an indicative target of at least 27 % improvement in energy efficiency 2030 compared to the same trend as before.

Given this background, our analysis has two main objectives: (i) to assess the contribution of implemented policies towards achieving the 2020 energy efficiency target of 20 %; (ii) to assess energy efficiency potentials beyond implemented policies until 2020 and 2030, mainly in view of the new 2030 target frame for energy efficiency. The "Study evaluating the current energy efficiency policy framework in the EU and providing orientation on policy options for realising the cost-effective energy-efficiency/saving potential until 2020 and beyond" (Fraunhofer ISI et al. 2014) serves as the basis for the scenario calculations presented in this paper.

The remainder of our paper is organised as follows. Section 2 outlines the applied methodological approach. Section 3 describes results of our analysis, thereby distinguishing between the target assessment up to 2020 and the potential analysis up to 2030. In the final section we discuss the main findings and derive implications for policy making.

Methodology

In order to evaluate the policy impacts up to 2020 as well as the energy efficiency potentials up to 2030, we apply a bottom-up modelling approach using detailed sector models for final energy demand:

- INVERT/EE-Lab (run by TU Vienna) for residential and non-residential buildings.
- The FORECAST platform (run by Fraunhofer ISI) covering an industrial model as well as the electricity uses in the residential and service sector.
- ASTRA (run by Fraunhofer ISI) providing potentials for the transport sector.

The major difference of these bottom-up models as compared to a model like PRIMES (EC 2008, 2013) is the large degree of detail in the representation of technologies, actors and saving options which is necessary to reflect technology and actor-specific even measure-specific barriers. Such barriers prevent private investors in households as well as companies and public organisations from realising energy savings potentials even though they are cost-effective under current economic conditions (e.g. IEA, 2012, Fleiter et al. 2013, Schlomann 2014, Schlomann and Schleich 2015). According to the classification by Sorrell et al. (2004), these barriers fall into the following broad categories: imperfect information and other transaction costs (e.g. search costs) for identifying energy use of buildings, products and services; hidden costs, such as overhead costs for management or for staff training; technical risks of energy-efficient technologies; financial risks associated with irreversible investments and uncertainties in the returns of energy efficiency measures; lack of access to internal or external capital; split incentives, preventing the investor in energy efficiency measures fully benefiting from the savings (e.g. the well-known landlord-tenant problem); and bounded rationality, which means that constraints on time, attention, and the ability to process information prevent individuals from making "rational" choices in complex decision problems. In addition, presenting technologies in such a detailed manner allows to make use of the growing empirical basis for technological learning in the modelling, hence lowering of the additional cost. Considering technological learning in a realistic manner provides further information on how policy instruments may contribute the cost of early market penetration of energy-efficient technologies.

In order to assess the different policy options and saving potentials, we develop the following 7 scenarios:

- Three baseline scenarios which differ in the way how policy measures implemented between 2008 and 2013 (here defined as "early action" period) are taken into account:
  - a baseline without early action [*Base_noEA]* which only contains policies implemented before 2008;
  - a baseline with early action [*Base_inclEA]* which includes policy measures implemented between 2008 and 2013;
  - a baseline with measures [*Base_WM]* also containing measures which are already accepted or close to being accepted in 2014 and the near future; this scenario is, however, rather close to the B*ase_inclEA* scenario or it can even be the same.
- One scenario with additional measures [*AM scenario*] not yet implemented which extends existing measures for each sector by around 3 % in order to reach the EED target in case there is a gap. Some new measures (which represent a generalization of successful measures at the national level) are also proposed, especially for the transport sector and space heating & hot water.
- Three scenarios representing saving potentials:
  - Potentials to 2030 with low policy intensity, reflected in high discount rates (sector-specific) and barriers persisting [*LPI scenario*].
  - Potentials to 2030 with high policy intensity, reflected in low discount rates (sector-specific) and barriers (partially or totally) removed [*HPI scenario*].
  - Potentials which are not economic[3] but the scenario induces costs not much higher than present level energy consumption entails, so that the scenario can be characterized as "near-economic" [*NE scenario*].

The first four scenarios are relevant for the projections to 2020 and the comparison with the EED 2020 target. The last three are relevant for the 2030 potentials.

3. I.e. the Net Present Value is negative given the discount rates used in the HPI scenario.

At the sectoral level, the focus of our analysis is on final energy demand. However, since the 2020 target is both expressed in final and primary energy in the EED, the level of primary energy which is reached in the different scenarios has to be analysed, too. For this purpose we mainly use the conversion factors to primary energy (excluding non-energy use) provided by PRIMES 2013 (EC 2013).

In order to ensure comparability with the PRIMES projections, the main general drivers for the development of energy consumption such as the international fuel prices, the energy wholesale prices, growth of GDP, the number of dwellings and the carbon prices were adapted from PRIMES 2013 (EC 2013). Sector-specific framework conditions, however, are implemented in the sector models we used for our analysis. The sectoral drivers we assumed in our analysis can be found in detail in the background study for this paper (Fraunhofer ISI et al. 2014).

Results

TARGET ACHIEVEMENT IN 2020

With regard to the achievement of the 2020 **final energy target** of 1,078 Mtoe the following main messages can be extracted from our bottom-up modeling analysis for EU-27:

- In 2020 the scenario including all policy measures before 2014 [*Base_inclEA*] misses the 2020 final energy target of 1,078 Mtoe (EU27) by around 2.3 %. This is somewhat less than the PRIMES 2013 projections, which find a gap of around 4 % (EC 2013). The *Base_WM* scenario, which includes measures expected or known to be starting at 2014, does not considerably change this figure.
- With an extension of present measures and the generalization of some successful measures from the national level it is possible to reach the 2020 target [*AM scenario*]. The corresponding extension of measures is discussed below.
- In view of a more ambitious realization of energy efficiency potentials up to 2030, it may be appropriate to discuss more ambitious measures already with a time horizon for 2020. This is shown by the fact that the *HPI* scenario, which implies a realization of economic potentials, exceeds the 2020 target by 4.9 %.

As already stated above, the *AM* scenario shows that it is possible to fully close the still existing gap to the 2020 target of around 2.3 % by a reasonable number of additional measures. The policies discussed in the *AM* scenario are additional to the *Base_WM* scenario, and are equivalent to the minimum necessary to close the 37 Mtoe gap to meeting the 2020 target. By sector, these measures are:

- **Residential/tertiary sector buildings**: The Energy Performance of Buildings Directive (EPBD) (Recast) has not yet been fully implemented in the Member States (MSs) and there are still a considerable number of open questions and some range of interpretation e.g. regarding the definition of nearly zero-energy buildings (nZEB). We assumed that MSs will implement the directive in an ambitious way to close the gap. These measures could contribute around 14.5 Mtoe to the required savings (of which two thirds in the residential sector).
- **Residential/tertiary sector appliances**: The policies taken into account here include the revisions of implementing directives of the eco-design directive that are due in 2014/2015, the recast of the Labelling scheme due in 2014 and a moderate adoption of new implementing measures. Until 2020, the additional estimated saving potential of such new implementing measures is mainly driven by the current efforts to include a system approach for lighting and cooling within the policy framework of Ecodesign, EED and EPBD by 2016, leading to estimated savings of 10 TWh/year in 2020. Overall the extension of measure for residential appliances may contribute 1.4 Mtoe; additional measures for tertiary appliances contribute another 4.7 Mtoe to close the gap.
- **Transport sector**: In difference to the other sectors, the selected further transport policy measures are not merely the extension of existing measures but rather the generalisation of successful measures existing partly at national level. The selection of these measures is based on the ASSIST project (Kritzinger et al. 2013) which assessed the social and economic impacts of transport policy measures as regards their probability of implementation indicated by the Transport White Paper from 2011. The following measures are added in the *AM* scenario starting from 2014, which in total are expected to contribute around 11.3 Mtoe to close the gap to the 2020 target:
  - A road charge of 6 EuroCent per vehicle-km driven on motorways for passenger cars; the new charge is assumed to substitute already existing charges in several Member States in case that the existing charge is lower than the new one.
  - The promotion of energy efficient public commercial vehicles which is assumed to lead to a step-wise reduction of fuel consumption of buses and light duty vehicles via influencing purchase decisions of public vehicles.
  - A stimulus programme providing owners of cars older than 10 years a rebate of 2000 Euro for buying a more efficient new car. A similar programme was e.g. introduced in Germany in 2009 for a limited time period in order to reach a higher scrapping ratio of old and inefficient cars (BMWi 2011).
  - A feebate system assuming a rebate or a fee for buying a new car depending on the CO_2 emission per vehicle-km of the car. For each gram of CO_2 less than a declining border until 2020, a rebate is given of 25 Euro. The border declines in parallel with the values in the passenger car CO_2 regulation down to 95 gram in 2021. The measure is expected to influence the purchasing behaviour for passenger cars (Schade et al. 2011).
- **Industry sector**: Measures to close the gap in 2020 in the industrial sector include revisions of implementing directives for the Ecodesign Directive that are due in 2014/2015. They also include full implementation of the EPBD (re-

cast) on MS level for which we assume an ambitious implementation for industrial premises particularly improving compliance with standards. For policies modelled in an aggregated way (including support/obligations for energy audits, energy management, information, capacity building, procurement obligations and also voluntary agreements), a higher level of ambition is assumed across all countries. This could be promoted by so-called Learning Networks for Energy Efficiency (LEEN) among the less-energy intensive European Industries which have been experienced in Germany, Switzerland, Austria as well as outside Europe to overcome transaction costs in companies. In Germany, these networks could double their energy efficiency path (Köwener et al. 2011). Further included in the possible measures set is the structural reform proposed by the Commission to repair the Emission Trading Scheme (ETS), resulting in a European Emission Allowance (EUA) price of about 35 Euros in 2030. Measures in the industry sector are expected to contribute another 5 Mtoe to the closure of the gap to the 2020 target.

The **primary energy target** may be at a distance of 1.7 % according to the assumptions in the modelling analysis. This both holds for the *Base_inclEA* and for the *Base_WM* scenarios. The conversion to primary energy assumes the same power generation mix as PRIMES 2013 (EC 2013), hence a similar share for renewable energy sources as in the PRIMES 2013 baseline.

THE 2030 POTENTIALS

In the *HPI* scenario assuming a high policy intensity, the **final energy consumption** could drop to 876 Mtoe, and in the *NE* scenario also including near-economic energy saving options even to 849 Mtoe, compared to a level of 1,098 Mtoe reached in 2012. Compared to the present PRIMES 2013 reference development (EC 2013), the *HPI* presents in 2030 additional economic savings of about 22 %. Expressed in the same metric as for the 2020 target, that is compared to the PRIMES 2007 projection for 2030 (EC 2008b), the *HPI* achieves savings of 38 %. In the case where also near economic potentials are realized, final energy can be reduced by 24 % compared to the PRIMES 2013 baseline. Table 1 summarises these potentials compared to the *Base_inclEA* and compared to 2008 for the *LPI, HPI* and *NE* scenarios (EU27). The summary shows that all sectors contribute substantially to the 2030 potentials, the transport and industry sector more strongly in the *LPI* scenario compared to the residential/tertiary sectors, and the latter more in the *HPI* and *NE* scenarios. The transport section contributes less in percentage terms because more of these measures are already anticipated and so included in the *Base_inclEA*.

With regard to the potentials expressed in **primary terms**, we assumed first that renewable energy sources (RES) would reach by 2030 a share of 27 % in gross final energy consumption as it was finally set as the target for 2030. In a variant we investigated a 35 % renewable share in gross final energy demand combined with higher shares of decentral CHP and 43 % thermal power conversion efficiency, as well as a partial realization of economic energy efficiency potentials in view of realizing a 40 % reduction in GHG emissions. Based on this, the following results can be stated for the *HPI* scenario with a high policy intensity, which is – from our point of view – the most appropriate scenario for an ambitious, but nevertheless economically feasible development of energy efficiency in the EU:

- In 2030, the *HPI* leads to a level of primary energy consumption of 1,160 Mtoe (using the conversion factors to primary energy from the PRIMES 2013 baseline), which is, as in the case final energy, a reduction by 22 % compared to PRIMES 2013 and by 38 % compared to the PRIMES 2007 baseline.
- Together with the higher penetration of renewable energies and decentral CHP and a conversion efficiency for thermal power generation of 43 %, primary energy consumption reaches a level of 1,109 Mtoe in 2030. This is a reduction by 25 % compared to the PRIMES 2013 reference development, and by 41 % compared to PRIMES 2007.

This means that in both variants the new 2030 energy efficiency target of a 27 % reduction in primary energy consumption compared – as the 2020 target – to the PRIMES 2007 trend is significantly exceeded.

Table 1. Summary of final energy savings in the LPI/HPI/NE scenarios (EU27) for 2030.

Potentials in 2030 compared to BASE_InclEA scenario	[Mtoe]			[%]		
	LPI	**HPI**	**NE**	**LPI**	**HPI**	**NE**
All final demand sectors	**103**	**194**	**221**	**9.6%**	**18.2%**	**20.6%**
Residential sector	23	73	79	8.3%	25.9%	28.1%
Tertiary sector	25	47	50	13.9%	25.9%	27.7%
Transport sector	28	41	46	9.2%	13.4%	14.9%
Industry sector	26	33	46	9.5%	12.2%	16.8%
Potentials in 2030 compared to 2008	[Mtoe]			[%]		
	LPI	**HPI**	**NE**	**LPI**	**HPI**	**NE**
All final demand sectors	**201**	**293**	**319**	**17.2%**	**25.0%**	**27.3%**
Residential sector	52	101	107	16.7%	32.7%	34.7%
Tertiary sector	34	56	59	17.9%	29.4%	31.1%
Transport sector	80	93	97	22.1%	25.7%	27.0%
Industry sector	36	43	56	11.6%	14.0%	18.0%

Finally, we calculated the 2030 potentials in terms of **GHG savings** compared to 1990. Fossil power generation was set at an average level of 50 % compared to a level of 35 % at the EU average today. We calculated the following variants:

- Assuming a level of 27 % in gross final energy consumption from RES corresponding to the target decided by the European Council (2014) in October 2014, by realising the economic *HPI* potentials for energy efficiency GHG emissions are reduced by more than 45 %.
- In the *HPI* combined with a larger penetration of renewable energies (35 % RES in final energy which is a level within reach given the present path to the 20 % target for renewable up to 2020) and an enhanced efficiency in the conversion sector, total GHG emissions can be reduced by 49.5 % compared to 1990. Energy related CO_2-emissions can be reduced by 55 % compared to 1990.
- In order to reach a level of 40 % GHG reduction in combination with 27 % share in renewable energies (which corresponds to the EU 2030 targets decided in October 2014), less than 50 % of the economic potentials for energy efficiency need to be realised.

THE COST/BENEFITS OF REALIZING THE HPI SCENARIO

The results above still neglect the economic benefits that are combined with a full realisation of economic potentials for energy efficiency. The overall economic benefits for realising targets in the range of 30–34 % are in the range of 22–27 billion Euro annually on average up to 2030. Note that these are annual average savings up to 2030 and imply only a partial realization of the *HPI* scenario. A full realization of the *HPI* would lead to average annual savings exceeding 40 billion Euro annually for the period to 2030 and would have reached over 80 billion Euro net savings in 2030. These benefits result from the fact that in the *HPI* scenario the Net Present Value is positive given the (relatively moderate) discount rates used in this scenario. This can largely compensate for the rather modest additional costs as compared to renewable energies if RES targets in the range of 30–35 % are envisaged as compared to the presently decided 27 %.

Discussion and Conclusions

With regard to the EU 2020 targets, our results show among others that the scenario including early action misses the 20 % energy saving target by about 2.3 %. Including additional measures (and intensifying existing measures) it is, however, possible to reach the 20 % target. This means that reaching the 2020 energy efficiency target is possible, but still needs some effort both at the level of the Member States and the EU. This both comprises the thorough implementation of already decided policies and measures (as e.g. of the EED and the EPBD) and the adoption of some additional measures in all energy demand sectors.

Regarding the new 2030 targets of the EU (European Council 2014), our modelling approach shows that primary energy consumption can be reduced by 41 % compared to the PRIMES 2007 baseline by fully exploiting the economic *HPI* potentials. This is considerably more than the reduction by 27 % as decided by the European Council (2014). The resulting decrease of GHG emissions amounts to more than 45 % in this scenario (and to almost 50 % in case of a higher share of renewable). On the other hand, in order to reach a level of 40 % GHG reduction in combination with 27 % share of RES – which corresponds to the respective EU 2030 targets – less than 50 % of the economic *HPI* potentials for energy efficiency need to be realised. These findings confirm former study results showing that more ambitious energy efficiency and GHG targets as finally decided in October 2014 are economically feasible (Höhne et al. 2013, Eichhammer 2013, Höhne et al. 2014, Harmsen et al. 2014, Schlomann and Eichhammer 2014). The proposed targets lie in an order of magnitude of 30–40 % for the energy efficiency target and around 50 % or even more for the GHG target.

A very important parameter which can significantly influence the results of a modelling-based impact evaluation as carried out here, are the discount rates which are used in the models and scenarios. Here we find that the PRIMES model and our scenario analysis take a rather different approach. While PRIMES integrates (perceived or existing) risks into the discount rates to a large degree with discount rates of up to 17.5 % to evaluate both decision making energy system costs, our scenario approach essentially reflects usual capital costs, considering that there are policy instruments to mitigate the risks and the risk perception. In that we argue that policies of the future can learn from present experiences. This approach leads to relative moderate discount rates between 2 % and 5 % (depending on the sector) in the HPI scenario. Also the perception of the energy user changes: with technologies developing they perceive less risk, awareness changes with respect to the threat of climate change, resource scarcity and high energy prices, a larger number consumers are willing to invest to mitigate those risks, policies are developed to accompany those awareness changes etc. In our view therefore, it is most appropriate to evaluate energy efficiency in the light of typical capital costs rather than by integrating risks and risk perception, as well as fragmented energy efficiency policies to a high degree already from the beginning into the calculation of both decision making and the total system costs. This view is supported by the recommendations of the latest 5th Assessment Report published by the International Panel for Climate Change IPCC (2014). It advocates the use of social discount rates and decreasing discount rates over time for the long-term investments (especially for buildings) in order to respond to questions of intergenerational equity. However, in the scenarios covered by this paper, we did not follow this approach.

While in general, the technologically detailed bottom-up models at the sectoral level which we used here, provide a good technological basis for an assessment of energy efficiency potentials, there are uncertainties remaining, mostly resulting from the input data. E.g., how fast efficient technologies would diffuse through the market without an energy efficiency policy is a critical, yet very uncertain assumption and empirical observations are not always available (e.g. mostly in the industrial sector the available technology-specific data is scarce). Besides improving these data issues, future research on the inclusion of the rebound effect into such an analysis could further improve the robustness of the scenario calculations. Up to now, direct rebound effects (Sorrell, 2007), i.e. a possibly negligent handling of energy as a result of the energy cost saved in an energy efficiency scenario are not explicitly taken into account in our models due to lack of data. An increasing availability of empirical data (Sorrell et al. 2009, Schleich et al. 2014) could, however, enable the direct rebound effect to be more and more included in a bottom-up modelling approach.

Based on the data on investment and energy costs implemented in our bottom-up simulation models, we could also quantify the overall economic benefits for realising the *HPI* scenario. They are in the range of 22–27 billion Euro annually on average up to 2030 for targets in the range of 30–34 %, over 40 billion Euro annually on average up to 2030 for a full realisation of the *HPI* and reach over 80 billion Euro annual savings in 2030, and more beyond. Moreover, we did not take into account the so-called co-benefits of energy efficiency. These comprise, for example, (i) macro-economic impacts such as an increase in GDP and employment, (ii) the improvement of competitiveness at the national or company level, and (iii) an increase in energy security through the reduction of energy imports. These co-benefits further improve the cost-effectiveness of the energy efficiency measures already included in the *HPI* scenario and can be an additional justification for implementation of effective energy efficiency policies. There are already some studies investigating these impacts more deeply at the international level (e.g. IEA, 2012, 2014), at the level of the EU (e.g. eceee 2013, Cambridge Econometrics 2013) or in some Member States as e.g. Germany (Fraunhofer ISI 2009, Lehr et al. 2012). Nevertheless, we still see the need for further research especially with regard to a systematic quantification of these co-benefits of energy efficiency in evaluations of policy instruments. A bottom-up modelling approach at the sectoral level, as applied here, can, however, be an important basis for a quantification of macroeconomic effects of energy efficiency policies, since it delivers important input data for such kind of macro-economic analysis. Methodologically, our bottom-up scenario analysis could, e.g., be combined with a dynamic input-output analysis, this would allow to study the impact of an energy efficiency scenario (as e.g. our *HPI*) regarding value added and employment compared to a baseline scenario.

To conclude, the detailed modelling of policies and technologies allows a sector-specific analysis of the contribution of individual policy instruments and technologies towards the energy efficiency targets set for 2020 and 2030. Only such detailed models allow simulating the different types of energy-efficiency policies (e.g. standards, taxes, ETS, audits, information programs, subsidies). On this level of detail, we think that our analysis is the broadest analysis of the current EU energy efficiency policy framework looking at all sectors in all Member States.

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Annex

Table A1. Overview of scenarios and potentials for final energy consumption in the EU27 (Mtoe).

EU27 Final Energy All Sectors [Mtoe]										2020 /				2030/				2020
	2008	2009	2010	2011	2012	2015	2020	2025	2030	2008	BASE_InclEA	PRIMES2007	PRIMES2013	2008	BASE_InclEA	PRIMES2007	PRIMES2013	Gap to target
BASE_NoEA	1164	1161	1164	1170	1176	1199	1211	1215	1216	104%	109%	90%	107%	104%	114%	86%	109%	9.9%
BASE_inclEA	1169	1168	1163	1144	1138	1135	1108	1087	1070	95%	100%	82%	98%	92%	100%	76%	96%	2.3%
BASE_WM	1169	1168	1163	1144	1137	1134	1108	1085	1067	95%	100%	82%	98%	91%	100%	76%	95%	2.2%
AM	1169	1166	1159	1137	1129	1116	1071	1039	998	92%	97%	79%	95%	85%	93%	71%	89%	-0.6%
LPI	1169	1166	1159	1137	1129	1116	1059	1019	967	91%	95%	79%	94%	83%	90%	69%	86%	-1.4%
HPI	1169	1166	1159	1137	1129	1116	1011	951	876	87%	91%	75%	89%	75%	82%	62%	78%	-4.9%
NE	1169	1166	1159	1137	1129	1116	1003	935	849	86%	90%	74%	89%	73%	79%	60%	76%	-5.6%
EU27 Final Energy All Sectors Comparison [Mtoe]																		
PRIMES 2007			1237			1302	1348	1383	1406			100%				100%		20.0%
PRIMES 2009			1169			1211	1229	1227	1216			91%				87%		11.2%
PRIMES 2009 (corrected for activities from PRIMES 2013)			1155			1162	1159	1154	1144			86%				81%		6.0%
PRIMES 2013			1151			1164	1130	1124	1119			84%				80%		3.9%
Eurostat	1168	1102	1154	1101	1098													
EED Target (final energy)							1078											0.0%

Notes:

- *The difference with Eurostat in the years 2008 to 2012 is largely due to the fact that Eurostat values not corrected for annual climatic variations, while the figures of the projections are normalized to 2005 (which was slightly colder than the average of the past ten years). For that reason warmer years such as 2009, 2011 and 2012 deviate stronger from the projections.*
- *The scenarios are also compared for 2020/2030 with 2008, with the Base_inclEA (which is considered here as the main baseline scenario and which is comparatively close to the recent PRIMES 2013 projections), with PRIMES 2013 and with the older PRIMES 2007 projections (which were used to establish the 20 % energy efficiency target for 2020 and the 27 % target for 2030 and which were developed before the financial and economic crisis which started 2008).*
- *The last column measures the gap to the 20% target. The percentage points for the gap refer here to the difference between the PRIMES 2007 projection of final energy of 1,348 Mtoe in 2020 and the target of 1,074 Mtoe in final energy. The total gap corresponds to 20 %.*

Source: Fraunhofer ISI et al. 2014.

Table A2. Overview of scenarios and potentials for primary energy consumption in the EU27 (Mtoe).

EU27 Primary Energy All Sectors [Mtoe]										**2020 /**				**2030/**				**2020**
(excl. non-energy uses)	**2008**	**2009**	**2010**	**2011**	**2012**	**2015**	**2020**	**2025**	**2030**	**2008**	**BASE_InclEA**	**PRIMES2007**	**PRIMES2013**	**2008**	**BASE_InclEA**	**PRIMES2007**	**PRIMES2013**	**Gap to target**
BASE_NoEA	1682	1681	1669	1696	1697	1667	1644	1626	1611	98%	109%	89%	107%	96%	114%	86%	109%	9.2%
BASE_inclEA	1689	1691	1668	1658	1641	1578	1504	1454	1418	89%	100%	82%	98%	84%	100%	76%	96%	1.7%
BASE_WM	1689	1691	1667	1658	1641	1577	1503	1452	1413	89%	100%	82%	98%	84%	100%	75%	95%	1.6%
AM	1689	1688	1661	1649	1629	1552	1453	1390	1322	86%	97%	79%	95%	78%	93%	71%	89%	-1.1%
LPI	1689	1688	1661	1649	1629	1552	1437	1363	1281	85%	95%	78%	94%	76%	90%	68%	86%	-2.0%
LPI (+27%RES; 44% RES-E; 41% thermal electric eff.)	1689					1552	1437	1351	1252	85%	95%	78%	94%	74%	88%	67%	84%	-2.0%
HPI	1689	1688	1661	1649	1629	1552	1373	1272	1160	81%	91%	75%	89%	69%	82%	62%	78%	-5.5%
HPI (+35%RES, 47% RES-E; 43% thermal electric eff.)	1689					1552	1364	1243	1109	81%	91%	74%	89%	66%	78%	59%	75%	-6.0%
NE	1689	1688	1661	1649	1629	1552	1361	1251	1125	81%	90%	74%	89%	67%	79%	60%	76%	-6.1%
NE (+35%RES; 55% RES-E; 45% thermal electric eff.)	1689					1552	1340	1198	1042	79%	89%	73%	87%	62%	73%	56%	70%	-7.3%
EU27 Primary Energy excl. Non energy uses [Mtoe]																		
PRIMES 2007			1738			1807	1842	1868	1873			100%				100%		20.0%
PRIMES 2009			1655			1677	1664	1654	1635			90%				87%		10.3%
PRIMES 2009 (corrected for activities from PRIMES 2013)			1636			1610	1569	1556	1538			85%				82%		5.2%
PRIMES 2013			1645			1619	1534	1504	1482			83%				79%		3.3%
Eurostat	1689	1595	1654	1597	1584													
EED Target (final energy)							1474											0.0%

Notes:

- *See the notes in Table A1.*
- *The last column measures the gap to the 20 % target. The percentage points for the gap refer here to the difference between the PRIMES 2007 projection of primary energy of 1,842 Mtoe in 2020 and the target of 1,478 Mtoe in primary energy. The total gap corresponds to 20 %.*
- *The final energy scenarios LPI, HPI and NE are combined with supply scenarios which go beyond the PRIMES 2013 baseline:*
- *LPI scenario: refurbishment of existing thermal power plants; renewables share at 27 % (44 % RES-E). Conversion efficiency of thermal power plants at 41 % in 2030.*
- *HPI scenario: electric conversion efficiency of thermal power generation at 43 % through use of decentral CHP that support renewables by offering flexibility services, the installation of the most efficient coal and gas-fired power plants when it comes to reinvestment, and raising the share of RES to 35 % (47 % RES-E).*
- *NE scenario: electric conversion efficiency of thermal power generation at 45 % implying larger use of gas-fired CCGT plants and of decentral co-generation schemes together with a RES-E corridor of up to 55 % by 2030 for the European power mix.*

Source: Fraunhofer ISI et al. 2014.