



# RESOURCE EFFICIENCY:

ECONOMICS AND OUTLOOK  
FOR ASIA AND THE PACIFIC

## Key Messages and Highlights



**We thank our Collaborators:**



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## KEY MESSAGES AND HIGHLIGHTS

### Key messages:

- Global sustainability depends on the creation and implementation of effective policies to support the dynamic Asia-Pacific region to transition to a new sustainable industrial system.
- This will be instrumental to deal with the dual objectives of increasing the material standard of living of people and reducing poverty, to ensure the integrity of resources and the environment.
- Resource efficient infrastructure associated with transport, energy and housing is critical, and massive amounts of new infrastructure are currently being planned. There is a twenty to thirty year window of opportunity for this transformation.
- The challenge for public policy is to achieve a sustainability transition, enabled by resource efficiency and systems innovation despite the inherent growth dynamic of the industrial transformation. What is required is a new 'industrial revolution' that provides food, housing, mobility, energy, and water with only about 20% of the per-capita resource use and emissions found in current systems.

### Highlights - Current resources trends:

1. Emerging global uncertainties mean resource efficiency needs to increase rapidly to offset material growth in the Asia-Pacific region while maintaining increased prosperity for the region's population. Increasing resource efficiency is a necessary but not sufficient condition for future prosperity, and environmental and resource integrity in the region. It needs to be augmented by behavioural change and systems innovation, i.e. new systems of provision of food, housing and mobility and new ways of supplying energy and water need to be designed for growing urban centres and rural areas.

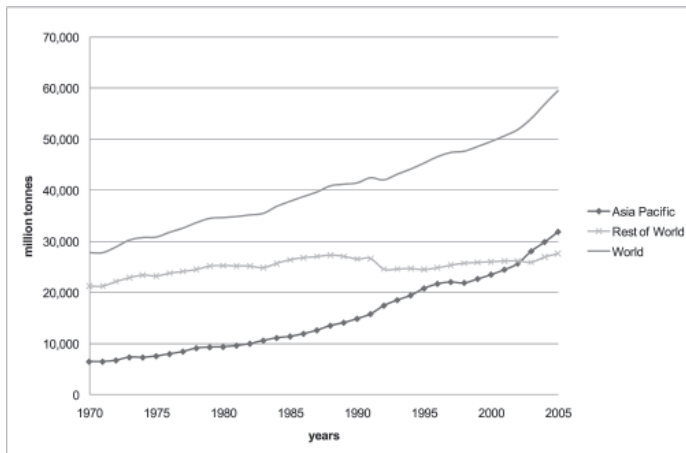
2. Asia and the Pacific constitutes the most dynamic region in the world today:
  - It has rapidly moved from an agrarian economy to an industrialized economy which has modified its ways of production and consumption and resource use patterns. Domestic material consumption grew at a compounding annual rate of 4.9% over the three decades from 1975 – 2005. The corresponding growth rate for the rest of the world was around 0.5%;
  - Resource use and emissions in this region have grown at a faster speed than in any other region, and many countries have reached the limits of domestically available resources, leading to net imports;
  - Changing conditions include reduced poverty, increasing wealth and per capita incomes which are linked to increased resource use. This has implications such as problems with sourcing affordable resources from world markets and avoiding environmental degradation.
3. The Asia-Pacific's rapid change is exacting a high (current and future) environmental cost. Problems include: pollution including greenhouse gas emissions, biodiversity loss, deteriorating ecosystems, and rapid resource depletion.
4. **Materials** – the region has become the highest resource user globally and this will increase further as per capita resource use is still relatively low.

Over the last three decades, the Asia-Pacific region has shifted from a biomass-based to a minerals-based economy. Construction materials were the fastest growing component of domestic material extraction. Fossil fuels, metal ores and biomass were the major net imports. Continuing improvements in material efficiency seem to be an endogenous trend in economic development and, on a global scale, material efficiency has improved over the last century.

At the beginning of the 21st century, the Asia-Pacific region has overtaken the rest of the world to become the single largest user of natural resources. In 2005, resources used including biomass, fossil fuels, metals, industrial and construction minerals amounted to around 32 billion tonnes, or 8.6 tonnes per capita. Its share of world domestic material consumption grew from just under 25% in 1975 to over 53% by 2005, accounting for nearly 85% of global total growth over that three decade period.



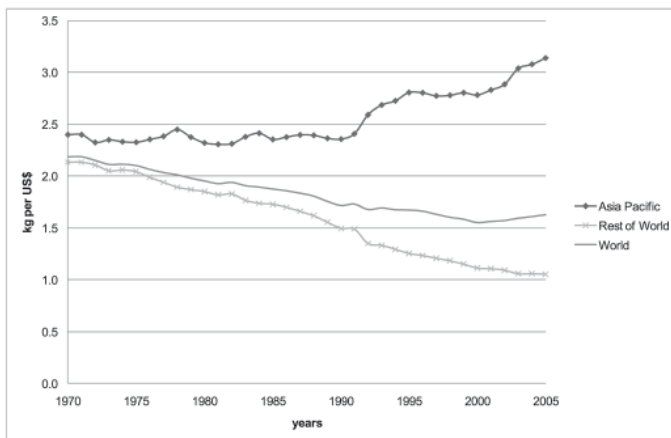
Domestic Material Consumption (DMC) in Asia-Pacific, the world and the rest of the world, 1970 -2005, million tonnes



Source: CSIRO and UNEP Asia-Pacific Material Flow Database  
[www.csiro.au/AsiaPacificMaterialFlows](http://www.csiro.au/AsiaPacificMaterialFlows)

In 1970-2005, material efficiency has improved from about 2.2 to 1.1 kilograms per US dollar of GDP, for the rest of the world. It remained stagnant in Asia and the Pacific at around 2.4 kg per \$US of GDP until 1990. Since then the region has lost efficiency, requiring 3.1 kg of materials per \$US of GDP by 2005. This is due to shifts in economic activity from very material efficient producers (e.g. Japan and Europe) to less efficient ones (e.g. China, India, South East Asia). Resource use is projected to grow to 80 billion tonnes by 2050 if it remains unmanaged.

Material intensity in Asia-Pacific, the World and Rest of the World, 1970 – 2005, kg per US\$



Source: CSIRO and UNEP Asia-Pacific Material Flow Database  
[www.csiro.au/AsiaPacificMaterialFlows](http://www.csiro.au/AsiaPacificMaterialFlows)

In 2000, the trend for material efficiency in Asia-Pacific reversed global material efficiency for the first time in a century, and the world today is using resources increasingly less efficiently.

Rising wealth and per capita incomes in Asia-Pacific are key drivers in material use, with population growth being a less important variable, while technology and innovation have been shown to be less important in mitigating growth in resource use and environmental impacts.

## 5. **Energy** – increasing with growing productivity and affluence.

Energy use in Asia and the Pacific has rapidly grown since 1970 from less than 45 to about 170 exajoules by 2005, a compounding annual growth rate of 3.9%. The corresponding figure for the rest of the world was only 1.4%. The region's share of total primary energy supply grew from 19% of the world total to over 35%, and will reach 50% by 2028.

The region has largely been able to meet the increased demand from domestic energy production. This has been achieved by greatly expanding the share of coal in the energy mix, and this has ratcheted up carbon emissions in the region. Coal has emerged from being slightly less important than either non-hydro renewables

or petroleum in domestic production of primary energy share (30%, 33% and 34%, respectively) in 1971, to being a larger component than both combined (47%, 16%, and 18%, respectively) in 2005. Consumption of coal by Asia-Pacific countries more than tripled from 1970 to 2005.

There is no example of a country in the Asia-Pacific region actually demonstrating a clear, sustained decrease in energy use per capita, and so little empirical support for the notion that increasing affluence beyond a certain point will lead to a decrease in energy use.

While the energy intensity has decreased from 18 to 12 megajoules per US dollar of GDP for the rest of the world in 1970-2005, Asia-Pacific shows no improvement in general, remaining at about 18 megajoules per US dollar of GDP.

Australia's demand for energy more than doubled between 1970 and 2005 yet its relative share across the region declined in this period, indicating how rapidly energy demand is growing across the whole region.

A noteworthy point is that Japan is one of the most energy efficient economies in the world, with the energy intensity as low as 4.4 megajoules per US dollar of GDP.

6. **Water** – supplies likely to be increasingly under pressure as demand and populations increase.

The Asia-Pacific region has increased total water withdrawals over the 15 year period (1985–2000) by 329,160 GL, representing an approximate 25% increase. All subregions have increased withdrawals, except Central Asia, which has maintained a constant withdrawal.

Many countries have been extracting water in an unsustainable manner by withdrawing more water per year than is available from renewable sources. The situation is serious in Central Asia, particularly in Uzbekistan, Turkmenistan, and Tajikistan. These countries are already withdrawing more water per year than is available from renewable sources. In South Asia, Pakistan, India, and Sri Lanka have also seen a large surge in extraction. In North-East Asia large volumes of withdrawals indicate that China has also been extracting water rapidly.

Central Asia withdraws significantly more water per capita, and as a whole, than other subregions (1998–2002). Australia and New Zealand have the second highest water withdrawal per capita, though this is significantly less than Central Asia.

Over 81% of annual water withdrawals in the Asia-Pacific region in the recent past (1998–2002) have been used for agriculture. Although the percentage of water withdrawn for agriculture may be high, the actual volume used varies widely between countries.

Water intensity increased, indicating that water productivity decreased, in the Asia-Pacific in 1985–2000, and less GDP has been generated while using the same amount of water.

Scenarios suggest that rising water withdrawals in developing countries mean that many river basins will be under severe stress by 2025 and also that groundwater tables will continue to fall: a situation likely to be exacerbated by competition for water between different sectors such as households, industry and agriculture.

7. **Land** – land use systems are changing: although efficiency is generally improving the urbanization trend is still in its infancy.

Regionally, the Asia-Pacific's transition from an agrarian socio-ecological regime into an industrialized one is still in the early phases and its effects on land use, while already substantial, will continue to evolve into the future.

Increased urbanization in many countries is attributed to economic, institutional and demographic shifts in the country and the fast changing aspirations and lifestyles of people who are moving to cities. Urban land area in the Asia-Pacific region is estimated to be around 2–3%, but it is hard to achieve a reliable estimate because of a lack of credible information. Given the increasing growth and impact of urban areas in the region, both environmentally and economically, there is an urgent need to improve the datasets of urban land use at both the national and regional scale.



Agricultural land expansion in the Asia-Pacific region has occurred at much higher rates than any other region in the world, increasing by some 6% from 1970 to 2007, compared with a growth of only 1% for the rest of the world.

The regional rate of decline in forest area eased between 2000 and 2005, primarily because of large-scale afforestation activities reported by China. However, deforestation rates in South-East Asia and the Pacific have continued, which has fuelled concerns of unsustainable logging practices in these subregions.

The development of carbon trading markets in the Asia-Pacific region has the potential to bring about major changes in land use and land use efficiency. This is already happening to some degree. There is growing interest in 'deforestation avoidance' carbon credits (i.e. REDD) that provide incentives to make sustaining a forest more attractive and profitable than timber production or conversion to other land uses such as agriculture.

8. **Emissions and waste** – these are growing due to rapid industrialization.

With the region's greatly increased participation in the world economy, any pronounced trend in the Asia-Pacific now heavily influences the emissions trajectory of the world as a whole.

Greenhouse gas emissions grew rapidly in the 1990s and then again from 2000-2005: overall greenhouse gas emissions increased between 1990 and 2005 from 10 billion to 16 billion tonnes, a compounding annual growth rate of around 3.2%. From 1970-2005, both South-East Asia and South Asia had growth rates for carbon dioxide above the regional average, at 4.1% and 3.3% respectively.

The externalization of production by some countries is leading to decreasing efficiency and increasing emissions in Asia and the Pacific. There is an indication, that a considerable proportion of greenhouse gas emissions are related to the Asia-Pacific region producing goods for consumers in the rest of the world.

Carbon dioxide intensities per unit of economic output indicates whether economies are acquiring the ability to deliver more economic output while having less impact on the environment. As was the case for materials intensity and energy intensity,

the carbon dioxide intensities for the region as a whole deteriorated somewhat over the period 1970–2005, with a compounding annual decrease of 0.65%. This is contrary to the trend for the world as a whole, which had a compounding annual increase in efficiency of around 1.2%.

9. **Scenarios** – opportunities exist for public policies to steer a sustainable transition to a green economy.

Three scenarios were established to show how resource use and emissions could develop under different scenarios: business as usual; a resource efficiency scenario; and a system innovation.

Resource efficiency may contribute to constraining the global environmental impact of rapid development and modernization in the Asia-Pacific region, but efficiency used in isolation will not avoid the undesirable environmental consequences.

The challenge for public policy is to achieve a sustainable transition, enabled by resource efficiency and systems innovation despite the inherent growth dynamic of the industrial transformation. What is required is a new ‘industrial revolution’ that provides food, housing, mobility, energy, and water with only about 20% of the per-capita resource use and emissions found in current systems.

Transitioning to a new sustainable industrial system (as one element of a long-term path to a green economy) will require:

- A rapid increase in the efficiency of resource use, and movement to systems of provision that use less resources;
- Innovation in policies that support resource efficiency and systems innovation;
- New forms of governance and institutions including (but not limited to) markets;
- Because the changes required are fundamental and large, policies that change the functioning of the whole economy, e.g. ecological taxes and budget reform, may be well suited to guide resource efficiency and systems innovation.

The modelling and scenarios shows that the system innovation approach could be applied across nations in the Asia-Pacific region, though it is anticipated that thoughtful design of policy, institutions, and governance would be required.

## Supporting messages – Process

1. *This project is highly innovative because of the new database for material flows that has been established on a country by country basis, and the modelling capacity for assessing future resource use and emissions. Modelling includes the Asia-Pacific Stocks and Flows model (APSF), a technology based biophysical model of the economy and a non-equilibrium monetary stocks and flows model (MCT). The APSF covers all relevant physical activity while the MCT portrays business cycles.*
2. *Sound decision making requires good data and analysis – this project represents a first and comprehensive step towards these by looking in detail at main material uses and resource efficiency in most countries of Asia and the Pacific and the region as a whole. A particular focus was given to 10 countries for which data was largely available: Australia, China, India, Indonesia, Japan, Republic of Korea, Lao People's Democratic Republic and Papua New Guinea. The database is available online at:*
  - [www.csiro.au/AsiaPacificMaterialFlows](http://www.csiro.au/AsiaPacificMaterialFlows)
  - <http://geodata.rrcap.unep.org/>
3. *Analysis covers period 1970 – 2005 which was chosen because it represents the recent period of rapid economic expansion for which there is available data.*
4. *Analysis used a robust and reliable method*
  - *The DPSIR (driving force-pressure-state-impact-response) framework which extends the established PSR (pressure-state-response) framework.*
5. *This analysis and assessment was carried out by a team of experts from credible scientific institutions in the Asia-Pacific region (Commonwealth Scientific and Industrial Research Organisation and University of Western Sydney from Australia, The Energy Research Institute from India. Institute of Policy and Management, Chinese Academy of Sciences and the Institute of Global Strategies from Japan). This work was possible due to financial support from the Government of Norway and counterpart contributions by the partners.*
6. *Assessment results are being communicated in relevant countries through outreach events aimed to raise national awareness and provide information for action by decision makers.*

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