EUROPEAN COMMISSION
DIRECTORATE-GENERAL JOINT RESEARCH CENTRE (JRC)

Exploratory Workshop on

Energy Sustainability in the Transition to Renewables: Framings from Social Practices and Complex Systems Theories

20-21 March 2018

JRC Ispra Site

Room 101/1003

Via E. Fermi, 2749
IT-21027 Ispra, Varese, Italy

Brief description of the event

The radical transition to renewable energies envisaged by research and policy strategies worldwide is often depicted as just a matter of technological substitution that will not affect our lifestyles. But it may be highly disruptive to many businesses and economies and would require a reorganization of social life that is not thoroughly studied and, most probably, cannot be anticipated in most instances[1]. This exploratory workshop aims to gather some of the leading scholars working on complex systems and social practices theories in order to explore the existing understanding of the challenges entailed by a radical transition[2] to renewables and to formulate practical policy and research indications.

The event is an exploratory research activity[3] implemented by Unit C2 (Energy Efficiency and Renewables) in collaboration with Unit I2 (Foresight, Behavioural Insights & Design for Policy) of the Joint Research

[1] Broadly speaking, it can be fairly assumed that two different types of transition are probably in competition. One type is bottom-up, decentralized, with numerous small-scale units, and practically realized by cooperatives, households, municipalities, NGOs, etc.. The other type is a top down and centralized transition where employed energy sources, even if highly distributed, are mainly managed by a limited number of actors.

[2] A radical transition to renewables is a transition like e.g. the one envisaged by the Beyond 2°C Scenario (B2DS) produced by the International Energy Agency (see the report *Energy Technology Perspectives 2017* recently published by IEA). In the B2DS, the energy sector is assumed to reach carbon neutrality by 2060 to limit future temperature increases to 1.75°C by 2100. To allow achieving this target, 90% of all cars on the road will have to become electric by 2060 under this scenario. Energy intensive industries are then assumed to contribute with a 36% reduction in cumulative direct CO2 emissions. Sustainable bioenergy with carbon capture and storage (CCS) delivers almost 5 gigatonnes of "negative emissions" in 2060. Compared with today, fossil fuel consumption for heating and cooling is then assumed to be cut in half by 2060 thanks to energy efficiency and switching to clean final energy carriers (including decarbonised electricity and district heating). The global power sector is in particular assumed to reach carbon neutrality through scaled up deployment of a portfolio of technologies, including 74% of generation from renewables (including 2% of sustainable bioenergy with CCS), 15% from nuclear, 7% from fossil fuelled power plants with CCS. The remainder of power generation is supposed to come from natural gas-fired generation. Concerning these types of scenario, it may worth stressing that the contribution expected by CCS is highly debated and that biofuels contribution remains under discussion for various reasons.

[3] Exploratory Research is a direct action for the JRC to pursue excellence. It aims to enable the JRC scientific and technical staff to pursue ambitious research projects and activities, without the requirement to address specific policy requests. It is a bottom-up process, where JRC scientists are invited to propose ideas for research projects and activities with the ambition to build up new scientific competences on emerging research fields and possible upcoming policy demands. Hence, exploratory research should be regarded as "initial phase" research which, if successful, may form the basis of more conclusive research for which it may help in

Centre of the European Commission (JRC). It is a follow up activity of a transdisciplinary experts' roundtable organized by the JRC[4] that led to the publication of a book with Springer[5].

Scientific importance, added value

There are two very relevant areas of methodological improvement that are usually not sufficiently considered by researchers and policy makers involved at different levels in the current transition to renewable energies. The first one relates to the need of adopting a complex system perspective[6] when performing research activities or designing and implementing relevant policies, whilst the second one concerns the need for a better understanding of the role that people's social practices can have in the making of this transition[7]. Current research and policy approaches typically miss recognizing how the large scale deployment of renewable energy sources can entail an increased generation of complex systems dynamics[8] where technologies and persons are progressively integrated within mutually reinforcing flows of energy, material and monetary resources. Challenges, nature and justifications for the generation of these dynamics are still very poorly understood and investigated. At the same time, the abovementioned approaches are mostly focused on stimulating technologies substitutions or on changing individual behaviours around single technologies. These types of approach are highly problematic for two reasons. Firstly, they do not consider that existing social practices might not be as adaptable as expected, representing a potential insuperable obstacle to the energy transition envisaged. Secondly, existing social practices can provide innumerable alternative solutions and approaches allowing better adaptation to the ever changing energy supply conditions that can be expected from this transition.

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determining research design, sampling methodology, data acquisition method, evaluation procedure, etc. Exploratory research projects and activities are embedded in the JRC knowledge production units and foster cross-unit collaborations.

[4] For further information on this event see http://iet.jrc.ec.europa.eu/energyefficiency/round-table/experts-round-table-practice-theory-and-complex-adaptive-systems-theory

[5] For further information on the book see https://e3p.jrc.ec.europa.eu/node/589 or http://www.springer.com/la/book/9783319337524

[6] Under a mere engineering and physical point of view, a complex systems perspective acknowledges and deals with the fundamental role played by *non-linear dynamics* within aggregates made by many and strongly coupled components. These dynamics cannot be studied neither through deterministic methods, nor through statistical ones (see e.g., Weaver, W. 1948. *Science and Complexity*. Scientific American 36: 536–544). These dynamics are however generally approached both under a positivist perspective (as most of engineers and physicists would do) and under a constructivist perspective (as sociologists would mostly do). Constructivists in particular generally see complex systems dynamics as something that cannot be understood and managed from the outside (i.e. these dynamics are seen as the result of a co-construction where the observer and the observed cannot be separated. These two entities are seen as one). They therefore see the evolution of socio-technical systems exhibiting these dynamics as a governance problem to be addressed through a mix of quantitative and qualitative methods and approaches where a large series of relevant human and non-human actors is involved (see, e.g. Latour, B., 2005, Re-assembling the Social: An Introduction to Actor-Network-Theory. Oxford University Press) and where techno-science and policy generally play an equally important role (see e.g. Funtowicz, S. and Ravetz, JR, 1990. *Uncertainty and Quality in Science for Policy.* Springer).

[7] Criticalities of current mainstream research methodologies and policy approaches derive fundamentally from the fact that energy supply and demand are studied and approached separately. This separation has produced research and policy strategies where new technologies are conceived as if they will have to fulfil people needs and wants imagined as something that will not be influenced by the new technologies themselves. On the other hand, this same separation has caused that people are typically seen as consumers of technologies to be informed and educated on how to properly use the new devices produced by techno-science and promoted by policy makers. The application of this dichotomous approach within current competitive market settings leads to neglect how energy supply and demand co-evolve and influence each other in a way that can work against higher sustainability. On the other hand, it leads to underestimate the active and fundamental contribution that people can give to produce extremely needed new social practices that can increase social wellbeing and the sustainability of the energy transition at the same time. Finding a way to exploit all the opportunities that have been lost in this way has become particularly important in the present time of geo-political turbulences where people are becoming increasingly disillusioned with public institutions and the democratic process itself.

[8] In so far as a transition to renewable energies entails the management of an increasing number of highly distributed and low intensity energy sources, a higher number of interactions among these sources, a different structure (topology) of interactions, like for example, a higher hierarchy (see Oltvai, Z.N., and A.L. Barabási. 2002. Life's complexity pyramid. Science 298 (5594):763–764.), it can probably be stated that this transition entails a complexification of energy systems. The possibility that this complexification will actually occur has however to be considered as a hypothesis. It is also worth mentioning that complex systems dynamics are basically those for which the concepts of resilience, adaptability, etc. have been developed by complex systems theorists in order to define strategies and approaches to cope with increased uncertainty and unpredictability. These dynamics can also be characterized in terms of two phenomenological principles defined as *maximization of energy flows* and *minimization of entropy production* (see e.g. Labanca et al., 2017. *Complex Systems and social practices in the energy transition*, Springer, pag. 36). Evolution dynamics following these principles are observed within a variety of natural systems which seem to increase their chances of survival in the long term by achieving a trade-off and optimal balance between power output maximization and energy efficiency improvement. By analogy with what observed in natural systems, complex system theorists expect that these dynamics will be increasingly exhibited also by future renewable energy networks due to the more highly fluctuating, interconnected, distributed and hierarchically managed character of employed energy sources.

The scientific added value of this exploratory workshop lies in its analysis of energy changes through the lens of *socio-technical* systems, which can reveal important challenges that are typically unacknowledged under mainstream technology and economics-oriented research approaches. These aspects relate e.g. to the social processes that can stimulate the transition, as wells as the social changes arising from the operation and organization of new energy systems[9]. Several scholars have argued e.g. that societies cannot be "decarbonized" without reducing the rate at which we consume energy and produce energy outputs[10]. A massive transition to renewables will therefore entail a revision of our lifestyles and the way in which we organize and conceive of travelling, products consumption, labour activities, etc. The targets at stake do not therefore just entail reductions of CO_2 emissions and of energy inputs used by technologies. They necessarily entail a reorganization of social life. For example, price declines among photovoltaic modules are likely to trigger a kind of race among utilities, communities and governments to establish whether utility-scale, community-scale or rooftop-scale will be the core of future energy systems. Depending on the social processes that will develop around and as a consequence of the on-going transition, different outcomes can be expected from this race[11]. All in all, renewable energies pose therefore important societal and energy sustainability[12] challenges, while disclosing important opportunities to reimagine and change existing lifestyles.

Structure and Expected Outcomes

The expected and concrete outcome of the workshop will consist of indications concerning new research activities that should be undertaken and of policy recommendations specifically formulated by investigating how social science and socio-technical studies on complex systems should be taken into account by researchers and policy makers dealing with the energy sustainability of the current and planned energy transition.

Five moderated discussion panels

The event will consist of *five* moderated discussion panels where invited scholars will provide thematic inputs for discussion. The *first* panel will discuss how deep decarbonisation will require a focus on affected complex systems rather than on individual technologies and regulations. This will mainly be done by combining a complex network with a social practice perspective. The *second* panel will instead debate the challenges posed by the existing energy metabolism of fossil-fuel based socio-economic systems for a radical transition to renewables. Moreover, it will show how ecosystem science and a deeper understanding of the politics of scarcity can serve as complementary perspectives to better address these challenges. The *third* panel will specifically focus on governance and will discuss challenges and opportunities associated with alternative energy provision models enabled by future low-carbon energy systems. The *fourth* panel will instead discuss insights provided by social science and socio-technical studies in relation to fundamental limitations and possibilities for improvement of forecast approaches currently applied to renewable energies. Finally, the *fifth* panel will deal with the role that people can play to make a radical transition to renewables possible. Social practice theories will serve in this case as a theoretical background to show how a large scale deployment of renewable energies can entail a much more active role of citizens in energy provision when compared to the simple role of energy end-users or

[9] For some information on this point see e.g. Clark A. Miller, Alastair Iles & Christopher F. Jones (2013) *The Social Dimensions of Energy Transitions*, Science as Culture, 22:2, 135-148, DOI: 10.1080/09505431.2013.786989

[10] See, for example, Smil, V., 2003. *Energy at the Crossroads: Global Perspectives and Uncertainties*. MIT press, ISBN 0-262-19492-9

[11] See also the two general types of competing transitions described in the first footnote of this text.

[12] In line with the Burndtland report definition for sustainable development (Our Common Future 1987), *sustainable energy* can be intended as energy that meets the needs of the present generations without compromising the ability of future generations to meet their own needs. As with sustainable development, the organizing principle for energy sustainability should include the fours domains of ecology, economics, politics and culture. This proposed definition clearly needs to be substantiated by explaining how this kind of energy sustainability can be achieved with the limited amount of globally available energy sources and by making it possible that these resources can be redistributed in a fair way.

energy buyers and sellers typically reserved to them within current energy forecasts informed by studies on technological innovation.

Event organisation and expected outcomes

Overall, about 40 selected researchers and policy makers are being invited to participate in the workshop. These include experts providing thematic inputs for discussions and JRC researchers. Experts providing thematic inputs have been requested to produce extended written abstracts summarising the contents of their contributions. These documents will be circulated among invited speakers participating in a same panel to stimulate exchanges of views and to prepare discussions during the two months preceding the workshop. During the workshop, invited discussants will be asked to express their views on what is presented and to write their reactions and ideas arising from their conversations with the experts. Moreover, invited representatives of relevant European Commission DGs will be asked to illustrate their positions on the debated topics. Collected written contributions, discussions' outcomes and proposals for future initiatives produced during the workshop will be summarized and made publicly available in a report produced immediately after the event by the JRC.

Draft Agenda

First Day - March 20th, 2018

08:45 – 09:00 **Welcome and Opening**

09:00 – 09:10 **Introduction to the Exploratory Workshop**
Christian Thiel (Head of JRC.C.02 Unit)

09:10 – 09:30 **Setting the Scene**

Nicola Labanca (JRC-C-2) and Ângela Pereira (JRC-I-2) will explain what is expected from the workshop, the organisation of the event over the two days and will propose possible next steps.

Discussion Panel 1: Complex Networks and Radical Transitions to Renewable Energies
Moderator: Paolo Bertoldi (JRC-C-2)

09:30-10:00 Energy Infrastructures, Social Practices and Low Carbon Transitions
Matt Watson (University of Sheffield – UK)

10:00-10:30 The Role of the Network in a Radical Transition to Renewables
Franco Ruzzenenti (Center for Energy and Environmental Sciences, IVEM – University of Groningen, The Netherlands)

10:30-11:00 *Panel Discussion*
Participants attending this discussion panel will be invited to express their views on what presented and write their reactions and ideas arising from this experts' conversation. This material will be utilized in the follow-up of the workshop.

11:00 -11:30 **Coffee Break**

Discussion Panel 2: Challenges Posed by Fossil Fuel Economies to Current Energy Transition Policies
Moderator: Fabio Monforti (JRC-C-5)

11:30-11:55 Renewable Energies: the Status of Current Low Carbon Technologies and the Energy Metabolism of Contemporary Societies
Mario Giampietro (Universitat Autonoma de Barcelona -UAB, Institute of Environmental Science and Technology - ICTA, Barcelona, Spain).

11:55-12:20 Flourishing within Limits to Growth (Revising Economic Systems by Using Nature as a Model)
Brian Fath (Towson University USA - International Institute for Applied Systems Analysis - Laxenburg, Austria).

12:20-12:45 The Politics of Scarcity in the Age of Renewables
Lyla Mehta (Institute of Development Studies – UK)

12:45-13:15 *Panel Discussion*
Participants attending this discussion panel will be invited to express their views on what presented and write their reactions and ideas arising from this experts' conversation. This material will be utilized in the follow-up of the workshop.

13:15 – 14:15 **Lunch Break**

Discussion Panel 3: Governance within Future Low-Carbon Socio-Technical Systems
Moderator: Aviel Verbruggen (University of Antwerp, Belgium)

14:15-14:40 Polycentric Governance Approaches for a Low-Carbon Transition
Thomas Bauwens (École Polytechnique Fédérale de Lausanne, Switzerland)

14:40-15:05 Collective Action Practices as the Basis for an Alternative Model for Energy Provision
Tine De Moor (International Association for the Study of the Commons, The Netherlands)

15:05-15:30 The Problem of Justice in Energy Transitions
Kristian Krieger (European Economic and Social Committee)

15:30-16:00 **Coffee Break**

16:00-16:30 Panel Discussion
Participants attending this discussion panel will be invited to express their views on what presented and write their reactions and ideas arising from this experts' conversation. This material will be utilized in the follow-up of the workshop.

16:30-17:00 **Wrap up and preliminary exploratory workshop outcome**

Second Day - March 21st, 2018

9:15 – 09:30 **Introduction to the second day of the workshop**

Nicola Labanca (JRC-C-2) and Angela Pereira (JRC-I-2) will briefly summarise the main conclusions of the first day and will explain what is expected from the discussion panels organized for the second day.

Discussion Panel 4: Energy Futures
Moderator: Thomas Völker (JRC-I-2)

09:30-09:55 Combining Qualitative and Quantitative Foresight Methods for Energy Futures
Erik Laes (Flemish Institute for Technological Research - VITO, Antwerp, Belgium)

09:55-10:20 Situating Consumer Practices in Energy Forecasts
Rebecca Wright (Sussex University, UK)

10:20-10:45 Futures Narratives and the Governance of Energy Transitions
Clark Miller (Arizona State University, USA)

10:45-11:15 **Coffee Break**

11:15-11:40 Energy Future Islands as Living Labs
Laura Watts (IT University of Copenhagen)

11:40-12:30 Panel Discussion
Participants attending this discussion panel will be invited to express their views on what presented and write their reactions and ideas arising from this experts' conversation. This material will be utilized in the follow-up of the workshop.

12:30 – 13:30 **Lunch Break**

Discussion Panel 5: People and their Bodies in Radical Transitions to Renewables
Moderator: Ângela Pereira (JRC-I-2)

13:30-13:55 The Role of the Body in Radical Transitions to Renewable Energies
Grégoire Wallenborn (Université Libre de Bruxelles, Belgium)

13:55-14:20 Grid Dependencies and Change Capacities: People and Demand Response under Renewables
Mithra Moezzi (Portland State University, USA)

14:20-14:45 Energy Transition: The Normalizing Power of Apparatuses
Dario Padovan (University of Turin, Italy)

14:45-15:20 P*anel Discussion*
Participants attending this discussion panel will be invited to express their views on what presented and write their reactions and ideas arising from this experts' conversation. This material will be utilized in the follow-up of the workshop.

15:20-15:50 **Coffee Break**

15:50-17:00 **Harvesting the past two days and follow-up**
Moderators: Nicola Labanca & Ângela Pereira

This final session will be dedicated to:

a) bring together different approaches.
b) allow European Commission Directorates General (DGs) colleagues to express their views on the discussed approaches.
c) follow up activities that can be of interest for participating researchers and policy makers.