



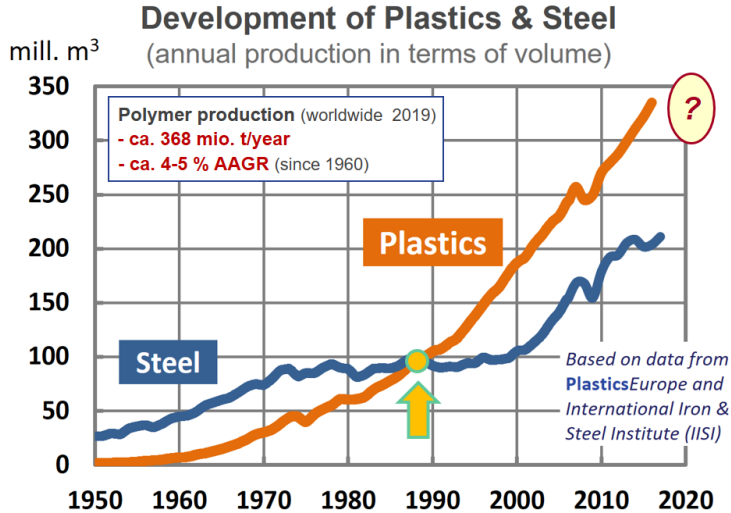
The need for **'SUSTAINABLE'** MANAGEMENT of **PLASTIC PACKAGING** and **SUP** in the EU

Reinhold W. LANG

Institute of Polymeric Materials and Testing
Johannes Kepler University, Linz

PLASTICS and the Human Enterprise (as of 1950)

PLASTICS – MATERIALS OF THE 21. CENTURY !?



... the flipside of the success?



The EU policy approach

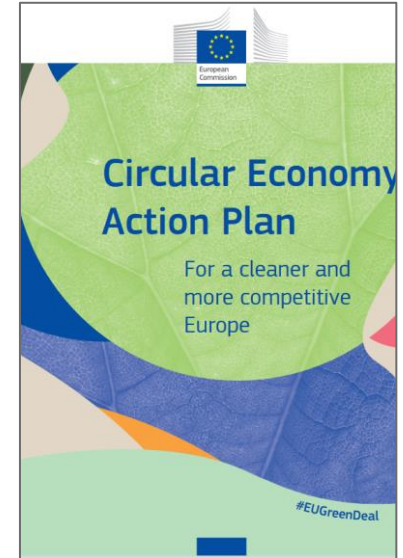
An EU Action Plan for the **Circular Economy** to

- 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]

OUTLINE: 2 TOPICS | 3 KEY MESSAGES

The need for **'SUSTAINABLE' MANAGEMENT** of **PLASTIC PACKAGING** and **SUP** in the EU

A topic in context to **two superordinate themes**:

(1) A meta-level perspective:

The **Anthropocene** and the **UN Agenda 2030** (SDGs)

(2) Transformative Change by Design:

A **meaningful** (resilient and smooth) **transition** to a **'sustainable' all-circular plastics & carbon economy**
[perspectives for Austria & the EU?]

Summary & Outlook (The Policy Dimension)

FRESH IMPULSES by Industry

Press conference (Sept. 03, 2021)

Alfred Stern

CEO of OMV (since Sept. 01, 2021)



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“

The UN-SDG perspective:
Planet | People/Prosperity | (Profit)

New OMV Strategy 2030
(March 15, 2022)

- **OMV aims** to become a leading, integrated sustainable fuels and 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**.

HYPOTHESIS 1

HYPOTHESIS 1: On the STATE OF THE WORLD

HUMANITY as a whole is facing an increasing number of so-called **GRAND CHALLENGES** which are highly interlinked & interdependent, causing multiple and evermore severe **CRISIS SITUATIONS**, threatening the survival of organized human societies.

FINANCIAL
CRISIS (2008)

CLIMATE
CRISIS

REFUGEE
CRISIS (2015)

SECURITY
CONFLICTS & WARS

PLASTICS WASTE
CRISIS

INCIDENTAL
CRISES

SARS-CoV-2
CRISIS (2020)

DEFORESTATION
& LAND USE
CRISIS

CUMULATIVE
CRISES

DYNAMICS OF THE HUMAN ENTERPRISE (1/3)

... The ANTHROPOCENE

www.futureearth.org

The International Geosphere-Biosphere Programme (IGBP)

hosted by the Royal Swedish Academy of Sciences

inspired in 2000 by

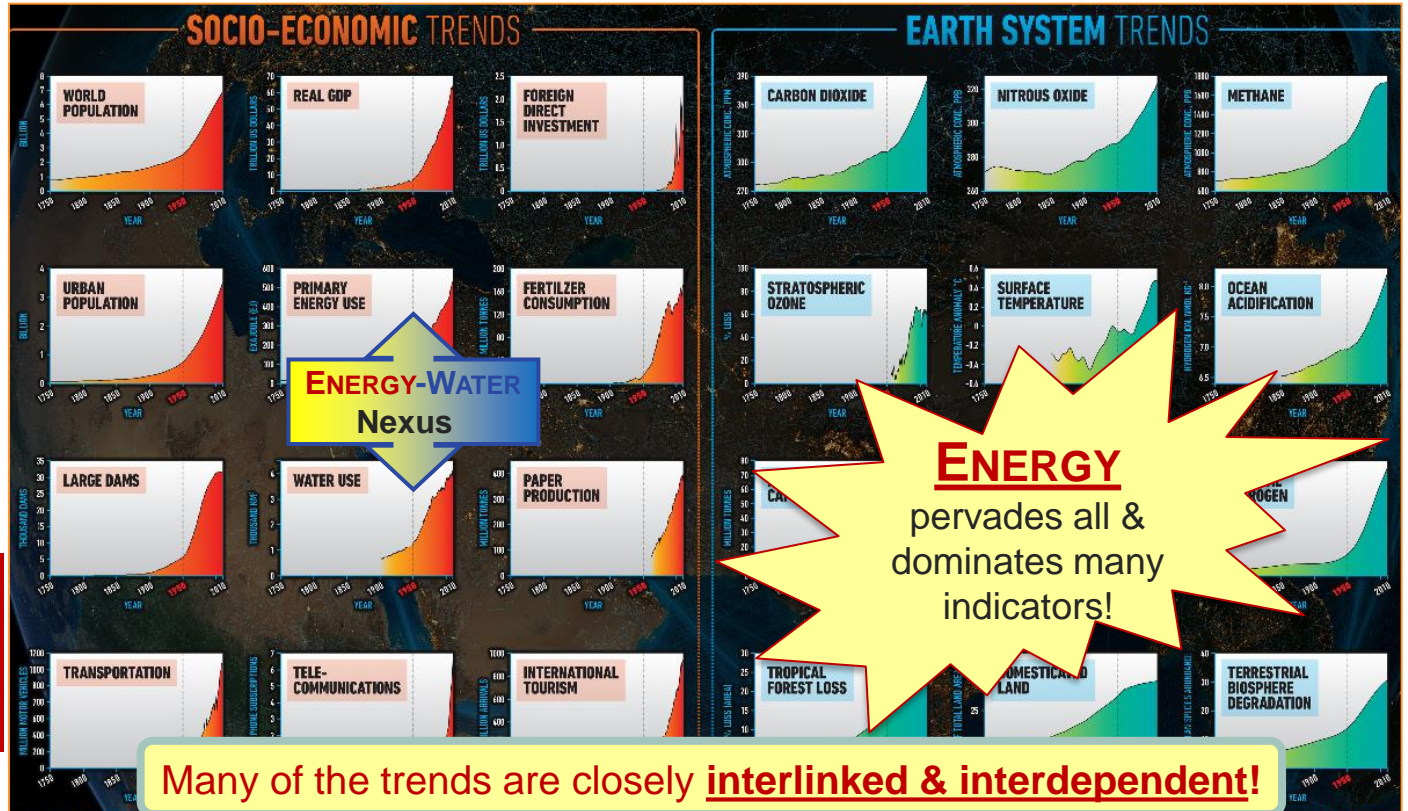
P. Crutzen

(Vice Chair of IGBP)



GREAT ACCELERATION charts:

- 12 socio-economic indicators
- 12 earth system indicators



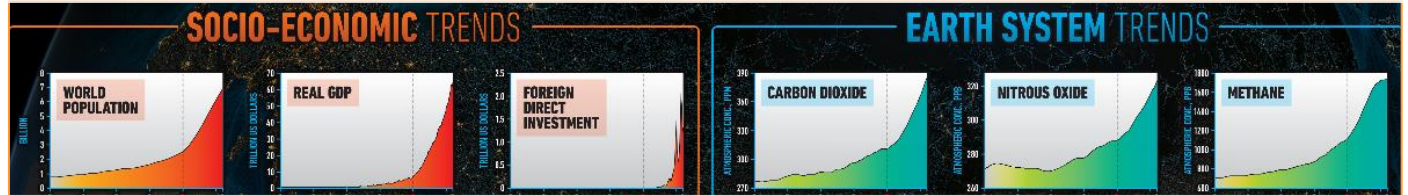
Reference:

adapted from W. Steffen, W. Broadgate, L. Deutsch, O. Gaffney and C. Ludwig (2015), *The Trajectory of the Anthropocene: the Great Acceleration*, *The Anthropocene Review*. Map & Design: Félix Pharand-Deschênes/Globaïa

DYNAMICS OF THE HUMAN ENTERPRISE (2/3)

... The ANTHROPOCENE

www.futureearth.org



The International
Geosphere-Biosphere
Programme (IGBP)

hosted by the Royal Swedish
Academy of Sciences

inspired in 2000 by

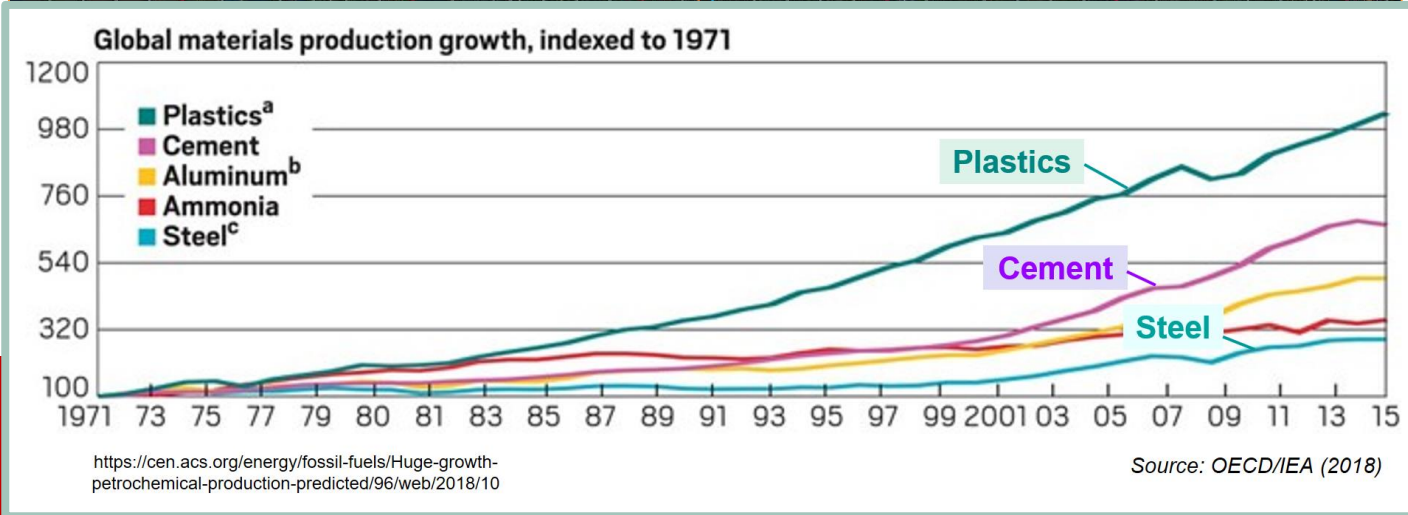
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GREAT ACCELERATION charts:

- 12 socio-economic indicators
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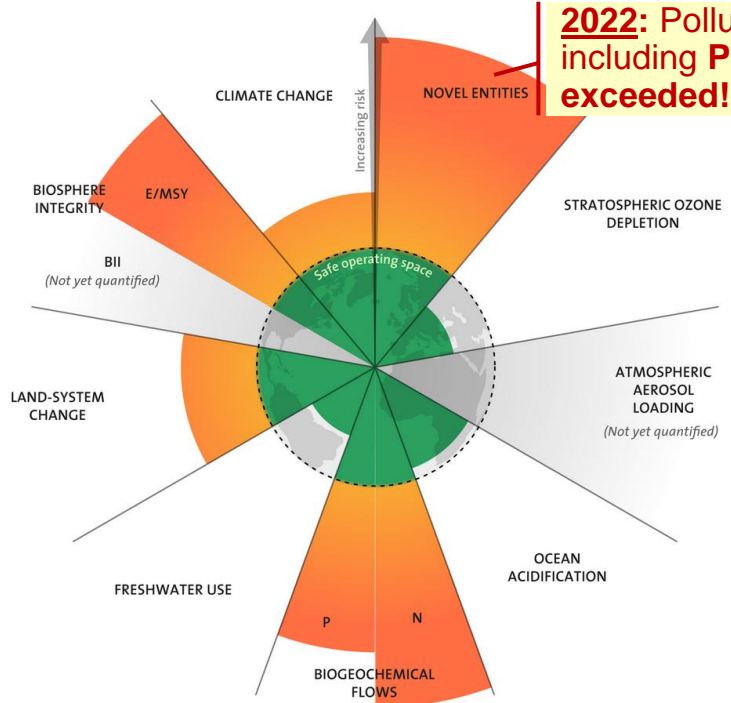
Many of the trends are closely **interlinked & interdependent!**

Reference:

adapted from W. Steffen, W. Broadgate, L. Deutsch, O. Gaffney and C. Ludwig (2015), *The Trajectory of the Anthropocene: the Great Acceleration*, *The Anthropocene Review*. Map & Design: Félix Pharand-Deschênes/Globaïa

DYNAMICS OF THE HUMAN ENTERPRISE (3/3)

... Surpassing of Planetary Ecological Limits?



2022: Pollutants, including PLASTICS, exceeded!

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!

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

SUSTAINABLE DEVELOPMENT

UN AGENDA 2030 | SUSTAINABLE DEVELOPMENT GOALS (SDGs)



FROM
MDGs
2015
TO
SDGs
2030



The **SDGs 2030**:

- 17 goals
- 169 targets

with indicators & monitoring scheme!

ENERGY

pervades all & dominates several SDGs & indicators!

www.un.org/sustainabledevelopment/

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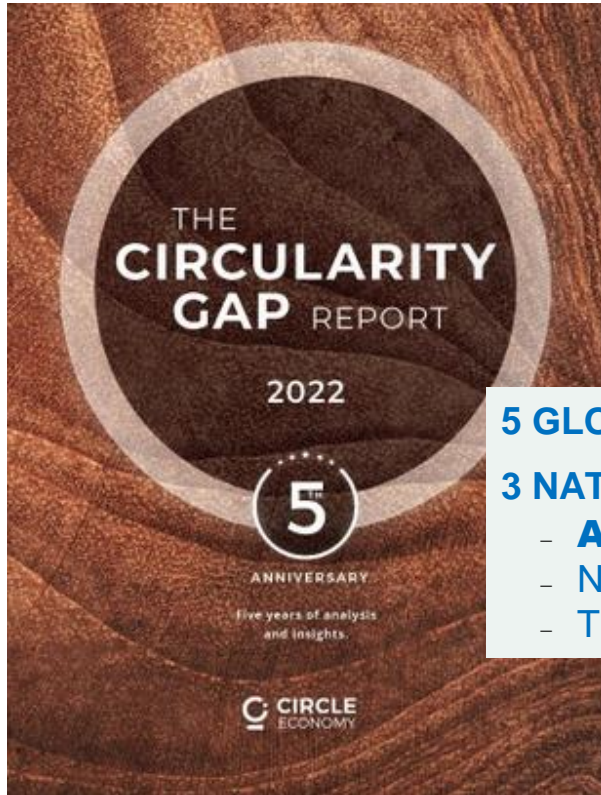
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[perspectives for Austria & the EU?]

Summary & Outlook (The Policy Dimension)

CIRCULARITY GAP Reports by Circle Economy



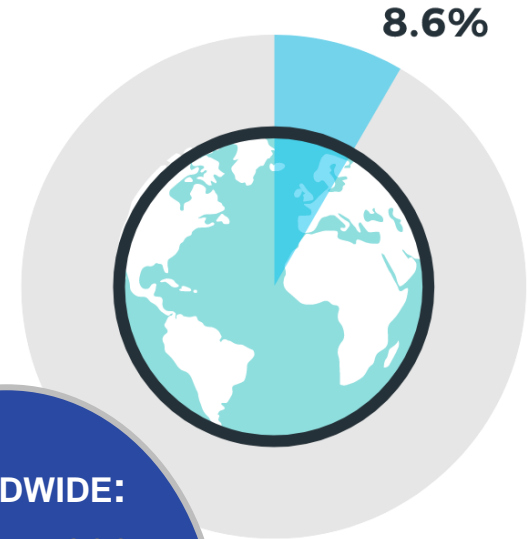
<https://www.circularity-gap.world/2022>

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

5 GLOBAL REPORTS (2018 – 2022)

3 NATIONAL REPORTS:

- Austria (9.7% in 2019)
- Norway
- The Netherlands



PLASTICS Circular Economy | CLOSING THE LOOP

The Plastic Bag Ban (enacted in Austria as of 01/2020)

Ein Sackerl statt einem Debatterl

JKU-Nachhaltigkeitssprecher Reinhold Lang über Wege aus dem Kunststoff-Dilemma



JKU-Prof. Reinhold Lang, Leiter des Instituts für Polymerwerkstoffe und -prüfung

JKU ist das Plastikackerl vor eine Politshow-Diskussion? Reinhold Lang: Das Verbot trifft nicht den Kern der Problematik. Das Plastikackerl steht für sieben bis achttausend Tonnen Kunststoffverbrauch im Jahr in Österreich. Das liegt größtenteils mengenmäßig aufgrund bei einem Prozent. Der Plastik-Verbrauch pro Jahr an Plastikackerl entspricht etwa einem CO₂-Äquivalent von einer 15 Kilometer langen Autofahrt mit dem Pkw.

Wie groß ist das Abfallproblem in Sachen Kunststoff in Österreich? Österreich hat im internationalen Vergleich mit der ARA (Abfall Recycling Austria), dem einzigen Abfallwirtschaftsunternehmen, man ist aber auch wie vor noch weit weg von einer zirkulären Kunststoffwirtschaft. Da ist noch viel zu tun. Alle Abfallströme betrachtet, ist Österreichs Wirtschaft nur zu einem Prozent aus Kunststoffen.

Damit sind wir noch nicht CO₂-neutral. Was muss man tun? Der Meinung nach geht die Bilanz die Koppelung der Erneuerbaren Energien und der Kreislaufwirtschaft zu schließen. Das hat damit zu tun, dass die Energieerzeugung für sich gesehen einen relativ schlechten Wirkungsgrad hat, extrem flächenintensiv ist und uns so in Flächenkonflikten mit Naherwartungsmitteln bringt. Deshalb bin ich da skeptisch.

OÖ Nachrichten
(Aug. 31, 2019)

Amount of Waste (AT)	in t (per year)	in %
Total Waste Streams	~ 424,000,000	100 %
Share CO ₂	~ 80,000,000	20 %
Share PLASTICS TOTAL	~ 920,000	0.2 %
Share PLASTICS BAGS	~ 7,000	0.002 %

Data source: Umweltbundesamt (2017), BMNT (2019), ARA (2019)

„Klarheit schaffen“: Wie Rhetorik die Fakten wegbläst

Nützt das Plastikackerlverbot der ÖVP tatsächlich dem Klimaschutz? Ein Beispiel aus der türkischen Show-Klimapolitik

FARTENCHECK:
BEREDIKT HARODOSLAWSKY

Es passiert nicht alle Tage, dass sich Politiker von Wissenschaftlern auf der Bühne prüfen lassen. Mitte September brachten die Klimaktivisten von Fridays for Future hochrangige Vertreter der Parteien dazu, ihre Klimaschutzpolitik im Festsaal der TU München zu diskutieren. Danach hat die



berbeitet. Der Plan wurde von der Kommission als unfertig eingestuft und muss nun bis in den Übergangsregierung übergeben werden. Hilfe auf der Bühne eines Klimawissenschaftlers ÖVP plant oder bereits in der Regierung ist ein zentraler Punkt", sagte Köstinger, "wir haben ja das Plastikackerl verboten. 7000 Tonnen Plastik weniger in Österreich pro Jahr". Das klingt ein bisschen wie ein Wahlversprechen, man konnte sich das als Wähler nicht vorstellen als sperrige Begriffe wie „ökosoziale Steuerreform“, die in der Klimapolitik zentralen Hebel in der Klimapolitik seien. In einem Wahlkampf, in dem erstmals das Thema Klimaschutz dominiert, bleiben Plastikackerl hängen.

FALTER (Sept. 25, 2019)
Does the Plastic Bag Ban serve Climate Protection?

Die ÖVP schickte zur „Großen Klimaprilgung“ Elisabeth Köstinger, die ehemalige Umweltministerin, die den Entwurf des Nationalen Energie- und Klimaschutzplans vorgelegt hat. „Abfallvermeidung ist ein zentraler Punkt“, sagte Köstinger, „wir haben ja das Plastikackerl verboten. 7000 Tonnen Plastik weniger in Österreich pro Jahr.“ Das klingt ein bisschen wie ein Wahlversprechen, man konnte sich das als Wähler nicht vorstellen als sperrige Begriffe wie „ökosoziale Steuerreform“, die in der Klimapolitik zentralen Hebel in der Klimapolitik seien. In einem Wahlkampf, in dem erstmals das Thema Klimaschutz dominiert, bleiben Plastikackerl hängen.

For the CLIMATE, this is WORTHLESS!

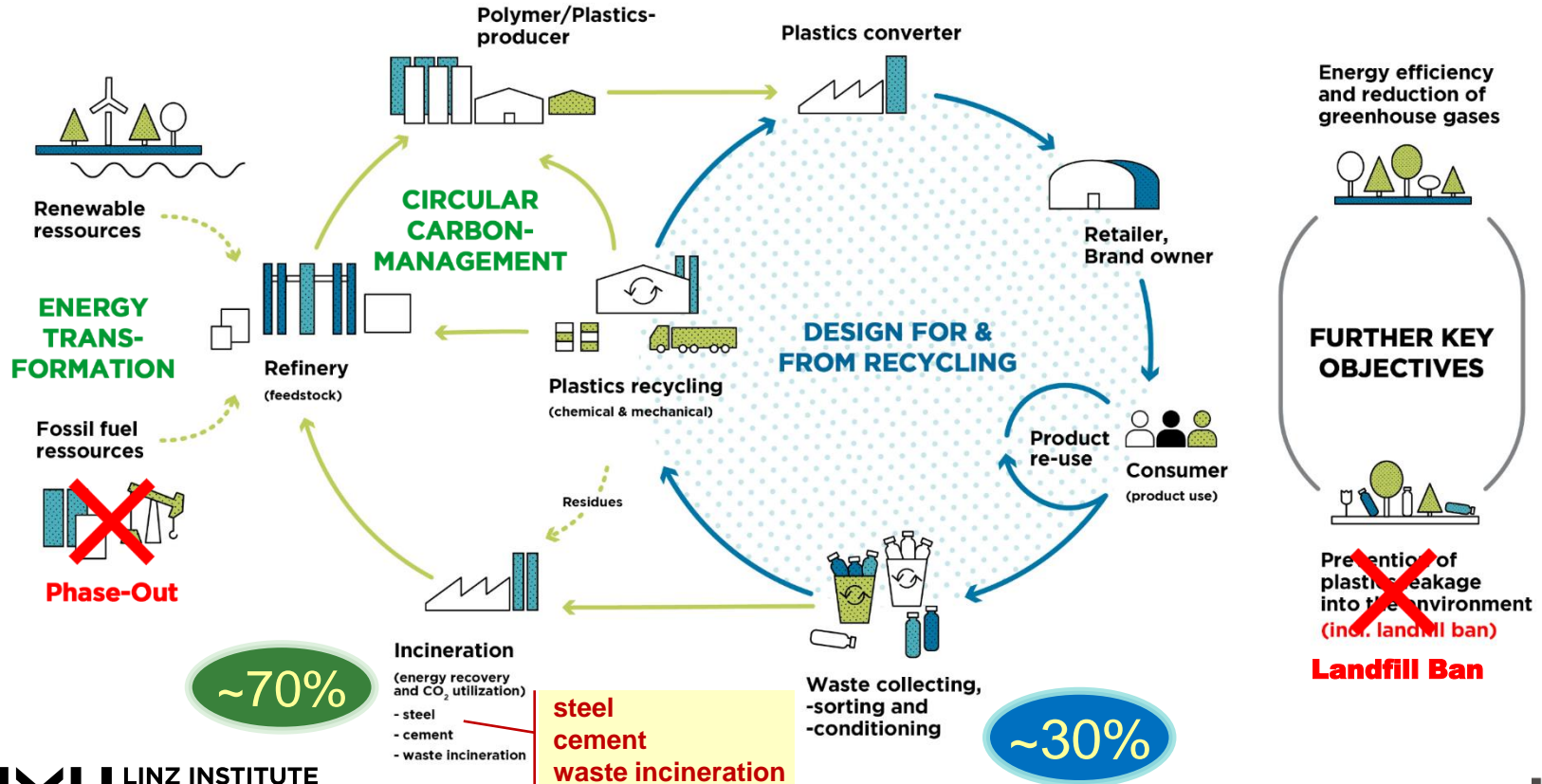
“The plastic bag issue is a never-ending story, which leads us on side tracks and keeps us from addressing the real important issues.”

R. W. Lang



PLASTICS Circular Economy | CLOSING THE LOOP

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



PLASTICS Recovery Options & Performance

The widening **performance gap**:
Mechanical recyclates vs. next generation “virgin” materials

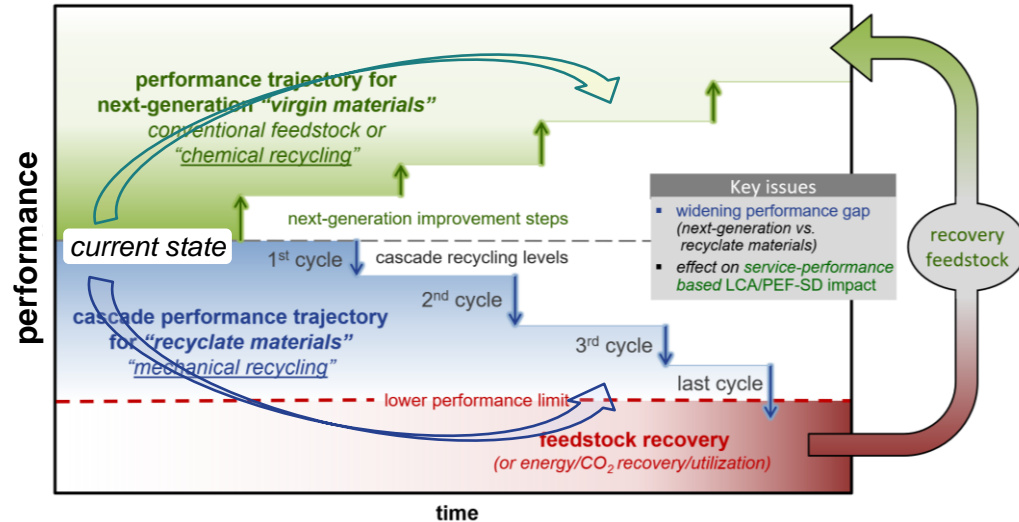
Principle pathways of product/material recovery

- **product reuse**
(repair, repurpose, etc.)
- **mechanical recycling**
(materials recycling)
- **chemical recycling**
(feedstock recycling)
- **energy recovery coupled with CO₂ utilization**
(CCU, feedstock recycling)

“down-cycling”
cascadic performance deterioration

“up-cycling”
innovation-driven performance enhancements

Service relevant material performance evolution



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)

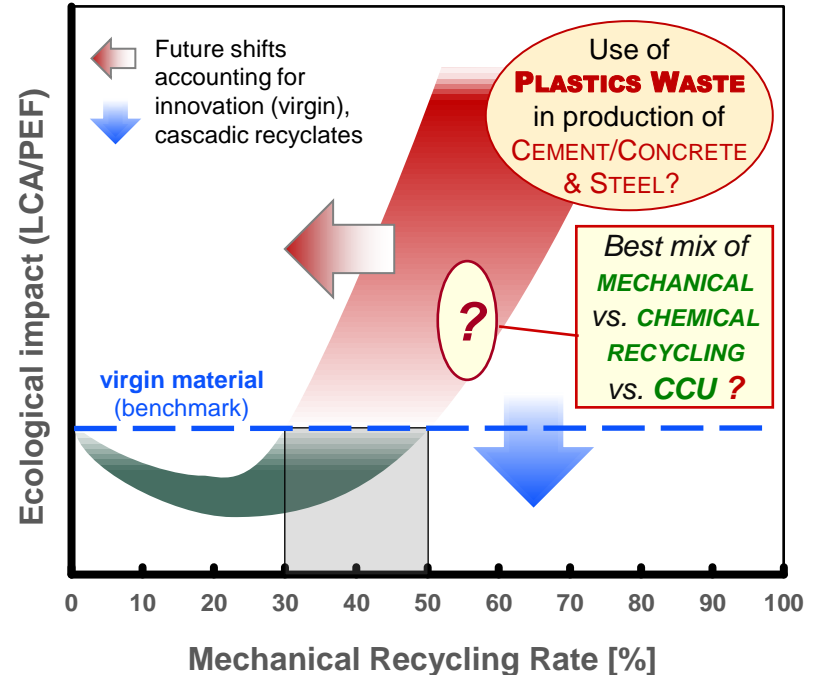
Some key findings (a selection):

- 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

KEY MESSAGE 1: ON PLASTICS (and other Materials) RECYCLING **Plastics & 'Sustainable' Circular Economy**

Not every **CIRCULAR ECONOMY** path
is per se **'SUSTAINABLE'!**

A product/application specific SYSTEMS PERSPECTIVE
incl. a comprehensive/full **LC/CB (PEF) ANALYSIS** guided approach is required
to determine **meaningful (sustainable!) recycling targets!**

Product Life Cycle Analysis (LCA/PEF) must become an
indispensable tool for all product development and marketing!

KEY MESSAGE 2: WHAT ABOUT THE ENERGY TRANSITION?
Plastics & 'Sustainable' Circular Economy

Any **'SUSTAINABLE' CIRCULAR ECONOMY path**
for **PLASTICS** must account for and reflect the
ongoing **ENERGY TRANSITION** to renewable energies!

The **ENERGY TRANSITION** together with new options for a
Circular Carbon Management (CCM/CCU; chemical/feedstock recycling, CO₂ utilization)
may be a **game changer** for the **CIRCULAR ECONOMY of PLASTICS**.

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[perspectives for Austria & the EU?]

Summary & Outlook (The Policy Dimension)

SUMMARY & OUTLOOK (1/2)

#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

A GREEN DEAL FOR AUSTRIA'S INDUSTRY

GOVERNMENTAL PROGRAM 2020 – 2024 (JANUARY 2020)

Aus Verantwortung
für Österreich.

Regierungsprogramm 2020–2024



Industrie und Gewerbe: ein Green Deal für Österreichs Wirtschaft

- Umfassende, sektorübergreifende Klima- und Kreislaufwirtschaftsstrategie mit prioritärer Ausrichtung auf die besonders energie- und emissionsintensiven Sektoren Stahlherzeugung, Chemie und Zement
- Spezielle Förderungen für industrielle Cluster-Leitprojekte von Branchenführern, bei denen Klimaschutz, F&E und Innovation einen hohen Stellenwert genießen, durch obengenannte Instrumente

[Online-Version:](#)
Page 83, as well as
pages 61/62, 73/74



**CIRCULAR
CARBON MANAGEMENT**
instead of
DECARBONISATION!

GOAL:

Climate neutral
AUSTRIA
BY 2040

KEY ITEMS & FEATURES:

- **INNOVATION to secure AUSTRIA'S industry:** energy efficiency, renewable energy technologies, **circular carbon-management** ([systems integration](#))
- **Cross-industrial SECTOR-COUPLING:** All-sector integrated energy, climate and circular economy strategy ([energy & materials economy](#))
- **Industrial FLAGSHIP-CLUSTER Initiatives** Cross-sectorial Flagship-Cluster Projects for the emission-intensive industry (**[Steel](#), [Chemicals/Plastics](#), [Cement](#), [Waste Management](#)**)
- **FUNDING & INCENTIVE mechanisms** Use of existing and development/implementation of novel national and European funding initiatives (IPCEI, Recovery & Resilience Facility, EU Innovation Fund, etc.)

A GREEN DEAL FOR AUSTRIA'S INDUSTRY

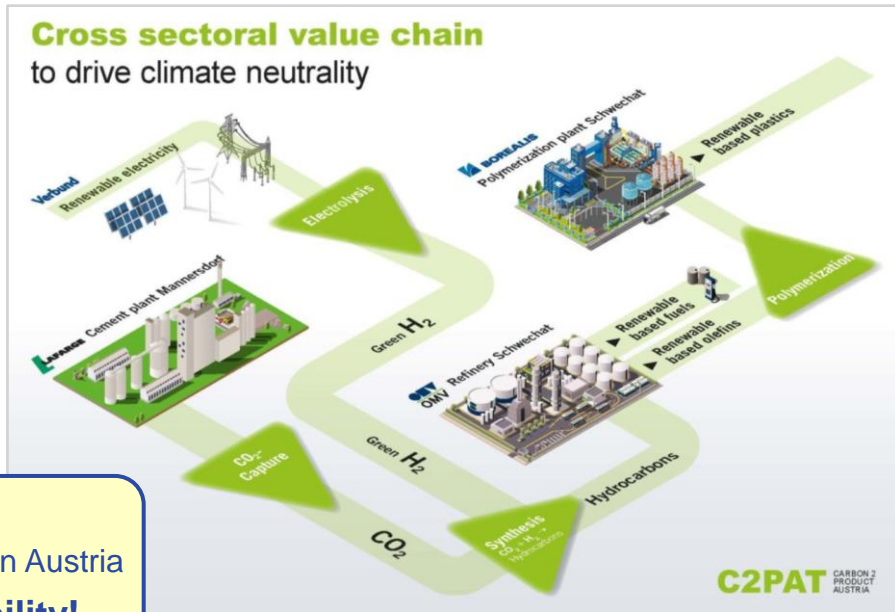
GOVERNMENTAL PROGRAM 2020 – 2024 | Cross-sectoral Flagship Initiatives

Potential cross-sectoral FLAGSHIP-CLUSTER 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, 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



Aim 2030:

- 700.000 t of CO₂ sequestration in Austria
- demonstration of global scalability!

Source: C2PAT consortium

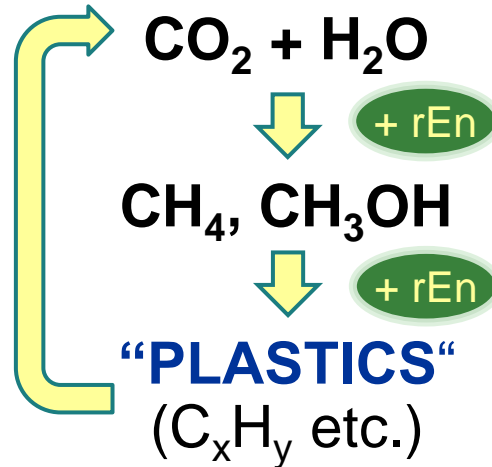
HUGE AMOUNTS OF RENEWABLE ENERGY NEEDED

A 'NEW GREEN DEAL' for Africa & Europe/Austria (1/2)



MOBILIZING "CARBON CIRCULARITY"?!

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



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

HUGE AMOUNTS OF RENEWABLE ENERGY NEEDED

A 'NEW GREEN DEAL' for Africa & Europe/Austria (2/2)



Export: Existing and new Gas Infrastructure *Eventually to be used for hydrogen*



- 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).

Desertec3.0

'Emission Free Energy for MENA and the World'
Club of Rome Austria, 15.9.2021

Paul Van Son, President Dii Desert Energy

NEW
GREEN DEAL
AFRICA-EUROPE
in partnership
at eye-level!

KEY MESSAGE 3: A **CATEGORICAL** STATEMENT
Why an Industrial Carbon Circularity is essential?

Without industrial **CARBON (CO₂) CIRCULARITY,**
No **CIRCULAR ECONOMY** and
No **SUSTAINABLE DEVELOPMENT !!!**

Recommended change in terminology: From **DECARBONIZATION** to **DEFOSSILIZATION**
and **sustainable, circular CARBON MANAGEMENT!**

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!**

SUMMARY & OUTLOOK (2/2)

Where are we coming from? | Where are we headed? | What are we aiming for?



Navigating the **NEXT GREAT (INDUSTRIAL) TRANSFORMATION?**

From a **FOSSIL-FUEL ENERGY** driven, linear & resource depleting prosperity model for a few ...



... to a **RENEWABLE (SOLAR) ENERGY** driven, circular & regenerative resource prosperity model for all!

Leave
no one
behind!

Key question (as to the current State-of-the-World):

ARE WE (HUMANS) LEARNING FAST ENOUGH (individually & collectively)?