

Cybernetic Democratic Economic Planning & Holistic Accounting

An economic framework to satisfy societal needs within planetary and regional boundaries

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03.04.2025



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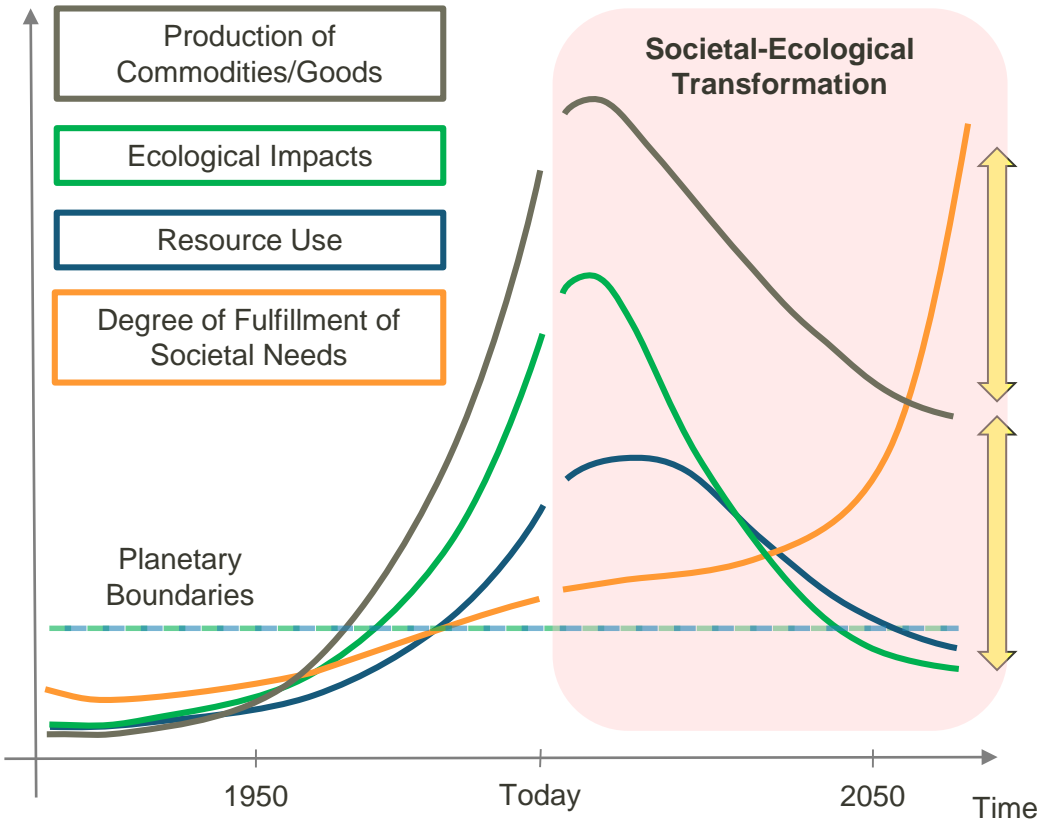
Former socialist and current capitalist societal relationships with nature (Görg, 2011) culminate into a profound socio-ecological crisis (O'Neill et al., 2018):

The transgression of planetary & regional ecological boundaries alongside the unequal & insufficient fulfilment of societal needs

How can we achieve a good life for all while staying within planetary boundaries?

Identifying viable pathways to determine which and how much resources can be used through which economic, technological, and societal practices to sustainably satisfy societal needs

1. Interdisciplinary methods of sustainability and environmental systems research: Transformation & Sustainability



Need for double decoupling to achieve a **good life for all within planetary and regional boundaries**

Long-term and global fulfillment of societal needs and well-being as an end (**social sustainability**)

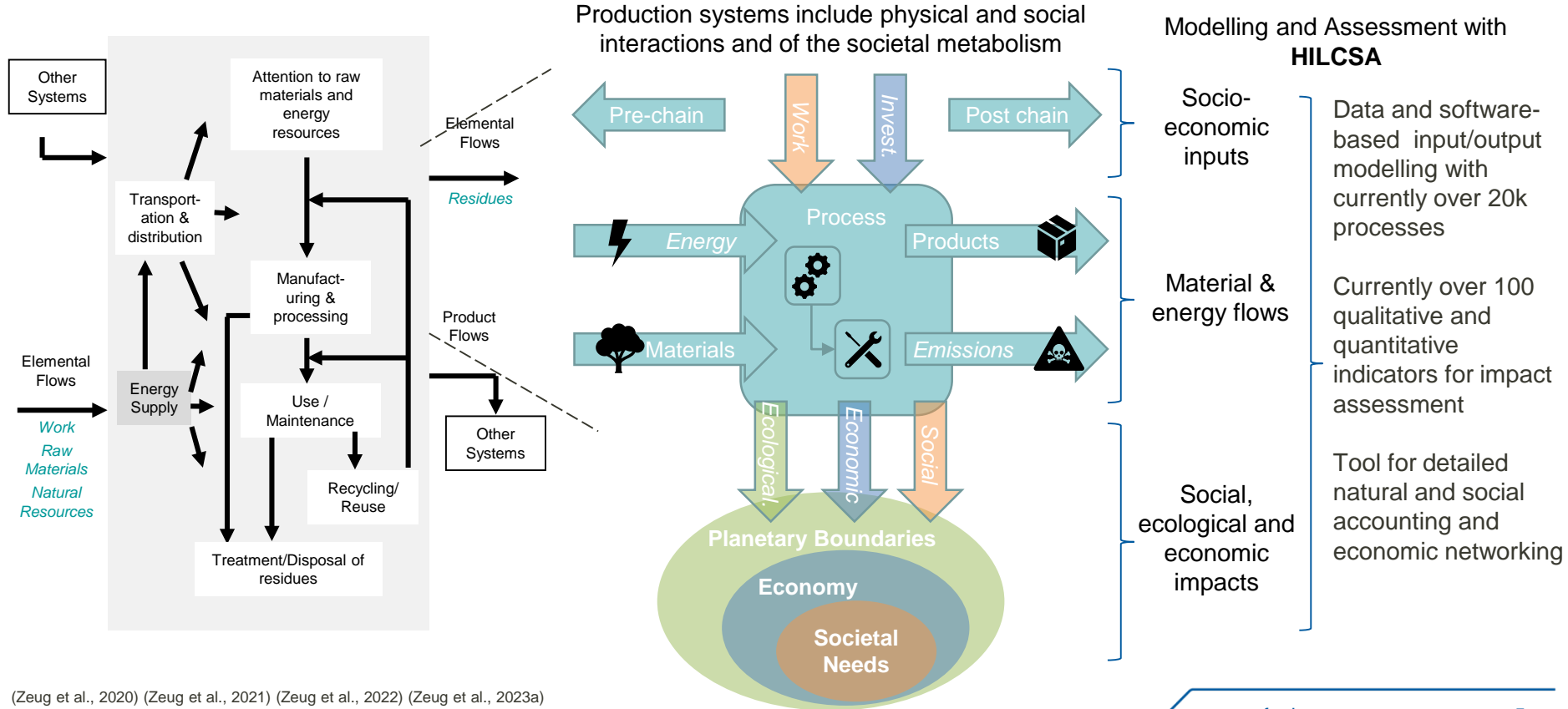
1. Decoupling of fulfillment of societal needs from increasing production of material goods (sufficient & effective)

Technologies and economic structures as efficient, effective and just provisioning systems enabling the fulfillment of societal needs within planetary boundaries (**economic sustainability**)

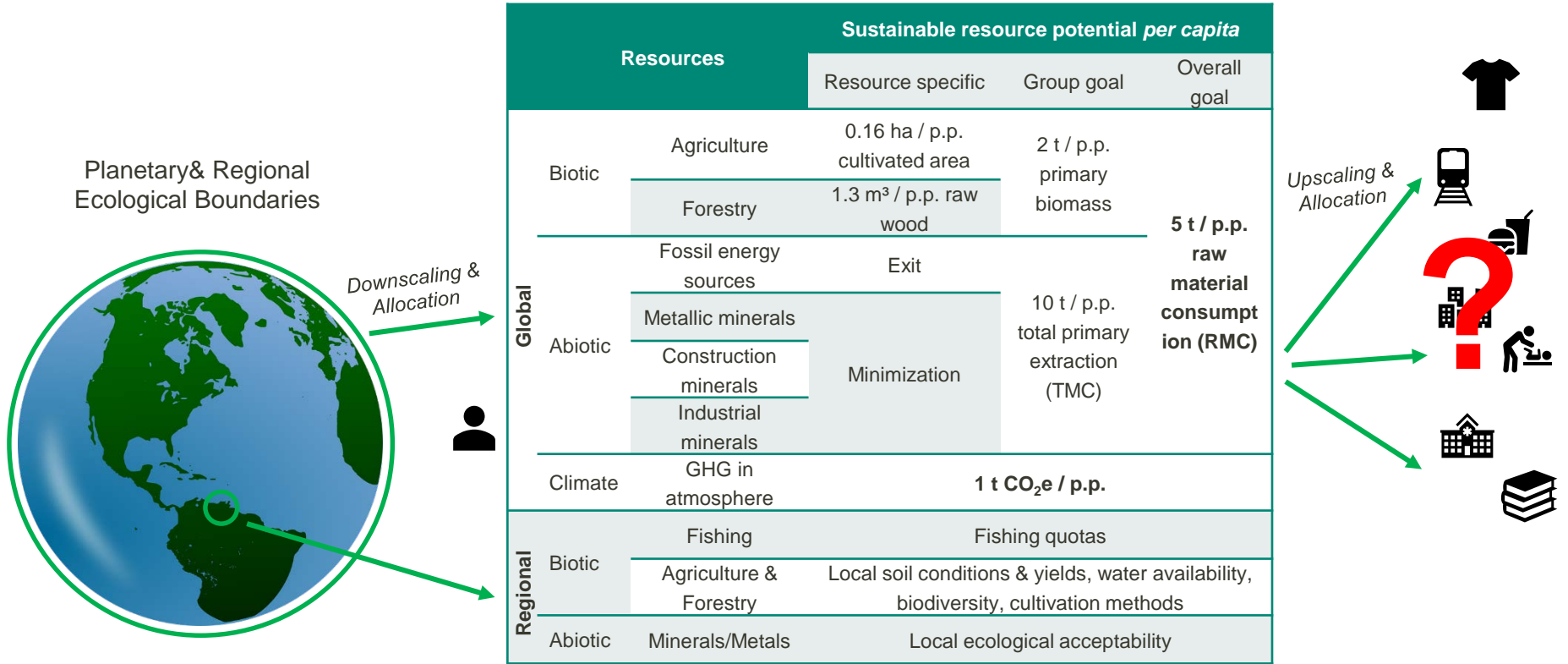
2. Decoupling of sufficient material production from increasing ecological, social and economic impacts (efficient)

Long-term stability of our environment as a basis of reproduction within planetary boundaries (**ecological sustainability**)

1. Interdisciplinary methods of sustainability and environmental systems research: Holistic and Integrated Life Cycle Sustainability Assessment



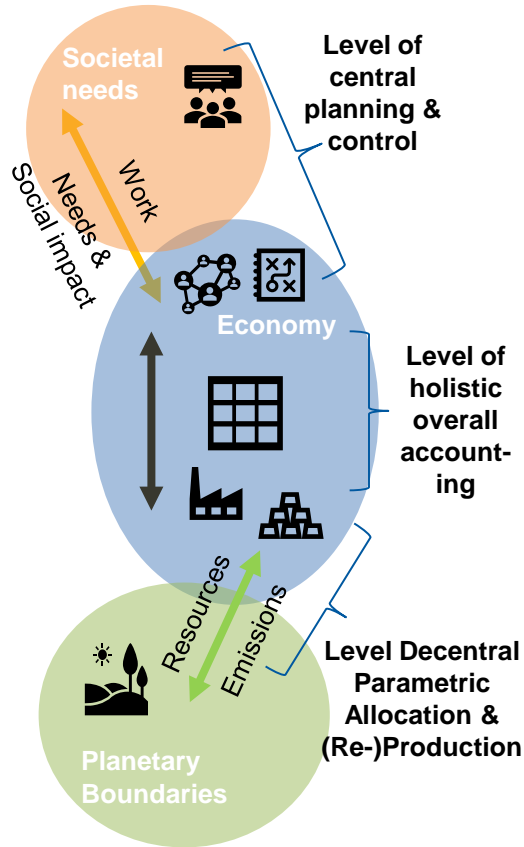
1. Interdisciplinary methods of sustainability and environmental systems research: Environmental systems research



2. Introduction to Democratic Economic Planning, Cybernetics & Holistic Accounting

- Cybernetics as science of control of complex systems: emergent properties in line with democratically defined goals (Devine, 1988; Pitt, 2022) by *parameters & rules of interaction* between autonomous subsystems, iterative coordination, feedback loops
- Cybernetic democratic economy planning (CDEP): primarily democratic *parametric* control of the *framework*, within which local units plan and act as autonomously as possible, with a view to both macro plans and their local, specific conditions (Heyer, 2025)
- Through multilevel, iterative coordination process: convergence of macro and micro plans and reconciliation of relatively autonomous micro activity (Laibman, 2001; Dapprich, 2022a)
- Local subsystems must be enabled by an *information system* to assess the consequences for the overall system (e.g., societal, ecological), as far as possible themselves and record required I/O
- Neurath (1919): incommensurability, a common denominator is 'pseudorational', needed: *calculation in-kind*; *Trade-offs* between incommensurable goals (Vettese and Pendergrass (2022) require multi-criteria decision-making (Planning for Entropy (2022))
- However, we need both disaggregation *and* aggregation: Aggregation is required to *reduce complexity* in planning, budgeting and accounting precisely because it enables commensurability between myriad different factors
- Goal: a *differentiated, multidimensional* and yet *complexity-reducing*, system of parameters; a coherent, holistic and transparent system of parameters and method of accounting enabling a system of *tokens* (Dapprich, 2022b)

3. General Implications & Scales of CDEP



- The following concept is an intermediate approach for a societal-ecological transformation, not the vanishing point of a communist utopia
- DPE aims to enable a good life for all within planetary boundaries & to take care as we would like to
- Democratic macro plans specify general priorities, development direction, investments, unconditional universal basic income (UBI) & services (UBS) and planetary boundaries; proportions and parameters for sectors and regions are broken down
- Planetary and social boundaries, budgets, proportions and allocation of the economy are result of ongoing conscious social deliberation and scientific analysis
- Accounting by Tokens: non-circulating units of account that reflect information about holistic costs, scarcity and utility of products & services (Heyer & Zeug, 2024)
- Tokens are stored and transferred via virtual accounts, Organizational budgets can not be accumulated or transferred to private budgets

4. Framework of CDEP & Holistic Accounting

4.1. Level of central planning & control

Token Budgets	Token Category	Economy Wide per year	Per Capita per Year	=	Universal Basic Income (UBI)	+	Reserves (R)	+	Universal Basic Services (UBS)	+	Non-Institutionalized Care (NIC)	+	Productive consumption (PC)
	Raw Material Consumption (RMC)	RMC_{ewa}	$RMC_{ppa} = \frac{RMC_{ewa}}{N_{pp}} = 5 t$	=	RMC_{ewa}^{UBI}	+	RMC_{ewa}^R	+	RMC_{ewa}^{UBS}	+	RMC_{ewa}^{NIC}	+	RMC_{ewa}^{PC}
	Green House Gas Emissions (GHG)	GHG_{ewa}	$GHG_{ppa} = \frac{GHG_{ewa}}{N_{pp}} = 1 CO_2e$	=	GHG_{ewa}^{UBI}	+	GHG_{ewa}^R	+	GHG_{ewa}^{UBS}	+	GHG_{ewa}^{NIC}	+	GHG_{ewa}^{PC}
	Working time (WT)	WT_{ewa}	$WT_{ppa} = \frac{WT_{ewa}}{N_{pp}} = 2350 h$	=	WT_{ewa}^{UBI}	+	WT_{ewa}^R	+	WT_{ewa}^{UBS}	+	WT_{ewa}^{NIC}	+	WT_{ewa}^{PC}

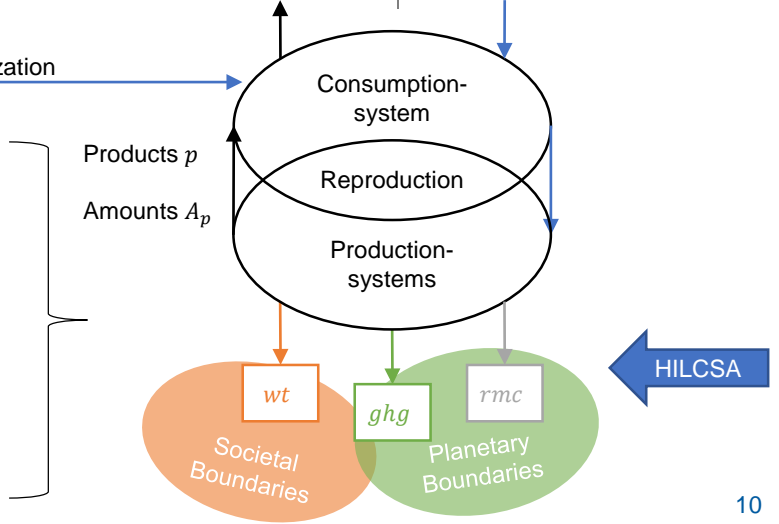
Adaption

Comparison (sustainability if $x_{ewa} = X_{ewa}$)

Incentivization

↑ Material, Energy & Goods Flows
 ↓ Budget & Information Flows (Signal of Relevance)

Economy Wide Product Price	Single Product Price	Economy wide (ew) impacts	Product specific impacts
$p_{ewa}^{RMC} = \frac{rmc_p A_p}{RMC_{ewa}}$	$p_p^{RMC} = \frac{rmc_p}{RMC_{ppa}}$	$rmc_{ew} = \sum rmc_p A_p$	rmc_p
$p_{ewa}^{GHG} = \frac{ghg_p A_p}{GHG_{ewa}}$	$p_p^{ghg} = \frac{ghg_p}{GHG_{ppa}}$	$ghg_{ew} = \sum ghg_p A_p$	ghg_p
$p_{ewa}^{WT} = \frac{wt_p A_p}{WT_{ewa}}$	$p_p^{wt} = \frac{wt_p}{WT_{ppa}}$	$wt_{ew} = \sum wt_p A_p$	wt_p



4.2. Level of overall holistic accounting

Sectoral economic modelling with I/O

Production sectors

Consumption Outputs

Intermediate demand

(Re-)Production system with sectoral resource use, intermediate interlinkages and specific technology paths

Production sectors

Consumption sectors
Universal Basic Income (UBI), Reserves (R), Universal Basic Services (UBS), Non-Institutionalized Care (NIC), Productive consumption (PC)

Resource inputs

Regional, global and sustainable availability of fossil (F), biogenic (B) and socio-economic (C) resources

Technologies & Value Chains with LCA

Lead Indicators

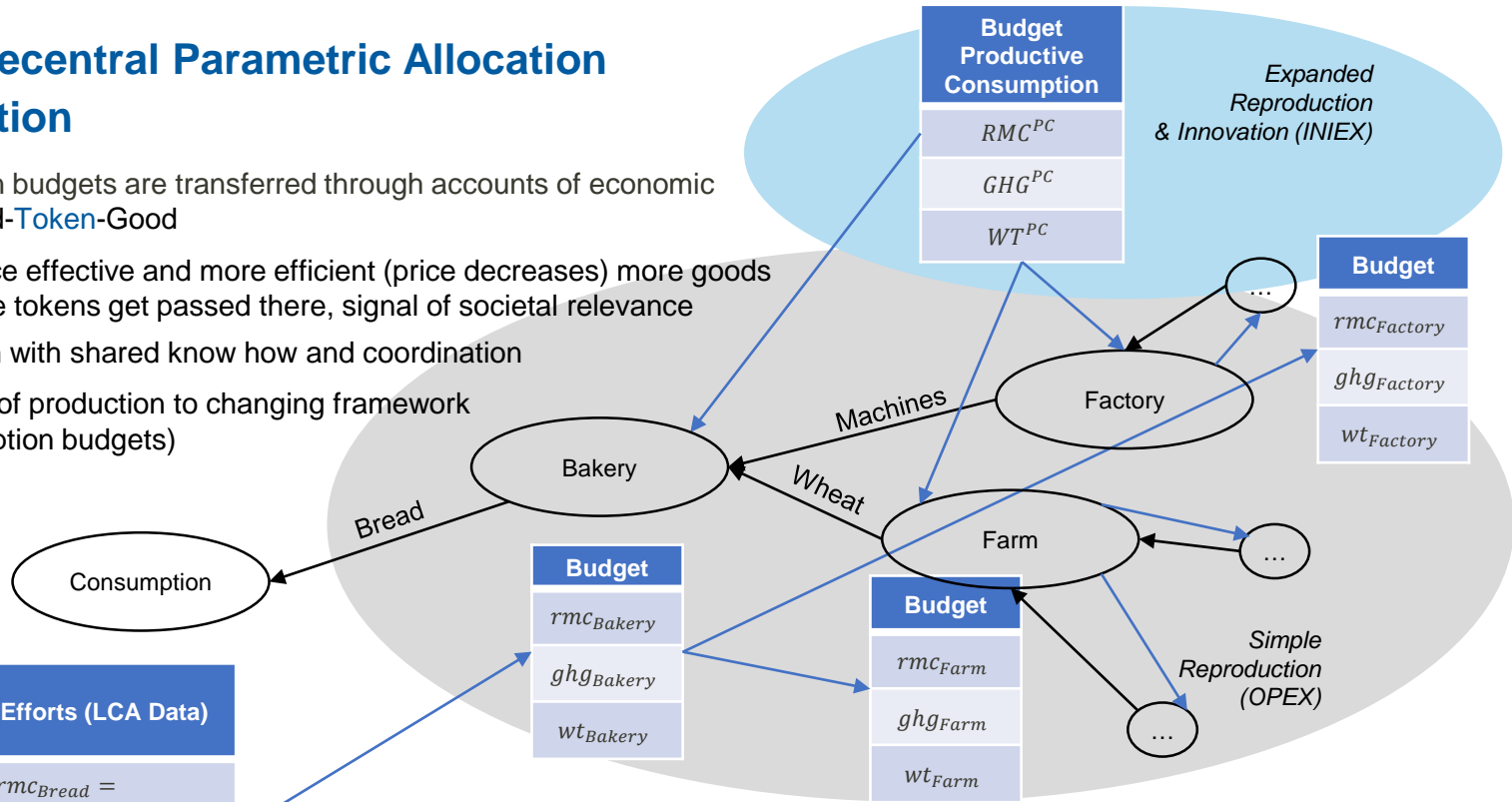
Raw Material Consumption (RMC), Green House Gas Emissions (GHG), Working Time (WT)

	Production sectors				Consumption Outputs				
Intermediate demand	s_1	s_2	...	s_3	UBI	R	UBS	NIC	PC
s_1	$a_{1,1}$	$a_{1,2}$	...	$a_{1,n}$	UBI_1	R_1	UBS_1	NIC_1	PC_1
s_2	$a_{2,1}$	$a_{2,2}$	...	$a_{2,n}$	UBI_2	R_2	UBS_2	NIC_2	PC_2
...
s_3	$a_{n,1}$	$a_{n,2}$	...	$a_{n,n}$	UBI_n	R_n	UBS_n	NIC_n	PC_n
F	F_1	F_1	...	F_n					
B	B_1	B_2	...	B_n					
C	C_1	C_2	...	C_n					
RMC	RMC_1	RMC_1	...	RMC_n					
GHG	GHG_1	GHG_2	...	GHG_n					
WT	WT_1	WT_2	...	WT_n					

- All information on inputs and outputs, stocks, performance, etc. is recorded using LCA data sets and integrated into the databases of the network
- Via databases and networks: regional and supra-regional, transparent, horizontal material exchange platforms for (intermediate) products

4.3. Level of Decentral Parametric Allocation & (Re-)Production

- On micro level token budgets are transferred through accounts of economic agents: G-T-G Good-Token-Good
- If companies produce effective and more efficient (price decreases) more goods are consumed, more tokens get passed there, signal of societal relevance
- Solidary competition with shared know how and coordination
- Automatic adaption of production to changing framework conditions (consumption budgets)



Single Product Price	Product Efforts (LCA Data)
$p_{Bread}^{RMC} = \frac{r_{mcBread}}{RMC_{ppa}}$	$r_{mcBread} = r_{mcBakery} + r_{mcFarm} + r_{mcFactory}$
$p_{Bread}^{GHG} = \frac{ghg_{Bread}}{GHG_{ppa}}$	$ghg_{Bread} = ghg_{Bakery} + ghg_{Farm} + ghg_{Factory}$
$p_{Bread}^{WT} = \frac{wt_{Bread}}{WT_{ppa}}$	$wt_{bread} = wt_{Bakery} + wt_{Farm} + wt_{Factory}$

- Operational expenditures (OPEX) as means of production and pre-products can be acquired by receiving tokens and passing them on (simple reproduction)
- Investment expenditures for expanded means of production and innovation (INIEX) are gained via productive consumption budgets from a flat-rate budget and budget under institutional control (Rochowicz, 2024)

4.3. Level of Decentral Parametric Allocation & (Re-)Production Pricing information of CDPE



Durchschnittliche Nährwerte

	Je 100 g (1 Portion)**	% (100g)
Brennwert	104 kJ / 25 kcal	1
Fett	0,5 g	<1%
- davon gesättigte Fettsäuren	0,1 g	<1%
Kohlenhydrate	3,6 g	1
- davon Zucker	3,6 g	1
Eiweiß	1,5 g	1
Salz	0,30 g	1



Source: Yvonne Weiß - Fotolia.com

5. Conclusions

- Cybernetic, ecological and democratic planned economy aims to solve questions about what, why and how we want to produce and care by societal deliberation, but based on algorithmically and technically advanced methods and information processing
- Our approach shows the need and potential for interdisciplinary model development
- Further and detailed design and simulation calculations of cybernetic planning mechanism, holistic accounting method, parameters/indicators, token system, agent-based-modelling, (...) will be subject of upcoming articles

Invitation to collaborate:

- What is missing in our CDEP model: the political system & societal relations, a transformation strategy, a lot of details, ...
- If you like what you see lets have a discussion and build a comprehensive framework, this here is only one module

Thanks!

References & Contact

- (Bringezu, 2022) Bringezu, S. (2022). *Das Weltbudget: Sichere und faire Ressourcennutzung als globale Überlebensstrategie*. Springer Fachmedien Wiesbaden.
- (Dapprich, 2022a) Optimal Planning with Consumer Feedback: A Simulation of a Socialist Economy. In: Review of Political Economy 35(4): 1-21. DOI: <https://doi.org/10.1080/09538259.2021.2005367>.
- (Dapprich, 2022b) Tokens make the world go round: socialist tokens as an alternative to money. In: Review of Evolutionary Political Economy 4: 497-513. DOI: <https://doi.org/10.1007/s43253-022-00091->
- (Devine, 1988) Democracy and economic planning: the political economy of a self-governing society. Cambridge, UK: Polity Press.
- (Görg et al., 2017) Görg, C., Brand, U., Haberl, H., Hummel, D., Jahn, T., & Liehr, S. (2017). Challenges for Social-Ecological Transformations: Contributions from Social and Political Ecology. Sustainability, 9(7), 1045. <https://www.mdpi.com/2071-1050/9/7/1045>
- (Heyer & Zeug, 2024) Heyer, J., & Zeug, W. (2024). Ökobilanz und kybernetische Wirtschaftsplanung. PROKLA. Zeitschrift für kritische Sozialwissenschaft, 54(215), 267-286. <https://doi.org/10.32387/prokla.v54i215.2116>
- (Heyer, 2025) Basic Problems of a Democratically Planned Economy. Bristol University Press, Bristol (forthcoming).
- (Laibman, 2001) 'Contours of the Maturing Socialist Economy', Historical Materialism, 9(1), pp. 85–110. Available at: <https://doi.org/10.1163/156920601760039195>.
- (O'Neill et al., 2018) O'Neill, D. W., Fanning, A. L., Lamb, W. F., & Steinberger, J. K. (2018). A good life for all within planetary boundaries. Nature Sustainability, 1(2), 88-95. <https://doi.org/10.1038/s41893-018-0021-4>
- (Pitt, 2022) Self-Organizing Multi-Agent Systems. Algorithmic Foundations of Cyber- Anarcho-Socialism. London/Hackensack. DOI: <https://doi.org/10.1142/q0307>.
- (Planning for Entropy, 2022) Democratic Economic Planning, Social Metabolism and the Environment. In: Science & Society 86(2): 291-313. DOI: <https://doi.org/10.1521/asis.2022.86.2.291>
- (Rochowicz, 2024) Rochowicz, N. (2024). Planning progress: Incorporating innovation and structural change into models of economic planning. Competition & Change, 29(1), 64-82. <https://doi.org/10.1177/10245294231220690>
- (Vettese/Pendergrass, 2022) Half-earth socialism: a plan to save the future from extinction, climate change, and pandemics. Verso, London/New York.
- (Zeug et al., 2020) Zeug, W., Bezama, A., & Thrän, D. (2020). *Towards a Holistic and Integrated Life Cycle Sustainability Assessment of the Bioeconomy – Background on Concepts, Visions and Measurements* (UFZ Discussion Papers, Issue. UFZ. https://www.ufz.de/export/data/global/243109_DP_7_2020_Zeugetal.pdf
- (Zeug et al., 2021) Zeug, W., Bezama, A., & Thrän, D. (2021). A framework for implementing holistic and integrated life cycle sustainability assessment of regional bioeconomy. *International Journal of Life Cycle Assessment*, 26(10), 1998-2023. <https://doi.org/10.1007/s11367-021-01983-1>
- (Zeug et al., 2023a) Zeug, W., Yupanqui, K. R. G., Bezama, A., & Thrän, D. (2023). Holistic and integrated life cycle sustainability assessment of prospective biomass to liquid production in Germany. *Journal of Cleaner Production*, 418. <https://doi.org/10.1016/j.jclepro.2023.138046>
- (Zeug et al., 2023b) Zeug, W., Bezama, A., & Thrän, D. (2023). Life Cycle Sustainability Assessment for Sustainable Bioeconomy, Societal-Ecological Transformation and Beyond. In Progress in Life Cycle Assessment 2021 (pp. 131-159). Springer. https://doi.org/10.1007/978-3-031-29294-1_8

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