

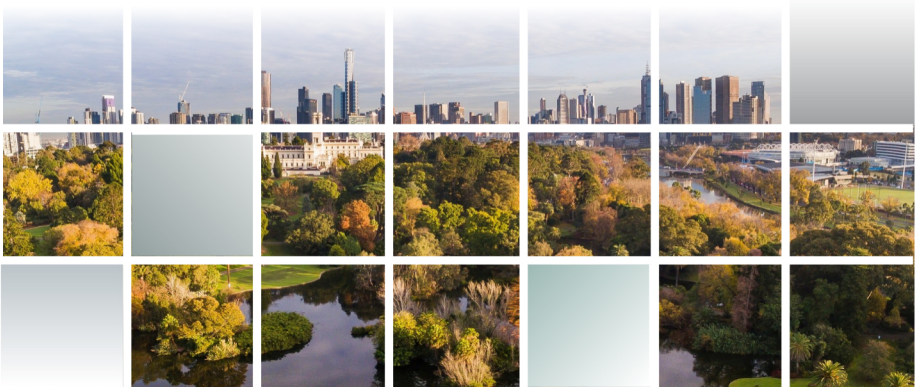


“TOWARDS SUSTAINABLE
ENERGY–WATER–FOOD NEXUS:
THE CONTRIBUTION OF A CLEANER PRODUCTION”

Advances in Cleaner Production CONFERENCE PROCEEDINGS

Melbourne - Australia - May, 26th - 2020

ONLINE WORKSHOP



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Educación a Distancia (UNED)	LLC.
Universidade de la Costa	VITO
Universidade do Rio Verde	Zimbabwe National Development
Universidade do Sul de Santa	Centre
Catarina	
Universidade Federal do Ceará	
Universidade Federal do Espírito	
Santo	
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Pernambuco	
Universidade La Salle	

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Alexis Sagastume Gutierrez

University of the Coast - Colombia

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Sussex University - UK

Saleen Ali

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RMTI University - Australia

Gregory Trencher

Tohoku University - Japan

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Special thanks are addressed to **Yugo Okida (in memoriam)**, the Vice-Rector of Post Graduation and Research of Universidade Paulista, **Dr. Marília Ancona-Lopez**, the Vice-Rector of Graduation of Universidade Paulista, and to **Dr. Marina Soligo**, Main Coordinator of Post Graduation and Research of Universidade Paulista, for their unconditional support.

Special Welcome Message

On behalf of the Organizing Committee, I am honored to welcome all participants and to express our greatest appreciation to the authors for the important works presented in this edition of the International Workshop on Advances in Cleaner Production.

The 9th IWACP, International Workshop on Advances in Cleaner Production, was planned to take place in Melbourne. However, the global health conditions have placed our community into a new challenge.

This event is a proof of the resilience and power of the research community to overcome the extraordinary world situation that we live in 2020.

The community that works with sustainability and development issues shows competence. Congratulations!

The extensive program, the representative number of participants, the quality of the conferences and contributions allows this event to be considered an academic success.

This is the consequence of the contributions from several colleagues spread across different parts of the world. Colleagues who have worked for several years in different types of institutions: academic, business and government.

You are responsible for the size and quality of the International Workshop on Advances in Cleaner Production.

My special thanks to Professor Linda Hancock, Prof. Linda Wollersheim, and Team. Without your special and competent support, this event would not have occurred.

I also hope that you will continue to contribute to the advancement of cleaner production and sustainable development.

Welcome!

General Chair and Founder

Biagio F. Giannetti – Paulista University (UNIP) - Brazil

Presentation

The "**International Workshop on Advances in Cleaner Production**" is a multi/interdisciplinary forum for the exchange of information and research results on technologies, concepts and policies based on Cleaner Production and conceived to assist the desired transition to a sustainable society.

Cleaner Production is a concept that goes far beyond the simple pollution control. It includes research and development of new processes, materials and products directed to promote the efficient use of resources and energy. Prevention must be the first approach of governments and corporations concerning sustainable development, and for this, environmental friendly strategies allied to economical robustness of products and services must be assured.

The adoption of Cleaner Production by governments, companies, and universities is getting speed with technical assistance and training programs, but it is worthy of attention that all these initiatives, even if implemented by all governments and corporations, do not guarantee the achievement of sustainable development. There is still a lack of a science, and consequently of a consolidated engineering devoted to the sustainable development.

Objectives

*The "9th International Workshop on Advances in Cleaner Production" is an international forum to be held **ONLINE** in May 26th, 2020 in Melbourne, Australia. The "9th International Workshop: Advances in Cleaner Production" aims to promote:*

1. The exchange of academic information;
2. The presentation of recent achievements;
3. The discussion of common problems and their possible solutions;
4. The contact among academic knowledge and corporative experiences;
5. The discussion of the event's theme "**Towards Sustainable Energy-Water-Food Nexus: The Contribution of Cleaner Production**".

Researchers interested on Cleaner Production and Sustainable Development are invited to submit papers. Authors devoted to correlated themes are also welcome

Program

Available on May 26th, 2020	
<p style="text-align: center;">Welcome Speech</p> <p style="text-align: center;">Julie Owens Deakin University</p> <p style="text-align: center;">Fethi Mansouri UNESCO and Alfred Deakin Institute for Citizenship and Globalisation</p> <p style="text-align: center;">Gordon Wallace Australian Research Council Centre of Excellence for Electromaterials Science</p> <p style="text-align: center;">Linda Hancock Deakin University</p> <p style="text-align: center;">Biagio Fernando Giannetti Paulista University-UNIP and Founding of ACPN</p>	<p>Special Keynote Speech Advances in Cleaner Production Awardees</p> <p style="text-align: center;">Zhifeng Yang Beijing Normal University</p> <p style="text-align: center;">Alexis Sagastume Gutierrez La Costa University</p>
<p style="text-align: center;">Keynote Speech</p> <p style="text-align: center;">Benjamin Sovacool Sussex University</p>	<p>Selected Oral Presentations</p>
<p style="text-align: center;">Plenary Presentations</p> <p style="text-align: center;">Saleen Ali University of Delaware</p> <p style="text-align: center;">Marilyn Brown Georgia Institute of Technology</p> <p style="text-align: center;">Maria Forsyth Deakin University</p> <p style="text-align: center;">Doug MacFarlane Monash University</p> <p style="text-align: center;">Adrian Panow Deakin University</p> <p style="text-align: center;">Susan Park University of Sydney</p> <p style="text-align: center;">Lauren Rickards RMIT University</p> <p style="text-align: center;">Greg Trencher Tohoku University</p>	

Special Keynote Speech

Advances in

Cleaner Production Awardees

China-US: Integrated Systems Modeling of Food-Energy-Water (FEW) Nexus for Urban Sustainability

Zhifeng Yang
Beijing Normal University - China

Food, energy and water are three essential resources for human society, but are faced with growth in demand and limited supply. Cities are critically important for advancing regional sustainable development and are thus placed at the center of the FEW nexus. In such context, we applied a project and got funded under the framework of international cooperation initiatives of China National Natural Science Foundation. The objectives of our joint project are: (1) Significantly advance our understanding of the urban food-energy-water system through quantitative and computational modeling; (2) Develop real-time interfaces that improve understanding of the behavior of urban FEW systems and increase decision support capability; (3) Grow the scientific workforce capable of studying and managing the urban FEW system. We mainly focused on clarifying the concept of FEW nexus, methods and the analytical framework. Secondly, the methods for instance LCA and MFA were used to analyze urban FEW nexus. After that, we explored the metabolic pathways and identified the influencing factors and adopted network analysis and system dynamic analysis to identify the network characteristics and reveal the mechanism. Finally, based on the above analysis, we tried to establish an integrated optimization model to search the optimal path of FEW supply and demand, and then provides some policy implications. This study will contribute to enhance FEW security and improve their utilization efficiency in a green urban economy and contribute significantly to the sustainable management of FEW resources.

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From Energy Efficiency to Cleaner Production. The need to Widespread Environmental Concern

Alexis Sagastume Gutierrez
University of the Coast - Colombia

Although small and medium-sized enterprises (SME's) are essential to the economic performance of most countries, their environmental performance is frequently invisible to environmental agencies that mostly focus on large companies. In SMEs, studies mostly address energy consumption while overlooking other non-energy benefits. This study combines the plan-do-check-act system for energy management with the cleaner production assessment methodology to link non-energy benefits to energy consumption, aiming at introducing the wider approach of cleaner production within an energy audit to SMEs. The results show higher efficiency standards in the use of water and raw materials, linked to a significant reduction of energy consumption in the production process.

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Webinar

Conceptual Frameworks and New Frontiers in Energy Justice

Benjamin Sovacool
Sussex University - UK

This presentation explores how concepts from justice and ethics can inform energy decision-making and highlight the futurity, fairness, and equity dimensions of energy production and use. It defines "energy justice" as a global energy system that fairly distributes both the benefits and costs of energy services, and one that contributes to more representative and inclusive energy decision-making. Such an assessment brings together core understandings of distributional and procedural justice alongside cosmopolitan interpretations of equity and recognitional notions of fairness. The presentation then focuses on six new frontiers or fruitful areas of future research. First is making the case for the involvement of non-Western justice theorists. Second is expanding beyond humans to look at the Rights of Nature or non-anthropocentric notions of justice. Third is focusing on cross-scalar issues of justice such as embodied emissions. Fourth is identifying business models and the co-benefits of justice. Fifth is better understanding the tradeoffs within energy justice principles. Sixth is confronting utopian or falsely constructed justice discourses. In doing so, the article presents an agenda constituted by 30 research questions. It argues in favor of "justice-aware" energy planning and policymaking, and it hopes that its (reconsidered) energy justice conceptual framework offers a critical tool to inform decision-making.

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Plenary Presentations

The Energy Budget of Large-Scale Land Acquisitions: The Potential role of Cleaner Production in Mitigating Climate Impacts

Saleen Ali
University of Delaware - USA

Modern food systems are heavily dependent on fossil fuels and currently consume 30% of the world's energy of which 10% occurs at the farm level. Around 2% of world energy use is dedicated specifically to the industrial manufacture of reactive nitrogen (Nr) products mainly through the Haber-Bosch process, so that Nr prices are closely coupled human needs since the 19th century. The 18th-19th century agricultural and industrial revolutions laid the foundation for exploitation of mined sources of N and P, and for development of the Haber-Bosch process, where energy is used to convert otherwise unreactive atmospheric di-nitrogen (N₂) into reactive nitrogen (Nr) compounds. Much of the growth of intensive food production is happening in major private land holdings being acquired in developing countries. Considering recent data on large land acquisitions from the Land Matrix dataset, this presentation will consider how a shift to natural fertilizer usage could mitigate the overall energy input from this sector, suggesting directed policy action at the land acquisition stage. This research project is part of a U.S. National Science Foundation Socio-ecological Synthesis Center grant that is currently underway on the Great Agrarian Transition.

First Mover Advantages Amid a Clean Energy Boom

Marilyn Brown

Georgia Institute of Technology – USA

Global energy-related CO₂ emissions are likely to continue to grow post-Covid-19. IEA forecasts that they will reach nearly 36 Gt annually by 2050. U.S. emissions have also been growing; at the same time the country is projected to become a net energy exporter in the next few years, for the first time since 1953. With the price of natural gas so low, it is difficult to reset the energy system. But across the globe and in pockets of the U.S., energy is on the verge of a complete makeover. Revamping electricity grids, restructuring energy networks, reengineering energy systems—all represent stellar economic opportunities for first-movers that can secure early market shares of clean energy. Using a systematic and replicable methodology, the Drawdown Georgia Project has identified 21 high-impact solutions that can move the state of Georgia toward carbon neutrality over the next decade. The short list includes solar farms and community scale solar, demand-side response, retrofitting buildings, electric vehicles, alternative mobility, afforestation, silvopasture, plant-rich diets, and reducing food waste.

Electrochemical Energy Storage - Beyond 2020

Maria Forsyth
Deakin University - Australia

Renewable energy technologies are making increasing inroads globally given the imperative of reducing carbon emissions. Over one quarter of the world's electricity supply is generated by renewables already, and this is set to continue to rapidly increase in many countries, including Australia. Whilst fossil fuels are likely to continue to have a role in energy generation, the other generation technologies including wind, solar, wave etc, are variable sources and dependent on day/night, weather, seasons etc. It is therefore accepted that energy storage must exist hand in hand with renewables. This storage can be based on water, chemical and electrochemical. Each of these must, and will, play a role in the future. The ideal storage method will depend on a given situation; whilst pumped hydro is perfectly suited to certain geographical features and hydrogen (in the form of H₂ or NH₃) is an exciting opportunity in particular for export, electrochemical energy storage – i.e. batteries – will still play an important role. This is in particular true for more remote areas where extended infrastructure does not yet exist and the cost of establishing and maintaining such infrastructure is uneconomical, It is also true for distributed systems where customers want more control over their energy supply, for example in cases of individual, self-sufficient homes or industries or even communities on a micro grid. Batteries will play a role in future energy security. Moreover, more than one battery chemistry is already available and more are set to hit the market. Again, different applications call for different technologies. As an example, cold climate versus hot humid conditions could be better suited to different chemistries. At present the main commercial offerings include various types of Li ion, Vanadium flow, Zinc Bromine, Lead acid. Increasingly we see Sodium (Na) ion start-ups showing the potential of replacing LIB with NIB. Ni/Zn, Ni/Fe are also examples of other possible chemistries either already available or being considered. The landscape is vast and no doubt confusing to the consumer. The choices made will depend on availability and cost in the short term. This is why LIBs have made such a push to power everything from personal electronics, to EVs, powerwalls and even Grid support. But even with LIBs what is required for an EV (rate, energy density, safety) and what one needs for a micro grid, or load levelling the grid, or for backup power for your solar panels, could well do with different chemistry. LIB batteries based on Nickel and Cobalt chemistries (such as NMC or NCA) are good when higher energy storage for EVs is required but possibly not necessary for stationary applications. LFP chemistry

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is currently more expensive up front but offers longer life and higher safety and hence might be better suited for the latter applications.

And let's not forget that the technologies we opt for will themselves have a ramification for society. We must also consider end of life, circular economy and ethical supply principles when choosing an energy storage technology for larger scale applications. If LIBs were used for every energy storage application then we would also run in to criticality of supply. Na and flow battery technologies certainly offer a more sustainable, and ultimately less expensive, option for larger scale storage and other applications where the highest energy density offered by some Lithium technologies is not mandatory. Significant research is still needed to develop the alternative technologies as well as develop sustainable methods for existing and future technologies. An overview of current and future technologies and Australia's possible role in these will be discussed.

Towards the “Ammonia-Economy”

Doug MacFarlane
Monash University - Australia

One of the options that is emerging as a potential energy source of the future is ammonia. Generated from renewable energy sources, especially in those parts of the world where solar and wind energy are plentiful, ammonia becomes the ideal transportable store of energy. Currently it is seen as the ideal way to transport hydrogen energy around the planet from ideal generating regions to centres of population; at destination port it can be converted back into hydrogen. But, ammonia itself burns like kerosene and is safer to use in many contexts than fossil fuels. Cars, buses, trains, even jet engines and power generation are all possible with ammonia as the fuel. So, what has been seen as our evolution towards the hydrogen economy is now becoming a stepping stone towards the “Ammonia Economy”, wherein our main fuel for almost every purpose is ammonia. This presentation will provide an overview of the developing technology around ammonia and its potential applications. We will also take a careful look at the impact of a vastly increased use of ammonia on the global nitrogen cycle. Clearly, we don't want to repeat humankind's mistakes with carbon and carbon dioxide, and the need for greater understanding of these global cycles is highlighted.

The Deakin Waurn Ponds Microgrid

Adrian Padow
Deakin University - Australia

Deakin University (Victoria, Australia), in collaboration with Mondo Power is constructing the largest on-campus microgrid system and research platform in Australia at the University's Waurn Ponds Campus. The initial infrastructure includes 7.25MW of solar generation, over 1MW/1MWh battery storage and real time links with a new research, teaching and visualisation centre which will be instrumental in training the next generation of energy professionals. A unique feature of the Waurn Ponds campus is that buildings occupy a small proportion of the 328 hectares of land. This has provided significant flexibility in configuration of the microgrid, including a ground mounted 7MW single axis tracked solar array. The first phase of the project will deliver approximately half of the 21GWh/year electricity consumption of the campus. Future development includes novel energy generation and storage technologies such as a variety of battery configurations and hydrogen. Maximising generation capacity to stabilise energy costs, improving emissions performance and smoothing campus demand whilst supporting a broad range of research was considered with great care during infrastructure specification and market engagement. The presentation will provide an update of the project and describe the pathway through planning, construction and operation.

Protecting Environmental Rights through International Grievance Mechanisms?

Susan Park
University of Sydney - Australia

This conference discusses the activities of the Independent Accountability Mechanisms (IAMs) of the Multilateral Development Banks (MDBs) within the broader literature on International Grievance Mechanisms and whether they can be used to achieve procedural environmental rights and the rights of nature. International Grievance Mechanisms are increasingly common means to attempt to rectify harm as a result of international interventions in developing countries by states, corporations, international organisations, and industry bodies including multi-stakeholder initiatives. This podcast analyses the different standards International Grievance Mechanisms use to provide access to justice, most notably the United Nations Guiding Principles, and the environmental and social protection standards promulgated first by the World Bank. I identify three procedural environmental rights within the standards: access to information, access to participation, and access to justice in environmental matters, in addition to referencing specific environmental protections. This matters because claimants seek recourse for failures to uphold their procedural environmental rights: a lack of access to information and a lack of access to participation. They also seek recourse for the rights of nature independent of their reliance on it. This is evidenced by a content analysis of 394 publicly available original grievance claims submitted to the IAMs up to the end of 2018. The chapters examine how the IAMs provide access to justice in environmental matters through two processes: 'problem solving' which is a form of alternative dispute resolution, and 'compliance investigations' that identify whether the harm resulted from the acts or omissions of the MDBs. Using a database of 1,052 claims to the IAMs over the course of their existence (Park 2019), the chapters detail how they provide recourse for environmental and social harm within the confines of international development financing.

Beyond Physical Flows to Cultural Complexities in Nexus Thinking: The Case of Biosolids-to-Biochar Transformation

Lauren Rickards
RMIT University - Australia

At the heart of the water-energy-food nexus is agriculture. Nexus thinking about agriculture has helped illuminate multiple systemic flows that exist between agriculture, water and energy and how these relate to climate change. Efforts to better link agricultural, water and energy systems include agricultural generation of renewable energy to lower greenhouse gas emissions and recycled water use in agriculture to improve climate resilience. Another complementary but overlooked linkage addresses the neglected and often long-distance flow between farms and water treatment generated by the consumption and conversation of food into human biosolid waste. This paper examines the potential to return such waste to agriculture in the form of biochar, which research suggests can boost agricultural soil health, reduce the need for energy- and emissions-intensive synthetic fertilisers and draw down atmospheric carbon. Combined with the way biochar-based management of wastewater sludge helps reduce greenhouse gas emissions and flood pollution risk, this means that making biochar out of human biosolids and using it in agriculture seems to be a no-brainer. However, scaling out biosolids-based biochar as a practical solution requires addressing risks exposed by other crucial and more open systems of the sort that reductionist nexus thinking, with its narrow focus on aligning physical flows, often overlooks. This paper outlines three complex and unpredictable “systems” that have to be taken into consideration if biosolids-based biochar is to become a real solution: the farming system, including farmers, external sources of advice available to them, and their continual weighting and negotiation of risks; the food system, including food safety regulators, food packaging, consumers, and the general public, for whom human biosolids are laden with meaning and risk; and the Earth system, including the soil microbes required to convert biochar into an agricultural resource and the nonlinear climatic feedbacks putting their sequestered carbon at risk. The paper concludes that, while an improvement on siloed thinking, nexus thinking itself is at risk of being irrelevant if it does not engage with the messiness of the social and nonlinear systems it inevitably collides with.

Developing and Diffusing Fuel-Cell Vehicles: Governance Strategies and Experiences in Japan

Gregory Trencher
Tohoku University - Japan

Numerous countries are promoting the diffusion of both Battery Electric Vehicles (BEVs) and Fuel-Cell Vehicles (FCVs) in attempting to accelerate the electrification of road transport. Both technologies hold unique advantages and disadvantages while also facing common barriers with regard to production and diffusion. Barriers may be classified into four categories: 1) supply-side (i.e. vehicle production), 2) infrastructure preparation (i.e. charging and fuelling), 3) demand-side (i.e. demand creation) and 4) institutional design. Relative to BEV literature, studies on FCV diffusion efforts are fewer. Also, while many studies highlight numerous barriers to the societal adoption of FCVs, knowledge on actual governance strategies to overcome these is lacking. In this presentation, I examine governance measures used by government and industry in Japan to accelerate the development and diffusion of FCVs. The above framework is applied to examine coping strategies employed, unresolved challenges and potential ways to overcome these. Data are sourced from expert interviews with government, industry and research institutes in addition to document analysis. Findings reveal robust measures to tackle supply-side and infrastructure challenges. Conversely, demand-side measures rely heavily on public subsidies and lack regulatory measures to stimulate vehicle demand. Also, institutional strategies to increase the pool of FCV makers are lacking visible outcomes. I conclude with several policy suggestions to overcome these unresolved challenges. : Gregory graduated from the University of Tokyo in 2014 with a Ph.D. in sustainability science. After spending two-and-a-half years at Clark University in the USA as an assistant professor he has been based at Tohoku University in Japan at the Graduate School of Environmental Studies as an associate professor since January 2017.

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Special Mentioned Papers

A Case Study from Austria: Material Efficiency Laboratory to Enhance Resource Efficiency in SMEs

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Abstract

The project "Material Efficiency Laboratory" was initiated in 2019 by the Austrian Ministry of Climate, Environment, Innovation and Technology to support pilot SME companies in increasing resource efficiency. As a result, a strategy to reach out to a large number of enterprises. "Resource efficiency" includes all raw and auxiliary materials, as well as the energy and water. At first, a tool was developed and a manual providing supporting information. The 47 questions address key elements of strategy, business models, management system, processes, products, and services. Secondly, 10 assessments were carried out with manufacturing companies from different sectors. The share of wasted materials ranged between 5% to 70% of material input. 10 to 15% of the waste could be avoided or recycled by awareness raising for optimum use of equipment, process control, better equipment, and recycling. The companies appreciated concrete suggestions and were open to discuss the use of alternative materials. Most of the companies were already using product-related services. A total of 87 measures were identified. A number of communication activities were carried out. Strategies were developed to further roll out resource efficiency to reach a critical mass. These strategies will be discussed in the full paper.

Keywords: *Austria, SME's, Material Efficiency Laboratory*

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Achieving Cleaner Production and Sustainable Industrial Development Goals through Effective Deployment of Concentrating Solar Thermal Technologies: Role of Providing Emission Reduction Credits

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Abstract

The climate changes due to the rapid increase in greenhouse gas emissions especially carbon dioxide is causing devastating impacts such as the spread of disease, extreme weather events, and increased food insecurity. These impacts are costing governments billions of dollars through rising health care costs, destruction of property, increased food prices, and more. The social cost of avoided carbon as an estimated net present value of avoided climatic damages should be provided to renewable, clean, and green energy technologies as an incentive to increase their techno-economic viability. As a case study, the impacts of different carbon reduction credit rates on the feasibility of concentrating solar thermal technology with a thermal output of 100 MW has been assessed in this research. The designed system is techno-economically assessed with and without providing carbon reduction credits varied from 0 to 60 USD/tCO₂. The results of the study revealed that the proposed project has the potential to reduce 612,272 tons of CO₂ annually and inclusion of carbon reduction credits increases the proposed system's techno-economic viability, significantly. The net present value increases by ~60% by the inclusion of 60 USD/tCO₂ as carbon reduction credits. The achieved results indicate that providing carbon reduction credits as an incentive to different emission free technologies will increase their techno-economic feasibility and help in achieving cleaner production and sustainable industrial development targets.

Keywords: *Cleaner Production, Solar Thermal Technologies*

Analyzing the path Towards Meeting Absolute Sustainability by Cross Investigation on Companies' Carbon Budget and Cost Figures: A Case of Gear Manufacturing in Automotive Industry

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Abstract

The automotive industry seeks to improve resource and operation efficiency and effectiveness, e.g. reducing process emissions. In the environmental impact and emission analysis context, greenhouse gas emissions are frequently used. Climate policies are introduced at different levels to reduce the environmental impact and stay within planetary boundaries. The first EU-wide climate law was proposed in 2019 to hit the net-zero carbon target by 2050. There is social pressure on industry for strict air pollution standards. Science-Based Targets (SBTs) are defined as a carbon budget to industrial sectors and companies as a cap to their environmental impact in line with the Paris Agreement. Climate policies have been used to restrain carbon emissions based on monetary measurements e.g. taxation and emission trading. Considering the polluter pays principle, this paper introduces a framework to investigate the operationalization of SBTs at the company level and its cost figures to analyse the effectiveness of carbon policies. It applies a gate-to-gate cost analysis to evaluate the environmental impact of gear production processes. The scope is limited to the global warming potential impact category based on CO₂ emissions. It uses the defined SBTs for heavy machinery and equipment industry based on a sectoral decarbonisation approach. It enables a company's sweet spot to ensure its profitability, meet its SBTs and pay an acceptable carbon tax. The results can support manufacturers to optimize their eco-efficiency, and assist climate policy makers to set effective carbon emission policies.

Keywords: *Science-Based Targets, Automotive Industry, Cross Investigation*

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Application of Quality Function Deployment to Green Hotel Design: Towards Water and Energy Efficiency

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-

Abstract

Hotels have been experiencing environmentally friendly pressure since customers are increasingly demanding for more hotel green attributes. Hence, hoteliers need to know which green attributes to employ, without jeopardizing the guests' satisfaction and service quality. The purpose of this paper is to study the application of the Quality Function Deployment (QFD) concept to green hotel design. It aims to identify green design features that integrate hotel customer's preferences and technical requirements. Data were collected using a questionnaire survey that included fifteen green hotel attributes and was distributed in Oporto city to both hotel guests and staff. The data from 396 valid responses were statistically analyzed using the software Statistical Package for Social Sciences (SPSS) and disposed on a relationship matrix with the technical requirements. Findings reveal that hotel end-users perceive as more important the attribute "Active system to detect and repair water leakage", followed by the implementation "Good sanitation practices". On the other hand, the "Change of bedsheets only upon request" and the "Use of low-flow toilets and sinks" were the least favorably perceived attributes. The House of Quality construction reveals that hotels should prioritize the implementation of a program of "Waste reuse and recycling" and "Use of energy efficiency techniques and technologies".

Keywords: *Quality Function Deployment (QFD), Statistical Package for Social Sciences (SPSS), Energy Efficiency, Green Hotel Design*

Assessment of Energy Storage Technologies in the Smart Grid

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Abstract

Electricity plays a crucial role in the energy supply of countries. Most of the primary energy sources for electricity generation are fossil fuels. However, limitations unbalance distribution, and environmental challenges related to fossil fuels have led policymakers and researchers to consider the utilization of alternative energy sources such as renewable energies. As using renewable energy resources become more popular, the transmission and distribution systems are also changing, in particular, the grid technologies. Smart grids are among the technologies that are developing both in R&D and implementation levels. Integration of the energy supply sources, growth of energy resiliency, and efficiency enhancement in the transmission and distribution systems are some examples of smart grid advantages. One of the essential challenges of smart grids is energy storage technologies, which have improved continuously. However, to have an integrated and robust smart grid, it is crucial to understand and identify the trends and future developments of storage technologies. In this research, first, the attractiveness and adaptation of energy storage technologies in smart grids are investigated. Then, technology lifecycle and adaptation trends are extracted based on the R&D attractiveness and market penetration. Afterward, by using the collected data, the position of each storage technology is outlined in the hype diagram. To verify the results of this research, they are compared with the technological readiness level of each storage technology. Also, the results are compared with the experts' opinions.

Keywords: *Smart Grid, Energy Storage*

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Business Operation Management Applied to Electric Scooter Recharging Industry

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Abstract

Recently, electric kickboard industry for single occupants has been booming toward the realization of environment friendly transportation of first-last mile. In order to survive the competition, each company needs kickboard charging method that minimizes the cost of collecting kickboards. The subject of this study is the resource operation method called Gig-economy that induces autonomous participation of temporary workers who are qualified for charging. Workers preempt kickboards that need charging through the app and are paid according to the number of kickboards collected and charged. This study proposes business models to increase the collection rate of kickboard and minimize the collection cost of company. Several operation concepts are introduced; whether to divide areas and assign workers to collect scooters only in that area, whether to group scooters to be collected in bundles, and whether to allow bidding for workers to express preference. It is shown that all suggestions give better profit to the company than the bass model and comparative analysis is done for profit change and profit per distance for workers. This study is expected to activate the electric scooter industries for lower carbon emission of transportation and give managerial insights for industries using Gig-economy for efficient management of resources.

Keywords: *Electric Scooter, Recharging Industry*

Carbon Footprint Evaluation of Coal Supply Chain in China: A Life Cycle Perspective

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Abstract

Coal is the cornerstone of energy system which is determined by China's energy structure and resource endowment. However, coal is a main source of carbon emissions and a major contributor to the greenhouse effect. Carbon emissions from coal supply chain would be noteworthy because it indicates the possibility of carbon emissions reduction. Based on a literature reviews on some related theories including life cycle theory, coal supply chain and carbon footprint and carbon emissions accounting methods, this study builds the carbon emission accounting models from coal supply chain by different coal-related products. Carbon emissions per unit economic value of various coal products are analyzed from the perspective of the whole life cycle. Finally this paper proposed some reasonable suggestions on reducing carbon emissions. The results show that coal-electricity is the biggest contributor to carbon emissions among all coal products from both the physical and economic perspectives and the coal mine gas is an important factor governing total carbon emissions in coal mining and washing process. Therefore, it's necessary to reduce the proportion of coal power and expand the scale of hydropower and wind power while develop clean production technologies for electricity vigorously. And gas capture technology is adopted to realize gas utilization.

Keywords: *Coal, Supply Chain, Carbon Footprint*

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Circular Economy Paths in the Olive Oil Industry: A Life Cycle Assessment Look into Environmental Performance and Benefits

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Abstract

Agricultural production is a sector with high socio-economic significance and key implications on employment and nutritional security. However, the environmental impacts of agrifood production and consumption patterns are quite significant, mainly due to the demand of large inputs of resources (fuels, chemicals, disposal of residues). The paper presents the results of an LCA based analysis of the production of olive oil in the Campania region of Italy. The aim of the study is to assess the energy and environmental impacts of an organic olive farm and olive oil production, in order to assess the contribution of each life cycle step to the energy and environmental impacts. All key parameters that are associated with the life cycle of olive oil production are observed and environmental "hotspots" are carefully analysed. In order to increase the sustainability of the process, also by-products conversion to a set of marketable products is assessed (chemicals, fertilizers, energy) and the potential of the entire direct and reverse chain is explored. The analysis is carried out according to the LCA standards of the ISO 14040-14044/2006 series. The study is based on a field analysis developed in representative farms and industries of Campania region and the data used for the development of mass and energy balances is related to the year 2018. Environmental impacts are observed at both sub-systems (cultivation of olive trees and olive oil production phase). Performance improvement options and additional efforts for valorisation of by-products are explored to minimize the impacts along the life cycle of the olive oil production.

Keywords: *Circular Economy, Olive Oil Industry*

Clean Mobility, Health and Environmental Education: Contributions of Urban and Peri-Urban Trails to Quality of Life in Municipalities

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Abstract

The big cities in Brazil, as well as in other parts of the world, have been growing in a disorganized way, in the sense of an appreciation of spaces for real estate expansion and a devaluation of public spaces for social uses and environmental conservation. The green infrastructure of the municipalities, be it urban, peri-urban or rural, can add quality of life to the population becoming an ally in the quality of life and well-being of the population. In this sense, this study aimed to analyze the infrastructure of urban and perurban trails that are already being used by the population in the municipality of Campinas in the state of São Paulo / Brazil, but still without public participation in their management. Initially, the trails were mapped, with the established routes varying from 1,700 to 11,000 meters. Three of these spaces are found in peri-urban areas with landscapes that vary between rural, forested and urban, one of which is located in a predominantly rural and an urban area. In this context, it is noteworthy that the trail that has the greatest infrastructure offered by the municipality has a greater number of visitors daily. Thus, it is worth emphasizing the importance of establishing research to support public policies that help municipalities to incorporate these spaces in their management. It is observed that, with little investment, digital technologies and creativity, these trails can generate direct benefits to the entire population, mainly in the matter of well-being and environmental valuation, in addition to contributing effectively to issues on climate change.

Keywords: *Clean Mobility, Urban and Peri-Urban Trails, Life Quality, Municipalities*

Development of an Urban Food-Energy-Water Nexus Model to Support Urban Planning

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Abstract

Steep emissions reductions are needed to achieve this goal reset in Paris Agreement to limit the increase to 1.5 °C by 2100. Current researches to meet the goal is dominated by supply-side CO₂ removal options, resulting in the neglect of demand-side. However, demand-side measures are also critical, especially the household sector. Firstly, direct and indirect household consumption contributes to 72% of global GHG emissions. And consumption-related GHG emissions from household sector keep increasing. Secondly, household sector can provide a short-term bridge to gain time for climate mitigation measures. Therefore, it is urgent to provide a new perspective to evaluate global household emissions reduction strategies. As three key subsystems, inextricable interrelationship existed among the food-energy-water (FEW) systems, synergistic management is critical to ensure the household CO₂ reduction. Nexus is an effective approach to provide solutions for the confusion. Hence, we aim to develop household FEW nexus dynamic models according to geographical and cultural characteristics for global cities to emphasize CO₂ mitigation through technological, behavioral or educational options on the household side. Different policies are considered to discover the best choice for global cities to reduce emissions to achieve the 1.5 °C ambition. This tool can provide long-term simulations from 2010 to 2050 to quantitatively estimate the potential emissions reduction of different diet patterns, household appliances and residential behaviors under possible management strategies. Some suggestions based on the simulation results are provided.

Keywords: *Food-Energy-Water Nexus, Global Warming*

Development of Photocatalytic Reactors for Water and Air Pollutant Treatment

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Abstract

The current rapid industrial development causes serious energy and environmental crises. Photocatalysis provides a potential strategy to solve these problems because these materials not only can directly convert solar energy into storable energy resources, but also can decompose organic pollutants under solar-light irradiation. This talk will cover our investigation on the synthesis-structure-property relationship of semiconductor metal oxide, and fabrication of the semiconductor catalyst-based reactors for practical application. The selected supporting materials to fabricate photocatalytic reactors so far include clay, graphene, nickle foam, melamine foam and nonwoven fabric. This talk will cover both the fundamental research and our practical on-site industrial trials, focusing on applying our developed materials for pollutant detection, water and air pollutant treatment. The ultimate goal is to develop efficient semiconductor photocatalysts for environmental remediation.

Keywords: *Photocatalytic Reactors, Pollutant Treatment*

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Green Jobs: An Ethical Alternative to Achieve a Low Carbon Economy

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Abstract

The world has been demanding at each new time cycle, work alternatives that allow the combination of human potentials and capabilities at the service of sustainable development and the decarbonization of business relations regarding ecosystem. Elaborated as a sustainable alternative, finding environmental protection and raising worldwide decent work, the Green Jobs emerge as an ethical solution in favor of a low carbon economy. The initiative developed by global entities such as the United Nations Environment Program (UNEP), the International Labor Organization (ILO), the International Organization of Employers (IOE) and the International Trade Union Confederation (ITUC), presents elements that raise the indispensability of discussions and the articulation between key contemporary concepts, in order to direct sustainable economic progress and social wellness. Therefore, the present work seeks to highlight initiatives that are moving towards a transition to a low carbon economy, based on economic activities that favor decarbonization. The research method is characterized as qualitative with documentary procedure. As a result, it is expected to point out how economic activities based on the green economy can generate new production forms oriented towards sustainable development.

Keywords: *Green Jobs, Low Carbon Economy*

How are Energy-Intensive Industries Affected by Carbon Tax? Case of Finnish Industries

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Abstract

Carbon Tax (CT) is one of the main policy tools of governments to decrease the level of greenhouse gas emission by managing fossil fuel consumption and encouraging renewable energy utilization. However, CT has consequences on the economy, industry, and social welfare of the countries, in particular for industry exporters with high energy-intensive structure. Currently, energy-intensive industries (EII) have a share of 53% of total OECD trades that is predicted to reach 60% in 2030. Therefore, while CT may affect the competitiveness of the industries and development plans in the future, it may change social welfare, economic indicators, industrial growth, and balance of trade that policymakers would not expect. Our research evaluates the effects of CT on an EII case country, Finland. Finland has a high dependency on fossil fuels imports, and its industrial structure is energy-intensive with dependency on product exports. We used a computable general equilibrium analysis method to show that a selected EIIs, including power generation, wood, mining, non-ferrous metals, iron, steel, and transportation, will be damaged by CT policy in Finland. Therefore, CT has not always a negative effect on the competitiveness of the EIIs, and industries such as other ferrous metals, textile, and leather industries are the winners of the competition in Finland.

Keywords: *Carbon Tax, Finland, Energy-Intensive Industries*

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How Green Marketing Can Help to Mitigate the Waste of Perishable Products

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Abstract

This study investigates how to reduce the Food Waste (FW) in the final links of food supply chains. In supermarkets, FW may be related to customer preferences (Göbel et al., 2015; Gollnhofer, 2017; Tromp et al., 2016), or problems with resupply (Aschemann-Witzel et al., 2017; de Hooge et al., 2018; Devin and Richards, 2018; Teller et al., 2018). In contrast, supermarkets can help mitigate their suppliers' FW. This mitigation may demand a reduction in the prices of products near the end of their validity - considering that humans can still consume these products (Aschemann-Witzel et al., 2015; Buisman et al., 2019; Filimonau and Gherbin, 2017; Teller et al., 2018). Price is one of the dimensions of Green Marketing (GM) that can increase the sale of items and sustainability (Dangelico and Vocalelli, 2017; Sharma et al., 2010), as well as the company's competitiveness (Mukonza and Swarts, 2020). Studies on GM in supermarkets focused on consumers' purchase intent (Goh and Balaji, 2016; Martínez et al., 2020). Despite the importance of GM to the FW mitigation, the other dimensions of GM still demand a better scientific understanding, namely: place, promotion, and product. These dimensions are being deeply investigated to unveil how retailers can best use GM to reduce FW in the food chain. Six supermarkets that operate in Brazil and six suppliers of perishable products will be investigated on multiple case studies. All suppliers have global operations and diversified products.

Keywords: *Green Marketing, Perishable Products*

Key Aspects on the Transition to a New Electric Mobility Paradigm: Impact on Electric Vehicles Servicing, Maintenance and Repairing

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Abstract

The movement of people and goods relies on economic and environmentally efficient transport systems. To increase transportation sustainability, a global effort is being carried out to develop new technologies with low- or zero-emission solutions. Electric mobility is one way to promote the decarbonising of the transport system as an alternative to conventional combustion engine technologies and fuels. The recent sales increase of electric vehicles (EV) at a global scale is a strong indicator of the transition that is taking towards a new electric mobility transportation shift. Nonetheless, several challenges have yet to be overcome. Alongside the technological pressure focusing on the EV technologies, such as increasingly higher autonomies or lower battery charging times, current automotive companies and service providers have yet to fully adapt to the challenges and demands related to EV maintenance and repair. Safety and hazard prevention due to the extremely high electric voltages, the demand dedicated staff qualifications or the need for special tools and repair shop layouts are amongst some of the issues related to the EV maintenance and repair. Current research focuses on identifying the key aspects related to the transition towards a new electric mobility paradigm. A conceptual framework discussing these aspects and their impacts on EV servicing are presented. This work allowed concluding that, even though the benefits of a greener mobility paradigm seem to be evident, the challenges of this new technology is yet very demanding for companies providing EV servicing, maintenance and repair.

Keywords: *Electric Vehicles, Maintenance and Repair*

Management of Organic Waste Fraction in a Brazilian Food Wholesale Market: Environmental Impacts Through a Life Cycle Assessment Perspective

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Abstract

The Brazilian food supply centre called CEAGESP, located in São Paulo, generates a yearly trading of about 3.200.000 tons of horticultural products. The average annual waste production is about 52,000 tons, with an organic fraction of 80%. This work aims to evaluate the environmental impacts of the organic waste fraction generated by CEAGESP in 2018 through a life cycle assessment (LCA) perspective, considering all steps from internal waste collection to waste degradation in landfill. The recipe midpoint method was considered focusing on those most related impact categories of waste management. Global warming potential (GWP) shows landfill methane emissions as the most important, while diesel consumption is the main source in Particular Matter Formation Potential (PMFP), Photochemical Oxidant Formation Potential (POFP), Terrestrial Acidification Potential (TAP) and Fossil Depletion potential (FDP). The steel used to fabricate vehicles is the main cause in Metal Depletion Potential (MDP) and Human Toxicity Potential (HTP), and the leachate generation is preponderant in Freshwater Eutrophication Potential (FEP). Internal collection & transport plays crucial role in PMFP, POFP, TAP and FDP, while waste degradation in GWP and FEP. Direct impacts, when present, are important for all categories assessed. Considering electricity produced in the landfill as avoided emissions, the environmental impacts in FDP and HTP are almost neutralized. In conclusion, to reduce the impacts, a vehicles substitution is suggested, besides seeking for a reduction on the waste generation.

Keywords: *Brazil, LCA, organic waste, sustainability.*

Operationalising Natural Capital Credit Risk Assessment in Agricultural Production

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Abstract

Financial institutions are starting to appreciate that they are exposed to risks associated with the impacts and dependencies on natural capital of the companies that they invest in, lend to, and insure. This is particularly true for banks lending to agriculture, being the sector with the highest exposure to natural capital dependencies, and a leading source of impacts. Commercial bank lending is a vital source of new finance, which is essential to achieve sustainable intensification targets. Yet current credit decision-making practice is still based primarily on conventional financial and management indicators, lacking any systematic identification or assessment of natural capital risks. This paper examines the extent to which suitable indicators and data sources are available to identify and evaluate the most significant (material) natural capital dependency risks for major Australian agricultural activities (broadacre cropping and livestock production). The paper shows that a relatively short list of material natural capital dependency risks can be identified for these sectors, and for most of these, suitable indicators and data sources to measure and assess these risks are available. Challenges remain in determining risk thresholds for some indicators, and quantifying the links between natural capital risk indicators and long-term financial performance.

Keywords: *Natural Capital Credit, Agricultural Production*

Risk Knowledge and Social Perception of Natural Hazards on Coffee Farmers in Brazil

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Abstract

This article aims to understand the knowledge of risk and social perception farmers' concerns about hazards in two different years. To this goal, the study on the risk knowledge and perception in rural areas with small coffee farms was carried out in the municipality of Caconde in the Southeast region of Brazil, through literature review and questionnaire delivered during a fieldwork conducted in 2016 and 2017. The results from 2016 and 2017 indicated drought as the greatest hazard for most farmers in Caconde's rural area, which is consistent with the literature. Rural residents are unaware that early warning systems are available from Civil Defense and the Agricultural Climate Risk Zoning. It was concluded that the perception of natural hazards in rural areas is understood as a social memory, while risk knowledge in rural areas is a notion that has gone through much controversy. Finally, for the regional context studied, the results did not show a evidence change of the result in the two years.

Keywords: *Risk Knowledge, Coffee Farmers, Naturas Hazards*

Shapley-Shubix Index Incorporated Debottlenecking Framework for Sustainable Food-Energy-Water Nexus Optimised Palm Oil-Based Complex

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Abstract

Palm oil industry has been suffering from environmental critics and one of them involves the climate change-driving biogas released during palm oil mill effluent (POME) treatment. An alternative solution to expensive biogas recovery, termed integrated palm oil-based complex (POBC), has been suggested to address the economic and environmental trade-offs in palm oil mill (POM) for cleaner production. With POME elimination and mill-refinery integration considered, POBC serves as an appropriate system for sustainable food-energy-water (FEW) nexus evaluation. In this study, fuzzy multi-objective optimisation is employed to optimise simultaneously the economic, energy and environmental aspects in POBC. For long-term means, it is desired to include debottlenecking in the POBC optimisation framework to study the internal process limitations on FEW nexus contributions. In a cooperative game context, each process creates distinctive impact or controlling power to the POBC performance. The Shapley-Shubix Power Index (SSI) has been applied in the notion of power for yes-no voting system. By evaluating the operate-fail possibilities of internal processes, SSI can be utilised to allocate the power of each process in achieving or failing the POBC performance target, prior to identifying the bottleneck process. Therefore, a novel process-level debottlenecking approach with SSI incorporation for a sustainable FEW system is proposed. The developed models are applied to the POBC case study according to the framework. The bottleneck processes concerning the FEW objectives within the POBC are determined based on the optimal results.

Keywords: *Palm Oil Mill Effluent (POME), Palm Oil-Based Complex (POBC), Food-Energy-Water (FEW)*

The Multiscale Fund-Flow Decomposition Analysis: Europe and China between 2000-2015

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Abstract

Decomposition analysis is used to explore the relative contribution of a set of factors driving the energy consumption of an economy. It was initially introduced in the late 70s to study the impacts of structural changes of energy consumption by industry. Its goal is to prevent misunderstandings and hasty inferences when analysing the relation of energy intensity with total energy consumption of a system. MuSIASEM addresses these epistemic concerns by framing these issues from complexity and biophysical economics. An innovative approach to decomposition analysis is proposed building on the flow-fund model of Georgescu-Roegen and the insights of multiscale integrated analysis. This method allows to study the entanglement between changes in size of the funds (nodes), intensity of the flows (metabolic rates) and structure (metabolic network) across different levels. In addition, a specific analysis of the dynamic equilibrium between the supply provided by hypercyclic part and the requirement of the dissipative part allows a study of the implications of the bio-economic pressure in the metabolic pattern. The method is illustrated and validated in a quantitative comparison considering changes in energy consumption, population size, demographic and economic structure, and technological performance of China and Europe between the years 2000 and 2015.

Keywords: *Decomposition Analysis, MuSIASEM*

The Role of Wind Energy in Brazil in the Context of Mitigating Climate Change and the Country's Related NDC under the Paris Agreement

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Abstract

The present work, using the systemic literature review as methodology, analyses, synergistically, the perspectives inherent to wind energy within the Brazilian energy matrix. Furthermore, the aim was to understand the role of this renewable energy source in the context of reaching the Brazilian Nationally Determined Contribution (NDC) linked to the Paris Agreement, originated at COP 21, held in Paris in 2015. To expand the domestic use of other renewables (in addition to hydro) in the supply of energy in order to achieve a 23% share in the national electricity matrix, according to the Brazilian NDC, the country needs to expand, in relative terms, the share of other renewables by 7.87%, which are currently at the 15.13% mark. Considering the 190 plants that are being and will be built, and their respective installed capacities, the share of the wind source may increase by 28% in relation to its current share. Thus, the role of wind energy tends to be essential for Brazil to reach its expressed NDC for 2025 (37% reduction in GHG emissions, compared to the base year 2005) and for 2030 (43% reduction in emissions of GHG, in relation to the base year 2005).

Keywords: *Paris Agreement, Wind Energy, Climate Change, Nationally Determined Contribution (NDC)*

Valuable Utilizations of Ecosystem Service, A Case Common Reed Water-Energy Nexus

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Abstract

"Delta Lady", an Interreg Europe project with 9 partners from nature parks in deltas, universities and many stakeholders, aims at sustainable use of ecosystems services. One of the cases is the Common Reed (*Phragmites* genus). This productive plant on more than 10 million hectares wetlands worldwide, about 1 million hectare in Europe, generates 3 to 30 dry ton per hectare yearly output. Wild reed provides habitats for fish, birds and other species and regulates water flows because accumulates sediments and nutrients. The paludiculture is essential for reducing greenhouse gasses and conservation of wetland and peatland. While nature management and cultivation are costly, the incomes from low-grade fuel and small market of roof thatching are low. Market opportunities are pursued, such as panels for insulation in constructions, lignin binders for furniture and advanced materials for handicrafts. Though this economic potential is large, transport is costly, production imperfect and marketing of novel products must compete with cheap chemical products. Potential large-scale reed utilization in a delta show contributions to CO₂ reduction, energy, water qualities along with large income. Policy instruments for assessment and development of the nature-based products on niche markets and human capabilities are envisaged.

Keywords: *Delta Ldy, Water-Energy Neus, Ecosystem Service*

Water Footprint of a Tropical Beef Cattle Production System: The Impact of Individual-Animal and Feed Management

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Abstract

The aims of this study were to calculate the water footprint for a tropical cow-calf-stocker-feedlot production system and to evaluate the influence of each individual-animal performance and type of diet. We also analyze the impact of these production aspects in the water consumed by feedlot cattle slaughtered in the year 2018 in Brazil. This study calculated the volumetric water footprint (WF). The reference units were: L kg LW-1 (liters per kg of live weight) and L kg CW-1 (liters per kg of carcass weight). The type of diet did not significant affect carcass weight and live weight ($p < 0.05$). The WF varied from 32,470 L - 29,828 L kg CW-1 and from 18,279 - 16,803 L kg LW-1. On the average, green water accounts for 99.3% of co-product and conventional diets to both reference units. The weight of animals did not significantly affect performance indicators and water footprints for conventional diet ($p < 0.05$), but the green and total water footprints were significantly affected for co-product diets ($p < 0.05$). Results show that the water footprint values for individual-animal were too random. There are animals that had a WF value much higher than average. The results demonstrate how the decision by which water footprint as a reference for calculation can result in scenarios that induce the proposition of actions and policies with considerable variation. Water footprint was not different for diets with co-product and conventional feed except when animal performance indicators were different. This study detected the influence of each animal performance and productivity aspects in green and blue water footprints.

Keywords: *Beef Cattle Production, Water Footprint, Feed Management*

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Why Sustainable Concrete Can Not Penetrate Concrete Markets?

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Abstract

Several studies have proved that sustainable concrete, such as geopolymer or alkali activated fly ash concrete, has mechanical and durability properties, similar or surpassed of that Portland cement concrete counterpart. However, knowing the sustainable concrete properties from outside an academic field, and marketing permeate are still immensely immature. The obstructions, including but not limited to the cost, marketing, legislative, lacking a coherent customer communication plan, and not adopting reducing global warming regulations, would be observed in this study. A survey will be conducted to better understand the field engineers and consumer prospective. Several solutions and justifications will be presented in this work.

Keywords: *Sustainable Concrete, Concrete Markets*

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Accepted Papers

A Decision-making Framework for Quantification of Housing Infrastructure Resilience against Flood Hazard

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Abstract

Resilience is defined as the enduring capacity of infrastructure systems against natural disasters. A natural disaster cannot be anticipated in any form by mankind. So, a strong framework can be created by applying the concept of resilience to enhance the enduring capacity and also for effective recovery. The housing infrastructure, in particular, which is the basic need for livelihood for people can be made more structurally resilient. An effective resilience-based framework for housing infrastructure requires the various type of previous disaster datasets from different sources. The involvement of an expert's opinion is also required for the representation of the nonlinear and complex relationship between the flood resilience parameters for housing infrastructure. In this work, initially, a hierarchical flood resilience model for housing infrastructure by a cause-effect diagram is developed using decision making trial and evaluation laboratory (DEMATEL) and interpretive structure modeling (ISM) method, which clearly confirms the relationships among various resilience parameters against flood hazard, then a field survey is performed to collect all the post-disaster data, next a flood Resilience-Based Decision-making Framework is developed using DEMATEL, ISM, and Bayesian network (BN) methods and lastly, the developed framework is then implemented in a Valley of India for flood resilience assessment.

Keywords: *Flood Hazard, Resilience,*

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A Four Pillars Proposal to Deepen the Research on Food Waste in the Nexus Context

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Abstract

Minimizing food wastes is a challenge for a circular economy (Sherwood, 2020). Food wastage is around 25% to 33% of the global food production (Aschermann-Witzel et al., 2018). It is estimated a per capita yearly food loss between 194 and 389 kg (Corrado and Sala, 2018). Agriculture production accounts significantly for the use of water and energy (Del Borghi et al., 2018). This work is underpinned in four pillars: (i) improvement of the research about concepts of food losses and food wastes in production and consumption; (ii) investigation on Circular Economy principles applied to food production and consumption and respective wastes; (iii) clarification of food-energy-water nexus in the context of food losses; (iv) description of innovations aimed at reducing food wastage in production and consumption. A literature review is employed to support the proposal (Pagani et al., 2015). Results: (i) conceptual disambiguation about losses and wastage (Cristóbal et al., 2018); (ii) relations between Circular Economy, Green and Bioeconomy in the scope of food wastage (D'Amato et al., 2019); (iii) inclusion of wastes in the Food-Water-Energy nexus (Lehman, 2018); (iv) new methodologies for food losses accounting (Philippidis et al., 2019) and consumption practices that drive food wastage (Hebrok and Heidenstrøm, 2019).

Keywords: *Food Waste, Nexus*

A Literature Review on Assisting Approaches for Product-Service Systems' Development

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Abstract

The circular economy is gaining more space amongst academia and industry as a path toward sustainable development. The Product-Service System (PSS) is pointed as a business model with a high potential of achieving a circular economy, especially through efficient consumption and production. Even though the literature on PSS is somewhat extensive and has been growing over the years, PSS is still troublesome to adopt, due to a lack of organization of the existing knowledge. This research seeks to gather and organize PSS development approaches (tools, methods, and processes) presented in the literature, according to the PSS lifecycle. A bibliographical analysis was first conducted, gathering researches in which PSS development approaches were mentioned. The approaches were later categorized, and their applications were analyzed. PSS Board, Service Blueprinting, Business Canvas Model and Quality Function Deployment are some of the main approaches studied. The analysis showed research gaps concerning practical knowledge on the PSS field and approaches that comprehend the whole PSS lifecycle, completing the circularity of the product-service offer. Future research could aim at fulfilling those gaps, applying conceptual elements of Product-Service Systems and supporting the transaction toward a more circular economy.

Keywords: *Product-Service System, Circular Economy*

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A Multi-Regional Input-Output Analysis of CO2 Emissions Embodied in Kazakh International Trade

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Abstract

Kazakhstan is one of the largest landlocked countries with rapidly increasing economy. The changes in industrial structure of Kazakhstan resulted in significant transformation on its CO₂ emissions profile. Also, Kazakhstan is one of the main exporters of oil and gas in the world. It exports more than 100 billion tonnes of oil equivalent every year. As well as other countries, it produces CO₂ emissions, which became the global environmental problem. Despite its emissions are relatively small compared to huge emitters as the US or China, Kazakhstan faces with great pressure in terms of reduction of CO₂ emissions and green development. By using Multi-Regional Input-Output (MRIO) analysis, this study analyses CO₂ trade emissions of all sectors of Kazakhstan on international level. Framework shows, that transport and electricity sectors are its fastest growing source of carbon dioxide emissions. The Government and authorities are committed to reduce the growth of greenhouse gas emissions from the transport sector in the largest cities, as well as improve urban environmental conditions by enhancing the management of public transportation and air quality. Kazakhstan's 2030 and 2050 strategies have policy actions in reducing greenhouse gas (GHG) emissions, also is a good chance for Kazakhstan to develop "Green Economy".

Keywords: *CO₂ emissions, Kazakhstan, MRIO analysis, green economy*

A Nature-Based Solar Drying System to Produce Organic Fertilizers from Agricultural Digestate

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Abstract

Animal manures, although their high moisture and low nutrient contents, are often used to substitute mineral nitrogen fertilizers. Therefore, concentration processes are usually required, being thermal technology one alternative. In this work, solar drying method was presented as an option to solve this problem. Animal manures were acidified to pH 5.5 and 6.5 for reducing of ammonia emissions. The pilot and semi-industrial plants were employed to produce a high value organic fertilizer that fits within the European fertilizer legislation. This process was conducted to produce two dried materials, dried matter content >90% with a nutrient composition of 4-6% total nitrogen, 26-30% total organic carbon, 4.4-5.37% P₂O₅ and 1.86-2.13% K₂O, fitting the European fertilizers legislation. Fresh digested manure and dried products were assessed through a phytotoxicity test with lettuce seeds with different dilution ratio, 0, 15, 25, 50, 75, 100%, to determine their corresponding germination index (Gi). The electrical conductivity appeared as a critical parameter related to Gi, since only digested manure and dried digestate surpass a Gi of 70% when the dilution ratio was 15%.

Keywords: *Organic Fertilizers, Solar Drying System, Germination Index (Gi)*

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A Review of LCAs Studies Analysing Dairy Processing Water Treatment

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Abstract

In 2015, after the abolition of dairy quotas, the European Union became the largest producer of dairy products in the world. While addressing the growing demand for food, this also leads to increased environmental impacts. A potential solution to reduce the environmental impacts and simultaneously reduce the need for mineral fertilisers is to consider dairy processing wastewater (DPWW) as a resource for recovery of nutrients. A commonly used tool for estimation of the environmental impacts associated with the dairy process is Life Cycle Assessment (LCA). In this work, a review of LCA studies on the environmental impact of dairy industries is presented, with a particular focus on DPWW treatment. From the review it was found that not all the LCA studies assess wastewater treatment (WWT) separately from the general waste treatment. In some cases, on-site WWT had been included because generally, in dairy industries a pre-treatment step is required before the wastewaters are sent into the sewer. When the WWT was included in the LCA it was found to be most significant for global warming, eutrophication, and water depletion. These impacts are mainly due to the whey and additives emitted with the wastewater, the transport of wastewater to municipal WWT plants, or the consumption of energy. While the possibility of using the information found in this study in future studies on nutrient recovery from DPWW was in focus, several weaknesses were identified. In particular, details on information relating to the treatment and allocation methods are missing

Keywords: *Life Cycle Assessment, Water Treatment*

A Review of Materials Impacts and Engineering Considerations Derived from a Life Cycle Assessments for Offshore Wind Projects

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Abstract

The offshore wind technology is an alternative to provide clean energy reducing the CO₂ emissions but present risks during the design, construction, operation and maintenance stages. The construction stages utilize materials for producing the elements and structures for the wind turbines, what may produce effects over the environment and mankind. This study analyzed technical and research documents for the 2009-2019 period and found a lack of information of the effects of construction materials over human health (respiratory, toxicity, cancer) and natural ecosystems (climate change, ozone depletion, ecotoxicity, acidification, eutrophication, water resource depletion). Then, this research suggest recommendations for a sustainable LCA application in the offshore wind industry, and evidenced the necessity to enhance the knowledge of specific materials and their contribution to the LCA indicators.

Keywords: *Life Cycle Assessment, Offshore Wind*

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A Review of the Brazilian Scientific Production on the Entrepreneurial University: The Third Mission

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Abstract

This article aims to analyze the scientific productions about entrepreneurial university and third mission, through a Systematic Literature Search, verifying the approach of Brazilian authors in this theme, in international bases. For that, we used the SSF - Systematic Search Flow method, applied in systematic and integrative reviews. The entrepreneurial university, which is a key institution in knowledge-based societies committed to the development of the region where it is located, is the key factor in achieving regional innovation. In the age of knowledge, the university has become an institution as important as industry and government, being responsible for the development of the knowledge space, as well as the innovation and consensus spaces. Thus, a literature review focusing on the search for Brazilian authors who have published in international bases of periodicals makes it possible to explore the theme of the Entrepreneurial University, providing an initial theoretical framework. This article contributed to the construction of an overview of Brazilian scientific production in international journals on the entrepreneurial university and third mission themes.

Keywords: *Third Mission, Entrepreneurial University*

A Simple and Reliable Proposal to Determine the Energetic Selfsustainability in UASB-Based Sewage Treatment Plants

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Abstract

The biogas produced in UASB Sewage Treatment Plants (STP) is of little use for energy purposes and its potential is often unknown. This paper aimed at proposing a simple and reliable alternative to determine the energetic selfsustainability in UASB reactors by using energy balance. To this end were considered (i) the electric energy production (E) that was determined considering the biogas energy potential according to Lobato et al. (2012) by the use of internal combustion engines (ICE); and (ii) electric energy consumption (Econ) that was ascribed to the Sewage Pumping Stations (SPS). For this purpose the Econ to pump sewage up to the top of UASB reactors was evaluated in some pressure heads (4m, 6m, 8m and 10m). After running the mathematical model to all STPs a linear regression was calculated between the variables "sewage flow" (axis x) and "biogas energy potential" (axis y). The results highlighted that there are 1,024 STPs operated by UASB reactors, with a predominance of small size units. The linear model adjusted to estimate the biogas energy potential (axis y) in STPs and the sewage flow (axis x) is represented by $y = 122.65x$ ($R^2 = 0.64$). Only 11.6% of the STPs presented technical feasibility to recovery biogas. It was proposed equations to estimate the "net electricity production" (energy balance) (axis y) as a function of the variable "sewage flow" in STPs operated by UASB reactors (axis x) according to the pressure heads. The mathematical equations are relevant tools for sanitation companies and its use can enable studies for the implementation of energy self-sufficiency projects by using simple input data.

Keywords: *UASB Sewage Treatment Plants (STP), Electric Energy Consumption*

Adaptation of a Carbon Footprint Calculation Tool for Dairy Production System

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Abstract

Calculation of Carbon Footprint (CF) in livestock sector is used to evaluate a product's life cycle, enabling process management and, thus, understanding its global warming relevance. However, one of the main constraints for environmental management in dairy sector is the need for specific data that are often unavailable due to absence of daily registration. With this, the objective was to develop an easy-to-supply CF accounting tool for farmers. The development was based on Brazilian GHG Protocol V.1.4 2018 tool, where greenhouse gas emission is converted into CO₂eq. In order to include the agricultural flows, the IPCC database (2013) and CML-IA baseline V.3.02 were used. The main result was a CF spreadsheet in excel® for a semi-intensive milk production system. The spreadsheet consisted of an interface where farm's employees include pertinent production and current information. With this, it is possible to estimate the CF with a high degree of detail and based on the milk life cycle, allowing the verification of the hotspots of the production system, and aiming at environmental management decision making. The main challenge identified in its implementation was the complexity linked to daily record that suggests the need for farm automatization especially in energy and input flows.

Keywords: *Carbon Footprint, Dairy Production System*

Additional Emission o Polluting Gases Generated By the Activation of Automotive Headlights

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Abstract

In 2016, the Chamber of Deputies passed a law in Brazil that mandates the use of low lights on highways even during the day. In order to problematize and evaluate the socio-environmental and socio-economic impacts of this law, an experimental test was carried out at the engine laboratory of the Mauá Institute of Technology in São Caetano do Sul / SP to relate the energy consumption of automobile lamps with the consumption of fuel generated by it and if there was an increase in the emission of gases (CO; HC; CO₂; O₂).

Keywords: *Emission of Pollution Gases, Automotive Headlights*

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Aeronautical Brazilian Prodiesel - Synergistic Analysis of Energy, Environmental and Socio-Economic Aspects and the Perspective of Use in the Current Days

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Abstract

Ever since the Kyoto Protocol, there has been a strong recommendation for the aviation and marine transportations sectors to lower their GHG emissions. In this context, the global aviation sector announced, in COP 21 (Paris, France, 2015), their global goal to reduce, until 2050, their CO₂ emissions by half, in comparison with their own in 2005. The plan for this goal takes in consideration measures of mitigation in short and medium term with technologic and economic instruments for decarbonizing. For example: new alternatives in short distance travels (like high speed train), retrofit planning, incentives to use biofuels as fuel source, reduction of the fossil fuels subsidies and adding cap and trade taxes for their use. In such context, the present study describes and analyzes the "Prodiesel" or "Prosene," the Brazilian biofuel for aviation developed in the late 1970s, in its energy, environmental, social and economic aspects and its use prospects today. This plant fuel can help Brazil meet its Nationally Determined Contribution -NDC - for reducing the Brazilian emission of GHG, which were included in the Paris Agreement.

Keywords: *Greenhouse Gases, Nationally Determined Contribution -NDC, Brazilian Prodiesel*

Air Pollution Biomonitoring of Metals Using Tradescantia pallida and Dracaena marginata

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Abstract

Air pollution has become one of the major problems for megacities in the world, and this is a global public health problem. Petrochemical industries are frequently associated with the emission of gases and particular matter. These emissions often include potentially toxic elements. In the present study, the active biomonitoring was carried out in two study sites using the *Tradescantia pallida* "Purpurea" and the *Dracaena marginata* "Tricolor". The accumulation of 17 elements in the leaves of these two plants was investigated yearly and by seasons. The first study site was located close to Capuava Petrochemical Complex (CPC), between Mauá and Santo André municipalities, in the state of Sao Paulo, Brazil. The second study site was Paranapiacaba, Santo André District, with some climatic differences (e.g. greater rainfall) more than 30 km from the petrochemical industry. Multifactorial ANOVA was used to identify the effects of the treatments, plants, cities and seasons over the elemental content in the leaves due to the atmospheric deposition. The two bio monitors responded differently. *Dracaena marginata* presented a better sensibility to metal exposition than *Tradescantia pallida*, with a clear response to Pb, Co, Cd, Mn, Ni and Sn. Capuava presented significantly higher levels of Pb and Sn than Paranapiacaba. To most elements, autumn and winter, the dry season were the seasons that produced leaves with higher metal content; only Cu and Sn exhibited a larger deposition on summer, the wettest season.

Keywords: *Capuava Petrochemical Complex (CPC). Air Pollution, Tradescantia pallida, Dracaena marginata*

Air Quality Bioindicators: Lichens in Urban Forests

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Abstract

The Forest Fragments are formed by the accelerated change in the use and occupation of the land that led to an indiscriminate suppression of vegetation in urban areas. One of the biggest consequences of this degradation is the so-called edge effects, as it is the region of the limits of an element from the landscape where the influences of the surroundings prevent the development from the interior environmental conditions, interfering in the pattern of spatial distribution of the species, as well as physical changes and physiological aspects of the development of a particular species. Proper maintenance of these green areas promotes numerous benefits that ensure environmental quality, including an improvement in the quality of atmospheric air. In addition to conventional physical-chemical methods of monitoring air quality, the use of bioindicators has also been gaining ground for the same purpose. Its use allows the integrated assessment of ecological effects caused by multiple sources of pollution, including atmospheric. Thus, lichens can be used as air quality bioindicators, based on their absence or presence. In a study carried out in a forest fragment in Campinas, São Paulo, Brazil, it was found the presence of lichens in five pre-established monitoring plots. However, it was concluded that only their presence does not give us the conclusion that the air quality is good, since factors of the edge effect (climatic conditions) interfere in their development, transforming them into bioindicators capable of indicating the impact caused by the use and occupation of the surroundings.

Keywords: *Air Quality, Lichens, Urban Forests*

An Analysis of the Efficiency of European Ports Using the Data Envelopment Analysis Tool

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Abstract

Ports increasingly have a consolidated position due to the vital importance in the logistics and commercial chain of nations. In this regard, after the significant competition presented with the course of globalization, it was necessary to improve the port management devices. Thus, this research intends to study using the Data Envelopment Analysis tool, presenting efficiency indicators, benchmarking and projections of port corrections for factors considered input and output. The following data were used such as average transport capacity per ship (TEU), number of containers transported (TEU), average age of ships, number of arrivals at the port and their average docking time, in order to establish relationships among the 23 DMU's analyzed in relation to the efficiency frontier. The results show a significant disparity between the port efficiencies of international ports between the CCR and BCC models. The top four most efficient ports in all analyzes were Germany, Spain, Belgium and France. However, it can be seen that the BCC model was less efficient compared to the CCR

Keywords: *European Ports, Data Envelopment Analysis Tool*

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An Assessment Between Electric Vehicles and Conventional Vehicles Focusing the Climate Change Mitigation

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Abstract

Hybrid and Electric vehicles are not a recent technological invention. Although since 1930 these vehicles had marginal contribution in the vehicle history. Currently, the electric vehicles had been considered as the future trend in the automotive industry. Among the reasons of the countries for this are: to reduce the dependence on oil, to promote more efficient use of energy and to cause less environmental impacts. In this paper, we expect to contribute with information about characteristics of environmental performance of electric vehicles in comparison with conventional internal combustion engine vehicles, analyzing the advantages and disadvantages, the environmental impacts caused in life cycle and how this technology could contribute to mitigate climate change. In addition, it is also discussed the impacts of the electric and hybrid vehicles expansion on the final energy demand. For this it was done a literature review of several papers in this field. One of the main results indicated that the more renewable energy grid, the greater the reduction of emissions from electric vehicles.

Keywords: *Electric Vehicles, Climate Change*

Analysis of Energy Saving and Greenhouse Gas Reduction in Beijing Low-Carbon Development Strategy Using LEAP Model

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Abstract

Ever-increasing energy demand and consumption exert huge impacts on global warming through greenhouse gas emission generated in electricity and heat production. According to the Emission Gap Report 2019, the emissions gap is larger than ever. Global GHGs emissions will not be curbed unless more immediate and effective actions are taken to contribute to the formidable mitigation task. Creating efficient and lower carbon energy systems through energy transition and increasing energy efficiency takes significant role in emission reduction policies. However, despite various compulsory and voluntary planning and policy initiatives, there is a dearth of the investigation of the effectiveness of the government policy and the ripple effect in terms of energy and GHG reduction aspects in cities. Long-range Energy Alternatives Planning system(LEAP) model is an effective simulation-based bottom-up energy model that can calculate the GHG reduction potentials in accordance with various policy scenarios through adjusting components and variables in different sectors. The results show that the total energy consumption of Beijing will increase slowly year by year. Carbon emissions will peak in 2020 and rebound slowly in 2035. The potential of different measures to mitigate GHG emissions in various industries and sectors is analyzed. Transportation and service sector are playing increasingly important role in Beijing's low carbon development. Therefore, the mitigation measures, such as advocating environmentally-friendly traffic modes, promoting green cars and increasing energy efficiency in service sectors, should be a priority.

Keywords: *LEAP Model, Greenhose Gas, Beijing*

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Analysis of the Impact of the Replacement of Toilets in Public Buildings Using Statistical Control Charts

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Abstract

Monitoring and evaluating water consumption in the built environment is fundamental for water conservation in urban areas. In relation to the built environment, toilets are responsible for a significant amount of water consumption in buildings of different types. In this manuscript the use of Statistical Control Charts to monitor building water consumption is proposed. The proposed method is applied to a case study on water consumption of toilets installed on a University campus. The study is conducted in order to investigate the impact of the Brazilian Technical Standard NBR 16727-1 regarding the requirements for toilet flushes volume. Water consumption in toilets was assessed by using digital water meters which recorded a total of 70,107 flushes. The open source R software was used to carry out the analysis, which can be replicated in other similar applications. The results show that the average daily volume per activation decreased from 7.54 to 5.28 liters/flush in analyzed toilets. The charts proved useful for detecting water consumption reduction and other outliers, emphasizing the importance of continuous monitoring. Complementarily, it was proved that the installation of plumbing fixtures in accordance with the new regulations can significantly reduce water consumption in public buildings.

Keywords: *Statistical Control Charts, Replacement of Toilets*

Analysis of the Spatial Distribution of Collection of Waste Oil from Frying in the City of São Paulo, SP, Brazil, Based on Sustainability

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Abstract

The municipality of São Paulo has a large number of sources producing waste oils and fats, with approximately 13,000 establishments. The potential polluter of these residues is immense, it is necessary a functional, sustainable program of collection and correct disposal for the oil. The objective of this work was to evaluate how the disposal of waste oil from frying is carried out in the city of São Paulo and to give suggestions for the generation of a public policy of the generating foci, collection and proper disposal of these wastes. The disposal of waste oils and fats in inappropriate places can cause numerous harmful impacts on the environment, impacts ranging from pollution of springs and soils to obstruction and clogging of networks. The methodology used was geographic information system in order to obtain a map of land use and occupation. The crossing of this information was associated with the most critical oil collection points in the municipality. It is concluded that this research can contribute to the awareness of the population, entrepreneurs and public managers about the problem of incorrect disposal of waste oils and fats, creating a positive culture, capable of involving all these agents, leading a sustainable policy.

Keywords: *Spatial Distribution, Waste Oil from Frying*

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Analysis of Ultraviolet Radiation in the Municipality of Rio Claro - SP, Brazil, for the Implementation of Public Policies for the Prevention of Skin Cancer

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Abstract

This study aims to produce a legal urban analysis for public policy reforms, prevention of skin cancer in the city of Rio Claro - SP, Brazil. It aims to broaden the vision and clarify as much as possible the importance of prioritizing preventive actions and, the aspects around the theme, stimulating the understanding and construction of knowledge. Based on the 2014 World Cancer Report from the World Agency for Research on Cancer (Iarc), it is unquestionable that cancer is a public health problem, especially among developing countries, where it is expected that in the coming decades, the impact of cancer on the population corresponds to 80% of the more than 20 million new cases estimated for 2025. It is essential that the monitoring of cancer prevention and control actions and their risk factors, including the supervision and evaluation of programmes, as well as the maintenance of a surveillance system with timely information and quality that supports epidemiological analyses for decision-making. This study stands out for being an action research that brings low-cost measures to training programs for health professionals.

Keywords: *Ultraviolet Radiation, Skin Cancer, Public Policies*

Analysis Tools for Measuring the Circular Economy

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Abstract

The state of art of Circular Economy clearly points the destructive and derogatory effects caused by the impacts of human production on the environment from the perspectives of Linear Economy. Presents the importance of generating actions that prevails on net sustainability for the wealth production. Economy and Circularity are aspects of social relations that walk together since de beginning of socioeconomic relations, whether by logic that there is no sale without purchase, or purchase without sale, action with a totally cyclical effect, as well by the macroeconomic analyzes on Economic Cycles, or even the condition of constant human production, which cyclically uses the nature to extract resources for the wealth production, that is, the theory of scarcity of natural resources. The current study creates, from the analogy with the ISLM curve, a economic analysis tool for Circular Economy. This tool allows to identify the Sustainability Margin point, from the intersection between the Government Protective Measures and Protective Postures of Citizens and Governments. Such analysis allows a better understanding and planning of actions of each one of the economic agents, citizens, companies and governments, within the macro, meso and micro levels.

Keywords: *Analysis Tools, Circular Economy*

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Analytical Tool to Evaluate Sustainability Performance in Industrial Processes

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Abstract

This paper aims to propose an improvement in the analytical tool EPIP (Environmental Performance in Industrial Processes). This improvement considers including social variables to evaluate performance in the economic-environmental-social context of industrial processes. The EPIP update, called here in this paper SPIP (Sustainability Performance in Industrial Processes) seeks to calculate the sustainability performance of industrial processes through the economic, environmental, and social analysis of the sustainable aspects. This tool is composed of three variables, the equivalent Cost of Sustainability (CSeq(n)) for each aspect in sustainability n, the Total equivalent Cost of Sustainability (TCSeq), and the Relative equivalent Cost of Sustainability (RCSeq(n)) for each aspect in sustainability n. The main variable (CSeq(n)) of the SPIP is composed of: economic variables consisting of costs applied to input and output data of material and energy; and environmental and social variables made up of life cycle impact categories referring to the inflows and outflows. Currently, the tool developed is in the application step in a case study. It is expected to be able to calculate the sustainability performance of an industrial process, with a single indicator response, in order to help decision-makers to seek improvements towards sustainability.

Keywords: *EPIP (Environmental Performance in Industrial Processes), Cost of Sustainability (CSeq(n))*

Application of Hydrothermal Carbonization (HTC) in Brazil: Perspectives for Waste Valorization

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Abstract

HTC is a process that enables the conversion of wet biomass into products, hence, opening a wide range of possible waste valorization strategies for countries where this type of waste is available. However, by conducting a literature review and patents search we found that despite being known since 1913, the application and even the research about HTC is not yet receiving proper attention in Brazil. Waste biomass is already recycled in Brazil, but there is room for improvement since the high moisture content, low energy density and presence of contaminants can make impossible or unfeasible the use of some technologies. Furthermore, its potential as a sustainable feedstock for carbon, other elements or molecules production is already being explored at waste biorefineries over the world but only few papers were published in Brazil. If we consider the fraction of biomass in municipal solid waste in Brazil, there is more than 41 million tons of biomass generated every year, indicating a huge potential to be explored. Therefore, transferring new technologies such as the hydrothermal carbonization (HTC) is vital for development of cleaner production in Brazil and more research is needed to quantify the full potential of HTC application in this country.

Keywords: *Hydrothermal carbonization (HTC), Waste Valorization*

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Approach Proposal for Circularity Assessment and Life Cycle Assessment Applied to Products: Case Study of a Crystalline Silicon Photovoltaic Solar Panel

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Abstract

This study proposes to evaluate the circularity, using CET (Circular Economy Toolkit), CEIP (Circular Economy Indicator Prototype), and MCI (Material Circularity Indicator), and to calculate the environmental impact through the LCA, for a 1st Generation Photovoltaic Solar Panel (PSP) manufactured in Brazil. In order to make the case study viable, it was defined that 100% of the PSP raw materials are virgin. For the destination of the PSP parts, 83% are recycled, 10% are incinerated, and 7% are sent to landfills. For the raw materials recovered after PSP use, we consider 100% of aluminum, 95% of glass, 81% of silicon, 85% of copper, and 40% of silver. Thus, CET indicated a great potential for improvement in the preservation or repair, in the reform or remanufacturing, and in the development of the product as a service. For the CEIP and MCI, the circularity results obtained were 57.2% and 44.32%, respectively. Finally, the LCA result showed a positive environmental impact on the localized power generation superior that the negative impact associated with the assembly and destination processes. Therefore, LCA can help to direct the circular economy actions, and products may have favorable environmental performance and not necessarily a high degree of circularity.

Keywords: *Photovoltaic Solar Panel (PSP), Life Cycle Assessment, CEIP (Circular Economy Indicator Prototype), MCI (Material Circularity Indicator)*

Assessing Economic Efficiency of the Circular Economy

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Abstract

Circular Economy (CE) is an evolving field which transcends many disciplines, with the potential to contribute to low carbon and green national and regional policies. Lack of convergence of the CE regarding key issues such as definition of the Economic Efficiency of the CE, key factors, assumption and constraints, which would all affect its conceptualization has been established to be critical and the extant literature and practice are yet to address these issues. We aim to address key research of CE focusing on its Economic Efficiency through a 4-step logical process: a conceptualization framework for understanding it; model development for quantifying it; empirical assessment to prove its relevance and establishing its growth opportunities across different sectors and scales. Potential contributions of this research would be to provide a robust framework and model to respectively help to understand and quantify the economic efficiency of the CE and give a helping hand not only to the academic community but also to the policymakers of the European Union to create a platform for systematic process in transitioning toward the CE.

Keywords: *Circular Economy, Economic Efficiency, Circular Economy Metric, Economics*

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Assessing Methodological Implications of LCA Boundaries. The Alaska Sockeye Supply Chain Case Study

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Abstract

Monitoring energy and water consumption and developing supply chain models is a priority to support decision-making regarding consumer tradeoffs. The definition of system boundaries within these models and their influence on the results can have significant impact on interpretation and ultimately consumer choices. This work draws on primary and secondary data to assess, through Life Cycle Assessment, the energy and water consumed to catch and process Sockeye salmon in Alaska (U.S.A). The energy associated with fishing and processing sockeye ranges between 20 and 30 MJ/kg with fishing accounting for, on average, 33% of the total energy embodied in products. The water embodied in final Sockeye products ranges between 5 and 40 liters/kg, mainly the result of processing and packaging. Where boundary definition becomes important is in support activities of the industry. For example, nearly 30,000 workers from other U.S. states and countries are flown north to work a very short (about 6 weeks) fishing season each year. In addition, a large monitoring and enforcement effort by both the State of Alaska and the Federal government is conducted each year. The implications of including energy and water for commuters and regulators are assessed to depict the system on a broader view.

Keywords: *LCA, Alaska, Supply Chain*

Assessing the Inclusion of Absolute Environmental Sustainability in Cleaner Production Processes: Case of Gear Manufacturing in Automotive Industry

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Abstract

The transportation industry has been working on resource and operation efficiency and effectiveness for many decades now to e.g. to optimize fuel economy and reduce process emissions. One of the manufacturing technologies, which is well adopted in this industry, is the Powder Metallurgy (PM). Steel PM emissions share in industrial emissions is currently small; however, this could change and become more notable due to the high pace advancement, adoption and deployment of emerging manufacturing technologies. Given the increase importance of sustainability issues and future associated risks to manufacturing due to e.g., tighter legislations and tougher pricing policy, it is not only the fact that material and energy conservations are indispensable to sustainable development, but also they are vital to manufacturing companies' existence. The PM industry has been regarded as energy and material efficient by many studies, which have sought for alternative cleaner production steps in the automotive industry. Although most of these studies acknowledged sustainability issues or at least the environmental aspects, neither comprehensive environmental assessment nor life cycle perspective have been conducted in their investigations. This paper reports an industrial gear manufacturing case study in the automotive industry in order to contribute to the field with the main intention of reducing the aforementioned gap. The paper put forward an agenda to analyse the environmental impacts of carrying out gear manufacturing activities based on the defined and operationalized planetary boundaries.

Keywords: *Automotive Industry, Gear Manufacturing, Environmental Sustainability.*

Assessment of Resources Efficiency and Environment Impact Reduction in Vietnamese Pangasius Production

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Abstract

Pangasius (Pangasianodon hypophthalmus) is a freshwater fish with high economic value which has been exported to more than 130 countries in the world. It is produced and processed mainly in the Mekong Delta region. This research aimed to assess the Vietnamese pangasius value chain which was implemented in 4 years from April 2013 to March 2017 in the Mekong Delta under the framework of the EU-co-funded SWITCH-Asia project: "Establishing a sustainable pangasius supply chain in Vietnam" (SUPA). The summary data obtained from this study shows that in the production/feeding period, 1 ton fresh pangasius consumed 8,084 m³ of water and 808.4 kWh of electricity; generated 88.31 kg of Biological Oxygen Demand (BOD); 408.22 kg of Chemical Oxygen Demand (COD); 42.25 kg of Total Nitrogen (TN) and 29.32 kg of Total Phosphorus (TP). In the fish processing, the study shows that in average, the resources and energy consumption were 35.7 m³ water and 1,187 kWh per ton of fillet fish. There have been reduction of natural resources and energy consumption and environmental emission for both main steps: production and processing. The experiment for production step showed the significant reduction of COD, BOD, TN, TP, and Total Suspended Solids (TSS) at 11.2%, 15.8%, 33%, 49.6% and 35.5% respectively. While, the Resources Efficient and Cleaner Production application at processing enterprises helps to cut down 127.05 kWh electricity, 7.5 m³ water per ton of fillet fish equivalents to 10.7% of electricity and CO₂ equivalent, 21% of water.

Keywords: *Pangasius, Mekong River*

Assessment of Water Consumption in Households Using Regression Tree

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Abstract

Understanding the factors influencing urban water consumption is essential for managing water resources. Domestic water consumption represents a significant portion of urban water consumption. The objective of this paper is to evaluate how socioeconomic variables related to residents and constructive variables related to households influence the domestic water consumption in the city of Joinville. Monthly water consumption, constructive characteristics and socioeconomic data from 394 households were analyzed. The analysis includes detailed descriptive statistics of monthly water consumption per household and daily per capita water consumption, in addition to socioeconomic and constructive variables. The analysis of descriptive statistics enhanced the understanding of the effects of the independent variables on the dependent variables monthly water consumption and per capita water consumption. Also, regression tree was applied to the data set. Amidst the findings, the variable income had a positive correlation with water consumption, whereas the number of members of a household had a negative correlation with per capita water consumption.

Keywords: *Water Consumption, Regrassion Tree, Households*

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Association of Design for Environment and Lean Manufacturing to Reduce Environmental Impact

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Abstract

Design for Environment (DfE) is a concept developed within the scope of Industrial Ecology for environmental management. Lean Manufacturing is a productive paradigm for operations management that aims to eliminate waste from production systems. The purpose of this article is to present a study that highlights the synergy between DfE and Lean practices. For the development of the study, a literature review was first carried out, where Lean and DfE practices were identified, analyzed and contextualized in the product development cycle. The second stage conducted a case study in a Lean company where the analyzed DfE practices were observed considering the product development cycle and the Lean objectives. As a result there is a framework where DfE practices, important for reducing environmental impacts, have been categorized according to the product development cycle. It was observed that there is a synergy between the practices of DfE and Lean and these can be used in a complementary way, in the product development cycle, reinforcing the efforts in search of the objectives of the Lean system to reduce the environmental impact. This work can contribute to organizational decision-makers to reduce the environmental impact with a focus on the environment.

Keywords: *Lean Manufacturing, Design for Environment*

Barriers and Facilitators to Community-Scale RE: What Does the Future of Community Energy Hold in Victoria?

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Abstract

Renewable energy (RE) is key for achieving carbon abatements set out in Nationally Determined Contributions under the Paris Agreement, now and into the future. But whether policy settings favour Big [Grid] Energy or facilitate both large-scale and small- to midscale community-RE, may impact the speed and depth of transitions. It is argued that small- and midscale community RE is key to distributed regional energy systems, community RE-buy-in and localised grids. The paper analyses both national and subnational policy frameworks impacting on small- and mid-scale community energy development and interrogates how community energy is enabled or hindered, and what this might mean for timely, effective, penetrative change away from fossil fuels. This paper discusses the key policy facilitators/barriers affecting community energy in Australia drawing on a Victorian case study of Hepburn Wind, Australia's first community-owned wind farm that commenced operation in 2011. By means of qualitative discourse analysis, the research (1) analyses underlying assumptions about the role of community energy in key national and subnational energy policy documents, and the prevailing power structures dominating RE policy, regulatory reforms and energy markets, and ultimately the fate of some mid-scale RE projects. (2) It analyses the impact of national-state policies on the selected case study as Hepburn Wind transitions to Hepburn Energy and plans to add 7MW of solar to its 2- turbine 4 MW wind turbine grid-connected energy generation. This analysis is a timely contribution to growing scholarly and public debate around citizen/community RE.

Keywords: *Renewable Energy, Community-Scale*

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Bibliometric study on SGI and Sustainable Development in Private Companies, a Viable Path to Sustainability

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Abstract

Sustainability is one of the most important issues for society today. Public and private companies, governments and society are increasingly active in the search for more sustainable results. One aspect to better face this challenge is the implementation of Integrated Management Systems in Health, Safety and Environment in organizations. Thus, this study aims to verify in the scientific literature how SGI can contribute to sustainable development and positive results for the company. A bibliometric study will be prepared based on Elsevier Scopus looking for articles published in Brazil related to the theme using the following keywords, Management system, health, safety and environment. The results will be tabulated and analyzed in different strata such as the authors' location, problem, types of company, sector and institution. After conducting the bibliometric study, it is expected that the results will be useful to visualize and guide how certification programs in Management systems in Brazil are contributing to companies for more positive results and also to observe the panorama of how academic production is positioned on this topic.

Keywords: *Sustainable Development, SGI*

Bio-CNG Production from Food Waste Biomass Product: From Principles to Implementation

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Abstract

Food Residue Biomass (FORBI) product was generated by drying and shredding pre-sorted Fermentable Household Food Waste, collected door-to-door in the Municipality of Halandri, Greece. FORBI is a homogeneous biomass product, devoid of odours that can be maintained when stored for prolonged periods of time because of its low moisture and used to produce alternative biofuels, compost and other valuable products. A 4 m³ mesophilic CSTR was used for the anaerobic digestion of FORBI. Under optimal conditions, almost 0.5 Lbiogas/Lbioreactor/d were produced with an average methane content of 65%. The anaerobic digestion of FORBI was modeled using ADM1 in the AQUASIM (Reichert, 1994) software framework. The produced biogas was upgraded to biomethane using an amine scrubber. The produced biomethane was devoid of H₂S with high purity of methane (98%). Finally, biomethane was compressed to 200 bars producing bio-CNG. The bio-CNG was used to move the waste collection trucks in a circular economy concept.

Keywords: *Food Residue Biomass (FORBI), Bio-CNG*

Biogenic Nanoparticles Toxicity toward Lettuce Seedlings may Involve Nitric Oxide Pathway

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Abstract

Copper oxide nanoparticles (CuO NPs) have been investigated as a solution for agriculture worldwide problems. CuO NPs are efficiently to inhibit several pathogens and they are been commercially used as nanopesticide. In addition, CuO NPs might be promising for plant growth, development and recovery of degraded soils. However, with its growing use in large agriculture area, its toxicity has been a topic of concern. The molecular pathway leading to these remarkable features of CuO NPs administration may be related to nitric oxide (NO) signaling. NO is a molecular messenger related to abiotic and biotic stress responses. CuO NPs may increase copper ions in plant. The increase of copper ions is well known to decompose S-nitrosothiols (RSNO) and generate NO. Our purpose in this study was to investigate the effect of CuO NPs on lettuce (*Lactuca sativa* L.) seedlings and the role of NO in its process. CuO NPs were synthesized using green tea extract as the reductor agent. They showed an average size diameter around 10 nm, as assessed by transmission electron microscopy (TEM). The lettuce seedlings were exposed to a wide CuO NPs concentration range of 0.2 to 300 $\mu\text{g mL}^{-1}$ and the germination rate and radicle elongation were analyzed. CuO NPs concentrations under 40 $\mu\text{g mL}^{-1}$ showed no phytotoxic behavior to lettuce seedling whereas concentrations equal or above 80 $\mu\text{g mL}^{-1}$ showed moderate to strong phytotoxic behavior. The optimum concentration was found to be at 20 $\mu\text{g mL}^{-1}$ which showed an enhancement of germination and radicle growth of lettuce seedling

Keywords: *Copper oxide nanoparticles (CuO NPs), Lactuca sativa L., Transmission Electron Microscopy (TEM)*

Brazilian Biodiesel Policy: Advances, Challenges and New Perspectives

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Abstract

The Biodiesel Production and Use Program (PNPB), launched in 2004, was the first rural and energy policy with social directives in Brazil. In addition to the implementation of the biodiesel industry and market, the Program aims to include family farmers as suppliers of raw materials. This work analysed the PNPB performance based on social, economic, technological and environmental dimensions since the start of compulsory blend at 2% in 2008. The environmental dimension is not explicitly mentioned in the Program goals but the literature review showed that it became a concern of the Brazilian scientific community by 2012. There was a reduction in external dependence on imported diesel and an economic advantage in this balance. The average annual income of the families included has increased but the social inclusion remain below expected, around 60.000 families, as the diversification of raw materials. This work suggest that the National Biofuel Policy (RenovaBio) can set new guidelines for the biodiesel expansion. The discussion points out about the necessity of innovations and greater use of waste materials at biodiesel production to compete with advanced biofuels. The RenovaBio Policy also need to consider the indirect land-use change (ILUC) emission for the Decarbonisation Credits (CBIOs) trade.

Keywords: *Biodiesel Production and Use Program (PNPB), Indirect Land-Use Change (ILUC), Decarbonisation Credits (CBIOs)*

Brazilian Potential for the Production of Organic Fertilizers Using Different Agricultural Wastes

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Abstract

The large Brazilian agricultural production is due in part to the high use of fertilizers, which results in dependence on these inputs. This study investigated the production capacity of organic fertilizers from waste generated in the main Brazilian agricultural and agro-industrial sectors. The circular economy can be promoted by contrasting the Brazilian production capacity with the demand for the agricultural market. In this sense, a bibliographic study was performed based on Brazilian agricultural production, agro-industrial waste and composting. It was observed that soybean, corn, and sugarcane crops are the largest generators of agricultural waste in 2016. For the year 2016, it was observed that the agricultural sector produced 21.4 million tons of swine manure and 56.8 million tons of waste from the poultry industry. It was possible to identify that the composting as a viable alternative treatment for most waste studied in the investigated regions. Also, it was found that, in quantitative terms, the amount of organic fertilizer that would be produced from these residues would exceed the demand of the national market. Thus, there would be Brazilian self-sufficiency in the organic fertilizer production sector, promoting the circular economy and environmental quality in the country.

Keywords: *Organic Fertilizers, Agricultural Wastes*

Building Information Model (BIM) and AQUA Haute Qualité Environnementale Certification (AQUA-HQE): Convergence towards Sustainability

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Abstract

Civil construction (CC) is essential for socioeconomic development by providing infrastructure, housing and job creation. However, civil construction is a major polluter. Then, several initiatives has been created to promote sustainability in civil construction, such as certifications, highlighting the Haute Qualité Environnementale (AQUA-HQE) certification. On the other hand, another influencer of CC is the adoption of the Building Information Model (BIM), a reference architecture for managing information throughout the life cycle of the building, but which does not yet explicitly consider aspects of sustainability. Thus, this research aims to evaluate the use of BIM in the development of sustainable projects together with the AQUA-HQE certification. It is a research of an applied nature, with a qualitative and quantitative approach, with descriptive and propositive objectives, with data collection based on bibliographic survey and documentary research. As a result, a feasibility study is expected for, and the creation of, a prototype tool within the BIM system that contains the AQUA-HQE certification criteria and is able to verify, if possible automatically, if the project in question preparation is sustainable according to the AQUA-HQE certification criteria.

Keywords: *AQUA-HQE, Building Information Model*

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Cadmium Sulfide Quantum Dots for Dye Effluent Treatment in Megathermal Climate Countries: Validation on of Rhodamine B

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Abstract

Nanoplate shaped cadmium sulfide (CdS) quantum dots (QDs) of 3.5nm size with increased band gap of 0.2 eV were prepared through host-guest mechanism using β -cyclodextrin as a reducing agent. Observed band gap and UV/vis spectral data assures the absorption capabilities of CdS nanoplates in visible light regions. Photocatalytic efficiency of CdS QDs was evaluated on the degradation of rhodamine B as model dye under solar light. The optimum parameters for the effective degradation obtained are (i) amount of catalyst: 50 mg , (ii) concentration of dye: 4ppm , (iii) pH of the medium: 7, (iv) reusability of catalyst: 90%, and (v) duration for complete decolourisation: 300min. A possible degradation pathway has been proposed based on the isosbestic points obtained in the absorption spectra and literature evidences. The study confirms the CdS QDs as an industrially important low cost material which could work effectively for the dye effluent treatment in megathermal climate countries.

Keywords: *Rhodamine B, Cadmium Sulfite, Dye Effluent*

Carboxylic and Non-Carboxylic Functionalized Natural SiO₂ Nanoparticles: Synthesis, Functionalization, Characterization and Uptake of Scandium (III) Ions from Aqueous Medium

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Abstract

The main purpose of this work is to develop an environmentally friendly and economically effective process to produce nano adsorbent which can separate scandium metal ions Sc (III) from an aqueous phase. Moreover, this approach is fully compatible with green chemistry principles. In this work, natural amorphous silica (SiO₂) nanoparticles were prepared by precipitation method from Iraqi rice husk followed by modification with 3-amino-propyl triethoxysilane (APTES) as coupling agent, 1-(2-pyridylazo)-2-naphthol (PAN) and ethylene-diamine-tetra-acetic acid (EDTA) as ligands. Scandium is a rare and precious metal, which has less abundance in natural mineral ores. It is often recovered in the form of by-products from industrial tailings and residues such as bauxite residue/red mud, accompanied with ample amounts of other impurities such as iron (Fe) and aluminum (Al) which of physicochemical properties are quite similar. Hence, the recovery of Sc from industrial wastes poses a great challenge. To evaluate the potential, the prepared hybrid nanoparticles were used for the solid liquid extraction of Sc (III) ions from model solutions due to the fact the REEs have a strong affinity for oxygen and nitrogen donors. The concentrations of scandium model solutions were investigated by ICP-OES technique. The particle size, morphology, specific surface area, phase structure, and surface modification were characterized by different techniques including SEM, AFM, BET, XRD, XRF and FT-IR techniques respectively. The FT-IR confirmed the surface modification of SiO₂ nanoparticles with APTES and EDTA and PAN functional groups.

Keywords: *SiO₂ Nanoparticles, Scandium (III) Ions*

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Cement Composites with Partial Replacement of Fine Aggregate Fraction by Sugarcane Bagasse Ash

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Abstract

During the process of processing both alcohol and sugar, large amounts of bagasse are generated. This bagasse is used, for the generation of energy in thermoelectric plants. The residue of this process is ash, a product discarded directly in the soil of crops inappropriately. Therefore, in order to dispose of this residue, this work aimed to evaluate the performance of sugarcane bagasse ash in partial replacement of fine aggregate in the production of coating mortar, concrete and concrete blocks for paving (pavers). In the mortar formulations, it was necessary to adjust the workability of the mortars with ash from the w/c ratio. For the concrete mixes, maintaining the w/c ratio, there was an increase in the compressive strength with the insertion of the ash that supposedly occurred due to the packaging of particles. For the paver's mixtures, the improvement of the mechanical properties was also verified with the use of ash, especially for the content of 30% that exceeded the compressive strength in 57.6% of the reference trace at 28 days. In addition, the materials were analyzed for the modulus of elasticity and absorption by immersion and significant improvements were verified with the substitution.

Keywords: *Cement Composites, Sugarcane Bagasse Ash*

Challenges and Opportunities in Coping with Food Waste in Households, Rio de Janeiro State, Brazil

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Abstract

In opposite to a global scenario where hunger affects around 821 million people and food supply forecasts for the coming decades are alarming, 1,3 billion tons of the world food produced is lost or wasted every year. Food waste has social, ethical, economic and environmental externalities. Food waste reduction and prevention are in accordance with the United Nations Sustainable Development Goals, 2030 Agenda for Sustainable Development. Particularly goal 12, Target 12.3 (halve per capita global food waste at the retail and consumer levels) and goal 2 (end hunger and achieve food security). In this sense, this study aims to propose strategies against households' food waste. These strategies were drawn from the main factors that contribute to food waste, identified through a survey conducted with more than 200 families, under different socioeconomic conditions, in the state of Rio de Janeiro, Brazil. The results revealed that simple measures, that could be adopted by any household, such as awareness-raising, better food management alternatives, and use of unconventional parts of fruits and vegetables such as leaves, bark and seeds, can reduce food waste and as a result, contribute to the challenge of achieving environmental sustainability, socioeconomic development and food security.

Keywords: *Food Waste, Households, SDG's*

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Characterization and Analysis of a Sustainable Multi-Modal Supply Chain in the Colombian Dairy Sector

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Abstract

A supply chain can be defined as a process in which suppliers, manufacturers, distributors, retailers, etc. who work together to transform raw materials into final products to deliver to the market. In the dairy sector, supply chains are networks of heterogeneous actors who do not usually form linearly integrated businesses. The integration of various modes of transportation can lead to reduced costs, increased flexibility and improved sustainability indicators. The present work proposes the characterization of the chain for the dairy sector in Colombia and the analysis of multimodal alternatives for the supply of dairy raw material in the Boyacá and Cundinamarca area. For this, the case study methodology is used with qualitative and quantitative data on the current situation (characterization of the logistics model) and possible alternative modes (analysis of scenarios by simulation). The impact on indicators of the three dimensions of sustainability is evaluated.

Keywords: *Colombian Dairy Sector, Multi-Modal Supply Chain*

China's Potential on Future Aluminium Sustainability

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Abstract

As the top producer of primary aluminium, China has confronted grand environmental challenges such as resource depletion, toxic emissions, and pollution in recent decades. Thus, this study aims to examine the China's historical pattern of aluminium demand, forecast its demand and carrying capacity considering six recycling rates for next 30 years. When developing appropriate forecasting models to the study, linear regression and population dynamics with yearly metal demand growth rates while optimizing comprehensive scenario analysis approaches were used. Furthermore, "reserve base", one of the resource sustainability indicators, was adopted as the benchmark in the sustainability analysis. The historical demand shows an obvious elevating tendency over the past 25 years. Especially, since 2000, almost an exponential growth can be observed. The forecasted results of this study indicate that annual aluminium demand will likely fall between 31 Mt and 81 Mt by 2050. The scenario analyses of projections show that aluminium demand will maximize in 2030 through 2.5% to 4.5% annual demand increases and exhibit a slight decline after that, under medium and low population variants. Interestingly, the carrying capacity assessment convinces to preserve the recycling rate in 40-50% under many scenarios concerned balancing the reserve base of 2015. This remarkable result would support to achieve aluminium sustainability in China. In order to achieve the desired recycling rate, China can consider improving government subsidies for recyclers, strengthening systems for the collection of old scrap, and introducing new policies.

Keywords: *Aluminum, Sustainability, China*

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Circular Economy: Sustainability in Sanitation Systems in Brazil, from the Perspective of UN's SDGs

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Abstract

The sanitation sector in Brazil has incorporated the idea of Circular Economy when seeking the sustainability of systems, even on a small scale, through networks of researchers and water reuse centers. The objective is to treat and take advantage of by-products generated in the treatment, such as sludge and biogas in the case of sewage treatment plants. In this context, the circular economy strategy can be inserted, which involves the reduction, reuse, recovery, and recycling of materials and energy. The Sustainable Development Goals (SDGs), send us to some reflections and goals for 2030, and water is present, directly or indirectly, in all of them, specially, in SDGs 6 it brings universal access to water and sanitation; SDG 1 poverty eradication; SDG 10 the reduction of inequalities; SDG 11 sustainable cities and communities, all have deep interfaces with sanitation, being really one of the elements of structuring life.

Keywords: *Circular Economy. Sustainability. Sanitation. Sustainable Development Goals (SDGs).*

Circular Economy and Green Chemistry: The Need for Radically Innovative Tools for Support of Sustainable Business Models

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-

Abstract

Over the last decade, the concept of Circular Economy (CE) has increasingly gained momentum as a way to address sustainable development and overcome the limits of the dominant production and consumption patterns. As defined by the Ellen MacArthur Foundation (2012), the main aim of CE is to increase the efficiency and lifetime of resource use, by promoting the adoption of closing-the-loop production patterns. The role that chemistry may play in the transition towards more sustainable models is crucial, as also denoted by the United Nations in the 2030 Agenda for Sustainable Development, focused on 17 Sustainable Development Goals, out of which 14 ones require appropriate application of chemistry concepts and patterns. Green and sustainable chemistry can be the key to unlock the economic potential of CE, by providing the basis for innovative products, made from renewable feedstocks and designed to be reused, recycled or recovered, with associated minimum energy requirements. In particular, the 12 principles of Green Chemistry (GC), formulated by Anastas and Warner (1998), are perfectly consistent with the CE model, to promote a decrease of the environmental impact of chemical products by considering aspects of their entire life cycle, from raw material to product use and fate. In this study, principles of GC together with a Life Cycle Thinking approach are applied to the residues of different supply chains (in particular agricultural and bio-based processes) to assess the prospects in terms of reducing impacts and responding to the demand for innovation generated by the depletion of non-renewable resources.

Keywords: *Green Chemistry, Sustainable Business Models*

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Circular Economy as a Driver to Sustainable Business Management

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Abstract

Circular economy can play an important role in the development of sustainable business management and it can be seen all throughout an organization. The organizational concern regarding environmental management has been growing worldwide. Environmental improvements in business activities encourage companies to think and act towards reducing the negative effects from ill environmental performance. Therefore, the study aims to discuss how circular economy may guide sustainable business management. On top of it, to the best of the authors' knowledge, this piece of research is unprecedented on the creation of a key-path map. To that end, it was identified the main business areas, within an organization, correlated to circular economy, namely strategic planning, cost management, supply chain management, quality management, research and development environmental management, process management, logistics and reverse logistics, service management and organizational culture, allowing a discussion on the main contributions of circular economy in each organizational area. The investigation allowed constructing a key path map providing researchers and practitioners with circular economy insights to sustainable business management practices. The study is a great driver for the industrial and academic sectors. It can assist in organizational decision making towards a more sustainable planet, providing knowledge and practice-based insights on the identified areas correlated to circular economy.

Keywords: *Circular Economy, Sustainable Business Management*

Circular Economy Case Study: The Use of Industry and Community Wastes for Production of Low Temperature-Glass Ceramic Tiles

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Abstract

Waste glass has become a global environmental problem due to landfill space occupancy. The waste glass is regarded as "a dangerous waste" in Thailand so the elimination of this waste needs special care and budget. In this paper, waste glass and fly ash, a by-product of the coal power production, were used for the production of glass-ceramic tiles. The waste glass was collected from the local municipality and was processed into powder of the required particle size. The glass powder was subsequently mixed with fly ash powder at various ratios and sintered at 700-1000 °C. As enriched with fluxing materials in both starting components, the glass-ceramic tiles could be sintered at the temperature > 1000 °C, rendering it an attractive choice for the glass-ceramic industry.

Keywords: *Waste Glass, Ceramic Tiles, Circular Economy*

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Circular Economy in the Dairy Industry

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Abstract

In opposite to a global scenario where hunger affects around 821 million people and food supply forecasts for the coming decades are alarming, 1,3 billion tons of the world food produced is lost or wasted every year. Food waste has social, ethical, economic and environmental externalities. Food waste reduction and prevention are in accordance with the United Nations Sustainable Development Goals, 2030 Agenda for Sustainable Development. Particularly goal 12, Target 12.3 (halve per capita global food waste at the retail and consumer levels) and goal 2 (end hunger and achieve food security). In this sense, this study aims to propose strategies against households' food waste. These strategies were drawn from the main factors that contribute to food waste, identified through a survey conducted with more than 200 families, under different socioeconomic conditions, in the state of Rio de Janeiro, Brazil. The results revealed that simple measures, that could be adopted by any household, such as awareness-raising, better food management alternatives, and use of unconventional parts of fruits and vegetables such as leaves, bark and seeds, can reduce food waste and as a result, contribute to the challenge of achieving environmental sustainability, socioeconomic development and food security.

Keywords: *Circular Economy, Dairy Industry*

Circular Economy in the Guanambi Municipality: A Preliminary Sought

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Abstract

Circular Economy (CE) is an approach to promote the responsible and cyclical use of resources, with different implementation scales, from micro (products and process) to macro scale (cities). Based on this concept, the European Union developed some key measuring indicators, comprising of production and consumption to competitiveness and innovation. This study investigated the challenges and opportunities of implementing CE concepts in the Guanambi municipality, Southwest of Bahia. A quantitative assessment comprised data from the National Basic Sanitation System (SNIS) and information on solid waste generation and recycling rates. The compilations showed that the rate of solid waste generation was increasing from 511 kg per capita in a year to 565.75, after five years. However, the recycling rate did not increase at the same level, rising just 0.5% in 5 years (2.5% to 3%). Decrements of solid waste generation indicate necessarily a reduction of consumption patterns: a substantial challenge in developing countries. In Guanambi, a dump receives all the household solid waste, reducing recycling opportunities. At the same time, the current situation favors initiatives, to create more sustainable products, based on CE. It would ideally culminate in a local supply chain, improving reuse and recycling.

Keywords: *Circular Economy, Basic Sanitation System, Guanambi*

Citrus Peel as Biomass for Solid Biofuel

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Abstract

Citrus fruits are tropical and subtropical fruits considered the most cultivated in the world, with orange being the most consumed fruit. Citrus has four main commodities which are oranges (70 percent of total output), tangerines/mandarins, lemons/limes and grapefruits. For developing countries that seek to diversify exports, citrus fruits represent 21% of 60% of vegetable commodities, with 40% of orange production being processed. Brazil, for the past 10 years, has remained at the top of the global orange production, supply and distribution (USDA, 2020; Lin et al., 2013). Agro-industrial waste is among the most abundant and accessible sources of biomass for conversion to solid biofuel, but sustainable bioenergy must be highly efficient. Therefore, the upper (UHV) and lower (PCI) calorific value of biofuel produced from citrus peels (pear orange, ponkan tangerine, Tahiti lemon), rice and English potato were evaluated, both conventional and organic cultivation. For this, density, total moisture content and ash content of twelve compositions were determined. Compressive strength and smoke density using Ringelmann scale were also determined. The UHV of the specimens varied between 14.6-17.2 MJ/kg and LHV between 13.1-15.8 MJ/kg, with the wood between 7.12-10.47 MJ/kg, and all samples presented maximum resistance suitable for the storage and handling of solid biofuel for domestic use. The smoke density for solid biofuel with biomass from organic cultivation was lower than those found in specimens from conventional cultivation. All the biofuels developed showed capability to replace traditional sources of heat.

Keywords: *Citrus Peel, Biomass, Solid Biofuel, LCA*

Cleaner Production: Case Study in a Dairy Industry in Rio de Janeiro

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Abstract

Corporate Environmental Management (GAE) is a worldwide trend, a strategy for sustainable development and compliance with environmental legislation. This article aims to propose the implementation of a Cleaner Production (P + L) program in a dairy industry, thus contributing to the manufacture of products in a sustainable way through the adoption of good environmental management practices, such as: conscious of raw material, reduction of costs associated with production, from the reduction of water and energy use, reduction of costs associated with reduction of pollutants. The adoption of P + L results in benefits for industry and the environment, such as: greater competitiveness, improved image, access to new markets and better environmental performance. For the development of this work, technical visits were made to a dairy industry, located in the state of Rio de Janeiro, Brazil. The diagnosis of the production processes was carried out, identifying the stages of the process responsible for the high consumption of raw material and generation of pollution (atmospheric emissions, effluents and waste), from which improvements were suggested. As a result, it was found that the analyzed industry is concerned with sustainable development, especially regarding the quality of the most efficient products and production processes, with a focus on sustainability.

Keywords: *Dairy Industry, Cleaner Production, Rio de Janeiro*

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Cleaner Production and Circular Economy: An Application in the Food Industry with Contributions to the SDG

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Abstract

Food production and transformation have a growing impact on the environment. Until the time, agriculture has been able to respond to the increase in the demand for food. However, the outlook for the future are uncertain, since the short of natural resources and climate change places the continuous capacity of the sector in a risk. An alternative strategy is to apply Cleaner Production (CP) Practices in order to achieve the fundamentals of Circular Economy (CE) and maximize the level of resource utilization. This research aims to evaluate the eco-efficiency of adopting CP with principles of CE in a large food company, as well as to evaluate the possible contributions to the Sustainable Development Goals (SDG). In terms of economic evaluation, the return on investment was calculated and motivated the executives because the result was less than 1 month. However, the calculated environmental benefits were many times higher than the economic ones, because there were reductions in the consumption of water, electricity and waste generation. These results are aligned with Water-Energy-Food Nexus and contribute with theory, practice and society in order to fill a relevant research gap, present a solution considering the interests of companies and relate to the SDG, respectively.

Keywords: *Food Production, SDG*

Climate Data Considered in Different Levels of Complexity to Estimate Nitrogen Emissions

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Abstract

Environmental quantification tools are becoming very popular, and they are using default factors/methods for simplified emission estimations. However, these simplifications may be providing erroneous values, especially, due to the exclusion/underuse of climate data. It is well known the effect of the climate on nitrogen emissions. For instance, nitrate is directly affected by ammonia in soil, which in turn is directly affected by temperature and humidity. At this work, we presented the results of nitrate emissions considering three approaches with different levels of complexity in five climates. The scenarios were created based on the top worldly maize producers. Approach 1, Product Environmental Footprint, showed the highest emissions in all scenarios because it just considers the amount of fertilizer inputs, not outputs. Approach 2 SALCA provided intermediate emission values, considering climate data by using coefficients for precipitation. Approach 3 Daisy, mechanist model that estimates emissions considering the entire nitrogen cycle, provided lowest emissions using adjusted geographical and temporal parameters (i.e. precipitation and temperature). Although the high demand for data makes more laborious and not always the possible application of environmental assessments models, they could be used to calibrate default values.

Keywords: *Climate Data, Nitrogen Emissions*

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Comparative Energy Analysis and Life Cycle Assessment of Typical Municipal Wastewater Treatment Plants

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Abstract

In urban regions, wastewater treatment plants (WWTPs) play a significant role in improving water quality. However, WWTPs would consume nonnegligible resource, energy and manpower, and are expensive to run, and generate sludge and treated wastewater whilst removing pollutants through specific techniques. Meanwhile, implementing upgrades on existing WWTPs is a feasible technical mean to address different water environment problems. The sustainability of the wastewater treatment industry is therefore challenging, and the comprehensive evaluation methods are required for assessing the sustainability of different wastewater treatment processes and schemes. In this study, the method of Emergy Analysis (EA) was applied to evaluate the sustainability of two typical WWTPs and their associated Anaerobic-Anoxic-Oxic (AAO) and Constant Water-level Sequencing Batch Reactor (CWSBR) processes in a certain city in northeast China, placing the total wastewater, resource, energy, economic input and emission of pollutants on the same scale with the improved emergy evaluation indicators. Based on the EA results, Life Cycle Assessment (LCA) was employed to analyze the potential environmental impacts of technical upgrades to existing WWTPs. The research results may provide a reference for policymakers to select the most sustainable and environment-friendly treatment processes and upgrade schemes for future wastewater treatment projects.

Keywords: *LCA, wastewater treatment plants*

Comparative Life Cycle Assessment of Two Types of Packaging for Household Cleaning Products

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Abstract

The consumption of products by modern society is constantly growing, generating large amounts of waste after the disposal of packaging. The impossible disassociation of packaging with the main product reinforces the importance of knowing the impact generated by these materials, from their production to the final disposal. The aim of this work was to compare the environmental efficiency of two types of packaging for household cleaning products in the state of São Paulo through life cycle analysis. The primary data for the modeling were obtained in a household cleaning industry in São Paulo and the secondary ones obtained in the GaBi software libraries. Impact assessment was carried out using the IMPACT 2002+ method, considering global warming potential and non-renewable energy consumption. The results showed that the Auto doser bottle presents a better environmental performance, with lower emissions of greenhouse gases and lower consumption of non-renewable energies. The processes that have the greatest influence on the global warming potential are the production of the electric energy consumed in both process and the production of the high-density polyethylene. The production processes of high-density polyethylene and low-density polyethylene plastic are the main contributors to the consumption of non-renewable energy.

Keywords: *Environmental Impacts, Polyethylene, LCA, Packaging Industries.*

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Comparison of Performance of Different Urea Production Methods Based on Economic Cost, Energy Consumption and Emissions' Impacts

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Abstract

With the development of urea production driven by agriculture, this industry is increasingly challenged by its high energy consumption and pollution especially in China. It is necessary to compare performance of different urea production methods for decision-making. Hence, this study evaluated the comprehensive performance of six scenarios of urea production (scenario 1 (2 and 3): natural gas ammonia production + carbon dioxide stripping to produce urea (ammonia stripping to produce urea and aqueous solution full-cycle urea production); scenario 4 (5 and 6): coal ammonia production + carbon dioxide stripping to produce urea (ammonia stripping to produce urea and aqueous solution full-cycle urea production)) using the proposed indicator system based on economic cost, energy use, and emissions' impacts from a life-cycle angle. The study results show that (1) the lowest economic cost per unit product is scenario 5 (1.90E+04 \$/t); (2) the minimum energy consumption per unit urea is scenario 5 (5.96E+04 MJ/t). Therein, the indirect energy consumption occupies 54.4751-54.9787% of total energy consumption; (3) as for pollution emissions' impacts, NH₃-N consumes the largest ecological services (99.8773-99.9514%) and the energy loss is mainly caused by SO₂ (48.9084-61.5037%). Comparatively, scenario 5 is more worth of promoting. Finally, some targeted suggestions are proposed.

Keywords: *Urea Production, Environmental Impacts*

Computational Modeling of Oily Sludge Gasification Process to Generate Electrical Energy Using Aspen Plus™ Software

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Abstract

This article studies the process of gasification of oily sludge from the oil refining and storage process, employing computational modeling that considers the chemical equilibrium and whose objective is to evaluate the production of syngas and its potential use for electricity generation, using the Aspen software Plus™ v.11.0. For this purpose, four scenarios were considered for the thermochemical conversion of oily sludge, which differ in the gasification agent (C1 with air, C2 with oxygen, C3 air/vapor mixture, and C4 oxygen/vapor mixture). The results show that the composition of the syngas behaved as expected for C1 and C2 analyzed when the equivalence ratio (ER) was varied, where the molar fraction of H₂ increased with the increase of ER until reaching a maximum value and then a decrease until ER of 0.45, and the molar fraction of CO had an increasing tendency until reaching the maximum value for ER of 0.45. On the other hand, the lower heating value decreased from 10.61 to 3.38 MJ/Nm³ for C1, while for C2, the change was from 12.18 to 7.23 MJ/Nm³. For C3 and C4, three steam/oily sludge ratios were used, and the behavior of the studied parameters was the same as for scenarios C1 and C2. Regarding electricity generation, an internal combustion engine was used, obtaining electrical powers in the range of 290 to 160 kW for all scenarios. Based on the properties of the synthesis gas, it was verified that the gasification of the oily sludge could be a viable alternative for the treatment and energy use of this residue.

Keywords: *syngas, Aspen Plus, oily sludge*

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Congruences between the Environmental Management Systems Requirements and the Organizational Life Cycle Assessment Guidelines

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Abstract

Since 2015, organizations have at their disposal two relevant environmental management standards, namely, ISO 14001 and ISO/TS 14072. The first one guides the implementation of Environmental Management Systems - EMS, which allows the identification, control, reduction and/or elimination of environmental aspects, especially the significant ones, given that, in its third edition, it highlights the life cycle perspective when evaluating its potential impacts. The second one, in turn, proposes to expand the life cycle assessment scope, traditionally applied to products, to the organizational level - O-LCA. The combined use of environmental management techniques adds value to the performance analysis and the decision-making process while helps organizations to meet the precepts of the circular economy and the UN sustainable development goals. Thus, this article aims to study the congruence between these two technical documents, by means of the requirements and guidelines verification and comparison, in order to guide their joint adoption and support in improving the environmental performance of organizations. Using the EMS requirements as reference, the results show that, from the scope definition to the determination of improvement opportunities, O-LCA allows for a clearer and more objective management, also helping to avoid loads displacement throughout the life cycle.

Keywords: *Environmental Management Systems Requirements, Life Cycle Assessment*

Content of Ca, Si and Mg on Percolated Water from Unsealed Roads - A Case of study from Brazil and Considerations of Potential Impact on Local Watershed

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Abstract

The unsealed roads in Brazil cover 1,350,200 km (78.5%) of the total road extension in the country. Since unsealed roads allow percolation and runoff resulting in surface and piping erosion, it is valuable the analysis of potential contaminants that can be carried by water, bringing a new perspective on assessment of water quality deterioration. This study evaluated samples under standard mechanical and chemical unsealed road stabilization methods. The samples were built following a matrix between the standards for unsealed road construction and three traffic volume (high - A, medium - C, and low - F). The sample matrix was tested by Constant Head (CH) tests evaluating the permeability and the Atomic Absorption Spectrophotometry (AAS) assessing the Ca, Si, and Mg content (three major chemical residuals from unsealed roads). This is a preliminary study to provide elements to understand the hydrogeochemical parameters to develop a water quality index for unsealed roads. A total of 90 CH residual water samples were analyzed and the domination of the elements was in the order of Ca>Si>Mg. These elements were 500 - 5.200% higher than natural water. This indicates potentially heavy alkaline percolated water, but more studies are required to understand the behavior of the parameters from this anthropic impact

Keywords: *Unsealed Roads, Constant Head, Atomic Absorption Spectrophotometry (AAS), Water Quality, Percolation, Piping Erosion*

Customer Preferences for Smart Meter Adoption

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Abstract

The Internet of Things (IoT) technologies provide several new features for the typical household smart meters. Despite this, the current literature presents a lack of studies about the adequate myriad of features these smart meters should present to appropriately meet customer needs. This article aims to understand the relation between the households and the smart meter configurations in the purchase decision process by the customer. A market research based on conjoint analysis has been carried out with 202 respondents from the metropolitan area of Florianopolis, in the south of Brazil. The CART decision tree analysis indicated that the availability of a mobile application is the most crucial feature of the smart meter system. It is followed by the possibility to control energy, water and gas. The results also show that home features and energy, water and gas expenses are less relevant in the customer decision to invest money in smart meters. The findings present opportunities to implement more appropriate configuration of smart meters.

Keywords: *Internet of things (IoT), CART decision*

Decarbonising the Global Aviation Sector - Overview Analysis of Selected Strategies

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Abstract

In 2015, closer 3.2 billion passengers a year and around 33% of world trade traveled by aircraft operation. This sector responds for around 3.5% of the global GDP. In the "other hand", the aviation sector, according 5AR of the IPCC, published in 2013, also produce circa de 2% of the world's human-induced CO₂ emission. In emerging economies, like China, India, Brazil, Russia or South Africa (the BRICS, in case), it's absolutely oportune to improve the understanding about the balance of the usually high economic growth of this sector with the global goal, clearly expressed by the United Nations Framework Climate Change Convention (UNFCCC), to reduce the CO₂ emission, helping the stabilization of the concentration of GHG in the atmosphere and mitigating the impacts of the climate change. Ever since the Kyoto Protocol, there has been a strong recommendation for the aviation and marine transportations sectors to lower their GHG emissions. In this context, the global aviation sector announced, in COP 21 (Paris, France, 2015), their global goal to reduce, until 2050, their CO₂ emissions by half, in comparison with their own in 2005. In such context, the present work is an academic research based on literature synergic analysis of the main recent reports produced by the International Civil Aviation Organization (ICAO) and by some of the main actors of the global aviation sector. The main target of the present study is to present an overview (focused in energy, environmental and economic issues) of selected strategies in the context of the main technologic and economic instruments for decarbonizing this sector.

Keywords: *International Civil Aviation Organization (ICAO), United Nations Framework Climate Change Convention (UNFCCC), CO₂ Emissions*

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Decommissioning of Large Ships: Review of Existing Alternatives for Final Destination

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Abstract

Many vessels have been routinely abandoned over the world. Large ships are commonly scrapped on beaches located in Southern Asia, often ignoring minimum safety standards for workers and creating serious health risks and damage to the environment. Concerned about this situation, the International Maritime Organization (IMO) promoted the Hong Kong Convention (HKC), in 2009, in order to establish guidelines for the safe recycling of ships. However, the Convention is not yet enforceable, pending the accession of more countries. The goal of this work is to review alternative practices available for the final destination of vessels after the end of their useful life. International legislation and guidelines have been identified, as well as relevant sources of environmental impacts regarding: traditional shipbreaking carried out on the beaches at Southern Asia; the environmentally preferable recycling proposed by the HKC; and the sinking of ships in order to create artificial marine reefs. We observed that, although environmentally compliant recycling is considered by IMO as the best option for ships that have reached their end-of-life, there are situations where sinking ships to create artificial reefs offers the best solution considering the criteria such as environmental aspects, worker safety and socioeconomic context.

Keywords: *Final Destination, Large Ships, International Maritime Organization (IMO), Hong Kong Convention (HKC)*

Deliberation as a Factor of Reducing Social Conflicts Related to Surface Mining Investments

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Abstract

Primary cause of social conflicts related to mining activities is lack of public trust in politicians and administration, the business world and overly complicated legal regulations. In planning process of surface mining investments spatial development is considered as the fundamental source of social conflicts. Social conflicts related to mining investments should be divided into two main categories: realistic and fictional one. The first category is connected with social objective concerns related to the mine's activity such as; site drainage, noise emission, landscape change, dust, roads destruction. The second category is closely linked with the stereotypes that arise around the mining industry. At the same time building social consensus for mining investments is multidimensional and complicated. Its boundary condition are: objective analysis of the situation, knowledge, lack of prejudices, tolerance, favouring the common interest over the particular one and discourse ethics. Unfortunately many examples indicates, that social debate does not fulfil those conditions and in many cases social decisions are not based on actual facts, but just on popular slogans. Breaking the deadlock in the case of social licence to operate can be done by using the tools of deliberative democracy. It's basic principles democracy are : (a) difficult choices, (b) social judgment, (c) democratic governance, (d) inclusion and equality. Fundamental values of deliberation are: fairness, impartiality, reasonableness, consensus without exclusion and discourse ethics.

Keywords: *Governanca, Social Conflicts, Mining Investments*

Development and Characterization of Ecovio / PBAT / Lignin Nanocomposites Reinforced with Cellulose Nanoparticles

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Abstract

In order to develop new materials in a cleaner production way, the use of agricultural waste and vegetable fibers in the development of biobased and biodegradable materials has increased recently in literature and industrial applications. In this way, bromelia (*Neoglaziovia variegata*) and palm (*Elaeis guineensis*) fibers were used as raw materials in the development of biodegradable polymer nanocomposites. In the present study, the nanocomposites were obtained incorporating cellulose nanocrystals (NCCs) obtained from bromelia fibers in a polymeric matrix based on blends of a commercial biodegradable polymer (Ecovio®) with polybutylene adipate terephthalate (PBAT) and lignin. Ecovio® is a blend of polylactic acid and PBAT, the increase of PBAT leads to a higher polymer workability and it more easily extruded. Lignin is known to enhance mechanical strength, here it was separated from palm fibers. The studied blend leads to a lower cost material if compared with Ecovio®. NCCs were obtained by hydrolysis in sulfuric acid, aprotic and protic ionic liquid. The acquired composites were characterized by thermogravimetric analysis, X-ray diffractometry, electronic transmission microscopy, atomic force microscopy and AFM and tensile test. The nanocomposites showed distinct morphology, good thermal stability and mechanical properties with potential for application in the agricultural packaging sector.

Keywords: *Nanoparticles, polybutylene adipate terephthalate (PBAT), Ecovio*

Development of a Small Pyrolyzer for the Production of Biochar Using Pruning Residues on Small Farms

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Abstract

Pruning residues in small properties and periurban yards can have multiple uses, from firewood in direct burning as an energy source to its use as organic fertilizers. However, the volume of material generated from pruning in tropical regions can be difficult to manage or even to dispose of. In this insertion, the biochar incorporated in the soil can be considered a technology used in the carbon sequestration and also in the recovery of degraded soils. Biochar is produced basically by burning organic matter in environments with little or no oxygen content, this process is known as pyrolysis. The present work designed and developed a small pyrolyzer that makes it possible to transform pruning waste in small properties into biochar. For the development of the project, computer-aided modeling was used. After this modeling, a prototype was built where two pyrolysis were carried out and analyzed. In the first firing, 20.15 kilograms of wood were completely pyrolyzed and carbonized and 8.26 kilograms of biochar were produced, in the second, 12.07 kilograms were introduced and 7.77 kilograms of biochar were generated. The prototype has functionality and potential for use, serving as a foundation for new proposals in this product line.

Keywords: *Small Farms, Small Pyrolyzer, Biochar, Pruning Residues*

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Development of a Visual Assessment Tool for Scholar Buildings

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Abstract

Civil construction is responsible for around one third of global greenhouse gas emissions, and also another third of all waste generated. The construction of a scholar building uses large amount of resources, so periodic maintenance and adequacy of existing buildings is a sustainable option, based on the premises of circular economy. The scholar infrastructure is fundamental in the students' learning process, so there is a need to create a comfortable and stimulating space, in addition to ensuring the constant functioning of the building. Based on the challenge that facility managers face, this study aims to develop a tool for scholar buildings' evaluation, which is easy to view and understand, for application in a visual inspection of a school facility. First, a literature review was conducted, aiming to identify the main criteria in the evaluation of scholar buildings. Then, some parameters were defined to carry out this assessment. Finally, a tool was proposed, in the form of a verification table, which aims to assess school facilities. It was concluded that the tool can facilitate the identification of possible problems in the scholar infrastructure, allowing the prioritization of interventions, ensuring greater comfort to users and less environmental impacts.

Keywords: *Scholar Buildings, Visual Assessment*

Development of an Integrated Framework for Achieving Sustainable Consumption and Production Through SDG Interlinkages

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Abstract

Aiming at decoupling economic growth from resource use and environmental degradation while advancing human well-being, sustainable consumption and production (SCP) stays as a stand-alone Goal 12 but also cuts across many other goals directly or indirectly under the Sustainable Development Goals (SDG). Recognised as one of the most effective enablers for achieving the SDGs, however, mainstreaming SCP in the national development plans remains a fragmented practice by setting individual targets while ignoring the interlinkages among them. This siloed approach has been a major constraint to tapping the full potential of SCP achievements through systemic change and a lifecycle thinking approach. This paper aims to develop a science-based framework on SCP interlinkages. Development of the framework is built upon a comprehensive knowledge on SDG interlinkages which remains a big gap in the existing literature. Two methodologies were applied for building the SCP framework including a systematic literature review on SCP interlinkages in the context of SDGs and the identification of indicators for monitoring. Through an initial expert consultation, major objectives of SCP mainstreaming were identified, including scale of resource use, decoupling, production and consumption patterns, technology, and enabling conditions. In addition, the over-arching role of Target 12.1 on implementation of the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns (10YFP) and using a circular economy as an entry point for implementation were recognised.

Keywords: *SDG Interlinkages, Sustainable Consumption*

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Development of Design Criteria for Net Zero Energy Building in Composite Climate Zone

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Abstract

Buildings nowadays are expected to be designed to meet higher energy performance, sustainability to enjoy healthy and comfortable environment for the occupants. With the growing public awareness of environment issues, the energy efficient design concept for construction of building are being accepted to reduce the day to day energy demand of the building. In this scenario, net zero energy building design is one of the solution to combat global warming by reducing energy demand and simultaneously use of renewable energy to run the operations of the building. This research work has exhaustive study for development of design criteria of net zero energy building in composite climate zone. The detailed technical parameters with respect to planning, orientation, envelope, HVAC, use of energy efficient materials in designing the building were analyzed and evaluated. There are three key design strategies to design net zero energy building; passive design strategy, active design strategy and renewable energy strategy. The net zero energy balance equation is derived from the three main design strategies supporting from four equations evaluating the total annual demand of energy, annual energy consumption reduction and annual renewable energy generation under the boundary of the building. This equation of net zero energy building was validated on designing and construction of BISA building located at Ludhiana, Punjab falls under the composite climate zone. The analysis, evaluation and validation have been carried out on system generated model of the building.

Keywords: *Net Zero Energy, Climate Zone, Design Criteria*

Development of Water Security Index for Saskatchewan using Grey Model Analysis

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Abstract

Today, water security can be the origin of several positive and negative developments in the world. As an initial step to cope with the crisis of water supply and demand stability in a sustainable and resilient way, measuring of proper water security index is required to motivate policy actions and assess the efficacy of interventions. The objective of this paper is to develop a water security index for Saskatchewan using Grey systems theory and rough AHP approach. The research method has a two-phase process. First, a Grey prediction model will be developed as an imperative approach to predict the values of different water security indicators like proportion of provincial population covered by a completed source water protection plan risk associated with Water Security Agency's dams, number of dams requiring upgrades, drinking water quality standards compliance, drinking water quality satisfaction, and number of sewage effluent discharges that represent a risk to source waters. Based on the predicted water security criteria values in the previous phase, a rough AHP method will be applied in phase two to achieve an aggregated water security index. This paper presents results from time-series analysis of alternative indicators of water security from Saskatchewan province in Canada.

Keywords: *Saskatchewan, Water Security Index*

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Digital Presence of the Fashion Companies at Facebook and Instagram

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Abstract

Based on the assumption that the interaction with the public, even outside the places where the business takes place (physical store), is the field in which customer loyalty and brand building occurs, the objective is to analyze the digital presence of companies, of the fashion segment of Araranguá - SC, in social networks Facebook and Instagram, based on the digital marketing mix. The analysis takes place under the focus of the Digital Marketing Mix, more specifically, the 8 P's of Vaz (2011). The theme is linked to the research interests developed in LABeGIS - Laboratory of Management, Innovation and Sustainability, linked to PPGTIC and to the research line Technology, Management and Innovation. Among the results are: the wide use of social networks by the companies of Araranguá-SC, analyzed in this research, highlighting: 1) the highest growth of Instagram in the analyzed period - both in number of followers and in publications of the pages and averages of interactions with customers - although, Facebook is a tool with more technological resources and more users, so far; 2) positive results in terms of interactions with the public were identified, associated with good practices such as regularity of publications, good image quality, mainly containing "real" people (clients, digital influencers and celebrities), 3) use of hashtags for potentialization of the reach, promotion of interactivity, 4) it was observed the absence of the sustainability theme in the social networks of the analyzed companies and, therefore, future studies can be developed in search of new knowledge on the use of digital marketing in social network

Keywords: *Fashion Companies, Social Networks*

Do Copper Oxide Nanoparticles Affect the Root-to-Plant and Soil-to-Plant Elemental Mobility in Lettuce (*Lactuca sativa*)?

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Abstract

One of the greatest challenges in the agriculture field is to provide an efficient and sustainable production. Nanotechnology has received a considerable focus as a feasible tool to overcome this challenge. Thus, copper oxide nanoparticles (CuO NPs) have been studied for agricultural applications, however information about their impact on elemental mobility in crops are still scarce. In this study, the effects of using CuO NPs on lettuce (*Lactuca sativa*) macro and micro elements distribution and mobility were evaluated. Pot experiments were performed, testing foliar and soil irrigation applications. The mobility indexes were calculated from root-to-plant (translocation factor-TF) and soil-to-plant (bioaccumulation factor-BF) in dry-base. An increasing of TF for Cd, Cu, Cr and Li and an increasing of BF for Ag, Ba, Cd, Li, Na, P, S and Zn was observed by foliar application. The soil irrigation application resulted in a TF increase for Cr and Cu and a decrease for P; and a BF increase for Cd and a decrease for Ag and Ba. Thus, our findings showed that CuO NPs exposure resulted in significant differences ($p < 0.05$) on several elements mobility and therefore this is an important parameter to be evaluated on NPs viability for agriculture applications.

Keywords: *Nanoparticle, Copper Oxide, Lettuce*

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Domestic Scale Energy-Water Nexus among LIGs in Tropical Countries

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Abstract

This article presents a comprehensive analysis of the energy-water nexus in rural tropical areas based on extensive field survey, focus group discussion, and interview with key informants. It presents the findings in five key areas: household water management, household and farming generated solid waste management, cooking fuel options, health and well-being and water related vulnerability. It has been found that agriculture forms the backbone of rural LIGs in tropical areas and they suffer from improper household and farming wastes disposal problems and lack access to safe drinking. Biogas for rural energy is sustainable, affordable, and has no negative effect on people's health or the environment, if handled properly, with animal dung and kitchen wastes as potential substrates. Water from tube wells are widely used for drinking, but this along with the lack of sanitation, causes frequent outbreak of water-borne diseases. Improper storage of water, poorly maintained tube wells, and arsenic in shallow wells pose additional threats to health like arsenicosis. This article suggests a combination of low-cost domestic scale DIY bio-sand filters for treating drinking water and biogas plants for solid waste management to obtain cooking fuel and manure for farming exploiting the warmer temperatures of these regions.

Keywords: *Energy-Water Nexus, LIG's, Domestic Scale*

Drinking Water Quality in Indigenous Reserves in the Region of Chapadão Parecis-Mato Grosso, Brazil

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Abstract

Unsatisfactory drinking water systems have enormous implications for environment and consumers, especially people still do not have basic sanitation facilities. Inadequate collection, treatment and supply water is common in the indigenous people because of lack management resources and guidelines for drinking-water quality. In this study, we evaluated the quality water for human consumption without treatment (food, hygiene and recreational activities) in four indigenous villages, of ethnic Parecis. We performed seven bimonthly collections from November 2016 to September 2017. The results showed water streams are not in accordance with Brazilian legislation (CONAMA Resolution No. 357, 2005 and CONAMA Resolution No. 274, 2000), which establishes the maximum limit of 200 thermotolerant coliforms per 100 milliliters in 80% of the sampled water or more of at least six samples collected during a one year period and undertaken every other month. The highest point values were C2 (EC was 5.5×10^4) and D1 (6.8×10^4) and EC value differences were between the dry and rainy periods, that are associated with trash deposits and other contaminants localized on the rivers banks. Our outcomes revealed that water used to food, hygiene and recreational activities have a low quality and without treatment, harming the health of indigenous people.

Keywords: *Thermotolerant microorganisms, Water Security, Drinking water*

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Drivers of Socioeconomic Development: Disclosure of Entrepreneurial University

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Abstract

How to make a university more entrepreneurial? Connecting it to society and the market, with projects that foster entrepreneurial thinking, both for economic and social development, with funding for all: researchers, students, entrepreneurs, making their surroundings more sustainable and improving life in vulnerable communities. This is a real social innovation! This article aims to analyze the elements that make the university an innovative organization. The university faces several questions about its core mission: teaching, as well as its research and extension activities, challenging its capacity for dialogue with society. In this sense, we can highlight two extremes: a perspective of the university that performs its actions beyond "walls", reaching entrepreneurship, innovation and technology transfer. And, the perspective of philanthropy or assistance, contrary to the involvement of the university with the demands of the productive sector, in which entrepreneurship should be encapsulated in special groups of the university. Universities exhibit in their mindset, traditional schemes, which present problems to deal with the growing demand for people who seek qualification, interdisciplinarity and diversity and, at the same time, with the significant increase in evasion, which make their stay at university, less attractive. As methodological procedures, we have: (1) Systematic Literature Review; (2) Construction of a questionnaire to verify the elements that constitute the entrepreneurial university for the economic and social development of a region, which will be submitted to specialists (key actors in universities).

Keywords: *Socioeconomic Development, Entrepreneurial University*

Drivers of Socioeconomic Development: The Disclosure of Third Mission of the Universities

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Abstract

How to make a university more entrepreneurial? Connecting it to society and the market, with projects that foster entrepreneurial thinking, both for economic and social development, with funding for all: researchers, students, entrepreneurs, making their surroundings more sustainable and improving life in vulnerable communities. This is a real social innovation! This article aims to analyze the elements that make the university an innovative organization. The university faces several questions about its activities, challenging its capacity for dialogue with society. In this sense, we can highlight two extremes: a perspective of the university that performs its actions beyond "walls", reaching entrepreneurship, innovation and technology transfer. And, the perspective of philanthropy or assistance, contrary to the involvement of the university with the demands of the productive sector, in which entrepreneurship should be encapsulated in special groups of the university. Universities exhibit in their mindset, traditional schemes, which present problems to deal with the growing demand for people who seek qualification, diversity and, at the same time, with the significant increase in evasion, which make their stay at university, less attractive. As methodological procedures: (1) Systematic Literature Review; (2) Questionnaire with key actors; (3) Content analysis to verifying the social impact of the university, its third mission. Brazil, as an emerging country, needs to provide the means and legal certainty for universities to play a new role in a knowledge-based economy.

Keywords: *Third Mission, Socioeconomic Development*

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Drones Application in Identifying Plant Faults for Sustainable Agriculture

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Abstract

The use of innovative technologies in precision agriculture is the answer to the changing needs of agricultural systems and environmental agencies. Precision agriculture can be used to make precise temporal and spatial decisions for increased efficiency and sustainable management. The use of drones provides an excellent opportunity for agricultural mapping allowing to identify planting failures caused by diseases, pests, lack of water and fertilizers, etc. Real-time remote sensing with high resolution and wide spatial capture allows for targeted decision making for objective actions with lower environmental and treatment impacts for improved planting, broadening the sustainable approach to the agricultural sector. The objective of this work is to evaluate studies already carried out in the identification of failures in drone plantations, and the results pointed to favorable data with its use, being a fast and accurate technology, enabling customized actions such as replanting sizing, application herbicides only in necessary locations and not in whole planting. The use of drones makes it possible to better plan the agricultural area so that failures do not recur, thus driving gains in sustainability and improved crop productivity.

Keywords: *Drones, agricultural mapping*

Dry Anaerobic Digestion of the Organic Fraction of Municipal Solid Waste (OFMSW), for Considerable Water Savings in Brazil and México

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Abstract

The proliferation of the organic fraction of municipal solid waste (OFMSW) is currently a serious problem in many developing countries, which has been translated into significant health and environmental issues (e.g. watershed contamination, pests, among others). Technologies such as Dry Anaerobic Digesters (DAD) can efficiently assist on meeting waste treatment needs. These technologies offer considerable advantages over other treatment methods, such as supply energy demands, produce fertilizers from digestate materials, contribute to reduce greenhouse gases (GHG) emissions, social benefits, among others. The importance of DAD systems also lays on the utilization of considerably less water quantities than traditional wet anaerobic digester systems, reducing the water footprint. This research attempts to prove this and demonstrate the feasibility of large-scale DAD plants to treat the OFMSW, particularly for arid and semiarid zones. For this purpose, this research conducts case studies to determine the real viability of DAD technologies in comparison with traditional wet anaerobic digestion plants, analyzing their effects in waste management, water savings and energy generation in Brazil and Mexico. Their applicability as large-scale digesters in these countries is deemed necessary for a sustainable treatment of the OFMSW, and remains to be demonstrated, which is the main intention of this project.

Keywords: *Organic Fraction of Municipal Solid Waste (OFMSW), Greenhouse Gases (GHG), Dry Anaerobic Digesters (DAD)*

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Ecological Concern has Direct Effect or Moderation Effect to Individual Perception of Social Impact and Social Innovation Intention

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Abstract

Social Innovation refers to the innovator pursuit of changing society, but not based on the income framework to strengthen social change and innovation, but more concerned about results and social change. In previous studies, there has been few discussion of individual perceived social impact to intention of social innovation. Previous experience or knowledge of social problems can affect attitudes and perceived social impact. The ability of individuals to understand the views and needs of the potential helped is positive related to the understanding of the actions needed. Previous experience, prosocial motivation and perspective taking may influence the individual perceptions of social impact. The purpose of this study is to identify the variables of attitude to explain the individual's behavioral intention, and the higher the individual's willingness to engage in social innovation when they feel that the greater the perceived social impact. This study suggests that individual perceptions on social issues can motivate individuals to perform better and help solve social and environmental problems. However, consumers around the world also want to buy more environmentally friendly products or services. Individual concern for environmental issues may moderate the relationship between individual perceived impact and social innovation intentions.

Keywords: *Social Impact, Social Innovation Intention*

Ecological Risk Transfer Model of Urban Agglomeration

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Abstract

The ecological risk of urban agglomerations has attracted great attention from human beings. However, the complexity of urban ecosystems and the limitations of existing risk analysis methods, has affected the ecological security protection of urban agglomerations. In this study, based on the direct pathway and indirect pathway of ecological risk transmission, which includes air pollution transmission pathway, water pollution transmission pathway and economic transmission pathway, the urban interaction effects under three risk propagation pathways were accounted. Further, the Bayesian network method was used to simulate the ecological risk transfer process between cities and optimize the ecological risk transfer network of urban agglomerations. Finally, taking the Pearl River Delta city cluster as an example, ecological risk transfer network is simulated. This research can provide scientific basis for ecological risk management and ecological security guarantee of urban agglomerations.

Keywords: *Urban Agglomeration, Ecological Risk*

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Economic Development and Sustainable Ethical Transitions: A Reading of the Water Crisis in the PCJ Hydrographic Basin, São Paulo, Brazil

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Abstract

With the concept of economic development, we observe that the activity of production and consumption of goods and services in constant growth is necessarily associated with social progress. However, there are limits. The intensive use of raw materials and energy has proved, in recent history, to be harmful to the environmental balance, requiring a new stance from economic agents. Thus, sustainable consumption would be the adoption of a lifestyle that seeks to promote social welfare indexes, minimizing the environmental impacts of economic activity. Among the natural resources used on a large scale, water, in order to be sustainable, requires that supply is in constant balance with demand. Where recently occurred, stress or water scarcity are phenomena that have been offset by ethically sustainable behaviors adopted by consumers. Based on documentary research, this study presents the mechanisms and processes of behavioral economics with which the River Basin Agency Piracicaba, Capivari, and Jundiaí manages water resources. The results of this analysis show that even with a reduction in water availability in the last six years, it was not necessary to resort to the suspension of its supply. The change in posture stimulated towards sustainable water consumption is considered fundamental for this achievement.

Keywords: *PCJ Basin, Water Crisis*

Economic Feasibility of Sustainable Strategies in the Purchasing Department of a Higher Education Institution in Brazil

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Abstract

The promotion of conscious consumption has become imperative in a society that has been rethinking its development model. The act of buying is increasingly expected to be based on sustainable criteria, both by individuals and institutions. For example, for a higher education institution (HEI), which demands large quantities of materials and inputs, sustainable purchases can represent an opportunity for multiple benefits listed in the social, environmental and economic dimensions. However, at the same time, sustainable purchases, given their unprecedented nature for many organizations and the lack of information, can increase speculation about the negative effects, especially those related to the economic part, making studies that facilitate decision making necessary. Therefore, the objective is to analyze the economic feasibility of two strategic options for sustainable purchases in a Brazilian HEI. The possibilities of replacing fluorescent lamps with LED and internal combustion cars with electric vehicles were analyzed. The results show that, between the two options, the purchase of LED lamps, despite the high investment, can present economic advantages in the short and long term. The results also discussed the possible impacts of the strategies sought by the HEI on social and environmental aspects.

Keywords: *Higher Education Institution, LED lamps, Sustainable Strategies*

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Economic Valuation of the Manure from Sheep and Beef Production Systems

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Abstract

The objective was to calculate the balance of nutrient use in production systems of lambs and beef cattle and to economically value the nutrients that remain in the system in the form of manure. The lamb production system occurred a stabilized herd with 300 matrices and the sale of 343 lambs per year. The beef cattle confinement system accounted for an annual production of 27,000 animals. For the calculations, the elements nitrogen (N), phosphorus (P), and potassium (K) were considered, the inputs being the diet and animals bought and the outputs being the sold or dead animals. The estimated value of manure was calculated based on the average market price of equivalent fertilizers such as urea, simple superphosphate, and potassium chloride. The balance represented the nutrients left in the system, in the form of feces and urine. The balance from lamb production was 887.75 kg of N, 215.95 kg of P, and 351.14 kg of K per year. The total value of manure was R\$ 7,555.12. The balance from cattle production was 563,619.86 kg of N, 89,571.30 kg of P, and 222,288.07 kg of K per year. The total value of manure was R\$ 4,368,432.08.

Keywords: *Economic Valuation, Manure, Sheep and Beef Production*

Effect of Formative Quizzes in Engineering Course on Student Learning Outcome

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Abstract

The effect of class activities and online quizzes on student's learning performance has been assessed. Two cohorts of full-time BEng and MEng Chemical Engineering students of Nottingham University in Malaysia campus registered in core chemical engineering modules at levels 4 and 7 were engaged in the study. There were 155 and 37 full-time students in level 4 (1st year) and level 7 (4th year) respectively. Nearly 64% of the level 4 students attended all quizzes and 2% were absent or attended one quiz. The level 7 students, on the other hand, showed less interest in the informative quizzes as they were not summative assessments. The analysis shows a strong linear correlation between the student's quiz participation and year average marks. The average module mark of level 4 BEng and MEng students was 4% higher than their yearly average marks. However, the module average mark of the level 7 module was 2% lower than the year average marks which may be due to their low participation in quizzes stems from lack of regular revisions and deep learning activities.

Keywords: *Formative Quizzes, Engineering Course, Learning*

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Effect of Portland Cement Implementation on Fractural and Microstructural Properties of Fly Ash-Based Geopolymer Concrete

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Abstract

Geopolymer concrete is one of sustainable materials, which it is not only reduce CO₂ emissions, but it also utilizes waste materials such as fly ash, blast furnace slag, or metakaolin. This study aims to investigate the effect of Portland cement incorporation in fly ash-based geopolymer concrete mix design. Portland cement was implemented by 0%, 5%, 10%, and 15% respectively. The sustainable binder to water ratio was 30%. Fracture test, compressive strength, and scanning electron microscope test were conducted to investigate the effect of Portland cement replacement. The geopolymerization process was monitored using acoustic emission sensors. The results showed that the compressive strength and fractural energy was increased when the Portland cement replacement was increased. The acoustic emission activity, attributed to the geopolymerization process, was enhanced when the Portland cement ratio was increased. The microstructural pattern was smoothed and microcracks were eliminated once Portland cement incorporation was improved. The results showed that using Portland cement as a partial replacement improved the mechanical and microstructural properties of fly ash-based geopolymer concrete.

Keywords: *Portland Cement, Geopolymer Concrete*

Effect of Process Parameters on the Extraction of Lignin from Lignocellulosic Biomass

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Abstract

Lignocellulosic biomass is regarded as a renewable alternative to fossil resource for the production of transportation fuel and chemicals. Lignocellulosic biomass constitutes of cellulose, hemicellulose, lignin, extractives and ash. Each of the biomass constituents has a unique molecular composition and structure. Effective use of the constituents (cellulose, hemicellulose, lignin, and extractives) in a bio-refinery is crucial for the sustainable production of fuel, chemical, and fine chemicals. Our approach is to disintegrate biomass into its constituents and subsequently upgrading the fractions to target precursor molecules. In the present studies, the focus is given on the extraction of the lignin fraction from beech wood chips. The effect of extraction parameters (pressure, temperature, time, and NaOH concentration) on lignin yield and purity has been studied. Three processing parameters (temperature, time and NaOH concentration) are lumped to severity factor (Ro) and their combined effect on the extraction of lignin has been studied. With increasing severity factor, lignin yield and purity increased. At (Ro) value of 7.66, lignin yield was 92% with 65.8% purity. The isolated lignin was characterized by SEM, FTIR, TGA and its heating value was assessed in Bomb Calorimeter.

Keywords: *Lignocellulosic Biomass, Lignin*

Effects in productivity and Leaf Gas Exchange in Lettuce (*Lactuca sativa L.*) using Copper Oxide Nanoparticles Biosynthesized with *Camelia sinensis*

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Abstract

The population, according to estimates, will be over 9 billion by 2050. Therefore, increased agricultural productivity is required. Thus, copper oxide nanoparticles (CuO NPs) have been used to increase productivity. Moreover, the biogenic synthesis of NPs is considered eco-friendly, cost-effective, and less toxic than traditional synthesis that used organic solvents and results in toxic byproducts. Thus, this study aimed to evaluate lettuce productivity (radial and longitudinal length, number of leaves and the fresh and dry weight) and leaf gas exchange (CO₂ assimilation, transpiration and stomatal conductance) applying CuO NPs. Plants were exposed by two different types of expositions (foliar and irrigation) and treatments (CuSO₄ salt and CuO NPs). Foliar exposition improved the fresh weight and number of leaves in comparison with control ($p < 0.05$). The NP treatment improved the dry weight as well as the salt treatment improved the longitudinal length. No statistical difference was observed in radial length. Regarding the leaf gas exchange, the CO₂ assimilation increased slightly after treatment with NP via foliar exposure. However, the salt decreased significantly compared to the control ($p < 0.05$). The stomatal conductance increased slightly with both expositions and treatments applied. Regarding the transpiration values, there was high variability among the measurements, which may be related to the time when each plant was measured. In conclusion, the application of CuO NPs in lettuce increased productivity, which is a promising result for NPs application in lettuce plants.

Keywords: *Nanoparticles, Lactuca sativa L., Camelia sinensis, Copper Oxide*

Emerging Pollutants as Barriers to Implementing Cleaner Production Measures: Case Study on a Pharmaceutical Company

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Abstract

Emerging contaminants are substances still not considered by regulatory standards and whose impacts on environment and human health are unknown; therefore they are not targeted by routine monitoring programs. The work reported here discuss barriers to implement cleaner production measures focused on emerging contaminants. The study was conducted in a pharmaceutical plant and assessed the viability of reusing the effluent generated during equipment cleaning. The effluent contains residues of doramectin, and its reuse is only possible if the substance is present at an acceptable level. The first diagnosed barrier to the proposed measure was the absence of environmental regulatory standards for doramectin, which led to developing and proposing an environmental quality criteria for the substance, based on ecotoxicology data; the derived criteria was considered preliminary due to lack of doramectin-related toxicology data. Also, the absence of analytical methods for quantifying doramectin in the effluent raised the need to estimate its concentration for substance. From the empirical data, we verified that the effluent was toxic to the environment, which is to be confirmed by further analysis. Consolidated studies on emerging contaminants are recommended to ensure the development of sustainable production measures addressing these substances.

Keywords: *Pharmaceutical Company, Cleaner Production, Emerging Pollutants*

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Emergy Evaluation of Crop, Livestock, and Integrated Crop-Livestock Systems in the Brazilian Cerrado and Amazon

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Abstract

Sustainable intensification of agriculture is crucial to deal with the challenges of feeding a growing population while promoting a rational use of environmental and economic resources. In this context, the assessment of means to engender productive synergies aiming at mitigating negative impacts is central to sustain agricultural production. We used the emergy synthesis approach to assess and compare the environmental performance of an integrated crop-livestock system (soybean and beef cattle) to a continuous crop (soybean/corn) and a continuous livestock (beef cattle) system using data from the 2017/18 crop season in Mato Grosso state, Brazil - the largest grain and beef producer in the country, which spans the ecologically diverse Amazon, Cerrado and Pantanal biomes. We used survey and empirical case studies data to characterize the typical farms for each production system. Economic indicators such as gross revenue, production costs and profitability were calculated to complement the sustainability assessments. The emergy indices indicated that the integrated crop-livestock system showed a balanced performance between input use and outputs offered to society. On the other hand, due to its heavy dependence on external inputs, the crop system presented the worst environmental results, whereas its higher productivity warranted the best economic results. Finally, the continuous livestock system results highlighted the challenge of traditional cattle ranches to increase profitability, while also improving the rational utilization of the available natural resources.

Keywords: *Brazilian Cerrado, Amazon, Emergy Evaluation*

Energy, CO₂ Emissions, and Value Added Embodied in the Trade of the BRICS

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Abstract

The BRICS economies group (i.e., Brazil, Russia, India, China, and South Africa) has become an important contributor to the growth of the world economy, which is increasingly concerned about carbon emissions due to the recent increase in energy use in these countries. While the embodied energy use related to emissions of the BRICS group has been discussed in the literature, an integrated analysis of energy, carbon footprints, and value added flows associated with international trade among the BRICS group has, to date, rarely been reported. Based on an improved Multi-Regional Input-Output model, South Africa was extracted from the rest of the world in the World Input-Output Database (WIOD) to analyze the above-mentioned flows embodied in trade within the BRICS countries, as well as between the BRICS group and other economies. The results show that the BRICS economic entity was a net embodied flows exporter. More flows were embodied in intermediate products than in final demand within the BRICS group. Compared with other BRICS economies, China, which is the largest transit country, transferred more embodied flows from Russia to other BRICS countries, and drove more embodied flows from major economies, including the United States and European countries outside the BRICS group than those within the BRICS group. However, China imported a relatively higher embodied energy and CO₂ in per unit value added from the BRICS countries than non-BRICS countries, while exporting relative lower embodied energy and CO₂ per value added to other BRICS economies than non-BRICS countries. The potential policy implications on cleaner development.

Keywords: *BRICS, CO₂ Emissions*

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Energy Recovery from Wastewater Treatment Plants (WTP) as Incentive to Improve Wastewater Treatment in São Luís Municipality, Brazil

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Abstract

In Brazil around 45-55% of domestic wastewater is collected and treated, a scenario which demands a broader coverage to accomplish the Sustainable Development Goals (SDG). The low coverage of sanitation services presents a possibility of utilizing Waste-to-Energy (WtE) technologies, adding value to residues and reducing plant operating costs. The adoption of this solution would foster circular economy and improve solutions for Energy-Water-Food Nexus. The present study aims to evaluate the conditions of WtE technology adoption for wastewater treatment in Brazilian poor municipalities. It analyzes the scenario for the implementation of WtE technologies in the existing and new Wastewater Treatment Plants (WTPs), as an incentive for improving the city's domestic wastewater treatment coverage. The study methodology evolves a literature review based on Archival Research and case study methods. The case study is conducted in the capital of one of the poorest States in Brazil, the municipality of São Luís. The study concluding remarks confirm that local conditions are crucial aspects for the feasibility of energy recovery project, in the case of São Luís wastewater does not have enough biomass to produce economic viable volume of biogas. However, codigestion can be used as a strategy to help improving its biogas potential.

Keywords: *Wastewater Treatment Plants (WTP), Sustainable Development Goals (SDG), Waste-to-Energy (WtE)*

Energy Sources and their Use in Mass Transport Systems: Pollution and Carbon Emissions

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Abstract

This study evaluates, classifies and indicates mass transport systems, highlighting its options for energetic efficiency and used technologies, connecting primitive, medieval and industrial technology. Ancient civilizations used to employ animal or human traction and steam powered transportation. Currently, Smart Cities use autonomous buses, powered by battery or biofuels, and electric charged trains, trams and rail metro (subways), using industry 4.0 technology. In the history of urban mass transport systems, there have been periods in which the energy used was cleaner than in other periods, aiming at energetic efficiency. The methodology explores documental research and bibliographical review on theoretical framework. However, in relation to transportation database we used statistics and operational research methods. We consider that in primitive (Mass Transport 0.0) and medieval (Mass Transport 1.0) technologies period, clearer energy sources were used, whereas between the first and the second industrial revolution (Mass Transport 2.0) there was an increase in the use of less clean energies. The pick period of less clean energy sources happens between the third (Mass Transport 3.0) and the fourth (Mass Transport 4.0) industrial revolutions. Notwithstanding, with the development of the current fourth industrial revolution, less polluting alternatives have been arising, causing less impact on urban and metropolitan environments of Smart Cities.

Keywords: *Smart Cities, Mas transport Systems, Carbon Emissions*

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Enhancing the Performance of Conventional Solar Still by Using Novel Stepped Absorbable Plates

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Abstract

A Novel Super water retaining material was blended by the backlash between Chitosan, EDTA, chrysopogon zizanioides and termed as CHEDZ. CHEDZ is formed by cross linking of chitosan molecules with the EDTA and zizanioides (EDZ) obtained during the reaction. The zizanioides used in this paper is helpful in removing bad odour and relieves blocks in blood cells. It is also used in evaporative coolers to wipe out algae, bacteria and other microorganisms. A latter audit reports that 21 major cities in India would suffer due to water deficit in 2020. To overcome this water desalination is one of the promising solution for this problem. Passive Solar stills can be used for water desalination. However, the amount of distilled water produced per unit area is somewhat low which makes the single-basin solar still unacceptable in some instances. This paper proposes a new methodology that can be coated on the single slope stepped absorbable plate. The CHEDZ is a type of super absorbent polymer that has the ability to retain water proportionate to its own mass. The CHEDZ can be coated on the stepped type absorbable plate to retain the water. Due to this the evaporation rate increases as well as harmful microorganisms gets ruined due to the presence of zizanioides. The distillate output affirmed that yield of proposed system is 3.05 L/day. The EHTC of the proposed still is 234.75%. The efficiency of the proposed still is 31.8% which is twice more than the conventional still. The energy efficiency rate is 18.34% and the exergy efficiency rate is 0.45%.

Keywords: *the EDTA and zizanioides (EDZ), Adsorbable Plates*

Environmental Assessment of Biodiesel Production from Beef Tallow in Brazil

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Abstract

Increased demand for biodiesel is expected in Brazil, driven by the 2030 Agenda. Intensification of biodiesel inclusion into national energy matrix ensuring reliable and sustainable access to energy (SDG 7) and aiming reduction of negative impacts related to climate change (SDG 13) has been proposed. In this sense, tallow can be an auspicious raw material as: it is often considered a byproduct from meat production; its utilization could free up soybean oil to other markets; and it is abundant as Brazil has the largest commercial herd globally. However, scarce information regarding this material is available. In this work, we propose a Life Cycle Inventory for the production of biodiesel from beef tallow in Brazil. The inventory was based on bibliographic research and consolidation of primary data, representing approximately 36% of the tallow transesterification capacity in 2018. The use of primary data was beneficial, as it increased the representativeness of the inventory. Moreover, completeness of the primary data available was deficient and required complementary improvements. Nevertheless, we believe that the data from this study may be useful to the LCA community, given the relevance of tallow biodiesel in the national context.

Keywords: *2030 Agenda, SDG's, Environmental Assessment, Biodiesel Production*

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Environmental Audit as Instrument for Analyzing the Sustainability of Industries in Rio De Janeiro-Brazil

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Abstract

In this work, we did a research with a documental analysis of environmental audit reports. It's was done through the consultation of 30% of the reports from State Environment Institute-INEA (environmental regulatory agency of the state of Rio de Janeiro/Brazil) database related to the years 2016 and 2017. The non-conformities included on the action plans were accounted and characterized. The numbers obtained were compared to those from other preceding studies from the years 2013, 2014 and 2015, in order to help us on the interpretation of the result and identification of tendencies about the main problems of sustainable faced by the organizations. The main non-conformities were related to the "regarding waste management", "regarding legal compliance" and "regarding materials management". Those correspond to more than a half of the total non-conformities, with 55.8% on 2016 and 51.8% on 2017. The item "regarding the management of materials" has replaced "regarding the management of liquid effluents" from the previous list. The data revealed the necessity to fortify mechanism of production control to reduce the environmental impacts of industries. In this context, the environmental audits can be great instruments to helps to identify the existents problems that compromise the sustainability in their production.

Keywords: *2030 Agenda, SDG's, Environmental Assessment, Biodiesel Production*

Environmental Criteria for Selection of Urban and Peri-Urban Forests for Food Production

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Abstract

According to UN SDG2 the objective is "End hunger, achieve food security and improved nutrition and promote sustainable agriculture", ensuring sustainable food production systems and implementing resilient agricultural practices. In this context are the concept of urban agroforestry, which aims the interaction between tree species and one or more types of culture. This system acts as a complementary alternative to ensure access to healthy and quality food as well as enabling new forms of interaction between man and nature. Therefore, this paper aimed to establish environmental criteria for the evaluation of the potential of food production in forest fragments in urban and peri-urban areas. Six criteria were selected and analyzed in GIS: total and nuclear area; circularity index; connectivity; springs; and degree of use and occupation in surrounding. By using Hierarchical Process Analysis (AHP) to weight the indicators, the index of the food production potential in forest remnants (IES_{prov}) was established: $IES_{prov} = (0,209a + 0,281b + 0,111c + 0,078d + 0,290e + 0,031f) / 10$ and could be classified as: very low; low; median; high or very high. The application of this criteria in Campinas / SP - Brazil proved to be effective and useful to urban or peri-urban area where there is interest in the implementation of agroforestry systems.

Keywords: *Food Production, Urban Forests*

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Environmental Effects Generated in the Production of Pellets

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Abstract

In general, about 60% of the volume of wood residues processed in industries turns into waste. The biomass of wood used as an energy source, represents about 14% of all energy used in the planet. The world demand for this biomass tends to double in the next thirty years. In Brazil, the rate of productive growth is even higher due to its high forest reserve, making it important to assess the environmental effects generated during its manufacture. In this sense, this article aims to measure the environmental effects generated in the production processes of pellets derived from pine wood. The Life Cycle Assessment (LCA) methodology was applied in the industrial phase using the Ecoinvent database and the EcoIndicator 99 method to specify environmental impacts. The results demonstrate that the pelletization process made the greatest contribution, with 61.2% of the impacts, caused by the use of fuels and higher energy consumption. The productive technological routes should be the main factors to mitigate the generated environmental effects. And process engineering techniques can optimize the productive potential of manufacturing for eco-efficiency.

Keywords: *Life Cycle Assessment (LCA), Pellets, Environmental Effects*

Environmental Efficiency of Water Services: A Data Envelop Analysis Application to the Italian Sector

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Abstract

The sustainability of the water resources is a pressing challenge. Natural forces, economic pressure and increasing population determine a significant growth in water use and pollution that need support by highly efficient water supply practices. The Italian water services with fragmented management and highly deficient infrastructure is a prominent case study. The impossibility of avoiding natural monopoly of water systems determined the imposition of a "for the market" competition in order to ensure efficient water use. In this work, a panel data of a group of Italian water utility companies is used to assess the environmental efficiency of the Italian water sector. The study uses the mathematical/linear programming of Data Envelopment Analysis (DEA) on a set of key variables including water losses (never considered in the previous studies) to assess technical and environmental efficiency in a time series of five years (2013-2018). Results show regional effects on water service sustainability as well as governance (public versus private companies) effect on both economic and environmental efficiency. This approach can be useful for policymakers to better design policy action in order to solve market failures and sustainability issues affecting the sector and water resource conservation goals

Keywords: *Data Envelop Analysis, Water Services*

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Environmental Impact Assessment of Snail Production in Greece

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Abstract

The huge demand for protein-rich foods is expected to increase by another 70-80% between 2012 and 2050. At the same time, production methods, especially for animal protein, are already posing a serious environmental threat. This study examines open full biological cycle production of the snail species *Helix aspersa* Muller, the most commonly traded species in Greece, and makes a life cycle assessment of its environmental impact. The study covers farm work required, from creation of a suitable environment for snail farming (e.g. reproduction and fattening areas) to packaging (i.e. until the snails leave the farm). The system's main environmental impact is due to the disposable plastic frames used for packaging and transporting the snails. The use of electricity also seems to create a significant environmental burden in several respects, because of the lignite used to generate power in Greece. The main conclusion is that snails of the species *Helix aspersa* Muller produced with the open full biological cycle method represent one of the most environmentally friendly sources of protein available.

Keywords: *Snail Production, Greece, Environmental Impact*

Environmental Impacts of Sugar Substitution in Fruit Jelly

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Abstract

A question arises regarding foods with substitutes for traditional ingredients. In addition to the benefits to human health, do foods also represent environmental benefits? In this context, this work compared the environmental impacts of two formulations of fruit jellies, different concerning the sugar type. Thus, an attributional cradle-to-gate Life Cycle Assessment compared conventional and new formulation jellies, sweetened with sugar and by concentrated apple juice, respectively. The life cycle inventory comprised data from primary and secondary sources. In the impact assessment phase, considered the ReCiPe Midpoint (H) 2016 method, selecting the most appropriate categories for the study. The results pointed to an increase in environmental impacts with the use of new substitute ingredients, because of the higher energy required for the concentrated juice production compared to sugar production. Thus, health benefits may not outweigh the associated environmental impacts, and healthier options are not necessarily associated with lesser environmental impacts.

Keywords: *Sustainability, Life Cycle Assessment, Fruit Processing, Food Industry*

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Environmental Management Instruments as a NSWP Action Mechanism in Sanitary Landfills: A Case Study in the Municipality of Nova Friburgo

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Abstract

The global concern regarding urban solid waste has increased as a result of production and consumption patterns, improper management and lack of final disposal areas. The huge volume of waste generated in urban centers results in a series of environmental, social, economic and administrative problems, all related to difficulties in implementing appropriate waste disposal solutions. In Brazil, Law 12,305 / 2010 (National Solid Waste Policy - NSWP) provided a legal framework to solid waste management. The law established a waste management hierarchy, defining sanitary landfills as a possible alternative for waste disposal. In this context, the adoption of a management model and environmental management instruments are needed to achieve environmental objectives. To illustrate the adoption of environmental management instruments in landfills, this study conducted a case study at the Waste Disposal Center, Brazilian Environmental Company Landfill (EBMA), located at Nova Friburgo municipality, Rio de Janeiro state. Based on the analysis conducted, this study identified that EBMA is implementing Environmental Management instruments, such as Environmental Management Systems, Environmental licensing, seeking the enhancement of its environmental performance and the fulfilment of its environmental obligations in a systematic manner that contributes to the pillars of sustainability: environmental, social and economic.

Keywords: *Sanitary Landfills, Nova Friburgo, NSWP*

Environmental Performance Evaluation Based on Cleaner Production Concepts: An Analysis of Three Methodological Proposals (SAPmaisL, P+L Index and IDRSI)

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Abstract

Three methodological proposals for Environmental Performance Evaluation are analyzed in this paper: SAPmaisL (Environmental Performance Evaluation System based on Cleaner Production concepts), the P+L Index (Cleaner Production Index for the transformation industry in Minas Gerais state) and IDRSI (Index for Industrial Solid Waste Disposal). These methodologies are contextualized within the industrial scenario, presenting companies' challenges to comply with legal determinations involving productive processes and the environment. Premises of the National Policy on Solid Waste and Cleaner Production are emphasized as well, as they are tools to support the management of industrial waste aligned with the provisions of the referred legislation. The goal of such research was to enhance the understanding of these methodologies based on discussions, underpinning a critical sense to managers, researchers, and others. Subsidies are given to the choice/elaboration of mechanisms for waste management in industrial corporations from the perspective of ecoefficiency, thus contributing to environmental improvement and promoting sustainable development. In conclusion, despite their differences, the researched methodologies are complementary and flexible, allowing companies to obtain support for decision-making on the conduction of their production processes based on Cleaner Production concepts.

Keywords: *SAPmaisL, P+L Index, IDRSI, Cleaner Production*

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Establishing Technological Networks and Institutional Arrangements for Energy Recovery of Municipal Solid Waste in the Metropolitan Region of Campinas

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Abstract

The integrated management of municipal solid waste (MSW) is one of the challenges of Brazilian municipal governments. Based on the objectives set by the Brazilian National Solid Waste Policy (PNRS), the present study aims to establish possibilities for institutional arrangements and technological networks to promote Waste-to-Energy (WtE) technologies for the energy recovery of MSW in metropolitan regions, having as a case study the Metropolitan Region of Campinas (RMC), Brazil. The results show that thermochemical technological routes presented the greater energy recovery potentials (e.g. incineration with around 390 GWh and gasification with around 383 GWh based in BAU scenario). Currently, the recovery rate of recyclable materials is 2,8%. When a greater recovery rate of recyclable materials by municipalities is considered (e.g. 20%), the energy recovery potentials change. Incineration decreases by 13% and gasification increases by 3%. By combining anaerobic digestion with thermochemical treatment, the figures for energy recovery are 310 GWh for incineration and 352 GWh for gasification. The technological arrangement with higher potential for energy and material recovery (i.e. recyclables and biofertilizer) is gasification plus anaerobic digestion. Hence, WtE systems can not only improve MSW management systems but also strengthens cooperation among municipalities through consortium and meet PNRS objectives.

Keywords: *Municipal Solid Waste (MSW), Brazilian National Solid Waste Policy (PNRS), Metropolitan Region of Campinas (RMC)*

Ethanol Production Forecast in Brazil and United States from 2020 until 2024 with Box-Jenkins Methodology

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Abstract

In Brazil, ethanol from sugarcane represents the most of Brazilian production while United States produces ethanol from corn. However, since 2011, mainly in Mato Grosso, corn ethanol production is increasing. This article aims to estimate ethanol production in Brazil and the United States, the world's largest ethanol producers. The authors chose to also estimate ethanol production in the states of Mato Grosso and São Paulo, in order to analyze changes in the Brazilian ethanol sector. Using the Box-Jenkins methodology, the article estimates an ethanol production in Brazil, São Paulo, Mato Grosso and United States from 2020 to 2024. Brazil series showed a higher projected growth rate compared to the United States and Mato Grosso series forecast also had a growth rate larger than in São Paulo, which corroborates to the hypothesis that Brazil is facing structural changes in the sector. All the results are interpreted considering a scenario without changes in other sectors.

Keywords: *Ethanol, Box-Jenkins Methodology*

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Ethical and Environmental Implications of Food Waste

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Abstract

Food waste is becoming a global issue since about one third of all the food produced worldwide for human consumption is wasted every year along the food supply chain. This is unacceptable considering that a large number of people (821 million) still do not have enough food for an active and a healthy life. In addition to the ethical aspects connected to wasting this huge amount of food in a still food insecure global context, this scenario also implies large environmental costs and impacts negatively impacting the biosphere. Indeed, a large consumption of renewable and non-renewable resources and the release of emissions are sustained to produce food in turn becoming waste. All this prevents from reaching the achievement of different United Nation Sustainable Development Goals. In this study, food security and LCA-based environmental indicators were calculated to assess the implications of food waste in fifteen different countries at both individual and national scale. At individual level, Kingdom of Saudi Arabia (KSA), United States of America (USA), United Arab Emirates (UAE), and Canada showed worse indicators compared to South Africa, Lebanon, Argentina, and Mexico. At national scale, all the social and environmental indicators calculated for the USA resulted much higher when compared to all other countries. Considering the remarkable ethical and environmental implications of food waste, the outcomes of this study are useful to inform citizens and policy makers about the urgent need for adopting more responsible food consumption patterns.

Keywords: *Food Waste, Food Security, LCA*

Evaluating the Transition Towards a Circular Economy in Agri-Food Supply Chains

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Abstract

The prevalent economic system is maintaining the expansive nature of capital while ignoring the presence of both physical and social boundaries. Circular Economy (CE) has emerged as a beacon for diverging from the extraction-centric and offshoring-oriented path of the dominant linear take-make-dispose model. Building on the value retention options of reduce-reuse-recycle (3Rs), CE constitutes a paradigm capable of inducing the necessary regenerative industrial transformations towards achieving sustainable production and consumption. Projected population growth dynamics, rural-urban migration, economic instability, competing claims over land resources and climate change are placing increasing pressure on agricultural systems. Furthermore, over 1/3 of global food production is wasted annually across the entire food supply chain, while food insecurity is becoming more evident in society. A systematic review of both academic and grey literature on the CE application on agri-food supply chains related literature is conducted to identify current retention practices and barriers to their implementation. Findings indicate the critical role of supply chain integration (SCI) on the adoption of 3Rs practices. Drawing upon supply network theory, resource-dependence theory (RDT) and resource-based view theory (RBV), a theoretical framework is developed that specifies the relationship between supply chain integration, supplier/customer dependence and adoption of CE practices.

Keywords: *Circular Economy, Agri-Food, Supply Chains*

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Evaluation of Adsorption Potential for Textile Dyes of the Different Granulometric Fractions of the Red Mud of the Sorocaba / Brazil Region

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Abstract

Contamination of water has been one of the major problems of modern society. The water in production processes has gained special attention because of the added value that has been attributed to them, through such devices as consumer pays and polluter pays principle, present in the Brazilian legislation. Within this context, the textile sector has a special prominence, because of its huge industrial park to generate large volumes of effluent, which when not properly treated, can cause serious environmental contamination. The textile effluents are characterized by being highly colored due to the presence of dyes that are not fixed in the fiber during the dyeing process. One of the techniques of treatment is based on the adsorption process. In this context, this paper studied how the adsorption capacity for textile dyes is altered when different grain size fractions of red mud as adsorbent. The results, using the red mud as adsorbent heat treated, show that the adsorption capacity of red mud total is greater at pH 4 with an average increase of 20 to 80% of the dye adsorption. For the sand fraction of red mud, the decrease in pH also led to an increase in the percentage of adsorption of 5 to 90%. The red mud all seem to have a high adsorption capacity for the dye Direct Green 26, showing values of q_m at pH 4 in the order of the coal trade. Already the sand fraction of red mud has a lower value of q_m , but with similar adsorption capacity of sawdust and salvinia. It can be concluded that the total red mud and sand fraction of red mud are good adsorbents for dye Direct Green 26, when this process occurs in acidic (pH = 4).

Keywords: *Red Mud, Textile Dyes, Granulometric Fractions*

Evaluation of the Climate Change Models Eta-HadGEN2-ES and Eta-MIROC5 in the Study of Extreme Events in South America regions

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Abstract

Mathematical models are an important tool in the study of climate change and its impacts. However, before using those models in future climate analyzes, they must be evaluated based on meteorological series obtained through weather stations. This is an important step to verify if the climatic model can be used to describe and quantify meteorological conditions of a certain area. Therefore, the objective of this paper is to evaluate the performance of the ETA model nested to the HadGEM2-ES and MIROC5 models, in the probabilistic description of extreme weather events of air temperature and rainfall in the state of São Paulo. The study was based on the general theory of extreme values, using the generalized extreme value distribution (GEV) to estimate the probability of extreme events occurring from the climate models compared to those observed in meteorological stations. The results obtained from the GEV parameters for the two models coherently describes Sao Paulo climate. In conclusion, both models (ETA-HadGEM2-ES and ETA-MIROC5) can be used to analyze the occurrence of extreme events in the state of Sao Paulo.

Keywords: *ETA-HadGEM2-ES and ETA-MIROC5, Climate Change, Generalized Extreme Value Distribution (GEV)*

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Evaluation of the Combined Application of Cleaner Production, Circular Economy and SMED to Reduce the Waste, Energy and Water in a Food Industry

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Abstract

Because of the country's economic instability, the Brazilian companies need to seek for new ways to enhance their productivity rates and increase the process efficiency. To overcome these challenges, the Cleaner Production (CP) has become a means for companies to improve their operational efficiency. Considering achieve the UN SGD to apply the sustainable development in industries, the Circular Economy practices, such as CP, can allow to reduce the production of waste and save resources, such water and energy in food production. One of the foundations of the Toyota Production System is the use of the Single Minute Exchange of Die (SMED), it has goal to reduce the setup time by decreasing the idle time of process and maximizing the productive system yield. Thus, this research aims to show the economic and environmental benefits of applying the CP practices combined with the SMED tool for a Dutch multinational food company. As a result, the SMED tool proved to be efficient in reducing equipment setup time by avoiding the acquisition of a new packaging machine and the application of circular economy indicated that it is possible to reduce the production of waste and the consume of energy and water in the food production.

Keywords: *Data Envelop Analysis, Water Services*

Evaluation of the Use of Nanofluids in an Internally Cooled Toolholder

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Abstract

Many research centers and laboratories have been focusing on finding practical applications for nanofluids. Considering that the high temperature in the cutting zone and its influence on the tool life represent challenges in machining process, in this study nanofluids are employed in a system analogous to an internally cooled toolholder which was developed aiming to eliminate the cutting fluid use without compromising machining efficiency. Because the use of cutting fluids brings negative impacts, concepts like sustainable manufacturing have come to be accepted in the metal cutting community. In this way, the purpose of this work consists in evaluate the application of alumina nanofluids (Al₂O₃/H₂O(DI)) with volume fraction of 0.06%, 0.12% and 0.19% circulating inside of an analogous system to the toolholder. The nanofluids were characterized aiming to help the understanding of the influence of nanoparticles in the heat transfer coefficient. Also, a conjugated heat transfer CFD simulation was carried out aiming to analyze the fluid behavior and the temperature distribution on the heated surface. The tests showed that the nanoparticles influenced the fluid viscosity increasing its value up to 19.8% at the highest concentration and also influenced the convective heat transfer coefficient (h), which achieved a maximum increase of 42%. Furthermore, it was identified a nanofluid stability over 72 hours. All the results and analysis confirm that nanofluids could collaborate for a higher efficiency of the internally cooled toolholder and, consequently, a reduction or elimination of the use of cutting fluids.

Keywords: *Nanofluids, Cooled Toolholder*

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Experimental Investigation of Thermo Electric Coolers for the Generation of Fresh Water from Atmospheric Air

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Abstract

This paper investigates about the performance of TEC for the production of potable water. The atmospheric water generator is the device which harvests water from the air includes some natural process like condensation. The mathematical modeling for the selection of number of TEC have been made. The performance investigation is done with the help of parameters such as COP, cooling capacity, dew point temperature and amount of water produced. The work is carried out at latitude 9.5o N and longitude 77.96oE in Kamaraj College of Engineering and Technology, Virudhunagar, Tamilnadu, India. The experiment is carried for the period for 12 hours from 06.00 am to 06.00 pm. The fresh water produced from air is 250ml/hr. The air flow rate of 0.155 kg/s was calculated as the best one for the producing maximum amount of water. The input current value above 3A gives better efficiency and maximum yield is obtained when compared with other lower current ratings. The maximum yield of 1.6L is obtained at 32oC. The factors which influence this process is relative humidity so it is most suitable for coastal and hilly regions. The average water produced from the present work is 6.01L/day. This will acts a promising solution for solving the major threat water scarcity.

Keywords: *Thermo Electric Coolers, Fresh Water*

Exploratory Research from Austria into SME Motivation for Energy Efficiency Investment

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Abstract

The reports of the International Energy Agency find that after years of growth, combined global investment in renewables and energy efficiency declined in 2017 and 2018. The IIEA states that there is a risk that the trend of investment shrinkage will continue in spite of various researches showing that there is a realistic potential for energy efficiency in many industries and significant potential for renewable energy. In the framework of the European PINE project, in Austria 20 energy audits in SME in different sectors were carried out. The audit method used a process unit based assessment approach and simple modelling of consumption. About 50 % of the adopted measures involved the implementation of frequency controlled drives, elimination of leakage of compressed air, heat recovery, and the modernization of lighting systems. After the project, it was analysed whether there was a relation between implementation of measures on energy efficiency and life cycle phase of the enterprises. It was found that in the sample of enterprises in this exploratory research, the majority of measures was implemented in companies in the maturation phase into process related improvements. Investment during the incubation, growth, and saturation phases was low in comparison. In the saturation phase, there was especially investment into infrastructure. The findings allow to develop tailored strategies for enterprises according to the different stages of their life cycle.

Keywords: SME's, IIEA, PINE Project

Exploring the Interplay between IT-based Banking & Sustainability

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Abstract

The banking organisations are amongst the largest adopters of IT-based business operations. Due to the call from society for adopting environmentally sustainable approaches, the banking organisations have been making prodigious efforts. This manuscript is based on exploring the interplay between IT-based banking and sustainable initiatives by the banks from employees' perspective with special reference to India. The objectives of the research include assessing banks' IT-based environmentally/socially sustainable initiatives, barriers in successful implementation, and the level of employees' orientations towards the initiatives. Using a survey method, the data were collected from 300 employees from the three leading bank groups in India. The banks were reportedly found to be at an infancy stage of implementing these practices into their strategic framework. The findings revealed that although banks have undertaken several environmentally sustainable initiatives, they were found to be lagging in incorporating preventive strategy, sustainable development strategy and policy-oriented initiatives. The employees depicted positive cognitions and attitude towards the banks' environmentally sustainable initiatives but reflected unfavourable behavioural intentions. Furthermore, the research highlighted the gaps: knowledge gap, knowing-doing gap, and opportunity gap concerning effective implementation. The study provides an overview of bank employees' engagement in implementation and offers valuable insights for achieving wide-ranging success.

Keywords: *IT-based Banking, Sustainability*

Factors Influencing the Perception of Exposure to Climate Risks by the Most Polluting Industries in the World

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Abstract

The literature highlights the existence of numerous studies on corporate disclosure of information on socio-environmental impacts, climate change and associated risks. In general, these studies focus on examining the determinants of disclosure of these types of information. However, few studies focus on assessing perceptions of exposure to climate risks in particular. These studies do not provide an empirical analysis of the factors that explain companies' perceptions of exposure to climate risks. This paper therefore represents one of the first works aimed at providing an in-depth empirical analysis of the potential underlying variables that influence companies' perception of exposure to climate risks. The research focuses on the 100 most polluting industries in the world, identified by the Carbon Disclosure Project's classification list. The selected sample consists of data from 36 companies in the world's most polluting industries located in 15 countries between 2015 and 2017. Our results show that, regardless of the region, companies feel more threatened by regulatory climate risks than by other risks. Nevertheless, companies located in Europe have a higher perception of their exposure to climate risks than companies in other regions. In addition, companies in BRICS and developing countries feel more exposed to climate risks than companies in the US and Canada. We also found that the intensity of carbon emission, climate regulation, the power of shareholder or the fact that the companies are from a developed country do not affect their perception. Instead, it is size and age that explain perception of exposure.

Keywords: *BRICS, Climate Risks*

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Farmers' Willingness-to-Pay for Eco-Friendly Agricultural Waste Management in Ethiopia: A Contingent Valuation

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Abstract

The abundance of agricultural waste (AW) production following rapid population growth and resource constraints has created an urgent need for sustainable agricultural waste management (AWM) for the welfare of rural society. In Ethiopia, open burning of biomass is common practice after harvest and in household cooking, and smoke and improperly discarded AW are also major problems. However, compared with municipal waste management, AWM is poorly addressed. In this study, we seek to assess the current AWM status, farmers' willingness to pay (WTP), and the factors affecting WTP for eco-friendly AWM in the Mirab Gojjam, Amhara region of Ethiopia, which has not been studied previously. Data were collected through a contingent valuation survey of 353 randomly selected farmers in early spring 2018 (February-April). We offered labour days and money as a payment vehicle. The mean annual WTP is 6.84 labour days (eq 273.50 Birr) and 8.20 Birr in monetary value, respectively. The strongly significant WTP factors are age, education, family size, source of income, land, livestock, and perception. The Tobit results indicate that the bid value in labour days, environmental perception, government subsidy, farm shortage, economic conditions, living in harmony with nature, and knowledge of AW strongly influenced the degree of farmers' amount to pay. The results are thus useful for understanding farmers' attitudes towards rural environment quality and WTP for eco-friendly AWM, as well as the need for private and public instruments in AW for developing policies and to turn waste into a resource.

Keywords: *Ethiopia, Agricultural Waste Management, Willingness-to-Pay*

Feasibility analysis of the implementation of a SHP as Alternative Energy Source in the Bacia Do Rio Turvo/RS-Brazil

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Abstract

The demand for energy also presents great challenges for a Brazilian society, both in the periphery of large urban centers and in developed versions. Therefore, the planning and regulation of the energy supply should go in search of forms of energy supply compatible with the energy potential and the national and regional socioeconomic needs. Therefore, it is necessary that each energy resource is strategically studied and harnessed, aiming at maximizing the benefits provided, promoting economic development, and minimizing negative impacts on the environment and society. For micro-regions, such as the Bacia do Rio Turvo, this development is of great importance, also of a macro-regional scope, in addition to that the demand for electric energy is increasing in these regions. This work presents a study about the feasibility of implementing a new Small Hydroelectric Power Plant (SHP) in the Esperança do Sul Axis, which is available for this purpose. The study encompasses several surveys related to the projects destined to the energetic use by means of hydroelectricity.

Keywords: *Bacia do Rio Turvo, Brazil, Small Hydroelectric Power Plant*

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Feasibility Analysis of Integrated IOT-Deep Learning Approaches for Identification and Classification of Solid Waste at Coastlines of South Al- Sharqia Region in Oman

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Abstract

Municipal solid waste generation is proliferating with increasing living standard, urbanization, and economic development. The concept of a smart city is adopting an integrating sensor-based Internet of Things (IoT) technologies with deep learning approaches to offer opportunities to handle waste management in sustainable ways. In this study at several coastline locations in Sur, South AL Sharqia, Oman, IoT devices such as 2D, 3D, and IR cameras with the smart sensor experimented with GPU based processing device to process the data (related to waste components). The data were collected by both manual approaches using statistical-based transect sampling method and through Raspberry Pi device for data collection to the server from the IoT Device. The collected datasets divided into training (70%) and testing (30%) sets and processed using pretrained convnet using TensorFlow of Python computational environment. The object detection is implemented with the developed model to detect and classify the waste components in a suitable way. Thus, the study developed an efficient prototype for data collection, processing, and classification into suitable parts for effective waste management at the coastline at South Al Sharqia region of Oman. Besides, some recommendations based on social survey and observations during sampling given to waste collection/disposal authority in the area.

Keywords: *Internet of Things, Smart cities, Deep learning, Smart Waste Classification, Integrated IOT-Deep Learning Prototype*

Fenton-Like Reactions for Agro-Food Industrial Wastewater Treatment

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Abstract

Food manufacturers are one of industrial sectors that release the largest volumes of wastewater with complex composition, causing serious environmental impacts when untreated. Some have been the topic of research because they still have problems on their treatment, e.g. those from slaughterhouses, dairy products and derived from processing of cassava flour and starch. Conventional effluent treatment are often inefficient for their remediation and thus the aim of this study was to evaluate Fenton-like reactions (pH 3.0 and hydrogen peroxide concentration 5000 mg L⁻¹) for treatment of above-mentioned wastewaters, reusing ferrous ions derived from the preliminary coagulation stage. Parameters such as Chemical Oxygen Demand (COD) and turbidity were determined in raw and treated effluents. Slaughterhouse and dairy effluents had an important reduction of organic load via Fenton like process (99 and 35% of reduction, respectively) and cassava wastewater had its best result with photo-Fenton like (70%). Reductions in turbidity reached 87, 11 and 68%, respectively. Therefore, the use of remaining iron from preliminary treatment stage shows a great potential as a catalyst for Fenton-like advanced oxidation processes, being less expensive (iron supplementation in the medium is avoided) and environmentally advantageous (reducing production of residual sludge and metal content in treated effluent).

Keywords: *Fenton-like Reactor, Wastewater Treatment*

Final Disposal and Valorization of Sewage Sludge: Current Practices and Ongoing Research

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Abstract

In both developed and developing countries, sludge disposal is an issue that has grown, considering the increase in the volume of wastewater treated. Sludge management worldwide is becoming increasingly difficult due to stringent regulations that make it difficult to apply sludge to farmland as fertilizer for disposal and recycling of nutrients. Consequently, it is very important to evaluate options towards a more efficient and sustainable sludge management, especially due to an increasing of sewage sludge production. In this context, reducing the sludge production and/or preparing it for further utilization are cost-effective alternatives in sludge management compared with standard practice. Minimizing the waste will reduce the environmental impacts of sludge management, and the recovery of resources allows for a circular economy. Objective: to compile information on current practices with regards to sewage sludge disposal and to investigate innovative techniques for its disposal and resource recovery from sludge. Methods: A literature review was performed. Results: The use and disposal of sewage sludge vary between countries. For instance, in countries where there is a deficit of soil organic matter, agricultural use is most common. Main disposal routes for sewage sludge are agriculture, incineration, landfill, compost and building materials. Main strategies for valorization of sewage sludge are: recovery from biosolids (as source of minerals and metals; substrate for high value products e.g. proteins, elements), energy recovery, and fertilizers from sludge. These options are discussed based on ongoing projects.

Keywords: *Sewage Sludge, Final Disposal*

Food Security Obstacles outlined by Sustainable Development Goals: Food Contamination by Cadmium

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Abstract

The concept of Food Security involves quality and quantity of the food offered. According to the third Sustainable Development Goal (SDG), of the United Nations (2015), settled down as a goal for the year 2030, a reduction of new diseases and deaths caused by the contamination of chemicals in the soil, consequently in the food grown in them. The intensive use of pesticides, causes the contamination of water, soil and food with heavy metal, such as Cd. An ingestion of Cd from contaminated food in the long term can induce, among other diseases, nephrotoxicity. The present compared the concentrations of Cd on lettuces and carrots sample grown in a conventional and organic way, sold in Rio de Janeiro - RJ - Brazil. The samples, after prior preparation, were subjected to acid extraction and analyzed using the Atomic Absorption Spectrometer / Graphite Furnace. In general, the results shown as organic vegetables has less concentrations of Cd when compared to vegetables grown by the conventional method. Despite the Cd rates being within the established limits, the result may underestimate the risks, due to simultaneous exposures to various substances. This result indicates solutions to achieve the SDG target.

Keywords: *Food Contamination, Food Security, Sustainable Development Goals*

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From Gaps to Trade-Offs in Reverse Flows of Medicines: Looking for Sustainable Business Models

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Abstract

Medicines reverse flows are under-researched regarding the way they could create sustainable value for the entire supply chain. Regardless the blossoming of reverse logistics (RL) and circular economy (CE) studies (Viegas et al., 2019), there are lack of practical indications on what types of sustainable business models (SBMs) and metrics could be employed to capture value from reverse pharmaceutical supply chain (PSC) products. The majority of RL studies on PSC medicines focus on optimized levels of returns considering few echelons (Hua et al., 2019) and including governmental subsidies (Liu et al., 2010). CE models are excessively dedicated to classification of value harnessing activities (Bocken et al., 2014; Lüdeke-Freund and Bocken, 2018), but lack practical forms of trade-offs. The literature is silent on Circular Business Models (CBM) and medicines. Current research on SBMs assumes a win-win situation between economic, social, and environmental dimensions, when this is not always the case (Gong et al., 2018). This research aims at highlighting the gaps for value creation in medicines reverse flows. A literature review on SBM, CBMs and trade-offs, combined with CE, RL and medicines, show that only 22 out of 309 studies allow to start a design of SBM medicines reverse flows.

Keywords: *Medicines Reverse Flows, Trade-Offs, Sustainable Business Model, Circular Economy*

Glycerol as a Nutritional Supplement in Microalgae Cultivation: Turning Waste into High Value Biomass

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Abstract

The aim of this study was to apply different concentrations of glycerol in the cultivation of the microalgae *Chlorella* sp. Inoculum production was performed in domestic effluent and cultivated in 2.5 L photobioreactors. The glycerol supplementation tests were conducted under the following conditions: control sample without addition of glycerol (C0) and inoculum with glycerol at concentrations levels of 7.5 g L⁻¹ (C1), 10.4 g L⁻¹ (C2) and 12.5 g L⁻¹ (C3). The remaining glycerol content was analyzed by high performance liquid chromatography (HPLC). Lipids were extracted by Bligh and Dyer method and analyzed by gas chromatography coupled to mass spectrometry (GC-MS). The results demonstrated that the highest biomass productivity yield was obtained in the experiment C1 (3.47 g L⁻¹). The consumption of glycerol showed that microalgae cultivated in C1 conditions consumed 3.75 g L⁻¹ of glycerol. In the 2.5 L scale, C1 supplementation had the highest consumption (50%). C2 test presented the highest lipid content with 29.8%. The predominant fatty acids were myristic acid (C14:0), palmitic acid (C16:0) and stearic acid (C18:0). This study showed that glycerol presented positive results when incorporated into microalgae cultivation, especially to obtaining fatty acids that can improve biodiesel production and quality.

Keywords: *Glycerol, Microalgae Cultivation*

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Green and Inclusive Energy Programs as a Means to the Attainment of Sustainable Development Goals in Zimbabwe

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Abstract

The importance of energy to Zimbabwe's economic development, social progress and ecological balance cannot be over-emphasized. Lack of access to energy is a sign of poverty hence making it harder to meet the SDGs. Desirably, energy should be: Abundant, Affordable, Safe, and Clean. However, most traditional energy sources such as coal are finite and as they get depleted their prices tend to rise. These traditional energy sources are dirty, i.e. they pollute the air and water bodies and detrimental effects to the health and well-being of people and cause climate change. The continued use of dirty energy sources will negatively affect the way future generations will live. They are not sustainable. In recent years the use of energy that is inexhaustible such as solar, wind and biogas has increased in many countries especially in the developed ones. This renewable energy is sustainable and modern and its prices are going down with technological advancement. As such there was need to carry a study on the Measurement and Monitoring of the access to modern and sustainable energy in Zimbabwe and the chances of achieving the 2030 targets. The study will determine where the SE4ALL program is in relation to the targets and how the on-going developmental programs can speed up access.

Keywords: *Sustainable Development Goals*

Green and Sustainable Production of Silver Nanoparticle Using Spent Coffee Grounds

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Abstract

Large amounts of spent coffee grounds (SCG) are produced each year worldwide. This material has no commercial value and is usually disposed off or, to a lesser extent, composted. In this study, we show that SCG can be used as a source of reducing and stabilizing agents to produce silver nanoparticles (Ag-NPs). SCG were extracted with aqueous ethanol at different ethanol/water ratios. Aliquots of the extract were then added to a silver nitrate solution under stirring and controlled temperature and pH conditions. The formation of Ag-NPs was monitored by the intensity of the plasmon resonance band of silver. Ag-NPs were characterized by XRD, DLS, TEM and zeta-potential measurements. The effects of temperature, pH, ethanol titer and reactant ratios were investigated using the response surface methodology. Under optimal reaction conditions, Ag-NPs with a size of 8-10 nm and a zeta potential of -30 to -20 mV were obtained. Overall, the results of this study indicate that SCG are a suitable starting material for the green synthesis of small-sized and stable Ag-NPs. Compared to traditional methods of NP production, this strategy does not require the use of toxic chemicals and provides an opportunity for the re-use of a waste.

Keywords: *Spent Coffee Grounds (SCG), Silver Nanoparticles*

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Green Business Checklist for Food Manufacturers

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Abstract

The City of Los Angeles, LA Sanitation and Environment (LASAN) is working together with the California Green Business Network to develop a Green Business Checklist to help local food manufacturers conserve energy, water, minimize waste, prevent pollution, and shrink their carbon footprints. The checklist will include general categories of: energy, pollution prevention, solid waste diversion and reuse, transportation, wastewater, and water conservation. LASAN is creating a shift from stick to carrot by using its direct connection to businesses. By spearheading partnerships with local public agencies, LASAN created a task force team to help businesses not only meet regulatory compliance, but also achieve the checklist goals and help retain local businesses in the City. Many industrial businesses are located in underserved communities and lack education in the benefits of sustainability. The Green Business Checklist provides a template uniquely tailored for food manufacturers to educate and help them to achieve sustainability. Recently, one food manufacturer saved on water and energy by following the Green Business checklist.

Keywords: *Green Business, Food Manufacturers*

Green Food Marketing: Strategy Propositions for Micro and Small Companies

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Abstract

The advances in product development research and green marketing strategies indicate an increase in interest for green products. Nevertheless, literature has not addressed the application of this context in micro and small companies. Thus, based on an exploratory qualitative research with eight experts, we investigate how sustainability can be inserted in the food industry to reduce the environmental impact, address consumers' growing search for green food, and to comply with legislation. Based on content and frequency analysis of the interviews, we developed propositions that can help micro and small firms to position green food products in the market. As a result, experts indicate the improvement of food companies' processes to reduce production costs and make green food prices more competitive. Experts also highlight the relevance of educating consumers and making communication strategies more persuasive and investing in smart packaging. Firms can also prioritize healthy food produced with local raw materials, and the use of cleaner production processes. Ecolabeling can also improve green marketing by increasing consumers' confidence in green food. Additionally, micro and small companies must prioritize short production and supply chains, through local retailers that are aligned with environmentally sustainable positioning.

Keywords: *Green Food Marketing, Micro and Small Companies*

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Green Supply Chain Management: An Analysis of the Most Relevant Papers According to Web of Science

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Abstract

The study wants to analyse the published papers about Green Supply Chain Management in the Web of Science database. Also, there is a necessity to valorise the GSCM theory background and to increase the investigated studies for identifying the publications. The research is classified as qualitative, through the Web of Science database, which has found 216 papers and to analyse were selected the ten most relevant papers. The findings have shown the first publication happened in 2003, although just in 2010 had started the growth of the writings about GSCM when it achieved 50 papers in 2018. The authors Zhu, Sarkis and Lai, are the most cited in the papers. It was possible to observe the article's evolution among GSCM, while the first studies have begun with environmental concerns in China, and consequently, in the manufacturing's addressing the GSCM practices. The automobile industries, thermal power plants and electronics industries are the research targets. In the end, proposes and model's validations to analyse the GSCM practices.

Keywords: *Green Supply Chain Management, Web of Science*

Happiness and Sustainability: Kaya Reggae Fest Case Study

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Abstract

Knowing the level of sustainability and happiness of individuals has been proposed by several researches. This research aims to understand the relationship between sustainability, through consumption, with well-being, through the measure of happiness. A case study was carried out with the participants of the reggae festival "Kaya Reggae Fest" that took place in November 2019 in the city of São Paulo, Brazil. The data collected on consumption were based on the Ecological Footprint (WWF) questionnaire, for demographic data the Brazil Criterion was used and Happiness was measured based on that of the Centre for Bhutan Studies. According to the organization of the event participated 4000 people from the festival, using a sample of 269 participants, after signing the consent form. The results show that with regard to socioeconomic classification, the participants are divided into 37% class C1, 31% class D, 21% class C2 and 11% class B2. The highest level of happiness sufficiency is in the B2 class with 0.77 and it is also the one with the largest Ecological Footprint 3.07 planets and the class with the lowest Ecological Footprint is the C2 with 2.21 planets and the least happy are the C2 and D both with 0.72. All are within the minimum limit to be considered happy, which according to the criteria established by the Bhutan instrument is 0.66. According to WWF, the average Ecological Footprint of São Paulo residents is 2.5 planets. Regarding the Ecological Footprint, all are above the acceptable that would be 1 planet. This research can contribute to public policy decision makers.

Keywords: *Happiness, Sustainability, Kaya Reggae Fest*

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Heat Treatment of Kraft Pulp Mills Primary Sludge

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Abstract

Kraft pulp mills are expanding rapidly in Brazil and industrial waste generation is increasing. Technical feasibility of using solid wastes from kraft pulp mills as raw material in other industries is an interesting approach to manage environmental and economic aspects of the industry. The search for new energy sources and the future shortage of non-renewable sources encourages the development of other sustainable energy sources by industries and countries. Modern biomass (pellets, briquettes and biomass subjected to the thermal process, torrefaction) emerges as industrial processes that increase the energy content of conventional sources of biomass. Primary and biological sludge are amongst the main solid wastes generated in the effluent treatment plants. These residues are normally disposed of in industrial landfills. In 2019, Brazilian pulp mills generated approximately 98 thousand tons of primary sludge. The present work aims to study the technical viability of the transformation of primary sludge in torrefied material. The effect of torrefaction temperature and residence time on the physical and chemical properties of the sludge and on the heating value will be evaluated. It is intended to obtain data on the energy potential of sludge, subjected to heat treatment and torrefaction and to establish the mass and energy yield in each of the treatments.

Keywords: *Kraft Pulp Mills, Primary Sludge*

Hidden Costs of Fossil-Fuel Power and the Role of Renewable Energy Technologies as a Beacon of Sustainable Cleaner Production

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Abstract

The greenhouse gases released from the combustion of fossil fuels such as natural gas, coal, and petroleum are the main source of climatic changes and global warming. Among different greenhouse gasses, CO₂ is the main contributor to global warming which is causing different climatic and health issues such as cyclones, skin diseases, etc. The statistics from the World Health Organization (WHO) revealed that 160,000 people die each year due to climatic changes. Therefore, it is very timely to effectively utilize the vast available potential of renewable resources especially solar energy to overcome the issue of harmful emissions and energy shortage. In this regard, the focus of this work is to encourage people and the government to employ available solar energy potential to develop zero energy communities which will greatly help to achieve sustainable energy infrastructure. The feasibility of a grid-connected PV power system is conducted for the climatic conditions of a rural community. The analysis is carried out based on project finances, fuel-saving potential, energy production, capacity factor, and reduction of greenhouse gas emissions. The results indicate that the proposed PV power plant can provide energy in remote areas at relatively better rates as compared to grid electricity.

Keywords: *Greenhouse Gases, Cleaner Production, Hidden Costs, Fossil-Fuel-Power*

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Higher Education and Sustainability: Early Research Experience and Mathematical Modelling

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Abstract

Universities and colleges can contribute to sustainability in different ways, from academic studies and research to the adoption of sustainable practice in their daily routine. This paper focuses on a specific type of teaching and research experience: the undergraduate students' first experience in research. Such kind of experience allows students to critically use theory and tools in applied research. More, this paper focuses on the contribution of mathematics and statistics in applied research on sustainability. Starting with a review of sustainability indicators, this study discusses the strength and limits of quantitative indicators and mathematical modeling when dealing with sustainable development. Then the experience of a Brazilian University is presented. The study covers the period starting in 2016, the first year of implementation of a master's degree in Sustainability by this University. Annually a meeting is held offering the students the opportunity of sharing the results obtained during the research period. After accessing the abstracts in the Proceedings Book of these meetings, a group of 41 undergraduate students' research projects were selected. All they were dealing with sustainability and quantitative approach. The main result is the limited use of a quantitative approach and a growing interest in a multidimensional vision of sustainability.

Keywords: *Higher Education, Mathematical Modelling*

How Can We Leverage the Circular Economy to Support Sustainable Land Use?

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Abstract

The Circular Economy (CE) is a sustainability paradigm that aims to minimize the input of virgin resources and output of wastes by closing material life-cycle loops. However, questions remain about the role of land within the CE framework and the framework's implications on land-use policy. This study explores the potential of the CE framework to support sustainable land-use through qualitative research methods. First, it introduces a conceptual illustration of the traditional-linear land-use practices and its limitations. Second, it provides a systematic review of the connections between land use and the CE concepts, followed by systems-mapping of successes and gaps in the existing literature. Third, it illustrates the extension of the conceptual CE framework to include a land dimension, showing the circular nature of land functions. Fourth, case studies of the 4R (Reduce, Reuse, Recycle, and Recover) strategies are discussed to provide feasible and proven approaches for policymakers to enhance sustainable land use management in the CE framework. In conclusion, this study suggests a paradigm shift and the potential benefits of considering the interactive two-in-one role of soil and space management for the sustainable land use agenda of the CE implementation.

Keywords: *Circular Economy, Sustainable Land Use*

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How Does Floriculture Agribusiness Seek Sustainability?

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Abstract

The agribusiness sector that adds the greatest economic value is floriculture. Its products are sought after by consumers with higher incomes and usually higher levels of education. And it is also the sector that most uses synthetic chemical inputs (pesticides and fertilizers) and in greater quantity per area, causing the greatest damage from pollution and environmental contamination. Consumers consciencious then start looking for products produced in an environmentally sustainable way. How is the sector then responding to this new demand? As a result of this problem, this article searched the scientific literature for the gaps that exist and for the paths that lead to the sustainability of the sector, and the direction of the research: if study of the productions environments or inputs used, or if has been studies done in logistics and marketing. For this, we searched the Web of Science databases, using the keywords "Sustainable and Floriculture", selecting articles from the last 10 years to make a qualitative analysis of this material. The results demonstrate that there is a new trend towards sustainability in this important sector and most initiatives are being successful.

Keywords: *Floriculture, Agribusiness, Sustainability*

Imagining Hydrogen Futures: Local and Regional Priorities

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Abstract

Visions are emerging for how renewable hydrogen (rH₂) can serve as an energy carrier for transport, heat & power, & as an industrial feedstock. As economies confront stricter carbon budgets, visions can coalesce into socio-technical imaginaries of rH₂ as central to clean, secure & carbon neutral futures. However, current strategies often fail to take a holistic view of uses, strict(er) imperatives of a carbon constrained future, or the broader socio-economic role of rH₂ generation systems. Departing in work responding to a Draft Tasmanian Renewable Hydrogen Action plan with a multi-level perspective, this paper aims to contribute to an improved rH₂ visioning processes. Two cases of different scale, & renewable energy mix & maturity are examined: (Tas. ca. 25TWh; Sweden ca. 500TWh). Both exhibit essentially carbon neutral electricity & have significant potential for generation of rH₂ based on abundant renewable resources, but have significant fossil reliance on fossil inputs for transport & industry. This analysis indicates that several issues currently cloud emergence of common, institutionalised and evidenced visions These include: inconsistent attention to energy autonomy, energy security, carbon neutrality bounds, & differing attention to socio-economic value creation at regional vs. national levels. The study concludes that rH₂ developments require community & regional embeddedness, & regional infrastructure, but are inherently dependent upon national imaginaries. This points towards a need for work to delineate how local & regional rH₂ initiatives can better position themselves within higher level discussions

Keywords: *Renewable hydrogen*

Impact of Oil Price Fluctuations on the Economic Resilience of Industries in Finland

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Abstract

Energy has a strategic role in the policies of governments. In particular, fossil fuel importers are being affected by fluctuations in prices and the world's uncertainties. This is very critical for countries with energy-intensive industries such as Finland. In this study, we assess the robustness of Finland's economy and industry to oil price fluctuations. We calculated the relationship between economic indicators and oil prices by using econometric methods such as multi regression and elasticity models. Our analysis shows that the average Brent crude oil price elasticity of energy demand in the industry is less than one in Finland. This inelastic form indicates that the Finnish industries being insensitive to changes in oil prices. So from the demand side perspective, the main reason is related to the creation and implementation of efficiency improvement policies for industries by the Finnish government that has decreased energy intensity of the Finnish industries. Indeed, policies such as carbon tax or managing prices have increased the robustness of the economy in Finland from energy price fluctuations. On the side and from the supply perspective, shifting the energy supply system in Finland from oil products to diversification resources such as natural gas and renewables has also improved the resiliency in Finland. Finally, some policy recommendations have been suggested for other economics.

Keywords: *Economic Resilience, Finland, Oil Price*

Impacts from Renewable Energy Businesses in Fragile and Conflict-Affected States: Lessons and Policy Proposals for Supporting Low-Carbon Energy Transitions, Peace and Stability

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Abstract

In fragile and conflict-affected states (FCS), there is concern that while renewable energy businesses assist transitions to low-carbon energy systems, businesses may unwittingly exacerbate conflict. For example, large wind or solar energy installations can cause tensions among surrounding communities, and/or those being resettled. This article examines the positive and negative impacts of new renewable energy systems and the businesses developing them, on peacebuilding and conflict in FCS. The article first presents a meta-analysis of literature addressing negative and positive links between renewable energy-related businesses (multinational corporations, state-owned enterprises, local businesses, and social enterprises) and conflict or peacebuilding within a selected number of FCS. The focus is on solar and wind energy installations in-country. The article assesses risks and opportunities for renewable energy projects to support peace and social cohesion. Key case studies of businesses with installations/initiatives that have impacted negatively and positively on peace are assessed, and analysed in relation to Business-Peacebuilding theory. Best and poor practice is discussed, alongside suggestions proposed for private and public policy decision-makers to enhance peacebuilding alongside countries' transitions to cleaner, low-carbon energy systems. Lessons can inform initiatives in FCS globally, and possibly non-conflict states by merging cleaner energy and community cohesion targets.

Keywords: *Fragile and Conflict-Affected States, Low-Carbon Energy Transitions*

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Implementation Assessment of Smart Mobility: The Case of a Small Portuguese Town

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Abstract

The city of Leiria, a small Portuguese town with a population of around 120.000, was used as a case study to understand what is the possibility of introducing smart mobility options. In small cities the mobility options are not the same and does not present the same variety as the ones of a big city and the increase in electric vehicles and the growth concern about environmental issues are driving people to opt for untraditional ways of transport themselves and their stuff. This work main target was to evaluate what can be done to mitigate the environmental effects associated with the increase in pollutant and greenhouse gas emissions from vehicles by introducing green and intelligent mobility solutions. In this sense, the current solutions available to people to move from the periphery to the urban area and even within it has been analysed. The possibilities of offer green mobility solutions without affecting the levels of comfort, price or even timetables have been assessed. This research is based on a method that considers the different routes used and the different mobility options currently available, considering the possible technological developments associated with vehicle propulsion. This technical analysis about the options and the way how this could be useful to the environment was integrated with a survey to people of Leiria, trying to realize what are their expectations and worries about smart mobility.

Keywords: *Smart Mobility, Leiria, Greenhouse Gases*

Implementation of Cleaner Production Approach in Petroleum Industry Considering the Multi - Lateral Environmental Agreement

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Abstract

Iran's economy is fairly diversified and the oil sector is an important part of the economy. Despite its economic benefits, oil production consumes a large amount of chemicals and generates considerable waste, posing a significant risk to human health and the environment. Iran is a party to chemicals and waste instruments such as the Basel, Rotterdam and Stockholm conventions and an active member of the Strategic Approach to International Chemicals Management, attaches great importance to the sound management of chemicals and waste. Cleaner Production (CP) is a continuous application of an integrated, preventive, environmental management strategy to increase overall efficiency and to reduce risks to human and environment. To tackle these environmental challenges, The UNEP is supporting Iran on an ambitious 18-month project to strengthen the country's institutional capacity for the sustainable management of chemicals and waste through a cleaner production approach within the oil industry. The objective of the Project is to support country-driven institutional strengthening at the national level, in the context of Cleaner Production to address the sound management of chemicals and wastes, taking into account the national development strategies, to increase sustainable public institutional capacity for the sound management of chemicals and wastes throughout their life cycle.

Keywords: *Cleaner Production, Petroleum industry*

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Implementation of Cleaner Production in Industrial Food Complex

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Abstract

Through Cleaner Production, it was possible to mitigate waste emissions from an industrial food complex, located in a large capital city in the interior of Brazil. All types of waste from the food sector produced on-site were analyzed. All residues were classified according to state, mass, potential environmental damage and possibility of reintegration in the production process. The environmental policy after the application of cleaner production was expanded to all sectors of the enterprise. The cultural change in the way it was organized changed relations among all stakeholders of the site, being the employees, directors and suppliers. The changes in the way waste are treated, in the organization of supplies and how to use them, and in environmental education have provided an Environmental Management System (EMS) integrated with the strategic planning of the enterprise, improving ecological awareness as a productive bonus, improving the efficiency of the industrial complex, adding social value to the enterprise. The results obtained through the P+L practices in food industrial complex presented in this work are replicable to any similar establishment and gave a vocation for implementation in other companies in the industry in the city where this work was developed.

Keywords: *Cleaner Production, Industrial Food Complex, Environmental Management System (EMS)*

Indian Energy Transitions - A Framework to Address the Energy Divide

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Abstract

INDIA's energy framework still relies 80 % on coal. Coal, Gas and fossil fuels are the mainstay. The contribution of renewables is still very limited inspite of major initiatives. Of the 50 top mineral producing districts, 70% fall under the 150 most backwards districts. India is one of top two countries most affected by natural disasters in the last decade [along with China] (IFRC, 2018, 179). Natural disasters and climate change pose considerable current and future risks to the Indian subcontinent (as evidenced by the recent Orissa cyclone and Kerala floods, where an entire state was flooded. India has targeted 225 GW of renewable energy by 2022 and aims to achieve the target. However a third of India's villages do not have a continuous source of electricity. Increasingly the energy divide has taken an urban -rural divide with rural areas being provided by solar power and urban areas by fossil fuels. At current rates we expect 225 GW BY 2030 with BAU scenario. Batteries for Solar storage will continue to be dominated by Lead Acid. COP24 With these challenges, the paper discusses how a framework for just and inclusive transitions based on the Katowice 2018 Solidarity and Just Transition Silesia Declaration, the ILO Guidelines for a Just Transition, OECD and other guidelines can be applied to the ongoing debates on India's Nationally Determined Contribution (NDC) under the Paris Agreement, and more particularly in relation to equitable and just transitions.

Keywords: *India, Energy Transitions*

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Indicators for Monitoring the Transformation towards a Circular Economy in Polish Regions

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Abstract

The circular economy (CE) is a concept that has not yet been clearly defined in the literature. Analyzing various attempts at its interpretation, it is possible to divide into the definition of circular economy which focuses on raw materials and waste. An example is the definition of circular economy contained in the Polish Road Map of transformation towards circular economy. Another definition of CE covers the entire ecosystem of entities (public and private sector, research institutes, society) and activities (regulations, business models, education, etc.) enabling transformation towards CE. The purpose of the article is to analyze the circular economy monitoring indicators at the level of Polish regions. Starting from the foundations of the concept of CE, a set of transformation indicators towards circular economy was created at the regional level. Identifying a set of indicators at the regional level is in practice similar to developing a similar set at the national level. However, due to the smaller size of the economy, it is necessary to properly interpret these values. The set of proposed indicators was divided into three groups: environmental, social and economic indicators and were consulted at the level of representatives of regional authorities. The study uses the data triangulation method, which ensures high quality of research with relatively low measurement error. The result of the research will be a set of indicators monitoring the transformation towards circular economy used in strategic and planning documents of regions.

Keywords: *Circular Economy, Polish Regions*

Industry 4.0: The Position of Consumers on Sustainability

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Abstract

A new production paradigm, called Industry 4.0, has emerged promising to increase productivity and resources savings for companies that will embrace it. Although much research has been done on the technological challenges to implement Industry 4.0, little attention has been focused on the position of consumers, related to the social side of sustainability. The aim of this study is to discuss the role of consumers within Industry 4.0, many times considered an easy prey to algorithms and digital technologies. The methodology used was bibliographic review and secondary data. The academic contribution and originality of this research are double: (1) awake that people want to make their lives easier to live, which Industry 4.0 intends to provide, but they also want to be treated with consideration and dignity, not as robots or as mass, (2) and that the social side of sustainability on Industry 4.0 should have as much importance as the technological side, or even more.

Keywords: *Cleaner Production, Petroleum industry*

Influence of Internal Temperatures and Methane Composition in Plug-Flow Digesters on Pig Farms

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Abstract

The plug-flow digesters are widely used to treat piggery manure in Brazil; meanwhile there are scarce studies that investigate the seasonal variations of temperature in the content of methane, especially in large scale units. The study was carried out in Teixeira (Minas Gerais State, Brazil) and the internal temperature (biomass) of two plug-flow digesters and methane composition in the biogas was monitored. The internal temperature was continuously measured by sensors and biogas samples were analyzed weekly in terms of methane composition in a gas analyzer (model GAS3100). The monitoring was performed from Jan. to Dec. 2019. In order to evaluate the seasonal temperature influence there were proposed two periods: summer (Jan., Feb and Dec.) and winter (Jun., Jul and Aug.). The data of methane content for the periods were subjected to statistical analysis of variance for significance level of 5%. The anaerobic digester operated in mesophilic conditions ranging from 20.3 to 26.9°C and methane content from 44.6 to 73.5%. Comparing the two periods the monthly average of CH₄ and internal temperature were 66.3%, 25.5°C (summer) and 48.2%, 22.1°C (winter), respectively. There was statistically significant differences for the CH₄ composition between the periods. It concludes that the reduction of internal temperature in digesters can directly influence the methane content.

Keywords: *Pig Farms, Plug-Flow-Digesters*

Influence of pH and Hydraulic Retention Time on the Hydrogen Production in a High Rate Anaerobic Sludge Reactor Inoculated with Prior Heat Treatment

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Abstract

Anaerobic digestion, gains greater recognition daily being a technology of water treatment, which can achieve high efficiency of contaminant removal in addition to energy recovery. These treatment systems are generally employed for treating waste water highly contaminated, because of its high conversion yields of methane, hydrogen, alcohols and volatile fatty acids. Because of this, one of the most promising sources of waste water comes from soft drinks industries, due to its high carbohydrate concentration. The anaerobic digestion system, is currently working in single phase, (ie. all phases of the system in a single reactor), however for this type of industry would be attractive works in two phases not only to accomplish the regulations but also to produce bioenergy. It is therefore the objective of the following study to evaluate the performance of an acidogenic reactor high rate, subject to variations of pH and hydraulic retention time (HRT), to evaluate the hydrogen production and volatile fatty acids under the influence of these parameters. The study has shown so far, that it is feasible to produce hydrogen from industrial real water produced in a non-alcoholic beverage industry, despite the large variation in the quality of the water present this industry. it was observed that the condition with the most promising results so far were the values of a pH 5.5 and a value of HRT 8h, in which a production of around 30% H₂ was generated together with a higher removal of carbohydrates. Also, the most important acids for this condition were the iso-butyric and propionic, with a concentration of 498.07 mgHIBut/L and 774 mgHIBut/L.

Keywords: *Anaerobic Sludge Reactor, HeratTreatmente, Hydraulic Retention*

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Institutional Models to CCS Technology in Brazil: A Brief Discussion of Regulatory Framework and Competence's Distribution

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Abstract

Energy sector is deeply in GHG emissions through several sources of electricity, heating, transport sector and other uses, and, globally, it is involved at almost half GHG' emissions. Therefore, it has been pointed as an important target to several changes that have to be taken by countries in order to modify their own public policies, as well as its companies and citizens behavior, who are final agent at GHG emission's chain and final users. For IPCC, adoption of governmental efforts is needed for GHG' emissions mitigation and for adapting to a possible warmed environment. They incentive carbon footprint's cut at all sector, for instance, using advanced and cleaner fossil-fuel technology, such as CCS technologies. From this perspective, CCS viability needs to be done through a framework that distributes responsibilities among all agents and thereby reduce intrinsic and individual risks and it allow establishment of incentive mechanisms for economic agents to implement. This research aims to discuss the distribution of competences among governmental agents linked to CCS technology in Brazil as cleaner fossil-fuel technology, its regulatory issues and effects on long-term liability as a path to economic feasible and its uses as instrument for energy's SDG.

Keywords: *CCS Technology, GHG's*

Integral Sustainability and Agenda 2030: A Theoretical Reflection

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Abstract

Since the Rio de Janeiro Earth Summit (synonymous Rio Summit, Rio Conference, or Earth Summit - Portuguese: ECO92), the term sustainability has been used at almost all international meetings and has become a permanent item on the commitment agenda for various entities and corporations. Nevertheless, the concept of sustainability is still an enigma in relation to its limits and magnitude. On the other hand, in 2015, as part of the 2030 Agenda for Sustainable Development which set out a 15-year plan to achieve the Goals, the 17 Goals were adopted by all UN Member States. In this context, the purpose of this scientific article is to present a discussion focused on the inherently multifaceted concept of sustainability into the Agenda 2030. In order to contribute to the elucidation of this issue, this research, through the descriptive, historical and normative method, will seek to epistemologically understand the term sustainability under Agenda 2030. A reflection will be made on the direction towards human uniqueness and sustainability, including a dialogue on Sustainable Development Goals.

Keywords: *Agenda 2030, Integral Sustainability*

Investigation of the Effect of Natural Gas Composition on the Performance of Solid Oxide Fuel Cell with Internal Reforming

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Abstract

Natural gas due to relatively low production cost, more readily available and environmental friendly, can be a suitable source for reforming in solid oxide fuel cells (SOFC). This gas is a hydrocarbon varying with zone mixture consisting primarily of methane and also may contain other heavier hydrocarbons, such as ethane, propane, butane and etc. with different operating performance on the SOFC. This paper aims to study the effect of the fuel chemical components gathered from five deposit zones of Iran on the tubular SOFC performance with direct internal reforming based electrochemical model. The presented SOFC computational model is constructed based on reforming, electrochemical and thermal analysis. The results indicated that the quality and percentage of the fuel mixture compositions have substantial effect on the SOFC performance. At low operating temperatures of the SOFC, the fuel with higher methane percentage delivers better performance, while at average operating temperatures; the SOFC performance is less sensitive to the variations of methane percentage. In contrast, the SOFC performance can be enhanced with lower percentage of methane at high operating temperatures. Also, at a constant temperature with low operating pressure of SOFC, variations of methane percentage do not influence the performance whereas, the performance of the SOFC is lessened at average operating pressures with fuel having high percentage of methane. In such conditions, the performance can be improved slightly using other types of gases. Furthermore, the efficiency of SOFC is dropped down in the field of high operating pressures for all type

Keywords: *Internal Refroming, Fuel Cells, Natural Gas*

Is Intensification of Cropping a Cleaner Production Option in Terms of Carbon Footprint in the Eastern Gangetic Plains (EGP)?

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Abstract

Food security is very much associated with cropping intensification in the EGP. The EGPs have more than 300 rice-based double or triple crop rotations in practice (with cropping intensity around 200%). The incorporation of crops requiring low input or based on the duration of crops has impacts on yield-scale greenhouse gas(GHG) emissions. Increased input use supports the sustainability of the cropping intensification. However, the environmental sustainability of the intensive cropping is in question due mainly to blanket use of nutrients, decreasing arable land area and cropping diversity. The life cycle analysis based C-footprints and hotspots of major cropping systems were estimated (based on local emission factors and on-farm emission data extrapolation) to know whether cropping intensification is a cleaner production option in the EGP. Growing short duration crops generated high rice equivalent yield but low C-footprint compared with rice. The incorporation of crops in the cropping system which requires minimal inputs for production can reduce the contribution to the C-footprint even further. Legumes have low footprints and soil health perspectives because they fix atmospheric nitrogen. Similarly, high input crops like potato and maize have high C-footprints due to the risk of high N₂O emissions from the application of a huge amount of N fertilizers.

Keywords: *Cleaner Productiob, Carbon Footprint*

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Kinetic Study of Alcoholic Fermentation of Inverted Honey and Inverted and Clarified Honey

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Abstract

The objective of this study was to study the kinetics of fermentations using inverted honey and clarified inverted honey from sugarcane, comparing the yield of alcohol and the consumption of sugars in discontinuous and discontinuous regimes fed, with and without prior clarification of honey. Thus, different clarification agents, different operating regimes, cellular behavior at high initial concentration of inoculum, as well as some variables that affect kinetic parameters were also evaluated. As well as the conversion factors and yield of the substrate and the main product formed, ethanol. From the various tests performed, maximum yields of the order of (72% to 78% of theoretical yield) were observed for the discontinuous tests with inverted honey and up to 84% for the tests with means constituted of clarified inverted honeys. Already for the discontinuously conducted experiments fed, results of up to 94% of the theoretical yield with clarified inverted honey were obtained. Thus, it was concluded that the experimental procedures adopted, both for clarification and the way of conducting the fermentation process, allowed an improvement in the alcoholic yield on a laboratory scale.

Keywords: *Inverted Honey, Clarified Honey*

Laboratory Performance of Asphalt Binder Extracted from Rubber Modified Asphalt Mixture Using Dry Process

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Abstract

The goal of this paper is to promote a dry process technology with tire rubber from scrap tires by investigating the laboratory performance of asphalt binder extracted from rubber modified asphalt mixture. Four types of asphalt mixtures, which included two mixture designs with and without rubber, were produced in a plant. The property of extracted asphalt binder from the mixtures was compared with the base asphalt and the rubber modified asphalt. The dynamic shear rheological property, multiple stress creep and recovery property, and low temperature cracking property of different types of binders were evaluated. Based on the test results, the rubber addition significantly increased the high temperature performance and slightly improved the low temperature characteristics of the base asphalt. The aged asphalt binder in the reclaimed asphalt pavement (RAP) increased the high temperature performance of the asphalt binder but decreased the low temperature cracking performance. The contribution of rubber in extracted asphalt binder to the low temperature performance was limited. However, the aged asphalt binder and rubber in extracted asphalt binder guaranteed the asphalt binder to sustain heavy traffic load at high temperatures. This rubberized mixture with RAP may provide an appropriate and environmental-friendly pavement designed for heavy traffic conditions.

Keywords: *Reclaimed Asphalt Pavement (RAP), Dry Process*

LCA in Fruits Processing: Challenges and Opportunities

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Abstract

Post-harvest processing stands out for promoting an increase in the shelf life of products derived from fruits, mainly for being able to reduce the speed at which deterioration reactions occur. However, in addition to increasing the quality of these products, efforts are needed to achieve more sustainable production, since the food industries are also responsible for a portion of the negative environmental impacts. For this reason, the application of Life Cycle Assessment (LCA) in this sector has grown a lot in recent years. The purpose of this article is to present the challenges and possible opportunities of the LCA in the fruit processing stage. Thus, a search was carried out in the Scopus database using the keywords "LCA and fruits," "LCA and food," and "LCA and agri-food systems," selecting articles from the last five years that applied the LCA method in the processing fruit. The review indicated the various products on which the method focused, with emphasis on products derived from tomatoes, fruit jams, beverages, and the use of technologies to reduce post-harvest losses. Publications generally presented difficulties in defining the functional unit, in the methods of data collection and in choosing the relevant impact categories for the study. On the other hand, because the main impacts of this sector are related to high energy consumption, some studies have presented opportunities for improvement, as in the case of analyzing scenarios for the production of bioenergy from waste generated by industrial activity.

Keywords: *LCA, Fruits Processing*

LCA of a Biologically Detoxified Cottonseed Cake to be Used for Monogastric Nutrition

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Abstract

Cottonseed cake (CSC) has high protein content (above 26%). However, presents restrictions for animals nutrition, due to the presence of toxic compounds, such as gossypol. Detoxification of CSC by biological treatment, using macrofungi, is an innovative process, that makes this biomass suitable for monogastric animal nutrition. Although it provides economic advantages, the process requires water, energy and other inputs. This study aimed to assess potential environmental impacts of a detoxified cottonseed cake (DCSC), seeking for the improvement of the process. The functional unit is 1 kg of DCSC, and the product system includes the transportation of substrates (CSC and sawdust), and all the processes for the detoxification, considered a gate to gate approach. SimaPro 8.5.0.0 was used for the assessment, and LCI based on primary data from a pilot scale, and secondary data from EcoInvent v.3.0. Recipe Midpoint H v.1.01 was applied to assess potential environmental impacts. Higher impacts were observed for the steps of colonization and sterilization of the substrate, for all the considered impact categories considered, due to the use of electric energy. For this study, in order to improve the environmental performance of DCSC, alternative procedures that consume less energy and also water, shall be sought.

Keywords: *LCA, Cottonseed Cake, Monogastric Nutrition*

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LD Steel Slag Utilization - An Asian Perspective

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Abstract

Basic oxygen steel making process accounts for around 70% of the steel produced in the world; along with that it generates around 100-200 kg of slag is generated. With the current level of BOF steel production (~ 1200 million ton), the slag generation is of the order of ~ 189 million ton. It is to be noted that though it has many valuable constituents; however, there are some constituent detrimental to its use in any particular applications. The Asian countries China, India and Japan are the first, second and third largest producer of crude steel in the world. Most of the slag generated in Japan is consumed in many applications whereas the utilization in China and India are meager. Overcoming the environmental regulations with ever increasing slag inventory (with out any substantial use) will be difficult. In order to withstand the pressures, and attain sustainability of the steel sector, this slag need to be put into some application. This abstract takes a look at the utilization of BOF/LD slag in the Asian countries vis-a-vis the rest of the world. Based on the facts available, process options to utilize maximum amount of slag will be arrived.

Keywords: *Steel Slag, Steel Production*

Legal Incentives for Waste Management in a GSCM Context: Potential for Boosting Circular Economy Implementation

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Abstract

Legislative aspects are frequently cited as the main pressures to implement Green Supply Chain Management (GSCM) practices such as green production and reverse logistics. At the same time, coercive/normative elements constitute drivers for Circular Economy implementation among manufacturers. An example in Brazil is the National Solid Waste Policy, which determined Reverse Logistics Systems (RLS) should be set up for specific products. A sectoral commitment signed in late 2019 established the creation of a RLS for Waste Electric and Electronic Equipment (WEEE) involving manufacturers, retailers, consumers and waste pickers associations, and therefore might benefit GSCM practices and boost circularity of the sector. A case study conducted in a city expected to participate in the RLS reveals examples of challenges for its implementation: the main WEEE collection and processing initiative is an organization with limited resources; it is not directly supported by manufacturers and does not interact with them. Data on the amount of WEEE processed were also lacking. We argue that legal instruments such as payment for ecosystem services might stimulate activities of Brazilian reverse chain organizations, constituting an incentive (rather than a coercion) for implementing GSCM practices and imparting a higher degree of circularity to the economy.

Keywords: *Green Supply Chain Management, Waste Electric and Electronic Equipment, Circular Economy, Waste Management*

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Life Cycle Assessment for Pigments Production from an Algal Turf Scrubber (ATS) System

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Abstract

The use of Algal turf scrubber (ATS) system for simultaneously bioremediation and biomass valorization can reduce the costs and environmental impacts involved in the steps of bioactive compounds production. In the present study, the life cycle assessment (LCA) of pigments production from periphytic biomass produced in a pilot scale ATS system was conducted. For LCA, 1 kg of pigments was established as a functional unit and a reference flow of 10 years. The ReCiPe midpoint was used in SimaPro software version 8.04 with the data from the system construction/operation, drying and pigments extraction. The results demonstrated that the use of ATS to obtain biomass for pigments extraction had a low impact in the main categories especially due to the use of water from a lake catchment for cultivation. Categories damages and impacts were mainly related to the high greenhouse gas emissions from the ATS construction, and the use of acetone as extraction solvent. On the other hand, even with the permanent demand for electricity (pump), the ATS operation presented less impacts than its production. This scenario indicated that the ATS system can be a suitable alternative to produce pigments from periphytic biomass while promoting the bioremediation of a eutrophic lake.

Keywords: *Algal Turf Scrubber (ATS) System, Life Cycle Assessment*

Life Cycle Assessment of a Typical Rex Rabbit Industry in Kubuqi Desert, China

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Abstract

Desertification prevention and control is one of the main and difficult issues in the world. The Kubuqi desert in Inner Mongolia is the seventh largest desert in China. After years of efforts, the development of sand industries has made important contributions to improve the local ecological environment, promoting economic development and improving people's well-being. However, the current sand industry chain is short and the wastes are not effectively reused, thus resulting in the waste of resources and environmental pollution. Therefore, we choose a typical rex rabbit industry in Kubuqi desert to compare the environmental impact and benefit between the traditional industry chain and the improved circular industry chain using life cycle assessment (LCA) method. Based on field research and data collection, a life cycle inventory of both scenarios is built, then the SimaPro software is applied for the impact assessment. The environmental impact and benefit of the two scenarios are obtained and compared. Finally, the recommendations for improvement are proposed aimed at the problems in the industry chain. This paper can provide a theoretical basis for improving the circular industry chain of rex rabbit industry and promoting the sustainable development of sand industries in local and other regions.

Keywords: *Kubuqi Desert, LCA, Rex Rabbit*

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Life Cycle Assessment of Hydrogen Buses for Public Transportation in Cities

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Abstract

Efforts aiming to propose energy alternatives are largely found in literature, specifically for the public transportation. In São Paulo, Brazil has experienced the use of hydrogen as energy source for public buses. This work aims to apply the Life Cycle Assessment (LCA) method on the installed project to generate and use hydrogen for public transportation in buses. System boundaries contains hydrogen production and storage in the filling station as well the bus itself consuming hydrogen and transporting people. It is expected that the results obtained from LCA for the hydrogen in public transportation will show better performance than for diesel, and other fuels such as biodiesel, electricity and liquefied petroleum gas (LPG), which would support its usage. This comparison will be made in two scenarios: Scenario #1 - LCA Considering the process for hydrogen generation and consumption, compared to other fuels in an infrastructure for the 4 buses tested in São Paulo from 2009 to 2016 Scenario #2 LCA Considering the complete replacement 4076 diesel-based public buses in São Paulo city with hydrogen-based buses. The main purpose is to verify whether this substitution will be able to accomplish the emissions reduction as proclaimed by Brazilian public agencies.

Keywords: *Hydrogen Buses, Life Cycle Assessment*

Life Cycle Assessment of Processes at Early Research Stage: The Case of Starch Extraction from Mango Kernel

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Abstract

In this work we analyze the challenge of designing environmentally sound processes, following the biorefinery approach, through the assessment of two alternative processes, designed to extract starch from mango kernel: A, extracting only starch and B, extracting starch, fat and polyphenols. Different production scales (laboratory and industry) and functionality approaches (one-product or multiproduct) were considered. For the one-product approach, the assessment referred to the mass of starch, adopting mass and economic allocation criteria. For the multiproduct approach, the assessment referred to the total revenue. Life cycle assessment, according to ISO 14040 and 14044, was adopted in a cradle to gate system perspective. When the one-product approach was adopted, process A performed better than B, for both allocation criteria used. When the multiproduct approach was evaluated, results changed, with process A performing worse than B. Moving from lab to modeled industrial scale showed that these results were maintained, although differences occurred in the identification of critical processes and in the magnitude of impacts since great reduction in the use of energy and water was achieved. We concluded that the selection of processes can be made at early development stage, but results from comparisons change according to the adopted functionality approach.

Keywords: *Life Cycle Assessment, Mango Kernel, Starch Extraction, ISO 14040, ISO 14044*

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Life Cycle Assessment of Water Heating Systems in a Residential Multifamily Building

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Abstract

Buildings are major responsible for the energetic consumption and potential greenhouse gas emissions during its life cycle. In this overview, building water heating systems are facilities that contribute to the building's energetic consumption, mainly in residential units, throughout its operational phase. The variability of possibilities available of energy source, reservation and distribution systems of hot water and types of construction materials used in these building systems allows, in the design phase, to make a lot of different system arrangement, depending on the decision-making process. Often, the definition of the facility typology for a building is made by a technical-economic decision. However, the system possibilities spectrum should consider the resources consumption and environmental impact generation throughout the life-cycle of these facilities. The research presents an application of a specific environmental management tool, based on Life-Cycle Analysis (LCA) in such hot water systems in the early design building phase. The method applies in the pre-operational phase, in order to enable to obtain relevant information about the environmental performance of buildings hot water systems and heating water systems, in order to assist the decision-making process of the technical team involved in the elaboration of the building projects, incorporating environmental information to it. This work insight a comparative study of solar heating water systems and natural gas heating water systems for a residential multifamily building to be constructed in Rio de Janeiro, Brazil.

Keywords: *Life Cycle Assessment, Water Heating Systems, Residential Multifamily Building*

Literature Systematic Review: Interrelationship between Product-Service System, Circular Economy and Sustainable Development Goals

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Abstract

Aiming to achieve the sustainable development with balance in ambiental, social and economic aspects, organizations are reshaping their production cycles. In this context, there is the need to critically analyze studies and practices with this objective, establishing interrelationships between concepts in the literature on sustainable development such as Product-Service System, Circular Economy and Sustainable Development Goals. Researches with an holistic view are needed to analyze the interaction between these concepts which are usually individually presented. Thus, this article aims to accomplish the state of the art on the interrelationship between the concepts presented, Product-Service System, Circular Economy and Sustainable Development Goals including papers published from 2008 to 2019. Therefore, the methodology is related to a literature systematic review, pointing to a bibliometric analysis and a content analysis of the articles exposing the interrelationships between the concepts. Thus, primarily in bibliometric analysis, there is a temporal trend in publications, co-citation of authors, research elite, grouping of keywords, and journals with the largest number of publications in the studied area. Content analysis describes the interrelationships between concepts, presenting the main highlights, the benefits and drawbacks that the literature has addressed in recent years and main trends.

Keywords: *Product-Service System, Ciscular Economy, Sustainable Development Goals*

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Microbial Fuel Cells for Fermentable Household Waste Extract Treatment and Bioenergy Production in Individual and Stack Configurations

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Abstract

Microbial fuel cells (MFCs) are bio-electrochemical devices which convert biomass spontaneously into electricity via the contribution of microorganisms [1]. Various types of wastewaters have been used as substrates in numerous MFC designs. In the present study fermentable household waste extract (1.6 gCOD / L) was used as the feed in four identical air cathode MFC units. The units were operated both in batch and continuous mode. Moreover, the power behavior of the units and the stack was assessed under series and parallel electrical configuration. The units within the stack were fed individually. The stack connection modes were evaluated through Linear Sweep Voltammetry (LSV) and Electrochemical Impedance Spectroscopy measurements (EIS). The COD removal was over 90% for each cell in batch operation (cycle duration 24 h), while in the case of continuous operation it was 60% (flow rate 0.7 ml/min). The electrical configuration did not affect the COD removal efficiency. The stack with the parallel connection produced a maximum power output of 1.5 mW ($R_{ext}=100 \Omega$) while in series connection the maximum power output was 6.4 mW ($R_{ext}=100 \Omega$). The effective volume of the stack was 400 ml.

Keywords: *Microbial Fuel Cells (MFCs), Linear Sweep Voltammetry (LSV), Electrochemical Impedance Spectroscopy measurements (EIS).*

Microbial Fuel Cell Using *Serratia Marcescens*, *Klebsiella pneumoniae* and Their Co-Culture

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Abstract

The technologies of the microbial fuel cell (MFC) have been interesting to the scientific community for the feasibility of the transformation of the organic waste matter directly into electrical energy through bio catalyzed or enzymatic bioelectrochemical reactions. In the present study, we used the effective co-culture system with *Serratia marcescens* AATB1 and *Klebsiella pneumoniae* AATB2 in MFC. The isolated strains *Serratia marcescens* AATB1 and *Klebsiella pneumoniae* AATB2 was identified as biofilm-producing bacteria by congo red agar (CRA) method. The experiments were carried out in two-chambered MFC setups with septic tank wastewater (STWW) as a substrate. Energy production by *S. marcescens*, *K. pneumoniae*, and their co-culture shown maximum current densities of 728.85 mA/m², 642.19 mA/m², and 869.11 mA/m², respectively with maximum power densities of 341.65 mW/m², 257.51 mW/m² and 398.69 mW/m² respectively. Cyclic voltammetry (CV) analysis revealed the electrochemical behavior of the anode biofilm for *S. marcescens*, *K. pneumoniae*, and their co-culture. Biofilm formation by adhesion of microbes on the electrode surface was visualized by confocal laser scanning microscope (CLSM) and scanning electron microscope (SEM). The electrode biofilm growth and viability by extracellular polymeric substances (EPSs) were analyzed.

Keywords: *Microbial fuel cells, Serratia Marcescens, Klebsiella pneumoniae*

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Minimizing Water and Energy Consumption through the Adoption of Cleaner Production with the Circular Economy Principles in the Tea Industry contributes to SDGs

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Abstract

The global population growth has an impact on the need to increase the food production, and in this context, the use of technologies becomes an important issue. The application of Circular Economy to maintain materials, products and services in a high degree of utility and value, important in the agricultural environment where controlling water use, energy consumption and soil are essential to get better results. Tea is a food with beneficial characteristics to human health, and the production processes in the tea industry consume a lot of water and generate large amounts of waste. No research has been identified in the literature that relates the cleaner production, circular economy and SDGs applied in the tea industry. Thereby, this research aims to evaluate the eco-efficiency of adopting cleaner production with the circular economy principles in the tea industry, and also, if it results in contributions to SDGs. The conclusions indicated that adoption of cleaner production with the circular economy principles can minimized the consumption of water, energy and waste generation in the tea industry, reducing environmental impacts, in addition to contributing to the SDGs. Also, an economic gain was obtained by reducing the resources consumption and selling organic waste.

Keywords: *Water and Energy, Cleaner Production, Circular Economy, SDG's*

Moringa Oleifera in the Treatment of Dairy Wastewater: An Ally in the quest For Sustainable Development

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Abstract

The dairy industry generates effluent with a great polluting potential, with high flow and concentration of organic matter, fats, suspended solids and nutrients. The primary treatment of this waste is responsible for the removal of solids and fats by the coagulation/flocculation process with the common use of iron or aluminum salts, which generate large volumes of sludge, have inferior efficiency at lower temperatures, with great pH change in the effluent and high toxicity. As an alternative to the use of chemical coagulants, coagulants from natural sources, such as Moringa oleifera extract, have been studied presenting high efficiency, low sludge volume and high biodegradability. These benefits are in line with the goals defined by the UN by assisting in the sustainable management of water, enabling inclusive and sustainable industrialization, favoring the sustainable management of chemicals and their residues. The present study evaluates the efficiency of Moringa oleifera seed extracts in an dairy industry effluent with Jar Test using different pH values and coagulant concentrations. As main results, the application of in natura and macerated seeds generates a more efficient and low-cost result, being the efficiency of the removal of color and turbidity directly linked to the size of the grain.

Keywords: *Moringa Oleifera, Dairy Wastewater, Sustainable Development*

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Multi-Objective Optimization of Fischer-Tropsch Synthesis in a Fixed-Bed Reactor Over a Co/Al₂O₃ Catalyst

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Abstract

A one-dimensional non-isothermal model for Fischer-Tropsch synthesis is studied and optimized using a multi-objective Differential Evolution (DE) algorithm. The kinetics were based on a semi-empirical model, which was incorporated into the equations for heat and mass transfer in the reactor. Comparisons with experimental results show that the model describes correctly the product distribution, mainly the selectivity deviations, under several operating conditions. Initially, the operating conditions were optimized by a single-objective DE to obtain maximum CO conversion and minimum CH₄ selectivity, results suggest a trade-off among objectives, i.e., an improvement gained for one objective is only achieved by making concessions to another objective. Multi-objective DE using the TOPSIS algorithm for decision analysis found the optimal as 60.21% and 6.65%, respectively, for CO conversion and CH₄ selectivity at P = 22.7 bar, H₂/CO = 2.7, T = 501.63 K, GHSV = 4002.17 Nmlg_{cat}⁽⁻¹⁾ h⁽⁻¹⁾ and %N₂ = 0.

Keywords: *Fischer-Tropsch Synthesis, Fixed-Bed Reactor, Al₂O₃*

Multiobjective Optimization of Reverse Logistics of Empty Pesticide Packaging Considering Environmental Impacts

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Abstract

Waste, emissions and contaminants are the main causes of pollution leading to worrying environmental imbalances. With this, sustainable alternatives are increasingly explored in order to bring improvements to the environmental performance in various anthropic activities. The Reverse Logistics (RL), in the context, is responsible for the reverse flow of materials with the purpose of generating value within the production chain. Greater importance is given when dealing with hazardous waste, as is the case with empty pesticide packaging, as they are mostly plastic. It is evident that the return of packaging to the production cycle depends fundamentally on an articulated transport network between the different echelons of the RL. In this sense, the work proposes to carry out the multiobjective optimization of a RL network of empty pesticide packaging, integrating Life Cycle Assessment (LCA) techniques, considering simultaneously the environmental and economic performance of the system. The environmental impact is measured through the contribution to climate change made by the operation of the RL network. The problem is formulated as a Mixed Integer Linear Programming (MILP) that seeks to optimize economic and environmental performance. The problem was developed in a GAMS environment in conjunction with the CPLEX solver. The applicability of the approach is tested through a RL case study of empty pesticide packaging in Paraná, Brazil, in order to validate the model presented. A set of Pareto solutions was obtained using the ϵ -constraint solution method, providing valuable information on the trade-off between the objectives.

Keywords: *Reverse Logistics, Life Cycle Assessment, Mixed Integer Linear Programming*

Nanopapers and Starch Nanocomposites Made of Nanocelluloses from Cellulosic Waste Sources

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Abstract

Nanocellulose is a kind of material which has been widely studied nowadays, due its versatility, biodegradability, availability and mechanical, chemical and optical properties. By the traditional way, nanocellulose is achieved by hydrolysis with strong inorganic acids and cellulosic pulp got from wood, however there are many acidic mediums able to hydrolyze cellulose by a greener approach, as well so many alternative cellulosic sources, as agricultural wastes, marine resources and postconsume processed materials. In this work, rambutan peel (*Nephelium lappaceum*), post-consume cardboard and the seaweed *Ulva compressa* have evaluated as alternative sources to get nanocellulose due their high local and national availability. Three different sulphurous mediums have used to hydrolysis: sulphuric acid (H₂SO₄), the aprotic ionic liquid 1-butyl-3-methyl-imidazolium hydrogensulphate [Bmim][HSO₄] and the protic ionic liquid 2hydroxylethylammonium hydrogensulphate [2-HEA][HSO₄]. Nanocelluloses with different properties were achieved depending on cellulosic source, sulphurous mediums and experimental parameters used to hydrolysis. Morphological, structural, spectroscopic, electrochemical and thermal analysis were carried out. The best nanocelluloses were evaluated as nanopapers and starch nanocomposites in their mechanical strength and optical proterties and good materials have been achieved. In this work we hope contribute scientifically to turn Bahia and Brazil large producer polos of nanocellulose, standing out in te sector of nanotechnology by the exploitation of its agricultural, forestry and marine potential.

Keywords: *Nonopapers, Nanocelluloses, Waste Sources*

New Paradigms of Collaborative Circular Business Models and a Circular Network

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Abstract

Development of circular business models (CBM) is essential towards a more sustainable socio-economic growth. The European "Green Deal" strategy highlights the importance of this transition by calling for immediate actions and collaboration to accelerate circularity. While circular value creation, proposition and capturing have been described as elements of CMB in the literature, less attention has been paid to a circular network or multi-stakeholder collaboration, also involving people or communities in this transdisciplinary setting. Based on a systematic literature review, this paper investigates existing paradigms and concepts of a circular network. This study provides a comprehensive framework of collaborative CBMs and proposes a set of principles for collective endeavour in CBMs shaping. Our findings reveal that in order to benefit the most from the circular network, collaboration and interaction models require changes in social behaviour and perception of the societal role in CBM innovations and the circular value chain. This study contributes to circular business model theory and practice. Identified dilemmas are mapping the future research agenda related to both the ownership of shared circular value creation, as well as engagement and leadership of self-managed teams of circular collaborative platforms.

Keywords: *Circular Business Models, Circular Networks, Collaboration, Business Management*

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Nodal Electrical Circuit Analysis Using Parallel GPU CUDA Computing

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Abstract

This study addresses the application of direct and iterative methods in solving electrical power systems. As an object of study a Digital Twin approach which for this context is a virtual representation of the electrical system in real time. The solutions of the power grid equations were analyzed through parallel computational processing. In the parallel processing approach for the solution of linear systems, modified nodal analysis (Kirchhoff's Law of Nodes) is used. With the processing analysis, it was possible to obtain computational gain to solve the variables such as the voltages in the "Nodes" and other electrical quantities such as current and power. The tiling technique was used in the thread hierarchy in GPUs. In practice, GPUs can fully release their computing power when the matrix size is large and there are enough blocks for the workload of each block. With the use of parallel models, an increase in the temporal performance of the Digital Twin is obtained allowing to monitor and control objects in real time, detection of cyber attacks, optimization of controls, validation of models, maintenance and anticipated and / or contrary measures. Finally, this work demonstrates important results obtained that will be incorporated into a Digital Twin model as foreseen in the Research Project Experimental Development of Digital Twin of the UHE-Jirau in Full Scope with Processing Technology of Complex Events Distributed for Systemic Investigations. (PD-06631-0007/2018).

Keywords: *Digital Twin, Circuit Analysis, Complex Systems, HPP. CUDA, Tiling*

Numerical Investigation of a Solar Air Conditioning System with Absorption Refrigeration in Kaduna, Nigeria

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Abstract

High increase in demand for air conditioning worldwide brings about a sharp increase in electricity consumption, because most of the air conditioning systems are vapour compression systems driven by electricity. In Nigeria for instance, electricity is mostly generated from privately owned small off grid electricity generating sets due to the acute shortage in electricity supply. In this study, a solar cooling system that comprises of a thermally-driven single stage absorption chiller and evacuated tube solar collector field as the heat source to power the chiller is modelled and simulated. The system is designed to meet the hourly cooling load of Research and Development Centre, Kaduna, Nigeria. The peak cooling load to be met by the system is 24 kW, while the daily working hours for the system are six hours, and works for nine months in a year. Analysis was carried out on the performance of the system; results show that to satisfy all the cooling demand; a 10 refrigeration tonne (RT) absorption chiller is required. At the optimum parameters, the system provides 100% of the required cooling in the first five hours of its operation in all the nine months, and between 99-100% in the last hour. The average annual coefficient of performance (COP) attained by the system is 0.69, the months with higher solar radiation having the lower COP likewise the hours with higher solar radiation. The annual savings in CO₂ emission is found to be 5.8 tonnes from the system.

Keywords: *Solar Air Conditioning, Nigeria, Absorption Refrigeration*

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Off-Grid Energy-Air-Water Nexus: Emergy Accounting of a Solar Distiller

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Abstract

New technologies for sustainable advancements in extreme conditions strive to build upon renewable energy sources, yet often hiding problematic upstream requirements, like rare materials, fossil fuels, or power grids. In this work, drinking water micro-generation systems for isolated environments are addressed. In particular, an innovative distiller for water desalination/purification is analysed by the Emergy Accounting Analysis (EMA) methodology. The solar still, named SOLWA®, can reach comparatively very high yields in the production of drinkable water, and has been designed for drinkable water supply in small isolated communities and in urban situations where electric network connections or conventional energy sources are unavailable. It has already drawn the interest of several nongovernmental organisations as well as the United Nations, which included SOLWA® in the Innovation for Development and South-South Cooperation programme (www.ideassonline.org). By the EMA method, some sustainability indicators are calculated. A focus is also dedicated to the emergy implications of the purification process as well as to the critical steps in terms of efficiency, i.e., the water-cooling recirculation and the solar collector. Expanding the findings of novel studies about a novel technology, the EMA method allows to further read potentials and limits of such a promising system, including purely ecological and socio-economic inputs upon which both the distiller and its micro-generation process critically depend.

Keywords: *Solar still, Water purification, Solar radiation, Renewables, Sustainability assessment, Emergy*

Off-Grid Renewable Energy for Cleaner Production in Developing Countries

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Abstract

The supply of electric power at low rates can help in setting ambitious targets to expand the reach of electricity to remote rural areas in developing countries. In this paper, an algorithm has been presented for optimal sizing and life cycle cost analysis of an off-grid solar PV system. A procedure to analyze the life cycle cost of the system has been carried out to access its viability in comparison to conventional sources of energy. The results of this study show that the installation of the off-grid PV system will be a beneficial option for private investors and local people of the individual communities in developing countries. This study can be used as a benchmark and guideline to design off-grid PV power plants for other facilities and locations with estimated load demands.

Keywords: *Cleaner Production, Developing Countries, Renewable Energy*

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Open Innovation Diffusion for Sustainable Business Models: Enablers and Barriers

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Abstract

Over the last decade the discussion about sustainable business models (SBM) has increased significantly. This importance is recognized at the global level with European Green Deal strategy and UN Sustainable development goals. It is of outstanding necessity to use open innovation (OI) strategies, as they can help to encounter economic, social, environmental values as inevitable elements of SBM. OI process builds more open-minded cooperation culture and flexible approach for creation of sustainable values. This paper has a specific focus on start-up companies in business incubators being as a powerful engine of OI. The systematic literature review reveals patterns of OI strategies for designing SBM elements. Empirically, a survey of nascent entrepreneurs in business incubators provides the evidence of the increasing prominence of OI strategies for transition to SBM. The results show difficulties in using OI, in particular, start-ups need specific competencies and dynamic capabilities, motivation, engagement and collaboration network. Business incubators as important OI actors are seen as enabling factors for start-ups to perform SBM. This research was conducted within the project "Open Innovation, No1.1.1.2/VIAA/3/19/426" funded by Postdoctoral Research Support Aid programme of Latvia.

Keywords: *Open Innovation, Sustainable Business Models*

Optimization of Enzyme-Assisted Aqueous Extraction of Phenolic Compounds from Pracaxi Pressed Cake

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Abstract

In recent years, the use of enzymatic processes in various industries has grown due to their specificities, such as low energy consumption, chemicals and water. Pracaxi [*Pentaclethra macroloba* (Willd.) Kuntze] press cake, a residue with a high content of residual oil, protein, and countless bioactive compounds. In enzymatic hydrolysis, enzymes disrupt the cell wall of lignocellulosic biomass, favoring the release of the various components. Three commercial enzymatic complexes (Celluclast 1.5 L, Pectinex Ultra SP-L, Viscozyme L) were evaluated in the aqueous extraction of phenolic compounds from pressed pracaxi cake. The optimization of the extraction conditions was based on a central rotational composite design (CCRD) combined with the response surface methodology (RSM). Temperature, pH and enzyme concentration [E%] were the independent variables and in response, the total phenolic content (TPC). The optimized extraction condition for all enzymes was achieved with T = 50 ° C, pH = 2.65 and [E%] = 3%. Pectinex Ultra SP-L (3441 ± 50 mg GAE.100g⁻¹ cake) and Celluclast 1.5 L (3362 ± 64 mg GAE.100g⁻¹ cake) had the highest TPC values compared to Viscozyme L (1803 ± 43 mg of GAE.100g⁻¹ cake). Based on the results, it can be said that the use of enzymes for the extraction of high added value compounds in the pressed pracaxi cake is a promising process for cleaner and ecological production.

Keywords: *Pracaxi Press Cake, Enzyme-Assisted Extraction, Clean Process, Phenolic Compounds*

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Optimized Hydrothermal Pretreatment for Biofuels Generation from Poplar Sawdust Waste

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Abstract

Lignocellulosic biomass including agricultural and forestry residues such as willow sawdust (WS) could be used as feedstock for methane or fermentative hydrogen production (FHP). Due to its high lignin (28.7 ± 0.2 g/100gTS) and holocellulose (cellulose: 35.6 ± 0.6 g/100gTS and hemicellulose: 21.5 ± 0.9 g/100gTS) content, an application of a proper pre-treatment is necessary to improve saccharification and total hydrogen and methane yields. In this study, hydrothermal pretreatment (HP) in combination with HCl, at a chemical loading of 2 g /100 g TS was carried out as a technique to enhance methane and FHP. Optimization of HP, was performed using a Central Composite Design, with two input parameters, the temperature (130.5-230oC) and process time (15.5 -60 min) to maximize saccharification and minimize the inhibitory compounds released (acetic acid, furans and phenolic compounds). Following pretreatment, the insoluble solids and the hydrolysates were separated by filtration and fully characterized in terms of their structural and chemical characteristics. Biochemical methane potential experiments and FHP tests were performed so as to assess the effect of HP conditions on biofuels production yields.

Keywords: *Poplar, Sawdust Waste*

Optimized Polyhydroxybutyrate (PHB) Production by Marine Bacterium: *Bacillus megaterium*

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Abstract

Polyhydroxybutyrate (PHB) accumulating *Bacillus megaterium* was isolated from marine water. To increase the PHB productivity by *Bacillus megaterium*, steps were taken to evaluate the effects of carbon sources (Arabinose, Glucose, Glycerol, Lactose, Lactic Acid, Mannitol, Sodium Acetate, Starch and Sucrose at a level of 20 g/L), nitrogen sources (Ammonium Chloride, Ammonium Sulphate, Glycine, Potassium Nitrate, Protease Peptone and Urea at a level of 20 g/L) and different pH. A maximum yield of 2.74 g/L of PHB was achieved for glucose as the carbon source and ammonium sulphate as the nitrogen source at pH 7. The optimized conditions were further used for batch fermentation throughout 72 h. Significantly maximum PHB of 5.61 g/L was obtained in a laboratory scale bioreactor at 64 h. The extracted polymer was compared with the authentic PHB and was confirmed to be PHB using FTIR, ¹H NMR, DSC and TGA analyses, respectively.

Keywords: *Polyhydroxybutyrate (PHB), Bacillus megaterium*

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Parallel Cultivation Method for Standardized Measurements of Metabolic Activity and Acid Potential in Dark Fermentation with Biogenic Residues

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Abstract

Dark fermentation has a great potential to provide short-chain carboxylic acids (SCCA) as substrate in many subsequent mono-cultivation bioprocesses. In contrast to biogas process development, no method has been described as a standard procedure for determining the SCCA potential for feedstock evaluation. The aim of this work was to develop a workflow for downscaling dark fermentation and to select suitable on line and at line measurements for the fast investigation of the SCCA production at various feedstock compositions, pre-treatments, loading rates and cultivation conditions. Applying the developed workflow, the SCCA potential was examined with a minimal working volume of 100mL that allows parallel investigation. A starting pH of between 5.0 and 5.8, and a maximum loading rate of 10% VS, with a substrate to inoculum ratio of 0.5:1 (% VS) was found to be optimal as test conditions. The individual on line monitoring of the CO₂ production was most suitable to quantify the metabolic activity, electrooptical polarizability was used to assess the culture viability. The results allow to estimate the process performance in the larger scale and the feasibility to couple it with mono-cultivation processes, which is shown at the example of polyunsaturated fatty acid production with heterotrophic algae.

Keywords: *Dark Fermentation, Biogenic Residues, Short-Chain Carboxylic Acids (SCCA)*

Participation of Local Communities in Improving the Management of Water and Sanitation in the PCJ Hydrographic Basin, São Paulo, Brazil

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Abstract

Indispensable for human survival, water is a natural resource whose production, distribution, and consumption depends on anthropic action. Given the recent episodes of water scarcity and the complex and widespread effects of climate change, water management has considered the environmental, economic, and social aspects necessary for the sustainability of this resource. Furthermore, in particular, education and communication mechanisms as practical solutions for the intended sustainability. In 2014, a prolonged drought brought significant disruptions to the water supply of the population of Central-South Brazil. Since then, within the scope of the Hydrographic Basins of the Piracicaba, Capivari and Jundiá Rivers, the reduction in water supply has been offset by the adoption of practices on other fronts. Through documentary research, using shared texts from the Agency responsible for the management of water resources in the PCJ Basins, we intend to identify which educational and communication mechanisms used to achieve the sustainability of these springs. We found that the stability between supply and demand achieved since 2014 stems from the different levels, environmental, social, and economic, in which they used educational and communication techniques with the local people. With this, we intend to demonstrate the critical role of education and communication for sustainability.

Keywords: *Local Communities, Management of Water, Sanitation, PCJ Basin*

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Pathways toward a Sustainable Food-Energy-Water Nexus via Community-Scale System Dynamic Modeling Analyses in Brazil

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Abstract

A sustainable urban Food-Energy-Water (FEW) nexus seeks to create a symbiosis in partnership with FEW communities and exploit cross-domain seams. This is rare in South America, especially in Brazil. In this study, community-scale system dynamic modeling analyses were developed for two cities located in Brazilian to integrate components, systems, and architectures in circular economy. These two cities, lacking integrative structures to foster urban FEW systems, include Florianópolis in Santa Catarina state and Vitória in Espírito Santo state. Both cities have a community-scale FEW system with similar symbiotic relationships to create strategies pivotal to FEW systems and to help the current decision-making processes. The FEW system analyses are based on the separation, treatment and effluent's valorization in urban agriculture and solar energy harvesting to demonstrate the complementarity between food waste, green energy supply, and urine collection with direct benefits for urban agriculture and energy-saving via green scheduling for irrigation. The preliminary results are meaningful by grey water (from sinks and bathrooms) recycling for irrigation based on a few local climate scenarios. The composts produced from households' organic waste can be applied in conjunction with urine (nutrients N and P) and struvite (mostly P) for fertilization in crop production.

Keywords: *Food-Energy-Water Nexus, Community-Scale System*

Pellets Production Using Sludge from Pulp Mill

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Abstract

Brazil is a world leader in pulp production and the industry expansion of the last years has brought a significant increase in the waste generation. The large generation of wastes is normally disposed of in industrial landfills that represent an economical and environmental questionable option. The establishment of novel forms of treatment and reuse of these materials is more appropriate and follows a worldwide trend of the so-called circular economy. It has been evaluated better alternatives for its management. Thermochemical conversion of the sludge proves to be an interesting option, since one of the products generated in this process is the ash that represents a much smaller volume, facilitating its transport and final disposal. The other product is steam that can be used energetically in the mill. The production of pellets from sludge may be a viable and stimulating option from an environmental and economic point of view, because the pelletizing process densifies the residues producing a material with a high calorific value and easy handling condition. The objective of this work was to use the primary and secondary sludge from the effluent treatment plant of a eucalyptus bleached kraft pulp mill for the production of pellets for energy purposes. The pellets were produced from a mixture of primary and secondary sludge, both from a Brazilian kraft pulp mill. It is expected to obtain pellets with viable heating values characteristics and chemical composition for energy production in the mill and a significant landfill disposal reduction, optimizing space and reducing costs for the industry.

Keywords: *Pellets Production, Pulp Mill, Sludge*

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Perception of Sustainability from Students of Civil Engineering

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Abstract

Recently, the Department of Education of Brazil changed the national guidelines to superior education, it highlights now the importance of a human formation in Engineering Schools. This shift in the guidelines matches UN's 2030 agenda, that establishes objectives and goals to people, government and interested parts towards a more sustainable planet. This study investigated the perception of sustainability of a Civil Engineering senior class. It was explored if the concepts of these students of a University Center in Brazil concurs with the UN sustainable development goals by using a likert scale questionnaire from -2 to 2. The alumni perception about sustainability narrows in specific themes, specially ODS 11 (1.7 points) and ODS 6, 7 and 12 (1.6 points). These items - energy, basic sanitation and consumption - interact deeply with basic civil engineering areas (material, structure, sanitation). ODS 3 (0.3 points) and ODS 5 (-0.4 points, the unique with negative score) scores indicate lack of awareness among students related to the connection between peace and gender equality and sustainability. The lowest scoring themes relate mutually with human sciences, in other words, it shows disconnection between what the Brazil engineering students are taught in class and the UN's agenda.

Keywords: *Civil Engineering, Sustainability, ODS's*

Performance of A High Rate Anaerobic Reactor Treating Soft Drink: Influence of pH and Organic Load Rate

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Abstract

The wastewater soft drink (WWSO), is one of the largest wastewater generators as a result of the development of its products. This type of wastewater is striking, despite being highly biodegradable, it contains high percentages of carbohydrates and a potential of generating sub products from effluents. Among such compounds are mentioned water, fructose, glucose, sucrose, lactose, fruit concentrates, flavoring agents, preservatives (tartaric acid, phosphoric acid), bicarbonate, carbonic acid, dissolved coal and mineral salts. Currently, most treatments in this industry are biological processes, including anaerobic digestion followed by activated sludge. However, it is so difficult to accomplish the regulations due to the high organic load typical of this wastewater. In this sense, the aim of the following work is to evaluate the performance of a high rate anaerobic reactor, varying the values of pH and OLR. For the experimental design it was used with a factorial design of 2⁻², for a total working time of 180 days, which have been operated during 60 days. Among the most visible results so far it shows that the removal of organic load is more efficient in conditions of pH 7.5 and OLR 16.0, this is regarding the condition of pH 7.5 and OLR 4.0, also for these same conditions, the removal of nutrients like nitrogen and phosphorus Total they have the same tendency respectively.

Keywords: *Anaerobic Reactor, Wastewater Soft Drink*

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Phosphate Fertilizers from Waste - An Example of Implementing a Circular Economy (CE) in the Fertilizer Sector

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Abstract

The use of waste as a source of raw materials in the fertilizer products and an implementation of nutrient recovery technologies are important parts of the transition process from linear economy into a sustainable and therefore well-balanced circular economy (CE). Paper presents a characteristic of sewage sludge ash (SSA) generated in the installation for the thermal transformation of municipal sewage sludge and an analysis of the possibility of using ashes for the production of fertilizers. SSA used in the research was produced in the mono-incineration plant (Cracow, Poland) and directed for the use as a source of secondary nutrients (phosphorus, potassium, calcium, sodium, magnesium, iron) in the fertilizer production. For this purpose, SSA samples were subjected to thermochemical transformation, as a result of which it was possible to increase the bioavailability of phosphorus and reduce the content of heavy metals in the obtained fertilizer products. In the thermochemical transformation process, solid sodium donors (Na) in the form of sodium bicarbonate (NaHCO_3) and sewage sludge (dried) were dosed to the SSA samples before direction to the thermal conversion at 1000°C for 30 minutes. The bioavailability of the obtained fertilizer products is much higher than that raw SSA (43.5%) and it is equal to 101.8%. The content of nutrients was comparable to the amount contained in raw SSA, and reached 14.7% for iron, 7.7% for calcium, 6.8% for phosphorus, 2.7% for sodium, 1.6% for magnesium and 0.9% for potassium. Similarly to SSA, a high silicon content of 7.1% was noted.

Keywords: *Circular Economy, Phosphate Fertilizers*

Potentially Toxic Elements Status on Lettuce (*Lactuca sativa*) and Soil from Urban Agriculture: A Case of Study in Santo André (Brazil)

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Abstract

Urban and peri-urban agriculture is seen as an alternative to increase levels of population sustainability, especially in developing countries, as it contributes to strengthening food security and citizenship in vulnerable communities. However, potentially toxic elements (PTEs), such as some metals and metalloids, eg As, Cd, Cu, Pb and Zn, are often detected in urban atmosphere, soils and in vegetables grown on them, a fact that can put food security at risk. These elements can pose the environment at risk and accumulate in human body resulting in several adverse health effects. The aim of this study was to evaluate the levels of some PTEs in lettuce (and their respective soils and soil amended compounds) produced in six different urban gardens in Santo André-SP, a city of the metropolitan region of São Paulo, Brazil. The elemental concentrations were measured by Inductively Coupled Plasma Mass Spectrometry. The highest levels of PTEs in soil were found in areas around the Capuava Petrochemical Complex, especially for Ba, Cu, Pb, Se and Zn. Considering the total average concentration of the elements in the lettuce of the gardens studied, the observed concentration order was: Zn>Ba>Cu>Pb=Mo>Cr>Ni>V>Cd>Co>As>Ag> Se. Lead levels were found above the maximum contaminant limit (MCL) values established by national and international agencies. The contents of the other PTEs were below the MCLs in the lettuces collected in this study.

Keywords: *Lactuca sativa*, *Potentially Toxic Elements*

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Preliminary Performance Evaluations of Sand Mastics of Asphalt Binder with Recycled Cathode Ray Tube (CRT) Glass Powders

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Abstract

Cathode Ray Tube (CRT) is the glass video display component of an electronic device (usually a television or a computer monitor). With the development of new technologies, CRT has been taken over by the thinner panel displays. It is widely known that waste CRT contains heavy metals at unacceptable levels, which may threaten public health, welfare, and the environment. The objective of this study is to evaluate the feasibility of using recycled CRT glass powders as an additive in asphalt binders. The 0.075 mm sized CRT glass powders were mixed with conventional asphalt PG 58-28 to produce sand mastics with CRT glass powders and asphalt binder. There are four contents (i.e., 0, 5, 10, and 15% (wt.)) of CRT glass powders that were used in this investigation. First, the leaching test was employed to evaluate the leaching potential of CRT glass modified asphalt binder since the high lead content in the CRT glass powders is harmful to the groundwater if the hazardous lead leached from the modified asphalt binders. Second, the high-temperature performance was characterized by the dynamic shear rheometer (DSR), while the low-temperature performance was investigated by the asphalt binder cracking device (ABCD). The leaching experimental results showed that, although the measured lead leaching of the pure CRT glass powder was higher than the regulatory level of 5 mg/L, the CRT glass powders as an additive in asphalt binders resolved the leaching issues to the external environment. Meanwhile, the DSR and ABCD results concluded that: 1) the high-temperature performance increased with the raised CRT glass powder contents.

Keywords: *Cathode Ray Tube (CRT), Asphalt Binder*

Preparation and Characterization of TiO₂, V₂O₅ and MnO₂ Nanoparticles Modified MWCNTs and their Application for Kerosene Removal from Water

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Abstract

The increased oil shipping caused water pollution by introducing harmful substances in to the water bodies. Functionalized multi-walled carbon nanotubes (MWCNTs) were prepared by chemical oxidation using sulfuric acid and nitric acid with high concentration in ratio of 7:3 respectively. The oxidized MWCNTs were impregnated with 2 wt% TiO₂, V₂O₅ and MnO₂ nanoparticles respectively. The modified MWCNTs were studied and characterized to determine the structure and chemical nature by X-ray diffraction (XRD). The morphological studies of the nanoparticle surface were carried out with Field Emission Scanning Electron Microscopy (FESEM) and Transmission Electron Microscopy (TEM). Atomic Force Microscopy (AFM) was used to determine the imaging of surface roughness for nano structures. Surface area analysis (BET) was used to determine surface area and pore volume for prepared metal oxides nanoparticles. Thermal Gravimetric (TG) investigation confirmed the decomposition steps of the prepared metal oxide nanoparticles and functionalized MWCNTs. Fourier Transform Infrared Spectrometer (FTIR) studies identified the vibrations of functional groups in metal oxide nanoparticles and functionalized MWCNTs. This preparation was used for the removal of kerosene from water. The Gas Chromatographic (GC) analyses indicated that high adsorption efficiencies for kerosene removal from water were obtained by using 2 wt% TiO₂ nanoparticles modified MWCNTs as compared with two other modified sorbents and parent MWCNTs. This can be due to the functionalization (oxidation) of MWCNTs with strong acids followed by modification with TiO₂ nanoparticles.

Keywords: *Kerosene Removal, TiO₂, V₂O₅, MnO₂*

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Preliminary Environmentally Sustainable Product Model Based on Green Supply Chain Management

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Abstract

For companies to meet the Sustainable Development Goals adopted by all United Nations Members (ONU), sustainable consumption and production are necessary through the conscious management of natural resources and paying attention to climate change. Thus, society must make a balance to meet the needs of current and future generations. For this, companies need to create environmentally sustainable alternatives for products and processes. Given this context, the research problem of the present study is: Which guidelines are possible to be elaborated in a way to reduce environmental impact and the integrated product development process (IPDP)? Given this context, this study aims to present a preliminary model that integrates the IPDP with green supply chain management (GSCM), building manufacturing processes more environmentally sustainable. Therefore, this study intends to present previously published models of IPDP related to the "operations factor": green purchase, green manufacturing, and green distribution, themes related to the GSCM. Following the product design steps and the "operations factor", the inputs, outputs, control, and mechanism for presenting the model were proposed, which will be represented through the Icam DEfinition for Function Modeling (IDEF0). The contribution of this study is to fill a gap in the literature that presents a model to be used by companies for the IPDP and GSCM integration, specifically related to the "operations factor" and environmental sustainability.

Keywords: *Green Supply Chain Management, Sustainable Product Model*

Preliminary Model of Product Development Based on the Function and Solution Definition Phases

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Abstract

Assessing the product functions associating them with the manufacturability aspects is crucial to reducing the manufacturing cost. Similarly, delivering project solutions with real costs compatible with the values perceived by the customer, becomes a relevant aspect for the success of a launch. Even in a concurrent engineering environment, there are no relevant tools that associate the Value Engineering (VE) concepts, when each function value is measured and comparing to each function cost after application of the Design for Assembly (DFA). This paper proposed a method that iteratively associates VE with DFA. This study analyzed if it is possible to apply the proposed method, where the alternatives generated with the DFA could be cyclically re-evaluated, function by function, in the previous stage of value analysis. With this, came to a assessment model proposal. As well as were projected their gains and limitations. Among the results, this study presents a report showing the relevance of the information collected, its particularities, impacts and limitations. Besides that, this paper has presented a new approach to support a product development process.

Keywords: *Value Engineering, Design for Assembly, Product Development*

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Product-Service System: Analysis of Electronic Products Life Cycle

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Abstract

The market competition associated with the programmed obsolescence of electronic products causes the increase in the number of residues of these products. The amount of research on the subject has been increasing sharply, thus revealing the importance and necessity of creating alternatives that solve the problem of the residues generated by these products. The Product-Service System is an alternative that aims at sustainability, bringing innovative solutions and, when coupled with environmental management tools such as Life Cycle Analysis provide a broader view of the environmental problem caused by these wastes. Thus, it is necessary to propose a life cycle analysis of a electronic product based on PSS concepts, based on literature data and the specific component on the subject. The software SIMAPRO® was used to simulate the analysis of the life cycle of the LCD screen of a discarded cell phone, where the results obtained corroborate with the results from literature, exposing the environmental and social impacts caused by these residues.

Keywords: *Product-Service System, Life Cycle*

Product-Service System for Delivery of Organic Food: Consumers Perception

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Abstract

The search for organic food has been growing and it follows a worldwide trend for products and services referring to health and well-being. This is justified by the Society unbelief in the modern chemical industry. Due to lack of time, people search for practicality migrating for demand of products for services, and solutions are found in the Product-Service System (PSS). Therefore, the aim of this study is to propose a PSS to deliver organic products in the cities of Southern Brazil, verifying the value sense of the critical success factors in the life of the PSS costumers. A systematic literature search was conducted to build the proposal, pointing out the gaps and critical factors to be analyzed, besides presenting the dimensions of the PSS: offer, consumer and provider. The study was conducted through a quantitative research strategy, using information obtained in a survey, applied to the North Mesoregions of Santa Catarina. All data collected was processed in the Statistical Package for the Social Sciences software (SPSS). The analyses suggest the value of the local organic production, where there is traceability of the products source, besides underscoring the social, economic and environmental benefits noticed the PSS.

Keywords: *Product-Service System, Organic Food*

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Product-Service Systems Development: Proposal for a Generic Model

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Abstract

Changes in production and consumption of products for a circular economy require the implementation of innovative business model, as a Product-Service Systems. This business model is based on sustainable development, provide an extension of the useful life of products and a solution to the scarcity of resources, considering the flow of materials during the life cycle. For deployment of business models as the Product-Service System, there is a need for methods and tools to support its development. In this sense, this research presents the proposal of a generic model of Product-Service System development based on its life cycle. Thus, the presented methods and tools facilitate and optimize the processes involved since the definition of requirements until its post-use destination. For this a bibliographic review of the most cited methods and tools in the literature was performed and a generic model proposal was developed. In order to identify the needs to make it more appropriate for the development of Product-Service Systems, the model proposal was evaluated by experts and retro-fed. Finally, the model was applied in literature cases to verify the generic model proposal.

Keywords: *Product-Service System, Development, Generic Model*

Productive Process of Starch Ethanol

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Abstract

One of the global concerns, including Brazil, is to obtain alternatives to reduce energy dependence on fossil fuels. Sweet potatoes, widely used in human and animal food, can be a solution. *Ipomoea potatoes L. (Lam.)* Is seen as an alternative raw material in the generation of ethanol, it has a short production cycle compared to sugarcane. The study analysed the production processes for transforming starch into ethanol in Brazil, China and the United States. The results showed that among the three processes analysed, the industrial process for the transformation of ethanol from sweet potatoes in China, saccharification and fermentation are simultaneous and in Brazil the saccharification process occurs by enzymatic hydrolysis, then the fermentation process occurs. The process energy from China uses mineral coal, the United States thermal (coal and natural gas) and electric (coal, natural gas and nuclear) energies and the Brazilian process uses biomass thermal energy and oil. This difference in origin can lead to different energy and environmental balances.

Keywords: *Sweet potato, Biofuel, Sustainable Production*

Productivity Modeling of Apparel Industry Using Hierarchical Evidential Reasoning

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Abstract

Due to the incomplete or missing information, limited domain knowledge, and failure to provide accurate judgments from decision-makers, uncertainties become an integral part of the productivity assessment process of apparel industries. The conventional productivity indicators mainly focused on quantitative criteria. Therefore, there is a need for a method that can handle both qualitative and quantitative measurements. In this study, the Hierarchical Evidential Reasoning (HER) framework is developed to assess apparel productivity and to handle the uncertainties in productivity assessment. The developed framework is implemented to assess the productivity of multiple apparel industries in Bangladesh. Results show that using the HER approach when assessing the productivity of different apparel organizations under uncertainty allows providing robust decisions, which brings out a more accurate, effective, and better-informed benchmarking tool to conduct the evaluation process. Hence, HER can facilitate productivity benchmarking, enabling organizations to compare themselves to the marketplace in a given sector of the industry as well as investigate the processes behind the excellent performance and thus yields the scope of this research.

Keywords: *Sweet potato, Biofuel, Sustainable Production*

Proper Disposal of Municipal Solid Waste and its Energy Benefits: A Study for the State of Minas Gerais, Brazil

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Abstract

In 2003, the State Foundation for the Environment (FEAM) of Minas Gerais (MG), Brazil, created the Program "Minas sem Lixões" to support its municipalities in a proper municipal solid waste (MSW) management by sending it to landfills. Landfills provide greater environmental control by collecting and using biogas, generated by the MSW's anaerobic decomposition. This work aimed to estimate the methane and electricity production from biogas recovery, considering the implementation of landfills in the municipalities of MG without proper waste's disposal. It was considered the landfills' operations starting and ending in 2020 and 2040, respectively. The software LandGEM®, developed by the United States Environmental Protection Agency, was used to model the biogas potential. The results were presented by delimiting MG in 12 mesoregions. The mesoregion that reached the highest values for methane and electricity production obtained 35,491,533 m³ and 120,671,214 kWh, respectively, while the mesoregion with the lowest values reached 5,878,682 m³ and 19,987,518 kWh. Moreover, the methane production remains even after the final landfills' operation. It can be concluded that the use of landfills' biogas represents a positive externality of proper disposal of MSW and it can contribute to increase the Brazilian renewable energy matrix.

Keywords: *Municipal Solid Waste (MSW), State Foundation for the Environment (FEAM), Energy Benefits*

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Reduction of Microbial Load in Cutting Fluid Using UV-C Radiation

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Abstract

The metalworking industry uses large volumes of cutting fluid during the parts manufacturing process. This fluid during its handling is contaminated by microorganisms from the parts, hands of the operators, the environment and machines, which alter its physical and chemical properties, reducing its useful life, resulting in the disposal and replacement with a new cutting fluid. The industrial sector seeks to develop/use new management tools to decrease the generation of waste, maximize the use of natural resources, reducing costs in the industry. In this sense, the objective of the present work was to evaluate the efficiency of the application of UV-C radiation in reducing the microbial load in cutting fluid to increase the product's useful life. For this purpose, two systems were assembled, one without UV-C radiation (control) and the other with two emerged UV-C lamps. The systems operated under the same conditions (volume, operating time and closed fluid recirculation circuit), simulating the workday (turned on during the day and turned off at night). Two repetitions of the experiment were performed, in the first the system operated for 36 hours and in the second for 60 hours. Cutting fluid aliquots were collected from the systems at different time intervals for bacteria and fungi counting. As a result, decay rates of 67% and 29% were obtained in the first repetition and 96% and 99% in the second for bacteria and fungi, respectively. It can be concluded that the process was efficient in reducing the microbial load in the cutting fluid, indicating the need for a longer exposure time of the fluid to UV-C radiation.

Keywords: *UV-C Radiation, Microbial Load, Cutting Fluid*

Research on the Marketization of Chinese Ecological Capital Based on Blockchain

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Abstract

Ecological capital is the important foundation for realizing sustainable economic and social development. The accounting of ecological capital and its marketization are not only important ways to realize the appreciation of ecological capital, but also one of the main development trends in the field of ecological environmental protection in the future. This study uses the emergy method to calculate the ecological capital of China's provinces and cities from 2000 to 2015. This method provides a unified dimension for the value of different ecological services and provides a transaction equivalent for the marketization of ecological capital. Blockchain is a distributed digital classified accounting system that can establish transparent contract processes and promote secure and reliable business transactions. Its data tamper-resistance, transparency, verification, and privacy and security have great appeal. As a result, policymakers around the world are interested in blockchain technology and are beginning to explore its potential to solve public policy issues. This exploration extends to climate change action and the electricity and carbon markets. This article addresses an important research gap by applying blockchain to ecological capital market transactions. Research shows that blockchain technology can reduce the cost of ecological capital market transactions and improve the efficiency, fairness and effectiveness of ecological capital market transactions.

Keywords: *Blockchain, Ecological capital*

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Reverse Logistics and Recycling Do Not Advance in the Textile Chain and Compromise the Brazilian Circular Economy

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Abstract

The textile chain and its residues are a challenge for all countries. The manufacture of fabrics and clothing does not have reverse logistics and this material is disposed of in normal garbage. Recycling could return them to the production chain and bring sustainability to the sector. This happens both in the production and in the disposal of used clothes. The reuse of these materials is carried out in small initiatives, carried out as charitable actions or used in the creation of handcrafted pieces. An education to raise awareness how to recycle and reuse waste, and a waste treatment policy that makes producers responsible can be a path to the circularity of this business chain. The aim of this article is to evaluate the circular economy and the discard of the clothes done by the consumer, to return these goods to productive process. A questionnaire was applied to find out how and where people discard their clothes, how much they spend and how long they last. The preliminary results show the 45% people discard the clothes with five years in medium.

Keywords: *Clothing, Garbage, Legislation, Waste Reuse, Textile Waste*

Scenario Planning, a New Planning Tool for the U.S. Pacific Northwest Forest Academy

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Abstract

With digitalization and global warming, the pace of change has increased, and unpredictability has grown, challenging society and its institutions to evolve within a highly globalized and interactive environment, while facing higher uncertainty in the future. In this project I tested a scenario planning tool for its potential to help higher education institutions integrate uncertainty in their strategic planning processes. The main objective was to study the relevance and feasibility of implementing the tool in a college of forestry. The project had three phases: 1) Identification of the main trends that influence higher education institutions; 2) Application of two scenario planning workshops, attended by faculty and graduate students; 3) Individual interviews with all participants. The conclusions were that Scenarios are relevant for forestry higher education institutions and feasible to be used. 2) There are significant challenges to adoption and implementation; 3) To prepare new generations of professionals with premises of scenarios is the most promising path to sensitize the forest sector to uncertain futures; 4) there is a huge opportunity for higher education institutions to become beacons for their related stakeholders in a knowledge based economy.

Keywords: *Pacific Northwest Forest Academy, Scenario Planning*

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Scientometric Analysis of Relations between Circular Economy, Plastic Packaging Industry and Clean Technologies

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Abstract

Brazil, despite having a national legislation for solid waste management that shares responsibility between manufacturers, importers, distributors, traders, retailers, consumers, and public agents, still has most plastic waste sent to landfills. This happens because only 15% of the Brazilian population has access to waste selective collection (BATISTA, et al., 2018). In this context, the Brazilian Plastic Industry Association (2016) has developed mechanisms that stimulate the circular economy aimed at this industrial segment, with the largest educational and social initiative of the plastic processing industry in Latin America and, through it, has already recycled more than 164 million plastic caps, the equivalent to almost 300 tons of material, raising over R\$ 550,000 to social institutions. Considering this scenario, for the understanding of technological progress and environmental interactions, it is important to measure indicators of scientific activity related to the problem, helping in the scientific synthesis that will support sustainability actions. Therefore, the objective of the research was to carry out a scientometric analysis of the relations of plastic packaging production and the circular economy, under the premise of the use of clean technologies and the organization of information to facilitate decision making in the public and private sector.

Keywords: *Circular Economy, Plastic Packaging Industry, Clean Technologies.*

Simple Can Be Harder Than Complex: How to Solve the Dilemma of Wicked Problems in Sustainability?

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Abstract

A wicked problem is a highly complex, ill-formulated, and a multi-stakeholder problem where both the information and the interconnections are thoroughly confusing. The approach to their handling has to holistically consider the whole problem because efforts to tame just a part of wicked problems is wrong. Managers, practitioners, and policymakers can feel overwhelmed by this kind of problem and respond with denial, postponement, and determinism, resulting in inertia, oversimplification, and short-sighted solutions. Examples of wicked problems include environmental degradation, climate change, the livability of megacities, food security, social inequality, and the like. Therefore, sustainability issues affecting business strategies and policymaking are wicked problems, the relevance of which drove the United Nations to fix the Sustainable Development Goals to improve the future for all by 2030. This paper uses the Intuitive Logics Scenario Approach for facing wicked sustainability problems. Particularly, the design of a theoretically founded method is proposed to decompose the wicked sustainability problems to minimize their reduction, to engage different stakeholder groups, to challenge established mindsets, to acknowledge and face uncertainty. Finally, an explicative application of the proposed method illustrates its potentialities for designing a sustainability-oriented business strategy or a public policy aimed at addressing a wicked sustainability problem.

Keywords: *wicked problems, sustainability*

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Simple Strategies to Speed Data Analysis and Decrease Energy Consumption

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Abstract

This work developed strategies for providing access to meaningful information with low cost and high speed to small communities, enterprises and entrepreneurs. Sharing of information becomes a viable path for sustainability since it implies in minimization of resource consumption, such as energy and water, and also provides ways for connecting distinct stakeholders. Plenty of data analysis systems provide energy control and connectivity, however, due to cloud computing requirements, constraints on software, such as bandwidth, and hardware, i.e., computational strength, increase costs and impede real time access for impoverish environment. Therefore, it was developed a fog computing based algorithm that, due to working at cloud border, permits high processing and data deliver in low latency. The methodology was based in Production Engineering and computational methods. The main obtained results were: A. temperature sensors were installed in a small community college in order to control data service and no-break performance; B. 30 million medical data was filtered and provide information in real time of health conditions in a small population, C. noise was removed from low quality images and patterns were identifying, such as fire. In conclusion, not only small enterprises but also a whole community could be attended with this approach.

Keywords: *Speed Data Analysis, Energy Consumption*

Socio-Environmental Vulnerability Metropolitan Region of Sao Paulo, SP, Brazil

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Abstract

The evolution of urban environments is the result of a wide range of social, technological, artistic, political and social factors in constant interaction over time. The negative aspects of urban agglomerations, such as public health issues, transport provision and destination of waste grow exponentially with the size of the metropolises. The São Paulo Metropolitan Region is the great national metropolis, presenting a projection that extends to the entire territory of the country, confirming its urban primacy, mainly for its material and intellectual production. Not by the chance, the region has been the subject of several studies, as understanding Brazilian urbanization without going through the experience of the São Paulo Metropolitan Region. This work aims to apply the use of geotechnologies to map aspects related to the socio-environmental vulnerability of the São Paulo Metropolitan Region, Brazil. Maps of land use and occupation, surface temperature, vegetation cover and accumulated precipitation were made. Mapping can contribute to a spatial analysis of the aspects of vulnerability in the urban area and thus can be a basis for sustainable planning of metropolitan areas.

Keywords: *Socio-Environmental Vulnerability, São Paulo*

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Socioeconomic and Socio-Environmental Externalities Associated with Wind Farms Implemented in the Isthm of Tehuantepec, Mexico

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Abstract

The present work aims to analyze the economic, social and environmental impacts caused by the development of wind projects in the Isthmus of Tehuantepec, in the Southwest of Mexico and, simultaneously, to evaluate, in a synergistic way, wind energy as an effectively viable option for the matrix Mexican energy sector by mapping and analyzing socio-environmental and economic externalities. The development of these parks represents, in this region of the country, a successful model for reducing GHG emissions, but there are controversies such as land displacement and lack of local development, which have generated socio-environmental conflicts that remain in force today. Therefore, the methodology adopted was based on a systematic literature review, as well as on the application of semi-structured interviews conducted in field research in situ. As a result of this study, it was possible to expand the compression regarding the following paradox: the wind farms implemented in the Isthmus, in fact, contribute to mitigate GHG emissions; however, according to the results of this manuscript, this environmental benefit did not result in any improvement in their socioeconomic vulnerabilities to local communities.

Keywords: *Wind Farms, Isthm of Tehuantepec, Socio-Environmental Externalities*

Socioeconomic Development and Appropriation of Oil Income in Brazilian Cities Facing the Santos Basin, from 2014/2019

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Abstract

The oil discovery of reserves and respective production in the Santos basin, increases in the oil price and the exchange rate contributed to the amount of royalties and special fee practically tripling between 2010 and 2011, confirming the trend in later years. The cities facing the Santos Basin, due to the fact that the oil layer of the Brazilian pre-salt layer is today one of the great bets of production and propelling studies for directing financial resources from the exploitation of oil and natural gas. The present paper intends to contribute to the discussions about the role of oil income in the socioeconomic development of the beneficiary oil cities based on case study. Cities are selected, considering the criterion of higher value of oil rents. Thus our methodology, including data analysis from 2014/2019. The socioeconomic data matrix will take into account those released by Municipal Human Development Index (HDI-M) and data of the State System of Data Analysis Foundation (SEADE). Budgetary data will be supported by the National Finance Series (FINBRA) bank of the National Treasury Secretariat and the INFO ROYALTIES database.

Keywords: *Socioeconomic Development, Santos Basin, Brazilian Cities*

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Solidarity Supply Chain

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Abstract

Supply chain management has definitely consolidated itself as a business practice and academic discipline. Over three decades, its development has led to the emergence of specialized management models due to some particularity presented by the supply chain, whether this particularity is related to strategic, product or market aspects, that is, related to some characteristic of the company itself. supply chain organization. In this article, we postulate and present an example of a new supply chain management model based on the principles of solidarity economy, called solidarity supply chain. A precise definition of the solidarity supply chain is made, as well as the detailed exposition of the attributes of this model to characterize it as such. At the end, an example is presented showing such attributes that allows it to be characterized as a solidary supply chain. A theoretical review of supply chain management and the main specialized supply chain management models that have emerged over the past two decades completes this article.

Keywords: *Supply Chain Management Models*

Structural Factor Model Leading Towards Achieving Sustainability for Indian Car Market

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Abstract

Achieving Sustainability with the traditional model of business may lead to a path not reaching the goal intended for. Industries under the pressure of government legislation to improve environmental effects and to maintain an agile way of working to fulfill the demand of consumers adopt new trends to become sustainable, without altering the basic approach toward handling the business and may found themselves on the wrong track in view of end-user. This study deals with the consumer perception about the effects of these steps taken by industries to move toward a sustainable approach, without any change in the business approach for the passenger car market in India. The whole car industry worldwide is talking about environmental issues and the adaptation of sustainable business models for a few decades now. The same is the case for the Indian car market, but the level of success achieved is contradictory. This study focuses on finding various factors that are concerned with the Passenger car customer, who is the part of this modified value chain and are adversely affected by the traditional Car business, working on the product sale only. A Structured model is suggested which shows the relationships among various factors with the proposed alternate business model based on the product-service system (PSS) rather than a product sale system for the Indian car market. Factors are primarily extracted through exploratory analysis and the relationship model is developed through the structural equation Modeling (SEM).

Keywords: *Structural Equation Modelling, Indian Car Market*

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Structured Innovation in Cleaner Production-A Case of Algal Biomass Production with Extracting Valuable Products

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Abstract

Innovation is a critical dimension of cleaner production. However, only a limited number of R&D activities lead to the technologies that enter the markets. One reason is the lack of structured innovation as a type of innovation that only generates value if accompanied by complementary innovations to respond to demand during the process development of cleaner production. Despite there are different tools and methods of process design and development, they mostly seem to miss solving problems with consideration to the feasibility and commercial aspects. Therefore, an approach is needed to measure, provide, and assess innovations and demand quantifiable results. In this research, we try to understand how sustainable cleaner technologies can be developed to bring added value to the markets and for customers. We present a new framework to model, generate, and select the right solutions for process innovation by using structured innovation. We adapt our framework for a process case of algal biomass production and extracting valuable products. Our framework has several advantages compared with the traditional way of process design and development. Not only it tries to solve the problems in the system design, but also it evaluates the possible innovations during the process development. Therefore, contradictions and conflicts in the processes are clarified and resolved. Also, the available and potential resources are identified to solve contradictions. Finally, the patterns of evolution to resolve contradictions and use of resources, in a Carbon & Energy -Negative Technology system is presented.

Keywords: *Algal Biomass, R&D*

Study Over El Niño and La Niña Influence on Mean Temperature Trends and Precipitation in Brazilian Regions

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Abstract

The objective of this work is to describe and analyze historical series of climatic parameters of mean air temperature and rainfall, in June and December, in cities throughout Brazil. The data related to the daily historical series were obtained from 243 meteorological stations of the National Institute of Meteorology (INMET) and analyzes were performed by applying statistical tests for detecting possible trends in the referred time series. It was observed that the non-parametric tests of Mann-Kendall and Pettitt are the most suitable for the analysis of climatic variables, allowing to detect from when there is a significant trend in a certain political region of the country. The correlation of these climatic magnitudes with the occurrence dates of the El Niño and La Niña phenomena allowed us to observe a strong association of the average temperature increase in the country in years of strong El Niño events, especially in the month of December.

Keywords: *Mean Temperature Trends, Precipitation, El Niño, La Niña*

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Supply Chains Types and Strategies for Circular Economy Transitions

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Abstract

The circular economy is considered a new economic paradigm. Its great comprehensiveness and complexity stem from different disciplines, requiring studies and efforts at different levels for effective and efficient implementation. Thus, it arguably remains a broad concept. Numerous definitions involve the post consumption product return, which is clearly connected to supply chain management. However, this issue has received limited attention in the CE context. Aiming to fill this theoretical gap, we present the body of academic literature on the circular economy from the supply chain management perspective, identifying the main supply chains, types and strategies that can contribute to the transition to the. We conduct a systematic literature review combining bibliometric and content analysis of studies published in the Scopus and Web of Science databases. The studies in our final sample note that the supply chains types most connected to the circular economy are closed-loop, open-loop, reverse, circular, sustainable and green supply chains, as well as, the management strategies are: collaborative management, integration of the triple bottom line and post consumption product value recovery for circular economy implementation. Furthermore, we suggest a circular economy supply chain as a result of integration of supply chains types and management strategies. This research contributes to broadening our understanding of the challenges involved in the transition to the circular economy and how supply chain management is related thereto.

Keywords: *Circular Economy, Supply Chains*

Survivability as a Substitute for Supply Chain Sustainability in the Case of a Pandemic Crisis

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Abstract

Sustainability aims to find a viable equilibrium between the economic, environmental and social dimensions in a normal situation of supply chain's operation. But in the case of the COVID19 crisis, and due to international containment measures, all the supply chains have been disrupted and many of them have come to a complete or partial standstill. This new situation, unprecedented in recent human history, brings about the new concept of supply chain Survivability. This new concept aims to find a new temporary equilibrium that allows the survival of supply chains during this pandemic crisis. By analogy to sustainability which puts the environmental dimension at the heart of its concerns, the concept of Survivability attaches great importance to the social dimension in order to protect human health and jobs which are the main conditions of supply chains Survivability. This can be done temporarily at the expense of economic and environmental dimensions. The objective of this research is to present this new theoretical concept of Survivability and show its analogies with that of sustainability. We also present the antecedents for building a capability for a supply chain to survive.

Keywords: *COVID-19, Survivability, Sustainability, Pandemic Crisis*

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Sustainability Assessment in Urban Area of Brazil Using Five-Capital Model and SDGs

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Abstract

This research aims to assess the sustainability of one neighborhood through multi-dimensional sustainability indicators and the Sustainable Development Goals (SDGs) proposed by the United Nations. The neighborhood under analysis is in the city of Curitiba-Brazil. To develop the analysis of the level of sustainability, the Five-capital Model indicators are applied together with the SDGs in an analysis structure. The census data provided by government sources, atmospheric monitoring data, and spatial data from the study sites were collected, and subsequently, these data were applied to the analysis structure. With the results obtained it is possible to analyze the level of sustainability of the neighborhood in Curitiba-Brazil and to analyze the model. With this research, it is expected that it will be possible to analyze the sustainability of the location under analysis, identifying the positive and negative points in sustainability for it, as well as ways to improve their performance towards sustainability. In addition, it is expected that it will be possible to evaluate the behavior of the Five-capital Model for the area, identifying improvement possibilities for the model used in the study.

Keywords: *SDG's, Urban Area, Brazil*

Sustainability Challenges in the Food Supply Chains Related to the COVID-19 Pandemic: An Extended Systematic Literature Review

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Abstract

Agriculture and food production are major contributions from the rural sector to a nation's economy and social well-being. Growing sustainability requirements within the food supply chain, regarding wastage and security, have become paramount issues for the food industry, requiring innovative capacity building through unique supply chain strategies. More recently, new challenges related to the COVID-19 pandemic have triggered concerns related to food supply capacity and safety. The study aims to uncover some of these challenges, exploring potential implications for the supply chain development. A systematic review of literature was conducted to uncover current sustainability challenges related to the COVID-19 pandemic. The main outcome of the study is related to potential strategies to address uncovered issues.

Keywords: *COVID-19, Food Supply Chains*

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Sustainable Energy-Water Nexus Solutions of Pumped Storage Power Station in Waste Mines: A Decision-Making Framework

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Abstract

With the implementation of the coal capacity reduction strategy, a large number of mines have been closed or abandoned in China. However, there are still a lot of available resources, such as mine water resources, the remaining coal and mine gas, space resources, etc. This research focuses on the nexus of water and space resources to build a pumped-storage system in the abandoned coal mines. The decision-making for site selection of a pumped storage power station in abandoned coal mines could require the general determinants of pumped storage power station and combine the special considerations from the underground coal mine space. After the make-up of the decision-making indicator system, the fuzzy multi-criteria decision making method is employed to select key indicators of the first-step pumped storage energy site primary selection, and finally construct a comprehensive site selection system to the second-step ranking for the construction of mine pumped storage energy station. More than 100 abandoned coal mines are inputted for the possible candidate of pumped storage power station building in abandoned coal mines. The research findings will have far-reaching significance in solving renewable energy penetration, environmental pollution, energy loss, etc., and contributing to achieve cleaner energy production and sustainable development of the coal mining industry

Keywords: *Energy-Water Nexus, Waste Mines*

Sustainable Practices in the Brazilian Chemical Industries: Obstacles and Challenges

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Abstract

Besides having strategic relevance for the economic and technical-scientific development of the modern society, the chemical industries are responsible for posing major risks for public health and environment. In this context, the chemical sector has been developing and implementing many sustainability practices and tools, resulting in greater competitiveness and access to new markets. In Brazil, the implementation of these sustainability practices faces major obstacles and challenges, which requires the understanding of the institutional scenario that shapes this implementation. In this sense, a bibliographic search was conducted and submitted to a categorical analysis in order to identify categories and subcategories of challenges. The applicability of the categories and subcategories selected were verified through a case study in a chemical industry located in Rio de Janeiro state, Brazil. The categories RD&I, Economic Viability, Public Sector Performance, Logistics and Awareness were identified as significant in the constitution of the institutional scenario. The categorical analysis results identified growth opportunities and barriers for the chemical industry considered. The development of systemic strategies and a greater integration between the different stakeholders is recommended in order to overcome the identified obstacles and challenges, and therefore, seek opportunities to achieve a Sustainable Development.

Keywords: *Sustainable Practices, Hotel Industry, Literature Review*

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Sustainable Practices in the Hotel Industry: A Systematic Literature Review

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Abstract

The environmental impacts generated by the tourism and hospitality sector have gained considerable attention from scholars in recent years. Green hotels and sustainable practices have been largely studied as a way to respond to the growing consumers' environmental awareness and to improve the environmental, social and economic impact of the sector. This growing body of literature uses different points of view, methodologies and theories, also investigating different geographical areas. The aim of this paper is to give a comprehensive overview of the academic studies on green hotel research, to identify research gaps and to provide potential future research directions on the topic. The paper explores the body of literature on sustainable practices in hotels, revisiting 600 articles collected through the Scopus databases, and evaluating these articles using specific structural dimensions to group the selected literature into analytical categories. With respect to past reviews produced by other scholars, this study contains various novelties that provide added value as: - a systematic approach to provide an exhaustive analysis of the topic with rigorous and reproducible research criteria; - a wide spectrum of scholars' publications (600 papers) specifically focused on sustainable practices in hotels; - an updated overview of this research field.

Keywords: *Sustainable Practices, Hotel Industry, Literature Review*

Sustainable Supply Chain Network Design in the Dairy Industry

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Abstract

During the past years, cattle husbandry for meat or milk production has been the target of numerous criticisms because of the environmental impacts associated with its execution. GHG emissions, soil erosion, and deforestation are linked to farms animal raising and feeding. Nonetheless, livestock is nowadays one of the most significant sources of livelihood in rural areas and provides millions of employees in both developed and developing countries. Moreover, as a result of global population growth, the demand for meat and milk is expected to be double by 2050. Consequently, the design or re-design of efficient, environmental, and social-friendly supply chain networks, from farms to distributors, constitutes one of the compelling challenges in the sector. This work presents a framework for the assessment of sustainability in the long-term development and re-design of the Colombian dairy industry. We selected a set of indicators attending to sustainable development goals in the industry context to measure sustainable performance. A mathematical model to the long-term supply chain network design for climate change adaptation is presented, including the adoption of sectorial mitigation actions. Finally, the use of an optimization strategy seeking to minimize the time to reach acceptable values for the sustainable indicators is presented.

Keywords: *Sustainable Supply Chain, Dairy Industry*

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Sustainable Universities: A Comparison of Sustainability Between Brazilian and Chinese Students

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Abstract

The main objective of a university is the training of students. University sustainability could be better targeted at students, since they are the ones who will play important roles within society and are the reason for the institution's existence. The objective of this paper was to evaluate the university sustainability of students, considering aspects of Ecological Footprint, happiness and academic performance with the Input-State-Output model. As each indicator has its objective, eight scenarios can be classified for students' lifestyles. A case study between Brazilian and Chinese students showed a similarity in a synthetic way to the model. Brazilian and Chinese students were classified as quasi-artificial, high use of natural resources, low happiness and high performance. However, while a Brazilian needs 2.8 planets to supply their lifestyle, Chinese need 2.0 planets. Chinese were considered less happy than Brazilians, with an index of 0.66 and 0.73, respectively; also less productive, with an average score of 7.0 for Chinese and 7.6 for Brazilians. With the chi-square it was possible to identify that happiness due to the ecological footprint are independent for both countries, and performance due to happiness are dependent, also for both countries. Odds Ratio showed that the chance of finding a happy / sustainable student in Brazil is 1.47, while in China 0.61. Also, the chance of finding a productive / happy student in the Brazilian group is 2.50, and in the Chinese group 1.70. This information can contribute to better targeting institutional decisions.

Keywords: *Sustainable Practices, Hotel Industry, Literature Review*

Sustainable Urban-Rural Food Production for Ethical and Just Transitions: EMErgy Assessment of a Community-Supported Agriculture Project in Italy

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Abstract

Global crises, such as the ongoing pandemic, highlight the interconnectedness and vulnerability of human systems, requiring integrated interdisciplinary studies aimed at breaking unsustainable and unjust practices. In this work, we address a horticultural co-production system, inspired by the Community-Supported Agriculture (CSA) model. In a highly industrialised area of Northern Italy, with significant wild land consumption, an alternative bottom-up experience is described. Local organic farming and just labour conditions seek ecological sustainability and social equity beyond the market dynamics. This CSA project contributes to the resilience of a territory currently affected by health and economic plights. Its claims, limits, and potentials are investigated by means of the EMErgy Accounting Analysis (EMA). The socio-ecological inputs and the monetary flows in the system at issue are identified and quantified and some key emergy-based sustainability indicators are calculated. Together with systems diagramming, the EMA assessment provides fruitful insight of a single scalable project, thus addressing the future opportunities for local improvement, the exportability to crisis and post-crisis scenarios, and the overall ethical sustainable transitions.

Keywords: : *Clean and Just Production, Local Food Systems, Resilient Cities, Organic farming, EMErgy Accounting*

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The Case Study of a Photovoltaic Plant Located at the University of L'Aquila: An Economic Analysis

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Abstract

Solar energy has contributed significantly to the energy transition towards a low carbon society. This study aims to evaluate the economic feasibility of a PV plant located at the University of L'Aquila, in a city characterized by an earthquake about ten years ago. The reconstruction process has not yet been completed and a solar PV plant moves towards a sustainable direction. In a subsidized market for plants with a nominal capacity greater than 20 kW assigning a priority to the public offices, an economic analysis based on the Discounted Cash Flow analysis is conducted. Net Present Value (NPV) and Discounted Payback Time (DPBT) are the indicators used and the Break-even point (BEP) analysis quantifies the value of the energy self-consumed in which the NPV is positive. Alternative scenarios based on the variation of the some critical variables are examined in order to support the decision-maker. An increase of the share of energy produced and self-consumed and the revenues associated to the subsidies are able to increase significantly the profits associated to the production of this clean energy.

Keywords: *Photovoltaic Plant, Economic analysis*

The Contribution of Ecosystem Services in River Basins to Water Security in Municipalities

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Abstract

The population increase associated with production and current consumption patterns intensifies the adoption of nature as a factor of value creation, recognizing ecosystem services as fundamental to provide the basic needs of the population, mainly the water supply in quality and quantity. Given the above, this study aimed to spatially identify water environmental services associated with different uses of the Atibaia River basin in the city of Campinas, state of São Paulo. For this, it was used geoprocessing tools, theoretical surveys and field visits. The results indicated that, being located in an Environmental Protection Area, 33.6% of the basin was covered by green areas and forest fragments. These, added to areas of agricultural activity, exposed soil and allotment represent a percentage of infiltration in the basin of 82.7%. Still, a basin exhibited 1177 springs, frequency of rivers of 2.60 n°/km² and 1.4% of the total area composed of aquatic ecosystems, being characterized as a potential producer of water. This diagnosis can assist in the implementation of the Payment for Environmental Services program in the municipality, allowing the identification and assessment of priority areas and assisting in the management of conservation and environmental recovery.

Keywords: *River Basins, Water Security, Ecosystem Services*

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The Contribution of Open Innovation to Cleaner Production in the Research Value Chain

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Abstract

Universities are responsible for knowledge creation in research ecosystems. The main outputs generated by them are Articles, Conference Papers, Books, Book chapters. Those outputs are the result of the so-called Research Value Chain, which encompass phases from "defining the question" to "publishing the results". Whether it is intentional or not, those outputs have a certain degree of openness on their development, e.g. funding, collaboration, experiments. This feature promotes the idea of the application of the concept of Open Innovation in Science tasks. Also, pressures from social and external systems to the relationship Industry-University (R&D system), contribute as guidance for new research, leading to outputs with a diverse range of subjects. One of the most critical topics is Cleaner Production. Society and an increasing number of environmentalists are pulling governments and scientific organisations to find cleaner methods of developing, manufacturing and distributing products. This study aims to analyse the top World Universities outputs' regarding subjects related to Cleaner Production by proposing the relationship of Open Innovation concepts in the Value Chain Research. Data gathered from central scientific databases will support the bibliographic analysis. The expected results of this study are the construction of a research network of the main actors related to cleaner production like co-authorship and funding of local governments and private companies, as well as opportunities to foster cleaner production development supported by open innovation in order to increase impact.

Keywords: *Research value chain, cleaner production*

The Conversion of Organic Fraction of Municipal Solid Waste into Resource by Solid-State Anaerobic Digestion

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Abstract

The organic fraction of municipal solid waste (OFMSW) is, in most cases, the major component from the total of municipal solid waste generated in a city. Therefore, it is often associated with the main environmental impacts, such as methane emissions and leachate percolation. In contrast with landfilling, the anaerobic digestion process allows the recovery of output materials and its transformation into by-products with high added values. Therefore, this work aims to evaluate the first data report of biogas and biosolid generated in a semi-industrial scale solid-state anaerobic digestion (SSAD) garage-type system located in Rio de Janeiro, Brazil. Regarding biogas production, it is estimated a biogas yield of 101.9 m³.t OFMSW-1, with a maximum of 76 % of methane content. This amount allows an estimated energy recovery of 3,379 kW per month, which could be used as electric or thermal energy, besides biomethane fuel. On the other hand, the system is able to produce 366 kg.t⁻¹OFMSW of biosolid, which is a stabilize organic material rich nutrients with potential agricultural use as organic compost or soil conditioner. In summary, the SSAD system can be considered an interesting alternative not only for OFMSW treatment but also as a circular economy driver.

Keywords: *Organic Fraction of Municipal Solid Waste, Solid-State Anaerobic Digestion*

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The Effect of Alternative Fuel Use on a New Generation Gasoline TSI Engine on Engine Performance and Emissions

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Abstract

In this study, gasoline mixtures of various alcohol derivatives (n-butanol and isobutanol) have been analyzed in different engine speeds on a new generation TSI engine in terms of engine performance and emissions. It is envisaged to investigate the most suitable working conditions for obtaining higher power / volume ratio, lower emissions, less fuel consumption, more torque, less friction and longer material life. Today, it has been determined that there is no research in our country about different alcohol mixtures in an engine with TSI technology. Experiments have been carried out in full throttle operation conditions and different engine speeds in a VW brand, 4 cylinder, 4 stroke, TSI engine. In the first stage of experimental studies; gasoline was used as replicate sample fuel, n-butanol and isobutanol were blended in different mixtures as 3% and 5% and tested in the engine. The maximum brake effective power value is measured at 3500, 4000 and 4500 rpm for different fuel mixtures. The highest brake effective power value was measured as 49.13 kW at 3500 rpm for RON 95 gasoline fuel and values measured in other fuels are 47.16 kW at 4000 rpm for N5 fuel, 46.53 kW at 4500 rpm for I5 fuel, 44.78 kW at 4500 rpm for I3 fuel and 44.51 kW at 4000 rpm for N3 fuel. The highest engine torque at 2000 rpm; was measured as 166.75 Nm for RON 95 gasoline fuel, 149.82 Nm for N5 fuel, 138.23 Nm for N3 fuel, 134.40 Nm for I5 fuel, and 133.61 Nm for I3 fuel. The measured engine torque values increased up to 2000 rpm in all fuels and reached the maximum level.

Keywords: TSI engine, n-butanol, isobutanol, alternative fuels

The Effect of CO₂ Release for 15 Countries in the World on the Climate Change and Possible Way to Utilization: A Review

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Abstract

As the demand on energy increases year by year, the Greenhouse gas emissions that responsible about the global warming become more significantly specially the carbon dioxide. Carbon dioxide (CO₂) is a foremost (Greenhouse gas emissions) contributor to threatening climate change. In this review paper the climate change due to the release of carbon dioxide will study for 15 countries in the world. The climate change leads to a different levels of potential environmental, physical, and health effects. Also extends to nature disasters (for instance storms, floods, heat waves and droughts), alteration in crop growing, rising in sea level, etc. The selection criteria for these countries was distributed of the countries based on the energy consumption into high, middle and low level of energy consumption. The three main sections for energy consumption namely: transportation, industrial and residential will review in details for these countries. The expect result will help to predict overall picture about the CO₂ emissions in the world and the best method to utilize it for others purposes.

Keywords: *CO₂ Release. Climate Change*

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The Energetic Metabolism of Post-Industrial Economies. A Framework to Account for Externalization Across Scales

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Abstract

Post-industrial societies heavily rely on the consumption of embodied energy for their activities - i.e., energy invested elsewhere to produce what is imported and consumed (or re-exported). The openness of the energy sector poses modelling challenges, calling for multi-scale, integrated analytical frames. We propose a methodology grounded in societal metabolism aimed at analysing the behaviour of a system's energy sector (where the system may be a region, a country, a continent, etc.). We make the distinction between three types of scales, relevant and necessary to contextualize the behaviour of the energy sector within a globalized economy: the macroscale, the mesoscale and the microscale. The methodology is applied to analyse the energy sector of EU19 countries, looking at local and externalised relationships. The results show that imported primary energy sources and energy carriers within the EU19 are associated with externalized pressures and impacts. For example, accounting for the externalized carbon emissions of the energy sector raises total GHG emissions of the sector by 60% on EU average. This has implications for the assessment of the effectiveness of global sustainability policies. By not accounting for externalized effects, energy models at different scales can miss relevant information for decision-making.

Keywords: *EU19, Greenhouse Gas Emissions, Energetic Metabolism*

The Improvement of Sustainable Performance in Cementitious Composites by the Insertion of Synthetic Fibers and Shrinkage Reducing Admixture to Reduce the Restrained Drying Shrinkage Cracking

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Abstract

The present research discusses the application of polypropylene fibers in cementitious composites to reduce restrained drying shrinkage cracking and, consequently, to increase the durability of this material. In addition, a comparison of the results with the use of the shrinkage reduction admixtures (RAS) and final analysis of the environmental impact through life-cycle analysis (LCA) is proposed to verify the sustainable use of each of these additions. Shrinkage tests and cracking verifications were carried out with different kinds and amounts of polypropylene fibers and SRA. Fiber-reinforced self-leveling mortar specimens were tested for cracking and shrinkage. After the shrinkage cracks formed, the surfaces were observed, images were gotten using digital image analysis and the crack thickness was measured. Therefore, mortars were submitted to LCA using the cradle-to-gate approach. From the results of the experimental cracking and retraction part, and from the sustainability analysis, it was found that the fibers and the additive acted in attenuating the retraction process. However, LCA has shown that certainly due to the additive manufacturing process, mortars using SRA had a greater impact potential than those with added fibers.

Keywords: *Life Cycle Analysis, Shrinkage Reduction Admixtures, Cementitious Composites*

The Impact on Water Scarcity of the Expansion of Cocoa Cultivation in a Semiarid Region in Brazil

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Abstract

Agricultural frontiers in Brazil have been expanding mainly in relation to fruit, including cocoa farming. Previously, it was believed that cocoa cultivation was limited to humid tropical regions, with annual rainfall index above 1500 mm. Currently, satisfactory results have been obtained in municipalities in the Brazilian Semiarid region with the use of irrigation, for example, Russas and Petrolina, municipalities with poorly distributed precipitation around 800 mm per year. On the one hand, studies have been showing an increase of up to 100% in the agricultural productivity of irrigated cocoa compared to conventional cultivation. On the other hand, irrigation in Semiarid regions can compete with other uses as human, ecosystem and animal feeding representing a relevant impact on regional water scarcity. In this context, the scenario for expanding cocoa in these Brazilian municipalities Semiarid was evaluated, considering the AWARE water scarcity characterization factors regionalized by Andrade et al. (2019). Among the 187 municipalities evaluated, 4 are located in areas whose water scarcity was considered very low, 36 low, 60 medium, 63 high and 24 very high. This preliminary analysis indicated that 77% of the municipalities considered for the expansion of irrigated cocoa are municipalities with water scarcity from "medium" to "very high". Thus, it is suggested that specific studies of water scarcity should be considered within the policies of expansion of irrigated cocoa cultivation in the Brazil, preventing the increase in cocoa production from competing with the other essential uses.

Keywords: *Cocoa Cultivation, Water Scarcity, Semiarid Region*

The Importance of PCJ Basins

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Abstract

The hydrographic basins of the Piracicaba, Capivari and Jundiaí (PCJ) rivers are responsible for the water supply of 76 cities in São Paulo and Minas Gerais. The sustainable development of these cities depends on the quality of this natural resource and detailed knowledge about the use of water for supply is essential. Therefore, it is necessary to research how the scientific literature approaches, from a methodological point of view, the use of river basins as important for sustainable development. This summary proposes a bibliometric study consulted the CAPES, Scielo and Spell databases using the keywords: hydrographic basin, water quality and PCJ basins. The results obtained will be tabulated and analyzed under several factors, such as: year of publication, origin of the authors, institution and type of publication. After conducting the bibliometric study, it is believed that the results will be useful to understand how the PCJ river basins have been helping the population that benefits from this natural resource.

Keywords: *PCJ Basins*

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The Integration of Circular Economy and Industry 4.0 for Developing a Roadmap for Sustainable Operations

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Abstract

In recent years, circular economy and industry 4.0 have emerged as one of the most discussed concepts in both academia and the business sector. However, the relationship between these two paradigms has not been much investigated in the literature. This paper aims to explore the impact of Industry 4.0 technologies on circular economy in order to develop an original roadmap that can help practitioners and policymakers to move towards sustainable operations. This is achieved through a qualitative approach of two stages. Stage 1 was a literature review to synthesize the current academic literature to develop a conceptual roadmap. Stage 2 was a validation stage based on semi-structured interviews with industrial managers and researchers. Based on this research, the adoption of Industry 4.0 technologies is expected to impact the achievement of circular economy principles.

Keywords: *Industry 4.0; Circular Economy, Sustainable Operations*

The Life Cycle Assessment Methodology Proposal to Improve the Environmental Impact of Mortars Focusing on Durability

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Abstract

This study aims to evaluate the life cycle of coating mortar contemplating insertions of mass and energy flows resulting from the prediction of the occurrence of the main pathological manifestations of this material, thus seeking to develop a methodology for life cycle assessment (LCA) that is more holistic and applicable. The methodology of the study consisted of submitting coating mortars, with the usual formulation in Brazilian civil works, to accelerated durability tests, with plastic shrinkage and efflorescence incidence. From these it is predicted the appearance of cracks and stains of calcium carbonate (CaCO₃) in the mortar coatings. In addition, the accelerated carbonation test and subsequent quantification of carbon content were carried out in order to verify the carbon fixation potential in the material. Thus, mortar LCA will be performed, with analysis from cradle to grave. Therefore, through the results of the durability tests, it is intended to define maintenance for the material use phase which will be inserted as mass and energy flows. Finally, from the impact potentials resulting from the LCA, the amounts of carbon fixed in the composition of the mortars will be subtracted, aiming to balance the impact and their environmental contribution.

Keywords: *Life Cycle Assesment, Calcium Carbonate, Mortars*

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The Role of Board Diversity on the Relationship between Corporate Environmental Performance and Corporate Financial Performance: A Conceptual Paper

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Abstract

Now environmental problems are serious problems all over the world, especially global warming. The climate change leading more frequent natural disasters, and increase disease, reduce labor productivity, and enhance the cumulative cost of countries, In recent years, the concept of sustainable development is an issue of growing interest to the national government, universities and other NGOs (non-government organizations). The relationship between corporate environmental performance (CEP) and corporate financial performance (CFP) composition is one of the most confusing phenomena about the research of firms and the natural environment. Good corporate governance is more helpful to increase environmental performance and financial performance. The impact of board characteristics (such as female directors, independent directors, and environmental committee) is good for firms' environmental performance. This study by examining the board roles influence the relationship between CEP and CFP. Further analysis will be conducted to examine what different this influence between east and western countries with cultural and economic discrepancy. The findings from this study have a significant contribution to the corporate environmental issues, corporate governance, and accounting regulation body.

Keywords: *Corporate Environmental Performance (CEP), Corporate Financial Performance (CFP)*

The Soil and its Ecosystem Services for Sustainability and Global Health

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Abstract

The comprehensive knowledge of the soil from its edaphological, pedagogical and agro-ecological analysis, provides support the vision of energy production, food security and the preservation of water quality, therefore, human and global health. In addition, on a planetary scale, natural phenomena and landscape dynamics still generated by human actions, promote changes in soil formation. Such changes modify the soil's taxonomy and its ecosystem services rapidly. Urbanization, conurbation, even the increase in technosystems associated with virtuality, electromagnetic flows, among others, interact with ecological energy flows, albedo and other energy dynamics that affect the distribution of micro, meso, macro and nano organisms that inhabit and form the soil. Such rapid transformations of land cover alter infiltration in the edaphic section, which in turn alters the quality of groundwater. For example, the taxa: Inceptisols and Entisols, with incipient pedogenetic development, regulate surface and underground water resources; Oxisols and Ultisols, support the tropical forest, recharge aquifers, are a genetic and medicine source. Then, the knowledge of geosystemic, hydrosystemic, and biosystemic interrelations offers a decision-makers planning tool. Contributing to the knowledge Sustainable Development Goals, such as (Goal 11, 13, 14 and 15): Make cities and human settlements inclusive, safe and resilient; Take urgent measures to combat climate change; Conserve the oceans and marine resources, and; Protect and restore terrestrial ecosystems and forests, combat desertification and stop the land degradation and biodiversity loss

Keywords: *Sustainability, global health*

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The Use of Solar Energy to Heat a Covered Lagoon Biodigester Effluent: A Study for a Pig Farm in Teixeiras, Minas Gerais, Brazil

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Abstract

Covered lagoon biodigesters are widely used in Brazil to treat agro-industrial effluents, since they have low cost and easy operation. However, under natural conditions, biodigesters operate at suboptimal temperatures, compromising the system efficiency and the biogas production. Thus, the use of external sources for heating the effluent can enhance the reactors' operation. The solar energy stands out for being a reference in the sustainability principles. This work aims to develop a system for heating a pig manure in a covered lagoon biodigester by the recovery of solar energy. The study was carried out through modeling and simulation, using the programs SketchUp, Version 17.2 and Energy-Plus Building, Version 8.7. The covered lagoon biodigester used in this research is placed in a pig farm located in the municipality of Teixeiras, Minas Gerais, Brazil. The solar panels have 72 monocrystalline solar cells, 370 W of power and an efficiency of 19.17%. The soil and effluent temperatures, as well as the physicochemical properties of the solar panels and the biodigester's building materials were used as input data. By the development of this work, it is believed that the recovery of solar energy can contribute to a greater energy sustainability of agro-industrial effluent treatment systems.

Keywords: *Covered Lagoon Biodigesters, Pig Farm, Solar Energy*

The Use of Wood on the Development of Sustainable Residences

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Abstract

Since ancient times, wood is used as regenerable and easily recyclable material, i.e., positive impact for the environment. This work aims the evaluation of a sustainable residence completely manufactured on recycled or recyclable material, especially wood. It was used case study methodology and Life Cycle Assessment. The developed project presents 30 m² of built-up area, used Design Cradle to Cradle (C2C) approach, and was built and maintained in São Paulo city, 10 million people metropolis in Brazil. It was possible to observe that the concepts and criteria of C2C were observed: no toxic reactants\material were found during construction or use; z-emission - specially garbage - due to biological cycles; completely modular system; easy for disassembly, upgrade and repair; water rational use and recycle, solar energy available, traceability. Some unexpected technologies were applied, such as burning the wood surface instead of painting, and it is not time consuming since house assembly occurred in less than a week. Thus, considering the low cost of the project, this approach and technology is suitable for the outskirts of big cities, for small cities, where space is not a concern but the cost of conventional construction is, or even large areas with available wood, such as farmers.

Keywords: *Sustainable Residences, Wood, Design Cradle to Cradle (C2C)*

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Transformation towards Circular Economy (CE) in Municipal Waste Management System - Model Approach

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Abstract

Municipal waste management is an area of environmental debates throughout the world. Sustainable municipal waste management is especially important in the transformation process towards a circular economy (CE), which is a global strategy. Paper proposes a conceptual model of transformation towards CE in municipal waste management, which has been developed based on the ReSOLVE framework. It takes the core principles of circularity and applies them to six actions: Regenerate, Share, Optimise, Loop, Virtualise, and Exchange. In each of presented actions, recommended tasks were indicated which should be taken by governments and residents themselves, such as landfill remediation, use of selected municipal waste fractions for economic purposes, sharing products with co-users, waste recovery, remanufacturing products or components, virtual solutions in everyday life to reduce the amount of generated waste or replacement of household appliances by items with a higher energy class. The proposed CE model framework could positively influence transformation towards CE in the national economics.

Keywords: *Circular Economy, Municipal Waste*

Urban Environmental Monitoring Stations in a Mediterranean Tourism Destination

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Abstract

European cities face vital challenges in terms of fuel consumption, traffic congestion, air and noise pollution, safety, resilience, and the overall quality of life. Urban areas, as the most crowded places, contribute significantly to human-made climate change. In the meantime, they are the most affected regions of climate change since global warming makes them more and more susceptible to prolonged extreme weather conditions. Monitoring methodology through a network of meteorological stations and traffic thermocameras in specific locations allocated in selected sites in a Mediterranean tourist city was developed and applied, incorporating the daily, monthly, and seasonal fluctuation of air pollutants and their correlation with the traffic load. This research work aims to demonstrate and evaluate the primary outcomes of the analysis and attempts to promote the transition towards sustainability by evaluating the impact of "green" activities regarding sustainable mobility, taking advantage of the implementation of Electric Vehicles (EVs) and smart techniques applied in the examined city. After the statistical analysis of the selected big data, safe conclusions were drawn on the impact of the congestion during working days, the seasonality impact due to tourism and the increased outdoor activities, the festivals' impact on air pollution (highly crowded events), etc.

Keywords: *Urban Environmental Monitoring Stations, Mediterranean Tourism*

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Use of Eucalyptus Chip Ash to Replace Portland Cement in Concrete

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Abstract

The Portland cement is one of the most used materials in the construction industry, however, during the manufacturing process there is a high CO₂ emission. Taking into account the need to reduce this gas in all production chains, this work aims to analyze the technical feasibility of using gray eucalyptus chips to replace Portland cement in concrete. Four concrete mixtures were produced with the replacement of the cement mass by the ash with granulometry less than 0,075 mm, in the contents of 0%, 10%, 20% and 30%. For mixtures, a consistency of 5 ± 1 cm was fixed. Compressive strength at 28 days was evaluated (ABNT NBR 5739: 2018). It was found that with a replacement of up to 30%, there was a 38% decrease in compressive strength compared to concrete without the residue, indicating the possibility of using in non-structural concretes and contributing to the practice of recycling waste by construction industry.

Keywords: *Cement Portland, Eucalyptus Chip Ash, Construction Industry*

Use of The Increasing Cereal Temperature During Milling as an Optimization Parameter of the Shelf Life at the Hammer Mill Blades

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Abstract

Experimental research is carried out in a feed mill in the Colombian Atlantic region. It is focused on testing the hypothesis of the increase in the cereal's temperature during its grinding can be useful as an indicator for change of the mill blades, 100 batches of 25 t of corn each is ground to grind a total of 25,000 tons, which is the useful life of the set of blades. In each batch, electricity consumption is controlled, as well as the increase in the temperature of the corn and the grinding time. An analysis of Operating Costs is carried out and the optimal time for changing the blades is determined and the temperature increases at this time. A set of blades is then used until its lifetime, changing the working edge of the blades each time the increase in the temperature of the corn reaches the limit value of temperature. The results have shown a significant improvement in energy performance and economical savings

Keywords: *Shelf Life, Hamme Mill Blades, Milling*

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Used Lubricant Oil Refining Industry: Recovery the Clay and the Residual Oil

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Abstract

In this work it is shown the results of techniques which can be used in the treatment of solid waste produced by the recycling of used or contaminated lubricating oil, for the purpose of providing possible solutions to reduce the disposal of residues resulting from this industry. To achieve this objective, different methods for the treatment of this waste, as chemical (different kinds of solvents) and physical (filtration), were used. Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) techniques were used for the evaluation of the effects of these procedures. These techniques show all the reactions of the samples during the heat treatments, such as, variation of the sample mass with temperature. Such measurements have been carried out for the gross sample, before and after the treatments carried out in the laboratory. The results shown that can be recovered both the clay used during the recycling process as well the residual oil.

Keywords: *Thermogravimetric analysis, oil refining industry*

Utilization of Oil Palm Waste as Eco bag to reduce Plastic Bag Consumption

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Abstract

Indonesia is the world's second largest contributor of plastics to the oceans at 0.48-1.29 million t/year. From entire plastic waste only 10-15% is recycled while 60-70% after single use will be put on final disposal sites, and 15-30% leaks into oceans. Hence it is obvious that single use of plastic would be significant problem in the waste management in Indonesia. The recycle bag or so-called Eco bag would be a solution since this eco bag could be reused several times hence reduce significantly environmental footprint. Considering abundant biomass waste such as empty fruit bunches (EFB) this study aims to enhance value added of the EFB into Eco bag. The study consists of the production process of fiber production, Eco bag production, and LCA of the eco bag. The LCA result by using SimaPro 9.0 as tool shows that the total GHG emissions to produce two Eco bag and cutleries are 9.5 kgCO₂eq. Hence, each Eco bag utilization could lead to GHG emission reduction by 12.1 kgCO₂eq. compared to the single use plastic utilization.

Keywords: *Empty Fruit Bunches (EFB), SimaPro 9.0, Oil Palm Waste, Plastic Bag*

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Waste Management Efficiency and Sustainability: An Ecologically Extended Data Envelop Analysis-DEA in the Italian Service

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Abstract

Waste production is gaining importance in the international debate as a crucial factor for attaining sustainability of human settlement and economic systems. Ecological efficiency of the production systems is crucial in the circular economy strategy to attain sustainability goals enabling wellbeing preservation of current and future generations. According to World Bank 2,01 billion of metric tons of solid waste are produced annually worldwide with an expected global growth of 3,40 billion metric by 2050. The waste production growing rate is calling for urgent policy actions for promoting modern waste management enhancing waste recycling and composting in a circular economy perspective. In accordance with Dyckhoff, et al. (2001) Data Envelop Anlysis DEA is a valid instrument in assessing companies' ecologically efficiency. Sarkis et al (2001 apply the DEa Model to waste sector. In this paper we analyse the environmental efficiency of Italian public waste sector by using DEA approach in order to analyse waste management efficiency in term of waste recycling maximization. Using panel data results show there are geographical differences in environmental and economic efficiency of waste management due to differences in technical management of the service, other explanatory variables (demographic and territorial) are implied in waste recycling efficiency.

Keywords: *Waste Management, Sustainability, Data Envelop Analysis-DEA*

Water-Energy-Food Nexus of Maize-Based Cropping System in the North China Plain

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Abstract

The predominant traditional wheat-maize cropping system led high water and energy consumption in North China Plain (NCP). It is significant for seeking a tradeoff between water, energy and food?WEF? nexus. This paper briefly describes the WEF nexus in seven maize-based cropping systems, compares which better facilitated crops production while reducing energy consumption and water depletion for agricultural sustainable development. The water and energy inputs of cropping systems per unit area and food supply were calculated based on the experimental results. The results showed that, the per unit area inputs of non-renewable energy and irrigation for water of multiple cropping maize-wheat (MW) system were the highest, and others systems decreased by 18%-48% and 12%-74% compare with MW system. Compared with the MW system, the groundwater for irrigation and non-renewable energy per unit food supply of the relay cropped maize-pea (MP) were increased by 33% and decreased by 12%, respectively, MP system decreased by 37% in food supply, decreased by 29% in groundwater for irrigation, and decreased by 43% in non-renewable energy. MP cropping system performs well considering food supply reduction ranges below 40%, while reducing water and energy consumption.

Keywords: *North China Plains (NCP), Water-Energy-Food Nexus, Maize-Based Cropping System*

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Water and Food Safety of Shanenawa Indigenous people of Shanekaya Village

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Abstract

The study will assess the supply of drinking water at Shanekaya indigenous village, located in Feijo, a city from a State of the North of Brazil, Acre, and this village is in Amazon Region. The focus of the study is to understand if the lack of potable water affects the health and economy of the Shanenawa people that lives in Shanekaya village. The more of 18 families, with more than 78 adults living at this village are working to increase their feeding capacity, a lot of the supplies that they need are not able to get from their new land, as they still were not able to develop the diversity of the supplies also they are encountering less wild animals, due to deforestation and burned forests in village` s surrounding, making them to buy animal protein supplies in the nearby city - Feijó. Another problem of contact with the urban environment was the introduction of refined sugar in the diet of the Shanekaya people, causing many dental problems, mainly in the children of Shanenawa people living in Shanekaya. The introduction of these and other industrialized foods, also causing the problem of non-organic waste, and the management of such residues is done by burning. Water has become scarce, the rain cycle has changed a lot as one of the effects of climate change, causing even the drinking water scarce, sometimes the drinking water is bought in the city or they get from the rai, boiled and passed through a cotton fabric to drink.

Keywords: *Shanekaya Village, Indigenous People, Water and Food Safety*

Water Implications of Integrated Assessments for Energy and Land-Use Systems Expansion in Brazil

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Abstract

Understanding the complex net of interactions between climate, energy generation, water resources, and land use is essential to guide more adequate technological choices and policies. While limiting the greenhouse gas emissions (GHG) is relevant globally, water restrictions are important locally. In Brazil, mitigation measures rely not only on restraining deforestation levels but also extensive use of renewable sources for the expansion of the energy sector. Integrated assessment models (IAM) that emphasize the evaluation of the energy and/or the land use systems, such as the BLUES (Brazilian Land-Use Energy System), often do not consider the availability of water resources. This study proposes a technical parametric model to test the increase of regional water requirements for two different climate scenarios of environmental governance in Brazil. This assessment shows that optimal solutions under land-use and energy perspectives are not feasible in terms of water resources. Furthermore, the increase of bioenergy use leads to an alarming expansion of irrigated area requirements, especially for sugarcane. Failing to consider water availability restrictions can lead to unfeasible results from the water resources perspective and aggravate water stress situations and conflicts over the use of water.

Keywords: *Greenhouse Gas (GHG), Integrated assessment models (IAM), BLUES (Brazilian Land-Use Energy System),*

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Water Quality in Indigenous Reserves from the Pareci Ethnicity in the Region of Chapadão Parecis-Mato Grosso/Brazil

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Abstract

The indiscriminate use of water has consequences for the environment and consumers, mainly those who do not have access to basic sanitation. In the indigenous population negligence in the collection and treatment of water in a correct way is frequently observed, in general they are lacking in resources and adequate guidance. The objective was to verify the quality of the water available for direct human consumption, without treatment, for food, hygiene and recreational activities in four indigenous villages. There were seven analyzes, with bimonthly collections, from November 2016 to September 2017. The data indicated that the water courses are not in accordance with CONAMA Resolution No. 357, art. 14, of March 17th, 2005 of March 17th, 2005 and CONAMA Resolution No. 274, of 2000, which establishes the maximum limit of 200 thermotolerant coliforms per 100 milliliters of water. In 80% of the samples the values were above that established by CONAMA resolutions. The points with the highest values were C2 (EC was 5.5×10^4) and D1 (6.8×10^4). There were differences in the EC values between the dry and rainy periods, associated with seasonality, deposits of garbage and other contaminants on the banks of rivers, with impacts on the health of the indigenous people.

Keywords: *Indigenous Reserves, Pareci Ethnicity, Mato Grosso*

Water Treatment Plant Sludge, Phosphogypsum and Waste of Production of Lime

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Abstract

The development of a new compost, for use in a sealing block in civil construction, from industrial waste aims to be an alternative recycling alternative for waste generating companies. The industrial waste that was used in this work as raw material were: construction and demolition waste, water treatment plant sludge, phosphogypsum - residue of phosphoric fertilizer production and waste of production of lime. For each of the 30 compositions, 55 samples of 20mm x 20mm cylinder size were molded and the mixtures were compressed with a pressure of 10 Mpa. For analysis, perform tests of resistance to uniaxial compression, water absorption, density, chemical analysis (XRF), mineralogical analysis (XRD) and physical analysis (SEM and EDS). At 3 days of age, a sample with 45% by weight of phosphogen reached 11,3 MPa for resistance to uniaxial compression and at 270 days it reached 24,7 MPa. Through XRD, XRF, SEM and EDS were analyzed by the physical processes of chemistry of the formation of structures of new materials through the transformation of various crystalline minerals and synthesis of amorphous substances, similar to gypsum structures. The new compound has a high mechanical strength value, which makes it possible and viable to use waste for the production of a sealing block.

Keywords: *Lime Production, Water Treatment*

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Web Based Idea Management System as a Tool to Foster Sustainability

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Abstract

Multiple information systems have been developed during the last decade to gain more from collaboration, knowledge management, and ideas. One type of such tool is idea management systems (IMS) - a manageable systematic tool to generate and evaluate ideas. Web-based IMS is used by many well-known organizations such as Heineken, Etsy, Panasonic, Sony, Fujitsu, Electrolux, Volvo, etc. The use of web-based IMS falls in line with current developments (such as growing importance of ICT, the spread of open innovation and co-innovation, etc.). The authors expect that throughout the following years the role of web-based IMS will grow as even more organizations will apply them. An there is the question will these systems as a tool to foster sustainability or even green IT? So the aim of the research is to theoretically analyze web-based IMS as green IT and their potential to foster sustainability. Methodological approach. To fill the gap, the paper aims by adapting the theoretical and empirical research approaches to create a description of web-based IMS as green IT and as sustainability foster. Implications. This paper makes an important novel contribution to the literature by developing the description of web-based IMS and green web-based IMS and its benefits.

Keywords: *Idea Management, Green IT, Sustainability Sustainable Business*

What We Know so far about Purchase Behavior Related to Green Products: A Review on Green Attributes

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Abstract

Current consumption and production patterns call for changes that reduce the impact of human activity on the environment. This can be achieved through green products, which are products that encompass environmentally sustainable attributes. Thus, understanding purchase behavior regarding them is relevant. Therefore, this research's main objective is to analyze consumer behavior on environmentally sustainable product attributes (green attributes). To reach the objective, a literature review was conducted. Our findings show that research on green product attributes and purchase behavior can be divided into 3 major research streams. The first stream is related to consumers' decision-making behavior for green product attributes and addresses the impact of green advertising and ecolabelling on purchase, willingness to pay and pricing aspects of green products. Additionally, studies in this stream aim to understand demographic aspects of green purchase and attitude-behavior gap. The second research stream is related to the psychological determinants of green consumption and articles in this stream are related to consumers' psychographic variables, values and goals, purchase involvement, priming. Finally, the last stream encompasses articles that measure the environmental friendliness of products. As such, research in this stream assesses the greenness perception of consumers and their expectations of green attributes.

Keywords: *Green Attributes, Purchase Behaviour*

Which Circular Economy Strategy is Suitable for EPS Packaging in the Food Sector?

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Abstract

The food industry widely uses the expanded polystyrene (EPS) packaging, which is one of the challenges to finding viable means for its reuse. This work sought to identify the best circular economy strategy for the EPS chain in the food sector. For this, a bibliographic survey sought out identifying the areas of use, limitations and opportunities. The strategies used for EPS in this sector include reducing, reusing, recycling and recovering materials in the production processes. None studies indicate the percentage of packages reduction in the period covered by this research. In the food industry, the composition and layout of these packages, as the difficulty of cleaning, limit their reuse. The recycling has some limitations related to the cost of transportation, equipment limitations, photochemical oxidants formation and the presence of chemical substances harmful to human health. The circular economy strategy for EPS packing with potential for use by the food industry is the recovery of chemical substances from by-products of food processing. Thus, the waste-reused allows its transformation into raw material for another packaging, contributing to reduce the consumption of new inputs.

Keywords: *Expanded Polystyrene, Waste Management, Environmental Impact, Circular Economy.*

Which Mathematical Model Best Fits the Methane Production in Pig Farms with Plug-Flow Digesters?

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Abstract

The plug-flow digesters are widely used to treat piggery manure in Brazil; until recently there has not been a reliable and robust mathematical model to estimate the methane production, especially in large scale units. This study aimed at comparing some methodologies reported in the literature to estimate the methane production in plug-flow digesters, such as: Chen (1983), CETESB (2006), mass balance (CHERNICHARO, 2016), and Intergovernmental Panel on Climate Change (IPCC, 2006). The input data for the models were obtained by monitoring two plug-flow digesters in a pig farm in Teixeiras (Minas Gerais State - Brazil) that treats the effluent from 10,820 animals, and methodologies' reference data. The real methane production (Preal) was determined from Sep. 2018 to Aug. 2019 due to the equivalent of electricity production in an internal combustion engine. The monthly average of Preal and models results were compared by using T test for a significance level of 5%. The average of Preal was $408.8 \text{ m}^3 \text{ d}^{-1}$, the models that did not presented statistically significant differences were Chen ($394.3 \text{ m}^3 \text{ d}^{-1}$) and IPCC ($498.2 \text{ m}^3 \text{ d}^{-1}$); on the other hand the models not indicated were CETESB ($1,513.2 \text{ m}^3 \text{ d}^{-1}$) and mass balance ($116.6 \text{ m}^3 \text{ d}^{-1}$) by presenting statistical differences. The mathematical model is a relevant tool and its use can enable studies for the implementation of energy self-sufficiency projects in pig farms.

Keywords: *Pig Farms, Methane Production, Mathematical Model*

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Will the Population Migration in Xiong'an New District Influence Urban Peak Carbon Emissions?

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Abstract

Xiong'an New District, in Hebei province and nearby Beijing, is planned to undertake the population and the noncapital functions of Beijing. For sustainable development, a difficulty faced by urban planners is that the maximum number of people can be migrated from Beijing to Xiong'an with the lowest impacts of Hebei's and Beijing's urban peak carbon emissions to achieve the goals of the Paris agreement. This paper establishes LEAP-based Hebei and Beijing medium-to-long-term prediction models and proposes three different populations migration and industrial transposition scenarios to test the impacts of urban GHG emissions. The main findings are as follows: (1) Increased population and building area will markedly increase GHG emissions from residential consumption in Hebei province, while slightly decrease GHG emissions in Beijing. (2) Green planning, including industrial structure changes, industrial transformation, will markedly decrease the GHG emissions in Hebei provinces and it can make down for the emissions increase due to the population migration. In summary based on the research, adjusting industrial structure, slowing down economic growth rate and promoting new energy vehicles while Xiong'an undertake the population can reduce the peak GHG emission of Hebei without affecting its development.

Keywords: *Xiong'an GHG's, Carbon Emissions*
