UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

CIRCULAR ECONOMY:

DEVELOPMENT OF RECYCLING INDUSTRIES

Meeting Proceedings

14-15 November 2018

UNIDO Headquarters

Conference Room C-3, 7th floor C-Building

Vienna International Centre

Vienna, Austria

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INDUSTRIAL DEVELOPMENT ORGANIZATION

Introduction to the conference:

I am very pleased to welcome UNIDO's valued partners to this conference on the recycling industries and the circular economy.

I believe that this event comes at a particularly significant time, where the depletion of finite resources, rising populations, rapid urban expansion, growing middle-class consumption levels, pollution and anthropogenic climate change are converging to place the world's economic and ecological systems under immense strain. In light of this, the circular economy in essence "doing more with less" is a response that comes at a time when there is a growing acknowledgement that we have exhausted the limits of our "take, make & dispose" linear economy, ushering in a new, regenerative growth paradigm, where waste is finally designed out of every echelon of our economic system.

Recycling is one of the main elements of a circular economy, due to its role in transforming post-consumer materials into valuable substances or products, feeding used materials back into the value chain and thus achieving the "waste-to-resource" paradigm. It is a theme that is growing alongside the prominence of circular economy, both in recognition of its centrality within the circular economy and in its own right as an issue that needs to be addressed due to increased waste, resource scarcity and in the growing awareness that waste can be a valuable resource.

Recycling is a job creator, a facilitator of the circular economy, acting as a catalyst and conduit of the materials that are fed back into the circular system. Thus, recycling a presents a "win-win-win" opportunity as-if harnessed correctly and efficiently-it offers the opportunity to address economic, environmental and social challenges.

UNIDO has long recognized the value of the circular economy and has been working on its building blocks for quite some time. In pursuance of our mandate to promote inclusive and sustainable industrial development, we have been providing a forum for our Members States to undertake briefings on the circular economy, to provide our Member States with relevant information and consultation on this emerging paradigm.

In this regard, we have ramped up our circular economy consultative and educational activities in 2018. In this year we have held a circular economy forum in Uruguay; a conference on the circular economy and the automotive industry with Slovenia; and numerous other information and educational events around the world, with a planned event on green design and the circular economy planned for early-mid 2019.

Now, over the next two days, we will hear from an array of participants representing international NGOs, industry representatives and policymakers from around the world, who will discuss the opportunities represented by recycling as part of the circular economy. Participants will also present innovative ideas and concepts. A focus of discussions will also be on identifying the barriers that currently hinder recycling industries around the world and

discussing measures that need to be instigated at all levels to ensure that recycling can reach its potential within a circular economy.

I believe that the diversity of participants present here today is testament to the level of interest in the circular economy and the joint determination to identify solutions that can harness all of the potential that recycling presents.

So thank you for those who have contributed to the successful outcomes of the next two days. I look forward to reviewing the achievements, as well as looking into the future and discovering all that we as a unified group can contribute, and how we can move the recycling industries forward to ensure that it is further embedded as a central cog of the circular economy.

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Day 1: Wednesday, 14 November 2018

11:00	***Welcome remarks*** Mr. Philippe Scholtès, Managing Director, Directorate of Programme Development and Technical Cooperation, UNIDO
11:00 – 12:00	***Plenary 1: Policies to support and barriers for recycling industry development*** Ms. Nilgün Taş, Deputy Director, Department of Environment, UNIDO Mr. Bing Zhu, Institute for Circular Economy of Tsinghua University, Beijing, China Mr. Ranjit S. Baxi, President, Bureau of International Recycling, Brussels, Belgium Ms. Sara Wingstrand, Research Analyst, New Plastics Economy, Ellen MacArthur Foundation **Moderator: Mr. Stephan Sicars, Director, Department of Environment, UNIDO**
12:00 – 13:00	***Interactive panel discussion and Q&A on the barriers to advance development of recycling industries*** Presentation: Barriers to Development of Recycling Industries Ms. Katharina Kummer-Peiry, Kummer Ecoconsult **Moderator: Mr. Stephan Sicars, Director, Department of Environment, UNIDO** Panel consists of Plenary 1 presenters
13:00 - 14:30	***Lunch break***

Afternoon session

14:30 – 16:00	**Plenary 2: Plastics Recycling** Mr. Bob Diderich, Head of Division, Environment, Health and Safety, OECD, Paris Ms. Emma Watkins, Senior Policy Analyst, Institute of European Environmental Policy Mr. Moussa Dia, Director General, SODIAPLAST Guinée Conakry Ms. Smita Mohanty, Director (Principal Scientist), Central Institute of Plastics Engineering & Technology, India **Moderator: Mr. Klaus Tyrkko, Department of Environment, UNIDO**
16:00 - 16:30 **Coffee break**	
16:30 – 18:00	**Plenary 3: Metals Recycling** Ms. Liselotte Schebek, Chair, Material Flow Management and Resource Economy, Technische Universität Darmstadt, Germany Ms. Susie Burrage, President , British Metals Recycling Association, United Kingdom Mr. Kittiphan Bangyikhan, Chief of Factory Development and Technical Support Group, Ministry of Industry, Thailand Mr. Leopoldo Clemente, Founder & CEO, LCD Trading SRL, Italy **Moderator: Ms. Carmela Centeno, Department of Environment, UNIDO**
18:00 **Cocktail Reception**	

Day 2: Thursday, 15 November 2018	
09:00 – 09:15	**Summary of Day 1**
09:15 – 10:45	**Plenary 4: Textile Recycling** Mr. Nils Månsson, Materials & Innovation Deployment Leader, IKEA Mr. Luca Querci, Vice-President, Cormatex SRL, Italy Mr. Wael Olama, Chairman, Perfect Spinning Co., Egypt Mr. Martin Böschen, CEO, Texaid AG, Switzerland Mr. Klaus Matilainen, Senior Advisor, Globe Hope, Finland **Moderator: Ms. Fatin Ali-Mohamed, Department of Environment, UNIDO**
10:45-11:15 **Coffee break**	
11:15 – 12:30	**Plenary 5: Composite Waste Streams Recycling** Mr. Alfredo Cueva, Department of Environment, UNIDO Mr. Chris Slijkhuis, E-Waste Recycling/Public Affairs, Müller-Gutenbrunn Group, Austria Ms. Sonia Valdivia, Program Manager, Sustainable Recycling Industries & Life Cycle Management, World Resources Forum **Moderator: Mr. Smail Alhilali, Department of Environment, UNIDO**
12:30 – 13:00	**Closing Plenary** Chairman's notes on a way forward and discussion

What is the circular economy?

The circular economy viewed in its simplest form, is about changing how we perceive and manage waste. The circular economy, which departs from the linear economic model into a new system whereby goods are made, used, reused, repaired and then converted again into reusable secondary raw materials.

In essence, this calls for a change in how we design, produce, and consume products, even in how or if we "own" products at all. There is also a corresponding need for changes in the supporting structures such business models to support this new paradigm, it calls for unparalleled cooperation through all echelons of society and a variety of actors.

A shift in narrative and systems - from a linear to more circular and regenerative systems - is an opportunity to embrace more innovative processes that, amongst others, strive for greater resource efficiency, with cleaner production processes that represent potential gains in economic, environmental and social terms.

How do the recycling industries fit within the circular economy?

Recycling plays a catalytic role in the circular economy by turning post-consumer materials into valuable substances or products, feeding used materials back into the value chain and correspondingly achieving the "waste-to-resource" paradigm. This translates into fewer virgin materials being used, less energy being consumed and less environmental impact. Recycling industries are also a significant employer globally, with an approximate 1.6 million people worldwide active in the recycling industry. Together, they handle more than 600 million tonnes of recyclables every year. With an annual turnover of more than $200 billion, the sector has already become a key driver for tomorrow's sustainable development." (Bureau of International Recycling).

Two days to discuss recycling as part of the circular economy

UNIDO hosted the conference "Circular Economy-Developing Recycling Industries" in Vienna from the 14-15th November 2018, in collaboration with its partners, representing the recycling industry, industry associations, think tanks and international organizations.

The conference programme featured presentations and facilitated panel discussions to foster dialogue and identify areas of convergence to accelerate progress on this issue. The two days were structured around identifying the current barriers hindering progress and elucidating the types of policies and measures that would support the development of robust and sustainable recycling industries around the world. Discussions also examined the **plastics, metals, textiles and composite waste streams t**o reveal barriers and opportunities to encourage the recycling of these waste streams and the strengthening of the industry.

Day One: Delving in-there's no time to waste

Day one offered insights into the drivers and barriers to the larger uptake of recycling activities in developing countries. Speakers representing a cross section of actors from the recycling world-from international organizations to think tanks and industry representatives-provided their perspectives on what they viewed to be the necessary policy drivers and barriers for the recycling industry to reach the scale that it must to become an integral "cog" of the circular economy. Thereafter the day delved into a panel discussion to further elucidate the main barriers to advancing the development of recycling industries. The afternoon session honed in on the specifics regarding the recycling of plastics and metals.

Plenary One: Policies to support and barriers for recycling industry development

Recycling operations and the establishment of a sustainable recycling industry still encounter barriers, many of which can be traced to a lack of, or a weak policy framework. Policymakers and sector stakeholders must therefore identify and address these barriers if recycling is to effectively play its role in the SDGs and the circular economy.

Ms. Nilgün Taş, Deputy Director, Department of Environment

Ms. Taş' discussion focused on discussing **the importance of policies to support recycling industries,** with a counteracting discussion of the **barriers to a circular economy**. Ms. Taş highlighted the vital role that the recycling industries can play in the context of a circular economy, which is becoming more pronounced and crucial in the context of growing populations, increasingly untenable resource extraction, in parallel with growing waste piles around the world, which she noted, are often improperly treated.

This, she noted, was ***the juncture where the circular economy could be leveraged,*** with the CE where *"**green design could lead to the design of products that are easy to dismantle, to be re-used or recycled in a resource efficient manner to save energy, raw materials. The circular economy is a great opportunity to minimize environmental pollution and to generate economic benefits at the same time. "***

> ***"84 billion tons of resources were extracted from earth (minerals, ores, fossil fuels, biomass, which have been used as products for physical products, construction, mobility, pharmaceuticals, consumables, food, however, only 9.6% (= 1.4 billion tons) of it has been cycled back into our systems.***"

Ms. Taş emphasized that the circular economy is about the creation of a value chain guided by an overarching principle to design waste out of products, producing resources efficiently, utilizing clean

technologies and renewable energy. She noted that it also departs from the linear economic model by encouraging remanufacture, effective distribution, and extending product life through repair and reuse, utilizing and product-as-service business models and to remove barriers to "waste as a resource" by developing recycling industries.

> ***China had recycled 282 million tons, representing more than half of the world's total."***
> "***Between 2014 and 2017, the amount of recycled resources had grown at an average annual rate of approximately 3.6% with a large variety of recycled resources (waste iron & steel, waste paper, waste plastics, waste nonferrous metals, and waste glass).***

Mr. Bing Zhu Institute for Circular Economy of Tsinghua University, Beijing, China provided participants with a **glimpse into the future of China's recycling industry,** outlining the **evolution of China's recycling industries**, its policies and progress-to date. Mr. Zhu noted that China's endorsement of recycling has been articulated at the highest level, as included in its 13th Five-Year Plan (2016-2020), which, he noted, contains clear instructions regarding the development of recycling industries as a part of China's strategic development of emerging sectors.

Mr. Zhu also expressed the belief that China showed great potential for scaling-up this work as indicated in estimates from the China National Resources Recycling Association (CRRA), which showed that ***China's recyclable resources will amount to 500 million tons by 2025,*** as various products reach their end of life in large quantities. "

He provided an overview of a number of the key barriers in relation to the collection system, which, he noted, is a fundamental requirement for a robust recycling industry. These barriers included a paucity of planning in relation to the distribution of collection stations; a lack of coverage and soundness of these collection systems; and a lack of order in terms of the collection process. Mr. Zhu further noted that the Extended Producer Responsibility (EPR) system needed to be further improved and popularized.

> ***"with the application of internet, IOT and big data technologies, more recycling models and management approaches will emerge, which will contribute to the development of the recycling industries, improved technologies will continuously boost the competitiveness of recycling industries, and more stringent environmental standards will drive the development, transformation and upgrading of recycling industries. "***

Mr. Zhu concluded his presentation on a positive note, noting that policies and regulations would only continue to improve, expressing his confidence in the continued emergence of innovative policy models.

Mr. Ranjit S. Baxi, President, Bureau of International Recycling, Brussels, Belgium identified **nine barriers to the development of recycling industries,** which could be managed

through adequate policies to support recycling industry development. A common challenge in many countries was that waste management infrastructure was weak or absent. This was particularly the case in countries where there was no common recycling culture. Further undermining this situation, was the low-no cost of landfill. Mr. Baxi expressed the belief that if there was indeed a recycling industry, then the collected waste would most likely be of a low quality. This in turn would lead to a marked difference in the quality of secondary raw materials vis-a-vis primary raw materials. This in turn leads to a lack of consumer acceptance of recycled products and limited market access for secondary raw materials.

There is also a perceived risk associated with financing such ventures as there was a risk associated with selling, buying and investing in recycled materials. In terms of sorting, there were limitations due to the higher costs of manual sorting compared with mechanical sorting. Environmental and trade policies were further undermining progress in this area.

To counteract these barriers, Mr. Baxi noted that policies could be a key instrument. In this respect, model legislation was required, which needed to be complemented by public education on recycling. This could occur both in schools as well as educating adults. Taxing landfill was also highlighted as another avenue to pursue, which he noted, should be supported by adequate enforcement of these activities. Policies could also play a role in incentivizing separate collection systems and creating an avenue for job creation.

At the international level, there was a need to promote and adopt international standards and best practice; to remove primary subsidies and in parallel to remove export/import trade barriers and adopt existing quality standards to and enforce the Stockholm Convention.

The overall effectiveness of recycling industries would be best supported in an environment where there is a stable legal and political framework, and more so in an environment where policies are optimized to ensure that they are economically, socially and environmentally sound and compatible.

Ms. Sara Wingstrand, Research Analyst, New Plastics Economy, Ellen MacArthur Foundation argued that **a linear economy (take-make-dispose),** which was prominent during the industrial revolution, **now leads to pollution and overexploitation of resources.** Instead, a circular economy, is defined which the three basic principles of (1) Design out waste & pollution, (2) Keep products & materials in use (3) Regenerate natural systems. She outlined the reasons as to the need to focus on circular plastic recycling, highlighting that "***around 86% of plastics on the market are not being collected and recycled***" and thus its economic value is also lost. Instead the ***new plastic economy focuses on the principles to eliminate, innovate and circulate.***

Interactive panel discussion and Q&A on the barriers to advance development of recycling industries Presentation: Barriers to Development of Recycling Industries Ms. Katharina Kummer-Peiry, Kummer Ecoconsult

Ms. Kummer-Peiry's background paper on the barriers to recycling industry development informed and guided discussions over the two days of the conference. Ms. Kummer-Peiry opened the interactive panel by giving a presentation, which outlined the most pertinent outcomes of her report. She grouped the main challenges **into four main categories; namely, institutional, structural and economic challenges; policy and regulatory; international trade; and industrial activity.**

Ms. Kummer-Peiry then detailed the main challenges under each of these headings, but concluded with a list of possible intervention areas that could help to address these issues. These included a favourable policy and governance framework; enabling and incentives; and international cooperation. She also underscored the importance of involving the informal sector in the stakeholder consultation process.

A country's framework conditions are also fundamental to a strong recycling industry. Ms. Kummer-Peiry noted that there are there are three key and essential fundamental elements that must be in existence, these are: an investment friendly environment that allows business development. This, however is contingent on political and economic stability, security and reliable infrastructure, which is closely tied with a functioning legal and institutional framework in which the industry can thrive. Secondly, there needs to be a fundamental paradigm shift towards perceiving waste as a valuable resource rather than a costly burden. Lastly, waste and materials management needs to be placed at the top of the political agenda, an in particular in development cooperation.

Ms. Kummer-Peiry concluded her presentation, opening up the panel for further discussion of the points that she'd raised in this presentation, encouraging participants to add their insights. A lively and insightful discussion followed, consisting of the contributions from the panel and the audience.

Plenary 2: Plastics Recycling

"Cheap, light, and versatile, plastics are the dominant materials of our modern economy. Their production is expected to double over the next two decades. Yet only 14% of all plastic packaging is collected for recycling after use and vast quantities escape into the environment. This not only results in a loss of USD 80 to 120 billion per year, but if the current trend continues, there could be more plastic than fish (by weight) in the ocean by 2050." The New Plastics Economy, the Ellen MacArthur Foundation

Mr. Bob Diderich, Head of Division, Environment, Health and Safety, OECD, Paris spoke about the OECD's work on **policies for better plastics management**. In his

talk, Mr. Diderich detailed the OECD's approach to the circular economy. The OECD feels strongly about the importance of addressing the plastic issue through recycling, to the extent that plastics recycling has formed one of three pillars of their circular economy strategy.

The OECD believes that there are multiple pathways for addressing the environmental impacts of plastics, such as the substitution of plastics through alternative materials, waste prevention (e.g. phase out single use plastics), improved biodegradability and better functioning of secondary plastics markets. OECD's work has focused on plastic recycling.

Mr. Diderich noted that the share of recycled plastics in the market is still small, with a number of issues preventing it from expanding at both the demand and the supply side. On the demand side, secondary plastics compete with virgin material but the OECD has proposed a number of policy interventions to help address the demand-side issues, particularly to support the development of a separate demand for R-plastics. These measures include recycled content product labels, public procurement, recycled content rules and a tax on virgin plastics.

The challenges associated with the supply side relate to quality, quantity and resilience. Again, the policy options are diverse, ranging from the introduction of dual or multiple stream collection systems, extended producer responsibility, restrictions on the use of hazardous additives, providing incentives for better plastics design and working with the informal sector amongst others.

Ms. Emma Watkins, Senior Policy Analyst, Institute of European Environmental Policy highlighted the **barriers to plastics recycling, policy approaches to support recycling and ideas for the future.** The barriers included a lack of infrastructure, current use of plastics, disruptive chemicals or additives that disrupt recycling processes and lack of awareness. There are a range of policy instruments that can be drawn on from the international-level down, which can be broadly grouped as international instruments; instruments commonly used at the national and sub-national level (including strategies or regulations, bans and phase-outs i.e. "command and control"); economic instruments, such as taxes and subsidies and investment measures; or voluntary tools. In the development sphere, aid for sustainable waste management including plastic collection and recycling, could also be a fruitful angle to pursue.

Exploring opportunities to leverage economies of scale in the form of cross-border cooperation was highlighted as one way in which recycling rates could be increased. International standards could also be drawn upon to strengthen this approach. Ms. Watkins also emphasized the crucial role that product design needed to play in order to ensure that products and their components were recyclable and for eco-modulation of fees paid by producers under Extended Producer Responsibility (EPR), based on areas such as material impacts and chemical additives as a lever to incentivize this.

Ms. Watkins spotlighted **China's recent ban on imports** of non-industrial plastic to improve plastic waste management worldwide as ***demonstrative way in which policy could have a significant ripple effects around the world***.

Mr. Moussa Dia, Director General, SODIAPLAST Guinée Conakry presented from **the perspective of a recycling company.** Speaking on behalf of his company, which is specialized in the collection and recycling of plastic waste presents in Guinea, Senegal and Burkina Faso & Sierra Leone. The main activities of SODIAPLAST are the collecting tri-preprocessing, fusion-molding, finish-marketing using the raw materials of soft and hard plastics (PET, PP, HDPE and LDPE) to produce semi-finished and finished products (broya, granula and household goods).

Mr. Dia's presentation helped to shed light on the challenges faced by a recycling company in the context of a lower income country context, also explaining how Sodiaplast is helping to implement circular economy activities, through its engagement at the stage of recycling, eco-design, also encouraging responsible consumption and extending the duration of product use.

Mr. Dia then discussed some of the common barriers for his company and the wider recycling industry. The non-existence of a selective sorting system at the point of collection, caused difficulties in accessing plastics, which may be contaminated by dirty waste, unsuitable for recycling, leading to high treatment costs. He also spoke of a lack of mastery of clean technologies for recycling waste, within a context where there was a lack of energy in general and a lack of clean energies in particular.

In terms of financing there were difficulties in accessing credit with banks for recycling entrepreneurs. In addition to these factors, the policy framework was also not conducive to encouraging recycling as there were no specific incentives and encouragement provided by the policy framework for recyclers, as they were treated on the same footing as any other company.

Ms. Smita Mohanty, Director (Principal Scientist), Central Institute of Plastics Engineering & Technology, India discussed the **recycling of plastics from an Indian perspective.** In India, the plastic industry is classified as upstream sector (manufacturing of polymers) and downstream sector (conversion of polymers into plastic articles). Ms. Mohanty also outlined the main barriers related to plastic waste along the value chain in India, which echoed the challenges faced in other countries. Namely, plastic waste's low value, with no incentive to collect. A lack of awareness, leading to littering and non-segregation at source. There is also a high cost of collection and transportation; and a lack of automation in the industry. Ms. Mohanty emphasized the importance of a consistent and comprehensive policy framework, which even if it did exist, would struggle with implementation. Despite this, ***"circular economy approaches, coupled with Extended Producer Responsibility (EPR) and recycling infrastructure presented***

an opportunity to be a long-term solution for improved plastic waste recycling."

Plenary 3: Metals Recycling

"Economic development is deeply linked to the use of metals. Recycling rates of metals are far lower than potential for reuse. Smartphones, flat screen TVs and USB keys all drive the demand for specialty and precious metals. ..Less than one-third of 60 studied have a recycling rate above 50 per cent, though many are crucial to clean technologies such as batteries for hybrid cars or magnets in wind turbines." **International Resource Panel**

Ms. Liselotte Schebek, Chair, Material Flow Management and Resource Economy, Technische Universität Darmstadt, Germany spoke about **the challenges to recycling metals** and also outlined **some potential strategies.** She described the link between the Sustainable Development Goals (SGDs) and proper metal recycling through the interlinkages of energy savings, mitigation of climate change, savings of water resources, pollution and human health effects.

"Although metals are in principle infinitely recyclable, the current status of metal recycling is often inefficient or non-existent."

Ms. Schebek discussed a number of constraints to increased metals recycling. She noted that there was a low collection rate of e-waste containing valuable metals. Deficient infrastructure; a difficulty in waste separation; the increasing complexity of products; and a lack of effective materials recovery technologies, which all converged to hamper the development of recycling industries. Similarly, the institutional framework was another complicating factor, which has led to a lack of adequate regulations, a paucity of professional management and a deficient collection mechanism and network. Financing is also a key missing ingredient, without the requisite financial incentives, there is no corresponding investment to imbue investor confidence in the market to catalyse the necessary investment.

A range of potential interventions were then highlighted, including making material flows traceable to undermine illicit trade. Classification schemes and data relating to material flows as part of a global knowledge base would help in this regard. In terms of supporting waste management in the developing country context, comprehensive solutions could be provided that cover technical support, the inclusion of the informal sector as well as the provision of professional training and incentives.

In regards to the recovery of critical raw materials, Ms. Schebek identified technologies for specific materials and products and the establishment of value chains could help to catalyse activity in this area. Lastly, Ms. Schebek emphasized that there needed to be more of a strategic approach, with much more ambition applied to "Design for Recycling" scenarios and planning for future material flows.

"Metal recycling and reuse is an increasingly important source of metal supply, and this dependence is anticipated to grow, particularly if we are to meet the targets of the United Nations Sustainable Development Goals."

Ms. Susie Burrage, President, British Metals Recycling Association, United Kingdom spoke about the **development of metals recycling in the circular economy.**

"The circular economy is not a top priority for metal recycling SMEs, which is regrettable as small businesses are the backbone of most economies, driving growth, opening new markets and creating jobs, and therefore their contribution is vital.

Ms. Burrage then detailed the challenges associated with e-waste to illuminate the multiple complexities associated with e-waste and metals recycling. E-waste provides a significant opportunity to minimise environmental impacts through the recovery of precious metals contained within this waste stream, yet, she noted that many electronic products end up in landfill at the end of their useful life. An underappreciated issue associated with e-waste recycling is that most of the effective business models are successful as they draw on a variety of revenue sources, not just from the sale of discarded e-waste for metals recovery. These include: receiving revenue from local municipalities and businesses for providing e-waste collection; processing services; and revenue from the sale of discarded electrical goods to repair and refurbishment companies.

In conclusion, Ms. Burrage emphasized that in order for the circular economy model to succeed, it was imperative to raise awareness across-the board as to the need to prevent waste and the need to reuse and then finally the need to recycle.

Mr. Kittiphan Bangyikhan, Chief of Factory Development and Technical Support Group, Ministry of Industry, Thailand discussed the **metals recycling industries in Thailand,** which has great potential due to demand from new investments made in the construction and manufacturing sectors. It is also the largest metal market in the region due to rising demand in its neighbouring countries. Thailand has the capabilities to produce various metal products and the potential to increase the value of products due to their broad supply chain.

Mr. Bangyikhan also explained that there are barriers to efficient metal recycling industry with a the lack of natural resources, poor management of replacement resources such as metal scrap, industrial waste and household waste, high production costs, especially the cost of energy such as electricity, fuel and coal etc. He further explained that there was a lack of local research and development in new technologies and innovations. Thai industry was also still using old technology/facilities, leading to environmental impacts, and a lack of efficiency and linkages in the supply chain.

To strengthen the metal recycling industry, Thailand's government has initiated the guideline for metal scrap classification and Thailand's 4.0 policy (productive growth, inclusive growth and green growth). This is supported by the Recycling Technology Research and Development Center targeting e-waste, metallurgical waste, waste water sludge and the plating &coating industry. There is also UNIDO-GEF cooperation for "Greening the Scrap Metal Value Chain through Promotion of BAT/BEP to Reduce U-POPs Releases from Recycling Facilities".

Mr. Leopoldo Clemente, Founder & CEO, LCD Trading SRL, Italy, began his presentation by highlighting the **importance of regulation and institutions to** the uptake of **recycling activities.** In this regard, he emphasized that each country has chosen to adhere to specific treaties concerning the scrap metal and that he would advise the governments of developing countries to adopt the international regulation and scrap classification with the same terminology.

"If we can imagine a new sustainability we can achieve it."

Mr. Clemente discussed the technical barriers towards improved metal recycling. Particularly, there is a need for proper quality checks of metals, to imbue confidence in their quality, which leads to higher prices.

Mr. Clemente then explained the range of factors that determine the quality of the material and its price. The price per ton of scrap is determined by various factors, price, the quality of the material, transport costs, labour costs, duties and taxes, are all factors that influence the price of metal. Financial barriers in terms of risks can derive from the variations of the Metals Exchange, the LME for instance, but there are financial instruments able to cover the risk.
Mr. Clemente concluded his presentation with the tenants of what he believes will cultivate a "culture of recycling", namely there needs to be (1) Compliance with permits and licenses necessary to buy/sell, (2) Quality of the material, (3) Price per ton, (4) Payment terms and (5)Ethical operators = ethical business.

Day Two: Waste is a terrible thing to waste

Day Two featured speakers representing global retail chains, national prime producers and exporters of regenerated yarn, featuring presentations and discussions on textile and composite waste streams.

Plenary 4: Textile Recycling

The equivalent of one garbage truck of textiles is landfilled or incinerated every second. 108M tons of nonrenewable resources are used each year to produce clothing. The textile industry will account for 25% of the global carbon budget by 2050. (Ellen MacArthur Foundation: Make Fashion Circular

Mr. Nils Månsson, Materials & Innovation Deployment Leader, IKEA that in 2017 "***textiles used for IKEA products are 51% from fossil-based materials, 39% from renewable materials and 9% from recycled materials; whereas the goal for 2030 is the conversion to 60% of renewable textile materials and 40% recyclable materials.*** He noted that it is IKEA's ambition that all articles sold all over the world shall comply with the strictest health, safety and environmental requirements on any of the sales markets; however, he noted that there are challenges with the preconditions for recycled textiles related to the type of secondary raw material and recycling method.

Mr. Månsson detailed IKEA's stance in regards to chemicals in materials, which propounds the toxic free circulation of materials, with harmful chemicals not allowed in their products. IKEA as a company supports the view that in order to increase the rates of recycling, there is a need for homogenization of chemical requirements, as well as a need to avoid demands on the exact reporting of chemical composition. They believe that the use of 'mixed fibres', should be allowed to avoid the need to separate pre- and post-consumer material and recognize that some challenges exist in using high ratios of recycled materials. For simplicity in labelling, waste should be regenerated into new resources, not put in landfills

He then discussed the international trade of waste, arguing that in order to strengthen recycling activities and recycling industries, there is a need to develop internationally accepted criteria for materials to be recyclable, to enable responsible cross-border movement of waste-based raw materials and intermediate products to enable producers and brands to legally collect waste.

Mr. Luca Querci, Vice-President, Cormatex SRL, Italy spoke about his company's operations, which **converts waste into new products**. Mr. Querci explained that

Cormatex is a textile machinery manufacturer for Woolen Spinning and Nonwoven material that uses lab formair technology to produce new products, such furniture and insulation, from recycled materials. Cormatex recycles different materials for different applications. For example, recycled cardboard and newspaper are used in insulation for building materials. Recycled tire cords are turned into thermal and acoustic insulation. Waste from mattress production (PU foam and latex) is used in home furnishings and mattress production. Carpet waste is used in the automatic industry.

He also believes that there are numerous economic and environmental benefits associated with utilizing recycled materials; namely, there is a reduction in the consumption of virgin materials; of waste disposal and production costs, which also often equates to environmental benefits. Less waste means less waste to be disposed of; a reduction in the consumption of raw materials and energy, leading to an overall positive impact on industrial production.

Mr. Wael Olama, Chairman, Perfect Spinning Co., Egypt discussed the sustainability of textile recycling, explaining that the main constraints to the two main sources of textile waste of post-consumer and post-industry textile waste are caused by today's fast fashion and worn out textiles, the latter which are not easy to recycle.

"Many consumers are aware of the environmental impact of fashion, but are not yet ready to change."

He postulated that a possible reason for this might lie in improper or a lack of marketing. The industry, he argued, is not yet mature enough to recognize the opportunity presented by recycled materials as a lot of products produced are from recycled materials, but have not been labelled as such. He concluded by saying that the market is still driven by the desire for a price advantage.

Mr. Martin Böschen, CEO, Texaid AG, Switzerland discussed the **current state of textile recycling,** explaining that textiles recycling is mainly limited to downcycling, such as the production of wipers for industrial use and shredding materials, with only very limited high value open or closed loop recycling process, such as cashmere and wool products being economically viable. There has been limited support or contributions by industry or municipalities/states, excepting for France. Correspondingly, he felt ***that policy needed to be implemented to encourage collection, sorting and recycling.***

"Less than 1% of collected textiles are recycled in a closed loop system." He then further explained some of the existing constraints to recycling, including the current situation that the large variety of materials used, which are heterogeneous and which increasingly consist of mixed fibres (e.g. polyester and cotton, cotton and elastane, wool and acryl). Correspondingly, accurate and standardized material composition is needed in garment labels.

Labelling, rather a lack thereof, is also an issue as garments are often received with the label removed by the consumer, or there are an extensive number of trims added, such as buttons and zips. The use of chemicals in the production process is also often unspecified and the technologies are not yet mature enough for large scale high-value recycling.

Mr. Böschen outlined a number of recommendations that he believed could address the current constraints to recycling. He felt that in the European context there was much that could be done to fulfil/enliven/enact the draft of the EU Waste Framework Directive, including the mandatory separate collection of used textiles, the exemption of recycled raw materials from REACH and comparable legislation and increased use of recycled raw materials by the textiles industry. He also noted that there was a need for funding and support for R&D into textile recycling and the development of new business models. At the trade level, there was a need to reduce non-tariff trade barriers for the export/import of used textiles and recycled raw materials

Mr. Klaus Matilainen, Senior Advisor, Globe Hope, Finland introduced his company, Globe Hope, which manages a broad ecosystem covering all aspects of textile recycling: collection, sorting out and refining processes of end-of-life textiles.

Every year wasted textile waste is about 3 000 000 000 kg in the USA, which in terms of water needs equates to 27 000 000 000 litres, equal to be sufficient for 986 301 people as basic water needs."

In addition, Globe Hope efficiently organizes different textile fractions to the right channels- at the same time optimizing carbon footprints. He also discussed the challenges faced in his industry, highlighting that the responsible and ***resource efficient recycling of work wear is problematic due the limited resources and know-how within organizations to optimally utilize materials***, including a lack of knowhow regarding the resource efficient utilization of textiles.

Plenary 5: Composite Waste Streams Recycling

A composite material comprises two or more components; its main characteristic being the superior properties the end material has, as opposed to those of each individual constituent on their own. Compound materials are valued for their strength, light weight, corrosion resistance and durability. They are present in a wide range of products such as electronics, clothes and the aeronautics, wind and naval industries amongst others.

"***E-waste encompasses everything from end-of-life refrigerators and television sets to solar panels, mobile phones and computers. In 2016, a staggering 44.7 million metric tons (Mt) of e-waste were generated— up 3.3 Mt or 8% from 2014. This is equal in weight to almost***

nine Great Pyramids of Giza, 4,500 Eiffel Towers, or 1.23 million fully loaded 18-wheel 40-ton trucks, enough to form a line 28,160 km long, the distance from New York to Bangkok and back.

This makes e-waste the fastest growing part of the world's domestic waste stream, and experts foresee a further 17% increase (to 52.2 million metric tons) of e-waste by 2021."
The Global E-waste Monitor 2017: Quantities, Flows and Resources

Mr. Alfredo Cueva, Department of Environment, UNIDO spoke about **UNIDO's E-waste program and the circular economy**. UNIDO's approach to e-waste management is to promote sustainable e-waste recycling industries that efficiently and safely recover valuable resources, to generate quality jobs, and care for the environment and health. Greening recycling industries is a key step for implementing a circular economy. In order to do this, UNIDO creates partnerships for action on technology transfer to help countries to develop e-waste management systems and strategies based on the whole recycling value chains and life-cycle analyses. UNIDO also enhances North-South and South-South and triangular cooperation and knowledge-sharing. In this regard, UNIDO's e-waste project portfolio, including on-going initiatives in LAC countries, Cambodia and the Philippines.

Mr. Cueva also provide an overview of e-waste facts and the associated challenges and opportunities at the global level. He noted that a lack of regulations created loopholes and uncertainty, creating the conditions for illegal operations and a limited management of the issues. He noted further that recycling options may be costly and subject to commodity price fluctuations. The matter was further complicated by a wide variety of stakeholders, leading to differing views and perspectives, creating challenges for political and policy responses, as well as challenging for the trans-boundary movement of e-waste as hazardous waste.

Mr. Chris Slijkhuis, E-Waste Recycling/Public Affairs, Müller-Gutenbrunn Group (MGG), Austria provided an overview of the WEEE industry, trends and some of his company's technology that breaks down WEEE and the processes employed. He then detailed the process that is undertaken for the treatment of WEEE Shredder Residues and presented the company's Sustainable Model of Re-Producing Plastics from WEEE, which they market as post-consumer recycled plastics (PCR Plastics).

Describing e-waste in Europe as a "mine" of resources; he argued that instead of utilizing e-waste as a resource, Europe was **losing *"well over 1 Mio MT from the EU Urban WEEE Mine***, which he believes ***constitutes a loss of materials from Europe.*** He argued that there were very few companies invested in WEEE plastics recycling and due to this loss of materials from its borders, the competitive pricing was to be found outside of Europe. He noted that the European recycling landscape was becoming increasingly complicated, exacerbated by ever increasing legal complexity.

Wrapping up his presentation, he emphasized that ***there needs to be an intelligent balance between "non-toxic and circular economy"*** and recognition that POPs in WEEE plastics does not make them hazardous. This situation needed to be addressed through increased legal certainty. He indicated that a threshold needed to be established for POP BFR substances and that, finally, practical and simple procedures are required for transboundary transport.

Ms. Sonia Valdivia, Program Manager, Sustainable Recycling Industries & Life Cycle Management, World Resources Forum spoke **about principles for Inclusive Recycling in global value chains** and the WRF's Sustainable Recycling Industries programme. Ms. Valdivia discussed the human side of waste and recycling processing and the informal sector that make up the bulk of this group in developing countries in particular.

Recycling offers opportunities. In developing countries more than 90% of recovered metals is done informally… but recycling by the informal sector poses risks and threats."

The informal sector uses child labour, contributes to environmental pollution and health hazards. Although recycling presents a significant economic opportunity, the numerous challenges associated with recycling and the informal sector, need to be addressed.

Although there are quality and sustainability standards for renewable and non-renewable resources, some of which were assessed, ranging from ISO Guide 82: 2014 to a range of standards on specific materials. Her organization is now addressing this gap found in the recycling industries that deal with secondary resources, through the International Workshop Agreement: Guidance Principles for the sustainable management of secondary metals (ISO IWA 19). The ISO IWA 19 aims to guide economic operators of secondary metals value chains, in the "efficient and credible implementation of improved recycling, in particular in emerging and developing economies."

The ISO IWA 19 is supported by a number of publications that examine the issue and opportunities to address these issues in more detail. For example, the SRI has released a publication that supports the development of national policy frameworks for the sustainable management of wastes, such as WEEE; Life Cycle Assessments of Selected Worst Practices in Secondary Metals Recovery and Recommendations to Moved Towards Good Practices.

Looking into the future, the WRF is pilot testing in countries and a series of training events regarding the adoption of the ISO IWA 19.

Results of audience polls

The identified barriers and possible focus areas discussed as part of the conference were then aligned with a range of potential policy and market solutions by means of an interactive poll,

where participants were able to indicate their preferred mechanism to address these challenges.

In regards to what participants believed to be the ***most efficient policies in the development of sustainable recycling industries***, more than half of respondents thought that waste management policies in favour of recycling would be most effective in catalyzing sustainable recycling industries.

In terms of the most ***preferred measures and incentives to support the development of recycling industries,*** participants preferred legislation that provided incentives and clear definitions, thereafter showing an equal preference for market interventions and manufacturing requirements favouring recycling.

Participants were asked what they thought was the ***most supportive form of international cooperation to support the development of recycling industries.*** Respondents thought that the harmonization of requirements and procedures for recyclables management was important. However, respondents also showed almost the same preference for targeted technical assistance and capacity building, with trade liberalization being the least preferred option.

In terms of the ***preferred policy options for steering the supply side of recycled plastics***, participants thought that extended producer responsibility would be the most effective option, followed by the introduction of dual or multiple stream collection systems. Lastly, incentives for better plastics design restrictions placed on the use of hazardous additives were viewed to be the least popular option.

In terms of ***steering the demand side of recycled plastics*** the most preferred option amongst respondents was a tax on virgin plastics, followed by recycled content rules.
The circular economy is an ambitious goal that will require systemic change and collaboration in order to align systems to support this transformation. But as this conference has shown, many recycling actors in the recycling world are positioning themselves, or have already positioned themselves to be an essential cog in the circular economy. And as this conference has shown, this momentum can be harnessed if efforts are aligned at all levels, so that the recycling industries can assume a central role within the circular economy.

Participants were also encouraged to look beyond policy as the only option for encouraging recycling. More specifically, in regards to metal recycling, participants were surveyed as to what they thought was the ***most effective non-policy measures to encourage metal recycling***. A slight majority thought that intelligent design for future recycling would be the most effective non-policy measure, followed by an improvement of the recycling technologies and then information and education. Standardization was the least popular option.

In concluding the polls, participants were asked to rank what they believed to be the ***main barriers to metals recycling***. A lack of standards and recycling were perceived to be the largest barriers, closely followed by price volatility, which in turn was followed by the cost of collection and virgin ores; the latter two options receiving equal votes.

The road ahead for recycling industries: Destination a circular economy

The two days of the conference were full of insights into the barriers currently keeping the recycling industries from realizing their full potential as part of the circular economy. However, the conference was also full with inspiring examples of how the industry is already participating in circular activities and leading the way in demonstrating that waste is indeed a valuable resource, with still so much potential that can-and urgently so-needs to be harnessed.

It was also a unique opportunity to bring recycling actors from around the world together, to affirm views, compare notes and to generate new ideas and to contribute to a shared way forward for UNIDO's programmatic and policy work, with the ambition of embedding recycling as a central cog in the circular economy.

Despite the diversity of the waste streams that were discussed, similar views, barriers and solutions were almost universal across and within each of the plenary sessions. All speakers expressed the need for policy framework to provide at both supply and demand side to create or change the conditions to increase the recycling rates in each of the different recycling categories.

Many participants felt that that Extended Producer Responsibility was a key policy approach, which needed to be a greater focus of policy responses. Similarly, many participants also argued for the development of internationally accepted criteria for recyclability of materials, to enable responsible cross border movement of waste based raw material and intermediate products to enable producers and brands to legally collect waste.

There was also a general consensus that there is a need to create partnerships for action on technology transfer to help countries to develop recycling systems and strategies based on the whole recycling value chains and life-cycle analyses. Many participants also expressed the need for the greening of recycling industries as a key ingredient to enable a circular economy.

The circular economy is an ambitious goal that will require systemic change and collaboration in order to align systems to support this transformation. But as this conference has shown, many recycling actors in the recycling world are positioning themselves, or have already positioned themselves to be an essential cog in the circular economy. And as this conference has shown, this momentum can be harnessed if efforts are aligned at all levels, so that the recycling industries can assume a central role within the circular economy.