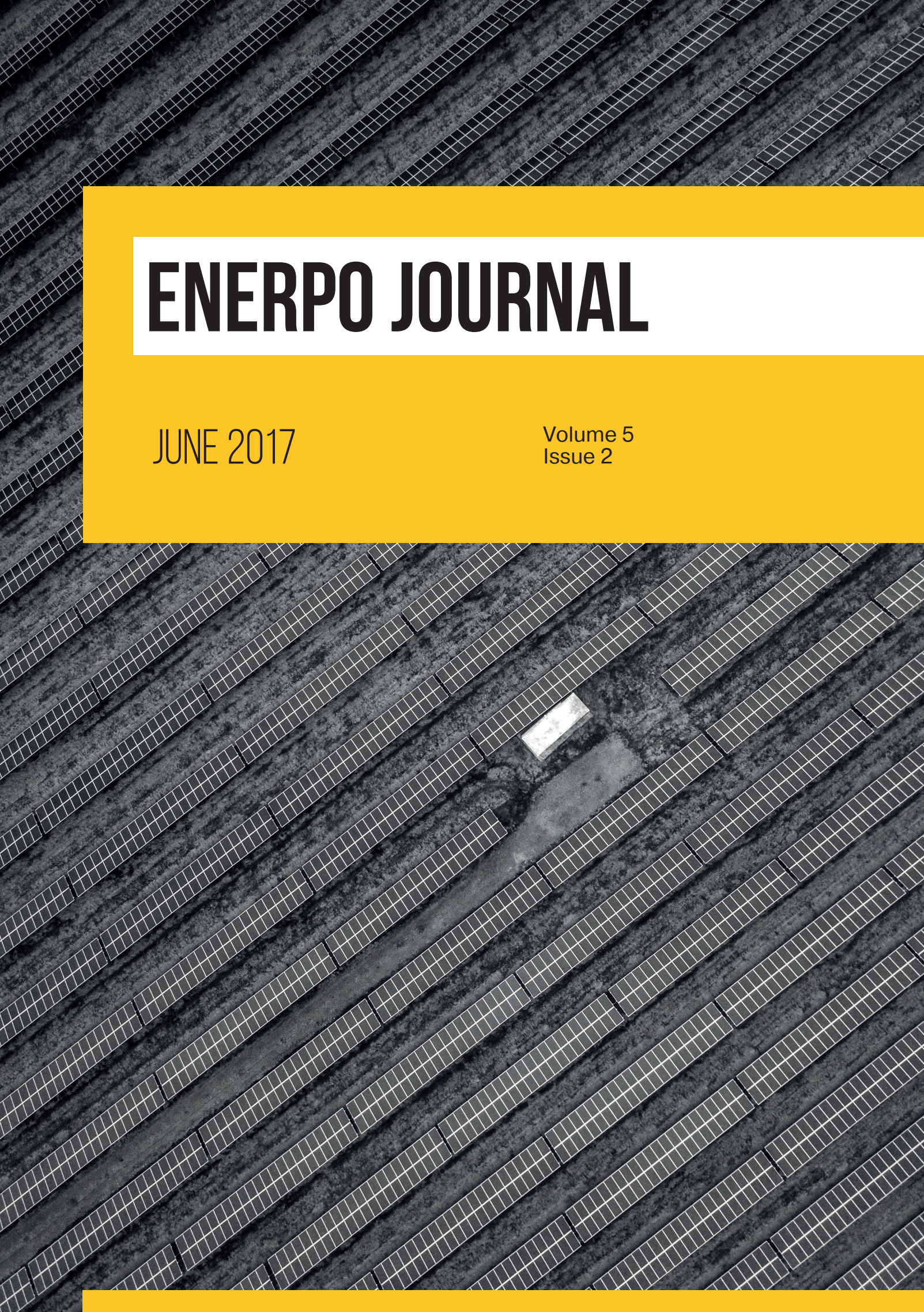

ENERPO JOURNAL

JUNE 2017

Volume 5
Issue 2

ENERPO JOUNRAL MANAGEMENT

EDITORIAL COUNCIL

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November 10, 2016 saw the annual ENERPO conference at the European University at Saint Petersburg. This year's conference, the Clean Energy Forum, embraced the topic: "Russian Economy, Energy and Environment: How to Find A Balance for Sustainable Development?" This report by Irina Mironova and Alberto Perego sums up the happenings of the conference, giving an insight into the Russian renewables sector, both in terms of domestic development as well as vis a vis the COP 21 or the Paris Agreement.

Key words: Paris Agreement, Russia, renewables, RES, COP 21

The development of hydrocarbon resources in the Arctic shelf is a topic of increasing interest. This is in light of the effects of climate change in the region and recent findings of enormous resource potential, which have led to the increasing politicization of hydrocarbon exploitation in the Arctic. Russia, as a worldwide leader in energy production, as well as the largest Arctic state, has a huge stake in exploring and developing Arctic resources. Considering recent Western sanctions against Russia, and the oil and gas industry in the Russian Arctic specifically, this paper examines the question of whether or not the sanctions will prevent Russia from extracting and exporting Arctic hydrocarbons and whether the effect will be long-term. The author argues that despite bad optics now, the sanctions actually will not prevent Russia from developing and exporting hydrocarbons from the Arctic in the long run.

Key words: Arctic, hydrocarbon E&P, investment, sanctions, energy security, Russia's energy policy

This paper gives an overview of the current potential of solar energy utilization through the use of solar power plants, and the applicability of this to lower income countries, with a case study on Tajikistan. The author discusses two main types of solar power plants: Concentrated Solar Power (CSP) and Photovoltaic (PV), and argues that at the current stage, PV plants are more feasible and preferable for Tajikistan. The case of Tajikistan helps to conclude that in lower income countries, PV plants appear to be a more preferred technology to be deployed, but is limited to small-scale PV systems only.

Key words: solar energy, solar power plant, PV, CSP, lower income countries, Tajikistan, Central Asia

The transportation sector is an essential part of any supply chain. During their studies, students of energy politics often focus either on upstream or downstream, but omitting the midstream sector is indeed a pity. In this interview with Pierre Jouvellier, ENERPO Graduate (2016), we discuss the new developments in the oil transport sector as well as perspectives on the innovations that can reshape the architecture of the oil business. The interview was held by Julie Nielen and Irina Mironova.

Key words: oil transportation, LNG, logistics, app development, innovation

ENERPO Research Center

EUROPEAN UNIVERSITY AT ST. PETERSBURG

The European University at St. Petersburg, being one of the first independent universities in post-Soviet Russia, has retained its freedom from state and corporate interests since its founding in 1994. Today EUSP seeks to continue its contribution to independent research by hosting ENERPO Research Center under its auspices. The goal of this Center is to provide a balanced analysis of the energy challenges faced by governments and companies worldwide, with a specific focus on Russia's role in global energy markets.

ENERPO Research Center will also enable domestic stakeholders to compare their experiences with international practice in the spheres of energy efficiency and sustainable development. The main purpose is to facilitate a more informed approach to the development and utilisation of energy resources in a 'greener' world. We strive to contribute to a better understanding of challenges faced by traditional energy systems, and our expertise will help policymakers and companies to navigate the quickly evolving energy landscape.

ENERPO Research Center creates educational programs on sustainable development, inclusive of the Paris Climate Agreement and Russia's obligations in environmental protection and climate change.

MAIN ACTIVITIES IN 2016-2017:

- Strategy and business-plan developed for a green investment fund
- Analytical report on world practice in 'green' financial instruments prepared
- International conference 'Clean Energy Forum' held in Saint Petersburg in 2016 and planned in 2017
- Corporate educational program in sustainable development, energy efficiency, and Russian climate policy put together
- Handbook on energy efficiency projects in the Northwestern Federal District put together

RESEARCH AREAS:

- Strategic policy development and advocacy for energy efficiency and clean energy;
- Climate change and the strengthening of Russia's position in the international climate agenda, in relation to international security and the environmentally-sensitive Arctic region;
- Development of green financial instruments, promotion of sustainable development best practices, and introduction of international standards for environmental and social risk management.

CONTACT DETAILS:

Maxim Titov
Executive Director, ENERPO Research Center

e-mail: *mtitov@eu.spb.ru*
phone: +7 (812) 386-76-22

ENERPO Journal
Volume 5 / Issue 2 / June 2017

CONFERENCE REPORT

CLEAN ENERGY FORUM 2016: FINDING A BALANCE FOR SUSTAINABLE DEVELOPMENT IN RUSSIA

Irina Mironova, Alberto Perego

Abstract

November 10, 2016 saw the annual ENERPO conference at the European University at Saint Petersburg. This year's conference, the Clean Energy Forum, embraced the topic: "Russian Economy, Energy and Environment: How to Find a Balance for Sustainable Development?" This report by Irina Mironova and Alberto Perego sums up the happenings of the conference, giving an insight into the Russian renewables sector, both in terms of domestic development as well as vis a vis the COP 21 or the Paris Agreement.

Key words: Paris Agreement, Russia, Renewables, RES, COP 21

November 10th was a particularly snowy day in Saint Petersburg. A blizzard swept through the city, and the winds swirled snow through the majestic streets. However, inside the marble walls of the European University at Saint Petersburg, the annual ENERPO conference was in full swing. This year's conference, the Clean Energy Forum, embraced the topic: **"Russian Economy, Energy and Environment: How to Find a Balance for Sustainable Development?"** The gloom and frost suggested that solar energy is off the table as an option for Russia in its work of developing sustainable policies. Days before the conference, the Americans elected Donald Trump, and many of the experts who spoke at the conference weighed in on the implications of this news to the implementation of the Paris Agreement.

The Clean Energy Forum brought together key experts to discuss a broad spectrum of problems related to the international regulatory framework, with a focus on both the economic and social implications of a new sustainable path for Russian economic development. The timing of the conference was determined by fate, as just last year, Russia had clearly expressed its strong commitment to climate change issues at COP21 in Paris. In December of 2016, the Russian State Assembly will focus on environmental issues, and the year 2017 has been declared the "Year of Ecology" in Russia.

This report is split into three thematic blocs: Russia and the Paris Agreement; the sustainable development model for Russia; and the role of private companies in creating such a model. Annex I includes charts from the presentations. Since the conference was held under Chatham House rules, there are no direct quotes and the source of the information will remain anonymous; the list of participants can be found in Annex II.

RUSSIA AND THE PARIS AGREEMENT

The forum started by addressing the Paris Agreement. The agreement was reached at the 21st session of the Conference of the Parties (COP 21) under the United Nations Framework Convention on Climate Change (UNFCCC), which took place in Paris in November 2015. The Agreement commits countries to action to combat climate change post-2020. An impressive 195 countries agreed to take action to limit global temperature rises. The agreement itself does not set specific emissions limits. Rather, each country submitted individual plans for emission cuts.[1] Some participants drew attention to the so-called "Paris euphoria" effect: reaching the agreement created an illusion that everything is under control, so the business-as-usual approach is likely to continue. The ideas of climate change mitigation have been around for the past 25 years, but annual CO^2 emissions are still accelerating. The reality is that emissions must decrease; even with a stable level of emissions, the planet is in trouble. And what we actually see during the 25 years of discussing climate change mitigation is an increase in emissions – today we emit 60% more than in 1990. Moreover, there is only a certain amount of CO^2 that can be emitted cumulatively over the years (carbon budget[2]), which means the more that is emitted today, the less we can afford to emit in the future. Therefore, considering the amount of emissions already produced, some say it is already far too late for a 1.5 °C scenario.[3] Realistically speaking, before Paris, the world was on track for a 6-8°C increase. If

1 Intended emission cuts are communicated in the form of INDCs, or Intended Nationally Determined Contributions.

2 Carbon budget is the overall amount of CO2 the world can emit while still having a chance of limiting global temperature increases. For a 2°C scenario, the estimated budget is estimated at 1 trillion tonnes of carbon (the figure may depend on the particular scenario). It is generally agreed that the world has used up more than half of this budget. (Source: World Resources Institute).

3 1.5°C scenario refers to the average global temperature rise relative to pre-industrial level. The target adopted by the United Nations Framework Convention on Climate Change (UNFCCC) is 2°C above pre-industrial level.

the voluntary pledges are met, this would lead to a 3-4°C increase of global temperatures relative to pre-industrial levels. Within this scenario, there is still a lack of clear and realistic plans when it comes to fossil fuels, as well asleaving out international bunkering (aviation and shipping). The 2°C scenario would require 80% of fossil fuel reserves remain in the ground.

So where does Russia fit in this story? The Russian economy is driven by fossil fuels. The carbon intensity of its economy has decreased over the past 25 years. Despite a lower amount of CO^2 emissions per USD, Russia is still well above world's average (Figure 1). The amount of carbon dioxide emitted per Terajoule of energy in the total primary energy supply is decreasing (Figure 2); however, the share of fossil fuels in TPES is among the highest in the world (Figure 3). The major factor behind Russia's efforts in decarbonisation will be the change in the fuel and energy complex in its economy. The hydrocarbon industry itself is an emitter: methane itself is a greenhouse gas; losses along the supply chain translate to an overall higher environmental impact; gas flaring is an unnecessary source of emissions. Although there has been progress in reducing gas flaring in the past years, Russian companies are not in the group of energy companies engaged in international climate change mitigation initiatives (Figure 4). Overall, it was noted several times that oil and gas companies are quite sceptical regarding climate change and global warming, which are seen often as theories rather than scientific facts. Hence, there is little enthusiasm from this side of the Paris Agreement.

Russia is not among the parties who have ratified the treaty before its entry into force on November 4, 2016. Russia's position relative to Paris Agreement ratification and its lack of progress were both noted by the participants. Answering the question of when the ratification is likely to take place, some conference participants said it likely wouldn't be ratified until 2019 or 2020. Climate Partnership of Russia, whose representative spoke at the forum, presented the anticipated schedule. Table 1 outlines what this timeline will likely resemble.

December 2016	Preliminary assessment of the macroeconomic consequences of the Paris Agreement's ratification
December 2017	Assessment of social and economic consequences
December 2017	Preparation of the Model of State Regulation of GHG
June 2019	Preparation of the Draft Federal Law on State Regulation of GHG Emissions
December 2019	Feasibility Report on Paris Agreement Ratification
December 2019	Low Carbon Development Strategy for Russia
December 2019, March 2020	Preparation of the draft President's Order on Limiting GHG Emissions during the period up to 2030, and Plan of Actions for Presidential Order Implementation

Table 1. Steps toward Paris Agreement ratification by Russia: timeline

Source: Oleg Pluzhnikov, Russian Climate Partnership. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

Even though there was strong resistance to limiting emissions, the fact that such a timeline has appeared is considered a step forward and thus a positive development. There are some expectations, however, that Russia will continue to play its important role as one of the larger emitter of GHG, at the international scene.

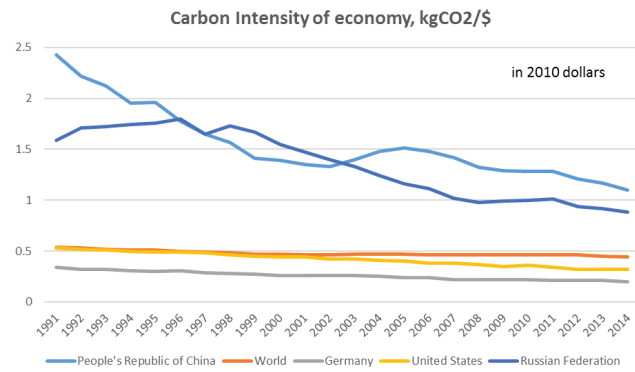

Figure 1. Carbon intensity of economy, kgCO2/$.

Source: Branko Milicevic, Sustainable Energy Division at UNECE based on IEA data. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

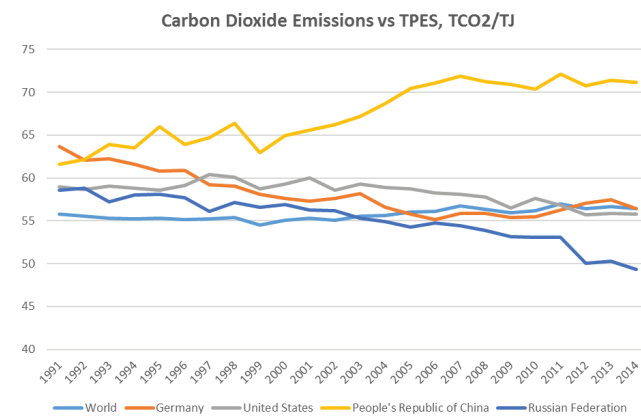

Figure 2. Carbon Dioxide Emissions VS TPES, Tonnes CO2 / TJ.

Source: Branko Milicevic, Sustainable Energy Division at UNECE based on IEA data. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

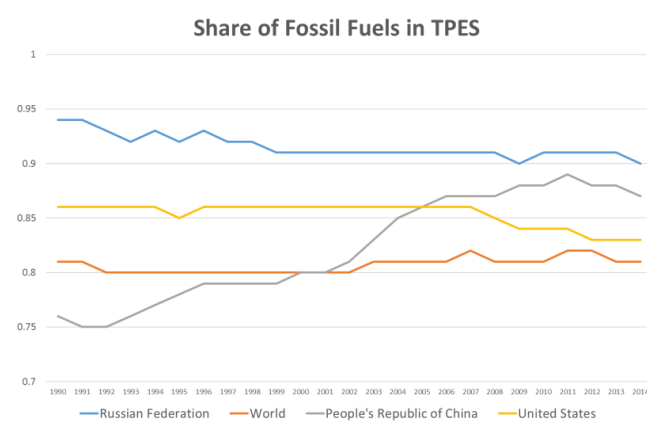

Figure 3. Share of fossil fuels in TPES.

Source: Branko Milicevic, Sustainable Energy Division at UNECE based on IEA data. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

One of the aspects is that Russia is now acting as a donor for developing countries and some projects funded or to be funded by the Russia are directly related to adaptation and mitigation. One of the projects to be mentioned is Russia proposal to support GEF (Global Environment Facility) project in Artic region to protect environmental sustainability

SUSTAINABLE DEVELOPMENT MODEL FOR RUSSIA: WHAT DOES IT ENTAIL?

Even though there were a lot of discussions about sustainable development for Russia, it was not possible to create one general mission. What the visitors saw at the forum was a list of examples of good practices. We were able to identify three key aspects that must be present on the sustainable development model, while the model itself should include many more points beyond these three.

Carbon price

One group of participants had an understanding that putting a price on carbon is imperative. As the current carbon pricing developments reveal, it is the only working mechanism for limiting emissions. The main question is which scheme to pursue: whether it should be a carbon tax, or a market for emission permits.

The main purpose throughout this mechanism is to redirect the investment from energy resource production to the efficient use of energy resources. On the other side of the hall, it was argued that carbon taxation needs to be globally adopted in order to be effective. Note that some areas which are characterised by high carbon emissions export goods to low emissions areas, and this undermines the whole idea of the "polluter pays" principle: the polluter pollutes because there is a consumer on the other side of the supply chain. Another problematic issue with carbon taxes is that employing tariffs to make carbon emitters pay for their pollution is often a controversial process violating many WTO rules.

Carbon footprint reporting

Currently, Russia is developing the basis for GHG emissions monitoring and reporting. The concept is laid out in the Government Decree №716-p (April 22, 2015). According to this document, all organisations emitting more than fifty thousand tonnes of CO2 equivalent per year, as well as all aviation, marine and river transportation companies, regardless of their volume of emissions, will be obliged to report their emission data. The report will contain direct and indirect emissions. How will emissions be measured? This is to be conducted according to the methodology published in June 2015 by the Ministry of Natural Resources. The following standards are used:

Company	Methane Emissions Reduction Initiative	Coalition to Completely Terminate Gas Flaring	Carbon Emissions Tarification Coalition	"Caring for Climate" Initiative	Oil and gas industry's climate initiative	Statements on countering climate change
BG GROUP	✓	✓		✓	✓	✓
bp		✓	✓	✓	✓	✓
eni	✓	✓	✓	✓	✓	✓
PEMEX	✓					✓
REPSOL	✓			✓		✓
saudi aramco						✓
		✓	✓	✓	✓	✓
Statoil	✓	✓	✓	✓	✓	✓
TOTAL	✓	✓	✓	✓	✓	✓
SOCAR		✓				
КазМунайГаз		✓				

Figure 4. Participation of the key players in climate change mitigation initiatives.

Source: Alisa Vasilieva, EY. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

• **ISO/TS 14067:2013 Greenhouse gases** — Carbon footprint of products — Requirements and guidelines for quantification and communication
• **GOST R 56276-2014 Greenhouse gases** (ГОСТ Р 56276-2014 Газы парниковые). Углеродный след продукции. Требования и руководящие указания по количественному определению и предоставлению информации (Introduced on January 1, 2016)
• **PAS 2050:2011** Specification for the assessment of the life cycle for greenhouse gas emissions of goods and services
• **GHG Protocol** Product Life Cycle Accounting and Reporting Standard

Carbon footprint reduction

After the carbon footprint is determined and reported, it would logically have to be reduced. This is done on a corporate level, and essentially many companies in the world are aiming for carbon neutrality. The necessary steps include:

• Determining the carbon footprint of a company for a certain period as well as in the base year;
• Preparing the emissions outlook taking into account business development plans;
• Determining potential, opportunities, and perspective solutions for emission cuts;
• Finalising the action plan;
• Setting the targets for emissions reductions.

As it often happens in Russia companies are considering any new legislation limiting emissions and pollution as some kind of new financial pressure on business. There is a tendency to increase tax pressure on business and any new payment related to environmental aspects of business activity may be seen very negatively based on previous experience. There is a strong will therefore to propose and support new approach, switching from sticks to carrots, i.e. introduce some incentives for environmentally friendly business. The idea is that such incentives can help business and motivate entrepreneurs to become greener rather than penalize it by taxes and duties.

THE ROLE OF THE PRIVATE SECTOR IN THE SUSTAINABLE MODEL FOR ECONOMIC DEVELOPMENT

One of the most important questions discussed by the participants of the conference was about how to engage businesses in the formulation of a sustainable development model for Russia. How can expertise and knowledge obtained by businesses be used in balancing economic prosperity with environmental considerations?

Climate Partnership of Russia was put forward as one of the examples of companies joining their efforts to reach an overarching objective of preserving the climate. This partnership is a joint initiative of Russian companies: they consolidate their efforts to mitigate the environmental impact of economic activities. Their Memorandum of Partnership states that the parties will work toward the creation of market and fiscal instruments in Russia to reequip the industry and move toward a greener economy.

Finally, participants have agreed on three key drivers for companies to become carbon-neutral or environmentally friendly: (i) pressure from the regulator – when a government introduces restrictions and sets up penalties and control mechanisms; (ii) importance for investors/shareholders – when the Norwegian Pension Fund is cancelling all its further investments in coal mining projects; and (iii) customer's behaviour – when people stop using plastic bags and turn back from supermarkets with junk food to local farmers with eco-labelled regional products. In the context of Russian business, large corporations like in the oil and gas industry have been increasingly careful about compliance with international environmental standards because they were borrowing money abroad from large investment funds. Such compliance was a prerequisite to get funding for further development (Sakhalin Energy, Yamal LNG etc.)

What can the companies do, and what should they do more? Firstly, they must continue pushing a low-carbon lobby. Secondly, they must actively participate in the discussion of Russia's low carbon strategy.

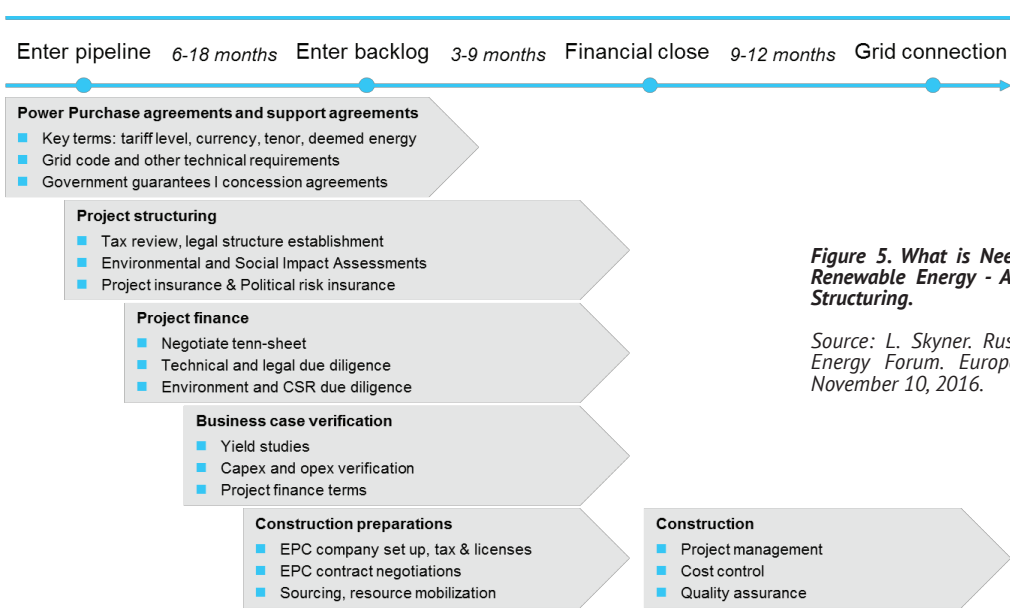

Figure 5. What is Needed for the Development of Russian Renewable Energy - A Comprehensive Approach to Project Structuring.

Source: L. Skyner. Russia 2017. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

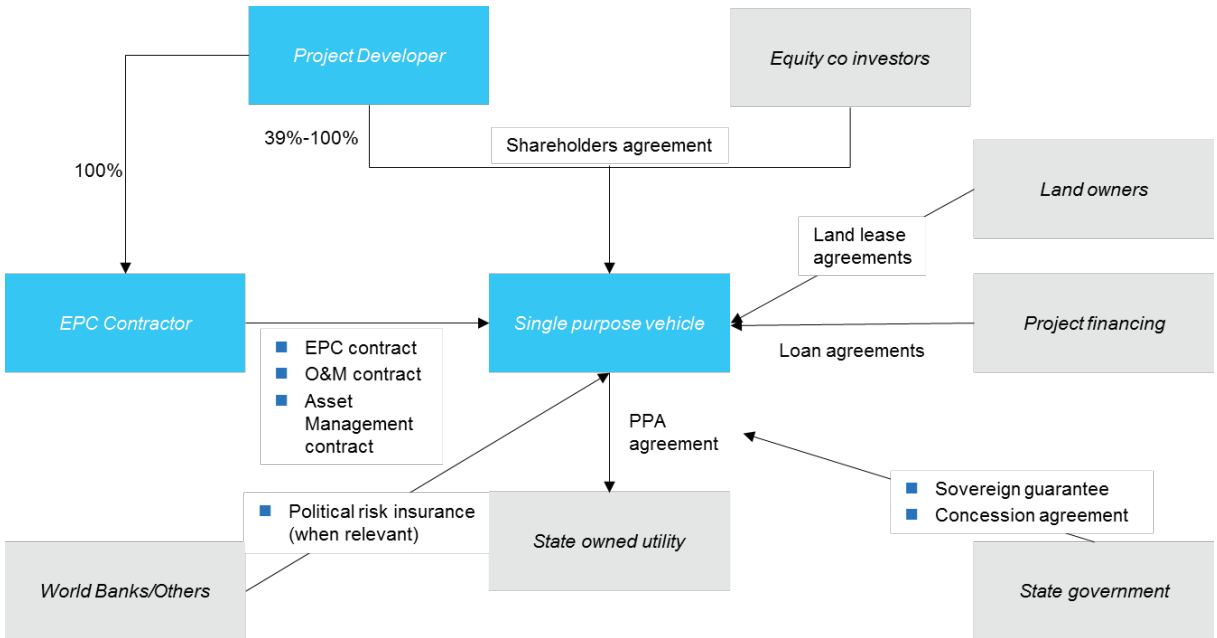

Figure 6. Utilising the Typical Project Structure.

Source: L. Skyner. Russia 2017. Presentation at the Clean Energy Forum. European University at Saint Petersburg, November 10, 2016.

Thirdly, they must cooperate with governmental bodies on creating the legal basis for introducing carbon pricing. Next, monitoring, reporting and verification should continue. Business entities should engage in Russian and international conferences, as well as with working groups to make their intentions known, and for their message to be heard.

Irina Mironova

Irina Mironova, Editor-in-Chief of the ENERPO Journal and other publications of the ENERPO Research Center. She is pursuing her PhD in Energy Economics. Irina has previously worked in research at the Energy Research Institute of the Russian Academy of Sciences, the Russian Center for Policy Studies, Energy Charter Secretariat, Clingendael International Energy Programme. Teaching experience includes ENERPO (Energy Politics in Eurasia MA Programme at the European University at Saint Petersburg), Venice International University, OSCE Academy in Bishkek.

Address for correspondence:
imironova@eu.spb.ru

Alberto Perego

Alberto Perego, MA student of the ENERPO Program, European University at Saint Petersburg. Alberto also works as an intern at the ENERPO Research Center. He has graduated from the Bocconi University's Law School (Milan, Italy), earning a Bachelor and Masters of Arts in law. Alberto's professional experience before entering ENERPO includes traineeship at De Berti Jacchia Franchini Forlani law firm (Milan, Italy).

Address for correspondence:
aperego@eu.spb.ru

CLEAN ENERGY FORUM 2016

Russian Economy, Energy and Environment: How to Find A Balance for Sustainable Development?

EUROPEAN UNIVERSITY AT ST. PETERSBURG

LIST OF PARTICIPANTS

(in order of appearance)

- **Maxim Titov**, Executive Director of the ENERPO Research Center, European University at Saint Petersburg
- **Max Gutbrod**, Partner, Baker&McKenzie CIS
- **Vladimir Lukin**, Manager, KPMG Corporate Governance and Sustainable Development Group
- **Sergey Vakulenko**, Head of Strategy and Innovations Department, Gazpromneft
- **Michael Yulkin**, Managing Director, Climate Change Global Services
- **Louis Skyner**, Senior Associate, Clifford Chance
- **Oleg Pluzhnikov**, Russian Climate Partnership
- **Evgeny Shvartz,** Director for Environmental Policy, WWF – Russia
- **Igor Semenov**, General Manager, EthnoExpert company
- **Alisa Vasilieva,** Senior Manager, Cleantech and Sustainability Services, EY
- **Eduard Akim**, Food and Agriculture Organization of the United Nations; Saint Petersburg State University of Industrial Technologies and Design (SPbSUITD)
- **Oleg Kharkhordin**, Rector, European University at Saint Petersburg
- **Nikita Lomagin,** Vice-Rector for GR, European University at Saint Petersburg

ENERPO Journal
Volume 5 / Issue 2 / June 2017

RUSSIAN HYDROCARBON DEVELOPMENT IN THE ARCTIC DESPITE SANCTIONS

Glenda Pavon-Suriel

Abstract

The development of hydrocarbon resources in the Arctic shelf is a topic of increasing interest. This is in light of the effects of climate change in the region and recent findings of enormous resource potential, which have led to the increasing politicization of hydrocarbon exploitation in the Arctic. Russia, as a worldwide leader in energy production, as well as the largest Arctic state, has a huge stake in exploring and developing Arctic resources. Considering recent Western sanctions against Russia, and the oil and gas industry in the Russian Arctic specifically, this paper examines the question of whether or not the sanctions will prevent Russia from extracting and exporting Arctic hydrocarbons and whether the effect will be long-term. The author argues that despite bad optics now, the sanctions actually will not prevent Russia from developing and exporting hydrocarbons from the Arctic in the long run.

Key words: Arctic, hydrocarbon E&P, investment, sanctions, energy security, Russia's energy policy

The Arctic is a massive area that spans about 1.5 times the size of Russia.[1] It is unique in terms of its ecosystem and climate, but also when it comes to geopolitics. Due in part to climate change, the area is drawing international attention and becoming increasingly politicized. In 2008, the US Geological Survey (USGS) published a report estimating huge potential amounts of undiscovered oil and gas reserves in the Arctic. This discovery, combined with the melting polar ice caps and thus easier access to the potential resources, has led to significant attention focused on the region. The Russian Federation has the largest land mass claims in the Arctic, which is one of the main reasons it has the greatest interests in the region. As a country that relies heavily on its oil and gas industry, Russia needs new fields to offset lower production from its aging fields.[2] Oil and gas activity and production in the Arctic is therefore particularly relevant to Russia. The sanctions regime, however, may limit Russia's ability to develop resources in the Arctic because it eliminates Western investments into the energy sector.[3] Nonetheless, Russia currently does maintain a presence in the Arctic and continues developing oil and gas resources when Western companies have withdrawn from high price Arctic projects facing increasing political pressure from climate change activists.

Considering the disadvantages of high costs, climate change and geopolitical concerns, what are the incentives for Russia to develop natural resource extraction in the Arctic? If the sanctions are aimed at limiting Western investment into high cost Arctic projects then will the Western sanctions prevent Russia from drilling in the Arctic? If the sanctions will prevent Russia from exploiting Arctic natural resources will the effect be long term?

The structure of this paper is as follows: in the first section, the I will describe the sanctions against Russia and how they are relevant to Russia's activity in the Arctic. I will then list and describe the economic as well as geopolitical disincentives and incentives for Russia to develop hydrocarbons in the Arctic region. I will then describe current activity in the Arctic. Finally, I will explain why there are several reasons Russia will develop Arctic hydrocarbons despite the disadvantages associated with this. Using qualitative methods, I will speculate as to what Russia is likely to do in the medium term. I will then conclude with long-term expectations.

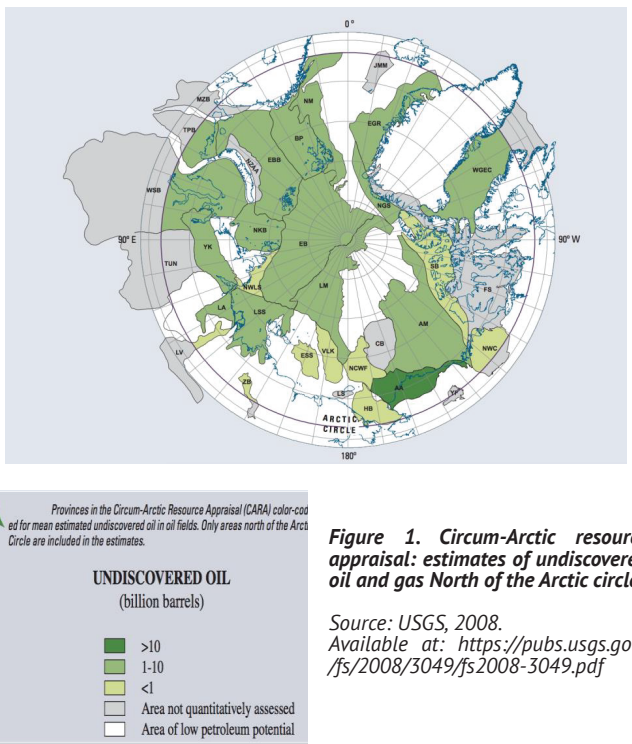

Figure 1. Circum-Arctic resource appraisal: estimates of undiscovered oil and gas North of the Arctic circle

Source: USGS, 2008. Available at: https://pubs.usgs.gov-/fs/2008/3049/fs2008-3049.pdf

1 *Arctic Info Agency, 2016. Arctic history. [online] Available at: < http://www.arctic info.com/encyclopedia/arctic-history/> [Accessed 4 November 2016].*

2 *Dadwal, S. R., 2014. Arctic: the next great game in energy geopolitics? Strategic Analysis, [e-journal] 38(6) pp. 812-814. November 2014.*

3 *Rotnem, T., 2016. Putin's Arctic strategy. Problems of Post-Communism. [e-journal] 27 October 2016. Available at: <http://www.tandfonline.com/loi/mppc20> [Accessed 4 November 2016].*

SANCTIONS OVERVIEW AND RUSSIAN INTERESTS IN ARCTIC HYDROCARBONS

Western Sanctions

The US sanctions focus in large part on the Russian energy industry. The sanctions not only target the financial systems by eliminating financing and investment funds, but they also target the development of technologies that would support the energy industry, particularly the oil and gas industry. According to the US Department of State, under Executive Order 13685 'the provision, exportation, or re-exportation of goods, services (not including financial services), or technology in support of exploration or production for deepwater, Arctic offshore, or shale projects that have the potential to produce oil in the Russian Federation' are prohibited.[4]

The sanctions are aimed at 'severely restricting Russia's freedom of maneuver in the Arctic'.[5] Further, the sanctions prohibit the supply of goods and services for the exploration of oil and gas in Russia and its maritime area, whilst also specifically stating the restriction of provision of items that aid offshore Arctic oil or gas exploration.[6] This paper examines the effectiveness of the sanctions on Arctic hydrocarbon development and production through qualitative data. What are Russia's plans in the Arctic? What are current projects in the Arctic for hydrocarbon production? Can Russia gain investments from countries that are not subject to the United States or European Union sanctions?

Russian interests in Arctic hydrocarbons

The largest country in the Arctic, Russia has major development plans to transform the Arctic into a spring of resources.[7] Global warming and the subsequent melting of the ice caps in the region is facilitating access to the region's vast resources, particularly hydrocarbons. The Russian Arctic strategy outlines the region's economic importance to the country as an energy producer, both currently and in the future. As Michael Roi states: "The Russian leadership clearly emphasizes the importance of the Arctic to the country's wealth and competitiveness on global markets and as a major source of revenue, mainly from the production of energy.[8]" This trend will continue in the future as Russia's currentfields age and production levels diminish. In order to maintain the status as an energy superpower, Russia will need to look to its Arctic resources.[9] Many of these resources will be offshore: according to the USGS, as much as 84 percent of the oil and gas resources in the Arctic are located offshore. This will require investments and technology Russia may not have, and that Western companies will not be able to provide due to sanctions.

INCENTIVES AND DISINCENTIVES FOR ARCTIC DRILLING

Incentives

Russia's incentives for exploiting the Arctic's resources are mainly economic. According to Rotnem, one of the focuses for Russia's Arctic strategy is to use the area for long-term economic development.[10] Tax revenues from fossil fuel production and oil and natural gas exports account for 40 percent of Russia's budget and many of the country's current resources come from aging fields where production is declining.[11] Russia must maintain its current production rates if it wants to keep its energy superpower status. This will require Arctic resources.[12]

Beyond economic interests, 'Russia has by far the greatest intrinsic interests in the Arctic'.[13] According to the US Geological Survey, 30 percent of the world's undiscovered natural gas reserves and 13 percent of the globe's oil reserves are located in the Arctic, with Russia's offshore shelf region perhaps holding the majority share of these totals.[14] Further, massive amounts of undiscovered oil are thought to lie in the Arctic basin just north of Russia, with a potential for extraction that will exceed Russia's Arctic onshore oilfields.[15] If long-term projections are considered, it is evident that the Arctic will be a source for future oil and gas supplies. According to Baev and Boersma, unless long-term projections are false, an additional 15 million barrels of oil per day will be needed by around 2035. "The Arctic is still viewed as one of the last frontiers where this precious resource may be found.[16]"

Disincentives

Despite the incentives for Russia to begin developing hydrocarbons in the Arctic, there are many disincentives that may prevent Russia from doing so in the near future.

4 US Department of State. Ukraine and Russia sanctions, 2017. [online] Available at: <https://www.state.gov/e/eb/tfs/spi/ukrainerussia/> [Accessed 6 February 2017].

5 Rotnem, T., 2016. Putin's Arctic strategy.Available at: <http://www.tandfonline.com/loi/rsan20> [Accessed 4 November 2016]

6 Reed S., 2014. Overview of the US and EU sanctions on Russia. [online] Available at: <https://www.reedsmith.com/files/Publication/9221cf81-e4f7-4907-ab2c-f7dc249eac58/Presentation/PublicationAttachment/441e0ec9-dbd8-4c3a-b1fa-0bf7ed4d5872/alert_14-255.pdf> [Accessed 6 November 2016].

7 Morozov, Y., 2012. Arctic 2030: What are the consequences of climate change? The Russian response. Bulletin of the Atomic Scientists, [e-journal] 68(4), pp. 22-27. 2012. Available at: <http://bos.sagepub.com/content/68/4/22> [Accessed 4 November 2016].

8 Roi, M. L., 2010. Russia: the greatest Arctic power? The journal of Slavic military studies, [e-journal] 23(4) pp. 551- 573. Available at: <http://www.tandfonline.com/loi/fslv20> [Accessed 4 November 2016].

9 Roi, M. L., 2010. Russia: the greatest Arctic power?

10 Rotnem, T., 2016.

11 Idem.

12 Dadwal, S. R., 2014. Arctic: the next great game in energy geopolitics?

13 Idem.

14 Rotnem, T., 2016.

15 Idem.

16 Baev, P. K. and Boersma, T., 2016. With Russia overextended elsewhere, Arctic cooperation gets a new chance. Order from Chaos, Brookings Institute. [online] Available at: <https://www.brookings.edu/blog/order-from-chaos/2016/02/18/with-russia-overextended-elsewhere-arctic-cooperation-gets-a-newchance/> [Accessed 16 May 2017].

Firstly, exploring and developing the Arctic for hydrocarbon resources will be extremely costly. According to Statoil, the costs of exploring and developing some Arctic wells could be as much as $500 million, four or five times the cost of deep-water wells not in the Arctic.[17] Current sanctions will prevent Western companies from providing the necessary funding for these projects, which presents tremendous challenges.

In addition to the high cost, drilling operations in the region are not possible year-round. Extreme weather conditions and technical difficulties mean that in many parts of the region, drilling can only occur for 106 days each year.[18] Given the fact that exploiting the region's hydrocarbons will require large investments and the fact that drilling can only take place for half a year implies low relative profitability of Arctic hydrocarbons. As Rotnem states: "With hydrocarbon prices at current levels the vast majority of Arctic production remains unprofitable.[19]"

Further, there is a level of uncertainty regarding the amount of hydrocarbons thought to exist in the Arctic shelf. The USGS report contains only estimates 'based on geological probabilities and not actual finds[20]'. With no guarantees as to the size of extractable hydrocarbon reserves, investments are more risky and less appealing. This makes further investment into the area less likely.

There are also major climate concerns for the region. These climate concerns are making the Arctic an increasingly politicized zone because of the risks to the area. The Arctic is particularly susceptible to global warming. Temperatures rise fastest on the earth's poles. The white snow and ice reflect sunlight, but the water absorbs the heat from the sun, instead. The seas then warm which melts more ice and then causes more heat from the sun to be absorbed. This then causes a snowball effect that amplifies temperatures.[21]

The Arctic is also an area vulnerable in the case of an oil spill. A major spill has never occurred and thus the process of cleanup is unknown. Conventional technology that removes oil from the surface of the water will not be effective amidst broken ice.[22] If oil from a spill were to spread and drift away, it could circle the Arctic for decades because at such low temperatures oil does not evaporate.[23] Burning the oil would perhaps be the most efficient method of removal, but this would lead to black soot covering much of the snow and further exacerbating climate change effects in the region.

17 Dadwal, S. R., 2014.

18 Idem.

19 Rotnem, T., 2016.

20 Dadwal, S. R., 2014.

21 Anderson, A., 2009. The great melt: The coming transformation of the Arctic. World Policy Journal, [ejournal] 26(4) pp. 53-64. Available at: <http://wpj.sagepub.com/content/26/4/53.citation> [Accessed 4 November 2016].

22 Anderson, A., 2009. The great melt: The coming transformation of the Arctic.

23 Idem.

CURRENT STATUS IN THE ARCTIC AND PROSPECTS

Current hydrocarbon projects

Despite incentives and disadvantages, the fact that Russia has already been extracting hydrocarbon resources in the Arctic must not be overlooked. Although much of the extraction is onshore, 'Russia has been active in natural gas and oil exploration since at least the 1970's'.[24] Thus the Arctic is already an important area for Russian natural gas and oil production. The Russian oil producer, Gazprom Neft, developed the Prirazlomnoye field on the Arctic shelf located in the Pechora Sea, and began exporting in 2014.[25] Gazprom Neft also began commercial production at Novoportovskoye in 2014, according to their website.[26] These projects demonstrate that the Russian government and Russian companies are committed and able to develop hydrocarbon resources in the Arctic, despite the sanctions.

Eastern pivot

It is not unlikely that Russia will look outside of European and American companies for investment in the development of the Arctic's hydrocarbon resources. For example, Russia is already looking to foster relationships with Asian countries, China in particular.[27] Cooperation with China will not only serve Russian interests but Chinese interests as well. Demand for energy is projected to grow in the Asian economies, which will mean Arctic resources are bound to grow in importance. In short, Arctic resources will increase in importance[28] for Russia if it wants to continue its status as a top energy producer, but also for China, that will look to Russia as a supplier for future energy. Considering the global structure of natural gas demand, Asia Pacific and China in particular, will be a key market for Russian natural gas in the long term.[29]

China's importance in Arctic development is also demonstrated by the fact that other Arctic states have begun fostering a stronger business relationship with China. Other Arctic states, meanwhile, are also not far behind. Iceland has stated that it is interested in developing stronger relations with China on Arctic resources, development, scientific research and other businesses, and China Offshore Oil Corporation (CNOOC) has been granted a license to carry out oil and gas exploration in Iceland's Dreki region'. [30]

24 Rotnem, T., 2016.

25 Gazprom Neft, 2016. Prirazlomnoye. [pdf] Available at: <http://www.gazprom-neft.com/company/business/exploration-and-production/new-projects/prirazlomnoe/> [Accessed 6 November 2016].

26 Gazprom Neft, 2016. Novoportovskoye, [pdf] Available at: <http://www.gazprom-neft.com/company/business/exploration-and-production/new-projects/new-port/>[Accessed 6 November 2016].

27 Dadwal, S. R., 2014.

28 Idem.

29 Russian Direct Investment Fund, 2014. Gas industry facts and figures. [pdf]] Available at: <http://investinrussia.com/data/files/sectors/RDIF-Brochure-Gas-download.pdf> [Accessed 5 February 2017].

30 Dadwal, S. R., 2014.

Chinese companies are already investing in various industries in the far Northern regions of Russia. Aside from telecommunications and pharmaceutical company investments, the Chinese company, Huaqing Housing Holding, has invested in the oil refinery sector in Yakutia as recently as 2015. Other Far East Asian companies are also investing in areas of the far North such as Yakutia.[31] In 2016, Japanese Mitsui & Co. Ltd. invested $194 million dollars in the construction of wind farms.[32] This signals that investment from foreign companies, particularly those from Asia are well underway in the Russian Far North energy industry.

China's presence in the Arctic council and interests in the Arctic

In addition to closer business ties, China was inducted into the Arctic Council as an observing member. In 2013, the Arctic council, which is made up of the eight Arctic countries (Canada, Denmark (through Greenland), Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States), added six non-Arctic countries including China, Japan, and Singapore as permanent observers with no voting rights.[33] This demonstrates the significance of non-Arctic countries and their role in key aspects of development and business. Indeed, hydrocarbon resource development will be central to development in the region.[34]

China also has its own intrinsic interests in developing closer business ties with Arctic states. As the new observer states, China has been the most eager for an increasing role in the region.[35] China's interest in the region is due to in large part to trade and natural resources, although the Northern Sea Route is also of interest, because it would cut down on fuel transport costs. This route would cross Russian territorial waters, significantly reducing the travel distance and therefore costs between Rotterdam and Shanghai.[36] Since China is a large energy importer, Russian supplies from the Northern Sea Route are a logical choice to fulfill part of China's energy needs. Long-term agreements with China National Petroleum Corporation (CNPC) providing oil and gas supplies from Russian offshore fields are already in place. [37]

The Northern Sea Route

Sea transport is the primary way external exports are supplied from Russia. The volume of goods going through Russian sea ports is projected to increase by almost 30 million tons by 2030. [38]

Major sea transport through Russian waterways occurs along the Northern Sea Route (NSR). Traffic along the NSR increased by 35% from 2015, according to the NSR administration.[39] Much of this increase can be attributed to the transport of oil and gas. Along the NSR the volume of oil and oil products increased 4 times to 3,473,822 tons. The volume of Liquid Natural gas shipments also increased. Since the Far East, particularly China is a primary market for Russian oil and gas supplies the NSR will be increasingly critical to the export of Russian oil and gas supplies from the Arctic.

The NSR is not only significant for supplies to China but the route would also be important for Japan. For Japan, which is the largest LNG importer in the world, the opening of the region means increased access to supplies from the Arctic, facilitation of transport, and thus diversification of energy supplies. Thus, the Northern Sea Route is significant in terms of transport of Arctic supplies.

Russia has already begun developing the NSR. Leadership in Russia hopes to develop the route for exporting Russia's hydrocarbons. The Russian government proclaims that the route is forty percent shorter, cheaper, and safer than the pirate infested routes along the Indian Ocean and the Straits of Malacca.[40] Large plans are thus underway for the development of the Northern Sea Route.

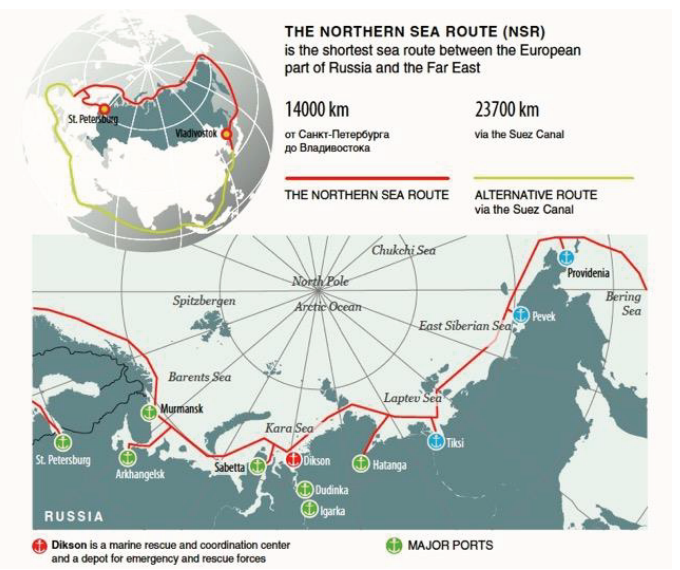

Figure 2. Breaking the ice: When will thousands of ships sail through the Northern Sea route?

Source: East Russia, 2016.
Available at: http://www.eastrussia.ru/eng/breaking-theice/

31 Russian Direct Investment Fund, 2014. Investment Announcements 2014. [online] Available at: <http://investinrussia.com/investment-tools/announcement?region=Republic+of+Sakha+%28Yakutia%29&per_page=20> [Accessed 5 February 2017].

32 Russian Direct Investment Fund, 2014. Investment Announcements 2014.

33 Dadwal, S. R., 2014.

34 Idem.

35 Idem.

36 Idem.

37 Idem.

38 Russian direct investment fund, 2013. Transport industry: freight transportation, facts and figures. "Structure of external cargo flow in Russia by transport type." pg. 27. [pdf] Available at: <http://investinrussia.com/data/files/sectors/TransportEng.pdf> [Accessed 5 February 2017].

39 Northern Sea Route information office, 2017. Transport volume on the Northern Sea Route increased in 2016. [online] Available at: <http://www.arctic-lio.com/node/264> [Accessed 5 February 2017].

40 Rotnem, T., 2016.

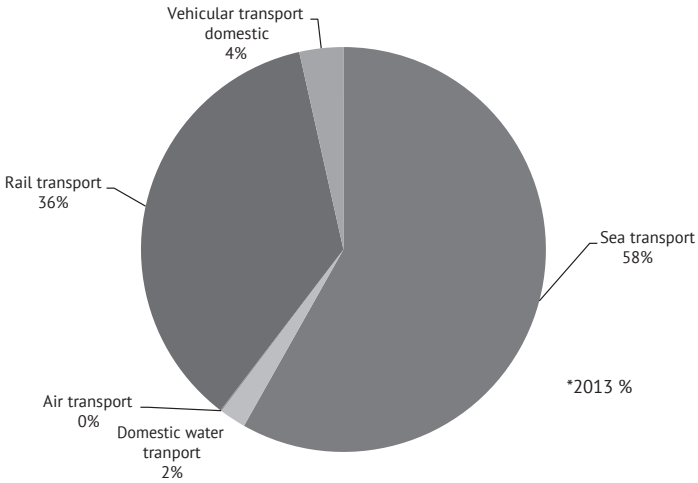

Figure 2. Breaking the ice: When will thousands of ships sail through the Northern Sea route?

Source: East Russia, 2016.
Available at: http://www.eastrussia.ru/eng/breaking-theice/

The Northern Sea Route is significant because it provides a way to transport oil and natural gas from the Arctic. Easier transport of oil and natural gas from the Arctic, despite the higher costs, makes it more appealing. If Arctic supplies were not only expensive to extract but also difficult for Russia to transport development of the hydrocarbons would not be worth the effort. This is well illustrated by the case of Alaskan offshore supplies from the US. According to Fjærtoft et al. the outer continental shelf of Alaska has declined in production.[41] Most importantly, Fjærtoft et al. stated that no gas has been exported due to a lack of an adequate export route.[42] Similarly, Shell stopped exploration and development in the Chukchi Sea in 2015. A large part of this consideration was likely the fact that 'transportation of hydrocarbon products from the Chukchi Sea is not straightforward'.[43] Although hydrocarbon exploration and development in the Arctic will come at a high cost, the Northern Sea Route is an incentive to export resources from the Arctic.

Time constraints of hydrocarbon development

Another important consideration is the time constraints of Arctic hydrocarbon development. According to Dadwal, accessing hydrocarbon resources from the Arctic and bringing them to the market could take twenty years or more.[44] Although this can be considered a drawback to the development of Arctic hydrocarbons, this may not be a drawback in the Russian case. Given the current low cost of petroleum products when combined with a lengthy timeline to develop Arctic hydrocarbons, this will allow Russian development to occur gradually. Gradual development will then take place until Arctic resources are more profitable in relation to other hydrocarbons or when Russian technology can efficiently capitalize on their extraction. In the short to medium term, shares of Arctic hydrocarbons in the world energy mix will not likely increase, whereas in the long term they will increase in importance. Their long term significance in the energy mix will be due not only to improvements in technology or the higher costs of petroleum products, but also because demand will increase, particularly in Asian countries.[45] China, Singapore, and Japan, which were all admitted to the Arctic council as observing members, are generally described as 'energy hungry'.[46] This appetite for energy and for fossil fuels, combined with the acknowledgement of their influence in the Arctic by the Arctic Council, implies that in the long term, these Asian countries will look to Russia and to Russian Arctic hydrocarbons for their energy demands.

Sanctions Backlash?

The Western sanctions against Russia may be a disincentive to exploration and hydrocarbons in the Arctic because they limit available technology and financing, but they may also be a provocation for Russia to act more proactively in the Arctic region. Russia is increasingly militarizing the region, and Dadwal stated that tensions between Russia and the West could draw them into conflict.[47] While conflict can mean military aggression it can also mean more resolve to explore and produce fossil fuels on Russian Arctic territory. Russian behavior in the Arctic has been described as frustrated with Western sanctions.[48] However, it is important to note that Rotnem describes many examples of Russian cooperation and diplomacy in the Arctic: "A significant body of evidence exists that demonstrates Russia's earlier commitment to a collaborative agenda in the Arctic. […] Russia's initial claims submission to the United Nations Commission […] was evidence that the country was committed to following the established international legal process for settling […] disputes. [49]" Furthermore, despite other geopolitical disputes, the Arctic has been an area characterized by geopolitical stability. Relevant countries have abided by international laws, which has been essential to maintaining stability within the region.[50] The Arctic council, which has 8 permanent members, 'has a hard track record of establishing and facilitating cooperation between Arctic states[51]'. Since international law holds that all countries have sovereign rights over the natural resources within their territories and Russia will not likely agitate the cooperation that characterizes the Arctic through aggressive military action, then perhaps that

41 Fjærtoft, D., Lindgren, P., Loe, J., and Lunden, L., 2011. Commerciality of Arctic offshore gas: A comparative study of the Snøhvit and Burger fields. [pdf] Available at: <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2014/11/WPM-56.pdf> [Accessed 4 November 2016].

42 Fjærtoft, D., Lindgren, P., Loe, J., and Lunden, L., 2011. Commerciality of Arctic offshore gas: A comparative study of the Snøhvit and Burger fields.

41 Idem.

44 Dadwal, S. R., 2014.

45 Idem.

46 Idem.

47 Idem.

48 Rotnem, T., 2016.

49 Idem.

50 Clifford, R., 2016. How has cooperation in the Arctic survived Western-Russian geopolitical tension? The Polar connection, [online] 18 December. Available at: <http://polarconnection.org/cooperation-arctic/> [Accessed 16 May 2017].

51 Clifford, R., 2016. How has cooperation in the Arctic survived Western-Russian geopolitical tension?

frustration will serve as motivation to develop their hydrocarbon resources in the Arctic. While the sanctions against Russia may be characterized as a source of frustration, that frustration may lead Russia to act in a collaborative and law-abiding way, not wanting to disrupt the cooperation that characterizes the region. The Russian foreign policy declaration states that the Russian Federation sees the existing international legal framework as sufficient to resolve any regional disputes.[52] Indeed, regional cooperation in the Arctic is crucial for each of the Arctic states to pursue their regional goals and ensure the prosperity of each of their Arctic populations.[53] When recent history demonstrates mutual diplomacy, it may be futile to say that the sanctions against Russia will be a source of conflict in the region. However, it may not be extreme to project that Russia will demonstrate a commitment to develop Arctic resources to which they have sovereign rights.

Ongoing domestic investment in the Russian Arctic and Far North

The final consideration for Russian oil and gas drilling in the Arctic is whether there is domestic capacity for investments in the region in spite of the sanctions, and if ongoing projects are underway. According to the Ministry of Economic Development of the Russian Federation, currently there are no federally funded projects in the Russian Arctic, but there are Russian companies which are investing heavily in many industries, including in the energy industry.[54] In Murmansk, several Russian companies have invested around $127 trillion Rubles into the development of transportation and communication, such as railways and road infrastructure.[55] Much of these investments target construction of infrastructure for the transport of coal, oil, and petroleum products. There are also ongoing projects for the development and extraction of other natural resources such as palladium, gold, nickel, and platinum in the Murmansk region. Russian companies are investing in key regions of the Russian Far North, and although investments are not only occurring in the energy sector of these regions, the development of transport infrastructure as well as housing, agriculture and forestry, and service industries will help to draw more commerce to the regions. The growth of other industries in the Russian Arctic will help to bolster the energy industry by increasing the attention and investment opportunities available to those target areas.

CONCLUSION

Russia is not only the largest Arctic country but it has a long history of development in the region. Although the Western sanctions target the oil and natural gas industry in the Arctic, Russia already has a presence in the region and has expressed its commitment to further explore and develop the region for natural resources. Increasing energy demand worldwide provides a further impetus for Russian natural resource development in the Arctic in light of the fact that many onshore fields are aging. Although the challenges are numerous, the incentives to develop and export hydrocarbons from the Arctic are more compelling. Countries not involved with the Western sanctions also have incentives to develop Arctic hydrocarbons and natural resources. This will allow Russian oil and gas producers to appeal to them for investments and technology necessary to exploit the Arctic's natural resources. In the long run when newer technologies are developed and the price of petroleum products increases, Russia will already have enough experience in the region. By committing to act in spite of sanctions now, Russia has ensured it will be a leader in the Arctic for many years to come.

52 Ministry of Foreign Affairs of the Russian Federation, 2016. Foreign policy concept of the Russian Federation. [pdf] Available at: <http://www.mid.ru/en/foreign_policy/official_documents/-/asset_publisher/CptICkB6BZ29/content/id/2542248> [Accessed 16 May 2017].

53 Clifford, R., 2016.

54 Ministry of economic development of the Russian Federation, 2017. Integrated foreign economic information portal. [pdf] Available at: <http://www.ved.gov.ru/eng/investing/investing-climat/> [Accessed 5 February 2017].

55 Ministry of economic development of the Russian Federation, 2017. Integrated foreign economic information portal.

Glena Pavon-Suriel

Glena Pavon-Suriel is an ENERPO alumnus focused on professionally growing in energy relations and currently living in Saint Petersburg.

Address for correspondence:
glendalp@gmail.com

ENERPO Journal
Volume 5 / Issue 2 / June 2017

SOLAR POWER: CSP AND PV PLANTS COMPARISON AND THEIR APPLICABILITY IN TAJIKISTAN

Gulnoza Khodizoda

Abstract

This paper gives an overview of the current potential of solar energy utilization through the use of solar power plants, and the applicability of this to lower income countries, with a case study on Tajikistan. The author discusses two main types of solar power plants: Concentrated Solar Power (CSP) and Photovoltaic (PV), and argues that at the current stage, PV plants are more feasible and preferable for Tajikistan. The case of Tajikistan helps to conclude that in lower income countries, PV plants appear to be a more preferred technology to be deployed, but is limited to small-scale PV systems only.

Key words: solar energy, solar power plant, PV, CSP, lower income countries, Tajikistan, Central Asia

Solar energy is the irradiation received from the sun and is considered to be the cleanest and most abundant renewable energy source available.[1] Solar energy is converted from thermal to electrical energy to create solar power, which is then used to meet energy demand. To meet their energy demands and diversify energy sources, solar energy is being actively used by industrialized countries. Germany is the world leader in solar energy use, with 41 GW installed as of the end of 2016.[2] The success of the country can mostly be explained by favorable conditions for the business, with skilled companies and good financing opportunities as well as strong public awareness about solar energy technologies. With the increased global interest in solar energy use, developing countries now also see the opportunity to deploy solar power in order to decrease their dependency on more expensive energy sources, and ensure energy security.

This paper aims to investigate the potential of building a solar power plant in a lower income country in order to provide off-grid electricity for rural and remote areas and to contribute to the countries' energy security. The essay is organized in the following way. We start with an overview of solar power plants (SPP), differentiating between two types: Concentrated Solar Power (CSP) and Photovoltaic (PV). After this, it analyses the case of Tajikistan, first reviewing the country's current energy system and continuing with the potential of building a SPP. The paper concludes with a discussion on the general applicability of SPP in lower income countries.

BRIEF INTRODUCTION TO SOLAR POWER

Concentrated Solar Power

Solar power plants convert sunlight into electricity, either directly or indirectly. Two main types of solar power plants can be distinguished: Concentrated Solar Power (CSP) and Photovoltaic (PV) power plants. Concentrated Solar Power (CSP), also called a solar thermal power plant, uses sunlight to heat a transfer fluid.[3] To produce electricity, heat is then used to operate the conventional power cycle and to drive a generator.[4] CSP has a storage system and might be hybridized with fossil fuels to meet the energy needs during low and non-solar periods. One of the examples of CSP technology is the solar power tower given in Figure 1.[5]

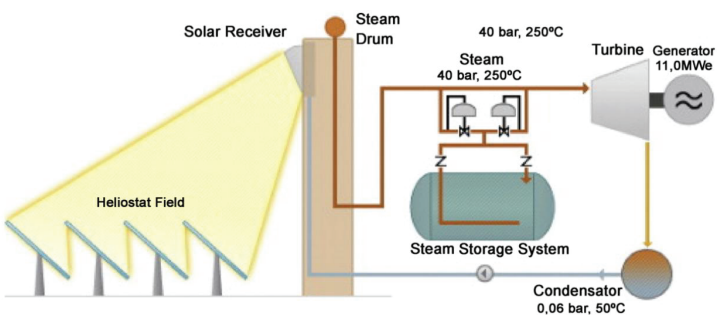

Figure 1. Schematics of a CPS Plant.

Source: Pavlovic et al, 2012, A Review of Concentrating Solar Power Plants in the World and Their Potential Use in Serbia.

1 UNDP, 2000. World Energy Assessment, 2000. [pdf] Available at: http://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/sustainable-energy/world-energy-assessment-energy-and-the-challenge-of-sustainability/World%20Energy%20Assessment-2000.pdf [Accessed 1 July 2016].

2 Fraunhofer ISE, 2017. Recent Facts about Photovoltaics in Germany. Available at: https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/recent-facts-about-photovoltaics-in-germany.pdf [Accessed 5 May 2017].

3 Pavlovic, T., Radonijic, I, Milosavljevic, D & Pantic L., 2012. A Review of Concentrating Solar Power Plants in the World and Their Potential Use in Serbia. Renewable and Sustainable Energy Reviews, 16(6), pp. 3891 - 3902. [pdf] Available at: http://sci-hub.cc/10.1016/j.rser.2012.03.042

4 Pavlovic, T., 2012. A Review of Concentrating Solar Power Plants in the World and Their Potential Use in Serbia.

5 Idem.

A solar power tower consists of a field of heliostats, which focuses solar irradiation onto the solar receiver. Then a transfer fluid, which can be water, molten salt, liquid sodium or air, is heated. Mechanical work is then converted to electrical energy by a steam generator after which it is sent to the distributive grid. The cycle is repeated by steam from the turbine being condensed and sent to the boiler to be heated by the solar receiver again.

One of the main benefits of the CSP plant is that, for more stable operating, it can be hybridized with other fossil fuels.[6] The other benefits of CSP include low operational costs, high efficiency, and the possibility to utilize thermal storage to better match supply with demand.

The barrier for utilizing CSP technology is the need for relatively high investments.[7] That is, the construction and installation costs are high, and it is more expensive due to the new technology involved. A CSP plant requires a considerable amount of space and it is highly location dependent, as the intensity of solar energy, availability of water and presence of infrastructure play a significant role in site selection. To avoid significant transmission losses, CSP should be constructed close to the electrical grid.

Photovoltaic

Photovoltaic (PV) power plants convert solar radiation directly into electricity.[8] Figure 2 shows an example of a solar PV plant.[9] At the first stage, solar PV modules are used to collect solar radiation. The output received from the PV modules is called DC electricity. Then the DC electricity passes to inverters where it is converted to alternating current (AC) electricity to be transmitted to the utility grid through an AC Service Panel.

PV, like the other methods of solar power generation, is a clean energy that does not emit greenhouse gasses. PV power generation is silent, as it does not use any other fuel but sunrays. Moreover, it can be constructed nearly everywhere, as it generates electricity directly from sunlight and requires minimal maintenance. PV is a fast-growing industry, with rapidly improving technology and expertise available, which makes it more cost-competitive compared to other solar power generators. PV can be constructed in any size to meet energy needs and be enlarged when needed.

However, there are some barriers in adopting PV. As PV uses direct sunlight, it is not efficient during nights or under clouds. It also cannot meet heating demands due to being available foremost during hot seasons. PV does not have a relatively low efficiency of around 17 to 40 percent. [10]

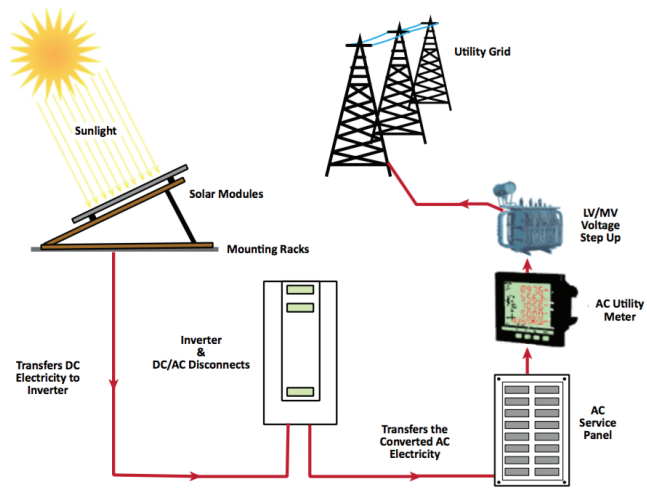

Figure 2. Overview of a Solar PV Power Plant

Source: Pavlovic et al, 2012.

CSP / PV comparison

There are several differences between CSP and PV plants. One of the advantages of PV plant is that it takes only 6 to 12 months[11] to build and can be installed everywhere where CSP can, but not vice versa.[12] PV is a technology that could cover power plant and residential sectors, whereas CSP is only commercially feasible in large scale projects. PV plants can be used in a decentralized power system, while the transmission grid is essential for CSP. One of the other characteristics of PV is that it can use not only direct sunlight but also diffuse radiation and, as such, can be installed at any location. CSP, in turn, needs direct solar irradiation, and the areas where it can be built are quite limited. This makes PV technology relatively simple to implement. As a result, developers and companies have focused on improving PV technology to decrease the costs associated with PV cells and PV power plants. However, there is no possibility of electricity storage in PV systems, while thermal energy can be stored in CSP plants. Nevertheless, PV is the technology that is widely spread across the world with an estimated 292 GW of installed capacity at of the end of 2016, whereas CSP capacity constitutes less than 5 GW[13] and has not been growing in the past couple of years. Therefore, with all its benefits, a PV plant appears to be the more preferred technology to be deployed at the first stages of utilizing solar energy.

6 Idem.

7 Idem.

8 International Finance Corporation, 2015. Utility-Scale Solar Photovoltaic Power Plants: A Project Developer's Guide. Available at: https://www.ifc.org/wps/wcm/connect/f05d3e00498e0841bb6fbbe54d141794/IFC+Solar+Report_Web+_08+05.pdf?MOD=AJPERES [Accessed 29 June 2016].

9 International Finance Corporation, 2015. Utility-Scale Solar Photovoltaic Power Plants: A Project Developer's Guide.

10 Karakaya, E., and Sriwannawit P., 2015. Barriers to the Adoption of the Photovoltaic Systems: The State of Art. Renewable and Sustainable Energy Reviews, 49, pp. 60-66. [pdf] Available at: http://www.sciencedirect.com.sci-hub.cc/science/article/pii/S1364032115003287

11 International Finance Corporation, 2015.

12 Mohaghegh, S., 2015. CSP vs PV – Understanding the Current Situation and Future Outlook. Available at: https://blogs.ucl.ac.uk/sustainable-resources/2015/11/30/csp-vs-pv-understanding-the-current-situation-and-future-outlook/ [Accessed 1 July 2016].

13 IRENA , 2017. Renewable Capacity Statistics 2017. [pdf] Available at: http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Capacity_Statistics_2017.pdf

APPLICABILITY OF SOLAR POWER SYSTEMS IN THE CASE OF TAJIKISTAN

Energy System of Tajikistan

Tajikistan is one of the poorest countries in the Central Asian region with the majority of the population – around 73 percent – living in rural areas with seasonal power shortages.[14] Out of these, around ten percent live in remote mountainous areas with poor or no access to an adequate electricity supply.[15] The problem is mainly due to the bad condition of the transmission and distribution systems, which also results in inefficiency and significant electricity losses. The rural population is most affected by the situation, and there are no real electricity grid renovation programs in those areas.

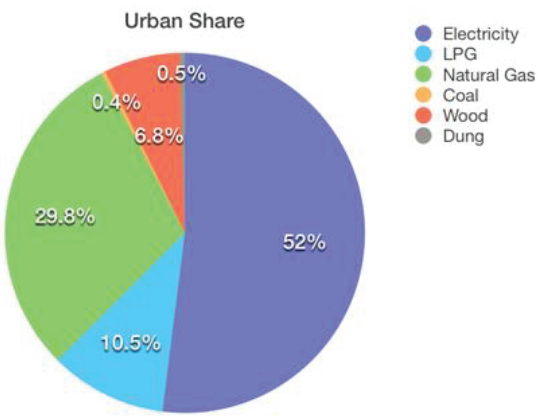

Figure 3. Urban Share of Energy Consumption in Tajikistan

Source: World Bank, Central Asia Longitudinal Inclusive Society Survey (CALISS), 2013.

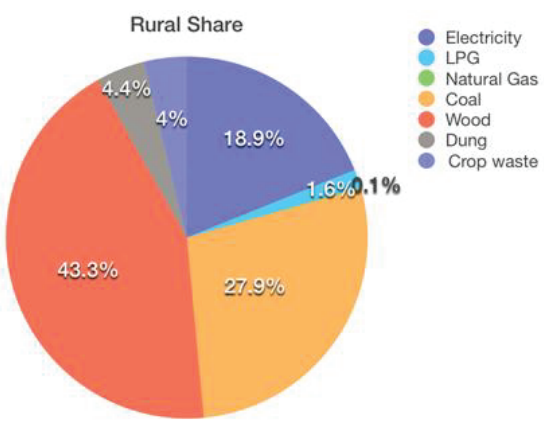

Figure 4. Rural Share of Energy Consumption in Tajikistan

Source: World Bank, Central Asia Longitudinal Inclusive Society Survey (CALISS), 2013.

14 Energy Charter Secretariat, 2013. In-Depth Energy Efficiency Review: Tajikistan. [pdf] Available at: http://www.energycharter.org/fileadmin/DocumentsMedia/IDEER/IDEER-Tajikistan_2013_en.pdf

15 Energy Charter Secretariat, 2013. In-Depth Energy Efficiency Review: Tajikistan.

Figure 3 shows the energy consumption of the urban population; Figure 4 shows the rural share. Clearly, the urban population has better electricity and natural gas supplies, whereas the rural population mainly relies on wood, coal and other biomass energy resources. The most severe situation occurs during the five months of winter when rural households receive less than four hours of electricity a day. As such, in order to heat a single room, an average household uses four tons of coal, making it a big financial burden for the family.[16] The usage of renewable energy sources could improve the situation of those households and solve problems with energy shortages.

Tajikistan has an excellent environment and climate to utilize its solar energy potential.[17] The country is located on 36°40' and 41°05' of the northern latitude and 67°31' and 75°14' of the eastern longitude.[18] It has 280 to 330 sunny days, with estimated 2100 to 3000 hours of solar energy, per year.[19] The solar radiation intensity varies in the highlands from 360 to 1120 MJ/m^2 and from 280 to 925 MJ/m^2 in the foothills. With a solar potential of around 25 billion kWh/year, Tajikistan could satisfy an estimated 10 to 20 percent of its total energy demand with solar power. However, the current use of solar energy is limited to solar greenhouses, improved solar stoves, and solar water heaters.

Potential to use CSP in Tajikistan

The feasibility to build CSP has its own specific features. Apart from essential meteorological requirements, one should also consider other key criteria, some of which are discussed below. [20]

Direct normal irradiance (DNI).[21] DNI is a measurement of the amount of solar radiation received by a unit area that is perpendicular to the incoming sunrays. To provide a viable energy yield for CSP, the DNI should be at least 2000 kWh/m^2 per year.[22] Figure 5 shows the DNI map for Tajikistan. It is clearly seen from the map that the highest DNI is concentrated in eastern part of Tajikistan. Despite the availability of DNI, its concentration in mountainous areas makes building CSP in those sites highly unlikely, due to both a lack of flat land available and remoteness. However, to meet the local needs, other construction sites can be considered.

16 dem.

17 Idem.

18 Idem.

19 Idem.

20 Stoddard, L., Owens, B., Morse, F. & Kearney, D., 2005. New Mexico Concentrating Solar Plant Feasibility Study. [pdf] Available at: http://www.emnrd.state.nm.us/ECMD/RenewableEnergy/documents/NMCSP-draft-final-rpt-02-05.pdf

21 Stoddard, L. et. al., 2005. New Mexico Concentrating Solar Plant Feasibility Study.

22 Lovegrove, K. & Stein, W., 2012. Concentrating Solar Power Technology: Principles, Developments and Applications, Cambridge: Woodhead Publishing. Available at: http://www.sciencedirect.com/science/book/9781845697693

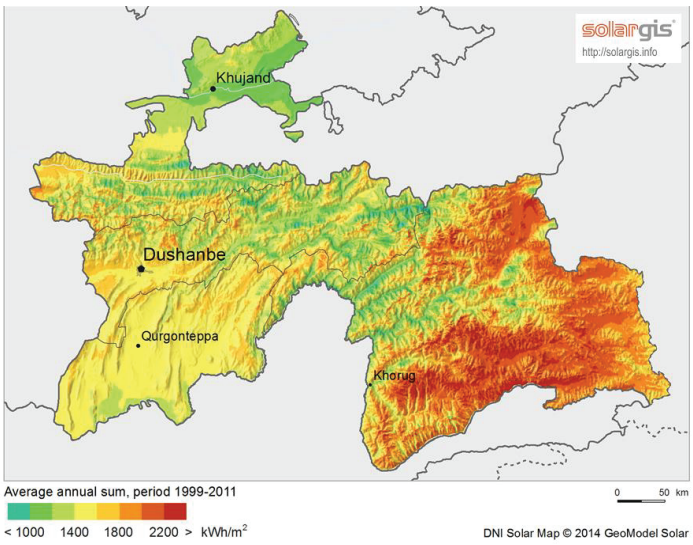

Figure 5. Direct NormAL Irradiation (DNI), Tajikistan

Source: Solargis, 2016.

Local water resources.[23] In CSP, water is primarily used as a cooling agent for steam turbine condensers. Tajikistan has abundant water resources, but the sites with the highest DNI often have limited water availability and the choice of a construction site should consider an optimal amount of both DNI and water resources available.

Grid Connection.[24] The electrical grid is essential for a CSP plant, and the distance between the plant and the grid should be minimal to avoid additional costs. Unfortunately, grid connection is the biggest obstacle for Tajikistan as rural areas have poor or no access to it. Moreover, the construction of new electrical grids would significantly increase the cost of the plant.

Proximity of roads.[25] Roads are important during the construction phase of the plant and are furthermore needed during the operation stage. This constraint is more critical for a CSP plant than for small scale PV because of the relative flexibility in site selection of a PV plant. However, there is no infrastructure in the mountainous areas of Tajikistan, which is especially problematic when we consider that those are the areas with the highest DNI concentration.

At the stage of the project development, a comprehensive feasibility analysis should be carried out with a focus on the specific requirements of CSP. The assessment of some of the key criteria helps to conclude that CSP construction for Tajikistan is a long and challenging process.

Potential to use PV in Tajikistan

The International Finance Corporation has released a set of guidelines for stakeholders interested in running PV projects titled: 'Utility-Scale Solar Photovoltaic Power Plants'.[26] This publication provides comprehensive information on each step in realizing a PV project from project development and agreements to construction, operation, maintenance, and financing the project. For the purpose of this study and in order to understand the potential of building PV plants in Tajikistan, our analysis has been made using Section 6 of the criteria of the IFC guidelines; 'Site Selection'.

Although there are no clear rules for the site selection, there are some main constraints that are essential in the assessment. These include solar resources, available land, local climate, topography, environmental designations, geotechnical conditions, geopolitical risks, accessibility, grid connection, module soiling, water availability, financial incentives, land use and local regulations.[27] The most impactful of these constraints are discussed below.

Solar Resources.[28] Tajikistan is located in the so-called 'Sun Belt', which refers to the sunniest countries with higher solar radiation. The country has on average 2500-3000 hours of sunshine in a year. As such, it is estimated that, if the solar energy potential would be fully utilized, sixty to eighty percent of the energy demand of the rural population could be met for ten months of the year[29] and using biomass for the remaining two months. However, when we consider the mountainous areas, shading can arise as a potential problem, due to the fact that even a small area of shade can significantly impact the energy output.

Grid Connection.[30] As previously stated, grid connection is the key constraint for Tajikistan, due to the poor condition of the electrical grid, which has unstable voltage and frequent power cut-offs. Opposed to CSP, PV plants can be constructed off-grid. Moreover, an estimated ten percent of the population lives in off-grid, remote, mountainous areas.[31] As such, the feasibility of constructing a new grid, as well as the possibility of renewing the old electricity grid, is low and it would significantly increase the cost of a PV project.

Water Availability.[32] Water availability need not be a constraint in Tajikistan. Although less urgent than with CSP, water availability is also a positive factor for a PV plant during project development and sites with better water access should be given preference. Apart from that, PV plants have an advantage to run on diffused solar energy.

23 Stoddard, L. et al, 2005.

24 Idem.

25 Idem.

26 International Finance Corporation, 2015.

27 Idem.

28 Idem.

29 UNECE, 2013. Research study for the Republic of Tajikistan within the framework of the project "The use of clean, renewable and / or alternative energy technologies for rural areas in Central Asia. [pdf] Available at: http://www.unece.org/fileadmin/DAM/project-monitoring/5-sustainable-energy/E234/2014_NationalStudies/TJ/TJ_Report.pdf

30 International Finance Corporation, 2015.

31 Energy Charter Secretariat, 2013.

32 International Finance Corporation, 2015.

Financial Incentives.[33] Currently, Tajikistan does not have a favorable investment climate, and few incentives exist. However, there is a clear rationale for the government to create those incentives, as building solar plants would bring more long-term benefits to the country in terms of better living conditions (by creating access to electricity and heat in areas lacking those entirely or on a stable basis), energy efficiency (by enhancing the use of energy source which does not lead to CO2 emissions) and energy security (by helping the country to avoid import dependency, as it would happen if the energy system develops in reliance on imported fuels).

When we look at the above-mentioned constraints, we see that although there are challenges to developing PV in Tajikistan, the conditions are generally more favorable than in the case of CSP. PV is preferable to CSP because it is more flexible in terms of needed investments, plant size and location as well as PV's ability to use both direct and diffused solar radiation.

Additionally, the fact that building a solar power plant requires much expertise as well as detailed feasibility assessments to overcome the constraints discussed above, solar projects might become even more difficult to implement when we consider the current socioeconomic conditions in Tajikistan. The potential barriers are found in financial, legislative, institutional, educational and technological spheres as well as in the energy market itself. Financial barriers include the poverty of the population, the limited availability of public and private funds, inappropriate tariff policies and an unfavorable investment climate. Legislative barriers include the absence of a legislative framework as well as inefficient regulations and strategies for the renewable energy sector. Institutional barriers consist of non-transparent management and ownership mechanisms in the energy sector, as well as corruption and weak governance. Educational and technological barriers are connected to the insufficient governmental support of Research and Development (R&D) activities, a lack of qualified staff and inadequate infrastructure. The energy market itself is very inflexible, with a low rate of reform, an underdeveloped framework of the new technologies market and no real incentives for private sector participation.
The analysis of the possibility to construct solar power plants in Tajikistan showed that PV solar is a more feasible option than CSP. However, after a more detailed discussion of the constraints in building PV plants, and looking at the socioeconomic barriers, we have to put the feasibility and probability of any future construction of the solar power plant in question.

33 Idem.

34 Kayumov, A., Kabutov, K., 2014. Socio-Economic Assessment of the Production and Consumption of Renewable Energy Sources in the Republic of Tajikistan. [pdf] Available at: http://waterwiki.net/images/6/63/Renewable_Energy_assessment_Tajikistan_(Eng).pdf [Accessed 10 June 2016].

35 Kayumov, A., Kabutov, K., 2014. Socio-Economic Assessment of the Production and Consumption of Renewable Energy Sources in the Republic of Tajikistan.

36 Idem.

The only way would be to construct small-scale PV systems, which require fewer investments, and can be built off-grid to meet the needs of a particular territory. Small-scale PV systems represent an autonomous system which supplies electricity directly to the household, and can be used for electricity and lightning.
One thing is certain: Tajikistan is in need for renewable energy, and specifically electricity. Solar energy in remote areas of the country, where the possibility to use other resources is very limited. However, the roll-out of PV solar would only be possible with active government support and strong political will, where the aim should be increased governance, transparency and accountability as well as the creation of a strong legal base and incentive programs to attract donors and investments.

CONCLUSION

The possibility to utilize solar energy provides an opportunity to lower income countries in terms of improving living standards of the population as well as ensuring better energy security. The analysis of CSP and PV solar power plants has shown that CSP is heavily location specific as it has unique requirements to be considered in site selection, which greatly limits the choice of CSP construction sites. Countries with high DNI, water availability, infrastructure and good investment climate might utilize CSP technology, but considering the high costs involved this is not the case for lower income countries. On the other side, PV plants, with their competitive cost, flexible plant size and usage of both direct and diffused solar radiation, are more feasible to be constructed in lower income countries.

The case of Tajikistan helps to conclude that in lower income countries, a PV plant appears to be the more preferred technology to be deployed at the first stages of utilizing solar energy. However, as countries lack a large-scale electricity grid and have other socioeconomic barriers, the construction potential of solar power plants becomes very limited and is only possible for small-scale PV systems.

Gulnoza Khodizoda

Gulnoza Khodizoda is currently working in Alif Capital, a Tajikistan-based microfinance organization. Gulnoza holds a MA degree in Economic Governance and Development from OSCE Academy in Bishkek, Kyrgyzstan.

Address for correspondence:
gulnoza.khodizoda@gmail.com

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ENERPO Journal
Volume 5 / Issue 2 / June 2017

UBERIZATION IN OIL TRANSPORTATION?
OSVFINDER REVOLUTIONIZING LOGISTICS

Pierre Jouvellier

Abstract

The transportation sector is an essential part of any supply chain. During their studies, students of energy politics often focus either on upstream or downstream, whereas omitting the midstream sector is indeed a pity. In this interview with Pierre Jouvellier, ENERPO Graduate (2016), we discuss new developments in the oil transport sector as well as perspectives on the innovations that could reshape the architecture of the oil business. Pierre Jouvellier did his BA degree in international business and Russian language and history at the University of Rennes in Western France, after which he did an internship at Total Gas in London. Interest in LNG industry and Russian affairs led Pierre to study with ENERPO in 2015-2016. In 2016, he continued with second MA degree in corporate finance with a minor in financial engineering at Kedge business school in Marseille. Since 2016, Pierre decided to focus on energy shipping and began working at OSVFinder. The interview was held by Julie Nielen and Irina Mironova.

Key words: Oil transportation, LNG, logistics, app development, innovation

ENERPO JOURNAL: Pierre, so you work at the marketing department of the company OSVFinder. Could you please tell us about your educational background and your path toward your current position?

PIERRE JOUVELLIER: Currently I am interning with the marketing department of the OSVFinder. This means that I do a bit of everything that would expand our client base. But coming to the company essentially was a choice to work in the energy shipping sector.

My BA degree is in international business and Russian language and history at the University of Rennes in Western France. After getting BA degree, I did an internship at Total Gas in London and during this internship I discovered LNG and became familiar with the shipping operations of coal, petroleum, coke and LNG trading. I decided that I wanted to study energy in Russia, and came to the EUSP. During the year at ENERPO I learned a lot about energy and geopolitics, economics of oil and gas markets and, of course, Russian culture and literature. After this MA degree in Russia I came back to France and I started a second MA degree in corporate finance and financial engineering. The part of the finance studies that impressed me most was venture capital and capital development, and this played a significant role in the choice of my next professional steps. I did consider applying for some banking jobs linked to oil derivatives. However, the economy of finance has changed a lot with the arrival of algorithmic trading and robotics, which leaves limited space for 'humans' to work in the sector. So, I decided to focus on the energy shipping sector.

I very much sympathise with start-ups. At a start-up, you basically learn everything: operational tasks, finance (how to raise funds for instance), marketing and even corporate communications. At a start-up, you learn about everything regarding the sector you are working in. After asking around, I encountered OSVFinder, and since it was a start-up in energy shipping, this was exactly the organisation that fit my interests and expectations.

Then, of course, I still had to get in. I think in the end, the best thing to use when searching a position in the oil and gas sector is personal connections. If I would give some advice to ENERPO students, I would stress that they have an opportunity to meet many people during the ENERPO conferences. And so, if you approach those people at the end of the conference, talk to them, ask them for their business card, and do not hesitate to follow up over the phone or email. Sometimes it works. Even if it does not bring a job, it expands your network.

ENERPO JOURNAL: Could you tell us a bit about the company?

PIERRE JOUVELLIER: OSVFinder is a French company based in Marseille, with plans to open offices in Singapore and Dubai (these two places are located on major international oil and gas trade routes). The basic idea behind the business is matching ship owners and charterers with the help of an application. Both types of players are registered in the system and can 'post' their availability or needs. The application then matches their requests to find the most efficient solutions for shipping. Currently, the company only works with offshore support vessels, but it would be very interesting for us to work with oil and gas tankers. The application lists almost seventy large shipping companies, and the total number of vessels registered with us is over 100 000 all over the world.

In my opinion, the application bears the potential to be globally disruptive. The application is the answer to the industry's need to avoid intermediaries, where you need to pay commissions. Commissions in case of the OSVFinder will be substituted by a clear and transparent subscription plan.

OSVFinder is a type of Uber for energy sector related shipping. Maybe the principle is closer to BlaBlaCar (where

you match the route and share a car: OSVFinder helps users to match the players). In any case, this is part of the 'Uberization' of society.

ENERPO JOURNAL: How do you feel about working in the shipping sector, which is decidedly less visible than, for instance, exploration and production? Did you ever want to be involved in a more visible sector?

PIERRE JOUVELLIER: I should mention right away that OSVFinder allows charterers to find assets with experienced crews in drilling and subsea maintenance and repairs, so we are not purely part of the shipping segment, but also indirectly involved in E&P. But overall, I have to agree that the oil and gas shipping industry, especially for off-shore support vessels, is indeed a somewhat 'hidden' part of the industry. Shipping is an essential link between production and sales, and as I learned at ENERPO last year, shipping is the basis for oil trading. Without this link, the markets would not exist. I agree that it is perhaps a less visible sector, but it is still a very important one.

Notably, our company, which I believe can make a major difference for the organisation of the shipping industry, is just three people, 33, 28 and 26 years old. I am very excited to be in this sector, being able to make a change, and doing it in a team like OSVFinder.

ENERPO JOURNAL: Do you have any other advice for ENERPO students?

PIERRE JOUVELLIER: I would advise students to be curious about the whole variety of distinct aspects of energy industry instead of focussing on one narrow item or topic. There are plenty of opportunities in this sector, and young people getting into the sector need to be very versatile. When dealing with a problem, bear in mind politics, marketing, finance, web development, logistical solutions, communications, etc.

My second piece of advice is to think about how things can be improved. Find a problem, and find a solution to solve the problem.

My third suggestion is to not only focus on big corporations or large institutions. Of course, when we talk about the energy sector, we instantly think of giants like ExxonMobil, Gazprom, Lukoil, Total, BP, Shell, etc. But there are many other companies in this sector (who provide great solutions to the giants). Think about new businesses, and think about new services for the oil industry when choosing career paths.

Last but not least, we are facing a new kind of industrial revolution, with robotics and computer science coming to the forefront. We will automate almost everything in the world. Industrial players will use more and more robots. But there is one thing that robots cannot replace, and I am pretty sure it is impossible to replace it: it is creativity and inventiveness. So, my last advice is to be creative when you search for solutions.

Pierre Jouvellier

Pierre Jouvellier holds BA degree in International Business and Russian Language and History from the University of Rennes in Western France, MA degree in Energy Politics in Eurasia from the European University at Saint Petersburg, and MA degree in Corporate Finance with a minor in Financial ngineering at Kedge business school in Marseille. Between his BA and MA studies, Pierre did an internship at Total Gas in London. Since 2016, Pierre works at OSVFinder.

Address for correspondence:
pierre.jouvellier@osvfinder.com

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The ENERPO Journal brings you up to date with events in international energy. The journal's main premise is that energy is not a weapon, and this basic understanding allows for a pragmatic and more productive cross-border cooperation in energy. The journal publishes articles on a number of energy sources and markets for various types of fuels, because the energy system is not confined only to oil and gas. The ENERPO Journal addresses specifics of national energy policies, political relations between the key players in international energy markets, the functioning of these markets, the institutional structure of the markets, and other issues.

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