



LEIBNIZ-INSTITUT  
für interdisziplinäre Studien e.V. (LIFIS)

*Dietrich Balzer, Justus Schollmeyer, Frieder Sieber*

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# TRIZ, Interdisciplinarity, and the Challenge of Sustainability

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Atlantic City, TRIZCON 2017,  
October 3-5

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# Content

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1. The Leibniz Institute for Interdisciplinary Studies
2. TRIZ and its potential to organise progressive interdisciplinary research
3. Interdisciplinarity and the Challenge of Sustainability
4. Towards an Interdisciplinary Multi-Level-Perspective for future TRIZ research

# 1) The Leibniz Institute for Interdisciplinary Studies

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# Historical Background

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Gottfried Wilhelm Leibniz  
1646-1716

- ❖ Philosopher
- ❖ Mathematician
- ❖ Ambassador
- ❖ Historian
- ❖ Political Consultant
- ❖ Engineer
- ❖ Inventor
- ❖ ...



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# Historical Background

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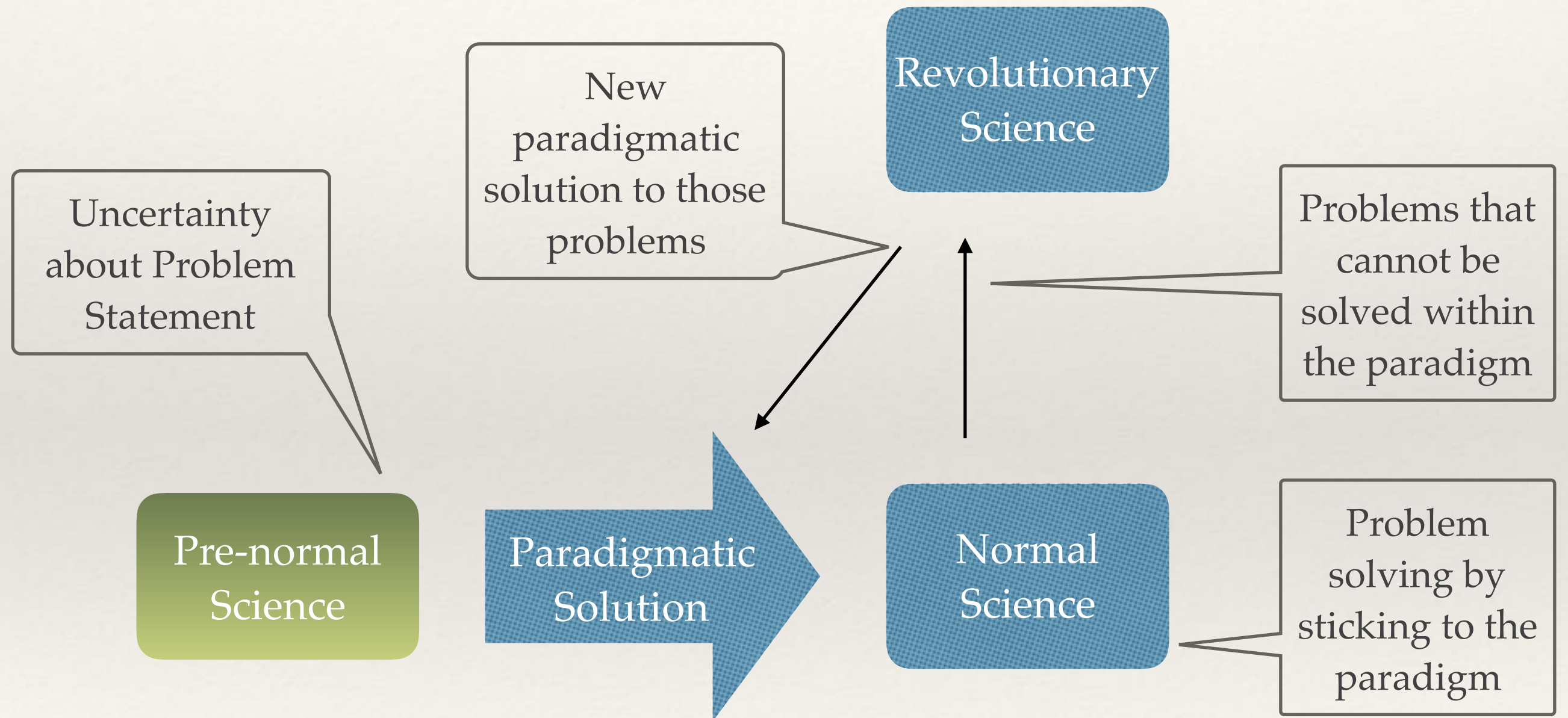
- ❖ 1700: Leibniz initiated the **Kurfürstlich Brandenburgische Sozietät der Wissenschaften** (*Electoral Brandenburgian Society of Sciences*)
- ❖ —> **Akademie der Wissenschaften in Berlin** (*Academy of Sciences in Berlin*)
  - ❖ 1746: Académie Royale des Sciences et Belles-Lettres
  - ❖ till 1945: Preußische Akademie der Wissenschaften
  - ❖ 1946-1972: Deutsche Akademie der Wissenschaften zu Berlin
  - ❖ from 1972: Akademie der Wissenschaften der DDR
  - ❖ from 1993: **Leibniz Sozietät der Wissenschaften**
  - ❖ from 2007: **Leibniz Sozietät der Wissenschaften zu Berlin**
- ❖ **More than 300 members from multiple disciplines** (monthly meetings)
  - ❖ 2002: **Leibniz Institute For Interdisciplinary Studies** (founded by members of the Leibniz Sozietät)

source: <https://leibnizsozietat.de/ueber-uns/geschichte/>

Philosophy	1. Prof. Dr. Gerhard Banse	Theodorstr. 13 12623 Berlin	28.07.1946
Earth science	2. Prof. Dr. Heinz Kautzleben	Schneewittchenstr. 18 12524 Berlin	31.03.1934
Economics	3. Dr. Karl-Heinz Klinger	Am Anger 4 15711 Königs Wusterhausen	20.09.1943
Engineering	4. Dipl.-Ing. Heinz Klötzner	Hauptstr. 110b 09128 Chemnitz	24.06.1949
Mathematics	5. Prof. Dr. Gerd Laßner	Zschopauer Str. 39 09573 Augustusburg	19.08.1940
Molecular biology	6. Dr. Dirk Laßner	Brockhausstr. 27 04229 Leipzig	22.12.1964
Ergonomics	7. Dr. Frank Löffler	Clausstr. 34 09126 Chemnitz	29.02.1960
Engineering	8. Dr. Günther Mann	Mörikestr. 3 74847 Obrigheim	13.07.1951
Chemistry	9. Prof. Dr. Siegfried Nowak	Handjerystr. 28a 12489 Berlin	17.04.1930
Chemistry	10. Prof. Dr. Gerhard Öhlmann	Nikolaikirchplatz 5 10178 Berlin	31.12.1931
Engineering	11. Dipl.-Ing. Klaus-Peter Steiger	Springbornstr. 110 12487 Berlin	26.12.1940
Molecular biology	12. Prof. Dr. Gert Wangermann	Mollstr. 10 10178 Berlin	15.11.1934

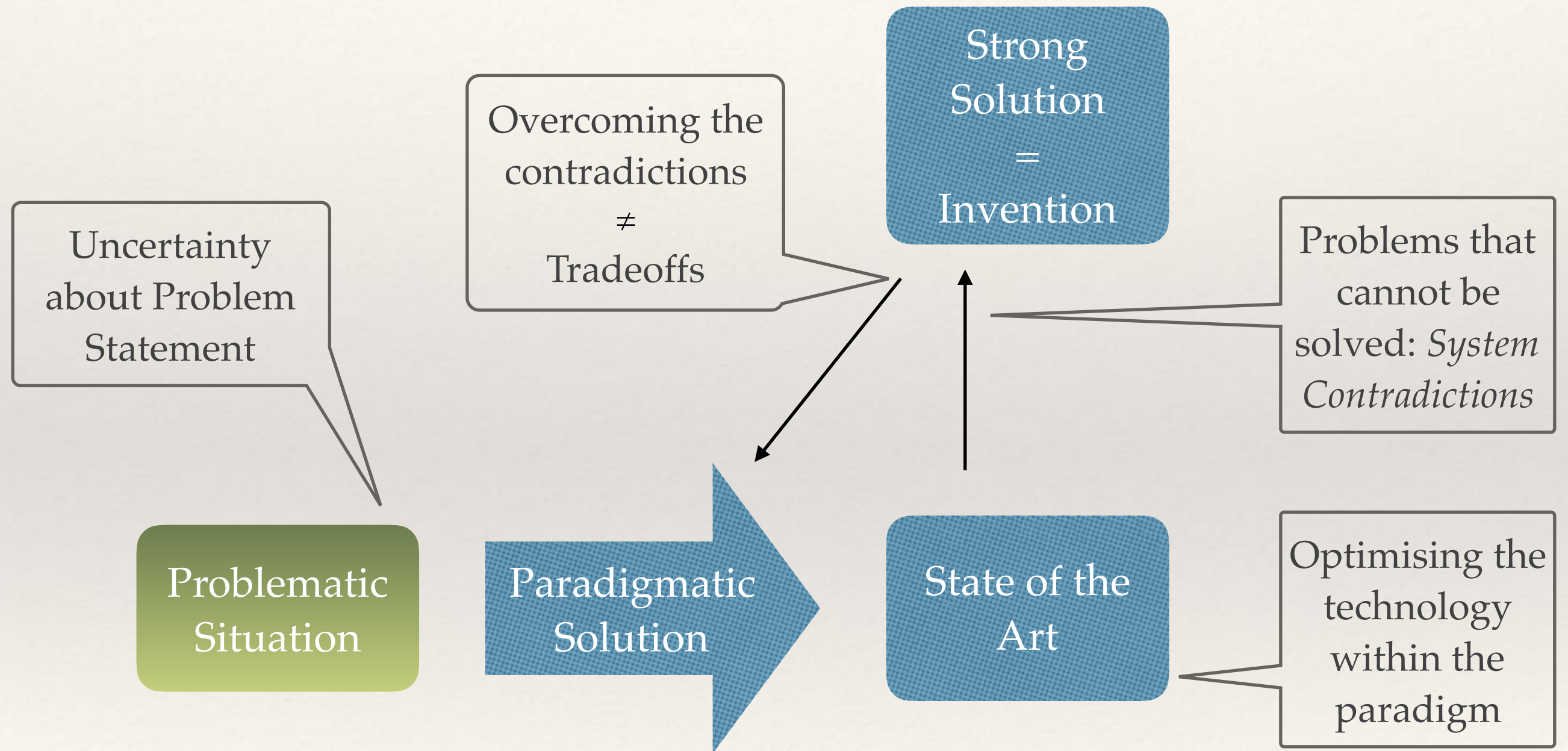
2) TRIZ and its potential to organise  
progressive interdisciplinary research

# Thomas Kuhn: The Structure of Scientific Revolutions (1962; 2nd ed. 1970)



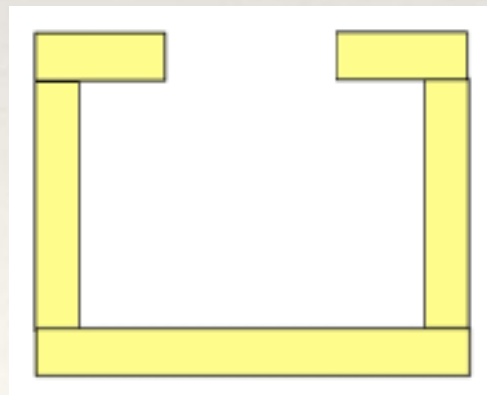
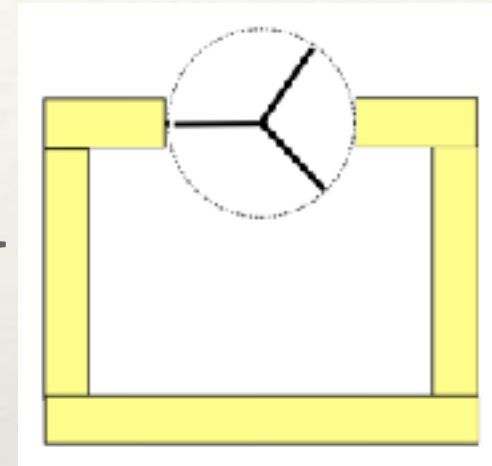


# Genrich S. Altshuller: The Theory of Inventive Problem Solving

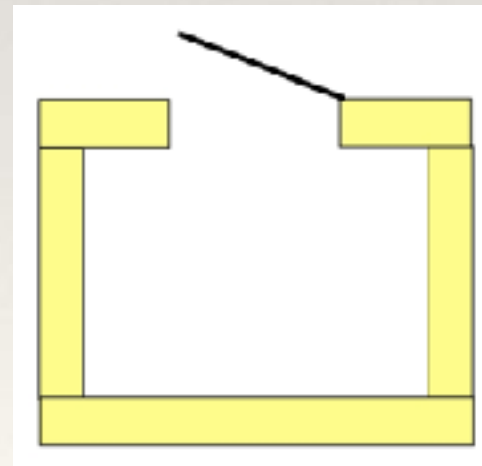


# System Contradiction

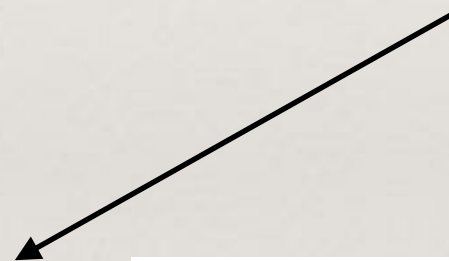
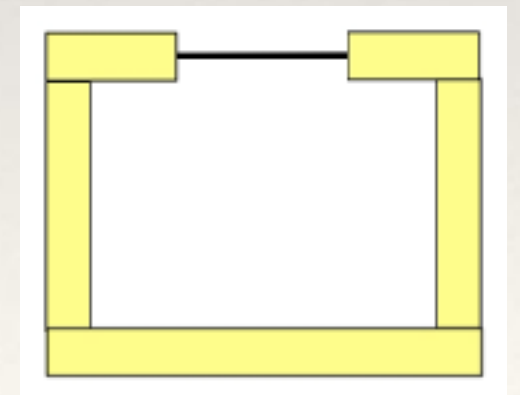
H. Bockhacker (1881):  
German Patent 18349  
and  
Theophilus Van Kannel  
(1888): US Patent 387571



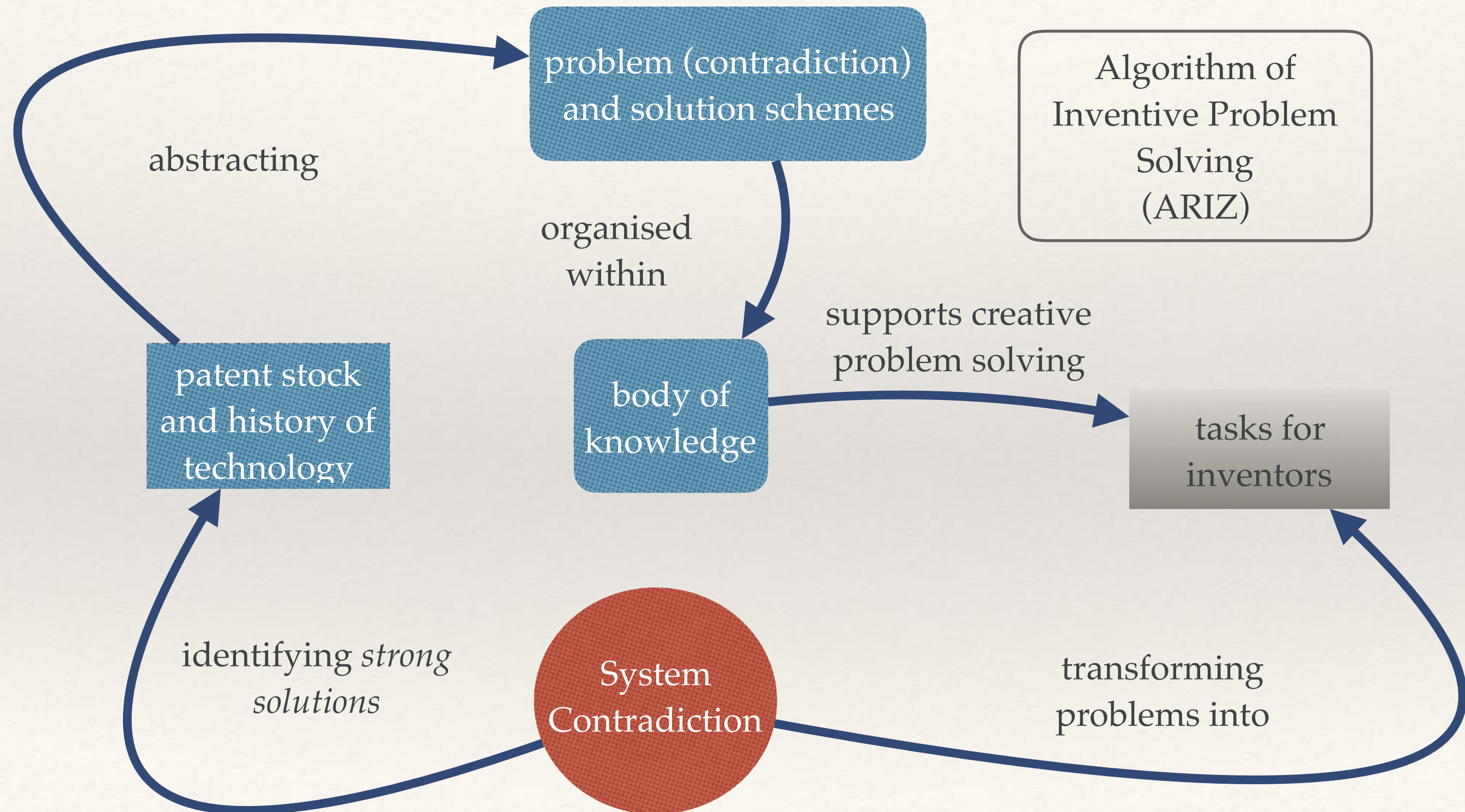
Paradigmatic  
Solution



or

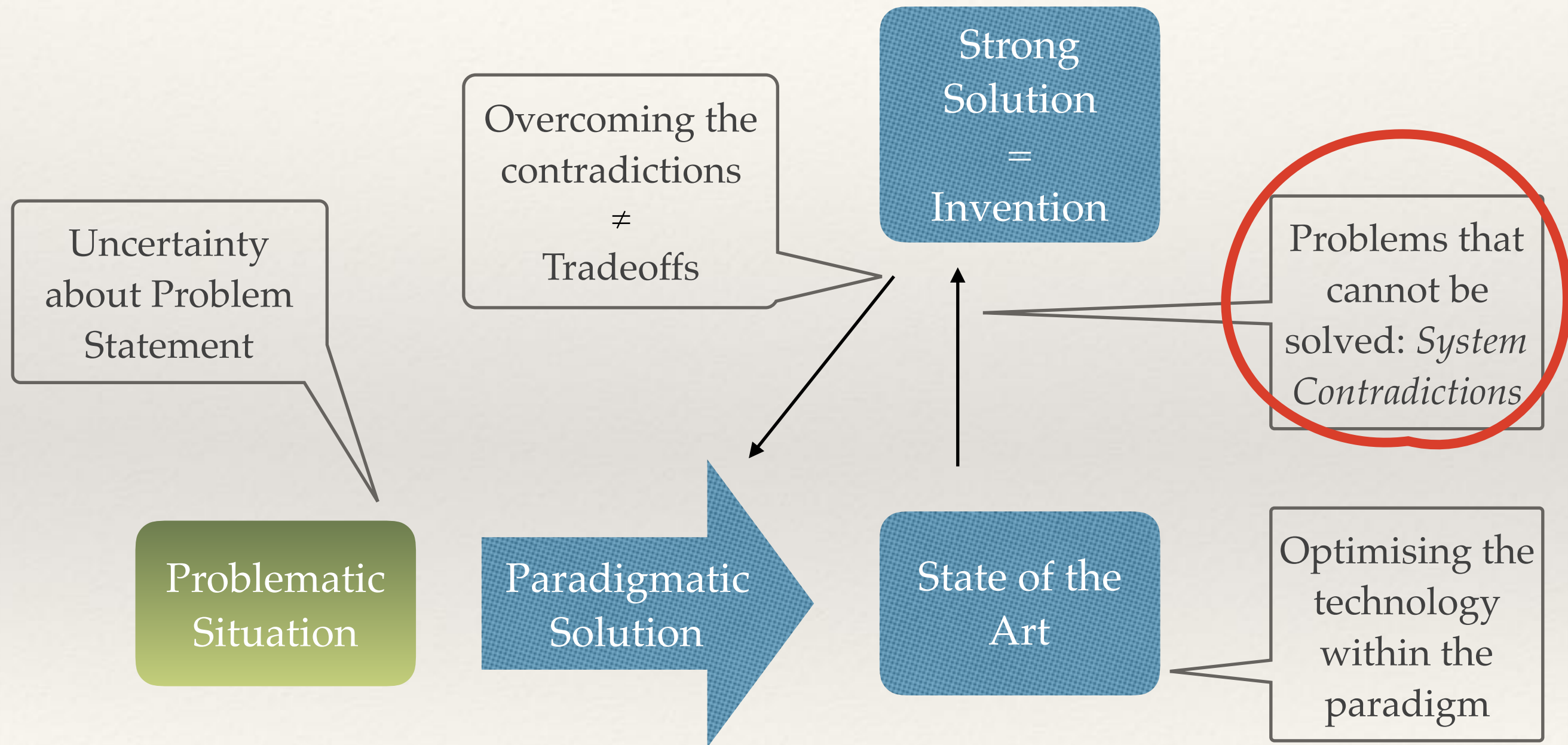


# On the heuristic value of the concept of system contradictions in technology



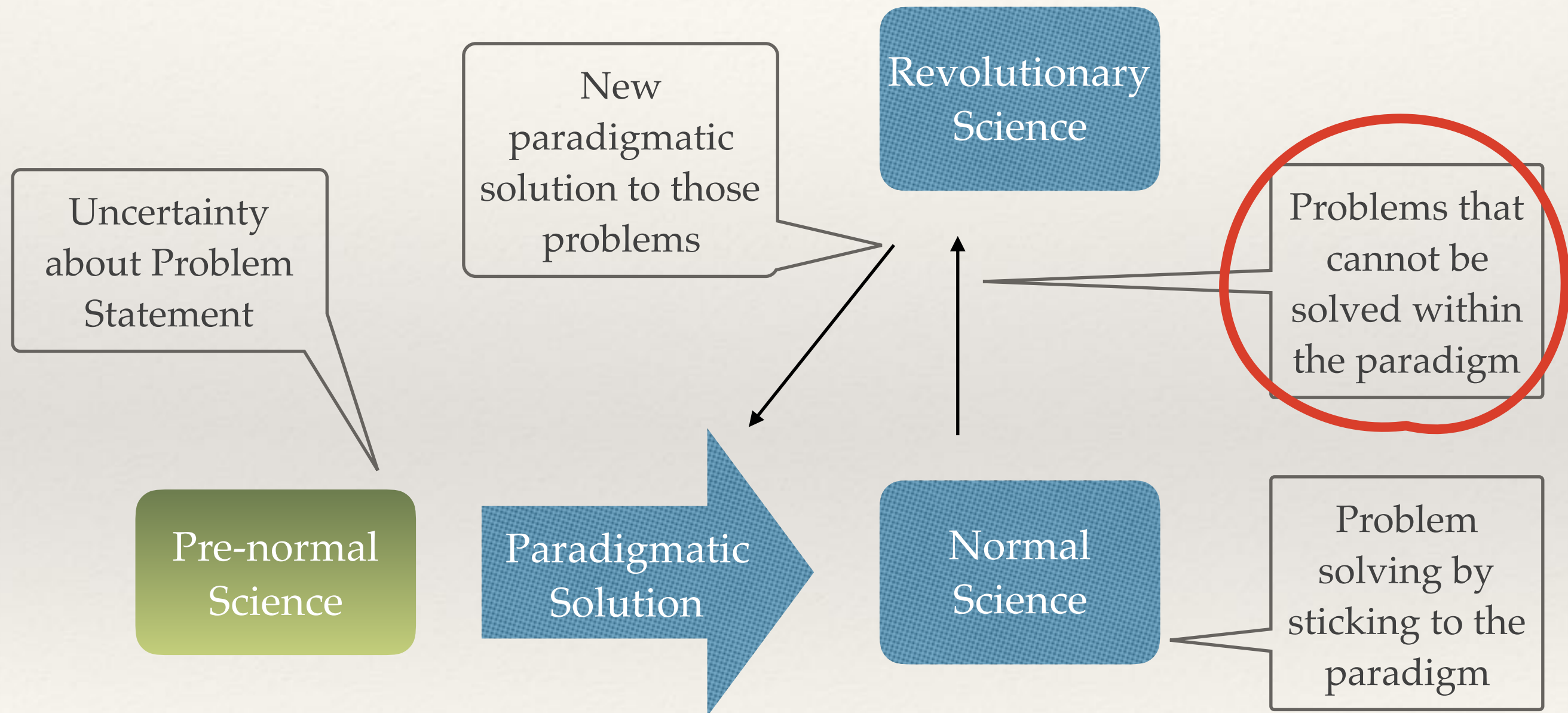


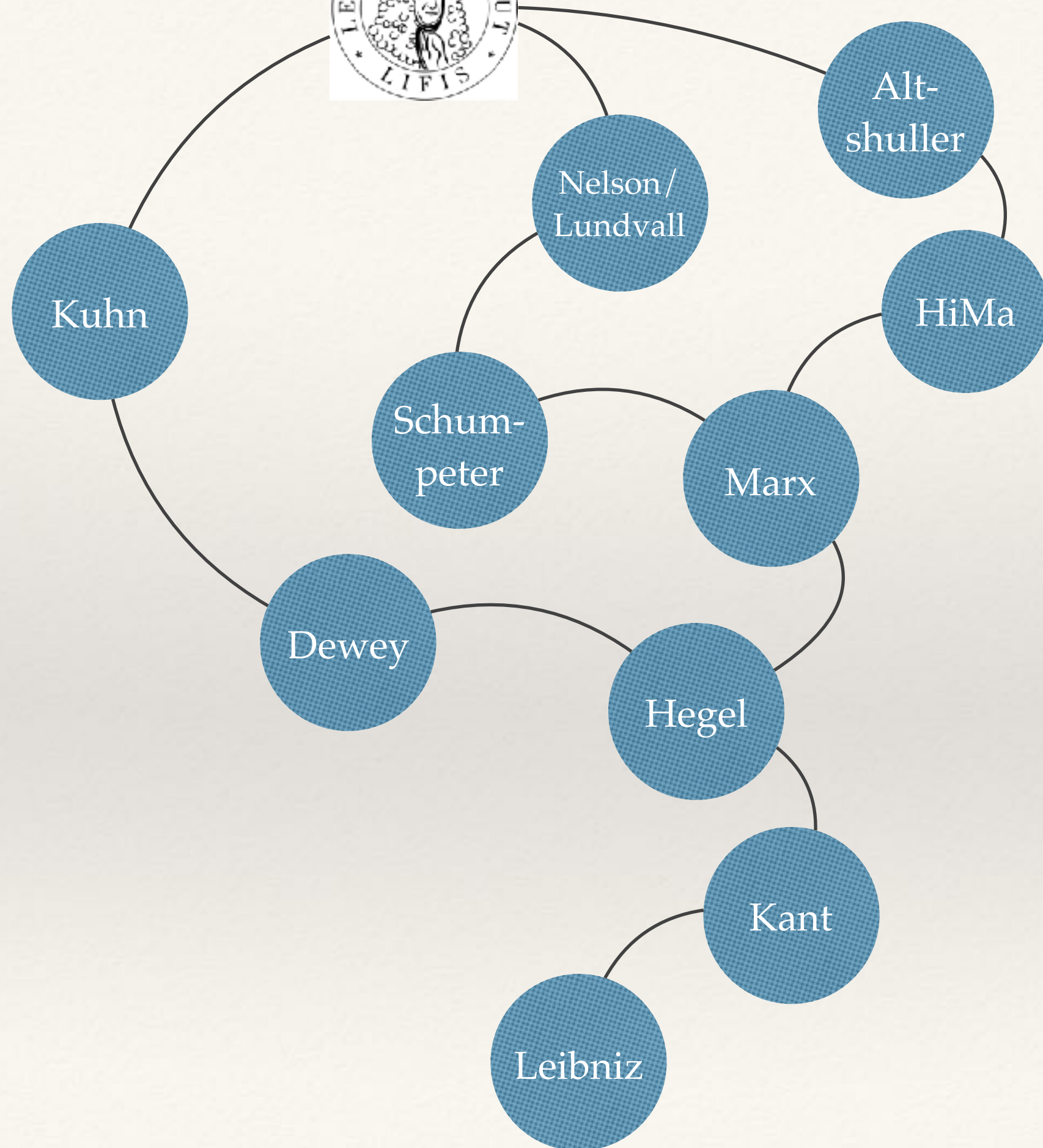
# Genrich S. Altshuller: The Theory of Inventive Problem Solving



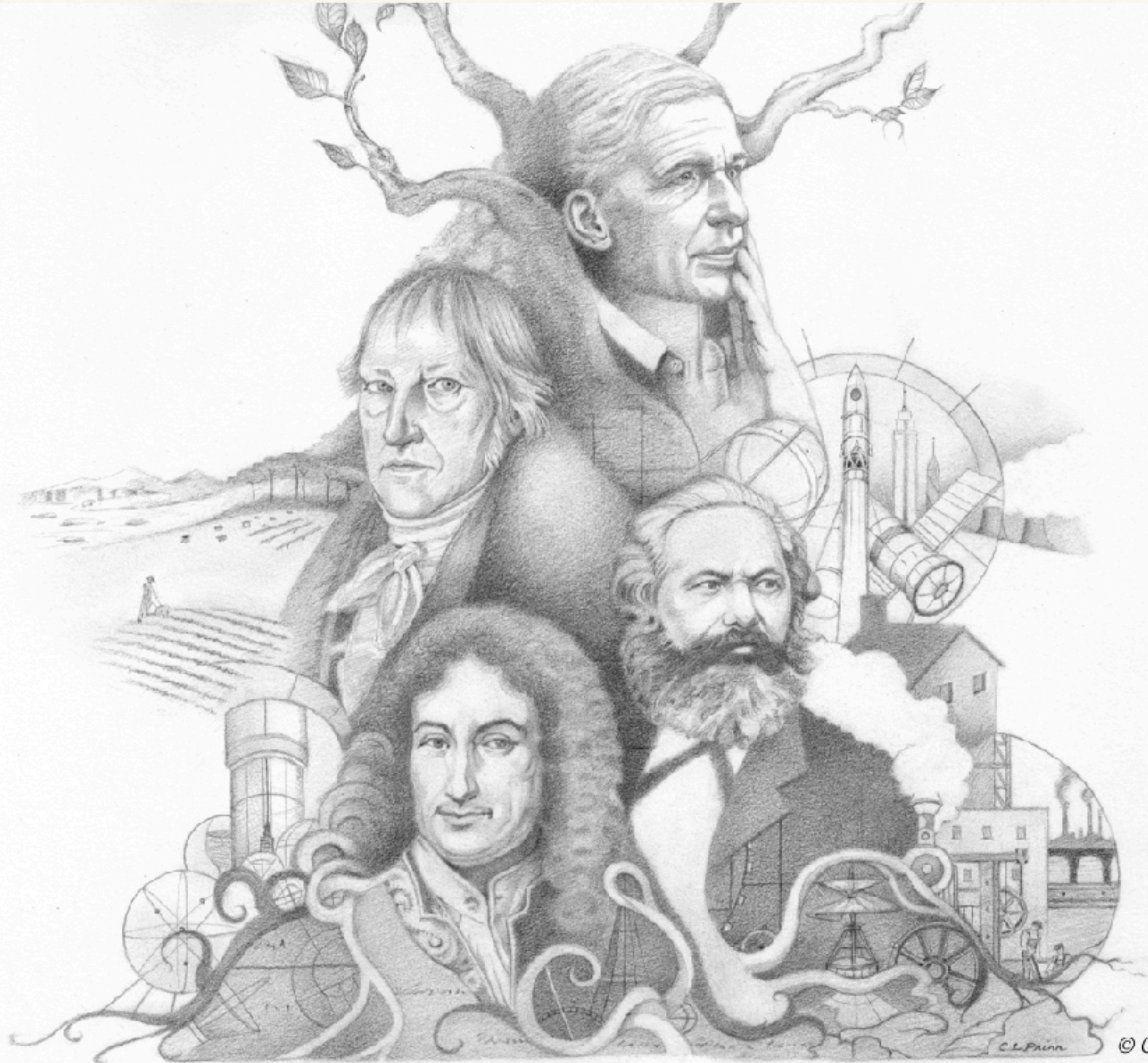


# Thomas Kuhn: The Structure of Scientific Revolutions



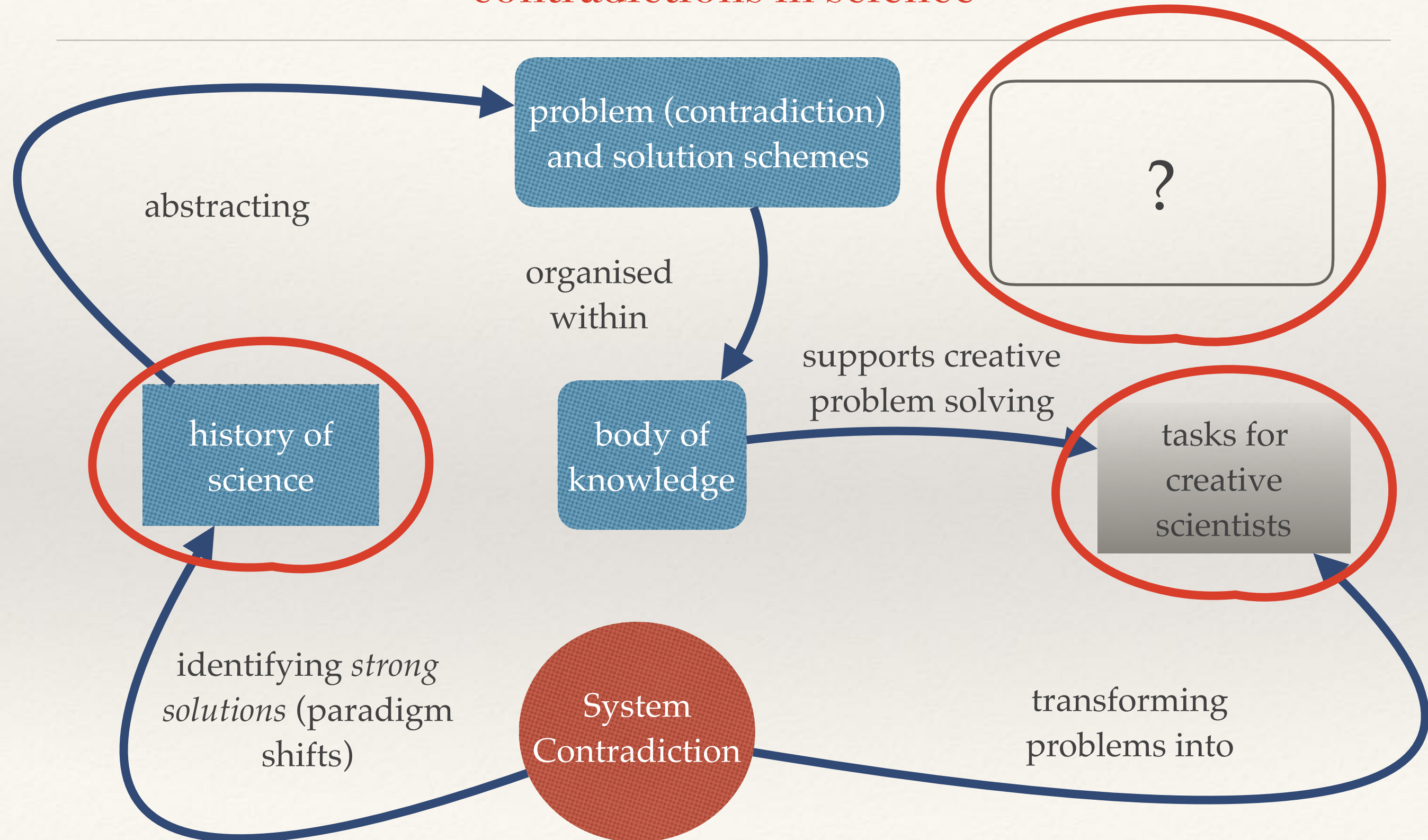




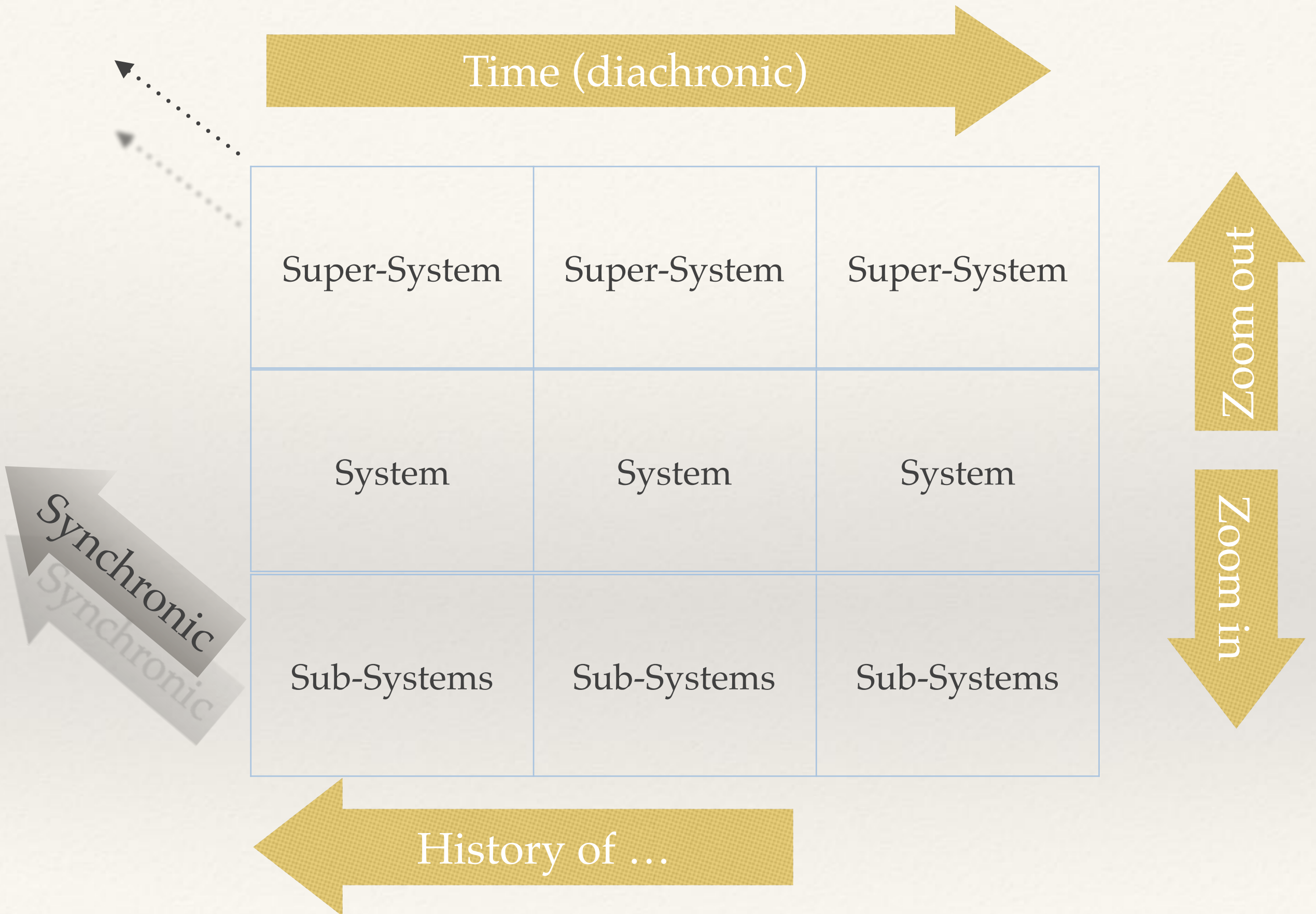




# On the potential heuristic value of the concept of system contradictions in science







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# TRIZ and Interdisciplinarity

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- ❖ **Synchronic:** A solution that works in field A might also work in field B — knowing the state of the art in many disciplines helps.
- ❖ **Diachronic:** A solution type that induced a paradigm shift in Field A might also induce a paradigm shift in Field B: knowing the history of multiple disciplines helps.
- ❖ **System Thinking:** Some solutions can only be tackled from a higher or lower system level, while the different levels are studied by different disciplines: knowing the perspectives from multiple disciplines helps.

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## On the potential heuristic value of the concept of system contradictions in management and entrepreneurship

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“In my opinion it is appropriate to say that a good entrepreneurial design has the character of a patent.” (transl. by J.S.)

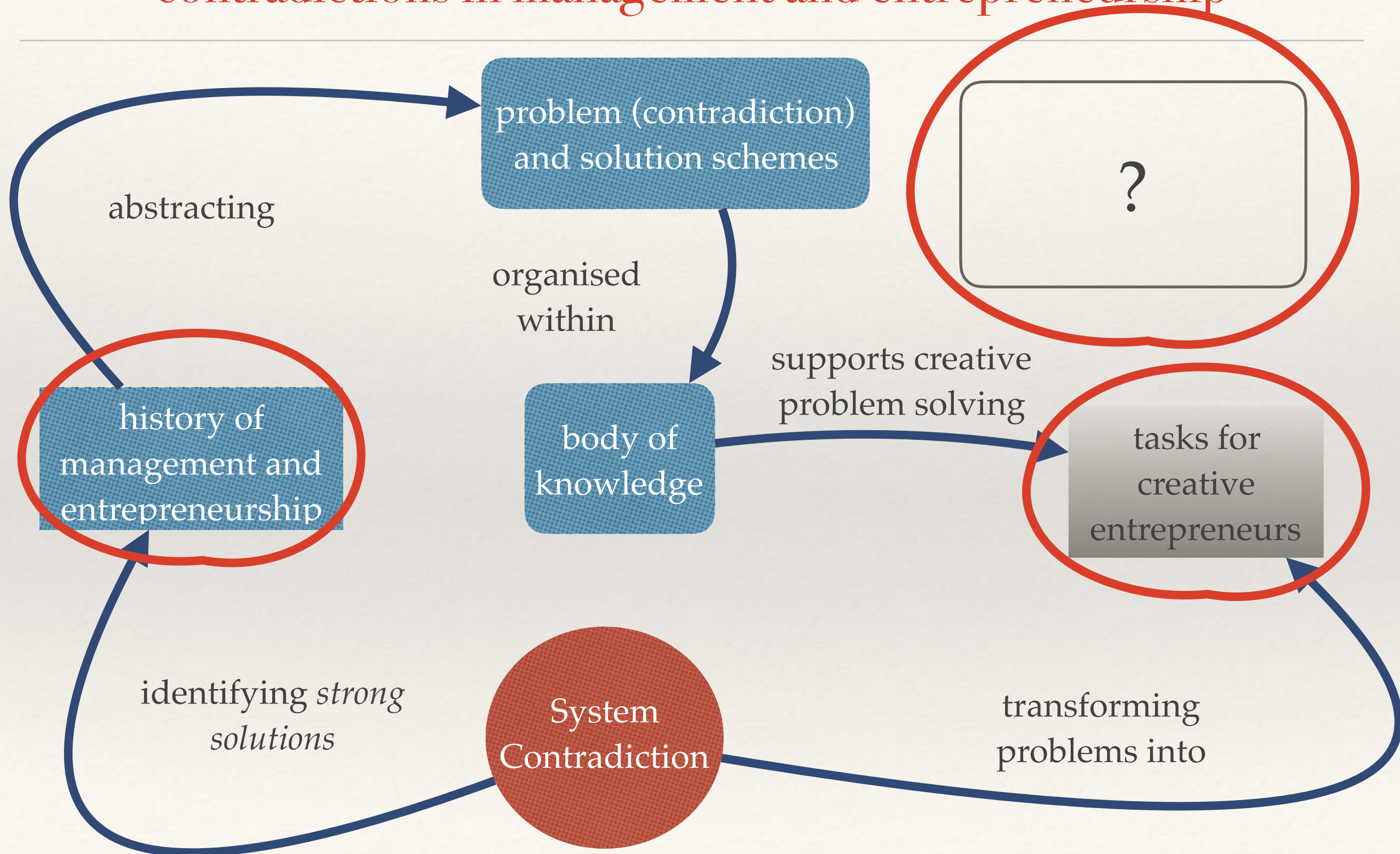
– Günter Faltn, *Kopf schlägt Kapital*, 2007, S. 57.

Management is basically always management of contradictions.

– Henry Mintzberg, *Mintzberg on Management: Inside Our Strange World of Organizations*, 1989.



# On the potential heuristic value of the concept of system contradictions in management and entrepreneurship





### 3) Interdisciplinarity and the challenge of sustainability

# Hans Carl von Carlowitz



1645–1714

- ❖ Mining administrator (at Freiberg) and son of a forest master
- ❖ 1700: Mining (ore) ↑ Timber ↓
- ❖ River system was engineered to import timber (postponed problem)
- ❖ Timber prices ↑ —> bankruptcies (10000 miners employed in the Erzgebirge)
- ❖ —> Formulated the concept of sustainability in forestry

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# Hans Carl von Carlowitz

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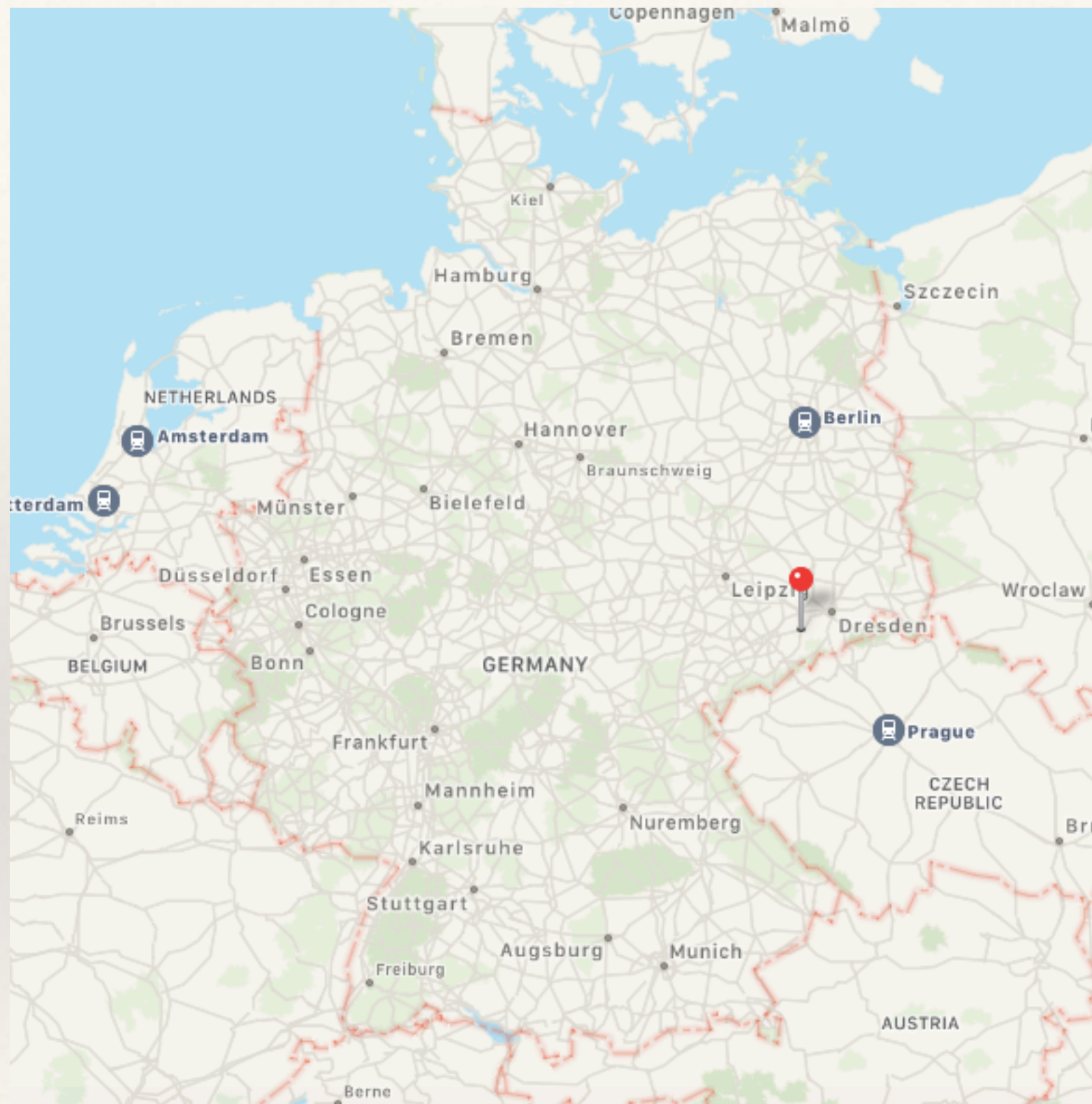
1645–1714



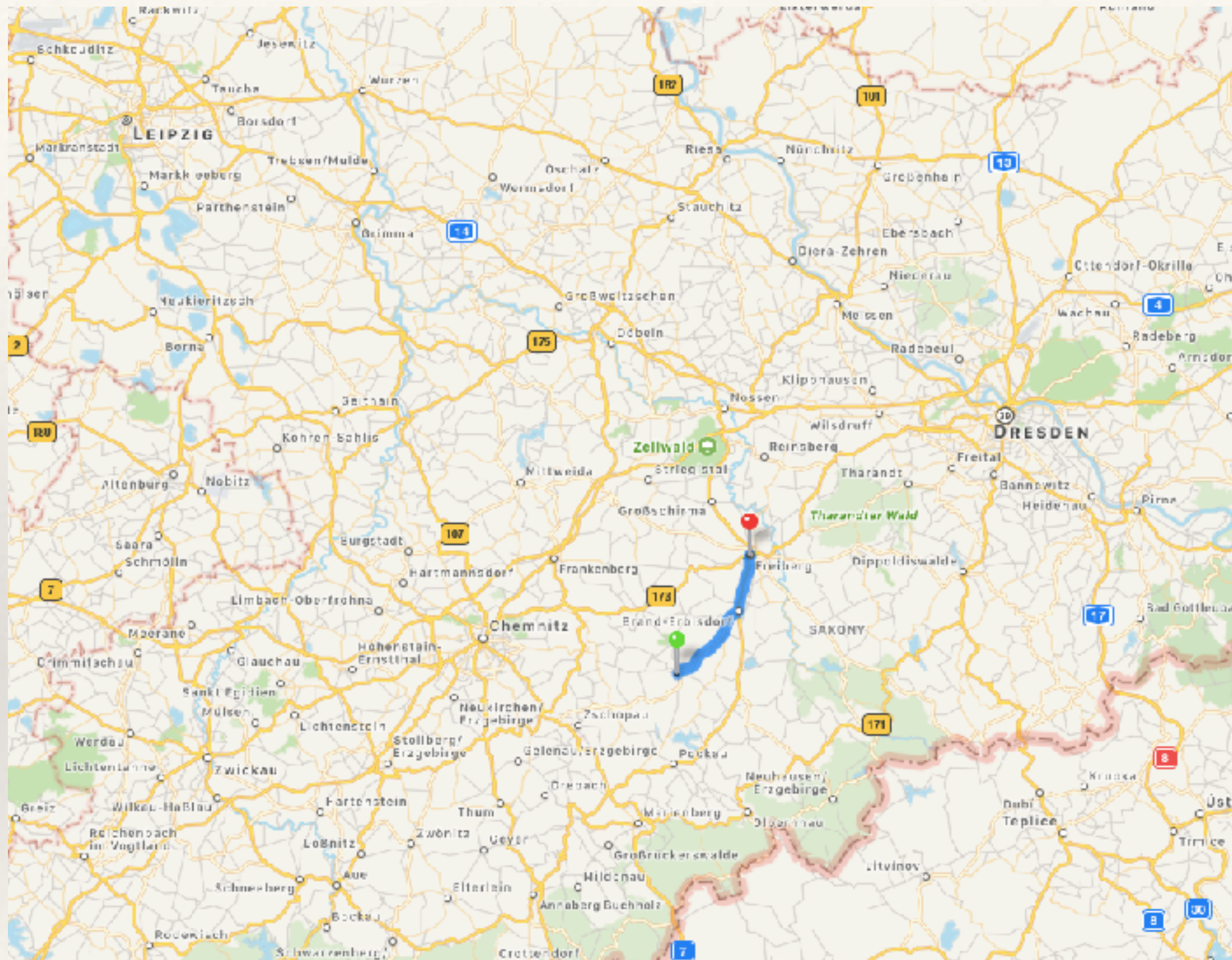
Gottfried Wilhelm Leibniz  
1646-1716



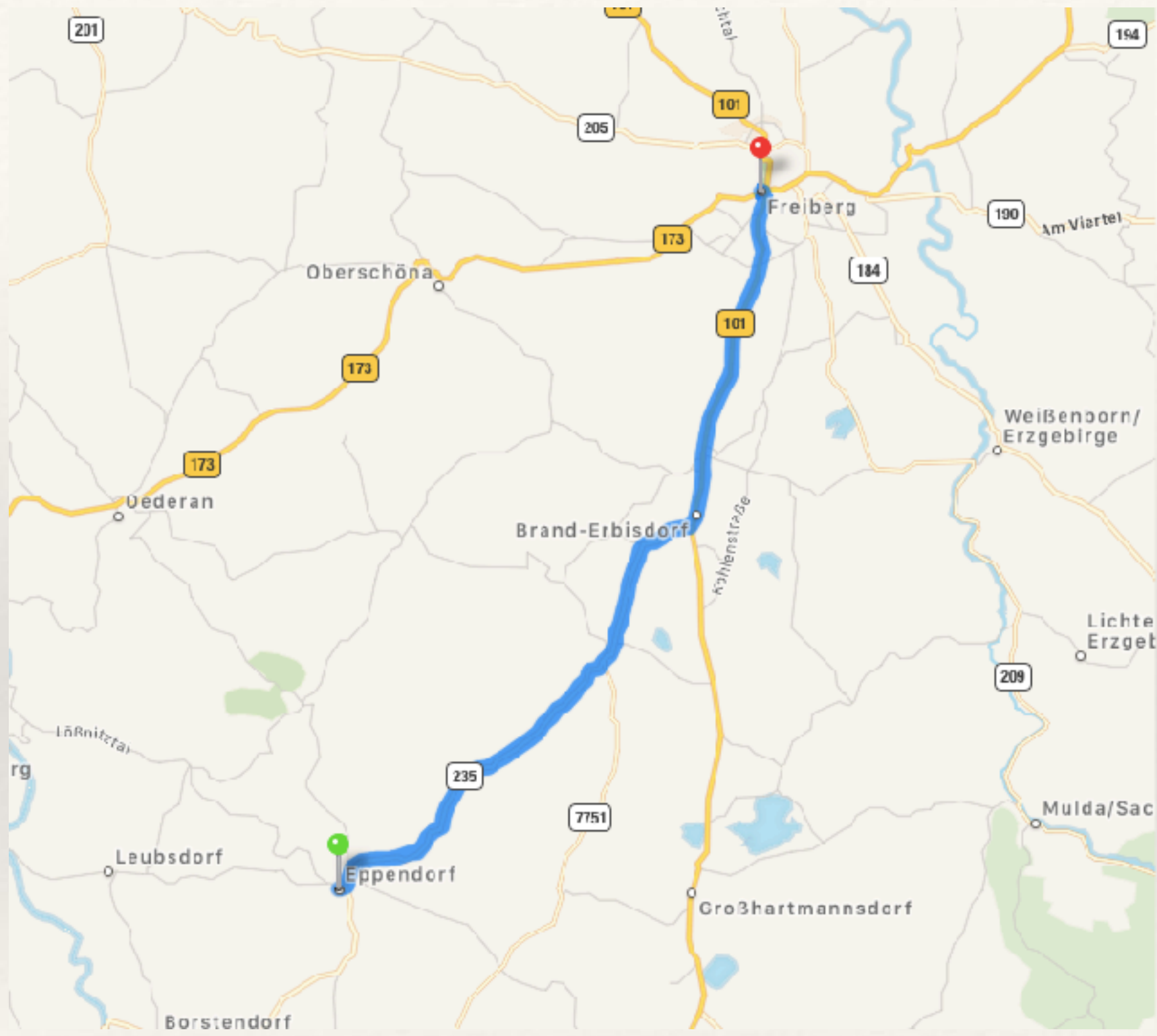
## 3.1) Resource efficiency











# Production of synthetic diesel

Polymerisation

Cellulose ( $C_6H_{11}O_5$ )

Biogenic waste

Depolymerisation

Plastics ( $C_{60-80}$ )

High-caloric waste

prolonging  
carbon chains

cracking  
carbon chains



chain of 14  
Carbon atoms



Polymerisation



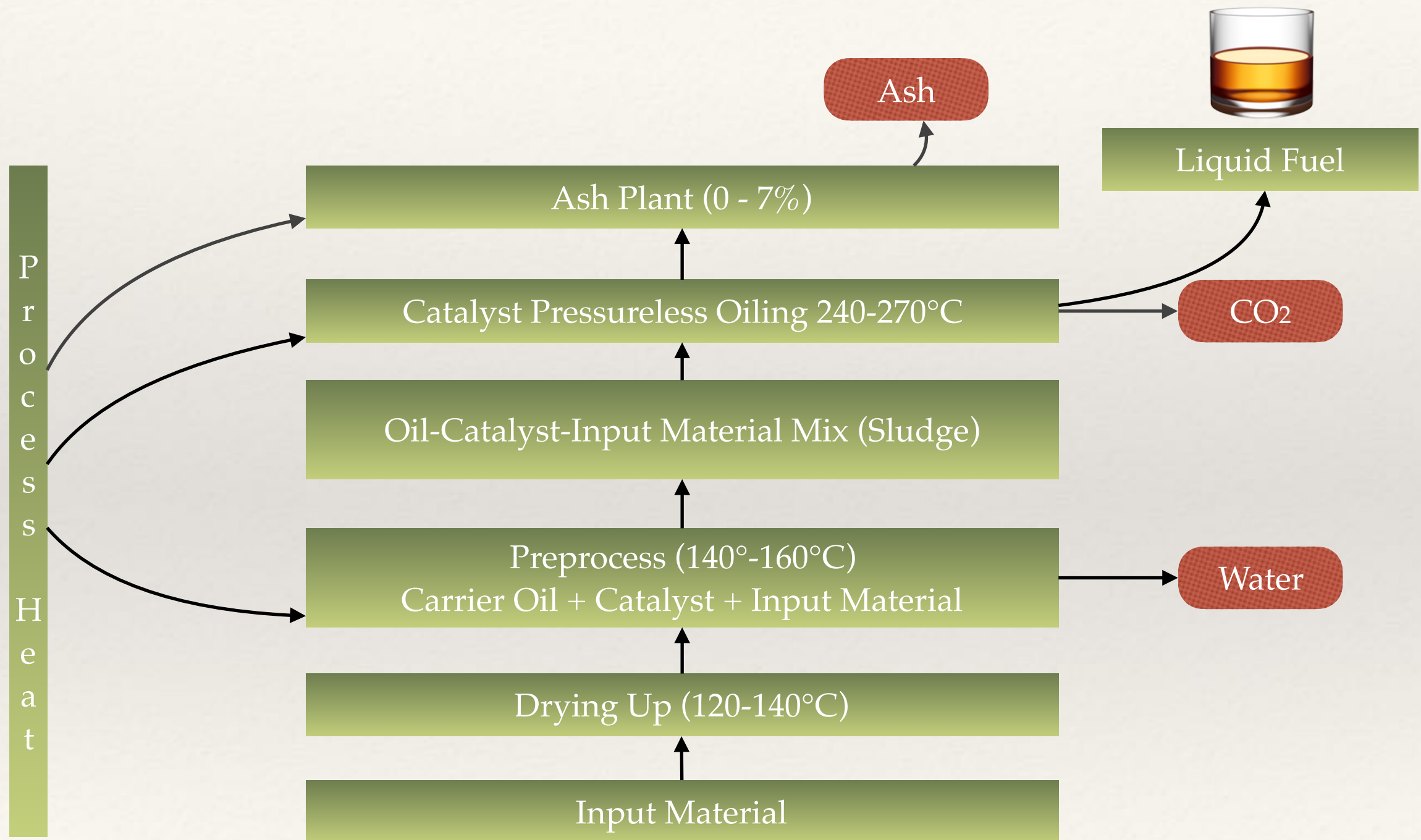
Depolymerisation

carbon chains  $\uparrow$   $\downarrow$

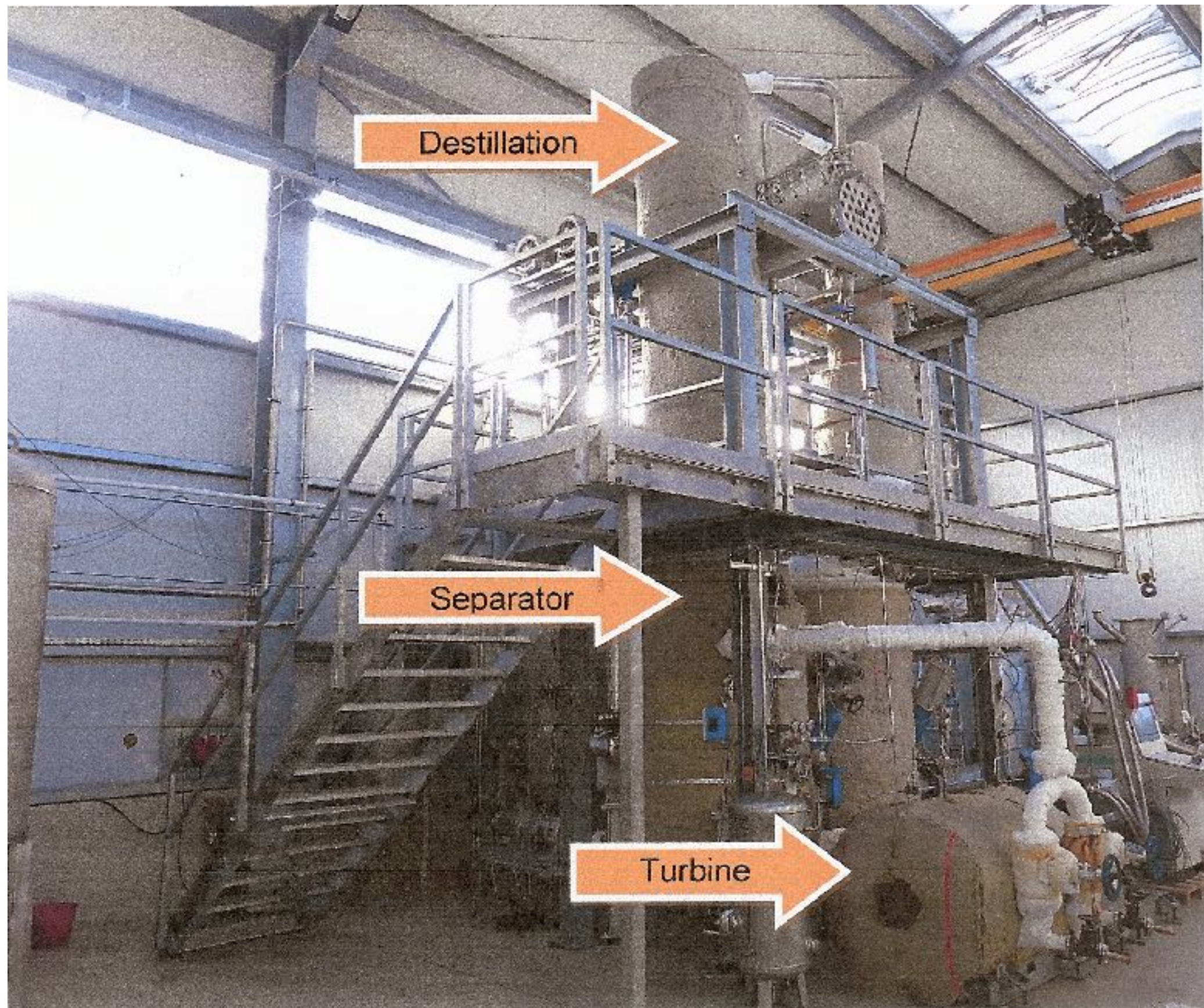




# Catalytic Pressureless Oiling









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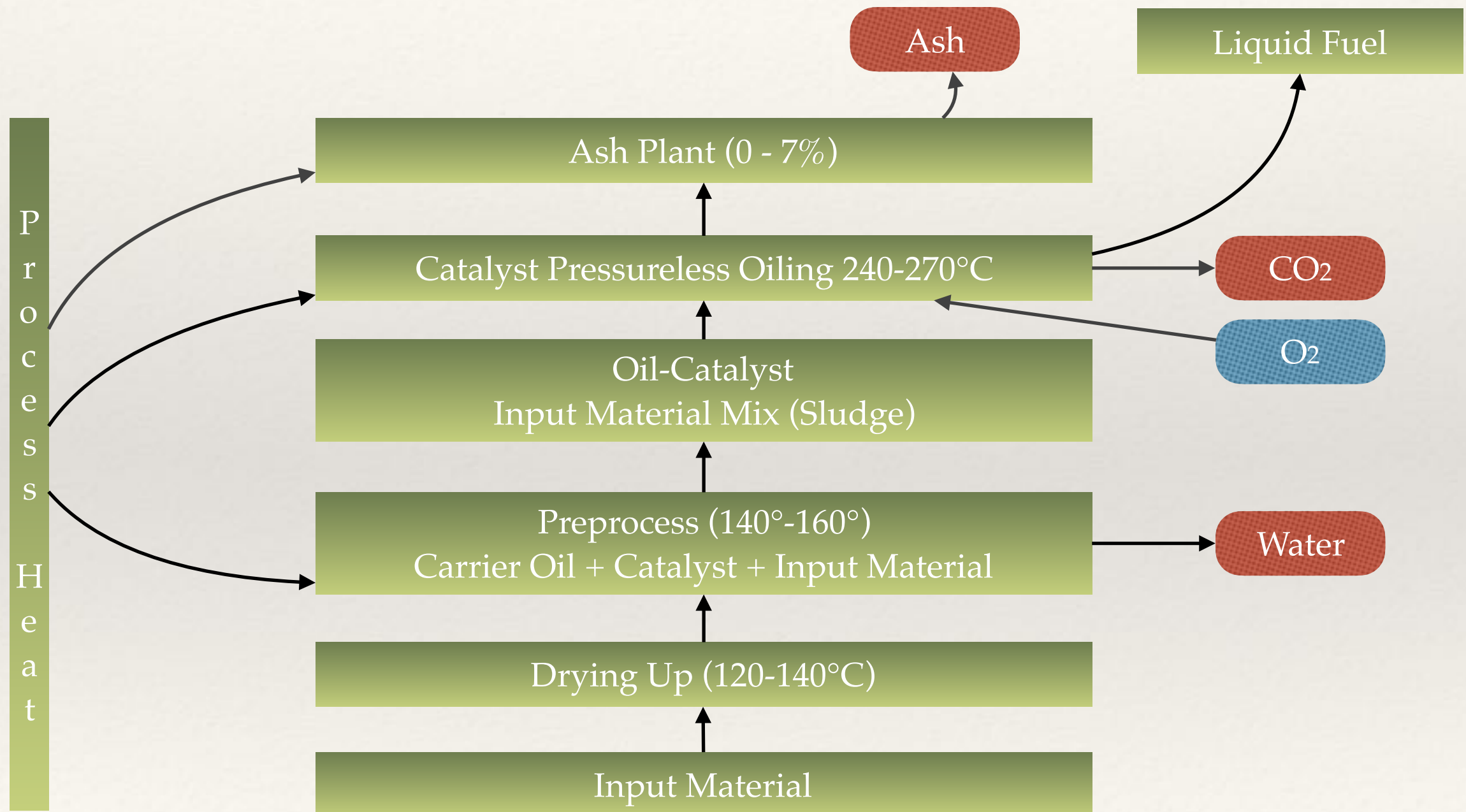
# Two problems occurred

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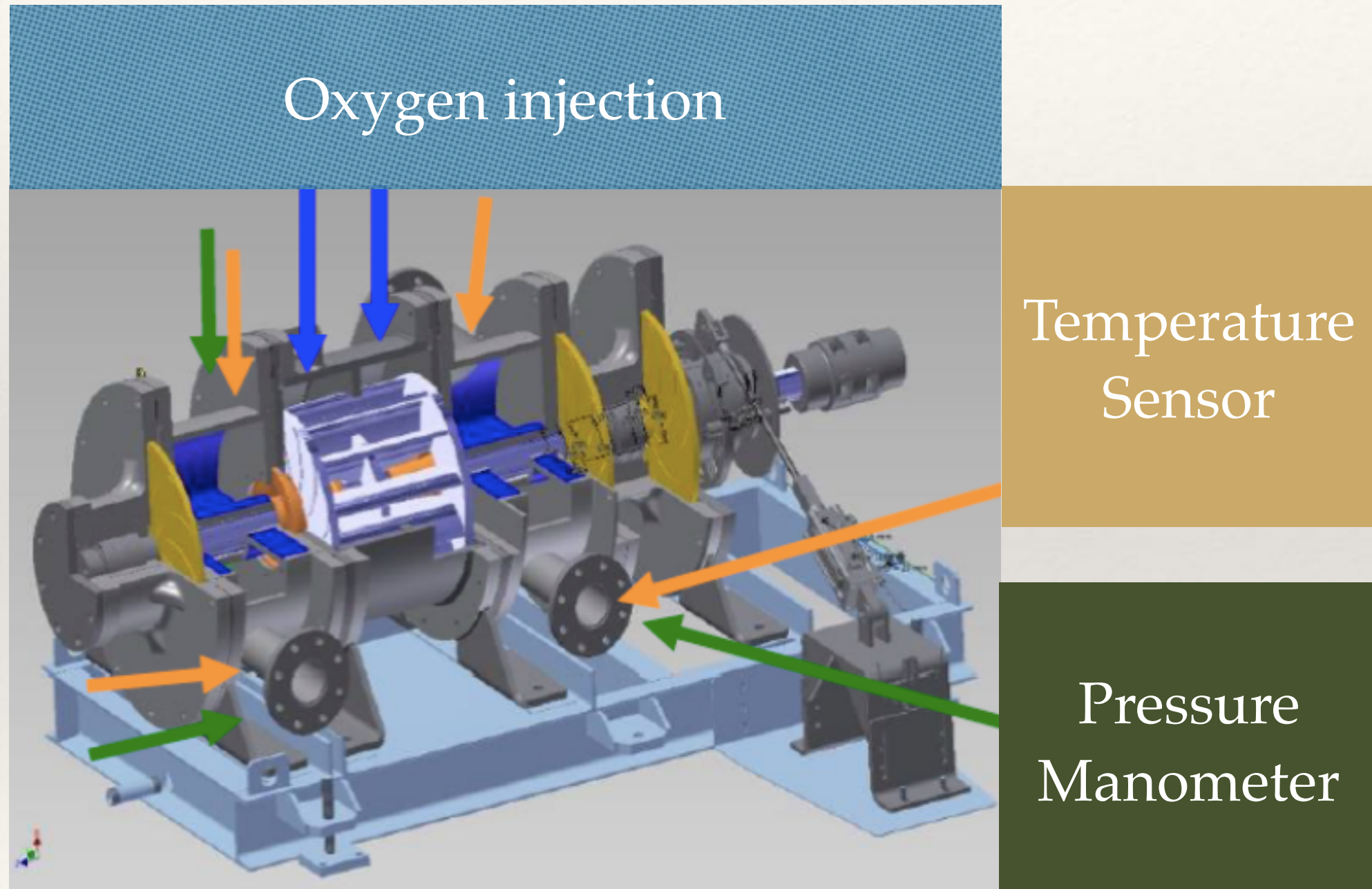
- 1) Low productivity of the plant



# Catalytic Pressureless Oiling with Oxygen Injection



# Development of a friction turbine with oxygen injection



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# Two problems occurred

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1) Low productivity of the plant

- solved by inventive principle “strong oxidants”

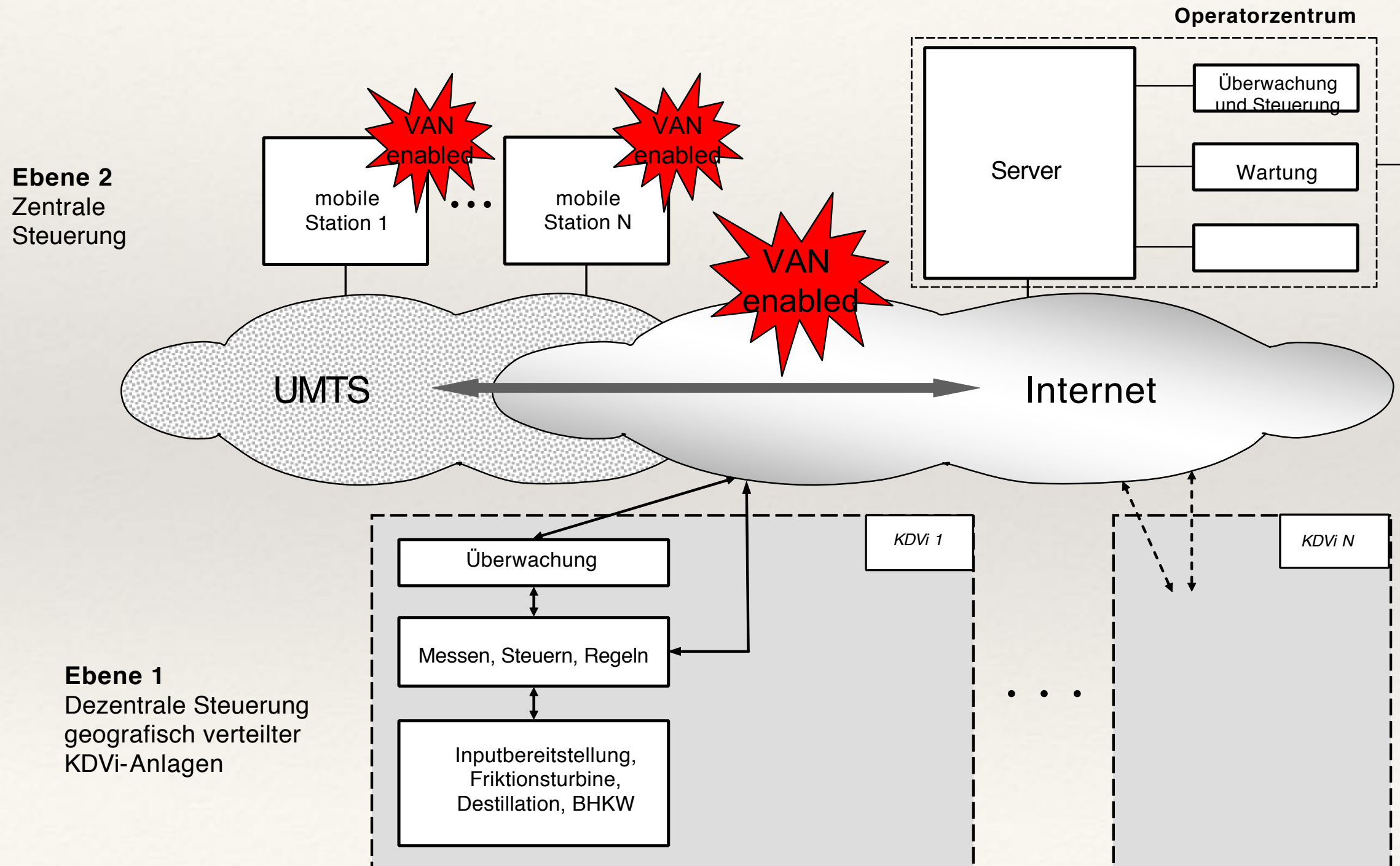
2) In order to generate control energy in a virtual power station, the performance parameters can not be changed quickly enough (the rate of change of the produced diesel quantity per time unit is too small)

- solved by developing it into a poly-system



# Central control of decentralized systems for catalytic pressureless oiling with oxygen injection

## Struktur von Prozessführung und Service



## 3.2) The root contradiction of sustainability

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# The Root Contradiction of Sustainability according to Georg Müller-Christ (2007 and 2014)

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Meeting a set of goals  
to the lowest costs in  
order to increase  
profitability

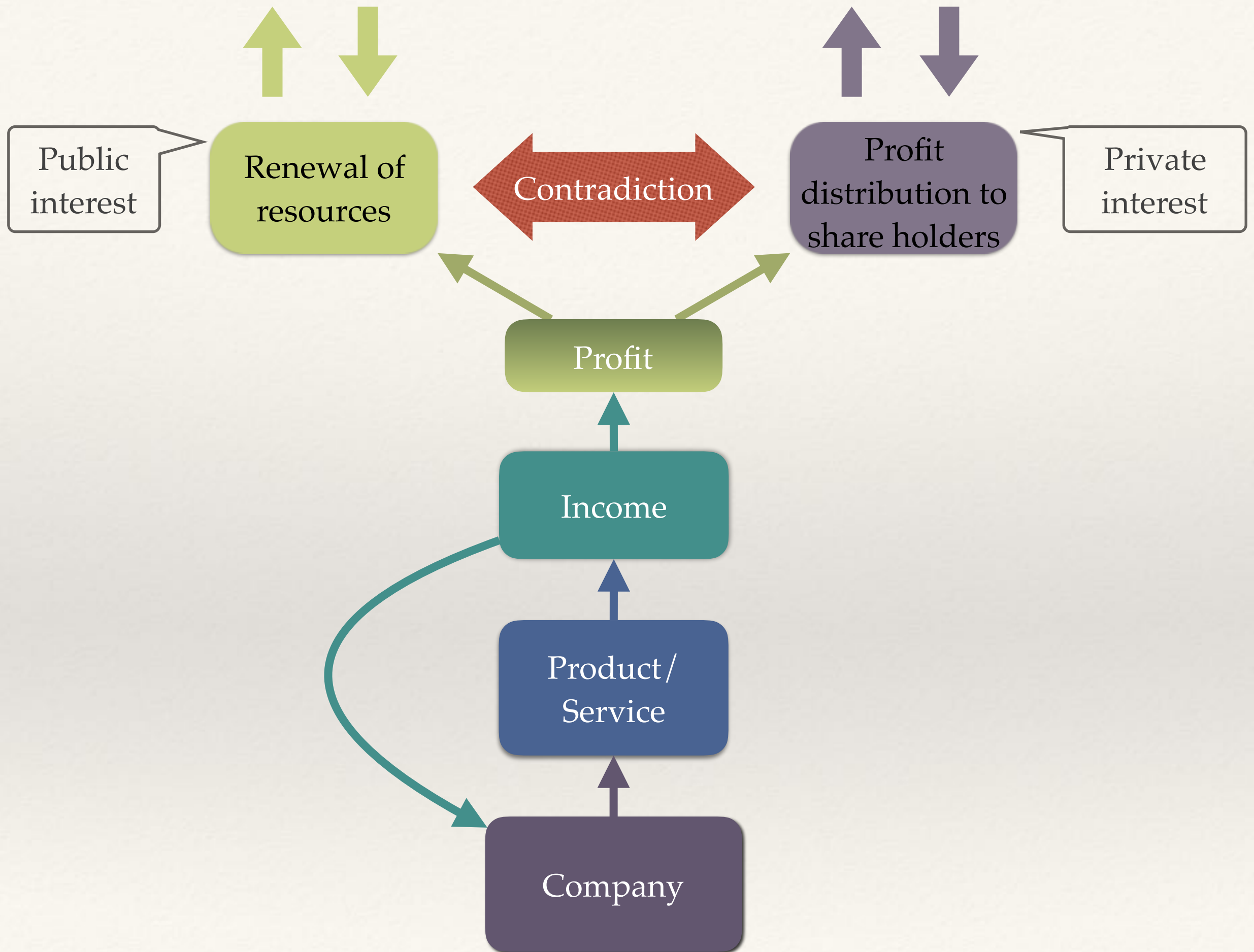
A) Efficiency

Renewal of the  
resources on which our  
reproduction depends

B) Sustainability

- ❖ Efficiency ↑ does not imply Sustainability
- ❖ Dilemma for managers: Spending a dollar for either A or B and thus either offending the shareholders or the public

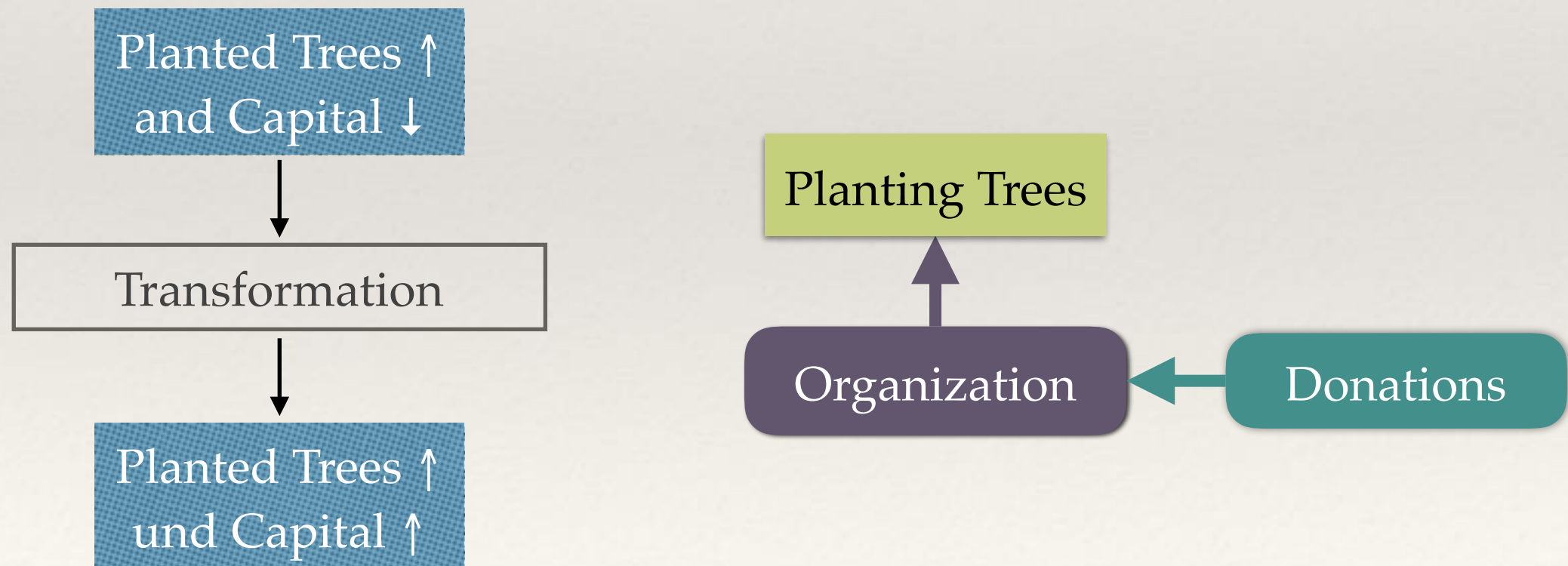




# First Solution Type

# Ecosia

- ❖ Planting trees to act against climate change
- ❖ When investing capital into tree planting, the capital will be rapidly consumed



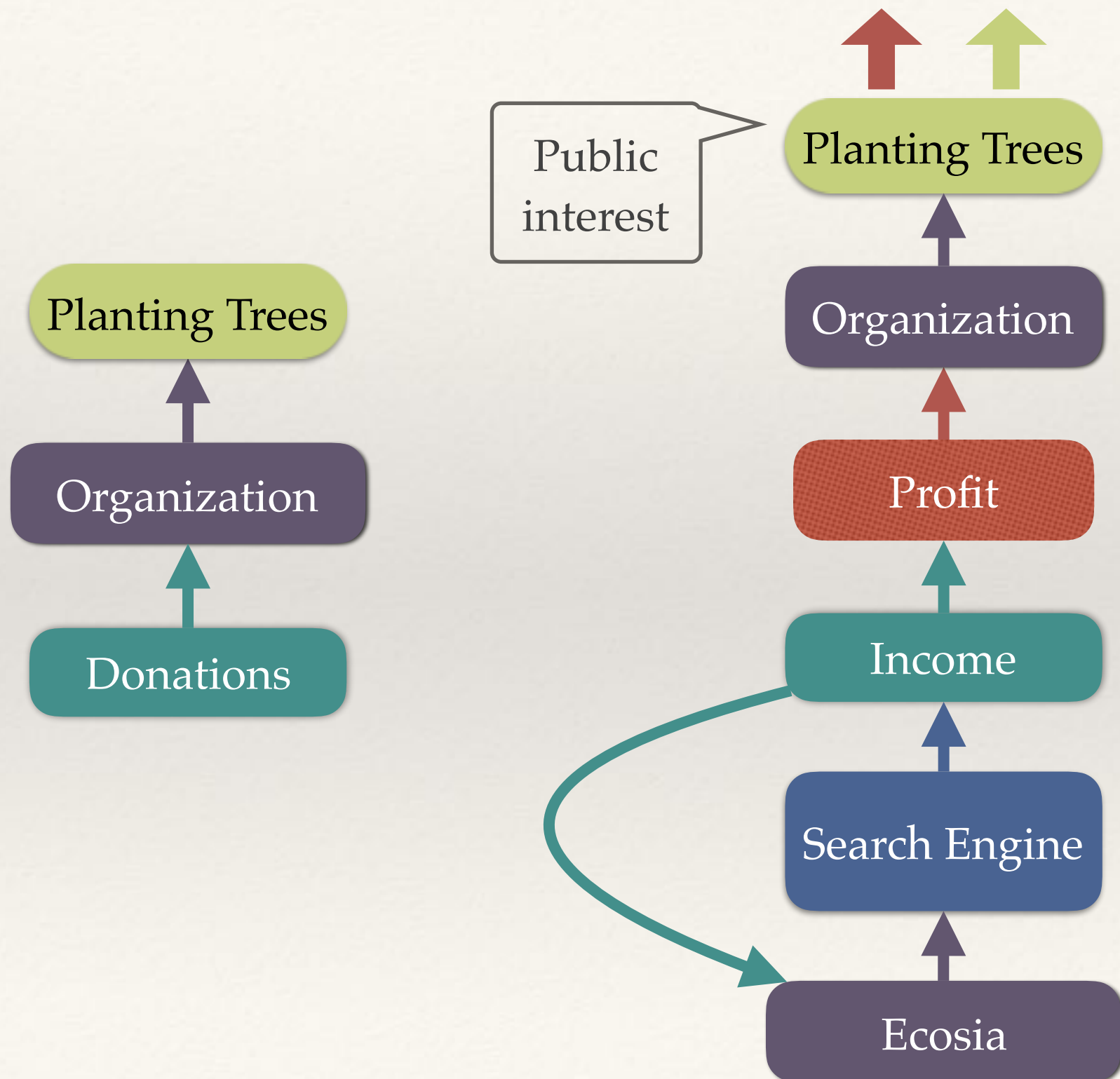




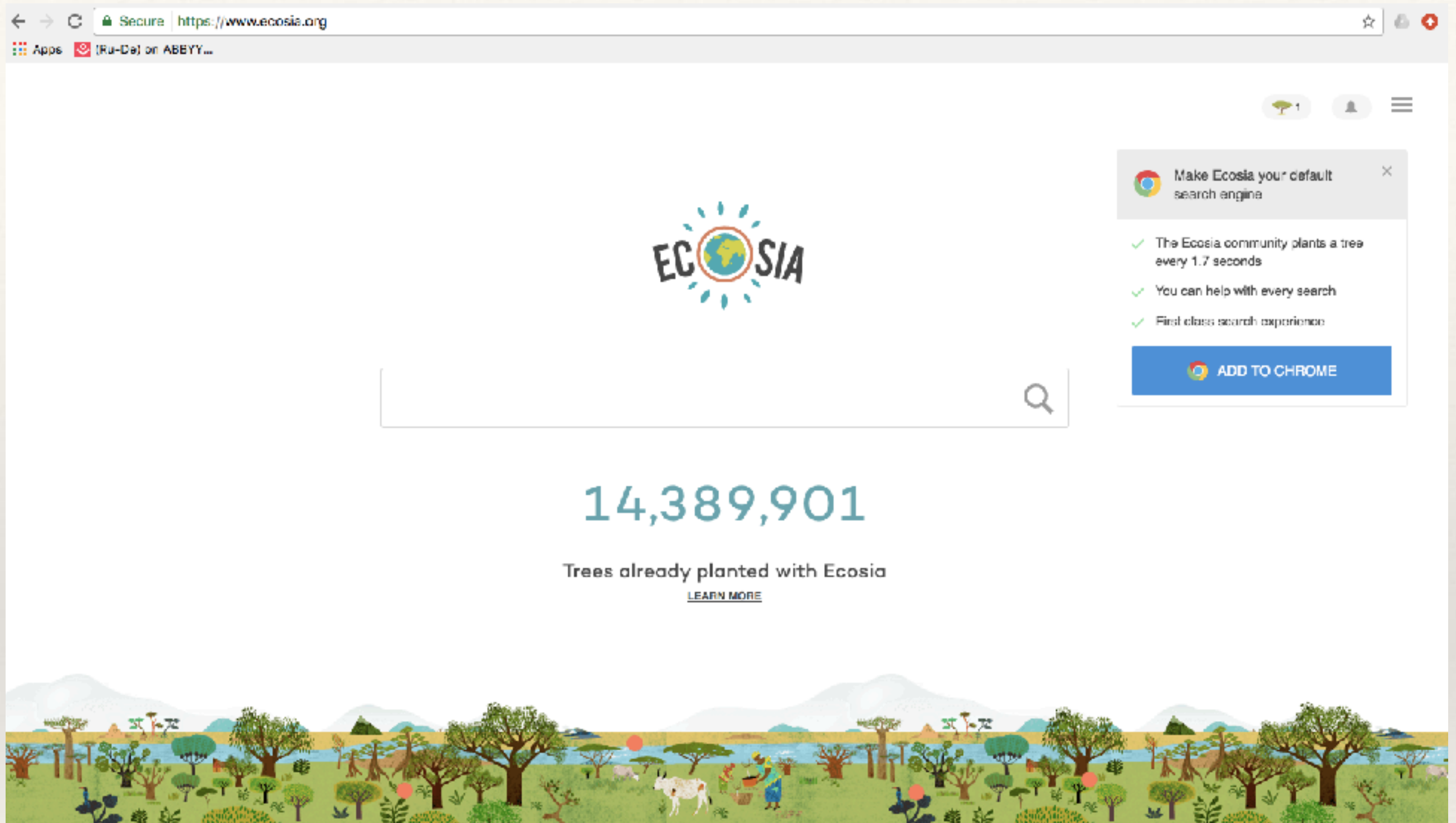
Christian Kroll

All photos on Ecosia taken from [https:// www.ecosia.org/](https://www.ecosia.org/)

# Ecosia





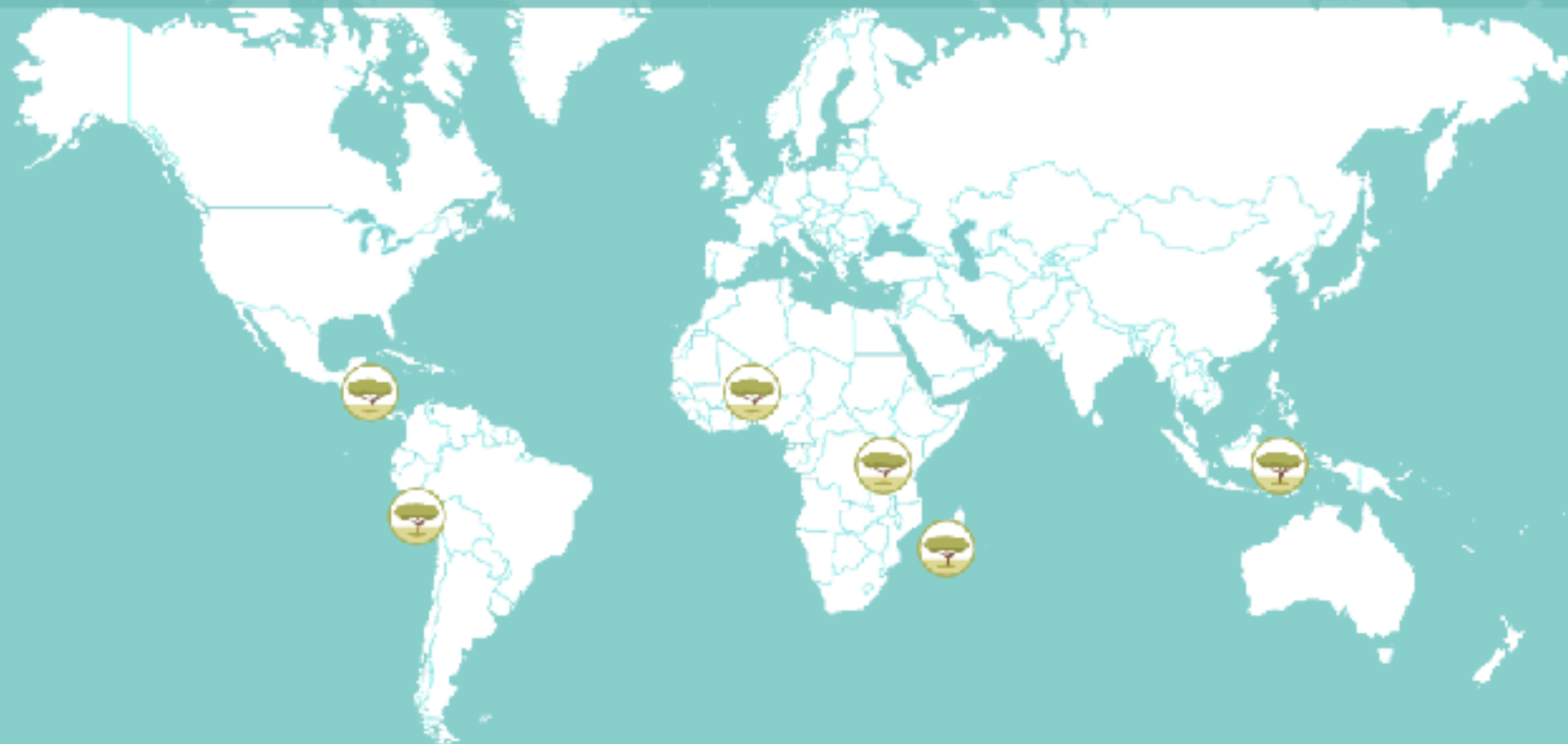


Screenshot of <https://www.ecosia.org/> from October 4, 2017:



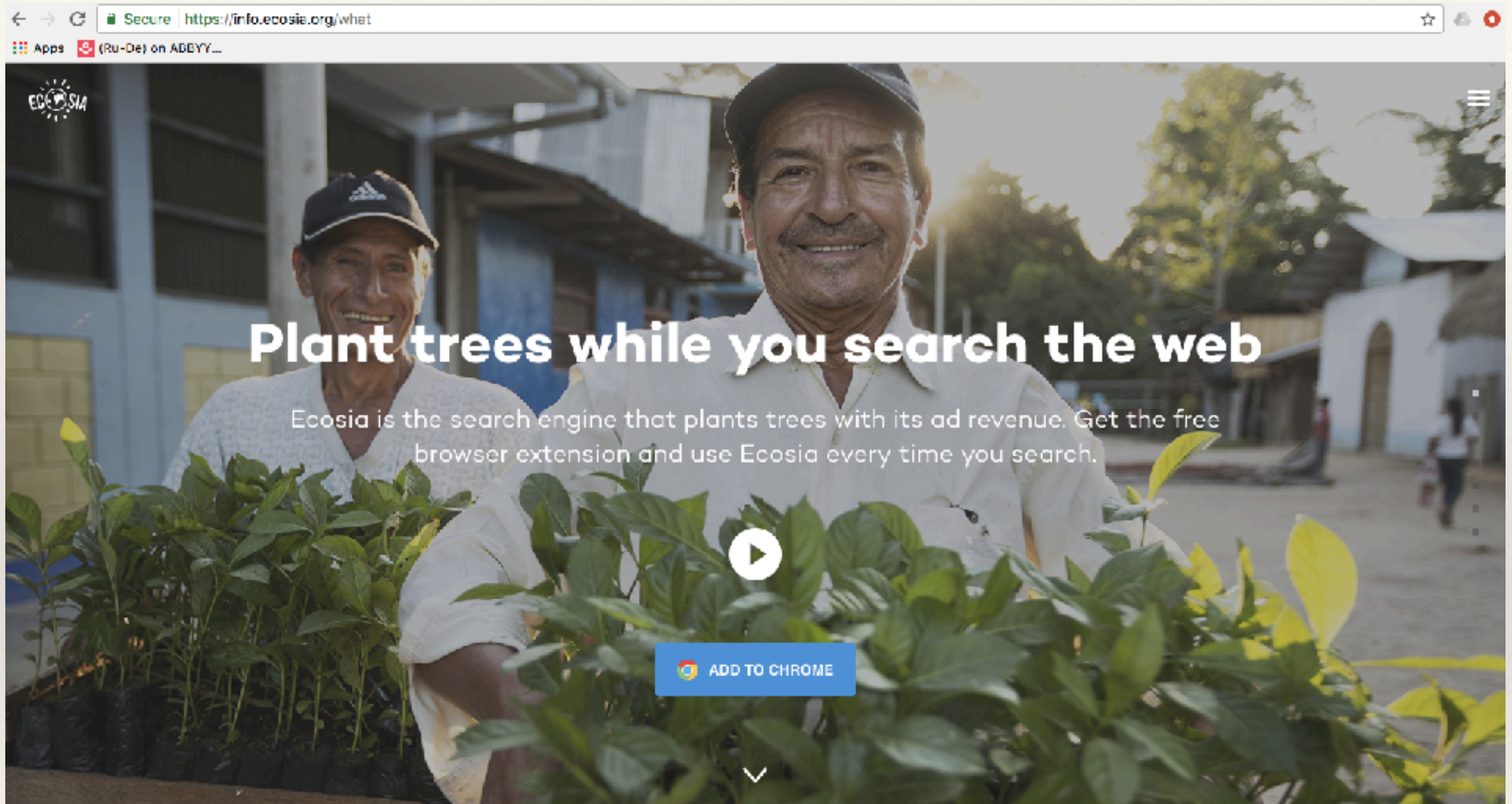
## We're planting all around the world

Each of the tree planting projects that we finance has a unique approach and is helping to reforest the world in a very special way.

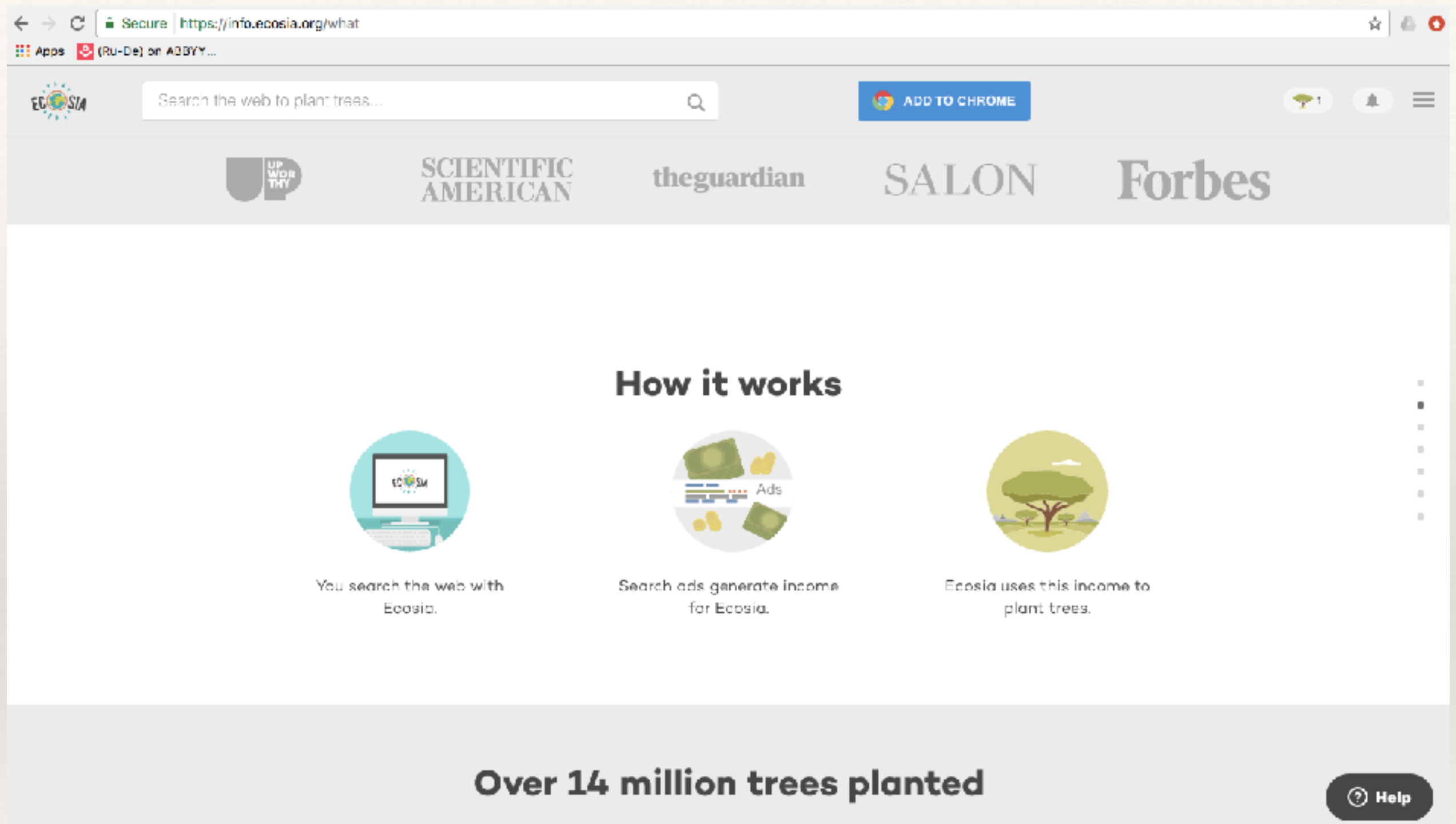


 Help

Screenshot of <https://www.ecosia.org/> from October 4, 2017:



Screenshot of <https://www.ecosia.org/> from October 4, 2017:



Screenshot of <https://www.ecosia.org/> from October 4, 2017:



← → ↻ Secure | <https://info.ecosia.org/what> ☆

Apps (Ru De) on ABBYY...

ECOSIA Search the web to plant trees... ADD TO CHROME

1.7 sec	OVER 5.5 million	NOW 14,389,969	OVER 4,911,896	0.22 euro
TO PLANT A TREE	ACTIVE USERS	TREES TOTAL	EUR INVESTED	PER TREE

**Trees are vital for our planet**

These are just a few of the benefits.

BIODIVERSITY

HAPPY PEOPLE

WATER SECURITY

CLEAN AIR

Help

Screenshot of <https://www.ecosia.org/> from October 4, 2017:

## Financial Reports & Tree Planting Receipts by Ecosia

32 items



July 2017



June 2017



May 2017



April 2017



March 2017



February 2017



January 2017



December 2016



November 2016

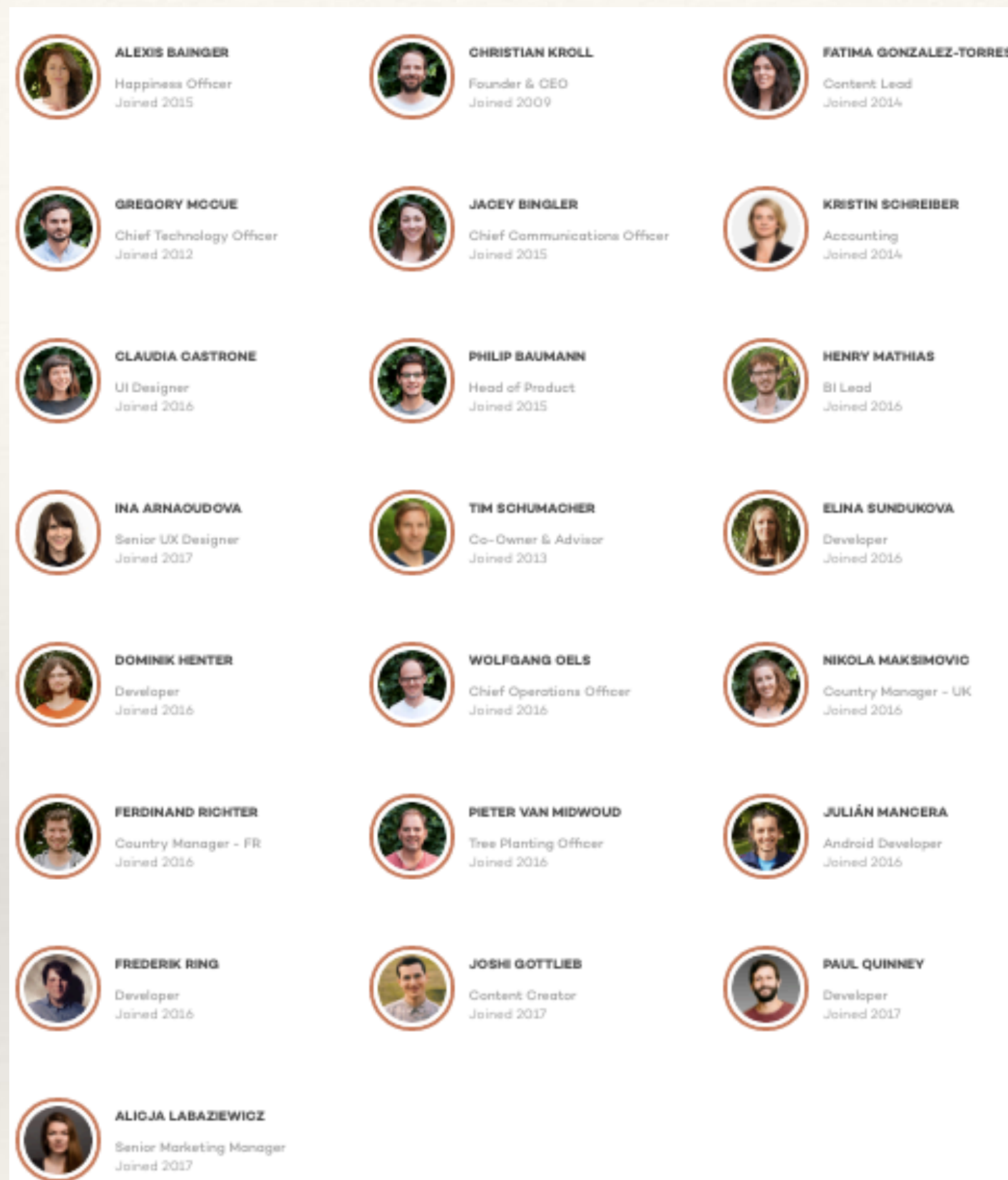


October 2016

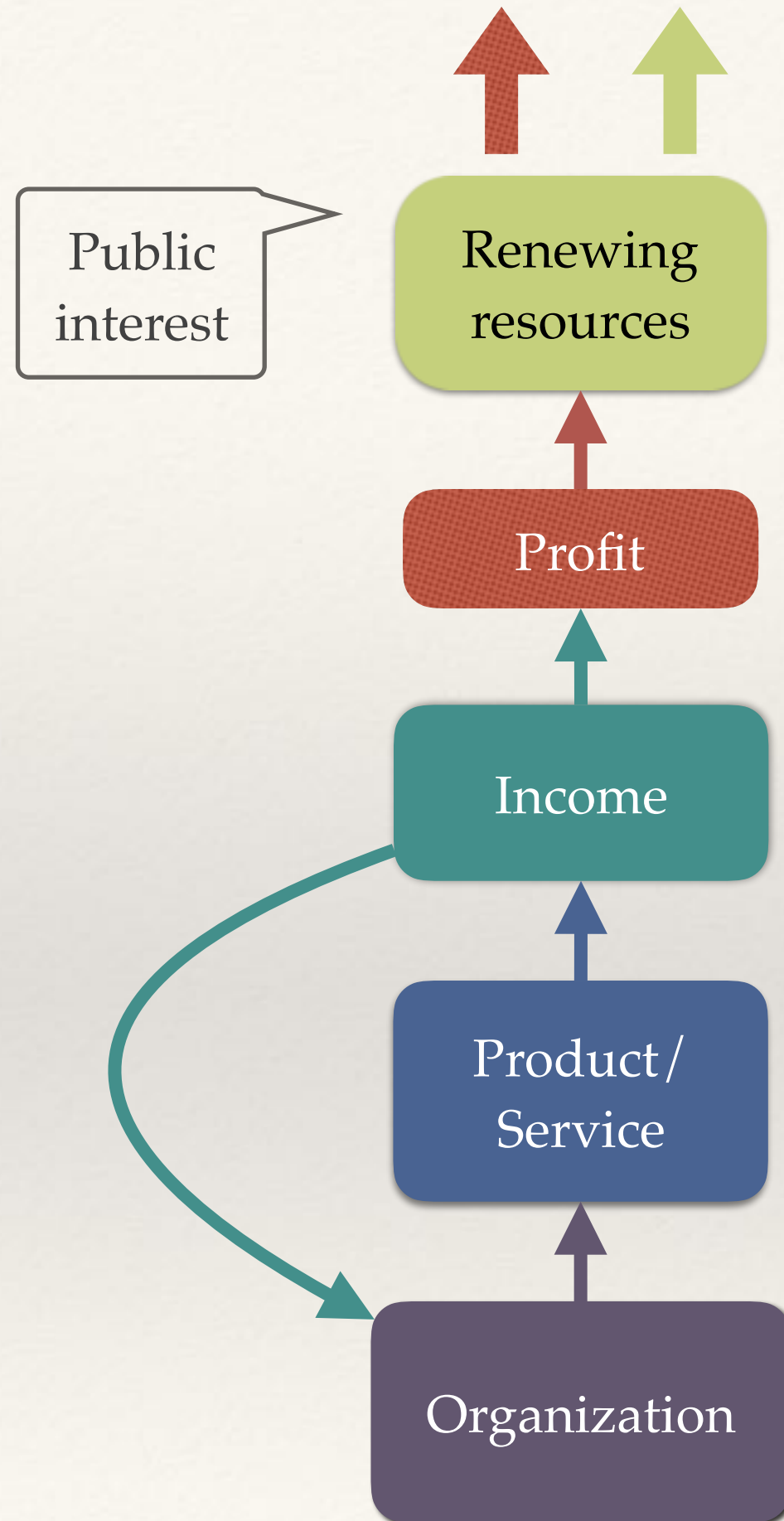
Screenshot of <https://www.ecosia.org/> from October 4, 2017:





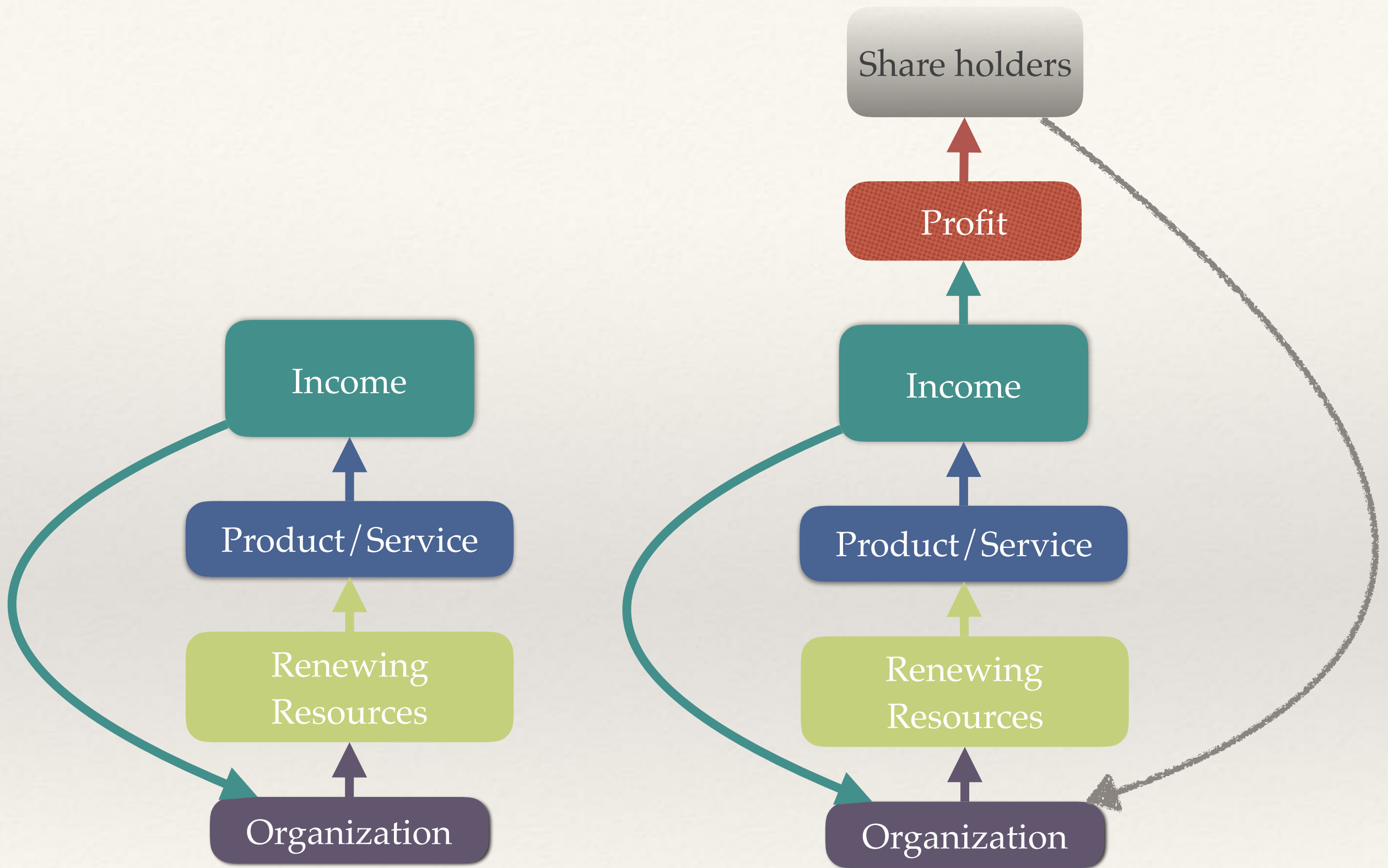


Screenshot of <https://www.ecosia.org/> from October 4, 2017:



# Second Solution Type





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# Richard Perkins

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Information and pictures taken from  
<http://www.ridgedalepermaculture.com/>

- ❖ Small Farm in Ridgedale, Sweden
- ❖ 4 months without frost; low light intensity
- ❖ Paying four Stockholm salaries
- ❖ After 5 years all investment costs paid off
- ❖ Constantly increasing soil quality





## DESIGN OVERVIEW



Savannah style wide spaced  
Nut plantings over pasture  
over Keyline subsoil pattern

Spring fed ponds and  
microclimate plantings

Mixed species Holistic Planned  
Grazing across all paddocks.  
Dairy Cows, Sheep, Layers &  
Broilers moving daily on  
planned grazing

Spring fed reflective pond and  
cold climate vines on  
protected slope

Sea Buckthorn & Japanese  
Quince plantation

Front field with fruit trees over  
berries on Keyline Layout  
optimized for maximum solar  
gain with trees in center of  
each row & berries on each side

Contoured kitchen gardens &  
paddy fields with commercial  
polytunnel, root cellar,  
extensive vegetable beds &  
microclimate leveraging

Jean Pain compost and  
wood fired heating system

Perennial leaf crops used as  
architectural features in farm  
center

Plant based sewage system

0.96Ha

0.66Ha

Reforestation  
Area  
1.76Ha

Larch  
0.2Ha

Nut Field  
2Ha

Bucky Field  
0.35Ha

Top Field  
1.84Ha

Car Park Field  
(borrowed)

Front Field  
0.65Ha

Farm Center  
0.93Ha

90 Yr+ Spruce

Pig paddocks and  
leaf tree reforestation

RAM pump supplies  
quick release water  
access across farm

Larger Creek

Keyline Agroforestry  
strips planted for  
optimal solar gain.  
Hazel, Apple, Pear, Plum  
& Cherry on back rows  
and Berry fruit along  
the front

30 yr+ Larch Planting

"The Medicine Cabinet" ;  
Berry & super fruits

Riparians protected from  
grazing animals & planted  
with Coppice timber, fruit,  
nut & berry production.  
Edible mushroom  
production below.

Smaller Creek

Rotational coppiced Willow  
biomass & windbreak

Natural Swimming pool

Teaching & Dining yurts  
and social spaces



See: <http://www.ridgedalepermaculture.com/>

Bill Mollison,  
David Holmgren

Perma-  
culture

- Energy cycling
- No waste
- Polyculture and diversity of species
- Observation and replication of natural patterns

P.A. Yeoman

Keyline  
Design®

- Profitable agriculture ↑ but Soil quality ↓
- Desertification and erosion
- Profitable agriculture ↑ Soil quality ↑

1. Climate
2. Land shape
3. Water
4. Roads
5. Trees
6. Buildings
7. Subdivision
8. Soil

Holistic  
Management®

Allan Savory

- Livestock ↑  
Desertification ↑
- Livestock ↓  
Desertification ↑
- (moving) Livestock ↑  
Land health ↑

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# Willie Smits

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- ❖ Reforestation of eroded grassland in Indonesia (Borneo and Sulawesi)

Pictures taken from a movie made by Raymond Hartman on the  
**Village hub in Tomohon**

<http://masarang.nl/en/projects/sugar-palm-miracle-tree/>







<http://masarang.nl/en/projects/sugar-palm-miracle-tree/>

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# Arenga Pinnata – Sugar Palm

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<http://masarang.nl/en/projects/sugar-palm-miracle-tree/>



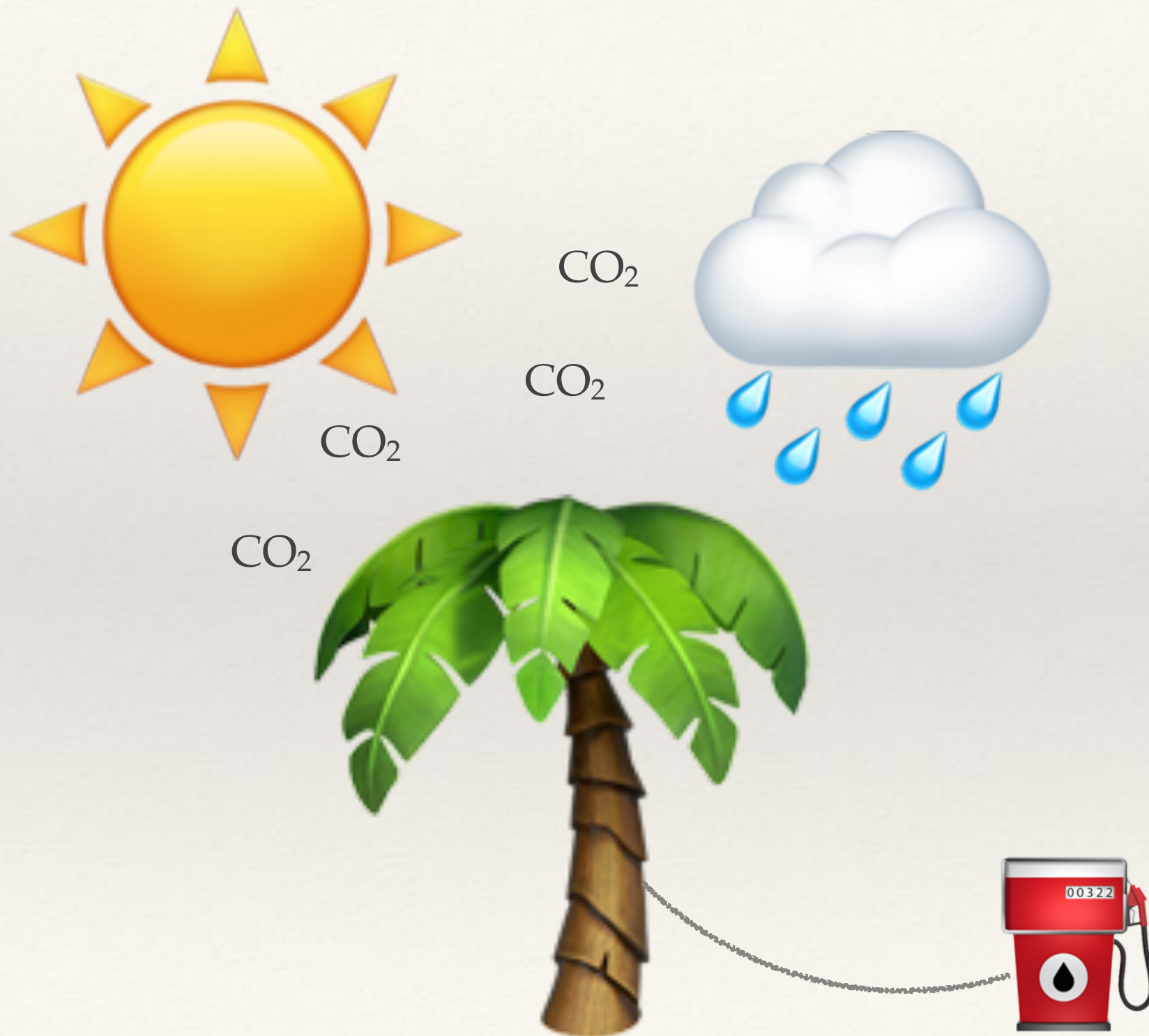
- ❖ The palm transforms sunlight, rainwater and carbon dioxide into sugar juice:
  - ❖ harvested on a daily basis (full grown palms 20-30 litres per day; some even 50)
  - ❖ sugar concentration of 11%
- ❖ 60 different products can be produced from the palm
- ❖ Produces 3 times more energy than raw cane sugar
- ❖ Longer and more efficient photosynthesis process
- ❖ Palm doesn't exhaust the soil
- ❖ No parts of the tree need to be cut off for harvest
- ❖ Grows on low-nutrient soils
- ❖ Profound root system: Protection against erosion, resisting fires and floods



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# Willie Smits

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4) Towards an Interdisciplinary Multi-Level-Perspective for future TRIZ research

Thank you!

