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Poster

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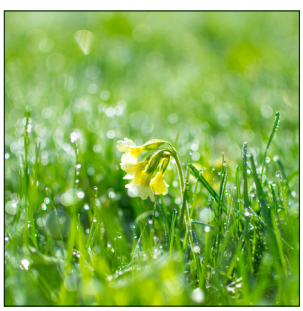


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Plastic Waste Classification System using image processing and deep learning

Janusz Bobulski and **Mariusz Kubanek**
Czestochowa University of Technology, Poland

The plastic waste management is a challenge for the whole world. Manual sorting of garbage is a tedious and expensive process, which is why scientists create and study automated sorting techniques to improve the overall efficiency of the recycling process. The plastic waste might be automatically selected on the sorting lines businesses for waste disposal by using methods of image processing and artificial intelligence, especially deep learning, to improve the overall efficiency of the recycling process. Waste segregation techniques and procedures are applied to major groups of materials such as paper, glass, metal, wood, and plastic. However, the biggest challenge is separating different types of materials in a given group, e.g. sorting different colors of glass or different types of plastics. The problem of plastic garbage is interesting and important at the same time due to the possibility of recycling only certain types of plastics (e.g. PET can be converted into polyester material). Thus, there is a problem with the separation of different types of plastics, some of which can be reused. One of the possibilities is the use of deep learning and convolutional neural network. In household waste, the most are plastic components, and the four dominant types: PET - polyethylene terephthalate, HDPE - high-density polyethylene, PP- polypropylene, PS- polystyrene. The main problem considered in this article is the creation of an automatic plastic waste segregation method, which can separate four mentioned categories: PS, PP, PE-HD and PET, and could be applicable on a sorting plant.

Speaker Biography

Janusz Bobulski has completed his PhD at the age of 29 years from Czestochowa University of Technology, Poland; in 2018 he received habilitation. He is the Associate Professor of Czestochowa University of Technology, Poland. He has over 70 publications that have been cited over 70 times, and his/her publication H-index is 5 and has been serving as an editorial board member of reputed Journals. His scientific interests include: artificial intelligence, image processing and recognition, pattern recognition, deep learning.

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Recycling of end-of-life vehicles for improved sustainability performance

Michael Bamidele Fakoya
University of Limpopo, South Africa

Recycling provides a beneficial alternative to natural resource consumption in production processes from an environmental responsibility perspective. There is a lack of commitment from motor vehicle industrial practitioners to the recycling of end-of-life vehicles. Furthermore, reliance on natural resources in manufacturing new vehicles harms the economy, society and environment. The study examines the impact of recycling end-of-life vehicles on the cost of new vehicles; reduction in carbon-monoxide emissions level; the cost of fuel consumption per kilometre; and volume of motor vehicle waste disposed to landfills using the theory of planned behaviour. A positive attitude by consumers can have an encouraging impact on the recycling of end-of-life vehicles and the effectiveness of environmental policies. Additionally, an effective way of collecting, reuse and recycling of end-of-life vehicles is necessary to address the negative impact on the environment, society and economy. Moreover, recycling end-of-life vehicles will result in the economic, social and environmental benefits.

Speaker Biography

Michael Bamidele Fakoya is a Professor of Accounting in the School of Accountancy at the University of Limpopo, South Africa, where he has been since 2009. From 2017 to date, he has been serving as the Head of Research, Africa Centre for Sustainability Accounting and Management (ACSAM), School of Accountancy, University of Limpopo, South Africa. He is the leader of the climate change and sustainability research niche area of the University of Limpopo. His research interests span both material flow cost accounting (MFCA) and environmental and sustainability management accounting. Much of his work is on improving the efficiency and performance of corporate processes. Professor Fakoya has published in leading international sustainability-related journals such as Journal of Cleaner Production; Sustainability; Environment Development and Sustainability and Sustainable Production and Consumption to mention a few. Many of his masters and doctoral students graduated in this area of research. He has attended many international conferences in the field of sustainability and responsible business.

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Video Presentation

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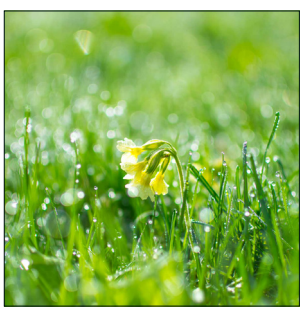


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Metal recovery from E-waste by innovative Hydrometallurgical Processes: GOLD-REC and FENIX Projects

Vegliò F
University of L'Aquila, Italy

Large amounts of wastes are generated at the end-of-life of electrical and electronic equipment (EEE). Presently, at industrial level, the technologies used for waste of electrical and electronic equipment (WEEE) or E-waste treatment are mostly focused on physical and thermal processes. However, both of them have important drawbacks; the physical procedures are able to achieve only the partial separation of major elements, i.e. copper, iron, aluminum; the thermal treatments require high cost of investments. Till present the hydrometallurgical processes, which are more efficient than physical ones and less costly than thermal procedures, have been only tested at laboratory scale levels. The main core of GOLD-REC and Fenix projects, that are based on the development of hydrometallurgical procedures for the recovery of both precious and base metals from waste printed circuit boards and not limited to, is to extend these procedures at larger scale. Both developed procedures makes the object of two international patent applications that are currently under review. GOLD-REC hydrometallurgical flowsheet consist in application of tow sequential leaching processes on the preliminary physical-mechanical treated WPCBs. The first leaching process make use of a diluted solution of sulfuric acid and hydrogen peroxide in which the dissolution of base metals (mainly copper) is achieved at an efficiency of about 99% and about 40% of Ag. The second one, that is applied on the solid residue of the first leaching process, consist of precious metals (Au and residual Ag) solubilization with thiourea as reagent, ferric sulfate as oxidant and sulfuric acid as pH controlling agent and has an efficiency of over 95%. In FENIX process a new reagents mix is used for leaching step (HCl, acetic acid and H2O2). Cu, Sn, Au and Ag are recovered by sequential cementation steps. This process can be applied also to automotive spent catalysts recovering 99% of Pd and 50% of Pt. Both processes are of high interests and novelty in the field of E-waste and spent catalyst recycling.

Speaker Biography

Vegliò F has completed his Master in Chemical Engineering at the age of 25 years from University of L'Aquila, Italy. He is the Full Professor at University of L'Aquila, Italy. He has over 200 publications that have been cited over 5254 times, and his/ publication H-index is 40 and has been serving as an editorial board member of reputed Journals.

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China's metal demand and apparent future on sustainability: The case of copper and aluminium

Disna Eheliyagoda, Xianlai Zeng and **Jinhui Li**
Tsinghua University, China

Urban mining and circular economy are popular concepts used in the development of sustainable metal consumption strategies in China since recent two decades. China produces and consumes a vast number of elements in the periodic table pushing resource demand into unchartered waters. Copper and aluminium are well-known and indispensable major metals in the modern Chinese society and their rapid growing demand is expected to continue without sign on sooner decrease in next three decades. Thus, this study intends to: (1) inspect historical pattern of supply and demand, (2) project demand until 2050, and (3) examine resource sustainability prospects under different recycling rates regarding copper and aluminium in China. Linear regression modeling and scenario analysis were adopted in future projections while using time-series analysis throughout the research. There could be seen rising trends in the copper and aluminium supply and demand from 1950 to 2015 disclosing almost an exponential growth after 2000. Forecasts of the scenario analysis demonstrate that both metal demand will continuously increase between 2015 and 2030, and thereafter, either become stable or decline slightly except at the stable demand growth scenario. Research results indicate that China's current trajectory with regard to copper demand is unsustainable. Recycling is a suitable practice to reduce primary resource consumption which would be more supported to achieve the circular economy; however, it is challenging in application due to high copper use in China which struggles to concern on imports. Furthermore, the results of aluminium encourage increasing the recycling rate approximately at 40-50% which may help China to acquire self- sustaining goal by 2050 regarding aluminium. Inadequacies in discarded product collection and existing policies hinder the progress of internal recycling industry which would be carefully addressed to maintain the future sustainability of copper and aluminium resources in China.

Speaker Biography

Disna Eheliyagoda is currently a doctoral candidate in Environmental Science and Engineering in Tsinghua University, Beijing, China. Her PhD research focuses on "Resource carrying capacity and criticality assessment of copper and aluminium in China." Not only that but she has also published a few articles on investigation of other critical metals, i.e. gallium and nickel, sustainability via end-of-life recycling parallel to her doctoral studies. She obtained her BS (Hons.) in Environmental Sciences and Natural Resources Management majoring Earth and Environmental Sciences at Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. While working as a junior researcher with "Chemical and environmental modelling research group" at National Institute of Fundamental Studies, Kandy, Sri Lanka, she completed her BS research on "Characterization of dissolved organic carbon in open dump leachate." After graduation, she joined to International Union for Conservation of Nature and Natural Resources (IUCN) to assist "Mangroves for the Future" project. After one year working period, she started her Master's studies in Environmental Management. She obtained her MS at Faculty of Graduate Studies, University of Colombo, Sri Lanka. While studying as a Master's student, she worked as a consultant in urban waste management which is related to her MS degree and she also performed an assessment in cleaner production and industrial ecology. After MS graduation, she worked as a full-time consultant at Research Unit, the Open University of Sri Lanka and a visiting lecturer in Environmental Studies until joining as a doctoral scholar to School of Environment, Tsinghua University, China in 2017.

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Eco-friendly approach for converting agricultural wastes to useful construction materials

Okonkwo U N[1] and **Enyinnia C P**[2]

[1]Michael Okpara University of Agriculture, Nigeria

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Agricultural activities have soared astronomically which resulted to massive generation of agricultural wastes. These agricultural wastes require proper handling to prevent them from constituting an environmental risk factor to human health. Agricultural wastes have been found to be good pozzolanic materials (a supplement or partial replacement for cement) in Civil engineering construction works. In most cases, they have richer chemical composition as construction materials when they are incinerated to ash. The process of their conversion to ash is purely a combustion reaction which inevitably releases large amounts of carbon monoxide and carbon dioxide into the atmosphere. These gaseous substances are very poisonous and as such are global problem. The careful handling of these dangerous gases during the process of conversion to ash has received very little attention in previous studies. Therefore, this paper recommended a simply designed system arrangement for the combustion of the agricultural wastes to ash and provision for the conversion of the poisonous gases into substances that are of economic value to man to save the atmosphere.

Speaker Biography

Okonkwo U N received B.Eng (Civil) from Federal University of Technology Owerri, M.Eng (Geotechnical Engineering) from Bayero University Kano and Ph.D (Geotechnical Engineering) from University of Nigeria Nsukka. He is currently a Senior Lecturer in the Department of Civil Engineering of Michael Okpara University of Agriculture Umudike as well as a consultant to Civil and Construction Engineering firms. He is also a registered Engineer by Council for Regulation of Engineering in Nigeria (COREN) and a member of American Society of Civil Engineers (ASCE). He has been teaching courses related to Soil Mechanics and Structural Foundation Engineering up to Postgraduate level for about twelve years now. He has to his credit many publications and also a reviewer as well as a member of editorial board in some reputable journals. He is happily married with three children.

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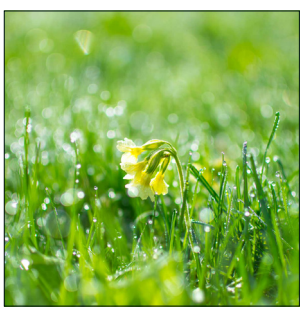


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Data-Driven sustainability for energy and materials recovery

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The City University of New York (CUNY), USA

Data-driven sustainability, a field that attempts to optimize environmental resources and reduce environmental impacts using methodologies from data science and environmental engineering, has been applied for analyzing energy and materials recovery (recycling) processes. These processes mainly involve materials collection, physical separation, volume reduction (compaction), and size reduction in Materials Recovery Facilities (MRFs), which are also necessary for Energy Recovery Facilities (ERFs or waste-to-energy facilities) as pretreatment processing prior to combustion and/or other chemical conversion processes. a decision-making algorithm has been developed for this study and allocates resources based on real-time data collected from sensors in various locations such as garbage containers, trucks as well as, the equipment in MRFs and ERFs. The result of this numerical analysis shows the optimized operation can reduce maximum 43% of time used in a separation process including eddy diffusion, cyclone (air), magnetic and electrostatic system, and scrubbers, 21% of cost in a compression (volume reduction) process used in compactors that applies forces or pressure to the solid waste materials to achieve volume reduction and density increase to aid in storage and carriage, and 32% of energy use for size reduction processes in the form of crushing, shredding, grinding, and milling.

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Sustainable development and environment of Biomass from agriculture residues

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Energy Research Institute (ERI), UK

This communication discusses a comprehensive review of biomass energy sources, environment and sustainable development. This includes all the biomass energy technologies, energy efficiency systems, energy conservation scenarios, energy savings and other mitigation measures necessary to reduce emissions globally. This study highlights the energy problem and the possible saving that can be achieved through the use of biomass sources energy. Also, this study clarifies the background of the study, highlights the potential energy saving that could be achieved through use of biomass energy source and describes the objectives, approach and scope of the theme. However, to be truly competitive in an open market situation, higher value products are required. Results suggest that biomass technology must be encouraged, promoted, invested, implemented, and demonstrated, but especially in remote rural areas.

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Circularity of Resources: Minimising unintended consequences with LCA and Life Cycle Benefit Analysis (LCBA) Metrics

David Baggs
Global GreenTag International Pty Ltd, Australia

Measuring the impacts and benefits of cyclic resource use is critical to ensure that the re-use of resources doesn't generate unintended consequences beyond the obvious benefits. All too often cyclic economy outcomes are seen as 'so obvious they don't need quantifying'. Except as any experienced Life Cycle Analysis (LCA) researcher will tell you, generally recyclates streams appear to have higher overall impacts than virgin streams and this is often used to prefer virgin resources.

The reason is LCA conventionally focusses on only negative impacts and there are no positive impact metrics to offset the additional negatives. Hence the development of Life Cycle Benefit Analysis by Global GreenTag's LCA partner, the Evah Institute and the publication by Global GreenTag's Environmental Product Declarations (EPDs) that present conventional LCA impacts and LBCA benefits side by side. LCBA provides the ability to measure the positives that enable the assessment of 'Net Zero' and 'Net Positive' products beyond carbon and climate braking, taking into account issues such as C02e re-absorption, resource re-recreation (resource consumption avoided), environmental services and biodiversity restoration, pollution reduction, oxygen generation, improved health conditions etc.

This paper presents the concept of LCBA and provides examples of how current EPDs already in the marketplace show the full benefits of products that contain post-consumer recycled content in a way that can ensure there is no net worse impacts generates in the striving towards the true circular economy.

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Towards 2025 National Packaging Targets

Brooke Donnelly
Australian Packaging Covenant Organisation (APCO), Australia

In response to China's National Sword, Australia's Commonwealth, state and territory environment ministers, and the President of the Australian Local Government Association, agreed to establish a sustainable path for Australia's recyclable waste. With regards to packaging, Ministers agreed to reduce the amount of waste generated and make it easier to recycle products. As a first step, Ministers announced a historic target to make 100% of packaging in Australia reusable, recyclable or compostable by 2025 or earlier. In 2018, Ministers committed governments to work with the Australian Packaging Covenant Organisation (APCO) to deliver this target.

The Implementation Plan for the 2025 National Packaging Targets has been developed in the context of increased attention on waste policy in Australia and internationally. This heightened focus is a result of increasing concern about the environmental impacts of packaging waste, such as the harmful effects of marine debris.

Recently the Federal Government committed $3m to support four new recycling education and resource recovery projects in Australia, which are being delivered by APCO and Planet Ark Environmental Foundation. The funding is part of the Federal Government's $203m package to increase recycling and reduce waste, protect Australia's unique threatened species and restore our waterways and coasts, and will provide essential resources and support to drive the delivery of the 2025 National Packaging Targets.

APCO's presentation will detail how our priority projects and collective action model are driving a circular economy for packaging which will result in reduced packaging waste and pollution, and improved product lifestyle management.

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Systems Transformation: Transitioning towards low carbon, resource efficient, and circular economy for global sustainability

Anthony Halog
University of Queensland, Australia

In the coming decades the world that we know today will be drastically transformed. Population and economic growth, particularly in developing countries, are radically changing the demand for food and natural resources. Due to the transformations caused by these megatrends, especially economic growth which is rapidly expanding the middle class and changing consumption patterns worldwide, it is expected that this will result to an increase of approximately 40 percent in the demand for food, water, energy and other resources in the next decades. To fulfil this demand in a sustainable and efficient manner while avoiding food and water scarcity as well as environmental catastrophes in the near future, some industries, particularly the ones involved in food and energy production, have to drastically change its current production systems towards circular and green economy.

In Australia, the agri- food industry has played a very important role in the scenario described above. It is one of the major food exporters in the world, supplying fast growing international markets in Asia and the Middle East. Though the Australian food supply chains are economically and technologically developed, it has been facing enduring challenges about its international competitiveness and environmental burdens caused by its production processes. An integrated framework for sustainability assessment is needed to precisely identify inefficiencies and environmental impacts created during food production processes.

This research proposes a combination of industrial ecology and systems science based methods and tools intending to develop a novel and useful methodological framework for life cycle sustainability analysis of the agri-food industry. The presentation highlights circular economy paradigm aiming to implement sustainable industrial processes to transform the current industrial model of agri-food supply chains. The results are expected to support government policy makers, business decision makers and other stakeholders involved in agri-food-energy production system in pursuit of green and circular economy. The framework will assist future Life Cycle and Integrated Sustainability Analysis and eco-redesign of food and other industrial systems.

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Ecologiq – Purposely greener infrastructure

Alexis Davison
Major Road Projects Victoria, Australia

Ecologiq is for people in the Victorian infrastructure industry who want their work to have a greener purpose. Our circular economy approach makes sustainably-built projects the new normal through the way we lead and act.

Victoria's transport infrastructure boom represents a once in a generation opportunity to create positive outcomes and contribute to cleaning up the waste. Ecologiq is about redirecting the Victorian transport infrastructure industry towards a greener purpose. We can recycle, repair and reuse more waste materials in our projects and make all of our new transport infrastructure sustainably built.

We will explore and test how we can use waste materials in our everyday work practices. We will research, innovate, share knowledge and encourage these uses in our flagship projects. We will align our environmental and sustainability standards with world-class benchmarks, and then push those benchmarks further. This effort will span government, industries, universities, and all who are interested in joining an era-defining push to make world-leading sustainable practices the new normal.

The circular economy, harnessing usable waste, will become our new standard and represents our bold, greener purpose.

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Development of Intelligent Waste Management System

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Increase of human population is proportion to waste generation. As the waste generation increasing rapidly, the effect is significant towards humanity, wildlife and the environment. Since it is impossible to reduce the number of wastes produced, a better handling system of waste is introduced which is recycling. Recycling is a good solution as 3/5 from 13.5 million metrics tonne waste generated yearly in Malaysia are recyclable materials but it is hard to implement as not everyone has a morale to practice this in their everyday life. To overcome this problem, development intelligent waste management system is proposed in this study. This product is a garbage bin, integrated with a microprocessor along with hardware's to ease the process of sorting recyclable wastes. It is easy to use as the device is turned on; the Camera is scans the rubbish, then image is sent to microprocessor and upload the image online using Google API platform to be analysed. Once it is identified, it sends back data to microprocessor to analyse and determine the type of waste. A motorized flap will then push the item into the designated compartments. For the purpose of power efficiency management, the device will turn to sleep mode once the process is completed. The proposed product in this study has never been commercialized and most of the bin available are either automated or used mainly to monitor. Apart from that, the bin friendly ecosystem provides an easy to maintain system.

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Urban wastes recycling into fired clay bricks: A review

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Brick is one of the most common masonry units used as building material. Due to the demand, different types of waste have been investigated to be incorporated into fired clay brick for example sludge wastes, agricultural wastes, fly ash, fuel wastes and other wastes. Previous investigations have demonstrated positive effects on the physical and mechanical properties such as lightweight bricks with improved shrinkage, porosity and strength. However, reduced performances in number of cases were also demonstrated. In addition, the high temperature in the firing process allows volatilization of dangerous components through emissions, changes the chemical characteristics of the material and eliminates the toxic components through fixation process. Therefore, this alternative disposal method for the urban waste may provide sustainable method to immobilise toxic chemicals that pose a very high risk to the environment through either leaching or emissions as well as providing a new construction product with improved properties providing the mix is appropriately designed and prepared for the required properties.

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Waste Management in the circular economy with a nexes approach

J D Seconna
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Circular economy systems retain the added value in products for as long as possible and eliminate waste.

They keep resources within the economy when a product has reached the end of its life so that they can be productively used again multiple times, hence, creating further various reasons for why we need a circular economy. Among them are increasing population and urbanisation, which are often accompanied by increasing demand on products and services. When we consume more, there is also a higher rate of waste generation. By 2025 global solid waste volumes are projected to increase from 1.3 to 2.2 billion tonnes. Additionally, resource scarcity and the increasing difficulty to extract natural resources further drive the move from a linear to a circular economy. The paradigm shift means looking at wastes as resources and saving primary resources, altogether moving to circular flow schemes.

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Solid and plastic waste from land to oceans – Challenges, opportunities and need for innovation in remedial and preventive measures

Michel Soto Chalhoub
Notre Dame University, Lebanon

Marine plastic pollution has become a major concern that is not limited to coastal areas but which has spread offshore forming trash gyres in the oceans. Drifting plastics have adverse effects on ecosystems and marine species with harmful effects including entanglement, ingestion, and suffocation. Floating plastics are vehicles to toxic pollutants and non-indigenous marine species that threaten biodiversity and affect human health. Micropastics (particles < 5 mm) are found in table salt - among other foods - and have therefore breached our diet.

About eight million metric tons of plastics are estimated to travel yearly into oceans. Predictive models that use data on solid waste generated per capita, estimate plastics moving from land to ocean through rivers. Watercourses running through densely populated areas generate mismanaged plastic waste, with about 88% conveyed through the top-ten ranked rivers. On a smaller scale, we developed a predictive model for rivers in Lebanon and concluded that such models require time series parameters related to river seasonality, climate change, hydrologic factors, and human activity near river beds.

Innovative techniques are recommended to reduce plastics at the source rather than react through remedial actions. Innovation should target bio-based manufacturing as well as biodegradable final products. Plastic-to-energy is part of remediation as proven by pyrolysis plants in the United States and Japan, in addition to promising technologies that aim at turning plastics into fuels. Recycling is another component of remedial actions, but recycled plastics lose their physical properties and become non-recyclable. If no disruptive innovation occurs to displace traditional plastics at the source, their production worldwide is expected to grow by about 4% yearly in the next ten years. Therefore, it is recommended to develop and commercialize process and product innovation as part of a preventive rather than remedial strategy.

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