



## **Sustainable development and research: What role for research?**

### **Moderator:**

Annette Verschuren, Chair and CEO of NStor Inc.

### **Panellists:**

Dr. Ashok Khosla, Chairman, Center for Development Alternatives

Dr. Mona Nemer, Chief Science Advisor (Canada)

Dr. Janez Potočnik, Co-Chair of the International Resource Panel, Partner at SYTEMIQ, former European Commissioner for Research and Innovation and for Environment

Moderator: Hello, everyone. My name is Annette Verschuren. I am a Canadian business woman and I'm absolutely delighted to be the moderator on this great panel.

We're opening the International Conference on Research Infrastructures (ICRI) and this topic that we're discussing today is sustainable development: what role science and research will play.

Let me set the stage for a minute. Urgent challenges of climate change and global development have been exposed by the pandemic. How do we collaborate internationally to address these urgent issues? And how do our science and research infrastructure enable a sustainable economic, environmental and social balance in our world? How can policy makers work with the private sector to move the needle? What will the impact be of companies taking on more responsibility in the social and environmental areas of their businesses? How do we get our developing nations accelerated to advance their economies through science and research? How do the developed countries genuinely step up and share and collaborate in this effort?

Just look at how the world is responding to this pandemic and how the developed countries are getting ahead. What do we do now to bridge the gap? We have to move. The capital in science and research we've collectively are putting in our individual countries must be leveraged to help developing countries. It's going to be critically important. This panel has been asked to help us look at our future through a modified lens. The old way isn't good enough anymore. And we don't have a lot of time, so the panellists are:

Dr. Mona Nemer. She is the chief science advisor to the Prime Minister of Canada and to the Minister of Innovation, Science and Economic Development and she's a leader in molecular cardiology. She's discovered



genes essential for normal heart development and diagnostic test for heart failure and the list goes on. Widely acclaimed, she's a graduate, a PhD graduate of McGill University and a post doctorate training at the Institut de recherches cliniques de Montréal (IRCM) and Columbia University.

Dr. Ashok Khosla is Chairman, Center for Development Alternatives. He's an environmentalist. He's a Harvard graduate in experimental physics. He's Co-Chair of the United Nations Environment Program's International Resource Panel. He is internationally known for pioneering and contributing to sustainable development, widely acclaimed in many institutions over the years and he's a member of the World Future Council.

Dr. Janez Potočnik is the Co-Chair of the International Resource Panel and former EU Commissioner for Science and Research, Innovation and the Environment. He completed his PhD from the University of Ljubljana. He has many, many posts in his country in Slovenia, from policy to economic assignments. He brings a wealth of knowledge to the world institutions.

I've asked the panellists to present in four to five minutes, their position on the topic that we're going to be discussing today and then we're going to be going into questions.

So if everybody's ready to go, I'm going to ask Dr. Mona Nemer to start. Mona?

Dr. Mona Nemer: Well good morning and thank you for having us here to discuss this very important topic. I'm going to start by welcoming all our international colleagues virtually to Canada. I'm very happy that we're able to have the conference, but regret that we can't welcome you here on Canadian soil. I hope it's only [00:04:11] for another time, rain check, if you want.

I'm going to address the issue of science and research and their contributions to our wellbeing, to prosperous and sustainable economies and societies. And as you've mentioned, just look at the past year with the pandemic and ask yourself: Could we have afforded not to have science, research and innovation? And I think that's the important question. There always seems to be more pressing immediacy needs and countries think that they can afford to wait or import the science and the solutions to their problems. But the reality is, we all need to double down on investments, in research, in science and innovation because the reality is, to address the challenges that we're facing, we need knowledge, we need understanding,



imagination, discovery, but we also need to transfer these discoveries into innovative products and into innovative policies.

So the question is not whether we can or not, afford to have trained people, to have unique infrastructures everywhere and to have them all connected, but the question is really, how to make sure that we can do it and that the entire world benefits from the immense potential of science and research.

Moderator: Thank you, Dr. Nemer. We'll now to go Dr. Ashok Khosla.

Dr. Ashok Khosla: Thank you. Thank you, Annette and I want to thank, particularly, the Canada Foundation for Innovation for organizing this incredible meeting and for inviting me to be a part of it.

What I wanted to talk about is probably unfamiliar territory for many of the participants, because I think one of the missing links in the whole sphere of science, engineering, innovation technology is what we might call “frugal” innovation. Innovation for frugal technologies that half the world needs but doesn't have access to and no one seems to be interested in supplying it.

The world has made unbelievable progress over the past century. People live longer, healthier, more comfortable lives. We have unimaginable opportunities for knowledge, fulfillment, happiness, but apparently not for wisdom or for empathy. When you look around us over the last year, you see a pandemic that some people think broke our system. Actually, what it did was it exposed a very broken system, I mean the system was already pretty well gone and the pandemic just exposed it. We have a world in which 2.5 billion people live without adequate sanitation, which causes more than 2 million deaths per year; 2.3 billion people without safe drinking water, which causes another 3.5 million deaths per year; 3 billion people with highly polluting cook stoves, which according to WHO, produces 4 million deaths per year, prematurely; and 1.5 billion people without adequate housing. How can that be if we have a system that's working? This was before the pandemic. Energy, electricity, food, decent jobs, livelihoods, several billion people around the world live without these and you know meanwhile, the resource base and the environment have been pretty well destroyed, both in the global North because of overconsumption and in the global South, too, because of need to satisfy the under availability of basic needs. These are complex issues and many of these can't be parked at the doors of science and technology. There are economic and political and financial issues. There's commitment to competence of governments, there's social and cultural frameworks but



frankly, science and technology could, I believe, have done a lot better. They have not done much for the marginalized and the poor, and they've done a lot for high tech: ultramodern devices, artificial intelligence, defence, etc., for the rich.

The sustainable development issues, the goals that we have for a better future for people, prosperity and the planet, means that we've got to eradicate poverty while we eliminate the threats, or even rejuvenate our climate, our biodiversity, our ecosystems, our resource base, our oceans and our life support systems. This means that to achieve these sustainable development goals, we need better lives by meeting basic needs and livelihoods and jobs, and regenerating the resource base.

So after COVID, we also need to put at the very top, the need not just for sustainability but for resilience to expect, if you like, the unexpected. To be able to design systems of decision-making that proactively expect things to happen that you didn't think of or you should have thought of and deal with them in a way that's good for the community.

Innovation is done by corporations, it's done by universities, it's done by government labs, but these are not enough for the kinds of issues that I'm most concerned about. These are things like water for drinking and irrigation, this is for energy for liking and cooking and pumping, for transport, for construction materials, for other materials, for paper, for food, for packaging, agriculture, horticulture, these are areas that need innovation that very few governments and public organizations, let alone the private sector, deal with in terms of what is needed for the poor.

My own organization, Development Alternatives, was the first institution setup nearly 40 years ago, 39 years ago, to innovate for sustainable development and I'd like to just share with you a little while during the question and answer period, what sort of things we do. But Development Alternatives is a not-for-profit. It's a civil society organization, it's a think tank and it's a social enterprise, and it does new kinds of innovation, frugal innovation that goes beyond what labs do to deal with these problems and we also incubate and try to multiply into the market. We found that the shibboleths of the old regime, intellectual property regimes and so on, get in the way of doing the work that we do, and we need a lot more funding. We were very fortunate in being royally funded, including by IDRC in Canada and by laterals from Switzerland, from the U.K., by foundations, etc., to be able to do a great deal, about which I would love to share with you in due course, but much more funding is now needed from a funding that is for



research and innovation that is relevant to the needs of the poor and to the needs of nature. And that's basically what I'd like to share with you.

Thank you.

Moderator: Thank you very much, Dr. Khosla, very interesting comments, as Mona's are as well.

Janez Potočnik, you're up next.

Dr. Janez Potočnik: Thank you, Annette. Just two points I would like to share with you in the opening. First, about separating pandemic from the broader context, I think this would be simply a mistake. The management of the COVID crisis was, and still is, not efficient as we would need and expect due to a few reasons.

First, we have not listened well to scientific warnings and prepared ourselves appropriately, since we have underestimated the probability and likelihood of pandemics, as well as the extent of the potential severity.

Second, we have not been able to act together, coordinate well our efforts, particularly practically on any level, despite the severe impacts and clear global threat for humanity.

Third, we have not been able to manage the crisis following the most obvious ethical goal: saving human lives. The strategy chosen in all the countries were not clear and were frequently changing following compromised between health and other interests, in particular, short-term economic interests.

And lastly, while substantial support was provided to many, this is still not changing the fact that the most vulnerable were hit most and solidarity in particular, towards low-income countries, has failed.

The positive part, it's mostly related to scientific efforts and the amount of funding and financial resources invested in funding solutions related to vaccine and other medicines. But even here, one can rule the analogy that we are rather focusing on consequences than really showing the readiness to address the real causes of the problem. And we know well that relieving the pain without curing the disease and addressing the reasons leading to it, have always a kind of limited effect. So this is a quite worrying pattern, which might likely replicate in the management also of the climate crisis or any other environmental-related crisis, and it's not difficult to [00:14:25 a world we see at] present. Many are saying, like Ashok said, that the post-

COVID world will not be the same again. It will be very much the same, unfortunately. We will hopefully just understand it better. Very likely, the frequency, severity of health-related outbreaks, climate-related extreme weather events will increase in future, thus we need to rethink the way we are managing the risks as individuals collectively, as private companies, public policy makers, locally, globally. So we need to collaborate more to build resilient societies and be better prepared. And if anything is clear here, it is the fact that the role of the science and policy making should strengthen.

And now to my second point, when we talk about climate change, biodiversity loss, pollution, health implications, we actually talk about the consequences and not about the reasons, drivers and pressures causing them. The latter, are connected to human activity, our behaviour to our unsustainable economies, if you wish. Why looking at natural resource flows is such a useful lens in understanding the underlying causes of the many challenges we face, because natural resources are the bridge between economy and competitive on one hand, and climate change, biodiversity loss, pollution, health implications on the other. And international resource panel, science policy interfacing in the area of resource management, where we are both with Ashok, strongly connected, tells us that only extraction and processing of natural resource materials causes 50 per cent of global climate change, over 90 per cent of water stress and land-related biodiversity loss, as well as one third of global air pollution. So, if you, for example, buy a new car, park it and not use it at all, you have already caused one third of the car-related air pollution because resources need to be extracted and car needs to be produced.

According to our estimates, without drastic changes, global resource consumption, it's predicted to double by 2060. Such a growth would be not only catastrophic for climate and biodiversity. It would be also detrimental for global fairness. Resources are being used much faster by high-income countries and the impacts are hitting even more than the others. [00:16:49 *IRP augmentation*] is conceptually built around the innovative need to decouple the growth of wellbeing and prosperity from natural resource use and environmental impacts. In the high-income countries, you do high consumption footprints. This would request a reduction of resource use in absolute terms. In most of the lower-income countries, there is still a need for increasing resource use to build the essential infrastructure. So decoupling means a higher growth in prosperity comparing to the growth in natural resource use. Decoupling is important for all, but it's urgent agenda



for high-income countries. Listening to scientific advice and IRP is supposed to create this critical mass of science in the area of resource development, it's important for the future we want. An important part of behaviour riddle guiding the development of human wellbeing in the right direction are market signals to us producers and consumers and we should stop giving the producers signals that destroying natural capital is free of charge. And we should stop confusing the consumers by asking them to behave responsibly, but requesting them to pay more if they do so.

I would [00:18:03] claiming that nature has intrinsic value. We have to respect and protect that we have to value it and that pricing. It's a perverse way of doing it. But until, as nicely put by Professor Stiglitz, invisible hand will often be invisible since it is often not there. This is in the very words of Arto Paasilinna leading to a charming mass suicide.

To conclude, environmental and social transformations are interconnected parts of the same sustainability paradigm. Without simultaneously addressing all the sustainable development growth spectrum, we have no real chance to succeed. So only through the holistic health check, only with the right diagnosis, one can start developing the right cure. And here is also where the debate about the importance of research infrastructure starts, which are respecting and supporting science and research as such, by understanding the role it, can and should play, in sustainable development and in addressing the climate change, and by exploring all options to substantially contribute to the wellbeing of the developing world.

Thank you.

Moderator:

Thank you, such an interesting number of presentations.

One of my first questions was going to be has the pandemic impacted climate change and sustainable development and I'm hearing from the panellists already, is that there may not be a big impact. I mean this year of pause, this year of reflection, this year of really exposing a lot of the social and economic impacts of this pandemic, we need to take this crisis and really take advantage of it. So, let's get into the meat of the discussion, shall we?

I'm going to start with you, Mona. What role do you anticipate science, and especially research infrastructure, what role can it play in addressing the challenge that we face in the coming years in terms of sustainable



development and climate change? What do you see that has to happen differently?

Dr. Mona Nemer: Well first, let me just say that I think that the pandemic has already had maybe both a negative and hopefully a long-term positive effect on our thinking. The negative effect is because it has diverted all attention from many of the sustainable development goals, of course, to one which is fighting the pandemic and let's remember that health is not only infectious diseases and that climate change has huge impact on other areas of health that have received less attention during these past months.

If we look forward, I certainly hope that we have learned from this pandemic in terms of how interconnected we are in reality and how solutions to our common enemies, if you want, or challenges, need to be interconnected as well and that it's really not a good idea in the midst of the crisis to try to build a highway or the plane as we say. So we need to use the time, the peace time, if you want, to put in place the human infrastructure, the physical infrastructure that we all need to be addressing challenges of sustainable natural resource extraction, food security, huge issue, the broader health question, as well as many others that have been alluded to from healthier water, housing. I mean it's incredible that we have at our fingertips, I believe in some countries, the solutions and yet we're not deploying them everywhere. But this is precisely where you need governments, the private sector and civil society to really work together because it's through this collaboration that the solutions are going to see the light.

Moderator: Mona, I think really great comments. But what I heard from all of you is the lack of collaboration that is happening in the world today. Question is the institutions that we have, can they address yes government, yes private sector, but the research infrastructure that we have today, can we address this or do we have to change the approach that we're looking at our research infrastructure? Janez, can you tackle that one?

Dr. Janez Potočnik: Certainly, the existing constitutions and the governments which we have can be better used and certainly could and should be improved. I think these are two basic things which we should understand.

If we are talking research infrastructure, in particular in the context of the developing world, we have to understand that of course, research infrastructure it's a major attraction. It's a trigger which is pulling the resources, the human resources around. And that's why investing those





kinds of infrastructure in the developing parts of the world, would be an important answer to some of the concerns which we today have. And these concerns are clearly that those infrastructures are more or less concentrated in the developed world that they are causing the brain drain and unfortunately, the conditions that many of the bright people which are emerging from the developing world are not returning to their own countries and contributing to the necessary developments there.

So one thing, which I think Mona rightly underlined and I would underline it again because it's crucial for the understanding of all the challenging which we are facing, as well as for the governments of the future, is exactly the fact that probably we are the first generation which is living in socio-ecological space of global dimension and it has never been like that before. It was always in the way, local. Now it's global, and we need to organize ourselves that we manage our home which is hosting us all together and our institutions, many of them are simply not accommodated to that challenge, nor it's our logic. So many countries are claiming that we need to strengthen our own responsibilities that we have to be less dependent on the others, but this is like you would not understand in which kind of the world you are living because we are bound to cooperate and we are bound to address many of the questions together. So I think if I can speak from the lenses of European Union in that context, I think exactly from the point of view of, if you remember eight years ago when European Union actually emerged, it was basically with only one reason that we would avoid the catastrophes connected to the peace and other things which are constantly happening in European territory. And while we have today, many of the challenges and we have to admit that, it is clear that in the very principle of sharing sovereignty, which we have done, we have actually achieved to avoid these major things which were happening in the past. And I think that the world today, it's pretty much in front of the same challenge: how to share sovereignty—actually to strengthen your own sovereignty to deal with the problems in the right way, because we are sharing the planet which we have to respect we are sharing the planet where we have to take care for also the others and nobody should be—as too many times it's happening—left behind.

Moderator: Janez, well-spoken.

Ashok, I love the word frugal. I loved your approach in terms of saying is the research and innovation happening for the market that needs to be



served? And how do we get the developing market advanced in frugal areas? I think this is a big issue. I also feel that there are big challenges.

I would love your perspective on this issue. I'm a business person and I'm saying look, if we can connect the developing countries objectives in these institutions—in Canada, I know that we do a lot of research in our country that isn't adapted, isn't used. And I think many of our institutions are producing good science, but are they being executed in the world? Are they focused on the right things? That we've got to stop taking from the planet, we've got to start giving back to this planet and we're not. Twice the resources are going to be used, as Janez says, over the next number of years.

Can you, Ashok, talk about how you envision the possibilities of how we can move this collaboration forward? How we can move our institutions forward to address these really critical issues that we're facing because I'm a little disappointed. I was hoping that the pandemic would help us really be more creative in terms of addressing these issues and I know that we're all dealing with the health and welfare of the people of the world, but I'm really concerned that climate change and other sustainability issues are causing the health and welfare of our world. Ashok?

Dr. Ashok Khosla: Well Annette, the two colleagues, Janez and Mona, have covered the need to extract from our experience with the pandemic, the lesson that we're all in it together, that what happens to you is going to happen to me. It could be mediated through a pandemic, a disease, an infection. It could be mediated through climate change because of something that I do causes climate change that is going to impact you. Whether it's the biodiversity in loss of species that are essential for medicinal or food or other reasons, all of these basically underlying the fact that it's not just altruism that we need, it's self-interest as well. I mean in an Adam Smiths' kind of way, we've got to recognize that people don't generously hand out things except under very special circumstances, and they will do so if they have a fairly quick return in terms of their own interests being met as well.

Now in the 1980s and '90s, I had a lot of experience with Canadian funding agencies like IDRC and CIDA and others, who were very generously, three four decades ago, supporting the kind of work that would make the lives of poor people better. I think that was, in some way, through a generosity based instinct that we need to take care of each other as well. But after that, it sort of evaporated.



And the last two decades, I've had very little to do with Canada, although I used to be there in and out, five, six times a year for various things. And the reason, I think is that all countries around the world, particularly in the global North, are turning inwards. They're less interested in their role in making the world a place that is good, not only for the world but for themselves as well.

I personally think that the frugal technologies that I'm talking about, are frugal because they are very soft on mother nature, they're very strong on community, they're very important for the wellbeing of individuals, particularly those who got left behind, particularly women and children and the disabled, the kinds of technologies that authorities, decision-makers in the realm of funding research and innovation do not think of, they don't think naturally of. And those are things that I think we've got to now put front and centre before them because without them, we can't go forward.

Now both Mona and Janez, particularly Janez, brought up the issue of the so-called brain drain, of the loss of the most valuable resource of all. Not gold, not platinum, not oil, but brains from poor countries being siphoned off, by being vacuumed out to places that actually don't really need them as badly. This is a real problem and I have a very ambiguous feeling about this because on the one hand, from the point of view of the individual, the scientist or the engineer or whoever, they're entitled to a better life and if they've got opportunity to do so somewhere else, more power to them. But they also, ultimately, cause a massive vacuum or by leaving behind problems that they were needed to solve. So it seems to me that what we've got to do is to rethink not just the hardware, the structures of our decision-making, for the softer parts of it, the incentives. Why do people go away? They go away for a better life, for better earnings, for better research conditions, for perhaps a Nobel Prize for the kinds of accolades and reward systems and recognitions they get. Well we've got to change that. We've got to make sure that people, who develop a new drinking water system or a new construction material that is relevant to the problems of very poor people, should be getting a Nobel Prize, too. And we're not doing that. I mean it's not very hard to set aside a million dollars and say every year we're going to give you an equivalent of a Nobel Prize for doing something that changes the lives of thousands, if not millions of women or people or farmers or whatever. And I don't think we're thinking hard enough in looking at how do you drive that innovation engine?



Moderator: And so is it time that we developed countries go to the developing countries? Is it time that we think with this world of digitization, how do we transfer and bridge these challenges? Mona?

Dr. Mona Nemer: You know this is a very important question and I personally strongly believe in science for development, for sustainable permanent development. I don't think that developing countries want handouts or that handouts are the way to get them to really take charge of themselves and to address their own problems, from drinking water, to how they want to see their society develop. And one thing that we haven't maybe sort of clearly pointed to is the role of research infrastructure in knowledge mobilization, in enabling civil societies, small and medium-size businesses and enterprises to access technology, to test solutions before they can be deployed to the market. And I think when we start thinking about it this way, it makes imminent sense to have large infrastructures specialized or even distributed infrastructure everywhere in the world and specifically, in developing countries so that we're going there for talent development and we're not siphoning the talent out of these countries.

The other thing I will say is, when we think about why we need the collaboration between the different sectors: civil societies, the researchers and the private sector. I think we have to recognize that each one of these sectors have their strengths and their capabilities. Researchers are great at discovering new things, at finding solutions, at observing, at providing the evidence and the data you need, but they're not trained as marketers and they're not trained for prototyping and they don't necessarily understand all the problems everywhere around the world, however, their solutions to one problem can be adapted to others. And that's why open science and open data and open collaborations are just so critical to addressing the issues that we're talking about and to really making sure that there is equitable sharing of knowledge and of the fruit of the knowledge.

Moderator: I think really important points you've made there, Mona. How do we connect these silos? And I see the research—maybe the wrong words—pillars, but the private sector pillar, not-for-profit pillar, government policy, research capacity infrastructure, how do we develop, collectively, a way to move forward? Are there examples in the world where addressing these issues in a cross-functional way, are there examples of this working anywhere?

Janez, can you give me some examples? I'm looking for solutions, right? I'm looking for ways in which—sorry, I'm a business person.



Dr. Janez Potočnik: No, you are just pointing to the right things, everything is right with that. I think it's these cross-pillar collaborations which you have mentioned, is essentially absolutely needed. You know that the majority of the research funding is anyway coming from the private sector. It's not coming from the public sector. But it's giving a lot of needs and hope also for the collaboration, if it's organized well. And what is important is that a lot of that is actually devoted to trying to address the societal needs so that the money is actually very much spent and addressing the right questions.

One thing which is the problem of the investment in research and science is of course that a lot of [00:38:48] policy makers, or even the business communities, are pretty much short-run, somehow fuelled. So either they invest in immediate needs or they see, for example, the investment in science as a kind of luxury investment which you can do in good times, which is just the opposite that's the way how you shouldn't do it. And also in the companies, if you look at what is actually driving their profits, how the companies are judged, they are not actually judged in a way that this is in the best way addressing the longer term needs and longer term challenges. Unfortunately, whether we like it or not, we are living in the time where not aligning short-term investments and policies with longer-term needs, could be detrimental and this is our fundamental [00:39:56] of the overall organization across the society, which is sometimes preventing exactly that type of collaboration which you are asking for, which you are seeing as an important and needed.

I see, for example, one of the things which is quite critical, which we will need to start thinking a bit, returning back to human needs because the economic system which we have created, it's actually fuelled by the amount of quantity of the production which we are putting on the market and this is rewarding us with a profit. But the human need is not a car. It's mobility. The human need is not this chair. It's sitting. Human need is not a refrigerator. A human need is chair and healthy food, and I can continue as much as you wish. And I think more going back to the human needs and more looking to the wellbeing story, which is a bit different story than actually the GPD story, which is currently prevailing and fuelling our developments, I think this is pretty essential if we want to come to the solutions which you were alluding to.

Moderator: So great, Janez, great discussion. But the Paris Accord has set targets and I'm hearing every minute, another major private sector organization announcing zero emissions, right? I don't know how much of this is going to

be executed, but certainly it has gotten the attention of people, right? And it's all about resources, the efficient use of our resources, I get that. But is this the mechanism to really get the research infrastructure facilities lined up with the policy makers, lined up with the private sector, to really push. We need to do something extraordinarily important and aggressive here. And so is this something that we can do? Ashok, what do you think?

Dr. Ashok Khosla: You know Annette, the things that both Mona and Janez were talking about are that need for changes in paradigms about our thinking about development as a whole, what is a better future? What is the world about? And those are fundamentally important, but just the research and innovation enterprise, the sector in which research leads to improve life through changes in technology, in institutions and value systems and so on, I think needs to be looked at fundamentally. The paradigms that we face are IDR intellectual property. They are peer-reviewed journals. They've been very successful. The last 200 years of research and innovation has been unbelievably successful and so nobody's questioning whether it can continue to be successful for the kinds of things that the SDGs and what you're talking about and the climate change, the Paris Accord, you see the building behind me. This building is entirely made of materials innovated by my organization. It has less than 30 per cent virgin materials. The rest are all recycled materials, recycled demolition waste, mining waste, power station waste, fly ash, and yet it's a fairly elegant building. We've been offered very, very good rents by embassies, by companies for occupying parts of it. Now the thing is it's symbolic of a totally different attitude. We did not do our research for finding kudos in the academic world. We didn't do our research to get Nobel Prizes. We did our research to solve problems of real people. We developed building materials or water systems or energy systems or livelihood systems that were needed in the market. And what Mona was saying, is absolutely right. In order to get them from the laboratory into the market, you've got to have incubation mechanisms, you've got to have multiplication mechanisms, you've got to have support systems, and we put those together. We had to. There was no way that we couldn't.

So the answer to your question is, on the one hand, we need to rethink what a good life is and all the things that Janez was just talking about, but we need to think of how our institutions for innovation are going to get us there and that is totally different. And I remember a very, very uncomfortable discussion with a Canadian research organization on the fact that we were not producing enough peer reviewed articles to

demonstrate that our work was good, because they could only judge us by an academic standard, whereas we were having a huge impact on the lives of millions of people. So I think it's important for us to rethink the innovation enterprise, to be both highly conscious of quality, no question about that, nobody's arguing, but is peer review the only way to achieve that? I don't think so. And I think we are really, now, looking for new ways to do research and defining what kinds of research we need to do.

Moderator: I think you're absolutely right. I mean take your building, there should be codes all through the world that should change to move this forward and we can't do it altogether, but I'll tell you, in our country, there are codes in every province. There are codes in every region that are different, electrical codes, plumbing codes, and building codes. It's amazing how inefficient we are, right? And so here's a place where I hope the three pillars can come together. I know this conversation could go on forever. I think I'm past my time frame, but I would love just to give you the last word. If you had a white paper, if you had an open sheet, Mona, and you had a wish of what could happen in the next five to ten years in the world, what would it be?

Dr. Mona Nemer: I would like us to rethink our research structures. I think science and research has served us very well, but we need to review the architecture, the structure and our business model. And I think even when you're a successful business, as you would know, Annette, you do need to have some introspection, to renew yourself and your model, to remain relevant. And I think what this pandemic has demonstrated, is that it's time that we do this exercise collectively and that we make sure that science, research and human imagination can continue to serve us collectively.

Moderator: I love a challenge, Mona. Brilliant! Janez, same question.

Dr. Janez Potočnik: Focus, as I said before, on human needs in the first place. Believe in science and to be quite honest and sincere as policy makers because this is actually raising the responsibility also of the scientists. And in the first place, whatever you will do, remain optimistic because optimists live longer and better.

Moderator: Yes. And they live longer, too.

Dr. Mona Nemer: And happier.

Moderator: And happier, yeah. We're a country that is reasonably happy and so I think that optimism is critically important. Ashok, last comments to you.



Dr. Ashok Khosla: Well mine is made easier because I would like to endorse both Mona and Janez because that's more or less what I would have said, too. But I can go beyond because I think to achieve those things, we need to rethink our structure of societal decision-making, of incentives in motivating people to do what is good for society as well as for themselves, and to keep in mind something that we never both to keep in mind before, that sustainability has been the driving constant for the last three, four decades, but now we've got to have resilience built into it and to resilience, I now attach the phrase "expect the unexpected" because if you're not going to be able to handle, other than earthquakes and maybe tsunamis and maybe asteroids, pretty well everything is either predictable or not predictable. And if it's not predictable, there's not much you can do about it. But what is predictable is that that there are going to be worse cases coming down the pike. There are going to be black swan events, and if you're going to be flattened every time that happens, then you can't really say very much about the human enterprise. We've got to be able to deal virtually with anything. Whether it's disease, whether it's climate change, whether it's species extinction, whether it's soil loss, whether it's forest destruction, forest fires, we have to now set up systems that basically prevent them from happening in the first place, but when they happen that we can deal with them in a sane and logical and an effective way.

Moderator: Beautifully said.

And I just want to close it out by saying I'm in the energy storage development business. I started a company in 2012 because all of my career, I have seen profit but also purpose in the work that I've [00:49:59 INAUDIBLE] in parts is recognizing social issues, recognizing environmental issues, recognizing economic issues and I think we've got to get engaged. I think we have to be bold, and I think we have to do things that are critical to move our world forward. So I just love this conversation. You're terrific people. I've learnt so much. I'm the business person here. I'm not the scientist, but I hear you and we'll continue to work hard to move the needle forward.

Thank you so much for this discussion.