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PRESENTATION

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

Hello. Good afternoon or good morning, if you are in North America and good evening, if you're in Asia, and welcome to our Investors Days today and tomorrow. The first day is a special one. As we've done last year, it will be dedicated to share with you the vision that TotalEnergies has of the energy landscape and our energy outlook 2021. And as you know, this session is special as it is open not only to investors, but we have also some media who will follow us this afternoon. As you also know, since we met last year, we changed our name to TotalEnergies. We changed our logo. We have reaffirmed a clear strategy to build a multi-energy company. And that's why we think it's important that we contribute as a responsible player to the debate around energy, the energy transition and climate change. This year, we have taken a new initiative, which is not only an update, and you will see there is quite a change, because this energy world is moving quickly, in our energy outlook 2021. But we have also taken another initiative, which is to publish a new report about the energy landscape, which is a report written in collaboration with Capgemini and Colette Lewiner, an energy expert, who are well known in France. In order to describe, I would say, the worldwide energy system: The energy debate is quite complex, primary energy, secondary energy supply, demand, many possibilities. And the more we go into the transition, the more we open different options for this evolution of the energy system. And we will prove this in our report. We will try to -- we hope to contribute, I would say, to install the debate about the future of energy on a solid basis. Helle will introduce you to this report, which will be available to you on our Internet site in French today and in English tomorrow. And so you will be able to learn all that you want to know about energy by reading these reports. I'm sure there will be many questions about it, but

it's, I think, a strong contribution so that we can have this debate on a solid basis. The second report that we are publishing today, you've begun to be accustomed to it. It's the third year that we publish it. It's the TotalEnergies Energy Outlook 2021, where if you follow us quickly, we have 2 scenarios, Momentum and Rupture, the Momentum being, I would say, Helle will explain you in line with, I would say, the policies which are published and committed by the various countries around the planet. And since last year, of course, A number of countries declared their ambition to get to Net-Zero by 2050. And the Rupture scenario is a scenario with fitting in line, I would say, meeting the target of the Paris agreement to have a temperature elevation well below 2 degrees compared to the pre-industrial era. So Helle will -- I will leave the floor to Helle now, and I hope that you will enjoy this presentation. It's a little long. So you will learn a lot but Helle will do it with dedication and patient. And after that, we'll have a Q&A session where we will first take the questions from the investors and then the question of the media. For the media, let's just be clear, we'll answer today: It's not a press conference on any topic. It's a session, which is dedicated to share with you the vision of TotalEnergies for the energy landscape, the present and the future, and so questions should be concentrated on this topic. But before I give the floor to Helle, of course, like in all session with TotalEnergies, we would like to introduce this meeting with a safety moment.

(presentation)

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

Good afternoon, everyone, or good morning if you're in the U.S. or elsewhere. And again, a very warm welcome. So we're going to start this afternoon with some highlights from the energy landscape. As Patrick told you, the idea behind the Energy Landscape is to share some facts and data about the current energy sector, so as to set the stage for the ongoing energy transition. So sharing knowledge and insights. We are covering simple stuff and quite complex matters. And my charts this afternoon are not at all a summary of this handbook. So if you are interested, again, don't hesitate, go to our website and download it, since it is available in both in English and French.

By way of an introduction, this is our shared sustainable energy challenge. Number one, ensuring a reliable affordable, accessible energy supply for a growing world population. Number two, protecting the planet and its inhabitant from the adverse effect of greenhouse gas emissions and their impact on climate change. Now why is that a challenge? Well, because by all considerations, the world population is widely expected to grow to 10 billion people, 30 years from now, up from roughly 8 billion people today. And as you can see on this chart to the right, the world GDP and energy demand have grown over the last 50 years more or less in sync with population growth. Carbon emissions linked to energy that are shown in the little gray box is also to the right. These emissions have gone up also from 15 gigatons in 200- -- sorry, 1970 to 33 gigatons in 2019. We cannot continue like that. Our societies must find a way to reconcile population growth and prosperity with a massive reduction in CO2 emissions.

Starting now with energy supply. Energy supply is generally split into 3 families: primary energy, meaning energy resources available from nature, and that's at the bottom of the chart here. Then secondary energies, requiring some form of man-made transformation, refined oil products, for instance, or power.

And finally, energy for final use at the top of the chart here, which is broken down to the kind of things we do with the available energy. Not everybody knows this, but you all do, 80% of the world's energy supply still relies on greenhouse gas emitting fossil fuel resources. This dependence is not sustainable. We must increase the share of other sources of energy.

One highlight we wanted to share with you all relates to energy value chains. So how we are moving from primary energy to secondary energy and then to find an end use? What you see here is exactly that moving from left to right. We are showing 2 examples of 2 energy value chains. At the top 2 examples for electricity, electricity made from the sun, photovoltaic and electricity made from gas via the liquefied natural gas value chain. To the bottom, we are showing 2 chains for hydrogen, hydrogen made from natural gas, which is gray hydrogen and green hydrogen, which is made from renewables, renewable power. I know the chart is crowded, and don't worry if you're interested by this topic, again, there is much more on it in the full report. In both cases, for similar end use, the number of transformation steps is very variable. You can see that, at least, from the crowded chart. The longer the production chain, the greater the potential losses and therefore, the cost. On the other hand, some of the longer value chains emit much less greenhouse gases. So there is a trade-off here. As an example, green hydrogen to the bottom of the chart, is much better in terms of emissions and gray hydrogen, there's virtually no emissions when you do green hydrogen. But the value chain yield today is very low, meaning that it's costly and therefore, green hydrogen is not at all consumer ready at scale today. So innovation in this kind of production value chain is going to be extremely important going forward. Another chart building on exactly the same idea. Here you see the performance yields of 3 kinds of vehicles broken down between the efficiency at the full production level and at the level of the engine or battery, the so-called tank-to-wheel efficiency. And the overall efficiency of a given chain is simply the multiplication of one by the other. What the chart shows is that the thermal cars, internal combustion engine cars that the world uses today are, in fact, highly, highly inefficient. And that's primarily due to the internal combustion engine. The overall efficiencies, you can see, is only 20%. But the current hydrogen-based fuel cells, and that's to the bottom of the chart, those cars are not very efficient either, 22% overall. On the other hand, battery-based electrical cars in the middle of the chart, you can see that they are extremely efficient at 73%. So that's one good reason to push for EV car adoption -- We avoid energy losses. And in fact, electrification is a major trend in the energy sector and not only in transport. So decarbonization is underway and electricity is the main enabler. This, again, therefore, implies that power must come from low carbon sources and indeed, low carbon electricity is at the core of a Net-Zero carbon emission-oriented world. That's for the good news. What the chart also wants to convey is that the less exciting news is that it takes time. Solar and wind electricity had increased close to 10% per annum over the last 30 years, but they still only represent roughly 10% of the overall global power mix. So we have a long way to go still, and actually, we need to accelerate. The magnitude of change that is needed varies country by country, as you can see to the right, because the starting point, meaning today, the energy -- electricity mix country by country is very different.

One word on Power Systems. And again, this is a crowded chart, I know, and go to the full report if you want to really understand the messages. But there is one key thing to remember, which is not too complicated. And that is that power generation and power consumption must be balanced at any point

in time. To the right, today's power systems are built upon schedule and manageable power capacities that come online to match demand, knowing that demand varies intraday, intra season and so on. These capacities are known as base loads and they're always running intermediate loads and peak loads. The massive introduction of intermittent renewables, meaning solar and wind, has a systemic impact on network balances because by definition, these renewable energies are not as predictable and reliable as all the sources of power. Our power systems need to adapt for that. Going forward, mitigation will come from building more storage capacity, building or maintaining intermediate and peak load capacities and also from working with customers on demand response. But let's be clear, today, we can't power a hospital with wind and solar electricity. They must be complemented by some form of firm power, reliable and predictable power. Gas can play that role as was recently decided in California, for instance. To wrap up on energy supply, the chart here summarizes the main characteristics to consider when we compare energy. We all do that all the time, but not always on a solid basis. We've listed here 7 key dimensions to consider. Now I'll read them because it's important. Energy density, energy availability or abundance, energy predictability or reliability, the impact on the electricity networks, other forms of externalities, typically emissions, both CO2 and methane for instance, corrective measures that can help on the negative externalities and then technology maturity. For illustrative purposes, we then in the current year, try to compare oil, natural gas and intermittent renewables against solar and wind. The takeaway is that comparisons are not at all straightforward. As you can see, these different energies score differently on each of these 7 criteria. We have not added costs on the table. Because if you want to do a good job on cost, then you have to put a price on emissions, on carbon and methane on one side, and the negative impacts on the networks, electricity networks on the other side.

So there's much more to be said on this topic of comparing energies. And again, if you're interested, we've dedicated a full chapter to that in the report. Just one other comment. The footprint of different energies is also to be considered. The footprint is linked to the density of the energies and to their engineering characteristics, which in the end, boils down to planned production yield. It's illustrated here in terms of square meters of land needed to power a 100-watt flat TV screen. You don't see oil on the chart because it's not really a good way to use oil to produce power. So hydro, of course, is a little specific because it's not at all modular. But what you can see here is that for the same amount of power, the land use required for wind or solar is way, way bigger than the square meters needed for a coal power plant, a nuclear power plant or a gas power plant. And this is a way of showing why there are acceptability issues linked to wind and solar, not everywhere, but in Europe, for instance, it is a mounting issue that has to be overcome.

So now a few words on energy demand. Where does it come from? I think we all know this. Energy is central to human life. We use energy every day to move around, to make stuff in industry, to heat and cool buildings and homes, to put the lights on and more and more and importantly, to communicate. When energy is plentiful, its consumption mix tends to vary according to end use. This is illustrated to the right for countries in the OECD. Specializing energies according to the end use for which they are the most efficient, so optimizing usage and mix, is one of the levers for a successful energy transition. But of course, that comment is not relevant if all the energy you have comes from traditional biomass for instance. What you see here now is the evolution of energy demand over the last 20 years by geography,

contrasting, the evolution of energy demand in developed countries, OECD and non-OECD countries. The obvious thing is that energy is -- energy demand is growing very fast in non-OECD countries and it is virtually flat and is probably going to be down in the future in the more developed countries. 1 billion people today do not have access to electricity. And for a lot of the non-OECD countries, access to energy is simply a prerequisite for their development. So people are not equal when it comes to energy. The chart here shows the 2018 consumption per capita in megawatt hours. What you can see is that Saudi's per capita consumption is very close to the one of the U.S. France is behind, but then much, much higher than India and Kenya, for instance. This energy consumption level is a direct function of energy access and of living standards. Hence, the need for just an inclusive transition, meaning enabling the energy demand per capita to go up in non-OECD countries while we decarbonize.

Given that energy consumption varies region by region, countries are not equal either when it comes to emissions. To the left here, you see the top 7 countries or regions in terms of emissions in one given year. In this case, it's 2019. So China is first, followed by the U.S., European Union and then comes India, Russia, Japan and Germany. Not really surprising, of course, when you factor in population size. So to the right, we are showing the same ranking, but in terms of emissions per capita. This data is a little less well known. I will let you review it and you may be surprised. And now the much more important picture, which is a comparison of the 10 largest CO2 emitters worldwide over the last 40 years since [1971] so a little more than 40 years. So that's in cumulative terms of CO2. Close of half of those cumulative tons come from us in the Western world, 25 from the U.S., 22 from the European Union. And developed countries have thrived without any constraints on greenhouse gas emissions, developing and emerging countries will need help to grow without following that same path. And this is at the top, top of the agenda of the upcoming COP26.

It also takes us back to where I started on our shared sustainable energy challenge. We all have a role to play for a successful transition, and we know what to do, which is summarized on the chart here. Avoid emissions, reduce them, compensate them, meaning compensate residual emissions when everything has been done to limit them to the strict, strict minimum level via avoiding and reducing. And then the fourth driver, which is innovation. All these drivers are effectively at play in the modeling work that we have done in our Energy Outlook.

So now I propose that we switch to the 2021 Energy Outlook from TotalEnergies. So moving on to the outlook. As a reminder, our energy outlook only focuses on energy demand and looks at how this demand may evolve over the next 30 years, so out to 2050. Last year, the European Green deal was one of the highlights of our outlook. As Patrick began to explain, this year one key modeling driver is that many more countries have joined the net-zero race with carbon neutrality pledges for 2050, sometimes 2060, which is great news for all of us, of course. We assume that these pledges will be delivered, and we have accounted for that therefore, in our 2021 Energy Outlook.

So like last year, we have modeled 2 demand forecast scenarios to 2050, with 2 really completely different methodologies. Momentum is a forward-looking scenario. Based upon the decarbonization strategies of the net-zero 50 countries, and that's what I'm going to call the countries that have pledges

to reach carbon neutrality net by 2050. And they are shown on the map in green to the left. Momentum also takes into account China's goal or ambition to reach net-zero by 2060. And this is why it's only partially green on the map to the left. For all other countries, momentum considers the announced pledges and naturally defined contributions. Momentum, because of these assumptions, goes way beyond a business-as-usual scenario and results in the 2.2 to 2.4 degree increase in temperatures by 2100. The second scenario, Rupture, has been built with a back-casting approach, using the IPCC emission scenarios. It has 66% probability of being well below 2 degrees. So rupture is a template for what needs to happen to be in a well below 2-degree world instead of a 2.2 or 2.5-degree world. And we've added to that at the very end of my presentation, a sensitivity on the additional efforts required to reach 1.5.

So elaborating a bit on this framework: The key assumptions for Momentum include a complete internal combustion engine sales ban by 2035 in all the net-zero 50 countries, and that's a major assumption. And when we say an internal combustion engine sales ban, it applies both to light-duty vehicles and to heavy-duty vehicles, meaning trucks. It also assumes the global acceleration of the transport revolution revolving around electrification and increased penetration of hydrogen and hydrogen-based e-fuels. It assumes a broad electrification also of end use in industry and in the residential and commercial sector, which I will call Res&Com, all of which creates a massive feedback loop on additional power demand and therefore, a need for many more renewables. Beyond that, Momentum assumes a widespread use of natural gas as a transition fuel, especially in power and industry much more than in transport, and we have much less gas in the transport segment than last year, for instance. Gas is also used as feedstock for blue hydrogen. On plastics, we've modeled a ban on single-use plastic (SUP) by 2040 for the net-zero 50 countries and China, and we've also increased recycling rates versus last year. China achieves 60% decarbonization by 2050 and its emission peak somewhere in the middle of the 2020s. The macro backdrop for Momentum is shown to the left here, it's 3% GDP growth per annum until 2050, and it results in a 0.5% growth per annum for energy demand. In Rupture, GDP is unchanged, but energy only grows at 0.3% per annum, which helps reach the well below 2-degree target. The important difference of Rupture versus similar well below 2-degree scenarios is that energy demand is up and not down, I insist on that.

Other than that, to go from Momentum to Rupture, the key drivers are the extension to all developing and emerging countries of the decarbonization policies and technologies implemented in the net-zero 50 countries. This raises, of course, a question of: How do you do that? And who pays? Meaning, are the richer countries ready to fund the energy transition beyond their borders?

The next chart elaborates on that question, talking about population growth and need for energy in developing countries, but we've already covered that in the energy landscape, so I will skip it. Now to know how to curb emissions, to curb greenhouse gas emissions, we need to know where they come from. Acting on energy is paramount as is shown on this chart. More than 2/3 of global greenhouse gases, meaning CO2, methane and so on, they are energy related. To the right, you see the breakdown of energy-related CO2 emissions. Transport and power sectors are the main contributors and therefore, top priority sectors to decarbonize. And this is what we've done in our modeling work. So how do we

decarbonize how to be on this energy transition pathway allowing for more energy on one hand and less emissions on the other hand? The common themes and takeaways from both in areas are listed here, and I'll read them quickly. It is that we have more energy, so growing energy demand in both scenarios. Oil plateaus before 2030 and then declines. Gas remains a key enabler of the energy transition, especially in Power & Industry and also for blue hydrogen, as I said. Liquids and gases become greener and greener through decarbonization. Electrification is absolutely key. And actually, we've modeled a pretty radical electrification, including in the transport sector. And therefore, there is also going to be an increasing need for storage. As we electrify, we need to electrify with lower carbon and therefore, renewables play a key role in both scenarios. We have increased our outlook for hydrogen and the penetration is much higher than last year, both in industry and in transport. And then finally, and you know this, we believe that carbon sinks, be they man-made through carbon capture and storage or nature-based NBS, carbon sinks are absolutely mandatory for the net-zero journey. The next chart here shows what you would call the key decarbonization drivers from our model, per sector final demand and then we've also added power to the very right. So we've listed a number of decarbonization drivers and try to qualify how important they are. So the impact level as being either low, medium or high. This impact level has been assessed in terms of technical and economic maturity of each driver and also its readiness to be deployed. I'm not going to cover everything, but just if we go by column quickly, what do we have? What you see is that energy efficiency and recycling are major drivers for industry. In transport, if I only to mention one driver, it's clearly electrification. Further, residential and commercial sector, Res&Com, electrification and energy efficiency are key contributors. And finally, for Power, the 2 most important drivers are switching away from coal to gas, adding in CCS, if possible, and increasing solar and wind deployments together with storage to mitigate the impact of these intermittent renewables.

We've also summarized the key modeling assumptions of our 2 scenarios because we did that last year. It was something some of you really liked. So you have that chart again, I'm not going to comment it, and we've actually covered most of what it says in here.

So now I'm going to move to Momentum. I'll cover 3 themes. The key energy transition levers, those that are listed here. So what's going on in transport? What about clean hydrogen and what about the related huge power demand. Secondly, I'll show you some charts wrapping up Momentum. And then I'll zoom in on the net-zero 50 countries because I think that's really important. The units are in petajoules per day. I hope you're familiar with conversions. Otherwise, the energy landscape gives you the right formulas. Starting with electrification and transport. Here you see the evolution of energy consumption of the light-duty vehicle segment that actually accounts for roughly half of the CO2 emissions of the transport sector today. The thermal car and truck sales ban in 2035 in the net-zero 50 countries accelerates EV and fuel cell penetration so that in this segment, those technologies reached 67% globally by 2050. And that is actually 100% in the net-zero 50 countries and 90% in China.

You can see to the right, the substitution of oil -- sorry, to the left, the substitution of oil is not so spectacular in 2030, but then really accelerates after 2030 and becomes pretty impressive by 2050 since oil falls below 50% of the light-duty energy mix.

For heavy-duty trucks, close to 30% of today's transport emissions, both electrification and hydrogen-based fuels contribute to the decarbonization. This scenario, if you go back to last year, is very different from what we had in 2020. Clean hydrogen-based solution here refer to both fuel cell and e-fuels, meaning green hydrogen combined with carbon molecules. To the right, you see the decarbonization traffic assumptions that we've used. So this is in kilometers per year for the 2 subsegments of urban heavy-duty and long-haul heavy duty. The degree of decarbonization is not at all the same. It's much higher in 2050 for the urban trucks and for the long haul trucks and the energy mix is not the same either as you can see.

Moving on to Aviation and Shipping, respectively, [13]% and [10]% of transport emissions. The main message is that the jury is still out on which low carbon fuel options will eventually prevail in those markets. In aviation, it will be difficult to do without liquid fuels in the coming years due to density needs and storage constraints. Our scenario here assumes penetration of biofuel and hydrogen-based fuels, so again, e-fuels combining green hydrogen and carbon. In the Marine sector, LNG moving to bio LNG will be part of the mix for a while, together with biofuels and probably a lot of fuels derived from clean hydrogen, including e-methanol and ammonia. That was for transport.

Now our second accelerating decarbonization driver, which is clean hydrogen. I already started covering that, of course, as I spoke about transport. Here, you see to the left, the overall use of clean hydrogen per sector in 2050 and 30. This picture is also very different from what we had last year. In 2050, the use of clean hydrogen is 4x bigger than today knowing, of course, that today, we have no clean hydrogen and the hydrogen we have is gray, so it's emitting CO2. In other words, hydrogen stops being a tiny niche market and sees demand picking up in all sectors, especially in transport and in industry. Also to the left, we show the split between green and blue hydrogen, and that's roughly 2/3 and 1/3. Blue hydrogen helps kick off the market at scale, pushes up demand for natural gas as shown here, and requires roughly 1 gigaton of CCS. And then to the right, what's the impact of green hydrogen? Well, we are highlighting the massive need for future power linked to green hydrogen production.

Green hydrogen makes up close to 15% of power demand in 2015. If we add in transport and its electrification, roughly 25% of 2050 power demand comes from sources of demand that do not exist today. In terms of growth, in power demand between today and the next 30 years, hydrogen and transport represent roughly 45% of the increase. And in Momentum, the overall power demand is up some 2.5% per annum over the next 30 years.

So what about power generation to accommodate for this increase in demand? Generation more than doubles by 2050 with solar and wind making up 85% of new capacities. Gas is the only fossil fuel to grow in the power mix due to its key role in coping with intermittency and demand seasonality.

To the right, you see our assumptions in terms of gigawatts of solar and wind. The capacities are multiplied by 10 in 30 years. The share dedicated to the production of green hydrogen is higher than today's solar and wind capacity. So it's massive. In addition to baseload capacities, an estimated 1,500

gigawatts of daily-based storage will be needed in 2050 to ensure firm power delivery. Green hydrogen can also do the job or help do the job with electricity storage.

Moving now on to the summary of Momentum. Here are the main decarbonization highlights of Momentum through now, first, total final consumption. Total final consumption grows steadily at 1.5% per annum. You see the mix to the left. The messages are: 1) electrification. Power becomes the #1 source of final energy in the early 2040; 2) mix diversification, decarbonization entails many more choices and adoption of low carbon solutions; 3) decrease in oil demand. Oil is down because of everything we said related to transport and due to the single-use plastic bans and recycling of plastics.

The area to the right, you see that the sector final demand that decarbonizes fastest is transport, and that is also a highly emitting sector. Power is not there because it's not considered a sector of final demand in case you were wondering. We've seen the growth in Power and Renewables, but what about oil and gas. The chart here is in BCM to the left for gas and in million barrels per day to the right for oil. In Momentum, natural gas demand grows by roughly 1% per annum. This CAGR is driven by Power & Industry and blue hydrogen. For oil, demand peaks in this decade with a decline of 1.9% after 2030. And we added that number to the chart here because we'd like to just remind everyone that this decline is well below the natural decline of existing oil fields that stands more at minus 3% or minus 4% per annum. Oil ends up at the level of 64 million barrels per day in 2050 in Momentum.

Final chart on Momentum. Here is a wrap-up in terms of primary energy demand and CO2 emissions decline. The net-zero 50 countries do take us a long way when it comes to decarbonization. And again, it leads to a world in the 2.2, 2.5 degree scenario. On the other hand, today's net-zero pledges are insufficient to reach global carbon neutrality. We need many more countries to join in, which is one of the key topics again for COP26. In Momentum, the residual CO2 emissions stand at 24 gigatons, and that's net of 3 gigatons of CCS.

Now let's take a closer look at these net zero 50 countries. I think it's really important to show how they play a pioneering role in adoption of low carbon energy solutions. They are modeled the same way in Momentum and in Rupture since they are net-zero in both scenarios. These countries, as shown on the chart here, represent plus or minus 10% of the world population. Their share in global GDP goes down over the next 30 years from 41% to 28%. And their share in global energy demand drops from roughly 1/3 to 20%. And that's, in fact, why their net-zero strategies are both absolutely critical to fight climate change and far from being enough. So here is a total primary energy demand evolution in these net-zero countries. We are talking about OECD countries. So energy demand is down by [0.9]% per annum, helped by energy efficiency and deep electrification. And this contained energy demand in these OECD countries leaves room for economic development and improvement in living standards in the rest of the world. The primary energy mix is highly diversified, as you can see to the left, with gas keeping its role, I'll come back to that. The share of fossils goes from the 80% of today that we talked about in the landscape to 33% in 2050, and coal is out.

Moving to the transport sector. The net-zero 50 countries are at the forefront of the so-called transport

revolution. With the internal combustion engine sales band in 2035, the fuel mix is, of course, evolving extremely rapidly even by 2030. And oil, as you can see on the chart here, is almost gone in the transport segment in 2050. The steep penetration of alternative fuels is also visible to the left, and alternative fuels means power-based fuels cells and e-fuels. And you can see here how that penetration is very different between all of the worldwide countries in Momentum and just the net-zero 50 countries that are shown to the right.

Now we come to power demand. Electrification is massive in all sectors, reaching 45% of end-user demand in the net-zero 50 countries, way above Momentum, which stands globally at 30%. Green hydrogen and transport make up close to 40% of power demand in 2050, and that's versus 25% in Momentum. 80% of new power demand is linked to these 2 sectors. So transport and green hydrogen. Again, that's what it says to the right, and we'll move on.

Let's talk about the consequences for power generation. The resulting picture is a huge increase, of course, in solar and wind capacities that make up 60% of the power mix in 2050 versus 48% for the whole world in Momentum. An important assumption that we've used is that the U.S. and European power grids are almost carbon-free by 2035, in line with the stated government goals. The grid stability and resilience is maintained, thanks to gas with CCS, nuclear, hydro and batteries.

So coming to gases demand in the net-zero 50 countries. As you know, we firmly believe that gas has a pivotal role to play in the next decade as a reliable and affordable transition fuel that will become greener and greener. And this certainly applies to the net-zero 50 countries also, at least for 4 reasons. There is plenty of coal to substitute in these countries. The power grid needs a baseload fuel given the high penetration of solar and wind that we've just discussed in the power networks. Gas is going greener and greener in these countries, and then gas is also needed to produce blue hydrogen. In the scenario, we have here, 50% of gases energy is green including biogas and green -- blue hydrogen and so on. And half of the remaining natural gas is abated via CCS, and that's used mainly in the power sector and in industry. Overall, 3/4 of gases are decarbonized in the net-zero 50 countries in 2050.

The chart here summarizes then the CO2 emissions pathway for Momentum and for the net-zero 50 countries. The contrast is stark, of course. We've assumed 2 gigatons of CCS in the net-zero 50 countries out of the total 3 gigatons for the whole world in Momentum. So the net-zero 50 countries also lead the way in deploying and using CCS technology. Carbon pricing is one of the market signals in those countries that can and will enable that. As you can see to the left now, CCS begins to play a visible role after 2030, and that's the pale shaded areas on the chart. To get rid of the residual 1 gigaton of emissions by 2050 will require nature-based solutions or a breakthrough in other technologies to remove carbon such as direct air capture, for instance. That's all I had to say on Momentum and the net-zero countries embedded in Momentum that are also modeling Rupture.

So I will now move to Rupture. Again, by construction, Rupture is a well below 2-degree scenario, assuming somehow that the whole world follow suit on the decarbonization implementation plans of the net-zero 50 countries. I will start with all the final consumption and then I'll move forward sector by

sector and then with primary energy demand. So here comes Rupture's final -- total final consumption. Rupture assumes an even faster worldwide electrification than in Momentum. Power becomes the #1 source of end-use energy by the mid-2030s and not in the early 2040s. Its share in the overall mix is much higher than all the fossil fuels combined by 2050, roughly 40% versus 30%. And then the 3 contributions in the final consumption mix of hydrogen-based energy, bioenergy and natural gas. These contributions and are very similar, as you can also see on the chart. To the right, you see how transport and industry experiences a massive drop in their CO2 emissions, and residential and commercial is only slightly behind.

So that's the total final consumption. The chart here contrasts power demand in Rupture with Momentum in 2050 compared to today. Rupture relies on the power sector that is 2.5x bigger in 2050 than it is today. And it requires 20% more power than in momentum. Electricity for green hydrogen, and you can see it on the bar charts here, contribute roughly 20% of power demand in 2050, and that's 50% more than in Momentum. The associated need for wind and solar to the right is staggering. Every year between now and 2050, every year over the next 30 years, the world has to add all of the existing installed solar capacity or all of the existing installed wind capacity because those 2 bases are actually very close. This will also require, of course, massive storage solutions, again, be they battery based or green hydrogen or some other new technology that will be invented.

The resulting power mix comes very close in Rupture to the one we talked about for the net-zero 50 countries. But here again, we're talking about the whole world. You see to the right how the power sector intensity goes down, how the carbon intensity sorry, goes down. It's already almost half in Momentum, and it comes close to 0 in Rupture.

Solar and wind to the left represent 100% of the global net increase in power by 2050. Achieving this effectively means capacity removing, changing the mix and therefore, effectively means rebuilding entirely the world's power systems over the next 30 years.

The chart here the summarizes contribution of clean hydrogen to this well below 2-degree world. The main use of clean hydrogen is in transport and industry for such industries such as steel, petchems, cement and so on. Total clean hydrogen demand exceeds 400 million tonnes in 2050 and 2/3 of that is green. Honestly, the orders of magnitude of power and gas needed to achieve this amount of clean hydrogen 30 years from now, these orders of magnitude are very difficult to apprehend I think. So we've tried to give you some benchmarks in the charts here. An electrolysis capacity that would require 2.5x the current solar and wind capacities. In terms of power needed for clean hydrogen, we're talking about the current power demand of China and the EU 29 countries, and so on and so forth. I'll let you read the details. Of course, scaling up hydrogen at this level also assumes that we can cost-effectively scale up electrolysis on one hand and CCS on the other hand for blue hydrogen.

Zooming in now on the final demand per sector. And I'll go a little fast, just hit the headlines. In transport, Rupture assumes that the ongoing growing transport revolution in the net-zero 50 countries and in China extends to the rest of the world. Non-oil alternative fuels reached more than 50% of

penetration in all the subsegments that are listed to the right here. So both in the light vehicle fleet, of course, but also in heavy duty and in aviation and in marine. Biofuels helps decarbonize the remaining liquids, so the remaining use of oil.

In industry, deep decarbonization actually hinges on multiple avenues. They're all listed to the left here. Coal-to-gas substitution and switching whenever possible and then gas-to-electricity. Switching to hydrogen whenever that is feasible, massive CCS deployments and recycling, both of new materials and of scrap materials -- sorry, only of scrap, but also plastics. The winning recipe is clearly a combination of all these alternatives when it comes to industry.

To the right, we focus on petchems and the related oil demand, which is down 40% in 2050 versus today in Rupture and down 20% already in Momentum due to the recycling assumptions and to the fact that in Rupture, we have a worldwide single-use plastic ban going on. In the residential and commercial sector, final demand is almost flat, as you can see here, between now and 2050.

How is that? Well, it's thanks to the strong energy efficiency gains, building refurbishment and new standards for new appliances, such as lighting, cooling, heating and so on. The Res&Com electrification ends up very high at more than 60% in Rupture due to the link between urbanization and electrification, and that's shown to the right. There is a massive trend going on in the world to increase urbanization that helps drive electrification in the residential and commercial sector. And so effectively, a lot of power in the Res&com sector on one hand and flat demand linked to efficiency and standards on appliances and buildings. In fact, decarbonization in this area is less a technical challenge than a socioeconomic challenge because very often, if I talk about households, those families whose homes need most refurbishing for energy efficiency purposes can hardly afford it. And this is true in non-OECD countries, but it's equally true in many households in our own OECD countries.

Coming to the world gases demand in Rupture. In our scenario, a well below 2-degree world still uses gaseous energies. The 3 main sectors being to the left, power gen, industry and production of blue hydrogen. If you see to the right, more than half of all the gas demand is satisfied via green gases: hydrogen, biomethane, CCS abated natural gas. So we see a massive push on clean gases in Rupture with this huge advantage, of course, that gas can reuse the existing infrastructure that is available worldwide for natural gas. In the same way, liquid fuels are also much greener in Rupture as shown on the chart here. Rupture entails a massive adoption of sustainable liquid fuels in all transport sectors as we already discussed, and they reach the liquid -- the sustainable liquid fuels reach 30% of liquids demand in 2050 and you can see that to the left. In Rupture oil demand ends up at roughly 40 million barrels per day in 2050. The chart here is, in fact, in millions of barrels per day.

Finally, here is the global primary energy mix in Rupture, reconciling greening the energy systems with sustainable growth for all. The mix is even more diversified than in Momentum, as you can see to the left. I will let you read the details. In terms of CO2 emissions, Rupture ends up with approximately 8 gigatons of residual emissions after taking into account 7 gigatons of CCS. Compared to Momentum, if you look to the right, 70% of the cumulative abatement required over the next 30 years come out of

Asia. And this is what you can see again -- you can see the impact of decarbonizing China, India and other Asian countries and then the rest of the world. As for net-zero 50 countries, residual emissions in Rupture will have to be abated either by nature-based solutions of our innovations in carbon removal technologies. So this is all I had to say on Rupture. And now I have 2 final charts on the sensitivity we did moving from a well below 2-degree world to a 1.5 degree world. We've done that via sensitivity once again, on option we've called it Rupture+. To make a long story short, assuming that there is a worldwide ban on internal combustion engine sales as of 2035, and if we assume that it removes 14 million barrels of oil demand in 2050 and reduces the emissions of CO2 by 2 gigatons. Rupture+ also assumes an increase in CCS from 7 gigatons to 8 gigatons. With that, global residual emissions fall below 5 gigatons in 2050, which makes this Rupture+ scenario consistent with the 1.5 degree temperature increase in 2100. But the real message is that moving from Rupture to Rupture+ and meeting this 1.5 target requires another step change in energy supply and demand driven by regulation, technology and behaviors. And just because you were probably going to ask anyway, my last page here shows the total primary energy demand in a 1.5-degree world. We've contrasted Rupture+ with the IEA net-zero emission scenario that was published back in May. Keep in mind, again, very importantly that energy demand continues to grow in Rupture+, which is not the case in the IEA net-zero emission scenario. To the right, you can see that oil demand ends up being very similar in Rupture+ and in the net-zero emission scenario in 2050. But you can also see that the trajectory to get there is very, very different. This concludes my presentation, and we are now ready to open up for Q&A. I would first, however, like to extend a very warm, big thank you to every colleague in TotalEnergies that helped put together this Energy Outlook. You've done a great job. Thank you very much to all of you. I would also like to add, as you're aware, that we consider the ongoing energy transition and the related investments as an opportunity for a multi-energy company like ourselves. We have the skills and competencies, the financial strength and the global reach to grow profitably in a lower carbon energy market. We'll hear more about that tomorrow. Thank you very much.

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

Thank you, Helle, for this performance, I must say, in 55 minutes to present these 2 studies, and comprehensive studies, with key messages about our energy system and the potential future of them; I think it's remarkable. I'm sure that we'll have some questions about these presentations. Once again, Helle made this performance to summarize the key messages for this presentation. She did not describe the whole content of each slide over, otherwise, I think, it will be another 50 minutes here, but it was a key message we got there. All that material will be available to all of you on our Internet sites. They are already, I think, on the Internet sites, put there during this presentation. But now I think I will open the floor to the Q&A session, and we are ready to take, Helle mainly and me if I can assist, the questions now.

QUESTIONS AND ANSWERS

Operator

(Operator Instructions)

The first question comes from line of Jon Rigby from UBS.

Jonathon Rigby ***UBS Investment Bank, Research Division - MD, Head of Oil Research and Lead Analyst***
Thank you, Patrick. I have 2 questions. The first is what are we supposed to do with these scenarios? Because it seems to me is that the Rupture seems highly improbable, Momentum seems incredibly tough. And so with the best in the world, it would seem to me that success over the next 20 or 30 years where we need to deliver Momentum. Does that sort of accord with your thinking? And if it does, how do you set your company strategy against that? Because it seems to me is that setting a normative outlook, a sort of backcasting from an outcome, isn't necessarily the best way of setting Total's strategy? And then the second question, just did you do any work on the cost differential. So the capital investment that the delta between, let's say, business as usual, that of Momentum than of Rupture. So we get some idea about what has to happen in dollars and cents terms over the next 30 years in terms of these outcomes?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Okay, Jon. I will help Helle as she spoke a lot, I will begin to answer and she can complement. I think for us, this type of scenarios, first of all, we have, as a company, I remind you the ambition get to net-zero. And we subscribed to the Paris targets, which is to work for a world which would be well below 2 degrees, first comment. Second comment, which is important from a strategy point of view, is what are the key trends, I would say, which are described, either on Momentum or in Rupture, then the question to which scenario will be really implemented and where the world will go, it's not only the matter of a company that supplies energy. It's mainly, as it was explained by Helle, a matter of demand. Driving the demand is, in fact, more linked to policies and change of behaviors linked to customer demand. So it's a global society. which must reinvent energy. So it's not so easy. Having said that, what are the trends? I think there is a key trend, which is electrification. So you can understand that when TotalEnergies has decided to submit to its shareholders the implementation of a strategy which is to build an electricity power business within the company, it is fully supported by this trend. So we see growth in energy coming, I would say, from electricity and mainly, as it was explained, from renewables, solar and wind. And one of the lessons, I think, for me when I read all these studies is that when people speak today about hydrogen and clean hydrogen, blue or probably green, I think these studies are the first documents that are really a comprehensive vision of what is the impact of producing green hydrogen, clean ammonia on a large scale, on the power demand. Because at the end, green hydrogen is fundamentally a matter of renewable energy plus water electrolysis providing this engine. And you have seen the impact. I think there are few charts where you perfectly see the additional demand for renewable electricity. This, by the way, makes me very comfortable when I have some questions from you, and I'm sure tomorrow it will come back. But it is not too ambitious to reach another 100 gigawatts. And what will be the impact if you produce all this renewable electricity? In fact, the demand for renewable electricity is huge if we want to reach such a world. So it's a comfort from my perspective in terms of strategy, it gives a strong comfort to this decision that we will allocate capital in a large way, around 25%, to growing renewable production and there is room for a lot of competition. Let me say, it's not competition. There is room there for many producers and investors. Last, I would say, or the second comment that we can also see in these scenarios: I would say that there is a very strong impact on the

electric mobility trend, I mean, which is quite new, in fact. I think, in fact, it's this world, it's moving a lot. As you've seen, we have announced on Friday some important agreements with Mercedes-Benz about battery business together with Stellantis. I don't think we would have done such a -- we have just doubled the size of this JV -- even more than doubled the size of this JV. There is very a huge acceleration on the, I would say, the electrification mobility. And that's for light vehicles, as Helle told you. And so this idea that the ICE ban by 2035, which seems to be ambitious, but Europe has at, I would say, at the forefront. In fact, we can see that if we don't generalize this type of approach, this -- but that's true that the challenge will be tough if we want to reach the objectives of the Paris agreement. It's 2035, it's not 2025. Why do I say that is because, in fact, you have a real impact on oil demand, which, of course, is important for us. Not immediately, these technologies have an impact on oil demand beyond 2035 which means that, and that's another lesson, there is a need to deliver to the people who today use these energies to meet the demand in oil and gas and at the same time to grow and to accelerate (technical difficulty). See where the decrease of oil demand would come in the next 10 years. Again, the ICE ban is beyond 2030, then that means that we need to continue to produce and invest in hydrocarbons. And the recent events on hydrocarbons prices, I think support that vision. So those are, I would say, the key lessons and that's, for me, why we are looking at that. Of course, it also makes us think about what we need now in TotalEnergies. And when I speak about hydrogen, again, it's a question of renewables. So all that we are doing today to be able to manage in a large way these renewable energies will be very important for us to develop our company tomorrow in clean and green hydrogen -- the cost differential, I mean, I asked the question like you, Jon, to my teams. And to be honest with you, we came up with some figures. But Helle and I have decided not to provide them today. I promise you that next year, we'll have them. We need to work hard on it. We need to be sure that we consider the many assumptions on that. It will decrease because you can imagine, like we've seen in the solar industry, and we're scaling up some new energies, we have a decrease of cost. So all that is difficult to factor in. But what I'm sure is that we need, at least, to invest $1 trillion per year if we want to be on the trajectory. Last year, we did not invest $1 trillion per year in these energies. I mean, oil and gas plus solar and wind, it was more around, I think, $700 billion to $800 billion.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Yes.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
So that means that we need to increase more the investments in energy in the coming years if we want to have to have a chance on the trajectory. By the way, in our strategy, we continue to invest and we have the willingness to continue to grow production of energy, of course, going more to decarbonized energy. But Jon, I will tell you -- on your specific question about the CapEx differential between the scenarios. I promise you that we'll come back to you next year, but...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
I can give an answer on the delta...

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

But Helle wants to do it. So...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
I can give you an answer on the delta Jon, but not on the absolute. So I mean, roughly, today, I would say, 30% more investments in Rupture than in Momentum, but what we're struggling with is making sure we have a solid basis for the -- what's the amount we're talking about here. So Patrick's [$1 trillion] per annum is probably a good proxy at this stage for Momentum. So we're looking at 20% or 30% or 40% more for Rupture. But then again, the difficulty is, of course, how you allow for costs decrease and scaling up of new technologies over the next 30 years. And when you put a number on that, you get a lot of uncertainties. So this is why we chose not to express the numbers in dollars. But the order of magnitude, if you want to go from one scenario to the other, again, my guess would be 30%.

Jonathon Rigby ***UBS Investment Bank, Research Division - MD, Head of Oil Research and Lead Analyst***
Very good. $100 billion to $200 billion or $300 billion, and you're talking real money, right?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
At least $300 billion.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Yes. At least.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
So that means that when compared to...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
30% or 40%.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
What we've done last year, it's almost globally doubling what we've done, what has been done.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
And again, Jon, this is only what we're talking about here, so oil and gas investments and renewable power and some storage and some CCS, but we are not costing energy efficiency or refurbishing of homes, and we're not adding in power transmission and distribution costs or increasing the capacity's global scale. We're not good at that. So we're being-- I like your question, Jon, because if I may just add to everything Patrick has said, I think we are humble. And we don't say that we know what the future looks like, but the message is also that we are ready to take whatever comes as an opportunity and to leverage that opportunity, we need to explore possible scenarios. And honestly, when we decided very early after last year, I mean, in the fall of last year, to model this thermal car and trucks ban in the net zero countries by 2035, there had not been all these OEM announcements that came later out of the GMs in the U.S. and so on. But -- so we were not following existing announcements, we're just playing with assumptions. And for ourselves, trying to understand what does this mean for the world, for certain

geographies, those geographies where we are more present, of course, so more Europe than the U.S., if we talk about selling oil or EV charging points. And then what impact might it have for our strategy, and we use it as one way of informing investment decisions, as Patrick said. So I think these scenarios are very important actually. Of course, I'm convinced, otherwise we wouldn't do it.

Operator

The next question comes from the line of Lydia Rainforth from Barclays.

Lydia Rose Emma Rainforth ***Barclays Bank PLC, Research Division - Director & Equity Analyst***

Thanks Helle Kristoffersen, as ever, for a great presentation. Two questions, if I could. The first one was coming back to hydrogen. And clearly, that has a more important role this year than last year. But I'm not sure I really understand what it is that's changed that. Is that related to policy on the government side? Or is it on the ventures that you're doing, that you're suddenly finding a lot more demand than you might have done a year ago? And then the second question was about energy chains and you said a little bit of time earlier on, talking about that. But do you think enough of those chains exist in practice? And whether that's kind of the hydrogen or the renewable energy seeing that there is enough of those chains to actually get things to the marketplace at the moment?

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

I'll start with the last one. And so on energy chains, and you were specifically, Lydia, asking about green hydrogen chains, the answer is no. We are still at a very early stage. And we are still piloting on a global scale on these green hydrogen production chains. But one element which is new between last year and this year is that there are many more pilots and there are many more projects being announced on the global scale out of the Middle East in the U.S., in Asia and of course, in Europe. Europe already had it last year with the green deal. So I'm trying to answer both questions at the same time. So there's bigger momentum for hydrogen today than there was a year ago. There's been a change of administration in the U.S. There have been these net-zero pledges out of countries who have very few resources at home like Japan. And there are all kinds of ideas around, as I try to explain, you can use green hydrogen and then create derivative liquid fuels or other forms of fuels from green hydrogen combining with carbon to e-fuels, sustainable liquid fuels for aviation, but also moving to ammonia or moving to methanol and shipping. And so we have increased the forecast for hydrogen demand by I think it's 100 million tons versus last year. So [1/3] more, if you want, which is substantial. And we have also decreased the gas demand in some of the transport sectors where hydrogen derived fuels may pick up. Again, shipping would be an example.

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

Yes. I think for hydrogen, as you know, there are 2 main roles. And I think that we -- which led us to introduce it in a larger way. And that's true, it's partly at the detriment of natural gas, in fact, in our scenario. I know that last year, all scenarios were quite gassy, I would say. This year, we use more, I would say, decarbonized gas rather than just gas. Why? Clearly, hydrogen everybody agrees will be a vector for hard to abate industrial segments, I would say, like cement, steel, et cetera. So we see -- but it's not enough. I think when you look to transportation, for the future of transportation. So more we

look to trucks, heavy duties, to shipping, to sustainable aviation fuels, we clearly see some space there for going to, I would say, liquids, some form of liquids, either synthetic fuels, e-methanol or ammonia or -- we see here that without these types of fuels, it will be difficult to reach the Paris targets. And so where does it come from? It comes fundamentally from renewables, from hydrogen. So I think it was this trend, and we observed that. And by the way, we contribute, we participate. As you know, we have it as part of the strategy to work together with the customers. So we have some teams of TotalEnergies, which are deeply involved today in works with the shipping industry, with aviation. We just announced this morning a new strategic partnership with Safran in the aviation industry. We are a strong partner of the Maersk Research Center for marine fuels. So we learn. We learn with them. We evaluate different, I would say, alternatives. And we have more and more conviction, and we work also with the truck heavy-duties, we know truck manufacturers, where we see a trend where electricity on one side, could occupy quite a large space when you go really to, I would say, long-haul avenues, then something like hydrogen should be positive. So we see more space for that. Having said that, we still have to work hard because we perfectly know that the cost of green hydrogen is not today in line with expectation of customers. Honestly, I think we have to work on it. And the challenge for all of us will be can we really scale down the cost of green hydrogen by being able to process this at a massive scale. This is what we will target as TotalEnergies. But again, one key driver will be obviously the capacity to drive down the cost of renewable energy, of clean energy, by making that at a very large scale, in large way. So yes, hydrogen has a larger role because it's the results of evolution of what we share with some of our big customers: a conviction that we'll need to drive in that direction.

So hydrogen. Yes, that's I think the answer.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

Yes, I'd like to add just one thing. If you go back to the chart I showed from the energy landscape, of course, if we talk about green hydrogen, we talk about renewables. And so if it's land-based renewables, you have this issue of land use and the amount of square meters or miles that you need to create the renewable power for the green hydrogen. It can be done offshore. It can be done outside of the borders of the hydrogen consuming country. And we don't share all the details of the model, but Lydia, I can tell you that in our modeling this year in Europe with the green deal and the consumption of hydrogen that we've modeled in Europe. Roughly half of it is imported, okay? Because if we do scale up hydrogen massively, it doesn't necessarily mean that all of it will be produced locally. So there may be new trade flows linked to hydrogen also.

Operator

Thank you. The next question comes from the line of Paul Cheng from Scotia.

Paul Cheng ***Scotiabank Global Banking and Markets, Research Division - Analyst***

Patrick and Helle, 2 questions, please. I think whether it's Momentum or Rupture the electrification and substantial increase of the alternative energy, solar and wind are really the key themes. But in order for that to work, -- That's I think the other bottleneck or the key is the battery storage, you need to increase it dramatically. But when we're looking at the building of the battery storage, they are quite polluted

quite dirty. And also, how should we look at the disposal of old batteries? I mean are potentially actually creating the problem from an environmental standpoint by trying to solve the carbon dioxide issue. So how should TotalEnergies and the world be looking at that aspect? The second question is on your chart, on the EV battery car, the efficiency, it says 73%. Just want to get clarification. Is that including from the actual creation of the electricity? Because I mean the battery efficiency is high, but the electricity transmission from the power plan to actually get charged to the battery. You could see it roll out emissions more, transmission more in power, particularly given the alternative energy source, their footprint is so high so that they are probably far away from the population center. So I just want to know, what that 73% will need?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
I will leave the second question to Helle. The first one, first, I think Helle insisted that one of the, I think, for us, the key limitation to the increase in renewable solar and wind is more a matter of footprint of space, I would say. We need -- before, TotalEnergies was looking for scarce resources underground. Now we are looking to scare resources at...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Above surface.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Above surface. It's a new challenge for us. It's not exactly the same skills that we need to have, but frankly, I think it's really -- one of questions we have asked, and we'll ask it to translate all these capacities into the square kilometers just to be able to have the idea of what it means. And that's why, I think, by the way, that like Helle said just before, the green deal obviously will be possible only if we are ready, of course, in Europe to import from abroad because I think we don't have enough space to build all these renewable capacities on the continent.

Coming back to your question about the batteries. Batteries -- in fact, it's not only batteries. When you develop electricity and you evolve intermittent renewables, it's a matter of energy storage. It's not only -- battery is one way to do it, but there are other ways to store energy. And by the way, hydrogen is one of them. You could imagine storing into hydrogen and then transporting hydrogen via networks and then delivering it. So there are other options. It is true. Your question is very true about recycling of batteries. As you know, TotalEnergies is involved through Saft. We have a battery company, and now we are establishing a new company called ACC with Stellantis and Mercedes Benz Daimler for batteries for EVs. And this is obviously one of the key issues that we are looking at, not only the Upstream, but the management of all the, I would say, raw materials. But what do we do after that with the batteries? There are some ideas about the second life of batteries and trying to extend them in order to continue to store energies, by the way, but it's obviously something which is very important to look to the life cycle analysis of these batteries.

Europe is taking, by the way, some regulations about it. It's a smart way, by the way, to oblige the competitors to have the same standards, not only if you want to sell batteries in Europe to accept the

same standards instead of global recycling and life cycle analysis of it. I show, there is a problem. I mean, there is an issue. By the way, each time, it's not specific to batteries. I mean there was a debate recently about the wind farms and the capacity to recycle these...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
The blades.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
The blades.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Yes.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
And Siemens has just announced recently that they are able to build blades, which will be recycled. So I think... I mean, we should have some wind farm manufacturer -- blade manufacturers announce that. But I mean it's -- I think, yes, true. We are obliged to invent a new way to find energy, so we find new problems, but I'm like always, nothing is -- if it were -- there was a perfect solution, we would have found it. But we don't -- we should not overestimate it, and I think it's not the limitation in the batteries. The battery, the issue is more of the cost of all that. It's not super efficient what we do today in terms of capacity to store. So we have still -- I think it's one of the sectors where clearly we'll have to innovate on other ways for a battery to store. So I think we are today with -- I'm absolutely convinced that these lithium ion technologies that we use today are not at all the final stage, including, by the way, the type of metals that we include in these batteries. We are working a lot on different chemistries in order, in fact, to try to avoid and to reduce the potential disposal issues by selecting the right chemistry at the entry of the problem. So I will let maybe...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Yes. And I'll go quick, Patrick. I believe the answer to your second question is, yes. But I'm ready to take it offline because I want to be sure I understand what you call full cycle so that we talk about the same things here. So we can follow up on that after the online meeting.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
So the EV battery efficiency question will be handled by Helle and Paul together. Next question?

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

Irene Himona ***Societe Generale Cross Asset Research - Equity Analyst***
I had 2 questions, please. First, our energy has become much more expensive, not just on the oil side, but importantly, on natural gas. We have high -- record high prices just ahead of winter. There's been a relative lack of recent LNG FIDs. So should we be somewhat concerned? Are you concerned about the

affordability of this transition for the consumer, even in the rich countries, especially as we need to rely on gas as a transition fuel? And then secondly, I realize you presented 2 demand scenarios today for the transition, not supply. But should we be concerned about the availability of the critical minerals required to effect the transition to all these clean energy technologies?

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

There again, I will leave the second question to Helle. That's the easy one. No, but I'm not sure we have the whole answer. In fact, we need to make this cycle go up. And I think it -- we are reading a lot about these questions. So I try to understand it. It's a little like the cost and the CapEx. We need to cycle fully the scenario down to the primary demand for metal, I think. And again, that's a moving part, but I understand your question. And I can tell you, by the way, it's part of when we work in the battery domain, we are -- that's part of the things that we have decided to better understand, in particular, for the JV that we have with ACC. How far should we go Upstream in terms of management and controlling, I would say, future costs of supply and what could be critical or not. On the first one, I think it's not -- I think it's more, I would say, a short-term issue. I think, Irene, you know perfectly as much as me that there is a lot of volatility in the energy market. And I think it's very clear that the -- so today, we experienced, I would say, like in many, not only in energy, by the way, in a lot of commodities, there is a strong stress on many supply chains and strong -- after the big decrease last year, a strong increase. Globally speaking, I think this global system of the world that we have built during 30 years is not really designed to accommodate such big growth. And so we see some stress, logistics increase suddenly -- I would say, sudden increase of demand, which is difficult to cope. It creates, of course, some inefficiencies and some stress on some markets.

The natural gas today is very high. At least, I mean, the spot market, let's be clear. Most of the gas markets are not so on spot, it's not true. Most of the gas market is sold on long-term contracts, and they have not reached the $25 per million BTU, et cetera. So it's really spot. I'm not sure it's not good. By the way, I'm not sure it will last. Of course, it's quite remarkable because it was summer time. The question more fundamentally that you have asked for me is, I mean and you know that I'm trying to repeat it regularly in different conferences to -- as a wake-up call to all the policymakers, but there is no miracle. We speak about a huge amount of this -- We speak about trillions and trillions of dollars. I don't see -- people could think that we'll be able to invest all these trillions of dollars to change fundamentally our energy system without an impact at the end on the customers. Even if we amortize these investments on 20 years, that's a lot of new investments, more -- but what we do normally in the previous year. So if you invest more somewhere, it will have to be reflected in the cost. It's for the customers. So there is no reason not to -- I don't know why people don't want to accept it. That's, of course, for governments, for policymakers, that's a major question. A major question, which is how you compensate it for, in particular, the low-income revenues. I think that's obvious, but -- and I think this question today, maybe it's spectacular, the way it's on their desk this year. Maybe they did not -- we are not expecting it. I mean, I would be -- I'm very humble, but none of us, I think, in the industry were expecting such an increase of prices at the beginning of the year. We were all planning with $40, $50 low gas prices. So suddenly, we see this disruption.

But I -- it's very clear that I think there is no way to make this transition. If the governments are serious about the Paris agreement without clearly putting on the table some clear schemes, with which they will compensate for low-income people, maybe not only them, by the way, the impact of this transition. If you take taxation on CO2, it's very good to put in place a CO2 pricing, and they have to do it if they want to influence the behavior of customers. But this amount of money must be given back to the consumers in order for them to find -- must be given back in a smart way. I mean helping them to change their behaviors of consumption and to reward the ones where, I would say, more diligent than the other one. So I think that's something, and I'm sure the citizens will not accept to pay more for CO2 or more for energy, if they have a feeling that is going just to finance the global deficits of other countries. That will not work. But this is a key question and that might be, I think, in the implementation, including in developed continent like Europe, I think it's probably the key obstacle to the [FID 455]. And you have seen the reaction of the countries. The commission has put on the table a very comprehensive scheme, which honestly, I can just subscribe to it. The problem now immediately for all governments is, how do we make it really pragmatic to implement? And this question of affordability is becoming -- So it's not only for natural gas, it's true for oil. It's true for -- by the way, it's true for electricity. You've seen the price of electricity that's more than doubled in Europe. So that's a key question for all this transition, and I think it's quite good, by the way, that it comes on the table just before the [COP26] because it's a matter, of course, on which the emerging countries have their own debate. But how do we finance the increase of, I would say, the necessity of more demand for energy to get people out of poverty and to elevate their living standards. In our own countries, developed countries, Net-Zero countries, we'll have this key question, which is, how do we make a just transition. I think the just transition should not be only a motor, it will have to become real because that is a matter of money now.

So the second one, I do have other elements of...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

No. No, it's a good question, Irene. And of course, we're looking at it. So recycling is part of the answer, moving to new metals or new minerals is part of the answer. And we have a good window, I think, of understanding at least of questions through everything we now do in batteries, including in the ACC JV. So we're looking at it. I would say that it -- there is an opportunity linked to the fact that until recently, demand was not so high. So there are, I would say, resources available that have not been put at work. There are mines and mining and critical material resources a little bit everywhere in the world, in Africa and Latin America, even in Canada, and of course, in regions like Asia. So we first have to really master supply, which is probably bigger than what people have thought. And then we have to look at the balances between supply and demand. So we are working on it.

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

But it's a moving target, because I observe the way that all soft are --- indeed people are changing the content of some of these critical elements.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

Back to what you said on changing, the chemistry...

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
It's changing the chemistry, and we told them to be careful with cobalt, and then we diminished a lot of cobalt content. So I think it's -- that's where it's complex because there are some fundamental elements, but there are also others which are more...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
There are options, and as you said also, Patrick, the battery technologies are going to change anyway, moving to solid state and then after solid state. That's an excellent question and it's a fascinating topic.

Operator
The next question comes from the line of Michele Della Vigna from Goldman Sachs.

Michele Della Vigna ***Goldman Sachs Group, Inc., Research Division - Co-Head of European Equity Research & MD***
My question really has to do with bio energy, which plays a major part in your scenarios, but to be fair, also in several other Net-Zero scenarios, especially for aviation and for shipping. And I was wondering, how confident you feel that the raw material will be there to fuel such a substantial growth there without really competing the other side with the role of nature-based solutions and also without the key role of agriculture to supply food for a growing global population.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Michele, it's a very good question for me. It's why, by the way, we have probably increased as well in our scenario what I call the hydrogen-based liquids fuel, synthetic fuels because it's very true. Maybe our own experience. We know we have suffered a little. I will come back on it, and I think it's not only the end, the soybean tomorrow, I think, in Europe. So my view is that -- and you also know that in our industry, we have invested a lot of money like other players to try to make what we call the 2G, second-generation biofuels to become a reality without a lot of success, to be honest. And so in my view, there will be -- of course, I would say, the biofuels are immediately available. So we can begin to make, for example, sustainable aviation fuels with biofuels. I have a first generation or even what I call some wasted animal fats or used cooking oil, but there will be a limit to that. Obviously, in this type of feedstock, which is quite limited, in fact, on the planet. So -- and I agree with you that the competition with agriculture and -- will be also limited to the first generation biofuels. It depends, of course, on the sensitivity of the continent, but what happened in Europe, I think will spread out. So this is why -- again, so yes, we will develop it, but I think it's for maybe a transition, a transition between oil today to integrate some of these biofuels, biodiesel within oil to reach [10%] or 1%, 2%, 5%, 10% in order to support the first decarbonization steps for the aviation, for example.

But beyond it, I'm absolutely convinced, we'll need to have other technologies like synthetic fuels. Otherwise, we'll get to the limit that you are proposing, which is a limit of -- in fact, again, by the way, it's a matter of space allocation and land allocation, land competition. And people will have to be able to get their food before they get their energy from the food. So I know this is differently, by the way, observed.

For example, in North America, this debate today seems to be not as strong within Europe, but I think it will rise. So we see that, yes, investments are to be done, but we need also to invest in the next generation of synthetic fuels.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
And I think, Michele, that what Patrick just said is exactly what is reflected in our 2 scenarios. So there is a room for bioenergy, but it's capped, if you want to say it like that. And we have, again, Patrick explained it, we've really significantly increased the H2-derived sustainable fuels for that reason because the other competition, of course, is with biodiversity if you talk about land use and you also run into biodiversity.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
And then the question will be, are we able to really develop these 2G technologies. But honestly, and I've shared that with most of my peers, we invested and unfortunately, yes, it works at a small scale, but on a very large scale, we will see some limitations to make it to...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
They come, of course, over the next 30 years, but we're not there yet for sure.

Operator
The next question comes from the line of Anish Kapadia from Palissy Advisors.

Anish Kapadia ***Palissy Advisors Limited - Director & Head of Energy***
I had one quick question and then a more detailed one. The first one was around your assumptions of 3% GDP growth with just 0.5% energy growth. I was just wondering, is there a risk to that in terms of GDP growth, if energy is only growing at 0.5% per annum and your thoughts around that? And then just going into a bit more detail, there was some very large numbers in the presentation when you look longer term, such as 1,500 gigawatts of battery is required. So I really wanted to kind of dig a bit more into the work you've done on the feasibility of getting to some of these numbers. Just given the -- some of these things are going to have quite large second order effects and maybe unintended consequences. So by this, I mean some of the things you've touched on like metals, the batteries, but also water usage for electrolyzers being able to -- for grid being able to cope with the higher electricity demand and gas networks being able to take hydrogen or even finding enough space for renewables and biofuels. So just wondering if you've looked into these effects, the constraints and does actually that create somewhat of an investment opportunity for Total in some of these secondary areas?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
I will let Helle answering to the 2 questions. Just one comment. It's clear that honestly, when we -- the more we are reading these scenarios, the more I think that we are willing to reinvent the world and that there are many unexpected consequences. I mean because what we built for this scenario is something that we -- We see it, but there are many of them. Space is land, and land management is an issue. So it's very difficult to be able to evaluate the all consequences. And I think that's part of the difficulty, I think,

by the way, also for policymakers, which is that the planning of this transition is tough because we are describing something, but which is not real today, which is at a pilot stage. So to extrapolate it is not easy, but by the way, I would insist that is why we recommend, globally speaking, to governments to think to what means transition. Transition means step by step. It does not mean that suddenly, we will be able to change the world overnight. I mean so step by step, because we need to be able to monitor this transition as well, including these unexpected consequences, but I will let Helle come back on the assumption of GDP and on this issue as well.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

Thank you, Anish, and thanks, Patrick. Is there a risk to that assumption? I would say, yes, because I cannot guarantee you what the GDP growth of the world will be every year over the next 30 years by definition. So humbly, we're looking at what the Oxford Institute and other big macroeconomic think tanks say about future growth. We have lowered the GDP assumption a little bit from last year. We had 3.3% last year. We've taken 3% this year because we got some feedback that maybe 3.3% was high. If you go back to the landscape, we had a chart showing that energy demand has been up globally by 1.8% over the last 20 years, driven by non-OECD. But -- so honestly, I don't think that the [0.5%] energy demand growth assumption is high. I think it's low. It does factor in also the energy efficiency increases that we have outlined in the model. So globally, it's not a forecast. It's an assumption in a model, but the 0.5% growth per annum in energy demand, if anything, looks low.

On the batteries, I would say, nothing to add to what Patrick just -- also just discussed. Yes, there are lots of unintended consequences of follow-on impacts of this whole transition. We talked about recycling. We talked about land use. We talked about competition for food. So I think Patrick said, as we use new energies, there will be new problems coming up and that's a fact. So we'd be happy to discuss this with you. But yes, there are consequences from moving from oil to power and then using more power and more solar and wind, needing the firm power capacities to stabilize the grid. And that's what makes it interesting also and full of opportunities.

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

Yes. Two additional comments on that one. First, about the GDP assumption. 3% is a little lower than last year, but the Net-Zero scenario from the IEA is around 2.8%. So I mean there is not much difference. And I think it's important because I think when we speak about a just transition, again, we must think that it's also a matter from somewhere being able to make this transition. We were discussing with Irene before about the population of our developed countries, but you know you have billions of people in this planet who want to, again, have higher living standards. And these ones, in our assumption, I think we have a... There is a growth of 3.4% in the last -- no, they have grown at 3.4% in the last 20 years. And they need it, they need this growth really because this transition will not be done against the population of all these emerging countries. That's not possible. So I think -- and this is again the -- how do we find the balance. So the concept that we can read today in some articles in the Western world that we could lower the growth in order to meet the Paris agreement, I think, will really raise a lot of issues in many countries. And I have -- I don't see the way to tell to these populations. Sorry for you. You will have to stay underdeveloped during many, many years because we have -- we are not taking enough actions. So

that's the point. And the second one -- sorry. And yes, you said, are there other opportunities there beyond when we speak about batteries or rare earth minerals and all that and connecting EVs to make on grids. I think that this is interesting technologies, but for TotalEnergies, let's first develop in the primary business, and let's build renewable proper scale in a profitable way.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Focus.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Focus. Yes, there will be additional ways to drive value out of these renewable or battery businesses, but let's be first professional. Let's make -- I would say, my message here is more, we want to be good in renewable products as a renewable producer, battery producer. And then beyond it, I'm sure that if we master in a profitable and professional way these technologies, we will be able to add additional values from power to grid and all these concepts, which are, I would say, interesting on paper. But let's first develop the mass EV before speaking about power to grid EVs otherwise. So it's a question to -- we follow that at the R&D level, but opportunities are yet to come. You're right, Anish.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
I just wanted to add one thing. Listening to you, Patrick, the other thing which is easy to do, but which we on purpose stayed away from, is just throw into the model a lot of energy efficiency increases over the next 10 years because that, again, can completely change the profile of energy demand. If you suddenly assume by some magic that energy efficiency can double from today until 2030, right? So we've tried to model assumptions that are aggressive, showing a real need to change what's going on and be on this transition path, but not throwing in completely unrealistic assumptions either.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Yes, knowing that, obviously, we are quite ambitious on this one. But I know -- and it's probably the one key difference of TotalEnergies' scenarios compared to others. We have energy demand, which continues to grow in [2050] compared to today. Most of the scenarios which are today published in order to cope with the Paris Agreement, consider that the demand -- energy demand will diminish, despite the rising population on the planet. We did not take that into account, but despite that, the average energy efficiency on the planet in the last 30 years, I think, something like 1.5%. And what we have put in the scenario is 2.5%. So yes, we have been ambitious on it. Mankind has not been able to do more than 1.5%. It's a general trend for 30 years when I read the papers. So we have added one point. One point with -- when you combine that with the growth of population, gives you a higher demand and not a lower demand. So if you add 2 points, yes, it's easy. The model will -- you will be on the Paris targets, but probably, it's absolutely unachievable unless something happens, which I do not know. And I don't know what would happen, but with COVID, we have -- we are -- our generation has to be ready to see some unexpected events, but -- okay, so that's a point about energy efficiency.

And -- but again, by the way, it's always a key message from the first emissions for all of us is to avoid emissions, which means to be more efficient. But we have taken into account 2.5% instead of 1.5%. And

again, it's a strong challenge for everybody, if we want to achieve it.

Operator
The next question comes from the line of Christopher Kuplent from Bank of America.

Christopher Kuplent ***BofA Securities, Research Division - Head of European Energy Equity Research***
Just hopefully 2 quick ones. I was interested in whether you're using this new outlook, and you've referred to quite a few interesting changes compared to last year, in shaping your views and assumptions embedded in your long-term planning. I think you were up to now using a $40 per ton CO2 price for your project deliberations. So if you could explain whether there is a direct link here between this study and your thoughts as they evolve and the long-term commodity price assumptions that you're using for running the business. And secondly, briefly, if that's possible. Just wondered, Patrick and Helle, what do you think is the main difference here between your Rupture scenario and the most recent Net-Zero 2050 scenario that the IEA has published? And perhaps, less about -- I think you've been quite clear, the inputs and the underlying assumptions, but behind the messaging, where do you think are the main differences here?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
I will take both questions. The first one, clearly, as you know, we were using $40, but we had -- we are asking our teams to run $100 per ton as from 2030. In fact, you will see tomorrow in my presentation that it's no longer an alternative and option to run $100, it becomes a key base scenario. So it's $40 per ton increasing to $100 per ton from 2030. By the way, we -- so we have -- I think it's consistent with the ambition of Total to get to Net-Zero. And with $100 per ton, I think we are covering most of the technologies we need in this assumption. So I will come back to commodity price. No, we keep, you will see, a $50 per barrel scenario. Even if very volatile, we should stop changing the assumption because of the short term because it's a matter of planning CapEx expenditures and what happened to our companies in the last 6 years since I'm CEO, not because I am CEO, but I can tell you that it's better to plan on a stable assumption rather than changing regularly.

The second one is -- I think Helle showed you. In fact, you have to compare Rupture+ because the IEA Net-Zero scenario was willing to cope with 1.5 degrees. So what are the differences? There are some similarities first. A lot of electricity, both scenarios have much more electricity, power is key, and renewables. So we converge in our scenarios on the amount of renewables. The production by 2050 requirement for oil, I think, is 24 million barrels per day, on one side, [26 million] on the other side. So that means that the landing point for oil is the same. There is more gas, I think, in the scenario from TotalEnergies than in the one of IEA. But the main difference, as Helle showed on the last slide -- is the trajectory between today, where the demand for oil is around 100 million barrels per day, a little less this year and the [25]. And the main difference is that in our scenario by 2030, we still have something like a decrease by 10%, I think, compared to the IEA, which decreases by 30%. And honestly, reducing the oil demand to 70 million barrel of oil per day by 2030 compared to [100 million], we don't know how this decrease could happen, where the demand will be erased in fact in 10 years. Again, if we took the assumption that the ICE ban in Europe represents 15 million barrel per day, , it's coming in [2045], not in

2030 -- not in 2025. So that's a key difference. It's the trajectory to get there. And of course, this has a main consequence for one of the spectacular conclusions, which has been drawn by some of the IEA scenario, which is to say, you must stop investing in oil and gas new investments because, yes, it's true, by the way; if you want to -- if the demand is only 70 million barrel oil per day in 10 years, which means a decrease of 3% per year, no need to invest much for the next 10 years in new projects. But it's not the supply that will create the demand, it's not true. If demand is still 90 million, like we anticipate by 2030 and not [70 million], and we produce only 70 million, the price will be at the roof and more than the roof. So maybe it's a good scenario for TotalEnergies and its shareholders. I'm not sure it's a good scenario for all the customers and citizens of the planet. So that's why it can be clear, as Helle reminded you, and you know that very well, Chris, I think, that they are our auditors. If we do not invest, we have a natural decline of 3% to 4% and then we'll have a lack of supply. So according to our trajectory, by 2030, we are more around [90 million], and that means that we need to continue to invest in some oil and gas fields if we want to meet demand. So again, the question in this transition is not to think that we can change the pattern of demand by constraining the supply. If we just do that, we'll have a huge spike in the price and a huge social instability on this planet. So we cannot do it like that. We need to monitor the transition smoothly, but we need also to work hard in order to substitute as quick as possible some oil demand from some customers. So -- and we -- and Total assigned this mission to our teams. When we can do that, we do it. And how why we work with many of our customers now.

Operator
The next question comes from the line of Jean-Luc Romain from CIC Market Solutions.

Jean-Luc Romain ***CIC Market Solutions, Research Division - Financial Analyst***
My question in (inaudible) was (inaudible). The remaining question I have is, how do you believe that such a massive increase in investment could come in the next 10 to 15 years, a $300 billion to $400 billion a year that would be needed in the Rupture scenario compared to the Momentum scenario?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Question was about CapEx increase between the scenarios. Please...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
No. Sorry, I want to make sure we understood the question because the line was not so good. Was the question about the incremental investments needed in Rupture versus Momentum?

Jean-Luc Romain ***CIC Market Solutions, Research Division - Financial Analyst***
Yes, that's very impressive. And I was wondering how that could happen to have such a massive increase?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Because you need much more renewables and much more electrolyzers. In fact, this going from, as Helle showed you, you have to substitute an additional 20 million barrels of oil per day. You have to have a substitution of, I would say, one scenario, one pattern of supply by the others requiring much more

CapEx in order to be able to deliver the same energy. And I think it's just a matter because you know -- we go from -- it was, I would say, the energy landscape presentation by Helle. You go from energies which are super efficient. Today, with all gas at certain level, we have the most efficient way to produce energy. In terms of costs per kilo, not in terms of CO2 for sure, but in terms of cost per of kilo...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Of density.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Of density. So the CapEx to produce one joule of energy when it comes from oil is much more efficient than when it comes from alternative energies like renewables, et cetera. So that's the famous chart where you can really look at it. And so this density, if you want the same amount of energy, you will have -- as its less dense, you will just have to invest much more. And again, -- It's just a matter of -- yes, it's true that we have to drive down the cost of solar and wind a lot. But at the end of the day, in terms of density of energy that we get, it's not the same. And if you need to transform your solar electricity into a synthetic fuel, combining that with CO2, making a transformation, that costs money. So it's that required investment. This is why it's not so easy to go from one to the other.

Yes, if you look more specifically, I have one comment from one person of my team, which is sending me a message so I can share with you. When you look to the power demand on one side, Momentum is something like globally, 7,500 terawatt hours. And in Momentum -- in Rupture, it's 11,500. So you know it's an increase of almost 50% of power demand. So these have to be invested. Okay, Jean-Luc, a new -- next question.

Operator
The next question comes from the line of Jason Gabelman from Cowen.

Jason Daniel Gabelman ***Cowen and Company, LLC, Research Division - Director & Analyst***
First, it seems like hydrogen, the pace of growth in hydrogen is probably the biggest change from last year looking out to 2050. But if we focus on changes versus last year's outlook to the mix out to 2030, what would you say is the biggest change in the outlook focusing on that 10-year period? And has that resulted in changes in what Total is doing in terms of their strategy? And then the second question, you alluded a handful of times to [COP26]. What do you think is the potential most material outcome from that conference as it relates to Total's strategy? What should we be looking for?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
The next 10 years, the big changes. No, I think it's just a confirmation of the acceleration of electricity.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Yes. It wouldn't be major, Jason. I would say, as Patrick said earlier, we have put a little less natural gas into some transport subsegments and put a little more beginning of e-fuels instead. But honestly, it doesn't have a major impact over the next 10 years. You need to go between 30 and 50.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Yes, you are right. Maybe we have -- within Total, we are more looking today to, I would say, e-mobility. We think for the next 10 years to invest more in e-mobility, and we have some question marks strategically in terms of what will be the use of natural gas as an alternative vector for transportation. If I may share with you, we think that this one, we need to monitor carefully the investments in this part. Yes, there are -- it could be really a transition -- And on the other side, spending more on what I say, e-mobility, either through charging, net charging points or through batteries, by the way. So that's more, I would say, for the next 10 years, one of the changes which could affect but...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
But it's not massive.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
It's marginal compared to what we had in mind. COP26, it will maybe surprise you. I think what we could expect from [COP26] is probably some clarity about this article. We need to -- if we want to be serious about Net-Zero in the future, we need to understand the way that all these, I would say, carbon credit markets will work? How do you evaluate the fact that you invest in one country compared to another place. I think it's urgent to have a clear framework. We know it's not easy, but I think speaking about Net-Zero, if we don't have a clear understanding of the way that all these -- even if its...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Voluntary.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Voluntary offset.

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Carbon (inaudible), yes.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
It works. And we have a clear and I would say, ethical...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***
Robust framework.

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
Ethical way to manage that. That will limit some investments, which might be very efficient in terms of, I mean, elimination of some emissions. So that for me, it's an important point. And I know that (inaudible) and others are working on it. I hope they will be able to convince government to progress for this part because there is no way to reach carbon neutrality without having to be able to optimize economically for the planet, our investments in order to be more efficient in terms of carbon credit. So I would say

that's something that I would -- which could have an influence on the way we work.

Operator
The next question comes from the line of Jason Kenney from Santander.

Jason S. Kenney ***Banco Santander, S.A., Research Division - Head of European Oil and Gas Equity Research***
Patrick, good to speak to you. I was wondering about the future of global hydrogen markets and the connectivity of exporting countries of green hydrogen or other hydrogen versus importing. And the preferred shipping technologies you think that could be developed over time because I'm conscious that we have a global ammonia market today, but it is toxic. Pressured vessels for hydrogen require massive infrastructure investment for pressurization and decompressing in different places. They're also point to point. And there is fast-growing research into solid-state hydrogen systems, which could prove disruptive over time and potentially, scale up quite rapidly 2030 onwards. So I'm just wondering, how you see global hydrogen markets and connectivity of hydrogen volumes in the 2030, 2050 timeframe?

Patrick Pouyanné ***TotalEnergies SE - Chairman, CEO & President***
It's an excellent question. And I think it's why we are -- and we have -- I think it's a reason why some companies are speaking about methanol. By the way, in methanol and ammonia. I agree with you, ammonia is a toxic. I perfectly agree. And by the way, it's not obvious at all when you ship ammonia -- you can use ammonia, of course. But the reverse reaction to go from ammonia to hydrogen is not at all a technology, which is today, I would say, controlled and...

It doesn't work at all. So we have to work hard. But methanol is another -- one of another way to ship, I would say, some hydrogen, and there is a lot of infrastructure already. But your question is very true about global H2 markets. We don't have -- we have nothing today. It's not easy technology. The liquefaction point, as you know, is much lower than for natural gas. So it raises a lot of issues and a lot of investments. So I agree that this question for me is not fully addressed today. And by the way, the projects at which we are looking, and I will not disclose the projects today and neither tomorrow, but we are working on some projects, to be sincere with you, more looking to ammonia at the end rather than H2 for the logistics. But to establish markets is maybe a nice way to do it before going to the whole logistics of it, but good question, Jason. And still, we are there at a level where we need to dig because it's not so easy.

Operator
The next -- we have no more analyst questions. Therefore, we will move to a general question. And the next question and final question comes from the line of Sara White from Reuters.

Sara White ***Reuters***
I'm the last one. I was just curious, I wanted to go back to something because you mentioned that in Europe, there were limitations when it comes to solar and wind projects in terms of footprint, in terms of space. Could you talk a bit about also the local opposition to some projects. I'm just wondering if you

think that's actually really a problem, particularly in France? And what can you actually do to try and overcome it? Can this actually affect your overall forecast? And then if you bear mind, I did want to ask a second thing. You said the world needs fossil fuels and transition fuels. With that in mind, do you think that there's any kind of broader lessons that we can take from the fuel shortages and disruptions that we see in the U.K. for the year to come as well.

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

The problem is not only in France. I think, by the way, you have issues with communities because it's a question again of land use. In fact, you have competition for us, and you have people. It's not only in France, by the way, we observed the same -- exactly the same problem in Germany, in Italy, by the way. And we begin to observe it in Spain as well. So I think the reality is that Europe is, I would say, is a humanized civilization. We have a density of population, which compared to many other countries like the U.S. or Australia, for example...

Helle Kristoffersen ***TotalEnergies SE - President of Strategy & Sustainability***

China.

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

Which is much, much -- we are much more dense. And so I'm not surprised, and it's why I was insisting that it's a question of scarcity above surface for renewables. And so that has to be taken into account. I read there was a study. It's an interesting study, which has been published in Italy by the [Ambrosetti Foundation]. We try to translate this -- the target that the European Commission has assigned by 2030, 40% of renewables in our mix in terms of -- they made a study. How long could it take to get through all the administrative process to build such capacities? And is the answer in this study by Ambrosetti, it's not 2030, but [2043]. There is a message there to policymakers, I think, to everybody. If -- and that I think that's very good this exercise. I mean this willingness of Europe to go for 55% by 2050 -- by 2030, sorry because it raises many issues. It puts people in front of the reality. How do we do that? And if yes, if we want to reach 40% of renewables in our mix, we need to build massive renewables for the next 10 years. And we need to have the land, and we will need to have the administrative process going through. And that's true that in our democracies, which is good, that raises questions. I think there is only one way to think of that. We will oblige governments to plan properly like I think the French government begins to think of that. We need to make some planning, but to do the planning properly, you need to put people around the table and not to antagonize people. If you let just people going, if it's a jungle, it will not work. So that's true that -- and for -- let's be clear for our strategy of TotalEnergies, this is one advantage of our company is that we think -- when we think renewables, we think on a worldwide basis. I will come back on that concept tomorrow. So yes, we have an ambition in Europe, but we are looking to other geographies where maybe this question of space and land use is less, I would say, critical than in Europe. So that's, I would say, a very good question. And I don't have all the answers, we will work, but we will not solve it alone, the energy producers. We have to solve it together with the society and policymakers and of course, the cities' representatives.

Yes, today -- no, but I mean the second question. Yes, it's true, Sarah. The planet today is working with

fossil fuels. 80% of the energy of this planet is fossil fuels, but the reality of the planet. It was true in 2010, it's still true in 2020. I think we decreased fossil fuels share by 1% in 10 years. And so that's all about again antagonizing energies one against the others and some players against the others will not be the solution. The transition -- the energy transition, the important word is transition. Transition means finding the right way to accommodate the present and the future. And I'm convinced that we'll not be able to build these decarbonized futures against this presence and the energy, it's not possible. People will not accept. And look, it's not because of CO2, it's because of COVID, but suddenly, we have diminished investments last year, very uncertainty, so less investments. Suddenly a lot of demand. which, by the way, is not bad. I mean, this increase of natural gas somewhere is coming from Asia, from China, fundamentally. Why? Because there are policies there which incentivize some producers, some energy consumers to use natural gas rather than coal. So fundamentally, it's coming also from a policy to control CO2 emissions. And when the Chinese government, despite what we said, is taking actions. And so you have more demand for natural gas. The increase of LNG demand by China in '21 compared with 2019 is plus 35%. Of course, this is a type of increase, which cannot be absorbed easily, if you don't continue to invest. So that has an influence on all these topics. So the lesson is that we need to monitor smoothly the transition by investing more and more in renewables and decarbonized energies. But at the same time, we need to maintain a certain level of investment in the energies that we are using today, and so this shifts customers. And this is, by the way, exactly the fundamentals of the strategy of TotalEnergies that I will describe tomorrow.

And as it is the last question, it gives me the perfect conclusion to this sequence today. And so thank you to all of you for your attendance. I know it was a very rich and dense presentation, but thank you, Helle, and thank you to all the teams who contributed to the quality of this presentation. It raises many questions from you, very interesting ones. We don't have all the answers. We try to share with you a lot of them, what we think, and we continue to learn, which is why I consider that it's very important in a company like TotalEnergies, I would say, because we are involved in these energy markets and more and more involved in many of these markets, we have some understandings. We don't say to you, we have the truth. We have different scenarios. There is no -- we are humble, but I think it's important that we contribute to the debate. And that's our objective today because this debate is key for us, not only as a company, but key for all of us as a member of the society. And again, I thank you for your attention, and tomorrow, after these markets, this potential market presentation, we'll come back to what TotalEnergies will implement as a strategy for the next 5 and 10 years. So thank you this afternoon, and I hope to answer to more questions in an tomorrow afternoon at 2:00 p.m. for the strategy and outlook presentation.