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Scientific and Technical Revolution: Yesterday, Today and Tomorrow

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Climate Change Mitigation and Renewable Energy Sources: International Legal Issues

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Abstract. Renewable energy today plays an important role in the decarbonization of the economy and, accordingly, in combating climate change processes. There is no specific international treaty regulating renewable energy sources *per se*. In the article we analyzed provisions on renewable energy and climate change that are contained in the UNFCCC, Kyoto Protocol, the Statute of International Renewable Energy Agency (IRENA), the Sustainable Energy for All Initiative, the Green Climate Fund, the Paris-Nairobi Climate Initiative, the Paris Agreement on Climate Change and related international climate change negotiations and declarations. At the same time, the practice of resolving disputes of the WTO Dispute Settlement Body shows that subsidizing the development of renewable energy sources is contrary to the WTO law, it is causing some concern. In conclusion, the authors note that a strategic tuning plan for the implementation of the Sustainable Development Goals (2016–2030), which pays considerable attention to improving the efficiency of using renewable energy sources, should be a definite tuning fork for the international community in this regard. The authors also notice the great importance of fulfilling their nationally determined contributions made under the Paris Agreement on Climate Change, and the interdependence and complementarity of the international legal obligations of states under SDG 7 and 13 and the 2015 Paris Agreement.

Keywords: Climate change · Renewable energy sources · Sustainable energy · The Paris agreement on climate change · Nationally determined contributions · International renewable energy agency

JEL Code: K320 · K330

1 Introduction

Energy is the key factor in the development of economy, industry, ensuring of the main human rights and needs, especially in electricity, cooking, heating, transportation, which are connected with all spheres of human activity. However, the production and using of energy can cause serious consequences for environment: air pollution, climate change, land and ecosystems degradation, water sources pollution, and others (Sokolova 2014). Energy production and use account for two-thirds of the world's

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greenhouse-gas (GHG) emissions (International Energy Agency 2015). GHG emissions have contributed significantly to the historic increase in atmospheric GHG concentrations (Akshalova 2018).

In its Fourth Assessment Report in 2007, the Intergovernmental Panel on Climate Change (IPCC) came out with a statement to the effect that 'most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations from burning fossil fuels and deforestation processes' (IPCC 2007). According to experts, energy (26%), industry (19%), land use and forestry (17%), agriculture (14%) and transport (13%) make the greatest contribution to these growths. The IPCC Fifth Assessment Report concluded that "The energy supply sector is the largest contributor to global greenhouse gas emissions (robust evidence, high agreement). In 2010, the energy supply sector was responsible for approximately 35% of total anthropogenic GHG emissions" (IPCC 2014).

The observed climate change causes long-term changes in average climatic indicators, as well as climate variability resulted from human activities, including anomalies (Bairamova 2015). In 1990, the United Nations General Assembly initiated the development of the international law in the field of climate change by passing Resolution 45/212 that launched formal negotiations for an international climate change treaty (UNGA Resolution 1990). Within two years the international community adopted United Nations Framework Convention on Climate Change (UNFCCC) in 1992. UNFCCC is the main legal mechanism of international climate change law, sets the parameters for global discourse and provides an essential forum for dialogue and decision-making on climate change matters (Carlarne et al. 2016). Nevertheless, the first World Climate Conference was held in 1979 with the support of the World Meteorological Organization, where the World Climate Program and the World Climate Research Program were adopted (Bodansky et al. 2010). The 1997 Kyoto Protocol, the Doha Amendment, and the 2015 Paris Agreement on Climate Change were also adopted.

Renewable energy sources (RES) play significant role in reducing GHG emissions and thus mitigating the effects of climate change. The mitigation scenarios envisioned by the IPCC consider the development of the renewable energy sector to be key to climate change mitigation (IPCC 2011). Moreover, lifecycle assessments for electricity generation indicate that GHG emissions from RE technologies are, in general, significantly lower than those associated with fossil fuel options (Farber and Peeters 2016), and in a range of conditions, employ less carbon capture and storage than fossil fuels. The median values for all RE range from 4 to 46 g CO2 eq/kWh while those for fossil fuels range from 469 to 1,001 g CO2 eq/kWh (excluding land use change emissions) (IPCC 2012).

2 Methods

The methodological basis of the study involves a combination of general scientific (dialectical, historical, inductive, deductive, analytical, synthetic) and private scientific methods (formal legal, comparative legal, interpretative, statistical, procedural and dynamic).

3 Results

Climate change will have impact on the size and geographic distribution of the technical potential for RES. RE sources are, in many cases, dependent on the climate, global climate change will affect the RE resource base, though the precise nature and magnitude of such impact is uncertain. Climate change is not anticipated to have significant impact on the size or geographic distribution of geothermal or ocean energy resources; on solar energy, in spite of influence on the distribution and variability of cloud cover; and on wind energy, though changes in the regional distribution of the wind energy resource may be expected (Inshakova 2019). With regard to hydropower, the overall impact on the global technical potential is expected to be slightly positive. However, results also indicate the possibility of substantial variations across regions and even within countries. The future technical potential for bioenergy could be influenced by climate change through the effects on biomass production such as altered soil conditions, precipitation, crop productivity and other factors. The overall impact of a global mean temperature change of less than 2 °C on the technical potential of bioenergy is expected to be relatively small on a global basis (IPCC 2012).

There is no specific international treaty regulating RES per se. Some provisions on renewable energy and climate change are contained in the UNFCCC, Kyoto Protocol, the Statute of International Renewable Energy Agency (IRENA), the Sustainable Energy for All Initiative, the Green Climate Fund, the Paris-Nairobi climate initiative, the Paris Agreement on Climate Change and related international climate change negotiations and declarations.

The UNFCCC does not provide energy-related obligations for States, and does not expressly mention renewable energy. However, UNFCCC had the provisions in the context of RES "to promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of GHG not controlled by the Montreal Protocol" (Abashidze et al. 2018).

Article 2 (1)(a)(iv) of Kyoto Protocol to UNFCCC establishes that states "shall implement research on, and promotion, development and increased use of, new and renewable forms of energy, of carbon dioxide sequestration technologies and of advanced and innovative environmentally sound technologies" (Kyoto Protocol 1997). The major achievement of the Kyoto Protocol was the commitment of Annex I parties to quantified emission reduction targets, which covered six gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride (Sands et al. 2012).

The Statute of IRENA is effectively the only mechanism designed specifically to advise, assist, and increase cooperation between states to further the global uptake of RE (Akshalova 2018a). The preamble of the Statute of IRENA admits that "RE can play major role in reducing greenhouse gas concentrations in the atmosphere, thereby contributing to the stabilization of the climate system, and allowing for a sustainable, secure and gentle transit to a low carbon economy" (The Statute of IRENA 2009). According to Article 2(b) of the Statute of IRENA, the "Agency shall promote the

widespread and increased adoption and the sustainable use of all forms of RE, taking into account the contribution of RE to climate protection" (The Statute of IRENA 2009).

In November 2011, UN Secretary-General Ban Ki-moon made the Vision Statement of the Sustainable Energy for All Initiative, which states that achieving the three objectives of sustainable energy for all (ensuring universal access to modern energy services; reducing the intensity of world energy consumption by 40%; increase the share of renewable energy in the world to 30%) by 2030 "together will maximize development benefits and help stabilize climate change in the long run" (The Vision Statement of the SE4ALL 2011). These provisions were confirmed in the Framework for Actions of the Sustainable Energy for All, adopted by the Secretary-General's High-level Group on Sustainable Energy for All (Framework for Actions of the SE4ALL 2012). By UNGA request, the UN Secretary-General followed up with the global challenge of SE4ALL, calling for a global energy transformation and specific, but meaningful targets for renewable primary energy production. This challenge is not legally binding on states, but is posed as advance international dialogue and inspire action (Bruce 2013).

The Green Climate Fund was established at the Sixteenth Session of the Conference of the Parties to the UNFCCC (COP16) in December 2010 in Cancun as an operating entity of the Financial Mechanism of realization of UNFCCC Article 11 (Decision 2010). The Green Climate Fund is governed by a Board consisting of twenty-four members of developing and developed country Parties, and is accountable to and functions under the COP to support adaptation and mitigation projects, including renewable energy projects. RE projects form a significant portion of the mitigation activities that the Fund is financing (Am and Drake 2016). For instance, the Green Climate Fund and European Bank for Reconstruction and Development provided funding for the Kazakhstan Renewable Framework project in October 2017 for a period of five years for supporting the construction of 8–11 renewable energy projects in Kazakhstan with a total capacity of 330 MW (Project GCF-EBRD). This project thus helps avoiding the emission of 12.9 million of the anticipated tons of CO2 equivalent.

The Paris-Nairobi climate initiative "Access to energy, sustainable development and climate change" was adopted on April 21, 2011. It stated that the international consensus on a common path to meet the energy-development-climate challenge can be achieved only if this path meets three requirements: a) universal access to modern energy for social services and for productive activities, by 2030; b) energy security (all countries must be able to meet their energy needs in a reliable and sustainable manner); c) climate responsible energy for Economic Growth and Social Progress (The Paris-Nairobi climate initiative 2011).

The 2015 Paris Agreement on climate change sets out a new agenda for implementing the UNFCCC and the UN Sustainable Development Goals 13 Climate action (The 2030 Agenda 2015). The Paris agreement depends for its acceptability and effectiveness on a few core conceptual pillars – the ambition of global efforts to lower GHG emissions, differentiation between developed and developing states, and the provision and mobilization of support for climate change efforts (Klein et al. 2017).

The Paris Agreement does not expressly mention RE. Meanwhile, the Article 4(2) of the Paris agreement establishes the requirement of states to "prepare, communicate

and maintain successive nationally determined contributions that it intends to achieve, pursuing domestic mitigation measures" (The Paris Agreement 2015). Renewable energy components feature prominently in the first round of NDCs arising from the Paris Agreement. The NDCs are at the heart of the Paris Agreement. Communications of new NDCs every five years are required to represent a progression in terms of mitigation ambition beyond the previous NDCs (Schleussner et al. 2016).

Kazakhstan presented its initial NDC to reducing GHG emissions to the Secretariat of the United Nations Framework Convention on Climate Change on September 28, 2015. It provides for a 15% reduction in greenhouse gas emissions by 2030 relative to the level of emissions in 1990 and a 25% reduction in emissions subject to international assistance to Kazakhstan (Nee 2016).

IRENA has undertaken an analysis of current NDCs. Of the 152 NDCs that were formally submitted to date (end-November 2018), some 111, or nearly three quarters, cite specific renewable energy targets, while another 34 acknowledge renewables as an important way to reduce GHG emissions and adapt to climate change impact (IRENA 2018). IRENA's analysis suggests that 'while renewable energy targets and policies are indeed critical components of NDCs, there is substantial scope for countries to increase their RE ambitions. This is true not only for the purposes of mitigation, but also to build resilience in the face of growing climate change impacts' (IRENA 2017).

Moreover, IRENA drew attention to the fact that the majority of NDCs include RE targets only for electricity generation. However, 14 countries also include targets for the production of liquid biofuels, 11 states call for advancement of biogas, and 8 states include the deployment of solar water heaters (IRENA 2017). All parties to UNFCCC have the opportunity to further strengthen their targets for renewables in next round of NDCs in 2020.

The range of policies and tools being adopted at national and local government levels include a provincial carbon tax (Britain Columbia, Canada), national renewable energy policy (Denmark), a seven-party agreement to reach a fossil independent transport sector by 2030 and become climate neutral by 2045 (Sweden), electrified short shipping, setting standards for building, national carbon tax to cut emissions (Chile), a pilot CO2 trading program (China), and the emissions reduction requirement for US states under the Clean Power Plan (though rescinded by President Trump) (Batruch 2017).

We also want to draw attention to the fact that the achievement of the NDCs put forward in the framework of the 2015 Paris Agreement may be adversely effected by the consideration of cases in the Dispute Settlement Body of the World Trade Organization. Often, governments develop a renewable energy support policy aimed at creating jobs and internal technological progress, which makes support for renewable energy dependent on the use of domestic technologies. However, this fact contradicts the requirements of the domestic component, which is prohibited by the WTO law (Solntsev 2018). This leads to the initiation of the WTO cases, which reveal a contradiction that the WTO's right to a "clean" climate policy aimed at promoting the use of renewable energy sources is incompatible with the WTO subsidy rules (Kulovesi 2014). Since 2010, 8 cases related to RE were filed in the WTO. Neither case considered whether, in the absence of domestic FIT content requirement, the WTO law

allows states to use a FIT to subsidize renewable energy, on the basis of renewable energy's environmental and climate benefits (Bodansky et al. 2017).

4 Conclusion/Recommendations

On the basis of the above, we conclude that RES are the main effective means in the climate change mitigation process and reducing GHG emissions. It was recognized in many international acts of obligatory and recommendatory nature. Increasing the number of renewable energy projects under the NDCs will contribute to climate protection, the achievement of SDG 13 and SDG 7, as well as the implementation of the Paris Agreement. All of this proves that the faithful implementation by States of their obligations under the Paris Agreement will have the multiple effect on observance of other international legal obligations, including the 2030 UN Agenda for sustainable development.

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References

Abashidze, A.Kh., Solntsev, A.M., Kodolova, A.V., Kruglov, D.A., Petrova, N.A.: International environmental law: documents and comments. International Legal Protection of the Atmosphere, Including the Ozone Layer, and Outer Space: Study Guide, vol. IV. RUDN, Moscow (2018)

Akshalova, R.: International legal regulation of the effect of renewable energy sources on the atmosphere protection against energy pollution. Bull. Eurasian Natl. Univ. Ser.: Law **4**(125), 137–148 (2018)

Akshalova, R.D.: International renewable energy agency as a specialized international organization. Law State 1–2(78–79), 130–141 (2018a)

Am, M.W., Drake, L.: International law and the renewable energy sector. In: Carlarne, C.P., Gray, K.R., Tarasofsky, R.G. (eds.) The Oxford Handbook of International Climate Change Law, pp. 357–390. Oxford University Press, Oxford (2016)

Bairamova, L.A.: On the issue of climate change on a global scale. Austrian J. Tech. Nat. Sci. **1–2**, 94–97 (2015)

Batruch, C.: Climate change and sustainability in the energy sector. J. World Energy Law Bus. **10**(5), 444–463 (2017)

Bodansky, D., Brunnée, J., Hey, E.: The Oxford Handbook of International Environmental law. Oxford University Press, Oxford (2010)

Bodansky, D., Brunnée, J., Rajamani, L.: International Climate Change Law. Oxford University Press, Oxford (2017)

Bruce, S.: International law and renewable energy: facilitating sustainable energy for all? Melb. J. Int. Law **14**, 1–36 (2013)

Carlarne, C.P., Gray, K.R., Tarasofsky, R.G.: The Oxford Handbook of International Climate Change Law. Oxford University Press, Oxford (2016)

Decision 1/CP.16: Report of the Conference of the Parties on its Sixteenth Session, FCCC/CP/2010/7/Add.1 (Cancun, Mexico, 29 November to 10 December 2010). https://unfccc.int/process-and-meetings/conferences/past-conferences/cancun-climate-change-conference-november-2010/cop-16+&cd=1&hl=ru&ct=clnk&gl=ru. Accessed 07 Apr 2019

Farber, D.A., Peeters, M.: Elgar Encyclopedia of Environmental Law. Climate Change Law, vol. 1. Edward Elgar Publishing, UK (2016)

International Energy Agency (2015): World Energy Outlook Special Report. Energy and Climate Change. https://www.connaissancedesenergies.org/sites/default/files/pdf-actualites/weo_2015_special_report_on_energy_and_climate_change.pdf. Accessed 03 Apr 2019

Inshakova, A.O., Inshakova, E.I., Marchukov, I.P.: Participation of international organizations and integration associations in the development of legal regulation of foreign trade in energy resources. In: Inshakov, O.V., Inshakova, A.O., Popkova, E.G. (eds.) Energy Sector: A Systemic Analysis of Economy, Foreign Trade and Legal Regulations, pp. 173–185. Springer, Cham (2019). https://doi.org/10.1007/978-3-319-90966-0_12

IPCC: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge (2007). https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-spm-1.pdf. Accessed 03 Apr 2019

IPCC: Summary for policymakers. In: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation. Cambridge University Press, Cambridge (2011). https://www.uncclearn.org/sites/default/files/inventory/ipcc15.pdf. Accessed 04 Apr 2019

IPCC: Special report on renewable energy sources and climate change mitigation. summary for policymakers. A Report of Working Group III of the IPCC and Technical Summary. Cambridge University Press, Cambridge (2012). https://www.ipcc.ch/site/assets/uploads/2018/03/SRREN_Full_Report-1.pdf. Accessed 04 Apr 2019

IPCC: Climate change 2014: mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge (2014). https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_full.pdf. Accessed 03 Apr 2019

IRENA (2017): Untapped potential for climate action: renewable energy in nationally determined contributions. International Renewable Energy Agency, Abu Dhabi. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/IRENA-Untapped-potential-2017-summary.pdf?la=en&hash=97BD94B76DC01A918E5101714E1333AE04E3AEEC. Accessed 08 Apr 2019

IRENA (2018): Renewable energy in national climate action. (#Renewables4Climate update for COP24), IRENA's 2018 analysis of renewable energy components of NDCs, International Renewable Energy Agency, Abu Dhabi. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Dec/IRENA_COP24_NDC_update_2018.pdf. Accessed 08 Apr 2019

Klein, D., Carazo, M.P., Doelle, M., Bulmer, J., Higham, A.: The Paris Agreement on Climate Change. Analysis and Commentary. Oxford University Press, Oxford (2017)

Kulovesi, K.: International trade disputes on renewable energy: testing ground for the mutual supportiveness of WTO law and climate change law. Rev. Eur. Comp. Int. Environ. Law **23** (3), 342–353 (2014)

Kyoto Protocol to United Nations Framework Convention on Climate Change (Kyoto, Japan, 11 December 1997). https://unfccc.int/resource/docs/convkp/kpeng.pdf. Accessed 06 Apr 2019

Nee, V.: Ratification of the Paris agreement by Kazakhstan: the main legal issues to be considered (2016). https://eenergy.media/2016/11/03/ratifikatsiya-kazahstanom-parizhskogo-soglasheniya-osnovnye-pravovye-voprosy-trebuyushhie-rassmotreniya/. Accessed 15 Apr 2019

Paris Agreement on Climate Change (Paris, France, 12 December 2015). https://unfccc.int/sites/default/files/english_paris_agreement.pdf. Accessed 08 Apr 2019

Paris-Nairobi Climate Initiative (2011): Access to clean energy for all in Africa and countries vulnerable to climate change. Access to Energy, Sustainable Development and Climate Change (Paris, France, Nairobi, Kenya, 21 April). https://inis.iaea.org/collection/NCLCollectionStore/_Public/43/054/43054809.pdf?r=1&r=1. Accessed 07 Apr 2019

Project FP047 GCF-EBRD Kazakhstan Renewable Framework. https://www.greenclimate.fund/projects/fp047. Accessed 07 Apr 2019

Sands, P., Peel, J., Fabra, A., MacKenzie, R.: Principle of International Environmental Law, 3rd edn. Cambridge University Press, Cambridge (2012)

Schleussner, C.-F., Rogelj, J., Schaeffer, M., Lissner, T., Licker, R., Fischer, E.M., Knutti, R., Levermann, A., Frieler, K., Hare, H.: Science and policy characteristics of the Paris agreement temperature goal. Nat. Clim. Chang. **6**, 827–835 (2016)

Sokolova, N.A.: International energetic security: environmental issues. Lex Russ. **120**(9), 1051–1060 (2014)

Solntsev, A.M.: Climate change: an international legal dimension. Moscow J. Int. Law **1**, 60–78 (2018)

The Statute of International Renewable Energy Agency (Bonn, Germany, 26 January 2009). https://www.state.gov/documents/organization/179955.pdf. Accessed 07 Apr 2019

The Sustainable Energy for All (January 2012): Framework for Action, the Secretary-General's High-level Group on Sustainable Energy for All. https://www.seforall.org/sites/default/files/SE_for_All_-_Framework_for_Action_FINAL.pdf. Accessed 07 Apr 2019

The Vision Statement (2011) by Ban Ki-moon Secretary-General of the United Nations. The Sustainable Energy for All Initiative. United Nations, United Nations Plaza, New York, USA. https://www.seforall.org/sites/default/files/SG_Sustainable_Energy_for_All_vision.pdf. Accessed 07Apr 2019

Transforming Our World: The 2030 Agenda for sustainable development (2015). UN General Assembly Resolution A/RES/70/1 (New York, NY, USA, 25 September 2015). https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf. Accessed 08 Apr 2019

United Nations General Assembly Resolution A/RES/45/212 (21 December 1990). Protection of global climate for present and future generations of mankind. https://www.un.org/documents/ga/res/45/a45r212.htm. Accessed 04 Apr 2019

Conclusion

The scientific and technological revolution of the late 20th century - early 21st century is logical, its stages are interrelated in a cohesive way, but its consequences are unpredictable. On the one hand, formation of the digital economy will solve a large variety of topical issues of mankind. Digital medicine will ensure complete coverage of world population with medical services, early disease detecting and curing most ailments; high-tech production sector will make it possible to produce goods and services for meeting even the most exclusive needs, and the innovative approach to farming will make it possible to solve the problem of world hunger.

On the other hand, the transition to Industry 4.0 implies new risks and threats. They are safety-related, as it is necessary to ensure safety in a new environment – digital environment, and by means of advanced – "intelligent" technologies, with social adaptation to permanent changes, as well as finding ways to maintain the balance and stability of economic systems in a global economic environment characterized by unprecedented dynamism.

Scenarios of development of the digital economy and Industry 4.0 described in the book will make it possible to reduce the degree of uncertainty and prepare for the upcoming changes in a timely manner, and the proposed theoretical and practical recommendations will make it possible to make the scientific and technological revolution controllable and harmonize it in accordance with development priorities of mankind.

Finally, regard must be paid to the fact that, although the book answers many topical questions of society and the economy, new topical issues were discovered as a result of studies. In particular, the established unidimensional view of the scientific and technological progress gives rise to the fair scientific criticism and needs enhanced reasoning or revision.

Economic systems are characterized by cyclic development. Therefore, the isolated consideration of the Fourth Industrial Revolution leads to its limited interpretation and prevents us from assessing its long-range consequences. Based on the fundamental principles and empirical observations of the Theory of Business Cycles, it appears that the current stage of development of the world economic

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system associated with the Fourth Industrial Revolution is the stage of expansion of the long-wave cycle (conjuncture cycles also known as K-waves, developed by N. Kondratiev).

Hence, a new world crisis should become a logical end of the revolution in the long-term. Searching for its sources – social, anthropogenic and environmental – currently deserves high attention for preventing the probable future crisis. It is recommended to dedicate further research to this scientific inquiry.