Metropolitan Water Reclamation District of Greater Chicago

Welcome to the September Edition of the 2021 M&R Seminar Series

NOTES FOR SEMINAR ATTENDEES

- All attendees' audio lines have been muted to minimize background noise.
- A question and answer session will follow the presentation.
- Please use the "Chat" feature to ask a question via text to "All Panelists."
- The presentation slides will be posted on the MWRD website after the seminar.
- This seminar has been approved by the ISPE for one PDH and approved by the IEPA for one TCH. Certificates will only be issued to participants who attend the entire presentation.

KULDIP KUMAR, Ph.D.
PRINCIPAL ENVIRONMENTAL SCIENTIST
METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

Dr. Kumar is leading the New Technology Evaluation Program at the Metropolitan Water Reclamation District of Greater Chicago (MWRD). This program focuses on evaluating technologies and processes with the goal of identifying those which have the greatest potential to optimize every aspect of the wastewater treatment process, including: operational reliability, maintenance, process performance, energy demand, environmental quality and compliance, and safety, in alignment with the MWRD's Strategic Plan. Dr. Kumar is also leading efforts at the MWRD to develop the Climate Action Plan and the Sustainability and Resiliency Action Plans.

SUSTAINABILITY

Still Relevant Or A Paradigm in Crisis

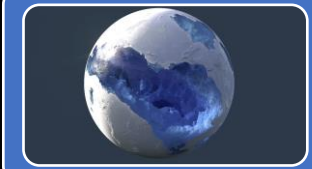
Kuldip Kumar
September 24, 2021
Monitoring and Research Department
Metropolitan Water Reclamation District of Greater Chicago

KumarK@mwrd.org

708.588.3579

Outline

SUSTAINABILITY FRAMEWOK



STATE OF THE PLANET EARTH

- Climate Change
- Degradation of Ecosystems

REGENERATIVE FRAMEWORK

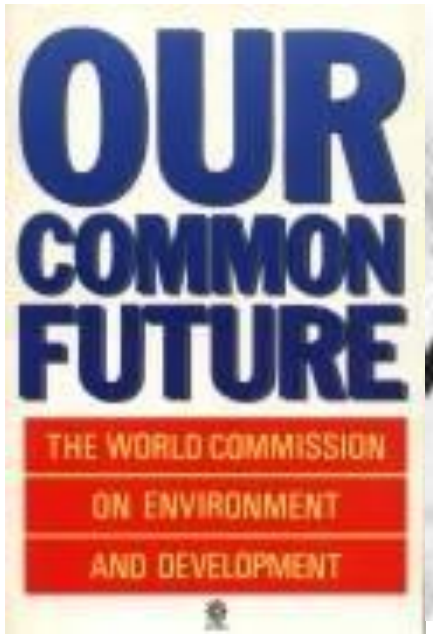
CIRCULAR ECONOMY – OPPURTUNITIES FOR REGIONAL RESILIENCE

REGENRATIVE FRAMEWORK - WHERE DOES MWRD STAND ?

CALL FOR ACTION

Sustainability and Sustainable Development

The 1987 UN report, “Our Common Future” (Brundtland Report): Raised serious concerns about the State of the Planet.



Gro Brundtland
Norwegian Prime Minister
Chair of WCED

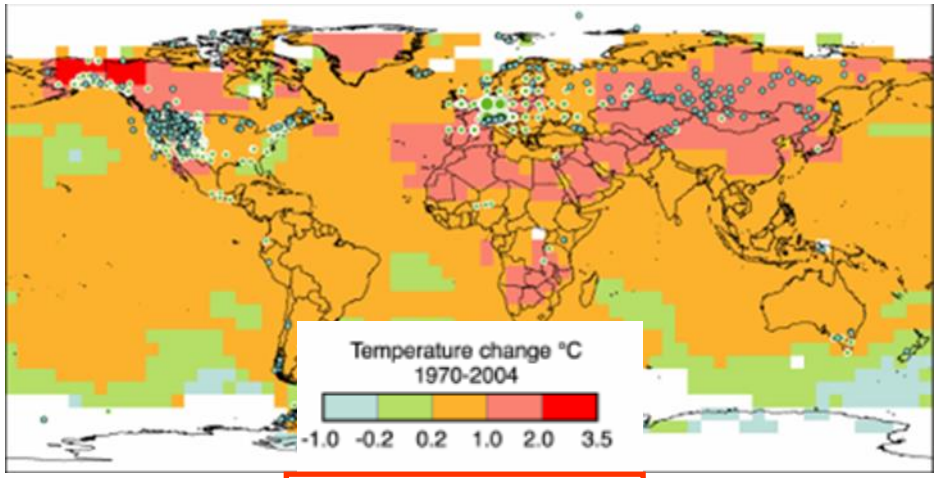
Sustainability: “Development that meets the needs of the present without compromising the ability of future generations to meet their needs.”

UNITED NATIONS

UN World Commission on Environment and Development,1987.

Follow-Up Report: Intergovernmental Panel on Climate Change (IPCC) (2007)

There are no major issues raised in Our Common Future for which the foreseeable trends are favorable



Global Warming

Erosion of Biodiversity

The biomass of fish is estimated to be 1/10 of what it was 50 years ago and is declining.

At the current rates of human destruction of natural ecosystems, 50% of all species of life on earth will be extinct in 100 years.

+130 countries

WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

UNEP

[Nobel Prize with Gore 2007]

USA TODAY

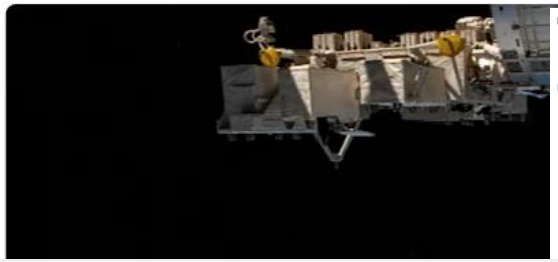
When turning on faucets is a source of stress: Climate change is starting to shape where Americans relocate

Swapna Venugopal Ramaswamy, USA TODAY

Mon, August 2, 2021, 1:47 PM · 9 min read

NBC NEWS

Earth's energy imbalance removes almost all doubt from human-made climate change



Three Americans create enough carbon emissions to kill one person, study finds

Oliver Milman

Thu, July 29, 2021, 4:00 AM · 4 min read

The Telegraph

World is on the brink of catastrophe, warns Government climate chief

MarketWatch

'Nowhere to run, nowhere to hide.' UN climate report warns of 'code red for humanity.'

TIME

These Scientists Linked June's Heat Wave to Climate Change in 9 Days. Their Work Could Revolutionize How We Talk About Climate

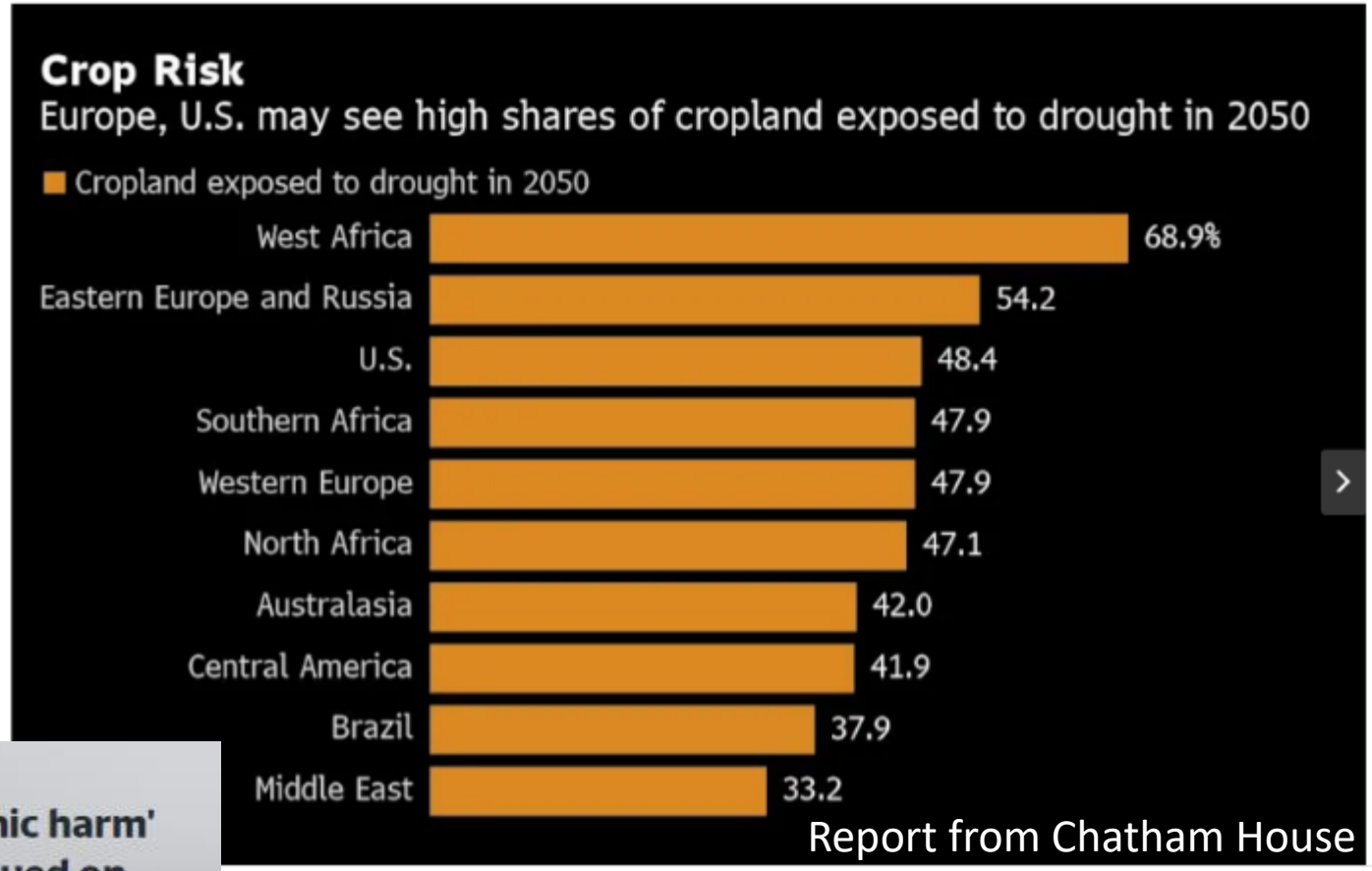
Alejandro de la Garza

July 13, 2021 · 8 min read

Report: Climate change could see 200 million move by 2050

Bloomberg

World Faces Growing Risk of Food Shortages Due to Climate Change



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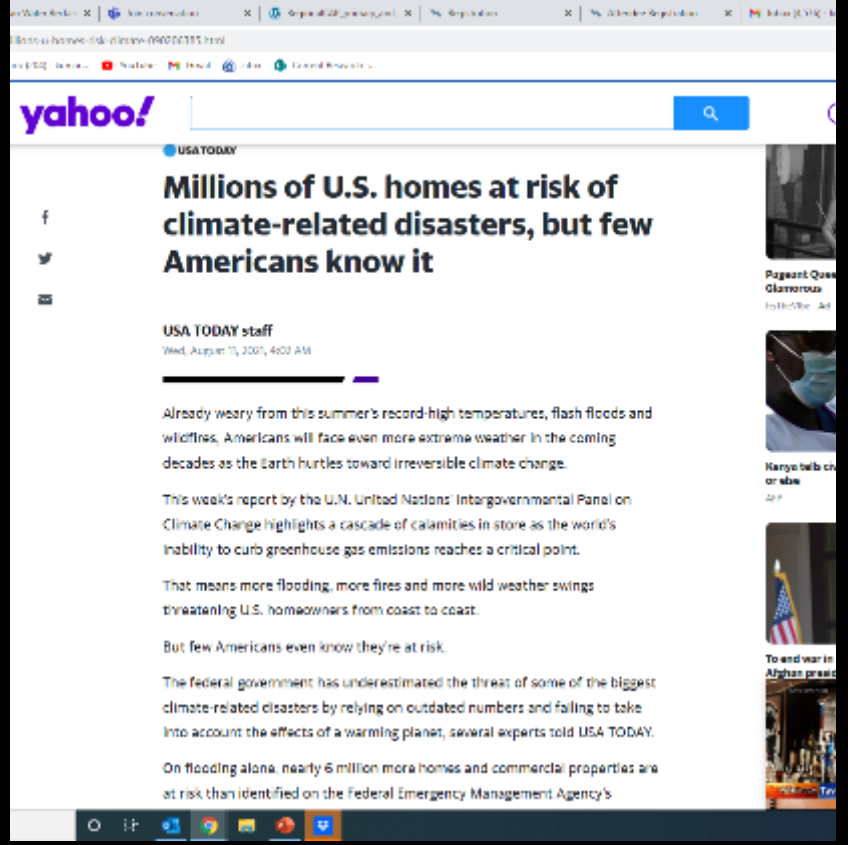
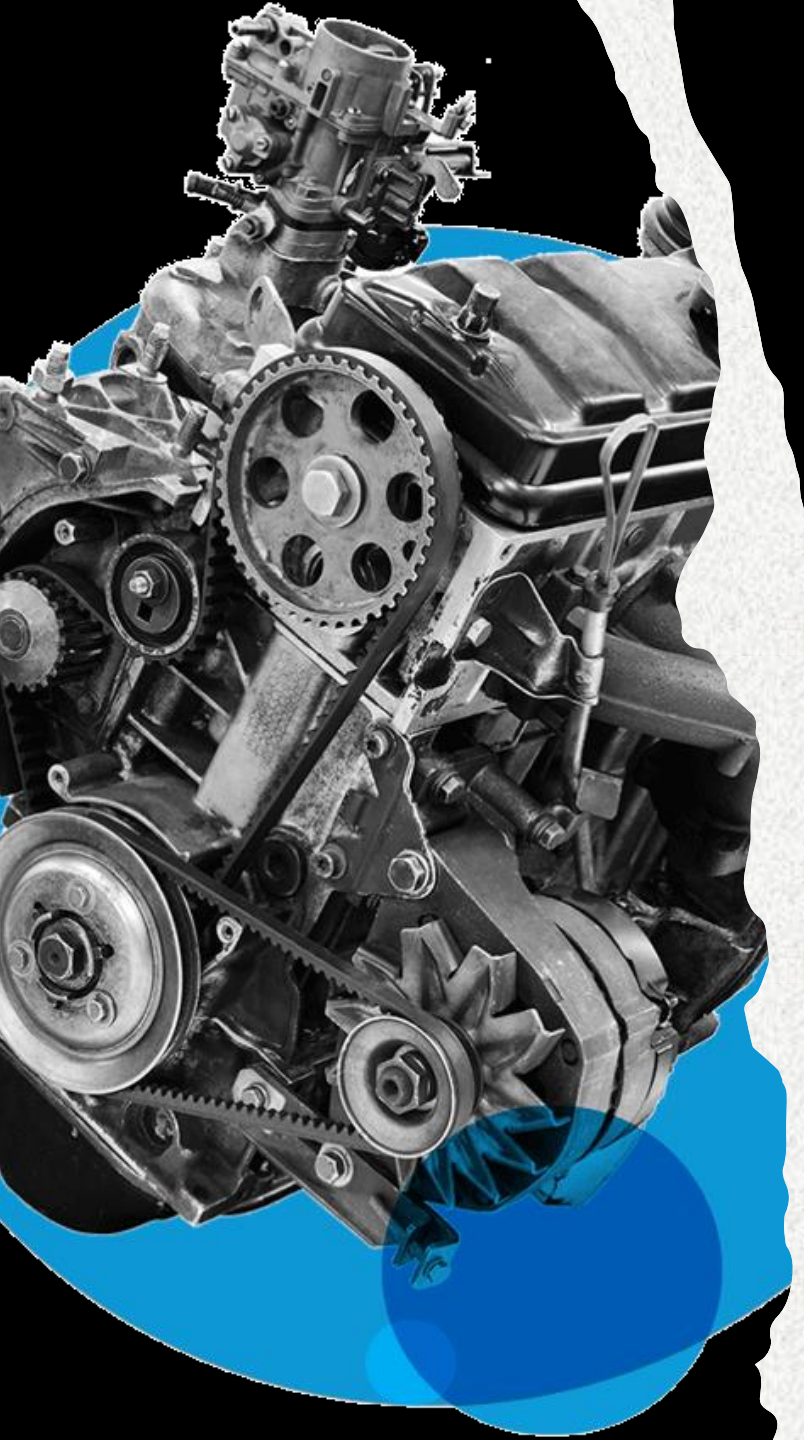


Who is communicating this risk to general public?

- Flooding: 6 million homes and commercial properties (FEMA and First Street Foundation)
- Wildfires: More homes face the risk of wildfires than current projections by the USDA Forest Service

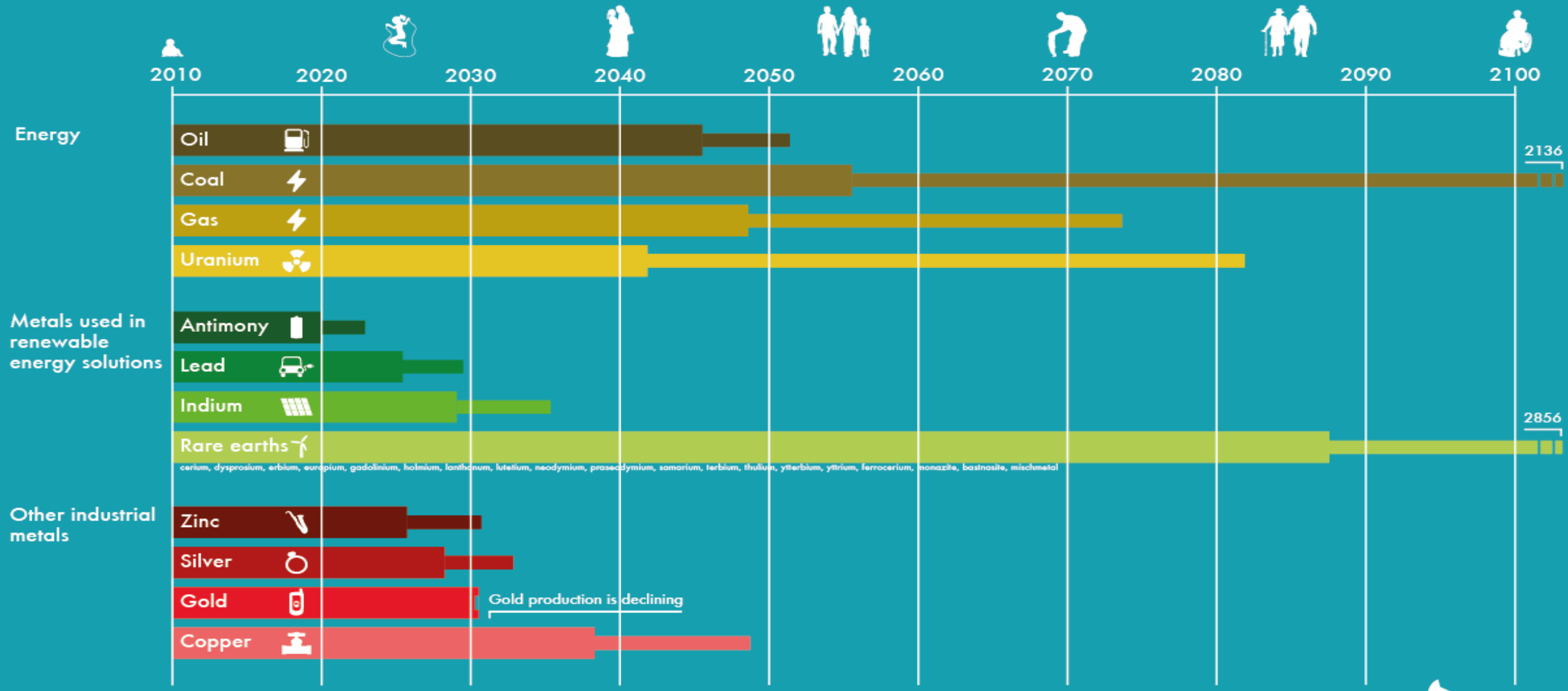


HISTORICAL RECKONING

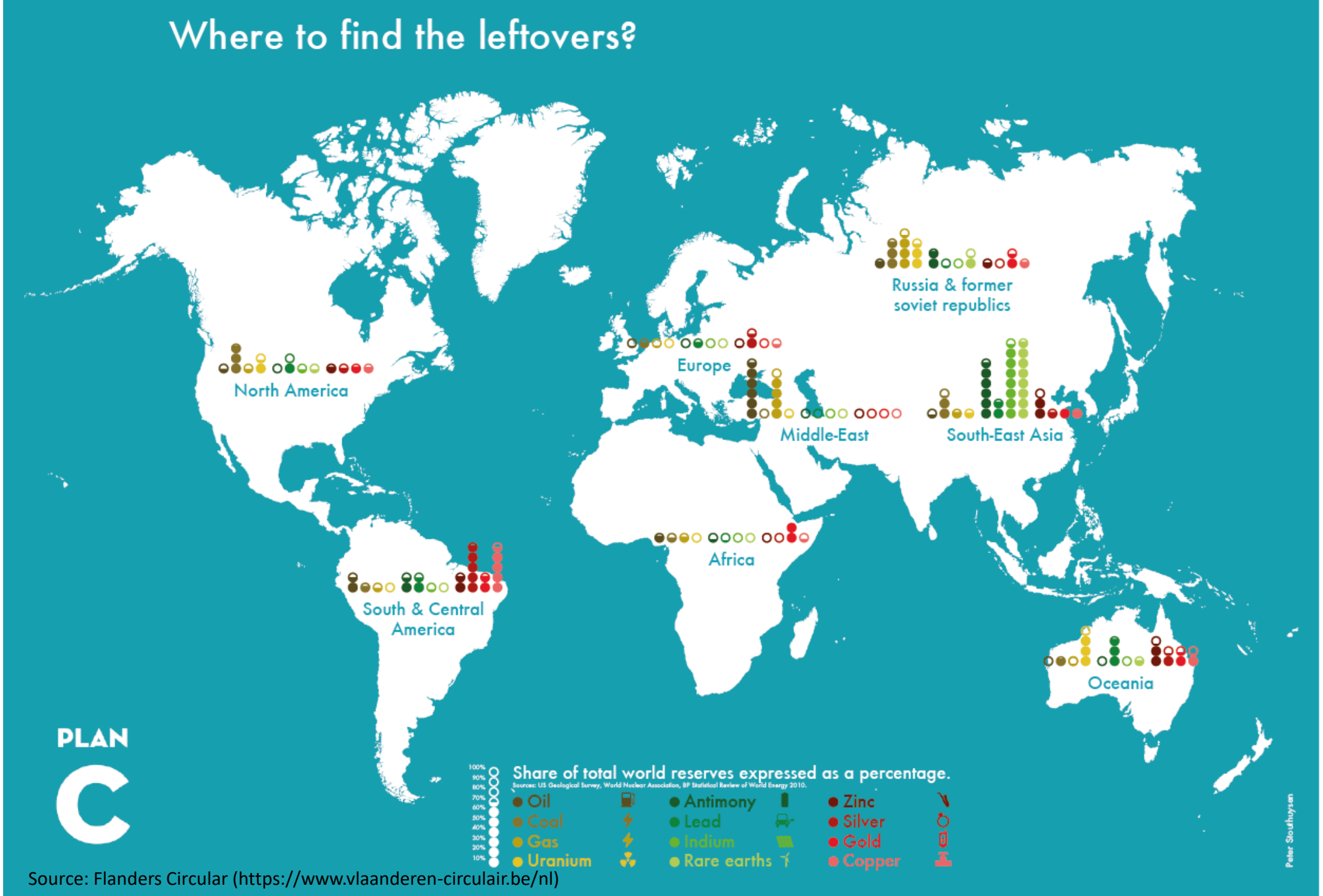
A Transformation in Our Ability to Make Things Changed Society – Industrial Revolution

- We turned resources into an extraordinary number of products.
- Since the industrial revolution, the rapid pace of technological progress has continued.
- The resulting innovations meant that many now have access to products from all over the world at affordable prices.
- These products have brought many of us levels of material comfort unimaginable to previous generations.

Born in 2010: How much is left for me?



Source: Flanders Circular (https://www.vlaanderen-circulair.be/nl)



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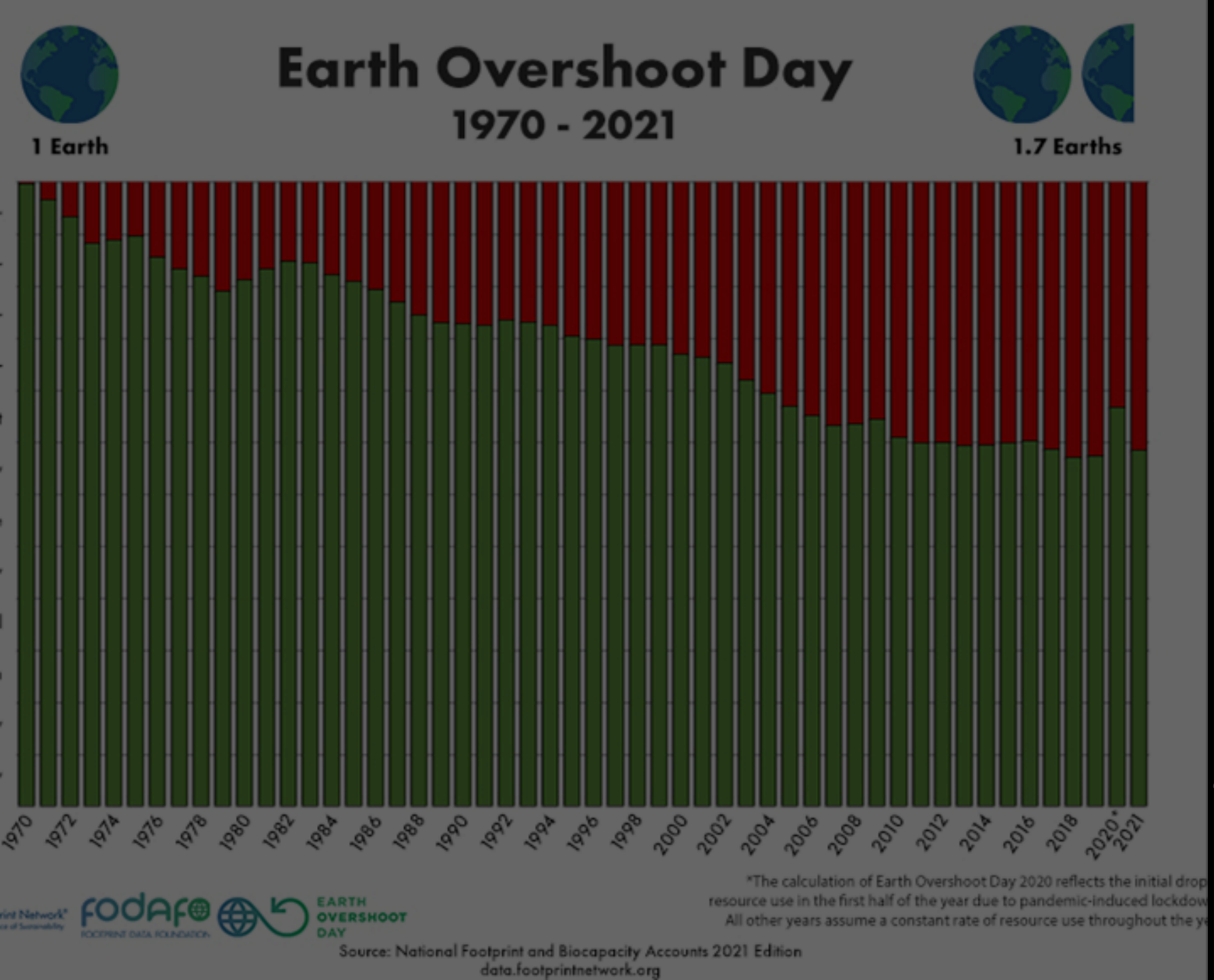
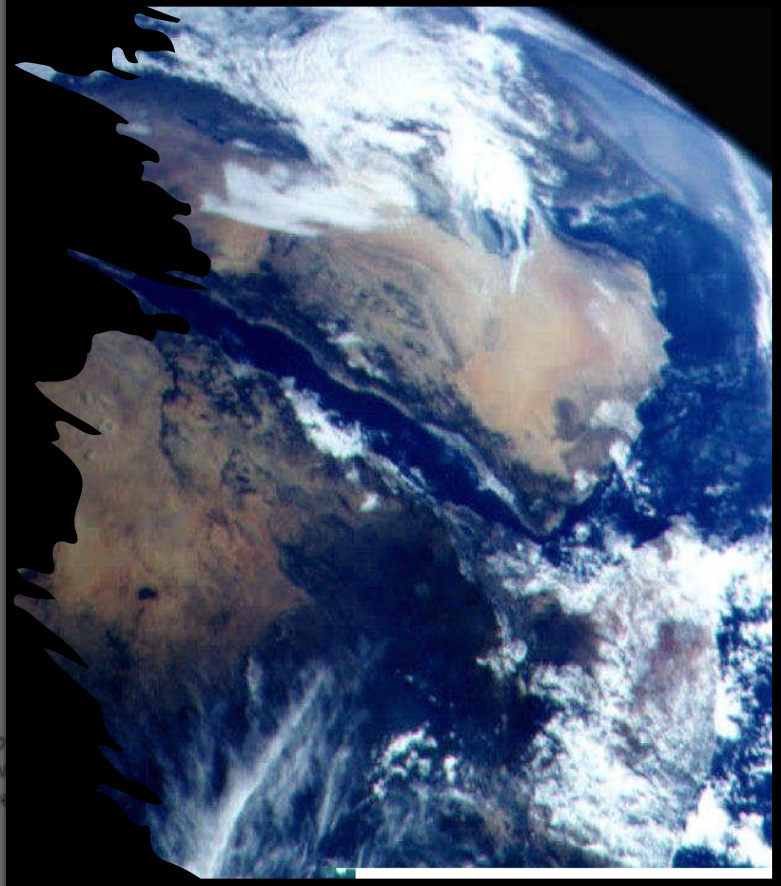


The date when humanity's demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year.

In 2021, it was on July 29.



Our Current Way of Doing Things Has Reached its Limits

The Current System is No Longer Working for Businesses, People, or the Environment

TAKE

- RESOURCES ARE TAKEN FROM THE GROUND

MAKE

- TO MAKE PRODUCTS WHICH ARE USED

WASTE

- WHEN PRODUCTS ARE NO LONGER NEEDED OR WANTED, THEY ARE DISCAREDED

Conventional Sustainability HOW THIS LOOKS TODAY ?

- Anthropocentrism
- Too unspecific
- Un-ambitious in its aims
- Economic development/growth
- Mitigating damage
- Efficiency

The aims included efficiency, **doing less harm** and mitigating damage to the environment, minimally acceptable levels of human wellbeing, managing nature and people, economic growth, and developing and implementing technological advances.

RESULT

Environmental and social degradation continue at increasing rates to the extent that "we are in a state of planetary emergency"

Worldwide energy and materials use is increasing, and we are either near or already have surpassed planetary limits and tipping points

"All I am saying is <u>NOW</u> is the time to develop the Technology to deflect an asteroid"

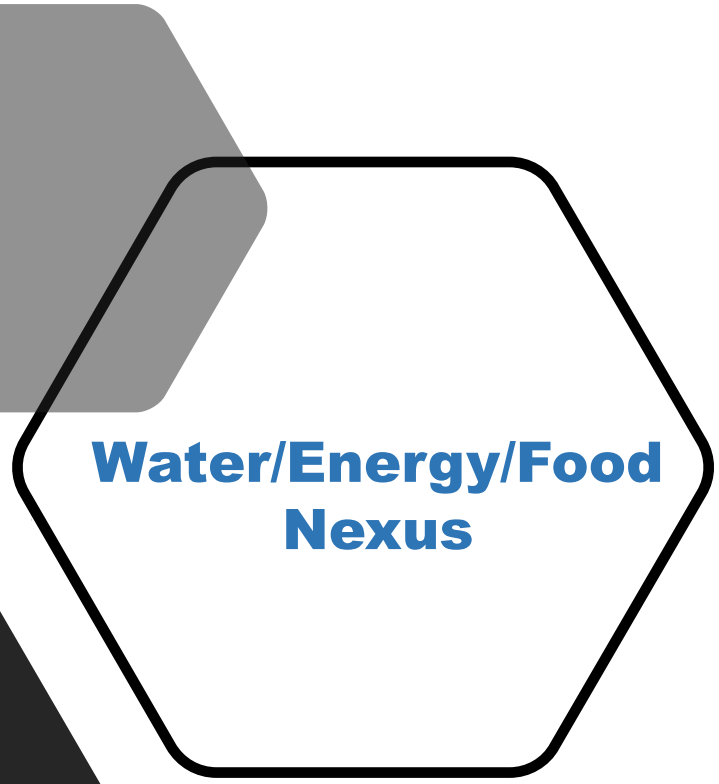
Source: New Yorker

Now What?

"We innovated to get us here"

I Think ....

"It is Time to INNOVATE Again to get Us Out of This Mess"



Is it Going to be Different This Time?

Looking Ahead

New Framework

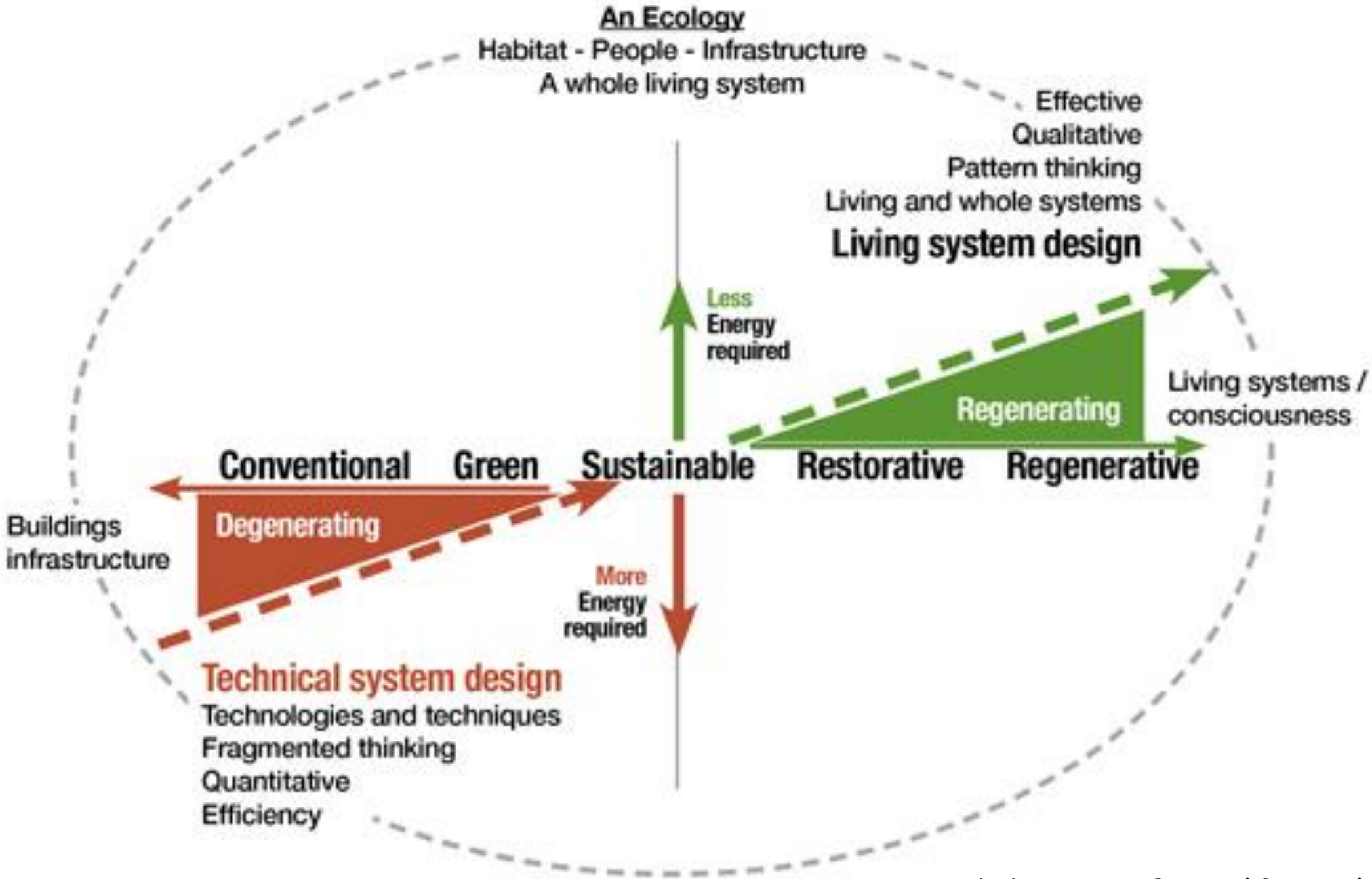
Smart people

Technology

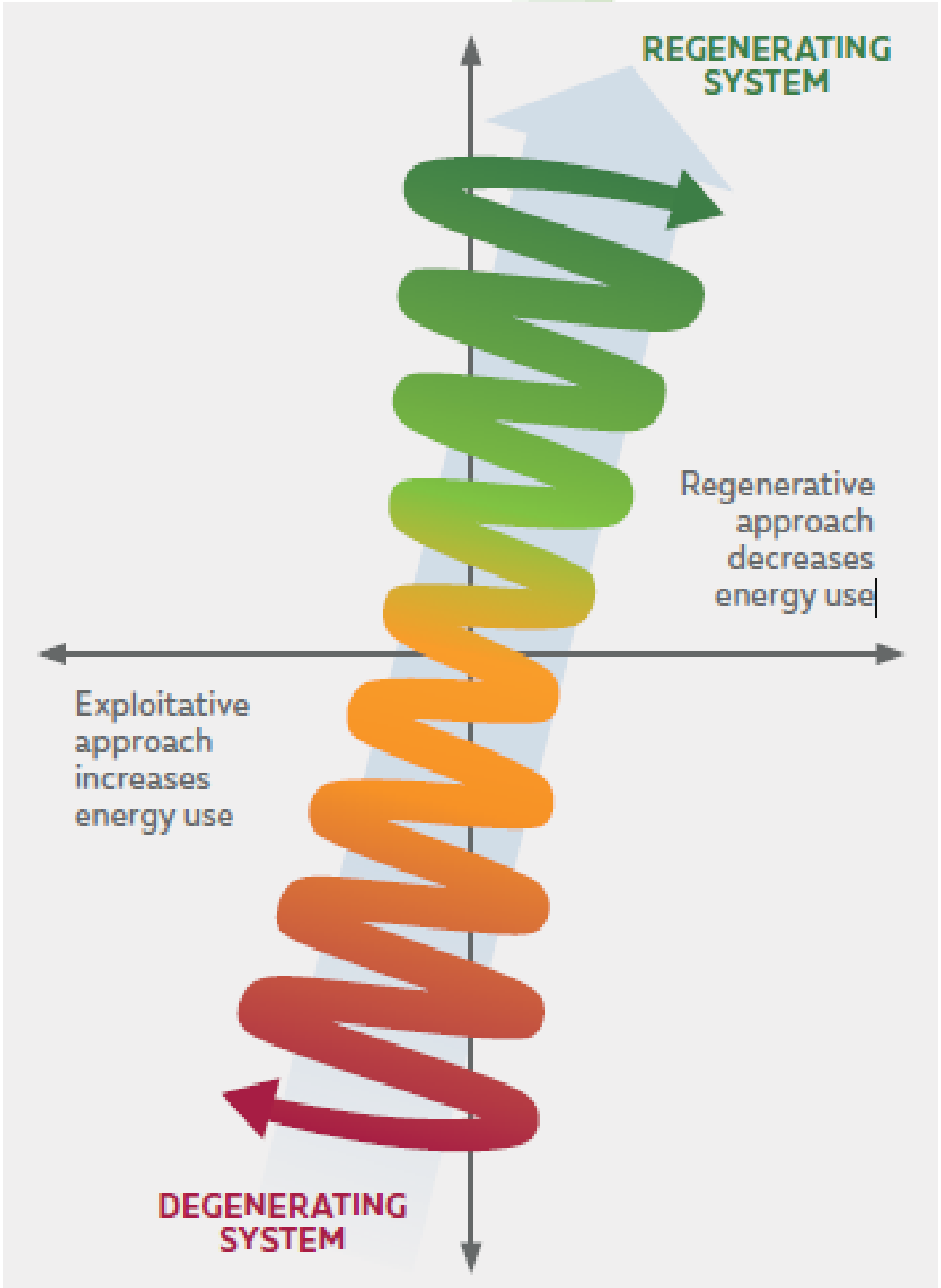
Drive

We now have the knowledge and tools to build an economy that is fit for the 21st Century.

It is Going to be Different This Time?



Source: Regenesis Group

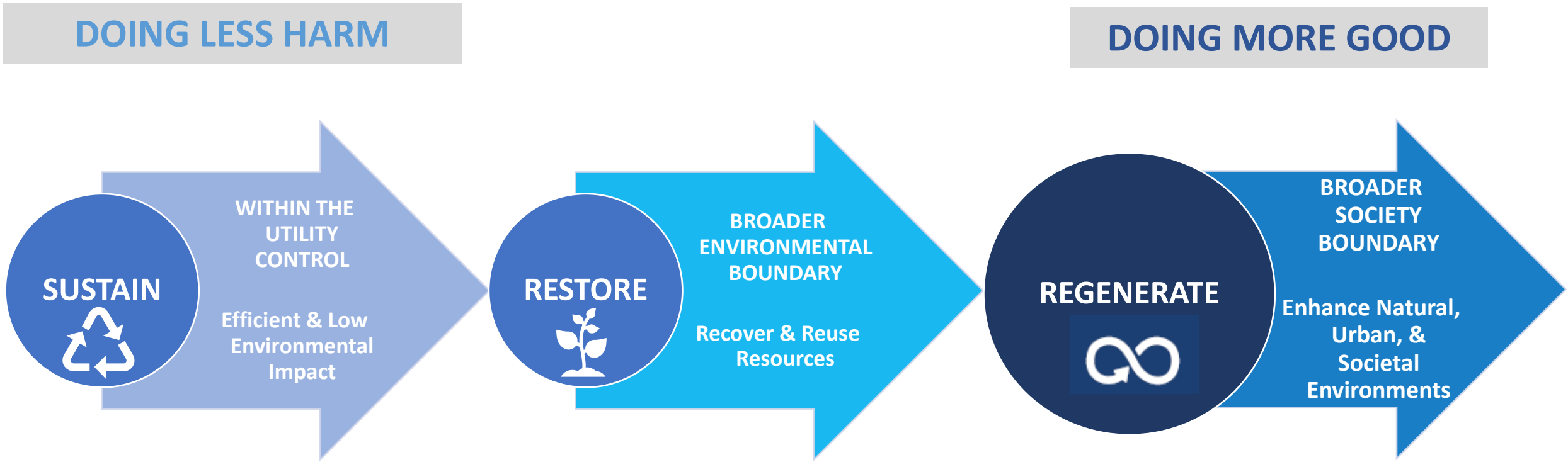


The Regenerative Design Framework

- **REGNERATIVE**
  Appropriate participation and design as nature
- **RESTORATIVE**
  Humans doing things to nature
- **SUSTAINABLE**
  Neutral point and not doing any more damage
- **CONVENTIONAL PRACTICE**
  Compliant with regulations

Image Adapted From: Regenesis Group

Transition Stages



Adopted from Mukhebir et al., 2020

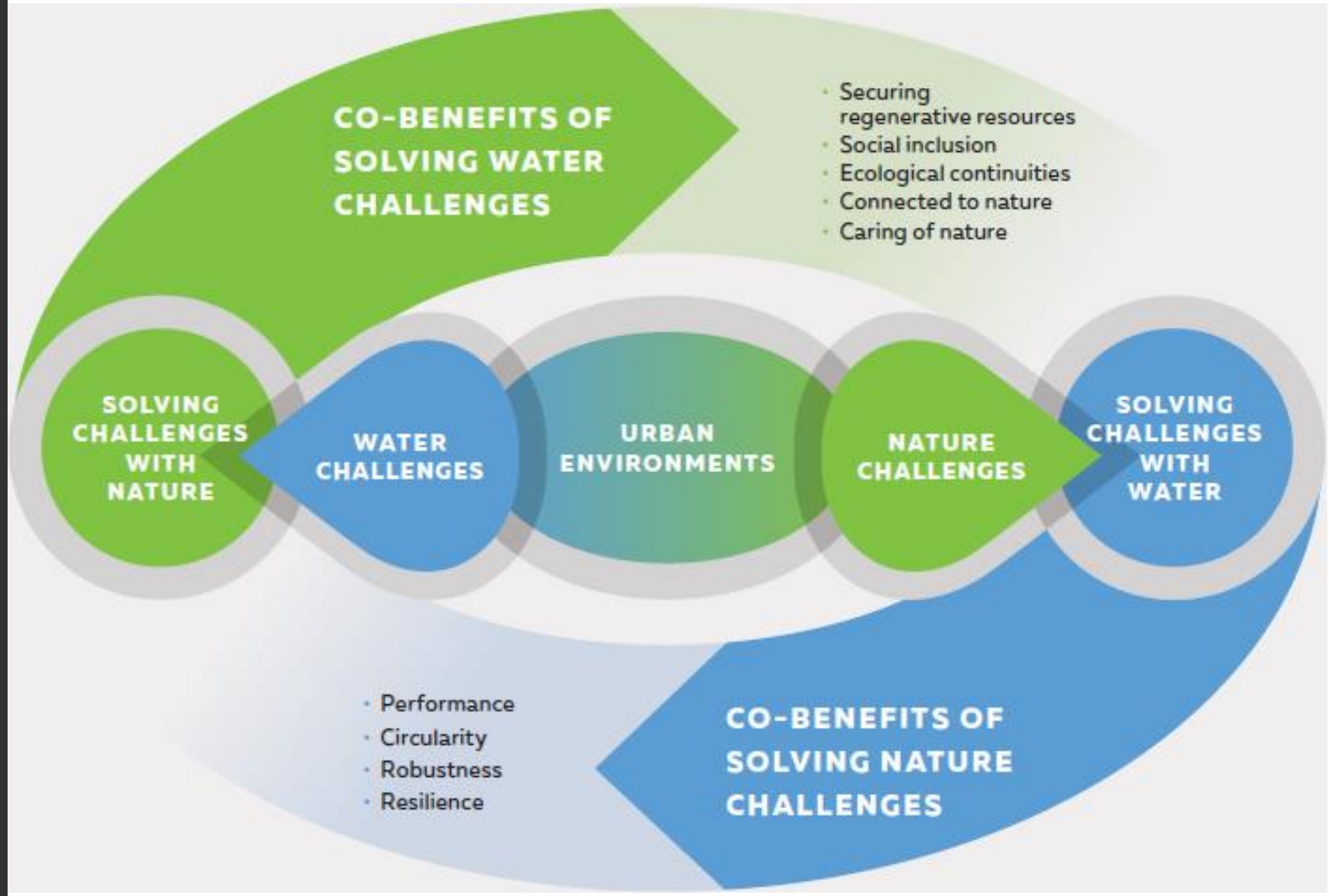
Working With Nature

WE CANNOT PROTECT SOMETHING WELL -

IF WE ARE NOT EMONTIONALLY CONNECTED TO IT

--- Sofia de Meyer

CE Thought Leader



From: Trommsdorff, 2020

REGENERATING THE NATURAL ENVIRONMENT

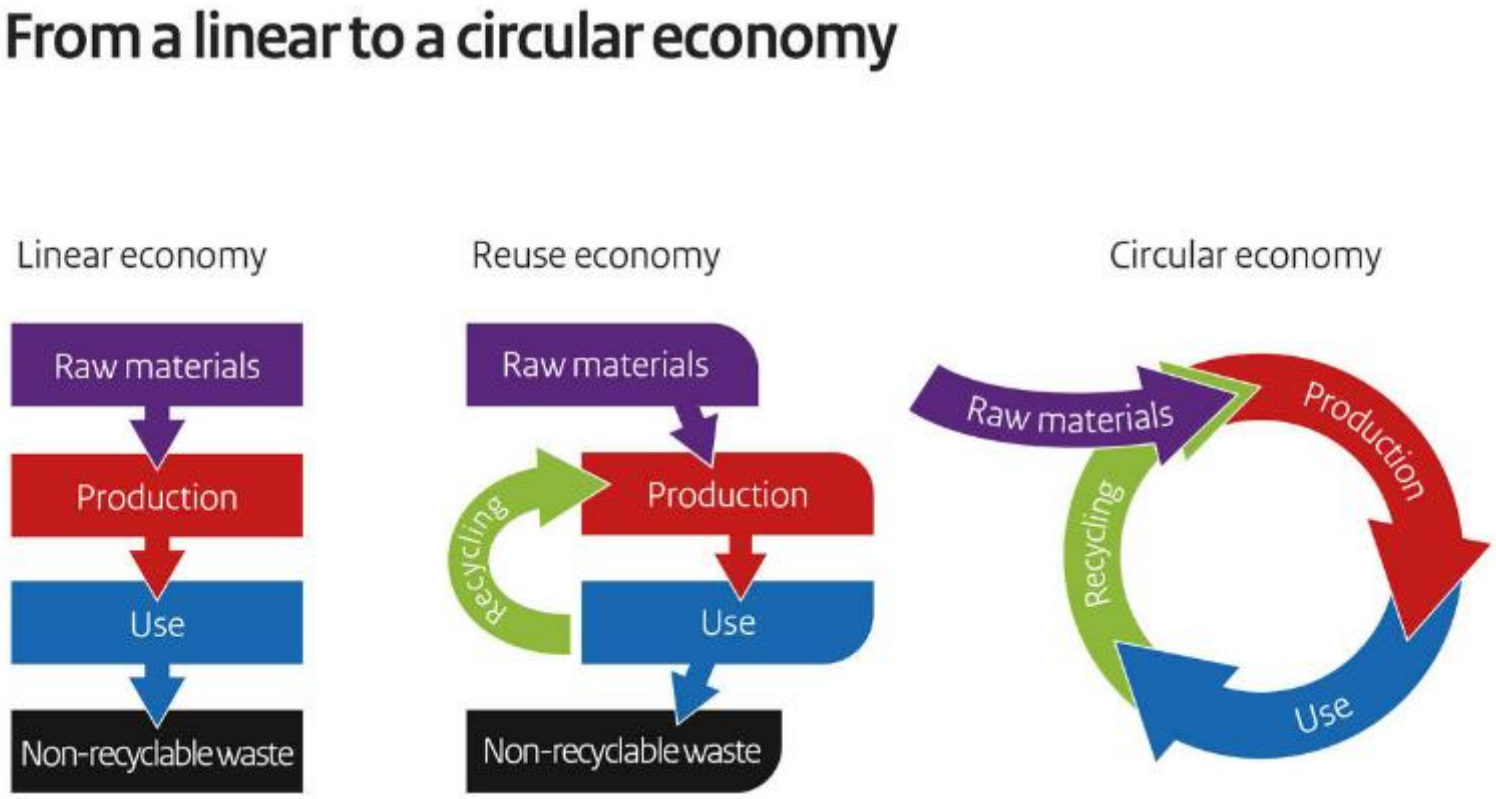
DESIGNING OUT WASTE EXTERNALITIES

KEEP RESOURCES IN USE

REGENERATING NATURAL CAPITAL

Circular Economy

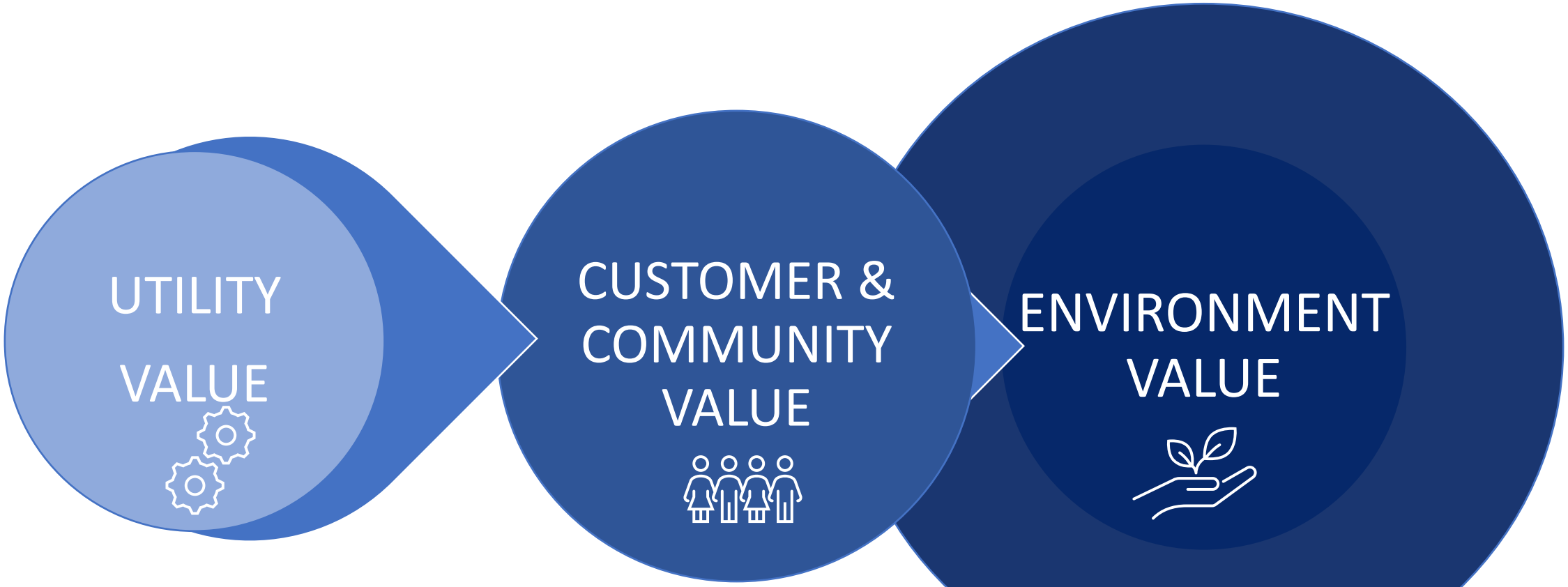
A Circular Economy is Based on the Principles of Designing Out Waste and Pollution, Keeping Products and Materials in Use, and Regenerating Natural Systems



Circular Economy
ELLEN MACARTHUR FOUNDATION

Government and policy	Insights for policymakers.
Education and learning	Courses and teaching resources.
Design	Includes circular design guide.
Business	Tools and guidance for businesses.

The Value in Adopting a Circular Economy Approach



Leaders in Innovation
Drivers of Transformational Change
Optimized Operational Costs
Deferred Capital Investments
Revenue Opportunities
Increased Adaptability
Inspired Workforce
Community Trust

Affordable Services
Reliable and Resilient Services
Livability Outcomes – Greening & Cooling
Increased Local Jobs

Lower GHG Emissions
Reduced Landfill Disposal
Improved Waterways & Oceans
Ecosystem Protection and Regeneration
Increased Nutrient Capture & Soil Health
Prosperity

Shift to Circular Economy

Leadership - Commitment to circular economy in the agency purpose

Planning & Partnerships – Shifting from siloed planning to integrated systems planning

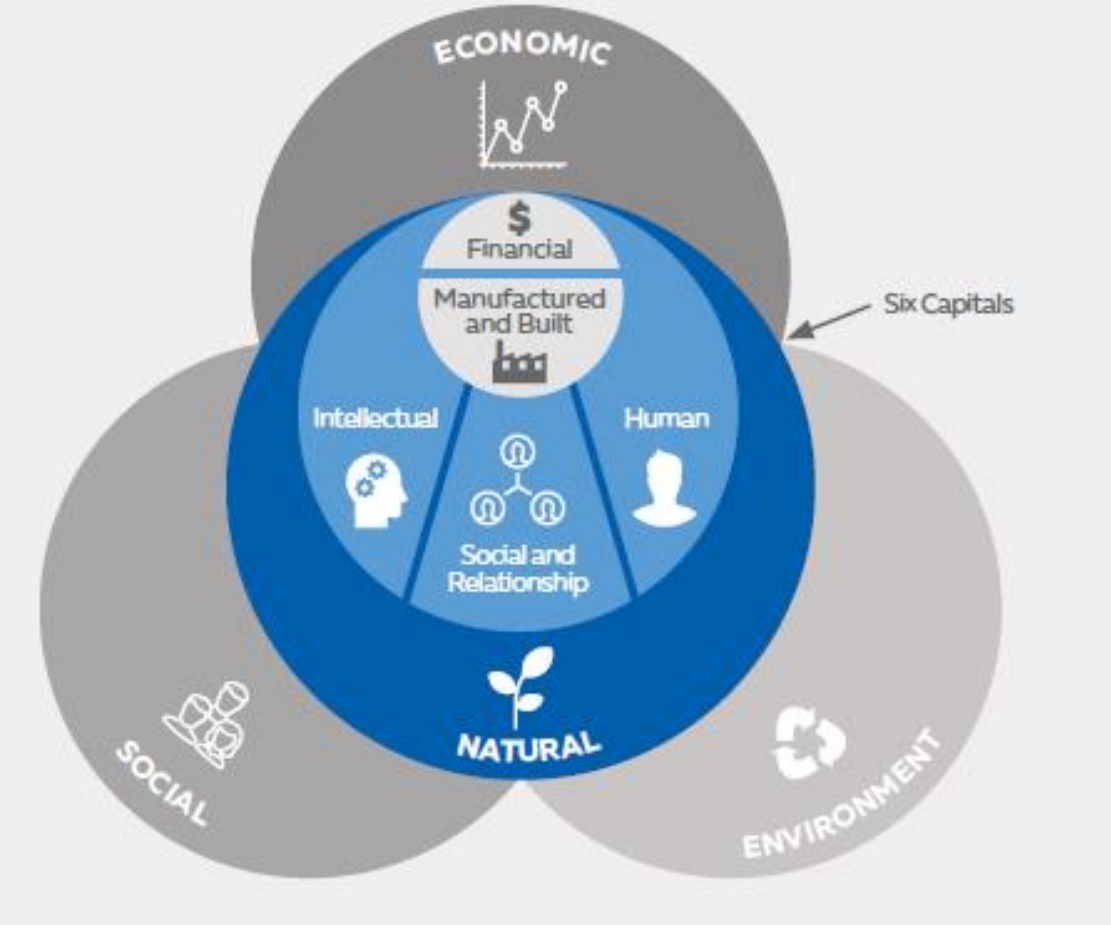
Regulation - provide clarity on the expectations, funding and delivery responsibility for livability related and circular economy outcomes

Economics & Markets – Not all externalities can or should be monetized, clearly resolve who benefits, who pays, and the timing of both

Culture & Knowledge – Knowledge and capacity of staff

Engagement & Communication – Acceptance of potential costs and understanding of the benefits

Six Capitals Approach



Financial Capital – Financial health and resilience of the agency

Natural Capital – Health of natural systems and resources

Human Capital – Employee's competencies and motivations to innovate

Social, Economic, & Relationships Capital – Broader societal benefits

Manufactured Capital – Asset management

Intellectual Capital – Organizational knowledge, such as intellectual property etc.

Transformative Computing and Blockchain Technology

Driven by Deep Research Challenges Posed by Sustainability

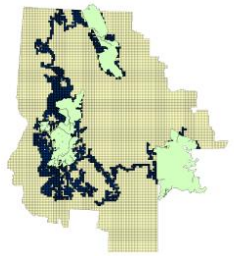
Design of policies to effectively manage Earth's natural resources translate into large-scale decision/optimization and learning problems, combining a mixture of discrete and continuous effects, in a highly dynamic and uncertain environment

Real world instance:

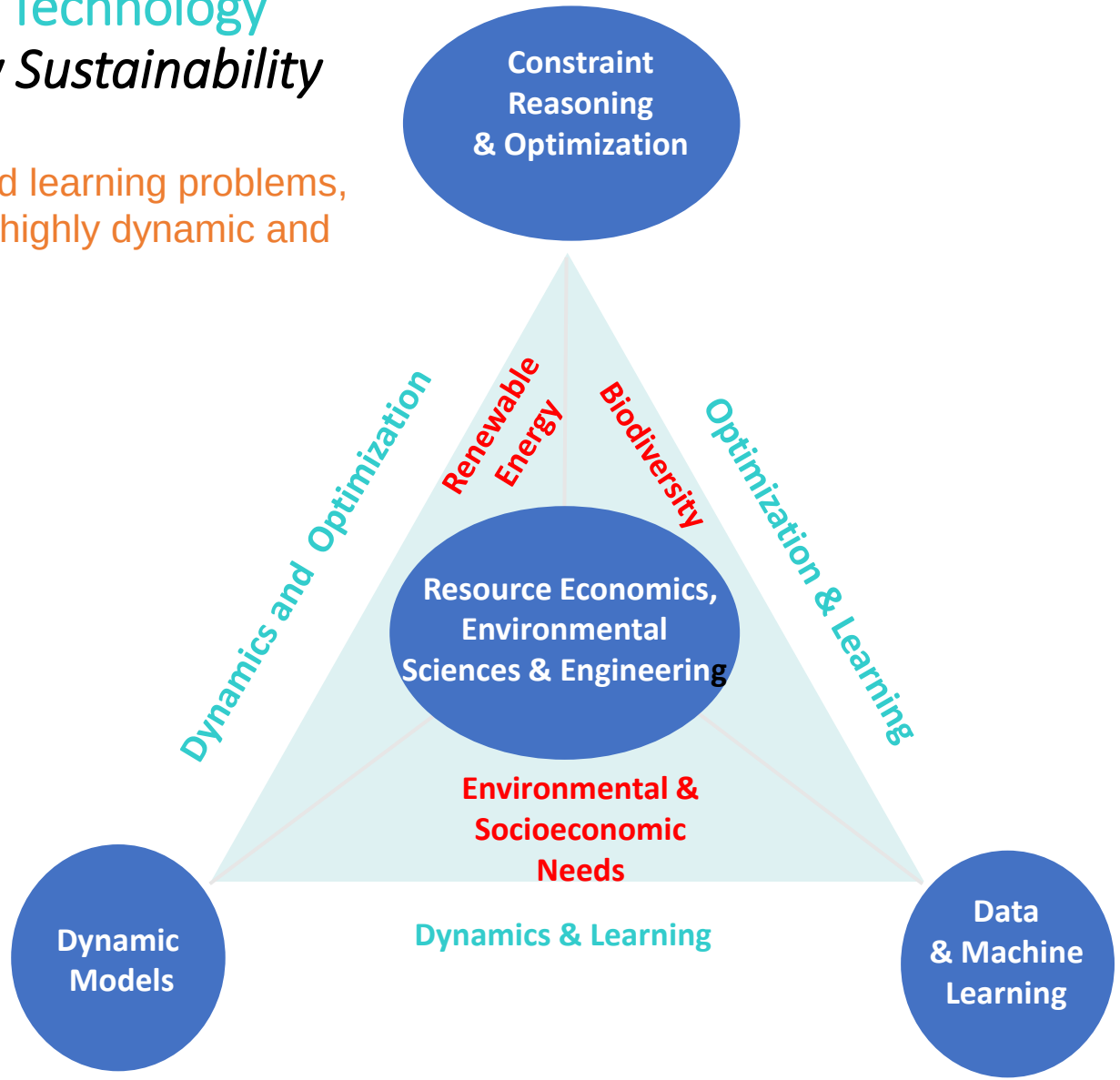
Corridor for grizzly bears in the Northern Rockies, connecting:

- **Yellowstone**
- **Salmon-Selway Ecosystem**
- **Glacier Park**

5 km grid (12788 land parcels): minimum cost solution



5 km grid (12788 land parcels): +1% of min. cost



Approach reduced corridor cost from $1 Billion to $10 Million

From: Carla Gomes – Cornell University

Circular Economy EV Battery

September 22, 2021
7:50 AM CDT
Last Updated 32 minutes ago

Sponsored by

standard chartered

2 minute read

Disrupted

Ford, Redwood form 'circular' supply chain for EV battery materials

By Paul Lienert

1. Reducing cost of EVs by reducing the dependence on imported materials

2. Reducing environmental impact from mining and refining of battery materials

3. Manufacturing in the US

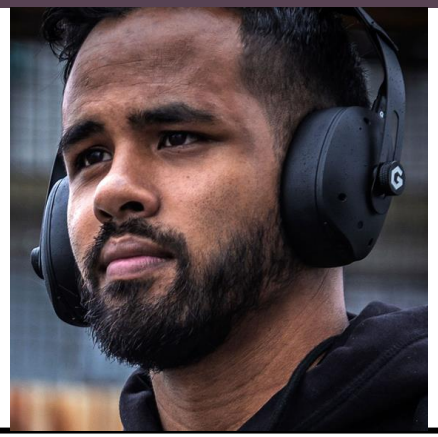
Circular Economy Factory for Vehicles Groupe Renault “RE-Factory”

Typical savings from the production of a remanufactured part are:

- 80% less energy
- 88% less water
- 92% less chemical products
- 70% less waste

1. Re-trofit - Extend the life of vehicles
2. Re-energy - Solutions for the production, storage and management of green energies
3. Re-cycle - Optimize the management of resources to support the ecosystem
4. Re-start - Promote innovation and knowledge sharing

Circular Economy
“RE-THINKING OWNERSHIP”
Headphones as a Service: Gerrard Street



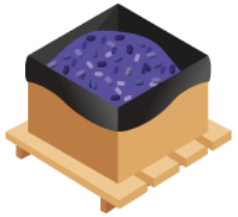
“Circular economy design is fully focused on how to design for reuse and/or recycling in combination with a product that consumers will love. In contrast, linear design thinking is only focused on designing a product that will sell."

1. Modular Design – Allow components to be reused

2. Products are Durable – Fewer virgin materials are used to create new headphones

3. Subscription Model – Allows recovery and upcycling of components

Kimberly-Clark Professional



Step 1 **Used PPE are Collected at Your Facility**

Step 2 **Collected PPE Transported to Recycling Partner**

Step 3 **Products Sorted & Processed to Plastic Pellets**

Step 4 **Raw Materials Molded to New Consumer Products**

EVALUATION OF THE USE OF DISPOSABLE GLOVES AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO AND POSSIBLE ALTERNATIVE ENVIRONMENTALLY FRIENDLY OPTIONS

By

Leo Quezada

Principal Storekeeper

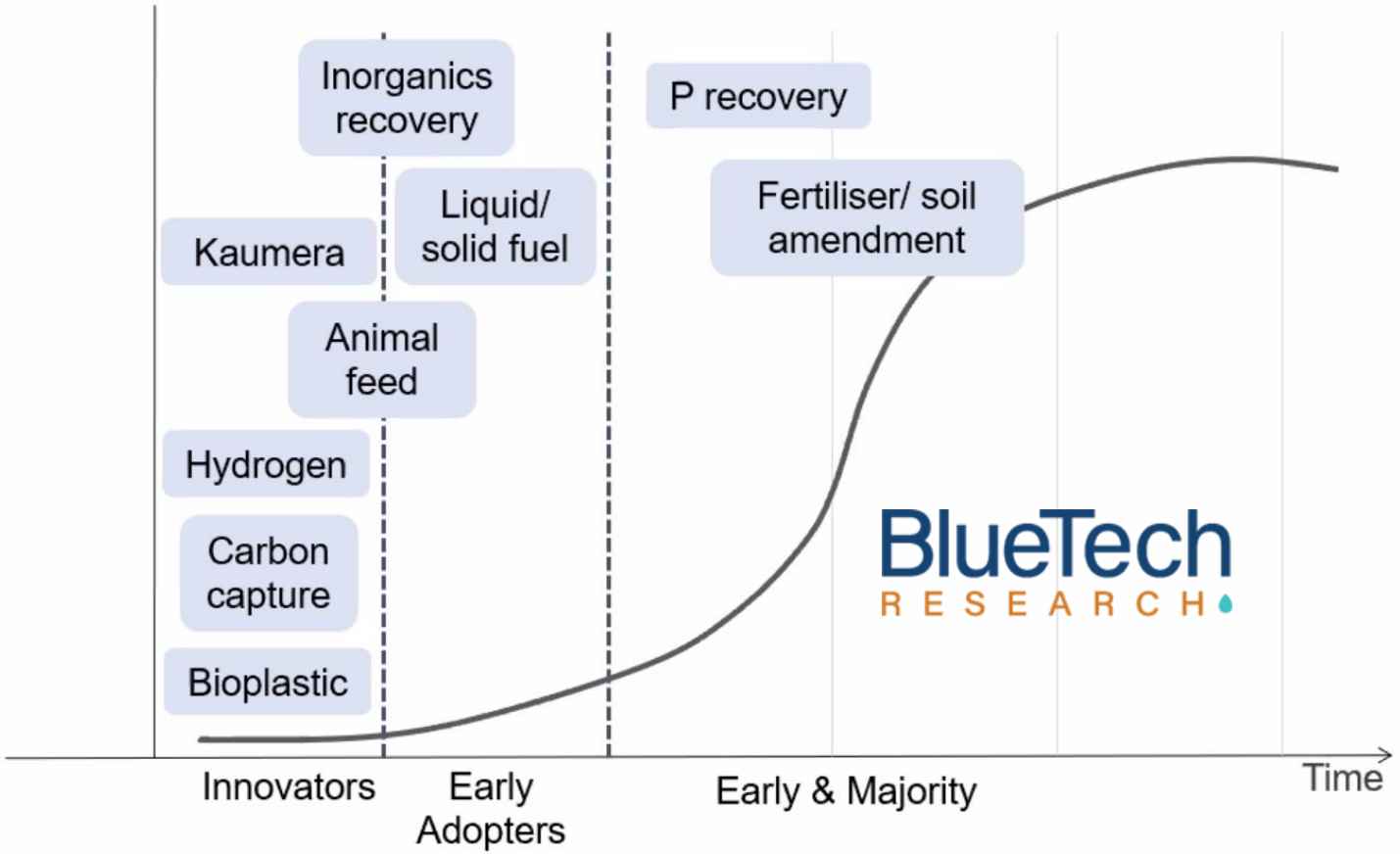
Kuldip Kumar

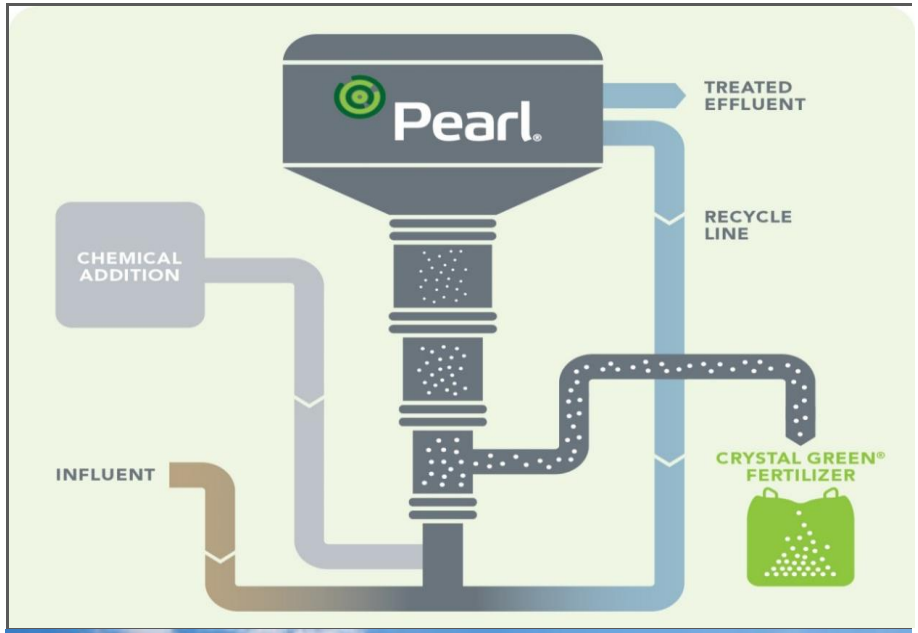
Principal Environmental Scientist

Jonathan S. Grabowy

Managing Civil Engineer

Circular Economy Technologies in Water – Horizon Scan



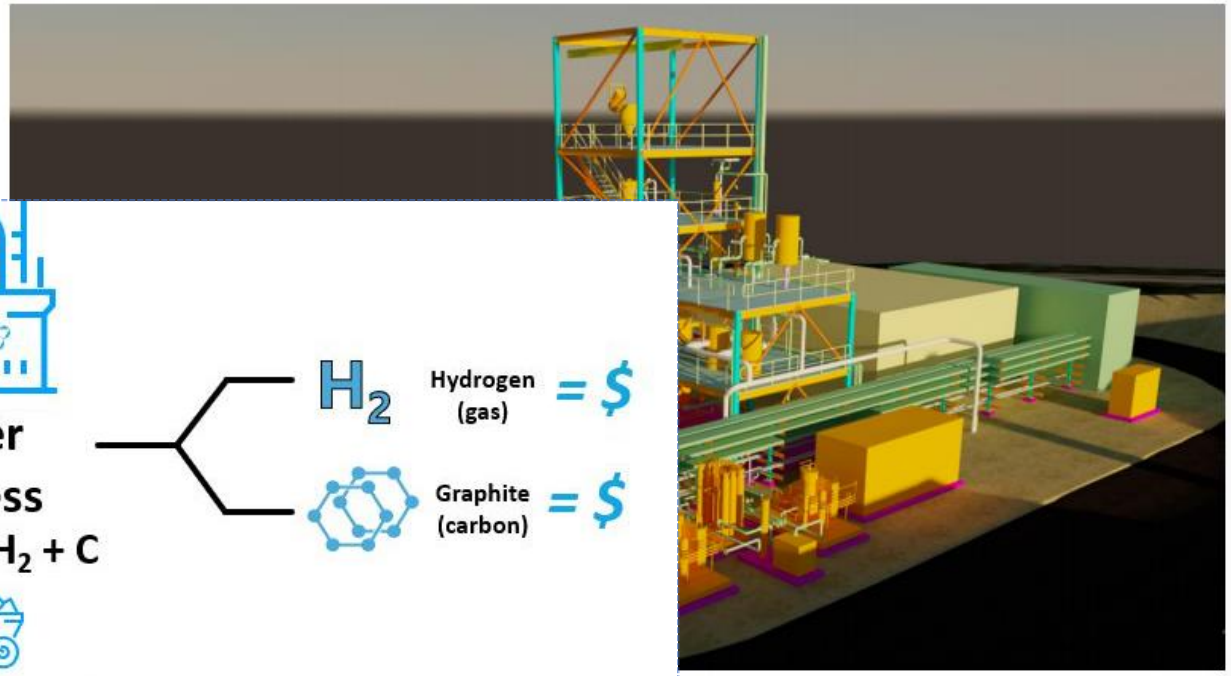


Methane to Hydrogen – Carbon Recovery

Producing Two Sustainable Products Without Creating CO2 in the Process

HAZER COMMERCIAL DEMONSTRATION PROJECT

First fully integrated larger scale demonstration of the Hazer Process



Project Summary

Location	Woodman Point WWTP (WA)
Feedstock Type	Biogas
Feedstock Vol.	~2 million Nm^3/year
Hydrogen	100 tpa (99.99% purity)
Graphite	~380 tpa (90 - 95% TGC)
Site Area	~4,000 m^2
Reactor Design	Pressurised Fluidised Bed
Heating	Electrical Heating

WATER CORPORATION

Owned by the people of WA

ARENA

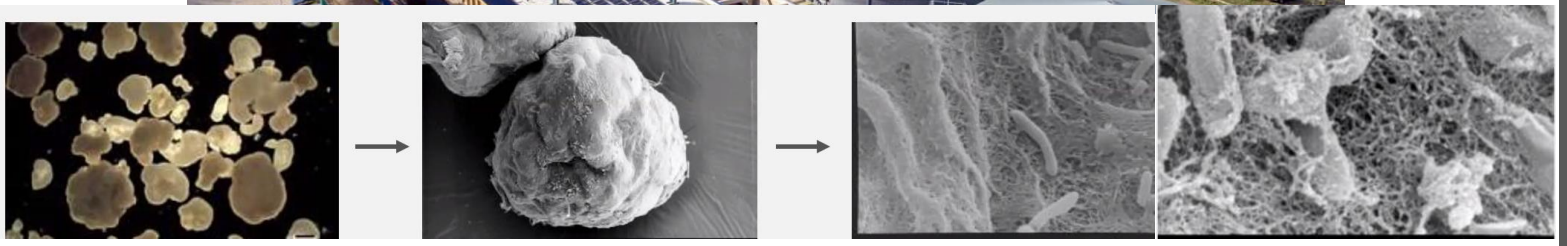
Australian Government
Australian Renewable Energy Agency

PRIMERO

Circular Economy

Extracellular Polymers as Raw Materials

"Kaumera: The matrix polymer of Aerobic Granular Sludge"



Current potential – 11 lbs/person/year
Plastics use is ~ 110 lbs/person/year
(~ 10% of the plastics solution)

Large Volumes of Sewage Sludge

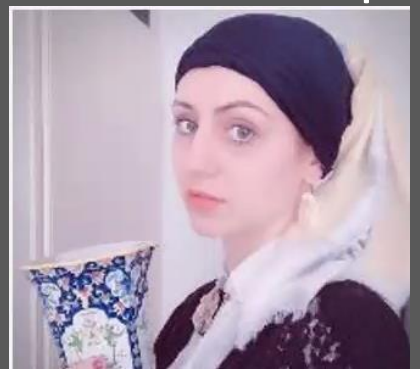
Gel Polymers: No oil competition

Gel Polymers: Market supply is limited

Negative aspects of oil-based polymers

Market volume is greater than for existing biopolymers

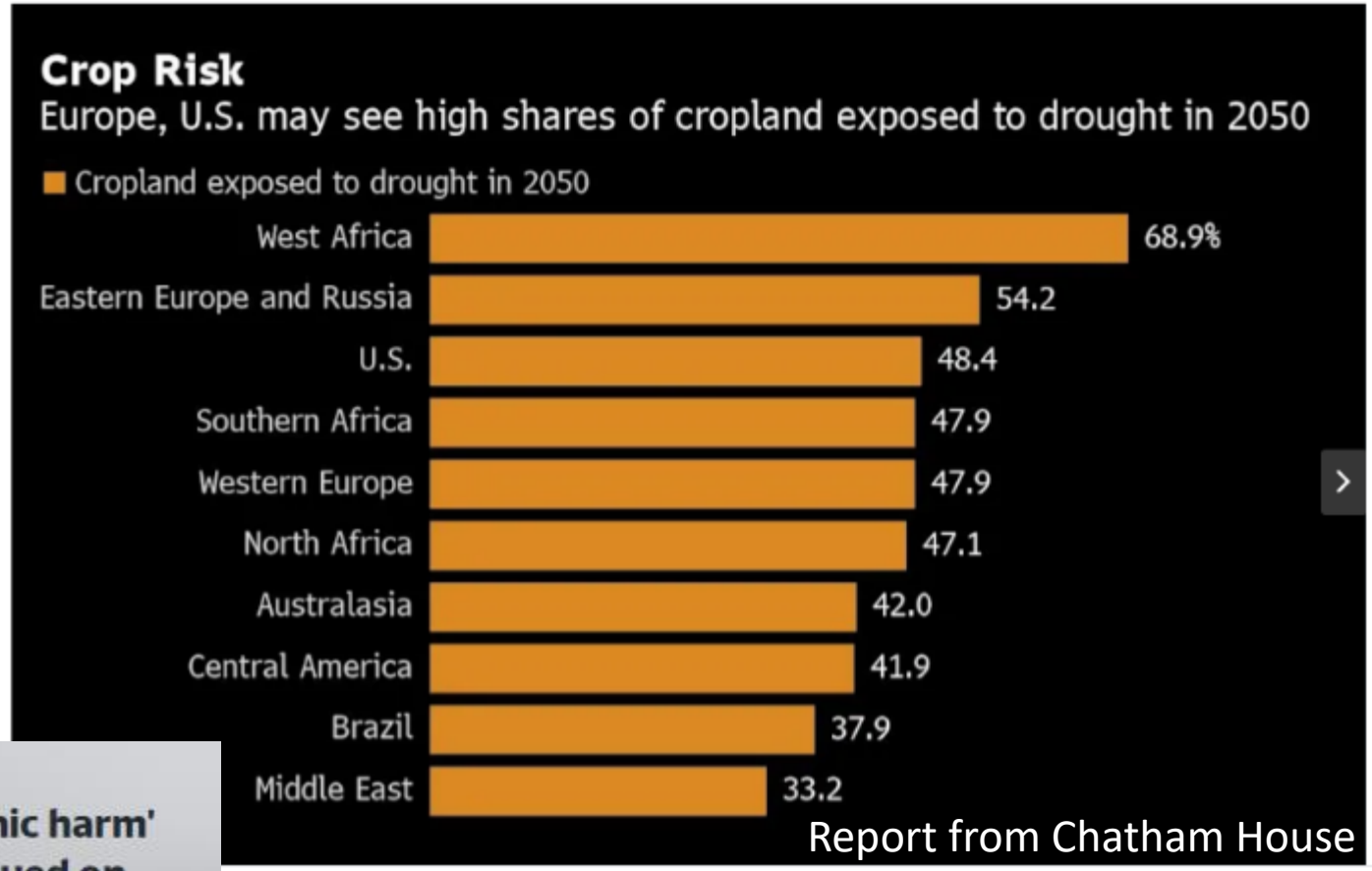
Many new materials possible



Report: Climate change could see 200 million move by 2050

Bloomberg

World Faces Growing Risk of Food Shortages Due to Climate Change



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'Catastrophic harm' warning issued on climate change

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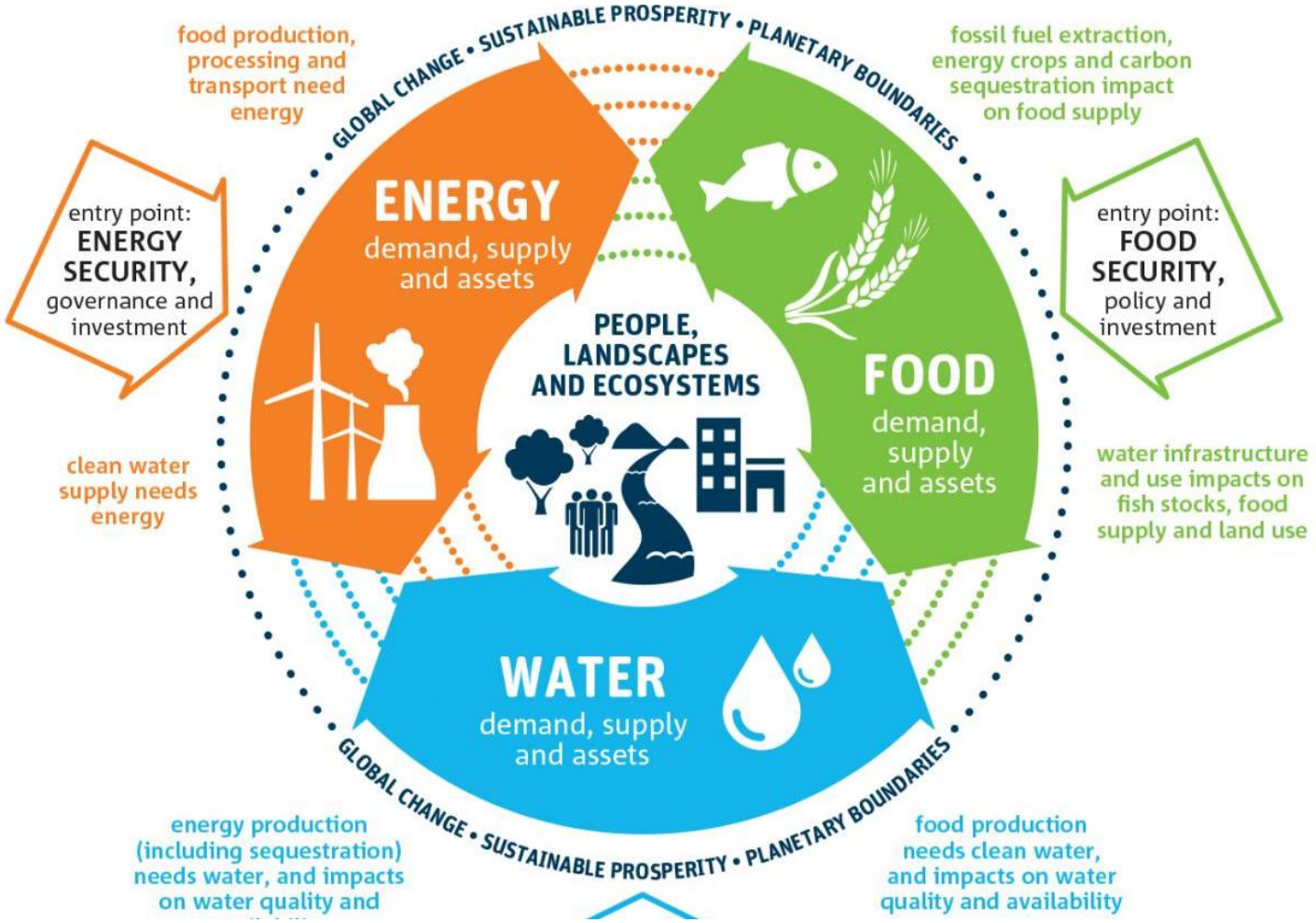
It is Time for Food ReDesign



Effluent Heat Recovery at WRRF

Circularity in Food ReDesign Examples Norfolk & Suffolk, UK

Greenhouse for Fresh Food

Two large greenhouses designed to provide 12% of tomato and bell peppers demand in the UK (Reduce Import from Netherlands)

Driver: Decarbonization of Agriculture

Partnering with Anglian Water (2 WRRFs)

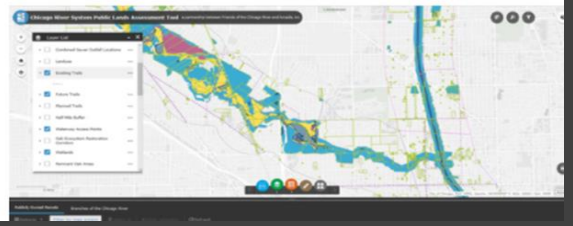
- Heat is extracted on the WRRF premises from treated effluent and transported 2.4 km
- 38 MW and 32 MW total capacity
- Year-round fresh production meeting local demand and 120 jobs
- 50% renewable energy government incentive made the systems economical
- 60,000 MT CO_{2e} GHG reduction per year

Please Watch These 2 Video's for more information:
https://www.youtube.com/watch?v=3a3VKjB_xr4

https://vimeo.com/459438153/63fe72c634

Public Land Natural Area Assessment Tool

Friends of the Chicago River partnered with Arcadis U.S., Inc. to develop a mapping tool to assess the conditions and qualities of all public land along the entire Chicago River system. We are thrilled to share this new Public Land Natural Area Assessment Tool with you.



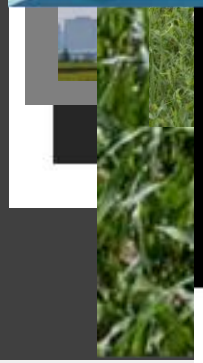
Brownfields Locator Tool

- Land Availability
- Water Availability
- Climate Change
- Low-carbon Energy
- Extending Growing Season

Food ReDesign in Illinois Opportunity for Venture Funds and Entrepreneurs – Transformative Computing to Make a Business Case

Circularity of Regional Urban and Peri Urban Fresh Food Systems

Regional Economy and Resilience



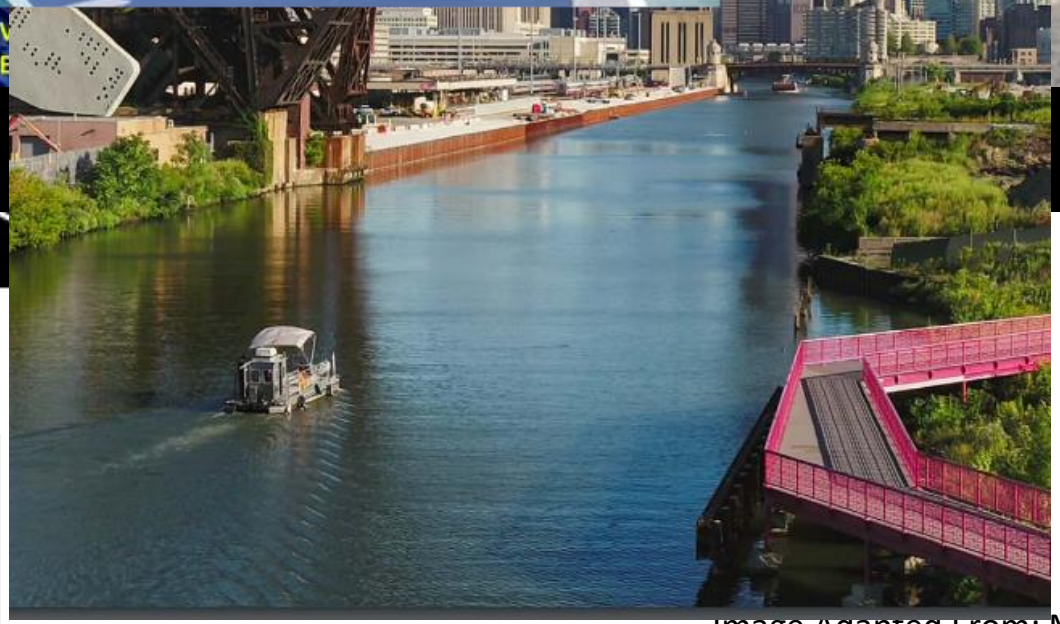
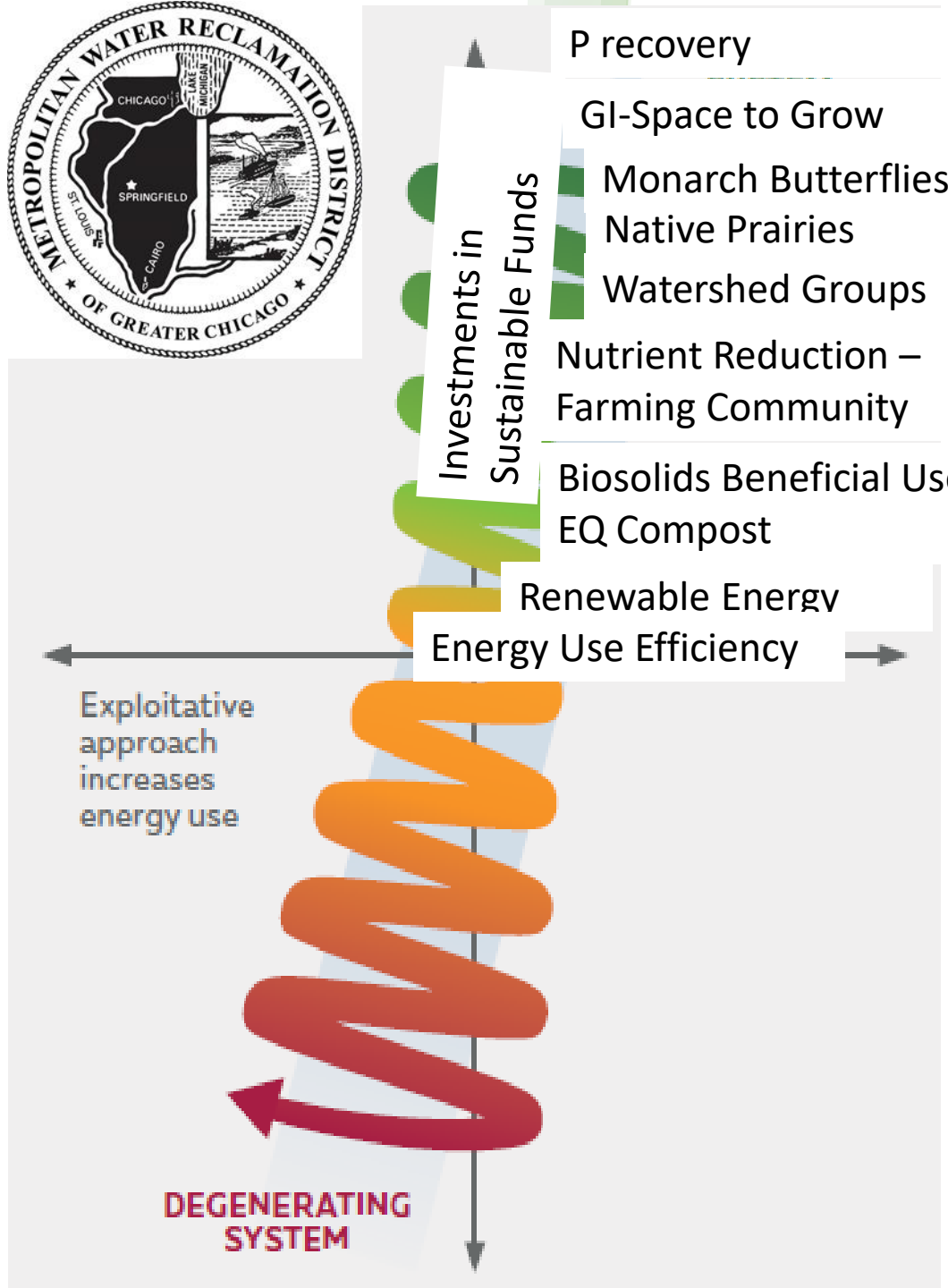


Image Adapted From: Mukheibir & Turner, 2020

The Regenerative Design Framework



- **REGNERATIVE**
  Appropriate participation and design as nature
- **RESTORATIVE**
  Humans doing things to nature
- **SUSTAINABLE**
  Neutral point and not doing any more damage
- **CONVENTIONAL PRACTICE**
  Compliant with regulations

Image Adapted From: Mukheibir & Turner, 2020

The Metropolitan Water Reclamation District of Greater Chicago "Utility of The Future Today"

Call for Action

Let us innovate to make the traditional linear approach “to be a relic of history.”

The technologies, some yet to be invented, the enthusiasm, the investment potential, the long-term equity outcomes are all there to create a new future of circularity rather than linearity.

We need to move beyond ‘sustaining’ to ‘restoring’ the material balance and then actively go further with ‘regenerative’ actions that will ensure the planets health, resilience, and prosperity for ALL.

Questions

Kuldip Kumar, PhD
Principal Environmental Scientist
MWRD Chicago
+1.708.588.3579
kumark@mwrd.org