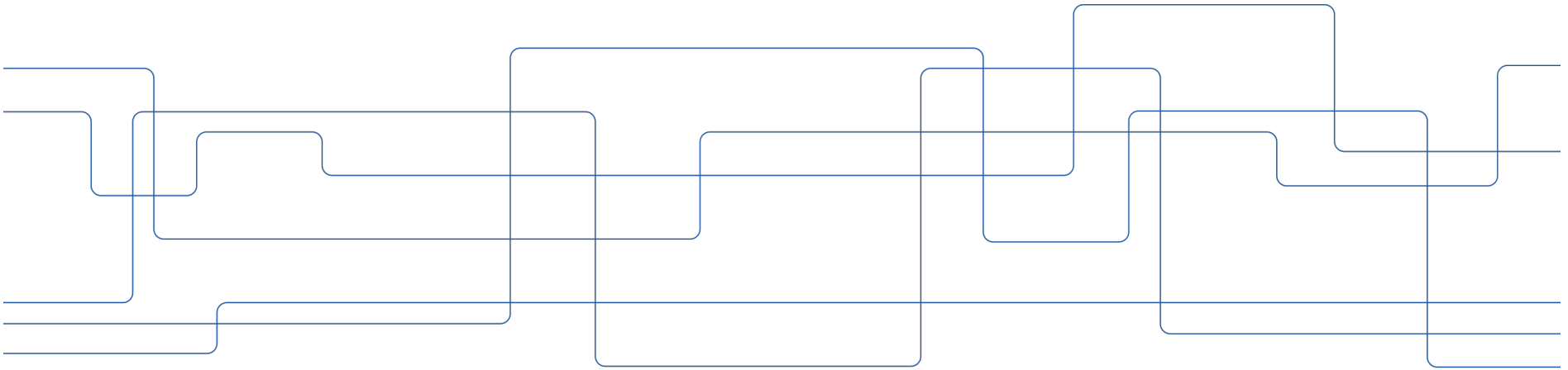
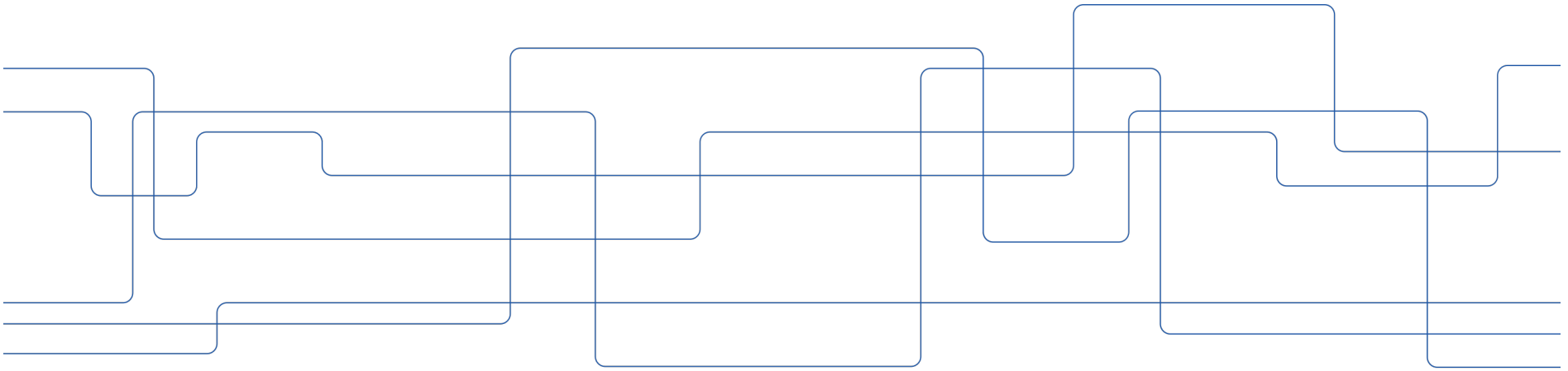
Computing within Limits

Daniel Pargman (pargman@kth.se)



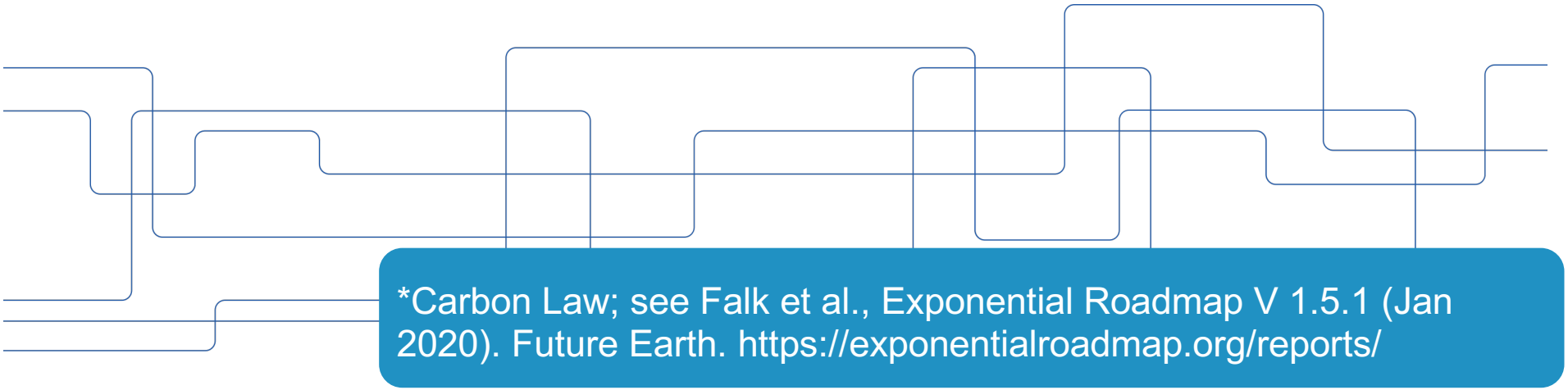
Computing within Limits and Carbon Law computing

Daniel Pargman (pargman@kth.se)



Computing within Limits and Carbon Law* computing

Daniel Pargman (pargman@kth.se)



*Carbon Law; see Falk et al., Exponential Roadmap V 1.5.1 (Jan 2020). Future Earth. https://exponentialroadmap.org/reports/

Sustainable Futures Lab (SF Lab)

Daniel Pargman

Elina Eriksson

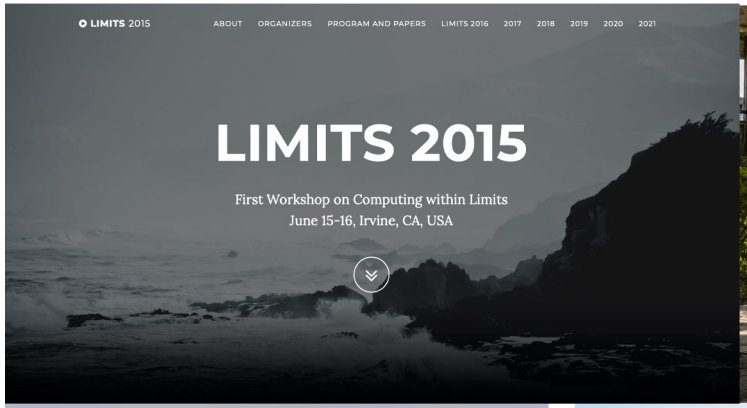
Blog: https://sflab.eecs.kth.se/

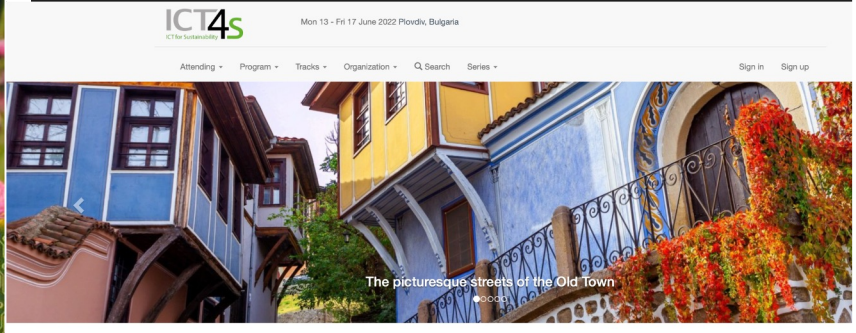
Sustainable Futures Lab (SF Lab)

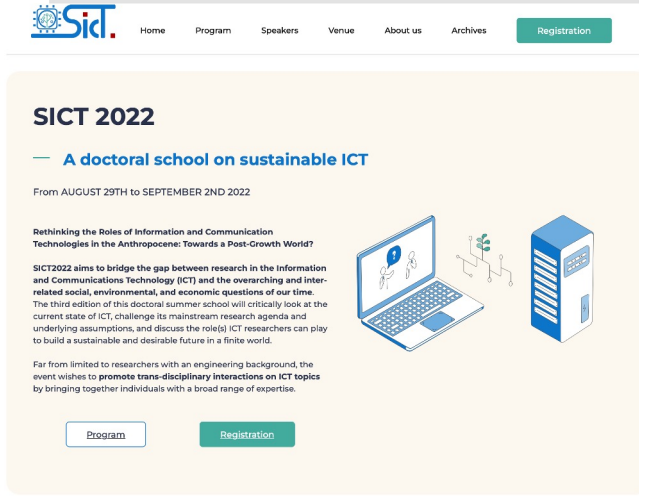
- **Research Focus**

1. ICT's role in the transition to a more sustainable society; a good life within planetary boundaries.
   - *Food*
   - *Energy*
   - *Transportation*
   - *Cities*
2. Futuring (future scenarios, counterfactuals, design fiction etc.)
3. ICT & Sustainability education

Exploring a new research field







Exploring a new research field

‹ Sustainability

Projects

Projects in MID4S

HabitWise

FLIGHT

FRIDGE

KITCHEN

Energy Review

Food Review

Homo Colossus

Event Horizon

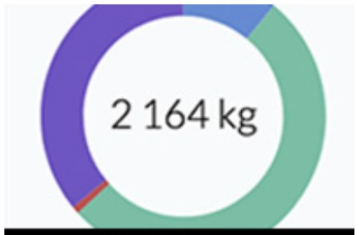
Digital Stewardship

Projects in MID4S


Food Review


FLIGHT


KITCHEN



HabitWise


FRIDGE


Energy Review


Homo Colossus


Event Horizon


Digital Stewardship


Sonic Interaction Design for Energy Efficiency


Ai and the Artistic Imaginary

‹ Sustainability

Projects

Projects in MID4S

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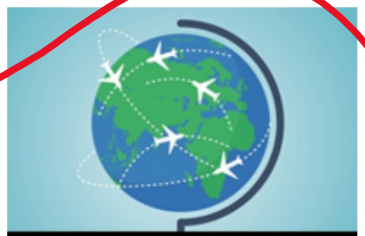
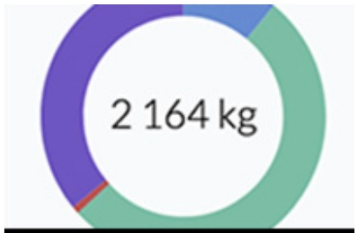


FLIGHT

KITCHEN

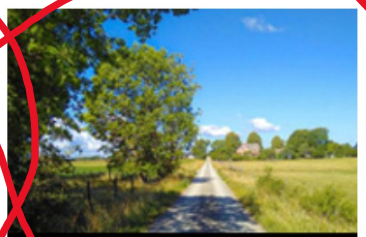


HabitWise

FRIDGE

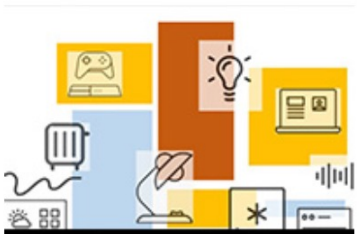
Energy Review

Homo Colossus



Event Horizon

Digital Stewardship



Sonic Interaction Design for Energy Efficiency

Ai and the Artistic Imaginary

We love to have guests!

Distinguished lecture: Adrian Friday

Save to calendar

SEP
06

Date and time: 6 September 2022, 13:00-14:00 CEST (UTC +2)
Speaker: Adrian Friday, Lancaster University
Title: Will ICT help save the world? Exploring the role of ICT in promoting sustainability

Where: Digital Futures hub, Osquars Backe 5, floor 2 at KTH main campus
Directions: https://www.digitalfutures.kth.se/contact/how-to-get-here/

OR

Zoom: https://kth-se.zoom.us/j/69560887455
Meeting ID: 695 6088 7455
Password: 755440

Moderator: Emil Björnson

Abstract: In the talk, I will discuss the magnitude of the challenge facing us. Why I believe technology is important in addressing this. I think many dominant narratives about the role of ICT are, I believe, wrong; and are, in fact, inherently limited in their view of possible gains and impacts ICT might have in the future. I'll then address my thoughts on whether ICT can help save the planet in the Anthropocene and offer some closing discussion points on things to consider to ensure that ongoing and future work is appropriately framed to have a genuine and positive impact.

Adrian Friday is a Scholar in residence in August 2022 at Digital Futures.

Bio: Adrian Friday is a Professor of Computing and Sustainability at Lancaster University, UK. My work focuses on how ubiquitous systems, data, and empirical studies reveal everyday life's environmental and energy impacts and offer new, more sustainable ways of doing. I am passionate about understanding the relationship between the digital and the future and how to promote sustainability. My collaborative and multidisciplinary projects in this area have focused on various sites of energy demand aligned with *digital futures*. These have included energy use in the home, thermal comfort, sustainable food shopping *(rich and healthy life*), and understanding last-mile logistics to promote sustainability ('smart society'). My ongoing projects focus on environmental and social justice for the gig economy and a significant new research programme exploring a combined statistical, machine learning and qualitative approaches toward net zero from energy and IoT data, co-designed with commercial stakeholders.

Computing within Limits and Carbon Law computing

Content:

1 Computing within Limits

2 Interactive session

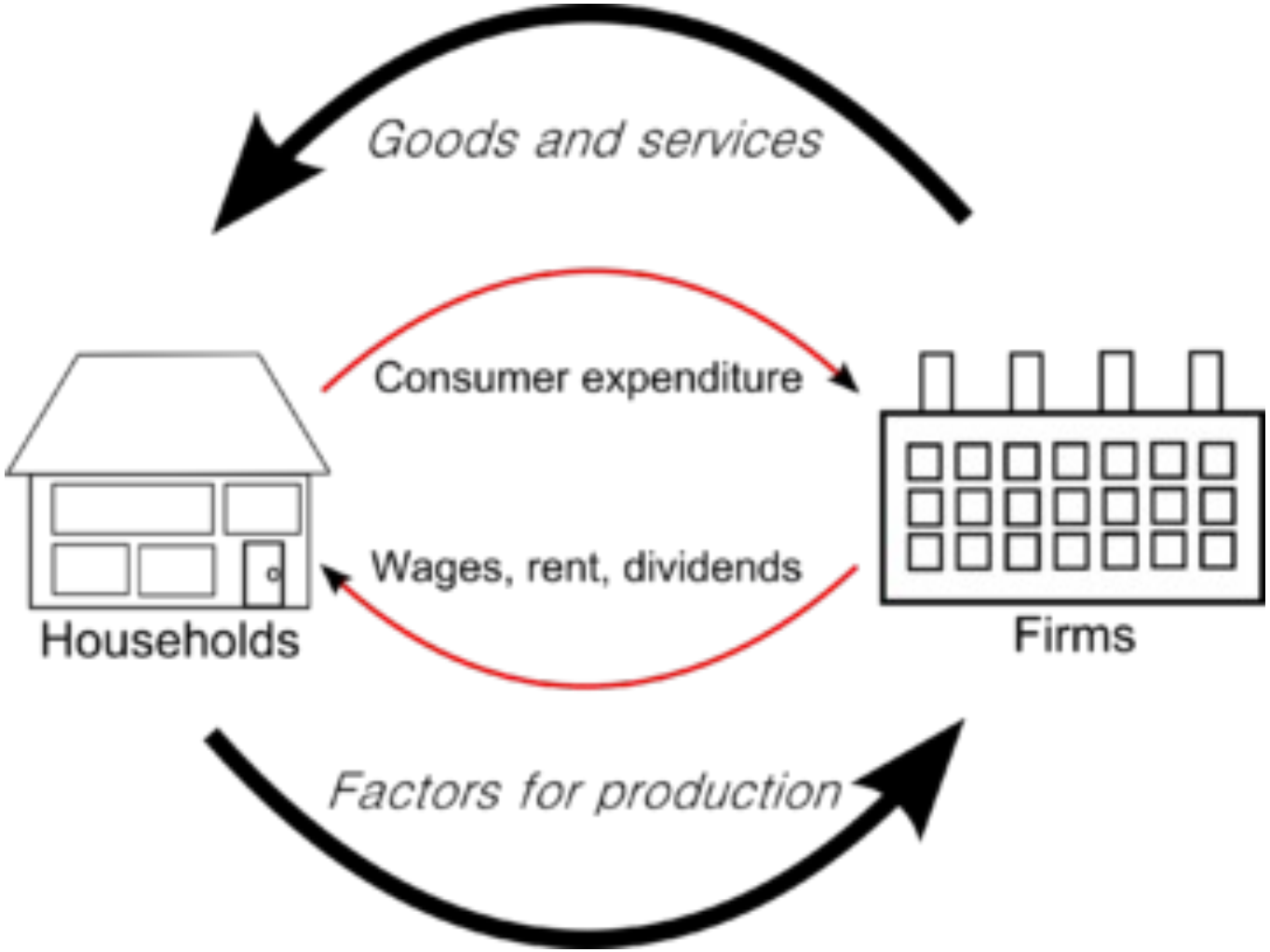
3 Computing within Limits applied

4 Q & A

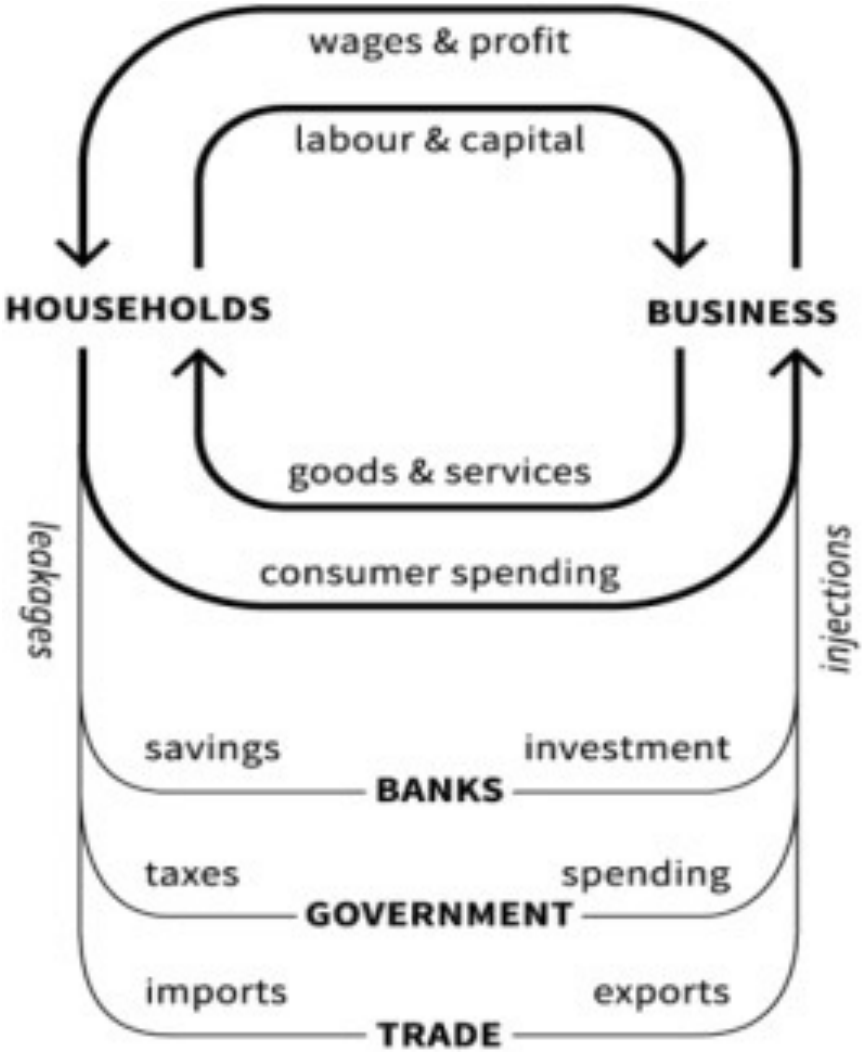
Computing within Limits and Carbon Law computing

My purpose with this talk!

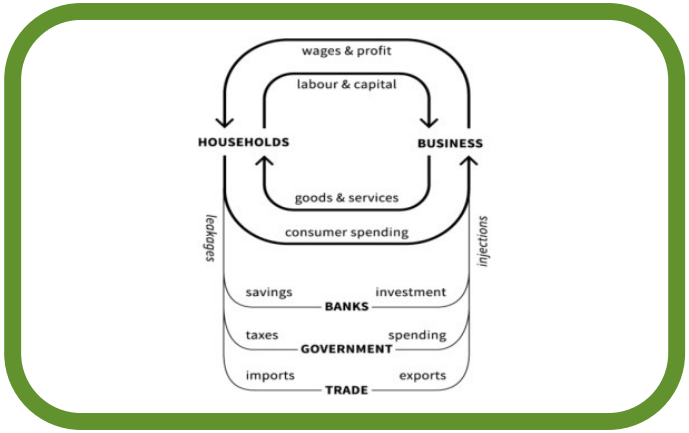
The circular flow of money and goods



The circular flow of money and goods



Traditional economist: ”This is the economy”

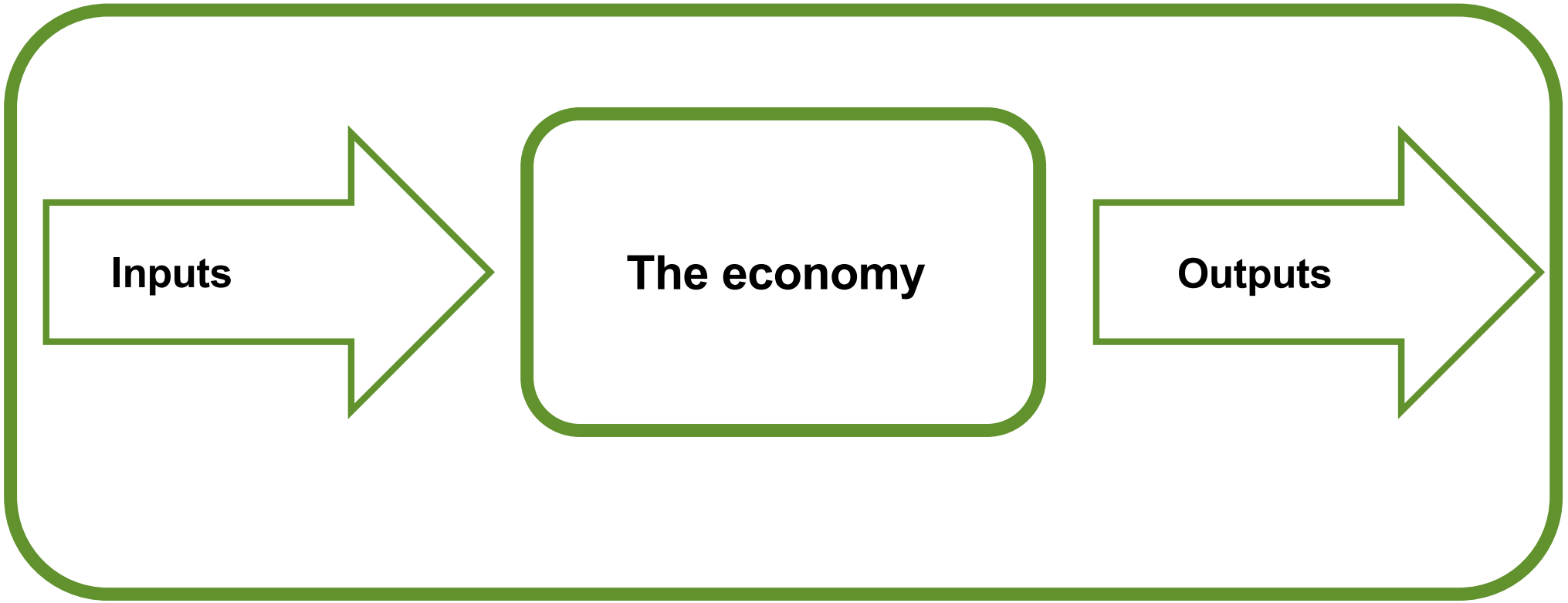


The economy

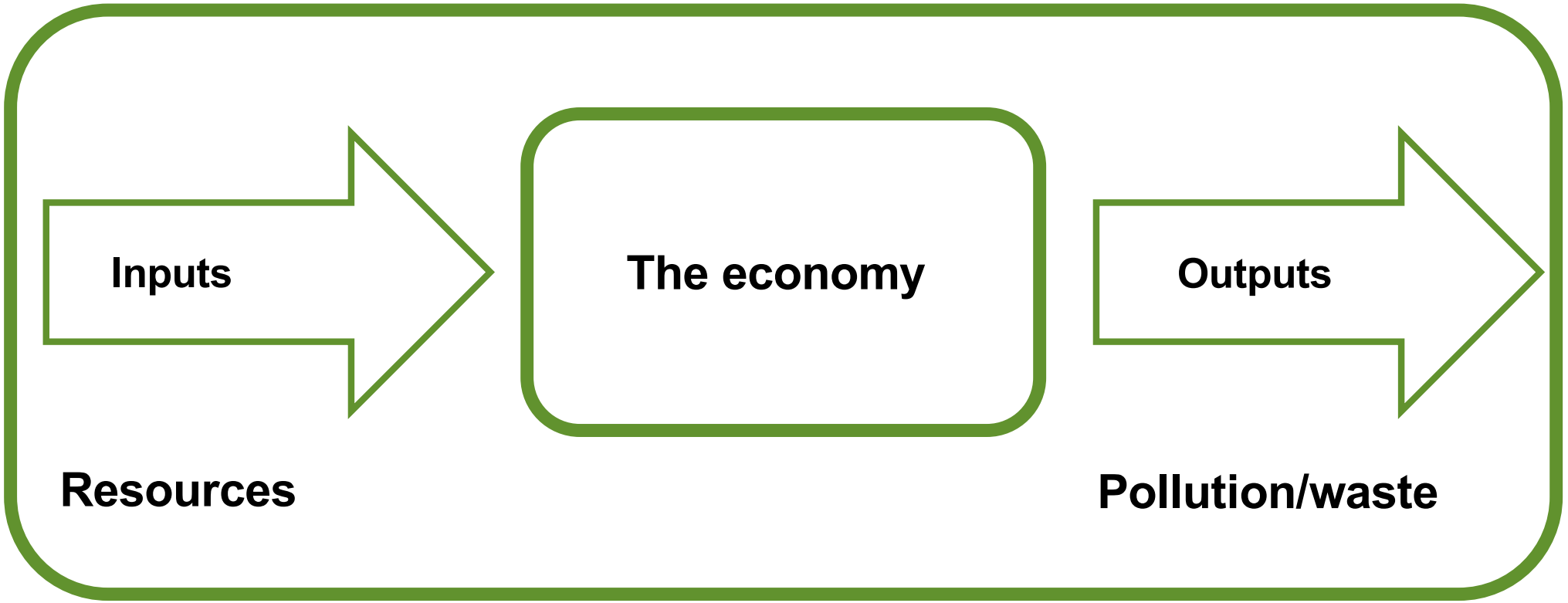
The economy

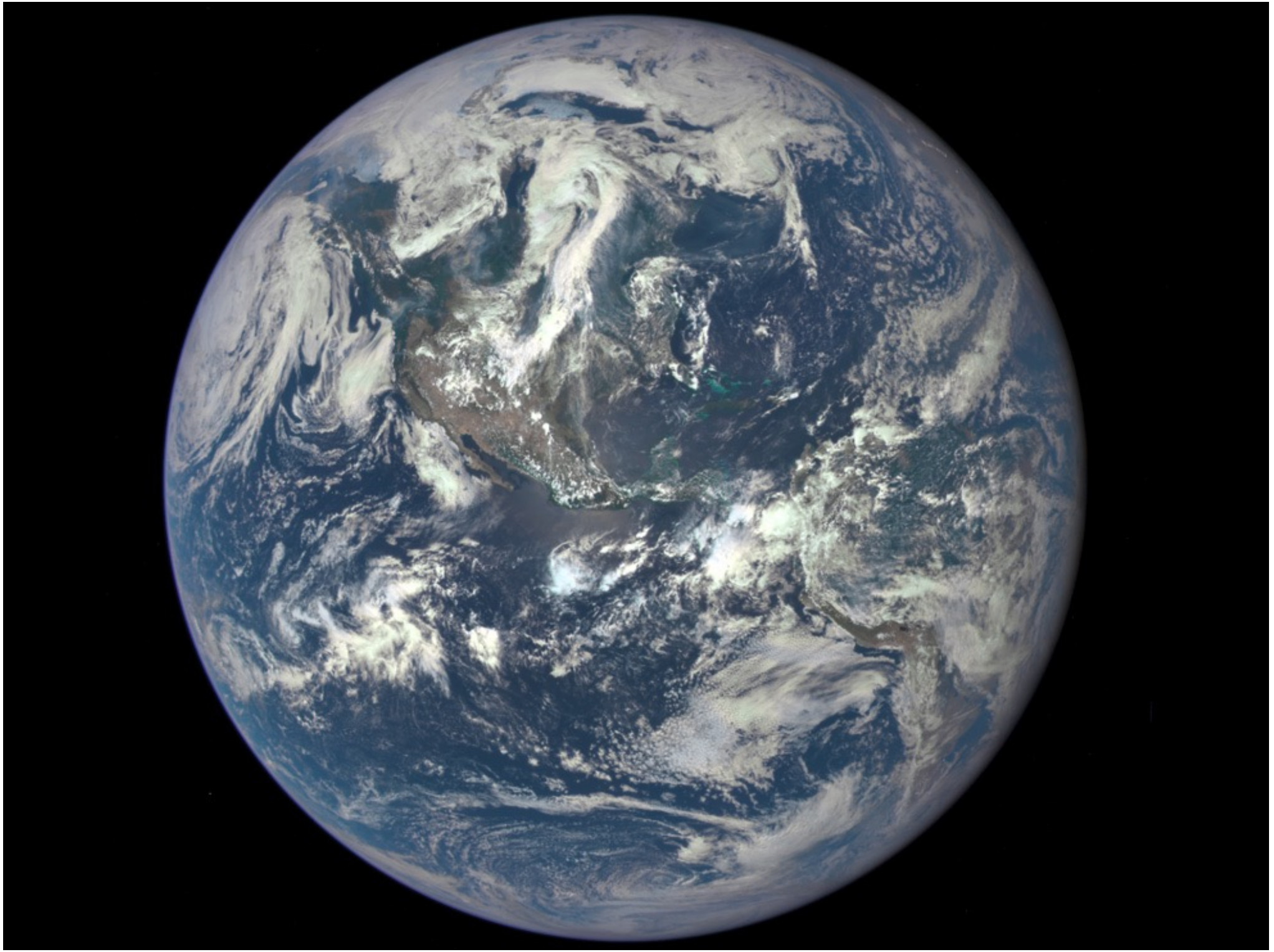
The economy

Herman Daly's heresy (World Bank 1994)



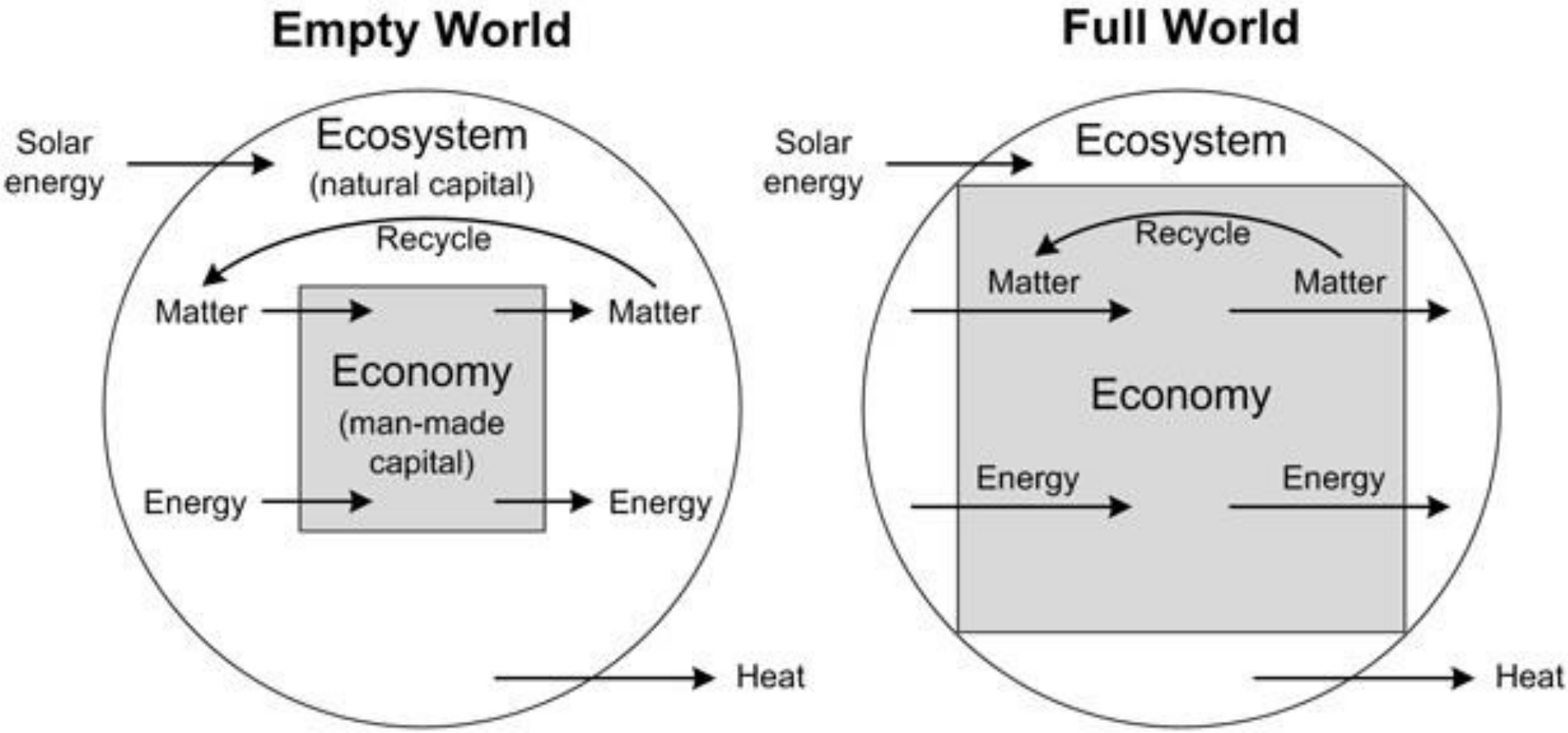
Herman Daly's heresy (World Bank 1994)





The size of the economy is limited by the fact that we live on a finite planet

Empty-world vs full-world economics



Daly, H. E. (1992). From empty-world economics to full-world economics: Recognizing an historical turning point in economic development. Population, technology and lifestyle, 23-37.

A focus on resources

Resources

Pollution/waste

Energy, minerals

Modern society

CO2, e-waste

A world of limitations

- **No lack of sustainability-related threats**
  - **Climate change**
  - **Species extinction**
  - **Pollution**
  - **Water scarcity**
  - **Limitations on food production**
  - **Overpopulation**
  - **Economic recession**
  - **Unemployment**
  - **Crisis of political leadership**
  - **Social instability**
  - **Peak oil**

A world of limitations

- **No lack of threats to business as usual**
  - Climate change
  - Species extinction
  - Pollution
  - Water scarcity
  - Limitations on food production
  - Overpopulation
  - Economic recession
  - Unemployment
  - Crisis of political leadership
  - Social instability
  - Peak oil

A world of limitations

- **No lack of threats to business as usual**
  - **Climate change**
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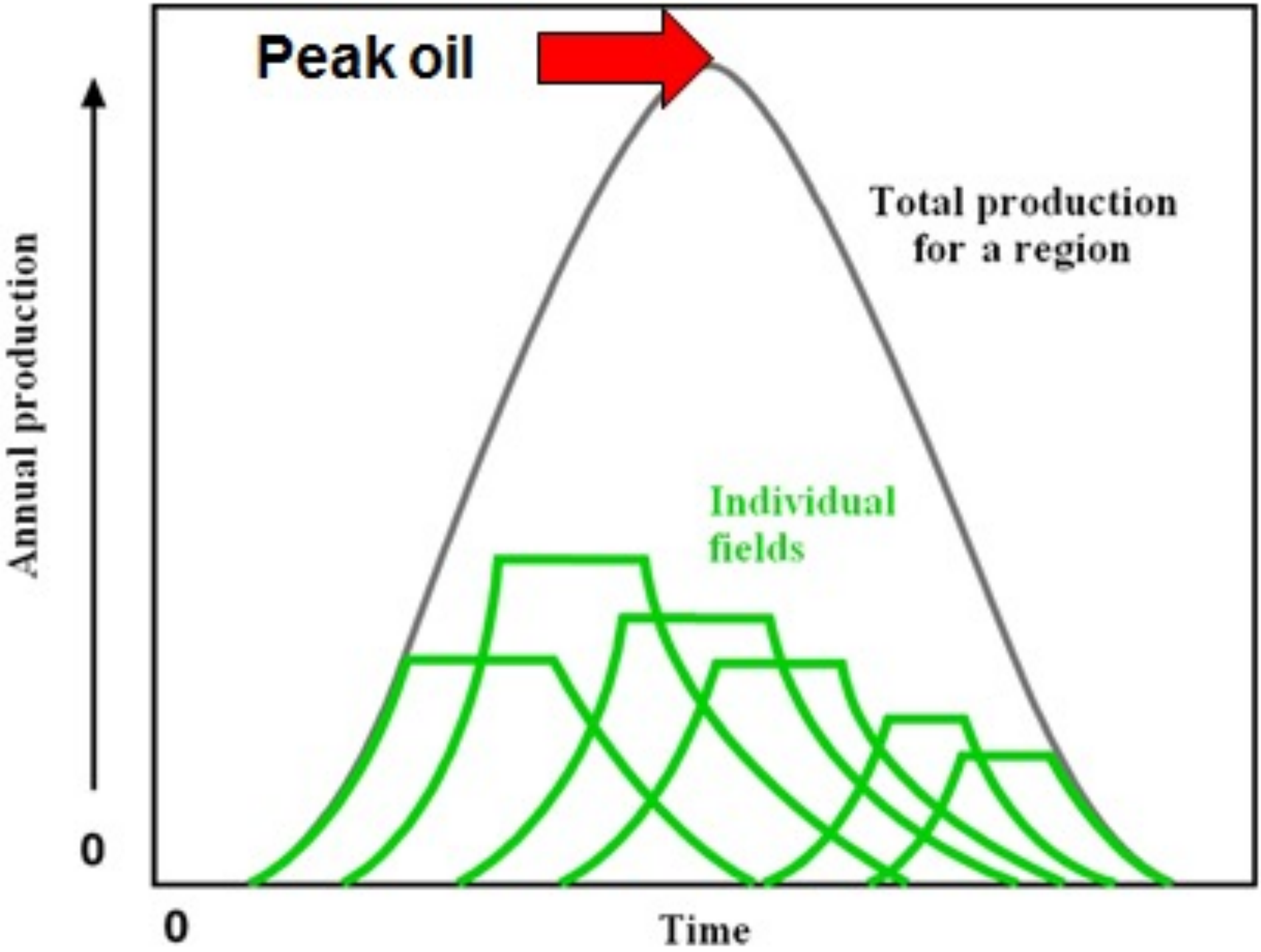
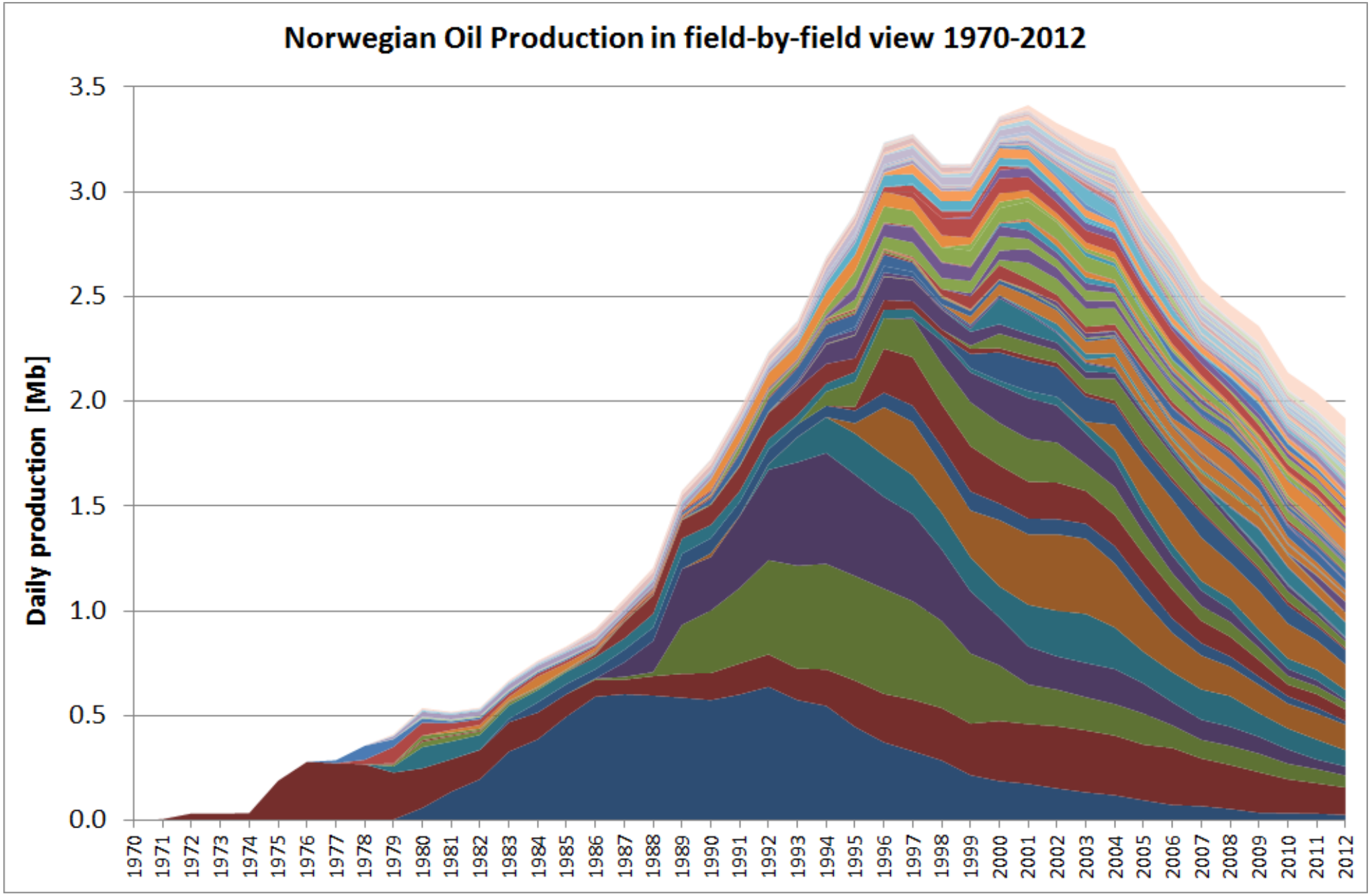
  - **Water scarcity**
  - **Limitations on food production**
  - **Overpopulation**
  - **Economic recession**
  - **Unemployment**
  - **Crisis of political leadership**
  - **Social instability**
  - **Peak oil**

Fossil fuels rule the world

- 80-85% of global energy is fossil fuels (oil, coal, gas)

- Oil is our most versatile and useful energy source
- More than 1/3 of worldwide energy use is oil
  - More than 95% of all transports depend on oil
- There is a lot of oil left but less will be extracted and/or costs will go up each year
- We are running out of ”good, cheap oil” and have to replace it with more expensive oil


Peak oil
Total production for a region
Individual fields
Annual production
0
0
Time


Norwegian Oil Production in field-by-field view 1970-2012
Daily production [Mb]
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1970
1971
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1973
1974
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2012

- **Oil is our most versatile and useful energy source**
- **1 barrel of oil = 159 liters**
- **1 barrel of oil = 90 USE**
- **Energy content = 25.000 hours of physical work**

Energy Research & Social Science 31 (2017) 170–178

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

What if there had only been half the oil? Rewriting history to envision the consequences of peak oil

Daniel Pargman[a,*], Elina Eriksson[a], Mikael Höök[b], Joshua Tanenbaum[c], Marcel Pufal[c], Josefin Wangel[d]

[a] School of Computer Science and Communication, KTH Royal Institute of Technology, Stockholm, Sweden
[b] Department of Earth Sciences, Natural Resources and Sustainable Development, Uppsala University, Sweden
[c] Department of Informatics, University of California, Irvine, CA, USA
[d] School of Architecture and the Built Environment, KTH Royal Institute of Technology, Stockholm Sweden

ARTICLE INFO

Keywords:
Peak oil
Contrafactual history
Allohistory
Thought experiment

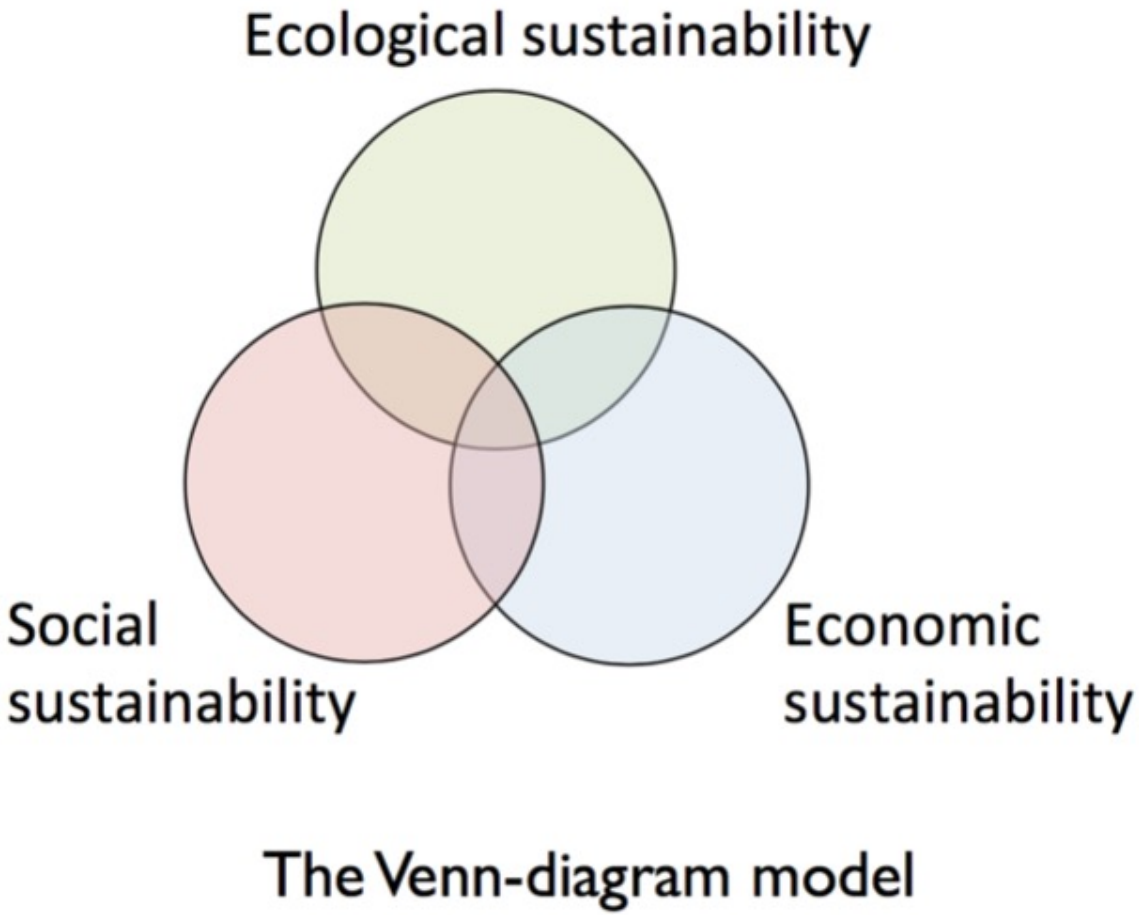
ABSTRACT

There is unequivocal evidence that we are facing the greatest energy transition since the dawn of the industrial age. We need to urgently shift from a global fossil fuel and CO_2-emitting energy system to 1) decrease our CO_2 emissions and combat the effects of climate change and 2) face a future of depleting fossil fuel resources.

Yet there is still a lack of collective action to start taking effective measures to meet these challenges. We argue that there is a need for narratives in general and for a special type of narrative in particular, *allohistorical scenarios*, that act as thought experiments whose main function is to defamiliarize us with what is taken for granted. Such scenarios invite us to explore plausible parallel paths, thereby making it possible to imagine futures that are essentially different from the path-dependence of an unyielding historical past. Such futures enable us to grapple with a present that is saturated by the inertia of past decisions and the sunken costs of existing infrastructure.

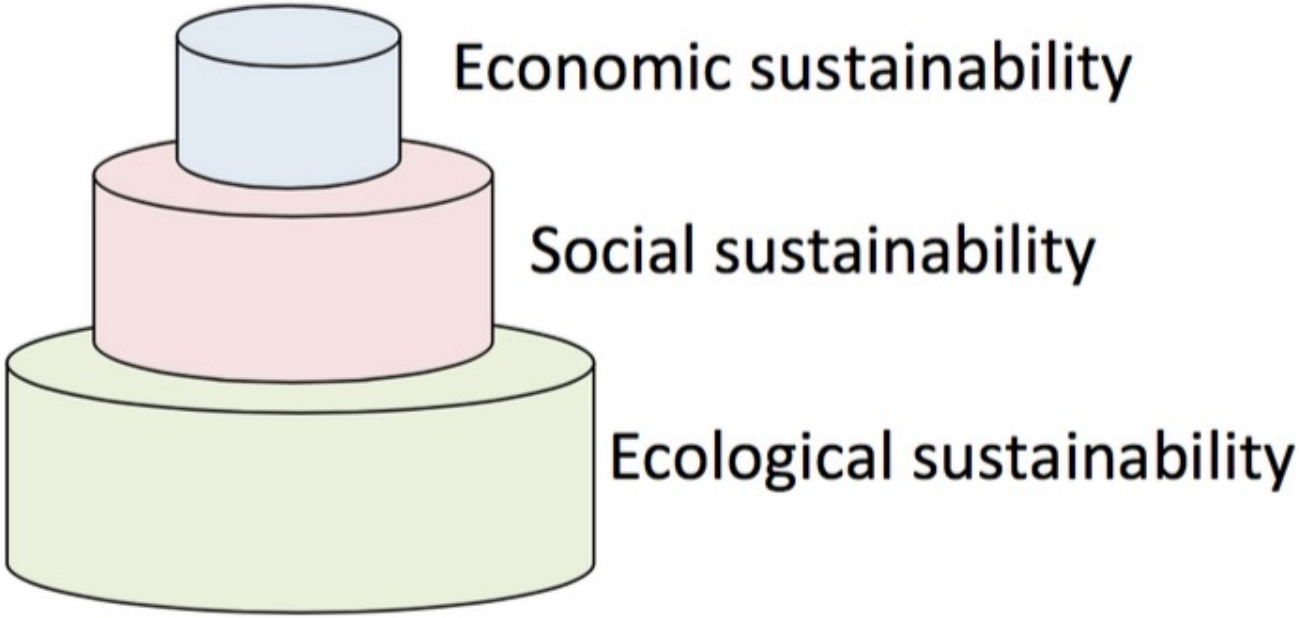
We here present the design rationale for the Coalworld scenario: an alternative world where only half the oil ever existed. We also describe the methodology and the assumptions that underlie the Coalworld scenario.

Sustainable Development



The Venn-diagram model

Sustainability



The wedding cake model

Computing within Limits: Three key principes

1. Question growth
2. Consider models of scarcity
3. Reduce energy and material consumption

Nardi, B., Tomlinson, B., Patterson, D. J., Chen, J., Pargman, D., Raghavan, B., & Penzenstadler, B. (2018). Computing within limits. Communications of the ACM, 61(10), 86-93.

What does Computing within Limits stand for?

First and second CfP (2015-2016):

"A goal of this community is to impact society through the design and development of computing systems in the abundant present for use in a future of limits and/or scarcity"

What does Computing within Limits stand for?

We envision two broad categories of papers: "discussion papers" and "systems papers”:

Discussion papers explore the nature of limits and computing [and] describe their impact on computing, and present directions for future research.

Systems papers describe the design, implementation, and evaluation of computing systems that work within or help cope with limits.

Limits pre-history

2010: I wrote ”Ubiquitous information in a world of limitations” for a Nordic research network symposium

http://danielpargman.blogspot.com/2010/10/ubicomp-in-world-of-limitations.html

2011: Barath Raghavan and Justin Ma wrote ”Networking in the Long Emergency” (In Proceedings of the 2nd ACM SIGCOMM workshop on Green networking).

Collapse Informatics: Augmenting the Sustainability & ICT4D Discourse in HCI

Bill Tomlinson[1], M. Six Silberman[2], Don Patterson[1], Yue Pan[3], and Eli Blevis[3]

[1]University of California, Irvine, CA, USA, {wmt, djp3}@uci.edu

[2]Bureau of Economic Interpretation, San Francisco, CA, USA, six.silberman@gmail.com

[3]Indiana University, Bloomington, IN, USA, {panyue, eblevis}@indiana.edu

ABSTRACT

Research in many fields argues that contemporary global industrial civilization will not persist indefinitely in its current form, and may, like many past human societies, eventually collapse. Arguments in environmental studies, anthropology, and other fields indicate that this transformation could begin within the next half-century. While imminent collapse is far from certain, it is prudent to consider now how to develop sociotechnical systems for use in these scenarios. We introduce the notion of collapse informatics—the study, design, and development of sociotechnical systems in the abundant present for use in a future of scarcity—as a complement to ICT4D and mitigation-oriented sustainable HCI. We draw on a variety of literatures to offer a set of relevant concepts and articulate the relationships among them to orient and evaluate collapse informatics work. Observing that collapse informatics poses a unique class of cross-cultural design problems, we sketch the design space of collapse informatics and provide a variety of example projects. We

INTRODUCTION[1]

History documents the rise and fall of many complex societies. Large human civilizations form over long periods of expansion, sometimes lasting centuries; however, most civilizations that have ever existed have collapsed [6,31]. The archaeologist Joseph Tainter defines collapse as "a rapid, significant loss of an established level of sociopolitical complexity" ([31], p. 7). In his parlance, "rapid" means "no more than a few decades" ([31], p. 4). Collapse manifests as the loss of the hallmarks of political complexity, namely: *"a lower degree of stratification and social differentiation; less economic and occupational specialization, of individuals, groups, and territories; less centralized control; that is, less regulation and integration of diverse economic and political groups by elites; less behavioral control and regimentation; less investment in the epiphenomena of complexity, those elements that define the concept of 'civilization': monumental architecture, artistic and literary achievements, and the like; less flow of*

Limits pre-history

2010: I wrote ”Ubiquitous information in a world of limitations” for a Nordic research network symposium

http://danielpargman.blogspot.com/2010/10/ubicomp-in-world-of-limitations.html

2011: Barath Raghavan and Justin Ma wrote ”Networking in the Long Emergency” (In Proceedings of the 2nd ACM SIGCOMM workshop on Green networking).

2014: Me and Barath Raghavan ”Rethinking sustainability in computing: From buzzword to non-negotiable limits” (Proceedings of the 8th Nordic Conference on Human-Computer Interaction)


LIMITS 2015
ABOUT
ORGANIZERS
PROGRAM AND PAPERS
LIMITS 2016
2017
2018
2019
2020
2021
LIMITS 2015
First Workshop on Computing within Limits
June 15-16, Irvine, CA, USA


LIMITS 2022
ABOUT
ORGANIZERS
PROGRAM
2015
2016
2017
2018
2019
2020
2021
LIMITS 2022
Eighth Workshop on Computing within Limits
June 21-22 2022
Registration is Open!

Why is Limits different?

1. Explores and invents a future for computing in a world of limits and/or scarcity
2. Encourage/accepts thought pieces (with no empirical materia)
3. Community support

Thinking about the future

Science fiction author William Gibson is known for having stated "The future is already here, it's just not very evenly distributed"

Google glasses

Thinking about the future

Science fiction author William Gibson is known for having stated “The future is already here, it’s just not very evenly distributed”

From another perspective, it makes just as much sense to state that “The collapse is already here, it’s just not very evenly distributed”

Computing within Limits and Carbon Law computing

Content:

1 Computing within Limits

2 Interactive session

3 Computing within Limits applied

4 Q & A

Computing within Limits and Carbon Law computing

Interactive session

1. Think (2-3 minutes)
2. Pair up (3 persons/group)
3. Discuss (ca 5 minutes)
4. Share

Questions for discussion:

- Have you been provoked?
  - If so, by what?
  - If not, why?

- What would a Limits perspective mean for:
  - Your own research?
  - Your home university, (computing) research in general, AI, computer security, society, X?

Computing within Limits Limits and Carbon Law computing

Content:

1 Computing within Limits

2 Interactive session

3 Computing within Limits applied

4 Q & A

First and second Limits CfP:

"A goal of this community is to impact society through the design and development of computing systems in the abundant present for use in a future of limits and/or scarcity"

- **But what does "a future of limits and/or scarcity" mean?**
- **What does practical (Limits, Carbon Law-compliant) research look like?**

What are we aiming for?

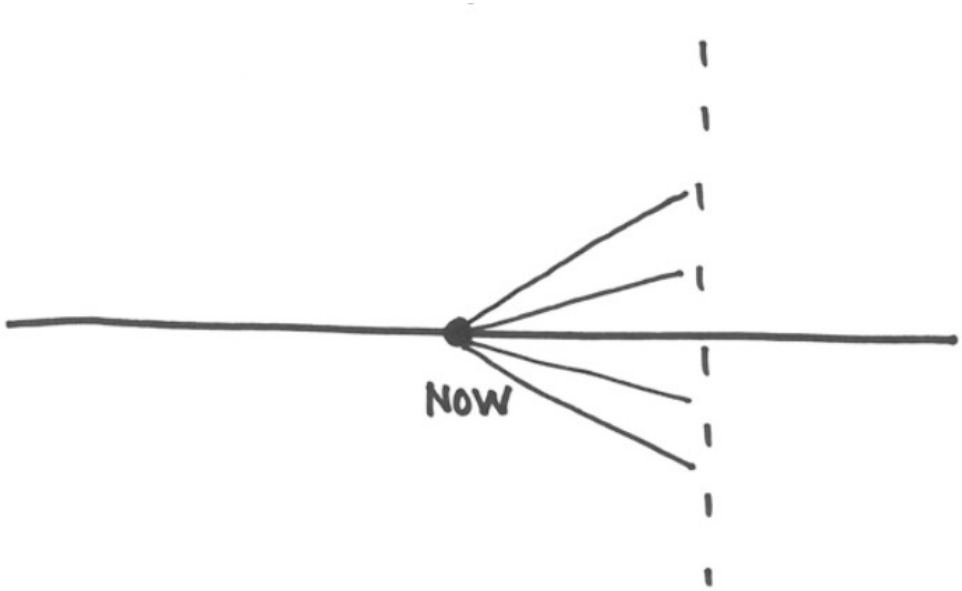
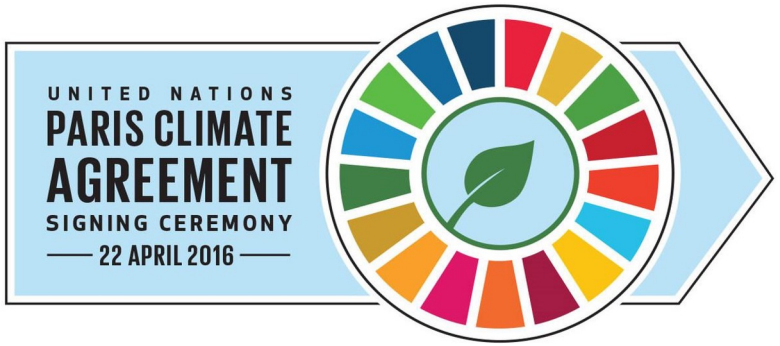


Figure 2 Design fiction can pluralize the future and show possibilities beyond business-as-usual.

Eriksson, E., & Pargman, D. (2018). Meeting the future in the past-using counterfactual history to imagine computing futures. Limits 2018

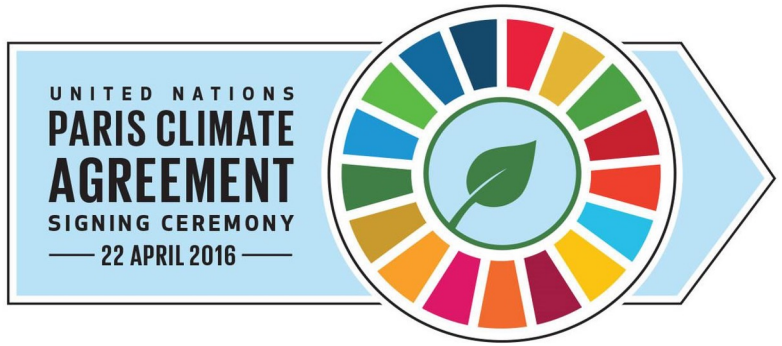
What are we aiming for?

- **196 countries support the Paris agreement – limit global warming to 2˚C (preferably 1.5˚C).**

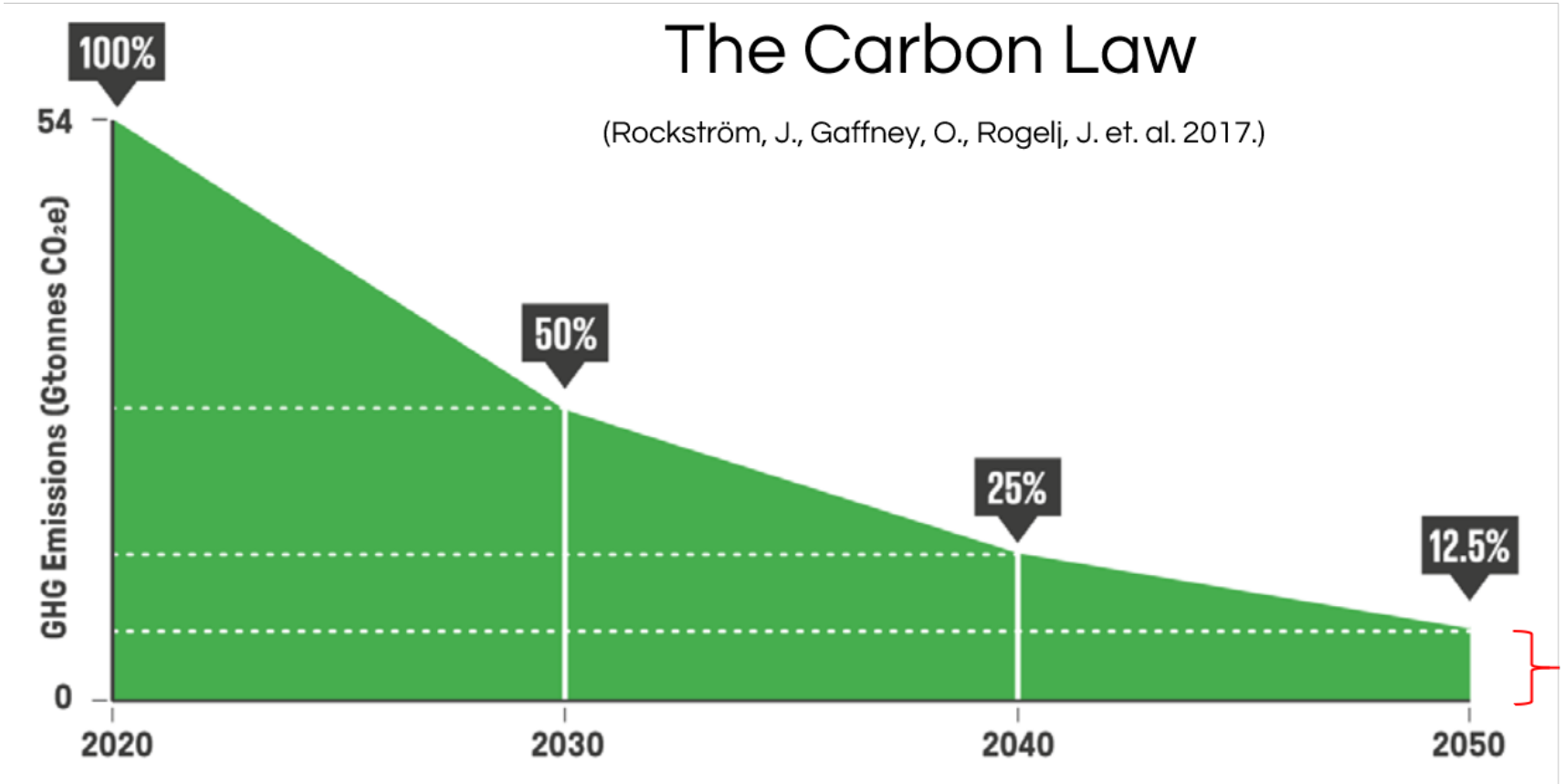


What are we aiming for?

- 196 countries support the Paris agreement – limit global warming to 2˚C (preferably 1.5˚C).
- → Then we have a limited "budget" for additional CO2 emissions
- → We have to reduce our CO2 emission in line with the The Carbon Law



What are we aiming for?



https://exponentialroadmap.org

Computing within Limits: Three key principes

1. Question growth
2. Consider models of scarcity
3. Reduce energy and material consumption

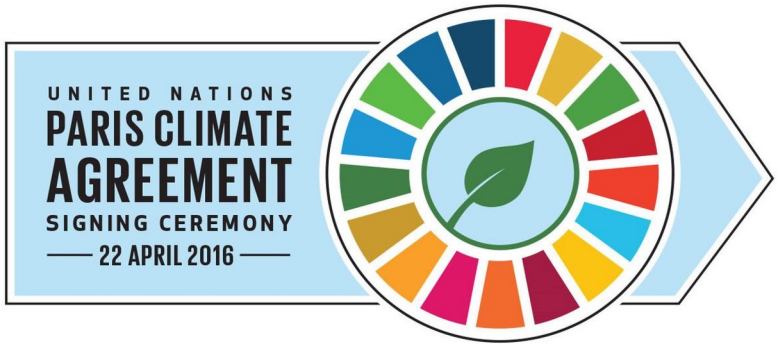
Nardi, B., Tomlinson, B., Patterson, D. J., Chen, J., Pargman, D., Raghavan, B., & Penzenstadler, B. (2018). Computing within limits. Communications of the ACM, 61(10), 86-93.

Computing within Limits: Four key principes

1. Question growth
2. Consider models of scarcity
3. Reduce energy and material consumption
4. Apply computing to solve *real-world* sustainability problems

What are we aiming for?

- **We have to reduce our CO2 emission in line with the The Carbon Law**
  - **This includes emissions from flying.**
  - **This includes emissions from KTH's flying**



FLIGHT

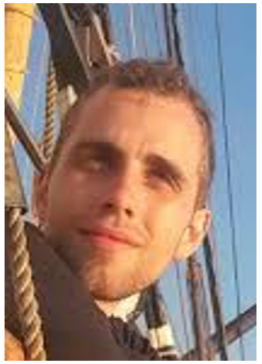
Decreased CO2-emissions in flight-intensive organisations: from data to practice


Daniel Pargman


Elina Eriksson


Markus Robèrt

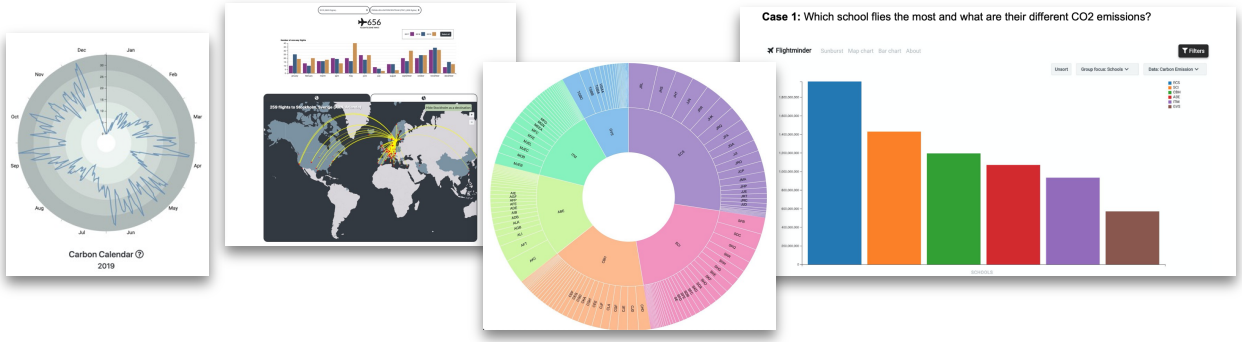

Jarmo Laaksolahti


Aksel Biørn-Hansen

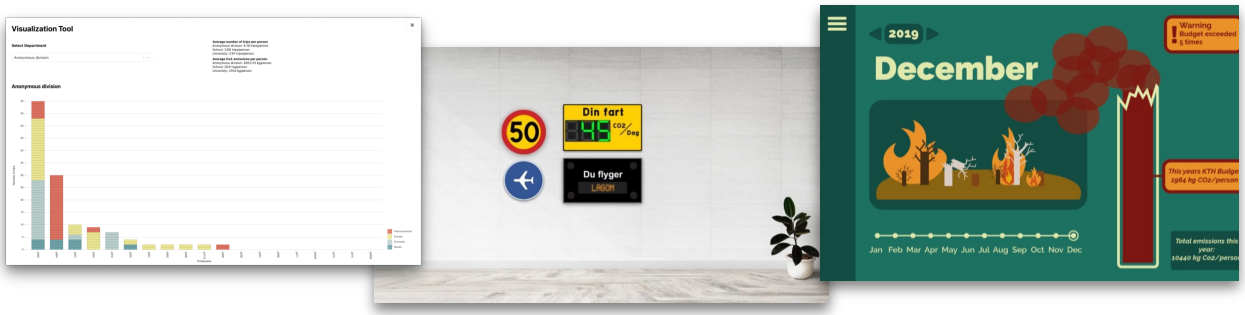
Energimyndigheten

Visualizing flying in an organisation

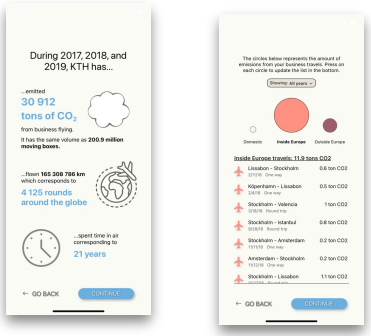
Top-down



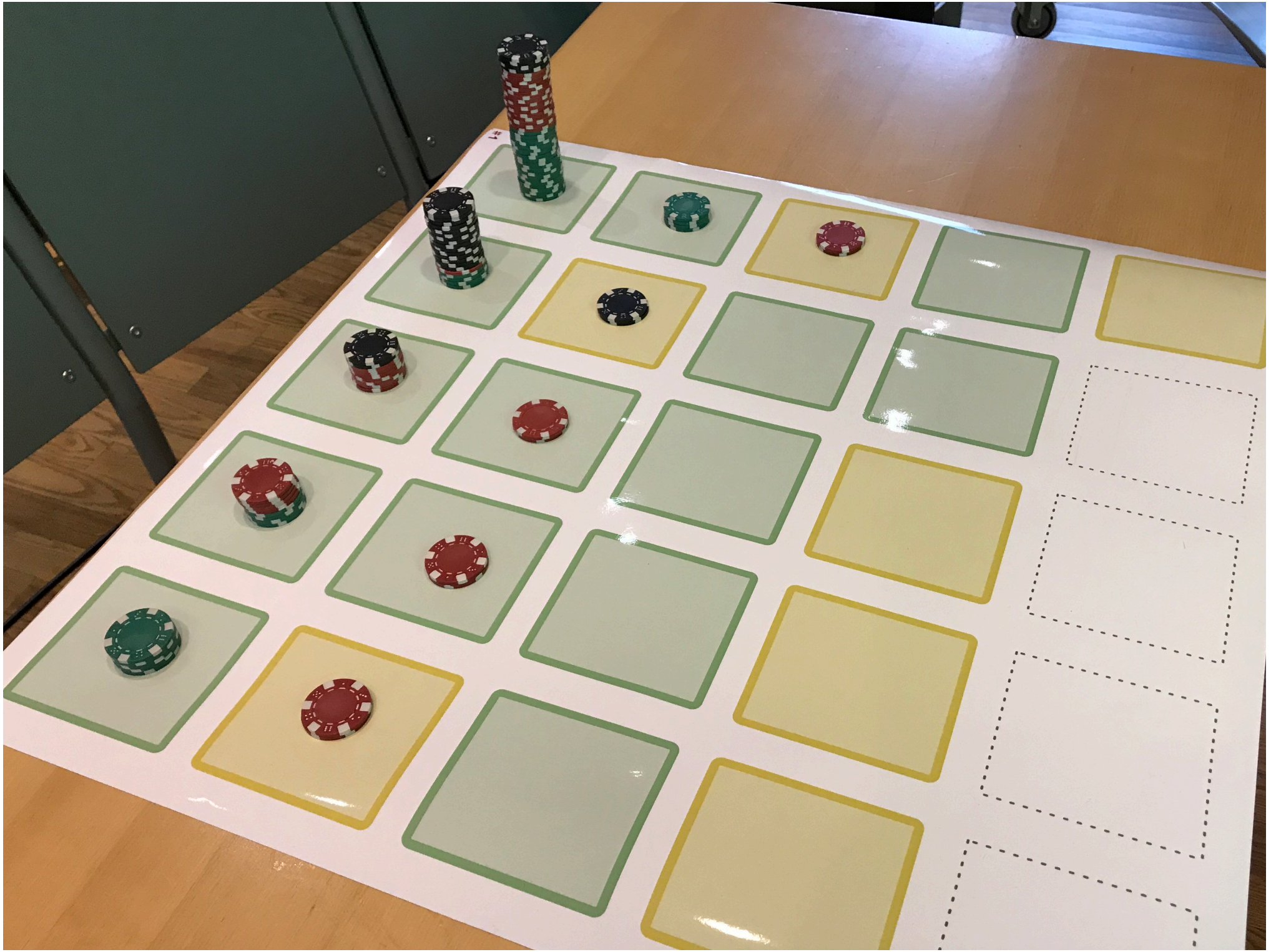
Middle-out



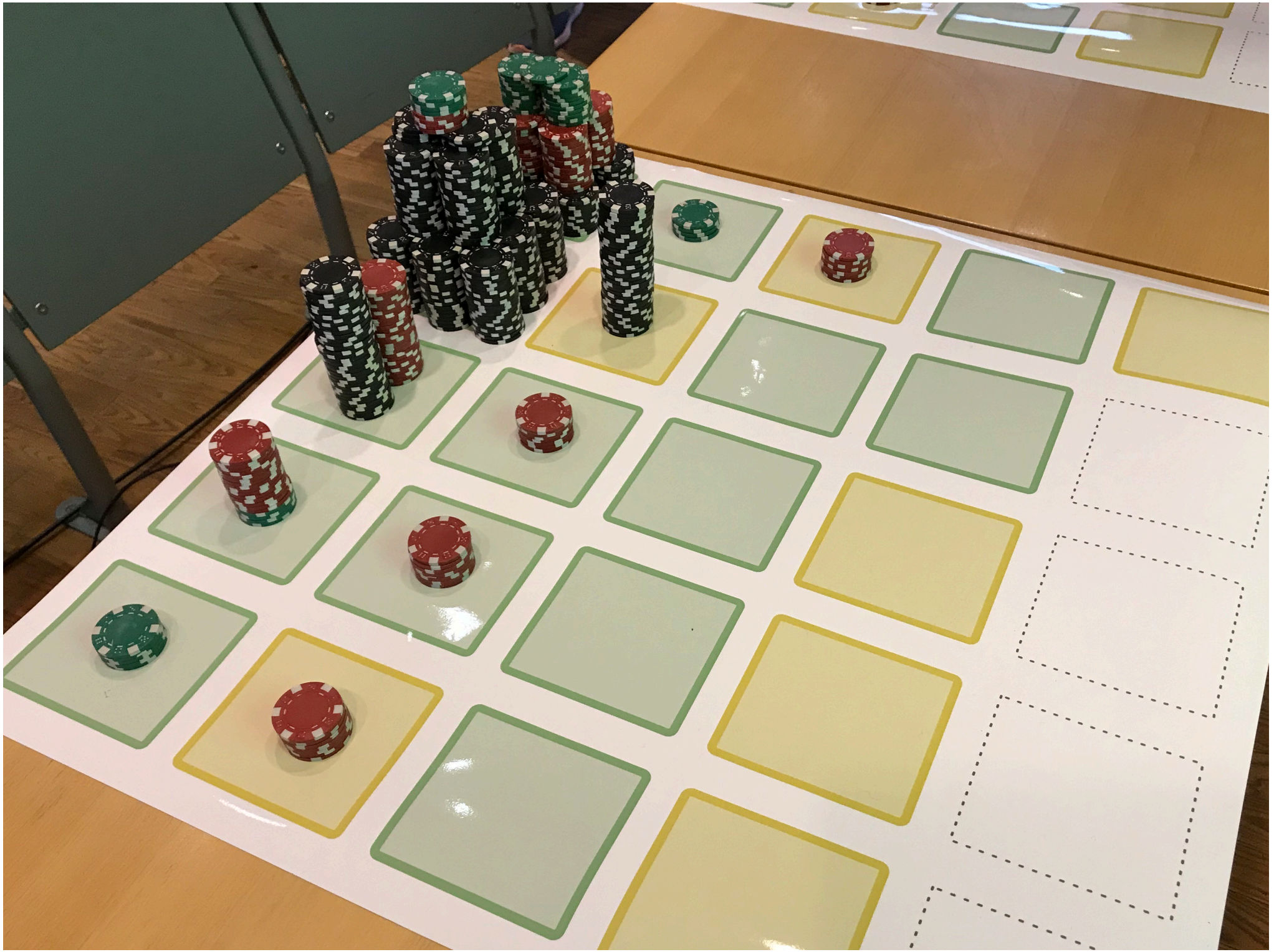
Bottom-up

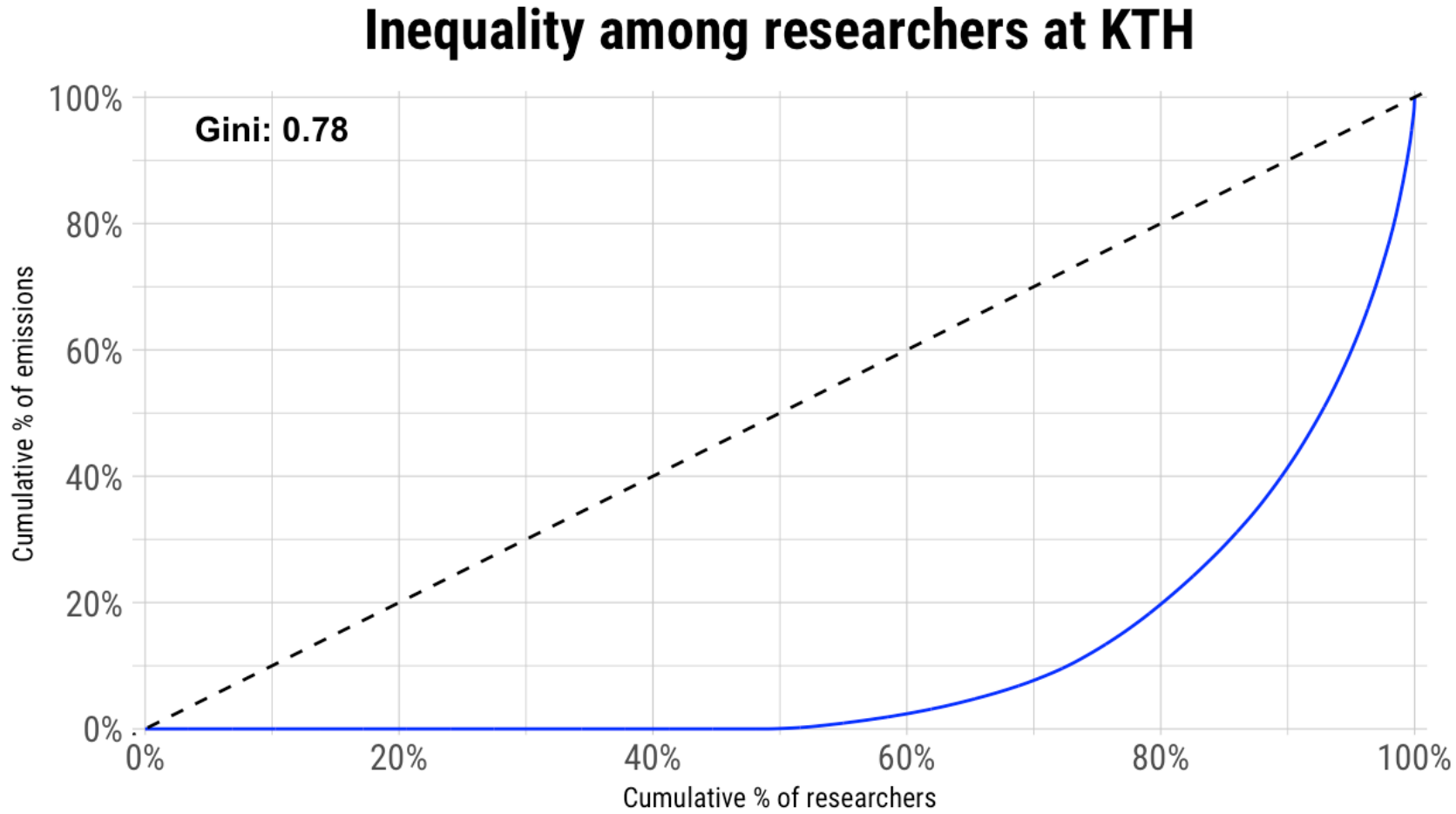


All one-way flight trips made by employees at a division during 2019

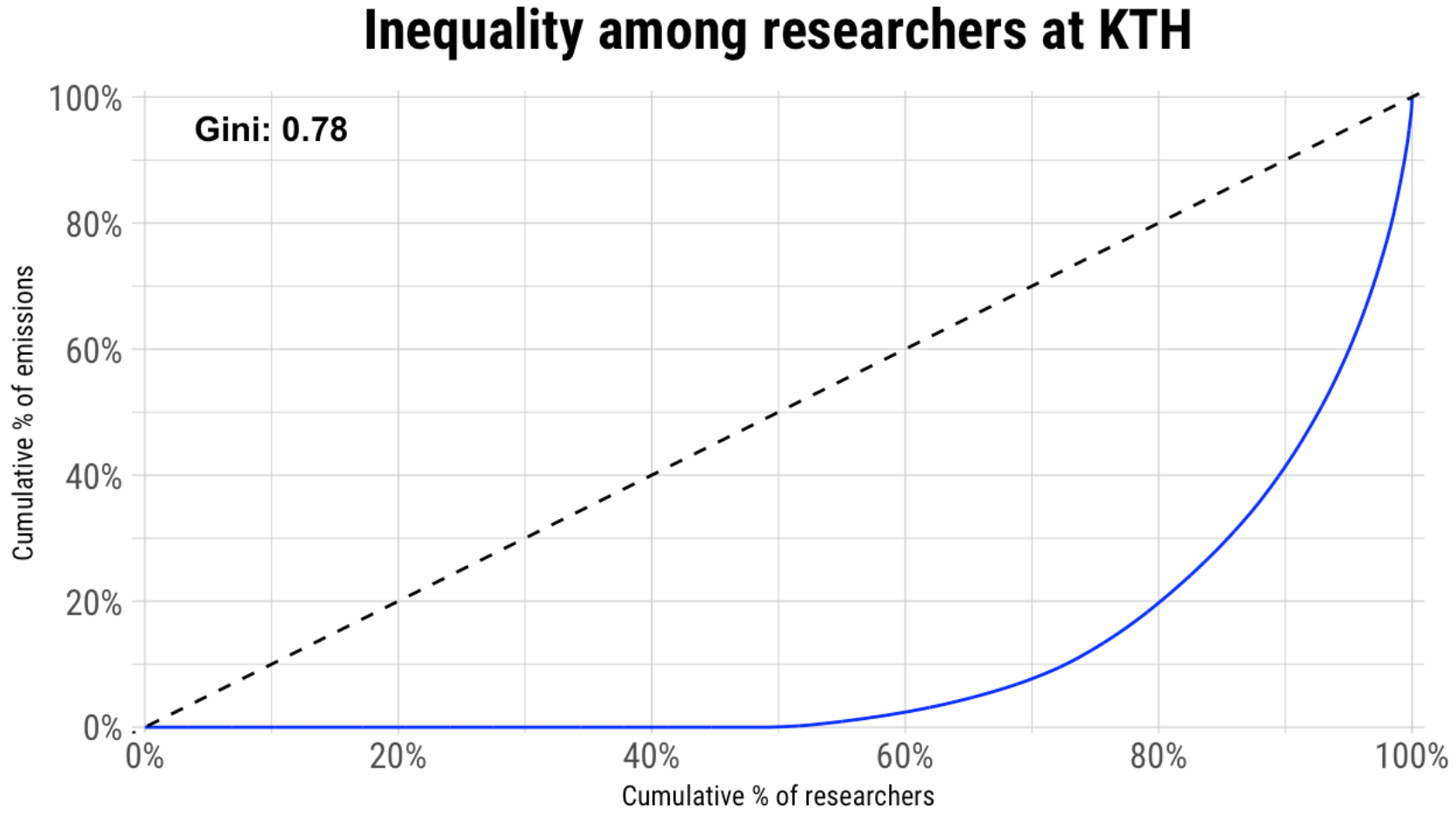


Materializing emissions




Inequality among researchers at KTH
Gini: 0.78
100%
80%
60%
40%
20%
0%
Cumulative % of emissions
0%
20%
40%
60%
80%
100%
Cumulative % of researchers

GINI-coefficient for the world economy = **0,65**
GINI-coefficient of flight emissions from KTH researchers = **0.78**



Our next project

“Reduced emissions from business travel: Joint efforts to achieve Swedish universities’ climate goals”

New project (2023-2024) with 22 partners (20 Swedish Higher Education Institutions)

Our next project

“Reduced emissions from business travel: Joint efforts to achieve Swedish universities’ climate goals”

New project (2023-2024) with 22 partners (20 Swedish Higher Education Institutions)

If we are granted money, we will need to hire a data science/statistics post-doc!

Computing within Limits and Carbon Law computing

Content:

1 Computing within Limits

2 Interactive session

3 Computing within Limims applied

4 Q & A

Thank you!

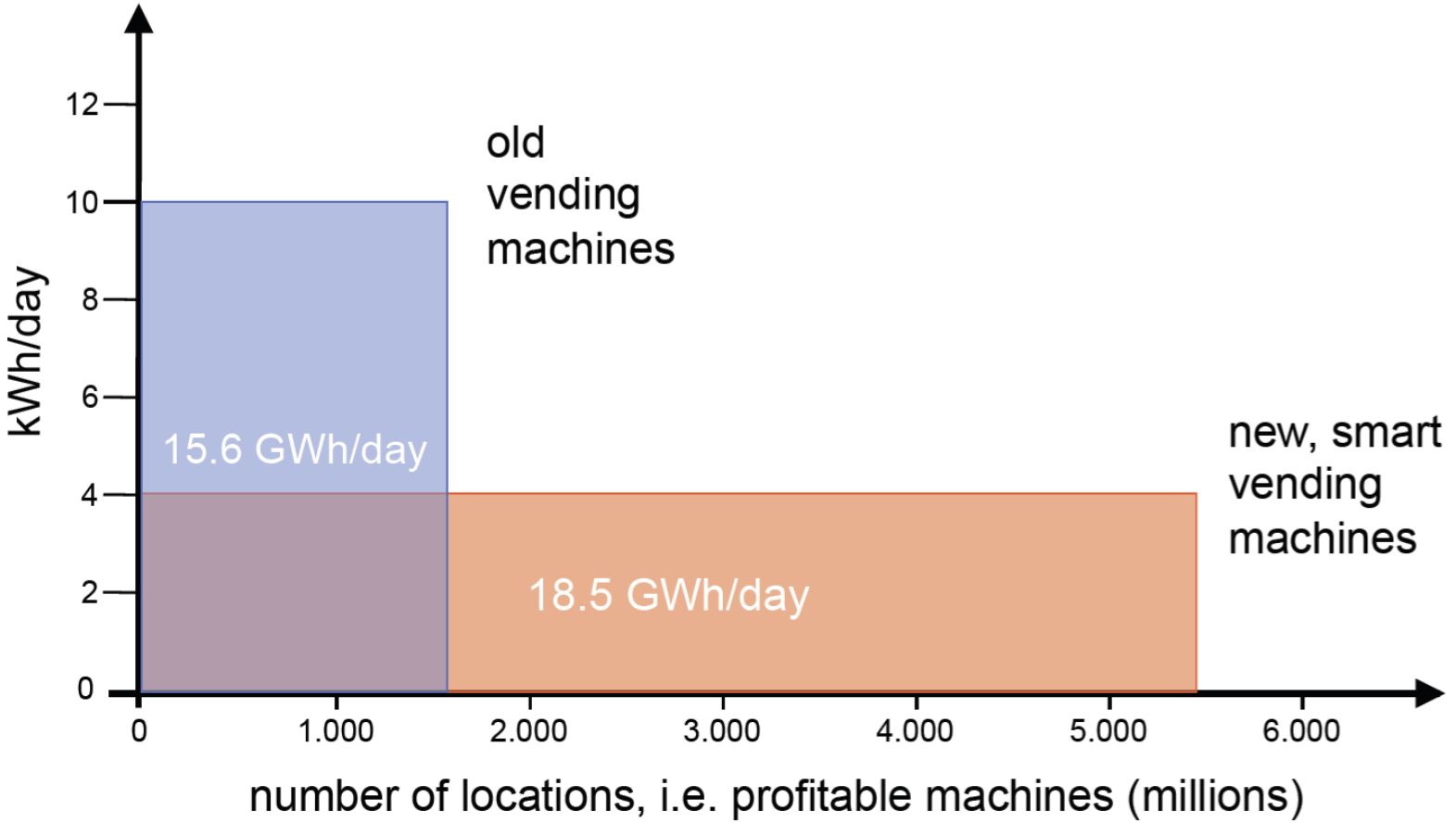
Daniel Pargman
pargman@kth.se

We have to talk about rebound effects

ICT is a promise and a threat:

Efficiency can lead to rebound and backfire effects!

Backfire effects
Smart vending machines



Hilty, L. (2012). Why energy efficiency is not sufficient–some remarks on “Green by IT”, EnviroInfo’12. Shaker Verlag, 13-20.

Smart vending machines
on Japanese streets

- **Number of old (big) machines has remained the same since 1995. Why?**

Smart vending machines
on Japanese streets

- Number of old (big) machines has remained the same since 1995. **Why?**
- Another limiting factor (beyond cost): space

We have to talk about AI

AI as a promise and a threat

- Efficiency
- Sufficiency

We have to talk about AI

AI as a promise and a threat

- Efficiency
- Sufficiency
- Solving real-world sustainability problems
  - FLIGHT project