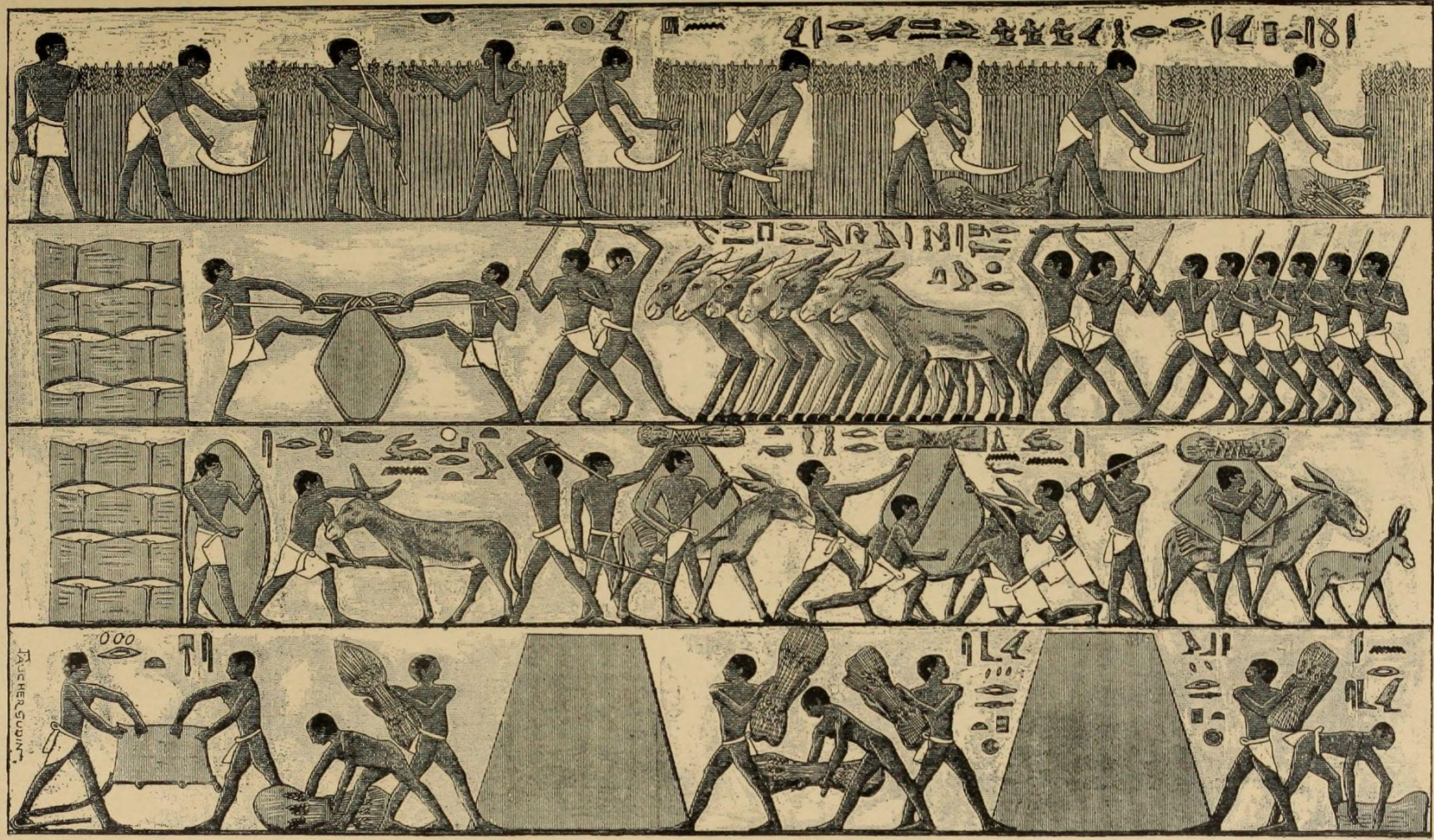
Intelligence artificielle et durabilité dans le milieu bâti: opportunités et défis pour un secteur en transformation

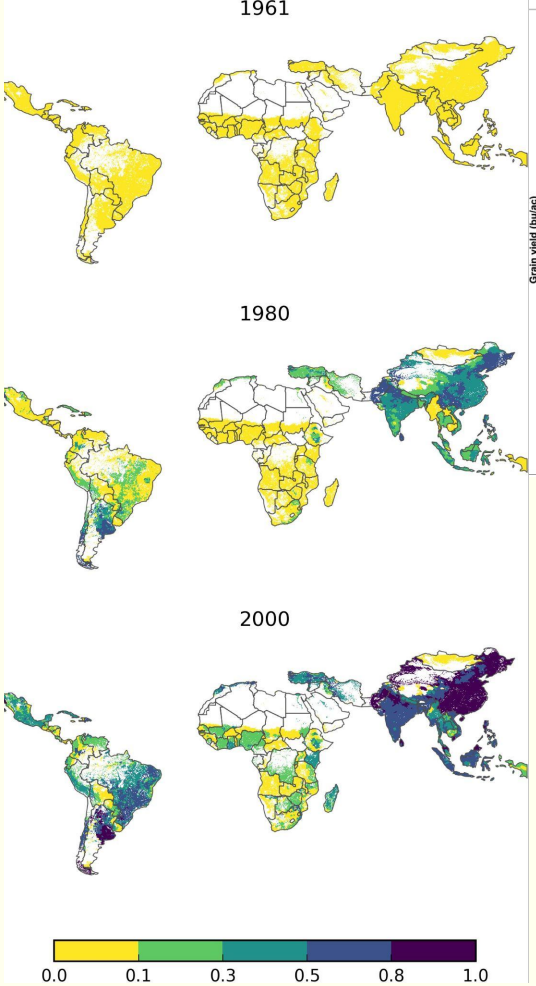
Sascha NICK

F'AR, forum d'architectures, 15.09.2025

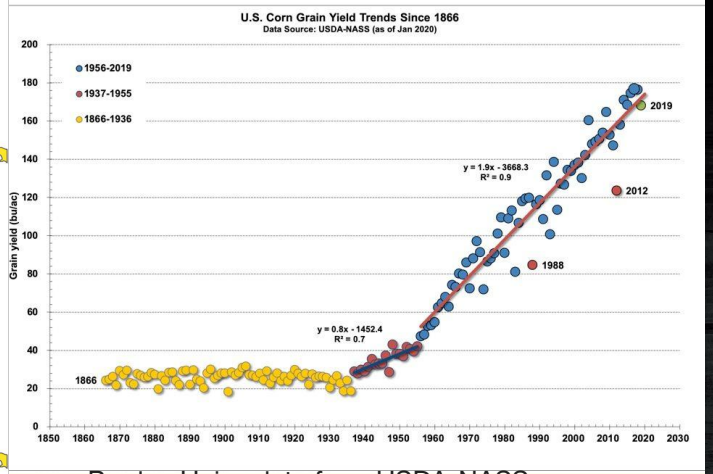


THE CUTTING AND CARRYING OF THE HARVEST.

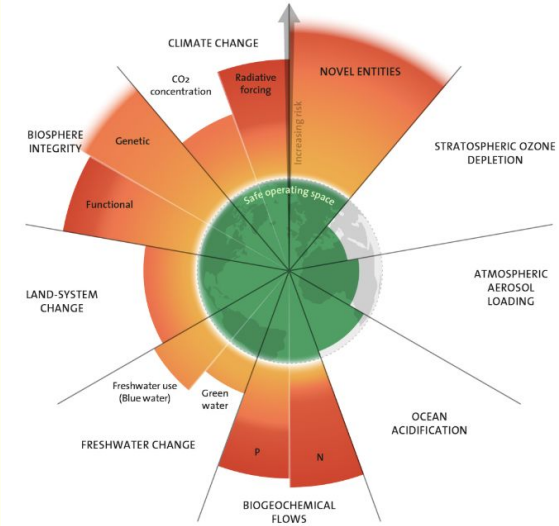
Drawn by Faucher-Gudin, from a photograph by DÜMICHEN, *Resultate*, vol. i. pl x.

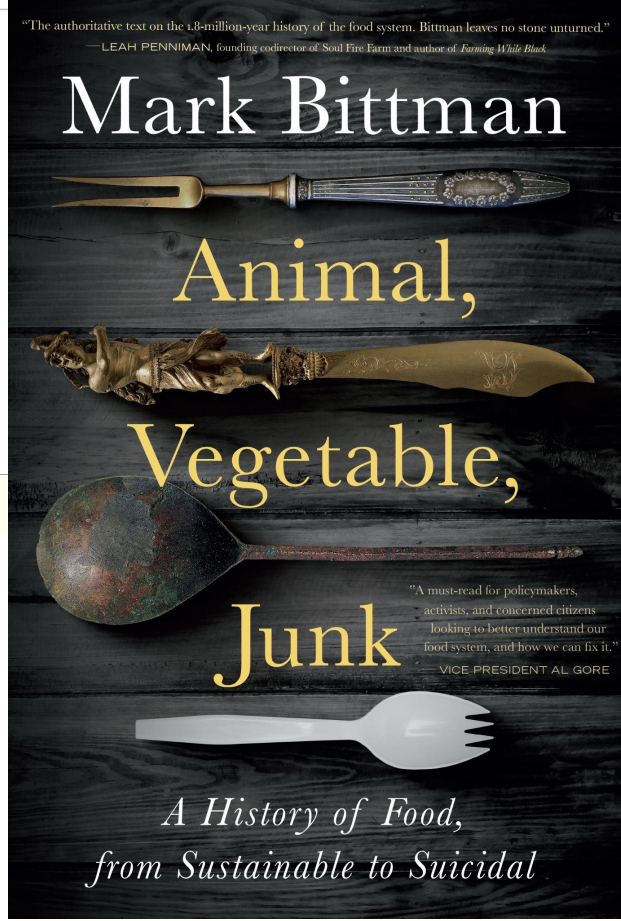


Modern Variety Diffusion Indicator (MVDI)
von Der Goltz et al., 2020, DOI



Purdue Univ., data from USDA-NASS





Tomato harvester

Introduced 1963

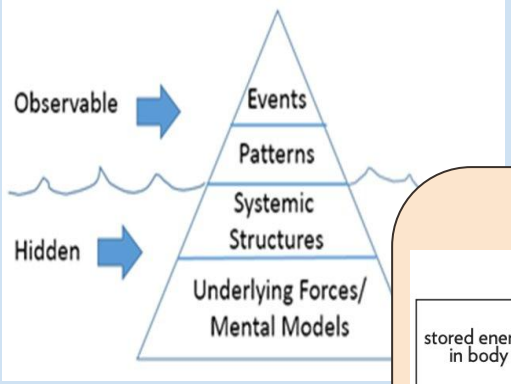
- Consolidation
- Jobs
- Tomato variety
- CA local food revolution

Sources UC Davis, 2015
Winner, 1980

Understanding the World → Systems

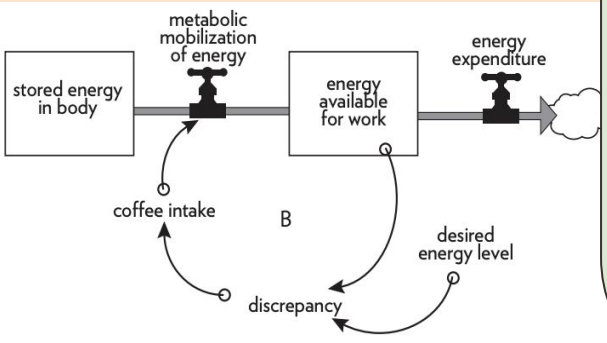
Emergence

Iceberg model



Monat et al. 2020

Stocks and flows



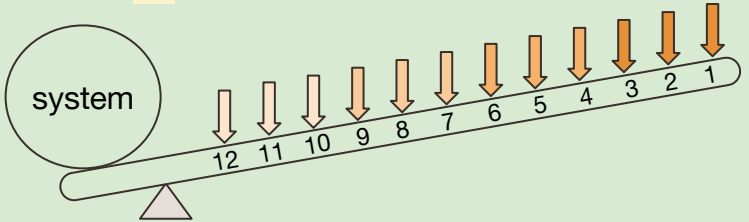
Meadows 2008

Leverage points

high

Intent	1. The power to transcend paradigms 2. Mindset, worldview, values 3. System goals
Design	4. Power to change system structure 5. System rules 6. Structure of information flow
Feed-back	7. Gain of positive feedback loops 8. Strength of negative feedback loops 9. Delays
Para-meters	10. Structure of stocks and flows 11. Buffer size 12. Parameters, incentives, standards

low



Adapted from Abson et al. 2017 and Meadows 1999

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Systems perspectives on transforming Swiss housing by 2040: wellbeing, shared spaces, sufficiency, and de-sprawl

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The Swiss habitat–buildings and related mobility–faces multiple interconnected problems which can only be solved together. These include high energy consumption, significant climate impact, excessive material use with low circularity, accelerating urban sprawl and ecosystem destruction, high mobility costs, low inclusion, and mixed wellbeing outcomes. Guided by values of wellbeing for all within planetary boundaries, we propose a normative scenario based on a nationwide moratorium on new construction until 2100, coupled with four simultaneous neighborhood-scale interventions: renovating buildings to achieve energy class A with high indoor environmental quality, creating flexible shared living spaces, ensuring essential daily services are available within

Swiss housing and mobility:

exceed ecological limits, overuse resources, and achieve mixed well-being.

Change is reachable in 20 years with existing skills/tech:

GHG -95%, biodiversity restored, housing for all.

- **Space:** Oversized, unequal; 17M rooms mostly empty. Sharing could halve space.
- **Energy:** 1% class A, 0.8%/yr renovation. Halt new construction, shift workforce → near-100% class A in 14 years.
- **Mobility:** Add essential services to all neighborhoods to cut travel and resource use.
- **Biodiversity:** Reverse sprawl, fragmentation, soil sealing; deconstruct 27% built m^2, reuse materials.

Citizen deliberation, expert support, and multilevel planning are vital.
Start now with **voluntary neighborhood pilots.**

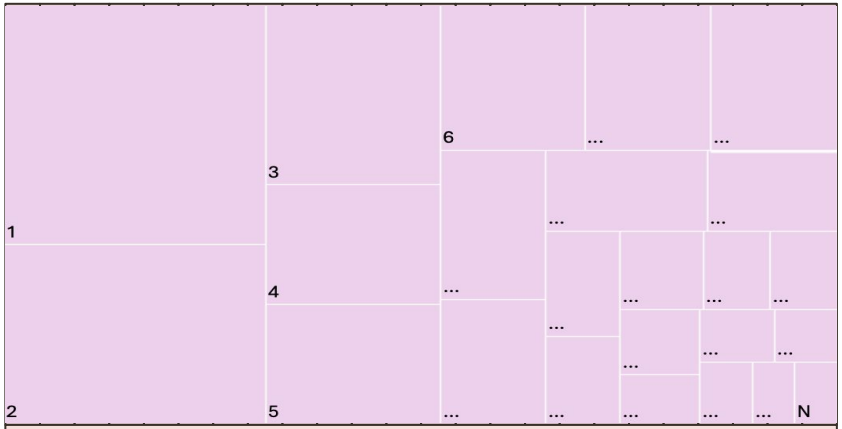
AI as enabler of transformation?

Housing spaces, from a human needs perspective

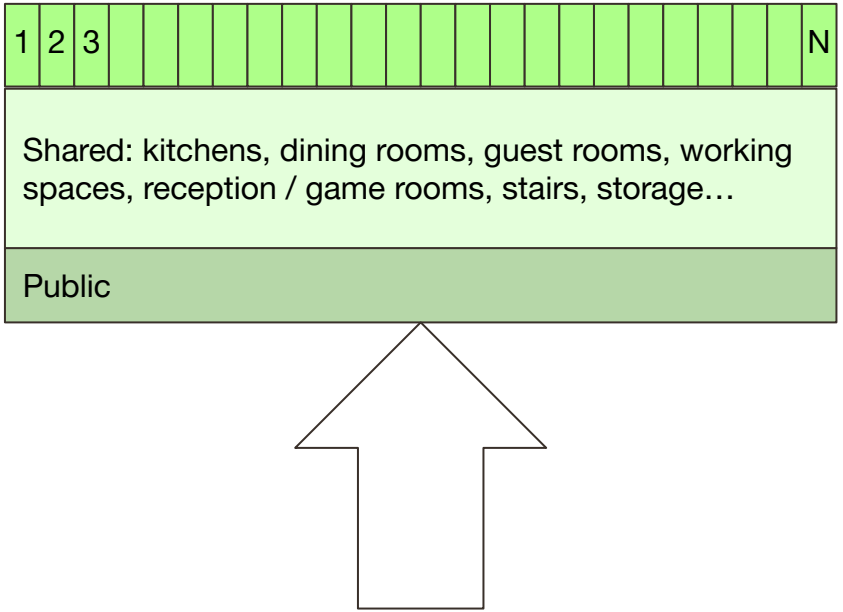
Shared spaces as synergistic satisfier for participation, creation, understanding, identity

CH 2022 habitable space per person: 46.5 m^2 (plus 10.4 m^2 shared and 3.9 m^2 secondary residences);
Public / non-habitable space per person: 15.5 m^2 (total 76.3 m^2)

2020 Private+Shared+Public, N people



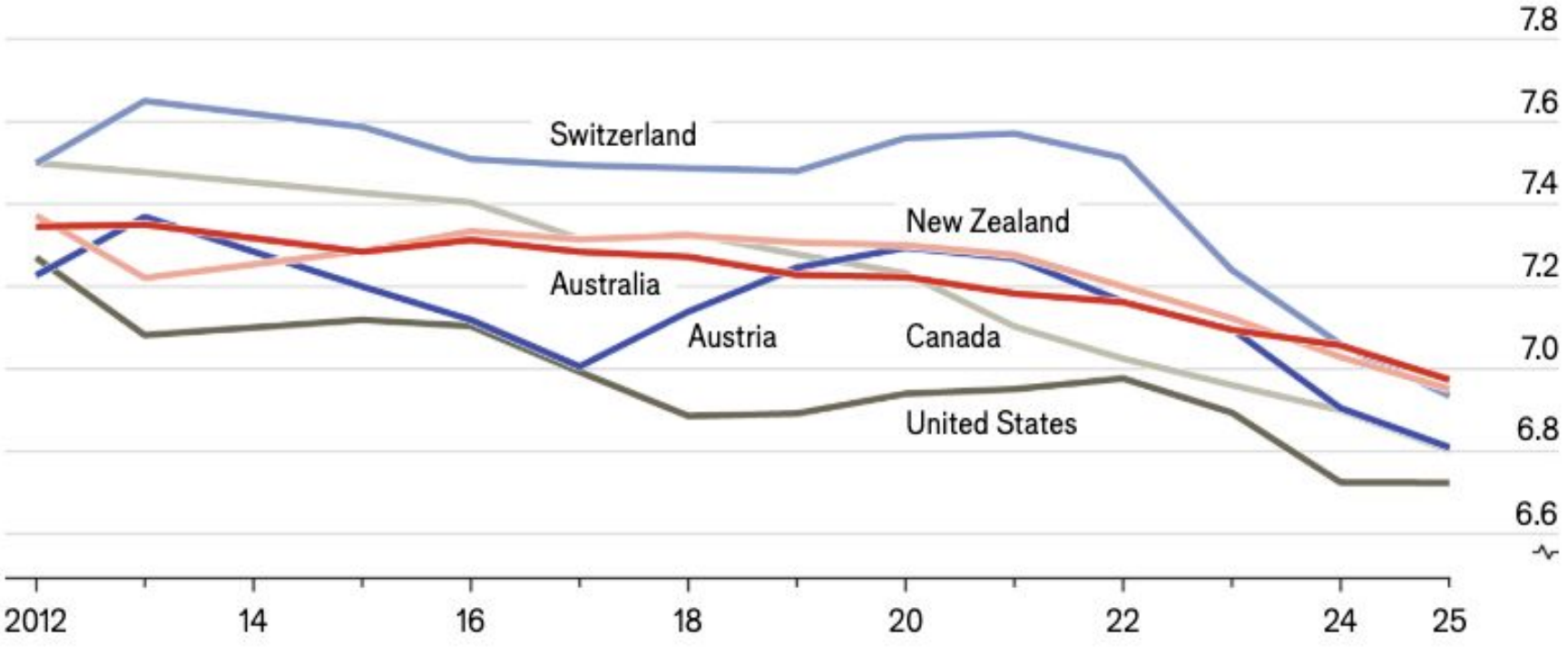
2040 Private+Shared+Public, N people



Empty chairs at empty tables

Life evaluation, 10=happiest

OECD countries with the greatest decline since 2012



Source: World Happiness Report, 2025

Model results

Full renovation of the Swiss building stock:

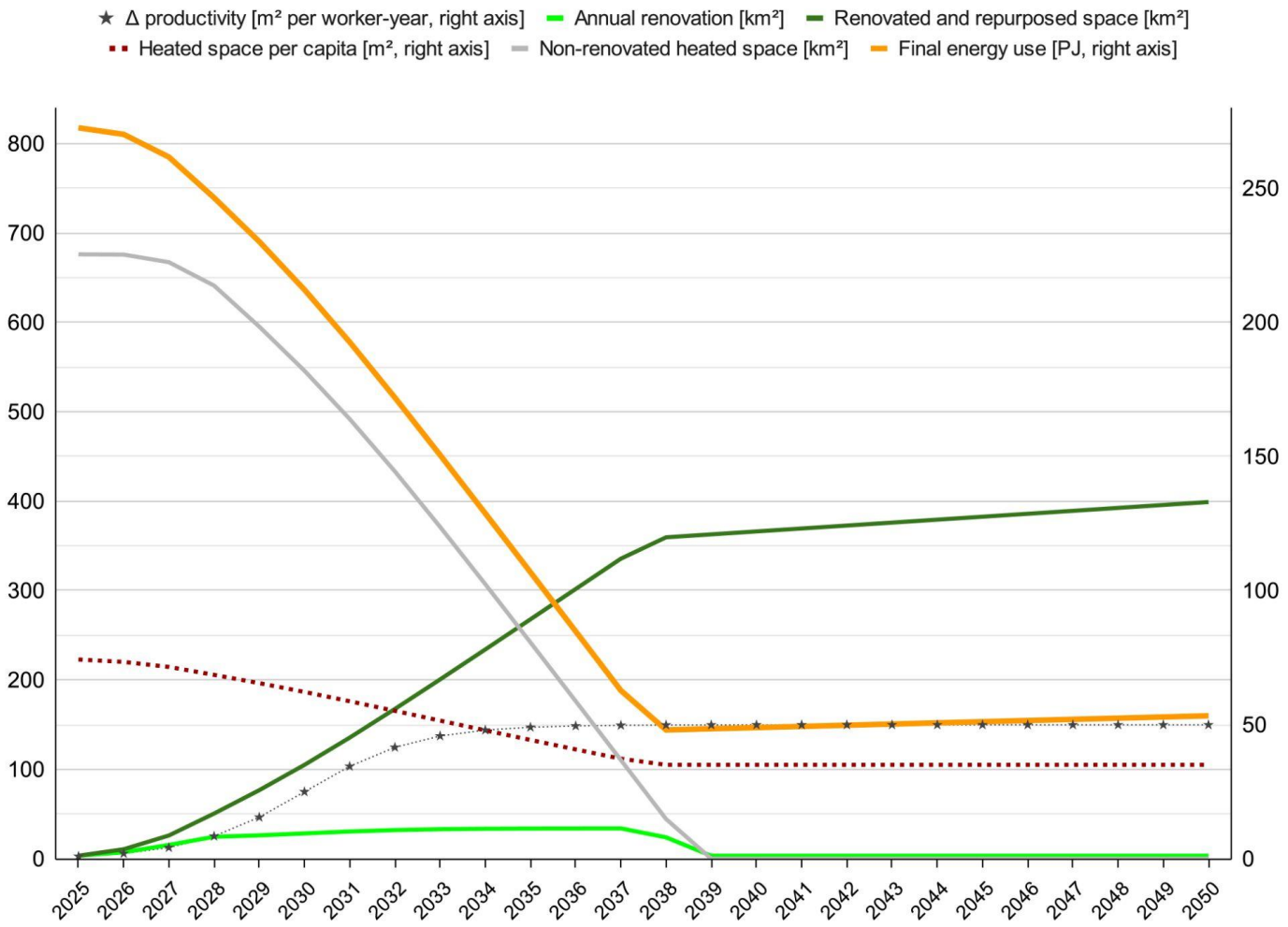
125 → 14 years

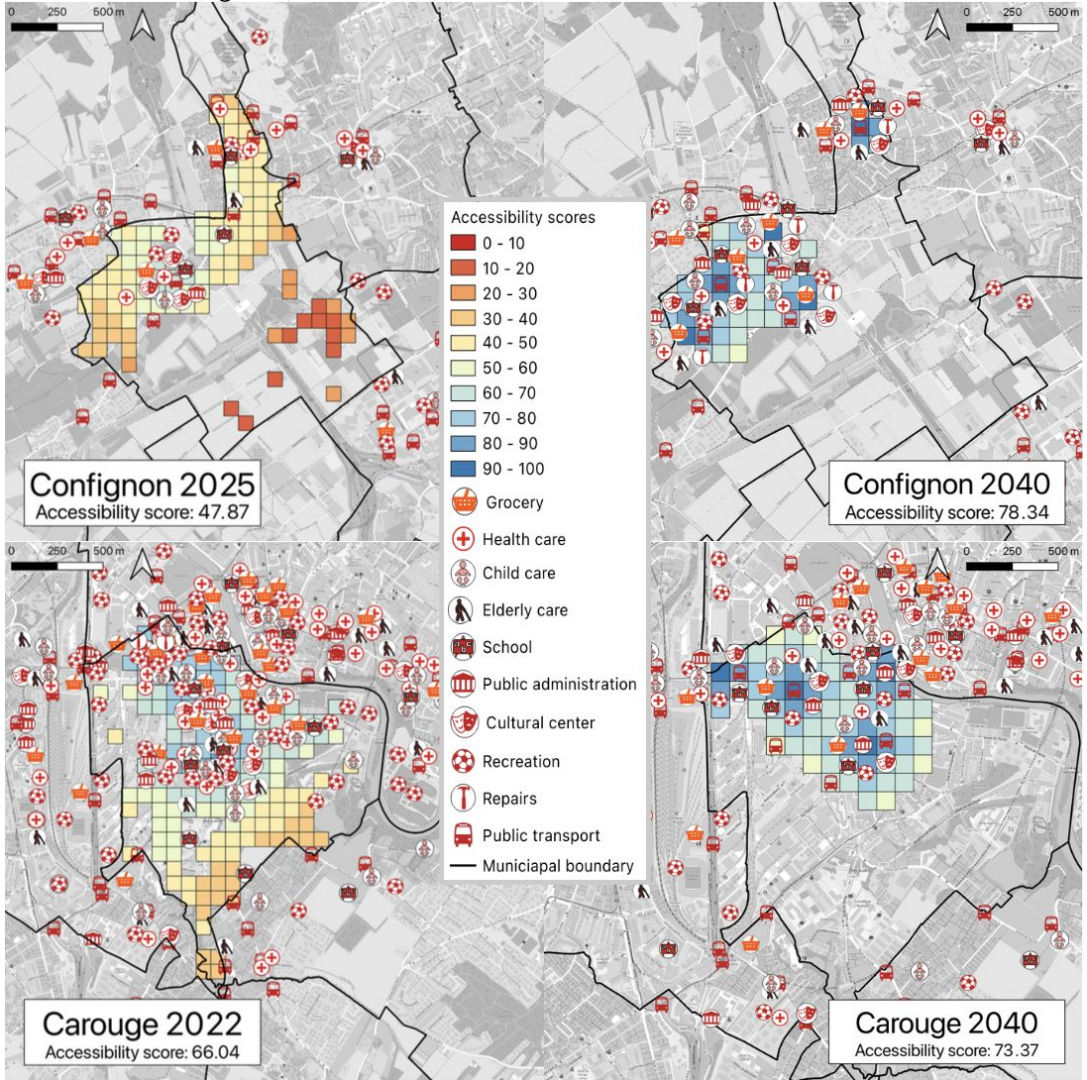
27.5% of m² not needed

Bottlenecks: initially **vacancies (0.5%)**, then **available workers**

Assumptions:

80% of workers remain in construction after moratorium; 100 m²/year renovated per worker, increasing to 150 m²/year over 10 years (S-curve)




Accessibility scores
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100
Grocery
Health care
Child care
Elderly care
School
Public administration
Cultural center
Recreation
Repairs
Public transport
Municiapal boundary
Confignon 2025
Accessibility score: 47.87
Confignon 2040
Accessibility score: 78.34
Carouge 2022
Accessibility score: 66.04
Carouge 2040
Accessibility score: 73.37
0 250 500 m

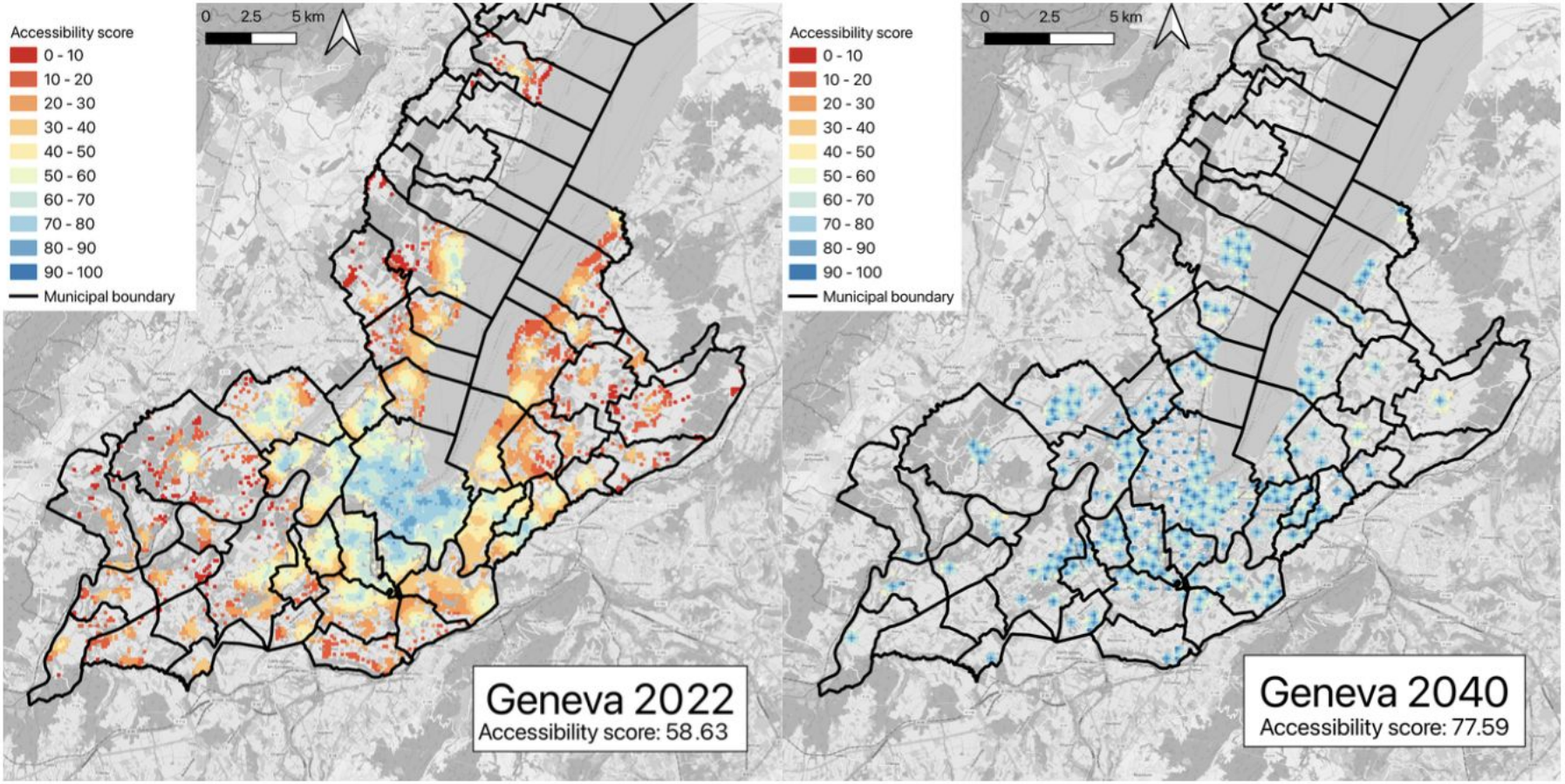


Figure 2. Map of canton Geneva, showing the accessibility score for each inhabited hectare in 2022, and after all four transformations have been completed in 2040.

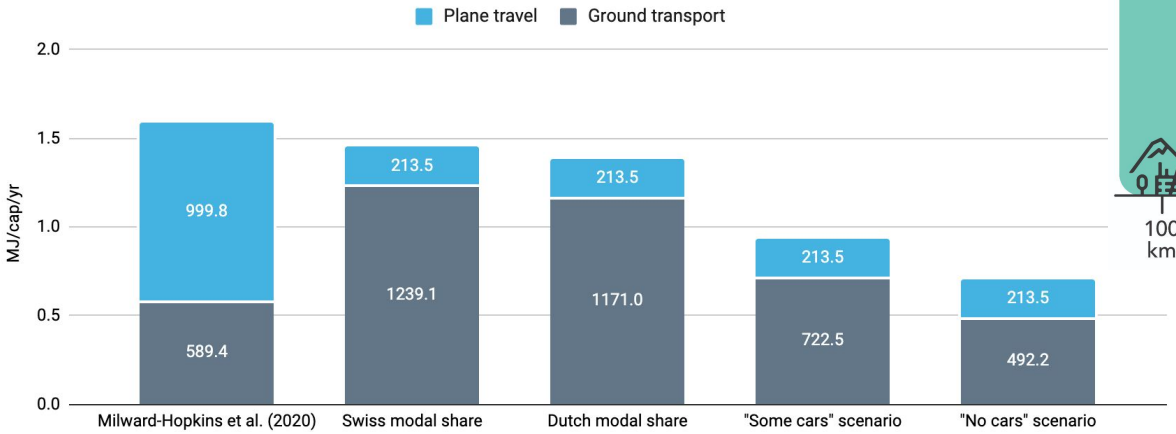
Transport reduction potential

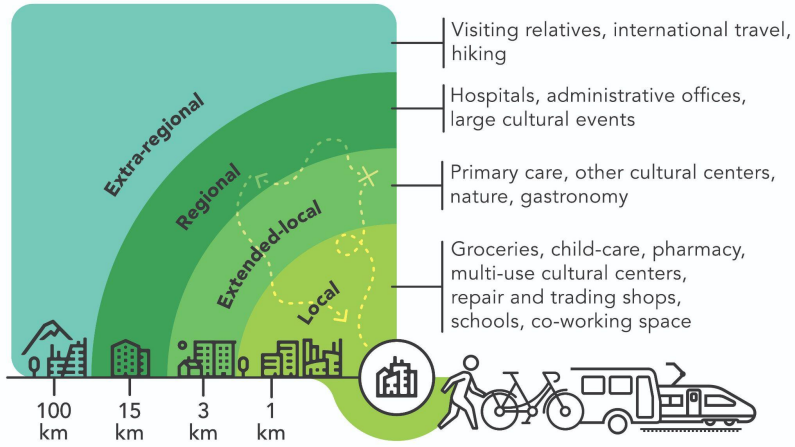
pkm -75%

Final energy -95% to -97%

31.55 → ~1 GJ/cap/yr

(277 → ~10 PJ/yr)



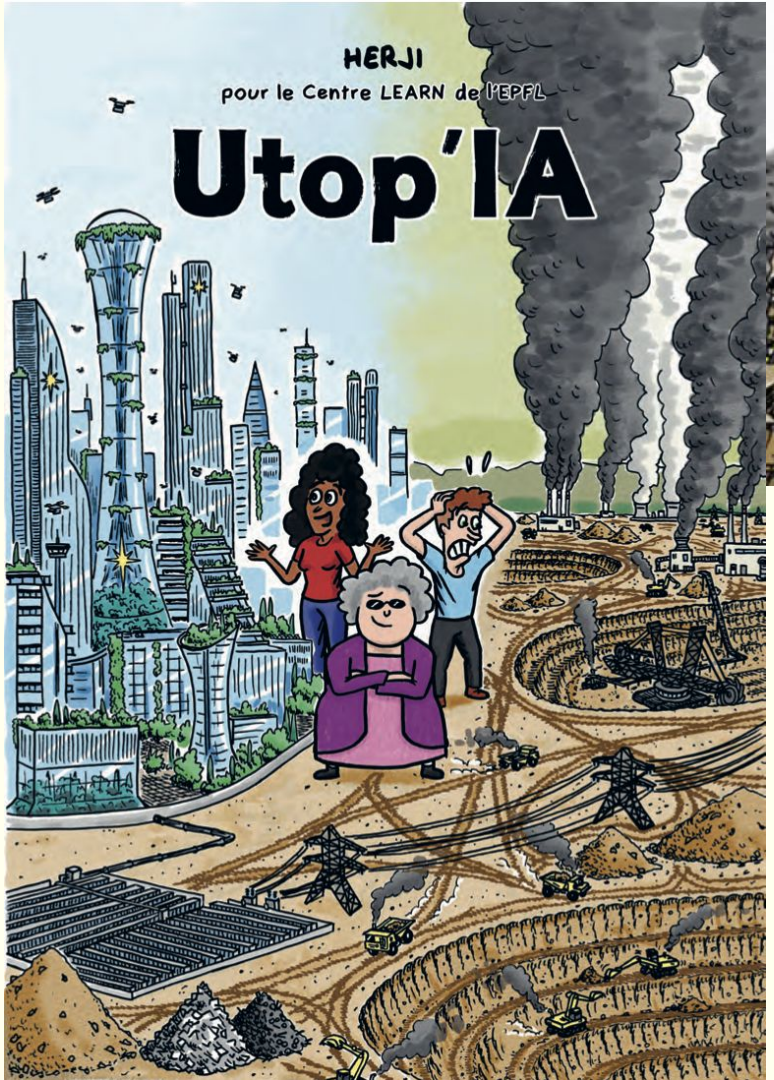


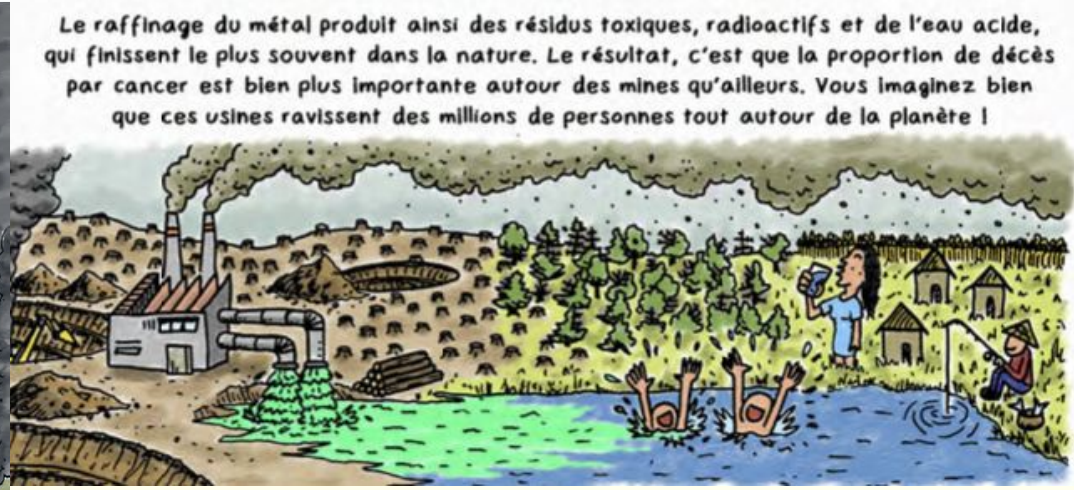
Method used or population considered		Annual mobility excluding air travel	Annual car transport	Annual public transport
Swiss population, 2015 Microcensus		13'754	7'611	3'372
Based on DLS best practice (Japan)		4'829	716	2'862
Interaction-based approach	Swiss modal share	3'241	1'717	495
	Dutch modal share	3'241	1'708	233
	“Some cars” scenario	3'241	587	1'143
	“No cars” scenario	3'241	0	1'704

SWICE Working Paper on DLS Mobility

Emile Chevrel, Joel Millward-Hopkins, Sascha Nick, Vivien Fisch-Romito
May 2024

	Transformation	Mission	Obstacles/risks	**Individuals** Residents, citizens, visitors	**Public / Communal** Federal, cantonal, communal offices; public utilities, public services, schools and universities, hospitals, community centers	**Private Sector** Builders, architects, engineers, materials providers, utilities, grid operators, transport providers, appliance makers, investors, banks
1	**Neighborhoods and mobility**	Integrated neighborhoods providing all essential local services including care, education, leisure, culture, and public transport, as well as biodiverse connected ecosystems.	Existing planning and zoning rules, regulation entrenching car dominance, urban sprawl, and individualized built and green spaces. Car-dependent leisure spaces and activities.	Consume and travel less; prioritize local leisure, culture, economy. Engage in local community, spend time outdoors.	Redesign neighborhoods for proximity, biodiversity, and resilience: green spaces, connected ecosystems, regulating urban heat and flooding. Enable community planning. Break car dependency.	(Re)build resilient, multifunctional territories, create local services and jobs. Provide spaces for leisure and culture, engage with residents and user communities. Respect "Social License".
2	**Housing renovation and reconfiguration**	Transform to flexible-use, mostly shared spaces, significantly reducing m² per person. Affordable, high-quality housing (air, sound, daylight), energy efficiency CECB A, heat pumps, area-wide renovation.	Rigid building standards, dominant real-estate models, high rents and costs; numerous obstacles to moving or downsizing.	Share activities and spaces, rethink values and priorities. Experiment and share experiences within collectives.	Set standards, support co-housing and community retrofits. Enable cooperative management and financing. Support individuals in transition.	Shift economic activity from new construction to renovation. Retrofit buildings for low energy demand, flexibility, and healthy collective living, repurpose or optimize offices and shops.
3	**Lifestyles and consumption**	Move to sufficiency: buy and use less material goods, share, maintain, and repair. Learning, work and production oriented to care and needs of society. Value time and social relations.	Whole economic system; cultural values of wealth accumulation, fashions, positional consumption, planned obsolescence; lack of habits, practices, knowledge, skills. Swiss employment and industry overrepresented in extractive and wealth-related sectors.	Cultural shift: buy very little, mostly locally, repair. Accept public luxury and private frugality. Enjoy new liberties to spend and work less, to lead a happier, healthier, and more meaningful life.	Provide incentives for low-impact lifestyles. Ensure and support repair activities. Restrict / make culturally unacceptable high-impact activities. Provide "public luxury": high-quality public spaces.	Provide services and products for sharing, repair, and reuse; enable sufficiency lifestyles. Shift from globalized supply to local value creation. Rethink corporate objectives.
4	**Energy transition and resilience**	Build resilient local energy systems: renewables, demand flexibility, prioritization, nested grids. Exit fossil fuels. Reduce demand. Energy communities.	Power of energy and industry incumbents, inflexible high demand, dependency on cheap energy (inequalities, high consumption).	Adjust activities to energy availability, become energy-aware. Rethink comfort habits.	Phase out fossil fuels. Align energy priorities with human needs and wellbeing; support energy communities and awareness programs.	Develop decentralized energy, provide flexibility solutions, ensure essential service continuity. Collaborate with energy communities.
5	**Policy, funding, incentives**	Policy roadmap, including funding, regulation and incentives, that prioritise healthy, active and democratic living in Switzerland within planetary boundaries.	Regulatory inertia, lobbying by incumbent sectors (fossil fuel, automotive, construction). Social norms, individualist culture, reluctance to change, impression that "Switzerland is already a model".	Fulfil moral obligations to all life, human and non-human. Participate in deliberative governance.	Design and enforce enabling policies, redistribute resources for equity and resilience, especially energy and m² per person. Promote economic democracy.	Align finance with sustainability, fund transition initiatives, innovate new business models. Shift focus from growth, profit, efficiency to community wellbeing.





"What matters is not technology itself, but the social or economic system in which it is embedded"

(Winner, 1980)