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Editorial

Introducing Oxford Open Energy and the energy quest

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The recent climate report [1] issued by the UN Intergovernmental Panel on Climate Change is alarming as the global greenhouse gas emissions are still remaining at a record high level, which could lead to catastrophic, irreversible consequences in our environment, such as loss of tropical forests in the Amazon, speeded melting of the ice caps and rising sea level. Reaching the goal of the Paris Climate Agreement from December 2015 aiming at limiting the average temperature rise from the pre-industrial time to 1.5°C would be a pre-requisite for keeping the expected consequences of the global climate change manageable. The present trend of the emissions, however, indicates a much higher temperature rise, which calls for stronger efforts globally to cut emissions.

Energy stands in the focal point of reducing the emissions as about two-thirds of all greenhouse gas emissions originate from energy production and use. To reach the Paris goals, these emissions would need to be halved every 10 years, so that carbon neutrality (emission sources equal to emission sinks) could be reached by middle of this century. This will be very challenging as still some 80% of all energy used originate from fossil fuels [2]. Also, the origin of the emissions is shifting from the rich, industrialized countries to the emerging economies with less financial resources. This in turn calls for a global view in climate change mitigation—and global climate solidarity. Accelerating the clean energy transition is of upmost importance in this context, which means in practice massive increase in renewable energy use and improving energy efficiency in the energy end-use side. Moreover, such an energy transition will not only mitigate climate change, but it will also affect other important drivers towards a more sustainable society such as clean air and health, energy security, energy poverty and development [3].

The forthcoming energy transition will impact the whole society and all of us. Importantly, viewing this transition from a techno-economic perspective only, e.g. seeking for the best technology matches and the cheapest solutions, may not be adequate and could even lead to sub-optimal solutions because different social questions such as social acceptability or fairness need also be considered when aiming at massive changes in the society. A just energy transition would not leave anybody out from the development, as stated by the European Union in its Green Deal policy, which aims making Europe carbon neutral by year 2050 [4]. Therefore, the energy transition also needs to be viewed in a socio-technical framework in which the change will take place if several autonomous layers such as technology, economics, policies and social aspects move simultaneously in a synchronous way. The change will take place only if technologies, institutions, business models, user practices and ecosystems are considered simultaneously [5].

The required energy transition described above involves a huge complexity often beyond the capabilities of present policies. The importance of science to provide advice is emphasized in this context, e.g. to explain what is possible or what could be possible in the future and what is needed for a successful outcome. A multidisciplinary and systemic approach involving different disciplines seems to be a promising way to address this grand challenge properly [6]. The transition to carbon neutrality would not only require rapid take-up of innovative clean energy technologies but also need to be accompanied with regulatory and market actions, along with behavioural and social changes to prioritize low-carbon options [7].

Technologies will remain in the core of the energy transition as old technical systems will need to be replaced by new ones. Different renewable energy technologies,

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in particular variable renewable electricity such as wind and solar power, are thought to play a key role in the decarbonization of energy systems. Actually, electrification based on these clean sources seems to be a promising strategy to decarbonize other sectors such as transport, heating and cooling [8]. Industries, which constitute the largest electricity consuming sector in many countries, could benefit much from electrification. As an example, there are serious efforts on electrifying production of chemicals and steel. Thus, the share of clean electricity in the total energy use could increase considerably in the coming decades to also help with emission reductions outside the traditional power sector. Electricity dominance in energy based on weather-dependent sources of power encompasses a range of new challenges often related to integration of large-scale wind and solar power schemes and securing adequate system flexibility to ensure high reliability of supply and management of possible power supply and demand mismatches. Here again, a systems view may become important in addition to individual technologies providing stability and flexibility, e.g. energy storage.

Moving away from a fossil fuel-based energy system to electricity relying on new technologies often requiring large amounts of different materials will create new dependencies, e.g. on critical materials, and could be subject to new types of geopolitical conflicts not yet experienced [9].

Technologies and technological innovations at different stages of development will be needed for reaching carbon neutrality on a long-term run. The International Energy Agency has assessed that technologies at prototype or demonstration stage presently are expected to contribute around one-third of emissions reductions needed, but a further 40% may come from technologies only at the earliest stages of adoption [10]. This calls for research, development and innovation on future frontier and breakthrough technologies as well, while now relying on today's best practice technologies to gearing up the energy transition. Scientific progress in fields such as new materials [11], artificial intelligence [12] and quantum computing, among others, could have profound effects on energy. One could for instance envision making fuels and chemicals from water, air and sunlight with proper catalysts [13]. Fundamental science for energy could thus have potential to produce 'game-changing' solutions, but the scale-up of such laboratory-scale devices to an energy-relevant scale needs a long time horizon and adequate risk-taking.

Likewise, research on energy policy and governance will be crucial to advance our understanding of how to reach the ambitious energy and climate goals. Policy efforts for new emerging energy technologies will be imperative, but equally important will be interventions supporting changes in social norms, institutional capacity and finance. Visions and roadmaps may also be important to express directionality and could be translated into bold missions and transformative strategies.

Oxford Open Energy by the Oxford University Press emerges from the above-described multi-dimensional and complex energy quest and the demand to create a suitable platform to deal with the multi-disciplinary issues in energy, but with an innovative touch. *Oxford Open Energy* is a broad-scope energy journal that welcomes submissions from scholars across the energy research disciplines, from scientists to policy makers, social scientists to engineers and beyond. The journal will promote a collaborative and inter-disciplinary approach to energy research, seeking to bring this community together as the best way of addressing the energy challenges that the world is facing. The journal will publish dedicated commentary articles in addition to traditional research articles in order to make sure that all researchers and readers can understand the broader ramifications of the work, whatever their personal area of expertise. Facilitating greater openness in all aspects of research dissemination is part of the journal's mission to create impact.

The main aims of *Oxford Open Energy* are to identify key topical challenges, to help provide relevant solutions for decarbonizing energy systems as part of the global energy transition and to deliver content with wide societal impact. In line with its aims, the journal welcomes cutting-edge research from fundamental to applied, covering energy science and technology, energy economics and markets, social aspects and socio-economics, policies and transition and sustainability. Interdisciplinary submissions that span more than one energy discipline are strongly encouraged.

The journal is supported by an international Editorial Board constituting of distinguished experts from different disciplines important to energy. The journal will also establish a board of young Early Career Researchers to engage them with the journal and train the future generation of editors for the energy community.

The editors and the publisher are very excited about *Oxford Open Energy*. We are confident that it has the potential to fill the needs of a broader, interdisciplinary academic forum in energy. We are convinced that it will help bringing in fresh and innovative perspectives into the energy field.

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