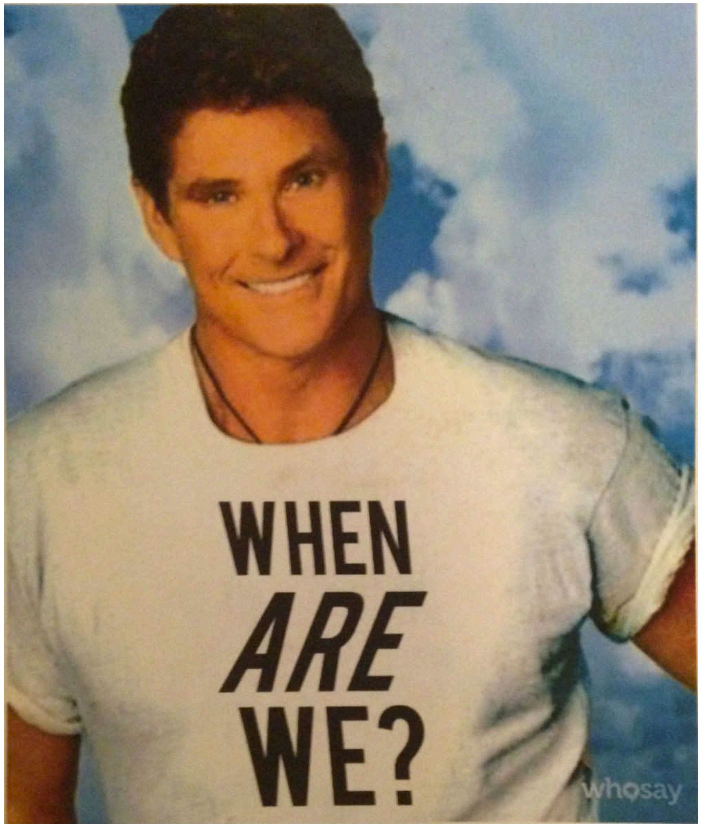
Penser les enjeux écologiques pour mieux agir: une nouvelle vision du monde

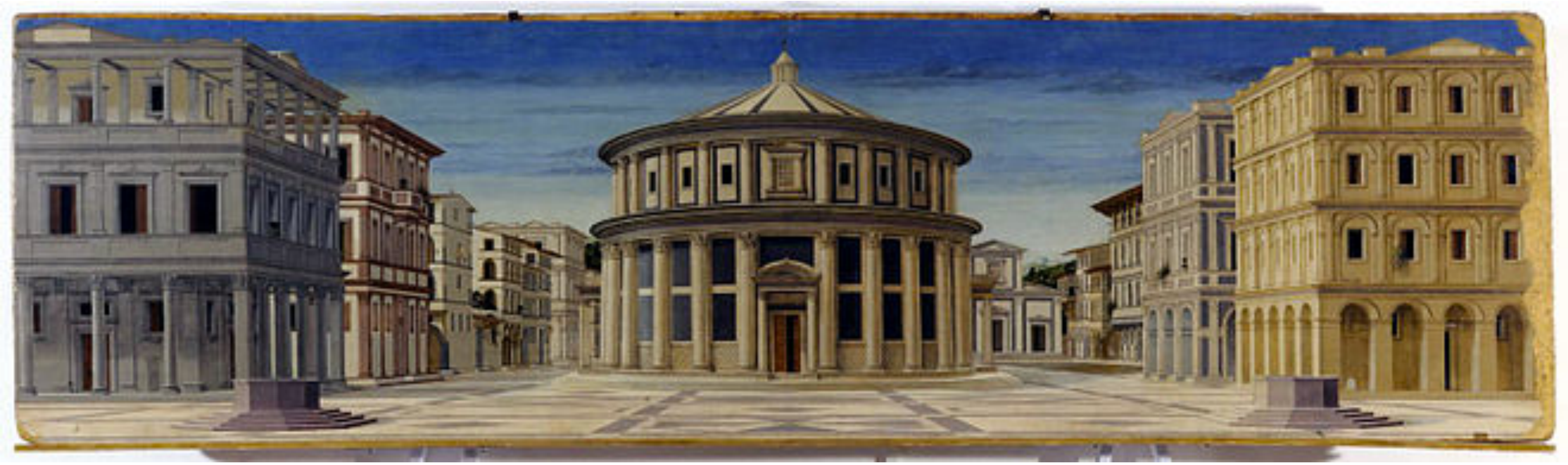
Olivier Hamant
RDP lab & Institut Michel Serres
Inra, ENS Lyon

I. Anthropocène


WHEN
ARE
WE?
whosay

Anthropocène: quelques signes

Un monde commensurable



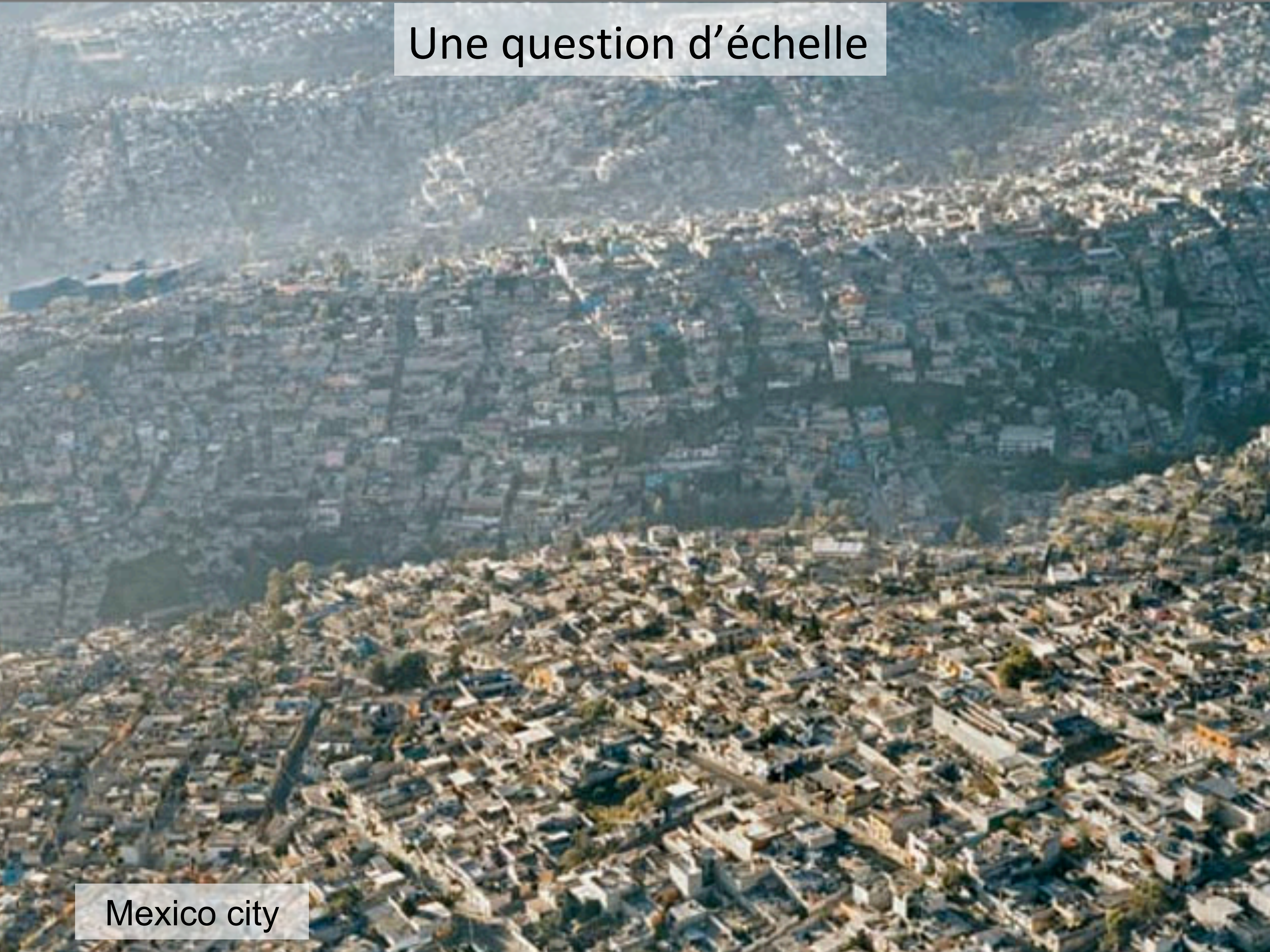
La Cité idéale à Urbino, Francesco di Giorgio Martini.

L'invention de la perspective (« Commensuratio »)
par Brunelleschi (1425) et Alberti (1437)

Une question d’échelle

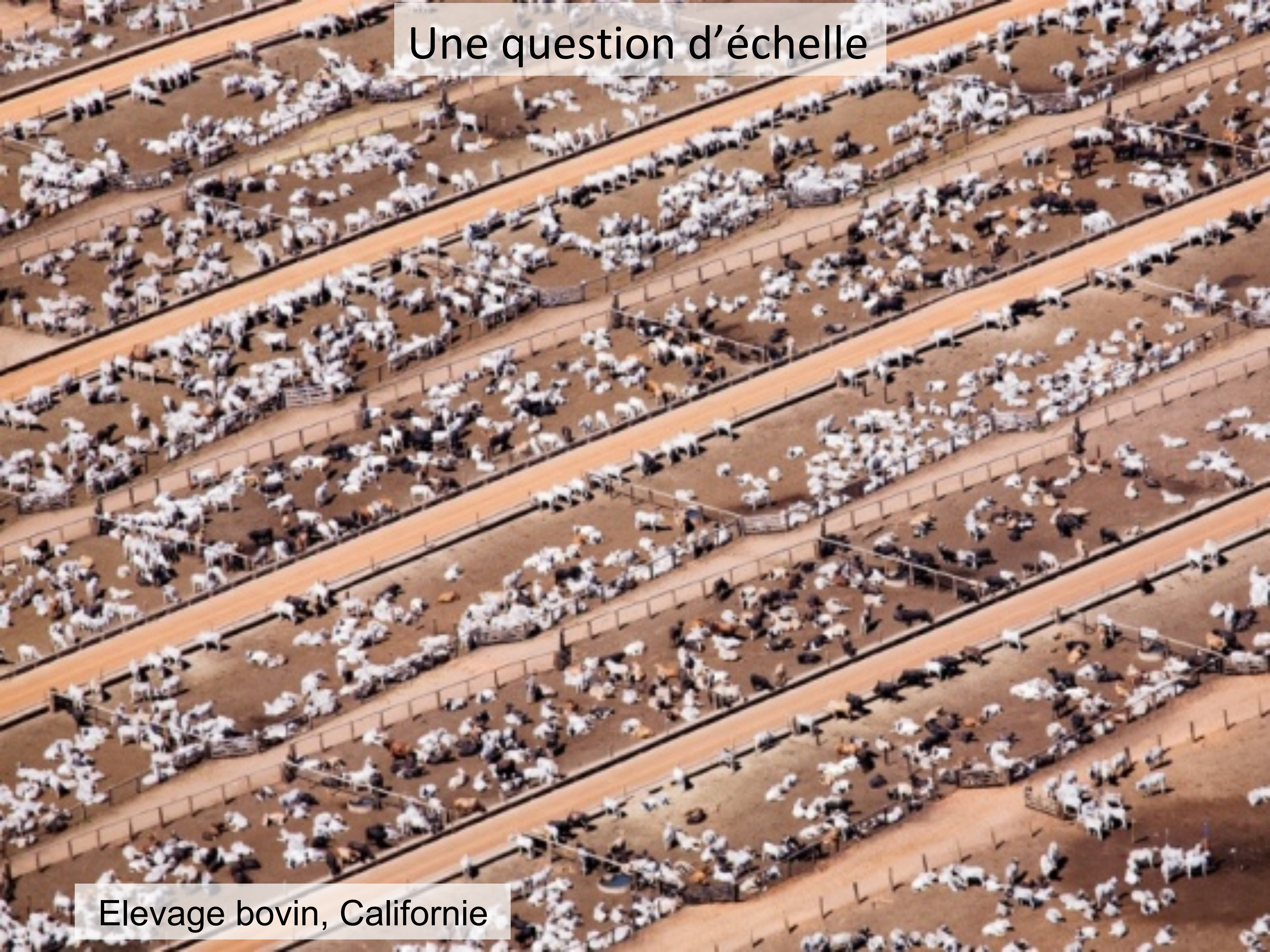
Shanghai

Une question d’échelle



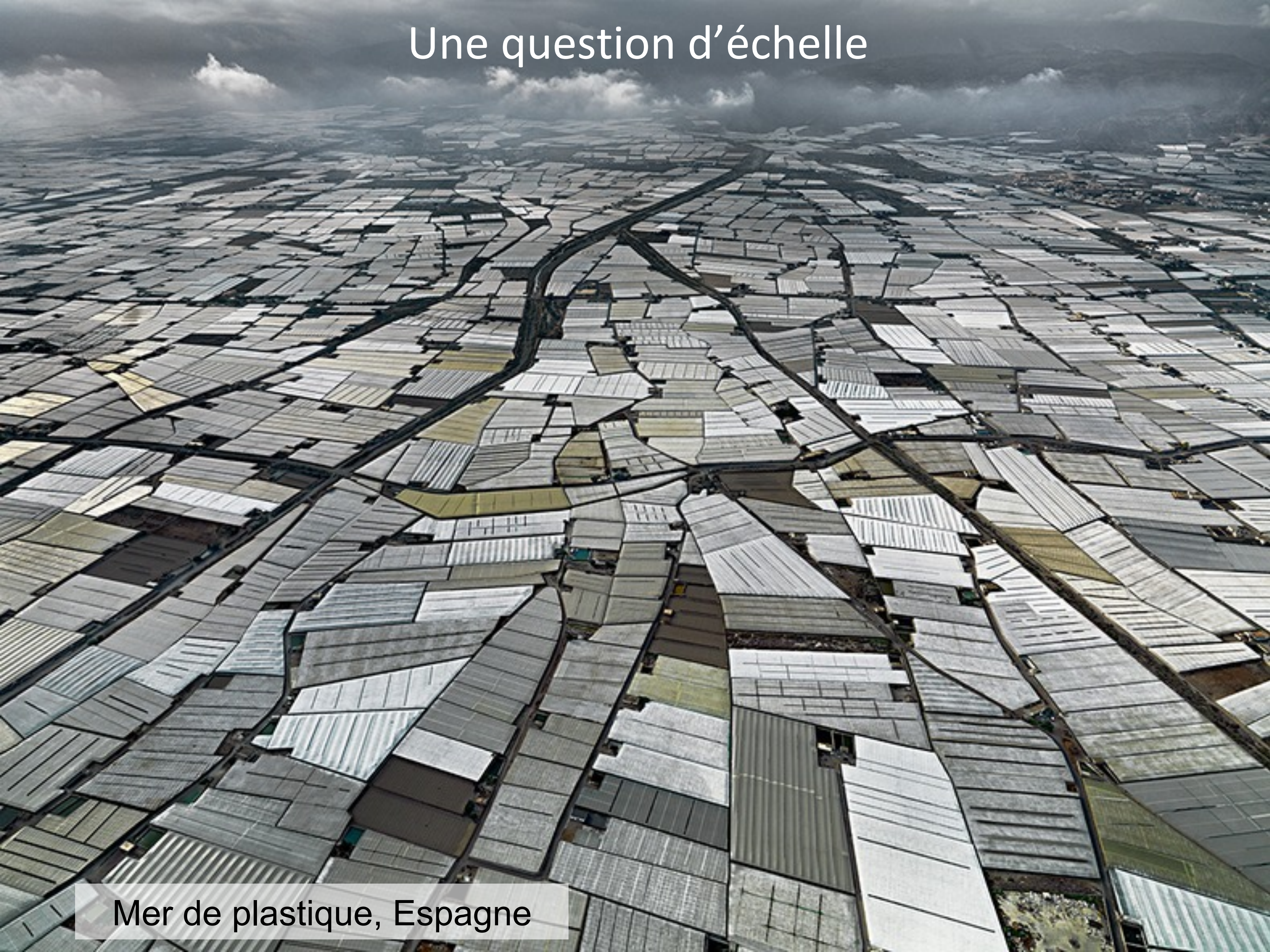
Mexico city

Une question d'échelle



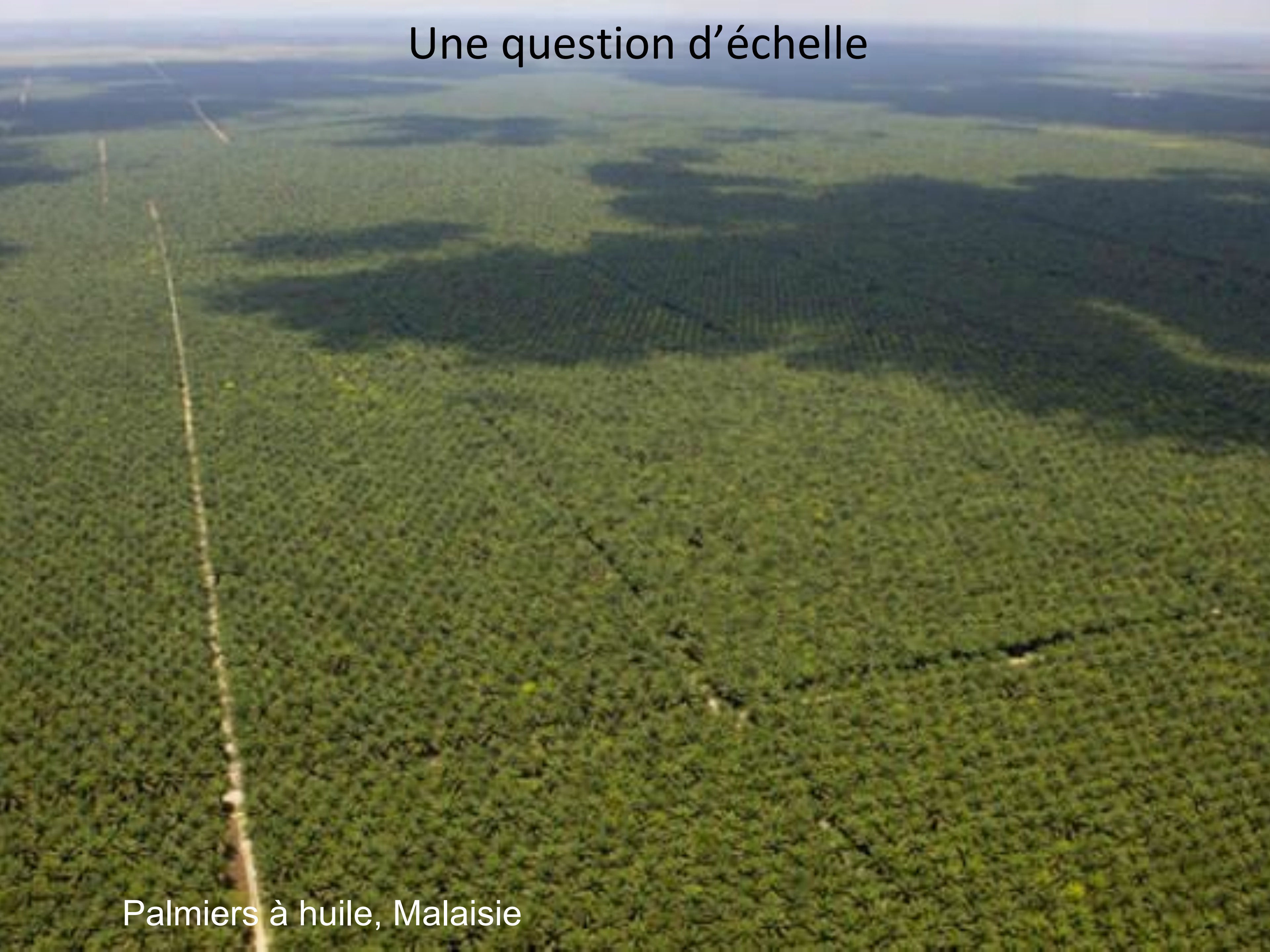
Elevage bovin, Californie

Une question d’échelle



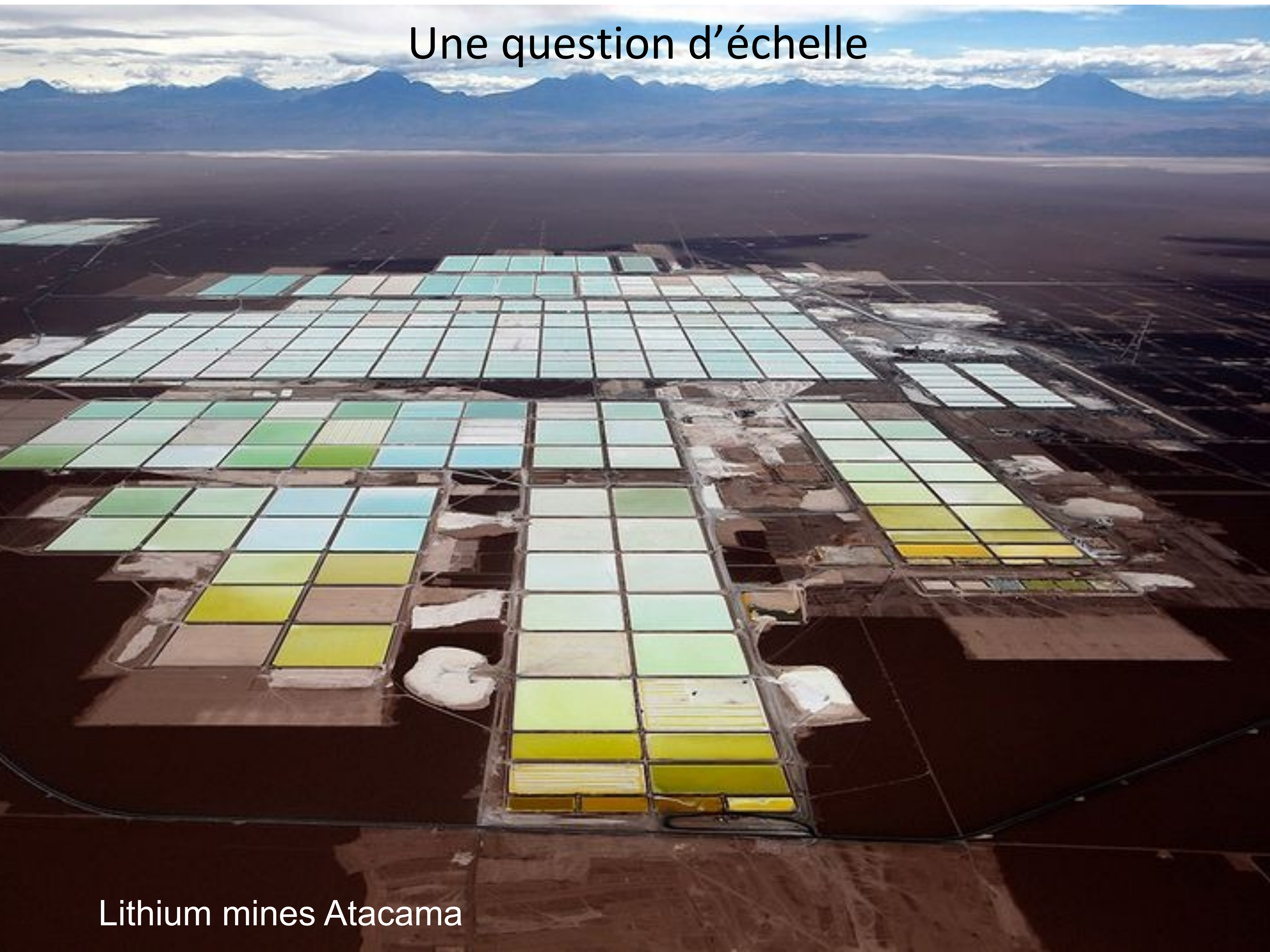
Mer de plastique, Espagne

Une question d’échelle



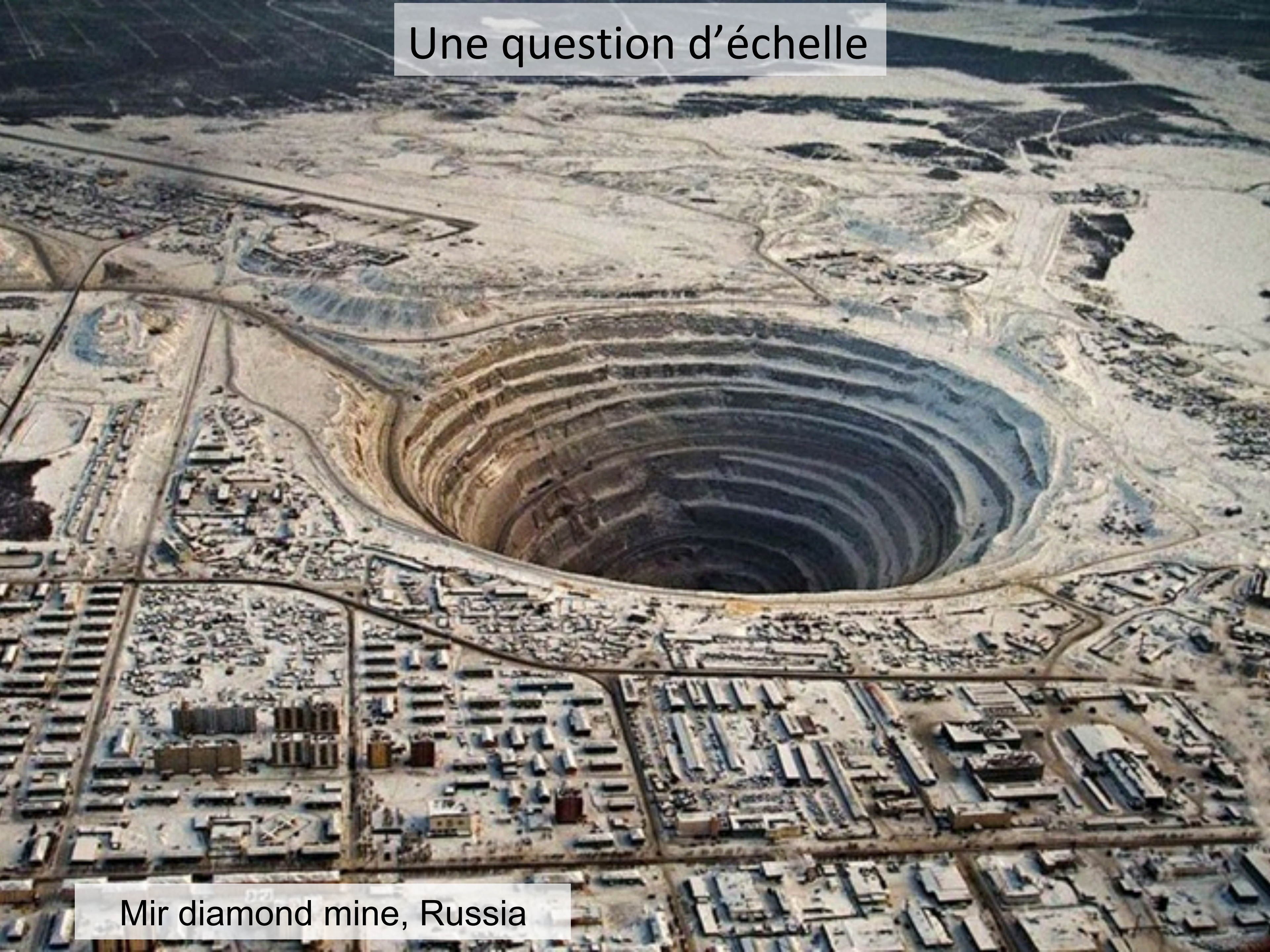
Palmiers à huile, Malaisie

Une question d’échelle



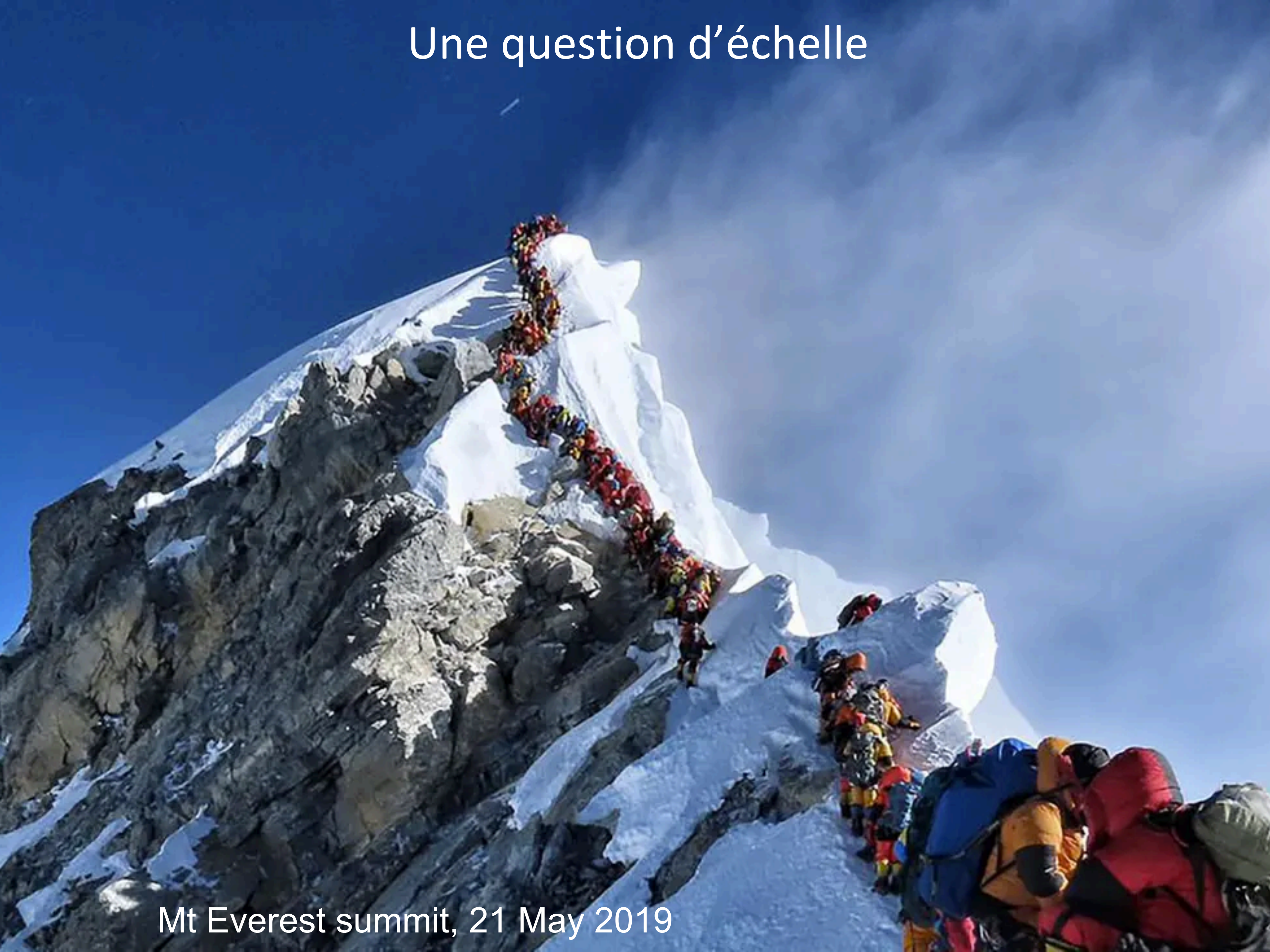
Lithium mines Atacama

Une question d’échelle



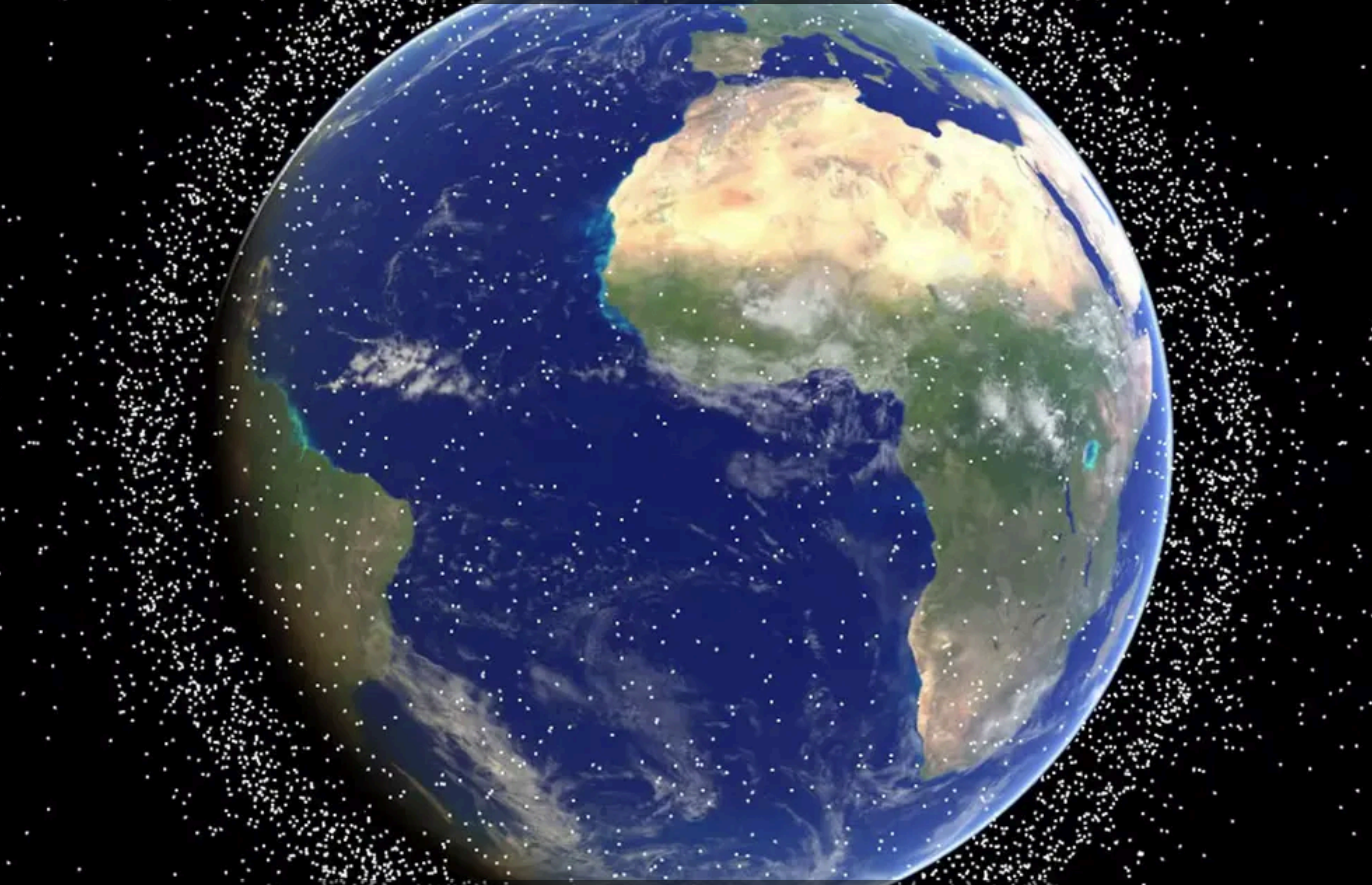
Mir diamond mine, Russia

Une question d'échelle



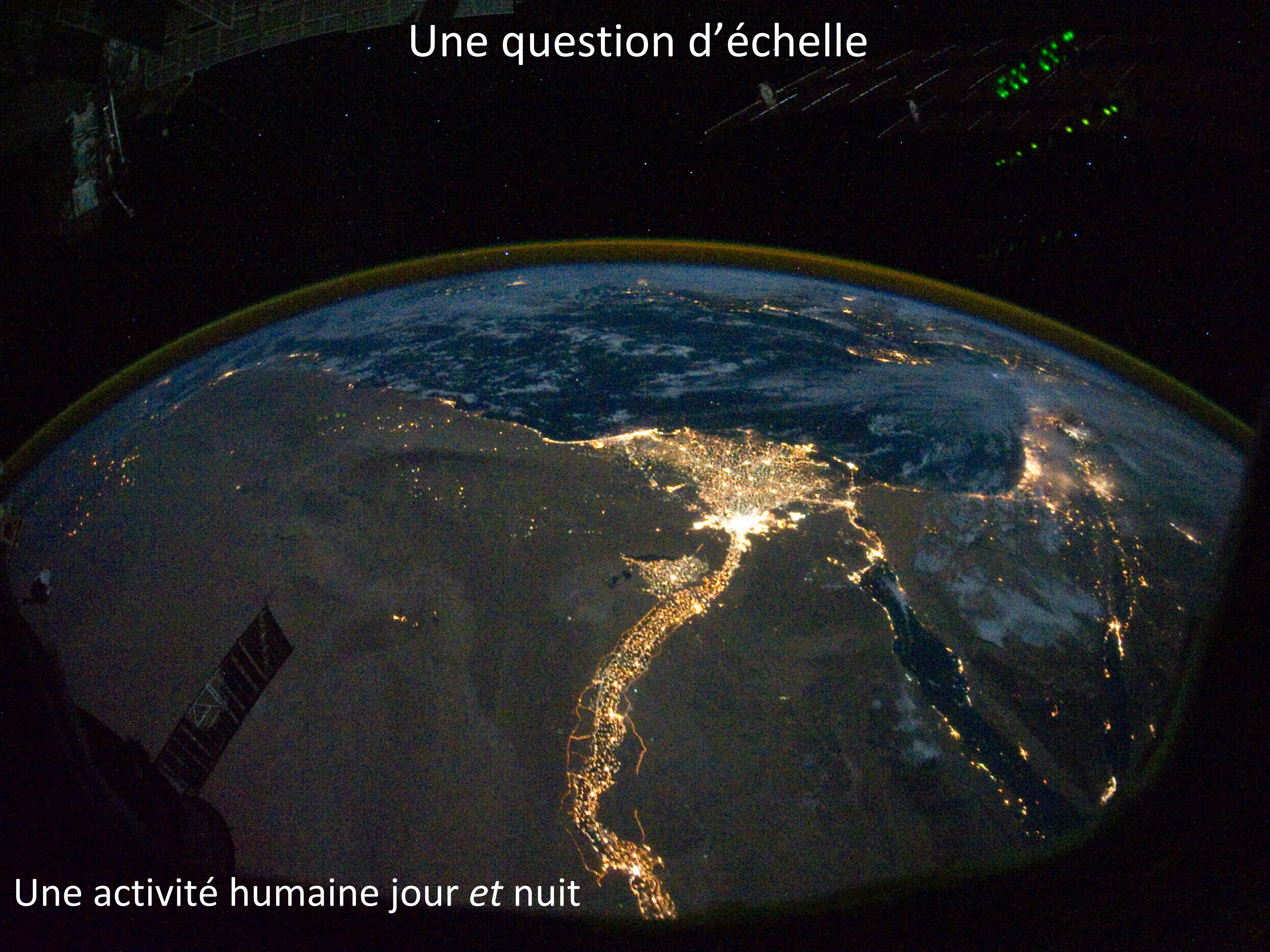
Mt Everest summit, 21 May 2019

Une question d’échelle



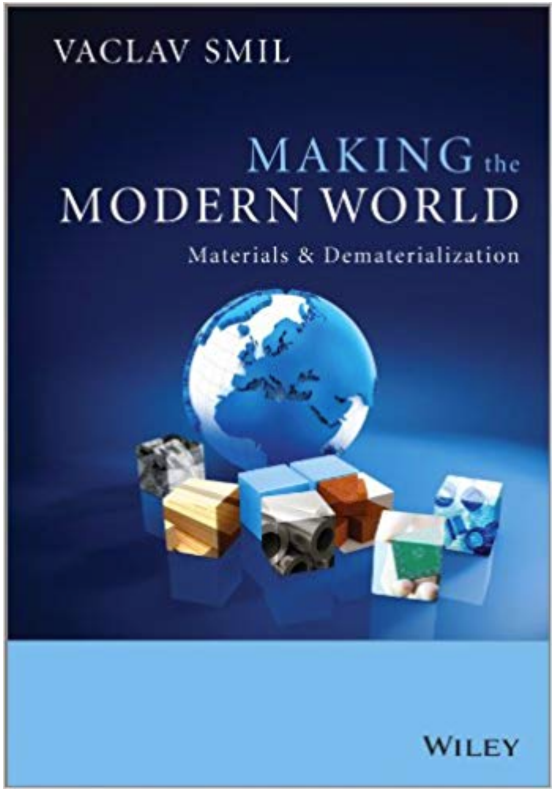
Space debris: 18 000 objects in orbit, only 7% are satellites

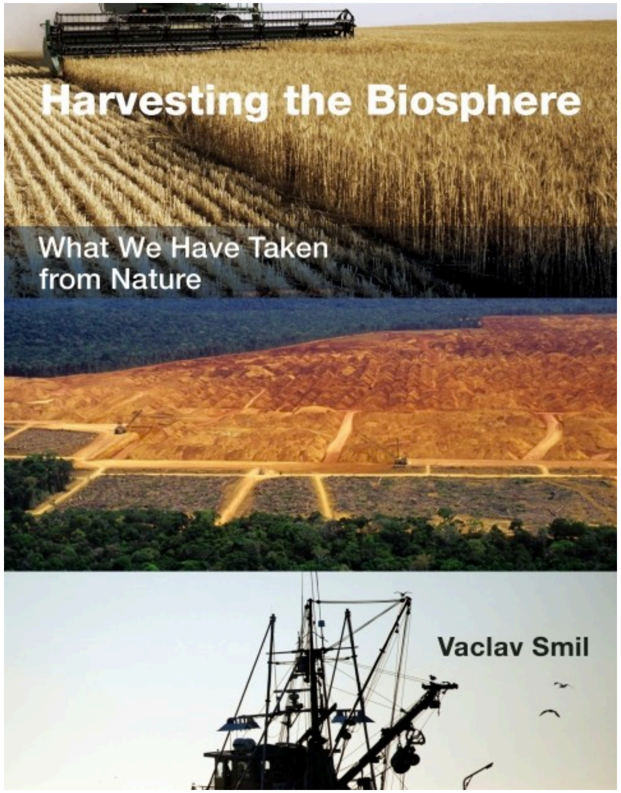
Une question d’échelle

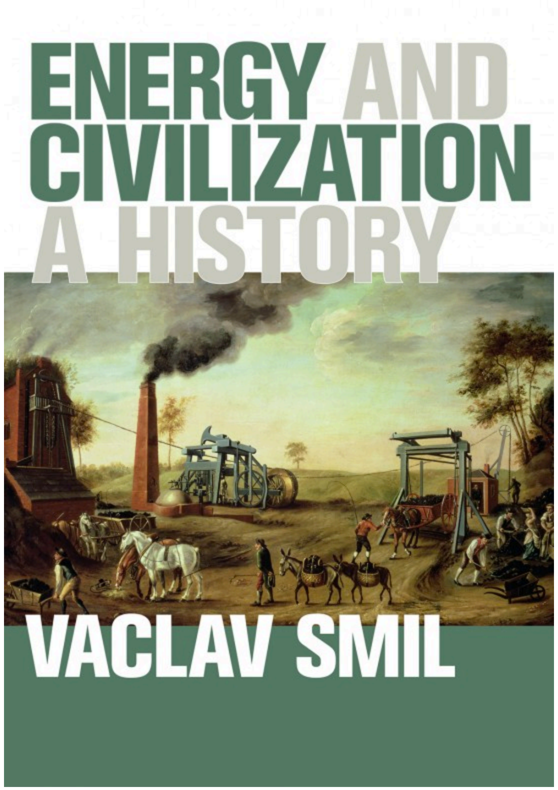


Une activité humaine jour *et* nuit

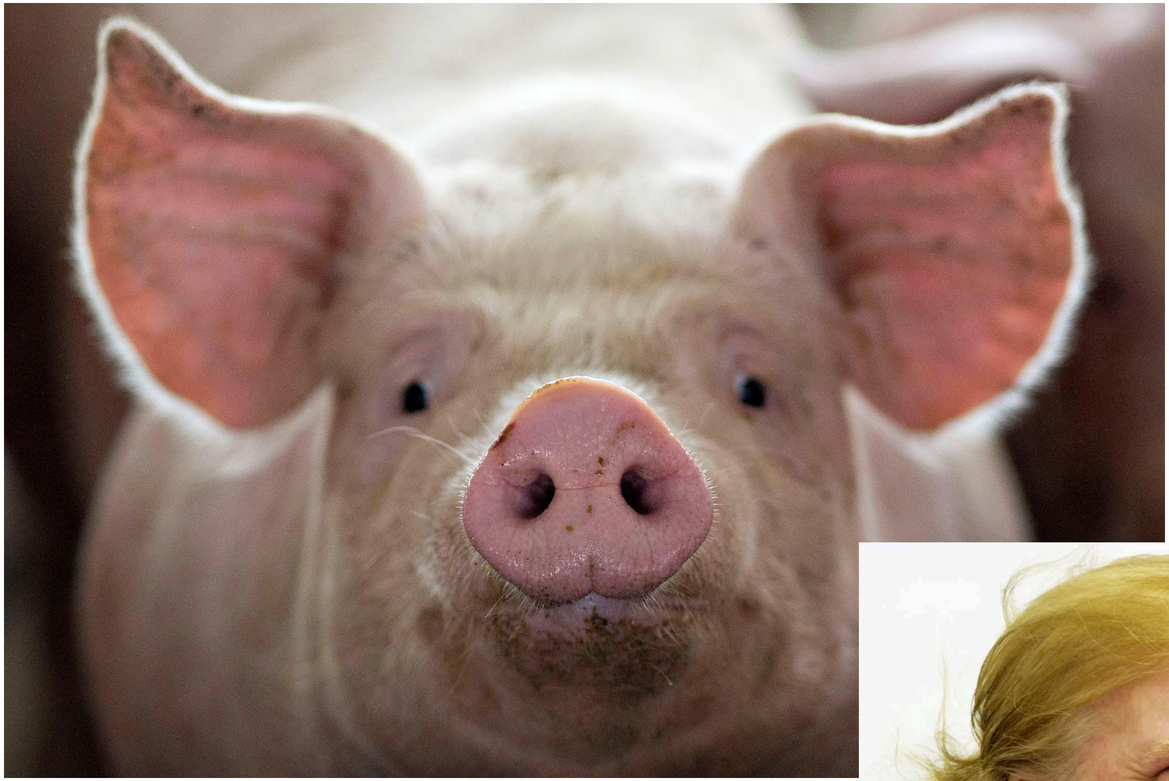
Lecture: Vaclav Smil


VACLAV SMIL
MAKING the MODERN WORLD
Materials & Dematerialization
WILEY


Harvesting the Biosphere
What We Have Taken from Nature
Vaclav Smil


ENERGY AND CIVILIZATION
A HISTORY
VACLAV SMIL

Vertébrés terrestres (en masse)



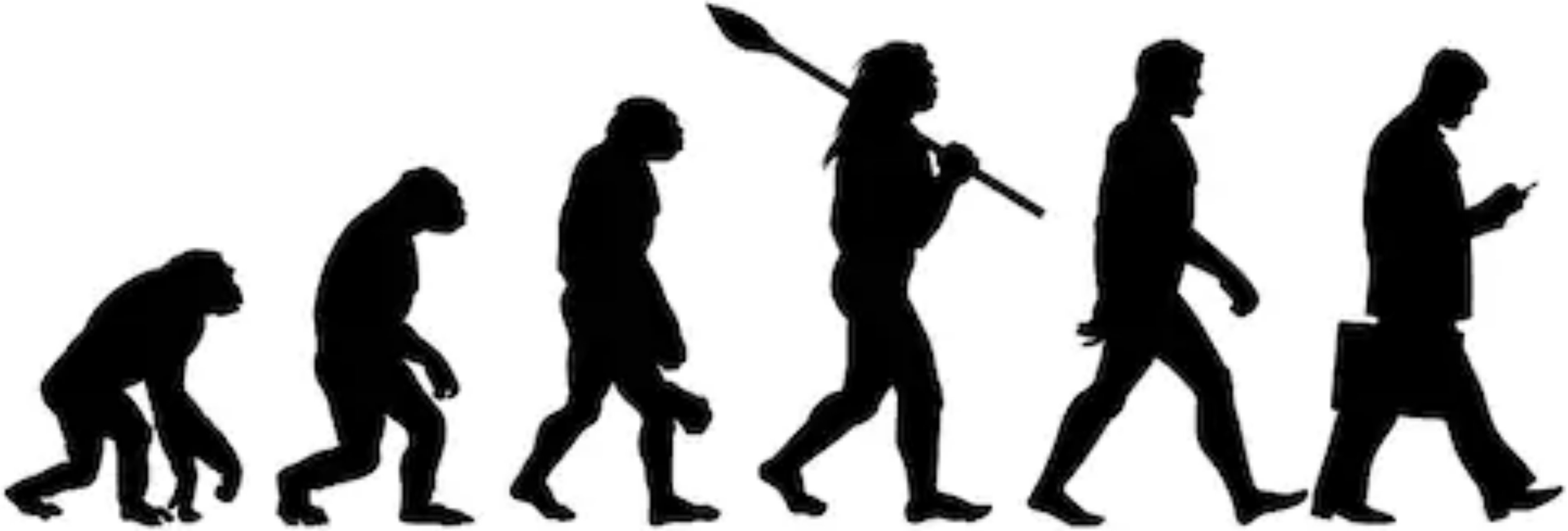
Animaux domestiqués
65%

Humains
32%

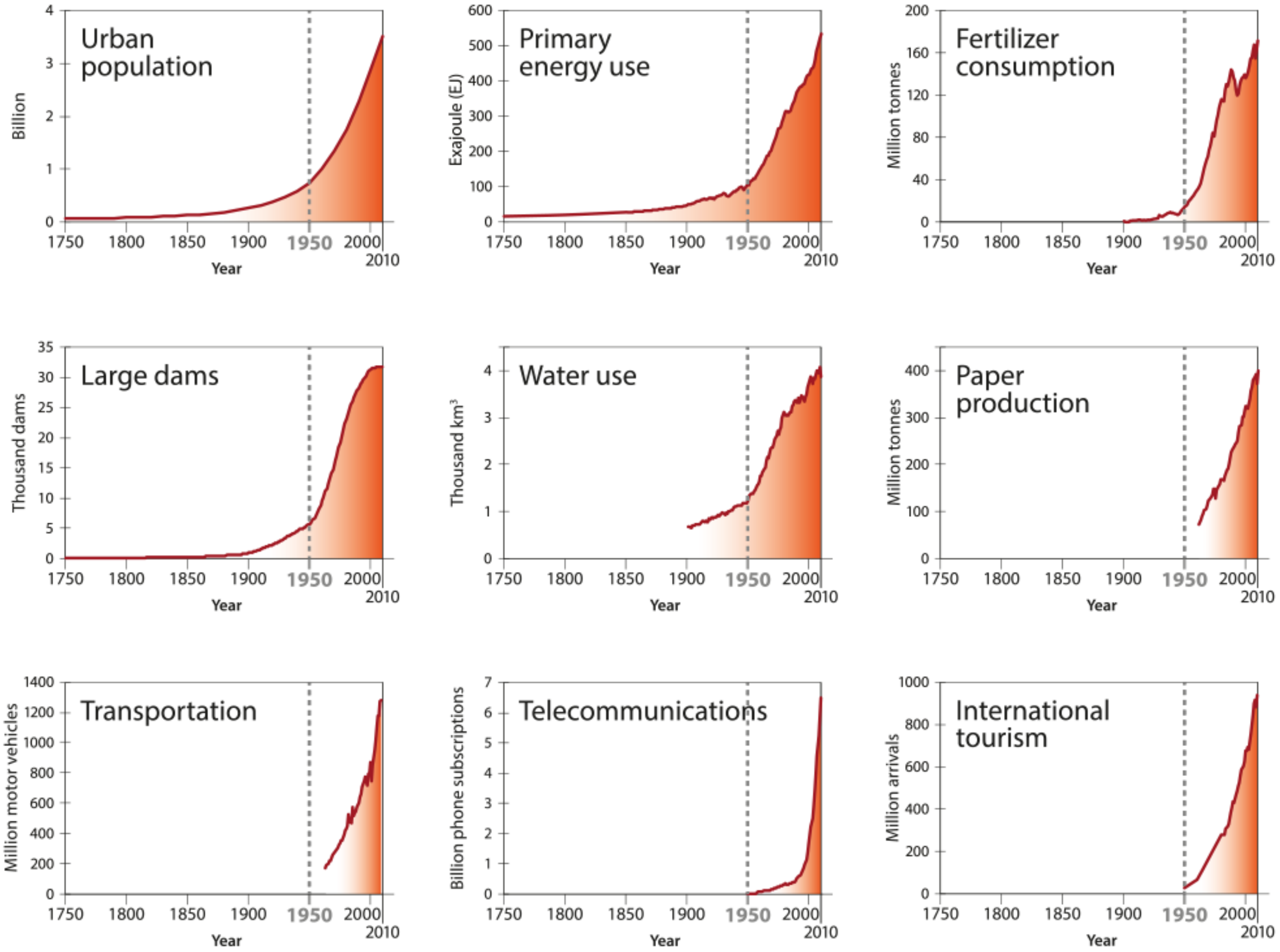
Vertébrés sauvages
<3%

Smil, 2002

Une dynamique linéaire?

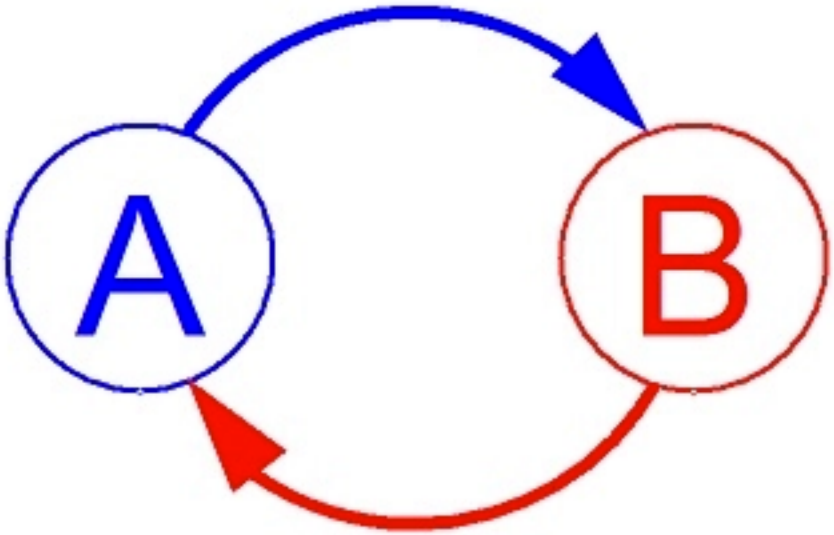


La grande accélération



Steffen *et al.*, 2007

Des mécanismes d’amplification



Un effet de cliquet (militaire)

Chaplin, Les temps modernes

Co-évolution avec la technosphère:
« Humans are the sexual organs of machines »

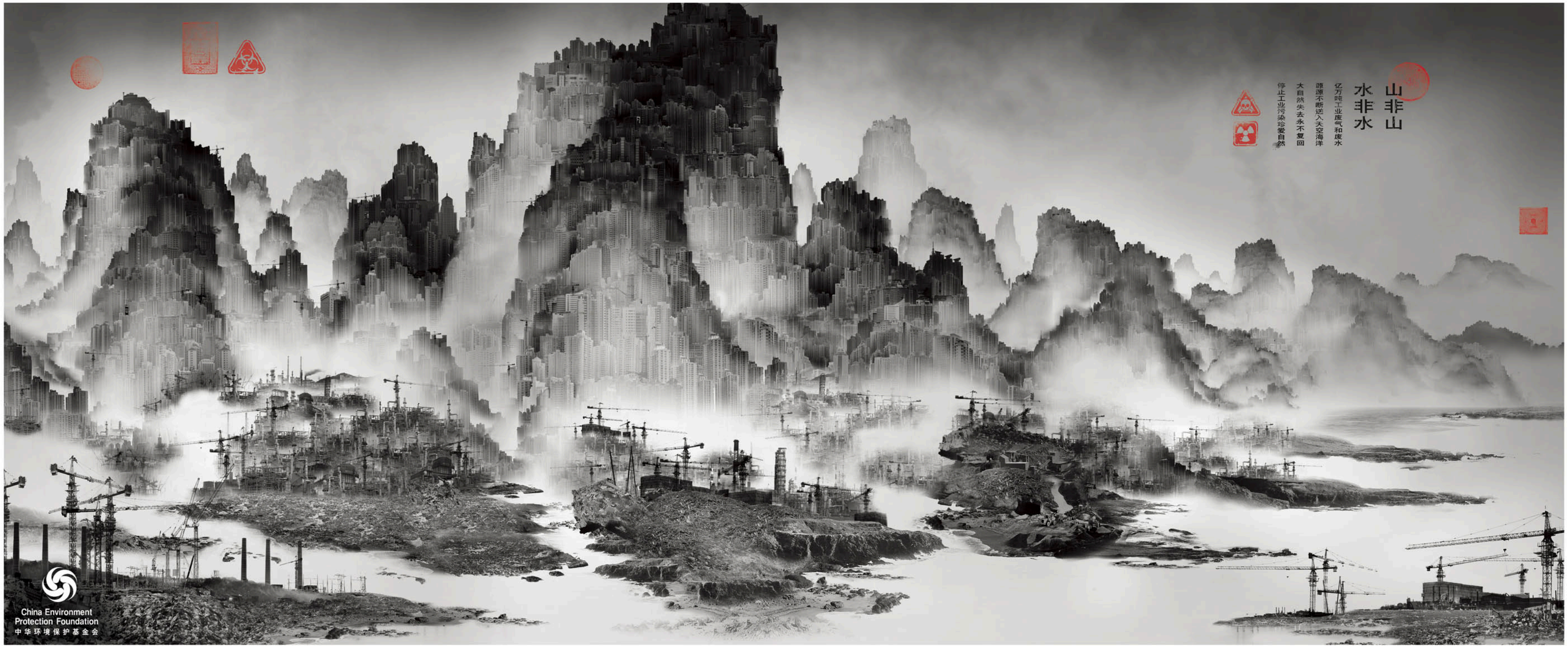
"Nous dépendons désormais des choses qui dépendent de nous"

(*M. Serres, le Contrat naturel, 1990)*

Nouvelles ontologies

“Nous sommes tous constitués de phosphate Marocain et Chinois”

La fin du dualisme nature-culture


山非山
水非水
亿万吨工业废气和废水
源源不断送入天空海洋
大自然失去永不复回
停止工业污染珍爱自然
China Environment Protection Foundation
中华环境保护基金会

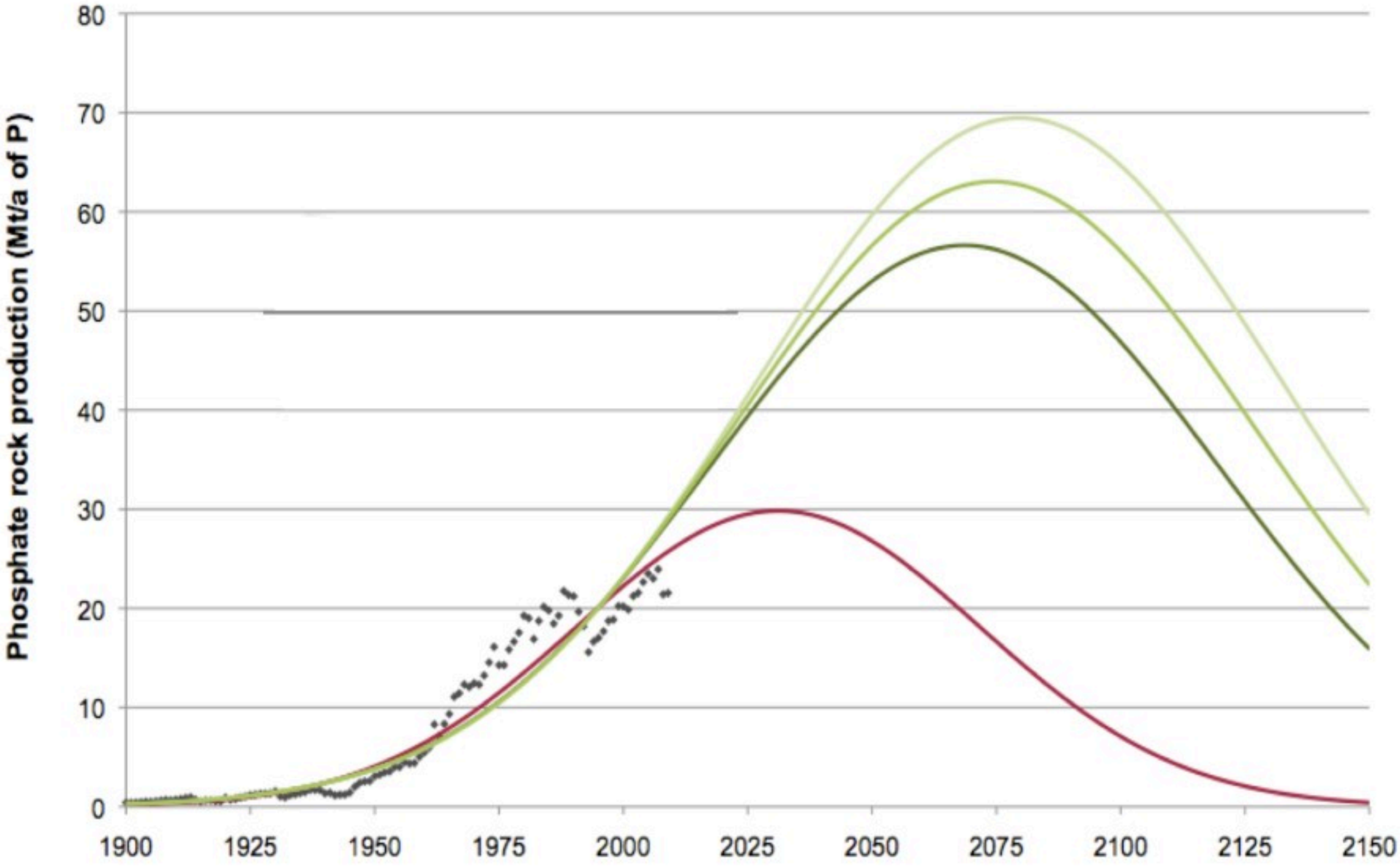
Yong Liang Yang

Symbionte ou parasite?

Algal bloom

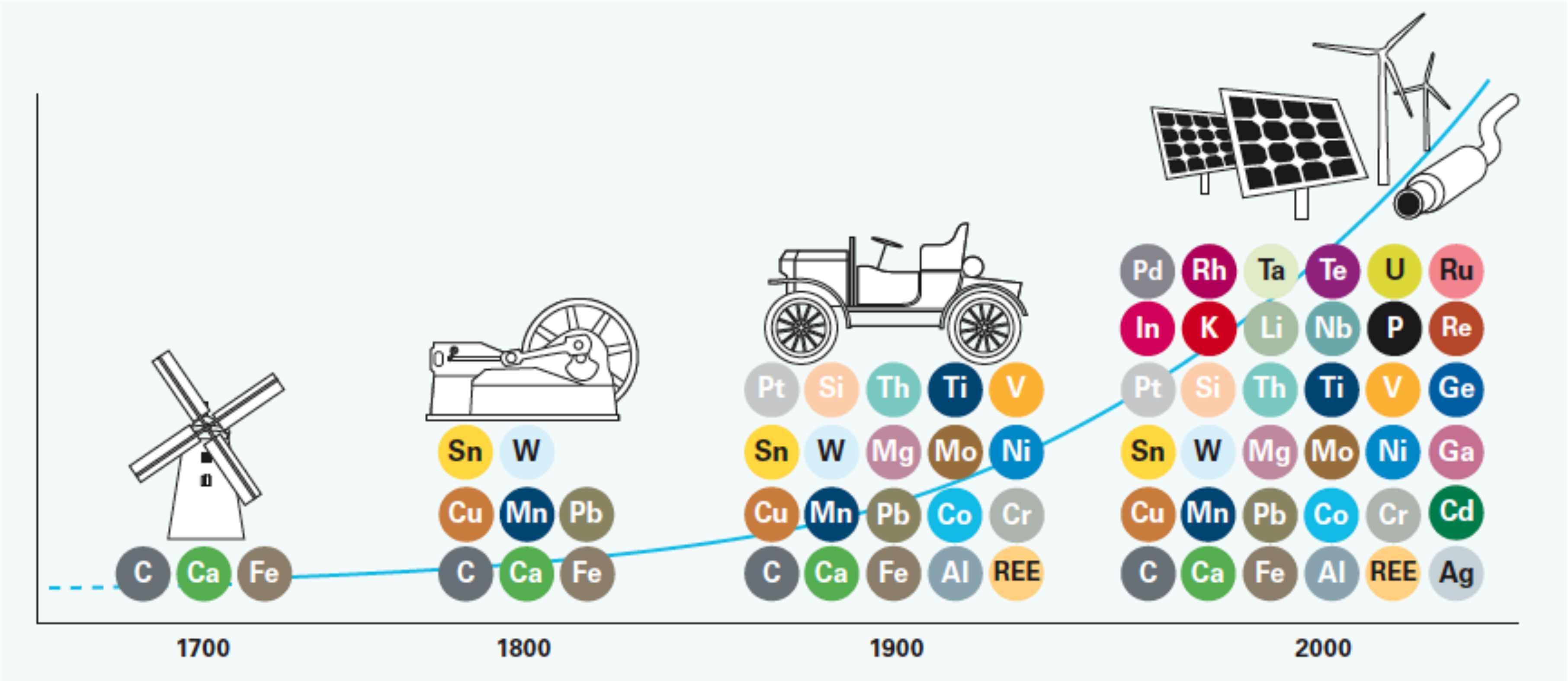
II. Ecocène
La finitude du monde

Les scénarios du pic de phosphore



Cordell *et al.*, 2009, 2011

Diversification et dispersion des éléments

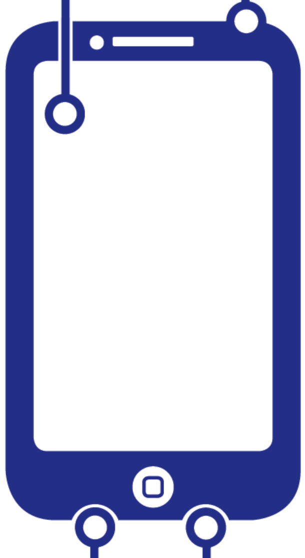

Pd
Rh
Ta
Te
U
Ru
In
K
Li
Nb
P
Re
Pt
Si
Th
Ti
V
Ge
Sn
W
Mg
Mo
Ni
Ga
Cu
Mn
Pb
Co
Cr
Cd
C
Ca
Fe
Al
REE
Ag
1700
1800
1900
2000

Elements nécessaires à la production d’énergie au cours de l’Histoire

Armin Reller

60 à 80% de la table périodique dans un smartphone

ELEMENTS COLOUR KEY: ● ALKALI METAL ● ALKALINE EARTH METAL ● TRANSITION METAL ● GROUP 13 ● GROUP 14 ● GROUP 15 ● GROUP 16 ● HALOGEN ● LANTHANIDE



SCREEN

- 49 In Indium
- 50 Sn Tin
- 8 O Oxygen

Indium tin oxide is a mixture of indium oxide and tin oxide, used in a transparent film in the screen that conducts electricity. This allows the screen to function as a touch screen.

- 13 Al Aluminium
- 14 Si Silicon
- 8 O Oxygen
- 19 K Potassium

The glass used on the majority of smartphones is an aluminosilicate glass, composed of a mix of alumina (Al_2O_3) and silica (SiO_2). This glass also contains potassium ions, which help to strengthen it.

- 39 Y Yttrium
- 57 La Lanthanum
- 65 Tb Terbium
- 59 Pr Praseodymium
- 63 Eu Europium
- 66 Dy Dysprosium
- 64 Gd Gadolinium

A variety of Rare Earth Element compounds are used in small quantities to produce the colours in the smartphone's screen. Some compounds are also used to reduce UV light penetration into the phone.

ELECTRONICS

Copper is used for wiring in the phone, whilst copper, gold and silver are the major metals from which microelectrical components are fashioned. Tantalum is the major component of micro-capacitors.

- 29 Cu Copper
- 47 Ag Silver
- 79 Au Gold
- 73 Ta Tantalum

Nickel is used in the microphone as well as for other electrical connections. Alloys including the elements praseodymium, gadolinium and neodymium are used in the magnets in the speaker and microphone. Neodymium, terbium and dysprosium are used in the vibration unit.

- 28 Ni Nickel
- 66 Dy Dysprosium
- 59 Pr Praseodymium
- 65 Tb Terbium
- 60 Nd Neodymium
- 64 Gd Gadolinium

Pure silicon is used to manufacture the chip in the phone. It is oxidised to produce non-conducting regions, then other elements are added in order to allow the chip to conduct electricity.

- 14 Si Silicon
- 8 O Oxygen
- 51 Sb Antimony
- 33 As Arsenic
- 15 P Phosphorus
- 31 Ga Gallium

Tin & lead are used to solder electronics in the phone. Newer lead-free solders use a mix of tin, copper and silver.

- 50 Sn Tin
- 82 Pb Lead

BATTERY

- 3 Li Lithium
- 27 Co Cobalt
- 6 C Carbon
- 13 Al Aluminium
- 8 O Oxygen

The majority of phones use lithium ion batteries, which are composed of lithium cobalt oxide as a positive electrode and graphite (carbon) as the negative electrode. Some batteries use other metals, such as manganese, in place of cobalt. The battery's casing is made of aluminium.

CASING

Magnesium compounds are alloyed to make some phone cases, whilst many are made of plastics. Plastics will also include flame retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.

- 6 C Carbon
- 12 Mg Magnesium
- 35 Br Bromine
- 28 Ni Nickel

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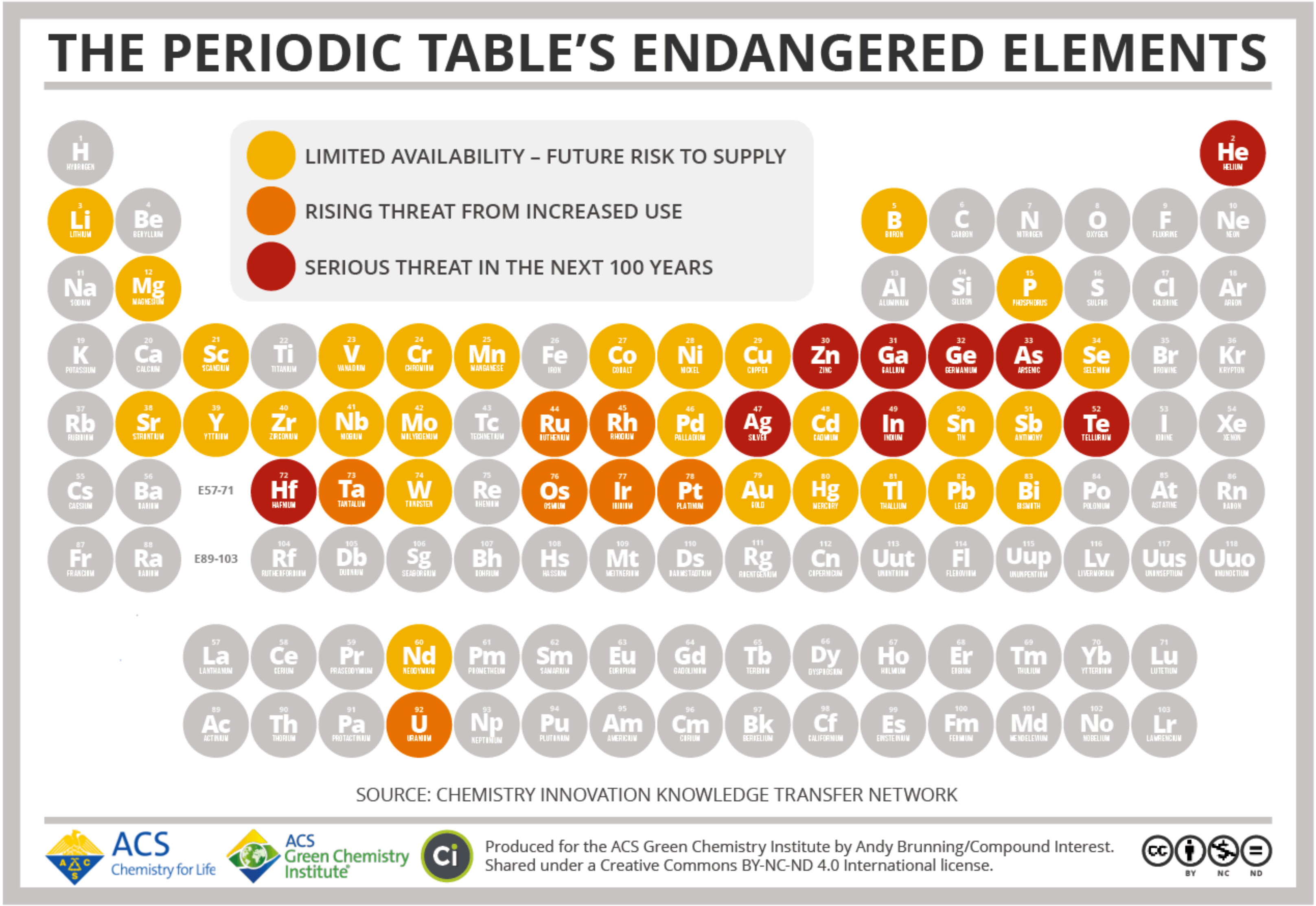
La fin des ressources?



THE PERIODIC TABLE'S ENDANGERED ELEMENTS

- 🟡 LIMITED AVAILABILITY – FUTURE RISK TO SUPPLY
- 🟠 RISING THREAT FROM INCREASED USE
- 🔴 SERIOUS THREAT IN THE NEXT 100 YEARS

SOURCE: CHEMISTRY INNOVATION KNOWLEDGE TRANSFER NETWORK

ACS Chemistry for Life
ACS Green Chemistry Institute
Produced for the ACS Green Chemistry Institute by Andy Brunning/Compound Interest.

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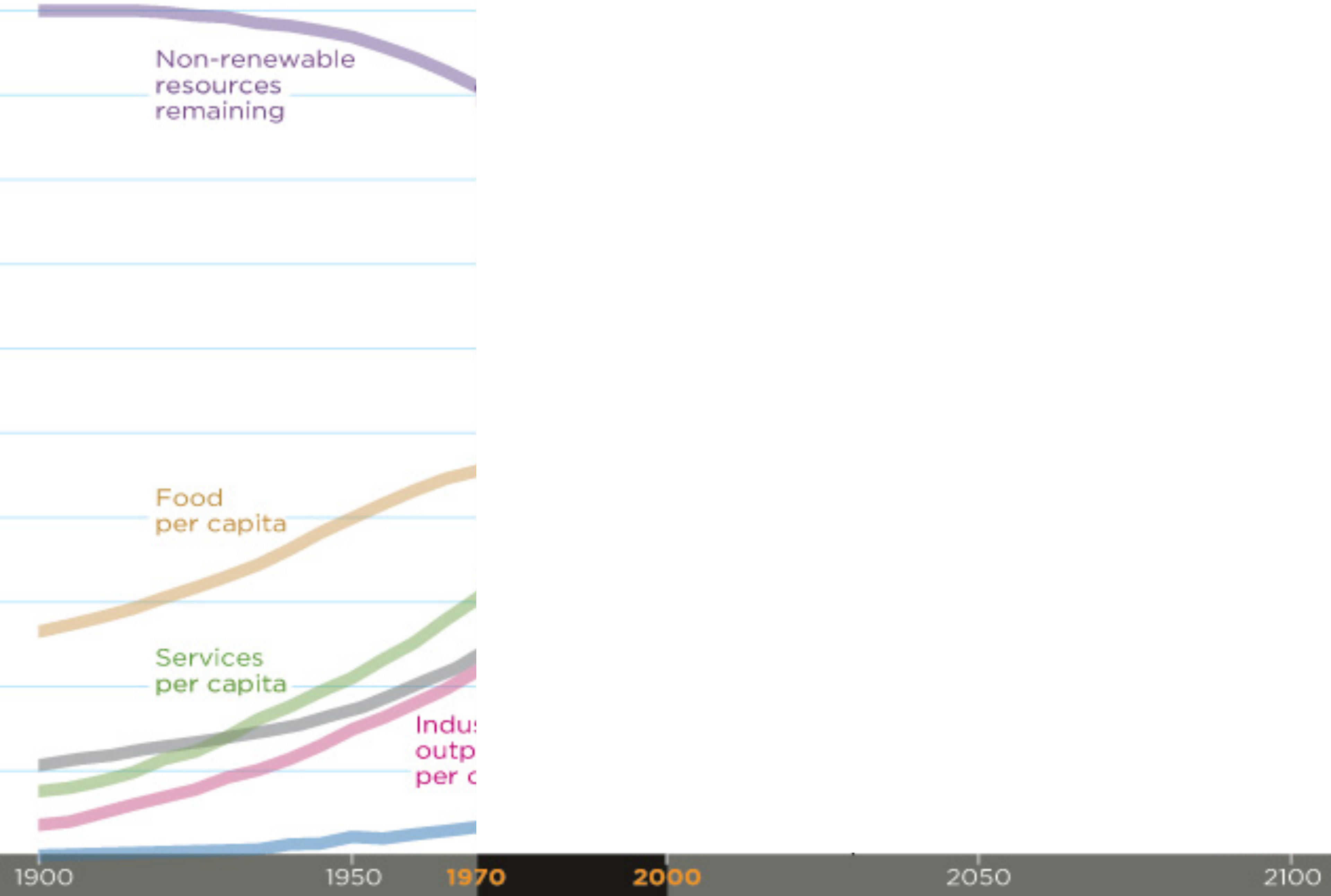
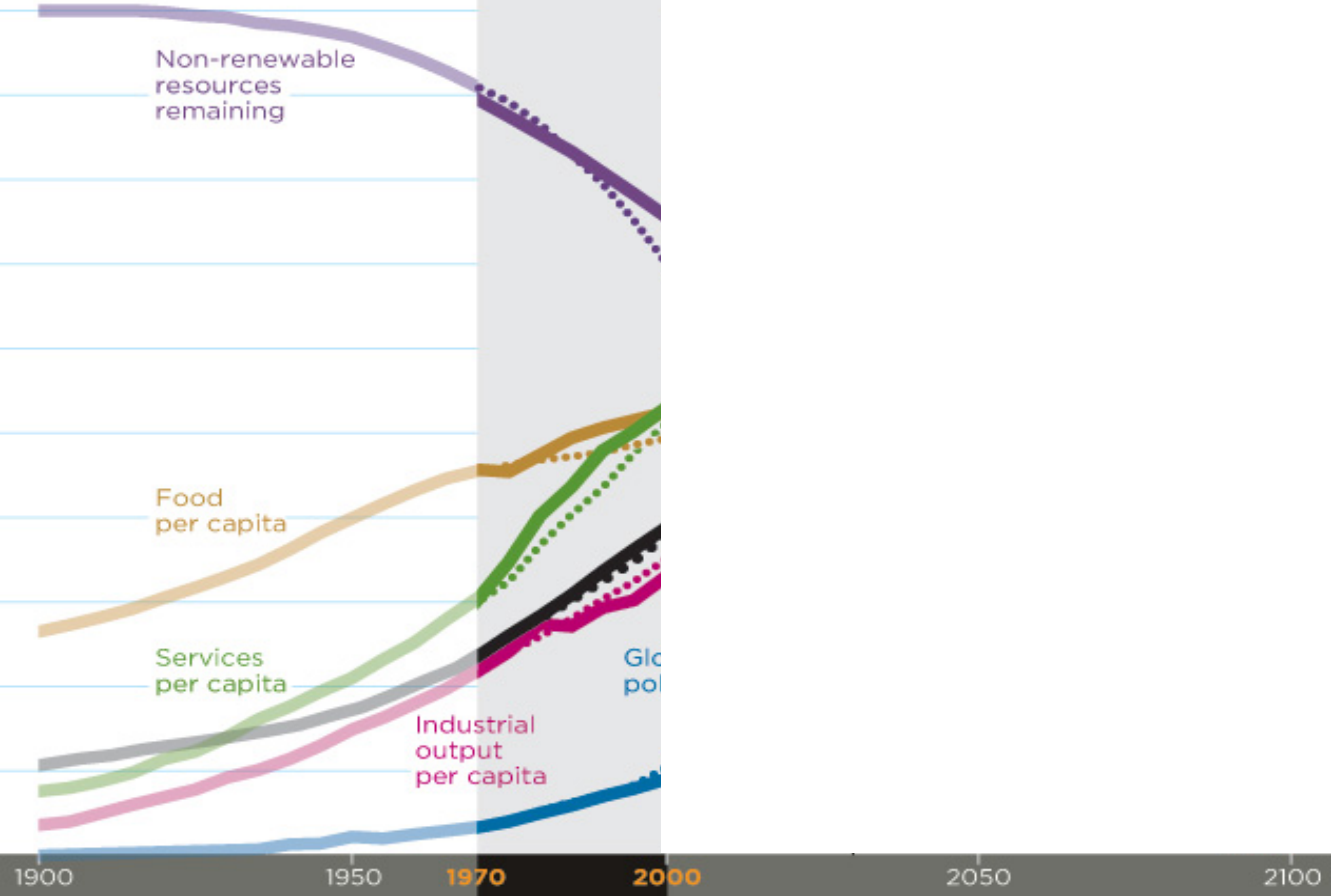
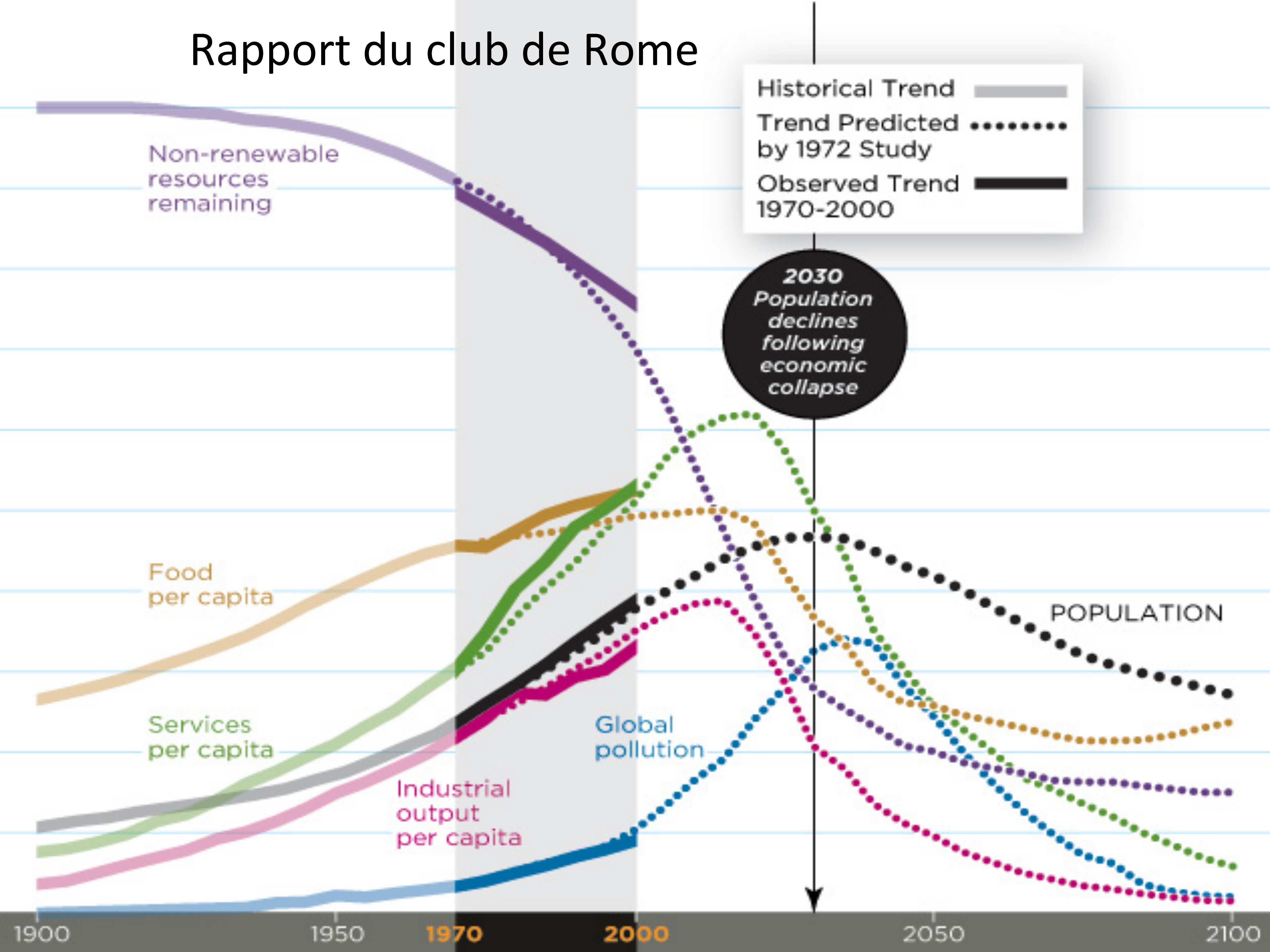
Rapport du club de Rome



Rapport du club de Rome



Rapport du club de Rome



Déni: Les craintes sont exagérées

I ♥ COAL
DRAIN THE SWAMP

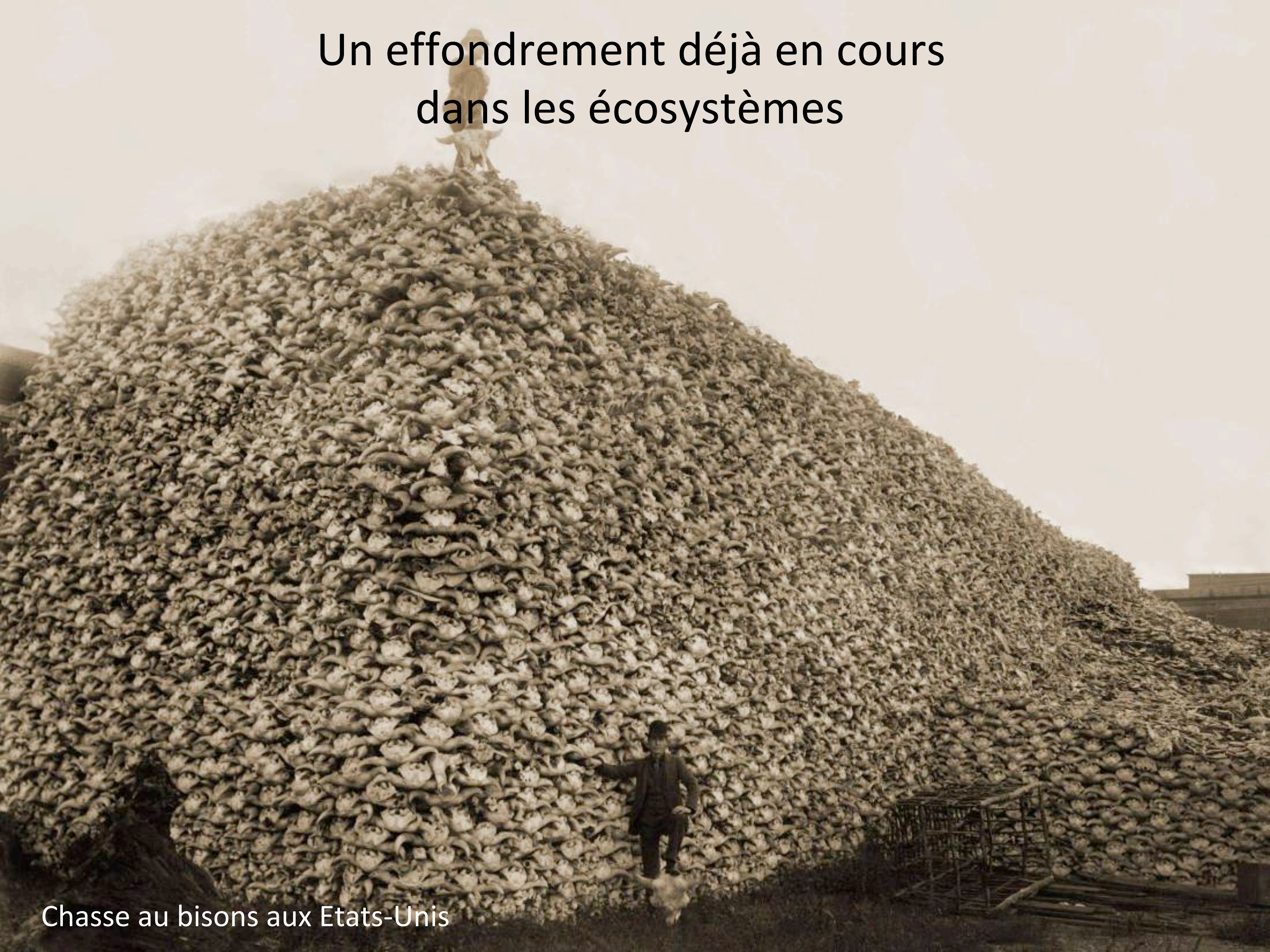
La technologie et l’intelligence humaine vont régler le problème

Fire, California

Le « business as usual » officiellement abandonné

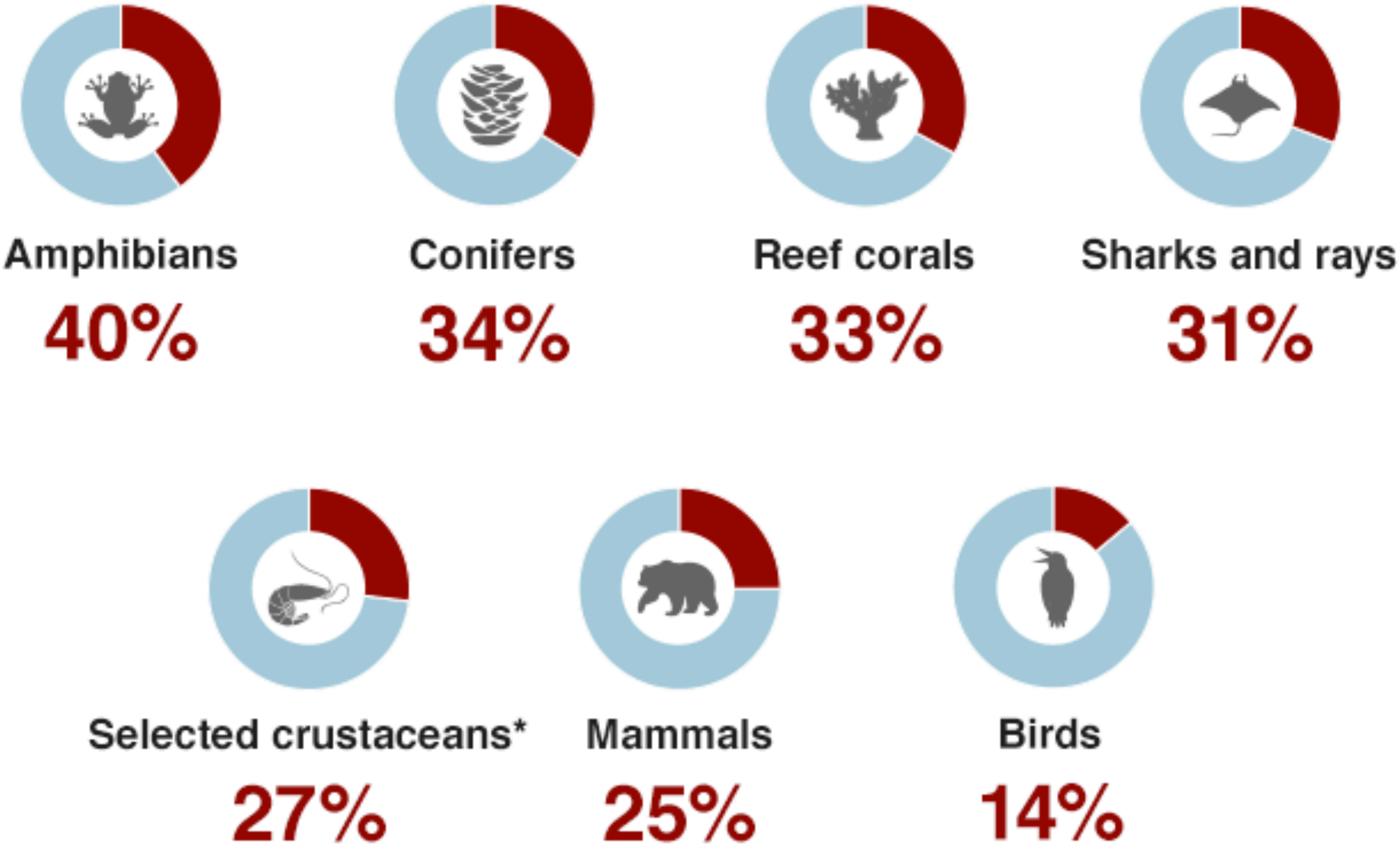
Nations Unies
Conférence sur les Changements Climatiques 2015
COP21/CMP11
Paris, France

Un effondrement déjà en cours dans les écosystèmes



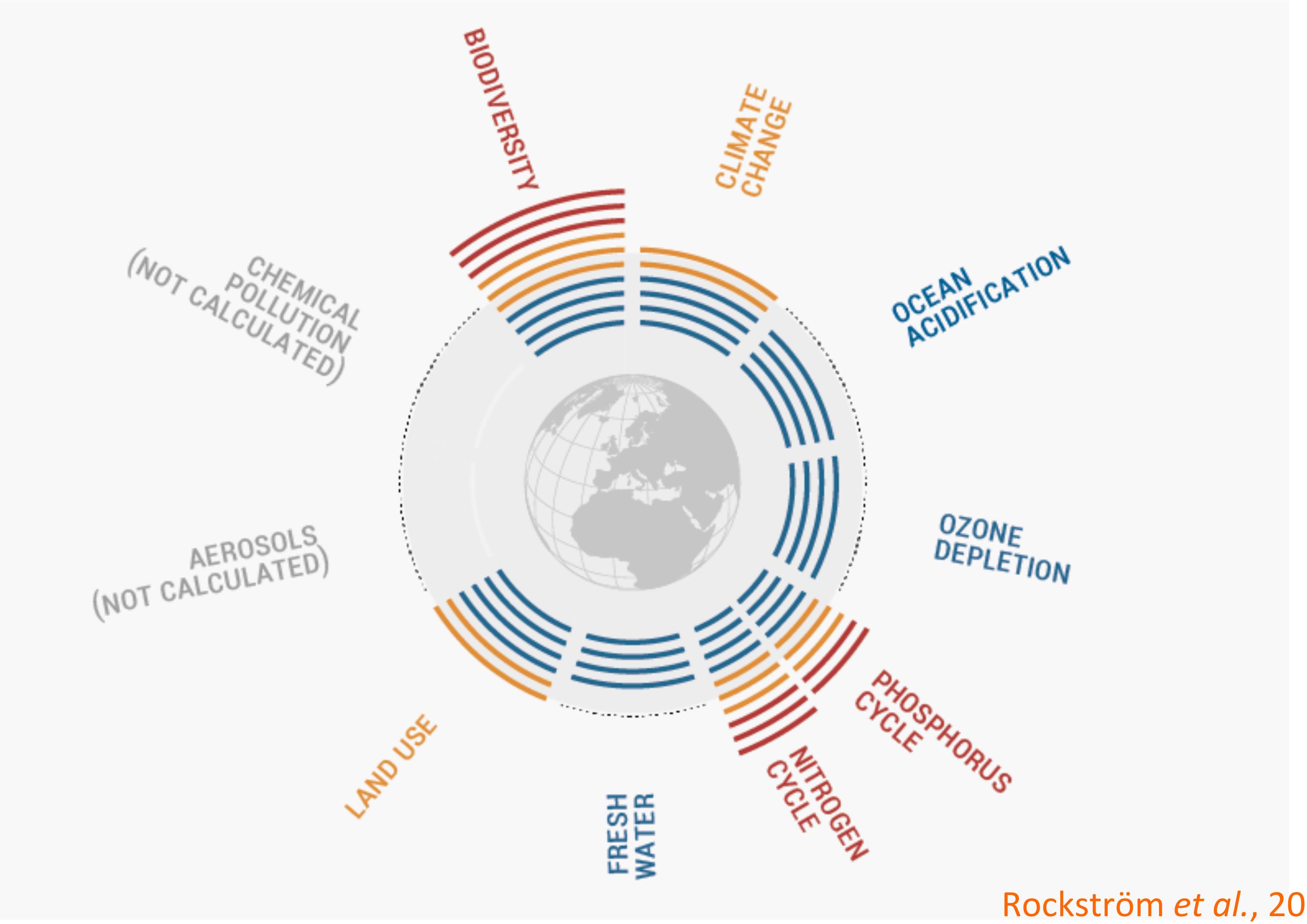
Chasse au bisons aux Etats-Unis

6$^{\text{ème}}$ extinction de masse des espèces



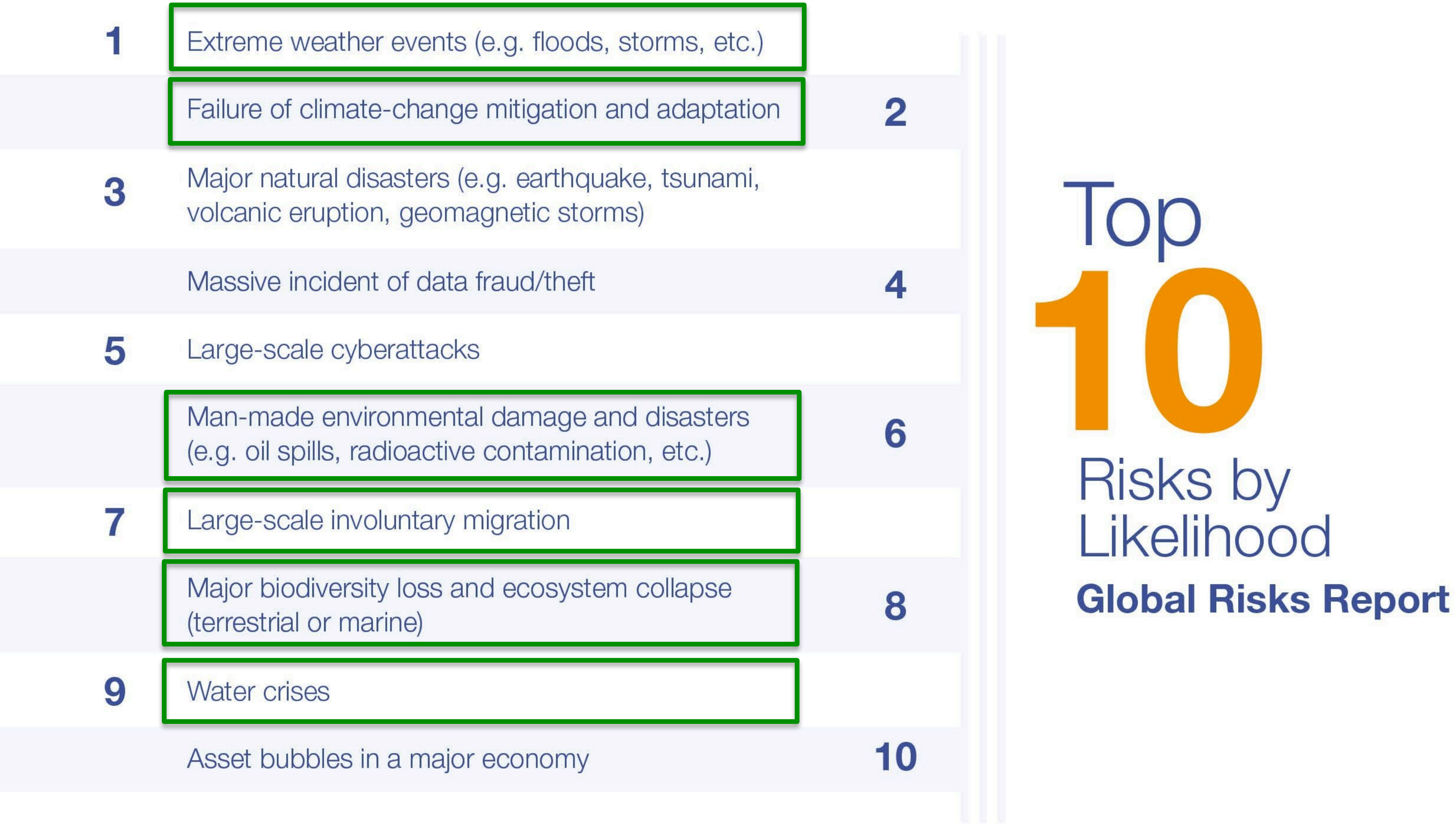
Source: IUCN

Une alerte: les frontières planétaires


BIODIVERSITY
CLIMATE CHANGE
OCEAN ACIDIFICATION
OZONE DEPLETION
PHOSPHORUS CYCLE
NITROGEN CYCLE
FRESH WATER
LAND USE
AEROSOLS (NOT CALCULATED)
CHEMICAL POLLUTION (NOT CALCULATED)

Rockström *et al.*, 2009

La question environnementale à l’agenda socio-économique



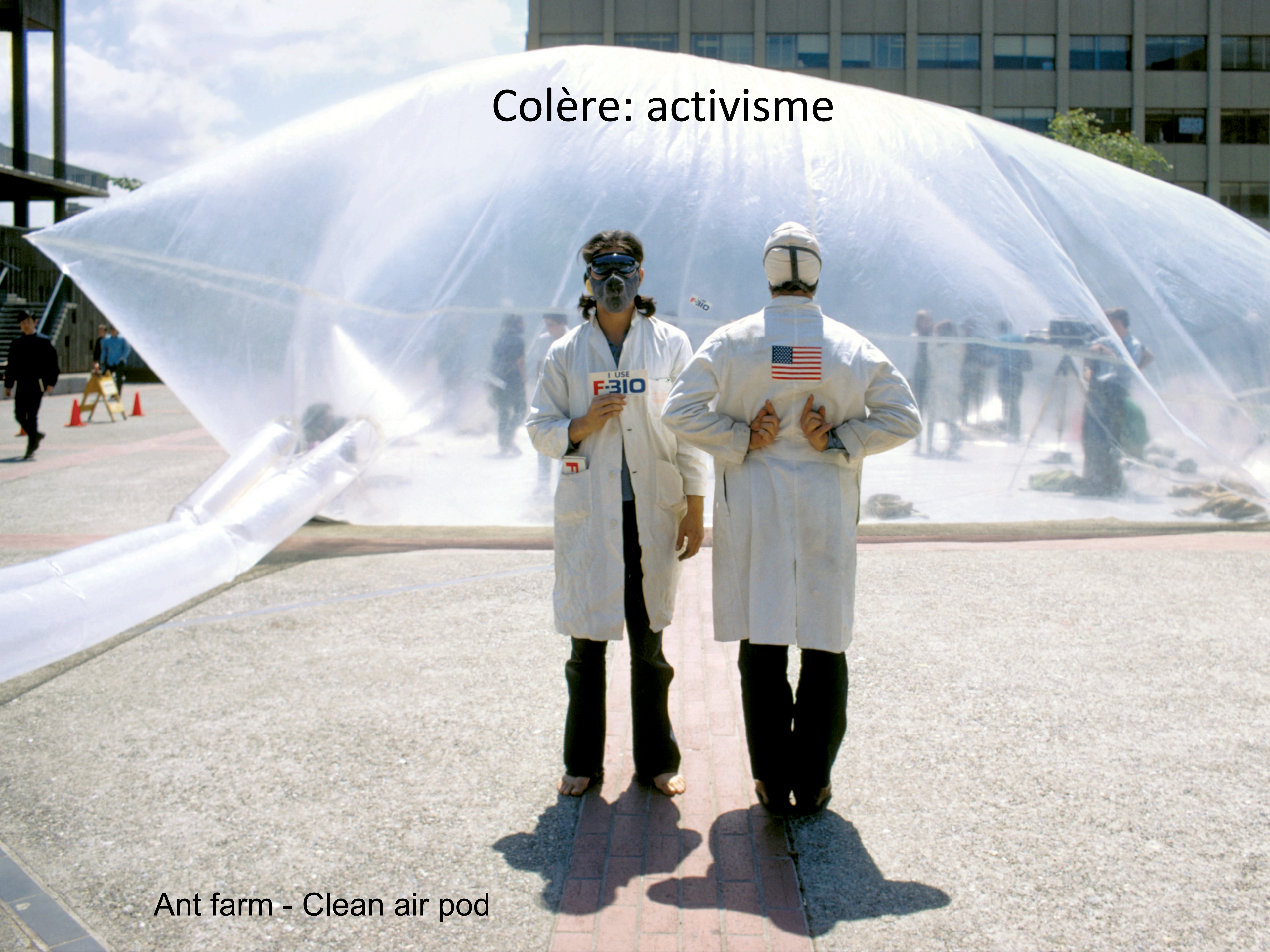
Top 10 Risks by Likelihood

Global Risks Report

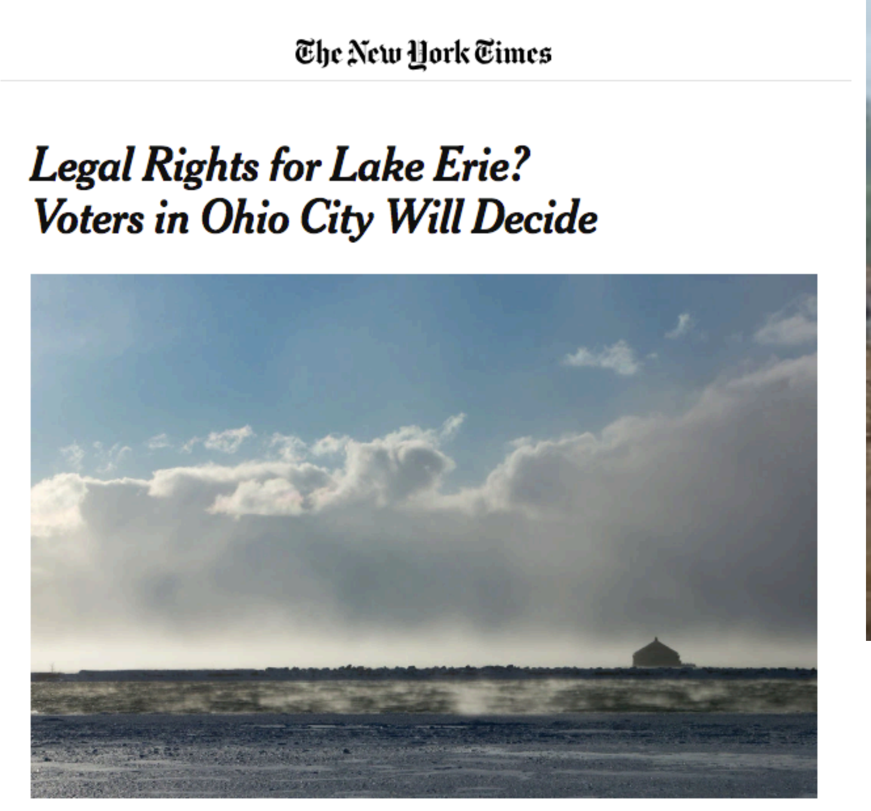
1	Extreme weather events (e.g. floods, storms, etc.)
2	Failure of climate-change mitigation and adaptation
3	Major natural disasters (e.g. earthquake, tsunami, volcanic eruption, geomagnetic storms)
4	Massive incident of data fraud/theft
5	Large-scale cyberattacks
6	Man-made environmental damage and disasters (e.g. oil spills, radioactive contamination, etc.)
7	Large-scale involuntary migration
8	Major biodiversity loss and ecosystem collapse (terrestrial or marine)
9	Water crises
10	Asset bubbles in a major economy

Source: WEF, 2019

Colère: activisme



Ant farm - Clean air pod



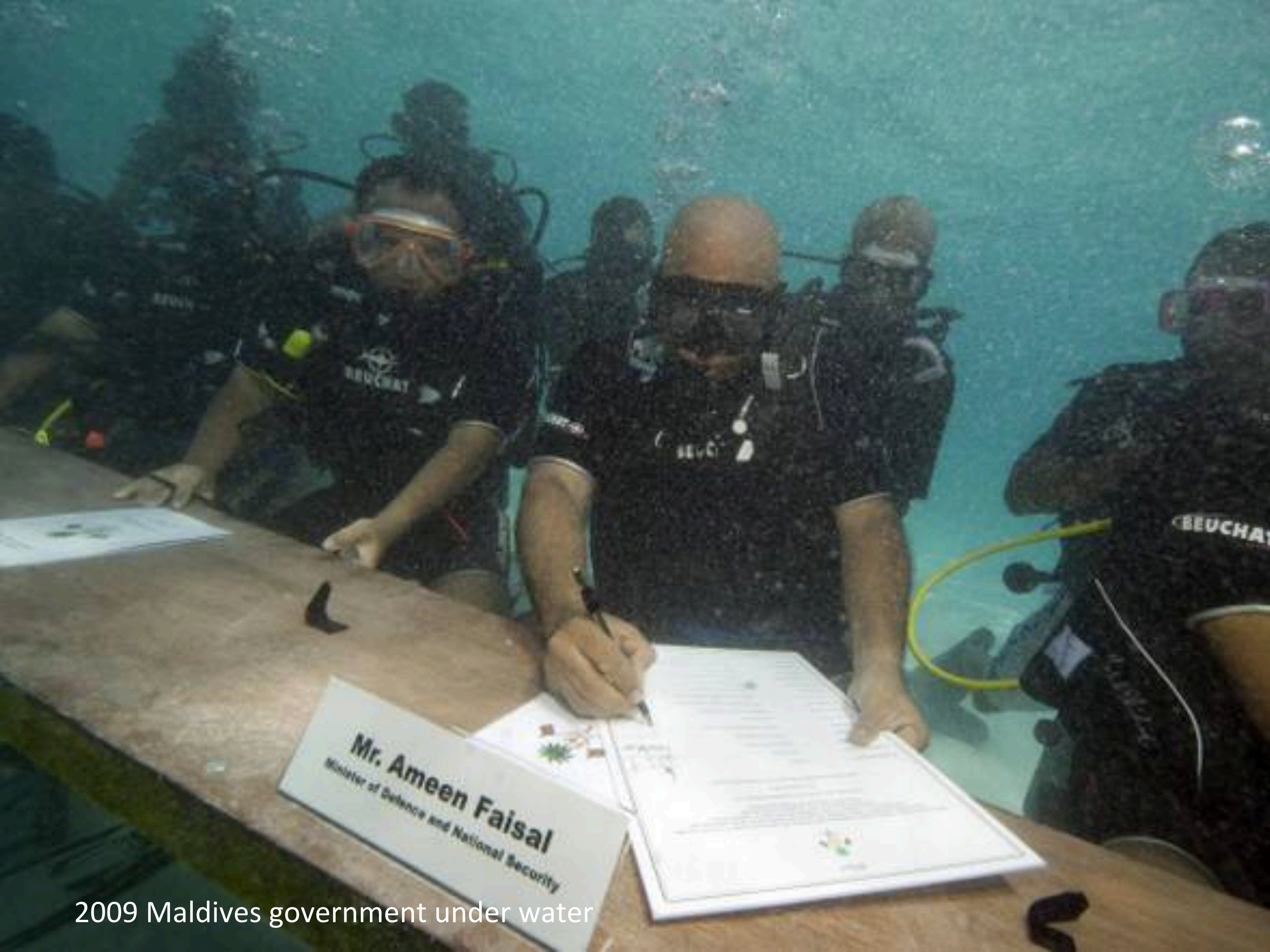
The New York Times

Legal Rights for Lake Erie? Voters in Ohio City Will Decide

Sivens

SKOLSTREJK
FÖR
KLIMATET

2 MILLIONS
DE SOUTIENS!
laffairedusiecle.net
L'AFFAIRE
DU SIÈCLE


BEUCHAT
BEUCHAT
Mr. Ameen Faisal
Minister of Defence and National Security

2009 Maldives government under water

Portrait: Alexandre Monnin

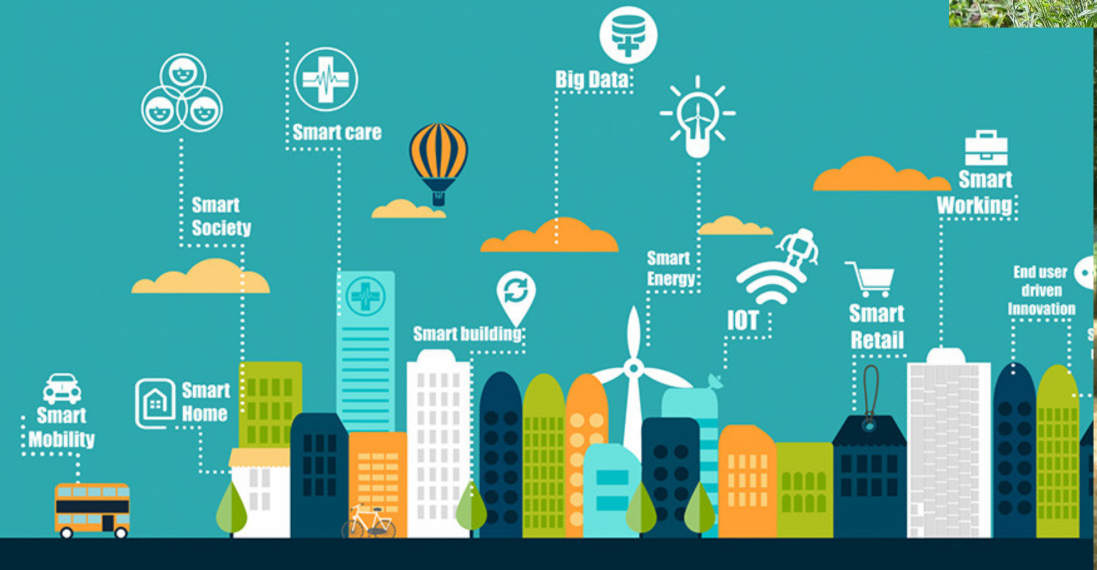
Alexandre Monnin
Origens medialab, Prof ESC

L'obsolescence du numérique?

Négociation: développement durable

Agro-écologie

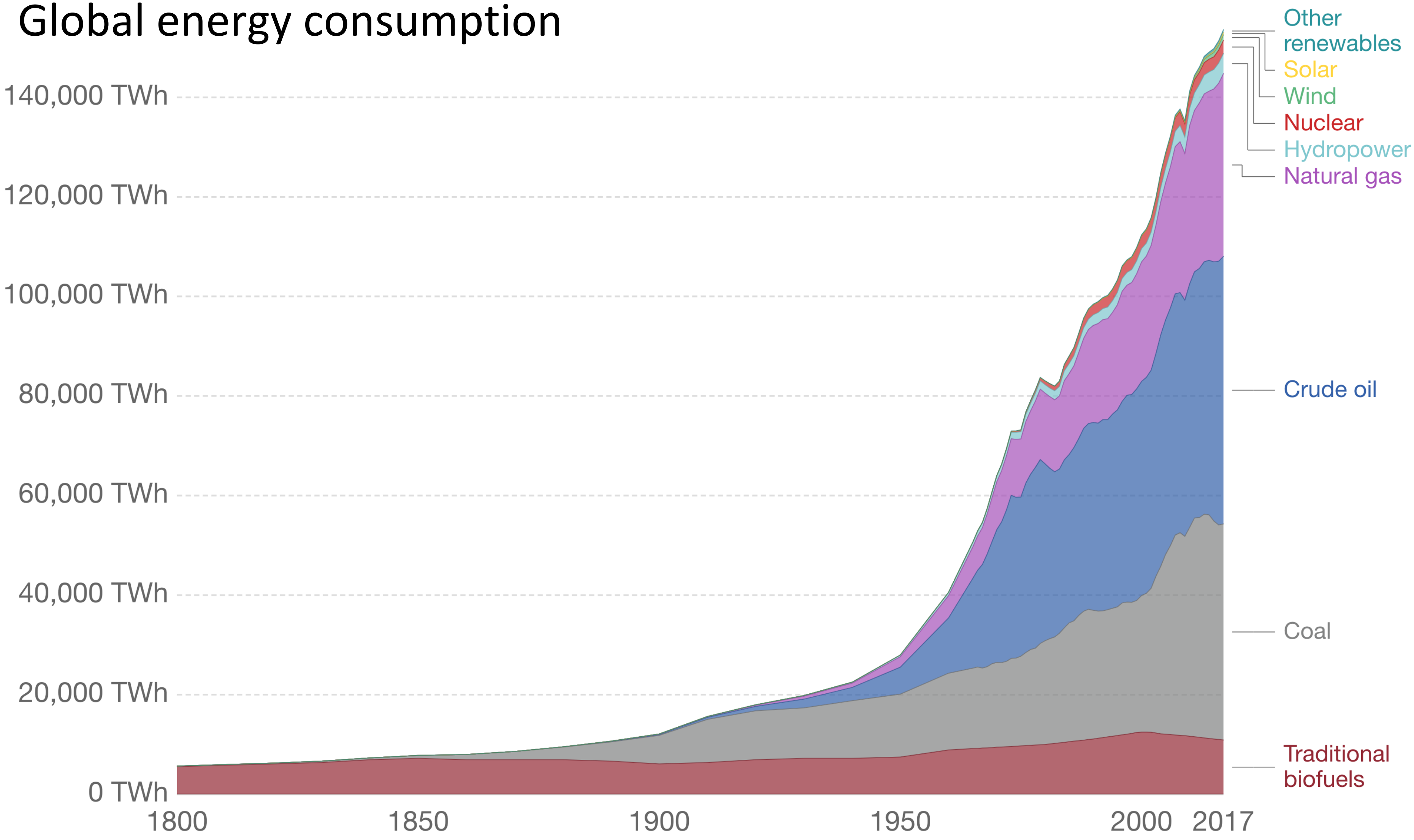
Frugalité numérique?


Smart Society
Smart care
Big Data
Smart Working
Smart Energy
Smart building
IOT
Smart Retail
End user driven Innovation
Smart Mobility
Smart Home

Agro-foresterie

Une transition ou une addition?

Global energy consumption



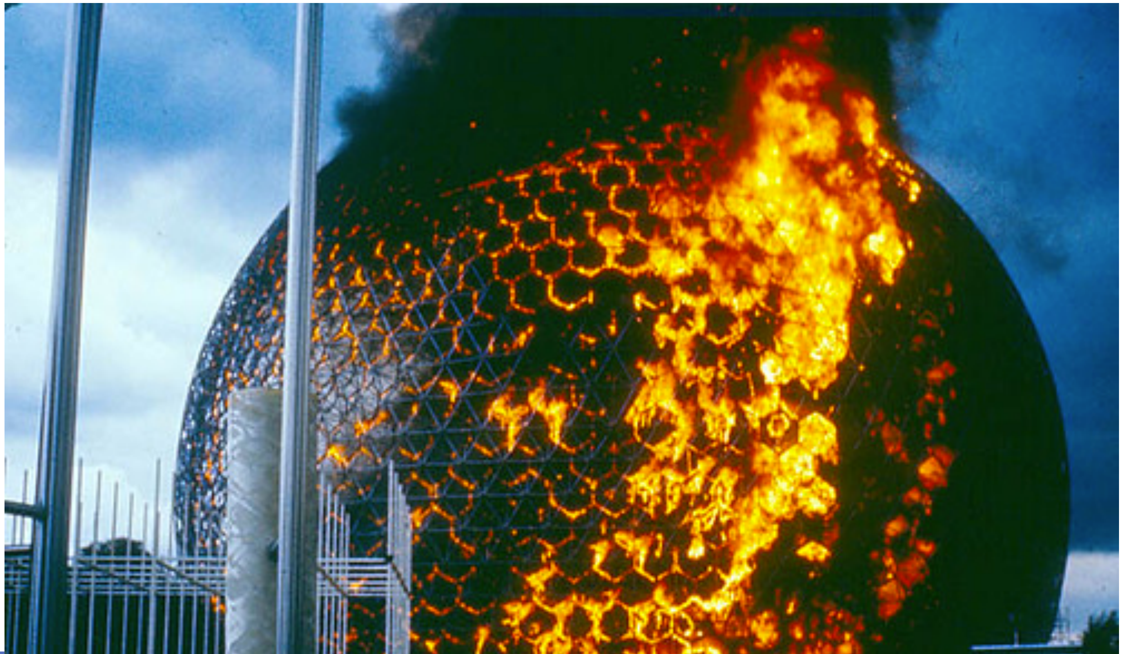
Source: Vaclav Smil (2017) and BP Statistical Review of World Energy

CC BY

Illusion du contrôle: la géo-ingéniérie

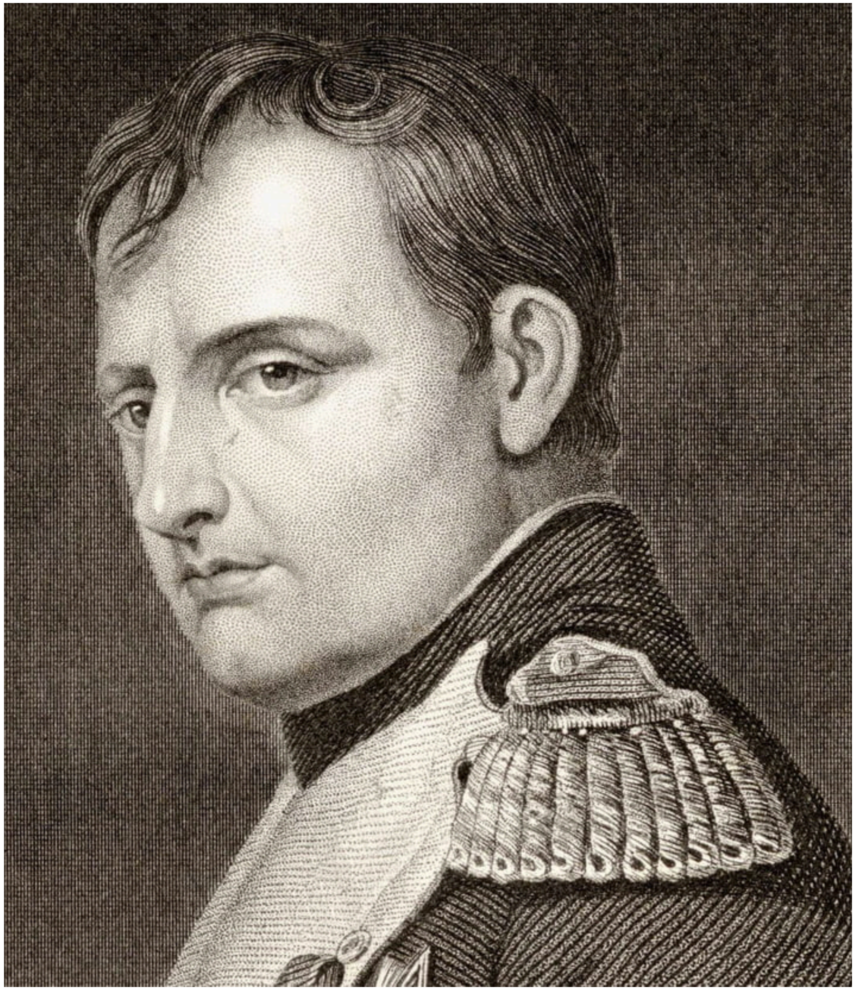
Philippe Petit, WTC New York, 7 août 1974

Dépression: Fin de la modernité (*et du du néolithique*)

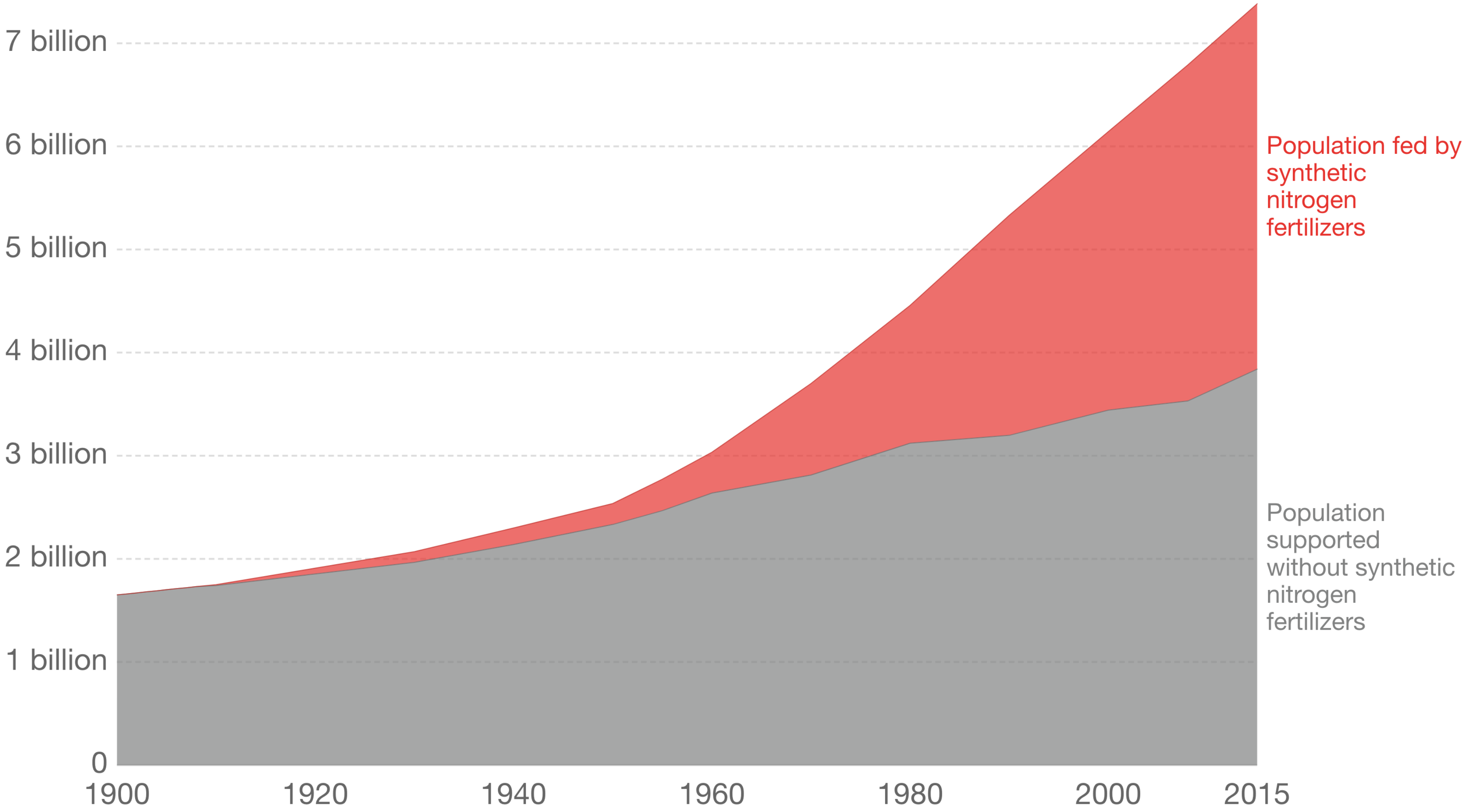


Biosphere (Montreal Expo’67) on fire (1976)

Questionner notre Histoire



Au delà du CO_2, le rôle du nitrate

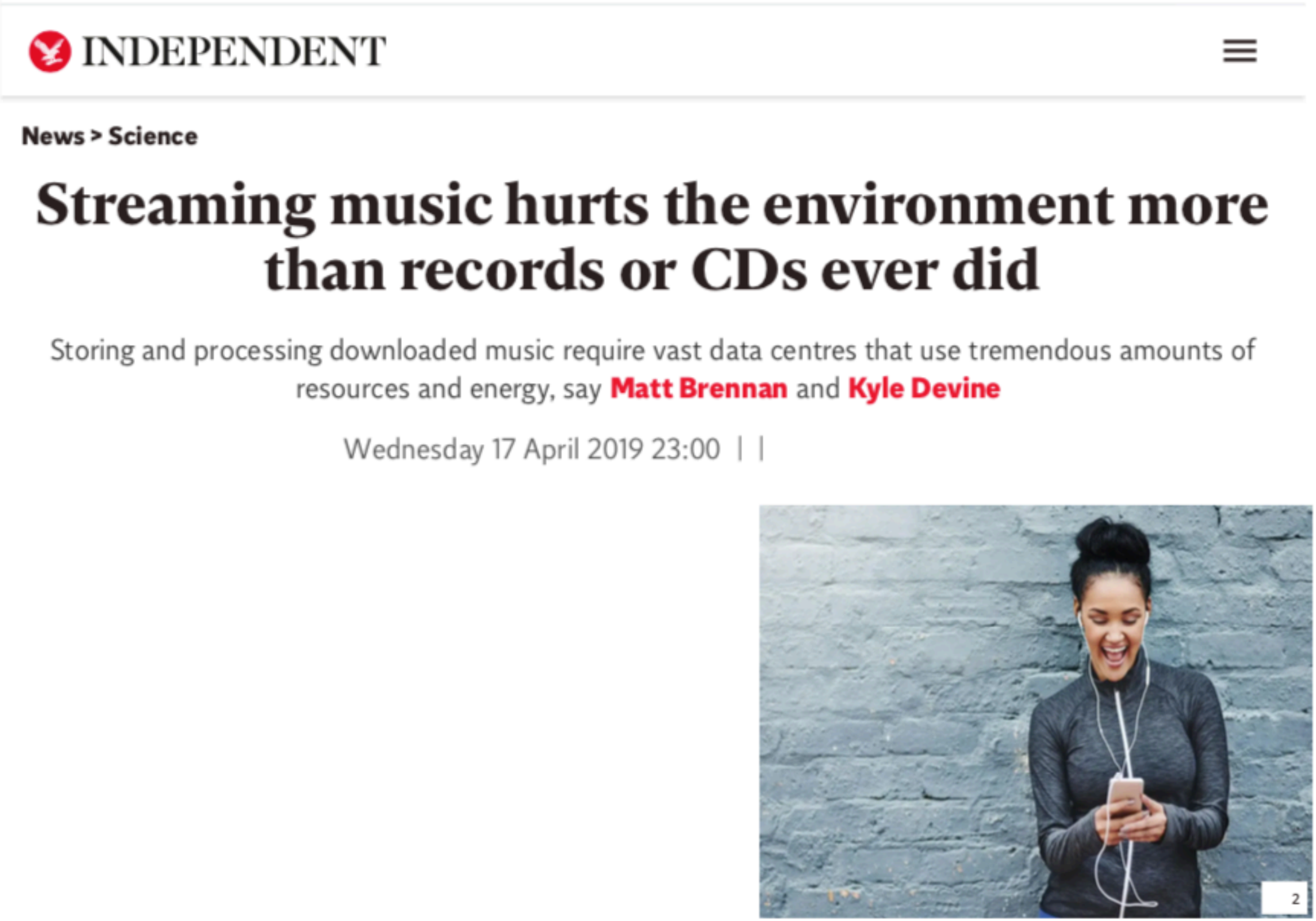


Source: Erisman et al. (2008); Smil (2002); Stewart (2005) OurWorldInData.org/how-many-people-does-synthetic-fertilizer-feed/ • CC BY

Une révolution « verte »?

- Une origine militaire
- Un rendement de savane
- Une culture sur brûlis
- Un déficit énergétique
- Une désertification des sols

Le mythe de la dématérialisation



INDEPENDENT

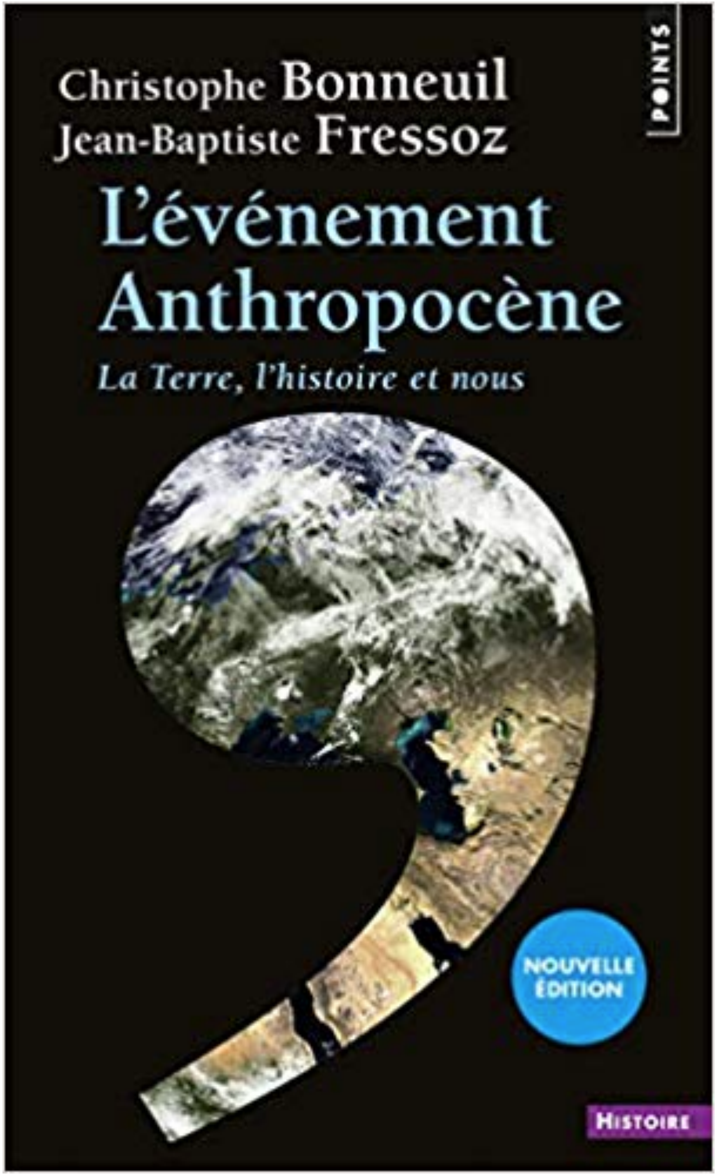
News > Science

Streaming music hurts the environment more than records or CDs ever did

Storing and processing downloaded music require vast data centres that use tremendous amounts of resources and energy, say **Matt Brennan** and **Kyle Devine**

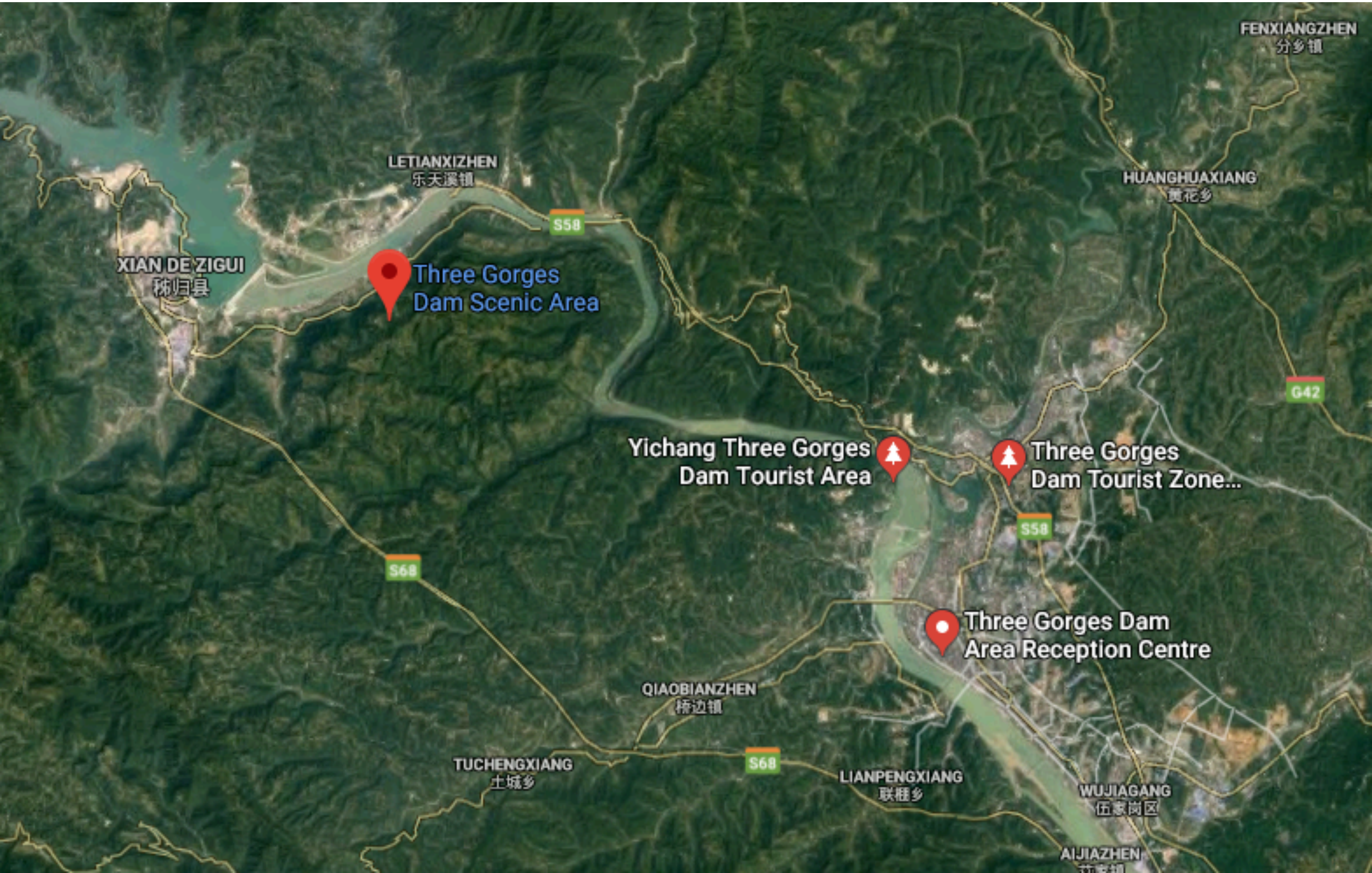
Wednesday 17 April 2019 23:00 | |

Lecture: L'événement anthropocène

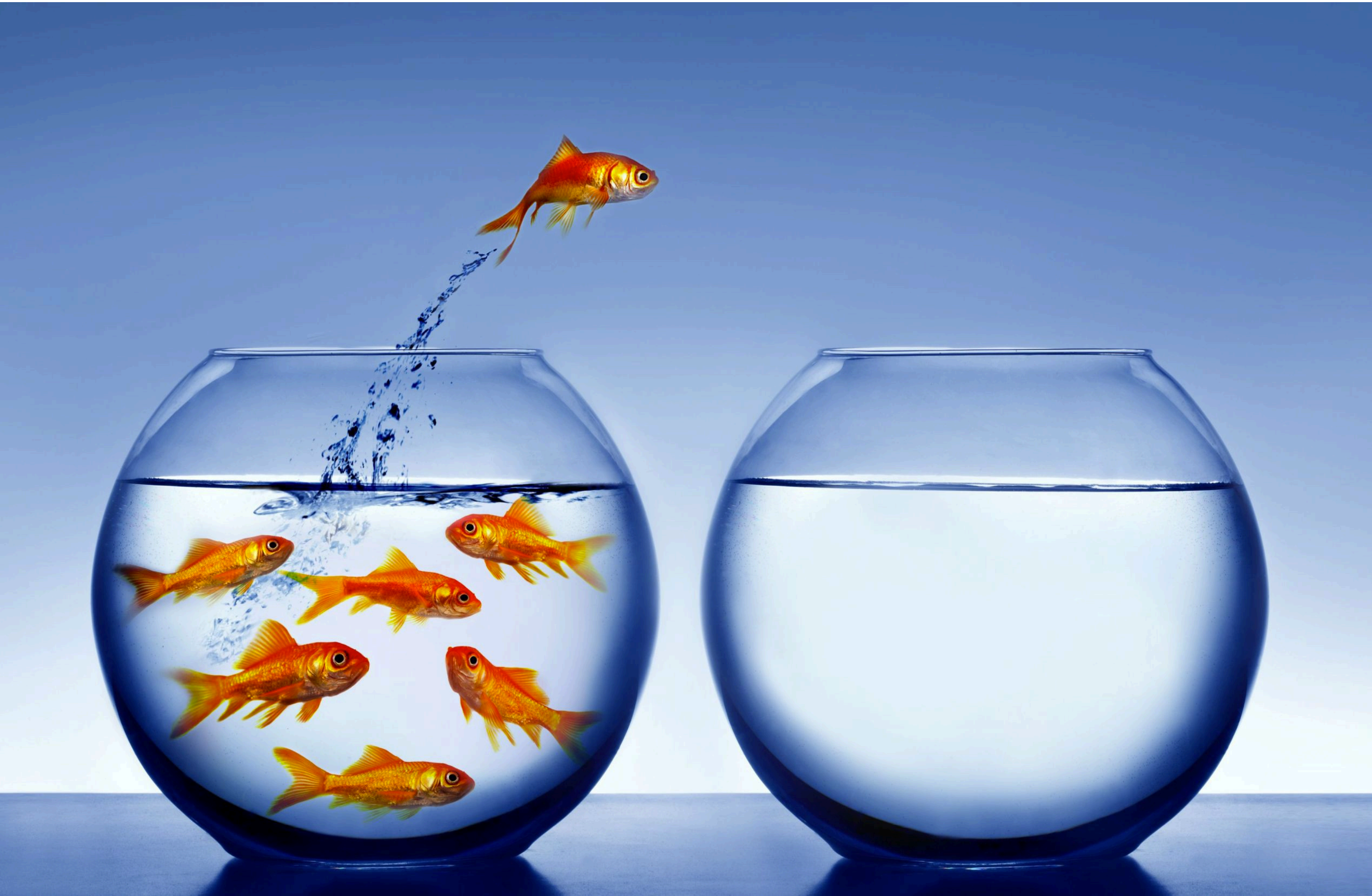

Christophe Bonneuil
Jean-Baptiste Fressoz
L'événement Anthropocène
La Terre, l'histoire et nous
POINTS
NOUVELLE ÉDITION
HISTOIRE

III. Agnotocène:
Pourquoi sommes-nous passifs?

Nous préférons ignorer une menace pour rester serein


FENXIANGZHEN
分乡镇
LETIANXIZHEN
乐天溪镇
HUANGHUAXIANG
黄花乡
S58
XIAN DE ZIGUI
秭归县
Three Gorges
Dam Scenic Area
G42
Yichang Three Gorges
Dam Tourist Area
Three Gorges
Dam Tourist Zone...
S58
S68
Three Gorges Dam
Area Reception Centre
QIAOBIANZHEN
桥边镇
TUCHENGXIANG
土城乡
S68
LIANPENGXIANG
联棚乡
WUJIAGANG
伍家岗区
AIJIAZHEN

Nous sommes plutôt conservateurs



Notre favorisons le court terme

(SCREAMING)
(BRAKES SCREECHING)

Nous comprenons mal les probabilités

Nous n’avons pas une pensée systémique

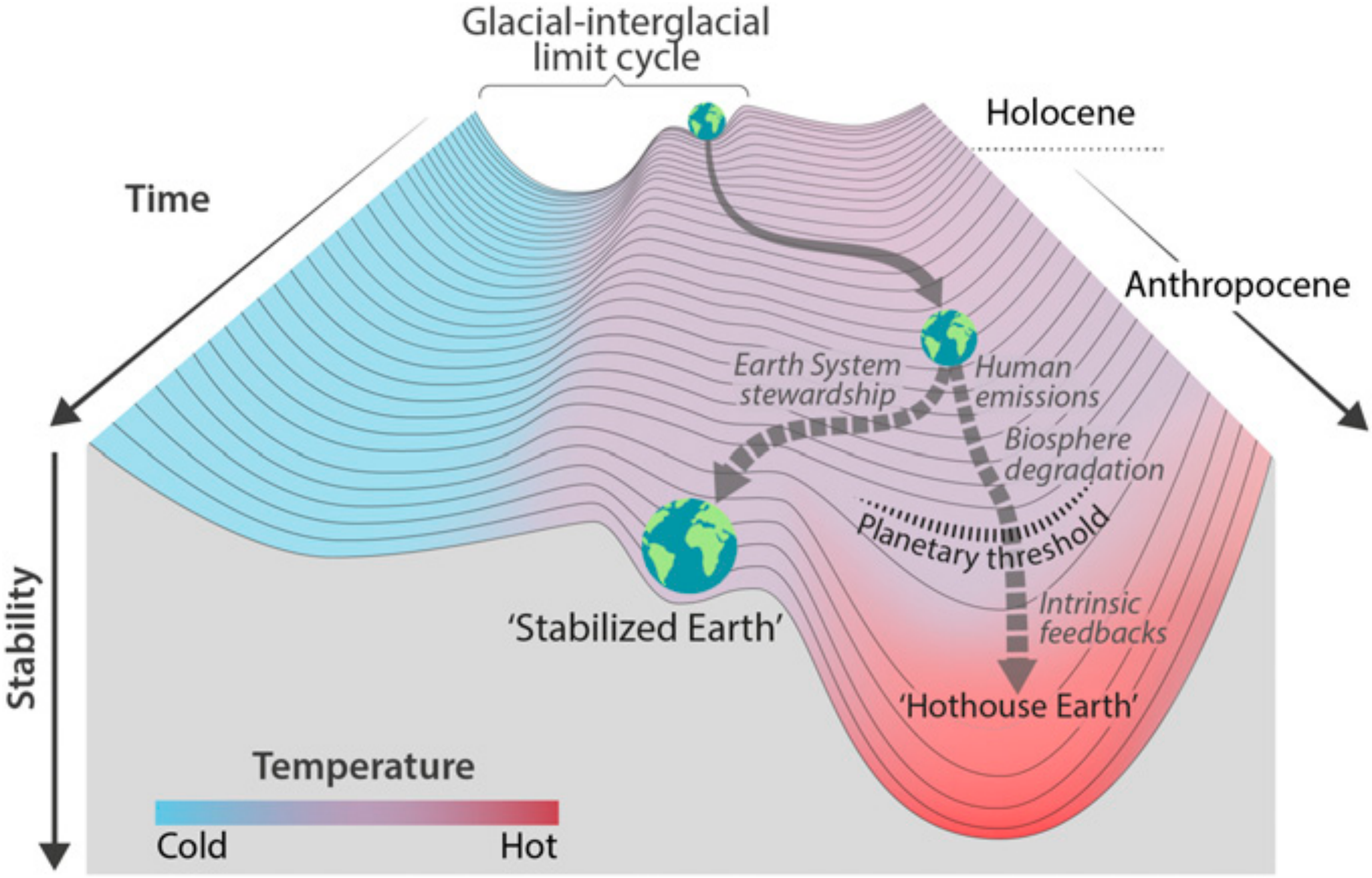
Exemple: le point de bascule

Nous n’avons pas une pensée systémique

Exemple: l’effet rebond

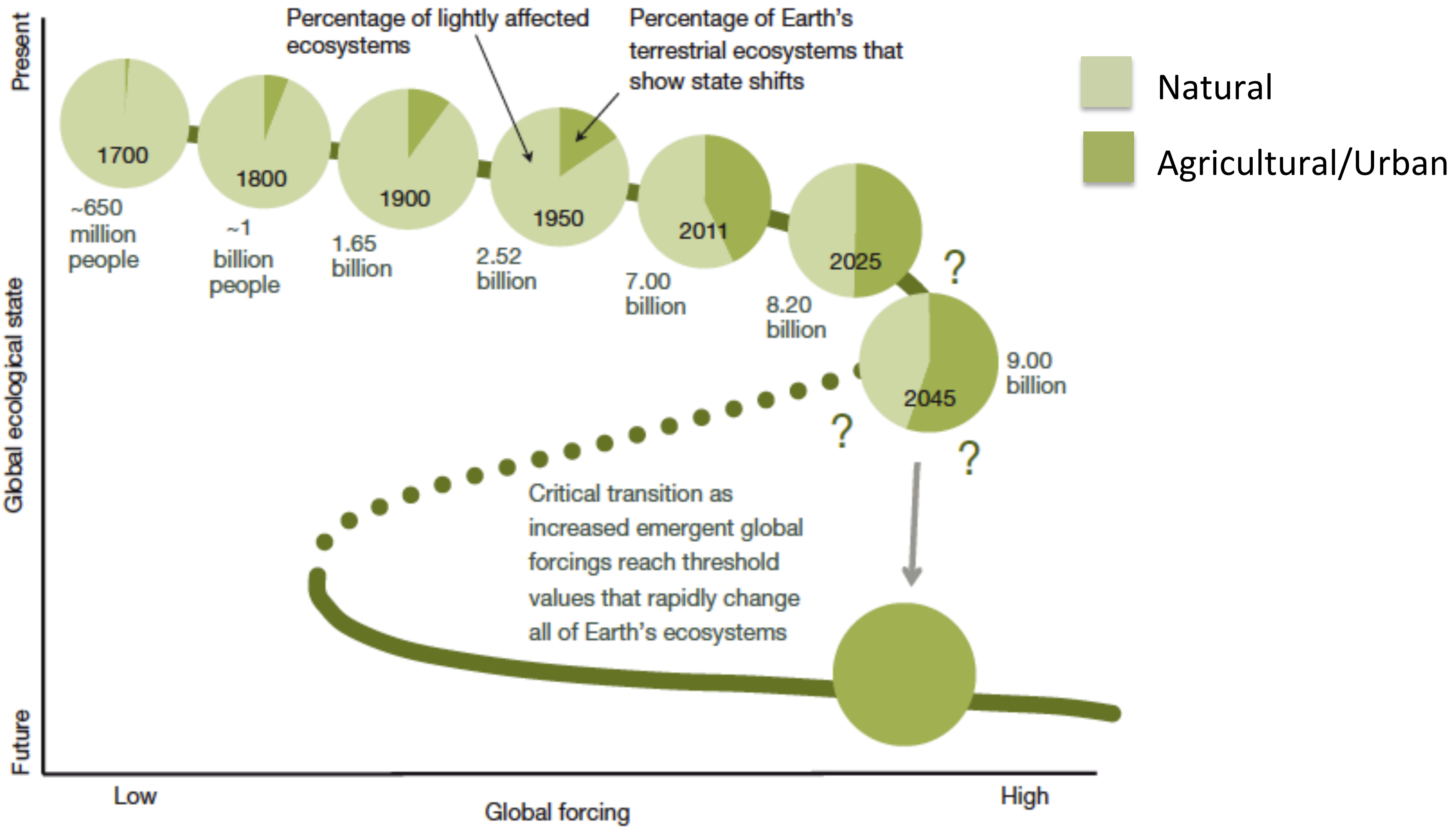
Paradoxe de Braess:
Cathy freeway, Houston, USA

Nous n’avons pas une pensée systémique
Exemple: les effets non linéaires


Glacial-interglacial limit cycle
Holocene
Time
Anthropocene
Earth System stewardship
Human emissions
Biosphere degradation
Planetary threshold
Intrinsic feedbacks
‘Stabilized Earth’
‘Hothouse Earth’
Stability
Temperature
Cold
Hot

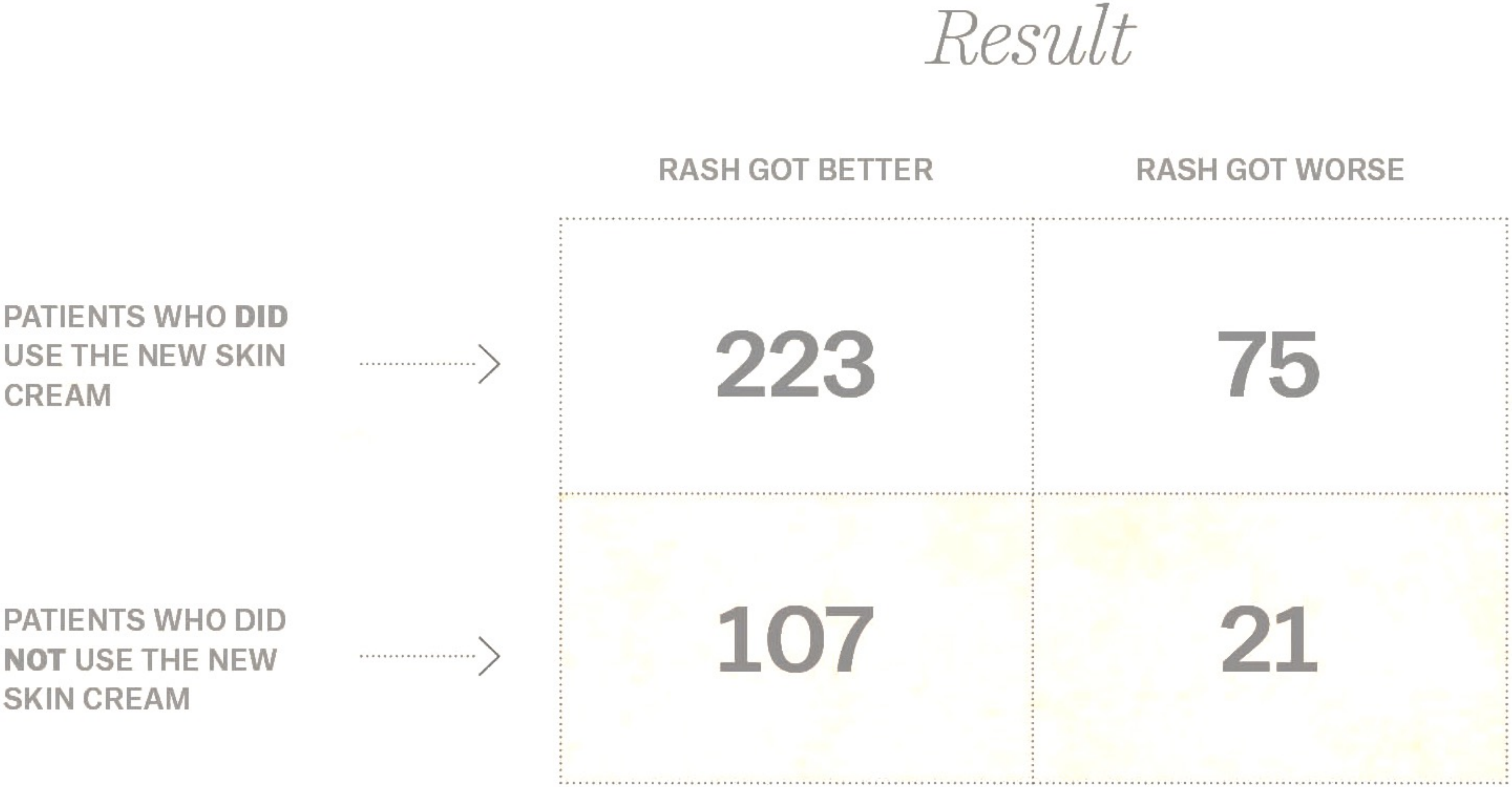
Steffen *et al.*, 2018

Nous n’avons pas une pensée systémique
Exemple: les effets non linéaires



Barnosky *et al.*, 2012

L’éducation renforce les biais idéologiques



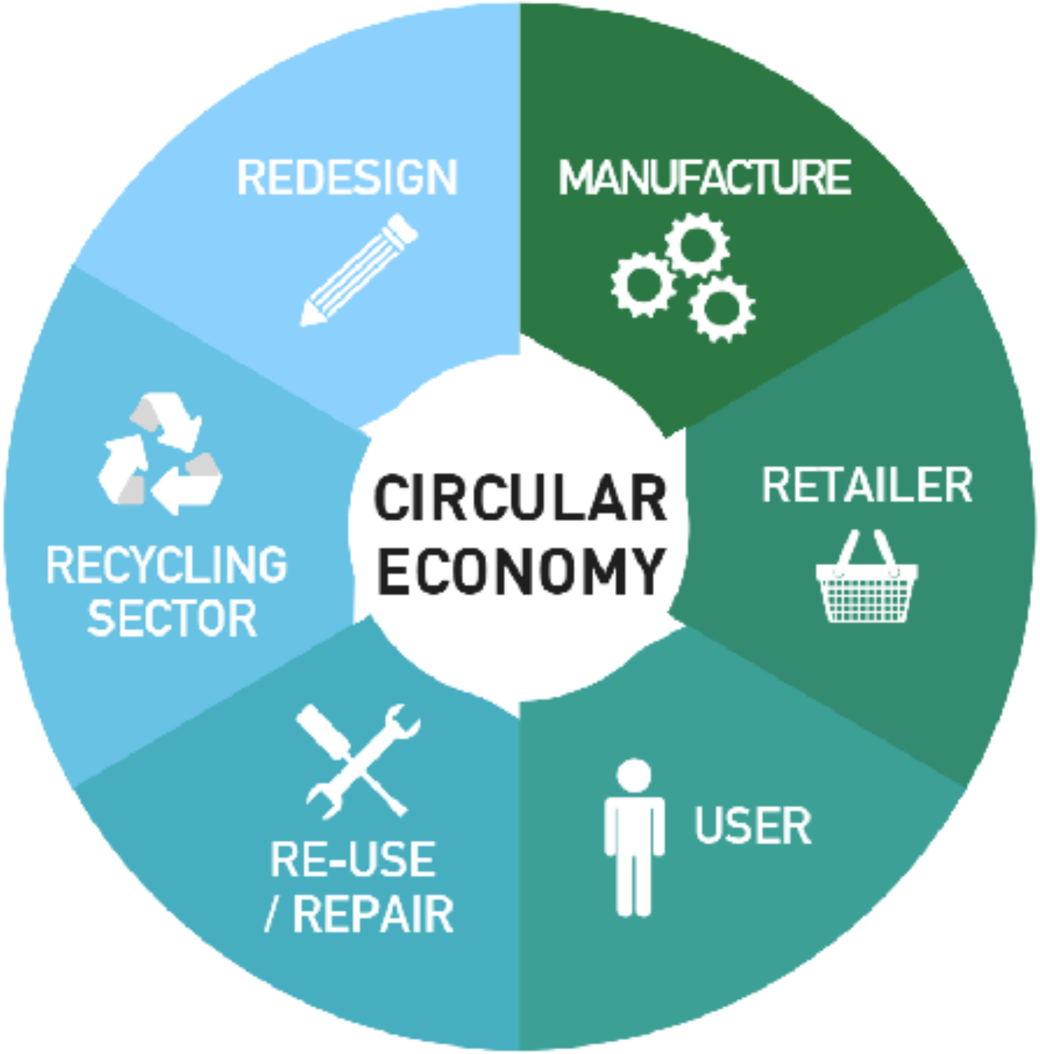
Result

	RASH GOT BETTER	RASH GOT WORSE
PATIENTS WHO **DID** USE THE NEW SKIN CREAM →	223	75
PATIENTS WHO DID **NOT** USE THE NEW SKIN CREAM →	107	21

Kahan *et al.*, 2013

IV. Gaïacène:
Actions?

Se reconnecter au monde physique

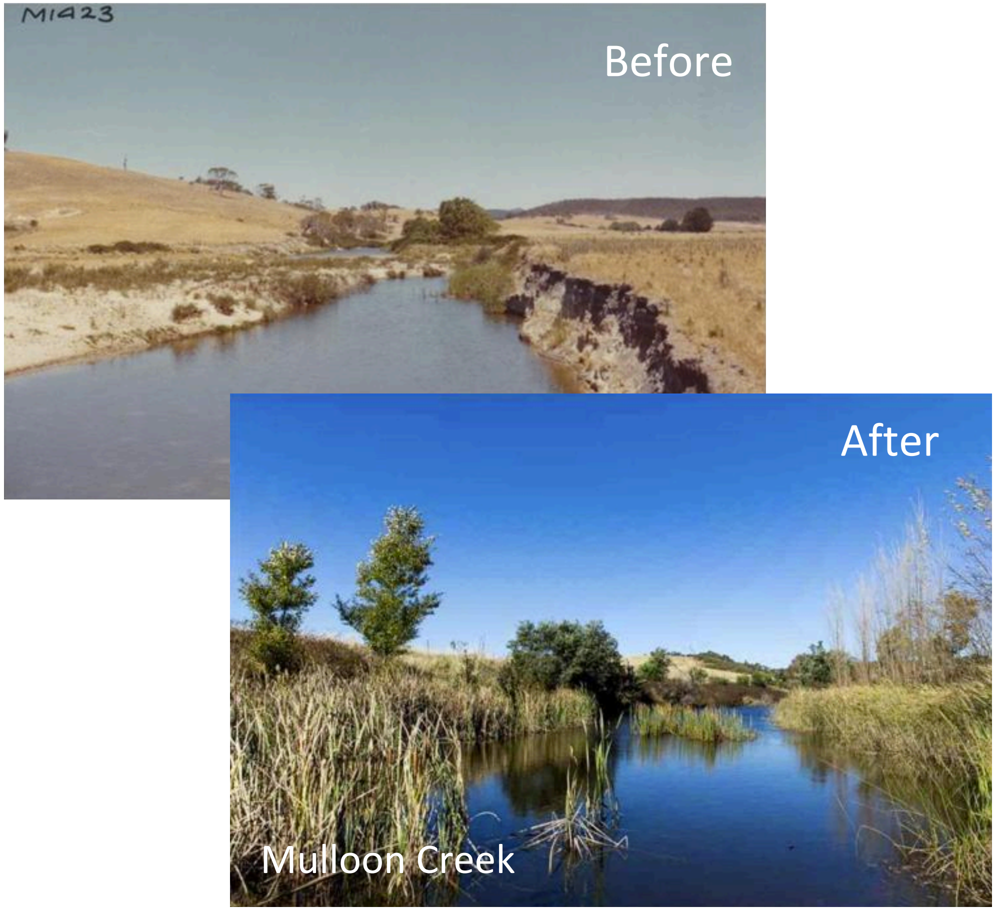

CIRCULAR ECONOMY
REDESIGN
MANUFACTURE
RETAILER
USER
RE-USE / REPAIR
RECYCLING SECTOR

(re)devenir Terrien

Biosphere II

Le rôle central des plantes à l’avenir

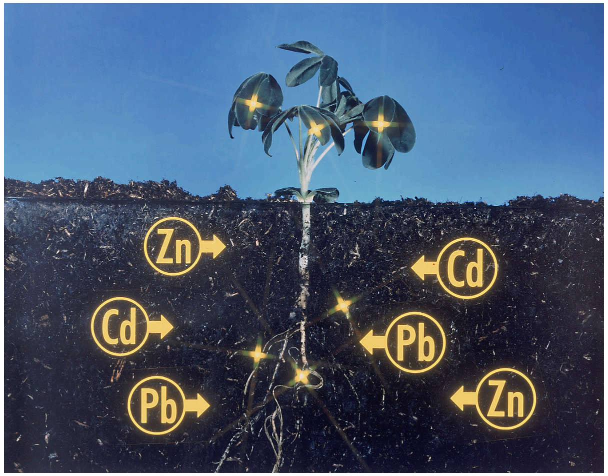
Céréales
pérennes


M1423
Before
After
Mulloon Creek

« Natural sequence farming »

Le rôle central des plantes à l'avenir

econick


Zn
Cd
Cd
Pb
Pb
Zn

Agromining
& phytorémédiation
& phytates

Biomatériaux

Numérique
« vert »

Frugalité/décroissance: « Moins mais mieux » ?

Une société de la croissance fondée sur des pénuries réelles ou artificielles

VERS

Une société de la sobriété fondée sur l’abondance des interactions

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Inverser les paradigmes ?

Utiliser la matière pour gagner du temps

VERS

Utiliser le temps pour préserver la matière

Inverser les paradigmes ?

Exploiter les écosystèmes
pour augmenter la production

VERS

Comment la production contribue
aux services écosystémiques

Inverser les paradigmes ?

Améliorer la performance

VERS

Améliorer la résilience

Katrina vs. Sandy

Pensée systémique: sous-optimalité ?

Construire la croissance sur l’optimisation des procédés

VERS

Construire l’adaptabilité sur les faiblesses des systèmes

Visite des Kogis
dans la Biovallée

Fondation Michel Serres

- Santé commune
- Capital naturel
- Dérèglement physicochimique
- Autonomie des territoires

Anthropocene curriculum

Anthropocene Curriculum| Campus 2016

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Complex Systems Institute
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