NTNU

POSITION PAPER ON THE EUROPEAN COMMISSION' S REPOWER EU PLAN

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NTNU
Norwegian University of Science and Technology

The Norwegian University of Science and Technology (NTNU) welcomes the European Commission's (EC) REPowerEU plan[1]. In particular, we support the vision related to boosting renewable energy and energy savings. At the same time NTNU emphasizes and recognizes how extremely ambitious, but also necessary, the REPowerEU plan is.

NTNU think that it will be very important to look at the sea areas further out, and then specifically at offshore wind and offshore energy networks, as these will be crucial for the REPowerEU plan to succeed at its ambitions.

In particular we would like to underline the following aspects:

Overall REPowerEU plan

With REPowerEU, the commission has launched an extraordinary important and ambitious plan for reducing EU's dependency on Russian gas and oil. To achieve this, the commission recommends accelerating the transition to a clean and climate friendly energy system through a set of new actions based on Fit for 55: 1) energy savings; 2) diversify energy supply; 3) substitute fossil fuels; 4) new ways to combine investments and reforms. We support this ambitious goal and the set of actions presented.

Managing the transition will require the capability to develop new energy technologies able to increase the efficiency of existing ones and reducing the related operational costs. This will be the case for the more mature technologies and systems like solar energy, energy efficiency and heat pumps. In this aspect, however, the REPowerEU plan lacks focus on the role that research, education and capacity building should play in keeping Europe's innovation capability. This is particularly true for hydrogen and (deepwater) offshore wind, which are still in an early stage of development.

[1] The REPowerEU Plan: EUR-Lex - COM:2022:230:FIN - EN - EUR-Lex (europa.eu)

Energy savings

Energy savings by cutting consumption in households and companies are of utmost importance to reducing imports of Russian gas and oil. We fully support the Commission proposal to increase the binding target of 13% in the Energy Efficient Directive.

In addition to direct reduction in buildings and industries, a number of buildings creating zero emission neighborhoods through the use of solar roof panels, heat pumps, micro grids, energy storage combined with digital technologies and smart systems are envisioned. A further expansion and acceleration of such systems should be further scaled up and realized in smart cities and regions. Particular attention should be devoted to overall societal planning of where people live and to strengthening the capacities of low-income groups to take part in the transitions, the final target of such a planning process being the reduction of transport distances between living and work as well as a change in how the transport itself is performed.

In the industry sector, one example is the use of high-temperature heat pumps in industrial applications replacing fossil fuels. Heat pump solutions have mostly been limited to temperatures up to 80°C, research activities of High Temperature Heat Pumps (HTHPs) with heat sink temperatures in the range of 90 to 160°C with suitable refrigerants are currently being performed.

Diversifying energy imports

The EU Energy Platform on common purchase of gas (pipeline gas, LNG, hydrogen) can lead to estimated short-term volumes of 30-70 bcm. The largest volumes may come from USA, Qatar and Australia in addition to the present gas imported from Norway and Algeria. Norway export 110 BCM of natural gas to Europe (Germany, Belgium and France) through pipelines accounting for some 20% of the natural gas use in Europe.

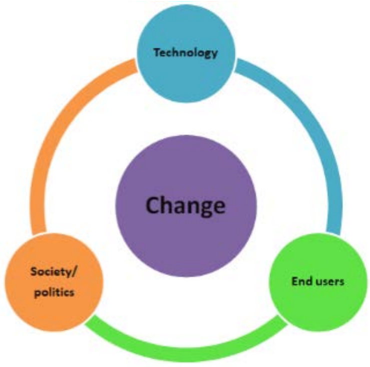
Norway is very well placed to be one of the major world exporters of hydrogen and in particular of blue hydrogen produced from natural gas (SMR – steam methane reforming process with CCUS - Carbon Capture, Utilization and Storage), and green hydrogen produced from water electrolysis powered by renewable energy sources (RES). Moreover, Norway is home of the largest manufacturer of low temperature water electrolysers with systems deployed worldwide. The Nordic power exchange, Nord Pool, was established at an early stage where considerable experiences have been achieved concerning the electricity market.

Combining the large storage capacity of the Norwegian hydropower with variable renewable energy, like wind and solar, can provide an improved flexibility in the electricity market through the export cables to Germany, Denmark and the Netherlands. Natural gas pipelines and storage as electricity interconnections can play a flexibility role in the energy sector in Europe both short term as well as in a longer time span. Hydrogen as an energy carrier has a great opportunity as a flexibility provider.

Comments on boosting renewable energies

Over the past 10-12 years, the energy system has undergone a transformation, which influences how we conduct energy research and the deployment of energy technologies and systems.

The use of energy accounts for approximately 75% of greenhouse gas emissions. To fulfil the Paris agreement and mitigate climate change, new technologies must be developed, and entire energy systems must change. Critical issues include (1) the **D**ecarbonizing of fossil energy resources; (2) Renewable energy technologies are typically smaller in scale, so they need to be **D**ecentralized; (3) New **D**igital solutions will be necessary to manage solutions that are more complex. **E**lectrification of the energy system will be necessary to replace fossil fuels in many processes, thus requiring increased **F**lexibility in the entire energy sector. In summary, new energy systems can be captured by the simple equation: 3D + E + F.



NTNU fully supports the plans for a massive speed-up and scale-up in renewable energy in both power generation, industry, buildings, and transport.

Challenges: In addition to technical innovations, the relations between new technologies and society at large are critical, leading to appropriate regulations, incentives, etc. Likewise, the relations between technologies and the end users must be considered, to ensure acceptance and the correct handling of new technologies. Finally, relations between society and end users, i.e. Citizens, are key in any democratic society.

To make the energy transition a reality, changes must be implemented, and finding sustainable solutions to these changes will require efforts from researchers in multiple disciplines working closely together. A decentralized system will foster more decisions to be taken by consumers and end-users, as options will be available both for the use of electricity and heating in the stationary energy systems as well as energy carriers in the transport system. Decarbonization and decentralization in the energy sector led to the need for improved digitalization. An integrated energy system of smart devices from various stakeholders must interact seamlessly and reliably with each other to provide a stable power supply.

One major question is how the scope of the transition and system integration can be widened to include citizens and their interaction with technologies and systems? **More insights into how to create inclusive engagement in energy transitions and sustainable practices is required. New practices, increased citizen engagement, and changes in behavior and culture are key to stimulating demand for low- carbon solutions, to creating political legitimacy, and to mobilizing the resources needed for the transition and system integration.** Changes are constrained by path dependencies resulting from design, technological, investment, planning, and construction decisions, as well as from social inertia generated by culture, norms, customs, and routine.

Hydrogen targets

REPowerEU pushes forward hydrogen as one of the main pillars of the strategy, and it recommends building an EU-wide hydrogen backbone. The target is to produce 10 million tons of renewable hydrogen inside the union and adding an equal amount of imported renewable hydrogen by 2030. This target is extremely ambitious and will be very hard to reach in eight years, knowing that global electrolytic hydrogen production currently is only 0.03 Million tons per year according to the International Energy Agency (IEA)[2].

In our view, the goal of producing the required amounts of hydrogen will not be possible without hydrogen from (Norwegian) natural gas with Carbon Capture, Utilization and Storage (CCUS), in addition to renewable hydrogen.

This calls for a serious reflection about **including blue hydrogen as an extra asset for the future EU energy mix**. This would entail **increasing research and innovation investments on CCUS technologies and infrastructures**. In contrast, electrolysis is costly, but involves no or negligible emissions (apart from those from electricity generation) and produces high-purity hydrogen (99.999%). For hydrogen storage, compression energy amounts to 10-15% of the hydrogen energy content (up to 30% for very high pressure). Renewable hydrogen at the “pump” could reach€5/kg depending on the electricity costs. Thus, the electricity prices are vital for the price development of hydrogen. By 2030, the hydrogen cost could reach <€3/kg (based on €500/kW Capex, 50kWh/kg efficiency, €50/MWh electricity).

The EU vision for 2030 is to have approximately 40 GW of water electrolysis installed, capable of producing zero emission hydrogen at a price lower than €3/kg. However, the energy transition in the EU will require significant amounts of hydrogen at a large scale until the power sector is fully decarbonized.

In our view, the timeline for hydrogen seems unrealistically tight, as many of the solutions are not yet mature and ready for market, and much more research is needed in all parts of the hydrogen value chain. In addition, the transition to hydrogen as an energy carrier and increased use as industrial gas will require new skills in industry, service sector and public management.

[2] International Energy Agency: www.iea.org/reports/hydrogen

Electrification

REPowerEU mentions electrification as an important part of the strategy, but electric vehicles are not given much attention in the document. This might be because the "Fit for 55" target of zero emissions for new cars by 2035 is believed to be sufficient. However, looking at the extremely ambitious targets for hydrogen for 2030, **a tighter timeline for phasing out fossil cars should be discussed**, since electric vehicles are now becoming mature.

In Norway, we have long experience with the successful integration of electric vehicles, and according to Statistics Norway, two out of three new cars are now electric[3]. This shows that electric vehicles are already the new standard in Norway, and lessons can be learned to help accelerate the transition in other countries as well[4]. Electrification of other transport technologies as well as other sectors, such as the building and industry sectors, is a major challenge. Using renewable electricity to produce green hydrogen as well will probably be an unsolved equation, in the short term. On top of that, tens of giga factories for battery production are in the planning, which also need electricity in the production process. Utilizing blue hydrogen using natural gas with CCUS will help solve the equation on the short term. In the longer timeframe, green hydrogen will be the ultimate solution.

Particular comments on offshore wind (as a part of The North Seas Energy Cooperation (NSEC))

We fully support the statement: "Europe is the global leader in offshore wind. To further strengthen the EU wind sector's global competitiveness and achieve the REPowerEU ambition with fast wind energy deployment, supply chains need to be strengthened and permitting drastically accelerated."

The mandate of The North Seas Energy Cooperation (NSEC) is to "support and facilitate the development of the offshore grid development and the large renewable energy potential in the region. This is a long-standing energy priority for the EU and the concerned countries Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, Norway, Sweden and the European Commission. The North Seas Energy Cooperation, aiming at facilitating the cost-effective deployment of offshore renewable energy, in particular wind, and promoting interconnection between the countries in the region. The declaration emphasizes the importance of voluntary cooperation, with the aim of securing a sustainable, secure and affordable energy supply for the North Seas countries."

We fully support the declaration, but this work must be accelerated if it is to have an impact on the REPowerEU timescale and investment plans. One very important aspect is to not only develop bottom fixed offshore wind systems, but also to accelerate development of floating systems, which have the largest potential globally. Lessons learned from Denmark and Scotland show it is extremely difficult to find good modes of co-existing between fishing interests and wind power interests, which will have to be considered.

[3] Statistics Norway: www.ssb.no
[4] Axios (News Article): www.axios.com/2019/01/30/the-lessons-of-norways-rapid-electric-vehicle-adoption

Carbon capture, Utilization and storage (CCUS): missing attention

Carbon Dioxide Capture, Utilization and Storage (CCUS) is one of the main objectives of the European energy policy, the low carbon policy. Most of the European countries are focusing on decarbonizing the power sector and energy intensive industry, thus reducing anthropogenic CO2 emissions.

Costs and storage issues have greatly affected the use of hydrogen as a fuel. The hydrogen retail price in Europe is ca. €10/kg. Hydrogen production costs depend upon the process, feedstock and production capacity and capability. In general, production from fossil fuels offers competitive prices and large-scale potential but cannot be considered a viable option for large-scale production in the absence of effective CCUS.

The Global CCS Institute[5] provide information through a database of facilities worldwide, ranging from large scale-, pilot- and demonstration facilities to test centers. Technology Centre Mongstad (TCM) is the world's largest facility for testing and improving CO2 capture, able to capture 100,000 tonnes CO2/ year. A new legal operation agreement for TCM was established in early 2020. The major open access RI on the ESFRI roadmap is ECCSEL-ERIC (European Research Infrastructure Consortium) for researchers to a top-quality European research infrastructure devoted to second and third generation CCUS technologies.

Long-term monitoring and documentation of stored CO2 in geological reservoirs have been achieved. The Sleipner CO2 Storage facility was the first in the world to inject CO2 into a dedicated offshore geological sandstone reservoir, starting in 1996; over 16.5 million tonnes have been injected by the end of 2016. The Snøhvit CO2 Storage facilities have captured more than 4 million tonnes of CO2 at an LNG facility in northern Norway, and transported in a pipeline back to the Snøhvit field offshore and injected into a storage reservoir. The first commercial CO2 storage in the North Sea, the Northern Lights[6] is a full-scale project in Norway, located offshore. **Now it is time to develop a roadmap at the European level utilizing the potential of carbon capture, transport and storage, CCUS.**

Clean energy transition

NTNU supports the REPowerEU strategy to accelerate the EU clean energy transition. This calls for radical innovations, but also massive deployment of existing technologies, such as hydrogen, biofuels, offshore wind, and CCUS. Enabling technologies like digitalisation may play a major role in these innovations. However, **transforming towards a deep decarbonisation requires looking beyond single technologies and sectors to understand how the energy transition can be accelerated.** Whereas earlier transitions were driven by new technologies/resource discoveries, the current energy transition is purposive, meaning that policy plays a key role. **A key aspect is aligning transition and industrial goals to mobilise businesses and legitimize transition policies, and to delegitimize unsustainable practices by mobilizing citizens.**

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5 The Global CCS Institute: https://www.globalccsinstitute.com/

6 The Northern Lights project: https://northernlightsccs.com/en/about

Education

Education and capacity building at all levels will play an extremely important role in the transition of the energy system. Existing study programs must adapt to the changed needs, and new study programs must be developed. **To ensure a long-term and successful transition to a clean energy system, education and research at university level should on renewable energy production and utilization, energy savings, storage systems, hydrogen and power systems, etc. must be emphasized on. Further education about societal changes is needed, and citizen engagement is of utmost importance to succeed.**

About NTNU

NTNU is a university with an international focus, and has a main profile in science and technology, a variety of programmes of professional study, and great academic breadth that also includes the humanities, social sciences, economics, medicine, health sciences, educational science, architecture, entrepreneurship, art disciplines and artistic activities. NTNU is the largest university in Norway with 9000 employees and 42 000 students. The university covers many areas of expertise and, in the energy area, educational and research activities span from sustainability aspects, renewable energy technologies, engineering, energy savings in buildings, industry and transport as well as energy system modelling, hydrogen value chains and CCUS. Social sciences, humanities, economics, and logistics are integrated in all aspects of energy.

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