TOTAL ENERGY OUTLOOK 2020 – 29 SEPTEMBER 2020

PRESENTATION

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Good morning or good afternoon to you all and thank you for joining our Investor Day. I'm Ladislas Paszkiewicz in charge of Investor Relations, and I'm here with Helle Kristoffersen and Patrick Pouyanné. As we have a lot of material to cover, this Investor Day is going to take place over 2 days, today and tomorrow, all virtual given the current sanitary context.

Today will be dedicated to the macro and tomorrow, to the strategy. Today, Helle will present the Total Energy Outlook. And after the presentation, Helle and Patrick will be here to take your questions, and I should stress that I wish you can focus your questions on this macro aspects.

But before we start, I'd like to share a safety moment with you. As you know, at Total, safety is a core value and comes first. So, we start our meetings of the day with a safety moment.

Helle Kristoffersen *TOTAL SE - President of Strategy & Innovation*

Thank you, Ladislas. Good afternoon, everyone. I hope that you're safe and sound and coping all right with the current COVID situation. Welcome to this presentation on Total's 2020 Energy Outlook. It's focused on energy demand and not on energy supply.

Some of you may remember that we shared our first energy outlook with you back in February 2019. A lot has happened since then. And the need to try and understand that what's going on in our markets is more critical than ever, given the fundamental changes at work in our industry. So here we are.

On the positive side, it's fair to say that the awareness that we need is massive, collective, concerted efforts to fight climate change. That awareness is becoming more and more widespread. The world needs a Net-Zero ambition, as the chart says here, and the world needs to take action to deliver against that ambition.

So that's for less carbon. On the other hand, economic growth and increasing populations aiming for better living standards imply a continued demand for more energy. In our scenarios today, we assume that worldwide GDP will grow at 3.3% per annum between now and 2050, which is below the last 20-year trend, and we assume that world population will be close to 10 billion people 30 years from now.

So, the challenge we're facing can be summarized as more energy and less carbon. And that's really a challenge for society as a whole, involving all the parties that are listed here on the chart, being states, local, regulators, cities, municipalities, investors, industry, consumers, technology, researchers, of course, including you and I.

The next chart is just a reminder of where the world carbon emissions come from. And it shows that 80%

of CO_2 emissions come from either energy supply or energy use. So, the message is simple. Dramatic action is needed on both fronts.

To simplify, and that's what the chart shows, there are 5 key sectors to work on: power, heat and generation, other energy production and transformation. And when it comes to end-user related emissions: industry, transport and buildings.

What's new is that there is one continent that has taken a leadership role on sustainability and on carbon neutrality. That's Europe, of course. As Ursula von der Leyen put it, the European Green Deal is Europe's man on the moon. It's bold, it's ambitious, it's game changing. It means achieving Net-Zero over the next 30 years. And by the way, you will hear more tomorrow on how we embed the Green Deal into our strategy.

So here are now the core assumptions behind the 2 scenarios that we're going to talk about today. Again, these scenarios are both raising the need for more energy and less carbon. Demand increases by 0.6% per annum in one scenario and by 0.4% in the other scenario. The EU Green Deal is embedded in both scenarios. And as we've done this, actually, we've added in as well the Net-Zero road maps of the U.K. and of Norway, meaning that when I talk about Europe today, I effectively include Norway and the U.K. into the EU 27.

The first scenario, Momentum is based on the national defined contributions of the Paris Agreement, as they've been updated by countries in 2019. It's in line with best industry practices around decarbonization, which means very aggressive deployment of proven technologies, electrical vehicles, solar and wind, biofuels and so on.

So, Momentum goes beyond the business-as-usual scenario. Nevertheless, it fails to meet the well below 2-degree target globally.

The second scenario that we've called Rupture is consistent with the 1.5-, 1.7-degree target and therefore, is consistent with a trajectory leading to Net-Zero. It's been built with a backcasting approach, and essentially means that the whole world commits to goals and targets that would be like the European Green Deal.

Technological breakthroughs are a prerequisite, together with the scaling up of new industries such as hydrogen, synthetic fuels, carbon capture and so on.

Here are now some more detailed assumptions behind our modeling. And we've contrasted those assumptions in 2050 with where the world was in 2018. I'm not going to cover everything on the chart here. But what you can see is that there are essentially 7 key drivers for decarbonization, 7 core themes that we're going to cover more in detail. I would just point out the last line on the chart here, which is energy efficiency acceleration.

We have modeled in Momentum, energy efficiency gains per annum around 2.6%. In Rupture, the efficiency grows to 2.9% per annum, and that compares with historical data over the last 20 years of 1.6% energy efficiency gains per annum. So, it's aggressive.

And finally, last chart of the introduction, here is a recap of the outcomes of our models. So, themes that are underpinning both scenarios and that are, therefore, critical to keep in mind when we try and stay ahead of the long-term trends in our markets. I will go through those 8 themes.

So first, energy demand is increasing in our 2 scenarios. Again, I think it's fair when we talk about Net-Zero to keep that as a backdrop, the need for more energy.

Electrification of end-users is massive and gaining pace. And therefore, of course, the power sector must decarbonize.

Oil demand will reach a plateau around 2030 and then decline slowly thereafter due to transport and petchem accelerated transformation.

Gas will continue to play a key role for decades. It has a key role to play in power systems, in heat and in transport.

Liquids and gases, on the other hand, will become greener. There will be an increased penetration of what we call renewable fuels, and that includes synthetic fuels, hydrogen-based fuels, biofuels, biogas and so on.

There is a promising potential for hydrogen to decarbonize industry, heavy-duty transport and gases. There will be a much stronger role and need for electricity storage as end-user demand electrifies and that storage could come, for instance, through batteries or through hydrogen.

And then lastly, carbon sinks are absolutely a necessity to reach Net-Zero.

Now, I will move to the scenarios. As I do this, I will first cover Momentum, and then I will show you how Rupture changes the picture, meaning that each time I go to Rupture, it's a way to show what needs to be done to be on a Net-Zero trajectory. And then at the very end of my presentation, I will show you how we've tried to account for the Green Deal in Europe.

So first, here is the evolution of the total primary energy demand in the world between 2018 and 2050. And its Momentum. Demand is up by 25%, entirely driven by non-OECD countries where GDP is expanding and where growing populations are lifted out of poverty with better living standards. The scenario assumes high energy efficiency gains worldwide, as I said earlier, and that results in an overall demand, which is held back and only grows by 0.6% per annum, which is less than 1/3 of the growth rate in demand over the last 20 years, that was 2%.

In terms of primary energy demand, renewables and natural gas play a key role and actually, they're both complementing each other and competing with each other. Coal is phased out in the EU, thanks to the European Green Deal, but not on a worldwide scale. And as I said, oil declines very slowly over the period.

Moving on to Rupture primary energy demand. The message is in the title. Net-Zero requires a radical transformation of our energy consumption. Rupture allows for a 10% increase in energy demand over the next 30 years, and nevertheless, produces an outcome, which is shown to the right here, which is that worldwide CO_2 emissions are divided by 4. And that means that they are falling from 33 gigatons to 8 gigatons after having accounted for 7.5 gigatons of carbon capture and storage.

So, the residual emissions in this scenario will have to be addressed through other technologies, such as nature-based solutions or future technologies like direct air capture or newer technologies still to be invented.

In this scenario, oil peaks again around 2030, and coal almost disappears on a worldwide scale. Gas retains a role, especially in power generation, but also in other sectors.

Looking at the same picture, but now from an end-user demand perspective, and back to Momentum, I will continue switching back and forth. In terms of final energy consumption, the most striking feature of this chart is probably that electricity takes over from oil as the #1 end-user source of energy in 2050. This is due to the very strong assumption on electrification of end-user demand, and that's what you can see to the right.

Electrification of end-user demand grows from 20% and to around 30%. And keep in mind, by the way, that electrification is a cornerstone of most national decarbonization strategies assuming then, of course, that power also decarbonizes. As a result of this assumption on electrification, 75% of the growth in energy demand is covered by electricity. And then again, of course, it means that power will have to go green, and we'll come back to that in just a while.

The electrification of end-user demand is even more massive in Rupture. It reaches 40%, you can see that on the chart. For this to happen, we really need to act starting today. Because what happens over the next decade is very important for the world to be on the Rupture trajectory of the chart and not staying on Momentum.

The left side of the chart shows something that's maybe obvious, but also worth underlining. As the global energy system decarbonizes, it also becomes much, much more diversified. And you can see that in the bar chart, which says 2050 Rupture. You can see all the colors, which are effectively all the end-user energies that are available in 2050. It means more option to all of us as end-users, and it means the introduction of new energy carriers, especially secondary energy carriers.

Power, hydrogen, biogas and biofuels account for more than 50% of end-user demand in 2050 in this scenario. That's, of course, a sea change versus today.

So, the world will need more power, meaning that power demand will increase rapidly. In Momentum here, the growth of power demand is 2.1% per annum, net of energy efficiency. 2.1%, that's 3.5x more than the growth rate of primary energy demand. All end-user sectors will electrify, and they will electrify more. In developed economies that will be essentially through fuel switching, especially in the residential and commercial area and in the industry.

In developing countries, access to energy is assumed to be dominated by access to power. The world transport sector will also electrify and will represent around 12% of power demand in 2050, up from around 2% in 2018. We'll come back to the power sector a little later.

In Rupture, growth in power demand is even faster. It's 2.9% per annum. You've heard Total say this before, "Electricity is the energy of the 21st century." Well, that's even more true in a low-carbon world. You'll notice to the left that electricity also becomes widely used to produce hydrogen. It says so, the #2 label on the bar chart, if you start from the beginning, on the Rupture 2050.

So, electricity for hydrogen, that would be water electrolysis with renewables. And that means that green hydrogen is assumed to make up more than 10%, effectively 12% of power demand in Rupture in 2050. That's a massive chunk of new demand.

And as a side comment, let me just stress that it's really important in these scenarios to close the loop on secondary energy carriers like hydrogen, because hydrogen is produced either from power or from gas, and therefore, the amount of gas or power consumed to create hydrogen needs to be accounted for in the models. If that's not the case, you cannot compare scenarios across each other.

On the right, we zoom in on the energy use in the industry. Electrification reaches 43%, that's the orange piece on the bar, but some heavy industries that require very high temperature, for instance, for heat, like cement, like steel, like chemicals, are hard to electrify. And therefore, the industry will continue to rely on other sources of energy, be they fossil fuel based or be they hydrogen-based, for example, and that's what we're showing on the chart here. In Rupture, we assume that CCS technologies will be deployed at scale. And will, therefore, abate 50% of the remaining emissions from the industry sector.

So of course, as I've said, to have an impact on carbon, this step increase in power demand means that power must go green. So, renewables take the lion's share of power generation in momentum.

Actually, 70% of the increase in power generation in this scenario is covered by solar and wind generation, which means doubling the pace of annual capacity growth versus the last 10 years for both offshore, onshore wind and solar are actually going much faster than the capacity additions of 2018.

As you can see, it halves the carbon intensity of the power sector. And therefore, it saves around 14 gigatons of CO_2. Gas is growing together with renewables to manage intermittency and seasonality and is also replacing some coal, especially in the OECD countries, and of course, in Europe with the Green Deal.

In Rupture, the emissions from the power sector almost disappear. That's what's shown to the right. It's a key contribution to carbon neutrality. If you remember the pie chart on the CO_2 emissions worldwide from the beginning, the power sector is a strong contributor to those emissions. But here, they're almost gone.

Coal has gone, at least 80% of the global power mix come from renewables, including hydro. Gas is still used in power generation, although its relative weight compared to today is obviously much smaller. And you can see that in the various colors on the bar chart to the left.

In fact, we believe that gas has a key role to play in the ongoing energy transition. Let's look at that first in Momentum and then in Rupture.

The outlook here for Momentum has natural gas demand growing by 1.3% per annum, driven by demand out of Asia, where there's a lot of coal to substitute. That would also fit very nicely with the recent announcement out of China that China wants to reach carbon neutrality in 2060. Gas' contribution is vital in the power generation, but also in the residential and commercial sectors for buildings and in the industry, both as combustion for heating and as feedstock.

In transport, most of the growth comes from trucks and bunkering. However, to fully play the role in the energy transition, gas has to become much greener and much cleaner. That will come at a cost, at least in the early years.

In Momentum, the green gas penetration is only around 8% in 2050 because of that additional cost, and that's what you can see on the top of the bar, says green gases. Essentially, therefore, because it's much more expensive and because there are not strong enough mandates or carbon regulation put in place in this scenario.

The European Green Deal means that half of the worldwide green gases demand will come from Europe in 2050.

Gas also retains a key role in Rupture, that's one thing we fundamentally believe in. Gas plays a central role on the path to carbon neutrality. It's flexible, it's affordable, it's reliable. It benefits in many countries from available infrastructure, and it is very broad-based used and can be of benefit to the whole economy.

In addition, it speeds up decarbonization everywhere where gas substitutes coal, and that's another key benefit.

To the right, you can see how natural gas gets complemented by biogas or biomethane and by hydrogen over time so that overall gases are on the rise in this scenario all the way to 2050. Unblended natural gas reaches a plateau around 2040.

The next chart here elaborates a little further on natural gas supply. And it compares Momentum and

Rupture. In our low-carbon outlook, gas becomes much greener than in Momentum. So, the penetration of green gases reaches 25%, which is roughly 3x more than in Momentum. When it comes to gas use, which is to the right, over 50% of gas use is decarbonized, thanks to carbon capture and storage, in addition to the green gases.

Moving on to oil and liquids. As I pointed out in the introduction in Momentum, oil demand reaches a plateau around 2030 and then declines slowly due to the accelerated substitution away from oil. Overall, liquids demand goes greener as for gas, thanks to biofuels penetration, which reaches around 8% worldwide in 2050. So, energy efficiency gains and regulation are impacting both transport and petchems worldwide, but with Europe leading the way and we'll come back to that.

The adoption of sustainable liquid fuels, meaning biofuels and synthetic fuels derived from hydrogen, for instance, is much more widespread in Rupture and reaches more than 20% of total liquids demand in 2050. So, carbon neutrality effectively requires this massive adoption of these newer kind of fuels, starting with biofuels and then over time, adding in synthetic fuels.

And nevertheless, maybe I should point out that there remains a solid base of demand for oil around 45 million barrels per day in 2050, coming primarily from the transport sector in emerging markets. But of course, that would be much less than the level of demand for oil that we know today.

Zooming in now on the transport sector. The Momentum chart here shows 2 things. To the right, you see a massive pickup in worldwide traffic, and that's all amalgamated road, air and sea traffic due to GDP expansion and access to mobility in emerging markets, together with the steady growth in freight transportation. So that pushes up fuels demand, obviously, but this increase is partially offset by improvements in energy efficiency and engine efficiency.

The second big message is that there is a major diversification in transport fuels, as you can see to the left, with a strong increase in electrification, but also in the use of gas, the use of sustainable liquid fuels, essentially biofuels in this scenario and even a little bit of hydrogen, all of which ultimately results in lower oil demand for transport in 2050.

So, the carbon intensity of the transport sector, which is also one of these big contributors to worldwide CO_2 emissions that ends up decreasing by around 25% and that saves 2 gigatons of CO_2 per annum in 2050, despite the growth in demand. That's less, of course, than in the power sector, which was close to 14 gigatons, but there's still very valuable contribution to carbon neutrality.

I'm staying on Momentum just for a while because the next chart here elaborates a little more on this mix diversification in transport. The message is, and I will let you look at it, that for the various subsegment, light-duty vehicles, heavy-duty vehicles, aviation or shipping, for those different subsectors, the best fuel will be different. There will be an increasing role of electrification in all cases, but then there will be a different use of the different fuels to decarbonize gases, sustainable liquid fuels and so on. That's what you see to the left.

And to the right, you can see that our scenario assumes a massive penetration of electrical vehicles in the light-duty vehicle fleet, reaching 60% in 2050. This is spurred not only by the EU Green Deal but also by China and the U.S.

In Rupture, the change in the transport fuel mix is even more radical, and effectively, as the title says, moving to Net-Zero requires a real revolution in transport. That effectively also, that's what the layered bar says in the chart to the left, so the bar called the Rupture 2050. All the layered colors are all the different fuels that will then be used in the transport sector.

So, what do we have? More autonomy in batteries will allow for strong electrification of light vehicles. Massive deployment of hydrogen and sustainable liquid fuels will help decarbonize heavy-duty vehicles and aviation. Gas, with incorporation of biogas, especially will be widely used, especially for shipping and heavy-duty vehicles.

I know that the headline news right now in aviation is aircrafts powered by hydrogen. What we're showing to the right is the most promising energies per transport categories. And if you take the second one, which is aviation, we have modeled a high penetration of sustainable liquid fuels, so not hydrogen. But we will add hydrogen into the aviation model in the next iteration of our scenarios.

But so, talking about hydrogen. This energy carrier is emerging as one of the most promising contributors to carbon neutrality. I remind you that clean hydrogen can be derived from either natural gas with carbon capture and storage, that's what's called blue hydrogen or from green power electrolysis, which is called green hydrogen.

You can see here how we've modeled the pickup in supply. And so, it's a scenario for both Momentum and Rupture. Once again, we have closed the loop of this hydrogen supply in our models for gas and for power. Meaning that what you've seen so far in terms of gas and power has accounted for this level of hydrogen supply being available in the world in 2050.

As you know, today, hydrogen is mainly used in refining and in some special chemical plants. Tomorrow, which we show that to the right, transport industry, storage and gas networks may all contribute to incremental hydrogen demand. For that to happen now, cost have to come down. There's a lot of people working on that. So, let's make the assumption that it will indeed happen.

I've got only a couple of charts left before turning to the European Green Deal, if there is time, and I think there is plenty of time, in fact.

One chart on petrochemicals. Petrochemicals is another sizable contributor to oil demand. So, it's worth looking at. The chart here actually combines the 2 scenarios, Momentum and Rupture. The message is that despite an increase in demand for plastics, especially in non-OECD countries, the oil demand for petrochemicals is likely to come down. And that's because we assume there will be a steady increase in

recycling on one hand, and also a progressive ban on single-use plastics, first in the EU and in China and then moving to Rupture on a worldwide basis.

All of this holds back the need for virgin plastics, and therefore, the need for oil. So, the steady increase in recycling is assumed to go from 7% to 50% of remaining plastics in 2050 in Rupture compared to 40% in Momentum.

We assume in Rupture that the single-use plastics ban is implemented on a worldwide scale, as I said, and only in Europe and China in Momentum.

And just a word on bioplastics, which is an interesting market, but which we think will remain a niche market over the next decade.

So much on energy demand, what about supply? We have only one chart on energy supply today, but it's an important chart. So, what you see here is the supply of natural gas, of oil and solar and wind capacities in gigawatts in 2018 first and then an assumption about demand in 2050.

And so, the column saying 2050 show the level of demand that comes from the Momentum scenario and the level of demand coming from Rupture. For gas and for oil, Momentum leads to more demand in 2050 than in Rupture, hence, the arrow going down. Whereas for renewable energy, solar and wind, Rupture assumes a higher demand than in Momentum, and therefore, the arrow is going up.

And then what we have tried to do is to extrapolate from the current supply of oil and gas, what will still be developed and generating supply in 2050? What could be handled through infill wells of existing fields? And then the massive need for new projects that you can see in orange for gas and in blue for oil.

For wind and solar, we're just showing the massive need for new projects in addition to the installed base in the world, which is a little orange rectangle in 2050. So the message is really that significant investments are needed for new oil and gas projects to offset the natural decline in the existing fields and also that significant investments are needed in renewables if you want to support low-carbon electrification and therefore, support the growing demand for power with low carbon.

As you know, we consider that this strong growth in renewables is an opportunity in addition to the continued need for new projects in oil and gas.

And then finally, where do we stand with respect to climate and carbon neutrality? Once again, as I said in the introduction, Momentum may be ambitious in many ways, but worldwide emissions are barely stabilized in this scenario even with the European Green Deal with respect to 2018. We're far from the target.

As shown here, even in Rupture, which is the bar to the further right, we need nature-based solutions, carbon capture and storage, direct air capture and other carbon things or negative emissions to get to

carbon neutrality. But will help from those carbon sinks, Rupture is on the right trajectory for Net-Zero.

What's important is to create the adequate policy framework for this to happen. We've listed just some very high-level prerequisites on the chart. Efficient carbon pricing schemes, strong regulation and mandates on biofuels, biogas and sustainable liquid fuels and incorporation and support, of course, for green innovation.

That's all I had really on our 2 worldwide scenarios, Momentum and Rupture. What I will now do is to go quickly over how we've tried to account for the European Green Deal in both of the scenarios that we've covered today.

And please remember, when I say Europe, I do include the U.K. and Norway. The first chart here is an attempt to show how the European Green Deal will fundamentally reshape the way energy is used and supplied in Europe. The fact is carbon neutrality requires a new energy system. I like this comparison with the man of the moon. It may seem impossible the way reaching the moon seemed impossible many years ago, but Europe is setting out to do it. We have 30 years to reach Net-Zero and every year count.

So, we need to mobilize all the drivers listed here, which are the same as the drivers we looked at for Momentum and Rupture, and there are many others, of course, as well. If you compare with Rupture, and I will let you do that, but you will see that everything has been severeized for Europe. All the drivers go far beyond the scenario in Rupture within the European Green Deal.

So, the Green Deal is even more disruptive, if you want, than Rupture on a worldwide basis. And so, you will see that Rupture effectively addresses both more energy and less carbon. Whereas in Europe, we can consider that we have the energy we need, and therefore, we can focus on less carbon.

So again, a recap of the emissions of CO_2 in Europe in 2018, just to set the stage. The 5 sectors that we spoke about are still there, but you'll see that power and heat generation and other energy and transformation plays an important role in energy supply, the emissions from energy supply. Whereas we've slightly changed the setup of residential and commercial sector, industry and transport make up most of the emissions from end-user use of energy.

So, reaching Net-Zero in Europe requires a combination of regulation, market instruments, including, of course, CO_2 pricing, technology breakthroughs and scale-up, for instance, for hydrogen, CCS, storage and sustainable liquid fuels and it also requires significant changes in end-user consumption patterns.

Cost efficiency and affordability of all these new solutions will be absolutely key for social acceptance.

This is what the total primary energy demand of Europe looks like in our illustrative Green Deal scenario.

As I said, and unlike for the other scenarios, you can see that the primary energy demand here is decreasing. It's decreasing by 35% versus 2018. That's because there are higher efficiency gains in Europe

than on a worldwide scale and also because the European GDP growth is roughly half of the worldwide GDP growth, over the next 30 years.

But you can see how carbon neutrality truly drives absolutely major transformations in the energy demand of Europe. Fossil fuels are down by some 70% to around 25% of primary energy demand. There is a residual demand for oil between 1 million and 2 million barrels per day concentrated in transport and in industry, including petrochemicals.

Natural gas is also keeping a key role in power and to generate blue hydrogen. The result of the Green Deal is that emissions are down by 95% in 2050 after accounting for 0.4 gigatons of CCS per annum. And you know that the commission just published very recently kind of a milestone for 2030, where emissions in the Green Deal would have to be down by 55%. In our scenario here, we are close to that milestone. I think we have minus 51% or 52% on the trajectory to Net-Zero in 2050. So, it's very consistent.

So very quickly, how is this massive reduction in CO_2 in Europe achieved? Well, again, electrification of final demand is a key driver. Electrification in Europe reaches 45% in 2050, and renewables are at the heart of Europe's electrification. The total power demand grows by 1.5% per annum, so that's much more, of course, than the total primary energy demand, which was decreasing. So, the growth in power is due to the massive scale-up of green hydrogen, which represents 25% of power generation in 2050.

I'll let you just dwell on that, 25% of new power demand coming from closing the loop of the use of hydrogen in Europe under the Green Deal, and that's twice as much as the power demand derived from hydrogen in Rupture, which was around 12% in 2050. With such a high demand for electrons in Europe and with power being largely derived from renewables, let me point out something else, the fact that firming up power is likely to become a key theme in Europe. Gas, batteries and hydrogen will all play an important role to create that supply of firm power.

The reliability and the flexibility of power supply will be key in Europe. And again, I think we'll hear more about that.

In fact, we believe that the Green Deal doesn't lessen the role of gas, on the contrary. But as in Rupture, gases will become much greener. They will account for green gases were around 25% of gas in 2050 in Rupture. Here, we assume that green gases account for 60% of gas in 2050, and up to 75%, 3/4 of European gas would be low carbon if you add in carbon capture and storage.

All gas combined represent an equivalent of 35% of Europe's primary energy demand in 2050, which, of course, is kind of theoretical calculation because these gases here are not all primary gases, they include hydrogen, for instance.

Beyond the traditional sectors using gas, again, blue hydrogen derived from natural gas, also contributes to pushing up demand. And you can see that on the bar chart called the 2050 Green Deal, it's at the very top.

And so, these various new green gases are a major contributor to Europe's deep decarbonization. All the more so, of course, is they can be deployed using the extensive existing gas infrastructure in Europe. Here again, we show how we have assumed the growth in hydrogen supply in Europe to the left and in biogas, biomethane supply in Europe to the right.

Blue hydrogen is likely to scale before green hydrogen because it's cheaper and easier to do, but both are required in the Green Deal. And biomethane is also a scalable green gas, but it may have a somewhat more limited potential, in the long run, both due to feedstock availability and potentially cost if hydrogen delivers on its promise on scaling up and becoming much cheaper.

In any case, the green gases deployment in Europe requires very large renewable energy resources, be it biomass or biomethane or be it, wind and solar and other renewable energies for green hydrogen.

Of course, you can also derive hydrogen from nuclear, which is low carbon, but not something every European country is looking at, at this stage.

Finally, a zoom on oil demand. As we've seen with the Green Deal, transport is being reinvented and oil demand becomes marginal. So, to the very left, you see the decrease on oil demand in Europe going from 2018 to what it would be without the Green Deal and what it becomes with the Green Deal. The substitution away from oil to cleaner energy takes hold in Europe, and we're showing to the right that we've assumed 90% penetration of electrical vehicles in the light-duty vehicles fleet in Europe.

And so, the transport mix becomes, what you can see in the middle. The energy consumption is divided by more than 2 owing to energy efficiency gains and electrification, and the transport sector in Europe is decarbonized up to 85%, leading to a 90% reduction in emissions from the transport sector.

Just as a comment, if you compare this with other scenarios, keep in mind then this is transport within Europe, so it excludes shipping and it excludes aviation.

The last chart on the European Green Deal. I know it's very early days, and I know that we're only beginning to work on the Green Deal in this continent, but if there were any lessons to be had for the rest of the world, what would they be? Or maybe better than lessons, let's call them no-regret moves on the path to decarbonization. We've listed 10 here, and I will end my presentation with those 10 no-regret moves learned from the European Green Deal.

Increased energy efficiency. In the Green Deal, there's a doubling of the pace in energy efficiency gains versus historical trends.

Put a higher price on CO_2. You know that Europe is working on efficient ETS and carbon border adjustment mechanisms to account for a cost related to carbon emissions.

Making electricity greener. In our illustrative scenario, 80% of power comes from renewables in Europe in 2050.

Eliminate coal. That's what the Green Deal does in Europe 30 years from now.

Pursue innovation in gases and pursue also efficient energy system balancing. We assume in our scenario that 25% of the equivalent of primary energy demand will come from multiple kinds of gases, natural gas and greener gases.

Expand the low-carbon hydrogen market and electricity storage. In our scenario, blue and green hydrogen makes up to 10% of final energy.

Promote sustainable fuels and gases. We've modeled up to 50% of sustainable liquid fuels incorporation in our scenario.

Make more efficient use of plastics. We've modeled a single-use plastics ban in Europe by 2040.

And then consider that carbon capture and storage, other negative emission technologies, nature-based solutions, direct air capture. All this is not an option, it's absolutely a necessity to reach carbon neutrality. In our Green Deal scenario, we captured 0.4 gigatons of CO_2 every year in 2050.

And then finally, speed up clean energy innovation. That can then lead to scaling up of cleaner industries, and that triggers a virtuous circle for Europe in terms of growth, jobs and well-being and that's essentially what the $1 trillion Green Deal investment plan sets out to do.

So that's what is all that I wanted to present today. Thank you for being online. Thank you for staying with us. I hope you found the presentation useful. You will hear tomorrow how our macro views tie in with our strategy.

I would like to thank all the teams in Total that have contributed to creating these scenarios and contributed, therefore, to the 2020 Total Energy Outlook. Thank you to you. And now we're ready to take questions, if you have any. Thank you.

QUESTIONS AND ANSWERS

Operator

Just as a reminder, Michele Della Vigna please go ahead with your question and announce your company's name.

Michele Della Vigna ***Goldman Sachs Group, Inc., Research Division - Co-Head of European Equity Research & MD***

Thank you very much Patrick and Helle for the fascinating presentation. It's Michele from Goldman Sachs. I had 2 questions, if I may? The first one goes back to your point that CCS is necessary. And I think we all agree with that. But there's a lot of public resistance, mainly because of the underground storage. I was wondering if you see an opportunity for a different use of CO_2, maybe strengthening cement or reverse-engineering fuels that would make CCUS more widely acceptable?

And then my second question is on carbon pricing that you rightly highlighted one of the core avenues to achieve Net-Zero. I was wondering how you see it evolving in Europe, it feels difficult to see an implementation of a broader and higher carbon price without a broader adjustment? And do you think Europe can get it implemented or we run the risk of having a new trade war at the WTO?

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***

Okay. Good afternoon, everybody. Happy to be with you this afternoon. I think I will let Helle answer to the carbon pricing, not making politics myself. And just on CCS, just a few remarks. First, I think carbon capture and storage, storage onshore will face some resistance. It's obvious to us. Frankly, when we think to CCS, we need to think more to offshore storages, at least in Europe, maybe it's different in the U.S., where you have large spaces, I would say, inhabited.

But in Europe, I think it is different, it will be difficult for me to develop CCS onshore. Having said that, we have an asset in Europe, which is the North Sea where we have developed and produced a lot of fields, which will be depleted. We've also an offshore industry, which is also an asset.

And so, the question for us will be, can we reverse all these depleted fields and this knowledge of offshore in the capacity to store. This is exactly the target of the Northern Lights projects that we developed with our friends of Equinor and Shell in Norway. I think it's somewhere a vision that we should share. And I think it's a vision which is shared by many of the countries which are neighbors of the North Sea, Norway, U.K., Netherlands and Denmark, which have, again, an history in the offshore industry.

Then there is, of course, other views because when we speak about carbon capture, there's something missing in CCUS and the use of CO_2 has probably quite an interesting way forward. When Helle mentioned the sustainable liquid fuels, we all think to this equation, which is CO_2 plus H_2 then giving some synthetic fuels, I would say. So, if you can combine capturing with the CO_2 and having some green hydrogen, you have the perfect equation, and then you can produce in the future sustainable liquid fuels.

So, this is synthetic fuel and today, we all know the chemistry of it. I think the scale-up is not so complex, it is mature technology but it's economically quite immature, in fact. We must develop the road to synthetic fuels. It's clear when we think to the aviation of the future, that's something on which we need to work. So, that would be probably, I think, capturing the CO_2. You are right Michele, it's probably better to think as use of CO_2. But of course, all these possibilities are today quite expensive and difficult to develop from an economical point of view.

Carbon pricing. Helle has worked a lot, and I would like to thank Helle and all the teams for this

presentation. I can tell you that it takes a lot of time to model all these scenarios. So, thank you to you and if you want to complement my own comments and take the second question?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
Patrick and Michele, I fully agreed on what has been said. Of course, I think the world research labs, in Japan, China, U.S., Europe and all over the world are working on the use of carbon. Indeed, the synthetic fuels are taking the stage today, but there are other R&D projects on carbon use. We have some ourselves. And of course, many start-ups are working on that topic also in addition to improving the way we capture carbon.

On carbon pricing, I think what you raised here, Michele, is really a key question for the competitiveness of Europe and for the European industry. If Europe unilaterally implements very high carbon pricing, there is no doubt that the consequences for the European economy, certainly for the European industry, would be very detrimental. But the commission is aware of that, and that's precisely why they are working on this project of a border adjustment. So, will it happen? Well, let's make the assumption that it will. Will it be simple to implement? Of course, not. And will it trigger trade war? Maybe. Maybe not.

But at least the notion within the Green Deal and within the commission is to create a level playing field for everybody wanting to sell goods to the final consumers in Europe. And I think that's a good way of trying to implement the carbon pricing. Now, of course, it will be very complex to do. There's no doubt about that.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
Just to complement, I think the Green Deal is globally a political project. And Europe wants to be, I like the image, which was used by Helle, to land on the moon.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
It was man on the moon.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
Okay, sorry. Landing on the moon. We want to be at the forefront of these climate change challenges. In fact, it is a huge opportunity for the continent to develop the technologies and know-how and not only to be green, but I think to have a green economy as a whole. Of course, this will require investments, and this will have a cost for everybody, including for the European consumers. We should not hide it. So, the question is obviously political, and can we bear the cost without having some rewards, which are the opportunity of creating jobs. I think it's not possible. So of course, this is creating a lot of discussions but either we are fully consistent in Europe or this could transform in a disaster, paying the cost and not having the rewards, which will be not accepted by the European population because you cannot believe that we will implement the Green Deal against citizens and the consumers in Europe.

What does that mean? I hear a lot about the complexity of it. Yes, it might be complex. I think the European business roundtable of industrialists, which we are part, is proposing to the commission to begin by taking

some sectors like cement, like steel to see how it could happen, to try to implement it sector by sector, not trying to have a very large approach, where we will raise many issues, but to try to be pragmatic and to see how it could work, of course, discussing with few countries around the world. But I think it's a way also to be pragmatic and to implement it. But I think, Michele, that the idea that we could develop the Green Deal without taking care of the jobs in Europe for citizens would be a huge mistake and will mean that we'll not be able to land on the moon.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
But I think, Patrick, as you said, the commission is at least addressing this. They are aware.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
Okay. Next question, maybe.

Operator
Our next question comes from the line of Christyan Malek from JPMorgan.

Christyan Fawzi Malek ***JPMorgan Chase & Co, Research Division - MD and Head of the EMEA Oil & Gas Equity Research***
Thank you for an excellent presentation, a very reasonable look on how we get to decarbonizing. And I have 2 questions. First, on your assumption of oil demand peaking or plateauing in 2030. Where could you be wrong in that peaking sooner? And ultimately, that target being pushed out due to replacement and ability to actually source alternative fuels?

And within that context, how are you thinking about project sanctioning, particularly with long lead times? I know we're going to hear more about it more, but it's one of the kind of pioneers and leaders in project greenfield investment. How do you manage that outlook in the context of what can be quite a varied peak?

And the second question is the extent to which you see the cost to decarbonize and how we should be thinking about that as analysts in modeling decarbonizing costs, whether it's carving storage or the other solutions that you've talked about? To what extent will you have to take the burden in terms of managing and investing in this? And should we be worried about its materiality?

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
I will let Helle answering to how our models could be wrong regarding the peak of oil demand. I will come back on FIDs myself.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
So, could the models be wrong? Absolutely. I mean there are multiple factors to this result that we've shown, which is that oil demand might peak around 2030. Honestly, I doubt it would happen much earlier. I think we have already been very aggressive in the modeling, and I will give you just one data point which I mentioned and that you'll find in the chart again which is an aggressive assumption on electrification of transport with the penetration of EVs and light-duty fleet, which is 60% worldwide in Momentum. And

China and Europe being leading that and Europe being with a Green Deal at almost 90%. So, I think we have a very severe scenario for oil demand. And therefore, of course, it could happen earlier, but I think there is more likelihood that it happens later than what we are showing here, although electrification of transport is happening.

And so, looking at FIDs....

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***

I'll take the first shot. Now just to comment, I know that one of our peers has announced that the peak is maybe already there. Nobody knows, in fact. Let's be clear. I'm sure also that I have some peers who consider that the peak will be in 2040 or plus. And honestly, I think we made a lot of mistakes in the past about supply peak. So, don't make the same mistake about demand peak. I think we don't move the energy system like it is. Obviously, this COVID pandemic has an impact on the short term and we could derive of it, but maybe we'll never come back to the 100-million-barrel oil per day that we experienced last year. We are not on that version. We should not forget the emerging world, where the demand is coming from. The real potential for the people there, looking for a better way of life and better living standards, like it was said by Helle. Of course, we see a lot of push for electric vehicles, but to make to EVs, you need to have electricity, and you don't have electricity everywhere. So honestly, I support what just Helle said, even in the Momentum scenario, which fails to reach a 1.5 degree.

The assumptions we have taken on board in terms of electrification on the worldwide level for transportation are very high. And we are not yet on this trend. So, having said that, what is the consequence for FIDs, Christyan? I will come back tomorrow but an easy consequence is that if you consider that you will have a peak, whenever it is, 2025, 2030, 2035 and then a decline, that means that this will have an impact on the oil price. So, the consequence for us is that we need to take into account a reasonable assumption. We take $50 on the long term. You can tell me that you are at $40. But again, we are at $40 in the middle of a huge crisis where we have seen a big drop of supply and a huge lack of demand. So, it's not so unreasonable to take $50. And that's the way we sanction the project. One of the main lessons pragmatically to our teams and to the executive committee is to stick to this assumption because I'm sure that in 2, 3 years, we'll see again higher prices and forget, like we have done in the last 5 years, where we went from $30 to $50 to $60. I think that's the fundamental message that we have.

Second remark. I think the main issue for me is not really on the project we sanctioned today because it's rare to have projects which have a plateau of 15 or 20 years. Most of the project we sanctioned have a plateau of 5 to 10 years and then decline. Most of the value we can extract for our shareholders are coming quickly in front of us like the Uganda projects on which we work today. But it's more a question when you go to exploration. When you go to exploration, you have a cycle to explore for 8 to 10 years and then you will produce beyond. That means that this question of oil demand has an impact, clearly, on the portfolio of exploration license we must take on board, which is to go, and I will come back more on this, on low-cost oil. That's the main consequence of it.

The last consequence is when you look to a very long-term oil, which is expensive like oil sands. Our

position is that it's probably better to avoid investing more in this type of place.

Cost to decarbonize and how to model the cost of the material, Helle?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
If the question, Christyan is for states, well, the costs are material. If it's for Total, I'm not sure I got your question. So, can you just rephrase it?

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
I think I got. I mean we announced that we use $100 per ton beyond 2030 as a sensitivity in our assumption. Is it the real cost to decarbonize? Maybe, Christyan, you can elaborate on your question as Helle asked you?

Christyan Fawzi Malek ***JPMorgan Chase & Co, Research Division - MD and Head of the EMEA Oil & Gas Equity Research***
When we've discussed before, you have the high returns project and it's also high carbon intensity. You want to retain that returns, so you sell the asset because it's above of average carbon intensity. You're going to have to spend money to decarbonize. The question becomes a trade-off in terms of how to think about that relative to returns. I know it's difficult to quantify that cost at this point. But this is one of those trade-offs, which I struggle with in terms of establishing if I'm looking at carbon and cost curve, when I'm looking at asset.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
Your question is on the Scope 1 and 2 emissions?

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
Yes, I think so.

Christyan Fawzi Malek ***JPMorgan Chase & Co, Research Division - MD and Head of the EMEA Oil & Gas Equity Research***
Yes.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
Okay. That's what I thought. Okay. I think we will talk about that a little bit tomorrow as well, but I think we have already told you that we take that into account when we look at projects.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
To answer a bit more precisely, Christyan, to your question, I think when you took $40 per ton immediately, the impact that we saw on the return of the project is less than 1%. So, it's not a major impact. $100 per ton beyond 2030, of course, will have a higher impact. But it's 2%, let's say, at the end. The more important question is finding a project which will be, I would say, achievable, and can match because you don't have all the situation around where you can make CCS and find the storage. So, it's more a question of

practicality. You can take the assumption of 2%.

Having said that, it's true that when you speak about hydrogen today, we are above $100 per ton. If you want to make green hydrogen economically equivalent to hydrogen from gas, the real cost is $300 per ton. At least, we know that the scale-up of this technology will decrease the cost. That's what we observed in renewables. And there are still a lot of efforts to be done in terms of how we can decrease the cost of the technology and to come back to something more acceptable. But all the projects on which we work are more, I would say, demonstration projects.

Look at what happened to solar or wind offshore. I think offshore wind, we were around $200 per megawatt 3 to 4 years ago. And today, we speak about $40 or $50 per megawatt. We need to put in place the right support to allow the emergence of such technologies and then the cost will drive down. We have to believe in the same mechanism, which, again, we observed very recently. But it's true that these technologies will not emerge without a very strong support from the states. It's clear that today, none of us can invest at an industrial scale without such a support. We can do a demonstration project to implement it at an initial scale. It will take a little time. It seems that the European states are willing to develop it because hydrogen is a core in the Green Deal. In France recently and in Germany, both governments have announced that within the package of support to the economy, they put hydrogen as of one of the core areas to invest. This could happen. And then if we have the costs going down, the impact on the returns will be minimized.

Okay. Next question, maybe.

Operator
Our next question comes from the line of Irene Himona from Societe Generale.

Irene Himona ***Societe Generale Cross Asset Research - Equity Analyst***
Going back to peak oil demand. Just a question on the difference between the 2 scenarios. I would have expected under the more aggressive scenario, Rupture, a much earlier peak than in the Momentum. I'm looking at Slide 11 and 12 that don't show a huge difference. I wonder if you can talk a little bit more about the inertia that you see in the current energy system that is preventing an earlier peak under Rupture?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
I think the quick answer to that is that when we say around 2030 in Momentum, it's a little later than that. And that Momentum is already very aggressive as we just discussed. You know that the fleets don't move that fast, but that's essentially the reason. But there is a little time lag difference.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
You have used the right word, Irene, inertia. I think there is an inertia, which is just that to renew a fleet of vehicles, it takes 8 to 10 years. It's not in a night that it will happen. There is an inertia in the system. That's clear. That's why we have this delay and there is not such difference in the early years. Okay. Next question.

Operator
Our next question comes from the line of Lydia Rainforth from Barclays.

Lydia Rose Emma Rainforth ***Barclays Bank PLC, Research Division - Director & Equity Analyst***
Two questions, if I could. The first one, you did talk of the need for technological breakthrough to get to the Rupture scenario. How far does the current technology get us? Is it 50%, 60%, 70% of the way there?

And then the second one, if I come back to hydrogen, I shall make the numbers on the residential and commercial and even the industry numbers look low relative to transport. So, can you just talk me through what the modeling assumes in terms of the blending of hydrogen? Or is that all closed-loop systems for it?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
So essentially, Lydia, I would say, at the macro level, what we've tried to do is to model Rupture making the best of existing technologies. But of course, if I take the example of batteries, they don't scale up as massively in Momentum as they would do in Rupture. But the answer to your first question is essentially what we see today, in terms of possibilities for massive scale-up of batteries and hydrogen and so on, is limited.

Green Gases. One example I gave is that if the world doesn't embark on other very high carbon pricing or mandates or other forms of incentives to decarbonized gas, it won't happen. And therefore, it won't create this pull for hydrogen demand, for instance, because let's not forget what Patrick just said, but hydrogen is much more costly than natural gas. So, making hydrogen, grey hydrogen from natural gas with steam methane reforming is by far, the best solution if you don't worry about carbon, right?

So Momentum is trying to make the best of all these existing technologies, but then hit the wall of cost, and it's the fact that there are not enough mandates worldwide outside of Europe to take you to where Rupture takes you effectively. And then on carbon capture, I don't know if it's going to be widespread in 20 years from now and 40 years from now. But the assumption, of course, is that these newer technologies will scale faster in a world where carbon has a higher cost.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
What are the key breakthroughs which are taken into account in Rupture? I think there are 2. One is energy storage. It's just fundamental. And frankly, I do not think that with lithium ion battery technology that we have today, we have what we need to make massive battery system at the scale we need in Rupture. So that means that this is a technology field where we need to continue to look for. There are, of course, solid state and other ideas. But I think we don't have the best technology in our hands. That's something just essential.

The other mention is about synthetic fuels. This idea that we could develop synthetic fuels is a very good idea. But when you look to what, is the technology today or how can we develop it, it's really something

fundamental. And then if you want to be Net Zero, you need to capture. We all hear about direct air capture technologies, because we see the limit of carbon capture and storage. We think that maybe there is a breakthrough that we don't have today. So, the amount of carbon capture taken in the Rupture scenario, which is around 7.5 billion tons per year is quite big, it's very large. In fact, it's even higher than what we need when I read the IEA scenario. So, I think this will require another breakthrough.

So, your question is, if we forget these 3 big technologies, where we would be in between Rupture and Momentum. I think we are not far from the Momentum scenario, a little better. So that means that without this breakthrough technology, clearly, we are not below 2 degrees. That's a message. So, I know that today, people think that we have all the technology in hand to reach the 1.5-degree scenario. I think it's not true. We need to continue to innovate and to look for. We're looking for. And I think it would be a mistake to believe that we have everything in our handn that it's just a matter of scaling up. Of course, we need to scale up what we have, but we also need to do more, which is to continue to look for technologies. I think the solution for climate change is not only a matter of carbon pricing, it's also a matter of investing massively in innovation. It would be a mistake to have public policies, which would focus more of the economic side or on the market side and would forget this necessity to support innovation in many fields.

The second question, what was it?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
Yes, Sorry, Lydia, can you repeat your second question?

Lydia Rose Emma Rainforth ***Barclays Bank PLC, Research Division - Director & Equity Analyst***
That's really helpful. It was just on hydrogen. I'm just wondering if you're looking at limits in terms of blending. When you're looking at the modeling, are you putting 10% blend into the mix? Or is it 20%? Or are you going to the 100% hydrogen and some of the heating at some stage?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
In Rupture, we're assuming that we're pushing the limits. As I just said, in Momentum, the incorporation of hydrogen remains limited. But again, it goes back to your first question and Rupture. I mean hydrogen becomes a strong contributor for industry, even potentially in Res. & Com. But we have tried to model something, which seems realistic today in terms of blending and including for power plants.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
For example, on power plants, today, engineers told us that there is a form of limit of maximum 20% of hydrogen in the gas power plant. Obviously, the question will be, how can we go beyond this? I think it's a matter of local innovation and research. Why should we not be able to do it? Today, it's not in our hand. Rupture has been designed without these limits. We considered them but it will be solved and then this hydrogen could be used extensively.

Having said that, you know also that there is another limit to green hydrogen, which will be the capacity to produce more and more renewables because green hydrogen is in front of that. You need the renewable

capacity. And so, there is a chicken and egg story in hydrogen, which will be another big issue. The figures when you make the models are massive. There was a chart in the presentation of Helle, where you could see that we need to increase a lot the renewable capacity if we just want to be able to produce a green hydrogen required by the Rupture scenario, which is massive and that is something that people should not forget. A limit to the capacity to develop the hydrogen will be the capacity, at the same time, to develop these huge renewable capacities only for the purpose of green hydrogen.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
In Europe, I told you that 25% of power demand would be linked to the need to produce green hydrogen. And in Rupture, it's around 12%. We've tried to model this.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
Look on Slide 26, the investments in solar and wind capacity: they double from 10,000 gigawatts in the Momentum scenario to 20,000 gigawatts. That additional 10,000 gigawatts are largely due to the fact that we have included in the Rupture scenario a lot of green hydrogen.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
Exactly. And so, I just repeat this importance of closing the loops. And if you compare our scenarios to other scenarios, you need to make sure that those scenarios have also tried to do this global close looping.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
Okay. Next question?

Operator
Our next question comes from the line of Alastair Syme from Citi.

Alastair Roderick Syme ***Citigroup Inc., Research Division - MD & Global Head of Oil and Gas Research***
It just sorts of struck me really on that last point that as you build more and more cheaper renewables, we get closer to a point of basically 0 marginal cost electricity. It does feel very deflationary. Do you think that view is right and that the outlook for energy could be very deflationary? And if it is right, how do you think the policy can act to continue to incentivize investment in an environment where return might start to degrade?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
So, Alastair, as you know, I think the answer is yes and no, but it's more no than yes. And the reason for that is that I do think renewables per se will become cheaper. But I do not think that necessarily means that the whole power sector will become deflationary. For this reason, the bigger the penetration of renewables, the higher the need for all the grid balancing and grid stabilization that we've spoken a little bit about. So, I don't think everybody has understood how renewables are capital intensive. Yes, the unit costs will come down, but the grid cost associated with a higher penetration of renewables is still something that I don't think has been modeled properly. And if we continue to see a role for gas in power generation for hydrogen over time for storage, as Patrick said, so for stable, reliable, flexible base loads

and that could be in some countries nuclear, of course. If we continue to see that, it's also because these power grids will be terribly complex to manage. And the notion is that I believe there will be a price to manage the power grids and that there will be incentives, market incentives that will come naturally, so that there is a space for new projects, providing what I call the firm power.

Patrick Pouyanné *TOTAL SE - Chairman, CEO & President*

Even if renewables will have a big growth, at the end, by 2050 in the Rupture scenario, electricity represent 40% of the demand for energy. The cheaper renewables will influence the electricity markets and I think it will put a lot of intraday volatility because when you will have all these offshore wind in U.K and when the wind is coming, it's coming for everybody at the same time. You could imagine having negative price at a certain point of the day. And then on the other side of the day, you will have better prices because we'll have less winds. This will create a lot of instability, in particular intraday instability.

Having said that, again, the world is looking, like it was said by Helle, to reliable energy. We'll never rely only on renewables. What recently happened in California, is, I think, a good lesson for everybody. Again, the customers want a reliable energy. That's why by 2050, you continue to look to the mix, and you will have in the mix, still some gas and some oil. Of course, the fact that there is a decline of demand for oil will influence the oil price. I don't see a global deflationary outlook for energy, but we are always wrong about the future price of energy. Again, my message is that renewables are part of the system, but the other part of the system will have also to be invested. And like Helle showed you, we need to continue to invest even by 2050 because of the natural oil declines in some oil resource and gas resource.

Helle Kristoffersen *TOTAL SE - President of Strategy & Innovation*

I'll just add one thing on power systems, Alastair. There's been a good study done in the U.K. and what would be required in the U.K. if it was a renewable-only electricity system, not energy. And I just remember, the 3 main words are effectively storage, we agree. Interconnections, we agree. But if everybody interconnects with an unstable grid, it doesn't help the grid. So, you still need stability, flexibility, reliability. And the last topic, of course, is sector coupling, which is an awful word, just to say that the fact that you can go from one energy to the other, for instance, through hydrogen can also be a way to address energy system instability. So, we essentially agree with the conclusions of the U.K. study.

Patrick Pouyanné *TOTAL SE - Chairman, CEO & President*

And the more you invest in renewables, the more we need to reinforce in decentralized energies, the more you will have to invest in grids, which today are little forgotten, especially interconnection and grids. People speak a lot about solar farms and implementing supply. But the electric systems have not been designed for that and even if people make it possible to absorb all this, again, you have intermittency and volatility issues. We'll have also huge investment to be done, which today are not taken into account in all the costs, which are mentioned. Because when we speak about renewable costs, we think as marginal to an existing system that somebody else has. And you know we learned in some segments like oil sands in the oil business. But when you invest in production, if you forget about the networks and the infrastructures, you could have some bad stories after that. I think that it could also happen in other segments. And these infrastructures are costing a lot. By the way, speaking about CCS, again, one of the

discovery we are doing by working on a project like Northern Lights is that, in fact, it's not a matter of capture and cost of storage, it's also a matter of cost of the infrastructure. That could be a limiting factor to the development of CCSs because if you need to build all these infrastructures, these are quite high. We should not go too quickly and to only look to one element of the chain, even if each element must diminish its cost.

Okay. Next question, maybe.

Operator
Our next question comes from the line of Christopher Kuplent from Bank of America Merrill Lynch.

Christopher Kuplent ***BofA Merrill Lynch, Research Division - Head of European Energy Equity Research***
Two questions. One for Helle regarding the modeling. And another one for maybe, Patrick, on some of your views politically on the topic of nuclear. You just said that for hydrogen to be profitable today, you need a very significant premium on carbon prices. And I suppose you could say the same about new nuclear. Why do you think nuclear has been struggling for regulatory support? And why do you think in these long-range forecasts that doesn't play a bigger role? What's your view?

And for you, Helle, just wanted to check whether these scenarios are driven primarily by the global warming? I.e., how do we get to 1.5? Or whether they are more bottom-up regarding your views on technologies because, ultimately, what I'm getting at is how do you take into account elasticity of demand? So, what kind of underlying price assumptions did you take? Or didn't you take any at all? And you just wanted to show what's feasible from a Net Zero perspective. I hope that makes sense.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
I'll answer that quickly because it's easy. As I told you, Rupture is a backcasting modeling exercise, where we start with what we want to achieve, which is reducing carbon emissions to be on the trajectory that brings us to carbon neutrality. So, we've worked backwards, if you want. Having taken that as a first approach, it is a bottom-up exercise. So, going country by country, sector by sector and looking at how demand might evolve to achieve that result and how demand in each of these sectors in each of these countries can be decarbonized.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***
So, Momentum is led by technology and innovation and Rupture is led by 1.5-degree to summarize but we had to develop it to see what we need in terms of breakthroughs.

To come back on nuclear. I think it's clear that best way to produce hydrogen today is to link it to nuclear. If I was a nuclear company, I would be a big advocate for more hydrogen. It's obvious to me. It's maybe a way to renew the interest for nuclear.

Having said that, what we observed in the world, in China and in Europe, excepting France, which is an exception, is a slowdown in nuclear program. Since Fukushima, there is a huge question mark about the

reliability, the security and the safety issue. It means that we see a bad trend for nuclear, which is coming from all the regulatory authorities that are increasing the level of requirements and making, as a consequence, nuclear not competitive. In France, I can tell you the nuclear safety authority is just putting more and more regulations. And at the end, it makes these nuclear projects very expensive and difficult to compete with other source of energy. So that's a question.

It's interesting to look to new technologies, like the nuclear modular technologies, which are looked by some start-ups in the U.S., in particular and is worth to look because it's a way to try to address on one side safety issues and on the other side to make a new concept that is less massive and less expensive. It's the idea to have small modules of 400 megawatts but to make some clusters modules. That's something which might be a way to revive the nuclear fuel in the future. It's clear that it's quite tempting to solve the 1.5-degree scenario, the Rupture scenario, by putting more nuclear, to be honest but we resisted. Today, there is a resistance. If you look to the debate in the European parliament, nuclear is considered as black as oil because there is the idea that nuclear is all about nuclear waste, and that's not acceptable.

Even in France, there was a poll very recently, which was mentioned to us recently by Mr. Canfin, the President of European Parliament Environmental Commission. The question asked to French people was the following: Does nuclear emit CO_2? 70% of the French people believe that nuclear is emitting CO_2. Nuclear in the mindset of people is linked to impact on the environment. That's something that has to be taken into account as it is a limit to the expansion of this technology. But again, never say never, it's good to have a look at these modular technologies in the U.S., which are currently being developed.

Next question.

Operator

Our next question comes from the line of Martijn Rats from Morgan Stanley.

Martijn Rats ***Morgan Stanley, Research Division - MD and Head of Oil Research***

I wanted to ask you about the oil market. And specifically, what present outlooks like this, which are becoming at least in our part of the world more consensual, what they are doing to the competitive dynamics? When oil prices were still very high, there was a lot of funding available, but the resources were relatively scarce, and you competed against other oil companies to gain access to resources all around the world. But outlooks like this sort of paint a very much opposite picture. It increasingly looks like there is a large amount of oil still to be monetized in coming decades, whilst at the same time, the amount of dollars that are willing to invest in upstream oil projects is increasingly scarce. So, it looks like the dynamic has turned around where the resources are now abundant, and the capital is scarce. Now I was wondering if this is an actual effect or whether I'm kind of sort of hypothesizing about something that isn't happening. Are you finding that countries that own large amounts of resources are sort of starting to adapt their behavior to outlooks like this and actually coming to you and say, "Hey, do you want to monetize our resources" and perhaps offer better terms than in the past? Or is that dynamic not yet happening?

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***

No. It does not happen yet, but it's a good dynamic because it's clear that there is maybe a large amount of oil. But again, with the perspective that we have, we need to look for oil which will have a low-cost to be produced. There is a lot of oil with a low-cost to be produced, but it's in the hand, mainly of some national companies. And by the way, when you say there is less capital to invest in oil, it's true probably for listed companies in the western world. It's not true for plenty of national companies, which have in their hand 90% of the reserves. It's an excellent question.

This is a challenge for us. That's why Total from my perspective, is well positioned. The question for us is: how can we have access to this oil resource, which have a low-cost to be produced in the future and in which country do we need to focus? That's true that most of them are in Middle East and North Africa. And for most of them, we all know that. That's why from this perspective, I think Total has a competitive advantage that will be used in the future, including to have access to these low-cost oil resources. The dynamic that you mentioned, Martijn, it's clearly on the top of our agenda. We need to work to create it. When we listen to the political leaders of these countries, they could be afraid that they will not produce all their resource. So, it's a question of do they want to accelerate it? And from this perspective, maybe some of them will accept to have part of our capital to be invested. That's a very clear and a very good observation, and I share your point.

Okay. Next question?

Operator
Our next question comes from the line of Anish Kapadia from Palissy Advisor.

Anish Kapadia ***Palissy Advisors Limited - Director & Head of Energy***
First question is, again, looking at the economic impact of the move to a greener world. There's clearly going to be a big governmental and consumer impact from the loss of taxes on things like gasoline and diesel at the pump, which are big sources of revenue and the cost of funding of the likes of hydrogen and CCS which are additional cost. Just wondering how you think about that and also in the context of potentially higher interest rates because one of the things that's helped renewables at the moment is very low interest rates.

And then the second question is just, again, looking out to 2050, there's a lot of things that could change, and there's a lot of other technologies that could be of interest. Can you just talk a little bit about some of the other low carbon sources of electricity, such as hydropower, geothermal and even more speculative like wave power and fusion? What are your thoughts around that? And how much investment are you putting in in terms of R&D on those technologies?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***
Yes. I will take maybe the last question first. We have hydro in the primary energy demand, so we have considered that. When you look around, there are not hundreds of new massive hydro projects worldwide. It's a good and old technology that has been largely, I would say, deployed in many countries. It will continue to be there, but we do not think that hydroelectricity projects will suddenly be booming. That

would be the quick answer.

Fusion, we mentioned a little bit when we talked about next-gen nuclear, which could be either fusion or decentralized nuclear plants and so on. So, I think we've covered that.

Wave, geothermal and whatnot, I think it may be there. Geothermal is already there. Wave technology, we know that very well, of course, through everything we do offshore. The yields from these turbines and these systems when there are not even turbines involved are very low. We don't think that it would be a game changer for the next 30 years. But having said so, we're probably going to be wrong. But that's how we've looked at that. It's part of the picture, but it doesn't really show up, except for hydro.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***

I think they are 3 segments. Hydro is quite mature, in fact. The reality is that hydro was the first renewable. When you look to the potential of very large hydro gigawatts, et cetera, you have a few in some emerging countries. But already, it has been quite developed. Hydro is the first renewable in the history of renewable energy. So, I think the potential to grow hydro is not so large, even if there are still some projects.

Wave could make a lot of sense in islands and isolated environments where the cost of energy is expensive.

Fusion, I think it's still at the R&D stage, so we are far from that. As a consequence, we didn't take that into account.

The first question is an interesting question, Anish. I don't believe that there will be a sort of inflation in the energy because of what you just mentioned. The more we'll develop all these new energies, the more taxes and costs there will be. I think this will have an impact on the global economy and the cost of energy. It's clear that today, all that is helping a lot to support and fund, but maybe it's a unique opportunity that Europe is trying to live on. It's clear that launching a 700 billion project on green energies in Europe is something you can do today in these circumstances, which help the states to subsidize and to fund all these massive investments that need to be done.

But it's clear as well that at the end, if there is a loss of taxes on one side, they will have to find other taxes. I'm absolutely convinced that if states don't receive taxes of gasoline in Europe tomorrow, they will tax the use of the roads because these infrastructures need to be financed and the maintenance of it. When you look to the electricity price for consumers in Europe today, you have more than 50% of taxes and they are used to finance the development of renewables. It's is already embedded.

In fact, in the mindset of people, renewables mean free energy. It's coming from the sun. It's coming from some wind. It's given to us by mother nature. So, in the mindset of the consumers, they think that this energy, which is given to us should be free. And that will be a political difficulty for the system to explain to the people that they will have to pay the same price for the electricity, which is in an EV, green electricity than what they are paying today for oil.

In fact, as you know, oil is not so expensive today and it's less expensive than water. That is something that could be a hurdle from a society point of view to deploy largely these energies.

Operator

Our next question is actually our last question, and it comes from the line of Jason Gabelman from Cowen.

Jason Daniel Gabelman ***Cowen and Company, LLC, Research Division - Director***

I have two. First, on the nature-based solutions, which haven't really been discussed today. What is the amount you expect to contribute? Is it the same in the Momentum and Rupture case? And do you expect those nature-based solutions to be kind of fully deployed in the near term, given their kind of lower cost in nature than some of the other solutions to reducing carbon emissions?

And then my second question is on slide 5, where you list out the sector-based assumptions. They are 2050 targets, but I was wondering which of these 7 do you expect to have the most and least progress made by 2030? Or if you think the progress is going to be immaterial to 2030? And then same question on which one of these sector-based assumptions, do you expect to have the most progress made by 2040?

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***

On NBS, I would say, we have essentially assumed the same amount of NBS in the 2 scenarios. Of course, the higher the price of carbon, the more projects would become economical, both for CCS and nature-based solutions and any other form of carbon capture or negative emissions. So that would be the short answer. And we also think that there are opportunities for nature-based solutions to be deployed short term because there are available projects that are less costly, for instance, than CCS short term. And of course, they cannot scale forever either in nature-based solutions.

Regarding our assumptions on slide 5., it is going to be a qualitative answer here. By 2030 and 2040, I think it depends also on different parts of the world. It's going to be difficult for me, Jason, to give you one short answer. Electrification of end-user demand, including transport, I think it's clear that China is set out to try and lead the electrical car industry. And so that is, therefore, going to happen even in the next 10 years. The same with the emission constraints put on conventional internal combustion cars in Europe. I think Europe and China will push ahead with electrification of transport passenger vehicles over the next 10 years. I think that's very likely to happen. And that's certainly what we've modeled in Momentum and see horizon for the rest of the world in Rupture. And certain states, of course, in the U.S. as well, like California would be a good example.

Power decarbonization. Again, it depends on the parts of the world, but Europe is trying to speed up decarbonization. On the other hand, you know that Germany is not going to phase out coal in the next 10 years. So, it will be contrasted.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***

I think this one is probably one of the easy one because we see a lot of investments coming in renewable.

I don't think we'll have industrial scale of CCS by 2030, maybe 2040, because it's quite expensive. So, we need to create the momentum. By the way, the oil and gas industry is quite engaged with the OGCI. I see many initiatives being taken, and it's necessary to go from a pilot demonstration to more industrial scale projects but we need also to convince the states and not only the Norwegian state.

Regarding energy efficiency, Helle reminded you what we have done in the last 20 years was around 1.5%, and I think this time its 1.6% of energy efficiency. On a longer period, you find more or less between 1% and 2%. The idea that we can accelerate the energy efficiency to something above 2.5% is a huge effort. I'm not convinced that today the policies are really at the level required to go from 1.5 to 2.5. That would be one of the big challenges. I would say, plastics probably 2030. We need to develop a chemical recycling technology and that's just emerging today. We have announced a project in Europe on our side last week. The 2030 horizon is a challenging one.

Helle Kristoffersen ***TOTAL SE - President of Strategy & Innovation***

Mechanical recycling is there, but it won't take us all the way we need and doesn't enable to recycle all plastics, especially for food users. You're right Patrick, chemical recycling would be a factor that might slow down recycling and plastic. Regarding single-use plastics ban, we are seeing indications that this may gain some traction in certain countries. And again, China and Europe would be leading.

Mobility. We spoke a little bit about it with gas getting greener. We've also touched upon when we've spoken about hydrogen and biogas. I think 2030 will be a stretch. 2040, more likely. It all goes back to what we discussed on the cost. This is extremely expensive to do. It goes back to government subsidies, incentives, fees and tariffs or whatever, and the ability for these greener gases to scale rapidly.

Patrick Pouyanné ***TOTAL SE - Chairman, CEO & President***

Just to remember to everybody that in 2005, nobody was speaking about large-scale solar. In 2015, it seems obvious to everybody that there is plenty of large-scale solar around the world. As a conclusion, in ten years, we all have to be optimistic about the capacity to innovate and technology. It would be a mistake to consider the future with only the present technologies. It's a matter, of course, of policies and putting all the strengths together. But if really, Europe is serious about hydrogen, in 10 years, you could have the same thing as we saw in renewables. At the time, Germany favored renewables following the Fukushima's accident. President Xi announced last week at the United Nation that China will be neutral by 2060. I'm convinced that it's a very serious announcement. And you will see the acceleration of China on EVs on hydrogen and all these new energies. When you see such a huge economy becoming serious about this topic, this will give a big impulse to the capacity of delivering these targets. We have to think to what happened in our energy world in the last 20 years. To develop new energies, we will require the right economic signals because renewables have been developed when oil was above $100 per barrel. As it was too expensive, it gave more room to develop better technologies. The economic signals are important.

I understand that it was the last question. So, thank you for your attendance. That was the first part. I think we spent 2 hours on this Total Energy Outlook 2020. It's paving the landscape for what we will explain tomorrow about our own strategy. I think it was worth to share with you the various scenarios and

challenges and how we can address this carbon neutrality, getting to Net Zero with you.

We've done it today because I know that your attention is strong to what Total is willing to do, but it was better to cut it in 2 parts. So tomorrow, I hope you will all be there by 2:00 p.m. Paris Time, 1:00 p.m. London Time and 8:00 a.m. New York Time. We've done it for you in the U.S. But even in Singapore, it will be 8 p.m., so I think it's acceptable. The session should last around 4 hours 30 minutes. We will have one session where I will present you the strategy of the company, then a Q&A on it. And then you will have 3 Zoom by Philippe on renewables, by Bernard on biofuels and by Alexis on electric mobility.

So, you should keep in your agenda from 2 to 6:30. But the more questions you will have, the better it will be, of course, for all of us.

Thank you for your attention today, and I hope you will all be here with us tomorrow afternoon.