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Green technologies and renewable energies – Innovating and patenting

Proceedings of the conference
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European Patent Academy

in co-operation with

patent trademark design
Norwegian Industrial Property Office

Introduction

As the green revolution continues to gain momentum, this conference, organised by the European Patent Academy of the EPO and co-hosted by the Norwegian Intellectual Property Office, provided a platform in the context of Climate Change Mitigation Technologies (CCMT) and their relationship with innovation.

Panel speakers and presenters selected from government, business, research and innovation agencies guided the 90 participants through a wide variety of the aspects of developing and implementing green technology.

Proceedings

Moderator

Erik Wold, well-known Norwegian news presenter and moderator, opened the conference. He highlighted the pivotal nature of the topic of green technology and renewal energy.

Opening

Per Foss *(Director General, Norwegian Industrial Property Office (NIPO))* took the floor welcoming all participants. He thanked the EPO for joining the NIPO in organising and planning the conference on such a critical topic as green technologies and renewable energies and their relationship with innovating and patenting.

The Norwegian policy in supporting innovation in the field of CCMTs

Daniel Bjarmann-Simonsen *(State Secretary to the Minister of Trade and Industry, Norway)* took the floor and immediately stressed the strategic importance of green issues for Norway, and specifically for Oslo. The city continues to enhance green perspectives. From an innovation perspective, he added, in 2000, IP represented a significant proportion of Norwegian companies' assets. This has not changed, and patents remain the keepers of valuable ideas. They make the business attractive and provide the entry ticket to the market. Today, he added, the green solution is key to business development. This is the future.

After outlining Norway's innovation pathway, from a landmark patent in 1905 creating fertiliser by extraction of nitrogen, through to electric ferries, which are an emerging technology, Mr Bjarmann-Simonsen explained how innovation increasingly supports the green wave. Further, Norway possesses a natural treasure trove based on three industries: oil, shipping and sea food. In the state budget for 2018, Innovation Norway and the business community are cooperating to push advances: to help increase exports of climate saving innovations in these industries. Industrial research currently represents 1% of Norway's GDP. The government is also committed: the goal is 2% of GDP dedicated to research, and the focus is now on low to zero emissions technology, having committed to a 40% reduction of emissions by 2030. **Norway recognises that it is the responsibility of wealthier nations to make the greater effort and to reach sustainability**.

The EPO supporting innovation in Europe

António Campinos *(President, EPO)* gave a video presentation identifying climate change as one of the most pressing issues facing our world, threatening our environment, our livelihoods, economies and even lives. He noted that as innovation has already given us answers to many other complex problems, it can do the same for climate change. Indeed, the patents granted by the EPO have been party to numerous high profile sustainable technologies leading the way in mitigation and adaptation. These include new designs for turbines, inspired by nature and which save energy, innovative ways to store harmful gases, and appliances that use less water. So the path is already well known. If we want to see these kinds of innovations in the future, however, major financial and technical investment is needed.

Patents are therefore crucial to encourage investment in sustainable technologies and to support their spread throughout global markets. Patent information is also instrumental as it allows inventors to build upon, and improve, existing technology. It gives researchers the tools they need to develop new solutions to mitigate and accommodate climate change. And it allows businesses to take effective, well-reasoned business decisions. To support it, the EPO regularly updates and improves its classification scheme for green technologies and provides patent information to the public for free.

In the arena of green technology, collaboration and co-operation is also necessary. Cooperation with the United Nations Environmental Programme (UNEP) provides means to identify and measure inventions that have the potential to contribute to climate change mitigation. Work with the International Renewable Energy Association (IRENA) also means we can make sure its patent information is widely available. As the green revolution continues, the EPO and its partners must look at the wealth of information available more closely and explore how innovation can be supported further.

Finally, he thanked the NIPO for their support in organising the conference. Armed with a deeper understanding of the issues, inventors will be better supported to develop new and exciting sustainable technologies.

On the same topic, ***Roberta Romano-Götsch*** (*Chief Operating Officer Mobility and Mechatronics, EPO)*, outlined how the EPO supports innovation, competitiveness and economic growth through its commitment to high quality patents. Again, the key message is that our planet is at risk through pollution and climate change. It falls to the whole population, inventors and policy makers together to address these issues. Whilst environmental policy is critical to the solution, innovation is the fundament.

In patent filings trends, there has been a growth in hydro, solar and wind power. In recent years, green transport and green buildings are in focus. Electric vehicles, including autonomous ships, application of low weight technology in cars with improved, intelligent controlling systems are supporting the green way. Smarter and more controllable buildings, with improved insulation materials add to the progress towards energy saving solutions. Europe has taken a leading role in the advancement of green technology, and with 2030 only a few years away, our commitment to the Paris Agreement 2015 is a high motivator. **This is our battle as custodians of our planet. Hopefully, the greatest impact of the 4th Industrial Revolution will be a green one.**

Ongoing international co-operation: how international organisations join efforts and work together with businesses to encourage climate change mitigation and adaptation

One of the key themes throughout the conference was that of cooperation and collaboration. This current topic was addressed in detail by six presenters who dealt with specific aspects from their organisation's perspective.

Robert Ondhowe (*Legal Officer, Law Division, UN Environment, United Nations Environment Programme (UNEP), Nairobi, Kenya)* immediately stressed the importance of partnership in the context of patents, innovation and green technology. In this respect, the role played by IP and patents was shown to be a hindrance in the non-developed nations. The UNEP empirical study performed with the EPO revealed that **only 1% of all patent applications relating to clean energy technologies worldwide have been filed in Africa**, with the vast majority (84%) of these in South Africa. IP rights simply did not feature on the radar of many policy makers. The course of the study was the first occasion that ministries of energy and environment met those in charge of IP. The second study, assessing the situation in Latin America and Caribbean showed less than 3% of clean energy technology patents were filed in the region. Happily it is growing rapidly (16% p.a.) with Brazil, Mexico and Argentina accounting for the lion's share. The third assessment addressed Europe, and shows a leader of green tech for the developed world.

For the UN to facilitate the process, the Secretary-General of the UN concluded in 2017 that the organisation must be innovative. The UNEP has a global infrastructure with a presence in 17 countries and contacts in 150. The greatest challenge to the organisation remains Asia, which, in IP terms is extremely variable. Pinnacles of innovation such as Japan and South Korea are leading lights, from which countries like Laos, Nepal and Bangladesh can use experience. When private business sets out, supported by the European patent system, the UN gives a platform as an independent facilitator. The organisation will stay neutral and support parties in cooperation and collaboration.

As to what stands in the way, it is clear that lack of awareness is a major factor. It is difficult for less developed countries to seek this kind of support. This is where the UN can be helpful.

Ilja Rudyk *(Senior Economist, EPO)* reflected from an economic perspective: living conditions and quality of life have now reached levels never seen before. China has brought more than 300 million people out of poverty in the last 10 years alone, thanks to economic and technological advances.

However, the price to be paid is consumption of the earth's resources. **The dilemma facing society across the globe is maintaining, if not improving, living conditions, and yet minimising the impact on the environment: innovation is the answer.**

There are three aspects to effective innovation: creation, deployment and dissemination – and what is important is to have the right incentives to invest in all parts of the process.

Patents can create the right incentives for all three aspects. Creation is supported by the fundamental model of the system, offering an exclusive right for the patentee. As far as deployment is concerned, exercising that right allows the innovator to prevent copying, secure financing, facilitate collaborations and technology commercialisation through licensing. This has been demonstrated by the SME case studies developed by the EPO. Finally, to dissemination: most patents expire before their allotted 20 years are up. However, the information disclosed in them is crucially important for engineers and scientists, as it is for IP professionals and management providing technical, legal and business information to society.

With the Y02 classification code, analysis of the information in the green sector is now possible. It has shown that **in absolute terms, the annual number of sustainable inventions has increased by a factor of over five from 1997 to 2016**. In relative terms, in comparison with all technological fields however, that growth peaked at more than 7% in 2011, falling steadily to 6% by 2015. The key question is why: from an economics perspective, it is more likely that innovation saturation has been reached in the primary areas of, for example, solar and wind power, and their commercialisation and dissemination are now the prevalent processes.

Francesco Pasimeni *(Policy Analyst, Joint Research Centre, European Commission, The Netherlands)* noted that Research, Innovation and Competitiveness is the fifth pillar of the Commission's energy union strategy; Security, Markets, Energy efficiency and Decarbonisation being the other four. In terms of global innovation, patents are used to assess inventive activity in comparison to other regions. China boasts the largest number of inventions in this area, however, when it comes to the effective value of the innovation, there is no doubt that Europe, Japan and the US lead the field. As a second consideration regarding the flow of innovation between regions, Europe and the US have a major role in both importing and exporting inventions. Finally, 90% of European inventions are from private sectors, with 65% from multinational corporations. A further trend is that in many countries, 70% of inventions are developed by subsidiaries in the same country as the multinational corporation. In summary, the patent data shows the deep involvement and interdependency between countries in CCMTs. **The EU's research shows that European development in renewable energy and sustainable transport is strong, and the future focus must be on private and public collaboration, and that, between countries.**

Ricardo Meléndez-Ortiz (*Co-founder and Chief Executive, International Centre for Trade and Sustainable Development (ICTSD), Geneva)* opened his presentation indicating that promoting sustainable development must be the aim of international trade policies. The relevance of IP in this area is a key question: is it an enabler or a barrier? To answer it, we need to understand what matters in IP and innovation development. The role it plays differs from sector to sector. In pharmaceuticals, a patent is highly valuable where there is no substitute. The holder can charge a high price. In renewable energy, solutions are off-patent; only specific aspects are patented. Royalties are paid at a technically lower level. There is healthier competition, and the benefits are shared with the customer, and so the environment is different. Looking at renewable energy, on the other hand, the IP map is more complicated. There are thousands of components for a wind tower, each may be patented. Development of the new classification system to highlight these contributory technologies was one of the steps towards clarifying the picture. When a protocol is agreed, for example the Kyoto effect, the trend is to develop massively in influential fields. Concerning licensing, the level is still very low. Enabling rapid diffusion is a clear benefit of licensing and should be supported. But it needs effort. As already explained less than 1% of clean energy technology is available in Africa and so such regions really need to shift their energy matrix too. **Technology transfer and innovation diffusion must be promoted to reach the goals of the Paris Agreement 2015.** Looking at fast tracking of applications at the largest seven patent offices around the world, it shows that this works. Concerning policy considerations, weak economies suffer from poor information, market power (too much by too few), and inability for high-tech personnel to network.

To sum up, and answer the question "where do we go from here". Licensing models with moderate costs aspects must be supported. IP is important! Protection is important, but technology alone is not the answer: consequently, trade policies are also essential.

Francisco Boshell *(Analyst in markets and standards for renewable energy technologies, International Renewable Energy Agency (IRENA), Bonn, Germany)*, introduced IRENA, an inter-governmental agency including over 180 countries; members and states in accession, and its mandate: "assist countries to accelerate renewable energy deployment."

Taking a step back, he pointed out that energy is the cause of two thirds of carbon dioxide emissions. It is predicted that renewal energy and energy efficiency can provide 90% of the emissions necessary by 2050, in line with Paris 2015. Cost reduction in the electricity sector has been massive, approaching comparison with traditional energy generation. It is foreseeable that all renewable electricity will be competitive with fossil fuels by 2020. Whereas previously, these were alternative energies, they are now mainstream. Renewable energy has increased steadily, and in 2012, more investment and new capacity has come from renewable energy than fossil fuels. The technology needs to be integrated, however: renewable power is locally concentrated, and its variable nature makes it difficult to integrate. Domestic power is only a third of the total energy consumption: industries, buildings and transport cover the rest; there is much progress to be made. There are huge business opportunities to extend electric vehicles' scope beyond domestic cars to commercial transport, both land-based, marine, and ultimately to aviation.

Francisco presented the International Standards and Patents in Renewable Energy platform (INSPIRE), a free web-tool using the EPO's PATSTAT database. It is an excellent example of cooperation between the EPO and IRENA. INSPIRE shows, in 2016, more than 600 000 patents in renewable energy with a 17% compound annual growth rate, mainly in solar, but also in bio energy fields. Following a peak in this rate in 2011 it has slowed since then. There are factors which contributed to this: maturity of the technology; integration of the developed components (e.g. smart charging of cars, which is growing massively now). The emphasis is moving to enabling technological development. Biofuels have also peaked in 2011, but related to investments in the sector. This is a result of lack of long-term policies for biofuels. **Without the EPO's Y02 patent classification, these conclusions would not be possible.** In summary, INSPIRE has shown the value of patent data to monitor and foster innovation in renewable energies.

Christina Aas *(Co-founder and CEO, Science [&] Technology AS, member of the IAA Committee on small satellites, Oslo)* pointed out the wide-ranging uses for which satellite technology is employed: from mobile phones to navigation tools and applications. More than domestic applications, governmental uses are highly significant. The European Commission launched the Sentinel initiative, the Earth Observation programme, which, at 25 TB of data per day, is now the world's third greatest data generator. The data is freely available; not only visible light images but radar data too. The number of environmental issues supported by satellite imaging continues to grow. The health of the oceans, vegetation and snow cover, and air pollution in cities, are all better monitored by satellites. There are currently 2000 active satellites, most driven by commercial entities for communication and earth monitoring purposes. These technologies are driven by states across the globe; not just the space race countries. The rate of growth is exponential: **22% of all objects in space were launched in the last eight years, and 6% in 2017 alone**. A case in point is the monitoring of forest fires in Portugal, where satellite imagery increases the capability to cover areas historically assessed by drone, by several orders of magnitude. With changes in climate this technology will be crucial in many further countries. Deep learning is also being used to identify clear cutting in forests and help the forestry commissions to improve – and it is fully automated. The rate of ice melting in Greenland is monitored. This in turn is affecting the ocean levels. AIS, the Norwegian ship tracking system prevents illegal fishing and dumping.
In short, as the technical capabilities of hardware improve, the level of detail and extrapolation of data to give valuable environmental guidance does likewise. **The eye in the sky is offering a caring hand to our planet.**

Patents underpin innovation: patenting landscape in the field of CCMTs

Bjørn Lillekjendlie (*Director, Patent Department, NIPO)* gave a short overview of the NIPO, and then followed up with analysis of green technology innovation, estimated at 800 000 documents published in the last 20 years. The absolute figure is less important than comparison between the fields and distribution across countries. Compared with medical technology at 1,3 million documents, it shows that innovation in green technology is significant, and of the correct order.

As to the geographical distribution, absolute investment is highest in the USA, Germany, South Korea, Japan, China, France, UK and the Nordic countries. Considering the amount of innovation in comparison with the carbon dioxide footprint, South Korea is the highest, Germany second, and followed by the Nordic countries. In comparison across sectors, energy generation is the largest, with a number of sectors for goods, and transportation. The smallest sector is Carbon Capture and Storage (CCS). For climate improvement, energy is important. The 1.5 degree threshold will not be reached without CCS.

Concerning energy production, additional solar power capacity has way exceeded other renewable sources in 2017, and between 2010 and 2017 its cost has fallen from $0,36 to $0,10, while the cost of fossil fuel has remained static at $0,07. Onshore wind has also fallen dramatically. These large price reductions are also reflected in the amount of patent investment in these fields over the last few years. The 90GW installed wind power capacity is linked to several thousand patents: IP investments are massively valuable. The Icelandic Patent Office performed a landscaping on geothermic energy, which showed a drop in patenting intensity as per solar power, since 2011. This is just a reflection of the technology's high level of maturity. After development, where innovation is most active, comes installation. Society has succeeded, and this success will continue to deliver even lower prices for renewal energy in the years to come.

Patents support new technologies in green techs: CCMTs and success stories in Norway

Robertha Höglund *(Head of IP, Elkem ASA, Oslo)* gave a short overview of the history and scale of Elkem, having been a technology provider for more than a century. Engagement of the CEO has shaped the company into a greener enterprise. To quote the mission statement, *"to contribute to a sustainable future by providing advanced silicon, silicones and carbon solutions, adding* ***value*** *to our stakeholders globally".*

Of its four business areas, together with silicon material, foundry products and carbon, the biggest area is silicones, based in Lyon. A new plant has now been commissioned in South America (Paraguay) and **in quest of a sustainable future, innovation is central to Elkem's activities** there. In this context, Elkem has filed a patent application for a method for the energy efficient production of metals and alloys by carbothermic reduction of minerals and ores, with which, they aim to reduce the 1,3 million tonnes of carbon dioxide released annually. A key element of the strategy is to replace fossil coal with biocarbon and locate the pyrolysis plant close to the silicon smelter. In the future, the carbons division will aim to support proliferation of electric vehicles with the production of graphite for lithium-ion batteries.

Boualem Mekki *(Head of Patent & CI Team, Elkem Silicones, Lyon)* presented a different field of activity. Fouling of marine vessels, by barnacles and other marine life, significant increases the energy used by ships. Silicone coating is an option which Elkem has further developed. Historically, a tin catalyst used in the field, which is environmentally detrimental. After research and further development, an improved system can be applied; cross-linking now occurs by the action of the catalyst together with the humidity of the air, which causes a hardened coat. Whilst marine life can attach to the hull, the surface is "slippery" and so they are moved along, and off the hull of the ship. A licensing programme was started 5-6 years ago with Dynergie as partner, and **using open licensing: this spreads the technology on a global level**. Identifying a suitable partner, and developing trust is key in succeeding with licensing.

One of the aspects in electric vehicles technology, is that the efficiency of the battery is highly sensitive to temperature: low temperature leads to poor performance. Elkem has developed a very light silicone foam, such that the battery is thermally insulated from the environment. Another usage for silicon foam is, in case of thermal runaway in one cell, foam prevents heat spreading to the next cell, and on. This provides a forty second window for occupants to vacate the car. In conclusion, the company operates a number of strategies with respect to the usage of its IP in order to optimise the value of their technology.

Duncan Park *(Head of Intellectual Property, Tomra ASA, Asker, Norway)* first provided some information on Tomra, and then gave a view on the circular economy. Tomra employees 3420 staff globally, and had a revenue of €784 million in 2017. The technology it develops is sensor-related sorting in the food industry, and the manufacture of packaging, allowing recycling of paper, plastic, and other materials. In mining, Tomra is active in the analysis of various minerals. In 2017, they found the second largest diamond ever recovered from the earth.

The recycling applications are global issues for the company, and further development is critical. 20% of staff are involved in R&D and 8% of revenue is re-invested in R&D. Its path to success has been studded with the acquisition of a number of companies since 1996, with revenue increasing since then. The sorting technology uses light to scan and analyse the image or the reaction between the material and the light, all at high speed. Sorting is performed using air jets or mechanical fingers. From an innovation perspective, patents, utility models, trade secrets, copyright, registered designs and trade mark registrations are all part of the Tomra IP strategy. Not only the IP vehicle, but also the filing strategy varies according to the industry concerned.

Duncan then gave an overview of the circular economy. A consequence of the linear economy is the vast wastage. Its approach is to take raw materials out of the ground, make a product, and then throw it away. In 2012, 2.5 tonnes of waste were either incinerated or sent to landfill for each person in the EU. Sustainability is the industry's reaction to the climate change issues. The circular economy is not a new concept, it merely implies use of a material should put value in the product, to be continually used, or it is disassembled.

So the question is how to enable society: industries have pushed against it, as it is complicated and more costly. Legislation will support, as will financial incentives. The responsibility of companies will also help. How the company addresses the concept must be within their processes and rules. New opportunities will emerge representing business models. **The shift in business models can be seen from Tomra's experience designing products for life extension, for recovery and recycling, for a circular supply chain and products as a service**, "You don't need a washing machine, you need to wash your clothes." This philosophy incentivises the manufacturer offering the service of washing clothes to produce a quality washing machine which therefore requires less maintenance. Big data is a major factor and becoming more important.

The process of design requires a list of priorities: in the circular economy, cost will fall in the ranking and repair facility will climb. The car industry is focussing on this, as are the packaging and construction industries. Customers do not want to see plastics in the oceans; and governments are putting the legislation in place. Sharing platforms are another way forward. Tomra has progressed from selling a product, to selling a product as a service, to selling a whole system. On the global scale, legislation is helping too: this July, Europe and China signed a memorandum of understanding on creating a circular economy. Trade issues compel companies to tread carefully and it must be a collective action. Companies will need to understand where their IP is and in what form. Licensing and access to rights and IP rights will have massive consequences on the implementation of their technologies.

Hege Økland *(CEO, NCE Maritime CleanTech, Stord, Norway)* gave a short presentation on Maritime CleanTech, a cluster including over 90 partners which, in itself, is a huge success factor for the company. The partners include equipment and service suppliers, yards, ship owners, power companies, R&D and education, public sector, regulators and finance and law: a highly diverse cross-section.

It has taken time to build the cluster; each partner requires a careful dialogue in order to move forward. Trust is key, and it takes time: willingness, and enthusiasm to cooperate are essential too.

The projects initiated have been directed at cargo vessels, passenger vessels, fishing vessels, offshore vessels, ferries and wireless charging. Just as the partners are varied, so are the projects.

The goal: simply to facilitate green development. It is important to use the 98% renewable energy. For example, "Ampere" is the first electrical ferry in the world. Energy costs are reduced by 70% compared with diesel. It is foreseen to have 80 electric ferries by 2021. Low or zero emission technology is necessary in all new contracts.

To the question, how, when some are competitors, this can work, the answer is with consortium agreements defining how the partners will cooperate, which are mandatory for all projects. Concerning IP, the NIPO has also worked together to support IP usage additionally concerning designs, trade marks and patents.

The innovation process is defined in Technology Readiness Level (TRL), from one to nine; basic concept to fully commercialised, respectively. So the tricky question is when should the patenting occur? In addition to the timing, the strategy, and the specific nature of the maritime industry are also factors and hence **careful consideration by the consortium is essential in order to optimise the commercial as well as the environmental success of a project.**

Green patenting and Y02 classification: how to find CCMT patents in Espacenet, practical examples and available online resources (including Internet platforms)

F. Javier Hurtado-Albir *(Examiner, Sector Information and Communications Technology, EPO)* introduced the Y02 section of the Cooperative Patent Classification (CPC), which covers "technologies or applications for mitigation or adaptation against climate change". This area has been developed to clearly identify documentation addressing environmental issues, in addition to being coded in the "traditional" areas of the classification system: from, for example, Human Necessities, Chemistry, Mechanical Engineering to Physics and Electricity. Y02 is attributed to six of the eight principle areas showing how widely technologies addressing climate change are distributed. **This extra classification code therefore facilitates identification of individual contribution in green technology**, as well as supporting data mining of patent documentation as has been shown with INSPIRE.

In addition to Espacenet, which can be used free of charge, for example, using classification code to restrict a search, PATSTAT can also be used to query EPO databases. PATSTAT does, however, require knowledge of the SQL programming language and is therefore not entirely straightforward. Further tools available include PATENTSCOPE and the IPC Green inventory, both from WIPO. It should be added that the CPC's Y02 codes are not provided in these databases, and so the documents are spread across the classification.

Panel discussion Topic 1: Patent management in collaborations, technology licensing in the field of CCMTs

Collaborative research is a key issue in the field of CCMTs, where the necessary competencies are often multidisciplinary. Licensing in and out is an essential element to build partnership, and a strong incentive for R&D in the sector, fostering return on investment. In addition to general discussion on this point, the panellists provided testimonies from their professional experience.

The session was chaired by ***Bjørn P. Ringvold*** *(Chief Intellectual Property Advisor, Equinor ASA, Stavanger, Norway)* who introduced the topic by asking how patent management be best integrated in the business plan.

Andreas Schuster *(Co-Founder and Technical Director, Orcan Energy, Munich)* reflected on how the technology that Orcan had developed is, at the component level, straightforward. Reverse engineering would be a relatively easy way for competitors to arrive at the product. In this respect, patenting was critical. Furthermore, working with suppliers on the improvement of the products, meant that the ownership of IP needed to be clarified from the outset. Joint ownership was avoided where possible. The IP rights then go to the party who has the greatest interest, and the other party had licensing rights. Timing of the filing was also critical, even if filing were made when the product was still "immature".

For successful IP strategy there are two questions: do I have control over my critical IP? Does the IP strategy pave the way for a later implementation of the business plan? If yes, this will lead to a success – assuming that the product is accepted by the public.

Tom Ekeberg *(Senior Partner, Team Manager and European Patent Attorney, Zacco Norway AS, Oslo)* has been in the IP business for 30 years or so in a variety of roles: examiner in the NIPO, attorney, and independent consultant. He noted that patent strategy often starts from the perspective of a large corporation which has the product, has the market, and the power to decide on protection or secrecy.

In a start-up or emerging technology, the traditional approach does not work. Specifically in the green technology business more capital is needed, workshops are necessary, access to specialised equipment and satellite data is often required, so collaboration is key. Low capital resources is equated with little clout. An important option to open is patents: not only as an exclusion right, but also a well-defined scope of what can be discussed, what can be regulated in contracts, and on the other hand a non-diclosure agreement (NDA). This can be used to build trust, to enter into dialogue, and to agree how results can be shared. **Patents are a starting point for collaboration.** This enables the start-up to build the workshop, buy the tools and get to work. In summary: use patents to define trust, and the scope of collaboration and the rights to access/use results.

Jon Wulff Petersen *(Director of Commercialisation Activities, Plougmann Vingtoft, Copenhagen)* has experience in consulting and has met many start-ups in the renewable energy industry. This has shown that larger companies have moved further and further away from technology. The environment is increasingly competitive for start-ups. He referred, as an example, to Kitemill, a Norwegian firm, which uses "kites" at up to 1000 m altitude to generate electricity. There are some ten start-ups around the globe competing in this field. The origin of the firm was a group of kite surfers who realised that this technology could be used to generate power. As the technique was already protected, they brought the patentee into the firm. The concept has evolved from "soft" kites to rigid ones. The current product is a cross between a small aircraft and a turbine blade. Tests have been done at the southern tip of Norway, and the first commercial product is now available, after 10 years. However, big players are needed to bring this to the market. The aviation authorities need to be on board, as must the regulation authorities and the public sector. **Whilst the availability of financing is sporadic, the life of IP is not.** It must be a continual asset; however, often IP suffers and becomes highly fragmented. Input from collaborators is needed to support the start-ups get "off the ground".

Bjørn P. Ringvold, referring to his own experience in a large organisation, added that Statoil had changed its name to Equinor in spring in order to move into renewable energy. Even though its production of 2 million barrels of oil per day is the staple income of the firm, renewable energy is increasingly important and they want to emphasise this. Equinor already has three off-shore wind farms, with capacity to power 650 000 homes. With increased investment in renewable energy, they plan to cut 20% from energy usage in its activities; to invest in start-ups too is strategic. **Off-shore wind is a growing business, which is close to profitable now, and so is a big business opportunity.** For Equinor, **suppliers with IP protection on their products are more interesting for possible collaboration.** IP and patent management give incentives to the suppliers to develop further, and provide them freedom to operate.

Panel Discussion Topic 2: Patents and fund raising in the field of CCMTs

Not only technological innovation, but capital and financing issues are also at the heart of CCMT development.
What is the motivation and prospect for an investor to "bet" on CCMTs?
How is this issue addressed on the side of the SME?

The session was chaired by ***Otto Scharf*** *(Director Communication Department, NIPO)* who opened the session asking what the most important aspects of policy in financial determination for a start-up would be.

Marius Holm *(Managing Director, Zero Emission Resource Organisation, Oslo)* noted that the critical question was whether there was a market for the product. The success of solar power, wind power, and batteries is purely based on R&D, funding, and material science. The reason it has been a success is that the German government created a market for solar when the price was a factor of ten times the competition. A similar experience was seen in Denmark for wind turbines. It is these initiatives which have encouraged further development opening up the market when without support, the technology was economically unviable. In terms of the speed of investment and development energy storage, however, heavy industrial applications, and aviation are not moving fast enough. Norway has made a breakthrough with electric ferries. As a result, in 20-30 years, all short haul shipping will be zero emissions. China, on the other hand, is still building coal-fired power stations. Politicians must be motivated to change this.

Andreas Schuster added, on the other hand, that **governmental support needed to be stable in the long term**. Owing to the frequent adjustments of the Erneuerbare-Energien-Gesetz (EEG) levy, in Germany, an unpredictable environment resulted. This led to uncertainty in the future of the biomass energy business, and therefore hindered development.

Hans Jørgen Vinje *(Head CLIMIT programme, Gassnova, Porsgrunn, Norway)* took the perspective from CCS, which is also a climate changing technology, but differs from solar and wind power. Whilst it is not a green product itself, it is a tool for making existing products such as cement, aluminium, steel, green. Each tonne of cement releases a tonne of carbon dioxide, and so CCS is the only technology to remove that carbon dioxide and improve cement as a green product. The full-scale project currently under development in Norway is unique. The purpose is to produce an infrastructure for CCS which could also be used by other countries in Europe. As a comparison, consider the challenge that solar and wind would have faced without the infrastructure of an existing national grid! In terms of motivation for securing financial support, this is the challenge ahead of the project.

Marius Holm added that whilst CCS is needed, to make it commercially viable, artificial markets need to be produced. An option would be a gradual licensing agreement, where carbon dioxide were bought back at 1 or a maximum of 10% of the total; gradually increasing might work. Alternatively, contracts might specify a lower carbon footprint for the product – this is how the "ferry revolution" started in Norway. Another possibility would be to put footprint requirements on the materials for buildings. **The perfect way would be to have a global capping trade solution, but that will not simply happen.** The solution is always a local approach which works, and which then goes global. It is also necessary to move from the dogma that the government should pick winners. There simply is not the time available to let this develop organically. Consequently, much government money needs to be "wasted" on failures. Society needs to invest on CCS projects and a dozen other possible "failures" in order to make the necessary progress on green technology.

Dimitris Giannoccaro *(CEO and Co-Founder, IamIP Sverige AB, Sundbyberg, Sweden)* commented with experience of having seen both sides of this issue. There is a risk that too many ideas are filed immediately. As a company, and particularly a start-up, it is essential to identify where the "real" invention is; above the threshold of being patentable. Again, the key question is whether the invention is currently commercially viable. Furthermore, **if the company's strategy is to use patents, there is a need to be able to enforce them**.

Otto Scharf questioned whether policies on CCS would help the industry in the same way that it had with solar and wind power. ***Marius Holm*** commented with reference to electric vehicles being the most effective policy in future reduction of carbon dioxide. With support, the price of batteries has fallen fivefold and will continue to drop, and so cheaper transport without emissions will result. There are countries willing and able to provide supportive policies. This does not mean that CCS is not a solution. There are areas where it was thought to be necessary. Ultimately coal will not be a viable option for power generation, even with CCS. However, CCS has its place and so supporting a cement factory with CCS is a positive step. The next step would be to specify zero emission solutions. ***Hans Jørgen Vinje*** agreed, noting that two thirds of the carbon dioxide cost from cement is the reduction of the limestone: this cannot be reduced. It is therefore necessary to focus CCS on such industries that do not have an option.

Whilst photovoltaic development has been a success, spearheaded by the German government, ***Otto Scharf*** noted that there are no European solar power manufacturers left. So from a European perspective, it is only a partial success. What can be learnt from this experience? The panel concurred that the experience in photovoltaic cells pointed to a question regarding the quality of the product: what is delivered against what is required by the market. Far Eastern manufacturers had been able to provide a quality of product which was good enough, whilst European manufacturers continued to provide more costly high quality products. The market then decided.

In a similar way, ***Marius Holm*** noted that the German automotive industry will have to face a massive challenge with the move towards electric vehicles. Traditional car-making skills and technologies will no longer be relevant. This will affect both the major manufacturers and their suppliers. ***Dimitris Giannoccaro*** added that small companies must manage their IP as the larger ones do. Simply put, protection is necessary first, in order to negotiate later. IP is certainly one of the key success factors in companies in the arena.

Panel Discussion Topic 3: Smart grids and optimisation of resources CCMTs and IT-related inventions: is Artificial Intelligence (AI) the 'new frontier' of green techs?

AI and smart grids are p*art of the fourth industrial revolution*
The first industrial revolution (steam energy, coal, transport) and the second industrial revolution (electricity, oil, and mass production) related to hardware technology.
The third industrial revolution (electronics and IT, flight, nuclear energy) relates to hardware and software technology, while the fourth industrial revolution (connectivity, software, artificial/distributed intelligence, the industrialisation of every process, renewable energy) seems to take us towards "super-software technology".
In that respect, is innovation in the CCMT field becoming more and more immaterially driven?

The session was chaired by ***Alexandros Papaderos*** *(Deputy Head of the Office for Research and Innovation and Head of TUM Patents and Licenses, Technical University of Munich (TUM))*, who opened the discussion asking why smart grids were necessary.

Ove Flataker *(Director for the Energy Regulatory Authority, The Norwegian Water Resources and Energy Directorate (NVE), Oslo)* suggested considering electricity as a physical commodity: what goes in and goes out of the electricity grid has to be in balance every second. Consumers do not think about the fact that switching on or off an oven has a complementary effect on power generation. There can be no traffic jam in the grid. Power generation is changing, however, as coal, gas and nuclear sources are being closed. Solar and wind power are increasing – but are dependent on the weather. In the future, electrification of the transport sector will place even greater stress on the grid. To satisfy customers, electric vehicles need to be charged in a short period of time, and so the balancing act becomes even more difficult. Consequently, the grid has to be optimised, and so smart grids take advantage of the improvements in intelligent ways to balance input and output.

Rune Hogga *(CEO, Nodes/AE Fleksibilitet, Kristiansand, Norway)* added that the move from Industry 3.0 to 4.0 is about connectivity: a bottom-up revolution. Today, production follows demand. In the future, the demand will have to follow production. Solving these issues with hardware in the grid would be extremely expensive. Utilising cloud solutions and avoiding hardware investment therefore reduce costs.

Atle Riise *(Senior Research Scientist, SINTEF Digital, Trondheim, Norway)*, addressed the question of AI per se. In this context, machine learning and data analysis manipulate large quantities of data, and provide prediction and production services on the one hand, optimisation on the other.

Rune Hogga continued, noting that data is being collected on many aspects of the performance of the grid. A number of algorithms are run to forecast how the grid will develop in the next 24 hours. In this way, a view of whether decisions are necessary in that period can be taken. ***Atle Riise*** pointed out that these AI applications address bottleneck problems, investment, balancing issues, trading issues and so on. Shifting consumption in the grid can lower the peak load, and since investment is normally focussed on the peak load, the operator profits. ***Ove Flataker*** agreed, observing that in Norway, pure electric vehicles now represent 40% of the new car market. If everyone charged their car at the same time, it will be necessary to invest €5000 per car in the grid, and with smart grids, this can be avoided. As a further step, batteries too, can be seen as an extension of the grid and facilitate a temporary store for electricity.

Javier Hurtado-Albir noted that the interaction between electric vehicles and the grid is an interesting one, not just as a temporary energy store, but also concerning the queueing of vehicles for charging (with switches having a delayed activation, depending on the grid's peak), and the power generation from braking; there is also a great deal of data to be exchanged with the grid. ***Rune Hogga*** commented that of the 250 million cars in Europe currently only one million are electric. Yet, in 2030, there will be 130 million electric vehicles. The issue of AI in the grid will therefore rapidly increase in importance. A final question concerns the possibility of standardisation, and who would retain the responsibility for the management of the grid, and for example, which cars would be charged first.

As to the patenting issues concerning AI, barriers should not be immediately seen within the scope of software application. ***Javier Hurtado-Albir*** remarked that patenting computer-implemented inventions has been a practice at the EPO for many years. With respect to the concerns that the patenting process may cause delays, ***Roberta Romano-Götsch*** noted that since 2014 the EPO has been implementing "Early Certainty". Search Reports with a written opinion are systematically provided within 6 months of filing. This affords the applicant a very clear view on the strength of their application. The goal is to complete examination in 12 months, and progress is being made in this direction. Furthermore, should the applicant wish to accelerate the process, mechanisms are available to do so.

Concluding session – A look into the future: the vision and policy of the European Commission

Fostering and deploying CCMTs in the European Economic Area (EEA) and in particular in the Scandinavian area

Piero De Bonis *(Policy Officer Renewable Energy Sources, Directorate General for Research & Innovation, European Commission, Brussels)* outlined the status of Horizon 2020, after four years' implementation. The interim evaluation was made in 2017, and concluded that it was an attractive programme, albeit the success rate was only 12% (and underfunded). In most cases, there were consortia of three or more partners working on a project together. The 2020 programme is now being updated in advance of next year's call for interest. "Open science", "Open innovation" and "Openness to the world" are key aspects. The total budget for 2018-2020 is €30 billion, of which €6 billion is allocated to the European Research Council. It is critically important that the key focus areas addressed in this final stage in the project are aligned with political priorities and achieve exceptional impact. The four identified areas are: "Low carbon" which will help directly towards the Paris Agreement; "Digitisation"; "Security" and "Circular Economy". Within each of the focus areas, many societal areas are affected, including space, energy, food security, climate and transport. He continued, referring again to "Technology Readiness Levels" (TRL) on the scale of 1 to 9 as a helpful tool to assess the level at a technology has reached, and to determine whether it is ripe for IP protection. This would usually be in a range from level 3 to level 6. The Council also operates an IPR helpdesk, which provides support to applicants specifically to 2020 projects.

The next programme, Horizon Europe will start in 2021, with similar goals as per Horizon 2020. The first pillar of this programme is "Open Science". Pillar two will be "Global Challenges", including climate and energy matters, and "Open Innovation" is the third pillar. The draft budget within pillar two, concerning climate and energy matters is some €15 billion. Mission orientation and citizens' involvement here are key components. The other aspects include support for breakthrough innovation, strengthening international cooperation, reinforcing openness and rationalisation of the funding landscape. In this latter respect, there are many partnerships, based on many different models. The goal will be to analyse these and determine which of the models are the most effective. The next steps will follow strategic planning, and increasingly, discussion with external stakeholders will play a stronger role.

The closing included a short overview of three major projects:

- "Strategic Energy Technology Plan", which has the objective of accelerating the development and deployment of low-carbon technologies through cooperation among EU countries, companies, research institutions, and the EU itself, based on common priorities, targets and actions. Here, fourteen implementation plans have been defined in the fields of energy generation, storage, efficiency and use.

- "Mission Innovation" was launched in 2015 with the involvement of 23 countries. These countries committed to double their expenditure on energy research. Thus far, it has launched eight innovation challenges in different technical fields and generated $4 million in research funding.

- "InnovFin" provides loans to technologies at TRLs 7 and 8, and so are not quite ready for commercialisation. Loans are provided up to 50% of the project cost, and are typically between €7,5 million and €75 million. Of key relevance for approval is that the project should be replicable elsewhere, and having an IP strategy is also considered positively. As to measurement of the success of the projects, CORDIS on the Commission's website provides a summary of the results which the projects have achieved.

Wrap up

Roberta Romano-Götsch reflected on the valuable contributions with energised and enthusiastic, interactive exchange. It is clear that as a society, we have to push innovation, and **an advance in green technology is not just an option, it is necessary**.

Researchers, scientists, and as seen just now, the contribution from the European Commission must be appreciated, valued, and built upon. As we heard from numerous speakers, patents also mean dissemination of information – to the benefit of further advancement.

Per Foss added that different stakeholders have different views, and different needs, and as the minister indicated at the start of the conference, financing and budgets are major topics. The NGOs have also have shown how data is used and generates such value to add to the equation.

The case histories also demonstrated the different approaches to IP rights. As for IP offices, patents play an important role with respect to technology promotion: a key role for patent information. IP could also help to keep manufacturing alive in Europe. From the perspective of a patent office, **innovation must be fostered, and growth promoted by delivering high quality patents**: consistency and predictability of the decision are their foundation. As to the approach from SMEs, awareness is a key component, and the ability to make the informed decisions at the right time needs supporting by IP offices.

Roberta Romano-Götsch concluded the conference noting that, in addition to SMEs, universities also are in need of information on IP matters. Provision of patent information is important. The value of a search report together with an opinion on patentability should not be underestimated with respect to supporting SMEs with strategic decisions concerning their approach to IP rights. In this way, a comprehensive assessment of an application's strength can be provided to the applicant in good time – supporting the need for those timely, informed decisions.

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