Études de l'Ifri

THE LANDSCAPE OF RENEWABLE ENERGIES IN EUROPE IN 2030

Michel CRUCIANI

June 2017

ifri Center for Energy

The Institut français des relations internationales (Ifri) is a research center and a forum for debate on major international political and economic issues. Headed by Thierry de Montbrial since its founding in 1979, Ifri is a non-governmental, non-profit organization.

As an independent think tank, Ifri sets its own research agenda, publishing its findings regularly for a global audience. Taking an interdisciplinary approach, Ifri brings together political and economic decision-makers, researchers and internationally renowned experts to animate its debate and research activities.

With offices in Paris and Brussels, Ifri stands out as one of the rare French think tanks to have positioned itself at the very heart of European and broader international debate.

ISBN: 978-2-36567-754-7

How to quote this document:

Michel Cruciani, "The Landscape of Renewable Energies in Europe in 2030", *Études de l'Ifri*, June 2017.

Ifri

27 rue de la Procession 75740 Paris Cedex 15 – FRANCE

Tel.: +33 (0)1 40 61 60 00 – Fax: +33 (0)1 40 61 60 60

Email: accueil@ifri.org

Ifri-Brussels

Rue Marie-Thérèse, 21 1000 – Brussels – BELGIUM

Tel.: +32 (0)2 238 51 10 – Fax: +32 (0)2 238 51 15

Email: bruxelles@ifri.org

Website: Ifri.org

Author

Michel Cruciani has been a Senior Advisor at the Centre of Geopolitics of Energy and Raw Materials (CGEMP), University Paris-Dauphine, since February 2007. He contributes in particular to studies, the organization of conferences, publications, and teaches on Renewable Energy for students following the Master's degree in "Energy, Finance, Carbon".

Michel Cruciani graduated from the Ecole Nationale Supérieure d'Arts et Métiers. Prior to the CGEMP, he worked for Gaz de France (Technical Services, then Economic Studies), and represented the CFDT (as a Member of the Board of Gaz de France, then as Deputy Secretary General of the Federation of Gas and Electricity), and finally worked within Electricité de France (Department of European Affairs).

In these jobs, he followed the liberalization of the gas and electricity industry in the United States and in Europe, as well as the rise of environmental concerns, leading to the adoption of climate policies, a new role for nuclear energy and the promotion of renewable energy.

Michel Cruciani has been associated with the work of the Energy Centre at IFRI since 2009.

Summary

On 30 November 2016, the European Commission tabled a package of proposals referred to here as the Clean Energy Package, covering a wide range of activities. This study only looks at the provisions to improve energy efficiency by 30% and to raise the share of renewable energy in consumption to 27% by 2030.

These objectives are assessed for the whole of the European Union. Nevertheless the texts mandate the European Commission to check that each Member State makes an honest contribution.

The 30% target for energy efficiency weakens the role assigned to the CO_2 market. Simulations suggest that this weakness will benefit coal, which will be more important through to 2030 than would have been the case with a 27% target, while natural gas is penalised following the very low CO_2 price.

The simulations also show that the renewable energy target will be largely achieved through very rapid growth of wind and solar electricity. The proposals of 30 November 2016 therefore seek to promote the development of these two sectors, by reforming the electricity market so that it sets a price that is profitable and reduces the need for state aid, while clearly reflecting the costs borne by different actors. This second point seems difficult to guarantee, especially in terms of the costs generated to grids following new connections which are to be facilitated, or indeed self-consumption which is being encouraged. Furthermore, it is not proved that by limiting the scope of action of network operators, economic optimality can be obtained while preserving the quality of supply.

The Clean Energy Package includes innovative measures relating to the heat (or cold) sectors, as well as transportation. These measures oblige suppliers to increase the volume of renewable energies in their energy and fuel sales. In these sectors, sustainability criteria required for bio-energies and the recorded CO_2 stocked in Europe's biomass could favour imported products (wood pellets and biofuels) as well as electrical solutions (heat pumps and battery-powered vehicles).

If the whole Package is adopted, forecasts indicate that renewable energies will account for 49% of all electricity consumed by 2030, including 20% from wind power and 9% from solar power. They will also

contribute to 26% of heating and cooling power. In the transport sector, biofuels will provide 7% of energy and electricity from renewables 1%. These figures hide a very wide distribution across countries. The risk of deepening inequalities between regions and different categories of consumers is a weakness of the Clean Energy Package, and calls for changes, or complementing it with external measures. Taking this concern into account will mitigate disappointments if expected job creation is concentrated only within certain regions and sectors of activity.

Table of Contents

Introduction

On 30 November 2016, the European Commission tabled a set of proposals aimed at restructuring the energy sector profoundly. Initially called the "Winter Package", though officially entitled *Clean Energy for All Europeans*, this set of measures is ambitious. In particular, it puts the European Union in lead position worldwide regarding renewable energies.

There is indeed a prevailing consensus in most countries to give renewables a central place in the policies required to meet the Paris climate agreement. It therefore seems appropriate to reshape the existing EU framework, which was designed in 2009, in view a possible agreement at the Copenhagen conference.

The new framework proposed by the Commission meets several other concerns identified by its offices. The most important of these is the fact that virtually all of the 28 EU Member States have chosen to achieve their 2020 target by focusing on the production of electricity using wind and photovoltaic power. This choice leads to significant adjustments in the organisation of electricity systems so that they can adapt to the variability of these sources, linked to the intermittency of sunlight and wind.

Despite the predominant role given to renewable electricity by the Clean Energy Package, it does not neglect other sectors: the Package introduces innovative measures relating to the use of heat (and cold), which often receive insufficient consideration, while also touching on transportation which has been little-affected to date.

This study only looks at those aspects of the Package which relate to renewable energies. To facilitate reading, the study adopts a sectoral approach in the main part of the text, made up of three chapters which set out specific measures in each sector. A preliminary chapter summarises the overall measures and principal results expected for 2030. This presentation highlights the coherence of the Package and the importance given to electricity. The concluding chapter provides a panoramic overview, accompanied by final recommendations.

The study draws almost exclusively on the texts which make up the Package. Including the documents cited in the Package involves several

Footnotes indicated by numbers are given at the end of the document, on page 43.

thousands of pages of text. However, they actually say relatively little on what the energy outlook in 2030 will be, and in particular they say little about likely costs. Moreover, the complexity of interactions in the texts comprising the Package makes simulations about the future fragile. Lastly, possible amendments by the European Parliament and the Council of the European Union[a] could well change the contents of the final texts markedly to those of 30 November 2016.

For all these reasons, the "landscape" indicated by the title of this study resembles more an impressionist painting, rather than a fresco rich in subtle detail. The study reflects the analyses of the author, inviting the reader to adopt a personal view of the situation described here.

a. In the rest of the text, the word "Council" will be used to name the Council of the European Union (i.e. the Council of Ministers).

The Clean Energy Package

Chronology

The European Union signed the Paris agreement and has therefore committed itself to the fight against climate change. On the 23rd and 24th October 2014, the European Council had fixed a general outline for this contribution, advocating three objectives for 2030:

- The reduction of greenhouse gas emissions by 40% compared to their level in 1990.
- An improvement in energy efficiency of least 27%.
- A contribution of renewables to at least 27% of final energy consumption.

The European Commission drafted a series of texts to transform this policy outline into a binding legal framework, following amendments by elected representatives (at the European Parliament) and representatives of Member States (in the Council).

The Commission first looked at greenhouse gases:

- On 15 July 2015, it presented a proposal for reforming the EU's Emissions Trading Scheme (ETS), aimed at cutting emissions by 43% in this sector by 2030, compared to 2005.[b]
- On 20 July 2016, the Commission tabled two proposals concerning sectors outside the ETS:
    - one relates to the distribution of efforts across Member States, in order to cut emissions by 30% in the sectors by 2030 (compared to 2005),
    - the other concerns taking natural storage into account in calculating emissions (the Land Use, Land Use Change and Forestry proposal, or LULUCF).

The Clean Energy Package thus now addresses energy efficiency and renewable energies. Forecasts for the latter indicate that they should provide nearly 50% of electricity consumed in 2030. This level requires redesigning other aspects of the EU's overall approach on energy, which were formulated before the rise of renewables. Accordingly, the Package

b. The ETS is applied to Europe's top 11,000 fuel-burning installations.

includes eight pieces of legislation, the last four relating exclusively or principally to electricity:

- Reinforcing the constraints on electricity efficiency,
- New energy performance of buildings (new buildings and renovation of existing buildings),
- Promotion of renewable energies,
- Rules on the Governance of the Energy Union,
- Recasting transmission regulation and the electricity wholesale market,
- Recasting the directive on the internal market in electricity (regarding mainly the retail market)
- Revising obligations concerning the security of electricity supplies,
- New missions assigned to the Agency for the Cooperation of Energy Regulators (ACER).

The 2030 objective

The legislative framework adopted in 2009 set binding objectives for each Member State by 2020. Their cumulative impact is meant to raise the share of renewables in final energy consumption to 20% for the EU as a whole. In the event of any breaches, the Commission may initiate sanctions against the Member State concerned. This procedure has not been retained. According to the proposition of 30 November 2016, the 27% binding target henceforth applies to the EU as a whole, by 2030.

How can we ensure that everyone contributes to the common effort? The proposal on governance assigns this task to the Commission.[1] States are invited to announce their contribution to this objective as of 2017, in a detailed project. The Commission will in turn reply with recommendations to improve the project content, so that the envelope of contributions is in line with the 27% objective. Each Member State will then commit itself to an action plan for the period 2020-2030. These plans include a series of linear paths, with a general overview, together with sectoral paths for consumption and technology. Subsequently, if the Commission finds that the results for a particular Member State fall below its general path, it will issue new recommendations to the country.

Although “recommendations” are at stake here, non-compliance could lead the Commission to initiate sanction procedures, because Article 28 of the proposition requires Member States to “take full account of them”. The European Parliament or Council will surely reformulate texts in order to

clarify the effective power of the Commission. Moreover, an automatic sanction is foreseen as of 2021 for Member States whose consumption of renewable energies does not meet the target for 2020 (Article 27). The sanction involves a financial contribution to a future European platform supporting projects of renewables. A mandate will be attributed to the Commission to create and manage the platform. A Member State which does not manage to respect its general energy path may also be required to make a payment to the platform.

Thus, the contribution of Member States to the common objective is based on a bottom-up mechanism, comparable to that of the Paris climate agreement. But in contrast to the latter, there will be means for putting pressure on countries acting as free riders: these will depend on the powers conferred upon the Commission's services to control policies pursued by Member States.

General provisions

Until 2015, Member States were able to encourage the development of sources of renewable energy very freely. A wide range of measures had been deployed, including for example tax exemptions and obligations to incorporate bio-energies, or state aid for investment in producing heat from renewable sources. The guidelines set out by the European Commission in 2014 restricted options in the period from 2017 to 2020.[2] It should be recalled that fixing guidelines is the exclusive responsibility of the Commission: they do not constitute hard law, but can be interpreted as references by the Commission – a kind of soft law – when it launches infringement procedures. Generally speaking Member States avoid contravening such guidelines!

The 2014 guidelines in particular set out a framework for investment aid for heating using renewables and bio-energies. For electricity, the proposals of 30 November 2016 confirm the pre-eminence of these guidelines. We do not yet know what their prescriptions for after 2020 will be, but the overall tendency will be towards supporting the primacy of market forces.c The only certainty is that it will no longer be possible to apply measures retroactively, which would impose suddenly different contractual specifications on operators than those they had subscribed to when commissioning their energy installations. According to the

c. From a Machiavellian perspective, it is possible to think that by waiting until the end of the debate to draft its guidelines for 2021-2030, the Commission retained the right to review at its own initiative any text it may consider to be too watered down by the Parliament or the Council in the course of legislative procedures.

Commission, this stipulation together with the obligation of Member States to stabilise their aid regimes for three years ahead, should offset the inherent uncertainties of market fluctuations. The publication of trajectories and their linearity are also destined to reinforce visibility for investors.

Even though Member States have quite a lot of room for manoeuvre in designing their own detailed action plans, the proposals for the directive on renewable energies introduces two specific obligations. The first consists of increasing the share of these energies in the production of heat and cold by at least 1% per year. The second obliges suppliers of transport fuels to incorporate a minimal fraction of "alternative" energies in their annual sales. In both cases, a system of tradable certificates will improve the flexibility of execution.

The 30 November 2016 Package also includes several measures to simplify administration. States are called on to simplify procedures applied to installations and to clarify technical specifications. Each State will create a single point of administrative contact, capable of delivering all permits required within a period of less than three years (one year for reinforcing existing installations). This contact point will also take care of relations with electricity grid management organisations. Simplification will play an important role in facilitating the renewal of units which have reached the end of their technical or commercial life. States are invited to take other measures aimed at creating a favourable context, such as campaigns to sensitise the general public, information for actors, training for professionals and the development of quality labels or certificates.

The texts retain articles dedicated to common projects between Member States or with third parties which were already listed in Directive 2009/28/EC but which have hardly resulted in concrete achievements due to the cumbersome nature of procedures. Given the concerns expressed by the Commission of measuring precisely the efforts of each country, the procedures put forward in 2016 appear to be equally burdensome. In contrast, the texts of 30 November 2016 stipulate that aid for electricity should be progressively opened up to installations located in other Member States (10% of capacity between 2021 and 2025, then 15% between 2026 and 2030). This clause, which is relatively easy to implement, in fact starts the genuine Europeanisation of the development of renewable energies.[d]

d. Significant existing actions include the 2012 agreement between Norway (a non-EU member) and Sweden on an integrated system of green certificates. A specific agreement was also reached between Germany and Denmark at the end of 2016, which allows for cross-border tenders for installing solar power capacity.

Main results

The European Commission has drawn up its proposals by respecting two constraints: a reduction in greenhouse gas emissions by 40%, and a share of renewables in final energy consumption of 27% for the whole of the EU (this covers the EU 28 as the work for the assessment was carried out before the Brexit referendum). Several regulatory options were tested for each text to evaluate their financial impact, using models which reproduced the functioning of the European energy system. The PRIMES model was the main tool for this, to which specific modules were connected (for agriculture, electricity, transportation, etc.). Its algorithms simulated investment, purchase and energy sales decisions as a function of price. They took into account technological progress and various national situations. The models are based on a hypothesis and set of assumptions (growth in each sector of activity, demographic change, the price of fossil fuels, etc.). These help to make the models rigorous but also vulnerable to unexpected upheavals, such as the fall in oil prices since 2015.

After a series of simulations, the overall framework considered to be optimal was set out in the EUCO30 scenario. This is not absolutely optimal, as each simulation revealed strong and weak points. But it was judged to be politically advantageous. The EUCO30 scenario assumes an improvement in energy efficiency of 30% in the decade from 2020 to 2030. As a result, the 30% figure has become a binding target in the Clean Energy Package. Table 1 presents the main results of the scenario. They set out the energy landscape in Europe the 2030, if the Package is adopted without change and if the underlying hypothesis and assumptions turn out to be true (in terms of demographics, growth, the oil price, etc.).

Table 1: Key Results of the EUCO30 Scenario for the EU 28

	2015	**2030**
Population (millions of inhabitants)	505	**516**
Gross domestic product (€ billions)	13 427	**16 682**
Energy intensity (toe/€ millions)	124	**86**
Final consumption (Mtoe)	1 133	**987**
Share of renewables in final consumption	16,1%	**27,1%**
in electricity consumption	28,2%	**48,7%**
in heat & cold	17,4%	**26,3%**
in transportation	6,9%	**19,0%**

N.B.: The rate of use in transport is marked up by multipliers (see chapter 4).

Source: PRIMES, Results of the EUCO policy scenarios.[3]

These objectives are extremely proactive and ambitious (they are sometimes judged as unrealistic), as the scenario forecasts average annual growth of GDP to be 1.4%, while the annual fall in final energy consumption is also forecast at 1.4%. In other words, energy intensity is improved by 2.7% per year which is twice the rate observed between 2020 and 2010 (1.2%), and still clearly higher than the expected rate between 2010 and 2020 (1.9%). It is understandable that the Commission chose "Energy efficiency first" as the subtitle of its proposal.

The effort of reducing consumption has a major consequence: the price of CO_2 in the ETS system will remain low, at €27/t for 2030. If energy efficiency does actually improve by 27% (the EUCO27 scenario) the simulation indicates a price of €42/t![4] A seemingly small spread between the constraints imposed by the two scenarios leads to a considerable divergence in the carbon price. The PRIMES model determines the supply/demand equilibrium as a function of price: the low CO_2 price in the EUCO30 scenario logically leads to greater consumption of coal in 2030 than in the EUCO27 scenario.

Table 2 shows how this shift takes place at the expense of natural gas, for which consumption falls by 10% in the two scenarios. The reduction of gas imports is highlighted as a benefit in the EUCO30 scenario, along with a slight fall in the average electricity price.

Table 2: Primary Energy Consumption in 2030 (in Mtoe)

Mtoe	EUCO27	EUCO30
Solid fuels	164	170
Petroleum products	470	463
Natural gas	351	317
Renewable energies	314	303
Total primary energy	1 486	1 438

Source: PRIMES, Results of the EUCO policy scenarios.[4]

Choosing the 30% objective for energy efficiency implicitly means giving up on having the CO_2 price play a directing role in reducing greenhouse gas emissions. It is possible to believe that this choice by the European Commission is a response to attitudes of Member States, which rejected its proposal to increase the carbon component of energy taxation and which have moved towards modest reform of the ETS.[e]

The impact study also shows that the 30% target for energy efficiency increases the cost of policies to achieve the renewable energy target of 27%. This cost is measured by a theoretical indicator, the "value of renewable energy", which rises from €7/MWh on average for the 27% energy efficiency target to €16/MWh for the 30% target (and from €7 to €23/MWh for electricity) [5] This indicator provides a kind of cost assessment of policies needed to reach the required level of investment in renewable energies. When the price of CO2 falls, the profitability of these investments falls too, requiring more costly support policies.

The 30% target has nevertheless been adopted, with the Commission considering that the resulting energy system in 2030 will better prepare the EU to be almost completely carbon free by 2050.[6] The simulations based on this objective conclude moreover that there will be a rise in the EU's GDP (+0.4%) and in the number of jobs (+0.2%) compared to the EUCO27 scenario.[7]

e. This reform was still being negotiated at the time of writing, although the mandate given to the negotiators seems very narrow. For most analysts, the reforms being consigned will not be enough to raise the CO2 price and will confine the ETS system to having a short-term adjustment function.

Heat and Cold

The regulatory framework

According to the EUCO30 simulation, a 30% improvement in energy efficiency will lead to a fall in primary energy consumption of about 14% between 2015 and 2030 for whole of the EU.[f] The effort will be uneven: electricity consumption will rise by about 4%, but transportation consumption will fall by 10%, while use in heating and cooling is set to drop by nearly 17%.[8] The penetration of renewable energies in this sector will therefore take place in a strained context: their share should rise from 18.1% in 2015 to 26.3% in 2030.[9] To make progress, Member States are authorised to aid investment, proportionally to the spread in costs with conventional installations.

As mentioned in the first chapter, the proposal for the Directive on renewable energies introduces a specific constraint, which consists of raising the share of renewables for heating and cooling, by at least 1% each year. Member States can transfer this requirement onto certain "mandatory participants", such as fuel suppliers, who must incorporate a certain fraction of renewables in their sales. Among the Member States which favour this option, a system of negotiable certificates makes it easier to respect the constraint, following the spirit of energy savings certificates ("white certificates") put in place in 15 countries.

The main purpose of this provision is to accelerate the penetration of renewable energies in existing buildings. For the new or renovated buildings the proposal of the Directive has stringent demands, as the construction code should impose a minimal level of renewable energies determined as a function of economic optimality.[g]

It is possible to question the compatibility of these measures with the texts on energy efficiency, in particular concerning two flagship measures:

f. It should be recalled that improving energy efficiency does not measure the cut in actual consumption between two dates, but the gap in consumption forecast if no action is taken and the expected results of specific actions. This gap is measured in energy units (usually Mtoe).

g. This concept is omnipresent in the proposal of the Directive. It is defined as the level of energy performance leading to the lowest costs over the economic life cycle. This is a cost-benefit calculation which includes investment costs linked to energy, as well as maintenance and operation costs (including energy costs), profits coming from the energy produced, etc.

- Each State is called on to achieve annual savings of 1.5% in volume terms of energy sales to final customers.[10]
- All new buildings should practically consume no energy as of 2021 (2019 for public buildings).[11]

Coherence is guaranteed by the fact that renewable energies are not accounted for in the volume to which the 1.5% reduction is applied, nor to the consumption by buildings. The accounting of these energies does not distinguish between energies produced on-site and energies delivered. Moreover, the method of calculation rules out equivalences: thus a building which consumes 3 MWh of gas in heating but which produces 3 MWh of electricity sold into the network, thanks to photovoltaic panels, will not be classified as having "almost zero consumption". It will obtain the efficiency label only on the condition that the building covers its heating needs from renewable energies.

Prospects

Heat from geothermal energy, solar thermal energy, biogas or energy obtained from organic waste and solid biomass will all be in competition with electricity either through direct use when the power comes from renewable sources, or when the power operates heat pumps. In the latter case, heat (or cold) extracted from the ambient environment is recorded according to a rigorous methodology.

With nearly 80% of the market for renewable heat in 2015, solid biomass now far outstrips heat pumps, which only captures 8%.[7] However, solid biomass, as well as biogas and organic waste, face several difficulties which could hinder their development:

- The Clean Energy Package imposes strict sustainability criteria on bio-energies used in facilities with a power greater than 20 MWth (and 0.5 MWe for biogas), which are likely to affect these resources.[12] The uncertainty created by this requirement is compounded by the authority which the Commission hopes to be given to modify criteria over the years.[13]
- The proper and full use of calories generated by combustion facilities depends often on the existence of a heat network which distributes heat to nearby consumers ("district heating"). Yet the profitability of such installations could fall under the impact of energy efficiency measures undertaken by clients, which could reduce their demand by about 0.8% per year between 2020 and 2030.[4]
- In 2012, existing heat networks obtained 40% of their energy from

natural gas and 29% from coal.[14] To facilitate the penetration of renewables, the Clean Energy Package obliges grid operators to provide free access to their installations to all producers of heat using renewables and wishing to be connected to a network. Rather than using biomass, these new market players could use powerful heat pumps, programmed to operate when electricity prices fall and so help store surplus wind and solar energy, in the form of heat.

- Lastly, the texts authorise consumers to disconnect themselves from heat networks which are not "effective".[h] In this case too, they may prefer heat pumps rather than wood-powered boilers.

Heat pumps do indeed benefit from a buoyant context. Future building codes will stimulate the production of local renewable energies in new and renovated buildings. Heat pumps are extremely competitive compared to other technologies. This should allow them to spread without aid or with very modest financial aid (estimated by the Commission at €3/MWh between 2008 and 2012).[15] Thanks to their performance, heat from renewables will expand in the household sector, implying only an €11 increase in bills per year, according to Commission estimates.[16] Heat pumps are also a privileged instrument for exploiting residential heat of waste water or regular ventilation in large buildings, metros/subways for example, in all areas of dense housing where self-generated electricity from solar panels or windmills is often difficult.

The study disseminated by the Agora Energiewende think-tank underlines their positive contributions. When heat pumps replace both oil-fired boilers and old electric radiators, the overall power required in moments of great cold varies little. For its part, the Ecofys consultancy has provided evidence of the benefits of a "hybrid" solution which consists of combining heat pumps with existing boilers in well insulated buildings.[17] In this case, gas boilers would provide extra heat during cold spells, with heat pumps providing basic heating. This limits their maximum power, which in turn reduces the need for reinforcing electricity networks. The Ecofys study shows that this solution is economically viable for all actors and could be supported by gas companies.

Indeed, at the EU level in 2012, gas provided 45% of heating and cooling requirements. Other energy sources made up the balance in fairly similar shares (heating oil, coal, biomass, electricity and district heating), although there were considerable variations from country to country.[18] In most countries, gas is supplied by large companies which are very often

h. In terms of Directive 2012/27/EU, an "efficient" grid uses at least 50% renewable energy or 75% of heat produced by co-generation.

multinational. The European Commission expects that the obligation to increase the share of renewables in such usages will mainly fall on these large gas companies which have sufficient know-how to minimise the financial impact on consumers. The gas companies for their part are seeking to maintain their market presence, which is falling, by focusing their activities on facilities using coal and heating oil. As well as providing bio-methane, they could provide hybrid solutions, whose energy contribution, calculated on the basis of primary energy consumed, will improve as we move towards the generation of 50% of electricity from renewables in 2030.

It was noted above that bio-energies will be affected by sustainability criteria. Solid biomass (wood energy) will face an additional difficulty: this stems from its twofold potential of providing energy and being beneficial to the climate, as forests are "carbon sinks". The European Commission wants CO_2 stored like this to be accounted for henceforth in the overall efforts to reduce greenhouse gas emissions (the LULUCF proposal). Increasing the use of wood to provide heat is equivalent to "de-storing", which then needs to be compensated by larger cuts in emissions in other sectors.

How Member States will arbitrate on these issues remains unknown, but some may prefer the climate benefits of local wood to its use as fuel. This would likely lead the EU to import more biomass from third countries, in order to attain its 2030 targets. In 2015, the EU was already the world's leading importer of wood pellets, with 7.2 million tonnes coming mainly from the United States and Canada. This was equivalent to 35% of its consumption. Both countries seem confident in their capacity to meet sustainability criteria that will soon be in force.[19]

The LULUCF proposal does not concern biogas or organic waste. Biogas can be exploited in two ways, depending on whether it is burnt to produce heat and electricity (in cogeneration plants) or purified to become bio-methane. Bio-methane may then be used as fuel in cars adapted to run on natural gas. Several countries have encouraged natural gas vehicles (NGVs), providing a potential outlet for bio-methane. If all the biogas produced while respecting new constraints set out by the Commission were to be transformed into bio-methane, the volume produced would account for 10% of estimated natural gas consumption in 2030.[20] This level appears sufficient for intra-European trade to take place, facilitated by a system guaranteeing origin which the Commission is proposing, to ensure accurate traceability. Guarantees of origin apply to all renewable energies, but energies which can circulate in grids, such as bio-methane or electricity, should make better use of them than energies restricted to local consumption, such as heat.

Electricity

Main provisions

The European Commission has given a central place to electricity in Europe's energy future, and a major role to the wind and solar power sectors within the electricity system. Indeed, only these two sectors have sufficient potential for development to meet future needs. Other sources of renewables (biomass, hydroelectricity, etc.) will rapidly run up against natural and economic limits. The Clean Energy Package is therefore largely designed from the perspective of facilitating the development of wind and solar power, well beyond 2030, by taking better account of their characteristics.

To stimulate electricity production in the decade from 2000 to 2010, several Member States implemented guaranteed purchasing prices over the long term. These tariffs were sometimes too generous, and disrupted the operation of the market while raising the kWh price for final customers. The guidelines published by the Commission in 2014, as well as its proposals in November 2016, henceforth limit such aid to small-scale facilities and emerging technologies.

For all other types of production, a reference provision has been set out consisting of direct sale into the market, combined either with a system of green certificates or with supplementary income determined through tenders. To ensure equivalence between these two approaches, the Commission wants Member States to implement calls for tender which are technologically neutral. In both cases, sale into the markets is accompanied by the financial responsibility of operators for imbalances in announced generation levels and actual generation deliveries.[i] Green certificates and supplementary income are described as temporary mechanisms, which mature sectors should soon not need.[21]

We can see here a further illustration of the hold of market forces in new clauses relating to the feeding of electricity into networks. While the 2009 legislative framework obliged system operators to give priority to the feeding of electricity from renewable sources into the network,[22] the Clean

i. The responsibility for achieving balance does not apply to small installations whose power is less than 500 kW up until 2025, and 250 kW as of 2026.

Energy Package seeks to limit this priority to small facilities, whose power is less than 500 kW up until 2025, and less than 250 kW afterwards.[23] By removing this advantage, market forces will be the only guide to decisions to sell electricity, applied both to renewable and conventional energies.

Can the electricity markets provide sufficient income?

The European Commission has replied in the affirmative, provided market rules are redrafted. Planned changes include:

- To account for the lower predictability of renewable energies, marketplaces will be open without any discrimination towards aggregators. They will allow players to participate very shortly before actual delivery (intraday or balancing markets) and provide trading time intervals of 15 minutes by 2025.
- Markets should also maximise the possibilities of cross-border trade; payment will be based on the marginal price of energy (only reflecting variable costs), without regulatory distortions (in particular with no price ceilings).
- The proposals open up the possibility of redeploying market areas, which today still largely correspond to national borders (as in Germany or France). In the future, they could be defined according to transport capacities (as in Italy and Sweden, for example). This new geographic division will increase the income of production units situated in areas with the least generation capacity.
- The texts set out precise rules for compensating electricity producers using renewables which may experience network congestion leading to losses.

Moreover, the Clean Energy Package encourages self-consumption of electricity from renewable sources, providing actors with various guarantees. They may act individually or collectively at the level of a building, a commercial site, or an antenna in the distribution network. They can also act through an aggregator. The sale of surplus production is facilitated, but at its “market value”. The texts also introduces the concept of a “renewable energy community” which may take the form of companies or non-profits and directly involve local citizens or their representatives. Such communities could operate their networks and are dedicated to producing, consuming, storing and selling this type of energy.

Results

Table 3 sets out forecasts from the EUCO30 simulation for installed capacity at the EU level, as well as for three economic indicators.

Table 3: Results of the EUCO30 Scenario (EU28)

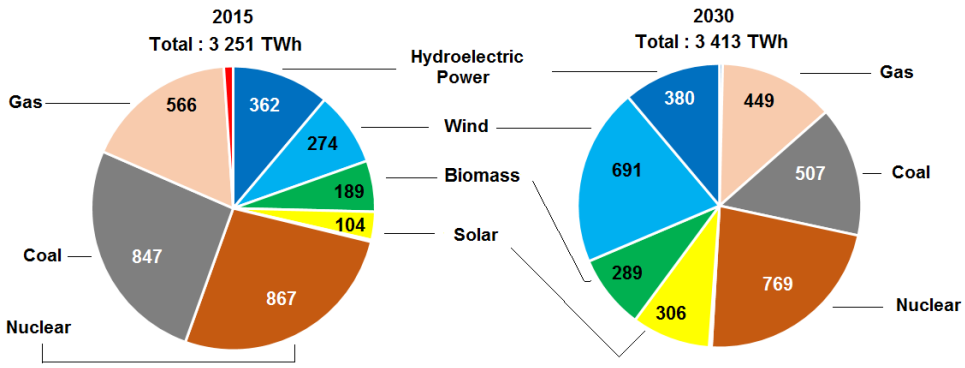
	2015	**2030**
	GW	**GW**
Installed Capacity	966	**1 125**
Conventional sources	571	**415**
Nuclear	121	**110**
Thermal	450	**305**
Renewable sources	396	**711**
Hydroelectricity	127	**133**
Wind	142	**285**
Solar	97	**237**
Biomass, Biogas and Waste	28	**54**
Other (marine energy, geothermal energy etc.)	1	**2**
Economic indicators	€/MWh	**€/MWh**
Average generation cost	85	**90**
Electricity price for households	209	**215**
Average cost for supporting renewables	17,3	**20**

Sources: PRIMES, Eurostat, CEER, SWD(2016)-418.[24]

The installed capacity of all renewable sources (excluding hydroelectric power) is doubled, while conventional sources are reduced by about 27%. Over the period, total capacity rises by 20%, with output growing by 5%. The simulation indicates a moderate rise in costs.[j] Graph 1 shows the origin of electricity production for 2015 and 2030.

j. The average cost of supporting renewable sources is here applied to all MWh consumed, with all types of renewables added together.

Graph 1: The Breakdown of Electricity Sources (EU28) in TWh



Source: PRIMES, Results of the EUCO policy scenarios.[25]

While hydroelectric power generation will remain stable, the volumes of electricity produced by wind and solar power will rise strongly, with slower growth from biomass energy (including here biogas and organic waste). Coal is set to decline, but continues to be the primary source of fossil fuels, ahead of gas. As explained in the first chapter, this follows relatively low CO_2 prices in the ETS system, linked to the estimates of energy efficiency in the simulation.

This development for the whole of the EU masks profound differences between countries. The European Commission is aware that the expansion of renewables depends to some extent on local potential, but much more on the level of aid provided and investor confidence in countries' institution which is key to determining access costs to capital. The Commission does not have the power to modify such confidence. However, it believes that the harmonisation put forward, which ranges from market rules through to administrative formalities, should reduce present discrepancies.

The EUCO30 simulation, which takes this harmonisation into account, shows that catch up will not take place in the 2020-2030 decade. With a sample of 16 countries, Table 4 compares the installed capacity of renewable energy sources in the five most-equipped Member States and in five of the least-equipped Member States, in 2015 and 2030. The first table gives figures for the total fleet, and the second relates installed power to the number of inhabitants in order to mitigate size effects. This data shows that the ranking hardly varies, with the continuing dominance of countries in Western Europe.

Table 4: Installed Electricity Generating Capacity from Wind Power, Solar Power and Biomass

Total in GW			
2015		2030	
Germany	88,2	Germay	157,8
Italy	32,7	Spain	68,5
Spain	31,3	UK	68,2
UK	26,9	Italy	57,9
France	17,7	France	56,8
Romania	4,9	Romania	10,1
Czech Rep	2,8	Bulgaria	6,1
Bulgaria	1,8	Czech Rep	5,7
Slovakia	0,8	Hungary	3,4
Hungary	0,6	Slovakia	1,4

Per capita (kW/person)			
2015		2030	
Denmark	1,4	Denmark	2,0
Germany	1,1	Germany	1,9
Sweden	1,0	Sweden	1,7
Spain	0,7	Spain	1,5
Belgium	0,6	Greece	1,4
Bulgaria	0,2	Czech Rep	0,5
Romania	0,2	Romania	0,5
Poland	0,2	Poland	0,5
Slovakia	0,1	Hungary	0,3
Hungary	0,1	Slovakia	0,3

Source: PRIMES, Results of the EUCO policy scenarios.[26]

Commentaries

Markets and state aid

The Commission is making a bold bet on relying so heavily on market forces to ensure the near doubling of installed renewable electricity generation and the functioning of an electricity system which is increasingly Europeanised. Its bet is all the riskier given that some proposed reforms are likely to meet strong opposition: for example, it is hard to see how Germany will accept creating two price zones, one with moderate prices in the North given the production of wind power, and another with higher prices in the South where much industry is located.

Conventional energies are still expected to provide about 50% of electricity in 2030. Several countries believe that an energy only market, based on the marginal cost of production, will not guarantee sufficient investment. These countries have decided to implement, in different ways, a capacity mechanism for the purpose of maintaining available power. The needs for investment in the conventional sector should not be under estimated, as today's thermal power stations are threatened by ageing, restrictions on emissions into the atmosphere, and by national and European regulations,[27] such as the proposal in the Clean Energy Package to prohibit access to capacity mechanisms for plants emitting more than 550g of CO_2/kWh.[28]

For renewable energies, the Clean Energy Package implicitly admits that income from the market will not be sufficient to trigger investment, since aid continues to be authorised, within an appropriate framework.

Until when? The impact study provides two series of conditions (11 in all) that need to be met.[29] A number of these seem impossible to meet by 2030. This study recalls a singularity: market incomes from renewable sources depend on production costs for conventional sources. However, the influx of renewable energies is creating overcapacity in the fleet of conventional power stations, pushing down their marginal cost. This phenomenon has been called "cannibalisation": the more renewable energies develop, the more market revenues fall. There is little chance that the marginal cost will pick up before the end of the present decade, as one of the factors which could lead to cost increases – the CO_2 price in the ETS system – is stuck at a low level given the emphasis put on energy efficiency. Accordingly, market reforms set out in the 30 November 2016 Package do indeed favour the most competitive renewable sources, but do not seem to announce the end of aid.

States can recover a small part of aid allocated. Indeed, the Clean Energy Package asserts that each MWh produced by renewables will be accompanied by a guarantee of origin, an electronic title that will be valid for one year and recognised throughout the EU. For producers receiving aid, the guarantee of origin is transferred to the State. Producers which are not aided will receive it directly (for example old hydraulic dams or wind and solar power farms at the end of their purchase contracts).

There is a market for guarantees of origin. At the moment, demand is stagnating at a very low level, because it only flows from consumers wanting to use "green" electricity. Given a wide range of supply, prices remain very low. In 2015, demand reached 357 TWh, about 31% of all electricity from renewable resources produced that year.[30] Demand mainly benefits Norway,[k] with a price estimated at less than €1/MWh.[31] New buyers will emerge tomorrow, notably among those energy suppliers which will be compelled to provide a minimum level of renewables in their electricity sales as of 2020, such as electricity suppliers for electric vehicles. This extra demand will no doubt push up the prices of guarantees of origin, but it seems unlikely that overall demand will be sufficient to generate significant income.

Consumers and new players

With the Clean Energy Package, the European Commission hopes that consumers will play an active role within the new system.

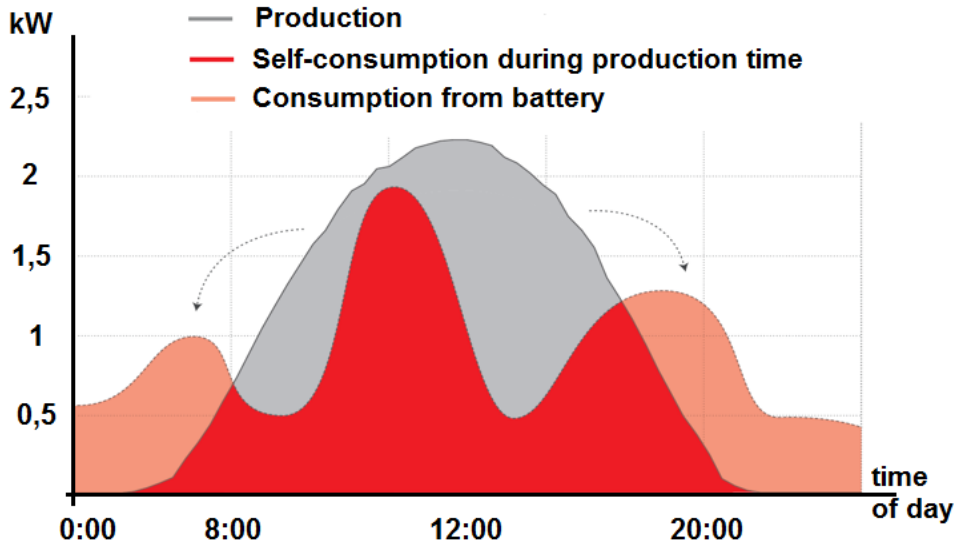
k. Guarantees of origin issued by Norway and Switzerland are valid in the EU.

Firstly, they are invited to choose "dynamic tariffs" which reflect generation costs in real time. These are much closer to the short-term price set in the wholesale markets. Consumers are also invited to modulate their consumption. Through such "demand management", some consumers will adapt to fluctuations of intermittent sources and will be invoiced with more favourable prices. In this case, profit depends on the difference between tariffs in off-peak and peak periods, on the "supply" component in the invoice. For industrial consumers, supplies are important. Managing demand can be very profitable and will become more so if routing tariffs[1] differentiate between off-peak and peak periods. For small consumers, potential gains risk being too small to favour dynamic tariffs. This is because the "supply" component of their invoices remains small, and because the share of consumption which cannot be shifted is charged at a very high level, especially once existing current price ceilings are abolished.

Secondly, consumers are encouraged to generate their own electricity using renewables, individually or as part of an energy community. The sale of surplus production will then take place at market prices. These however may sometimes be very low: self-consumers may be better off storing their surplus production and deferring consumption. Graph 2 describes a simple production and consumption model for individual installations of solar panels and batteries. It may be profitable especially for communities to turn to intermediaries, so-called aggregators. The latter can manage installations to maximise gains, according to the best market opportunities. Their role could extend to demand management as described above. The Clean Energy Package transfers rights devolved to individual self-consumers to aggregators. Thus, an aggregator bringing together several installations with a unitary power of less than 500 kW retains all the individual priorities to feed electricity into the system.

1. "Routing tariffs" here include transmission and distribution charges.

Graph 2: Self-Consumers with Photovoltaic Output and Storage



Source: European Commission.[32]

Grids

By reviewing the texts making up the Clean Energy Package, the overall philosophy becomes clear. It is based on encouraging private initiatives in favour of renewable energies, by mitigating regulatory barriers, and on guiding investor choices through the smooth functioning of the market. Grids are at the heart of this system, and it is here that the balance between legitimate supervision and free market forces seems to be the most delicate to achieve. Some examples illustrate the problems legislators face.

- ***Network charges***

In several countries, wind or solar power farms have experienced much faster growth than the strengthening of grids needed to absorb the energy produced. This results in high costs for the community, linked to compensating production which is not absorbed and to the sub-optimal use of power stations ("re-dispatching"). The Clean Energy Package advocates a response based on charges for connection to the networks which should reflect costs strictly. How is this principle to be put into practice? The Commission has asked ACER to make proposals.[33]

Let us take a concrete case. The texts require that installations with an electricity capacity of less than 50 kW shall be allowed to connect to the grid following a notification to the distribution system operator.[34] If a connection charge is to quantify the capacity of the local network to accept production, how is the size of the zone applying this charge to be defined?

Should there be a price signal by voltage level? Over what period should the signal apply, in order not to penalise initial projects, which lead to lines being reinforced, nor favour later projects that already benefit from upgraded grids?

More generally, connection charges should be adjusted as a function of required investments. Thus, new installations which accept temporary cuts in their production would pay lower connection charges, with network equipment being designed to average capacities, and no more as a function of peak output.

At another level, proposals put forward on 30 November 2016 encourage self-consumption. As a result, payments made to the distribution grid operators are lower. Their revenue is forecast to fall by 7.2% by 2030 in Germany with respect to their income in 2013.[35] Within the present regulatory framework, so-called "prosumers" (producers-consumers) may draw on the full electricity load they require during certain periods and at other times feed all the energy they produce into the network when operating at full capacity. A special tariff for this type of client would seem to be essential, proportional both to the capacity of cables which connect them (a fixed part in their invoices) and the energy they feed in or take out of the grid (a variable part). Imbalances between the fixed and variable parts would then penalise either prosumers (undue charges), or the grid operator (revenue losses), or other consumers (a transfer of spending to their detriment).[m] A major issue for all interested parties lies in the evolution of the two components of the charges for use of networks ("routing tariff"), the charge which pays for available power at any instant, and the charge which varies with the energy produced or consumed within a given period.

- ***The quality of the electric current***

Table 3 shows that production from intermittent sources (wind and solar power) is set to reach 29% of average annual output in 2030. However, at certain times of the year this ratio will be higher, if sunshine and wind are favourable when consumption is low. Unless regulations change, several European regions could be entirely supplied from these two sources on such days. A strong change in sunshine or wind could then trigger measures aimed at avoiding the deterioration of equipment; a fall in output would lead to a surge in power on lines serving the region, in order to prevent interruptions in the supply of electricity. Yet such surges in power

m. It is appropriate to allocate their share of charges to self-consumers, in order to compensate of aid provided to renewables, in proportion to the energy taken from the grid at present.

could in turn lead to the shutdown of connections to prevent overheating, etc. This would lead to a major blackout. Such an event actually took place in the State of South Australia on 28 September 2016, in a space of 87 seconds. Power was then cut for several hours, affecting 850,000 customers.[36]

The power failure was partly explained by the fact that wind and solar power sources were connected to the grid after passing through a converter (they are therefore "non-synchronous"). This deprives them of the inertia that characterises alternators used in other production units. In case of brief incidents, such inertia contributes to the stability of current frequency, the parameter which triggers protection devices. Efforts are being made to develop electronic equipment which can simulate equivalent inertia, but the texts of 30 November 2016 do not provide for their generalised use in the fleet of intermittent power installations. That said, the Commission reserves the right to adopt new rules at a later date.[37]

Even if it does not lead to incidents, the variability of wind and solar power causes fluctuations in voltage on lines which absorb this electricity. This phenomenon occurs purely locally, but it requires complementary equipment in the distribution networks in order for contractual voltage norms to be respected.

The significant supply of electricity from intermittent sources therefore raises the needs of "system services", which allow network operators to guarantee the continuity of electricity supplies that comply with set specifications. Despite efforts underway, renewable energy installations continue to be poorly adapted to frequency and voltage control, but they can contribute to "energy" services, such as primary and secondary reserves, balancing supply and demand in short time. The Clean Energy Package includes several clauses guaranteeing that all services will be managed according to market rules, and that renewable sources should have access to them, in order to generate additional income.

Electricity storage mechanisms play an important role in ensuring several services. The Clean Energy Package imposes the same market based rules on storage as on generation. These rules penalise centralised facilities, such as pumped storage power stations (PSPSs), because they pay the routing of electricity similarly to ordinary consumers. This spending reduces their profitability, which is based on the price spread between peak and off-peak periods that renewable output has compressed. Decentralised storage facilities on the other hand are experiencing remarkable growth, especially thanks to progress made with modern batteries. They are often located at production sites, and so only pay for routing when they feed electricity into the grid. Yet these feeding charges are generally much lower

than consumption charges for use of networks. Will ACER suggest rebalancing these two components?

The Clean Energy Package wants to reserve the ownership and management of storage facilities for market players, namely producers, consumers and aggregators. These players will seek to maximise profits by storing and de-storing subject to their expectations of prices on the wholesale market. However, such electricity flows will lead, under certain circumstances, to greater spending on grids, which will be passed on to all consumers (spending derives from the dimensioning of facilities, system services and transmission line losses). By contrast, if storage facilities are operated by grid managers (power transmission and distribution) the reverse may occur, in the same circumstances, leading to lower routing costs for all consumers: storage capacity is sometimes considered as "virtual grid". Several experiences have shown the usefulness of this option (such as the French projects Nice grid for distribution and Ringo grid for transmission). The 2012 directive on energy efficiency opens up this possibility.[38] Although the 2012 directive has not been rescinded by the 30 November 2016 proposals, the latter nevertheless restricts the freedom of regulators to allow grid operators to possess storage facilities, albeit by way of derogation.

Transport

Overview

Legislation in force since 2009 has largely spared the transport sector, which logically consumes relatively little renewable energy: only 6% in 2015 compared to 16.4% for all sectors.[39] The main efforts so far concern so-called first-generation biofuels, mainly based on plants used for food. This sector was encouraged as of 2003 by an incentive directive, and then further stimulated in 2009 by a more ambitious target leading to rapid growth. Since 2012 there has been however a clear slowdown, with the Commission backtracking and announcing very strict sustainability criteria, adopted in 2015. The Clean Energy Package once again modifies the outlook.

Firstly, the objective concerning energy efficiency, which seeks a 30% improvement by 2030, is accompanied by a tightening of emission regulations for cars, which should be reduced to 80g CO_2/km by 2025 and two 70g by 2030, compared to the 95g CO_2/km for 2021, set out in present legislation. This pressure on emissions is encouraging carmakers to include (non-emitting) electric vehicles in their portfolio, as emissions are calculated on the average of vehicles sold. As electricity is increasingly generated by renewables, the transport sector automatically increases its contribution to this common target.

Secondly, fuel suppliers are obliged to include a rising share of "alternative" energies in their sales (see chapter 1), including:

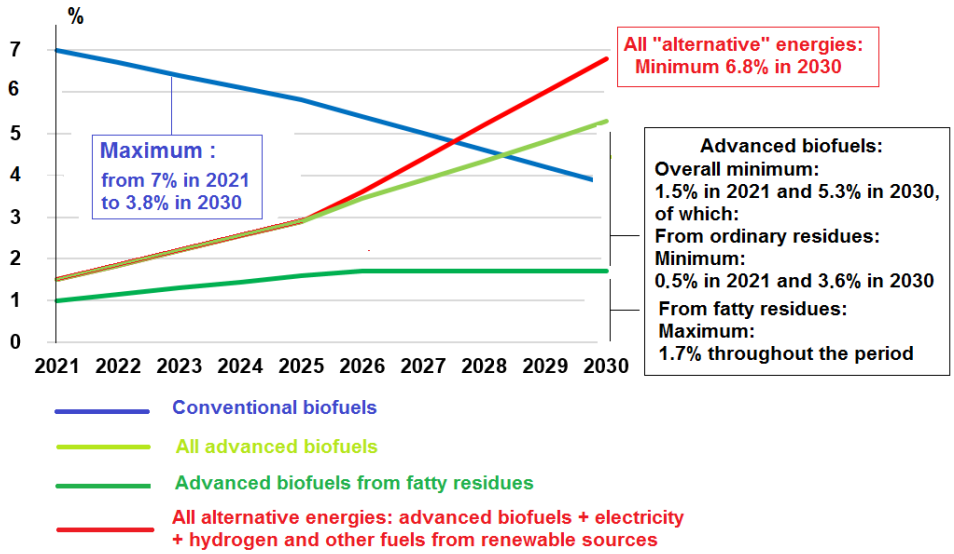
- Electricity from renewable sources, and "artificial" fuels, such as hydrogen, which are also produced from renewables.
- Advanced biofuels, liquid or gaseous, divided into two subgroups: those which are derived from algae or ordinary residues and those derived from molasses or fatty residues.

The share of these energies should reach 6.8% in 2030.

The incorporation of renewables is supervised, with a minimum or maximum for each category, evolving over the decade between 2020 and 2030, according to the paths shown in Graph 3. The incorporation of conventional biofuels, based on crops used for food or livestock feed, remains authorised up to a certain ceiling set to fall during the period. But

it is not obligatory. The 2014 guidelines specified that the production of these first-generation biofuels will no longer receive aid after 2020.[40]

Graph 3: Lower and Upper Limits for Including "Alternative" Energies between 2020 and 2030



Source: Article 25 and Annex X of the proposal COM(2016)-767.

The sustainability criteria imposed on all bio-energies also apply to advanced biofuels. Despite the criticisms made of conventional biofuels, derived from food crops, the Commission has not wanted to exclude them completely, considering that the 2030 objective will be too costly to achieve if advanced biofuels are the only available instrument. The development of the latter however seems indispensable for transportation means for which electrification still seems far off, such as heavy goods vehicles and barges. Apart from bio-methane and oils extracted from algae, advanced biofuels include ethanol of lignocellulosic origin, oils obtained by the pyrolysis of organic matter and synthetic biofuels, especially methanol or power to liquid.

Results

Contrary to the electricity sector, the simulations provide little detail on the breakdown of renewables in transportation. The overall result indicates that they will only account for 19% of final consumption by the sector in 2030.41 But this figure is misleading, since it is calculated using a very specific methodology, which for example allows the energy content of certain advanced biofuels to be multiplied by two, while the contribution of

electricity from renewables is multiplied by five when consumed by electric vehicles.[42] The gross figures of the simulation lead to a much more modest result, with a share of all biofuels equal to 6.6%, and an electricity share of 2.2% for all energy consumed in the transport sector in 2030. If it is assumed that electricity from renewable sources will make up 50% of all production in 2030, its contribution will only represent 1.1% of consumption in transport.

This figure in turn calls for some reservations because it comes from a simulation based on old assumptions. These use a battery price between €320 and €360 per kWh.[43] This level is far greater than those of recent studies which indicate costs of between €150 and €200 per kWh.[44] The commercial strategies of manufacturers, the clean mobility policies launched in large cities and the rapid creation of charging station networks in Europe will very likely accelerate the spread of electric vehicles.

With regard to biofuels, the proposals of the Clean Energy Package retain the focus of 2009 texts, which do not require production within the EU. Currently, and as is the case for biomass (see chapter 2), some biofuels are imported. In 2014, about 10% of bio-ethanol and 26% of bio-diesel consumed in the EU came from third countries. In the same year, local raw materials made up 60% of the inputs for bio-diesel produced in Europe, the remaining 40% being imported.[45] The development of the hydrogenation process for producing bio-diesel as of 2010 has favoured the inflow of imported products, such as palm oil, which provided about 17% of the raw materials used in the EU in this sector, in 2015.[46] At the same time, a new EU Directive was adopted (2015/1513/EU) imposing much stricter constraints than previously on the origin of raw materials.

The uncertainty about the progress of completing technologies among advanced biofuels makes it impossible to see how imports will evolve during the 2020-2030 decade. The 2015 framework has been preserved by the 30 November 2016 Package, which includes a measure to create national databases ensuring accurate traceability.

Returning to the use of electricity in transport, along with the public policies mentioned above, its development will also depend on private initiatives to facilitate coordination between users and two other players in the electricity system: the supplier concerning the price of electricity and the grid manager concerning the availability of power facilities that can feed recharging stations. Such availability in fact conditions the time of electric recharge – slow, fast or intermediate – and its cost. Managing this interface could lead to a specific business model, opening the door to aggregators of services for electric vehicles which are capable of enhancing and exploiting the storage capacities of car fleets.

When car fleets are not in use, their batteries represent a significant storage capacity that can be used to provide services to grids, such as frequency and voltage regulation or demand smoothing. These functions however depend on the remote control of all vehicles on the one hand, and regulations adapted for this new usage on the other hand: the minimal power required to participate in calls for tender, the required duration of service commitment and the level of remuneration proposed all shape the participation of such new players. Here again, the intervention of aggregators will prove valuable.

Lastly, it should be noted that the Clean Energy Package does not especially encourage the use of hydrogen in the transport sector. The energy required in producing this gas (by electrolysis) and for the restitution of electricity (with fuel cells) completely weakens the whole energy balance which is taken into account to promote electricity production from renewable resources in the transport sector. If the performance of batteries continues to improve at the rate observed in recent years, the direct use of electricity from renewables in vehicles will limit the role for hydrogen until 2030.

Conclusion

The European Parliament and the Council have the power to amend profoundly the proposals tabled by the European Commission on 30 November 2016. These two bodies could especially give up the 30% objective relating to energy efficiency, whose application will weaken the ETS system and raise the costs of measures put into place to reach the 27% target for renewables in final consumption in the EU by 2030.

Assuming that Parliament and Council retain the Commission's choices, simulations for 2030 give results summarised in Table 5.

Table 5: The Share of Renewables in Final Energy Consumption (in %)

Electricity	49
Hydroelectric power	0
Wind	0
Solar	0
Biomass	0
Other renewables	0
Heat & Cold	26
Transport	
Biofuels	7
Renewable electricity	1

Source: PRIMES, Results of the EUCO policy scenarios.[47]

From this perspective, the major effort through to 2030 will be borne by the electricity sector. The regular falls in the cost of components will allow installed capacity to be doubled for wind power and to rise by a factor of 2.4 for solar power, at the EU 28 level. These multiplier coefficients also apply to capacity installed in Eastern Europe; however their present level in this region is modest, and even in 2030 the installed capacity will remain considerably lower than in West European countries. To avoid political resentment, it will surely be possible to encourage joint projects between Member States in the two regions, for example by guarantees of an equal access cost to capital.

The Clean Energy Package envisages a gradual reduction in aid to wind and solar power, thanks to a reformed and integrated electricity market. The price per MWh in this market, and so the income of renewables tomorrow, will continue to be set by the generation costs of conventional power stations (nuclear power, gas and coal). These power stations will moreover continue to provide essential functions in terms of supply security and electrical current quality. In several Member States, the upholding of conventional power station fleets will also require certain types of aid, such as capacity mechanisms or long term contracts.

According to the current draft of the Clean Energy Package, the Commission has retained the right to evaluate the reality of needs on a case-by-case basis, and issue new guidelines on authorised aid between 2021 and 2030. It will also have the power to fix a number of important parameters, while other criteria will be set by external bodies such as the ACER. This postponement of decisions until later is a weakness. The uncertainty that follows is likely to slow down investments which are actually desirable to encourage.

Beyond the figures, the 30 November 2016 Package will transform the electricity landscape by 2030 from a qualitative point of view. The most likely novelty will be the emergence of aggregators, capable of managing composite sets of scattered production as well as storage and consumption which are partly modular. Aggregators will also need to be able to process masses of data flowing from intelligent devices that will proliferate in grids and with clients. The texts favour small installations, outright generation or self-consumption using simplified procedures. To get the best out of agreed investments, good knowledge of the electricity market seems vital, and recourse to intermediaries with the required know-how is likely to become widespread. A minimum level of aggregation seems particularly necessary to exploit the possibilities of dynamic pricing, as recommended by the Clean Energy Package.

The desire to render investments in the production sector profitable only on the basis of market forces may however lead to measures which are far from providing general economic optimality. The most difficult issues relate to grids. It will be difficult to define a price signal which exactly reflects the cost generated by each type of user. For the sake of social justice, it is however necessary to address this issue, especially given the development of self-consumption. Even though few projections exist at present, the phenomenon should become significant during the next decade, but the advantages it provides will remain unaffordable for a part of the population due to insufficient savings and inadequate housing.

Targeted energy efficiency actions for this population could compensate this handicap. If well directed by government, such action could also enhance the operation of heat production and use, which today is lost in dense infrastructures, such as the centres of urban areas. Heat pumps would seem to be a natural tool for such facilities. Solid biomass (bio-energy) continues to have a room for development in producing heat, but new constraints of sustainability and a better appreciation of biomass's function as a carbon sink will limit its expanded use. It would be unfortunate if the achievement of targets for renewable heat production involves massive wood imports.

The possibility of new external dependencies by 2030 however is not to be ruled out. This risk is inherent in an open economy, such as the EU, which is adopting an ambitious policy over a relatively short time horizon, with binding targets such as those set out in 30 November 2016 Package. The approach of the Package which is favourable to market forces should stimulate service-oriented activities, which are little exposed to off-shoring. But much uncertainty prevails for manufacturing activities. In principle, European industry has the means to supply the necessary equipment and facilities for the application of the Clean Energy Package. But it may find itself in an unfavourable situation vis-à-vis foreign competitors which benefit from determined government support. For example, aid provided by Chinese public authorities to local battery producers has no equivalent in Europe and could provide them with a strong position in the global market. It should also be recalled that not all EU Member States have an industrial infrastructure to accommodate job growth promised in the sector: employment could concentrate in regions already well-off.

By launching the Clean Energy Package, the Commission has asserted that it will make the EU a world leader in renewable energies. How can it be guaranteed that the Package leads to a fair distribution of jobs? In the amendments which the European Parliament and Council will prepare, there is no greater concern than making the Clean Energy Package beneficial to all Member States and all population categories.

References

1. COM (2016)-759, *Proposal for a regulation on the governance of the Energy Union*.

2. Guidelines on state aid for environmental protection and energy for the period 2014-2020 (2014/C - 200/01) 28 June 2014.

3. PRIMES, *Technical report on Member State results of the EUCO policy scenarios*, By E3MLab & IIASA, December 2016, p. 70-71.

4. SWD(2016)-418, European Commission, *Impact Assessment accompanying the proposal for the recast of the directive on the promotion of the use of energy from renewable sources*, third part, p. 275.

5. *Ibid.*, p. 253-254.

6. SWD (2016)-405, European Commission, *Impact Assessment accompanying the proposal amending the directive on energy efficiency*, p. 109 and after: Section 6 – "Comparison of the policy options".

7. Cambridge Econometrics, *Summary of E3ME Modelling*, December 2016, page 4.

8. Author's calculations based on data from the EUCO30 simulations (note 4), SWD (2016)-418 (note 5) page 37 and COM (2017)-57 (note 37), p. 6.

9. Share in 2015: COM (2017)-57, European Commission, *Renewable Energy Progress Report,* 1st February 2017, p. 5.
Share in 2030: PRIMES, idem note 3, p. 70-71.

10. New Article 7 of the Directive relating to energy efficiency, as modified by proposition COM (2016) 761.

11. New Article 9 of the Directive relating to the energy performance of buildings 2010/31/EU, and Article 1, paragraph 1 of annexe I, as modified by proposition COM (2016) 765.

12. COM (2016)-767, proposal for re-drafting the Directive on the promotion of renewable energies, Articles 26, 27 and 28.

13. COM (2016)-767, note 12, Article 25, paragraph 5.

14. SWD (2016)-418, idem note 4, page 45.

15. SWD (2016)-405, European Commission, *Impact Assessment accompanying the proposal amending the directive on energy efficiency*, p. 109 and after: Section 6 – "Comparison of the policy options"p. 91.

16. SWD (2016)-418, idem note 6, third part, p. 275.

17. Agora Energiewende, *Heat transition 2030*, study conducted by the Fraunhofer Institute, February 2017.

Ecofys, *Total cost of heat in residential sector*, 5 July 2016.

18. SWD (2016)-418, idem note 4, p. 275.

19. USDA, GAIN Report, *EU Biofuels Annual 2016*, 29 June 2016, p. 32, and William Strauss, *Global Wood Pellet Markets: Forecasts for Demand*, 25 July 2016, p. 7.

20. European Commission, *Optimal use of biogas from waste streams*, December 2016, and PRIMES, idem note 3, p. 70-71.

21. SWD (2016)-418, idem note 4, p. 275.

22. Article 16 of the 2009/28/EU Directive relating to renewable energies.

23. COM (2016)-861, *Proposal for a regulation on the internal market for electricity,* article 11.
The ceilings are divided by two (respectively becoming 250 and 125 kW), when the cumulative effective eligible capacity exceeds 15% of the total capacity installed in the country.

24. Sources :
- PRIMES, *idem note 3*, p. 70-71.
- Price of electricity for households 2015 : Eurostat, series nrg_pc_204
- Average cost of support to renewable sources 2015: CEER, *Status Review of Renewable Support Schemes in Europe*, 11 April 2017, page 19.

25. PRIMES, *idem note 3*, p. 70 et 71.

26. PRIMES, *idem note 3*, p. 74 à 127.

27. Directive 2010/75/EU of the 24 November 2010 relating to industrial emissions (the so-called IED Directive) and the Directive 2016/2284/EU of the 14 December 2016 concerning the reduction of national emissions of certain atmospheric pollutants (the so-called revised NEC Directive).

28. COM (2016)-861, *Proposal for a regulation on the internal market for electricity,* article 23.

29. SWD (2016)-418, idem note 4, p. 275.

30. Association of Issuing Bodies, *Connecting – Annual Report 2015*, page 9.

31. SWD (2016)-418, idem note 4, p. 149.

32. European Commission, *Best Practices on Renewable Energy Self-Consumption*, COM (2015)-141, p. 4.

33. COM (2016)-861, idem note 23, Article 16, paragraph 9.

34. COM (2016)-767, proposal for a Directive relating to the promotion of renewable energies, Article 17, paragraph 1.

35. SWD (2016)-418, idem note 4, p. 144.

36. Australian Energy Market Operator, *Black System South Australia 28 September 2016*, published March 2017.

37. COM (2016)-861, idem note 23, article 11.

38. Annex XI, paragraph 2, of Directive 2012/27/EU relating to energy efficiency.

39. COM (2017)-57, European Commission, *Renewable Energy Progress Report*, p. 9.

40. Paragraphs 112, 113 and 114 of the 28 June 2014 guidelines, idem note 2.

41. PRIMES, idem note 3, p. 70 et 71.

42. Directive 2009/28/EU for the promotion of renewable energies, new Article 3 as modified by Directive 2015/1513/EU.

43. SWD (2016)-418, idem note 4, p. 224.

44 . Bloomberg New Energy Finance, *Distributed Solar and Storage Roadmap - Innovation for Cool Earth Forum*, December 2015, p. 12.

45. COM (2017)-57, idem note 39, p. 16 et 17.

46. USDA, GAIN Report, *EU Biofuels Annual 2016*, 29 juin 2016, p. 32, and William Strauss, *Global Wood Pellet Markets: Forecasts for Demand*, 25 July 2016, p. 22.

47 . PRIMES, idem note 3, p. 70 et 71.

institut français
des relations
internationales