



# *Circular Economy and Digital World*

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# INTERNATIONAL POLICY NEEDS A SCIENCE BASE

The international resource panel was created in 2007 as a **science-policy interface** in responding to economic growth, escalating use of natural resources and deteriorating environment and climate change.



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Climate Change

IPCC

Biodiversity Loss

IPBES

Hazardous Substances

Assessments under  
the Basel Convention

Ozone Depletion

Montreal Protocol's  
Scientific Assessments

Resource Efficiency

International  
Resource Panel IRP



International  
Resource  
Panel

# SDGs DIRECTLY DEPENDENT ON NATURAL RESOURCES



**OUTLINE OF A CIRCULAR ECONOMY**

**PRINCIPLE**

**1**

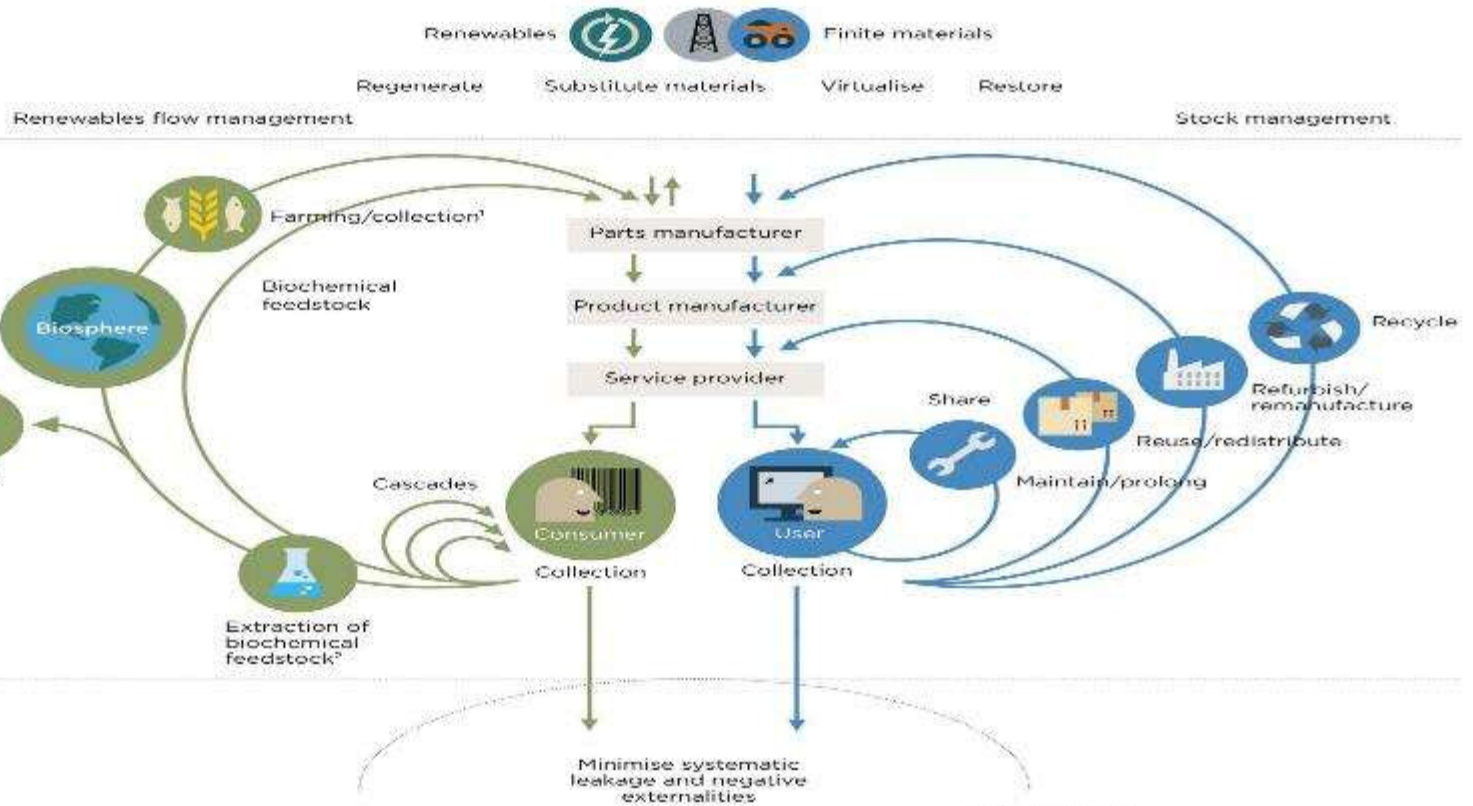
Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows  
 ReSOLVE levers: regenerate, virtualise, exchange

It looks as if CE diagram is our final destination..... It's only a means .....

**PRINCIPLE**

**2**

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles  
 ReSOLVE levers: regenerate, share, optimise, loop



**PRINCIPLE**

**3**

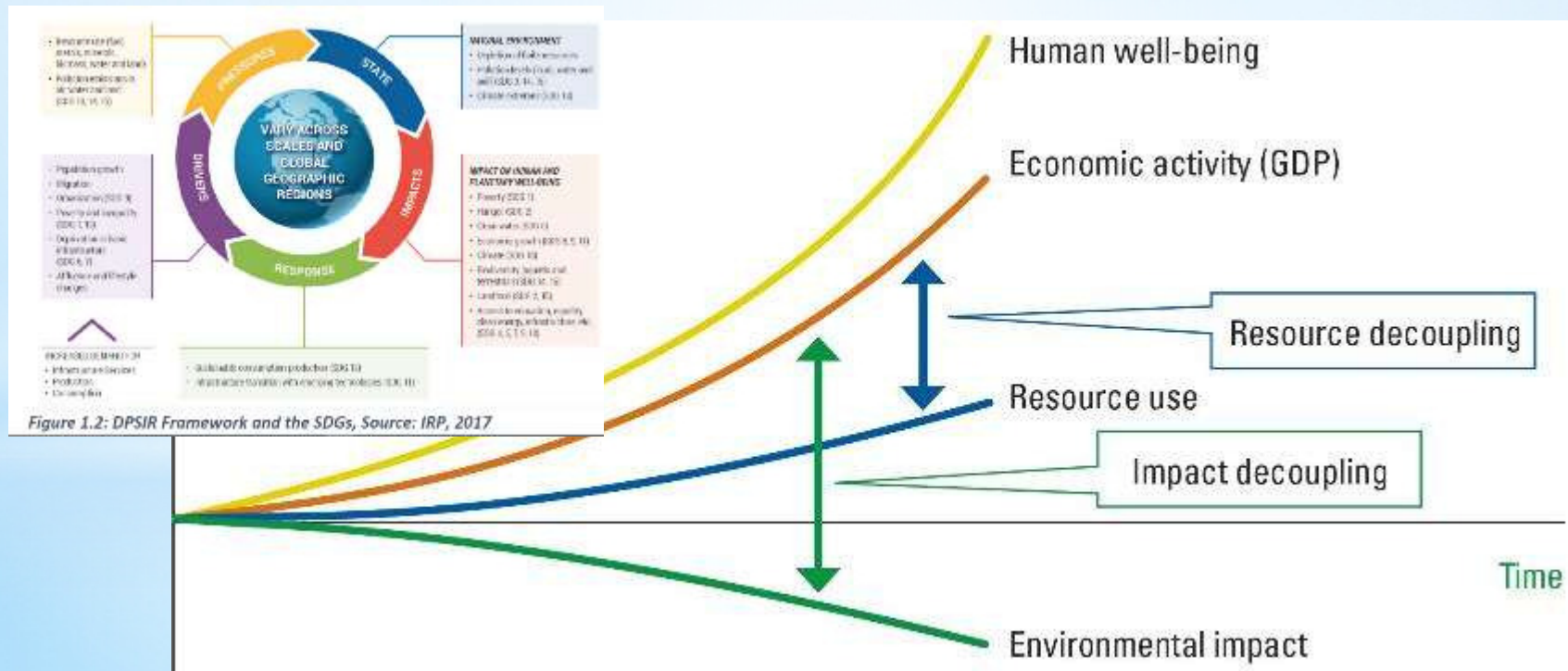
Foster system effectiveness by revealing and designing out negative externalities  
 All ReSOLVE levers

<sup>1</sup> Hunting and fishing  
<sup>2</sup> Can take both post-harvest and post-consumer waste as an input  
 Source: Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment; drawing from Braungart & McDonough, Cradle to Cradle (2013)



International Resource Panel

Sustainable Development is the main goal while Decoupling is the framework behind SDGs  
At this point of time .... DPSIR



*... Industrial Engineering can always  
innovate and make continuous improvement ...  
Circular Economy*

Upstream Production



«Re-use

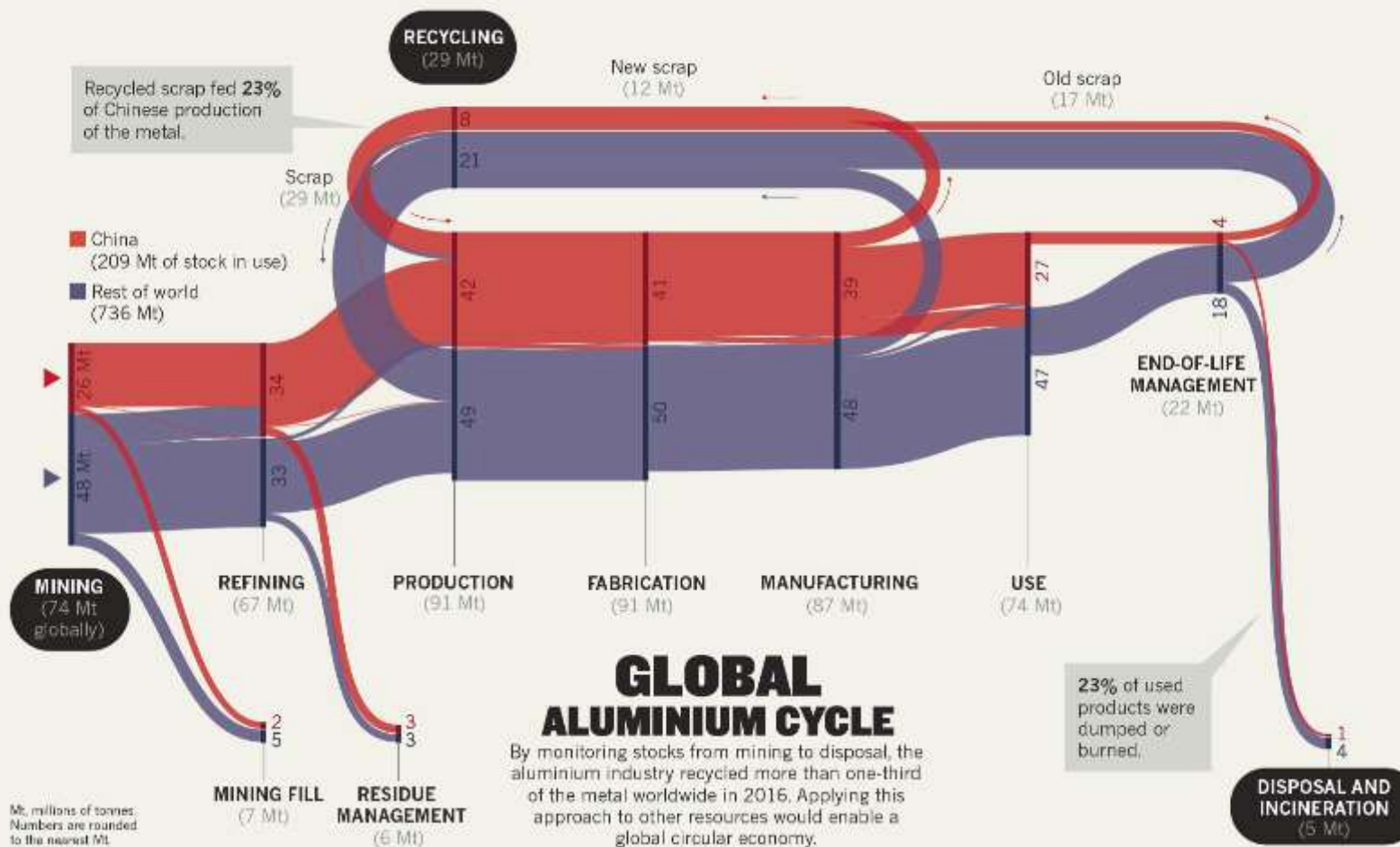
«Recycle

«Re-manufacture

Downstream Production

# Globalize the Circular Economy

(NATURE | VOL 565 | 10 JANUARY 2019)





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## THE NEW UNEP IRP MATERIAL FLOW AND RESOURCE PRODUCTIVITY DATA SET



- A **coherent account of material use in the global economy** and for every nation, complementary to the System of National Accounts
- A **large data set covering 40 years** (1970-2010) and most countries of the world.
- Presents **direct and consumption-based material flow indicators**, covering total usage, per capita use and material use per US\$.
- Information should **help identify opportunities, risks and vulnerabilities** related to the global supply of primary materials and show the **potential for efficiency gains and reductions in material use** in the global economy







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# GLOBAL MATERIAL FLOWS AND RESOURCE PRODUCTIVITY (1970-2010)



- **Consumption** has been stronger driver of growth in material use than population growth
- **Since 2000 material efficiency has declined** - global economy needs more materials per unit of GDP. Production has shifted from material efficient countries to countries that have lower material efficiency
- The **richest countries** consume on average **10 times more** materials as the poorest
- The level of well-being achieved in wealthy industrial countries **cannot be generalised globally based on the same system of production and consumption**





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# GLOBAL MATERIAL USE HAS ACCELERATED



- Annual global extraction of materials grew from **22 billion tonnes in 1970** to around **70 billion tonnes in 2010** and **90+BT in 2017**
- **Non-metallic minerals used in construction** was the **fastest growing group of materials**

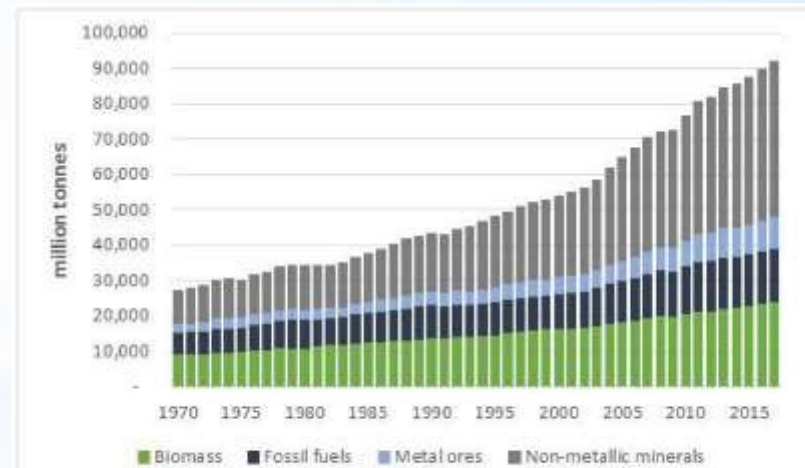
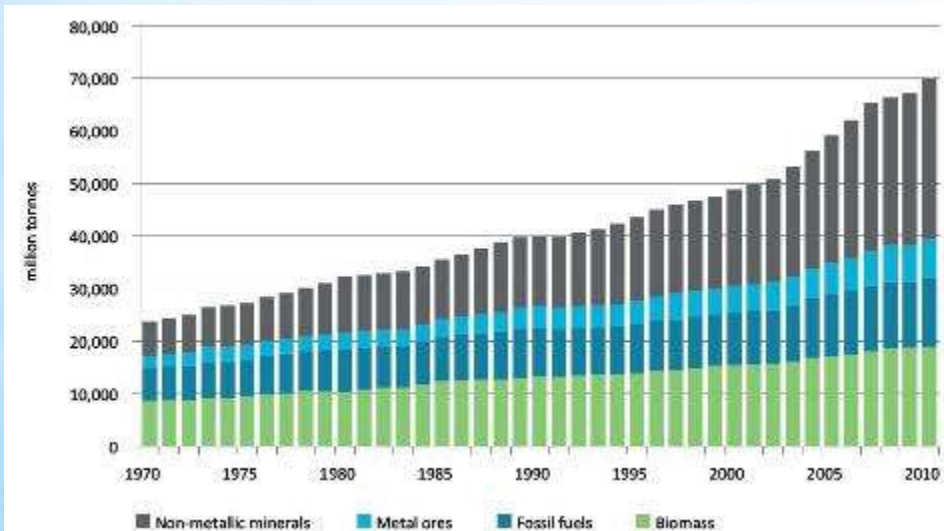


Figure 2.4: Global material extraction, four main material categories, 1970 - 2017, million tons. Source UNEP International Resource Panel, Global Material Flow Database

Global material extraction (DE) by four material categories, 1970-2010-2017, million tonnes

# MATERIAL EXTRACTION GREW UNEVENLY IN THE GLOBAL ECONOMY

- *Asia and the Pacific* had the *largest growth*, especially China and Southeast Asia
- Growth in Asia and the Pacific reverberated in *Latin America and Africa* who supplied materials to Asia

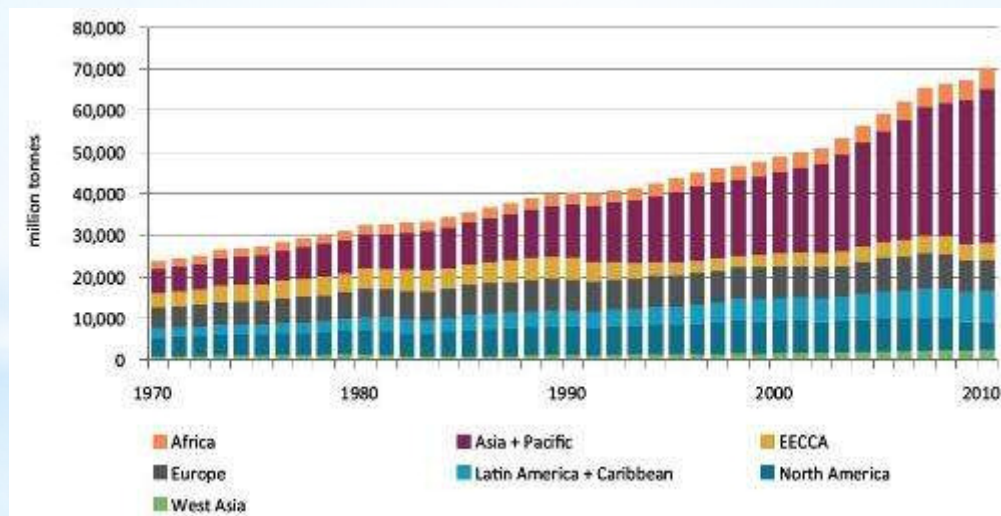


Figure 2. Domestic extraction (DE) by seven subregions, 1970-2010, million tonnes

# CONSUMPTION PATTERN & TECHNOLOGY INNOVATION COMBINED ARE DRIVING GLOBAL MATERIAL USE

- Partly Circular Economy using eco-industrial development (EID) has been solving the resource consumption by producer effectively in 2000-2015. The technological innovation driving more consumption will be tackled in the 2015-2030.

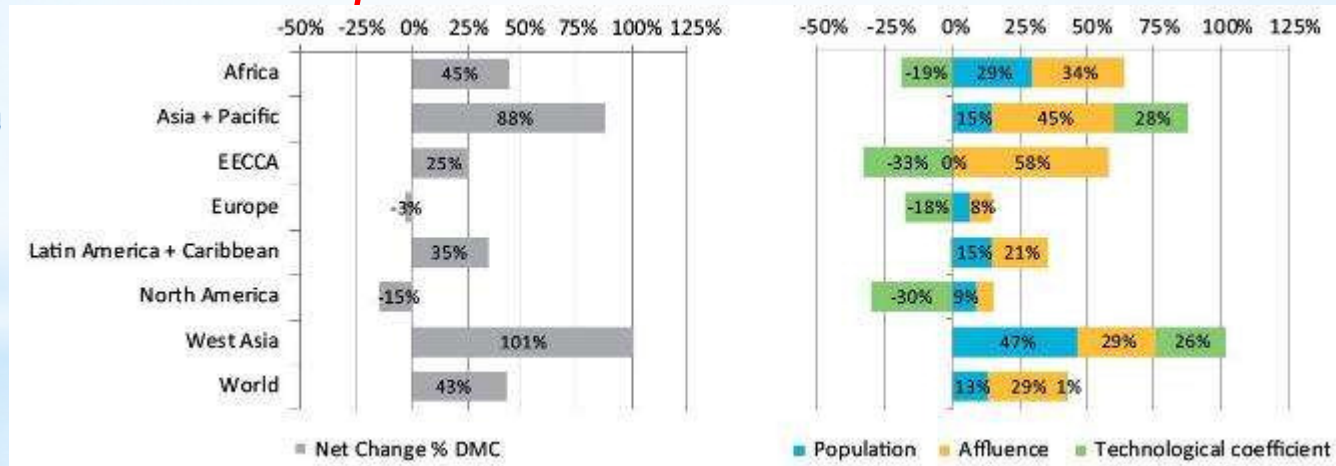
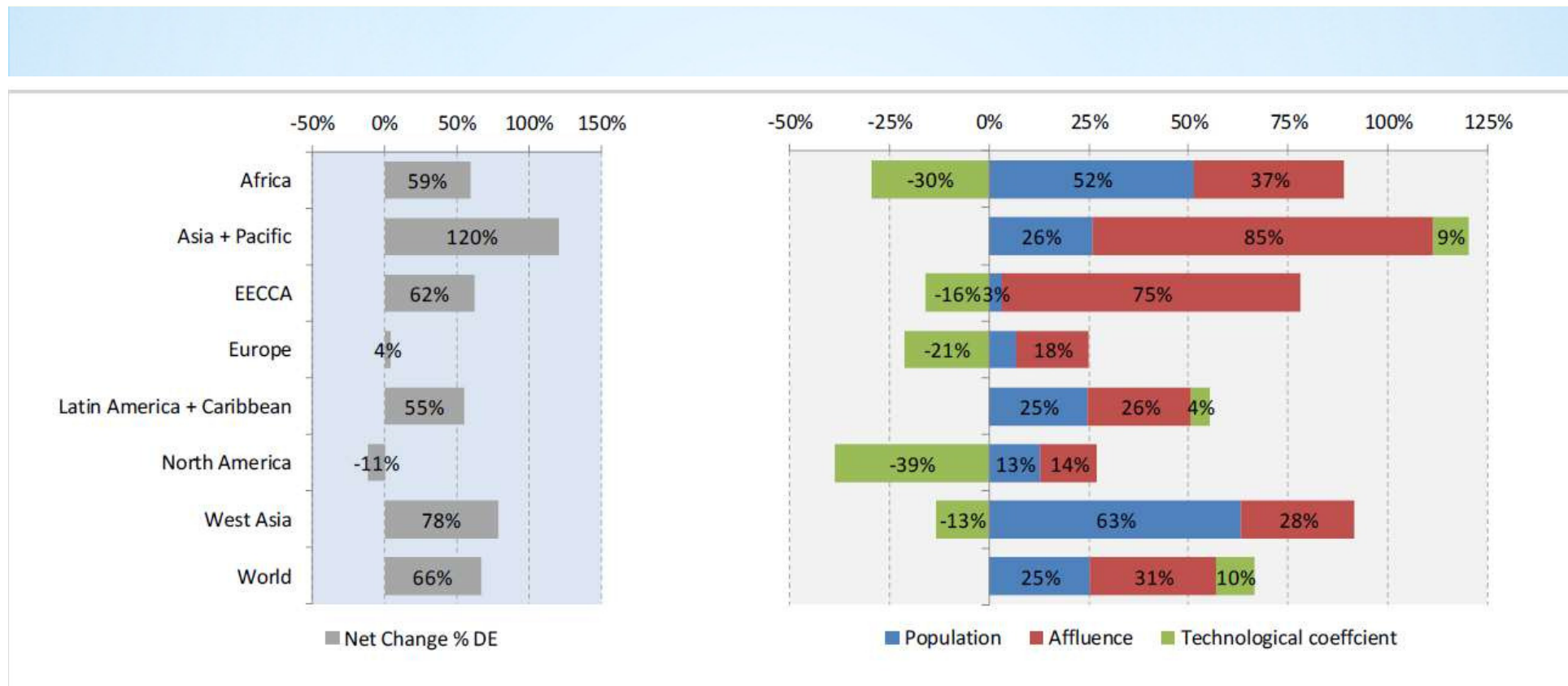


Figure 5. Drivers of net change in domestic material consumption between 2000 and 2010 for world regions: population, affluence, and material intensity



**Figure 2.21: Drivers of Domestic Extraction, 2000 - 2016, percentage. Source: UNEP International Resource Panel, Material Flow Database**

## SCP Push-Pull Scenario

### SUPPLY

Eco-design  
Green Procurement  
Circular Economy  
RECP  
LCA  
Technology Progress  
Policy Options



### DEMAND

Lifestyle  
Marketing ads  
'Mesolimbic  
Dopaminergic  
Reward  
System'  
Human needs  
Human wants  
Human desires



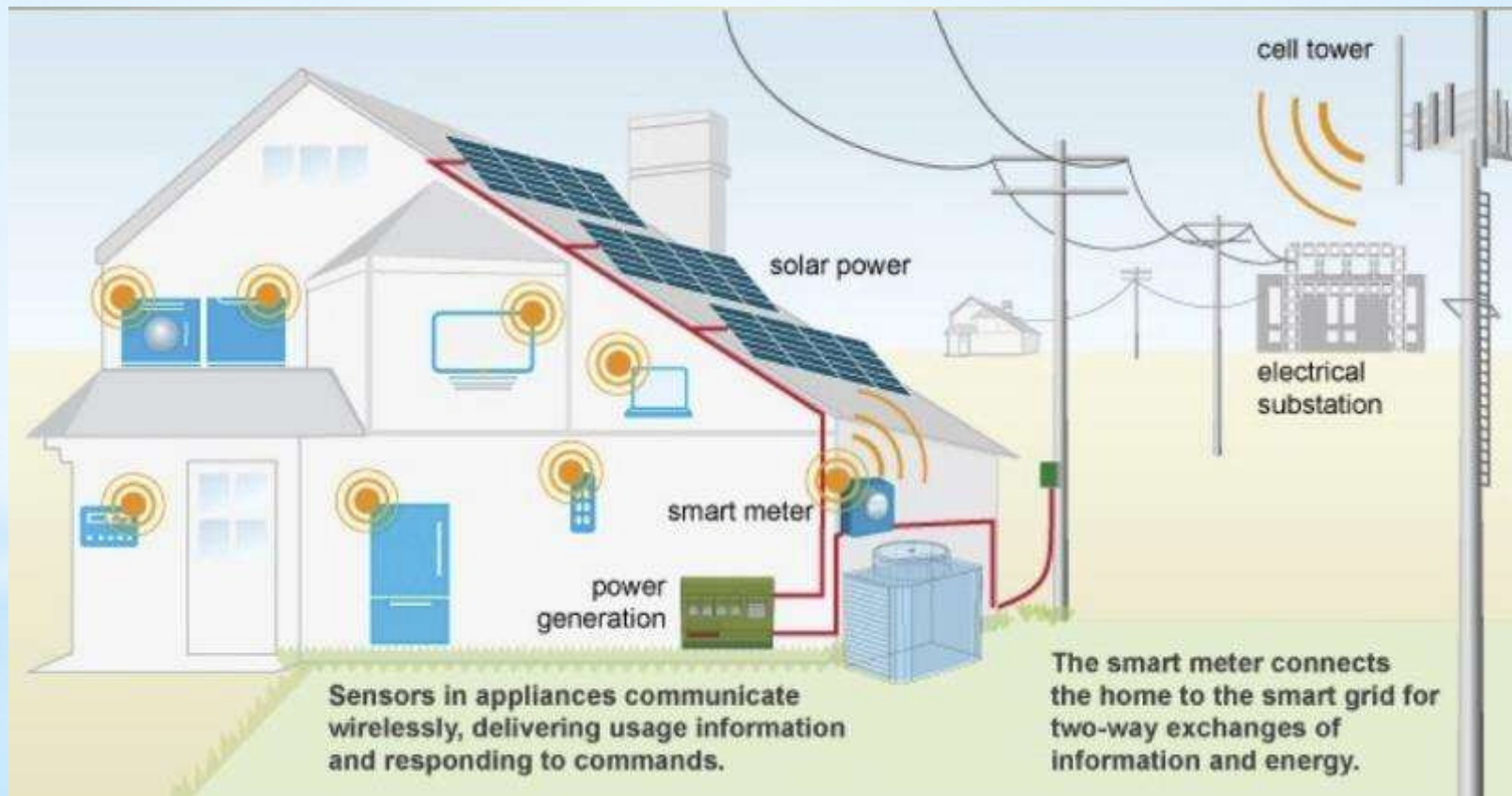
## Innovative Technology

“... every aspect of our lives is increasingly influenced by an invisible network of technologies and devices that collect, transmit, and analyse incomprehensibly large amounts of information .....

1. Internet of Things (IoT)
2. Blockchain
3. Big Data
4. Artificial Intelligence

effective and cheaper extremely fast

# Smart Meters





# Singapore's Jurong Lake District

- Aims to demonstrate how technology can enable a liveable and sustainable urban environment, and a key feature is IoT technology.... But ..... Wifi bandwidth, stability, etc necessity
- Data from farecards and sensors throughout the district will give planners a clearer sense of the location, types, and frequency of transport services that are needed and cater to these needs more effectively.

**Smart Singapore**

Singapore is expanding its use of technology to entrench its position as a leading global city and improve Singaporeans' quality of life. Here are some upcoming initiatives:

**Paragon pilot:** The first "smart" housing project will be launched in Paragon next year, and will include energy-efficient measures like motion sensor lights in car parks.

**One ring to pay them all:** An embedded chip could turn a ring, a watch or your identity card into a payment device, eliminating the need for cash or credit cards.

**Remember me:** A new digital platform is being developed to bypass the need for citizens to provide their personal data repeatedly for government transactions.

**Mapping the future:** A new 3D map project called Virtual Singapore will integrate layers of data about Singapore's buildings, land and environment. Government agencies and other organisations can use it to solve problems such as identifying the most flood-prone areas, while the public can contribute information like traffic patterns or the locations of their favourite (or least) stores.

**Phone home:** Controlling household appliances from a smart phone may be possible once HDB determines the digital infrastructure needed for an automated home. Trials start next year.

**Senior sensors:** Sensors in the homes of the elderly will monitor their movements and send alerts to caregivers if regular behaviour is disrupted.

**Virtual therapy:** A "tele-rehab" system being tested at community hospitals will allow patients to perform therapy exercises at home, while sensors attached to their limbs transmit data back to the hospitals.

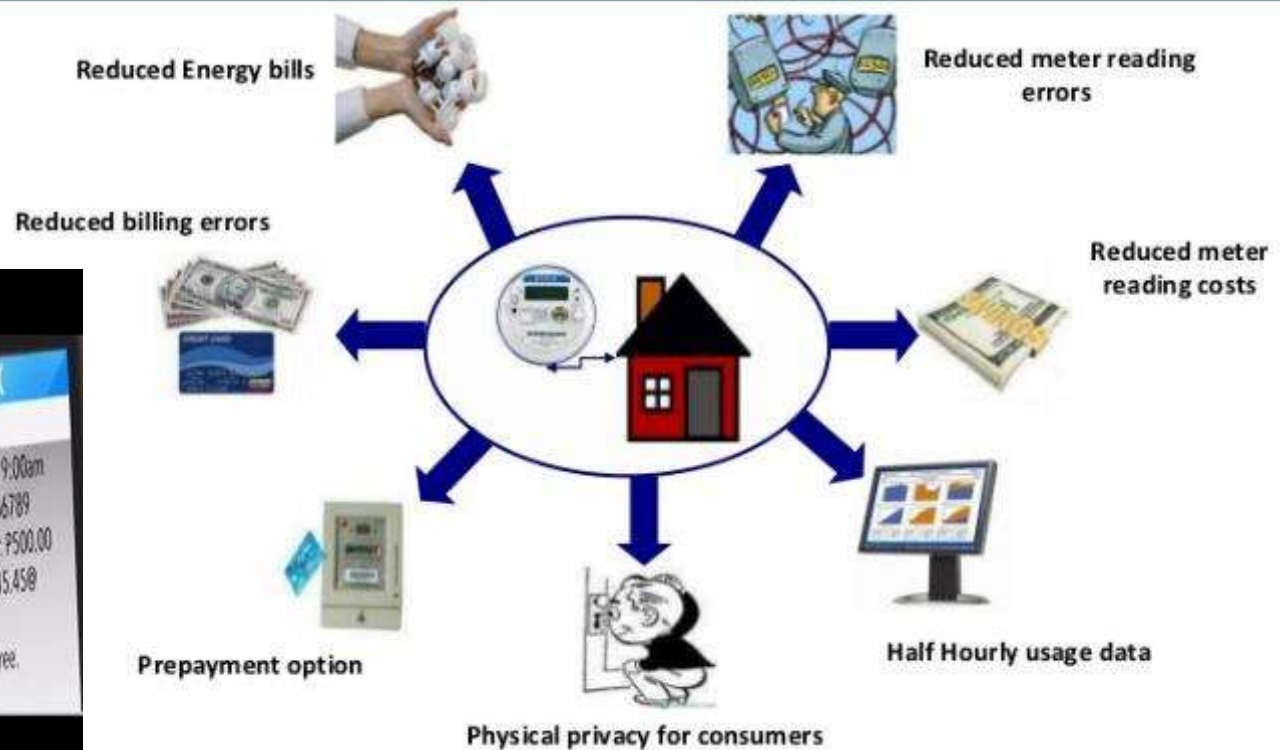
**Where's my bus:** By next March, commuters can use the MyTransport app to find out bus arrival times by the minute and how crowded each bus is.

**"Public" transport:** Self-driving cars will be tested on public roads for the first time some January next year, in One-North at Buena Vista.

GRAPHICS: MIKE W. DODD AND CHENG CHEN; DESIGN: TEST, ENCEL MIKOVIC

# IoT Example 2: Manila Electric Co. (Meralco)

## Advanced Metering Benefits



## Applications of Blockchain: Peer to peer clean energy sharing

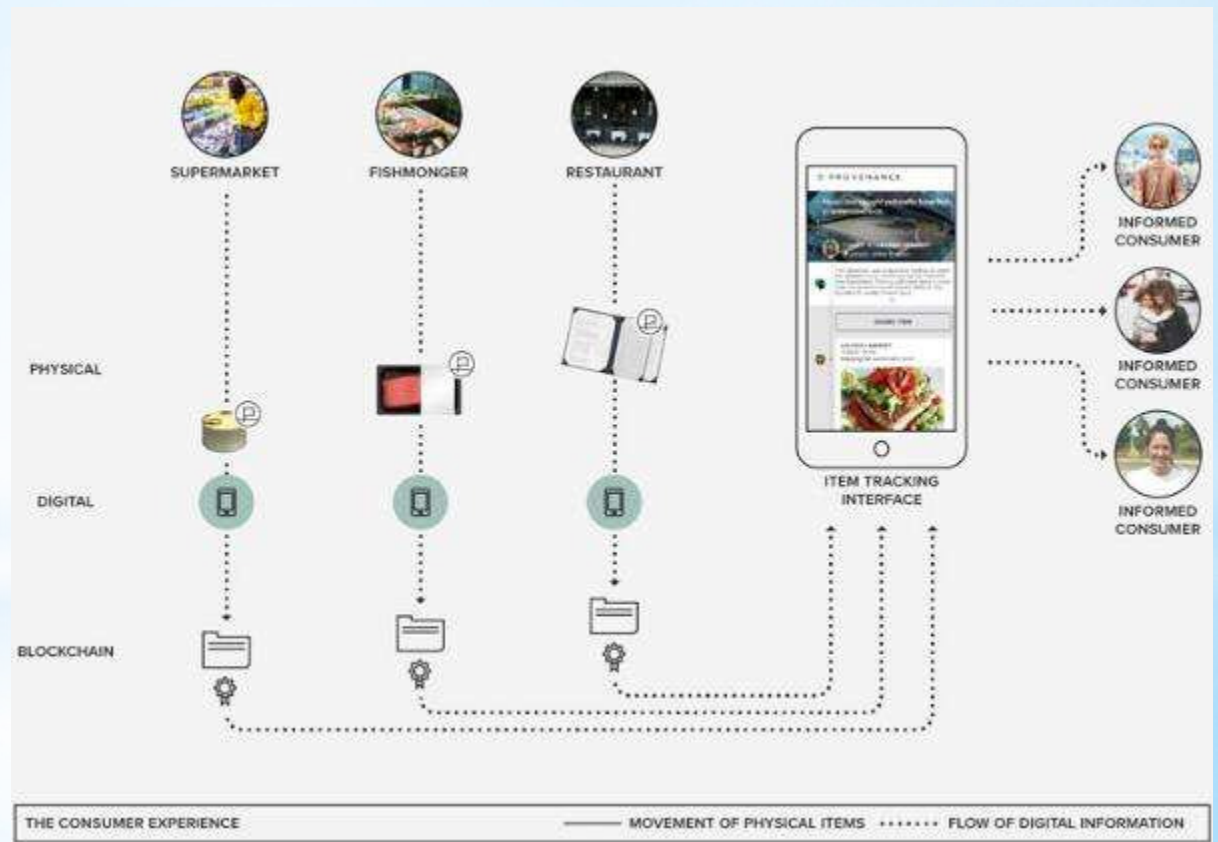


- Australian firm Power Ledger commenced a trial in Bangkok's Sukhumvit neighbourhood where an apartment complex, a school, a mall, and a dental hospital with solar panels trade clean energy with one another, and the city's electricity grid, over a blockchain marketplace.
- the system is one of the world's largest peer to peer renewable energy trading platforms using blockchain.

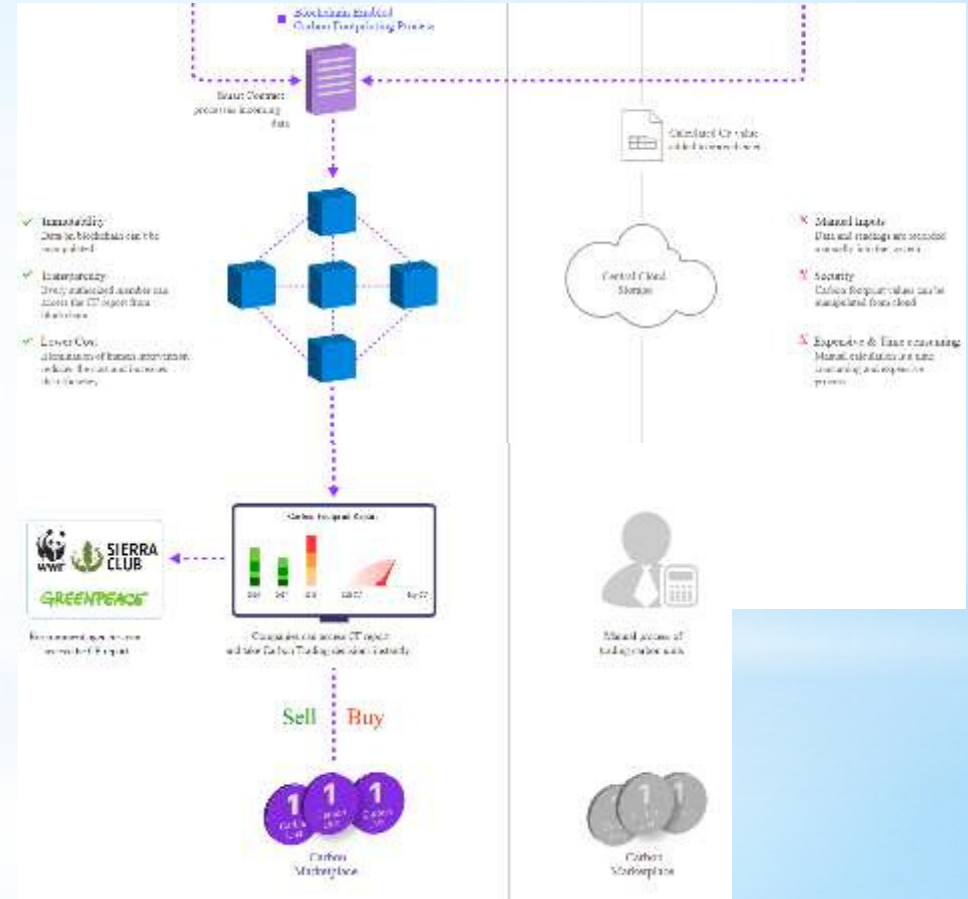
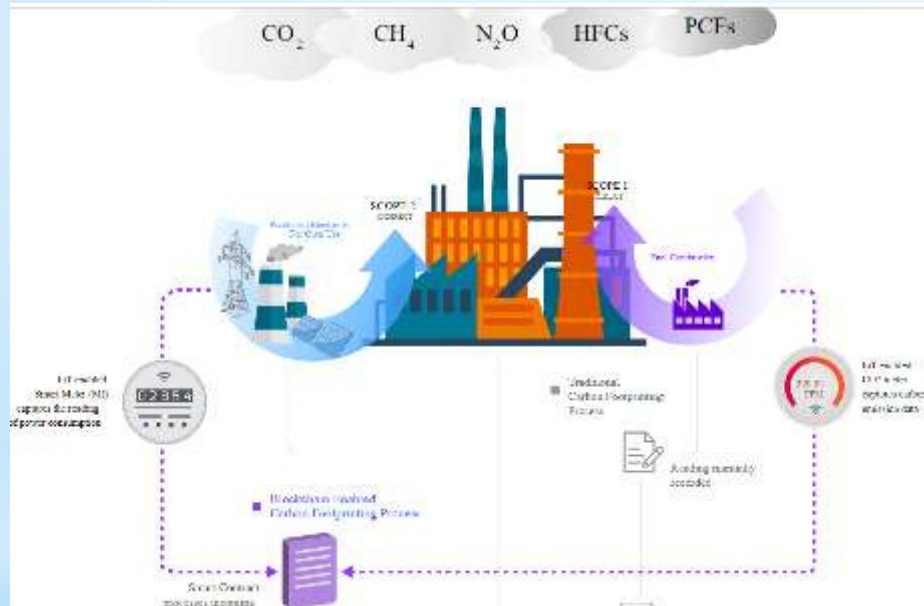
## Innovative Technology

### 2. Blockchain

#### Provenance



# Applications of Blockchain: Carbon Footprinting

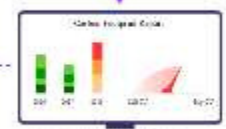


- ✓ **Immutability**  
Data in blockchain can't be easily altered
- ✓ **Integrity**  
Directly validated numbers are stored on the IT system from the blockchain
- ✓ **Lower Cost**  
Automation of human intervention reduces the cost and increases the accuracy

- ✗ **Storage Issues**  
Data and ratings are recorded centrally in the cloud
- ✗ **Security**  
Carbon footprint values can be manipulated from cloud
- ✗ **Expense & Time consuming**  
Manual calculations of a time-consuming & expensive process



Environmental non-governmental organization



Companies can access IT system and take the Carbon Footprint value directly



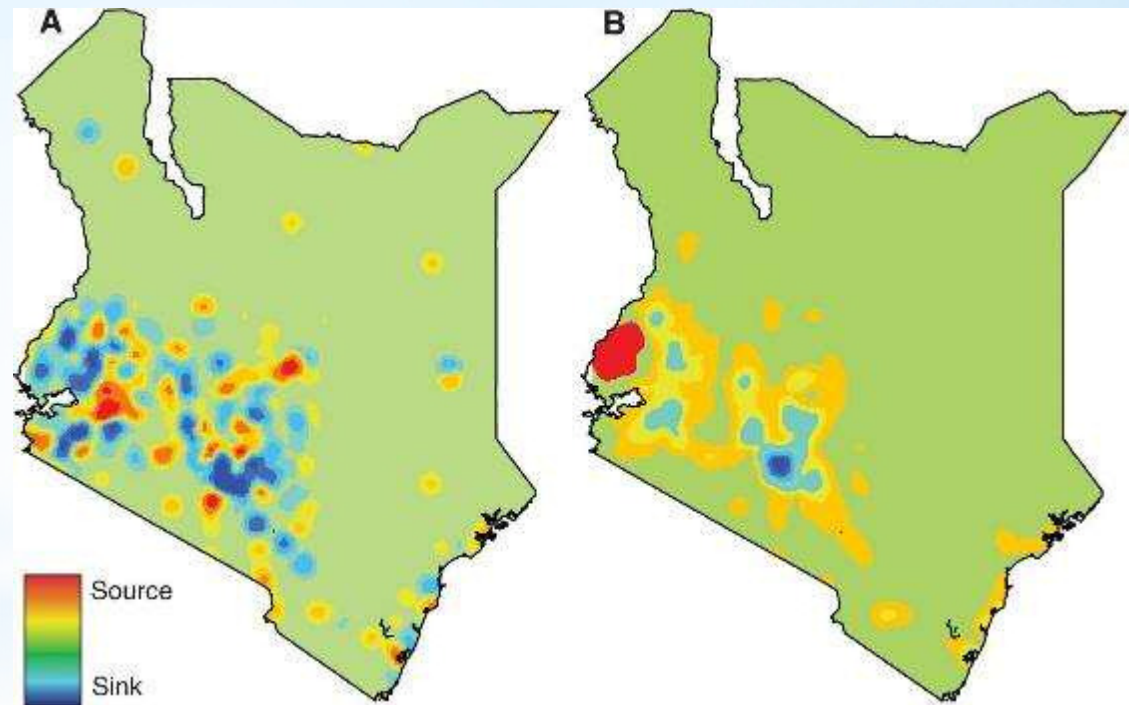
Manual process of taking carbon value



Carbon Marketplace

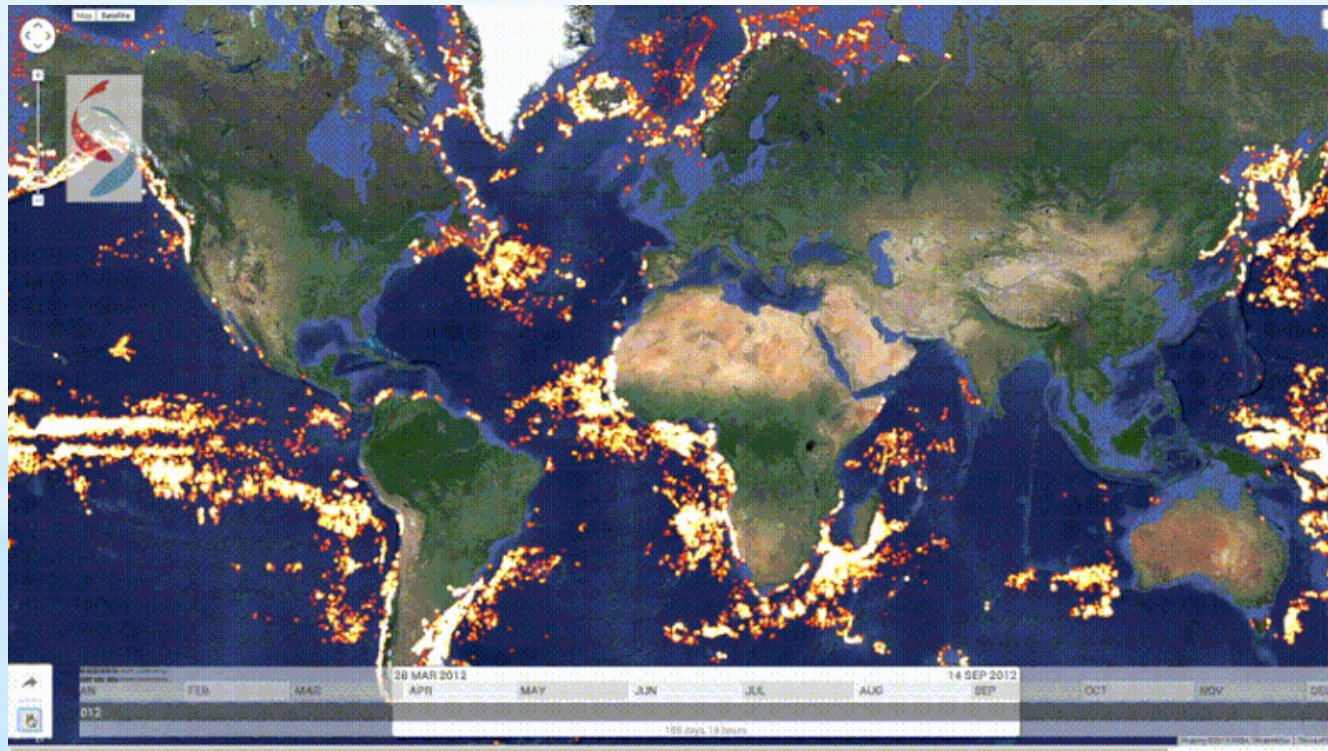
## Big Data Applications

- Human travel patterns and malaria-** In Kenya, Caroline Buckee, a Harvard University researcher processed data from 15 million cell phones in 2012 to identify how human travel patterns contributed to the spread of malaria—this helped officials allocate resources to disease control efforts.



(A) Travel sources and sinks. (B) Parasite sources and sinks.

**Global Fishing Watch** - launched in 2016, the platform processes over 22 million position messages from more than 200,000 ships ever day to detect patterns that signify which vessels are fishing, when and where. This allows anyone with an internet connection to see fishing activity anywhere in the ocean in near real-time, for free.



## Innovative Technology

### 4. Artificial Intelligence

#### The Climate Corporation's Climate Fieldview software

**CLIMATE FIELDVIEW**

Climate FieldView provides all the tools necessary to ensure efficiency and informed decisions all year long

- Weather**  
Real-time and future forecasted weather up to 3 hours
- Script Creator**  
Create variable-rate planting scripts
- Data Visualization**  
Real-time field data collection for future informed decision making
- Field Health Advisor**  
Satellite imagery to detect crop issues
- Scouting**  
Drop geo-located pins in your field to identify specific areas of interest
- Nitrogen Advisor**  
Anticipate field level nitrogen supplies based on applications, crop stage and weather



# Thank you for listening!



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Some photos, general info, and animation may be obtained from google searched websites

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