Uncertainty management

Dealing with inherent uncertainty in complex (socio-enviro-technical) systems

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1. What are Complex Systems?

2. The importance of Framing?

3. A Case Study:
Energy-Climate-Economic Nexus

4. Overarching Context

5. Managing Complex Uncertainty?

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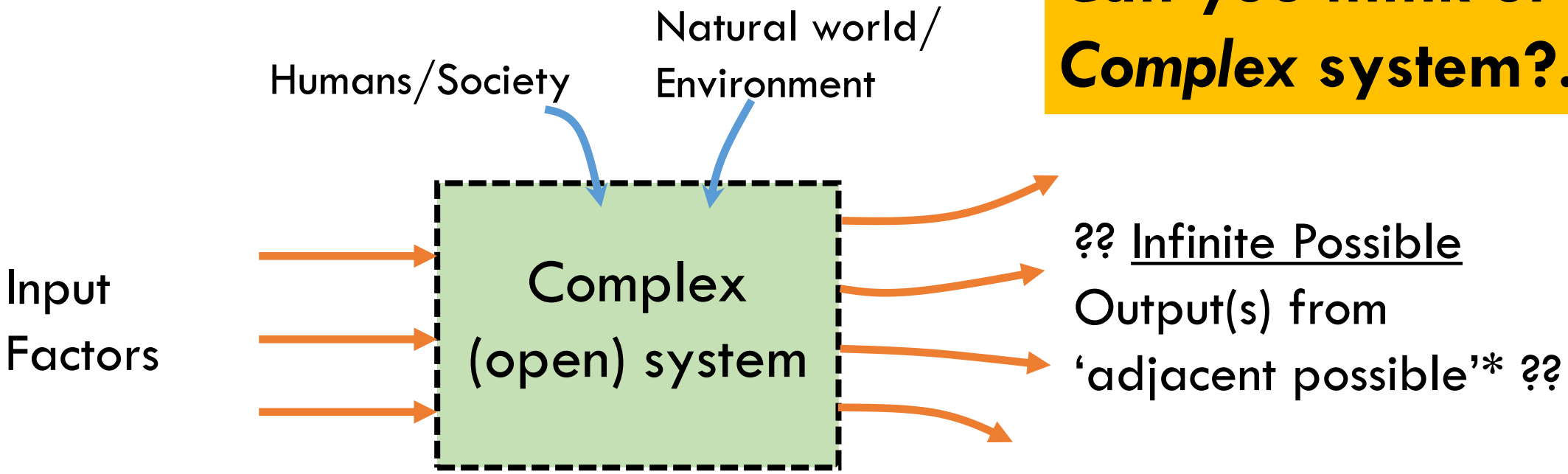
Complex Systems; Inherent Uncertainty

Can you think of a *Complex* system?..

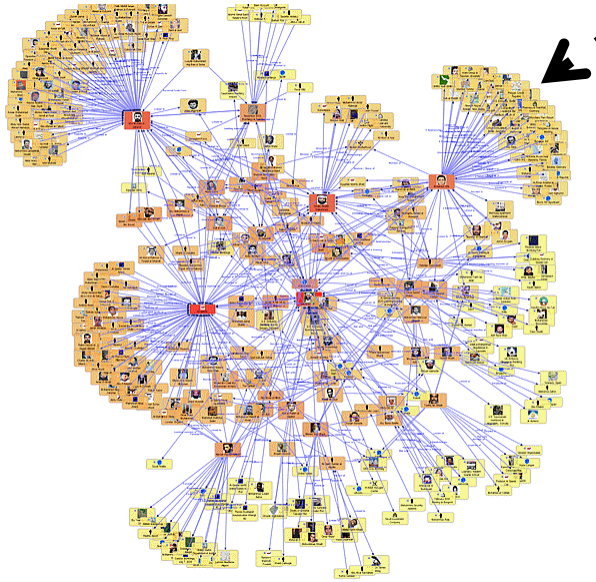


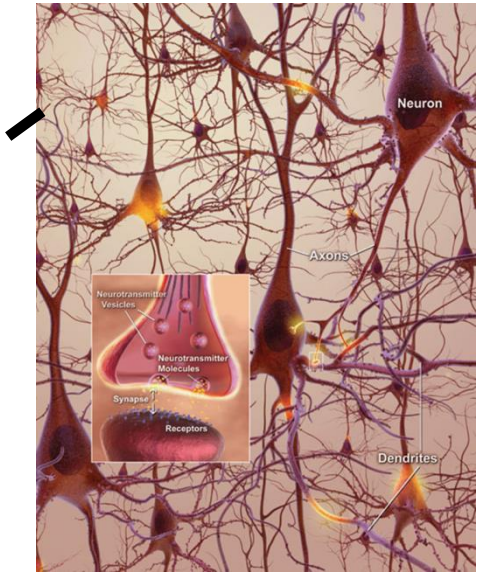
*System **outputs** cannot be **deterministically** predicted, never mind their associated **probabilities.***

*Stuart Kauffman

What is Complexity?

At a basic physical level, complex systems comprise a **large** number of **nodes** or **agents** (or atoms or cells or units) which exhibit a degree of **organisational structure** and are linked together via a **large** number of **connections.**

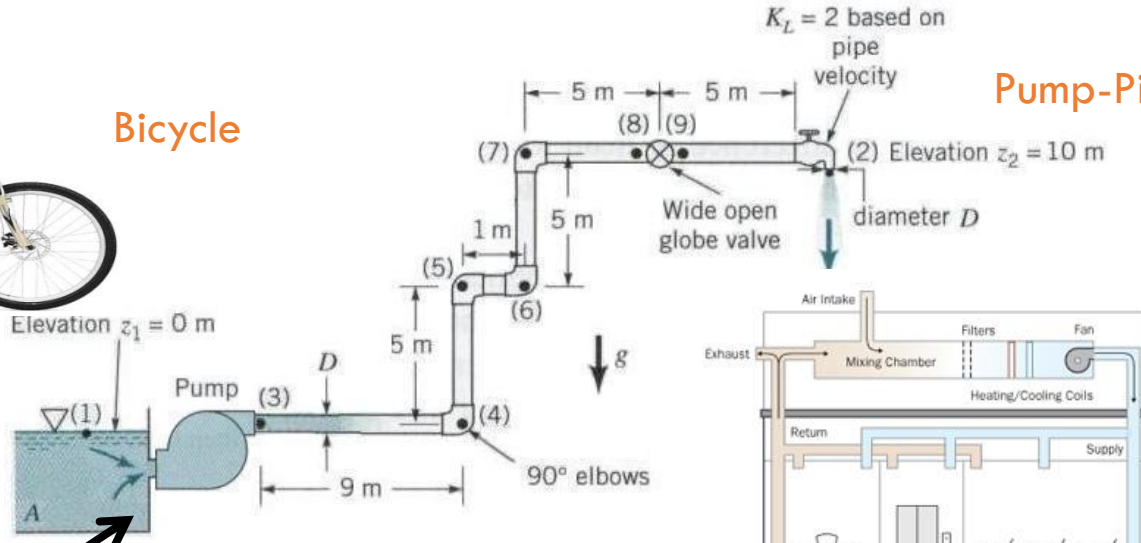




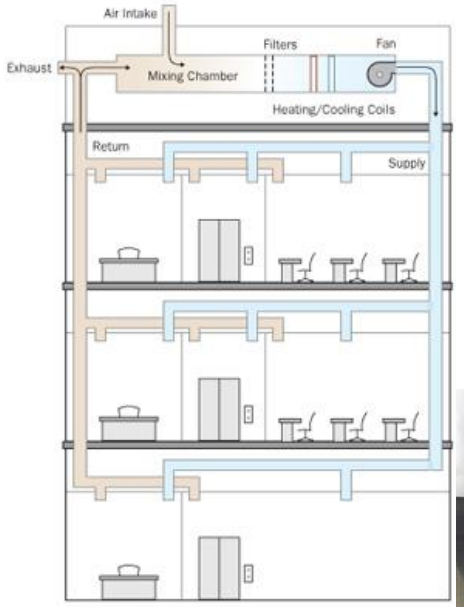
Complex neural connections (above) feed into complex social connections (left)

Complex Systems: involve Human or Natural components..

Bicycle



Pump-Pipeline System



HVAC System

Nuclear Plant

SIMPLE SYSTEMS

HUMAN AGENCY ADDS COMPLEXITY

COMPLICATED SYSTEMS

Complex Systems: Operate as Open Dynamic systems

Complex systems operate as **<u>open</u> systems** which may transfer of **material, energy** and **information** across the system boundary.

The **system boundary** is a **function of the observer,** who will **'frame'** the system. Examples include ecosystems (forest, lake, bog, etc.), a manufacturing plant, the earth's atmosphere, a city, the economy.

Complex Systems: exhibit Emergent behaviour

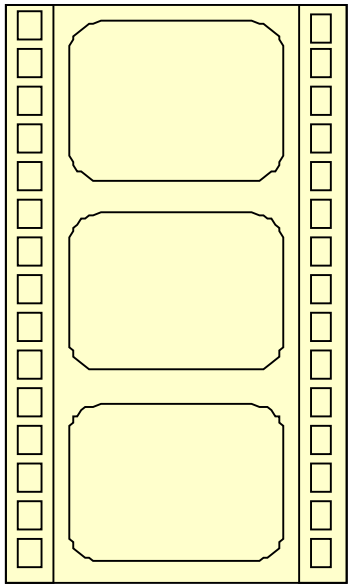
e.g. art, creativity, aesthetic beauty, culture, transcendence, value, civilisation

each greater than just the sum of its individual parts

'Allegory of Painting (The Painter in His Studio)' c. 1666 by Johannes Vermeer Kunsthistorisches Museum, Vienna

Complex Systems: exhibit Emergence

Each of the individual **agents** in the system are **unaware** of the emergent behaviour of the system.



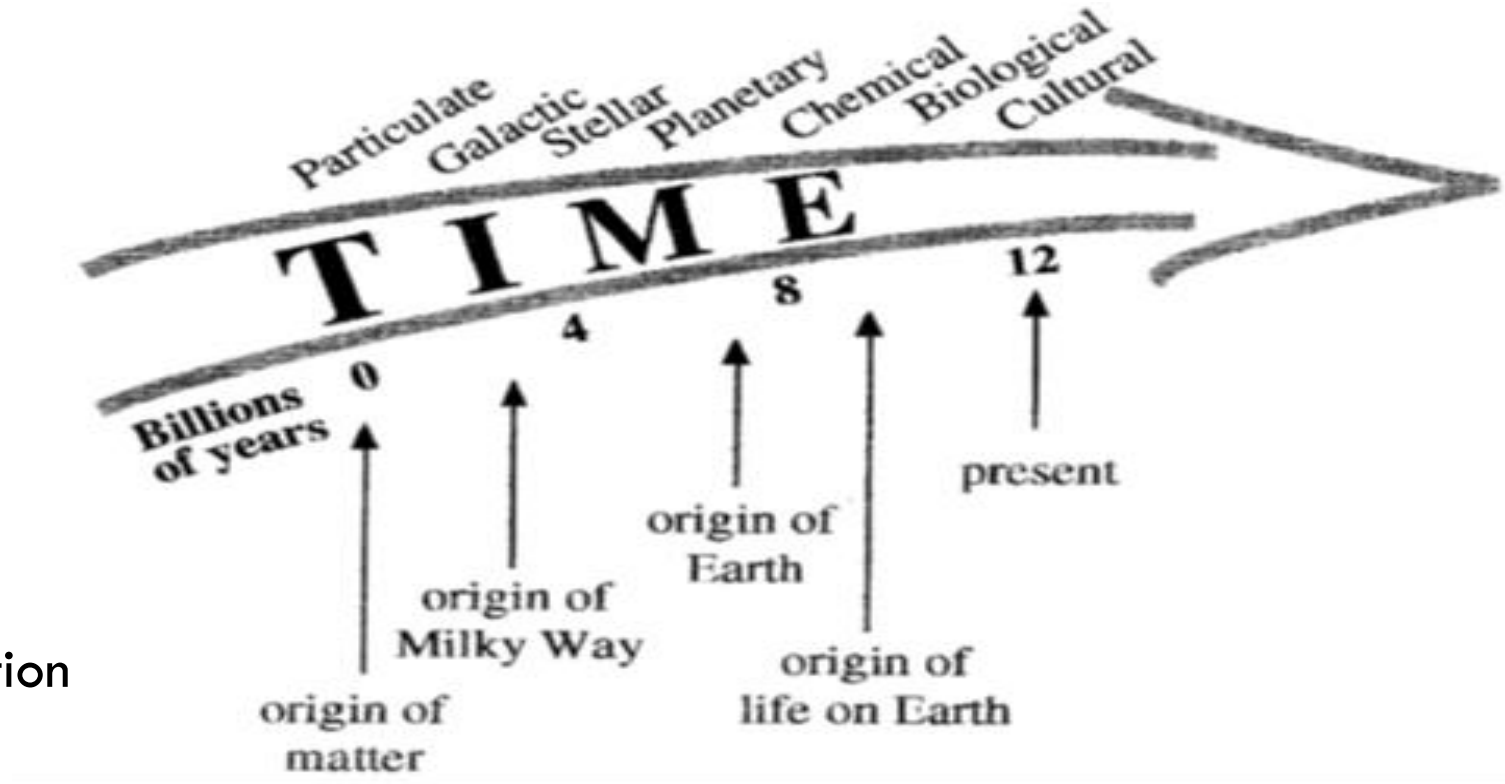
- Self-organization @ L'Arc de Triomphe:

https://www.youtube.com/watch?v=LXcFmmBSyNI

Complex Emergence: Cosmic Evolution

Over billions of years, non-equilibrium thermodynamic conditions in the presence of matter allowed the emergence of increasingly complex systems in the form of:

- elements
- galaxies and stars
- heavy elements
- molecules
- life forms
- Agency, values and meaning
- intelligence
- (human) self awareness
- " culture
  & technological civilisation



(Chaisson, 2005)

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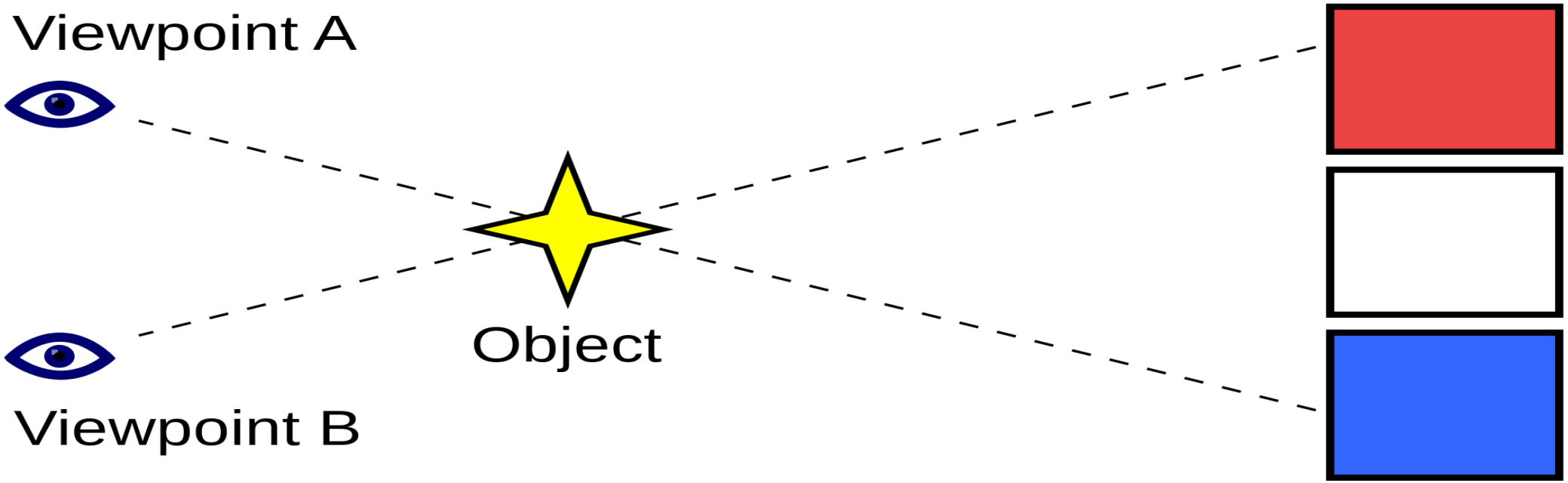
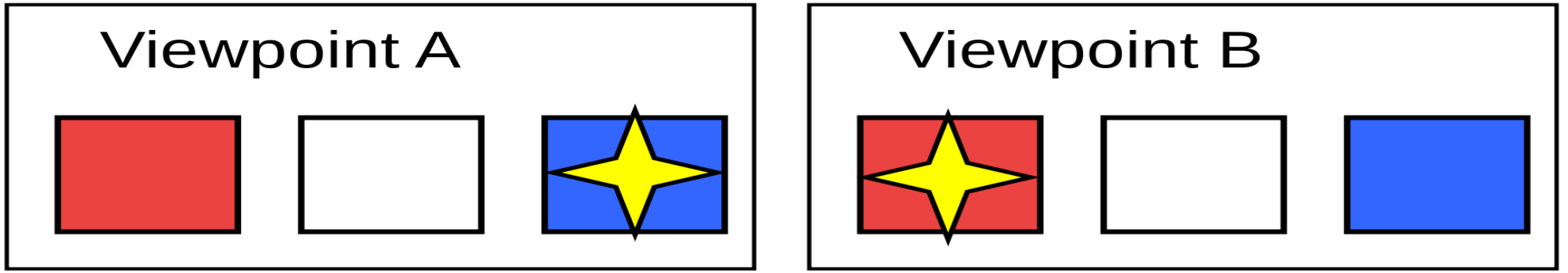
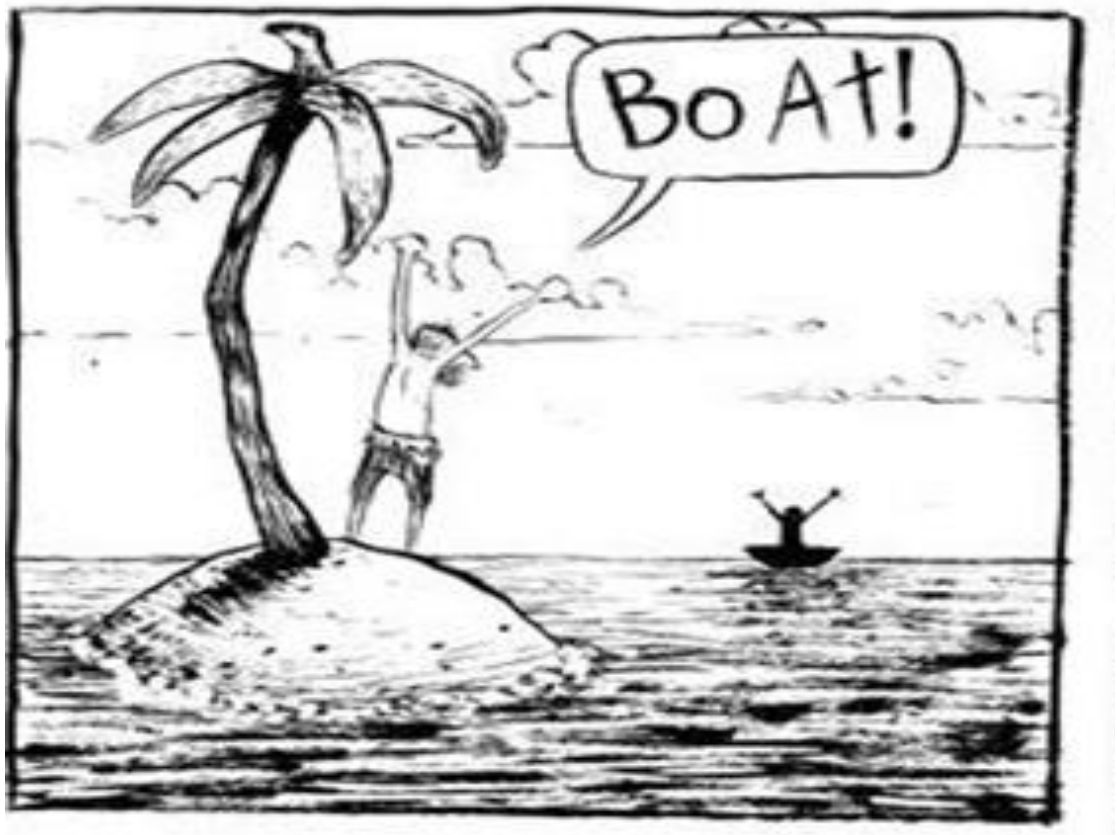
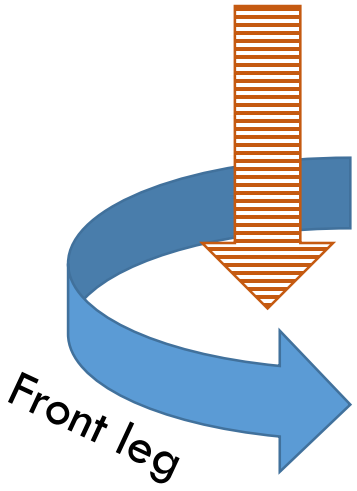

Viewpoint A
Object
Viewpoint B
Distant background


Viewpoint A
Viewpoint B

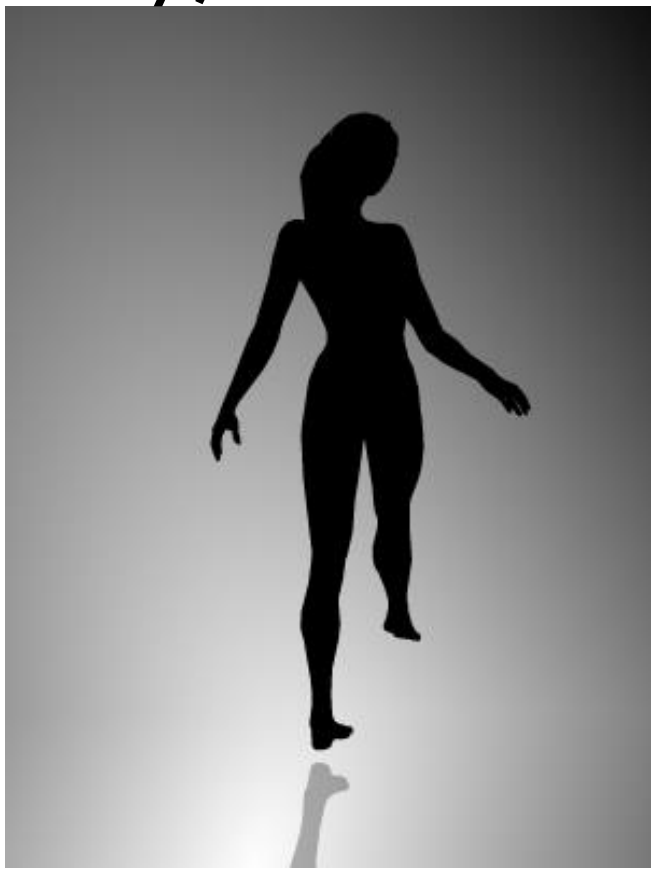
ELLSWORTH LAND
MARIE BYRD LAND
QUEEN MAUD LAND
WILKES LAND
NEW ZEALAND
AUSTRALIA
BRAZIL
ECUADOR
UNITED STATES OF AMERICA
CANADA
CHINA
RUSSIA
GREENLAND
ICELAND

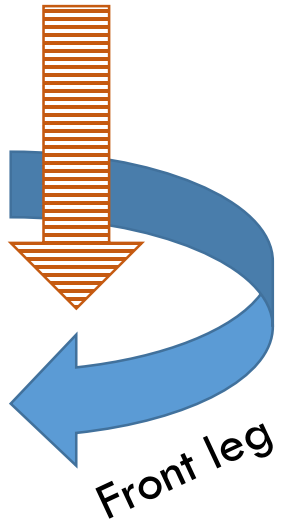

Bo At!

Perceived truth and reality; a function of framing



Turning anti-clockwise?



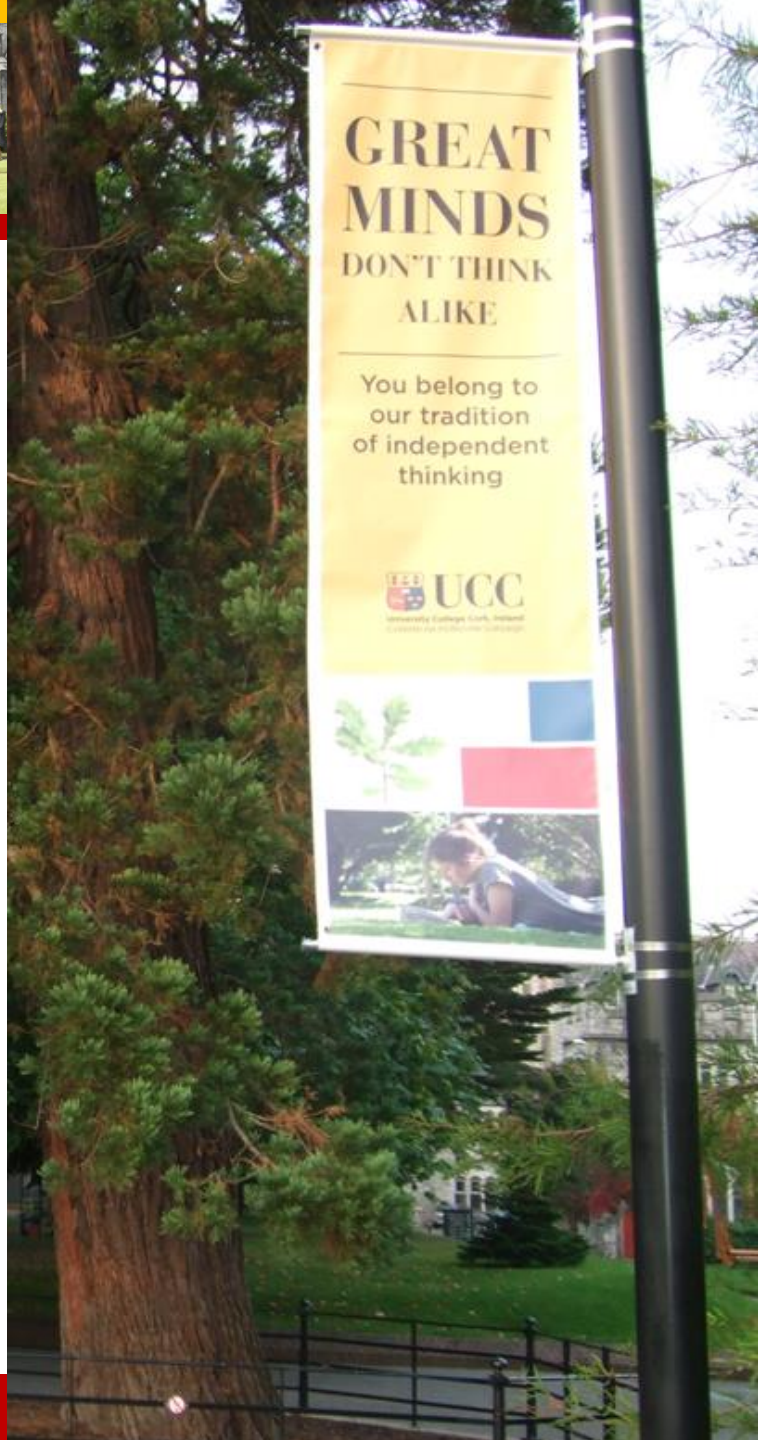


..or clockwise?!

"Reality is merely an illusion, albeit a very persistent one"

Albert Einstein

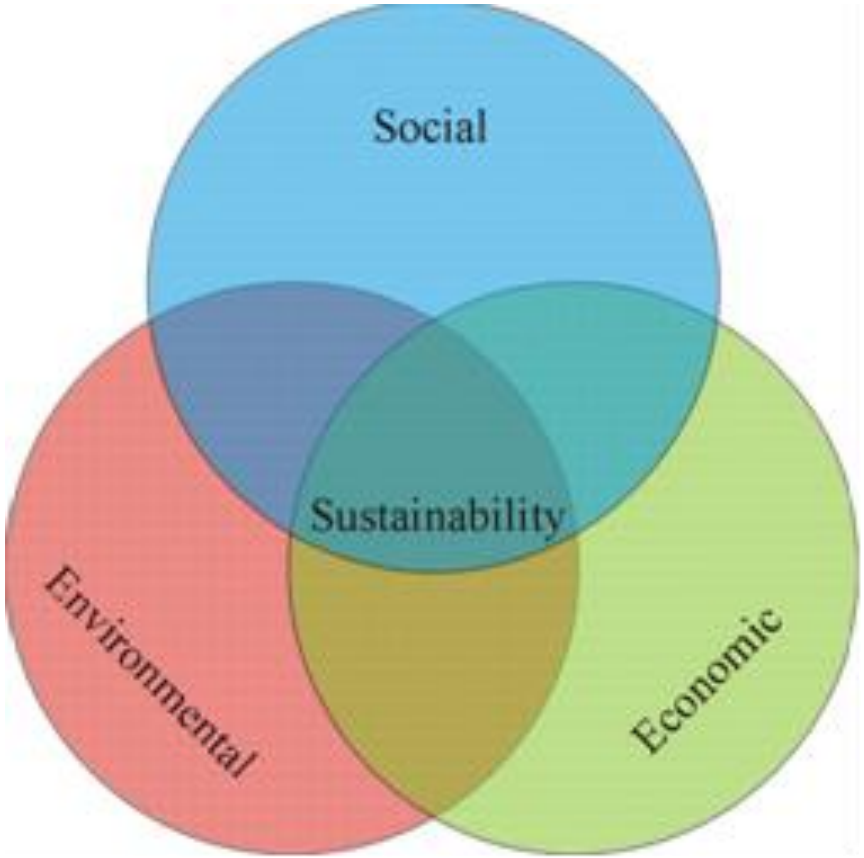
Alternative Framings often require..
Independent, Critical, Creative thinking,
Dissent from Groupthink..



Contrasting Framings of (un)Sustainability?

Contrasting Framings of (un)Sustainability?

Interlocking Circles Model;
Envisages Balance/trade offs/potential 'win-wins'



Contrasting Framings of (un)Sustainability?

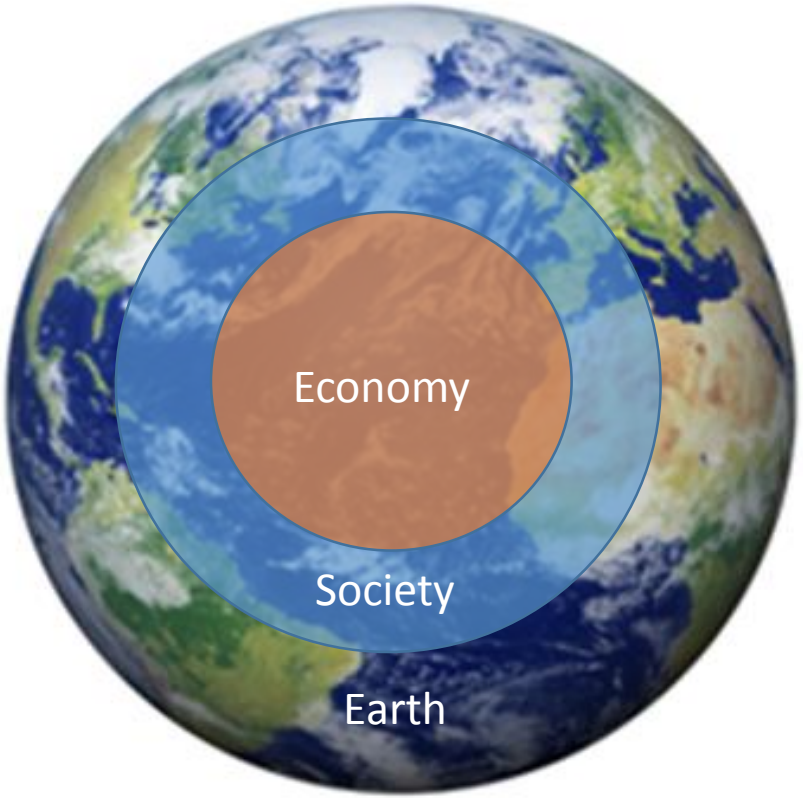
Concentric Circles Model;

No environment => No society!

(=> No economy!)

<u>One</u> Explicit Bottom line.

=> Everlasting Economic & Societal growth is **deeply problematic** in context of fixed physical planetary **Limits**



Contrasting Framings of (un)Sustainability?

"Sustainability is the possibility that humans and other life will

on Earth forever." John Ehrenfeld (2008)

Ehrenfeld (2013): '**Flourishing** is nothing more than a state recognized when one says: "All my **cares** are being **satisfied**, at least for the moment.'"

Contrasting Framings of (un)Sustainability?

Robert Ulanowicz's model of system sustainability- as **contingent balance** between agonistic (complimentary, though opposing) tendencies of **Order & Control** (ascendancy) and **Chaos & Flexibility** (redundancy, creativity).

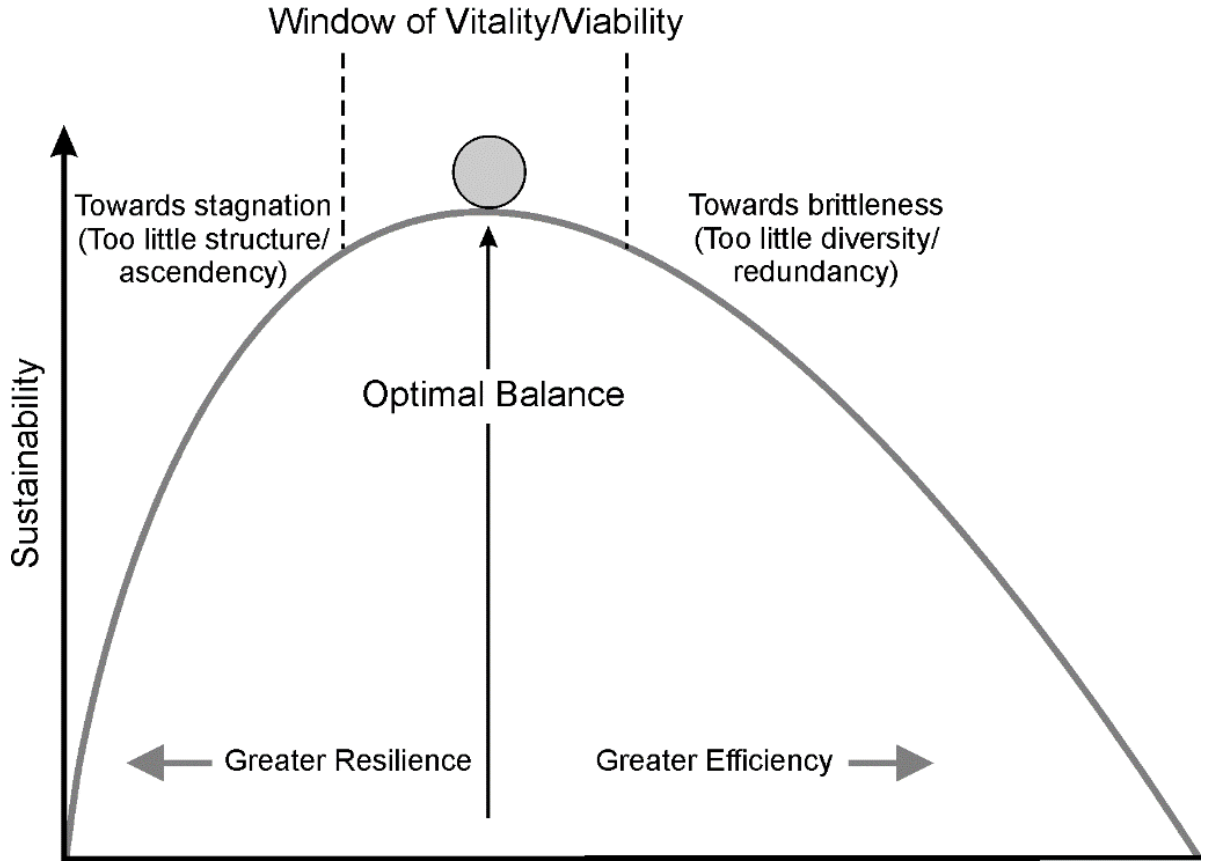


Image from: *Byrne (2016) Sustainability as contingent balance between opposing though interdependent tendencies, p.47 In: E. Byrne, G. Mullally & C. Sage (Eds.) Transdisciplinary Perspectives on Transitions to Sustainability (Routledge, 2016)*

Contrasting Framings of (un)Sustainability?

"Reducing energy demand is compatible with economic growth"

Prof. Ed Rubin

(Carnegie Mellon Univ.)

ISALab, Valencia, 11 June 2018

Contrasting Framings of (un)Sustainability?

"The Impossible Hamster"

New Economic Forum (NEF)

(cited by Dr Dai Morgan, U. Cambridge, ISALab, Valencia, 12 June 2018)

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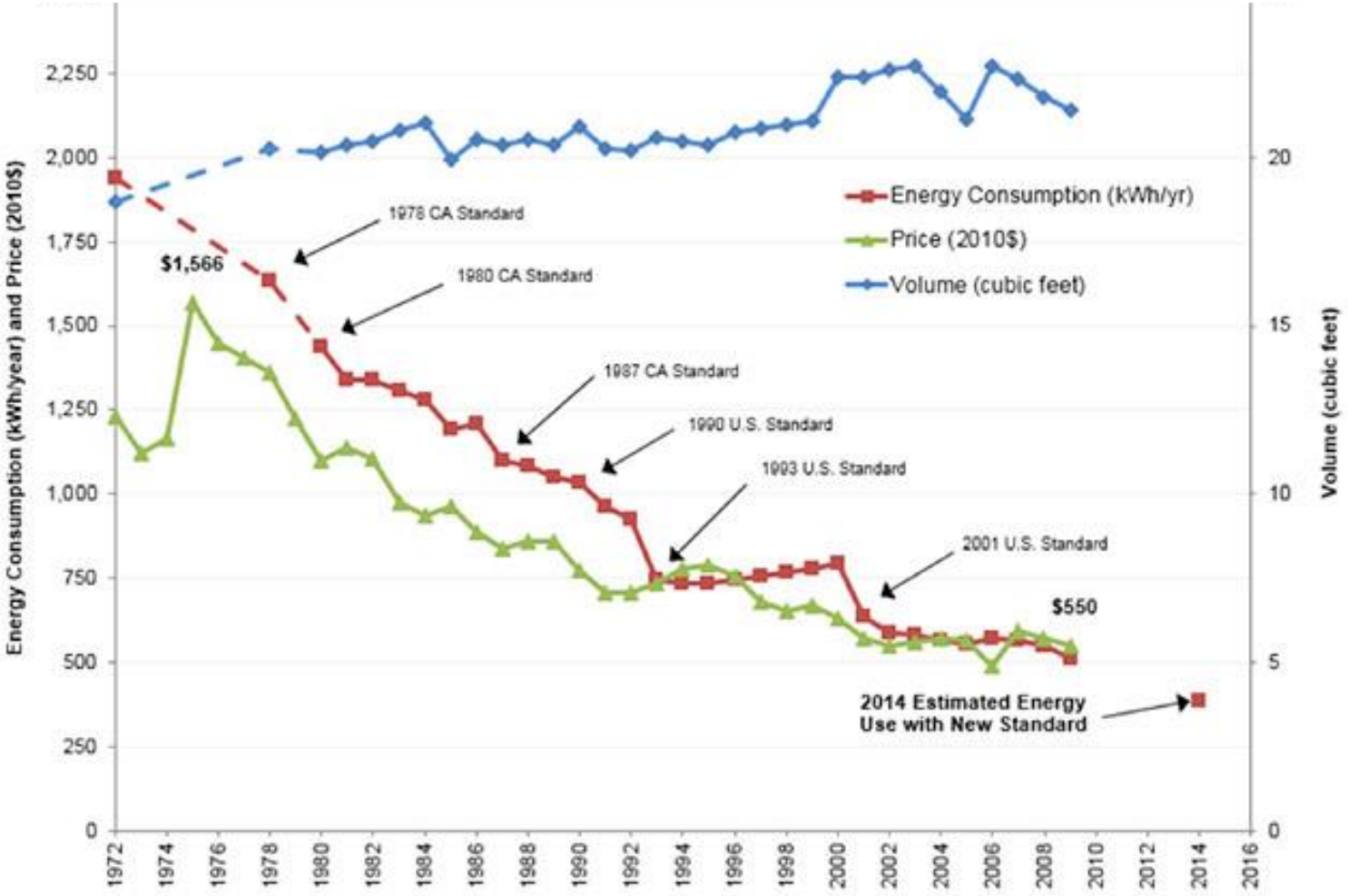
Energy-Climate-Economic Nexus

Where are we heading?

The facts and data..

The Bigger (and Longer term) Picture?; Global Energy use



US Household Refrigerator Trends:

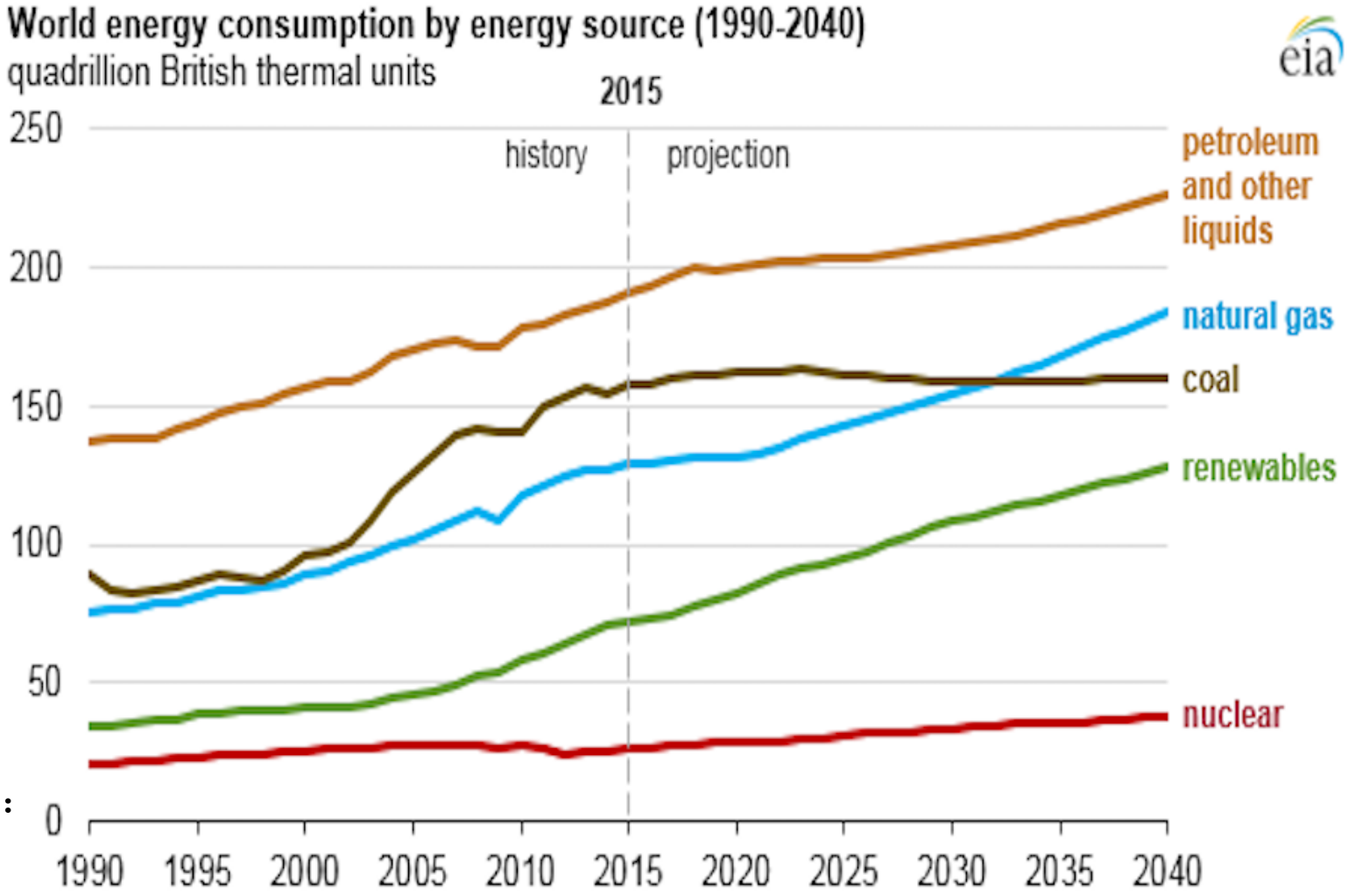
- Increased efficiency – driven by regulatory standards
- Reduced Cost per unit

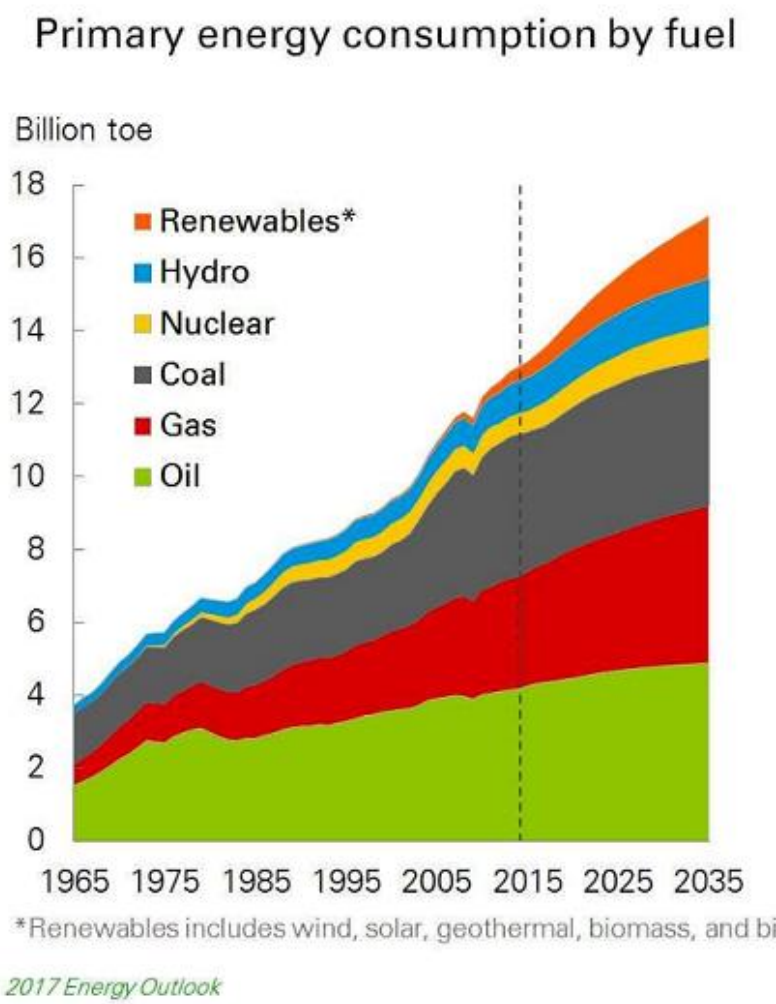
BUT:

- Increased unit size (Rebound effect/'Jevons' Paradox'))

Source: ACEEE American Council for an Energy-Efficient Economy

The Bigger (and Longer term) Picture?; Global Energy use





Sources :
EIA, BP

Global Energy Trends, 2018 edition. A step backward for the energy transition?

30 May 2018

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Enerdata intelligence + consulting

Press Release

After a 3-year stagnation, CO_2 emissions are on the rise again

Energy mix decarbonization and energy efficiency improvements remain insufficient

Paris (France) – May 30, 2018

+3.7%

Economic growth

At purchasing power parity

2016:

+2.1%

11.1 Gtoe

Rising energy consumption

+2%

27 $GtCO_2$

Rebound in CO_2

*: CO_2-energy emissions from energy combustion (>80% of CO_2 emissions)

"Reducing energy demand is compatible with economic growth"? A Contested Perspective; little empirical historical evidence base

Source: Enerdata (2018)

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Overarching Context:

Why, in light of all we know, do we find it so difficult to make any Progress?

or

What are the Structural Barriers to achieving Sustainability?

Overarching Context:

Why individuals

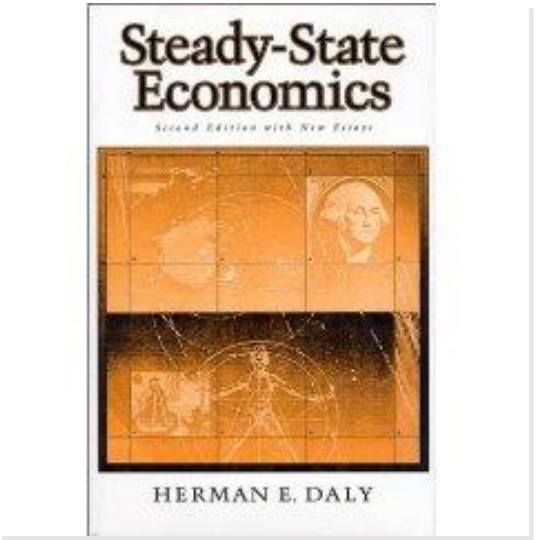
The Dominant Global Paradigm of

CONSUMPTIVE GROWTH

are the Structural

Barriers to achieving Sustainability?

Paradigm of GROWTH



Herman Daly (2009):

*"When we **"grow up"** the first thing to do is to **stop further growth**, to become a **mature steady state** in physical dimensions, and then concentrate on **qualitative development** and maintenance: knowledge, wisdom, justice, ..etc."*

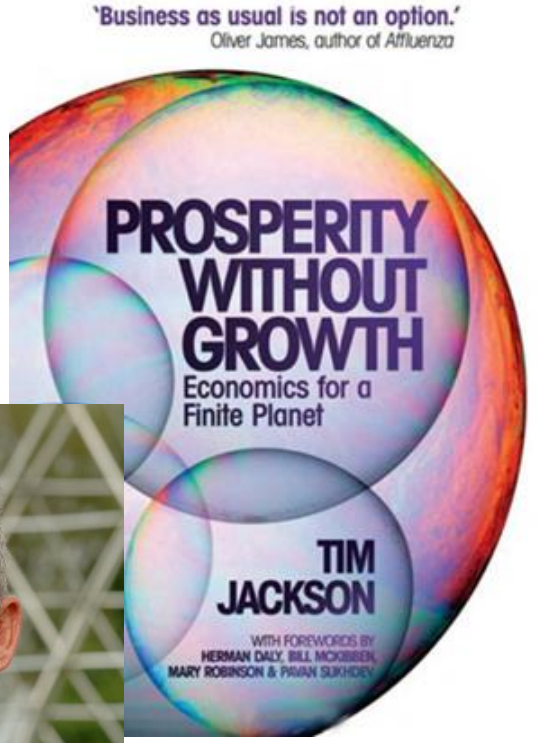
Paradigm of GROWTH

Growth for the sake of growth is the ideology of the cancer cell.

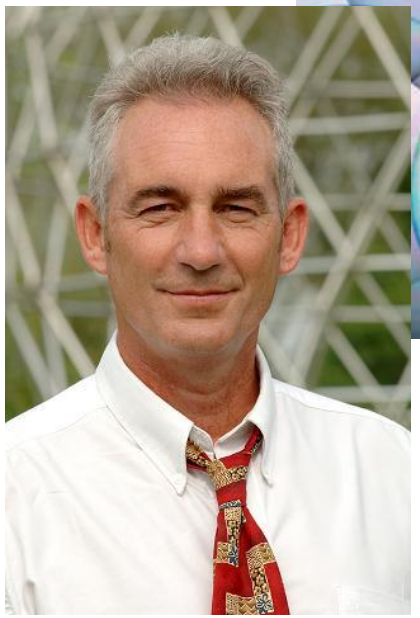
(Edward Abbey)

Paradigm of GROWTH

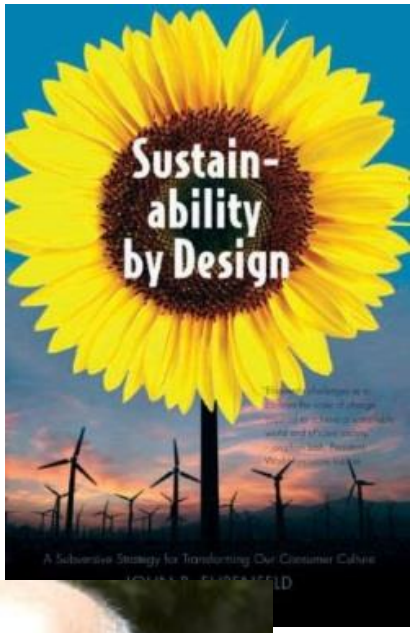
Tim Jackson (2009) argues in ***'Prosperity without Growth'*** that we cannot find 'prosperity' in GDP growth:



*"An **economy** predicated on the perpetual expansion of debt-driven materialistic **consumption** is **unsustainable** ecologically, **problematic** socially and **unstable** economically"*



Paradigm of CONSUMPTIVE GROWTH

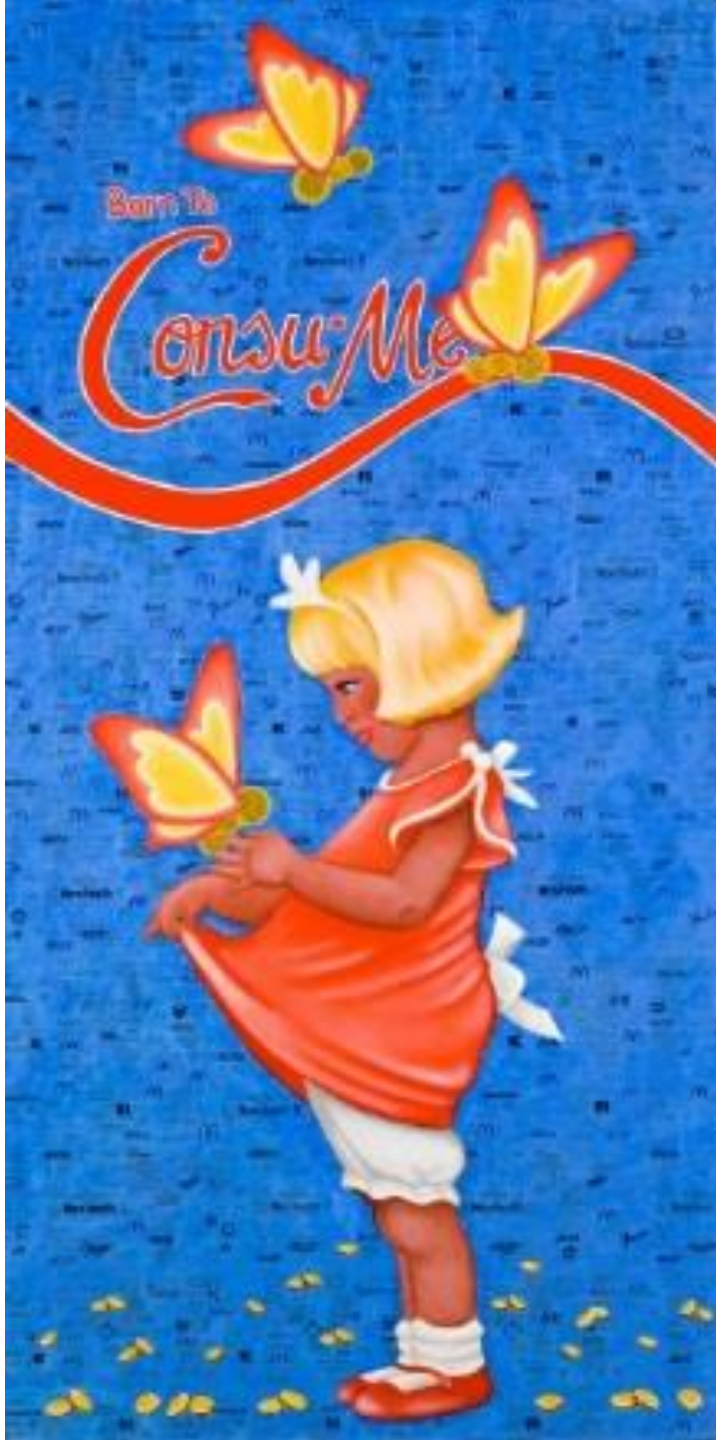


John Ehrenfeld (2008):

Promoting **increased consumption** as a means of stimulating **growth** produces neither **prosperity** nor **flourishing** but rather **inauthenticity** leaving '*a hole, something* ***unsatisfied*** *even if the task seems to have been successfully executed*', resulting in an **addictive** craving for more.

Alternative framings to the dominant paradigm:

The Metaphoric power of ART *as a critique of Consumerism*



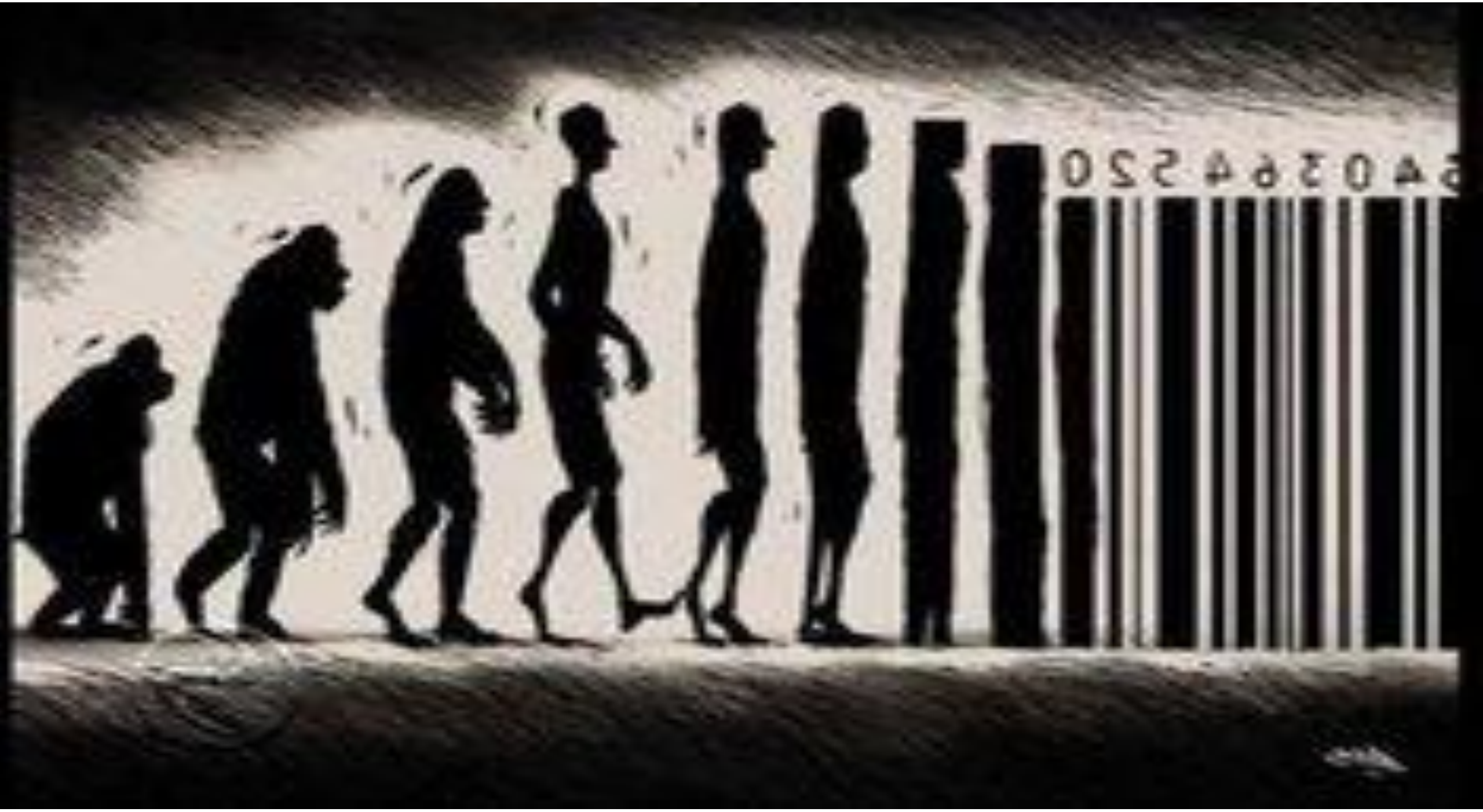
Freya Tripp

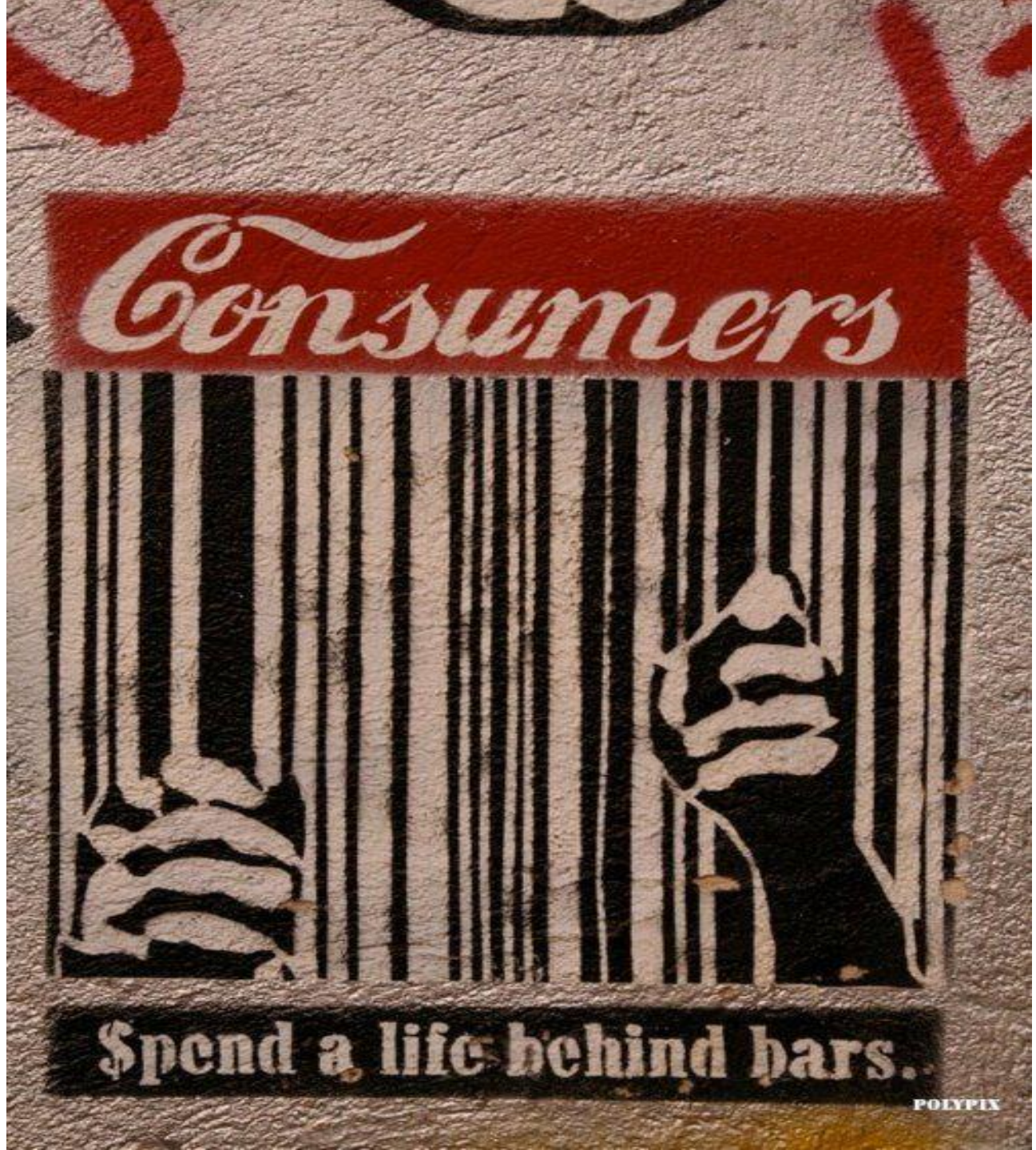
THEN...
REPAIR SHOP
CARTOON MOVEMENT
NOW...
REPAIR SHOP
CLOSED
!

give
its
urers
with
e is
this
ge in

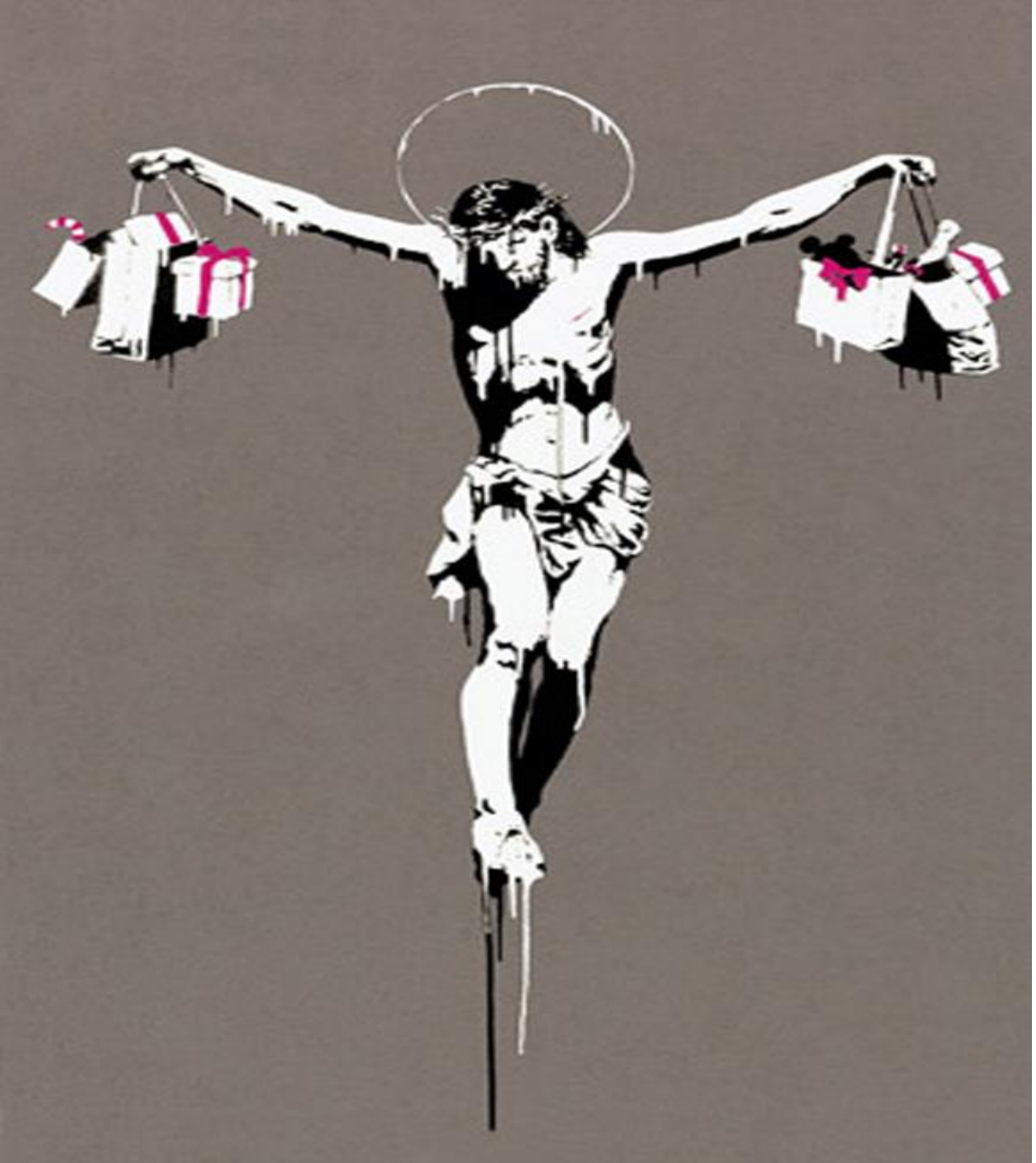
IPAD THEREFORE IAM

The iPad is the only show in town at the moment when it comes




Consumers
$pend a life behind bars.
POLYPIX

THE JOY OF NOT BEING SOLD ANYTHING
MAIDEN



Jesus Christ with Shopping Bags
(Banksy, 2005)

The BUYERARCHY of NEEDS

(with apologies to Maslow)

sarah L.com

THIS YEAR, RISE ABOVE IT

BUY NOTHING DAY
BUY NOTHING CHRISTMAS
NOVEMBER 25TH/26TH

COMMON THREADS INITIATIVE

REDUCE

WE make useful gear that lasts a long time
YOU don't buy what you don't need

REPAIR

WE help you repair your Patagonia gear
YOU pledge to fix what's broken

REUSE

WE help find a home for Patagonia gear
you no longer need
YOU sell or pass it on*

RECYCLE

WE will take back your Patagonia gear
that is worn out
YOU pledge to keep your stuff out of
the landfill and incinerator

REIMAGINE

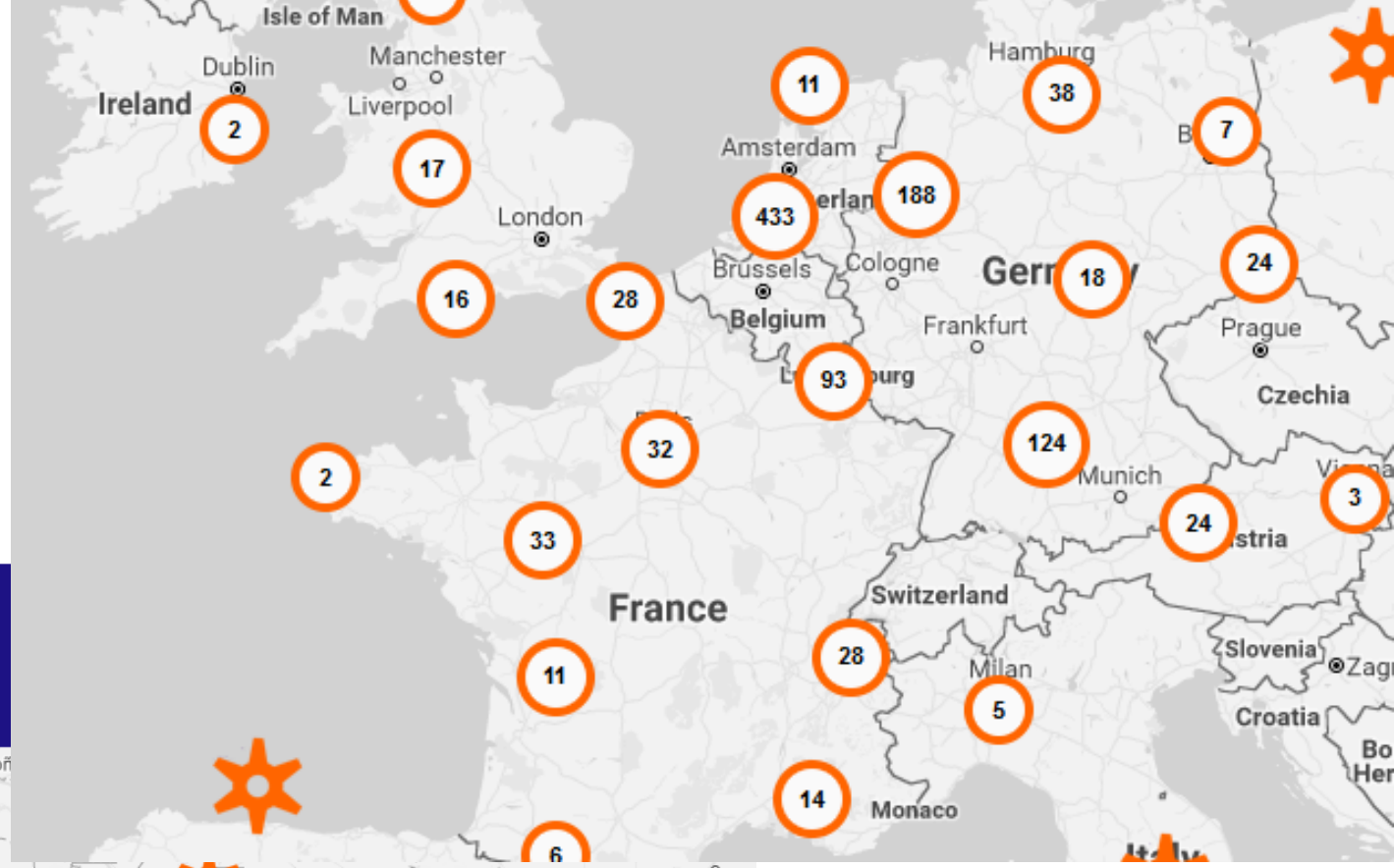
TOGETHER we reimagine a world where we take
only what nature can replace

patagonia

How many brands can run an ad like this?

Repair Café

Visit a Repair Café



VISIT ONE OF OUR 1251 REPAIR CAFÉS

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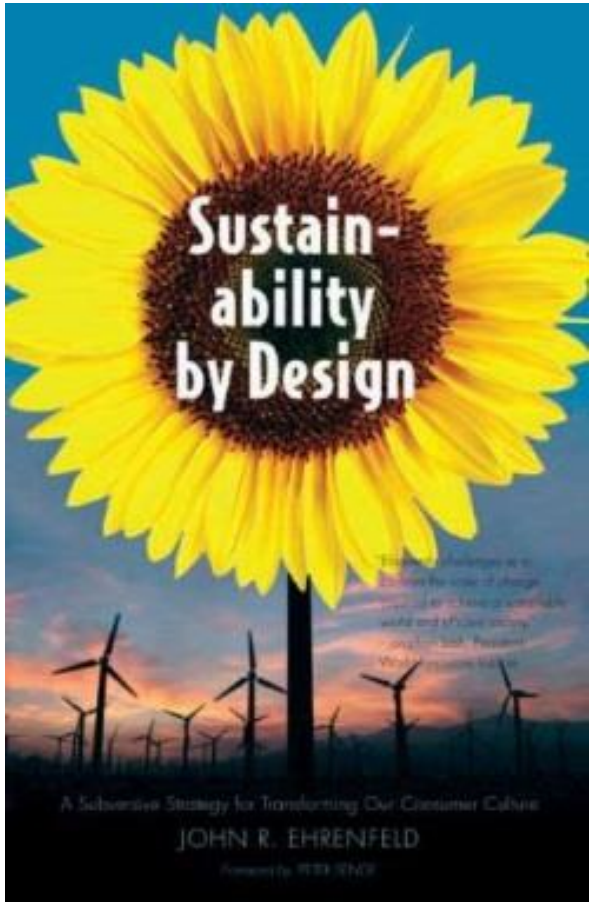
Managing Uncertainty in Complex Systems?

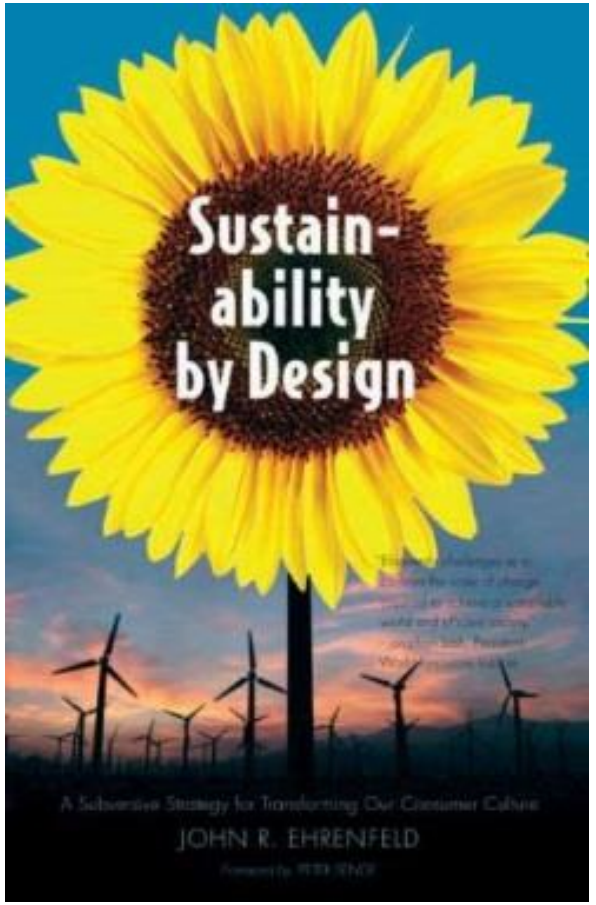
John Ehrenfeld suggests that Adaptive Governance, which would seek to maintain some emergent system property such as resilience, is more appropriate than traditional Systems Management, where the focus tends to be on some quantitative outcomes such as sustainable yield.



Managing Uncertainty in Complex Systems?

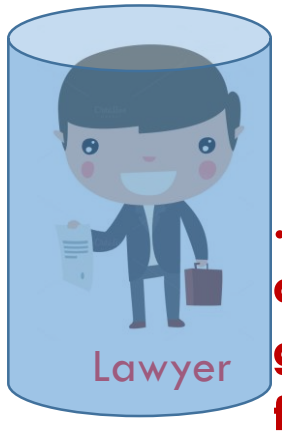
"If a single feature of adaptive governance stands out, it is the criticality of building understanding about the system. In practice this generally means a constant search for and recognition of areas of uncertainty and ignorance, coupled to planned intervention designed to produce learning as well as keep the system functioning and healthy."

John Ehrenfeld (Sustainability by Design, p. 183)

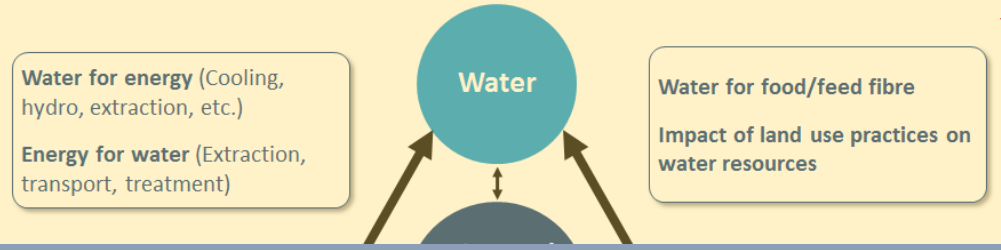


How can we best;

- identify suitable possible interventions
- to achieve experiential system learning and healthy (sustainable) functioning
- of complex socio-enviro-technical systems with inherent uncertainty? (e.g. your project, water in Cape Town, South Africa)

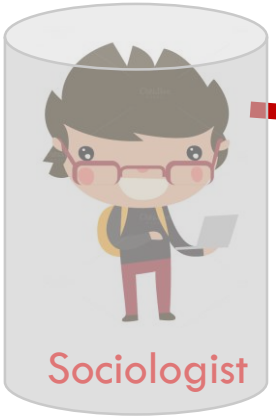


..developing/ applying a global legal frame



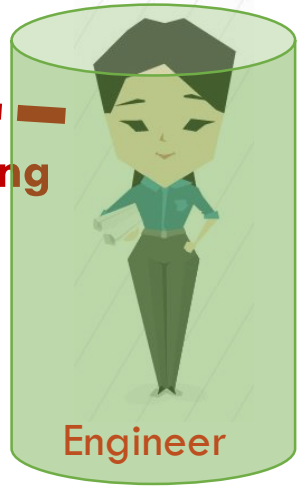
..incorporating economic externalities

'There are no whole truths; all truths are half-truths.
It is trying to treat them as whole truths that plays the devil.'
Alfred North Whitehead (1954)



..how humans relate to world around them through stories, myths, (meta-)narratives; ultimately an issue of ethics

..developing/applying appropriate technologies



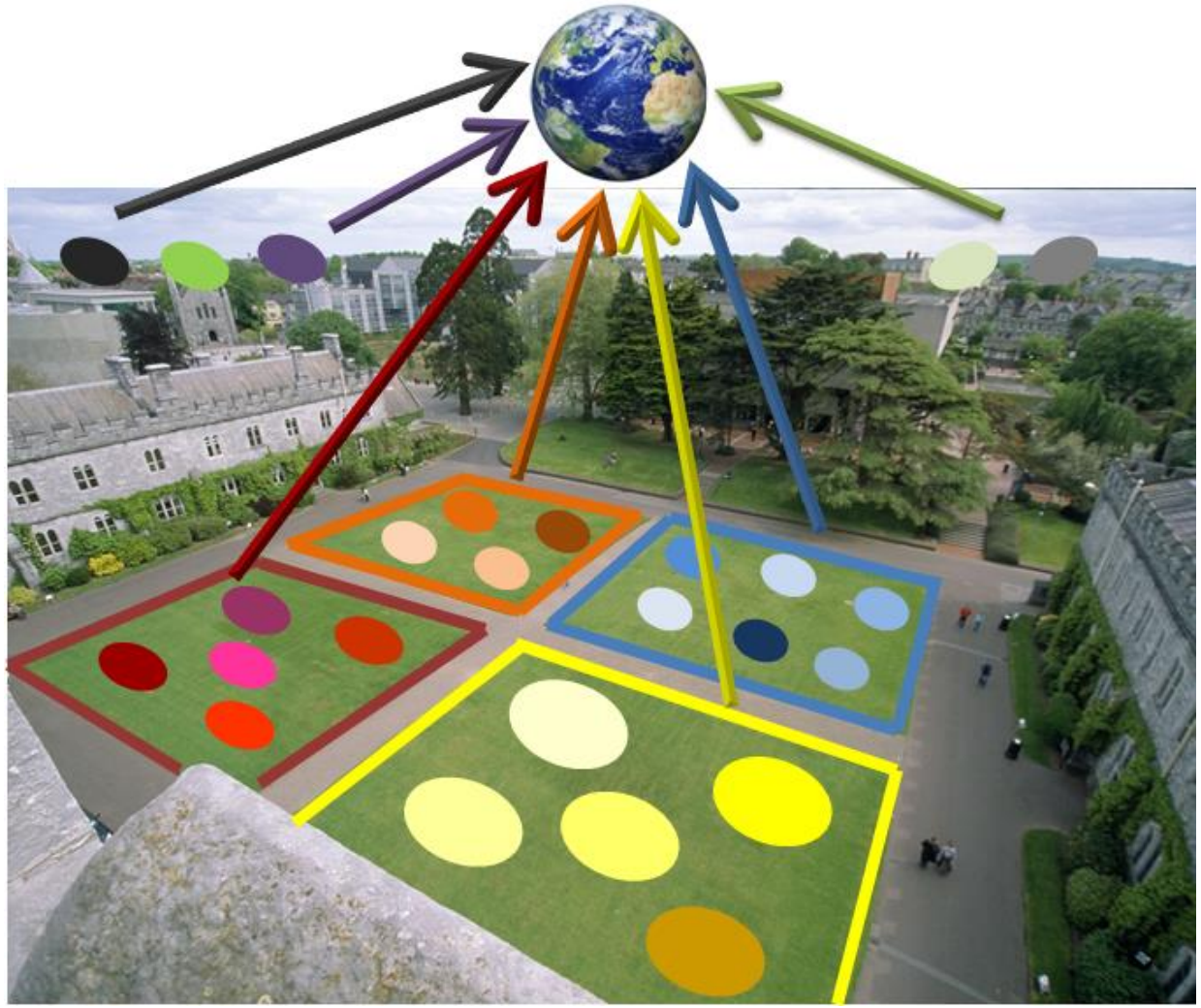
Transdisciplinarity; seeking ***emergent*** knowledge built on strong ***disciplinary*** pillars, while ***transcending*** them

Los Cuatro Postes, Ávila, Spain

'*Unitas multiplex*' (Morin, 2008)

'*Unity amidst diversity and diversity through the unity*' (Klein, 2004)

Morin, E., 2008. On Complexity. Hampton Press.
Klein, J. T., 2004. Prospects for transdisciplinarity. *Futures*, 36, 515-526.



Key take away points:

1. *Socio-Enviro-Technical Systems are **Complex**, and are characterised by **inherent Uncertainty.***

2. *Such systems cannot be uniquely and 'objectively' described but are open to **framing.***

3. *'Managing' such uncertainty is best achieved through **Adaptive Governance**; **understanding** the system and proposing potentially useful **interventions**, which can best be done via **Transdisciplinary** approaches.*