## CORPORATE PARTICIPANTS

**Helle Kristoffersen** *TotalEnergies SE - President of Strategy & Sustainability*
**Patrick Pouyanné** *TotalEnergies SE - Chairman, CEO & President*
**Renaud Lions** *TotalEnergies SE - SVP of IR*

## PRESENTATION

**Operator**
Good afternoon. This is the conference operator. Welcome, and thank you for joining the TotalEnergies' Energy Outlook 2022 Conference Call. (Operator Instructions)

At this time, I would like to turn the conference over to Mr. Renaud Lions. Please go ahead, sir.

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**Renaud Lions *TotalEnergies SE - SVP of IR***
Good afternoon, good morning, wherever you are. Welcome to TotalEnergies' Investor Days 2022. The event will be in 2 parts. Tomorrow, we will be in New York City for a full day of exchange and updates on our strategy and business outlook.

Today, we are presenting the first part, which is our energy outlook. The session will be followed by a Q&A. But for now, let's open the session with a sustainability moment and a short movie.

(presentation)

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**Patrick Pouyanné *TotalEnergies SE - Chairman, CEO & President***
So good afternoon or good morning. I'm very happy to welcome you today for this TotalEnergies' energy outlook together with Helle Kristoffersen. In fact, Helle will work, and I will listen like you. It's our fourth time that we publish this TotalEnergies' energy outlook. And I think it's an important effort of all the teams in the company in order to try to give and to share with you a vision of the energy markets, which are, I would say, are quite moving markets.

And so we'll present you and Helle will take -- embark you in this journey through the Momentum and Rupture and Rupture+ scenario. I will not be longer, but I will leave the floor to Helle, and then we'll try to answer together to your questions. Helle, floor is yours.

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**Helle Kristoffersen *TotalEnergies SE - President of Strategy & Sustainability***
Hello, everyone, and a very warm welcome. Thank you for joining our presentation on our 2022 outlook, as Renaud just said and Patrick introduced it. As you know, our outlook explores the possible trajectories for energy demand between now and 2050, taking into account the need to accelerate decarbonization to cope with global warming.

The context for this year's addition is obviously very different from last year. I think that's clear to all of us. Before I elaborate on that point, here is a first view on some energy trends over the last 20 years. Lots of

data on the chart, but the key takeaways are the following: there are tangible signs that the energy transition has started. For instance, the decoupling between GDP and emissions growth, thanks to energy intensity gains. The fact that power is now the fastest-growing energy and oil is the slowest one. Recognizing also that natural gas and renewables have been growing at the same pace over the last 2 decades.

On the other hand, growth in coal demand remains very high, and the share of fossil fuels in the overall energy mix has barely moved in 20 years. It's still above 80%. So we have clearly a lot more work ahead of us to build a low-carbon diversified energy system.

As we were working on our models with everybody in the teams, one top of mind question was the following: Will the current market disruptions speed up or slow down the energy transition. And of course, there are short-term trends pointing in both directions. Energy demand has proven extremely dynamic in 2021 post-COVID and also in the first half of this year. This has happened at a time when energy security and energy affordability are taking the center stage politically and economically. Oil and gas matter, it's as simple as that.

Coal demand is rising sharply right now, not good for sustainability, of course. By contrast, it also underscores the role of natural gas as a transition energy. On the more positive side, energy efficiency efforts are gaining pace not only because of the high prices, but because people worry that they simply won't have enough energy. Energy efficiency measures are essential to reaching the goals of the Paris Agreement. So anything that goes in that direction is good news.

We can all contribute, you and I and companies and everybody in society, and you will here tomorrow how TotalEnergies intends to play its part. Other good news. The EU and the U.S. have come up with new plans to accelerate the deployment of renewables. That's embedded in the EU REPower plan and the Inflation Reduction Act in the U.S.

Clean hydrogen continues to gain traction. And richer countries will hopefully deliver on their commitment to support the energy transition in the rest of the world at the upcoming COP, paving the way for a more just transition. The first important step in that direction will be to effectively contribute the $100 billion per year promise in Paris, and that was going to start in 2020. Overall, I think that we are all aware that the real challenge is what's listed at the bottom of the chart here, mainly preserving energy security and affordability through the transition.

So here are now, as Patrick said, our 2 demand forecast scenarios to 2050. They are built with the same logic as last year for those of you who follow us. Momentum is a forward-looking scenario. It takes at face value, all the stated commitments to reach carbon neutrality by 2050 and all the NDCs of other countries. It is the same framework as the APS scenario that the IEA published last fall after our first edition of Momentum in that framework. Momentum goes way beyond the business' usual case, but it still results in temperature increases of between 2.1 and 2.3 degrees in 2100 using IPCC P66 curves.

Rupture to the right uses a back-casting approach. It has been built on purpose, so as to be in a well below 2-degree world, again, using the IPCC P66 curves. Global warming is limited in this scenario to 1.7 degrees. And then as Patrick said, we have also run a sensitivity on Rupture called Rupture+ to test under which conditions we could go from a 1.7-degree scenario to a 1.5-degree scenario with a P50 framework, which is the same framework as the one adopted by the IEA in their net-zero emission scenario. So I will elaborate a little more than last year on Rupture+ towards the end of this presentation.

Here is now a recap of the scenario assumptions in both cases. GDP growth is assumed to be 3% per annum in both scenarios, but energy demand growth is different. It grows at 0.4% in Momentum and is halved to 0.2% per annum in Rupture. Again, this compares with 2% growth per annum in energy demand over the last 20 years, so we have modeled quite a change in these trends when it comes to demand.

Momentum assumes an accelerated deployment of greener molecules and electrons. First, more efforts are needed compared to last year since the starting point post COVID is higher. Then the transport revolution with substitution away from oil keeps gaining pace, and we have modeled a massive electrification of road traffic, including heavy-duty, and stepped up the use of sustainable liquid fuels for aviation and marine.

Electrification of end use is also becoming broad-based outside of transport and drives up the deployment of renewables. Natural gas keeps its role as a critical transition fuel in all sectors, except perhaps road transport. Biofuels and biogas are seeing increased penetration in select markets. And as I said earlier, the potential of hydrogen – clean hydrogen is confirmed with a ramp-up after 2030, either as a clean gas or through its derivatives such as ammonia or methanol. And finally, we've also revisited the demand for plastics, where recycling is definitely picking up. That's for Momentum.

Rupture then essentially requires that all these decarbonization drivers, mainly of the net-zero '50, countries be disseminated at scale across other markets. And its key assumptions are listed here. I will let you read them. Just remember that this well below 2-degree scenario allows for energy demand to grow slightly over the next 30 years, which is a major difference with most comparable scenarios. So just if you're trying to benchmark, keep that in mind.

The chart here is from momentum. It shows how the overall demand growth of 0.4% per annum covers two completely different realities. A decrease in OECD, thanks to strong progress on energy efficiency, mostly in the form of energy savings. That's what's shown to the right of the chart. And then an increase in energy demand of close to 1% in non-OECD countries to the left.

Here, the story is very much about energy access for growing populations, increased living standards and energy efficiencies coming not from savings, of course, but from the switch to modern forms of energy, moving away from low-density, inefficient traditional biomass. We'll hear more about that in a while when we cover Africa. But for this transition to happen and for energy to grow and change content in Africa and elsewhere in emerging markets, once again, it is critical that the developed countries help the rest of the world via funding, technical transfers, training of people and so on.

We know that we need to curb emissions, but how do we do that? Just in case it's not crystal clear. Acting on energy is paramount because 2/3 of greenhouse gas emissions are energy-related. It's mostly CO2, but it's also methane, and we are well aware at TotalEnergies that methane needs specific and urgent action. Maybe you remember the sustainability moment that we just showed through the little film.

As you can see, coping with emissions from power and transport, that's to the right, is what will have the biggest immediate impact. Getting rid of coal is also an obvious priority. That's all the very dark colors to the right. And this is, of course, what we've tried to do in our 2 scenarios, act on emissions that are summarized here.

So this chart here recaps the key modeling drivers of our scenarios. It's a chart that some of you like to have and they are listed here. I can cover them quickly. The numbers are rounded up, but again, I think it's useful. So the 7 drivers are: strong electrification of end use; deep decarbonization of power supply; gases going greener; sustainable mobility; increased plastic circularity; CCS, of course, is required to abate remaining emissions; and I insist on the last driver here, energy efficiency acceleration, doing much better in the 2 scenarios than what we have been doing over the last 20 years, 2.4% in Momentum, 2.6% in Rupture, even more in the net-zero '50 countries, and that compares to 1.5% energy intensity improvement since 2000. So accelerated energy efficiency is definitely also required.

Now I move on to Momentum. And the major transition levers of this scenario can be summed up, I would say, in 3 categories that are listed here: a revolution in transport; a massive growth in clean power, knowing that all the net-zero '50 policies of countries around the world, they all have electrification as a driver on clean power; and then the progressive pickup of the use of clean hydrogen.

The units in the following charts is going to be in petajoules per day, except stated otherwise. So here is, first, the evolution of energy consumption in the light duty vehicle segment. So that's patented cars and 2-wheelers and so on. That covers -- that represents around 50% of CO2 emissions in transport. So it's big, it needs to be tackled.

The massive electrification of fleets in the net-zero '50 countries and in China is confirmed as the #1 decarbonization driver of this demand segment. It's true for both passenger cars and 2 to 3 wheelers. Maybe you noted that last year, the electrification of 2 to 3 wheelers in the world displaced almost 1 million-barrel per day of oil demand. So that's definitely something to look for.

This electrification trend is largely driven by the thermal cars sales ban in 2035 in Europe and in several of the states of the United States. It will not be a smooth transition. Let me flag that because the transition requires well-functioning, well-supplied power networks, and it also requires enormous amounts of new infrastructure.

Nevertheless, in 2050, the electrical vehicles and fuel cell passenger cars reach 55% of passenger cars globally in the world in terms of penetration, and that's 100% of penetration in the fleets of net-zero '50

countries and close to 90% penetration in China. Because of that, oil demand ends up just around 50% in the light-duty mix in 2050.

For heavy-duty vehicles, that is around 30% of today's transport emissions. Electrification, biofuels and H2-based fuels, all contribute to decarbonization. You can see all the colors on the chart to the left in 2050. In this chart, clean hydrogen-based solutions mean fuel cells on one hand and H2-based e-fuels on the other hand, so the e-fuels that you get by combining hydrogen and carbon molecules.

Regulation plays its role in this segment as well via ban on thermal heavy-duty engine sales in 2040 in all the net-zero '50 countries. That's the assumption that we have modeled. There have been quite a lot of developments in electrical trucks over the last year or so, both urban trucks and long-haul trucks, and we are seeing improved perspectives to decarbonize both. Overall, therefore, the heavy-duty demand ends up with the same share of oil in 2050 as a mix for light-duty, again, around 50% or a little more.

Moving on to aviation and shipping that represent, respectively, 12% and 10% of transport emissions. A lot is going on in these 2 sectors as well to decarbonize via new targets that have been endorsed by the IMO and by the IATA.

Aviation cannot do without liquids due to density needs and storage constraints. So the scenario here assumes an increased share of biofuels for airplanes at the expense of road transport because road has other options. Over time, there will also be a high penetration of hydrogen derived fuels, the famous sustainable aviation fuels, the SAF.

For shipping, decarbonization will happen in 2 ways, revolving first around LNG and biogas, and then after 2030, around a strong pickup in clean hydrogen derived fuels, including e-methanol and e-ammonia. That was for transport.

But this electrification of transport and of energy end use more broadly then leads to a massive need for clean power. And that's what this chart is about. Note that we exclude hydrogen -- green hydrogen from this chart here. We'll close the loop on that a little later. So power demand, excluding hydrogen, is up by 2% per annum in Momentum.

Transport represents roughly 1/3 of the increase to 2050. The second -- it's the second largest contributor behind residential and commercial. So even without hydrogen, power generation almost doubles over the next 30 years. Solar and wind make up for 90% of the new capacity in our model. And that means that renewables capacities are multiplied by 7 in 30 years, and they end up representing roughly 60% of global power capacities in 2050.

Gas is the only fossil fuel to grow in power due to its key role in coping with renewables intermittency on one hand and demand seasonality on the other hand. Gas provides flexible, reliable and dispatchable power. The overall emission factor of power is down by 75%, including CCS.

Here is now a chart on oil and gas demand. So this chart is in Bcm and million barrels per day. To the left, you see the growth of natural gas without blue hydrogen. It grows in the first decade, when it helps replace coal in power and industry. And then after 2030, gas enters a long-lasting plateau, starting in the early 2030s.

For oil, demand reaches a plateau at the end of this decade and starts declining after 2030 at a rate which is shown here to the right, around 2.3% per annum. And this is, of course, well below the natural decline of existing oil fields. So we definitely need new oil projects in this scenario. Oil demand ends up close to 60 million barrels per day in 2050.

What about clean hydrogen. So moving on to clean hydrogen. As you've well understood, it's one of the new molecules associated with the transition. Its potential is enormous with a tenfold increase between 2030 and 2050, only a slight increase until 2030. What's needed now is to build the required infrastructure and value chain and stimulate demand through subsidies or supply-side incentives lowering overall cost.

Transport and hard-to-abate industry make up most of end-user demand, as you can see on the chart to the left. In terms of technology, we assume that the supply will be split between green and blue with roughly 1/3 for blue and 2/3 for green. Blue hydrogen, that's to the right now, adds more than 10% to gas demand in 2050, requiring roughly 1 gigaton of CCS.

Green hydrogen adds 15% to power demand. It may not sound big. But remember that in Momentum, the power capacity are already incredibly high. So adding 15% to power demand effectively means tripling today's worldwide solar and wind capacities. We'll talk a little more about the footprint required for renewables towards the end of my presentation.

So here is now the evolution of total final consumption. In total final consumption in Momentum, again, it grows around 0.4% per annum. The messages are the following: electrons take over from oil as the #1 source of final energy around 2040. The mix diversifies a lot, as you can see from the colors, and the new molecules such as hydrogen and its derivatives begin to have a visible contribution by 2050 for sure. Transport, that's to the right, decarbonizes much faster than the other sectors in purple, as you can see.

And if we now move to primary energy demand and CO2 emissions, what do we have? Here is the wrap-up for Momentum. Despite the efforts of the net-zero '50 countries and the NDCs of everybody else, we end up in a world where temperature increases between 2.1 and 2.3 degrees, as I already said. And residual emissions stand at 24 gigatons in Momentum, net of 3 gigatons of CCS. So more efforts required.

Before I move on to Rupture, I now have a few charts with some focus presentations. One on the net-zero '50 countries, one on the EU and one focus on Africa. First, the net-zero '50 countries. They play a pioneering role in the adoption of low-carbon solutions, and they are modeled in the same way in Momentum and in Rupture.

We now have 40 net-zero '50 countries in our model. They dominate the world economies, you can see

on the chart here, and they also dominate energy demand, but that will no longer be the case in 30 years from now, which is why the policies of this block are both incredibly important to fight climate change and far from being enough. The main game changers in these countries are listed here on the chart.

Power generation becomes carbon neutral around 2040, net of some CCS. Road transport becomes carbon neutral by 2050. Electrification is very high with clean power. And there is a strong penetration of clean hydrogen and green gases. With that as levers, here is the primary energy demand in the net-zero '50 block. Remember that these countries are on aggregate the richer and the more developed ones. This is why demand is down in this block by close to 1% per annum via electrification and strong policies aiming at energy efficiency and energy savings.

The mix is highly diversified, and the share of fossil fuels is divided by 2 in 2050. So it goes from today's 80% to 40%. Coal is virtually gone. Oil demand ends up at 8 million barrels per day in 2050. Natural gas having helped getting rid of coal keeps a role in power as a complement to renewables and to produce blue hydrogen. Its uses combined with CCS.

Indeed, out of the 3 gigatons of CCS that we've modeled in Momentum in 2050, 2 gigatons go to the net-zero '50 countries. So they also lead on CCS, of course. And CCS begins to play a visible role after 2030. The residual emissions of these countries in 2050 are around 1 gigaton of emissions and they will require nature-based solutions or new technologies such as direct air capture.

Now I zoom in within the net-zero '50 countries, I zoom in on Europe. So that's the EU 27, excluding the U.K. and Norway. So for the EU, our model assumes that the continent manages to harness the short-term turbulence with respect to energy, security and affordability, and therefore, continues to push on and advance the green deal.

Within the net-zero '50 countries, the EU is a frontrunner on several accounts. In terms of decline in the use of fossil fuels, aggressive deployment of bioenergy and renewables and a stronger role for renewables overall explained in part by a very high penetration of green hydrogen. Green hydrogen uses up roughly 1/3 of the solar and wind that you can see on the chart here to the left.

The EU also leads in terms of decreasing energy demand, thanks to extremely high energy efforts. And making the link with today's energy crisis, it's clear that we have a unique opportunity to pursue and anchor energy efficiency efforts right now. So let's just do that. Energy efficiency is clearly all the more relevant in Europe as it's becoming crystal clear that energy security and the green transition come with a high cost.

The next zoom is on the transition in developing countries, those that don't have a net-zero target for good reasons. We've chosen to talk about Africa, 1 billion people today, 2 billion in 2050, and they aspire to have much better living conditions and they need energy for that. As you can see, Africa's share in the global emissions is ridiculously low, and it will remain so, which causes African leaders to be more and more vocal about their intent to use their abundant natural resource, solar, wind, hydro, fossil fuels for

the development of their continent, and they are right, of course. It's going to be one of the key messages of this upcoming COP in Egypt.

So here, you see the energy mix of Africa today and in 2050 in our 2 scenarios, Momentum and Rupture. The striking part is the huge share of traditional biomass in dark green, which is highly inefficient and bad for climate, human health and biodiversity. So the transition opportunity for Africa, one of the opportunities, is to stop burning waste and wood and switch to more modern energy, which will enable more energy for more people with a very modest impact on CO2 emissions.

As you can see in a well below 2-degree scenario, which is Rupture to the far right, that means effectively eliminating traditional biomass and replacing it with a mix of all other more modern energies, including oil and gas, and of course, a lot more power, clean power. One way to get rid of traditional biomass, to substitute that biomass, is in fact electrification. Africa's need for power is going to be driven in the first place by the rising populations and rising urbanization.

You can see to the right here that ResCom makes up for some 50% of power demand in 2050 in our 2 scenarios. Power generation is multiplied by 3 in Momentum and by 5 in Rupture. And depending on the scenario, 80% to 100% of the growth comes from solar, wind and hydro, all clean energies that Africa has plenty of. For that to happen, Africa needs funding and support and an improved power sector governance because power is, of course, entirely local.

Now I move on to Rupture. And remember that by construction, it's a well below 2-degree scenario, assuming that the whole world somehow follow suit on the net-zero '50 countries. With respect to total final consumption, electrification needs to happen even faster than in Momentum, and it needs to be extended to developing countries.

Power becomes the #1 source of final energy around 2037. The share of power in the mix is 1.5x higher than all fossil fuels combined in 2050. And the 3 contributions of hydrogen-based energy, bioenergy and natural gas ends up pretty similar in our model. Looking to the right, both transport and industries see massive drops in their CO2 emissions, and ResCom is only slightly behind.

So let's now look at final demand just quickly sector by sector. In transport, Rupture assumes that the ongoing substitution away from oil in the net-zero '50 countries and China extends to the rest of the world. The share of non-fossil fuel increases for all types of traffic. And oil ends up representing less than 1/3 of transport demand in 2050.

Industry and ResCom. These 2 sectors both see deep electrification and very high energy efficiency gains. In industry, decarbonization is facilitated by multiple in-depth changes to processes. Coal to gas switching, gas to power, pickup in hydrogen and 3x more CCS than in Momentum. We have 0.5 gigatons in industry in Momentum, in Rupture, it's 1.5 gigatons.

In the ResCom sector, electrification reaches close to 2/3 of final demand due to the link with urbanization.

Demand is further reined in by energy efficiency gains in appliances, lighting and so on. And as you know, and I'd like to stress this, the energy efficiency gains in that segment is more a socioeconomic issue than a technical challenge.

Power demand in Rupture grows at around 2.5%, excluding green hydrogen. To be in this well below 2-degree world, we need to entirely rebuild the power system. Not only that, in 2050, its size has to be twice as large as it is today. Electricity from solar and wind is staggering big, 30% larger in 2050 than all the power generated in the world today.

Such a new power system shared by intermittent renewables will require massive storage solutions, be they battery-based or green hydrogen based or using some new technology. That new power system will also require large-scale grid upgrades, including flexible and dispatchable power plants. More on that in just a few charts.

In Rupture, clean hydrogen represents a market close to 500 million tonnes per annum in 2050, 1.5x more than in Momentum. 2/3 of that is green, 1/3 of that is blue. Those proportions don't vary very much in our model. And that adds 20% to both power and gas demand in 2050. Again, the orders of magnitude here are very, very big, and I think they're difficult to apprehend.

So we've given some benchmarks on the chart here. In 2050, blue hydrogen would use as much gas as all of Asia today. And green hydrogen would be produced from the equivalent of half of today's power demand. Half of today's power demand only for green hydrogen tomorrow, that's pretty big.

Here is a view of gases demand in Rupture, not only natural gas, but all forms of gases. Overall demand grows at 1% per annum with a massive push on clean gases, and that is what you can see to the right. 60% of gases demand is satisfied via green gases, that is hydrogen, biomethane and CCS-abated natural gas in 2050. And there are 3 main demand pools for gases: power generation, industry and blue hydrogen, of course.

Liquid fuels also become much greener. In the transport sector, the sustainable liquid fuels, meaning biofuels and e-fuels reach 40% of liquids demand in 2050, and oil demand overall falls to 37 million barrels per day in 2050 in Rupture. So here is the wrap-up of the total primary energy demand for Rupture, reconciling a greener energy system with sustainable energy for everyone. And as you can see, the mix is much more diversified than in Momentum. I will let you look into the details.

Rupture ends up with approximately 7 gigatons of residual emissions, net of 6.5 gigatons of CCS. And I know 6.5 sounds very precise, so please bear with me. If you look to the right, compared to Momentum, 70% of the cumulative abatements required over the next 30 years come out of Asia. So this is a work that needs to happen to move from Momentum to Rupture. We need to work a lot helping and partnering with Asia to decarbonize. As for the net-zero '50 countries, residual emissions in Rupture will have to be abated through nature-based solutions or innovation in carbon removal technologies.

Now in this chart here, we have attempted to do 2 things: close the loop on the investments required for Rupture, the amount of dollars required to be spent between now and 2050, that's to the left; and also, closing the loop on the land requirements for the onshore renewable deployments in Rupture. This is only orders of magnitudes, but we thought we wanted to share this with you.

First on investments. It's kind of obvious, but the energy transition means that we have to fund the building of a new energy system, I think that's clear, while continuing to invest in the existing one to address short and midterm demand. So it's cost.

In this decade alone, we will have to double investments. That's what you can see on the chart. We need to go from roughly $1 trillion at present to $2 trillion in 2030. A lot of those investments will have to go into renewables, power grids, energy storage systems, electrolyzers. But even in Rupture, which is the basis for this quantification, we also need to invest in new oil and gas projects, not just maintenance, to satisfy demand.

To the right, then you see the land required for the deployment of the solar and onshore wind capabilities that we have in Rupture. There is no real issue if you look at aggregate numbers. We're talking about a footprint that is below 1% of available land that we qualified as available land, land with low-density vegetation. And that, of course, is something that can be disputed, but it's just again, orders of magnitude.

However, there are 2 groups of countries below, I would say, the global picture. Those where the footprint of renewables is effectively a no brainer because they've got plenty of empty spaces, even if the empty spaces may be far away from the demand centers and the demand pools. And that would be, for instance, China or the U.S.

And then there are countries where renewables will increasingly require public support or even mandates because the territory is already very densely occupied. This is the case of the EU. And Germany's recent decision to dedicate 2% of its land to onshore wind would be a case in point. Of course, that's also an excellent reason to invest in offshore wind, and that is what we're doing.

I will finish on a couple of charts on how to get from a well below 2-degree scenario to a 1.5-degree scenario. And we've done that, as I said earlier, by a sensitivity on Rupture called Rupture+. The main drivers are shown here. And what we've done is essentially look at how we can reduce carbon further, sector by sector. So we list here what modeling assumptions we've used for industry, for transport for the residential and commercial sector and for power.

We remove roughly 6 gigatons of CO2 in 2050 from the Rupture scenario, and we increased CCS only slightly from 6.5 to 7.5, which happens to be consistent with the IEA's net-zero emission scenario. And overall, doing this, makes Rupture+ consistent with the 1.5 temperature increase in 2100 using the P50 framework of the IEA. So the important message, of course, is that it can be done, but it's very, very demanding on all of us. And so the takeaway is that meeting the 1.5 degree requires another step change in energy supply and in energy demand, driven by regulation, technology and our behaviors.

Here is a resulting total primary energy demand contrasting Rupture+ with Rupture and with the net-zero emission scenario of the IEA. Oil demand ends up being pretty similar in Rupture+ and in the net-zero emission scenario in 2050. I think that's 23 million barrels per day in 1 scenario and 24 million in the other one. So we agree on the landing point for oil, but we do not share the same trajectory at all. And another important difference is that energy demand does continue to grow even in Rupture+, which, of course, is not the case in the IEA net-zero emission scenario.

So just to be very clear, you may remember that the net-zero emission scenario of the IEA is a 1.5-degree scenario so-called without overshoot. And therefore, in fact, it's not achievable. That is what the IEA's own short and midterm demand forecast clearly tell us. The world is very far from being on the trajectory with no overshoot. On the other hand, given the way it's constructed, Rupture+ here overshoots. So it requires implementation of negative CO2 solutions post 2050. And on this chart here, we're just try to represent that to be completely clear.

The order of magnitude of negative emissions is equivalent to some 4 gigatons per year between 2050 and 2100. It does not seem impossible at all in terms of scale, provided that we all continue to focus our R&D and innovation efforts on decarbonization and carbon removal. At TotalEnergies, we currently allocate more than 60% of our R&D efforts to clean tech and will continue to increase our efforts and our commitments.

So my last chart here just summarizes the key highlights of findings from everything I just covered. And it's here for your convenience, and I will maybe close by just repeating them very quickly. The short-term trajectory of global energy demand is not going in the right direction, so more efforts are needed to decarbonize, while ensuring energy security and affordability.

The current crisis is for sure an opportunity to increase and anchor energy efficiency measures, which are critical to reaching the goals of the Paris Agreement. In the richer world, electrification of end-user demand is a structural evolution that helps reduce emissions and increase energy efficiency because electrical engines are just very efficient. Significant investments in clean power and electrical power grid is essential for the success of this electrification trend.

In non-OECD countries, particularly Africa, switching away from traditional biomass to modern energy will improve energy efficiency, while providing affordable energy access to grow populations, better living standards and of course, economic development. Natural gas continues to play a key role in this transition. It ensures firm power, dispatchable power, complementing renewables and replacing coal in all sectors of final demand.

Gas will become green over time and its growth will be accompanied by carbon capture and methane emissions containment solutions. Hydrogen and sustainable liquid fuels are promising decarbonization drivers, but they will scale up after 2030. So in the meanwhile, renewable diesel and biogas will develop.

And then the current decade is really decisive when it comes to investments. Investments in low carbon power must double between now and 2030 to reach 1.5 trillion per year in 2030 and earlier than that actually. Even in a well below 2-degree scenario, investments in new oil and gas developments is required to satisfy consumer demand, at least until 2030, in the middle of that decade. And finally, the energy transition also requires massive investments in clean tech R&D.

I'll stop here. I'll thank publicly everybody involved in putting together this analysis. Thank you, team. Well done. And now Patrick and I, we're ready for Q&A.

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## QUESTIONS AND ANSWERS

**Operator**

(Operator Instructions) The first question is from Henri Patricot with UBS.

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**Henri Jerome Dieudonne Marie Patricot** ***UBS Investment Bank, Research Division - Associate Director and Equity Research Analyst***

I have 2 questions, please, on the scenarios that you present. The first one on natural gas and looking back at the numbers that you had last year. One thing that struck me is that you do have a much lower natural gas demand in your Momentum scenario in 2050 than last year. I can have a guess at what's driving these changes given where we see gas prices and recent events. But I was interested in if you can give us a sense of the moving parts here, why you've cut the long-term gas demand that much in that scenario?

And then secondly, I had a question on the energy savings that you have in these 2 scenarios relatively close to 2.4% to 2.6% with sharp -- even both quite a step up versus what we've seen over the past 20 years. So where do you expect that significant improvement to come from in efficiencies?

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

So the first question, I think, on natural gas. First, it's not linked to the short-term prices. I would say even if, I would say, high gas prices as today will contribute to demand destruction. But it's not the reason why on the long term, there is less gas demand in our scenarios.

I think the fundamental evolution for me is linked to 2. One is technically, is that we put hydrogen when it's blue hydrogen outside of the gas demand. We consider it's a hydrogen demand, even if it will require some gas when it's blue. But you know the 1/3, 2/3 that we took as an assumption for clean hydrogen is not, I mean, it's not a scientific share. It's just an evaluation. So we put this gas demand for hydrogen aside of the gas, first remark.

The second point is on transportation. In fact, what we observed, there was quite a big push to use gas as a fuel, I would say, for heavy-duty and even for marine transportation. We believe that this, in particular, for heavy duty will not be as strong as we thought in the previous years because we observed a big push first on the electricity-driven trucks.

I think all these investments, which are done by car manufacturers and EVs. And so in the battery technologies, it's billions of dollars. It's thousands of people, engineers and technicians. We believe that it will accelerate strongly this -- I mean, the capacity of these batteries, including on the next step for heavy duty.

So electrification is a longer -- this is a different assumption in terms of the way to decarbonize, I would say, truck transformation. So that's just, I would say, the 2 main reasons behind this demand, this lower demand for gas in these scenarios. On the other question, maybe, Helle, you can -- there were 2 questions.

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
Yes, I didn't catch the second question. We couldn't hear it. If you don't mind repeating.

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**Henri Jerome Dieudonne Marie Patricot** ***UBS Investment Bank, Research Division - Associate Director and Equity Research Analyst***
Yes, the second question was on the energy savings increase that you have in the scenarios going from 1.5% per annum -- sorry, 2.4%. Where do you expect that improvement to come from?

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
So in the 2 scenarios, so it has to happen across the board because the data you just mentioned is really globally. The net-zero '50 countries, they lead. And again, as we try to show there is a difference between the OECD countries and the non-OECD countries. So in OECD, demand will go down because of energy efficiency. I mentioned net-zero '50, I mentioned Europe. And there will be mandates, and I would say they are rich enough to invest in the efficiency programs.

In non-OECD, the big piece of the energy efficiency improvement will come from moving away from traditional biomass, which is inefficient. So even without increasing energy demand a lot, it does increase close to 1%, but you can improve energy efficiency enormously by switching away from this inefficient form of energy.

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**Patrick Pouyanné** ***TotalEnergies SE - Chairman, CEO & President***
On energy savings, to be clear, it's one of the big challenge, we know that. But it's a huge improvement compared to what we do for the last 20 years, and we are making something like around 1% plus. We need to go to 2.5% to 3%. And I think this, by the way, for OECD countries in particular, or even for the world, these huge -- these rises of energy prices is a unique opportunity to put in the mindset on all the population, but we need to save energy.

And I think we see more and more energy efficiency programs being implemented in many of our countries, in particular, in Europe. And I think it's really for governments, a very unique opportunity to develop these programs and then maybe to embark everybody to anchor them, I would say, in the future of any energy policy because there is no way to make the transition without really reducing consumption of energy.

It's very ambitious because, as you know, on the other side, in emerging countries, the population is growing. And so you have these 2 opposite trends. But I think it's clearly something on which we need to accelerate. By the way, it will help to save money today and so saving inflation, it would also help to security of supply. If we did less, it means it's a nice way to solve the security of supply that we could face here in Europe.

I see some questions coming, by the way, from somebody in the plane. Irene is in the plane. So maybe I will ask myself or to Helle the questions because we see that appearing on the screens. So just the first question from Irene, that's for Helle, I will just make the journalist today. In both scenarios, electrification is a key lever for decarbonization. Can you talk about the challenge that infrastructure constraint creates in terms of the cost of massive expansion of grids? That's the first question.

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
So the challenge that infrastructure constraint creates in terms of cost. Well, I guess it's back to funding the energy transition overall. It's a question of allocation of public money. We know that it is going to cause several basis points of GDP to change our energy systems. And so I don't think there is an answer to your question, Irene, in terms of the cost, we try -- so again, it's a choice. It's a choice of society. It's a choice of countries, and it will require dedicating 2%, 3%, 4% of GDP to changing the energy system and electrified.

We try to address this year this point of footprint because there is a cost, and then there is the cost in dollars and if you want to call it like that, the cost in land. And this is why we try to come up with the focus on just land requirements. And it's clear that in Europe, there is a question.

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**Patrick Pouyanné** ***TotalEnergies SE - Chairman, CEO & President***
Just to add on the answer. I think we tried in one of the slides to evaluate the level of investments for this transition. We said and Helle said from $500 to -- we need to add $1 trillion -- $1.5 trillion for, I would say, the new decarbonized energy system, almost half of it are grids. And in fact, when you grow, you look to the trend up to 2050, it's even growing to more than $1 trillion should be dedicated to grid.

I think, by the way, it's a very important message today to -- in particular here, in Europe to all governments. Today, we face -- part of the difficulty we face in this gas and power markets are not enough interconnections. In fact, we discovered, but we don't -- we have established a liberalized market, but without maybe physical, I would say, access to this market.

And so I think it's very important, not only on the short term, but it's no regrets investments, I would say, to invest in grids. At the national level or the continental levels, probably we have grids, which have been established quite a long time ago. And there is – you know when the car manufacturers like the CEO of Stellantis says, okay, we will build the cars, the EVs, but do we have the infrastructure?

It's not only a matter of charging points, and we will have the charging points, I'm not worried about it. It's

also a matter of grids. You have probably observed that 2 weeks ago, I think, in California on one side, in China on the other side at the same time, the governments have asked EV owners to leave their cars at home.

I'm not sure it will be a lot of success for the citizens if we begin to say, we make the transition but by the way, our grid does not support all this EV charging, and you need to leave your car at home. So it's a really fundamental, I think, aspect and your question is very good. We need and we -- I mean, and we're not only private players. I mean the public and private players must really tackle this grid issue, electricity grids.

Okay. Next question's from the -- no -- we see some questions coming on our screens, but maybe the lady should ask us some questions.

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**Operator**
(Operator Instructions)

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**Patrick Pouyanné** ***TotalEnergies SE - Chairman, CEO & President***
Okay. So I will take 1 question in the meantime, which is on the screen.

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
I can read it for you, Patrick?

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**Patrick Pouyanné** ***TotalEnergies SE - Chairman, CEO & President***
Yes. If you want.

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
Okay. So sustainable aviation fuel growth, aviation, how do you see the challenge of building supply chain and infrastructure for feedstock.

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**Patrick Pouyanné** ***TotalEnergies SE - Chairman, CEO & President***
I think we have made an announcement yesterday and Bernard Pinatel will come back on it tomorrow in New York, but we had to secure the supply of, I would say, animal fats and used cook oil with a partnership with one of the leading player in Europe, SARIA, a German company, in order to secure the supply to our new plants in Grandpuits to make sustainable aviation fuel. By the way, it's a good agreement, it will increase the amount of sustainable aviation fuel we will be able to produce. But that demonstrates, I think this example, one of the, let's say, the challenge. The challenge is that when you look to all these, I would say, waste, vegetable waste or biomass waste, I would say, all municipal waste by the way, in which we will try to find, I would say, the fat, which is required to make this sustainable aviation fuel have to be collected. And all these, I would say, supply chain does not exist everywhere or we need to increase that and to invest in that.

It will be in cooperation, I think, between the people who are taking care of this waste and ourselves in the industry, where we are able to build the plants to produce the sustainable aviation fuel. So there is a

bridge to fill between these 2 industries. One way we'll do it in Grandpuits is to, by the way, joint ownership on both sides. So sharing the risk, I would say, on the waste collection side, but also on the SAF production side, it's maybe a model which has to be developed.

But just -- we made just to show you that it's a real challenge. We make a theoretical exercise within TotalEnergies, which is -- I can share with you the results. We see -- okay, if we take all the waste coming from animal waste or biomass waste plus all the municipal waste and we identify what is the fat in it. And we try to transform all these at a world level, right? So you take everything at the world level, and you transfer that into SAF, only dedicating all this fat coming from waste to SAF. It will represent only half of the sustainable aviation fuel, which would be required if you want to decarbonize 100% of the plane fuels. That means that we could cover only 50%. So that's why, by the way, in our scenarios, we introduced e-fuels. Because if you don't go to synthetic fuels, in terms of liquids, we don't see if we could fully decarbonize or find a way to decarbonize the fuels for planes.

So that's an example of -- I think it represents a challenge because it's -- it will be massive. And obviously, our scenario is just something which would not be possible to achieve. But again, that's proof once again that we'll need to diversify really the various sources of energy to go to this decarbonization path to net-zero.

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

And there was a second part of the question, which was, will there be limitations on demand? And I think it's fair to say that short-term demand for sustainable aviation fuel is higher than supply. And so it's a good market, but...

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

Yes. I think that's when it exists in many things. We discussed about gas just before and the fact that the people, transportation gas they want to decarbonize the gas to go for biogas. We observe it for biofuel. So clearly, you have today, which is good, an accelerated demand compared to the capacity of supply which will be a strong driver for us to invest.

And by the way, it's the strategy of TotalEnergies is to embark more and more of investments in these new molecules, as I call them, is because we see this market emerging. They need to continue to have the support from -- in particular in Europe and in the U.S. as well, with fiscal support in the U.S. or fuel regulations support in Europe. But that means that, yes, it's a good incentive to accelerate investments in order to meet the demand. But we might have some years where demand will be constrained by supply, which is good for the price in the economies.

Is there another question? I got another one on the screen. Maybe they are all in the plane. I don't know if they are moving. So Alastair is asking you, how do you think about the current trend in EU policymakers to shelter consumers from the impact of rising prices?

I think that's a very strong lesson for all of us, what is happening this year. Because on the one side, in

Glasgow for COP26, where there's a huge call in particular from all developed countries' governments to stop subsidies for fossil fuels. That was a huge call. Even raising their finger to other emerging countries, you must stop subsidizing fossil fuels.

Now we face the reality of this transition. We have this strong shock from the Ukrainian war, price increase. And what do we do in all the countries, we are entering into heavy subsidies programs for fossil fuels. It's true in many countries. Why? Because that's, I think, it was a big lesson for me. When we say energy is a matter of reliability, security of supply, of sustainability, climate change, and we also add affordability.

And the reality in this triangle, and more and more after 25 years in this energy I'm convinced, it's the affordability part which is the tricky point, which is the most important point because energy is at the core of your life for a citizen. You need to drive, you need to – it's your home, you need to – and for an industry it's just a fundamental requirement for industries economy to develop the economy.

And so of course, the cost of this energy is just a primary factor of competitiveness, of even allowing people to live normally. So that's something we rediscover and when governments have no other way for the time being, to subsidize. Of course, it's the contrary to any, I would say, climate-driven policy. So that's why some governments begin to be uncomfortable. But the reality, it raised a real issue, which is how we'll manage to make this transition by investing, and you've seen the figure. We need to double the investments.

And so if we put that in the price of the energy of today, obviously, it does not work. There is another strong message for me behind it, is that we make a mistake today by believing that we must do at the same time increasing investments in the new energies, decarbonized energies, and stopping investments in, I would say, the energy of today, hydrocarbons. We cannot exit as long as we do not build the new system. And to try to exit at the same time, what is the result, we lower the investments, which you can see on the chart, which was shown by Helle, have really driven our investment lower in hydrocarbons from 600 billion, 700 billion to 400 million, 500 billion.

So we drive because we are asked to exit, so we exit, but then we don't have enough supply to meet the demand, which does not diminish. That's the point on which people also -- that there are many lessons of this crisis. And I think if policymakers are facing the reality, maybe we should come together to a better dialogue. And you need the dialogue between suppliers, customers, country governments, companies, even if the pressure today is quite hard on everybody to try to find solutions. But again, this will not be so easy to find, as to organize and to plan this transition.

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

But if I just circle back to the earlier discussion, again, energy efficiency is absolutely part of the solution, and the U.S., Europe right now, put a lot of emphasis on that in addition to the price caps, of course, saving energy. Yes.

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

This one is for you. Because -- so Jason on the screen again. One of the challenges of EV penetration is the availability of rare earth metals and copper. Do you see this as a limiting factor to EV growth?

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
It's certainly a good question, Jason, and it's for sure a very hot topic across the board. If I may remind everybody just on a humorous note, when President Trump wanted to visit Denmark towards the end of his tenure, he said, "I'm coming to buy Greenland". And that was one of the reasons, he had the rare earth metals of Greenland in his mind. Then the Prime Minister said it's not for sale, and so he canceled his trip.

But so it is indeed a hot topic, Jason. I think we all need to work on the supply chains. We know that there are available sources and resources out there in many countries. And so there can be developed new mines a little bit around the world, but we also know that there are bottlenecks, and for certain metals, there is only a handful of countries that have a lot of resources. So the picture is mixed, and it's something I think we all need to work more on.

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**Patrick Pouyanné** ***TotalEnergies SE - Chairman, CEO & President***
Yes. I think it's a difficult question, in fact, because I mean I'm not -- I mean, I remember what happened in the solar industry, and we invested in SunPower, we suffered of that. At the beginning of the solar industry, there was a strong belief that there was a problem of scarcity of polysilicon material. And I know what we've done, we committed for a 10-year long-term agreement to be sure to secure the polysilicon for the wafers, et cetera. It was one of the most -- it was a huge mistake.

And everybody was convinced there was a scarcity. And in fact, it was a huge mistake. Why? Because then the volume has been -- I would say, the number of the solar [units] has managed to drive its cost down. And all these polysilicon plants were invested by many people, and we saw at a certain point, 5 years after, price going down. We had our long-term contract, which was higher than the rest of the companies, out of the money. And so obviously, commodity -- it's a commodity business.

So I think that when people speak a bit about lithium or things like that, today, if you take the situation of today, yes, there is not much lithium production, but you don't have so much demand. But the demand is coming. All these giga factories are emerging everywhere. And so I'm convinced that we'll open a lithium mine and that maybe today, lithium is expensive.

By the way, it's very expensive. I think it has been multiplied by 5 or 6 in the last year. But it will go down again because it's a commodity business. So -- and on very specific, I would say, rare earth metals like cobalt, we begin to find the ways to innovate to get rid of them, in fact, in the batteries.

Your question on copper is more interesting because it could affect not only EVs, by the way copper, but we know electric cables, when you make offshore wind farms, you need a lot of copper. And I begin to have some suppliers who told us be careful, we have -- we might face a shortage of copper to make all these wind farms that you are ready to invest around the world. So that's something on which I will be frank with you in TotalEnergies, we need to be -- to invest to better understand each of these materials.

But it's very possible that the world, the planet will go from 1 dependency, which is oil and gas, and gas in particular, this year with Russian gas, to another dependency, which is another type of material. You know the planet is round. And so at the end, everything is limited on the planet. And so there are some debates how to manage the growth and to shift into this new world.

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

But I'll just add, Patrick, the recycling opportunity, of course, as well, Jason. That's part of what can be done in addition to what Patrick said.

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

These are very large questions. Can you discuss challenges in the outlook driven by the Russia-Ukraine war, EU Fit for 55 and Inflation Reduction Act in the U.S. Maybe you think I was answering to the question.

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

No, what I can do if it's on the model because, of course, it's a broader question to Patrick. But on the model, we, in Europe, what I showed you is entirely consistent with Fit for 55. It doesn't quite reach REPower. Especially on the power grid, we have not been able to match the very, very ambitious new targets for Europe on renewable power to be completely transparent, but we are a long way and we are beyond the Green Deal. And on power networks in the U.S., we are aligned with the targets for reduced emissions on the power grid in the IRA of this summer. So we are consistent with the Inflation Reduction Act for the U.S. by 2030.

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

Okay. Then Oswald, is asking a question on the screen. How is Rupture scenario affected by what could be a Rupture between the east and west worlds going forward.

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

So I can begin the answer from the model, Patrick, and then you can take over more broadly. But Oswald, you're right. So Rupture is built upon this idea that a lot of countries will be able to follow suit on the net-zero '50 countries. And for that, they require funding, of course, and support in all kinds of other forms, technology, training and everything else.

So if the world splits up, the question is which richer countries will fund the emerging ones in what part of the world. But there is a need for transfers from the richer part of the world to the emerging part of the world for Rupture to happen. And it goes back to the $100 billion per annum and then it goes back to who will fund it. And we know that the Western world has signed up for amounts of money that are not quite there, but the biggest amounts come from the Western world. And then the question is, what will other richer countries do, including China?

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

Yes. And -- but your question, Oswald, is very, I think, is an excellent one because clearly as Helle said, you

can be in a net-zero scenario only if you embark everybody on the same levers for decarbonization. I don't know if it's 1.7 or 1.5, but you need to embark. If you look only the -- if the Momentum is based on, in fact, the OECD being net-zero, more or less, plus some additional countries like the UAE, but most of them are OECD ones and the other countries are looking to growing their NDCs, which already are ambitious.

So that's true, but if you see a divide between the east and the west that we can observe, it could -- it will not be good at all to achieve the Paris -- goals of the Paris Agreement. Let's be very clear. And that's something because we could see some people telling us, okay, you want to go in that direction, but on our side, we have a growing population, we need low-cost energy, and the low-cost energy is, by the way, today, the answer is coal.

You know what is happening today in these countries in the south or the global south, not only the east, is that their gas is too expensive, so they go back to coal, which obviously is not going in the right direction. But as Helle said, I think there is no way to make this Paris Agreement objective becoming reality if we, on the Western side do not transfer the $100 billion we promised to them from 2020. I'm afraid we have already missed 2 years. So let's -- it's a very important matter.

A question about petrochemicals and larger circular chemicals, can you elaborate here? I will ask it to Helle. Petrochemical demand for naphtha should have been a key growth area for the oil business, but you have a large circular chemicals assumption. Can you discuss this assumption of large circular chemicals.

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

Yes. So what -- we'll need to give you the data off-line because our model is pretty complex on petrochemicals. So it's -- for the 6 leading polymers, we have curves of decrease of oil demand linked to the increased penetration of recycling, but it's not something that I can easily sum up online. So if you really want the data, send me an e-mail, and we will give you the drivers. But indeed -- and so -- but again, we've tried to do this in a precise way based on the market data we have and what we observe in the different parts of the world where we are present. And so it's not easy to summarize, but there are curves.

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

But what is clear is that, yes, it's true that we have, I think, deliberately, we are strong believer that circular chemicals technology will be developed. I see a real acceleration in many -- and of course, it's helped by the energy price. We know that recycling -- chemical recycling for polymers requires a higher price of energy. And so -- but what we observed is that there are many plants, which begin to be developed and invested. Still, I would say, our plant is 50,000 tonnes, which is far from I would say, what we make for a large polymer plant, which is more 500,000 tonnes.

But we see this technology being developed. There is a strong push for the society to do that. So maybe we have introduced it. But to be honest, we have never been so convinced by the future of all these petrochemicals. Yes, it's part of the market, but it's a limited market, I would say. And so the size of the transition, it will not fundamentally change the demand for oil, not in the way that some people were thinking a few, I would say, 5 years ago.

We have -- who is asking a question, I don't know. Another question, yes. In your scenarios, do you assume grid connected electricity of hydrogen production or stand-alone dedicated solar and wind projects for hydrogen production?

We are more on the second one. I think we -- if -- I mean, again, there are different type of what is called hydrogen production. But if we want to reach the 300 million tonnes, which we have mentioned I think as an assumption by 2050, that means that fundamentally, the hydrogen will become -- will find a market for massive production on hydrogen. And the key to produce hydrogen will be where do we find the lowest cost of electricity.

And is it by making gas plus CCS in the U.S.? Probably. It could be very competitive, but it will be limited by the resource of gas at a certain point and of carbon storage.

Is it by identifying some very strong wind and solar areas like in Oman or in some areas or in India in order to dedicate some of these renewable resource to hydrogen production? That will be a question.

So connection to grid, of course, helps to, I would say, have a higher utilization rate of electrolyzers, which is quite important in lowering the cost of the hydrogen. It could be a solution when the grid will be decarbonized itself. As long as you to know you're just mixing that. So at this stage, I would say it's both ways. We -- our models are not precise enough, I would say, to answer precisely to your question.

What we try to do is to translate the hydrogen production, the green hydrogen production into electricity demand. And you've seen that it's 10%, 15% of (inaudible) demand, which is on the top -- 18% exactly in Rupture -- which is on the top of the increase of capacity of electricity just to meet the electrification of the demand. So that's why these scenarios around hydrogen are really raising huge questions.

And you know – there is a debate, for example, in France to make hydrogen -- between France and Germany. Do we make hydrogen from nuclear or not, the question for France is first to make more power from nuclear before to be able to dedicate some capacities -- nuclear capacity to make hydrogen. So this debate seems to be a little on the second stage.

The first stage is first, let's have the decarbonized power to really provides the electricity that the economy will require and again, it's already a challenge to double it compared to what we have today. So hydrogen is adding another level of complexity and of demand, which might somewhere be a question mark for the world transition in fact.

So a question about products. I think the cost of the -- from Kim. Hello, Kim.

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

So there's a question here on do we close the loop in the -- yes -- so the cost of decarbonized materials, such as net-zero steel, net-zero aluminum, cement is expected to be much higher than conventional

materials. So is this inevitable increase in cost, did we factor that into our forecasts when we did the dollar quantification of the investments needed?

The short answer is no. But in our forecast, so we looked at quantities from the model and then we applied estimated costs, Kim. And we did that as best we could. I'm not sure we closed the loop on the fact that steel would be more costly over time. But on the other hand, we might have done it without having that as a purpose. It depends on the curves that we've used for the maturity of new technologies and then the decline in unit cost.

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

But what is true is that behind your question, Kim, and I think this is what you write – the way you write it, is that there is something wrong to believe that we can continue to lower the cost of solar and wind infinitely. I think we have reached maybe in the history, something very low. By the way, we see the cost going up because of supply chain, but it's true that at the end of the day, if we need to use net-zero steel, net-zero aluminum to build these plants, so cost will increase.

So I think there is something which we need to -- this one by the way, when we said about what is -- what could be the cost of the transition, Helle was cautious. She said it's a rough figure. We just wanted to -- I'm not sure we are right with $1.5 trillion or $3 trillion figures. What the message is, when it's compared to what we spend today, which is in the range of $1 trillion, $1.5 trillion, we need at least to double that. And so that's the cost. And the source of the cost will be various ones, this one that you raised might be one of it.

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

And the broader element here is that -- I mean, the transition is, by definition, inflationary. So you're right on that, too, Kim. And again, I have a kind of visual picture in my mind of the cost curves that we have used in the model. And as Patrick said, only rough numbers, but we are not in the camp of those saying that wind and solar costs nothing. And that cost will continue to decrease at the same speed in the next 20 years as what we've seen in the previous 20 years. There is clearly going to be a floor and it's factored into the numbers we showed you.

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

So there is another question which is interesting for Alessandro. Does energy outlook point to higher oil demand in 2030 -- for light vehicles in 2030 compared to '21. Can you explain? I think he's right.

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

So the answer is yes. Two reasons for that. The first one is that we're starting off a higher demand than what we had last year because '21 was extremely high in terms of demand for oil and the beginning of 2022 as well. So we have -- starting from a higher first initial point.

And the second reason is that we have slightly changed our assumptions for the existing fleets, and we have allowed for the existing fleet of passenger cars to last a little longer. And when you extend the lifetime

of a thermal car, then you extend the use of oil. And we've done that based on what we have observed, so real data over the last 3 years compared to the assumptions we had last year.

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

And I think that even if media loves to title that EVs represent 20% of the -- or 25%, I would say, of new car sales in our countries. They are still 75%. And there are many countries where EV is not deployed. We have population -- so you still have, I would say, a global fleet, which is increasing, in fact. And so yes, it's true that in 2030, the percentage of penetration in absolute terms of EV will not be so high. And then -- so oil will still be used, I would say.

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

So that's the main reason extending the lifespan of existing passenger cars because of what we have observed and we didn't have that data last year. And other than that, I would say, we have not taken a complete ban on the thermal car sales in the U.S. in 2035. We've only taken it in the states that have committed or already indicated that they would implement it. So it's roughly a little less than half of the U.S. states.

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

Okay. EV would represent in our scenario, I don't know if it's Rupture or Momentum, 10% of the global world fleet.

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

The other meaningful changes to oil demand, Alessandro is that we have electrified heavy-duty more than last year. I tried to explain that. And as Patrick also mentioned, we have changed the assumptions for gas in road transport. That would be that.

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

Great. I understand from the screen, I don't know here we don't, but we have no more questions. So I would like to thank you for your attendance this afternoon. 1 hour, 30 minutes was not too long, this presentation. A lot of information was delivered, of course, by Helle. You have to absorb that. I think it's a good introduction to our meetings tomorrow.

We'll be -- with all the executive committee in New York, and we'll have opportunities, of course, to answer to more questions. Tomorrow, of course, the objective being to speak about, I would say, our shorter term. But all this vision of demand, of course, is driving part of the strategy of Total moving to TotalEnergies. So it's important to year-after-year monitor that. And I will tell you in the world of energy, sometimes we have the impression it's moving targets or moving markets.

So having said that, there are some trends. And I think we -- I hope we have given today another contribution to, as I said in my introduction, the energy dialogue. COP27 will be, once again, maybe, probably in a different mood than it was in Glasgow. I think security of supply, sustainability, affordability will be at the core probably of the debate, but it's also a way to progress in the transition.

Thank you again to all the teams who have contributed to this study and this report that we published today. And so see you tomorrow to discuss about TotalEnergies' strategy and outlook. Thank you.

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**Helle Kristoffersen** ***TotalEnergies SE - President of Strategy & Sustainability***
Thank you. Bye.

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