SPECIAL COMMITTEE ON ARTIFICIAL INTELLIGENCE

IN A DIGITAL AGE (AIDA)

HEARING ON AI AND THE GREEN DEAL

Panel I: AI governance and the European Green Deal

Clara de la Torre, *Deputy Director-General, DG CLIMA, European Commission*

Shereen Zorba, *Head of the Secretariat of the UN Science-Policy Business Forum*

Josef Aschbacher, *Director of Earth Observation Programmes, European Space Agency (ESA)*

Guillaume Pitron, *Journalist and Author*

*** * ***

Panel II: Exchange of views with experts

Lynn H. Kaack, *Postdoctoral Researcher, ETH Zürich, and Chair, Climate Change AI*

Cathleen Berger, *Sustainability Steward, Mozilla*

Victor Galaz, *Deputy Director of Stockholm Resilience Centre (Stockholm University) and Program Director at Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences)*

BRUSSELS

WEDNESDAY 27 JANUARY 2021

1-002-0000

IN THE CHAIR: DRAGOŞ TUDORACHE

Chair of the Special Committee on Artificial Intelligence in a Digital Age

(The hearing opened at 9.04)

Opening remarks

1-004-0000

Chair. – Good morning, dear colleagues and Happy New Year, since it's the first official hearing of AIDA for 2021. It's also a hearing where we bring together – and this was a request that came unanimously from all groups represented in AIDA – the two top priorities for this political cycle: the green agenda and the digital agenda.

Today we're trying to look into some interesting questions that bring these two issues together. Are frontier technologies an enabler for the digital transformation of our economies and societies? Are they technologies that are actually consuming, and therefore upsetting the balance between benefits and costs? So these are only some of the issues that we will first hear our speakers address. We will then have two dynamic sessions in which our Members will have the possibility to interact in the usual manner, i.e. by asking individual questions with individual answers from our speakers, again between two sessions, and in the end there will be a closing session.

We have three hours for this. This is the agenda for today and, if you agree, I would formally ask you to adopt the agenda for our meeting. If anyone doesn't intervene I will assume that is the case. I also want to say that the draft minutes of the meeting of 2 December are available online.

So with that, we will kick off the hearing today. I have the pleasure to introduce the Chair of the Committee on the Environment, Public Health and Food Safety (ENVI), my colleague Pascal Canfin. Thank you very much Pascal for being also able to be present physically with us today. We look forward to hearing not only the opinion of the ENVI Committee, but to a good opening for today's discussion. Pascal, the floor is yours.

1-005-0000

Pascal Canfin, *Chair of the Committee on the Environment, Public Health and Food Safety***.** – Thank you for your invitation, Chair. Thank you for leading the work on the very important topic of artificial intelligence (AI).

There is no ENVI Committee position, as such, because actually you and your committee is taking the lead role in Parliament and leading Parliament's thinking on the connection between AI and various challenges. The one we are going to focus on today is the Green Deal. So, really I'm here to listen to the experts and the Members, rather than to provide expertise or a political position from the ENVI Committee or from Parliament itself.

Just to open the session, though, what I would like to get from this discussion and the experts' analysis is to understand not only how artificial intelligence could speed up and help the Green Deal and, conversely, the associated risks in terms of, for instance, data space energy consumption, but also perhaps to examine some sectoral changes. For example, if we develop artificial intelligence, what might happen in terms of mobility? What might happen in terms of energy production and management of the energy system? What might happen in the other big challenges we face and have to overcome if we are serious about the key element of the Green Deal, meaning climate neutrality by 2050?

So that's the thinking and the information I would like to get from the experts today: to enter into some concrete cases so that we can inject the thinking of your committee into legislation, into the thinking of Parliament, on the pieces of the Green Deal. Now we are talking about carbon pricing. We are talking about housing, refurbishment, electric mobility. We are talking about many, many elements that have a direct economic and industrial impact. To be honest, we do not usually factor in artificial intelligence, and that's exactly the added value of this discussion today: to connect the dots and help make us smarter at the end of this meeting.

So, once again, thank you Dragoș for organising it, and thank you to this committee for leading Parliament's thinking on this.

1-006-0000
Chair. – Thank you very much, Pascal, for these opening remarks. You are very right in what you say. It is natural that the digital and the green transition overlap; they influence each other and, ultimately, they depend on each other. I too am very eager to hear what our experts will say today and what questions our Members will put to them.

Panel I: AI governance and the European Green Deal

1-008-0000
Chair. – So, with that I would like to kick-start the first session, 'AI governance and the European Green Deal'. We have four speakers who will introduce this session. I would ask them to try and stick to the five minute slot for introductory remarks. Then I have the list of speakers from the groups and here, as always, we will follow the tradition of the four minute slot for each MEP: two minutes for the question and then two minutes for the direct answer from the experts. Please, I would ask my colleagues, the Members, to direct their questions to one of the speakers if they can. If not, I will try to direct it to one of the speakers, depending on the topic.

I will introduce the speakers. First, we will hear from Clara de la Torre, Deputy Director General DG CLIMA, European Commission. We will then have Shereen Zorba, Head of the Secretariat of the UN Science Policy Business Forum on the Environment and Chief of Science Policy Business Interface, UN Environment Programme. Then Joseph Aschbacher, Director of Earth Observation Programmes at the European Space Agency and, at the end, Guillaume Pitron, journalist and author of 'The Rare Metals War: The Dark Side of Clean Energy and Digital Technologies'.

As is already obvious from the positions they hold, each speaker will bring a different perspective on the topic of this session. An interesting one, and hopefully one that will also open up the debate and give the Members an opportunity to put forward their questions on the issues that interest them the most on this topic.

So, with that, I will give the floor to Clara de la Torre. I hope you can hear and see us Ms de la Torre. You have the floor for five minutes.

1-009-0000
Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – Thank you for inviting us to this session, which is absolutely essential, as you were saying, to understand a number of things and to make legislation.

I don't need to explain here what the Green Deal is. It's the growth strategy, it's the response of the Union to the climate threat and the degradation of the environment, and it's driving our way to our 2050 climate-neutrality objective. Digital technologies and, in particular, artificial intelligence play a crucial role in helping us to reach these objectives because, without digital transformation that is paired or twinned with the green transformation, we will not get there.

Digital technologies are a type of enabling technologies. But what are they enablers for? For reducing the greenhouse gas emissions in key sectors. It is estimated that the ICT technologies have the potential to reduce greenhouse gas emissions ten times more than its own footprint, which is already currently estimated at more than 2% of all the global emissions and is expected to increase. However, despite that, they can help us reduce emissions somewhere else. Because they are enablers, they are essential for optimising the manufacturing processes, as Mr Canfin just mentioned, to decarbonise mobility and logistics, to improve the energy efficiency of buildings and to reduce the use of pesticides and fertilisers. Artificial intelligence is essential to render our cities smart, for them to use their resources efficiently, to reduce traffic congestion, to increase the use of renewable energy in cities and to reduce waste, which as you know is a huge problem.

So the potential for artificial intelligence is very high. At the same time, for this potential to be unleashed, we need to succeed in establishing trust in the use of artificial intelligence. And we also need powerful, adequate and smart digital infrastructure, namely to use the huge amount of data which, at the end of the day, is the input, the raw material of the artificial intelligence.

We also need to address the environmental impact of the artificial intelligence systems themselves within the sector and this is linked mainly to the use of energy. Other technologies have other impacts but artificial intelligence, in particular, is linked to the use of energy and this throughout the whole supply chain from training the algorithms to collecting data and storing this data.

In view of that, the European Commission is making progress in the context of the recently adopted programmes: there is a new framework and a new budget. We are accelerating research in Horizon Europe, and we're working on the next generation of artificial intelligence technology, aiming mainly at having more energy and data-efficient processes. And, as well, an important avenue of research is the capability of local processing in small devices which, by the way, reduce the use of energy and the costs associated with data transfers.

In terms of hardware, the Commission is supporting research and deployment of technologies in the field of microelectronics and energy-efficient processors, as well as implementing measures to foster green data centres, which we know are huge consumers of energy.

A key component of artificial intelligence is precisely the generation of data and the Commission is supporting the creation of a common Green Deal data space – green data for all, as they call it – that will generate data from very new data ecosystems across Europe. We are also supporting the so-called Destination Earth, which is the digital twin of the planet with very high-precision digital models of the earth, and this together will allow us to better predict, for example, extreme weather events, to analyse climate change, to monitor the emissions and thereafter to undertake mitigation and adaptation actions.

Finally, a broad third programme is a European space programme. We have geo satellites and a Google alliance, which is a source as well of massive volumes of Earth observation data which is produced, as we know, on a daily basis.

One minute to address a third issue. We need technology, we need trust, but we need in this transformation to dwell on the behaviours. Artificial intelligence can empower companies and citizens to make more sustainable choices by providing a better analysis of the impact of their consuming decisions or their production decisions.

On a last note, I'm glad that we can count on the support of the European Parliament, of this House in the endeavour of getting this programme up and running. Let us not forget that we have 35% of the Recovery and Resilience Facility dedicated to the Green Deal and 20% to

digitalisation. Digitalisation solutions are also supported in the Digital Europe programme. I mentioned Horizon Europe. Let us not forget either the Structural and Investment Funds, where investment in green and digital projects is also possible.

So, these are my introductory remarks. In a nutshell, digital, artificial intelligence cannot be decoupled from the green transition for us to reach our 2050 climate objectives. Thank you.

1-010-0000
Chair. – Thank you very much Deputy Director-General de la Torre. We will come back to you with questions. I'm sure that our Members will have plenty for you. We will now move on to the second intervention from Shereen Zorba, Head of the Secretariat of the UN Science Policy-Business Forum on the Environment and Chief of Science-Policy Business Interface. I had a discussion with Ms Zorba in preparation for this hearing, and found that she had a particularly interesting view and perspective, also given the multilateral work done by the UN in this area, so I am sure that her introductory remarks will already instil a lot of interest for debate later. Ms Zorba, the floor is yours for five minutes.

1-011-0000
Shereen Zorba, *Head of Secretariat, UN Science-Policy-Business Forum on the Environment and Chief of Science-Policy-Business Interface, UN Environment Programme***.** – Thank you very much indeed, and thank you for allowing me the opportunity to engage with you this morning.

I wanted to start by saying that the promise of exponential technology, of which AI is a very significant one, will transform the future – or is already transforming the future – into a greener, more sustainable future. This promise is already immense. But the promise does not come without its perils, and there is no such space, as we experience this more, as the multilateral space, where the word 'multilateral' is changing its meaning and significance as the world continues to evolve. Next year, the UN Environment Programme (UNEP) and the Stockholm Convention will mark 50 years of environmental multilateralism. And the work that we are involved in – on the digital, on AI, on big data – begs the question, is multilateralism just about Member States working together, or are more actors entering this space, including the giant technologies? And to what extent does this space (in terms of the existing multilateral platforms) allow the space for really important discussions to be had? Because the breakneck speed with which technologies are growing could be a leap into the unknown if not accompanied by the enlightened governance required to regulate, manage and hold accountabilities in place. Trust is a huge issue between data providers, data owners and those who will use that big data to fuel the AI race.

So in the area of sustainability, this is huge, and it's a very important issue to consider and move forward on very quickly, because time may not be on our side as things evolve at lightning speed. So it is not unfair to ask the question: is he or she, who owns the technology, and so owns the future, considering the future of sustainability? We've invited the Committee – we've invited the Chair – to be part of a very important consultation that will take place with the technology giants, with governments, with multiple stakeholders next month, and we hope that we will see this conversation evolve.

The big digital transformation is already helping multiple organisations – and this is the good news – to reduce their environmental impact and also to deliver better business results, since environmental sustainability has become a business imperative that defines a company's prospects in today's competitive marketplace. For example, more industries are using data and digital tech to apply the circular economy, the estimated potential value of which in Europe alone will be EUR 1.8 trillion by 2030 according to the Ellen MacArthur Foundation. They are applying green intelligent workflows. But the question remains: is this equitable? Do all countries and all businesses around the globe have the capacity to reach out and use such

technologies? More environmental data equals more insights and more progress. This is absolutely true, but let us also remember that according to the UNEP's reports on measuring progress in achieving the Sustainable Development Goals (SDGs), 68% of the data required to report on the environmental indicators of the SDGs is missing. The data is simply not there, so how can we measure progress?

Data information underpins the ability of economic actors to drive change in business priorities and practices. Greater transparency and insight allow consumers, companies, investors and governments to change the way they buy, produce, sell, transport, consume and govern. The myriad of new stakeholders across borders means the evolution of new governance structures. Are we going to be in control of these evolving governance structures? And again, this does not necessarily mean inclusivity.

Now, you have a brief slide on your screens, and this slide, provided courtesy of IBM, shows the capacity of frontier technologies to transform environmental management – a process which is very much already in progress. We see AI applying learning algorithms for better models, refining responses to problems, optimising resource consumption. We see advanced analytics processing huge volumes of data in record time, 5G providing faster connectivity, hybrid multi-clouds providing the seamless integration of data and aggregation.

At the UN we are building models and pilots – together with the giants managing and providing the technologies, Member States and our scientific bodies – to try and understand how this is going to impact our future and how are we going to cope, especially how we will manage to integrate data from multiple sources, including citizen science, and how this might impact our idea of democracy. We will be launching such an initiative next week and hopefully with you next month.

So, in this marathon, it's very important to acknowledge the opportunities. It is also very important to acknowledge the need to work across borders, because this is the nature of the technology, very much like the nature of environmental impact. To date, no country has a specific clause in place concerning ethical and responsible AI for the planet. Will companies self-monitor? Will governments step in to regulate more formally? And how are we going to implement greater transparency and greater equity? Regulations may be necessary to both encourage AI for the planet, to improve trust and to manage associated risks.

In conclusion, equity, equality and inclusivity are the foundations for any effort towards global sustainable development, environmental sustainability and democracy. The marathon to deploy finance and reap the amazing benefits of AI would need to be accompanied by deliberate and conspicuous efforts to create the ethical, equitable and inclusive standards required for an ethical, equitable and inclusive world.

1-012-0000

Josef Aschbacher, *Director of Earth Observation Programmes, European Space Agency***.** – Thank you very much. First of all, good morning to the Members of the European Parliament. Thank you also Mr Dragoş Tudorache and Pascal Canfin for this invitation. It's really good to speak about AI and the Green Deal.

You may ask, what can we do from space? As you mentioned, space is taking our planet's pulse. We have a number of satellites in space that measure the various parameters of our earth's systems – the atmosphere, the oceans, the land surface, the ice caps – and see how they work together. These satellites not only make sure that we understand how our system works, but also provide input to help us predict and model some of the elements of our planet. And this is really crucial because this is exactly what the people need, what society needs, what the European population needs, and also the global population.

So, of course, we are addressing climate change with our satellites. This is already well known and has been well communicated, but I should also like to say that Europe today is in a unique position as we are global leaders in terms of the assets we have built up. Our satellites collectively – that is the satellites of the European Space Agency, the ones of the programme led by the European Union (Copernicus), of the meteorological programme EUMETSAT, but also of the missions of our Member States and of commercial missions – are today, I would say, the gold standard in earth observation worldwide. This is of course not credible when I say it as a member of the European Space Agency, but our colleagues at NASA, in Japan, in China, also acknowledge Europe's leadership in this field. And I think Europe can be proud of this. Europe has really achieved, through Copernicus in particular, which is led by the European Union and implemented and co-funded by the European Space Agency, a real asset to monitor our planet from space on a regular basis.

So this is good news. We disseminate the largest volume of data worldwide – about 250 terabytes per day – to the global community and this data is picked up and used in many disciplines and many parts. But what is unique – and here we come to the key topic of today's hearing – is that we have here all the satellites we need to support climate change, and in particular the Green Deal's implementation. But, of course, we are also supporting the digital agenda.

So how do we do that? Let me come back again to the investments we have made in space. The European Union and the European Space Agency member states have invested several billion there together, and these are some of the best assets we have. What we need to do next – and this is something I'm promoting together with the European Commission and other partners in Europe – is translate this capacity, this excellence in space, down to the ground. 'To the ground' means making sure that this data is being used by the community, by society, not only to see what is happening but even to make predictions of its future evolution or, even better, to develop scenarios, which we call 'what-if scenarios', where you can change certain parameters and allow forecasts to be made.

So how do we do that? We have been in contact with the European Commission in particular, and I would really like to acknowledge the leadership of the European Commission, especially the Director-General of DG Connect, Roberto Viola, but also Commissioner Breton, for the vision in pushing the digital agenda and making sure that we are catching up on some of these assets. So how we do it? We are combining the earth observation assets under the Copernicus programme and other observation data with earth system modelling, with artificial intelligence and machine learning, and we are using supercomputers, or high-performance computing, in order to create digital twins of our planet to allow for these what-if scenarios. These what-if scenarios will be able to simulate, for example, some of the impacts which people are having on the planet.

Let me take the Green Deal as a reference and the goal to be carbon neutral by 2050. We want to simulate – perhaps per country or per region – what would happen if coal power plants were switched off, say, five years earlier or 10 years earlier in some countries? What would be the impact on our carbon cycle, on our emissions, and what would it mean for carbon neutrality? What would happen if we changed our traffic transformation faster than anticipated, switching from diesel and gasoline-driven vehicles to more sustainable resources? How fast do we need to proceed? What is the impact on pollution? What is the impact on other elements regarding the Green Deal? One other example is certainly the change of energy towards greener, more sustainable energy resources.
We would like to make all these simulations and have these what-if scenarios to see what happens if I change this parameter by that amount in order to help citizens, but also to help

decision-makers to implement the policies that we need to implement at European level. And this really is an effort we are making together with DG Connect, as I mentioned.

This year we are in the process of putting together a concrete proposal to support Destination Earth, as the Commission's programme is called. We are teaming up with the European Centre for Medium-Range Weather Forecasts and with EUMETSAT, led by the European Space Agency, to put the first elements together to create these digital twins. Of course, this is a long-term project. It will probably run for many, many years and will be a major investment. But we are starting the first phase this year, and I really think that this is what Europe needs to do to combine our current strengths in space with the discipline of artificial intelligence, of computing, of digital processes, in order to stay ahead and inform our citizens the best we can.

1-013-0000
Chair. – Thank you very much. And now for our last speaker of the first session, Mr Guillaume Pitron, journalist and author of 'The Rare Metals War: The Dark Side of Clean Energy and Digital Technologies'. Of course, we are particularly eager to see his take on the issue of how much consumption we can actually expect from frontier technologies, and whether the balance is the right one. Mr Pitron, I hope you can hear us. You have five minutes.

1-014-0000
Guillaume Pitron, *journalist and author***.** – Many thanks for your invitation.

I will apply this question to the metal and materials sector, this being the one I know best – or the least inadequately, anyway.

As you know, we are trying to move to a low-carbon world, but the aim of the Green Deal is also to move to a low-resource world. So how can we continue to drive economic growth while using fewer resources? This is where the concept of the circular economy is relevant, since it enables us to better optimise the resources we need to develop our lifestyles and, more precisely, digital technology resources.

I will quickly run through, in five points, how artificial intelligence – a catch-all term covering a huge area – or rather digital technologies can help us to economise on resources firstly in the seven pillars of the circular economy, and then more precisely in the metals sector.

Digital technologies can enable the development of 'smart mining'. Mining accounts for 10% of global electricity consumption. If we develop and install sensors in mines which will allow us to have autonomous machines in place of, for example, human activity, we will use less electricity in underground mines and for the devices which inject oxygen to make the environment suitable for people to work in.

Artificial intelligence enables us to undertake ethical sourcing so that we can keep a better check on the origin of minerals, particularly conflict minerals. An example is the 'Circulor' tool, which uses blockchain to enable better traceability of materials.

Artificial intelligence will help us share information on secondary resource repositories. Europe has 500 000 landfill sites, which constitute a possible source of 'critical raw materials', as the Commission terms them. Where are these sites? How can we find out more about what they contain? How can we match the provision of secondary materials to the demand? This is where existing databases such as ProSUM, a platform for data on secondary resources which was set up by the Commission between 2015 and 2017, can be improved with the aid of digital tools.

Artificial intelligence enables new materials to be developed. This is the purpose of the Materials Genome Initiative, which was launched by the Obama administration and consists of putting digital technologies at the service of the transition to materials which are more complex

yet more economical in terms of energy and resources and which have useful properties. And digital technologies can also be used to develop recycling processes, with tools – robots – better able to sort through the mounds of materials on a rubbish tip.

This all comes at a cost, which must be taken into account: if digital technologies are to be fully developed, resources are needed which are precisely the ones we have to use sparingly. We need beryllium, a metal described by the Commission as critical. Digital technologies account for 42% of the global consumption of beryllium. They account for 63% of the consumption of dysprosium: another critical metal, according to the Commission. The figures for gallium and for indium production are 70% and 60% respectively – and we could add lithium, cobalt and graphite. The cost of materials accounts for three quarters of the cost of digital technologies.

Where are these resources extracted, and under what conditions? The MIPS (material input per service unit) – a German ratio – tells us, for example, that making a chip requires 16 000 times as much in terms of resources as the weight of the chip. The more you dematerialise, the higher the material cost. And this is a paradox which must be taken into consideration.

There is also an energy cost, as all this infrastructure needed for data processing goes through data centres and must be processed by data centres, among others. And this gives rise to an electrical cost: an energy cost to keep all the infrastructure facilities functioning. And as we know, digital technologies today account for some 4% of greenhouse gas emissions, and this might be 8% tomorrow, as all these infrastructures function on the basis of coal, particularly in China.

We should also mention industrial symbioses, where the circular economy is in operation, such as at Kalundborg in Denmark, or the Recylex company, which recycles lead batteries. These function by means of the long-standing links between the economic actors, continuous communication among the stakeholders, collaboration rather than competition between the actors, and in-house training of engineers. This all drives a loop and a circular economy, economising on materials. Moreover, the circular economy loop starts up and functions not just as a result of technologies but also quite simply as a result of human interaction.

In other words, technology is good, but it isn't everything. A low-carbon, low-resource world will not only be a digital world, it will also be a world in which human intelligence will have to be taken into account.

1-015-0000

Eva Maydell (PPE). – Thank you very much Chair, and thank you to all the panellists. It was very interesting to listen to all of you. I have a question for Professor Josef Aschbacher. Basically, I am very fascinated by the way the European Space Agency's Digital Twin Earth project is composed. I think it could have a very profound effect on the way we examine the earth and, in Europe in particular, on how we monitor human activity. So my question in a way is very simple: if, Professor, you had a large amount of resources and funding, let's say amounting to EUR one billion, to spend under Digital Twin Earth to help European sustainability efforts, how would you spend it? Which areas do you think have the greatest net positive potential?

1-016-0000

Josef Aschbacher, *Director of Earth Observation Programmes, European Space Agency***.** – Thank you, Ms Maydell, for your question. So if I had unlimited resources, and this is hypothetical but it would be ideal, I think it is obvious that – and you probably know better than me – in some of the domains of the IT world Europe is lagging behind the US and China, for example in artificial intelligence, super computing and so on. This is something which is a fact and unfortunately this is the situation we are in today.

However, in space, we have a global leadership which is far superior to the other two nations or other countries in the world. So what I really would like to do, if I had the resources, would be to make sure that these assets that we have, where we have already invested billions together – in particular the European Union through DG DEFIS, which is leading Copernicus for the European Commission, but also the European Space Agency – are used for the maximum benefit of citizens. Of course we need to further build them up to make sure that we are staying on top of the competition through innovation, but we must use them so they are of maximum benefit for citizens.

I really would commit to using the high-performance computers implemented and developed by DG Connect to build up a big framework where European society can participate in this digital twin earth creation. What do I mean? It may sound a bit theoretical, but it has to be an open system architecture that allows companies and citizens to, on the one hand, benefit from the information which is being produced or have access to data, artificial intelligence, machine learning, algorithms and some of the model outputs which we create, and, on the other hand, develop their own business, their own application, their own information that they want for their daily lives, whether this is to monitor the rise in sea level, the impact of temperature increases on their local community or whatever the application may be. But we must really offer this open architecture in terms of a cloud-based core system and allow them to benefit from this, but also offer them capabilities, either through contracts to build up the system, or even on a commercial basis if they want to offer a certain data set, a certain algorithm that they have developed for other users that benefit from this basic infrastructure that we are building up.

Overall, if you ask me, this is a billion euro project or maybe a multi-billion euro project and it will take a couple of years to realise and to have a full digital twin of our planet. A full digital twin is probably never possible, but getting to certain domains where we can simulate the earth as closely as possible will certainly require the engagement of the major players in Europe on the space side, on the machine learning side, on the earth system modelling side and on the computing side. It is not a trivial project; it's a multifaceted, multi-problem project that we need to initiate and it will take a couple of years. But we can achieve quick results in perhaps two years. That's at least the plan we have now, with first samples of models of digital twins to simulate, for example, extreme weather events on the one side or climate change impacts on the other.

So yes, it's very exciting. I think Europe can really catch up here because we have, on the one hand, a global leadership and, on the other hand, we want to pull up on some of the other domains where we are a bit behind, and the combination of both can be very powerful.

1-017-0000

Ibán García Del Blanco (S&D). – This has been very interesting. Thank you very much for your contributions.

The objective concerns the carbon footprint of the technologies themselves. The cooling equipment needed for the development of this type of technology alone accounts for an estimated 4% of greenhouse gas emissions. It has also been calculated that, if nothing is done, this is likely to double by 2025. It is true, as the first speaker said, that there are offset systems and that they can even make us do better.

My question is chiefly addressed to the representative of the United Nations or who works at the United Nations. From a global perspective, does this objective really form part of the strategies of all regions in the world, and are we reaching levels of standardisation of approaches to this type of objective, and the internalisation of these needs, even into the algorithms themselves? Here we have just approved rules that call for an environmental requirement in

technologies developed in Europe, but I don't know whether the rest of the world shares the same level of concern about the need to take this type of measures.

Earlier the journalist also spoke of the need to change the materials themselves. In short, these are issues that are all (*inaudible*) necessary, but in practice, is there a true global strategy that we can trust will be capable of delivering everything we need to do?

1-018-0000
Shereen Zorba, *Head of Secretariat, UN Science-Policy-Business Forum on the Environment and Chief of Science-Policy-Business Interface, UN Environment Programme***.** – A very relevant and difficult question. So maybe let me try and answer in two parts.

The first part relates to algorithms and managing algorithms. Well, the UN is the sum of its parts, which are the governments. So governments have to agree to that and they have to take decisions regarding that. So, the United Nations Environment Assembly is going to meet in February, meaning we have a full year for decisions, because it's going to be adjourned until February 2022. This gives us a whole year to work with governments on regulatory frameworks and to actually try to first launch a study on the environmental impact of AI.

Second, how do you want to regulate? Should you regulate AI or regulate algorithms when it comes to the environment and emissions? Well, we need a study first; we need a base line and then we need to move from there towards regulation.

The UN Environment Assembly (UNEA-5) has a whole year until February 2022. I think this is an invitation to Member States to go ahead and give us their marching orders.

1-019-0000
Stéphane Séjourné (Renew). – Thank you for these very interesting contributions.

As we can see, infrastructure and process in AI are expensive, and the digital transition will have to be part of the environmental transition in habits – I think we are all aware of this. And artificial intelligence will greatly improve our habits. We are meeting today via videoconference, and some of us have used neither a train, nor a plane, nor a car to enable us to take part. This is also technological progress, a green factor which I believe to be a competitive advantage but which must remain a factor in innovation and performance.

I have some questions about what Members of Parliament ask themselves as they wonder about their role as part of the governance operation.

The issue of technological standards is a global one which everyone is rehashing: as we await global governance, what is the role of national parliaments and, from our point of view, of the European Parliament in sectoral legislations?

Can we move forward on some things without calling into question global competitiveness in this area, or should we wait for us to be organised internationally before we act? It is a question of our usefulness at the present time with regard to these areas of transition.

1-020-0000
Clara de la Torre, *Deputy Director-General (DG CLIMA)***.** – I would like to go back to the answer from the representative of the United Nations, who said that we have a collection of decision-makers and governance systems that must operate in tandem.

As you know – and this applies to the European Union and all international organisations – the fact that the European Union can present a common position – a common governance – has inspired other parts of the world to follow its example and take decisions either at local or at

United Nations level. Just think about all the climate negotiations, all the statements made after the European Union announced its intention to become climate-neutral.

As you know, the Commission has drawn up a plan to coordinate artificial intelligence actions in the Member States and intends to review the plan in the course of this year to make sure that what we do at European level – or at least at the level of the Member States of the European Union – results in good synergies, that we are heading in the same direction, that we have the same vision and that we share the same values. This is easier said than done, but we will do our utmost to achieve it.

1-021-0000

Alessandra Basso (ID). – Thank you, Chair. Thank you to the speakers for their fascinating contributions.

I have a question for Professor Pitron concerning the over-exploitation of the rare metals required for the digital transition. I can think of a number of issues to which this energy revolution could give rise. Indeed, you have already mentioned them yourself.

First, paradoxically, we are facing ecological and human rights challenges. Extraordinary, unique places such as the salt lakes and Bolivia are being destroyed by lithium extraction, which drains the water supply, depriving poor farming communities of this scarce resource. Or then there's cobalt mining in the Democratic Republic of the Congo, an industry which – against a backdrop of political instability – relies on child exploitation. And all for a technology that may become obsolete in a few years.

At the same time, this push for the green transition may have devastating repercussions at the global strategic level. In 2019, China was the world's largest producer of rare earths, but also the largest importer, followed by the United States. This industry is, then, hugely concentrated in a single country which, paradoxically, is likely to become our main competitor.

Therefore, I would ask: are we not perhaps investing too much in technologies which are still in their infancy, and so potentially throwing money at the wrong solutions?

You spoke about using new technologies to optimise the mining of these rare metals, for example through the use of smart mining and blockchain to identify whether metals have been environmentally extracted or not. How do you envisage deploying such technologies in technologically less-developed countries, such as some third world countries?

1-022-0000

Guillaume Pitron, *journalist and author***.** – You have mentioned a number of points which I will try to address very briefly.

You asked which metals are environmentally sustainable and which are not. There are essentially no environmentally sustainable metals. There is no such thing as a green metal. There is no such thing as a sustainable metal.

The best kind of metal is basically one that we do not use. This is not me pleading the case for degrowth: far from it. It is not my way of looking at things, but what is certain is that, by definition, we need to use fewer resources, even if this means simply being more conservative in how we use digital technologies – which we replace, on average, every 18 months – on a daily basis, to name just one area.

The most sustainable kind of metal is the one that we recycle. The problem today is recycling not just big metals, which we recycle relatively freely, but also small metals. This is an expression used by economists to describe much rarer metals in the earth's crust or which are

more diluted than big metals and are integrated in technologies – particularly digital technologies – and also in green technologies in such a way that they cannot be recycled. And so we find that the recycling rate for some of the small metals, which are also critical metals as defined by the Commission, is 15%, 10%, 5% or even 0%. The issue of recycling is therefore an absolutely fundamental one; even more important is the matter of collecting these primary materials.

More generally – and I can only agree with you – we must, again, implement this green transition. It is better to have green technologies than oil-based ones. But this is not simply moving from darkness into light: it's rather more complicated than that. Whether or not we build a low-carbon, digital world which would be dematerialised in the service of a low-carbon world by going off to mine huge, vast, outrageous quantities of rare primary materials, this would necessarily result in a reshuffling of the pack in terms of global energy policy. And so to an energy policy based on oil would be added one which was centred around these primary materials, where we are reliant particularly on China.

How then can we extract these resources under decent conditions, in contrast to those favoured by the Chinese? How can we avoid dependence on China, particularly in terms of extracting these resources? How can they be extracted in the most responsible way possible and as locally as possible?

This raises the question of European mining and of whether we can agree to opening mines in Europe to provide our own metals and to mine in the best possible conditions with the aim of making digital technologies as sustainable as possible.

1-023-0000

Kim Van Sparrentak (Verts/ALE). – Good morning. Thank you, Mr Chair. First of all, I would like to thank the panel for being here today to discuss this important topic that is close to my heart. My question today is about reconciling our digital and environmental transitions. We are in a climate crisis and we have to change every aspect of our society as soon as possible to prevent the worst. But, historically, we have seen that optimistic technological promises, such as clean coal, have only delayed real action. So I'm wondering in what ways the Commission is trying to prevent delaying real change in colluding sectors.

We know that artificial intelligence and the availability of data are crucial for the EU's energy transition towards renewables. Also, AI can help save energy in processes, but we cannot ignore the impact of ICT on the environment. An estimate from the University of Massachusetts shows that training AI in digital home assistance costs 300 tonnes of CO_2, and Mr Pitron has already given us an idea of the use of rare materials.

We also see that our increasing data flows in our data centres guzzle energy. In my home country, the Netherlands, we recently opened our largest wind energy farm and the energy produced by this wind farm is being used for the increasing energy demands of data centres rather than actually contributing to lower CO_2 emissions. We must ensure our digital transition and climate transition promote each other and are not mutually exclusive.

My question to the panel – and especially to Mr Pitron and Ms de la Torre – is how can we ensure the digital transition promotes the climate transition, and which regulatory actions are necessary to curb the climate impact of digital technologies?

1-024-0000

Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – This is an important topic and it's not an easy one. When we are referring to transition technologies, for example, as did the Member of Parliament, when we are looking at investments that need to be made, in particular now where we are investing a huge amount of money in a recovery plan, we have to be mindful

precisely of what could be bringing us to what is called stranded assets and will prevent us from really anchoring the transformation we need.

So, transition technologies are two-sided. There are some places where it is virtually the only solution for a while, but we always keep in mind that these transition technologies have to be coupled with longer-term technological transformations that will lead to decarbonisation, and this also applies to digital technologies, whether we are talking about the software or the hardware, as we have heard.

1-025-0000

Guillaume Pitron, *journalist and author***.** – Very quickly, to answer your question, the best way to reconcile these already exists and can be seen in action: it is the so-called smart grid, enabling networks to be regulated.

Green technologies are intermittent technologies. In the absence of sustainable storage solutions, digital technologies' computing tools and services can be used by the electricity network to ensure that the right amount of electricity enters the network and reaches the right person needing to use that electricity at that exact time.

This would result in less electricity being wasted and in better optimisation of its use. Again, these digital technologies – the smart grids – use a huge amount of resources and, interestingly, although the concept of the smart city is much talked about and will definitely be necessary, no one is really familiar with its life cycle analysis (LCA).

The first person to have tackled this is Kikki Lambrecht, a researcher at the University of Copenhagen in Denmark, who attempted to carry out a life cycle analysis of a smart city by considering what each of the digital technologies contributes to the environment and at what cost.

Her results, which are interesting and at the same time rather shocking, show that she does not necessarily arrive at the conclusion that there is a positive outcome. Even if the city was better organised and easier to live in, and if there was perhaps less traffic and it would be more pleasant to live in for 50% to 70% of people, she does not necessarily arrive at the conclusion that there are clear environmental benefits, given the data and the materials which would be needed to construct the smart city. Nonetheless, this is a direction we should move in: we clearly need an evolution towards smarter cities.

1-026-0000

Geert Bourgeois (ECR). – Chair, this is an extremely fascinating topic. I would like to thank all the panel members very much indeed. I see two main themes. Firstly: How are we going to use artificial intelligence (AI) in the fight against climate change? The panel members have already provided many examples of this. I would like to add a few examples from my country's experience, namely using AI to optimise wind turbines or cooling systems of data centres.

But I want to focus here on the fact that AI itself is an energy guzzler. I believe that the EU is uniquely placed to become a global frontrunner, ahead of China and the US. We are leaders or have a very strong position when it comes to semiconductors. In my opinion, we should really focus on decentralisation and limit the role played by the cloud by processing data and applying algorithms as close to hardware as possible.

Ms de la Torre mentioned that research is being done into this. I have a specific question for her: What actions and plans is the Commission putting in place to deploy edge computing and apply algorithms as close to hardware as possible with a view to limiting the role played by the cloud?

1-027-0000

Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – Thank you. I'm not a specialist in the field, so if we have more replies, we will come back to you. But my understanding is that we are working on small devices, which are precisely less intensive in energy and in data consumption. So this is part of the research that is being done. We are not yet there, but we're getting there.

1-028-0000

Sabrina Pignedoli (NI). – Good morning everyone. Implementing the Green Deal will also mean deploying technologies that will help reduce the consumption and use of fossil fuels. Artificial intelligence offers many options in this regard, yet, to date, these have been largely overlooked in the fight against climate change. Are we probing deep enough in exploring ways to harness the full potential of artificial intelligence in this field?

In the context of the recovery plan, what technology will be leveraged to achieve the objectives of the green revolution and the green transition, and to incorporate artificial intelligence into business practices?

Then, I would like to pick up on a question raised by our colleague from the Greens on the use of artificial intelligence and electricity consumption. Has the Commission already performed a general estimate of the possible costs/benefits linked to the use of artificial intelligence in the fight against climate change and in promoting the efficient use of energy, not only of that derived from fossil fuels? Might it be possible to power AI systems using only renewables?

Lastly, a question particularly close to my heart: I would like to know what stage we are at with planning and implementing AI-based systems in the recycling and reuse sector. I am thinking, for example, about the tracking, separation and recycling of plastic.

1-029-0000

Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – Thank you. Indeed, we do not have data on the potential and the consumption of artificial intelligence itself within the whole ICT sector. As I was saying, the digital sector consumes around 2% of energy – even more according to other estimates – and it's increasing exponentially because of the increased use resulting from the digital transition. But I can't give you exact data for artificial intelligence alone.

As to the question of whether we're going to invest in the transitions in the recovery plans: yes. As mentioned, the recovery plans have a number of conditions. Two of them – which are certainly not mutually exclusive but mutually reinforcing – are that 37% of the funds have to be climate-friendly, so invested explicitly in reaching the objective for 2050, and 20% of the funds have to be invested in digital. There will be many projects which will be at the same time an investment, for improving recycling, starting with the collection of waste, which is already a complicated issue, followed by the smart re-uses, which were mentioned. Artificial intelligence is a pervasive technology and is therefore an enabler for many other transitions, namely the green one.

1-030-0000

Anna-Michelle Assimakopoulou (PPE). – Thank you. My question is for the Commission and Ms de la Torre, and it involves the carbon footprint of AI. In fact it follows up on a reply I have just received to a written question from Commissioner Breton, where he notes that the environmental sustainability of AI systems is clearly one of the objectives presented in your communication on building trust in AI. He says that the Commission is acting to improve the environmental performance of AI systems and aims to address the issue in the review of the coordinated action plan of 2021, and is also exploring to what extent this aspect can be included in the future legal proposal on AI.

So I would appreciate it if the Commission representative today could briefly give me a few more details on how this is going to be addressed, the carbon footprint of AI in the review of the coordinated plan and the future legislative proposal.

1-031-0000
Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – Thank you. With due respect, Member of Parliament, I will have to come back to you. Indeed, under the leadership of Commissioner Breton, our colleagues in other DGs are revising the coordinated action plan with the Member States. I am unable to provide you with details, but my understanding is that the proposal is (*inaudible passage*), and I'm sure contact will be made with the Parliament as soon as possible.

1-032-0000
Miapetra Kumpula-Natri (S&D). – Thank you. I very much welcome all the speakers to our committee and I appreciate the topics you all raised. I appreciate the digital twin as another globe to analyse the climate change efforts and also what we can do to prevent the big picture from the weather changes and so on. I also welcome the UN to work with us; I hope we can continue. I have been reading the new digital strategy for the UN and noted the new tech envoy nation but regret that there was no mentioning of the climate aspect at all, so I wish Ms Zorba good luck in her work in the UN.

But, if possible, I will also ask Ms de la Torre, but if the answer is like the previous answer then the other UN speaker can also comment. My question is that, as we lack the figures, what is the estimation of the ICT data sector needs for electricity? The data strategy mentioned that nowadays it is presented globally and then we work on the data strategy and on the very final graphs. Yet we cannot find the figures that the Commission is using. Still we do have fairly clear road maps for 2050. I welcomed the fact that it was mentioned that the sector's handprint can deliver 10 times more benefits than the footprint, which is the carbon emissions. But then this is in the air if we want to analyse more carefully what is the good we can't achieve because I'm afraid that there is a challenge that we are speaking about limiting the data centres and I strongly believe that, with the help of the AI and better data management, we really can do this 10 times more handprint than footprint.

But I hope the Commission can provide us figures very quickly. And, at the same time, I know that we have to build it from the beginning, respecting the environment and climate aspects for the data centres, for the green programming, for the data minimisation – not to store something that is not used at all. It's neither good for the security. So this is my main question. But if Ms de la Torre cannot answer then I will happily hear from the UN on how they see putting the sectors together in their programmes.

1-033-0000
Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – Thank you. I have some data here which shows that the ICT sector uses 4% to 9% of electricity and that this could increase to as much as 13% by 2030; that's important and the greening of electricity is therefore a must. E-waste is growing by 3% to 5% per year, and we recycle only around 42% of it. The total raw material value that is wasted – and one of the speakers made reference to this – is estimated to be approximately EUR 13 billion, as a result of not recycling this e-waste. And, as I was saying in my presentation, the ICT sector accounts for 2% of emissions – some estimates go up to 3.6% of emissions – and there are estimates that tell us that the ICT footprint could reach 14% by 2040.

Let us not forget either the potential that these technologies have to reduce the overall carbon footprint of the economy by a magnitude of 10.

1-034-0000
Shereen Zorba, *Head of Secretariat, UN Science-Policy-Business Forum on the Environment and Chief of Science-Policy-Business Interface, UN Environment Programme***.** – Following up,

I would just say that, in terms of the carbon footprint, the technology giants, including Microsoft, project that AI will have a footprint of nearly 44% globally by 2025, and this is huge. So, on your point regarding the big data strategy – and I hope you're referring to UNEP's big data strategy, which is due by 2025 and still in progress – indeed, there is a great need to try and ensure that the different sectors are included in our estimates.

Now, we are going to have a very special open session and, through the Chair, we invite you and everybody on the Committee and beyond to speak to the designers of the big data strategy, who will be more than happy to take your suggestions on board. You will also be able to interact with the technology owners, who will be able to say more about AI technologies' footprint – from its energy footprint, e-waste footprint, to obviously its carbon footprint and beyond.

So, in short, the opportunity is still there. We are still working on these aspects and I think, given the evolution of the different topics and the different interests, and also the inputs that are coming in, this is a great moment on the 18th afternoon CET to bring up these topics, and we will open the floor for that to be included. This is the best we can do in terms of inclusivity. But it's also the best format to bring multiple sectors into the conversation as we work on these strategies.

The Science-Policy-Business Forum on the Environment is a UN body that was created as part of UNEP in 2017. It strengthens the interface between science, policy and the business sectors in the context of society at large. From 18 to 20 February, we will have three days of different hearings, where these matters will be discussed publicly, with two panels of experts, and then later the recommendations will be fed to the UN Environment Assembly.

1-035-0000
Susana Solís Pérez (Renew). – It is a pleasure to listen to the experts today.

My question is for Ms De la Torre, because I believe that the Green Deal is probably the most important political measure that the European Union has committed itself to in decades. And the potential of artificial intelligence to help us achieve these goals is beyond doubt. What is more, today's speakers have been saying that without artificial intelligence or enabling technologies we will not be able to achieve the goals.

And the worrying thing is that we in Europe lack resources. We have to ensure that we squeeze the most out of our funds in the context of the recovery plan. And some studies of European companies say that this potential is not fully realised because we are not scaling up environmental solutions, and owing to a lack of training among workers.

So I would like to ask you what measures are going to be taken to improve investment in European companies seeking solutions to these environmental challenges. Also – as Mr Aschbacher wondered – what are we going to do to ensure that this green data which is now available is used by society and can be developed and taken by companies as the basis to build an entrepreneurial ecosystem based on this data in respect of which we in Europe appear to have a great competitive advantage?

1-036-0000
Clara de la Torre, *Deputy Director-General, DG CLIMA***.** – Thank you, Ms Solís Pérez, for your question.

Unfortunately, there is indeed a lot of unrealised potential in our investment in technology in Europe, not only in artificial intelligence, but also in other fields, such as clean – in the more traditional sense of the word – technologies and mobility technologies. And, precisely because we know that this one of the European Union's weak spots, we have a series of funds. I could cite the Innovation Fund, which is financed from a proportion of the revenue from the emissions

trading scheme (ETS). This is a dedicated fund for scaling-up and deployment of technologies – none of which are phased out – that have proven effective in reducing greenhouse gas emissions.

The Digital Europe programme also focuses on digital effects, but can also be used to deploy a great many technologies, some of which will be useful in effecting decarbonisation.

And, to be brief, your comment on data is very important. As you all know, the Commission has made a raft of proposals on the digital market, dealing with data and other aspects used to establish who owns them, who has the right to use them, what they can be used for, what the advantages of a very open system are, but also what we have to do to ascertain their impact on competitiveness when that data comes from private companies, and so on. It is a whole world, a complex world, that the Commission is addressing and it is working very hard because this is an absolutely indispensable task.

1-037-0000

Josef Aschbacher, *Director of Earth Observation Programmes, European Space Agency***.** – Thank you for this question on how to ensure that society can use these data. This is of course a very fundamental question. Let me start with what we have in place today, which is the use of Copernicus Satellite Sentinel data, as we call them. They are free and open to everyone. So if you want to see a satellite image of yesterday of your city, of your house, of your surroundings, you can download it for free from my website, the address of which I can give you. This is the principle of free and open data policy.

Of course, if we go towards a digital twin Earth, there will also be a part of the information free of charge, which will be provided because of investments made by the public sector. There will also be a segment that may be commercially available by companies that are offering added value and services that are derived. And this will also be the future philosophy. There will be one part of this AI-based information which will be simulating our planet Earth, our digital twin, and some of it will be available for free, really to create a better awareness of knowledge, of how far we are in the implementation of the Green Deal for example, but some other parts will be offered by commercial companies. So this is really the philosophy which we're working towards, but as I said, we are at the very beginning of creating digital twin Earth, but this is the situation at this point in time.

1-038-0000

Chair. – There was also a nuance related to skills, to jobs and to the readiness of societies from this point of view, for both transformations. Ms Zorba, maybe you would like to address this angle?

1-039-0000

Shereen Zorba, *Head of Secretariat, UN Science-Policy-Business Forum on the Environment and Chief of Science-Policy-Business Interface, UN Environment Programme***.** – Thank you very much and indeed, Chair, this specific point in terms of capacity, whether it is capacity in terms of skill set or capacity in terms of resources and legislation, is a global issue at the end of the day. Europe is very important. Europe has empowered lots of good in recent years in terms of sustainability, and its position in the world to do so and its support of many developing countries and the least-developed countries in this area, in terms of jobs, skills and capacity-building, is immense. Therefore, decisions taken in this area will have an impact.

Therefore, whether we're talking about the carbon footprint, resource efficiency, sustainable consumption and production, or circularity, we know that the technology is there and it is evolving. But, who owns the technology, who has the skill set to develop this technology anywhere in the world – not only in Europe but also in developing countries and the least-developed countries – and who owns the data and who will own the data once the data is configured from data to knowledge using AI, these are big question marks. I hope that we have

the wisdom and the strength to move forward with baseline studies to try and understand better as we take decisions moving forward.

I hope we also use the international platforms available to us through the UN and other multilateral organisations to channel some of the ideas exchanged, the engagement, and finally work towards financing and decision-making.

So, building capacity in an equitable manner is important, but so is having a long-term vision at the end of the road, understanding the impact of the decisions we take today and also sometimes acknowledging some of the limitations.

So, thank you for this opportunity and thank you for the excellent panel and the very thought-provoking questions we received today. We hope to continue this conversation.

1-040-0000

Guillaume Pitron, *journalist and author***.** – Thank you for inviting me and giving me the chance to address the panel and Parliament.

To conclude, I would point out that a dematerialised world will be very materialistic, which is always an interesting paradox to emphasise. Digital technologies are neither good nor bad; they will be what we make of them, and they will accept the good and the not-so-good. They will facilitate the development of fantastic digital tools enabling animal populations or endangered species to be tracked from space or global warming to be better assessed.

From another perspective, they will also enable hundreds of billions of connected objects to be placed on the market, not all of which will help fight climate change and improve our industrial processes but which will serve the most commonplace of our needs – often the most futile and perhaps even the most useless ones.

So there is also this rebound effect, as it was called by the British economist Stanley Jevons, which refers to the best of these technologies being accompanied by an increase in consumption, which drives this dramatic acceleration. So in the end, speaking personally – as someone who has been working on these issues for some years – I do not know if this will deliver more benefits than disadvantages or vice versa. In fact nobody knows, and again, speaking personally, I don't either.

But there have been many studies which have tried to calculate the impact in terms of the benefits of digital technologies, and these have reached very contrasting and even contradictory conclusions. Some tell us that the impact will be positive, others that it will be negative. I have found that those which tell me that it will be positive are generally from the world of business, while those which tell me that it will be negative are from the world of NGOs. In fact, NGOs and the world of business have never managed to work together on a study or to produce a joint study.

The fact is, they do not understand each other – this is what I have found by talking to a lot of experts about this. Should we not begin by considering these opposing opinions together to produce a study which lets us calculate the cost of digital technologies as against their advantages in an objective way? And with the aim of having one piece of information which should be as reliable as possible, rather than a mass of data which confuses us – and me in particular as a journalist, as – once again – the data come from different, contradictory sources.

1-041-0000

Chair. – Thank you very much, Mr Pitron. In fact, I would like to thank all four speakers for spending time with us at our hearing this morning and for giving us very interesting perspectives on today's topic.

Panel II: Exchange of views with experts

1-043-0000
Chair. – We will now move on to the second panel, where we are hoping, referring to what Mr Pitron was saying about the lack of a clear study and clear data as to whether we actually have benefits or not from the balance between benefits and costs, to see if we have the right balance. We're zooming into a different perspective on today's conversation, because we are going to hear from the academic sector and have two very interesting guests: Postdoctoral Researcher, Lynn Kaack, from Zürich, the Chair of Climate Change AI, and Victor Galaz, Deputy Director and Associate Professor, from Stockholm Resilience Centre and Programme Director for Beijer Institute of Ecological Economics. We also have a representative from the world of business: Cathleen Berger, Sustainability Steward at Mozilla.

1-044-0000
Lynn H. Kaack, *Postdoctoral Researcher at ETH Zürich and Chair of Climate Change AI***.** – Good morning and thank you so much for the invitation.

AI can be used in many different ways to help climate change mitigation and adaptation. For example, it can help to develop next-generation batteries, it can monitor land use changes and it can improve rail operations. These are just a few examples. Together with leading machine learning and climate researchers, I wrote a report with more than 800 references, providing a good impression of how many different ways machine learning can be used to address climate change. Today, I wanted to share some ideas on what Europe can do to promote research, development and demonstration in this area and to align AI with climate strategies.

The first idea is to create dedicated multi-disciplinary research centres. Climate change mitigation is not a field; it's a goal that encompasses a whole set of fields, including natural sciences, engineering, public policy, and many more. Machine learning and these fields do not naturally overlap, and it can be difficult to bring the right people to the table.

I did my PhD at Carnegie Mellon University, which is a leader in AI but also unique regarding interdisciplinary work. What I learned there is that you do not only need to put people from different disciplines into the same room, but you also need to educate some who know a bit of both, and they can translate between the disciplines.

So one approach for the EU could be to create dedicated research centres, modelled for example on the Mila - Quebec AI Institute in Canada or the proposed GBP 100 million centre for AI and climate in the UK.

My second point is to ensure the democratisation of AI literacy and implementation capacity. I like to think of AI and machine learning as a new engineering discipline and this means that organisations looking to leverage AI for sustainability need to have expensive AI engineers on their teams. One idea could be a programme to fund machine-learning engineers to spend some time, for example two years, in an organisation or company to work specifically on climate-related problems. Like this, the EU can help organisations develop AI expertise internally for their greenhouse gas emission mitigation programmes. This approach could also prevent outsourcing important expertise and sensitive data to tech companies.

The third idea is to develop standards, best practices and appropriate regulation. So, the EU has a goal to be carbon neutral by 2050, which means that climate action will have to happen on a very short timescale. However, if applied wrong or unnecessarily, AI can be a distraction, and it can divert time and money away from other approaches. This means we need to get things right from the start and the EU can take a leading role in developing best practices and standards in this area.

So, there's a lot to be figured out if we want to make AI part of existing processes, especially in critical infrastructure, which is so intertwined with climate change. For example, electricity system operators need to be able to trust the AI-based forecasts that they use for decision-making and the forecasts also need to be adapted to their needs. In these sectors, some existing regulation also needs to be revisited and adapted to digitalisation and AI. So, AI applications and critical infrastructure must have people in mind and incorporate considerations of trustworthiness, in particular ethics and robustness.

There are many more policy approaches that could be discussed here, but I want to take the time to share two final thoughts. Please be attentive to the technological and economic changes that AI brings and how these affect climate change strategies. In particular, AI encompasses a wide set of methods and technologies that can, for example, also be deployed for oil and gas exploration. AI can also boost economic activity or change technologies in ways that bear new challenges for climate change mitigation. So for example, autonomous vehicle technologies can potentially increase driving. From a decarbonisation perspective, we will need to monitor such developments closely.

And the last point is, don't let AI detract from other decarbonisation approaches. It cannot replace most of them. For example, smart building technology cannot replace energy retrofits on buildings, like insulating the envelope. Therefore, I really like to think of AI as a tool to help leverage the climate change approaches that are already on the table.

1-045-0000

Cathleen Berger, *Sustainability Steward, Mozilla***.** – Thank you so much for inviting me. Many aspects that I'll touch upon have been flagged today already, and this just shows that it's no doubt an incredibly timely and important discussion. Both digital and green developments provide an immense opportunity to drive change and make a far-reaching, positive impact, but they need closer coordination, making sure that one learns from the other.

I'm going to start with the EU's approach to AI. I very much support the objectives to develop a human-centric approach to AI that the EU is putting forward. There's promise and potential for new and cutting-edge technologies like AI to provide immense benefits and advancements to society, for instance, through medicine, through satellites, through food production – all of which are getting more important as the climate crisis rages on.

At the same time, we have seen some harmful uses of AI amplify discrimination and bias, undermine privacy, and violate trust online. In addition, the volume of data stored across the world – data that is used to train AI – is growing. In fact, it's likely to quadruple from the current 40 zettabytes to 175 zettabytes by 2025. This requires immense resources for data storage and processing, handled by massive physical data centres. These data centres have a significant environmental footprint, not just in terms of the amounts of electricity they consume, but they also require land to be built on, gallons and gallons of water to be cooled, and the hardware in these data centres contains rare earth materials that are still being mined under questionable conditions.

In other words, the benefits of AI have to be assessed in light of their tremendous impact on scarce resources. This brings me to the European Green Deal. The actions set out in the EU's Green Deal are all critical, though they lack ambition in view of the scientific advice on how much and at what speed we need to transform our society. One critical question for me is not so much whether technology has a role to play but which technologies will really make a positive difference in the long term. To answer this, we need to be in a better position to do our homework and generally assess the environmental impact of technologies and digital products, specifically AI.

I'm going to give you a practical example with Mozilla, the organisation behind the Firefox browser. Mozilla conducted its first greenhouse gas emissions assessment last year, and we learned so much. To start with, greenhouse gas emissions accounting is incredibly complex, though it forms the basis upon which we know how and where to actually improve, and we are in dire need of actual best practices on how to do so well. In addition, I'm still surprised as to how little detail or meaningful guidance there is about how to actually measure the environmental impact of digital products.

We reported that the impact of the use of Mozilla products makes up 98% of Mozilla's overall greenhouse gas emissions. That's significant, and it is absolutely an approximation. We can't yet actually measure the energy that's required to run and use our products specifically. Instead, we are estimating how much power is required to use the devices needed to access Mozilla products for the time we know people spend on them. So, in other words, we estimate the overall impact of desktop computers, laptops, tablets or phones while online.

Whether people read the news, use their email, watch cat videos or shop, we don't actually know or differentiate that. For now, this helps us get a sense of the impact of the internet on the environment, but it makes it really challenging to know how to best mitigate its effects through our products. In addition, I learned through talking to a lot of experts over the last years that scopes and categories that companies and organisations report on is anything but straightforward, which makes comparing results immensely difficult – if indeed they share their numbers at all.

But without greenhouse gas emissions assessments, how do we even know whether the tech that we invest in is really environmentally friendly? This is certainly true for artificial intelligence. So, the positive uses of AI for mitigating the climate crisis can only be net positive if we know their own environmental impact. And we've heard so many numbers today like, 'ICT is 2% of overall emissions', 'could rise to 13%'. But what do we actually account for in those numbers? Is it electricity only or all the categories that need to be accounted for in greenhouse gas assessments?

To sum up, the talent is to create the space for innovation while really remaining vigilant about the risks and protecting against them, notably for the environment. And I'm not telling anyone anything new, that we need systemic solutions, but the focus for me as a business representative is the fact that we need standards for greenhouse gas emissions accounting and we need mandatory, transparent reporting against all scopes of the Greenhouse Gas Protocol (GHGP) to make results comparable and be able to have cross-sector and cross-industry collaboration to really make sure we have net positive impact on what we're trying to achieve. And that probably also means that we need regulation for environmental impact assessments in the tech sector, including for digital products and emerging tech like AI.

As a practical result, it also means investing in open-sourcing emission factors, calculation formulas and tools that don't just approximate but actually calculate the impact of digital products too. Because having done it so far, we don't know how to do that and it's very costly. Some of the big tech players may be able to do this, but as soon as you look at small and medium-sized enterprises, it's going to be way too costly to do this well. So if we want to have actual data that guides our decision-making, we need to invest in making sure it's available.

1-046-0000

Victor Galaz, *Deputy Director of Stockholm Resilience Centre (Stockholm University) and Programme Director at Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences)***.** – Thank you for inviting me to speak to you today on this very important topic. Since my time is limited – and more limited now – I will focus my contribution on three observations

and three concerns that I have, and on three recommendations that I believe are very important in this domain.

Let me start with the observations. The first observation is that the definition of climate and climate change whenever we talk about AI is often too narrow. Applications of AI span beyond modelling a prediction and optimisation of energy systems and traffic flows. I think we need to recognise that the climate system is fundamentally connected to our living planet, so that means biodiversity, forests, oceans, agriculture, ecosystems and more. If we embrace this connection, we need to embrace our role in it and promote a constructive agenda that brings together a responsible development and deployment of AI which acknowledges that connection.

My second observation is that applications of AI include issues that are much broader than climate mitigation and optimisation of resource flows. I think AI has the potential, if used responsibly, to help people and communities, civil society, governments and the private sector to reduce risks, to support climate adaptation and, at best, even to inspire climate innovation. We need that broader view today.

My third observation is that the time to direct and steer the potential of AI for the climate challenge is now. There is a growing interest in society in general, in the private sector and in the research community, and these are all mobilising and shaping their agenda and setting up plans. The urgency of the climate challenge makes this an urgent need and a good time to direct the potential of AI. So, I think the potential of AI for the climate challenge is not about optimising systems, but augmenting the capacity of people to address the climate challenge in all its dimensions.

The three concerns. The first is related to the risk of hype. I think as the pressures on our climate system and the living planet increase, so does our hope that we will be able to find AI solutions to deeply complex challenges and social and economic challenges. I think our knowledge about whether AI does actually offer large climate benefits is very limited. The assessments that I've seen so far are not only preliminary but, at times, I would also say too optimistic. Some of this hype is quite often advanced by the private sector and I think it could use a solid reality check as the field evolves over time.

My second concern relates to exploration. I think the deployment of AI systems and related technologies, like 5G, the internet of things and robotics, may very well lead to the accelerated extraction of natural capital and loss of ecosystems. The concern lies not only with the possible accelerated extraction of fossil fuels and minerals, but also with the expansion of monocultures on land and seascapes, loss of biodiversity and, of course, increased pressures on raw materials, as was mentioned earlier this morning.

So, if we're to use AI in a responsible manner, we need to find ways to break the cycles of acceleration and of loss of resilience that have created the problems we see today.

The third concern is lack of transparency. I think all of us in the research community investigating real-world applications of AI systems discovered very quickly that information about models, data and implications is treated as proprietary information by the private sector. This is a concern because a lot of innovation in the sector is driven by the private sector, and limited insight means limited transparency, and limited transparency also means limited accountability.

So how can and should the EU and representatives of the EU Parliament try to address these challenges, and support the planetary responsible development and deployment of AI? There are three key aspects, as I see it. To sum up, one is that I believe that the EU needs a clearer agenda on how AI could support planetary stewardship and resilience. To me, integrating our

living planet in the climate system is the key aspect and making sure that AI supports not only mitigation but also climate adaptation and innovation. So the world doesn't need more AI; it needs smarter AI.

Second, the EU needs to develop better overview capacities of AI-augmented technologies in domains critical for climate stability, and a safe and just transition towards sustainability. That means monitoring, supporting, and, when needed, even challenging the deployment of AI technologies, as they shape our ecosystems, the climate system and even our perceptions of our changing planet.

And then the last point. I believe that the EU needs to explore and use its influence as a large investor in these technologies. This means demanding that companies and government agencies make sure that the data is findable, accessible and reusable, while ensuring fairness, accuracy, confidentiality and transparency. These are two principles known as fair and fact, and this applies to both the data and the algorithms and tools they use.

I realise these are all big questions and big challenges. But, again, I think the time to discuss how to direct the development of AI systems for climate stability and sustainability for all is now. So thanks for listening and thanks for your engagement on these issues. I look forward to further discussions.

1-047-0000

Eva Maydell (PPE). – Thank you very much Chair and thank you to all the panellists. My question goes to Ms Berger on sustainability and the tech sector. I assume some of the other speakers might also have a view on the matter, but since it is difficult to take the floor, if Ms Berger could respond, that would be much appreciated.

So, in every discussion we have on digital policy and, more particularly, when it comes to the data strategy, there is the reoccurring theme of the carbon emissions that are steadily growing and that are released by the tech sector. There is a lot of concern that if we do nothing about it, emissions will increase dramatically. I personally think that's the case for any sector. But I also think that the tech sector is key if it has to work on the matter and also reduce not only its own environmental impact but also that of the economy at large.

So I wanted to ask you what sort of, and how many, benefits and, most importantly, efficiency gains have your sustainability efforts had in your organisation and what is your advice to us as policymakers on how much we could realistically put pressure on the sector to become more sustainable?

1-048-0000

Cathleen Berger, *Sustainability Steward, Mozilla***.** – Thank you so much for the very interesting question. It is indeed a good question. I'll give you another example of something I'm struggling with for Mozilla, which although sizeable is a comparatively small tech player.

While we use science-based targets to know whether we can increase efficiency enough to stay within the global warming limit of 1.5° by still growing, providing the benefits of the technology and making sure that we're not using more resources than we can globally in order to stay within those limits, there is no guidance on how to do that for digital products. So we can do that for operations, we can do that for our buildings, we can reduce that for the operations we have and we can work with supply chains and value chains, but so far the guidance is still pending on how to actually adopt science-based targets for digital products, because it is so difficult to actually measure the impact because we can't differentiate what the streaming service is, what the browser is, what the training data is.

We just don't know how to measure it, because the data points aren't there, and it's not comparable. So when we're setting science-based targets, we're setting them assuming that we'll figure out more as we go along and being super aware that the time is running out. There are a lot of voluntary measures and most big tech players have by now committed to science-based targets and carbon neutrality. And we're figuring out how to actually pull it off as we go.

So I think in part it's about increasing the transparency around what's actually going on and in part it's about helping us have the measurements, the tools and the comparisons that are necessary in order to actually implement the steps, because right now we're exploring as we go. So we're innovating in terms of how to reduce as we're trying to implement at the same time. So it's a really difficult question to answer. I can just say that for digital products setting science-based targets is still messy, because there's very little best practice guidance on how to do it well.

1-049-0000

Adriana Maldonado López (S&D). – First of all, I would like to thank the three panellists who have come to this committee meeting today because I believe the issue we are discussing here today to be of vital importance. We are aware that the European Green Deal is here to stay, that we have to be able to work together as a society as a whole to achieve the objectives that we as the European Union have set ourselves.

It is essential that artificial intelligence both helps us to achieve the climate objectives enshrined in the European Green Deal and to bring about digitalisation itself. And the artificial intelligence that we create must also be sustainable, because otherwise we would not be fulfilling the purpose or aim of the European Green Deal.

I would like to focus on two very specific questions.

Firstly, I would like to ask how the speakers think we can make the aforementioned assessment of whether measures are sustainable; how we can establish these elements, these assessment criteria to ascertain whether the sector itself or the artificial intelligence we create is sustainable, and what elements will also have to be taken into account at a regulatory level to make this assessment.

Secondly, I would also like to ask them if they have any kind of map or description of our current situation, showing how the artificial intelligence produced in Europe currently compares to that from the rest of the world in terms of the sustainability of the sector.

1-050-0000

Lynn H. Kaack, *Postdoctoral Researcher at ETH Zürich and Chair of Climate Change AI***.** – So the question was how do we actually measure the impact of AI applications. Here one thing one has to realise from the start is that AI is often just a component of a larger product or strategy that's employed. So, ultimately, the traditional ways of estimating the impact of that product or strategy can be employed, but then estimating the additional benefit of AI is still difficult. So here, I think research into AI impact assessments is still at the very beginning.

Another thing I want to point out is that feasibility is really important here too. So if we evaluate a proposed solution, we have to really understand if it is something that can be employed at scale, something that will always look the same in different organisations or products where it's being used. Here we're still really at the beginning of understanding this space.

Regarding the second part of the question about whether AI developed in other countries has a different impact on the environment, I have not come across differences here but I haven't had a closer look into how to even measure these differences. Sorry, I don't think I can make a statement on this.

1-051-0000
Victor Galaz, *Deputy Director of Stockholm Resilience Centre (Stockholm University) and Programme Director at Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences)***.** – Those are very good questions, thank you very much. Since this is a growing and relatively new field, I would say that one useful way to look at it would be through the sustainable development goals – if you're interested in impacts, that is, in really looking at the full social, ecological, climate impacts. What is challenging in our domain is the fact that we're mostly focusing on direct impacts. So we're focusing on the carbon emissions, for example, from these models.

What I find difficult is the fact that the indirect impacts will be much more difficult to assess since they happen in different systems and they happen over a very long time lapse. I think a fair comparison would be assessing the impact of social media. How would we have done that 10 years ago? And I think we would all agree that just focusing on the carbon emissions of social media servers would be a very limited assessment of the impact it has had on our societies at large. So I think, as a community, we are still struggling to get to the indirect long-term impacts.

Differences between AI systems developed in Europe and the US? I haven't seen any studies on that yet, so I can't answer that. I would guess that the differences are not that large, but it remains to be studied.

1-052-0000
Svenja Hahn (Renew). – Thank you Dragoș. We are tackling the biggest challenges of our time with science and technology. This is clear from the pandemic, and it must also be our response to climate change. Our living conditions and economy do not become sustainable simply by our doing without things; it is rather through progress and innovation that we make a sustainable and responsible future possible.

The EU has set itself very ambitious goals with the European Green Deal, particularly a significant reduction in CO_2 emissions. But we can only achieve this with technology and innovation and especially with artificial intelligence. This is why 20% of the Recovery Fund is going towards digitalisation – and rightly so. An outstanding digital infrastructure and a proper, innovation-friendly legal framework are indispensable for Europe to be successful. Digital policy and AI legislation must be European. Countries going it alone enfeeble our common market and our capacity for innovation.

We are currently working on this legal framework in the European Parliament, and I am certain that this will enable Europe to become innovation-friendly and that we will be able to combat climate change together with digital solutions. Because the Green Deal and digitalisation must go hand in hand.

I would like to ask Ms Berger von Mozilla some questions. The effort you are putting into sustainability is most impressive. Could you perhaps tell us more about the cost of the measures, and also when you expect them to become economically viable? If you could say something about that. What can other large corporations, for example, learn from the example of Mozilla? And what measures would be practicable or advisable for small companies to take? And above all: do you have any tips for us as politicians? What can politics contribute here? Thank you.

1-053-0000
Cathleen Berger, *Sustainability Steward, Mozilla***.** – Thank you for the question. I am going to switch back to English just to make it easier for the interpreters.

The costs of this are significant. In order to do the assessments, we had a team of over 60 people within Mozilla who had to collect data for us. So if you just count the hours worked by people

doing that, plus my team working full time on these issues, it's quite a significant investment, not to mention the experts we had to hire in order to make the calculations; it's not something a small company can just pull off. It costs a lot of money, and then to go for carbon neutrality on the emissions that we haven't yet been able to avoid, we had to invest in sequestration projects to offset them. So we're definitely talking six figures to pull that off. It's significant.

When will this pay off? It pays off because our business is not relevant if the planet is no longer habitable. So this sort of investment is always a long-term investment and it's really hard to make the cost-benefit analysis. At the same time, it is very clear, given the scale on which we operate, that there is no question that this investment is absolutely necessary, because we have a responsibility. We can't, as a mission-driven organisation, ignore the fact that products in our operations have an impact on the planet, so it's necessary.

What can we do to help pay this forward and make sure that others come along? As I said before, we need way more transparency and best practices, so we need to help open-source the tools and the methodologies to make the results comparable. It's going to be tremendous, particularly for –medium-sized companies – to not have to pay that much money in order to make those calculations.

I would also note that a lot of the emissions factors, if you are operating globally, are behind paywalls. You have to pay licensing fees in order to be able to make those assessments on an annual basis. If we are really committed to making this change, supporting this through governments, through initiatives, is probably going to be critical, because otherwise you can't force companies or smaller organisations to pay more for that. So there's definitely a lot to be opened up and made more transparent and comparable. Mozilla will do its part to publish as much as we can on what we have learned, including the methodologies, but it's a process that takes time and definitely significant investment on our side as well.

1-054-0000
David Cormand (Verts/ALE). I hope I won't have a connection problem but I'm not sure: the connection is poor where I am.

Thank you for your very interesting contributions on this complicated topic. The issue which concerns us in today's hearing is to find out how we can ensure that the development of artificial intelligence will help us to achieve the objectives of the European Green Deal and even to do more than that. How we can find out if this technology will help us move towards a green transition or, by contrast, if it will keep us rooted in the current model, one which is destructive from an environmental perspective and which generates greenhouse gases.

We firmly believe that, if artificial intelligence is to be sustainable, there is no point in optimising the existing development model by tweaking it – we know it is unsustainable; what we need to do is identify new solutions, imagine a new future, a new way for our economy, consumption and production to function. Seen from this perspective, there is a danger that some AI applications will make us even more dependent on gas pipelines, industrial and chemical agriculture or geoengineering. There is no sense in all of this if it serves no purpose.

Similarly, some solutions might seem useful, such as the development of smart buildings, in improving the energy and heat efficiency of buildings, yet they may have many rebound effects which nullify or reverse the desired benefit of reducing greenhouse gases.

I would therefore like to ask you the following questions. How are you going about ensuring that AI applications do not result in more disadvantages than advantages? In particular, how can we ensure that cost-benefit studies on the social and environmental impact of a particular artificial intelligence are carried out automatically, before its development?

Do you think there is a need to regulate mandatory provision of access to the environmental data of digital technologies? Do you think the idea of planetary boundaries developed by the Stockholm Resilience Centre is a good framework for assessing the net impact of artificial intelligence?

1-055-0000

Victor Galaz, *Deputy Director of Stockholm Resilience Centre (Stockholm University) and Programme Director at Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences)***.** – Thank you very much. That's a difficult and very challenging question, but I think if I can offer a general overview of the science – sustainability science in particular – in terms of steering technological development, I think you need to be very clear on three different things, especially from a policy side.

First of all, the direction, meaning where you want this technology to go; you need to be very clear on that direction and vision of that. The second thing is to make sure that you promote diversity. So you need to acknowledge that AI technologies are just part of a very rapidly moving technological domain and make sure that you have that diversity, you promote diversity of these technologies and applications.

And then the last point, which is probably the most challenging, is to make sure that you have a proper overview of distribution – distributional effects – that might be both positive benefits, but also risks, and to develop that overview capacity of these AI systems. And that's a very big issue, but it's an issue that many governments are struggling with at the moment. What I think the EU could do is to have a much clearer sustainability focus on that overview capacity and skills.

So that would be my recommendation: a clear direction, make sure that you have diversity and make sure that you keep track of distributional impacts on these technologies.

1-056-0000

Sabrina Pignedoli (NI). – The pandemic has changed the way we live. Has a study been carried out to ascertain whether over this period people and businesses have changed their views on artificial intelligence, sustainability and the fight against climate change?

Lockdown brought home the importance of the local community and the need to strengthen AI systems at the local level – at the village, small municipality and city district level. Are there any projects designed to set up local data ecosystems to foster smart and interactive communities? What stage are we at in rolling out edge computing across the EU's many peripheral regions? Are there any plans for related partnership schemes bringing together institutions, academics, the world of finance, and business?

1-057-0000

Lynn H. Kaack, *Postdoctoral Researcher at ETH Zürich and Chair of Climate Change AI* **.** – I am not aware of a study regarding the opinions of citizens on digital AI and sustainability, but I can't exclude the fact that one exists. Regarding decentralised AI capabilities, I think I addressed that a little bit in my talk. So far these machine learning researchers and experts are a scarce resource and they're fairly expensive, so there is still an issue with skill here, with skilled labour. But it's definitely a strategy that should be promoted to increase the capacity to set up and deal with AI models on a local basis in small organisations, small companies and local governments, and there's a lot to be done in this regard.

So far most of the AI capacity is with large tech companies or data consultancies, which would be in most cases employed for such applications, and I think it's really important that local governments and smaller institutions build this kind of capacity if they are looking to leverage

AI models. This is in particular with regard to the long-term sustainability of such models because they do need to have somebody who understands the model really well for the lifetime of its use, to facilitate retraining, for example, adjustments of the models. So it's really important to have this kind of expertise with the people who are using the models.

1-058-0000
Henna Virkkunen (PPE). – Thank you, Chair. Thank you to all our experts. It was very interesting to hear your thoughts and priorities, and how we could benefit from AI when fighting climate change. I think it would be more interesting to hear from the research and business side now. If we want to boost investments and innovation in this field, what should be the main priorities at European level? Many of you already mentioned priorities, but if we could speak now especially about the recovery plans, because the Member States are now planning where they are going to invest to recover, and the Green Deal and digitalisation will be priorities.

So, what would you like to see now, as all the European Member States are planning their investments? What should be the top priority now from an AI perspective, if we try to combine it with the Green Deal? Is it more infrastructure? Is it research and science? Is it innovation, SMEs, educational skills? What is the most important area this year? Where should the Member States invest now to make sure that we can boost investments and innovations in this field?

1-059-0000
Cathleen Berger, *Sustainability Steward, Mozilla***.** – Thanks so much for that. I was sitting here thinking of all the things. I am not sure I have the answer for this fascinating question. There are so many AI applications that right now it would be very tricky for me to pick a single one, or just one field, to make the investment in, because we need systemic responses. Moreover, as we've discussed all morning, at this point we don't necessarily know what the cost-benefit analysis is for a particular AI implementation. But I do think that, as we invest, asking for that sort of transparency and asking for an assessment before we make large-scale investments – no matter whether that is in innovation or in mitigation – is the question.

So, we need investment either way, because we are pressed for time to make the green transition and recover after all the investments we've made in the pandemic, but before we do so, let's make sure we have the assessments, so we don't regret whichever field we choose to invest in the most.

1-060-0000
Victor Galaz, *Deputy Director of Stockholm Resilience Centre (Stockholm University) and Programme Director at Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences)***.** – I think that's a very difficult and very important question and I will probably repeat what I've said already, but I think: avoid thinking that there is one solution that you can just invest in to get a big impact. I think diversity is key here. Invest in diversity, invest in an infrastructure that is accessible to people, civil society and governments and companies. I think it's not AI technologies that will help us solve the climate challenge, it's people. So make sure that it is accessible.

The second part of it that I think is really, really critical, again repeating myself: make sure to develop overview capacities. So make sure that you keep track of risks proactively and as these technologies move into society, how do you make sure that the distributional impacts are what you would like them to look like, to avoid distributing risks among the most vulnerable, for example, or making sure that the benefits are distributed in a fair way. So I think diversity and overview capacities are two key aspects.

1-061-0000
Adam Bielan (ECR). – Thank you Chair and sorry for the delay. First of all, I would like to thank all the experts for their interventions. My attention is drawn mainly to Ms Kaack and the question of using AI in the fight against climate change. The EU has taken many measures to

decrease the carbon intensity of freight, but it seems that more can be done using AI tools to manage this, particularly by more efficient multi-modal connections.

The recent mobility package is a vivid example of law, which actually represents a step backwards. Indeed, the compulsory return of vehicles effectively pushes out some transport providers from the EU's single market and imposes significant barriers on others. In other words, we now have empty trucks having to return home, eliminating efficiency gains that could occur, and potentially producing unnecessary emissions. Do you believe, based on your research, that Members and Commissioners should have considered different legislative measures employing AI, and what can be done at this stage? In addition, I would like to ask you how AI could address cities' day-to-day climate-related challenges. In your view, how can public administrations tap into these types of resources, using smart public procurement, for example using Gulf tech platforms?

1-062-0000

Lynn H. Kaack, *Postdoctoral Researcher, ETH Zürich, and Chair, Climate Change AI***.** – Thank you so much for your questions. So, in the freight sector AI can, for example, help to coordinate between modes in so-called intelligent transportation systems, which are currently under development, and it can also help to have more efficient routing or to consolidate freight in less-than-truckload settings, where you actually leverage larger shipping entities for multiple shipments. So there's a lot in terms of optimisation and efficiency gains that can be done via AI or computerised algorithms. This potential has to be incentivised economically.

So I think it's always really important that when thinking about making efficiency gains through AI which should have an impact on the climate, we need to create economic incentives for the businesses, for the shippers, to actually leverage these technologies. I think that's really our main lever that we have here.

Regarding urban areas and how they can leverage AI, I would say that currently the technology is very much at a pilot stage. There are a lot of proven concepts from research and there are some examples where these things have been tried out in reality. But what really needs to happen now are more pilot projects, more demonstration projects, to really understand the costs and benefits, and the risks associated with these types of technologies. There is even an EU fund procurement programme, which is called 'AI4Cities', which is specifically targeted at using AI for sustainability applications in urban areas. This, to my knowledge, is the only dedicated procurement programme in this area. So there is a lot to be done in terms of making these projects become a reality and really understanding what it means to implement them and what the costs and benefits associated with them are in reality.

1-063-0000

Maria-Manuel Leitão-Marques (S&D). – Thank you for all the presentations. This is very useful for us lawmakers, especially considering that we will spend most of 2021 discussing AI in the European Union and, of course, the Green Deal.

My question is for Ms Kaack. Clearly AI can be a powerful tool to solve climate problems, demonstrated here with proposals ranging from CO_2 reduction to modelling emissions and precision agriculture, and so many other applications which have been discussed here today in different presentations and also clearly in the AI climate change paper.

I saw a recent interview where you mentioned the difficulty of attracting AI and data science experts, data scientists, to solve the societal challenges of finding a high-paying career in that sector. This is a very important problem. How can the EU help? By increasing funding for AI and climate projects or for research? It's by having a good data strategy for climate-related data.

Regarding data strategy, Ms de la Torre from the European Commission was with us in the first panel today and spoke about the creation of a Green Deal data space that pools and expands access to climate data. Could that be a solution to unlock decentralised local AI solutions for climate problems instead of relying on big tech where most AI expertise and resources is currently held? And what is the impact of this decentralised view and approach, also in the conception of energy, which uses a decentralised model to stock our data? Thank you very much.

1-064-0000

Lynn H. Kaack, *Postdoctoral Researcher, ETH Zürich, and Chair, Climate Change AI***.** – The first question was on the difficulties of bringing tech talent or machine learning talent into the sustainability space. Here I think we have multiple levels of difficulties. The first one is that working on sustainability applications, on climate change applications as such, is very difficult if you're not from the field itself. So if you are a trained machine learning engineer and have spent most of your career working on machine learning problems, you will have difficulties understanding where to even start applying your skills in this area.

Then we also really need to facilitate interdisciplinary and cross-sectoral collaborations between machine learning engineers and those who really understand the problem, in order to develop ideas that are meaningful and useful in practice. One thing to consider, and here the EU could actually be helpful, is facilitating routes for machine learning engineers who are already interested in working in this area. The idea would be to match them up or place them in institutes, organisations or local governments that have a need or an interest in developing these kinds of strategies. This will help the machine learning engineers to really understand the problem that actually needs to be developed as they sit within the organisation and have access to all of the issues, the knowledge and the data, and it will help the organisation to develop the skills internally and understand better what they need in the long-run to employ this kind of approach.

Then, regarding open data, it's always useful for planning or decision-making in general to have access to this data. It's a really important prerequisite, but it's not sufficient. So, you need to have the expertise on what to do with the data and you need to have a good grasp of the problems faced to understand how this data relates to the problem that you're trying to solve. So, yes, it's necessary, but it's not a sufficient step to actually get things going. You also need to understand the analytics and the problem-solving that can be done with this type of data.

1-065-0000

Susana Solís Pérez (Renew). – Thank you very much to all the panellists, I really appreciated the approach you took in your speeches.

I think we need technology to meet our climate change targets and we in this AIDA Commission are interested in ensuring artificial intelligence has an ultimately positive impact on society.

And we are therefore engaged in thinking – as well as having very valuable reflections from you – on how to assess the impact of technology and, as has been said before, how to quantify progress. And I think, given what has been said, that companies have to make a comprehensive assessment. Just quantifying the economic impact of technology – that looks like the easy part – is not enough, as Ms Berger said, we need an environmental impact assessment, and that is no easy task. You said that there is a lack of guidelines and rules on how to measure this, and I would like you to give us some recommendations because I think that is key for this committee.

But there is also the social impact. Mr Galaz said that we need to promote diversity and to know how this technology is going to affect us as a society, how we can ensure it is a fair system and, in short, what future this technology is going to bring. And I think this is a very interesting line of thought for our committee.

And that brings me to a recommendation made by Ms Kaack, which is that we need multi-disciplinary research centres. In other words, it should not just be programmers designing the technology, but also philosophers, sociologists, psychologists, etc. And I would like her to make a recommendation in the field of education. Because I understand that technical universities need to include social sciences in their curricula and that engineers also need to have leadership skills within multi-disciplinary teams. Social science universities, meanwhile, also need to offer technology- and programming-related subjects so students can understand how this technology is created. If possible, I would like her to provide our committee with some insight, some recommendations in this regard.

Many thanks for all the contributions.

1-066-0000

Cathleen Berger, *Sustainability Steward, Mozilla***.** – Thank you very much for that. The question was for suggestions on how we could evaluate and quantify progress better and how to do so. I'll connect that to your second question of do we need to have more multidisciplinary education and integrate that better. I myself studied years and years and years ago but I also studied interdisciplinary and I do think that that interconnection is necessary. We need specialists but we also need to be aware of a lot of things. I think there are some measures that, whether you call it ethical or accountability design, but paying attention to diversity, equity and inclusion, long-term impact, sustainability, privacy – all of those need to be part of our assessment and reporting on the impact on society necessarily includes all of them. It needs to include the impact on climate, it needs to include the impact on diversity and inclusion.

So yes, it makes it more complex and yes maybe it slows down every now and then when you can actually launch a product, but the long-term consequences are going to be that much better for it. And I think the EU, if we take the comparison of the GDPR for instance, we've grown more willing to ask is everything we can do really what we should do when we look at data, because we understand that we need to protect privacy for our freedoms, for our ability to act, for our agencies and individuals. And I think that's the same we need to do in terms of environmental impact. Is the technology or the solution that we're presenting really outweighing the negative impacts on the environment? That's just the question we need to learn to answer for everything we do, and it takes training and it takes a mind-set change, but it's totally possible.

1-067-0000

Victor Galaz, *Deputy Director, Associate Professor, Stockholm Resilience Centre (Stockholm University) & Program Director, Beijer Institute of Ecological Economics (Royal Swedish Academy of Sciences)***.** – Thank you, Chair. I think to follow up on what has been said before, I think applying AI to the climate challenge requires considerable domain expertise. So it's not just something that you can add to a technical degree, I think, but something that tends to be underestimated, and this is something that we discovered here in Sweden – the fact that you need people with the capacity to bridge disciplines and bridge academia and society. I think that's what we normally would call trans-disciplinary skills, and that type of skill set is missing at the moment, I would say. People with the ability to really be able to talk to AI scientists and climate scientists, and at the same time with industry and governments, is definitely missing.

To be able to boost that, my experience is that you need solid long-term commitment to build that capacity up, whether it's research centres or big programmes. It's a skill that will take a long time to develop. So you require a considerable commitment to make that happen.

1-068-0000

Lynn H. Kaack, *Postdoctoral Researcher, ETH Zürich, and Chair, Climate Change AI***.** – I can really only second what has been said before. I mean, we definitely need to bring social sciences and engineering sciences, natural sciences, all to the same table. I myself have such an

interdisciplinary background. It's really important in this area because climate change affects people's lives in so many ways. It affects equity, so we really need to have social scientists on board here.

Closing remarks

1-070-0000

Chair. – Thank you very much to all three speakers for helping us answer some of the questions that we have, as members of the AIDA Committee, in our endeavour to assess during the mandate of this special committee the impact of artificial intelligence in various walks of life.

I think the interplay between the digital and the green transitions was one of the evidences coming forward from today's discussions, but there are also a good number of either still underlying or new questions that have arisen, which makes me believe that somewhere in the course of this year we may need to come back – at least in a more focused fashion – on some of the more concrete elements of today's discussion.

With that I also close the second panel. Again, thanks a lot for the three speakers for making time and for their very useful contributions. As always – or in fact as started at the first substantial hearing we had on AI in health – we will produce a short summary at the level of the Secretariat, with the main conclusions, takeaways, key messages that came out of the interventions today. We will then distribute that to the groups for their contributions.

(The hearing closed at 11.44)