



German Advisory Council on Global Change

International Symposium

**Towards Low-Carbon Prosperity:
National Strategies and International Partnerships**
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Welcome and Introduction

Dirk Messner, Vice Chair, WBGU

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Dear Excellencies, dear Ladies and Gentlemen,

I would like to cordially welcome you to our conference “Low-Carbon Prosperity, National Strategies, and International Partnerships.” This symposium should provide an impulse. It is about crossroads that pave the way to sustainability, about the transformation to climate compatibility in the global economy, and about the question of how future-compliant prosperity for soon-to-be 9 billion people can be enabled within the limits of the earth system. First of all, I would like to express my gratitude to the high-ranking speakers and panelists at today’s conference: ministers, state secretaries, representatives of the economy, research, and society - individuals who are taking national and international responsibility for the transformation towards sustainability.

We will be expecting Chancellor Merkel in a few minutes, who will present her position on “Low-Carbon Transformation”, and we are very happy that the Chancellor is taking the time to attend this international conference. We hope that we can get a discussion started that will continue to be instrumental beyond this day.

Some preliminary remarks on the topic of sustainability transformation. There are always options. When it comes to development paths in the world economy in the context of global warming, we have three options:

Firstly, we have the option to operate with “business as usual”, and in this case we would end up on an adaptation path in the next decades, which would imply continually increasing investments to address the impacts of climate change. By no means would we reach the two-degree target, which has been internationally agreed upon. We would end up in a world economy characterized by global conflicts on distribution and resources, as well as a high degree of economic and social uncertainty. We would push the cost of this development path off to the next generation. And even though we know that early investments in the prevention of climate change are much cheaper than investing in the future to adapt to dangerous climate change - Nicholas Stern, who is here in this room, has done the math, and many others have confirmed his calculations.

The adaptation path is an option – a bad option.

We have a second option that I have often heard about recently, when I discussed the topic of low-carbon transformation strategies in the U.S.: geo-engineering. The idea behind it is that the transformation to sustainability is complicated, that we may not be able to cope with it technologically and financially. The perspective of the geo-engineering debate is: cool the earth down artificially. This is the second path which is theoretically available to us. Costs unknown. Risks incalculable.

The third path, which is available to us, is the one we want to discuss today. We want to discuss the different paths of this third option. Which different paths are there to realize the transformation to climate compatibility? The requirements that characterize this path are the following: we should remain in the two-degree



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1 Welcome and Introduction

corridor, which is strongly commended by natural scientists; for this to succeed, we must act on the most important international shifting in favor of climate compatibility over the next decade. By mid-century, we must have achieved a substantial decarbonization of the world economy. Three transformation fields are in the center of this change: energy systems, rapidly growing urban areas globally, and land use systems.

The German Advisory Council on Global Change (WBGU) recommends following this path. The WBGU considers this third path to be the only responsible one. In 2011, the advisory council presented a study in which we investigated the transformation to climate compatibility and sustainability, and elaborated pathways in this direction. We compare this transformation with two other major transformations in the history of mankind: firstly, with the Industrial Revolution about 250 years ago, which capitalized on a fossil energy system, brought a tremendous acceleration of innovation along with it, achieved major increases in welfare in many countries, but has now brought humanity to the brink of the earth system; secondly, with the Neolithic Revolution, during which the human race invented agriculture and animal husbandry some 10,000 years ago. What must now take place is a third transformation that enables perspectives for 9 billion people without jeopardizing the stability of the earth system.

When we presented our reports to the Ministers for Environment and Research, Mrs. Schavan and Mr. Röttgen both reacted in a similar manner. They compared the transformation to sustainability with a civilizational thrust of humanity. I think they are right, because this does not only require fundamental structural changes in the economy, but technological, institutional, and social innovation in a densely networked world society. In its study, the WBGU showed that the transformation to sustainability can succeed. Kant would speak of the “conditions of possibility.”

A technology assessment showed that the technological requirements for a low-carbon transformation in the energy sector, in cities, and in land use already exist. This is a very important result, because if we did not have the technology, then even with all the strength of the world we could not lead it to its goal.

Another element is just as important. We need actors that are driving the transformation: in the economy, in politics, in science and in societies. The WBGU study showed that the number of “change agents” in the world economy, the number of governments or cities that are moving in such a direction, has strongly increased. Also, the number of scientists creating the knowledge base for the transformation is increasing. The number of change agents has reached a criti-

cal level, which can enable the transformation.

In the WBGU study, we discuss “tipping points” in the world economic system. Tipping points imply that old, resource intensive and climate damaging growth patterns are still there, but the new growth pattern is emerging. Thus, it will require efforts to achieve a tipping point towards sustainability.

The German “Energiewende”, the transformation of the energy system, could be such a tipping point with global reach. The stronger orientation of the World Bank in the direction of “Green Transformation”, “Green Energy Systems” and “Green Investments” could unfold transformative effects. Huge low-carbon investments in China change the structure of world economy. Today, we will discuss how we can make the transformation irreversible.

In summary, the WBGU transformation study comes to the conclusion that the basic elements which are necessary for the transition to climate compatibility are existent. But the level of ambition in economy and society that we need to make this transformation irreversible is still not high enough, if the two-degree goal is to be taken seriously. I would like to conclude with three key challenges:

Firstly, it is essential that the climate negotiation process is completed successfully. Without global regulatory policy and international incentive mechanisms, a radical reduction of greenhouse gas emissions is not possible. But we have also learned that the climate negotiation process is slow and vast. Therefore, we plead for pioneer alliances of countries to move jointly in the direction of climate compatibility and in this way can reach tipping points in the world economy. For this reason, we have brought high-ranking representatives from 10 different countries together here today, whose joint actions could accelerate the transformation to sustainability.

Secondly, a fundamental change of perspective in politics, economy and society is necessary. It is about a change of perspective, in which long-term interests must be enforced against short-term interest. This is a fundamental problem. All the technologies in the world cannot help us if we do not break these long-term and short-term problems down. One finds an increasing number of representatives in business and politics today who would agree if one argues that we will have to generate a sustainable economy in the mid-term, by 2030-40, because the limits of the earth system are soon to be reached. But these future-oriented interests are impeded by short-term actions.

It therefore requires a change in direction. Transformation means a change in direction. It implies the requirement of a change in the direction of future orientation, thus overcoming the “dictatorship of the pre-

sent" that John Schellnhuber talks about. The rights of future generations and the long-term stability of the earth system need to be systematically integrated in the considerations of our actions. This is a question of political responsibility, an ethical challenge and finally, a prerequisite for the transformation to sustainability to succeed before crises in the earth system force us to divert. Kant has described the Enlightenment as a "change in the way of thinking" of mankind. The transformation to sustainability requires a similar change in perspective.

Thirdly, we must urgently bring together two strands of discussions: the one on overcoming the financial and debt crisis in OECD countries and overcoming the turbulences of the world market, and the one on transformation to climate compatibility. In both cases, it is about problems of the long-term and the short-term - the shifting of costs on future generations and global regulatory policies. Overcoming the debt crisis on the basis of a climate damaging and resource-intensive growth pattern is unacceptable.

Let me conclude my considerations. In the WBGU report, we talk about the transition to sustainability on the basis of a social contract. "Social contract" means that the transition of the world economy cannot be imposed, cannot be decreed. It also does not easily evolve from market dynamics. It needs to emerge in the interplay of economy, society and politics. The building blocks of such a social contract are pretty straightforward and clear. It is about accepting the limits of the earth system, putting the rights of future generations into account, and finding a fair compromise in the transition to sustainability within and between our societies. That is what we want to discuss and argue about today. I cordially welcome you once again on behalf of the WBGU and would like to thank you for attention.

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Setting the Stage Hans Joachim Schellnhuber, Chair, WBGU

Ladies and Gentlemen,

it is a great pleasure for the German Advisory Council on Global Change (WBGU) and for me – in my capacity as WBGU Chair – to welcome the Federal Chancellor who will deliver the keynote speech of this symposium. Mrs. Merkel joins us here today in spite of many pressing issues she has to deal with in these turbulent times. Her presence is most appreciated by everybody who is concerned about the sustainability of our civilization, which is ultimately a question of good house-keeping – in financial as well as in environmental respects.

To set the stage for the Chancellor, I would like to share a few thoughts and observations with you. Let me first emphasize that the science is unequivocal about climate change: it is predominantly man-made (“anthropogenic”), and under a “business-as-usual” scenario our globe will warm by 6–8°C till the year 2300. However, the majority of experts estimate that humankind will only be able to cope with a maximum of about 2°C rise in planetary mean surface temperature. Thus, there is an evident gap between where we are heading and where we remain safe.

Meanwhile, a tiny group of dissenting climate scientists and an armada of non-experts keep on confusing decision makers and the public at large. They maintain that there is no evidence for dangerous anthropogenic interference with the climate system. Such an intervention is actually no news to the historians of science: As director of the Potsdam Institute for Climate Impact Research (PIK) I have the privilege of working on the Telegraph Hill in the former office of Karl Schwarzschild. This giant of astrophysics was the first to solve the field equations of Einstein’s general theory of relativity. Albert Einstein himself, rather fed up with the hysterical public debate – mainly led by laymen – of his groundbreaking work, sarcastically commented in 1920. “This world is a strange madhouse. Currently, every coachman and every waiter is debating whether relativity theory is correct. Belief in this matter depends on political party affiliation.” (Sherwood, 2011)

So, we have been here before. People tend to accept

even compelling evidence only if it can be accommodated neatly within their world views. This becomes evident also in the current debt crisis, which may push entire states to the brink of failure. Essential information on the respective state of affairs is provided by international rating agencies, which assess the solvency of national economies. Many politicians react quite angrily to those ratings, but the markets evaluate and employ them in a quite merciless way.

Environmental scientists, in turn, could be called “planetary rating agents”: we are assessing the natural resources still available for operating the global industrial metabolism. In particular, we can calculate the residual carbon budget commensurable with the 2°C guardrail. There is not much left...

Quite generally, state-of-the-art research tells us that our civilization is accumulating debt over debt for



Hans-Joachim Schellnhuber

future generations. This is a most inconvenient truth, yet it needs to be spelled out. Regarding prosperity, growth and debt there is a particularly disturbing number, derived in a recent study (Tapia Granados et al., 2012) and reflecting the present predicament of fossil-fuel based business: one trillion dollars of global economic growth corresponds to adding one half of a ppm CO₂ to the atmosphere's gas mix. Note, of course, that this is only true for the conventional expansion of commercial activities, i.e., for "black growth". Therefore, this very connection between creating prosperity and accumulating carbon in the air needs to be broken if planetary sustainability is to be achieved. This is a formidable, but well-defined challenge. And last year, the WBGU demonstrated in its flagship report "World in Transition: A Social Contract for Sustainability" that the job can be done indeed. There are ways to increase prosperity and to contract carbon output at the same time. This is, in fact, the overarching theme of our symposium. Lord Stern and others will elaborate in some detail on that challenge in their respective contributions below.

These statements will make another important point, namely that there is a multitude of possible pathways towards sustainable growth and low-carbon prosperity. In other words, many different roads lead to the desired destination, and the avenue chosen may depend much on national or cultural specifics. But climate chaos can only be avoided if every country goes down its favorite road until the very end, that is, complete decarbonization.

Individual tasks will become much easier if roadmaps are compared and travelling companies are formed. This calls for concrete bi- and multilateral cooperation at an unprecedented level. Instigating such collaboration is the ultimate objective of this event, and, even more so, of the forthcoming Rio+20 conference. But let us not expect too much from global summits – sub-global alliances of pioneer nations and change agents may break even more new ground.

Chancellor Merkel has turned fiscal, social, and environmental sustainability into the mantra of her political strategies. Thus, there is probably no incumbent head of government in the world more qualified than her to give the keynote speech for this meeting. We feel tremendously honored that she has accepted our invitation.

Madam Federal Chancellor,
the stage is yours.

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Keynote Angela Merkel, Chancellor of the Federal Republic of Germany

Professor Schellnhuber, Lord Stern, Mr Molina, State Secretary Schütte, Fellow Members of the German Bundestag, and above all you, Ladies and Gentlemen, who are the guests here today,

the title of this symposium – and this is 20 years after Rio – is Towards Low-Carbon Prosperity. It's a topic that is regrettably still not obsolete. We could even say that it's more up to date than ever. Granted, there has been some movement over the last 20 years on all those issues relating to exploitation of resources and climate change – movement towards solving those problems. However, things have been moving too slowly compared to the speed of the changes we find ourselves faced with. Global CO₂ emissions have continued to rise. We therefore need to keep pushing to make sure that our goal of limiting the temperature increase to two degrees is not forgotten.



As Lord Stern has demonstrated, doing nothing has a high price. We have to be constantly reminding ourselves that things will not get any better if we avoid taking action. It may seem like the path of least resistance, but it will prove to be just the opposite in the long term. Finding a sensible way to deal with our finite resources as well as climate change has become a completely global issue. The last twenty years have made it clear that the issue is no longer something for the industrialized countries to address alone. Even if they did go it alone and take all the right action, we would still have a climate change problem; global warming would still continue. Nowadays, the responsibility lies with other countries too. That said, what we agreed in the Framework Convention on Climate Change still holds true: we have common but differentiated responsibilities. The industrialized countries have a prominent role to play wherever they can, in particular when it comes to developing and testing technology as well as taking the lead in new policies.

When I talk about these issues, I always pair climate change with efficient resource management or the problem of finite resources. That's my way of avoiding the discussion that the sceptics always raise, about whether or not climate change is really going to be as severe as people say. Even those who don't believe in climate change are forced to acknowledge that there is a problem when faced with the fact that the world population is heading towards the 9-billion mark. Don't misunderstand me. Personally, I believe that something is happening to our climate. But just to avoid wasting time talking about whether or not that is the case, I will say this: those people who don't want to believe it, who are always spreading doubts and concentrating on the things we can't know for sure – they should simply recall that 9-billion mark and take a look at the speed at which we are using up our mineral resources. They will then reach the same conclusion as someone who does acknowledge climate change, i.e. that we are better off if we can dissolve our dependence on conventionally generated energy. The two crucial elements of the answer must therefore be changing our energy

supplies, by switching to renewables, and dealing more efficiently with energy and the resources we have.

Looking at the way commodities prices develop, fluctuations notwithstanding, the trend is clear. In the vast majority of cases, scarcity results in price rises and competition for stockpiles. Even though some are now experiencing a degree of relief thanks to shale gas, that relief cannot be so extensive and lasting as to allow us to forget everything we have said about energy efficiency and renewable energy. The German Advisory Council on Global Change has brought these issues to the fore time and again since it was established twenty years ago. Let me take this opportunity to thank all the people who have been dedicating their energies to that work over the last two decades.

I think we can all agree that we need a follow-up agreement to the Kyoto Protocol – a new climate change agreement. From time to time we have reason to be hopeful, and sometimes – I'm just going to say it – things do get frustrating. But then, just when you're thinking that there is no hope at all, we do see a bit of progress. The impression is that progress is always too slow, but it's progress nonetheless. It was meaningful, for example, that we agreed in Durban to keep going, to keep working towards a climate change agreement.

It is also important that we not take our eye off the goal of reducing greenhouse gas emissions. Germany is very keen to forge ahead here and reduce its emissions by 40% of 1990 levels by 2020, and 80% by 2050. We are pressing for ambitious policies at the European level too. We have some scope for action right now. That is obvious in the prices of certificates, which don't give the impression that scarcity has reached desperate levels. There will therefore be more said on the matter. Among other things, the funding for all the essential measures we are planning is very closely connected to revenue from the trade in certificates.

It needs to be acknowledged that the EU did reduce its annual greenhouse gas emissions by more than 15% between 1990 and 2010. Germany contributed not a little to that success. We shouldn't harp on about it, but we also shouldn't be under any illusions either – Germany was responsible for a very large proportion of that reduction. However, it isn't likely that we will be able to play quite such a prominent part in future reductions, as Germany's reunification is not something we can repeat. We are now on the same playing field as everyone else.

That hasn't stopped us enacting lots of legislation to become one of the most energy-efficient and environmentally friendly economies in the world, especially when it comes to industrial production. We are still lagging far behind that level in the sphere of private consumption, such as in the heating market.

There is still a lot that we can do there.

We have decided to raise the proportion of renewables in our overall energy consumption to 60% by 2050. For electricity consumption, that figure is to be 80%. That means we need to be establishing the right conditions now. My Government adapted our energy policy once again in view of what happened in Fukushima last year. That led to a consensus across German society on phasing out certain forms of energy, like nuclear power. The same level of consensus has not yet been reached with regard to the changes and infrastructure that will be necessary to make that a reality. We still have a long way to go yet, as it is clear that switching to the era of renewable energy implies a massive qualitative adjustment for energy supplies and the economy concerned.

Our legislation incentivizing renewables development has to be integrated with the decreasing but still essential use of classic usually fossil fuels that provide base-load power. That will be the key task of the next few years. We are going to need some radical new thinking to make sure that fossil-fuel energy production – which has always been profitable – remains economical without at the same time giving up on incentives to boost the renewables sector. This is going to involve capacity markets. We just need to watch that we don't end up only producing subsidized energy but keep things cost effective too.

When we speak about sustainability, one thing has always been clear to us, namely the three-part principle of being environmentally friendly, socially just and cost effective. We are going to have to think about that in quite a radically new way now. For example, if the renewable energy has priority flowing into the grid, as it does in Germany, that doesn't automatically chime with the running of a newly built coal-power plant and its base-load hours.

To make it work, two things are essential. The first is that we adapt the grids, as they are going to have very different tasks to rise to than they did before. There is a lot of work being done in that regard, particularly in terms of the requisite technology. The second aspect of the transition is that we need to find ways of storing power. The search for electricity storage is one of the major challenges of times and calls for innovative solutions. That is why so much research is being undertaken in that field.

Research is the key if our switch to renewables is to succeed. The German Government, thanks to the Research Minister's High-Tech Strategy, has found a way of speaking honestly about what research areas we are world leaders in and what areas still need work. Energy is a particularly significant field of research. However, we are nonetheless aware that other coun-

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tries have high ambitions in that area too. In other words, if we want to remain innovative, we are going to have to really work at it.

This isn't just about a storage facility here or a section of the grid there, nor even about the technology we will need; it is also about the whole of society working together. I'm talking, for example, about the carbon-free city, smart grids and completely altered consumer behaviour. Consumers have to think for themselves about the factors that make something attractive or otherwise. That will mean a change in behaviour across society, the argument for which is still to be won. We can think ourselves lucky to have discovered the blessings of IT, the internet and all the possibilities of data sharing at just the right time. If it weren't for them, it would be impossible to manage all the interconnected logistics necessary to switch to a completely different sort of economy. As we can see, humanity always comes up with something useful to help us manage the changes we undertake.

The people of Germany are not always as willing to change as we might wish. But we have to see that the only way we will maintain our prosperity in the coming decades is by staying innovative. As our average age rises and our horizons tend to shrink as we age, our society is very much at risk of resting too complacently on its laurels. We need to be doing all we can to use life-long learning to encourage people to look beyond their horizons and maintain our ability to innovate, which our progress is grounded in. There are emerging economic powers doing exactly that extremely well.

Our efforts involve many small elements, such as pilot projects for carbon-free cities, smart grids and for an extremely energy-efficient house. A few months ago, I joined Urban Development Minister Peter Ramsauer to open the Efficiency House Plus; a four-person family has moved in and will report on what it's like to live in. As you can tell, our capabilities are growing in many areas. Over the coming years, we need to connect them up.

It goes without saying that international agreements and cooperation are tremendously helpful. Here, too, there has been a whole series of successes, and I'm not just talking about the timetable developed at Durban, nor just about the new cooperative constellations in world politics.

A country like China knows it can no longer play the same role in energy supply and climate change policy as it did 20 years ago, and that basically has two reasons. Firstly, its own energy needs and use of natural resources are higher than ever before. Secondly though, it is just not as easy nowadays to form the partnerships with developing countries that one may wish to.

We all remember when the G77 plus China was an

immutable formation, back when we negotiated the Kyoto Protocol. Things aren't that simple anymore. Suddenly the G77 are aligning themselves more with Europe, while China, we could almost say, is having to work on keeping its old partners. The balance of power does shift and change, and it brings new alliances when it does so. Durban could not have been successful without close collaboration between developing countries and states within Europe.

Let me say very clearly that my vision of Germany and Europe taking a leading role also has an ethical dimension. Of course, taking that role is partly about safeguarding our own standard of living. But it is also our moral duty to conduct test phases, to learn how best to deal with the complex of new energy supplies, resource efficiency and efficient technology, and to subsidize progress. After all, while other countries did not yet have the wherewithal to pursue the same prosperity as we enjoyed, we spent many years and decades overexploiting the world's resources. With that in mind, we have a duty to redress the balance somewhat. I feel that we should step up to that duty and, what's more, turn it to our advantage.

That means using our Energy and Climate Fund for the agreed projects and the developing countries. It's therefore very important that we really are able to mobilize the resources we have promised, because a large number of countries have based their hopes of taking essential measures on the availability of those resources. The Green Economy Roadmap is of key importance, and we need to consolidate it at the United Nations with more detailed substance and timeframes. Managing that will be particularly significant in the run-up to Rio.

One long-running problem that is still outstanding and is sadly not going to be resolved in Rio is the fact that the UN still doesn't have an institution focused on sustainability and protecting the environment – an institution which I feel it needs in view of how significant those topics are. The key areas it would address would be of course climate change but also biodiversity and many other topics that require attention. As I have said before, I am also not going to object to the high probability that the organization would be based in Africa. I think that's a good thing. The UNEP there stands as a useful foundation. But it is a sad indictment of the pace at which the international community works to note that we have reached the 20th anniversary of Rio without making any progress on this point.

You are all here representing various branches of science, and I want to say one thing to you: stay stubborn. And, to put it bluntly, don't be afraid to get on politicians' nerves from time to time. If you have good arguments, we will listen, and we won't be able to

wriggle out of them. That communication is happening all over the place. Keep working to increase the community within our society of people who say yes, we need fundamental change.

The last 20 years have seen a major shift in thinking, on the part of industry as well as many ordinary people, but all the progress we make will be in vain if the change comes too late. That's why I am always urging people to look at what will happen if we do nothing – and it's a harsh prospect. Even if the changes we are experiencing would have happened without industrialization – to come back to the doubters for a moment – that doesn't change the fact that there are seven billion of us on this planet and there'll be eight billion before long, with the majority living in completely different parts of the world than hundreds of years ago. That fact alone is going to have consequences capable of triggering conflicts across our civilization which will cost us dear.

I can tell you that this is why the German Government has committed itself to the Council for Sustainable Development, and to the German Advisory Council on Global Change, as organizations that will scrutinize what we do and force us to think differently. We are well aware that we still have a lot of work to do in many areas, from demographic sustainability, to budgetary sustainability, to resource sustainability, to environmental sustainability.

I would also like to ask the environmental community for a little support when it comes to budgetary sustainability. We are currently caught up in a discussion which sometimes seems utterly bizarre to me. People are saying that we do nothing but save these days. I must point out that what we are actually discussing is whether to spend ten percent more than we have per year or only five percent, or perhaps three. Almost nowhere is the discussion about actually paying anything back, and almost nowhere are we talking about only spending what we earn in any one year. There are a few Scandinavian countries setting an example in this regard, but in all other cases, when people say "austerity" they actually mean running a deficit of three to six percent. I cannot see this doing us a lot of good in the long run. Sustainability needs to become a central tenet in every area of our lives. Sound growth and well-founded prosperity cannot be built on debt, greater use of resources and other such wasteful practices.

Since I know that you all already know that, I will simply say this: let us stand firm together, all courageously doing our bit, to make the change we need happen. Convincing the majority is not always easy, but I believe it is our duty to do so. I wish you all the very best of discussions. It has been a privilege to speak to you – thank you very much indeed.

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Session 1: Towards Low-Carbon Transformation

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Su Wei, National Development and Reform Commission, China

Distinguished Panelists, Ladies and Gentlemen,

I am greatly honoured to be a speaker at the International Symposium on Low-Carbon Prosperity organized by the German Advisory Council on Global Change. I am so pleased to take this opportunity to share my views on low-carbon transformation from a Chinese perspective.

The global climate change has been recognized as the biggest challenge to humanity in the 21 century. World leaders as well as scientists and economists have been working very hard to seek good solutions to the

climate problem. At the international level, on the basis of the scientific assessment of the Intergovernmental Panel on Climate Change, the world nations were able to agree on the international climate regime, represented by the United Nations Framework Convention on Climate Change and its Kyoto Protocol. The climate challenge requires all nations joining their hands and working together by taking specific actions of both mitigation and adaptation in accordance with the principles of equity and common but differentiated responsibilities. However, actions alone cannot ultimately resolve the climate problem. The actions need to be combined with the revolution of the minds and the innovation of technologies. This will give birth to the new socio-economic revolution characterized by low-carbon emis-



From left to right: Mario Molina; Emma Lindberg; Leena Srivastava; Lord Nicholas Stern; Su Wei; Moderator: Hans-Joachim Schellnhuber.

sions. From Copenhagen to Cancun and Durban, low-carbon development and transformation has been gaining more and more support and embracing universal acceptance. Low-carbon development has become the mainstream of world economic development and technology innovation. Low-carbon development is possible, necessary and doable.

Against this background, how does China see low-carbon development? What does China do in terms of low-carbon development? And what has China achieved in pursuing low-carbon development? I would like to use three words to answer those questions, i.e. pioneering, piloting and practicing.

First, by PIONEERING, I mean that China is among the first to integrate the low-carbon concept into its national social and economic development plan. China considers low-carbon development as a fundamental national strategy and sees great opportunities to transform the way of economic development and to restructure the economy. Green and low-carbon development has become the guiding policy of the 12th five-year plan for social and economic development to achieve sustainable development through building resource conservation and environment friendly society. It is really a big change of development mentality and routing. We are seeking new path for industrialization. GDP growth is no longer the only objective to pursue. More emphasis is placed on the quality and efficiency of economic development. The aspirational GDP growth rate for the 12th five-year plan is reduced from 7.5% for the previous 11th five-year plan to 7%. In order to reduce the carbon intensity of economic growth, the 12th five-year plan calls for a reasonable cap on total amount of energy consumption and outlines various policies and measures to mitigate carbon emissions, ranging from economy restructuring, energy conservation and improving energy efficiency, enlarging the share of non-fossil energy in the primary energy consumption to enhancing carbon sinks through afforestation and sustainable forest management. Specific targets have been set for the 12th five-year plan period, i.e. by 2015 to reduce energy intensity by 16% and carbon intensity by 17% and to increase non-fossil energy share to 11.4%, as a part of the endeavor to achieve the 40-45% carbon intensity reduction and the 15% non-fossil energy share by 2020. We are preparing a ten year national program on climate change up to 2020, which will be submitted to the State Council for approval and published by the end of the year. We have also looked into the future and embarked on research and studies on a longer term low-carbon strategy, with a view to formulating our national low-carbon development roadmap towards 2050.

Secondly, by PILOTING, I mean that we are exploring



Su Wei, National Development and Reform Commission of the People's Republic of China, Director General of Climate Change.

various ways of low-carbon development and try to build the appropriate model and gain experiences. Since there is no established model to follow, and given the differences in economic development level and natural resources endowment, full consideration has to be given to the local conditions and specific circumstances in piloting low-carbon development. In this regard, we had already launched a piloting program of low-carbon provinces and cities. The piloting regions have already presented their implementation plans with clear objectives, policies, measures, actions to reduce carbon intensity as well as various institutional arrangements and mechanisms. We have also initiated piloting carbon trading systems in seven provinces and cities, including Beijing, Shanghai, Tianjin, Chongqing, Shenzhen, Guangdong and Hubei. In the designing of these piloting trading systems, close coordination is needed to ensure that those independent piloting systems could be linked and easily merged into one regional system. We are researching on standards for low-carbon product labeling and on the issue of carbon footprint. We have chosen Guangdong province and Chongqing city as piloting regions.

Thirdly, by PRACTISING, I mean that implementation actions have already got off the ground. For the previous 11th five-year plan period, we had been able to achieve the 20% energy intensity target and had

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saved energy about 630mtce, equivalent to saving 1500mt of CO₂ emissions. For the current 12th five-year plan period, the State Council had issued two very important documents last year, one is regarding energy conservation and the other is on greenhouse gas emissions. Various specific initiatives have been launched, including on energy conservation, development of renewables, low-carbon transportation, low-carbon technology R&D, GHG inventory and MRV procedures. Both the energy intensity and carbon intensity targets have been sub-distributed to each and every province across the country. A combination of policies and incentives are put in place to promote energy efficiency and the development of renewables. All new development projects are subject to energy conservation assessment. We had also used the feed-in tariff to promote renewable energy. We have launched various public campaigns to enhance low-carbon awareness and disseminate information on how the public could make contribution to a low-carbon society, and to transform people's consumption behavior and way of life.

In conclusion, I would say that low-carbon transformation is in the best interest of both China's and the world's development and prosperity. China is a constructive player in the international partnership towards low-carbon future. Thank you.

Mario Molina, Nobel Prize Laureate, Mexico/USA

Thank you very much. Ladies and Gentlemen,

I would like to thank the German Advisory Council on Global Change for giving me the opportunity to participate today in this forum on low-carbon prosperity.

I will attempt to make three points. The first one is a perspective on actions of the United States government on the topic of climate change. The second one involves a description of some actions of the Mexican Government. The third point is a summary of my personal view on what else is needed to effectively address the climate change challenge.

An important question is whether society is confronting the climate change challenge realistically. Although we already heard the setting for this from Chancellor Angela Merkel and from John Schellnhuber and Dirk Messner, I will add my own perspective. I want to stress that I am not giving you this information as an official representative of the US Government or the Mexican Government; it is really just my personal opinion.

I will mention a few examples describing US actions.

One is that President Obama put in place fuel economy standards that will nearly double the efficiency of the vehicles employed in the United States over the

next decade. This step will reduce oil consumption by more than two million barrels a day by 2025. Also, earlier this year President Obama proposed a new energy policy focused on renewables.

As you probably know, there are some tough internal political problems in the United States connected with the climate change issue. Other issues, such as energy security and the economy, receive a great deal of attention. So, this new energy policy proposed by President Obama has also as a goal to decrease the dependence on foreign oil, and it is a response to increase demand for oil in China, India, Brazil, etc., and to instability in the Middle East. Furthermore, the idea is that promoting renewable energies in the United States will create jobs. It is good for the economy. Other proposed actions by the United States Government include putting an end to a century of subsidies to the oil industry, which is indeed an ambitious goal. Just a couple of days ago, President Obama announced that he is pressing congress to invest in American clean energy manufacturers. This investment will create jobs through innovation and development of new technologies and new fuels that reduce the reliance on fossil fuels, and leads furthermore to more secure energy sources.

Let me move to the second point. In Mexico we and others are working on developing a credible, economic development plan that has low-carbon emissions. We



Mario Molina, Member of U.S. President's Committee of Advisors in Science and Technology and Nobel Prize Laureate, Mexico and USA.

are doing this in collaboration with international institutions, including the GIZ – that is *Die Deutsche Gesellschaft für Internationale Zusammenarbeit* here in Germany. The goal is not only to work in Mexico, but to build a coalition of developing countries with similar perspectives on the climate change issue. In fact, the Mexican congress just passed a new climate change law with the compromise of reducing greenhouse gas emissions by 50% by 2050. That again is fairly ambitious, and this goal is contingent on the successful implementation of an international climate change agreement; it remains to be seen whether such an agreement can be reached in the next few years.

What Mexico is promoting at the moment are the so-called win-win measures, such as those connected with improving energy efficiency, removing energy subsidies – along the same lines as the United States. Also, I would like to mention another point: this past February the United States, Canada, Sweden, Mexico, Ghana, and Bangladesh are starting an initiative to cut methane, hydrofluorocarbons (which are replacements for the CFCs that deplete the ozone layer), and soot, that is, black carbon. These are compounds that contribute significantly to climate change, accounting together for about 40% of the rise in global temperatures.

The main idea is that emissions of these compounds can be controlled with existing air quality regulations. Hence, the controls can be implemented even in the absence of international climate change agreements. I have been involved in some of the research that leads to these conclusions. Let me clarify, however, that we are not proposing to reduce the emissions of these compounds instead of those of carbon dioxide, but in addition to those of carbon dioxide. The time scales are important: we are talking about short-lived non-CO₂ climate change forcers, and the advantage of controlling their emissions is that the maximum temperature to be reached in the next few decades will be reduced. But this will matter little if CO₂ emissions continue with business as usual.

Here is my last point: we know that in Copenhagen, in 2009, well over a hundred heads of state agreed on the aspirational goal of limiting the average surface temperature increase to 2°C. It is often said that this is what science tells us, and that reaching the goal avoids dangerous interference with the climate system, minimizing the chance of reaching certain tipping points that might lead to irreversible changes in climate. But, in fact, science does not tell us what to do. It just tells us what might happen if we continue or not with business as usual.

The 2 degrees goal has to do with economics as well. It is a reasonable compromise in the sense that a tighter goal might be too expensive. We are talking about a cost to society of the order of one or two per cent of

global GDP. The message is that business as usual emissions will most likely lead to a larger cost to society, as has been so effectively communicated by Lord Nicholas Stern; we will hear from him in a moment.

I want to make another point. We are not just talking about a problem that will materialize towards the end of the century – a long-term problem. We are actually beginning to see effects such as extreme weather events. In fact, here in Germany, in Potsdam, there is some very important work pointing to the reality of these climate changes that are already happening. Thus, the point is that it is the economy not just for the future, but for the very near future as well. We have to get started, but society is not responding yet, and the 2 degree goal is perhaps no longer achievable. In my view, incremental or voluntary measures are not sufficient, and we do need an international agreement that places directly or indirectly a price on greenhouse gas emissions so that the necessary changes are actually implemented.

There are difficulties with achieving such international agreements, such as coming to consensus between developed countries and emerging economies – but in principle such problems can be dealt with. On the other hand, a major bottleneck at the moment has to do with internal politics in the United States: at present the US Congress will not ratify a climate change treaty, and hence countries like China or India are not likely to reduce emissions or to ratify international agreements.

The Republican Party in the United States has embraced a position of denial of climate change science, which is, in my view, a position totally unacceptable in terms of a rational interpretation of the facts based on science. This political reality is the reason that the words “climate change” do not appear in the announcements on energy policies made by President Obama that I referred to a minute ago. President Obama is, in fact, personally convinced that we need to work hard to achieve these goals, but the political reality prevents dealing with stronger positions.

Yet, the science of climate change is well-established – both by theory and by observations, as evidenced by the support of major organisations worldwide, such as the National Academies of Sciences and other professional organisations. Of course, uncertainties do remain in the science as well as the economics of the climate change issue. But, there is little doubt, in my view, that the risk of inaction is truly significant. There are plenty of precedents for society and for people to act in the face of uncertainties that are much larger than those characterising the climate change threat.

But let me finish by stating that I am cautiously optimistic. There are indications of divisions within the Republican Party in the United States. Taking into

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account that extreme climate events, such as heat waves, floods, droughts, will most likely continue in the next few years, I believe that society will be further convinced – even in the United States – that the climate change threat is real, and that urgent action is warranted; science and rationality should in the end prevail.

Let me end by stating that in my opinion increasing the investment in clean energy, technology, and energy efficiency is crucial, and that economic growth is not threatened by reducing emissions of greenhouse gases; it is actually threatened by continuing with business as usual. Incremental measures are not sufficient to properly address the climate change challenge, and truly revolutionary measures dealing with fossil fuel consumption, deforestation and various other activities of society are needed and can be accomplished most efficiently through an international agreement.

Thank you.

Leena Srivastava, The Energy and Resources Institute India (TERI)

Nearly four years ago, we made a study in India that spoke about the fact that there is a huge opportunity for the country to move towards low-carbon development. This was due to the stage of India's development that indicated that a large part of its infrastructure remained to be put in place and that consumption choices in the country were still being defined. This study, which we have presented in the Conference of the Parties in Poznan, also highlighted the need for strong international cooperation and identified a number of areas in which such cooperation would greatly facilitate the needed transformations. While the study itself is available on the website, it reaffirms the point that today the techno-economic feasibility of making the transformations we need is more real than ever before. The key problem remains with financing and the financing mechanisms.

But, one of the important problems that we are probably not giving enough attention to is the politico-institutional systems that need to be in place in order to support the transformations. While we have done a lot of work on analysing the technological and financial needs, there has not been enough attention paid to changes in governance systems that are required. The institutions that were designed to take care of the problems of the 20th century may not be able to address the problems of the 21st century. We must, today, be able to involve much larger communities in this debate, including the political scientists. So, how do we go about bringing such changes is a real challenge?



Lena Srivastava, Executive Director Operations (TERI) India.

When I look at India, specifically, I think there are a number of actions that the country is already taking, indicating a belief in the real threat of climate change and that action needs to be taken. We have the national action plan on climate change and eight missions that define specific areas of intervention that cover almost everything that we need to be able to do in terms of directions, as far as climate change is concerned. But, there remains a huge gap between the still ambitious program of the government of India and what efforts needed to remain in the 2°C guardrail.

As in the case of every other country in the world, urbanisation and transport systems are key areas from where major contributions to a low-carbon economy would come. In India, we are looking at doubling the population in urban areas in the next 20-odd years. We still have very low levels of ownership of vehicles. Both these facts give us an opportunity to do things differently and to benefit from international cooperation. As India looks to either expand its already congested cities or build new ones, it will have to integrate environmental and energy considerations intrinsically into the whole planning and implementation process. But, there is a huge capacity gap that needs to be filled – both on the human resources side as also in the institutional set up which currently does not adequately promote integrated urban development approaches.

In the area of transport, India is investing substantially on urban public transport systems, but it is far from

what is required to be done. Here again lies a huge challenge, in this case of finance, but also of designing the right kinds of public, or mass transport, systems. Just because the city of Delhi has a sparkling new metro system does not mean that this is the solution to the mobility problems of every other city in the country. Also, given the very low level of vehicle ownership, why is it that we cannot think about actually mandating a number of the global automobile manufacturers to focus almost exclusively on very efficient small vehicles that are either running on electricity or on hybrid systems? This would reduce the congestion pressure and energy demand in a country like India.

India also needs to assess its renewable energy potential using state-of-art tools and techniques. In a recent exercise, TERI developed an integrated renewable energy plan for the state of Gujarat in the Western part of India. A proper scientific exercise was undertaken looking at land use, land use planning, the available water resources, the laid-out infrastructure in terms of roads and city grids, etc. and a renewable energy resource potential of about 700 GW was established for that particular state against earlier estimates of less than 100 GW. Now, to translate this into useful energy will require a huge coordinated approach across various administrative bodies and the design of innovatively designed incentivising policy frameworks, which is no mean challenge.

There are other areas like water supply, sewage, and sanitation, where energy intensity and energy consumption levels are extremely high. We need to develop alternative business models. The existing business models for delivery of these services are extremely energy intensive and from an era where energy was not such a major concern. Going forward, we have to see how we can develop more decentralised service delivery models that will minimise the carbon footprint of providing these services in areas where they do not exist.

Finally, India has nearly 700 million people who don't have access to clean cooking energy solutions. And about 400 million to 450 million people who don't have electricity in their homes. The small and medium enterprise sector too is extremely important from a livelihoods perspective and will remain so, but it does not get enough attention as far as investments in R&D for technology up gradation and resource efficiency improvements are concerned. This is another area where international cooperation, and the setting up of international mechanisms, for supporting efficient technology development for the size and scale of this particular sector can go a very long way in contributing to reducing emissions from here. Thank you very much.



Emma Lindberg, Political Advisor, Swedish Ministry for the Environment.

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Emma Lindberg, Swedish Ministry for the Environment

Political advisor Emma Lindberg, on behalf of Minister Lena Ek.

Mr. Chair, Ministers, Ladies, Gentlemen,

firstly, I would like to send my sincerest regards from the Swedish minister for the Environment, Lena Ek who fell ill last night and could therefore not be here today. It is unfortunate and minister Ek had looked forward to be here. I will try to do my best to fill her place. I would like, on behalf of minister Ek, to thank you for inviting us to speak at this important event and in this session.

40 years ago, in 1972 the United Nations Conference on the Human Environment was held in Stockholm. It was recognized that protection of the environment affects the well-being of people and economic development throughout the world.

Two weeks ago, minister for the environment Lena Ek and minister for development cooperation Gunilla Carlsson hosted the conference Stockholm +40, with approximately 700 participants from 72 countries and ministers from over 40 countries where we focused on issues central to the upcoming Rio+20 summit.

The summary of the conference emphasised the need to focus upon the benefits of action, that policy

has to be science based and the need to respect planetary and social boundaries.

The Stockholm call for Action called for the urgent need to implement commitments already made, take additional actions and develop sustainable development goals so that our economies can become truly green and inclusive.

40 years into the future Sweden will have no net emissions of greenhouse gases. When evaluating progress made in Sweden to date, one achievement stands out: The decoupling of the level of greenhouse gas emissions and economic growth. CO₂ emissions have almost halved, while our GDP has doubled.

We get many questions on why the current national accounting of emissions does not take the climate impact of imported goods into account and I am interested in hearing your thoughts on this topic.

Sweden was, in 1991, one of the first countries in the world to introduce a CO₂ tax. It provides a long-term policy orientation, which creates predictability and incentives for investment. But certainly simply raising taxes does not create a world class business climate. Therefore, lowering taxes on other things is part of the Governments "Green Tax Shift". Taxes on emissions are raised while taxes on labour are lowered. Sweden would be more than happy if more countries want to adopt CO₂ taxes or making green tax shifts. Due to early climate policies and carbon tax, Sweden is on track to reach our national target of reducing greenhouse gases by 40% until 2020 compared to 1990.

We have recently started a broad process, involving stakeholders from many parts of society, to create a Swedish roadmap on how to reach our goal of no net emissions in 2050. In this process we will draw up scenarios taking into account preconditions and possibilities in all sectors of society and outline necessary measures and policy instruments to secure year by year emission reductions. A fulfilment of the climate goals requires transformative changes, and early movers will benefit the most. A specific national priority is that the Swedish fleet of vehicles shall be independent of fossil fuel by 2030. This is a big challenge. With the help of economic instruments the number of eco cars has increased significantly.

Another policy that interests me greatly is the French self financed system where polluting cars pay higher fees and this extra fee is transferred to less polluting cars. Climate is not the only challenge. One has to take a holistic approach. Sweden's objective is to solve the main environmental problems within a generation through 16 world unique environment quality targets covering everything from climate to chemicals to ecosystems.

To strengthen the commitment from e.g. ministers of

finance and CEOs we need a "Stern 2.0" that focuses on the benefits of climate action, benefits for ecosystem service and biodiversity but also for green job creation and innovation. In our summary of the Stockholm +40 conference, the "Stockholm call for Action" says that we need to set the economic policies in place to make it simple, affordable and attractive to act sustainably and move towards a circular economy with radically improved resource use. On that theme, I feel that we in Europe need to discuss how we set targets. It happens that the political will is missing when we set targets. But this cannot stop us from saying what we need to do if we listen to science.

I have for long listened carefully to the over hundred countries who say that 1,5°C is dangerous enough and feel so even more after the recent reports of methane releases. OECD gave us the latest report on the potentially catastrophic consequences of inaction. The Stockholm call for Action asks for a major report on the Benefits of Action. This will help us taking decisive steps towards an inclusive green economy.

The UN climate negotiations are as important as ever, but must be complemented with other actions. One such action is the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutant that was initiated in Stockholm two weeks ago.

Countries from North and South as well as other actors have decided on joint actions to raise awareness, develop policies and measures and improve the scientific understanding of short-lived climate pollutants. The Coalition is open to all Countries that wish to become partners to the Coalition and Sweden invites other countries to join.

Thank you!

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Lord Nicholas Stern, London School of Economics

The European Union has reached a critical point in its history, facing simultaneously a severe political-economic crisis, and its biggest opportunity to create and sustain prosperity and well-being for its people.

Voters in Greece, France and the UK have sent a clear signal in the past week that they want governments to give priority to jobs and opportunities as well as reducing deficits and debt. Prolonged stagnation or recession not only wastes resources now and deeply damages the skills of the next generation, but it may also produce dangerous political instability.

I have worked on public finances, public policy and economic growth all my professional life, as an academic at the London School of Economics and Political Science, as Chief Economist of the European Bank for Reconstruction and Development (EBRD) and of the

World Bank, and as a senior official at the UK Treasury. I take fiscal responsibility seriously. We must start with 3 basic economic realities: 1) fiscal responsibility and growth are inseparable – the absence of one undermines the other, 2) an attempt at a consumption-led recovery will not be credible, 3) structural reform is essential for increasing productivity and competitiveness but takes time.

Although domestic consumption in most Member States is weak, many companies have significant savings and strong credit positions. But to invest they require confidence not only in the future of the sectors they invest in but also in the public policies that are associated with them. The low-carbon sector is the only credible growth story over the next few decades. It offers the prospect of intense creativity and innovation which can deliver an attractive and prosperous future not just for Europe, but the world as a whole.

The high-carbon path leads to huge risks of potentially catastrophic societal and economic consequences from climate change. We know we must act now to manage these risks even as we deal with the current economic crisis; delay, as the International Energy Agency and the Intergovernmental Panel on Climate Change have demonstrated very clearly, is dangerous. In order to have a reasonable chance of avoiding global warming of more than 2°C, global emissions will have to be reduced from the current level of 50 billion tonnes of carbon-dioxide-equivalent per year today to less than 20 billion tonnes in 2050, and average global per capita emissions will have to fall from about 7 tonnes per head to around 2 tonnes. That means that over the next four decades, assuming the long-term trends in growth that can come from sound management, we will have to cut emissions per unit of output by a factor of about 7 or 8 in order to reduce absolute global emissions by a factor of at least 2.5.

Such a goal can be achieved only through a radical economic transformation, particularly in terms of how energy is generated and used. We need the rapid development and deployment of technologies that decarbonise our economies and bring a halt to deforestation. We can achieve big gains in the near term through existing technologies that increase energy efficiency and reduce our dependence on 'dirty' fossil fuels, particularly coal. Natural gas can hasten the transition and may have a role to play in the medium term if carbon capture and storage can be made to work on a commercial scale.

But to achieve the necessary reduction in emissions over the next four decades, the European Union must act to accelerate the pace of progress across the Member States. Past industrial revolutions teach us that investment flows to pioneers. Private investment will drive this low-carbon industrial revolution as long as



Lord Nicholas Stern is I.G. Professor of Economics and Government and Chair of the Grantham Research Institute on Climate Change and the Environment at London School of Economics and Political Science.

policy-makers show the way through clear and credible policies to tackle the six key market failures that are currently obstructing the advance.

First amongst these failures is the greenhouse gas externality which should be corrected through carbon pricing. Further market failures which require public policies include: research, development and deployment; networks such as electricity grids and public transport; capital markets and their management of risk; the provision of information; and the lack of pricing of co-benefits, such as cleaner, safer, and more secure economic activity, that arise from the shift to low-carbon growth, over and above the avoided risks of climate change.

Private investors are discouraged from exploiting opportunities in the low-carbon sector by the risk that national governments and the European Union as a whole will fail to implement consistent policies to overcome these market failures. Policy-makers can boost investor confidence, and still exercise fiscal responsibility: through clarity and credibility in their actions they reduce policy risk. If governments do not correct failures, they distort markets.

By increasing the ambition of the European Union's target for reducing greenhouse gas emissions in 2020, to 30% from 20%, compared to levels in 1990, Euro-

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pean governments can provide the impetus for a strong and steady carbon price and signal their commitment to the transformation.

Governments can also step up their support for research, development and deployment of technologies via the European Institute of Technology, but also by working directly with major universities and companies.

They can leverage private investment in the low-carbon sector through finance from the European Investment Bank and the EBRD. The involvement of those institutions itself reduces policy risks, as I saw first-hand in my six years as Chief Economist of the EBRD in the 1990s.

Governments can embark on the upgrade of the power network across the continent, allowing electricity to be transmitted more efficiently and smartly to match supply and demand across a truly European super-grid. Let us have a grid that allows us to generate solar energy where it is sunny, wind energy where it is windy, geothermal energy where the rocks are hot, and at the same time facilitate the management of the intermittency of some renewables. For example, it could greatly assist Germany's energy transition, link Poland to southern solar, and stimulate activity in Spain.

Some of the necessary programmes, such as energy efficiency and aspects of public transport, can generate activity quickly. Others take longer but action must start now. Overall the scale could be substantial.

By offering a clear vision for the unleashing of the low-carbon economy, framed by credible and stable policies, the European Union can unlock private sector investment and usher in a period of investment, growth and opportunity, to the benefit of all. And now, more than ever, with both fiscal responsibility and growth, we need policies that can bind Europe together around the shared goal of a cleaner and more secure energy policy, just as Europe's founders focused on economic and political cohesion by beginning with coal and steel six decades ago. Sound economics and wise politics surely point in the same direction.

Session 2: Sustainable Prosperity Through Innovation

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Georg Schütte, German Federal Ministry of Education and Research

Alliances for Transformation – Channels of Communication between Science and Society

If we look at the latest flagship report of the German Advisory Council on Global Change (WBGU), we find a strong agreement regarding the goals that should be achieved. But the Devil is in the detail, as always. The true challenge lies in figuring out how to achieve each single implementation step. Now when we talk about implementation, we have to look at how to balance interests – possibly competing and incompatible interests. Therefore, we need to focus on each implementation step and each conflicting goal individually.

So, when we talk about sustainable prosperity – or maybe better, about sustainable development of prosperity – then we should also talk about possible conflicts between individual consumers or economic actors and the goals that we all consider to be normatively essential.

This is where I will pick up the idea of Lena Srivastava, who talked about committing all car manufacturers to first produce a small car with climate-neutral consumption. In Germany, we are currently discussing the market penetration of electric vehicles. In some cases they are sold in high-priced segments by manufacturers, who are the drivers of innovation for this exact reason. Due to the purchasing power made available, these initially expensive technologies can be paid for through the high-priced segment. What follows could be a mass



From left to right: Caio Koch-Weser; Andrew Beebe; Frank Mattern; Georg Schütte; Moderator: Jürgen Schmid.

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market penetration of small cars. So, what would be the next suitable step in this case – first the production of small cars, or first cars in a high-priced segment?

Now I will focus on the role of science. One task of science is to bring up questions concerning conventional wisdom. Thus, we have to think about the way how to address this challenge: Where do we provide precise requirements, and where does science act autonomic? Thus far, I have provided you with a small insight into the issue of conflicting goals.

So what does the latest flagship report of WBGU “World in Transition – A Social Contract for Sustainability” show us? It states that science and research should be inclusive, transparent, cross-thematic, involve new topics and new actors. We have just heard this on the previous panel. When we talk about innovation, it’s not just technological innovation. The social sciences also need to be involved. Transparency is an issue which we have already heard about from Lord Stern. The sciences should be publicly accessible, participatory – this means involving new groups in the scientific process – transdisciplinary and interdisciplinary. These are all buzz words as we know, but implementing transparency institutionally, structurally and thematically is truly a huge challenge. This is due to the fact that functional transparency requires a cross-sectional and well-financed perspective.

In his opening remarks, Professor Messner mentioned that we all know how much money we need to invest to cope with these challenges. I would reply, from the perspective of a Ministry of Research, that we always get told “it’s never enough”. So, how much do we really need? How much do we really have? And – a very important point – how can we invest the available resources efficiently and effectively? In my point of view, these are some of the main challenges.

My next point focuses on science and research as a driver of innovation.

Picking up the point of science being “inclusive”, we are trying to work on involving new actors in the scientific process. In this case, “we” means the German Federal Ministry for Education and Research (BMBF), respectively the federal German level. We are a policy-designing ministry but also promote research. In addition to the research funding agencies in Germany and the funding agencies that organize themselves in scientific circles, the BMBF also provides financial resources for research and development. Our aim is to raise the potential for innovation and remove structural deficits. So what are we doing to meet the demands of inclusiveness? We have all our support programs for so-called upstream agenda purposes. That means we enter into discussion with the stakeholders, in areas such as energy research, climate research and sustainability



Georg Schütte, State Secretary, German Federal Ministry of Education and Research.

research. These agenda processes seek to understand which the needs of science and economy are.

In addition – and this is a new topic on which we are working to find the appropriate form – we conduct dialogues with society. Last year we launched a society dialogue on energy technologies and have asked concerning the German energy transition: What are the rights of citizens when faced with high-technology development of the energy sector?

As a further point we have set up a strategic advisory board (Forschungsunion Wirtschaft – Wissenschaft), where politics, academia and business come together and discuss future challenges in the areas of climate and energy, health and nutrition, mobility, communication, and civil security. I mention these topics because the aspects of sustainability are cross-cutting and relevant in all these areas. However, it is not surprising that there will also partially be some conflicting goals and conflicts in resource allocation. How much money should we spend on health research? How much money should we spend on energy research? These are political decisions that we need to make, but we have also to discuss these questions within these appropriate bodies.

As an additional example, we have declared 2012 as the Science Year for Sustainability “Project Earth: Our Future” (Zukunftsprojekt Erde). A variety of events with numerous actors have taken place throughout the

country, with the goal of raising public awareness of the issues and research challenges that are being faced, and most importantly, to address the issue of sustainability as a whole.

Other important requirements of science and research are transparency and accountability.

Science can give us no clear answers. Mario Molina has just mentioned that science shows only what is possible. This means, that we can expect alternatives and scenarios from science. The German National Academy of Sciences (Leopoldina) and the National Academy of Sciences and Engineering (acatech) seek to provide this answer in the field of energy research. They published a first report, which focused on an integrated energy research program, in 2009. In 2011 they presented a further developed position and called it: the renewable energy option. The option of nuclear energy was among the decisions made at that table. Now it is time to present the next alternative within this option. What do we do as a ministry of research? We constantly have exchange with the science academies in order to see upcoming developments as we cannot fully predict processes such as the energy revolution. Looking only to the year 2050 is too far in the future and too complex of a situation for immediate fundamental decisions. That means, we should engage in learning together, where we are constantly developing new alternatives to present scenarios to meet the basic decisions that must be adapted as required.

However, this means that science must bear the responsibility of making recommendations. To create the appropriate policies we need these recommendations. Science should also serve as an early warning system which shows which ideas fail and which won't work.

My next point is to present to you some examples from the field of sustainability research. When we talk about the implementation and value creation potential of research, we are facing the five major challenges of climate and energy, health and nutrition, mobility, communication, and civil security. These challenges are so huge and abstract, that we have to break them down.

In the area of climate and energy, for example, we are funding a project for the city of the future (Morgenstadt), which means the objective of a CO₂-neutral and environmentally efficient city. The project includes a dialogue among researchers and companies to discuss about a road-map of specific technologies that address demands of the city of the future. Some of the questions are: When could we provide these technologies? What new business models do we need in order to bring these technologies to the market? Under which conditions the civil society would accept these technologies, and when we should look therefore for alternative solutions. These working groups discuss new models

for urban development for example in India, which may be applicable as good practice examples for the development of cities worldwide. Similarly the BMBF plans to set up good practice examples in 30 German cities. Currently, we have launched a project for municipalities to increase the dialogue between the political leadership of a city and its citizens with the goal of developing urban sustainability concepts within one year. Using these sustainability concepts, we plan to set up a research agenda in a second step.

Another example for sustainability research is the German energy transition (Energiewende). In cooperation with national academies, we are currently creating a map for energy research in Germany.

Together with German science organizations we are establishing a research platform for energy transition.

In addition, we want to enter into a regular dialogue with science, which it itself organizes, and re-adjusts time and again between the tension of their self-control and the societal demands. The dialogue shall focus the energy transition, regarding what needs to be done in the short, medium and long-term.

Moreover, we want to involve the system perspective in this process. That does not only include working with natural sciences and technology, but also – for example – with economists, social scientists and demographic researchers. The goal is to advance the topic of energy transition in a cross-disciplinary kind. Therefore, we seek to establish a dialogue ranging from the technology sciences to the so-called social sciences.

This leads us to the international dimension, which will be the last catchphrase of my speech.

We need international cooperation – in Europe and beyond –, because some technologies can simply not be funded or developed by a single country or region. If we think about fusion power research, just to name a major technology project that is not uncontroversial, as an element of future energy supply after 2050, research into this technology cannot be funded by Germany alone. The short and middle-term challenges of energy policy therefore make it necessary for us to bundle research resources in other areas of priority. At the same time, this also means we must keep ourselves open for the long-term options. This is only possible through international cooperations.

Secondly, the conditions themselves show that research on climate change and energy cannot be developed solely on the national level, since the challenges are global. We heard the keyword 'Geo-engineering' from Professor Messner's opening statement, a controversial line of research. We asked ourselves: How can we deal with it? Our first answer is: We will not promote geo-engineering technologies through funding of applied research. But we need to be aware of

what is happening in this field. If these technologies are used in other countries, this may also impact the climate or weather phenomena in Germany or other parts of Europe. Therefore, we must be aware of current research.

My third point for international cooperation is responsibility, and assumption of responsibility. We, the BMBF, have entered into a research alliance with two regions in Africa, namely in western and southern Africa, where we are setting up research centers for sustainable land development. German researchers and their partners in Africa are exploring the impact of climate change phenomena on local land use in African countries. Funding is provided to set up local universities and graduate schools, research equipment and capacity building of local staff. The ultimate goal is to develop practical recommendations for concrete measures and actions for national governments and even for regional decision-makers.

This was a broad overview of our international collaborations in the area of sustainability research. I am very curious about the following discussions.

Thank you very much for your attention.



Frank Mattern, Head of McKinsey & Company's German Office.

Frank Mattern, McKinsey & Company's German Office

The energy turnaround in Germany is now a fact of life, and companies are preparing to deal with the consequences. What are these consequences? For many companies, the turnaround means new opportunities. For others, however, it's a massive new burden, bringing unforeseeable changes in the way they do business. What I would like to focus on here are three aspects:

- Protecting the climate.
- The costs of the energy turnaround.
- The questions that still need answers.

Protecting the Climate

Assuming that the current legal framework remains more or less the same and the German economy grows by 1.6% a year between now and 2020, then it will be possible in Germany to lower CO₂ emissions by about 30% compared with the level in 1990. This would make Germany a global champion in protecting the climate. Trying to top this target and reduce emissions even more is, in our view, currently not advisable for Germany. Why? Because reaching the 30% target will already require enormous efforts to avoid putting too great a strain on the economy and technology. The energy turnaround is in progress, but it is still far from complete.

Costs of the Energy Turnaround

From our calculations, it is already foreseeable that the financial burdens will be very, very significant. By 2020, the cost of the energy turnaround will have increased by 60% to € 21.5 billion a year. In the energy sector alone, the additional costs for Germany between 2011 and 2020 will amount to about € 175 billion. In Germany the industry segments that are especially energy intensive are already under heavy competitive pressure. For example:

- Gas prices in America are around 75% lower than here, and the electricity prices about 50% lower,
- and even in comparison with other countries in Europe, the price of electricity for industries in Germany is about 25% higher.

The situation will go from bad to worse if industry is also forced to shoulder the currently massively increasing costs for expanding renewable sources of energy and the electricity networks. If the energy-intensive industries lose their current exemption, their earnings before interest and taxes will fall on average by 50%. Many companies would no longer be able to compete, and would move elsewhere or disappear from the market. Our analysis also shows that the additional burden on private households will be even heavier. Given the additional charges on industry, the price consumers will have to pay for „green electricity“ by 2020 will be almost 60% higher than today.

Questions in Search of Answers

First: There is one piece of good news about the transformation of our energy system is that, by 2020, the German economy's dependence on fossil fuel imports will decrease by 21%. This is good news generally. It is also important because due to the increasing scarcity of fossil fuels globally, the security of supply will also decrease.

Second: The security of the electricity supply in Germany has been noticeably reduced following the decisions to phase out nuclear power and shut down some of the plants immediately. We need a thorough assessment of the supply situation in order to start taking action to secure Germany's power supply.

Third and main point: we need to develop a truly integrated perspective on energy policy. That applies not only to the federal and state governments. It also applies to companies. We need integrated project management if we want to make the energy turnaround a success for Germany. That implies, first, concentrating on what is feasible – such as speeding up the expansion of the ultra-high voltage transmission grid. And we must manage the consequences of the cost explosion. We must make every possible effort to hold the line on the costs of the energy turnaround and secure its sound financing, without excessive social burdens or overtaxing the industry. We should also concentrate on the most economical measures: increasing energy efficiency and making the expansion of renewables less costly. Both these measures create value for German industry because it's the companies here in Germany that supply the technology that's needed and install it locally.

The energy turnaround has created a unique environment as Germany transforms itself to a less energy intensive economy. This will spur innovation in energy production, distribution and usage. Clearly, we're not there yet. But if we succeed, we can make the energy turnaround an economic success story for Germany.

..... Andrew Beebe, Suntech Power Holdings

If you haven't read the McKinsey Report, I would strongly endorse it; it is an incredible piece of work. Hearing your very brief summaries, I wanted to yield my time to you just so that we could get more of it. But, please read the report – all of their work around renewables is some of the most in-depth research and most economically applied research that I think we have.

I come from the United States, and I came here under the agreement that I would not have to explain the behavior of American politicians as part of my presentation. So, it is probably easier to just solve climate



Andrew Beebe, Chief Commercial Officer, Suntech Power Holdings.

change crises than to figure that one out.

With that said, I work with Suntech; I run worldwide sales and marketing. We are the largest solar company in the world. The job is a fantastic one. I used to do product development and product management; so, I can also speak to some of the technology innovations that we have been working on. But, in my current job, I get to travel the world, helping sell solar in all corners. When I get on the plane, I love to get a window seat so that I can sort of prospect for opportunities of the many open rooftops that we have, and, of course, the vast open spaces that we have. It is inspiring, because I look down and see billions of dollars of opportunity.

Now, I came from Verona this morning, and the person who was helping me book the flights was lamenting that I had to make many stops: in Munich on the way up and Frankfurt on the way back. I explained that this was great, because I could do further prospecting and see all the incredible development that has happened. I fly to Munich often, and I really can, over the years, see the growth of our industry just from a window on an airplane.

A lot of discussion today has been focused on what we have to do in the future. Of course, in our industry we greatly appreciate that. But, I just want to take a step back and towards the desire for optimism that was articulated earlier, talk a little bit about what has happened to date, because especially in this part of the world,

I think that everyone needs to congratulate themselves, particularly the policymakers – I am sure many people in the room – and the political leaders, first in Germany and then across Europe, who took great political risk sometimes and had great fortitude in their resolve to make sure that renewable energy became a reality.

I know we have a long way to go, but after Germany and other European countries started using the feed-in tariff mechanism, we now have 50 countries around the world that have followed that path. In the US we have taken a different approach, and now in China we see a feed-in tariff coming into play; this year China alone will do 5 GW of solar, and in the United States we will probably do 2.5 to 3.5 to 4 GW of solar. So, these are tremendous transformations that started right here. So, in part, on behalf of the global solar industry, I am here to say thank you for that leadership. It cannot be underestimated. We really deeply appreciate it.

Another incredible benefit of all that policy work – while there is going to be extraordinary revisionist history where people look back and say: hey, we overpaid, or that was the wrong policy, or whatever – the real impact of the last ten years, or the last twenty years, was the radical reduction of the costs of building out renewable energy.

I was just asked earlier about: where are we seeing grid parity in reality? There really are markets where we are seeing grid parity. While in the industry we get concerned, of course, about the changes to the German laws, changes in the Italian laws, and other places – they do have bumpy transitions for people who have quarterly earnings to deal with every three months. We still see a transformation that is truly happening to the extent that now in Germany at the end of this year, residentially, we will see a feed-in tariff that is lower than the actual value of the consumed power – at least on a purchased or retail purchased basis – and yet we are going to see Germany still be a very, very large market in the second half of this year.

That is because we have seen the cost of solar drop 70% in the last five years. In the last five years solar has gone down to the point where we are now selling solar panels at below a dollar a watt. When I got into the industry ten years ago, this was the magic number: a dollar a watt. Now we have reached it, and somebody told me – actually we meant installed cost, not the cost of the panels. So, it turns out that we still have a little bit of work to do. But really, even that dollar a watt of installed capability in most parts of the world, and probably Germany first, will be reached over the next few years. This is a radical transformation of the solar industry and, of course, the accessibility of renewables. I think it is worth noting too, we have been talking about high-voltage lines around Germany – high-vol-

tage lines or access-lines to offshore wind – all these issues are, of course, real; so we have an energy web. But, on my flight into Munich I saw hundreds of homes and buildings that were installing solar right there.

Historically, those were feeding back into the grid, have impact on the grid load, and have need for smart grid. But, in the future, most of those will be self-consumed on site. That is also a transformation that actually alleviates some of the need for a lot of that infrastructure build-out. We will see that happen, I think, around the world.

There has been a lot of debate recently in the news about this being sort of a country-versus-country thing or an aspect of national pride about which country has supremacy. Of course, this is concurrent with a massive oversupply in our industry that results in a lot of companies, including our own, going through a lot of pain and challenges.

But, ultimately, that oversupply has led to radical cost reduction, and it will lead to a lot of changes throughout the industry. But, when you look at this country-versus-country thing, I want to get away from that – every speaker up there until this time has been talking really about the global challenge. When you speak about policy, or the academic, or the political aspect of making the climate safer in our future, we don't talk about us versus them. We talk about: how do we do this collectively. I think when we look closely at the industries that are being built up around renewables, we find the same dynamic at play. At the high-level it may be easy to say: it is us versus them. But, when you peel back the layer, or in our case when you look at our technology, you realize that, in fact, our panels are made all around the world. We manufacture most of our panels in China, although we have manufacturing in the US and Korea now, and Japan as well. But, really, most of our manufacturing in China, most of the content for those panels, comes from outside of China.

We have created a global industry. It is that sort of global nature of the industry that I think is built on the backs of this incredible policy support that we have had. So, just quickly I will say: we are working deeply on R&D. Suntech has 450 engineers around the world working on next-generation solar technology. There is a very clear road map to reduce at least another 30% of our cost from all of our panels. That is a great step forward, but it takes a lot more. We are working with Fraunhofer, with University of New South Wales in Australia, with universities in the United States, to make sure that we can push the R&D envelope; because in the last five years, maybe the last ten years, much of what drove down the cost of solar was scale. That is great, and it is terrific to have that scale here in Germany, China, and around the world. But, the next

level is going to take a lot more than just building a few more, or a dozen more, massive factories. We need incredible innovations. There are incredible innovations happening across solar. On the technology side, I think we are going to see a lot of that come from Germany, Europe, and from around the world.

But there is one other piece of innovation, that is the financial innovation. I would pause at that, and we see this playing out with companies right now in Italy doing door-to-door sales of solar with no money down, where you have a lower cost of power in your first month with no money down and the generation is on your rooftop.

The same thing is happening in the United States. This is done because of financial innovation. The ability of banks, and central banks, and institutions to get behind the financing of renewable energy, has transformed the way we pay for renewable power. Instead of buying a watt peak, which was sort of the transformation with the way we had to buy it over the last two decades, we are not back to buying kilowatt hours, which is what consumers and energy buyers are used to.

So, the innovation is not just happening on the technology side but also happening on the finance side. Schopenhauer, the German philosopher, talked about the transitions of truth and how truth went through three phases. At first you were ridiculed when you put something out there as a great idea. Then you were violently opposed, and then eventually you were just taken as self-evident. We see the renewable energy space going through these stages quite clearly. In the beginning it was not taken seriously. This could never be big. I remember ten years ago somebody said to me: someday we will be selling gigawatts of this stuff; the guy next to him said: no, that will just never happen. These guys were in the solar industry, and that was ten short years ago.

Now we are in the stage of violent opposition. I think some of it is quite quiet, but there are those out there that are aggressively attempting to drive division in our industries and trying to point out or slow down the transition to renewable energy. So, I would just encourage everyone to stay strong during these challenges where we can sometimes be depressed or pushed aside, and realize that if we all come together globally, we are going to drive those costs down; and from an economic standpoint as well as a technology standpoint, we can actually make a lot of this reality.

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Caio Koch-Weser, Deutsche Bank Group, UK

How financial innovation can contribute to transforming the economic and environmental crisis we face into opportunities and what is needed to grow this financial innovation.

1. The challenge – the critical next decade

Keeping the world from warming more than 2°C will be impossible unless emissions peak and start rapidly declining by 2017. Threats to economic growth are expanding due to rising natural resource demands driven by 3bn new entrants to the middle class in the coming decades, increasing costs of resource development, commodity price correlation creating increased price volatility and delaying investment in infrastructure. These increasing costs will weigh on economic growth unless society focuses on dramatic resource efficiency improvements.

2. The opportunity

We can change this pathway. An economic transformation will create multiple and mutually reinforcing benefits. Green growth is an increasingly important driver for innovation and wealth creation. UNEP concludes that a green investment scenario of 2% of global GDP generates as much growth and employment compared to BAU, while creating environmental and social benefits and



Caio Koch-Weser, Vice Chairman Deutsche Bank Group, UK.

5 Session 2: Sustainable Prosperity Through Innovation

reducing risks. However, more analysis is needed on how 'inclusive green growth' is aligned with broader economic growth, particularly on employment where initial evidence is positive.

3. Global climate negotiations vs. bottom-up action

Despite some progress in Durban, we should not hold out hope for an international breakthrough but seek alternative ways of moving forward. Significant investments are being made: US\$140bn+ in 3500+ CDM projects, US\$260bn clean energy investments, US\$70-120bn in North-South green finance (50% from business).

There is also promise in the bottom-up 'coalitions of willing' countries, cities and corporations. Examples include the 650 Consumer Goods companies' aim to eliminate deforestation in their supply chains; China's low-carbon focus; countries like South Korea and Mexico creating green growth plans; 50+ countries creating energy access plans and other countries examining domestic carbon markets; California's 2013 carbon market may link with Quebec; the US' coal to gas power generation switch; EPA increasing vehicle efficiency standards and working to regulate power stations and industry.

4. Bridging the green infrastructure investment gap-policy

In total, ~US\$1 trillion is currently being invested globally in green infrastructure but a significant gap remains: an additional ~US\$1 trillion/year of investments. To bridge this gap, policy changes are required and much more effort is necessary to leverage private investment. Reform of EU ETS is needed in order to restore market scarcity, address the over-allocation caused by the recession and create some sort of carbon central bank to create greater supply flexibility. Bloomberg shows a stricter EU carbon target would only cost € 7-9/capita. Internationally, more countries need to adopt robust carbon pricing policies, building on China's 7 carbon trading pilots, Australia's new carbon price, Mexico and South Korea's new climate change laws. The G20 should live-up to their commitment to phase-out inefficient fossil fuel subsidies. Improved energy efficiency policies: instead of only debating tax credits, policies like the UK's Green Deal 'on-bill' financing and Energy Savings Agreements are needed to allow building owners to 'pay as you save' with investors financing of retrofits secured against energy bills.

5. Financing and leveraging private investment

Even with the right policies, risks remain that reduce investor certainty. We need to dramatically increase efforts to leverage private investments with the limited

public funding placed in risk mitigation and co-investment structures. Examples exist of how this can be done and efforts need to be scaled up. Examples include: Tiered risk-sharing or "waterfall" structured funds like EU energy efficiency fund, KfW/BMU Global climate partnership fund (we are the fund manager); Deutsche Bank and KfW's GET FiT pilot in East Africa; IFC Utility Energy Efficiency Finance Program in China leveraged private investment 100x and reduced the equivalent of 25 coal power plants' emissions. These and other examples align with the conclusions of the UN's Advisory Group on Climate Finance: it is challenging but feasible to raise the international goal of an additional US\$100bn in climate finance.

Deutsche Bank played a leading role in the B20's report to the G20 meeting chaired by Mexico's President Calderon. At the G20 meeting, a new green growth alliance of international financial institutions, development banks, and private investors formed with the aim expand the number and scale of public-private finance structures. The G20 welcomed the alliance's formation.

6. Conclusion

With the right policy frameworks, business will make the required investments, assume relevant risks and embrace the opportunities of a green economic transformation. The economic crisis can be made into an opportunity with more 'coalitions of the willing' taking action through government policies, public private cooperation and transformative corporate sector projects. Policy changes are also necessary such as strengthening and wider reform of the EU ETS, improved 'pay as you save' approaches to energy efficiency, and phasing out inefficient fossil fuel subsidies with resources transferred to assist the poor and expand public-private infrastructure funds. Multi-lateral and national development banks can and should dramatically increase efforts to leverage private investment.

These actions will increase private investment, contribute to economic growth, reduce unemployment and address our natural resource and climate challenges.

Session 3: Panel Discussion Pathways and Possibilities of Partnerships for Low-Carbon Prosperity

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Nebojsa Nakicenovic, WBGU

Your Excellences, Ladies and Gentlemen,

let me first say what a privilege it is for me to have the opportunity to be at this symposium. I found the discussions very inspirational, in particular the talk by the chancellor this morning. It amplified my belief or faith that 2012 is a symbolic year that offers many great opportunities to actually initiate actions for transformational change toward decarbonization. To do this we need a vigorous action agenda or agendas (one should say plural) in different countries, different businesses, and in the public and private sectors. And I think this is the basis for the new partnerships. For me partnership is the way to go forward.

We should not forget that we are just 40 days away from the Rio+20 conference; which does not leave much time. On the positive side, the good news is that general awareness is really increasing that current trends are unsustainable and that transformational change toward decarbonization is overdue and needs to be accelerated immediately. So in a way, Rio is the beginning we should have had 20 years ago; maybe it is a bit late, on the other it is never too late to start.

The German Advisory Council on Global Change (WBGU) has recently published an important report about transformational change toward decarbonization. I am sure many of you have seen it in German; there is now also an English translation that can be downloaded from the WBGU website. One of the major conclusions of that report, at least from my perspec-



From left to right: Nebojsa Nakicenovic; Mika Obayashi; Manish Bapna; Urban Rid; Katherine Richardson; Moderator: Dirk Messner.

tive, is that while transformation is happening it needs to be accelerated: it has to become vigorous, and it has to become pervasive within the next decade. This morning we talked about resources being limited; I think that time is an important resource that is also limited. That is, the time we have to achieve this transformation is limited. This kind of thinking and conclusion is amplified in other studies: for example, the Global Energy Assessment (GEA) that was based on the work of some 500 scientists and experts around the world and in which I had the privilege to serve as the Director. The GEA report will be launched at Rio+20.

Another reason this year may be a symbolic one, is that the UN General Assembly declared 2012 the Year of Sustainable Energy For All. This is a really important initiative. Ban Ki-moon himself, the UN Secretary General, has put lots of his political energy behind this initiative and has called for three, I would call, aspirational and visionary energy goals for 2030 that I think can also catalyze the transformational process and enhance other partnerships toward sustainable energy futures that we have around the world. This initiative could also provide a new bottom-up entry point to address climate change issues in addition to negotiations at the global level that clearly need to continue. This way energy would become an important entry point for resolving other global challenges including climate change.

The first of the three goals is to provide universal access to sustainable energy for all by 2030. This is extremely important because about three billion people still cook with solid fuels, which is a huge barrier to development, not to mention the effects on human health, and of those about one and a half billion people do not have access to electricity. The second goal is to double the rate of efficiency improvement: translated into action this would mean something like a 40% reduction in energy needs by 2030 with the same level of energy services. The third goal, which is important in this context, is to double the share of renewables worldwide to 30% by 2030; this symbolizes the need for decarbonization.

Both the German Advisory Council on Global Change in its transformational report as well as the Global Energy Assessment have identified a number of development pathways that could fulfill these three goals of UN Secretary General, Ban Ki-moon. These transformational development pathways would not only fulfill the three goals but also bring many more benefits, such as energy security, a reduction in air pollution, in particular indoor air pollution and its effects on human health. In the context of decarbonization it is important to note that in the long-term these three objectives are consistent with achieving climate stabilization at less than 2°C by 2100. Of course, additional actions will be



Nebojsa Nakicenovic

required beyond 2030 to attain the climate goals. This is a beginning, but a very important beginning. Now, where is the challenge?

As we have heard in previous panels and also from the Chancellor, the main challenge is to achieve an increase in energy investment by 50% more than we invest today, perhaps even 100%. I personally believe that both these studies show that with the right policies in place this is doable. For example: we give about the same amount worldwide for energy subsidies today, namely about 50% of total energy investments. And, by and large, these subsidies are inhibiting the transformational change we are talking about. Therefore, it is actually a question of doing things differently that is really important and this is why I think this initiative is essential. Let me just make another comment. Two weeks ago London hosted the Clean Energy Ministerial meeting, which I know some of you attended. One of the objectives of the meeting was to have specific commitments from the private sector and governments in fulfilling these three goals by Rio+20, of course not globally, action has to be local. The idea is to involve private business partners and about 50 developing countries to develop their own action agendas for Rio+20. Again, I think this would also be a good bottom-up complimentary way to start fulfilling the three global objectives.

So let me in conclusion say that I am exceedingly enthusiastic about this initiative. I think it offers really

a unique pathway to a sustainable future, and perhaps what is most important, it may let us break out of our lock-in to the current fossil-fuel intensive development paths.

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Manish Bapna, World Resources Institute, USA

WRI is a think-tank focused on global environmental challenges. From our work, we see that the world is truly taking notice of Germany's energy transition and watching with admiration.

It is not an exaggeration to say that this is the single most important national-level initiative to tackle the climate crisis. That this is happening during tough economic times and in a manufacturing-based economy makes the effort that much more relevant.

Yet knowledge of Germany's energy transition is very modest. We recently conducted a survey of ~30 climate and energy policy experts from around the world. A few findings:

- › Wide recognition of ambition yet limited knowledge of targets/details of transition.
- › Significant interest in how Germany is undertaking the transition – how it is dealing with implementation issues such as transmission or storage, how it is handling the politics of the transition recognizing that there are winners and losers. These “how” questions are of much more interest than questions about “why” the transition or “what” is proposed.
- › German experience is relevant but differs from place to place. For example, Japan is interested in nuclear phase-out questions while US is interested in jobs/competitiveness.

We recognize that there is a lot of work to do on implementation but laying the foundation for selected countries – especially the US, China and India – to learn is absolutely critical.

We know efforts to share Germany's experience are underway but it is our impression that these efforts are not yet reaching key audiences. It is important to think carefully about each audience, how to convey relevant messages in an accessible manner, what language and narratives will work in each country and who are the best messengers. Often the messenger is as important as the message.

Not asking Germany to tell the world what to do but learning deeply from Germany's energy transition is absolutely vital if we are all to shift to a low-carbon pathway in time. Final point: the importance of political leadership can't be overstated.

Chancellor, your visibility on the global stage on this issue is critical to help motivate other leaders. For example, you have opened this major conference on



Manish Bapna, Acting President, World Resources Institute, USA.

low-carbon prosperity today. Speaking at similar low-carbon events in other locations such as Washington or Beijing would be incredibly powerful.

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Katherine Richardson, University of Copenhagen

There are three sectors we need to partner for the transition to occur: 1) Business; i.e. the locomotive for the transition. 2) Policy (where I include the general public although some people might argue that these are really two distinct sectors) and 3) the academic community. I will use the Danish experience to illustrate the roles of each of these partners.

A simple understanding of supply and demand tells us that sooner or later we will have to remove fossil fuels from our energy system. The price of their continued extraction and use will become too great. While most people agree on that, their response is usually “well, we will wait until the price gets too high before we worry about it”. There are two problems with that approach. One is energy infrastructure is quite long-lived (often on the order of 40–50 years). Therefore, you have to be pretty confident about what the price of fossil fuels is going to be the next 40 years in order to be able to make wise investments in infrastructure. The other problem is that there are geopolitical issues related to some fossil fuels, which can mean that even

though they technically may be on the planet, they may be difficult to get a hold of. Energy security has a value, even though our economic models don't include this.

It was in this light, that the Danish government in 2008 established a commission to examine when Denmark could become independent of fossil fuels. I was Chair of the Commission. Our starting point the fact that, sooner or later, we are going to have eliminate fossil fuels from the energy sector. We don't know when but we do know that the EU has a goal of 80-95% emissions reductions in 2050. Looking at the profile of Denmark's emissions, we could see that there is absolutely no chance, unless CCS becomes viable, that we can reach an 80% reduction unless we remove essentially all fossil fuels.

Our analyses showed that it would be possible with available technologies to remove fossil fuels from the energy and transport sectors by 2050 and the two macroeconomic studies we conducted both showed that, if you integrate the energy costs over the next 40 years for Denmark, there is essentially no price difference between continuing with fossil fuels or moving to renewable (Denmark has no nuclear). It is now the official goal of the country to remove fossil fuels from its energy system, including transport by 2050. Denmark is the only country in the world, as far as I know, that has the goal of removing fossil fuels by a specific date.

Much of the discussion today has focused on emissions reductions but this approach is only treating the symptom; not the cause of the problem. We have seen with the discussion on bio-diesel in Europe right now, if you only focus on the emissions, then you can run down some dead-ends. Now, every climate initiative in Denmark is thought of in terms of what it means for the 2050 goal. The fact that the country has this vision and has established the framework to begin the transition (with the support of 172 out of 179 Members of Parliament) has made a huge difference for the business sector. The role of the policy sector in the transition is to provide the framework for the market to work. We want market mechanisms to deliver the transition but there is no such thing as a truly free market. Politicians must make the regulation that supports the transition. Today, for example, thanks to the policy goal of removing fossil fuels from the energy system, no-one in Denmark would dream of investing in new coal infrastructure. This is not about picking the winner; this is about identifying the loser.

Some speakers have emphasised here that we don't know what the right future energy mix is. No. We don't. Nobody does, because the market has to let it evolve. At the moment, Denmark also has the goal that



Katherine Richardson, University of Copenhagen, former Chair of the Climate Commission, Denmark.

50% of our electricity has to come from wind by 2020. You say: "Oh, well, you are picking the winner, then you are picking wind." No. We know that wind is going to have to come much more into the system. Right now in Denmark, wind is the one that is closest to be economically viable compared to coal. In fact, on land, it is viable compared to coal. Unfortunately, most people do not want windmills in their backyards; so we are putting it at sea, which makes it a little bit more expensive but that is a detail.

The technology necessary for Denmark to achieve its goal exists today. We need to continue, however, to do research, because the technology will get better, cheaper, and more efficient but we could make the transition today if we had to do it. Thus, although research must continue, the need for research should not be used as an excuse for not starting the transition.

Often, when they hear of the Danish goal, people say to me, "You will never make it." Well, maybe not. We might not make it by 2050, but the fact that we have said that we are trying to get there, and we are planning to get there, means that we are likely to be very much closer to the goal in 2050 than countries which are not yet planning for the transition.

How can we make partnerships work between the academic community, the political community, and the business community? Well, one of the things that we talk a lot about is public private partnerships. Mostly,

when we think of public private partnerships, we think business, and we think policy – or local municipalities. It is important, however, that we also partner with the academic community. We need research in order to understand what public-private partnership models work under different conditions and cultures. We need the work of the academic community to support good making in the transition. For that reason, we have at my university established at my own university a Sustainability Science Centre (www.sustainability.ku.dk). This Centre serves as a “door” through which public and private sector decision makers can access the competences at the University of Copenhagen that can support the decisions being made in the transition to a low-carbon economy.

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Urban Rid, German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

I feel the burden as one of the senior officials being responsible for this transformational change. I clearly see the lack in outreach – we have to do much more in international cooperation. With an instrument like our international climate initiative we already do a lot. The next ten years are decisive to meet the climate target, to remain below 2°C. It is not a perspective that we get an ambitious and effective agreement in 2020, decisive is what we do the next 10 years. That is the issue at stake. And from this point of view I think it is really important that Germany manages a transformational change of its energy system that’s credible, that works, that’s cost-effective and where prices for electricity and energy are affordable for private consumers and industry.

After the Fukushima nuclear disaster, Germany decided to have a full phase out of nuclear power by 2022. Germany also committed itself to reduce greenhouse gases by 40% based on 1990 levels. That is really a challenge, we have to do a lot and we feel the burden on us.

What are the basic elements of this strategy? Renewables are not in the first row. In my opinion, in Germany as well as in other countries, the focus is too much on power generation and too much on the energy mix. Instead, the focus has to be on energy efficiency, on the demand side and related issues. Energy efficiency is the most important element; we need ambitious targets, for instance to reduce electricity consumption by 10% until 2020 and other targets. The demand side management is also very important, including load management etc. By these means we will increase the share of renewables. Today the share of renewables in power generation in Germany is 20%. At the end it



Urban Rid, Director General, German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

will be crucial that all the elements fit together. These elements include the power generation, the grid extension, the new technologies, we will apply smart grid and smart meter. These elements have to come together to become an efficient and cost-effective energy system, where we can produce one unit of GDP with 50% of the energy we needed before. That is the target.

While transforming our energy system we might make mistakes, but we learn from this, and I hope that we have a good learning curve. We already made some important steps and the second part is, and that I think is the purpose of this meeting today, the outreach, the cooperation we need, and the exchange to learn from each other.

However, we should do more and we are active. Germany’s international climate initiative is something we put a lot of effort into. We cooperate with developing countries and with emerging economies in all relevant areas of action like mitigation action plans, low-carbon development strategies, emission trading schemes or energy efficiency in the building sector. We have also intense contacts with international partners, for example with Japan. I had several conversations with members of the Japanese parliament about feed-in tariffs, on how to enlarge the share of renewables, about power generation and related questions. I am head of a German-Chinese working group on climate policy and energy-related issues. So I think Germany

does a lot, but it is still not sufficient, we should do even more.

It is of utmost importance that we do as much as we can to meet the climate targets to remain below 2°C mean surface temperature.

But at the end other countries will judge Germany's Energiewende based on questions like: Will it work? Will it be okay from a technical point of view? Will it be cost-effective? What effects the Energiewende will have on the prices for electricity? There has never been a programme for innovation in Germany like the transformation of the energy system. You may look to power generation, you may look to smart meters, to grid technology, all these are elements for innovation. A country that is able to manage this transformation, and to do it in a cost-effective way and from an ecological point of view in a sustainable way, is really excellently positioned for international competition. Germany would like to enlarge the levels of cooperation and do more.

Mika Ohbayashi, Japan Renewable Energy Foundation

Thank you Dirk, and thank you for inviting me at this very important conference with distinguished speakers and distinguished audience.

I think that I would rather focus on Japan's domestic situation, and also that I will focus on the need of the collaboration with other countries as well as international cooperation. But before I get into the point of the challenges that we are facing, I would like to deliver, the recent Japanese energy news – since the 5th of May, four days ago, all the electricity production in Japan has been nuclear free.

We shut down 54 reactors, which were online 14 months ago, this is the consequence of terrible accidents which were occurred and are still continuing at Fukushima Daiichi, I have to say. Those reactors are shut down under legal inspection not for dismantling. But, I still would like to celebrate this situation, because we are not living in dark. We are still enjoying efficient public transport system in Tokyo – at least when I left Tokyo two days ago. I used efficient Narita Express from Tokyo to the Narita.

Of course, we do not expect this continuously. But the question is: when and how we will be able to enjoy this situation again in future: will it be 2020, or 2030, or 2050? If the government accords to the new rule they introduced, with 40 years lifetime for all reactors, the dependency for nuclear power in Japan in 2030 will be around 12%. And the government said that we have to decrease the reliance on nuclear generation, so we have



Mika Ohbayashi, Japan Renewable Energy Foundation.

to accelerate this 12% will be lower in 2030. So how we chose 10% to zero in 2030 is the discussion (*at this time of the middle of May 2012, government still had an option of 35% nuclear power in 2030). This kind of discussion, like percentage of nuclear, is going on at the governmental committee, and they will submit the new energy policy proposal in this summer.

So, this is a timing, for the energy saving, and the massive expansion of renewable energies in Japan. Energy saving does not mean one way, sudden cut off of power supply nor rotary blackouts. It should be efficient load management and comfortable energy efficiency measures. Japan used to promote electricity used in heat sector, as well as all electricity houses and buildings, those kinds of policies have to be abandoned.

Renewables, Japan will enact a feed-in tariff on the 1st of July this year. I think that the most of you, or some of you, might be aware that a very high tariff will be set for the feed-in tariff in Japan, such as ¥ 40, let's say €ct 40 for 10kW or more solar PV and €ct 23 for 20 kW or more wind power, and also like €ct 33 for forest waste.

So, it sounds promising – actually I got so many questions from my renewable energy friends in Europe, how is it that they can get the chance to have their wind power business in Japan? Yes, we have high tariff, but, the problem is that we don't have, for example, the priority access for renewables to the grid. We are still living in the kind of vertically integrated, regionally

monopolised utilities and grid is still owned by them. There is no transparent information on grid access – not only for renewables but for the new power producers; so that more than 97% of the electricity market is still occupied by big utilities, and 3% is for new power producers. We introduced the restructuring of electric industries ten years ago, but this is the situation. For renewables we need fair treatment and priority access to the grid, and for transparent market, we should start the discussion of electricity system reform and unbundling to bring competitive electricity market as soon as possible.

Many challenges that we are facing, and unfortunately we are focusing on domestic issues. NGO as well, are also focusing on encouraging our own government to promote renewables and to end up in a much more sustainable way of energy home. So, I think we need cooperation from other countries to advocate with their advanced renewables, energy policies. I believe Germany can offer their very sophisticated design of feed-in tariffs scheme to Japan and renewable energy policy as well as the heat energy policy of renewables. And also, for example, like electricity system restructuring, we can learn from Nordic countries – successful stories of their Nordic pole. And maybe from the US: I think the American utilities can teach the Japanese utilities about their very sophisticated or advanced demand side management program for the consumers.

This kind of international cooperation is much needed for Japan. And also international discussions such as UNFCCC is also very important for Japan. Actually, unfortunately, the climate change discussion in Japan is banished. There is no discussion on climate change, because we are really threatened by the government and the utilities, that without nuclear, and then we cannot accomplish the climate change mitigation, and then we have to abandon the kind of proposal from the current government 25% reduction in 2020; it cannot be achieved without nuclear, and really most the people believe about it. There are kind of sceptic discussions really emerging in Japan. The people say that the climate change is just a kind of promotion of nuclear power. So, we are now facing very difficult situation as environmentalists and renewable energy promoters. But, I think that we have to learn from the international lessons and discussions. I believe that promotion of renewable and energy saving is the only way to achieve phasing out nuclear. And I think that we can do that, and for achieving that, we need a kind of international voices of supports. Thank you very much.

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Concluding Remarks

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Hans Joachim Schellnhuber, Chair, WBGU

This symposium constitutes, in a certain way, a gathering of the “global sustainability village”.

Whilst convened in Berlin, it is not solely focused on the “Deutsche Energiewende” – the recent German u-turn on the future energy mix – but addresses the broader debate of renewable energy sources powering worldwide enhancement of well-being. So this meeting has truly introduced an important global perspective.

Yet, another crucial perspective became discernible throughout the day and stays with me personally: It is no big news that we cannot afford any longer to deny that we are accumulating tremendous debts on future generations – fiscal debts, carbon debts, depletion debts, planetary debts. This has been made crystal-clear, time and again, by the Nobel Laureates Symposium Series on Global Sustainability which I helped to establish in 2007 (Potsdam Memorandum 2007). By the way, the keynote speaker at the first event of that series was Angela Merkel – just as today. However, the new theme that emerged today is that *we cannot afford to be depressed*.

And this is vital, since the challenges ahead for all of us are most tiring and demanding. There is simply no alternative – no there isn’t – to being courageous and moving forward. That is, I believe, a powerful message from our meeting.

As we approach the end of a short symposium’s day, we hopefully also witness the beginning of a long and steady process of interaction. The partnership issue was raised throughout the meeting, and this topic was deliberately chosen for the last panel. Outstanding experts and pioneers have shared their thoughts on that with us. The take-home message was that international cooperation is not at all easy – and not all impossible. The multi-lateral negotiation process towards a global treaty on emission reduction targets needs to continue. The schedule set at the COP 17 in Durban last year envisaged a global agreement reached by 2015 (and implemented by 2020). This is an important and

certainly ambitious goal, yet it is neither exclusive nor ultimate, if we accept the mechanisms of “realpolitik”. Our Chinese panelist Su Wei remarked, quite appropriately: “Let’s not get depressed if it doesn’t happen in 2015 – it may happen at some point later”.

Still, the global sustainability village cannot just sit and wait for a miraculous breakthrough; we need to move forward at the same time. What the scientific community and the wider community of pertinent experts can offer is to *start a parallel evidence-based process*. You may call it a bottom-up movement driven by scholars and researchers who may be representatives of the various national academies or members of bodies like the German Advisory Council on Global Change (WBGU).

In fact, the spectrum of perspectives as presented today offers already invaluable insights and



Hans Joachim Schellnhuber

experiences. For instance, France has made significant progress with e-mobility including bicycle fleets in Paris, a place where you would not expect leading sustainability initiatives to happen. Denmark is on its irreversible way to phasing out fossil fuels completely by 2050. India has embarked upon the novel design of settlements, while just across the border China is exploring its very own portfolio of clean-energy sources. And so on ...

This diversity of approaches is both an advantage and a disadvantage. National and cultural boundary conditions may be so different that it is difficult to derive lessons that can be shared by the global community. By way of contrast, there are many observations and discoveries which add to the worldwide pool of useful, if not crucial knowledge. A coordinated, well-structured dialogue transcending national frontiers could be instrumental in rapidly expanding and tapping that pool for the benefit of everybody. We need to learn from each other rather than to point fingers at our next-door neighbors and to our more distant relatives on Earth.

Our common cognitive journey is determined, to a large extent, by the challenges defined by just a few laws of physics. The latter govern, in particular, the techniques for generating, transforming, storing and transporting energy. While you have primitive universalities in handling fossil fuels (ideally, you drill a hole in the middle of nowhere and ship the extracted oil somewhere), dealing with renewable energy sources is a matter where regional or even local specificities can be of paramount importance. Thus, in a first step of the proposed initiative, a comprehensive worldwide monitoring and analysis of potentials and obstacles should be performed. The recently completed "Global Energy Assessment" (GEA) would provide an excellent starting point for this (GEA, 2012).

A second major step should focus on identifying, comparing and sharing best practices. Even more importantly, however, one needs to nail down *worst practices*, i.e. misconceptions and flawed implementations that might emerge almost anywhere irrespective of national idiosyncrasies. Revealing that spectrum of potentially fatal mistakes would be most helpful for avoiding dead-end streets on the passage to sustainability.

A third step would include the listing of win-win options, where innovation partnerships – between states, cities and sectors – promise to significantly accelerate the decarbonization of economies and settlements. The collaboration of the respective research communities would be of paramount importance in this context. Further steps can easily be imagined.

This symposium could mark the beginning of the coordinated process just sketched. The international scientific community is predestined to pioneer the

global transition to sustainability through this initiative and similar ones. Why? Because that community is already fully globalized! When discussing the design of electricity grids, for instance, with a, say, Indian, Chinese, or American colleague, I do not agree or disagree on any fundamentals. They have been settled a long time ago, so the basis for planetary cooperation is well established.

Again, it is Albert Einstein who provides the right insight by directing us to the resource we need to tap in the first place. He once famously noted that

"Fantasy is more important than knowledge, because knowledge is limited."

Many things have been said today about the technological and sociopolitical challenges and obstacles to be overcome, not least in such fields as energy efficiency and sustainable production. Why not take Einstein's advice and move towards a world enterprise that will rise above all those challenges and obstacles? *Fantasy Unlimited* would be an appropriate name for this enterprise.

I thank you all for having been here!

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**German Advisory Council on Global Change
(WBGU)**

The German Advisory Council on Global Change (WBGU) is an independent scientific advisory body set up by the German government. The WBGU provides policy-makers with recommendations for action and research. Its flagship report 'World in Transition – A Social Contract for Sustainability' can be downloaded from the WBGU website.

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