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TOWARDS A RESILIENT PLANET:
ENSURING A SUSTAINABLE AND EQUITABLE FUTURE

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Meeting the Twin Goals- Energy Security and Resource Security

PLENARY SESSION: SUMMARY

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Plenary Session

About the Session

As markets go bullish on clean energy technologies and pressure mounts to move away from fossil-fuel energy systems, governments across the world will intensify their efforts to deploy renewable energy technologies. This will also include efforts to address energy poverty and provide energy access. What will be implications of mineral insecurity on addressing efforts to address energy poverty? What will be other socio-economic implications in upstream areas where the mining of critical minerals take place? What will be the implications for material flow as well as circular economy measures? Goal 12 of the SDGs is concerned with natural resource use. In this regard a key question is how can the linkages between SDG 12 and SDG 7 be strengthened? The issue of better factoring 'resource security' in discussions around energy transitions and addressing energy poverty has not received adequate attention. This session was aimed to be a critical reflection on the present narratives around energy transitions from the perspective of 'resource security'.

Speakers

Chair

- Mr Suman Bery, Non-Resident Fellow, Bruegel

Leadership Addresses

- Lord Adair Turner, Chairman, Energy Transitions Commission
- Dr Janez Potočnik, Co-chair, International Resource Panel
- Dr Ajay Mathur, Director General, International Solar Alliance
- Dr Youba Sokona, Vice Chair, Intergovernmental Panel on Climate Change
- Dr Shonali Pachauri, Research Group Leader, International Institute for Applied Systems Analysis

Disclaimer

The text of the addresses is based on auto-generated transcript from YouTube. Minor edits were made on grammar and spelling. The exact wording of the discussion can be accessed from YouTube video: https://youtu.be/jlBCSwDSiVw.

Actionable Messages

Message 1: We need to evolve the energy transitions discussions from being focused around products and technologies to being more service oriented. For example, in the transport sector, the core problem is also the huge underutilization of private vehicles, leading to inefficient overuse of resources. The society needs mobility and not need cars. Combining supply and demand part of policy questions and offering even more convincing policy answers to fighting climate change.

Message 2: Considering the various risks including commodity prices, renewable-energy based systems could not only contribute to decarbonisation goals but also to a fossil fuel-based system. However, it is also crucially important to anticipate and manage the challenges which energy transitions can bring. Robust regulatory instruments and sourcing commitments is essential to mitigate adverse environmental impacts and commodity risks.

Message 3: Undesirable lock-ins due to energy transitions need to get due attention and need to be mitigated. The Global Stocktake to be held during COP28 offers an opportunity to look at the unintended adverse effects of climate measures and should be seen as an important means to advance the kinds of safeguards that are needed for equitable transitions towards the Paris Agreement's goals.

Message 4: Potential solutions exist that also factor in the resource angle, which are currently not taken fully into account in energy transitions. There is also a need to address the prevailing silos logic, leading to improvements in one area, while creating unintended consequences in the others. With the right approaches and policies, the world can avoid, maximize co-benefits and avoid future lock-ins.

Message 5: Extended producers ownership and creating value through services, rather than products is a very promising avenue to further explore. Diverse sectors are already benefiting from product and service models. There is a need to design incentives so that the producer remains the owner and is therefore incentivized to design it to last and to extract value from the product at the end of its life. The three sectors of digitalization, mobility, and shelter access require particular focus while considering circular economy measures.

Message 6: Technologies based on liquid metals sodium-ion batteries instead of lithium-ion batteries, are being tested. Sodium is much more diverse in its availability than lithium. The development of new kinds of chemistries could address resource issues in future and hence this area needs more focus in terms of research and policies.

Message 7: Energy transitions need to ensure distributive implications along with considering life-cycle approaches. The role of the state is important as basically a strong state direction is needed for such a radical shift and yet there is also a belief that decentralization may be the route to go. For poor countries in Africa, it is not an issue of transition, it is an issue of jump-starting because the system does not exist at all. Along with supply-oriented measures, there is a need to further factor in demand-oriented measures.

Message 8: What we are seeing is a convergence between the ability to provide decentralized renewable-based electricity in rural areas, the interests of the electricity distribution companies and the global interests on climate action. It is these kinds of convergences, we need to find, in order for the political support for the changes that we need.

Making Words Count @WSDS 2022

> As an economist, I am always sceptical of the idea of shortage and if you let markets work, then shortages have a way of correcting themselves. So challenges to energy transitions is not only about physical constraints, it is going to be about geopolitical constraints as well.
>
> ***Mr Suman Bery***
> ***Non-Resident Fellow, Bruegel***

> Three things are already very clear. First, that in the long-term, there are no inherent resource constraints which could prevent massive clean electrification. Second that any adverse local environmental impacts of new mineral exploitation will be far less than those imposed by fossil fuel extraction. Third, that we must manage the transition carefully.
>
> ***Lord Adair Turner***
> ***Chairman, Energy Transitions Commission***

> The consequences for the triple planetary crisis will be severe. What we really need are systemic interventions, which would limit the need for energy and resource use in the first place. We must focus not only on decarbonisation, indeed most important, but also on the need to dematerialize the systems we depend on.
>
> ***Dr Janez Potočnik***
> ***Co-chair, International Resource Panel***

> The fundamental change that is happening is that now we are seeing materials being used, which have a far greater degree of geographical diversity and availability. So for PV cells, basic organic materials are being used. What we are seeing is the development of new kinds of chemistries which address the resource issue.
>
> ***Dr Ajay Mathur***
> ***Director General, International Solar Alliance***

> The Global Stocktake certainly offers an opportunity to look at the unintended adverse effects of climate measures and could therefore be one important space to advance the kinds of safeguards that are needed for equitable transitions towards the Paris Agreement's goals. This must be done across all sorts of fora.
>
> ***Dr Youba Sokona***
> ***Vice Chair, Intergovernmental Panel on Climate Change***

> There are ways to address the mismatch between climate, energy and resource or material policies. One is looking at ways to limit material stock growth through dematerialization, material efficiency and transition to a more service-based economy. Second, product lifetime extension through repair, maintenance, resale, reuse and repurposing of obsolete fossil infrastructure for instance. Finally, waste reduction and management through collection and treatment of systems that optimize reuse and recycling.
>
> ***Dr Shonali Pachauri***
>
> ***Research Group Leader, International Institute for Applied Systems Analysis***

Emcee's Welcome

Dr Shailly Kedia, Senior Fellow, The Energy and Resources Institute

Namaste and greetings to all of you! On behalf of the Energy and Resources Institute, TERI, I welcome you all to the World Sustainable Development Summit, the only independently convened event of such a scale in the developing world that brings together world leaders on a single platform. We thank you for joining the Plenary Session on: Meeting the Twin Goals- Energy Security and Resource Security.

As markets go bullish on clean energy technologies and pressure mounts to move away from fossil-fuel energy systems, governments across the world will intensify their efforts to deploy renewable energy technologies.
However, inconvenient questions should be asked on aspects concerning availability of resources (including critical minerals) and life cycle approaches to renewable energy technologies.

To that end, this session is aimed to be a critical reflection on the present narratives around energy transitions from the perspective of 'resource security'. With this, I have the honour of inviting Mr Suman Bery, who is also on the WSDS International Steering Committee, to moderate the discussions.

Chair

Mr Suman Bery, Non-Resident Fellow, Bruegel

Thank you TERI for once again involving in this very important and exciting event at a critical time and allowing me the privilege of chairing such an illustrious panel on an important topic. You have already signalled what the core issue is here, which is essentially that there is a conflict between the issue of 'energy security' (and the focus here will be decarbonisation in energy rather than in other areas) and 'resource security'. As an economist, I am always sceptical of the idea of shortage and if you let markets work, then shortages have a way of correcting themselves. So challenges to energy transitions is not only about physical constraints, it is going to be about geopolitical constraints as well. And I do hope that our illustrious speakers will acknowledge that this as both a technical issue but also a political issue.

Leadership Address

Lord Adair Turner, Chairman, Energy Transitions Commission

It is a great pleasure to join TERI's World Sustainable Development Summit again this year. I have been here for many years and I hope that next year, I can be there in Delhi in person. Today's topic of natural resource supply and security to support energy transitions is a crucial one. All credible analysis show that the only route to a zero carbon economy is to electrify as much of the economy as possible and to completely decarbonize electricity supply. And as a result, the total global electricity generation would need to increase four or five times with two times increases even in rich developed countries, fifteen times in Africa and maybe six times in India by 2050. And the analyses by many organizations, including the joint ETC (Energy Transitions Commission) TERI analysis of the Indian power system show that such huge zero carbon power systems based primarily on renewables will be able in future to deliver power at costs no higher than today's fossil fuel based systems.

Inevitably, this new energy system with clean electricity at its core creates new material demands- silicon for solar panels, steel for wind turbines, rare earths for electric magnets and motors, lithium manganese and cobalt for batteries. That is why, this year, as part of a detailed look at what we call all the possible barriers to clean electrification, the ETC is going to look in detail at all of the issues related to natural resource supply, from land area needed to support renewables development to the minerals needed to support electrification. But I believe that three things are already very clear. First, that in the long-term, there are no inherent resource constraints which could prevent massive clean electrification. Second, that any adverse local environmental impacts of new mineral exploitation will be far less than those imposed by fossil fuel extraction. Third, that we must manage the transition carefully.

First, the good news, there are no inherent resource constraints. I could illustrate that for many required resources for solar or wind resources to support that huge increase in electricity or for the water needed for green hydrogen electrolysis or for any of the minerals. But let me focus for illustration on one, about which one often hears concerns- lithium. Lithium will almost certainly remain the crucial element in batteries and if in 2050 there are two billion electric cars on the road globally, each with a 60 kilowatt hour battery. That will require a stock of lithium in those batteries of about 19 million tons of pure lithium but economically accessible resources of lithium are currently estimated by the US geological survey are 80 million tons and that estimate has increased from 53 million tons in just 2018 reflecting a familiar pattern in which, once a mineral becomes more valuable more resources are identified which relates to the point that Suman made a few minutes ago that markets have a way of correcting themselves.

19 million tons of lithium will probably, at the peak, require mining about 1 million tons of pure lithium per annum or about seven million tons to use. Lithium mining, if done badly, has significant adverse local environmental impacts. There is a use of toxic chemicals such as hydrochloric acid when we extract lithium carbonate from rock deposits or there is very large water inputs used to extract it from salt flats. But however bad it is, the environmental impact of mining for seven million tons of lithium carbonate use per annum, is bound to be minimal compared with the local environmental impact of mining 7000 million tons of coal per annum, which is what the world does today. Just keep those figures in mind, 7 million tons of lithium, 7000 million tons of coal. And across all of the material inputs which we need for our future system, their adverse environmental impact at the local level is bound to be of an order of magnitude or two or three orders of magnitude smaller than our old fossil fuel-based system, which is not just a happy coincident, but inherent to the very nature of this new renewable system.

Until now, to get energy we have taken massive amounts of fossil fuels out of the earth each year. Seven thousand million tons of coal, 36.5 billion barrels of oil, 3.9 trillion cubic meters of gas. We have burnt it in chemical reactions, which produce 30 billion tons of CO2 and then the next year we have done the same all over again. In a renewable system, by contrast, we take much smaller quantities of inorganic minerals and we put them into structures- silicon in the solar panels, copper in the wires, lithium in the batteries, rare earths in the motors. The photons of sunlight and the motion of the wind then generate stream of electrons, which we can use to heat or cool our buildings, to drive our machines or to create hydrogen molecules. And at the end of the year, those structures, those wires, those silicon panels, those batteries are largely unchanged and ready to do the job all over again the next year. So it is very important not to let concerns about the natural resource and environmental impact of the new energy system, slow the transition away from the far more harmful fossil fuel-based systems. But it is also crucially important to anticipate and manage the challenges which the transition will bring. Mining lithium is less harmful, far less harmful than mining coal, because the quantities involved are trivial in comparison. But we will need tight regulation and sourcing commitments from the companies which source these materials in order to make sure that the adverse environmental impacts are as small as possible.

19 million tons of lithium in two billion cars could, with the technologies already available, be almost continually recycled at end of life but that will only occur with strong regulation to enforce end-of-life product responsibility. Cobalt production in the Democratic Republic of Congo often involves dangerous artisanal mining and child labour. Strong sourcing standards must prevent this alongside what is already occurring. Technological innovation, which is already dramatically reducing the use of cobalt in batteries and in some cases eliminating it entirely, and major companies at the top of the key value chain such as the automotive and battery companies must develop on an anticipatory basis supply chains which can anticipate surges of demand. Otherwise, short-term bottlenecks will produce huge temporary price surges such as we have seen with cobalt which was up 40% in the last year, nickel was up 30% and lithium was up several hundred percent. Though let us remember that the fossil fuel based systems has been equally or even more volatile in terms of short-term price cycles with natural gas prices in Europe, Japan and Korea rising 400% in just the last six months and India hiking the gas tariff by 62% last September with further increases anticipated. So short-term price spikes seem to be just inherent imperfections of a capitalist system, which never fully anticipates well, the future supply and demand. But it is applicable in the fossil fuel based system quite as much as the new system.

Indeed the great prize is that, in principle, a renewable energy system could be not only far cleaner but also more economically stable than a fossil fuel-based system. That will only be the case, if governments and companies make it so. Thank you very much for listening, and I look forward to the discussions.

Leadership Address

Dr Janez Potočnik, Co-chair, International Resource Panel

It is a real pleasure to participate on this important panel. Let me try to briefly address all the four questions you have identified for us. But being a co-chair of International Resource Panel, I simply cannot avoid addressing broader resource perspectives and avoid only focusing on securing critical minerals for energy needs. Since we believe that broad systemic approach is actually essential, currently the focus is mainly on addressing supply side problems.

The focus is on optimizing greening and cleaning the current economic model. Unfortunately, we believe that this will not be enough to meet the 1.5 degrees target. Deep system change transformation is needed, and without any delay, current efforts are to a large extent ignoring the need for a deep system change transformation which would address also the over consumption in high income countries. And the reason for the fact that we are already overshooting some of the planetary boundaries today which is leading to lasting tensions among high-income and low-income

countries is that the real drivers and pressures are not adequately addressed when natural resource management related matters are discussed, for example, industry or transport.

The focus remains on a surface level not really addressing the real systemic change solutions. For example, a Glasgow breakthrough was announced on road transport aiming for zero emissions vehicles to be the new normal that is accessible, affordable and sustainable in all regions by 2030. Important. But I sincerely hope this will not become a new normal since it would not remove the core problem related to huge underutilization of private vehicles, leading to inefficient overuse of resources. Do not forget, we actually need mobility, we do not need cars.

In my capacity as co-chair of the International Resource Panel, together with Izabella, would like to introduce the panel in just one sentence. We are science-policy interface hosted by UNEP brought together to produce new insights on the management of natural resources, its impacts, and solutions. Under natural resources, we understand biomass, metals, non-metallic minerals and fossil fuels. All mentioned are actually called materials and are extracted from the earth as well as water and land. We know from IRP work included in our most comprehensive report called the Global Resource Outlook, that extraction and processing of natural resources drives all aspects of the triple planetary crisis of climate change, biodiversity loss, and pollution with health implications included. It is responsible for 50% of the global climate change. Energy use is a significant driver of the extraction and processing. Impacts are mainly due to the production of fossil fuel products and biomass but also steel and cement. Natural resources also cause over 90% of global land-related biodiversity loss, mainly due to agriculture, timber production or ocean resource use and water stress. Natural resource industries such as steel and coal are also behind one third of global air pollution as well as water and land pollution. We also know that the trends are alarming. Material use, which comprises everything extracted from the earth, has tripled since 1970 and IRP data tells us that without transformative change, it will double again by 2060.

The consequences for the triple planetary crisis will be severe. Therefore, we know it is absolutely necessary to decouple growth in well-being and prosperity from natural resource use and its impacts. What we really need are systemic interventions, which would limit the need for energy and resource use in the first place. We must focus not only on decarbonisation, indeed most important, but also on the need to dematerialize the systems we depend on. This is important for all but urgent for high income countries.

I am talking about mobility, housing, nutrition and some consumer goods. By looking far beyond most common questions, too many times related, to recycling, we need to reject the assumption that these systems need to be so resource intensive. The most powerful instrument to deliver this transformative change also already widely accepted is circular economy. If understood broadly, it captures incentivizing repair, reuse, recovery and of course recycling as well as optimal product utilization and experimentation with new business models and new ways of creating value. Instead, for example, asking how to make car industry cleaner, which is indeed very important, we should also be asking a question- how we can reorganize mobility system to use less resources. And what role in that aspect, private car, hopefully lighter could play?

So combining supply and demand part of policy questions and offering even more convincing policy answers to fighting climate change. Extended producers ownership and creating value through services, rather than products is a very promising avenue to explore. Diverse sectors are already benefiting from product and service models, for example, renting rather than owing a washing machine. Revisit the incentives so that the producer remains the owner and is therefore incentivized to design it to last, to repair and to extract value from the product at the end of its life. The amount of washing machines produced and sold to consumers, which is currently the basis for making profits, would in the case of service provision become part of producers cost. Instead of being incentivized to use more resources, they could be incentivized to innovate for saving resources and increase their service related profits.

In short, circular economy strategies can make a massive contribution to achieving climate and biodiversity targets, through reducing demand for energy and for resources simultaneously.

Second, what are the implications of this mismatch of strengthened climate ambitions and the availability of critical minerals that are essential to realizing these ambitions on climate and energy policy? First of all, as mentioned it is not about only critical minerals and their importance to achieve the energy transition ambitions. The importance of various materials uses for reaching climate and also other environmental targets as explained before are broader and complex. We need to refocus policy towards ‘systemic solutions’ which reduce the need for resource and energy all together.

If we focus policy only on specific improvements, we can cause unintended consequences, ignore potential trade-offs, and even create future lock-ins. We need to think about the whole system when designing those solutions to maximize co-benefits. For example, limiting urban sprawl and better city design will not only reduce the resource requirements to the built environment, but it will also minimize the amount of time you need to sit in the traffic on your morning commute and reduce the need for commute in the first place.

Recent IRP work offers system solutions in housing and mobility, two systems where changing patterns of utilization, as well as making the material use embedded in their products circular, could make considerable contribution to reducing emissions. By taking this systems approach, we can turn difficult transition needs into big societal opportunities. By improving housing infrastructure, mobility, nutrition systems, we can strategically improve their societal functions, something that is much harder to do when we only look at cleaning up production. In sum, we need to decouple the function of mobility, housing, nutrition and well-being overall from the virgin resource use and environmental impacts. However, if we look at countries current nationally determined contributions and national climate plans, we can see that this systemic approach, despite efforts of many including some panel members, is still missing.

Third, what are the geopolitical implications of more expensive, delayed and less efficient energy transitions due to resource insecurity? Human consequences of resource insecurity are huge, including macroeconomic and political instability. The links between resource use and human well-being are of course critical, and in a resource-constrained world, it is even more important to ensure that the resources we use, are delivering as much as possible for meeting human needs.

The IRP next Global Resource Outlook, aims to quantify these links by measuring how the resource utilizing system we depend on, are contributing to our well-being. By measuring the performance of these systems, we can unlock the opportunities to reduce resource use and its impacts while continuing to increase human well-being around the world, especially, in low-income countries.

And finally, as you rightly stated before your last question that resources are crucial for sustainable consumption and production in particular for realizing SDG 12, and then ask how can links between SDG 12 and SDG 7 be further strengthened. As mentioned, natural resources are the root of the planetary crisis and energy is a major fuel for better life, but also a driver of resource extraction. Resources are deeply linked to almost all SDGs, including, delivering clean and secure energy as in SDG 7. But there are also other implications linked to biodiversity. This is one of the reasons, why with co-chair Izabella Teixeira, we have just delivered building biodiversity through natural resource management approach think piece. For effective future actions on biodiversity, we need to be focused also on root causes in addition to conservation. The problem is that we are using more resources than needed to meet demands and using them in incredibly inefficient linear systems. Most biodiversity discussions still mainly focus on how to increase conservation areas but it is actually more than that. We have to look at broader questions for addressing the challenges we face.

To conclude, the natural resources optic provides us with a real message of hope. With the right approach and policies, we could address the challenges together and simultaneously avoid potential trade-offs, maximize co-benefits and avoid future lock-ins. We could also address the prevailing silos logic, leading to improvements in one area, while creating unintended consequences in the others. We can also show that we have learned some lessons from mistakes done in the past. Thank you very much.

Leadership Address

Dr Ajay Mathur, Director General, International Solar Alliance

There are two things which stand out, the first as we rightly noted in the beginning are the economic imperatives, and clearly as demand increases, and as more and more of the procurement occurs on a competitive basis, we see efficiencies rising up, not just in the performance but also in resource use and availability. That is how one makes the system more competitive and efficient.

The second point which was made also was the issue of politics and that is what I would like to focus on as well. Where we are today, we have seen that for the last four years, the capacity addition of renewable energy in terms of growth, globally as well in India has been far more than that of fossil fuels. Why is that? So the first issue is that of sheer perceptions regarding the future with a host of countries announcing that they will go to net zero between 2040 and 2070. Because the writing is on the wall that investing in fossil fuels means investing in a stranded asset. That is the first one and therefore we see the politics reflecting the perceptions that are being created as we speak.

The second is the issue of the importance of the availability of energy to each person in the world and particularly in the developing world. This is important to every political leader in the world but it often gets subsumed in the larger issue of the 'haves' versus the 'have nots'. That is where the politics comes in.

Let me share with you what our perceptions have been over the time that I have been at the International Solar Alliance. The first is that the availability of materials needs to be decentralized. This, I think, becomes important. The blockage of the Suez Canal shows how important it is that countries feel comfortable that they will get the resources that they need when they need.

What we also need is the creation of a large number of centres of supply, which are competitive with each other. This obviously means, increasing demand in various places and the second is ensuring that initially what was of a greater cost, is available at a lesser cost and that somehow the new sources can be competitive.

At the political level, therefore, we need these kinds of interventions in place across the world. One of the other significant interventions is what we are seeing in India the Production Linked Incentive (PLI) programme where incentives are based on efficiency and market competitiveness. What this tells us is that there are all kinds of interesting instruments that can be put into place to decentralize the manufacturing and therefore create a greater degree of confidence that the solar cells would be available.

It is equally important that we address the issue of energy security not in just in terms of imports, but also in terms of energy available to households. This is important, because at the end of the day, every political system needs the confidence of the people that they are meeting their needs. People who are gaining from the system that exists today, for example mining coal, selling oil to those who came could also gain from the system tomorrow.

Manufacturing solar panels means that we need to integrate the solar and battery supply systems on one side and distribution systems. In my view, the new system and, particularly solar-based, provides a great opportunity in terms of its modularity and consequently, to provide electricity resources in places where it was not available. In the state of Maharashtra, we are seeing that the electricity company provides electricity at 7.48 rupees (about 10 US cents) per unit kilowatt-hour of electricity. The rural substations are ready to supply electricity at 3 rupees per kilowatt-hour. So 3 rupees and 7.48. What we are seeing is a convergence between the ability to provide electricity in rural areas, the interests of the electricity distribution companies and the global interest. It is these kinds of convergences, we need to find, in order for the political support for the changes that we need.

The last issue that I would lead to is the resource issue. As far as materials are concerned, we have seen the price rises and short-term spikes in the oil and gas. The fundamental change that is happening is that now we are seeing materials being used, which have a far greater degree of geographical diversity and availability. So for PV cells, basic organic materials are being used. We are seeing copper zinc tin sulfide (CZTS) solar cells, we are seeing dye-sensitized solar cells (DSSCs), we see quantum dot solar cell (QDSC) being used. We are yet to see as to which of these will hit the market. Research is pointing in the direction of diversifying the base from a pure poly-silicon based PV module.

There are assumptions that that lithium factories would form the basis of both storage batteries for electricity generation and storage batteries for cars and other mobile applications. But it seems we are moving in different directions. We have seen one large Indian company invest a few hundred billion dollars in acquiring battery companies which are based on liquid metals sodium-ion batteries instead of lithium-ion batteries. Sodium is much more diverse in its availability than lithium and it is cheaper but needs higher temperatures. It also curves so you need to put it in stainless steel containers. What we are seeing is the development of new kinds of chemistries which address the resource issue.

We do need to do more in terms of waste disposal and handling. This is an issue of great importance on how you separate out the materials. This means that upfront, we need specifications which allow materials used in batteries and panels to be properly dismantled. As a part of the International Solar Alliance, we are working with the governments to see how these things can be implemented.

Leadership Address

Dr Youba Sokona, Vice Chair, Intergovernmental Panel on Climate Change

Good morning, good afternoon and good evening depending where you are physically located and attending this very important event.

It is a great pleasure and an honour for me to attend the 2022 World Sustainable Development Summit. I am grateful to The Energy and Resources Institute, for inviting me to its flagship annual event as a speaker on "Meeting the twin goals: Energy Security and Resource Security".

As you know, the Paris Agreement calls for global warming to be kept well below 2 degrees above pre-industrial levels while pursuing efforts to limit it to 1.5 degrees. The Intergovernmental Panel on Climate Change Special Report on Global Warming of 1.5 released in 2018 indicated that limiting warming to 1.5 degrees is not impossible – but, in many parts of the world, it would require unprecedented transitions in all aspects of society – including energy, land, urban, infrastructure, and industrial systems. The global transition towards decarbonisation, in particular the energy sector, is a fundamental prerequisite in realizing these major challenges.

The world is increasingly committed to decarbonize as the majority of countries, many cities and companies have either set or are considering setting system-wide net zero emissions targets. Evidence shows that renewable energy and solar in particular will play a central role in the global energy transition. Renewables have become in most cases the cheapest source for electricity generation and the electric storage costs have halved within the last two years and are continuing a rapid downward trajectory.

The required energy security from the massive deployment of renewables is contingent of securing the availability of large amount of critical minerals such as lithium to build and to operate efficiently those clean energy systems. So critical minerals are unavoidable to ensure energy transition, but clearly, they have not yet received adequate attention particularly in developing countries, nor by policy makers in general. Critical minerals are not so integral to the debates on energy transition and/or the just energy transition. Among various issues to examine it is important to ensure that those minerals are extracted in ways that do not hurt people and ecosystems and also the scramble for resources does not become a race to secure market shares that sacrifices interests of countries and communities where they are extracted. Some of the challenges such as land grabbing, unequitable redistribution of profits to vulnerable/affected communities, and human right abuse. They will require another, much more fundamental and deeper debate that forces us to call for sufficiency, and directly question current and project quantity, throughput and consumption levels. It means critical examination of decades of blind belief in unlimited growth, and rather the formulation of different development models. Insights from these debates open up for major, positive changes in terms of international collaboration and redirection of priorities, but the perceived tensions and scarcity may also lead to unhelpful competition and scramble for resources that sacrifices core premises for well-being and sustainability.

The rapid and massive need to reduce emission and moving towards as close to real-zero emissions as possible requires making sure that energy systems remain decarbonized, resilient and safe. Critical minerals are essential ingredients for the realization of this ambition. So, it is important to look beyond the mismatch between climate policy and energy policy – we must factor in overall levels of critical minerals/resource use. The critical minerals such as lithium and rare earth metals essential for renewable energy storage and generation are also used for other things. We then need to figure out as a global society what are our priority needs. Technology development may also increase the spectrum of new alternatives for green electricity generation.

The rising threat of climate is more and more requiring the world is moving towards electrification of the economy while decarbonizing their electric power system. This move will lead to an increased demand for non-carbon-emitting sources of electricity and energy storage technologies, and in turn will grow the demand for these technology components, minerals and materials. It is not surprising that more and more, as pointed out by the concept note, "supply chain security for the minerals and materials needed in clean energy technologies has become a strategic issue, not only because it could affect the pace of clean energy technology deployment around the world but also because clean energy technology has become the latest frontier for the geo-economic rivalries".

Meeting the twin goals of energy security and resource security needs a realization upfront that current development models that builds on expectations of continued, lasting economic growth everywhere is not possible, nor likely desirable. Yes, for example African societies will need to grow economically for quite some time, but advanced, wealthy economics cannot continue this way. The material flows inherently connected with increased consumption, economic growth and all forms of energy will put too much pressure on our planetary systems. In this context we likely need to look at convergence in per capita energy use levels; not only to the transition to renewables. Some have been talking about a convergence of energy use levels towards "responsible well-being levels". It is time to start looking to this seriously.

There will also be need to ensure a global regime to effectively ensure maximum recycling of both critical minerals and other materials. This has been lagging much too long. It is time for the international community to ensure public

resources are devoted to build structure and institutions to handle this, and most importantly, to get common and stringent standards, requirements and regulations. This needs international cooperation and unity – beyond what single countries can do. The Global Stocktake certainly offers an opportunity to look at the unintended adverse effects of climate measures and could therefore be one important space to advance the kinds of safeguards that are needed for equitable transitions towards the Paris Agreement's goals. This must be done across all sorts of fora.

It is absolutely crucial to now put full attention to ensuring that the transition to renewables and a decarbonized society does not lead to, and justify, new forms of exploitation and environmental harm. The transition is not simply about switching fuels, it must be about the way we organize our economies, set priorities and define what is real progress and well-being including scaling down where needed.

Thank you for your attention.

Leadership Address

Dr Shonali Pachauri, Research Group Leader, International Institute for Applied Systems Analysis

We have already heard a lot and many important strands of thought on how to better factor resources security issues in discussions around energy transitions and decarbonisation so what I would like to focus on in the next few minutes is really how this all relates to the goal of addressing energy poverty and iniquities globally.

Following on what Youba also alluded to in his intervention, we know that you know addressing energy poverty effectively means considering access to decent living standards beyond mere electricity access or clean cooking access. Understanding the resources and environmental impacts of this, we know that we live in a world of vast inequalities and basically access to decent living services globally are unequally distributed and this is also reflected in the individual contributions to greenhouse gas emissions at a global scale. We know that providing deprived populations with decent housing, nutrition, mobility and other basic services, will require additional infrastructure to be built. The emissions from the production of materials and infrastructure development has increased as a share of total global greenhouse gas emissions in the last two decades so without consideration of the additional material and energy requirements of additional infrastructure needs, we are sure to increase these emissions further.

However, there are huge potentials to reduce greenhouse gas emissions and other environmental impacts and technologies are available today to increase material efficiencies particularly in many construction and manufacturing sectors. So understanding energy and material requirements for achieving decent living standards everywhere is a first essential step to better factor in resource security issues in discussions around energy transitions and energy poverty. The implications of not doing so will be dire, if particularly distributional implications of transitions plans and existing inequities in resource availability and living standards are not accounted for.

In particular, digitalization, mobility, and shelter access are three important areas that require particular focus. While digitalization has a relatively small material and mineral footprint as compared to mobility and shelter, we know that the electrical and electronic equipment accounts for a sizeable share of the total global material flows in copper, lead, tin, antimony and other rare earth minerals. These three sectors- digitalization, mobility, and buildings & housing services are of importance when we consider issues of circular economy.

Meeting the rising needs for these services, will require more infrastructure to be built but this needs to be done in ways that looks at doing this more resource efficiently and with lower environmental impacts. Beyond the material and resource intensity for infrastructure built and emissions consequences, there are other environmental impacts such as those on biodiversity and air pollution such as PM2.5 emissions from mining and smelting that also need to be considered in a shift from fossil fuels to renewable energy, which is critical.

Achieving climate goals may mean more metal intensive, material intensive requirements for solar panels, wind turbines and electric vehicles and so really could mean that in certain regions, there could be an increase in PM2.5 emissions from mining and smelting to meet these demands which could account for up to 10% to 30% of anthropogenic emissions in many countries by 2040.

Looking at regions, where this might become an issue means addressing also broader air pollution related concerns that may arise. Issues of resource security have started receiving increasing attention but in fact, much needs to be done in particular in the transportation and shelter sectors. We have talked about more integrated, more multi-objective approaches in current policies of energy transitions. Circular economy concept can be an important one to

illustrate the whole life cycle of a product or a service and connect the resource inputs with production, the entire supply chain, consumption and waste or emissions outputs.

There can be possible rebound effects and trade-offs as well so these have to also be factored in in such analysis, in particular there are three strategies that can be seen as possible ways to address the mismatch between climate, energy and resource or material policies. One, is looking at ways to limit material stock growth through dematerialization, material efficiency and transition to a more service-based economy. Second, product lifetime extension through repair, maintenance, resale, reuse and repurposing of obsolete fossil infrastructure for instance. Finally, waste reduction and management through collection and treatment of systems that optimize reuse and recycling.

We know that sustainable consumption and production patterns will be essential to meet the growing water, energy, food, mineral and material needs and to meet the demands of a growing population and address energy poverty. Globally, political efforts really need to shift from increasing efficiency to decreasing overall consumption and from identifying problems to finding solutions. Resource needs for certain parts of the population will rise but efforts need to consider ways of redistribution and setting sufficiency thresholds to avoid over consumption associated with affluence and waste.

Evaluation of actions, policies and measures related to the energy system transformation or expansion of infrastructure need to consider the effects on SDG 12 and on sustainable development broadly and to consider potential trade-offs and synergies in providing human well-being for all without expanding resource and material-use extensively or their environmental impacts. I think that circular economy approaches are going to be critical to achieve this and inform my integrated and coherent policies.

Discussions

Mr Suman Bery, Non-Resident Fellow, Bruegel

The issue of communication is crucial. There is also the issues of rent that will arise as these markets get established. We started off by talking about energy security and resource security, but what is also important is both household or human security as well as national security. There are two, at least two very different perspectives on economic growth which, for an economist, is the god to worship which according to some is the wrong god to be worshipping. There are a lot of people in the world who have legitimate material needs and the point is to provide that with less damage. The focus really is on energy security although we have started to talk about resources more broadly. There are also substantial technical solutions, so the issue is really about the political how and the issue of how to communicate this nationally and globally. The third issue is the communications issue. It seems to me that the various distributional elements of this globally, across the corporate sector, whether you should be taxing windfall rents or whether you should allow windfalls to accrue to expand supply. The question of the resource footprint of the rich everywhere, not just the rich and the rich countries but the rich and poor countries as well. So obviously, the link between financial power and political power is coming under a great deal of scrutiny. The issue of inequality is something that politics was invented to deal with. The role of the state is important as basically a strong state direction is needed for such a radical shift and yet there is also a belief that decentralization may be the route to go. Let us remind ourselves that the India of Gandhiji's vision was basically that of self-sufficient, rural societies and that do a pretty good job of the circular economy.

Lord Adair Turner, Chairman, Energy Transitions Commission

On the question of how do we communicate what really matters and I think, the crucial thing is to always keep coming back to the fundamental facts. Let me give you an example. At the ETC, we believe that we will need to produce by mid-century, say 500 million tons of hydrogen for the global economy rather than 100 million tons today with 80 percent of that coming from the green electrolysis route. At various forums, people have said, but what about the natural resource requirement? What about the water that you need for electrolysis? But then run some numbers, every ton of hydrogen requires nine tons of water, if you know the molecular weight, you can pretty quickly work that out so if we need 400 million tons of green hydrogen, we point we need about 3.6 billion tons of water, let us call it four billion tons. That is big. It is an area of four cubic kilometres, which is a big space. But let us compare it with total global water use which is 4 trillion tons not 4 billion. Out of the 4 trillion, 90 to 95 percent is being used in agriculture. The use of water in agriculture is three orders of magnitude bigger than the use of water for all the green hydrogen that we will need and the use of water in green hydrogen is a trivial problem and I make this point to illustrate a wider problem when we talk about planetary boundaries in a general sense and the horrors of deforestation. There is a contribution to that of mineral extraction when we build cobalt mines or nickel mines, they will go into the forest but let us be clear that 95 plus of all our planetary boundary problems and in particular our destruction of

forests with the CO2 impact and biodiversity, is food and fiber and it is fundamentally because food and fiber, the way we do it in the world, at the moment, is a stunningly inefficient system, particularly if we eat meat. We run a photosynthetic process to produce vegetable protein in which we turn about one percent of the sun's energy into energy within the vegetable matter. That compares with 15 to 20 percent, when we build a field of solar panels. But when we decide that we want to eat meat protein, we turn that vegetable protein through another processing plant called the cow, which is only four percent efficient and it is this stunning inefficiency of the photosynthetic and the meat production system by animals. That means that if 8 billion people want to eat meat, we will destroy the planet. Let us be clear that is a problem 100 times bigger than all the nickel, copper, lithium and cobalt in the world. We must know where the big problems are that we need to solve.

Dr Janez Potočnik, Co-chair, International Resource Panel
There might be two different perspectives but what is important is that we have the same goal. The irrational overuse of natural resources, which we have developed with the prevailing economic model, is causing today the overconsumption, in particularly, in high income countries and I think that is a fact. And this is one of the main reasons on why actually we are overshooting the planetary boundaries on many levels. Climate change is an important part of that, probably most important, but it is not the only one. Others are also important. We have to use natural resources rationally and in a responsible way and some of them are absolutely limited. Ask our African colleague, how much every drop of water matters for them or how much every hectare of fertile land matters for them. There are important issues which we cannot deny and at the end it is about meeting human needs in the most efficient and least damaging way and fixing the inequalities which are currently existing. In low-income countries, their human needs are far from being yet met. We understand very well that there will be additional resource needs but for that we need to focus on the overall economic systems to not repeat some of the mistakes which were done in the high income countries. I really think that energy community is doing an impressive and an incredibly important job but what and I tried to shed light on was that there are potential solutions existing which are coming also from the resource angle, which are currently not taken fully into account. These solutions could help to solve their problems better and quicker.

Dr Ajay Mathur, Director General, International Solar Alliance
In terms of trade-offs, it is never a 'this' or 'that' question, it is a compromise. The biggest compromise that we have to do is on intervention versus free markets. What has happened? We now need interventions at different scales and at different places. Yesterday, the model was that we would set up large fossil fuel based power stations and have a grid that takes electricity everywhere. We have already moved into a system where we have de-licensed much of it, the only part which is licensed in most parts of the world is how the electricity reaches your home. We might be moving into a system where, that too is not regulated but what is regulated is the quality of supply. This is important because the quality of supply could include- where the electricity is coming from? Whether it is renewables or batteries or solar panels? Ensuring proper waste disposal and handling is crucial. The short point that I would like to leave is not that we cut meat out completely, but if we can reduce it by 20%, the world will be better off.

Dr Youba Sokona, Vice Chair, Intergovernmental Panel on Climate Change
I do agree with everything that has been said but what is important is that 'context matters. When we discuss issues at the global level, we often overlook the problem of billions of people. We have technical solutions, political platforms and business cases but when it comes to addressing fundamental issues on energy transitions, we are completely blind. For poor countries in Africa, it is not an issue of transition, it is an issue of jump-starting because the system does not exist at all. We need to build the system, this is one element and then we can move away from the dominant system. What we are not questioning is that is the supply-oriented system. We need a demand-oriented system. One fundamental problem that no one at the global level is talking about is phasing out the use of charcoal and firewood for cooking and that relates to all aspect that has been addressed by all the speakers. This is a fundamental element for any transition but that if we have the possibility to do it by 2030 or 2040 that will be a completely game changer. It is important to keep in mind that 'context matters' and then we cannot have a discussion at the global level not consider the context at the local level.

Dr Shonali Pachauri, Research Group Leader, International Institute for Applied Systems Analysis
I think we have heard many different perspectives, but I think we have all kind of agreed in a way that we cannot use the old growth paradigm as it has existed. It has to be growth with redistribution and it has to be growth with considering the whole life cycle of good. We need to think about those who have too much and those who have nothing.
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