The urgency of our problems gets things moving

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Question: How can we overcome the energy and climate crisis?

Radermacher: We have an energy crisis in that 80 percent of the energy we need for our prosperity is still produced from fossil fuels. And it is precisely these fossil fuels that are fuelling the climate problem through CO_2 emissions. This is why we have an energy crisis that is directly linked to a climate crisis. And the question is: Can we solve this situation without massive impoverishment, even though the world population will grow by a third to ten billion people by 2050? That is the problem, and we may be able to cope by the skin of our teeth. But there is much more evidence to suggest that we will not succeed. If there were a bet to be made here, I would bet that we will not reach the two-degree target. But then we would still aim for the two-and-a-half degree target or the three-degree target or the three-and-a-half degree target afterwards, because every half degree will potentially make the situation even worse for mankind. That is why efforts make sense in any case because then it is about the extent of the catastrophe. Of course, the best thing would be to stay below two degrees.

That is an extreme challenge.

It is great and existential. As part of our impending failure, millions upon millions of people will lose their center of life, their home. There is the potential for civil wars, perhaps international conflicts and much more tension for the world as a whole. And this in a situation where we are heading towards impoverishment because massive material values are being destroyed.

A historical comparison

You sometimes like to draw a historical parallel with Germany and Europe 300 years ago.

The world then was in a similar situation as it is today. Because a resource crucial to prosperity became extremely scarce. At that time, it was wood. Wood was initially an essential material for construction. But it was also the basis of all fleets. And at that time gigantic naval wars were fought. These wars depended on the availability of large warships. For example, it took 1,000 oaks to build a large liner for the British, who were on their way to becoming the largest naval power at the time. Furthermore, wood was the energetic basis of the world at that time, for example in metal processing. And so, for example, the melting of silver and gold depended on the availability of wood and charcoal. The silver mines in the Harz Mountains, for example, were the financing basis of the Electorate of Saxon at that time. But this silver had to be melted down and gigantic quantities of wood were needed for this.

Wood formed a major bottleneck. Many notions of sustainability (among others Hans Carl von Carlowitz), to which we still refer today, are a result of this time. It was said at that time that we should not take more wood from the forest than it can regrow. This is a crucial idea of the circular economy or sustainability. However, these appeals did not bear fruit. If I find myself in a naval war, I cannot say to my opponent that we should now wait 100 years until enough new oak trees have grown back. And only then will we continue with our war. So, what happens? You have to win the war. Because if you lose it, it means the end for your own view of the world and your own rule.

What have the people done?

They started to protect their own forests but then they made use of neighbors all the more violently. This is particularly evident in the case of Venice, the great naval power on the Mediterranean Sea, which at the time was in conflict with the Ottoman Empire. There were great naval battles there. The most famous is probably the battle of Lepanto. What did the Venetians do? They protected their forests along the Piave river up to the Dolomites. And then they "harvested" the forests of their neighbors along the Dalmatian coast, with the result that today there are no trees at all.

A technical solution

How was the wood problem solved?

It was solved by the invention of the steam engine. Some would say it was solved by coal. But coal had existed much earlier. I was born in Aachen. Nearby is one of the earliest coal mines in Europe. It was operated by monks in the area of Herzogenrath (Rolduc). It went many hundreds of meters deep into the earth. But with the technologies of the time, it was not possible to bring much coal to the surface. Coal was a kind of niche product, not the backbone of an economy. Coal becomes the solution the moment you can use the energy of coal to bring more coal out of the earth. The steam engine does that. With the energy surplus of coal, you can start working with iron and steel. You can build big, iron winding towers. Then you can build railroads and wagons and rails. With the steam engine, trains became mobile in the first place and conquered the world. And with it you can also mine coal on a large-scale underground. It will then be possible to transport it far over the land. One can take coal to where steel is to be produced. If you want to understand what it means to be able to use the energy of coal on a large scale, as a German you only have to think of the Ruhr area (*Ruhrgebiet*). The Ruhr area is a result of the invention of the steam engine. This Ruhr area was the basis of the two greatest world wars of all times. In the end, the invention of the steam engine solved the energy problems of that time. The steam engine is what saved the forest, not moral appeals or calls for restraint.

What did the steam engine do?

The invention of this engine came in a situation with less than a billion people worldwide, where the standard of living of the population in Europe, the most developed part of the world, was on the brink of collapse. Since then, the number of people has increased tenfold. Before the invention of the steam engine, people had the feeling that we were going up against the wall. The shortage of resources made a

bright future impossible. But with a new technology and a new resource, it was now possible to increase prosperity a hundredfold to where we are now. Today, however, we realize that coal and fossil fuels are creating a new problem. At the time, no one had thought of this at all, because this problem was not even known, namely that the CO_2 that is emitted into the atmosphere by combustion changes our climate unpleasantly. This means that we can overcome resource bottlenecks with new resources. But with every new resource, there is always the possibility on the horizon that it can also become a new bottleneck, with its direct or indirect effects.

What does the situation back then have to do with the one today?

It can be described as follows: Our way of doing business over the past 300 years required a large "landfill" for CO_2 - the atmosphere. CO_2 is a by-product of energy production. This is a problem in so far as one can only have one (i.e. the energy) at the price of producing the other (i.e. the CO_2 emissions). In those days people carelessly burned fossil fuels. Now that we have indirectly exhausted the resource "CO_2 landfill" to such an extent that we are already seeing unpleasant climate changes, things are getting serious. For example, we can calculate how little landfill space we still have if we want to meet the two-degree target. There is very little time left. There is only enough for one or two decades at today's emission levels. The golden age of fossil energy is now more or less over, and that is not so much different from the situation 300 years ago.

Moral appeals are ineffective

What can we learn from that historical situation?

I learn the following from the historical situation: Moral appeals do not help. 300 years ago, they did not help, they had not before that and they do not today. And for two reasons:

When I build a civilization, it takes me a very long time to bring it to a certain level. But to bring it down from that level is very fast. This is called the Seneca effect. There is often very little time left in these processes. That is the one thing you have to take into account. Orderly deconstruction does not succeed under these circumstances. Chaos and massive distribution conflicts are looming.

The other thing is this: if you are in a competitive situation, historically for example in the conflict between the states over control of North America in the Seven Years' War between France and Great Britain or the conflict over control of the Mediterranean Sea between Venice and the Ottoman Empire, then it is difficult. Powerful actors threaten each other. It is a situation that involves existential risks - and at the same time has enormous potential for profits. In this situation a moral appeal is of no use. For if all parties involved do not hold back in roughly the same way, it is pointless for only one party to hold back. Because then the other party will take everything that one party saves. In mathematical game theory, such unfortunate situations in which all the players ultimately harm each other by pursuing only their self-interests are called the "prisoner's dilemma". A related term is "tragedy of the commons".

What really helps?

Sometimes nothing at all. Many cultures have collapsed in this way. The alternative is technical progress. So historically, we have solved such situations again and again through technical progress. Even in today's situation, the focus has to be on a technical solution that allows us to provide even more energy than we consume today, and that tends to be even cheaper than today and still carbon neutral and environmentally friendly. Then we can continue to live our lives. In addition, billions more can live well. And yet we will not harm the resource base or the climate because we have found a clever technical solution. This is what we should focus on.

We are still experiencing moral and political outrage today, for example at the demonstrations of Fridays for Future.

Yes, the moral dimension plays a major role, because people feel that something threatening is coming. At the same time, however, one must always take into account that currently the power situation on Earth is such that the final decisions are made at the political level by about 200 states, with a few large and powerful states setting the tone. All these states have completely different situations and ideas to begin with. They have completely different levels of prosperity and different military resources. The populations are differently educated, with different ethics and with different historical experiences. In other words, they are a completely heterogeneous group of actors who are confronted with the climate problem. And who at the same time have completely different ideas about who is to blame and who must pay first and foremost for something new to come.

So far, there has been little agreement on climate issues.

This is the case. Unfortunately, some large and powerful states are also the best in obstruction. In this situation, there is a popular evasive reaction by wealthy countries, which enjoy their wealth and feel that they are being blamed for this wealth. This is unfair inasmuch as the rich countries, in return, have brought much to all other countries, namely through the technical progress they have made, which, however, has led to high emissions, even in previously colonized countries. The others have adopted this technical progress quickly and gladly and profited from it, as it has often meant a better life. At the same time, there is the accusation that we have created the CO_2 problem. And now we are supposed to pay until they reach our level of prosperity, while they are allowed to emit more and more CO_2 as they catch up - China, for example.

Reverting to the national and regional

What does that mean politically?

In this situation, there is something like a mental regression to what is yours - for us this is no longer even the European Union, but the nation state, for some people even the city in which they live. There you have the impetus to be the good or the good person by proving on the spot that all this is possible. Then, with enormous effort, attempts are made to change lifestyles through adjustments and regulations. Then you can say: look here, we have done our part. We are banning coal, we are closing the nuclear power plants, we are the good guys. But if you were to think

about it, you would come to the conclusion that this strategy would drive you right up against the wall. Because the future of the climate is being decided in the densely populated emerging economies. Germany, with its 2 percent share of global CO_2 emissions, plays no part in this. Nor, by the way, as a role model, because poor countries cannot finance what rich countries are trying to show off. That is why I always like to describe the narrowing down to the national framework with the following joke:

There is a man standing under a lantern on the highway looking for something. Another motorist stops and asks: "Can I help you, have you lost something?" “Yes,” the man says, “I have lost my car keys.” “Where exactly did you lose the keys?” “I lost them back there.” “But then why are you looking here? At least there is light here.” This simile makes it clear: the search is completely pointless. But if I manage to convince myself that I am making a meaningful contribution, then at least I am making a contribution. I have given my best. In the fight for the global climate on the "German front".

Do you currently see any promising idea for solving the climate issue in political debates?

The world has pursued a sensible strategy for a very long time. It has been guided by the Montreal Protocol, with which the CFC problem ("ozone hole") was indeed solved. This global approach was to be applied to the climate problem. To do this, the total annual emissions permitted worldwide must be capped worldwide. Then one has to think about a path to reduce these capped emissions year by year. Then you have to distribute property rights to this limited budget, which is getting smaller and smaller over the years. The emission rights must then be allocated to the states so that they can use these rights or trade among themselves. Because some countries may receive many rights that they do not need. Others get too few rights for what they do economically. If these states trade rights among themselves, the rights will be sold at a reasonable price. In the end, the market will regulate where you can achieve the largest possible impact for the climate for the money you spend. That would have been a good solution. But it failed because there was no agreement on who gets how many rights out of this shrinking cake.

Climate policy has failed

Can you describe that in more detail?

The decisive questions were: How many rights will the USA get? How many rights will the Chinese get? How many rights will the Indians get? Three logics were used to argue about this. The first logic was: a state receives about as many rights in proportion to the economic output it provides or needs for this output. That would have been a solution that ultimately favored rich economies because countries would get more rights the richer, they are. The second variant: we look at the number of people and distribute the rights in such a way that everyone gets the same share. This is called climate justice. Climate justice was particularly attractive for poor countries whose populations are growing rapidly. But climate justice was a disaster from the US point of view because a citizen of this rich country would have had the same rights as an Indian. And at the same time the number of Indians is growing massively. In addition, the total number of rights is constantly being reduced. This

means that the Indians are getting an ever-larger share of the volume. While the USA, with all its prosperity, is getting a smaller and smaller share of the shrinking volume and has to buy many rights from the Indians as a result. There is a third solution, which is called “grandfathering”. You simply stick with the percentage distribution at one point in time, say 20 years ago. This solution is good for rich countries because under these conditions they get a high percentage of rights. They would also get a high percentage of the shrinking total volume. This would be a disaster for the poor countries. Because they would receive a comparatively small share, and that with a growing population. So this is what we have been arguing about. The rich countries were too stupid to realize that the best solution for them would have been to involve the populous countries with their ambitions for growth by accepting the logic of climate justice. After the world had stopped communicating, we were actually in a situation where there was no longer a reasonable solution.

That is the situation we are in now.

Yes, because now we are confronted with the fact that China has by far the largest CO_2 emissions in the world. China could take advantage of this constellation to become the factory of the world. China was a developing country. China had a right to economic development. And if now the Chinese were to produce more CO_2 emissions, then that was inevitable and had a dimension of justice. Now one could argue today that the Indians and the Africans and all other poor countries on the globe are allowed to progress to where the Chinese already are, for reasons of justice. But: If that were to happen, then we would not be at two degrees but at a four-degree-increase. And what good is a fundamental position of justice if it leads to a collapse of the climate system? So, it doesn't work like that. We have pursued a path that does not work. And we are already paying a high price for it.

You said that we need a technical solution. What would it look like?

In the future we will need much more energy than we do today. Because the size of humanity is growing and because expectations of prosperity are increasing. One of the ways the world is currently solving its energy deficit is by increasing the number of coal-fired power stations. That is the obvious reaction. Of course, this is massively damaging to the climate. But since these coal-fired power plants are being built in African countries and in India, for example, we again have the justice argument as justification. But coal-fired power plants are also being built in China and Japan. China continues to "hide" behind the fact that it is also a developing country. The Japanese say they live on a small island. They have very special problems, and they built particularly clean coal-fired power plants.

Solar energy

The alternative would be?

First of all, we have a source that allows us to use the much-needed energy without emitting CO_2 into the atmosphere. That is using the energy of the sun. There would be a second option. That is the great heat in the depth of the earth, for which we would have to drill several thousand meters deep - “super-deep geothermal energy”. That is however very difficult, nobody really dares at present to try that. Therefore, we try to solve the problem with the sun alone. And we have actually achieved a lot in

the past 30 to 40 years. On the one hand, there is the issue of wind power and on the other hand, photovoltaics. But "harvesting the sun" is expensive. Especially if you do it in Germany. Then there is the controversy about the locations for wind turbines. And photovoltaics is also about land, and that is expensive in this country. But the decisive point is that if you look at the so-called peak power, i.e. the maximum of what can be extracted from the sun per unit of time during the day when the sky is clear, then in temperate latitudes we may reach a total of only 1,000 peak hours per year, while a year has almost 9,000 hours. In the Sahara we end up with perhaps 3,000 peak hours. Central Europe is just not the most favorable location for harvesting the sun.

Gaseous and liquid energy sources

The alternative would be sun deserts like the Sahara.

In the Sahara, the benchmarks are two to three times as good as in Germany. In the Arabian and Chilean deserts, the same applies. So, we have an interesting instrument at our disposal. But this instrument has the disadvantage that what it produces is electricity and nothing else. We can meet about 50 percent of our total energy needs with electricity. The other half is heavy industry, cement, chemicals, vehicles and aircraft. For this we need energy-rich gases or liquids, for example gasoline. These liquids have the advantage that they can store a lot of energy in a small space. The energy density of gasoline is about one hundred times greater than that of an electric battery. And you can store this gasoline without any problems - for example, in a canister in the garage. Even after ten years, you just tip the contents into a car and drive around in it. So, we need the energy in two forms. We need it as electricity, and we need it as energy-rich gases and liquids, with both forms is convertible into one another. This means that we can produce the liquids from electricity and we can produce electricity from the liquids. But the problem is that these conversion processes involve energy losses. The whole world of energy is quite complicated.

How can we turn green electricity into green gases and energy-rich liquids?

Green gas today would mainly be green hydrogen, which we produce from renewable energy. And we do this by electrolysis of water. And if you want to go from electricity to gases to energy-rich liquids, methanol plays a central role as a bridge between many needs and options.

Is the technology to produce green hydrogen and liquid energy carriers available?

It is available because this is not a new approach. These gases and liquids are already available in large volumes today, and have been for many decades. Methanol, also known as "liquid electricity", is the second most frequently synthesized liquid in the world. And hydrogen is also produced in large quantities. But both of these are produced today primarily with the help of energy from fossil fuels. So, the technologies are available because we have been using them on a large scale for a long time in a “black variant” regarding the energy input needed. The new thing is that we are now trying to replace these black solutions with green solutions. Production is often done using electricity. So, we need a lot of green

electricity - a crucial bottleneck - and then efficient processes to move from green electricity to green hydrogen and green methanol and then to synthetic fuels.

The price of electricity is decisive

Where exactly lies the bottleneck?

With the green power supply. Over 50 percent of our electricity in Germany is still not green. And now many new applications are being added, such as electric mobility. And these new applications will only become attractive to the world if they are comparatively inexpensive. After all, a future for the world in poverty may be good for the environment and climate, but it is neither a politically enforceable nor a desirable program. But if we want a world in prosperity, energy must not cost much more than it does today. We know that we must get green electricity at a price of less than two eurocents per kilowatt hour, at the point of delivery to the electrolysis plant. We have electricity prices of over 30 eurocents per kilowatt hour in Germany today. If the electricity is cheap enough, we get the green hydrogen via electrolysis for 1 euro per kilo. That is where we have to get to. If we do that here, with our renewables, we are at 3 to 4 Euro per kilo of hydrogen today. You can do that, but it is not profitable. So, we have to produce green gases and liquids cheaply so that they can compete with fossil fuels. Especially for poorer countries it is not an option to replace cheap coal with expensive renewable energy sources and comparatively cheap gasoline with expensive synthetic, carbon neutral gasoline. Because this simply means that many people who are not doing well anyway would be even worse off.

The conversion of electricity via hydrogen to methanol is quite inefficient. Is that a problem?

No. The fact is that coal, for example, is also highly inefficient in its use. Most coal-fired power plants do not even have an efficiency of 40 percent. But that does not bother anyone if the coal is just cheap. Ultimately it does not matter whether something is efficient or inefficient. Life as such is highly inefficient. So, if I have enough of a resource that does not cost much, I can use it inefficiently. Ultimately, it is all about the price ratio: What does it cost me? And if I can get away much cheaper with a highly inefficient solution than with an efficient expensive solution because the cost of the resources is simply so different, then I have no problem choosing the inefficient solution. For us, the benchmark is the comparison with the status quo. The world lives with a cost structure, for example for gasoline. Interestingly, almost half of the costs we pay there are taxes. We don't expect synthetic fuels to be exempt from taxes because they have to finance the road network, for example. Our aim is to produce a synthetic gasoline that does not cost much more than current gasoline, even though it bears the same tax burden.

The big energy puzzles

The Global Energy Solutions association focuses on the production of large quantities of green gases and green liquids as energy sources. What does the solution actually look like?

Actually, we do not have a new solution. But we have put a complicated puzzle together again. And that gives us an affordable option for a carbon neutral world - a

decisive contribution. There are many people today who believe that we only need green hydrogen in addition to the renewable power-producing processes - and then we would be done. But green hydrogen also has its limits. For example, there are major problems in transporting hydrogen across oceans. And if you do not have a reasonable way of transporting it across continents and oceans, the discussion in Europe will return to green hydrogen from Europe. And, as I said, it is quite expensive. Besides, Europe does not have the volumes of green hydrogen that are needed because green electricity is not available in the required volumes. If you want to have and use really large quantities of green hydrogen, you have to convert it into another form that is well suited for transport to the EU. And perhaps the best option is to combine the green hydrogen with CO_2. This produces methanol. Methanol is the simplest liquid carbon substance available. It has the advantage that it can be easily transported, like oil or gasoline. This also means that you can continue to use the existing transport infrastructure. So, the same pipelines, the same tankers, the same filling stations.

And the trick, as you have already said, is the mass use of CO_2.

Today we have industries where it is very difficult and expensive to decouple from CO_2. You need new solutions, for example for steel or cement. And of course, we would also need solutions for fossil fuel power plants, both those that already exist and those that are still planned in large numbers. And if we do not somehow get these power plants carbon neutral, we can forget the two-degree goal anyway. Methanol is the natural absorber of incredible amounts of CO_2. We can turn cement plants carbon neutral by capturing CO_2. We can turn chemical plants carbon neutral in the same way. This is relatively inexpensive. So, we do not have to find new technical processes for steel production or the cement industry. We can even keep the coal-fired power plants if we only capture the CO_2. But then we have to do something with the CO_2. Methanol is a good choice here. By combining hydrogen with CO_2, we get methanol. And this methanol fortunately is of such property that it can be used for many things. We can make methanol gasoline and methanol diesel, for example. We can use it to fuel all the gasoline and diesel vehicles that we have today. So, we can make the entire stock of combustion engine cars in Europe and worldwide carbon neutral without anyone having to replace their car. These are options that open up great opportunities and have hardly been discussed in this form so far.

Methanol gasoline

If you change the fuel, do you not have to technically convert the cars?

If you want these cars to run on methanol, then you have to convert the car. You can add maybe 15 percent methanol to normal gasoline, which would help. But even for that you have to change engine settings. But if you make methanol gasoline by synthesis, it is identical to today's gasoline. You can use chemical processes to produce a carbon neutral gasoline that is no different from the gasoline we make from oil today. However, it will be substantially more expensive than methanol itself, about 40 to 50 eurocents more per liter. But including taxes, we still end up with a price per liter of below 2 euros. If that is the cost for saving our civilization, we probably can live with it. Pure methanol is of course clearly cheaper.

If a vehicle burns methanol, it nevertheless also emits CO_2.

Yes, but you should consider the following in this context: Today we have two processes in which CO_2 is produced. First, we take the coal out of the Earth, we turn it into electricity: CO_2 is released into the atmosphere. Second, we take oil out of the Earth, we turn it into gasoline, the cars drive around using it: CO_2 is released up into the sky. Global Energy Solutions proposes for the future: We take coal out of the Earth, we turn it into electricity, but we capture the CO_2. That amount of CO_2 is not released into the atmosphere anymore. We turn this CO_2 into a synthetic fuel. With this, we drive our cars. Here, CO_2 is still released into the atmosphere. This would be the same amount of CO_2 that has been emitted so far by fuel consumption. If both processes had the same volume, we would have cut emissions by half using the new method. In other words, we save the coal power plants' emissions. But we still do not have any carbon neutral cars.

And you cannot get them carbon neutral either?

Of concern are all those processes where it is difficult or not worthwhile to capture CO_2. Individual mobility is a case in point. Because a single car simply emits too little CO_2. This also applies to heating and cooling units in private buildings, for example. In other words, wherever CO_2 cannot be captured cost-effectively, it is ultimately released into the atmosphere. We have calculated that this will amount to around 10 billion tons per year. Maybe a little more or less, depending on how you solve the heating and cooling problem, for example. You can also do that electrically. You have to figure out the right solution to each problem because you sometimes do need coal in certain technical processes. In steel power plants, for example, you do not just need coal for energy, you also need carbon as a material as it is built into the metal grid of the steel. So, for certain industrial processes we will still need carbon as a raw material.

Circular Economy

CO_2 can also be recycled several times?

Yes, because we still have to supply the chemical industry with carbon. We have to supply the glass industry, we have to supply the cement industry, we have to supply the steel industry. We run steelworks with methanol, we capture the CO_2 again and reuse it. With the methanol we operate a seawater desalination plant or a chemical process. We capture the CO_2 again. And only lastly, we use it for fuelling our cars. And only then CO_2 is released into the atmosphere. In a world that consumes much more energy than today, we will probably release only 10 billion tons of CO_2 into the sky each year. That is all that remains if we operate cleverly with synthetic fuels such as methanol and use this technical recycling to remove three-quarters or four-fifths or five-sixths of the problem. What remains is the last quarter, fifth or sixth. That is these 10 billion tons.

And then, in addition to the technical CO_2 recycling, there is also a natural one.

Yes, because fortunately we can biologically extract an additional 10 billion tons of CO_2 from the atmosphere year after year with the help of a new policy with regard to forests, soils, rainforests, mangrove forests, wet biotopes. These are the so-called

negative emissions “produced” by Nature-based Solutions. If we promote and finance these biological processes wisely, they will generate a great deal of wealth while also removing CO_2 from the atmosphere. At the same time, new value is created. Where there are degraded areas in the tropics today, new forests are created. Where today we destroy soils agriculturally, better soils are created by adding carbon. The only difficulty today is that we have no global programs that pursue and finance this goal. When you talk about recycling, you also need a money cycle. The polluter must pay so that someone else can repair the damage. Remedying the damage means that emitted CO_2 is taken out of the atmosphere again. And if we cooperate well with the tropical countries, this also helps their economic development and nature, for instance regarding biodiversity. Overall, this promotes the implementation of the Sustainable Development Goals, the global sustainability goals of the United Nations, which are also called 2030 Agenda. It also alleviates the world population pressure. But none of this is currently state of the art in politics.

Cooperation on an equal footing

This would also require new mechanisms for international cooperation.

Yes, the countries of the South, which have often been the losers so far, would suddenly be the ones that could offer a lot. They could offer the sun deserts. They could offer enormous potential for biological sequestration. And all of that with fair business relations. This creates a partnership on an equal footing with solutions which, in my view, are also the industrial policy solutions of the future. For example, we are developing new technical options in Europe and our partners have the geography and the location. We cooperate to our mutual advantage. I like to put it this way: We can only solve our climate problems without losing prosperity if we cooperate very closely with Africa, for example. And Africa can only solve its prosperity ambitions and its emerging climate problems if it cooperates closely with us. In my view, this is a key positive element in the proposal we are pursuing at Global Energy Solutions. In this context, the German Federal Ministry for Economic Cooperation and Development speaks of a much-needed "Marshall Plan with Africa".

What is your vision?

We want to make a significant contribution to ensuring that there is a world with ten billion people who can live in prosperity, in peace with nature and with a great deal of freedom, as we are used to in Europe today. We want to provide sufficient energy to achieve this. We want to do this in such a way that it is affordable and does not destroy the environment or the climate system. Our vision is to protect the environment and the climate system, to achieve social balance, with ever greater prosperity in global cooperation. This vision lives from the fact that there is a technically and organizationally affordable solution to the energy problem. We want to further develop this solution and spread the word. At the same time, the association brings a lot of analytical and technical expertise to the table and interacts with large global networks of key players from many different fields. We are facing a complex challenge. We are trying to bring together many building blocks in such a way that a viable solution is found.

Transport problems

What does that mean practically?

Just ask yourself whether we should mainly obtain green hydrogen from Europe. If so, we will not have a transport problem because we can use our gas networks. But then we will also have to produce the green electricity here. Unless we would bring the green electricity from the Sahara here. That was once the goal of the *Desertec* project. There are major technical and regulatory hurdles but there are also acceptance problems among the population. In practical terms, this means that we have little chance of importing green electricity from other continents at a reasonable price. On the other hand, however, it is also foreseeable that we will not be able to produce enough green electricity in Germany or Europe, not to mention cheap green electricity. So, you almost naturally realize that large parts of the green hydrogen ought to be produced outside of Europe on the basis of the solar power generated there, for example in the large sun deserts.

And could we import it?

For hydrogen, too, as mentioned before, there is unfortunately no cheap and reasonable solution in maritime transport so far. So, we are either left with a solution here at home, which is very expensive and limited in volume - or with a solution in the Chilean or Arabian deserts or in the Sahara, for example. But then the question arises again: How do you bring the energy to Europe? This is exactly where the possibility of combining hydrogen and CO_2 to form methanol comes into play. Then you have a liquid that is easy to transport. In addition, you also have the possibility of recycling CO_2 on a large scale. You then also have the opportunity to produce synthetic fuels to render the fleet of internal combustion vehicles carbon neutral.

Why methanol? Are there also other possibilities?

On the level of carbon molecules, methanol is the simplest solution when it comes to liquids containing energy. Methane is the simplest solution when it comes to gases. Methane has advantages, methane has disadvantages. Ammonia is another solution, also with advantages and disadvantages. Both in turn must be weighed in relation to methanol. Then there is another alternative with regard to the production process: the so-called Fischer-Tropsch process. So, there are many practical questions which all have to be clarified. We are looking for feasible and entrepreneurially attractive ways forward. After all, we want to motivate investors to invest in the production of green energy in the sun deserts of the world. The association will address all these questions with its first major project. We will do so with an open mind and scientific thoroughness in exchange with many other experts.

Economically successful

What makes you so sure that it pays off?

Of course, we started our analyses several years ago. With our experts and the expertise of partners from our network, we have already made extensive preliminary considerations that make us optimistic that the path we have outlined can work. This path can now be further differentiated. And it will also be the case that there are

things that we do not yet know. But then it will look even better overall than it already does now.

What about a pilot plant?

A pilot plant is currently being built in Morocco, supported by the German Federal Ministry for Economic Cooperation and Development (BMZ). We are closely related to this BMZ project because we are also a BMZ/GIZ project ourselves. We certainly have the ambition to elaborate our previous deliberations in just a few months so that we can still provide an input to the German EU Council Presidency. And we hope that perhaps in six months' time we will already have a relatively solid framework which we will then have examined by other institutions and stakeholders. And I mean rigorously examined. All our premises and results must be put to the test. It is a question of validity. Based on this, we would like to deliver a final report on the first project in just over two years. But of course, meanwhile we also want to talk to potential investors to motivate and mobilize them. And in the political process, we will be involved in the regulatory debate. After all, smart regulation at European and German level is a prerequisite for making investments worthwhile, for example in green electricity from desert areas. And that in turn is important for our talks with potential investors, to whom we will then convey the interest of the industrial partners involved in our project.

Do you have concrete objectives?

My ambition is that we can motivate a group of investors to implement a project with an electrolysis capacity of 5,000 megawatts. 5,000 megawatts, that is also the goal of the German hydrogen strategy until 2030. By that time, we would like to have a production facility in North Africa of precisely this size in order to produce around 4 million tons of methanol. This would make it possible, for example, to replace one tenth of the gasoline used in Germany with methanol gasoline in a carbon neutral way. However, the investments required will be more than 10 billion euros. The largest part of this is needed for the production of the green desert electricity.

Success or failure

Many developments in the energy sector are currently heading in a different direction. You represent an outsider position. Why should it be successful?

My life experience is that when pressure has built up, things can develop quickly. In the climate and energy sector there is a lot of concern. One can almost speak of hysteria. I would like to describe this with a smile. You have a boiler in which water boils. And you are constantly adding new energy. The whole thing is in danger of exploding. And you see that many people are trying to do a lot of things. But much of what is tried does not solve the problem. Rather, in some cases it even stokes up the process further. Then it is clear that clever considerations that actually have a solution potential will have a great chance of being heard at some point. In the beginning, you can paint a rosy picture of business models using many illusions. But then everything fails because of the realities. At some point, sheer necessity leads to the willingness to try something else. I believe that we at Global Energy Solutions will provide a consistent solution. And at some point, people will be glad to have access

to it. I have experienced something similar in my life many times before. And I assume that this will be all the same again.

So, if you have your way the end of the world will not happen.

Yes, but even if we do not solve the problems, we will not experience an end of the world, but a horrible state for the people and our civilization. If what we have in mind is successful, we can avoid this. I imagine that a positive future of the world in 2070 will roughly look like what life in Europe looks like today - but for the whole globe and its then ten billion people. They live in prosperity and freedom and in peace with nature and the climate. Unfortunately, we are miles away from that today.