



Carbon emission trading as a climate change mitigation tool

David Andrej
Zilina University
Zilina, Slovakia
andrej.david@fpedas.uniza.sk

Abstract

Climate change has become the most urgent social and ecological problem in recent years. Now it has become a self-driving process that causes more and more problems, because it is constantly changing the climate of the different parts of the Earth. Consequently, the natural habitat of local species is diminishing, and this process rapidly decreases biodiversity. This is just one of the reasons why leaders worldwide have decided to stop this process and reverse it back to the initial stages. One of the means of achieving this is to regulate the number of harmful gases the countries can emit. The Emission Trading System was established in the EU to build a legal and supervised structure around this process.

Keywords

Carbon emission, Trading, Mitigation, Sustainability

1. Simple models– the one-point economy

Since the 1990s, most developed countries have realized that their industrial manufacturing and non-service-based production contribute to climate change. This is one side of the coin, because on the other side of production is consumption, a process in which everyone on Earth engages (Rimkus et al., 2018). The Hollywood movies made it seem cool to have loud, fast, big cars burning fossil fuels that are immensely worsening the climate. New icons like Elon Musk and other technology unicorns are shaping the industry like never before. Transportation is changing to become greener. The food industry is trying to promote goods that require less carbon emission during growth and production. What led to this point? The most important step was taken in the 1990's, to be more exact in 1997: the Kyoto Protocol (UNFCCC, 1997) entered into force in 2005. This agreement was signed by 192 bold, developed countries, claiming that they will do anything in their power to reduce climate change as much as possible (Zöldy, 2019). Some countries and associations have made bolder steps, such as the EU, announcing that they will reach a net-zero carbon emission by 2050. There is a country that is even bolder, Russia, which announced that they will reach the net-zero in carbon emission by 2025.

What does this mean in reality? How can a country reach net zero carbon emission if they are producing the same or more carbon dioxide than before? The answer for this is carbon emission trading. It works like magic, as the old saying goes. On the one hand, it is magic because no one is really changing anything while doing carbon emission trading, except paying money for companies that have the capability to sequester carbon from the air, or put it simply, clean their emission. Elon Musk offered 100 million dollars for someone who can come up with an idea how to clean the air and capture carbon faster and better than mother nature does (Clifford, 2021). So, this is why it is magic on the other hand, because these companies do clean the air.

Biological air filters have been known since the beginning of time. Plants that can engage in photosynthesis are capturing carbon from the air, and they make oxygen and water from it. This is the magic companies benefit from who engage in carbon emission trading (Szabó et al., 2018). There are many ways to use forests as air filters in emission trading, but the method that is getting more and more popular is trading emission with carbon credits. This method emerged when governments tightened the quotas regarding emissions and both countries and market actors had to accept it. They proposed a solution that is quick, efficient and develops rapidly, in a similar manner to production and the service segment of consumerism. Moreover, countries which cannot meet their quota boundaries can trade emission or by the leftover from other, carbon efficient countries such as Switzerland, Poland or Hungary. but consumers can also reduce their carbon footprint by purchasing offsets on the voluntary market. This article investigates both the voluntary and the obligatory part of carbon emission trading based on the relevant literature.

2. Methodology and background

This study relies on various sources on the concepts of climate change and carbon emissions trading. The aim of this literature review is to deepen the knowledge about the topic in question and about the most important tool that currently exists in the market to reduce carbon emissions as a means to mitigate climate change, highlighting its potential impact on the environment. Climate change is a change in the usual weather found in a place, e.g. average precipitation



or average temperature for a month or a season. Climate change is not only local, but global: it is also a change in Earth's climate. Weather can change in just a few hours, but climate takes hundreds or even millions of years to change.

Since the beginning of the Industrial Revolution in 1760, people and their activities have emerged as significant factors in driving the climate on Earth, due to the tremendous negative impact caused by them, which is increasingly alarming as time passes by. Greenhouse gases (which are emitted during the combustion of fossil fuels for manufacturing, heating, land clearing, and transportation) continue to build up in Earth's atmosphere. These gases enhance the atmosphere's ability to hold in heat, which has resulted in accelerated melting of ice at the poles and of mountain glaciers and has altered reliable temperature and rainfall patterns in other parts of the world. The changes that we are witnessing in climate can have huge public health impacts, for example, floods and droughts can both impact our drinking water quality and our recreational water quality, which limits the time that we can interact with nature affecting our health and well-being.

The Paris Agreement (UNFCCC, 2015) is a landmark international accord that was adopted by nearly every nation in 2015 to address climate change and its negative impacts. The agreement aims to substantially reduce global greenhouse gas emissions, in an effort to limit the global temperature increase in this century to 2 °C above preindustrial levels, while pursuing the means to limit the increase to 1.5 °C. The agreement includes commitments from all major emitting countries to cut their climate pollution and to strengthen those commitments over time. The pact provides a pathway for developed nations to assist developing nations in their climate change mitigation and adaptation efforts, and it creates a framework for the transparent monitoring, reporting, and meeting of countries' individual and collective climate goals.

According to the United Nations Secretary-General, António Guterres (2021), 2021 was “the make it or break it” year. As the previous year was the second warmest year in history, the future gives us serious concerns. This means that after more than 5 years after the Paris Agreement, the situation regarding climate change just got even worse with record greenhouse gas concentrations, increasing land and ocean temperatures, sea level rise, melting ice and glacier retreat and extreme weather. In accordance with the data gathered by the National Centers for Environmental Information (NOAA), it is extremely worrying that 2020 was the second warmest year. The reason is that it was a La Niña year, which is a year where the sea surface temperature across the eastern equatorial part of the central Pacific Ocean is lower than normal, causing the global temperature to fall. That clearly did not happen, which illustrates how serious the current situation is.

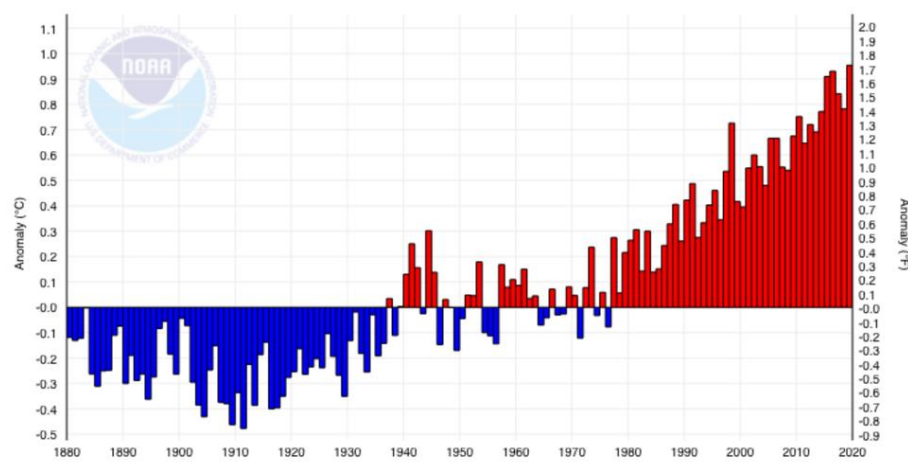


Figure 1. Global land and ocean temperature anomalies
(source: National Oceanic and Atmospheric Administration – NOAA, 2019)

Figure 1 shows the seven warmest years in the 1880–2020 record have all occurred since 2014, while the 10 warmest years have occurred since 2005. We can conclude that action must take place, otherwise, the years onward will most likely break records after records regarding global land and ocean surface temperature. With all these goals established by the Paris Agreement in mind and issues in hand, many researches have been trying to find effective ways to reduce greenhouse gases emissions.

3. –Carbon emission trading

Carbon emission trading emerged as a way for governments to try to reduce their greenhouse gas emissions, more precisely that of carbon dioxide, a crucial component in the fight against climate change. It is a market-based system that aims to provide economic incentives for countries and companies to reduce their environmental footprint. Almost all



activities, from travel to agriculture, lead to the emission of gases such as carbon dioxide, thus contributing to the greenhouse effect responsible for climate change. Unlike voluntary offsets, where consumers can choose to pay a company to balance its carbon footprint by funding reforestation projects, as forests absorb CO₂, carbon trading is a legally binding scheme that caps total emissions and allows organizations to negotiate their allocation, hence the term “cap and trade” (Dahlan et al., 2022). The emission limits of such systems are calculated by governments and policymakers and must be compatible with their previously defined goals of limiting environmental damage. Companies that have substantially more negative impact on the environment due to their emissions, receive allowances proportionate to their historical emissions and with that, they can manage their emissions properly and effectively. For example, if a company is emitting more than their allowances offer, they will have to purchase more carbon credits in the carbon market. I exact opposite happens when they emit less than the maximum allowed, as that excess can be sold on the market.

There are many organizations that cannot sustain such reduction of their emissions for the simple reason that it would cost their businesses to produce less, resulting in an even lower profit. This is where the voluntary carbon market is useful. This proves to be a viable solution, because this method does not only help the overproducing organizations reach their net zero carbon emissions goal, but also increases social responsibility and establishes a healthy and green corporate image. Also, for the newer, small and sustainable projects, the voluntary carbon market turns out to be a huge opportunity due to its lower development/transaction costs.

Carbon credits are units of measurement that correspond to one ton of carbon dioxide equivalent (t CO₂e). They are used to calculate the reduction in greenhouse gas (GHG) emissions and their possible trade value. Based on the Global Warming Potential (GWP), all greenhouse gases are converted into t CO₂e. Therefore, the term “carbon equivalent” (or Coe) is the representation of greenhouse gases in the form of CO₂. I greater the global warming potential of a gas relative to CO₂ is, the greater the amount of CO₂ represented in CO₂e for it is. Nations that promote greenhouse gas emission reductions receive a reduction certification that will count as carbon credits. The latter, in turn, can be traded with countries that have not reduced emissions. Thus, the more a country reduces emissions in tons of CO₂ equivalent, the greater the amount of carbon credits available for trade for them is, proportionally.

The price of carbon is determined by supply and demand, with supply units capped at an acceptable level causing the cost to vary depending on whether or not companies find alternatives to pollution. By putting a price on damaging activity, the system provides a financial incentive for companies to reduce emissions while reducing the overall cost of these reductions, since the cheapest improvements are made first. In the past, there have been other “cap and trade” systems that have been successful in solving environmental problems, including one about sulfur dioxide emissions, which resulted in a reduction of acid rain in the United States (Rocha et al., 2015). Compared to direct regulations or taxes, carbon emissions trading does not require much government intervention in the economy, leaving businesses to find their own solutions. Many environmentalists believe that as long as the cost of emitting greenhouse gases is high enough, encouraging these types of alternatives could be a relatively simple and efficient method to boost decarbonization (Razzaq et al., 2022).

However, an oversupply of carbon allowances during the 2008 financial crisis saw the price of pollution lowered in the EU trading system, resulting in companies seeing their incentives to change behavior reduced. A decade later, in response to events triggered by the financial crisis, the EU created the “market stability reserve,” or in short MSR, which gives the European Commission the ability to increase or decrease the supply of carbon units. As a result, their price has tripled from €8 per ton of CO₂ to around €25 per ton of CO₂ in one year. In turn, the energy sector has shifted production from coal-fired power plants to cleaner, natural gas-fired production, which produces less CO₂. In 2019, emissions declined by 8.7%, the largest decline since 2009.

Carbon pricing very effectively encourages the shift of production and consumption choices towards low and zero carbon options, which is required to limit climate change. The EU carbon emissions market has also caught the attention of hedge funds and traders. While OPEC controls one-third of the global oil supply, the EU regulates all carbon allowances in its emissions trading system. And with the EU’s long-term goal of gradually increasing the price of carbon units, they are seen as a popular long-term investment. The current COVID-19 pandemic has led to a lack of carbon allowances, as all economic activities have begun to decline, resulting in prices now being back above pre-COVID levels. However, there are concerns that emitters with a higher market weight may find loopholes in carbon trading systems.

Unlike the previous Kyoto Protocol agreement, the current Paris Climate Agreement declared in 2015 obligates all signatories, not just the most developed economies, to impose carbon emission targets. If this agreement is successfully implemented, analysts believe that international emissions trading could eventually reduce global emissions by 60 to 80 percent by 2035, which would be an extraordinary breakthrough. The growing popularity of cap-and-trade systems, and the rising price of carbon permits are forcing companies to consider their effect on the climate, which has led to a reduction in emissions. Although imperfect, the EU’s carbon trading scheme is a model for other economies to emulate. Also, earlier this year, China launched the world’s largest carbon market for the thermal power industry, with this sector accounting for about 40% of the country’s emissions, equivalent to twice the emissions covered by the EU carbon market



(Li et al., 2022). Carbon emission trading is becoming more and more attractive due to its positive results on the reduction of global carbon footprint, and it is believed that the market for carbon credits could be worth \$50 billion in 2030.

4. Analysis – Criticism and difficulties of the system

According to experts, the low market uptake of carbon credits is due to the fact that projects involving carbon credits are not developed with the sole purpose of selling them (Burke, Gambhir, 2022). Typically, they are energy projects where the sale of carbon credits is one element of revenue. Thus, if the sale of carbon credits does not compensate for the cost difference between cleaner and conventional energy, the emission reduction project is put aside. In addition, the market's lack of adherence to carbon credits is caused by the uncertainty of approval of projects involving GHG emission reductions. Countries selling carbon credits feel the need for a firm commitment from the purchasing countries. In some cases, carbon credit selling countries are not able to create and maintain project teams due to lack of personnel. Furthermore, the fact that each country reduces emissions brings a real risk that some will put on the market credits for emissions they are not reducing. This would be a disaster for the mechanism itself but, above all, for the atmosphere.

There are some further fears when it comes to carbon emissions trading. Critics of this system say that countries facing economic difficulties might be tempted to cheat by making their overall emissions cap too generous or by using accounting tricks to overstate reductions. For example, a nation might reduce its carbon emissions by building a wind farm to replace a coal-fired power plant. It would free up some of its carbon allowance, which could be sold to another country, but would still count as a reduction in the first country's emissions, even if the overall output did not change. There are also fears that large polluters may relocate across borders to avoid joining a cap-and-trade scheme or find more lenient jurisdiction. Another criticism of carbon markets is that developed countries, responsible for most of the pollution to date, can invest in low-carbon technology and have reoriented their economies towards less carbon-intensive activities, unlike poorer nations. Climate advocates also argue that too much emphasis on merely redistributing pollution obscures the fundamental need for all countries to transition away from fossil fuels shortly to avoid severe and irreversible environmental damage.

Given that global efforts to reduce greenhouse gas emissions may generate demand for carbon credits, it is clear that the world will need a voluntary, large-scale, transparent, verifiable and environmentally friendly carbon market. However, today's market is fragmented and complex. Some credit certificates represent dubious emission reductions at best. Pricing data is limited, so buyers need to know whether they have paid a reasonable price. Also, suppliers have to manage their risks through financing and carbon reduction projects without knowing how much the buyer will eventually pay for carbon credits. However, as governments have tightened environmental regulations, the figures have reflected a significant improvement, shown themselves to be far more optimistic, and have even broken records for the valuation of emissions. It is even likely that the number of cap-and-trade markets will increase as many countries, cities, and companies around the world try to fulfil their ambitious promise of net zero carbon emissions by 2050, a target set by the United Nations

5. Conclusion

While carbon emissions trading is attractive in theory, it has not been easy to implement, especially at its inception. The first international carbon market was created under the United Nations' Kyoto Protocol on Climate Change in 1997. However, the market collapsed after widespread reports of corruption and abuse of the system. After that, in 2005, the European Union's Emissions Trading System emerged, being the oldest active carbon market to date but not the only one. There are other schemes in countries such as Canada, Japan, South Korea, Switzerland, New Zealand and the United States. Carbon credits emerged with the Kyoto Protocol, an international agreement that established that between 2008 and 2012, developed countries should reduce greenhouse gas emissions by 5.2% (on average) relative to levels measured in 1990. Although the reduction target was collective, each country obtained individual targets that were higher or lower according to their stage of development. In this way, developing countries were allowed to increase their emissions. The treaty is based on the principle of "common but differentiated responsibilities": the obligation to reduce emissions in developed countries is greater. After all, historically, they are (more) responsible for the current concentrations of greenhouse gases emitted into the atmosphere.

The European Union had the target of reducing 8% of its emissions, while the US 7%, Japan 6%, and Russia 0%. In contrast, Australia was allowed an 8% increase and Iceland 10%. Developing countries, including China and India, were not required to reduce emissions. The United States and Canada refused to ratify the Kyoto Protocol, because the agreed commitments would negatively affect their economies. All these definitions were in line with the Clean Development Mechanism (CDM) created by the Kyoto Protocol, which predicts the certified emissions reduction. Those who promote the reduction of polluting gas emissions are entitled to the certification of carbon credits and can trade them with countries with targets to meet.

However, with the Paris Agreement – a treaty under the United Nations Framework Convention on Climate Change (UNFCCC) that governs measures to reduce carbon dioxide emissions from 2020 onwards and that replaced the Kyoto Protocol – it was established that emission reduction targets and purchases are all defined domestically, i.e., each country defines how much it wants to reduce and how and from whom it wants to buy carbon credits. Another key driver of



controlling the emission and also initiating a carbon cap system are the post-Soviet countries. Since their industrial system is not up to date, they still keep emitting high amounts of carbon dioxide and warming the air.

Carbon emission trading not only helps mitigate the effects of climate change, but also helps develop poor, third-world countries. Numerous companies are day by day planting new forests across the globe, mainly in developing countries, so that they can help the people there. Moreover, these caps are calculated based on how much carbon is captured overall in the country. It means that measurements also include the forests and agricultural products that are already in the country. It is the reason why they are not able to sell carbon sequestrations twice in the country because biologically, it is unmanageable for a plant to capture twice as much as possible.

As a consequence, companies need to build new forest projects worldwide to increase their carbon cap and decrease the amount of carbon they emit into the air. By doing this, these projects also need to be dealt with all the time, so by building projects, they not only help mother nature but also help other, poorer nations with meaningful jobs for the people in the area. That is why they, on the one hand, choose poorer countries. On the other hand, as De Miguel et al. (2009) shows, involving developed countries can also affect the price of carbon capturing potential or carbon sequestrations. The price of labour there and other key price drivers are much lower and significantly more available than in developed countries. This is why they can influence the price of carbon offsets to a great extent.

As a result, most countries like the European Union set up the EU ETS system (EU Emissions Trading System), and we will see an increasing number of such systems in the future, so that the carbon cap business will be clean from carbon dioxide and business market manipulation. However, there is another issue. We should divide developing countries into two segments because these two segments are affected differently by the world trade of carbon offsets. The first segment is for those developing countries that participate in energy export, and the second is for countries that do not engage in such activities with their surroundings or other countries of the world. As the countries must take part in the carbon cap program, the energy resources such as oil or gas need to be taxed and also traded with keeping carbon emission minimizing in mind. Furthermore, the involvement of the US in the world trade on the carbon market is also a major factor, because if the American segment is active, or we shall say more active, the tax on carbon emission is lower and also the prices are much lower.

In 2020, the European Union declared in what they would be trying to accomplish the impossible. They are trying to guess what the future trends of climate change mitigation related to carbon trade will look like. It is always hard to project and predict the future, but the trends predict that it will be much greener than it is today. The carbon cap regarding the ETS system that was previously allowed was reduced in 2019 by 9,1%. This means that companies had to cut back their emissions by almost one-tenth of their ongoing production. It did not come as a surprise, because all the participating countries agreed to these reductions. Since the EU's ETS covers 40% of the carbon reduction within the EU (EEA, 2020), they control almost half of it.

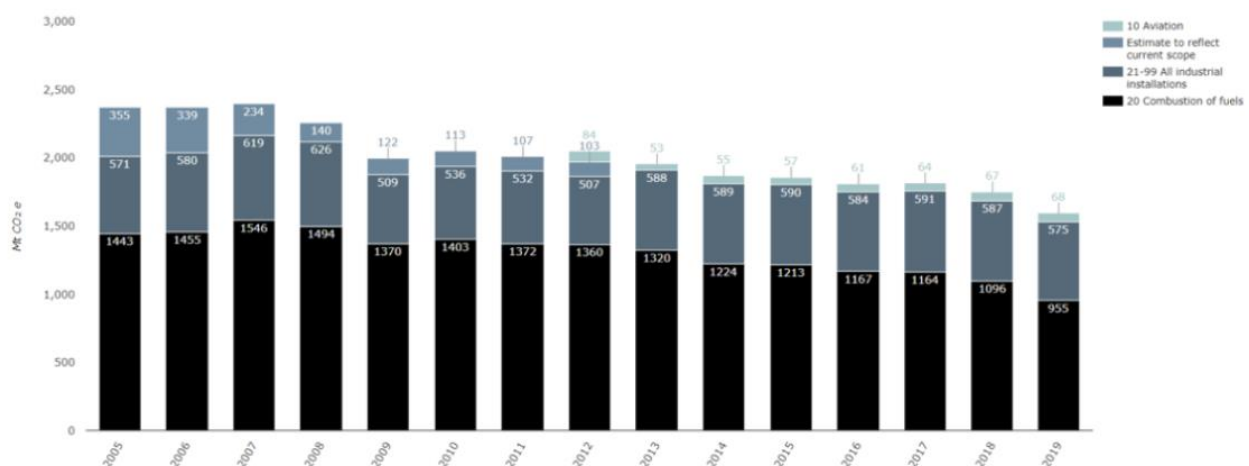


Figure 2. EU ETS emissions by activity type
(source: EEA 2020)

Carbon emission within the EU has fallen back by 35% between 2005 and 2019 (see Figure 2). The most significant drivers of these emissions are the combustion industry and the industrial installations, which are responsible for most of the EU's and the other countries' carbon emissions. It also means that it will be inevitable to change the industry



appliances and machinery that drive the combustion industry emission. We can also conclude that, shortly, the demand for carbon offset in the next 20 years, will grow rapidly, but after that it will decline since most drivers of the emission will be replaced and eliminated. “Seventeen countries anticipate a decrease in their ETS emissions between 2019 and 2030, mainly due to growth in the use of renewable energy and the phase-out of carbon-intensive power generation capacity” (EEA, 2020: 5). Because of the previously mentioned factors and statements based on the regulations and the past changes, we can conclude that trading in the next few decades will rapidly increase but close to the middle of the century it will decline, because the member states will reach carbon neutrality. In this phase, the role of carbon trade will be to sustain the reached carbon emission level.

Acknowledgement

The author is grateful for the contribution of Carina Cruz, Daniel Cruz, Marcell Dengi, and Eva Kozak. The author highly appreciates the work of reviewers and their valuable comments.

References

- António Guterres (2021): Press Conference by Secretary-General António Guterres at United Nations Headquarters, URL: <https://press.un.org/en/2021/sgsm20688.doc.htm> (accessed: 16 Sept 2022)
- Burke, J., & Gambhir, A. (2022). Policy incentives for Greenhouse Gas Removal Techniques: the risks of premature inclusion in carbon markets and the need for a multi-pronged policy framework. *Energy and Climate Change*, 100074. DOI: <https://doi.org/jd9x>
- Clifford, C. (2021). The who, what and where of Elon Musk’s \$100 million prize money for carbon capture innovation. *CNBC*. URL: <https://www.cnbc.com/2021/02/08/who-what-where-of-elon-musks-100-million-prize-for-carbon-capture.html> (Downloaded: 15 September 2022)
- Dahlan, N. Y., Ahmad, N., Ilham, N. I., Yusoff, S. H. (2022). Energy security: role of renewable and low-carbon technologies. In Asif, M. (ed.). *Handbook of Energy and Environmental Security*. Academic Press. 39–60. DOI: <https://doi.org/jd88>
- De Miguel, C., Ludeña, C., Schuschny, A. (2009): Climate change and reduction of CO₂ emissions. United Nations ECLAC, Santiago. URL: <https://repositorio.cepal.org/handle/11362/5692> (Downloaded: 15 September 2022)
- EEA – European Environment Agency (2020): The EU Emission Trading System in 2020: trends and projections. Climate change mitigation, Briefing no.20/2020 URL: <https://www.eea.europa.eu/themes/climate/the-eu-emissions-trading-system/the-eu-emissions-trading-system> (Downloaded: 15 September 2022 10:52)
- Li, F., Zhang, D., Zhang, J., & Kou, G. (2022). Measuring the energy production and utilization efficiency of Chinese thermal power industry with the fixed-sum carbon emission constraint. *International Journal of Production Economics*, 252, 108571. DOI: <https://doi.org/jd9w>
- NOAA - National Oceanic and Atmospheric Administration (2019): Global Climate Report, URL: <https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/201912>
- Razzaq, A., Sharif, A., An, H., Aloui, C. (2022). Testing the directional predictability between carbon trading and sectoral stocks in China: New insights using cross-quantilogram and rolling window causality approaches. *Technological Forecasting and Social Change*. 182, 121846. DOI: <https://doi.org/jd89>
- Rimkus, A., Matijošius, J., Bogdevičius, M., Bereczky, Á., Török, Á. (2018). An investigation of the efficiency of using O₂ and H₂ (hydroxide gas-HHO) gas additives in a ci engine operating on diesel fuel and biodiesel. *Energy*. 152, 640–651. DOI: <https://doi.org/gdnhsb>
- Rocha, P., Das, T. K., Nanduri, V., & Botterud, A. (2015). Impact of CO₂ cap-and-trade programs on restructured power markets with generation capacity investments. *International Journal of Electrical Power & Energy Systems*, 71, 195-208. DOI: <https://doi.org/jd9v>
- Szabó, M., Szalmáné Csete, M., Pálvölgyi, T. (2018). Resilient regions from sustainable development perspective. *European Journal of Sustainable Development*. 7(1), 395–411. DOI: <https://doi.org/hfrf>
- UNFCCC – United Nations Framework Convention on Climate Change (1997). Kyoto protocol. URL: http://unfccc.int/kyoto_protocol/items/2830.php (accessed on 15 Sept 2022).
- UNFCCC – United Nations Framework Convention on Climate Change (2015). Paris agreement. URL: <https://heionline.org/HOL/LandingPage?handle=hein.journals/intlm55&div=46&id=&page=>
- Zöldy, M. (2019). Improving heavy duty vehicles fuel consumption with density and friction modifier. *International Journal of Automotive Technology*. 20(5), 971–978. DOI: <https://doi.org/f9ws>