6th World Conference on Climate Change

September 02-03, 2019 | Berlin, Germany

Posters

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"Metha-Cycle": Methanol cycle for storage of renewable energy

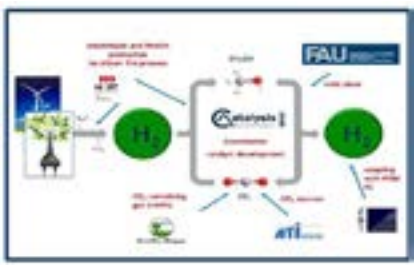
Anastasiya Agapova, Henrik Junge and **Matthias Beller**
Leibniz Institut für Katalyse, Germany

Here we present the renewable energy project "Metha-Cycle". The aim of this project is the technological development of energy and hydrogen storage in methanol. This technology also enables the carbon dioxide based chemical storage of renewable energies as well as a decentralized supply of energy and hydrogen.

Statement of the Problem: The concept of "hydrogen economy" in the renewable energy field is an attractive developing topic, since hydrogen is being viewed as environmentally benign energy carrier. Storage of hydrogen is a challenge, because its liquefaction is rather costly and has its challenges. That is why the chemical storage of hydrogen in liquid organic compounds and its release on demand is currently in focus. Presently there are many systems under investigation (formic acid, methanol, LOHC). Methanol, having high gravimetric and volumetric hydrogen content under ambient conditions and long term stability, is viewed as very promising for this purpose.

Methodology & Theoretical Orientation: The aim of the project is the technological development of energy and hydrogen storage in methanol via CO_2 neutral cycle. The aim of the LIKAT sub-project is the development of suitable catalysts for hydrogen production. The obtained data and catalysts should serve as the basis for operation of a miniplant in FAU Erlangen-Nurnberg. The aim of ZBT Duisburg subproject is the development of a polymer electrolyte (PEM) fuel cell system for the efficient conversion of H_2 produced from MeOH while simultaneously providing the reaction enthalpy necessary for the catalytic splitting of methanol. A second focus of the LIKAT subproject is the development of catalysts for low-temperature methanol production by direct hydrogenation of CO_2. The aim of HOST subproject is a modular simulation of the entire system of methanol production and reconversion by wind and solar power. The present interdisciplinary project enables indirect storage of wind energy in the form of methanol, and further methanol conversion into electrical energy via low-temperature hydrogen release in a fuel cell.

Findings: For LIKAT subproject we report an improved bi-catalytic system for methanol dehydrogenation, using two ruthenium-based PNP pincer complexes at mild conditions (TON > 17000). The proposed system exhibits synergistic activity under significantly reduced base amount. For low scale reaction at least 120 h of continuous hydrogen generation is achieved with good product selectivity.



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7. P. Sponholz, D. Mellmann, H. Junge, M. Beller. Towards practical setup for hydrogen production from formic acid. ChemSusChem, 2013, 6, 1172

Biography

Anastasiya Agapova graduated from Lomonosov State University with chemistry degree. She is working now in Leibniz Institut für Katalyse (Rostock, Germany) on her PhD thesis in the group "Catalysis for Energy" under supervision of Prof. M. Beller.

Notes:

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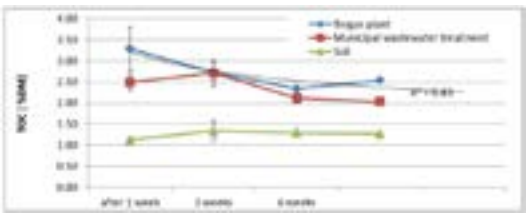
Carbon sequestration in the soil fertilized with digestate as a method of mitigating the CO2 emissions

Katarzyna Wójcik Oliveira
Lublin University of Technology, Poland

The currently observed increase of the CO_2 concentration in the atmosphere contributes to the global warming. Carbon sequestration is one of the ways to mitigate the CO_2 emissions to the atmosphere. Soil can play a significant role in carbon retention and reduction of the greenhouse effect. On the other hand, soils especially degraded ones and that used as agricultural land require fertilization. One of the method of improving the fertility of the soils involves using the organic waste, which can be a valuable source of nutrients and has a positive effect on the physical and physicochemical properties of soils. The effect of digestate properties on carbon fate in soil were the aim of the study. The pot experiment with using slightly acid soil (pH 5.6) and two types of digestates: (a) from the biogas plant and (2) the anaerobically stabilized sewage sludge from a municipal wastewater treatment plant were conducted. The digestates were added to the soil in doses that increase the initial carbon concentration to 2% dry weight, and the pots which included the soil-waste mixtures and soil alone (as control sample) were incubated at 20°C for 60 days in thermostated chamber. During the experiment the soil samples (in three repetitions) were taken four times, after the 1st, 3rd, 6th and 9th week. The significant decrease of organic carbon content were observed until the 6th week, and then the carbon content was stabilized. In the soil without amendments, the content of organic carbon did not change significantly.



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4. Wójcik Oliveira K. and Niedbała G., Mitigation of greenhouse gases emissions impact and their influence on terrestrial ecosystem, IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE (EES), ISSN: 1755-1315, w: Earth and Environmental Science, 8th International Conference on Future Environment and Energy (ICFEE 2018), Phuket, Thailand, January 10-12, 2018, s.151-155.

5. Pawłowski L., Cel W. and Wójcik-Oliveira K., Sustainability aspects of biofuel production, IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE (EES), ISSN: 1755-1315, w: Earth and Environmental Science, 8th International Conference on Future Environment and Energy (ICFEE 2018), Phuket, Thailand, January 10-12, 2018, s.190-195

Biography

Katarzyna Wójcik Oliveira is a PhD student at Faculty of Environmental Engineering of Lublin University of Technology. She graduated from Environmental Protection at Lublin University of Life Science and from Soil Science at UNESP, Brazil. Her areas of interest include global warming, Earth science, climate change, CO_2 capture and sequestration. The goal of her research is to study the impact of environmental factors on retention and transformations of carbon in the soils fertilized with post-fermentation waste.

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Assessment of technical efficiency and carbon footprint of spring barley cultivation in Poland

Tomasz Żyłowski
Institute of Soil Science and Plant Cultivation (IUNG-PIB), Poland

Introduction: Ensuring food security while reducing adverse environmental impact is the main goal of sustainable agriculture. Effective use of agricultural inputs, such as: fertilizers, biocides, fuel, seeds can reduce the impact of cultivation on the environment by limiting greenhouse gases (GHG) emissions. The purpose of this study is to evaluate the efficiency of spring barley cultivation in Poland to indicate the reasons for its inefficiency and to assess the possibility of the carbon footprint (CF) reduction potential.

Methodology & Theoretical Orientation: Survey data from 113 farms cultivating spring barley in season 2015/2016 were used. The joint application of CF and Data Envelopment Analysis (CF+DEA) 5-step method was applied to assess eco-efficiency. The carbon footprint of the crop cultivation and its reduction potential for inefficient farms were estimated. Fractional Regression Model (FRM) was used to explain how farm specific variables (structural and environmental factors) influence efficiency of spring barley cultivation.

Findings: The results revealed that the average values of technical, pure technical and scale efficiency scores were 0.72 (± 0.20), 0.80 (± 0.19), 0.91 (± 0.13), respectively. The fully effective farms consume less mineral fertilizers (N–43%, P–10%, K–21%) and fuel (15%) than inefficient farms having 19% higher yield level. The cultivation of spring barley results with average CF of 2484 (± 1516) kg CO_2e ha^{-1} The economic size of farm, cultivated area, soil quality and annual rainfall significantly affect the results of technical efficiency.

Conclusion & Significance: The results indicate that the improvement of spring barley cultivation technology through the effective use of inputs, especially mineral fertilizers, could lead to reduction of carbon footprint in its cultivation by an average of 32%, which leads to reduction of greenhouse gas emissions by 744 kg CO_2e ha^{-1}.

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1. Biograce (2015) Biograce – complete list of standard values, Version 4 public to harmonise European GHG calculations,
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3. Ramalho E. A., Ramalho J.S., Henriques P. D. (2010) Fractional regression models for second stage DEA efficiency analyses. Journal of Productivity Analysis 34 (3): 239-255. DOI: 10.1007/s11123-010-0184-0.

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Biography

Tomasz Żyłowski is a researcher at Department of Bioeconomy and System Analysis (Institute of Soil Science and Plant Cultivation – State Research Institute) in Pulawy, Poland.

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Accepted Abstracts

Climate Change 2019

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The where, who and what of sustainable cacao for livelihood, life and land

Alyssa Jade McDonald – Baertl
University of Sydney, Australia

Statement of the Problem: Weaving cacao agriz-zones and climate change, together with the politics of farmer adaption and family health, this research brings an interdisciplinary (plant pathology, public health and business) approach to upskill farmers in a way that is truly sustainable for their land, wealth and health directly citing latest research from case studies in Bougainville, and Sulawesi. Where – The biggest contribution to carbon footprint of a chocolate bar comes from the farming, which echoes IPCC reports tracing agriculture as responsible for up to 29% of green-house gas emissions. The need to collaborate between science and farming for a new way forward in conservation agriculture is called for and there is opportunity for agri-zone specific site-level climate adaption planning and training with farming. Who - Addressing a farmer's pain-points and their ability to make a sustainable living income is vital and although farmers have been very adaptive to earth's evolutions in the past, there is evidence to suggest that there is an unprecedented rate of change, as well as reducing cacao yields.

Methodology & Theoretical Orientation: Literature review and case studies from latest interventions in Bougainville Papua New Guinea, and Sulawesi Indonesia.

Findings: Conservation agriculture in cacao has four surprising opportunities to meet these challenges and resolve other challenges at the same time. 1) Agroforestry which from diversity creates new income sources, as well as improved soil nutrition and lower carbon footprint. 2) Unique projects have shown how cacao can contribute to post-conflict resolution and 3) contribute to the measures outlined in the Sendai Framework for risk reduction.

Conclusion & Significance: As cacao yield decreases, yet financial investments increase, cacao farmer training needs to have impact-criteria meeting health, wealth and land care objectives for livelihood, land, life and learning. These key criteria are outlined in the result.

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Global warming and the role of exogenous shocks in enhancing international cooperation: Are we there yet?

Anna Malova
University of Glasgow, UK

Statement of the Problem: There are several well-established facts in the literature on climate change. First, is that international agreements are not able to sustain high levels of participation and deep emission cuts at the same time. Second, with appropriate use of sticks and carrots, they are. Third, that by deterring non-participation, we deter non-compliance as well. Fourth, from the story of the Montreal Protocol it follows that when necessary, countries can cooperate on the Pareto-efficient outcome of the underlying game. Lastly, climate change poses an existential threat to humanity, and we do not have much time left to stop. Now, we nonetheless observe suboptimal levels of individual abatement and modest levels of cooperation. Thus, the purpose of this study is to establish the role of unilateral actions in the solution of the collective problem of climate change and to investigate whether external shocks can increase international cooperation.

Methodology & Theoretical Orientation: Using game-theoretic approach, I build a model which incorporates uncertainty in the form of damages from the natural disasters that have a certain probability of occurring and can be altered by the levels of players' abatement.

Findings: There are three major finding. (i) No IEA will be stable unless it requires unilaterally chosen levels of abatement; (ii) time-inconsistent players tend to procrastinate, but under certain values of parameters can turn into time-consistent due to higher perceived probability of future damages; (iii) time-consistent players can, on the contrary, become time-inconsistent and deviate from transition to business-as-usual over time.

Conclusion & Significance: External shocks will have no effect on the chosen abatement levels unless politicians exhibit some form of statistical biases when estimating the probability of future damages. To increase global abatement, it is necessary that countries unilaterally set more ambitious targets, otherwise free riding and non-compliance are unavoidable.

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User friendly R-code for data extraction from GCM and RCM outputs

Burak O. Akgun, Buket Mesta and Elcin Kentel
Middle East Technical University, Turkey

Statement of the Problem: The trend in the climate parameters in the last decades and the climate change (CC) modeling projections indicate potential changes in climate and connected environmental parameters which are expected to create adverse impacts on Earth System. As CC related risks become more apparent relevant studies gain higher pace. Research on CC impacts significantly depend on availability of the data. Climate model outputs are commonly used in further numerical analyses and as inputs for successive modeling studies such as hydrologic models. The outputs of Global and Regional Climate Models (GCMs and RCMs) are generated in NetCDF file format and available online in this format for researchers' download and utilization in open-access databases of ESGF (Earth System Grid Federation), CORDEX (Coordinated Regional Downscaling Experiment) and similar. However, even for regional domains four dimensional data (spatial and time dimensions) of long horizon climate simulation outputs necessitate working with very large size files in NetCDF file format which is not suitable to be processed by other type of data processing and modeling programs. Hence, researchers are facing problems in extracting specific data for their temporal and spatial focus from these files. Although there are already some commercial and non-commercial software and computer programming codes to extract desired data from these datasets most of them necessitate familiarity with various computer languages, thus are not easy to use. Here, we developed a simple efficient R-code to extract data from GCM and RCM outputs.

Methodology: Based on the spatial and temporal characteristic of the NetCDF file, an R-code is developed. The "ncdf4" and "openxlsx" packages are used in the code.Outcomes: Using the developed R-code time series data of climate parameters can be obtained in Microsoft Excel format suitable to be used in further hydrological modeling by relevant software (e.g. HEC-HMS). Extracted data can also be used for further multimodel ensemble analysis of climate model outcomes for selected local focus area by the use of relevant data processing tools.

Conclusion & Significance: The user-friendly R-code code is public and provides timesaving for all end-user researchers from various fields that utilize the open-access data in ESGF and CORDEX databases. The structure of the developed R-code enables researchers to easily extract data from a series of NetCDF files in Microsoft Excel format. A video explaining "How to use the R-code" is prepared and shared together with the R-code.

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Influence of rising sea levels on Venetian tourism and culture

Caroline Hogan
Berkshire School, USA

Venice has been sinking for centuries, and as sea levels have risen exponentially, the sinking city has drawn more attention. The damages to infrastructure are focused on in the news, but the cultural damage of this sea level rise is often overlooked. The sudden increase in the rising sea level has led to an increase in tourism as tourists endeavor to visit Venice before significant physical damages to infrastructure occur. Additionally, this influx of tourists and the economic benefits that arise from tourism, along with the limited residential spaces available on the island have resulted in foreign (often temporary) residents supplanting native Venetians. While the benefits of tourism provide immediate economic resources for the city of Venice, ultimately tourism has resulted in an inauthentic Venetian culture that appears to be more performative rather than genuine. In this paper, I argue that while the damages to Venetian infrastructure are important, the intangible damage rising sea levels have had on the Venetian population must be considered to fully understand and solve the problems faced by the city.

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Adapting to climate change in local health departments

Grace McClain
National Association of County and City Health Officials, USA

Environmental health impacts of a changing global climate include increased rates of asthma in children and adults, increased heat-related injury and death, displacement due to extreme weather events, mental health concerns, and other public health impacts. Local health departments (LHDs) are an important resource for community health, and accordingly should anticipate these effects. It is currently unknown how LHDs are currently serving communities in the context of climate and health, and demonstration sites organized by the National Association of County and City Health Officials (NACCHO) aim to support these efforts.NACCHO announced a request for applications to identify local health departments with intermediate experience in preparing for climate change. The program then provided grants to these selected jurisdictions for small projects to mitigate negative health impacts of climate change. Finally, an evaluation was conducted to describe how LHDs could support and improve the health of communities in the future. Demonstration sites were organized in collaboration with the Centers for Disease Control and Prevention Center for Climate and Health.

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Comprehensive review of chemical and mechanical degradation of well cement in Co_2 environment for Ccs operations

Priyesh Jani and **Abdulmohsin Imqam**
Missouri University of Science and Technology, USA

Statement of the Problem: Carbon capture and storage operations reduce emission of carbon dioxide into the atmosphere which has a large impact on the environment. Long-term storage of carbon dioxide in a reservoir depends on the degradation of Portland cement used to cast these wells due to carbon dioxide. The objective of this research is to provide a comprehensive review of past investigations to help understand the cement's degradation, the provided solutions to this problem and discuss a potential alternative.

Methodology: Tables were made with information about the types of cement, the curing conditions and the exposure conditions (experimental conditions) used in different studies and their conclusions. Tables comprised of experimental studies conducted on neat Portland cement and cement mix (Portland cement + additives) were included. Field studies were also discussed. Possible migration paths of CO_2 and exposure conditions that are likely to happen inside the reservoir were discussed. Quantitative data was extracted from these investigations to understand the structural changes after the exposure. Histograms were made from the data acquired to determine the most used type of cement, exposure condition and additive. The data were constructed to explain different curing and exposure conditions.

Findings: Data analysis shows that wide ranges of curing and exposure conditions made the comparison of structural changes impossible between the studies. However, the increase or decrease in porosity, strength, permeability and density of cement cores after CO_2 exposure, and alteration depths were compared. Mostly, researchers used class H and class G well cement with CO_2 saturated brine/water at static conditions. Flyash is found to be best known pozzolan and can be reliably mixed with cement to provide long term integrity in CO_2 storage operations. However, studies suggest that higher amounts of this additive have a negative impact on the cement mix for this environment. Flyash-based geopolymer cement was suggested to be used in CO_2 storage operations due to its environmentally friendly nature and higher durability in CO_2 environment than Portland cement.

Novel Information: The research provided a critical review about the past investigations, which became helpful in understanding the degradation process of Portland cement in a CO_2 environment and the behavior of additives. A new flyash-based geopolymer cement was proposed and discussed.

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The unattended role of wellbeing and equity in sustainability and climate change policies in Europe

Sonia Quiroga[1] and **Pablo Martinez-Juarez**[2]
[1]Universidad de Alcalá, Spain
[2]Universidad Autonoma de Madrid, Spain

Public effort on climate change policies has been growing in the last years in Europe, and with it, the attention put over its effectiveness, efficiency and impact over equity. One of the sources of problems is the excessive rigidness of top-down approaches. The development of a wide and diverse range of measures would ease the task of broadening the view and letting stakeholders to find solutions that fit best. Innovation is the key of this approach, but creativity in problem solving is discouraged. Identification of societal needs is also basic, as needs and resources will fluctuate throughout time. While biodiversity, ecosystem conservation or provisioning ecosystem services are highly regarded, some other indirect effects provided to society (e.g. cultural value) are often forgotten and this would explain the excess of attention that has been paid to policies such as grey infrastructures. While their positive impact as adaptive measures is undeniable, their cost efficiency may not be as clear as it should. Soft adaptation measures such as Ecosystem-based Adaptation has been showing encouraging results, even taking just into account their ability to fulfil their direct role. While clear and varied objectives are important, unexpected benefits arising from different measures, or co-benefits, must also be considered. Co-benefits from ecosystem improvement and conservation may affect wellbeing and health. Green environments have been associated not only with stress reduction, but also with lower prevalence rates in different illnesses and health problems. It has also been suggested that green neighborhoods reduce health inequalities, providing better health to both high and low income areas, but improving health conditions more strongly in economically deprived areas. This subject will be of growing importance as climate change affects the income structure and there is still much to be analyzed on the potential reduction of socioeconomic inequalities through environmental policies.

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Compositional analytics for GHG, SOX, NOX from industrial flaring- know before you can act

Swapan Saha
Mannat Technologies, UAE

Statement of the Problem: Oil & Gas Industry and Energy sector has a prominent role to play in achieving sustainable, viable and doable GHG reduction to meet the UN Sustainable Development Goals. Approach towards establishing a rule-based quantification of GHG, SOX, NOX and other pollutants are diverse, and its accuracy is often questionable. It is also observed that regulatory approaches vary from region to region and country to country. Global data for flaring is based on Satellite Data or Company furnished date or other estimates. NOAA statement says that global flaring reporting based on Satellite passing by may not capture the flaring as some flares don't burn hot enough to be included in NOAA dataset, they may not have been burning when the satellite passed overhead, the flare may not be frequent enough to make it past the 3 detection threshold, heavy clouds may have obscured the flare from the sensor, etc. GHG, SOX, NOX can be established when composition of the flared gas is known. All other estimations will have its own errors. Even though it is widely thought that everything that is flared is GHG or pollutant; it is not true. Flared gas may contain Nitrogen, Steam, other components which are not GHG and have no negative impact on atmosphere. Also, it is a misnomer that everything is burnt in flare produces CO2 and combustion efficiency is always 100%. Combustion efficiency varies widely based on flare design, types of gas flared and many other factors which are not always reported out. Unburnt components would have different effects to atmosphere (e.g. unburnt Methane, Ethane, Propane, BTX, etc.) Industry need proven, accurate, technically feasible and commercially viable method to determine realistic GHG, SOX, NOX reporting; both in company level as well as country level. This paper provides practical insight and systematic approach in moving from current state to Best in Industry Sector and further to Best in Class in determining GHG from flaring. This method will lead to focused and system-based technology deployment and operational adjustment to avoid, minimize flaring which is auditable.