



“TEN YEARS WORKING TOGETHER  
FOR A SUSTAINABLE FUTURE”

Advances in Cleaner Production

# CONFERENCE PROCEEDINGS

São Paulo - Brazil - May 24<sup>th</sup>-26<sup>th</sup> - 2017

Universidade Paulista - *Campus* Indianópolis



*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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# Conference Proceedings

May, 24<sup>th</sup> to 26<sup>th</sup> 2017

São Paulo, SP, Brazil

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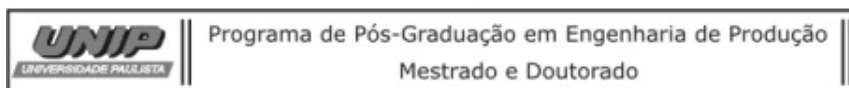
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Boosting Knowledge Exchange Seeking for Sustainability

in participation with



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PPGEP-UNIP – Post-Graduate Program in Production Engineering of the Paulista University

### Organized by:

ACPN - Advances in Cleaner Production Network

### In Participation with

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## Message of Welcome

On behalf of the Organizing Committee, we have the honor to welcome for this opportunity to all participants, and to express my greatest wishes that the event will serve to establish fruitful collaborations among participants.

The extensive program, the representative number of participants, the quality of the conferences and contributions allows this event to be considered the most important event held in Brazil addressing Cleaner Production. It is the consequence of contributions from several colleagues scattered in different parts of Brazil and of the World. Colleagues who are working 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**. The impact will largely depend on the interaction and discussion that will occur among you, encouraged by the organization of this event.

**Welcome!**

**Bienvenidos!**

**Bem-Vindos!**

We wish a fruitful participation, a pleasant stay, and that you have a good return to your home institutions. We hope also that you continue contributing to the Advance of Cleaner Production and Sustainable Development.

Biagio F. Giannetti  
Conference chair

Zhifeng Yang  
Conference co-chair



## 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.

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## Objectives

The "**6<sup>th</sup> International Workshop on Advances in Cleaner Production**" is an international forum to be held in May 24<sup>th</sup> to 26<sup>th</sup>, 2017 in São Paulo, Brazil. The "6<sup>th</sup> International Workshop: Advances in Cleaner Production" aims to promote:

- The exchange of academic information
- The presentation of recent achievements
- The discussion of common problems and their possible solutions
- The contact among academic knowledge and corporative experiences

The discussion of the event's theme "Ten Years Working Together for a Sustainable Future"

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## Program

Time	May 24 <sup>th</sup> , 2017 (Wednesday)	May 25 <sup>th</sup> , 2017 (Thursday)	May 26 <sup>th</sup> , 2017 (Friday)
8:00 to 9:40	Reception	Oral Presentation (5A)	Oral Presentation (6A)
9:40 to 10:00	Opening ceremony	Break	Break
10:00 to 10:30		<b>Workshops</b> Sustainability of Supply Chains <b>Bruno Silvestre</b>  Industry Innovation <b>Carlos Montalvo</b>  Decreasing Corporate and Family Carbon Footprint <b>Luís Eduardo Velázquez            Contreras</b>  Sustainable Cities <b>Gengyuan Liu</b>	<b>Workshop</b>  Applying the Ecological Footprint: Unleashing Innovation for One- Planet Cities.  <b>Matthis Wackernagel</b> <i>(Global Footprint            Network - USA &amp;            Switzerland)</i>
10:30 to 12:00	<b>Opening Conference:</b>  Ecological Footprint - Fundamentals for Building a Successful Future  <b>Matthis Wackernagel</b> <i>(Global Footprint            Network - USA &amp;            Switzerland)</i>		
12:00 to 13:30	Lunch	Lunch	Lunch

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## Program

Time	May 24 <sup>th</sup> , 2017 (Wednesday)	May 25 <sup>th</sup> , 2017 (Thursday)	May 26 <sup>th</sup> , 2017 (Friday)
13:30 to 15:00	<p><b>Conference</b></p> <p>Are you Serious? The Importance, Nature and Gaps of Managing Sustainable Supply Chains</p> <p><b>Bruno Silvestre</b> (University of Manitoba - Canada)</p>	<p><b>Conference:</b></p> <p>Global Income Inequality and Climate Change</p> <p><b>Klaus Hubacek</b> (University of Maryland - USA)</p>	<p><b>Conference:</b></p> <p>International Perspectives from Climate Change</p> <p><b>Luiz Eduardo Velásques Contreras</b> (University of Sonora - Mexico)</p>
15:00 to 16:30	<b>Oral Presentations (4B)</b>	<b>Oral Presentations (5B)</b>	<b>Oral Presentations (6B)</b>
16:30 to 16:50	<b>Coffee break</b>	<b>Coffee break</b>	<b>Coffee break</b>
16:50 to 18:50	<p><b>Plenary Presentations</b></p> <p>Inno4sd Network: Promoting Sustainability</p> <p><b>Carlos Montalvo</b> <i>Netherlands Organisation for applied Scientific Research (TNO) - Netherlands</i></p> <p>Towards Clean and Resilient Energy and Transportation Infrastructures</p> <p><b>Hossam Gaber</b> <i>University of Ontario Institute of Technology - Canada</i></p> <p>Bolivia's Lithium Frontier: Can Cleaner Technologies Harness a Mineral Development Boom?</p> <p><b>Linda Hancock</b> <i>Deakin University - Australia</i></p>	<p><b>Workshop:</b></p> <p>Ten Years Working Together for a Sustainable Future: What About the Next Ten?</p> <p><b>Donald Huisingh</b> (University of Tennessee - USA)</p>	<p><b>Closing Conference:</b></p> <p>The Evolution of Cities: "Brains" or "Parasites" of Sustainable Production and Consumption Processes in China</p> <p><b>Gengyuan Liu</b> (Beijing Normal University - China)</p>
18:50 to 19:50			<b>Closing Ceremony and Cocktail</b>

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo – Brazil – May 24<sup>th</sup> - 26<sup>th</sup> - 2017

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**Conferences**

**and**

**Oral Presentations**

**24<sup>th</sup> May 2017**

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

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**24<sup>th</sup> May 2017**

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**10h30-12h00**

**Opening Conference**

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**Matthis Wackernagel**

**Global Footprint Network -  
USA & Switzerland**

Ecological Footprint -  
Fundamentals for Building a  
Successful Future

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## **Ecological Footprint - Fundamentals for Building a Successful Future**

Mathis Wackernagel

*Global Footprint Network - California, US & Switzerland*

The Paris declaration consolidated first and foremost, that there is a limited carbon budget, and that what counts are net-emissions. Further, as we move out of fossil fuel, the main resource to power our economies is the regenerative capacity of ecosystems. Access to regenerative capacity is therefore becoming the limiting factor. This global resource transformation puts South America into a strong position, particularly compared to other regions. How can economies most effectively manage the emerging risks and opportunities associated with the post-Paris world? Mathis Wackernagel will present data-driven frameworks to help shape and test policy and investment opportunities, and track progress.

For more background on Global Footprint Network check out these resources:

- A visual introduction to Global Footprint Network's work: [www.footprintnetwork.org/images/article\\_uploads/2012\\_Annual\\_Report.pdf](http://www.footprintnetwork.org/images/article_uploads/2012_Annual_Report.pdf)
- Mathis Wackernagel's recent HDI-Footprint TEDx talk (<https://www.youtube.com/watch?v=3M29BY86bP4&feature=youtu.be>)
- A video on how Footprint Accounts work, lasting only 2.5 min ([https://www.youtube.com/watch?v=\\_T5M3MiPFW4&feature=youtu.be](https://www.youtube.com/watch?v=_T5M3MiPFW4&feature=youtu.be))
- An interactive maps to see time series of all countries [www.footprintnetwork.org/map](http://www.footprintnetwork.org/map)
- The "Ecological Wealth of Nations" which provides a more detailed explanation: [www.footprintnetwork.org/images/uploads/Ecological\\_Wealth\\_of\\_Nations.pdf](http://www.footprintnetwork.org/images/uploads/Ecological_Wealth_of_Nations.pdf)

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**24<sup>th</sup> May 2017**

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**13h30 -15h00      Conference**

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**Bruno Silvestre**

**University of Manitoba -  
Canada**

Are you serious? The  
Importance, Nature and Gaps of  
Managing Sustainable Supply  
Chains

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## **Are you serious? The Importance, Nature and Gaps of Managing Sustainable Supply Chains**

Bruno Silvestre  
*University of Manitoba - Canada*

Although research on sustainable supply chain management has made many valuable contributions, in practice businesses still tend to follow the profit maximization paradigm. Also, there is a dearth of empirical evidence and theoretical reflection on how supply chains incorporate sustainability in developing and emerging economies. Drawing from established management theories (e.g., institutional theory, evolutionary theory, complexity theory, learning/innovation, RBV) and practice, the aim of this talk is to discuss these two gaps by exploring alternative ways of thinking and how supply chain sustainability can be implemented and managed in different settings. This talk stresses that becoming a sustainable supply chain is not a destination, but a journey, where trajectory and time matter. Given the evolutionary nature of supply chain sustainability trajectories, this talk highlights that supply chains learn and evolve just as organizations do. Also, it is argued that supply chains face additional barriers to sustainability in developing and emerging economies due to the existence of highly turbulent business environments and institutional voids, and this contributes to a higher degree of complexity and uncertainty. The talk finalizes with implications for theory and practice of sustainable supply chain management as well as several avenues for further research on the topic.

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## **24<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 4B**

**Room 1**

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Reuse of Management and Recycling Construction Materials: Identification of the Main Waste and Legal Interpretation of the Standarts of Reuse and Recycling

The Artisan Recycling on UNIOESTE - Foz do Iguaçu Campus

Adequacy of the Food Complex of the Goiás Engineering Club to Cleaner Production

The Trash Becomes Profit for Brazilian Grocery Retail

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## **Reuse of Management and Recycling Construction Materials: Identification of the Main Waste and Legal Interpretation of the Standarts of Reuse and Recycling**

MATUCK, C. A.P., ADAMI, F. A. C., CAMARGO, M., SANTOS, M. G. F.,  
GIORDANO, F.

*Universidade Santa Cecília, Santos, São Paulo.*

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### **Abstract**

The present work seeks, under the light of the National Solid Waste Policy, Resolutions of CONAMA and Sparse Legislation, to identify the main waste produced by the Brazilian Civil Construction Industry and its harmful action. The study aims to evaluate, in a general way, the need of saving raw materials to avoid waste disposal. A legal interpretation is made of the applicability of the general rules on classification of waste, its management, reuse, recycling, transportation, packaging and final destination.

**Keywords:** *Environmental Management of Civil Construction Waste, Environmental Impacts of Civil Construction, Construction Pollution, Materials Saving in Civil Construction, Recycling of Construction Materials, Reuse of Civil Construction Materials;*

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## **The Artisan Recycling on UNIOESTE – Foz do Iguaçu Campus**

GARCIA, F. S. <sup>a\*</sup>, MARTINES, A. I. T. <sup>b</sup>,

*a. Universidade Estadual do Oeste do Paraná - UNIOESTE*

*b. Universidade Estadual do Oeste do Paraná - UNIOESTE*

*\*seupapelnasociedade@gmail.com*

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### **Abstract**

Considering the laws and regulations of Paraná State, the University of the West of Paraná – UNIOESTE can't stop producing printed documents, which brings a big volume of paper that is discarded. To attend the dispositions of the Law nº12.305/2010 the project "Your Role in Society" was created, within it the paper discarded on the administration sectors is collected, separated and artisan recycled. That new paper returns to the administrations sectors in a new shape of institutional interesting products. The actions accomplished by the project encompass the offer of recycling workshops, where it is possible to replicate the artisan recycling technique, several times doing a social work, considering the attendance of demands of public schools. Besides that, the team counts with an assistant professor, specialized in Chemical Engineering, that analyses the effluents beget by the artisan production, suggesting methods and processes that make possible to minimize even more the aggressions to the environment.

**Keywords:** *environment management, social and environment responsibility, paper artisan recycling.*

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## **Adequacy of the Food Complex of the Goiás Engineering Club to Cleaner Production**

MELVIN, I. B. <sup>a</sup>, MARENGÃO, M. <sup>a</sup>, AVELAR, G. <sup>a</sup>, PASQUALETTO, A. <sup>a</sup>, MURO JR., A. <sup>a\*</sup>

*a. Instituto Federal de Educação, Ciência e Tecnologia de Goiás - IFG, Goiânia*

*\*Prof. Dr. Aldo Muro Jr., murojr@gmail.com*

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### **Abstract**

Operating with the technologies of Cleaner Production, it has been undertaken an analysis of the production processes of the food complex of the Engineering Club of Goiás (CENG), located in Goiânia, Brazil, in order to indicate the parts of the productive sector that potentially cause environmental and economic impacts. It was adopted a quantification methodology for the food residues generated by the kitchen in a midweek day and a weekend, from preparation and consumption of meals and use of disposable cups and charcoal. After the analysis, alternatives were proposed to optimize the processes, minimizing the problems found, so as to combine economic advantages with ecological advantages, suggesting practices of Cleaner Production associated with Environmental Education. The results showed the need for the adequation of the club's food complex and implantation of Cleaner Production, once it has as its principles the application of Environmental Education, Environmental Management and Sustainable Development. With the demonstration of the viability of projects like this, many productive sectors that do not deal with sustainability for considering it inapplicable will recognize the importance of applying the concept in their services, in addition to using the necessary techniques and tools to adapt themselves into Cleaner Production. By this means, measures are implemented in order to improve the food processing in a sustainable manner and to raise awareness among the community and the employees involved. Furthermore, it is concluded that the productive activity in restaurants, kitchens and cafeterias has potential to implement sustainable practices, using the Cleaner Production program.

**Keywords:** *Cleaner Production; Sustainability; Restaurants; Kitchen; Food Residues.*

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## **The Trash Becomes Profit for Brazilian Grocery Retail**

BRAGA JUNIOR, S. S. <sup>a\*</sup>, DIAS, K. T. S. <sup>a</sup>, BRAGA, W. R. O. <sup>a</sup>, FORTI, J. C. <sup>a</sup>

*a. Universidade Estadual Paulista "Júlio de Mesquita Filho", FCE/Tupã*

*\*Corresponding author, sergio@tupa.unesp.br*

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### **Abstract**

The aim of this work was to analyze the reverse logistics implemented in 22 grocery retails located in São Paulo state (Brazil) and to quantify the profit obtained with this implementation. For this, during 24 months the quantities of cardboard and plastic discarded by these grocery retails were monitored. As a result, it was possible to observe that the supermarket corporation increased its net profit with the practice of reverse logistics in value proportional to the net profit generated by two supermarkets with revenue of 600 thousand dollars. It was concluded that the implementation of reverse logistics was satisfactory, as well as generating environmental benefits resulting from waste reduction, also contributed to the generation of direct and indirect jobs generated by business growth.

**Keywords:** *Reverse Logistics; Grocery Retail; Supermarket; Sustainability; Waste Management.*

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## **24<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 4B**

**Room 2**

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Consumers of Organic Products : Understanding their Behavior

Reflections on the Concept of Sustainability, its Adjectivies and Human Unity

What is Materiality in GRI G4? A Discussion and Agenda for Future Research

Social Innovation in the Productive Sector of the Brazilian Wine Chain - Co-Creation of Innovative Ideas in Processes, Products and Services in Multidisciplinary Environments

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## **Consumers of Organic Products: Understanding their Behavior**

FREITAS, T. M. <sup>a,c\*</sup>, TRIERWEILLER, A. C. <sup>a</sup>

*a. Universidade Federal de Santa de Catarina, Brasil*

*\*Corresponding author, tatianamarcelino23@hotmail.com*

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### **Abstract**

The market for organic products is growing, it is necessary to deepen the studies on the behavior of the consumers, their real motivations of purchase as well as, the difficulties and limitations in the structures of production, supply and commercialization. The objective of this article was to perform an analysis of the literature on organic products and related topics, to elaborate a previous version of the research questionnaire that will applied, in a future survey, with current and potential consumers of organic products, their consumption motivations. This is a stage of the Work of Completion of Course of the main author of the article, which also intends to use social networks to promote organic products. Finally, we believe that this article contributed to new proposals with the organic food sector and, furthermore, we can do a broader reflection on the need for new consumption patterns.

**Keywords:** *Organic products; Consumer behavior; Social networks.*

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## **Reflections on the Concept of Sustainability, its Adjectives and Human Unity Idea**

COSTA, H.K.M.<sup>a\*</sup>; WEBER, N.A.B.<sup>a</sup>; MOUTINHO DOS SANTOS, E.<sup>a</sup>

*a. Instituto de Energia e Ambiente, Universidade de São Paulo  
\*Hirdan Katarina de Medeiros Costa, hirdankatarina@gmail.com*

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### **Abstract**

Using of the term sustainability appears in our times as one of the words most in vogue in society. The term appears in various branches of society and spreads itself by various social, political and economic sectors. It can also find a clear correlation between sustainability and practices that protect the environment. Also, there is the correlation between sustainability and the discussion of the improvement of human and social relations, with a focus on reducing poverty and marginalization. The term also has ample space in the theoretical constructions of the natural sciences. Ultimately, what is sustainability? In order to contribute to the elucidation of this issue, this paper, through the descriptive, historical and normative methods, seeks to understand epistemologically the term sustainability. Then, it finds out the evolution of the adjectives over time, as well as its content in the context of the physical limitations of the earth. Finally, the paper makes up a reflection on human integrity and sustainability.

**Keywords:** *Epistemology of Sustainability; adjectives of Sustainability; Human Uniqueness.*

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## What is Materiality in GRI G4? A Discussion and Agenda for Future Research

CARPEJANI, P.<sup>a\*</sup>, PINHEIRO DE LIMA, E.<sup>ab</sup>,  
MACHADO, C. G.<sup>a</sup>

*a. Department of Industrial and Systems Engineering –  
Pontifical Catholic University of Parana (PUCPR), Curitiba,  
PR, Brazil*

*b. Department of Industrial and Systems Engineering –  
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Branco, PR, Brazil*

*\*pablo.carpejani@pucpr.edu.br*

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### Abstract

Many researchers and professionals in the sustainability area do not know or do not have a clear definition of materiality. This subject has gained international recognition by being the key element of sustainability performance measurement. As of 2013, Global Reporting Initiative used the G4 Guidelines and made it easier for the companies to disclose their sustainability performance through materiality, setting priorities between the pillars of sustainable and the needs of their stakeholders. This study aims to explore the definitions of materiality among the G4 Guidelines, creating, at the same time, the future research agenda. It was used an integrative literature review methodology. The procedure allows to respond to the research problem, since the approach supports a organized, systematic and broad analysis of the information found. The method provides understanding of materiality based on previous studies. The results show that, although materiality has been emphasized in 2013, there is still no vast literature on the subject. Moreover, subjectivity is inherent to the topic. There is a lack of clear instructions related to the application and mathematical support regarding the use of the factors. The article contributes to science, uncovering the real meaning of materiality and pointing out research gaps. The findings suggest an extensive field for future academic research, since the knowledge about the concept's operationalization it's built on the practice, especially in business environment.

**Keywords:** *Materiality, Global Reporting Initiative (GRI), Indicators, Sustainability*

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## **Social Innovation in the Productive Sector of the Brazilian Wine Chain - Co-Creation of Innovative Ideas in Processes, Products and Services in Multidisciplinary Environments**

MENEGOTTO, M. L. A.<sup>a</sup>; CAMARGO, M. E.<sup>a</sup>; PEREIRA, M. E.<sup>b</sup>; FERNANDES, A. J.<sup>b</sup>

*a. Universidade Caxias do Sul, Rio Grande do Sul*

*b. Universidade de Aveiro, Portugal  
margamenegotto@hotmail.com*

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### **Abstract**

This article aims to identifying the process of social innovation of the Brazilian wine chain based on the analysis of document characteristics and interviews conducted during the last two decades. The work was characterized as exploratory and descriptive, and seeks to deepen the analysis of the work involving the theme of social innovation, social responsibility and corporate social responsibility of its actors and processes in the Brazilian wine chain. As main results of the study it can be evidenced that the wine chain makes social innovations focused on the well being of the actors of the links as well as the sustainability of the sector are focused. The data gathered presuppose that the planning of the sector planning returns with sustainability responsibility in function of the actors of the links of possessing a strong one of which there is an additional to in developing the configurational theory of social innovation that helps to classify companies in terms of their strategies, relationships and the organization's performances within the links of the productive chain with Formation of a metric for the evaluation of sustainability indicators for the productive sectors, involving the main production chain and the auxiliary.

**Keywords:** *Social Innovation. Social Responsibility. Brazilian Wine Chain.*

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## 24<sup>th</sup> May 2017

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**15h00-16h30**

**Session 4B**

**Room 3**

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Energy Efficiency Assessment of the Brazilian Pre-Salt Petroleum

Efficiency and Allocation of Emission Allowances over more Sustainable European Countries

Analyzing the CDM Impact in the Brazilian Chemical Sector

Cities Characteristics Impact in GHG Emissions

Evaluation of the Physical and Virtual Water Transfers for Beijing City in China

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## Energy Efficiency Assessment of the Brazilian Pre-salt Petroleum

CLASEN, A. P. <sup>a,b</sup>, AGOSTINHO, F. <sup>a\*</sup>

*a. Universidade Paulista, São Paulo, Programa de Pós-graduação em Engenharia de Produção, Laboratório de Produção e Meio Ambiente*

*b. Universidade Paulista, Santos, Graduação em Engenharia Civil*

*\*Corresponding author, feni@unip.br, feniagostinho@gmail.com*

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### Abstract

The recent discoveries of petroleum storages located at Brazilian coast could push Brazil as an important player in the world energy sector. A large volume offshore petroleum reservoir was found close to Espírito Santo, Rio de Janeiro and São Paulo States; this reservoir is located in deep seawater (8km) after the pre-salt layer. Among others, due to all technological, economic, energetic, environmental and political issues regarding the extraction of this pre-salt petroleum creates challenges at the same time put uncertainties on the potential benefits obtained after its extraction. Focusing on energy issues, the large demand of materials and energy needed to extract the pre-salt petroleum raises doubts about its real energy benefit provided to society. This work assess the energy efficiency of petroleum extracted from the Brazilian pre-salt layer. Results shown an Energy Return on Investment (EROI) of 17.5; this indicates that for 1 Joule of fossil fuel invested on the pre-salt petroleum extraction would provide an average of 17.5 Joules of fossil fuel. This number points out a positive performance for the Brazilian pre-salt petroleum, which is similar to other systems as found in scientific literature; for instance, oil and gas production in China and Canada in 2010 with an EROI of 10 and 15 respectively, and a value from 0.8 to 10 to the ethanol from sugarcane.

**Keywords:** *Embodied energy; EROI; Petroleum; Pre-salt layer.*

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## **Efficiency and Allocation of Emission Allowances over more Sustainable European Countries**

CUCCHIELLA, F.<sup>a</sup>, D'ADAMO, I.<sup>a</sup>, GASTALDI, M.<sup>a\*</sup>, MILIACCA, M.<sup>b</sup>

*a. Department of Industrial and Information Engineering and Economics, University of L'Aquila, via Giovanni Gronchi 18, 67100 L'Aquila, Italy*

*b. Department of Enterprise Engineering, University of Rome "Tor Vergata", Via del Politecnico 1, 00133 Rome, Italy*

*\*Corresponding author, massimo.gastaldi@univaq.it*

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### **Abstract**

Uncontrolled CO<sub>2</sub> emissions and excessive energy dependence strongly contribute to climate change preventing economic and sustainable development. The European mitigation program is very ambitious: new objectives up to 2030 provide for a 40% reduction of GHG emissions and an increase of 27% for renewables and energy efficiency. Competitiveness would save on imports of oil and gas, to increase the gross domestic product and create new jobs in the renewable energy and energy efficiency. This study uses GHG emissions, total energy consumption and renewable energy consumption as input variables for the evaluation and the analysis of the economic and social sustainability performance of Countries belonging to the European Economic Area. Data Envelopment Analysis (DEA) model allows the identification of the less competitive areas in terms of sustainable growth and the Zero Sum Gains Data Envelopment Analysis model is used to determine how they should vary the inputs so that the economic system reaches efficiency.

**Keywords:** *Sustainable Development, Greenhouse Gas Emissions, Energy Management, Renewable Energy, ZSG DEA.*

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## Analyzing the CDM Impact in the Brazilian Chemical Sector

FREITAS, C. V. M.<sup>a,c\*</sup>, SILVA, M. L. P. S.<sup>a,b</sup>

*a. Programa de Pós-graduação, Centro Paula Souza, São Paulo, SP, Brasil*

*b. Escola Politécnica, Universidade de São Paulo, São Paulo, SP, Brasil*

*c. Clavi Soluções Sustentáveis., São Paulo, SP, Brasil*

*\*Corresponding author, [freitasclaudia0@gmail.com](mailto:freitasclaudia0@gmail.com)*

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### Abstract

This work aimed to obtain a better understanding of the impact of the use of the Clean Development Mechanism (CDM) in the Brazilian chemical industry. The CDM was a very important mechanism in the last two or three decades for the reduction of some greenhouse gases (GHG) with high environmental impact and global warming potential, such as nitrous oxide (N<sub>2</sub>O), with a potential of 310. In addition, the chemical sector has acted boldly to meet ambitious targets as set out in the UN Climate Convention. However, with the new standards and / or mechanisms created under the Paris Agreement, the options for maintaining such a reduction are rare, making it crucial to understand the importance of the CDM for the sector. The methodology used was documentary evaluation of the main CDM projects developed in the country and, in a second step, attention to the processes involving the removal of N<sub>2</sub>O. It was possible to observe three distinct moments in the process, the promising beginning that, in addition to causing a significant reduction in GHG emissions, corresponds to the good valuation of carbon credits, but with the new governmental positions and also increasingly restrictive rules, such credits devalued. With the implementation of the reduction targets, the Kyoto Protocol and its CDM can once again be a negotiation tool for the carbon market aligned with the new mechanisms now proposed that, if they use previous learning, can favor the country in meeting its own goals reduction.

**Keywords:** CDM, Chemical Sector, N<sub>2</sub>O

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## Cities Characteristics Impact in GHG Emissions

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### Abstract

Despite technology progress, world per capita energy demand is increasing. Relying mostly on fossil fuel sources, energy production and consumption causes environmental impacts and contributes to climate change. Almost 75% of the world's energy is consumed in the urban environment. Therefore, understanding the dynamics of energy consumption in cities enables effective mitigation actions. Based on an adapted STIRPAT model, this work analyzes the relationships between characteristics of ten Brazilian cities with CO<sub>2</sub> emissions related to direct energy consumption. Model's results indicate that population is the most important driver for emissions (elasticity, coefficient 0.996), followed by residential emissions (0.846), and direct energy consumption (0.481). It is verified that population affluence (0.161) and electricity generation emission factors (0.017) also contribute positively to increasing emissions. Amongst the modeled variables, just technological advance (-0.216) and increasing of the attractions points density (-0.018) contribute to CO<sub>2</sub> emissions reduction. It is concluded that public policies, such as energy security, the use of renewable sources and the encouragement for decentralization, such as increasing attractions points, are alternatives to CO<sub>2</sub> emissions reduction.

**Keywords:** *cities, emissions, energy, planning, modeling*

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## Evaluation of the Physical and Virtual Water Transfers for Beijing City in China

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### Abstract

Freshwater resources are unevenly and geographically distributed in China. In Beijing city, located in the North China Plain with per capita water availability under 150m<sup>3</sup>/y, the Water Stress Index (WSI) has been over 100% under extreme water stresses. Water supply gap threatens to sink Beijing's ambitious develop goal as one of the center of political, economic and cultural in the world. Therefore, China has started to construct the world's largest physical water transfer project — the South-North Water Transfer Project (SNWTP) since 2010. Of which, 13 Gm<sup>3</sup> water is transferred from the Yangtze River Basin to Huang-Huai-Hai River Basin annually through the Middle Route project to Beijing and Tianjin in the Northern. Besides physical water transfer project, virtual water strategy is another solution to remedy regional water scarcity. Virtual water defined as the water required for the production of goods and services along their supply chains, is transferred along the domestic and international economic trade. Based on virtual water transfer, water scarce region, such as Beijing, imports water-intensive products instead of producing them locally in order to save local water resources. In this paper, a model linking the interregional trade data in China and in the world was built and applied to account the virtual water flow throughout the entire supply chain from the domestic provinces to the world. Based on this, we accounted the physical and virtual water transfer for the social economic system in Beijing city and evaluated the impact on the regional water stress in China.

**Keywords:** Water transfer; virtual water; Beijing city; multiregional input-output analysis

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## **24<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 4B**

**Room 4**

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Environment Sustainability of a University Institution by Calculating the Ecological Footprint

Evaluation of Sustainability in Service Operations in Seven Higher Education Institutions in Brazil

Difficulties and Barriers Observed in Cleaner Production Implementation: Literature Review

Bibliometrics Analysis in the SJCP's Coming from IWACP: Ten Years Working Together for a Sustainable Future

Hospital Environmental Performance Measurement: A Bibliometric Review of Literature (1987-2017)

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## Environmental Sustainability of a University Institution by Calculating the Ecological Footprint

SOARES, D. F. <sup>a\*</sup>, LIED, E. B. <sup>a</sup>, MAGALHÃES, A. P. <sup>b</sup>, TREVISAN, A. P. <sup>c</sup>, MOREJON, C. F. M. <sup>d</sup>, ARCEGO, C. V. <sup>d</sup>, SANTOS JUNIOR, E. L. <sup>a</sup>

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### Abstract

The methodology of Ecological Footprint (EF) is to calculate the size of bioproductive area needed to produce resources and assimilate the emissions of carbon dioxide (CO<sub>2</sub>) produced by population. In this context, it sought to quantify the average consumption of the main resources used every day in Federal Technological University of Paraná, Campus Medianeira (UTFPR-MD) during the year 2015. The results indicate a total Ecological Footprint of 177.41 hectares, equivalent to an area about 15 times larger than the campus. It was found that the consumption of food and infrastructure and buildings, together account for 84% of CO<sub>2</sub> emissions and EF composition. The electricity consumption resulted in an area twice the area of the campus. While the consumption of paper, mobility and transportation, those are with less impact, less than 4% of the total. The per capita contribution of EF at campus corresponds to 0.0753 ha/person/year, this score is near to EF national score which is 0.0725 ha/person/year.

**Keywords:** *Sustainability indicators. Universities. Environmental Impacts.*

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## **Evaluation of Sustainability in Service Operations in Seven Higher Education Institutions in Brazil**

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### **Abstract**

The objective of this research is to identify good sustainability practices in service operations in seven higher education institutions, through an evaluation model in the service operations of higher education institutions. The model consists of a structure composed of five axes: 1) Governance / Policies, (2) People, (3) Food, (4) Energy / Water, (5) Waste / Environment and 134 criteria. To do so, a field study was conducted in Brazil by the first author of this article to obtain in-depth data on sustainability in the higher education institutions analyzed. In addition to direct observations and document collection, interviews were also conducted with teachers / academics, students, and staff. It was verified that the absence of government incentives for sustainability in the HEI is a point present in five of the seven HEI surveys. Another crucial point is the difficulty in associating the curriculum with service operations, as the managers are unable to associate these two areas, which prevents or delays studies on sustainability in service operations.

**Keywords:** *sustainability, evaluation, higher education institutions, operations, services.*

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## **Difficulties and Barriers Observed in Cleaner Production Implementation: Literature Review**

MATOS, L. M <sup>a\*</sup>. ANHOLON, R. <sup>a</sup> SILVA, D. <sup>a</sup> QUELHAS, O.L.G. <sup>b</sup>

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### **Abstract**

This article has been written with the goal of contributing to the body of knowledge of Industrial Sustainability and, more specifically, initiatives utilizing the Cleaner Production methodology. As it is increasingly known in the academic and business community, industrial sustainability has nowadays become a matter of utmost importance. Therefore, the impetus to provide solutions and increase the knowledge basis of the different methodologies that aim to add up to this broader goal is highly relevant nowadays. The Cleaner Production approach is a preventive environmental *eco-efficiency* strategy that has been showing positive results since its debut in 1989. Since then, its goals have been broadened from the strictly operational dimension it had in its origins to a larger scope that seeks to embrace the goals of sustainability and, considering the triple bottom line strategy – economic, social and environmental goals – contribute to a more sustainable society. However, despite its dissemination, Cleaner Production methodology is not a unanimous consideration when companies' strategies are formulated and there are factors that hinder its adoption. Aiming to address this issue, this article utilized the method of bibliographic survey to seek, in the recent literature, which ones were the main barriers and difficulties found at different levels in promoting and implementing Cleaner Production. A total of 111 articles about the theme and from well-known scientific publishers have been thoroughly reviewed and sorted by its relevance to the authors goal. After the broader review, 38 articles were chosen to comprise a table presenting the main categories of specific barriers and difficulties mentioned and how many and which authors brought up each category. The results and categories have then been discussed and a conclusion drawn. Observing the results, it is possible to state that there is still a significant number of factors hindering the adoption of Cleaner Production. Those refer to a myriad of internal and external factors such as the participation of social actors that include governments, labor force, financial institutions and also internal organizational and also businesses operational questions in knowledge management, funding, follow-up issues and lack of properly qualified labor force, among others.

**Keywords:** *Cleaner Production, barriers and difficulties, literature review, sustainability.*

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## **Bibliometrics Analysis in the *SJCP's* Coming from *IWACP*: Ten Years Working Together for a Sustainable Future**

OLIVEIRA NETO, G. C.<sup>a</sup>, PINTO, F. R.<sup>a</sup>, COSTA, I. S.<sup>a</sup>,

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### **Abstract**

The aim this research was assessment the papers published in the five Special Journal of Cleaner Production resultings of discussions and publishers in the International Workshop Advances in Cleaner Production to present drivers to future researchs. In data analysis was investigated the research methods utilized, researched countries, ecoeficiency tolls adopted and mainly the approaches of research in terms environmental, economics and social. The method adopted was bibliometric and content revision in 167 paper with data analysis through descriptive statistics and analysis of social networks with the use of UCINET-Draw. We conclude some opportunities for future research: (i) development of more research using the research-action methodology for the development of conceptual models and implementation in organizational practice; (Ii) although good foreign relations in SJCP publications from the IWACP could present cases that show comparisons among countries with Brazil to show means of technology transfer to improve the environmental management of Brazilian companies; (Iiii) the opportunity to conduct research on industrial ecology and exergy; And (iv) future research focusing on the relationship between the three variables (environmental, economic and social), contributing to sustainability. O método adotado foi revisão bibliométrica e de conteúdo em 167 artigos com análise de dados por meio de estatística descritiva e análise de redes sociais com o uso do *UCINET-Draw*.

**Keywords:** *Bibliometrics analysis, International Workshop Advances in Cleaner Production.*

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## **Hospital Environmental Performance Measurement: A Bibliometric Review of Literature (1987-2017)**

PASQUALINI BLASS, A. <sup>a,c\*</sup>, GOUVEA DA COSTA, S. E. <sup>a,b</sup>, BORGES, L. A. <sup>c</sup>

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*\*Corresponding author, apasqualini@unidavi.edu.br*

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### **Abstract**

New environmental regulations and ongoing pressures on cutting costs and improving quality have forced hospitals to improve the performance of their operations, especially in developing countries. Healthcare deals with a significant amount of hazardous and non-hazardous materials and produce polluting outputs. Frameworks that directly address the measurement of environmental performance are regarded as paramount. The present study represents a bibliometric review of the literature on the topic 'hospital environmental performance measurement' during the period 1987-2017, i.e, since the publication of the Brundtland Report. A set of 10 papers was regarded as relevant to the study. A certain prevalence of studies placed in high-income countries was found, but a growing focus on the specific context of developing countries was also identified. The content analysis revealed that the proposal and testing of frameworks for the measurement of environmental performance in hospitals are still needed.

**Keywords:** *Environmental performance. Measurement. Hospitals. Bibliometric review.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **24<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 4B**

**Room 5**

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Development of a Tool to Enhance the Monitoring of Licensed Industrial Activities and Promote Continuous Improvement

Barriers to Implementation of the Waste Management Plan: A Case Study

Analysis of the Technological Impact for Industry and its Effects on the Production and Destination of its Waste: A Case Study of the Industry of Surfboards

Criteria for Performance Evaluation in Municipal Solid Waste Management

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## Development of a Tool to Enhance the Monitoring of Licensed Industrial Activities and Promote Continuous Improvement

RODRIGUES, V. I. <sup>a,b\*</sup>, TUBINO, R. M. <sup>a</sup>, MALFATTI, C. F. <sup>a</sup>, BERWANGER, J. A. <sup>a,b</sup>

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### Abstract

Environmental licensing in Brazil and Rio Grande do Sul is an instrument used to command and control, which requires compliance with legal requirements and environmental standards, but does not encourage continuous improvement. This approach is carried out at all stages of the licensing process, and because it is focused on controlling environmental aspects, and not minimizing or reducing them, it encourages the use of end-of-pipe technologies and not the search for cleaner technologies. Instrument of command and control, it is important in the beginning of the implementation of the environmental management, but it can not remain for long, as it does not generate evolution, paralyzes environmental development, and generates a dependence on state oversight to maintain the system. This work aims to propose a methodology for the use of a licensing and monitoring policy for industrial activities in the state of Rio Grande do Sul, based not only on an instrument of command and control, but also on an economic instrument. Therefore, it is proposed to develop a matrix to determine the environmental performance of companies. As requirements of this matrix will be placed, the mandatory compliance (laws and conditions and restriction of the environmental permission), the environmental management and the ones that indicate continuous improvement. The input data from this matrix will cover the period from 2013 to 2016. The sum of the requirements in this matrix will result in a percentage from 0 to 100%, where the closer to 100%, the better will be the performance. The objectives and goals of each indicator were initially established, assessing compliance with legislation and improving its best outcome. In this first moment the calculation of the index will be evaluating the best performance of the enterprise itself and with the evolution of the tool the objective is to make comparisons with the results of the same branch and finally the best practices performed in the world. The performance evaluation could be used by the Environmental Agency as an indicator for which projects to supervise, but also, by the Secretary of the Environment, as a tool to begin to change the environmental management policies, working with environmental incentives for those companies with the best performance. Initially, the matrix was applied to companies in the metal mechanic sector, from the activity of surface treatment activity with painting and without casting, of the city of Caxias do Sul. This will be the pilot group, but the matrix will be elaborated so that it can be used by all branches of industry activity. The results obtained with the matrix, demonstrate exactly what the theory describes, in an environment where the control imposed to the entrepreneur is by the attendance of a legislative standard and not the demonstration of continuous improvement, there is no evolution of the environmental performance over the 3-year period of the companies. Therefore, the inclusion of a tool to evaluate environmental performance is a necessary instrument for the country's environmental evolution.

**Keywords:** *Environmental permition, Instrument of command and control, environmental performance, continuous improvement*

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## **Barriers to Implementation of the Waste Management Plan: A Case Study**

ARRAGE, H. A.<sup>a</sup>, AL KHATIB, M. M.<sup>a</sup>, ANTONIASSI, B. A.<sup>a</sup>, PINTO, E. M.<sup>a</sup>  
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### **Abstract**

This paper presents the results from an evaluation of barriers encountered in the initial phase of implementation of an Integrated Solid Waste Management Plan carried out in a medium-sized commercial enterprise. The Shopping Center are currently passing for a process of implementing the Integrated waste management plan and, already at this stage, organizational, cultural, attitudinal, technical and economic obstacles have been detected, thus are being treated as challenge by its administration. So that, the integrated waste management plan is conducted in order to attend the Planning and Current laws. This evaluation, which consists of a diagnosis of the real situations involving employees, clients and management groups, has been followed throughout the entire process and will serve as a basis for the formulation of corrective strategies during the implementation of the integrated waste management plan. This seeks to comply with the legislation recommended in the National Solid Waste Policy through a correct classification, destination and or treatment of the main waste generated, as well as, the targets for reduction and better alternatives for the environmental sustainability. The results demonstrate barriers especially in the organizational, systemic, economic, technical and attitudinal order, with emphasis on the previous lack of knowledge of employees and entrepreneurs, regarding compliance requirements of Brazilian Law 12305/2010. The results obtained support a parallel work that has just begun and that promotes environmental education and actions, with the aim to integrate the society in the process of reduction, reuse and recycling of waste.

**Keywords:** *Barrier, Waste Management, Integrated Solid Waste Management Plan, National Solid Waste Policy, Urban Solid*

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## **Analysis of the Technological Impact for Industry and its Effects on the Production and Destination of Its Waste: A Case Study of the Industry of Surfboards**

BARCELOS, R. L.<sup>a</sup>, MAGNAGO, R. F.<sup>b\*</sup>, LERIPIO, A. A.<sup>c</sup>

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### **Abstract**

The concept of Cleaner Production advocates the continuous application of preventive and integrated environmental strategies to processes, products and services, incorporating the most efficient use of natural resources and minimizing the generation of waste and pollution, as well as the risks To human health. But not always technological innovations in production bring with it an improvement for Cleaner Production. The surfboard industry has been dismissive of P & L. Works pointed to a concentration of the residues of the productive process in the manufacturers due to the verticalization of the production stages. But from the incorporation of the technology of machining of the blocks of polyurethane through Computerized Numerical Control (CNC) there was a horizontalization of the process. The introduction of the technology provoked the emergence of companies that started to incorporate the productive sector. From this structural change of the industry came the questioning of which actors produce waste and how they manage it. The objective of this work was to map the current process, identifying the residues in the actors inserted in the productive chain detailing how these wastes are managed. A case study was carried out where the object analysis was carried out through the application of a field study where a mapping addressed the qualitative and quantitative issues of the production of surfboards. The data collection was done through a visit to the pre-selected targets through the application of Cleaner Production forms. Throughout the research it was evident that the links of the production chain can be executed by different actors participating in the industry, with a decoupling of the links from the manufacturers, mainly related to the volume of production. That is, the largest concentration of outsourcing of steps occurs in the smaller manufacturers with a shift in the volume of materials and waste for large distributors, large manufacturers and rolling mills. It was clear that the introduction of CNC technology was responsible for the decentralization of waste, previously focused only on manufacturers, but that technological innovation had no impact on waste reduction or reuse, or even better disposal management.

**Keywords:** *Cleaner Production. Technological Impact. Waste Management. Surfboard industry.*

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## **Criteria for Performance Evaluation in Municipal Solid Waste Management**

FERNANDES, M. L. <sup>a</sup>, \*, RODRIGUES, A. P. <sup>a</sup>, SOARES, A.C.<sup>c</sup>, GOUVEA DA COSTA, S. <sup>a,b</sup>, BORTOLUZZI, S.C.<sup>a</sup>, PINHEIRO DE LIMA, E. <sup>a,b</sup>

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### **Abstract**

The sustainability issue and sustainable development are terms of relevance in recent years, particularly associated with debates of corporate social and environmental responsibility. In this sense, the instruments of evaluation of environmental performance have the function of reflecting the management strategies integrating with the sustainability actions. Based on this context, the present work has the objective of evaluating the performance of sustainable operations in the management of solid waste in a city in the southwest of Paraná. For this, the particularities of the context are taken into account, identifying the indicators that meet the dimensions of social, economic and environmental concern. For the development of the model an adaptation of the Multicriteria Methodology for Decision Aid – Constructivist - MCDA-C was made, allowing the comparison of the proposed objectives with the indicators obtained from the literature and specialists in the area. From the conception of the model, it was diagnosed that the sustainability that involves the solid waste management operations of the city obtained a score of 30 points, presenting a market-level performance, with a great potential of upgrading to be implemented through improvement actions.

**Keywords:** *Performance evaluation, Waste management, Multicriteria decision support, Sustainable operations*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **24<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 4B**

**Room 6**

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Proposing Robustness Index for Emergy Accounting

Hybrid Fuzzy C-Means Model for Solar Energy Facilities Clustering on American Contaminated Sites

Investigating the Environmental Damage: A Detailed Study about the Main Reference Methods for Economic and Social Aspects Integration

Strategic-Eco-Efficiency Determinants of Chinese Companies in Brazil

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## **Proposing Robustness Index for Emergy Accounting**

BUENO, M. F. F. <sup>a,b \*</sup>

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*b. Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais, Minas Gerais*

*\*Maria de Fátima de Freitas Bueno,  
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### **Abstract**

The robustness of a scientific method must be investigated with the aim of identifying the main variables or factors that influence its results or answers. A method is considered robust if insensitive to deviations of the suppositions it bases itself upon. This study proposes an equation capable of assessing the robustness of emergy accounting, with the aim of establishing parameters and identifying factors that can affect results obtained when using the method. Emergy environmental accounting is used to assess the use of resources in the production of a product or service. It is an innovative method, however, it still lacks standardization of evaluation procedures. An equation to identify the robustness of a group of systems and the emergy ternary diagram to present the results were used in this study. Results obtained from applying the equation to a group of systems were compatible with their dispersion in the emergy ternary diagram. The area defined on the diagram can indicate the probable interval in which future studies will have their results inserted. That is due to the fact that the inflows necessary for the production of a product or service direct a given system and are, basically, the same for similar systems.

**Keywords:** *emergy, ternary diagram, robustness, robustness index*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Hybrid fuzzy C-Means Model for Solar Energy Facilities Clustering on American Contaminated Sites

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### Abstract

The present article used a hybrid fuzzy c-means model to cluster and define suitable locations, in terms of mapped area, distance to transmission lines and daily solar incidence, for solar energy capture facilities in the continental United States. The data used came from the National Solar Radiation Database (NSRDB), a collection of hourly measurements of solar radiation and meteorological data, and the RE-Powering America's Land project of the United States Environmental Protection Agency (EPA), whose purpose is to identify abandoned and contaminated areas that are ideal for renewable energy projects. Initially, data preprocessing was performed for substitution of missing data, normalization and principal component analysis (PCA). Then, the proposed hybrid clustering algorithm was applied. It is a fuzzy c-means model initialized by metaheuristics, namely genetic algorithm (GA), differential evolution (DE) and particle swarm optimization (PSO). The number of clusters was validated by three metrics: Calinski-Harabasz Index, Davies-Bouldin Index and Silhouette Coefficient. The three tests were unanimous, indicating two clusters as the ideal number, that is, a cluster for locations with potential for allocation of solar energy capture facilities and another for sites with no potential. As a result of the proposed hybrid approach, there was an increase in the training speed of the fuzzy c-means algorithm, which required a smaller number of iterations to reach the same objective function value. Visually, we can see the predominance of the allocation of the facilities in states with a higher average incidence of solar radiation, which is therefore the predominant factor in the convergence of the algorithm, which is in line with what was expected. Finally, the environmental-economic-social gains are considered with the revitalization of unproductive and contaminated land for the implantation of solar plants.

**Keywords:** *Clustering; Fuzzy c-means; Metaheuristics; Solar energy; Soil reuse.*

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## **Investigating the Environmental Damage: A Detailed Study about the Main Reference Methods for Economic and Social Aspects Integration**

LUCCHETTI, M.C. <sup>a\*</sup>, ARCESE G. <sup>b</sup>, MAIORINO L. <sup>c</sup>, MERLI R. <sup>a</sup>, PREZIOSI M. <sup>a</sup>

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*c. ISPRA - Italian National Institute for Environmental Protection and Research, Italy*

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### **Abstract**

In 2013, ISPRA (Italian National Institute for Environmental Protection and Research) and the Department of Business Studies of Roma Tre University signed a cooperative framework agreement to launch a joint research project for the development and the implementation of methodologies and tools able to accurately quantifying and assessing Environmental Damage, also considering the Life Cycle Assessment (LCA) approach and its application in the field (M.I.D.A. Research Program, Methodologies for environmental damage individuation). In this view, the scientific literature on the Life Cycle Impact Assessment (LCIA) has been reviewed, in order to find those LCIA methods that could be suited to accomplish the goals of Environmental Damage Assessment. Recent developments are leading to advances in the practice of LCIA. Life Cycle Assessment (LCA) is definitely a useful tool in order to assess and quantify environmental impacts, but its appropriateness as a methodology to address the requirements of environmental damage remains uncertain. As a first step, we have defined the environmental damage and so fully understand its requirements. Then, we have tried to find how, under the light of recent developments, the LCA methodology could offer opportunities to match these specific requirements. After that, in the second phase we have considered different aspects for the assessment and quantification of environmental damage, including the risk assessment methods, and integrated it in a Corporate Social Responsibility (CSR) Strategy in a managerial perspective. This paper shown these actual results and the outlook of these research project goals.

**Keywords:** *Environmental Damage, Risk Assessment, Environmental damage indicators, WTP, DALY, Impact Pathway*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Strategic-Eco-Efficiency Determinants of Chinese Companies in Brazil**

MACLENNAN, M. L. F..<sup>a,c\*</sup>, OLIVA, F. L..<sup>a,b</sup>

a. *Centro Universitário FEI. São Bernardo do Campo*

b. *Universidade de São Paulo, FEA, São Paulo*

\*Corresponding author, [Ferranty@hotmail.com](mailto:Ferranty@hotmail.com)

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### **Abstract**

This research investigates the influence of the strategic tripod on eco-efficiency strategies undertaken by Chinese companies operating in Brazil. Concerns about environmental sustainability are recurrent both in academy and in business, especially because of the impact of Chinese productive export manufacturing activities on the environment. China is an emerging country with the highest economic growth rates in the world, but its image also reflects their vulnerability on ecological issues. To this end, environmental sustainability is operationalized into eco-efficiency, translated into eco-innovation, eco-reputation and green manufacturing; methodology was quantitative, with data collected and analyzed by structural equation model. Authors find a positive association between internal resources and eco-efficiency into its three developments (eco-innovation, eco-green reputation and green manufacturing). Industry-based view shows a positive association among green manufacturing and eco-reputation, but no with eco-innovation. Institutional aspects could not be associated with any of the eco-efficiency strategies. This research contributes to the understanding of strategic determinants on environmental initiatives and highlights the importance of resources for the implementation of green strategies abroad. Results do not confirm the impact of local institutions on strategy, which exposes the limited extent of this theory. It appears that Chinese eco-innovation is not influenced by institutional demands from local market.

**Keywords:** *eco-efficiency, emerging markets, strategic tripod*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

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## **24<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 4B**

**Room 7**

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Immobilization Study of Toxic Elements Present in Coal Ash through the Treatment with Immobilizing Agents

Evaluation of the Electrodialysis Process in the Treatment of Phosphate Containing Solution

Ceramic Incorporated with Ornamental Stones Waste Obtained from the Blocks Sawing Using Multiwire Technology: Environmental Characterization

Utilization of Kaolin Residue fir Plasma-Assisted lectrolytic Oxidation in Aluminum Alloy 5052

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## **Immobilization Study of Toxic Elements Present in Coal Ash Through the Treatment with Immobilizing Agents**

CAMPELLO, F. A.<sup>a\*</sup>, IZIDORO, J. C.<sup>a</sup>, GHILHEN, S.  
N.<sup>a</sup>, FUNGARO D. A.<sup>a</sup>

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### **Abstract**

The capacity to immobilize toxic elements present in coal ashes using organosilane (OS) and surfactant (SF) as immobilizing agents was determined by batch experiments. The coal ashes used in the study was collected at the Figueira Thermal Power Plant, located in the city of Figueira, State of Paraná. Firstly, the influence of ash mass/water volume ratio on the concentration of the elements in the leachates was evaluated. Subsequently, the capacities of immobilization of toxic elements using the different immobilizing agents, pH and conductivity of the leachates were determined. A significant reduction in the concentration of the elements was observed for all leachate samples obtained from the ashes treated with OS. Concentration reductions using OS were 89%, 77%, 42% and 11% for Cr, Mo, As and Se, respectively. When SF was used to the ashes treatment, the concentration reduction in the leachates was above 60% for all elements. These results show that both the organosilane and the surfactant can be used as immobilizing agents for the retention of toxic elements present in coal ashes.

**Keywords:** *coal ashes, metal immobilizing agents, organosilane, surfactant.*

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## Evaluation of the Electrodialysis Process in the Treatment of Phosphate Containing Solution

ROTTA, E. H. <sup>a</sup>, BITENCOURT, C. S. <sup>a</sup>, MARDER, L. <sup>a</sup>,  
BERNARDES, A. M. <sup>a</sup>

*a. LACOR, PPGE3M, Universidade Federal do Rio Grande do Sul, Rio Grande do Sul*

*\*Corresponding author, eh.rotta@gmail.com*

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### Abstract

Phosphorus (P) is inherent to all life forms. The increasing in crop production requires an increase in the use of P as fertilizer, usually produced from phosphate rocks, a non-renewable source that are being depleted. On the other side, high levels of P on surface water from wastewater and agricultural may lead to environmental problems, such as eutrophication. Therefore, the present work evaluated the technical feasibility of a 5-compartment electrodialysis (ED) cell in the treatment of phosphate containing solution, prepared using  $\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$  and  $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$  salts, aiming the recovery of P from municipal wastewater. Heterogeneous cation- (HDX100) and anion- (HDX200) ion-exchange membranes were used. Current-voltage curves (CVCs) showed that the current density to be used in electrodialysis tests was limited by the HDX200 anion-exchange membrane. The average percent extraction (pe%) of sodium was 92%, while for phosphate-containing species was 61%. The phosphate-containing species removal may be restricted by the formation of a non-chargeable specie,  $\text{H}_3\text{PO}_4$ , resulted from changes on the pH conditions in the diluted compartment.

**Keywords:** *phosphorus, sewage, membrane process, P-recovery.*

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## **Ceramic Incorporated with Ornamental Stones Waste Obtained from the Blocks Sawing Using Multiwire Technology: Environmental Characterization**

GADIOLI, M. C. B. <sup>a\*</sup>, PIZETA, P. P. <sup>a</sup>, AGUIAR, M. C. <sup>b</sup>

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*b. State University of the North Fluminense, Campos dos Goytacazes  
\*mborlini@cetem.gov.br*

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### **Abstract**

In 2016, the ornamental stones production in Brazil was of 9,300,000 tons. The ornamental stones wastes are a growing concern in the country, due to the amount of material generated and your destination. As there are a wide variety of rocks and different technologies there is the need for characterization of waste, especially the environmental characterization. In recent years there has been major change in the use of technologies for stone sawing, where almost 50% of the materials are sawn with the multiwire technology. The objective of the present work was to the environmental characterization of ceramics with ornamental stones waste from processing the blocks in multiwire. The waste was characterized before your incorporation in ceramics. Were used the waste and the clay in the proportion of 25 and 75%, respectively, for the preparation of the ceramic body. Specimens were fabricated by uniaxial press-molding at 20 MPa, dried and sintered at 1030°C. The following properties were determined: linear shrinkage, water absorption and flexural rupture strength. Were realized leaching and solution tests for characterization of ceramic residue. According to the parameters analyzed, the stones residue studied was classified as inert not and the ceramic material with 25% of waste as inert. This result shows that the use of waste in ceramic can be an alternative to the use of stones waste and consequently reducing the environmental impact.

**Keywords:** *waste, ceramic, environmental impact.*

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## Utilization of Kaolin Residue for Plasma-Assisted Electrolytic Oxidation in Aluminum Alloy 5052

PÁLINKÁS, F.B.S.M. <sup>a\*</sup>, ANTUNES, M.L.P.<sup>a</sup>, SOUZA, J.A.S.<sup>b</sup>, CRUZ, N.C. <sup>a</sup>, RANGEL, E.C. <sup>a</sup>

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*b. Universidade Federal do Para, Faculdade de  
Engenharia Química, ITEC, Belém, PA*

*\*Corresponding author, engcivil.fabiola@gmail.com*

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### Abstract

Kaolin is a mineral widely exploited in the national and international trade for various industrial purposes especially for bleaching and paper filler. The kaolin processing process generates 500 thousand tons of annual residue. Residue is usually disposed of in hills and can cause environmental damage such as contamination of water and soil, as well as changes in the natural landscape. Aiming at the valorization of the kaolin residue, this work proposes its use in the production of protective coatings in aluminum alloy by the technique of electrolytic oxidation assisted by plasma (PEO) and evaluation of the characteristics of the coatings obtained. PEO is the name given to the technique for treating metal surfaces similar to anodizing, but combined with the atmospheric plasma technique. In this work, coatings on 5052 aluminum alloy substrates were produced by PEO using electrolytic solution of 5 g/L kaolin residue, the time of deposition being varied in 5, 10 and 15 minutes, in order to investigate the Properties of the coatings obtained under these conditions. The coatings were evaluated for their thickness, chemical and mineral composition, wettability, roughness and morphology. In this way a rough and hydrophilic coating was produced, whose morphology is characterized by pores and regions of coalescence. The elemental chemical composition of these coatings shows Al, Si, O and Mg, elements present in the aluminum alloy and in the electrolytic solution. This coating is composed of ceramic material and presents crystalline structure corresponding to alumina. For a longer deposition time (15 minutes) a crystalline structure corresponding to mullite is also formed. These compounds are characterized by good chemical stability, high refractoriness and ability to withstand high temperatures, allowing their use in the development of new materials technologies.

**Keywords:** *Kaolin, kaolin residue, electrolytic plasma, ceramic coating.*

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## 24<sup>th</sup> May 2017

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**16h50-18h50**

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**Plenary Presentations**

**Carlos Montalvo**

**Netherlands Organization for  
applied Scientific Research  
(TNO) - Netherlands**

Inno4sd Network: Promoting  
Sustainability

**Hossam Gaber**

**University of Ontario Institute of  
Technology - Canada**

Towards Clean and Resilient Energy  
and Transportation Infrastructures

**Linda Hancock**

**Deakin University - Australia**

Bolivia's Lithium Frontier: Can  
Cleaner Technologies Harness a  
Mineral Development Boom?

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## **Inno4sd Network: Promoting Sustainability**

Carlos Montalvo

*Netherlands Organisation for applied Scientific Research (TNO)  
Netherlands*

The inno4sd network aims to advance the state-of-the-art on innovation for sustainability by:

- Linking policy, research and development, and business to support sustainability goals;
- Supporting knowledge connectivity, collaboration, leverages, education and influence;
- Reducing fragmentation via the connection of multiple networks;
- Serving as one stop shop for advanced manufacturing technologies for cleaner production and facilitating access to matching funds.

Inno4sd will support the emergence of a sustainable economy, contributing to economic growth and supporting the achievement of the Sustainable Development Goals (SDGs), by consolidating the global eco-innovation community. By mobilising actors from around the world, the network aims to coordinate and create links between initiatives to bridge gaps in understanding and ensure that research findings can be practically applied to support transformative change.

### ***Linking policy, research and development, and business to support sustainability goals***

Inno4sd brings together actors from across all sectors related to sustainability and innovation, to support the transition towards a green economy. This involves mobilising and linking actors from regional, national and international policy backgrounds with researchers and academics, as well as business practitioners and innovators, to discuss how the state-of-the-art in innovation can be practically applied to support transformative change.

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### ***Supporting knowledge connectivity, collaboration, leverages, education and influence***

Inno4sd seeks to foster collaboration and knowledge sharing amongst different practitioners and backgrounds to discover new ways to overcome barriers to sustainable development. Ultimately, this aims for greater impact from sustainability research, with ideas being spread to new audiences, having greater impact upon how policy-makers set sustainability frameworks, how businesses consider the green economy, and how researchers look to resolve sustainability challenges.

### ***Reducing fragmentation via the connection of multiple networks***

Inno4sd mobilises global actors to reduce fragmentation in the sustainability community. By building a network-of-networks, inno4sd will avoid duplication of effort, harmonise definitions across different cultures, manage conflicting interests and trade-offs and increase awareness of how innovation can support sustainability.

### ***Waging a network of Research Institutions to accelerate the uptake of advanced manufacturing for sustainable and cleaner production***

Inno4sd acts as one stop shop to the current and upcoming advanced manufacturing technologies for sustainable production. The services provided span from the identification of suitable solutions, manufacturability feasibility and access to matching funding.



## **Towards Clean and Resilient Energy and Transportation Infrastructures**

Hossam Gaber  
*University of Ontario Institute of Technology  
Canada*

This talk will explore recent research and technologies to achieve clean energy and transportation infrastructures. The talk will explore smart energy grid engineering systems and interconnected micro energy grids using clean energy technologies. Also, design and control methods will be discussed to improve the performance and to achieve clean energy infrastructures. Micro Energy Grids with Solar, Storage, gas-power, and Flywheel systems will be discussed to achieve clean transportation infrastructures. Methods and technologies of waste-to-energy systems will be discussed to provide clean energy and fuel supply to meet regional demands. Finally, the proposed smart energy infrastructures will be integrated with environmental protection monitoring systems with risk measures and protection measures to ensure clean production systems.

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## **Bolivia's Lithium Frontier: Can Cleaner Technologies Harness a Mineral Development Boom?**

Linda Hancock  
*Deakin University*  
*Australia*

In 2014, Bolivia's President Morales announced a state investment of \$995 million to develop the world's largest lithium reserves, located in Bolivia's Salar de Uyuni. Lithium production is promoted as enabling development in this impoverished, indigenously populated country which has historically suffered terrible environmental and social impacts from mineral exploitation. Lacking expertise and capital to sustainably produce lithium, Bolivia's plans for lithium industrialization through vertically integrated mineral development and public-private partnerships with foreign corporations, include a desire to harness the most environmentally appropriate technologies. We discuss the debate on cleaner production for lithium, challenges of Bolivia's lithium industrialization, and investigate how the desire for clean technologies has cultivated unusual partnerships between state enterprises and foreign-owned private corporations. We consider this model for developing remote mineral reserves for advanced technologies that are necessary for the global transition from a fossil fuel to low carbon economy, and for addressing sustainable development goals. Lithium is vital for energy storage, renewable energy and the electric vehicle industry. To meet rising lithium demand, with minimal environmental and social impacts, novel approaches to international resource extraction partnerships transcending ideological biases will be needed, and their efficacy evaluated. Our research aims to pave the way to such an evaluative framework, using Bolivia's lithium as a central case. Key research issues for developing the framework and initial criteria of evaluation are proposed.

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**Conferences**

**and**

**Oral Presentations**

**25<sup>th</sup> May 2017**

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **25<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 5A**

**Room 1**

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Upcycling in the Fashion Segment: Case Study at Recollection Lab

Cycle Assessment of Jeans Pants Production

Emergy Analysis for Brazilian Cotton Agriculture

Use of Linear Programming to Define the Cleaner Production Mix in the Textile Industry

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## **Upcycling in the Fashion Segment: Case Study at Recollection Lab**

LUCIETTI, T. J. <sup>a\*</sup>, RAMOS, M. D. S. <sup>a</sup>, SORATTO, R. B. <sup>a</sup>, TRIERWEILLER, A. C. <sup>a</sup>,

*a. Universidade Federal de Santa Catarina – UFSC,  
Araranguá - SC*

*\*Corresponding author, tamy\_aru@hotmail.com*

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### **Abstract**

The short life cycle of a fashion product has been a major environmental problem. From the raw material to the disposal several environmental impacts are generated, seeking a minimization of these problems brands with the concept of upcycling are emerging. What would have as destiny the trash becomes becoming the object of desire of many consumers. In this study, we focus on sustainability in fashion, as well as a brief case study of the Recollection Lab brand, and how reuse of discarded pieces served as a raw material for the emergence of a new niche in fashion that is: upcycling.

**Keywords:** *Fashion design, sustainability, upcycling, conscious consumption.*

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## Cycle Assessment of Jeans Pants Production

MORITA, A. M. <sup>a</sup>, MOORE, C. C. S <sup>b</sup>., KULAY, L. A. <sup>b</sup>,  
RAVAGNANI, M. A. S. S. <sup>a,\*</sup>

*a. Universidade Estadual de Maringá, Maringá*

*b. Universidade de São Paulo, São Paulo*

*\*Corresponding author, massravagnani@uem.br*

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### Abstract

Brazil is the second major manufacturer and the third greater consumer of fabric for jeans pants production in the world. Considering this situation, in the present work it was studied the environmental impacts of the jeans pants production chain in Brazil. It was considered an analysis since the fiber extraction to the finishing stage of the jeans pants or a cradle to gate analysis. Life Cycle Assessment was used in the evaluation of the environmental performance of the jeans pants production considering practices, proceedings and operating conducts regularly in use in Brazil. The environmental impacts relative to the gas and liquid emissions and solid waste in the environment were considered. ReCiPe Midpoint method was used to the categories climate change, territorial acidification, fresh water eutrophication, territorial eco-toxicity, photochemical ozone formation and water depletion. After this, the impacts related to the resources consumption were computed, using the method Cumulative Energy Demand, to the categories non-renewable fossil, non-renewable nuclear, non-renewable biomass, renewable biomass, renewable wind, renewable solar and renewable water. Results showed that the stages of the cotton cultivation, thread transportation and jeans pants finishing have very important contribution in the environmental impacts categories evaluated. In terms of primary energy the consumption of crude oil and natural gas are the most important contributions. It is suggested for the reduction of these impacts substituting natural cotton by synthetic fibers, changing technology for finished jeans pants washing, using steam generators that burn biomass and, finally, developing studies to identify lower distances between the fiber production and the pants manufacturing to reduce the environmental impacts to acceptable levels.

**Keywords:** *LCA, environmental impacts, jeans pants.*

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## Emergy Analysis for Brazilian Cotton Agriculture

BLATT, E. F. <sup>a</sup>, ALMEIDA, C.M.V.B. <sup>a</sup>,

*a. Universidade Paulista, São Paulo*

*\*Corresponding author, edu.blatt@hotmail.com*

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### Abstract

The aim of this paper is applying environment accounting in Emergy to analysis the Brazilian cotton agricultural production system. To determine which cotton agricultural production items, have more relevance. This study takes into consideration the diversity of Brazilian cotton production characteristics per region, the calculation data are the weighted mean per production per productive area. The results of this paper are compared into with two Brazilian and one North American Articles and the Emergy Sustainability Index results at all studied cotton production systems shown results <1 that characterize cotton agriculture as a short term value for sustainability classification. Demanding high amount of fertilizers and pesticides. Those are purchased inputs into the production system.

**Keywords:** *emergy; environmental accounting; cotton agricultural systems, environmental sustainability metrics in cotton agriculture.*

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## Use of Linear Programming to Define the Cleaner Production Mix in the Textile Industry

BOTELHO, W. C.<sup>a,\*</sup>, SILVA, D. P.<sup>b</sup>, BATISTA, E.<sup>c</sup>, GIANNINI, H.<sup>d</sup>, BOTELHO, R. M.<sup>e</sup>

*a. Faculdade Drummond de Andrade, São Paulo*

*b. Faculdade Drummond de Andrade, São Paulo*

*c. Faculdade Drummond de Andrade, São Paulo*

*d. Faculdade Drummond de Andrade, São Paulo*

*e. FAMOSP – União Cultural e Educacional Mozarteum, São Paulo*

*\*Corresponding author, wagner.costa.botelho@gmail.com*

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### Abstract

The present work aims to find a cost-effective solution for the production mix of a company specialized in the manufacture of fabrics, so that there are no leftovers / fabric burrs, which impact the environment, thus making the process cleaner. The great challenge of the industry is the production of products followed with the limitations of cost, development, cutting, sewing, finishing and the productive capacity of each product that dilute in particularities and devices different from the methods of productivity. The study deals with the linear programming method that was developed with the help of Excel software and the solver tool to maximize company profit, reduce the relevant costs of manufacturing restrictions and reduce tissue surplus during cutting, which generates Waste in the landfills and streets around the garments. The result of the application was better than expected, being 7% above the stipulated target for the analyzed year, even after a bad first quarter.

**Keywords:** *Cleaner production, Production mix, Linear programming, Planning, Waste from the textile industry.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **25<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 5A**

**Room 2**

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Eco-Efficiency Analysis of Hand Drying Systems

Street Lighting Management with Eco-Efficiency

The State of Art of Recycling of Electrical and Electronic Waste in Brazil

Modelling the Generation of Waste Electrical Household Appliances:  
Characterization of the Home Flow in the City of Campos-RJ

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## Eco-Efficiency Analysis of Hand Drying Systems

CARVALHO, J. S. <sup>a\*</sup>, OLIVEIRA, S. A. <sup>a</sup>

*a. Universidade Federal do ABC (UFABC), Santo André/SP, Brasil*

*\*Corresponding author, jessika.souzac@hotmail.com*

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### Abstract

In order to meet current legal requirements that demand control and reduction of solid waste generation, as well as society's interest in more sustainable options in the execution of their daily activities, the paper addresses an Eco-efficiency Analysis comparing alternatives for hand drying in environments with different rates of movement of people: Shopping Center (high) and University Center (low). The Eco-efficiency Analysis, which analyzed the combined environmental and economic performances, was carried out based on internationally recognized methodologies, tools and databases, which follow ISO 14040 series standards. The technologies studied refer to those available in the market with the function of hand drying, from which the electric dryer by hot air jet was selected; alternatives of 5 and 15 seconds of constant use. The alternative in comparison consists on two or three towels of Paper offered in plastic dispenser. By means of a survey that counted with 1350 responses, it was possible to observe that about 75% of the target public has a preference for using paper towels, and this choice is mainly motivated by the requirements of practicality and hygiene. Despite this preference, 42% of the participants believe in the efficiency of electric dryers. It was also realized that the society is concerned about environmental and social issues arising from the production, use and final destination of both alternatives. In addition, approximately 69% of the respondents considered the option of electric dryers as the best alternative to reduce the impacts on the environment. After the analysis, the use of electric dryers by hot-air jet was pointed out as the most eco-efficient option. The drying time using the electric dryer is not significant in terms of environmental and economic impacts in either of the alternatives. However, the amount of paper towels used is determinant, and the alternative of three paper towels was presented as the less eco-efficient. It was also observed that in high circulation places, the use of electric dryer stands out as the most economical alternative. Thus, its use, in addition to bringing lower environmental and economic impacts throughout the life cycle, supplies the current governmental demands and the expectation of consumption of a significant portion of the target public of the research.

**Keywords:** *Urban Solid Waste, Hand Drying, Eco-efficiency Analysis, Life Cycle Assessment.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Street Lighting Management with Eco-efficiency

SANCHEZ JUNIOR, O.<sup>a\*</sup>

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*\*osanchez@ipt.br*

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### Abstract

The paper presents a proposal for a model of analysis of the eco-efficiency of street lighting projects. Its purpose is to subsidize public policies and regulations. It is a proactive, preventive and innovative approach that establishes as the focus the transition to a sustainable society. We used Life Cycle Assessment tools to define a roadmap for both environmental and economic evaluation. The results show the feasibility and relevance of the approach and point to the necessary complementary developments.

**Keywords:** *Eco-efficiency, Public lighting, LCA, LCC.*

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## **The State of the Art of Recycling of Electrical and Electronic Waste in Brazil**

SANTANA, E. V. B<sup>a(\*)</sup>, ELABRAS-VEIGA, L. B<sup>b</sup>.

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*\*Corresponding author, eduardovictor.bs@hotmail.com*

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### **Abstract**

The recycling of Electrical and Electronic Waste (WEEE) in Brazil is an industry sector that still requires much development, particularly the phase that comes before materials transformation into new products, which is the waste management phase. The National Policy on Solid Waste (NPSW), established in 2010, through Law 12,305, provides a legal framework in order to structure WEEE management in Brazil. From the policy objective perspective, the law established the solid waste management hierarchy. From the policy instrument perspective, the law defined the reverse logistics systems. In the light of the NPSW, this study conducted a state of the art analysis of WEEE generation and management in Brazil and the main legislation in the field. Based on the analysis conducted, this study identified as the major obstacle to WEEE management in Brazil the failure to ratify the WEEE sectoral agreement, as stated by the NPSW.

**Keywords:** *Electronic Waste, Recycling, National Policy on Solid Waste, Sector Agreement, Brazil*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Modelling the Generation of Waste Electrical Household Appliances: Characterization of the Home Flow in the City of Campos-RJ**

PESSANHA, L. P. M. <sup>a\*</sup>, MORALES, G. <sup>a</sup>

*a. Universidade Estadual do Norte Fluminense - UENF*

*\*Corresponding author, luizmpessanha@gmail.com*

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### **Abstract**

The management of Waste Electrical and Electronic Equipment (WEEE) or electronic waste (e-waste) has been a major concern for urban communities due to the large volumes of waste generated, from the end of the 20th century. In this context, this research seeks to collect important information for the implementation of an embracing and regular system of Reverse Logistics for WEEE in the city of Campos dos Goytacazes - RJ. This information corresponds to an estimation of the potential of generating WEEE (such as, mobile phone, computers and tablets) in the city, characterizing the home flow and its peculiarities. Therefore, was proposed an estimation model based on the indicator of equipment present with the consumer. The data required for this research were collected through the application of questionnaire to a representative and random sample in the city under study. It was observed that the results found support as decisions taken in the WEEE management system. It important to emphasize that this research was carried out under current sustainability considerations according to which Brazilian solid waste legislation is determined. The results are approximate as global estimates of the specific, researched electronic waste.

**Keywords:** *Electronic waste, Reverse logistics, Generation models.*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **25<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 5A**

**Room 3**

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Sustainability and Performance in Organization: An Analysis of the Triple Bottom Line Approach

Proposal of a Template to Sustainability Management by Integrating Triple Bottom Line and Balanced Scorecard from the Quality Management

Benefits of Integrating Life Cycle Assessment into the Product Development

Environmental Sustainability and Lean Production: A Case Study

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## **Sustainability and Performance in Organizations: an Analysis of the Triple Bottom Line Approach**

HOURNEAUX JUNIOR, F. <sup>a\*</sup>, GALLELI, B. <sup>a</sup>, NUNES, B. <sup>b</sup>.

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### **Abstract**

This theoretical study aims to discuss how to define organizational performance regarding sustainability based on the Triple Bottom Line (TBL) approach, that is, economic, social and environmental dimensions. The analysis is based on defining what Sustainability-Oriented Organizational Performance (SOOP) is, and to discuss three theoretical propositions, as follows. Proposition 1: Sustainability-Oriented Organizational Performance should consider, simultaneously and in an integrated way, economic, social and environmental aspects; Proposition 2: Considering the TBL approach, Sustainability-Oriented Organizational Performance will have different compositions within the three dimensions, economic, social and environmental; And finally, Proposition 3: Sustainability-Oriented Organizational Performance will be defined differently for each organization in each period. After an analysis of the unfolding of the propositions, the article is finished with suggestions for an initial research agenda for studies that can empirically investigate its validity.

**Keywords:** *sustainability, triple bottom line, sustainability performance, performance measurement.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Proposal of a Template to Sustainability Management by integrating Triple Bottom Line and Balanced Scorecard from the Quality Management**

NICOLETTI JUNIOR, A. <sup>a \*</sup>, OLIVEIRA, M. C. <sup>a,b</sup>, HELLENO, A. L. <sup>a,b</sup>

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*b. Universidade Presbiteriana Mackenzie, São Paulo / SP – Brazil*

*\*Corresponding author, alercionicoletti@hotmail.com*

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### **Abstract**

This article aims to propose a model for corporate Sustainability Management based on the integration of the Quality management system with the triple bottom line (TBL) pillars of sustainability and the organizational performance perspectives of the Balanced ScoreCard (BSC). The theoretical survey verified the increase of studies about the development of management models considering the operations management in sustainability. However, it was verified a gap in literature of the full integration of the concepts involving TBL and BSC, as a management model to corporate sustainability. The construction of the model contemplated the fulfillment of the 12 noted correlations between the TBL pillars (economic, social and environmental) and the BSC perspectives (people, process, market and financial), comprising both the requirements of sustainability and organizational performance.

**Keywords:** *sustainability; Balanced ScoreCard; Triple Bottom Line; organizational performance; Quality management.*

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## **Benefits of Integrating Life Cycle Assessment into the Product Development**

LUZ, L. M. <sup>a\*</sup>, FRANCISCO, A. C. <sup>a</sup>, PIEKARSKI, C. M.

*a. Universidade Tecnológica Federal do Paraná, Ponta Grossa*  
*\*Corresponding author, leila.mendesdaluz@gmail.com*

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### **Abstract**

The development of sustainable products has been perceived as a challenging issue in academia and industry. In order to meet the demands of sustainable development and minimize the complexity involved in this process, tools have been developed and applied to the product development process (PDP). Among them is the Life Cycle Assessment (LCA) that has been increasingly used to evaluate the environmental impacts of products and a new trend results in the application of LCA still in the PDP, from being retrospective to being prospective. This can bring several benefits to the organization. Therefore, the present article aims to make a survey of the main benefits obtained by the integration of LCA in the PDP. For this, a methodological approach was used to review the literature. With this study it can be noticed that despite the barriers found in the integration of the LCA in the PDP, the LCA has great potential to contribute significantly in the optimization of this process and to result in several benefits for the organization.

**Keywords:** *life cycle assessment, product development process, integrating, benefits.*

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## **Environmental Sustainability and Lean Production: A Case Study**

QUEIROZ, G. A. <sup>a,c\*</sup>, ESPOSTO, K F. <sup>b</sup>, ALVES FILHO, A. G. <sup>a</sup>,  
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*b. Universidade de São Paulo, São Carlos*

*\*geandraqueiroz@gmail.com*

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### **Abstract**

This research intends to address, in a preliminary way, the possibility of integrated implementation of environmental sustainability and lean production practices, considering the roles of such practices in the company's operations strategy. It examines the case of a subsidiary of a multinational company inserted in a highly competitive and dynamic environment and operating in several market segments (security, automotive products, electrical products and graphic communication). The research had as objective to verify how the environmental sustainability is inserted in a strategy of operations guided by the lean production. For this, the research methods were used: exploratory bibliographic review and case study. The results of the research show that environmental sustainability has been considered in the decisions oriented to the implementation of lean production practices in the company, but, in the managers' view, the integration of the practices can be quite laborious.

**Keywords:** *Environmental Sustainability; Operations Strategy; Lean Production.*

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## **25<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 5A**

**Room 4**

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Analysis of MSW to Energy Conversion Process for Sustainable Community

Multi-Objective Optimization of a New Sustainable Methanol Plant with Cogenerated Energy

The Perspectives of Biomethane to Contribute to Increase the NG Supply

A Profitability Analysis of Small-Scale Biomethane Plants

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## **Analysis of MSW to Energy Conversion Process for Sustainable Community**

GABBAR, H.A.<sup>a,b</sup>, ABOUGHALY, M.<sup>b</sup>

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- 

### **Abstract**

Municipal solid waste witnessed an exponential increase globally due to plastic, paper and organic material high production without considering appropriate recycling strategies. Pyrolysis and gasification is considered the most promising chemical recycling techniques, which can help prevent incineration and landfilling. Both processes have low environmental impacts, high product value, ability of electricity generation illustrated in this work. The paper discusses the major process units in industrial chemical recycling plants, life cycle assessment (LCA) in terms of GHG emissions, process stages and system design and justifies gasification and pyrolysis over other thermal treatment methods. Pyrolysis and gasification produce hydrocarbon gaseous and liquid products which can be utilized for energy production or chemicals synthesis while only incineration produce thermal energy. Both processes also produce the highest electrical production per ton in comparison with incineration with higher carbon dioxide emissions than incineration but lower dioxins, NO<sub>x</sub>, HCl, CO emissions.

**Keywords:** *Sustainable engineering, clean energy, global warming, pyrolysis, gasification, incineration*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Multi-objective Optimization of a New Sustainable Methanol Plant with Cogenerated Energy

ROCHA, L. B. <sup>a\*</sup>, GIMENES, M. L. <sup>a</sup>, FARIA, S. H. B. <sup>a</sup>, SILVA, R. O. <sup>a</sup>, JIMÉNEZ, L. <sup>b</sup>

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*\*Corresponding author, pg52814@uem.br*

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### Abstract

Contemplating the situation of biofuels, the objective of this work is to investigate the techno-economic feasibility of methanol synthesis using carbon dioxide captured as an output of fermentation process in bioethanol production distilleries, carrying out an integrated analysis of the overall system. Up to now, studies limited to evaluate the methanol production hydrogenating CO<sub>2</sub> from fossil sources. Systems assessed in this perspective usually are not economically viable due to the high cost associated to obtain hydrogen. In this work, we designed a new sustainable methanol production process from a renewable source. Aiming to promote the advancement and applicability of carbon capture processes, an industrial methanol plant was modeled in Aspen Plus<sup>®</sup>. The hydrogen required was produced electrolyzing treated water of the distilleries, producing oxygen as a valuable byproduct. Design parameters were manipulated taking into account the associated capital costs and applying factorial design and sensitivity analysis techniques. The response surfaces were obtained according to the amount of bagasse used to cogenerate energy, which has a direct relation with the objective function, attempting to minimize the total annualized costs and the CO<sub>2</sub> Net of the scenario. The results show that the problem of high-energy consumption for the production of hydrogen via electrolysis was bypassed using co-generated energy, being possible and viable to synthesize this process in distilleries able to emit more than 350,000 ton/year of CO<sub>2</sub> with enough cogeneration plants installed. The gross profits obtained by this process are derived from the methanol and oxygen produced being significantly superior by a factor of 4.5 compared to sale of electricity and 8.0 for sale of pure hydrogen. The designed plant led us to conclude that this improved process can be implemented and is an innovative option for carbon mitigation, contributing to the sustainable production of methanol.

**Keywords:** *Ethanol distillery, Optimization, Methanol synthesis, Cogeneration; Hybrid models.*

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## The Perspectives of Biomethane to Contribute to Increase the NG Supply

GARCILASSO, V. P. <sup>a</sup>, SANTOS, M. M. <sup>a</sup>, PEREIRA, A. S. <sup>a</sup>, JOPPERT, C. L. <sup>a</sup>, PERECIN, D. <sup>a</sup>, POVEDA, M. <sup>a</sup>, COLUNA N. E. <sup>a</sup>, COELHO, S. T. <sup>a\*</sup>

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*\*Corresponding author, suani@iee.usp*

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### Abstract

The Bioenergy Research Group of the Institute of Energy and Environment at the University of São Paulo (GBIO / IEE / USP) is developing the "Project 27 - The biomethane contribution prospects to increase the supply of natural gas in São Paulo" - within the Research Center for Innovation in Natural Gas (RCGI). This is a center of advanced studies on sustainable use of gas, created at USP with funding from FAPESP / Shell / BG. This Project 27 will map the production of biogas and biomethane from vinasse, animal residues (livestock waste and residues from slaughterhouses) and urban residues (solid wastes and liquid effluents). It is important to mention that, besides the use of biogas for energy production, there is another option. After the upgrading process of biogas (CO<sub>2</sub> and impurities removal), biomethane can be used as a primary source of energy to be fed into NG pipelines and be distributed to different consumers, as well as in the form of CNG when necessary. Also, in the case of biomethane from vinasse, it can be used to fuel the sugar mills' diesel fleet (trucks and agricultural equipment). During the development of Project 27, financial, technical, environmental and social aspects of production and use of biomethane will be analyzed. These aspects will be addressed as important points to encourage the biomethane market in São Paulo, such as the need to consider the fundamental synergy between biogas for energy generation and basic sanitation. In view of the above, this article aims to present Project 27, as well as the preliminary results obtained so far.

**Keywords:** *biogas, biomethane, urban waste, agro-industrial waste, energy potential.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## A Profitability Analysis of Small-Scale Biomethane Plants

CUCCHIELLA, F. <sup>a</sup>, D'ADAMO, I. <sup>a</sup>, GASTALDI, M.<sup>a,\*</sup>, MILIACCA, M. <sup>b</sup>

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- 

### Abstract

European countries aim to achieve a more competitive, safe and sustainable energy system. Biomethane is a promising renewable energy carrier and the main point of strength is its flexibility. In fact, this resource can be injected directly into the public gas grid, or can be converted into electricity and heat in cogeneration units, or can be used in the transport sector as vehicle fuel. Literature analysis highlights as the role of subsidies is strategic to develop the biomethane production and countries, as Germany, Sweden, United Kingdom, Switzerland and Netherlands, have registered a significant growth in the last years. This paper proposes a mathematical and economic model useful to evaluate the profitability of biomethane injected into the gas grid. The indicators used are Net Present Value and Discounted Payback Time. The baseline scenario analyses three different small-scale sizes (50 m<sup>3</sup>/h, 100 m<sup>3</sup>/h and 150 m<sup>3</sup>/h) concerning two typologies of substrates (municipal solid waste msw and a mixture of maize and manure residues). A sensitivity analysis on the main critical variables (subsidies, investment costs of biogas production, transport costs of substrates and percentage of maintenance and overhead costs in biogas production) is conducted. The profitability of biomethane, also for small-scale plants and when are recovered a wide range of waste, can contribute to develop the circular economy and consequently, it plays a role in a sustainable future.

**Keywords:** *biomethane, economic analysis, small-scale plants, subsidies, sustainability*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **25<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 5A**

**Room 5**

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Reuse of Post-Consumer Polyethylene Terephthalate in the Construction Industry

Sustainability Assessment Criteria for a Green Building Enterprise

Wood Construction and Circular Building: Potential for Sustainability

Product System for Life Cycle Assessment for Road Construction

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## Reuse of Post-Consumer Polyethylene Terephthalate in the Construction Industry

MARQUES, D. V.<sup>a\*</sup>, BARCELOS, R. L.<sup>b</sup>, MAGNAGO, R. F.<sup>a</sup>

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### Abstract

There is an increasing demand for polyethylene terephthalate from the beverage sector like in water, oil, and soft drink packaging, which implicates the need to give a suitable destination to waste PET bottles. In order to attribute value to this material, more and more new means of re-use are being sought. For that purpose, we carried out a bibliographic study on new insulating materials for buildings with use of PET residue and an estimation of its potential to replace Expanded Polystyrene (EPS) used as thermal and sound insulation for slabs. We found polyurethane composites with the incorporation of 35% and 45% of PET and alumina trihydrate, which may be an option as a thermal and sound insulation because they meet the Brazilian standards, presenting adequate behavior in the horizontal burning rate test and mechanical compressive strength. It was estimated that between 14 to 18 tons of PET were recycled in Brazil in 2012. Of the total Brazilian production of PET in 2012, a production between 14 and 18 thousand tons of PET was estimated. The incorporation of PET into a new material increases the percentage of recycling and provides gains for the environment and society, thus reducing the amount of waste and contributing to cleaner production dissemination.

**Keywords:** *Recycling, Polyethylene terephthalate, Polyurethane, construction industry.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Sustainability Assessment Criteria for a Green Building Enterprise**

SANTOS, L. C. R. <sup>a\*</sup>, RIESEMBERG, R. R. C. <sup>a</sup>, PINHEIRO DE LIMA, E. <sup>a,b</sup>

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### **Abstract**

Nature is finite, the semi-renewable resources and the ecosystems' capacity to absorb the pollutants has made the concern for sustainability rise. Some factors that are making resources limited are population growth and increased per capita consumption. It should be noted that the impact of buildings on natural resources is significant. The construction industry is identified as the sector with human activities that most consume natural resources, in addition to using energy intensively, causing negative environmental impacts. Besides the impacts related to the consumption of matter and energy, there are those associated to the generation of solid, liquid and gaseous wastes. Thus, it is estimated that more than 50% of the solid waste generated by all human activities comes from construction, so the limitation of the sources of resources and the finite capacity of the ecosystems are the challenges to achieve an ecologically sustainable economy. However, management professionals have been struggling to integrate their operations with sustainability issues. From the context, the research problem is presented: what are the results obtained from a process of evaluation of the sustainable operations of an organization in the civil construction segment? Thus, the objective was to identify the results obtained from an evaluation process of sustainable operations of an organization in the civil construction segment. This organization is the EuroBusiness, located in Curitiba, in the State of Paraná - Brazil, the first venture in the South of Brazil to receive the LEED Platinum Seal, the highest level of certification by LEED, accounting for less than 2% of Certified ventures around the world. To reach the proposed objective, the research is considered of an applied nature, with a qualitative approach and exploratory, descriptive and analytical objectives. Standardized data collection techniques involve a literature review and interviews with specialists. The results indicate that the strategy adopted by EuroBusiness involved aspects of envelopment, lighting, measurement and verification, green roofing, use and reuse of water and indoor air quality (IAQ) and contortion. In this way, it can be seen that the high technology used by the project throughout the project, reduces its operational cost and its environmental impact with the concern for saving natural resources.

**Keywords:** *sustainable green building, domotics, sustainable product development.*

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"TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE"

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017



## Wood Construction and Circular Building: Potential for sustainability

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*\*Corresponding author, simonetavares83@gmail.com*

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### Abstract

The construction industry in Brazil is characterized as having great environmental impact, consumption of materials and waste production. On the other hand, is one of the most important economic and social sectors, responsible for our built environment construction, the generation of many of jobs and the economy. Against a framework of exhaustion of raw materials, population increase, and of global warming caused by anthropogenic actions, is fundamental to develop new approaches for a suitable construction, or a new construction's paradigms. Therefore, within the scope of the Circular Economy is proposed the Design for Circularity, through the Circular Building, which is designed and developed aiming high durability, flexibility, recyclability and disassembling, using materials of sustainable origin, non-toxic, with high quality and functional performance, that can be reused unlimited times. It is about designing for the maximum performance of materials and edification without the loss of quality. Thus, the goal of this paper is to evaluate what is the wood potential as material that contributes to the Design for Circularity and Circular Building, by analyzing its intrinsic and relational properties, in the frame construction system. The article has a qualitative methodological approach, of an exploratory nature, based on the systematic literature review. The findings demonstrate that wood, through the frame construction, has high potential for Design for Circularity, contributing to a more sustainable building.

**Keywords:** *Circular Building, Design for Circularity, wood, frame construction, sustainability.*

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## **Product System for Life Cycle Assessment for Road Construction**

GRAEL, P. F. F. <sup>a</sup>BEZERRA, B. S. <sup>a</sup>,

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### **Abstract**

A system of Life Cycle Assessment (LCA) in highways is a field of research that is expanding, but until recent times, the methodology is still little applied in practice, especially in Brazil. The application of this technique has been used to generate knowledge, studies, either as independent quantification tools or for comparisons. The construction sector is one of the main responsible for the substantial consumption of energy and natural resources. And in this context, a road system is a generator of considerable environmental impacts. The objective of this work is to raise the product system in the construction of highways, in its respective supply chain. In order to carry out this research it was adopted a qualitative research in the application of a case study to verify the environmental processes and impacts that exist in a supply chain of highway construction. The result achieved was the construction of a product system of a supply chain of road systems, which will base the assessment of the life cycle assessment of this respective process.

**Keywords:** *Life cycle assessment, supply chain, road system, sustainability.*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **25<sup>th</sup> May 2017**

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**8h00-9h40****Session 5A****Room 6**

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Cleaner Production for Rock Quarrying 'Campel Construções e Máquinas Pesadas LTDA'

Portland Cement Production with Dregs and Grits from Kraft Pulp Mills Incorporation to the Clinker

Case Study on Selective Colection in Electromechanical Laboratories: First Initiatives Based on na Evaluative Model

Diagnosis of Waste from a Red Ceramics Towards to Cleaner Production

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## **Cleaner Production for Rock Quarrying 'Campel Construções e Máquinas Pesadas LTDA'**

PONTES, J. C. <sup>a\*</sup>, SILVA, V. P. <sup>b</sup>, LIMA, V. L. A <sup>c</sup>, NASCIMENTO, P. H. M. <sup>d</sup>

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b. Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Norte, Natal-RN

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### **Abstract**

At this turn of the century, several sectors of Brazilian industry still maintain investments in end-of-pipe control, when it should be in preventions, which would avoid or minimize pollution during the production. In the mineral sector, mainly in the mining operation, it still makes use of end-of-pipe technologies. Regarding the rock blasting operation using explosives, loading and transportation, numerous socio-environmental problems have been occurring as wastage and generation of residue throughout the operation process, affecting workers' quality of life, the well-being of communities and the surrounding environment. In this mineral sector, the environmental problems seems to be related to the fly rock, the vibrations, the wastes generated, the emission of dust and gases after the detonation, the increase of the noises, besides the visual and landscape alteration. Therefore, the present study aimed to propose the application of the cleaner production on the rock blasting in the rock quarry of Campel Construções e Máquinas Pesadas Ltda, located in Taipu-RN, aiming at the reduction of waste and the generation of residues. Proceeding the study, the following methodological procedures were used: survey of references, book reports and field research at the mentioned quarry. A diagnosis was made of the mining operation process, followed by the loading and transport phase of the disassembled material. The results of the study and the diagnosis of the situation in which the quarry is located in relation to the waste that has been generated in the phases of the mining operation. It is concluded that the application of cleaner production techniques: it will imply in optimizing the explosive load ratio in the rock blasting carried out in the quarry object of study, it can provide a greater efficiency in the productive process and decrease of the problems listed above, as well as, quality of life.

**Keywords:** Cleaner production. Pollution Prevention. Rock Blasting. Quarry.

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## **Portland Cement Production with Dregs and Grits from Kraft Pulp Mills Incorporation to the Clinker**

TORRES, C. M. M. E. <sup>a</sup>, SILVA, C. M. <sup>a\*</sup>, PEDROTI, L. G. <sup>b</sup>, FERNANDES, W. E. H. <sup>b</sup>, BALLOTIN, F. C <sup>c</sup>, ZANUNCIO, J. C. <sup>d</sup>.

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### **Abstract**

Kraft pulp mills are expanding rapidly in Brazil and industrial waste generation is increasing. Concern about the increase in waste generation and disposal are growing. Waste must be preferentially recycled or reused and when this is not possible, it must be disposed in an environmentally sound manner. 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. Pulp mill wastes are classified as non-hazardous and non-inert according to the Brazilian NBR 10.004. This paper proposes evaluate the technical feasibility of the incorporation of alkaline wastes named dregs and grits, to cement clinker in different proportions as raw material in the cement Portland industry. The research was carried out in three steps. First, it was carried out the characterization of dregs, grits and clinker. Second, the preparation of specimens in the dimensions of 5 cm diameter and 10 cm in length approximately using different proportions (0, 2.5, 5, 7.5, 10 and 15%), of dregs and grits were made, Third, the laboratory testing (determination of soundness by the Le Chatelier method, determination of setting times, determination of water content of the paste with normal consistency, determination of compressive strength and static modulus of elasticity) were carried out. The results showed that the addition of dregs and grits to clinker up to 10% were feasible according to the Portland cement Brazilian standards.

**Keywords:** *Kraft pulp mills; Dregs; Grits; Waste management; clinker*

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## Case Study on Selective Collection in Electromechanical Laboratories: First Initiatives Based on an Evaluative Model

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### Abstract

The objective of this research is to verify the benefits of the selective collection in electromechanical laboratories in an educational institution that offers technical courses, with the aim of verifying the current situation of the institution regarding sustainable initiatives. An evaluation was first carried out by means of a model called Sustainability Assessment for Higher Technological Education (SAHTE), in a structure composed of five axes and 134 criteria. The model presents guidelines for beginners and highlights good practices found in educational institutions. In the first evaluation, there was a low adherence to the sustainable initiatives of the institution with the 134 criteria distributed in the five axes of the model, as only 26 criteria were met. After the evaluation, a meeting was held with teachers and coordinators in which the implementation of selective collection in electromechanical laboratories was chosen, the choice being justified due to the importance of the course for the region, the number of students involved, and the total absence of Selective collection in laboratories. After the implementation of the selective collection in the laboratories, the fulfillment of 16 criteria was observed, distributed among the five axes of the evaluative model. This demonstrates that in this case, a very specific point, selective collection in electromechanical laboratories, directs the institution to meet criteria not only in the fifth axis waste, but in all five axes. This was due to the environmental awareness generated by the activity, research of the students and teachers, involvement of the collectors association and the community during the implementation of the selective collection and the insertion of the activity planned for the next classes of the electromechanical course. Actions on selective collection are necessary in the future for the entire institution.

**Keywords:** *sustainability, laboratories, electromechanical, evaluation, selective collection.*

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## **Diagnosis of Waste from a Red Ceramics Towards to Cleaner Production**

SILVA, R. G. <sup>a\*</sup>, SILVA, V. P. <sup>b</sup>

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### **Abstract**

There are not many diagnoses and studies, produced on the waste situation and residue generation in the field of the production process of the red or structural ceramics industry. Also, there are not many qualitative and quantitatively information about the waste and residues that have been generated. Therefore, this study seeks to preliminarily diagnose the waste situation at the company Villar Produtos Cerâmicos de Tangará-RN, with a view to proposing cleaner production (CP). The research method consisted on bibliographical and documentary research, as well as a case study of the cited company, including technical visits, observations and analysis of inputs and outputs of the production processes, following the CP methodology of the Brazilian National Center of Clean Technologies. The results showed that the largest input waste was concentrated in the extrusion, cutting, drying and burning processes. The first three added up to a water waste of 39.88%. The last two together wasted 76.23% of electricity. And, only, the burning was responsible for 30.15% of the clay waste. It is concluded that it's imperative for the red ceramic industry to take advantage of CP techniques to reduce production waste.

**Keywords:** *cleaner production, sustainability, red ceramics, diagnosis, waste.*

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## **25<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 5A**

**Room 7**

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Soft Sensors to Assess the Energy Consumption in the Formation of Lead-Acid Batteries

The Conceptual Proposal of a Hybrid Solar Photovoltaic Module with Water Coil Cooling

Environmental Impacts of the Potential Nationalization of the Production of Li-Ion Cells for Electric Vehicle Batteries in Brazil

Bolivia's Lithium Frontier: Can Cleaner Technologies Harness a Mineral Development Boom?

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## **Soft Sensors to Assess the Energy Consumption in the Formation of Lead-Acid Batteries**

CABELLO, J.J.<sup>a</sup>, SAGASTUME, A.<sup>a</sup>, SOUSA, V.<sup>a</sup> HERRERA, H.<sup>a</sup>, BALBIS, M.<sup>a</sup>, SILVA, J.<sup>a</sup>

*a. Universidad de la Costa. Colombia.*

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### **Abstract**

Lead-acid batteries are essential for different economic activities and are, in general, energy intensive products. However, there is a limited discussion on how to assess the energy consumption and its efficiency for battery manufacturing. This study assess the process of battery formation, which is essential in manufacturing lead-acid batteries, and account for over half of the energy consumption of battery production. The assessment is implemented in a battery plant using data from a 4 years period to develop an energy performance indicator (EnPI), used to assess the efficiency of battery formation. To implement the EnPI a soft sensor is developed. Results show that the implementation of the proposed EnPI combined with other measures, resulted in a reduction of 3 to 5% of the electricity consumption of battery formation.

**Keywords:** *Battery formation, energy efficiency, battery production*

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## **The Conceptual Proposal of a Hybrid Solar Photovoltaic Module with Water Coil Cooling**

ZANLORENZI, G.<sup>a</sup>, SZEJKA, A. L. <sup>a\*</sup>, SOUZA, T. M.<sup>b</sup>

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### **Abstract**

The Solar Photovoltaic (PV) modules present loss of generation potential because of the solar cells heating by solar irradiation. This loss occurs due to the increase of the layer between the P and N junction of the cell, instigating that for the same quantity of solar irradiation, the cooled cell has a greater potential in relation to the heated cell. The aim of this research is to propose a conceptual model of a cooling system for a Solar PV Module in order to achieve a generation potential superior to the same solar irradiation power. The development of the conceptual model used the 15 meters of copper tube in order to make the coil cooling, which it will be in contact with the superior part of the solar photovoltaic module. Aluminium plates were used to expand the thermal contact between Solar PV Module and Cool Fluid. The tests with the hybrid solar PV module in a real application show a temperature reduction of 14,6 °C in relation to the original Solar PV Module. This temperature reduction increases in 21.1 W of the power rating in the peak of energy generation as well as leads to a gain of 1,16% of electrical efficiency. The conceptual proposal implementation shows a better use of solar energy, since the hybrid system increases the absorption of solar irradiation and heats the water that can be stored in a suitable container for future use. Finally, the calculus of the hybrid efficiency of the module presents a utilization of the irradiation in 36.93%, that is, a gain of 222.25% in relation to the original system, which reached an efficiency of 11.46% during the peak of energy generation.

**Keywords:** *Solar Energy, Efficiency, Solar PV Hybrid System, Water Coil Cooling, Heat Transfer*

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## **Environmental Impacts of the Potential Nationalization of the Production of Li-Ion Cells for Electric Vehicle Batteries in Brazil**

VELANDIA VARGAS, J. E.<sup>a,\*</sup>, MANZI, G. H.<sup>a</sup>, COOPER, R. E.<sup>a</sup>, SEABRA, J.<sup>a</sup>, ANHOLON, R.<sup>a</sup>

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### **Abstract**

This paper presents the results of the Life Cycle Assessment in order to compare the benefits of a potential nationalization of the production of Li-Ion battery cells in Brazil. To elaborate the analysis, several sources of the specialized literature and the Brazilian productive sector were consulted to modify the Life Cycle Inventories (LCI) for battery cells, present in Ecoinvent V 3.1. The results, obtained through the CML2000 method, indicate that potential nationalization of batteries would cause a product that has disadvantages in five of nine categories of environmental impact compared to a battery that reflects conditions of production in the world average. Additionally, it has been found that the anode and cathode are the main contributors to most impact categories. Finally, impact contributions throughout the manufacturing process lifecycle were analyzed, without including final provision, for three categories of impact: global warming, human toxicity and eutrophication, in order to look for the critical or major contribution steps. The results for global warming show that aluminum production is the main contribution due to the intensive use of energy in aluminum production. Regarding human toxicity and eutrophication the results show that the extraction of metals such as copper are linked to the greatest impacts.

**Keywords:** *Life Cycle Assessment, Life Cycle Inventories, Lithium Battery Cell, Product Nationalization, Electric Vehicles.*

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## **Bolivia's Lithium Frontier: Can Cleaner Technologies Harness a Mineral Development Boom?**

HANCOCK, L.<sup>a\*</sup>, RALPH, N.<sup>b</sup>, ALI, S.H.<sup>c</sup>

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  - b. *Associate Research Fellow, ARC (Australian Research Council) Centre of Excellence for Electromaterials Science, and Alfred Deakin Institute, Deakin University, Melbourne*
  - c. *Blue and Gold Distinguished Professor of Energy and the Environment, University of Delaware, Newark*
- \*Corresponding author, [linda.hancock@deakin.edu.au](mailto:linda.hancock@deakin.edu.au)
- 

### **Abstract**

In 2014, Bolivia's President Morales announced a state investment of \$995 million to develop the world's largest lithium reserves, located in Bolivia's Salar de Uyuni. Lithium production is promoted as enabling development in this impoverished, indigenously populated country which has historically suffered terrible environmental and social impacts from mineral exploitation. Lacking expertise and capital to sustainably produce lithium, Bolivia's plans for lithium industrialization through vertically integrated mineral development and public-private partnerships with foreign corporations, include a desire to harness the most environmentally appropriate technologies. We discuss the debate on cleaner production for lithium, challenges of Bolivia's lithium industrialization, and investigate how the desire for clean technologies has cultivated unusual partnerships between state enterprises and foreign-owned private corporations. We consider this model for developing remote mineral reserves for advanced technologies that are necessary for the global transition from a fossil fuel to low carbon economy, and for addressing sustainable development goals. Lithium is vital for energy storage, renewable energy and the electric vehicle industry. To meet rising lithium demand, with minimal environmental and social impacts, novel approaches to international resource extraction partnerships transcending ideological biases will be needed, and their efficacy evaluated. Our research aims to pave the way to such an evaluative framework, using Bolivia's lithium as a central case. Key research issues for developing the framework and initial criteria of evaluation are proposed.

**Keywords:** *lithium, Bolivia, extraction, public-private partnerships*

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**25<sup>th</sup> May 2017**

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**13h30 -15h00      Conference**

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**Klaus Hubacek**

**University of Maryland - USA**

Global Income Inequality and  
Climate Change

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## **Global Income Inequality and Climate Change**

Klaus Hubacek  
*University of Maryland - USA*

“End poverty in all its forms everywhere” is the first of the United Nation’s Sustainable Development Goals (SDGs) adopted September 2015; setting targets of eradicating extreme poverty by 2030 for all people everywhere. In parallel another United Nations process took place that culminated in December 2015 where 195 countries adopted the new Paris Agreement under the United Nations Framework Convention on Climate Change aimed to keep warming to well below 2°C above pre-industrial levels in the long-term while recognizing developing countries right to eradicate extreme poverty and develop sustainably. These agreements provide a basis for putting the world economies on a sustainable pathway. However, both agreements do not prescribe how these ambitious goals may be achieved in a compatible manner, nor how the burden or responsibility of achieving them may be shared.

About 50% of the global population, that is more than 3.7 billion people, live on less than 3\$ Purchasing Power Parity (PPP) a day. The top 10% earn more 23\$ (PPP) per day. Clearly lifestyles, consumption patterns and associated per capita carbon footprints differ enormously between rich and poor and from country to country. But what are the differences in terms of carbon footprint? What is the contribution to total carbon emissions of the global

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middle class or the global elites? Do we see a convergence of consumption patterns and carbon footprints of rich folks across countries? What are the carbon implications of moving hundreds of millions of people out of poverty as proposed in the sustainable development goals? To answer these questions, we use consumer expenditure surveys for different income categories for most countries around the world. These are linked to a global multiregional input-output model to calculate carbon footprints for different income categories for poor and rich countries, and specifically for the US. The paper shows how to link different datasets to estimate the effects of our consumption choices throughout global supply chains and presents some answers and implications.

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 1**

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Bibliometric Mapping of Scientific Literature of Eco-Innovation (1978-2017)

The Influence of Competitive Intelligence in Environmentally Sustainable Innovation Management

Cleaner Production, Social Responsibility and Eco-Innovation as Antecedents of Environmental Awareness and Sustainable Consumption: The Generations's Perception of a Sustainable Future

Eco Innovation in the Context of Green Supply Chain Management: A Proposal of a Conceptual Framework

Systematization and Classification of Cleaner Production Practices, Techniques and Tools

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## **Bibliometric Mapping of Scientific Literature of Eco-Innovation (1978-2017)**

VAZ, C. R. <sup>a\*</sup>, LEZANA, A. G. R. <sup>a</sup>, URIONA MALDONADO, M.<sup>a</sup>

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*\*caroline.vaz@posgrad.ufsc.br*

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### **Abstract**

This article aimed to present a bibliometric mapping on the theme Eco-Innovation, to allow the researcher to understand the state of the art of the researched area. The research was classified as a review of structured, exploratory-descriptive literature. The Web of Science database was used in January 2017 with the combination of five keywords in the 40 year time period. Histology, VOSviewer and NAILS software were used to analyze the data. The results were presented as follows: i) the most representative versus most cited authors, ii) the main research centers versus the countries, iii) the more representative journals versus the more cited ones, iv) the co-occurrences of keywords, v) the more articles Quoted versus most cited references. In this way, it can be concluded that the first published work on the subject was in 1978 by Kostomo, the issue of Environmental Innovation in Finland. The most representative authors, both in the sample and in the number of citations, are the authors Rennings, Horbach, Mazzanti, Chen, Kemp, Wagner and Oltra. The most representative journals in the sample and number of citations are the Journal of Cleaner Production and Ecological Economics. In relation to research centers, the University of Ferrara and the University of Castilla de la Mancha stand out, both in terms of the number of documents and the number of citations. The most representative countries are UK, Spain, Italy, the Netherlands and the United States. And finally, the paper that presented the most citation and is found in the cited references, is that of Rennings, entitled Redefining innovation - eco-innovation research and the contribution from ecological economics, with 151 citations.

**Keywords:** *Green Innovation, Sustainable Innovation, Environmental Innovation, Eco-Innovation, Bibliometric Analysis*

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## **The Influence of Competitive Intelligence in Environmentally Sustainable Innovation Management**

MARCON, A <sup>a\*</sup>, MELATI, C. <sup>b</sup>, HEINZE, M. <sup>b</sup>, DE MEDEIROS, J. F. <sup>a</sup>, RIBEIRO, J. L. D. <sup>a</sup>

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### **Abstract**

Current social, economic and, mainly, environmental changes affect companies in several forms. Consequently, managers need to implement environmentally sustainable innovations that mitigate the impact exerted by companies' operations on the society. These environmentally sustainable innovations can arise from both companies' internal or external sources. In this sense, the general objective of this paper was to understand the role played by companies' competitive intelligence on the environmentally sustainable innovation management. Specifically, it aimed (i) to identify motivations, practices and the benefits perceived by companies in their green actions, (ii) to map the competitive intelligence mechanisms used by companies to collect information on environmentally sustainable innovations and (iii) to analyze how competitive intelligence aids and affects the decision for green innovation management practices. In order to reach the objective proposed, a qualitative exploratory research was performed through the analysis of three cases of companies based in Brazil. In sum, the results indicate that the organizations use the information arising from the external environment to acquire and gather knowledge on sustainability and, thus, develop organizational, marketing, product and process innovations. To that end, they apply market researches, participate in sustainability-oriented events and associations, monitor current environmental legislations and follow specialized publications and/or reports. The results also indicate that companies hire specialized human resources and specialized consulting companies, adhere to environmental certifications, such as ISO 14001, cooperate with stakeholders and analyze product and process chains to guarantee an environmentally sustainable innovation management. Theoretically, it can be stated that this study contributes to the spread of the use of competitive intelligence as a competitive advantage driver and as an important tool to stimulate environmentally sustainable innovation practices.

**Keywords:** *Environmentally Sustainable Innovation Management; Competitive Intelligence; Sustainability; Sustainable Innovation*

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## **Cleaner Production, Social Responsibility and Eco-Innovation as Antecedents of Environmental Awareness and Sustainable Consumption: The Generations's Perception of a Sustainable Future**

SEVERO, E. A<sup>a,\*</sup>, GUIMARÃES, J. C. F.<sup>b</sup>, DORION, E. C. H.<sup>c</sup>, GIRARDI, G.<sup>a</sup>

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b. *Universidade Federal de Pelotas (UFPEL), Pelotas*

c. *Universidade de Caxias do Sul (UCS), Caxias do Sul*

\*Corresponding author, [elianasevero2@hotmail.com](mailto:elianasevero2@hotmail.com)

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### **Abstract**

The increase in population, the high consumption of food and products, as well as the generation of domestic and industrial waste has triggered impacts on the environment, which compromises the maintenance of natural resources for a sustainable future. Cleaner production (CP), social responsibility (SR) and eco-innovation (EI) aim at sustainability, where environmental awareness (EA) and sustainable consumption (SC) include the principles and values linked to the environment issues that contribute to a sustainable future. The purpose of this study is to measure the EA antecedent relations, considering the constructs of CP, SR and EI. The study also analyzes the relationship between EA and SC, as well as their moderating effect on the Baby boomers and the X and Y generations on the relationships between the constructs. The research is based on the perception of 1123 participants from different generations from the region of south Brazil and the method includes a quantitative and descriptive research, through modeling of structural equations. The results highlight that there is an important relationship between CP, SR and EI, which positively influence EA and consequently, SC. The study also shows a strong correlation between CP and IE. In this context, both generations present different perceptions about those constructs, however the "Baby boomers" generation presented a greater perception from the CP actions carried out by the companies. Consequently, it is evident for the companies to start disclosing CP as an opportunity window, which stimulates SC and benefits the environment. Such positioning may become fundamental for the maintenance of natural resources and the quality of life for future generations.

**Keywords:** *Cleaner production. Social responsibility. Eco-innovation. Sustainable consumption. Generations.*

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## **Eco Innovation in the Context of Green Supply Chain Management: A Proposal of a Conceptual Framework**

SOUZA, W. J. V. <sup>a\*</sup>, SCUR, G. <sup>a</sup>, HILSDORF, W. C. <sup>a</sup>

*a. Centro Universitário FEI, São Bernardo do Campo*

*\*Corresponding author, wjvsouza@gmail.com*

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### **Abstract**

Both practitioners and researchers have been reporting a special interest in eco-innovation issues. The academic perspective points to the need that the number of researches should be increased in developing countries. A topic that has received little attention from the literature is the way in which a company can identify and develop eco-innovations within the green supply chain management (GSCM) context. Therefore, the aim of this paper is to propose a theoretical framework to analyze the eco-innovation deployment within the GSCM context considering: (1) the environmental practices implemented throughout the GSCM, classifying them by eco-innovation category (incremental or radical); and (2) the environmental performance indicators.

**Keywords:** *GSCM; Eco-innovation; Environmental practices; Environmental performance Indicators*

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## **Systematization and Classification of Cleaner Production Practices, Techniques and Tools**

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### **Abstract**

Cleaner Production (CP) is a preventive environmental management approach aimed at reducing pollution at source. Despite the success stories, the literature indicates barriers that hamper the implementation and dissemination of CP in companies. Among these barriers are the lacks of detailed and systematized information on practices that generate results and can be applied in CP implementation process. The main objective of this work is to systematize and classify the practices, techniques and tools of Cleaner Production to support companies in the implementation of Cleaner Production. For this, 357 practices were identified by means of a systematic review (159 classified as management practices and 196 classified as operational practices) and 77 techniques / tools. The practices, techniques and tools were classified according to the stages of the Cleaner Production methodology and its application scope (process, product and value chain) to indicate in which steps it can support the implementation of the methodology. In addition, operational practices were classified in relation to the Cleaner Production strategy adopted and environmental aspects for which they establish control and the techniques / tools were classified according to its functional types to specify which practices can be supported by their application.

**Keywords:** *Cleaner production, CP, Practices, Techniques and Tools.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 2**

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Cleaner Production Practices Towards Circular Economy Implementation at the Micro-Level: An Empirical Investigation of a Home Appliance Manufacturer

The Influence of Enterpreneurial and Market and Knowledge Management Orientations about a Cleaner Production and the Sustainable Competitive Advantage

Analysis of Circular Economy in the Administrative-Managerial Programs of Sustainability in the Public Sector

Megacity Food-Energy-Water Pathway Analysis based on A Systems Thinking Dynamic Circular Economy Calculator

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## **Cleaner Production Practices Towards Circular Economy Implementation at the Micro-Level: An Empirical Investigation of a Home Appliance Manufacturer**

SOUSA-ZOMER, T.T.<sup>a,\*</sup>, MAGALHÃES, L.<sup>b</sup>, ZANCUL, E.<sup>b</sup>, CAMPOS, L.M.S.<sup>a</sup>, CAUCHICK-MIGUEL, P.A.<sup>a,b</sup>

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### **Abstract**

The concept of circularity has been widely discussed in the literature, but the implementation of the circular economy (CE) concept at the micro-level remains unexplored. Manufacturing companies should develop new business strategies and implement new practices in the transition process towards a circular economy model at the bottom-up. Cleaner production (CP) principles and practices have been discussed as essential for CE adoption at the micro-level, but specific studies should be conducted regarding the adoption and effects of cleaner production in promoting CE. Thus, this paper aims to explore the cleaner production principles and practices adopted by a manufacturing company located in an emerging economy in order to understand how those were valuable to foster CE implementation. A case-based research was adopted in this investigation. The CP practices introduced by the company were analyzed, their connections with the requirements to be measured when transitioning to a CE paradigm, and with CE areas at the micro-level. An inductive approach was adopted to develop some propositions regarding CP and CE interactions. The main findings revealed that CP practices for product optimization are valuable to CE implementation regarding circular product design strategies. The CP principle of input substitution is valuable to reduce input and use of natural resources as well as to increase the share of renewable and recyclable resources. Technological optimization can contribute to reducing emissions level. In addition, it could be noticed that CP practices at the production area enable CE practices implementation at the micro-level and a connection with other CE areas (i.e. waste management, consumption, and support). Moreover, the findings confirmed that all CP practices and principles implemented by the company were enablers to the CE issues implementation regarding the new business strategy. Further studies may focus on testing the propositions developed in this study in other manufacturing contexts as well as on the investigation of possible cause-effect relationship that may exist between CP and CE practices adoption.

**Keywords:** *circular economy, product-service systems, cleaner production, home appliance manufacturer.*

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## **The Influence of Enterpreneurial and Market and Knowledge Management Orientations about a Cleaner Production and the Sustainable Competitve Advantage**

GUIMARÃES, J. C. F.<sup>a</sup>, SEVERO, E. A.<sup>b</sup>\*, VASCONCELOS, C. R. M.<sup>c</sup>

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### **Abstract**

Enterprises from different economic sectors play a fundamental role in furthering a sustainable development in the region where it is inserted. However, it is the environmental practices of these organizations which determine the prompt impacts on environmental sustainability. In this sense, a Cleaner Production (CP) is responsible for the decrease in natural and material resources consumption and energy, as well as for the systematic decrease in waste and pollutants emission. Thus, it is important to identify the strategical guides which came before the CP and, consequently, lead the enterprises to achieve a Sustainable Competitive Advantage (SCA) before their competitors. In this context, this research aims at analyzing the influence of Entrepreneurial Orientation (EO), Market Orientation (MO) and Knowledge Management Orientation (KM), about the CP and the SCA. The present research was about a survey applied to 1.774 small and medium enterprises in Southern Brazil, in the sectors of transformation industry, commerce and services, and it was analyzed by the Structural Equation Modeling, typifying it as a quantitative and descriptive research. The results show there is an intense previous influence (EO, MO, KM) over the CP, pointing out that the correlations among the three antecedents have a high intensity, showing that the enterprises researched use the strategical guides (EO, MO, KM) separately, and that, when they are combined, there is a higher chance of CP success, with a significant increase in SCA for the small and medium enterprises.

**Keywords:** *Cleaner production. Sustainable competitive advantage. Entrepreneurial orientation. Market orientation. Orientation knowledge management.*

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## **Analysis of Circular Economy in the administrative-managerial programs of sustainability in the Public Sector**

SILVA, R. G. <sup>a,c\*</sup>, MELLO, D. P. <sup>a,b</sup>, MELO, M.B.C.<sup>a,c</sup>, ALVES, L. S.<sup>a,d</sup>, EL-DEIR, S. G.<sup>a,e</sup>

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### **Abstract**

Faced with socio-environmental demands, economic growth marked by the socio-metabolic reproduction of capital is becoming increasingly exclusive and predatory. The existing structure of production of goods and services no answers to the new reconfiguration experienced by the current market. The 21<sup>st</sup> century sees a repositioning of the production chain in the sense of mitigating the negative impacts on the environment. From the study of management models proposed by the public service, it's possible the implementing or encouraging the structuring for an economic model based on sustainability, since there are government programs that are aligned with the establishment of operational parameters linked to socio-environmental public policies. In this context, the identification of mechanisms that are targeted to the principles of circular economy is relevant to understand of development focused on the parsimonious use of natural resources and in the establishment of *modus operandis* that encourage the internalization of such precepts by the economy. The purpose of this paper assumes the importance of the aforementioned sector as an example of organization aimed at implementing environmental efficiency, with the possibility of spreading these initiatives in other productive sectors among public and private enterprises. In fact, the reality is still well behind a process of internalization and radical change in the internal management of the public sector regarding the rational use of natural resources and the full implementation of circular economy. Socio-environmental planning, be it voluntary or imposed (Agenda 21, Public Administration Environmental Agenda, Sustainable Logistics Program and Eco Committee of Pernambuco), arises as a regulatory and supervisory instrument of good practices, to assist the process of public governance, to achieve success in the process of changing the inertia toward conscientious action, through socio-environmental responsibility. In this context, it is possible to observe that there are feasible public initiatives that endorse, in many aspects, the ramifications of circular economy. Such initiatives denote the potential for replicability in other organizations under similar conditions.

**Keywords:** *Courts; Environmental efficiency; Public administration.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Megacity Food-Energy-Water Pathway Analysis based on A Systems Thinking Dynamic Circular Economy Calculator**

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### **Abstract**

Circular economy is regarded as a policy for fulfilling the sustainable development which has been implemented for 9 years by the government in many cities of China. Chinese circular economy view insists to overcome the dilemma between the economic depression and energy shortage in the nationwide. However, a circular economy may have a different flavor in different megacities, depending on geographic, environmental, economic or social factors. Besides, few literatures contribute to checking the efficiency of current circular economy policies, especially in the aspect of regional wide, which will be practically helpful in guiding China's future development. In this paper, we proposed an Urban Circular Economy Calculator based on a full Excel version energy-based urban dynamic model, which is a feasible approach to help the policy-makers create circular economy pathway under different food-energy-water (FEW) policies. The scenario analysis approach has been used in this Urban Circular Economy Calculator to illustrate a greener economy under alternative assumptions of the FEW Circular Economy policy. What's more, long-term simulation will be provided by the calculator to test the trajectories of Circular Economy policy effects under the assumptions of the associated levels. Taking Beijing city as a case, the impact of different circular economy policies can be observed by using real scientific data. This model can be applied to other cities as well in the light of their actual situation respectively. In that case, suggestions on regional management, which make sure our cities achieve friendly and sustainable development over a long period of time can be proposed for our government accordingly.

**Keywords:** *Energy analysis, Urban dynamic model, Circular economy, Food-Energy-Water (FEW) policies, Scenario analysis.*

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 3**

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Sustainable Supply Chain Management: The Missing Link of Social Sustainability

Motivations for Corporate Social and Environmental Responsibility: Bibliographic Mapping and Research Hypothesis Proposition

Assessment of the Integration Between Corporate Social Responsibility Practices and Management Processes in Brazilian Companies

The ESG-Environmental, Social and Governance Performance in Different Institutional Environments

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## **Sustainable Supply Chain Management: The Missing Link of Social Sustainability**

MORAIS, D. O. C. <sup>a\*</sup>, SILVESTRE, B. S. <sup>b</sup>

*a. Fundação Getúlio Vargas – Escola de Administração de Empresas de São Paulo, São Paulo, Brazil*

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### **Abstract**

The social dimension of sustainability has been poorly investigated when compared to the environmental dimension, especially in sustainable supply chain management studies. This lack of attention is problematic for the theory and practice of managing sustainable supply chains. This research aims to help filling this gap and addresses the following question: how focal companies implement and manage social sustainability into their supply chains? The concepts of supply chain engagement and initial motivation shed additional light on the topic and taken together generate a useful model that can improve our understanding of the complex interactions between the management of supply chains and their social sustainability performance. We selected four cases of social initiatives undertaken by focal companies within their supply chains and used them as practical examples of the four different supply chain approaches to social sustainability developed in this paper. We finish the paper with implications of this research for the practice of supply chain management as well as contributions to the associated theory.

**Keywords:** *Supply Chain Social Sustainability; Sustainable Supply Chain Management; Supply Chain Engagement; Sustainable Motivation; Sustainability.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Motivations for Corporate Social and Environmental Responsibility: Bibliographic Mapping and Research Hypothesis Proposition

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### Abstract

The present study aimed to identify the main motivations for the adhesion to Corporate Social and Environmental Responsibility (CSER) and, subsequently, it aimed to propose research hypotheses to be validated in future studies. Methodologically, a bibliographical research was conducted through keyword searches in scientific databases. As to the results, initially the motivations mapped in the 54 articles analyzed were classified into internal (derived from the needs and beliefs that arise from within the company) and external motivations (derived from the influences exerted by external or the competitive environment, such as stakeholders). Afterward, the diverging nomenclatures for the same motivation were standardized, and the result originated a list of fifteen motivations: build employee trust; seek innovations through CSER; integrate CSER practices to quality management; improve process productivity and efficiency; increase the company's economic performance; mitigate risks; reduce costs; develop corporate responsibility actions for the society and for the environment; prevent and control pollution and minimize waste generation; managers' personal values; to adequate the organization to stakeholder pressure; add value to the brand through brand differentiation (competitive advantage); seize market opportunities; comply with legislations and regulations; increase customer satisfaction; improve the company's image; The research hypotheses about the distinct corporate motivations for CSER were developed considering three levels of analysis: (i) institutional; (ii) organizational; and (iii) individual levels.

**Keywords:** *Corporate Social and Environmental Responsibility. Motivations. Organizations and sustainability.*

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## **Assessment of the Integration between Corporate Social Responsibility Practices and Management Processes in Brazilian Companies**

CAZERI, G. T.<sup>a\*</sup>. ANHOLON, R.<sup>a</sup> COOPER ORDOÑEZ, R.E.<sup>a</sup> SILVA, D.<sup>a</sup>  
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### **Abstract**

This article aims to assess the integration between Corporate Social Responsibility (CSR) practices and management processes in Brazilian companies, according to the perception of professionals with expertise in the theme. The strategy used was a survey, using as an instrument to collect data a questionnaire. Data were collected from 48 respondents, and these data were analyzed using the Multidimensional Scheduling (EMD) and Exploratory Factor Analysis (AFE) for one factor. The EMD was used to identify outlier respondents and AFE was used to order the practices studied. The results showed improvement opportunities in all practices and that some practices are developed superficially. When analyzed comparatively, using factorial scores, two practices were highlighted. The first one associated to report the results to the stakeholders and the second one associated to performance evaluation via indicators. On the other hand, it was also noticed that practices with lower application degrees are related to planning activities, which compromises better results in the integration process. The results presented here are important and can be useful for business managers and academics in future research.

**Keywords:** *Corporate Social Responsibility, Integration with Management Process, Survey*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **The ESG-Environmental, Social and Governance Performance in Different Institutional Environments**

GARCIA, A. S. <sup>a,\*</sup>, ORSATO, R. <sup>a</sup>, MENDES-DA-SILVA, W. <sup>a</sup>

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### **Abstract**

Considering the institutional, cultural and regulatory differences between countries, this research investigates the differences between the performance of ESG-Environmental, Social and Governance and its relation with the financial performance of companies from emerging and developed countries. Through the ASSET4 database, the panel data methodology was used with 2,165 companies from developed and emerging countries. The results allow us to accept the hypotheses raised that there is a prevalence of the institutional environment in relation to financial performance and ESG performance. In addition, it was also found that companies from controversial sectors have better performance ESG than companies from other sectors.

**Keywords:** *Corporate social responsibility, ESG performance, sustainability*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 4**

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Evaluation of Cleaner Production Opportunities for the Horizontal Packaging Process

Environmental, Economic and Technical Performance: A Comparative Study of Carrier Bags

The Production Planning and Control Eco-Efficient: A Case Study in the Plastic Segment

Design Requirements for Sustainable Products Development: A Framework Proposal

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## Evaluation of Cleaner Production Opportunities for the Horizontal Packaging Process

STALTER, C. F. <sup>a\*</sup>, MORAES, C. A. M. <sup>a</sup>

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### Abstract

Bioriented polypropylene (BOPP) is a type of flexible polymer widely used in the film format for the packaging of various materials, including in the food market. The packaging route begins with the production of the film that goes into the flexographic printing process and then reaches the horizontal packaging process. The three processes are carried out by different companies and each one presents its environmental impacts, in this sense, this work aims to carry out the diagnosis of these processes and from this survey, to point out Cleaner Production (P + L) opportunities in the packaging process seeking reduction of waste in the generating source. The potential environmental impacts of each of the processes were identified and the packaging process also identified opportunities for improvement aimed at reducing the generation of waste at source. For this, it was taken into account that the company that carries out the packaging process has two different machines for the same type of process: one old and one of a more current model. From a simple process follow-up, it was identified that the old machine generates a greater amount of waste when compared to the new one. In this way, it was highlighted as an opportunity to improve the proper quality control of the coils, to replace the manual feeding of the mats by the automatic feeding and the installation of a stop sensor so that the machine interrupts the process when there is no material on the mat, avoiding the generation of empty packages that are discarded as waste.

**Keywords:** *BOPP, packaging, Cleaner Production.*

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## **Environmental, Economic and Technical Performance: A Comparative Study of Carrier Bags**

CARVALHO, J. S. <sup>a</sup>, MACEDO, J.R.N. <sup>a</sup>, OLIVEIRA, S. A. <sup>a</sup>, ROSA, D.S. <sup>a\*</sup>

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### **Abstract**

The concept of sustainable development arose from the questioning about the availability and rate of consumption of natural resources. The methodology of Life Cycle Assessment (LCA) and the concept of Eco-efficiency have been making a high contribution to the literature. The main objective of these is to manage sustainability with results that clarify less impacting alternatives to a process or product. In this context, the unfavorable scenario of the inadequate final destination of the plastic material after its use needs further deepening. The present article presents results of an analysis performed comparing different materials for application in disposable bags according to NBR ISO 14040 standard series. Biodegradable bags developed with Ecovio® compositions (biodegradable polymer, composed of poly (butylene adipate coterephthalate) (PBAT) and poly (lactic acid) (PLA), Ecoflex® (based on PBAT), Economical and technical analysis of these compositions was compared with conventional alternatives (kraft paper bag - PAPEL and polyethylene - PE). The simultaneous balance with environmental, economic and technical impact indicators was carried out to verify the alternatives with the best behaviors. In the development of the analysis were used methodologies that evaluate both environmental performance and also characterize polymer films. The results showed that among the 12 categories analyzed, the most relevant were Solid Residues / Energy Consumption (environmental performance) and Contact Angle / Water Sorption (technical performance). Conventional bags did not obtain a financial return after final destination, however they presented the lowest cost throughout the life cycle. Finally, the combined Environmental Impact and Characterization matrices showed that the ECO sample presented the best balance, showing the lowest environmental impact and a satisfactory technical performance.

**Keywords:** *Biodegradable polymers, disposable bags, Life Cycle Assessment, Characterization of polymers*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017



## **The Production Planning and Control Eco-Efficient: A Case Study in the Plastic Segment**

COSTA, I. S. <sup>a\*</sup>, OLIVEIRA NETO, G. C. <sup>a</sup>, LOPES, D. R. G. <sup>a</sup>,  
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### **Abstract**

Eco-efficiency allows a company to be environmentally responsible and at the same time obtain economic gains through its productivity or services. In the midst of the economic and environmental challenges faced by organizations, activities such as recycling, reuse, energy saving, preventive maintenance and Setup, among other creative actions, are challenges that the Production Planning and Control (PPC) must face in this new scenario to make an enterprise eco-efficient. In this context, the present study aims to verify the benefits that the activities carried out by the PPC can provide to organizations, both in the economic and environmental aspects of companies in the plastic segment. In the present study, a case study was carried out, and as a data collection technique, a semi-structured interview was conducted with the PPC manager. To evaluate the environmental impact, the MIF eco-efficiency tool was used, resources used in the Wuppertal Institute table (2014). Through values, (prices and quantities) of the raw material, reports and interviews, besides participant observation, it was possible to carry out calculations of the economic and environmental values obtained before and after implementing the SMED methodology in the production line, for the reduction of setup in a company of the plastic branch. As well as other actions accompanied by the PPC as recovery and reuse of raw material and substitution of non-renewable by renewable raw material. With the joint implementation of actions, the company obtained economic and environmental benefits, providing a quantity of R\$ 1,009,316.74 with reduction, recovery and reuse of chips in the production process, and a reduction of 42,644.52 tons avoided to be withdrawn from the ecosystems in a period of six months.

**Keywords:** *Eco-efficiency, PPC, setup, reuse, renewable raw material.*

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## Design Requirements for Sustainable Products Development: a Framework Proposal

FERNANDES, P. T. <sup>a\*</sup>, MATTIODA, R. A. A. <sup>a</sup>

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### Abstract

In the integrated product development process (IPDP) the sustainability requires an increasingly broad contextual approach. Sustainable project processes, organizations committed to sustainable development, and managers trained in sustainability are all necessary, though perhaps insufficient, elements for the design of sustainable products. For a company to be sustainable it must adopt sustainability in a systemic way, where all parts of the organization and the phases of the project are considered. Its final product should include aspects that consider issues related to sustainability at a strategic level, especially in the phases related to the planning and conceptual design of the products. In this context, this study searches to identify the necessary design requirements for the implementation of activities focused on sustainability issues in product development. For this investigation, two stages of literature review and content analysis were performed, generating a total of 82 articles examined. As a result, seven new project activities are presented: (a) Identification of the product category, (b) Definition of the End-of-life (EOL) strategy, (c) Identification of sustainable best practices, (E) Life cycle analysis, (f) Assessment of legal issues, and (g) Verification of design recommendations for the product category. From these, the authors propose a preliminary framework for the development of a future reference model for sustainable IPDP.

**Keywords:** *product development, sustainability, ecodesign, sustainable products, project requirements.*

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 5**

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Proposal for a Preliminary Model of Integrated Product Development Oriented to Production Activities

The Principles of Industry 4.0 and the Sustainability Impacts of the Enterprise Value Chain

Planned Obsolence and Sustainability

Proposal to Include Sustainability Aspects in the Product Development Process

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## **Proposal for a Preliminary Model of Integrated Product Development Oriented to Production Activities**

FAGAN, A. M. V. <sup>a,b\*</sup>, CANGIOLIERI JUNIOR, O. <sup>b</sup>

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### **Abstract**

This work was directed from a study of the phases of the development cycle of PDP and PDIP models, and of works that approached the integration of the manufacture to the development of products. It was verified that the integration of the manufacturing to the PDIP presents gaps, mainly in the phase of production, since the majority of the works are focused in the stages of design and do not consider the complete cycle of development of the product. Therefore, the objective of this work was to propose a preliminary model of integrated product development oriented to production activities throughout the product life cycle. The proposed model presents three phases and seven stages, where each stage has specific activities integrated with the production. As a next step, the model will be tested in Multiuse Goods Not Consumers of clothing products belonging to the fashion corridor, located in the state of Paraná.

**Keywords:** *Integrated Product Development Process; Project; Manufacturing, Cleaner Production, Concurrent Engineering.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **The Principles of Industry 4.0 and the Sustainability Impacts of the Enterprise Value Chain**

PALMA, J. M. B. <sup>a\*</sup>, BUENO, U. S. <sup>a</sup>, STOROLLI, W. G. <sup>a</sup>, SCHIAVUZZO, P. L. <sup>a</sup>, CESAR, F. I. G. <sup>a,b</sup>, MAKIYA, I. K. <sup>a</sup>

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### **Abstract**

The growing interest for sustainability has led companies to adjust their strategies to include initiatives for the advancement of the three pillars of business sustainability in environmental, economic and social dimensions. These initiatives often are restricted to the internal actions in enterprises, and the results normally do not expand across the entire company business value chain. Some restrictions are still blocking the advance of sustainability at all levels, since finding solutions requires integration efforts and major changes in products, processes and behavior of people operating in highly complex networks. With the advance of new technologies, especially those from the Industry 4.0 (I.4.0), a high level of connectivity between the processes benefits the expansion of customized products and other elements that suggest deep changes in organizational environments and in society, contributing to the sustainability dimensions. In this scenario, this study intends to evaluate the relationship between sustainability and Industry 4.0 principles, which may impact in advancing the strategies within the company business value chain.

**Keywords:** *Industry 4.0, sustainability, value chain, environment.*

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## Planned Obsolescence and Sustainability

SATYRO, W. C.<sup>a\*</sup>, SACOMANO, J. B.<sup>a</sup>, CONTADOR, J. C.<sup>a</sup>,  
CARDOSO, A.<sup>a</sup>, SILVA, E. P.<sup>a</sup>

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*\*Corresponding author, satyro.walter@gmail.com*

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### Abstract

Substantial increase in interest about environmental issues has occurred in the last decades with academy, industry, government, leaders and general society more concerned about sustainability. Although much research has been done on ways to provide better conditions of environment and cleaner production, little attention has been paid to the impact of the short life cycle of the current products in sustainability and also to the necessity of providing natural resources to supply goods to a human population with a growth rate never seen before. Using literature review and secondary data, the objective of this paper is to study the necessity of changing the paradigm of planned obsolescence to the one of long-lasting products and to present some suggestions on how to keep them updated under so many changes and innovation to which the products are subject in the present days. The originality and practical implications of this research is to arouse interest that global developing based on a consumption society is no longer sustainable, and a new and less consumerist society should replace the current one.

**Keywords:** *sustainability, life cycle, obsolescence, consumerism, innovation*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Proposal to Include Sustainability Aspects in the Product Development Process**

LEÓN C. A. V.<sup>a</sup>, CORDEIRO, G. A.<sup>a</sup>, DEPAULA, C. P.a, PACHECO JR, M. A.<sup>a</sup>, COOPER, R. E.<sup>a</sup>

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\*Corresponding author, camila.a.leon.v@gmail.com*

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### **Abstract**

Innovation and sustainability are considered imminent trends for companies that seek to continue competitive in a globalized market. Part of the responsibility to build a more sustainable society is associated with the capacity of the Product Development Process (PDP) team adopt these concepts in its routine in the business environment. In this scenario, there are few researches that consistently addresses the insertion of sustainability in the PDP, more specifically regard to the Triple Bottom Line (economic, social, environmental) dimensions, factor by which sustainability is measured. Considering that few surveys show clearly this relationship, this paper aims to contribute to the improvement of the PDP through the theoretical suggestion of incorporating sustainability aspects, in this case 11 approaches and tools that are applicable in the different PDP phases. Furthermore, is specifically defined in which phase this concepts should be applied.

**Keywords:** *Sustainability, Product Development Process (PDP), Triple Bottom Line, Sustainability Approaches and Tools.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 6**

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Business Cooperation Networks: Arrozeiras do Sul Experience

Carbon Footprint of Intensive Broiler Production

Development of a Complement for Animal Feeding from Microalga *Chlorella* sp Biomass

Sustainable of tomatoes supply chain management – Cases of study

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## **Business Cooperation Networks: Arrozeiras do Sul Experience**

D'OLIVEIRA, J. L. P. <sup>a\*</sup>, PASQUALETTO, A. <sup>a</sup>, GUEDES, L. G. de R. <sup>b</sup>

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### **Abstract**

Business Networking becomes a brilliant alternative so several objectives can be achieved in less time, with better quality, lower cost and meeting current production needs within the criteria of environmental sustainability. In this paper, considerations based on a field research, supported by a theoretical reference on the structuring and operations of Business Networks are presented, as well as validated by a praxis evidence of what occurred and still occurs in the Arrozeira do Sul Network in the south of Brazil. This network effectively establishes the search for the concept of Cleaner Production, achieving consistency in its criteria of environmental sustainability.

**Keywords:** *Cooperation Networks, Cleaner Production, Sustainability.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Carbon Footprint of Intensive Broiler Production

LIMA, N. D. S.<sup>a\*</sup>, NÄÄS, I. A.<sup>a</sup>, GARCIA, R. G.<sup>b</sup>

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### Abstract

The intensive broiler production is a significant economic activity when considering the increase in broiler production and the number of slaughtered birds. However, this commercial segment needs to adjust to the perspectives of low carbon emission economy. There is a lack of information of carbon equivalent emitted in the broiler production supply chain under certain rearing conditions. Therefore this study aimed to estimate the greenhouse gasses (GHG) from broilers reared in the dark-house system in Brazil and to find the carbon footprint for subsidizing future mitigation. Dark house systems consisted of a house 15 m wide, 150 m long and 3.8 m high, and a floor area of 31500 m<sup>2</sup> with forced ventilation; exhaust fans (12 with an air flow of 580 m<sup>3</sup> s<sup>-1</sup>), a high-pressure fogging system, and internal built walls painted with a black coating. To evaluate the carbon footprint the total rearing time was considered (1d old to 42d old). Data from 5 similar houses were registered including electricity use, dimensions, and material of the house, the number of reared birds, litter management, the number of flocks in the same litter per year, and feed ration. GHG emissions were estimated using the method developed by the World Resources Institute using emission factors based on the region and the type of animal, according to the recommendations of the IPCC for inventories. Mechanical emissions were approximately 97% of the total emissions. Annual total emissions from mechanical sources added 740 tons of CO<sub>2</sub>eq/year. This value is a result of the use of electricity (21 tons of CO<sub>2</sub>eq/year) and the technological level of the system (exhaust fans, automatic feeders, and drinkers). Emission from the litter added up 55 tons of CO<sub>2</sub>eq/year. Feed represented nearly 75% of all emissions depending on the origin and the type of feed grains for the production of the feed ration. The total estimation of the environmental impact of broiler production under the dark-house system in the center-west of Brazil is 740 tons of CO<sub>2</sub>eq/year.

**Keywords:** *environmental impact; greenhouse gasses; broiler meat*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

## Development of A Complement For Animal Feeding From Microalga *Chlorella* sp Biomass

CANTU, L.C.<sup>a</sup>, PRADO, M.R.<sup>a\*</sup>, BALLAO, M.C.R.<sup>a</sup>, RAMALHO, A.M.<sup>b</sup>

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b. *Universidade Federal do Paraná (UFPR)*

\*Corresponding author, [mrealprado@utfpr.edu.br](mailto:mrealprado@utfpr.edu.br)

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### Abstract

This work had as objective to cultivate the microalga *Chlorella* sp., and use their freeze-dried biomass to produce a fish feed supplement, comparing the characteristics of microalgal biomass with a commercial fish feed. After the culture, separation and lyophilizing process for preservation of the samples, characterization tests were carried out, such as proteins, lipids, ashes, moisture, carbohydrates and biological assays. The physical-chemical tests were carried out on the micro-algae *Chlorella* sp., in the diet for pure fish (Bottom Fish), and in mixtures of fish feed with the microalgae *Chlorella* sp. in different proportions. An increase of the protein content by 0.83% and the lipid content of 239.47% was observed. There was a decrease of 6.97% in the carbohydrate content, as well as in the ash and moisture content, which were 34.65% and 24.26%, respectively, in the substitution of 50% of microalgae in the feed composition. As fish demand a higher protein demand for their development than the other animals, the greater protein growth is measured when a microalga is incorporated. The *Chlorella* sp. presents as a promising complement for fish feed presenting a crude protein content of 36.9%.

**Keywords:** *food technology, bioenergy, centesimal composition, alternative foods.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Sustainable of Tomatoes Supply Chain Management – Cases of Study**

CAMILO, R. <sup>a\*</sup>, MANO, T.B. <sup>a</sup>, ROCHA, L. B. <sup>a</sup>, ALMEIDA, R. A. de <sup>b</sup>,  
REZENDE, R.V. de P. <sup>b</sup>, RAVAGNANI, M. da A.S.S. <sup>a</sup>

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### **Abstract**

It is important to think about ways to reduce costs and also minimize negative environmental impacts in the fruits and vegetables supply chain, seeking to improve the distribution system of these products for markets and benefits for society. An innovative approach to supply chain (SC) management requires a general bi-objective optimization framework that incorporates Life Cycle Assessment (LCA) principles. Linear Programming (LP) is a powerful mathematical technique that can be used as a tool in LCA. The objective of this work is to make an environmental and economic evaluation of the SC of tomatoes for the region of the Umuarama city, Brazil, accounting for different process configurations. The production of tomatoes has an important participation in the region economy. The scope of work encompasses three levels of decision-making within the life cycle: producers, warehouses and markets. The information gathering was performed from interviews with the producers, the supermarkets and the warehouses involved. The LCA study applied in this work was carried out according to ISO 14044/2009. A model of multiobjective LP was developed for the environmental and economic evaluation of SC and the global optimization solved with CPLEX 12.1 algorithm available on GAMS<sup>®</sup>, accounting for different environmental and economic charges simultaneously. As a result, the Pareto frontier was found offering a number of feasible options for system improvements. There are possibilities for improvement in the Tomato Supply Chain Management, since changes in process configuration can be translated into minimization of costs and environmental impacts.

**Keywords:** *Optimization. Life Cycle Assessment. Sustainability Management. Value Chain. Tomato.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **25<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 5B**

**Room 7**

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Artificial Stone Produced with Stone Powder and Polymeric Agglomerant

Life Cycle Assessment of Wastewater Treatment Systems Including Constructed Wetlands

Produced Water Treatment by Nanofiltration

Use of Experimental Design in the Study of Water Absorption of Ceramic Incorporated with Red Mud

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## **Artificial Stone Produced with Stone Powder and Polymeric Agglomerant**

AGUIAR, M. C. <sup>a\*</sup>, SILVA, A. G. P. <sup>a</sup>, GADIOLI, M. C. B <sup>b</sup>

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- b. CETEM/NR-ES, Centro de Tecnologia Mineral – CETEM / Núcleo Regional do Espírito Santo. Rodovia Cachoeiro-Alegre, km 05, Morro Grande, Cachoeiro de Itapemirim-ES.

\*maricostalonga2@gmail.com

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### **Abstract**

Artificial stone are nowadays extremely important in civil construction, constituting remarkable branches of this industry. This material is produced by 95% of natural aggregates, that is, it is considered practically natural material. The objective of this work was to study the production of artificial stone for application in interior lining, using waste from the marble industry of the Cachoeiro de Itapemirim-ES region. The physical and mechanical properties of the plates and composites and matrix with resin were studied, with the addition of marble waste in a specific range of 20, 80 and 180 mesh granulometry. The plates were produced by means of the vacuum vibration technique. For the parts produced the density and the water absorption were determined. The material was submitted to tests of resistance to compression and flexion. The artificial marble presented good properties, with its maximum bending tensile strength of 37.75 MPa and maximum compressive strength of 72.47 MPa. The results indicated that the marble waste has great potential for its use in the production of artificial stone and is an alternative to give a destination for this waste generated in the order of millions of tons that represents serious environmental problem.

**Keywords:** *Artificial stone, marble, resin.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Life Cycle Assessment of Wastewater Treatment Systems Including Constructed Wetlands

RESENDE, J.D.<sup>a\*</sup>, NOLASCO, M. A.<sup>a</sup>, PACCA, S.A.<sup>a</sup>

*a. Universidade de São Paulo, São Paulo*

*\*Corresponding author, julianadr@usp.br*

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### Abstract

Decentralized wastewater treatment systems, although having some advantages in relation to centralized systems, also cause environmental impacts. This characteristic, must be taken into account in the selection of an alternative technology to treat wastewater or in propose improvements to existing systems. One of the tools that can be used to assess the environmental performance of wastewater treatment systems is the Life Cycle Assessment (LCA). In this study, LCA was used in order to analyze and compare the potential environmental impacts of two configurations of decentralized wastewater treatment systems involving constructed wetlands. The constructed wetlands studied were built using two distinct materials: fiberglass and brick masonry. The modeling of systems and calculations involved in the assessing of the life cycle impacts were realized through the use of openLCA software. The impact assessment method used for the categories of terrestrial acidification, climate change, eutrophication of fresh water, formation of photochemical oxidants, formation of particulate matter and freshwater depletion was the ReCiPe method. The results showed that the potential impacts related to the use of masonry with bricks for the construction of the systems are greater than the potential impacts related to the use of fiber of glass for all impact categories studied.

**Keywords:** *LCA, Life Cycle Assessment, constructed wetlands, ReCiPe, OpenLCA*

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## Produced Water Treatment by Nanofiltration

TURRA, C. \*, GIACOBBO, A., BERNARDES, A. M.

LACOR, PPGE3M, Universidade Federal do Rio Grande do Sul, Rio Grande do Sul

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### Abstract

The problem about produced water (PW) is worst if we consider that, for a single gallon of petroleum, there are three gallons of produced water as byproduct. PW is composed of a wide range of salts, suspended solids, chemical products such as antifloculating and anticorrosive substances and some organic products, being a treatment necessary either to disposal to the environment as to reuse. For this, the membrane processes such as ultra, micro and nanofiltration is becoming an option. In this study, nanofiltration (NF) membrane was characterized in terms of hydraulic permeability ( $L_p$ ) and rejection coefficient ( $R$ ), to be used as membrane process for onshore PW treatment. A synthetic effluent, simulating PW from onshore platform, was treated by NF in different operational conditions, combining three values of feed flow rate (96, 192 and 240 L.h<sup>-1</sup>) and pressures varying from 2 – 6 bars. Temperature and pH were practically constant, with few modifications during the assays. The optimal regime, ie. feed flow rate and applied pressure, was the combination of 192 L.h<sup>-1</sup> of feed flow rate and 6 bars of pressure, which was capable to remove more than 81% of ions present in the synthetic PW. Between all the assays, the NF membrane was washed until  $L_p$  reached at least 90% the initial value. This fact proves that NF is a very effective method in salts removing from PW, promoting water reuse, recycling and correct disposal.

**Keywords:** *membrane processes, nanofiltration, reuse and disposal, produced water treatment*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Use of Experimental Design in the Study of Water Absorption of Ceramic Incorporated with Red Mud**

BABISK, M. P. <sup>a\*</sup>, BUROCK, I. P. <sup>b</sup>, RIBEIRO, L. S. <sup>a</sup>, PRADO, U. S. <sup>c</sup>,  
MONTEIRO, S. N. <sup>d</sup>, VIEIRA, C. M. F. <sup>a</sup>

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*d. Instituto Militar de Engenharia, Rio de Janeiro*

*\*michellebabisk@hotmail.com*

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### **Abstract**

During the processes of alumina processing, in the Bayer process, an insoluble residue known as red mud is generated. The incorporation of industrial waste in ceramics has been widely used today in the search for alternative raw materials, and also seeking an environmentally correct disposal of waste that pollute. The objective of this work was to use experimental design to study water absorption in ceramic incorporated with red mud. Experimental points were used, whose contents of the materials used varied from 0 to 100%, and the formulations fired at 950°C, the dry density of the raw materials and linear shrinkage of the compositions were also investigated. The green clay and the mixtures containing the highest percentages of the same presented lower values of water absorption and linear shrinkage of firing. The mathematical model that fitted the most was the special cubic. The results obtained in the planning of mixtures show that for the three experimental regions proposed, the special cubic model was the one that most adjusted to the real results, and that this is statistically the best mathematical model and should be used to evaluate the water absorption.

**Keywords:** *Red mud, red ceramic, residue, experimental design*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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**Conferences**

**and**

**Oral Presentations**

**26<sup>th</sup> May 2017**

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **26<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 6A**

**Room 1**

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Global Efficiency of the Brazilian Soybean Transportation for Exportation: Road Versus Railroad Systems

Environmental Sustainability Practices in Logistics Service Providers: A Literature Review

Towards a More Sustainable Passenger Transport: Management of Disutility Related to Environmental Impacts

Sustainability Management in Ports

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## Global Efficiency of the Brazilian Soybean Transportation for Exportation: Road Versus Railroad Systems

RICHARD SILVA, T. <sup>a, b, \*</sup>, AGOSTINHO, F. <sup>a</sup>

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b. *Fatec da Baixada Santista*

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### Abstract

The efficient flow of Brazilian agricultural and industrial production to the exporting ports is considered as fundamental to guarantee quality and competitiveness to Brazilian products. Currently, the road system comprises 61% of the Brazilian transport matrix, followed by rail 21% and waterway 18%. Strategic plans by the government point to subsidizing the growth of the railway modality to reach 35% of the transport matrix, but generally these decisions are based exclusively on economic indicators. In this sense, this work aims to evaluate the emergy (written with "m") global efficiency of the road and rail modes in Brazil. Due to its importance in the Brazilian gross domestic product, the soybean commodity is considered as a case study (year 2014/2015), and the boundaries of the evaluated system includes its production at Mato Grosso State to the Port of Santos city. Results indicate an emergy demand for the road system of 6.25E5 sej/ton.km, while the rail system demands 73.9E5 sej/ton.km. These values represent an emergy global efficiency of approximately 12 times higher for the road system, being, therefore, the modal that should be promoted from an emergy perspective. Anyhow, it is recognized the need in considering other aspects as economic, social, logistics, etc., to subsidize a better informed decision.

**Keywords:** *Emergy accounting; Santos port; Soybean; Road transport; Railroad transport.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Environmental Sustainability practices in Logistics Service Providers: A literature review**

FROIO, J. P. <sup>a\*</sup>, BEZERRA, S. B. <sup>a</sup>

*a. UNESP - Univ Estadual Paulista, Faculdade de Engenharia de Bauru/SP  
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### **Abstract**

Environmental sustainability is a topic that has captured attention by both scientific community and organizations due to increased environmental concern throughout the world. In this context, companies from various sectors have adopted environmentally friendly practices in their activities making processes, services and goods environmentally sustainable. Logistics Service providers (LSP) from several countries act in this direction, carrying out internal and external environmental practices. This literature review sought articles published in international journals that bring many types of green practices undertaken only by LSP companies around the world, different from other studies already published. To analyze the selected articles, a classification in form of a framework with seven approaches was used to classify both internal and external environmental practices. This study showed that the logistics sector has been trying to cooperate with other sectors to minimize impacts on the environment. Some results are presented: several practices are still incipient; most of them are internal to the company; there is no compliance of practices among the sector, so most LSP companies try individually to take actions in favor of environmental sustainability, with little involvement of supply chain partners or customers. This study contributes: to the literature, since it has gathered studies about environmental sustainability practices adopted only by LSP, as for the sector which can benefit from the knowledge of practices carried out worldwide.

**Keywords:** *Outsourcing Logistics, Green Initiatives, Green practices adoption, Third-party Logistics, Sustainability*

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## **Towards a More Sustainable Passenger Transport: Management of Disutility Related to Environmental Impacts**

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*b National Association of Public Transportation - ANTP.*

*\*Corresponding author, helcioru@uol.com.br*

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### **Abstract**

Passenger Transport (PT) imposes disadvantages (disutilities) to its users. One of these disutilities is the environmental impact caused by greenhouse gases emissions from PT vehicles, specifically CO<sub>2</sub>, the main cause of global warming. This paper aims to show ways to manage this disutility, drawing from Brazilian experience, using two freely available planning tools: (i) reduction in the consumption of fossil fuels in Public Transport vehicles by the substitution of buses, and (ii) changes of modal-split (modal share).

**Keywords:** *passenger transport; disutilities; management of environmental impacts; public transport; modal-split*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Sustainability Management in Ports**

FOSSILE, D. K. <sup>a</sup>, GOUVEA DA COSTA, S. E. <sup>a,b</sup>

*a. Pontifical Catholic University, Paraná*

*b. Federal University of Technology, Paraná*

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### **Abstract**

The paper aims to present an analysis of the scientific production on sustainability management in ports. The main objective of the study is to quantitatively analyze what has been produced regarding the management of sustainability in ports and qualitatively examine the evolution of the studies, identifying gaps and research opportunities. Science Direct represented the database. For the data analysis, Microsoft Excel®, Wordle™ e Ucinet® were used. The terms "sustainability management in seaports and ports" were used as key expressions. This generated a sample of 36 papers on the topic. At the end of the study, the outcomes of the descriptive statistics with the identification of the most cited authors, papers and journals by researchers around the world, relationship network of citations and a keyword cloud were presented. Considering the research outcomes, it was observed that the majority of studies on sustainability management in ports has been developed in European ports and there is an exponential growth on studies related to the topic. This implies that journals and researchers have shown a growing interest in further investigate this area. Thus, this study becomes an important asset for the development of ideas, concepts and approach perspectives on the topic.

**Keywords:** *Sustainability management, ports, performance indicators.*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

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## **26<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 6A**

**Room 2**

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Industrial Symbiosis: What Have Been Researching?

Transforming an Industrial District into an Ecological Industrial Park: A Methodological Proposal

Development of a Questionnaire for the Evaluation of Industrial Symbiosis Indicators

A Reflection on the Product Development Process Integrated with Sustainability

---

## Industrial Symbiosis: What Have Been Researching?

CAVALCANTE, E. T. D. <sup>a,b</sup>, SILVA, E. A. <sup>a</sup>

*a. Universidade Federal do Piauí, Teresina*

*b. Faculdade Ademar Rosado, Teresina*

*\*Corresponding author, elissatd@yahoo.com.br*

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### Abstract

The issue of industrial waste is wide and can generate several by-products when properly utilized. The analogy of industrial activity to ecology is a tendency to perceive the need to look the processes in a cyclical and non-linear way. In this way the Industrial Ecology has several approaches, among them the industrial symbiosis that is the object of this research. The objective of this paper was to analyze the scientific production on industrial symbiosis in the period from 2006 to 2016. In this article we used the EndNote, an online software that manages some international bases and assists in the cataloging the bibliography, there are the British Library and Library of Congress. The Science Direct database was used as well as the CAPES database and also BDTD – Brazilian Digital Library of Theses and Dissertations (both Brazilians). To this purpose, a bibliometry was performed in which the first moment was the choice of key words for research in the databases: industrial waste, industrial symbiosis. More than 130,000 researches on industrial waste were found, however exclusions were made for the final qualitative analysis on 10 articles to content characterization. It was noticed that the Brazilian Law 12,305 / 2010 dealing with the National Solid Waste Policy has not been addressed directly in the surveys even for the Brazilian researches. And it was identified some gaps for future researches such as the need of public policies for the success of ecoparks and industrial symbiosis.

**Keywords:** *bibliometry, industrial symbiosis, industrial waste management.*

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## **Transforming an Industrial District into an Ecological Industrial Park: A Methodological Proposal**

TRAMA, C. P. <sup>a\*</sup>, MAGRINI, A. <sup>a</sup>

*a. Energy Planning Program, Alberto Luiz Coimbra Institute for Graduate Studies and Engineering Research, Federal University of Rio de Janeiro, Rio de Janeiro*

*\*Corresponding author, cibelle.trama@gmail.com*

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### **Abstract**

The Industrial Ecology (IE), by its principles and instruments, such as Industrial Symbiosis (IS) and Ecological Industrial Park (EIP), enables the connection of productive activities and the acquisition of environmental, social and economic benefits. In the scope of IE and the operation of Industrial Districts (IDs), this article aims to present a methodology for the transformation of an ID into an EIP. Initially, a synthesis of the concepts of IE, IS and EIP is presented. Then, the methodology proposed for the transformation of an ID into an EIP is described, structured in the evaluation of the potential of enterprises of an ID to compose an EIP and in the proposition of suitable scenarios for the conversion of the district into an EIP. By way of validation, the proposed methodology is applied to the José Vieira de Mendonça Industrial District, located in the Municipality of Vespasiano, Minas Gerais state (MG). It is noticed that the methodological proposal presented here for the conversion of IDs into EIPs, while announces itself as gradual and inspiring of an IE culture's establishment in the scope of IDs, allows the integrated and collaborative incorporation of sustainability practices into its operation, which can result in gains both for the district itself and for the environments where it is located.

**Keywords:** *Industrial Ecology, Ecological Industrial Park, Industrial Symbiosis, Industrial District, Brazil*

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## Development of a Questionnaire for the Evaluation of Industrial Symbiosis Indicators

PIERE, B. A.<sup>a,\*</sup>, MANTESE, G. C.<sup>a</sup>, AMARAL, D. C.<sup>a</sup>

*a. University of São Paulo*

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### Abstract

The concept of Eco-Industrial Park (EIP) consists in a business community that aims to improve the economic, social and environmental performance through the cooperation and sharing of services and waste among companies, which characterize the Industrial Symbiosis (SI) process. It is possible to find, performance indicators for the measurement and monitoring of symbiosis, however, there is not a consolidated indicator, which purpose is to guarantee the quality, reliability and objectivity of environmental and social impact assessments. This article has as main objective to adapt the criteria proposed by Mantese et al. (2016) in the development of a questionnaire to be applied with specialists in the evaluation of indicators of industrial symbiosis, using the methodology of Cloquell-Ballester et al. (2006) for the validation of environmental indicators by specialists. It presents the developed study and the online form and the results of its test with an expert of indicators. The result shows that the questionnaire is able to be applied and presents the future stages of this research.

**Keywords:** *Industrial Symbiosis, Validation of Indicators, 3S Methodology*

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## **A Reflection on the Product Development Process Integrated with Sustainability**

TEIXEIRA, G. F. G. <sup>a</sup>, CANCEGLIERI JUNIOR, O. <sup>b\*</sup>

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### **Abstract**

The academic debate on sustainability plays a significant growth in several segments. Among these, there is the debate on integrating sustainability into the Product Development Process (PDP). Thus, the present study aims to identify which are the connecting elements between these two areas of knowledge. The work was carried out through a systematic bibliographic research and resulted in 14,891 searches, of which 101 were classified. The research covered the studies published in the period from 2006 to 2016. Finally, the research result describes that the dedication to the study is relevant. Study on the integration of sustainability into the product development process, based on the need for further studies in this field and also for its constant growth, thus proving to be an area with opportunities for future research.

**Keywords:** *Sustainability; Product Development Process (PDP); Systematic Bibliographic Research.*

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## **26<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 6A**

**Room 3**

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Evaluation of Pelletization Methods of Zeolitic Material from Coal Ash

Use of Red Mud Activated at Different Temperatures as a Low Cost Adsorbent of Reactive Dye

Use of Solid Waste in the Cleaner Production of Soli Bricks Cement: Physical and Mechanical Characterization

Characterization of Soil Mixtures and Waste Foundry Sand

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## Evaluation of Pelletization Methods of Zeolitic Material from Coal Ash

BERTOLINI, T. C. R.<sup>a\*</sup>, GHILHEN, S. N.<sup>a</sup>, FUNGARO D. A.<sup>a</sup>

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### Abstract

The evaluation of different methods of pelletization of zeolitic material synthesized from coal ashes was described in this work. The coal fly ash used in the synthesis of the zeolite by alkaline hydrothermal treatment were collected in the Thermoelectric Complex Jorge Lacerda, located in the Santa Catarina State, Brazil, the largest coal burning thermoelectric complex of Latin America. The raw material and synthesized zeolite in powder form were characterized to obtain chemical composition, mineralogical composition and cation-exchange capacity. The pellets were formed by mixing of zeolitic material with one or more binders and addition of deionized water. The obtained plastic mass was molded manually in the form of spheres in the size range between 4 mm and 7 mm. Different methodologies of pelletization of zeolite material were evaluated by determining the cation exchange capacity of the obtained products, workability, physical strength and water stability. The pelletized zeolitic material obtained by the best method evaluated in this study was selected for future application as adsorbent material in the effluent treatment.

**Keywords:** coal fly ashes, hydrothermal treatment, zeolite, pelletization, pellets, adsorbent material.

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## Use of Red Mud Activated at Different Temperatures as a Low Cost Adsorbent of Reactive Dye

ANTUNES, M.L.P. <sup>a\*</sup>, CONCEIÇÃO, F.T. <sup>b</sup>, NAVARRO, G.R.B. <sup>b</sup>,  
FERNANDES, A.M. <sup>c</sup>, DURRANT, S.F. <sup>a</sup>

a. UNESP – São Paulo State University (UNESP), Institute of Science and Technology, Sorocaba, S.P.

b. UNESP – São Paulo State University (UNESP), Institute of Geosciences and Exact Sciences, Rio Claro, S.P.

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\*Corresponding author, malu@sorocaba.unesp.br

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### Abstract

The bauxite refine residue (Red Mud) is an important waste generated in the aluminum production, and its reuse should be used as a low-cost adsorbent in environmental remediation and industrial effluent treatment, including the reactive blue 19 dye (RB19) used in the textile industry. This study aimed to investigate the thermal treated influence on adsorption of RB19 by red mud, comparing with adsorption capacity of natural red mud. Thermal treatment results in a greater surface area, which results in an increased adsorption capacity due to more available adsorption sites. Adsorption of RB 19 has been found to be best achieved in acidic conditions using red mud heated to 500°C, with an adsorption capacity of 416 mg g<sup>-1</sup> compared to 357 mg g<sup>-1</sup> for untreated red mud. Sodalite can be the main phase related to the adsorption capacity of RB19 on natural and thermal treated red mud. However, with the increase in temperature, there is a partial decomposition of this mineral phase, being this fact responsible for the lowest  $q_m$  values observed in RM800 (337 mg g<sup>-1</sup>).

**Keywords:** Red Mud, Reactive dye adsorption, Isotherms models, Environmental Management.

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## Use Of Solid Waste in the Cleaner Production of Soil Bricks Cement: Physical and Mechanical Characterization

PAIXÃO, R. M.<sup>A</sup>; SILVA, J. R. R. DA<sup>A</sup>; AQUOTTI, N. C. F.<sup>B</sup>; SILVA, P. S. DA<sup>B</sup>; LIZAMA, M. A. P.<sup>B,C</sup>; ANDREAZZI, M. A.<sup>B,C</sup>; GONÇALVES, J. E.<sup>B,C,\*</sup>

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b. *<sup>2</sup>Programa de Pós-Graduação em Tecnologias Limpas/ Centro Universitário de Maringá/ Av. Guedner, 1610, 87.050-390, Maringá - Paraná, Brasil / phone + 55 44 98802-3286*

c. *<sup>3</sup>Instituto Cesumar de Ciência, Tecnologia e Inovação - ICETI/ Av. Guedner, 1610, 87.050-390, Maringá - Paraná, Brasil*

*\*Corresponding author, [jose.goncalves@unicesumar.edu.br](mailto:jose.goncalves@unicesumar.edu.br)*

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### Abstract

The use of ethanol and sugar industry waste and the furniture industry waste in the manufacture of soil-cement bricks is an environmentally sustainable alternative that preserves non-renewable resources and enables the recovery of such waste, instead of simply throwing them in nature. In addition, soil-cement bricks do not go through the cooking process, avoiding deforestation and consequently air pollution. In this paper, we analyzed the influence of the addition of sugarcane bagasse ash and sawdust on the physical and mechanical characteristics of soil-cement brick. The bricks were molded and pressed, using percentages of 35% of sandy and clay soil, cement and sugarcane bagasse ash ranging from 10-30% and 10% of sawdust, all compared to the mass of the resulting mixing soil-cement-recycled. The results showed that the incorporation of recycled waste (sugarcane bagasse ash and sawdust) to the soil-cement brick remained the mechanical properties, enabling cost reduction and production of best quality pressed bricks, becoming thus, an excellent alternative to the use of these materials.

**Keywords:** *Brick soil-cement-recycled, Sugarcane bagasse ash, Sawdust, Environmental reuse*

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## Characterization of Soil Mixtures and Waste Foundry Sand

CARDOSO, S. M. <sup>a</sup>, MACEDO, G. A. <sup>a</sup>, SARRO, W. S. <sup>a\*</sup>, FERREIRA, G. C. S. <sup>a</sup>, SILVA, V. P. A. <sup>a</sup>, PEREIRA, R. S. <sup>a</sup>

<sup>a</sup>*Faculdade de Tecnologia - Universidade Estadual de Campinas, São Paulo*

*\*Corresponding author, welidasarro@gmail.com*

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### Abstract

The application of waste in several areas of the productive sector demands urgency in the application of sustainability concepts. Waste Foundry Sand (WFS), used for the granulometric stabilization of clay soils, is one of the residues with promising results to overcome the demand for reuse and sustainability in the transportation sector. This experimental work studies soil mixtures + WFS with the objective of verifying physical characteristics and mechanical behavior, aiming the application in structural layers of flexible pavements. Therefore, granulometry, plasticity, ultrasound and unconfined axial compression tests were performed. We conclude that the incorporation of up to 40% of ADF is indicated to compose the layers of base and sub-base of paving, besides the ultrasound technique is a promising tool for technological control of compacted soils.

**Keywords:** *Geotechnics, technological control, solid waste, sustainability*

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## **26<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 6A**

**Room 4**

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Sustainable Alternatives for Urban Water Supply in Sanitation Companies

Intervening Factors in the Consumption of Water in Residential Buildings in the City of Joinville

Sustainability Strategies for Coastal Aquifer Analysis: Hermosillo Coast

Improvement of Gray Water Footprint Calculation Method Bades on Comprehensive Evaluation

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## Sustainable Alternatives for Urban Water Supply in Sanitation Companies

POZZA, C. B. <sup>a\*</sup>, VIEIRO, A. <sup>a</sup>, OLIVEIRA, G. A. <sup>a</sup>, TROJAN, F. <sup>a,b</sup>

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### Abstract

The aim of this work was to investigate the sustainable practices of urban water supply by the Supply Companies in the Paraná and Santa Catarina states and to verify if these supply companies do the monitoring of these practices by performance indicators, which express the dimensions of the *triple bottom line*. For the initial analysis, a literature review was carried out on sustainable management of water resources and water footprint concepts, sustainable supply alternatives and indicators of sustainable performance. The research is characterized regarding its nature as applied, regarding its objectives as exploratory / descriptive feature, the technique used was a case study and data collection was made on the Supply Companies and on the website of the National Information System on Sanitation. It was verified whether the practices focused at sustainability that the companies practice are inserted in the *triple bottom line* and reach the economic, social and environmental levels. The indicator model used, as reference in this study was the Sabesp's Indicators Panel, being addressed the operational, environmental, economic and social indicators. It was verified that losses in the production process and distribution are critical factors for the sustainability of these Companies, presenting high percentages when compared to the percentage of Sabesp's losses.

**Keywords:** Sustainability, water supply, indicators.

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## **Intervening Factors in the Consumption of Water in Residential Buildings in the City of Joinville**

DIAS, T. F. <sup>a</sup>, KALBUSCH, A. <sup>a\*</sup>, HENNING, E. <sup>a</sup>

*a. Santa Catarina State University (UDESC), Civil Engineering Graduate Program  
\*Corresponding author, andeza.kalbusch@udesc.br*

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### **Abstract**

This article aims to identify the factors that may influence water consumption in residential buildings in the city of Joinville (Southern Brazil), through the analysis of socioeconomic constructive variables. A non-probabilistic sample was established with the application of a questionnaire with 23 questions to survey characteristics of 47 residential buildings, totaling 1422 residential units. The model describing water consumption was identified from a multiple linear regression analysis. Within the analysis, it was verified that the variables related to the constructive aspects of the building are statistically significant to explain water consumption (m<sup>3</sup> / day). However, both constructive and socioeconomic aspects were statistically significant for the water consumption index (liters per person per day). The results contribute to a better understanding of the variables related to water consumption in residential buildings, and may be useful for local government when planning sustainable policies.

**Keywords:** *Consumption index, water consumption, buildings.*

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## **Sustainability Strategies for Coastal Aquifer Analysis: Hermosillo Coast**

ZEPEDA QUINTANA, D. S. <sup>a</sup>, LOEZA RENTERIA, C. M. <sup>a\*</sup>, OJEDA DE LA CRUZ, A. <sup>a</sup>, VELAZQUEZ CONTRERAS, L. E. <sup>a</sup>

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*\*Corresponding author: marianalorent@gmail.com*

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### **Abstract**

**Purpose** – The purpose of this paper is to identify the opportunity areas in coastal aquifer research to guide water management actors in their practice, management, education and future research. **Design/methodology/approach** – Literature review of papers, methodologies, agency reports, books and website documents was conducted in order to identify practices and strategies worldwide towards a sustainable management of water resources that can lead to a cross-sectional plan. **Findings** – Sustainable strategies for coastal aquifers depend on many variables that nowadays are working separately. Therefore, if the business-as-usual strategies are not enough to reach sustainability, decision makers should work together in a holistic way to have accurate information that can serve as an updated scientific basis. **Practical implications** – The paper discusses how the coastal aquifers should be managed in order to use its resources in a sustainable manner, so human water needs can be satisfied and the freshwater resources can be preserved. **Originality/value** – Even though there is plenty information about coastal aquifers and its management in literature, most of the information discuss specific topics of the entire coastal aquifers management. The originality/value of this paper is the interaction of the sustainability pillars towards future holistic strategies based on the state of art of this topic.

**Keywords:** *climate change, coastal aquifer, marine intrusion, sustainability*

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## **Improvement of Gray Water Footprint Calculation Method Based on Comprehensive Evaluation**

HUI LI<sup>A</sup>, GENGYUAN LIU<sup>A,B,\*</sup>, ZHIFENG YANG<sup>A,B,\*</sup>, CASAZZA, M. <sup>C</sup>,  
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*Corresponding Author liugengyuan@bnu.edu.cn (G.Y. LIU)*

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### **Abstract**

The Gray Water Footprint (GWF) analysis method, defined as the volume of fresh water required to assimilate the load of pollutants discharged into water based on natural background concentrations and existing ambient water quality standards, has been widely used in regional water quality management. In traditional calculation method, GWF value is obtained by dividing the load of critical pollutant by the difference between the ambient water quality standard for that pollutant and its natural background concentration in the receiving water body. In other words, GWF refers to the volume of freshwater that is always only required to assimilate the load of the largest concentration of pollutants based on existing ambient water quality standards. However, many studies have raised questions about this traditional single factor evaluation method, since it lacks the consideration to the combined effects of multiple pollutants, which will lead a higher GWF result in confidence-limit rate. In this study, a new GWF calculation framework oriented the solutions of multi-pollutants is proposed based on a 2-phases calibration model. In the first phases, we consider the dilution and autopurification process of multi-pollutants in natural waters. In the second phases, several comprehensive evaluation methods, such as the fuzzy synthetic evaluation (FSE), principal component analysis (PCA) and fuzzy inference system (FIS), are applied to determine the "ecological threshold" of GWF. The application conditions and uncertainties of the three multi-factors appraisal methods have also been discussed. Our research gives the methodological support for the precise calculation of GWF.

**Keywords:** *Gray water footprint, single index method, comprehensive evaluation, fuzzy inference system, principal component analysis, fuzzy inference system.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **26<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 6A**

**Room 5**

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Different Paths for Sustainability through PSS

Analysis of Post-Retail Cardboard Chain from the Perspective of Green Supply Chain Management

The Bullwhip Effect in Closed Loop Supply Chain: A Systematic Literature Review

A Reflection on Product Development Oriented for Green Supply Chain Management

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## Different Paths for Sustainability through PSS

PEREIRA, V. R. <sup>a\*</sup>, KREYE, M. <sup>b</sup>, CARVALHO, M.M. <sup>c</sup>

*a. Universidade Presbiteriana Mackenzie, São Paulo*

*b. Technical University of Denmark, Denmark*

*c. Universidad de São Paulo, São Paulo*

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### Abstract

Pressures from globalization lead manufacturing companies particularly in the healthcare sector to increasingly incorporate services into their offerings. They shift their core business processes to become solution providers such as Product-Service Systems (PSS) and create value for their customer base. This shift has also been termed servitization. The focus is often on business-to-business (B2B), where the PSS provider maintains and ensures operability of the equipment for a customer organization. Business models for PSS usually grow around the physical asset, which can be owned by the PSS provider who offers the asset's use or owned by the customer who requests additional support for the asset. Value is added through ensuring the product performance and availability. Product-service Systems (PSS) increasingly characterize sectors with public-private partnerships such as healthcare. The adoption of such PSS can vary depending on the contingency of the business environment favoring different levels of servitization adaptations. This paper investigates how the pressures from the business environments constitute drivers for PSS development. The paper presents evidence from two case studies set in the healthcare industry in Brazil and Denmark. The presented data includes semi-structured interviews with managers and engineers involved in the PSS as well as secondary data. This paper shows that the business environments in the healthcare industry are characterized by increasing level of regulation and differ in their level of investments that determine whether the PSS development is customer pulled or provider pushed. The customer-pull in Brazil led to a quick adoption of result-oriented PSS while the provider-push in Denmark was characterized by a slower adoption of product-focused PSS. Both cases showed different levels of economic, social, environmental and operational issues. This paper contributes to current literature by understanding the different paths of PSS development is enhanced by explaining the drivers for providers and customers to engage in a servitization strategy and develop the required capabilities to be successful in this business opportunity. The most important drivers identified financial, operational and environmental.

**Keywords:** *Product-service system; case study; environment; healthcare.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Analysis of Post-Retail Cardboard Chain from the Perspective of Green Supply Chain Management**

DIAS, K. T. S.<sup>a\*</sup>, FERRARI, D. B.<sup>a</sup>, BRAGA JÚNIOR, S. S.<sup>a</sup>, SATOLO, E. G.<sup>a</sup>, PUTTI, F. F.<sup>a</sup>

*a. University Estadual Paulista "Júlio de Mesquita Filho", FCE/Tupã*  
*\*Corresponding author, kaasdias@live.com*

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### **Abstract**

To remain competitive, organizations establish integrations with their partners, customers and suppliers through a supply chain. This integration occurs through the sharing of resources and information, in a cohesive and high performance business model, in order to meet the needs of consumers. One of the competitive strategies adopted in the supply chain management (SCM) context is the green supply chain management (GSCM) approach. This approach, like SCM, helps organizations and their partners achieve corporate profit and market share goals, but incorporates environmental aspects related to operational activities that occur along the chain, since environmental concerns have been a frequent theme in the business world. One of the practices supported by GSCM is reverse logistics, which allows the return of products and packaging to the production cycle, thus promoting the mitigation of possible environmental impacts, if these products / packaging were incorrectly discarded. Regarding the packaging, the return activities correspond to the reverse logistics of post-consumption, and refer to those products that have reached the end of their useful life. However, when it comes to cardboard packs, these are commonly reused, since they have favorable characteristics for such accomplishment, such as: high strength, easy handling and low cost. Thus, it is considered that the shelf life of the cardboard is not limited to the final consumer and therefore the chain to which this product belongs is not restricted to this agent either, as SCM scope analyzes are generally conducted. In this sense, starting from the retail perspective, as the corporate agent closest to the consumer, this study aims to analyze the structure of the cardboard chain, given from the discarding of retail, from the perspective of the GSCM. Therefore, the methodology adopted is a qualitative approach, of a descriptive and exploratory nature. The data were collected through bibliographic research and the conduction of semi-structured interviews with the organizations belonging to the cardboard chain. The information obtained allowed the elaboration of a mapping, in which it was possible to identify that, after being discarded by the retail sector, the cardboard is directed to three different paths, being two chains of consumption and one of discarding. In addition, after this identification, we conducted analyzes of each destination of the cardboard by the environmental perspective given by the approach of the GSCM. As a result of this analysis, it was identified that the most appropriate way that cardboard can take after its disposal is to follow a recycling chain, which will allow the reduction of environmental impacts regarding the extraction of natural raw materials, as well as the economy of resources such as water and energy.

**Keywords:** *Cardboard. Retail. GSCM. Disposal of packaging.*

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"TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE"

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

## **The Bullwhip Effect in Closed Loop Supply Chain: a Systematic Literature Review**

BRAZ, A.C.<sup>a,\*</sup>, DE MELLO, A.M.<sup>a</sup>, VASCONCELOS GOMES, L.A.<sup>a</sup>,  
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São Paulo (FEA/USP)*

*\* Corresponding author, acarlosbraz@hotmail.com\**

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### **Abstract**

The bullwhip effect one of the most studied phenomenon in forward supply chains is also growing interest from the academia to be studied in closed loop supply chains. This paper aims to compare the bullwhip effect causes and factors in forward supply chains with those for closed loop supply chains. The methodology used was a systematic literature review of the papers that were published in academic journals and conferences about bullwhip effect in closed loop supply chains. We find that the factor: increasing product return rate to mitigate or decrease the bullwhip effect was quantitatively the most representative, since this factor is fundamentally inherent of the closed loop supply chains dynamics, we have proposed that implementing the closed loop supply chains instead of the forward supply chains can reduce or even eliminating the bullwhip effect.

**Keywords:** *closed loop supply chain, bullwhip effect*

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## **A Reflection on Product Development Oriented for Green Supply Chain Management**

CANCIGLIERI JUNIOR, O. <sup>a\*</sup>, RECHE, A. Y. U. <sup>b\*</sup>

*a. Pontifícia Universidade Católica do Paraná, Curitiba*

*b. Pontifícia Universidade Católica do Paraná, Curitiba / Serviço Nacional de Aprendizagem Industrial, Arapongas*

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### **Abstract**

The product development process is an activity that that need integration with the supply chain: suppliers, manufacturers and customers. The objective of this article is to analyze publications about the subject product development and green supply chain. For the literature review, it was searched for the concepts of product development process, product development stages, suppliers and customers integration in product development, supply chain business processes, supply chain management, green supply chain management, sustainable supply chain management and triple bottom line. Methodology: A bibliographical survey was conducted in Capes database, covering the articles published in scientific journals up to 2016. Results: The topic of product development oriented to the green supply chain management still does not have a consensus, being treated with a broad approach.

**Keywords:** *product development, supply chain management, green supply chain management, triple bottom line.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

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## **26<sup>th</sup> May 2017**

<b>8h00-9h40</b>	<b>Session 6A</b>	<b>Room 6</b>
<p>Natural Capital Inclusion in Company's Financial Reports: A Discussion on its Accounting Rules and Practical Adoption</p> <p>The Services Sustainability: Considerations on the Materiality of Accommodation Services from the Concept of a Product Life Cycle</p> <p>The Financial Services Sector and the Transition towards the Green Economy in Brazil</p> <p>Evaluation of Costs, Benefits and Externalities Associated with the Product Life Cycle in the Context of the Circular Economy: A Study for Aluminum Packaging</p>		

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## **Natural Capital Inclusion in Company's Financial Reports: A Discussion on Its Accounting Rules and Practical Adoption**

AMARAL, P.L.<sup>a,\*</sup>, AGOSTINHO, F.<sup>a</sup>

<sup>a</sup> *Universidade Paulista, São Paulo, Programa de Pós-graduação em Engenharia de Produção, Laboratório de Produção e Meio Ambiente*

\* *Corresponding author, patricialagranha@hotmail.com*

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### **Abstract**

In the last decades the problem of scarcity of natural resources common to society, also known as "the tragedy of commons", has promoted heated discussions about a sustainable future. In this sense, the call for preserving the stocks of natural capital, which provide the necessary natural resources to the production systems, has been recognized. A potential alternative for this could be the inclusion of natural capital into the companies' financial statements. However, established accounting rules on what can be accounted and where, are to be respected and followed. This work aims to promote a discussion on the possibilities for the quantification and insertion of natural capital items into the accounting statements of companies. Specifically, water and electricity companies holding concession contracts are considered as a case study, to bring about a critical discussion. The challenges involved in the adoption of the IFRS international accounting standards are presented and discussed, considering the legal possibilities of including natural capital in accounting. It is observed that even with international regulating organs recognizing the importance of accounting for natural capital in a quest to better handle and preserve it so it can feed production systems, wider and deeper studies and discussions, and certain precautions before allowing their inclusion are in need. Advances and possibilities can be observed, however, the complex and standardized accounting system should be the aim of urgent actions in the sense of allowing for the inclusion of natural capital into accounting statements.

**Keywords:** *natural capital, Environmental accounting; Energy; IFRS; Concession Agreements; Sustainability.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **The Services Sustainability: Considerations on the Materiality of Accommodation Services from the Concept of a Product Life Cycle**

VOLPI, Y. D.\*, PAULINO, S. R.

*University of São Paulo, São Paulo, Brazil*

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### **Abstract**

While tourism is recognized as a catalyst for a wide range of service activities that are potentially damaging to the environment, which motivates several research and actions that aim to promote the sector's sustainability, immateriality remains a widely accepted characteristic in the understanding of the nature of services in general. In this sense, the research aims to clarify the materiality of accommodation services, in light of theories of the service economy and using the concept of a product life cycle. For this purpose, bibliographic research is used to compile inputs and outputs associated with the environmental aspects of the product provided by accommodation businesses that are generated in the production and consumption stages of these services. Inputs (electricity, water, food/beverage, personal care products, cleaning products and pest control chemicals) and outputs (effluent discharges, atmospheric emissions, noise emission and waste generation) represent flows of energy and matter that can be interpreted based on the discussion of the materiality inherent in the service activities.

**Keywords:** *materiality of services, accommodation businesses, environmental requirements, tourism*

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## **The Financial Services Sector and the Transition towards the Green Economy in Brazil**

MORAES, S. S. <sup>a</sup>, DEUS, R. M., <sup>a</sup> BATTISTELLE, R. A. G. <sup>a\*</sup>

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### **Abstract**

This study aims to discuss the contribution of the financial services sector to the transition towards a Green Economy in Brazil. By means consultation of documents and scientific articles published on the theme and the visit to the official website of the Brazilian Federation of Banks (FEBRABAN), we conducted the research. The main topic studied was the environment and Green Economy, by means analyzing the publications related on the "Café com Sustentabilidade" topic. The results show that from the agreements and regulations and specific laws, such as the Paris Agreement, the Forest Code and Resolution 4327 of April 2014, the banking sector has sought partnerships to discuss and create programs and actions that contribute to the transition towards a Green Economy. The goals of Paris Agreement signed by Brazil in 2015 highlights and covers the sectors with significant potential for pollution. As the banking industry finances investments in the sectors studied, there is an excellent opportunity to improve the environmental conditions in the execution of such enterprises from the contribution of the banking sector through the release of resources and supervision.

**Keywords:** *Banks; Agriculture; Sustainable Buildings; Forest Recovery.*

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## **Evaluation of Costs, Benefits and Externalities Associated with the Product Life Cycle in the Context of the Circular Economy: A Study for Aluminum Packaging**

ALBUQUERQUE, T. L M, MATTOS, C. A. (\*), SCUR, G., KISSIMOTO, K.

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### **Abstract**

The Circular Economy aims to transform waste into resources and seeks to link the production and consumption activities. Conceptual logic for value creation is based on the economic value obtained by reusing a product for the production of new offerings. The development of business models in the context of the Circular Economy is gaining importance in the academic, corporate and government environments. The transition of companies from a linear to a Circular Economy (CE) brings a series of challenges, and it is essential to understand the impact of changes in their business models. In this context, it is necessary to evaluate the costs, benefits and externalities by applying tools that capture the variables involved throughout the life cycle of a product. Thus, objective aims to analyze the benefits of using aluminum packaging in the food industry, combining the Life Cycle Costing (LCC) method and externalities, since in the context of the circular economy one should consider not only the cost of one Product during its life cycle, but also the economic benefit or added value for society. The study seeks to contribute to the evolution of concepts and methods by helping to integrate and optimize economic, social and environmental considerations to provide more sustainable scenarios in the future. The results obtained through the LCC method and externalities indicated economic benefit and reduction of CO<sub>2</sub>.

**Keywords:** *Circular Economy, LCC, aluminum packaging, Externalities*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

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## **26<sup>th</sup> May 2017**

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**8h00-9h40**

**Session 6A**

**Room 7**

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Optimization Methane Production through Anaerobic Codigestion of Swine Waste

Eco-Efficiency in a Metalworking Industry of Campinas/SP Region: Reduction of Setup time and Carbon Footprint

Environmental Impact Assessment of the Structural Ceramics Industry as a Cleaner Production Tool

Evaluation of Liquid and Solid Bio-Fertilizer as Energy Disposals from Biomass Degraded by Bio-Digestion in the Production of Horticultural Bedding Plants at the Department of Agricultural Sciences – Cordoba - Argentina

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## Optimization Methane Production through Anaerobic Codigestion of Swine Waste

CAILLOT, V. A.<sup>a</sup>, SOUZA, J.<sup>a</sup>, SILVA, C. B.<sup>a</sup>, SECCO C.<sup>a</sup>,  
FRANCISCO, A. C.<sup>a</sup>

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*\*Corresponding author, vanessacaillot@hotmail.com*

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### Abstract

Continuous primary energy consumption has motivated the scientists of the world to search for renewable energy sources that could substitute fossil fuels. Anaerobic co-digestion has been cited in the literature as effective way to treat waste from swine breeding and to produce biogas for the generation of energy, but for efficiency in methane production it is important to choose the best co-substrate and a mixing ratio more efficient. The objective of this study was to investigate in the literature the substrates that have been used, the amount of methane generated and the difficulties and advantages associated with the process. The results demonstrated superior yield of methane production with the anaerobic co-digestion with respect to DA of the animal manure alone. Proving that the choice of complementary substrate generates the equilibrium of several parameters of the cosubstrate mixture: macro and micronutrients, C:N ratio, pH, toxic compounds generated higher biogas production and greater plant viability.

**Keywords:** *Anaerobic codigestion, swine waste, biogas.*

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## **Eco-Efficiency in a Metalworking Industry of Campinas/SP Region: Reduction of Setup time and Carbon Footprint**

LEME, R. D. J. <sup>a</sup>, LOPES SILVA, D. A. <sup>a</sup>

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### **Abstract**

Losses of time and resources, such as materials, infrastructure, financial capital, and labor can reduce productivity and competitiveness of industries. In order to promote cleaner production, lean solutions integrated to the sustainable manufacturing concept can be adopted to minimize such losses. This integration can generate competitive advantages not only in financial terms, but contributing also to reduction of environmental impacts, operational advantages, increasing productivity and creating more value to companies. In this context, aiming at reducing unproductive times, one can focus on minimizing setup time of machines and equipment. Considering a high precision mold making company from Campinas region of São Paulo State of Brazil, the following question arises: how to identify improvement opportunities to reduce setup times and activities on its machining processes? There are several approaches that could be applied to solve this question, however, this paper focused on the integration of sustainable manufacturing with lean manufacturing practices and, for this, an eco-efficiency study was carried out through the application of SMED tool integrated with Carbon Footprint of machining processes. The case study results showed that it was possible to reduce long setup times by up to 88.4%, while carbon footprint was also minimized by up to 81.3%. Simple improvements were performed at the evaluated machining processes based on simple changes, such as standardization of setup activities and time & methods procedures. Finally, the combined approach of SMED with Carbon Footprint can be used to assist more companies to improve eco-efficiency in manufacturing processes towards a more sustainable future.

**Keywords:** *Eco-efficiency. Carbon Footprint. Quick Tooling Change. SMED. Lean Manufacturing.*

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## **Environmental Impact Assessment of the Structural Ceramics Industry as a Cleaner Production Tool**

SANTOS JR, E.L.<sup>a\*</sup>; LIED, E.B.<sup>a</sup>; ACERGO, C.V.<sup>a</sup>; FAQUIM, V.<sup>b</sup>;  
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*b. Technological Federal University of Paraná, Medianeira, PR.*

*\* eliasjunior@utfpr.edu.br*

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### **Abstract**

The manufacture of ceramic materials is one of the oldest industrial processes and after the development of numerous technologies worldwide, the ceramic industry plays an important role in the Brazilian economy. The process of manufacturing ceramic artifacts consists basically of four stages, namely: preparation of the raw material and the mass, formation of the parts, heat treatment and the finishing step. In parallel with this process, there are environmental concerns, since several residues are generated by this activity in each of the above stages, which will vary with the ceramic typology, ie, with a red or white base. The structural ceramics industry, also known as red ceramics, produces perforated bricks, massive bricks, slabs or slabs, structural and structural blocks, tiles, shackles and rustic floors. It is a basic activity, when making civil construction, in general, from the simplest to the most sophisticated. The present study aimed to demonstrate the process of manufacturing red-based ceramic artifacts, analyzing the potential for degradation to the environment, as well as presenting possibilities of applicability of the cleaner production methodology in this sector, with a view to optimizing the production process, reducing Of the generation of waste in the generating sources, as well as the possibility of transforming some waste into co-products, minimizing the use of raw materials and inputs. In relation to the methodology applied in the development of this work, it is classified as basic, qualitative, descriptive and bibliographical. The literature review indicated the existence of low technological density in the ceramic sector in Brazil. The sector of the red ceramic industry is little dynamic in the development of new products.

**Keywords:** *red ceramics, environmental impact, reduction, waste, production.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Evaluation of Liquid and Solid Bio-Fertilizer as Energy Disposals from Biomass Degraded by Bio-Digestion in the Production of Horticultural Bedding Plants at the Department of Agricultural Sciences – Cordoba - Argentina**

STOBBIA, D.<sup>a</sup>, VIERA FERNÁNDEZ B.<sup>a</sup>, DUTTO J. <sup>a</sup>, LEDESMA A.<sup>a</sup>

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*\*dstobbia@hotmail.com.*

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### **Abstract**

The use of bio-digesters is a clear example of Socially Appropriate Technology, generating biogas at domestic or commercial scale plus liquid and solid bio-fertilizer. Bio-digestion is a natural process that corresponds to the anaerobic cycle of carbon, actioned and combined with different groups of bacteria in total absence of oxygen, using organic materials to feed and reproduce. In this digestion it is possible to identify two type of products as fertilizers: the liquid bio fertilizer called "biol" (effluent) and the solid bio fertilizer called "biosol" (digested mud). This bio-factors promote the growth of vegetables and can be apply both to the foliage as to the seed through imbibition. The main purpose of this paper is to evaluate the behavior of liquid and solid bio-fertilizer, coming from the biomass of solid urban disposals (SUD) on the germination and growth of horticultural bedding seeds. Five experiments for the biol were proposed, T1: 100% Water, T2, 75% Water and 25% Biol, T3: 50% Water and 50% Biol, T4: 25% Water and 75% Biol and T5: 100% biol. For the biosol, the experiments were T1: 100% Water, T2, 75% Water and 25% Biosol, T3: 50% Water and 50% Biosol, T4: 25% Water and 75% Biosol and T5: 100% Biosol. Even though both bio-fertilizers energetically promote higher growth of bedding seeds and higher percentages of germination, the doses used are different depending whether it is liquid or solid. The solid urban disposals provide a residual biomass with an important biological potential to improve degraded soils and horticultural or bio-intensive production.

**Keywords:** *bio-fertilizer, bio-digestion, germination, bedding seed growth, bio-production.*

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**26<sup>th</sup> May 2017**

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**13h30-15h00      Conference**

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**Luís Eduardo Velázquez  
Contreras**

**University Sonora - Mexico**

International Perspectives from  
Climate Change

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## **International Perspectives from Climate Change**

*Luís Eduardo Velázquez Contreras  
University of Sonora - Mexico*

This conference has the purpose of debating different perspectives for adapting/mitigating climate change from technical to cultural perspectives taking into account socioeconomics, geographic, and gender differences. Climate change is an imperative and global topic that has been debated in multidisciplinary and multicultural stages. Traditionally, Climate Change is seen within a hard science perspective, but human daily behaviors that led to anthropogenic causes have often been ignored. Therefore, the presentation will be an excellent opportunity to get involved attendees from many disciplines and cultures in order to reach the Paris Agreement goal of limiting global warming to well below 2°C.

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 1**

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The Importance of Solar Energy for Sustainable Social Development

Different Perceptions of Corporate Citizenship in a Company in the Brazilian Power Sector

Life Cycle Assessment of Cleaner Electricity Generation Systems: An Analysis of Scientific Production

Energy Consumption vs. Investments on Electric Sector: A Case Study on Eletrobrás-PI

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## The Importance of Solar Energy for Sustainable Social Development

TSURUDA, L. K.<sup>a,b</sup>, MENDES, T. A.<sup>a,b\*</sup>, VITOR, L. R.<sup>b</sup>, SILVEIRA, M. B.<sup>b</sup>

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*b. Agência Goiana de Habitação (AGEHAB), Goiânia, Goiás, Brasil*

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### Abstract

The use of polluting energy sources in meeting the growing demand for energy directly impacts the environment, affecting the present and future generations. The shortage of non-renewable sources, fueled by the energy crisis, has led to intensive studies and research into the diversity of the energy matrix, implementing alternative and renewable energy sources. Thus, the objective of this article was to evaluate the application of solar energy as a means of promoting sustainable and social development in single family social housing (HISU), state of Goiás. The energy efficiency actions implemented in the HISU, mainly in relation to photovoltaic generation, provided an average consumption saving of 145.0 kWh month<sup>-1</sup> to only 21.9 kWh month<sup>-1</sup> per HISU, that is, a reduction of 85,0%. Environmentally, this energy saving is equivalent to avoiding the emission of 73.53 kg CO<sup>2</sup> year<sup>-1</sup> per HISU in the atmosphere.

**Keywords:** *Renewable Energy, Energy Efficiency, Housing of Social Interest (HIS).*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Different Perceptions of Corporate Citizenship in a Company in the Brazilian Power Sector

PACHECO, L. M. <sup>a\*</sup>, KRUGER, C. <sup>b</sup>, LOURENÇÃO, M. T. A. <sup>b</sup>, ALVES, M. F. R. <sup>b</sup>, CALDANA, A. C. F. <sup>b</sup>

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*b. Universidade de São Paulo/FEA-RP, São Paulo*

*\*Corresponding author, lari.marchiori@gmail.com*

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### Abstract

Currently, the Sustainable Development Goals (SDG) gave basis to the SDG Compass which invites all companies to integrate SDGs into organizational practices and evaluate the company's position on the issue. Corporate citizenship gained space in the discussion of the responsibilities of the firms regarding sustainability. Several models were developed for the later, being corporate citizenship one of those. Some authors advocate that this is not a stagnant concept inside a company, which must flow through stages for achieving maturity on the subject. Based on a validated assessment tool, a Brazilian company was surveyed and the perception of 131 employees on eight dimensions of corporate citizenship was measured. Considering the internal stakeholders perception of the concept a prerogative for a company's citizenship performance, it is relevant to understand the general organizational climate to improve the internal marketing strategies for sustainability. Through a cluster analysis, it was possible to identify two distinct groups among the employees: ones that classifies the company in an early stage of corporate citizenship maturity and other that consider the company in a high level of maturity and understanding of this concept. Therefore, the integration of the concept among the different organizational areas, an important step when developing a sustainability strategy, needs to be reinforced through internal communication and alignment to engage employees in the corporate citizenship actions of the company.

**Keywords:** *corporate sustainability; sustainable development goals; integration; internal marketing.*

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## **Life Cycle Assessment of Cleaner Electricity Generation Systems: An Analysis of Scientific Production**

BARROS, M. V. <sup>a\*</sup>, PIEKARSKI, C. M. <sup>a</sup>, SALVADOR, R. <sup>a</sup>

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*\*Corresponding author, murillo.vetroni@gmail.com*

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### **Abstract**

The search for electricity cleaner production has become a research and development item in several countries. There are demands for investments, developments of new technologies and knowledge generation about the environmental performances of different sources of electricity generation. Thus, this work aims to perform a systematized theoretical analysis of scientific research on Life Cycle Assessment (LCA) of electric power generation systems. The systematized theoretical analysis was constructed using Methodi Ordinatio method. The criteria for theoretical analysis were: keywords ("LCA + Electric\* Mix\*", "LCA + Electric\* Energy + Life Cycle Assessment + Energy Production"), author, year, country, university, periodic, JCR, number of citations and Methodi Ordinatio. After the application of the method 26 articles were selected for discussion. that the results show that there is a higher incidence of articles published in European countries. Among the main evaluation methods used are the ReCipe, CML, Impact 2002+, CED. Another highlight is that the studies show that wind energy has one of the lowest environmental impact indexes in its generation compared to other sources according to the articles addressed. In some countries, cleaner sources are promising due to their capacity to generate electricity through locations with high wind rates and high sunlight capture. In this way, the results can be used in public policies, development actions and incentives of different energy matrices and contribute to the scientific literature on LCA and electric power generation.

**Keywords:** *LCA, Electricity, Environmental performance, Energy matrix*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Energy Consumption vs. Investments on Electric Sector: A Case Study on Eletrobrás-PI**

OLIVEIRA, J. C. <sup>a,d\*</sup>, IBIAPINO, T. R. <sup>a,b\*</sup>, MOURA, L. S. <sup>c</sup>, COSTA NETO, P. L. O. <sup>d</sup>

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*c. Uninovafapi, Teresina*

*d. Universidade Paulista, São Paulo*

*\*thais.ibiapina@hotmail.com*

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### **Abstract**

This paper aims to study the evolution of energy consumption in the State of Piauí in relation to investments in renewable energy. Therefore, a bibliographic review was performed to collect the main data. The results show that in the period there was a considerable increase in the consumption of electric energy and few investments in the generation of renewable energy for the State. It was also observed that despite Piauí's potential in clean energy sources, investments continue to grow, giving Piauí a prominent role in the production of renewable energy.

**Keywords:** *electricity, energy consumption, renewable energy*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 2**

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Environmental and Energetic Performance Evaluation of Mouthwashes with Different Sensorial Aspect from a Latin American Plant

Life Cycle Assessment (LCA) in Automotive Sector: Case Study in an Exhaust Valve Producer

Comparison of Environmental Impacts of Two Forms of Ice Cream Palletising

Indicators for Waste Electrical and Electronic Equipment: A Preliminary Comparison

---

## **Environmental and Energetic Performance Evaluation of Mouthwashes with Different Sensorial Aspect from a Latin American Plant**

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*a. Departamento de Engenharia Química da Escola Politécnica da Universidade de São Paulo, São Paulo*

*\*Corresponding author, lucas.cubas@usp.br*

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### **Abstract**

Personal care industry is competitive and consumers' opinion – based on sensorial perception – is decisive for success of a product or brand. In this context, environmental factor may be a market differential. Hence, this study compared energetic and environmental performance related to the production of 1.0 m<sup>3</sup> of two mouthwashes which meet different consumers for organoleptic aspects, but presenting the same primary function. The evaluation was conducted according to Life Cycle Assessment technique. This brought up that Product 'A', a formula with short chain alcohol, presents Primary Energy Demand equal to 77.4 GJ/FU, while Product 'B', containing alcohol with multiple hydroxyl groups, requires 20.3 GJ/FU. In terms of impacts from emissions, Product 'A' again demonstrated lower performance versus Product 'B'. In this case, unfavorable results of Climate Change, Agricultural Land Occupation and Water Depletion categories are pointed out. For all these impacts, significant contribution of inerting fluid is noticed in Product 'A' processing. Thus, consumption quantity of this utility material was varied for a Sensitivity Analysis. As reference for this estimative, the equivalence between Climate Change performance of 'A' and 'B' was assumed. In this condition, Product 'A' Primary Energy Demand decreased to 38.8 GJ/FU: a 50% reduction. In other exploratory assessment, Carbon Balance was carried out to both products, which sequestered CO<sub>2</sub> portions from air were incorporated and biogenic quantity of the same compound was emitted to atmosphere. From this perspective, environmental performance of 'A' significantly surpassed 'B', since the first product was able to capture more carbon than its emission. The conclusions of this study are useful for future developments which can be implemented in the product systems of both personal care items.

**Keywords:** *personal care; environmental performance; energetic performance; LCA; chemical processes.*

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## **Life Cycle Assessment (LCA) in Automotive Sector: Case Study in an Exhaust Valve Producer**

LOPES SILVA, D. A. <sup>a</sup>, OLIVEIRA, J. A. <sup>b</sup>, SILVA, E. J. <sup>c</sup>, OMETTO, A. R. <sup>c</sup>

*a. Universidade Federal de São Carlos (UFSCar), Sorocaba/SP*

*b. Universidade Estadual Paulista "Júlio Mesquita Filho" (UNESP), São João da Boa Vista/SP*

*c. Universidade de São Paulo (USP), São Carlos/SP*

*\*Corresponding author, diogo.apls@ufscar.br*

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### **Abstract**

Depending on the production sector and type of product, the environmental impacts of products placed on the market may be more significant outside the "factory-gate", i.e., those impacts may be more associated with the upstream and/or downstream life cycle stages of manufacturing. This is the case in many automotive industries, where environmental impacts of vehicles and their components show more significant contributions during the use phase compared to the manufacturing. Thus, this article aims to contribute to further research involving Life Cycle Assessment (LCA) studies in the automotive sector, focusing on the case involving the production of exhaust valves in Brazil. For this, a LCA was applied in a cradle-to-grave perspective of exhaust valves, and the results indicated that more than 90% of the impacts are due to the use phase of the product in vehicle engines. Thirteen midpoint impact categories were evaluated, including global warming potential, particulate matter formation potential, and human toxicity potential. Finally, suggestions for improvement were proposed to minimize part of the environmental hotspots identified in the study.

**Keywords:** *Environmental Management. Sustainable Production. Automotive Industry. Life Cycle Management.*

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## Comparison of Environmental Impacts of Two Forms of Ice Cream Palletising

LEOPASSI, A. P. F. <sup>a</sup>, MORIS, V. A. S. <sup>a</sup>, SILVA, D. A. L. <sup>a</sup>, NUNES, A. O. <sup>a\*</sup>

*a. Universidade Federal de São Carlos, Sorocaba*

*\* Corresponding author, andreaoliveira\_n@hotmail.com*

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### Abstract

Currently, among the resulting environmental impacts of everyday contemporary life, those caused by packaging are one of the most serious and worrying, since these materials are necessary for almost all consumer goods purchased daily. In addition, the growth of consumerism leads to an increase in the quantity of waste generated that negatively impacts the environment. Given the high volume of packaging consumed each day, the present work aims to evaluate and compare the environmental impacts between two different ways of palletizing ice cream pots in a company at São Paulo countryside through the use of Life Cycle Assessment methodology and SimaPro software. It was possible to identify the reduction of the environmental impacts of the current scenario to the scenario with the new palletizing way, mainly due to transportation, which decreased and consequently reduced CO<sub>2</sub> emissions considerably, followed by reduction in consumption of cardboard and, lastly, of plastics.

**Palavras-chave:** *environmental impacts, packaging, palletizing, cardboard, LCA.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Indicators for Waste Electrical and Electronic Equipment: A Preliminary Comparison**

PEREIRA, R. S. C. <sup>a\*</sup>, RIBEIRO, F. M. <sup>a</sup>, GÜNTHER, W. M. R. <sup>b</sup>

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*b. Public Health Faculty – University of São Paulo, São Paulo*

*\*Corresponding author raissascp@gmail.com*

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### **Abstract**

The growth of waste electrical and electronic equipment (WEEE) generation is a global phenomenon that tends to be intensified. WEEE management presents deficiencies and challenges, and reverse logistics (RL) has emerged as one of the instruments to improve it. The purpose of this work is to identify and compare sets of indicators related to WEEE management, in order to evaluate its applicability to the Brazilian context. Indicators proposed in two international publications were comparatively analyzed, using two criteria: relevance and data availability. Among 68 analyzed indicators, 44 were considered as applicable to the Brazilian context, through few adaptations. These indicators may be divided into two major categories: one related to the global evaluation of the implementation of WEEE RL in the country, and the other related to the performance evaluation of WEEE RL systems, to contribute to definitely implement WEEE RL in Brazil.

**Keywords:** *WEEE, Reverse Logistics, Indicators.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 3**

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Conception of the Reverse Logistics Network for the Recovery of "Electronic Waste" (e-waste)

Mapping for the Treatment of Electrical and Electronic Waste in a Higher Education Institution

A Short-Cut Model for Predicting Biomethane Availability after Biogas Upgrading

Multi-Objective Optimization of an Industrial Ethanol Distillation System Using Direct and Indirect Heating

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## **Conception of the Reverse Logistics Network for the Recovery of "Electronic waste" (e-waste)**

MARQUES, C. S. A. <sup>A\*</sup>, MINUSSI, C.R. <sup>B</sup>, TIOSSI, F.M<sup>C</sup>

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*b. Universidade Estadual Paulista – FEIS/UNESP*

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### **Abstract**

In recent decades, the rapid development of new technologies and new materials, as well as the reduction of costs of packaging, computers, appliances, cars, among others, have contributed to the generation of products with shorter and clearer life cycles. Tendency towards disposability, leading to one of the planet's greatest environmental problems: solid waste. Waste Electrical and Electronic Equipment (WEEE) are also part of this context because at the end of their useful life, ie exhausting all possible repair, upgrading or reuse, are considered "e-waste", and are currently one of the Major environmental problems in the world, as they are the fastest growing. Thus, there is the dimension of many environmental problems related to electronic waste in the world, so the reverse distribution channels are viable alternatives to return them to their point of origin minimizing losses to the environment, among other factors. The present research seeks to describe the characteristics of WEEE and its reverse network, as well as the operational processes related to the reverse logistics system. Moreover, it proposes to define a reverse network model for e-waste with the support of Fuzzy logic. The parameters and the decision variables will be defined from the functions and characteristics defined for the reverse network. We hope to get an efficient solution to the problem with the utmost satisfaction. In the course of the study, some network product recovery are presented as a way to contribute to a better return process of products to their legal destination

**Keywords:** *Reverse logistics, e-waste, reverse logistics networks.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## Mapping for the Treatment of Electrical and Electronic Waste in a Higher Education Institution

RIBEIRO, K. A. <sup>a\*</sup>, SANTOS, R. G. <sup>a</sup>, OLIVEIRA NETO, G. C. <sup>a</sup>,  
POMPONE, E. C. <sup>a</sup>

*a. Universidade Nove de Julho, São Paulo*  
*\*kleberaristides@uninove.edu.br*

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### Abstract

This paper aims to present and analyze the processes of treatment of technological waste from the activities of the area of information technology in a higher education institution. Therefore, interviews with the technical teams involved in these processes were conducted, with emphasis on the equipment and inputs used by the area of information technology. In this study, the policy developed for the asset management of the organization that deals with the life cycle of Information Technology equipment, from its acquisition to disposal was analyzed. It was possible to conclude that in this institution the treatment is carried out in accordance with the norms and regulations in force. In addition, it was verified that before discarding the product, donations are made to registered companies if the equipment is in operation. In the case of non-operating equipment, the components in good condition are removed and the remainder is discarded and withdrawn by specialized and government-accredited companies. The contribution of this paper is the presentation of the policy of use, update, reuse, donation and disposal of assets, and the mapping of the life cycle process of equipment and information technology inputs.

**Keywords:** *Electrical and electronic equipment waste; Asset policy; Life cycle; Donation and disposal.*

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## **A Short-Cut Model for Predicting Biomethane Availability after Biogas Upgrading**

JOPPERT, C. L.<sup>a\*</sup>, PERECIN, D.<sup>a</sup>, COELHO, S. T.<sup>a</sup>, CAMACHO, J. L. P.<sup>b</sup>

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*\*Corresponding author, caio.joppert@usp.br*

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### **Abstract**

Biomethane figures with increasing importance in the bioenergy sector. As a renewable energy source that promotes waste recovery and GHG (greenhouse gases) reduction, biomethane use aligns with cleaner production principles. However, many of the final uses to biomethane require an upgrading and cleaning process, to remove contaminants such as H<sub>2</sub>S and CO<sub>2</sub>. Facing the great amount of technological options to promote biogas upgrading and cleaning up to this date, it might be a rather challenging task to have a first estimate of biomethane availability required for a conceptual project level. Thus, the main objective of this paper is to propose a short-cut, mass balance-based model to predict biomethane availability after promoting a biogas cleaning and upgrading process regardless of the source of organic feedstock or the choice of the cleaning technology. The model development results into interesting dimensionless parameters, such as the gas contamination factors. Relevant parameters regarding biomethane use, such as its LHV and Wobbe index are also adapted to this model. The correlation with data from literature shows that the model has a satisfactory prediction when methane losses in the upgrading process are less than 3%.

**Keywords:** *Biogas, Biomethane, Upgrading, Availability, Shortcut*

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## Multi-Objective Optimization of an Industrial Ethanol Distillation System Using Direct and Indirect Heating

SILVA, R. O. <sup>a\*</sup>, TORRES, C. M. <sup>b</sup>, ROCHA, L. B. <sup>a</sup>, LIMA, O. C. M. <sup>a</sup>,  
COUTU, A. <sup>b</sup>, BRUNET, R. <sup>b</sup>, JIMÉNEZ, L. <sup>b</sup>, JORGE, L. M. <sup>a</sup>

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*\*Corresponding author, orgeda@hotmail.com*

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### Abstract

In this work, the performance of an ethanol from sugarcane autonomous distillery simulated on AspenHysys is evaluated using an automated tool programmed on Matlab to assess the environmental and economic impacts associated. We compare the current plant operation (direct heating), located in the South of Brazil, with the use of indirect heating, analyzing vinasse discharge using trucks, as well as the effect of its application in the soil. Results show that the replacement of direct steam injection by reboiler decreases approximately 15% of the vinasse quantity, consequently, decreasing the associated problems generated. Moreover, as the modifications do not change flegma and ethanol flowrates, the revamping might be done without further operational changes. The environmental evaluation presents positive results, showing that the distillery may decrease the eighteen environmental impacts categories assessed. From an economic perspective, the plant could also have higher net profits with the use of reboiler than direct steam injection to heat the distillation column. Finally, the new improved system is treated as a multi-objective optimization problem and it is solved by using the weighted sum method for the Pareto frontier technique to find the best compromise, to be as interesting economically as ecologically.

**Keywords:** *Simulation, Sugarcane vinasse, Economic evaluation, Environmental assessment, Multi-objective optimization.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017

*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 4**

---

The principles of Industry 4.0 and the Sustainability Impacts of the Enterprise Value Chain

Circular Economy Yesterday and Today: A Bibliometric Analysis

Performance of Operations Sustainable of Process of Public Procurement

Search for Competitive Advantage through the Implementation of Environmental Management Systems

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## **The principles of Industry 4.0 and the Sustainability Impacts of the Enterprise Value Chain**

PALMA, J. M. B.<sup>a\*</sup>, BUENO, U. S.<sup>a</sup>, STOROLLI, W. G.<sup>a</sup>, SCHIAVUZZO, P. L.<sup>a</sup>,  
CESAR, F. I. G.<sup>a,b</sup>, MAKIYA, I. K.<sup>a</sup>

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### **Abstract**

The growing interest for sustainability has led companies to adjust their strategies to include initiatives for the advancement of the three pillars of business sustainability in environmental, economic and social dimensions. These initiatives often are restricted to the internal actions in enterprises, and the results normally do not expand across the entire company business value chain. Some restrictions are still blocking the advance of sustainability at all levels, since finding solutions requires integration efforts and major changes in products, processes and behavior of people operating in highly complex networks. With the advance of new technologies, especially those from the Industry 4.0 (I.4.0), a high level of connectivity between the processes benefits the expansion of customized products and other elements that suggest deep changes in organizational environments and in society, contributing to the sustainability dimensions. In this scenario, this study intends to evaluate the relationship between sustainability and Industry 4.0 principles, which may impact in advancing the strategies within the company business value chain.

**Keywords:** *Industry 4.0, sustainability, value chain, environment.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Circular Economy Yesterday and Today: A Bibliometric Analysis**

DEUS, R. M.<sup>a\*</sup>, SAVIETTO, J. P.<sup>b</sup>, OMETTO, A. R.<sup>b</sup>,  
BATTISTELLE, R. A. G.<sup>a</sup>

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### **Abstract**

Sustainability remains a significantly debated issue for both post-industrialized and industrialized countries, many of which are still in the early stages of sustainable development. Circular economy comes as a model to drive towards sustainability because material flows are like biological cycles, that is, products are designed and planned for a cyclical metabolism through the generation of value. Thus, this article aims to evaluate the current state of the art, based on bibliometric tools and discusses the role of the circular economy in the scientific literature in the past and present. We concluded that the topic of the circular economy is still emerging, that is, since 2006, articles on this subject have been published in the *Web of Science* database, and since then it has grown steadily. Several countries have issued on the subject; however, China has been highlighted both regarding publication and citation impact. The main institution with the best indicators of production is the *Chinese Academy of Sciences*. The *Journal of Cleaner Production* is the main journal with 25.6% of all publications, being the bridge between all the others journals since it has the main publications. The circular economy has much to develop, especially in Latin America, which has a low representation of a subject of such importance.

**Keywords:** *Circular Economy; Bibliometrics; Systematic review.*

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## Performance of Operations Sustainable of Process of Public Procurement

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### Abstract

Sustainability is a theme that has gained wide prominence in the last decades, given the scarcity of natural resources, environmental degradation, and it is important and necessary to include environmental and social aspects in contracting, given the purchasing power of governments. Thus, the present research aims to evaluate the performance of the sustainable operations of the hiring process at the Universidade Tecnológica Federal do Paraná - Câmpus Pato Branco. The study can be characterized as descriptive, and a case study was carried out. After the bibliographic review of the literature, an analysis was made of the tenders made by Câmpus in the years 2015 and 2016, available at the Shopping Portal of the Federal Government, in the pregão (electronic form), invitation and price Identify the materials, categories and amounts spent on the acquisition of materials and products with sustainable characteristics. Being materials: office, cleaning, electrical, graphic, air conditioners, and final waste disposal and engineering services. In 2015, the percentage of sustainable contracting was approximately 1% and in 2016 1.81% in the acquisitions, in the bidding modalities analyzed, and the sustainable public contracting carried out by Campus is still incipient. It was also possible to conclude that recycled A4 paper was purchased for a higher value in the years 2015 and 2016 when compared to white A4 paper but that the difference was minimal. Following this, a semi-structured interview was conducted with the head of the Purchasing Division to verify the barriers to sustainable public procurement, being: the legislation itself, the price, the quality of the products and, depending on the category of products, there is still no significant quantitative Suppliers to ensure broad competition. So it is possible to conclude that it is necessary to the UTFPR - Câmpus Pato Branco, to carry out a planning for sustainable acquisitions and to encourage the requesters to acquire environmentally friendly materials and products, since the legislation is difficult to make changes because it depends on the government.

**Keywords:** *Public procurement, performance, sustainable and operations.*

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## **Search for Competitive Advantage through the Implementation of Environmental Management Systems**

SOUZA, V. F. <sup>a</sup>, OLIVEIRA, C. F. B. <sup>a</sup>, PEREIRA, H. D. <sup>a</sup>, PINTO, E, M, <sup>a</sup>  
PAVELOSKI, E. M. <sup>a\*</sup>

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### **Abstract**

The search for sustainable competitive advantage includes the adoption of environmentally correct practices in order to achieve a green consumer who opts choosing besides the price / quality ratio, companies environmentally friend. This study aimed to identify, through the application of a Survey and interviews with open and closed questions, what are the main factors that drive organizations in the search for the implementation of Environmental Management Systems as a form of differentiation and competitive advantage. The questionnaires covered questions about the benefits gained from their implementation. As a result more noticeable, was observed a counterpoint to the common sense that the companies have previously environmental concerns for the decisions of search for certifications. The great majority of the administrators related that the decisions are in the first instance directed to the increase of the capacity of new contracts that properly related to environmental factors as they should. With regard to environmental management tools, the study found that these are used to raise business opportunities by strengthening the competitiveness of their companies. The work shows that the implementation and certification of the environmental management systems, present several competitive benefits and reinforce the image of the companies in the increasingly demanding market scenario.

**Keywords:** *Competitiveness, Green Consumer, Environmental Marketing, Environmental Management System, Competitive Advantage.*

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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 5**

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Development of Wood-Thermoplastic Pellets Made of Starch Adhesive to Injection Molding

Comparative Analysis of the Tensile Properties of Polyester to Epoxy Matrixes Composites Reinforced with Hemp Fibers

Fenton-Like Reactions for Effluent Remediation of Cassava Processing

Characterization of Textile Effluent Treated by Adsorption with Residual Adsorbent Generated in the Aluminum Industry

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## **Development of Wood-Thermoplastic Pellets Made of Starch Adhesive to Injection Molding**

GONDAK, M. O. <sup>a\*</sup>, ARAÚJO, M. S. <sup>a</sup>

*a. Universidade Tecnológica Federal do Paraná (UTFPR), Curitiba*  
*\*Corresponding author, mgondak@gmail.com*

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### **Abstract**

The techniques of conformation of pellets of thermoplastic-wood composite involve the use of extrusion machines or hot mixers. However, the manufacturers of wood dust can not afford such expensive equipment, so this work shows the possibility of cold conformation of pellets of plastic wood with the help of an adhesive based on starch and sodium hydroxide (NaOH). The adhesives were prepared with 10, 15 and 20g of soluble starch for each 100mL suspension. Then, the adhesives were mixtured with 30% of sawdust and micronized LDPE. Laboratories tests were performed evaluating Melt Flow Index and mechanical characterization in the compounds, as well as testing of injection molding, which indicated that the material has great potential to be used, since the resistance increases with the concentration of starch in the adhesive and with the amount of adhesive in the compound.

**Keywords:** *wood-plastic, LDPE, composite, starch adhesive, injection molding*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Comparative Analysis of the Tensile Properties of Polyester to Epoxy Matrixes Composites Reinforced with Hemp Fibers**

MANTOVANI, D. P. <sup>a</sup>, ROHEN, L. A.<sup>a</sup>, NEVES, A. C. C.<sup>a</sup>, VIEIRA, J. S. <sup>a</sup>, PONTES, L. A. P. <sup>a</sup>, VIEIRA, C. M. F. <sup>a</sup>, MARGEM, F. M.<sup>b</sup>, MONTEIRO, S. N. <sup>c</sup>

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### **Abstract**

This present work consists in comparing the tensile properties of polyester and epoxy matrix composites reinforced with hemp fibers. According to ASTM D-638-14 the matrix, polyester and epoxy reinforcing specimens reinforced with different volumes of hemp, 0%, 10%, 20% and 30% fibers were made and suitably tested by a universal machine INSTRON model 5582 of the LAMAV / UENF. The epoxy matrix composites reinforced with 30% of fibers presented tensile strength, of 53.08 MPa, while those of polyester matrix, 25.44 MPa. The elastic modulus, epoxy matrix composites, in a volume of 30%, was 1.75 GPa and the polyester matrix 4.05 GPa. The tests showed comparatively that the resistance of the epoxy reinforced with hemp fiber composites is superior to the composites of polyester matrix. However, the stiffness of these polyester / hemp fiber composites is higher than the epoxy / hemp fiber ones. The determination of the mechanical properties of these new composites materials contributed to the search for new sustainable materials, economically viable and technologically advanced.

**Keywords:** *tensile properties, composites, polyester, epoxy, hemp fibers.*

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## Fenton-Like Reactions for Effluent Remediation of Cassava Processing

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### Abstract

Manipueira is an effluent derived from processing of cassava flour and starch. Due to its high organic load, attributed to presence of high concentrations of carbohydrates, it causes an environmental impact when untreated. Conventional treatment processes are inefficient and, thus, the objective of this study was to evaluate Fenton and photo-Fenton like reactions for treatment of manipueira, using ferrous ions derived from preliminary coagulation step. Raw effluent was characterized and compared with subsequent results in terms of turbidity, absorbance ( $A/A_0$ ), electrical conductivity and Chemical Oxygen Demand (COD). The reactions were evaluated by 3 variations of pH and hydrogen peroxide concentrations, verifying more relevant analytical responses in terms of color and turbidity. At higher pH and peroxide concentration, a decay of 64% was observed in relation to turbidity and 27% in relation to COD. Therefore, the use of iron remaining in preliminary treatment stage shows a great potential for making tertiary treatment more economical and less aggressive to environment, by the reduced production of residual sludge, which reduces polluting potential of the effluent also in terms of solid waste.

**Keywords:** *Agroindustrial Effluent, Advanced Oxidative Process, Tertiary Treatment.*

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## **Characterization of Textile Effluent Treated by Adsorption with Residual Adsorbent Generated in the Aluminum Industry**

ROSSI, T. R.<sup>a\*</sup>, TANAKA, Y. H.<sup>a</sup>, CANO, V.<sup>a</sup>, ANDRADE, H.<sup>a</sup>, MIYADAHIRA, C. A. G.<sup>a</sup>, NOLASCO, M.<sup>a</sup>, COSTA, S. M.<sup>a</sup>, COSTA, S. A.<sup>a</sup>

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### **Abstract**

The textile industry uses large quantities of synthetic dyes in the process of textile processing. The generation of non-fixed dye in the textile substrates contributes to the pollution of the effluents. In order to comply with the legislation and strategies of Cleaner Production, the textile industries have been looking for sustainable alternatives for the treatment of effluents. A poorly exploited but potentially adsorbent material for the removal of color from textile effluents is the residue generated in the oil filtration process used in the lamination of aluminum sheets. For the textile industry to use this residue, an assessment of the characterization of their behavior becomes necessary. A textile effluent composed of 3BL solophenyl red dye and chemical additives commonly used by the textile industry was used. The experiments were performed in batch, adding 20 g of the residue and 500 mL of the effluent. The pH was adjusted to 4 with HCl, and the reaction was kept under stirring at 300 rpm for 30 minutes. The effluent was filtered through Buckner's funnel, centrifuged and the recovered liquid was evaluated for absorbance at 280 and 531 nm, pH, Chemical Oxygen Demand (COD), and anions. The results showed that the pH of the treated effluent did not change during the adsorption process. The reduction of the absorbance at 280 nm shows a possible reduction of the aromatic compounds and the absorbance at 531 nm indicated 95% of the color removal of the effluent color. The COD of the effluent treated in relation to the raw effluent showed a reduction of 64.1%. In terms of ions measured in the treated effluent, it was observed an increase in chloride and sulphate ion contents and a reduction of phosphate ions in relation to the effluent. It can be concluded that the adsorbent generated from the waste studied from aluminum industry may be an adsorbent used to treat effluents in textile industry. The increase of sulfate ions in the effluent treated by the adsorbent raises the need for future studies that demonstrate the potential of reuse of the treated water.

**Keywords:** *adsorbent, textile industry, aluminum industry, textile effluent, waste.*

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"TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE"

São Paulo - Brazil - May 24<sup>th</sup> - 26<sup>th</sup> - 2017



*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 6**

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On the Implementation of a Circular Economy: Role of Institutional Capacity Building

Application of Method 3R (Reuse, Remanufacture and Recycling) in a Machine Line Based on Circular Economy

Corporate Sustainability and Organizational Culture from the Perspective of Intra-Organizational Relationships

Analysis of the Application of the LEED Methodology in a Building in the City of São Luís-MA

Analysis of Biodiesel Use in a Commercial Bamboo Plantation as an Alternative to Diesel Oil

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## **On the Implementation of a Circular Economy: Role of Institutional Capacity Building**

CEGLIA, D. <sup>a,b\*</sup>, ABREU, M.C.S. <sup>a\*</sup>, EVANS, S. <sup>c</sup>

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### **Abstract**

This paper aims to explore the role of institutional capacity building in the development of a circular economy. The study was conducted using open-end interviews with firms and other actors about the industrial symbiosis in the United Kingdom in the light of the particular conditions of the National Industrial Symbiosis Programme (NISP) experience. A content analysis methodology was applied to the interviews results. Our survey indicates that limited institutional capacity building imposed real constraints of a circular economy. The phase-out of industrial symbiosis in the UK has raised several concerns that should be taken into account. Our results demonstrate that knowledge and relational resources and mobilization capacities were weakly developed. Increasing knowledge and relational resources enable companies to increase mobilization capacity. The design of circular economy should include critical importance of these institutional capacities which positively influenced its adoption as a long-term waste and resource availability solution among companies.

**Keywords:** *Industrial Symbiosis, Circular Economy, Industrial Ecology, Solid Waste Management, Institutional Capacity*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Application of Method 3R (Reuse, Remanufacture, and Recycling) in a Machine Line Based on Circular Economy**

VICENTE NETO, L. <sup>a,b\*</sup>, HELLENO, A. L. <sup>b</sup>

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### **Abstract**

Given the demands of the market and maintaining competitive conditions, many companies are looking for technologies that enable them to innovate their processes and products. The environmental impact related to the exploitation of natural resources can be considered a problem due to the linear production-consumption flow. Therefore, this work focuses on the study of real initiatives to develop environmentally friendly processes and their results in relation to the concept of circular economy in the application of the 3R method in a line of machining. With an applied methodological approach and exploratory objective, we divided the application into three phases: (1) Reuse and Redistribution; (2) Remanufacturing and (3) Recycling. The products are machined in a turning line, where cutting tools (inserts) are the most commonly used objects. It can be observed that in the linear production model, there is an increase in tool disposal. Applying the concepts of based on circular economy we have a gain in the useful life of the cutting tools without the need to modify the production parameters. It is concluded that it is possible to apply the concepts of circular economy, but there is a need for everyone involved in the production process.

**Keywords:** *Circular Economy, Machining, 3R, Automotive Industry*

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## **Corporate Sustainability and Organizational Culture from the Perspective of Intra-Organizational Relationships**

SOUZA, J. B. <sup>a, b\*</sup>, SACOMANO, J. B. <sup>a, b</sup>, KYRILLOS, S. L. <sup>c</sup>

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*b. Universidade Paulista-PPGEP, São Paulo-SP*  
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*\*José Barrozo de Souza, josebarrozo@gmail.com*
- 

### **Abstract**

The concept of corporate sustainability has gained importance in recent years in organizational theory and practice. While there is still a lack of clarity about what constitutes business sustainability and the best way to achieve it, scholars suggest that the road to adopting corporate sustainability principles is through the adoption of a sustainability-oriented organizational culture. In this article, we present an analysis of this suggested link between the cultural orientation of an organization and the search for principles of corporate sustainability in the bias of intra-organizational relationships. Specifically, we search for (1) what sustainability-oriented organizational culture means, (2) if it is possible for organizations to present an organizational culture oriented toward corporate sustainability, and (3) whether organizations can become more sustainable, through the sharing of information and knowledge on the bias of intra-organizational relationships. Challenges and future research are described.

**Keywords:** *Performance, Function, Organization, Production.*

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## **Analysis of the Application of the LEED Methodology in a Building in the City of São Luís-MA**

FERREIRA, L. A., NETO, A. F. V., DEMETRIO, J. C. C., DEMETRIO, F. J. C.\*

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### **Abstract**

Daily debates are held regarding the environment, resource rationalization and green building, and Brazil follows the worldwide trend of technological development in search of products that follow the sustainable line. Faced with this problem, which is not limited to this country, Green Buildings represent a significant contribution to reducing the consumption of natural resources, both in the construction and operation of buildings (maintenance). Within this framework, environmental certification is an important instrument that has great potential to implement better sustainability practices in the sector. This paper focuses on the LEED (Leadership in Energy and Environmental Design) methodology, which is a certification for sustainable constructions, conceived and awarded by the US Green Building Council (USGBC), according to rationalization criteria of resources (energy, water, etc.) served by a building. It will be presented the LEED certification, an application of the same in a work in the city of São Luís, its advantages and a comparison of costs in the implementation of the criteria of the LEED methodology.

**Keywords:** *Environmental Certification; Sustainable construction; LEED Methodology.*

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## **Sensibility Analysis of Biodiesel use in a Commercial Bamboo Plantation in Alternative to Diesel Oil**

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### **Abstract**

In Ghelmandi Netto 2009 and Ghelmandi Netto, et. al., 2012, a Multicriteria Evaluation (MCE) was applied in a northeastern commercial bamboo plantation - located in Maranhão state - focused on paper production. The MCE has shown that the diesel oil is one of the inputs more required during the whole plantation lifespan - 25 years. This work proposes a sensibility analysis, replacing the diesel oil used in the bamboo plantation for biodiesel, considered a 'cleaner' input. This sensibility analysis aims to analyze the effects and impacts of this replacement. Nowadays the mandatory determination of Brazilian government is that the diesel oil sold must have 8% of biodiesel (B8 mixture). The other scenarios, that compound the sensibility analysis in addition of B8 mixture, are B25, B75 and B100 mixtures.

**Keywords:** *Sensibility analysis, bamboo plantation, multicriteria evaluation, biodiesel, diesel oil*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 7**

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The Widening Concept of "Cleaner Production"

Environmentally Sustainable Product Development Process: Diagnostic and Suggestions for Small and Medium-Sized Enterprises

Identification of Cleaner Production Opportunities in a Plastic Recycling Cooperative

Applicability of Lean and Sustainable Production in Sanitizers and Cosmetic Industries in the State of Goiás

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## The Widening Concept of “Cleaner Production”

HENS L. <sup>a\*</sup>, CABELLO-ERAS J.J. <sup>b,c</sup>, GARCIA-LORENZO D. <sup>c</sup>, CHAMORO C. <sup>b</sup>,  
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### Abstract

“Cleaner production ” (CP) emerged in the aftermath of the 1987 Brundtland Commission (WCED, 1987) and calls for less and more efficient energy and materials use and the substitution of more harmful products (for the environment and health) by less dangerous ones. Cleaner production was the reply of industry to the inter-sectorial and socio-economic call for sustainable development. The technical aims widened. Originally they were targeted to improve environmentally inferior products to less inferior ones. Today the goal is producing quality products using renewable energy efficiently and producing zero waste, while emitting no pollution. The perspective of the scope also changed from environmental sustainability to the wider “Corporate Social Responsibility” (CSR). This includes that post-modern companies have not only responsibilities on their economic performance and the environment, but should also act on issues including human rights and resources, business ethics, and community involvement. This widening of contents necessitates more and better adapted methods. During the past 45 years the number of assessment methods (preventing pollution and its effects) increased significantly from environmental aspects (EIA), over health (HIA) and policy aspects (SEA), to sustainability assessment, addressing not only environmental, but in an integrated way also social, economic, and ethical issues of the evaluation. This paper reviews this evolution of ideas. It provides not only the concepts, but is equally based on examples illustrating different aspects of this evolution. It acts as a guide towards contemporary CSR and advocates its support towards education and research.

**Keywords:** *Cleaner production, corporate social responsibility, renewable energy.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Environmentally Sustainable Product Development Process: Diagnostic and Suggestions for Small and Medium-Sized Enterprises**

LAGO, N. C.<sup>a</sup>, KOLLING, C.<sup>a</sup>, MEDEIROS, J. F. <sup>a.b\*</sup>, RIBEIRO, J. L. D. <sup>b</sup>,  
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### **Abstract**

The present study aimed (i) to investigate the approaches and the advances made in the academic discussion regarding the alignment between environmental sustainability and the product development process, and (ii) to develop a diagnostic on small and medium-sized enterprises that operate in southern Brazil. To that end, an exploratory research was performed in two steps: a bibliographical and a field research. The bibliographical research was carried out on Web of Science and Scopus databases. The field research was performed with the managers of 18 industries of different segments. Regarding the theoretical research, the results indicate that some studies highlight that sustainability practices must be integrated into the existing product development processes, other studies propose that specific models should be developed, and, finally, another field of research highlight tools that can be used in sustainable development processes. As to the field research, it can be stated that the organizations sampled understand the need for environmental sustainability in products and processes, and define internal drivers for the adoption of the adequate practices, adapting to the regulatory pressures and to the market demands. Nevertheless, the results also show that the companies' present structural gaps in the product development processes, perform incomplete sustainable design actions and do not possess broad experience in the specific activities of the green product development process. Considering the results, a referential system to orient the practice of an environmentally sustainable product development process is proposed.

**Keywords:** *Green Product Development Process. Environmental Sustainability. Green Product Innovations.*

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## **Identification of Cleaner Production Opportunities in a Plastic Recycling Cooperative**

SANTOS, F. F. <sup>a\*</sup>, PAIVA, J. M.F <sup>a</sup>; MORIS, V.A.S. <sup>a</sup>

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### **Abstract**

Recycling is considered an important strategy to meet the challenge of waste generation and to develop more sustainable practices. The recycling chain in Brazil is considered complex because it involves multiple actors, among them, it is possible to highlight the performance of the scavengers as fundamental agents in the viabilization of recycling. However, the scavengers are not always recognized, they are the ones that benefit least in the chain and they face several difficulties. In the quest to overcome difficulties and obtain a better position in the chain, the collectors have organized themselves in cooperatives, networks and recycling centers of materials. From the environmental point of view, recycling processes, especially of post-consumer plastics, can also have an impact on the environment, if management is not established from the collection until the final disposal of the same. Thus, it is important to adopt environmental management tools such as Cleaner Production (CP), for example, that result in benefits to the environment, society and organizations. The objective of this study was to identify opportunities for improvement in the plastic recycling process in a cooperative in Sorocaba - SP, through the use of the CP tool. A literature review and technical visits were carried out in a cooperative that performs the recycling process of Polyethylene (PE) and Polypropylene (PP), transforming them into flakes and / or pellets. It was sought to obtain general characterization information and the environmental aspects of the recycling process, in order to suggest improvements to the process and to identify the main barriers of CP in the cooperative. The study revealed that the recycling process of the cooperative is passive to generate several environmental impacts, mainly due to the absence of standardization of the raw material and the high consumption of water in the washing stage and consequent generation of effluents, which in turn is not treated. 25 improvement opportunities were identified, focusing mainly on level 1 of housekeeping. There were several CP barriers in the cooperative, especially those related to financial issues and lack of government support. Thus, it is necessary to overcome these barriers to an effective implementation of the CP and obtain the consequent economic, environmental and social benefits.

**Keywords:** *Environmental management. Cleaner Production. Recycling. Cooperative. Plastics.*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **Applicability of Lean and Sustainable Production in Sanitizers and Cosmetic Industries in the State of Goiás**

ALMEIDA, S. <sup>a\*</sup>, SOUZA, F. F <sup>b</sup>, PASQUALETTO, A. <sup>b</sup>, TEIXEIRA, D. <sup>b</sup>

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### **Abstract**

The objective of this study was to address the environmental practices in the companies of cleaning products (sanitizers) and products of personal hygiene, perfumery and cosmetics (HPPC) in the state of Goiás through concepts of lean production, green manufacture and analysis of management practices in order to reduce environmental impacts, highlighting its tools and principles, as well as the benefits and losses of the combination of both practices, and presents the concrete results, indicators and their effects, by means of explanatory analysis, exposing a hypothetical-deductive scientific method of questionnaires of national and regional sanitation companies supporting or not the theories already proven. The results demonstrate that the industries of these branches that are more familiar with good practices of lean production (PE) and environmental management (GA), obtain better operational performance.

**Keywords:** *Lean Manufacturing, sustainability, Environmental Management.*

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*In* Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.

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## **26<sup>th</sup> May 2017**

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**15h00-16h30**

**Session 6B**

**Room 8**

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Environmental Performance Evaluation - A New Tool for the Industry

Industrial Symbiosis Expanded for Building a Sustainable Society

Performance of the Triple Bottom Line on Brazilian Industrial Production

Industrial Losses Cause by Floods: Is it Worthwhile to Stay in Risk?

Motivations Behind the EMAS Stagation and Enabling Measures to Stimulate new Registrations: Characterization of Public Administrations and Private-Owned Organizations

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## **Environmental Performance Evaluation - A New Tool for the Industry**

MACENO, M.M.C. <sup>a\*</sup>, PAWLOSKY, U. <sup>a</sup>, MACHADO, K.S. <sup>a</sup>, SELEME, R. <sup>a</sup>

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### **Abstract**

Several tools are available in the literature to evaluate environmental performance. However, there is a lack of scientifically addressed analytical tools focusing industrial processes. Thus, based on a literature review, this study aimed to construct and test a new analytical tool for environmental performance evaluation specifically in the industry. This tool named EPIP (Environmental Performance of Industrial Processes) has as main function to identify environmental aspects with worst performance and to drive decision-making toward environmental improvements. In order to assess the effectiveness of EPIP, this tool was applied in a manufacturing industry packaging yogurt cup. The analysis of the results showed that the environmental aspects with worst performance were related to the thermoforming activities, such as energy consumption, solid waste generation and air pollution emissions. Altogether, the outcomes of this study showed that EPIP is a significant contribution to the industry, mainly those with low level of environmental management maturity, which are starting to move toward the environmental sustainability.

**Keywords:** *Environmental Performance Evaluation; Environmental Sustainability; Industrial Processes; Environmental Impact Assessment*

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In Giannetti, B.F.; Almeida, C.M.V.B.; Agostinho, F. (editors): *Advances in Cleaner Production, Proceedings of the 6<sup>th</sup> International Workshop, UNIP, São Paulo, SP, Brazil. May 24<sup>th</sup> - 26<sup>th</sup>, 2017.*

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## **Industrial Symbiosis Expanded for Building a Sustainable Society**

SILVA, L. F. <sup>a,b\*</sup>, OLIVEIRA, P. S. G. <sup>c</sup>, GUEVARA, A. J. H. <sup>b</sup>,  
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### **Abstract**

The purpose of this theoretical conceptual article is to present a framework for a conceptual model of Industrial Symbiosis Expanded, to build such model the consumer was inserted in your role such as *prosumer*. The reason for the relevance of this proposition is that most of the time the concept of Industrial Symbiosis is related only to interorganizational relationships (Ammenberg et al., 2015, Martin, 2015, Trokanas, Cafelja and Raafat, 2015). Consumers in turn are treated as inert parts in the industrial chain. In this way, by inserting consumers into the industrial system, adopting a perspective under the concept of *prosumer* (Ritzer, Dean, Jurgenson, 2012, Seran, Izvercian, 2014), It is possible to promote synergistic activities in which the individual can generate benefits not only to himself but to other agents. This situation can be evidenced in the studies of Nazari et al. (2014) and Rathnayaka et al. (2014) on the production and consumption of energy and the gains in establishing synergistic relationships between companies and consumers, the latter also producing and re-feeding the electric system. The proposition of the presented conceptual model followed a three-dimensional perspective aligned with the dimensions of the Triple Bottom line (Elkington, 1998), demonstrating the symbiotic interaction and cooperation between the three synergetic systems - natural, industrial and *prosumer*.

**Keywords:** *Industrial Symbiosis; Sustainability; Sustainable Production; Industrial Ecology; Prosumer.*

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## **Performance of the Triple Bottom Line on Brazilian Industrial Production**

NEVES, F. O. \*, SALGADO, E. G. <sup>a</sup>,

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### **Abstract**

Researchers emphasize that companies need to integrate the concept of sustainability into their strategies through the practice of organizational culture. This leads to the convergence of the domains of the relationship between production and sustainability through strategic management. This way, this concept of industrial sustainability is a crucial factor for the development of industrial volume. Therefore, the present paper aimed to study which factors of the triple bottom line (3BL) are influencing in the process of Brazilian industrial sustainability, represented by its industrial production. For this, the influence of sixteen factors was evaluated: economic, environmental and social sustainability and Brazilian industrial production through the adjustment of multiple regression models. Carbon dioxide (CO<sub>2</sub>), Workforce (FT) and Human Development Index (HDI) were the factors that influenced industrial production in Brazil. There was no adjustment of any economic sustainability factor related to the industrial production. The conclusions of this paper may be useful for industry as a research tool in different aspects of Brazilian industrial production.

**Keywords:** *Triple Bottom Line; Industrial production; Regression model.*

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## **Industrial Losses Cause by Floods: Is it Worthwhile to Stay in Risk?**

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### **Abstract**

Disasters are harmful events that damage natural and anthropogenic environments. Urban floods are a type of natural disaster with high negative impact to society. The economic effects of urban floods are under-researched within the Brazilian industrial sector. Esteio municipality, in the Metropolitan Region of Porto Alegre, Rio Grande do Sul State, Brazil, is rated in 18<sup>th</sup> place in terms of Gross Domestic Product (GDP) among 497 State municipalities, and it has the highest demographic density in Rio Grande do Sul, with almost 3,000 inhabitants per square kilometer. It is also highly vulnerable to floods, given its low topography and the presence of a main river and two tributary streams that run along its 32.5 square kilometers. This study employs open interviews with six private, two governmental, and four non-governmental agents based in Esteio. It has the aim to clarify their understanding of resilience to floods, and to unveil experiences of industrial losses in the main flood events, recorded in 2013 and in 2015. Private firms avoid talking about losses, and prefer instead to emphasize their mitigation actions, thereby taking risks regarding the high probability of future floods. The perception of resilience by firms is disguised or shallow, focused on palliative measures. Local firms, mainly small ones, usually accept the risk of keep their business in the municipality, because they have roots in Esteio. Further research is necessary to better classify and quantify industrial losses caused by floods. Such data would enable business owners to get better prepared for future natural disasters.

**Keywords:** *Industrial losses. Supply chain disruption. Floods. Resilience.*

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## **Motivations Behind the EMAS Stagation and Enabling Measures to Stimulate New Registrations: Characterization of Public Administrations and Private-Owned Organizations**

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### **Abstract**

The Eco-Management and Audit Scheme (EMAS) is a voluntary Regulation that defines a management instrument developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance. Today the EMAS is undergoing a revision process, in order to fit organizations' and stakeholders' requirements and increase its diffusion. Italy accounts for roughly 1,000 of the 4,000 certified European organizations, and, especially during the last five years, a growing number of organizations have not renewed the certification. This context determined a stagnation in the number of EMAS registered organizations. Thus, the aim of the survey is to investigate why a growing number of Italian organizations have dropped out of EMAS, and to identify which enabling measures would be more effective in order to encourage organizations to move back to the certification. The target of the questionnaire were the 339 Italian organizations that did not renew their EMAS registration between 2010 and 2015, there were 99 respondents. In this paper, certified Public Administrations and private-owned organizations are compared in order to delineate significant differences between the two groups. Concerning motivations for not renewing EMAS, implementation costs were the key reasons for both groups. Conversely, considering the possible enabling measures, while private-owned organizations demand long term tax benefits, Public Administrations prefer a greater consideration of EMAS in public funding. This paper systematically addresses the phenomenon for the first time, contributing to reducing the existing gap in literature, and providing an input to decision-makers who are overseeing the EMAS revision process.

**Keywords:** *EMAS; Environmental Management Systems; ISO 14001; EMAS barriers; public Organizations.*

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**26<sup>th</sup> May 2017**

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**16h50 -18h50      Closing Conference**

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**Gengyuan Liu**

**Beijing Normal University -  
China**

The Evolution of Cities: "Brains"  
or "Parasites" of Sustainable  
Production and Consumption  
Processes in China

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## **The Evolution of Cities: “Brains” or “Parasites” of Sustainable Production and Consumption Processes in China**

Gengyuan Liu and Zhifeng Yang

*Beijing Normal University – China*

In the last two decades, remarkable progress in the promotion and implementation in China has occurred and generated a huge change of land use, energy and other resources demand, as well as environmental problems. It is therefore of paramount importance to explore the driving forces and the consequences of such a trend, as far as environmental integrity and resource availability are concerned. Special focus must be placed to possible changes in driving forces, in order to understand to what extent such a trend is continuous and irreversible or, instead, if sustainable metabolic processes in cities are likely to slow down as a consequence of the expected decline of available energy and material resources. Previous studies have already recognized the importance of the energy and material basis in support to urbanization trends and expressed concerns about the environmental consequences resulted from urbanization. What is missing is an integrated approach capable of establishing a bridge across the three legs of urban sustainability: (i) economic viability; (ii) social desirability; and (iii) ecological compatibility.

This study describes the development of a forecasting model, named the thermodynamic-based urban dynamic model, capable of accurately simulating the observed resource consumption, economic growth, and environmental impact of Dalian from 2000 to 2050. This model differs from previous urban dynamic models by monitoring the negative effects to human well-being and ecosystem integrity in the developing urban systems.

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Statistical information and calibration were also considered in this dynamic accounting. The results showed that the production and consumption processes in Dalian are heavily relied on non-renewable resources. Although the economic structure of Dalian was generally optimized, Dalian continued to face enormous resource and environmental pressures caused by the rapid economic growth. This study advances the temporal dynamic principles through integrating upstream and downstream evaluation methods to quantify the environmental impact by addressing specific damages to human health and ecosystem's integrity and by linking such impacts to a supplyside environmental cost evaluation.

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