



Zoogeography

Lesson 16

Restoration Ecology

- Given the significant impact of human activity on landscapes and the high cost of real estate, restoration often emerges as a more viable solution than alternatives.
- This field is relatively new and has seen considerable advancements.
- However, true restoration—returning a landscape to its original beauty and functionality—remains challenging and is seldom fully achieved.

- Specifically, RE is «the process of intentionally altering a site to establish a defined, indigenous, historic ecosystem»
- The goal is to emulate the structure, function, diversity and dynamics of the specific ecosystem
- Moving a degraded system back towards one of greater structural and functional diversity

Different Restoration Approaches

- Reclamation
- Revegetation
- Rehabilitation
- Re-creation
- Ecological engineering

- **Reclamation**

Stabilisation of the land and/or minimizing further degradation. It aims at converting land damaged through resource extraction or poor management to a productive use.

- **Revegetation**

Using native plants

- **Rehabilitation**

to repair and replace the essential or primary ecosystem structures and functions which have been altered or eliminated by disturbance.

Re-creation

Attempt to return to historic condition

- **Ecological engineering**

the design of ecosystems for the mutual benefit of humans and nature.



What does a reduction in biodiversity mean?



Restoration of soil

- the technique of enhancing compacted soils to improve their porosity and nutrient retention. It includes **biological** (worms and other soil organisms) and **mechanical aeration, mechanical loosening** (tilling), **planting dense vegetation**, and applying **soil amendments**.

FIVE PRINCIPLES FOR SOIL RESTORATION

1. Green is good – and year-round green is even better

Use of [multi-species cover crops](#), animal integration, multispecies pastures, and strategic grazing. In parks and gardens, plant diversity and mowing height are important factors. Bare soil has no photosynthetic capacity. Bare soil is also a net carbon source and is vulnerable to erosion by wind and water.

2. Microbes matter

The significance of the plant-microbe bridge in transferring and stabilizing carbon in soil is becoming increasingly recognized. The [soil microbiome](#) is now heralded as the next frontier in soil restoration research.

3. Diversity is indispensable

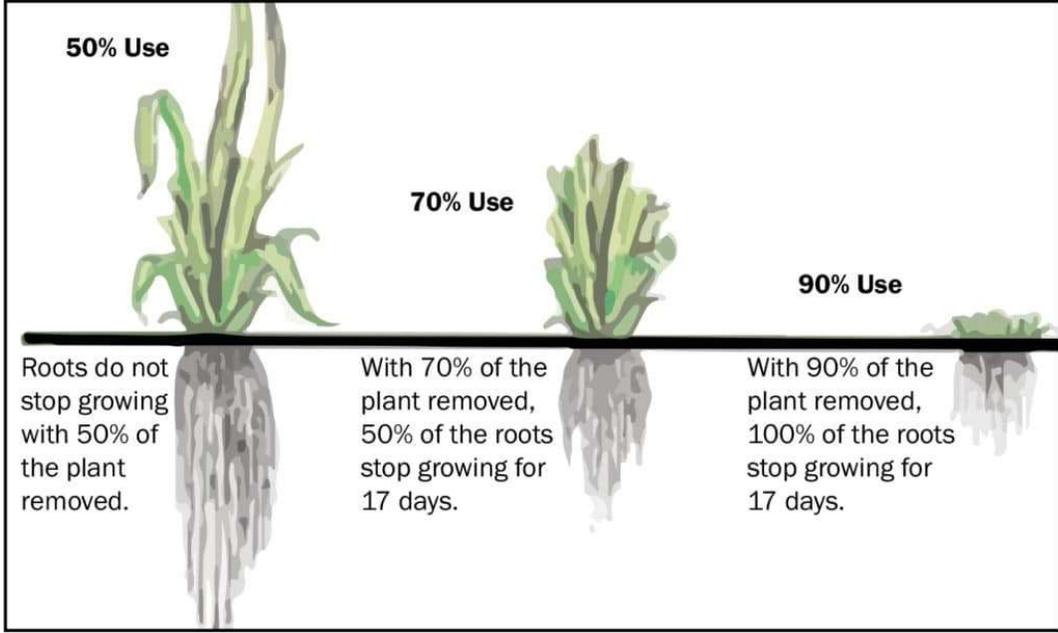
Every plant exudes its own unique blend of sugars, enzymes, and other biological compounds, many of which act as signals to soil microbes. The greater the diversity of plants, the greater the diversity of microbes, and the more robust the soil ecosystem

4. Chemical use can be dangerous

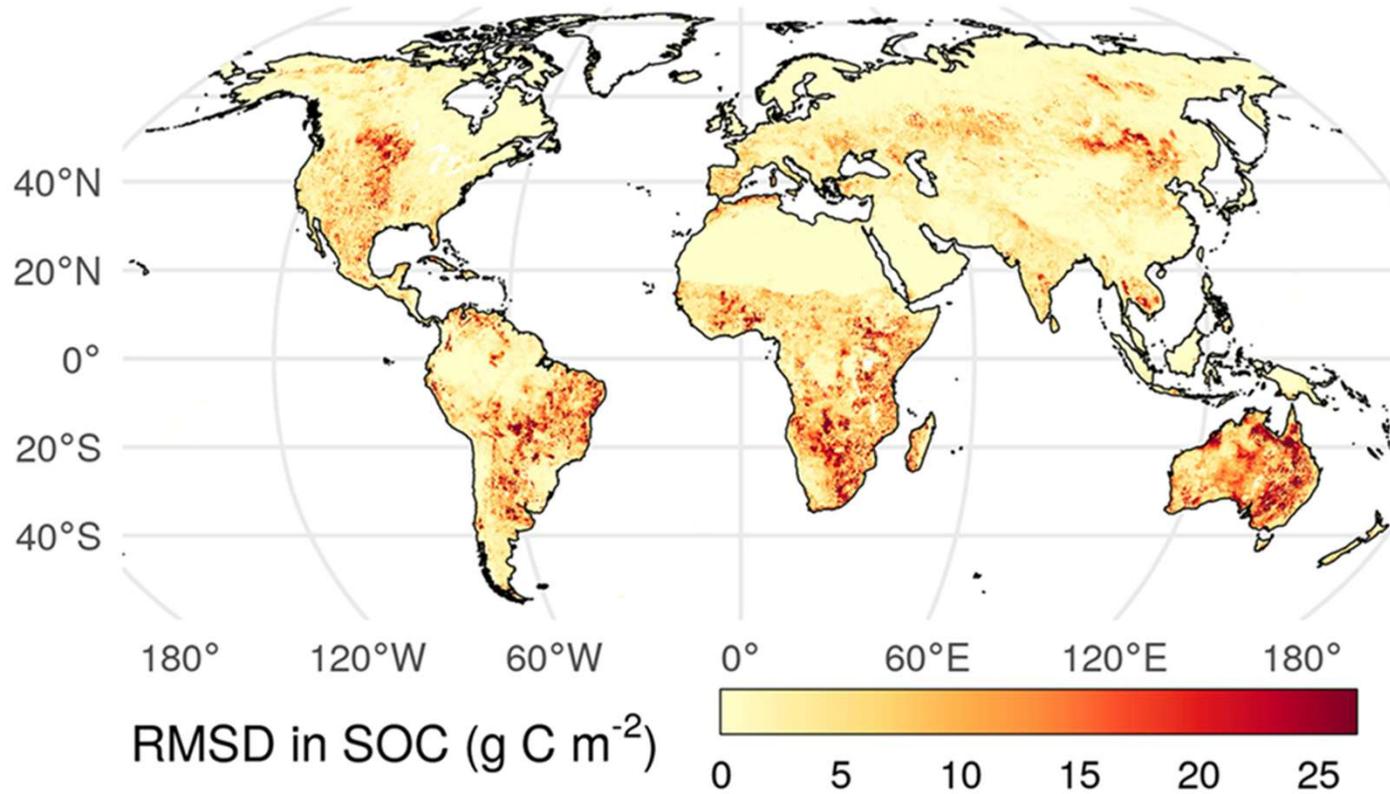
Living soils can significantly improve the mineral cycle. Researchers have shown, for example, that mycorrhizal fungi can supply up to 90 percent of plants' nitrogen (N) and phosphorous (P) requirements

5. Avoid aggressive tillage

Tillage may provide an apparent quick-fix to soil problems created by lack of deep-rooted living cover. Repeated and/or aggressive tillage increases the susceptibility of the soil to erosion, though. It also depletes soil carbon and organic nitrogen, rapidly mineralizes soil nutrients

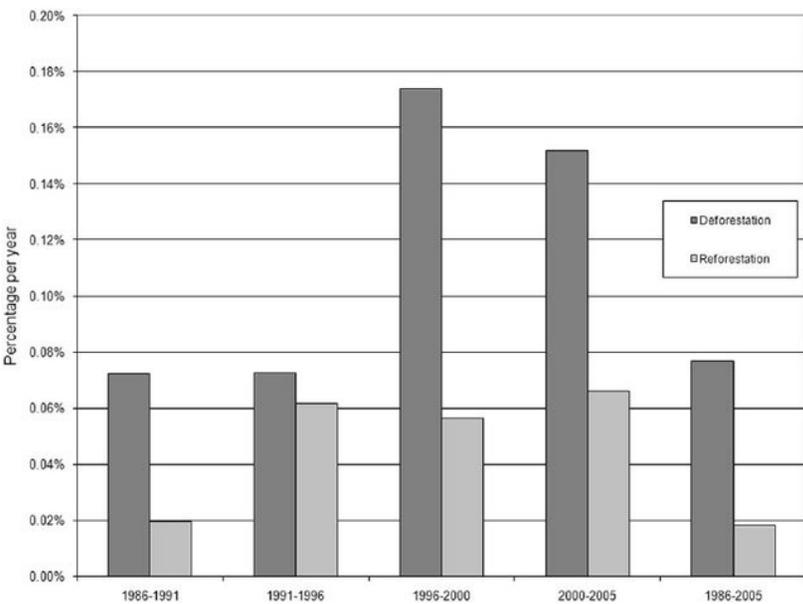


Soil organic carbon (SOC) is a key soil health and carbon storage metric that is climate sensitive



[doi:10.1029/2020JG006100](https://doi.org/10.1029/2020JG006100).

Reforestation



Amazon deforestation: Rates and patterns of land cover change and fragmentation in Pando, northern Bolivia, 1986 to 2005

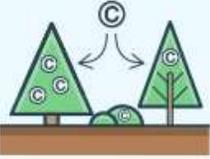
DOI: [10.1177/03091333111399492](https://doi.org/10.1177/03091333111399492)

 IBERDROLA

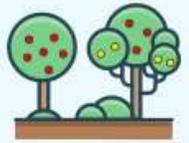
Why is it important to take care of forests?



They **enrich the soil with nutrients** through their roots and the leaves that fall from the treetops



They are Earth's **biggest carbon sinks**, absorbing carbon dioxide and releasing oxygen



They are a source of both **basic and supplementary food** and income for millions of people



They are like **natural aqueducts** that redistribute up to 95% of the water they absorb



They are home to **80% of the world's biodiversity** (animals, plants and insects)

Source: FAO.

Wetland restoration

- Wetland restoration and management can involve: technical, spatially large-scale measures (including the installation of ditches for rewetting or the cutback of dykes to enable flooding); technical small-scale measures such as clearing trees; changes in land-use and agricultural measures, such as **adapting cultivation practices** in wetland areas.
- They can **improve the hydrological regime** of degraded wetlands and generally **enhance habitat quality**. Creating artificial or constructed wetlands in urban areas can also contribute to flood attenuation, water quality improvement and habitat and landscape enhancement.



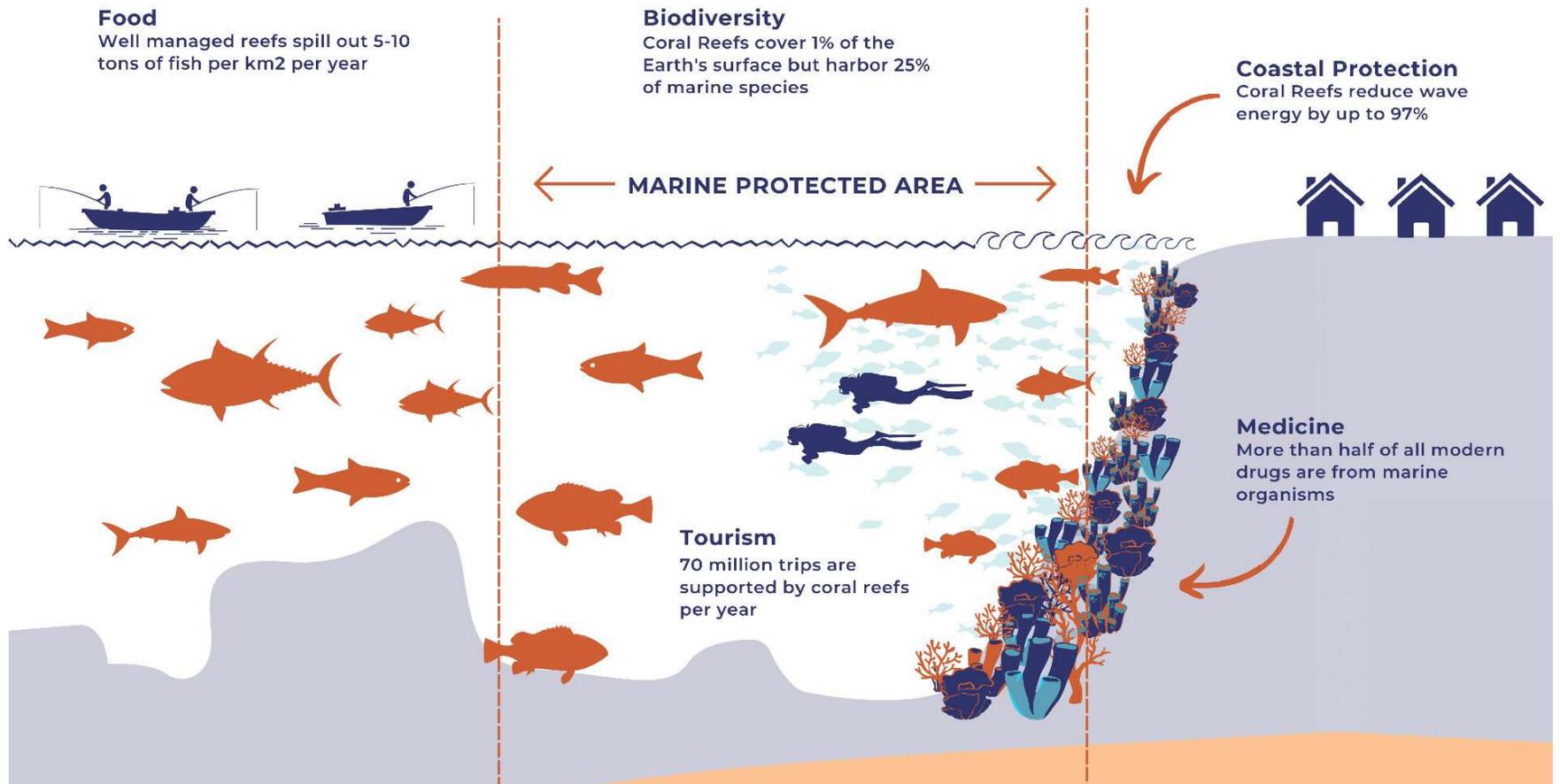
Coastal habitat rehabilitation

The area where land meets sea is often a place of spectacular biodiversity and ecological beauty. The coastal zone makes up only 10% of the ocean environment but is home to over 90% of all marine species.

Rehabilitation of coastal bluffs and escarpments involves structure removal, repairing changes in estuarine function, and beach enhancement. Sustainable rehabilitation by removing bulkheads placed along cliffs and bluffs restores natural sediment input to the nearshore.

What are the techniques of coastal habitat rehabilitation/restoration?

The importance of coral reef ecosystems



Institution of PAs

- Recognized as efficient tools for protecting ecosystems, Protected Areas (PAs) are areas that are delimited and managed with the aim of conserving biodiversity. Creating a balance between biodiversity conservation and sustainable human activities, PAs restore the resources needed for the economic and social development of neighbouring populations.
- In some PAs, the establishment of highly protected areas with no fishing/hunting activity, accelerates the restoration of ecosystems and fishery/wildlife resources.

Protected areas (PAs)

- 15% of the Earth's land surface;
- Categorized by the International Union for Conservation of Nature (IUCN)
- Different type of PAs



WELL MANAGED MARINE PROTECTED AREAS SUPPORT FISHERIES

IN EUROPEAN WATERS

evidence shows that well-managed MPAs benefit fish and invertebrates.



EXAMPLE: TORRE GUACETO PROTECTED AREA, ITALY

15x

The MPA not only exports adults and juveniles, large-sized spawners produce **15 times** more eggs and larvae within the MPA than outside.

100 km

Sea breams move up to 100 km into fishing grounds

2x

Catches double where the MPA is co-managed with fishermen

EXAMPLE: COLUMBRETES ISLANDS PROTECTED AREA, SPAIN

20x

The spawning potential of lobsters within the MPA has increased by up to **20 times** compared to exploited areas.

4 km

Individuals move up to 4 km into fishing grounds.

10%

Lobsters from MPAs are larger, generating a **10%** net income for fishermen

KEY PRINCIPLES FOR MPAs TO WORK:



Well designed



Enforcement & compliance



Part of an Integrated Management Plan



Sustainably financed



Local community engagement and staff capacity

WWF works globally to support Marine Protected Areas and ensure they contribute to securing food and livelihoods for people while conserving critical habitat and species. In some European MPAs, for example, collaboration with fishermen have allowed them to increase the quantity and quality of fishing yields and revenue.

www.panda.org/mpa



Design by Catalyze

SOURCES: PISCO 2011, Gore et al 2010, Guisetti & Clavelle 2010, Guisetti 2007, Gore et al 2006, Di Franco et al (in press)

WELL MANAGED MARINE PROTECTED AREAS SUPPORT FISHERIES

MPAs IMPROVE THE HEALTH OF OCEANS BY:



MPA

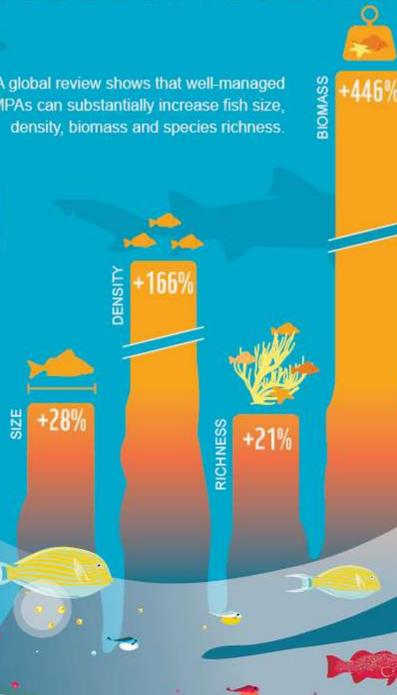
KEY PRINCIPLES FOR MPAs TO WORK:



MPAs SUPPORT LIVELIHOODS

In Apo Islands, Philippines, fishers have doubled their catch rate 18 years after the MPA was created. As a result, they go out to sea less, saving on fuel and time.

A global review shows that well-managed MPAs can substantially increase fish size, density, biomass and species richness.



MPAs CAN PUMP FISH INTO ADJACENT AREAS

As fish populations recover within MPAs, juveniles and adults can spill over across the boundaries and replenish fishing grounds.

EXAMPLE: APO ISLAND PROTECTED AREA, PHILIPPINES

Surgeonfish and jackfish represent 40-75% of local fishery yields.

Since the MPA was established, their population has tripled...

...resulting in an increase in catch per unit effort of **+50%**

MPAs CAN EXPORT LARVAE INTO ADJACENT AREAS

Larger fish inside MPAs produce disproportionately more eggs and larvae. Some larvae then drift to fished areas.

EXAMPLE: GREAT BARRIER REEF PROTECTED AREA, AUSTRALIA

The coral trout and the stripey snapper are exploited locally.

Local MPAs produce **± 50%** of total juvenile recruitment in nearby fished areas.

SOURCES: Harrison et al., 2012; Lester et al., 2009; Russ et al., 2004

Design by: Catalyze

Globally, WWF works to support Marine Protected Areas and ensure they contribute to securing food and livelihoods for people while conserving critical habitat and species.

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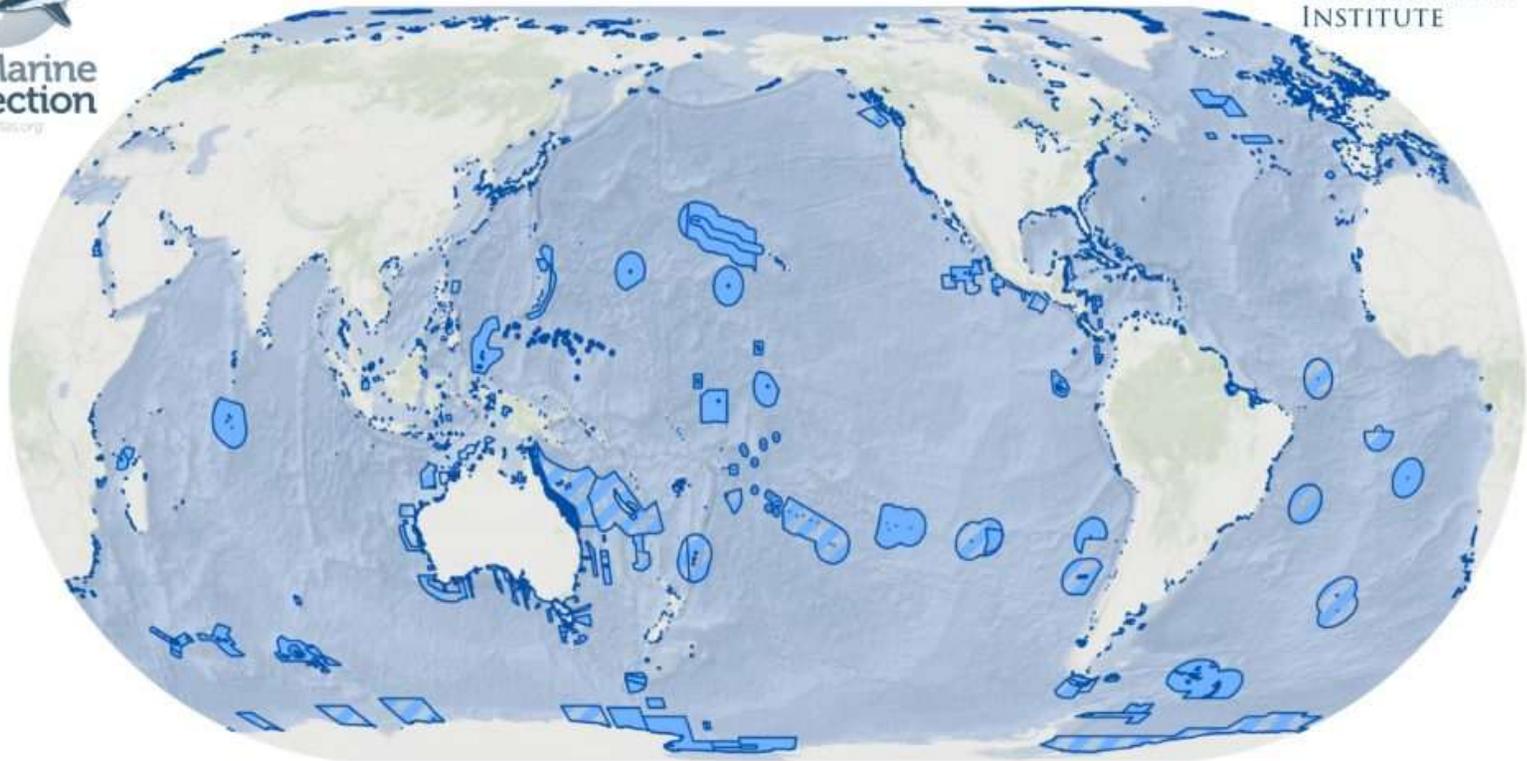




MPAtlas of **Marine Protection**
mpatlas.org



MARINE
CONSERVATION
INSTITUTE



Date: 3/21/2018

Data: Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community, MPAtlas.org

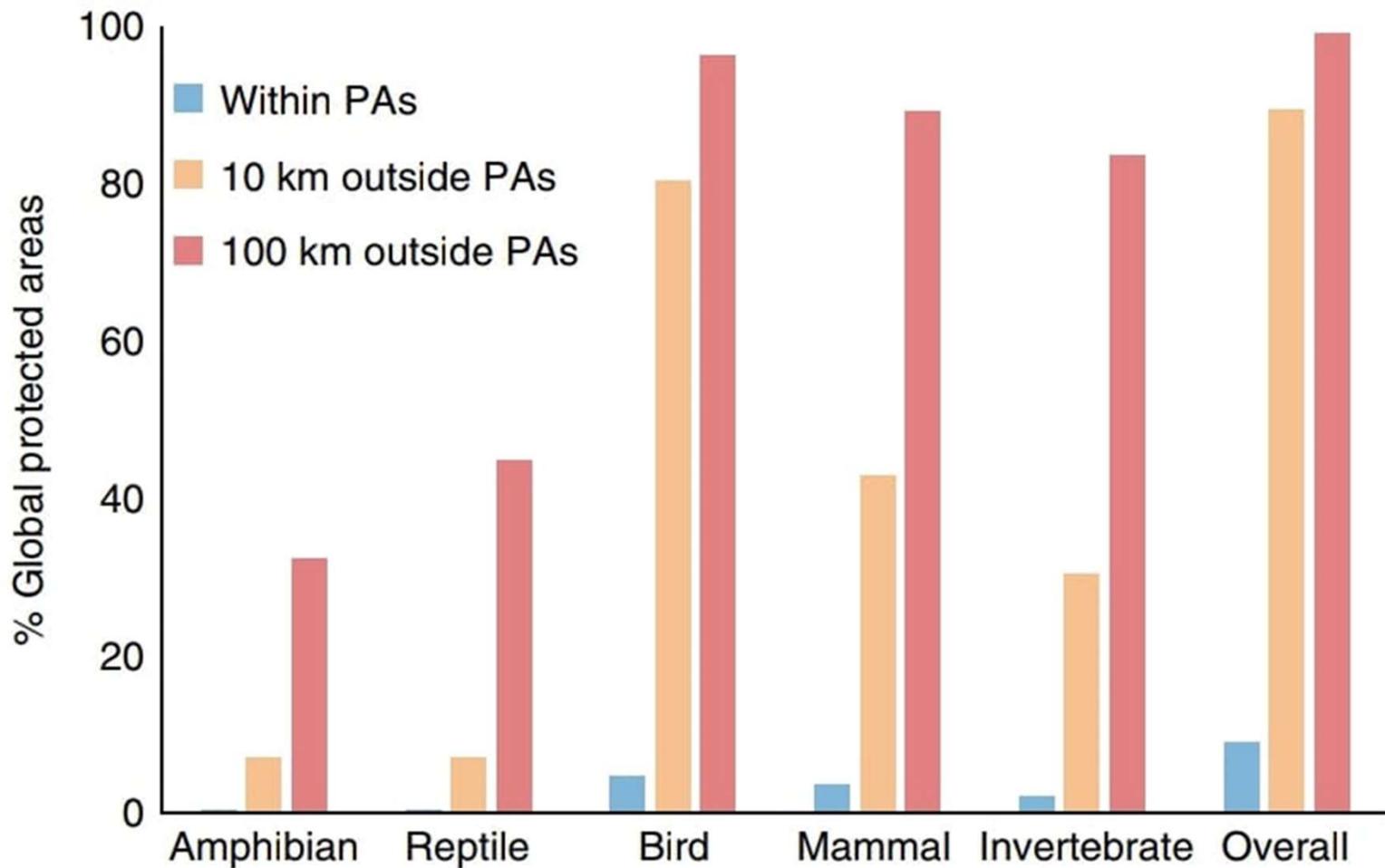


Fig. 2 Proportion of global terrestrial PAs and the surrounding areas (10 and 100 km distance to PA boundaries) colonized by different taxonomic groups. We designated PAs as invaded when at least one animal species



- We are used to thinking of our modern **cities** as grey masses of **asphalt, concrete, skyscrapers**: in many ways, this is not such a far-from-real stereotype. This, of course, does not mean that it is not possible to bring some healthy **greenery** into **urban environments**.



URBANIZATION !!



Urbanisation is the process of development and organisation that leads a built-up area to take on the typical characteristics of a city.

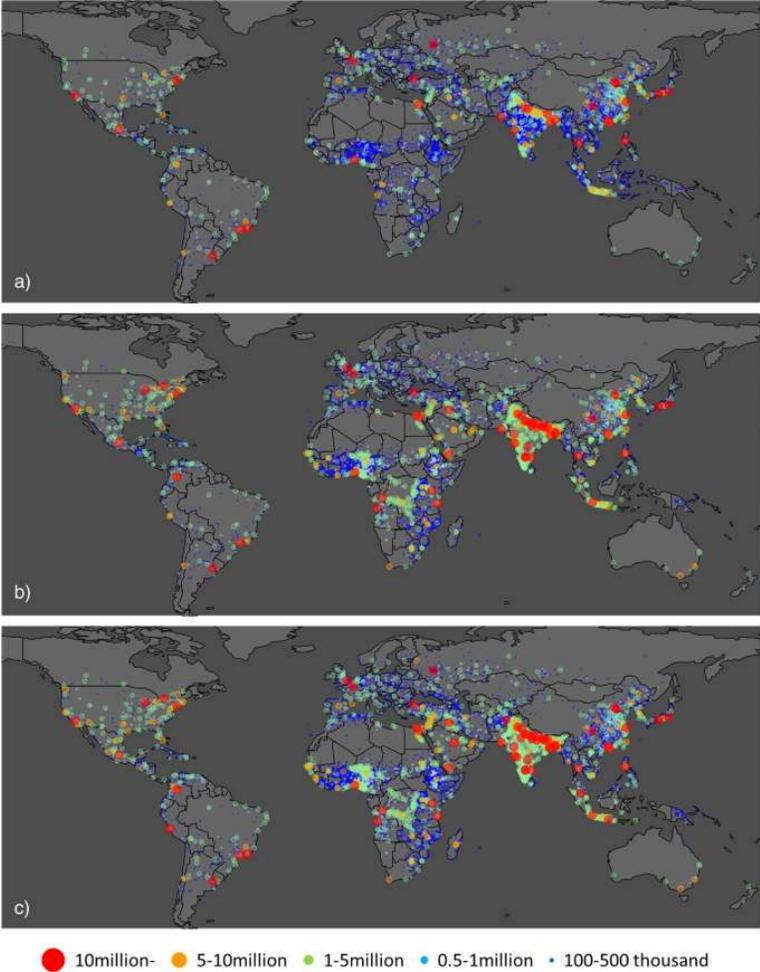


Industrial Revolution in the early 19th century

- Creation of urbanisation works transport networks, sewerage networks.
- Surrounding area affected by city expansion.- Pollution, chaos and stress.
- Societal behaviour and customs.

Future population projection in urban agglomerations worldwide and throughout the 21st century

Future population projection in urban agglomerations worldwide and throughout the 21st century



Kii, 2021. doi.org/10.1038/s42949-020-00007-5

a Data for 2010. b, c Projections for 2100 under scenarios SSP1, 2, respectively.

Urban climate



Climate change & pollution

Characteristics of cities that generate climate effects:

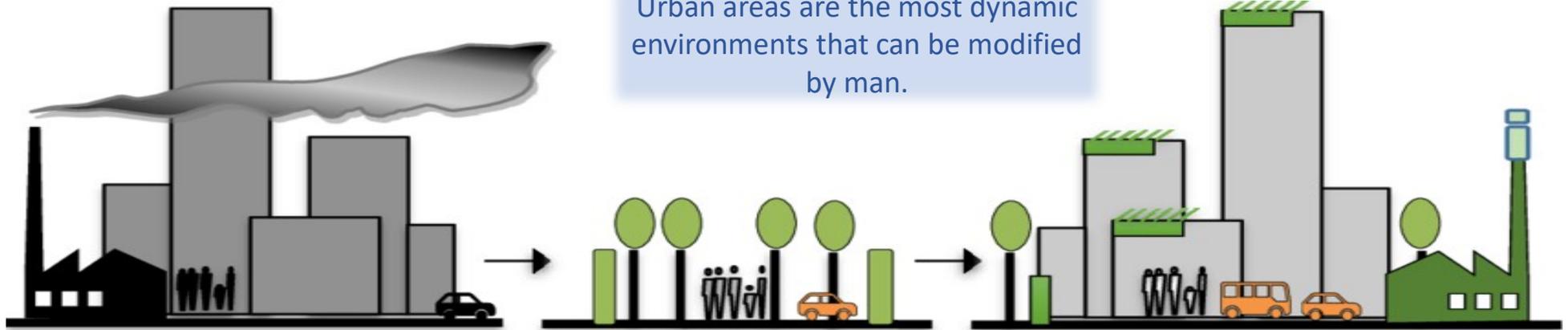
- building materials with high thermal capacity
- distribution of buildings, streets and green areas
- fast loss/removal of water from the surface of streets



green ext-/intensification

Urban vegetation elements

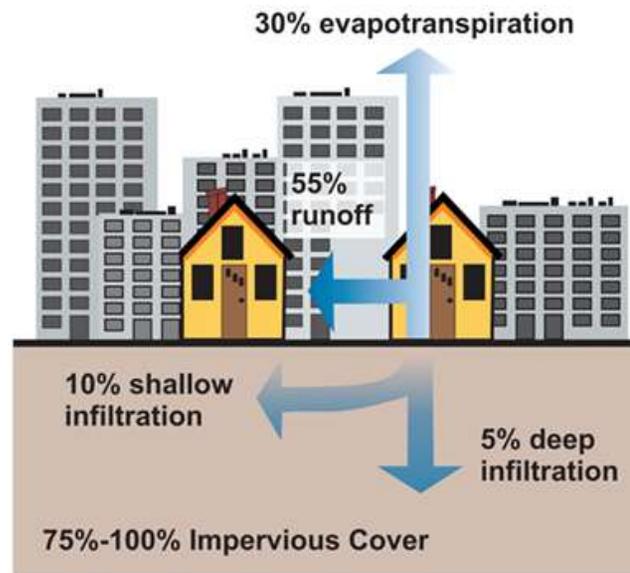
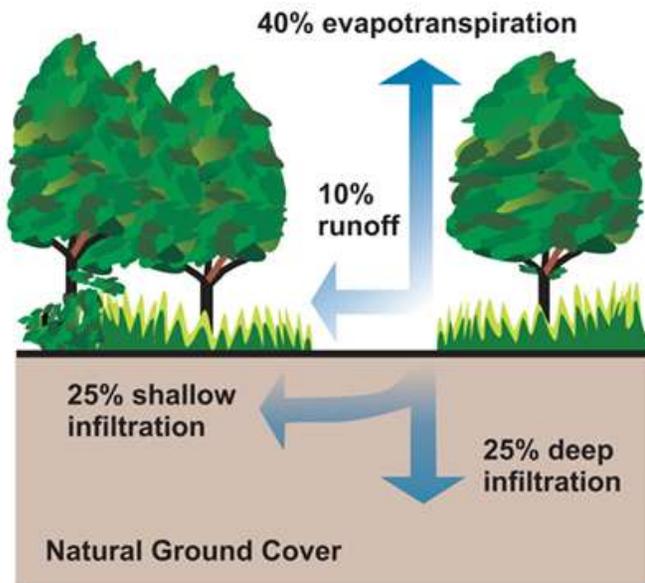
Urban areas are the most dynamic environments that can be modified by man.



In città, gli **alberi** fanno la differenza

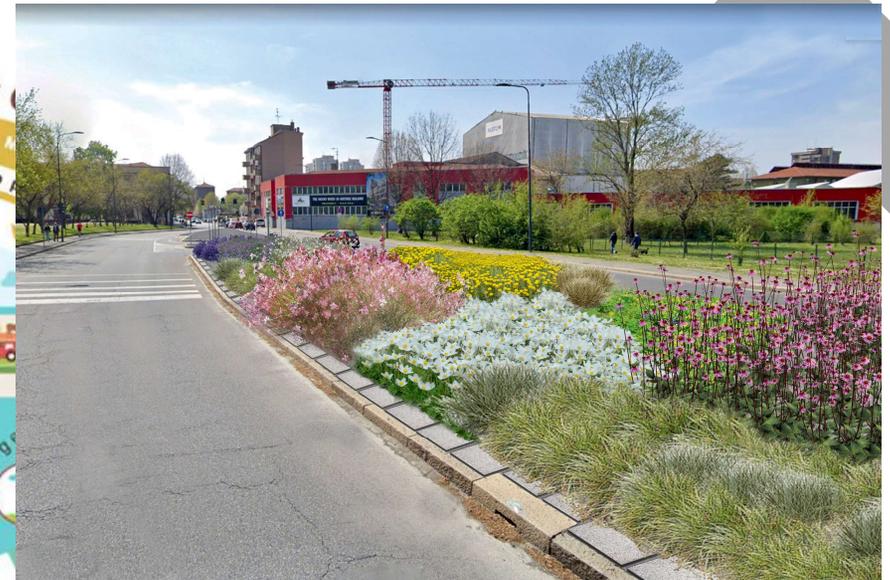


Run off



Nature Based Solution

Desanding the road surface (in car parks, for example)

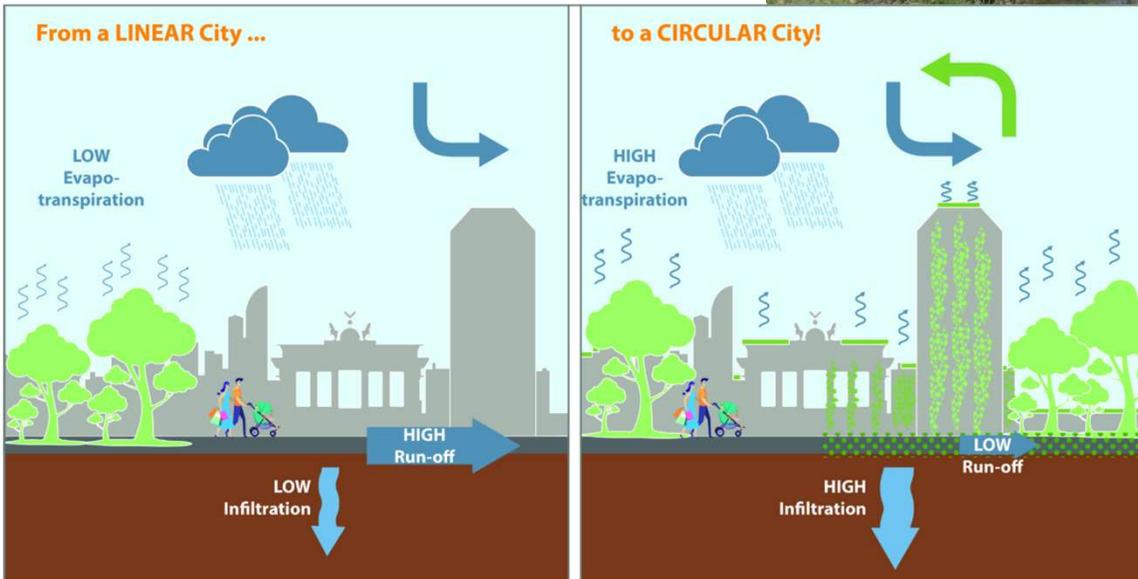


Vertical farm

In Berlin, vegetables are grown in the (disused) airport.

In Paris 300 varieties of s on the roofs of the Galerie Lafayette.





Denver

Median income: \$47K

Median income: \$198K



Boston

Median income: \$50K

Median income: \$190K



Baltimore

Median income: \$31K

Median income: \$154K



Portland, Ore.

Median income: \$39K

Median income: \$161K





Scientifically Proven To Save Birds

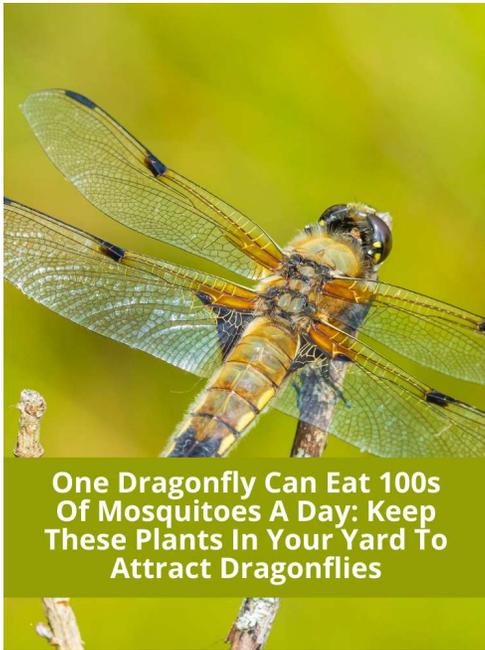
- ✓ Comfortable
- ✓ Washable
- ✓ 100% Cotton
- ✓ Made in USA
- ✓ Reflective Trim
Protects cats at night and makes them visible in the dark.



In our houses

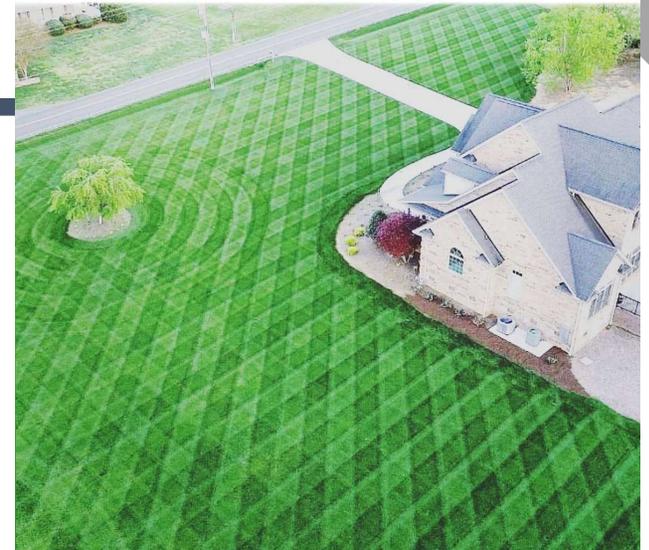


What we can do?



People: I never see butterflies or lightning bugs in my yard

Their yard:



Industrial area

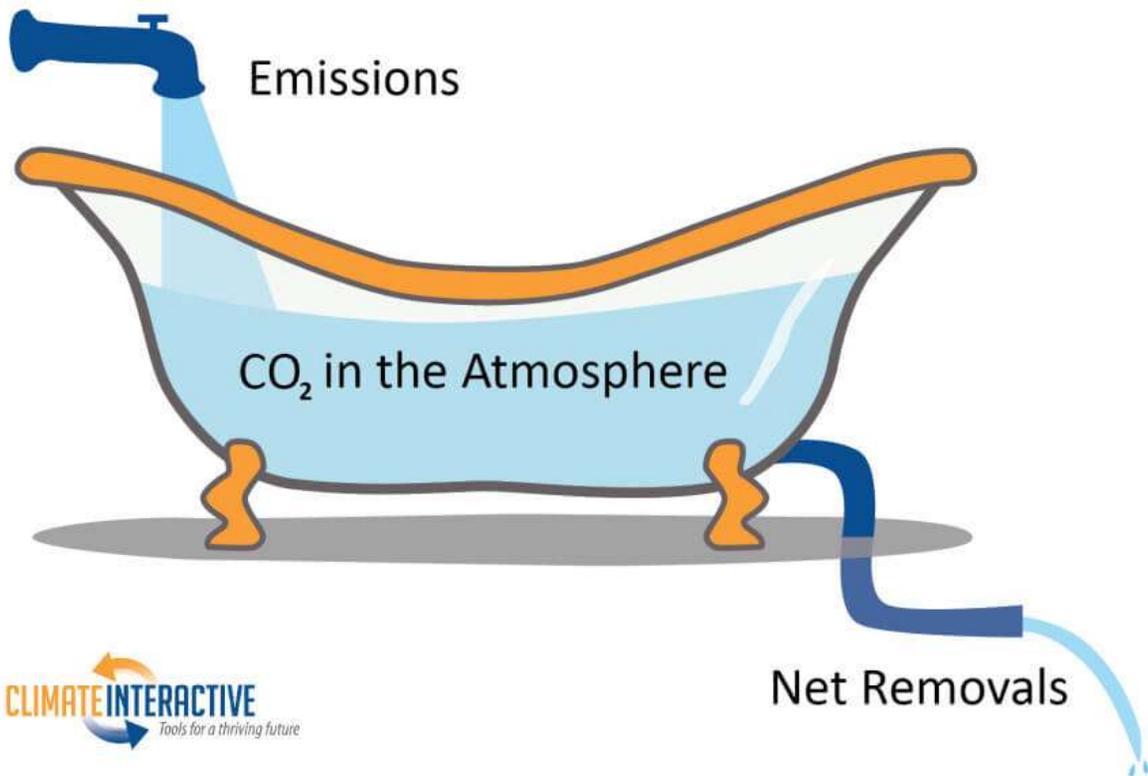


Green and Sustainability in Industrial Areas



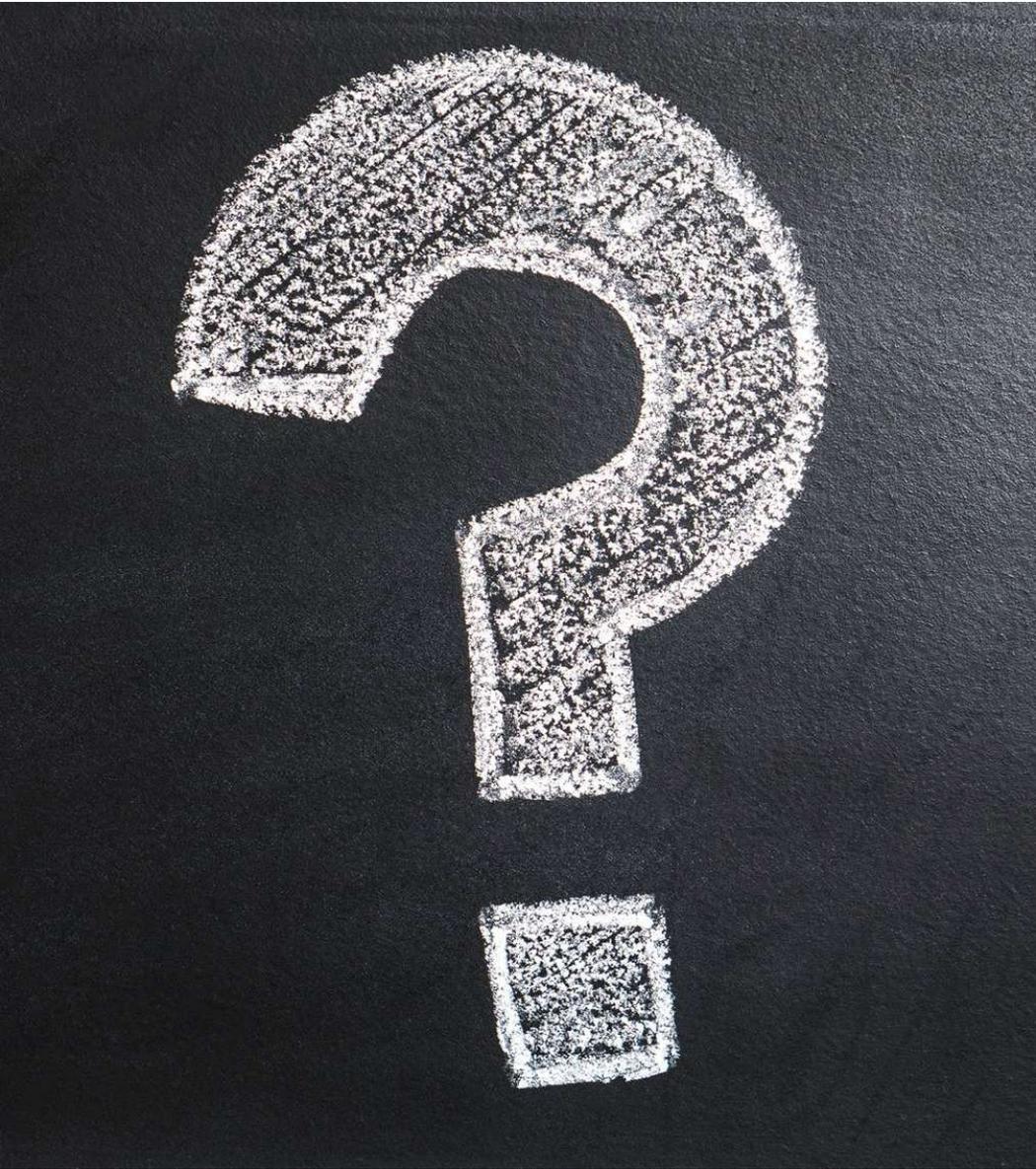
2,7 MWh of heat
and 0,8 MWh of
electricity





Overall framing by Dr. John Sterman, MIT Sloan

IF YOU
CHANGE
NOTHING,
NOTHING
WILL
CHANGE



Questions

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