

The transformational challenges of climate change: An interview with Professor John Schellnhuber and Professor Ottmar Edenhofer

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Interviewer: John Wiseman

John Wiseman: I'd like to begin by asking how you would summarise the implications of the most recent climate science evidence for current global emissions and climate trends?

John Schellnhuber: I think we have more or less solved the detection and attribution problem which was the original task for the IPCC. That means: yes, we are obviously observing global warming trends, which have regional variations, of course. And yes, we know with a very high probability, now that human interference is to be blamed for the major part of that change. You can still argue whether it is 80%, 60% or 75%.

Part of the diagnosis is that we are already seeing impacts all over the world. But in my view this is not an important point because this is just the beginning and naturally the impacts are fairly faint and weak. I went to the Seychelles, a little while ago, a beautiful tropical island group. The house which I had rented was directly at the beach, but its manager told me that 20 years ago when they built that house there was a broad street between it and the sea. This means that some 10 metres of beach were just eaten up by the ocean over the course of 2 decades. In particular vulnerable regions like these islands people have not the slightest doubt that something is impacting their environment, but nevertheless I think the observed impacts so far are comparably marginal.

So the big question is the prognosis, based on our physical models, and with all the uncertainties we are aware of. For this, we probably need to consider the following range, which is basically represented by the new RCP scenarios.

We have the highest plausible scenario suggestions that by 2300 will more or less deliver - our best guess – a warming of 8 degrees which will be sustained over many hundreds of years.

And then there is of course a range of desirable, much more ambitious scenarios that lead to a 2 degree warming. Generally, the 2 degree threshold is considered to represent an upper bound for a manageable situation, particularly in terms of sea-level rise.

The worst of plausible outcomes is a world that simply removes all the conditions under which human civilisation were created. We would be kicked completely out of the Holocene, which is such a sad prospect that I often try to avoid looking at the consequences. I have a 4 year old son, and it is often very hard to imagine what it means for future generations if we inadvertently or willingly just catapult ourselves out of the planetary boundaries for human well-being.

Now if you know that this is the range, the next question is: What are the specific implications of 2, 4, 6, 8 degrees warming – and is there a way of adapting to that? The other big question is: Can we deliver the best-case world, namely the 2 degrees world and what are the means for achieving that?

JW: Can I take the adaptation question first. There was a recent widely quoted speech by the CEO of Exxon where he argues that human beings can engineer their way out of most things and can therefore adapt to most things. What's your response to the argument that we can adapt - human beings can adapt to anything?

JS: I'm just writing a paper on that, on "adapting" to an 8 degrees warmer world. And we just finished a report for the World Bank on a 4 degrees world, a little bit inspired by the 'Four Degrees or More' conferences that were held in Oxford and then in Melbourne. Even that – a 4 degrees world - is quite scary.

The problem is the following: We do have evidence about what the impacts of 4 degrees, or 6, or even 8 degrees warming might be -we would certainly lose the big ice sheets and so on. But there is almost no scientific evidence about how to adapt to that.

So if people, on the one hand, accuse scientists that we are not dealing in a correct way with the uncertainties involved - the impacts analysis and even climate modelling - they take the liberty on the other hand, of telling us in a sweeping way that adaptation to 6 or 8 degrees is actually a piece of cake. To me, this is blatant dishonesty. The CEO of a company with vested interests might not be aware of the scientific basis of his statement - or lack thereof - but there are actually some scientists who just say, yes, adaptation is okay, we can do that – while there is no scientific for evidence it. I'm not saying there's scientific evidence against it - there is simply no scientific evidence at all: The scientific debate of the limits to adaptation has not even started - so if I do not have sound knowledge about it, I'd rather hold my word back.

Plus, there's a fundamental dilemma here which is even bigger. There clearly are regions which are more vulnerable, and these are precisely the regions of lesser economic power. They cannot just easily grow and develop out of the predicament. Hence you would need an international transfer of money if they were to be guarded against the impacts of unmitigated global warming. The United States, Australia, Germany and others would have to provide for the funding, and so far it is hard to recognize their willingness to do that. In fact, if that willingness could be organised, it could also be directed at investments into clean technologies, at actually mitigating global warming before it's too late. This symmetry of problems and challenges in mitigation and adaptation is something I think science should investigate.

Now coming back to the lower end scenario of 2 or even 1.5 degrees. This implies, to the best of our knowledge, that we have to first peak global emissions before 2020. We then have to completely phase out fossil fuels – i.e., go down to zero emissions - by around 2070.

And then, and that's the third fact, carbon emissions need to become negative, and that means removing about three to four gigatonnes of CO₂ from the atmosphere every year. That is what the best of our scientific evidence tells us.

We have this problem, we know that humanity is involved in causing it, we know that the 2 degrees guard rail would probably be the best insurance we can buy. But the price for this insurance is fairly high. It means a complete transformation of the global economic system.

The cardinal issue is that either you deny the scientific evidence of global warming entirely or you acknowledge it but then deem the 2 degrees guard rail politically impossible and state that the world can adapt to any degree of warming and thereby deny the lack of scientific evidence of its feasibility. Or you acknowledge both, the basic problem and our basic ignorance concerning the limits to adaptation and think the 2 degrees guard rail is doable. The question then is how it can be achieved.

JW: What do you say to more pessimistic people who say it is too late to prevent runaway climate change?

JS: I would say there's no way to attach sound probabilities to future pathways of human society at the global scale.

I've looked very carefully at past historical transformations. I looked into the Industrial Revolution, the Neolithic Revolution, I read dozens of books on the history of technology. These are truly complex, highly non-linear, and often self-referential processes where you have self-fulfilling prophecies and self-avoiding prophecies involved in equal measures. So the answer is: nobody can really come up with a reasonable probability assessment, but you cannot seriously and compellingly exclude the possibility of a transformation either – and that is actually my hope.

As a physicist, I always need a metaphor. The metaphor here is that of a phase transitions. I have done some work on phase transitions in magnetic systems. There what you learn is that if you see a system change phase from solid to liquid, it's often an extremely in-homogeneous process. You have small pockets of change which combine through complicated neighbourhoods and networks - and finally tip the system into another phase.

There is self-organisation at all scales actually, these are even fractal structures. I looked into the fractal dimensions of that, and what you need for a phase change is at least a weak background field - that would be the global governance 'field' if you like. However weak it is, it needs to exist in order to single out a new phase.

These physical processes are of mind-boggling complexity. But in practical terms, it means if you have even small pockets of change, and if the new phase is very robust and attractive, even these seeds of change can combine to tip the entire system into a new mode of operation.

So the amplification factors of innovation, to talk concretely - new technologies, new community structures, new ways of designing cities - such amplification factors can be quite powerful.

There is a very rough insight regarding the history of societal phase transitions – which has to be taken of course with a lot of caution: If you have a co-existence of textile industry production systems, say mechanical based on steam engines, competing with the traditional approach, and you reach the loading of the entire system with the new mode at a CT- 20% level, the old system succumbs.

So what I assume is that if we could create - whoever *we* is - if one, the world, humanity, could create a non-fossil fuel energy system with at least 10 to 20% market share, propelled by feed-in tariffs or other suitable means, then the system will just move into the other phase. That again means that the answer is hidden in the amplification factors that are probably in the system already. Realizing these, highly non-linear opportunities could be arising. Thus, we probably could do it if we – and again I say *we*, the people who take the problem seriously - would use the resources one has at hand in a very wise and a very intelligent way. In other words, sowing the seeds of change in a subtle way might do the job.

JW: I'd like to ask your views on the best way to talk about targets and guard rails. When people talk about the possibility of a '2 degree climate guard rail' – or parts per million targets, or carbon budget targets, what's your preferred response to that question?

JS: I've always argued that you need something concrete. The ultimate metric is the impacts of climate change - what is it that you want to avoid. You do not want to avoid 750 ppm, who cares, but you want to avoid certain impacts that are really hard to cope with.

It turns out that global mean temperature is the best simple metric you can get, because all the impacts somehow scale with it. CO₂e ppm doesn't tell people anything in the end, it's just an intermediate variable so to speak. So yes, I've worked very hard for a long time to argue that global mean temperature should be the target. It is simple, it is very compelling and in the end and it is something decision-makers can understand.

It is an also compelling metric because it can be conveyed in a way that lay people can relate to: Think of your body temperature, 37 degrees centigrade. If you add 2 degrees to your body temperature you are in fever, 39 degrees. If you add 5 degrees you are dead. Think in precisely the same terms about planetary mean temperature. Human bodies have all types of reactions and compensating mechanisms – if you hold your arm in the sun it will be much warmer and your skin might burn, but all in all you have an equilibrium temperature which will be kept stable. This is also probably true for the globe as such, as a system, with all types of cooling mechanisms.

If we add 2 degrees we would be in the danger zone already, we would feel uncomfortable. If we go to 5 degrees, the world as we know it will be gone.

I found this metaphor usually convincing for everybody. Translating climate change into ocean acidity might be good for a chemist and maybe for an atmospheric physicist but it doesn't ring a bell for a lay audience. So there are both, scientific reasons, because many impacts scale with the mean temperature, and psychological reasons, because rising temperatures is something everybody can relate to, that make global mean temperature an adequate metric.

Actually the only tangible success of global climate policy since 1992 is that we have more or less an agreement on the 2 degrees guard rail. In the end we as scientists have to give the politicians a clear orientation, and this is really the only number that has transpired from the overall process. If we would sacrifice that as well, we are back to square one. Actually now we are still at square two - two degrees.

JW: I would be interested to hear what sort of response the ideas about post carbon economy transition strategies outlined in the report 'A Social Contract for Sustainability' by the German Advisory Council on Global Change report have had in Germany?

Ottmar Edenhofer: Most of the economists weren't positive about it because they had the feeling that this 'great transition' idea and social contract idea is almost against liberalism. From my point of view this is an ongoing and an emerging debate. There is an Enquête-Commission on Economic Growth in Germany now - on the prospects of economic growth as such and there's a big controversy on that issue. I wrote an article on 'Green Growth', and another one on the topic as to 'who owns the atmosphere'. We are in the middle of a certainly very heated debate presently.

Basically, the opponents of climate policy try to frame the debate in a way which suggests that climate scientists and climate policy advocates are against what, in their minds, is liberalism. So they will try to find a way to connect them with some kind of green dictatorship, to depict them as imposers of some strange ideas and restraints on society.

JS: People say, 'well the markets will deliver', but we are not arguing about markets. We are saying that a political decision maker, in order to bring about the deliberate transformation towards a new global energy system, which would be unprecedented in human history, has to act politically. A feed-in tariff is not something that will simply emerge from markets, how could it? Boundary conditions are not created by the system itself. They are created by those who oversee the system clearly. So markets may be wonderful in delivering in the end the lowest-cost solutions, but the boundary conditions have to be set by a social contract - a social contract as expressed by democratic institutions.

So what we are simply saying is that if - only if - , a democratic state is concerned about climate change, and wants to do something about it, then we [can] define a few options, what could be done, in order to create the framework conditions that would allow the markets, creative people, and civil society to deliver.

OE: The crucial point is, in any case, that you have to redefine property rights. If you assume a boundary condition for the climate, for example the 2° C target, then either way you have to define property rights, common property rights, private property rights concerning the atmosphere. This has strong distributional implications because after all oil, coal and gas deposits are still rich. Scarcity is not the limiting factor here. The factor which will force mankind to act is the limited disposal space of the atmosphere. People will have to be convinced that the majority of fossil resources have to be left underground. In other words: trying to convince them of this equals convincing them to leave their assets untouched and therefore devalue them completely. This is one of the reasons people feel -

JS: - they are not amused.

JW: I am increasingly struck by the number of people with extensive experience in climate change politics who now say 'look there's lots of complexities here, but at the end of the day the question of vested interests in general - the coal and oil industry in particular - and stranded assets are more and more crystalising as the fundamental obstacle or challenge in this discussion'.

OE: Yes, and I believe that we are in the middle of the biggest coal renaissance since industrialisation. I've been involved in a big controversy about this in Europe and also here in Germany because there is probably no peak oil.

JS: A there's certainly no peak coal.

OE: There is no peak coal.

JS: But I might add actually that Ottmar is an excellent economist and he deals with the economic system, design of markets, all these things, boundary conditions. I would add, and that was also my remark in the *Nature* Editorial, that the other side of the coin, apart from the big companies, is of course human nature. That means individuals, consumers, electorates. That is the other part that needs to be considered because there is, if you like, an alliance between the big companies who have shareholders and who have their vested interest in big oil and – yes - the individual on the ground, on a plane, on a ship, on a cruise. There we are driven by convenience and the aspiration for a better life which these days mean more consumption. It's a perfect alliance clearly. Because without that support, either clandestine or openly, by the individual consumers companies with big vested interests could not grow and unfold.

I mean let's face it. If you were the CEO of a large oil company and told people that a gallon of gas will now cost twice as much because the Environment Protection Agency wants it that way, a million people would demonstrate outside Capitol Hill in no time. Without that backing of what you would call public opinion, companies couldn't do much.

That's why social science needs to find ways how you could disentangle that alliance for the sake of future generations. All these people who would like to have a very cheap gallon of gas also have children and grandchildren, and they are seriously concerned about the future of their grandchildren but they don't see the mismatch between these two attitudes.

So I would just like to add that, on the one hand it's this big question of re-distributing property rights on this planet if you take into account the scarcity of the atmospheric "dumping space" for our emissions. But on the other hand we're not just talking about Exxon, Shell, BP and the like. We are also talking about Jack Smith next door, and Susan Potter next door, or whoever it is, and ourselves of course. I mean you can only afford to fly here to Berlin because air travelling is ridiculously cheap given the scarcity of the atmospheric space. So we are all in a sense prisoners to that system, and to break up this really grand prisoners dilemma requires more than just finger pointing at the Exxons of this world.

JW: **Given that prisoner's dilemma. I wondered if you could talk about policy and political priorities and how one breaks through the psychological, the attitudinal barriers as well?**

OE: I personally think that most importantly the creating of illusions has to be avoided. The "Green Growth" story belongs in this category, which, admittedly, upsets me immensely. The promoters of "Green Growth" try to draw our attention to energy efficiency rather than to the limited disposal space of the atmosphere.

So emissions have to be capped and the carbon budget has to be defined clearly. This is of great importance. In my opinion the pricing of CO₂ and trading emissions is fundamental. The near future will probably not bring a CO₂ tax or a global cap and trade system. However, in Australia presently a carbon trading system is emerging, there is one already in Europe and China currently is testing an emissions trading scheme. This is a very important, a first essential step in the right direction.

Secondly, a technology policy including CCS, renewables, bio-mass plus CCS and carbon dioxide removal technologies is indispensable and could be linked to renewable energy policy. Clearly, this is a long-term project and to make it competitive will probably take two decades. It is crucial to embed the entire energy

system in a carbon cycle management system – beyond the energy system to the whole global land use pattern which is a very daunting issue, and widely underestimated by many.

I would like to illustrate this by giving an example. Let's assume Brazil would be subsidised in order to stop the cutting down of the rainforest. This would have an immediate effect on the owners of land. Climate impacts in India will also have a strong impact if there is a decline in productivity, thus benefitting those same land owners. So the land issue, and also managing this important resource, is incredibly important, far beyond the narrow design of sustainable management systems, and also bears heavy consequences for carbon pricing. If we only impose taxes on coal, oil and gas or include these fossil resources in an emissions trade system, we run the risk of furthering de-forestation at a large scale. For this reason, we have to think about how to include the land sector in this whole game. Which will be, undoubtedly, incredibly complicated.

Furthermore, the climate debate should be linked to the public finance debate. Taking into account and including the land use side of the problem, carbon pricing is not sufficient. Models for sustainable land use management are needed. In particular, we have to focus on land taxation, land rent taxation. Because many climate policies might incentivise the land owners, they will not be accepted from a social point of view. Take compact cities as an example. Compact cities will always lead to an increase or even explosion of land rents. This distribution issue will have to be dealt with in wide parts of the world.

To render these huge transformation pathways socially acceptable – not only from a psychological point of view – will be a major task in the future. At the Technical University in Berlin we recently set up new types of models which enable us to study the interaction of carbon pricing, land taxation, taxation of capital and labour. These have so far yielded very promising results which we hope to publish next year. Looking at these unprecedented transformation pathways we need to find solutions which go beyond pure technology policy and pure carbon pricing in the energy sector.

JS: Let me just chip in. We talked about transformation, how it could be brought about. I'll give you an example. The German feed-in tariff which is almost too successful to cope with because it will cost a lot of money, because so many people are buying into that. But during Easter time this year photovoltaic panels produced for a few hours more electricity than 20 nuclear power stations taken together. Roughly 22 gigawatts, just amazing. Ten years ago solar energy was almost non-existent, people told us it will never make a significant contribution. Can you imagine just the entire capacity of all these nuclear power stations which took a long time to build and hundreds of billions of Euros to fund. So what came together? Three things:

First of all a new technology came about. In fact, it is not entirely new. It first solar cell that could be employed to run electrical equipment was invented at Bell Labs in 1953 along with the transistor, so it's a very old fashioned thing. But the technology was there already.

So you have the innovation of the technology. The second thing you need is the government setting a framework, maybe an incentive, or a subsidy. In this case it was well-intended and not even well-designed but a well-meant boundary condition.

The third thing you need is public support. Everybody loves the sun and everybody loves renewable energy, at least here in Germany. The technology is quite easy to understand and you can do it locally. Everybody has the chance to put it on the roof. There are no side effects, no nuclear waste or anything else. You cannot create a weapon out of it, and it's inexhaustible in principle.

What I'm saying is: Political will, individual psychology, and technological innovation come together to create tremendous innovation dynamics - tremendous substitution dynamics if you like - which in a few years has already overtaken, at least in installed capacity, the nuclear power industry in Germany. So this is a 'proof of concept' that, yes, we can create big transitions.

JW: One countervailing pressure working against those three factors you mention would be the particular interests of those who are going to be left with stranded assets: the coal, and the fossil fuel industries. How do you deal with that?

OE: It's a very interesting issue particularly in Germany because I think the most important factor here are the utility owners. They basically have given in, they accept the political change. But the crucial question is the success of photovoltaics and also the success of wind power. It leads to the situation where most of the time the marginal costs equal zero. But on the other hand we are lacking an incentive to build back-up capacities. This needs to be changed.

I believe the feed-in tariff system was enormously successful. We have implicitly subsidised China because there was a market of declining costs. The reason why we have to transform our feed-in tariff system is that we are now facing a new situation, namely that of zero or even negative prices for electricity.

JS: Because episodically you have so much sun and wind here that Germany cannot absorb it. So we have to export it and have to ask our neighbours for example in the Czech Republic to absorb it. And we pay them for that.

OE: This example shows that a completely new energy market has to be designed considering backup system, storage, demand management. A market emerging by itself will not fulfil the specific and highly complex requirements. This is the discussion now, the reasonable design of the capacity market, of a new energy market. Governments will have to learn that imposing taxes or subsidising technologies won't do.

JS: So you need not just the invisible hand of Adam Smith but highly visible hands of democratic governments. That is a paradigm shift.

OE: Designing markets, I see this as one of the future tasks of the government, the visible hands.

JS: ...even the transparent hands...

OE: This is the kind of debate we have now, the design of the market. So far, no agreement has been reached on this issue, nor as to how much investment should go into grid expansion. But here the discussions must take place on the European level as this is about European energy policy. One of the questions is how much of what shall be used, like hydropower in Norway. It's a very interesting debate around a huge transformation which has already begun.

JW: At what scale can these interventions be most effective? To what extent can this be done on a German level or does it require a European scale?

OE: In my opinion a European scale will be indispensable. We have designed a model and done simulations with it where the investment in grid expansion is explicitly taken into account. We should not forget that in Europe we are committed to climate policy which means reducing emissions. So promoting renewables and building up the eight gigawatts with coal power plants already approved or under construction is an easy

task at present. But then this is my main concern, that if we do this – the eight gigawatts with coal -, then ten years down the road or so, when the European Commission might decide to reduce emissions, all these nice guys will be queuing up at to the Commission saying, look we built up these new power plants, you cannot reduce the emissions now because by this you will also reduce the value of our assets. So we have to take into account a much longer time horizon than 2020, we have to go beyond 2020.

JS: We have to avoid lock-in effects in Europe. So yes - the answer is we need a European solution. At the same time citizens as individuals – and that is very unique – now have the chance to completely convert their energy supply. If you have a patch of land, if you have a roof, if you have a farm, you can become almost autonomous. 80% of the domestic energy is just for heating and boiling water. So you can get pretty much autonomous in that. It's not the same for industry, that's a different thing.

So you have an interesting mixture of decentralised solutions for individuals and centralised European solutions for the big industry. Of course both have to be sort of orchestrated. The orchestration of this transformation at all scales, that is the big change and challenge for policy.

OE: Yes, and this is almost an unknown area. Traditional economics have only limited knowledge about this new situation.

JS: Social systems innovation, social science innovation...

JW: **This question of 'market redesign' is at the heart of a lot of those projects it seems?**

OE: Yes... we are trying to operate at two levels, which I think is very important. On one level, we try to find out what is a reasonable solution, from a social planner's point of view so to speak.

JS: The first best option.

OE: The first best option. I am always very curious when people say the European grid expansion is not realistic. I would like to see what from a systemic point of view is a reasonable option.

The second step is that we identify who the actors are and what they are doing. Sometimes the actors will do exactly what is needed to achieve a social optimal but most of the time that's not the case. Then we focus on the market design, how to incentivise what you desire to achieve. This can only be done if you have a rough idea of what your grid should look like. Lacking that, the question as to what could be a reasonable market design cannot be answered.

We are doing all this to at least have a rough understanding of what is socially rational, what the real world actors are doing, and then to try to find out what could be a reasonable orchestration of different policy instruments.

JS: What Ottmar describes is an extremely sophisticated task to fulfill. You have these various cases, you have all types of actors involved, you have long term perspectives, medium term perspectives, short term perspectives. You have to avoid lock-ins, you have many different pathways towards the same goal, and you have many actors walking on different pathways as well. So even the transformation of the energy system in Germany is really an awe-inspiring and at the same time extremely intimidating task, let alone the European and the global orchestration.

OE: We invested into this– we decided to set up a group on that because it is a kind of social laboratory, so you have to study it.

JS: Germany is like a guinea-pig.

OE: Yes and I believe in the global scheme. The next three to five years will not show much progress. But now we do have a sort of social laboratory which will give us the chance to develop an understanding about how this transformation process is evolving.

JS: Australia is also a social laboratory now with your carbon tax but I'm pretty sure it will come to an end in a year or so, I mean if the opposition will win the next election. They will try to just kill it and unfortunately this interesting experiment will come to an end. But you know...

JW: **Where else in the world do you think are the most promising 'laboratories'?**

OE: China, I would say. But I fear that they are not on a sustainable pathway. China has had tremendous success, yet I doubt that it is sustainable. We should also study what are the preconditions for a collapse in one year or another in the next ten years.

JS: For many reasons.

OE: For many reasons, demographics is one. I don't regard China as an experiment which will give us the opportunity to study the reasons for its failure. What I am saying is that it will most probably not turn out to be a sustainable role model. And the most interesting fact about China is that it is not at all a centrally planned economy.

JS: By no means.

OE: By no means.

JS: And it never has been by the way.

OE: This is very interesting, and the most intriguing thing is that they have zones where experiments can be started. Then they try to upscale this kind of experiment. There is a lot to be learnt from that and from the courage of the Chinese to set up such zones. Even if it may not be successful in the long run it is worthwhile to study those developments.

JW: **This question of the importance of 'laboratories' and how exemplar initiatives can be game-changing is a theme that keeps coming up in a lot of discussions.**

JS: I think processes on a country-level scale are very important. Denmark for example has decided to completely phase out fossil fuels by 2050. It's not a big economy but nevertheless people are well-to-do, it's probably about the highest quality of life in the world there. So that's a very good example of how it can work. You also have California, you have a few countries.

OE: Scandinavia tends to be widely underestimated in several respects. They have one of the best education systems, one of the best pension systems, financial stability. They dealt with the financial crisis in the 90s in a spectacular way.

JS: And they have an extremely high quality of life in spite of high taxation levels. It's simply not true that if you lower the taxation that people become happy automatically as the Republican Party would have it.

JW: **You mentioned China, what about other developing countries?**

OE: You will find a number of very promising developments in some African countries, especially South Africa is interesting in this respect. I would also like to highlight Uganda which is a remarkable example. I visited Uganda and was extremely impressed by the overwhelming optimism of the population. The population is very young, black, white, Asian, and their optimistic view towards a better future is highly impressive.

JS: And Morocco is also an interesting example because there are now options to link energy systems across continents. In Germany and Europe we talk about DeserTec. Actually there is now the first big renewable power plant being built in Morocco. This is a paternalistic system, they have a king. It's a sort of semi-democratic system. They are extremely keen to support that, so yes here and there there are places - there are labs emerging

But in the end the three labs that currently really count are probably Germany, China and California.

OE: I find the idea to write a series of reports on good governance to find out what are the success stories and what are the preconditions for the success stories in terms of governance very intriguing. What John described in relation to governance is really important. You always need a government, it's not about the markets alone.

We need to talk about the visible hands. In social science an underlying narrative exists which says there's an evolutionary process. Plenty of invisible hands so to speak. This is not entirely true, the most important inventions are made by visible hands, for example, the capital markets. It was an invention by the government to finance the railroad system, it was not an emerging, an evolving, self-organised issue.

It might be helpful to write reports to describe examples of good governance in order to improve our understanding of such success stories but also of the spectacular failures. In the course of this social transformation process we need to focus more on the visible hand.

JS: I think the other thing is that the power of the individual is still underestimated.

OE: Yes that is right, and that of civil society.

JS: I mean not because of the new media, that goes without saying. But in the end my experience is that if I talk to companies, all would love to appear green, particularly in Germany and Europe. Why? Because they are worried consumers will be turning their backs on them. The funny thing is they even create entire departments now for risk analysis - reputation risk analysis. They probably spend more money on these departments than on sustainability. Because they fear the slightest loss of reputation so to speak, of image-degradation in the public. So on the one hand a consumer is completely powerless, on the other hand you are holding tremendous power. This dynamics and how it interacts – our governments can team up with the individuals in order to create progress. It is completely under-researched and its potential certainly under-tapped so far.

JW: **One question I'm keen to ask is a back-casting question. It's to imagine we are here in 2030 -2035 – and the shifts in economic de-carbonisation have been at a scale and speed which gives us**

considerably increased confidence that we're going to be able to meet a two degree guard rail target. In a few sentences what happened? How did we get here?

OE: Not because of some kind of climate issues, some extreme events. Probably because people have experienced that some social change can be learnt and implemented rather easily. The German energy transition and the European transition proved to be key developments. In Europe we have shown that we can overcome nationalism without necessarily losing all our national identities. We have some kind of European solidarity and we have shown the world that cooperation at this scale is at least somewhat important. We have a kind of fiscal union, we have a joint financial policy. And in order to reduce the debt all the finance ministers are interested in taxing CO₂, energy and land-use.

JS: I'll give you four reasons why the fairytale might come true:

One is very sadly that a few disasters will happen. Hurricane Katrina changed many things in America. More or less the climate debate was also there before 2004 and 2005. But then it was really reignited. Nobody, in particular not climate scientists, hope that disasters generate this type of dynamics. But invariably it will happen in the next decades and it will get worse and worse if we are not complete idiots regarding calculations.

The second thing is leadership. I mean what Ms Merkel did with the German experiment is simply happening because she had the guts to say she had been wrong. This type of leadership will be necessary, maybe in China, maybe in the United States, maybe in Australia.

The third reason are some glaring examples of social innovation. For example I just recently went to a region here in Germany where people say we want to have energy supply completely done on a communitarian basis. We, the citizens, will buy the power plants. We will buy the networks, the grids and so on, we will do it.

The fourth thing, my wildcard, if you like that could best overcome what I call the fossil nuclear complex, could be the fossil protagonists themselves. In a week from now we will receive a delegation from Qatar including many influential people.

For OPEC countries there are two ways. They can say, yes we have another 50 years of oil, and we can and will live wonderfully of that. After that we will all move to Switzerland. That is one plot. But the alternative option could be: Shouldn't we use our wonderful capital which is precisely coming from oil, and gas, in order to - in a role-modelling way - transform ourselves into a sustainable society.

That's precisely what the people in Qatar will tell you if you ask them. They say, yes we know. We can live happily for the next three or four decades which is when we will buy our properties in California, Monaco or London. Then we will sort of dissolve as a society. But there are some other people who say, I would like to see us around also in hundred years from now, and we have the means for doing it. We have the capital, we can buy all types of technology, we have the sun, we have the wind, we have everything you need. If one or two major OPEC countries launched a big transformation, a Great Transformation, on their own ground, then this would send a very strong signal to the world. So it would be the, if you like, the stalwarts of the fossil system who would overcome it themselves. This is a really strong story and that would be my favourite plot.

OE: And it also nicely resonates with what I said. About putting the money, the resource funds, into a kind of investment fund for the system. Because it is very important that Qatar has a sovereign wealth fund.

And this is also something for the lay people because we are all savers. They are saving for their pensions. Pensions are perceived no longer reliable because governments are not committed to securing them. In order to reduce the pressure in the future, pension funds or wealth funds could play a crucial role in this transformation process. It's not only about being consumers, we have to educate people to become the most important investors. This could force the transformation of the capital market system, this would also be in my plot.

JW: Thank you.