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COMMITTEE ON CULTURE, SCIENCE, EDUCATION AND MEDIA

Addendum to the minutes of the meeting held by videoconference on Friday, 5 February 2021

6. Research policies and environment protection (open to the public)
Rapporteur: Mr Olivier Becht, France, ALDE
[AS/Cult (2021) 03]

Opening of the hearing

The Chairperson welcomed the members and guests. Being the rapporteur, he asked Mr Rampi, 1st Vice-Chairperson of the Committee, to take the chair.

Mr Rampi took the chair. He welcomed the members and guests:

- **Mr Robby Berloznik**, Member of the TEC-UNFCCC (Technology Executive Committee of the United Nations Framework Convention on Climate Change); Senior Adviser, Flemish Institute for Technological Research (VITO) – Director, Programme of the Global Science Technology and Innovation Conferences (G-STIC)

- **Mr Pierre Laboué**, Research fellow at the French Institute for International and Strategic Affairs (IRIS), France

- **Mr Patrice Simon**, Professor at the University of Toulouse III - Paul Sabatier; Deputy Director of the Research Network on Electrochemical Energy Storage (RS2E) of the French National Centre for Scientific Research (CNRS), France

- **Mr Karl W. Steininger**, Professor of Climate Economics and Sustainable Transition, Wegener Centre for Climate and Global Change (WEGC) and Department of Economics, University of Graz, Austria

- **Ms Nathalie Lazaric**, Economist, Director of Research, National Centre for Scientific Research (CNRS) at the Research Group in Law, Economy and Management (GREDEG) – Joint CNRS / Côte d´Azur University;

Mr Rampi reminded the participants that the rapporteur, Mr Olivier Becht, had drawn up a memorandum available online explaining the aim of the hearing and indicating how it would be conducted, and members were invited to refer to it. He called the rapporteur to give his initial presentation and, in order to ensure the smooth running of the meeting, asked him to organise the experts' contributions and the discussions.

Mr Becht noted that the whole of the Parliamentary Assembly's June part-session would be devoted to environmental and human rights issues, which were extremely important for the very future of our planet. Most European countries had signed the Paris Agreement to achieve carbon neutrality. It was necessary to considerably reduce so-called greenhouse gases, and especially hydrocarbon emissions, and with that in mind work had to be done on the energy question. In order to combat global warming and achieve carbon neutrality by 2050, it was necessary to replace hydrocarbons, which were the biggest source of greenhouse gas

[1] Document declassified by the committee on 26 March 2021

emissions, by new sources of energy. It was necessary not only to consider the alternative energy sources available today, especially solar and wind, but also their impact on the environment. A closer inspection revealed that the production of solar panels and batteries to store the electricity produced by renewables required many minerals and rare-earth elements, such as cobalt. Those materials were extracted under environmentally critical conditions and at heavy environmental cost. It might be asked whether work should not be done on other, non-polluting energy sources – ones that were known but not yet produced on a large scale or ones that were as yet unknown but research might one day discover. It would be pretentious to believe that in the 21st century humanity had discovered everything. The atom had been unknown 120 years ago, yet atomic energy had been developed in the last century. It was highly likely, and desirable, that sources of energy remained to be discovered in the natural world and should therefore be sought.

A second aspect to be highlighted was the recycling of raw materials, which were resources required not only for energy generation but also for all industrial production and mass consumption needs. At the pace at which those materials were being consumed, most – crude oil, silver, iron, cobalt, uranium, etc. – were likely to be used up before the century’s end, which was very worrying. That raised the question of what resources future generations would need for their own development, not to mention the risks of pollution entailed by our destruction of those materials once the product had been consumed. It was necessary to develop a circular economy, i.e. to recycle all materials and reuse them in a future production cycle. Despite the progress on recycling, there were still a number of materials that could not be recycled and others that could only be recycled a limited number of times before being destroyed.

Extremely important research was needed both into the development of new energy sources and into recycling. All countries faced that challenge, including major producers of hydrocarbons, such as Norway. The aim was not only to protect the environment but also to ensure economic development because countries that lived off the income from hydrocarbons would have to develop beyond 2050 and achieve carbon neutrality while ensuring their population’s prosperity. He wished to highlight those points in the report.

Mr Becht thanked the experts who had agreed to take part in the two round tables. The first was on “The research and innovation policy on clean energies and circular economy” and the second on “Synergies and pooling of research efforts aimed at climate neutrality at domestic and international levels”. He then gave the floor to Mr Berloznik.

Mr Berloznik said that the purpose of his presentation was to highlight some key points and main trends concerning research policies and their context. He first noted that the present context was “a world of change”; and changes were also rapid within the Science, Technology and Innovation (STI) and knowledge systems. There was a growing acceptance of the crucial role of STI for the modernisation of the economic system and for increasing the welfare of our societies. This role was widely accepted even in the global context in which the Sustainable Development Goals (SDGs) were framing the aims, plans, efforts and funding of research and development (R&D). There was also a wide acceptance of the need for a more circular economy and a climate-safe environment in connection with the idea of a sustainable future for our children.

He had also noted a global engagement of different stakeholders within the STI system. More and more researchers were engaging in this direction; they did not isolate themselves from the societal objectives, such as the SDGs and sustainable development, for example, backing the ideas of people and planet profit and of participation, and operationally handling in their day-to-day context the sustainability of our societies as a key target. Similarly, the public sector was more engaged and had SDGs as concrete policy targets, these having been made measurable and monitorable. Also, the private sector was more engaged.

The system was becoming increasingly complex and characterised by the interdependency of its components: for example, health, environment and energy were more and more treated as interrelated sectors. This was important when looking at technological solutions to problems confronted within decision-making. This also meant that policy solutions and policy plans were more and more multi-level (from the local to the global) and multi-sectoral. Results and successful efforts were tied to due consideration for the interrelation between sectors and this was a challenge for those who had to design and develop policies (plans, programmes, new institutions, etc.).

Complexity was also due to more and more actors entering the STI system. It was simpler in the past with the so-called triple helix: governments, universities and the private sector. Today, citizens had entered the STI system (e.g.: citizen science); communities had entered the system (e.g.: smart cities development, driven by digitisation and by communities’ needs). Expert knowledge, which had previously been the only source of wisdom, was extending with the ideas and knowledge of these communities and with citizen participation.

Moreover, knowledge silos were disappearing and there were fewer sectoral boundaries within the STI system. Interdependency and complexity had led to cross-cutting fields and issues-oriented co-operation between researchers and R&D actors; water issues, climate resilience, energy and resource management were going together (e.g.: Oceans – "blue research clusters"). These multidisciplinary, cross-cutting issues had to be dealt with in a way which challenged the creativity of researchers and of decision makers.

New R&D communities were constructed around these new emerging issues; they were "virtual" communities (as internet allowed for this) but also "spatial"; for example, in the field of energy, there was a concentration of knowledge in specific places, where universities, research institutes and start-ups were working together to build knowledge, and usable, efficient and effective technologies and solutions (e.g. EnergyVille in Flanders). These developments meant new governance challenges. Not only funding and how to distribute funding but also how to cope with these new complexities.

In conclusion, Mr Berloznik considered that the future was for "sustainable solutions-targeted policies". They had to be sustainable, but also solution-targeted, as it was not possible to wait too long for concrete solutions. The first thing to do was to identify existing solutions, i.e. existing effective, market-ready technologies which were not yet on the market and help them to go on the market. It was important to accelerate market penetration of these technologies and upscale them, and this required new and creative approaches. There were a lot of these approaches at global and multilateral levels. An example was the "Green Climate Fund", a financial mechanism of the UNFCCC and of the Paris Agreement, which was funding incubators and accelerators, specifically targeted at picking up existing, sustainable, technologies and seeking to push them on the market.

Finally, Mr Berloznik stressed that policy development for a green economy should be inspired by global perspectives and circular economy thinking, as was happening with the SDGs, which had set concrete targets and measurable objectives. It was necessary to use and optimise existing funding mechanisms and organisations that were already promoting and supporting new approaches. The role and responsibility of decision makers had to be better articulated. He had the impression that the research system was sometimes a bit "autistic", independent from policy makers; there should be more guidance from representatives of democratic institutions; they should show the way towards a more sustainable and solution-targeted future.

Mr Becht thanked Mr Berloznik and gave the floor to the other experts on the subject of the Round table 1.

Round table 1 – "The research and innovation policy on clean energies and circular economy"

Professor Simon opened the round table with a presentation entitled "*Feedback on the development of an innovative and ambitious technology, the sodium-ion battery, in France*". TIAMAT, a company set up in 2017 following the restructuring of academic research in France, had developed applied research on batteries that used sodium instead of lithium. Unlike lithium, sodium was very widely available, and sodium-ion batteries were made for mobility and for stationary storage. They were not intended to be a substitute for lithium-ion batteries, as a sodium-ion battery had about 60% of the energy of an equivalent lithium-ion battery and would not be used to fuel a vehicle with a range of 500 km. In addition to the low cost of the sodium and the lack of pressure regarding its availability, the big advantage lay in the power technology, with rapid charge and discharge (just a few minutes) and a long service life.

The sodium-ion battery technology could be used for electromobility, especially for hybrid vehicles with 48V start/stop batteries. Sodium-ion batteries also enabled energy to be recovered during braking and then released to restart engines. They were also good batteries for hydrogen vehicles, as fuel cells did not have enough power. The charging speed was very interesting in terms of its suitability for electric buses and short-range vehicles. Another noteworthy application was the replacement of lead batteries in combustion vehicles, as sodium-ion batteries had a longer service life and more power. Apart from the mobility applications (including, for example, hybrid aircraft and hydrogen-powered trains) and their use for small electrical tools, these batteries had important applications for the stationary storage of renewable energy sources and the regulation of voltage fluctuations or power fluctuations in networks.

The launch of the project had been financed by government funds and the European Union, but its development had run up against a number of obstacles. In that connection, Professor Simon mentioned the "Airbus of batteries", an "important project of common European interest" (IPCEI) worth several billion euros aimed at developing two battery assembly lines, one in France and the other in Germany. Involving Total/SAFT and other companies, the project's aim was to develop electromobility on the basis of lithium-ion batteries and conduct research on their power and range. TIAMAT, with its power technology, had been completely ignored and disregarded and had received no state support to move to the next stage. It produced 700 prototypes a month but in order to develop the company and scale up production of sodium-ion batteries, it needed either significant funding to set up a small pilot production line or to develop a partnership with an industrial manufacturer.

Professor Simon thought there was a need to develop a technology watch activity in strategic areas (based on start-ups) and to consider possible innovations in order to identify the best of them and support their development. TIAMAT was currently unable to increase the number of cells from 700 a month to several thousand in Europe by transferring its production to battery manufacturers' assembly lines, but it had received an excellent immediate offer to go and set up in China. It had now reached a turning point: should it leave to make sodium-ion batteries in China, as it was unknown and had no partners in France or Europe? Incentives needed to be created to support innovation and partnerships between start-ups and the major groups. Taking the example of sodium-ion batteries, those partnerships would enable production capacity to be increased. In that connection, sodium-ion technology needed precisely the same production facilities as lithium-ion technology.

Professor Steininger's initial contribution was on "*Addressing the seasonal fluctuation of photovoltaics (PV)*". A first question was what national policy makers should consider in order to identify which energy sources should be given priority, and if research on totally new (and maybe not yet known) energy sources was ongoing. At present, given the 2050 timeline for climate neutrality, he could not see any new sources of energy. He noted that, among the existing sources, PV had by far the largest physical and economic potential to date; thermonuclear fusion seemed to be developing well but it would take far too long to catch up with PV to be of relevance for mitigation of climate change by mid-century, in terms of cost and ease of construction.

The rapporteur's introductory memorandum indicated that it was crucial not to overlook the constraints hindering energy source development. For PV, a key constraint was seasonal fluctuation; therefore, Professor Steininger wished to focus on how to address it.

Starting by pointing to the potential of renewable sources (in comparison with the potential of the total reserves of fossil fuels), he stressed that solar influx to our planet was so large that PV panels covering just 2% of our desert areas would suffice to produce all current global energy demand (energy, not just electricity). The issue was, however, matching location and time of demand, on the one hand, and production, on the other.

Prices of both PV modules and storage had declined dramatically: Since 2010, PV module cost had been reduced by factor 10, and battery cost by factor 8. The International Energy Agency considered PV the cheapest energy source at present. As indicated on the title page of the Economist in September 2020, these developments would change geopolitics.

Professor Steininger then noted that, while PV storage had become so cheap that it could well serve the daily cycles (day-night); the generation of electricity was subject to large seasonal fluctuation: depending on the latitude of the location, winter production was only 1/4 to 1/8 of summer production. One possibility was to install 4 to 8 times the capacity and produce enormous amounts of excess electricity in summer, to be used in winter; the alternative – and this would turn out much cheaper – was to connect to the other hemisphere (where it was summer when we had winter) and exchange electricity, to the mutual benefit of regions of both hemispheres. Whenever it was summer in a region it would be a net exporter; whenever it was winter, it would be a net importer.

Transmission cables would be used year-round, transporting energy in alternating direction. A combination of suitable locations in Europe, and e.g. in Australia, Saudi Arabia, Israel and South America could perfectly serve the current load profile of Europe. This option was attractive in economic terms and in terms of mutual development – the best use of the transmission cable being when it connected areas of roughly equal economic activity levels. Therefore, Professor Steininger considered it could be one promising element of the global clean energy system.

To go in this direction and support energy for the future, Professor Steininger listed the following issues for research and innovation policy:
- engineering, physics and groundworks of intercontinental and deep-sea cable transmission;
- power electronics – integration across generation locations;
- given the large initial investments required, the collaborative investment financing;
- within Europe, mechanisms to regulate access to renewable energy imports among countries and/or possibly energy intensive industries;

- legal and political preconditions for this new energy system.[2]

Finally, there was clearly an issue of pooling of efforts at international and European level, as the system had a global aspiration.

The rapporteur also had a second question on how to support a "circular economy". In this respect, Professor Steininger noted that there was currently significant demand for hydrogen/renewable electricity in industry. Circular carbon management was one example: e.g. demand for steel production conversion and cement industry carbon capture and use (CCU) alone would by far exceed remaining additional renewable electricity capacity in many countries including a country like Austria, not mentioning other demands (transport, household heat pumps, other industry). Here, the research issues were:
- alternatives to hydrogen (as there were a lot of conversion losses) for selected applications; and
- integrated systems of functionalities and accordingly integrated renewable energy systems.[3]

Mr Laboué addressed the subject of "*Energy transition and geopolitical issues: geopolitical constraints and risks generated by the development of a new technology for Europe*". His presentation was based on a recent report entitled (in translation) "*European Battery Alliance: challenges and European perspectives*",[4] which had been drawn up by a monitoring centre in association with IRIS, Enerdata and Cassini. The key issue was taking account not only of economic, social and environmental constraints but also of the geopolitical risk in the approach to research innovation and work in the area of the energy transition. Alongside sustainable development issues, there was also the question of markets and strategic autonomy.

Batteries were a highly topical subject and provided an extremely interesting solution in sustainable development and energy transition terms.[5] Global demand for them was set to explode and would increase tenfold between 2020 and 2030, driven mainly by electric vehicles. It was extremely important to recognise that China was now the world's leading battery maker and produced three-quarters of all battery cells. Its domination went further, however, as the country also made cathodes, which were another key battery component. Its relative power in the case of those technologies and the question of strategic autonomy therefore had to be taken into account with a view to other countries controlling their own destiny when it came to switching from one technology to another.

Moreover, that domination could extend far beyond mere industrial domination because China was also a dominant player as far as raw materials were concerned. The raw materials from which batteries were made were not found in the Middle East (like crude oil) but were much more widely dispersed, for example cobalt in the Democratic Republic of Congo (DRC), lithium in Chile, etc. There was one common aspect, however: the capacities for refining those materials were concentrated in China. To be more precise, it controlled 100% of the refining of graphite and 82% in the case of cobalt, which were both key elements in the batteries most widely used today, especially for vehicles (lithium-nickel-manganese-cobalt [LiNMC] batteries). That amounted to a real stranglehold as far as that technology was concerned.

Furthermore, three-quarters of patents on lithium-ion battery technology were now held by Asian countries: Japan, South Korea and China. The share of Europe as a whole was more or less marginal, which was extremely problematic for the development of those technologies in Europe and other countries, as they were very much eclipsed by those Asian countries. There was only one European company in the top ten of applicants for battery technology patents, namely Bosch, which was quite some way behind Samsung, Panasonic and LG, etc.

In conclusion, research and innovation in the area of energy transition were of major geostrategic importance. If research efforts were not pooled at the European level in order to make up some lost ground, there was a risk of a triple paradox:

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[2] For example, governance of the establishment and operation of transmission infrastructure; negotiation and maintenance of respective international agreements.
[3] For example, more sophisticated formwork shuttering can reduce concrete demand for ceilings by >60% with at least the same stability; activated elements (such as concrete ceilings) can store (heat) energy as an integral part of the building energy system.
[4] See here (French only). The report was drawn up by the Observatory for the Security of Energy Trade Flows and Materials (*Observatoire de la sécurité des flux et des matières énergétiques*), which is co-ordinated by the Institute of International and Strategic Relations (IRIS), in association with Enerdata and Cassini, under a contract with the General Directorate for International Relations and Strategy (DGRIS) of the French Ministry of the Armed Forces.
[5] For more information, see Professor Jean Marie Tarascon's article "*Les batteries sont-elles la bonne option pour un développement durable ?*" ("Are batteries the right sustainable development option?").

- at the level of sustainable development, Europe would be forced to import more batteries from China and thus increase its CO^2 emissions to implement solutions aimed at decarbonising our economies;
- at the level of a sustainable economy, if Europe switched too quickly to a technology it did not sufficiently master, it risked weakening the entire European car industry with extremely serious social consequences;
- at the strategic level, the risk was of undermining European political autonomy, because Europe would be dependent on other countries for as long as batteries were the absolute key to energy transition and European research and innovation were insufficiently well-developed.

Research and innovation in Europe were real keys to winning future battles on the battery front and in the area of sustainable development in general.

Ms Lazaric focused her presentation on *"the challenges of the circular economy and clean energies"*. The aim was to establish a new circular economy based on the principle of "closing the life-cycle" of products, services, waste, materials, water and energy. That involved the "three RS": R1 Reuse, R2 Repair and R3 Recycle. CNRS researchers were heavily involved in all those areas. The research focused, for example,
- in R1, on green chemistry in the durability of materials, the reuse of waste heat from processes, social reuse practices in the human and social sciences (HSS);
- in R2, on self-repairing materials, robotics, eco-design, behavioural economics, law, etc.;
- in R3, on chemical recycling of polymers, processes for the recovery of critical metals and rare earths and purification mechanisms and processes.

Research was carried out at numerous CNRS institutes and also included the social sciences.

The challenges of the circular economy were considerable. They did not involve marginal activities but, according to the National Institute of Statistics and Economic Studies (INSEE), tomorrow's jobs, coupled with the highest value-added growth, the largest number of patents, and research and development (R&D). The green economy, which included the circular economy and renewable energy sources, was the real spearhead of the current economy and had involved nearly a million jobs in 2015. In the period from 2004 to 2015, the number of jobs in the environmental goods and services industry had risen by 33% and reached 440 950 in 2015, representing 1.7% of total employment in France. In the same period, the valued added of that industry had risen by an average of 3.9% a year and production by 4.2%. It was a sector driven by environmental regulation (energy and renewable energy – EnR, REACH regulation of chemicals, laws on waste and regulation of the recycling of plastics).

Regulation had prompted industry to act and had brought about innovations and technological solutions. Researchers were studying new scientific issues, such as:
- the use of hydrogen and green hydrogen for the decarbonisation of industry;
- the recycling of plastics;
- the search for green molecule platforms to create new polymers and the introduction of bio-sourced materials to replace traditional materials.

Innovating was not enough. Innovations had to be socially acceptable, so the CNRS also conducted a considerable amount of research in the human and social sciences to determine the social acceptability of innovations, as well as research into behavioural economics and into environmental preferences to ensure that the circular economy could fit into a supply/demand dynamic. Behavioural tools employed in laboratories (nudges, boosts) were really important for the social acceptance of certain technologies and in order to reduce energy consumption and promote the circular economy.

In addition, great entrepreneurial drive was being exhibited by major groups (Michelin, Veolia, Paprec), start-ups and other circular economy players, such as co-operatives and all the social and solidarity economy bodies that were operating at the local level, were involved in social and innovative experimentation, employed social inclusion-based approaches and provided context-based local solutions in view of the major challenges of the circular economy.

Nonetheless, there were still many obstacles and barriers, which came to light when establishing the circular economy. A cross-disciplinary approach was needed to meet future challenges and it was also necessary to understand that the introduction of innovations and new technologies, such as bio-sourced plastics (e.g., the BIOLOOP project), could create other types of problems. For example, bio-sourced plastics thrown into the sea and eaten by fish caused just as much harm as traditional plastics because they did not have time to biodegrade. Therefore, research unaccompanied by a "social inclusion and social acceptance and demand" component would lead to other problems. It was not simply a matter of devising technical solutions but of seeing how they were integrated into the current system and how they helped to provide genuine answers. The current paradox of bio-sourced materials and the failure to recycle them (low profitability owing to the small quantities involved) meant that the impact of technical innovations alone in solving every problem needed to be put into perspective.

There were very significant economic and behavioural challenges. The human and social sciences were essential for providing responses and could help public policymakers to draw up proper technical solutions. In the case of energy, it was necessary to understand consumer behaviour, changes in habits and any rebound effects.[6] There was also a need to introduce necessary institutional changes and provide institutions with new means of understanding those cross-cutting problems. If the circular economy were going to take root in the face of all those challenges, it was important to bear in mind the dynamism and history of the relevant areas and regions, which were the drivers of that economy and of the social and solidarity economy and were key places of local experimentation. A top-down approach should be avoided, and the focus should be on the players that introduced innovative solutions in areas and regions and backed them up. That was the only way forward if the circular economy were to be able to really have a social impact and reduce inequalities, which was a major challenge for the circular economy and ecological transition.

Debate

Ms Taliashvili noted that research and technology development were linked to the market, and to the benefits for companies. Without a clear vision of the market, no one was able to invest in research. On the one hand, there were research institutions and universities and, on the other hand, big corporations with their business plans, planning innovations according to how they saw the market. She asked what the experts could recommend: how to shift more power to research that did not see a big market or turnout yet, but targeted very important innovation? The experts had talked about behavioural economics, and consumer behaviour. To have profitable innovation, consumers already needed to be there; but often very important innovation had no real consumers in the present because it was for the future. What could be done to promote innovation which could make crucial changes in the environment but was not yet marketable?

Mr Becht suggested that the experts could reply to the question in the second round table. Where research was concerned, a vital question was indeed knowing whether everything should focus on the market, i.e. efforts made by private-sector researchers or synergies between public laboratories and private companies on condition that those efforts showed a profit on the market or whether there was also a share of the anticipated outcome of research, both public and private, that was not profit-oriented because researchers quite often discovered things they were not looking for.

Mr Français was pleased about the quality of the contributions and asked Professor Steininger about the transmission of energy over long distances: what were the expectations on that subject? He had heard people talk about that basic research for thirty years and wondered whether there was a more precise timeline.

Mr Becht asked Professor Steininger to reply to the question regarding exchanges of energy flows. Sufficient energy could be produced for the entire planet in the southern hemisphere for the northern winter and vice versa, but there was still a need for “highways” for the swift transfer of that energy. Was that achievable and if so, how?

Professor Steininger replied that there were at present direct current lines for up to 8 000 km. One country which was really moving ahead was China. China was buying up distribution networks in various continents and linking up to them, because it knew that, for example, linking up with Australia helped to even production and match the load. He believed that improving the batteries and spreading out the grid and energy production would be the combination for our future renewable electricity system. Experience had been gained and losses were quite small: 1% per approximately 1 000 km for High Voltage Direct Current (HVDC) lines. Therefore, this North-South interconnection was really an option which could make a significant contribution. The difficulty was the large investment costs in the beginning. All European public utilities, taken together, were much smaller than the Chinese state grid. Co-ordination and a decision to invest in this direction were a necessary common effort.

Mr Becht thought the geopolitical risk should also be taken into account because if all electricity production were made dependent on a specific number of countries to supply the other hemisphere, there needed to be

[6] The rebound effect, which is observed whenever eco-efficient energy sources are introduced, means that the initial effects of a technical solution are undermined by an increase in the quantities consumed. It has been observed, for example, after thermal renovation work has been carried out, especially in the case of social housing.

a number of guarantees that no one would press the switch to cut off the electricity for whatever reason, as that could destroy a country in just a few days.

Mr Berloznik wished to comment briefly on the question of public acceptance. It was important that when research led to a product, then someone could afford and be open to accept and buy the product. However, what he had heard, had been a traditional approach to that question. It was important to look at the research cycle from idea to product; and of course, public acceptance was not something to create at the end. Consumers and stakeholders were asking more and more for a role in decision-making, including on the research trajectory, on how products were developed, and their needs were considered in product development. In this way, there were fewer problems at the end, as people had their needs satisfied by the product. In the area of information and communication technologies (ICT), the new products on the market were quickly accepted by the public, but this was not the case with other products, such as vaccines, for example, or technology products in the energy field. It was important to consider how to involve stakeholders more in the development of technological products and not to leave the problem to the end.

Professor Simon referred to sodium-ion batteries and said he disagreed with Mr Berloznik's remarks since the problem on that precise point was not that the product did not meet a need or had not been designed to do so, as the need for power was clearly identified in all the roadmaps issued by vehicle and battery manufacturers. The problem had resulted from a strategic decision to only develop high energy density batteries. The Chinese were very keen on that technology for making powerful batteries. The market was there but it was difficult to make oneself heard in Europe, as a different strategic decision had been taken on energy.

Round table 2 - "Synergies and pooling of research efforts aimed at climate neutrality at domestic and international levels"

The round table started with **Professor Steininger**'s presentation on "*Supporting co-ordination of cross-organisational value-added chains in a circular economy*" as a potential improvement to the governance of research policy.

He explained that the circular economy had great potential for a climate-neutral production and consumption system (meeting SDGs 12 and 13), because it could be designed to adhere to three central principles in the approach to transformation: the principles of inversion, integration and innovation.

Regarding "inversion", he explained that, rather than starting from the question of how to supply energy or materials, we should start from what the functionality or service was that we wanted, and then think how we could best supply it. For example, if we needed a sturdy, solid ceiling, it could be created (with the same, or even better, stability) with clever structures using 40-70% less concrete, and thus less cement, cement production being one of the largest greenhouse gas (GHG) emitters to date. Additionally, the concrete elements could be used as activated elements for storing energy (e.g. heat) integrated into our housing energy systems, thus optimising across the whole value chain of supplying the functionalities we wanted.

Regarding "integration", he stressed the need to integrate across all means, as for example, in the mobility system, integration across transport modes, which was realised by supplying adequate hubs.

"Innovation" was crucial at many stages along the whole value-added chain. Professor Steininger cited as an example, for the remaining cement produced, an innovative project, "carbon to product Austria" (C2PAT), where CO_2 emissions from cement production were captured and hydrogen was used to methanise the CO_2 to methane or methanol which could then be used either as fuel or as feedstock for the chemical and pharmaceutical industry.

Professor Steininger then identified some implications for the governance of research policies. First, on pooling of efforts, he noted that there were initial efforts from some companies to get cross-company value-added chains working; yet, broader integration of society as a whole (which would be necessary for both acceptability and also robust overall solutions) and (mostly) national policy were lacking. Pooling of efforts was crucial, as success was dependent on building upon all expertise and on development of a common vision for the future, imagination which could then attract further innovation. There were obstacles, however: co-ordination of a value-added chain was required across separate and legally independent entities (enterprises); thus, this was mainly an issue of trust, matching cultures and long-term reliability.

Common research could be the leverage to foster such collaboration. Only by having common and shared targets could near-term steps also be set in the common interest. Successful transformation involved not only solutions in individual subsystems; the connection of subsystem solutions was also crucial. As stated in the initial presentation, the system was increasingly complex and interdependent; therefore, research governance needed to foster and support work on these connections. In the Netherlands, for example, some universities had changed their promotion evaluation criteria, now including not only journal impact points, but also criteria of contributions to cross-disciplinary teamwork and collaboration.

Therefore, the question was how to enhance collaboration, synergies and pooling of efforts at domestic, European and global level. In this respect, Professor Steininger highlighted the following elements:

- co-design, co-creation, co-production between scientists and stakeholders was already broadly taking place;
- science could partly act as a "neutral" information broker between society and even policy, on the one hand, and industry on the other; it could provide a dialogue platform for information exchange;
- new skills were needed for science reaching out to practitioner-policy dialogues;[7]
- stakeholder dialogue processes and transdisciplinary research should be fostered;[8]
- regarding public-private synergies, national and European research funds needed to be geared more towards long-term innovation demands, for example, targeting not only carbon capture and storage (CCS) but also carbon capture and use (CCU) to really have a circular economy;
- regarding international co-operation, it was important to define core areas (e.g. renewable energy) where co-operation outside the EU was crucial and to design the research framework accordingly, to allow for such co-operation for mutual benefit.

Referring to Ms Taliashvili's remarks and to the issue of co-operation between universities and large companies, Professor Steininger said that the rate of innovation and the rate of research could come up when, at least within Europe, consortia were built among the large companies to work together with publicly funded science. Adequate incentives for industrial partners might include a time lag (possibly differentiated by field) before the publication of results, to allow adequate returns on private research expenses which enhanced industrial contributions.

On the behavioural side, Mr Berloznik had answered the question: by integrating consumers into the development process, it would be possible to get off to a quicker start and to disseminate thinking more quickly.

He concluded that, in so doing, it would be possible to support, and often enable, development well in line with the achievement of the SDGs, and then have a flourishing world.

Professor Simon set out the "*Feedback on the establishment of and state support for a national research federation aimed at pooling efforts in the field of batteries and supercapacitors*". That had involved the creation of the Research Network on Electrochemical Energy Storage (RS2E), a scientific and industrial network set up on the joint initiative of the CNRS and the Ministry of Higher Education and Research (MESR) with the main aim of unlocking the scientific and technological potential for inventing the batteries of the future and making the technological breakthroughs to bring them to market.

Human and technical resources had been shared with characterisation and prototyping platforms at the national level (in France) and input had been provided for the development of a national scientific policy on the subject of the electrochemical storage of energy, and therefore batteries. The network was based on three pillars: 17 research laboratories spread across France, 16 industrial partners in France and three public bodies specialising in technology transfer. The virtuous circle it was intended to create involved laboratories carrying out basic research and, through the establishments specialising in technology transfer, transferring it to the industrial partners.

The network had an annual budget of €8 million and employed more than 120 researchers together with a large number of PhD and post-doctorate students, who produced several scientific publications a year. It possessed several dozen patents (CNRS) and two start-ups had been created. There were ten or so battery research projects, including on the subject of solid electrolytes for solid-state batteries, advanced Li-ion batteries, chemical innovations (including sodium-ion), battery recycling and battery safety and life cycles. There was also a prototyping platform and a battery manufacturing platform.

[7] For example, skills required to host such dialogues, to make research results accessible for practitioners and policy makers and to reintegrate practitioner and policy maker feedbacks into the research process.

[8] For example, by clearly allowing for, or requiring, a sufficient percentage of research financing; acknowledging successful dialogue events in terms of reputation and corresponding career promotion; establishing more effective funding criteria for selection of research (which would thus be properly oriented).

On a positive note, Professor Simon emphasised that the RS2E network had been set up by the CNRS and the MESR, with a single collaborative structure between laboratories and industry and strong state support via the Laboratories of Excellence programme (a million euros a year). The network had received strong national recognition and had helped to rewrite the academic roadmap on the subject of batteries. It was, above all, a means of pooling resources and responsibilities.

There were a number of obstacles, however. The network was seen as an academic tool and was mentioned either very little or not at all in the "*Airbus of batteries*". The major European research projects should draw on the structuring of research at the national level and should strengthen the joint funding of laboratory-industry projects on strategic matters. In such projects, laboratories very quickly identified innovative developments and start-ups were there to take on the risk inherent in innovation and grow rapidly with the support of the major companies to develop academic-industrial collaboration. From the outset, synergies needed to be strengthened between laboratories and industry on issues identified.

In conclusion, Professor Simon referred to a Franco-German collaboration project involving research into the manufacture of batteries in France and Germany: There was a clear political will in that case but the MESR was having difficulty in getting funding released on the French side. Responsiveness needed to be improved (the dialogue between the MESR and the Ministry for Economic Affairs) and the funds necessary for strategic investment had to be freed up.

Mr Laboué introduced the subject of "*The strategic importance of pooling research and development efforts – the case of batteries*". The main issue was whether the geostrategic challenges constituted an obstacle to or, on the contrary, acted as a stimulus for pooling research efforts at the European level. In the case of batteries, those challenges currently acted as a real stimulus, as there was a geostrategic reality that had to be borne in mind. China's spending on R&D already exceeded that of the European Union, which raised the issue of when it would exceed that of the United States. No European country was in a position on its own to release sufficient investment capacities or offer a large enough market without the development of synergies with other European countries.

It was worth noting that the European battery alliance, known as the "Airbus of batteries", was not repeating the mistake made with solar panels, where the European Union had subsidised demand while China had supported supply, resulting in the European solar panel market being completely crippled by extremely competitive supplies from China. A different approach was being followed with the "Airbus of batteries": the European Union was investing in the development of supply, and innovation and research were central to the alliance.

From the strategy point of view, the plan placed considerable emphasis on the environmental aspects of batteries, on the circular economy and on eco-design, which could ultimately enable Europe to develop a competitive advantage and defend its own interests. For example, eco-design and recycling would not only limit the environmental footprint of batteries but also enable resources not found on the continent of Europe (but in China, India, etc.) to be recovered. Research nonetheless had to be done to set up urban mines and potentially offer batteries on the global market with a low environmental footprint, thus supporting local European industry. It was there that there was an interesting return loop in the European alliance in its present form.

Projects of common European interest (IPCEIs), such as those concerning batteries, were exceptions to the European rules on state subsidies for companies and also symbolised the European synergies throughout the value chain: raw materials, cells, battery systems and recycling.

Ms Lazaric spoke about "public and private co-ordination and international co-operation". In the case of public-private collaboration, it was very important to have an objective with regard to sustainability and the circular economy. Private interests should not take precedence over public interests and thus relegate the common good and the sustainable development goals to the back burner.

International research was essential for achieving a decarbonised economy. There were many European programmes in which all stakeholders, even small players, could take part. That provided a new intellectual background to the choice of the future ecological transition and tomorrow's circular economy.

China was an increasingly major player and accounted for nearly a quarter of all scientific publications. On the other hand, many players from sub-Saharan Africa or South East Asia were completely absent when it came to the subject of the decarbonised economy. Co-operation agreements should be put in place to include all absent players and enable them to participate in international research. The CNRS was also playing a strategic role in international co-operation with the establishment of international laboratories in Singapore and India, but that was not enough and it should be expanded.

There needed to be public-private collaboration and international co-operation to bring about a low-carbon transition. As many individuals as possible should be included to preserve biodiversity and achieve all the low-carbon transition goals. However, that transition would benefit certain sectors and destroy jobs in traditional sectors. Agreement needed to be reached with all players to establish what transition was wanted for the future and how those traditional sectors could make corrections and adjustments. It was also necessary to involve local areas and regions so that they succeeded in making the transition and creating a dynamic force for change that had a positive impact on social inequalities. Behavioural economics should not make corrections at the end of the process but make it possible to co-design and co-construct technical solutions – the innovations of tomorrow. All players should be involved, not at the end of the chain but from the outset, which was of major importance for the regions and for Europe as a whole. That could be clearly seen in the case of sustainable cities, where the emphasis had all too often been on different technologies (smart meters, smart grids, etc.), with citizens being involved last of all. If those sustainable cities were to succeed and if they were to reduce social inequalities, then as many citizens as possible should be involved. That was an intellectual challenge: consideration should be given to what tools to use to involve citizens at all levels; otherwise, ecological transition targets would not be met and public/private co-ordination would serve no purpose. There were critical housing policy and health policy challenges that went beyond climate-change issues and were also linked to the challenges of tomorrow's economy. That economy should not be synonymous with degrowth but with fresh impetus. Success would come if all stakeholders at all levels were involved: public and non-state players, as well as regional, national and European players. Collaboration was difficult, to be sure, but that was the price to pay in order to provide meaning and get all stakeholders to act together to find solutions to the immense challenges of the future.

Debate

Mr Becht stressed that the environment and combating climate change were global issues and not only European concerns. There was only one planet and everyone was concerned by the need to find new energy sources that caused less pollution and to be able to recycle all raw materials in order to also safeguard future generations. In his opinion, those who discovered, developed, harnessed, produced and marketed the energy sources of tomorrow would, economically and politically, be the new masters of the world. That had always been the case in the history of humanity: prosperity had always been based on the control of resources and energy. China had gained a head-start on research and innovation, as well as on the control of the raw materials necessary to produce and store energy. That raised the question of the involvement of all European countries, not only members of the European Union, but also every country in the Greater Europe, and it therefore made it necessary to consider the role of the Council of Europe.

As Robert Schumann had said, progress on European construction would be made in small steps and based on concrete co-operation. Such co-operation did exist within the Council of Europe, for example the Pharmacopeia. Could there be room for co-operative ventures in the energy field, for example a kind of European bank for raw materials needed to store energy? Perhaps countries might be more eager to respect human rights, democracy and the rule of law if there were greater integration in other co-operative schemes, like energy and the control of resources, to make the planet more attractive and keep it habitable for future generations. There were other issues in the debate that went beyond the matter of energy sources and the environment.

Mr Français said dominance was exercised over the smallest players. If the continent of Europe failed to act united in the area of applied research and basic research, there would be significant economic consequences, including for world stability. Balance needed to be restored on various issues. The focus here was on energy, but the same question arose with regard to biotechnological research. There was frustration among researchers whose voices were not heard, and there was no forum for listening to good ideas. If there were a message to be given by the Council of Europe, then it was that idea of listening that forms the basis of research; As had been said, a small idea could become a very big idea, especially if it were shared with others. A second point was the role of the state. He wondered whether the state should or could work with the private sector. Researchers were required to work with the utmost independence, but they needed financial resources and states were increasingly running out of money. How could the business sector be involved in the development of research? A final point was product value development. It was now realised that transferring energy from one continent to another was very costly, and states needed to foster industrial autonomy and preserve their economic prosperity.

Mr Becht thanked the experts for the quality of their contributions and their reflections during the hearing. The many different approaches now provided him with additional input for the committee's report. He also thanked the members of the committee for their interest and for sharing their analyses. As rapporteur, it was his responsibility to gather members' thoughts and contributions and he would take them into account in the final report, which he hoped to submit to the committee for discussion and adoption in April or May so that it could be debated in June by the Parliamentary Assembly.

Mr Rampi thanked the experts for their very interesting contributions, closed the hearing and handed the chair back to Mr Becht.