IÑIGO CAPELLÁN-PÉREZ

BEYOND GREEN GROWTH: FACING ENERGY REALITIES

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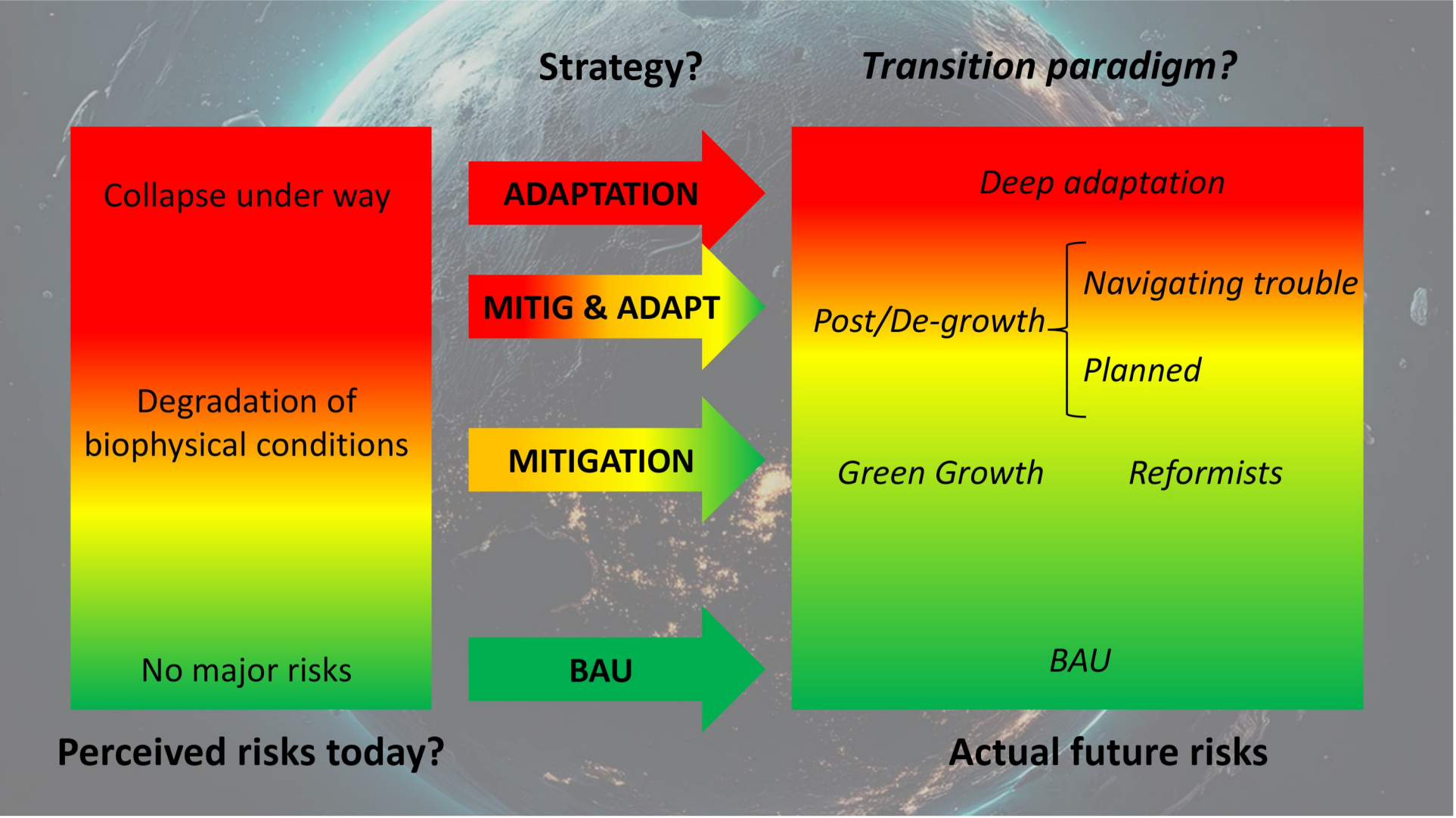
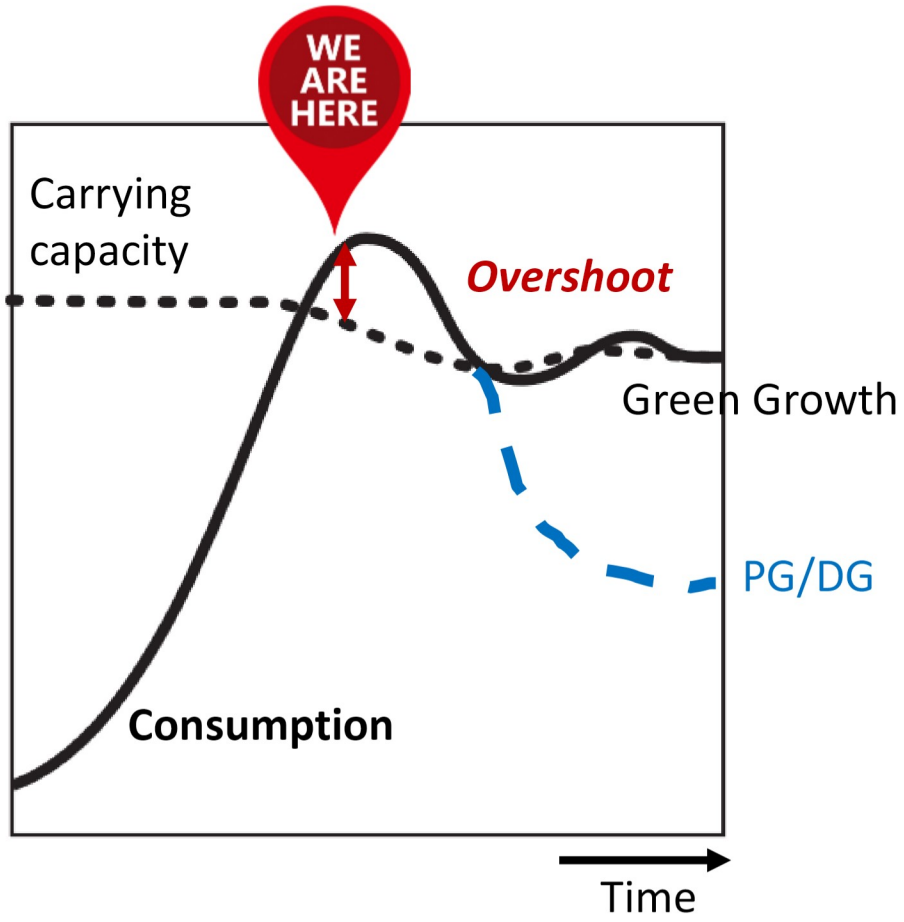
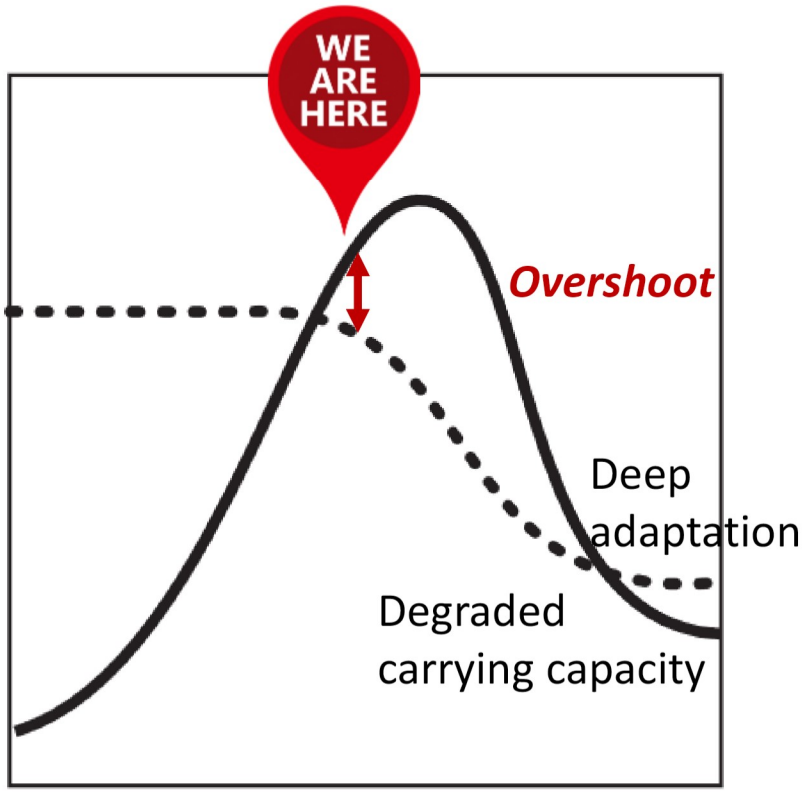
https://geeds.es/en/

UVa geeds


Strategy?
Transition paradigm?
Collapse under way
Degradation of biophysical conditions
No major risks
ADAPTATION
MITIG & ADAPT
MITIGATION
BAU
Deep adaptation
Post/De-growth
Navigating trouble
Planned
Green Growth
Reformists
BAU
Perceived risks today?
Actual future risks



c) Overshoot and Oscillation



d) Overshoot and Collapse

What is Green Growth?

worldadaptationforum.org

Main elements

Capitalism

Economic growth

Efficiency improvements

Electrification

Low carbon novel technologies

Timely reaction to scarcities; substitutions

Policies and mechanisms

"Circular" Economy

Public-private partnerships

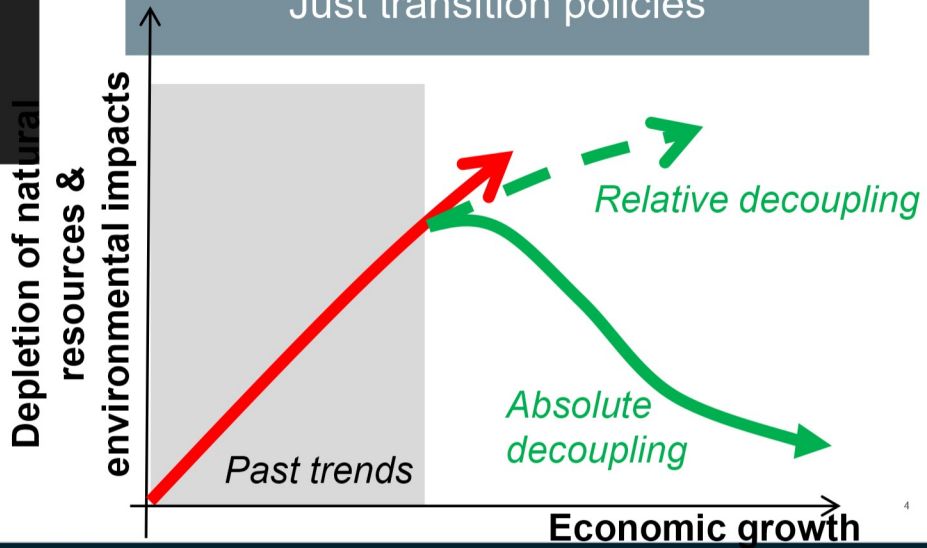
Green finance and markets instruments

Just transition policies

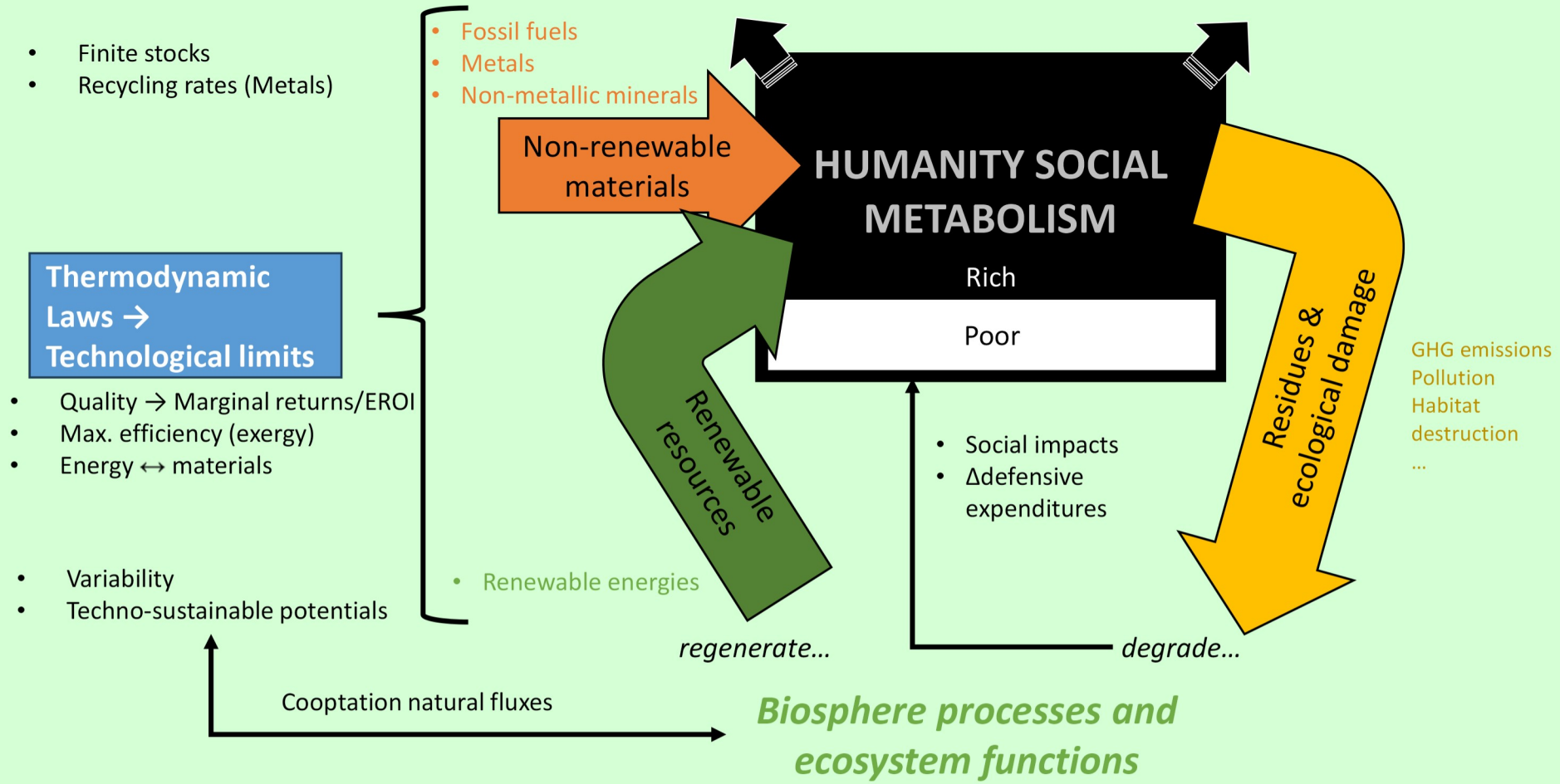
Targets

SDGs

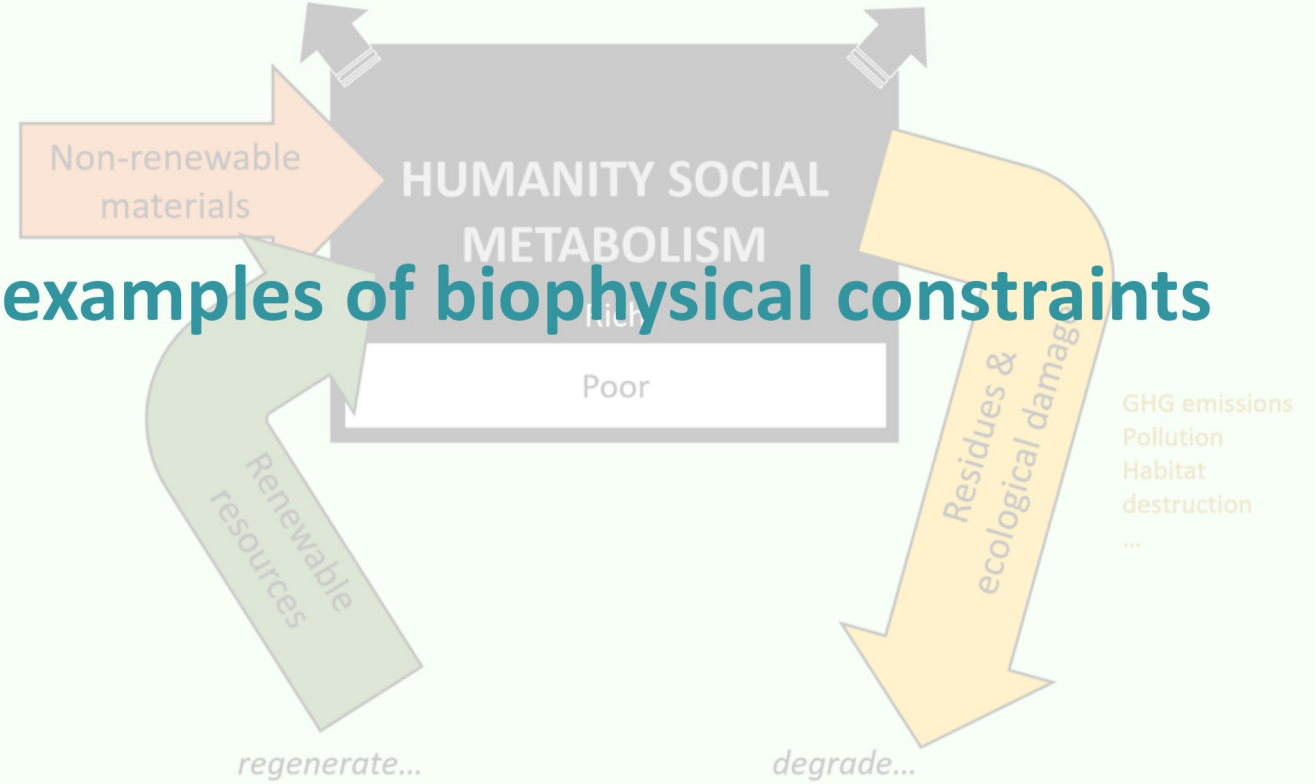
Absolute decoupling



Biophysical constraints on future energy pathways



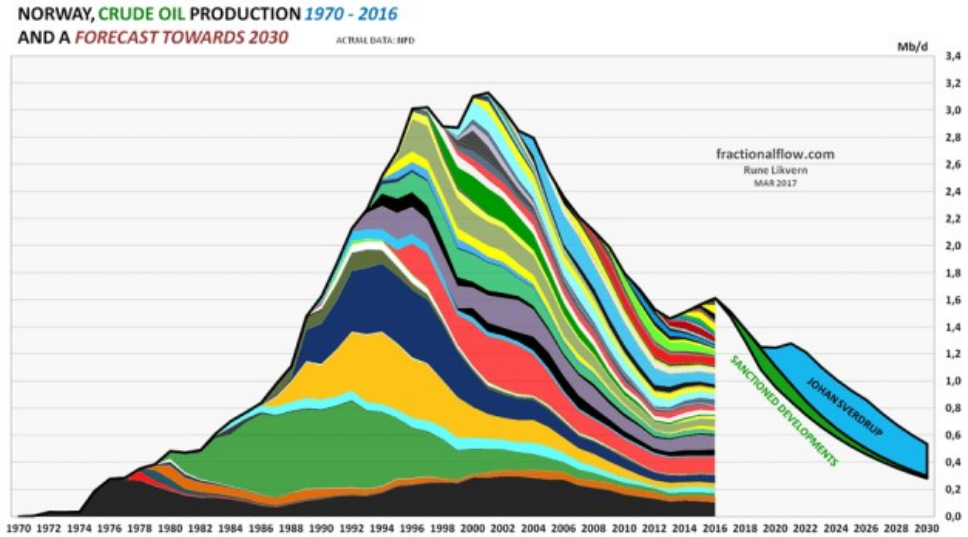
Biophysical constraints on future energy pathways

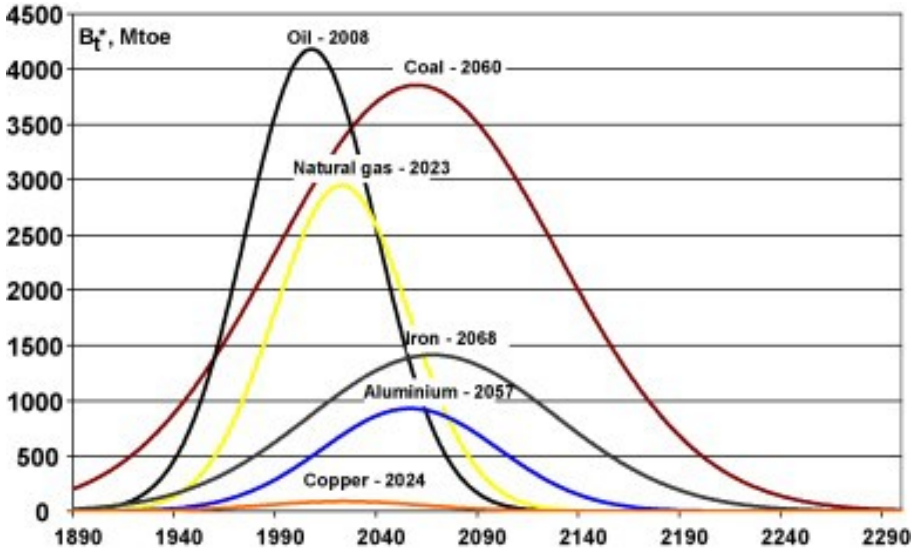


Selection of examples of biophysical constraints

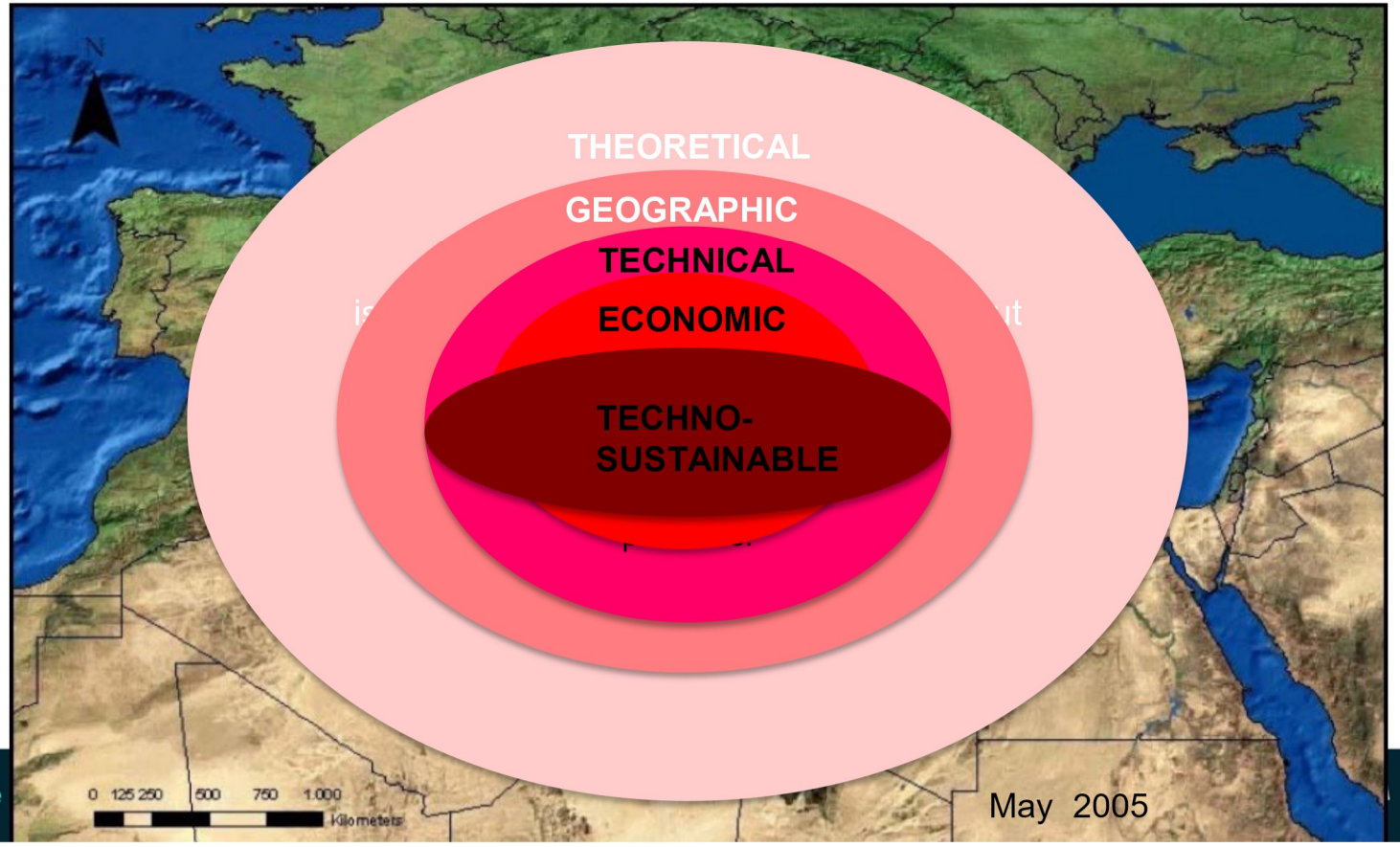
Depletable non-renewable resources

- ~85% energy used globally is fossil.
- Fossil fuels and materials are the “base” energies to perform the transition!
- Oil fracking revolution in USA temporary pause





Potential of renewables?

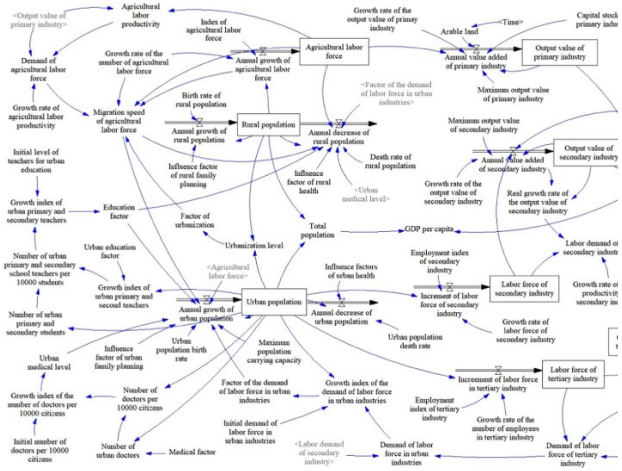


Methods – simulation results applying dynamic models

Mental models

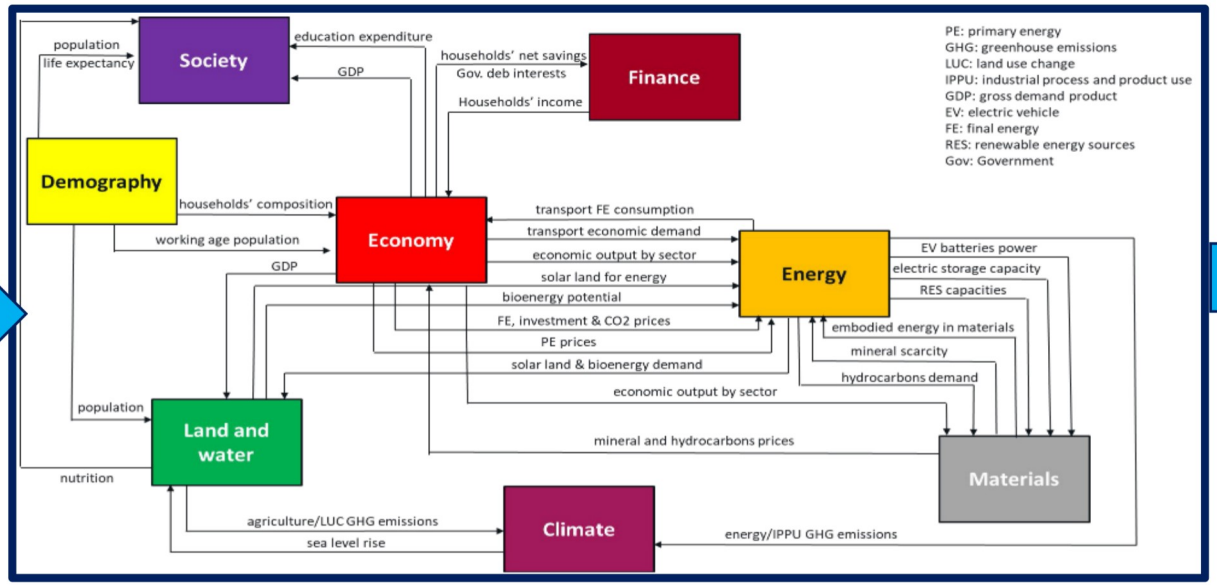
Theoretical models

Quantitative models

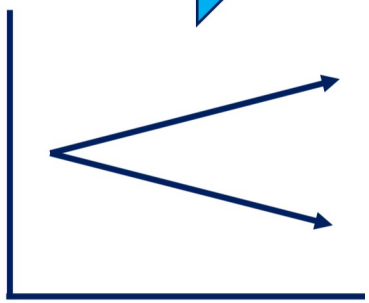


MEDEAS & WILIAM: System Dynamics Integrated Assessment Models (IAMs)

Scenarios ≈ *inputs* from model



Analysis of results



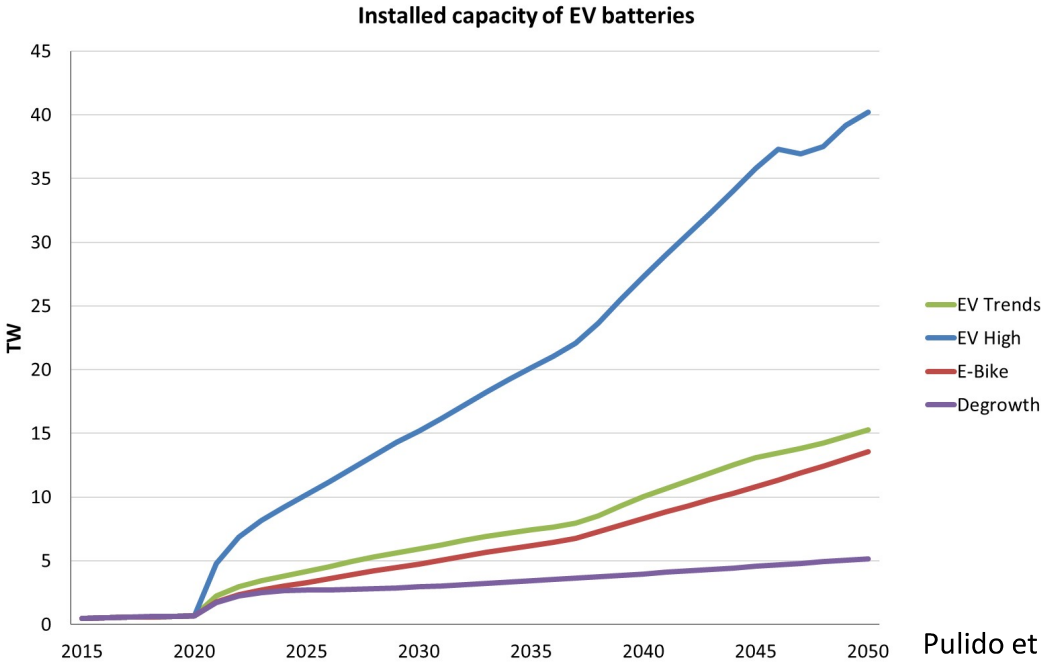
https://geeds.es/medeas/

https://github.com/LOCOMOTION-h2020/WILIAM_model_VENSIM

GitHub

Materials for global transport electrification

- MEDEAS-W model:



Pulido et al 2022

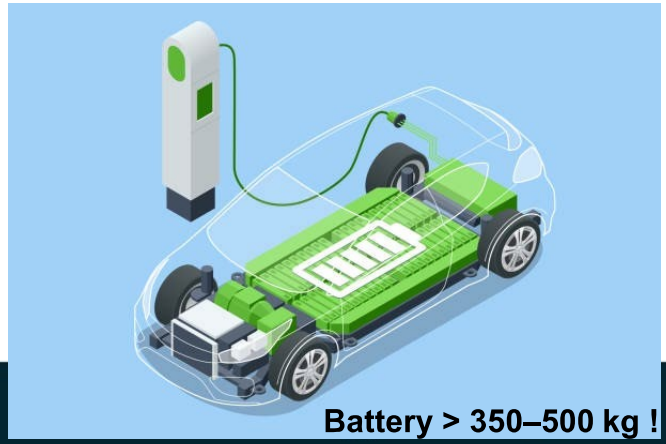
5 types of batteries depending on different critical materials:

NMC - NCA

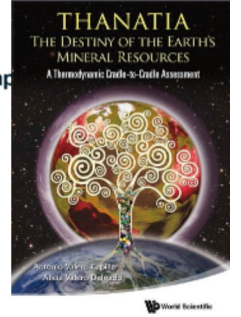
Co, Ni, Li

LFP

~~Co, Ni,~~ Li
+ Al, P, Fe, Cu



Materials for global transport electrification



Recycling rates

To reach high recycling rates:

- High recycling at the end of lifetime (**vs thermodynamical limits**)
- Sufficient stock available for recicling (**vs growth**)

INCREASE OF MINING !

Drill, baby, drill…

Green growth (and postgrowth, to a lesser extent):

Reserves > Al, Cu, Co, Li, Mn, Ni…

European Commission

EN

Aid, Development cooperation, Fundamental rights

International Partnerships

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Home > News and events > News > Global Gateway: European Union committed to sustainable mining partnerships at Mining Indaba conference

NEWS ANNOUNCEMENT | 3 February 2025 | Cape Town | Directorate-General for International Partnerships | 3 min read

Global Gateway: European Union committed to sustainable mining partnerships at Mining Indaba conference

The European Union (EU) proudly participates in the Investing in African Mining Indaba conference, reinforcing its commitment to fostering sustainable and mutually beneficial partnerships with Africa's mining sector.

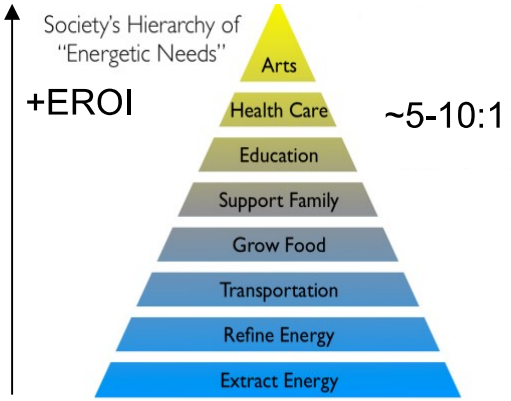
The EU, alongside its Member States, banks, and the private sector, stands ready to collaborate with African counterparts to boost the region's mining industry while ensuring long-term economic growth, environmental sustainability, and innovation.

"The EU is committed to partnering with Africa for a sustainable future. Our presence at this year's Mining

Energy Return on Energy Investment (EROI)

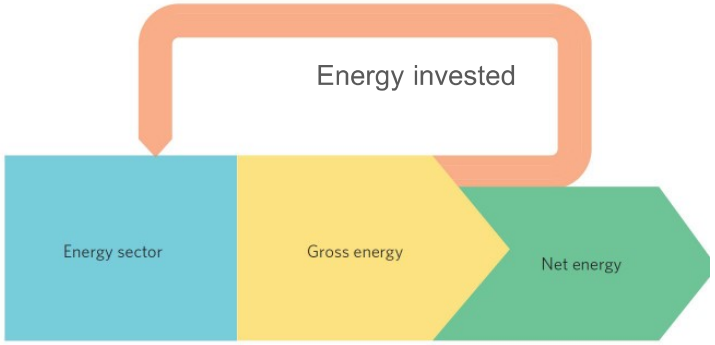
$$EROI = \frac{Gross\ energy\ returned}{energy\ invested}$$

- If societal EROI < 1:1 -> collapse!
- To be functional: societal EROI >> 1:1



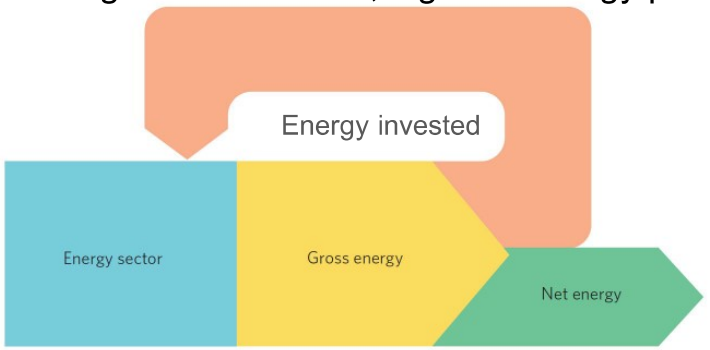
~5-10:1

Hall et al 2014



Dale et al., (2014)

High societal EROI, high net energy per capita



Low societal EROI, low net energy per capita

Simulation results

- Simulation of Green Growth for EU (80% RES by 2050)
- Application of hydrogen to hard-to-abate sectors (chemical industry, refineries, Steel, synthetic fuels)
- WILIAM model

	EROI system 2050
Baseline	~7:1
Green baseline	~4:1
Green baseline + h2 industry	~2:1

hydra https://www.hydraproject.eu/

Campos-Rodríguez et al 2024 (article in preparation)

** $EROI_{st}$ min for industrial socieites: 5-10:1

* A system with EROI ≤ 1:1 is impossible

Limits to techn improvements (1)

SilverSeek.com
20th YEAR ANNIVERSARY

Shifting material criticalities

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Samsung's Silver Solid State Battery Technology. 1 Kilogram of Silver per Car

August 14, 2024

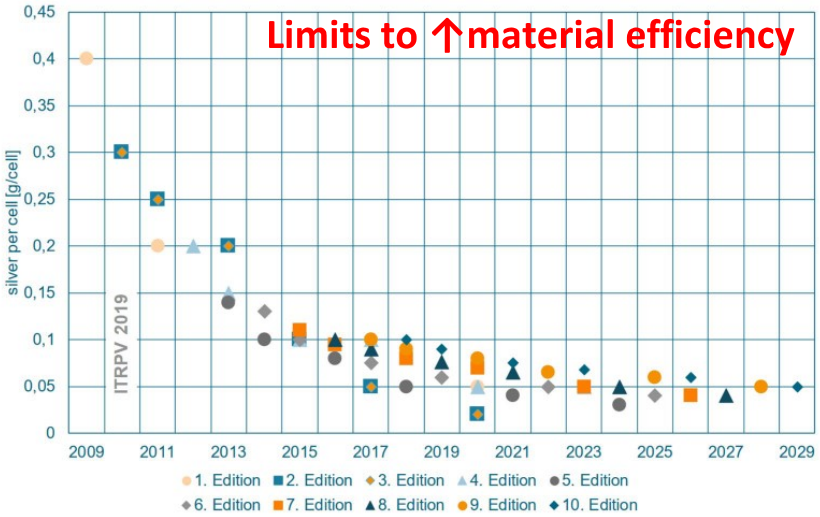
Jon Forrest Little

264 Shares

Because of Silver, you get these improved performance characteristics:
1. 600-mile range (about double the average range on today's market)
2. Full charge in 9 minutes
3. Lighter weight
4. Lifespan of 20 years

Review ITRPV predictions

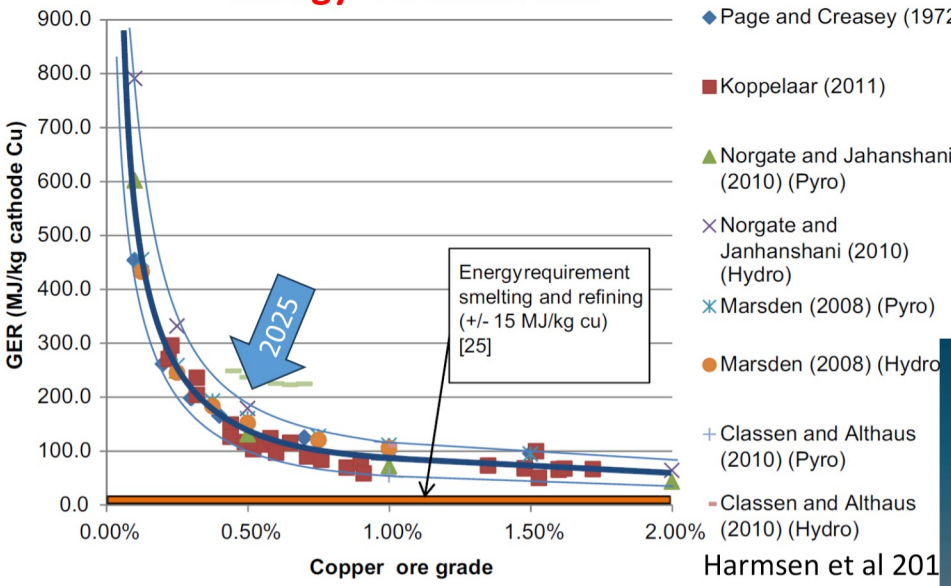
Silver amount per cell



Limits to techn improvements (2)

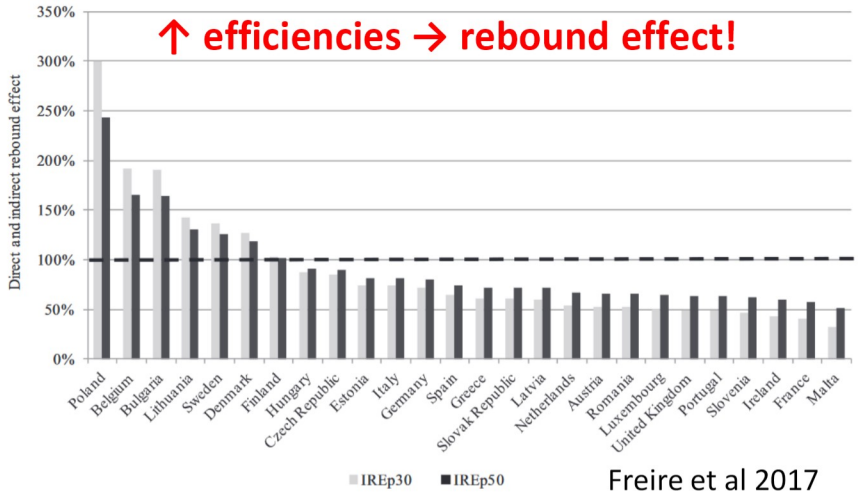
worldadaptationforum.org

energy ↔ materials

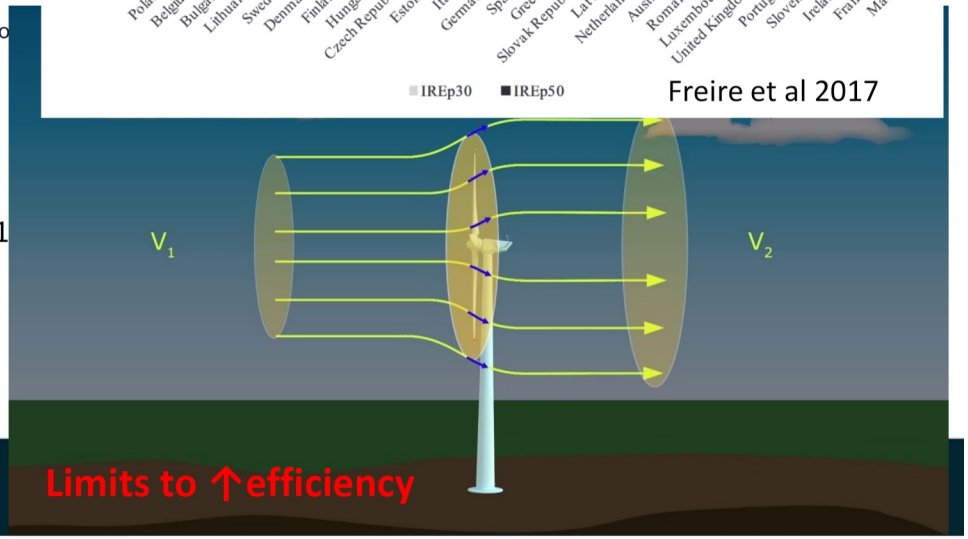


Harmsen et al 201

↑ efficiencies → rebound effect!



Freire et al 2017



Limits to ↑efficiency

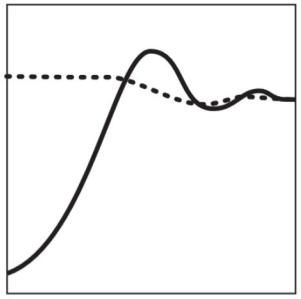
Conclusions
About renewables

- **Renewables are not unlimited!** Potential reduced by biophysical constraints that reduce their potential (variability, minerals, land…).

- **PARADOX**: the faster the transition to renewables, the greater the pressure on the system's viability

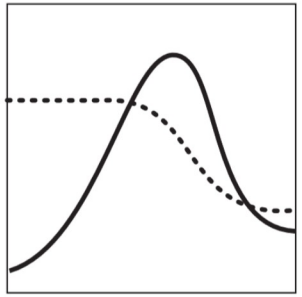
Conclusions
About transition

- **Green Growth faces underexplored shortcomings**
- **Degrowth scenarios ease achieving targets** *yet still taking shape*
- **There are no technically optimal solutions for the transition(s) — only political and social decisions**



c) Overshoot and oscillation results if

- **Signals or responses are delayed, and**
- **Limits are unerodable or are able to recover quickly from erosion.**



d) Overshoot and collapse results if

- **Signals or responses are delayed, and**
- **Limits are erodable (irreversibly degraded when exceeded).**

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UVa geeds grupo de energía, economía y dinámica de sistemas

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