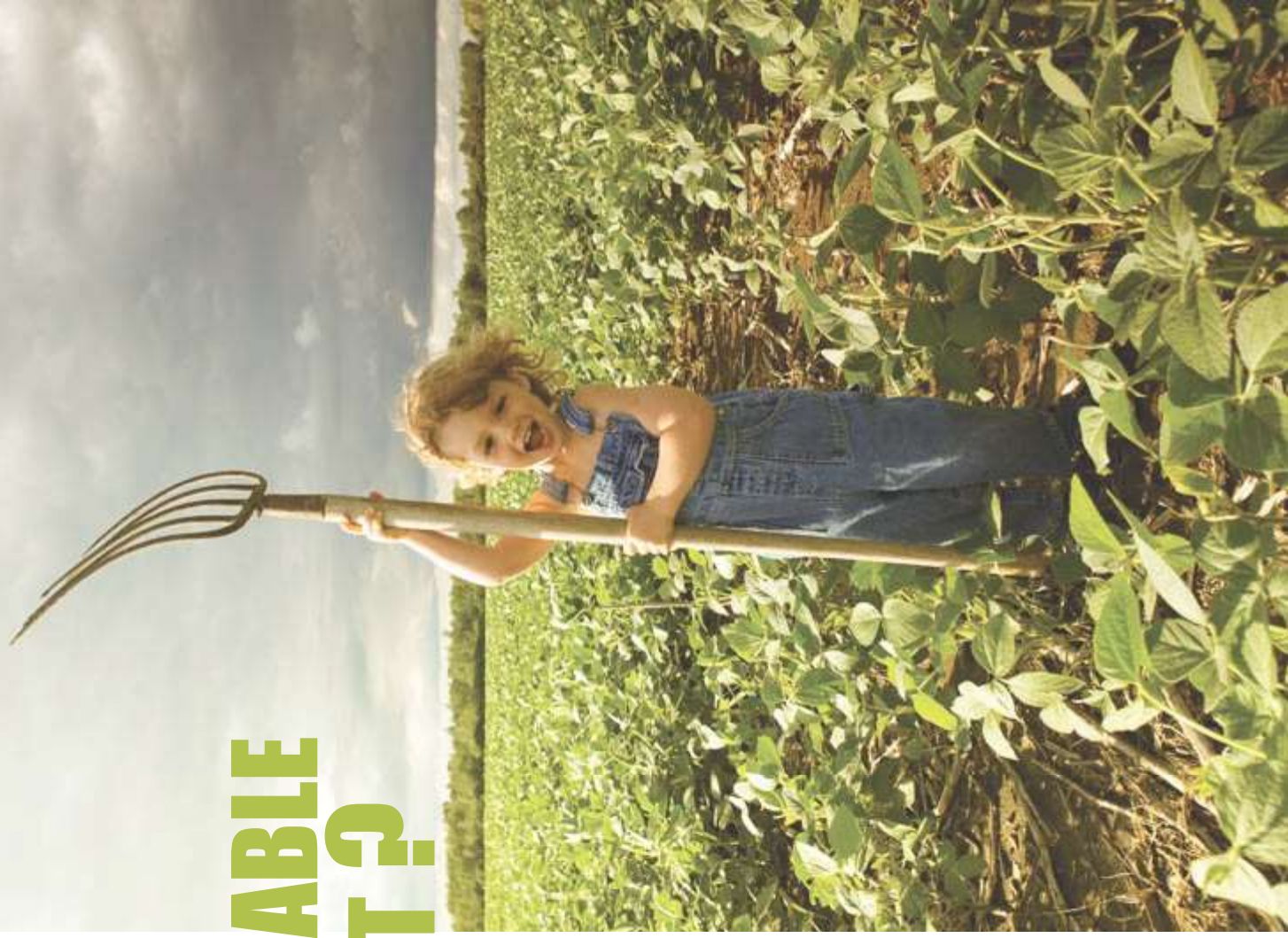


17 octobre 2018

GEMBLoux

DÉVELOPPEMENT DURABLE ET/OU EFFONDREMENT ?

PABLO SERVIGNE





Peter Menzel « Hungry Planet »

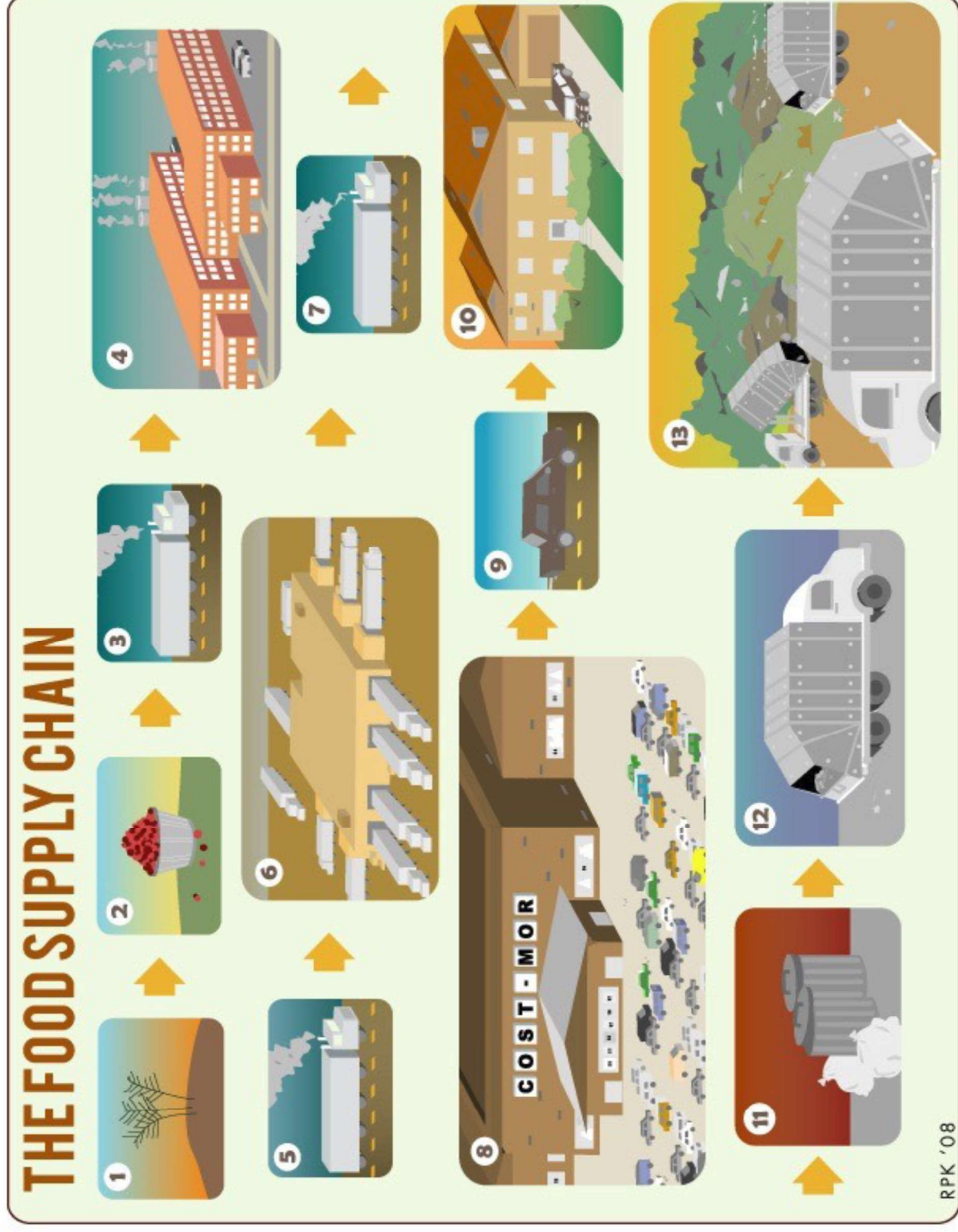


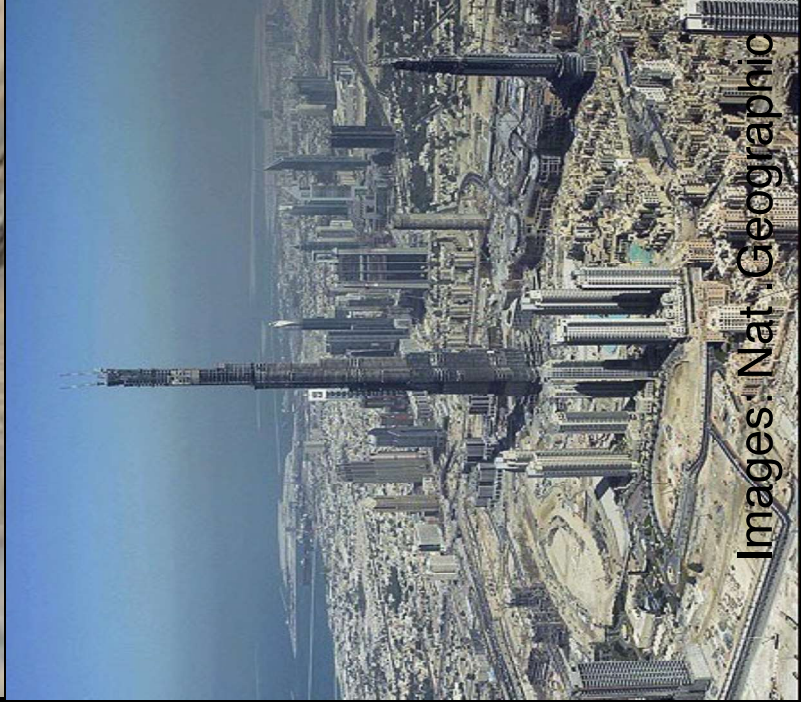
Peter Menzel « Hungry Planet »

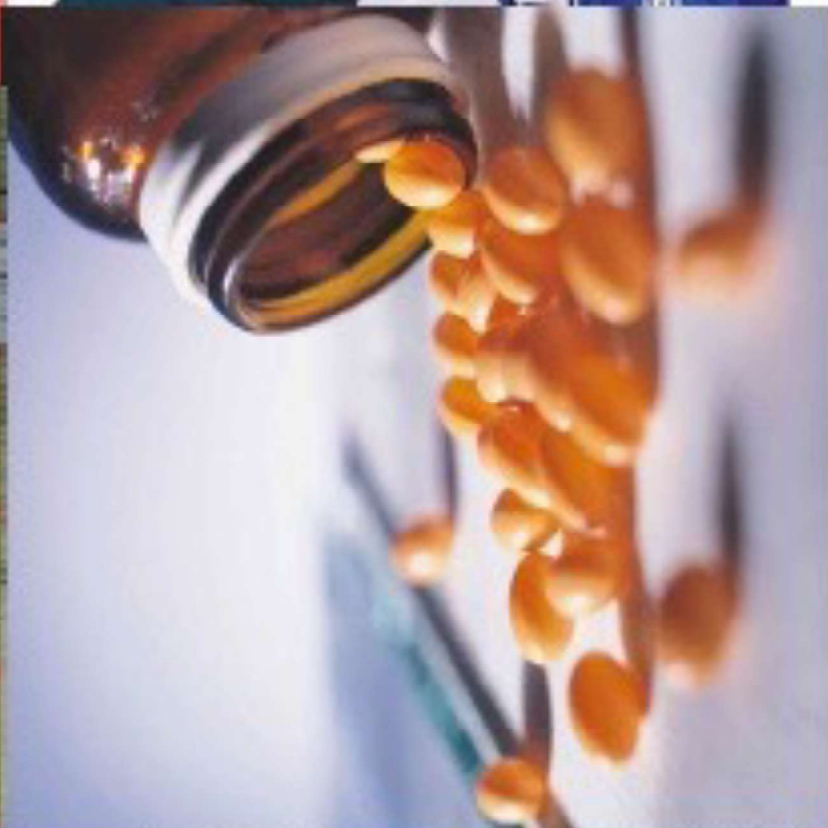


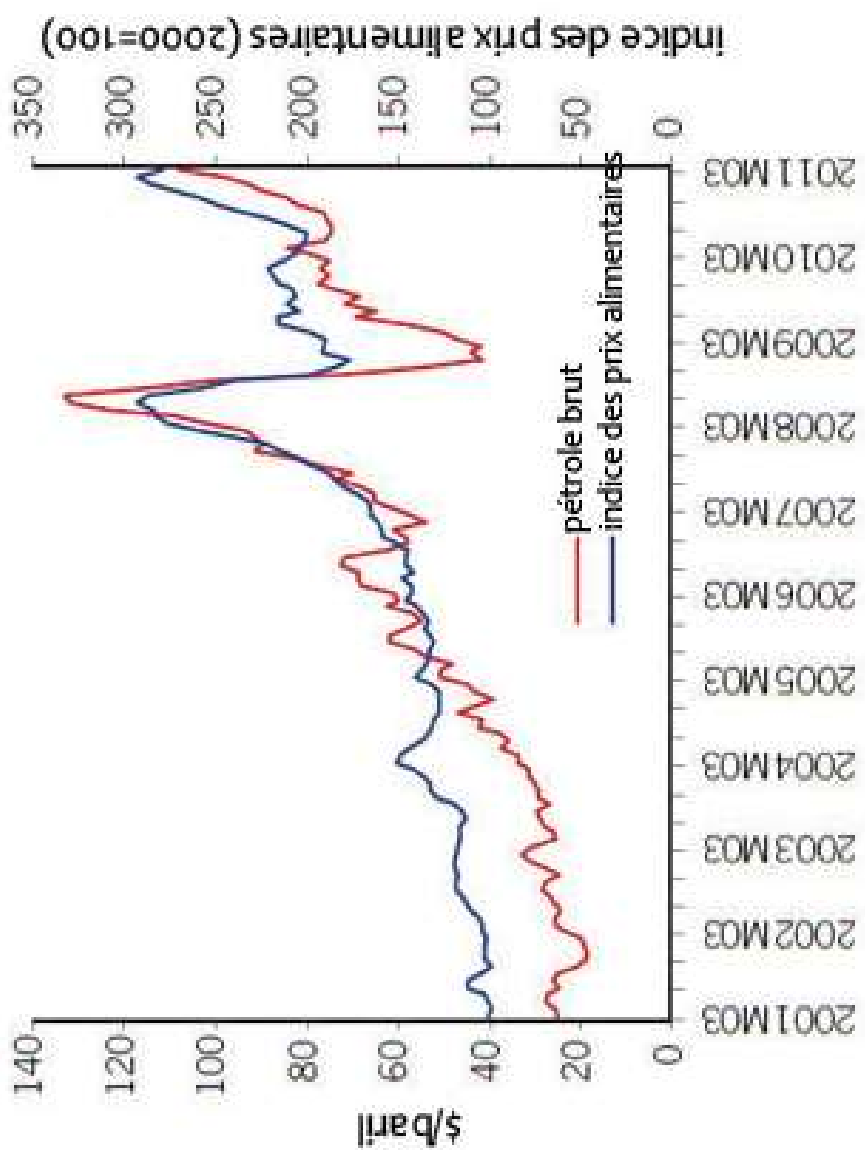


Le système alimentaire industriel



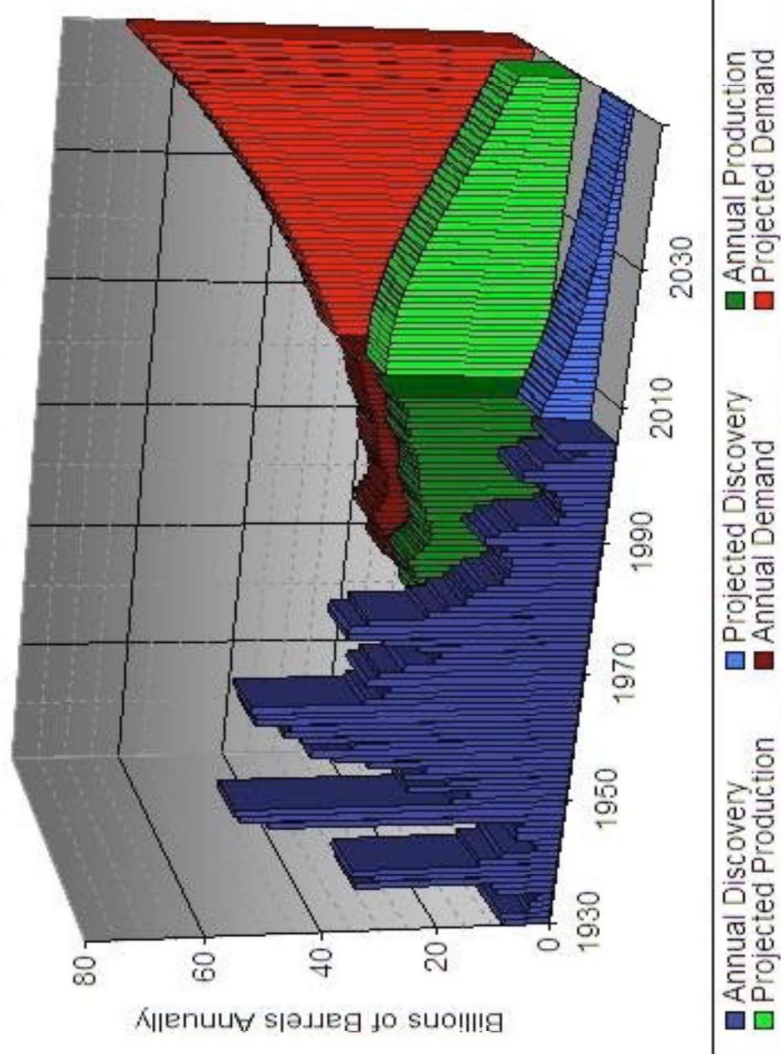






Peak oil

World Overview (Discovery, Production and Demand)



Taux de retour énergétique

- 1900 : un baril permet d'extraire 100 barils
- 1990 : un baril permet d'extraire 35 barils
- 2007 : un baril permet d'extraire 12 barils

EROEI

L'extinction du moteur : la question des limites

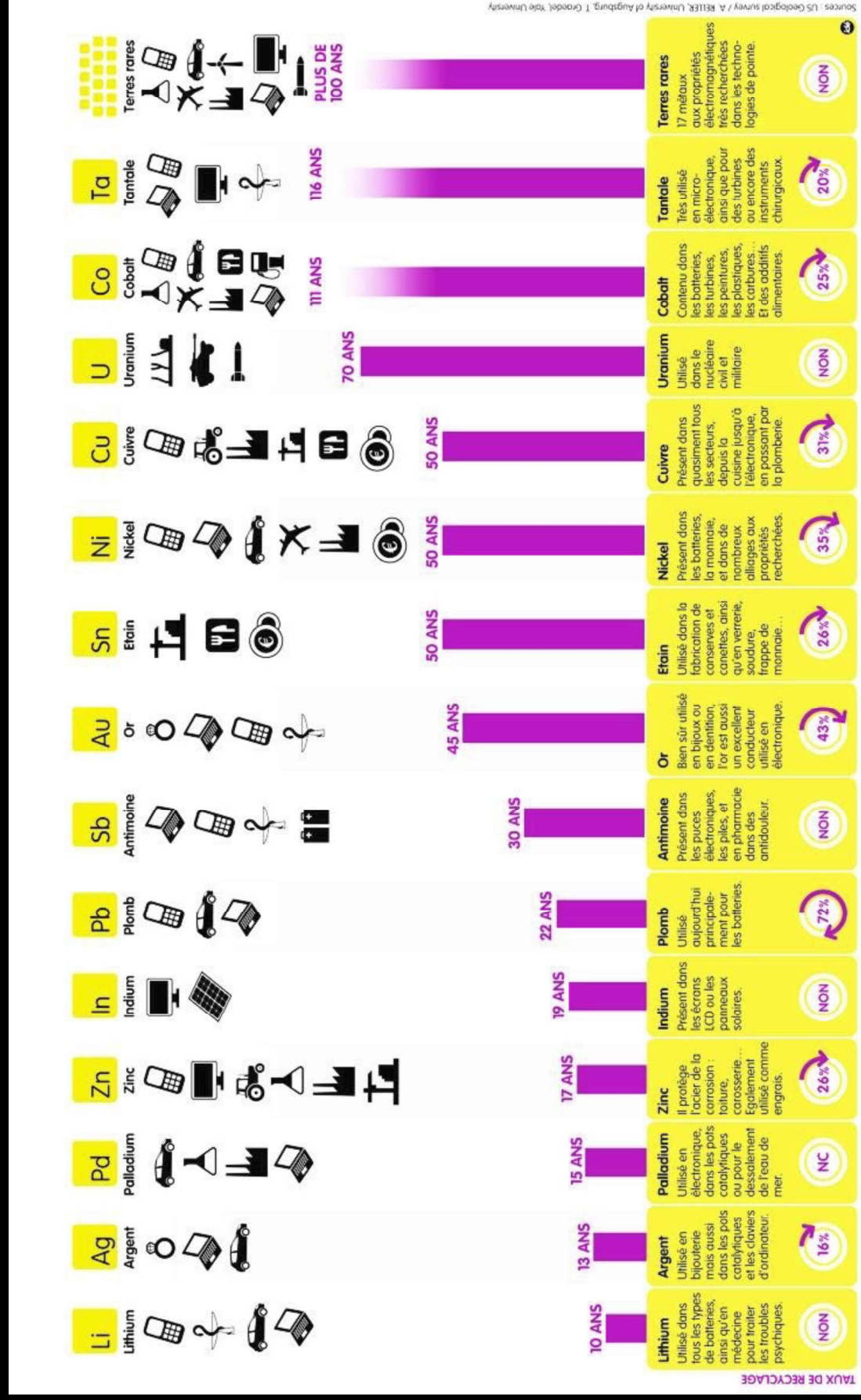
Approvisionnement
en énergie



Système
financier

Autres “limites”

sable, phosphore, métaux, minerais...



Data: USGS - Yale University

Pour atteindre la puissance des énergies fossiles, la construction de fermes solaires et d'éoliennes pour la remplacer nécessitera la production de

- 15x plus de béton
- 90x plus d'aluminium et
- 50x plus de fer, de cuivre et de verre.

VIDAL, Olivier, GOFFÉ, Bruno et ARNDT, Nicholas. Metals for a low-carbon society. *Nature Geoscience*. 2013. Vol. 6, n° 11, pp. 894-896. (Univ. Grenoble et Aix-Marseille)

Pour 50% de probabilité de réussir à contenir le réchauffement en dessous de 2°C, il nous faudrait avoir construit pour 2028 (soit en 10 ans)

- 40x plus d'éoliennes de 5 MW
- 26x plus de km² de PV
- 15x plus de km² de serres à algues

JONES, Glenn A. et WARNER, Kevin J. The 21st century population-energy-climate nexus. *Energy Policy*. 2016. Vol. 93, pp. 206-212.

**SYSTÈMES
ALIMENTAIRES
DÉPENDANTS
DU PÉTROLE**

+

FIN DU PÉTROLE

=

**FIN DE NOS
SYSTÈMES
ALIMENTAIRES**

PABLO SERVIGNE

NOURRIR L'EUROPE EN TEMPS DE CRISE

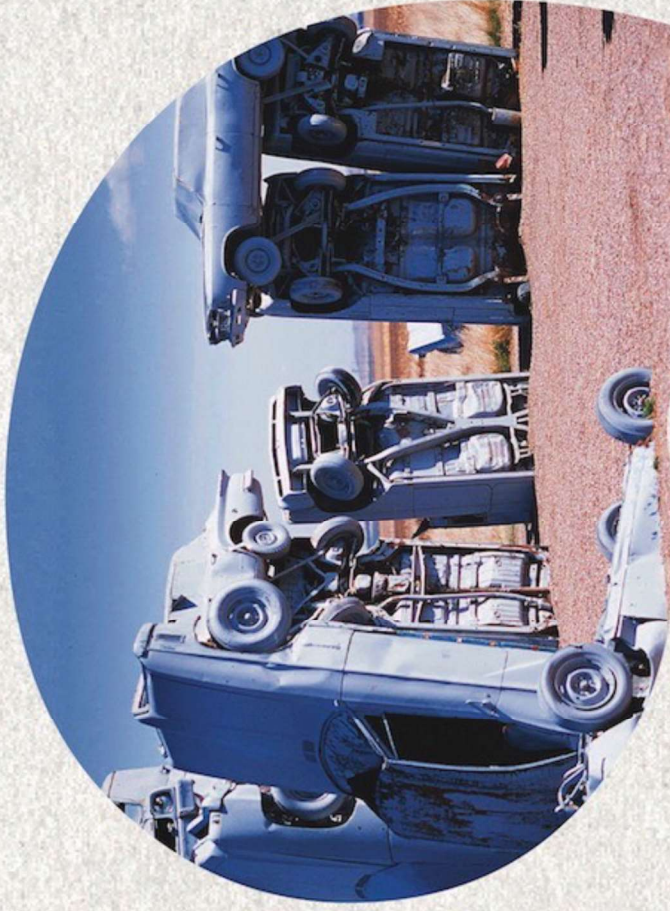
VERS DES SYSTÈMES
ALIMENTAIRES RÉSILIENTS



COMMENT TOUT PEUT S'EFFONDRE

Pablo Servigne
Raphaël Stevens

Petit manuel de collapsologie à l'usage des générations présentes





La grande accélération



SOURCE: igbp.net | Steffen et al., 2005, Global Change and the Earth System, Springer, pp. 132-133
DESIGN: Globalia.org

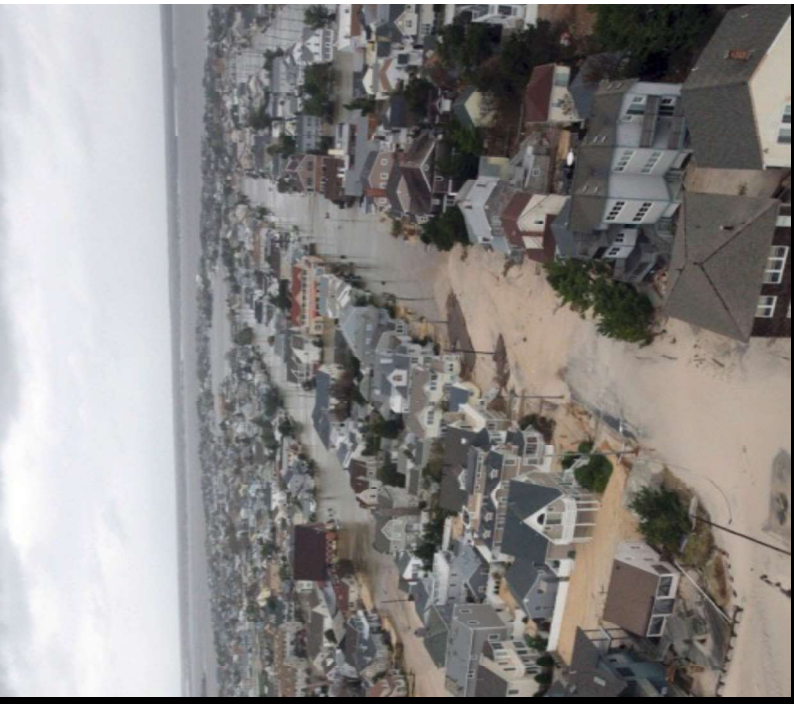
ANTHROPOCENE



La biodiversité disparaît...

99% of Rhinos gone since 1914.
97% of Tigers gone since 1914.
90% of Lions gone since 1993.
90% of Sea Turtles gone since 1980.
90% of Monarch Butterflies gone since 1995.
90% of Big Ocean Fish gone since 1950.
80% of Antarctic Krill gone since 1975.
80% of Western Gorillas gone since 1955.
60% of Forest Elephants gone since 1970.
50% of Great Barrier Reef gone since 1985.
40% of Giraffes gone since 2000.
30% of Marine Birds gone since 1995.
70% of Marine Birds gone since 1950.
28% of Land Animals gone since 1970.
28% of All Marine Animals gone since 1970.
97% – Humans & Livestock are 97% of land-air vertebrate biomass. 10,000 years ago we were 0.01% of land-air vertebrate biomass





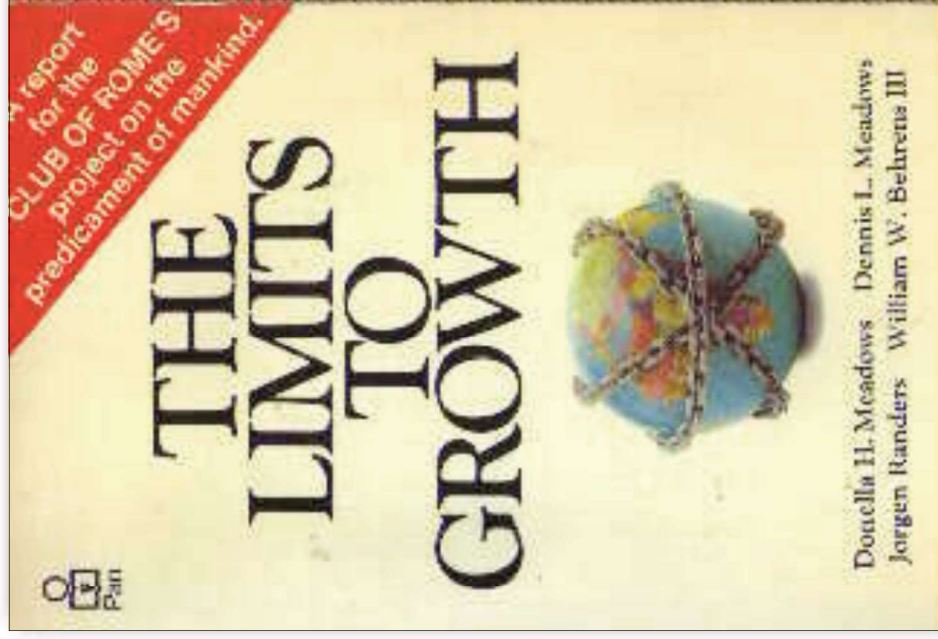
Verrouillages

- Systémique
 - **Sociotechnique** (Infrastructures, énergie fossile, agriculture...)
 - **Institutionnel/politique** (affectation des fonds publics pour les alternatives, clivage gauche vs droite, ...)
 - **Monétaire** (argent-dette et impératif de croissance)
- Individuel et collectif
 - **Cognitif** (habitation, perception du danger, ...)
 - **Comportemental** (habitudes de consommation)
 - **Déni**
 - **Valeurs, imaginaire, vision du monde**
 - **Marchands de doute**



Penser la transdisciplinarité et la complexité





1972



2004

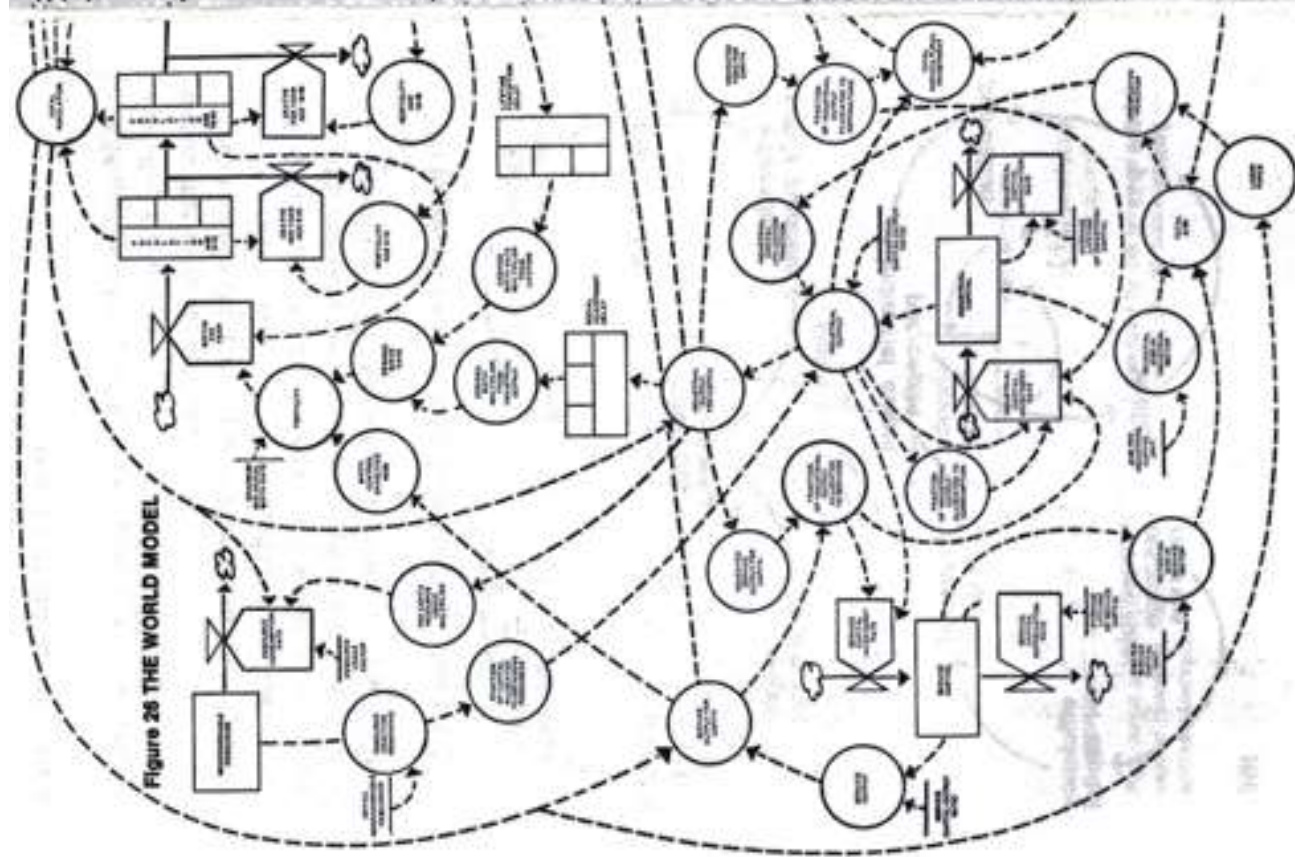
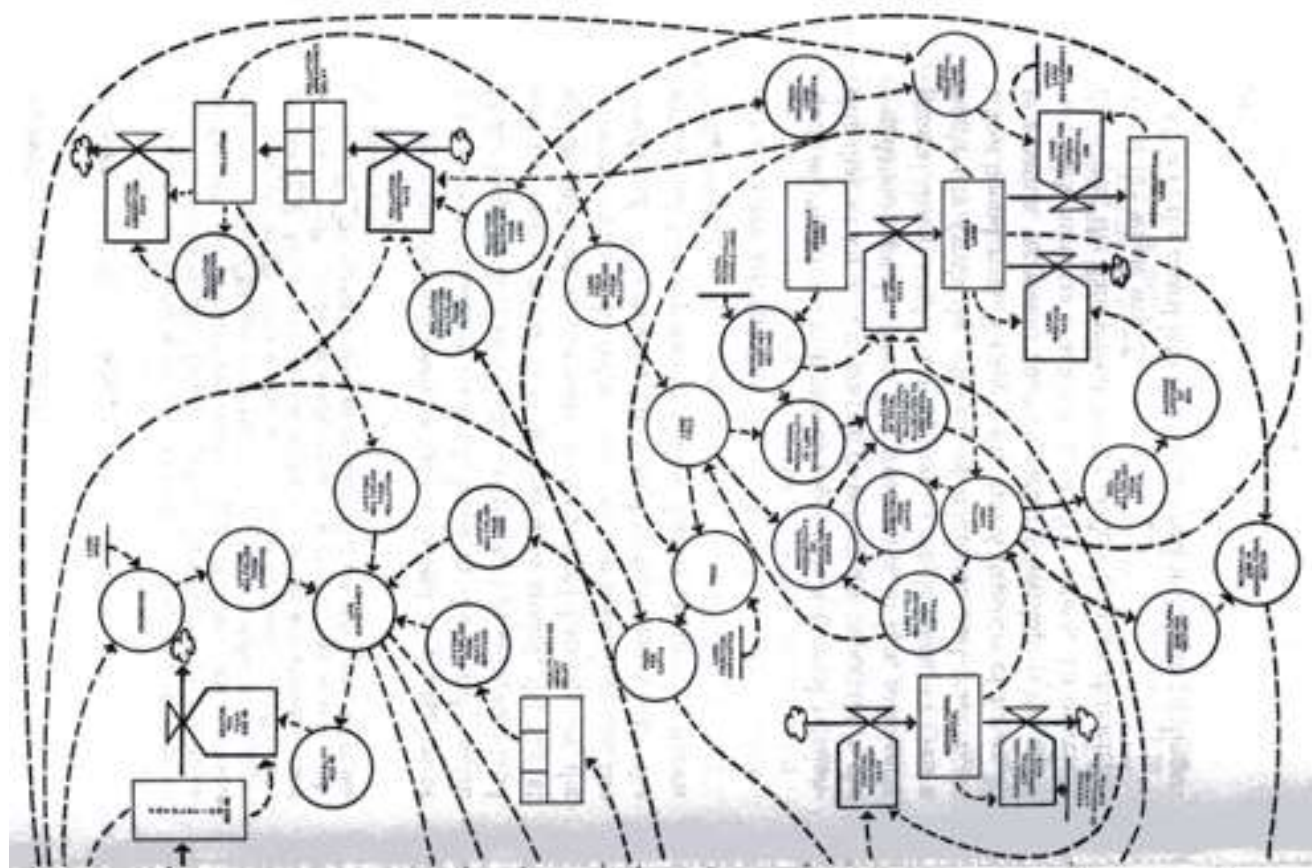


Figure 26 THE WORLD MODEL

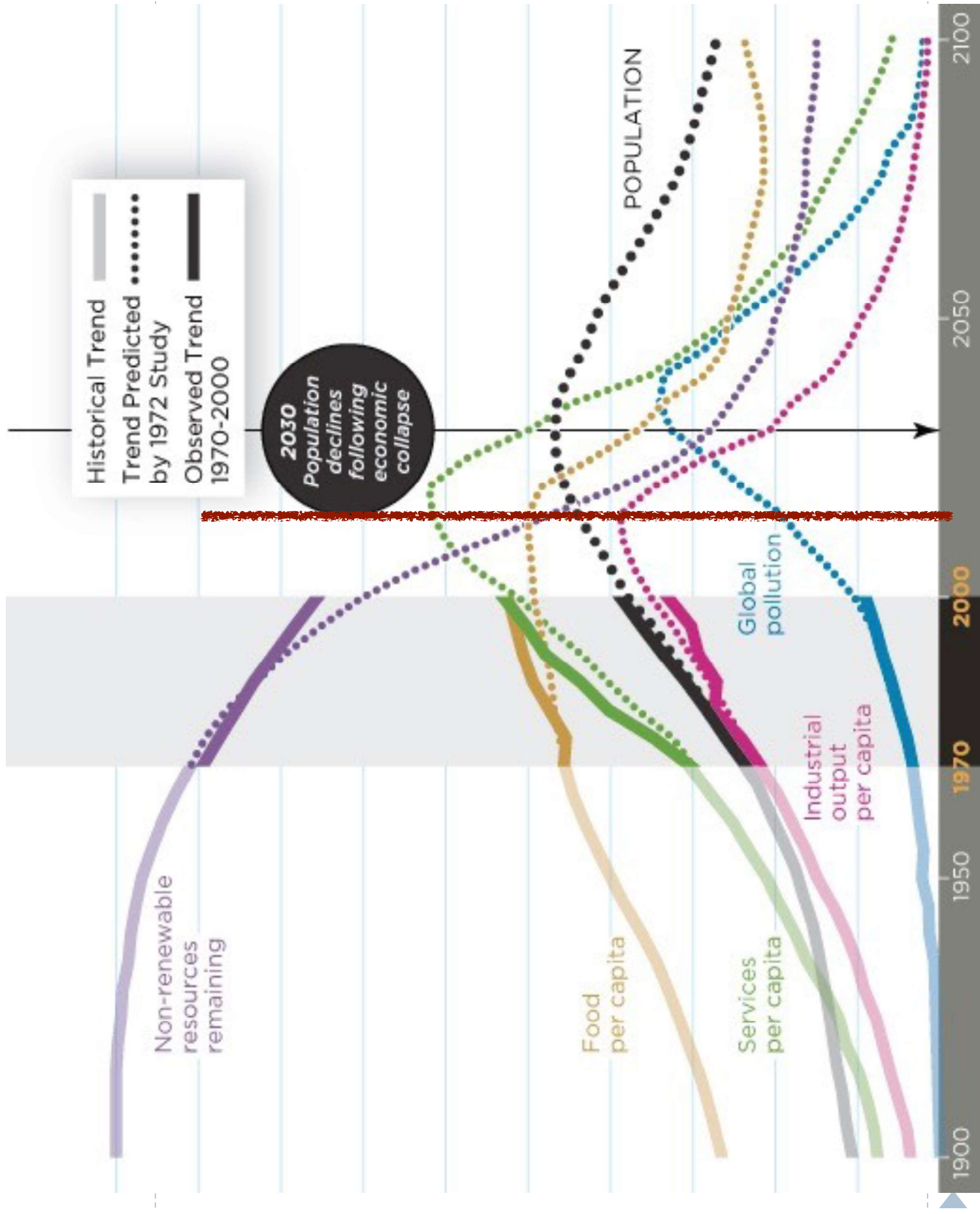
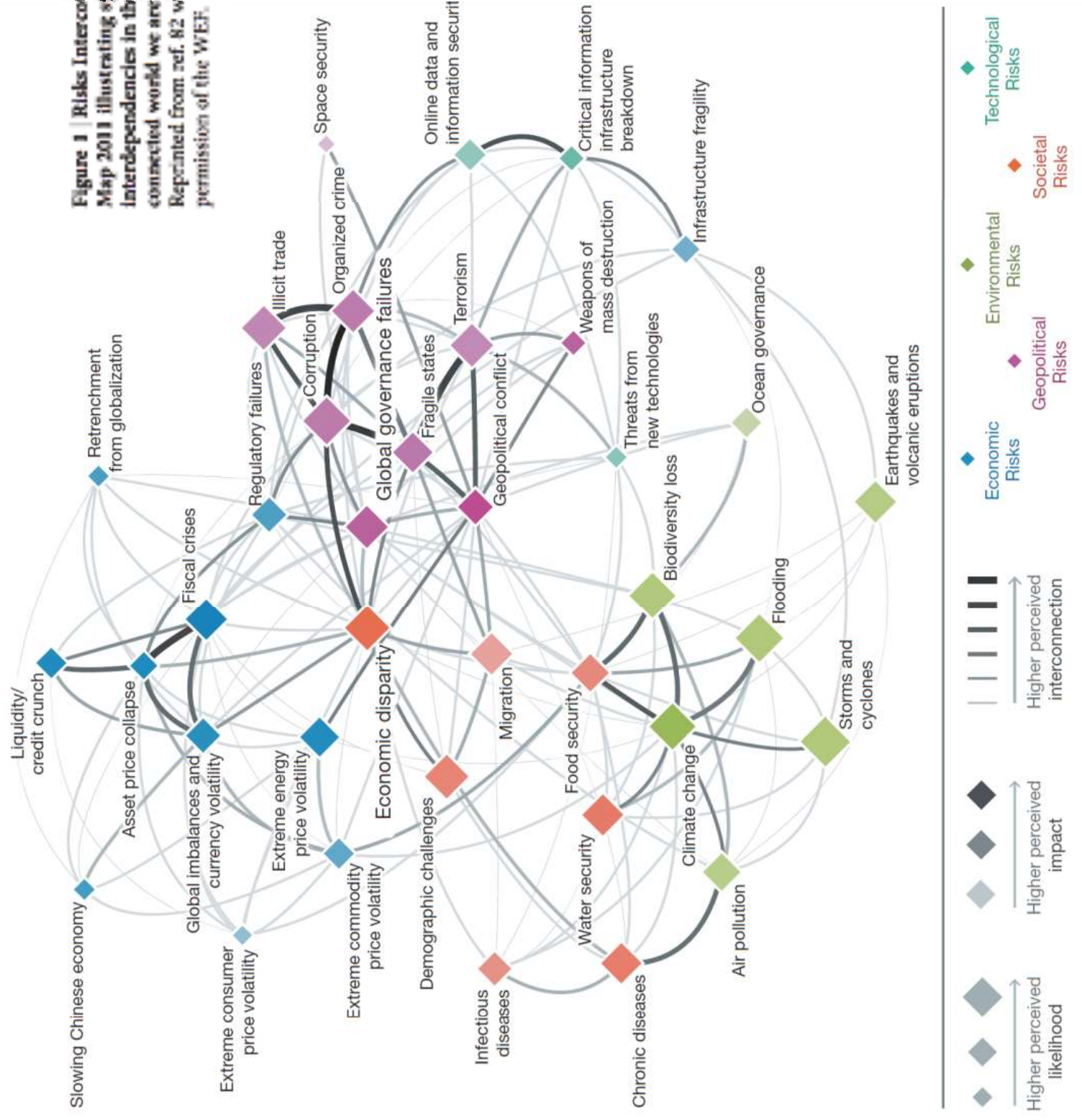
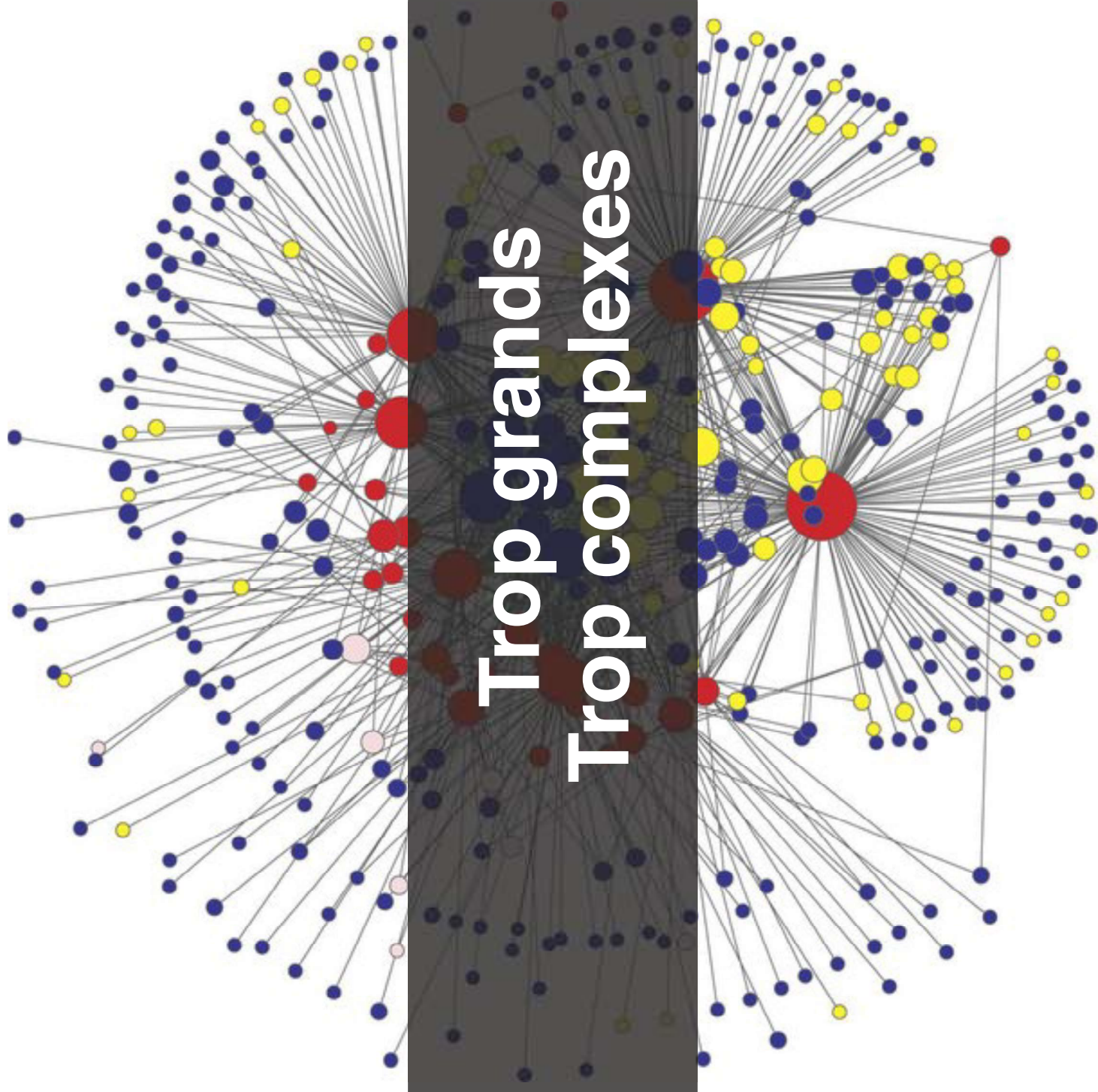
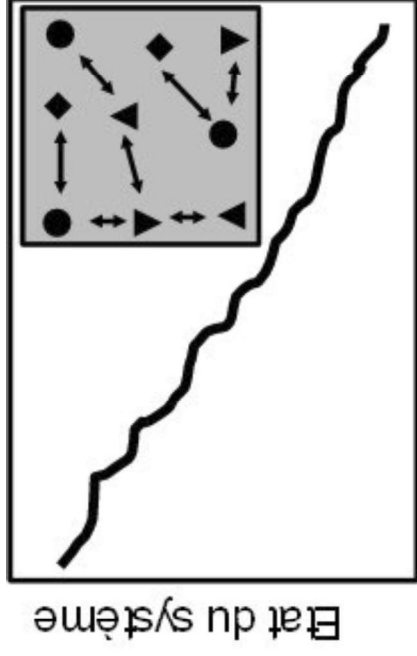


Figure 1 | Risks Interconnection
Map 2011 illustrating systemic interdependencies in the hyper-connected world we are living in. Reprinted from ref. 82 with permission of the WEF.





Réponses types des réseaux complexes aux perturbations

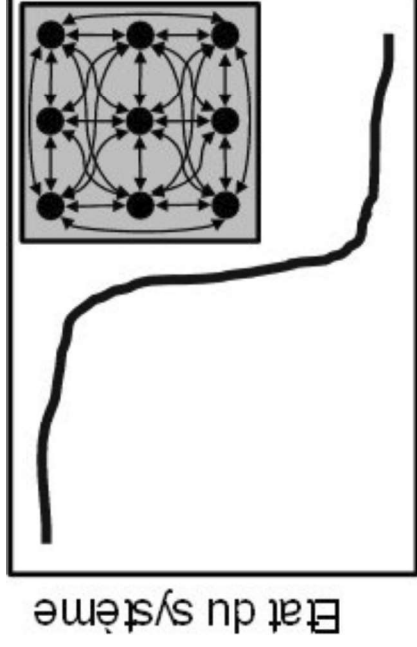


Contrainte

Modularité
+
Hétérogénéité



Capacité
adaptative
+
Pertes locales
+
Changement
graduel

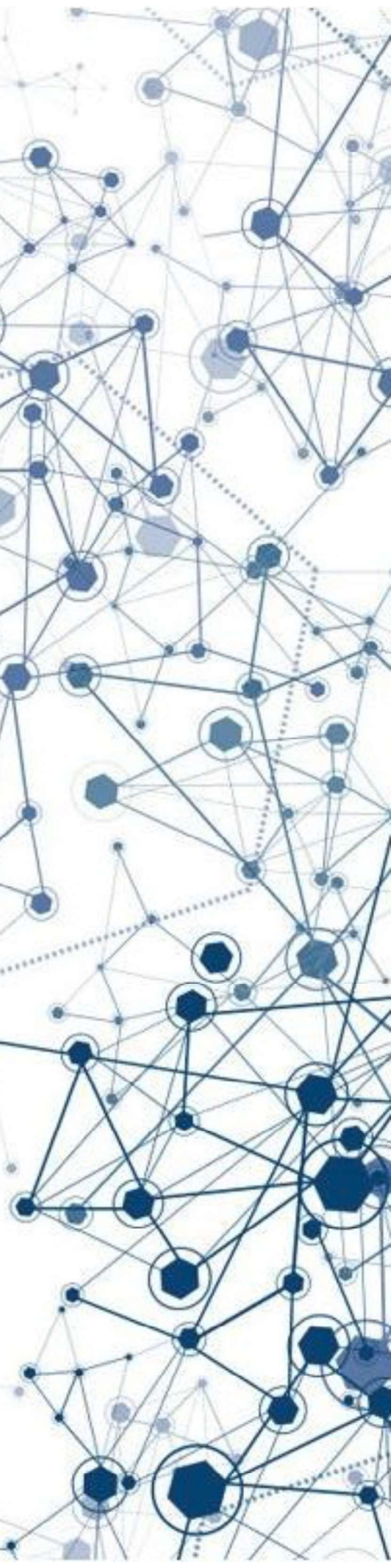


Contrainte

Connectivité
+
Homogénéité



Résistance au
changement
+
Réparations
locales
+
Transitions
critiques



Systèmes complexes

Boucles de rétroaction & réseaux

Risques systémiques

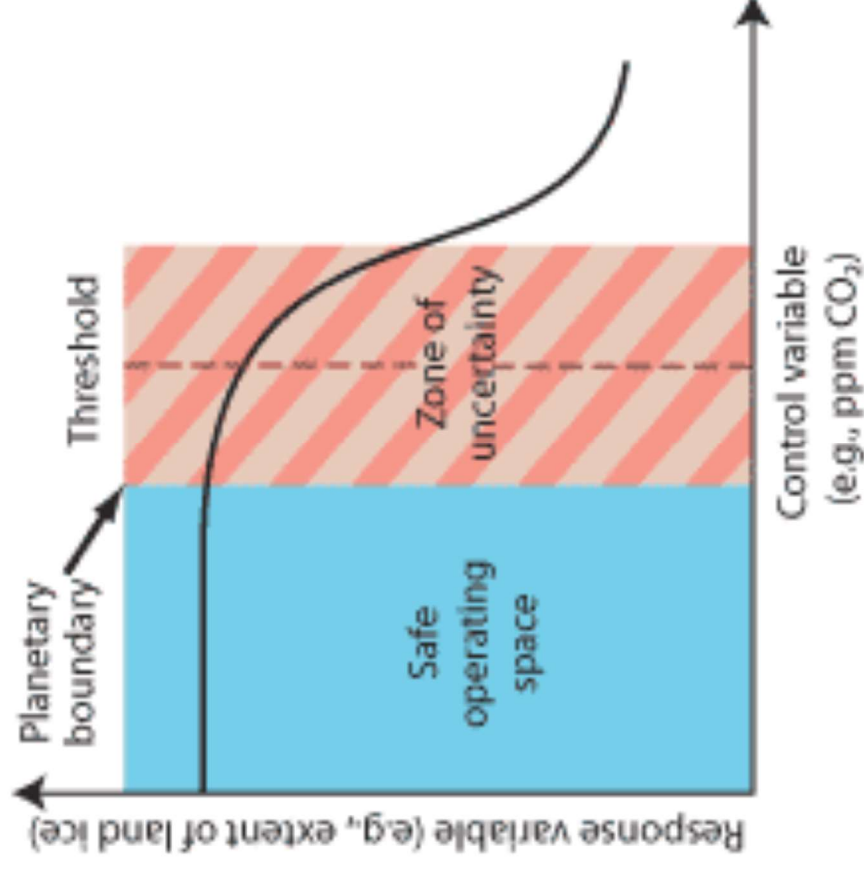
Seuils (*tipping points*)

Contagion

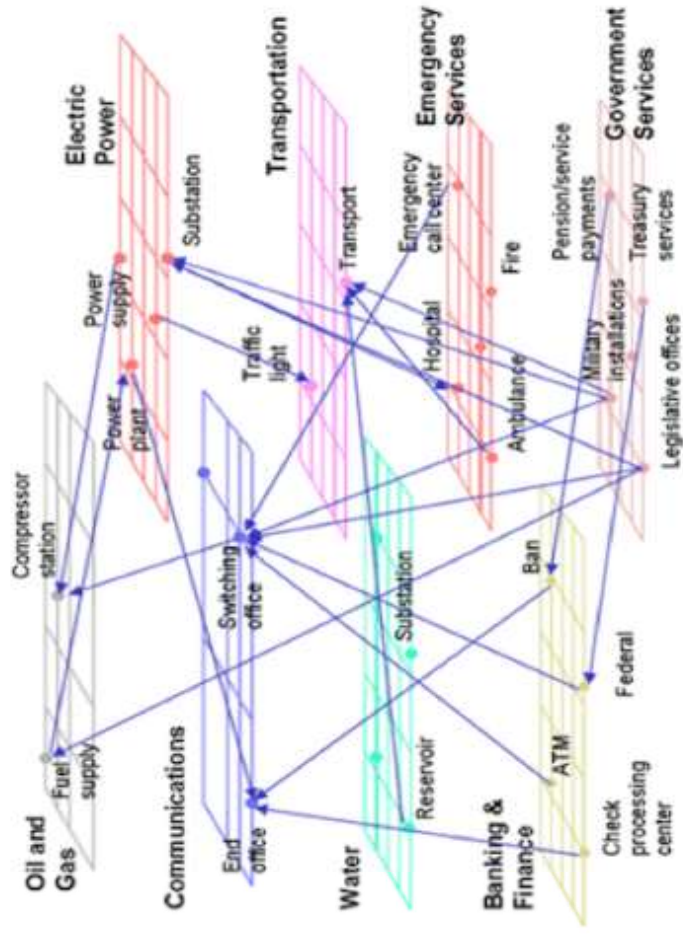
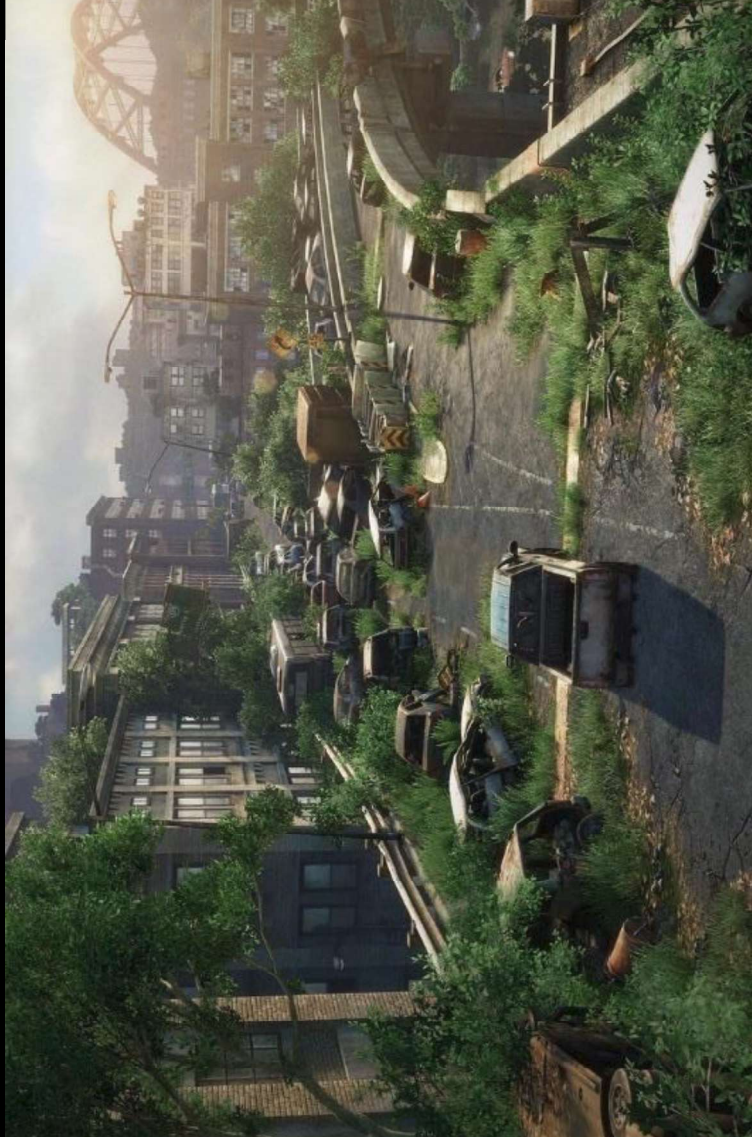
Hysteresis

Signaux avant-coureurs (EWS)

Effets de seuils et zones d'incertitude



Vers des ruptures irréversibles ?



MARC ELSBERG

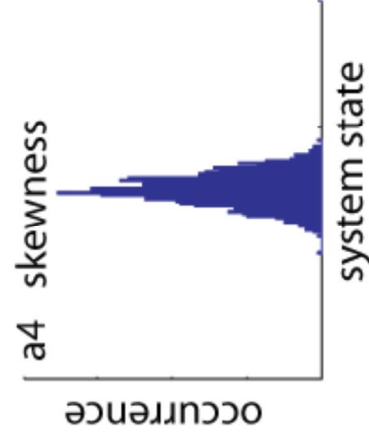
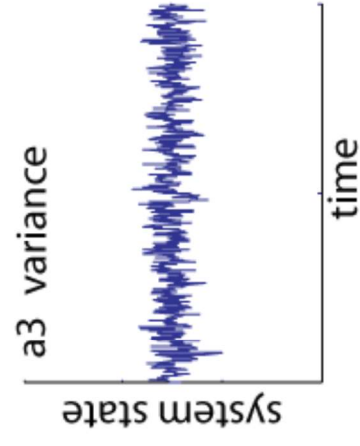
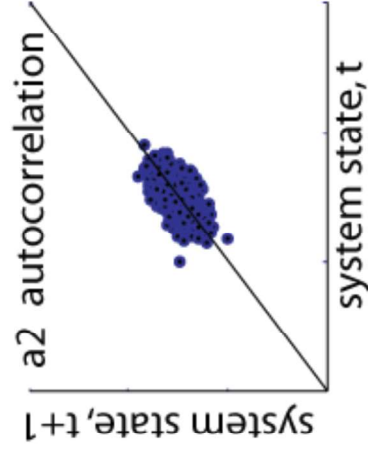
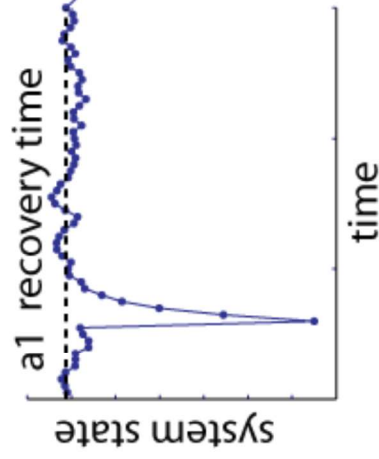
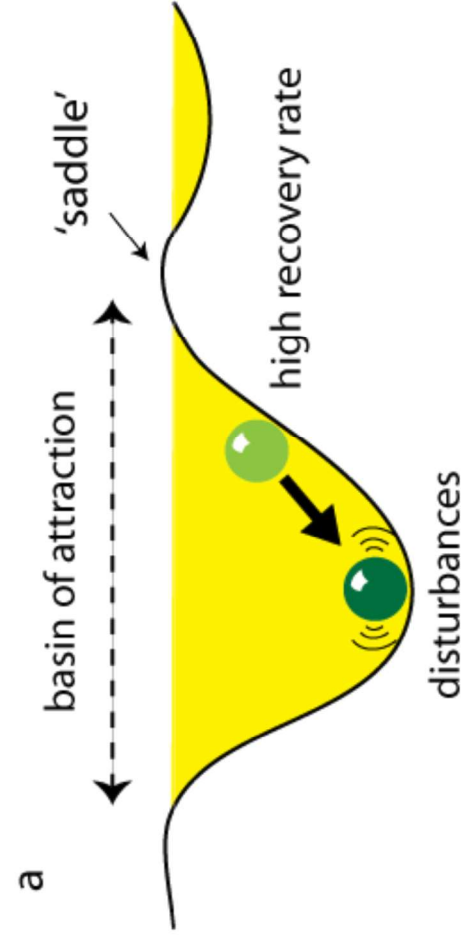
BLACK OUT

Demain il sera trop tard

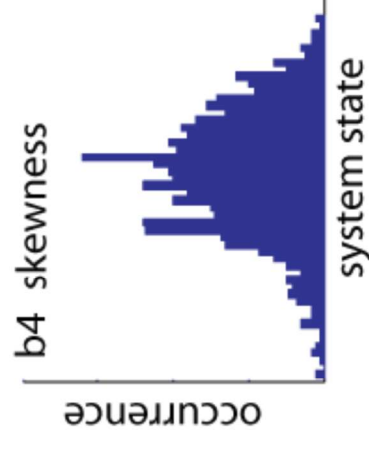
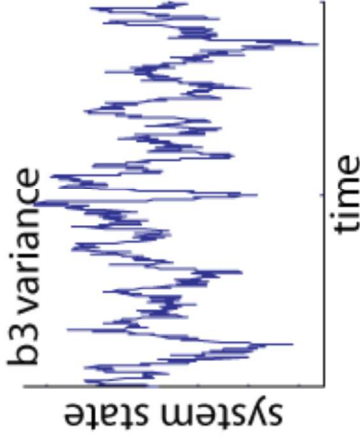
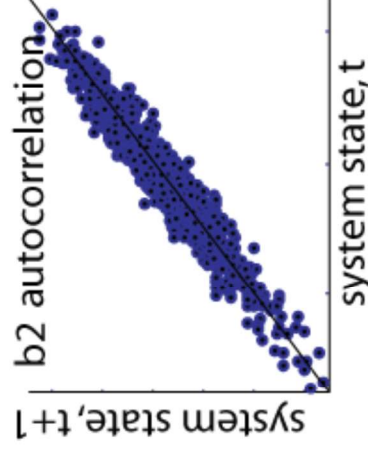
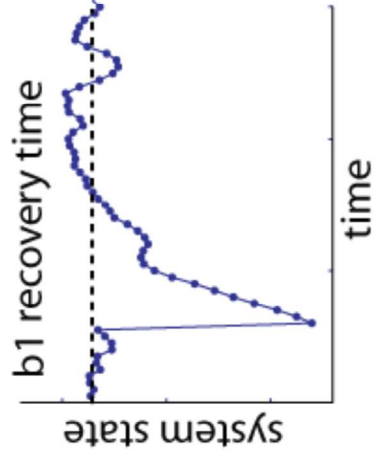
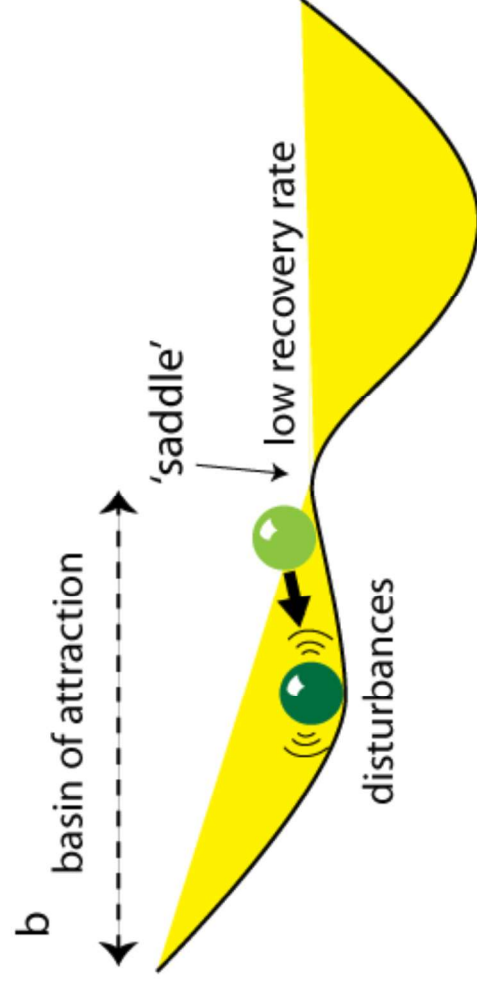


thriller

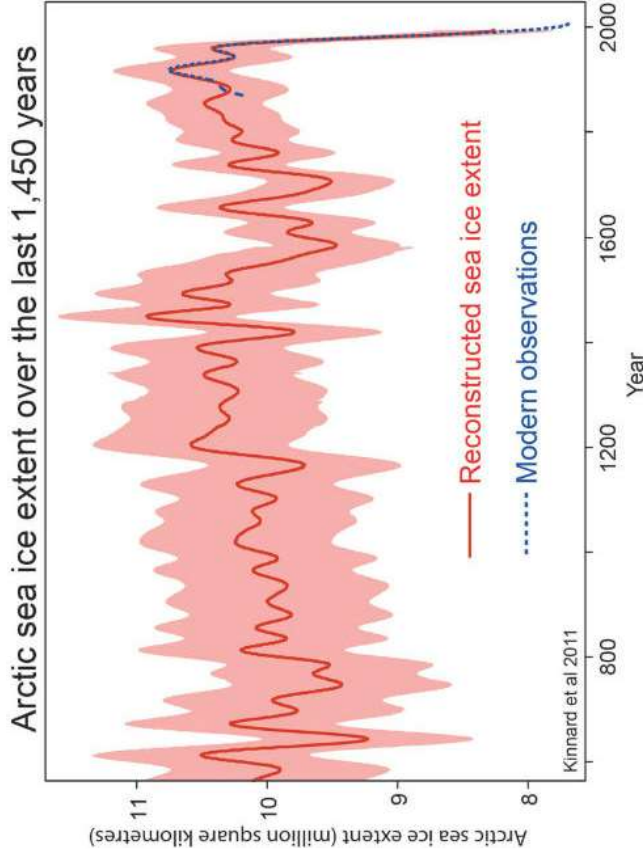
far from the transition



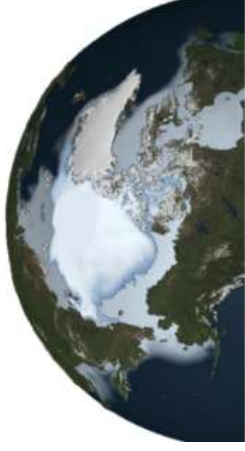
close to the transition



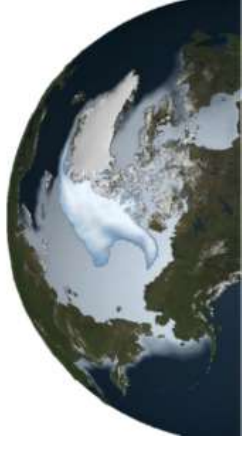
Signaux avant-coureurs



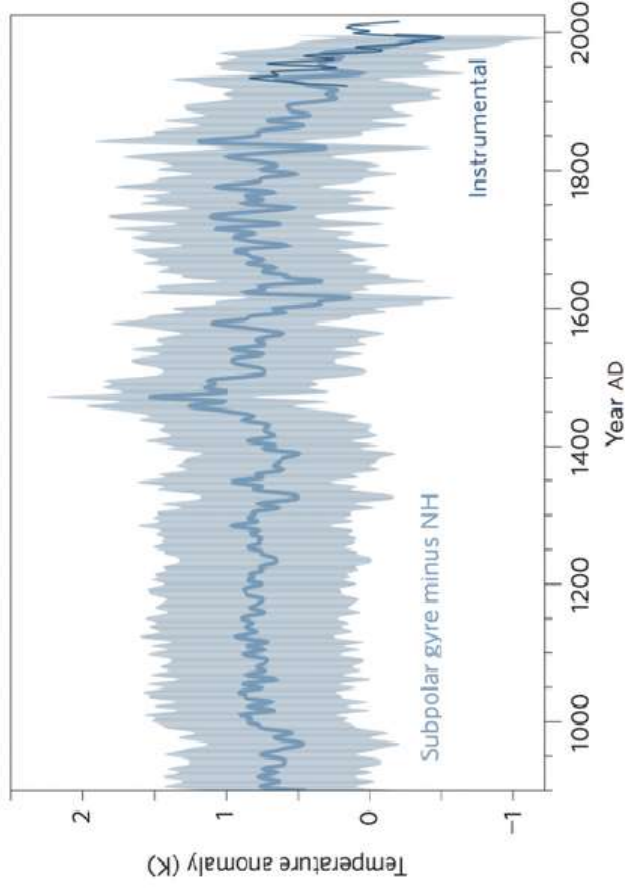
1980



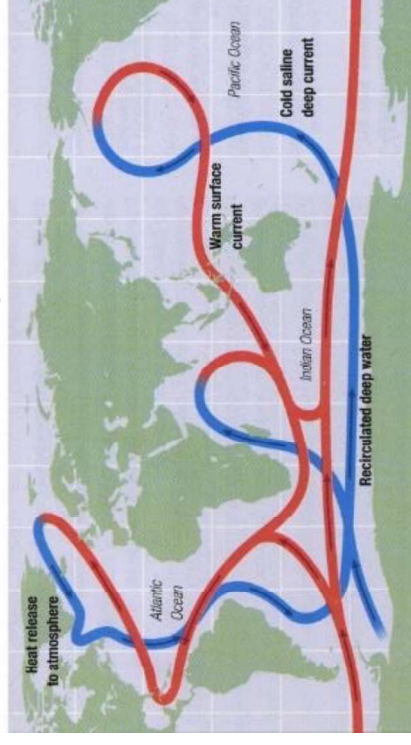
2012

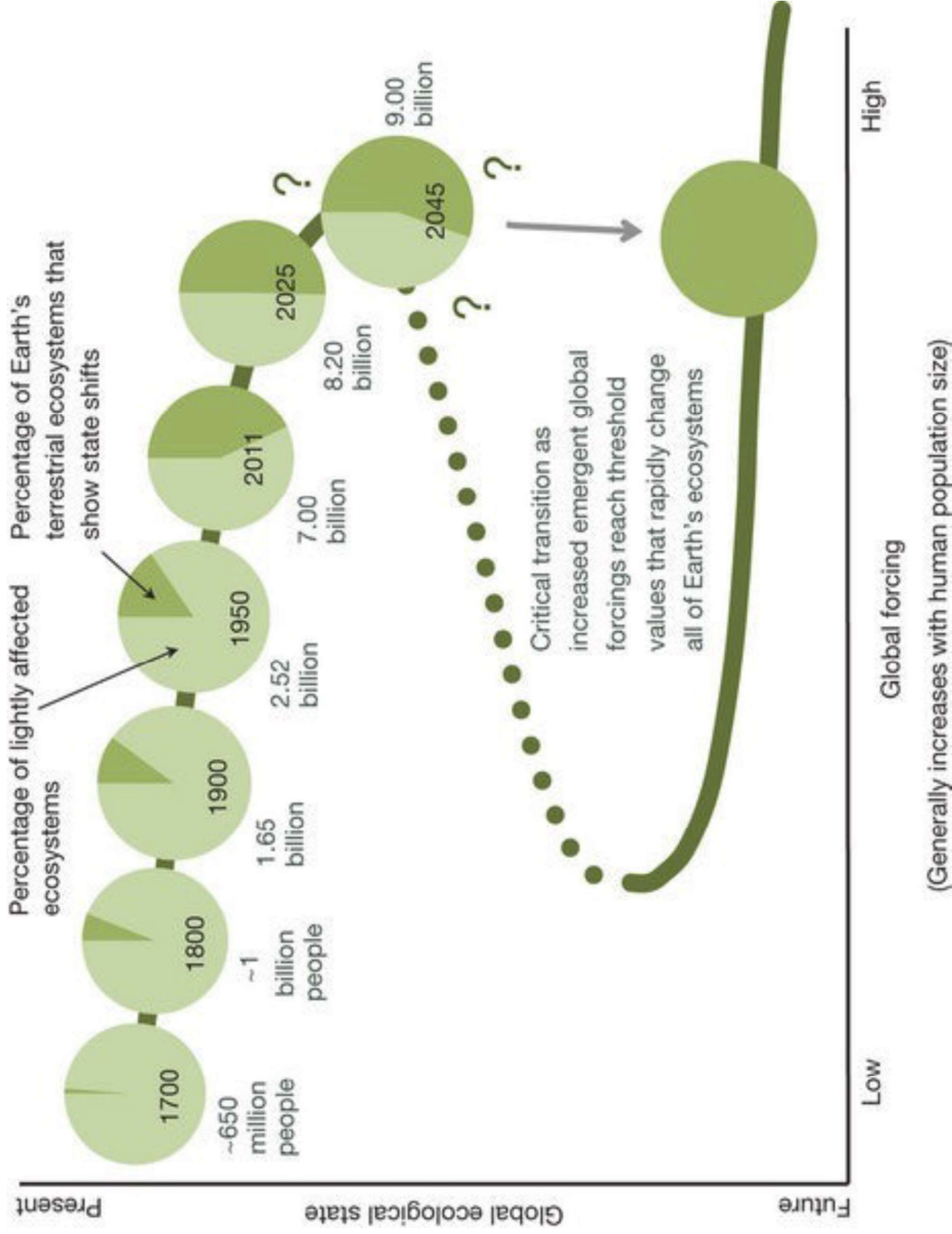


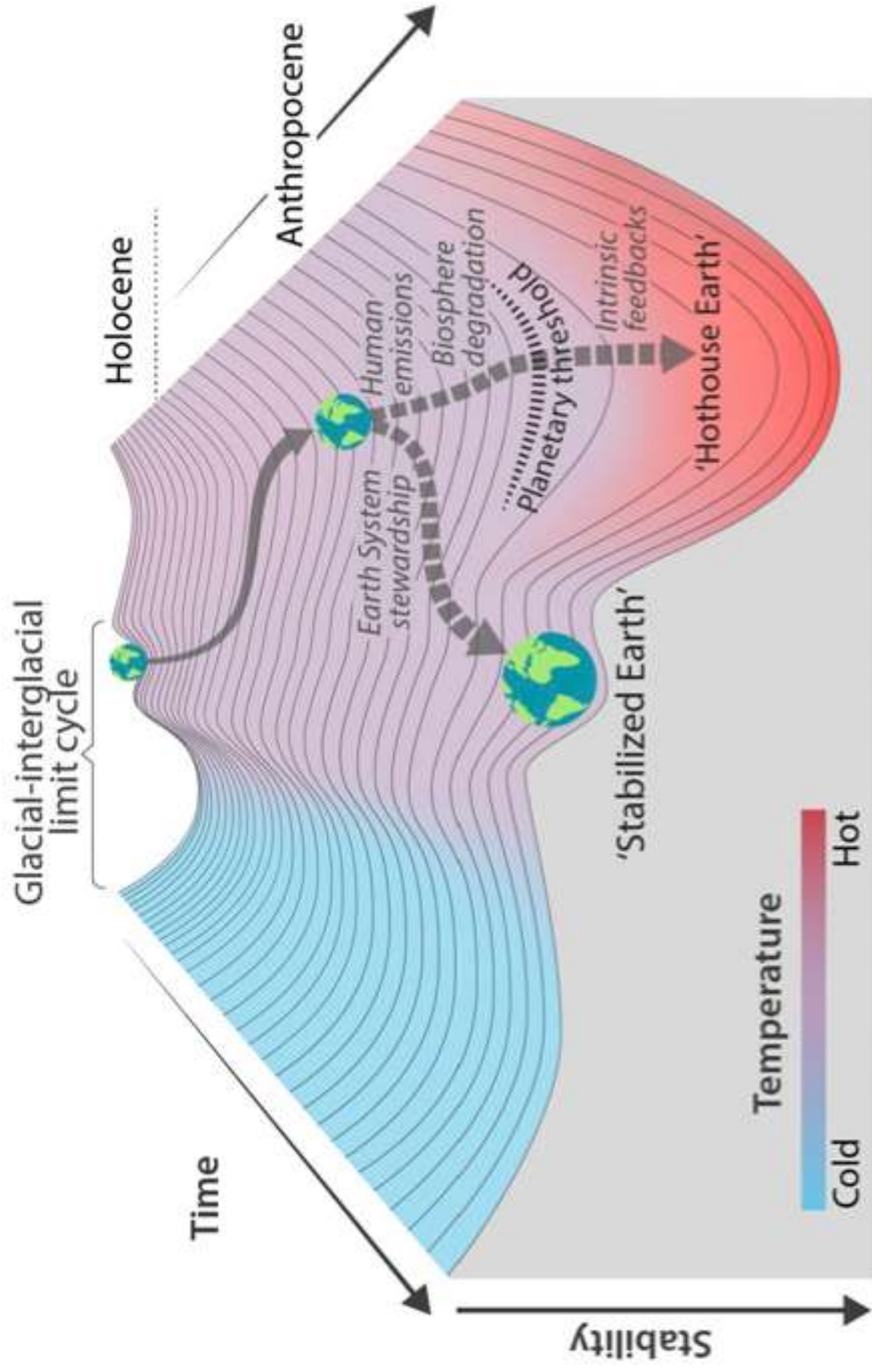
NASA (2012)

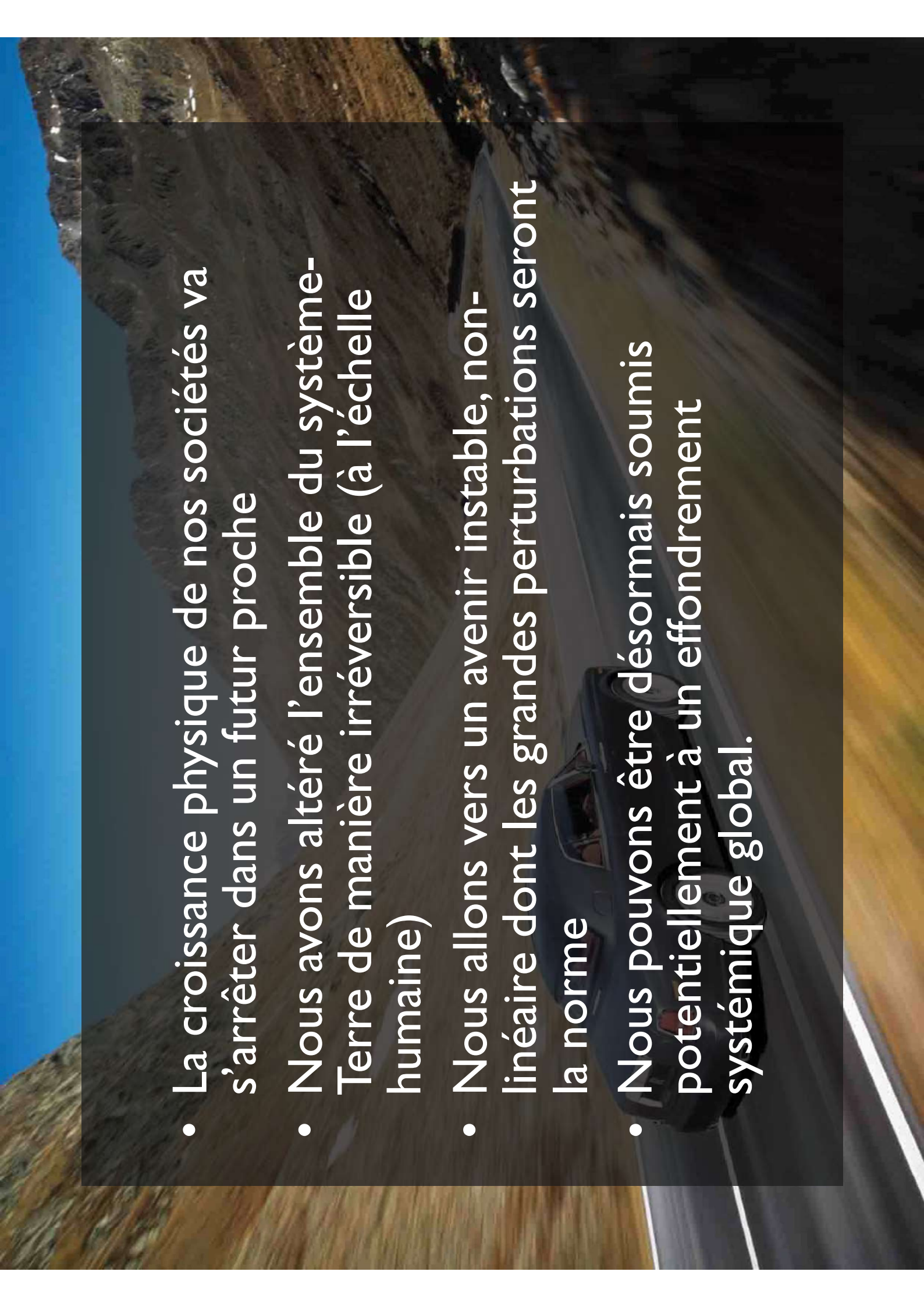


Global Ocean Conveyor Circulation

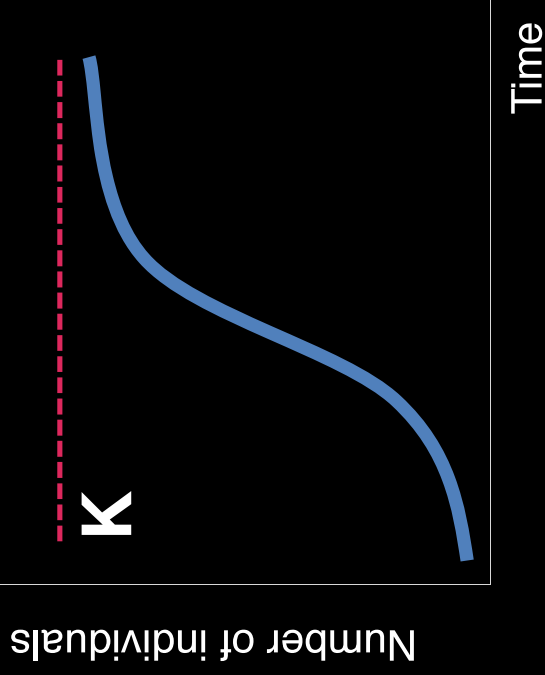




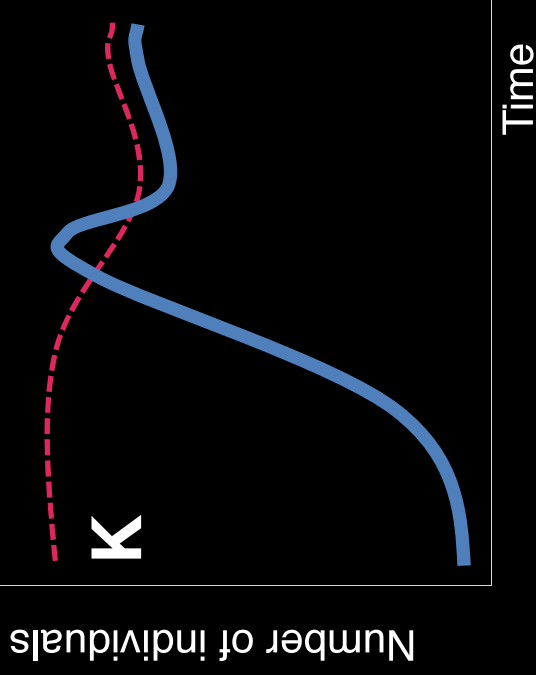


- 
- A dark-colored car is driving on a winding asphalt road that curves through a rugged, mountainous landscape. The road is flanked by steep, rocky slopes and sparse vegetation. The sky is a clear, bright blue. The car is positioned in the lower right of the frame, moving towards the left. The overall scene conveys a sense of journey and exploration in a natural setting.
- La croissance physique de nos sociétés va s'arrêter dans un futur proche
 - Nous avons altéré l'ensemble du système-Terre de manière irréversible (à l'échelle humaine)
 - Nous allons vers un avenir instable, non-linéaire dont les grandes perturbations seront la norme
 - Nous pouvons être désormais soumis potentiellement à un effondrement systémique global.

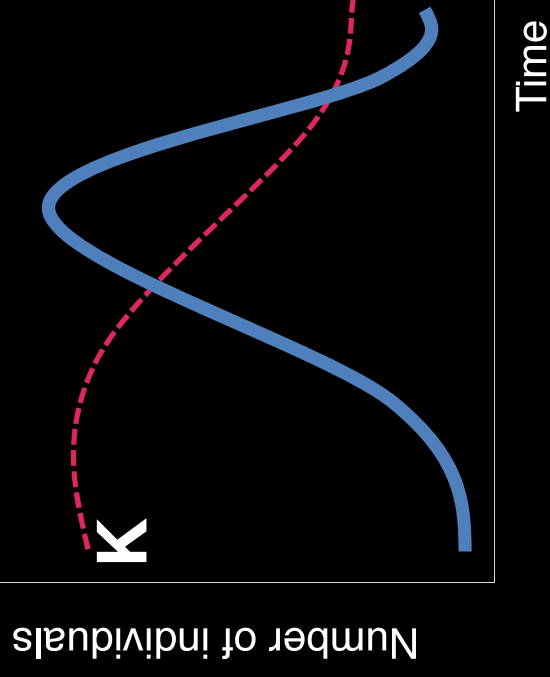
Sigmoid Approach to Equilibrium

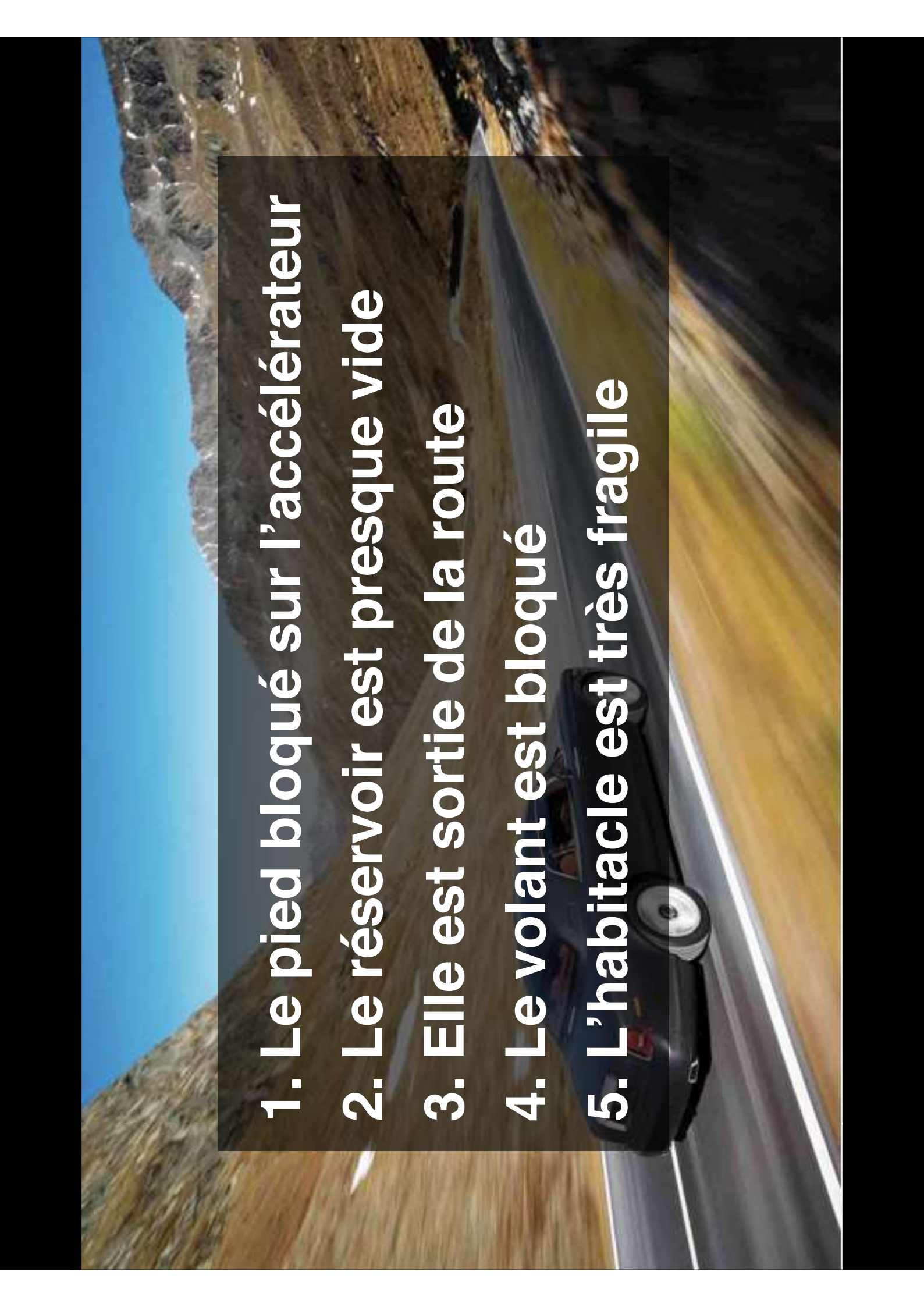


Overshoot and Oscillation



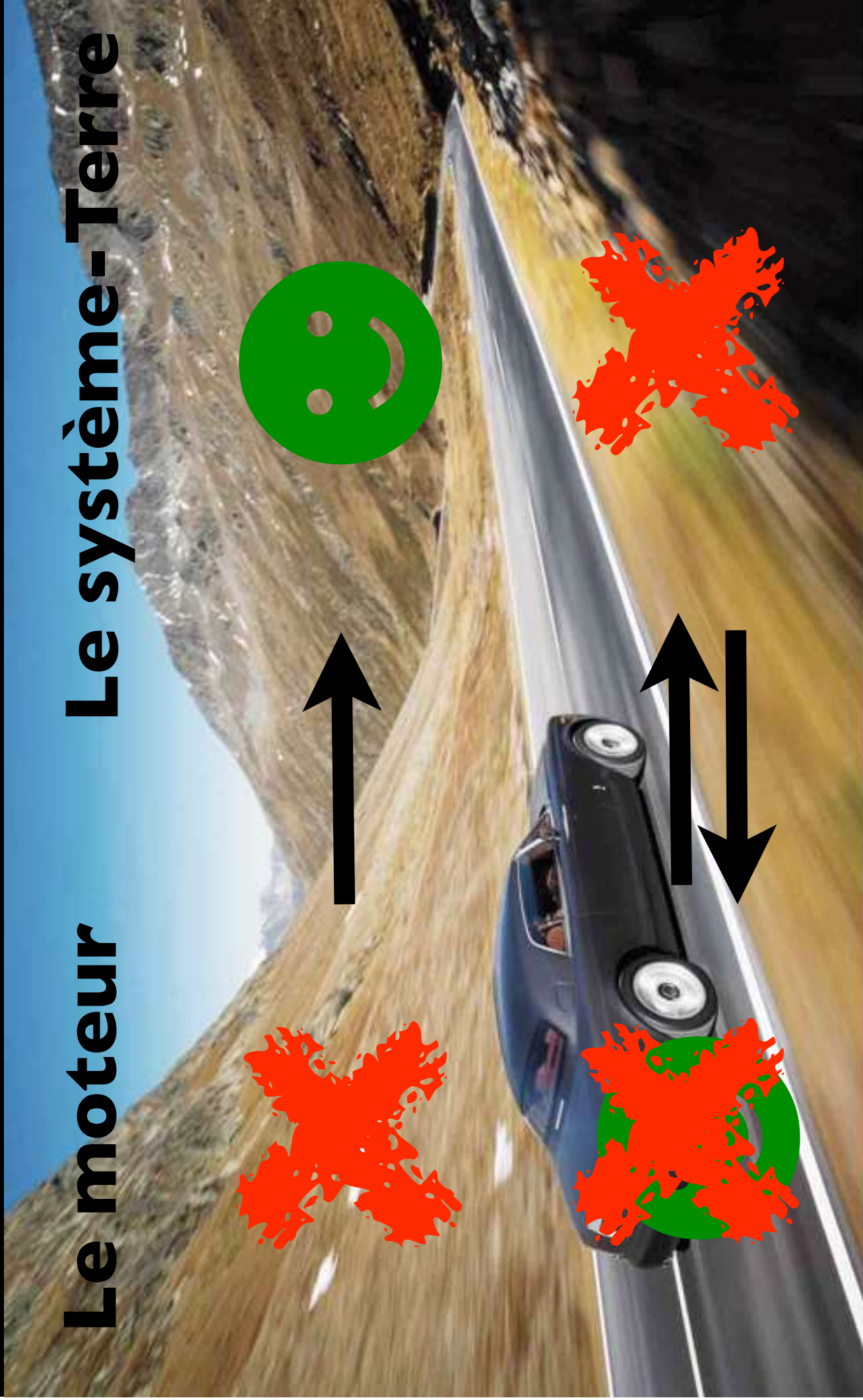
Overshoot and collapse



- 
- A dark blue classic car is driving on a winding mountain road. The road is paved and has white lines. The surrounding landscape is hilly and grassy, with some snow patches visible on the slopes. The sky is clear and blue. The car is moving towards the right side of the frame.
1. Le pied bloqué sur l'accélérateur
 2. Le réservoir est presque vide
 3. Elle est sortie de la route
 4. Le volant est bloqué
 5. L'habitacle est très fragile

Le moteur

Le système-Terre



A quelles conditions
le concept de **développement durable**
peut-il éviter l'**effondrement**
de la civilisation moderne ?

Quelques marges de manoeuvre

**1. On peut réduire la
production/prédation**



1433

IN THE UK, SEVEN
MILLION TONNES OF
FOOD VALUED AT
ABOUT £10 BILLION IS
THROWN AWAY FROM
HOMES EVERY YEAR.





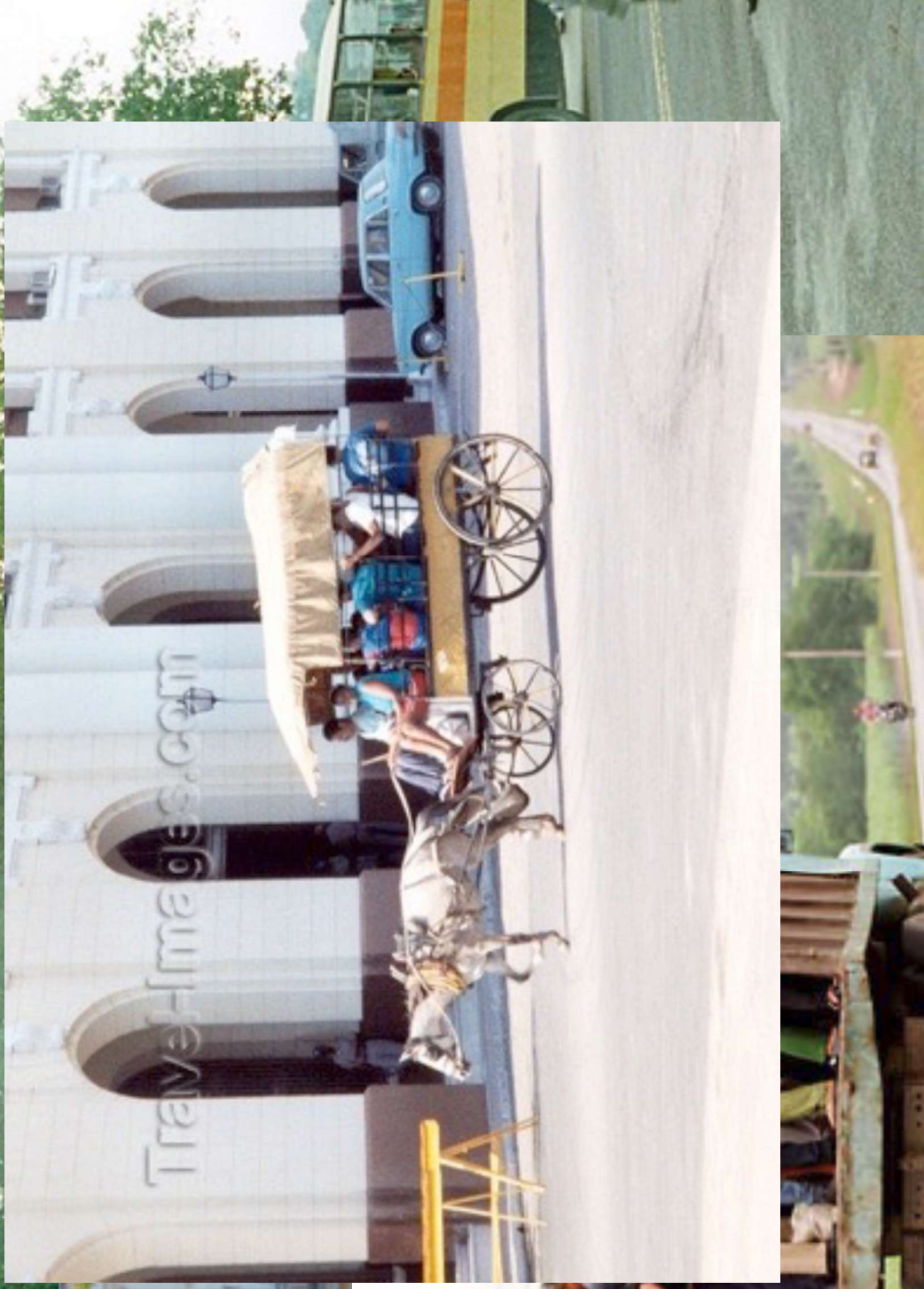
1. On peut réduire la production/prédation

- = à condition de laisser les énergies fossiles
- = à condition de réduire massivement le commerce international
- = à condition de réduire le niveau de vie des riches
- = à condition de penser collectivement la natalité
- = risque d'effondrement financier/économique !

**2. On sait gérer les pénuries
(faire vite et à grande échelle)**

1973 : premier choc pétrolier







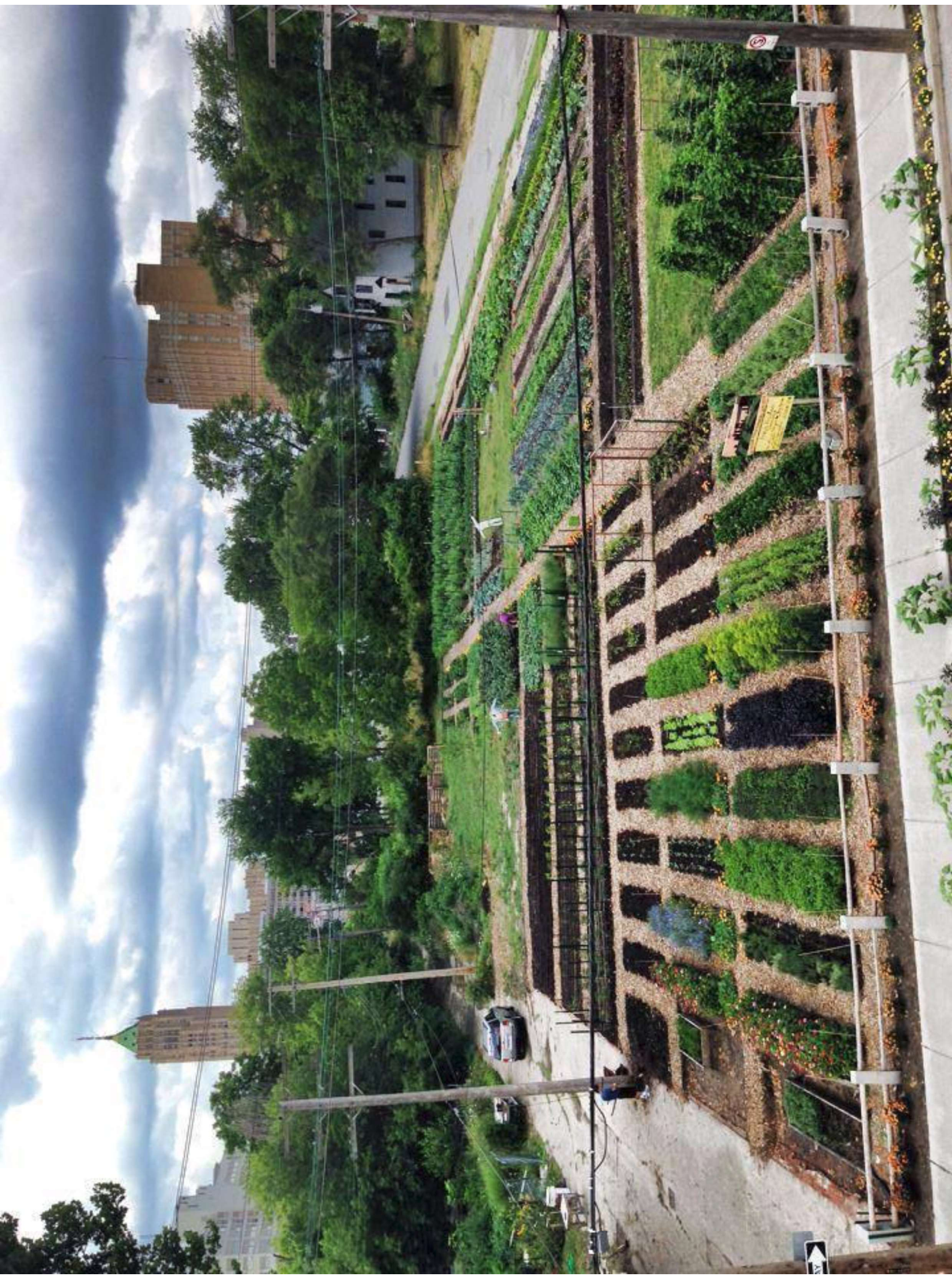


Cuba - Right Livelihood Award 1999

Grupo de Agricultura Orgánica, GAO (Cuba)







Uncle Sam says-

GARDEN

To Cut Food Costs



Ask the-

U.S. Department of Agriculture Washington, D.C.

For a FREE Bulletin on Gardening - It's food for thought







"OF COURSE I CAN!"



I'm patriotic as can be —
And ration points won't worry me!"

WAR FOOD ADMINISTRATION
WASHINGTON, D. C.

**DIG ON
FOR
VICTORY**



Robert Taylor