

MASTER'S THESIS

Course code: EN310E

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Is there a Kodak moment? *Survey of Russian student's perceptions toward decarbonization*

Date: 01.09.2021

Total number of pages: 82

Preface

Decrease in carbon emissions are of vital importance in global policies fighting climate change. Because of Russia's economic reliance on export of oil and gas, and they being the largest producers of fossil fuels in the world, their energy politics concerns to many.

Russia provides in total 10% of the primary energy production and is the largest exporter of energy resources in the world, based on fossil fuels. And the export stood for 36% of the country's federal budget in revenues. This is the main points inspiring the creation of this thesis.

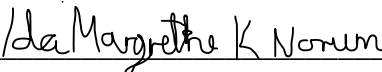
This is a master-thesis that forms the concluding part of the study program Master of Science in Energy Management. Corresponding to section 8.2.2 in the *Guide for the Master Thesis* is this thesis written as a scientific article with a kappe. The goal is to publish the article in *Journal of Cleaner Production* as publishing journal and is therefore written under the journal's guidelines¹.

I want to show my highest gratitude and appreciation of the people helping me through this journey. My heartfelt thanks go to the students participating in the survey, as well as the professors distributing the questionnaires, for providing me with the empirical data needed to implement the survey study; offering insight into their perceptions and relationship toward decarbonization.

A special gratitude is given the supervisors of the thesis, Elena Dybtsyna and Raj Krishnan Shankar, as well as Anatoli Bourmistrov whose academic and motivational support was irreplaceable. They followed me every step of the way ready to answer questions and give advice when the chaos the journey set to be at sometimes took over. Their guidance was especially important since I was writing the thesis alone. They were someone I could spar with and made sure the writing of the thesis was not as lonely as it could have been. Thank you.

Lastly, I would like to offer my thanks to Nord University and MGIMO for wonderful years as a student at their facilities. And I hope this thesis will be enjoyable to read, and dream that it will make contributions valuable to academia and organizations dealing with decarbonization.

Steinkjer, September 1st 2021



Ida Margrethe Kalseth Norum

¹ [<https://www.elsevier.com/journals/journal-of-cleaner-production/0959-6526/guide-for-authors>]

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Part 1: Introductory chapter

The inspiration for this thesis was the research project “Is this Russia’s Kodak moment? Russian perspectives on the energy transition (KODAK)” that is run by the Norwegian Institute of International Affairs (NUPI). The project examines the Russian energy actors, and if they are aware of the possibility of swift decarbonization of the global energy supply as well as what consequences they think it will have for the Russian energy exportation (NUPI, 2019)

The KODAK project is a project that will consist of, among other things, analysis of key challenges for the Russian economy, and according to the project description it will also look at “interrelationship with Russian domestic and foreign policy-making, and how they affect the future trajectory of the Russian economy. Key challenges of particular relevance to the project are corruption and the shadow economy in Russia; capital flight; the development of the banking system; and the development of the energy sector” (NUPI, 2019). This thesis contribution is pointed at the development of the energy sector and is especially focusing on Russian students’ perception of their energy future.

The term “Kodak moment” is used about failure to foresee market trends as well as technological changes threatening the existing business models. Kodak moment comes from inability to adapt to the coming future due to “comfort” so that business collapses due to irrelevance. When the film and printing industry shifted over from analogue to digital, Kodak failed to respond to the changing environment (Solis, 2017). I would argue that there are useful parallels and learning opportunities to take from Kodaks experience over to other fields and industries. Kodak was a leading company at its peak when they failed to innovate, and therefore they ended up filing for bankruptcy. Today the energy sector is full of innovation. The global energy industry is experiencing high pressure and support for change towards a more climate friendly production both on political and consumer-levels. Russia is the leading energy producing country today, but have chosen to not pay much attention to green changes, while a lot of competing countries are going through an energy transition from fossil fuels into renewable energy. For Russia it might mean that strong focus on fossil fuels and lack on renewables will lead to Kodak-moment in the future, if the energy sector will not change until it is forced to change or die. This is what makes it relevant to ask if this is a Kodak-moment.

The answer will be yes if their energy production ends up being irrelevant globally due to lack of paid attention toward changes in the market.

And perceptions among Russian students is used as a mean to research if Russia is likely to change their awareness in the upcoming years. The more radical views are shared by youngsters/students the greater chance that there will be a swift change in the future. This thesis is contributing to the Kodak-project by looking at young people present day perceptions and attitudes towards decarbonization as an indicator of whether the change towards renewables in energy sector will come sooner or later.

Background and theoretical framework

This chapter will be presenting the theoretical framework of my article, which also creates the theoretical foundation for my empirical findings. Human capital theory and protection motivation theory is used, as well as literature concerning the current energy development in Russia, because they provide a theoretical framework and understanding of the current energy situation in Russia as well as how humans work in order to study students possible effect on the future carbon emissions policies and actions. Based on theories from human behaviour, attitude, and perceptions it is developed a model to understand how perceptions is created.

Climate change is a heated topic, and different nations have different takes on how to handle it. Many parts of the climate change have been up for discussion. It has been discussed if human activities affect it or not, and if we should do anything to change it. And when acknowledging climate change it is possible to respond with adoption or mitigation, where adoption consists of reducing risk to the population from climate change, while mitigation efforts are focusing on reducing emissions affecting climate change (Semenza et al, 2008).

Significance of decarbonization in Russia

Fossil fuels are the main contributor to global energy production (IEA, 2017), yet their continued use is unsustainable (IPCC, 2018). Reserves for oil, gas and coal were estimated to be depleted between 2042 and 2112 in 2009 (Shafiee & Topal) and their use for energy production accounts for 58% of carbon dioxide emissions globally (IEA, 2017). It is essential

to decarbonise electricity generation by 2050 in order to mitigate climate change (IPCC, 2018). Individual actions can contribute to a rapid reduction in CO₂ emissions (Dietz et al, 2009). However, despite the availability of low-carbon and renewable energy sources, transition away from fossil fuels remains sub-optimal (IEA, 2017). Understanding factors that motivate reduction of fossil fuel use may inform interventions to increase this behaviour and contribute to the minimisation of harm (Clayton et al., 2015). Existing theories of persuasive communication provide one avenue to identifying these targets (Cismaru et al, 2011).

Even if there is an increasing interest in lowering the carbon emissions on a global basis, it is still disagreements about how to handle the climate change. It exists several nations and organizations that do not believe in a rapid decarbonization or have shown their scepticism against it. One of these nations is Russia.

Russia provides 10% of the primary global energy production and is the largest exporter of energy resources in the world. At the same time, Russia also accounts for 5% of global energy consumption (Mitrova & Melnikov, 2019). Russia is among the top three exporting countries of gas, oil, and coal according to the International Energy Agency's Energy Atlas (2020). As a leading country in the energy sector and the country with the fourth highest carbon dioxide emission in the world (Henderson & Mitrova, 2020), Russia's actions are of global interest, especially since these will significantly affect the world market and climate emissions. At the same time the country is vulnerable to global market changes since energy exports account for a large part of the national economy. Close to 70% of Russia's total petroleum production was exported in 2016. And the industry accounted for 36% of the country's federal budget revenues, making it a key component for the economy (Barden, 2017).

Protection motivation theory

Climate changes represent a threat to the global society. Protection motivation theory (PMT) is a theory used to explain how threat appraisal and coping ability affects changes in behaviour. In earlier research have PMT been linked up with the intention to reduce the use of fossil fuels due to carbon emissions (Kothe et al, 2019).

The theory postulates that engagement in adaptive (i.e. protective behaviour) or maladaptive responses (i.e. avoidance of or failure to engage in the protective behaviour) in response to a threat event, is determined by two parallel cognitive processes - threat appraisal and coping

appraisal (Norman et al, 2015; Prentice-Dunn & Rogers, 1986; Rogers, 1975). Threat appraisal is determined by perceptions of seriousness of the threat (severity); likelihood of personal exposure to the threat (susceptibility); and benefits of engaging in the maladaptive response (Prentice-Dunn & Rogers, 1986; Norman et al., 2015). When severity and susceptibility are high and maladaptive response rewards are low, the overall threat appraisal is high. Coping appraisal is determined by perceptions of the effectiveness of the adaptive response in averting the threat (response efficacy); personal capability to perform the protective behaviour (self-efficacy); and costs that might arise from adopting the protective behaviour (Norman et al., 2015). High response efficacy and self-efficacy and low response costs result in high coping appraisal. These processes determine intention to adopt a protective behaviour; specifically, intention to engage in protective behaviour increases when both threat and coping appraisals are high (Maddux & Rogers, 1983; Norman et al., 2015; Prentice-Dunn & Rogers, 1986; Rogers, 1975)

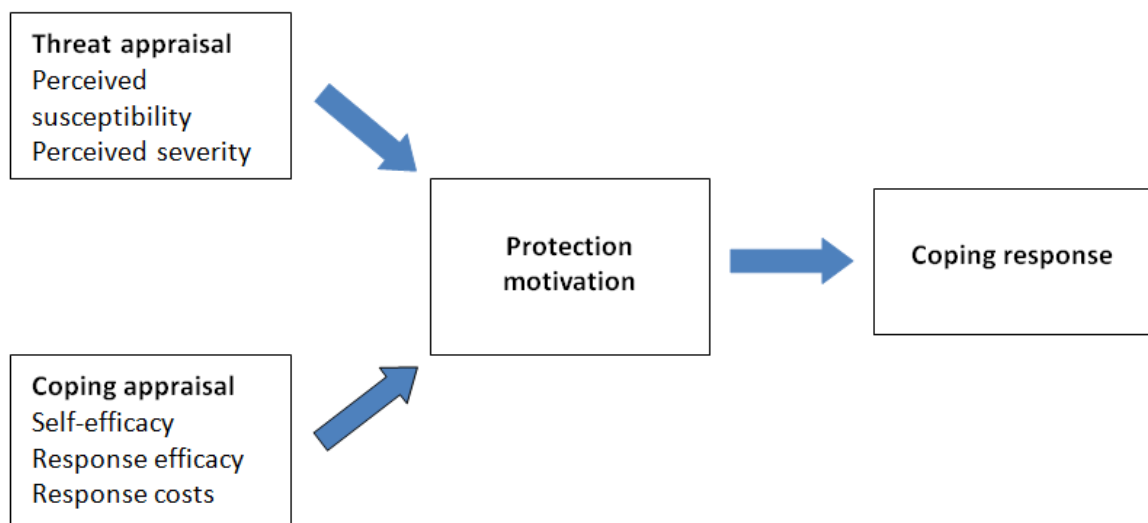


Figure A: Protection motivation theory. Adapted from Rogers et al. (1983).

Protection motivation theory contributes with a psychological model showing how the perceived severity of the threat affects the coping response. Studies done in other countries indicate that people are more likely to let themselves convince about climate change if they experience the consequences directly. As an example is it is likely to see farmers change and adapting to climate change in areas where it is getting more difficult to grow crop as a result of the change (Truelove et al, 2015; Esham & Garforth, 2012; Reser & Swim, 2011).

Human capital theory

Human capital theory gives focus to the significance education and training have as a key to participation in the new global economy (Almendarez, 2013). Human capital refers to the economic value of a person's skills and experience.

Reading earlier research, the human capital theory have been used to study the dynamics of climate change mitigation because human capital gives to the creation of knowledge and development of new products, including cleaner and more energy-saving technologies (Carraro et al, 2014).

Perception and attitude

Humans' perception of the global phenomena like climate change was early identified as crucial contribution to environmental problems and solution by the Committee on the Human Dimensions of Global Change which is a part of the US National Research Council Committees (Rayner, 1992).

Based on the research question and literature review I developed a model to show variables that can affect the perceptions.

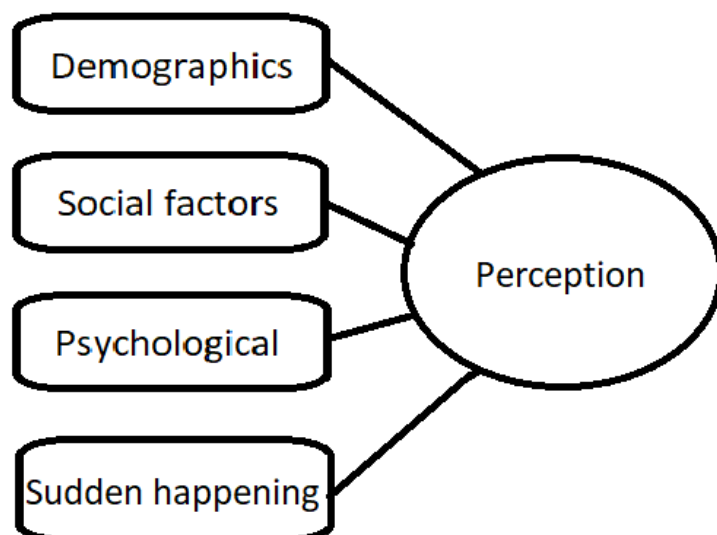


Figure B: Factors affecting perception.

This model is created to find what variables I need to control for in the survey and later analysis. Each variable can be split up in smaller factors.

The survey is developed with dependent and independent variables to find cause and effect on the perception. The independent variables are either nominal, ordinal or interval data based on the nature of the variables. While the dependent variables are measured by either an interval or ratio scale with 5 or more options, which makes it possible to do statistical analysis.

Demographic:

A factor that is mentioned in many earlier research projects are that attitudes correlates strongly with knowledge and age. Karlstrøm & Ryghaug (2014) found that people above the age of 60 often is against the use of renewable energy.

Semenza et al (2008) found that high-income individuals in Huston and Portland was more likely to be aware of climate change than low-income individuals. They also found that women in general was more concerned about the climate than men, this is also a factor mentioned in other articles. While Ek (2005) found that the individual support of wind power decrease with age and income in Sweeden.

Resistance against non-conforming bias is one of the other factors working against new information. Humans unconsciously seeks consistence in already existing believes, and therefor overlook new information that undermines our already existing understanding, this is working against possible attitude changes due to new information and knowledge (Maas et al, 2003).

According to Guo et al. (2021) it is usually three factors affecting attitude and behaviour toward climate change, personal attributes (such as age and gender) go in under the demographic factor in my model. They highlighted socioeconomic factors (such as social network and sources of information) and psychological factors (experienced change, value systems) as the other important factors affecting the behaviour toward climate change.

Social factors:

Social factors include socioeconomics, sources of influence, social networks and communities. Socioeconomics affect societies progress, stagnation or stagnation based on the

economy on local, regional, or global level. It measures economic activity and institutions up against ethical values (Hellmich, 2015). This is very relevant in the Russian context since the energy industry is heavily tangled up with the Russian economy.

If the information flow in favour of the opposite attitude increases continuously, at a point people will change attitude (Maas et al, 2003). This correlates with the earlier mentioned correlation between attitude towards the green shift and knowledge (Karlstrøm & Ryghaug, 2014). Age can also be related to knowledge since both schooling and the social environment have changed with time.

A study from North-West Romania indicated a positive attitude towards renewables from young and highly educated individuals, and that the greatest barriers is created by lack of knowledge as well as cost (Arion et al, 2018). They also pointed out that the government supports the renewables development, and that its use is rising. The Romanian policies regarding renewable energy are very different from the Russian, where renewable energy get nearly no attention (Ministry of economic development of the Russian Federation, 2020). Variation in perception related to climate change can be associated with political believes and other cultural values (Weber, 2010).

According to Fan (2017) is social media the most influential source when it comes to environmental information, while education is known as the secondary source. At the same time as social media are linking the global society together, what you get most exposed for can vary from geographical position and the social environment people already are living within.

Community is an important concept when it comes to social thought. There are many different definitions of community (Muniz and O'Guinn 2001). It usually consists of characteristics such as "Consciousness of kind", referring to the intrinsic connection members within a community feels toward each other, and a feeling of differentiation they have concerning individuals and groups outside of their community. Tradition and shared rituals is another factor communities often shares.

A country is often described as a sort of a community. Its inhabitants share more than just a geographical area, they also share the law and other norms, values, customs, and identity. Religion, common history, traditions, language, and a similar education are some of the aspects that often binds the inhabitants together (Tonnie, 2002)

Psychological:

Variation in perception related to climate change can be associated with political beliefs and other cultural values (Weber, 2010). If a person lives in an interdependent social world where it is many rules on how to behave, it becomes important for the human to consider the context and relationships. While living with more individualistic and independent social circumstances make the person more concerned of the main object, without taking to much attention on other persons wants and needs (Miyamoto & Nisbett, 2005). Esham and Garforth found that social barriers as cognitive and normative factors was equally important as other socioeconomic factors when it comes to adoption toward climate change (2012).

Emotions is another factor routinely affect our perception, Clore and Zandra (2011) did in their article about emotion and perception write: "Fear, for example, can affect low-level visual processes, sad moods can alter susceptibility to visual illusions, and goal-directed desires can change the apparent size of goal-relevant objects". Emotional state can also affect if a person's attention is focused globally or locally (Clore & Gasper, 2002). This can affect the individual's perception on decarbonization because it is possible that what the individual view as the best for the planet or the global market are not the same as what he views as the best for his own nation, let alone the even smaller local community the person lives in or the social group he belongs to. This means that the local community may have a large impact on the persons perception, and that the emotional state can move the perception between factors such as that the local workplaces and economy are very dependent on the existing oil sector therefor it is most important to guard the industry as it is, and that the world's climate is dependent on a change in the energy sector therefor decarbonization is most important. But this does not mean that the answers gotten is affected by the current mood of the participants, it only means that this is a factor that may affect an individual's perception.

It is also found that a individual's emotional involvement affect how extreme an attitude is, and how easy it is to change that individuals attitude. High emotional involvement lead to a stronger and often more extreme attitude. And a strong and extreme attitude will be more difficult to change or influence than a weaker and less extreme attitude (Maas et al, 2003).

Sudden happening:

Behavioural research done in the past 30 years is strongly suggesting that attention-catching and emotionally engaging informative interventions can be required to awake engagement to climate change (Weber, 2010)

Rare climate events as frosts, flooding or droughts seem to have a smaller impact on humans' general perception, this is explained with the fact that it rarely happens, and it can even more rarely be said to have happened recently, and recent happenings is given more weight than distant events. But when rare impacts do happen, they have a bigger impact on decisions than what is warranted by their probability. It is also found that learning by personal experience is preferred attending over learning from statistical description. Personal experience does quickly make associations, in this case turning the experience into feelings like dread, fear or anxiety for the climate. This influences the perception, and the whole process goes automatically. The same cannot be said by statistical description which both is a slower and requires effort from the individual (Weber, 2010). At the same time flooding will not cause any change in perception of climate change in those instances where the person do not know the correlation between climate change and flooding.

Higher emotional involvement leads to a stronger and more extreme attitude, which creates a higher barrier for attitude change. At the same time a lower involvement makes the human mind more open for attitude changes, leading back to sudden happenings as well as education and social exposure of information (Maas et al, 2003). Therefore how extreme a sudden happening must be to affect a perception change vary on the already existing level of involvement.

It can be questioned if sudden happenings are relevant for the Russian energy development today. No sudden happenings have been able to shake the Russian energy developments this far. But it is still possible that a new one may be able to affect Russia in the future, even though there is no clear sign of such an happening today. It might be that Russia is dependent on a sudden happening to change.

Methodology

This chapter is meant to give a more in-depth explanation of the methodology than the article will show. Even though some of the key elements will be mentioned both here and in the article, to ensure clarity this chapter will investigate design and many practical parts about the method that is not mentioned in the article.

During my education I have gotten Russian students, politics, energy industry and culture to know. And I have gained interest in their national politics and the energy industrial development. Russia is a large country with a lot of influence, and it is the largest energy exporter in the world. This makes their development relevant on a global level. Therefore I welcomed the opportunity to further explore a part of the development in Russia that is familiar to me, and to contribute to NUPIs project about the Russian perspectives on the energy transition.

Method design

When method design is chosen it is important to gain a clear understanding of the framework that is used to gather primary data. In this research project the goal was to get a description about how the Russian students of today think about decarbonization and energy transition. Survey analysis was used to find the answer in this thesis, because a survey makes it possible to measure trends among a large group of people.

This project with the master's thesis was a long process. Completing the final result, with both the cape and the article, was only a small part of the process. When writing an article or a master's thesis like this, it can quickly look like there has been a linear process where you start with a plan and execute it step by step until the plan is complete. This has not been the case through the work on this thesis. I started with a plan, but after that it was far from a linear process, the work went more through a hermeneutic process from beginning to end.

A hermeneutic circle consists of the totality of what happens when we interpret a text and form an opinion of its content, from our assessment of the sender's background, situation and intention to our assessment of the text itself and the medium it reaches us through, and on to our own self-reflection (Bontekoe,1996). This is how meaning is formed through the process

of interpretation, regardless of whether we are aware that the process is taking place or not. I used the hermeneutic circle to make myself aware of my own and the text's horizons, and to let this awareness be part of the process of creating meaning in a text. The parts are understood and interpreted from the whole - and the whole is understood and interpreted from the parts. That is, as a circle or spiral, with a mutual exchange relationship between parts and the whole. This is how our perception and understanding of the parts and the whole changes and expands through the process of interpretation (Crotty, 1998).

In this project, the hermeneutic circle was used to understand what was important, and how to handle the results we got. Over the last six months, there has been a lot of back and forth, and several important parts of the thesis have changed a lot since the project began.

It all started when I was asked if I wanted to be part of Nupi's Kodak project. Since the project dealt with something I have a great interest in, namely energy transition, and I could get the opportunity to experience working with such a project, it was easy for me to say yes.

After the first meeting regarding this project, I knew the following: I wanted to contribute to this project by writing about attitudes among students in Russia regarding decarbonization, and I wanted to figure out if there was any Kodak moment in sight as a result of these attitudes.

After that I started reading up on the topic, and started my first part of the literature analysis. This was a job that took a lot of time, and at the same time gave little visible result as it was difficult to know what was relevant and how I should attack the task. In retrospect, I see that this part of the work, which at that time seemed unfruitful, was very important for the foundation of my thesis. It did not result in much text, but it contributed a lot of knowledge, and an understanding of the issue I could never have acquired without these countless hours spent reading published articles and documents. I read about how attitudes develop, about Russia's political situation, about attitudes and energy transition in the rest of the world. I learned about a lot that influenced the direction my master's thesis eventually took and that comes through it, and I learned about a lot that I did not need in the final product, but which I still would not have been without.

After the first literature review, which was both chaotic and structured at the same time, it was time to design the model. Due to a literature review and conversations with supervisors, I had at this time come to the conclusion that we should shift the focus from attitude to perception because the latter was easier to measure. It was also questioned whether it would be possible

at all to confirm or deny one Kodak moment through such an article, and this was something that was pondered a lot throughout the life of the project.

The model was carefully designed to capture the essence of the important factors that influence perception. The first versions of the model were much larger and more complicated than the one I show here as figure 1. But it was stripped down to the most basic for the sake of clarity, with the thought that it could be edited later when I had gained more knowledge and gained a clearer direction of my thesis could build on it with the factors that were most relevant to my particular project. Then I created an extended model describing the full process of the specific article created as can be seen as Figure 2 in my article.

Questionnaires were developed based on the model and literature, and the work with this was one of the really time-consuming works in this project. A draft was first made with possible questions based on the model, literature and previous studies that could be reminiscent of mine, and this draft was changed many times through reading new literature and good discussions and feedback from supervisors. The final result was not finished until February, and very few of the questions I ended up with were to be seen in the first drafts. The only questions that remained constant were the questions about age and associated institution, so this was a long hermeneutic process.

When the questionnaire was sent out, it was time for even more literature review, and the first real attempt to write part of the article, namely the introduction, was underway. I have written about the hermeneutic process earlier on page 14, and here I find it appropriate to point out that everything I have done with this task has gone through the entire hermeneutic circle several times. It has gone from literature search to draft, to new literature search to new draft, to guidance and new changes again and again and again.

At one point, we had collected enough answers to the questionnaire, and it was time to start analysing received data material. The data contained in the web form had to be coded first before it was downloaded in SPSS for processing. In the beginning, a lot of descriptive statistics were reviewed to explore which parts of the material seemed interesting to go deeper into. Among other things, it was discovered early on how many of the participants had never heard of decarbonisation before, which was a very interesting discovery.

Regression and t-tests were performed in search of significant correlations. The data were also divided into groups to see if they behaved differently and showed clear trends if several variables were merged. For example, everyone who studied business administration or similar

subjects was merged into one variable, and everyone who studied other things was merged into another variable.

The results of these tests were often that there was no significant correlation, which at one point made me very unsure if this task would work. But then with the help of some reflection and conversations with researchers with experience, it became clearer and clearer that the lack of significant correlations was not a defeat, but that it was instead my discovery. My first hypotheses based on the literature review were that there would be significant correlations to be found, but my results refuted that this was the case in my study. Among my participants, there was both little knowledge and little commitment to decarbonization. The study showed that neither the school nor society focused on informing students about this topic, and that there was no revolutionary driving force among these students that is likely to change how Russia handles decarbonization in the future. This was a surprising finding in that community involvement in decarbonization has been taken for granted in research in other countries (Souvik & Sourav, 2017). At the same time, it is in line with previous research on energy transition in Russia, which concluded that there was little will and slow change when it comes to energy transition in Russia.

Based on current energy policies and scenarios I created four different future energy scenarios. They were produced to be as neutral as possible in choice of wording, so that the respondents were not affected by negative or positively charged words. They were also all written with realistic wording that should enable the respondents choose the scenario they see as most likely to happen over the next 10 years without any influence from the questionnaire.

The first scenario they are presented with in the questionnaire is one scenario where Russia invests fossil fuels to an even greater degree than they already do today, where a bigger volume results in even greater emissions than what Russia has today. This is compatible with existing forecast that expects fossil fuels to have its peak no earlier than in year 2040 (Caineng et al, 2016). While the second scenario is that energy production looks the same in 10 years as it does today.

The third scenario is named energy mix and is inspired by a change we already see hints of today through the drafts released from the Ministry of economic development of the Russian Federation (2020). It assumes that nuclear power and hydropower will be the two carbon-free energy producers that grow and account for much of the decarbonization process.

Hydropower is the only renewable energy form that is large in today's Russia, while nuclear power is an object of investment these days (Khrushcheva & Maltby, 2016)

The fourth scenario is the one including the largest change, where there is a noticeable growth in all forms for renewable energy, and where Russia follows the goals set by EU. The scenarios are formed a bit moderately because changes regarding energy production often takes many years. If it consists of setting up a new platform or creating a wind power plantation it is a large and expensive project concerning many stakeholders, everyone from the government to the closest neighbours might have something to say.

It was also set up scenarios to figure out if the students saw themselves working toward decarbonization in the future or not. This to figure out if them themselves would like to make a change within the energy industry.

Journal

Writing an article, I also needed to find a journal to publish it within. This is a decision that is evaluated over time. I used different methods to find the right journal. First of all, I got to know different relevant journals through my literature search. I recognised that it sometimes was several articles which was very relevant for my research in one single journal. This showed me that my article was relevant for them as it would add a new angle in an already existing discussion.

I also retrieved recommendations from more experienced researchers in my network, and I searched for journals linked to energy, decarbonization/carbon emissions, sustainability, climate change or development in Russia in the Norwegian register for scientific journals, series and publishers at NSD.

After I had found a sample of over 10 journals that potentially could fit my article I sat down and considered each one of them, giving them scores based on level of journals as well as relevancy.

The Norwegian register for scientific journals has a quality measurement divided into different levels. All registered journals are recognized using the weighted funding model and journals approved as scientific publication channels will be listed here.

The approved journals will be ranked as level 1 or level 2 journals, where level 1 is the lowest and level 2 is the highest ranking (NSD, 2021). Publishing in these journals can yield publication points for the institutions publishing, and they also have a higher reputation than the journals that is not approved. If a journal is not listed in the register at all it does not necessary mean that it is a bad journal, it might just have not been evaluated yet since it is a lot of journals out there.

I decided to reach for a level 2 journal with the name “Journal of Cleaner Production”. I choose this journal because it is a journal that focus on environmental and sustainability research and practise. They aim at discussing “encompassing environmental and sustainability issues in corporations, governments, education institutions, regions, and societies” (Klemes et al.). There is published articles in this journal before that focus on perception of zero emissions within governments and industries, and I consider my article a good addition to this discussion. Publishing in a level 2 journal is demanding when it comes to the article’s quality. The topic perception of decarbonization among Russian students are highly relevant and the analysis is built on a large data material which makes the findings representative to a satisfactory degree. It will be a good addition to the discussion about carbon emissions and energy transition in global context, since Russia is a very important energy nation, and their production has a large impact on global emission targets. Because of the relevant topic and the implications of the findings, I found it reasonable to strive for publishing in a journal such as the Journal of Cleaner Productions where it has a larger visibility towards researchers and groups or institutions the research is relevant for than it would gain in a journal of non-existing or lower level.

Data collection

The data collection is divided into two parts: Finding relevant secondary data, and my own data collection through a survey.

Secondary data is already existing research, reports, and publications that researchers gather to reuse in their own research (Yin, 2018). I used secondary data to do a literature review, to inspire development of the questionnaire, and to continuous comparison throughout this thesis. I find the data by searching in peer-reviewed journals and search engines as Springer,

Tandfonline, Scopus and Google Scholar on terms relevant to my research question. Publications where it is done studies with some similarities to my own on perceptions and attitude toward energy transition is highly relevant and can be used both as an inspiration and comparison to my own findings. I have not found research completely similar to this one regarding the chosen countries, but the literature review still identifies relevant research.

I also search for more theoretic background on human attitude and perception, and about how the four countries are doing right now concerning decarbonization. When searching I used a variation of search strings with similar meaning to find as relevant articles as possible. Searching for strings like “decarbonization”, “energy transition”, “green shift”, “energy neutrality”, “renewable energy” combined with “attitudes”, “perception”, “policies” and “politics”. National policies, company policies in dominating energy companies, scenarios and other information were also investigated and used to give an impression on the current situation.

Sampling

As soon as the questionnaire was completed, it was sent to the selected universities in Russia. These universities were recruited through convenience sampling. When it comes to the questionnaire the goal was to send out questionnaires to different universities in Russia. Through my available research network lecturers at 6 Russian Universities was recruited to convey a link to the questionnaire in their classes and give the students time during the lectures to answer them. In this way the lecturers encouraged students to attend the survey.

It was important to send out the questionnaires early since it takes time to distribute it to the right places and get participants to answer. It was also the most important part for my analysis and contribution to the field. It is important to get enough participants to make the answers representable so it can be used in further research and give a realistic picture of the existing situation. Using the network to ask the lecturers for help was a way to archive this goal, and it is reasonable to believe it could have been much more difficult, and even could have been impossible to get so many relevant answers in such a short timeframe without any help. To avoid language confusion and get more people to answer the questionnaire was translated to Russian.

The sample size is an important factor when reporting differences or describing how representative the study results is. The answer rate was unequally distributed with different answer rates from the universities, and I treated the data material accordingly to make sure a low answer rate among some categories did not make my analysis unreliable. The goal was to get at least 200-300 respondents from the students, and the thesis ended up achieving 380 usable respondents.

Survey

Handling of data material about private individuals is strictly regulated by law in Norway. To secure that the survey and data handling followed these regulations I reported the research paper to NSD and described how I planned to execute both the survey and the data handling. NSD considered that no information that was acquired in the survey process could identify individuals participating directly or indirectly in this project, as long as it was carried out in accordance with what was documented due to my report as can be seen in Appendix B. This meant that the project could go on without further assessments from NSD, as long as it was made sure that the digital questionnaire provider used could secure that IP- or e-mail address of the participants did not connect to the answer. The chosen questionnaire provider in this project was Nettskjema, a provider I got recommended to use both from Nord University and NSD due to its security.

The questionnaire has been tested towards a control group which is my fellow students studying Energy management, to see if the questions are interpreted as they are supposed to and if the answers will be clear and reliable to use in the analysis. They delivered constructive critique that made me able to alter the questionnaire to the better. I have also shared and discussed the questionnaire with researchers at the High North Centre, as well as received feedback from one of the researchers at NUPI. The final questionnaire is adjusted due to the mentioned feedback and discussions. The survey was made to be completely anonymous, and I choose not to ask about personal information. This because it was not necessary to collect personal information to answer my research questions, and some responders might feel freer when the answers are anonymous (Gillham, 2008).

Most of the questions in the questionnaire are independent variables asking about gender, age, what education they have, if they have studied any courses related to decarbonization, if it is a topic, they show interest for etc. And then I have two dependent variables, concerning perception and attitude. Asking about what energy scenario they find most likely to be the situation in their country in 10years. Based on this scenario they also was asked if they believed their country will be ahead, on the same level as or behind the rest of the world regarding development of decarbonization. The last question asks where the responder see himself in the future, if he will work with fossil fuels, renewable energy, or something else, and if they will engage in decarbonization.

Data analysis

After collecting the survey, I did a correlation analysis between the variables to see how significant these correlations are and make an interpretation of these findings. The findings were then compared with the earlier literature review and other secondary sources, as well as the initial hypotheses.

I received 453 answers in total. To process the data, I first coded it, then downloaded it into the analysis program SPSS. Then I first used the program to find flawed and missing values. Having a strategy to handle missing values is important to prevent biased estimates, distorted statistic, and conclusions that is invalid (Acock, 2005). There are many ways to handle missing values. In this project it was chosen to remove the missing values listwise, which means that the participants with missing values was removed completely from the dataset. Listwise deletion was chosen because the missing values of the dataset was missing completely at random, and listwise deletion is considered an unbiased way of handling these type of missing values (Acock, 2005). 380 responses were left in the dataset after deleting the respondents with missing values, and this is the data all the results in this study are based on.

Descriptive statistics gained from the survey was highlighted to describe the situation among students in Russia today. And t-tables and regression models were used to find correlations that could explain the findings. The goal was split into two parts. First it was researched what kind of perceptions and attitudes the students had toward decarbonization, then it was

examined why the students developed the perceptions they had, and the extent to which demographic, social or psychological factors affected their perceptions.

Another model was created during the data collection and writing process. This model works like a flow-chart, and is meant to illustrate the process from beginning literature review to the conclusions. The model begins by describing factors identified early on as important factors affecting perceptions.

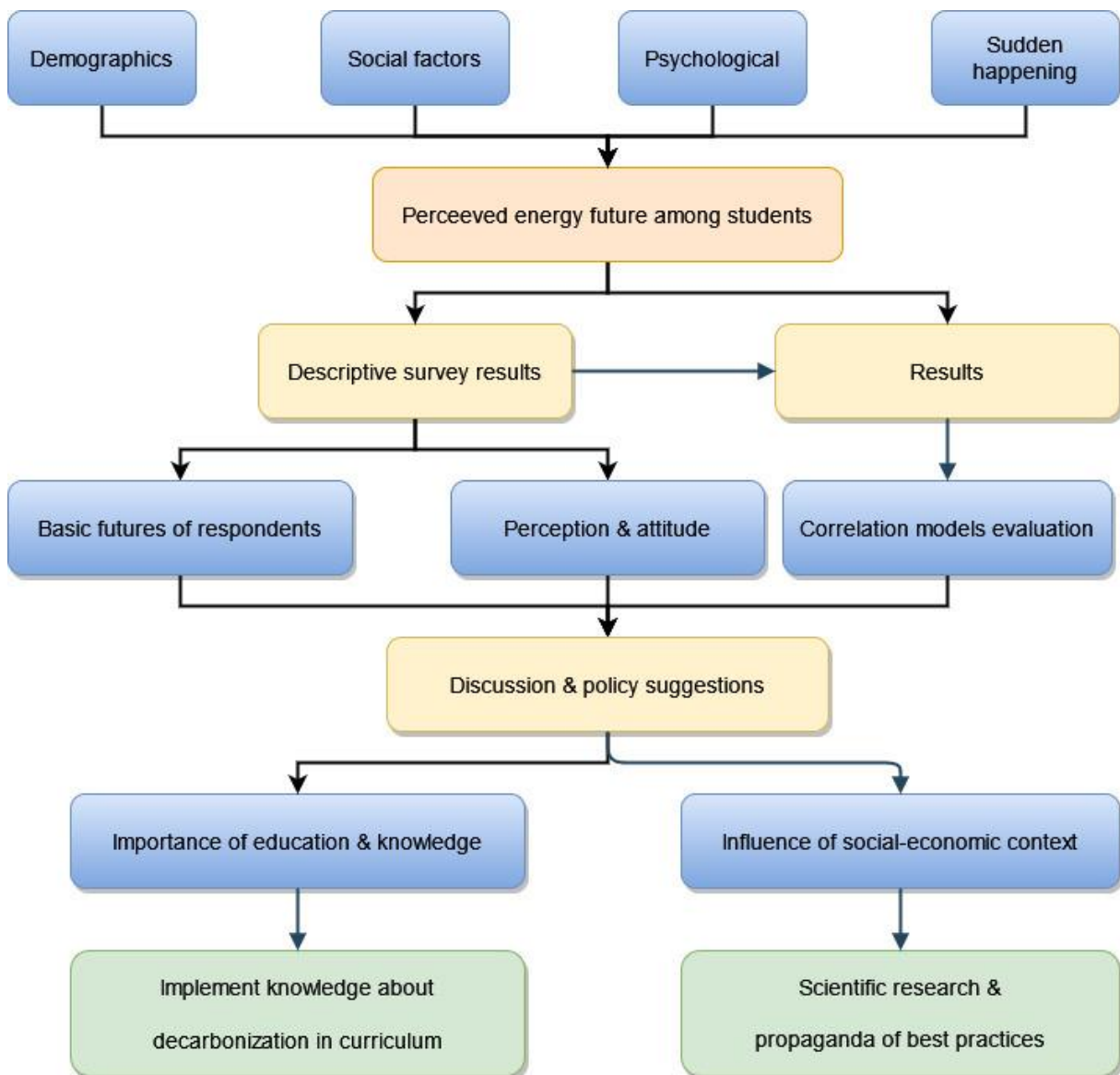


Figure C: *Early conceptual framework of students decarbonization perceptions.*

The model describes both the scientific process as well as how different factors have the power to affect how the students think. While this model still is a bit generalized, there is an

altered version in the article which emphasise even more on the specific survey results gathered during this research project, identifying what factors the survey found important.

Findings

Drawing on the conclusion stakeholders wanting a decrease in carbon emissions within Russia are encouraged to engage in actions to spread information regarding the topic and try to introduce decarbonization as part of the school systems curriculum. This is especially relevant for the students studying fields relevant to the energy industry. Knowledge and awareness on how carbon emissions affect the climate have the potential to make the energy industry transform in a more prominent way than it is today.

The findings that are presented in the article's results show that there is little knowledge about decarbonization among the students. The students' perceptions do not clearly prefer one of the presented scenarios, but the scenario with most renewable energy was least popular. There was neither any signs showing many students wanting to work toward lower carbon emissions in the future. All of these points toward a discussion and conclusion that there is low engagement among the students when it comes to decarbonization, and there is no sign that they are going to function as drivers for change in Russia.

Therefore the findings indicate that Russia's Kodak moment have not yet happened. If EU and the global industry is successful in producing enough renewable energy to phase out the energy import based on fossil fuels. The students do not see it as likely that Russia will follow the market change, and there is an overweight among students who believe Russia will develop more slowly than the global market when it comes to decarbonization compared to those who believe Russia will develop faster than the rest of the world. It is possible that Russia will be forced to change in the future if action toward decarbonization are not taken based on the survey. And according to the "Kodak-moment" theory will a forced change come at a greater economic cost than a chosen one.

The survey revealed that in general, carbon emissions are to a large degree not a topic the students participating in this survey habitually discuss. However, the survey created some engagement, something that was very prominent at the last question, which was an open text box: "Do you have any comments or reflections to add regarding this survey?". Many students responded. Several responses stated that they did not know what decarbonization was before completing the questionnaire, but they actually felt the survey in itself had helped them

understand what decarbonization is. There were comments stating that they were very interested in this topic and that they hoped to connect their future with it, and comments suggesting that decarbonization was both unprofitable and harmful.

Limitations

In this paper the Russian student's perception of decarbonization is explored. It is looked at how different demographic and social factors affect this perception, and attitudes toward making a change when it comes to carbon emissions have been researched. However, there is limitations that must be acknowledged. First, after receiving the results it came clear that there might have been more efficient to use a five- or seven-point Likert scale in the questions that only have a four-point Likert scale. This because it turned out difficult to find significant correlations based on the scale that was used, and a larger scale could have made the statistics more clear and easier to interpret.

In addition, the universities compared was all taken out from an already existing network. Convenience sampling can be perceived both as a strength and a possible limitation. Even though the universities were in six different cities the universities could have been chosen in a more structured way. But as mentioned above there is a probability that this study would be impossible to fulfil in this amount of time without using the existing network. The universities did also have a good geographical spread, showing perceptions from different parts of Russia. A weakness is that two of the contributing universities had a high answer rate, and the other four had a smaller impact on the results. Evening out the answers from these 6 universities would have been an advantage.

This as well as limitations introduced in the article make points out several parts of working with the thesis that could be improved based on the results it ended up with. Nevertheless, this study could be useful for policymakers and those managing the curriculums for the universities. Or other organizations with an interest in making the population aware of and engaged in the carbon emission development.

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Part 2: Scientific article

Is there a Kodak moment? -Survey of Russian students decarbonization perceptions-

Highlights:

- Decarbonization in Russia from the students' perception is analysed.
- Only 49.7% of the respondent had not heard about decarbonization before this study.
- Two key influencing factors: education and gender.
- Relation between possible factors affecting perception.

Abstract

Decrease in carbon emissions from the energy industry is seen as one of the important actions to stagnate the global climate change. The energy industry has been dominated by fossil fuels in over 200 years, but the latest years a third transformation in energy development has been introduced, transforming from traditional fossil fuels to non-fossil renewable energy.

Russia is the world's biggest energy producer but are not partaking in the transformation to the same extent as for example the European Union. Because of this Russia's energy future is of global interest. It is also very important for Russia itself since their national economy are heavily tangled up with their energy production, and failure to follow the market trends can get severe consequences for their economy.

The understanding of perception toward decarbonization among Russian students have not gotten attention from earlier studies. This study focusses on what perceptions the students have toward Russia's future participation in the energy transformation, with a special focus on decarbonization. While using correlation analyses to explore the underlying principles of the student's perceptions and their understanding of decarbonization. When finding participants it was given a special focus towards students that might work with the energy industry in the future.

Through a survey study with 380 students from 6 different universities in Russia we found that: 30% of the participants believe Russia will be behind the rest of the world in 10 years when it comes to development of decarbonization; 49,7% of the students had not heard about decarbonization before; 70% of the participants have never discuss decarbonization among friends or family, and only 10,8% of the participants have ever taken a class at school regarding decarbonization.

Key measures to enhance change in perception among the students include tailored and specialized education at the universities and publicity of best practices.

Keywords

Decarbonization, Students, Russia, Perception, Carbon, Climate.

1. Introduction

Decarbonization is no longer just talk, it is in motion and the engagement spreads across large parts of the globe (Dasandi et al, 2021). But still there are countries that do not engage in the decarbonization-movement. This study investigates if the younger generations perceptions as well as attitudes indicates a turning point in areas where decarbonization has not been prioritized. Even countries reluctant to change might be forced to by market powers. Failure to foresee and develop in line with market trends as well as technological changes threatening existing business models can lead to a situation described as “Kodak moment” where waiting to innovate until it is forced can come at great economical cost.

Decarbonization is an important tool for dealing with climate change, which is considered an obvious threat to humankind (National Academies of Sciences, 2019). Researchers have found that the global temperature is increasing, creating extreme weather events such as hurricanes and heatwaves threatening both ecosystems and society (IPCC, 2018). It has been found that within a few decades we will reach the point of no return if the ongoing trends with CO₂ emissions continue, and politicians, organizations, and individuals are looking at decarbonization to “save the world” (Jackson, et al., 2018).

Decarbonization, in a narrow sense can be defined as a “decrease of CO₂ emission intensity in a trend” (Sun, 2005). In the energy sector the decarbonization process consist of phasing

out carbon emissions from the use of fossil fuels. It includes actions such as reduction in the use of fossil fuels, increasing the use of carbon capture, and of renewable energy sources like wind power, solar power, and biomass to reduce the emissions of carbon dioxide into the atmosphere (Mitrova & Melnikov, 2019). Decarbonization is a part of the ongoing energy transition and is driven both by the climate agenda, technological progress, national economy, and each country's need for stronger individual energy security.

As the major source of carbon emissions, the energy industry plays a fundamental role in minimizing the impacts of rapid climate change (Beck & Joshi, 2015). And since climate change has serious consequences for all nations it is a hot topic among researchers, politicians, and the general public. It is debated to what degree we should take actions against the change and there are questions about how much we need to do in order to avert a crisis. Some argue that we rather should focus on adapting to the change rather than working against it (Häkkinen & Akrami, 2014) (Wang & Zhang, 2020) (Ntanos et al, 2018). The debate also involves how much should be sacrificed in order to try to combat climate change, because large parts of the world economy are dependent on the fossil fuel industry.

One factor known to affect the development within the energy transition that is lacking further investigation is the social dynamic changes within a population. For example, getting a new generation into the workforce can affect the development in carbon emissions. This is the inspiration for this project, where I will study students' perceptions of and attitudes to decarbonization. Both perception and attitude will sometimes differ from the reality, but these are seen as factors affecting and determining behaviour (Arbuckle, Morton, & Hobbs, 2013). In this study I reached out to students in higher education about to enter the workforce to identify the existing trends and see if these students have perceptions or attitudes that contradict or confirm earlier studies on energy transition and decarbonization in a Russian context.

Every generation has its own traits distinguishing it from other generations (Gardner & Davis, 2013). Generation studies tend to point to a transformative and universal change in young people's attitudes compared to those of their predecessors (Twenge, 2014). And according to a large-scale study done among 10 000 young adults is climate change the single biggest worry for 18-25 year olds today (Amnesty International, 2019). Young people are powerful drivers for change in behaviour according to De Leeuw et al (2013), and several studies have

been conducted on how new generations and young people will affect society in other countries (Desrues, 2012; Wyn & Woodman, 2007). According to Xiaofeng et al. (2019) the degree of social cognition affects the choices of institutions. While Mirza et al. (2009) found that raising public awareness of benefits concerning renewable energy facilitates the implementation of renewable energy projects. When discussing factors affecting students' perception toward decarbonization, three types of factors are considered, including students' personal attributes (e.g. gender, age, education, agricultural experience), psychological (e.g. perceived change of temperature or precipitation) and socioeconomic factors (e.g. social network, workplaces, access to markets).

Global studies about renewable energy have acknowledged public awareness as a factor affecting decarbonization but have chosen not to dive into it because they argue that on a global level it is a public consensus that decarbonization is wanted (Xiaofeng et al, 2019; Souvik & Sourav, 2017). However, this is a very general statement, and in the Russian context the consensus is not to be taken for granted since Russian climate policies have differed from those in the West and large parts of rest of the global community (Forbes & Stammler, 2009). A draft was released of Russia's long-term strategy to let carbon emissions increase until 2030, and not go down to a net-zero emission until 2100 (Ministry of economic development of the Russian Federation, 2020). Whether or not Russian students agree on the plan presented in the long-term drafts and their perceptions of the future may help us understand if there will be a change in carbon emission development in Russia, as well as other nations with similar strategies, in near future. The students will eventually be forming the energy development of their country, either directly by working in the industry, or indirectly as consumers and citizens.

Young people are much less likely to believe oil and gas is good for society. And in a survey executed in America it was found that 62% of 16-19 year-olds and 44% of 20-35 year-olds find a career in the industry unappealing (EY, 2017). Despite its high salaries has the oil and gas industry struggled to hire new young workers, and the number of business graduates choosing a career in the industry dropped 40% between 2006 and 2017, and later has dropped 16% from 2019 to 2021 (EY,2017; FT,2021). 91% of students care about working for an ethical company, and 67% considered it unethical doing a job that contributes to climate change (Trendence U.K., as cited by WorldOil, 2019).

A survey conducted for financial times by linkedin based on starting careers of 3,5 million business graduates around the world found that while graduates choosing a career in oil and

gas has fallen by 40% since 2006, graduates recruited into renewable and environmental industry has increased by 20% (FT, 2021). This article search to find out if this also applies to nations hesitating to decarbonization today.

In terms of national and local practices, every nation has its own approach to the topic, formed by the culture, the national research, the traditional political system, and the consequences they face (Halder et al, 2016). Therefore, different nationalities also have their own scenarios based on how the country follows up on decarbonization. Research at national and local levels has yielded insights into local strategies and their impacts (Guo et al, 2021; Mitrova & Melnikov, 2019; Halder et al, 2016). This study is researched in a Russian context, while the framework is based on perception development in general and can be adopted to studies researching perceptions in other countries as well.

Russia is one of the countries being criticized for not doing enough to decarbonize (Doyle & Farand, 2020; Ross, 2020). Students' perceptions are especially interesting in Russian context, since Russia is one of the leading energy producing countries, and their future climate policies and actions will significantly affect the rest of the world (Ross, 2020). Whether changes regarding decarbonization are made is of great relevance, likewise what measures and actions are needed to provoke such a change. Even though other factors may not show signs of rapid development, social cognition can change the market in a relatively short time if the trend among the younger generation is strong enough.

Research on Russia's position in the energy transition has shown that the country have been slow to react, and that the prospects for change are poor (Henderson & Mitrova, 2020; Porfiriev & Roginko, 2017; Fortov & Popel, 2014). It is found potential in resources that could be developed within the country, but the will to develop renewable energy as an alternative to fossil fuels is lacking (Mitrova & Melnikov, 2019). Other studies focus on the existing transition, taking a more optimistic view of the development, even though it is still slow (Koch & Tynkkynen, 2019).

The purpose of this study is to identify students' perceptions of decarbonization in their country, what influences such perceptions, and what attitudes the students themselves have towards working towards decarbonization in the future. And to investigate how the development towards decarbonization in Russia might change over time. A better understanding of how attitudes to and perceptions of decarbonization are formed can be used

as a roadmap for key stakeholders as to how and where to change in a meaningful way when a change in perceptions and attitude is desirable. It can indicate how information about decarbonization should be handled to reach young people and make a change. Therefore, we are investigating the students' views towards decarbonation in Russia as well as the factors that can form those views.

2. Literature review and model development

Earlier studies point to the slow development of decarbonization in Russia both now and in the near future (Henderson & Mitrova, 2020). Public awareness has been acknowledged as a factor affecting decarbonization, but it has not been further investigated within the Russian decarbonization context.

A conceptual framework was developed based on factors identified in the literature review as influential when it comes to perceptions, with emphasis on research in conjunction with climate change and/or sustainability. A psychological process perception and adoption to climate change and decarbonization is assumed. Individuals tend to choose their behaviour patterns based on perceived change, impacts and adaptive capacity according to protection motivation theory (Rogers, 1975), and intentions to work toward decarbonization are highest when the risk of climate change is perceived as high combined with a belief that they can cope with the threat (Kothe et al, 2019). As the individuals are aware and looking at both risks and loss associated with decarbonization, they might evaluate costs and benefits of coping strategies, and then determine if they want to take adaptive actions (Guo et al, 2021).

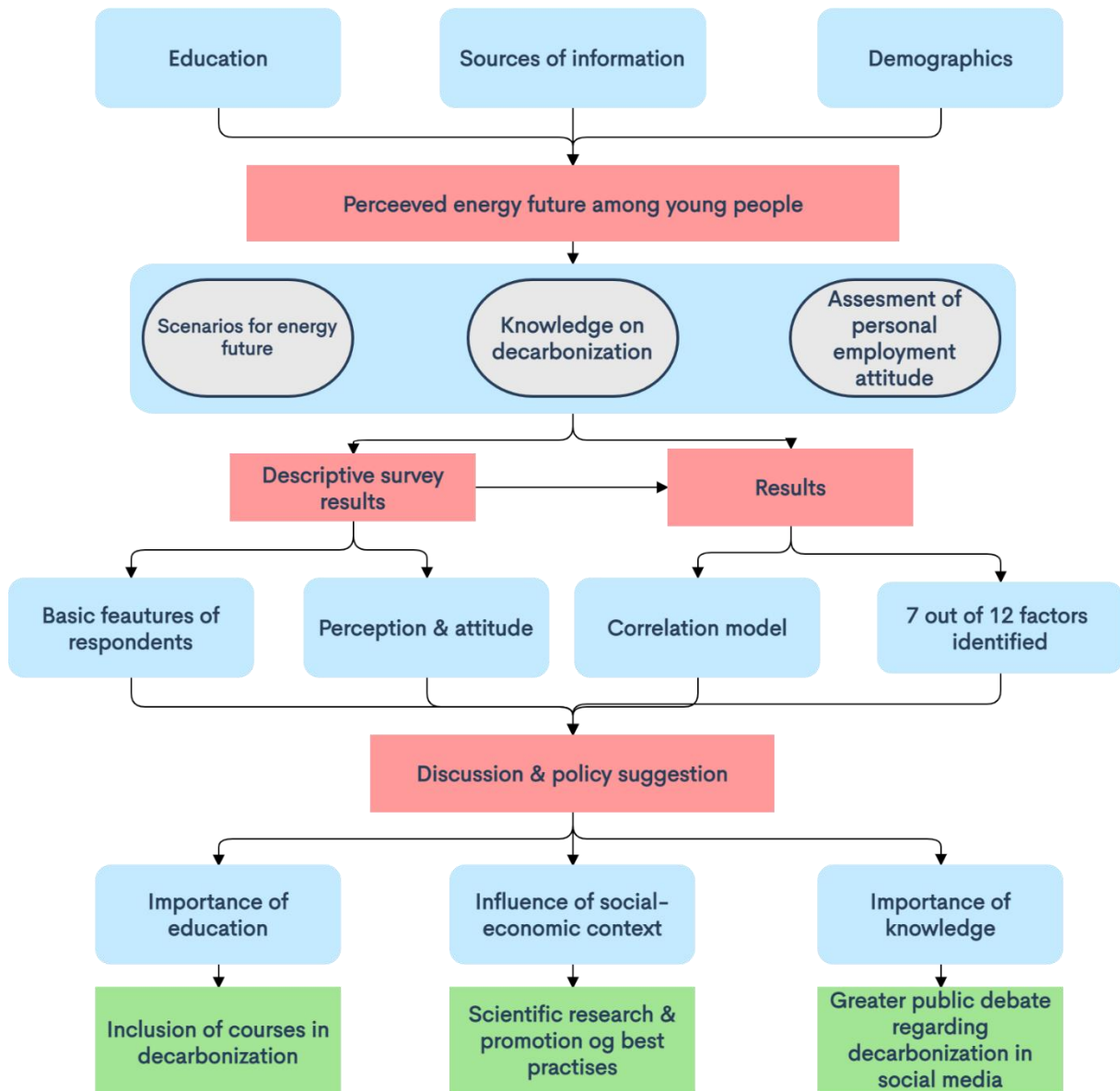


Figure 1: Conceptual framework of students decarbonization perceptions.

Then I created a survey with questions intended to elicit the students’ awareness, perceptions and attitudes to decarbonization, as well as what influences them. The questionnaire was based on an early literature review identifying demographics, social factors, psychological factors and sudden happenings as decisive factors affecting perceptions (Guo et al, 2021; Arion et al, 2018; Weber, 2010).

Guo et al. (2021) identifies three factors affecting attitude and behaviour toward climate change. Personal attributes (such as age and gender), socioeconomic factors (hereunder social

network and sources of information), and psychological factors (experienced change, value systems).

A factor that is mentioned in earlier research projects are that attitudes correlates strongly with knowledge and age (Arion et al, 2018; Karlstrøm & Ryghaug, 2014; Ek, 2005). It was also pointed out that the use of renewable energy was rising where the governments supported it. Therefor variation in perception related to climate change can be associated with political believes and other cultural values (Weber, 2010).

Sources of information have been noticed as an important factor in earlier research. Fan (2007) found that social media is the most influential source of environmental information, with education as the second most influential source. This may vary from geographic position. The survey used sources of information as one of the independent variables to see what and how sources of information influenced the sample group of students.

As well as eliciting students' existing perceptions and attitudes, this study also researched what factors that are most crucial in forming a special set of perceptions of and attitudes toward decarbonization. The perceptions may differ due to the length and specialization in the students' education, what sources they use to acquire information or other demographic factors. A better understanding of how perceptions of decarbonization are formed can be used as a roadmap for key stakeholders as to how and where to change in a meaningful way if a change in perception or attitude is desirable. It can indicate how information about decarbonization should be provided to reach young people. Universities play an important role in the provision of sustainability due to the special educational mission in society (Dagiliute et al, 2018; Yuan et al, 2013). By preparing and formulating appropriate curricula and syllabi, the university can shape students' personalities with certain provisions, in this case their views on carbon emissions.

An interesting perspective in this survey is whether Russian students are aware of the possibility of swift decarbonization of the global energy supply, and if they have heard about decarbonization at all. If they have not heard about decarbonization it will be more difficult to answer the survey for the participants since they have not had time in advance to reflect on the topic as it is today. The answer to this will help understand how the social and learning environment are concerning decarbonization among the students of today in Russia.

According to a study conducted in Lithuania, individuals with knowledge about “climate change” are more likely to work towards it than are individuals who are unaware of the topic (Dagiliute et al, 2018). However, the outcome among Russian students differed from this. One possible explanation for this is that they learn different ways to think within the nations. The fact that the students have heard about decarbonization before does not necessarily mean they have a good impression of it; they can just as likely have heard how decarbonization is threatening the economy, workplaces, and their position in society. This study also looks at how the perception correlates with the individual’s attitude. The students may believe their country will develop in one direction, but this does not mean that this is the direction the student himself supports the most. Students may endeavour to determine whether the topic appears interesting or relevant to them, and if it is seen as a relevant topic in the society.

The study is a contribution to the literature on energy transition in Russia, global energy scenarios, and what factors affect perceptions of decarbonization. It focuses on energy development in conjunction with climate change and social behaviour. The results are discussed further down in the article, and the conclusion includes some suggestions for change.

3. Materials and methods

The survey consisted of two parts, most of the questions concern demographics and independent variables which the literature analysis indicated as factors affecting perceptions and attitudes. The last parts include questions eliciting the students’ perceptions of and attitudes to decarbonization in the energy industry.

The definition of decarbonization used in this article are a term to describe the phasing out of carbon dioxide emissions from the use of fossil fuels and includes actions like reduction in the use of fossil fuels, increasing use of carbon capture, and increasing use of renewable energy sources like wind power, solar power, and biomass to reduce the emissions of carbon dioxide to the atmosphere. Decarbonization also includes energy transition, energy neutrality, and the green shift in the energy sector. This is the same definition as the one used in the questionnaire, to make it easier for the students to see the different opportunities of decarbonization and what it meant before they answered the survey.

The term knowledge is used a lot in the article. The respondents were after getting the definition asked if they had ever heard of decarbonization before. The group that answered yes at this question is the group counted as the group with knowledge (on the topic) from before they attended the survey.

The questions intended to elicit attitudes and perceptions were made into scenarios where the students were asked to rate the scenarios from least likely to most likely, and the scenarios were constructed with the existing energy policies and industry in mind. They were all formulated to sound realistic, and during development the focus was on keeping the wording of the scenarios neutral to avoid leading participants.

They were presented for four different scenarios regarding perception. The first one described an increase in use of fossil fuels and was the scenario farthest away from decarbonization. The second was a business-as-usual scenario, where the emissions more or less would stand still at the existing level. The third scenario was called “energy mix” and included a partly decarbonization based on increased use of the traditional non-emission alternatives as nuclear power and hydropower. While the last scenario pictured the largest decarbonization with focus on renewable energy where sun and wind-power would experience a growth. Then they were asked to rate the scenarios plausibility based on their perception, where 1 was least plausible, and 4 was most plausible.

Then five scenarios regarding their attitude toward working with and supporting decarbonization followed. They were asked if they saw themselves work in the renewable energy sector, the fossil fuel sector, or not in the energy sector at all. And no matter if they wanted to work with fossil fuels, or not in the energy industry at all, they were asked if they would engage in decarbonization. This was rated with numbers from 1 to 5 where 5 was most plausible.

The survey was carried out from January to February 2021 using a digital survey platform to conduct the whole survey, and the participants were given a link to this survey to participate. Before being sent to the participants a pilot survey was conducted in a class studying energy management in Norway, and adjustments were made based on feedback gathered in the pilot survey to improve and refine both the questions and the instrument.

The survey was translated from English into Russian to avoid wrong or missing answers due to language barriers. After the translation, the questionnaire was sent to six different universities in six cities in Russia to ascertain what affects the students' perceptions and what perceptions are present. To distribute the questionnaire to the students, professors at the various universities were asked to present the survey in their classes. These professors were reached using the research network available at the university. This was chosen because of convenience and due to the resources available in the research process. The universities were geographically remote from each other and covered different areas of the country. By the time I closed the survey I had 453 responses from students at six universities. After removing missing values from the data collection, I was left with 381 usable answers.

To compare attitudes and perceptions among different groups of students and determine which factors affected the student's perception most, both t-tests and regression analyses were run. Chi-square was used to test differences between the scores of students' involvement in activities related to decarbonization at the university via other socio-demographic variables.

4. Results

Demographics are one of the factors found influential when it comes to perception. The demographic differences among the respondents make it possible to analyse whether they have any influence or not and says something about how representative the sample is.

Table 1. Demographic characteristics of the survey.

Variable	Heard about decarbonization	Not heard about decarbonization	Heard about decarbonization in %	Not heard about decarbonization in %
Total	192	189	50,3%	49,7%
Gender				
Male	87	86	45.5%	36.5%
Female	105	103	54.5%	63.5%
Age				
17-20	118	116	61.3%	69.8%
21-24	45	49	23.6%	25.9%
25-28	9	5	4.7%	2.6%
29-32	5	1	2.6%	0.5%
33-36	9	1	4.7%	0.5%
37-40	3	0	1.6%	0%
>40	3	1	1.6%	0.5%
Education				
Not seeking a degree	2	3	1%	1.6%
Bachelor	147	168	76.4%	88.9%
Master/PhD	43	18	22.5%	9.5%
Faculties				
Business administration	67	79	35.1%	41.8%
Engineering and technology	29	22	15.2%	11.6%
Natural sciences	20	12	10.5%	6.3%
Energy	24	14	12.6%	7.4%
Other	51	62	26.6%	32.9%

Other faculties include environmental science, journalism, law, politics, with more.

The demographic composition of the samples is shown in Table 1 compared to their prior knowledge about decarbonization. Females outnumber males among the participants, which matches the general trends in Russian universities, where approximately 55.25% of students enrolling in Russian universities in 2018/2019 were females, and where female students outnumber male students in the age category from 18 to 24 years (Statista Research Department, 2021). The majority of respondents in all universities were studying for a bachelor's degree. Master and PhD students tend to be more aware of decarbonization than Bachelor students, this also correlates with age. The respondents are mostly young people and based on this table it is an almost similar distribution among disciplines.

After receiving the answers, the fields of studies were grouped into two categories for analysis: Students studying business administration and students studying other fields. This was done because a large number of the respondents were studying business administration, and it was possible to see that this group's responses differed from the rest. The group of non-business students consists mostly of natural sciences (8.3%), energy (9.2%), technology and engineering students (13.3%), with smaller percentages of other studies.

There is another important part of the survey that consists of the dependent variables this study wants to see the effect on. This concerns the perception scenarios about where they see the Russian energy industry in 10 years as well as how they think the decarbonization development will evolve compared to the rest of the world. There is also attitude scenarios asking if they see themselves working toward decarbonization in the future or not.

Table 2: Mean and spread among Russian student`s perception of scenarios.

Scale	Mean	SD	Factor Loading
Perceptions			
Fossil fuels	2.66	1.024	0.660
As usual	2.86	0.922	0.787
Energy mix	2.95	0.917	-0.607
Renewable energy	2.45	1.016	-0.767
Attitudes			
Positive to working with decarbonization in the fossil fuel industry	1.92	1.188	0.838
Negative to working with decarbonization in the fossil fuel industry	2.03	1.288	0.680
Positive to working with renewable energy	2.19	1.287	0.838
Positive to working with decarbonization outside the energy industry	2.88	1.485	0.786
Negative to working with decarbonization outside the energy industry	3.13	1.590	0.755

Table 2 presents the distribution of responses regarding the dependent variables. This is telling us that there are small differences in preference among all the students as a group. The energy mix is valued as more likely than the other scenarios, but it is noticeable that none of the scenarios was a clear favourite. What we can see is that the distribution is not very large, all scenarios do to a certain degree seem possible according to the general students' perceptions. Response options to the questionnaire consist of two Likert scales where 1 is least likely and the highest number is most likely.

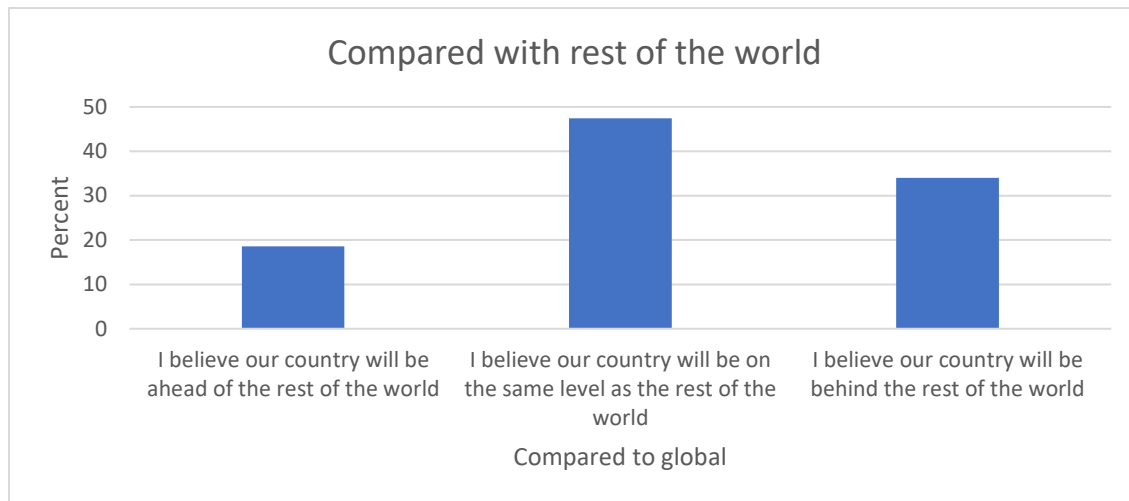


Figure 2: Perceived decarbonization future compared with rest of the world.

The participants were also asked if they believed Russia would be ahead or behind the rest of the world regarding decarbonization in 10 years. All in all, 30% of the participants believed Russia will be behind the rest of the world in ten years when it comes to development of decarbonization. Fifty per cent believed they will be on the same level as rest of the world.

4.1 Knowledge as a driver for change

One of the factors included in the survey was knowledge the participants had about decarbonization from before. Earlier studies found that students with knowledge about carbon emissions are more likely have a positive attitude toward decarbonization and become drivers of change (Dagiliute et al, 2018). In the survey we measure the student's knowledge against the attitude scenarios as well as if they are spreading the word by discussing or engage in activities regarding decarbonization.

To test this the students were asked if they had heard about decarbonization. Before this question they were also given a definition stating that in this survey decarbonization was used as a term to describe phasing out carbon dioxide emissions from the use of fossil fuels. That it included a reduction in the use of fossil fuels, increasing use of carbon capture, and increasing use of renewable energy sources like wind power, solar power, and biomass to reduce the emissions of carbon dioxide to the atmosphere. It was also stated that for this survey, decarbonization included energy transition, energy neutrality, and green shift in the energy sector. Even after being provided with a thorough definition and explanation of what decarbonization consist of, 49.7% of all participants answered that they had never heard of

decarbonization before. The results further show that even though half of the participants had not heard of this concept before, they had their own opinions when it came to how the energy industry will and should develop in the years to come.

However, comparison between the group that had not heard of decarbonization and the group that had heard revealed no significant differences regarding attitudes and perception with a T-value at -5 or lower, and a P-value close to 0 in every scenario.

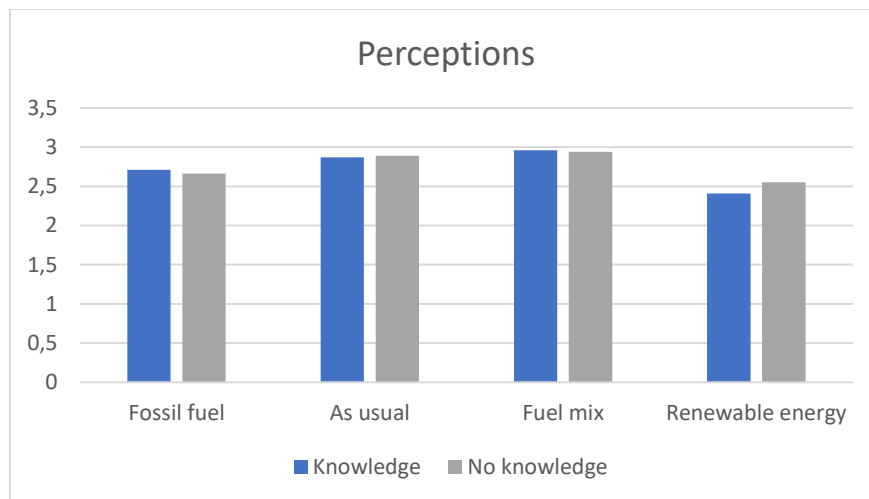


Figure 3: Perceptions toward the future based on knowledge.

We can observe that according to the student's perception renewable energy is considered least likely as being the Russian future. Both those who know and those who do not perceive the energy mix scenario where nuclear energy and hydropower development prominent as the most likely future, while business as usual is the second most shared perception of Russia's energy future as shown in figure 2. This is very consistent with the energy transition strategy in Russia, where hydropower and nuclear power are on the rise (Ministry of economic development of the Russian Federation, 2020). This did not support the earlier research which argued higher knowledge lead to higher belief in decarbonization in Russia. This can be based on the local policies and opinions the students get exposed to. When learning about a phenomenon it can be highlighted in many ways. Carbon emissions may be described as a problem, or as a necessity worth the impacts it may or may not have on the climate.

4.2 Education

The survey found that only 10.8% of the participants had ever taken a class at school on decarbonization, showing that it is not a part of most students' curriculum. And if we look at

the students together as a whole group there was no preference toward decarbonization. But when looking at the different factors affecting decarbonization it might be possible to see different perceptions among different groups of the students. Arion et al. found that young and highly educated individuals tend to have a positive attitude toward renewable energy, and that the greatest barriers is created by lack of knowledge together with cost (2018).

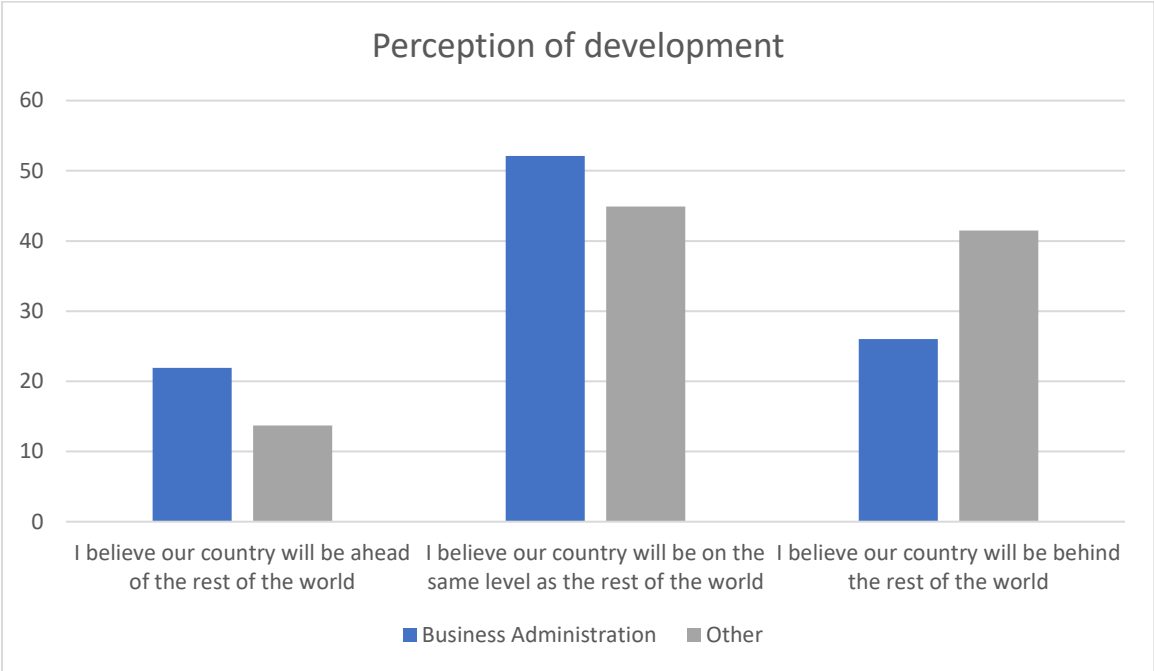


Figure 3: Perceived decarbonization future compared with rest of the world based on field.

Regarding fields of study, it was found that business students believed firmly in Russia being ahead of the rest of the world when it comes to the development of decarbonization, while non-business students did not. They had the most divided and positive perceptions of Russia’s energy future. Figure 3 shows that most of the business students either had higher expectations of decarbonization in the future than the other student groups. university they belonged to did not have any effect on these responses. Due to the literature findings, it was decided to ask the participants what university they belonged to, making it possible to look later for patterns based on how tied the local communities were to the energy industry and what affect this had. However, it was not control for geographic home location before university. Business students also had a significantly lower belief than other students in “business as usual” as the future, which might reflect education regarding innovation and business development.

		Correlations	
		Knowledge	Degree currently seekingg
Kendall's tau_b	Knowledge	Correlation Coefficient	1,000
		Sig. (2-tailed)	.002
		N	380
	Degree currently seekingg	Correlation Coefficient	-,158**
		Sig. (2-tailed)	.002
		N	380
Spearman's rho	Knowledge	Correlation Coefficient	1,000
		Sig. (2-tailed)	.002
		N	380
	Degree currently seekingg	Correlation Coefficient	-,159**
		Sig. (2-tailed)	.002
		N	380

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Knowledge compared to level of education.

Knowledge increases with education, and it was somewhat evenly distributed between the fields. The two fields with a noticeably higher number of students with knowledge than not was students studying energy or natural sciences.

Among students who had heard about decarbonization before, a significantly positive correlation was found at the 0.05 level (2-tailed) between higher education and belief that Russia will be ahead of the rest of the world when it comes to development of decarbonization. But at the same time this group did not have a significantly firmer belief in the renewable energy scenario as Russia’s future. This may indicate that the students either do not believe in large changes in the rest of the world when it comes to carbon emissions, or they may believe that an increase in the use of hydropower and nuclear power together with better technology and carbon capture will drive Russia into being one of the most developed countries when it comes to decarbonization.

4.3 Sources of information

Weber (2010) stated that variation in perception related to climate change can be associated with political believes and other cultural values. Those with knowledge about decarbonization recognized education as one of their important influences regarding the topic and preferred industrial and governmental papers. This shows that the industry and the politics pursued by

the government had a major impact on the students, showing that official policies are an important aspect affecting the participants, and also that industry itself is an important factor when it comes to information sharing. Overall, social media was the most important source of information when we include those unfamiliar with decarbonization which is consistent with the earlier literature review where social media was found to be the most influential source regarding environmental information (Fan, 2017).

The survey revealed that in general, carbon emissions are to a large degree not a topic the students participating in this survey habitually discuss. However, the survey created some engagement. 70% reported that they never discuss decarbonization among friends or family, and only approximately 10% had engaged in any forms of activity regarding decarbonization during in their student days. The survey also asked the participants how often they searched for information about decarbonization, and the group searching often for information about decarbonization agrees with the majority seeing nuclear and hydropower as the future.

		Correlations			
			Frequency discussion about decarbonization	I can see myself working in the fossil fuels industry	Engagement in activities concerning decarbonization
Kendall's tau_b	Frequency discussion about decarbonization	Correlation Coefficient	1,000	-,142*	,275**
		Sig. (2-tailed)	.	,011	,000
		N	380	260	380
	Will to work with fossil fuels	Correlation Coefficient	-,142*	1,000	-,182**
		Sig. (2-tailed)	,011	.	,002
		N	260	260	260
	Engagement in activities regarding decarbonization	Correlation Coefficient	,275**	-,182**	1,000
		Sig. (2-tailed)	,000	,002	.
		N	380	260	380
Spearman's rho	Frequency discussion about decarbonization	Correlation Coefficient	1,000	-,158*	,283**
		Sig. (2-tailed)	.	,011	,000
		N	380	260	380
	Will to work with fossil fuels	Correlation Coefficient	-,158*	1,000	-,196**
		Sig. (2-tailed)	,011	.	,002
		N	260	260	260
	Engagement in activities regarding decarbonization	Correlation Coefficient	,283**	-,196**	1,000
		Sig. (2-tailed)	,000	,002	.
		N	380	260	380
		*. Correlation is significant at the 0.05 level (2-tailed).			
		**. Correlation is significant at the 0.01 level (2-tailed).			

Table 3: *Engagement and will to work for decarbonization in the future.*

The survey results show that students attending courses or engaging during studies in activities regarding decarbonization during the study time related to decarbonization and those who discuss decarbonization among friends and family were more interested in working with it in the future. In Table 3 it is possible to see a significant negative correlation between engagement in activities regarding decarbonization, and a positive attitude toward working in the fossil fuel industry.

5. Discussion and recommendations

Student's perceptions toward decarbonization in the future, as showed by empirical findings, are divided and spread around possible energy future scenarios. To work with wind and solar energy is less attracting for these participating students in Russia. However, their attitudes indicate a noticeable expansion in wind and solar industry in the future compared to the current situation. The interesting part is that it is a higher belief in hydro and nuclear power as the future. Hydropower is the only fully renewable energy form that already is making a noticeable part of Russia's electricity, accounting for 20,6% of Russia's total electricity production (RusHydro, 2020). Nuclear energy on the other hand is often not considered a renewable energy source because of the uranium used, but nuclear power does not produce carbon dioxide emissions, and several countries use nuclear power to drive their decarbonization (Sovacool et al, 2020).

Since it is few significant differences or correlations concerning the perception scenarios it is difficult to conclude that the perception shows any changes within the country. Here it would have been very interesting to see what student's ten years ago thought about it. Or what people with more work experience think about the scenarios. Even if it is not possible to see any significant favourite when it comes to what the students think will be their energy future, it is possible that it has changed the last decade. Such a change can only be seen by research conducted over a longer time span.

5.1 Knowledge

Earlier studies found that students with knowledge about carbon emissions are more likely have a positive attitude toward decarbonization and become drivers of change (Dagiliute et al, 2018). This study did not confirm these earlier findings.

The survey revealed no significant difference in perceptions based on responders' prior knowledge of decarbonization. Looking at why we ended up with the same result is interesting. Despite knowledge there is a force reducing its effect. There might be several factors affecting this result. It is possible that there is a reflexivity trap present where the knowledge also leads their expectance, with the individuals ending up confirming already existing knowledge (Beaulieu-Brossard, 2015; Kobayashi, 2003).

Examining sources of information and what is learnt about decarbonization might contribute to an understanding of this results. The survey found that decarbonization is not given much attention at school, and we know the existing politics concerning the topic is hesitant toward change because of Russia's economic reliance on the fossil fuel industry. The industry accounted for 36% of the country's federal budget revenues, making it a key component for the economy (Barden, 2017). This is also relevant concerning other countries who is hesitating in their contributions to decarbonization.

5.2 Importance of education

The literature analysis identified education as one of the factors possibly influencing perceptions of carbon emissions (Arion et al, 2018) while the data collected in this survey found it evident that there was little interest in carbon emissions in the six participating universities. Including climate change and carbon emissions in the education system can be beneficial for understanding the issue, but this is dependent on the will to teach the students about the topic.

While those with knowledge about decarbonization recognized education as one of their important influences, they preferred industrial and governmental papers. This shows that industry and government policies had a major impact on the students, showing that official policies are an important aspect affecting the participants, and also that industry itself is an important factor when it comes to information dissemination. Overall social media seemed to be the most important source of information when we include those unfamiliar with decarbonization, this confirmed earlier studies with the same findings (Fan, 2007). A greater focus on decarbonization in the curriculum can alter these results because the students cannot report education as an important source of influence as long as the universities do not focus on it. Social media together with a gradually higher acceptance toward humans' effect on the climate change among politicians can be the opening toward making both students and other citizens more aware of the issue. Another possibility is to make it a part of the curriculums at schools and universities.

5.2 Influence of social-economic context

The results show that industrial and governmental document was seen as the most influential sources of influence among students with knowledge. With a governmental energy policy that do not favour renewable energy (Ministry of economic development of the Russian Federation, 2020), and an industry that still choose to focus on fossil fuels, it is reasonable that the students with knowledge do not favour renewables either. Since industrial documents are of the student's interest, an adaption of renewable energy within Russia can bring more focus toward why it is perceived as climate friendly, and therefor improve awareness of carbon emissions.

Being informed about decarbonization does not mean that the individual has learned what might be expected. People can be introduced to the topic from different perspectives. It is also possible that individuals' connection to an industry with high carbon emissions causes them to perceive decarbonization as a threat. Whole local communities may be dependent on an industry, a factory, or an oil rig. Some communities are built around specific workplaces. As Arion et al. pointed out, it was not only lack of knowledge that created large barrier toward renewables, but costs were also an important part of it.

Social media were the most influential source of information among the students without expressed knowledge from before. The social media links the global society together, making it possible to affect other countries to a larger degree than it was possible before, but geographical position and social environment will still affect what we see on social media.

Protection motivation theory points out three factors affecting how humans evaluate the threat of climate change. The three factors consist of the perceived effectiveness of doing something about the threat, personal capabilities, and costs related to choosing the path of protective behaviour (Norman et al, 2015). Since Russia's economy is so heavily tangled up with the oil and gas industry, it is important to add possible alternatives that can take the place of fossil fuels directly when it comes to working places and economy to make decarbonization a real option for a large part of the population.

6. Limitations and future directions

There are uncertainties that exist considering the students perceptions toward decarbonization. There are several types of uncertainties in this study, including uncertainties in understanding the process of student's perception and attitude, uncertainties in the methodology used to

select the key influential factors, as well as regarding model and data parameters. For instance, did nearly half of the respondents answer they had not heard about decarbonization before. Therefore the respondents may possibly not answer the scenarios without really having much knowledge on what decarbonization is, and why it is important, which might increase the uncertainty of the survey data. It was chosen to include their answers anyway since the lack of knowledge also was an important finding, and the student's might be a part of forming the energy future of Russia even without this knowledge.

For future studies it could be included a question to map what exactly the participants thought about decarbonization as a phenomenon. A person discussing it frequently can just as well be for it as against it. And this survey did not fully cover that option. All in all, the questionnaire was developed to be short and easy to answer which can be a limitation since a larger, more thorough questionnaire could make it possible to compare and possibly cover a larger aspect of the perceptions and how they were made, while a shorter questionnaire decreases the risk for more missing values.

Moreover, future research should perform a cross-country analysis, evaluating perceptions in different countries for purposes of comparison. This would be very helpful revealing the difference between countries where decarbonization is prioritized, and countries where it is not. This research contributes to exploring the current situation among students in Russia, but a cross-country analysis would help get an even better insight into whether the country is developing in pace with the global community.

Another finding that was not further explored was the significant difference between males and females when it came to searching for information. Gender is a highly researched topic, but it could be interesting to seek an explanation.

It could also be rewarding to compare my findings with those of a similar study on working individuals, preferably making a distinction between different lengths of experience in the energy industry. Such a study would be able to further explore if there is a change in perceptions and attitudes in the younger generation.

7. Conclusion

In recent decades increasing interest in minimizing carbon emissions has been observed on a global basis. But there are still countries hesitating to implement decarbonization in the

energy industry. This survey was created to test if there are any implications that young student's perceptions differ from the from different universities were chosen to ascertain students' perceptions of future decarbonization differ from today's situation. However, little focus on decarbonization was found among the students participating in this research, nor were any large specific groups identified among the participants having significantly positive perceptions of or attitudes to decarbonization. But when digging deeper into the data material, a slight preference for an energy mix of nuclear energy and hydropower was found, which is consistent with the existing politics in Russia. The country is already expanding its nuclear power capacity, and hydropower accounts for approximately 20% of electricity production (RusHydro). The students' perceptions did not noticeably favour either business as usual or increasing fossil fuel or other renewable energy sources as the most likely future, nor did they see themselves working toward decarbonization, leaving an impression that engagement among both those for and those opposed to change in carbon emission production is really low.

Overall, the findings do indicate a perception of more nuclear energy and hydropower, but little will to work specifically towards decarbonization. The attitudes of the students were fairly equally distributed, giving no sign of a clear preference among the students as a group.

This research's findings indicate that Russia's Kodak moment have not yet happened. If EU and the global industry is successful in producing enough renewable energy to phase out the energy import based on fossil fuels. The students do not see it as likely that Russia will follow the market change, and there is an overweight among students who believe Russia will develop more slowly than the global market when it comes to decarbonization compared to those who believe Russia will develop faster than the rest of the world. It is possible that Russia will be forced to change in the future if action toward decarbonization are not taken based on the survey. And according to the "Kodak-moment" theory will a forced change come at a greater economic cost than a chosen one.

The survey found that most of the students had never taken any specific courses or been involved in any activities concerning decarbonization. At the same time, the students who during their studies had participated in activities regarding decarbonization were more willing to work towards decarbonization than the rest of the group. These results indicate that a new focus on decarbonization at the universities could have a positive impact if the government or the universities wish to change this trend.

This study suggest education discussing climate change and carbon emissions to increase the awareness of emissions among students. Tailored courses should be created according to field of study and to which degree the students will work with the energy industry in the future.

Best practise to introduce this to the students should be more researched, and gain publicity to improve knowledge and implementation. It is suggested to make knowledge about decarbonization a part of the curriculum, to learn more about the climate change.

The main factors affecting the populations perceptions and attitudes, and promotion of best practises could be conducted to create a public debate about the topic. For the debate to reach students it should be taken in both in education and in the public, especially attention toward decarbonization in social media have potential to have an effect on the population.

Aknowledgements

I would like to thank my supervisors Elena Dybtsyna and Raj Krishnan Shankar, as well as Anatoli Bourmistrov for their guidance and support through this project. I would also like to thank all the professors helping me distributing the questionnaires to the students, and the translators. I would like to express my gratitude toward the education I have received at Nord University and MGIMO, and all the professors as well as fellow students that have made this journey educational in a joyful way.

Funding

This research is part of the project «Is this Russia's Kodak Moment? Russian perspectives on the energy transition» run in collaboration between Nord University and Norwegian Institute of International Affairs (NUPI). It is funded by the Research Council of Norway (RCN), project number 287937, duration 01.2019 – 11.2022

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Appendix A: Questionnaire

Perception of Decarbonization

This survey will take about 10 minutes.

(If you are using a mobile phone when answering it is recommended to turn the screen horizontally).

The goal of this survey is to map the attitudes and perceptions of decarbonization among students. We will compare answers from different countries to see if there are differences in trends across nations.

In this survey, **decarbonization** is defined as *a term to describe phasing out carbon dioxide emissions from the use of fossil fuels. It includes a reduction in the use of fossil fuels, increasing use of carbon capture, and increasing use of renewable energy sources like wind power, solar power, and biomass to reduce the emissions of carbon dioxide to the atmosphere. For this survey, decarbonization includes as well energy transition, energy neutrality and green shift in the energy sector.*

Have you heard about decarbonization described as above?

Yes No

Age

17-20 21-24 25-28 29-32 33-36 37-40 >40

Gender

Male Female

What is the highest education you have completed?

- Secondary school
- Bachelor's degree
- Master's degree
- PhD

What degree are you currently seeking?

- Bachelor's degree
- Master's degree

- PhD
- Not seeking a degree

At which institution are you taking your degree now?

- *Baltic State Technical University/BSTU (St. Petersburg)*
- *MGIMO University (Moscow)*
- *Murmansk State Technical University (Murmansk)*
- *Northern Arctic Federal University (Arkhangelsk)*
- *Russian State Hydrometeorological University (St. Petersburg)*
- *Tyumen State University (Tyumen)*
- *Ukhta State Technical University (Ukhta)*

What field are you studying?

- Aeronautics and Aviation Science | Anthropology | Art | Business Administration | Chemistry | Economics | Education | Energy | Engineering and Technology | Environmental Science and Health | Journalism and Mass Communication | Language | Law | Mathematics | Military | Music | Natural Science | Nursing | Oceanography | Pharmacy | Photography | Physical Therapy | Political Science and International Relations | Psychology | Public Relations and Administration | Statistics | Social science | Sports | Urban Planning | None of the alternatives above

Have you taken any specific courses about decarbonization anywhere in your education?

Yes No

If yes, did you firstly take this course abroad or at your home institution?

- Abroad
- Home institution
- Other institution in Russia

Which of these statements reflects your actions during your education?

(Possible to choose several options)

- I engaged in projects regarding decarbonization
- I attended conferences regarding decarbonization
- I took part at interest group regarding decarbonization (research club, young group activities, etc.)

- I have not been involved in any of the options above

How often do you search for information regarding decarbonization?

Check the alternative closest to reality.

- Once a day
- Once a week
- Once a month
- 2-6 times a year
- It do not search for information regarding decarbonization

What sources influence your ideas of decarbonization?

Rate the options from 1-6 where 1 is least influential, and 6 is most influential.

1 – Least influential 6- Most influential NA

- Social media
- Friends and family
- Education
- Newspapers
- Academic journals
- Government and industrial documents

How often is decarbonization discussed at home with family or friends?

Check the alternative closest to reality.

- Once a day
- Once a week
- Once a month
- 2-6 times a year
- It is not a discussion we have

Which of these energy scenarios do you see as the most likely in your country 10 years from now?

Rate their plausibility based on your perception. 1 is least plausible, while 4 is most plausible

1 – Least plausible 4 – Most plausible NA

- Fossil fuels will keep their position as the market leader. Lack of storage of renewable energy as well as economic challenges makes it more natural to lean on an already well-established petroleum industry. And the growth in renewable energy will stagnate.

- The energy policies will be close to what they are today. Coal will decrease because of already started projects and policies. Natural gas, oil, and renewables will all increase to cover the earlier coal market and the increasing global energy demand from population growth and a better economy.
- Hydropower and nuclear power will be the fastest growing energy sources, followed by natural gas who still dominates the fuel mix. Other renewable energy sources will increase marginally. Energy efficient use increases, but we will still see a growing energy consumption due to increasing economy.
- Reduction in energy intensity and significant growth in the market share of renewable energy sources. In this scenario the CO2 emissions never bounce fully back up after the pandemic and will continue to decrease afterwards. Renewable energy will become cheaper, creating an extra advantage in the market competition, while the demand for fossil fuels decreases.

Based on the scenarios above: where do you believe your country will be in development of decarbonization compared to the rest of the world?

- I believe our country will be ahead of the rest of the world
- I believe our country will be on the same level as the rest of the world
- I believe our country will be behind the rest of the world

Where do you see yourself in the future?

Rate the most likely possibilities based on your beliefs. 1 is most likely, while 6 is least likely:

1 – Least likely

5 – Most likely

NA

- I see myself working in the fossil fuels industry and will not engage in decarbonization.
- I see myself working in the fossil fuels industry and will engage in decarbonization.
- I see myself working with renewable energy, trying to make it a bigger part of the energy mix than it is today.
- I see myself not working in the energy sector and will not engage in climate-friendly activities or support decarbonization.
- I see myself not working in the energy sector but will engage in climate-friendly activities and support decarbonization.

Do you have any comments or reflections to add regarding this survey?

Thank you for your time!

Appendix B: Evaluation from NSD

3.5.2021

Meldeskjema for behandling av personopplysninger



NSD sin vurdering

Prosjekttittel

Perception of Decarbonization - Is this Russias Kodak Moment?

Referansenummer

291574

Registrert

22.03.2021 av Ida Margrethe Kalseth Norum - ida.m.norum@student.nord.no

Behandlingsansvarlig institusjon

Nord Universitet / Fakultet for samfunnsvitenskap / Internasjonale relasjoner, nordområder og miljø

Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)

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Type prosjekt

Studentprosjekt, masterstudium

Kontaktinformasjon, student

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Prosjektperiode

01.10.2020 - 01.07.2021

Status

29.04.2021 - Vurdert anonym

Vurdering (1)

29.04.2021 - Vurdert anonym

Det er vår vurdering at det ikke skal behandles opplysninger som kan identifisere enkeltpersoner direkte eller indirekte i dette prosjektet, så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjema med vedlegg 29.4.2021.

Prosjektet trenger derfor ikke en vurdering fra NSD.

Vi legger til grunn at spørreskjemaet ikke registreres bakgrunnsopplysninger som kan være identifiserende, hverken alene eller sett i sammenheng. Videre legger vi til grunn at undersøkelsen gjennomføres på en måte som sikrer at IP- eller e-postadresse ikke kobles til den enkelte besvarelse. Det må velges en spørreskjemaleverandør som sikrer dette. Se eksempelvis nettsidene til Nettskjema (som UiT har avtale med)

<https://meldeskjema.nsd.no/vurdering/60548a01-8987-4fd9-9b7f-516890715947>
3.5.2021

Meldeskjema for behandling av personopplysninger

1/2

om dette: <https://www.uio.no/tjenester/it/adm-app/nettskjema/hjelp/ikke-lagre-personinfo.html>

HVA MÅ DU GJØRE DERSOM DU LIKEVEL SKAL BEHANDLE PERSONOPPLYSNINGER?

Dersom prosjektopplegget endres og det likevel blir aktuelt å behandle personopplysninger, må du melde dette til NSD ved å oppdatere meldeskjemaet. Vent på svar før du setter i gang med behandlingen av personopplysninger.

VI AVSLUTTER OPPFØLGING AV PROSJEKTET

Siden prosjektet ikke behandler personopplysninger, avslutter vi all videre oppfølging.

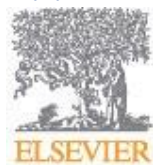
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Appendix C: Author guidelines for Journal of Cleaner Production



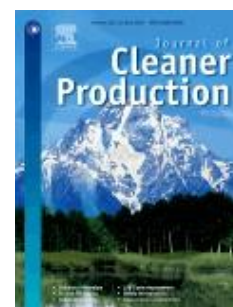
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AUTHOR INFORMATION PACK

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The ***Journal of Cleaner Production*** is an international, transdisciplinary journal focusing on Cleaner Production, Environmental, and Sustainability research and practice. Through our published articles, we aim at helping societies become more sustainable.

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