

**FOR PARTICIPANTS ONLY
28 SEPTEMBER 2015
ENGLISH ONLY**

**UNITED NATIONS
CENTRE FOR REGIONAL DEVELOPMENT**

In collaboration with

**Ministry of Environment and Energy (MEE), Maldives
Ministry of Tourism (MoT), Maldives, and
Ministry of the Environment, Government of Japan**

**SIXTH REGIONAL 3R FORUM IN ASIA AND THE PACIFIC,
16-19 AUGUST 2015, MALE, MALDIVES**

**Evolving Resource Efficient Economies in Asia and the Pacific ~ 3Rs in
Macro-Economic Policies - Cases**

(Background Paper for Plenary Session 1 of the Programme)

Final Draft

This background paper has been prepared by Dr. Heinz Schandl, for the Sixth Regional 3R Forum in Asia and the Pacific. The views expressed herein are those of the author only and do not necessarily reflect the views of the United Nations.

Resource efficiency and waste minimization achieved through the 3Rs. A core element of Asia-Pacific governments' economic growth strategies

Background paper for the 6th regional 3R Forum in Asia and the Pacific organized by the Government of the Maldives, the Japanese Ministry of the Environment and the United Nations Commission for Regional Development

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15 September 2015

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Foreword

Concern about assuring affordable, equitable and environmentally sustainable access to natural resources is well founded. Global use of natural resources has accelerated during the past decade and emissions and wastes have grown in line with growing extraction and use of resources. Asia and the Pacific has been the most dynamic region globally and most of the growth in resource use has been triggered by the urban–industrial transformation in Asia and the Pacific. The world is not running out of fossil fuels, metals and construction materials even as global population continues to grow and people become more affluent and hence their consumption requires larger inputs of materials, energy and water. Resource prices, however, are expected to continue to grow since the most accessible reserves have been exploited and environmental and social constraints to increased extraction are growing globally.

Biomass production (crops, timber and fish) also requires increasing amounts of land and inputs to further increase yields to feed a growing global population and to respond to changing diets. Climate change and urban air and water pollution as well as fast-increasing waste flows are of even greater concern than securing resource supply. Environmental and social issues around rising natural resource use are increasingly interconnected and pressure points are converging rapidly. The policy community in Asia and the Pacific has recognized the large challenges of resource supply security, increasing waste and pollution, and climate change as impediments to future growth and rising material standards of living in the region.

The business opportunities of the century ahead lie in the domain of resource efficiency and waste minimization in a number of important areas of provision including housing, mobility, food, water and energy. These essential services can be provided at much lower environmental cost and many businesses are already engaged in these areas in providing sustainable services. Future prosperity of economies in Asia and the Pacific and the ability to achieve the ambitious post-2015 development agenda for the region will rely on more effective and efficient use of natural resources, lower emissions and less waste. There is large potential for increasing resource efficiency and minimizing waste and emissions in the region.

While there is a double dividend of increased well-being and lower environmental impact to yield, change is not always occurring spontaneously. Well-designed policies for achieving resource efficiency and waste minimization through the 3Rs – reduce, reuse and recycle – are important to guide change towards sustainable development in Asia and the Pacific.

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Acknowledgments

This report was commissioned by the United Nations Commission for Regional Development. We would like to thank Chikako Takase and Mohanty Choudhury Rudra Charan for their kind invitation to contribute to the 6th regional 3R Forum for Asia and the Pacific.

Executive summary

The need to achieve more with less is one of the defining megatrends in the twenty-first century. It is especially important for the Asia-Pacific region, which is the most populous world region and despite significant progress in economic and human development still lags behind other regions in achieving a high material standard of living for its people. The backbone of prosperity in today's wealthy countries has been declining prices for natural resources for most of the twentieth century. The economic context for development, however, has changed dramatically in recent years. Supplying natural resources today is technically more difficult, and has higher social and economic costs because the most accessible reserves have already been depleted. Because of this, economic prosperity and human well-being in Asia and the Pacific will rely on the ability to use natural resources more effectively and efficiently.

Asia and the Pacific has been a dynamic force for the global use of natural resources – materials, energy, land and water – and for waste and emissions. While per capita levels of resource use and emissions are still comparatively low, Asia and Pacific has become the largest user of materials and is catching up fast to the rest of the world in terms of energy use and carbon emissions. If economic growth continues, resource use and emissions in the region will further accelerate, putting immense pressure on global supply. At the same time, economies in Asia and Pacific are not making the most of their natural resources. Resource productivity is much lower compared to the global average and even more so when compared to the most advanced economies. In other words, the region does not get enough value out of its natural resources and emissions.

This signals an immense opportunity for improvements in resource efficiency and waste and emissions reduction. In fact, because of the changing global economic context, many if not most of the economic opportunities for businesses and households in Asia and the Pacific will occur in what many now call the “green economy” and will involve sustainable consumption and production as a main priority. The ability to reduce material and energy inputs for production, to reuse products and infrastructure and to recycle precious materials instead of using virgin materials will define the economic future of the region.

The importance of sustainable natural resource management, resource efficiency and waste minimization, as well as emission reductions, have now been acknowledged by the global policy community. Resource efficiency, sustainable resource management and waste reduction are important elements of the post-2015 development agenda and specific objectives in the new sustainable development goals. Environment ministers and authorities in Asia and the Pacific have recently agreed on the regional priorities for sustainable development which include the same objectives. Most recently, the G7 leaders have initiated a global resource efficiency initiative which relies on the Kobe 3R Action Plan.

Many countries in the Asia-Pacific region have been at the forefront of policy development for new policy settings and tools that support resource-efficient, green and sustainable urban and industrial development. Japan and PR China are among a small group of countries, globally, which have signed up to the principle of circular economy to support processes and activities which help decouple economic activity from ever-growing resource use and emissions.

These policy initiatives have a great likelihood of achieving the desired outcomes because of the enormous technological potential that exists for resource efficiency and emission and waste reduction in key economic sectors. A small number of economic activities including heavy industry, construction and housing, transport and mobility, agriculture and food and energy provision are responsible for more than three quarters of all environment pressures and impacts. The resource and emission-intensive sectors have the potential to reduce their environmental impact by 80% or more.

The change required in how we produce and consume is very large. It requires a new industrial revolution to put in Asia and the Pacific on a different development path underpinned by a new quality of economic growth. Such change will not happen spontaneously but will require well-designed policies to facilitate the

innovation that needs to occur in businesses, government agencies and households. Transformational policies or overall incentives are required.

There is a catalogue of policies including green budget and tax reform, carbon trading and changing the way in which we subsidize resource intensive activities that are available to the policy community. Governments and businesses will need to rethink the ways in which they invest to redirect investments to appropriate infrastructure, products and ways of providing the essential services of housing, mobility and food to the large population of Asia and the Pacific.

Sustainability policy is characterized by complexity, uncertainty and contestation, which may make it more difficult for the policy community and society at large to make the social choices that are required to ensure a prosper and sustainable future for Asia-Pacific industries and communities.

1 Current trends in resource use, waste and emissions and the economy

Asia and the Pacific is the most economically dynamic region of the world and has seen high economic growth, reduced poverty and growing incomes resulting in the formation of a new middle class in cities in the region. During the past 10 years (2005–15) average yearly growth in Asia and the Pacific was 4.9% during a time when the rest of world economy grew by 1.6%. While most economies faltered during the Global Financial Crisis (2008–09) growth in Asia and the Pacific continued. The average per capita income in Asia and the Pacific in 2015 was US\$4,335 (exchange rate based at 2005 prices) which is one third of the rest of the world at US\$12,918.

Many parts of Asia and the Pacific are in the midst of a fundamental urban–industrial transformation which is occurring at a scale and speed never before experienced in world history. Technologies and businesses, lifestyles and aspirations are changing and these cause changes in natural resource use, waste and emissions that are triggered by new industrial activities, urban infrastructure and changing consumption behaviours. The transformation creates a very different life in cities and in the countryside with lots of overlaps between city and country. Many cities and urban planning authorities, in fact, can hardly keep up with the large influx of new population.

The United Nations Environment Program has recently published a comprehensive report and dataset for Asia and the Pacific (UNEP 2015) covering 4 decades of natural resource use and emissions in Asia and the Pacific. The data can be accessed via the UNEP Live online data platform at <http://uneplive.unep.org/>

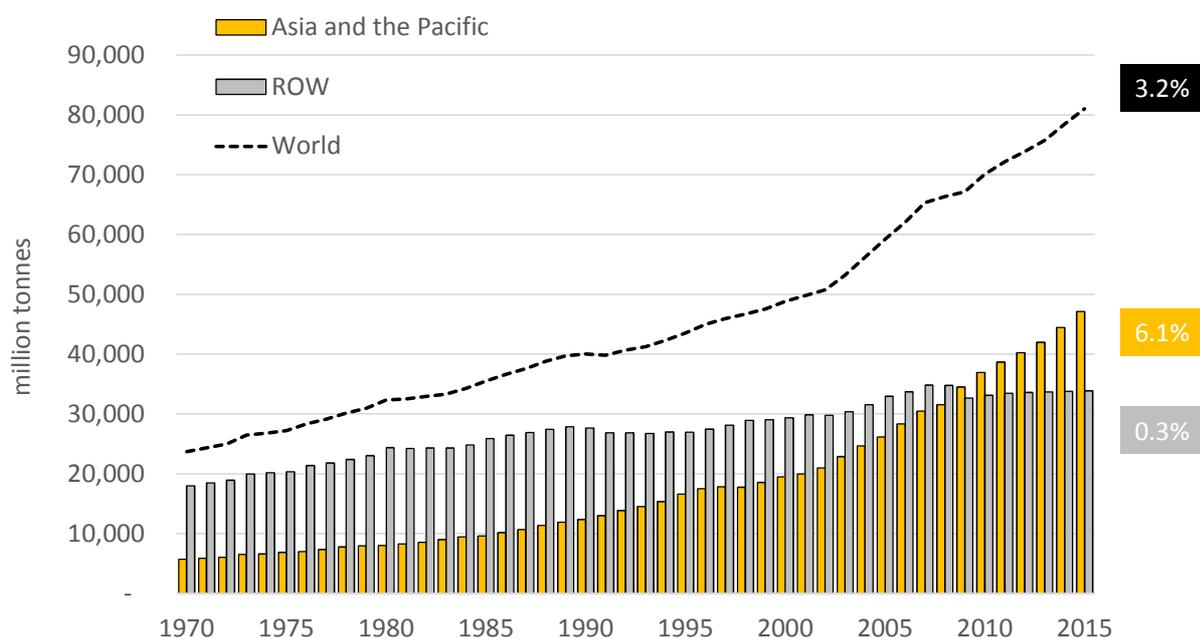


Figure 1 Material use in the Asia-Pacific region, the rest of the world and the world, 1970 to 2015. Source: UNEP (2015)

The use of materials – biomass, fossil fuels, metals and construction minerals – has grown by an average of 6.1% between 2005 and 2015 which has meant that Asia and the Pacific has become the largest user of material globally. Material use grew faster than GDP which has resulted in decreasing resource productivity in Asia and the Pacific as a whole (Figure 1).

Energy use has also grown substantially in Asia and the Pacific during the 1970 to 2015 period at an average rate of growth of 5.7% per year (Figure 2).

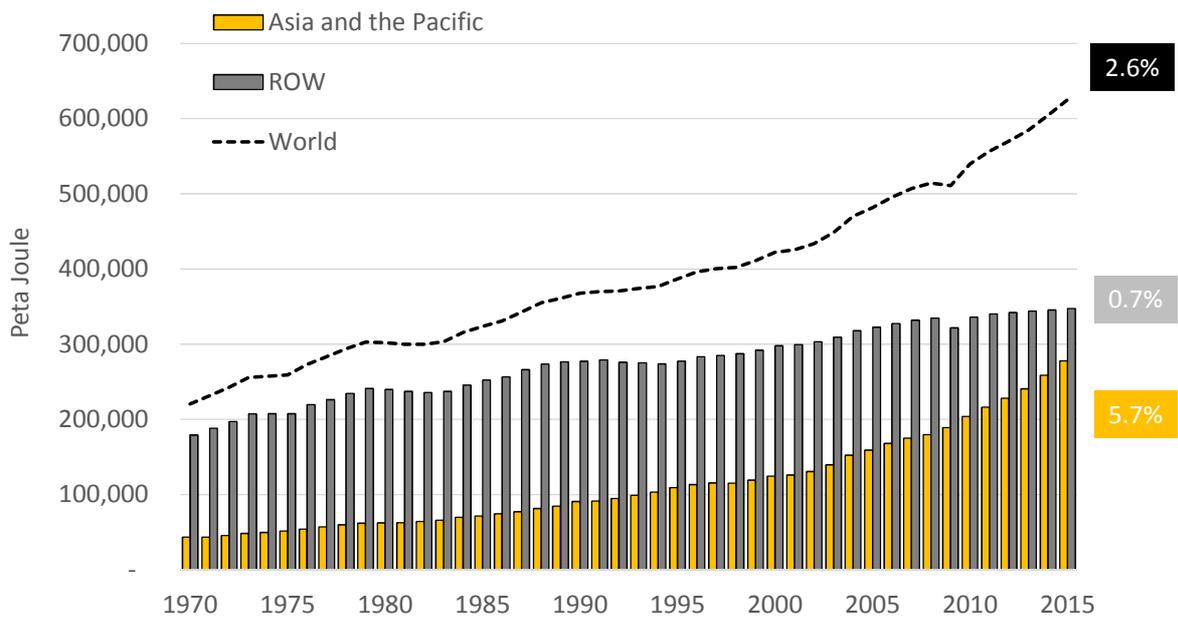


Figure 2 Energy use in the Asia-Pacific region, the rest of the world and the world, 1970 to 2015. Source: UNEP (2015)

Greenhouse gas emissions have grown in parallel with energy use but at a lower yearly average rate of 3.3% (Figure 3).

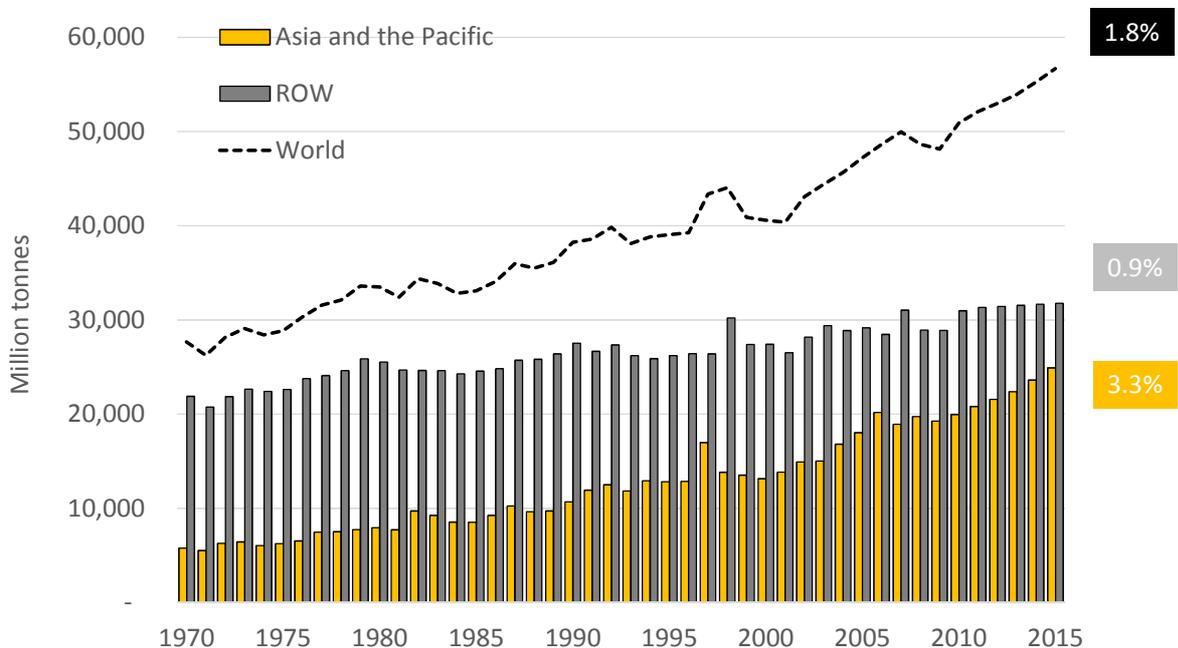


Figure 3 Greenhouse gas emissions in the Asia-Pacific region, the rest of the world and the world, 1970 to 2015. Source: UNEP (2015)

Material intensity is measured as domestic material consumption per unit of GDP (at 2005 constant prices, exchange values) and reported in kilograms of materials used per dollar of GDP (Figure 4).

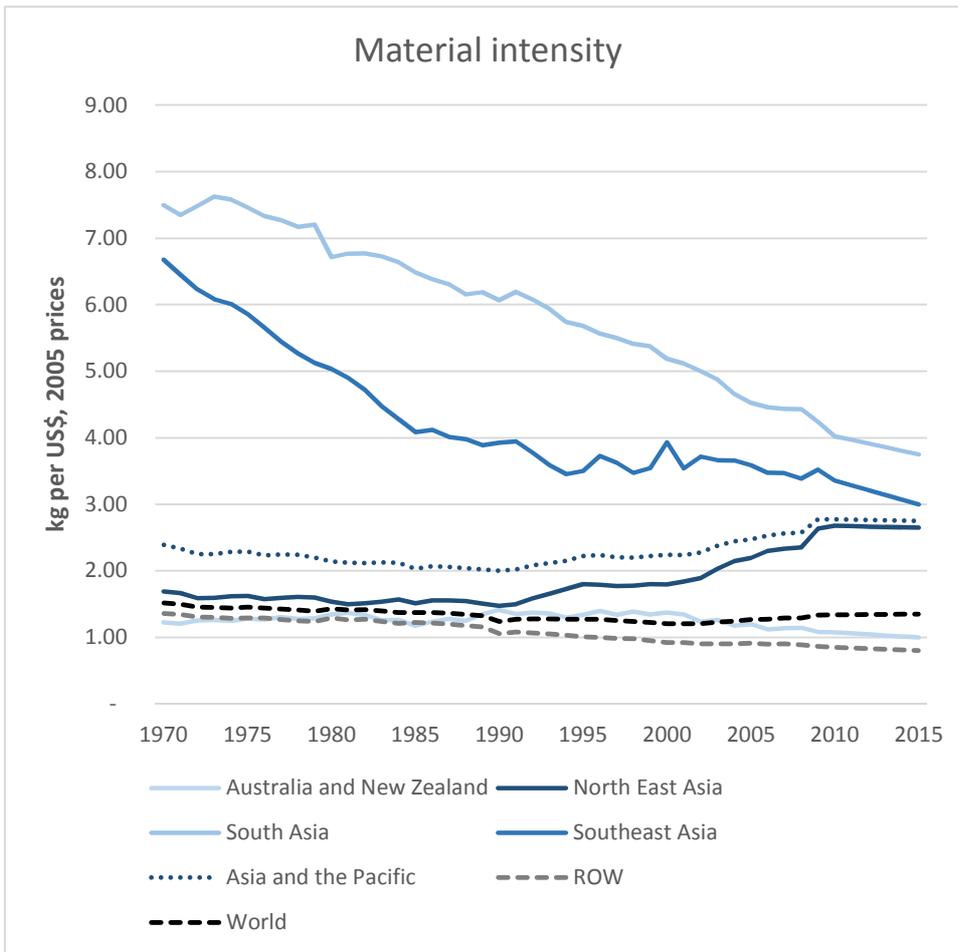


Figure 4 Material intensity in the Asia-Pacific region, the rest of the world and the world, 1970 to 2015. Source: UNEP (2015)

Asia and the Pacific needs more than double the global average of materials per dollar and while most regions in Asia and the Pacific have improved their material efficiency, this has not been the case for North East Asia and the Asia-Pacific region as a whole.

Energy intensity is measured as total primary energy supply per unit of GDP (at 2005 constant prices, exchange values) and reported in MJ of energy used per dollar of GDP.

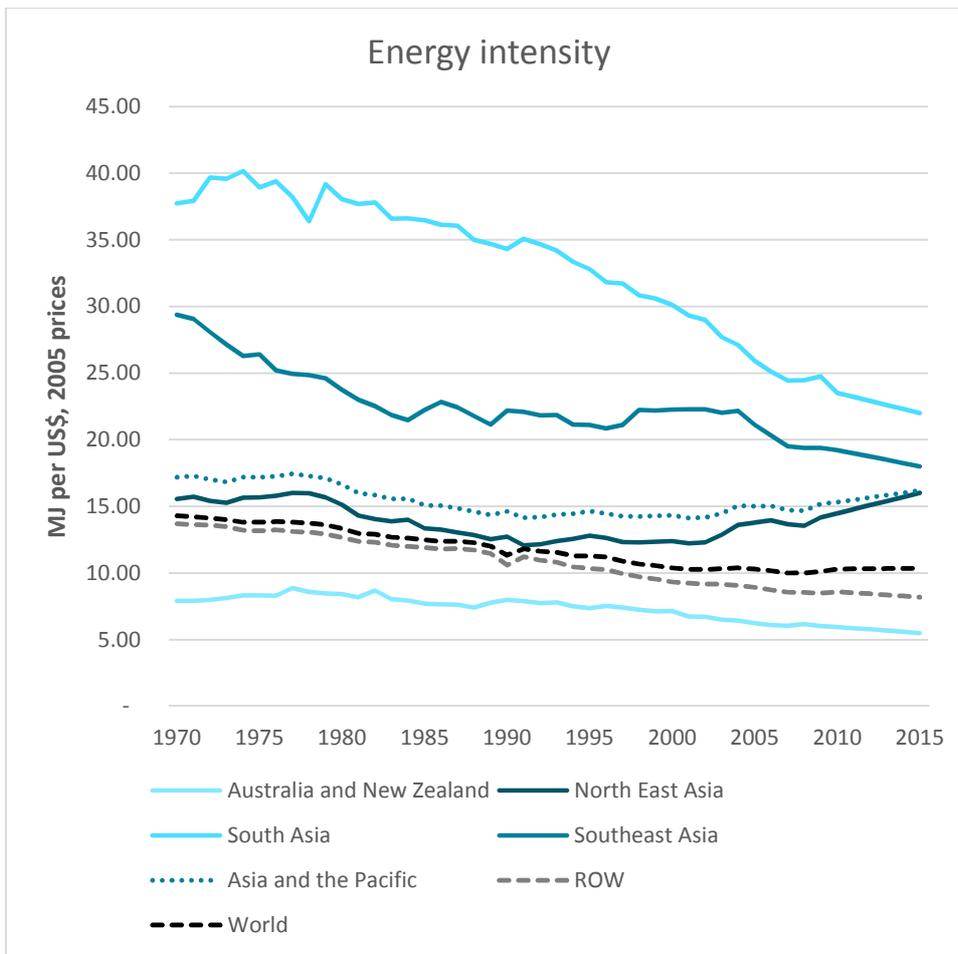


Figure 5 Energy intensity in the Asia-Pacific region, the rest of the world and the world, 1970 to 2015. Source: UNEP (2015)

A similar trend as observed for materials intensity is replicated for energy intensity (Figure 5). Asia and the Pacific economies need more than double the amount of energy per dollar of output than the world average and energy efficiency is degrading in North East Asia meaning that North East Asia today uses more energy per dollar than in the 1990s. This is caused by the rapid transition to manufacturing and urban living and consumption.

2 Global and regional policy initiatives

In the past few years the issues of resource efficiency and waste minimization have entered the international policymaking stage. The Rio +20 outcome document *The Future We Want* (United Nations, 2012) acknowledged the importance of sustainable management of natural resources and the need to reduce emissions and waste as a fundamental condition for human development. The post-2015 development agenda includes an ambitious set of new sustainable development goals, some of which explicitly address needs to improve the efficiency of natural resource use, emission reduction and waste minimization.

Goal 8 of the new SDGs aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. One subgoal asks for improvements in resource efficiency:

- 8.4 Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead.

Goal 12 is a stand-alone goal to ensure sustainable consumption and production patterns. Two subgoals ask for sustainable and efficient natural resource management and waste minimization achieved through the 3Rs:

- 12.2 By 2030, achieve the sustainable management and efficient use of natural resources
- 12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.

There is an expectation among the international policy community that the new sustainable development goals will guide international and national efforts to improve human development outcomes and at the same time secure the integrity of the natural resource base and ecosystem functions.

In May 2015, a first forum of ministers and environmental authorities from Asia and the Pacific was held in Bangkok. The Chair's summary of this meeting outlines the environmental policy agenda for the region and demonstrates a focus on climate, resources and waste.

- The effect of **climate change and disasters** and increasing vulnerability of countries in Asia and the Pacific, which will continue to impose economic losses that could offset development gains, increase poverty and threaten water and food security.
- Deteriorating health and rising costs from **air, water and soil pollution** due to emissions, effluent and waste from industry, transport and agriculture.
- Threatened **food, water and energy security** due to increasing population, rapid urbanization, changes in land use and widespread pollution.
- **Increasing resource use**, with little improvement in **resource efficiency**, causing degradation and loss of ecosystems services and additional financial burdens.
- **Gaps in scientific knowledge and evidence-based** understanding of the causes of environmental degradation were adversely affecting the confidence of policymakers in taking timely and decisive action to safeguard the common environment.

These broad agreed guidelines can provide direction to national governments and businesses in the Asia-Pacific region for policy initiatives and business plans to support the objectives.

Perhaps the most significant event in international policy is the resource efficiency initiative announced at the group of seven (G7) leaders' meeting in Germany in June 2015. G7 leaders agreed that the protection and efficient use of natural resources is vital for sustainable development. The initiative strives to improve resource efficiency, which is considered crucial for the competitiveness of industries, for economic growth and employment, and for the protection of the environment, climate and planet. The G7 also agreed to build on the "Kobe 3R Action Plan", and on other existing initiatives, to continue to take ambitious action to improve resource efficiency as part of broader strategy to promote sustainable materials management and material cycle societies. The G7-Alliance on Resource Efficiency was established as a forum to share knowledge and create information networks on a voluntary basis.

These high-level policy statements made by the representatives of the most powerful economies and by environment ministers from Asia and the Pacific align very well with the efforts of the Asia-Pacific 3R Forum as detailed in the Hanoi Declaration and the Surabaya Declaration. They provide legitimation and technical support for countries to develop policy settings in the domains of resource efficiency and waste minimization. In fact, many countries in Asia and the Pacific have been very active in this policy domain over the past decade and some countries can be seen as global leaders in this public policy domain.

2.1 Examples from countries

2.1.1 The Peoples Republic of China

In the past three decades PR China has undergone perhaps the most remarkable economic transition ever experienced in world history. PR China has become one of the world's largest producers of manufactured goods and a major participant in the consumption of raw materials and energy for the production of goods and services. A high average rate of economic growth, a significant rise in per capita GDP and growing household incomes have allowed the country to make impressive progress in human development and lifted some 500 million people out of poverty. The rapid economic development and huge progress in the material standard of living have contributed to a large increase in the demand for materials (iron ore, concrete), energy and water and has led to a fast increase in greenhouse gas emissions, waste generation and urban air pollution. Another consequence of PR China's economic progress since the 1970s has been growth in inequality, a widening rural–urban income gap and increasing gender disparities. During a time in which PR China has become a major force in global resource use and emissions, the policy community in PR China has made great efforts to mitigate the environmental consequences of rapid economic growth.

Chinese policymakers have been highly committed to building a resource-saving and environmentally-friendly economy and society and have developed a significant number of high-level and sectoral policies that support harmonizing environmental and economic objectives. Most noteworthy is the adoption of the Circular Economy Promotion Law in 2009. This is a comprehensive legal framework aiming to improve resource efficiency, reduce emissions, promote environmental conservation and help achieve sustainable development. PR China's effort to embrace the principle of circular economy as a guiding new paradigm for economic, industrial, and urban development of the country adds to earlier initiatives to achieve cleaner production in PR China's industrial sector. Implementation of cleaner production principles in the early 1990s helped to mitigate the serious environmental problems experienced at that time. The Cleaner Production Promotion Law of 2003 governs the implementation of all cleaner production activities – demonstration projects, training and promotion centres – and seeks to promote increased resource efficiency, and reduction and avoidance of pollution.

The broad directions of Chinese social and economic development, including environmental outcomes, are regulated in consecutive five-year plans. The 11th five-year plan (2006–2010) marked a shift from previous plans and set new objectives for economic development in line with PR China's emerging challenges that required a more balanced and sustainable economic growth, greater material and energy efficiency, reduced emission intensity, better living standards and balanced urban–rural development. The 12th five-year plan (2011–2015) is strengthening the efforts of the previous plan for sustainable growth, economic

restructuring, social equality and environmental protection supported by initiatives to move to a knowledge-based economy, high-tech oriented businesses and a stronger service sector.

PR China has been a leader in investing in renewable energy, public transport systems (high-speed rail) and urban infrastructure improvements and has set ambitious targets for a stabilization path for greenhouse gases to combat climate change.

Over the past four decades, because of a multiplicity of factors including structural change in the economy, improvements in technology and a fast-rising national income (which has grown much faster than resource use and emissions) PR China has achieved large improvements in material, energy and emissions intensity of the economy. In 1970, 9 kg of materials, 70 GJ of energy and 7 kg of emissions were required for every dollar of economic activity. By 2010 this had been reduced to 6 kg of materials, 28 GJ of energy and 3 kg of emissions. Nevertheless per capita levels of material use have grown from 4 tonnes in 1970 to 17 tonnes in 2010, energy use from 30 GJ per capita to 80 GJ per capita, and greenhouse gas emissions from 3.5 tonnes per capita to 8 tonnes per capita.

There is still a large gap between the resource and emissions intensity of PR China and OECD countries. Some of this is explained by PR China's role as an exporter of manufactured goods to the world which means that some environmental pressures that occur in PR China are related to consumption abroad. The difference between direct and footprint measurements is largest for energy and smallest for emissions. Even so, it needs to be seen how the considerable efforts of national policy settings can be translated into further, more rapid improvements in the resource and emissions intensity of the Chinese economy, contributing to reduced waste flows.

A main issue there will be the ability to implement national policies at the provincial level and in cities. One advantage of PR China is the central role of the National Planning and Reform Commission in coordinating line agencies to achieve the outcomes desired by the national development plan, and the promotion laws for the circular economy and cleaner production and the sectoral legislation which supports those high-level policy statements. The national policy goals, however, need to be owned by line agencies, provincial and local governments, and businesses and households to be successful in the very large task of moving PR China to a circular economy and ecological civilization.

2.1.2 India

India is the seventh-largest country by geographical area in the world. It shares land borders with Pakistan, PR China, Nepal, Bhutan, Myanmar and Bangladesh. The territory of India represents a geographical amalgamation of mountain ranges, valleys, desert regions, tropical rainforests, fertile plains, dry plateaus, as well as coastal areas (UNEP, 2012).

India is the other very large economy in Asia and has also seen tremendous economic growth in recent years. Compared to other Asian economies, urbanization has been a slower process in India and inequality and poverty prevails in the country. Almost 30% of the population was estimated to be living below the poverty line in 2010 (CIA, 2015). Despite India's vigorous economy, many social and economic problems have remained unresolved because of low educational and skill levels of parts of the population, inadequate public health and infrastructure, limited employment opportunities outside of agriculture, insufficient access to public and higher education and very large rural to urban migration which many cities cannot keep up with in terms of housing and transport infrastructure and social services.

The current modes of economic growth and high population density are causing fast environmental and natural resource degradation. India's GDP currently comprises about 18% agriculture, 24% industry and 58% services, however its labour force comprised (in 2012) about 49% agricultural workers, 20% industrial workers and 31% service workers, indicating that there is still a lot of subsistence agriculture (CIA, 2015). Environmental issues in India include deforestation, soil erosion, air and water pollution and a huge and growing population (CIA, 2015). India is the second most populous country in the world, with around 1.25 billion people (UNDP, 2015). India has been slower to urbanize than many other Asian countries; currently about 32% of its population live in cities (UNDP, 2015).

India develops and implements national five-year plans to guide policies at both national and subnational levels. It also uses more specific action plans to set targets for issues such as renewable energy, energy efficiency, water efficiency, ecosystem protection and the rehabilitation of degraded land (UNEP, 2012). The 11th plan has 4 targets addressing environmental issues two of which are specifically relevant to resource efficiency and include to comply with WTO standards for air quality in the city by 2010-11 and to improve the energy efficiency of the economy by 20% until 2016-17.

India also has a number of national plans and strategies that complement the environmental objectives of the economic development plan. The most important such national action with regard to resource efficiency is the National Action Plan of Climate Change (NAPCC) of 2008 which includes investments into renewable energy, energy efficiency and for improving the knowledge base to combat climate change. Especially energy efficiency in buildings has been target by the Indian government as an area of improvement that serves both economic and environmental outcomes and has led to a start rating system for buildings introduced by the bureau of energy efficiency. Energy efficiency standards have also been developed for the fast growing industry sector and household appliances.

Like many countries of the region India faces increasing challenges of growing amounts of urban and industrial waste. The waste streams are also becoming more complex with increasing shares of plastics, electronic and hazardous waste. Indies waste management policies are very comprehensive and advanced. For household waste it focusses on incineration and heat recovery and composting of waste. The e-waste regulation is based on the principle of extended producer responsibility to make producers and importers responsible for the waste treatment of end of life products. Implementation of the policies is often hampered, however, by a lack of financial capital and to install collection systems and industrial facilities for recycling that can handle the ever growing waste flows. India would profit from further investment into capacity building especially at provincial and local government levels to grow the knowledgebase of the policy and business sector for the economic opportunities that exist in the domain of resource efficiency and resource recovery from waste and waste minimization.

2.1.3 Indonesia

Indonesia is the fourth most populous country in the world (after PR China, India and the United States) with approximately 250 million people (UNDP, 2015). Originally a traditional agriculture-based economy, Indonesia has shifted a large portion of its economic activity toward manufacturing and services. However, its economic structures are still primarily based on the extraction and harvesting of natural resources and only a few industries focus on products with added value (UNEP, 2012). The country is also experiencing a rapid process of urbanization, with about 53% of the population now living in urban areas (UNDP, 2015).

Robust domestic economic growth, rising household incomes and positive labour market outcomes have all contributed to the gradual decline in poverty (UNEP, 2012). However, latest figures show that around 6% of the population (15 million people) still live in “multidimensional poverty” (UNDP, 2015) and the informal sector accounts for about 68% of the workforce (ILO, 2015). Urban poverty is increasing and there is also a major development gap between the western and eastern parts of Indonesia (UNEP, 2012).

Indonesia has an abundance of natural resources. It has numerous energy sources, including crude oil, natural gas and coal and an abundance of renewable energy sources, such as geothermal and hydropower (MEA, 2011). Indonesia has the third largest area of tropical forest in the world and a large number of rural people depend directly on forests for their livelihoods. However, rapid deforestation as a result of large-scale illegal logging is a major problem and more than 50% of forest areas have already been degraded (UNEP, 2012).

Indonesia, with its vast shoreline and very high coastal population, is particularly vulnerable to climate change impacts. Rising sea levels and temperatures, in combination with changes in rainfall periods and extreme weather events, are expected to significantly affect human life (UNEP, 2012). While Indonesia’s carbon dioxide emissions are still relatively low at 1.8 tonnes per capita (UNDP, 2015) these will continue to grow as the population grows larger, more urbanized and more wealthy, and international trade (which already accounts for over 50% of GDP (UNDP, 2015)) increases. Indonesia launched its *Master Plan for the*

Acceleration and Expansion of Indonesia's Economic Development (MP3EI, 2011–2025) in 2011. The MP3EI is a long-term strategy that seeks to move Indonesia into the top ten global economies by 2025. It aims to achieve economic growth rates of seven to nine per cent annually and recognizes the need for Indonesia to structurally transform its economy. The MP3EI has been designed to be integrated and coordinated with Indonesia's five-year development plans (MEA, 2011; UNEP, 2012).

Indonesia has a National Development Planning Agency which is responsible for creating development plans to cover various policy domains. Environmental goals covered by the plans include pollution reduction, forest fire reduction and renewable energy targets. The housing and construction sector in Indonesia is characterised by a shortage of appropriate housing opportunities especially for low income households which has led to the growth of many informal and self-constructed settlements or Kampongs that have become a major feature of any Indonesian city. The Indonesian government has aimed to improve the policy setting for managing the social and environmental outcomes in these settlements. The policies focus on the supply of housing but lack specific reference to improved energy efficiency of buildings or sustainable building design. Introducing such standards offers a very large opportunity in a situation of rapid infrastructure growth. The environmental improvements that could be achieved would have a lasting legacy for resource efficiency and climate change mitigation. Innovations in building standards and energy efficiency could be based on the skills and financial capacity of the local building industry and would create large economic opportunities for the industry.

Transport is another fast growing sector in Indonesia and the road infrastructure in and between cities is not keeping up with the increasing needs of private transportation. The government plans for major infrastructure improvements which include investment in public transport infrastructure in cities which would help boost liveability and productivity of cities. The Blueprint on Urban Transportation released by the Indonesian government aims to enhance the transport infrastructure of Jakarta, Bandung, Surabaya and Medan and includes the construction of an electric railway system.

The ministry of environment in 2009 provided provisions for the implementation of environmental management systems, eco-labelling and environmentally sound technology for the growing industry sector. Indonesia adopted the National Policy on Cleaner Production in 2003 to encourage companies to implement 5R principles (rethink, reduce, reuse, recycle, recover). The Indonesian Cleaner Production Center (ICPC) was established in 2004 to promote cleaner production (CP) implementation in the country. The ICPC also facilitates CP training (UNEP, 2012). While Indonesia has extensive laws covering environmental issues, implementation can be a challenge, particularly at the local government level (UNEP, 2012). This will be complemented by an energy labelling system for electric appliances and lighting systems.

In Indonesia, landfill is used as the dominant way to deal with the fast increasing amount of household and industrial waste. Indonesia's strategy for solid waste management established in 2006 has a strong focus on 3R principles and has targets for the reduction of the total amount of solid waste. The waste management law of 2008 includes objectives for waste reduction and recycling. Local governments are supported to establish 3R waste facilities but issues of open dumping persist and need to be tackled by improved awareness and government initiatives.

2.1.4 Viet Nam

Following successful economic policy reform (*doi moi*) in the 1980s, Viet Nam has developed rapidly over the past three decades. Consistently high rates of economic growth meant that Viet Nam officially graduated to middle-income country status in 2010 (WB, 2013). Government policy provides for a transition from a centrally planned economy toward one that is increasingly market-oriented, with a socialist orientation (UNEP, 2012).

Viet Nam is undergoing a fundamental structural shift in its economy, away from the agricultural, forestry and fisheries sector towards industry and services (UNEP, 2012). A policy of rapid industrialization is pursued by the government as a means of achieving socioeconomic objectives. The services sector is currently the largest sector in the economy and the biggest contributor to the overall growth rate.

Increasing tourist numbers have led to significant foreign investment into real estate and hospitality (UNEP, 2012).

Climate change and associated natural disasters are a real threat for Viet Nam, due to its very long coastline, high dependence on agriculture, and relatively low levels of development in rural areas. Many poor people depend on natural resources for their livelihoods, but supplies are threatened by unsustainable practices. Insufficient investment in water supply, sanitation, waste management and transport are leading to pollution (WB, 2013). According to estimates by the Ministry of Natural Resources and Environment sea level rise along the Vietnamese coast may average 0.75 m by 2100 and coastal areas containing big cities (such as Ho Chi Minh City) will be seriously affected (UNEP, 2012).

Viet Nam has a National 3R Strategy which sets targets to 2020 (UNEP, 2011) but it is uncertain to what degree this has been implemented at this stage. The Vietnamese Government's main strategy for development comprises the 10-year Socio-Economic Development Strategy (SEDS) and the 5-year Socio-Economic Development Plan (SEDP). The actions that are needed to translate the 10-year SEDS into reality are described in the 5-year SEDPs (UNEP, 2012). The strategies address issues such as macroeconomic stability, economic restructuring and environmental protection, and have placed increasing emphasis on sustainable development (including establishing a low-carbon economy) in recent years (UNEP, 2012).

The ministry of construction is pursuing several policy initiatives to improve the environmental outcomes of the buildings and construction sector. A comprehensive building energy code was established in 2005 focussing on the thermal efficiency of the building envelope, lighting standards and general building performance standards. Similar to other Southeast Asian developing countries building activity is very rapid in Viet Nam requiring fast increasing amounts of cement, concrete and iron and steel and a rapidly increasing number of housing units. There is very large potential for energy and water savings in building stock which will create a lasting economic benefit if implemented now.

In transportation, the main focus of Viet Nam's Transport Sector Development Strategy to 2020 is the construction and upgrading of the major highway system which hardly copes with the rising automobile and truck numbers. The government has also endorsed, however, the development of key public transport infrastructure focussing on mass transit systems in key urban areas to deal with traffic congestion and productivity loss caused by the long hours spent in traffic. The Vietnamese government signed the Bangkok 2020 declaration for sustainable transport goals for 2010-2020 which established quantifiable targets for sustainable transport. The newly developed national strategy for environmentally sustainable transport seeks to reduce CO₂ emissions from vehicles by 30% over 2005 emission levels, to provide 10% clean fuels to the fuel mix, and to achieve a 50% rate of urban journeys made by using public transport.

Waste management has become an urgent issue for public policy amidst rapid rising amounts of municipal and industrial waste and insufficient waste management infrastructures. The national strategy of integrated solid waste management of 2009 sets targets for reuse and recycling until 2025 which includes a target of 90% recycling for household waste by 2025 with an interim target of 60% to be achieved by 2015. Through the introduction of 3R pilot projects and investment into waste management, collection and recycling facilities the government aims to achieve the very ambitious waste minimization goals.

2.1.5 Thailand

Thailand is one of the foremost development success stories in Asia, with decades of sustained growth and impressive poverty reduction. Since the mid-1980s, average real per capita income has roughly tripled (UNEP, 2012). However, the financial crisis in the late 1990s and political instability since 2006 have caused an economic slowdown, severely affecting several sectors of the economy.

Thailand's economic structure has undergone major changes in the past four decades. Its economy, once largely agricultural, has been transformed by the development of the industrial and services sectors. The services sector is currently the largest contributor to GDP, comprising over 50% of GDP in recent years (CIA, 2015). Annual tourist arrivals had increased to over 19 million by 2015 (UNDP, 2015). Industrial growth was initially driven by labour-intensive manufacturing activities such as textiles and clothing but more recently has increasingly been supported by capital-intensive industries such as automobiles, electronics and

chemicals. Thailand's export sector has played an important part in driving economic growth over the past three decades (UNEP, 2012).

Over 50% of the Thai population live in urban areas (CIA, 2015). Thailand's rating on the UNDP Human Development Index (HDI) has improved steadily over the past three decades; it is currently ranked 89th in the world, putting it ahead of most other developing countries in Southeast Asia (UNDP, 2015). The incidence of poverty has fallen over the past three decades. However, the benefits of Thailand's success have not been shared equally by all and there is still significant inequality in education, income and life expectancy (UNDP, 2015). Some regions, particularly in the rural south and northeast, are lagging behind the rest of the country. A high proportion of the workforce is in vulnerable, informal employment, mostly working in the agriculture, transport, trade and construction sectors (UNDP, 2015; UNEP, 2012).

Growth in industrialization, urbanization and intensified agricultural production has relied extensively on the country's natural resources. For instance, forest cover fell dramatically from 53% in 1961 to 25% in 1998. In the fisheries sector, over-harvesting of marine fisheries has reduced fishing yields by 90%. Rapid industrial expansion and population growth have also degraded land and water quality, caused loss of natural habitats, and generated increasing levels of air and water pollution (UNEP, 2012).

Thailand uses National Economic and Social Development Plans to specify its strategic development frameworks. These include specific environmental targets involving, for example, forest protection, water quality, emissions, waste disposal and resource efficiency (UNEP, 2012).

The 11th national development plan has given greater prominence to sustainable consumption and production (SCP) efforts with the aim to build a happy society based on equity, fairness and resilience. The improvement of natural resources and environmental quality achieved through resource efficiency and the effective and sustainable use of natural resources is one target area of the 11th plan. It includes conservation and restoration of natural resources, a shift in the development paradigm and consumption towards environmentally beneficial outcomes and to improve the eco-efficiency of production and services.

This goes hand in hand with efforts in the building and construction sector guided by a housing policy that has long term goals and the secure housing program. Like in many other countries, the main focus is on housing supply, affordability and combating informal urban settlements. It also includes energy efficiency improvements through the implementation of mandatory building codes and energy efficiency standards. The Building Energy Code (BEC) comprises of requirements for the energy efficiency of the building envelope, air condition systems and lighting systems. Weak enforcement has limited the success of implementation, however, and the government has aimed to implement new building codes and energy efficiency standards at all stages of the building process including design, construction and operation.

Thailand's transport sector is dominated by road transport and a high share of funding has gone into the construction of new highways and roads with more limited financial resources being available for rail and other public transport. The city of Bangkok has led the way in investing in public transportation which has helped reduce levels of urban congestion considerable and may be used as a national example to improve urban public mass transport systems. The growth in transportation needs still overwhelms the capacity of and funding in to public transport and more needs to be done to grow mass transportation systems, to develop standards for low emission cars and clean engines.

Thailand also has the most extensive and comprehensive energy efficiency standard for appliances and labelling programs of the whole region. A voluntary labelling program based on a 5-star energy rating systems has been introduced and mandatory standards exist for six types of home appliances including air conditioners and refrigerators). In 2008, the Thai government instituted a green public procurement policy reflecting the fact that the government is a very large consumer in Thailand. The 10th plan also includes provisions for the manufacturing sector and heavy industry including the promotion of cleaner production for SME's, the creation of markets for eco-efficient products through green public procurement, eco-labelling and green supply chains, and public awareness raising campaigns to motivate sustainable lifestyles and environmentally responsible consumer behaviour.

Waste creates a large policy challenge in Thailand which is why the economic development has included specific targets for reuse and recycling of waste, proper management of hazardous waste and for the creation of a return system for different waste stream including e-waste and toxic waste.

2.1.6 Philippines

The Philippine archipelago comprises over 7000 islands and, unlike most countries in Southeast Asia, it has no land boundaries with other countries (CIA, 2015). Its HDI ranking is currently 117 (UNDP, 2015). The Philippines' long-term economic performance has been disappointing and growth is lagging behind in comparison to its neighbours. In the past, major challenges to the Philippine economy have been high unemployment, slow poverty reduction, and stagnant investment, reflecting a slow industrialization process (UNEP, 2012). Since the 1970s, the Philippine economy has transformed from a predominantly agricultural country to an economy driven by its services sector. Currently, the industry and service sectors together account for over 88% of GDP. The contribution of the service sector significantly exceeds that of the industry sector, currently accounting for over 57% of GDP (CIA, 2015). International trade comprises over 64% of GDP and one major source of trade revenue is the export of labour, with over 10% of GDP consisting of remittances (UNDP, 2015).

The Philippines has one of the highest population growth rates in Asia (UNEP, 2012). It is also one of the most urbanized countries in the region, with almost 50% of the population living in cities (UNDP, 2015). Massive and continuing rural–urban migration flows can mainly be attributed to the hope for better job opportunities in urban areas for the rural poor (UNEP, 2012).

Despite progress in recent years, the incidence of poverty remains very high in the Philippines. Significant subnational disparities in both incomes and human development outcomes continue to exist (UNDP, 2015). According to most development indicators, the southern Philippines lags behind the rest of the country. Between 2006 and 2009, the national poverty rate rose to nearly 27%, with even higher levels of poverty in rural areas (ADB, 2011).

The Philippines contains a significant amount of natural resources and is one of 17 megadiverse countries in terms of biodiversity resources in the world (Department of the Environment, 2015). However, population growth, economic activities and the over-exploitation of resources have led to significant environmental degradation over recent decades. The Philippines is also particularly vulnerable to climate change impacts due to its geography and the large share of the population that is poor and dependent on natural resources (ADB, 2011). Evidence suggests that development challenges for the Philippines are very large and that well-designed policies will be required to guide the country to greater prosperity at lower environmental costs (UNEP, 2012).

The National Economic and Development Authority is responsible for the creation of the Philippines Development Plan (PDP). The current PDP covers the period 2011 to 2016 and focuses on achieving inclusive growth, good governance and reduced corruption. It intends to create adequate employment opportunities and rising incomes to significantly lower poverty and inequities (UNEP, 2012). The current PDP also provides greater attention to climate change, environmental protection and natural resource conservation. Specific environment-related goals and objectives include improving the protection of natural resources, improving environmental quality for a cleaner and healthier environment, and enhancing adaptive capacities to cope with environmental hazards including climate change (UNEP, 2012).

The Philippines, like many other countries, faces rapid rising demand for housing infrastructure and serious housing supply shortages which has led to increasing numbers of slums and informal settlements. The gap between housing needs and newly constructed houses is increasing every year. The latest development plan 2011-2016 aims for the provision of 1.5 million new housing units by 2016. The government launched a national slum upgrading strategy in 2011. The economic development plan includes a number of environmental objectives and focuses on the use of domestic and recyclable building materials, locally available skills, the promotion of green technologies in the construction process, green architecture and design and resilient building design which helps to adapt to a changing climate. The objectives include the establishment of urban parks to reduce the urban heat island effect and to provide public open green

space. Efforts to increase the energy efficiency of buildings are another important domain of government strategy which main focus is, however, the implementation of energy efficient lighting by retrofitting government and residential buildings. Additional efforts need to be made to address the heating and cooling requirements of the built infrastructure.

Traffic congestion and air pollution are chronic problems in most of the Philippines major cities. The National Environmentally Sustainable Transport Strategy of 2011 promotes the establishment of a rapid bus transport system, the expansion of urban rail networks as well as the use of hybrid vehicles in the public transport fleet. The economic development plan envisions a transport system which is safe, secure, efficient, viable, competitive, dependable, integrated, and environmentally sustainable and people oriented. This includes initiatives for active transport in cities. There is an additional focus on biofuels. The biofuels act of 2006 mandates that gasoline has to be blended with 10% ethanol and 5% biodiesel by 2011.

The Philippines introduced a national eco-labelling program, green public procurement and an extended producer responsibility bill to improve cleaner production and encourage sustainable consumption. Waste management poses a significant challenge and the country has limited treatment and disposal facilities for hazardous waste. The waste management act promotes recycling, waste segregation and composting but facilities need to be improved to keep up with the fast rising amounts of waste.

2.1.7 Bangladesh

Bangladesh lies in the north-eastern part of South Asia. The climate is typically tropical; hot and humid summers and short, mild winters. The monsoon season normally lasts from June to October and brings heavy rainfall to the country. Most of the land is flat alluvial deltas of large rivers flowing from the Himalayas. It is also one of the country's most vulnerable to natural calamities in the world. Floods, tropical cyclones, tornadoes and tidal bores occur almost every year. It is very vulnerable to effects of climate change, which may result in more extreme weather events, increased rainfall and sea level rise (UNEP, 2012; CIA, 2015).

Bangladesh has limited reserves of coal and natural gas. The proven reserve of gas will be exhausted within a few years, leaving the country dependent on imported fossil fuels. The country's main endowments include a vast human resource base and rich agricultural land. Bangladesh is a low-income country, with a per capita GDP of US\$2363 (UNDP, 2015). Forty-seven per cent of Bangladeshis are employed in the agriculture sector, with rice as the single most important product (CIA, 2015). In recent years, garment exports have become an important economic activity and the main source of foreign currency. Remittances from overseas Bangladeshis account for more than 10% of GDP (UNDP, 2015). Other important exports are frozen foods (fish and seafood), leather, agricultural products, jute and jute products (CIA, 2015). The country mainly imports cotton, machinery, iron and steel, foodstuffs and chemicals. Its main trading partners are the USA and EU countries (CIA, 2015).

Bangladesh is the ninth most populous country in the world (CIA, 2015). At over 1000 people per square kilometre, it is also one of the most densely populated countries in the world. Twenty-nine per cent of the population lives in urban areas – most of them in the capital city Dhaka (UNDP, 2015). To make a living, many people are forced to live on and cultivate flood-prone land. The severe lack of sanitation facilities makes waterborne diseases prevalent all over the country. Soil degradation and water pollution resulting from the use of commercial pesticides and fertilizers have also become major challenges (UNEP, 2012).

Bangladesh has many policies related to environmental protection, resource efficiency, and sustainable consumption and production. Past research (UNEP, 2012) indicated that implementation was challenging as responsibility was spread across numerous different ministries and agencies.

The urbanization strategy of the 6th economic development plan presents a comprehensive approach to urban sustainability and includes improving the governance of cities, better urban land management, environmental management, creating sustainable transportation, improving urban infrastructure and services and inclusion of the needs of low income groups and the poor. The need to balance housing affordability, the large supply of housing units and to improve the environmental outcomes of the building sector poses a challenge for public policy in Bangladesh like in so many other Asian developing countries.

The main focus of the transport strategy of the economic development plan is to improve the transport infrastructure in a cost-effective and environmentally friendly fashion. This requires, however, major improvements in the country's major road networks and ferry transportation system. The main barriers to implementation are the geography of the country, lack of capital and weak implementation capacity.

Air pollution has been a main focus of policy and the department of the environment has implemented an air quality management project. The UNCRD has assisted the country in creating a national 3R strategy to manage various forms of waste. A special problem are the large amounts of organic waste from the growing livestock and poultry industry and the usage for renewable energy and fertilizer production are explored.

Opportunities to invest in and plan for resource efficiency and waste minimization

It is not about either economic growth or resource and environmental conservation. The notion of decoupling provides a powerful hypothesis that we can increase economic activity, human well-being, and material standards of living while at the same time reducing the amount of materials and energy that are needed to fuel production and consumption activities and also reducing waste and emissions. Decoupling aims to achieve more with less. There is ample research available now indicating that decarbonization of the energy system and dematerialization of the economy can occur with negligible impact on economic growth and employment.

Most economies, as a matter of fact, earn a yearly dividend of resource efficiency almost spontaneously. There are however different causes for decoupling. They include:

- decoupling through maturation
- decoupling through technological improvements of existing systems
- decoupling through outsourcing
- decoupling through systems innovation.

2.2 Decoupling through maturation and structural change of the economy

As developing country economies become more industrialized and urbanized their economic base also changes. This structural change away from agriculture towards manufacturing and service sector activities usually yields a dividend of increasing resource efficiency and a reduction in the emission and waste intensity of the economy. This happens because service sector activities have a lower resource and emission intensity than primary sectors of the economy which deal with large bulk resource flows. This dividend is not earned when a country heavily engages in mining- and energy-led economic development where large resource, emission and waste flows occur in the country for the sake of export and consumption abroad. This dividend of wealthy, mature economies in terms of resource efficiency is one reason why developed countries have much better (apparent) resource and emission intensities despite a larger overall scale of resource use and emissions.

2.3 Decoupling or recoupling through technology change

Beside structural change economies also mature through learning by doing and through engaging with new technologies that have previously not been available which may benefit decoupling or may have the contrary effect of recoupling. The shift from traditional technologies and practices for the provision of housing, mobility, food, water and energy is prevalent in many Asian and Pacific developing economies. When traditional provision systems are replaced by modern systems of provision, production and consumption it often leads to an increase in material and energy use and emissions, such as is the case when urban mobility is increasingly provided by private automobiles and when overall mobility increases.

2.4 Decoupling through outsourcing

Decoupling can also occur because material-, energy- and emission-intensive processes have been outsourced to third countries. The resource- and emission-intensive stages in product life cycles are not hosted in the domestic economy anymore and the economy appears to be more resource-efficient. Artificial success in decoupling has therefore occurred because of burden shifting. If domestic extraction and production is replaced by imported materials and products, resource use may decline domestically, but still occur elsewhere in the world where the material-intensive and polluting stages in products' life cycles now take place.

2.5 Decoupling through systems innovation

Decoupling may occur through research and investment in design, practices and technologies that reduce natural resource use and emissions through eco-efficient production and responsible consumption. This form of decoupling requires the initiative of business to aim for cleaner eco-efficient production, of households to engage in sustainable consumption practices, and of governments to provide regulation and funds to establish sustainable urban infrastructure including buildings and transport and mobility options.

This form of decoupling relies on ingenuity, experiments, and innovation. New systems of provision will need to be developed and tested. They often challenge the current regime of how a provision – for example energy or electricity – is provided. Experiments may not be economically viable when they first occur. Government policy can assist greatly in the innovation process by providing a niche in which new technology or a system of provision can prosper before it becomes viable on its own. In many cases, organizations, businesses or individuals which profit from the status quo may oppose the new way of providing a provision. Incentives can, however, be changed through policy intervention. This will often include compensation for groups that are losing because of the innovation becoming more widespread to support a soft transition.

Substantial potential for resource efficiency and waste minimization exist in the resource- and emission-intensive sectors of any economy. They may occur in heavy industry, in the provision of housing, mobility, energy and water, which taken together are responsible for the lion's share of natural resource use, waste and emissions – close to 80%.

2.6 Opportunities in heavy industry – iron and steel, cement, and paper industries

Heavy industries offer very large potential for resource efficiency improvements. These are responsible for a large share of primary energy use and they create commensurate levels of emissions and waste. There are large differences in the energy requirement per tonne of steel produced in different countries despite the fact that the steel industry has now become a global industry. There are two main types of processes employed to produce steel, the basic oxygen furnace and the electric furnace. While the latter is more efficient it requires considerable amounts of scrap steel which may not be available in a situation of very fast infrastructure growth such as has occurred in PR China recently. Efficiency improvements may be achieved by fuel switching, that is replacing coal as the main fuel, heat and power recovery, and changes in feedstock.

Next to steel, cement is the other bulk material that underpins the process of urbanization and establishment of new building and transport natural infrastructure in most of Asia and the Pacific. Cement is required for concrete production which is increasingly used in the fast growing cities. Cement production offers quite some potential for energy efficiency, related to the kiln technology that is chosen and can vary

by a factor of two between wet kilns and the more efficient dry kilns. Efficiency improvements will, however, rely on incentives that are presented to producers through specific policy settings. A price on carbon, for instance, would provide a very strong incentive to improve energy efficiency while the establishment of collection systems for scrap steel would help to make it easier for producers to engage with technologies that depend on recycled steel.

2.7 Opportunities in construction and housing

The construction and use of residential, commercial and industrial buildings has a very large environmental footprint including land-use change, the mobilization of large amounts of iron and steel, cement, and sand and gravel, and the associated use of primary materials and energy in the construction phase. The quality of the building stock determines the amount of energy that is required for thermal comfort (heating and cooling) and lighting and use of water. It also determines the lifetime of the building stock, the amount of refurbishment that needs to be undertaken and the time at which the building will need to be decommissioned and replaced. Extending the lifetime and use phase of buildings and reducing the amount of energy and water required for a building operation has important consequences for energy requirements, greenhouse gas emissions and building demolition waste. Well-designed building stock provides greater comfort to residents, reduces the cost of operating buildings and provides good environmental outcomes.

The type of buildings and the quality of the built infrastructure is regulated by zoning laws and building standards. Zoning is usually a responsibility of city and local governments and forms part of the urban or regional planning process. Building standards may be a regional or national responsibility. It is important that standards are met not just in the planning phase of building but also as an outcome of the building process.

Example: The rate of urbanization in India is still comparatively low. Many people live in village houses built using traditional techniques and building materials. However, the rapidly increasing cities and large investments into urban infrastructure in recent years have made the construction sector a very large industry. Residential and commercial buildings require very large inputs of construction materials and play an important role in India's energy use, especially for air conditioning. The relatively high cost of energy in India provides incentives for efficiency and the notion of energy-efficient buildings has quickly gained ground. To provide the necessary building standards and building codes to support energy-efficiency investments the Bureau of Energy Efficiency has introduced a star rating system for buildings. There is a need to strengthen the capacity of local administration and of the building industry to apply standards in the planning and building phases. There are many examples of innovative building practices which reduce the need for iron, steel and concrete and utilize locally available skills as well as design options for cooling buildings that do not require electricity use. A very large consumer of energy is the brick industry which also contributes large amounts of greenhouse gas emissions because of often inefficient and outdated kiln technologies. NGOs such as, for example, Development Alternatives have introduced techniques for producing bricks with lower emissions, and for saving on steel and concrete in high-rise buildings through design innovation.

2.8 Opportunities in transport and mobility

The transport of primary materials and goods and mobility of people can be organized by various means of transport which have widely different resource- and emissions-intensities. Investments into public transport systems and active transport (bike lanes, walkable cities) provide beneficial environmental and health outcomes. If mobility in cities and between cities relies too heavily on private automobiles this impacts negatively on productivity, urban air quality and health. Public urban transport and suitable urban

infrastructure for active transport rely on public investment or on private–public partnerships because of the (sometimes very large) cost of the initial investment.

If urban authorities align the development plan for a city with a transport plan with sustainability outcomes in mind there is a greater likelihood of achieving positive environmental, health and social outcomes because people on lower incomes will benefit disproportionately from a well-functioning public transport system.

In a globalized economy primary materials and goods are transported over ever-greater distances. This necessitates a plan for freight transport which relies to a large extent on rail and water transport to minimize environmental and health impacts.

Example: PR China, similar to many other countries in Asia and the Pacific, has experienced rapid motorization since the early 1990s. This was related to a decision to create a local Chinese automotive industry which was one of the pillars of PR China’s industrialization effort. PR China has now overtaken the United States to become the biggest automobile market in the world. Fast-rising car ownership has necessitated investments into the expansion of the Chinese road network to accommodate the increased volume of private traffic. To combat rising levels of emissions from private transport, PR China has instituted mandatory fuel economy standards and also promotes the use of alternative fuels including hybrid, electrical and compressed natural gas driven vehicles.

At the same time, Chinese cities and the national government have also invested into urban public transportation and the world’s largest high-speed rail network to provide alternatives to private transport. Private car ownership per household is still low by international standards and the focus on reliable and comfortable public transport may help to avoid a very rapid increase in private car ownership which would have detrimental impacts on urban air quality and PR China’s efforts to mitigate greenhouse gas emissions, and also have negative health outcomes.

2.9 Opportunities in agriculture and food

The agricultural sector in Asia and the Pacific has a significant ecological footprint. It also employs and directly feeds a large number of people in many countries and needs to provide food for a growing urban population. The sector is also most vulnerable to climate change mainly through reduced water availability and drier climates. Important resource efficiency opportunities exist in the domains of energy and water. There are many areas where energy is being wasted in agriculture, including lighting, heating, ventilation, air circulation and refrigeration and major improvements can be made in the animal, dairy and crop farming sectors. Next to traditional energy efficiency measures, which are often not fully utilized on farms, there is large potential for using renewable energy for water pumping and heating and drying; sources include solar electricity, wind power and hydropower. Organic recycling and fertilizer production helps improve soil quality. The selection of food crop species and efficient irrigation technologies can be massively improved, as can irrigation scheduling efficiency of water use. This may include rainwater harvesting and treating and reusing of urban wastewater for peri-urban agriculture. Resource efficiency and waste minimization in the agricultural and food sectors will include both traditional and technologically advanced strategies and will need to be tailored to the specific circumstances of the agricultural systems where they will be used. Another important area for efficiency improvement is the domain of food waste, where large amounts of savings can be made along the whole supply chain.

Example: Thailand’s master plan for agricultural development aims for improvements in the management of natural resources and the environment as a base for sustainable agricultural production. Foreigners are encouraged to use fewer chemical fertilizers and pesticides and to use natural alternatives and organic production where possible. The 11th national economic and social development plan (NESDP) for the 2012 to 2016 period aims for a further increase in agricultural productivity and value generation. This objective is supported by increased investment into research and development into more efficient plant and animal

species and but also by utilizing eco-friendly technologies and processes. The plan promotes sustainable agricultural practices, improvements in agricultural management, promotion of income security for farmers and balancing food and energy security at household and community levels. Challenges include food safety issues such as chemical residues, low quality manufacturing and new diseases. The Thai government has developed a full labelling scheme to certify products that meet quality and safety standards.

2.10 Opportunities in energy provision

There are now ample examples of the financial viability of renewable energy generation including solar, wind and geothermal. Many countries have seen a fast uptake of renewable energy at the private household, community or business scale. As a result, costs have come down significantly and now financially viable alternatives to fossil fuel based energy and electricity generation exist. Developments in battery and storage capacity are improving fast, both in terms of the amount of energy that can be stored and reducing costs of energy storage. Renewable energy generation can operate independently from a grid, which creates interesting opportunities for regional communities located in remote areas for which there are many examples in Asia and the Pacific. In such a context, renewable energy may well offer an affordable alternative to traditional energy generation capacity and distribution through a grid.

Example: PR China is the world's second largest energy consumer after the United States and is one of the world's fastest-growing energy sectors which relies to a large extent on carbon-intensive fossil fuels. Coal dominates the country's energy supply. Electricity generation contributes massively to greenhouse gas emissions and urban air pollution. During the 11th five-year plan the Chinese government and local authorities made very large efforts to reduce energy intensity of the economy through the closure of outdated and inefficient power generation and industrial facilities. The 12th five-year plan includes legally-binding energy intensity reduction targets of 16%. The Chinese government is also in the process of developing and trialling a range of market mechanisms to complement existing regulations and standards in the energy sector. The key market mechanisms outlined in the 12th FYP include a carbon tax for a number of advanced economic areas, a natural resources tax and a carbon emissions trading scheme. The legal foundation for future institutions that facilitate and energy transition away from coal and towards renewable energy will be provided by the new Chinese climate change law. It is important to note that PR China is also the world's largest investor into solar electricity generation development and implementation.

3 Overarching transformational policies

3.1 Ecological budget and tax reform

The twentieth century was characterized by large investments into labour productivity that often occurred at the cost of material and energy productivity, which improved much less over the same period of time. Labour has the largest average cost share, accounting for about 70% of overall production costs (the remainder being 25% capital and 5% energy and materials) and hence investment into labour productivity, to reduce cost, appeared to be a legitimate strategy. Gains in labour productivity were to some extent returned to workers as increased salaries or additional recreation leave and hence productivity gains were neutralized as soon as they occurred, driving a next effort to raise productivity.

In a global economic context where natural resources and the absorptive capacity of ecosystems are becoming limiting factors for economic growth and increased human well-being, a system of resource efficiency incentives needs to be set up. This is what ecological budget and tax reform aims for. A price on virgin primary materials is established, creating government income and encouraging efforts to increase the productivity of resource use to compensate for rising costs of resources. The revenue is offset by reductions in taxes on employment so that the resource price works in a revenue-neutral way. When, after a period, efficiency gains have occurred the level of the resource price is raised, encouraging a next wave of efficiency improvements.

In such a tax regime investments into resource conservation and reduction of waste and emissions are encouraged and labour can be spent to allow for such improvements to occur through, for example, repair and sharing systems which become more economically viable in such a taxation environment. The ecological budget and tax reform resets the incentives for businesses and households to encourage a triple dividend of reduced costs, increased employment and environmental benefits to occur.

3.2 Removing perverse subsidies

In many countries primary industries including mining and energy generation are subsidized. There are also many cases of subsidies on gasoline and other fossil fuels or electricity which encourage higher usage in production and in household consumption. These subsidies need be removed to ensure a level playing field for all economic actors, for example in the energy generation sector, and to encourage shifts to low-carbon, low-waste and resource-saving practices.

3.3 Carbon price (trade and cap)

Substantial reductions in greenhouse gas emissions are possible and they require strong abatement mechanisms to occur. A price on carbon appears to be the most efficient way to encourage businesses and households to reduce their greenhouse gas emissions through the introduction of a market mechanism. The price of emissions is established through the trading mechanism, lower-income households are compensated for higher energy costs, and the total amount of carbon emissions is capped in line with a national emission reduction target or a carbon intensity reduction target.

3.4 Investing in a green economy

To achieve the social, economic and environmental objectives set by the sustainable development goals for Asia and the Pacific will require a substantial redesign of major systems of provision. Investments in housing, mobility, food, energy and water provision need to be directed towards low energy and emission

buildings, public transport systems in cities and rapid transportation systems between cities, freight on rail, low-input agriculture and diets with less meat and dairy, renewable and distributed energy generation infrastructure and water saving infrastructure. In doing so, investments consider the material, energy and carbon intensity of a dollar of investment and are directed towards production processes, infrastructure and practices that have the lowest intensity.

In high- and middle-income countries this may involve revisiting investment decisions and redirecting funds towards resource-efficient and low-waste practices. Low-income countries will require considerable amounts of foreign investment to achieve sustainable infrastructure and sustainable systems of production and consumption.

4 The way forward

Environmental ministers and authorities in Asia and the Pacific identified common goals and challenges on their first forum held in Bangkok and organized by the United Nations Environment Programme (UNEP) in May 2015. This will strengthen the position of Asia and the Pacific in the forthcoming United Nations Environment Assembly (UNEA) meeting in 2016. The agreement reached by environment ministers needs to become a whole of government agenda in many countries. One way to ensure that finance and treasury and economic planning ministries in Asia-Pacific countries are aware and buy into an integrated agenda for furthering sustainable development in the region is to use the process of economic integration and technical cooperation facilitated by the Economic and Social Commission for Asia and the Pacific (ESCAP) as a window of opportunity to integrate environmental and natural resource issues onto the agenda.

The process of economic integration and technical cooperation in Asia and Pacific aims to create many opportunities for economic growth and to increase the standard of living in Asian and Pacific economies. It is very important, however, to design new initiatives that enhance trade, connectivity, and investment in such a way that the opportunities of sustainable resource management, waste minimization and low-carbon development are mainstreamed into those initiatives. This could take many forms such as, for example, prioritizing investments into green sectors of the economy such as renewable energy, sustainable housing and transport, and eco-efficient manufacturing and green cities. It could involve focusing connectivity on transport modes of that have a lower impact on natural resources and climate including public transport, prioritizing rail and sea for the transport of goods and services and focusing on low emission technologies.

With regard to trade it will become important to create certificates and labelling systems that inform buyers about the sustainability performance of traded goods and services. The report shows the risk that exists for the supply security of strategic natural resources and for raising emissions and waste flows and demonstrates the degree to which economies in Asia and Pacific are vulnerable in the case of price increases for natural resources (energy carriers, metals, food and fibre, and timber) and because of accelerating climate change.

Institutions respond naturally to complex policy problems when there is agreement that there is a problem, when there is something that can be done about it, and when there is willingness to act. In many countries in Asia and the Pacific, for good reasons, there is a tension between environment and sustainable objectives and economic growth objectives in the public discourse. This perceived contradiction makes it more difficult to implement the ambitious policy goals of the 3Rs and other high-level policy initiatives which include green growth, circular economy, and sustainable production and consumption.

The regional 3R Forum has the potential to trigger a public conversation and debate about the need to align environment and development outcomes and to highlight that in fact, especially in the medium and long term, there is no contradiction between sustainable resource natural management, climate mitigation and economic growth. The 3R Forum, since its inception, has facilitated a partnership between the policy, business and science communities. It should now extend its remit to facilitate a broader public debate about the importance of sustainable resource management for the future prosperity of the Asia and the Pacific region.

Governments could consider establishing a regional advisory panel of eminent scientists and community leaders to support the policy community by providing evidence-based trusted advice for policymakers on to how improve economic prosperity and human well-being in the region through resource efficiency and sustainable natural resource management.

A network of regional innovation centres for resource efficiency, waste and emission minimization could be established to drive innovation culture in Asia and the Pacific economies and provide practical examples and technologies that help countries to achieve their policy objectives in the domain of decoupling wealth

from resource use and waste. This could be achieved by linking and enhancing the status of cleaner production centres that already exist in many countries.

Subsidies that encourage resource use and contradict resource efficiency and waste minimization objectives such as subsidies for natural resources (fossil fuels) should be phased out and lower-income households should be directly compensated for higher prices.

Regional transformative policies should be promoted, such as the creation of a regional cap and trade system for carbon emissions or efforts towards a more comprehensive ecological budget and tax reform that puts a price on resources while reducing labour costs. Such policies would need to be adapted to the particular economic and development context in each country and could be restricted to certain economic zones.

Trade agreements and market liberalization in the trade sector should monitor the environmental impact of traded goods in terms of, for instance, their carbon or material and energy intensity, and this information should become a factor in establishing trade agreements.

Regional financing mechanisms for projects and experiments that enhance resource efficiency and help minimize waste and emissions should be developed to help innovative projects get on board.

A regional system of gain sharing for resource exporting countries needs to be established to allow for resource profits to flow to the general public in extractive communities and to service the common good in a nation.

Regional private–public partnerships need be promoted to establish demonstration projects of eco-city precincts and eco-industrial parks in member countries to allow other countries to learn from best practice.

A knowledge-sharing platform based on a university collaboration network should be established to allow policymakers to be kept up-to-date with the best available information. This could be enlarged to an Asia-Pacific research area comparable to the mission-directed research in the European Union which supports centres of excellence that addresses very specific policy problems through research.

Abbreviations and acronyms

ADB	Asian Development Bank
ESCAP	Economic and Social Commission for Asia and the Pacific
FYP	five-year plan
G7	group of seven [industrialized nations of the world, i.e. Canada, USA, France, Germany, Italy, Japan and the UK]
GDP	gross domestic product
MJ	megajoule
NGO	non-government organization
PPP	purchasing power parity
SDGs	sustainable development goals
UNDP	United Nations Development Programme
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
WB	World Bank

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