Clean energy supply chains
Workshop by EC-JRC and IEA-EGRD
12-13 Dec. 2023 | Petten, The Netherlands

THE GLOBAL GOALS
For Sustainable Development

Navigating towards an ‘all-circular’ Plastics & Carbon Economy

CO_2 as *renewable* feedstock and *new* industrial commodity

Reinhold W. LANG
Institute of Polymeric Materials and Testing
Johannes Kepler University, Linz/Austria

JOHANNES KEPLER UNIVERSITY LINZ

ipmt Institute of Polymeric Materials and Testing

3 Topics in context to Plastics

(1) On the **COP28** and ***'beyond'*** **...**

– **'phase-out** vs. **phase-down'** of (unabated) **fossil fuels?**

(2) On ***'essential'*** **materials** and **global prosperity**

(3) On **cross-sectoral *'circular'* Carbon Management** (ccCM)

[– incentivizing ccCM via a **new carbon accounting** (and funding instruments)**]**

[– feasibility/equity/justice: A *NEW (Green) Deal* AFRICA–EUROPE]

ANNEX
incl. 5 Key Messages

My '*metaphorical*' storyline: Where do we come from? | Who [where] are we? | Where are we headed?
What is the Meaning ***[Purpose]*** **of Life?**

The EVOLUTION role model | Why industrial ccCM?

What is the meaning *[purpose]* of life?

Michael Russell: **On the Emergence of Life** *(05/2011)*

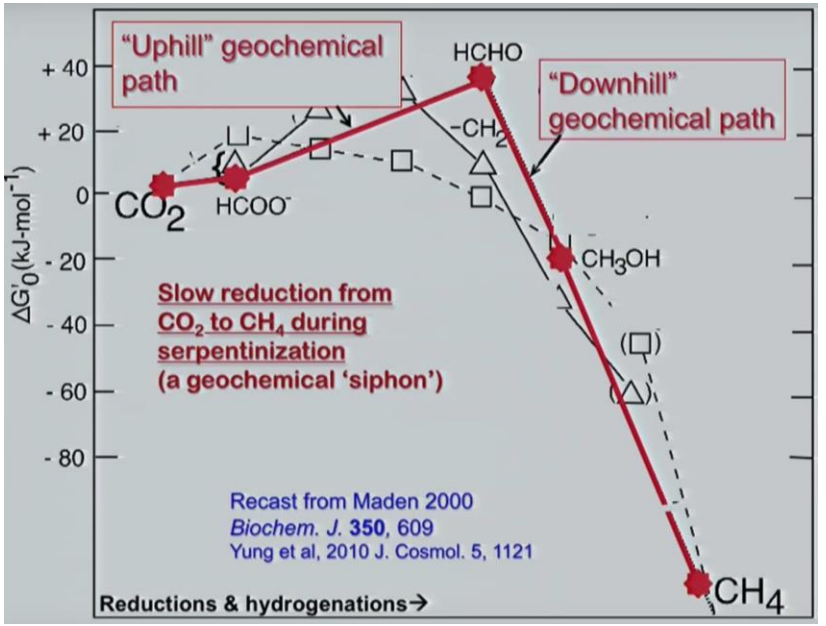


The **PURPOSE OF LIFE** *is the* **HYDROGENATION OF CARBON DIOXIDE**

MICHAEL RUSSEL
On the Emergence of Life Through "Negative" Entropy Trapping

Molecular Frontiers Symposium at the Royal Swedish Academy of Sciences, May 2011

https://www.youtube.com/watch?v=SF2uj0Oxqhg



TOPIC (1): Key moments at COP28 (1/2)

Phase-out vs. phase-down of (unabated) fossil fuels?




Cop28

The Guardian
News website of the year

Cop28 president says there is 'no science' behind demands for phase-out of fossil fuels

Exclusive: UAE's Sultan Al Jaber says phase-out of coal, oil and gas would take world 'back into caves'

Cop28 live - latest updates

Damian Carrington and Ben Stockton

Sun 3 Dec 2023 11.33 CET

Sultan Al Jaber: 'There is no science out there that says that the phase-out of fossil fuel is what's going to achieve 1.5C.' Photograph: Anadolu/Getty Images

The Guardian
3 Dec. 2023

Dr. Sultan Al Jaber | 21 Nov. 2023
[live online event in a dialogue with *'SHE changes climate'*]

*"… **There is no science out there, or no scenario out there,** that says that the **phase-out of fossil fuel is what's going to achieve 1.5C**."*

*"Please help me, **show me the roadmap** for a phase-out of fossil fuel that **will allow for sustainable socioeconomic development**, unless **you want to take the world back into caves**."*

…

*"A **phase-down and a phase-out** of fossil fuel in my view **is inevitable**. **That is essential.** But we need to be real serious and pragmatic about it."*

Dr. Sultan Al Jaber | Positions & Functions

- **President Designate of COP28**
- **CEO of ADNOC** (Abu Dhabi National Oil Company)
- **UAE Minister** of Industry and Advanced Technology
- Founding CEO & chairman of **Masdar**

https://www.theguardian.com/environment/2023/dec/03/back-into-caves-cop28-president-dismisses-phase-out-of-fossil-fuels

The COP Presidency Challenge

Managing alignment of [vastly] diverging interests … (1/2)

4 Letters to Parties

by COP28 presidency [July – Nov. 2023]


15 pages


27 pages


27 pages


2 pages

4 paradigm shifts

- **Fast-tracking the energy transition and slashing emissions before 2030**;
- **Transforming climate finance**, by delivering on old promises and setting the framework for a new deal on finance;
- Putting **nature, people, lives and livelihoods at the heart** of climate action;
- Mobilizing for the **most inclusive COP ever**.

Diplomat [N.N.] "expressing a common view" when referring to **Sultan Al Jaber**
[The Guardian, Article by Fiona Harvey; 7 Oct. 2023]

"He's the only one we've got, we need to work with him, to prevent him being undermined at home, or by Saudi** [Arabia] **…"

Dr. Sultan Al Jaber | 4 Dec. 2023
[Press conference at COP28, Dubai']

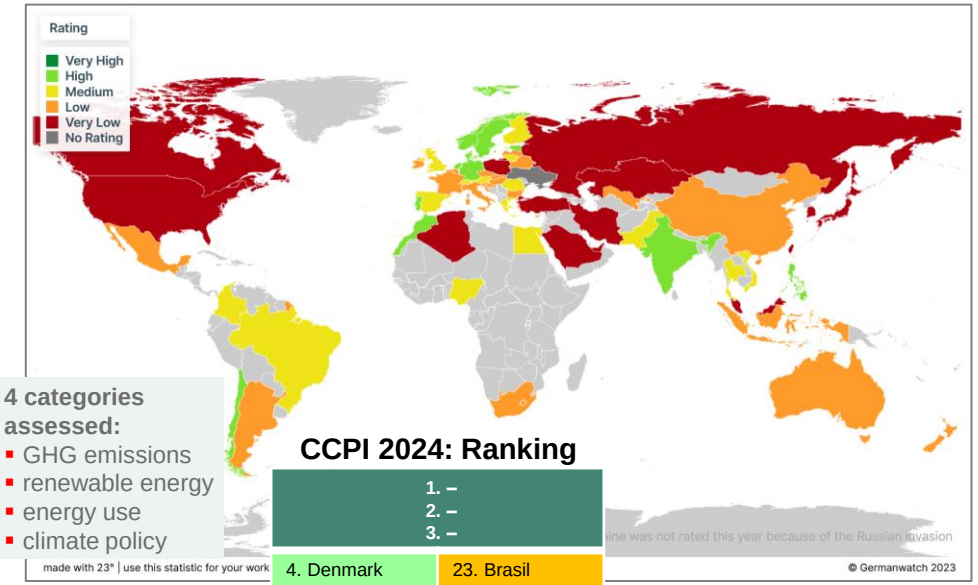
"I respect the science in everything I do.
I have repeatedly said that it is the science that has guided the principles or strategy as Cop28 president. We have always built everything, every step of the way, on the science, on the facts."

*"I have said over and over **the phase-down and the phase-out of fossil fuel is inevitable. In fact, it is essential**."*

The COP Presidency Challenge

Managing the alignment of *[vastly]* diverging positions & interests … (2/2)

The Climate Change Performance Index (CCPI)



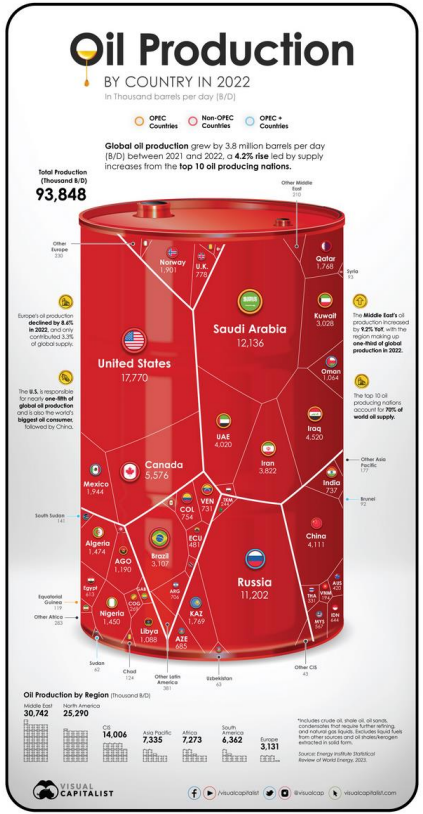
4 categories assessed:

- GHG emissions
- renewable energy
- energy use
- climate policy

https://ccpi.org/

CCPI 2024: Ranking

1. – 2. – 3. –		
4. Denmark 5. Estonia 6. Philippines 7. India 8. Netherlands 9. Marocco 10. Sweden 14. Germany **16 EU overall**	23. Brasil **32. Austria** 51. China	57. USA 63. Russian F. **65. UAE** 66. Iran 67. Saudi Arabia



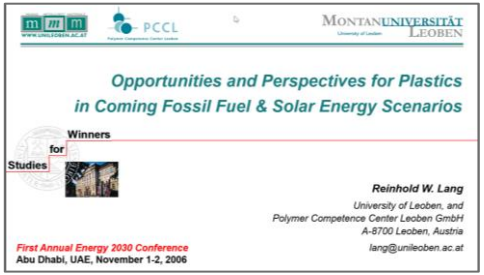
The World's Biggest Oil Producers
(OPEC, OPEC+, Non-OPEC)

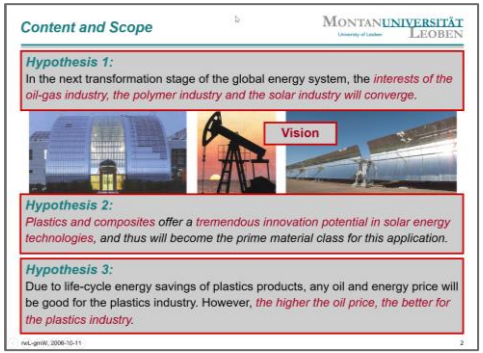
Understanding COP from the **fossil fuel perspective:**

A complex interaction of region/state/company positions & interests!?

Source:
Visual Capitalist
https://www.visualcapitalist.com/charted-worlds-biggest-oil-producers-in-2022/

A brief **flashback to my Keynote** with 3 Hypotheses at the **First Annual Energy 2030 Conference,** Nov. 1-2, 2006 | Abu Dhabi, UAE





Hypotheses by R. W. Lang as of 1994

Hypothesis 1:

In the **next transformation stage** of the **global energy system**, the **interests of the oil-gas industry**, **the polymer industry** and **the solar industry will** *[must]* **converge.**

Hypothesis 2:

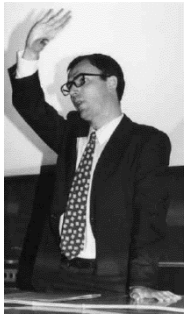
Plastics and composites offer a **tremendous innovation potential** in **solar** *[renewable]* **energy technologies**, and thus will become the **prime material class** for these applications.

Hypothesis 3:

Due to life-cycle energy savings of plastics products, **any oil and energy price** will be **good for the plastics industry**. However, **the higher the oil price, the better for the plastics industry!**

THE TRANSFORMATION OF THE ENERGY SYSTEM?

A brief retrospect to my Inaugural Lectures 1994 & 2010



Oct. 1994: Inaugural Lecture 1
MU Leoben

SUSTAINABLE DEVELOPMENT:
Role and Perspectives for Polymeric Materials

University of Leoben (A), October 1994

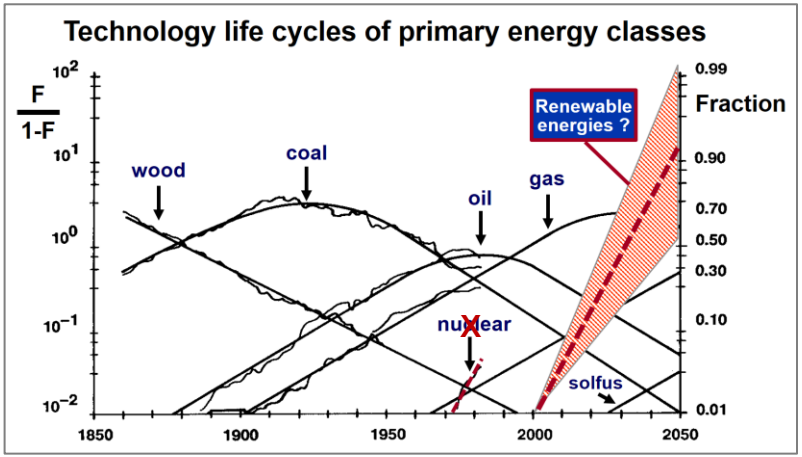
R. W. Lang

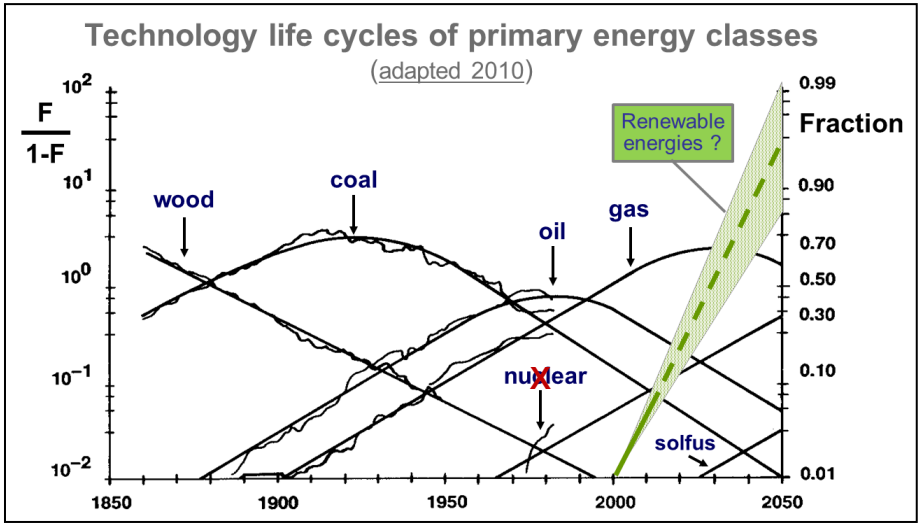


March 2010: Inaugural Lecture 2
JKU Linz

POLYMERIC MATERIALS & POLYMER SCIENCE FOR *SUSTAINABLE DEVELOPMENT* TECHNOLOGIES

R. W. Lang



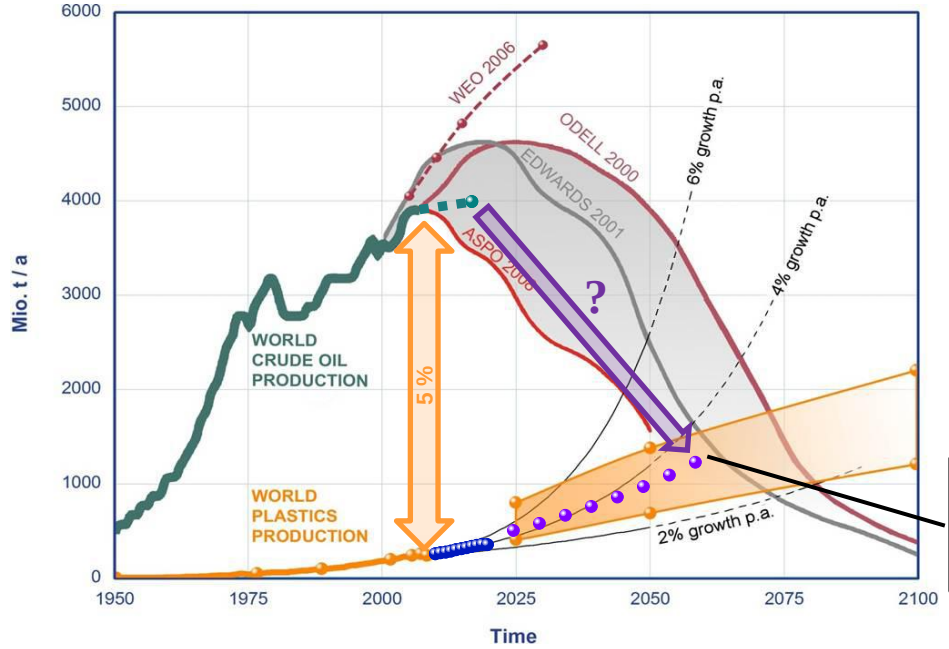


Adapted from IIASA (Laxemburg, A): C. Marchetti u. N. Nakicenovic, 1997; A. Grübler u. N. Nakicenovic, 1987

THE TRANSFORMATION OF THE ENERGY SYSTEM?

The PLASTICS context – Defossilization!?

Plastics Growth Scenarios & Peak Oil Problems and Consequences?



R. W. Lang
March 2010



Inaugural Lecture

POLYMERIC MATERIALS & POLYMER SCIENCE FOR *SUSTAINABLE DEVELOPMENT* TECHNOLOGIES

*Johannes Kepler University Linz (A), March **2010***

2 questions for the **Polymer Industry**:

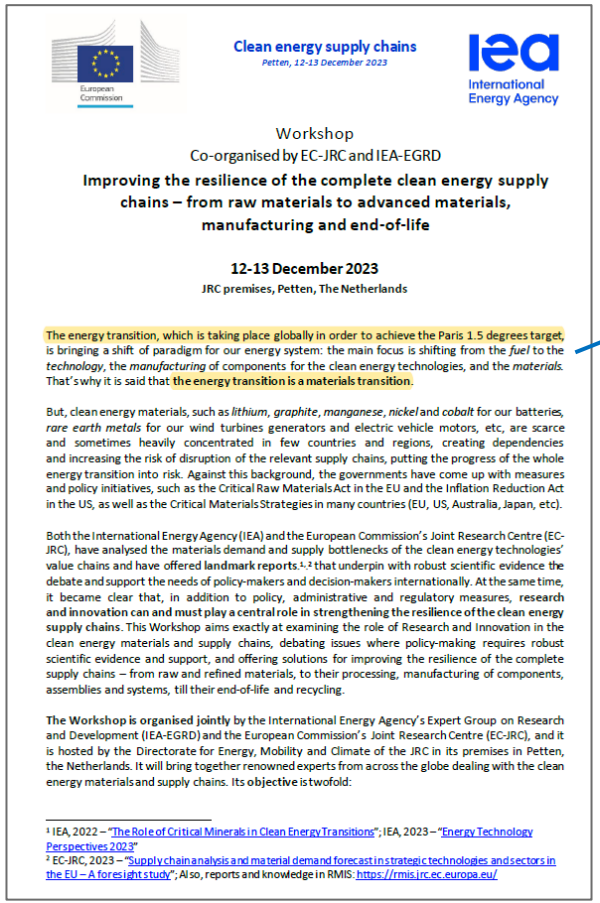
- **How realistic** is such a scenario and **what are the risks?**
- **How can and will the Polymer Industry deal** with such a situation?

2050:
~80 – 100 %
for plastics?

phase-out vs. phase-down?

WAG THE DOG?

TOPIC (2) | On *'essential'* materials and global prosperity



Clean energy supply chains
Petten, 12-13 December 2023

European Commission

International Energy Agency

Workshop
Co-organised by EC-JRC and IEA-EGRD

Improving the resilience of the complete clean energy supply chains – from raw materials to advanced materials, manufacturing and end-of-life

12-13 December 2023
JRC premises, Petten, The Netherlands

The energy transition, which is taking place globally in order to achieve the Paris 1.5 degrees target, is bringing a shift of paradigm for our energy system: the main focus is shifting from the *fuel* to the *technology*, the *manufacturing* of components for the clean energy technologies, and the *materials*. That's why it is said that **the energy transition is a materials transition**.

But, clean energy materials, such as *lithium*, *graphite*, *manganese*, *nickel* and *cobalt* for our batteries, *rare earth metals* for our wind turbines generators and electric vehicle motors, etc, are scarce and sometimes heavily concentrated in few countries and regions, creating dependencies and increasing the risk of disruption of the relevant supply chains, putting the progress of the whole energy transition into risk. Against this background, the governments have come up with measures and policy initiatives, such as the Critical Raw Materials Act in the EU and the Inflation Reduction Act in the US, as well as the Critical Materials Strategies in many countries (EU, US, Australia, Japan, etc).

Both the International Energy Agency (IEA) and the European Commission's Joint Research Centre (EC-JRC), have analysed the materials demand and supply bottlenecks of the clean energy technologies' value chains and have offered **landmark reports**.[1,2] that underpin with robust scientific evidence the debate and support the needs of policy-makers and decision-makers internationally. At the same time, it became clear that, in addition to policy, administrative and regulatory measures, **research and innovation can and must play a central role in strengthening the resilience of the clean energy supply chains**. This Workshop aims exactly at examining the role of Research and Innovation in the clean energy materials and supply chains, debating issues where policy-making requires robust scientific evidence and support, and offering solutions for improving the resilience of the complete supply chains – from raw and refined materials, to their processing, manufacturing of components, assemblies and systems, till their end-of-life and recycling.

The Workshop is organised jointly by the International Energy Agency's Expert Group on Research and Development (IEA-EGRD) and the European Commission's Joint Research Centre (EC-JRC), and it is hosted by the Directorate for Energy, Mobility and Climate of the JRC in its premises in Petten, the Netherlands. It will bring together renowned experts from across the globe dealing with the clean energy materials and supply chains. Its **objective** is twofold:

[1] IEA, 2022 – "The Role of Critical Minerals in Clean Energy Transitions"; IEA, 2023 – "Energy Technology Perspectives 2023"
[2] EC-JRC, 2023 – "Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study"; Also, reports and knowledge in RMIS: https://rmis.jrc.ec.europa.eu/

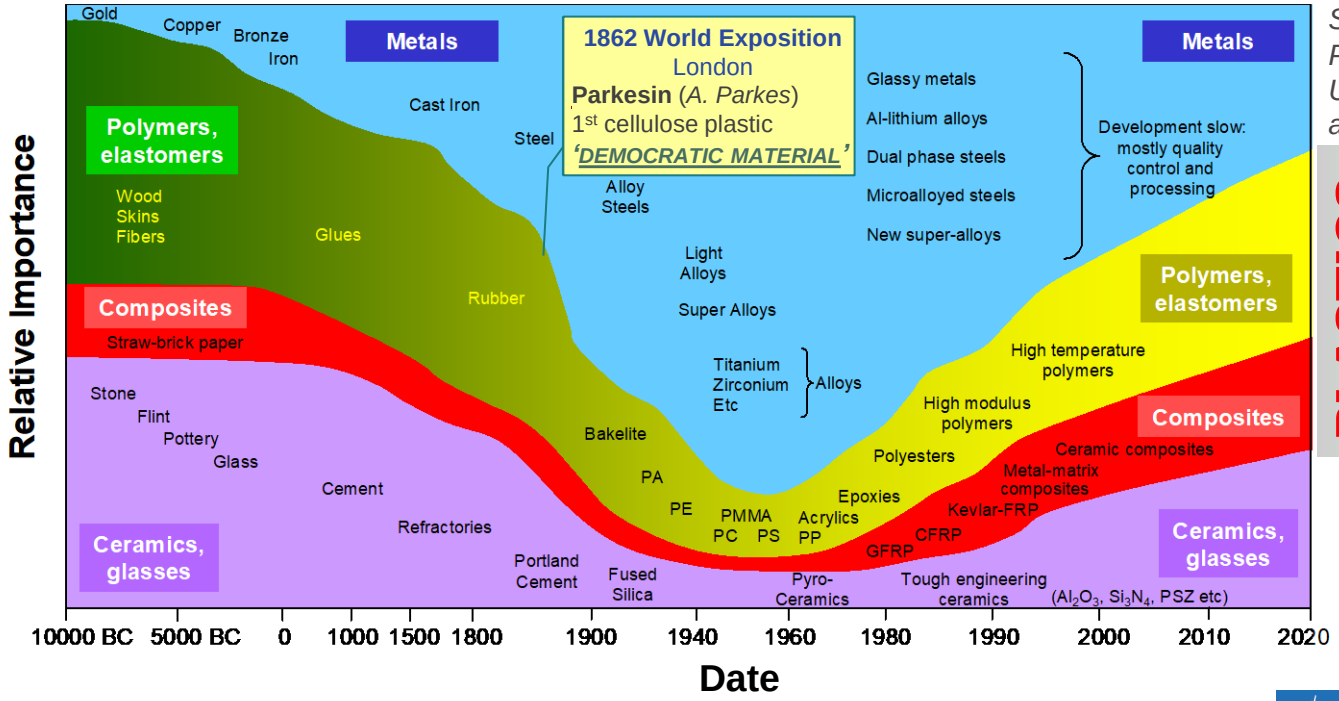
A brief reminder …

The energy transition,
which is taking place globally in order to achieve the Paris 1.5 degrees target,
…. [also] **is a materials transition**.

… which needs to account for the strive towards
***intra- & inter-generational* global prosperity**
in a **just & equitable**,
sustainable socio-economic-ecological manner!

MATERIALS and the Human Enterprise (as of 10.000 BC)

Importance of "GRAND" MATERIAL CLASSES in the history of human civilization



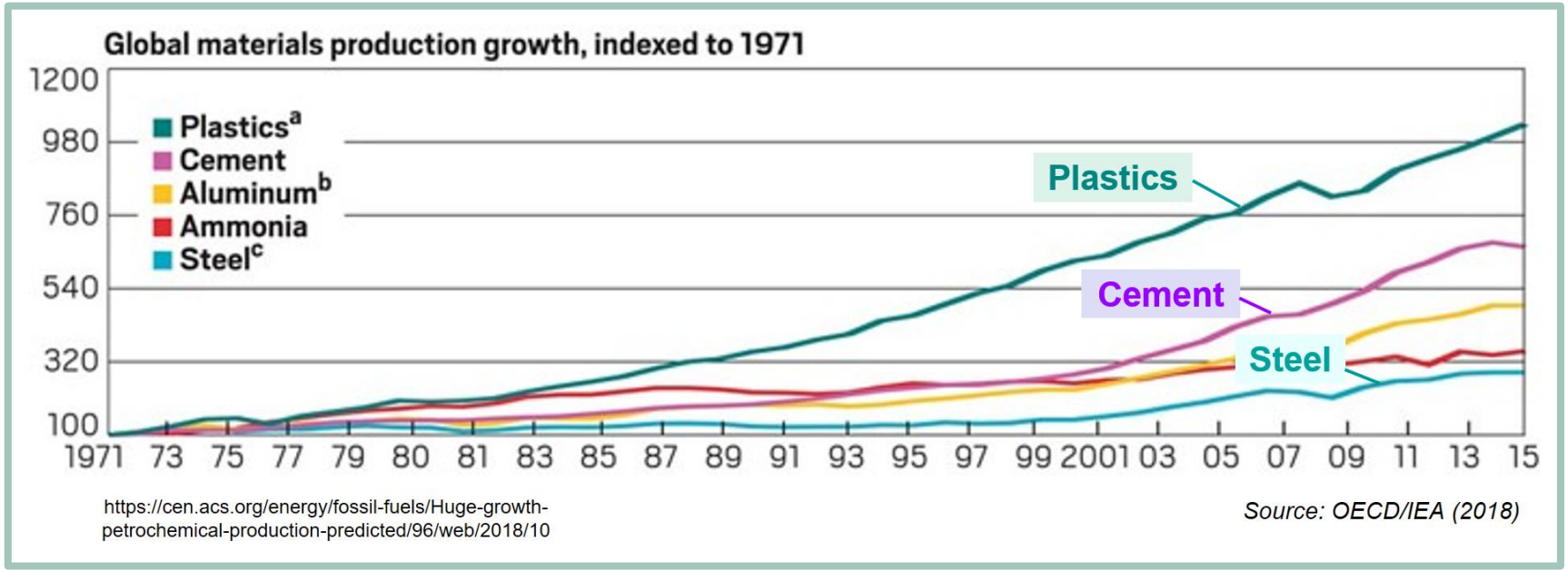
Source:
*Prof. M. **Ashby** (1999)*
Univ. of Cambridge (UK); adapted

PLASTICS, Composite & Hybrids

THE **PLASTICS AGE (?)**: "Plastics – Materials of the 21. Century"

Plastics
The Material for the 21st Century

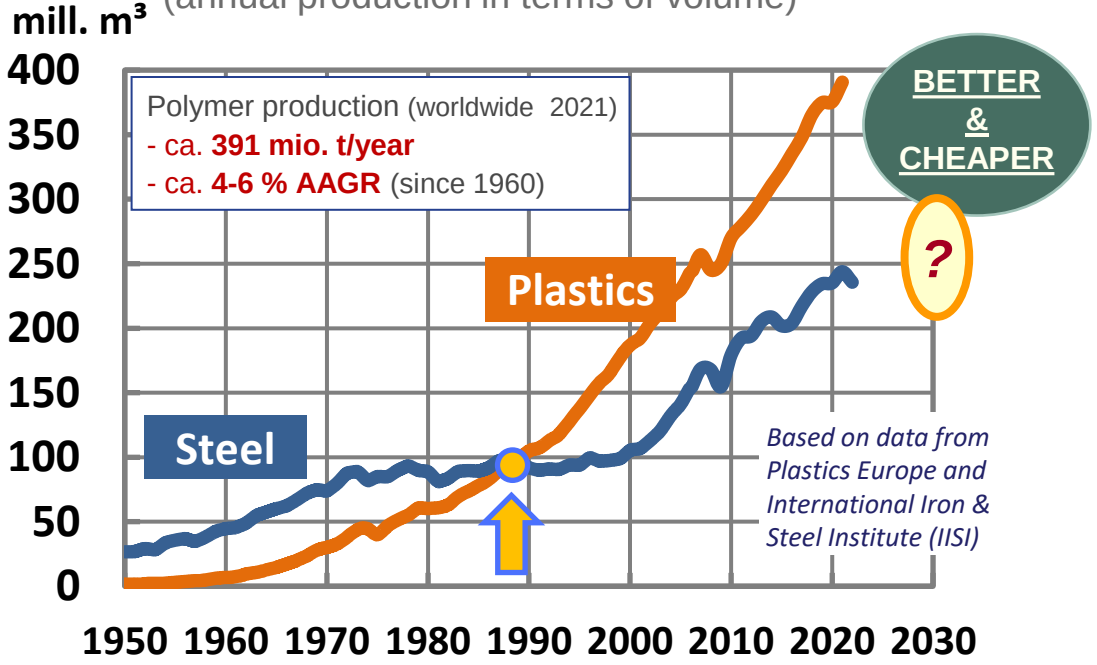
Dynamics of the Global Production of ‘ESSENTIAL’ MATERIALS



PLASTICS | Materials of the 21st Century ?! (1/2)

Development of Plastics & Steel

(annual production in terms of volume)



7 key success factors of plastics

Properties	wide range and tailorable property profiles
Design	high design flexibility; large potential for multi-functional integration
Processing	excellent processability
Economy	cost efficient products
Ecology	energy efficient products/applications
Innovation	still outstanding & extraordinary potential
Growth Potential	essentially no resource limitation

Plastics and polymer composites/hybrids still exhibit an **exceptional innovation, growth & growth rate potential**, unmatched by other materials.

PLASTICS | Materials of the 21st Century ?! (2/2)

ReThinking PLASTICS for Sustainable Development (as of K2013)

THE GLOBAL GOALS
For Sustainable Development

UN Agenda: *Sustainable Development*

- Millennium Development Goals – **MDGs 2015**
- Sustainable Development Goals – SDGs 2030
  (17 goals and 169 targets with indicators etc.)



JKU-PM&T focus on **SDGs 3, 4, 6, 7, 9, 12, 17**

JKU-IPMT on-line tool (first presented at K2016)
sdg-info.polysustain.com

Improved product services driven by

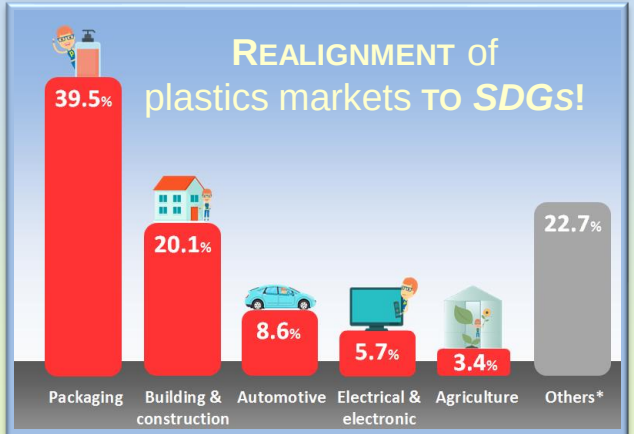
- enhanced performance
- more efficiency & systems intelligence
- less energy & material
- use of regenerative resources

How to **translate the SDGs** under planetary constraints to **technologies and materials?**

Main technology & materials relevant areas

- energy & water
- food security & nutrition
- housing & infrastructure
- transport & mobility
- health & well-being

European Plastics Demand by segment (2014)



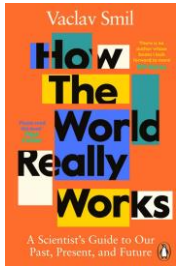
DO **MORE** WITH **LESS**,
DO **BETTER** & **CHEAPER**,
BE **CIRCULAR** & **REGENERATIVE**!

JKU

ipmt

THE BIG PICTURE | How the world really works?

The SCIENCE behind how we got here and where we're going … ["Numbers don't lie"]



How the World Really Works
Vaclav Smil
May 2022

Chapter 3: **The 4 material/matter pillars of modern civilization***

- **Cement:** *a world created by concrete*
- **Steel:** *ubiquitous and recyclable*
- **Plastics:** ***diverse, useful, troublesome***
- **Ammonia:** *the gas that feeds the world*

*account for 17% of primary energy and 25% of CO_2 emissions

"essential" materials:
- **~15 %** energy
- **~23 %** CO_2

HTA-Total
~33 % !!!

Present and Future Production Volumes
p.a. worldwide

Essential Materials [rough estimate]	**2019** in Mt	**2050** x-fold growth in Low-Income Countries*
Cement	4500	x10+
Steel	1800	x15
Plastics	**370**	**x30+**
Ammonia	150	x2+

UN SDGs: *"A world we want for all!"*

Equity

CO_2 emissions of Transport Sector
p.a. worldwide (2018, IEA)

Mobility & Transport*	**2018** share
Road (passenger)	**45 %**
Road (freight)	30 %
Aviation	12 %
Shipping	11 %
Pipelines oil, gas, water, steam etc.	**2 %**

HTA transport > 50 %

*Global transport emissions – total (2018): **~8 Gt** CO_2 (24 %)
https://ourworldindata.org/co2-emissions-from-transport

PLASTICS: WHERE ARE WE HEADED ?

"From being (perceived as) **a problem**, to (again) becoming **part of the solution**"?



Waste disposal[1]





Pollution of the environment[3]



ACHILLES HEEL of Plastics!



Waste transport to third countries[2]





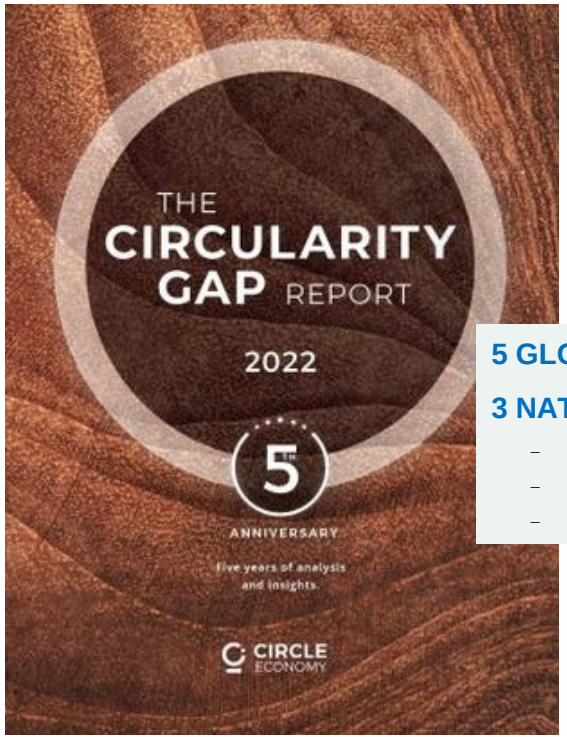


[1]www.taz.de; [2]© imago stock&people (imago stock&people)
[3]www.coastalcare.org; http://www.sunwarrior.com/news/the-garbage-patch-one-bags-exodus-to-the-ocean-video

Picture by worldbank.org
Mohamed Abdulraheem

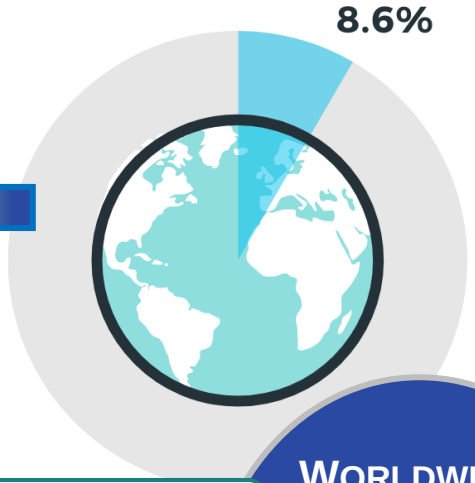
CLIMATE CRISIS & Circular Economy in Context

CIRCULARITY GAP Reports by Circle Economy



https://www.circularity-gap.world/2022

HALF A TRILLION TONNES OF VIRGIN MATERIALS, OUR WORLD IS ONLY 8.6% CIRCULAR.



5 GLOBAL REPORTS (2018 – 2022)

3 NATIONAL REPORTS:

- **Austria**
- Norway
- The Netherlands

WAG THE DOG?

WORLDWIDE:

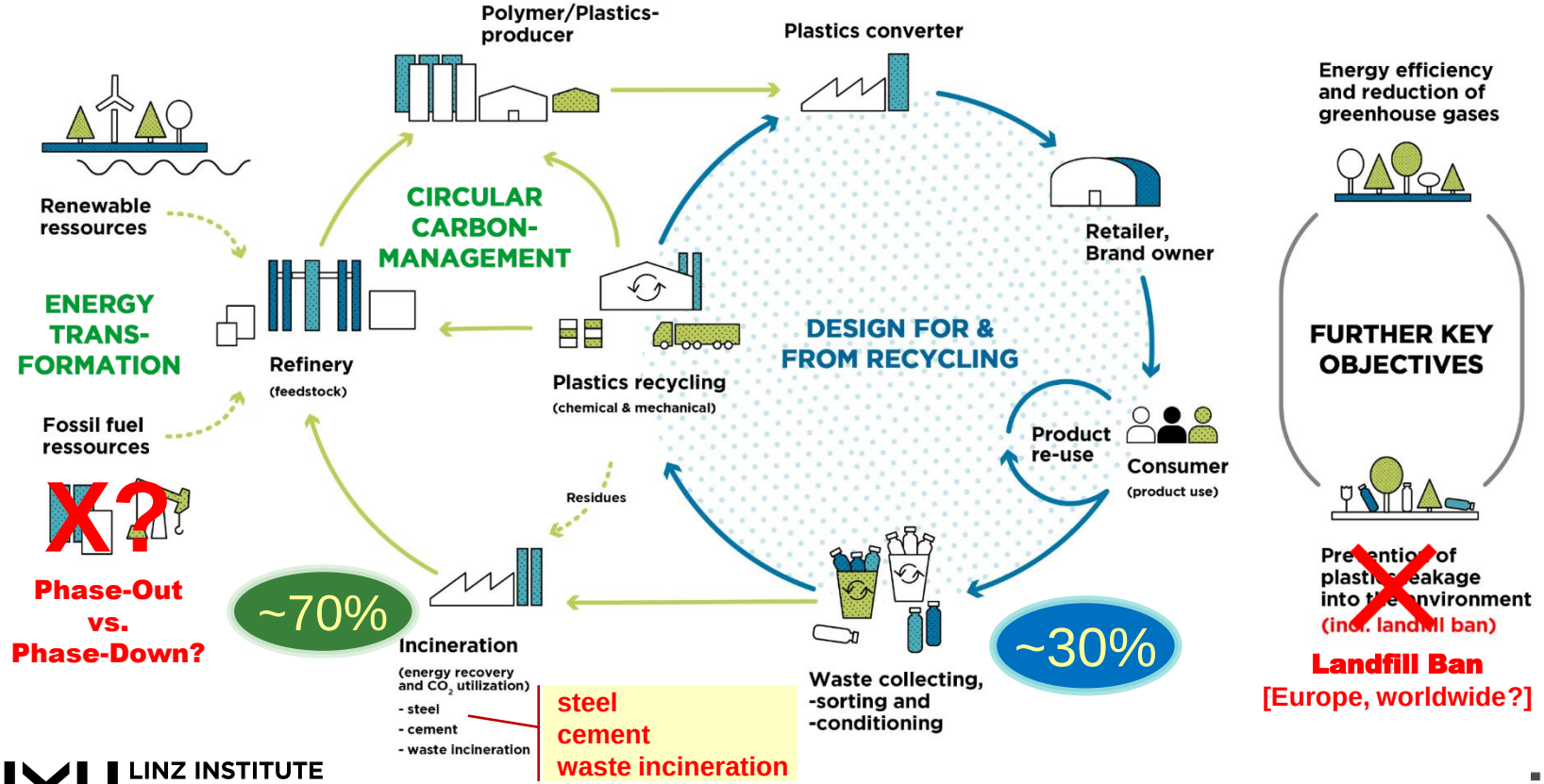
FACTOR ~200
between
CO_2 EMISSIONS
(non-visible)
vs.
PLASTICS WASTE
(visible)

Main Conclusion (ARA Press Release 06/2019)

A national economy which directly or indirectly (imported goods) strongly depends on **FOSSIL FUELS** **can never be circular!**

PLASTICS Circular Economy | CLOSING THE LOOP

Towards all-circular process pathways (data below for Austria)



PLASTICS Recovery Options & PERFORMANCE

Principle pathways of product/material recovery

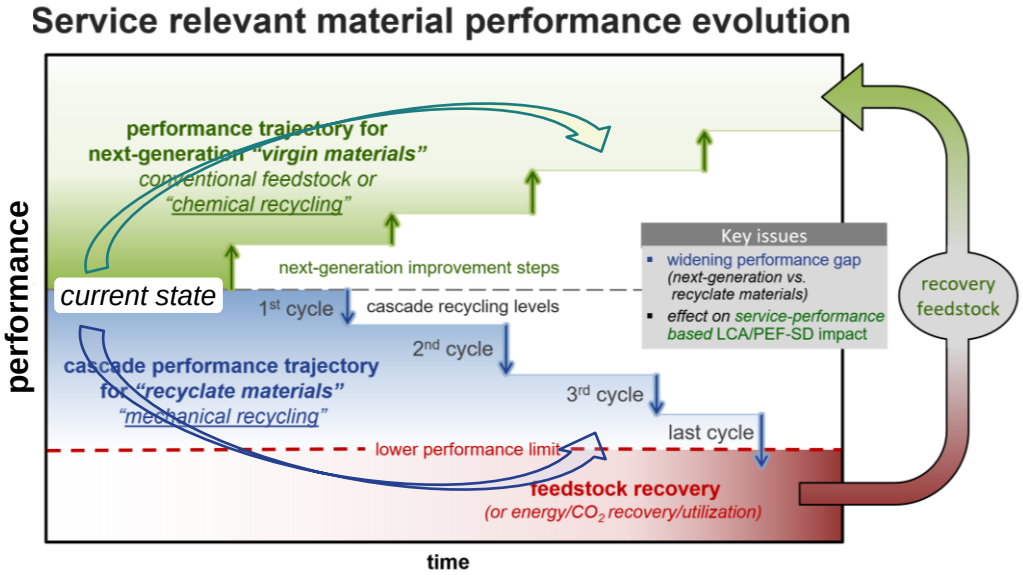
- **product reuse** (repair, repurpose, etc.)
- **mechanical recycling** (materials recycling)

"down-cycling" cascadic performance deterioration

- **chemical recycling** (feedstock recycling)
- **energy recovery** coupled with **CO_2 utilization** (CCU, feedstock recycling)

"up-cycling" innovation-driven performance enhancements

The widening performance gap:
Mechanical recyclates vs. next generation "virgin" materials



R. W. Lang, University of Linz (A), October 2015

PLASTICS RECYCLING AND ECO-EFFICIENCY

STUDIES BY DENKSTATT GMBH (H. PILZ, ET AL., 2010/2014/2015)

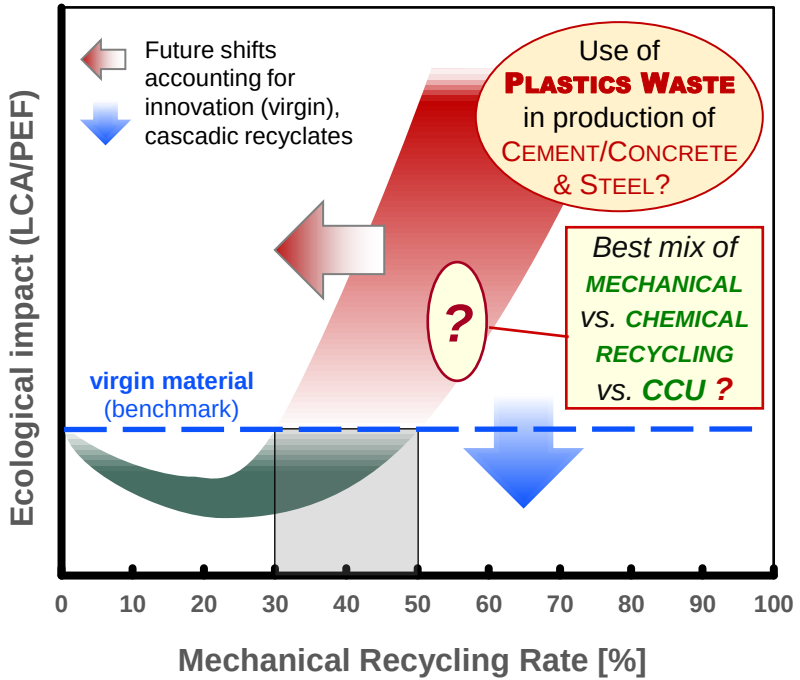
Some key findings (a selection)**:**

- *Resource/energy/GHG efficiency can be high (best) even at low 'mechanical' recycling rates*
- *Compared to other materials, the material/energy/GHG reduction realized by plastics packaging is often several times higher than the remaining optimization potential for higher plastics recycling*
- *For plastics waste,* ***NO general waste management hierarchy*** *for recovery options can be derived from environmental benefits*
- Eco-efficient (sustainable) recovery of post-use plastics requires a product specific **life cycle (LC)/cost benefit (CB) analysis**
- Rough estimation of **maximum eco-efficient, mechanical plastic packaging recycling** (incl. domestic and commercial):

- INPUT based: 35 – 53 %
- OUTPUT based: 31 – 43 %

Source: ***"Criteria for eco-efficient (sustainable) plastic recycling and waste management"***
Fact based findings from 20 years of denkstatt studies
denkstatt GmbH, 2014

Ecological impact of substitution of virgin plastics by plastics recyclates (materials level)



Source: R. W. Lang,
University of Linz (A), October 2015

VISION: A NEW CARBON MANAGEMENT

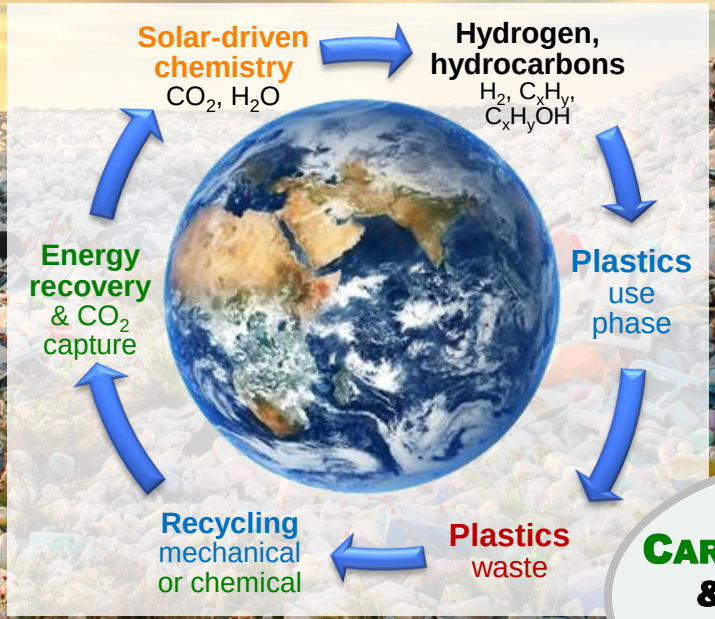
Towards a solar-driven ALL-CIRCULAR PLASTICS & CARBON ECONOMY (1/2)

Principle pathways of material recovery

- **mechanical recycling** (materials recycling)
- **chemical recycling** (feedstock recycling)
- **energy recovery** with **CO_2 capture & use** (feedstock recycling)

cascadic performance deterioration

innovation-driven performance enhancements



$CO_2 + H_2O$

+ rEn

CH_4, CH_3OH

+ rEn

"PLASTICS"

(C_xH_y etc.)

CIRCULAR CARBON MANAGEMENT & DEFOSSILISATION instead of DECARBONISATION!

Picture by worldbank.org
Mohamed Abdulraheem

A GREEN DEAL FOR AUSTRIA'S INDUSTRY

GOVERNMENTAL PROGRAM 2020 – 2024 | Cross-sectoral Flagship Initiatives

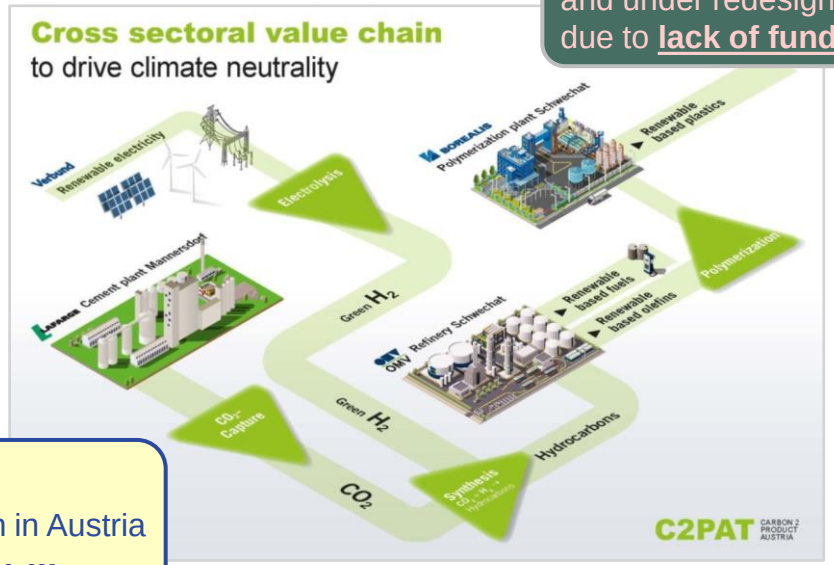
Potential cross-sectoral *'circular'* Carbon FLAGSHIP-CLUSTER/HUB Initiatives:

- **"STEEL & PLASTICS"**
  e.g. voestalpine, Borealis, VERBUND, RAG, N.N.
- **"CEMENT & PLASTICS"**
  e.g. Lafarge, Borealis, OMV, VERBUND, N.N.
- **"WASTE MANAGEMENT"**
  e.g. Wien Energie, Linz AG, ARA, Saubermacher, Borealis, N.N.
- **"GREEN ENERGY INFRASTRUCTURE"**
  e.g. OMV, VERBUND, RAG, N.N.

MEDIA & PRESS RELEASE: **24 JUNE 2020**
MOU: LAFARGE/OMV/VERBUND/BOREALIS
"Carbon2ProductAustria" [short: **C2PAT**]

AUGUST 2021
C2PAT GmbH

Project currently on hold and under redesign due to **lack of funding!?**

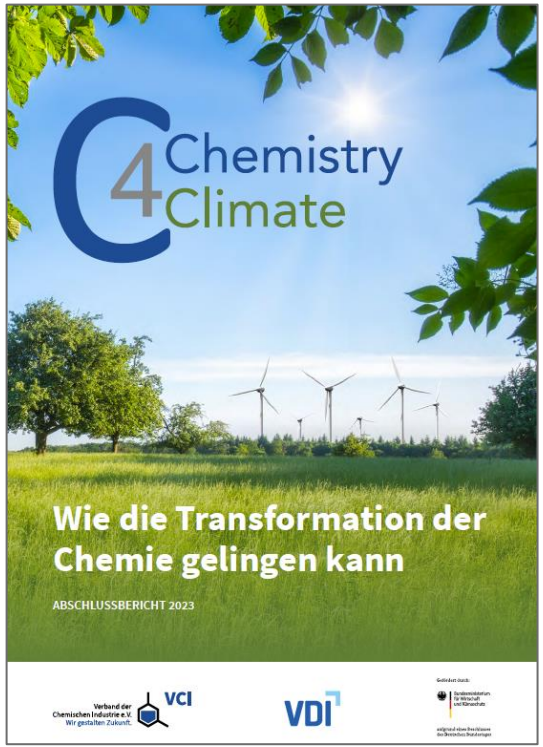


Aim 2030 (C2PATplus)

- **750.000 t** of CO_2 sequestration in Austria
- demonstration of **global scalability!**

Source: C2PAT consortium

Chemistry4Climate (April 2023)



https://www.vci.de/services/publikationen/chemistry4climate-abschlussbericht-2023.jsp

Chemistry4Climate

April 26, 2023

A Report by
- VCI – German Chemical Industry Association
- VDI – Association of German Engineers

funded by the Federal Ministry for Economic Affairs and Climate Action, Germany

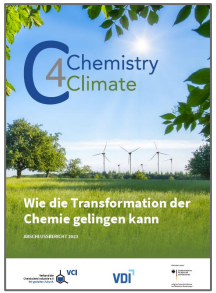
How to successfully **manage & implement** the **transformation** of the **Chemical Industry**



Opening message by
Robert Habeck
Federal Minister for Economic Affairs and Climate Action, Germany

"… it is about **tangible implementation measures**. Especially **Circular Economy** and **emphasis on CCU vs. CCS** offer **great potential, which we want to exploit**."

Chemistry4Climate (April 2023)



Three Scenarios
[German chemical sector **net-zero by 2045**]

Scenario 1: Focus on max. use of **direct electricity**

Scenario 2: Focus on **hydrogen** and **PtX fuels & feedstock**

Scenario 3: Focus on **secondary feedstock** (plastics waste, biomass)

Phase-out vs. phase-down?

Is **Carbon** becoming a **critical raw material?**

Table 2 (p.17): Comparison of 3 scenarios in terms of main features

Parameter [Einheit]	Szenario 1	Szenario 2	Szenario 3	Anmerkung
Strombedarf [TWh]	464	508	325	Inkl. Strombedarf für Wasserstoff. In Szenario 2 am höchsten wegen hohen H_2-Bedarfs
Wasserstoffbedarf [TWh]	214	283	148	H_2-Bedarf für Fischer-Tropsch-Naphtha und Brennstoff in Szenario 2 besonders hoch
CO_2-Bedarf [kt]	44.051	51.977	21.310	Fischer-Tropsch-Naphtha-Route (Szenario 2) hat den höchsten CO_2-Bedarf
Biomassebedarf [kt Trockenmasse]	2.700 für Spezialchemie		26.576 für Grundstoff-, 2.700 für Spezialchemie	Nutzung zusätzlicher Biomasse und Einsatz in Grundstoffchemie nur in Szenario 3; dann max. verfügbares Potenzial ausgeschöpft
Kunststoffabfallbedarf [kt]	3.160 für mech. Recycling		3.160 für mech. Recycling, 2.228 für chem. Recycling	Chemisches Recycling und Einsatz in Grundstoffchemie nur in Szenario 3; dann max. verfügbares Potenzial ausgeschöpft
Fischer-Tropsch-Naphtha-Bedarf [kt]	-	15.334	6.134	
Bio-Naphtha-Bedarf [kt]	-	-	5.691	Nur in Szenario 3
Methanolbedarf [kt]	30.558	-	-	Nur in Szenario 1 für MTO/MTA Methanol zu Olefinen und Aromaten
Nomin. Investitionen [Mio. €]	40.296	40.623	25.676	In Szenario 1 und 2 wegen Investitionen in Elektrolyseure am höchsten

Some key findings for Germany 2045 (a selection):

- Beyond **large amounts of renewable electricity and green H_2, huge amounts of CO_2 needed!**
- **CO_2 demand p.a. for chemical sector** (depending on scenario; excluding synthetic fuels/e-fuels)

  21 – 52 Mt of CO_2
- Estimated **CO_2 availability** of HTA industries:

  50 – 60 Mt of CO_2
- Due to (current) **biased/skewed EU regulations** [*"good (bio-based)"* vs. *"bad & ugly (nonbio-based)"* CO_2] **strong use conflicts for bio-based CO_2** expected!
- Nominal investments: **25-40 bill. Euro** [German GDP 2022: ~4 trill. Euro]

FRESH IMPULSES from Industry and COP28 (2 examples)



Alfred Stern | CEO of OMV (since Sept. 2021)
OMV Capital Markets Day (16 March 2022)



Source: https://www.omv.com/en/news/220316-omv-strategy-2030

New OMV Strategy 2030

(16 March 2022)

- Fundamental **shift from linear towards circular business approach:**
  OMV aims to become a leading, integrated sustainable fuels & materials company with a **strong focus on circular economy** solutions
- **Net-zero** (Scope 1, 2 and 3) to be reached by **no later than 2050!**

The Guardian
News website of the year

The Guardian
13 July 2023

President-Designate of COP28
Sultan Al Jaber | CEO ADNOC



UAE Plan for COP28 [Nov./Dec. 2023]

- **The 1.5°C goal**
- **National plans** ("global stocktake")
- **Phase out or phase down?**
- **Clean energy**
  (double energy efficiency,
  triple renewable energy capacity by 2030
- **Role of fossil fuel companies**
- **'All emissions, everywhere'**
- **Climate finance**
- **Inclusivity**

UAE: the first country in the Gulf region to pledge **net-zero emissions by 2050!**

Musabbeh Al Kaabi [**Interview** | S&P Global, 17 Aug. 2023]
ADNOC Executive Director of Low Carbon Solutions & International Growth

"The **[CCUS] target** … around a minimum of **5 million t/year** [by 2030], … I see a **possibility** that **we will increase that target as we speak**, … we need to firm up a few parameters.
"I see a future where …
with carbon capture to become carbon neutral."

TOPIC (1): Key moments at COP28 (2/2)

Phase-out vs. phase-down of (unabated) fossil fuels?

DRAFT TEXT by the COP28 President

on First global stocktake under the Paris Agreement

11 Dec. 2023 | 16:30

39. … recognizes the need for deep, rapid and sustained reductions in GHG emissions and calls upon Parties to take actions that could include, inter alia:

(a) **Tripling renewable energy capacity globally** and **doubling the global average annual rate of energy efficiency improvements by 2030**;

(b) **Rapidly phasing down unabated coal** and **limitations on permitting new and unabated coal power generation;**

(d) Accelerating zero and low emissions technologies, including, inter alia, … **removal technologies**, including such as **carbon capture and utilization and storage**, …

(e) **Reducing both consumption and production of fossil fuels**, in a just, orderly and equitable manner so as to **achieve net zero by, before, or around 2050 in keeping with the science**;

…..

OUTCOME: First global stocktake Proposal by the COP28 President

13 Dec. 2023

28. … recognizes the need for deep, rapid and sustained reductions in greenhouse gas emissions in line with 1.5 °C pathways and calls on Parties to contribute to …:

(a) **Tripling renewable energy capacity globally** and **doubling the global average annual rate of energy efficiency improvements by 2030**;

(b) **Accelerating efforts** towards the **phase-down of unabated coal power**;

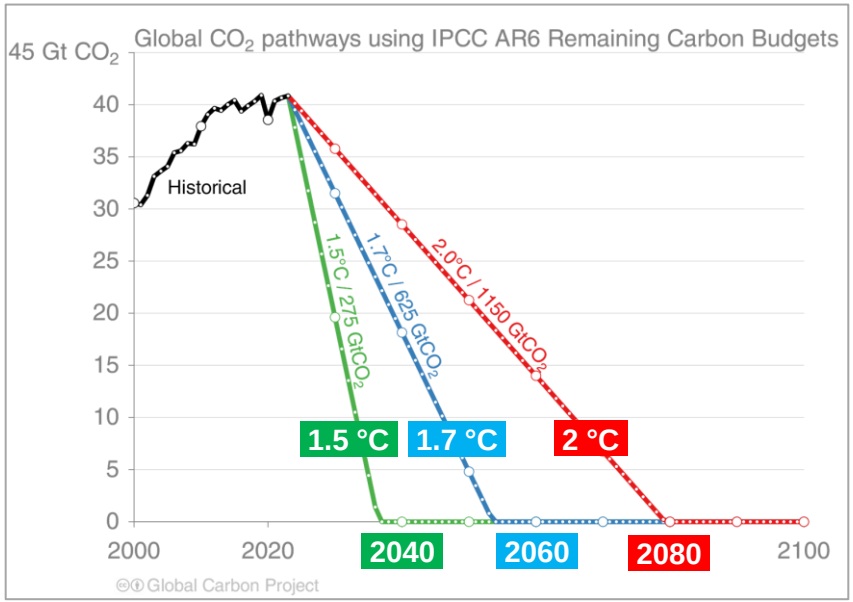
(d) **Transitioning away from fossil fuels in energy systems**, in a just, orderly and equitable manner, **accelerating action in this critical decade**, so as to **achieve net zero by 2050 in keeping with the science**;

(e) Accelerating zero- and low-emission technologies, including, inter alia, … **removal technologies** such as **carbon capture and utilization and storage**, particularly in HTA sectors …

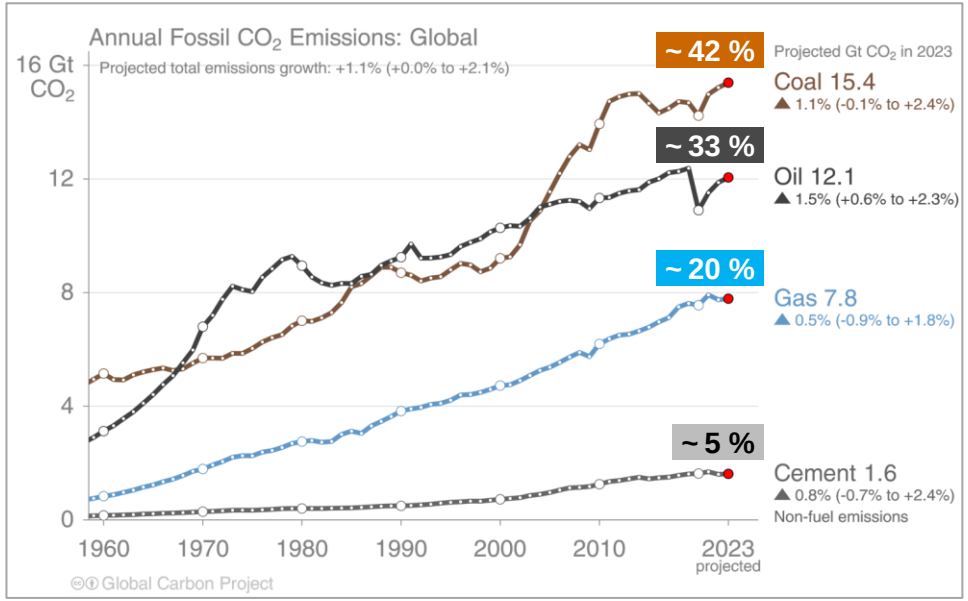
THE TRANSFORMATION OF THE ENERGY SYSTEM?

Keeping within the range of 1.5 – 2 °C global temperature rise?

Global CO_2 net-zero pathways for 1.5 – 2 °C



Annual fossil CO_2 emissions (global)



Source: **Presentation at COP28 |** Dubai, 5 Dec. 2023; adapted & extended by R. W. Lang

GLOBAL CARBON project

The GCP is a Global Research Project of futureearth Research. Innovation. Sustainability.

and a Research Partner of WCRP World Climate Research Programme

JKU

ipmt

THE TRANSFORMATION OF THE ENERGY SYSTEM?

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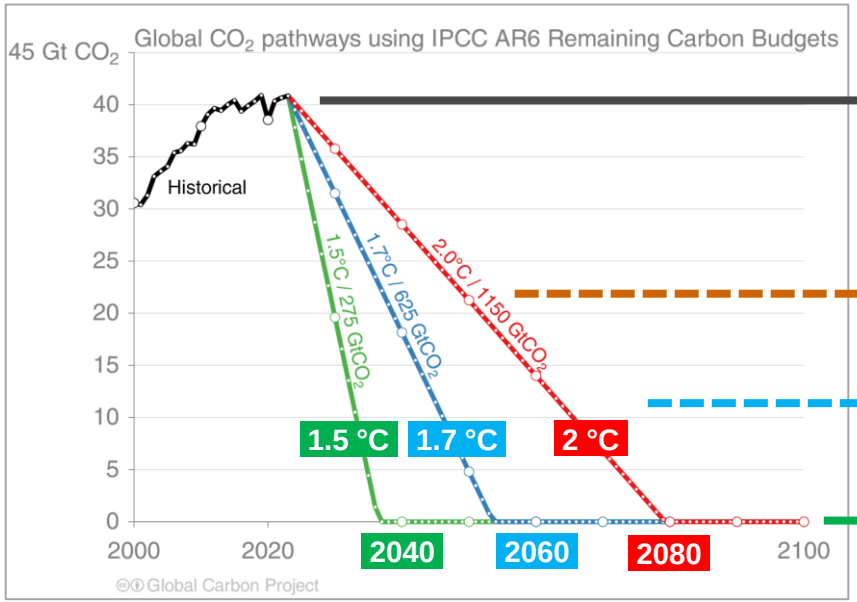

Proposal for transition to Net-zero:
phase-out vs. phase-down of (unabated) fossil fuels?

100 %

- 42 % | Phase-out of Coal (asap)

ca. **- 29 % | Phase-down Oil/Gas**
(phase-out of unabated Oil/Gas)

ca. **- 29 % | Carbon Management**
(CCS, CCU, DAC | HTA industries/traffic)

0 %

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Source: **Presentation at COP28 |** Dubai, 5 Dec. 2023; adapted & extended by R. W. Lang

JKU

ipmt

Key Take-Away Message: A **CATEGORICAL** statement
Why an **Industrial Carbon Circularity** is **essential?**

Without industrial CARBON (CO_2) CIRCULARITY,

No CIRCULAR ECONOMY and

No SUSTAINABLE DEVELOPMENT !!!

Recommended change in terminology: From **DECARBONIZATION** to **DEFOSSILIZATION**

and **sustainable, cross-sectoral & circular**

CARBON MANAGEMENT (ccCM)!

The EVOLUTION role model | Why industrial ccCM?

What is the meaning *[purpose]* of life?

Michael Russell: **On the Emergence of Life** *(05/2011)*

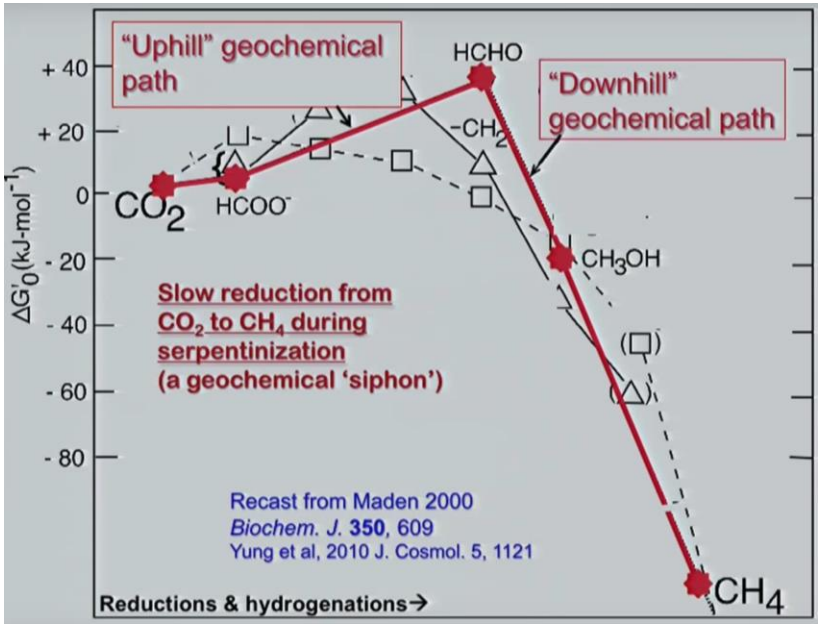


The **PURPOSE OF LIFE** *is the* **HYDROGENATION OF CARBON DIOXIDE**

MICHAEL RUSSEL
On the Emergence of Life Through "Negative" Entropy Trapping

Molecular Frontiers Symposium at the Royal Swedish Academy of Sciences, May 2011

https://www.youtube.com/watch?v=SF2uj0Oxqhg



THE GLOBAL GOALS
For Sustainable Development

Navigating towards an ‘all-circular’ Plastics & Carbon Economy

ANNEX | Back-up slides

Reinhold W. LANG
Institute of Polymeric Materials and Testing
Johannes Kepler University, Linz/Austria

JOHANNES KEPLER UNIVERSITY LINZ

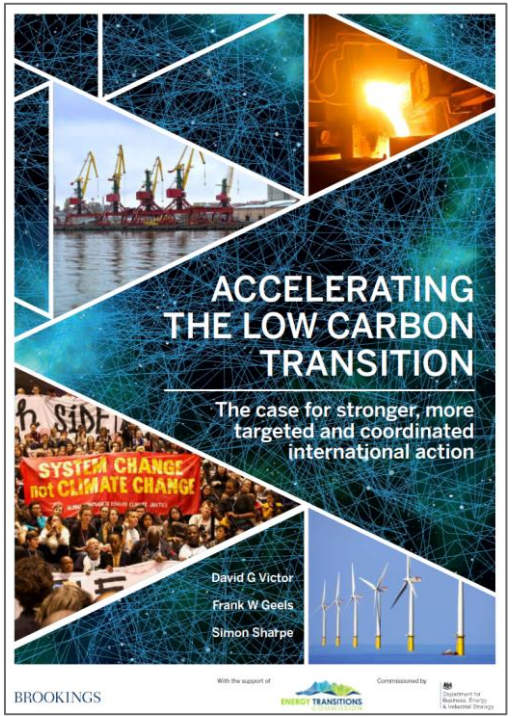
ipmt Institute of Polymeric Materials and Testing

ANNEX | Back-up slides

- A **NEW industrial carbon management** to accelerate the low & circular carbon transition: examples from the fossil fuel industry (**ADNOC** and **OMV**)
- Establishing a coherent and incentivizing **policy framework** for **industrial Carbon Management (CCU/S) and Carbon Accounting**
- **Sensitive Intervention Points** (SIPs): in search of ***'silver bullets'?***
- Creating **Win-Win-Win solutions** by establishing a ***NEW Deal* AFRICA–EUROPE** at eye-level partnership
- A **Résumé Hypothesis** on plastics waste and **5 Key Messages**

Accelerating the LOW CARBON TRANSITION

The special case and the essential role of **'hard-to-abate (HTA)' industries**



http://www.energy-transitions.org/sites/default/files/Accelerating-The-Transitions_Report.pdf

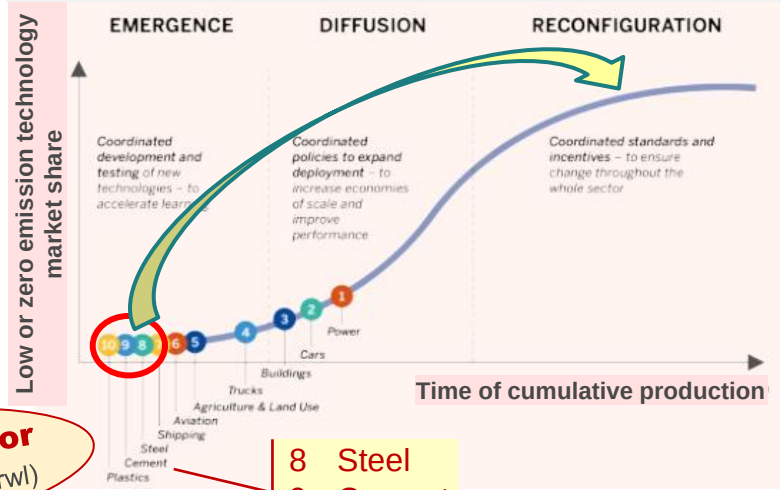
BROOKINGS REPORT (Nov. 2019) by

David G. VICTOR (UC San Diego; lead author IPCC 5th Assessment Report)
Frank W. GEELS (Univ. of Manchester; lead author IPCC 5th Assessment Report)
Simon SHARP (UK Government Department 'Business, Energy & Industrial Strategy'; Research Fellow and Lecturer at Univ. of Cambridge UC London)

Report
aims to highlight

- How **technology transitions** happen
- How **international cooperation** and **coordinated action** can steer and accelerate technological transitions
- **Points of leverage** for coordinated international action

Progress of 10 Sectors' Low Carbon Transitions and Properties for Coordinated Action



8 Steel
9 Cement
10 Plastics

There is great **POTENTIAL for CROSS-SECTORIAL ACTION!** (rwl)

Oil & Gas 2023 Ranking | Top 50 by BrandFinance

Most valuable and strongest Oil & Gas brands

2023	2022	Logo	Name	Country	2023	2022	2023	2022
1 =	1		Shell		$48,209M	$49,925M	AA+	AAA-
2 =	2		Aramco		$45,227M	$43,637M	AA+	AA
3 =	3		PetroChina		$29,647M	$29,656M	AA	AA
4 =	4		Sinopec		$27,145M	$25,165M	AA+	AA+
5 ^	6		TotalEnergies		$20,723M	$15,086M	AA	AA+
6 ^	7		Chevron		$17,427M	$14,588M	A+	AA-
7 v	5		BP		$16,654M	$19,001M	A+	AA
8 ^	9		ADNOC		$14,209M	$12,760M	AA+	AA+
9 ^	12		Equinor		$13,099M	$9,342M	AAA-	AAA-
10 v	8		PETRONAS		$12,712M	$13,596M	AAA	AAA
11 v	10		ExxonMobil					
12 v	11		Eni					
13 ^	17		ConocoPhillips					
14 ^	19		PTT					
15 ^	18		CNRL					
16 v	14		Gazprom					
17 v	13		CNOOC					
18 v	15		Lukoil					
19 ^	30		SLB					
20 ^	23		Valero					
21 ^	26		Phillips 66					
22 v	16		Repsol					
23			ENEOS					
24 ^	32		Marathon Petroleum					
25 ^	27		Energy Transfer					

2023	2022	Logo	Name	Country	2023	2022	2023	2022
26 v	25		Enbridge					
27 v	21		Reliance					
28 ^	35		Oxy					
29 =	29		Mobil					
30 v	24		Esso					
31 =	31		KPC					
32 v	22		Indian Oil					
33 =	33		Petrobras					
34			Orlen					
35 ^	48		Devon					
36 ^	37		SK Innovation					
37			Pertamina					
38 v	28		Ecopetrol					
39 ^	42		Baker Hughes					
40 v	38		Pioneer Natural					
41 =	41		Halliburton					
42 v	20		Pemex					
43			Qatargas					
44 v	43		Suncor Energy					
45			Hess					
46 v	45		Neste					
47 ^	49		Inpex					
48			AkerBP					
49 v	39		Exxon					
50 v	34		Rosneft					

Source: **BrandFinance** | https://brandirectory.com/rankings/oil-and-gas/table

FRESH IMPULSES | COP28 in UAE (Dubai; 30 Nov – 12 Dec, 2023)

Cop28

The Guardian
News website of the year

Fiona Harvey *and* Ajit Niranjan

Thu 13 Jul 2023 13.38 BST

The Guardian
13 July, 2023

Explainer

What is the UAE Cop28 plan of climate action?

Sultan Al Jaber has laid out his long-awaited strategy at a meeting in Brussels. Here's what it covers



Sultan Al Jaber's plan has been broadly welcomed by experts and civil society. Photograph: John Giles/PA

Sultan Al Jaber, president of the Cop28 UN climate summit to be held this November in the United Arab Emirates, has laid out his long-awaited plan of action at a meeting of governments in Brussels.

The plan covers all the main aspects of climate action, based on the 2015 Paris agreement, now divided into what Al Jaber termed the four pillars, or four Fs: fast-tracking the transition to a low-CO_2 world; fixing climate finance; focusing on people, lives and livelihoods; and full inclusivity.

https://www.theguardian.com/environment/2023/jul/13/what-is-the-uae-cop28-plan-of-climate-action

President of COP28
Sultan Al Jaber, CEO ADNOC



UAE Plan for COP28 [Nov./Dec. 2023]

- **The 1.5C goal**
- **National plans** ("global stocktake")
- **Phase out or phase down?**
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UAE: the first country in the Gulf region to pledge **net-zero emissions by 2050!**

Interview | S&P Global (Aug. 17, 2023)
Musabbeh Al Kaabi, ADNOC Executive Director of Low Carbon Solutions & Internat. Growth

"The **[CCUS] target** … around a minimum of **5 million t/year** [by 2030],
… I see a **possibility** that **we will increase that target as we speak**,
… we need to firm up a few parameters.
"I see a future where … **with carbon capture to become carbon neutral**."

Commentary | FORTUNE (Sept. 19, 2023)
Sultan Al Jaber, CEO ADNOC & President-designate of COP28

"Is the **world capable of mobilizing the trillions of dollars** necessary to fund the climate transition? **I believe the answer is yes** … "
"… **creating a better climate finance system** can catalyze the **biggest economic transformation since the Industrial Revolution.**"
"**Governments need to unleash the potential of the private sector by creating the right policy incentives and instruments.**"

FRESH IMPULSES | OMV – Overall aims & Strategy

Press conference (Sept. 03, 2021)

Alfred Stern

CEO of OMV (since Sept. 01, 2021)


Samstag, 4. September 2021

mit Primus

OMV-Chef: „Der Wandel ist unausweichlich“

Zum Amtsantritt sagt Alfred Stern, wohin die Reise der OMV gehen wird. Die Säulen des Konzerns seien Kreislaufwirtschaft, Nachhaltigkeit und Einhaltung der Pariser Klimaziele.

Von Claudia Haase

Hundert Tage Schonfrist? Nicht mit Alfred Stern. Seit Mittwoch ist er OMV-Chef, damit der wichtigste Lenker in der Geschichte des teilstaatlichen Öl- und Gaskonzerns, der wegen des Klimawandels vor historischen Herausforderungen steht.

Schon am zweiten Tag in seiner neuen Funktion öffnet der 56-jährige Steirer Stern Donnerstagabend die OMV-Chefetage für die Wirtschaftsjournalisten der Tagesmedien. Eine große Runde in Klubsesseln, in der Stern ohne Powerpoint und Unterlagen völlig frei spricht, nicht auf einem Podium, sondern eher wie ein Mitglied der Gruppe. Nach nur wenigen Sekunden dieser klare Satz: „Wahrscheinlich steht die OMV vor dem größten Wandel in der Unternehmensgeschichte.“

Wohin die Reise der OMV gehen muss, erklärt er in 17 Minuten – noch ohne Details zur neuen Strategie, die Anfang 2022 fertig sein soll. An ihr wird seit Monaten gearbeitet. Ex-Chef Rainer Seele, der den Kurswechsel eingeleitet hatte, war nicht mehr dabei, aber alle anderen Vorstände, auch Explorationschef Johann Pleininger, dem ja zugeschrieben wurde, die viel stärkere Petrochemie-Ausrichtung durch den Borealis-Zukauf torpediert zu haben.

An der Notwendigkeit der Energiewende lässt Stern keine Sekunde Zweifel. Im Gegenteil: „Die Veränderungen müssen schnell, tiefgreifend und teilweise beschleunigend sein“, sagt er. „Ich bin ziemlich überzeugt davon, dass in zehn Jahren kein Öl- und Gasunternehmen so aussehen wird, wie es heute aussieht. Das Wichtige an diesen Transformationen ist, dass man an einen Punkt kommt, wo man die Notwendigkeit der Änderung akzeptiert. Sobald man das gemacht hat, kann man in den Änderungen auch Chancen erkennen.“ Dafür müsse man aber erst die Unausweichlichkeit begreifen.

Der größte Erfolg für ihn in zehn Jahren sei, „wenn wir eine OMV haben, die noch immer zu den führenden Unternehmen Österreichs gehört und die einen Beitrag zu einem nachhaltigen Leben leistet.“ Kein anderer Öl- und Gaskonzern weltweit habe einen so großen Chemieanteil im Portfolio, so umfassendes technologisches Know-how auf den verschiedenen Feldern der Kreislaufwirtschaft und Rohstoff-Rückgewinnungstechnologien. Diese Potenziale will Stern zur starken Differenzierung fernab des klassischen Geschäfts nutzen, „wo wir den Wettbewerb schlagen können“.

Die neuen Säulen der OMV seien Kreislaufwirtschaft, Nachhaltigkeit und die Einhaltung der Pariser Klimaziele. Die Reihenfolge ist für Stern klar: „Planet, People, Profit.“

Das jüngste Spitzenergebnis der OMV stammt schon zur Hälfte aus dem Chemiegeschäft. Dass künftig weniger als die aktuell knapp 500.000 Barrel Öl und Gas pro Tag gefördert werden dürften, muss nicht zwingend zulasten des Profits gehen. Die OMV beherrscht inzwischen ein Re-Öl-Verfahren, bei dem Kunststoffe wieder zu Öl werden. Plan war immer, das in große Dimensionen zu transferieren. Auch Pflanzenöle werden bereits in die Raffinerieprozesse eingebracht.

Essenziell für die Transformation sei eine Lernkultur mit Konflikt und Diskurs. „Ich möchte, dass wir diese Diskurse ... men zurück ... missverstä... erfolgsrate... en Spitze, ... Borealis-C... der Zeit le... geht.“ Ob... gebe es ... viele OMV ... ausweichl... bereits ak...

Konkret ... del das Au... Russland-... wenn sich ... legt. Mehr ... stellenmet... ben. Zu V... die rumän... ist Stern ... trum verfü...

Kleine Zeitung
Samstag, 4. September 2021

Sterns Wandel folgt der Devise „Planet, People, Profit“ ...

Der neue OMV-Chef im Porträt
Kleine-Zeitung-App
Kleinezeitung.at/wirtschaft





Source: https://www.omv.com/en/news/220316-omv-strategy-2030

“Transformative Change is unavoidable”
(„Der Wandel ist unausweichlich“):

*”The **TRANSFORMATION** must be **fast, profound** and in parts **accelerating**.“*

- The **NEW PILLARS** of OMV:
  Circular Economy, Sustainability and the **Paris Climate Goals**
- **Priority order** for **FUTURE STRATEGY**:
  “Planet, People, Profit“

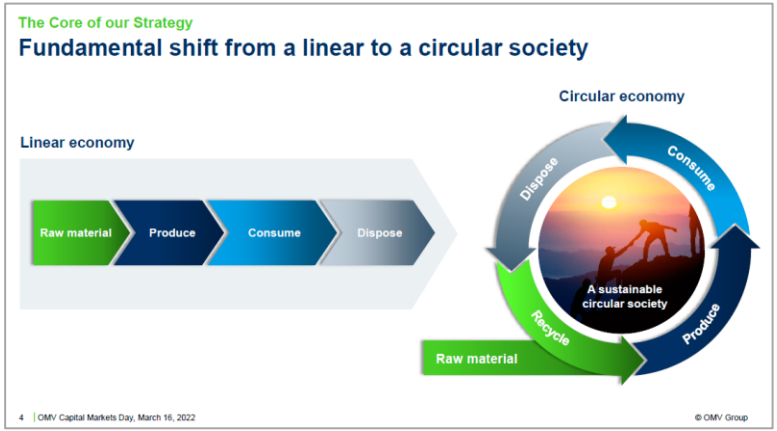
New OMV Strategy 2030

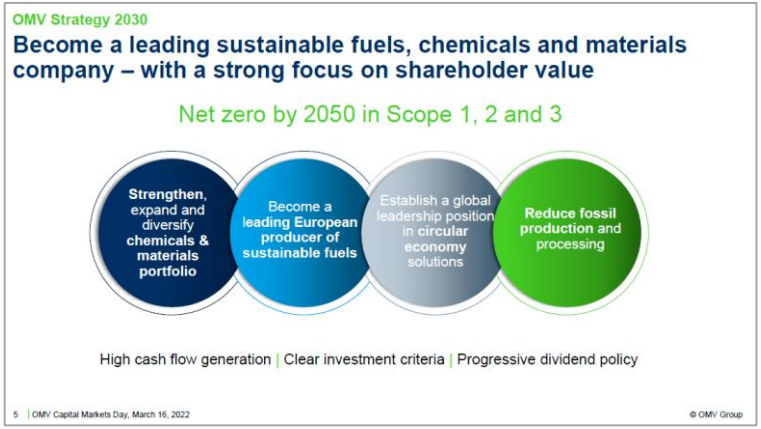
(March 16, 2022)

- Fundamental **shift from linear towards circular business approach:**
  OMV aims to become a leading, integrated sustainable fuels & materials company with a **strong focus on circular economy** solutions
- **Net-zero** (Scope 1, 2 and 3) to be reached by **no later than 2050!**

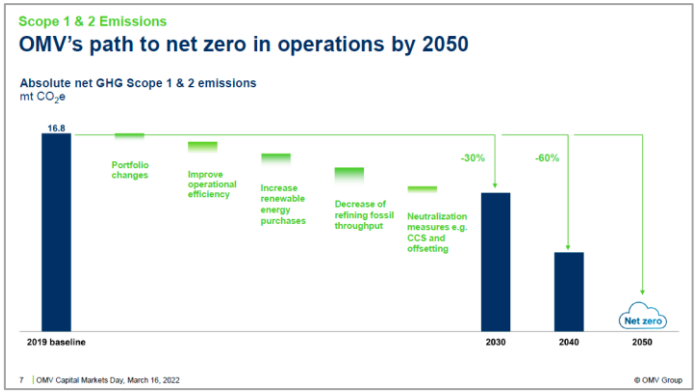
OMV Strategy 2030 (16 March 2022)

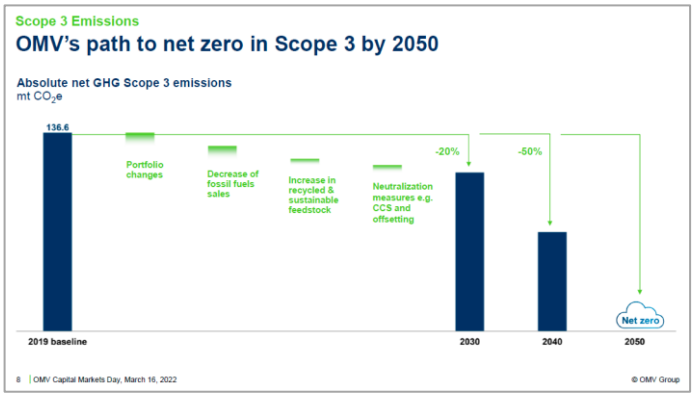
Transformation to net-zero by 2050 or sooner | Scope 1, 2 and 3





Source: **OMV Group |** https://www.omv.com/en/about-us/company/strategy

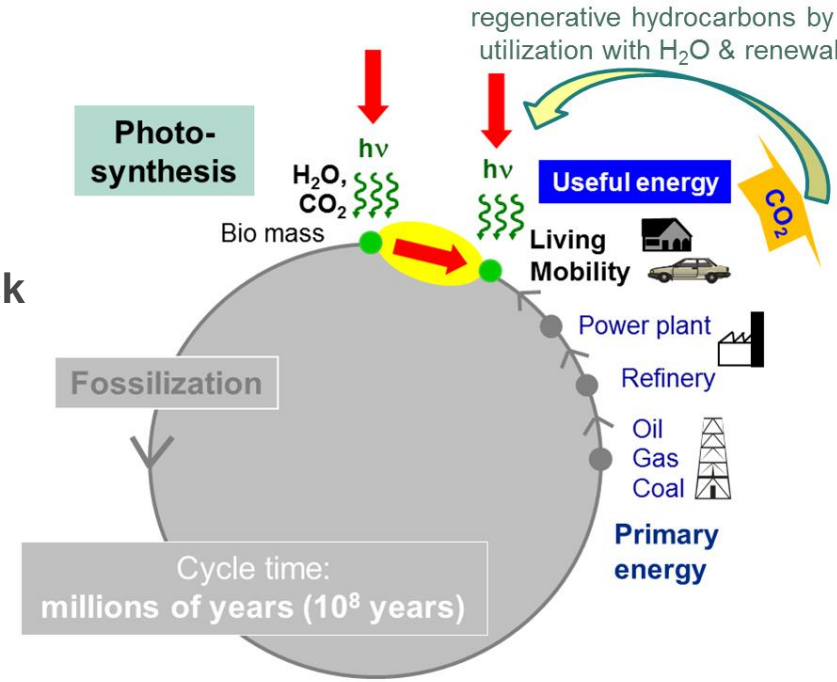




VISION: A NEW CARBON MANAGEMENT

Towards a solar-driven ALL-CIRCULAR PLASTICS & CARBON ECONOMY (1/3)

From current to future energy/feedstock technologies



*The **fossil energy/feedstock cycle***

*The **regenerative energy/feedstock cycle***

Cycle time:
up to max. ~100 years

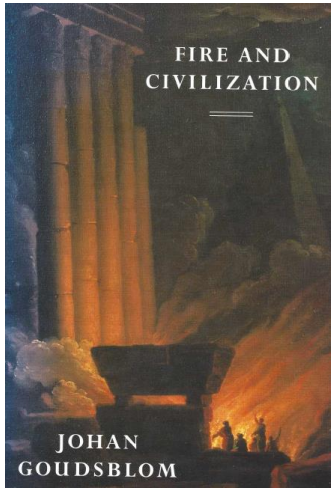
CIRCULAR CARBON MANAGEMENT & DEFOSSILISATION instead of DECARBONISATION!

The PLASTICS Context & Perspective

How we got here and where we're going …

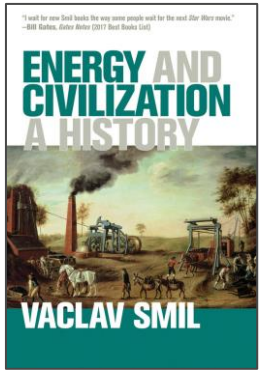
Another perspective on **CCU** (carbon capture & utilization):

Control *['taming']* of Fire – NEXT LEVEL: from the civilization-historical **importance** of **FIRE** to **re-thinking the ancient Greek Prometheus mythology**



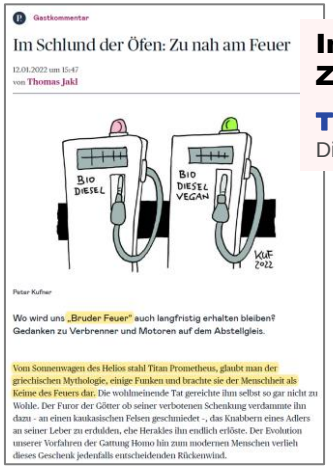
Fire and Civilization

Johan GOUDSBLOM
Penguin Press; **1992**



Energy and Civilization
A History

Vaclav SMIL
MIT Press; **Oct. 2018**


Gastkommentar

Im Schlund der Öfen: Zu nah am Feuer

12.01.2022 um 15:47
von Thomas Jakl

Peter Kufner

Wo wird uns „Bruder Feuer" auch langfristig erhalten bleiben? Gedanken zu Verbrenner und Motoren auf dem Abstellgleis.

Vom Sonnenwagen des Helios stahl Titan Prometheus, glaubt man der griechischen Mythologie, einige Funken und brachte sie der Menschheit als Keime des Feuers dar. Die wohlmeinende Tat gereichte ihm selbst so gar nicht zu Wohle. Der Furor der Götter ob seiner verbotenen Schenkung verdammte ihn dazu - an einen kaukasischen Felsen geschmiedet -, das Knabbern eines Adlers an seiner Leber zu erdulden, ehe Herakles ihn endlich erlöste. Der Evolution unserer Vorfahren der Gattung Homo hin zum modernen Menschen verlieh dieses Geschenk jedenfalls entscheidenden Rückenwind.

Im Schlund der Öfen:
Zu nah am Feuer

Thomas JAKL
Die Presse; **12. 01.2022**



Die Reue des Pometheus:
Von der Gabe des Feuers
zur globalen Brandstiftung

Peter SLOTERDIJK
Suhrkamp; **March 2023**

ANNEX | Back-up slides

- A **NEW industrial carbon management** to accelerate the low & circular carbon transition: examples from the fossil fuel industry (**ADNOC** and **OMV**)
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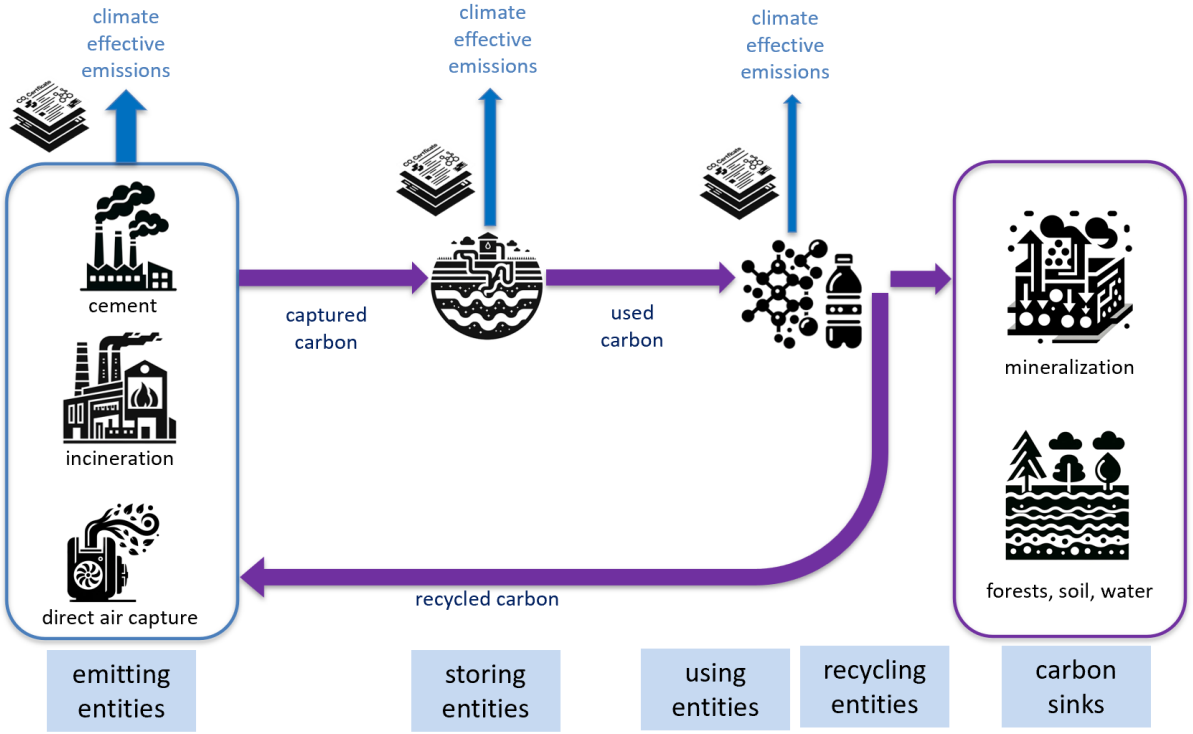
Cross-sectoral Circular Carbon Management (ccCM)

Carbon flows and comprehensive, all-inclusive carbon accounting

[S. Schleicher and R. W. Lang; Dec. 2023]



R. W. Lang, S. P. Schleicher, M. Elkerbout (December 2023)


POLICY BRIEF

Climate-neutral hard-to-abate industries by 2050 or sooner?

The urgent need for radical CCS/U policy adaptations and the special role of the cement industry

Reinhold W. Lang
Stefan P. Schleicher
Milan Elkerbout

Cross-sectoral Circular Carbon Management (ccCM)

The next challenges for carbon accounting [S. Schleicher and R. W. Lang; Oct. 2023]

Shifts in EU industrial policies

Reform of EU Emissions Trading System (ETS)

- Steeper reduction path for emissions cap
- Faster reaction to surpluses via Market Stability Reserve (MSR)
- Carbon Border Adjustment Mechanism (CBAM)
- **Funding out of auctioning** for
  - Modernization Fund
  - **Innovation Fund**
  - Social Climate Fund

Net-Zero Industry Act

Includes the following technologies:

- Solar photovoltaic and solar thermal technologies
- Onshore and offshore renewable technologies
- Battery/storage technologies
- Heat pumps and geothermal energy technologies
- Electrolysers and fuel cells
- Sustainable Biogas/Biomethane technologies
- Grid technologies
- **Carbon Capture and Storage (CCS) technologies**
- **But not ccCM (!!!)**

Incentives from comprehensive Carbon Accounting

Needs for a reform of current carbon accounting issues

[S. Schleicher and R. W. Lang; Oct. 2023]

Emissions captured and stored (CCS)

- No allowances to be submitted if emissions are stored permanently under a permit.
- But allowances need to be submitted if capture, transport, and storage are separate activities.

The current ETS Directive does not recognize CCU/ccCM!

Emissions from biomass

- Installations using exclusively biomass are not covered by the ETS Directive.
- Emissions from biomass are considered zero.
- Negative emissions from biomass are currently not accounted for, e.g. by permanent storage of emissions from the combustion of biomass.

The current ETS Directive lacks of rewards for negative emissions!

Conclusion(s) & claim:

- The rather **limited amount** of (sustainable-cascadic) **biogenic C/CO_2 feedstock** is heavily contested and most likely **insufficient to meet all market demands for carbon!**
- Technological **non-biogenic C/CO_2** emission from HTA industries and alike, utilized via **CCU** in **cross-sectoral, circular Carbon Management** schemes, are to **be treated equal** to **biogenic C/CO_2** emissions **in ETS Directives.**

Cross-sectoral Circular Carbon Management (ccCM)

The next challenges for circular economy strategies & policies and needs for a reform [S. Schleicher and R. W. Lang; Oct. 2023]

Shifts in EU Circular Economy (CE) strategies & policies

Reform of EU Circular Economy Action Plan (CEAP)

- With regard to CCU, of special relevance in the EU CEAP is the **Plastics Strategy**
- Regulations & aims for **mechanical recycling** exist partially, discussion as to chemical recycling ongoing.
- **EU plastics packaging waste levy** of **800 €/t** for not mechanically recycled waste **translates to ca. 255 €/t of CO_2** (no steering mechanism prescribed!)

The current EU CE Strategy does not recognize CCU/ccCM!

Shifts in AT Circular Economy (CE) strategies & policies (Dec. 2022)

Reform of AT Circular Economy Strategy

- **CCU acknowledged as mid-term necessity** to decarbonize HTA industries and to achieve techno-spheric carbon circularity
- **Plastics packaging waste levy** currently financed from federal budget (no steering effect!)

The current AT CE Strategy is rather unassertive & hesitant as to a rapid large-scale ccCM implementation!

Conclusion & claim:

- **Incineration of plastics & organic matter** (of non-biogenic feedstock) coupled with **thermal energy use** and **CCU** driven by renewable energy, should be acknowledged as **viable "chemical" recycling route** at EU and national policy levels!

Incentivizing targeted innovations for Cross-sectoral Circular Carbon Management (ccCM)

[S. Schleicher and R. W. Lang; Oct. 2023]

Reformulating the targets for ccCM

- Carbon **storage** alone is not a viable strategy; whenever feasible, it should preferably be tied to **utilization** with the aim of full **circular** carbon management.

Reforming carbon accounting consistent with circular carbon strategies

- A reformed accounting scheme should be based on **full carbon value chains** independent of the source and utilization of carbon.

Supporting the structural transition for ccCM

- The two key actions for structural reforms are **cross-sectoral cooperation** and **circular use of carbon**.

Providing matching funding schemes that support the structural transition to ccCM

- This motivates an **Austrian Innovation and Transition Fund (AITF)** with a setup similar to the ERP Fund.

Austrian Innovation and Transition Fund (AITF)*

Making targeted innovations for cross-sectoral Carbon Management effective

[S. Schleicher and R. W. Lang; Oct. 2023]

Key requirements for the transition to industrial structures for ccCM

- Developing **carbon value chains** that gradually lead to fully circular carbon use.
- This requires **innovative cross-sectoral cooperation**.
- The **risks** of the related transition process need to be **contained**.
- Although the basic lines of a transition to ccCM-compatible structures are emerging, there is still a lot of **R & D needed** on processes, infrastructure, business models, and market designs.

Incentives and support for ccCM by a matching financial mechanism

- The task of **restructuring Austrian HTA industries** is in many respects similar to the reconstruction of Austrian industry after the Second World War, with the **ERP Fund** serving as a highly successful financial tool.
- A similar financial mechanism, coined **Austrian Innovation and Transition Fund (AITF)**, could be installed for the extremely challenging transition to ccCM structures.
- Basic design elements of this fund should be
  - **joint responsibilities** of participating industries
  - **long-term financing** from public and private sources

*** Remark:** the **"AUSTRIAN Innovation & Transition Fund (AITF)"**, together with the IPCEI-initiative on *"Decarbonizing the Industry"*, is explicitly listed in the **"National Reform Program 2021"** (p.37-38)

To-Dos | Fathoming and forging adequate strategies & policies

Essential items for cross-sectoral circular HTA Carbon Management (HTA-ccCM)

[S. Schleicher and R. W. Lang; Oct. 2023]

Extending the scope of the EU ETS and the EU Innovation Fund for incentivizing ccCM

The current regulation of the EU ETS needs a shift from single installations to full carbon value chains & full industrial (techno-spheric) carbon circularity

- Installations should be allowed to opt-in to **cluster along carbon value chains** with synergies from cross-sectoral and circular carbon management.
- These clusters would report **consolidated emissions** considering the impact of **carbon capture & utilization (CCU)** also incl. **intermediate storage (i.e. CCUiS)**.
- Installations could still get **free allocations** and would benefit from the **lower consolidated emissions**.
- The **EU Innovation Fund** should foster and prioritize projects that aim for cross-sectoral and circular carbon value chains.

Enabling AT (national) policies & funding schemes for supporting ccCM

Putting CCS/CCiS into a ccCM framework

- Any regulation concerning **carbon capture & storage (CCS)** should be done in view of **carbon utilization (CCUiS)** and thus **circular carbon management (ccCM).**
- Just regulating CCS is therefore not recommended.

Financing targeted innovations

- **Scope, size and risks** of the industrial transformations needed require financial mechanisms beyond the current ones (e.g. such as UFI) with
  - **joint responsibilities** of participating industries,
  - **long-term financing** from public and private sources.
- This motivates the establishment of an **Austrian Innovation and Transition Fund (AITF)**.

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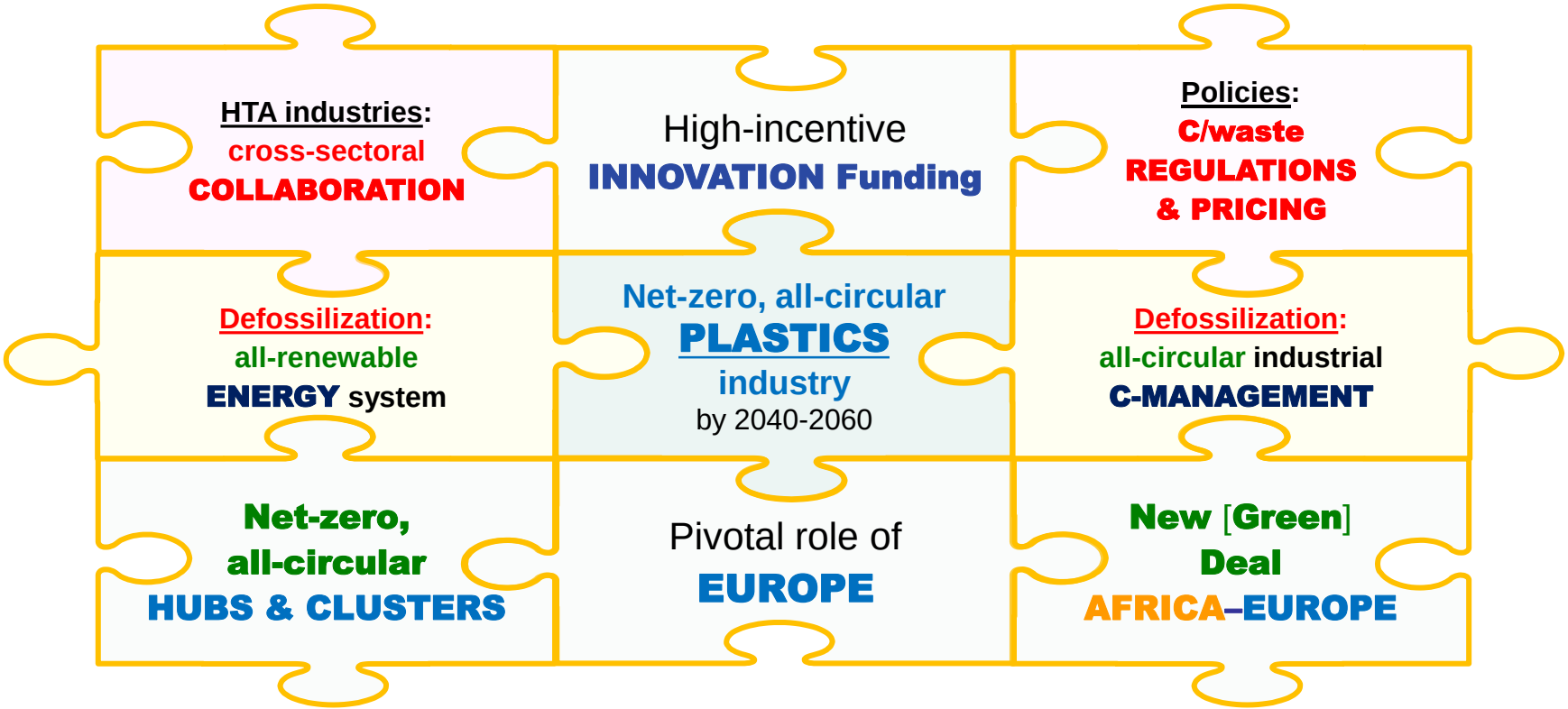
Navigating the Great Industrial Transformation

Essential items of a **“complex FORREST puzzle”**



Sensitive Intervention Points (SIPs)

Covering cross-cutting & cross-sectoral perspectives

An Example …

#forumFUTURE proposes a …
'NEW INDUSTRIAL DEAL' for **AUSTRIA & EUROPE**

Energy- & Climate Politics and **Circular Economy**
are economic, environmental and resource political
TOP PRIORITIES of the **EUROPEAN UNION!**

ReThinking ENERGY- & MATERIAL Economics:
A CROSS-SECTORAL Energy, Climate & Circular Economy Strategy!

#forumFUTURE
KOMPETENZFORUM FÜR NACHHALTIGE ENTWICKLUNG
IN POLITIK, WIRTSCHAFT & GESELLSCHAFT

In search of the "Silver Bullet" …

Towards an
All-circular,
all-regenerative
"CARBON & PLASTICS ECONOMY"!

Systems Transformation via **Sensitive Intervention Points** (SIPs)

In search of proper **Carbon Pricing**? | Another **Metaphor!**

Exploiting socioeconomic tipping points and amplifiers?!

A NEW APPROACH TO CLIMATE INTERVENTIONS

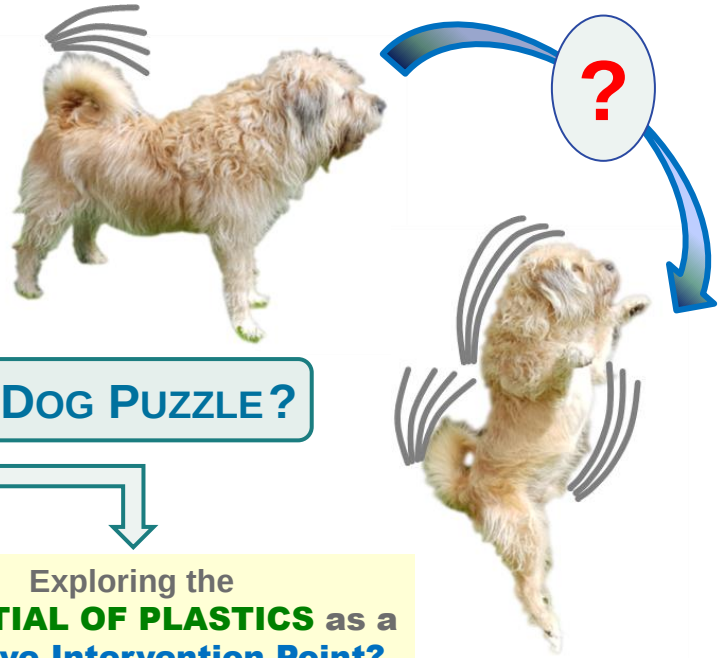
Sensitive Intervention Points:
How can economic butterfly wings create a climate action tornado?

Oxford Martin Programme on the Post-Carbon Transition

11 April 2019

post-carbon TRANSITION | OXFORD MARTIN SCHOOL | UNIVERSITY OF OXFORD

https://www.oxfordmartin.ox.ac.uk/post-carbon/



WAG THE DOG PUZZLE?

Exploring the
POTENTIAL OF PLASTICS as a
Sensitive Intervention Point?

A potential SIP: The EU Plastics Waste Levy (as of 2021)

A miscarried attempt for an environmental tax or OPPORTUNITY?

Is the **EU Plastics Waste Levy** a **"SENSITIVE INTERVENTION POINT"**, which may become a **"TIPPING POINT" for the entire fossil energy system …?**

PLASTICS Waste*
(Austria 2018)
~ 0.2 Mio. tons

* non-recycled packaging waste

?

WAG THE DOG?



CO_2 emissions
(Austria 2018)
~67 (!) Mio. tons



EU PLASTICS waste levy
800 Euro/ton (as of 2021)

Converted **"reference price"** for **CO_2 emissions**
~250 Euro/ton (as of 20??)

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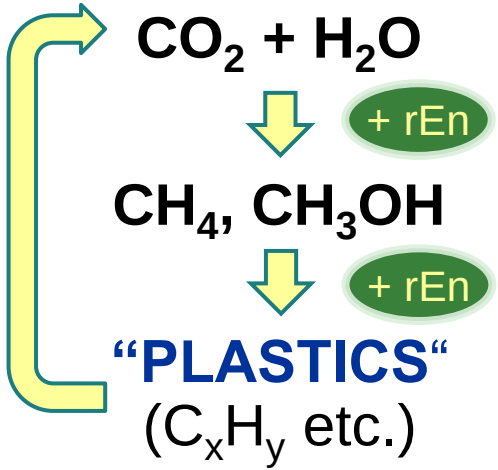
How to mobilize Technosphere “CARBON CIRCULARITY“?

HUGE AMOUNTS OF RENEWABLE ENERGY REQUIRED!

From **Carbondioxide**
to
Methane & **Methanol**
to
PLASTICS
in a circle – HOW?



THE GLOBAL GOALS
For Sustainable Development

17 PARTNERSHIPS FOR THE GOALS

NEW GREEN DEAL
AFRICA-EUROPA
in transdisciplinary
partnership
at eye-level!

How to mobilize Technosphere “CARBON CIRCULARITY“?



Desertec3.0

‘Emission Free Energy for MENA and the World’

Club of Rome Austria, 15.9.2021

Paul Van Son, President Dii Desert Energy

17 PARTNERSHIPS FOR THE GOALS

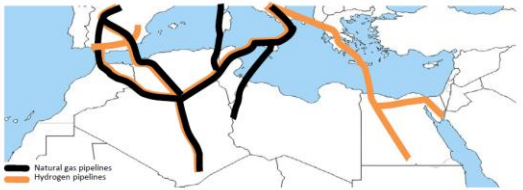
THE GLOBAL GOALS
For Sustainable Development

Export: Existing and new Gas Infrastructure

Eventually to be used for hydrogen

Dii





- Natural gas infrastructure Europe - North Africa (left figure) and first outline for a hydrogen backbone infrastructure Europe-North Africa (figure above)
- An existing gas infrastructure from Algeria and Morocco could be converted to a hydrogen infrastructure (grey-orange lines).
- A ‘‘new’’ hydrogen transport pipeline must be realized from Italy to Greece, crossing the Mediterranean Sea to Egypt, which could eventually be extended to the Middle East (orange line).

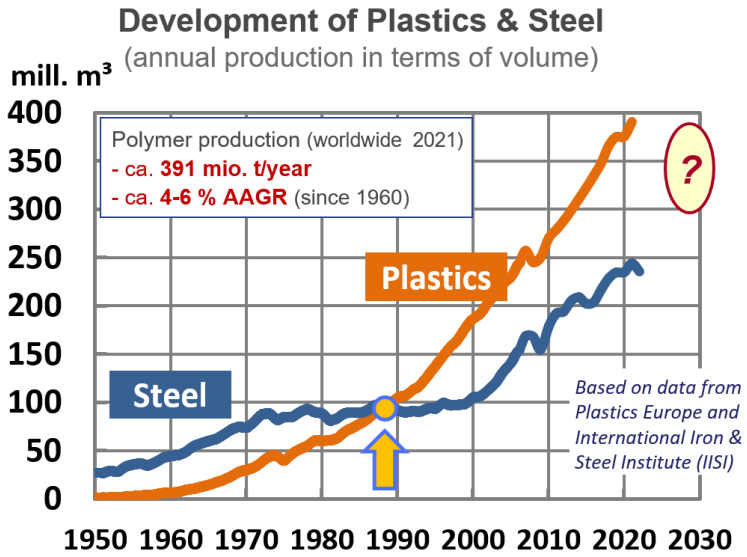
© Dii Desert Energy

15

NEW GREEN DEAL
AFRICA-EUROPA
in transdisciplinary
partnership
at eye-level!

The PLASTICS Context & Perspective

PLASTICS – MATERIALS OF THE 21. CENTURY ?!



… the flipside of the success?





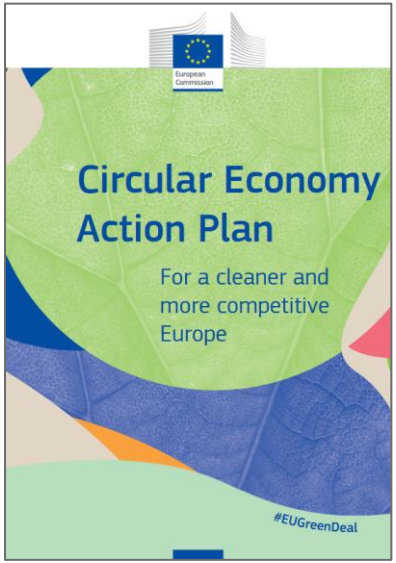


The **EU policy** approach

An **EU Action Plan** for the **Circular Economy** to

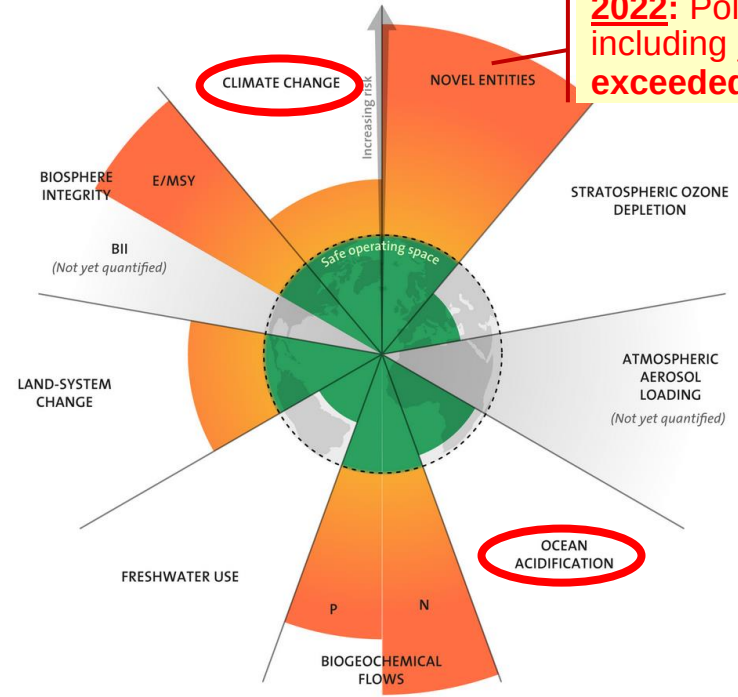
- to boost global competitiveness
- foster sustainable economic growth
- generate new jobs
- reduce GHG emissions

Recycling targets for **plastics packaging waste** (put forth 2018):
50 % by 2025
55 % by 2030



The new **CIRCULAR ECONOMY ACTION PLAN (CEAP)** [March 2020]

Surpassing Planetary Ecological Limits | Plastics Pollution



Credit: Designed by Azote for Stockholm Resilience Centre, based on analysis in Persson et al 2022 and Steffen et al 2015. Click to download.

2022: Pollutants, including **PLASTICS**, **exceeded!**

… how to resolve the problems of **microplastics?**

The Ecological Compass

*indicating the operating ranges of human activity (**9 AREAS**)*

Planetary boundaries according to ***Rockström et al.*** *(2009),* ***Steffen et al.*** *(2015/2019)* and ***Persson et al. (2022):***

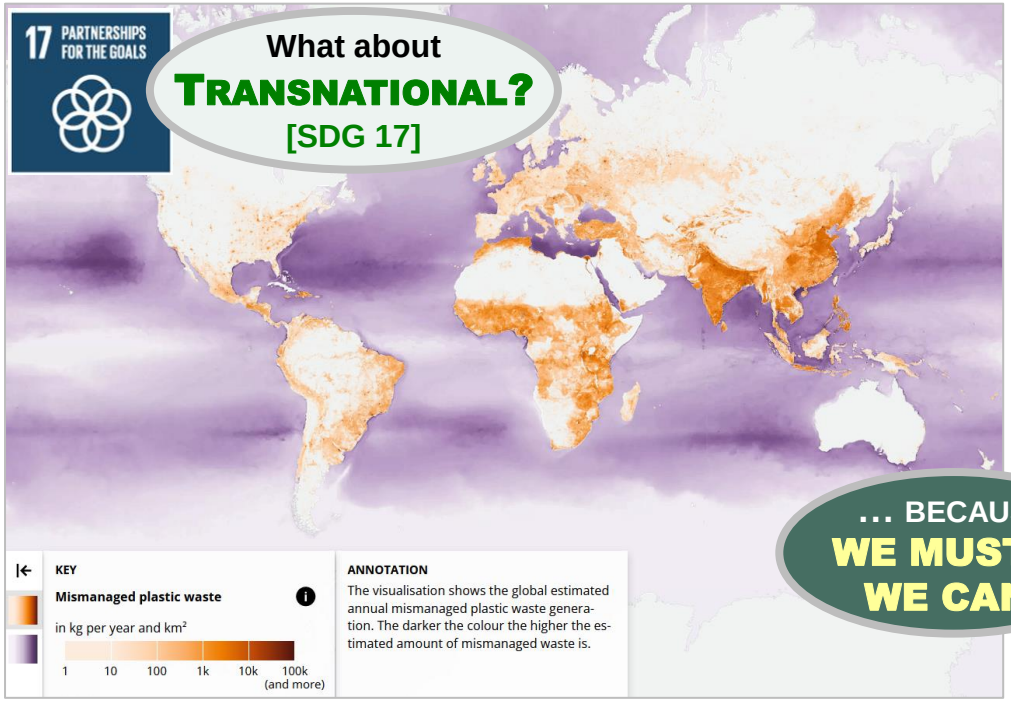
- **Beyond zone of uncertainty** (high risk)
- **In zone of uncertainty** (increasing risk)
- **Below boundary** (safe)
- **Boundary not yet quantified**

Source: https://www.stockholmresilience.org/research/research-news/2022-01-18-safe-planetary-boundary-for-pollutants-including-plastics-exceeded-say-researchers.html

THE EQUITY ISSUE:
~20 % rich cause
~70% of the problems!

UN Intergovernmental Negotiation Committee on Plastics Pollution [3rd Session (INC-3), 13-19 Nov. 2023, Nairobi]

Where does mismanaged plastics waste come from?



The Global Plastic Navigator was designed and developed by **dumpark** exclusively for **WWF.**

© WWF / dumpark; all rights reserved

Urgent need for **SDG 17 related transnational collaborations,** with **multiple win/win effects** in terms of (among others)**:**

- **renewable energy supply**
- **green molecules** (H_2/CH_4/CH_3OH/NH_3)
- **waste management incl. CCU**
- **benefits for most vulnerable people** (climate/environmental justice & health equity)

https://plasticnavigator.wwf.de/#/en/explore/?st=0&ch=0&ui-info=0&ui-mpol=show%3Atrue&layers=surface-concentration%7Cmismanaged-waste&mview=89.23322%7C-405%7C-89.22375%7C675

PERSPECTIVES: CLOSING THE LOOP
Fair Trade & Social Eco-Plastics ...
AN AFRICAN START-UP CASE STUDY SUPPORTED BY JKU LINZ

17 PARTNERSHIPS FOR THE GOALS

Waste picker benefits through MR. GREEN AFRICA model

- **30 % more income** - stable price politic
- **Tools & Protection** - Gloves, Boots, Mobile Phone
- **Track record of Income** - Access to Loans
- **Training Programs** - Life & Entrepreneurial Skills
- **Health Care & Assistance**

CURRENT TRADE MODEL

Streets or Dumpsites (post consumer waste) → Waste Picker → Informal Scrap Yards → Informal Broker → Informal Processing → Manufacturer End Product

Current Waste collection & processing model is informal and inefficient: the product changes hands at least 3 times before value addition.

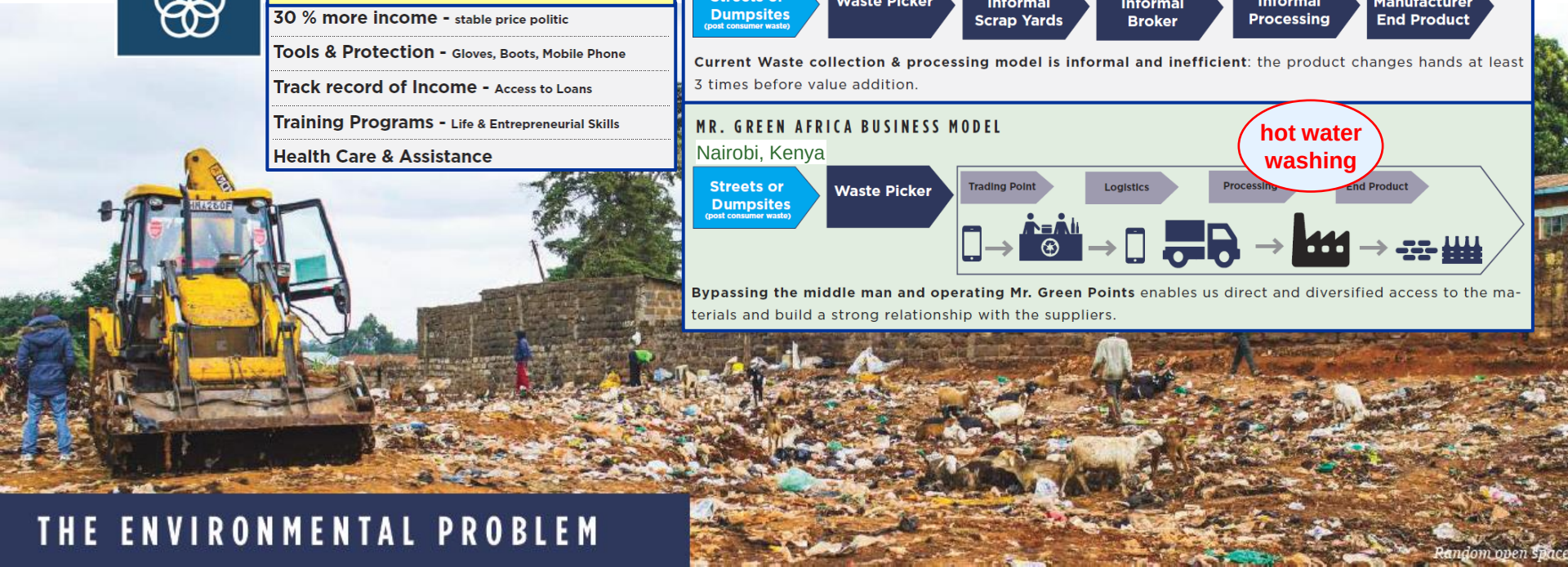
MR. GREEN AFRICA BUSINESS MODEL

Nairobi, Kenya

hot water washing

Streets or Dumpsites (post consumer waste) → Waste Picker → Trading Point → Logistics → Processing → End Product

Bypassing the middle man and operating Mr. Green Points enables us direct and diversified access to the materials and build a strong relationship with the suppliers.



THE ENVIRONMENTAL PROBLEM

Random open space

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On **Plastics Waste** and the Economic System

META-LEVEL PERSPECTIVE ON PLASTICS WASTE

[conveyed by R. W. LANG in a dialogue with Federal Minister Elisabeth KÖSTINGER at JKU, April 2019]

PLASTICS WASTE is the **VISIBLE expression and reflection** of a meanwhile **dysfunctional economic system** …

… which has roots in outdated economic model conceptions and ways of thinking from a time prior or at the beginning of the industrial revolution ...

… which urgently needs a **paradigmatic revision & modernization**!

A NEW MINDSET?!

Adam Smith: *The Wealth of Nations* (***1776***)

Old Guiding Principle: ***"ENRICH YOURSELF!"***
- free market regulation via **"invisible hand"**
- general prosperity via **"trickle down"**

New Guiding Principle (SDG perspective):
Planet | People/Prosperity | Profit

UN: *The Global Goals 2030* (*17 SDGs; **2015***)

"A WORLD WE WANT FOR ALL!" *(Leave no one behind!)*
- market regulation via internalization of **external costs** (social, environmental), e.g. an intelligent **carbon price/tax as "invisible hand"** (?)
- inclusive prosperity by accounting for intra/inter-generational **"equity issues"**

Picture by worldbank.org
Mohamed Abdulraheem

KEY MESSAGE #1: A CATEGORICAL statement
Why an Industrial Carbon Circularity is essential?

Without industrial CARBON (CO_2) CIRCULARITY,

No CIRCULAR ECONOMY and

No SUSTAINABLE DEVELOPMENT !!!

Recommended change in terminology: From **DECARBONIZATION** to **DEFOSSILIZATION**

and **sustainable, cross-sectoral & circular CARBON MANAGEMENT (ccCM)!**

KEY MESSAGE #2:

Industrial Carbon Capture & Use (CCU) – The SILVER BULLET?

Establishing **plastics waste incineration** **coupled with** **Carbon Capture & Use (CCU)** as a viable **"chemical" recycling" route** for **plastics waste** is **essential** (indispensable) and **paves the way** for a ***'sustainable'* all-circular PLASTICS sector!**

Note: **INCINERATION** of **PLASTICS** coupled with **thermal energy use and CCU** driven by **renewable energy** needs to be acknowledged as **'recycling'** in terms of a valid **Circular Economy option** at **EU policy levels!**

KEY MESSAGE #3:

H_2 and CO_2 as *'renewable'* feedstock & new industrial commodities?

On the complementary role of green H_2 & green CH_4/CH_3OH/NH_3

From an **energy transition perspective**, but specifically an **industrial transformation perspective**, a **focus on green hydrogen** (H_2) is **important**, but we **must widen the scope** to **green forms** of **methane** (CH_4), **methanol** (CH_3OH) & **ammonia** (NH_3)!

KEY MESSAGE #4: The role (obligation!) **of HTA industries**
Cross-sectoral collaboration is essential!

With their **exceptional** **capabilities & expertise**
along with their **management competencies**,

the **hard-to-abate (HTA) industries**
[steel, cement, plastics & chemicals, waste incineration]
- via **cross-sectoral collaboration** –
must **spearhead CCU technology development**
and **large-scale** (global!) **implementation**.

KEY MESSAGE #5: Transnational collaboration

Why transnational partnerships are essential?

Considering the **huge amounts** of **renewable energy** required for **techno-sphere C-CIRCULARITY**, a **'New Green Deal'** FOR **Africa & Europe/Austria** is **URGENTLY** NEEDED**!!!**

THE GLOBAL GOALS
For Sustainable Development

17 PARTNERSHIPS FOR THE GOALS

NEW GREEN DEAL AFRICA-EUROPA
in transdisciplinary
partnership at eye-level!