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Resource use in the Asia-Pacific
A booklet of infographics

UNEP in collaboration with CSIRO THE UNIVERSITY OF SYDNEY

UNITED NATIONS ENVIRONMENT PROGRAMME

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Resource use in the Asia-Pacific
A booklet of infographics

Introduction

Understanding how efficiently we use natural resources is a vital step for designing policies to tackle inefficiencies. This booklet of infographics - based on the UNEP report “Indicators for a Resource Efficient and Green Asia and the Pacific” - reveals the patterns and the evolution of natural resource use in Asia-Pacific over the past 40 years. The findings of the report that are captured here provide a number of messages for decision makers including the following.

- The Asia-Pacific region consumes more than half of the world’s materials with increasing rates of growth and increasing material use per person. The use of materials in the Asia-Pacific region increased from 5.7 to 37 billion tonnes per year between 1970 and 2010. Global material consumption is 70 billion tonnes per year, so the Asia-Pacific region uses approximately 53%.
- There is great potential to improve the efficiency of materials use in Asia-Pacific. On average, Asia-Pacific needs 3 kilograms of materials to produce one dollar of GDP and this lags far behind the rest of the world, for which on average only 1 kilogram is needed per dollar of GDP.
- Looking at the Asia-Pacific region as a whole, the majority of materials used are not for exports but for consumption within the region. For a region known as the “manufacturing hub of the world”, the Asia-Pacific region is an exporter only in financial terms; in physical terms it is a net importer of materials.
- Energy consumption has increased more than fourfold in developing countries in the Asia-Pacific region and is dominated by non-renewable energy sources. In the developing countries group of the region, coal and petroleum represent three quarters of energy consumption, while in the industrialized countries coal and petroleum accounted for two thirds of overall consumption.
- Water use per person is decreasing and water efficiency is improving, driven by the agricultural sector and irrigation. During the past four decades, the region’s share of the global water consumption increased only slightly, from 51% in 1970 to 55% in 2010, with the developing countries group accounting for over 51% of use and the industrialized countries group responsible for less than 4%.
- Greenhouse Gas (GHG) emissions have increased fourfold, but emissions per dollar have reduced by three quarters in developing countries. Despite a fourfold increase in emissions in the region, there has been a dramatic reduction of carbon intensity in developing countries. In 1970, carbon intensity was almost 10 kg CO_2-eq per dollar, whereas in 2010, it fell to below 3 kg CO_2-eq per dollar.

The booklet presents these and additional findings in a graphical format, allowing readers to understand better the trends of resource use and resource efficiency in the region. Some of the main messages from the infographics are also highlighted on each page. The infographics and the report on which they were based are part of UNEP’s aim to communicate the latest science for policymakers to inspire and support action. We hope that the materials presented here help to convey the messages on resource use and efficiency in Asia-Pacific to the broadest possible audience and inspire us all into action.

The role of resources and emissions in our world

Atmosphere

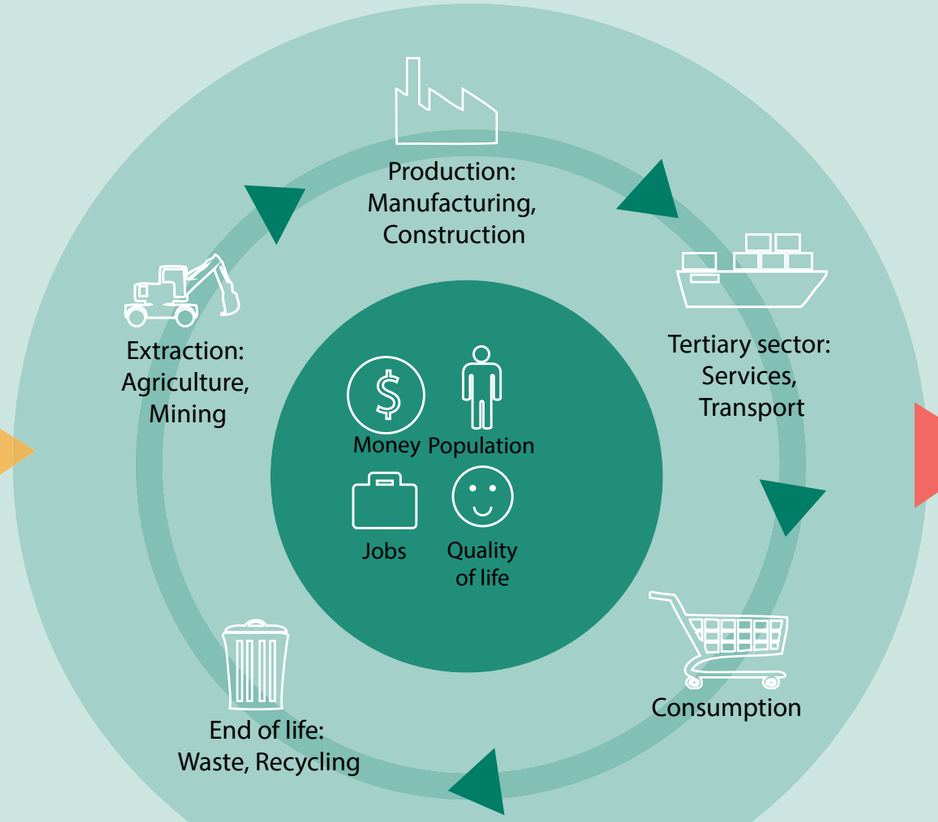
Hydrosphere
- Oceans, Rivers, Groundwater, Lakes

Earth's crust
- Soils, Geological Sources, Land

Water use

Material use

Energy use



Air emissions

Water emissions

Waste

Atmosphere

Hydrosphere
- oceans, rivers, groundwater, lakes

Earth's crust - soils, geological sources, land

4 Indicators are needed to keep track of our resource use. If we know how much we are using, how **efficiently** we are using it, and what we use it for, we can make better decisions about the use of resources.

The most important objectives are to ensure that natural resources remain available and affordable, while keeping emissions to the environment within safe limits.

1 All societies depend on natural resources for human development through the provision of food, feed, fuel and fibre for people. Natural resources also serve as inputs to economic activities.

Some resources are renewable, like water. To remain as such they need to be managed sustainably. Others are non renewable, such as metal ores and fossil fuels.

For non-renewable resources it can be difficult to know the quantity of reserves that we have left, yet we still extract the

2 We use resources over the entire life cycle from extraction (mining and agriculture) to production, consumption and finally to the end of life, where they are either recycled or disposed.

Through each of these stages, society converts the natural resources into something that addresses our needs and wants - food, buildings, mobiliy - and generates other kinds of value, such as employment, money and well being.

3 Over the whole life cycle, the use of resources creates environmental impacts. Extraction, production, consumption, transport and waste processes all lead to emissions, pollution and waste that impacts the air, water and environment which we depend on.

What are natural resources?

Natural resources are the physical basis of our social and economic activities. In this report we distinguish between four main types:

Materials
(measured in tonnes)

Water
(measured in litres or cubic meters)

Energy
(measured in Joules)

Land
(measured in squared kilometers)

They can be described further:

Materials:
Biomass (crops like food and cotton, animal products, forest products)
Fossil Fuels (coal, oil, natural gas)
Construction minerals
Metal ores (iron, copper, aluminium etc)

Water:
Groundwater
Freshwater
Rainwater

Energy:
Sourced from Coal, Renewables, Oil, Gas, Nuclear

Land:
There are different categories of land, but measuring land use is outside the scope of this report.

There are many kinds of emissions to water, air and land. In this report we included only the ones which are measured using internationally recognised, complete data-sets - which include a subset of greenhouse gas emissions. These include:

Greenhouse Gases:
Carbon dioxide (CO_2)
Methane (CH_4)
Nitrous oxides (N_2O)
Fluorinated greenhouse gases (F-gases)

How do we measure them?

Absolute resource use - looking at the totals:

Material Use - measured by "Domestic Material Consumption"
This is the extraction of materials through mining and agriculture, plus imports, minus exports.

Water use - measured by recorded extraction from the water system.

Energy use - measured by "Total Primary Energy Supply"
This is energy produced domestically, plus imports, minus exports.

Land use - measured in kilometers squared
Due to data limitations, it is outside the scope of this report.

Physical Trade Balance
The physical trade balance is the difference in mass between imports and exports.
A negative physical trade balance means that a country or region is a net exporter.
A positive physical trade balance means a country is a net importer.

Helps us compare!

To help us understand how we stand compared to our neighbours we can divide absolute numbers by population and GDP:

$1

Resource efficiency - measured by "Resource Intensity"
Resource Intensity can be calculated for any of the natural resources or emissions, by dividing resource use (or emissions) by GDP. The units will be kilograms or joules or squared kilometers per dollar, depending on which resource is investigated. A high resource intensity indicates a low resource efficiency.

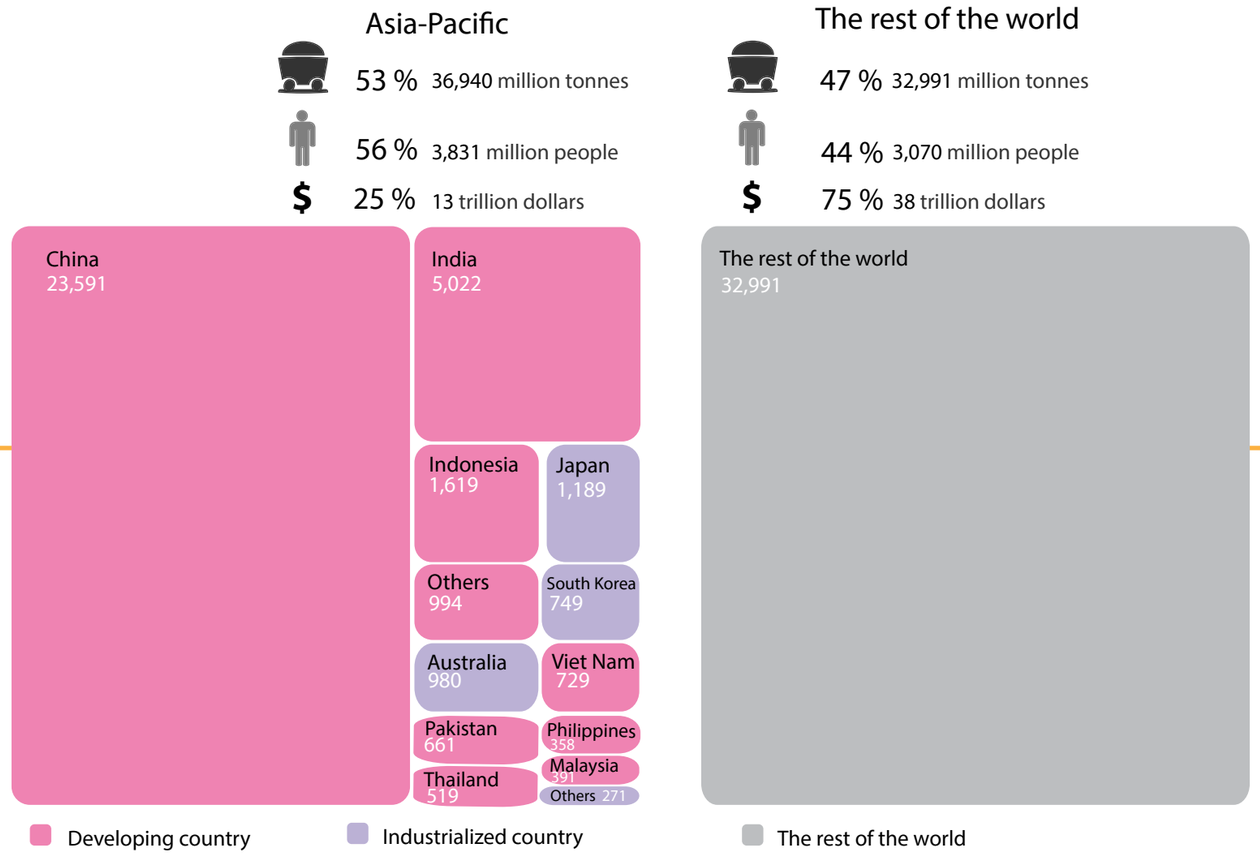
Resource use per capita
Resource use per capita helps us to compare resource use between large and small populations. However, it does not imply equal access to resources by all parts of the population, and may vary within each country. Resources may also be "used" in a country without coming in direct contact with its citizens, for example in the case of mining for export.

A snapshot of material use in the Asia-Pacific region

How much does the Asia-Pacific use compared to the rest of the world?

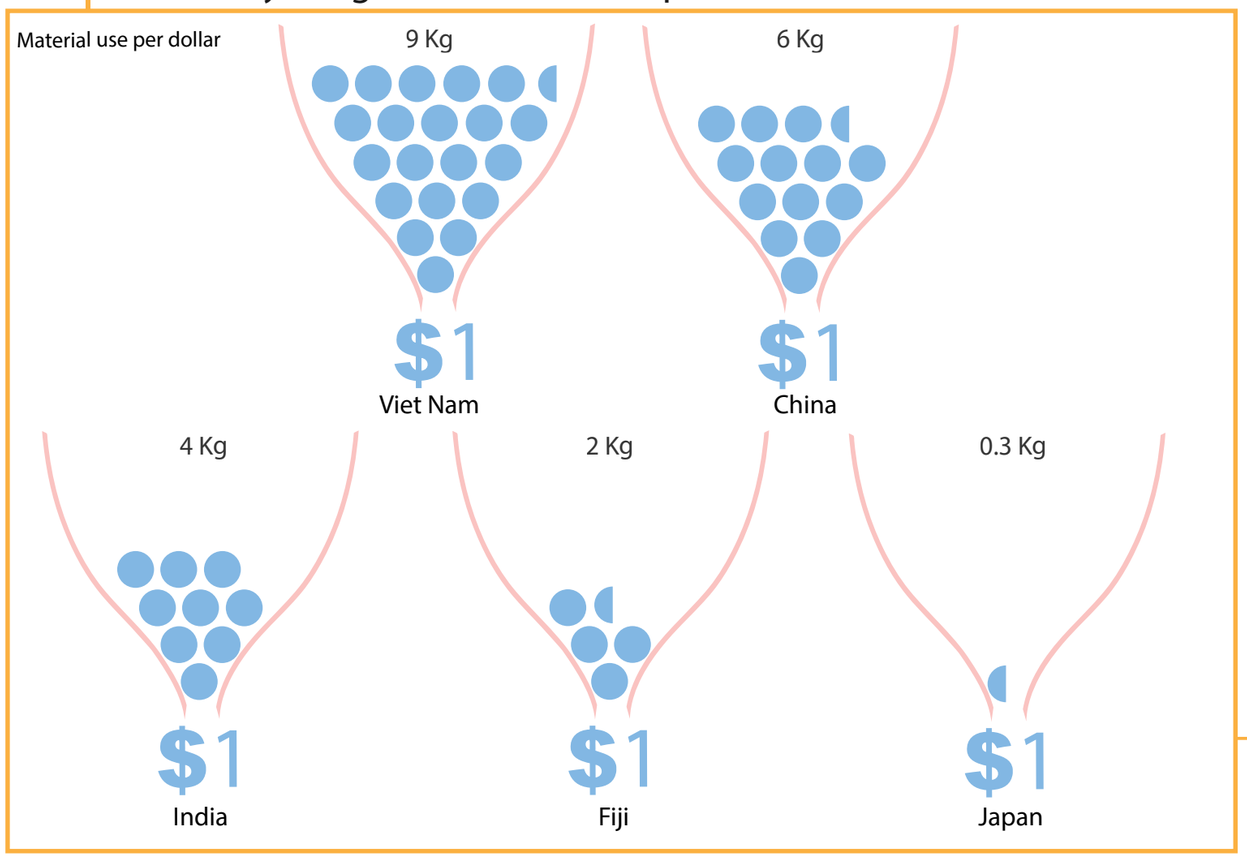
Year 2010

Material use
Unit: million tonnes

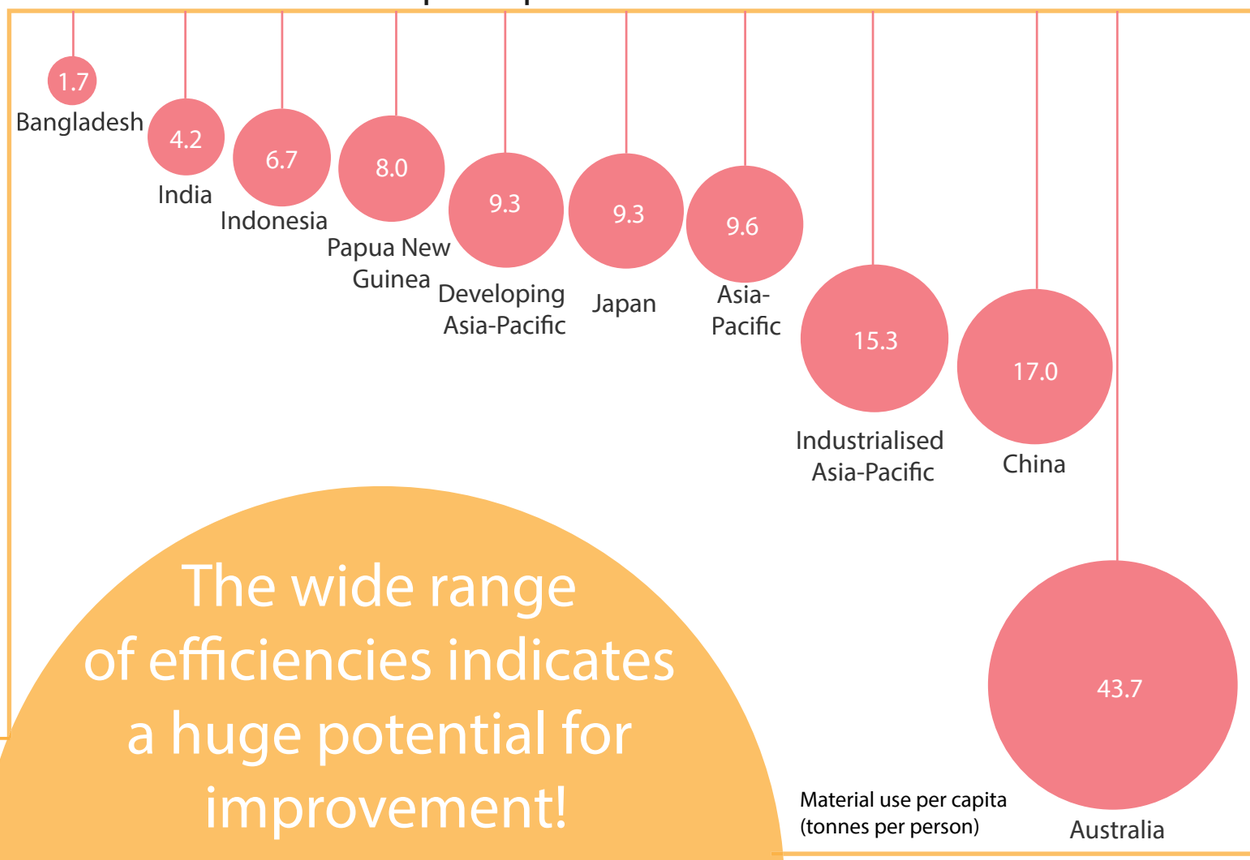


Why does the Asia-Pacific region consume more materials than the rest of the world? To start with, the region hosts more than half the world's population. But there are other reasons, such as the diverse range of efficiencies of the economies in Asia-Pacific, as well as major differences in per capita consumption of materials.

How many kilograms of materials per dollar of GDP?



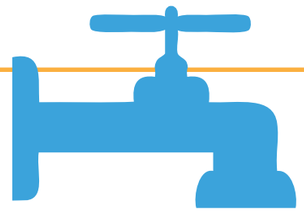
What about material use per capita?



The wide range of efficiencies indicates a huge potential for improvement!

Resource use per person over time

Developing countries in the Asia-Pacific still consume fewer resources per person than the industrialized countries. However they are catching up fast. In 1970, on average a person in a developing country consumed only 24% as much materials as the average person in industrialized countries. In 2010, the proportion increased to 61%.

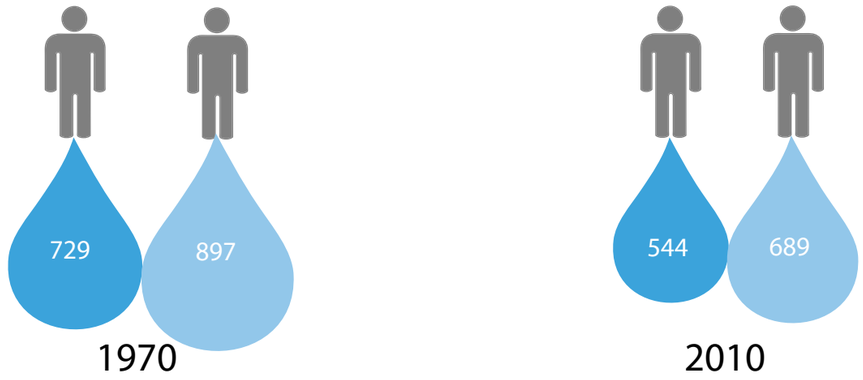


Water use per person

Developing countries

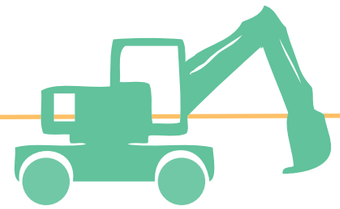
Industrialized countries

Kilolitres per person



1970

2010

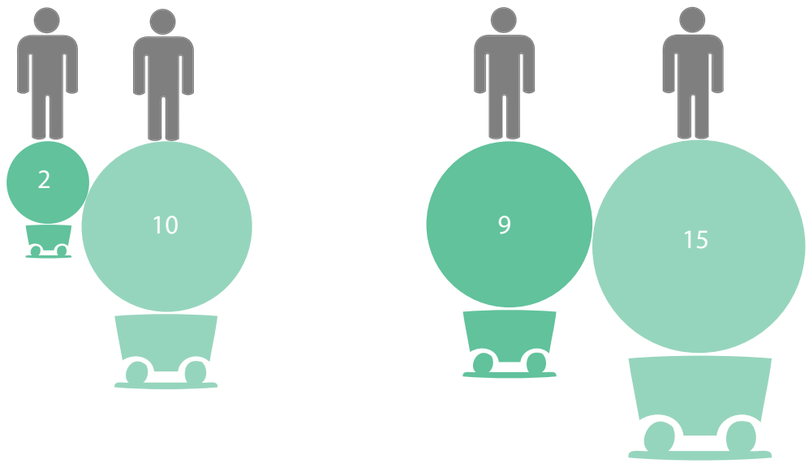


Material use per person

Developing countries

Industrialized countries

Tonnes per person



1970

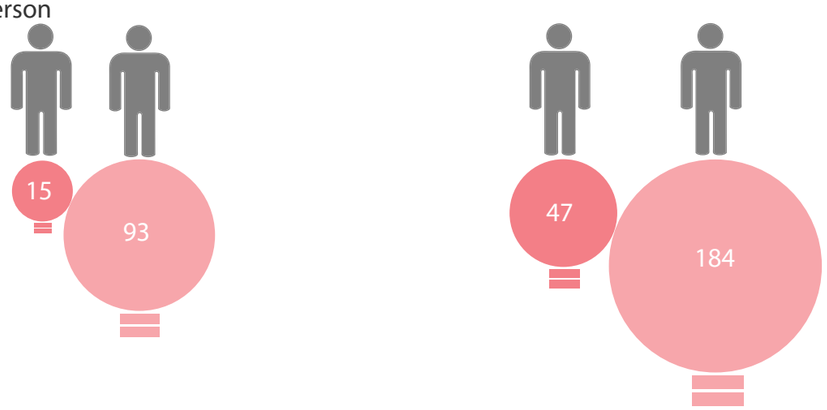
2010

Energy use per person

Developing countries

Industrialized countries

Gigajoules per person



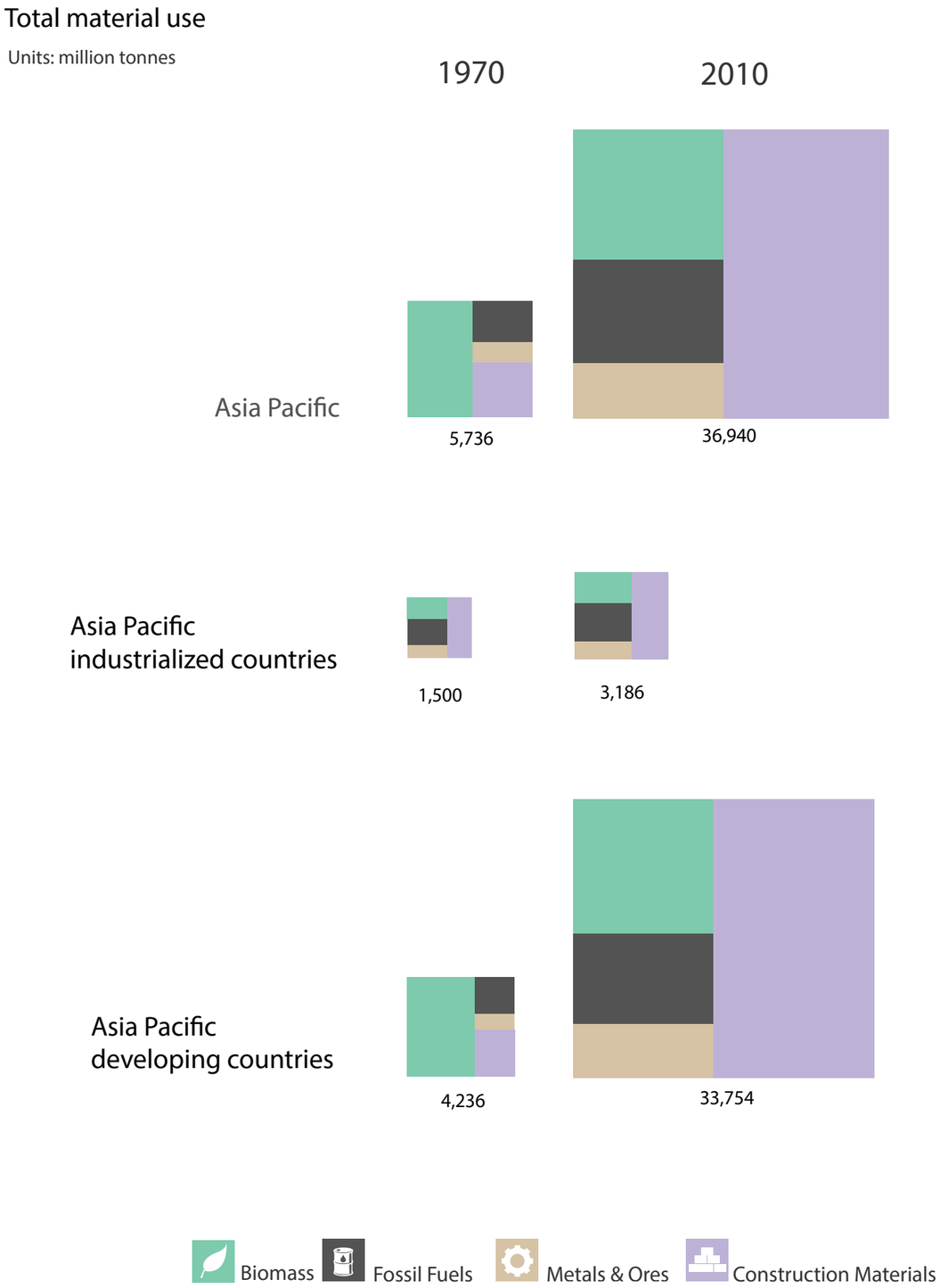
1970

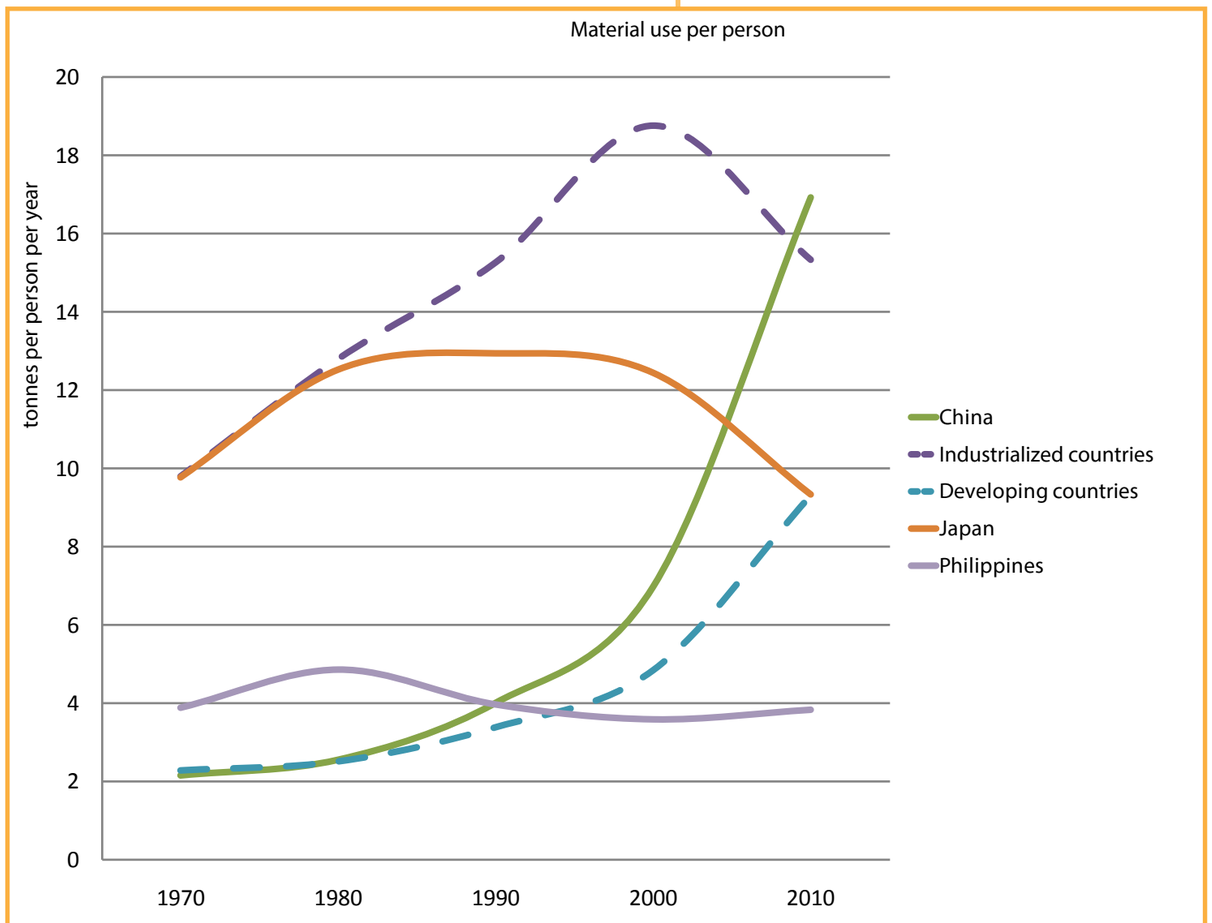
2010

Energy availability is still a challenge in developing Asia-Pacific!

What type of materials do we use in the Asia-Pacific, and how has this changed over time?

Material use is growing rapidly in the region, both in total and per person. At the country level, there are three trends: rising as in China, falling as in Japan, and stable as in the Philippines.

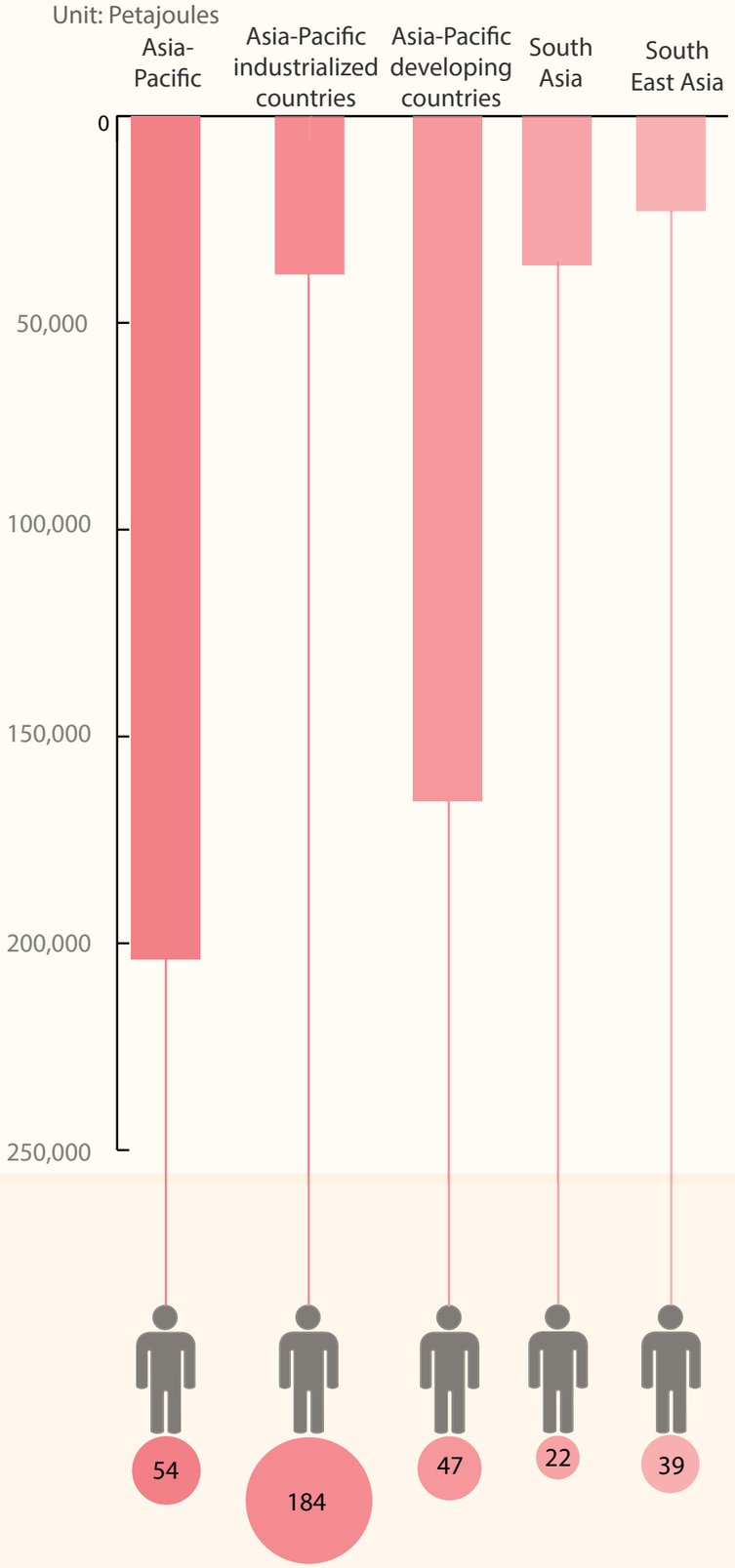




Material use is growing rapidly!

Total energy use

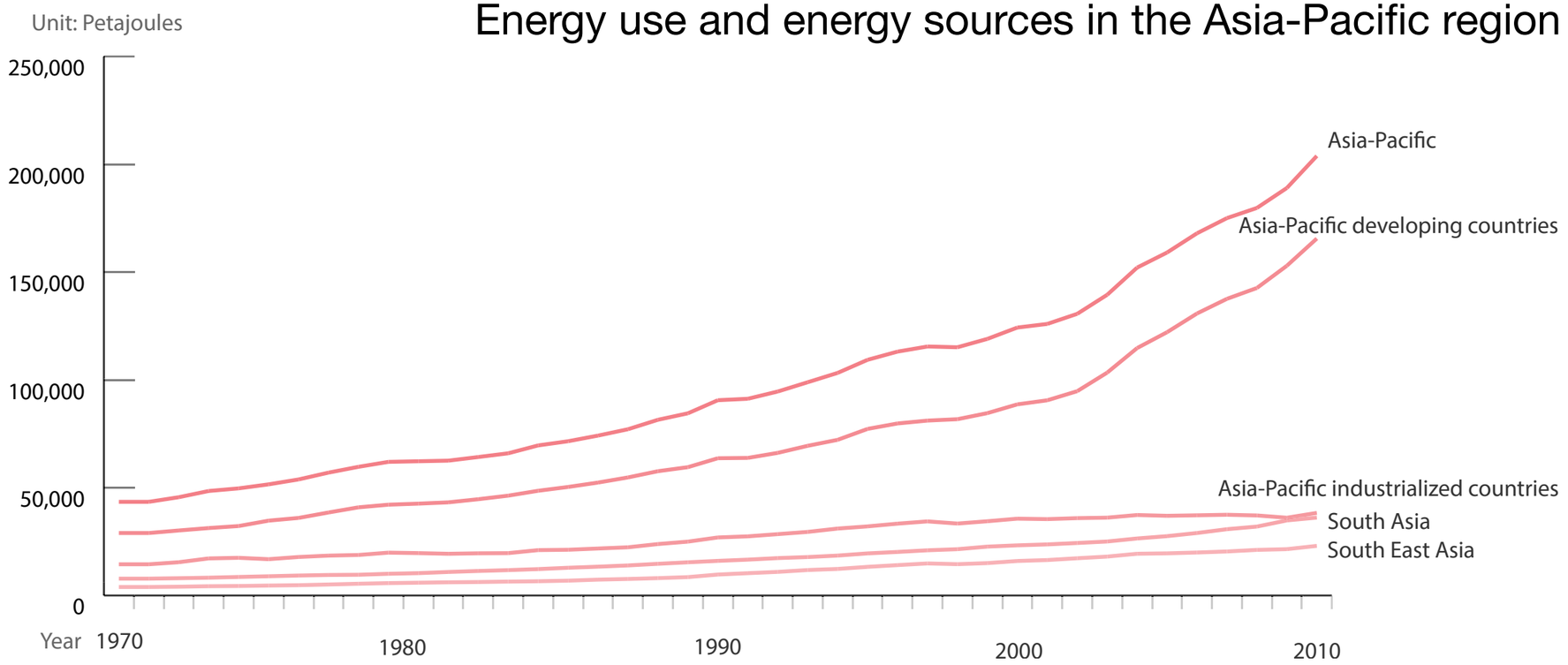
Unit: Petajoules



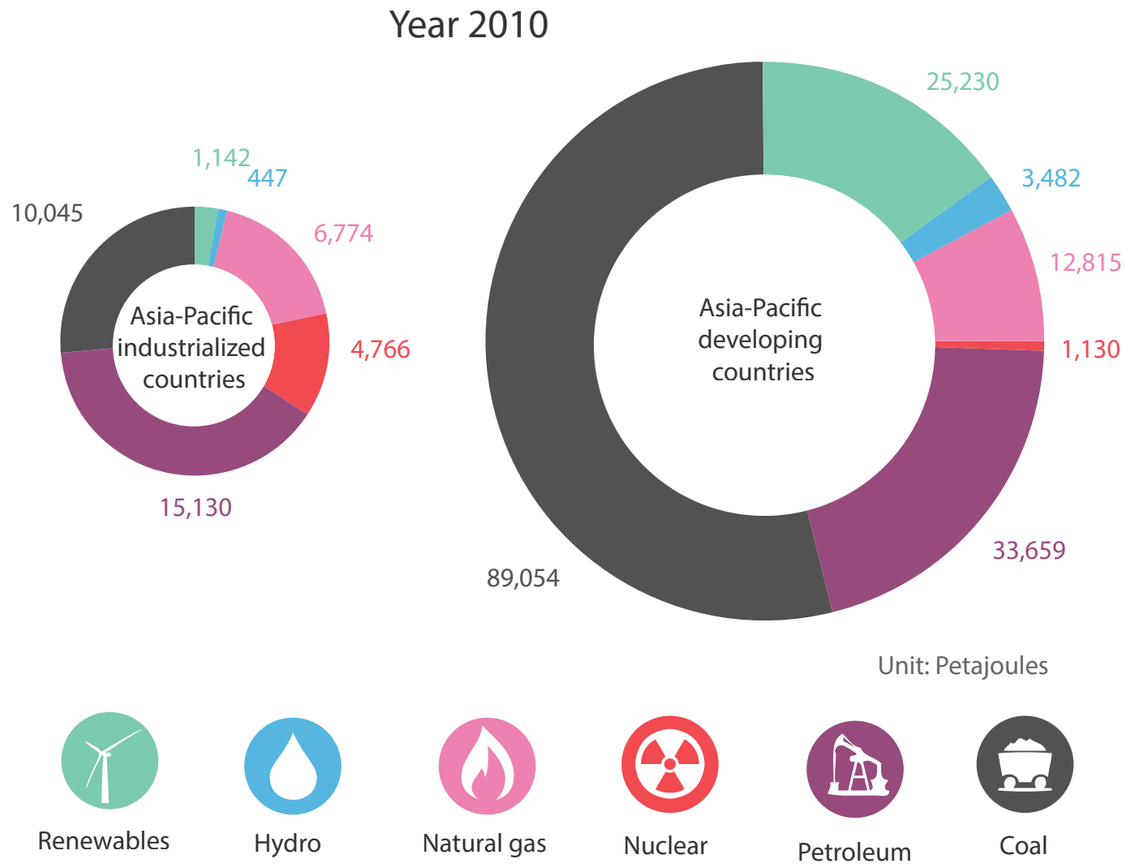
Energy use per person

Gigajoules per person

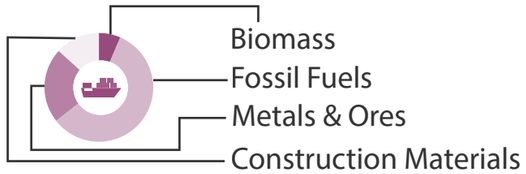
Energy use and energy sources in the Asia-Pacific region



Since the late 1990's energy consumption has increased much faster than before in the Asia-Pacific developing countries. Coal and Oil are three quarters of energy consumption in Asia-Pacific developing countries.



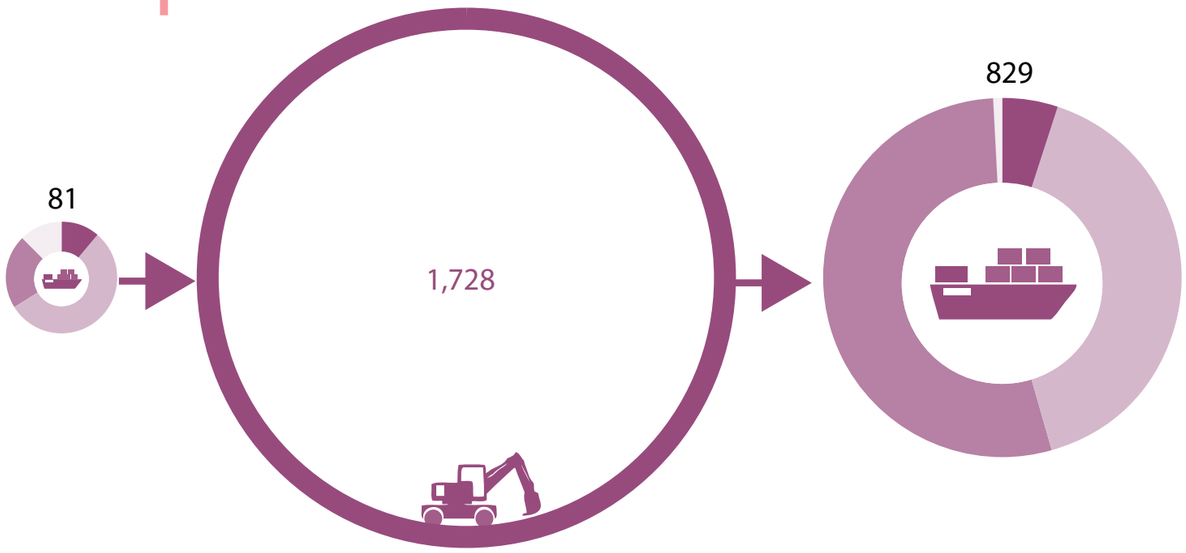
Material use in different types of economies



Material use is calculated by adding the mass of domestic extraction and imports and subtracting the mass of exports.

Australia

Import + Domestic Extraction − Export

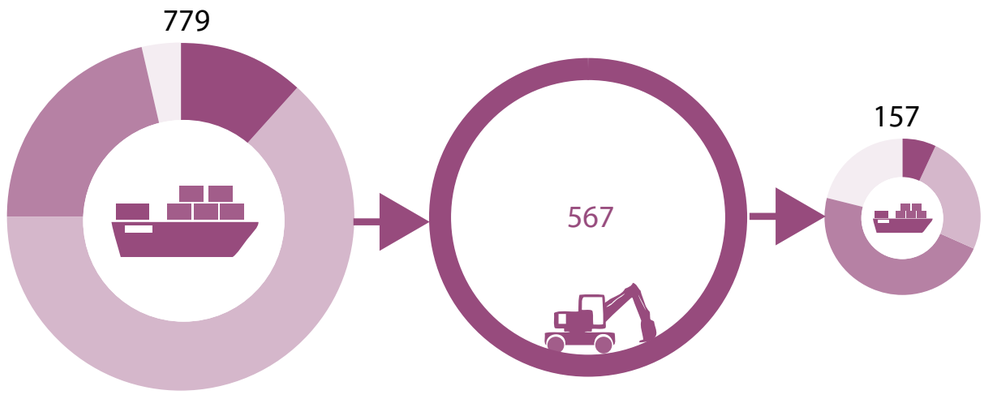


Material use = 980

Units: million tonnes

Japan

Import + Domestic Extraction − Export



Material use = 1,189

Units: million tonnes

Australia extracts almost double what it actually uses domestically

Japan's imports make up two-thirds of its material use.

Explaining the footprint

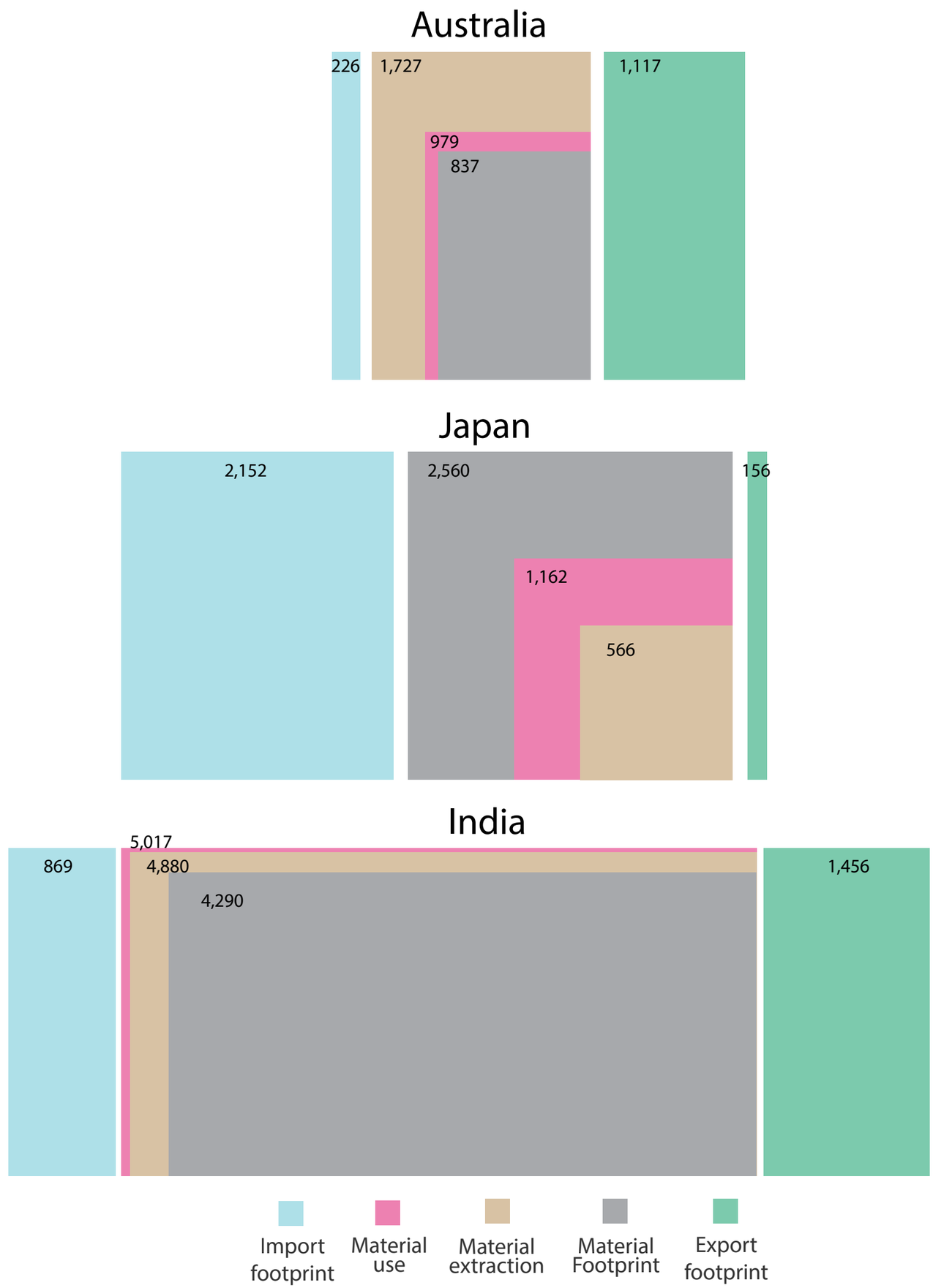
Data on the Extraction, Imports and Exports of a country (i.e. the material use of a country) are not enough to represent the overall impact of an economy upon the environment.

While material use reflects the production of goods and services, “material footprint” is based on consumption patterns. The material footprint indicates the amount of resources or emissions that can be attributed to final demand (consumption and capital investment) in a country. It shows the responsibility of a country’s consumption along the supply chain of resources and emissions which may occur anywhere in the world to satisfy final demand of that country. The footprint approach corrects the direct indicators for the upstream requirements of trade.

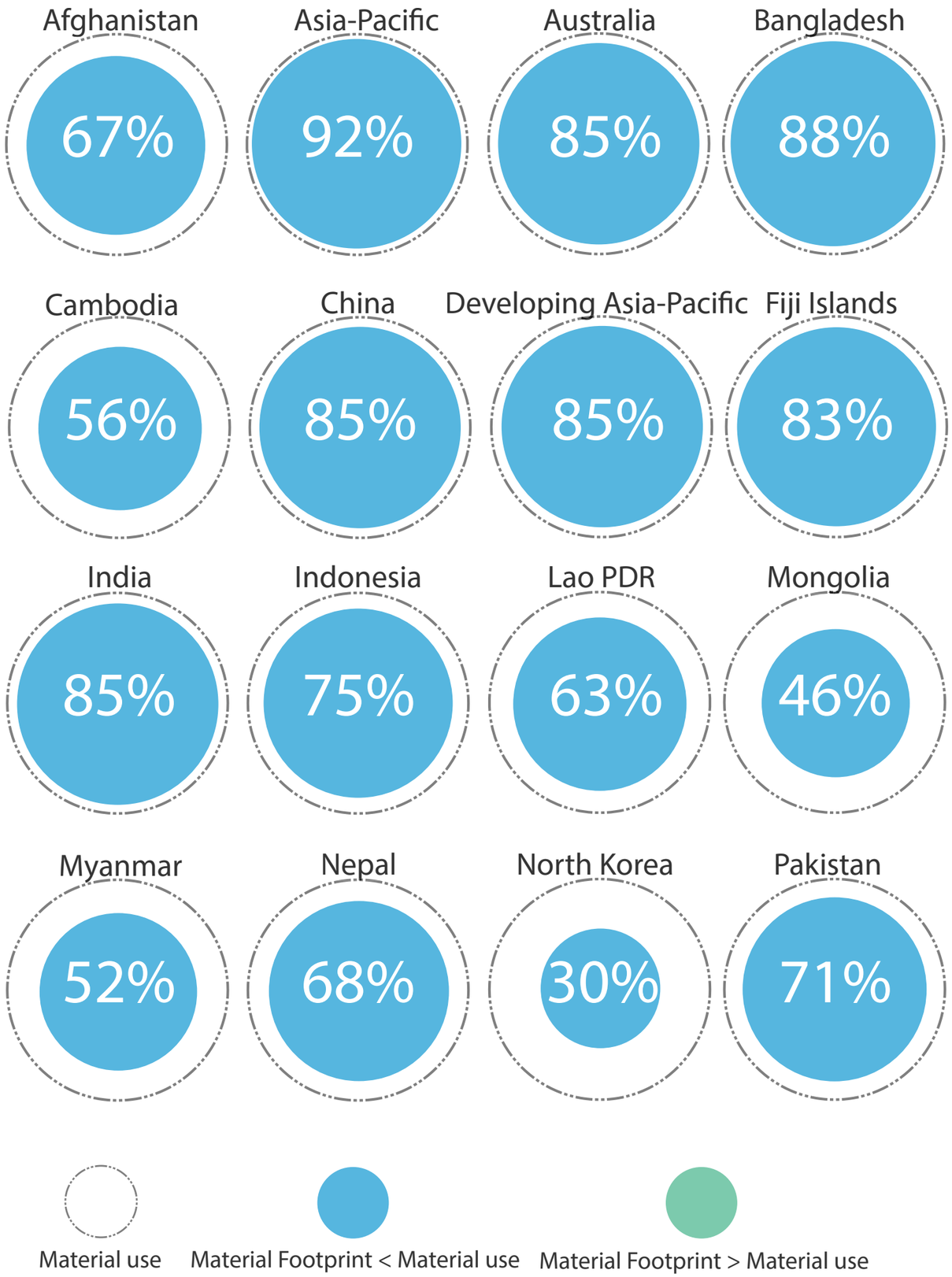
To calculate the material footprint we use data on the footprint of imports and exports.

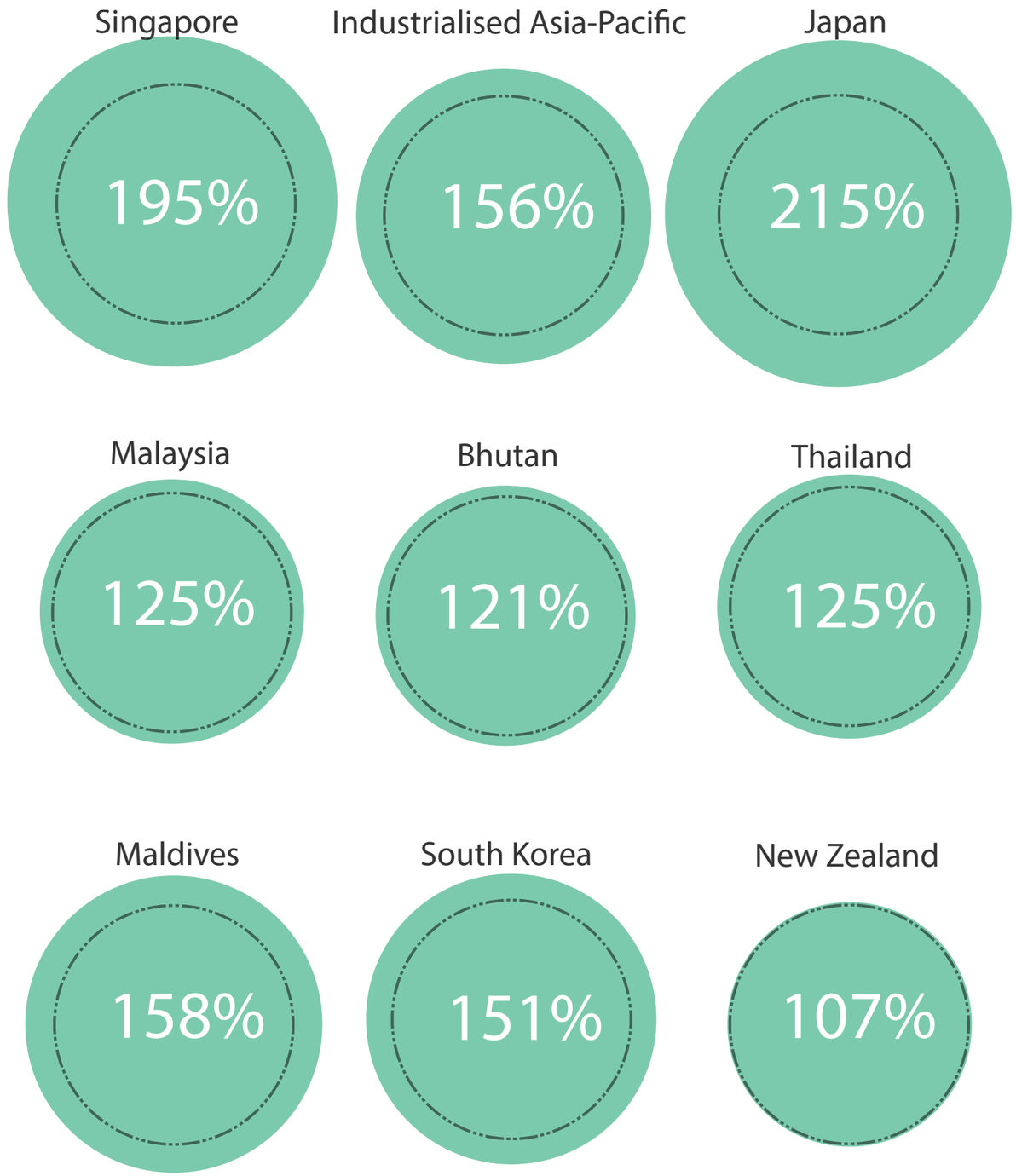
On the opposite page, three typical country profiles are shown.

- Australian exports have a large footprint, equal to 64% of its extraction. Hence, the material footprint is smaller than direct material use.
- Japan has a very large import footprint. It is 4 times bigger than what is extracted in Japan. Hence the material footprint is far larger than direct material use.
- In India, import and export footprints are quite small compared to extraction. The footprint is close in value to material use.



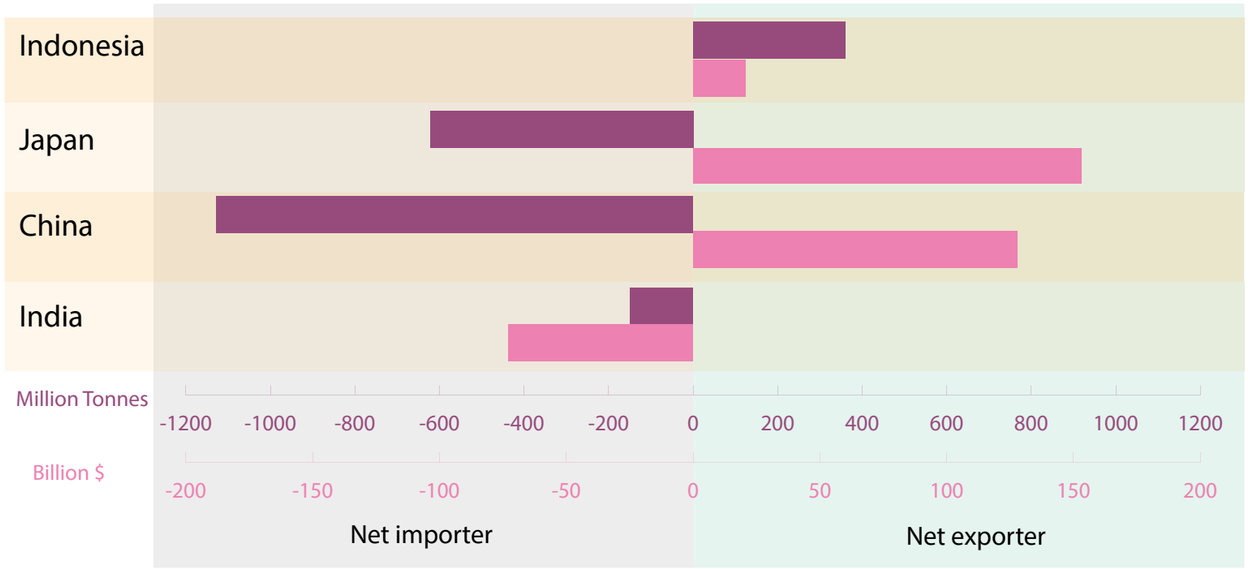
Relation between material footprint and material use in selected countries



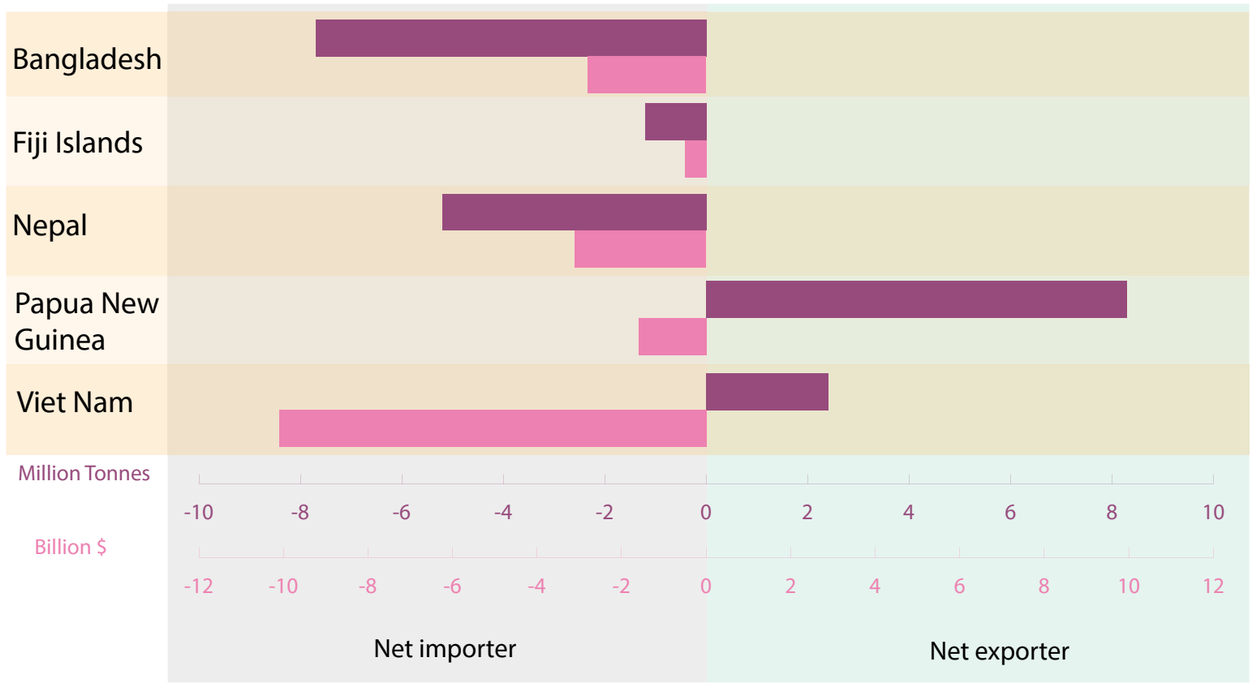


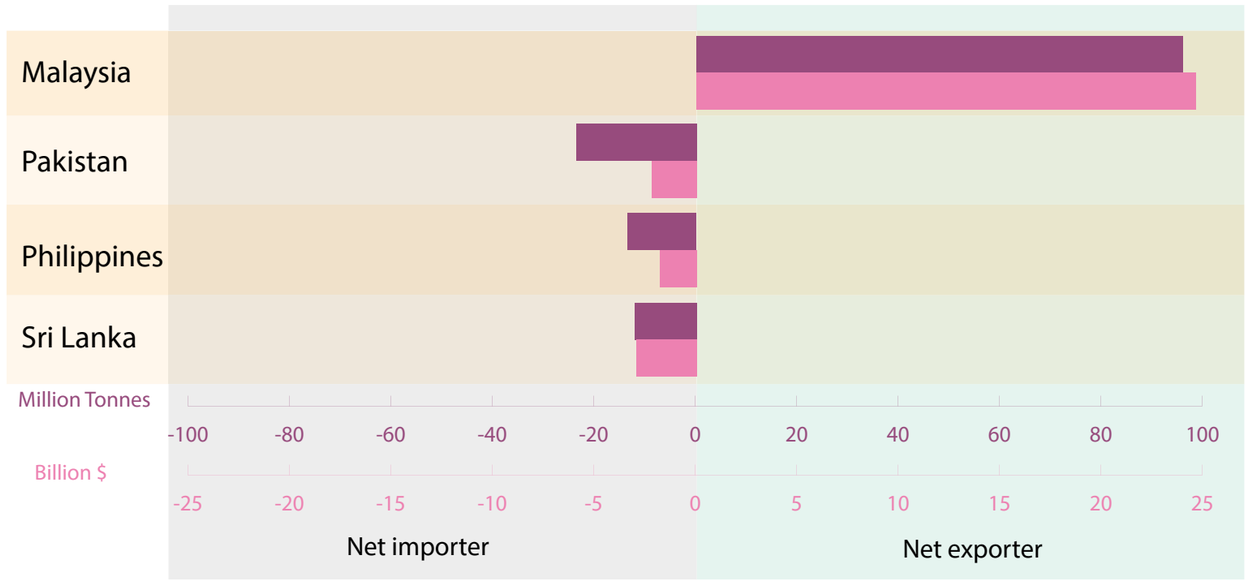
In the blue coloured countries, the footprint is smaller than material use, indicating that some of its material use is a by-product of its exports.
In the green coloured countries, the footprint is larger than material use, indicating their consumption depends on foreign material use.

Physical vs economic trade balances in groups of countries



Counting imports and exports in terms of economic value and physical volumes could make a country both an exporter and importer.

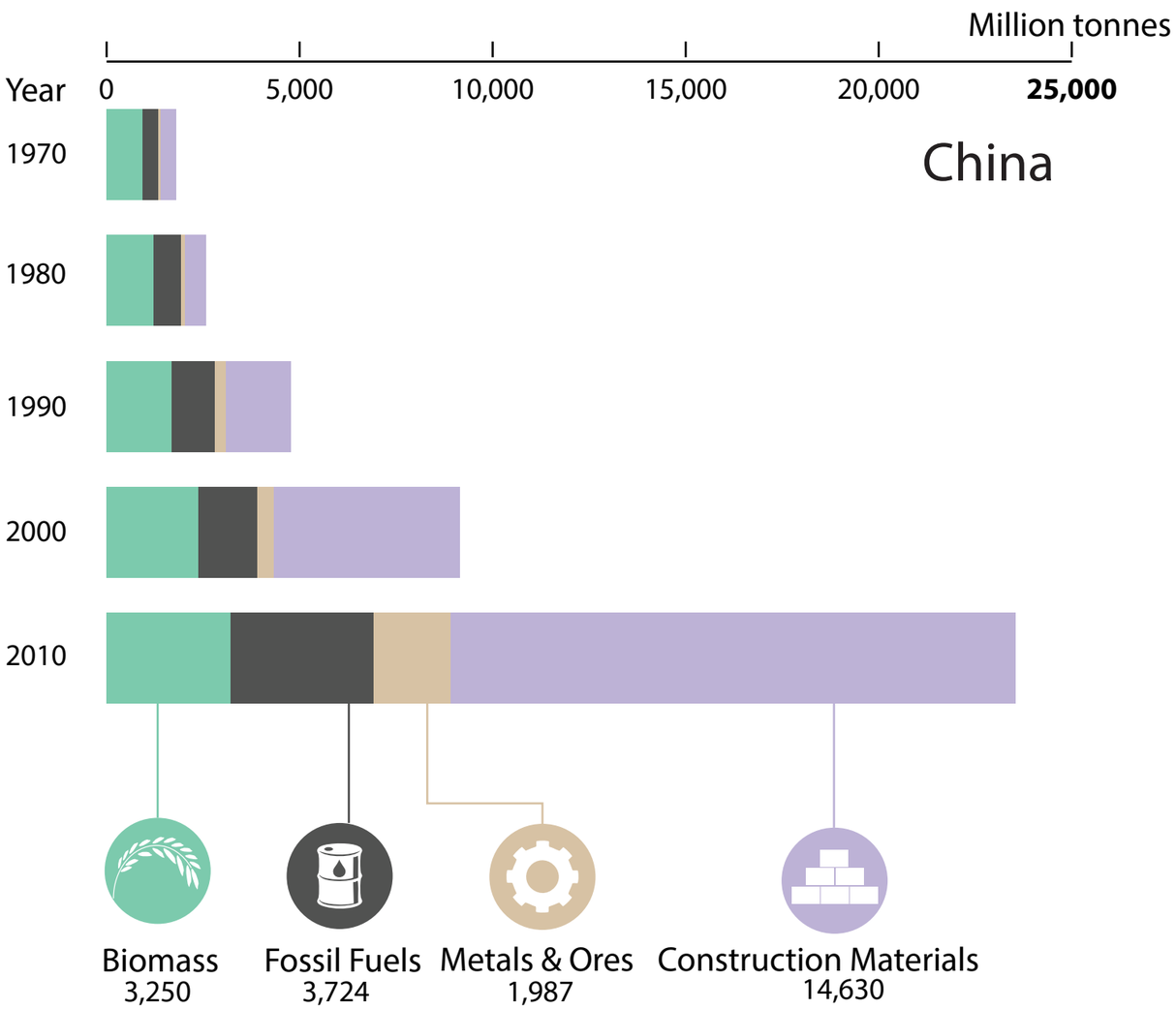


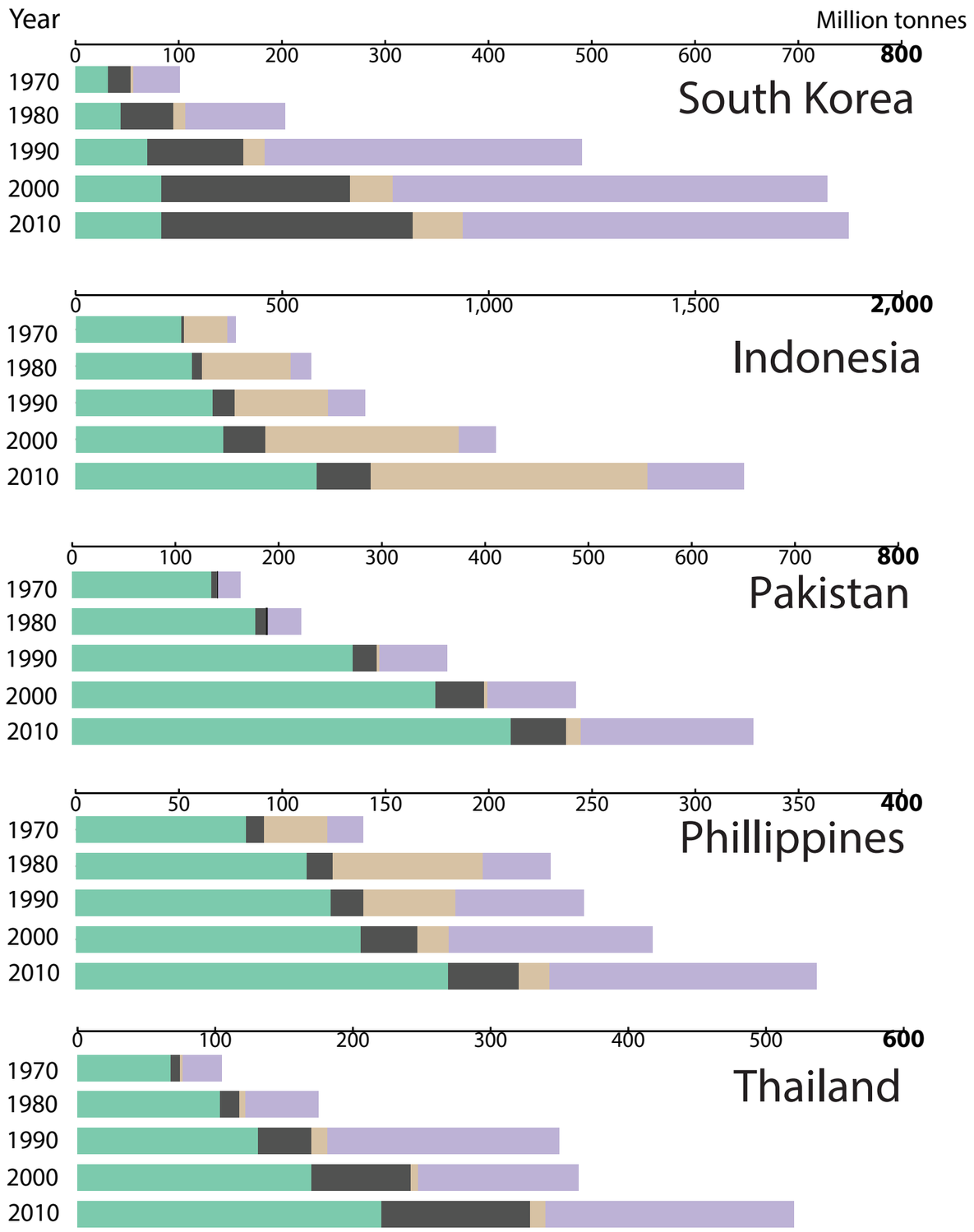


Physical trade balance year 2010
Economic trade balance year 2010

Some countries are exporters economically, but importers in physical terms.

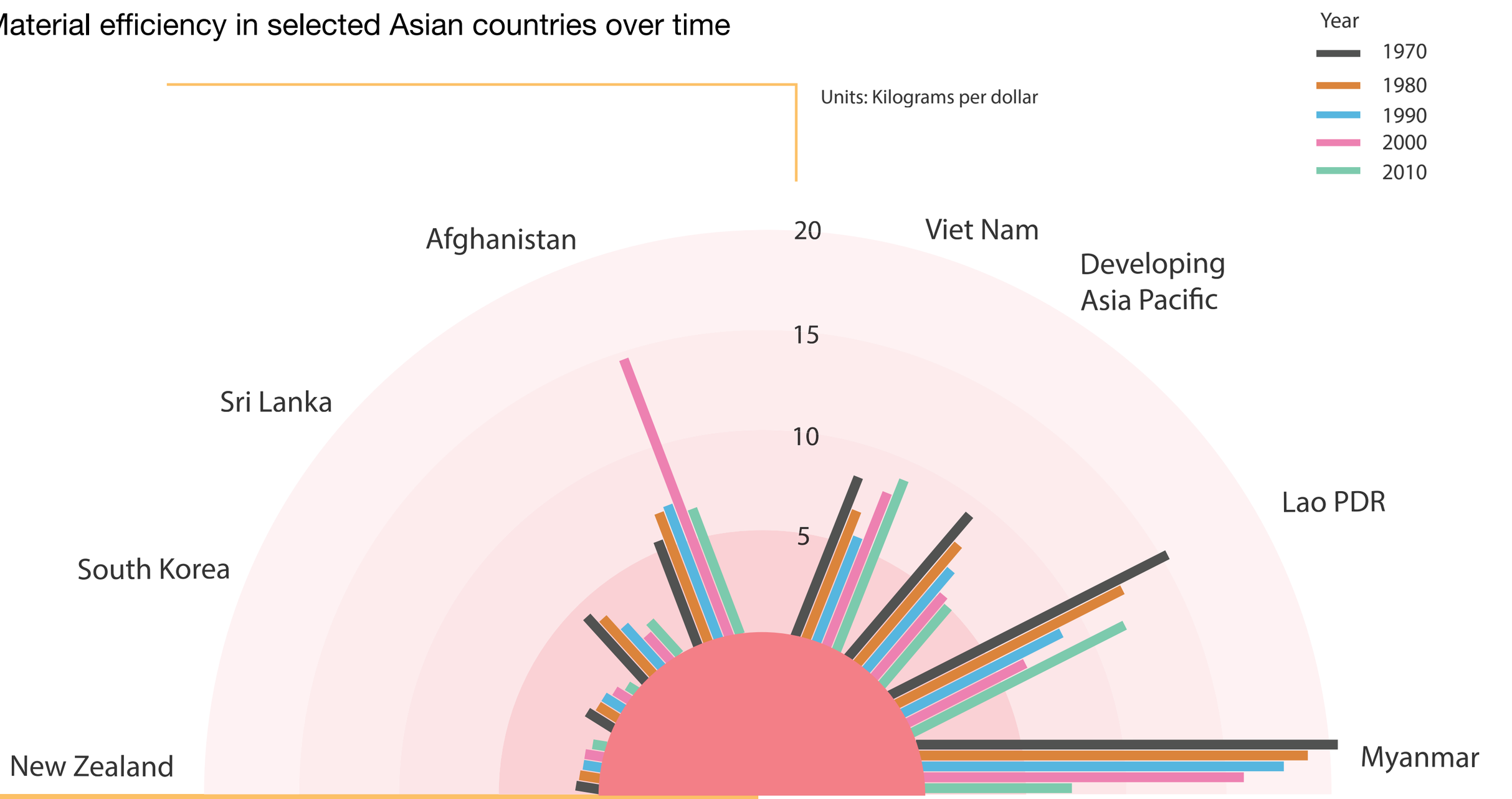
Trends in material use over time





Asia is consuming more and more of everything... but on different scales between countries.

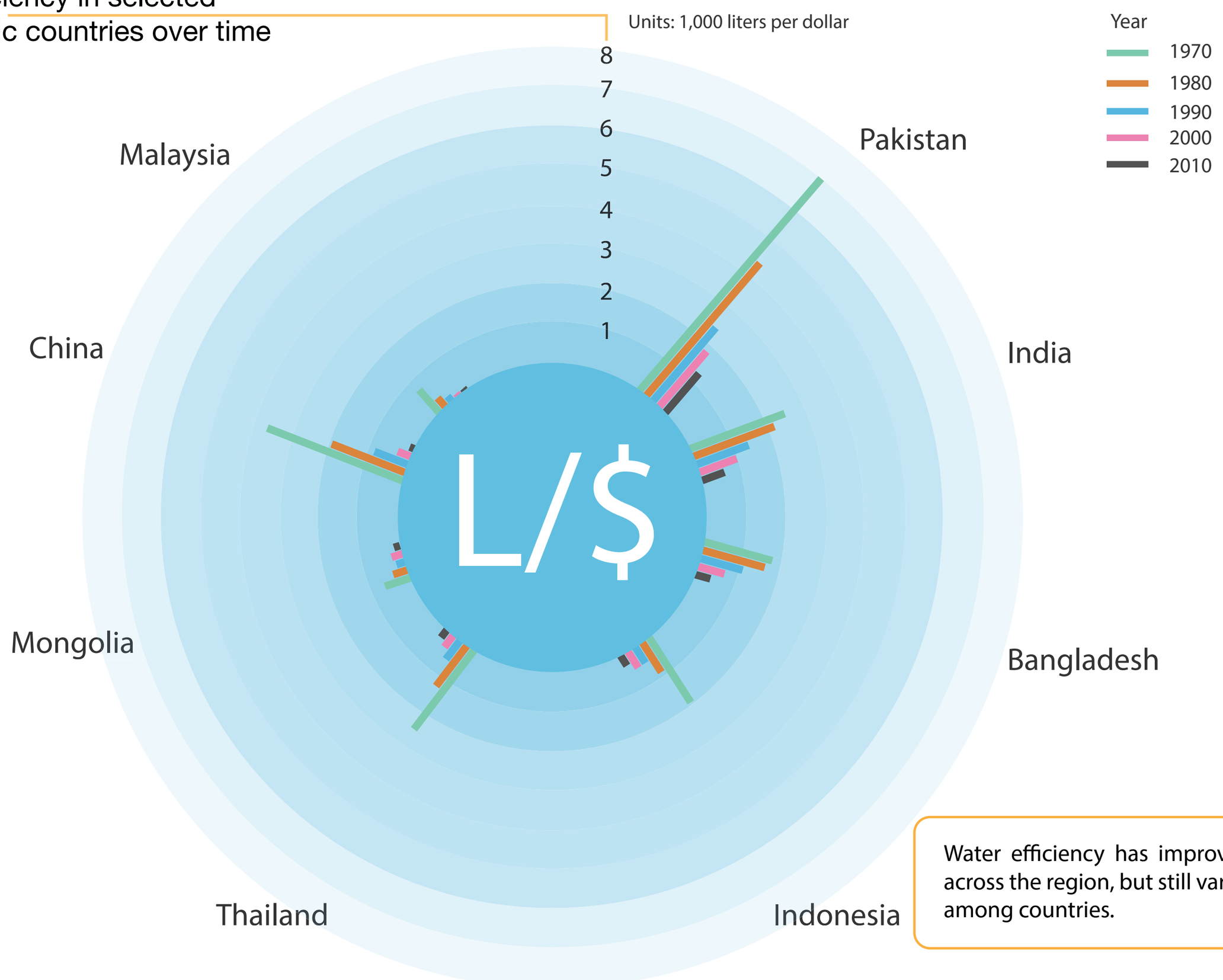
Material efficiency in selected Asian countries over time



The most efficient country in the region is performing 67 times better than the least efficient!

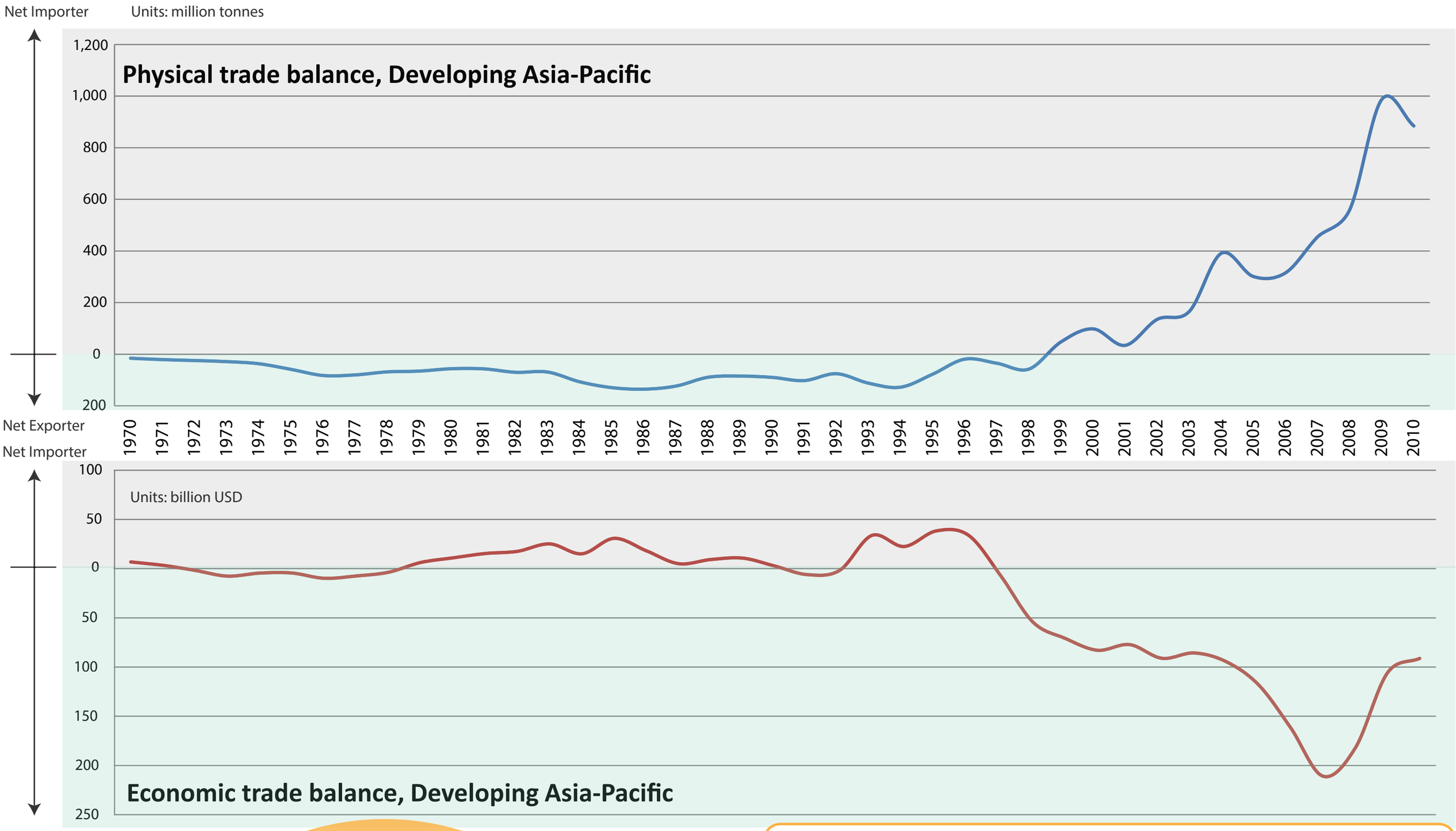
Developing countries in the Asia-Pacific region use five times as more materials per dollar of GDP (5kg/$) than the rest of the world, and ten times more than industrialized countries (0.4kg/$) in the Asia-Pacific region. The regional averages mask wide ranges from 17kg/$ down to 0.3kg/$ with the poorer countries most dependent on natural resources often having very low resource efficiency.

Water efficiency in selected Asia-Pacific countries over time



Water efficiency has improved across the region, but still varies among countries.

The evolution of trade balances in the developing countries of the Asia-Pacific



Exporter or importer?

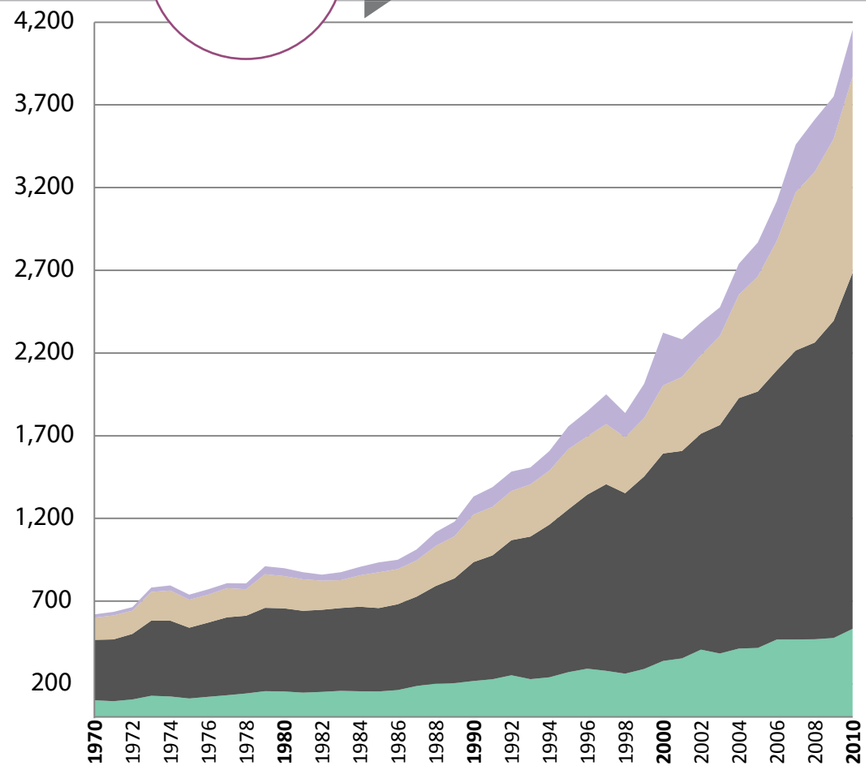
In the late 1990s, developing countries in the Asia-Pacific, known as the "manufacturing hub of the world", changed their role in international trade.
On an economic basis, these countries collectively switched from being net importers to net exporters, as they increasingly used labour inputs to add value to exports.
On a physcial basis however, these countries switched from being exporters to importers, implying that they become increasingly dependent upon resources sourced from outside the region.

Composition of imports and exports of materials in the Asia-Pacific region over time

Units: million tonnes

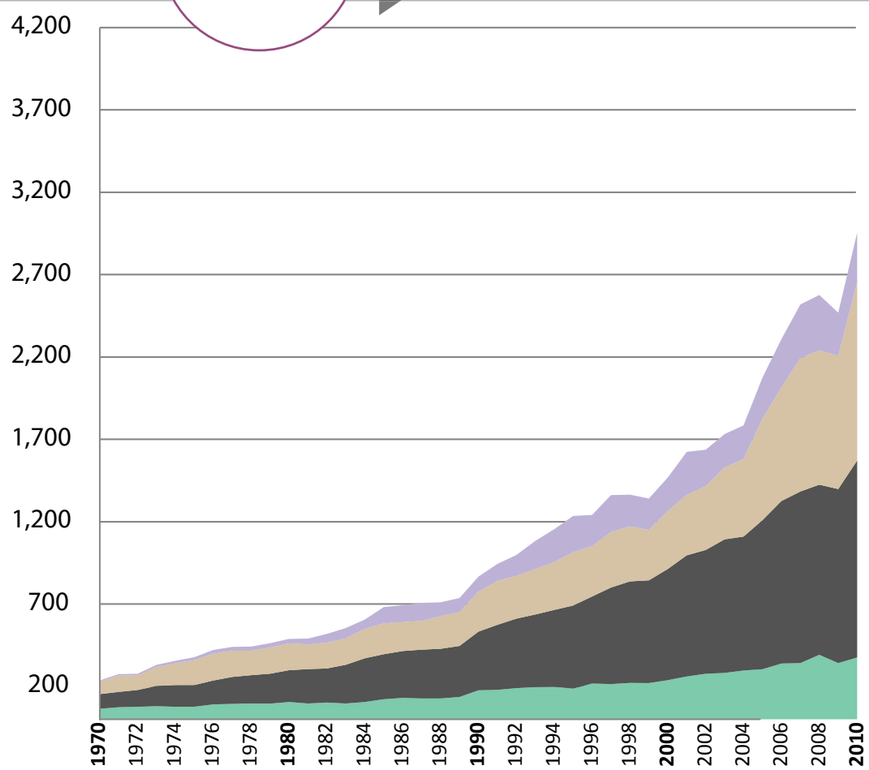
Import

Asia-Pacific



Units: million tonnes

Export



Since the 1970s, the Asia-Pacific region has increasingly imported and exported resources, implying that materials will increasingly dominate trade discussions.

Construction Materials

Metals & Ores

Fossil Fuels

Biomass

Both imports and exports are growing rapidly!

Share (%) of different sectors of the country's **material** footprint

Total material footprint
Units: Million tonnes

- < 1,000
- 1,000 - 10,000
- >10,000

Mining and energy

Agriculture

Manufacturing

Construction

Transport

Services

	China	India	Japan	Indonesia	Malaysia	Bangladesh	New Zealand	Nepal	Sri Lanka	Lao PDR
Total material footprint	20,100	4,290	2,560	1,210	490	226	94	57	51	31
Manufacturing			37%	32%	33%	50%	37%	49%	51%	
Construction	41%	31%								37%
Material footprint per person (Unit: tonnes per person)	14.5	3.6	20.1	5.0	17.3	1.5	21.5	2.1	2.5	4.8
Material footprint intensity (Unit: kilograms per dollar)	5.2	3.4	0.6	3.2	2.7	2.6	0.8	5.6	1.5	7.7

Share (%) of different sectors of the Asia-Pacific's **energy** footprint

Total energy footprint
Units: Petajoules

- < 100,000
- 100,000 - 150,000
- >150,000

	Asia Pacific	Asia Pacific developing countries	Asia Pacific industrialized countries
Mining and energy	47%	47%	47%
Agriculture	2%	1%	2%
Manufacturing	31%	25%	33%
Construction	1%	1%	1%
Transport	14%	18%	13%
Services	5%	7%	4%
Energy footprint per person (Unit: Gigajoules per person)	41.1	32.0	199.3
Energy footprint intensity (Unit: Megajoules per dollar)	11.9	17.9	6.1

Sectoral GHGs footprint in selected countries in the Asia-Pacific

Thousand tonnes

- < 100,000
- 100,000 - 1,000,000
- >1,000,000

Mining and energy

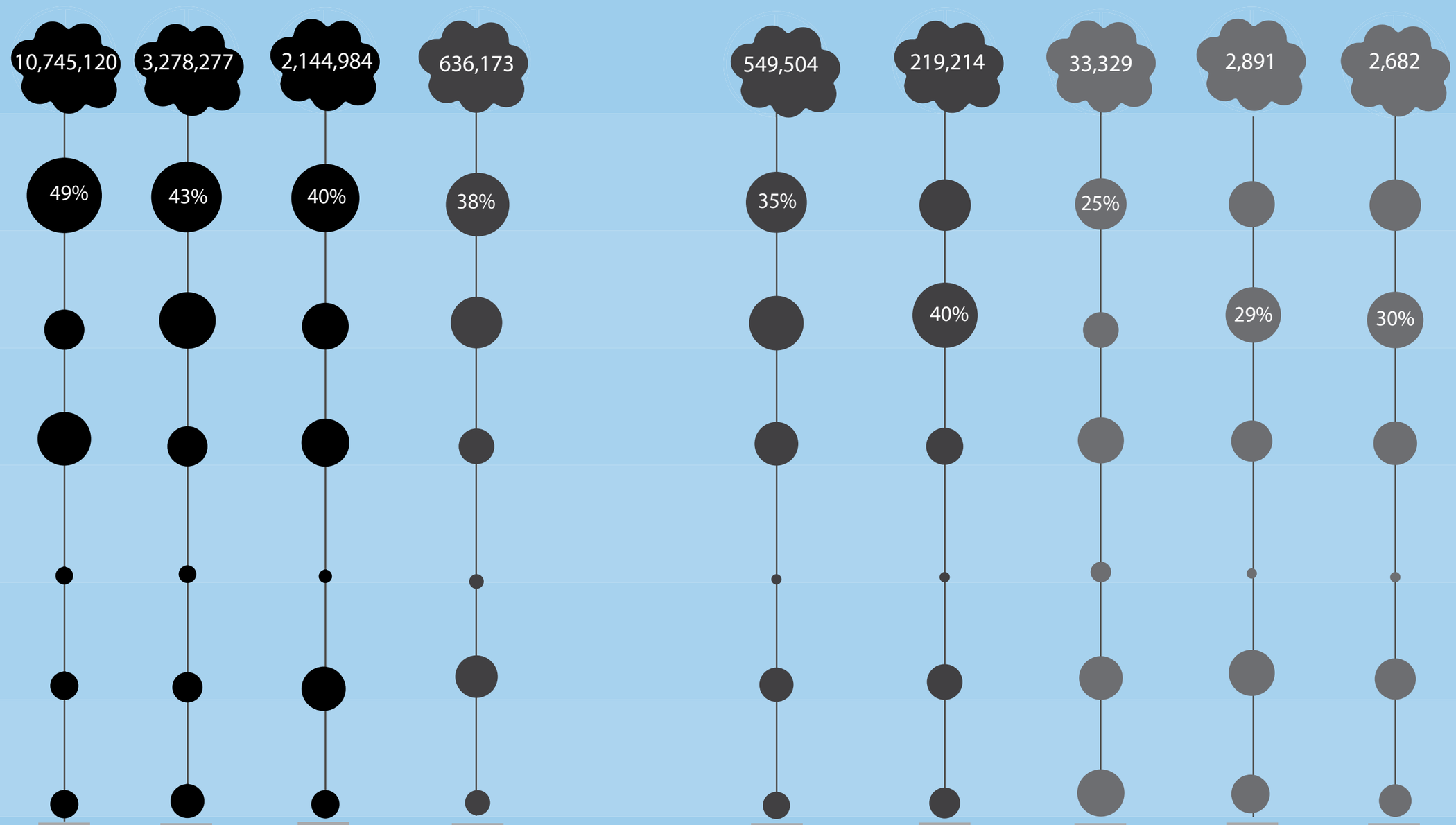
Agriculture

Manufacturing

Construction

Transport

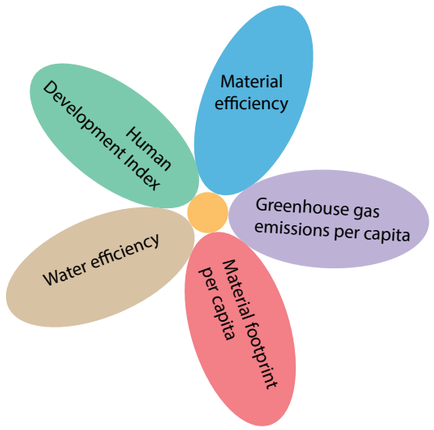
Services



	China	India	Japan	Australia	Thailand	Philippines	Sri Lanka	Fiji Islands	Maldives
GHG footprint per person (Unit: tonnes per person)	7.7	2.7	16.8	28.4	8.3	2.3	1.6	3.4	8.2
GHG footprint per dollar (Unit: Kilograms per person)	2.8	2.68	0.5	0.7	2.4	1.6	1.0	1.0	1.6

Putting it all together:
resource efficiency and human development

Each flower presents country performance in five different indicators.



- **Material efficiency**
(measured in kilograms per dollar)

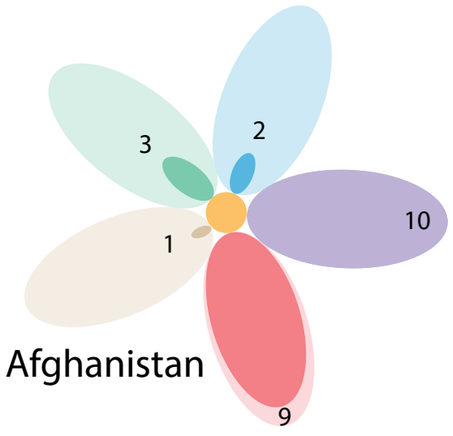
- **Greenhouse gas emissions per capita**
(measured in tonnes per capita)

- **Material footprint per capita**
(measured in tonnes per capita)

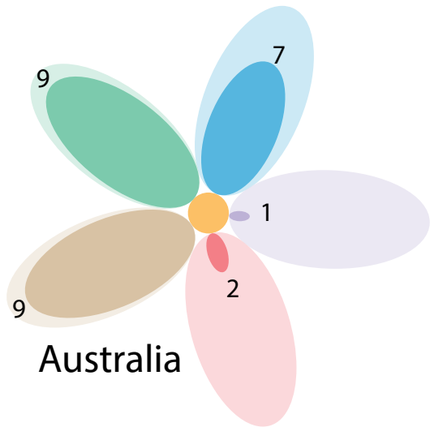
- **Water efficiency**
(measured in litres per dollar)

- **Human Development Index**
(measured as the average of three indexes measuring human development: life expectancy, years of schooling and gross national income per capita).

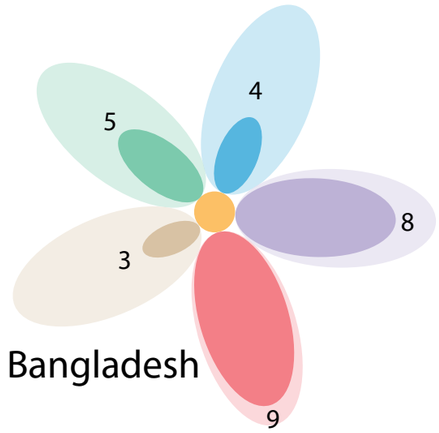
Performance is indexed from 1 to 10, with 1 representing the most resource intensive value in the region, and 10 representing the most resource efficient value. As HDI is already indexed, we simply multiply it by 10 to fit it to the scale.



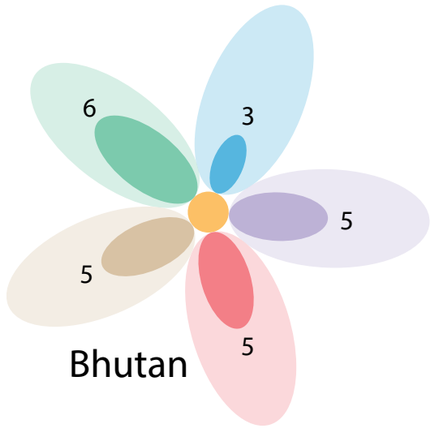
Afghanistan



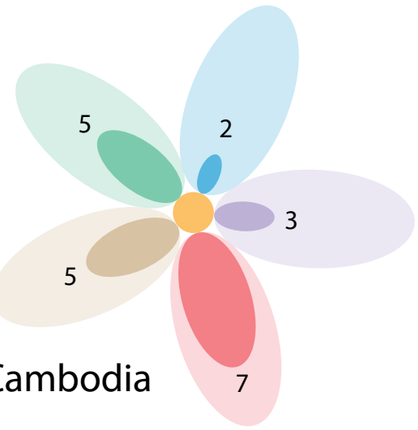
Australia



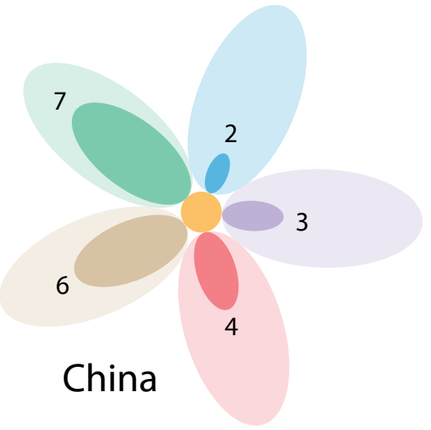
Bangladesh



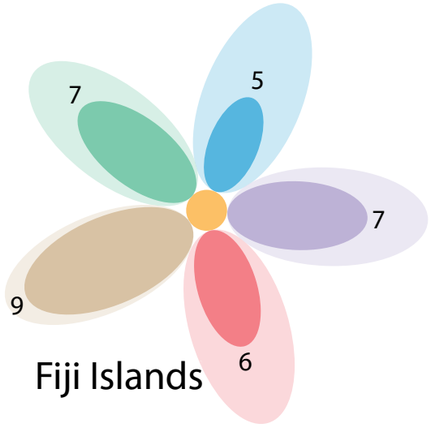
Bhutan



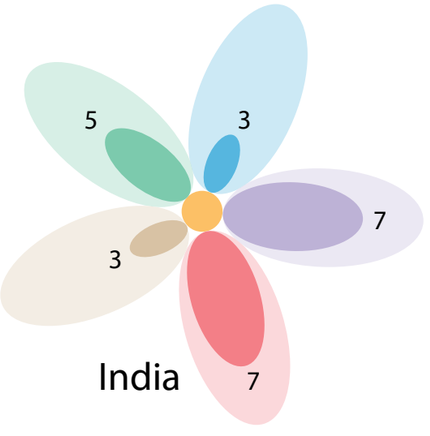
Cambodia



China



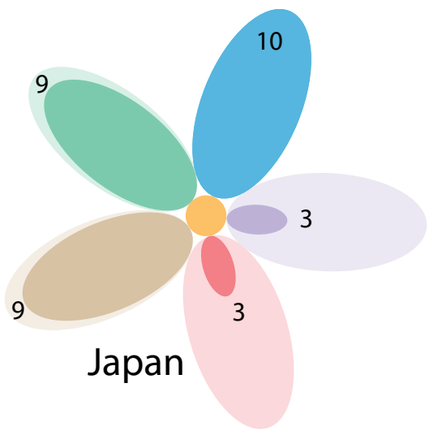
Fiji Islands



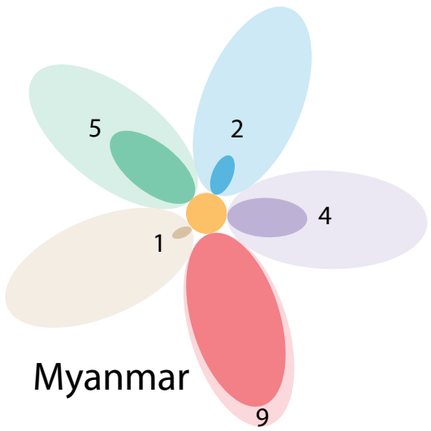
India

Putting it all together:
resource efficiency and human development

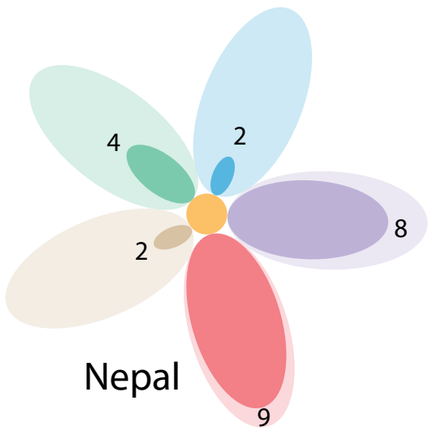
Indonesia



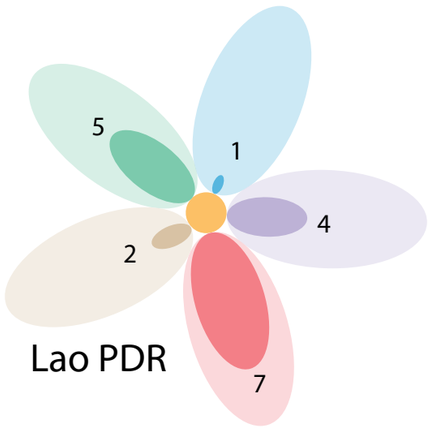
Japan



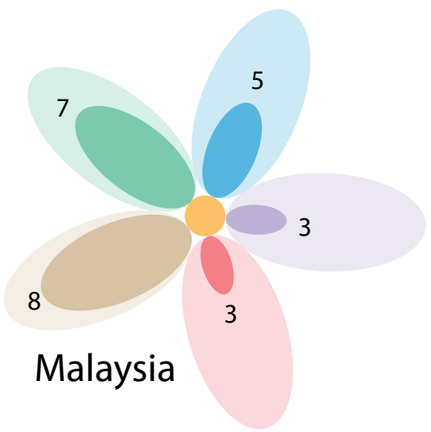
Myanmar



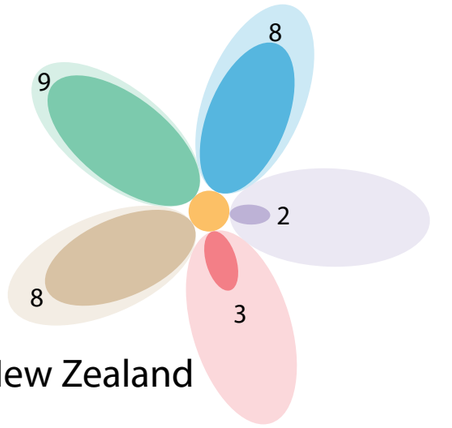
Nepal



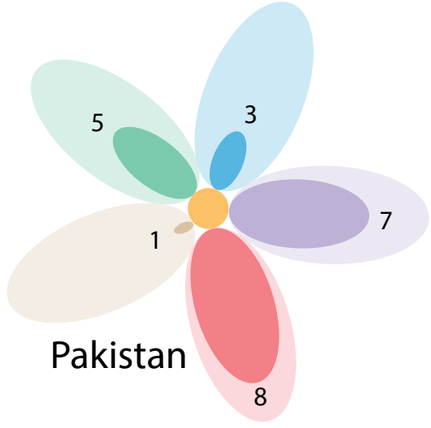
Lao PDR



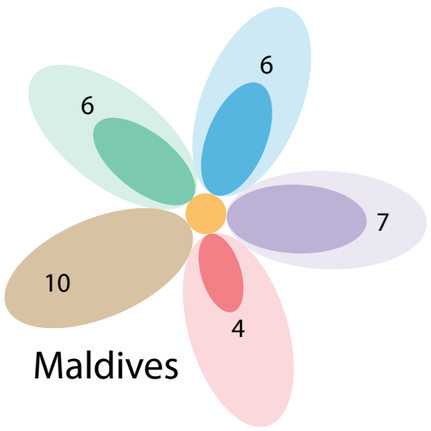
Malaysia



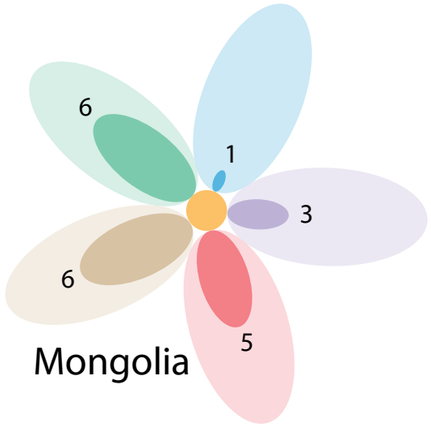
New Zealand



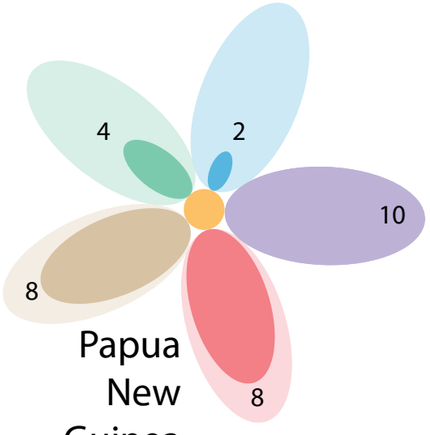
Pakistan



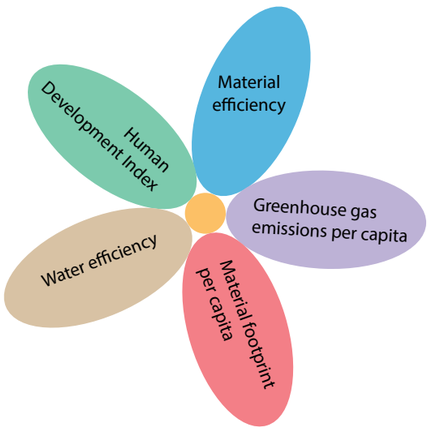
Maldives



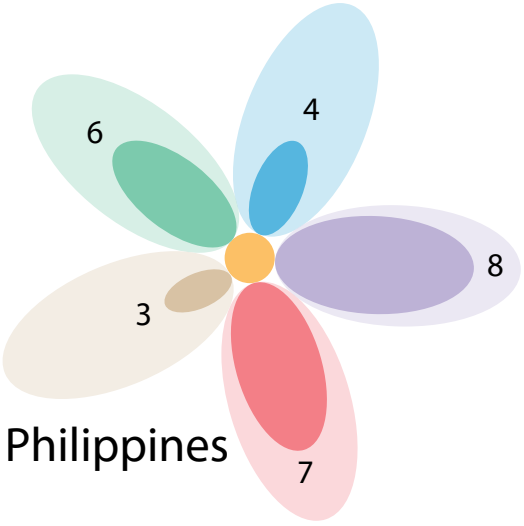
Mongolia



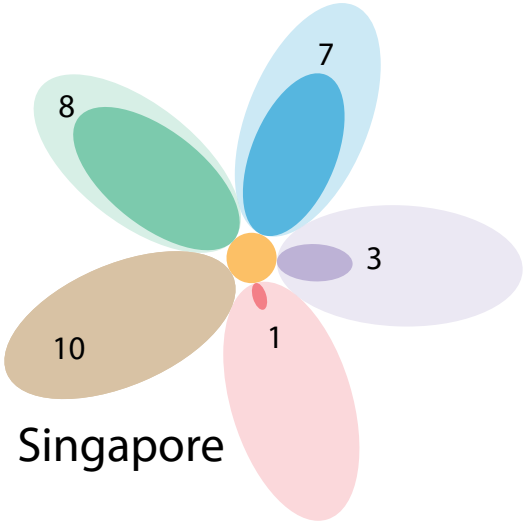
Papua New Guinea



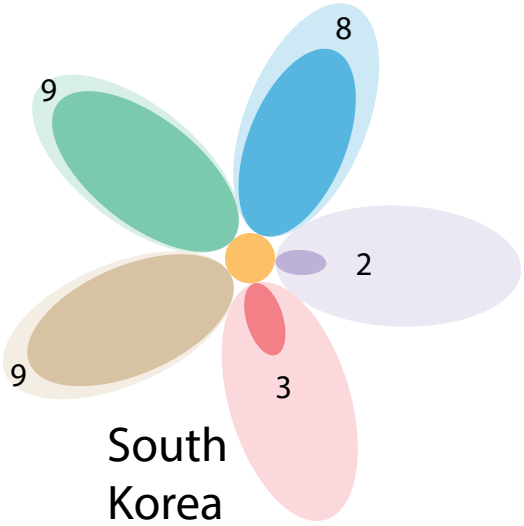
Putting it all together:
resource efficiency and human development



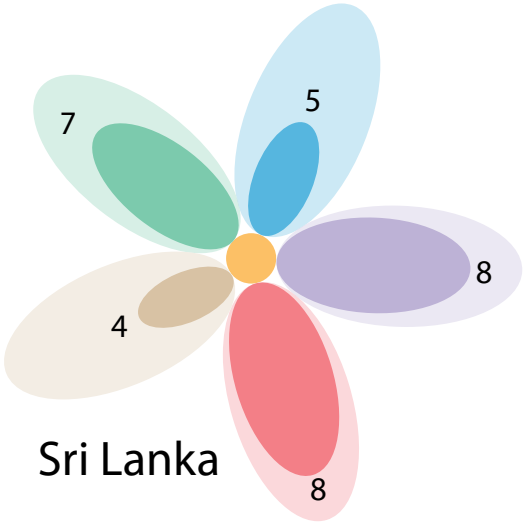
Philippines



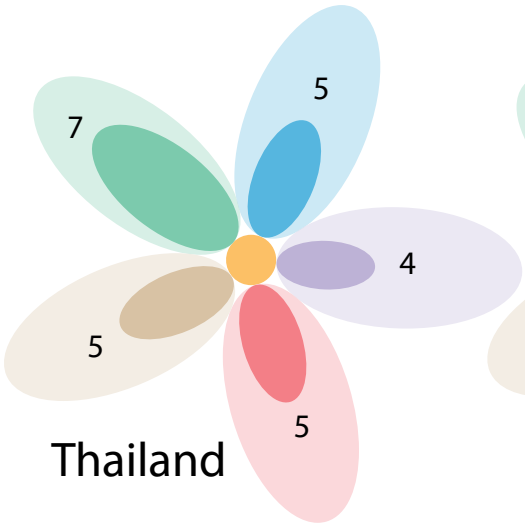
Singapore



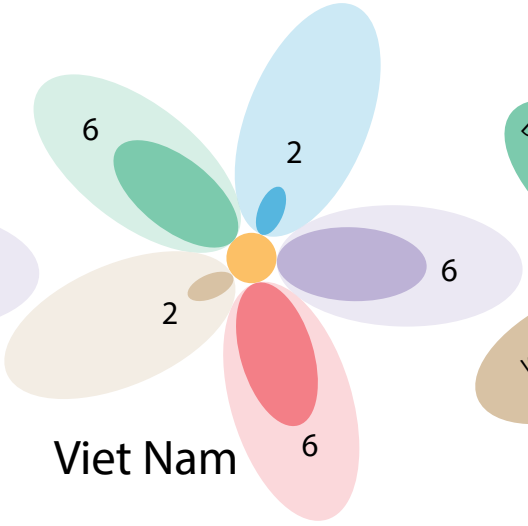
South Korea



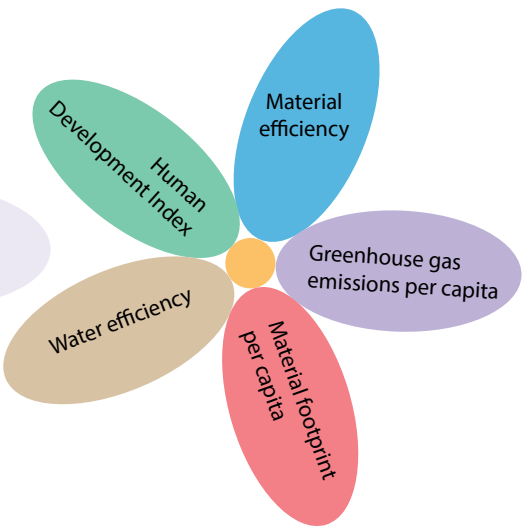
Sri Lanka



Thailand



Viet Nam



About the UNEP Division of Technology, Industry and Economics

Set up in 1975, three years after UNEP was created, the Division of Technology, Industry and Economics (DTIE) provides solutions to policy-makers and helps change the business environment by offering platforms for dialogue and co-operation, innovative policy options, pilot projects and creative market mechanisms.

DTIE plays a leading role in three of the six UNEP strategic priorities: **climate change, harmful substances and hazardous waste, resource efficiency.**

DTIE is also actively contributing to the **Green Economy Initiative** launched by UNEP in 2008. This aims to shift national and world economies on to a new path, in which jobs and output growth are driven by increased investment in green sectors, and by a switch of consumers' preferences towards environmentally friendly goods and services.

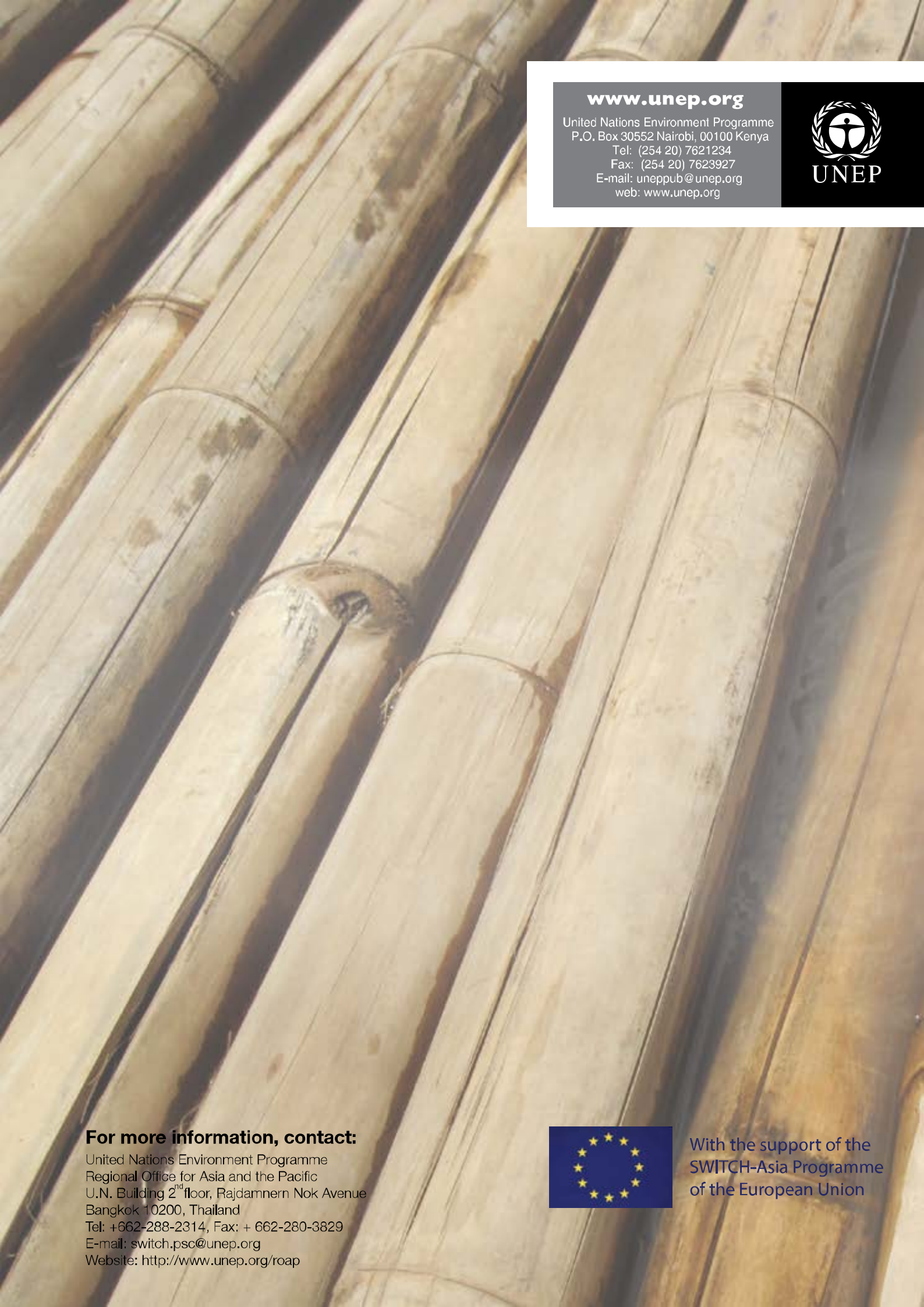
Moreover, DTIE is responsible for **fulfilling UNEP's mandate as an implementing agency for the Montreal Protocol Multilateral Fund** and plays an executing role for a number of UNEP projects financed by the Global Environment Facility.

The Office of the Director, located in Paris, coordinates activities through:

- **The International Environmental Technology Centre** - IETC (Osaka), promotes the collection and dissemination of knowledge on Environmentally Sound Technologies with a focus on waste management. The broad objective is to enhance the understanding of converting waste into a resource and thus reduce impacts on human health and the environment (land, water and air).
- **Sustainable Consumption and Production** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
- **Chemicals** (Geneva), which catalyses global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
- **Energy** (Paris and Nairobi), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

DTIE works with many partners (other UN agencies and programmes, international organizations, governments, non-governmental organizations, business, industry, the media and the public) to raise awareness, improve the transfer of knowledge and information, foster technological cooperation and implement international conventions and agreements.

For more information,
www.unep.org/dtie



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