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PROGRAMME AT A GLANCE

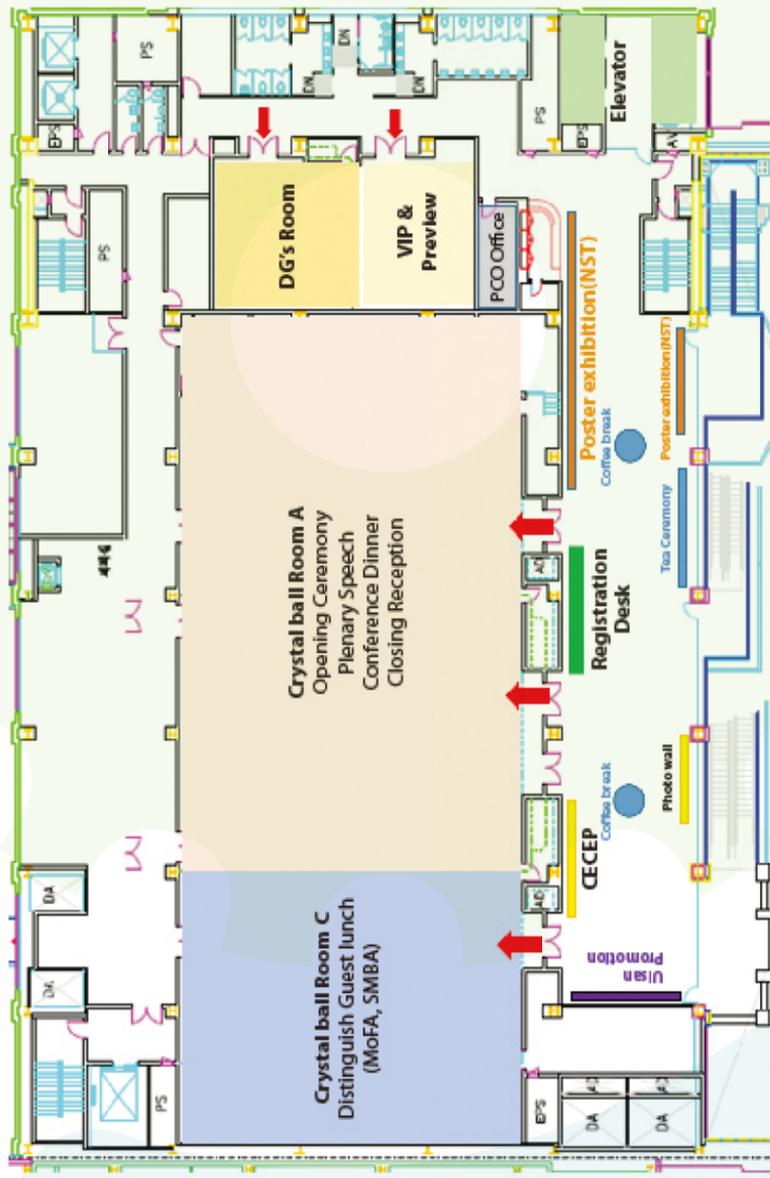
	28 June – Day 1
08:30-09:00	Registration
09:00-09:30	
09:30-10:00	Opening Ceremony
10:00-10:30	
10:30-11:00	Signing Ceremony
11:00-11:30	Coffee and Tea
11:30-12:00	High-Level Panel Green Industry for Sustainable Cities
12:00-12:30	
12:30-13:00	Lunch hosted by the Minister of Foreign Affairs
13:00-13:30	
13:30-14:00	
14:00-14:30	Plenary 1 The Korean Green Growth Strategy in Urban Industrial Areas: The Ulsan Experience
14:30-15:00	
15:00-15:30	
15:30-16:00	Coffee and Tea
16:00-16:30	Plenary 2 Low-Carbon Transport and Energy for Sustainable Cities
16:30-17:00	
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19:00-	Dinner hosted by UNIDO and Ulsan Metropolitan City



29 June – Day 2	
08:30-09:00	Summary of Day 1
09:00-09:30	Plenary 3 Introduction to Green Industry and the Circular Economy
09:30-10:00	Green Industry and the Circular Economy: Eco-Industrial Parks, Towards a Common Framework
10:00-10:30	
10:30-11:00	
11:00-11:30	Coffee and Tea
11:30-12:00	Green Industry and the Circular Economy: Opportunities for Sound/Innovative Chemicals Management in Cities
12:00-12:30	
12:30-13:00	Lunch hosted by the Small and Medium Business Administration
13:00-13:30	
13:30-14:00	
14:00-14:30	Plenary 4
14:30-15:00	Towards a Green Industry Index
15:00-15:30	Plenary 5
15:30-16:00	Science, Technology and Innovation for Sustainable Cities
16:00-16:30	Coffee and Tea
16:30-17:00	Key Findings and Recommendations of the Conference
17:00-17:30	
17:30-18:00	Closing Plenary and Adoption of Ulsan Statement
18:00-18:30	Closing Reception
18:30-19:00	
19:00-19:30	
30 June – Day 3: Industrial Site Visits	

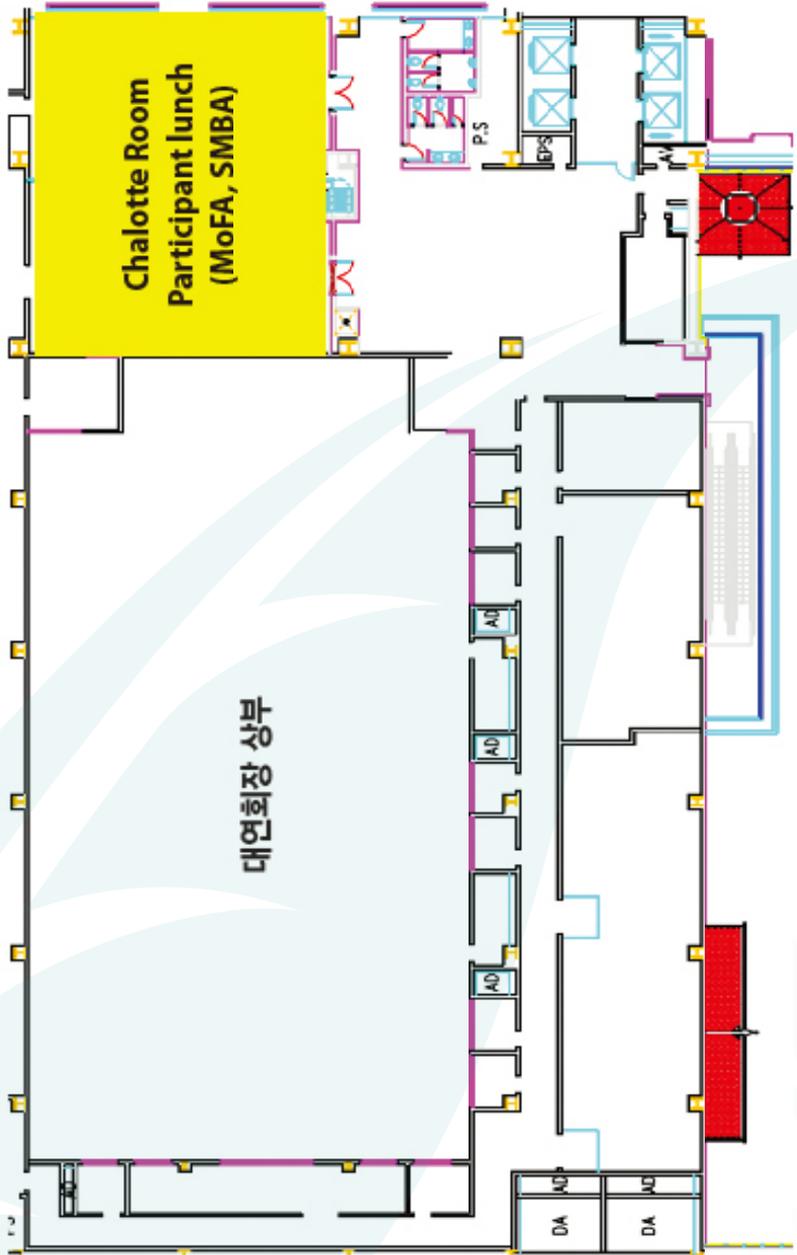
FLOOR PLAN

[2nd Floor]





[3rd Floor]



AGENDA

Tuesday, 28 June 2016 – Ulsan

08:30-09:30 Registration

09:30-10:30 Opening ceremony

Moderator

Korean conference moderator

Video message

Mr. Ban Ki-moon, Secretary-General, United Nations

Speakers

- **Mr. Kim Gi-hyeon**, Mayor of Ulsan Metropolitan City
- **Mr. Li Yong**, Director General, UNIDO
- **Mr. Park Won-joo**, Deputy Minister, Ministry of Trade, Industry and Energy, Republic of Korea
- **Mr. Wang Xiaokang**, Chairman, China Energy Conservation and Environmental Protection Group
- **Mr. Park Yeong-chul**, Chairman, Ulsan Metropolitan Council
- **Mr. Oh Yeon-cheon**, President, University of Ulsan
- **Mr. Kim Bok Chul**, Director General, Directorate of Policy, National Research Council of Science and Technology
- **Mr. Choi Su-gyu**, Vice SME Minister, Small and Medium Business Administration
- **Mr. Joo Dong-joo**, Senior Research Fellow, Korea Institute for Industrial Economics and Trade

10:30-11:00 Signing ceremony

Memorandums of understanding will be signed respectively between:

- UNIDO and the University of Ulsan Joint Declaration
- UNIDO and the National Research Council of Science and Technology; and
- UNIDO and the China Energy Conservation and Environmental Protection Group.

11:00-11:30 Coffee and tea

Press interviews

11:30-12:30 High-Level Panel: Green Industry for Sustainable Cities

Seventy per cent of the global population is expected to live in urban areas by 2050. Cities will therefore play a fundamental role in the achievement of the 2030 Agenda for Sustainable Development. They can nurture a new type of industrialization that creates jobs and relies on innovation, green technology, high value-added and skilled labour.

The panel will review experiences from industrialized and developing countries, linking the new industrialization paradigm to the megatrend on urban development. The discussions will focus on the preconditions for cities in developing countries to grow sustainably and become competitive hubs for innovative and green manufacturing.



Chair

Mr. Pradeep Monga, Director, Department of Energy, UNIDO

Video message

Mr. Joan Clos, Executive Director, United Nations Human Settlements Programme

Speakers

- **Mr. Marco Kamiya**, Coordinator and Leader, Urban Economy and Finance Branch, United Nations Human Settlements Programme
- **H.E. Ms. Atchaka Sibunruang**, Minister of Industry, Thailand
- **H.E. Mr. Humayoon Rasaw**, Minister of Commerce and Industries, Afghanistan
- **H.E. Mr. Amir Hossain Amu**, Minister of Industry, Bangladesh
- **H.E. Mr. Adan Mohamed**, Cabinet Secretary, Ministry of Industry, Investment and Trade, Kenya
- **H.E. Mr. Cham Prasidh**, Minister of Industry and Handicrafts, Cambodia
- **Ms. Enkhbayar Tsendendorj**, Executive Director, Urban Development Resource Center, Mongolia

12:30-14:00

Lunch hosted by the Ministry of Foreign Affairs

Remarks by **Mr. Choi Jong-moon**, Deputy Minister of Foreign Affairs, Republic of Korea

14:00-15:30

Plenary 1: The Korean Green Growth Strategy in Urban Industrial Areas: The Ulsan Experience

As economic drivers of national growth and the location of growing environmental concerns, cities have a key role in advancing green industrial policies. The city of Ulsan – the single largest manufacturing hub in the Republic of Korea – has been very successful in promoting environmental restoration and in converting conventional industrial complexes into eco-industrial parks through inter-industry waste, energy, and material exchange.

This session will address the following questions:

- Which lessons can developing and transition economies learn from the Ulsan experience?
- What kinds of business models are needed to implement green industrial policies?
- What partnership models can the Republic of Korea offer to support developing countries?

Chair

Mr. Kim Jin-ho, Head of Cleaner Production Planning Office, Korea National Cleaner Production Centre

Speakers

- **Mr. Chang Soo-rae**, Director General of Creative Economy Executive Office, Ulsan Metropolitan City
- **Ms. Jeong Mi-hoon**, Manager, Green Business Team, Industrial Location and Environment Department, Korea Industrial Complex Corporation

AGENDA

- **Mr. Kim Jung-hoon**, Manager, Ulsan Eco-Industrial Park Centre, Korea Industrial Complex Corporation
- **Mr. Woo Hang-soo**, Research and Development Centre Manager, New Energy Technology Institute, Ulsan Technopark

15:30-16:00 Coffee and tea

16:00-17:30 **Plenary 2: Low-Carbon Transport and Energy for Sustainable Cities**

Sustainable Cities are hubs of innovation, employment and industrialization. Such cities are where new technologies and new business models emerge. Cities are also becoming increasingly involved in climate action and the adoption of low-carbon solutions, since a high percentage of carbon emissions is related to the use of fossil fuels for urban transport and energy.

The session will focus on the role of industry and the private sector in enhancing urban sustainability, particularly in the areas of transport and energy. The session will also look at integrated strategies – encompassing the urban, industry, transport and energy sectors – aimed at fostering low-carbon transport and energy systems.

The following questions will be addressed:

- How can cities better serve as innovation hubs in the areas of transport and energy?
- How do energy companies, local governments, academia and consumers agree on and implement new energy solutions in cities?
- What kinds of new energy business models are emerging in cities?
- How are smart small and medium-sized enterprises and renewable energy companies triggering changes in traditional energy and transport systems?

Chair

Mr. Jukka Uosukainen, Director, Climate Technology Centre and Network

Introduction by:

Mr. Pradeep Monga, Director, Department of Energy, UNIDO

Speakers

- **Mr. Radmir Ildarovich Beliaev**, Head of the Division of Economic Development, Naberezhnye Chelny
- **Ms. Xueman Wang**, Coordinator, Cities and Climate Change Global Practice, World Bank
- **Ms. Tonilyn Lim**, Industrial Development Officer, Department of Energy, UNIDO
- **Mr. Carel Petrus Snyman**, Senior Manager, Cleaner Mobility Programme, South African National Energy Development Institute
- **Mr. Datuk Nik A. Faizul Bin Abd. Mallek**, Managing Director, MIGHT Technology Nurturing
- **Ms. Mo Jung-youn**, Associate Research Fellow, Korea Institute for Industrial Economics and Trade
- **Mr. Marc Wolfram**, Associate Professor, Urban Sustainability Transitions Lab, Yonsei University

19:30

Dinner hosted by the Ulsan Metropolitan City and UNIDO

Wednesday, 29 June 2016 – Ulsan

09:00-09:15 **Summary of Day 1 – Outlook of Day 2 by Korean conference moderator**

09:15-09:30 **Plenary 3: Introduction to Green Industry and the Circular Economy**

This session will provide an overview of how Green Industry contributes to the Circular Economy. Key Green Industry activities, such as eco-industrial parks and sound chemicals management, will be presented and discussed. The session will highlight approaches that minimize pollution and waste, and in which resources are either re-used or safely re-absorbed by the environment.

Introduction by:

Mr. Stephan Sicars, Director, Department of Environment, UNIDO

09:30-11:00 **Green Industry and the Circular Economy: Eco-Industrial Parks, Towards a Common Framework**

The session will present a summary of UNIDO's global assessment on eco-industrial parks in 13 developing countries, including key lessons learned, trends and examples for the way forward.

The session will focus on:

- Learning from best practice: the Ulsan Eco-Industrial Park experience.
- The challenge of defining a common approach for eco-industrial park development.
- A standardized approach: piloting a framework of minimum requirements for eco-industrial park development.

Chair

Mr. Smail Alhilali, Industrial Development Officer, Department of Environment, UNIDO

Speakers

- **Mr. Suren Erkman**, Head of Industrial Ecology Group, University of Lausanne
- **Mr. Park Hung-suck**, Professor, University of Ulsan
- **Mr. Kim Byoung-jo**, Deputy Director of Resource Recycling Division, Ulsan Metropolitan City Government
- **Mr. Etienne Kechichian**, Senior Private Sector Development Specialist, World Bank Group
- **Mr. Zhang Hua**, Deputy Director General, Weifang Binhai Economic Development Zone
- **Mr. Dong Tran Duy**, General Director, Ministry of Planning and Investment
- **Mr. Bharat Jain**, Member Secretary, Gujarat Cleaner Production Centre
- **Ms. Michelle Zhao**, Chairwoman and General Manager, Sino-Swiss Zhenjiang Eco-Industrial Park

AGENDA

11:00-11:30 Coffee and tea

11:30-12:45 **Green Industry and the Circular Economy: Opportunities for Sound/Innovative Chemicals Management in Cities**

Chemistry lies at the heart of many of processes in metropolitan areas as it provides fundamental building blocks for construction, energy, communication, transport, water and waste management. This session provides insights into different approaches of sound/innovative chemicals management that can support building sustainable cities by means of green chemistry and green engineering technologies, new circular economy business models and new training materials for policymakers, businessmen and technicians.

Chair

Mr. Stephan Sicars, Director, Department of Environment, UNIDO

Speakers

- **Ms. Petra Schwager**, Industrial Development Officer, Department of Environment, UNIDO
- **Mr. Branko Dunjic**, Director, National Cleaner Production Centre, Serbia
- **Ms. Anke Joas**, Director, BiPRO GmbH, Germany
- **Mr. Marcos Alegre**, Executive Director, National Cleaner Production Centre, Peru

12:45-14:00 **Lunch hosted by the Small and Medium Business Administration and the Small and Medium Business Corporation**

14:00-15:00 **Plenary 4: Towards a Green Industry Index**

The session will review international examples of green industry indexes and ranking systems by identifying common elements and lessons learned. It aims to lay the foundation for establishing a global Green Industry Index through a task-force of international experts.

Chair

Mr. Rene Van Berkel, Chief Technical Advisor, Indonesia, UNIDO

Speakers

- **Mr. Pan Haoran**, Professor, Beijing Normal University, Green Industry Platform, China Project Management
- **Mr. Anthony Shun Fung Chiu**, Professor of Industrial Systems Engineering, De La Salle University
- **Mr. Kiran Ananth**, Senior Counsellor, Confederation of Indian Industry
- **Mr. Lintong Sopandi Hutahaean**, Head, Centre for Assessment and Development of Green Industry and Environment, Ministry of Industry, Indonesia
- **Ms. Jane Nyakang'o**, Director, National Cleaner Production Centre, Kenya



15:00–16:00

Plenary 5: Science, Technology and Innovation for Sustainable Cities

The session will look at technology, policy options and innovative business models that address some of the key challenges of rapid urbanization and natural resource depletion, with a particular focus on:

- Green technology and research and development.
- Industrial innovation, efficiency and competitiveness.
- Smart grid and demand-side management.
- Innovative start-ups, small and medium-sized enterprises, and public-private partnerships.

Chair

Mr. Pranab Baruah, Senior Knowledge Manager, Global Green Growth Institute

Speakers

- **Mr. Song Jae-ryoung**, Team Leader, Research and Development Strategy and Policy Division, National Research Council of Science and Technology
- **Mr. Lee Tae-sung**, Senior Manager, Small and Medium Business Corporation
- **Ms. Irene Hofmeijer**, Founder and Executive Director, Life Out Of Plastic
- **Mr. Sanjay Banka**, Executive Director, Banka BioLoo Pvt. Ltd.
- **Mr. Charles G. Kwesiga**, Executive Director, Uganda Industrial Research Institute
- **Mr. Serguei Golovanov**, Chief Executive Officer, GOLEM IMS GMBH, Austria

16:00-16:30

Coffee and tea

16:30–17:30

Key findings and recommendations of the conference

The session will summarize discussions, contributions from the floor, key issues and action points to be considered for inclusion in the Ulsan Statement.

Chair

Mr. Zou Ciyong, Director, Department of Partnerships and Results Monitoring, UNIDO

Contributors

High-level officials from UNIDO Member States

17:30–18:00

Closing plenary and Ulsan Statement

The concluding session will present the final recommendations of the fourth Green Industry Conference in the form of an Ulsan Statement. The Ulsan Statement will serve as a reference document for future discussion on city-level Green Industry initiatives.

Moderator

Korean conference moderator

AGENDA

Closing remarks

- **Mr. Stephan Sicars**, Director, Department of Environment, UNIDO
- **Mr. Oh Gyu-taek**, Deputy Mayor, Ulsan Metropolitan City

18:00-19:00 Closing reception

Thursday, 30 June 2016 – Industrial site visits

09:00-10:00/10:30 Hyundai Heavy Industry

Moderator

To be provided by Hyundai

Translation

To be provided by Hyundai

Since its founding in 1972, Hyundai Heavy Industry has developed into the world's largest shipbuilding company. Headquartered in Ulsan, Republic of Korea, the company is active in numerous industries, including shipbuilding, industrial plant facilities, engines and industrial machinery, electrical appliances, construction equipment, and green energy.



Transport to industrial sites (organized shuttle bus)

11:00-12:00 SK Energy

Moderator: To be provided by SK Energy

Translation: To be provided by SK Energy

The Republic of Korea's largest oil refiner, SK Energy controls about 35 per cent of the country's fuel retail market and operates 4,270 service stations. The firm is involved in oil exploration and production in 15 countries and has reserves equivalent to 500 million barrels of oil. The company supplies natural gas to Seoul and other cities in Korea, in addition to producing lubricants, low-pollutant gasoline and petrochemicals.

11:00-12:00 Ulsan Hydrogen Town

Moderator: To be provided by UHT

Translation: To be provided by UHT

Established in 2012, Ulsan Hydrogen Town is a community housing around 140 families using hydrogen for their energy needs. The Hydrogen Town will contribute to transforming Ulsan into a green city and a technology leader in the fields of hydrogen and fuel cells. As such, it will serve as a model for reducing dependency on fossil fuels and decreasing overall greenhouse gas emissions from factories and vehicles.

Return to the hotel – End of programme

BIOGRAPHIES OF SPEAKERS

Tuesday, 28 June 2016 – Opening Ceremony

Video Message

Mr. Ban Ki-moon, Secretary-General, United Nations

Mr. Ban Ki-moon is the eighth Secretary-General of the United Nations. His priorities have been to mobilize world leaders around a set of new global challenges, from climate change and economic upheaval to pandemics and increasing pressures involving food, energy and water. He has sought to be a bridge-builder, to give voice to the world's poorest and most vulnerable people, and to strengthen the Organization itself. He received a Bachelor's degree in International Relations from Seoul National University in 1970, and earned a Master of Public Administration from the John F. Kennedy School of Government at Harvard University in 1985. Mr. Ban was awarded the degree of Doctor of Laws (Honoris Causa) by the University of Malta. He further received an honorary degree of Doctor of Laws from the University of Washington in October 2009.



Speakers

Mr. Kim Gi-hyeon, Mayor of Ulsan Metropolitan City

Mr. Kim Gi-hyeon is the sixth Mayor of Ulsan Metropolitan City. Prior to this post, he was a member of the 17th, 18th and 19th Parliament, from 2004 to 2014, and served as the chairman of the Saenuri Party Policy Committee and the Hannara Grand National Policy Coordination Committee. He has received several awards, including the 18th and the 19th National Assembly Award, the Excellent and Model Member Award from the NGO Monitor, the Republic of Korea "Great Hankukin" Award and the Members of Congress Invitation Award. Previously, he served as President of the Ulsan General Volunteer Center and as a judge at the Daegu and Ulsan District Court after passing the Judicial Examination in 1983. Mr. Kim holds a Master's degree in Commercial Law from Seoul National University.





Mr. Li Yong, Director General, UNIDO

Mr. Li Yong, Director General of the United Nations Industrial Development Organization (UNIDO), has an extensive career as a senior economic and financial policymaker. As Vice-Minister of Finance of the People's Republic of China and member of the Monetary Policy Committee of the Central Bank for a decade, Mr. Li was involved in setting and harmonizing fiscal, monetary and industrial policies, and in supporting sound economic growth in China. He pushed forward financial sector reform, and prompted major financial institutions to establish corporate governance, deal with toxic assets and strengthen risk management. Mr. Li has given great importance to fiscal and financial measures in favour of agricultural development and small and medium-sized enterprises, the cornerstones for creating economic opportunities, reducing poverty and promoting gender equality. He played a key role in China's cooperation with multilateral development organizations, such as the World Bank Group and the Asian Development Bank.



Mr. Park Won-joo, Deputy Minister, Ministry of Trade, Industry and Energy, Republic of Korea

Mr. Park Won-joo is currently the Deputy Minister for Planning and Coordination, Ministry of Trade, Industry and Energy (MOTIE), Republic of Korea. Prior to this role, he was the spokesperson for MOTIE (2014-2015), Director General for Industrial Policy (2013-2014) and Director General for Industrial and Economic Policy (2012-2013). From 2009 to 2012, he served as Minister Counselor to the Embassy of the Republic of Korea in Japan.



He holds a PhD in Economics from the University of Indiana, an MA in Public Policy and a BA in Economics from Seoul National University.

BIOGRAPHIES OF SPEAKERS

Mr. Wang Xiaokang, Chairman, China Energy Conservation and Environmental Protection Group

Mr. Wang Xiaokang is the Chairman of the Board, and the legal representative of the China Energy Conservation and Environmental Protection Group (CECEP). He's a member of the 12th National Committee of CPPCC, and member of the CPPCC Committee of Population, Resources and Environment, Chairman of the China Industrial Energy Conservation and Clean Production Association, member of the National Strategy and Advisory Committee for Production Power as well as one of the leading experts for compiling the National Report of Climate Change (3rd Edition).



Mr. Wang has a deep knowledge of the energy-saving and environmental protection industry, and related laws and regulations in China. He is a promoter, advocate, and practitioner of China's low-carbon economy and green philosophy. He is one of the Top 60 Business Elites since the 60th anniversary of the People's Republic of China. From 2009 to now, Mr. Wang has been engaged in compiling the "China Energy Conservation and Emission Reduction Development Report" as one of the leading editors, and devoted himself to the research and drafting of important documents on behalf of the central government, the State Council and relevant ministries. Mr. Wang is an active participant of several domestic and international events on trade, including the Chinese-German Forum for Economic and Technological Cooperation, the G8+5 Legislators Forum on Climate Change, COP17/CMP7 in Durban, and the Globalization Forum by Harvard University. He contributes to positively improving the image of Chinese companies and entrepreneurs in China and abroad. Mr. Wang has a Bachelor's degree in Law from Peking University, and an MBA from the Business School of the University of International Business and Economics.

Mr. Park Yeong-chul, Chairman, Ulsan Metropolitan Council

Mr. Park Yeong-chul is Chairman of Ulsan Metropolitan Council. He currently also serves as President of the Alumni Association of Ulsan College and as Advisor to the Ulsan Metropolitan City Merchants Association. Previously, he held the post of Vice-Chairman of the first half of the 2nd Ulsan Metropolitan City Jung-gu council and Chairman of the second half of the 3rd Ulsan Metropolitan City Jung-gu council. He was also President of the Alumni Association of Boksan Elementary School, President of the Seoulsan Lions Clubs, and Chairman of the Administration Autonomy Committee of the second half of the Ulsan Metropolitan City council. Mr. Park Yeong-chul has a degree from Ulsan College, Republic of Korea.





Mr. Oh Yeon-cheon, President, University of Ulsan

Mr. Oh Yeon-cheon is President of the University of Ulsan since 2015. Prior to this, he was Koret Fellow Professor at Stanford University, United States, and Chairman of the Judicial Policy Advisory Committee. From 2010 to 2014, he was President of Seoul National University (SNU) as well as its Chairman of the Board of Trustees. From 2005 to 2009, he held several posts at the Ministry of Knowledge and Economics. Prior to this, he served as Chairman of the Information and Communication Policy Review Committee at the Ministry of Information and Communication, among other government posts. He was Dean of the Graduate School of Public Administration at SNU between 2000 to 2004, previously worked as a consultant for the World Bank, and as a Visiting Professor at the University of Berlin, Germany, among other posts. He has written several books and received notable awards, including the Order of Service Merit in 2015 and 2005, as well as the Award for 20 years of continuous service at SNU (2003). Mr. Oh Yeon-cheon holds a Bachelor's degree in Political Science from Seoul National University, a Master's degree and a PhD in Public Administration from New York University, United States.



**Mr. Bok Chul Kim, President, Director General, Directorate of Policy,
National Research Council of Science and Technology**

Mr. Bok Chul Kim (PhD) is Director General of the Directorate of Policy at the National Research Council of Science and Technology since 2015. Prior to this role, he held various positions at the Korea Institute of Geoscience and Mineral Resources, including as Executive Director of the Geological Research Division (2014-2015), Director of the Planning and Coordination Division (2010-2012), Director of the Geo-Information Division (2005-2008), and as senior researcher (1988-2005). He also serves as Vice-President of the Korea Society of Economic and Environmental Geology and since the beginning of 2016, as Vice-President of the Korea Technology Innovation Society.



Mr. Bok Chul Kim holds a PhD from Yonsei University, Republic of Korea. He did a Postdoctoral Fellowship at Stanford University, United States, and is a visiting professor at the University of Calgary, Canada.

BIOGRAPHIES OF SPEAKERS

Mr. Choi Su-gyu, Vice SME Minister, Small and Medium Business Administration

Mr. Choi Su-gyu is Vice SME Minister at the Small and Medium Business Administration (SMBA) since 2014. Prior to this role, he served as Secretary to the President for SMEs, Presidential Office, and held various senior positions at SMBA, including as Director-General of the SME Policy Bureau, Administrator for the Gyeonggi region, Director-General of the Business Start-up and Venture Bureau, Director-General of the Technology Bureau, and Director of the Policy Planning and Coordination Division, among many others. He has Bachelor's degree in Business Administration from the Korea University, and Master of Public Administration from the University of Oregon, United States.



Mr. Yu Byoung-gyu, President, Korea Institute for Industrial Economics and Trade

Mr. Yu Byoung-gyu (PhD) is President of the Korea Institute for Industrial Economics and Trade (KIET), one of Korea's public economic think tanks. Before being appointed as president of KIET, he worked as Director of several research divisions at the Hyundai Research Institute, such as the Division of Current Survey and Forecasting, Division of Economic Policy and the Division of Industrial Strategy, covering the period from 1988 to 2013. In addition, between 2013 and 2016, he worked as the Secretary-General of the National Economic Advisory Council for the Korean President. He also worked for SAIS of Johns Hopkins University from 2011 to 2012 as a visiting scholar. Mr. Byoung-gyu Yu has been a member of many government policy advisory committees, such as the presidential committee on Ageing Society and Population Policy. His major publications include "The process of Economic Development of Korea and its Future", and "Strategy for Digital management of manufacturing companies".





High-Level Panel: Green Industry for Sustainable Cities

Chair

Mr. Philippe Scholtès, Managing Director, Programme Development and Technical Cooperation, UNIDO

Philippe Scholtès is Managing Director of Programme Development and Technical Cooperation at UNIDO. He oversees technical assistance programmes of UNIDO – a portfolio of over 700 projects of a total value of one billion dollars, delivered by 220 staff at UNIDO Headquarters in Vienna and over 1,200 project personnel in a hundred countries. Prior to his role of Managing Director, Mr. Scholtès was Director of UNIDO's Agribusiness Development Department; he also served as the UNIDO Representative in Viet Nam and as Regional Director for South Asia in New Delhi, India.



Mr. Scholtès, a Belgian national, holds an MSc degree in Engineering (major electro-mechanics) and an MSc degree in Economics (major mathematical economics). He has published on economics, energy economics and industrial organizations, among other areas.

Video Message

Mr. Joan Clos, Executive Director, United Nations Human Settlements Programme

Since October 2010, Dr. Joan Clos is the Executive Director of the United Nations Human Settlements Programme (UN-Habitat) at the level of Undersecretary-General by the United Nations General Assembly. Dr. Clos is a medical doctor with a distinguished career in public service and diplomacy. He was twice elected Mayor of Barcelona serving two terms during the years 1997 to 2006. He was Minister of Industry, Tourism and Trade of Spain between 2006 and 2008. Prior to joining the United Nations, he served as Spanish ambassador to Turkey and Azerbaijan. At the international level, Dr. Clos previously served as President of Metropolis – international network of cities; President of the World Association of Cities and Local Authorities; Chairman of the United Nations Advisory Committee of Local Authorities, and member of the Council of European Municipalities and Regions.



Dr. Clos received a number of awards, including a gold medal from the Royal Institute of British Architects in 1999 for transforming Barcelona, and in 2002 he won the UN-Habitat Scroll of Honour Award for encouraging global cooperation between local authorities and the United Nations.

Speakers

Mr. Marco Kamiya, Coordinator and Leader, Urban Economy and Finance Branch, United Nations Human Settlements Programme

Mr. Marco Kamiya is head of the Urban Economy and Finance Branch of the United Nations Human Settlements Programme (UN-HABITAT). He directs field projects in Asia, Africa and Latin America. Mr. Kamiya conducts research on municipal finance, the economics of urban expansion, private sector development, and local infrastructure-investment policy. He is also member of the Habitat III advisory group on local finance and the UN Inter-Agency Task Force on Financing for Development.



Previously, he occupied senior positions at the Development Bank of Latin America (CAF), the Inter-American Development Bank and PADECO Co., Ltd., an international development firm headquartered in Tokyo.

Mr. Kamiya studied Economics at the National University of San Marcos, Peru, and the Waseda University, Japan, as well as International Development at Harvard University. He is co-author of the forthcoming UN-HABITAT handbook on “Finance for City Leaders”, co-editor of the World Cities Report 2016, and has published on topics such as innovation, private sector development, entrepreneurship and competitiveness.

H.E. Ms. Atchaka Sibunruang, Minister of Industry, Thailand

H.E. Ms. Atchaka Sibunruang is the Minister of Industry, Thailand since September 2015. Prior to this role, she served in several senior positions within the Ministry of Industry, including as Permanent Secretary, Director-General to the Department of Industrial Promotion, and Deputy Permanent Secretary at the Office of the Permanent Secretary, among others. H.E. Ms. Atchaka Sibunruang also had a long career at the Office of the Board of Investment in various capacities, including as Secretary-General (2008-2012), Senior Executive Investment Advisor (2004-2005) and Assistant Secretary General (2002-2004), among others. She has been a consultant for various international organizations including the World Bank, the United Nations Conference on Trade and Development, and Foreign Investment Advisory Services. H.E. Ms. Atchaka Sibunruang was also a visiting lecturer at several universities, such as Thammasat University, Chulalongkorn University, National Institute of Development Administration, etc. She has published numerous papers covering topics such as foreign direct investment and industrial policies in Thailand.



She holds a Bachelor's degree in Economics from Chulalongkorn University, Thailand, and a Master's and PhD in Economics from the University of Sussex, United Kingdom.



H.E. Mr. Humayoon Rasaw, Minister of Commerce and Industries, Afghanistan

H.E. Mr. Humayoon Rasaw is the Minister of Commerce and Industries of Afghanistan. He is experienced in economic leadership, industrial and economic development, and has worked in various capacities for government organizations and international agencies, both inside and outside the country. He was Head of the United Nations Development Programme (UNDP) Capacity- Building Programme in South Sudan, the General Director of UNIDO in Afghanistan, Head of Information Technology Projects at UNDP, as well as the Head of the Logistics Department of the World Food Programme and the United Nations Food and Agriculture Organization.



He holds a Bachelor's degree in Natural Sciences from Kabul University and a Master's degree in Information Technology from the University of Preston.

Mr. Hoang Quoc Vuong, Vice-Minister of Industry and Trade, Viet Nam

Since 2010, Mr. Hoang Quoc Vuong serves as Vice-Minister of Industry and Trade of Viet Nam. He is currently responsible for the energy sector, namely national policy development and improvements in energy efficiency.



Besides providing direct supervision to the Local Industries Agency, the Technical Safety and Industrial Environment Agency and Electricity of Viet Nam (EVN), Mr. Hoang is also in charge of monitoring the development of chemical, bio-chemical and petro-chemical industries conducted by the Viet Nam Chemistry Agency and the Viet Nam National Chemical Group (VINACHEM).

Before being appointed as a Vice Chairman of Thai Nguyen People's Committee in 2008, Mr. Hoang worked for EVN from 1985 to 2003 where he held several senior positions, including as Director of the International Cooperation Department, Chief Assistant to President and Chief Executive Officer.

He has a Diploma and Bachelor's degrees in Geology, Law and Economics and graduated from Trinity College of Dublin, Ireland, with a Master's degree in Business Administration.

H.E. Mr. Amir Hossain Amu, Minister of Industry, Bangladesh

H.E. Mr. Amir Hossain Amu is the Minister of Industry of Bangladesh. He was first elected as a Member of the Parliament in 1996 and served as the Minister of Food. He was re-elected as a Member of Parliament in 2008. He then took over as the Minister for Land and Disaster Management and Relief in 2013. He was sworn in as the Ministry of Industry in January 2014.



H.E. Mr. Amu was the Joint Secretary of the Bangladesh Awami League and the Chairman of the Bangladesh Awami Jubo League in 1978. He has also served as the Joint Secretary of the Bangladesh Awami League Central Committee, and was elected as the Presidium Member of the Central Committee of Bangladesh Awami League in 1992.

H.E. Mr. Amu obtained a post-graduate degree in History from Dhaka University and has an undergraduate degree from Barisal BM College, along with a Bachelor of Laws degree from Barisal Law College.

H.E. Mr. Adan Mohamed, Cabinet Secretary, Ministry of Industry, Investment and Trade, Kenya

H.E. Mr. Adan Mohamed is the Cabinet Secretary for Industry, Investment and Trade, Republic of Kenya. Prior to this appointment, he was the Chief Administrative Officer for Barclays Africa, with responsibility for ten Barclays Bank subsidiaries in Africa. In addition, he was responsible for Brand and Marketing, Corporate Communications and Citizenship across Barclays Africa businesses.



He also held various senior roles at Barclays including as Chief Executive Officer of Barclays Kenya for over ten years, and as Managing Director from Barclays East and West Africa since 2008. He also worked in senior finance roles at Barclays Bank. Prior to joining Barclays, he worked for Pricewaterhouse Coopers (London) in the Management Consultancy and Business Advisory Services. His international career has seen him serve in the United Kingdom, United States and Africa.

He served in many other capacities both in the private and public sector of Kenya, including: as Chairman of the Kenya Bankers Association, member of the Kenya National Economic and Social Council, and Chairman of Jomo Kenyatta University of Agriculture and Technology, among others.

H.E. Mr. Adan Mohamed received Presidential recognition and was bestowed the Elder of the Golden Hearts Award for his leading role and distinguished service in both the private and public sector. He is an MBA graduate from Harvard Business School and an alumni of the University of Nairobi, Kenya where he graduated with a First Class Honors degree in Commerce (Accounting option). He is also a Member of the Institute of Chartered Accountants in England and Wales.



**H.E. Mr. Cham Prasidh, Minister of Industry and Handicrafts,
Cambodia**

H.E. Mr. Cham Prasidh is Minister of Industry and Handicrafts of Cambodia since 2013. Previously, he served as Senior Minister and Minister of Commerce for 15 years. He is Member of the Cambodian People's Party and represents Siem Reap Province in the National Assembly of Cambodia since 2003.



**Ms. Enkhbayar Tsedendorj, Executive Director, Urban Development
Resource Center, Mongolia**

Ms. Tsedendorj is Chairperson and Executive Director of the Urban Development Resource Center (UDRC) of Mongolia, a non-governmental organization that promotes community-driven urban and infrastructure upgrading activities which she founded in 2005. UDRC has supported over 300 community groups in implementing more than 200 small community infrastructure and housing projects, through trainings and community planning and survey exercises.



Over the past 20 years, she has worked in areas related to urban development, housing and the housing finance sector in Mongolia. Ms. Tsedendorj is a PhD graduate from the Academy of Management, Ulaanbaatar, and holds a Master's degree in Business Administration and Civil Engineering. Her professional and managerial skills have been enhanced through various trainings, including at the Civil Engineering Institute in Russia and at the Institute of Housing and Urban Development Studies of the Netherlands.

From 2007 to 2013, she was the Chief Executive Officer of the Mongolian Mortgage Corporation, the country's first secondary mortgage market institution. From 2001 to 2007, she was Project Director for the Housing Finance Sector Project of the Asia Development Bank. The project laid the foundation for a bottom-up urban planning approach through eight pilot housing area action plans and introduced a long-term housing finance system, which marked the beginning of a primary mortgage market in Mongolia. Ms. Tsedendorj worked for central government organizations until 1999, after which she worked as an independent consultant.

Plenary 1: The Korean Green Growth Strategy in Urban Industrial Areas: The Ulsan Experience

Chair

Mr. Kim Jin-ho, Head of Cleaner Production Planning Office, Korea National Cleaner Production Centre

Mr. Kim Jin-ho is the head of the Cleaner Production Planning Office at the Korea National Cleaner Production Centre. He started his career conducting research on resource circulation and took part in the Korean Eco-Industrial Park project from 2005 until 2008.



His current work focuses on establishing statistics on cleaner production (eco-efficiency index), developing business models on green products and services, and providing consulting services for manufacturing processes of small and medium-sized enterprises. He holds a PhD in Environmental Engineering from the University College London, United Kingdom, and served as a board member to the Korean Society for Industrial Ecology.

Speakers

Mr. Chang Soo-rae, Director General of Creative Economy Executive Office, Ulsan Metropolitan City

Mr. Chang Soo-rae is the current Director General of the Creative Economy Executive Office of Ulsan Metropolitan City. He has more than 35 years of professional experience across various divisions of Ulsan Metropolitan City. Among others, he served as head of Cultural Arts, Director of the East City District, as well as head of Tourism, in addition to being in charge of the planning division of Ulsan Metropolitan City.





Ms. Jeong Mi-hoon, Manager, Green Business Team, Industrial Location and Environment Department, Korean Industrial Complex Corporation



Ms. Jeong Mi-hoon is Manager of the Korea Industrial Complex Corporation (KICOX) and is in charge of international cooperation for the Green Business Team. She has been promoting knowledge exchange on behalf of the Korean Eco-Industrial Park programme by organizing international events, facilitating study tours, participating in consulting projects, and contributing to international meetings and events. Before joining KICOX, she held several posts in the environmental field, with a focus on issues related to soil and water.

She holds a Bachelor's and a Master's degree in Environmental Science and Engineering from Ewha Woman's University, Republic of Korea. She also holds a PhD from Purdue University, United States, in the area of natural resource management. The latter focused on managing the impacts of urbanization in the perspective of smart growth through technologies such as geographic information systems, hydrologic models, multi-criteria optimization, artificial neural networks and heuristic algorithms.

Mr. Kim Jung-hoon, Manager, Ulsan Eco-Industrial Park Centre, Korea Industrial Complex Corporation



Mr. Kim Jung-hoon joined the Ulsan Regional Eco-Industrial Park (EIP) Project Division of the Korea Industrial Complex Corporation as manager in March 2007. The EIP project is an industrial symbiosis programme that supports increased productivity based on industrial by-products. His role is to develop a business model from datum and diagnosis about by-products of each process. Since 2007, he and the EIP Project Division have developed more than 70 industrial symbiosis models in the Ulsan Metropolitan City. Currently, about 30 cases of industrial symbiosis are operating.

Mr. Woo Hang-soo, Research and Development Centre Manager, New Energy Technology Institute, Ulsan Technopark

Mr. Woo Hang-soo (PhD) is Chief of the Research and Development (R&D) Centre, New Energy Technology Institute, Ulsan Technopark. His major research areas include hydrogen, fuel cells, secondary batteries, ESSs and future energy at the Centre.



Currently, he is a project director of the Ulsan Hydrogen Town and the "Building-up of an eco-friendly fuel cell test-bed complex" using by-product Hydrogen. Ulsan Hydrogen Town is the largest hydrogen-powered town in the world, with 195KW of proton exchange membrane fuel cells in operation since 2013. 1MW of fuel cell test-bed platform supplied by pipe-lined by-product hydrogen and the R&D Centre are under construction, to be completed by the end of 2018. Finally, he is dreaming of a New Delta Project for the transformation of cars, shipbuilding, chemicals on basic manufacturing-based industries to Energy industry 4.0 for Ulsan industry.

He holds a Ph.D. with the Selective Catalytic in Chemical Engineering from Pusan National University. In particular, he is interested in by-product hydrogen and carbon dioxide generated from chemical industry.



Plenary 2: Low-Carbon Transport and Energy for Sustainable Cities

Chair

Mr. Jukka Uosukainen, Director, Climate Technology Centre and Network

Mr. Jukka Uosukainen is the Director of the Climate Technology Centre and Network (CTCN), the operational arm of the United Nations Framework Convention on Climate Change (UNFCCC) Technology Mechanism. The CTCN provides technical assistance and capacity-building in response to developing country requests for technology transfer by mobilizing its global network of technology experts to design and deliver customized solutions.



An engineer by training, Mr. Uosukainen has worked in the fields of environment, technology and development for over three decades, serving as the European Union Lead Negotiator and Co-Chairman for UNFCCC subsidiary body meetings, the Basel Convention and the Montreal Protocol. He has also acted as the Chairman for the UNFCCC Expert Group on Technology Transfer and facilitated technology negotiations during the Poznan and Durban Climate Meetings. Mr. Uosukainen chaired the United Nations Environment Programme Governing Council's Committee of the Whole, and has also been the key negotiator for his government in the work of the UN Commission for Sustainable Development, leading to the Johannesburg and Rio Summits in 2002 and 2012. Prior to joining the CTCN, Mr. Uosukainen served as Director General of the International Affairs Unit in the Ministry of the Environment of Finland.

Introduction

Mr. Pradeep Monga, Director, Department of Energy, UNIDO

Mr. Pradeep Monga (PhD) is Director of the Department of Energy and the Special Representative on Energy to the Director General of UNIDO. He is an energy and sustainable development expert with over 30 years of working experience in the field of policy, strategic planning and clean technologies. His primary responsibility is to provide strategic policy advice to Member States on sustainable energy and industrial issues, and lead an inter-disciplinary team of energy experts, planners and networks of international energy technology centres at UNIDO to promote technical cooperation projects, programmes and partnerships in the field of energy efficiency, renewable energy and low-carbon technologies in developing countries and countries in transition.



Speakers

Mr. Radmir Ildarovich Beliaev, Head of the Division of Economic Development, Naberezhnye Chelny

Mr. Beliaev is Head of Economic Development and Entrepreneurial Support Department of Naberezhnye Chelny. In the past, he served as Deputy Head of the same department (2011-2016) as well as Chief specialist of the Department of Youth Affairs of the Executive Committee (2009-2011). From 2008 to 2010 he was the Vice-President of the Regional Public Organization "League of Students of the Republic of Tatarstan".



Mr. Beliaev holds a Master of Public Administration from the Russian Academy of National Economy and Public Administration (2014) and a Master in Information Systems and Technologies from Kazan (Volga) Federal University.

Ms. Xueman Wang, Coordinator, Cities and Climate Change Global Practice, World Bank

Ms. Xueman Wang is Coordinator of the Cities and Climate Change Global Practice of the World Bank (WB). She leads the WB Global Platform for Sustainable Cities, in addition to working on the design of the International Energy Efficiency Facility to promote green bonds. She was a Team Leader for the Partnership for Market Readiness of the WB, a global programme that supports countries to prepare and implement carbon-pricing schemes, such as emission trading and carbon tax. She has played a critical role in helping China develop a national carbon market and was part of the core team that set up the world's largest carbon fund in 2007.



Ms. Xueman Wang was one of the lead authors of the 2010 World Development Report, "Development and Climate Change". Prior to joining the WB, she worked for the Secretariat of the Convention on Biological Diversity in Montreal, Canada, on biosafety, trade and environment. Before that, she worked at the UN Climate Change Secretariat in Bonn, Germany, where she was responsible for climate negotiations and the compliance regime. Prior to the UN, she worked with the Government of China on a range of issues including China's Agenda 21, climate change and desertification. She was a member of the Climate Change Council of the Global Agenda of the World Economic Forum from 2012 to 2014. She earned Master of Laws degrees from Wuhan University, China, and the Fletcher School of Law and Diplomacy of Tufts University, 2000.



Ms. Tonilyn P. Lim, Industrial Development Officer, Department of Energy, UNIDO

Ms. Tonilyn P. Lim is a project manager at the Renewable and Rural Energy Division, Department of Energy at UNIDO headquarters in Vienna, Austria. She is the Department's focal point for technical cooperation projects related to sustainable cities.



Her previous responsibilities involved project and portfolio management on the thematic areas of environment and energy in the South Asia Region at UNIDO's Regional Office in India. Prior to joining UNIDO, Ms. Lim held leadership positions in the Philippine Government dealing with industrial park environmental management and financial institution business continuity management. She has over 15 years of experience in the fields of environment, energy, climate change and disaster risk, in industrial and urban contexts.

Ms. Lim holds a Master's degree in Environmental Management from the Ateneo De Manila University and the University of San Francisco. She is an MSc candidate in Renewable Energy, at the Technical University of Vienna.

Mr. Carel Petrus Snyman, Senior Manager, Cleaner Mobility Programme, South African National Energy Development Institute

Mr. Carel Petrus Snyman's involvement in energy-related issues began in 1988, when he joined the National Energy Council (NEC) – a governmental energy forum funding research and assisting the Government in energy policy development. He chaired the steering committees responsible for the removal of lead from fuel, and for the establishment of an optimal octane structure for South Africa in collaboration with the automotive and oil industries. Most of his work focused on alternative transport energy, which led to the start of a programme on evaluation of electric vehicle technologies.



When the NEC closed their doors in 1992, he continued his career at Eskom where he was responsible for the Electric Transport Programme. After Eskom stopped doing work on electric vehicles in 2002, and after a short career in information technology, Mr. Snyman established his own business and energy consulting company. His clients included the Automotive Industry Development Corporation and the South African National Energy Development Institute (SANEDI). Mr. Snyman joined SANEDI in June 2013.

Mr. Datuk Nik A. Faizul Bin Abd. Mallek, Managing Director, MIGHT Technology Nurturing

Mr. Datuk Nik is the Group Managing Director of MIGHT Technology Nurturing SdnBhd (MTN). MTN is the technology nurturing and implementation arm of MIGHT aimed at empowering high-tech small and medium-sized enterprises in strategic areas addressing urbanization and climate change. Among its flagship initiative is the GEF/UNIDO Sustainable Cities Malaysia Programme. By bridging market, technology and funding/investments, MTN acts as the catalyst for value addition in industry.



At MIGHT, he led the implementation of several national initiatives and projects, namely the National Technology Foresight Project, the Science, Technology and Innovation Strategic Plan, and the Innovative SME Certification Programme (1-InnoCERT). Mr. Datuk Nik has over 25 years of diversified experience, both in industry and government, on policy, strategic, sectoral development and mission-driven high-impact projects.

Ms. Mo Jung-youn, Associate Research Fellow, Korea Institute for Industrial Economics and Trade

Ms. Jung-youn is an Associate Research Fellow at the Korea Institute for Industrial Economics and Trade. She works on new growth engine industries, especially the environment and energy sectors. Her research interest lies at the intersection of energy economics and environmental economics. She is currently studying the impact of new electricity market technologies, such as demand response, renewable energy and the energy storage system, that help improve energy efficiency and reduce carbon emissions. In line with this interest, she is currently working on developing a zero carbon city by adopting various renewable sources and carbon reduction technologies, in both the manufacturing and electricity generation industry. She holds a PhD degree in Economics from Cornell University, United States.





**Mr. Marc Wolfram, Associate Professor, Urban Sustainability
Transitions Lab, Yonsei University**

Mr. Marc Wolfram is Associate Professor at the Department of Urban Planning and Engineering, Yonsei University (Seoul). His research deals with the dynamics of urban change and the strategies and approaches for steering such change towards sustainability. He focuses on innovation in urban governance, and policy and planning that enable and guide system transitions. This implies a particular concern for socio-technical and social-ecological systems converging in cities, and the factors driving or inhibiting their transformation across spatial scales. As a consultant and researcher in Europe, he has accumulated over ten years of experience working on diverse urban sustainability issues with local governments, city networks and the European Commission. He also taught as a lecturer in graduate studies and professional training programmes in Germany. His academic background includes studies in architecture, urban and regional planning (BA and MA), as well as social sciences (PhD, Post-Doc) at various universities in Europe.



BIOGRAPHIES OF SPEAKERS

Wednesday, 29 June 2016

Plenary 3: Introduction to Green Industry and the Circular Economy

Introduction

Mr. Stephan Sicars, Director, Department of Environment, UNIDO

Since February 2015, Mr. Stephan Sicars serves as Director of the Department of Environment at UNIDO, before which he was Director of the Montreal Protocol Branch of UNIDO. For ten years, he held the post of Senior Programme Officer with the Multilateral Fund for the Implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer. He also worked at, and subsequently managed, the Research Centre for Refrigeration and Heat Pumps in Germany. Mr. Sicars further worked as a consultant on environmental issues, undertaking research projects for various clients, from international industries to NGOs and governments. He was the coordinating lead author for the Intergovernmental Panel on Climate Change, and received the US-EPA Ozone Award.



Mr. Sicars holds a Master's degree in Mechanical Engineering from Hanover University with specialization in energy- and process engineering.

Green Industry and the Circular Economy: Eco-industrial Parks. Towards a Common Framework

Chair

Mr. Smail Alhilali, Industrial Development Officer, Department of Environment, UNIDO

Mr. Smail Alhilali is an Industrial Development Officer with the Industrial Resource Efficiency Division of the Department of Environment at UNIDO, Vienna, Austria. He is responsible of the implementation of the global resource efficient and cleaner production (RECP) programme in developing countries and transition economies. His current work mainly focuses on implementing pilot projects on eco-industrial parks in China, Colombia, Costa Rica, Egypt, India and South Africa.



From 2007 to 2015, he implemented RECP-related projects in developing countries in the Africa, Arab and Asia regions and coordinated UNIDO's work on sustainable e-waste management, with a particular focus on Africa.



Prior to joining UNIDO, Mr. Alhilali was Director of the Morocco National Cleaner Production Centre from 2003 to 2007. He implemented cleaner production-related projects with particular focus on UNIDO-UNEP programmes in Morocco. He was a founding member of the African Roundtable on Sustainable Consumption and Production (2004). From 1994 to 2003, he served in different positions with the National Centre for Nuclear Energy, Science and Technology in Morocco. Mr. Alhilali holds a Master's degree in Nuclear Safety Engineering as well as a Master's degree in Mechanical Engineering.

Speakers

Mr. Suren Erkman, Head of the Industrial Ecology Group, University of Lausanne

Mr. Suren Erkman is Professor at the University of Lausanne (UNIL), Switzerland, and Head of the Industrial Ecology Group, Institute of Earth Surface Dynamics, Faculty of Geosciences and Environment.



With a background in philosophy and biology, followed by a PhD in Environmental Sciences, Mr. Erkman started his career as a registered science/technology and business journalist and editor. He has been working as an independent writer and researcher, and as Senior Consultant for UNIDO, the United Nations Environment Programme, the United Nations Development Programme, the Global Environment Facility, Swiss and foreign government agencies, foundations and various private companies, before joining UNIL in 2005.

He has been contributing to the emerging field of industrial ecology since the 1990s. In 1995, he founded the Industrial Ecology Praxis, the first international network devoted to the promotion, dissemination and implementation of industrial ecology. He is also Chairman of the Board of SOFIES International, a leading international consultancy company on industrial ecology.

Some of his ongoing research projects at UNIL include: eco-industrial development strategies, with a focus on eco-industrial parks; the detection, implementation and evaluation of industrial symbioses; closed artificial ecosystems as drivers of eco-innovation and the circular economy; and the valorization of CO₂ in the perspective of industrial ecology.

Mr. Park Hung-suck, Professor, University of Ulsan

Mr. Park Hung-suck is Professor of Civil and Environmental Engineering and Director of Centers for Clean Technology and Resource Recycling, and the Center for Green Construction Material at the University of Ulsan, Republic of Korea.



He served as Director of the Ulsan Eco-Industrial Park (EIP) Center for 10 years (2004-2014), after which he became Director General for the South-East region of the EIP initiative, including the Ulsan EIP Center at the Korea Industrial Complex Corporation.

His research interests focus on developing R&D modules for industries situated in Ulsan EIPs, specifically looking at qualitative/quantitative recycling and management of resources and energy, and sustainable business opportunities for investors and stakeholders. He has been an invited speaker on EIP development and green growth at events in China, Japan, Thailand, India and the province of Taiwan, as well as for organizations such as UNIDO (Sanghai, May 2010, Tokyo 2011, Gwangzhou 2013) and the OECD (Paris, October 2010). He has consulting experience for the United Nations Economic and Social Commission for Asia and the Pacific (2009) and has worked on projects of the International Finance Corporation of the World BankGroup (Bangladesh 2012, Viet Nam 2016).

**Mr. Kim Byoung-jo, Deputy Director of Resource Recycling Division,
Ulsan Metropolitan City Government**

Mr. Kim Byoung-jo currently serves as the Deputy Director of the Resource Recycling Division of the Ulsan Metropolitan City Government. His career began at the Environmental Management Division of Ulju County in 1989, after which he worked in the Environmental Protection Division of the Health and Environment Bureau of Ulsan City, followed by a post in the Ulsan Branch of the Busan District Public Prosecutor's Office in 1997. From 1998, he served as Deputy Director of Environmental Monitoring Affairs of the Dong-gu District, Ulsan Metropolitan City. He has held several posts at the Green Environment Bureau of Ulsan Metropolitan City: from 2003 in the Environmental Management Division; from 2011 as Deputy Director of Green Growth Affairs; and from 2015 as Deputy Director of Resource Recycling Affairs. He holds a Master's degree from the Graduate School of Environmental Engineering at Busan University, Republic of Korea.





Mr. Etienne Kechichian, Senior Private Sector Development Specialist, World Bank Group

Mr. Etienne Kechichian leads the Climate Competitive Industries (CCI) work within the World Bank Group, which seeks to improve the competitiveness of manufacturing sectors through green and climate-friendly policies and investments. These policies may include energy efficient standards and labelling systems, green fiscal incentives, eco-industrial parks and climate-smart technologies. His CCI project engagements include Mauritania, Pakistan, Egypt, Jordan, Turkey, Viet Nam, Nigeria and Bangladesh. He has co-authored a handbook on developing low carbon zones, and is currently working on two publications related to the link between manufacturing competitiveness and climate change policies.



Prior to this work, Mr. Kechichian worked globally on special economic zones (SEZs) projects. These projects helped improve the legal and regulatory framework governing SEZs and generate private sector investment for their development, management and promotion. He holds a Bachelor's degree in Psychology and a Master's degree in International Relations from the University of Nice, France.

Mr. Zhang Hua, Deputy Director General, Weifang Binhai Economic Development Zone

Mr. Zhang Hua is the Deputy Director General of the Weifang Binhai Economic and Technological Development Zone, a post he holds since 2013. He is currently in charge of science, technology, intellectual property, foreign affairs, commerce, foreign investment and trade.



Mr. Zhang received his PhD in Chemistry from the University of California, Irvine. After completion of his degree, he served as the section member of the major project office for the Weifang Municipal Government. From 2010 to 2013, Mr. Zhang held the position of Vice-Director in the major projects office. During this period, he also obtained his Master's degree in Public Administration from Peking University.

Mr. Dong Tran Duy, General Director, Ministry of Planning and Investment

Mr. Dong Tran Duy is the Director General of the Department for Economic Zones Management of the Ministry of Planning and Investment, Viet Nam. He is a key member of the National Council for Industrial Park and Economic Zone Development and an advisor to the Minister in the fields of industrial zones, economic zone development, and foreign direct investment. He is currently working on promoting the institutionalization of eco-industrial parks in Viet Nam.



He is also the National Director for the project titled “Implementation of eco-industrial park initiative for sustainable industrial zones in Viet Nam”. Funded by the Global Environment Facility, the State Secretariat for Economic Affairs of Switzerland and UNIDO, the three-year project is being implemented since 2015. Mr. Dong Tran Duy holds a Master of Science degree with a major in Public Policy from Hoshihobashu University in Japan.

Mr. Bharat Jain, Member Secretary, Gujarat Cleaner Production Centre

Mr. Bharat Jain (PhD) has 40 years of experience in planning, designing and executing water supply, drainage, sewage treatment plants and common effluent treatment plants for industrial parks. He has dealt with pollution control schemes of industrial estates, environmental management schemes for industries, environmental impact assessments, selection and planning of industrial estates, and planning and design of infrastructure for industrial estates. At present, he is head of the Gujarat Cleaner Production Centre and has carried out cleaner production assessments in more than 100 industries, including chemicals, pharmaceuticals, paper, electroplating, fisheries, dairy and textiles.



He has published more than 50 papers in national and international journals. He has presented case studies on the successful implementation of cleaner production and the development and retrofitting of existing industrial estates into eco-industrial parks at various national and international forums. He is member of various technical committees of the Government of India and has contributed to the formation of national policies pertaining to financial assistance for cleaner production and clean technology. He has guided more than 50 students in their post-graduate dissertation and is an external faculty member of several engineering colleges. Mr. Bharat Jain (PhD) is a graduate in Civil Engineering with a post-graduate degree and a PhD in Environmental Engineering.



Ms. Michelle Zhao, Chairwoman and General Manager, Sino-Swiss Zhenjiang Eco- Industrial Park

Ms. Michelle Zhao is the Chairwoman of Jiangsu Scitury Allied Investment and Development Co., Ltd, a state-owned enterprise in China in charge of the overall management of the Sino-Swiss Zhenjiang Eco-Industrial Park.



She has six years of experience working as a government official in a state-level economic and development zone in China. Ms. Michelle Zhao also has abundant experience in the field of international cooperation, in particular relating to the sustainability of eco-industrial parks. She developed the International Solution Center for Eco-Problems and co-organized the Motor Efficient Pilot Project in 2015, and the UNIDO Resource Efficient and Cleaner Production pilot project in 2016. Ms. Zhao holds a Master's degree in Economics.

Green Industry and the Circular Economy: Opportunities for Sound/Innovative Chemicals Management in Cities

Chair

Mr. Stephan Sicars, Director, Department of Environment, UNIDO

For biography, please see page 34.

Speakers

Petra Schwager, Industrial Development Officer, Department of Environment, UNIDO

Petra has over 20 years of experience in developing and managing industrial resource efficiency and cleaner production programmes in developing countries and economies in transition. In her work, she cooperates with governments, the private sector, non-governmental organizations, and academia in advancing sustainable production patterns and policies. She continuously seeks innovative approaches and concepts to respond to the emerging needs of industry, in particular small and medium-sized enterprises, and provides strategic and technical advice on the upscaling and mainstreaming of resource efficiency.



In 2004, she initiated UNIDO's global activities for the promotion of Chemical Leasing, an innovative circular economy business model that shifts the focus from increasing the sales volume of chemicals to the function of a chemical. She heads the development of new approaches to environmentally sound management of chemicals and chemicals waste, green chemistry and sustainable industrial parks.

She was recently appointed as Team Leader for UNIDO's flagship initiative the Programme for Country Partnership for Peru, where she manages a multi-disciplinary team of UNIDO experts to develop a comprehensive and multi-stakeholder programme to support nation-wide efforts to drive productive diversification, in line with the principles of inclusive and sustainable industrial development.

Petra is the co-author of the book "Chemical Leasing goes global". She studied Economics at the Vienna University of Business Administration and Social Sciences.



Mr. Branko Dunjić, Director, National Cleaner Production Centre, Serbia

Mr. Branko Dunjić is Director of the National Cleaner Production Centre (NCPC) in Serbia. Since 2007, he has been managing the NCPC, established within the framework of a UNIDO-sponsored project. The Centre has successfully performed over 100 cleaner production assessments in companies, helping clients save an average of EUR 100,000 per year.



Mr. Dunjić has a PhD in Chemical Engineering with specialization in polymeric materials. During his career, he worked at the University of Belgrade teaching polymer chemistry, then joined Duga IBL where he worked as a research and development manager as well as a manager for one of the production units.

Ms. Anke Joas, Director, BiPRO GmbH, Germany

Ms. Anke Joas (PhD) is Director of BiPRO GmbH. For the last 10 years, Ms. Joas has been responsible for the management of persistent organic pollutants (POPs) and waste at BiPRO, and is head of the sustainability, environment and health departments. She is trained as a medical doctor and has over 20 years of professional work experience. She has been providing consultancy services in the areas of environment, health and sustainability since 1999.



Ms. Joas has long-term expertise in chemical risk assessment and risk management, waste prevention and sound waste management, and in sustainable development and the circular economy. She was a project leader for European projects in the fields of sustainability, health and environment, POPs, waste management, green economy and sustainable chemistry.

Currently, Ms. Joas is leading national and European level projects on sustainable chemistry, and the health impacts of environmental chemicals and pesticides. In addition, she is involved in several initiatives including Chemical Leasing; the Strategic Approach to International Chemicals Management; the Prior Informed Consent regulation; the Registration, Evaluation, Authorisation and Restriction of Chemicals regulation; and regulations on occupational health. Her focus is on policy decision-making, and her particular expertise includes training, awareness raising, risk assessment and risk management.

Mr. Marcos Alegre, Executive Director, National Cleaner Production Centre, Peru

Mr. Marcos Alegre is Executive Director of the National Cleaner Production Centre named Centro de Ecoeficiencia y Responsabilidad Social, administrated by Grupo GEA in Peru. Since 1998, he was responsible for Grupo GEA's small and medium- sized enterprise and sustainability projects. In 2008, he led one of the first Eco-Industrial Park initiatives in the biggest industrial zone in Peru, located in Callao port city. He is co-author of the book "Territories Eco-efficient. Callao's Eco-Industrial Park. 2010. CER/SECO". Currently, he is an environmental consultant for the Ministry of Production for the Industrial Park of Ancon in Lima city.



Mr. Alegre has experience as an independent consultant on environmental issues in Peru and other Latin American countries. He worked as a consultant for the World Bank, the Inter-American Development Bank, the United States Agency for International Development, the International Labour Organization and UNIDO, among others.

He was nominated by Supreme Decree as member of the Steering Committee of the Environmental Evaluation and Enforcement Entity (OEFA) for 2016 to 2020. OEFA is the public authority for environmental enforcement in Peru.

Mr. Alegre graduated as a Sanitary Engineer from the National University of Engineering, Peru, with a Master of Science in Water and Environmental Management from Loughborough University of Technology, United Kingdom. He was awarded by UNIDO as trainer on Cleaner Production in 2008.



Plenary 4: Towards a Green Industry Index

Chair

Mr. Rene Van Berkel, Chief Technical Advisor, Indonesia, UNIDO

Mr. Rene Van Berkel is the Chief Technical Advisor for UNIDO's Resource efficient and Cleaner Production (RECP) programme in Indonesia since June 2015. He supports national implementation partners and government counterparts to upscale and mainstream RECP through technical inputs for training, assessment, advocacy and policy development.



From 2008, he served as Chief of the Cleaner and Sustainable Production Unit at UNIDO. He provided oversight for the global RECP programme, guided the establishment and operation of the RECP network, and of the thematic work on eco-industrial parks and RECP methods and tools. He also designed and managed national RECP programmes in Albania, Indonesia and Myanmar and a regional RECP demonstration programme in the Eastern Partnership region of the European Union. He was also a key resource on green industry policy, low carbon and climate resilient industry, and corporate social responsibility.

Prior to joining UNIDO, he was an independent consultant in eco-efficiency, industrial ecology and sustainable technology. From 1999 to 2006 he was Australia's first full Professor of Cleaner Production at Curtin University of Technology, Perth. From 1989 to 1999, he held various research and leadership positions at the University of Amsterdam, the Netherlands. Mr. Rene Van Berkel is a Dutch national and holds a PhD in Environmental Science from the University of Amsterdam.

Speakers

Mr. Pan Haoran, Professor, Beijing Normal University, Green Industry Platform, China Project Management

Mr. Pan Haoran is a Professor of Economics at the School of Economics and Resource Management, Beijing Normal University, China. He specializes in the use of quantitative economic techniques to analyze environmental and resource issues, management and policy. His background is in statistics, econometrics, economic modelling and applied economics. His current research interests include integrated assessment modelling, green computable general equilibrium modelling, climate change, ocean management and green growth. He has extensive international experience in environment and resource-related projects, including through multidisciplinary collaborations. Mr. Pan has worked as a research economist in the Universities of Leuven, Cambridge and Portsmouth, and in China. He holds a PhD in Economics from Tilburg University, the Netherlands.



Plenary 4: Towards a Green Industry Index

Mr. Anthony Shun Fung Chiu, Professor of Industrial Systems Engineering, De La Salle University

Mr. Anthony Shun Fung Chiu is a JM Reyes Chair Professor and Research Fellow at De La Salle University, Manila. He has advised doctoral research works and published more than 160 papers, book chapters, and keynote documents in the field of sustainable consumption and production, resource efficient and cleaner production, and industrial ecology/eco-industrial development. He serves as member of the international expert committee of the United Nations Green Industry Platform, wherein his publications cover training manuals, policy action plans and industrial policies for the Asia-Pacific region. He was a Philippine delegate to the United Nations at the Rio+20 Summit, a delegate to the Asia-Pacific Roadmap on the 2030 Agenda and the Sustainable Development Goals, and a member of the Philippine National Pollution Adjudication Board.



Mr. Chiu also serves several international research entities as President (APRSCP, ISBITM, APIEMS) and Board Director (ISIE, IFPR). He is also an editorial board member (JCLP, JPIIE, JCIIE, PIE) of international journals and co-chairs the Philippine Industrial Engineering Certification Board. He is the first Philippine awardee of the American Society of Mechanical Engineers as outstanding international correspondent, and the first Philippine ASEAN Engineer in the field of Industrial Engineering from academia. Currently, he also serves as focal point for APEC Engineer.

Mr. Kiran Ananth, Senior Counsellor, Confederation of Indian Industry

Mr. Kiran Ananth leads the energy efficiency and climate change activities at the Confederation of Indian Industry Godrej Green Business Centre, India. He has over 16 years of experience in improving energy efficiency across various levels, company, sector and policy. He was instrumental in conceptualizing and implementing various programmes supported by international donors and development agencies. He delivered training programmes related to energy efficiency and climate change, and conducted several climate change mitigation and management studies for industries and governments. He also published several publications, manuals, case study booklets, etc. related to energy efficiency and climate change. Mr. Kiran Ananth is a member of various technical committees on energy efficiency and sustainability. He is trained as a mechanical engineer with a Master's degree in Energy Conservation and Management.





Mr. Lintong Sopandi Hutahaean, Head, Centre for Assessment and Development of Green Industry and Environment, Ministry of Industry, Indonesia

Ms. Jane Nyakang'o, Director, National Cleaner Production Centre, Kenya

Ms. Jane Nyakang'o (PhD) is Director of the Kenya National Cleaner Production Centre (KNPC) and the President elect of the African Roundtable on Sustainable Consumption and Production.

Ms. Nyakang'o is a trained environmental technology and policy practitioner with a combined 25 years of experience in green growth, particularly on environment, energy and climate change. Her latest projects in the field of green growth focus on: the circular economy; resource efficiency and industrial symbiosis, both from the technology and policy perspective, in Kenya as well as the African continent; waste management, water footprint, low-carbon and climate resilient development; and sustainable financing. Also trained in management, she is the founding and current Director of KNPC. Prior to this role, she was Head of the Energy and Environment Division of the Kenya Industrial Research and Development Institute.



Plenary 5: Science, Technology and Innovation for Sustainable Cities

Chair

Mr. Pranab Baruah, Senior Knowledge Manager, Global Green Growth Institute

Mr. Pranab Baruah (PhD) is Senior Knowledge Manager at the Knowledge Solutions Division of the Global Green Growth Institute (GGGI), Republic of Korea. Mr. Baruah contributes to GGGI's knowledge management and energy thematic area activities, and also serves as the Senior Research Manager at the Green Growth Knowledge Platform Secretariat in Geneva, Switzerland.



Mr. Baruah served in senior researcher and management roles at Oxford University, the University of Tokyo and a leading Japanese think tank, contributing to large multi-stakeholder projects on low-carbon cities, national energy and infrastructure transition, industrial energy efficiency, geoinformatics for forest management, and global carbon budget assessments. He has led joint collaborative research projects with industry and government, and advised corporations on carbon strategy development and supply chain carbon management.

Mr. Pranab holds a PhD in Engineering, an MBA in Renewable Energy and Carbon Management, and a professional license in Green Building Design and Construction (LEED AP BD+C). He is based at GGGI's Seoul Headquarters.

Speakers

Mr. Song Jae-ryoung, Team Leader, Research and Development Strategy and Policy Division, National Research Council of Science and Technology

Mr. Song Jae-ryoung is Team Leader at the Research and Development Strategy and Policy Division of the National Research Council of Science and Technology (NST). He was seconded from the Green Technology Centre, Korea to the NST to promote sustainable development in science and technology. His interests lie in research and development (R&D) and technology cooperation between the Republic of Korea and developing countries. For the last five years, his policy research has focused on official development assistance (ODA) and science and technology communication strategies. He also serves on the re-unification agenda for relatives to the R&D cooperation between South and North Korea. He is looking forward to working on practical projects together with UNIDO. He is studying for his doctorate on the effectiveness of science communication and public relations in science and technology and ODA at Sogang University in Korea.





Mr. Lee Tae-sung, Senior Manager, Small and Medium Business Corporation

Mr. Lee Tae-sung is Senior Manager at the Small and Medium Business Corporation (SBC), a non-profit, government-funded organization established to implement government policies and programmes that support the growth of Korean SMEs. He has held several senior positions at SBC, including as Head of the Green Business Promotion Office and Head of the Technical Development Support Team. He also worked for Hyundai as Assistant Manager for the Integrated Logistics Support Team, Hyundai Precision, and as part of the Domestic Plant Business Team, Hyundai Engineering and Construction.

Mr. Tae-sung is a member of the Green Growth Congregation of the Korea National Strategy Institute and an advisory board member of Green Growth Korea for Bucheon city. In 2011, he received the Achievement Award from the Ministry of Environment and, in 2010, the Achievement Award from Inno-Biz Korea. He holds a Bachelor's degree in Electrical Engineering from Inha University, Republic of Korea.

Ms. Irene Hofmeijer, Founder and Executive Director, Life Out Of Plastic

Ms. Irene Hofmeijer is the founder of Life Out Of Plastic (L.O.O.P), a women-led Peruvian social enterprise that inspires consumers to take actions that have positive environmental impacts through responsible consumption and citizen campaigns. Founded in 2011, L.O.O.P. has developed a local value chain for the recycling of PET bottles into polyester fiber. The sale of L.O.O.P. products and services raises funds for awareness campaigns that focus on the impacts of plastic pollution on marine ecosystems and that promote the use of alternative products to disposable plastics.



Before L.O.O.P, Ms. Hofmeijer was involved in environmental health research projects involving marginalized urban populations of Lima and indigenous communities of the Peruvian Amazon. In 2014, she took a sabbatical to work for Peru's Ministry of Environment as the Official Youth and Gender Liaison for the UNFCCC – COP20 presidency team. She holds a Bachelor degree in Environmental Science from McGill University, Canada, and is currently part of the Duke University Environmental Leadership Programme, expecting to graduate with a Master's degree in Environmental Management in May 2017. Irene is also an International Youth Foundation Global Laureate Fellow and a member of the Global Shapers Community, an initiative of the World Economic Forum.

Plenary 5: Science, Technology and Innovation for Sustainable Cities

Mr. Sanjay Banka, Executive Director, Banka BioLoo Pvt. Ltd.

Mr. Sanjay Banka is Managing Director of Banka BioLoo, India. He has worked in family business, start-ups, multinational corporations, and co-founded the company Banka BioLoo with his wife Namita Banka. He has extensive experience in humanitarian issues, primarily related to water and sanitation, including the provision of sustainable sanitation for schools. He is an expert on sustainable WaSH (water, sanitation and hygiene) and has participated in events such as the Sustainable WaSH Forum (Netherlands, 2014).



His company Banka BioLoo was selected for the 2015 cohort of the Global Social Benefit Institute (USA). He also represented Banka BioLoo at the United Nations Solutions Summit in September 2015, where the company was among 14 entities selected to present innovative solutions, out of 838 submissions from more than 100 countries. Namita Banka was also featured as a female entrepreneur success story on the Green Industry Platform in December 2014.

Mr. Banka is a prolific writer and speaker on sustainable sanitation. With an academic background in sciences, humanities, human rights, law and business management, he has a strong understanding of society, economy and policy, along with issues related to technology and sustainable development.

Mr. Charles G. Kwesiga, Executive Director, Uganda Industrial Research Institute (TBC)

Mr. Charles G. Kwesiga (PhD) is the Executive Director of Uganda Industrial Research Institute (UIRI). An Industrial Engineer by profession, Mr. Kwesiga has significant experience as a corporate manager, management consultant, educator and entrepreneur. As Executive Director at UIRI, he oversees activities that include: technology transfer and diffusion; process and product development; business incubation; contract engineering services and applied research and development. The Government of Uganda has twice awarded him medals for meritorious service, and he has received numerous honours from civic groups.



Mr. Kwesiga also serves as President of the World Association of Industrial and Technological Research Organizations, for which he was elected on a two-year term beginning January 2015. He is also Chairman of the Management Team of the Uganda Petroleum Institute, a Senior Presidential Advisor (on retainer) for scientific innovations, for the Government of Uganda, and a Member of the Board of Control of the Senior Command and Staff College (SCSC) of Uganda People's Defence Forces in Kimaka. He is also a member of the teaching staff at SCSC.

Mr. Kwesiga's holds a Bachelor's degree in Industrial Technology, and Master's and Doctorate degrees in Industrial Engineering (with a focus on manufacturing, production and inventory control, operations research, process design and control).



Mr. Serguei Golovanov, Chief Executive Officer, GOLEM IMS GMBH, Austria

Mr. Serguei Golovanov is Chief Executive Officer of GOLEM IMS GMBH, Austria, and Chief Architect of information and communication technology (ICT) innovation at Pharos Navigator. In this role, he focuses on novel concepts for the digital transformation of smart and future cities, urban services, smart enterprises, factories of the future, management of assets, and water, waste, energy, environment, and quality issues. The company is an active member of the European Innovation Partnership on Smart Cities and Communities, the Alliance for Internet of Things Innovation, and the Digital Agenda.



The UNIDO Pharos software suite has been implemented in industrial modernization and capacity-building projects across several countries under a long-term UNIDO-GOLEM contract beginning in 2000. Mr. Golovanov led these projects as a UNIDO international consultant, coach and trainer. He was an invited speaker at various international events and conferences in Europe, Africa, Asia, Latin America and the Middle East. Mr. Golovanov has in-depth experience in advanced systems sciences, design and modeling of complex cyber-physical systems, ICT architectures, measurements, metrology, and knowledge management. Prior to his work as an entrepreneur and technology leader, he was a researcher at the International Institute for Applied Systems Analysis studying sustainable development of the biosphere and climate change. Mr. Golovanov obtained his PhD from the Institute for Systems Studies of the Academy of Sciences, Russian Federation, and an advanced degree in Engineering from Moscow Aviation Technical University.

Closing remarks

Mr. Philippe Scholtès, Managing Director, Programme Development and Technical Cooperation, UNIDO

For biography, please see page 21.

Mr. Oh Gyu-taek, Deputy Mayor, Ulsan Metropolitan City

Mr. Oh Gyu-taek is the Deputy Mayor of Ulsan Metropolitan City. Prior to this role, he worked for the Central Officials Training Institute and the Strategy and Finance Committee of the National Assembly Assignment. In 2012, he worked for the Ministry of Education, Science and Technology, and was the Secretary-General of Gunsan University, and served on the Ministry of Strategy and Finance earlier that same year. In 2011, he held the post of Section Chief of the Defense Budget at the Administrative Budget Office. Mr. Oh Gyu-taek also served many years at the Ministry of Planning and Budget in various departments. He has a Master's degree in Public Administration from Birmingham University, United Kingdom. He also holds a Master's degree in Administration and a Bachelor's in Economics from Yonsei University, Republic of Korea.



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1. Introduction

Industry and cities share a symbiotic and mutually reinforcing relationship, and their interdependence is projected to increase in fast-growing economies. While cities are hubs of innovation, education and labour pools, industry represents an important driver for sustainable economic growth, job creation and increased productivity.

Industry has always played a key role in the development of urban and peri-urban areas and will continue to do so in the next decades, particularly in cities with lower income levels. The relevance of cities in the development debate has gained momentum in recent years, due to the global urban demographic boom and economic growth patterns often driven at the local level.

Today, more than half of the global population lives in urban areas and more than 80 per cent of global gross domestic product (GDP) is generated in cities. (UN DESA, 2014; UN HABITAT III, 2016c; UN, 2016). With the proper conditions and policies in place, cities and industry can act together as the main engine to alleviate poverty through inclusive growth and job creation, thus contributing to social well-being while addressing climate change and environmental degradation by making consumption and production patterns more sustainable. Indeed, significant imbalances between economic growth, job creation and environmental sustainability might arise, as only less than one in five cities¹ are able to outperform their national economies on all three measures (World Bank, 2015). Therefore, tackling these challenges through an integrated approach such as UNIDO's inclusive and sustainable industrial development (ISID) is crucial.

UNIDO's organizational mandate to achieve ISID was adopted by its Member States in December 2013 through the Lima Declaration. It is defined as follows: "Inclusive" in this context means that industrial development must include all countries and all peoples, as well as the private sector, civil society organizations, multinational development institutions, and all parts of the UN system, and offer equal opportunities and an equitable distribution of the benefits of industrialization to all stakeholders. The term "sustainable" addresses the need to decouple the prosperity generated from industrial activities from excessive natural resource use and negative environmental impacts" (UNIDO, 2016a). Furthermore, Green Industry is a critical component of ISID, and identifies concrete initiatives and approaches that contribute to the sustainability of UNIDO's industrial development programmes.

Addressing the aforementioned issues, UNIDO's fourth Green Industry Conference (GIC) seeks to build on the outcomes of the previous conferences which provided a pathway for diffusing knowledge and promoting and upscaling green industry practices at a global level. The first conference was held in 2009 in Manila, Philippines where the Manila Declaration on Green Industry in Asia was endorsed. The Declaration outlined the steps needed to reduce the resource intensity and greenhouse gas (GHG) emissions of industries in Asia and track progress towards a low-carbon industrial future. In 2011 and 2013, the second

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and third conferences followed in Tokyo, Japan and Guangzhou, China respectively. During these two conferences, concrete examples of the application of Green Industry concepts to manufacturing processes were showcased and participants discussed ways to upscale and mainstream Green Industry policies, methods and techniques (UNIDO, n.d.).

Titled “Green Industry for Sustainable Cities”, the fourth GIC will bring together around 300 representatives from local and national governments, industry, academia and civil society to explore the interdependence of industry and cities in the context of resource efficiency, green technology and eco-innovation. This conference, to be held from 28 to 30 June in Ulsan, Republic of Korea, is jointly organized by the Ulsan Metropolitan City and UNIDO, with the support of the Republic of Korea’s Ministry of Trade, Industry and Energy, Ministry of Foreign Affairs, the Korea Energy Agency, the Korea Institute for Industrial Economics and Trade, the Korean Small and Medium Business Administration, the Korean National Research Council of Science and Technology, and the China Energy Conservation and Environmental Protection Group.

The conference will address issues that will contribute to the achievement of the Sustainable Development Goals (SDGs). Although the topic of Green Industry has implications on virtually all aspects of the 2030 Agenda, the conference will underline the direct contribution of Green Industry and sustainable cities to SDG 7 (“Ensure access to affordable, reliable, sustainable and modern energy for all”), SDG9 (“Build resilient infrastructure, promoting inclusive and sustainable industrialization and foster innovation”), SDG 11 (“Make cities and human settlements inclusive, safe, resilient and sustainable”) and SDG 12 (“Make production and consumption patterns more sustainable”).

In addition, the fourth GIC will discuss the crucial contribution of industrialization to the achievement of the goal of sustainable urban development, which will be promoted at the United Nations Conference on Housing and Sustainable Urban Development (HABITAT III) in Quito, to be held from 17 to 20 October 2016. The HABITAT III conference is being convened by the United Nations General Assembly to reinvigorate the global commitment to sustainable urbanization and focus on the implementation of a New Urban Agenda, building on the Habitat Agenda of Istanbul in 1996. HABITAT III will be among the first United Nations global summits after the adoption of the SDGs, and thus represents a major opportunity to capitalize on the momentum of the 2030 Agenda and to elaborate a New Urban Agenda with a robust multilateral framework to guide sustainable urbanization priorities and actions to come (UN HABITAT III, 2016a).

¹ Based on a database from Oxford Economics with a total of 750 cities.

2. The green and sustainable triangle

Urbanization, industry and the SDGs are deeply interrelated with sustainable cities. Figure 1 depicts the link between these components.

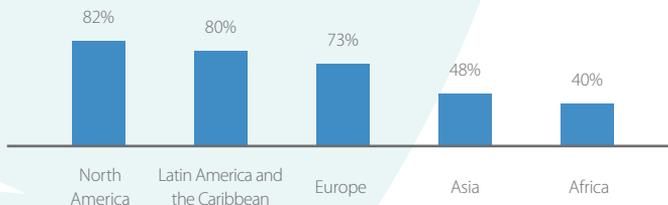
Figure 1: Interdependent, indispensable components for green and sustainable cities



Urbanization plays a crucial role in national and global agendas for sustainable development and industrialization. As a matter of fact, cities can be thought of as units of analysis and implementation of the SDGs. On the one hand, a widespread urbanization process is expected, particularly in developing countries—54 per cent of the global population lived in urban areas in 2014 and is expected to increase to 66 per cent by 2050 (UN DESA, 2014). On the other hand, the majority of current economic growth, industrial production and development efforts are concentrated in suburban and urban areas. The rapid pace of urbanization especially affects developing countries as 95 per cent of all urban expansion will occur there in the decades to come (UN, 2016). This will have far-reaching implications on the sustainable production and consumption of manufactured goods.

From a regional perspective, North America, Latin America and the Caribbean, and Europe represent the most urbanized regions, followed by Africa and Asia (see Figure 2).

Figure 2: Percentage of total population living in urban areas, 2014



Source: UN (2016).

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There is a wide diversity in the administrative boundaries that define a city. For example, in many parts of Asia, such as Indonesia and China, the known administrative regions include very large rural areas. Even in the case of Karawang in West Java, a city that is home to more than 20 industrial parks, including the single largest in South East Asia, the municipal region includes a land area that is still roughly 70 per cent agricultural. While these figures are likely to change in a rapidly urbanizing and industrializing world, the complexity of urban economic structure and administrative scope calls for a comprehensive approach to urban development.

The strong growth of urban areas can bring a wide range of advantages for industrial and national development, as cities often show higher diversity, knowledge spillovers, income, productivity and economic growth than rural areas, and they are able to use infrastructure more efficiently. Moreover, densely-populated urban environments exhibit considerable potential for maximizing the benefits of agglomeration economies. In this regard, suburban or semi-urban conurbations may offer rich potential for exploiting economies of scale through industrial business parks and special economic zones. Such spatial configurations allow for an enabling environment for multi-sector partnerships among industry, research institutes and governmental organizations, thus leveraging a broad range of expertise, resources and synergies for research, increased productivity and ultimately, greater economic growth. The World Bank Group (2015) confirms in their report on the competitiveness of cities that 72 per cent of cities in the Oxford Economics database (a total of 750 cities) outperformed their countries in terms of productivity in 2012, whereas production centres and market towns experienced the fastest growth.

Nevertheless, if rapid and unregulated urban growth takes place, combined with weak institutional arrangements and urban planning, serious challenges will arise for the population, the environment and ultimately the economy - as they have in the past. The industrial sector bears particular responsibility as it is a key resource user and contributor to pollution, waste and GHG emissions (UNIDO, n.d.a). Hence, there is an urgent need for cities to be at the forefront of the circular economy. As a result of their scale and proximity, cities are crucial in driving this process. First, between incoming and outgoing flows of materials, a process of accumulation takes place at the urban level whereby cities offer a scale of supply large enough to create valuable collection and recovery opportunities. Secondly, cities provide far-reaching opportunities for innovation and the adoption of green technologies, as they offer both a highly skilled workforce and an advanced market. Thirdly, cities offer greater proximity between stakeholders, be they citizens, retailers or service providers. This provides a key enabler for the development of new business models relying on services and more collaborative approaches.



In this regard, the greening of industry and cities needs to be taken as a serious and urgent task. Green Industry, which represents a crucial thematic component of UNIDO's ISID mandate, focuses on the potential of industries to decouple economic growth from increasing resource consumption and is key to making industries in cities greener, healthier as well as more sustainable and inclusive (Figure 3).

Figure 3: Progress towards green and sustainable cities



The decoupling of environmental impacts from economic growth is key to reconciling manufacturing growth with a green economy. UNIDO defines a green industrial policy as an industrial policy that is meant to trigger and facilitate structural changes as entailed, or required, both to respond to environmental conditions or situations, and to develop a green, circular economy (PAGE, 2016). It is meant to embed the manufacturing industry in a green economy concept.

In recent years, sluggish rates of economic growth and increased unemployment, especially among vulnerable groups such as young people and women, have renewed a demand for industrial productivity and policies in developed countries. This is evidenced by recognition of the value of reindustrialization for economic growth and shared prosperity by governments of several developed countries or regional integration organizations in recent years, including those of the United States, Japan and the European Union.

The “new industrial revolution” offers strong potential to protect the environment and increase resource efficiency, productivity and effectiveness in industry and cities. Due to the additional knowledge, skills and innovative tools brought along, new industrialization programmes support the achievement of smart and green industry, cities and the goals of the 2030 Agenda.

3. The green and sustainable way for industry and cities

3.1. The role of industry in driving urbanization

Industry and cities share strong interlinkages since urbanization has historically provided the catalyst for the transition from predominantly agricultural societies exhibiting low levels of value addition to modern industrial societies. The first structural transformation towards manufacturing was accompanied by less land-intensive needs and a distinct tendency of clustering of economic activities in urban contexts. Even from the early stages of industrialization, these clustering tendencies and urbanization steps were key for manufacturing firms to benefit from knowledge spillovers, shared inputs, easier quality control, efficiency, lower transaction costs and centralization of specialized skills. Another consequence of the first structural transformation and growing urbanization was that people followed jobs in the cities: in some circumstances, rural-urban migration was even enforced by law. In turn, when manufacturing firms mature or operate in the low-tech sector, where they are becoming less dependent on the benefits of cities, they tend to suburbanize rather than ruralize (UNIDO, 2013a). Urbanization has historically spurred productivity advances through industrialization, something which is equally true of developed and developing countries (IIP, 2015). Moreover, the urbanization and industrialization of society brought along lower poverty rates in the long-term and lower shares of populations living in slums than cities relying on non-tradable services in resource exporting countries (Gollin, Jedwab and Vollrath, 2016).

3.2. Why industrialization still matters in cities

As in the past, growth, urbanization and higher levels of development are strongly correlated whereas rapid industrialization has been and continues to be the main driver of income and job creation (UN HABITAT, 2016 and UNIDO, 2011a). UNIDO estimates that manufacturing provided more than half a billion jobs in 2010. Around 200 million formal jobs were created worldwide in 2010, while every one job in manufacturing generates 2.2 jobs in other sectors because of industrialization's job multiplier effect (UNIDO, 2013a). Considering that urban growth will take place mainly in emerging and developing countries, industry plays a key role for making cities more inclusive.

Industrialization has an especially high significance in cities of developing and emerging countries with lower income levels because it tends to act as a trigger for the transformation of market towns into production centres. On the other hand, cities of higher income levels (above GDP per capita of USD 20,000) tend to move away from industry towards financial services. Another element supporting the case for a prominent role of industry in cities is that urban value addition is expected to rise from 27 per cent in 2010 to 29 per cent in 2030 in the 770 biggest cities, while cities currently account for 80 per cent of the global GDP (UN HABITAT III, 2016b; IIP 2015).



3.3. The urgent need for green industry and sustainable cities

The benefits of industrialization and urbanization have been described so far. Undeniably, in the absence of integrated sustainable approaches, industry and cities are also majorly responsible for environmental degradation, often with serious threats to human health. The list below highlights some of the most evident negative effects of bad urban industrial practices:

- Cities are responsible for nearly three quarters of global energy use, more than 70 per cent of global energy-related carbon dioxide emissions, more than 60 to 80 per cent of global material consumption and an enormous ecological footprint (IIP, 2015; UN HABITAT III, 2015; Greenhouse Gas Protocol n.d. and UNEP, 2012).
- The water footprint of cities covers 41 per cent of the earth's surface, although urban areas cover only 2 per cent of the global land surface (McDonald, 2014 in HABITAT III, 2015).
- Industrial growth, urbanization and the increasing use of synthetic organic substances create serious impacts on the environment: de-oxygenated dead zones are growing rapidly in the seas and oceans since an estimated 90 per cent of all wastewater in developing countries is discharged untreated directly into waters where it pollutes the usable water supply. Around 245,000 kms of marine ecosystems are also affected with impacts on fisheries, livelihoods and the food chain (Corcoran et al., 2010).
- Urban waste quantities in developing countries are growing rapidly due to urban population growth. A focus on waste and resource management has the potential to achieve perhaps 15 to 20 per cent short-term mitigation of climate change (UNEP, 2015). Furthermore, using recycled steel is associated with 60 to 70 per cent lower overall energy consumption, aluminum with 95 per cent, paper 65 per cent and plastics from 80 to 88 per cent respectively (UNIDO, 2011a).
- Industry accounts for nearly one-third of the world's total energy consumption (IEA WEO, 2014 in UNIDO, n.d.c).
- Between 2010 and 2030, the final industrial energy demand is projected to increase by anywhere from 1.6 billion tons of oil equivalent (Btoe) to 4.3 Btoe per year globally in a baseline scenario, principally due to elevating demands of emerging economies of Asia, and to a lesser extent in the Middle East and Africa (IIP, 2015).
- The reliance on fossil fuels, particularly coal, and higher energy use has resulted in increased air pollution (IIP, 2015). More than 80 per cent of people living in urban areas are exposed to air quality levels that exceed the World Health Organization limits, often exasperated by motorized transport and traffic congestions (WHO, n.d.).
- Global chemical output (produced and shipped) has increased from USD 171 billion in the year 1970, to over USD 4 trillion in 2013 (UNEP, 2013b).

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- Contaminated water from inadequate industrial wastewater management provides one of the greatest challenges. It restricts development and increases poverty through costs to health care and lost labour productivity. Around 1 in 10 people lack access to safe water supply, 1 in 3 lack access to basic sanitation service, and at least 1.8 million children under the age of five die yearly due to water-related disease. Flooding and stagnant rainwater create conditions for mosquitoes and the incidence of water-related diseases, such as dengue, diarrhea and leptospirosis, is increasing in developing countries (WHO and UNICEF, 2015).

These figures represent only a part of the whole picture. They call for urgent preventive and mitigation measures and ultimately a green, inclusive and sustainable approach. Developing countries are affected by these developments due to the relocation of global industrial production since the 1990s, especially in China and India (UNIDO, 2011a). Green Industry makes methods of production more sustainable, improves resource productivity significantly and at the same time reduces GHG emissions. Key components of this green approach include:

- Dematerializing products (developing new products that require less resources);
- Increasing process efficiency (by reducing the intensity of energy, materials, and water usage in the production process);
- Minimizing process emissions (through adopting clean technologies);
- Achieving sound chemicals management (by substituting hazardous chemicals with less risky substances, lowering chemical consumption and chemical waste, and reducing risks from chemicals-related accidents);
- Changing business practices in urban areas (for example by switching from traditional to new business models such as Smart Public Lighting, Chemical Leasing, Car Sharing, etc.);
- Switching to low-carbon inputs (using renewable and other clean sources of energy and materials); and
- Closing the material loop through recovering materials for reuse as feedstock for energy and input materials.

However, cities in developed and developing countries can differ markedly in their capacity to deliver this green transition, especially with regard to technology, science and capacity for real time data production and analysis. The transition to green technologies and the creation of new green industries, particularly in the urban and peri-urban context, is a priority in both developed and developing countries (UNIDO, 2011a). Green industrialization itself further needs to become an integral part of sustainable city planning and to be realized in tandem with income and job creation, to secure net contributions to poverty alleviation (UNIDO, 2011a; UNIDO, n.d.a). Success factors, such as the socio-economics of the urban divide, the inclusion of bottom-up participatory governance, infrastructure change programmes, smart urban logistics and spatial planning, smart design, finance, technology, skills transfer and development, and innovation, all have implications for the transition to sustainable, resource efficient urban development (UNEP, 2012).



3.4. Lessons learned from smart, sustainable and resource efficient cities

A lack of adequate planning accompanied by weak national, regional and local institutional frameworks has frequently resulted in inadequate municipal provision of infrastructure, spatial planning and social capital, which can in turn beget social and environmental degradation. In addition, the lack of capacity to provide necessary educational programmes, limited application of appropriate technologies and poor infrastructure are further hurdles for inclusive and sustainable urban growth and industrialization. UN HABITAT has identified seven main impediments to urban prosperity: poor governance and weak institutions; corruption; inadequate infrastructure; high incidence of slums and poverty; high costs of doing business; poorly developed human capital; and high crime rates (UN HABITAT, 2012). These challenges call for sustainable green city development, sound industrialization planning and smart policymaking.

The better cities are managed, the more they possess technical, institutional and financial capacity to control social and environmental costs - and the better cities are connected, the better they can provide basic infrastructure at lower costs and with greater reliability. For example, the sound management of chemicals in cities, throughout their entire life cycle, is crucial to prevent negative impacts via discharges, emissions, accidents or incomplete end-of-life treatment. The acquisition and transfer of appropriate technologies is a pillar for achieving inclusive and sustainable industrial development in cities. These technologies can drastically reduce energy use and pollution by increasing industrial energy efficiency and improving cleaner production and waste management performances in industry and cities (IIP, 2015 and UN, 2016).

"Resource efficiency is a key driver of success that promotes sustainable consumption and production (SCP), facilitates a transition to a green economy and thus contributes to achieving global sustainable development. In cities, resource efficiency enhances the quality of life in urban areas by minimizing resource extraction, energy consumption and waste generation and while simultaneously safeguarding ecosystem services" (UNEP, n.d., p. 2).

Resource efficiency is thus a major component for the greening of cities, as seen in the examples below. In order to achieve more sustainable cities, a concerted policy emphasis on smart growth and climate approaches is a prerequisite. Here, information and communication technology (ICT) has an enormous potential to contribute to urban industrial development and to convert agglomerations into smart and sustainable cities (UN HABITATI II, 2016b). "*A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, cultural and environmental aspects*" (UNESCO, 2015, p.3). These smart and sustainable cities need to include the following key dimensions: ICT, environmental sustainability, productivity, quality of life, equity and social inclusion, and physical infrastructure (ITU-T, 2015). Smart city projects comprise all aspects of urban life – they require ecological sustainability through renewable energies, efficient architectures and smart traffic infrastructure.

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Furthermore, investments not only in infrastructure and transport, but also in green technologies are required to empower cities' development. "The development of sustainable cities requires integrated interventions in sustainable planning, sustainable investment and sustainable technologies." (UNIDO, n.d.a, p. 5). Especially in developing countries, basic infrastructure, such as roads, ICT, sanitation, electrical power and water, remains scarce. About 2.6 billion people in the developing world face difficulties in accessing electricity on a regular basis, 2.5 billion people worldwide lack access to basic sanitation, almost 800 million people lack access to water and 1 to 1.5 billion people are without access to reliable phone services. Undeveloped infrastructure limits not only access to health care and education, but also access to markets, jobs, information and training (UN, 2016). As investments in infrastructure and technology imply significant up-front expenses and resources, which developing countries are often not able to cover, the transfer of technology, knowledge and expertise is crucial (UNIDO, 2013b).

An example of such good practices is the Korean city of Ulsan - the host of this year's Green Industry Conference. Located in the South Eastern region of the country, and the industrial capital of the Republic of Korea, Ulsan provides a positive example of industrial modernization and greening over a sustained period of time. Of particular interest is the city's eco-industrial park (EIP) project, aimed at adopting an industrial symbiosis approach for Ulsan (Park et al., 2008). The Ulsan EIP centre was established in 2007 and has played a crucial role in implementing a more convenient and user-friendly symbiosis in the national industrial complex (Behera et al., 2012).

Another example of brownfield inclusive and sustainable industrial development in the urban context is the city of Shenyang, a large industrial city in North Eastern China. Shenyang offers a successful example of a heavy polluted industrial city which has made considerable strides with regard to sustainability (see Box 1). Effective brownfield redevelopment took place by moving heavy polluting industries into the suburbs to newer facilities with desulfurization equipment and by revitalizing former urban industrial districts, accompanied by an urban green space increase of 30 per cent from 2005 to 2007 (Ross, 2003 and Woetzel, 2011).

Another often cited example of a successful eco-city with a green industry strategy at its core is Tianjin, the third largest city in China with a population of around 11.76 million (UNEP, 2012). Despite the many good practice elements in Tianjin, however, a serious accident in August 2015 also revealed major shortcomings in industrial safety and residential building planning. Indeed, a stronger safety and environmental framework would have helped to prevent or at least mitigate the scale of the accident. This tragic example shows the crucial importance of integrated urban planning, encompassing residential, industrial and infrastructure arrangements, to facilitate economic activity, reduce displacement time and minimize safety risks and pollution.



Box 1: Shenyang: An industrial city turns green

Shenyang is an industrial city with a population of about 8 million people, located in Northeast China. It has been for many years an industrial hub within China and has suffered from environmental degradation in previous decades. Through several initiatives, the city is now focusing on a more environmentally-friendly policy approach through the expansion of green spaces and adaption of environmental policies.

“Turning Green” is an environmental urban planning project focused on transforming Shenyang into a more sustainable city to live and work in. Within the scope of the project, Shenyang has followed the example of smaller cities by devoting higher priority to the use of buses and improving the reliability of public transport services by decreasing delays.

Moreover, Shenyang has decreased its dependence on fossil fuels since 2010 by substituting usage of coal heating with natural gas in many residential areas. Urban green spaces have also been created over the past two years, increasing by an estimated 30 per cent.

In recent years, Shenyang has also been at the centre of a significant number of European Union (EU)-funded projects focusing on technical cooperation with China, emphasizing sustainability. The main collaboration in this regard is the Shenyang Urban Planning Project (SUPP), which assists the Government of Shenyang in promoting integrated planning and coordination of urban design policies for sustainable development.

The project aims not only at safeguarding the environment and improving the quality of life in Shenyang, but also supports initiatives in industrial regeneration, development of project marketing, air quality and energy efficiency in the urbanization process. To this end, there have been several themes established for urban development planning throughout the project cycle, such as:

- Establishing an integrated planning process through cooperation of relevant agencies;
- Forming an urban management approach to support sustainable urban development;
- Encouraging close cooperation between the private and the public sector to enable the utilization of appropriate resources for financing urban development and infrastructure;
- Recycling land and properties by restoring degraded land;
- Maintaining the basic needs of infrastructure through affordable household prices;

- Providing easily accessible and usable streets and spaces that meet social and economic needs; and
- Developing programmes for the improvement of existing investments and maintaining an affordable level of housing.

The SUPP project is highly relevant for the enforcement of planning processes and has witnessed a highly effective and successful collaboration between the EU and China in terms of social, economic and environmental sustainability. Shenyang thus represents an exemplar of Green Industry and sustainable urban development coming together.

3.5. New industrial revolution: making cities even greener and smarter

The accelerated technological advancement and digitalization in industrial production will revolutionize the way goods and services are produced. This “new industrial revolution”² has great potential to contribute significantly to the green, resource efficient and sustainable development of cities, especially in developing and emerging countries. The revolution is based on Cyber-physical Systems, the Internet of Things and Services as well as cloud computing and can be seen as the increasing digitization of production. Future production, logistics and work processes will be changing further as a consequence of the interconnectedness of humans, machines and resources. Progress in innovations, such as open/big data, virtual augmented reality, additive manufacturing, robotics, new materials, sensor technology and real time data, are outcomes of this revolution and imply a significant potential to produce further system innovation, new business models and to increase the flexibility, resource efficiency, productivity, interconnectivity and individualization of products.

Improvements such as cleaner production processes, less material consumption and higher energy efficiency in particular, are considerably boosted through new sensor technologies, high precision control and real time information (e.g. data on material and energy flows) (Acatech, 2015; G20, 2016; Müller and Schiappacasse, 2014 and GIZ, 2014). Recent studies (McKinsey, 2011 and Accenture, 2015) suggest that well-performing circular economy business models and the optimization of resource productivity could generate potential savings of around USD 3 to 4 trillion by 2030. As the new technologies enable the production of not only cleaner but also smaller lots and more specialized products in just-in-sequence supply designed to customer needs, there are less storage requirements. This in turn brings along important consequences for the allocation of factories as they can be better integrated in cities without jeopardizing ecological health. Intelligent infrastructure is another result of the current revolution and contributes to urban and industrial development substantially. Intelligent

² “New industrial revolution” is the designation used, inter alia, by the G20. Other definitions for the same phenomenon range from “Industrie 4.0” used in Germany, to “Industria Conectada 4.0” referred to in Spain, just to name a few.



infrastructure not only connects people to people, but also people to city systems and city systems to each other. This leads to high flexibility and adaption to changing circumstances because of real time data. Smart transport systems can additionally inform road users with real time information on traffic problems to avoid congestion (UNEP, 2011). Smart grids are also part of smart infrastructure and are defined as *“an electricity network that uses digital and other advanced technologies to monitor and manage transport of electricity from all generation sources to meet the varying electricity demands of end-users.”* (IEA 2011, p.6).

Box 2: Advanced manufacturing in Bangalore

Bangalore is the third largest city of India with an estimated population of 10.2 million people. Apart from having national science, management and research institutes, the city established also several engineering colleges and industrial training institutes, supporting an excellent workforce. Bangalore is the so-called “Silicon Valley of India” and also home to an increasingly advanced manufacturing industry. Aeronautics, heavy industries, automotive, small- scale space technology and biotechnology industries are mostly based within various special economic zones in Bangalore. Other important existing industrial clusters in Bangalore are machine tools, power looms, electronic goods, ready-made garments, light engineering and leather products.

Bangalore’s preconditions for advanced manufacturing are due to its highly skilled workforce and technology as well as its availability of telecommunication infrastructure, information technology parks, government policies, specialized services, and the link between industry and research institutions. Nevertheless, Bangalore needs to urgently address the challenges of its roadway infrastructure, implement high quality public transport, and strengthen reliable water and power supplies to pave the way for the new industrial revolution.

Source: Müller and Herzog (2015)

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Despite all these benefits, the implementation of the new industrial revolution is not feasible in every city. Some preconditions need to be fulfilled (See Box 2):

1. ICT can improve urban development through high quality public spaces, well connected grids, well designed density, increased resource efficiency, growth with reduced carbon emissions, knowledge creation, and management that addresses needs and risks (UN HABITAT III, 2016b). ICT can be the entry point for the new industrial revolution, especially for developing countries.

2. Appropriate economic and urban frameworks are required including:

- The availability of raw materials, skilled labour as well as training institutes;
- Sufficient land for setting up advanced manufacturing plants;
- Reliable water and electricity supply and well connected, unclogged transportation networks for people and goods (including mass rapid transport systems);
- The capacity to manage complex systems as well as available standardization and reference architecture; and
- Regulatory frameworks and government policies to support these developments (*Mueller and Herzog 2015, Kagermann, H., Wahlster, W. and Helbig, J., 2013 and Acatech 2015*).

In order to be able to analyze the existing potential and expected benefits of this new revolution, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ, the German Federal Enterprise for International Cooperation) recommends developing an “Industry 4.0 Readiness Assessment Toolbox”. Furthermore, the success of the new industrial revolution depends highly on appropriate framework conditions and smart (urban) planning (GIZ, 2014; Müller and Herzog, 2015). Although the advances of this revolution take place primarily in industrialized countries, emerging and developing countries follow suit. For example, the United States and Europe are the current industry leaders in manufacturing, but as patents for many additive technologies will expire over the next five to ten years, China is already heavily investing in this technology aiming to become a key player as soon as the existing patents expire (IDA, 2012, in UNIDO, 2013b).



4. UNIDO's approach and future perspectives for Green Industry and sustainable cities

Because of its longstanding experience as a United Nations specialized agency assisting countries towards inclusive and sustainable industrialization, and the Organization's associated Green Industry initiatives, UNIDO contributes significantly to sustainable industrial and urban development globally. The Green Industry initiative was launched in 2009 during the first international Green Industry Conference in Manila, Philippines. This initiative focuses on enabling developing countries to achieve equitable economic growth without harming the environment and the climate, by creating conditions that allow industries to reduce pollution and resource use significantly, while continuing to provide goods and decent employment (UNIDO, 2011a). Apart from providing services and expertise to promote sustainable patterns of production, UNIDO further helps developing countries in obtaining clean technology transfer, and implementing environmentally sound policies and environmental agreements (UNIDO, n.d.b).

In its 50 years of existence, UNIDO has been able to identify various solutions to make industries in cities and countries greener and more sustainable. In the following section, some of UNIDO's valuable contributions to greening industry and urbanization are presented - including four major concepts, namely smart and sustainable cities, circular economy, eco-industrial parks and Green Industry indicators, followed by several key elements of Green Industry (renewable energy, low-carbon transport, green entrepreneurship and sound chemicals management). These key elements are also included in the concepts of smart and sustainable cities, circular economies and eco-industrial parks.

4.1. Smart, sustainable and green cities

UNIDO contributes to global action towards sustainable cities through four principal development interventions: enabling policy and institutional mechanisms; innovation and technology demonstration; facilitating investments and partnerships; and knowledge management. Thematically, the key areas of interventions include promoting climate resilient industries hosted by cities, promoting climate smart city services, and developing sustainable value chains of products for cities. Industrial energy efficiency, renewable energy, green supply chains, energy management systems (including ISO 50001), low-emission technologies and transport, smart waste refineries and smart mini-grids, new energy vehicles, sustainable building materials and clean fuels are at the core of UNIDO's actions towards green and sustainable cities. As the new industrial revolution provides crucial technologies for making cities even smarter and more sustainable, UNIDO supports developing countries in technology transfer, the development of new innovations, and capacity-building for required skills and knowledge.

Currently, UNIDO is involved as an implementing agency of the Global Environment Facility's Sustainable Cities Integrated Approach Pilot (SC-IAP), with specific projects in Cote D'Ivoire, India, Malaysia and Senegal. SC-IAP supports cities in developing action plans and realizing innovative demonstration projects towards becoming sustainable and resource efficient. SC-IAP helps cities to address the challenges of urbanization and environmental degradation through better integrated models of urban design, planning and implementation. Local action will be strengthened while promoting coordinated national, regional and global partnerships to combine forces (UNIDO, n.d.a).

One of these projects is realized in Melaka, Malaysia, with the aim to promote an integrated approach to urban policymaking and management, guided by an evidence-based, multi-dimensional and broadly inclusive planning process that balances economic, social and environmental resource considerations. Furthermore, the project builds awareness and institutional capacity, and promotes investment in climate risk mitigation technologies through demonstration projects. As 73 per cent of Malaysia's population lives in urban areas (2012 figures), the country faces both challenges and opportunities. The main barriers include a lack of suitable policy, regulations and incentive programmes to encourage investment in smart cities, a lack of information on the preconditions for sustainable cities, limited capacity to introduce these technologies and measures, and a lack of necessary supporting infrastructure. UNIDO will help the country to overcome these challenges by supporting the development of national urban policy frameworks, improved planning and management in Melaka city, greater investment in urban management modalities, and increased knowledge and partnerships on sustainable cities (UNIDO, n.d.a).

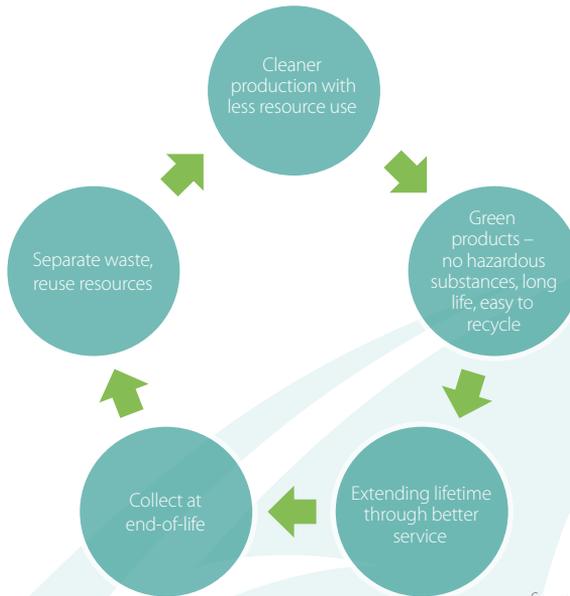
4.2. Circular economy

Declining natural resources as well as approximately 65 billion tons of raw materials entering the economic system in 2010, with an expected rise up 82 billion tons in 2020, are making the linear model of resource consumption and the "take-make-dispose" pattern unsustainable. In contrast, circular economy is an economic and industrial model that is restorative and regenerative by design. Taking a new systemic perspective, it replaces the concept of waste with the one of restoration and aims to decouple economic growth from the use of virgin resources.

"A circular economy is an industrial system that is restorative or regenerative by intention and design. (...) It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models" (Ellen MacArthur Foundation 2013, p. 7).



Figure 4: The circular economy



Source: UNIDO

UNIDO promotes and supports the concept of transforming industries into contributors to the circular economy through process optimization measures of resource circularity as well as end-of-pipe solutions. This will ultimately diminish pollution or waste by re-using resources or ensuring their safe re-absorption by the environment (Sicars, 2016) (See Figure 4). Recycling and reducing resources can not only bring along benefits for the environment, but they are also cost effective and more independent of resource price volatilities, imports and fluctuating market volumes (UNIDO, 2016b). As such, a circular economy can help businesses save material costs and reach new markets, improve customer relationships and hedge supply risks. For cities, the circular economy can offer a coherent framework for creating resilient economies in healthy environments, and provide a source of innovation and entrepreneurship while enabling the creation of local employment. Nevertheless, challenges in circular economies still remain as resource efficient design, manufacturing, and remanufacturing are knowledge-intensive and need suitable and cost-effective technology providers close to the markets. Therefore, there is merit in exploring how to implement the concept of a circular economy most effectively: through a conducive policy environment, knowledge and technology transfer, and financing and innovative business models, where UNIDO has already showed successful work (UNIDO, 2016b).

4.3. Eco-industrial parks

Eco-industrial parks (EIPs) are crucial for cities' industrial zones, sustainable and green job creation as well as goods and service delivery. As such, industrial parks are the drivers of industrialization and prosperity and can foster rapid economic development, the transfer and adaptation of technologies, and the creation of knowledge and skills. When industrial parks are matched with higher standards of environmental and social responsibility, the application of resource efficient production methods as well as the reuse of waste energy and waste materials, they can evolve into eco-industrial parks. As per its definition, an eco-industrial park *"...is a community of manufacturing and service businesses located on common property. Members seek enhanced environmental, economic and social performance through collaboration in managing environmental and resource issues and, thus, engaging into an industrial symbiosis."* (Lowe n.d., p. 2) Some EIPs have already adapted industrial synergies fostering business relations for by-product exchange among companies, while also introducing principles of resource circularity as a combination of end-of-pipe solutions and process optimization. These measures allow the increase of resource utilization and efficiency, cleaner production and innovation in product and process design, whereby the reduction, reuse and recycling of "waste" material have top priority.

Given the potential of eco-industrial parks for unleashing inclusive and sustainable industrial development, UNIDO supports the mainstreaming and upscaling of EIPs in developing and emerging economies. Hereby, UNIDO follows a holistic EIP methodology that covers five pillars ranging from approaching companies on an individual level to industrial symbiosis concepts, as well as the inclusion of infrastructure, management and zoning structures:

- Enterprise level resource efficiency;
- Collective resource efficiency;
- Shared environment and utility services;
- Park management, operations and logistics; and
- Spatial planning, zoning and built environment.

The implementation of such projects yields great economic, social and environmental benefits. As such, successful eco-industrial parks are able to generate positive impacts on local and regional economic performance by enabling new and innovative business opportunities. EIPs also create social benefits through new employment possibilities and increased educational and training programmes. Negative environmental impacts caused by industrial operations can be tremendously reduced through environmental management and pollution prevention systems. Consequently, thanks to EIP measures, industrial zones in urban and suburban areas and cities get substantially cleaner.

Ongoing pilot eco-industrial park projects implemented by UNIDO are located in Asia, Africa and Latin America, including: Argentina, Bolivia, Chile, China, Colombia, Costa Rica, El Salvador, Guatemala, India, Panama, Paraguay, South Africa and Viet Nam. Pipeline projects include Costa Rica, Egypt and Peru.



4.4. Renewable energy

Energy from fossil fuels causes environmental degradation from extractive activities and combustion-induced GHG emissions, and its provision is heavily affected by an extremely volatile commodity market. Consequently, UNIDO promotes the application of renewable energy technologies, particularly in developing countries, for productive uses. Renewable energies, such as biomass, solar heat, wind power, tidal and wave energies, allow for the achievement of inclusive and sustainable industrialization. Furthermore, energy recovery from municipal waste represents an opportunity for cities to cover energy requirements through sustainable waste management and, at the same time, create employment and income without degrading the environment (UNIDO, 2014).

4.5. Low-carbon transport

Sustainable transport in cities is crucial for maintaining good air quality, reducing energy use and GHG emissions, and for an efficient public transport network. UNIDO promotes higher efficiency and low-carbon production throughout the vehicle manufacturing chain, fosters enabling policy frameworks, strengthens local capacities and enhances knowledge transfer and innovation (UNIDO, n.d.a). UNIDO supports countries in promoting electro-mobility (by establishing smart renewable energy-based charging stations), while also encouraging non-motorized transport (through the provision of cycling lanes and supporting the bicycle industry), the switch to alternative fuels (e.g. compressed natural gas/liquefied petroleum gas, biofuels) and improved energy management systems (municipal transport companies - buses, trolleys, metros; truck companies; railways, airlines and shipping). Policies (i.e. fuel economy/performance standards, taxes, fiscal incentives, etc.) are indispensable to meeting environmental compliance stipulations.

4.6. Green entrepreneurship

UNIDO supports green entrepreneurship by improving access to skills and green technologies, and supporting small and medium-sized enterprises. Developing new green businesses can also involve formalizing already existing informal economic activities, and/or gaining expertise on emerging green technologies. Decentralized and off-grid clean energy solutions can further empower entrepreneurship and address possible lacks of reliable energy supply (UNIDO, 2011a). As knowledge spillovers, productivity and efficiency are higher in cities, green entrepreneurship further benefits from multiplier effects.

4.7. Sound and innovative chemicals management

Chemistry lies at the heart of many urban processes as it provides fundamental building blocks for construction, energy, communication, transport, water and waste management, among other areas. UNIDO's Green Industry approach, UNIDO's approach to sound and innovative chemicals management and UNIDO's Global Chemical Leasing Programme aim to ensure more responsible production using chemicals safely, avoiding over-use, phasing out and substituting hazardous substances and improving practices for handling and managing chemicals (UNIDO, 2011a and 2016). For example, through chemical leasing, UNIDO promotes a circular economy business model through which users only pay for the services rendered by the chemicals and not for the volume of chemicals consumed. By decoupling the payment from the consumption of chemicals, chemical leasing encourages better chemicals management, which results in environmental advantages and economic benefits (for both suppliers and users of chemicals) (UNIDO, 2011band 2016).

In general terms, sound and innovative chemicals management requires new ways of capacity-building for industrial and urban stakeholders. UNIDO as a partner organization of the IOMC promotes the online-based IOMC3 "Toolbox for decision-making in chemicals management". This Toolbox is an Internet-based tool that enables countries to identify the most relevant and efficient tools to address specific national problems in chemicals management. It comprises different systems, schemes and toolkits (including the chemical leasing online toolkit, available at <http://www.chemicalleasing-toolkit.org>) that can support building sustainable communities by means of green chemistry and green engineering technologies, new circular economy business models and new training materials for policymakers, businessmen and technicians (UNIDO, 2016c).

³ The Inter-Organization Programme for the Sound Management of Chemicals (IOMC) was established in 1995 to strengthen cooperation and increase coordination in the field of chemical safety. The IOMC is the pre-eminent mechanism for initiating, facilitating and coordinating international action to achieve the 2020 goal³ for the sound management of chemicals. UNIDO is one of the Participating Organization at the IOMC together with the Food and Agriculture Organization, the International Labour Organization, the United Nations Development Programme, the United Nations Environment Programme, the United Nations Institute for Training and Research, the World Health Organization (WHO), the World Bank and the Organisation for Economic Co-operation and Development. The WHO is the administering organization for the IOMC and provides secretariat services to the Inter-Organization Coordinating Committee.



4.8. Green Industry Index

A transparent and evidence-based appraisal and incentive system for Green Industry efforts, comprising of inter alia environmentally sustainable management policies, training, investment, etc. and Green Industry achievements, such as compliance with environmental laws, resource efficiency gains and economic benefits obtained, is required. Such a system will help to enhance the monitoring, evaluation and certification of these efforts and lastly provide a reward structure. As such, a Green Industry Index will encourage companies to exceed basic environmental compliance requirements, or foster the creation of new and innovative industries that deliver environmental goods and services. At the city level, the Viennese Eco-Business Plan, a programme of the city of Vienna, Austria, is a pertinent example, helping to support local enterprises in the introduction of environmentally sound management practices with the overarching goal of promoting a sustainable local economy through efficient and economical business practices. Furthermore, there are already several examples of environmental ratings and recognition schemes from around the world that can be drawn on to custom-design an appropriate generic and global rating scheme for UNIDO and its partners.

In pursuance of this, UNIDO, with its partners, will assess the potential of a proposed Green Industry Index around four main framing questions: what type of Green Industry effort; how to assess this effort/performance; what type of incentives; and lastly, Green Industry Index ownership/modalities of cooperation and associated transparency issues. UNIDO is also working in partnership with the Beijing Normal University, School of Economics and Resources, to develop a Green Industry Index methodology to assess the environmental performance of business and industries in China.

5. Conclusions

The fourth UNIDO Green Industry Conference, to be held in Ulsan, Republic of Korea from 28 to 30 June 2016, will explore the interdependence between industry and cities in the context of resource efficiency, sound chemicals management, green technology and eco-innovation. Green Industry, as an integral component of UNIDO's ISID approach, plays an essential role in making cities green and sustainable hubs for inclusive economic growth and is, as such, a crucial driver for the implementation of the Sustainable Development Goals.

The fourth GIC focuses on cities as they not only host more than half of the world's population, but also produce around 80 per cent of global GDP and show increasing trajectories in terms of industry value added. Cities and industry share a long history, and they spur the formation of hubs of innovation, economic growth, jobs, productivity, knowledge spillovers and higher incomes, and the efficient use of infrastructure. Unfortunately, at the same time, they can lead to environmental degradation if green industrial policies are not taken into consideration.

Investment in sound chemicals management, green technologies and low-carbon infrastructure, as well as sound environmental technology transfer and policymaking, are indispensable for sustainable urban development. New circular economy business models are needed in order to maximize value along the chain, and enable assets to be continually re-introduced to markets while creating win-win situations for all involved stakeholders and the environment. The new industrial revolution has great promise in terms of technology and innovation but also needs to be made available to developing countries through technology and knowledge transfer and capacity-building. Furthermore, the transparent planning and management of cities are preconditions for successful urban inclusive and sustainable development.

UNIDO, as a specialized agency, has a critical role in promoting green technology, knowledge transfer and capacity-building, as well as in assisting cities in sustainable and sound environmental policymaking and partnership formation. The implementation of concepts such as the SC-IAP approach for sustainable cities, a circular model for industrial development, eco-industrial parks, low-carbon transport, renewable energy, cleaner and resource efficient production, a Green Industry Index, capacity-building, and the promotion of investment and financing for low-carbon and resource efficient manufacturing industries, are all fundamental for sustainable development in the urban context. These crucial topics will be discussed by representatives of local and national governments, industry, academia and civil society to further explore and support the implementation of sustainable green solutions. The conference will close with recommendations presented in the form of the Ulsan Statement, to serve as a reference for future discussions. The fourth GIC also welcomes the adoption of the Paris Agreement by the twenty-first session of the Conference of the



Parties in Paris 2015, reaffirming the importance and priority of promoting Green Industry solutions as an integral approach to reducing GHG emissions. Finally, the conference will provide key recommendations to comply with the target of sustainable urban development of the upcoming HABITAT III conference in Quito and the implementation of a New Urban Agenda.

REFERENCES

Acatech, 2011: *Smart Cities. Position paper No 10. Munich and Berlin.*

-----, 2015: *Industry 4.0, Urban Development and German International Development Cooperation. Acatech Position Paper. Munich.*

ADB (Asian Development Bank), 2010: *Urban Innovations and Best Practices. Available at: <http://www.adb.org/sites/default/files/publication/27868/urbandev-prc-nov2010-ecocity.pdf>, Last access 10.05.2016.*

Behera, Sh.K., Kim, J., Lee, S., Suh, S., Park, H., 2012. Evolution of "designed" industrial symbiosis networks in the Ulsan Eco-Industrial Park: "research and development into business" as the enabling framework. *Journal of Cleaner Production* 29-30, 103-112

Corcoran, E., C. Nellemann, E. Baker, R. Bos, D. Osborn, H. Savelli. (2010). *Sick Water? The central role of wastewater management in sustainable development. United Nations Environment Programme, UN-HABITAT, GRID-Arendal.*

Ellen MacArthur Foundation, 2013: *Towards the circular economy. Economic and business rationale for an accelerated transition.*

GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), 2014: *Advanced Manufacturing. Industry 4.0 and Urban Development. Discussion Paper. Bonn and Eschborn.*

Gollin, D., Jedwab, R. and Vollrath, D., 2016: *Urbanization with and without Industrialization. J Econ. Growth* 21, pp 21-35.

Greenhouse Gas Protocol, n.d.: *GHG Protocol for Cities. Available at: <http://www.ghgprotocol.org/city-accounting>, Last access 5.5.2016.*

G20, 2016: *G20 New Industrial Revolution Action Plan, forthcoming.*

IDA, 2012: *Emerging Global Trends in Advanced Manufacturing. Institute for Defense Analyses Paper P-4603 for the Office of the Director of National Intelligence.*

IEA (International Energy Agency), 2011: *Technology Roadmap. Smart Grids. Paris.*

IIP (Institute for Industrial Productivity), 2015: *The Role of Industry in Forging Green Cities. Washington DC.*

ITU-T (International Telecommunication Union), 2015: *Key Performance Indicators Definitions for Smart Sustainable Cities.*

Kagermann, H., Wahlster, W. and Helbig, J., 2013: *Securing the Future of German Manufacturing Industry. Recommendations for Implementing the Strategic Initiative Industrie 4.0. Final report of the Industrie 4.0 Working Group. Acatech.*

KAS (Konrad-Adenauer Stiftung) and EU (European Union), 2014: *Eco-cities: Sharing European and Asian Best Practices and Experiences. Eds. W. Hofmeister, P. Rueppel and L.L. Fook. Singapore.*

Lowe, E., n.d.: *An Eco-Industrial Park Definition for the Circular Economy. Prepared for the Policy and Research Center for Environment and Economy, State Environmental Protection Administration, China.*

Müller, B. and Herzog, O., 2015: *Industry 4.0 and Urban Development. The Case of India. Acatech.*

Müller, B. and Schiappacasse, P., 2014: *Industry 4.0. Why the city matters. Perspectives for international development cooperation. Available at: http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Material_fuer_Sonderseiten/Symposium_Advanced_Manufacturing/2014-09-04/2_Presentation_by_Prof_Dr_B_Mueller.pdf, Last access: 05.12.2016.*



Park, H., Eldon, R., Choi, S., Chiu, A., 2008. *Strategies for sustainable development of industrial parks in Ulsan, South Korea- From spontaneous evolution to systematic expansion of industrial symbiosis.* *Journal of Environmental Management* 87, 1-13

Ross, P., 2003: *Shenyang Urban Planning Project.* 39th ISOCARP Congress 2003. Available at: http://www.isocarp.net/Data/case_studies/280.pdf, Last access 10.5.2016.

Sicars, S., 2016: *EC-UNIDO Meeting on the Circular Economy.*

Singapore Government, n.d.: *The Sino-Singapore Tianjin Eco-City: A Model for Sustainable Development.* Available at: <http://www.tianjinecocity.gov.sg/index.htm>, Last access 10.05.2016.

TEDA (Tianjin Economic Technological Development Area), n.d.: *Tianjin Economic Technological Development Area.* Available at: <http://en.teda.gov.cn/html/ewwz/portal/index/index.htm>, Last access 10.05.2016.

UN (United Nations), 2016: *Sustainable Development Goals.* Available at: <http://www.un.org/sustainabledevelopment/>, Last access 5.5.2016.

UN HABITAT III, 2016a: *HABITAT III Conference.* Available at: <https://www.habitat3.org>, Last access 5.5.2016.

-----, 2016b: *Smart cities. HABITAT III Issue Papers No. 21.* New York.

-----, 2016c: *The New Urban Agenda. Zero Draft Outcome Document.* New York.

-----, 2015: *Urban Ecosystems and Resource Management. HABITAT III Issue Papers No. 16.* New York.
UN HABITAT, 2016: *Urbanization and Structural Transformation. Series 2.* Nairobi.

-----, 2015: *Urban Ecosystems and Resource Management. HABITAT III Issue Papers No. 16.* New York.

2012: *State of the World's Cities 2012/2013. Prosperity of Cities.* New York.

UNDESA (United Nations, Department of Economic and Social Affairs, Population Division), 2014: *World Urbanization Prospects. The 2014 Revision, Highlights.*

UNEP (United Nations Environment Programme), 2015: *Global Waste Management Outlook.* Nairobi.

-----, 2013a: *The Sino-Singapore Tianjin Eco-City: A Practical Model for Sustainable Development. UNEP South-South Cooperation Case Study.* Nairobi.

-----, 2013b: *The Global Chemicals Outlook.* Nairobi.

-----, 2012: *Sustainable, Resource Efficient Cities – Making it Happen!* Nairobi.

-----, 2011: *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication.*

-----, n.d.: *Global Initiative for Resource-efficient Cities. Engine to Sustainability.* Paris.

UNESCO (United Nations Economic and Social Council), 2015: *The UNECE-ITU Smart Sustainable Cities Indicators. Seventy-sixth Session. Geneva, 14-15 December 2015.*

UNIDO (United Nations Industrial Development Organization), 2016a: *ISID Operation Platform.* Available at: <https://isid.unido.org/about.html>, Last Access 10.05.2016.

REFERENCES

- , 2016b: *Circular Economy: The Road Ahead*. WEF Session Briefing Note. World Economic Forum, Davos.
- , 2016c: *Global Promotion and Implementation of Chemical Leasing Business Models in Industry*. Vienna.
- , 2015: *Leaflet: Eco-Industrial Parks – Industrial Symbiosis for the Environment*. Unpublished.
- , 2014: *Renewable Energy for Inclusive and Sustainable Development. The Case of Biomass Gasification*. Vienna.
- , 2013a: *Industrial Development Report 2013. Sustaining Employment Growth – The Role of Manufacturing and Structural Change*. Vienna.
- , 2013b: *Emerging trends in global Manufacturing Industries*. Vienna.
- , 2011a: *UNIDO Green Industry Initiative for Sustainable Industrial Development*. Vienna.
- , 2011b: *Chemical Leasing: A Global Success Story. Innovative Business Approaches for Sound and Efficient Chemicals Management*. Vienna.
- , n.d.a: *Sustainable Cities. Hubs of Innovation, Jobs, Industrialization and Climate Action*. Vienna.
- , n.d.b: *The 2030 Agenda for Sustainable Development: Achieving the Industry-related Goals and Targets*. Vienna.
- , n.d.c: *UNIDO Energy Programme. Industrial Energy Efficiency Unit. A low-carbon Path to Enhanced Industrial Competitiveness*. Vienna.
- , n.d.d: *Past Green Industry Conferences*. Available at: <http://www.unido.org/news-centre/events/past-events/past-green-industry-conferences.html>, Last access 10.05.2016.
- , n.d.e: *Eco-Industrial Park Initiative for Sustainable Industrial Zones in Vietnam*. Vienna.
- , n.d.f: *Eco-Industrial Parks*. Vienna.
- WHO (World Health Organization), n.d.: *Air pollution levels rising in many of the world's poorest cities*. Available at: <http://www.who.int/mediacentre/news/releases/2016/air-pollution-rising/en/>, Last access 19.5.2016.
- Woetzel, J., 2011: *How Green are China's cities? McKinsey and Company Article*. Available at: <http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/how-green-are-chinas-cities>, Last access 10.5.2016.
- World Bank, 2015: *Competitive Cities for Jobs and Growth: What, Who, and How*. Washington DC.
- Partnership for Action on Green Economy (PAGE), 2016: *Practitioner's Guide to Strategic Green Industrial Policy*.
- World Health Organization and UNICEF Joint Monitoring Programme (JMP), 2015. *Progress on Drinking Water and Sanitation, 2015 Update and MDG Assessment*.
- Van Berkel, R., 2015: *Green Industry Enterprise Rating. Regional Expert Meeting on Green Industry 9-10th February 2015, Policy for Low-Carbon Growth in SE Asia*.

