Module 1
Circular Economy Introduction

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12:03
Wed, 29 Aug
Samsung
GALAXY Note II
Xperia™ Z
BlackBerry
Blank to keep
you moving
SkyDrive
10:08
29°C

LINEAR ECONOMY

RESOURCE EXTRACTION | PRODUCTION | DISTRIBUTION | CONSUMPTION | WASTE

2015:

80 billion
tonnes Materials

2050:

150 billion
Tonnes Materials

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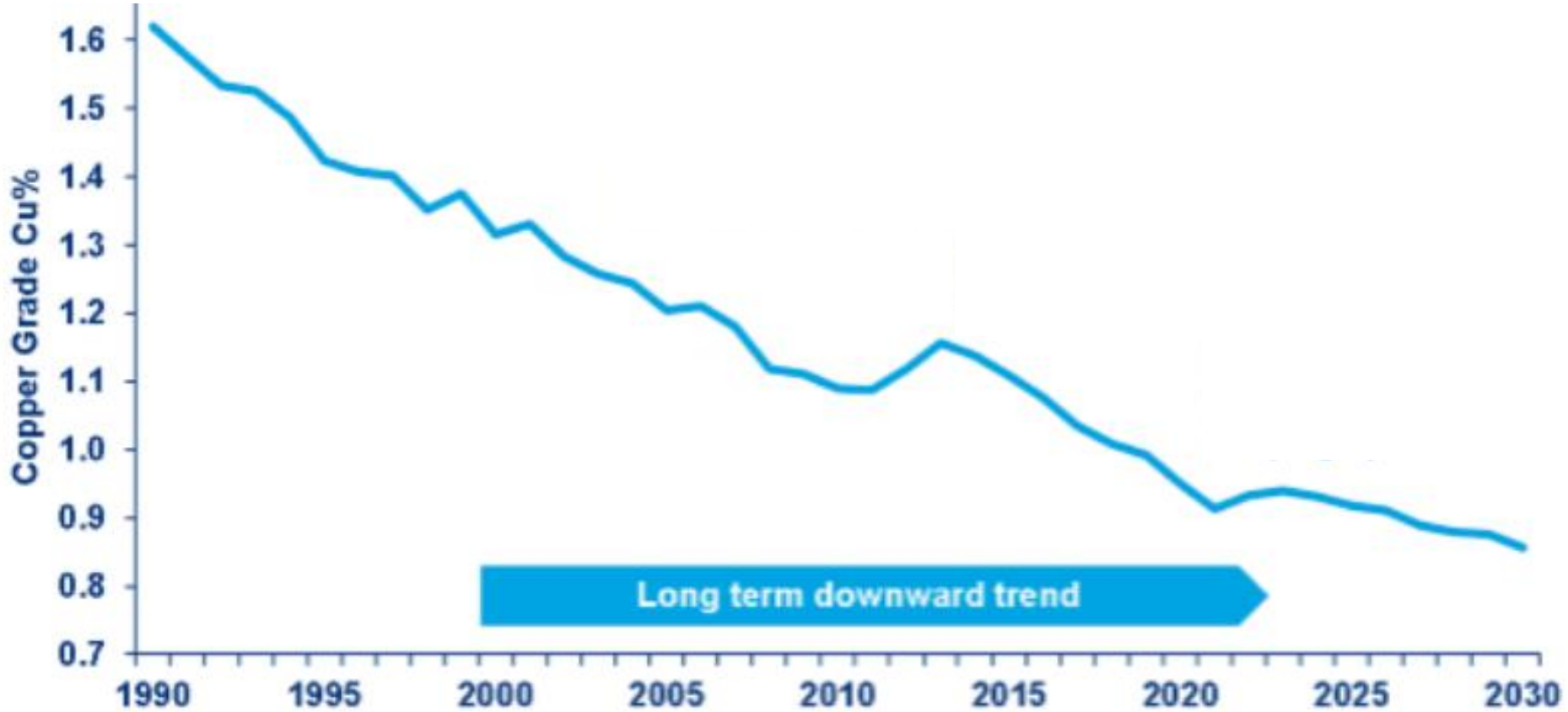
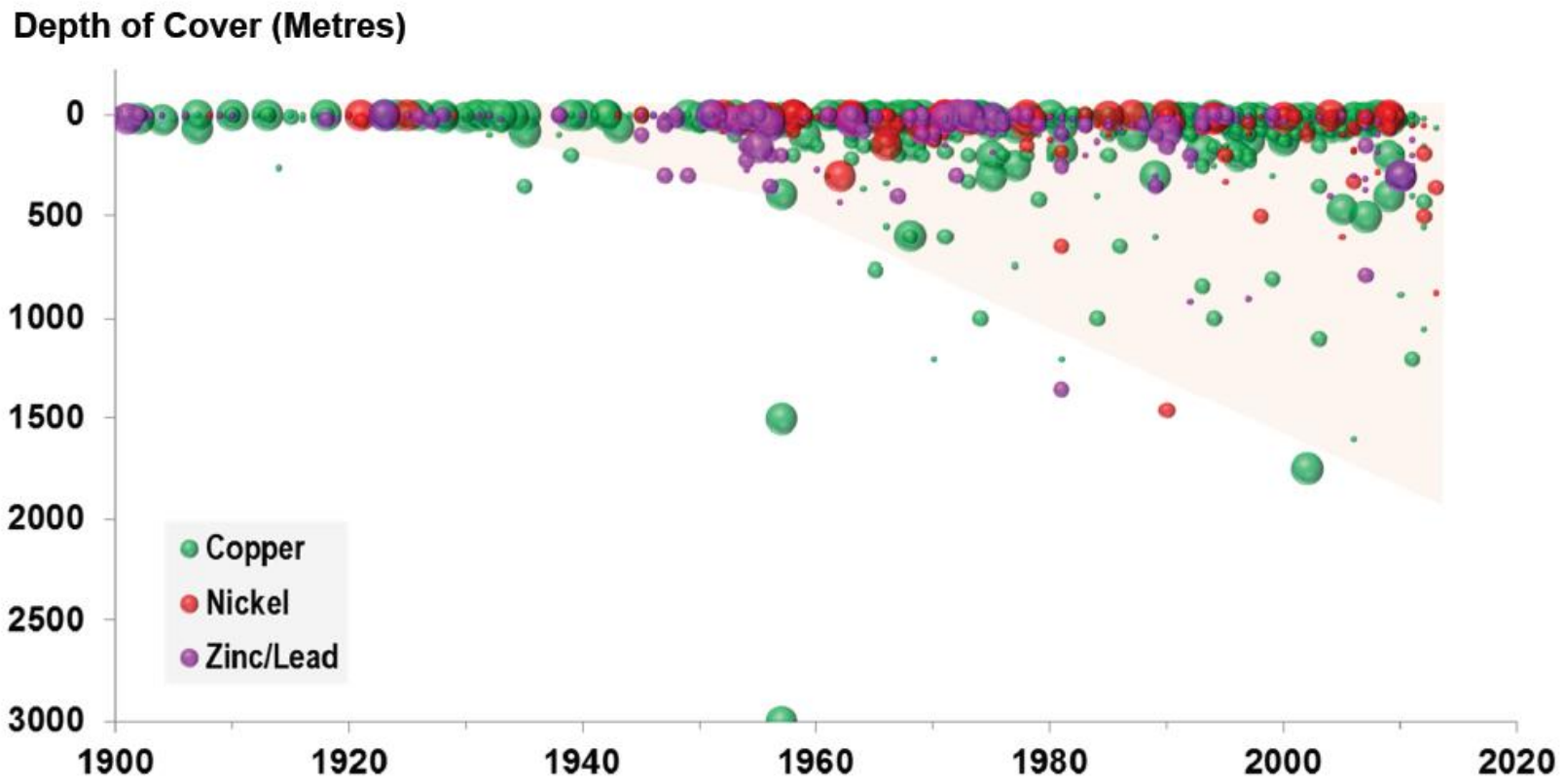
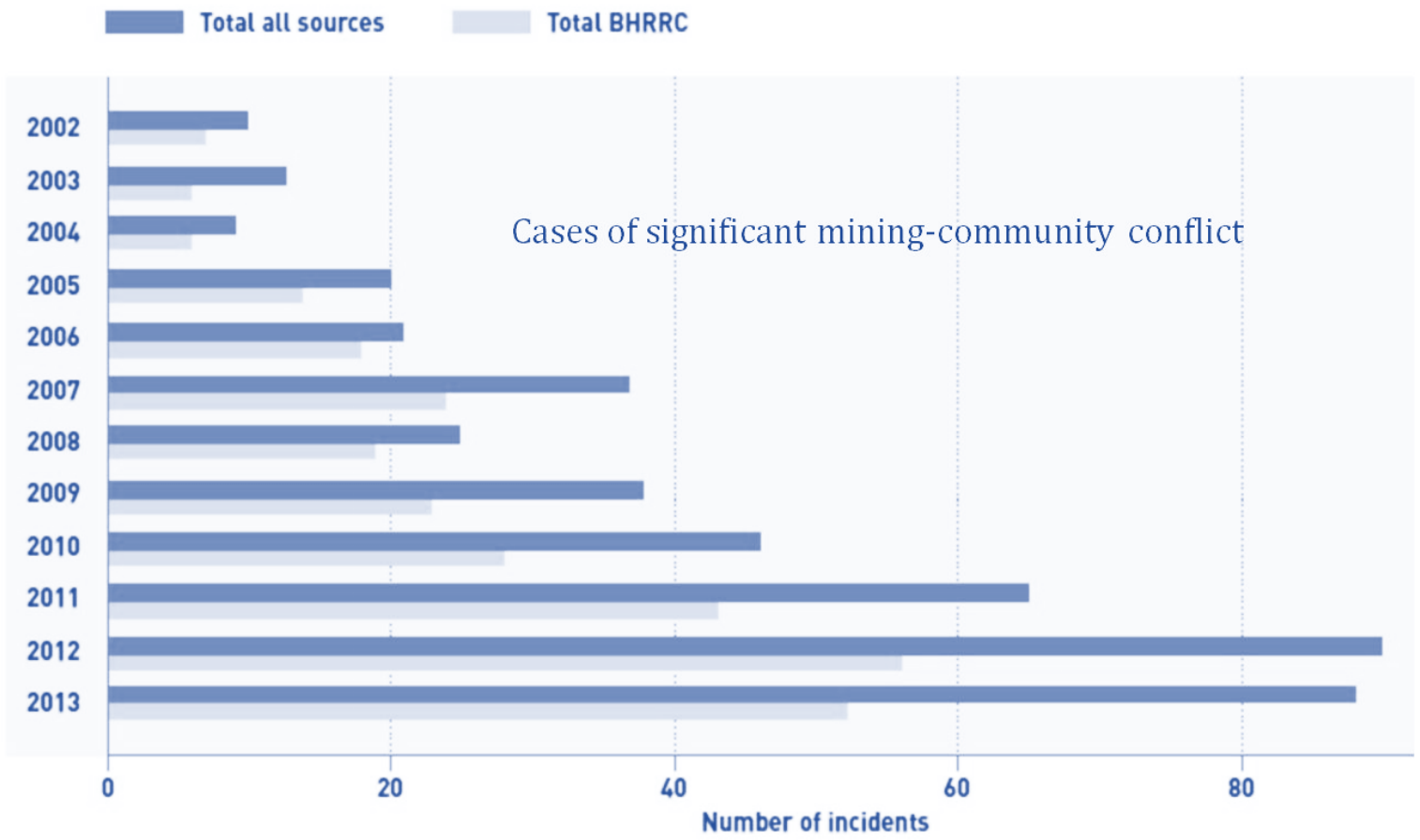
GEOLOGICAL SCARCITY-
ORE GRADES DECLINING



GEOLOGICAL SCARCITY-
MINES GETTING DEEPER



GEOGRAPHIC SCARCITY
DEPOSITS IN AWKWARD PLACES



GEOGRAPHIC SCARCITY

...REALLY AWKWARD PLACES

ASTEROIDS

DEEP SEA

CUTE SWEDISH TOWN

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GEOGRAPHIC SCARCITY
...REALLY AWKWARD PLACES

Space mining a step closer as Japan successfully lands rovers on ASTEROID

SPACE mining is one step closer after Japan successfully landed two rovers on the surface of an asteroid.

Share Tweet 51

By Rachel O'Donoghue / Published 22nd September 2018

ASTEROIDS

Deep-Sea Mining for Rare-Earth Metals Looms, as Do Environmental Questions

From Environment & Energy Report REQUEST A DEMO

Turn to the nation's most objective and informative daily environmental news resource to learn how the United States and key players around the world are responding to the environmental...

By Adam Allington and Stephen Lee

Once thought too expensive and too difficult, commercial scale mining of the deep sea is poised to become a reality as early as 2019. But scientists warn reaching rare minerals on and under the sea floor could cause irreversible damage to an

DEEP SEA

Swedish town makes unprecedented move for iron ore mine

Hugues Honore | April 02, 2015

6 0

CUTE SWEDISH TOWN

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GEOPOLITICAL SCARCITY

COUNTRIES HAVE MONOPOLIES ON CRITICAL MINERALS

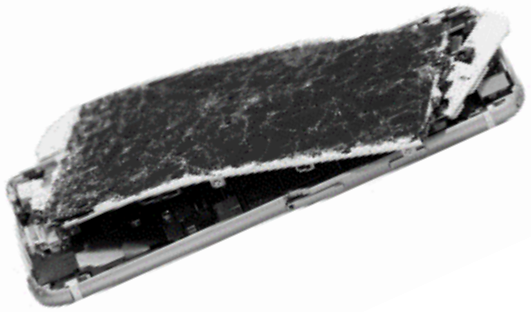
China rare earth: US, EU, Japan accuse China of hoarding minerals needed for technology parts

By **DON MELVIN** Associated Press
Tues., March 13, 2012

~~LINEAR~~ ECONOMY

RESOURCE EXTRACTION → PRODUCTI… → …RIBUTION → CONSUMPTION → WASTE

CIRCULAR ECONOMY



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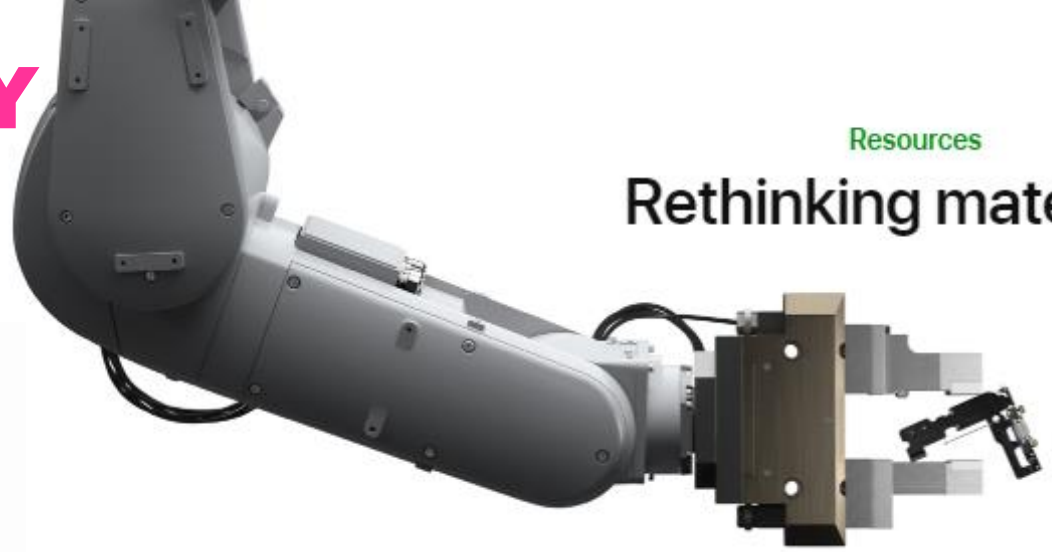
CIRCULAR ECONOMY

APPLE



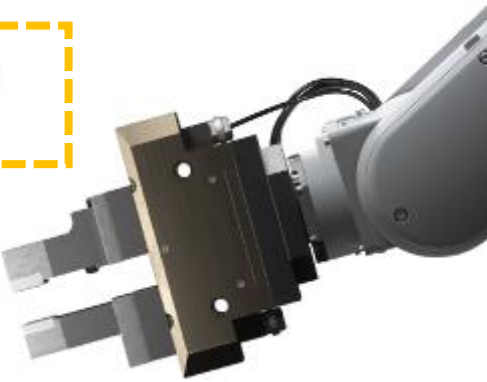
Resources

Rethinking materials.

Mining less from the earth. And more from old devices.

There are a lot of valuable materials inside old devices that are perfect for making new products. The challenge is that recovering them is extraordinarily complex and hard to do efficiently. So we've put our passion for innovation into piloting new recycling technologies. With advancements like Daisy, our newest disassembly robot, we can recover more materials and at a higher quality.

Ultimately, we want to make products using only renewable resources or recycled material. And we want to return an equivalent amount of material to the market, to be used by us or others. Our ambition is that one day we'll extract nothing from the earth.



Meet Daisy, the ultimate recycling robot.

Our newest disassembly robot, Daisy, is the most innovative and efficient

TECHNOLOGY CAN SUPPORT RESOURCE EFFICIENCY

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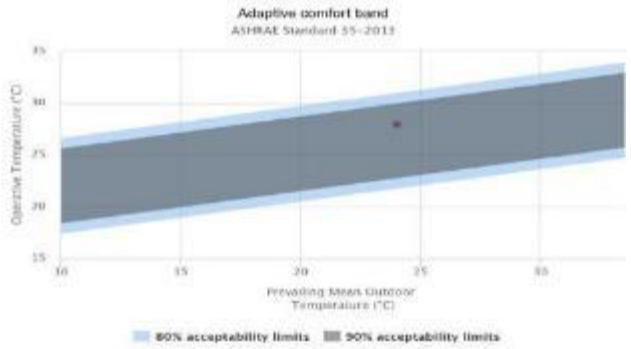
INTERNET OF THINGS

BRINGING ENIVRONMENTAL DATA INTO THE PICTURE



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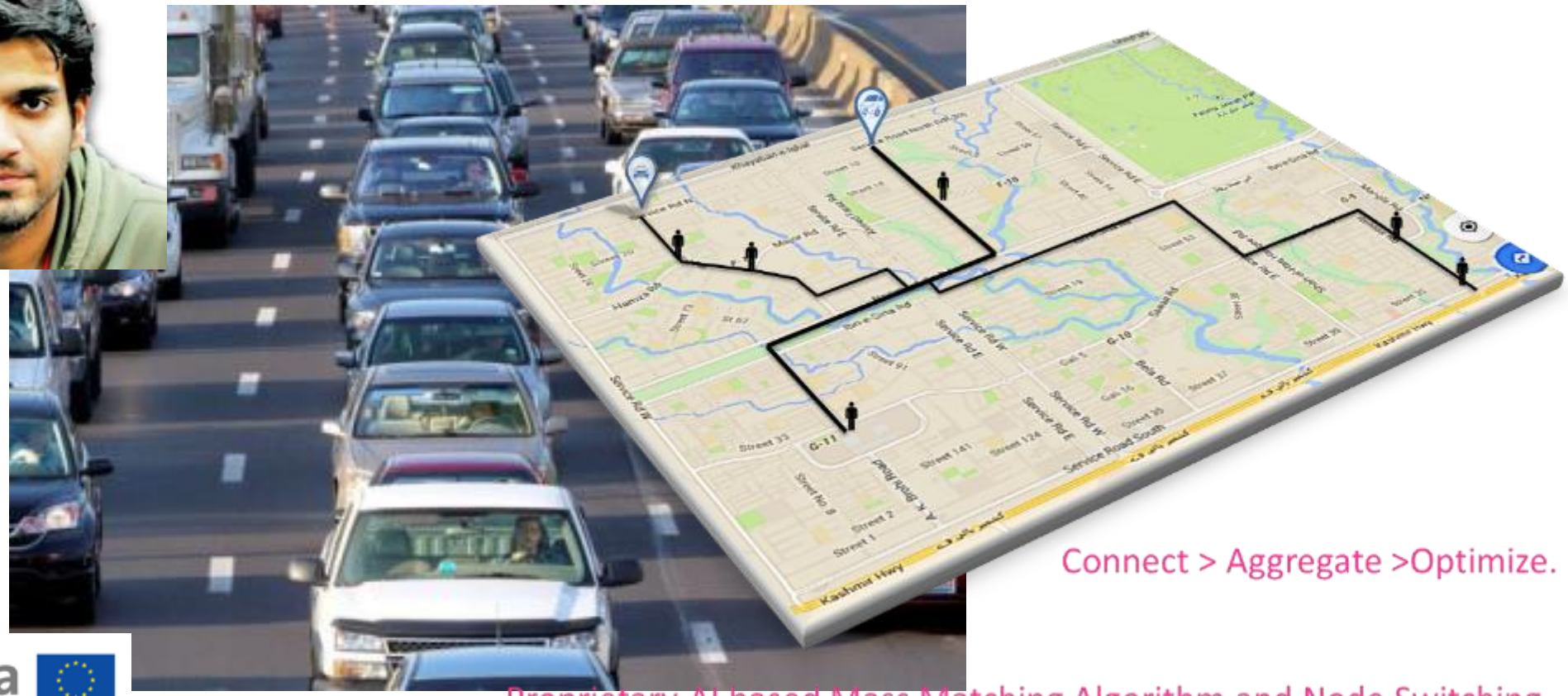
ARTIFICIAL INTELLIGENCE, MACHINE LEARNING

PROCESSING COMPLEX DATA FOR OPTIMAL ENVIRONMENTAL DECISIONS

RASAI enables a Smart Dynamic Transit Network



Connect > Aggregate >Optimize.

Proprietary AI based Mass Matching Algorithm and Node Switching

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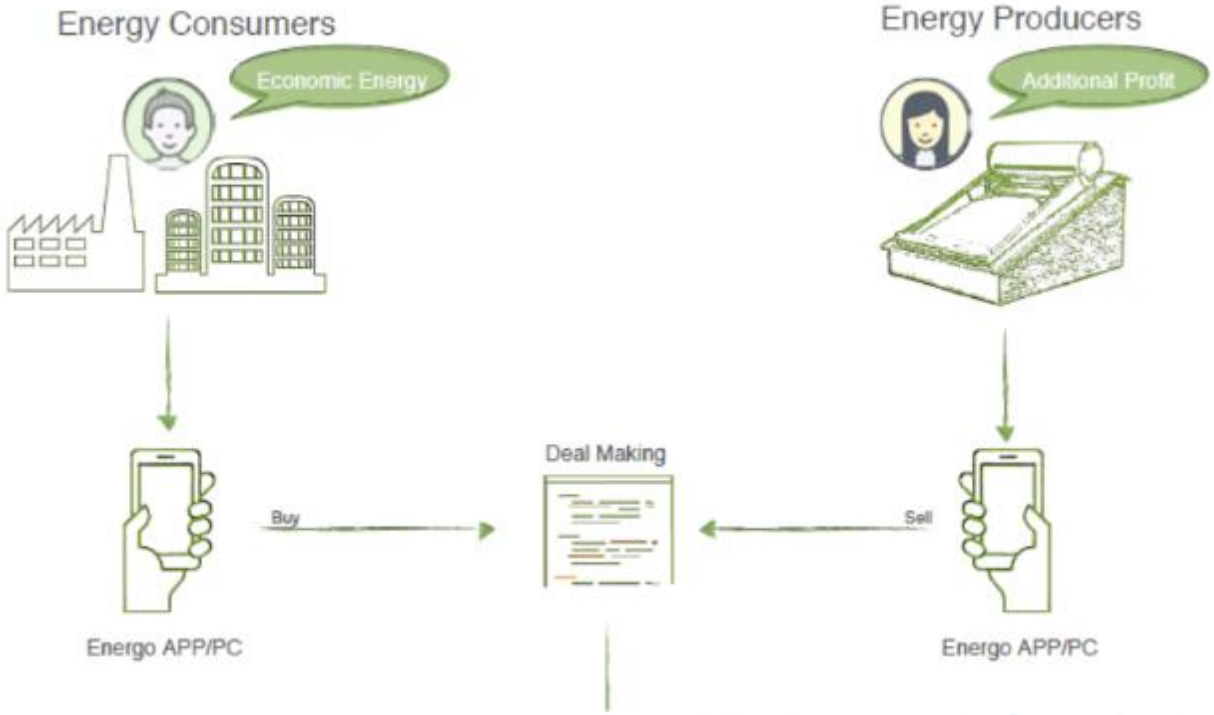
BLOCKCHAIN

1. SUPPLY CHAIN TRANSPARENCY
VOTE WITH MY DOLLARS

2. TOKENIZE RECYCLING
GAMEFY CIRCULAR ECONOMY

3. P2P ENERGY TRANSACTIONS
ENABLES DECENTRALISED RENEWABLES



SO LET'S GET STARTED

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1. Natural Resources

2. Causal chain (DPSIR)

3. Circular Economy Concepts

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Summary – Resource Productivity

1. **Natural resources** more include materials, energy, water, land. The use of these natural resources leads to emissions to the environment, and land use change.
2. **Materials** can be divided into abiotic (fossil fuels, minerals, metal ores) and biotic (biomass from agriculture, forestry, fisheries).
3. **Resource use** can be measured by accounting for extraction, imports and exports. Upstream resource use is accounted for in footprints.
4. **Resource productivity can be measured** by dividing the economic benefits a country or sector gets out of each tonne of materials.
5. **Resource productivity can be increased** through specific policies at the national level, and measures at the sector level.

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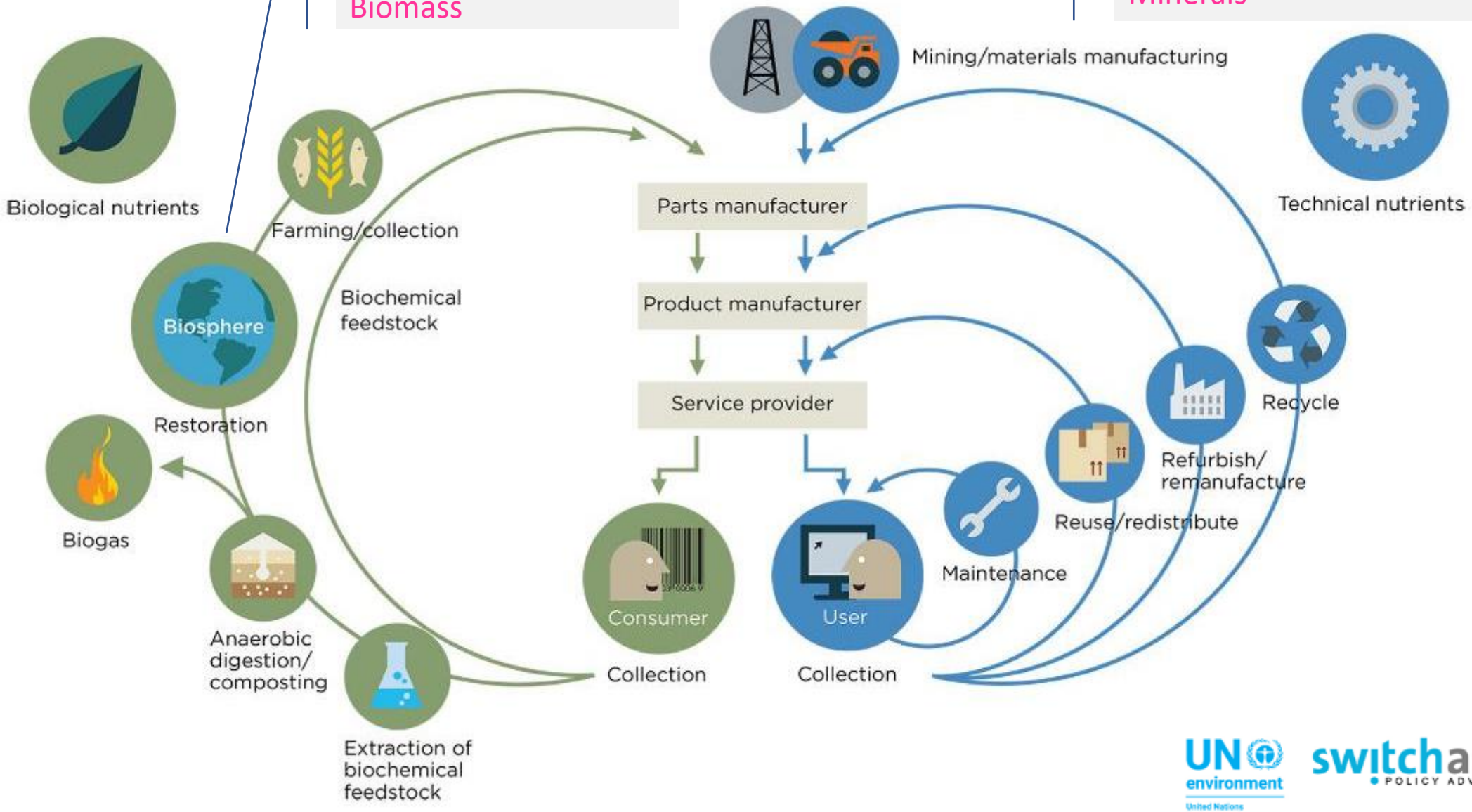
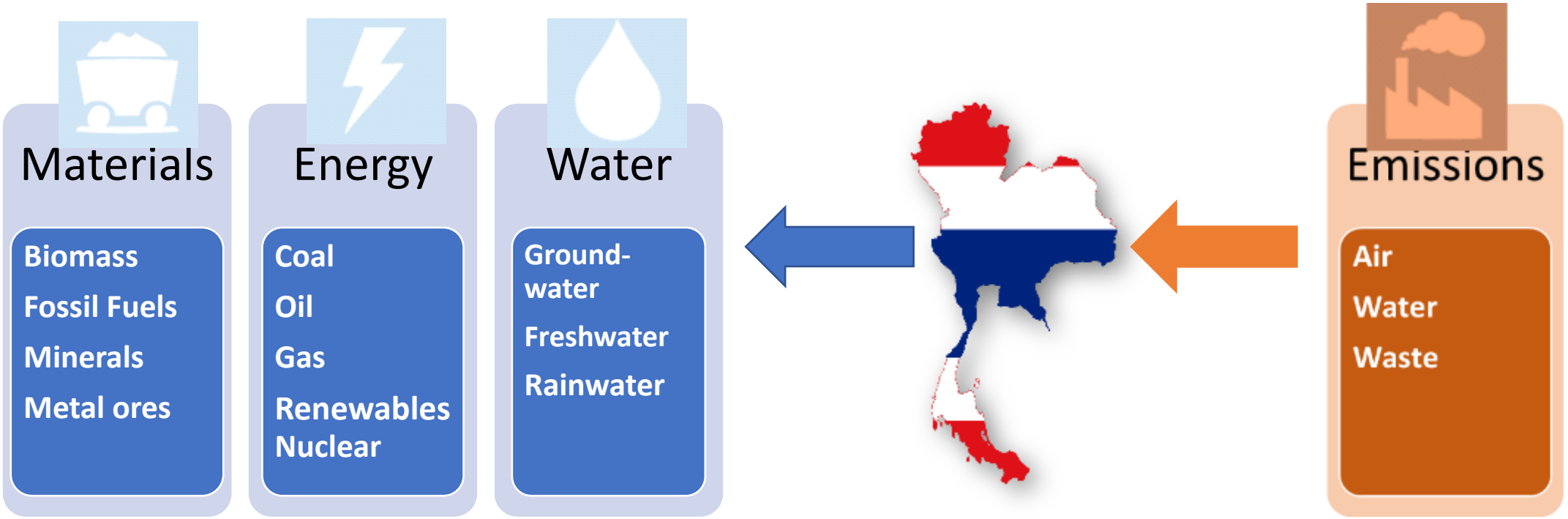
Where are the natural resources?

Biotic:
Biomass

Abiotic:
Fossil Fuels
Metal Ores
Minerals



What are natural resources?



Natural resources are the physical basis of our social and economic activities. How much can you use sustainably?

What level of emissions the environment can absorb?

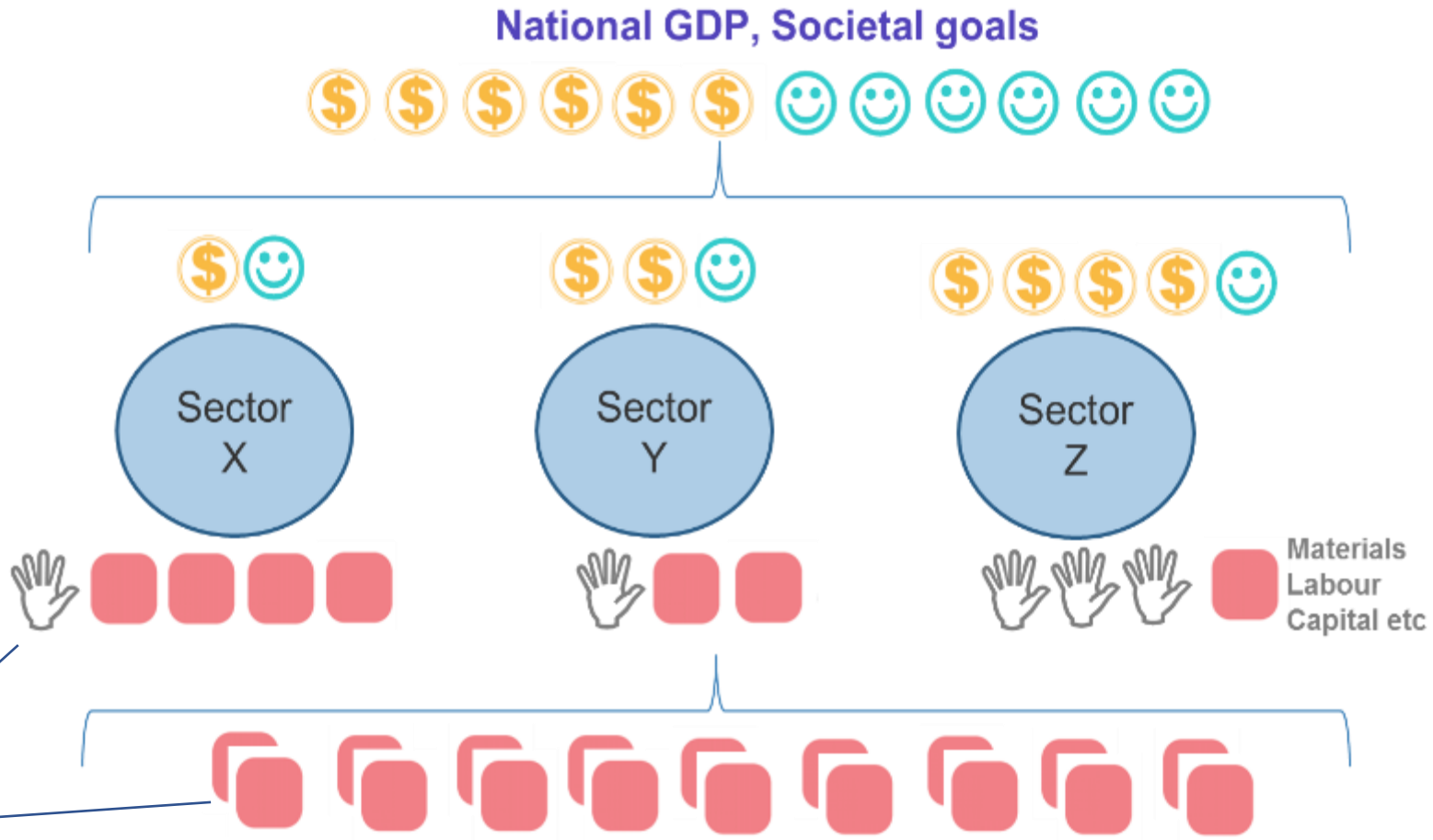
Why do we use natural resources?

Societal benefits

Production and Consumption

Labour

Natural Resources



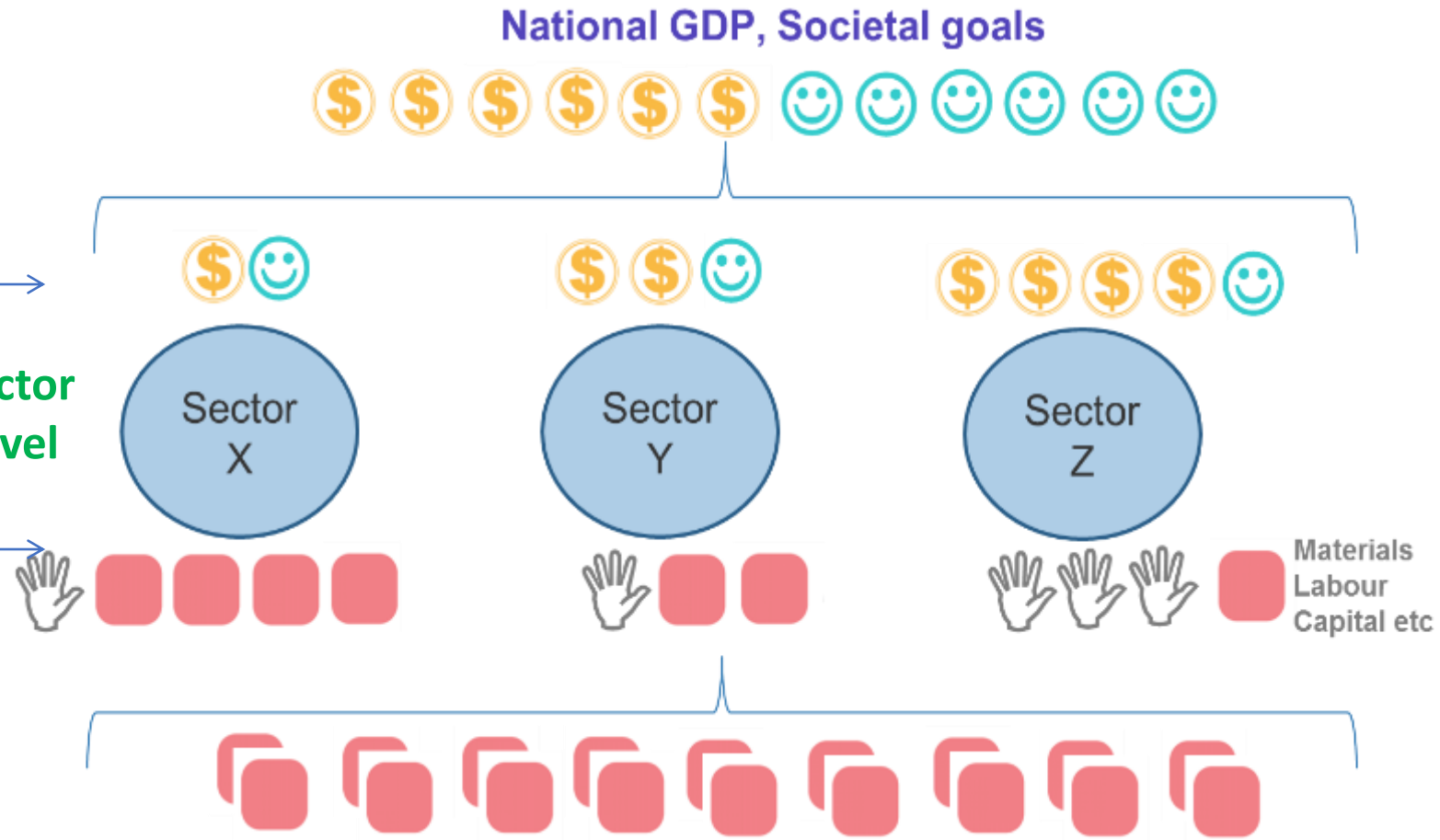
What is Resource Productivity?

Macroeconomic level

Resource Productivity is the ratio between natural resource use and the socio-economic benefits they generate

$/Tonne

Sector level



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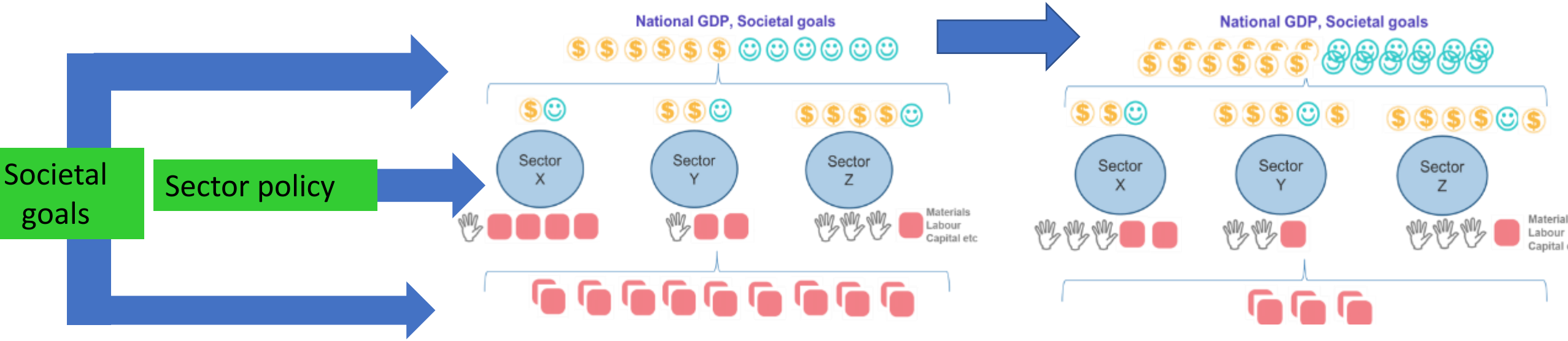
What is Resource Productivity?



Can you spot the difference?

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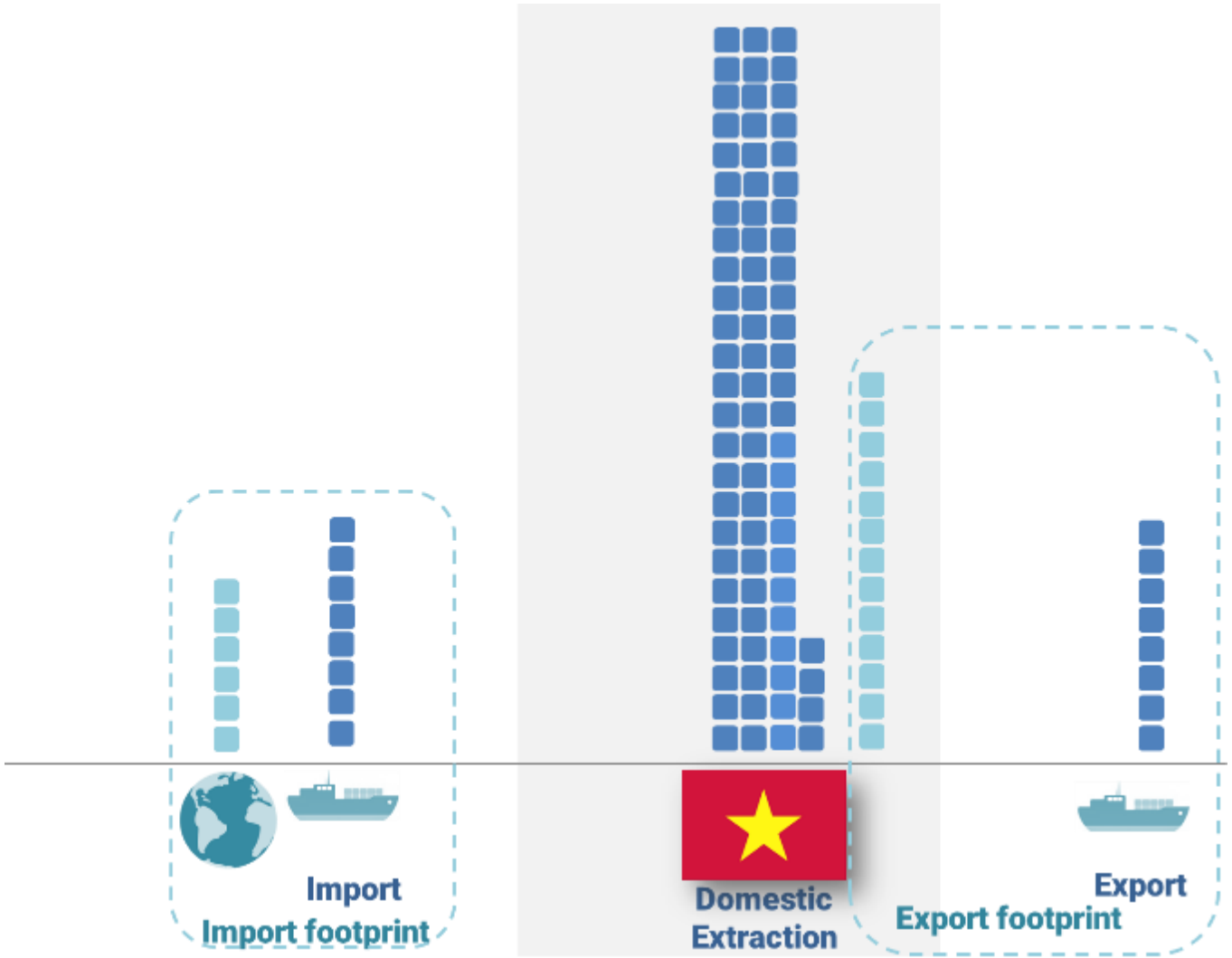
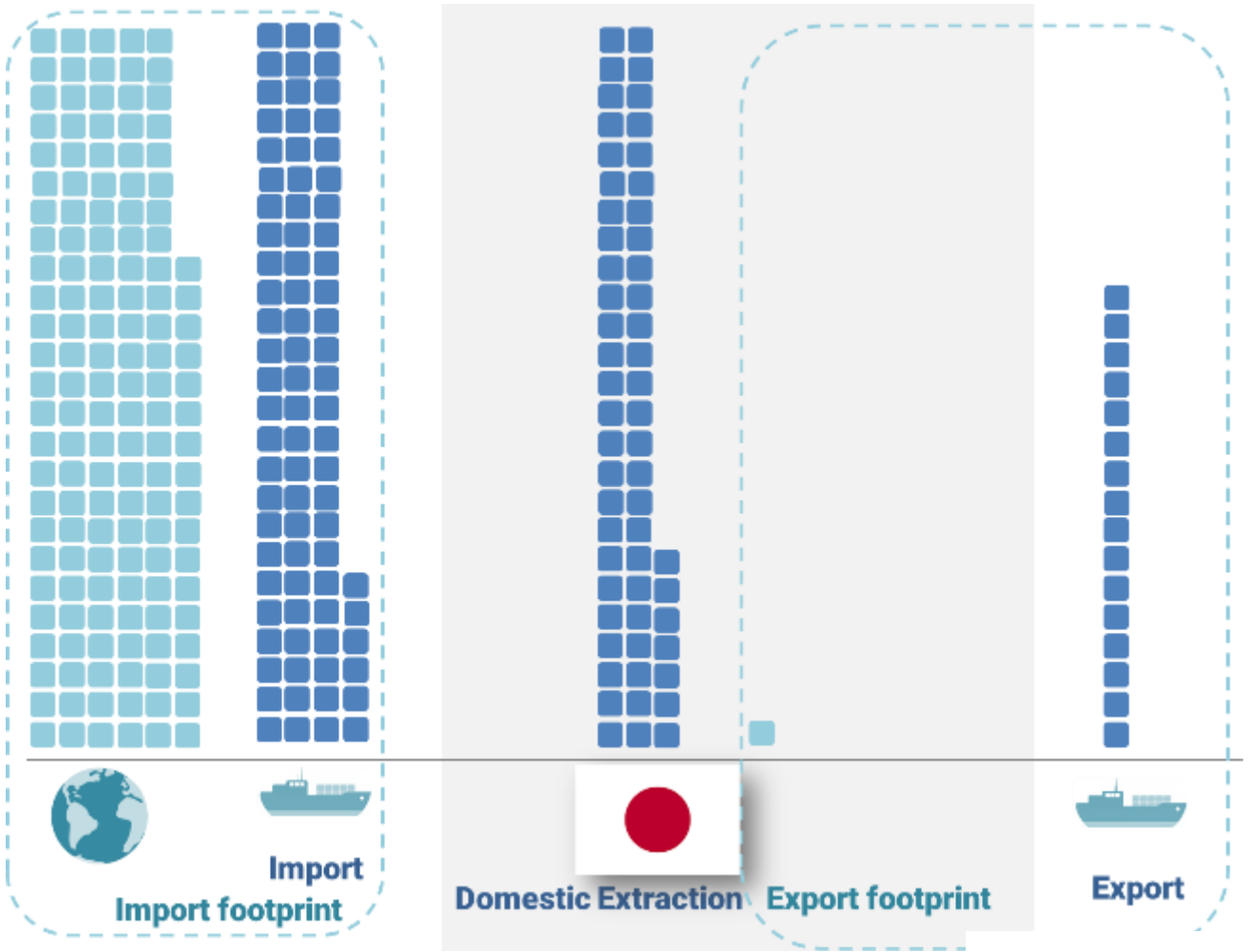
Population: 93 million
GDP: 98 billion
Resource efficiency: 9.8 kg/$

Per Capita:
Import footprint: 1.5 t
Import: 0.8 t
Domestic Extraction: 10.4 t
Material Footprint: 8.9 t
Export Footprint: 3 t
Export: 0.9 t



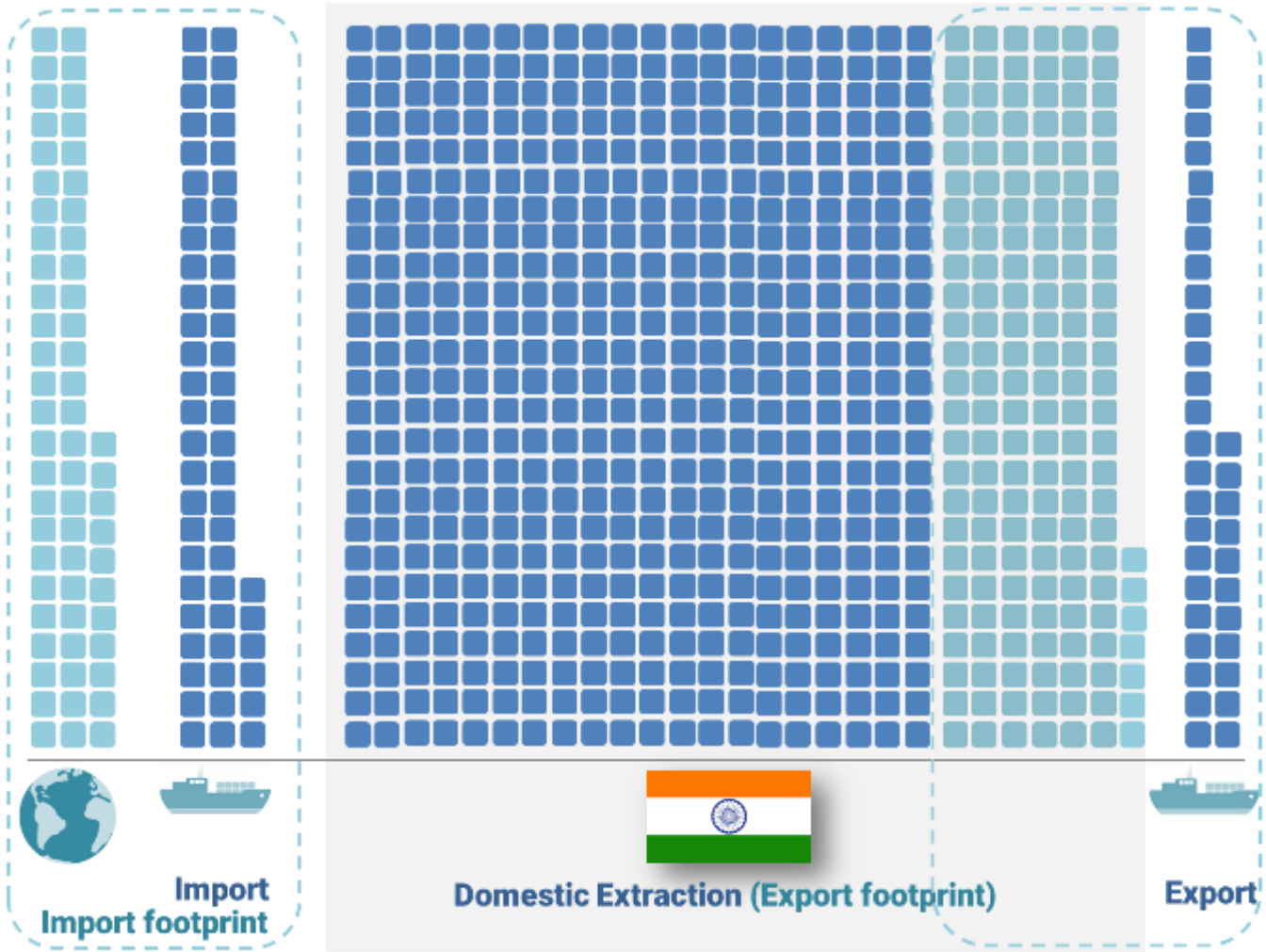
Population: 126 million
GDP: 4,800 billion
Resource efficiency: 0.3 kg/$

Per Capita:
Import footprint: 18 t
Import: 6 t
Domestic Extraction: 5 t
Material Footprint: 21 t
Export Footprint: 1.3 t
Export: 1.3 t



Population: 1,300 billion
GDP: 1,700 billion
Resource efficiency: 4 kg/$

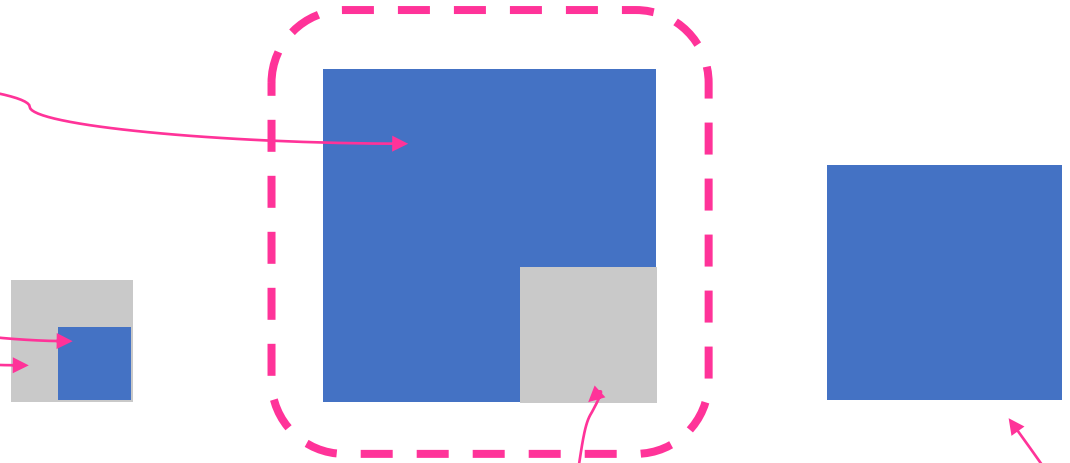
Per Capita:
Import footprint: 0.9 t
Import: 0.4 t
Domestic Extraction: 5 t
Material Footprint: 4.5 t
Export Footprint: 1.5 t
Export: 0.3 t



What is YOUR country's Resource Productivity?

Draw your national resource use profile!

1. Extraction (1,997 million tonnes)
2. Imports (93 million tonnes)
3. Import Footprint (261 million tonnes)
4. Export Footprint (1,292 million tonnes)
5. Exports (958 million tonnes)
6. GDP (1.005 trillion)
7. Resource Productivity = GDP/(Imports + Extraction – Exports)



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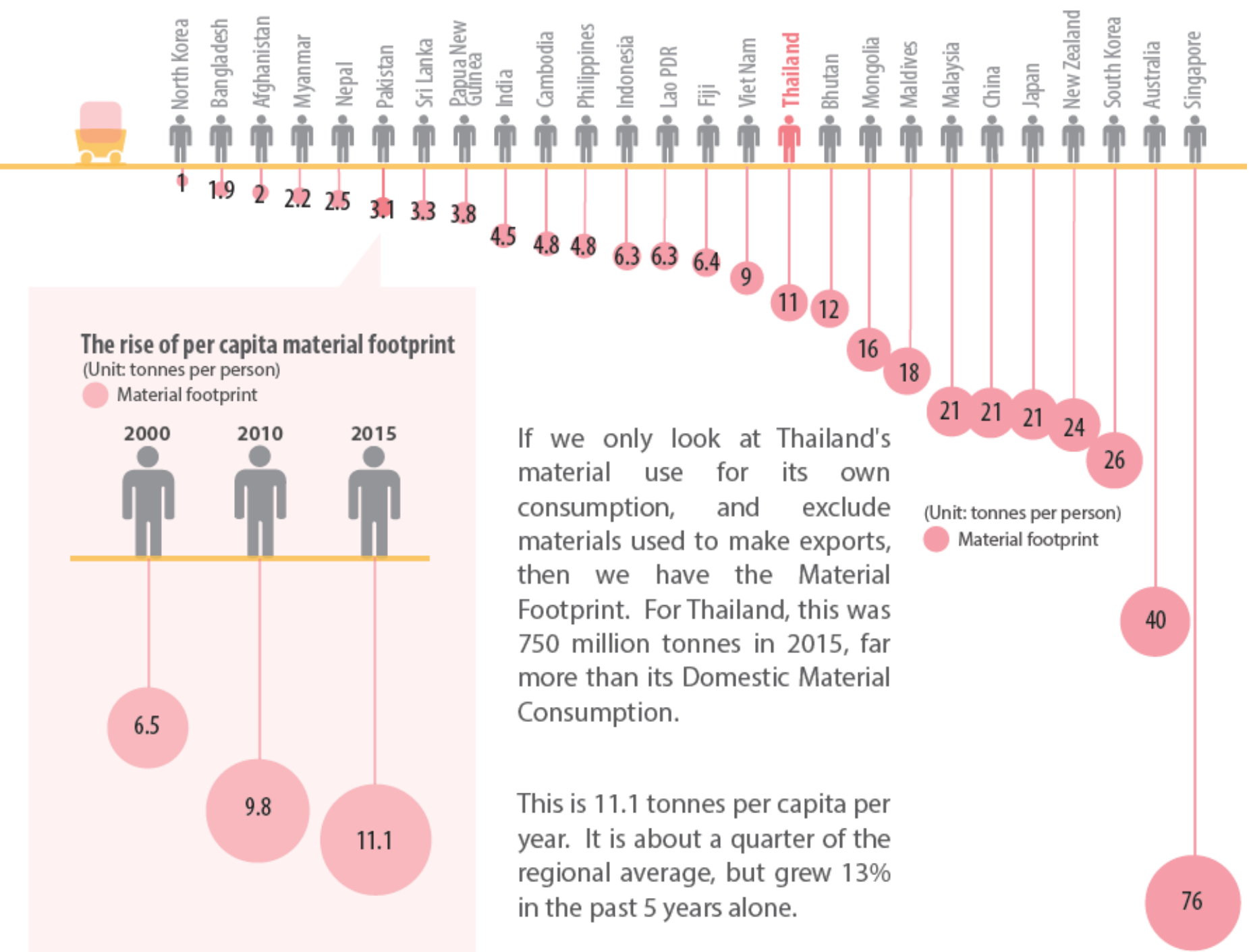

The rise of per capita material footprint

(Unit: tonnes per person)

Material footprint

If we only look at Thailand's material use for its own consumption, and exclude materials used to make exports, then we have the Material Footprint. For Thailand, this was 750 million tonnes in 2015, far more than its Domestic Material Consumption.

This is 11.1 tonnes per capita per year. It is about a quarter of the regional average, but grew 13% in the past 5 years alone.

1. Natural Resources

2. Causal chain (DPSIR)

3. Circular Economy Concepts

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Summary – DPSIR and the causal chain

1. **Resource use** more is part of a causal chain referred to as the extended Drivers-Pressures-State-Impact-Response (DPSIR) framework.
2. **Drivers.** Societal goals and demographics trigger a causal chain by shaping production and consumption activities.
3. **Pressures**. Production and Consumption lead to resource use and emissions.
4. **State**. Impacts only occur if resource use and emissions exceed thresholds, or planetary boundaries.
5. **Impacts**. Impacts include climate change, biodiversity loss, resource scarcity and human health impacts.
6. **Responses**. Decision makers in government, the private sector, and civil society can respond to impacts, with actions addressing Drivers.

How are resources linked to impacts?

Drivers -> Pressures -> State -> Impacts -> Response

Affluence

Economic Growth

Jobs, Incomes

Welfare

Inequality/ access

Population

Population growth

Demographics

Urbanisation

Extraction

- Agriculture
- Mining
- Forestry/Fishing

Production

- Processing
- -Infrastructure
- Manufact'g

Trade

Consump'n

- Food
- Fuel
- Housing
- Government

Waste/EoL

Resources

- Land
- Water
- Energy
- Materials Biomass, Minerals, Fossil Fuels

Emissions

- Air
- Water
- Soil
- Biosphere

Resource reserves

Atmospheric concentration

Hydrosphere concentration

Biodiversity

(Planetary boundaries or thresholds)

Climate Change

Resource Scarcity/ Prices

Biodiversity loss

Human health

Policies

Regulatory instruments

Regional/ National policies

Economic Instruments

Indicators

Investments

Technology

Technology

R&D

Awareness raising

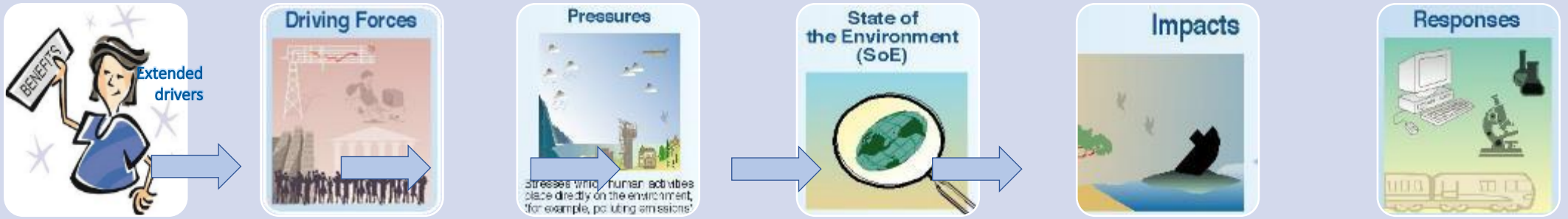
Private Sector

and more!

Circular Economy Responses

From Fossil Fuels to Biofuels?

Drivers -> Pressures -> State -> Impacts -> Response



Affluence

Economic Growth

Jobs, Incomes

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Technology

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R&D

Awareness raising

Private Sector

and more!

Circular Economy Responses

1. Natural Resources

2. Causal chain (DPSIR)

3. Circular Economy Concepts

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Summary – Circular Economy

1. **The three principles of circular economy** are to Preserve and enhance natural capital, Optimise resource yield, and Foster system effectiveness.
2. **The six business actions of circular economy** include Regenerate. Share. Optimise. Loop. Virtualise/Digitise. Exchange.
3. **These business actions can translate into specific measures** of Remanufacturing, Refurbishing, Recycling, Upcycling, Downcycling, Share, Pay per use, Repair, Redistribute/secondhand, Donate, Extend lifespan, Shift to biocycle, Digitise.
4. **Circular Economy measures mitigate risks**: Price risk, Supply risk, Natural system degradation, and Trade risk.
5. **Circular Economy measures can leverage opportunities:** Rise of smartphones, Internet of Things, Industry 4.0 level manufacturing. Decreased cost of renewables, Consumer acceptance, Growth of financial capital and partnerships, Urbanisation.

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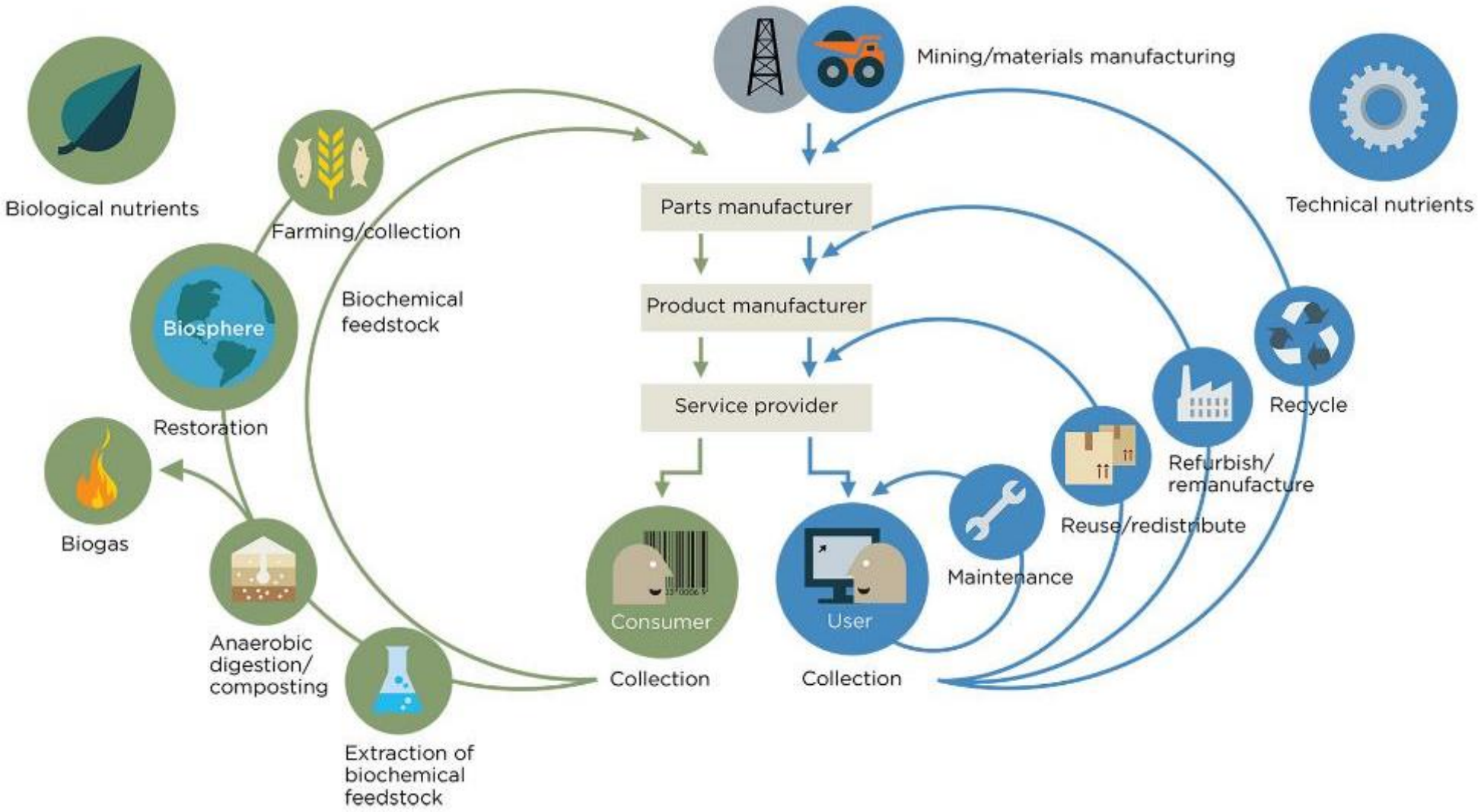
Circular Economy Concepts



Circular Economy … Principles

A. Preserve and enhance natural capital – measure what you have (stocks), and what you can use (flows). Switch from non-renewables to renewables (higher flows possible!)

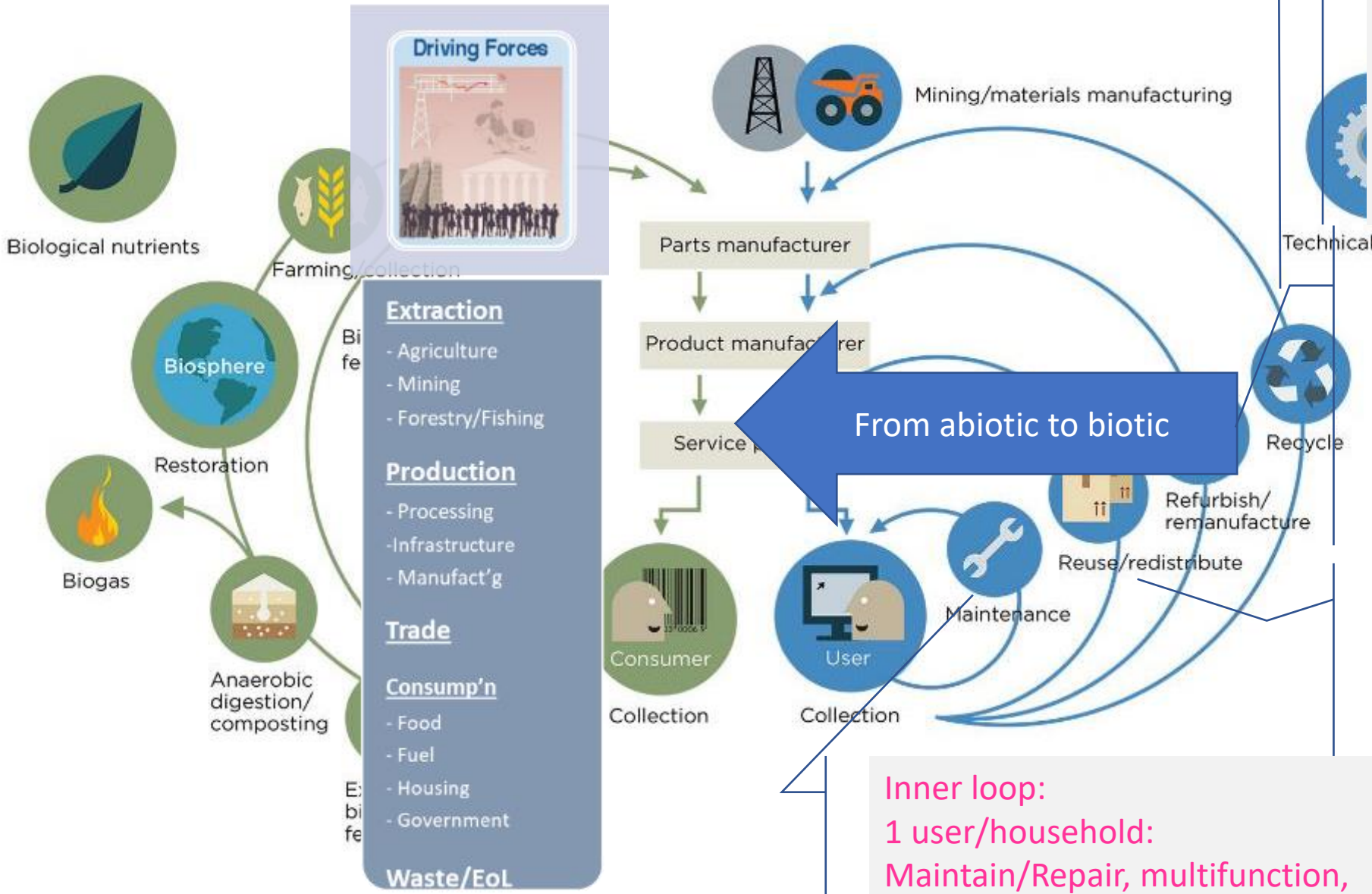
B. Optimise resource yields – circulate products, components and materials at their highest possible value

C. Foster system effectiveness – design out negative externalities like pollution and waste

… and Business Actions

1. Regenerate. Move to renewable resources, while protecting the biosphere.
2. Share. Keep loop speed low by maximizing the use of a product at user/service provider level.
3. Optimise. Remove waste from production (3D printing, automation, remote sensing, autonomous vehicles)
4. Loop. Keep components and materials in closed loops, prioritise the ‘inner loops’.
5. Virtualise/Digitise. Books, music, shopping centers, virtual office, skype
6. Exchange. Apply new technologies and ways of doing things

Circular Economy Concepts



Fourth loop: Back to primary sector

Recycling – Recovering materials to be used for same purpose

Downcycling – convert to a lesser quality/function

Upcycling – higher quality or function

Third loop: Back to producers:

Refurbish – Repair or replace components to restore product to good working condition.

Remanufacture – Recover components whole and reuse them in new products.

Second loop:

Multiuser: Share, rent, redistribute, secondhand, donate

Inner loop:

1 user/household:

Maintain/Repair, multifunction, maximise use, extend lifespan

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Circular Economy Concepts – Match the columns

1. Reuse of Caterpillar truck components in new trucks
2. “Buy me once” eCommerce
3. Aluminum soft drink cans
4. Grab, Uber, Mobike, Ofo, Obike
5. Airbnb, peer to peer lending
6. Secondhand computers resold with some upgraded/repaired parts.
7. eBay
8. Food rescue
9. Pineapple fibres into leather bags
10. Woodchips into particleboard
11. Youtube videos showing you how to replace iPhone screen
12. From gasoline to biodiesel
13. Paper books to eBooks

A. Remanufacturing
B. Refurbishing
C. Recycling
D. Upcycling
E. Downcycling
F. Share
G. Rental
H. Repair
I. Redistribute/secondhand
J. Donate
K. Extend lifespan
L. Shift to biocycle
M. Digitise

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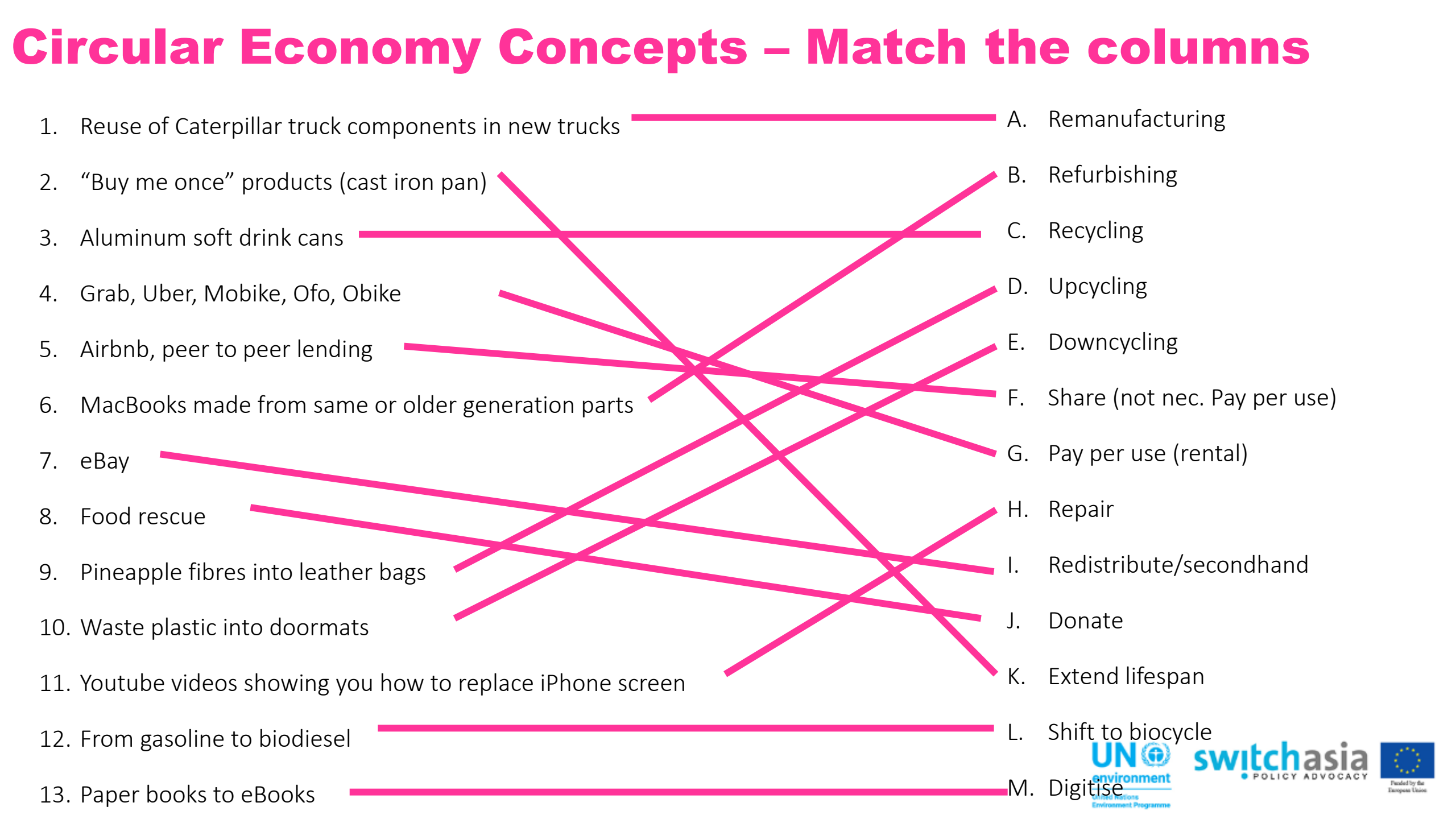
Circular Economy Concepts – Match the columns

1. Reuse of Caterpillar truck components in new trucks
2. “Buy me once” products (cast iron pan)
3. Aluminum soft drink cans
4. Grab, Uber, Mobike, Ofo, Obike
5. Airbnb, peer to peer lending
6. MacBooks made from same or older generation parts
7. eBay
8. Food rescue
9. Pineapple fibres into leather bags
10. Waste plastic into doormats
11. Youtube videos showing you how to replace iPhone screen
12. From gasoline to biodiesel
13. Paper books to eBooks

A. Remanufacturing
B. Refurbishing
C. Recycling
D. Upcycling
E. Downcycling
F. Share (not nec. Pay per use)
G. Pay per use (rental)
H. Repair
I. Redistribute/secondhand
J. Donate
K. Extend lifespan
L. Shift to biocycle
M. Digitise



Circular Economy Concepts

Questions:

1. What is the difference between share and rental?

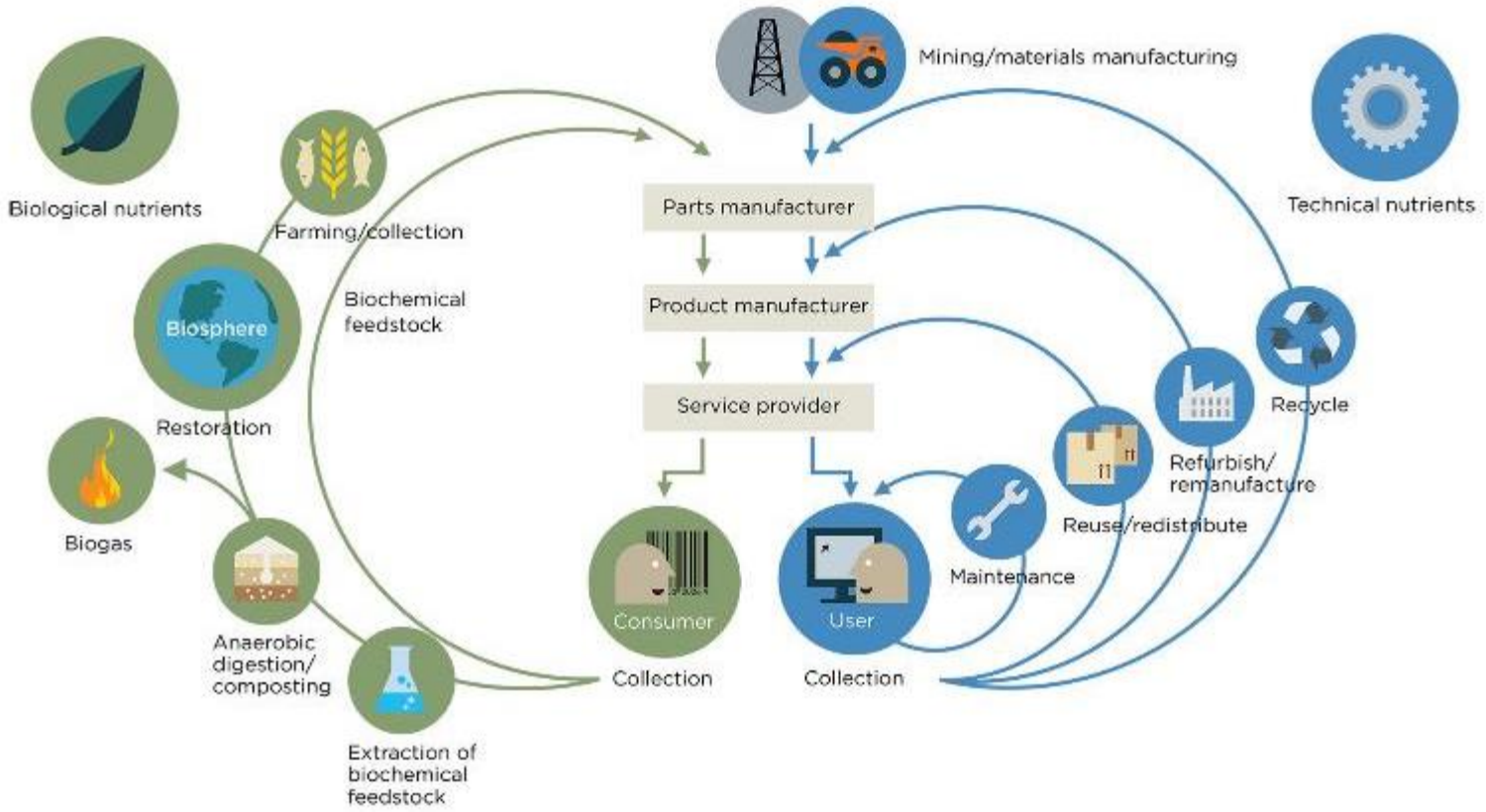
2. What is the key difference between Share/Rental and Redistribute/Donate?

3. What is the difference between remanufacturing and refurbishing?

A. Remanufacturing
B. Refurbishing
C. Recycling
D. Upcycling
E. Downcycling
F. Share (not nec. Pay per use)
G. Pay per use (rental)
H. Repair
I. Redistribute/secondhand
J. Donate
K. Extend lifespan
L. Shift to biocycle
M. Digitise

Circular Economy Concepts – Your projects!

Which of these concepts could be used in your project?



A. Remanufacturing
B. Refurbishing
C. Recycling
D. Upcycling
E. Downcycling
F. Share
G. Rental
H. Repair
I. Redistribute/secondhand
J. Donate
K. Extend lifespan
L. Shift to biocycle
M. Digitise

Circular Economy – Mitigating risks of a linear economy

Which of these risks apply to your country or business?

1. **Price risk** – I'm worried that the materials I need will suddenly become expensive.
2. **Supply risk** – We're worried that the supply might change in the next decades:
    1. Geological risk – running out
    2. Geopolitical risk – countries start to hoard critical minerals
    3. Geographic risk – oops, the nearest deposit is in a place I don't want to mess with
3. **Natural system degradation** – I'm worried the impacts of resource extraction, production, use or waste management (or lack of) might cause environmental and/or reputational damage (and be regulated in the future).
4. **Trade risk** – I'm worried we won't be able to trade with the country that produces the materials I need due to trade restrictions, tariffs or other issue.

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Circular Economy – Upcoming opportunities

Which of these opportunities to you want to take advantage of?

1. **Rise of smartphones** – more connectivity = **access** to more supply/demand of small amounts of materials.
2. **Internet of Things** – more connectivity = more data = enhances optimization and speed of processes.
3. **Industry 4.0 level manufacturing** – 3D printing and other precision techniques reduce waste, automation increases speed which enable just in time production, reducing wasteful inventory.
4. **Decreased cost of renewables** – accelerates the shift away from fossil fuels, towards longer lasting and reduced amount of resource use per unit of energy.
5. **Consumer acceptance** – the rise of the share economy has shifted social norms away from wasteful **ownership** towards optimized **access** of products.
6. **Growth of financial capital and partnerships** available for businesses that enable circular economy.
7. **Urbanisation** trends lead to higher population density which facilitates circulation.

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Summary – Resource Productivity

1. **Natural resources** more include materials, energy, water, land. The use of these natural resources leads to emissions to the environment, and land use change.
2. **Materials** can be divided into abiotic (fossil fuels, minerals, metal ores) and biotic (biomass from agriculture, forestry, fisheries).
3. **Resource use** can be measured by accounting for extraction, imports and exports. Upstream resource use is accounted for in footprints.
4. **Resource productivity can be measured** by dividing the economic benefits a country or sector gets out of each tonne of materials.
5. **Resource productivity can be increased** through specific policies at the national level, and measures at the sector level.

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Summary – DPSIR and the causal chain

1. **Resource use** more is part of a causal chain referred to as the extended Drivers-Pressures-State-Impact-Response (DPSIR) framework.
2. **Drivers.** Societal goals and demographics trigger a causal chain by shaping production and consumption activities.
3. **Pressures**. Production and Consumption lead to resource use and emissions.
4. **State**. Impacts only occur if resource use and emissions exceed thresholds, or planetary boundaries.
5. **Impacts**. Impacts include climate change, biodiversity loss, resource scarcity and human health impacts.
6. **Responses**. Decision makers in government, the private sector, and civil society can respond to impacts, with actions addressing Drivers.

Summary – Circular Economy

1. **The three principles of circular economy** are to Preserve and enhance natural capital, Optimise resource yield, and Foster system effectiveness.
2. **The six business actions of circular economy** include Regenerate. Share. Optimise. Loop. Virtualise/Digitise. Exchange.
3. **These business actions can translate into specific measures** of Remanufacturing, Refurbishing, Recycling, Upcycling, Downcycling, Share, Pay per use, Repair, Redistribute/secondhand, Donate, Extend lifespan, Shift to biocycle, Digitise.
4. **Circular Economy measures mitigate risks**: Price risk, Supply risk, Natural system degradation, and Trade risk.
5. **Circular Economy measures can leverage opportunities:** Rise of smartphones, Internet of Things, Industry 4.0 level manufacturing. Decreased cost of renewables, Consumer acceptance, Growth of financial capital and partnerships, Urbanisation.

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Circular Economy – your turn

Working in groups of 5-6, identify the following for one project

- Describe the current linear economy mechanism behind the problem you see.
- For each Circular Economy principle, describe potential business actions and specific actions that could underpin a circular economy solution.

THANK YOU

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