International Conference on
Socio-Environmental Footprints

energy materials justice waste

Latest LCA Research on sustainable Energy storage

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Life Cycle Thinking Group

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This activity is part of the grant RYC2022-037773-I, financed by the Spanish Ministry of Science and Innovation (MCIN/AEI/10.13039/501100011033) and by the European Social Fund ESF+

Sustainability

A garden in a bottle that hasn't been watered in over 40 years

Monica Sanchez || Gardening

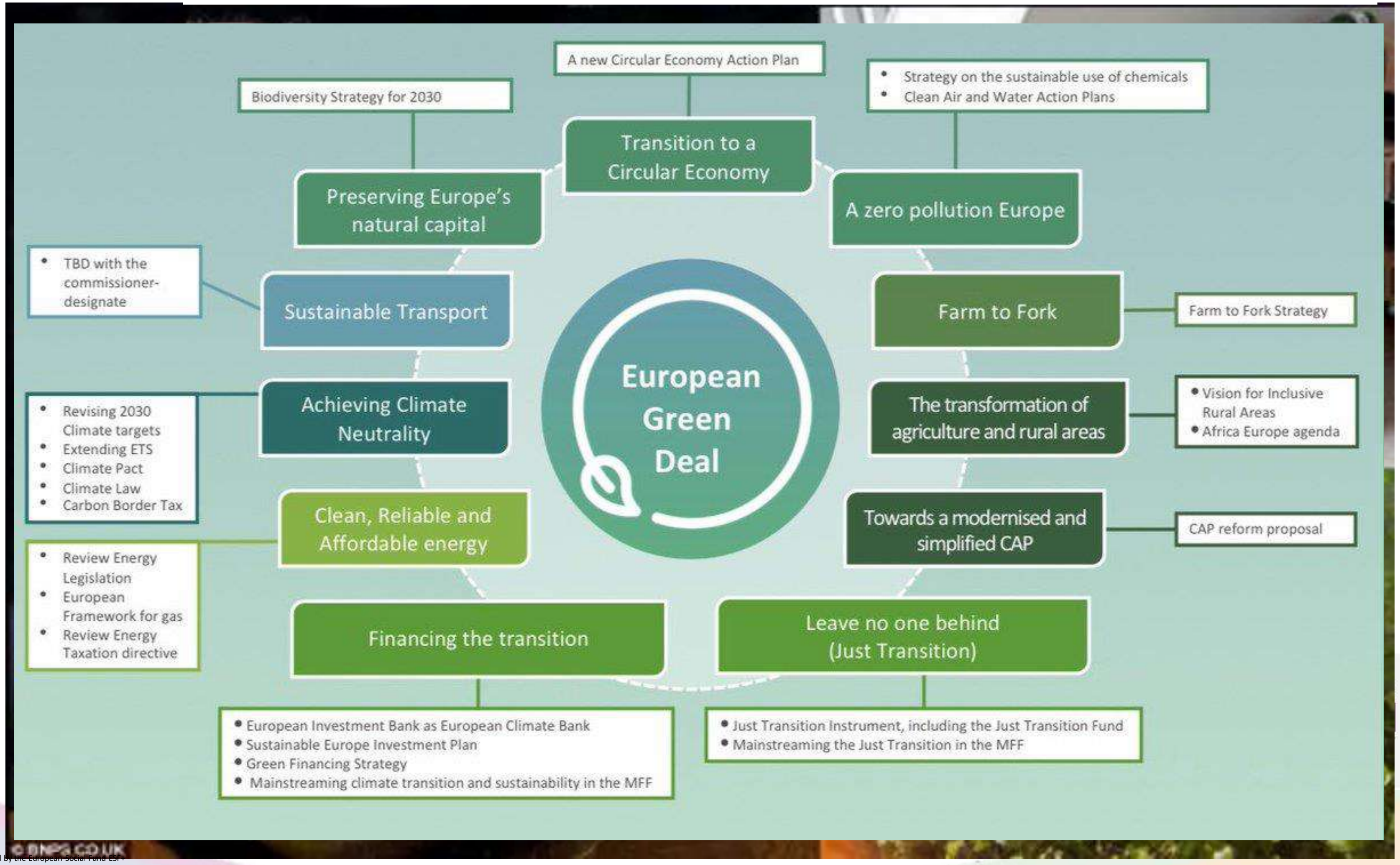
https://www.jardineriaon.com/en/a-garden-in-a-bottle-that-hasn%27t-been-watered-in-over-40-years.html

Some keywords

Planetary boundaries

Circular economy

European Green Deal



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The role of energy storage

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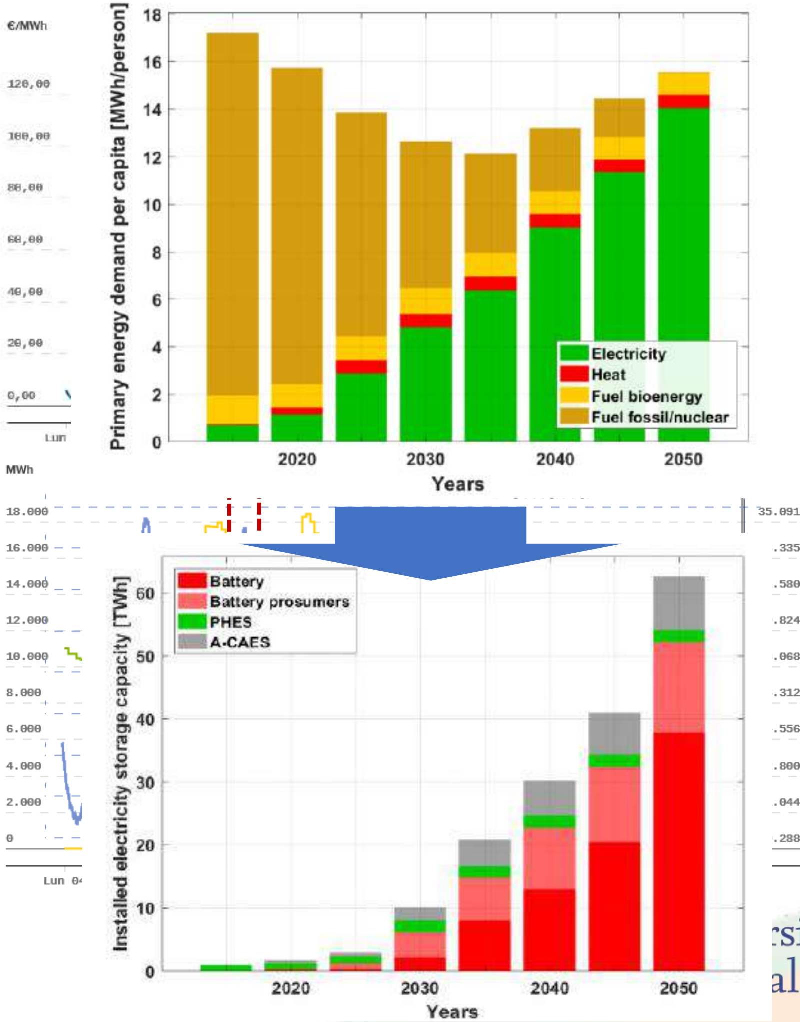
Energy storage/ batteries as key technology for a decarbonized future

- Essential for decarbonising transport and for balancing generation and demand
- Very high growth rates (>20%), energy and material intensive, import dependent
- Batteries one of the key sectors in the focus of the Green Deal
- Substantial effort for increasing sustainability (Batteries Regulation, Raw Materials Act, etc.)



Ram M., Bogdanov D., Aghahosseini A., Gulagi A., Oyewo A.S., Child M., Caldera U., Sadovskaia K., Farfan J., Barbosa LSNS., Fasihi M., Khalili S., Dalheimer B., Gruber G., Traber T., De Caluwe F., Fell H.-J., Breyer C. Global Energy System based on 100% Renewable Energy – Power, Heat, Transport and Desalination Sectors. Study by Lappeenranta University of Technology and Energy Watch Group, Lappeenranta, Berlin, March 2019.

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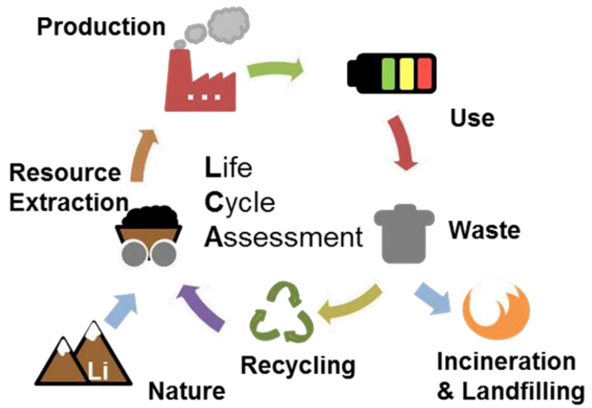
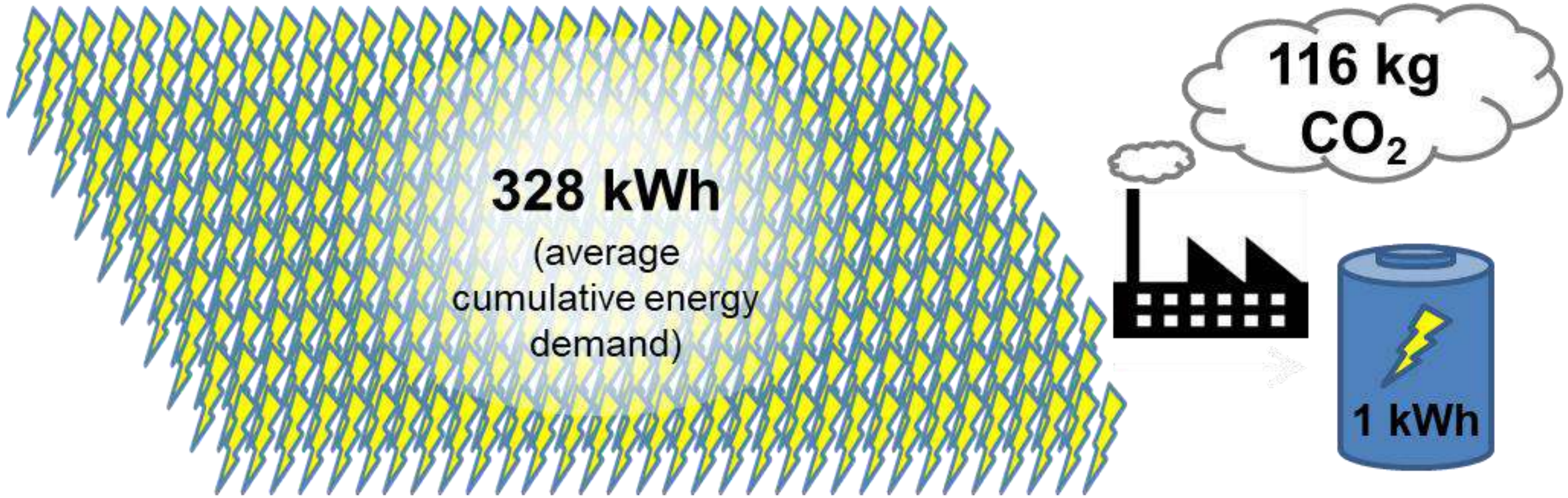
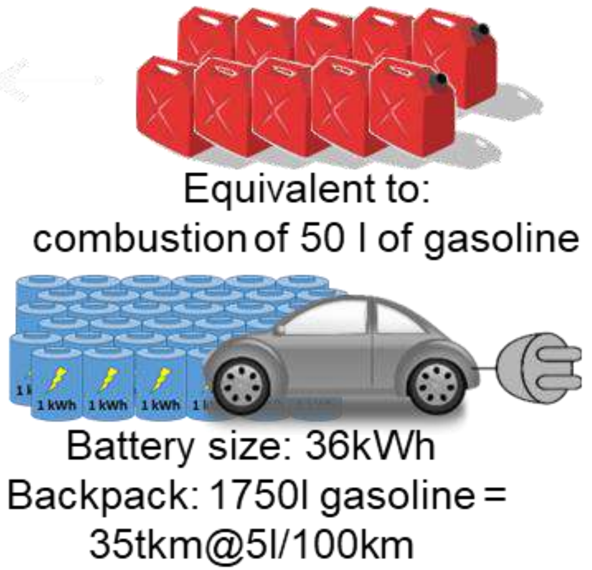
Environmental impacts

Carbon footprint

- Shift of burdens from use-phase (tailpipe emissions) to production (mainly battery)
- Need for a life cycle approach (life cycle assessment)







* Peters JF, Baumann MJ, Braun J, Weil M. The environmental impact of Li-Ion batteries and the role of key parameters – A review. Renew Sustain Energy Rev, 67, 491–506 (2017)

Crenna et al. (2021) Towards more flexibility and transparency in life cycle inventories for Lithium-ion batteries. Resources, Conservation and Recycling 170, 105619. https://doi.org/10.1016/j.resconrec.2021.105619

Recent trends in LCA

energy materials justice waste

Developments in the field of LCA of energy storage

- Strong increase of interest in LCA, also from industry
- Harmonisation of approaches, policy alignment

Policy support

- Prospective assessments, future-oriented
- Combination with integrated assessment models (IAM)
- Integration of real time data and optimization of the use-phase

Anticipative approaches

- Data provision, development of AI-generated databases
- Open source software packages (python, brightway, ..)

Data science

- Broadening the scope: s-LCA, absolute Sust. Assessment

New aspects

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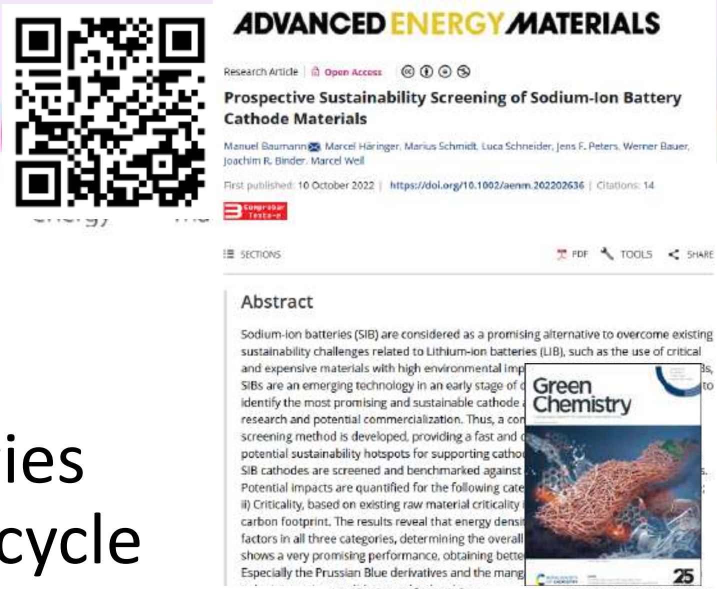
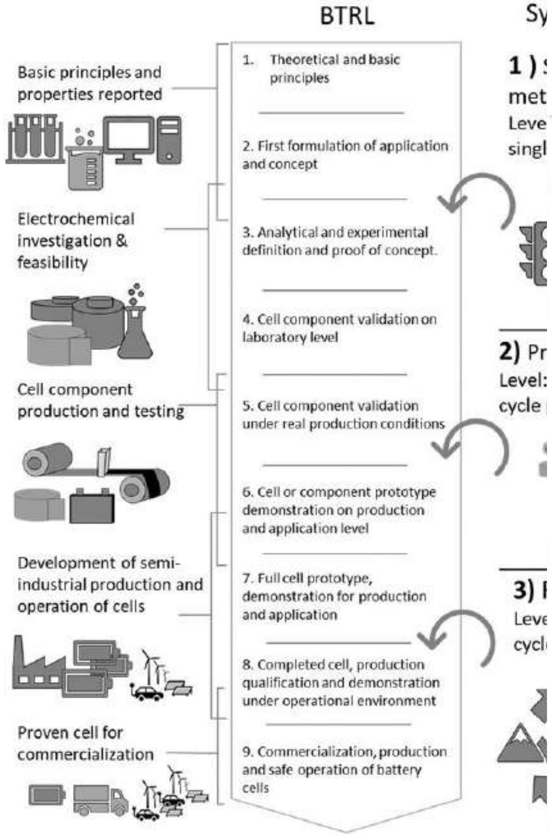
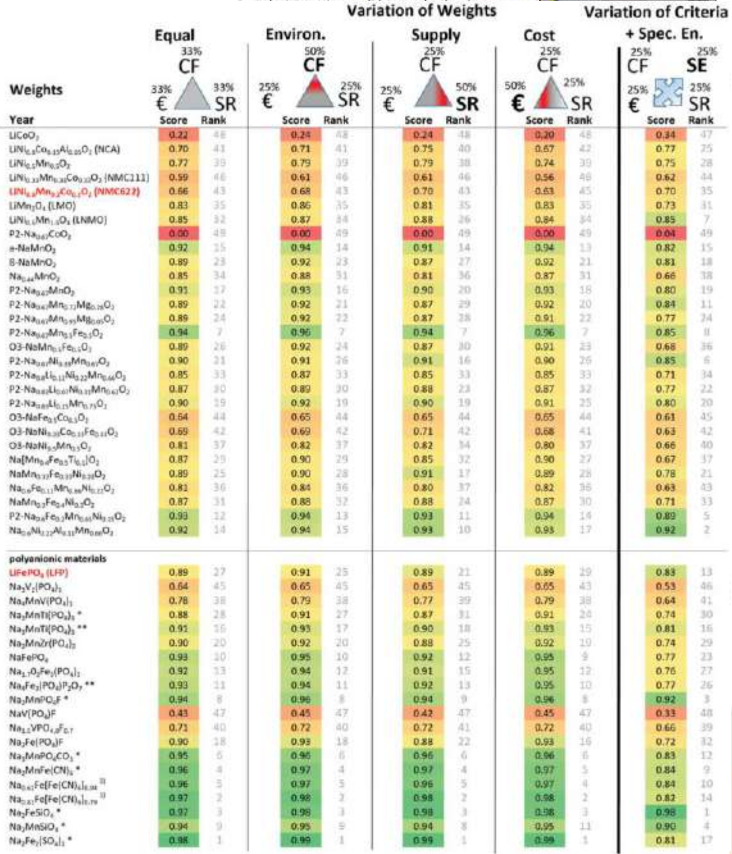
Recent trends in LCA



Prospective LCA

- Aimed at anticipating impacts of emerging technologies and of changing framework conditions along the life cycle
- Challenges for prospective LCA:
  - Rapid technological change
  - Operating in rapidly changing environment
  - Recycling (somewhen in the future)
  - **Use phase** (energy storage devices participate in the energy market) -> how to account for electricity?





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Recent trends in LCA

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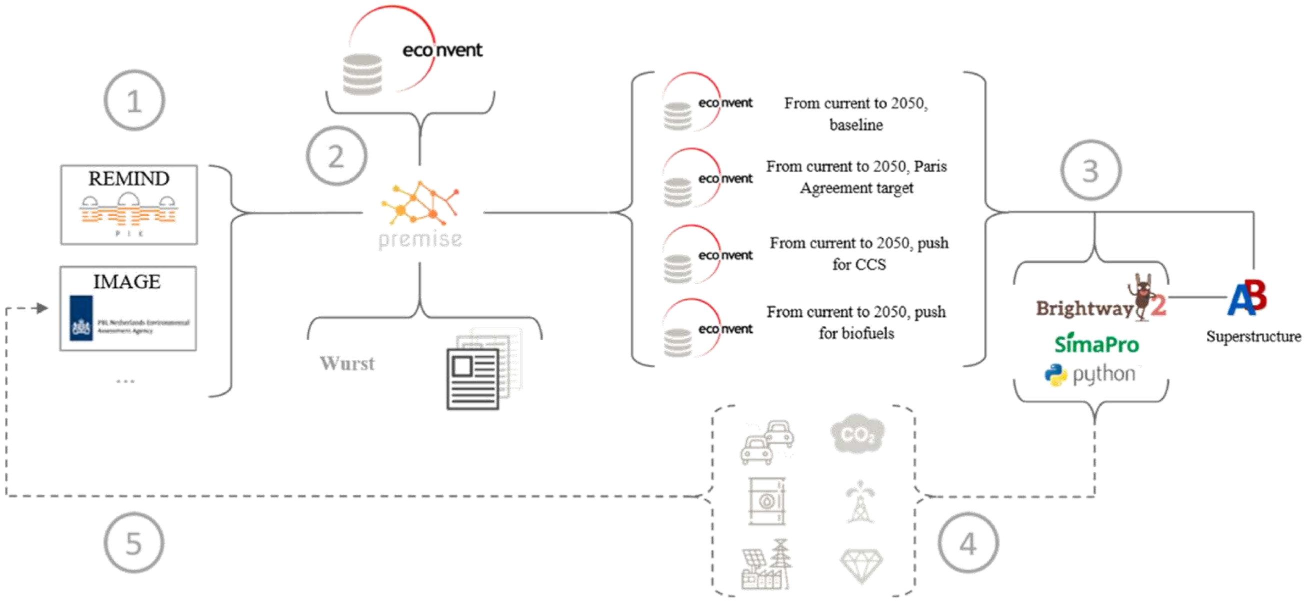
Combination with integrated assessment models (IAM)

- Part of prospective LCA, aiming at incorporating energy system models into LCA



Renewable and Sustainable Energy Reviews
Volume 160, May 2022, 112311

PRospective EnvironMental Impact asSEment (*premise*): A streamlined approac to producing databases for prospective life cycle assessment using integrated assessment models

R. Sacchi, T. Terlouw, K. Siala, A. Dirnaichner, C. Bauer, B. Cox, C. Mutel, V. Daioglou, G. Luderer

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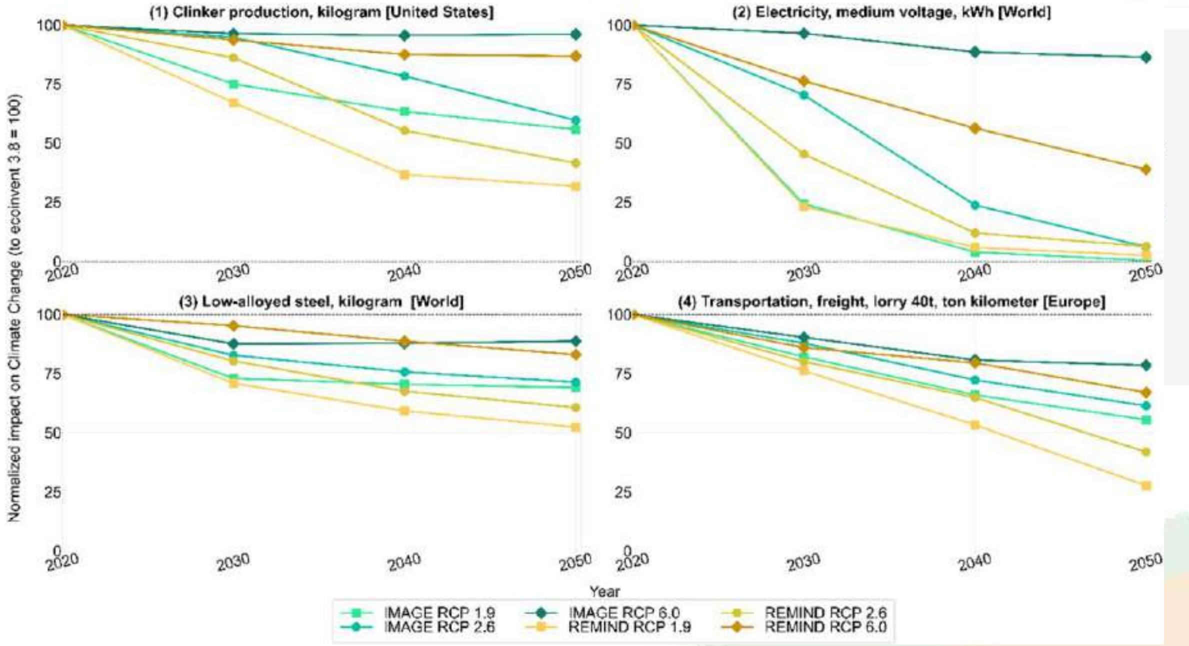
https://doi.org/10.1016/j.rser.2022.112311



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Recent trends in LCA

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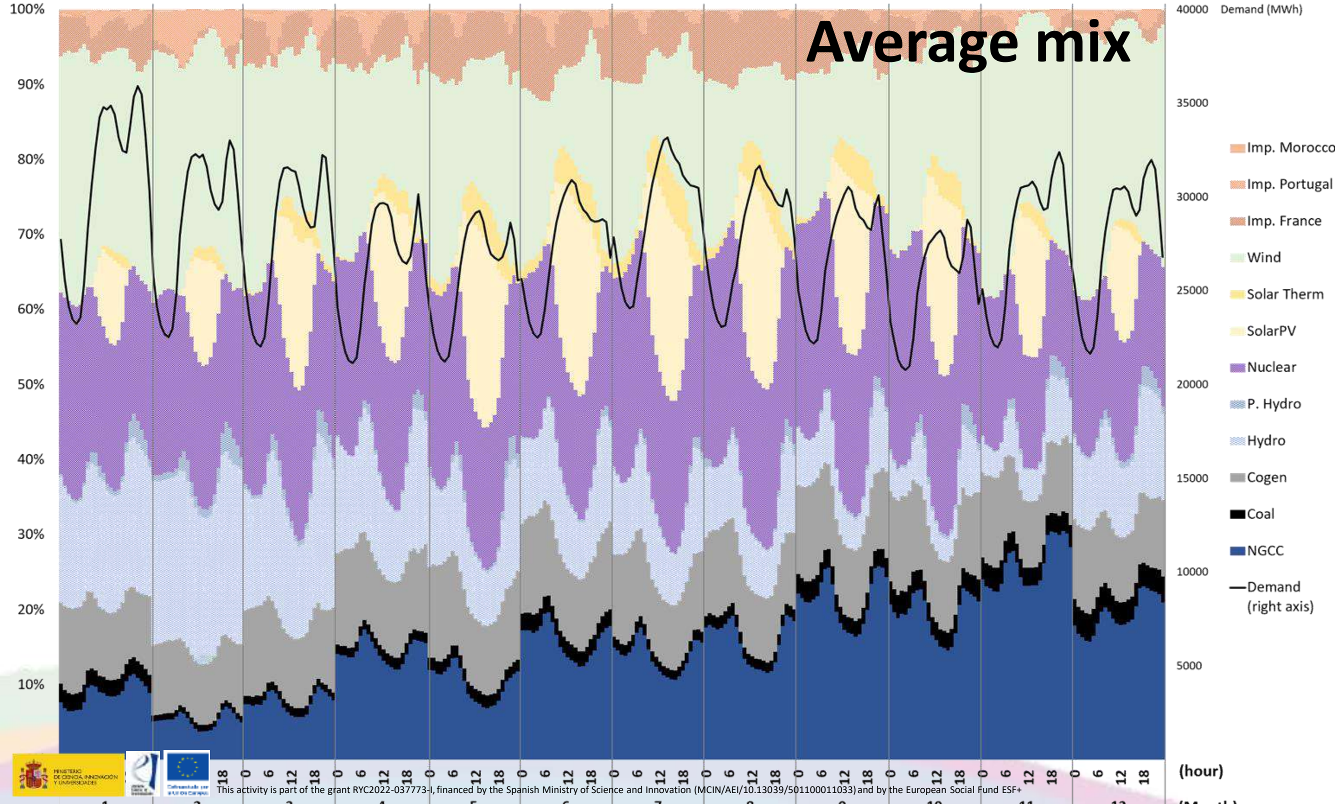
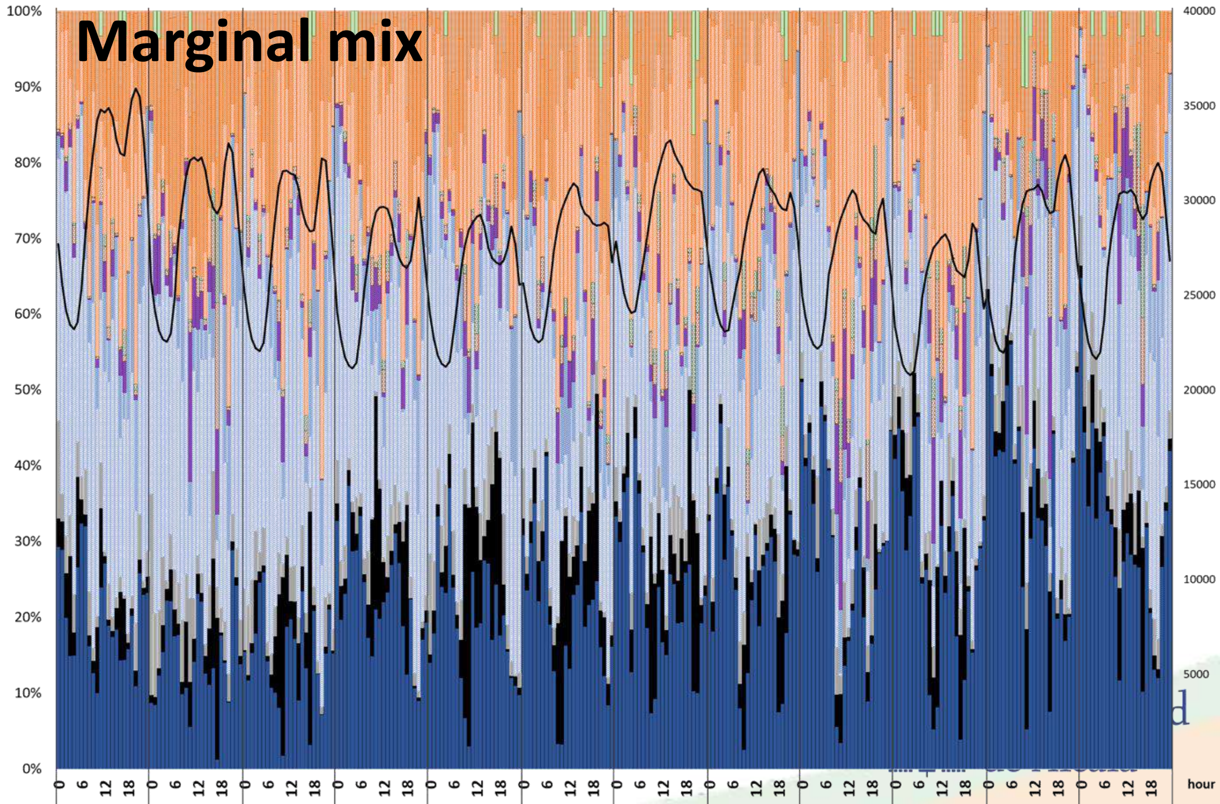
Integration of real time data and optimization of the use-phase

- Energy storage participates actively in the electricity market
- Need to consider marginal electricity mixes and hourly generation





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Recent trends in LCA

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Integration of real time data and optimization of the use-phase

- Varying emission intensity of grid electricity
- Potential to optimize operation (use-phase)

Average mix

TIER 1 — Hourly emissions [gCO_2eq/kWh] - average mix

hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
00:00	134.4	95.7	120.0	152.9	151.4	177.0	154.1	164.6	201.5	202.9	213.8	192.8
01:00	132.9	96.5	123.2	153.2	151.9	179.6	153.8	167.3	200.9	200.9	212.7	191.2
02:00	132.8	97.4	124.5	155.1	151.7	183.6	153.6	167.2	200.7	199.1	213.5	191.3
03:00	132.2	98.8	125.6	155.9	152.0	184.0	154.6	167.3	201.8	202.9	212.0	191.1
04:00	132.9	99.7	126.2	156.8	154.0	186.2	157.9	170.0	204.1	204.2	212.8	191.0
05:00	133.9	99.3	128.7	158.6	156.0	188.2	161.8	172.9	206.9	206.6	217.0	193.0
06:00	136.0	99.4	131.0	167.3	161.6	194.1	169.1	175.0	212.1	211.9	223.1	194.6
07:00	140.2	101.4	129.2	169.7	161.1	193.1	173.3	177.6	215.6	208.1	223.9	194.9
08:00	138.5	101.8	125.6	166.6	154.4	185.6	166.5	171.1	215.8	207.2	222.6	194.6
09:00	135.7	99.9	122.4	161.7	146.9	178.0	158.5	160.8	204.8	199.5	215.4	190.0
10:00	132.9	96.7	117.9	158.4	138.1	170.6	150.7	151.2	188.4	187.1	206.8	185.7
11:00	131.7	93.8	116.0	155.0	134.8	167.2	146.3	146.5	180.3	177.6	201.4	183.0
12:00	130.0	91.8	114.7	152.4	132.1	163.6	142.5	144.3	175.4	173.5	200.9	181.6
13:00	129.6	91.9	112.5	149.7	130.0	161.1	139.0	142.3	172.9	168.4	200.7	181.8
14:00	130.2	92.0	112.4	149.5	127.4	158.5	137.2	141.2	172.5	167.5	201.1	184.1
15:00	132.3	93.9	112.9	149.1	126.4	156.1	135.3	139.9	171.5	167.3	204.8	186.7
16:00	135.6	95.9	115.5	149.5	126.7	156.5	134.4	138.3	173.7	171.3	215.2	195.5
17:00	141.6	101.1	121.3	152.7	126.7	160.1	137.2	139.2	180.1	180.1	232.0	205.9
18:00	143.3	106.1	126.3	158.1	128.9	165.0	141.4	143.6	189.2	198.3	231.8	204.2
19:00	143.2	107.2	127.5	160.0	135.8	166.9	146.0	153.9	203.4	206.1	230.5	202.0
20:00	140.2	105.2	122.9	158.9	142.1	171.5	151.4	163.7	209.1	200.1	228.3	199.7
21:00	138.5	101.6	121.2	156.8	142.9	172.5	156.1	168.5	209.3	199.0	231.3	199.7
22:00	138.1	99.8	121.0	158.7	146.8	175.4	156.6	168.4	211.5	200.5	233.0	201.4
23:00	136.3	97.8	121.4	159.7	149.5	179.1	156.7	167.5	209.4	200.4	229.2	199.2
Avg	*135.6*	*98.4*	*121.3*	*156.8*	*141.6*	*172.6*	*150.3*	*157.1*	*194.9*	*192.1*	*217.0*	*193.0*

Marginal mix

TIER 2 — Hourly marginal emissions [gCO_2eq/kWh]

hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
00:00	291.2	247.3	171.3	259.1	221.3	267.2	238.0	239.3	324.8	326.7	325.1	351.3
01:00	245.2	189.8	195.7	193.5	224.6	240.2	246.5	249.2	294.0	380.6	325.6	341.5
02:00	226.4	237.7	166.1	210.4	230.1	259.2	237.7	262.4	260.4	339.0	295.4	333.0
03:00	297.3	251.7	254.4	250.0	240.6	265.0	324.0	273.5	231.9	364.1	335.0	377.7
04:00	285.8	197.3	265.1	256.9	361.7	282.3	233.7	247.0	249.9	397.4	422.6	422.5
05:00	331.2	248.9	257.9	300.8	324.1	306.6	292.4	270.6	333.8	409.8	384.2	418.3
06:00	247.4	230.1	173.7	308.0	294.3	286.4	277.2	243.8	263.5	310.4	336.0	352.2
07:00	278.3	293.9	212.4	278.9	281.0	264.3	292.1	242.6	297.9	268.9	353.1	297.3
08:00	245.9	259.5	258.9	272.8	258.8	184.5	202.7	215.4	314.3	282.3	300.1	264.0
09:00	181.6	257.6	295.2	319.7	535.3	379.7	493.6	277.1	230.5	347.3	332.3	280.5
10:00	389.3	295.2	409.8	479.7	515.1	464.6	379.4	400.6	286.4	391.7	367.7	397.7
11:00	362.0	318.3	303.6	434.2	425.0	513.5	332.1	308.9	277.8	430.9	375.9	252.0
12:00	234.7	272.5	230.1	321.7	465.6	402.3	356.2	277.4	292.8	386.6	345.8	274.4
13:00	273.8	280.1	215.1	242.9	302.6	311.2	312.7	338.5	273.2	350.0	361.9	323.0
14:00	180.6	199.0	201.3	268.8	254.4	282.4	304.5	242.2	266.2	317.8	249.9	236.7
15:00	213.7	222.9	255.0	233.3	280.5	305.7	249.2	236.4	264.9	299.1	267.0	305.4
16:00	326.1	375.8	263.0	290.7	416.2	263.0	276.8	269.5	240.5	388.1	337.2	485.3
17:00	258.7	389.3	508.6	391.5	400.3	391.7	309.0	220.5	219.2	390.0	288.0	258.6
18:00	221.0	200.8	206.6	487.6	472.6	376.5	271.8	319.7	277.9	405.5	237.1	220.1
19:00	244.4	231.4	185.9	208.2	270.1	467.9	385.0	326.0	289.2	242.2	278.3	206.0
20:00	234.3	208.6	180.0	185.8	199.7	358.1	432.9	558.4	212.0	232.1	270.3	218.5
21:00	263.8	274.5	244.4	249.8	187.6	318.9	448.3	261.0	249.8	242.0	236.8	275.5
22:00	210.8	255.3	193.5	206.3	216.4	244.1	231.0	224.5	225.9	243.4	256.0	247.5
23:00	230.9	210.3	160.7	196.4	162.0	163.3	200.9	208.0	252.1	233.9	298.1	267.0
Avg	*261.4*	*256.2*	*242.0*	*285.3*	*314.2*	*316.6*	*305.3*	*279.7*	*267.9*	*332.5*	*315.8*	*308.6*

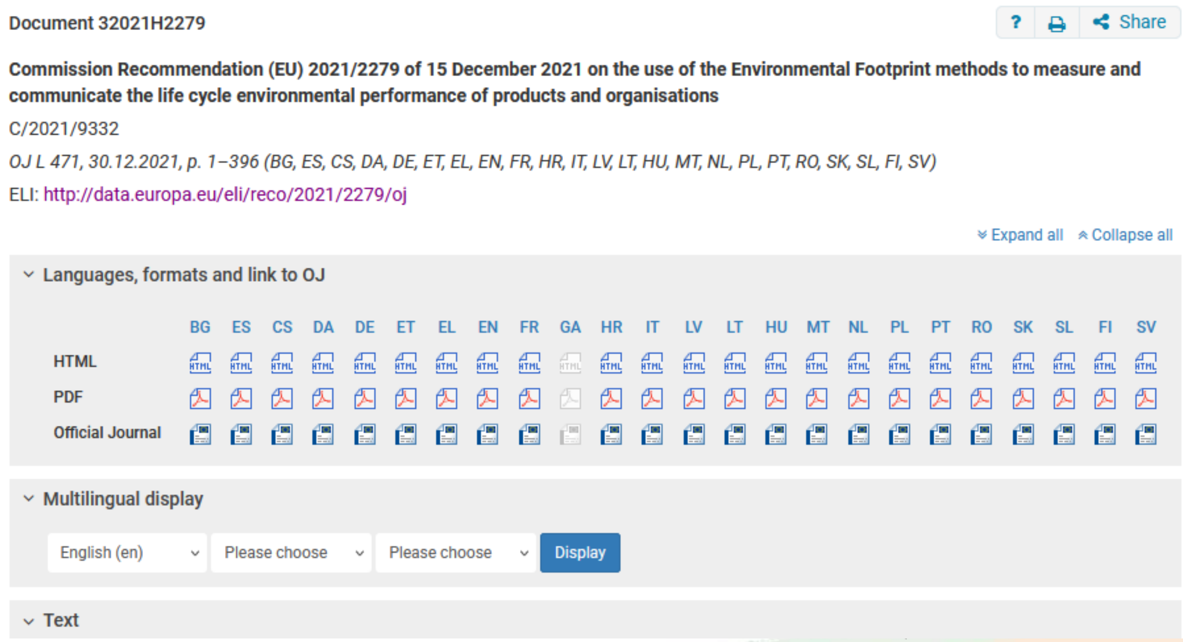
Recent trends in LCA

energy materials justice waste

Harmonisation of approaches, policy alignment

- EF Method for Product Environmental Footprints (PEF)
- Provide detailed guidelines on LCA modelling and data use
- Complex and not always unambiguous
- EF dataset repository for exclusive use in PEF studies (free of charge)
- EoL Modelling via the CFF (circular footprint formula)
- Basis for EU legislation (such as the carbon footprint for batteries)

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H2279



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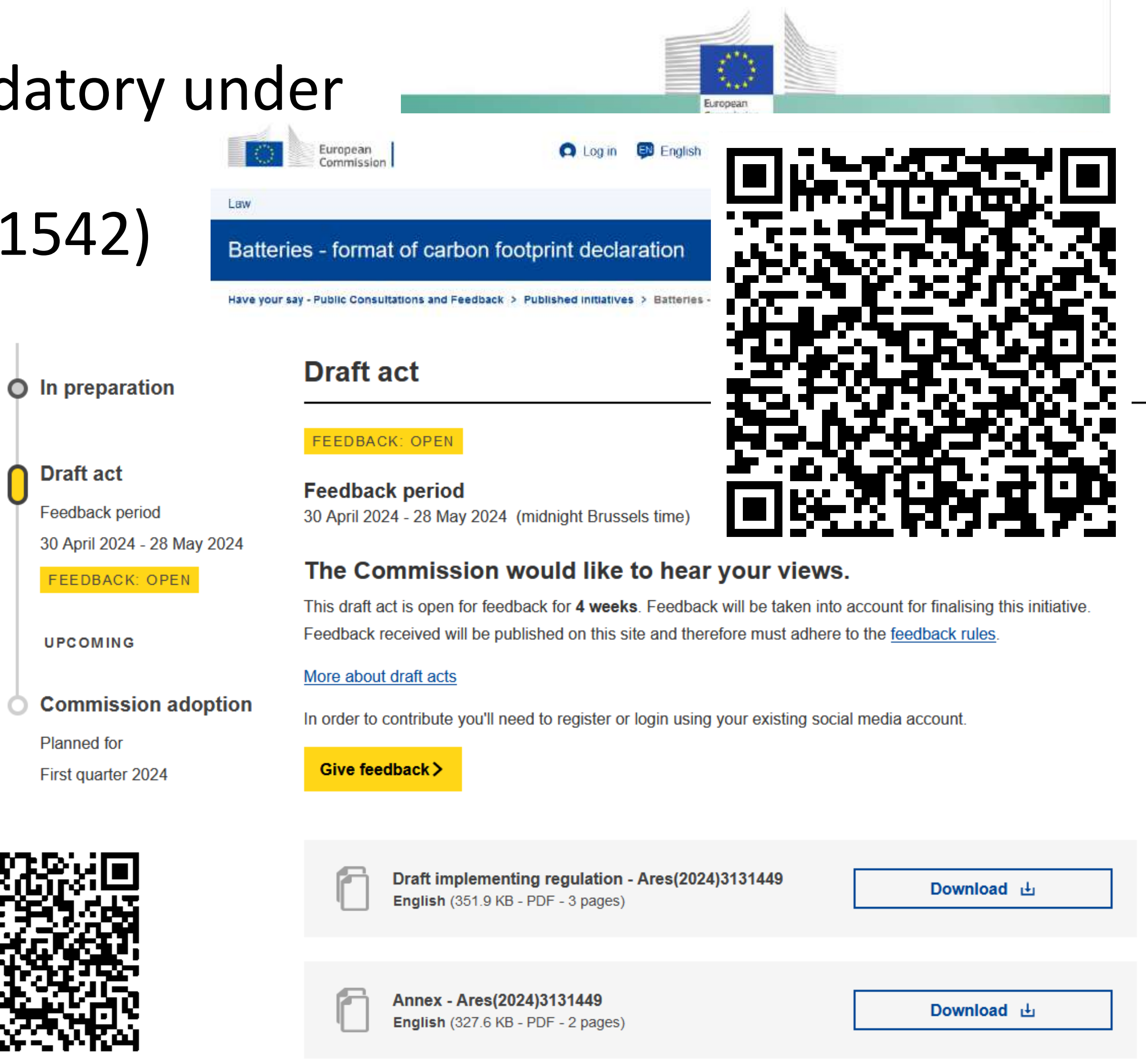
LCA applied in policy

energy materials justice waste

- Carbon Footprint declaration mandatory under new EU Battery Regulation (Article 7 of Regulation (EU) 2023/1542)
  - From 2025 for EV batteries
  - From 2026 for Industrial batteries
  - From 2027 for LMT batteries
  - From 2030 for flow batteries
- Delegated Act with carbon footprint rules published on Have your Say
- Methodology based on EF Recommendations by the EC

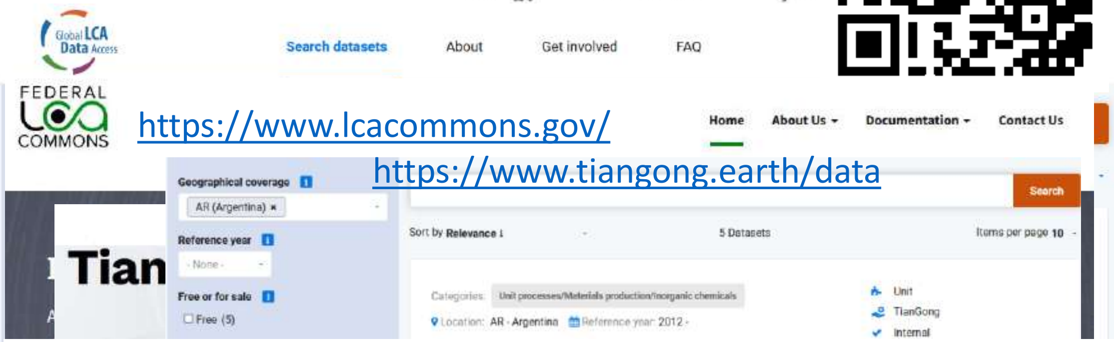
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H2279



Recent trends in LCA

Data provision and databases

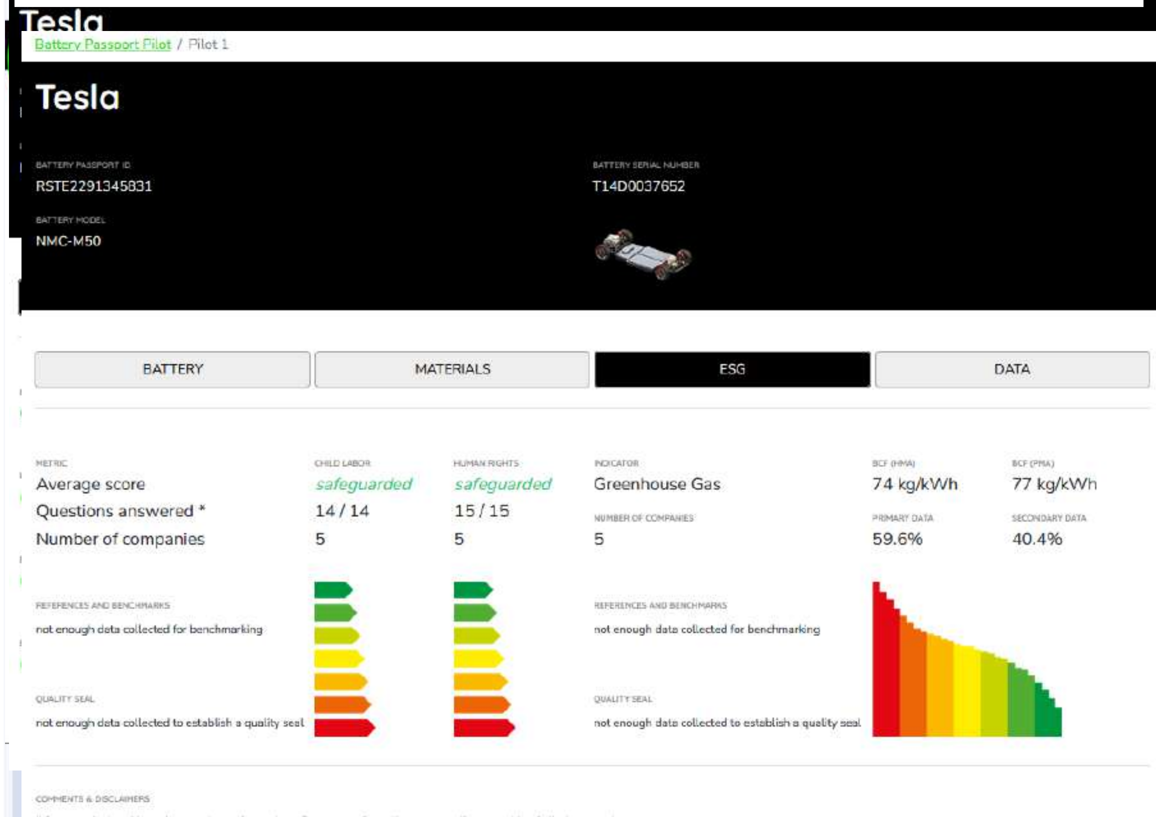
- Quest for data, driven (partially) by regulation
- LCI data often hidden or unaccessible
- Efforts needed (and increasingly being made) to improve data findability and accessibility
- Examples:
  - GLAD (Global LCA Data Access network)
  - US Federal LCA Commons
  - Tiangong LCI Data Working Group
  - LCIA results (carbon footprint studies)



https://www.lcacommons.gov/

https://www.tiangong.earth/data

https://www.globalbattery.org/action-platforms-menu/pilot-test/



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Recent trends in LCA

Widening the scope: Social LCA

- Quantification of social impacts via s-LCA (social Life Cycle Assessment)
- Guidelines and methodology support by UNEP Life Cycle Initiative
- Stakeholder categories and subcategories
UNEP 2020 Guidelines

https://www.lifecycleinitiative.org/library/guidelines-for-social-life-cycle-assessment-of-products-and-organisations-2020/

Stakeholder categories	Worker	Local community	Value chain actors (not including consumers)	Consumer	Society	Children
Subcategories	1. Freedom of association and collective barganing 2. Child labor 3. Fair salary 4. Working hours 5. Forced labor 6. Equal opportu-nities/discri-mination 7. Health and safety 8. Social bene-fits/social security 9. Employment relationship 10. Sexual harassment 11. Smallholders including farmers	1. Access to material resources 2. Access to immaterial resources 3. Delocalization and migration 4. Cultural heri-tage 5. Safe and healthy living conditions 6. Respect of indigenous rights 7. Community engagement 8. Local employ-ment 9. Secure living conditions	1. Fair compe-tition 2. Promoting social res-ponsibility 3. Supplier rela-tionships 4. Respect of intellectual property rights 5. Wealth distri-bution	1. Health and safety 2. Feedback mechanism 3. Consumer privacy 4. Transparency 5. End-of-life responsibility	1. Public com-mitments to sustainability issues 2. Contribution to economic development 3. Prevention and mitigation of armed conflicts 4. Technology development 5. Corruption 6. Ethical treatment of animals 7. Poverty alle-viation	1. Education provided in the local commu-nity 2. Health issues for children as consumers 3. Children concerns regarding marketing practices

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Recent trends in LCA

energy materials justice waste

Social impacts

Material	Country	Materials supply (mining stage): % reserves and resources	% global mining production	% EU sourcing	Governance: Resource Governance Index	Worldwide Governance Indicators	Conflicts: INFORM - HH	Fragile State Index	Global Peace Index	Human and social rights: Child labour*	Fair salary*	Global Slavery Index	Environment: Environmental Performance Index	Water Risk Index
COBALT	Australia	10	4	1	1	1	1	1	1	1	1	1	2	3
	Congo DR	46	57	69	3	4	4	4	4	4	2	4	3	1
	Finland	1	1	14	n.a.	1	1	1	1	1	1	1	1	1
LITHIUM	Argentina	20	12	5	n.a.	2.5	1	2	1	2	1	1	2	2
	Australia	8	36	65	1	1	1	1	1	1	1	1	2	3
	Bolivia	21	0	0	n.a.	3	3	3	2	4	3	2	2	1
	Chile	12	38	0	1	2	2	2	1	2	1	1	2	3
	Portugal	0	0	10	n.a.	2	1	1	1	2	2	2	2	3
	USA	13	3	0	1	1.3	3	2	3	1	1	1	2	2
MANGANESE	Australia	14	17	1	1	1	1	1	1	1	1	1	2	3
	Brazil	1	7	17	n.a.	3	3	3	2	2	1	1	2	1
	China	2	17	0	n.a.	3	3	3	2	3	2	2.5	2	3
	Gabon	10	10	20	n.a.	3	3	3	2	4	1	3.5	3	1
	South Africa	41	28	25	2	2.5	3	3	3	n.a.	1	2	3	3
	USA	10	0	0	1	1.3	3	2	3	1	1	1	2	2
NATURAL GRAPHITE	Brazil	1	7	12	n.a.	3	3	3	2	2	1	1	2	1
	China	0	64	47	n.a.	3	3	3	2	3	2	2.5	2	3
	India	0	11	0	n.a.	2.5	3	3	3	1	2	2.5	3	3
	Mozambique	68	0	0	n.a.	3	2	3	2	4	1	3	3	2
	Tanzania	13	0	0	2	3	2	3	1	4	1	3	3	3
NICKEL	Australia	13	11	0	1	1	1	1	1	1	1	1	2	3
	Canada	7	10	7	n.a.	1	1	1	1	1	1	1	2	1
	China	3	4	47	n.a.	3	3	3	2	3	2	2.5	2	3
	Greece	1	1	10	n.a.	2.5	2	2	1	1	1	3	2	3
	Indonesia	17	18	0	1	3	3	3	1	2	1	2.5	3	3
	Philippines	10	17	0	2	3	4	3	3	2	3	3	2	3
	Russian Federation	11	11	0	n.a.	3	3	3	4	2	1	3.5	2	1
	South Africa	4	2	14	2	2.5	3	3	3	n.a.	1	2	3	3

1, low risk; 2, medium risk; 3, high risk; 4, very high risk. n.a. not available

:tps://publications.jrc.ec.europa.eu/repository/bitstream/JRC120422/surebatt_report_
nal_26_06_2020_%281%29.pdf

This activity is part of the grant RYC2022-037794, funded by the Spanish Ministry of Science and Innovation (MCIN/AEI/10.13039/501100011033) and by the European Social Fund ESF+

Sustainability of batteries

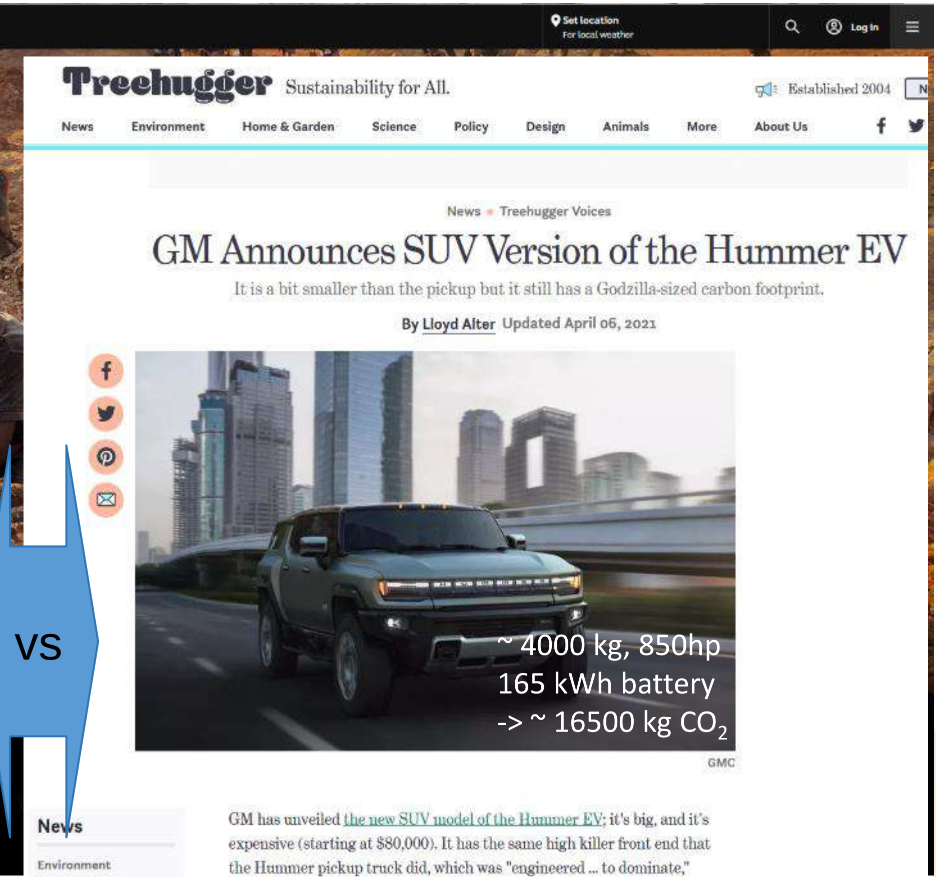
Much more than GHG emissions..

- Chances and risks of EU technology development and deployment
  - Added value vs. impacts (social, env.)
  - Distribution of added value and benefit (or impacts) for local community
  - Social benefits vs. environmental impacts
- Need for efficient use of resources
  - downsizing? Consumption pat
  - Prosumerism?
  - Circular economy levers: collection and recovery

    (~30% of all EoL vehicles with unknown whereabout)
  - Product responsibility

https://www.abc.net.au/news/2022-02-24/cobalt-mining-in-the-congo-green-energy/100802588

VS



~ 4000 kg, 850hp
165 kWh battery
-> ~ 16500 kg CO_2

This activity is part of the grant RYC2022-037773-I, financed by the Spanish Ministry of Science and Innovation (MCIN/AEI/10.13039/501100011033) and by the European Social Fund ESF+

Still a long way..

Environmental Impacts -> Battery Regulation

Greening the battery supply chain

- Carbon footprint declaration: LCA approach
- Carbon footprint classes
- Minimum recycled content
- Recycling rates

Product

Social Impacts -> Due Diligence Act

Social standards along the supply chains

- Identify, prevent and mitigate adverse human rights and environmental impacts
- establish governance systems and measures in place to this end

Company

Much broader perspective required..

- Diversification of SRM countries

nature

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Article | Open Access | Published: 31 May 2023

Safe and just Earth system boundaries

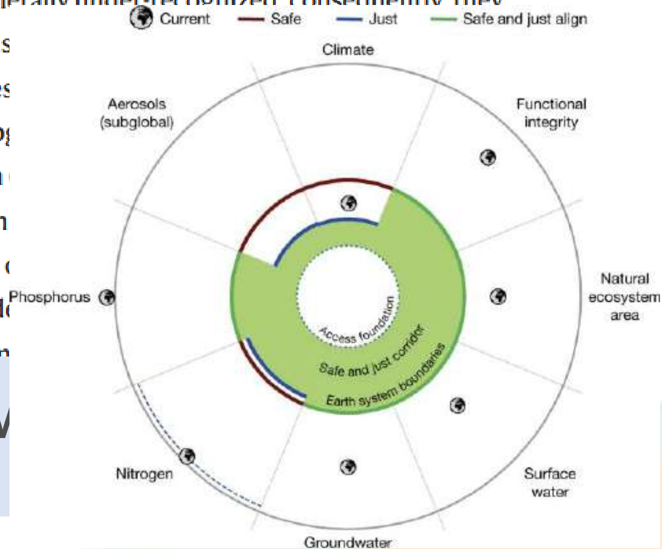
Johan Rockström, Joyeeta Gupta, Dahe Qin, Steven J. Lade, Jesse F. Abrams, Lauren S. Andersen, David I. Armstrong McKay, Xuemei Bai, Govindasamy Bala, Stuart E. Bunn, Daniel Ciobanu, Fabrice DeClerck, Kristie Ebi, Lauren Gifford, Christopher Gordon, Syezlin Hasan, Norichika Kanie, Timothy M. Lenton, Sina Loriani, Diana M. Liverman, Awaz Mohamed, Nebojsa Nakicenovic, David Obura, Daniel Ospina, ... Xin Zhang

+ Show authors

Nature (2023) | Cite this article

Abstract

The stability and resilience of the Earth system and human well-being are inseparably linked[1,2,3], yet their interdependencies are generally under-recognized; consequently they are often treated independently[4,5]. Here, we us quantify safe and just Earth system boundaries nutrient cycles, and aerosols at global and sub the resilience and stability of the Earth system significant harm to humans from Earth system condition for justice)[4]. The stricter of the safe just ESB. Our findings show that justice consid than safety considerations for climate and atm



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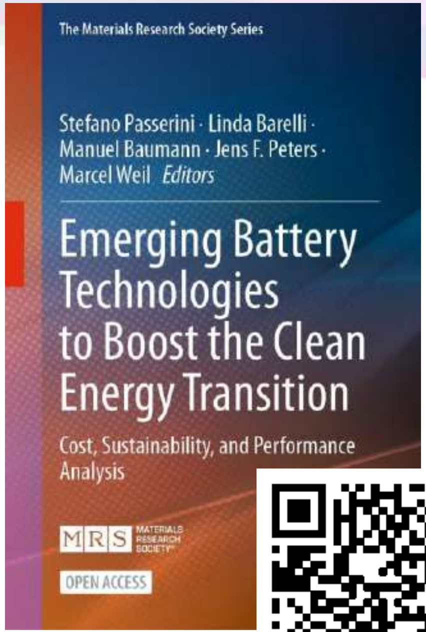

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Underlying data available openly on Zenodo:

https://zenodo.org/badge/DOI/10.5281/zenodo.4742246.svg

DOI: 10.1039/d1se01292d

LinkedIn

https://www.linkedin.com/in/jens-peters-3b153a24/

https://www.nature.com/articles/s41893-023-01067-y

Universidad de Alcalá

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Universidad de Alcalá

Conferencia Internacional de Impactos Socioambientales

International Conference on Socio-Environmental Footprints

Eredu ekonomikoaren gizarte- eta ingurumen-aztarnei buruzko Nazioarteko konferentzia


Yana Curi
El impacto de la actividad petrolera
en la Amazonía ecuatoriana

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Seeking Feminist Justice Against Corporate Power

Ana María Palacios Briceño & Júlia Martí Comas

Amarantas Feminist Collective

Life Cycle Thinking Group medicusmundi Universidad del País Vasco Euskal Herriko Unibertsitatea

Index

1. Research Design

1. Case studies pertaining the right to health, the right to a dignified life and freedom from violence

1. Lessons from resistances

Research design: an overview

Objectives:

1. Expand the understanding of the impacts and violated rights caused by transnational corporations
    a) Conduct a feminist and community-based analysis of corporate activities
    b) Undertake a feminist critique of International Human Rights Law
2. Recognise resistance strategies led by women
3. Facilitate knowledge exchange among women's collectives

What are the impacts of corporate activities in interaction with the current model of patriarchal social reproduction?

What reparations are being implemented with a focus on victims' needs?

Research design: methodology (I)

- Theorical framework:
  - Theories of corporate impunity as defined by Sociology of Law
  - Feminist economics
  - Ecofeminist analysis of land and environmental defense actions
- Interviews and focal groups with 35 activists
- Contrast with the key figures of the women's groups

Research design: methodology (II)

- Study cases:
  - Meatzaldea Bizirik (Muskiz-Abanto, Bizkaia) – Oil refinery
  - Movimento dos Atingidos por Barragens (MAB, Brazil) – Mining tailings dam disaster
  - Un Salto de Vida (Jalisco, México) – Industrial pollution
  - Alianza contra la pobreza energética (Cataluña) – Power cuts and high tariffs
- Criteria: inclusive decision-making, prioritising women's perspectives and acknowledging diverse backgrounds.

The right to health: Un Salto de Vida (A Leap of Life)

Background:

- Since the 1980s, El Salto (Jalisco, Mexico) and the surrounding towns have experienced significant industrial growth
- Two industrial corridors have developed, encompassing 1,700 companies in sectors such as chemicals, pharmaceuticals, automotive and electronics
- Over 50,000 people have been exposed to environmental contamination in the area
- This contamination has primarily been caused by industrial transformation activities (CEDHJ, 2021)

Localización del río Santiago, en el poniente de México.
ALFREDO GARCÍA

Credit: Alfredo García/ElPaís.com

The right to health: Un Salto de Vida (A Leap of Life)

Public health emergency:

- A study on children found that 40 per cent had arsenic and 98 per cent had cadmium in their blood.
- Limited epidemiological studies show higher rates of kidney, liver, and cancer damage.

Impacts on reproductive health:

- Toxins in water and air can disrupt hormones and harm fetal development and reproductive systems.

Credit: https://unsaltodevida.wordpress.com/

The right to health: Brumadinho Dam Disaster

Background:

- A tailings dam collapsed in January 2019
- Mining Vale S.A
- 12 million cubic meters of toxic mud and waste
- 270 people dead and another 11 missing
- More than 100,000 people affected

Brumadinho dam disaster, Minas Gerais

Credit: https://mab.org.br

The right to health: Brumadinho Dam Disaster

Increased exposure to contaminated water:

- Women have more frequently been exposed to contaminated water due to their roles in agriculture, fishing, and domestic work

- **Deterioration of mental health**:
    - Antidepressant use has increased by 56 per cent and anxiolytic use by 79 per cent
    - Women have experienced trauma and concern over potential illnesses caused by toxins
    - Stress and anxiety are worsened by increased care work, income loss, and reduced social interaction

Credit: https://mab.org.br

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Right to health: Petronor Oil Refinary

Credit: Boslan

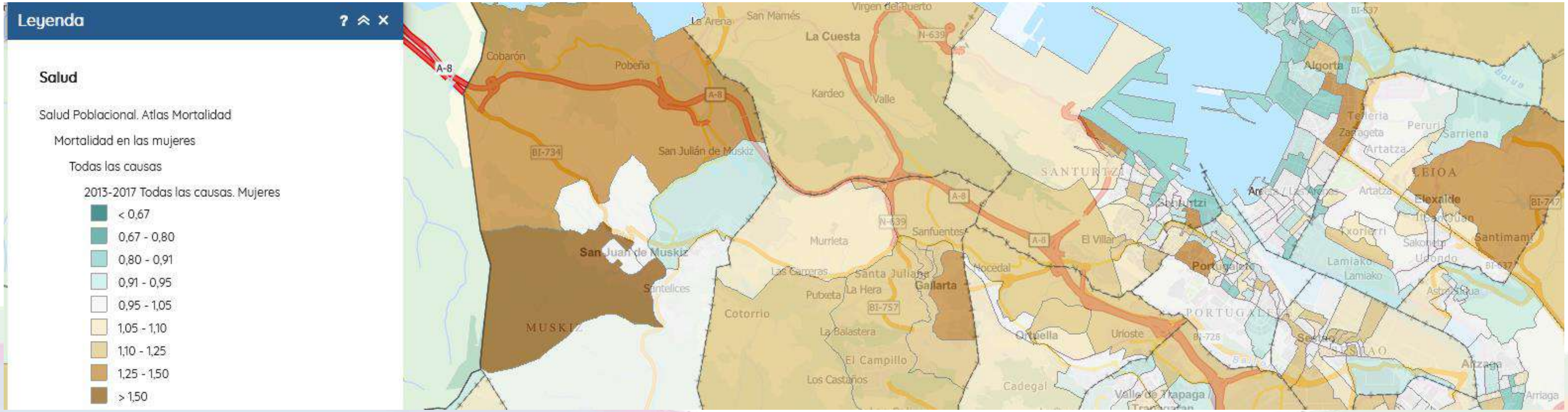
Background:

- Inaugurated in 1972
- Petronor-Repsol Company
- The largest oil refinery in the state and one of the most significant in Europe.
- Situated near the urban centers of Muskiz and Abanto-Zierbena.
- Emissions into the air and water: benzene, toluene, xylene, among others

Barrio San Julián, Muskiz.

Right to health: Petronor Oil Refinery

- **Excess mortality:** Neighborhoods nearby show a 68 per cent higher mortality rate among women (2013-2017) compared to the Basque Country
- **Reproductive health issues:** Activists documented cases of fetal malformations, miscarriages, rare diseases and low birth weights
- **Stress and anxiety**: Heightened by insecurity and incidents causing childhood trauma
- **Fear and misinformation:** Pervasive fear due to lack of comprehensive epidemiological studies



Credit: geoEuskadi

Right to a dignified life: Alliance Against Energy Poverty (APE)

Background:
- In 2014, APE initiated efforts to combat energy poverty
- 15 per cent of Spain's population grapples with energy poverty
- Catalunya faces significant challenges, with 25.7 per cent of men and 49.7 per cent of women at risk of poverty

The right to a dignified life and freedom from violence:
- **Institutional Violence:** 58 per cent of APE members report experiencing poor or offensive treatment in social services
- **Indebtedness**: 26 per cent of APE members have debts exceeding 1,000 euros
- **Insecurity:** Disruptions in supply, harassment by companies, increased vulnerability to other forms of violence, and media-driven criminalisation
- **Poor health**: Both mental and physical linked to factors like inadequate temperatures

Credit: https://pobresaenergetica.es/

The right to health: Un Salto de Vida (A Leap of Life)

The right to a dignified life and freedom from violence:

- **Precarity**: Work overloads and family illnesses fuel economic strain
- **Information blackout:** health risks concealed, breeding insecurity and fear
- **Community disintegration**: Loss of social gathering spaces and community belonging
- **Blame game**: mothers of sick youth scapegoated, adding to their burden
- **Persecution**: harassment, threats and attacks against human rights defenders

Credit: https://unsaltodevida.wordpress.com/

Lessons from resistances

1. **Comprehensive impact analysis**: Understanding the full scope of human rights and environmental impacts and their root causes
2. **Recognizing intersecting forms of violence and mental health consequences:** Acknowledging environmental effects and their impact on mental well-being
3. **Demanding enhanced public control and preventative measures**: Ensuring corporate accountability, both domestically and internationally
4. **Re-imagining justice**: Combining legal avenues and with collective strategies to build transformative and collective reparations
5. **Holistic approach to struggles**: Building strong local alliances and integrating different planes of action without prioritising one over the other
6. **Strategies to protect**: Creating both local and international protection measures for environmental and human rights defenders

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Sustainability and Socioenvironmental Footprints

A Comprehensive Overview

Ethical Considerations in Sustainability

Hannah Arendt (1958)
Arendt posits that every citizen shapes our collective future.

Federico Demaria (2018)
Natural resources and environmental impacts are unequally distributed.

Daniel W. O'Neill (2018)
No country meets basic needs for its citizens at a globally sustainable level of resource use.

Vittorio Hösle (1991)
Hösle critiques the decline in ethical awareness despite technical advances, urging reintegration of ethics into sustainability

Ethical Integration
Develop initiatives and research with quantifiable indicators and real-life scenarios to enhance sustainability.

COP28 UAE

The Limits to Growth (1972)

The Club of Rome warned about the finite limits of Earth's resources and the potential catastrophic consequences of ignoring them.

Global Actions

Global efforts to address climate change remain insufficient, highlighting the need for stronger international commitments and tangible outcomes

Energy Models

Energy Models: Hans Jonas highlighted the long-term, complex, and often invisible consequences of a fossil-fuel-based energy system, complicating the attribution of responsibility and accountability.

Energy Justice and Hidden Energy Flows

Energy Justice

Energy Justice demands equitable distribution of energy benefits and burdens

Outsourcing Issues

Hidden energy flows highlight justice and responsibility issues in outsourcing goods and services.

Global Inequalities

Powerful entities benefit from energy resources while vulnerable populations bear the costs

Moving Forward: Actionable Indicators

Quantifiable Indicators

Develop measurable indicators to ensure sustainability efforts are grounded in empirical reality..

Initiatives

Encourage initiatives addressing sustainability's multifaceted nature, including circular economy, energy efficiency, and social equity.

Call to Action

Addressing these indicators can correct misinterpretations of sustainability and promote a just global response to climate change.

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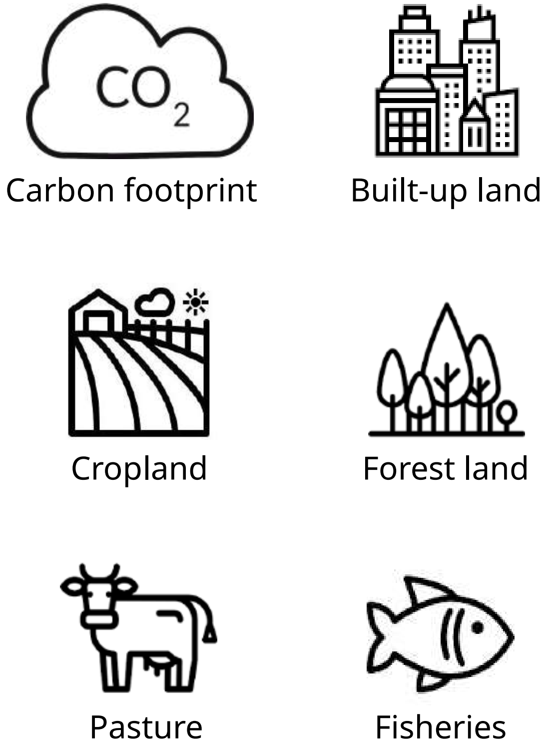
What is a footprint?

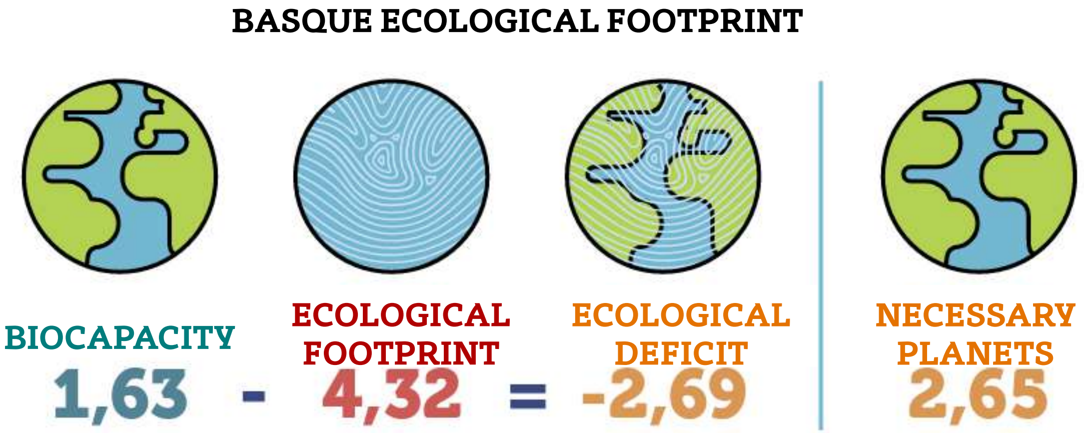
How to generate the knowledge towards a low-impact living

Estitxu Villamor
EKOPOL Research Group
estitxu.villamor@ehu.eus

Ecological footprint

- The total area of land needed to sustain an urban region.
- Very simple and popular.
- Many pressures on environment cannot be measured in area units.

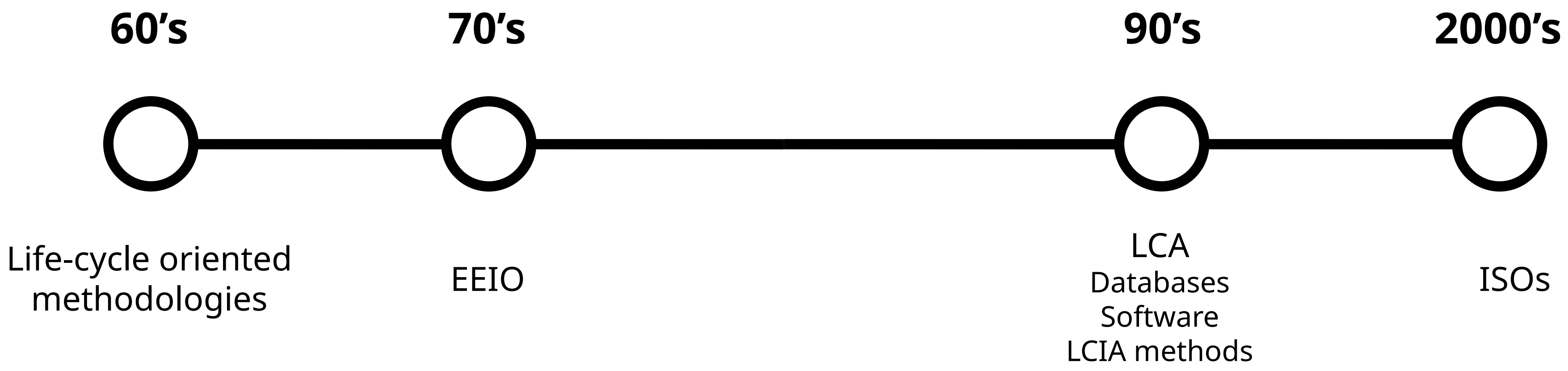




Matustik, J. and Koci, V., 2021. What is a footprint? *J. Clean. Prod.* 285, 124833.
Rees, W.E, 1992. Ecological footprints and appropriated carrying capacity: what urban economics leaves out. *Environ. Urbanization* 4 (2), 121-130.

Life Cycle Assessment and Input-Output

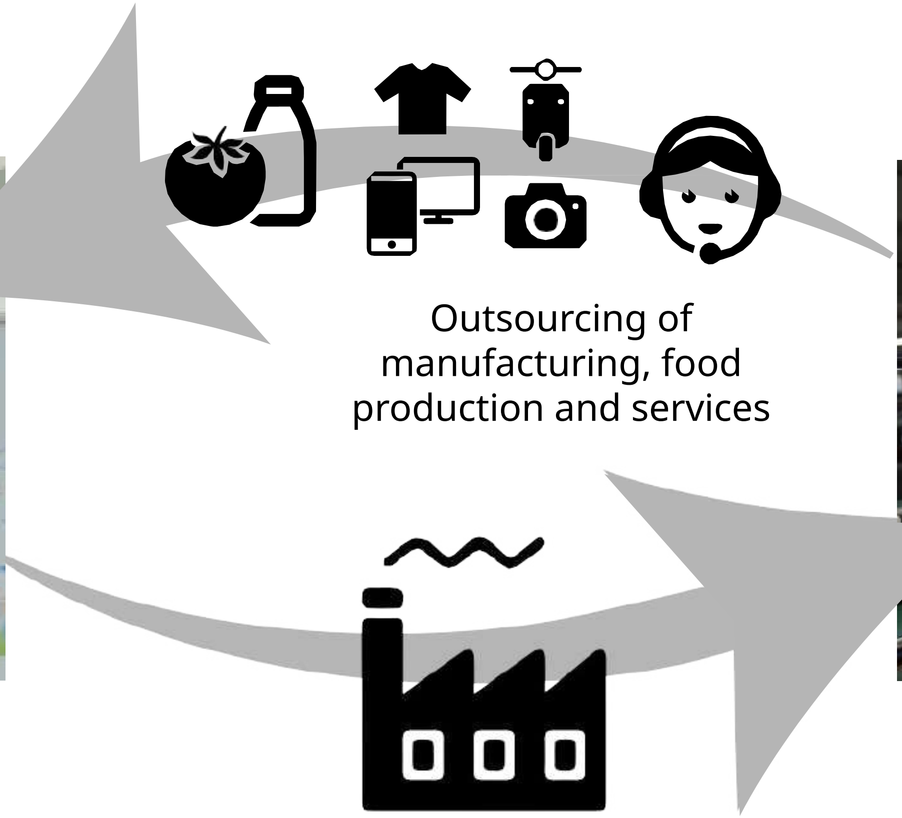
- Bottom-up vs top-down methodologies.
- Footprint family: carbon, energy, water, land, material…



Consumption Based Accounting

Global North

SEEMS TO CONSUME
LESS RESOURCES



CF of a smartphone: ~65 kg CO_2 eq.

Global South

SEEMS TO CONSUME
MORE RESOURCES

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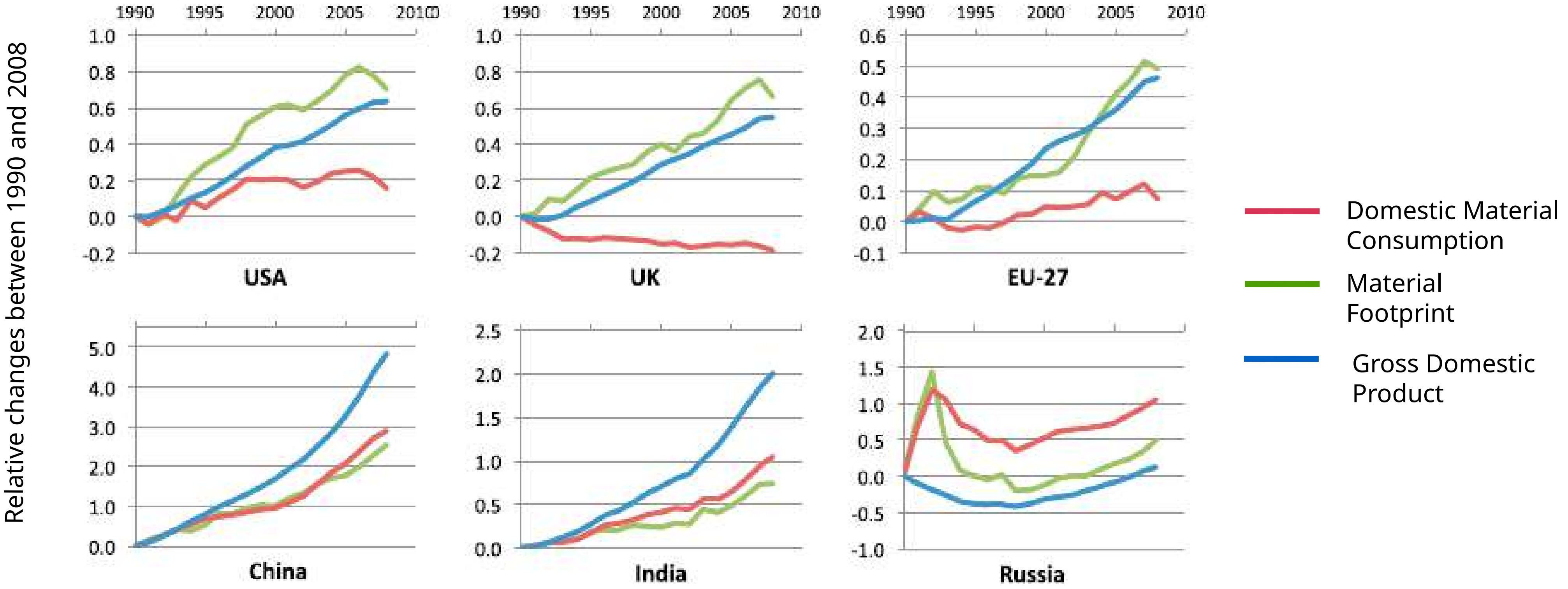
Material footprint

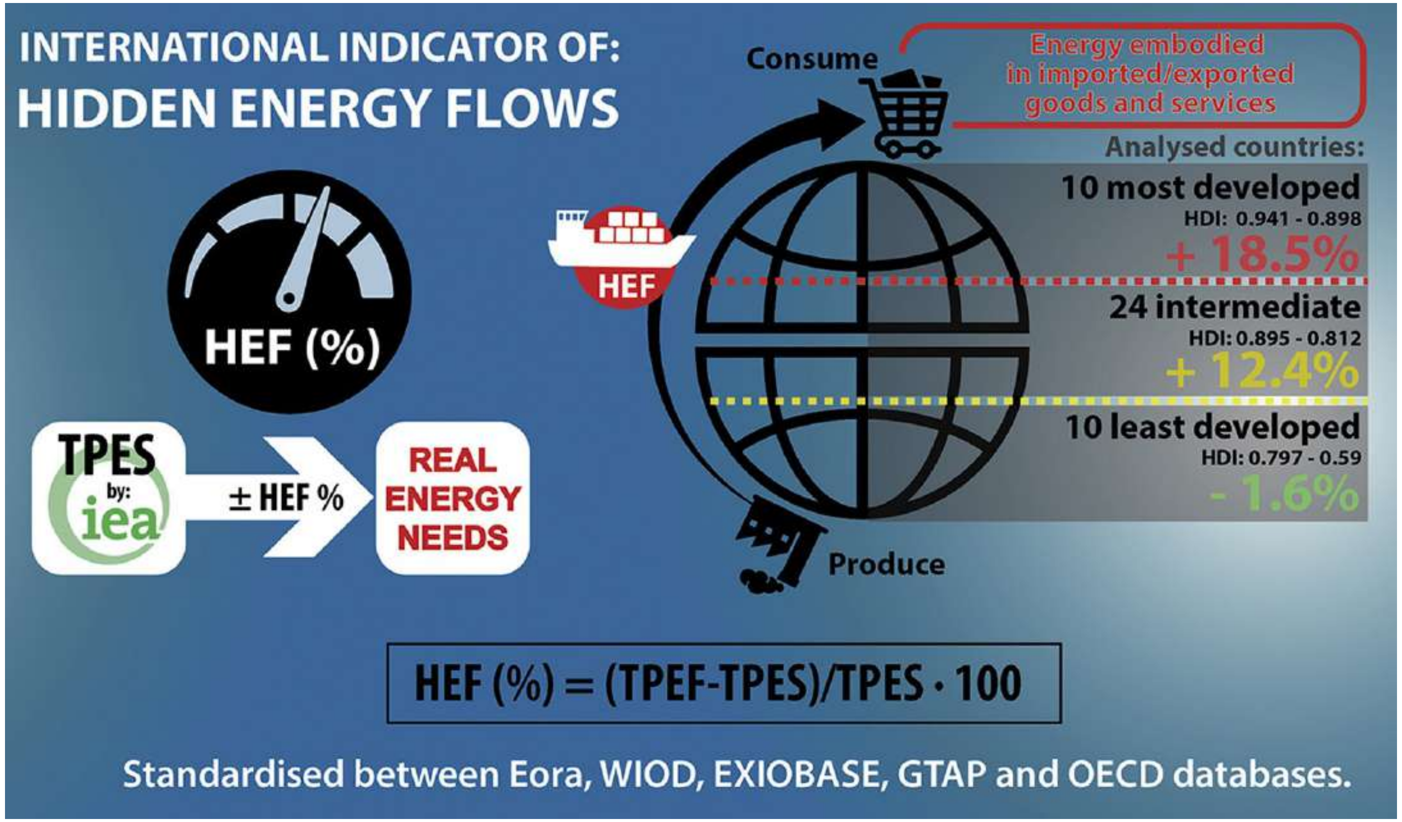
materials



Wiedmann, T.O. et al., 2015. The material footprint of nations. *PNAS* 112 (20), 6271-6276.

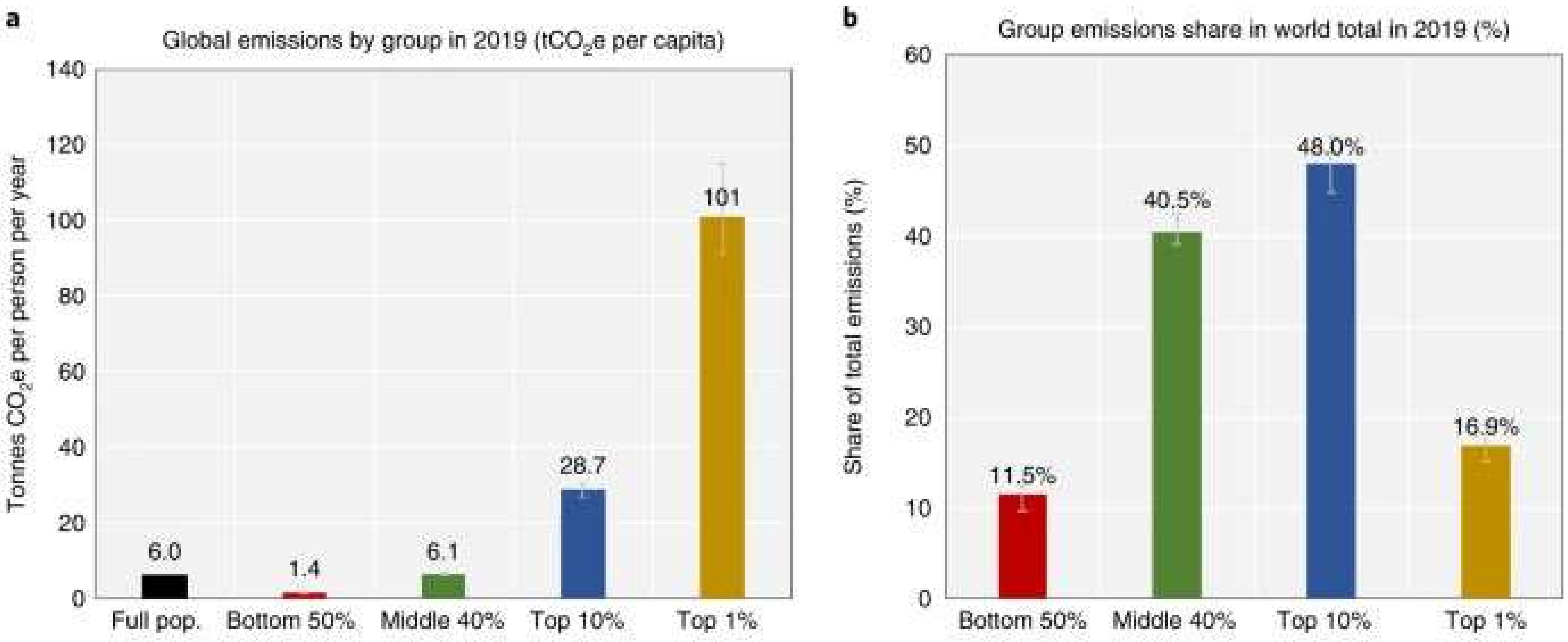
Energy footprint

energy



Akizu-Gardoki, O. et al., 2021. Hidden Energy Flow indicator to reflect the outsourced energy requirements of countries *J. Clean. Prod.* 278, 123827.

Carbon footprint



Chancel, L., 2022. Global carbon inequality over 1990-2019. *Nat. Sustain.* 5, 931-938.

Ecological debt

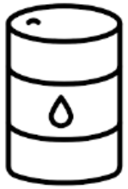
- Disproportionate use that wealthy countries make of the environmental space without paying for it.
- Ecologically unequal exchange.

In 2015 Global North appropriated a total of…

12 Gt of raw material eq.
(43% of total N consumption)

188 M life-yrs eq.
(30% of total N cons.)

822 Mha embedded land.
(21% of total N cons.)



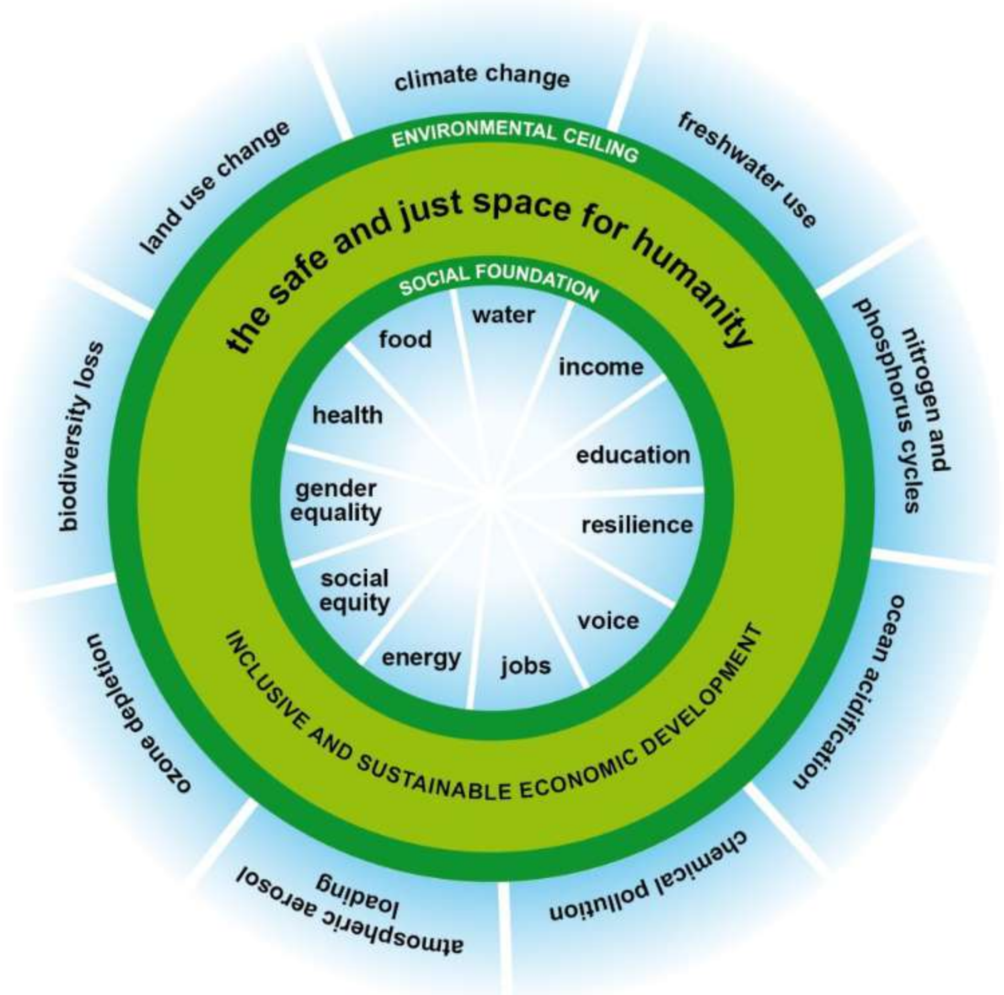
21 EJ of embedded energy
(10% of total N cons.)

Hickel, J. et al., 2022. Imperialist appropriation in the world economy: Drain from the global South through unequal exchange. *Global Environmental Change* 73, 102467

Final remarks

Footprints are consumption based indicators for measuring the position in Raworth's safe and just space for humanity.

Tools for designing sustainable objects, services and countries.



Raworth, K., 2012. *A safe and just space for humanity*. Oxfam Discussion Paper.

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Life Cycle Thinking Group (LCTG) and the Master’s Degree in Circular Economy: Business Application

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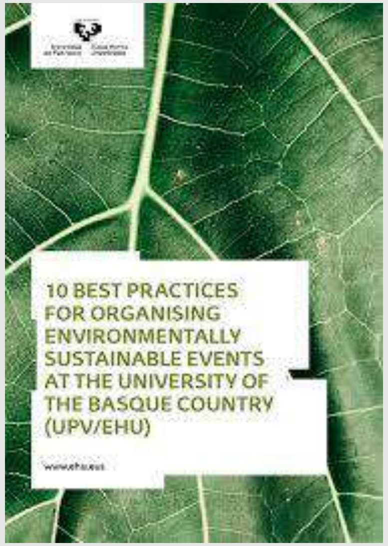
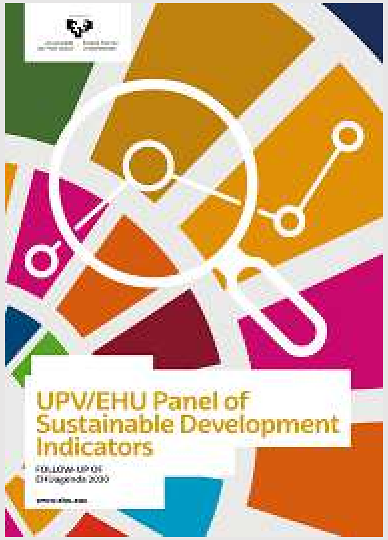
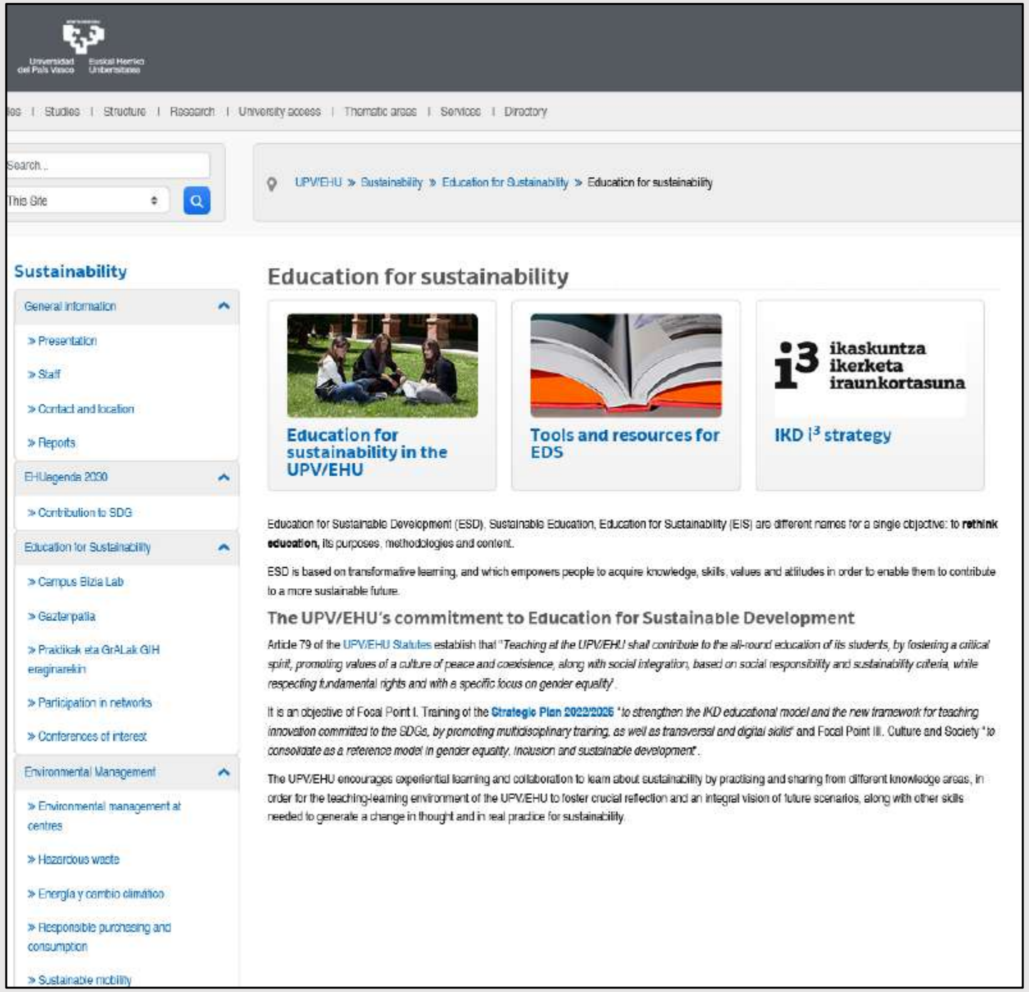
Figure 1. Diagram of coverage in terms of SDGs by EHUagenda 2030 for sustainable development.





https://www.ehu.eus/documents/4736101/11938005/EHUAgenda-2030-ENG.pdf/487b2c83-51e1-d0e2-dcd1-af419b2b5c26



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CBL
CAMPUS BIZIA LAB.

Campus BiziaLab (CBL) es un programa que impulsa el avance en la sostenibilidad en la propia Universidad mediante la colaboración de Personal Docente e Investigador (PDI), Personal de Administración y Servicios (PAS) y alumnado que realiza Trabajos Fin de Grado (TFG) y Trabajos de Master (TFM) de diferentes disciplinas y saberes en proyectos innovadores que utilizan el Campus como laboratorio con objeto de responder a retos de sostenibilidad de la propia universidad.

Gaztenpatia es un proyecto intercultural que promueve la empatía y la solidaridad con sociedades con mayores dificultades. Está dirigido al alumnado universitario interesado en realizar sus Prácticas y Trabajos Fin de Grado (TFG) en colaboración con proyectos de desarrollo ejecutados por las organizaciones socias de Asociación de Entidades Locales Vascas Cooperantes-EuskalFondoa en Centroamérica, Cuba y los Campamentos Saharauis.

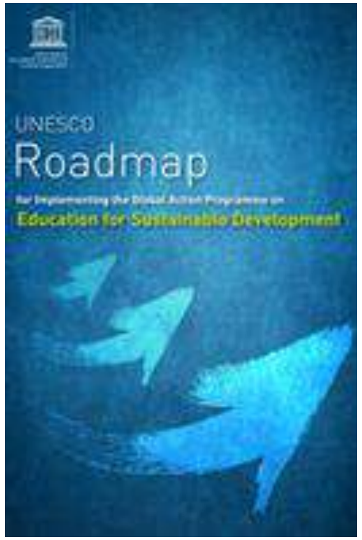
Education for sustainability

Education for sustainability in the UPV/EHU

Tools and resources for EDS

i3 ikaskuntza ikerketa iraunkortasuna

IKD i[3] strategy



IKD i³ strategy

i3 ikaskuntza ikerketa iraunkortasuna

The University of the Basque Country approved its own IKD education model in 2010, just as the community Higher Education policy came into force. Since then it has implemented a number of institutional programmes to foster active, innovative methodologies, assist elementary and advanced educational innovation teams, train and stimulate the educational development of its lecturers, assess teaching activity, and accredit qualifications and centres. Management tools and support and orientation materials have been developed amid a large amount of common construction work.

In addition to mandatory monitoring processes, the results were measured specifically on two occasions. This was done in 2016 by means of the "EHUn bizi" Survey by the Teaching Assessment Service on students finishing the course (3,437 students; 54.82%); and in 2019 through the University of the Basque Country's Transversal Competences Report conducted by the Practicums and Employability Department on teaching and coordination units. The results demonstrate that the work carried out illustrates the gains perceived by the students in terms of relevant transversal competences, but also point out the need to seek new innovative formulas to drive development of advanced and complex transversal competences (critical thought, leadership, creativity, sustainability, multilingualism and multiculturalism).

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Bilbao School of Engineering

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ENERGIAREN EUSKAL ERAKUNDEA
ENTE VASCO DE LA ENERGÍA

VICINAY marine innovación

Competencies

1. **Apply theoretical knowledge in Circular Economy** in basic and advanced aspects of engineering design.
2. Apply product design theories taking into account the **life cycle**.
3. **Transmit,** in written and oral form, to your professional environment and to scientific society in general, **new knowledge** developed in a clear and precise manner.

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ES

Máster de Formación Permanente

Economía Circular: Aplicación a la Empresa

Inicio Programa Profesorado Prácticas Matrícula

UPV/EHU › Estudiar › Másteres y Posgrados › Oferta de títulos propios › Economía Circular: Aplicación a la Empresa

CLAVES DEL TÍTULO

En los últimos dos siglos hemos sobreexplotado nuestros recursos naturales haciéndolos cada vez más escasos y difíciles de obtener. Por ello, la cuarta revolución industrial está representando un cambio disruptivo en el desarrollo tecnológico; desarrollo que deberá ir de la mano de un desacoplamiento entre el crecimiento económico y el consumo de recursos naturales. Este último aspecto está proporcionando oportunidades para crear nuevos modelos de negocio, irrumpir en nuevos mercados y generar empleos de calidad en el ámbito de la Economía Circular.

En el modelo circular, el valor de los productos y materiales se mantiene durante el mayor tiempo posible en la cadena de valor, la extracción de materias primas se reduce al mínimo y los recursos se reintroducen repetidamente en el ciclo productivo con el objetivo "*Zero Waste*". En definitiva, supone un cambio del "extraer, producir, usar y tirar" al "repensar, rediseñar, reducir, reutilizar, reparar, remanufacturar, reciclar y recuperar" y, en definitiva, "hacer más con menos".

El máster se alinea con las políticas europeas derivadas del Pacto Verde Europeo (*Green Deal*), y con la Estrategia de Economía Circular de Euskadi 2030 y el Basque Green Deal, que cobran cada vez más fuerza en este momento de emergencia climática y superación de los límites del planeta.

El máster cuenta con convenios de colaboración con la Sociedad Pública de Gestión Ambiental del Gobierno Vasco IHOBE y con el BASQUE ECODESIGN CENTER.

En la docencia también participan instituciones como ACLIMA, AZTI, EVE, SIDEREX, ELIKA y NEIKER, entre otros.

PLAZAS OFERTADAS
25

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Semipresencial

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Castellano

CALENDARIO
Octubre 2024
Diciembre 2025

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60 Créditos ECTS

PRECIO ORIENTATIV
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LUGAR DE IMPARTICIÓN
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CONTACTO
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946017325-8212-2039

UPV/EHU » Research » Life Cycle Thinking Research Group » Education » Master`s Degrees

Master`s Degrees

The Group mainly collaborates with three master's degrees:

- **Master's degree in Circular Economy: Business Application**
- **Master's degree in European Project Management**
- **Master's degree in Industrial Engineering**

Life Cycle Thinking Group

Programa

Curso académico 2024/25

Materia	Idiomas	Créditos ECTS	Tipo	Modalidad
Ecodiseño y Economía Circular	Castellano	3	Obligatorio	Mixta
Economía Circular en la Empresa: Del Ecodiseño a la Comercialización y Adopción del Producto por el Mercado	Castellano	6	Obligatorio	Mixta
Economía Circular en la Empresa: Emprendimiento Sostenible, Modelos de Negocio de Economía Circular	Castellano	3	Obligatorio	Mixta
Economía Circular: Contexto y Aspectos Generales. Ecoinnovación	Castellano	6	Obligatorio	Mixta
Herramientas de Gestión Ambiental en la Empresa	Castellano	3	Obligatorio	Mixta
Impactos Ambientales Derivados de la Producción-consumo de Productos y Servicios	Castellano	3	Obligatorio	Mixta
Iniciativas de Economía Circular. Descripción de Casos	Castellano	9	Obligatorio	Mixta
Life Cycle Thinking 1: Herramientas para el Cálculo y la Comunicación	Castellano	3	Obligatorio	Mixta
Life Cycle Thinking 2: Cuantificación de la Huella Ambiental de Producto	Castellano	3	Obligatorio	Mixta
Sectores estratégicos de la Economía Circular	Castellano	9	Obligatorio	Mixta

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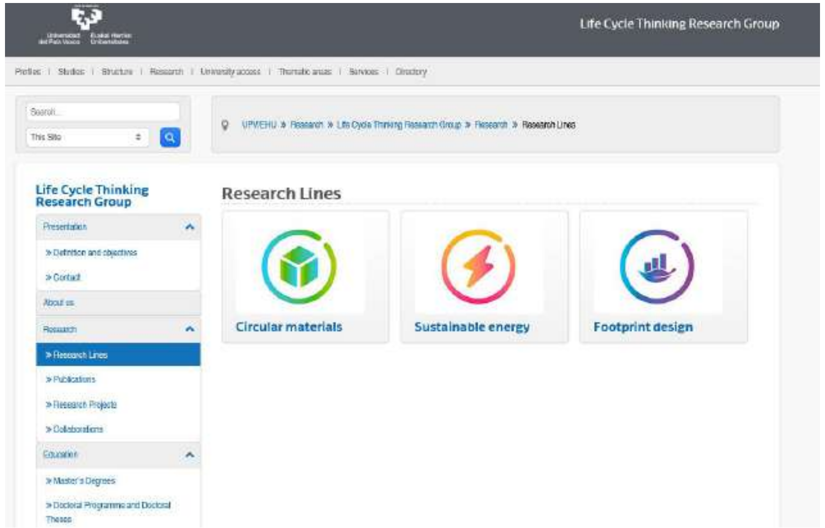
Life Cycle Thinking Group

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- Hugo Afonso González

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Circular materials

Resources, Conservation and Recycling
Volume 198, November 2023, 107182

Full length article

Prospective life cycle assessment of poly (ethylene terephthalate) upcycling via chemoselective depolymerization

Maider Iturrondobeitia [a, b], Laura Alonso [a], Erlantz Lizundia [a, c]

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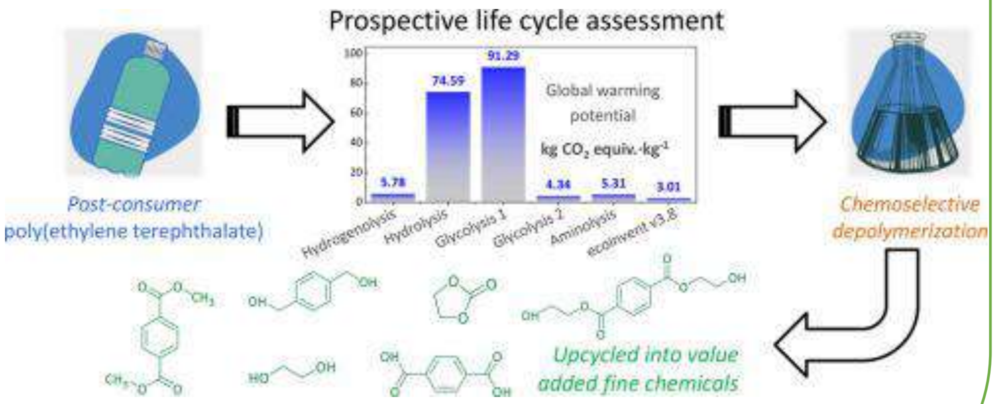


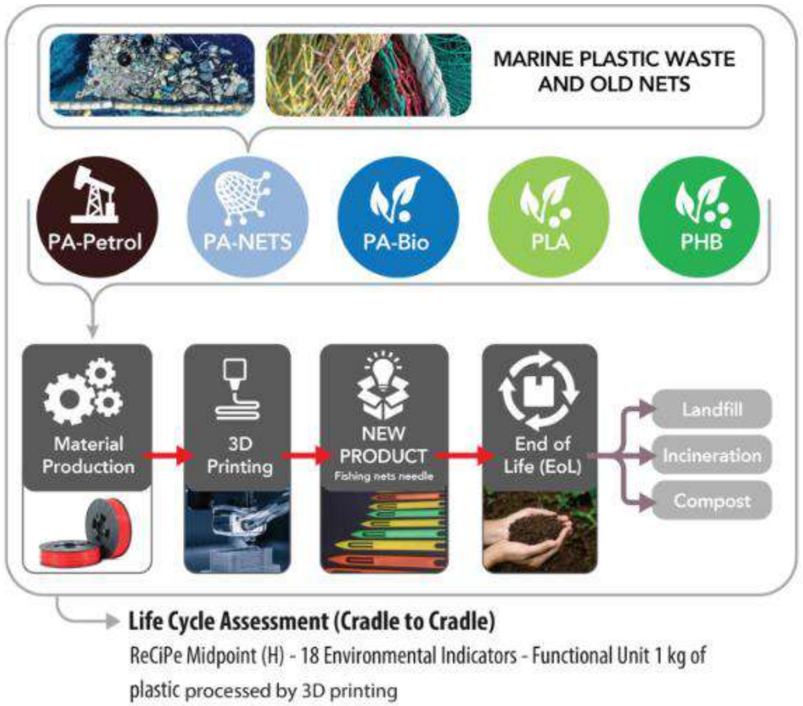
DOI: 10.1111/jiec.13302

JOURNAL OF INDUSTRIAL ECOLOGY   WILEY

RESEARCH ARTICLE

3D printing to enable the reuse of marine plastic waste with reduced environmental impacts

Naiara Cañado[1] | Erlantz Lizundia[1,2] | Ortzi Akizu-Gardoki[1,3] | Rikardo Minguez[1] | Blanca Lekube[4] | Alex Arrillaga[4] | Maider Iturrondobeitia[1,5]



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Sustainable energy

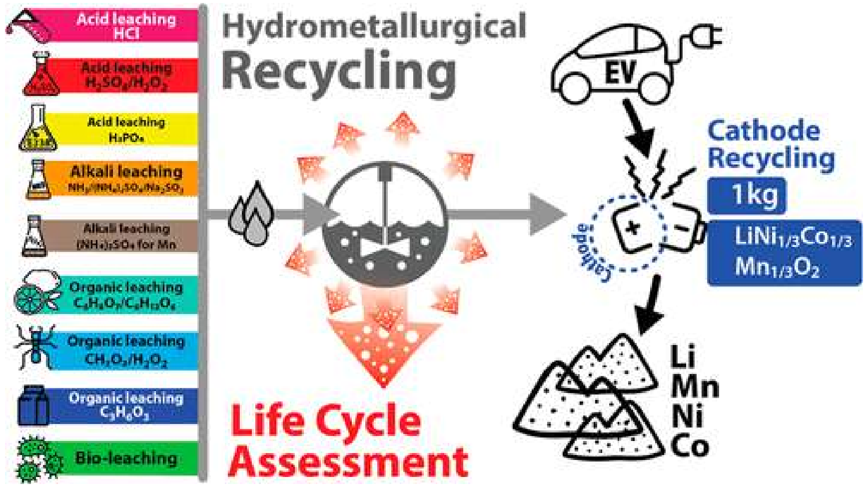
ACS Sustainable Chemistry & Engineering

pubs.acs.org/journal/ascecg Research Article

Environmental Impact Assessment of $LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$ Hydrometallurgical Cathode Recycling from Spent Lithium-Ion Batteries

Maider Iturrondobeitia, Claudia Vallejo, Maria Berroci, Ortzi Akizu-Gardoki, Rikardo Minguez, and Erlantz Lizundia*

Cite This: ACS Sustainable Chem. Eng. 2022, 10, 9798−9810 Read Online



ADVANCED SUSTAINABLE SYSTEMS

Research Article | Open Access

Environmental Impacts of Aqueous Zinc Ion Batteries Based on Life Cycle Assessment

Maider Iturrondobeitia, Ortzi Akizu-Gardoki, Oier Amondarain, Rikardo Minguez, Erlantz Lizundia

First published: 17 October 2021 | https://doi-org.ehu.idm.oclc.org/10.1002/adsu.202100308 |
Citations: 18

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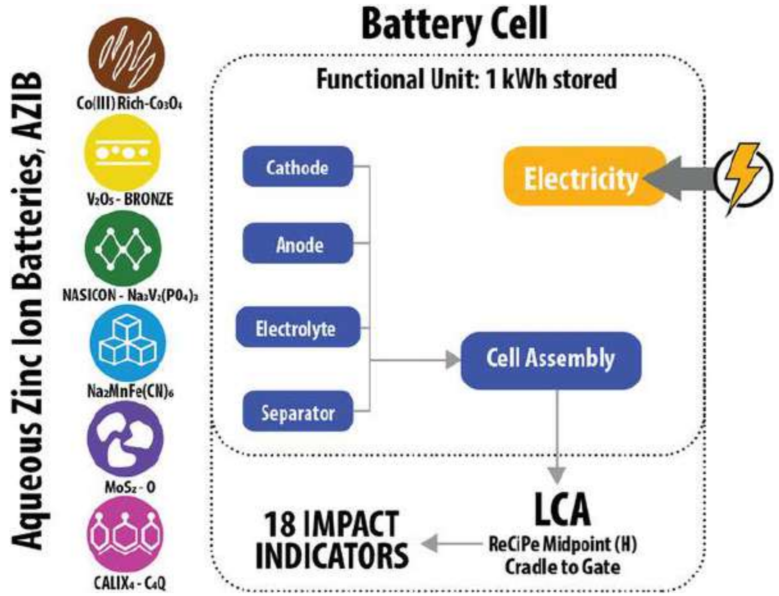

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Footprint design

ELSEVIER
Journal of Cleaner Production
Volume 418, 15 September 2023, 138149

Towards sustainable passenger transport: Carbon emission reduction scenarios for a medium-sized city

Jacid Montoya-Torres [a b], Ortzi Akizu-Gardoki [a c], Carlos Alejandre [a], Maider Iturrondobeitia [a d]

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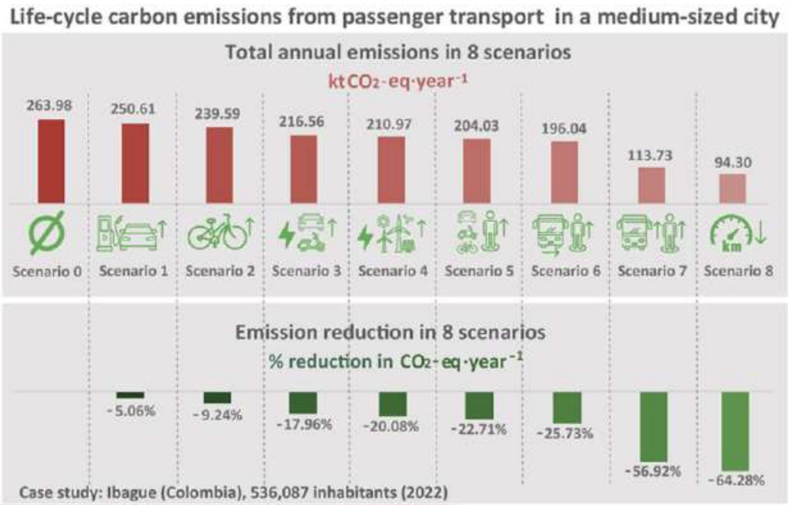
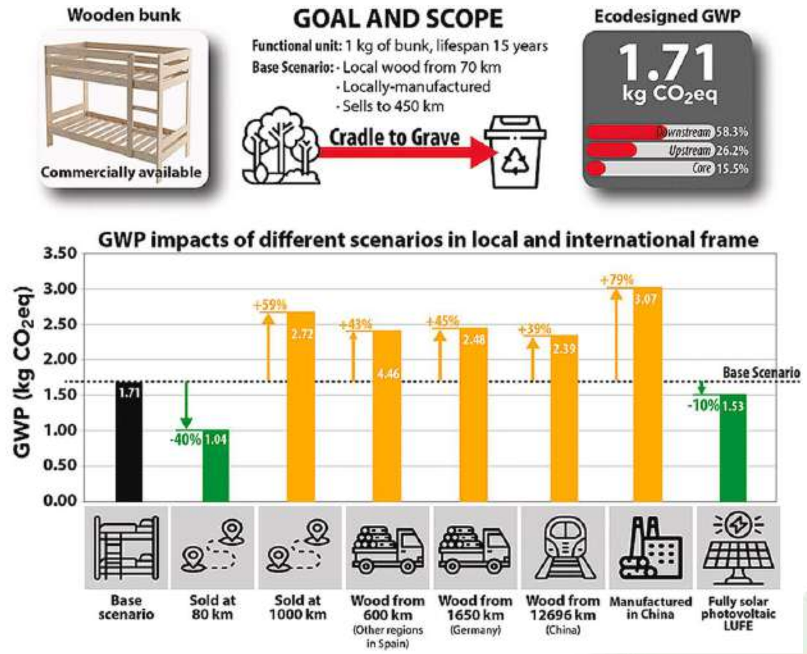


Contents lists available at ScienceDirect
ELSEVIER
Journal of Cleaner Production
journal homepage: www.elsevier.com/locate/jclepro

Beyond ecodesign, internationalized markets enhance the global warming potential in the wood furniture sector

Maider Coloma-Jiménez [a], Ortzi Akizu-Gardoki [a,b], Erlantz Lizundia [a,c,*]



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Lifestages, ages and generational Carbon Footprints

Dr Anne Owen
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Life Cycle Thinking Group medicusmundi Universidad del País Vasco Euskal Herriko Unibertsitatea

- Rationale – why consider lifestages, ages and generations?
- Data and methods
- How has the UK’s carbon footprint changed over time?
- What are the drivers of change/difference?
- Age period & cohort effects – definitions, findings and policy implications
- Limitations and future work

Rationale: why consider lifestages, ages and generations

- UK Sixth Carbon Budget requires 78% reduction in territorial emissions 1990-2035 (CCC, 2020) - role for demand reductions
- Previous research focusses on role of age, income, education, employment status, urban/rural location – role of changing generations remains poorly understood

Known age effects	Role of generation
• Emissions increase with age but fall again with old age (Büchs and Schnepf, 2013; Christis et al., 2019; Haq et al., 2007; Liu, J. et al., 2022; Lévay et al., 2021). • Older people higher home energy emissions (Büchs et al., 2018; Büchs and Schnepf, 2013; Christis et al., 2019; Lévay et al., 2021) • Emissions from car travel tend to be higher for middle aged and older people compared to those of younger people (Büchs et al., 2018; Mattioli et al., 2023) • Younger people are more likely to have high carbon emissions from air travel (Büchs and Mattioli, 2021; Mattioli et al., 2023)	• Younger generations more concerned about climate change, but opposing discourses exist portraying younger generations as more aligned with throwaway, consumerist culture (Diprose et al., 2019; Twenge et al., 2012). • Longitudinal study - car ownership Germany declining. Millennials least likely to use car. Bike use increased more among Babyboomer and Gen X members than among millennials over time (Konietzka and Neugebauer, 2023). • Studies focussing on environmental behaviours through a generational lens remain inconclusive

Data and methods

MRIO database	**Overview**	UKMRIO database (constructed by UoL) calculates UK's consumption-based emissions account (Barrett et al., 2013). The UK is one of the few nations to report consumption emissions - recognised as an 'Official Statistic' (Defra, 2022).
	Construction notes	SUT tables from UK's Office of National Statistics. Extract domestic use. Convert to basic prices. Disaggregate imports to and exports from UK using a modified version of EXIOBASE. RoW to RoW data taken directly from EXIOBASE converted to GBP.
	Years	1990 - 2021
	Sectors	112 industrial sectors. UK household final demand disaggregated to 105 COICOP products
	Regions	12 (UK, Brazil, Russia, India, China, South Africa, USA, Japan, Rest of EU, Rest of Europe, Rest of OECD, Rest of Africa, Rest of America, Rest of Asia, Rest of Middle East)
Household survey data	**Overview**	Living Costs and Food Survey (LCFS) - sample of ~6000 representative UK households – weight supplied to indicate the proportion of UK household represented by each surveyed household
	Data collected	Spend on over 300 product types – aggregated to 105 COICOP products Additional information is collected such as the age, sex and occupation of members of the household reference person (HRP), the total household income, taxes paid, and the location, tenure and dwelling type
	Generations	Using age of HRP assign each household to one of Millennial and younger, Generation X, Babyboomer, Silent and older
Carbon multipliers	**Method**	Calculate footprint by 105 COICOP products. Divide by total spend by product from LCFS to generate multiplier that takes product taxes (VAT) into account

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How has the UK's carbon footprint changed over time?

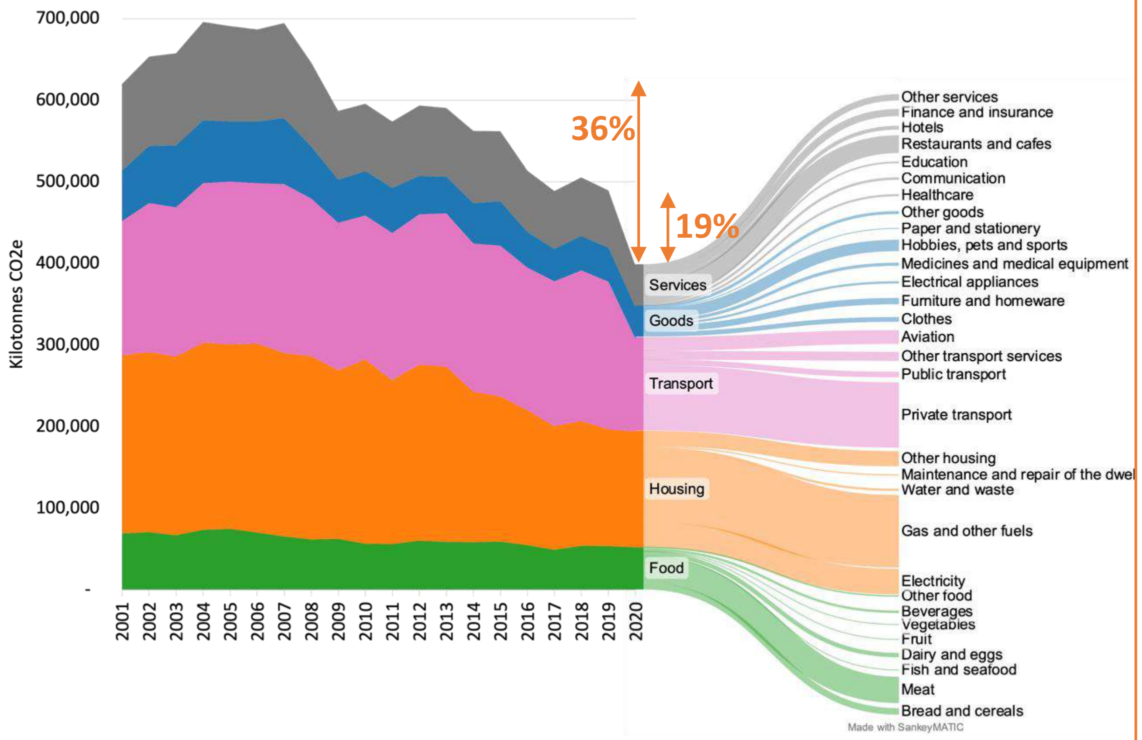

Figure 1: UK Household Carbon Footprint 2001-2020 by product group

93MtCO2e of reduction during the COVID-19 pandemic

- Air travel – 29MtCO2e (**Babyboomers** 12MtCO2e)
- Cars – 22.3MtCO2e (**Babyboomers** 10MtCO2e; **GenX** 9MtCO2e)
- Restaurants – 9MtCO2e

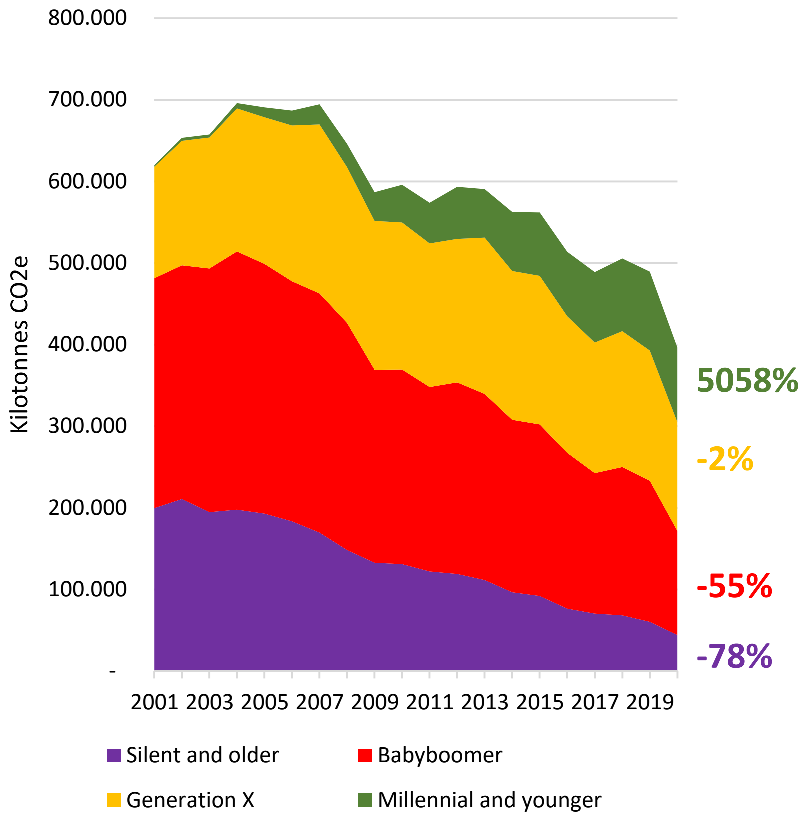

Figure 2: UK Household Carbon Footprint 2001-2020 by generation

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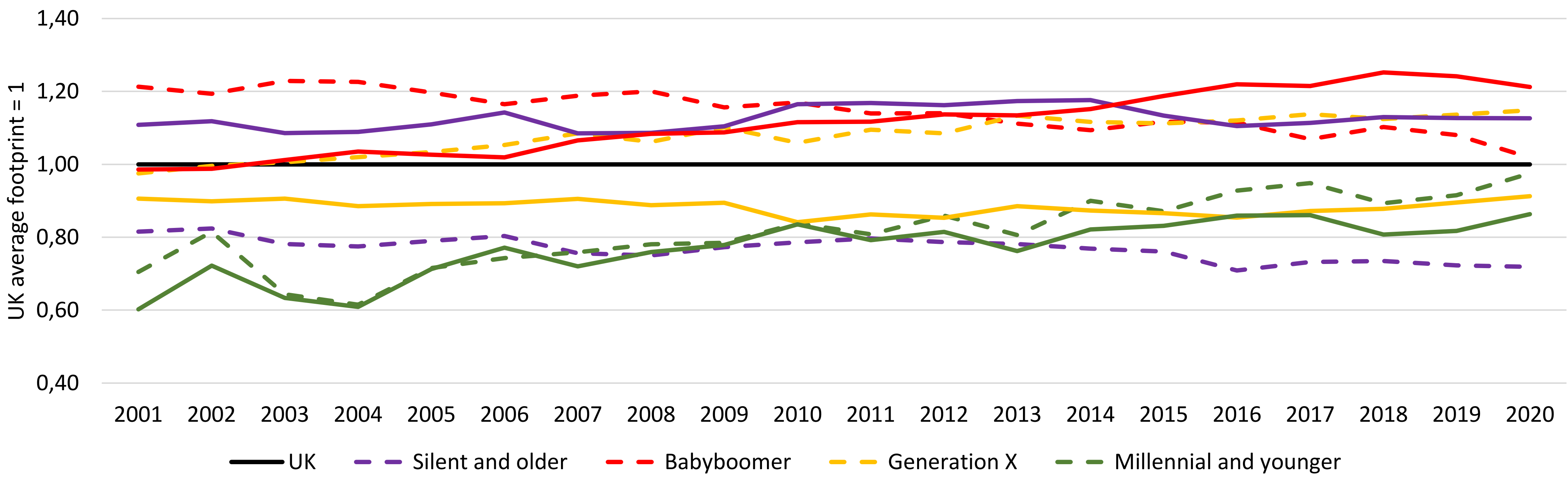

Figure 3: Per capita footprints (solid) and household footprints (dashed) of generational groups relative to UK average 2001-2020 (UK average = 1)

- Per capita perspective: **Millennials** & **Babyboomers** take on more emissions with age but **Silent** generation & **Gen X** maintain a similar position w.r.t UK average
- Per household perspective: **Millennials** & **Gen X** take on more emissions with age but **Millennials** always below UK average. **Silent** and **Babyboomers** reduce
- Per capita **Babyboomer** footprints increase w.r.t UK average due to reducing household occupancy as they become 'empty-nesters'
- Per household **Babyboomer** footprint decreases w.r.t UK average due to the household size decreasing

What are the drivers of change?

Use Dietzenbacher and Lose (1998) structural decomposition equations to calculate the drivers of changes in emissions.

Decompose $\mathbf{T} = \mathbf{h}.\mathbf{o}.\mathbf{s}.\mathbf{b}.\mathbf{m}$ using a five factor D&L decomposition where:

"What are the most important drivers of change in the household emissions associated with each generation between 2001 and 2020?"			
	Variable short name	**Description**	**Unit**
T	Total	Total UK consumption-based emissions of a generation	KtonnesCO_2e
h	Number of households	Total number of households in generation [1x1]	NA
o	Occupancy	Population per household headed by that generation [1x1]	NA
s	Spend per capita	Total per capita spend by a household headed by that generation	£ GBP
b	Basket of goods	Proportion of spend by product group for that generation	NA
m	Multiplier	Emissions intensity of products	KtonnesCO2e/£

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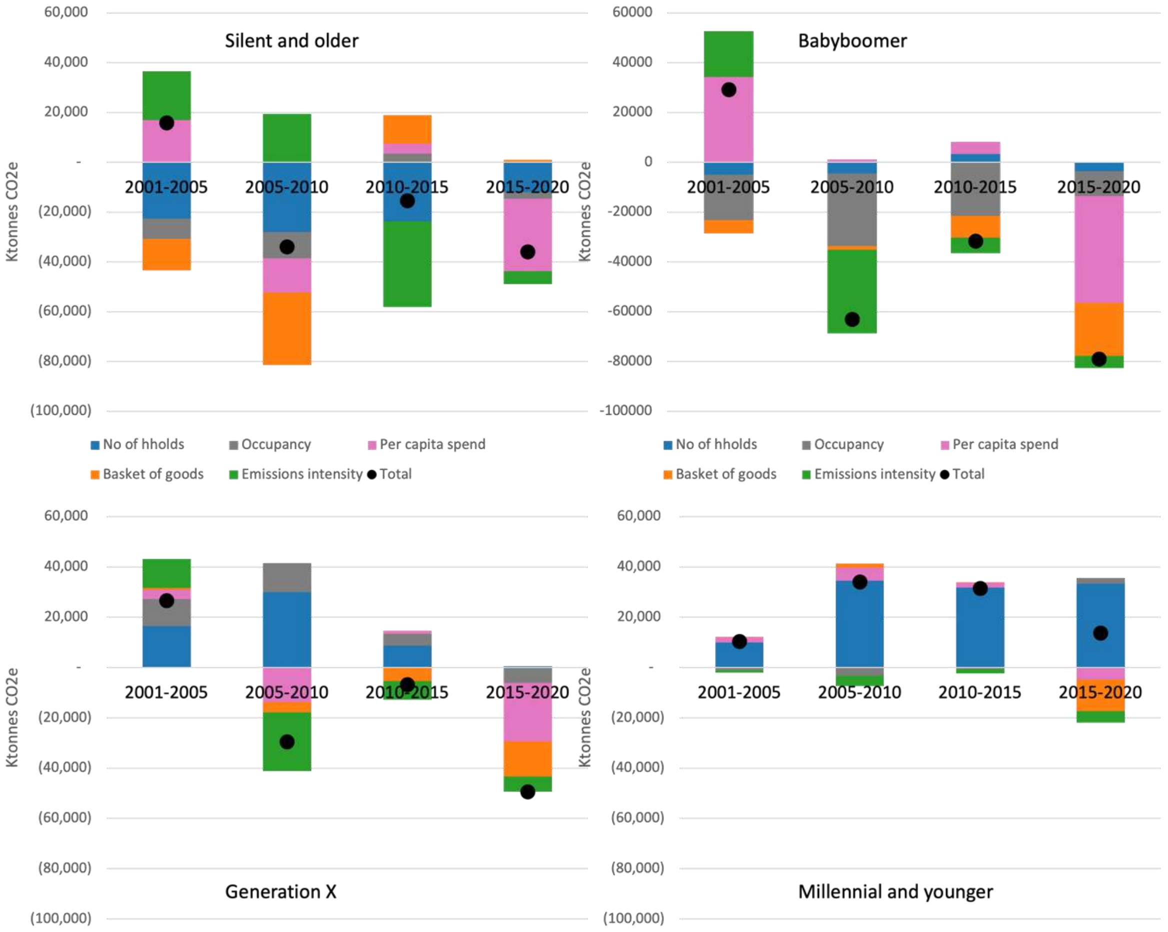

Figure 4: Structural Decomposition Analysis showing the important factors driving changes in total emissions by each generation between 2001 and 2020

- Change in the number of households reduces Silent Generation footprint and increases footprint associated Gen X and Millennials
- Occupancy changes have driven down Babyboomer emissions. These households may become ‘empty-nesters’ as children leave home. Increases the total footprint of Generation X, indicating these households starting families
- Emissions intensity increased emissions in early years then decreased post 2005
- Total spend increased emissions at the start of the time period. The economic recession of 2008-2009 seems to have had most effect on the Silent and Gen X. Covid spend had most effect on Babyboomers.
- Baskets of goods tends to act as a decreaser with the exception of Silent between 2010 and 2015. Time when Silent retire leading to a change in spending habits associated with being at home more and taking a greater number of holidays.
- For Millennials and Gen X, the times basket effect is positive correspond to when total spend has an increasing effect and the groups are in their early 20s. Perhaps we are seeing a change in spending habits due to increased earning potential.

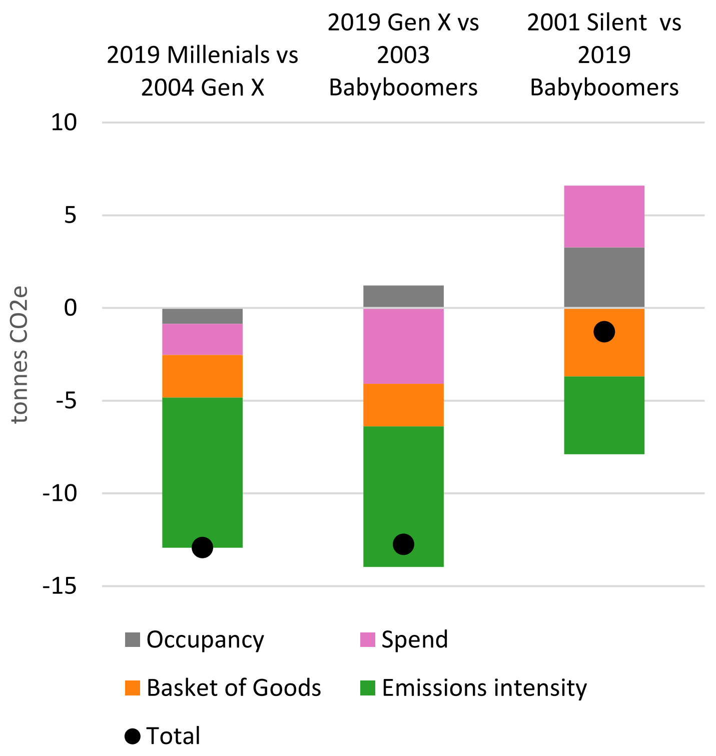

Figure 5: Structural Decomposition Analysis comparing average household emissions of different generational groups at the same lifestage

- 2019 Millennials, who would be aged <39, had a household footprint 12.9 tonnes CO_2e smaller than Gen X at the same age
  - Improvements in emissions intensity explains 63% of this difference, but other factors also contribute to this difference
  - The type of products bought by Millennials in 2019 are less emissions intensive, they spent less per person and have fewer people per household; each factor contributing 18, 13 and 7%
- 2019 Gen X households, aged 39-54, had a footprint 12.7 tonnes smaller than similarly aged Babyboomers
  - spend per capita is the second largest driver of difference
  - occupancy acts as a positive driver, implying at that at a similar age, Babyboomers have started to decrease their household size.
- 2019 Babyboomers aged 55-73 had a footprint 1.3 tonnes smaller than similarly aged Silent
  - only emissions intensity and basket contribute to reductions
  - Babyboomers have a larger equivalent spend and a larger occupancy at the same lifestage.

APC effects (Yang et al., 2008)

	AGE	PERIOD	COHORT
Definition	Variation associated with different age groups	Variation over time periods that affect all age groups simultaneously	Changes across groups of individuals who experience an initial event such as birth in the same year or years
APC effects in UK carbon footprint	Evidence of age increasing footprint - concentrated at certain points in a person's lifetime and depends if consider per capita or per household as unit	2001-2020 emissions reduction for all generational groups due to rapid decarbonisation	Occupancy is cohort effect – having children later, boomerang adults Unable to fully determine cohort effects at this stage Need to observe Millennials becoming settled family units and Gen X retiring to assert generational traits to emissions profiles
Policy implications	Climate policy needs to recognise that the needs of households change with ***aging*** and lifestage	Climate policy also needs to recognise ***period*** effects – e.g. COVID-19 pandemic effected spending behaviours of all ages	Consumption patterns differ between ***cohorts***. Differences related to levels of concern about climate change and outlooks which shape cultures of consumption. Policy should reflect this when targeting specific groups to encourage sustained reductions of carbon footprints

Limitations & future work

- LCFS records year of birth of the household reference person. We assume spend assigned to the whole household is the representative spend of that generation - several generations within the household?

- Could resample to only include single person households, but much variation in spend between Gen X and Silent explained by Gen X spending on behalf of children. Excluding families would not be representative of the typical household

- While we focus on generations, we acknowledge that these are not homogenous groups - attitudes, behaviours, life choices and resulting carbon footprints are additionally shaped by factors such as income, education, employment, health, gender, location, etc.

Thank you!

Please ask me questions

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