

EUROPE'S ELECTRICITY GRIDS: JOINING UP THE DOTS

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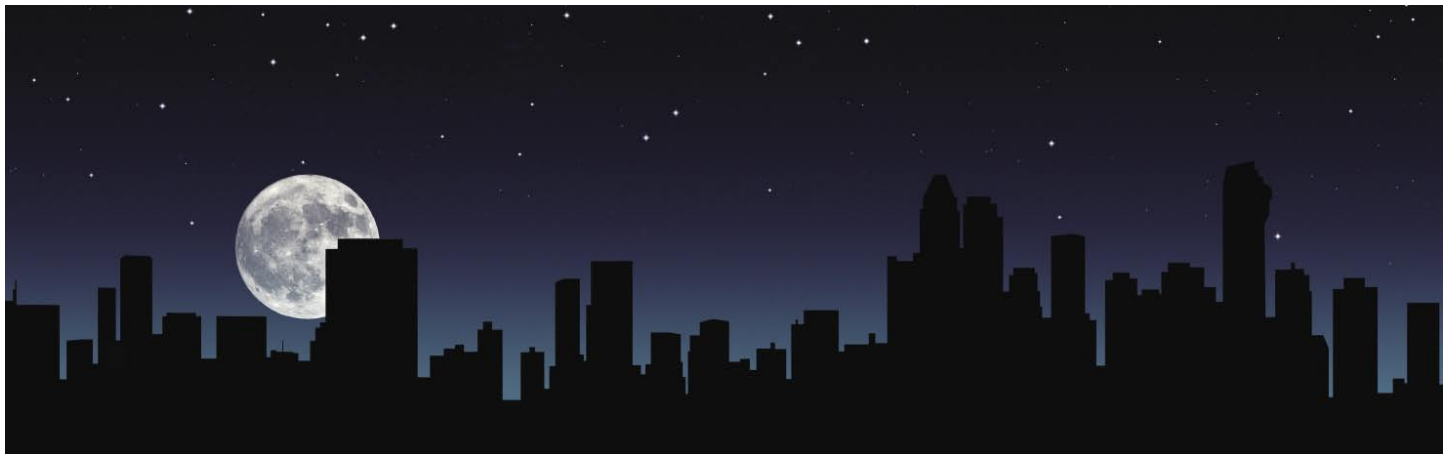


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Grid blackout threat weighs on renewables take up



After years of trying to persuade sceptics, the renewable energy industry continues to face an uphill battle in convincing power producers that integrating more renewable energies like wind and solar will not put the electricity grid in jeopardy.

The policy chief of Europe's electricity industry association has told EurActiv that Europe will have to slow down its integration of renewable energies or risk power cuts and systems instability because of the slow pace of cross-border grid improvements.

"Either you go very fast in the transition - which is impossible [because] smart grids are expensive and the storage is not there in the needed scope - or you diminish the speed for integrating renewables into the system," Susanne Nies of Eurelectric told EurActiv in a phone interview.

Given a choice between meeting the EU's target of getting 20% of energy - and 35% of the EU's electricity mix - from renewables by 2020 or keeping the system stable, "I would rather say that system stability and avoiding blackouts is more important," she said.

Nies cited a report claiming a rise of serious systems stability incidents last year from 300

to 1,000 across a swathe of northern Europe, and said that the Czech Republic came close to power black-outs in November and December 2010.

"We want to meet the 2020 targets but we need to be very careful," she said, "because the worst case scenario is one in which we have a series of blackouts in Europe and there would be a loss of support first for the utilities but maybe also for the renewables. That would be a disaster."

Her words reflect pessimism in the electricity transmission industry about the likelihood of balancing capacity for variable energy sources like wind and solar in time for 2020. Usually though, this is voiced off the record.

Lights out

Speaking to EurActiv last month, another industry insider said that renewables advocates "want to increase solar panels and we want to keep the lights on, but if the lights go out because PV [solar photovoltaic energy] has not maintained the power quality, it's not in either of our interests."

"If we're connecting things that the system wasn't designed for," the source continued,

"we're putting stresses on it. Some people think it is a bit conservative for network operators to say that, but maybe it's good to have a bit of conservatism when you're thinking about a constant electricity supply. There is a bit of a trade-off between security of supply and reliability" and renewables.

Renewable energy advocates accept that Europe's grid systems were built for fossil fuels but "the point is that this period is over," said Arthouros Zervos, president of the European Renewable Energy Council. "We have to adapt and do it fast."

Hydro pumps

Hydroelectric pump storage is currently the most efficient way of balancing electricity loads which can vary for renewables, when the weather is cloudy or windless.

Zervos said that some counties such as Italy had a probable excess of pump storage capacity while others had deficits.

As a result, "we would need much less storage if we improved our [cross-border] interconnections," Zervos told EurActiv, "because then you could use the storage capacity of

your neighbouring countries."

Anders Eldrup, chief executive of Dong Energy and a former permanent secretary in the Danish finance ministry, noted that similar concerns about integrating renewables had been expressed in his country's past.

"When Denmark began pioneering onshore and offshore wind 35 years ago, people said 'When it becomes 5% of total supply, we'll have an unstable system'," he told EurActiv.

"Then they said 'when its 10%', but we managed. Today it is more than 22%, the government wants to increase it to 50% in 2020, and the system is stable."

One common algorithm

To advance electricity market integration by 2014, the EU hopes to have implemented one 'common algorithm' to determine electricity prices across Europe.

In the same year, common network code requirements for Europe's power networks, currently being devised by the European Network of Transmission System Operators for Electricity (ENTSO-E), are also scheduled to take effect.

"The future will be

challenging," one ENTSO-E source said of current grid integration concerns. "Keeping a secure system in the next years is our main concern and we are taking all possible actions within our legal mandate to support this goal."

Nies called for the EU to mount a public acceptance campaign to overcome planning objections to transmission grid construction, better balancing provisions for renewables, more pump storage and grid interconnections, improved risk-sharing facilities, and a resolution of 'loop flow' problems, which can involve electricity being sent through several countries to avoid transmission bottlenecks.

But she also sounded a note of caution about anticipated haggling over the energy infrastructure package.

"I am very afraid that member states will refuse to use the regional funds in the infrastructure package for those projects which are not exclusively in their national interest," she said.

"For the cross-border interconnections we need, there has to be a commitment from member states for much more Europe. It is impossible to do this with a nationalistic and North Korean-type approach."

Poll reveals wide support for EU grid action



A survey of European stakeholders has found overwhelming support for giving priority, funds and planning waivers to allow the speedy construction of European grid infrastructure.

In a survey of businesses, industrial associations, NGOs and think tanks, 81% of respondents said that creating a single European electricity market, and the needed grid infrastructure, should be an EU policy priority.

"We couldn't agree more," said Susanne Nies of Eurelectric, an association representing major European power generators.

Because of phase out's of capacity, such as nuclear energy in Germany, and a need to balance variable energies such as wind and solar, "there is a need for a speedy, timely and fast extension – and improvement – of the European grid to make it fit for the new energy system," she told EurActiv.

"It needs to be done as fast as possible," said Nies, who is head of unit for energy policy and generation at Eurelectric.

Almost 98% of those polled in the survey believed that Europe needs to upgrade, extend and fully interconnect its electricity grids to achieve a single electricity market and 75% wanted the EU to increase financial support to enable this to happen.

Grid permitting

On the issue of grid permitting procedures, which has progressively vexed

stakeholders in the new electricity grid economy, 87% said that the EU should issue permits more quickly, and another 70% supported the EU imposing time limits for resolving planning disputes.

"It is rare that there is such remarkable unanimity across industry and NGOs on a piece of legislation coming before the European Parliament," Julian Scola, a spokesman for the European Wind Energy Association told EurActiv.

"It sends a message that there is very strong support for the EU taking action to speed up the grid permitting process and proposing new financing mechanisms," he said.

Speaking at a European Economic and Social Committee conference, the energy commissioner, Günther Oettinger, said it was "irreconcilable" that "the construction of electricity cables across the Pyrenees took thirty years because one member state had no interest in that competition."

The self-selecting online survey was conducted for EWEA by the public affairs consultancy Hill and Knowlton, and only involved 45 respondents.

Nonetheless, "they certainly represent a very large number of members and, in many cases, thought leaders in their field," Julian Scola pointed out.

Participants in the survey included the European Policy Centre, the Andalusian Energy Agency, the Nature Conservancy in Europe, and the European Battery Manufacturers Association.

EU's 10-year power grid plan 'driven by renewables'

In March, the European Network of Transmission Systems Operators (ENTSO-E) will submit a comprehensive 10-year plan for public consultation which shows that most of the continent's investments in electricity infrastructure will be "driven directly or indirectly by renewable integration concerns," ENTSO-E told EurActiv.

One official familiar with the proposal said renewable energies would be a driving force behind the proposed 10-year network development plan that will be tabled in March.

The plan will present highly detailed proposals on infrastructure that contribute to the EU's energy goals and supply security, including projects to connect renewable energy sources to transmission networks within and between countries.

This would be done using bi-directional energy flows from regions which may be, for example, rich in wind power. Energy will be transported to European hubs and nodes, with power potentially also being sent back the other way, to compensate for times when winds are not blowing.

Unlike ENTSO-E's last, the new 10-year network development plan will look at projects from a "big picture" perspective that takes into account consumption growth, grid reinforcements and bulk power flows, ENTSO-E said.

About one fourth of the infrastructure will relate to projects that are delayed most due to lengthy permitting processes. "This is why the new 'Regulation on guidelines for trans-European energy infrastructure' is such a big step forward, as it provides for solutions to accelerate the

building of new infrastructure," an ENTSO-E source told EurActiv.

Cost-benefit analyses

The plan will also include criteria and indicators required under EU legislation as a way to help policymakers select the projects that best contribute to the EU's energy goals.

"Interpretation of these indicators in the context of a cost-benefit analysis should be done prudently as it is very difficult to quantify and monetise in precise figures all factors that play a role in a project assessment", ENTSO-E said. "Only then the cost-benefit analyses can be a useful starting point for decision making".

However, doubts have emerged about the usefulness of the cost-benefit analyses that ENTSO-E has been asked to carry out for individual projects.

These relate to the cost allocation and ranking of infrastructure projects between countries that could bring electricity from southern Europe to the north or vice versa.

António Correia de Campos, the European Parliament's rapporteur on the energy infrastructure package, said cost-benefit analyses "help the decision-maker but they don't dictate a decision."

He said he expected that the ENTSO-E cost analysis would "bring a common measure, monetisation of cost benefits, societal analysis, sometimes alternative proposals, and it may give light to parts of the proposals that are not fully clear."

But one informed EU source said that, because of a lack of clarity in the legislation, Europe's

political echelons seemed to be "looking for a black box in which you push a button and you get precise numbers and, at least with projects of common interest it doesn't work like that."

"Not everything can be quantified and monetised," the source said.

Grid interconnectors

Arthouros Zervos, president of the European Wind Energy Association (EWEA), said evaluating the benefits of grid interconnections to both parties in any situation was a highly difficult call to make.

"If you have two neighbouring countries and one has a market which is more expensive, the benefit will look different from one side or the other," he told EurActiv, "so how do you calculate the benefit?"

"It is not going to be an easy exercise because the politicians are throwing the ball to the technical people (ENTSO-E) when it is also a political decision," he said.

Zervos is also a special advisor to the Greek environment ministry, and was for five years a science officer in the European Commission's Renewable Energy Unit.

One compromise solution could involve regional groups that the EU is planning to set up to validate the cost parameters for infrastructure projects.

"But we won't provide the ranking," an ENTSO-E source said. "It is not our task to say that 'this project is more important than the other'. The devil is always in the detail and our task is to assess the projects based on a set of criteria."



Knives out over plan on electric grid permits



EU proposals to impose a three-year deadline on local authorities to issue construction permits for new power lines has met with sharp opposition in the 27-country bloc, EurActiv has learned.

According to European Commission proposals published in October, local populations would have three years to try to prevent new transmission grid projects being built. Beyond that deadline, the projects would go through.

"That time frame is probably too stringent," said António Correia de Campos, the European Parliament's rapporteur on the €9.1-billion energy infrastruc-

ture package, which includes the three-year proposal.

"We need to relax a bit and look into the viability of performing these tasks to such an early and stringent schedule," he said.

The infrastructure package also proposes spending €45 million to create 'grids tsars' with the power to overrule local objections and push through projects that meet "significant delays or implementation difficulties."

But EurActiv understands that member states are also worried that such provisions could undermine the concept of subsidiarity, or devolving power to the most decentralised authority.

That has set alarm bells ringing in Brussels. "Because we are talking about European climate targets, we have very strong concerns that these permitting provisions may not stay in the final text," an EU source told EurActiv.

"We see them as an opportunity, a large contribution to the infrastructure package, and as consistent with best practices in Europe," the source added.

Bottlenecks

The need to address bottlenecks has long been acknowledged by the European Commission.

An internal working paper accompanying the original infrastructure proposal, seen by EurActiv, noted enormous delays due to public opposition and administrative red tape. That is the case, for example, for Steiermarkleitung, an Austrian power line project that has faced delays for up to 25 years.

The same applies to the 380 kV French-Spanish interconnector power line, which was commissioned in the 1970s and is not expected to be finished until at least 2014.

While strong public opposition and lengthy administrative procedures are nominally blamed, observers allege that France, which sources nearly 90% of its electricity from nuclear power, has little interest in importing cheaper energy supplies.

"The real time frame for the approval and building of big lines or interconnectors is in the order of 10 years," said Arthouros Zervos, the president of the European Wind Energy Association.

"I can see the point, that three years is a short time but you have to be stringent," Zervos told EurActiv. "If you are 'more relaxed', you will be talking about meeting EU targets in 2030, rather than 2020."

Critics say that transmission lines pose health risks to nearby communities, lower house prices, and are dangerous for birds.

A potential answer to these problems has been found in new research by an independent group of engineering consultants, which has found that burying electricity cables is far cheaper than was previously thought.

Designer pylons

Concerns about the unsightliness of electricity pylons were also addressed last October in a competition to fashion 'designer pylons', which was won by a Danish 'T-Pylon' design.

A more weighty criticism of the energy infrastructure package is that its 12 favoured projects prioritise fossil fuels over renewables.

"The distortion in favour of gas is particularly evident in the proposed priority corridors, with four corridors related to gas and only one entirely devoted to renewable energy transmission," the Green MEP Claude Thurnes said at the time of the package's launch.

Nonetheless, advocates of a rapid expansion and 'smartening' of network systems maintain that current networks were mostly built in the mid-20th century and are unable to integrate renewable energies, which are needed if the EU is to meet its 2020 targets.

"If you want more renewables in place, you need more transmission lines," an EU official told EurActiv. "Without it, you will not reach the 2020 targets. It's as simple as that."

Oettinger pleads for energy network package

Energy Commissioner Günther Oettinger, whose efficiency directive has been gutted by member states, yesterday (14 February) pleaded with Europe's energy ministers to back his department's remaining flagship, a €9.1-billion energy infrastructure package.

"I'm pleading with you not to come up with reservations but with general support that can be crucial to our generation," an impassioned Oettinger told the ministerial roundtable in Brussels.

Europe's electricity networks are currently stuck in "the world of 19th century principalities," and without a rapid roll-out of energy transmission grids, "it will be the end of Europe," Oettinger warned darkly.

"We have the euro crisis, the energy crisis, an economic crisis, and this continent – that means you and me – would no longer deserve to be taken seriously," he said.

The EU's energy infrastructure package, which was launched in October, broke new ground by earmarking

money from the EU's 2014-2020 budget for spending on energy transmission networks to connect Europe's grid, and integrate renewables within it.

The grants would go as 'seed money' to projects such as north-south electricity grid interconnections, innovative energy storage projects, and an offshore grid in the North Sea to transport wind power across the continent.

Austerity

Some EU countries complain that the cost of upgrading infrastructure at a time of austerity is too high, but Oettinger countered that the €9.1 billion earmark was a fraction of the EU's 2014-2020 budget, and just 4.5% of the €200 billion needed for infrastructure spending by 2020.

"We can't fail to negotiate the €9 billion that's necessary, because €4 billion is not going to work," he said. "You would be better doing the interconnections yourselves."

Some member states



are reluctant to take steps that would favour a perceived European interest above immediate national considerations, often phrased in the language of 'subsidiarity,' or devolution of powers to the smallest unit.

During the ministerial roundtable, the Czech Republic called for cost allocations to take into account countries benefiting from infrastructure projects.

The Czech energy minister also described proposals to limit planning appeals to three years as "far reaching"

and a "transfer of powers from national bodies [that] we cannot support."

Grid tsars

Under the EU's proposals, a three-year deadline would be slapped on planning appeals – which have been known to drag on for decades – and 'grids tsars' would be created with the power to overrule infrastructure projects that meet with local objections.

Officials in Brussels are privately frustrated that member states which

condemned Germany's decision not to coordinate its move away from nuclear power should object to attempts to coordinate action on grid networks.

"We are sharing the same grids and electricity doesn't know any national borders," one source told EurActiv. "Whatever happens in one corner of the grid affects everyone else in Europe."

A "cultural revolution" was needed to change mentalities away from a national to a collective self-interest, the official said.

Burying electricity power lines 'cheaper than UK National Grid' claims



Countryside campaigners fighting hundreds of miles of 50-metre tall electricity pylons said that they have been vindicated by an independent report, which says burying cables is far cheaper than has been claimed by the National Grid.

The report by engineering consultants Parsons Brinckerhoff into the comparative costs of

routing transmission lines was commissioned by government planning body the Infrastructure Planning Commission (IPC).

It found that underground cabling was 4.5-5.7 times more expensive than traditional overhead pylons. This compares with the claim of being 10-20 times more expensive, which is often made by the National Grid company in planning

applications. The National Grid has been the monopoly supplier of UK pylons for 60 years.

When costs are calculated over 40 years, overhead cables were found to cost between £2.2m/km and £4.2m/km to install and maintain, compared with between £10.2m/km and £24m/km for those buried. Costs varied according to the technology used and the voltage of the lines.

Campaign to Protect Rural England (CPRE) said the latest figures made it feasible for the government to insist that cables are buried when crossing national parks, or protected areas like areas of outstanding national beauty.

Calling for a new study to consider environmental and social costs, a spokesman for the group said: "We are not saying that you should bury all cables, and we accept that this is a more expensive option, but we think people would be prepared to pay a few extra pounds a year to have them buried in treasured landscapes like national parks and areas of outstanding beauty."

The report's authors considered several ways to bury

the cables, including putting them in tunnels, directly into the ground and in gas-insulated pipes. On every count, it was far cheaper to use overhead lines.

The report did not try to calculate the social and environmental costs of the pylons, which have been deeply resented when proposed in some areas. However, it concluded that there may be visual intrusion, community disruption, loss of property values and concerns about radiation.

However, National Grid said the study's findings were broadly in line with the costs it had been quoting. David Mercer, National Grid's major infrastructure development manager, added: "This report will be a valuable contribution to the public debate on the right balance between visual impact and costs that must ultimately be paid for by consumers."

More than 200 miles of new transmission lines are expected to be demanded in the next 10 years, in order to connect new nuclear power stations and onshore and offshore windfarms to the grid.

The masts have been strongly

opposed in Scotland, the Lake District and mid-Wales. Some of the proposed lines would cut through England's finest landscapes like the Mendip Hills, Somerset, and the Dedham Vale on the Essex-Suffolk border.

The Campaign for National Parks (CNP) welcomed the report's findings. Its deputy chief executive, Ruth Chambers, said: "We welcome the report's conclusion that underground solutions for electricity transmission are cheaper than previously thought. There will now be a more level playing field between overhead and underground technologies, making it easier for solutions that respect England's finest landscapes to be implemented."

"This is only part of the jigsaw. We wanted to give the IPC a tool to apply to future applications," said Mark Winfield, consultant with Parsons Brinckerhoff and lead author of the report.

Last year, a Danish "T-Pylon" design by Copenhagen-based practice Bystrup won a competition by the Department of Energy and Climate Change to design new pylons.

Renewables chief: 2030 targets are 'a must'

Arthouros Zervos, president of the European Wind Energy Association, shares his perspective on how to improve Europe's ageing power grid networks so that they can integrate the large amounts of renewable energies needed to meet the EU's 2020 targets.



Arthouros Zervos is president of the European Wind Energy Association (EWEA). He spoke to EurActiv's environment and climate change correspondent Arthur Neslen.

António Correia de Campos, the European Parliament's rapporteur on the energy infrastructure package, said the proposed three-year time limit for grid permitting and planning applications was too stringent and needed to be relaxed. Other EU sources are concerned and forecast a battle behind closed doors. What do you think?

I can see the point because the real time frame for the approval and building of big lines or interconnectors is in the order of 10 years. Most of this time is spent on permitting. Usually there are reactions from the local population, and you have these delays. It could be that the three years was put there as a fair compromise. I can see the point that it is a short time but you have to be stringent and make an effort. If you're more relaxed, projects will still take more than 10 years

and it is not going to work.

The question of coordinators is very important to solve problems. I can see that probably we'll have reaction from Council on this issue because member states never like that [stringency]. But if we want to successfully reach our 2020 targets, we're already in 2012, and soon it will be 2013. If you're 'more relaxed', you will be talking about meeting EU targets in 2030, rather than 2020, and we need that infrastructure on the electricity side. The Commission is talking about the Single European Market by 2014. How will it be achieved in two years without having the infrastructure in place? So OK, lets wait until 2015 or 2016 and then the whole story becomes less comprehensive. Market planning and grid planning in reality can't work without interventions on infrastructure, it is impossible - or rather it will only work in some parts of the Union, mainly in central

Europe where you have already some strong interconnections.

With grids, there seems to be a problem of too much national thinking, and countries imagining themselves at a competitive disadvantage when competing with other states' energy supplies. Some EU officials say we need a 'cultural revolution' to start viewing cross-border transmission as being in both the collective and national self-interest but how can that come about?

Well it is very difficult because it is a technical issue and for the revolution you need to have the involvement of the people. It is difficult for the general population to be involved in that logic. But I agree that you need to rethink the story. Having the internal market function - which means interconnection - will benefit

the consumer, because it ensures that the system works more efficiently. The cost problem is not about tomorrow but the day after tomorrow. It's clear that the most efficient system is the one that can use national markets - with all their limitations - and still go to a more European market. Subsidiarity and 'who controls' are other issues. We are in a time where nationalism is becoming stronger and will affect even this issue. We should work on that in different ways, from the political, technical and regulatory sides.

Some electricity industry figures say that given the current pace of integrating renewables into a grid system which they weren't designed for, and the lack of storage capacity, there could be systems instability and power blackouts leading to a loss of public support. Given the choice,

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they say they would prefer systems stability to more renewables, even if it means rewriting the 2020 targets. Is that accurate in your opinion?

Of course it is not accurate. I've been in this story for 30 years and I have heard different arguments for why renewables will cause problems. There is an issue. It is clear that the grid was constructed for centralised production from big fossil fuels and not renewables, and that's the way it has been developed. The point is that this period is over. We are moving towards

is correct. I think we have to speed up our infrastructure to accommodate the renewables which are developing and that's really the choice that we have in our hands.

The energy commissioner, Günther Oettinger said at a press conference last week: "I would really like to see the day when we have a security of electricity supply directive. This would require each member state to store the equivalent of 10 days of its electricity consumption." Do you think that was forward thinking?

It is difficult to say because the price depends on the conditions you have. There are places with inexpensive pump storage and others without. It has to do with the civil works that you need. It is not a technology story – hydro is really not that expensive – usually it is the infrastructure that you need to build for civil works that is quite variable. But we already have a lot in Europe, the question is how you use it. In Greece, we have some pump storage - not enough - but it is used at night when we have cheap lignite [coal] production, to pump water for use at peak hours. But this is a different conception of

neighbouring countries and one has a market which is more expensive, the benefit will look different from one side or the other. If these markets function together in the future, it means one price will go up and the other will go down. If you take the sum of the whole system and look at it independently, you'll see it's better. But in the short term, we'll have an increase in prices for one side. So how do you calculate the benefit? After an independent technical calculation of the benefits, you have a look at the political aspect, and between the two you'll have the final compromise. It is not going to be an easy exercise because the politicians are throwing the ball to the technical people [ENTSO-E] when it is also a political decision. This happens many times.

There is going to be distribution to different European areas and I think that the infrastructure package has been done quite well in that sense. Why would Greece be interested in the offshore grid in Northern Europe, or Northern Europe be interested in a strong grid in the South? But because it is divided between the different corridors and priorities, it is political at the end of the day. You have to be inclusive and move in all countries at the same time which is not the most efficient and does not have the best cost benefit.

What are you hoping and expecting to find in the EU's renewables communication later this spring about milestones and interim targets?

The most important element is that we are expecting a target for 2030. It is a must, the story that the renewables strategy should be built on. In 2001, we had the initial indicative target for 21% of European renewables targets in electricity [as a share of the power mix] which we reached in 2010. Every time you put a target for renewables, you will have a large amount of people and organisations saying 'this is impossible and too high'. But it has worked. The new 2020 targets which are binding targets have been working in the different member states, and especially those that were not very keen on the EU. This is the big effect we can have. So if we look at investment cycles and how investors can have confidence in investing, then

we have to take a longer term view than just 2020. The main policy point of discussion on this renewables strategy is the target for 2030.

Are you just expecting targets for emissions reductions?

I am talking about targets for renewables.

What targets would you like to see?

As EREC [European Renewable Energy Council], we came out last year with 45% [for 2030] but I wouldn't say that the number is critical. If it is 40% or 50%, the issue is to have an ambitious target up to 2030 and give confidence that this policy will continue and has a milestone in 2030. It is extremely important for continuing development, otherwise what will happen in 2021? You have the targets until 2020 and then what? There is a lot of talk about support schemes, but they are a different story. The question is: how do you arrive at this target? The main element for 2020 was the 20% binding target. It made the policy difference. That is what we expect from the process now. The rest is secondary.



a more distributed generation and a large-scale integration of renewables. We have adapted and to do it fast.

We would need much less storage if we improved our [cross-border] interconnections because then you could use the storage capacity of your neighbouring countries. If you have pump storage, you have a possibility sitting there in your reservoirs. We use it every day in our system. We have hydro-reservoirs which are not even pump storage and in reality, it's electricity stored there. Most of the European systems have these so how difficult will this be?

There's a lot of pump storage capacity in Italy because in the 1970s when they decided to build a lot of nuclear stations, they built a lot of pump storage at the same time. Finally, when they abandoned nuclear they just ended up with pump storage capacity! It is there now and it's not used. In many countries, storage capacity is not enough but in Italy it's probably more than enough. If you have an interconnected system then you use these capacities. So I don't think the argument that renewables are going to have to slow down

It might be that this is the equivalent of the 30 days of gas supplies they currently have. I think you should have a flexible system which can react to different conditions in different ways. You always have different sources in an electricity system. With gas, you have one supply, although you could have different suppliers, and these days we have a security of supply problem with gas from Russia. There could be an emergency because of the gas supply. You have to design a system which is flexible enough to respond to different situations. You need a lot of sources and I think that renewables have an advantage there. If you have wind, water, solar and geothermal, you could also have flexibility in the system. You need to have some storage - it's always helpful - but it's not the same thing as having a gas storage supply which is a single source. With renewables, flexibility – what to do when there is no wind? – is built into the system.

How long do you think it will be before the price of storage comes down to levels that industry is comfortable with?

using pump storage to integrate large amounts of renewables. The whole system has to be conceived and planned in a different way. I don't think you will need a large amount of storage, depending on what part of Europe you are in. A really efficient system will integrate large amounts of renewables. We're not far from there but we have to plan for it.

There are rumblings that the cost-benefit analyses which ENTSO-E [the European Network of Transmission System Operators for Electricity] have been tasked with delivering on energy infrastructure projects are a political football that the political echelons in the EU should have taken responsibility for. What do you think?

I would agree because costs and benefits are also a political story, that's clear. How can we evaluate what will benefit a country if it has an interconnection with a neighbour? It is a very difficult calculation, connected with the internal market. If you have two

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