

Computational Methods in Urban Studies

Week 12: Systems - Prospective & strategic planning

Plan

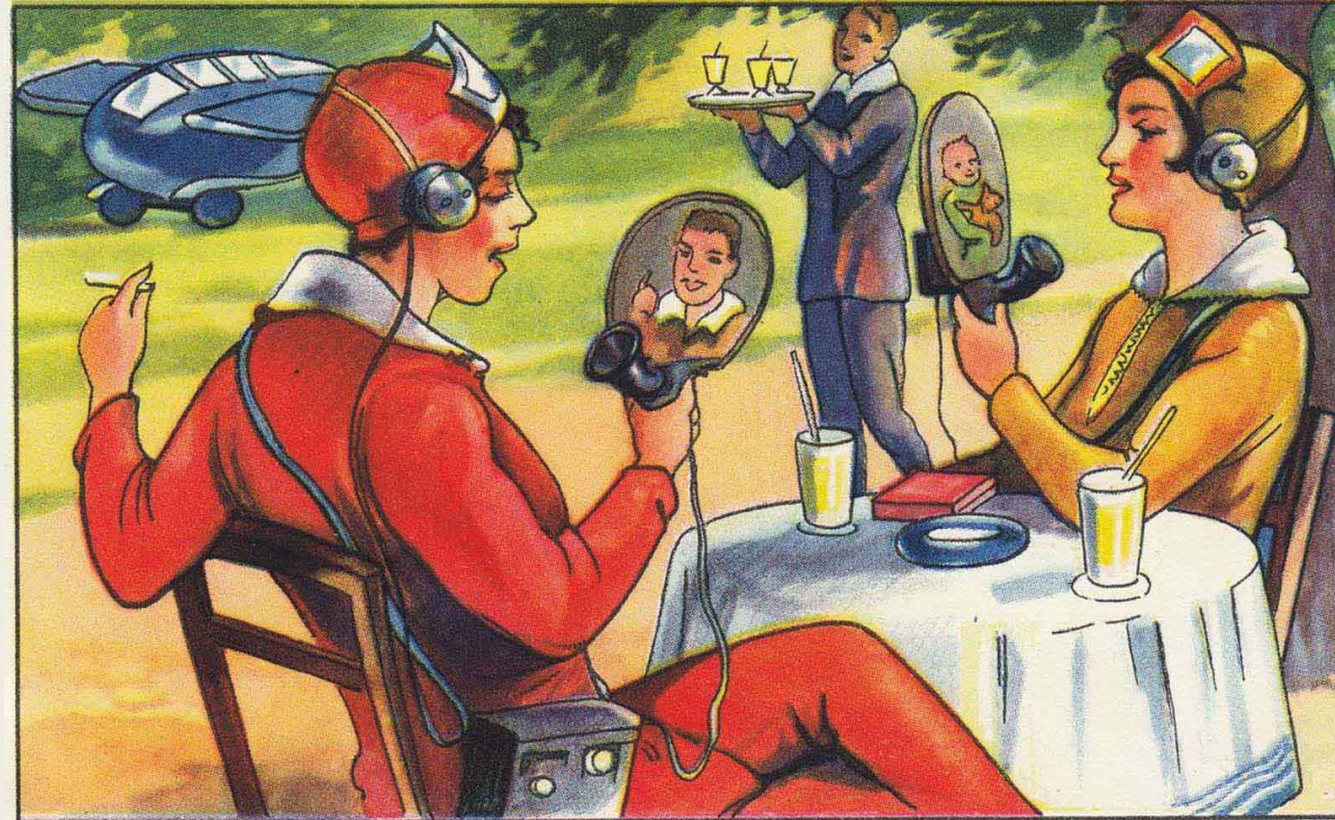
- 1. Technology & society**
 - Energy & equity
 - Tools for conviviality
- 2. Social ecology**
 - Social metabolism
 - Land use & materiality
- 3. Strategic foresight**
 - Scenario design & analysis
 - Prospective methodologies
- 4. Applications to urban systems**
- 5. Scenario analysis in practice**



The Plot

- **What do we mean by “prospective”?**
 - Futurists have existed for probably as long as humans have been humans – prophets, fortune-tellers, diviners...
 - Modern futurism became popular in the late 1800s and early 1900s, and increased with the rapid and often violent societal and technological changes of WWI

réf.: <https://rarehistoricalphotos.com/futuristic-visions-cards-germany/> ↓

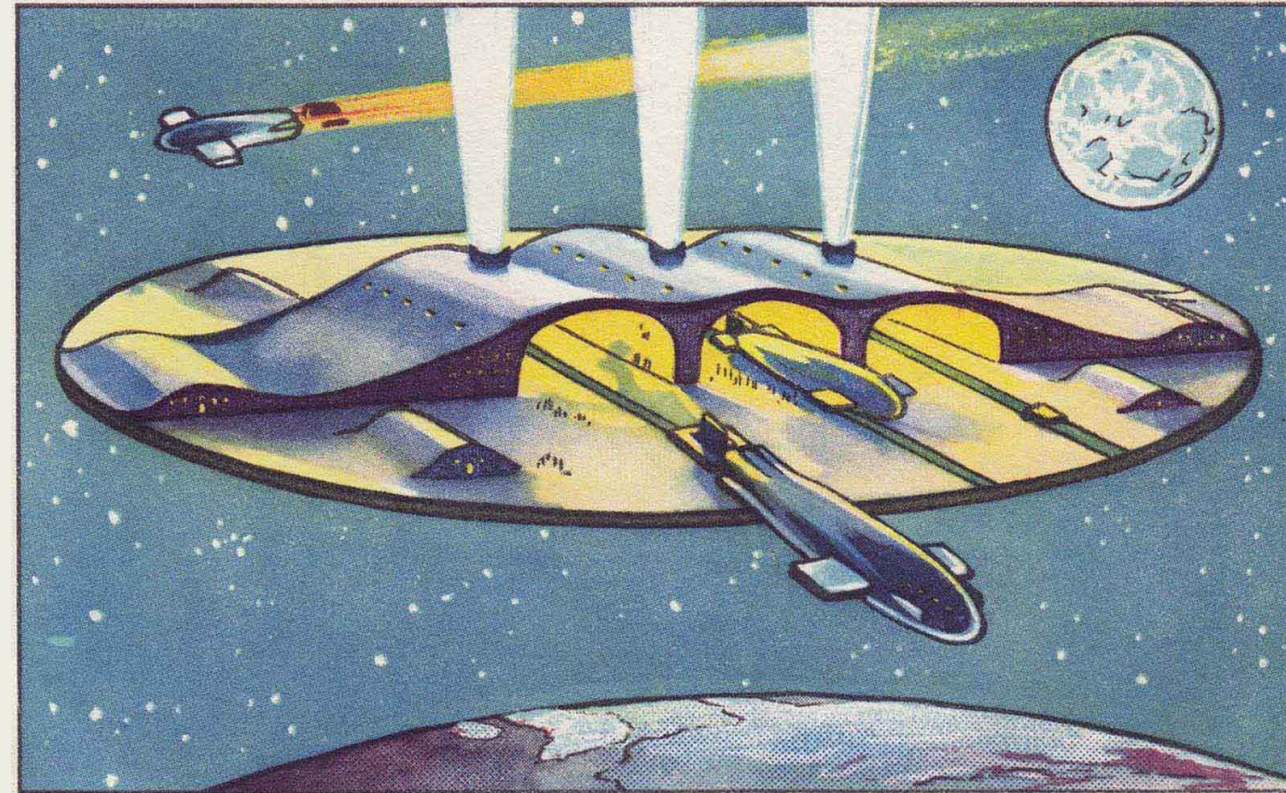


“Each person has their own transmitter and receiver and can communicate with friends and relatives using certain wavelengths. But television technology has become so advanced that people can talk and watch their friends in real-time. The transmitter and receiver are no longer bound to the location but are carried in a box the size of a photo apparatus.” - 1930

The Plot

- **“The future is already here – it’s just not evenly distributed.” – William Gibson**
 - What’s your take on this statement?
 - Why does technology have a prominent role in future narratives?
 - Future visions as revelator of present obsessions & underlying power dynamics
 - Who is imagining/dictating our future?

réf.: <https://rarehistoricalphotos.com/futuristic-visions-cards-germany/> ↓

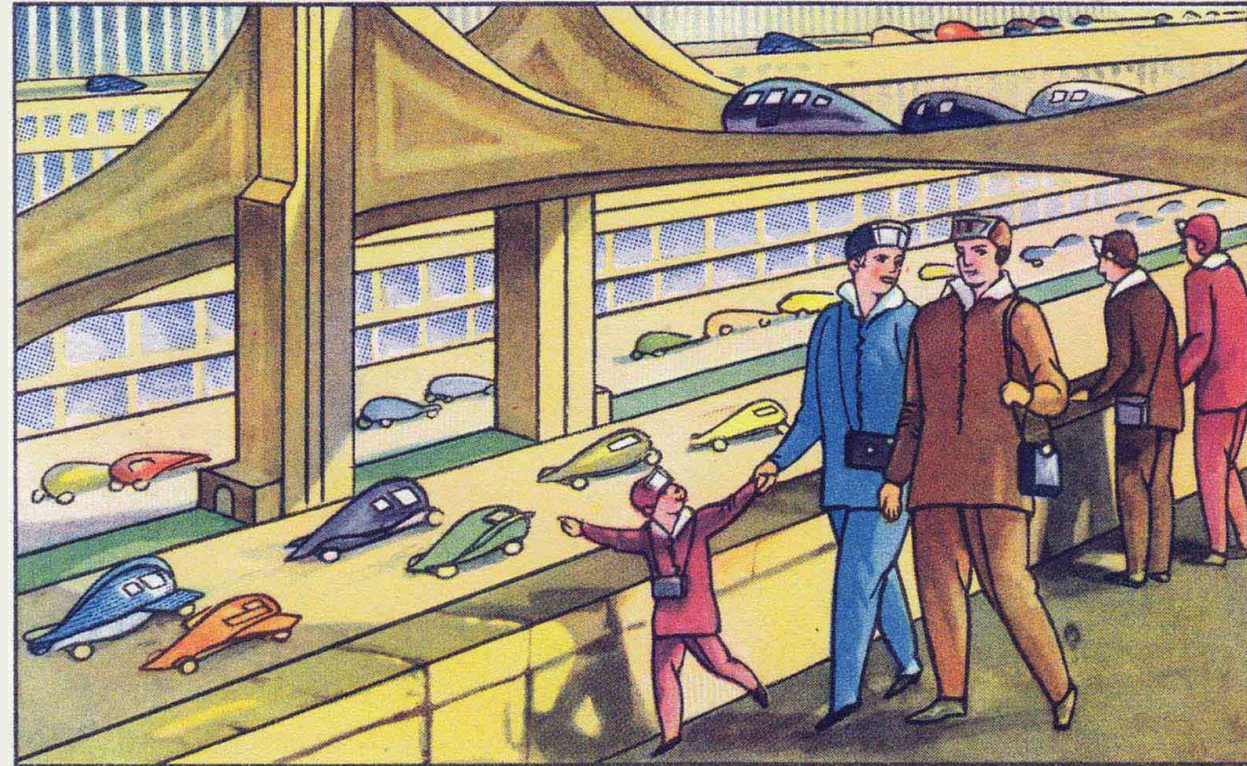


“Because there are rare minerals on the Moon, America has built a \$20 billion enterprise named MoMA-A.G. (Moon Minerals A.G.). At this dock station, the ships can renew their rocket fuel. The station floats freely in the space.” - 1930

The Plot

- **Scenario design: a tool to anticipate plural futures, rather than predicting it**
 - It is impossible to predict the future
 - However, possible scenarios can be created
 - These scenarios can then be used to estimate impacts, implications & recommendations

réf.: <https://rarehistoricalphotos.com/futuristic-visions-cards-germany/> ↓



“The horses are gone and electricity has replaced the steam power. The pedestrians are no longer in danger from traffic because the motorways and sidewalks are strictly separated. All men and women wear uniform clothing: zipped suits and pants.” - 1930

1. Technology & society

réf.: <https://paleofuture.com/blog/2015/2/4/42-visions-for-tomorrow-from-the-golden-age-of-futurism>



1. Technology & society

- **Energy and equity (Ivan Illich, 1973)**

- Written at the time of the first petroleum shock
- Showed that more energy leads to less equity
- Criticism of speed and energy intensity associated with industrial technology
- Forefather of the concept of “just transition”

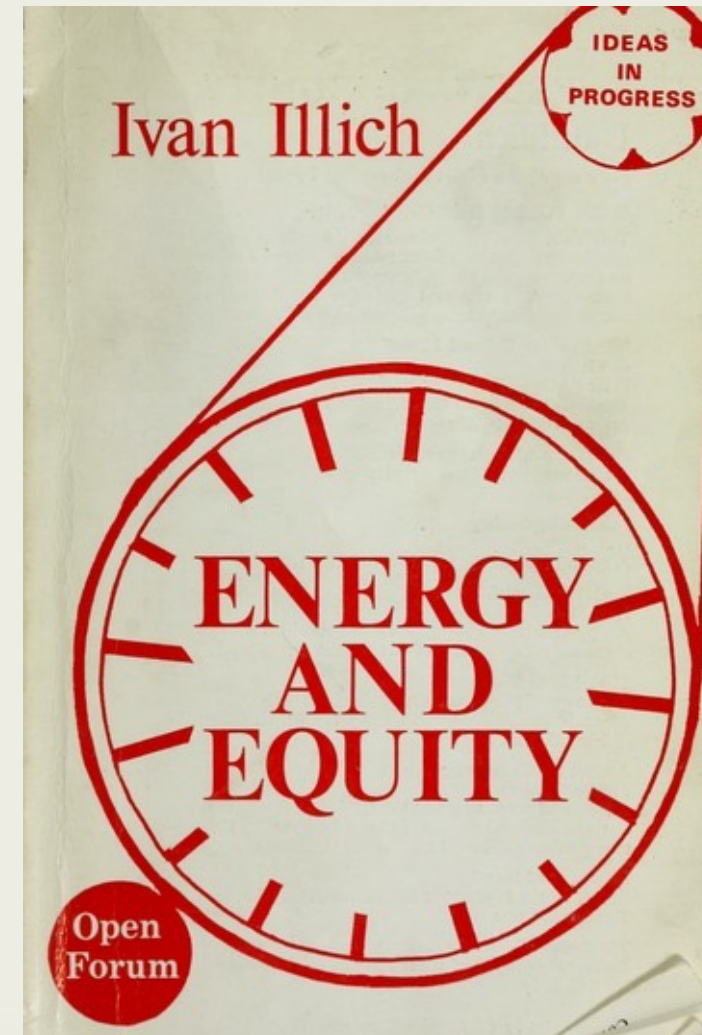
“Any industrial product that comes in per capita quanta beyond a given intensity exercises a radical monopoly over the satisfaction of a need. Beyond some point, compulsory schooling destroys the environment for learning, medical systems dry up the nontherapeutic sources of health, and transport smothers traffic.”

réf.:
https://blogs.ubc.ca/landscapesofenergy/files/2010/11/ivan-illich-energy_and_equity.pdf ↓

- 1 THE ENERGY CRISIS
- 2 THE INDUSTRIALIZATION OF TRAFFIC
- 3 SPEED-STUNNED IMAGINATION
- 4 NET TRANSFER OF LIFE-TIME
- 5 THE INEFFECTIVENESS OF ACCELERATION
- 6 THE RADICAL MONOPOLY OF INDUSTRY
- 7 THE ELUSIVE THRESHOLD
- 8 DEGREES OF SELF-POWERED MOBILITY
- 9 DOMINANT VERSUS SUBSIDIARY MOTORS
- 10 UNDEREQUIPMENT, OVERDEVELOPMENT, A

1. Technology & society

“The model American male devotes more than 1,600 hours a year to his car. He sits in it while it goes and while it stands idling. He parks it and searches for it. He earns the money to put down on it and to meet the monthly installments. He works to pay for gasoline, tolls, insurance, taxes, and tickets. He spends four of his sixteen waking hours on the road or gathering his resources for it. And this figure does not take into account the time consumed by other activities dictated by transport: time spent in hospitals, traffic courts, and garages; time spent watching automobile commercials or attending consumer education meetings to improve the quality of the next buy. The model American puts in 1,600 hours to get 7,500 miles: less than five miles per hour. In countries deprived of a transportation industry, people manage to do the same, walking wherever they want to go, and they allocate only 3 to 8 per cent of their society’s time budget to traffic instead of 28 per cent. What distinguishes the traffic in rich countries from the traffic in poor countries is not more mileage per hour of life-time for the majority, but more hours of compulsory consumption of high doses of energy, packaged and unequally distributed by the transport industry.”



1. Technology & society

- **Tools for conviviality (Ivan Illich, 1973)**

- Two watersheds
- Convivial tools (e.g. bicycle, ball-bearing, motor, telephone, etc.)
- Industrial technology, which enslaves rather than liberates man

“I choose the term conviviality to designate the opposite of industrial productivity. I intend it to mean autonomous and creative intercourse among persons, and the intercourse of persons with their environment; and this in contrast with the conditioned response of persons to the demands made upon them by others, and by a man-made environment. I consider conviviality to be individual freedom realized in personal interdependence and, as such, an intrinsic ethical value. I believe that, in any society, as conviviality is reduced below a certain level, no amount of industrial productivity can effectively satisfy the needs it creates among society’s members.”

réf.:

https://arl.human.cornell.edu/linked%20docs/Illich_Tools_for_Conviviality.pdf ↓

- I. Two Watersheds
- II. Convivial Reconstruction
- III. The Multiple Balance
 - a. Biological Degradation
 - b. Radical Monopoly
 - c. Overprogramming
 - d. Polarization
 - e. Obsolescence
 - f. Frustration
- IV. Recovery
 - a. The Demythologization of Science
 - b. The Rediscovery of Language
 - c. The Recovery of Legal Procedure
- V. Political Inversion
 - a. Myths and Majorities
 - b. From Breakdown to Chaos
 - c. Insight into Crisis
 - d. Sudden Change

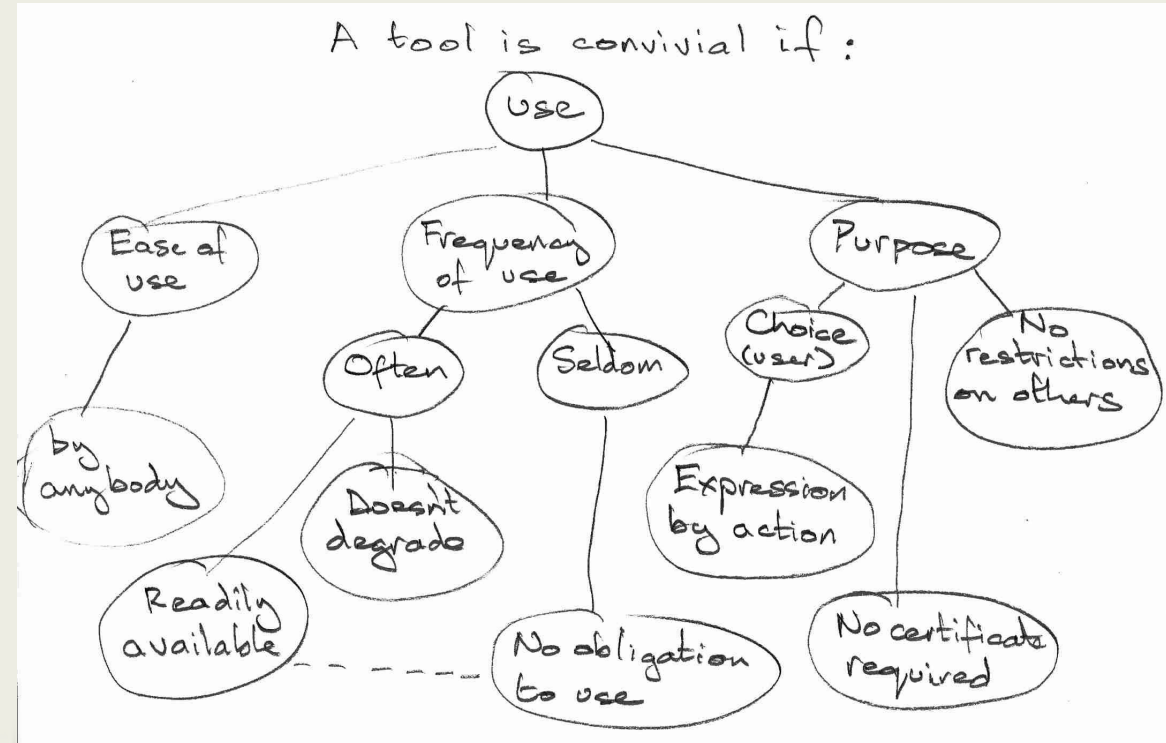


1. Technology & society

Each of you shares an example of convivial tools

- can be easily used, by anybody, as often or as seldom as desired
- are used to accomplish a purpose chosen by the user
- the use of such tools by one person does not restrain another from using them equally
- do not require previous certification of the user
- do not impose any obligation to use them
- allow users to pursue their goals in their own ways
- allow the user to express meaning in action.

réf.: <https://northernschool.info/node/600> ↓

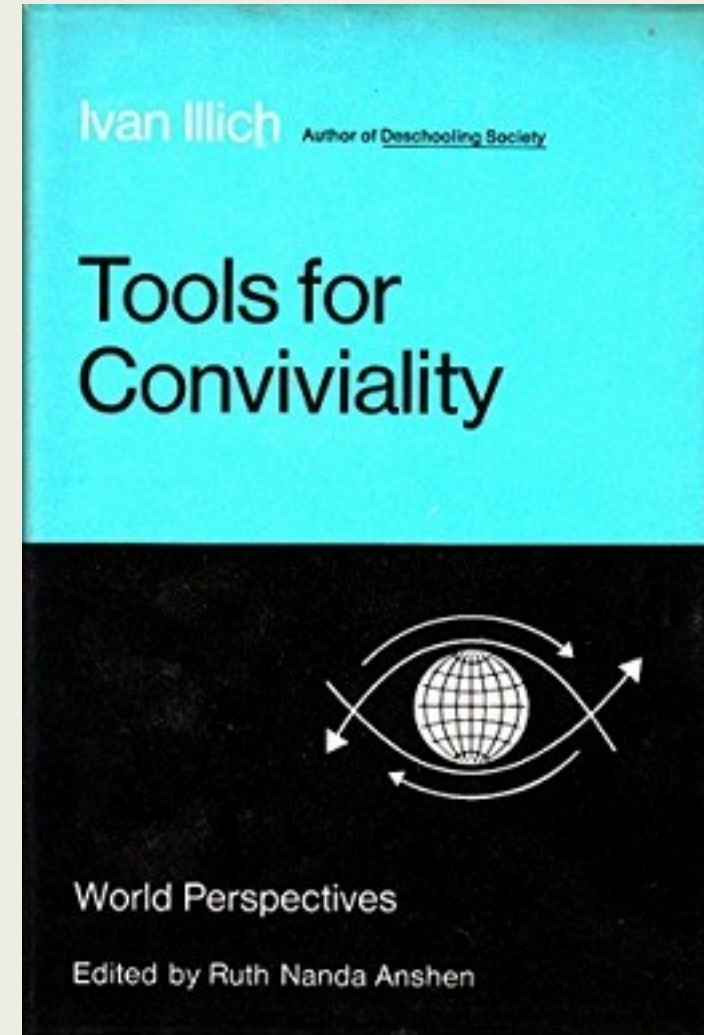


1. Technology & society

- **Radical monopoly**

- Dominance of one (industrial) product which reshapes our daily life to impede our ability to satisfy our own needs
- e.g. car for transport, school for education, hospital for health

“A thirsty man might desire a cold, gaseous, and sweet drink and find himself restricted to the choice of just one brand. He still remains free to quench his thirst with beer or water. Only if and when his thirst is translated without meaningful alternatives into the need for a Coke would the monopoly become radical. By “radical monopoly” I mean the dominance of one type of product rather than the dominance of one brand. I speak about radical monopoly when one industrial production process exercises an exclusive control over the satisfaction of a pressing need, and excludes nonindustrial activities from competition. Cars can thus monopolize traffic. They can shape a city into their image—practically ruling out locomotion on foot or by bicycle.”



1. Technology & society

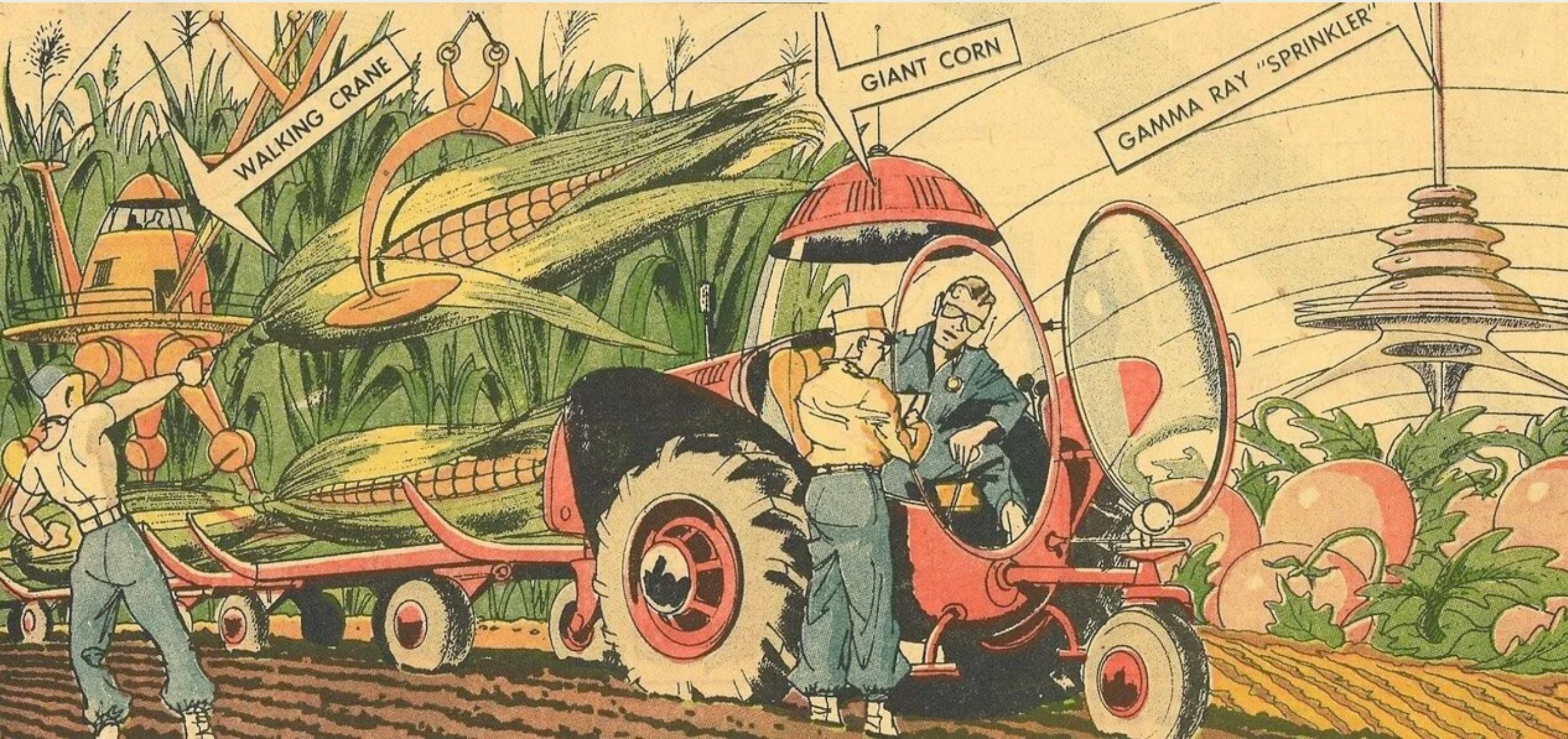
- Each of you shares an example of radical monopoly

réf.: <https://www.reddit.com/r/fuckcars/> ↓



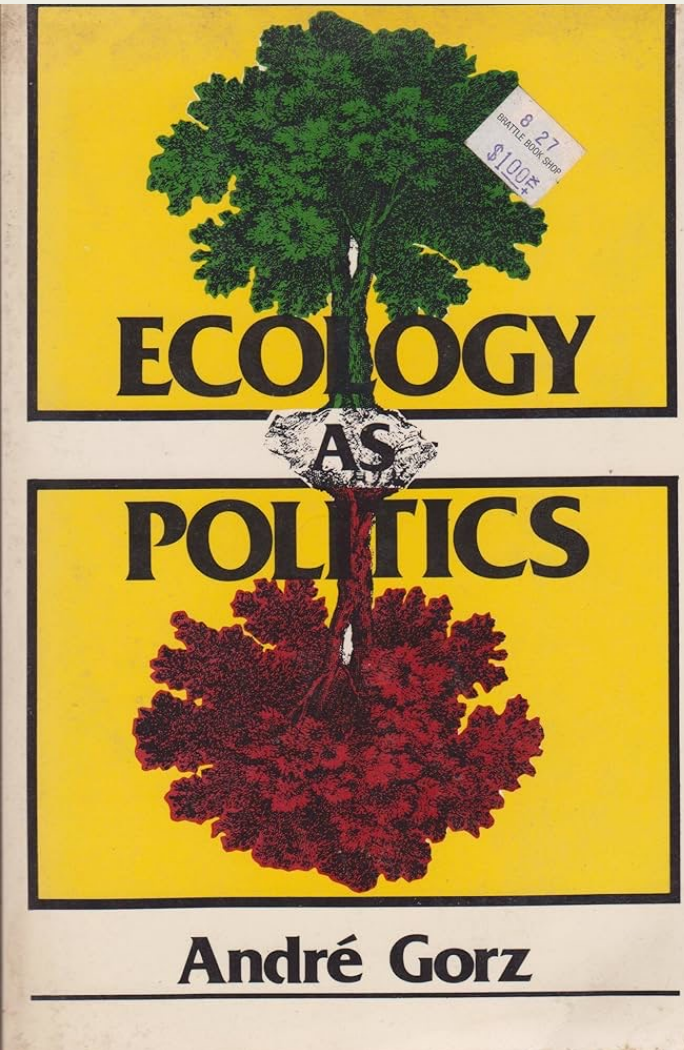
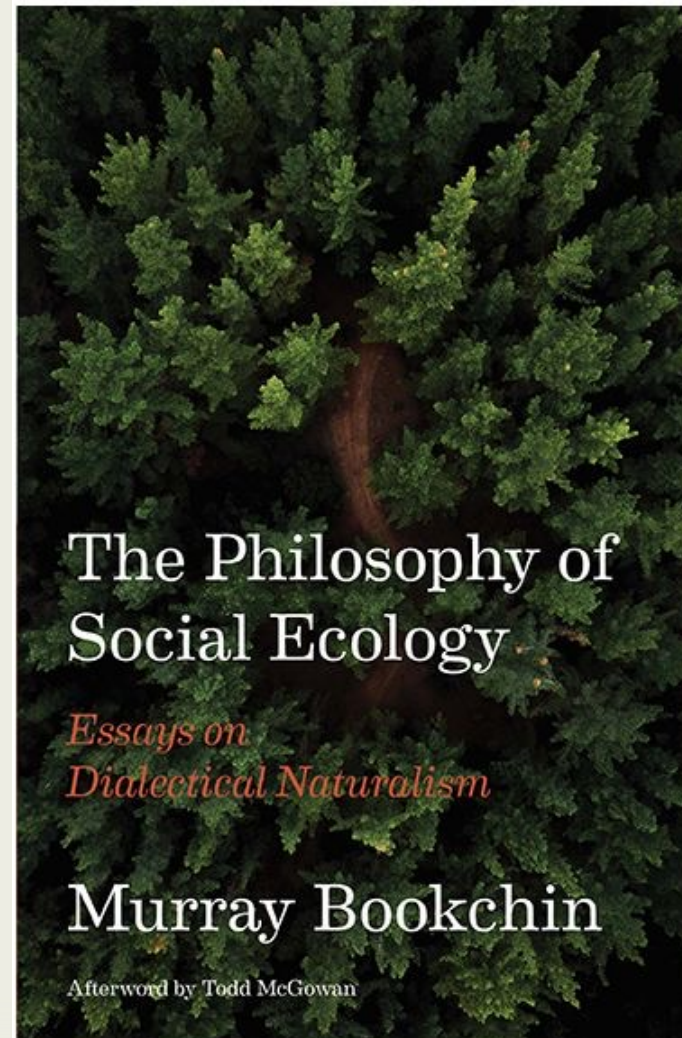
2. Social ecology

réf.: <https://paleofuture.com/blog/2015/2/4/42-visions-for-tomorrow-from-the-golden-age-of-futurism> ↓



2. Social ecology

- **Social ecology**
 - H. Haberl, M. Fischer-Kowalski, F. Krausmann – the “Vienna School”
- **Ecological economics**
 - J. Martinez-Allier, G. Kallis – the “Barcelona school”
 - J. Steinberger, C. Binder – towards a “Lausanne school”?
- **Political ecology**
 - Murray Bookchin
 - André Gorz



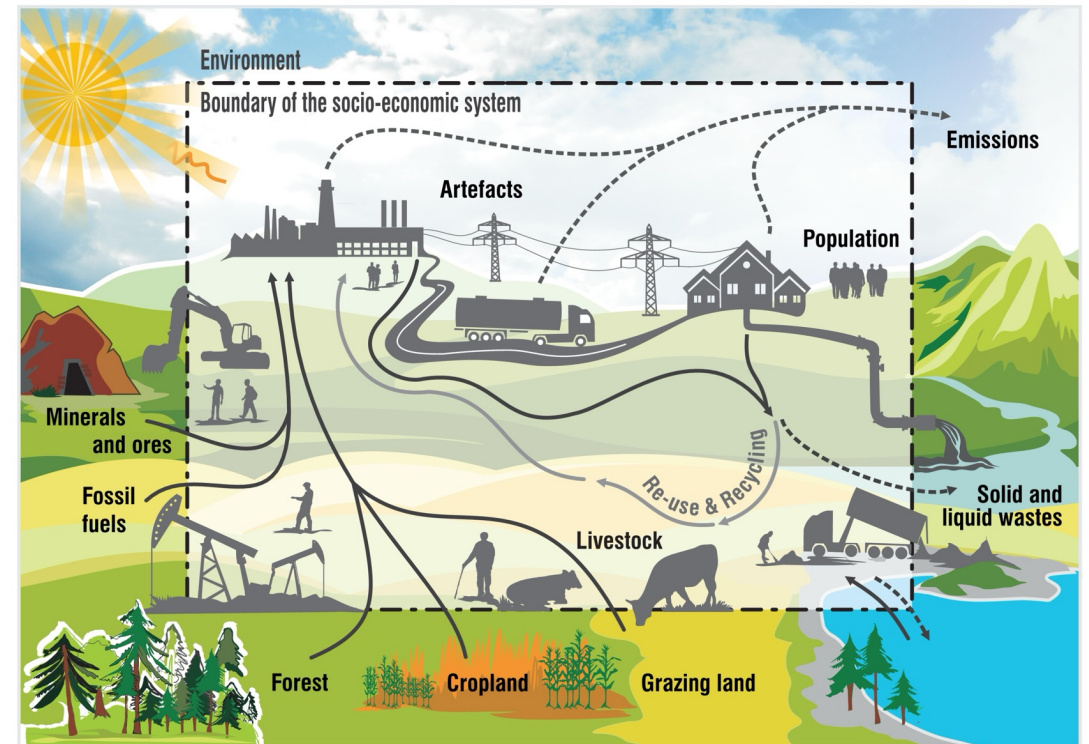
2. Social ecology

• Social metabolism

→ “urban metabolism” meets “planetary urbanization”

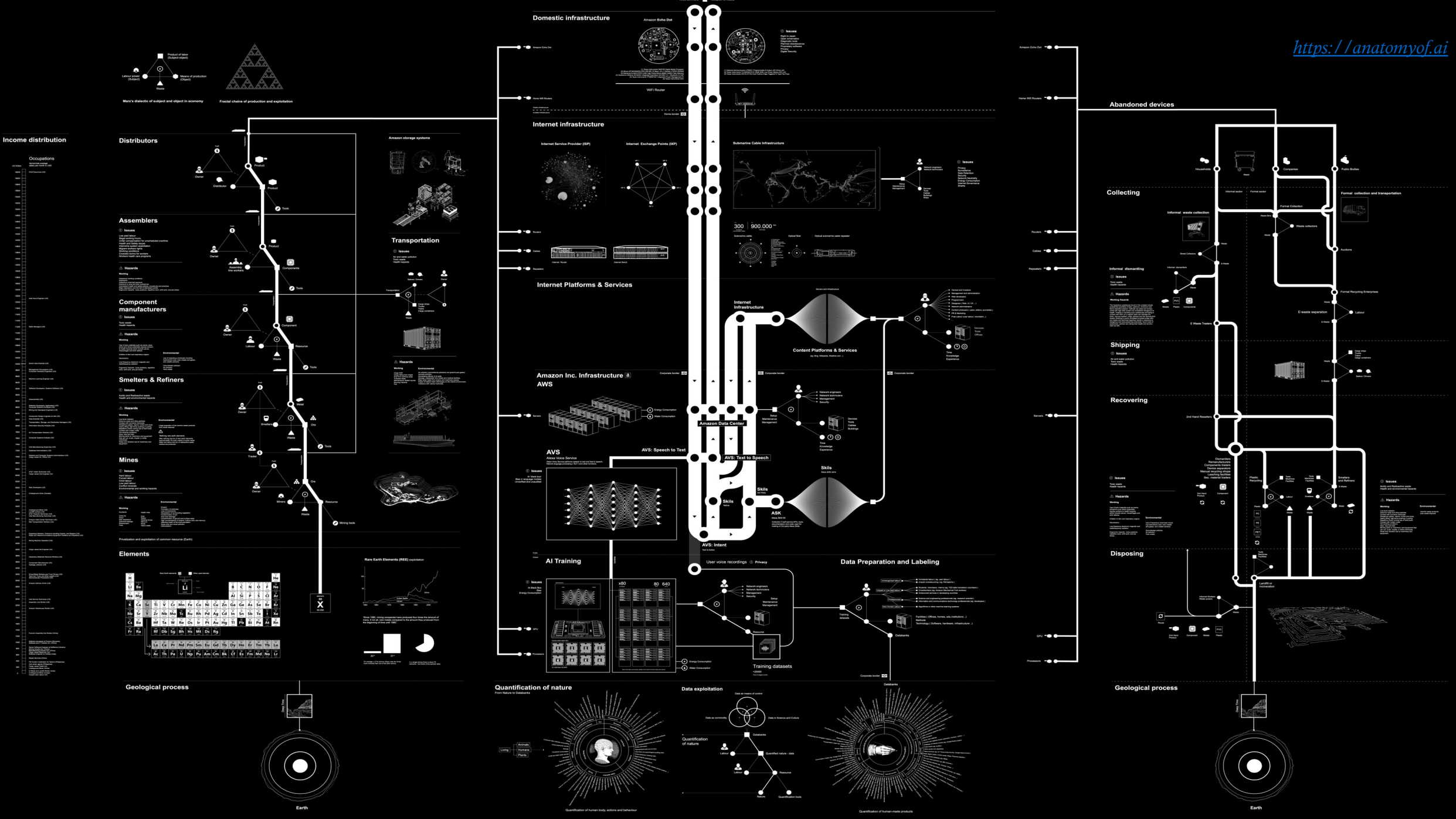
“Societies depend on a continuous throughput of materials and energy required to build up, maintain and operate their material stocks (e.g. buildings, infrastructures, machinery as well as humans and livestock). This "social metabolism" can be seen as a functional equivalent of biological metabolism. Socio-metabolic research links the use of biophysical resources to social organization, recognizing that the quantity, composition, sources and sinks of resources used, as well as the material stocks created in the process, reflect socio-economic production and consumption systems that are highly variable across time and space.”

réf.: <https://boku.ac.at/en/wiso/isec/research/gesellschaftlicher-stoffwechsel> ↓



2. Social ecology

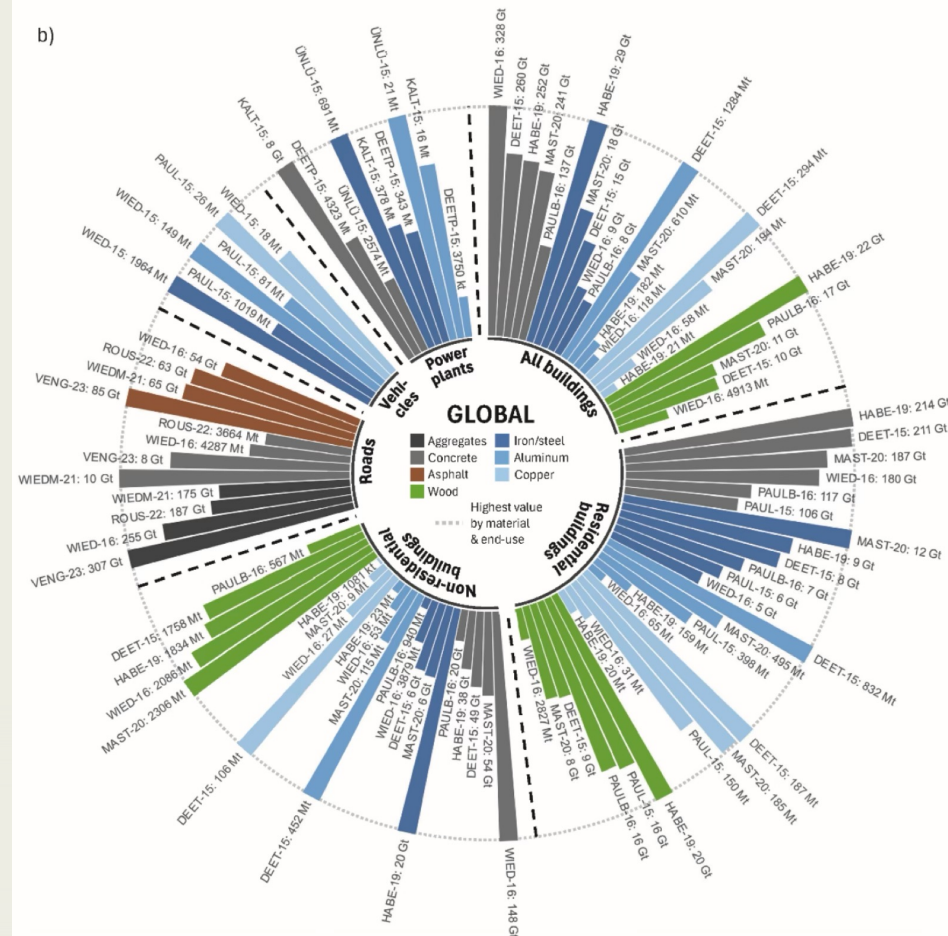
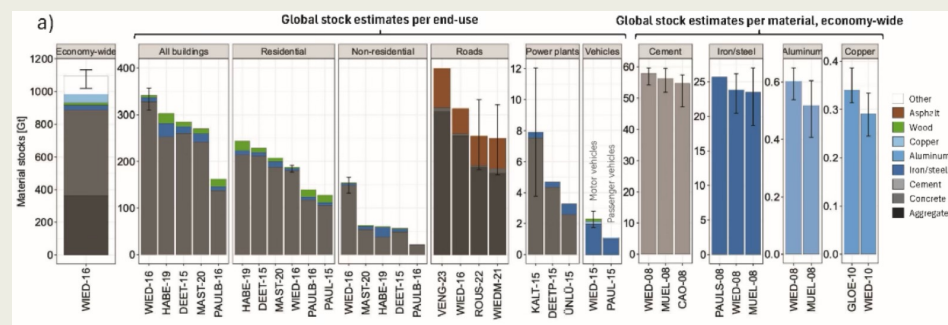
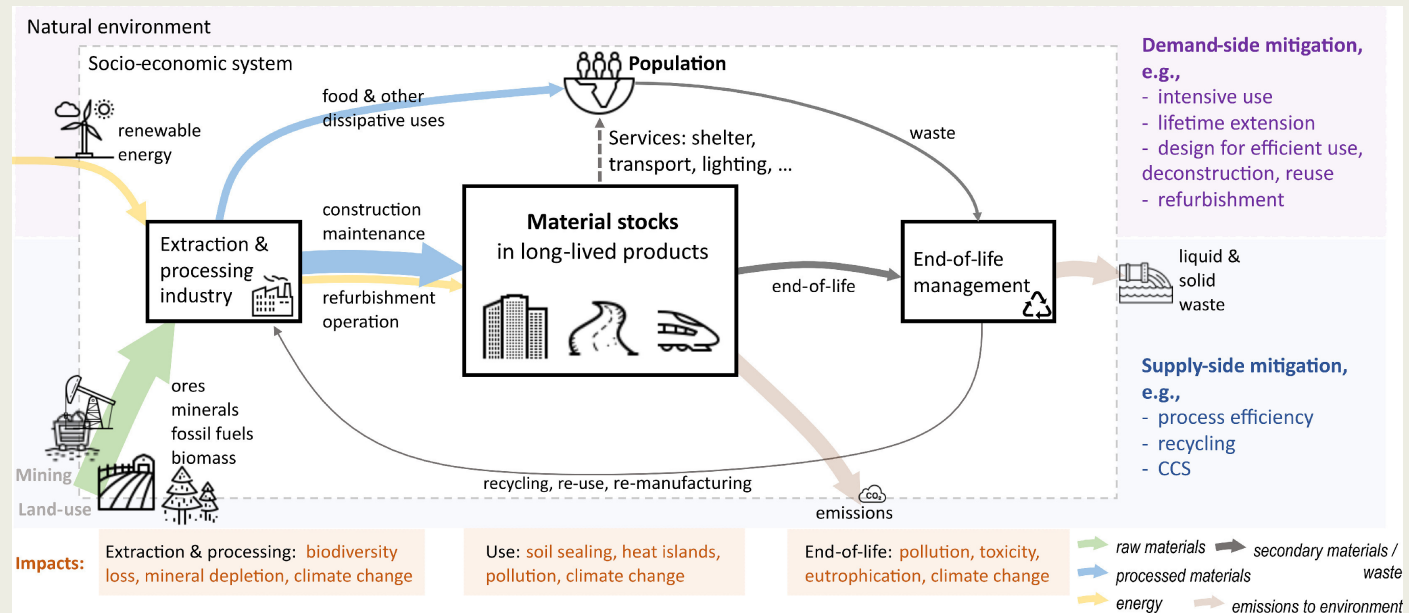
- **Key research questions of social metabolism:**
 - How to consistently quantify societies' material and energy flows as well as material stocks across various functional and spatial scales? What are appropriate units of measurement and aggregation?
 - What are the differences between the levels of resource use and material stocks among countries and world regions, and how can these be explained? How to define sustainable resource use?
 - What are the causal relations between the physical and the monetary economy? What preconditions facilitate current industrial metabolic patterns, and what are their environmental consequences?
 - How can knowledge of socio-metabolic patterns of stocks and flows gain momentum in policy? How can this knowledge be transformed into feasible strategies of decoupling or dematerialization?
 - What impact does global trade have upon resource use and what are its environmental consequences? How can national indicators and accounting systems be adapted to consistently take ecological terms of trade into account?



2. Social ecology

Materiality and land use

- Material flow analysis of global infrastructure stocks
- China cement consumption last 2yrs > US in XXth century
- Yet, research shows that only small increases in material stocks are needed to achieve decent living standards globally



ref.: Streeck, J., Baumgart, A., Haberl, H., Krausmann, F., Cai, B., Fishman, T., ... & Wiedenhofer, D. (2024). Quantifying material stocks in long-lived products: research frontiers for sustainable resource-use strategies ↑ & →

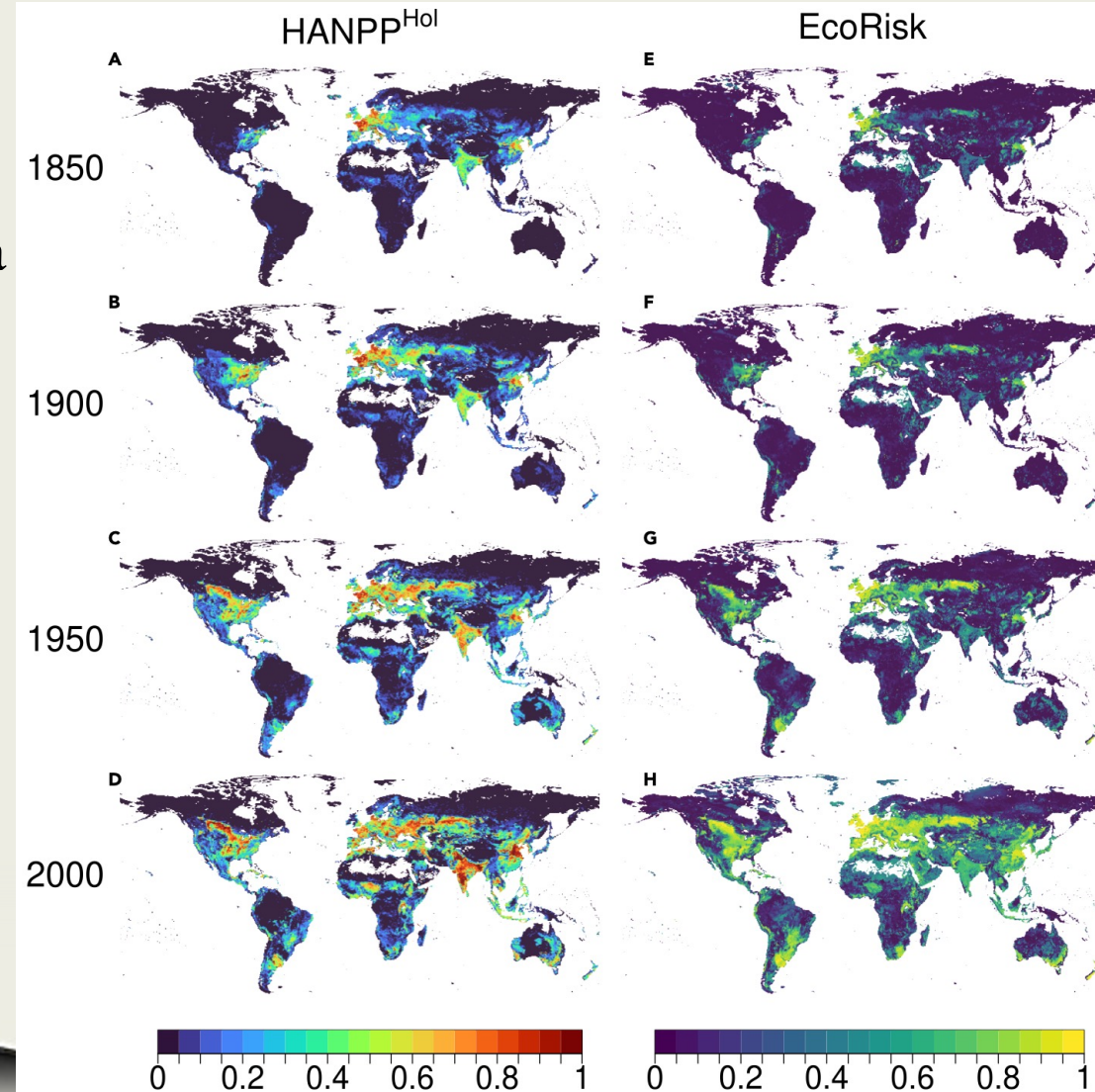
2. Social ecology

Materiality and land use

- Over half of Earth's land surface has transgressed critical ecological thresholds, signaling a breach of planetary boundaries for functional biosphere integrity
- Land-use change and resource extraction can become a blind spot when ecology is reduced to climate change

“A stable Earth system requires a healthy biosphere, but many ecosystems are being pushed beyond safe limits due to human activities such as land-use change, resource extraction, or climate changes. Several indicators exist to assess the local state of the biosphere. However, ones that can be aggregated globally and directly linked to planetary-scale thresholds for ecosystem integrity are still lacking, compromising our ability to mitigate degradation and deploy conservation strategies.”

réf.: Stenzel, F., Uri, L.B., Braun, J., Breier, J., Erb, K., Gerten, D., Haberl, H., Matej, S., Milo, R., Ostberg, S. and Rockström, J., 2025. Breaching planetary boundaries: Over half of global land area suffers critical losses in functional biosphere integrity. One Earth, 8(8) ↓



3. Strategic foresight

réf.: <https://paleofuture.com/blog/2015/2/4/42-visions-for-tomorrow-from-the-golden-age-of-futurism>



3. Strategic foresight

- **What is strategic foresight / *prospective* ?**
 - As foresight gains visibility, communicative flair often outpaces analytical depth. Catchy metaphors and fashionable reframings make futures feel accessible, but they also risk detaching the field from its core: systematic exploration, evidence-based reasoning, and strategic linkage to decision-making.
 - Impact-driven foresight connects imagination with implementation. It traces clear lines between today's signals, tomorrow's uncertainties, and the concrete actions required to navigate them.
 - This requires structure – anchored time horizons, transparent assumptions, and accountable pathways – not slogans or semantic innovation. The future may be uncertain, but the method for engaging it should remain intelligible and testable.

“Foresight thrives when creativity meets discipline. Yet in recent years, the field has seen a growing tendency toward rhetorical flourish and motivational metaphors. This reflection argues for re-centering foresight on its methodological foundations – so that anticipation remains a tool for shaping futures, not for performing them.” Rafael Popper

3. Strategic foresight

- Core principles of strategic foresight:

réf.: <https://rafaelpopper.wordpress.com> ↓



PROSPECTIVE PRINCIPLE

Foresight isn't prediction: it treats the future as open and helps us anticipate and shape preferred visions.



PARTICIPATION PRINCIPLE

Foresight convenes diverse voices: engaging stakeholders to deliberate, analyse, and synthesize for inclusive outcomes.



POLICYMAKING PRINCIPLE

Foresight goes beyond analysis: empowering actors to shape the future; do it only when actions can follow.



EVIDENCE PRINCIPLE

Foresight blends judgment with trend, forecast, and data-uncertain futures, but outputs grounded in evidence.



COORDINATION PRINCIPLE

Foresight engages multiple actors to debate futures and align around agendas, coordinating effort and resources.



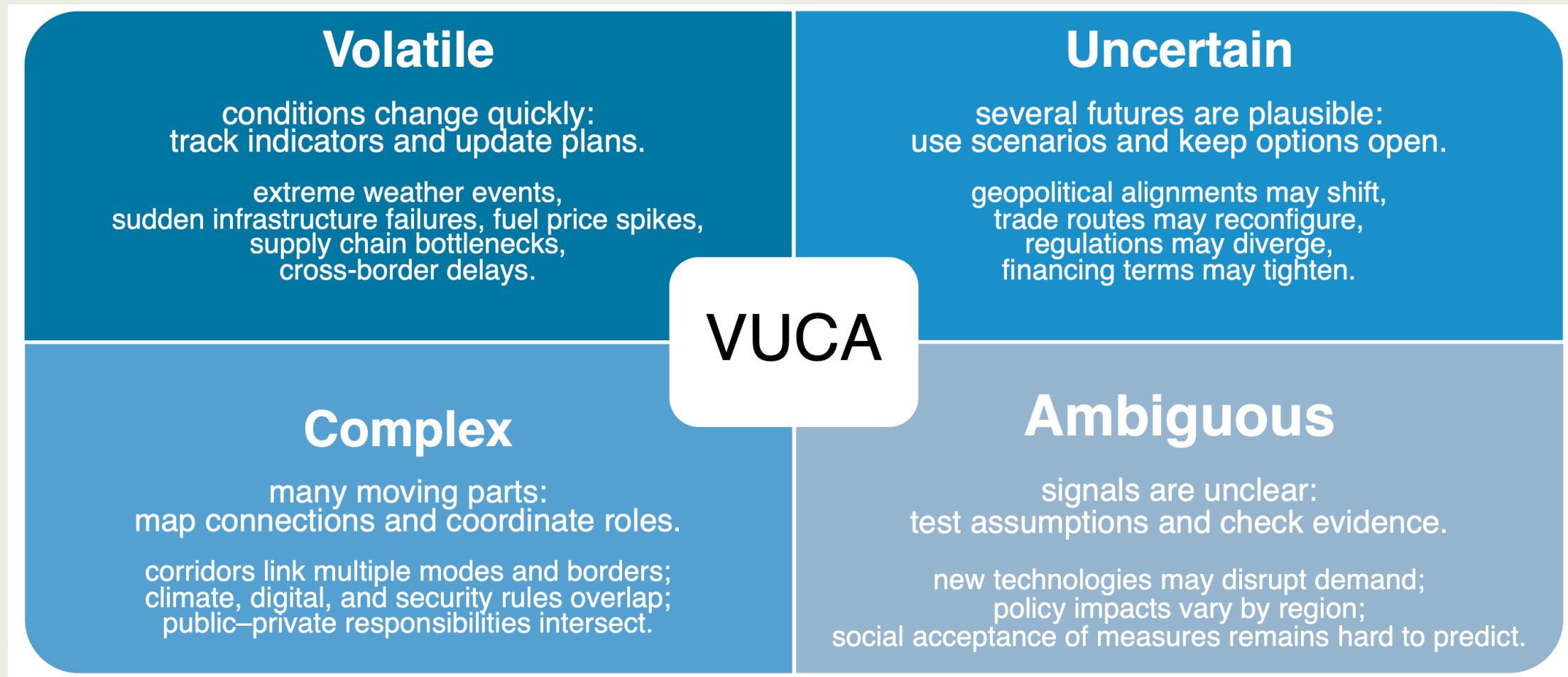
TRANSDISCIPLINE PRINCIPLE

Foresight embraces complexity: crossing disciplines, deepening understanding, building relationships.

3. Strategic foresight

- The VUCA framework:

réf.: <https://rafaelpopper.wordpress.com> ↓



3. Strategic foresight

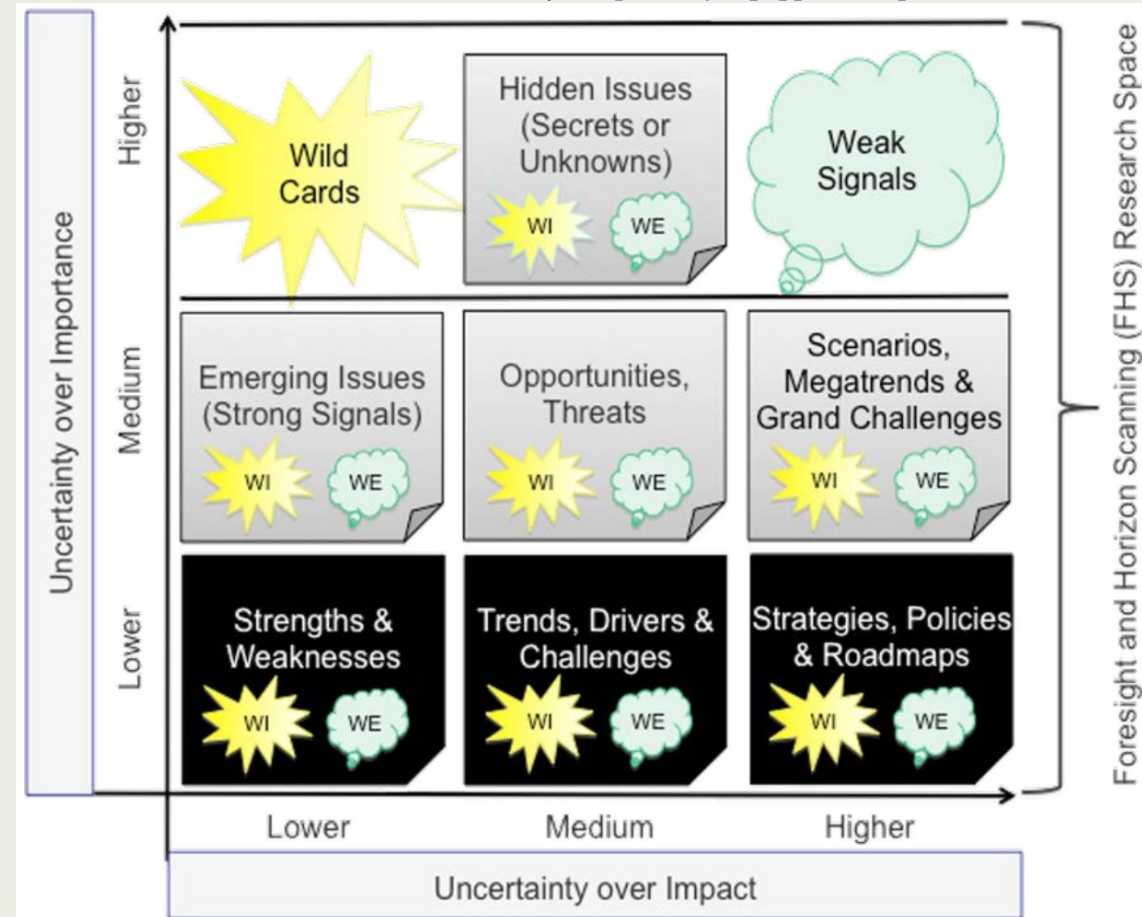
• What is a scenario?

- “A scenario is not a future reality but rather a means to represent it with the aim of clarifying present action in light of possible and desirable futures”
- the complexity of problems require methods as rigorous and participatory as possible

“The term strategy has been misused and even abused. Worse, the word scenario is often confused with strategy [...] One of the main functions of the strategic futures exercise is to eliminate two errors that we usually describe as the “hammer’s risk” and the “nail’s dream.” In other words, we forget what a hammer’s function is when staring at a nail (the nail’s dream) or we know how to use a hammer and imagine that every problem is like a nail (the hammer’s risk)”

réf.: Godet, M. (2000). *The art of scenarios and strategic planning: tools and pitfalls. Technological forecasting and social change*, 65(1), 3-22.

réf.: <https://rafaelpopper.wordpress.com> ↓



Foresight and Horizon Scanning (FHS) Research Space

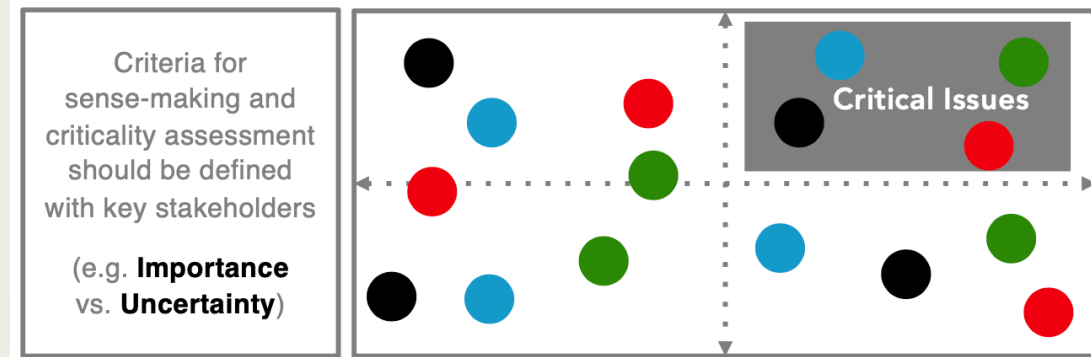
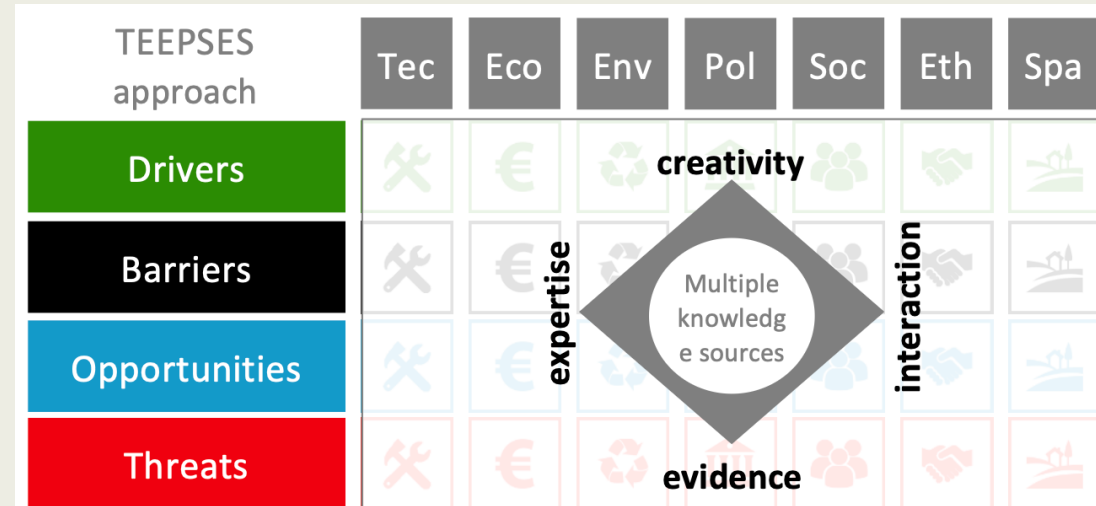
3. Strategic foresight

- **Drivers/Barriers/Opportunities/Threats can be:**

- Technological,
- Economic
- Environmental
- Political
- Social
- Ethical
- Spatial
- ...

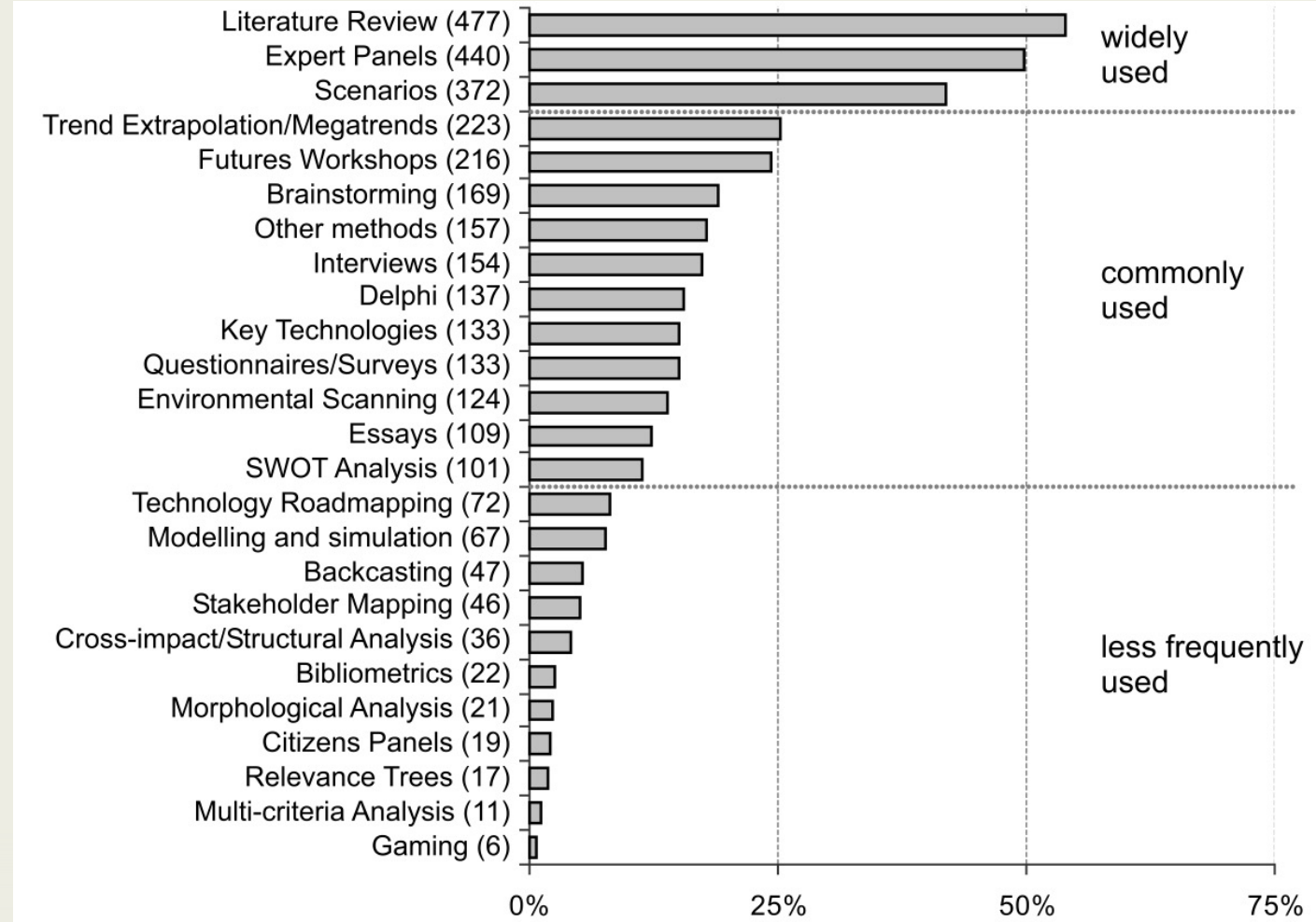
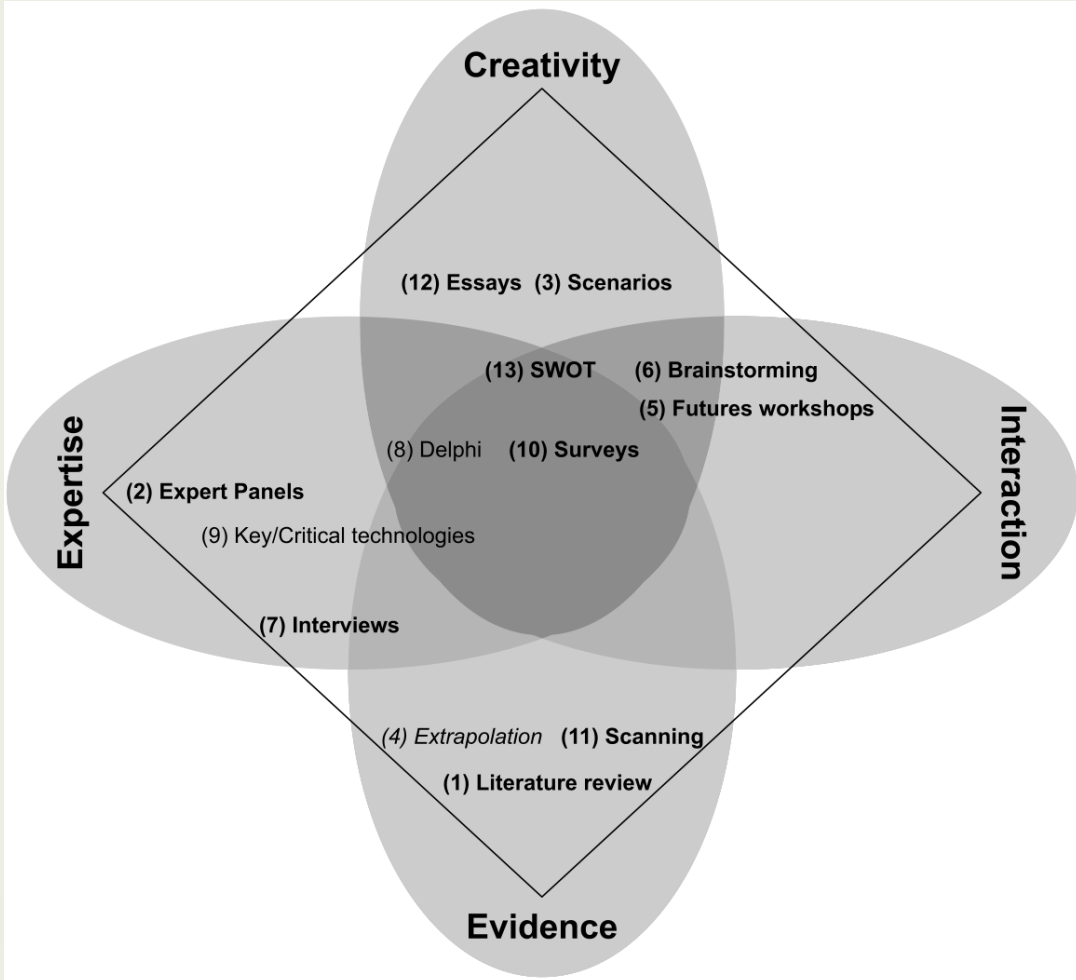
- **Assess their importance vs uncertainty**

réf.: <https://rafaelpopper.wordpress.com> ↓



3. Strategic foresight

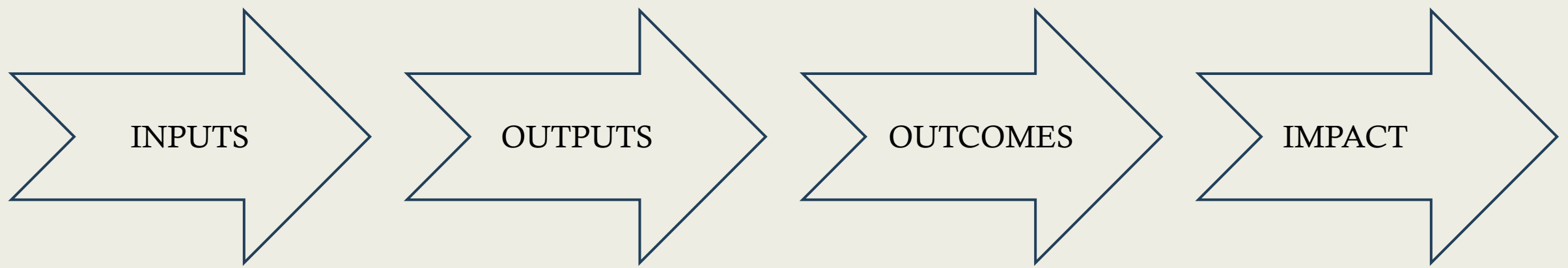
- Combining strategic foresight methods: creativity, interaction, evidence, expertise



réf.: Popper, R. (2008). How are foresight methods selected?. foresight, 10(6), 62-89.

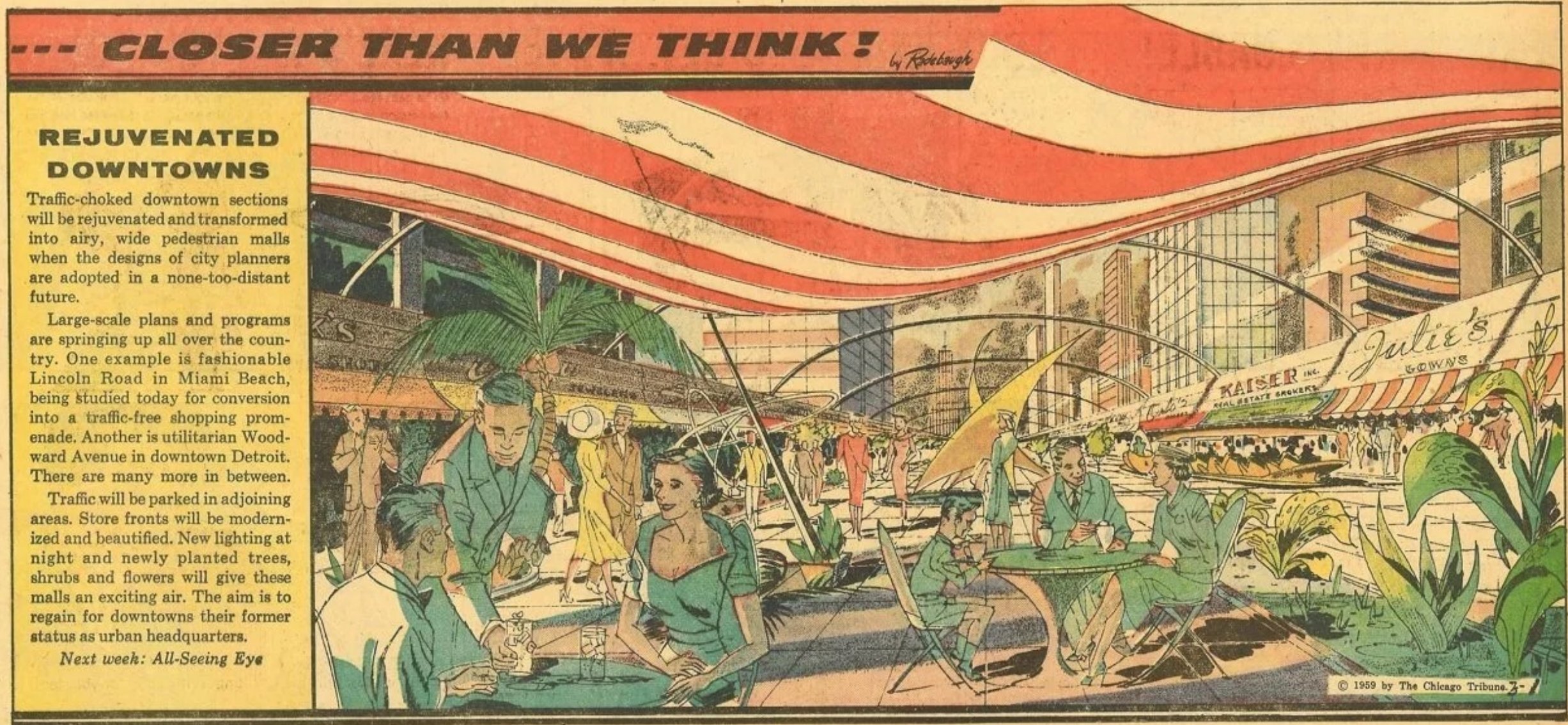
3. Strategic foresight

- **Theory of Change: a framework to think through impactful projects**



4. Applications to Urban Systems

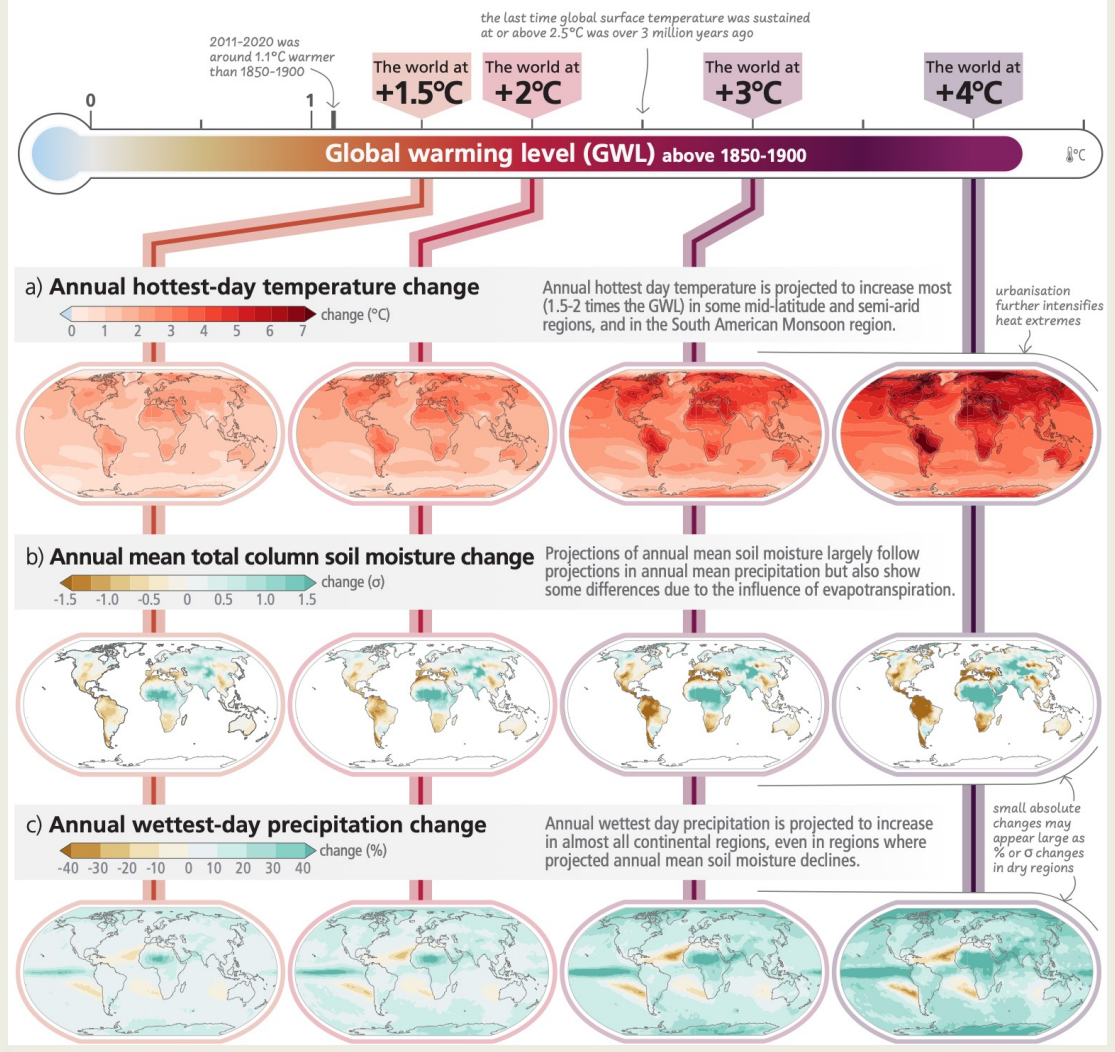
réf.: <https://paleofuture.com/blog/2015/2/4/42-visions-for-tomorrow-from-the-golden-age-of-futurism> ↓



4. Applications to Urban Systems

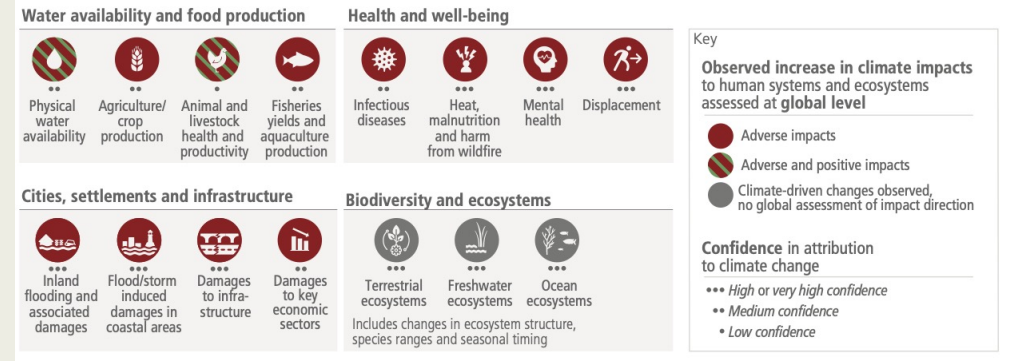
ref.: https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

With every increment of global warming, regional changes in mean climate and extremes become more widespread and pronounced

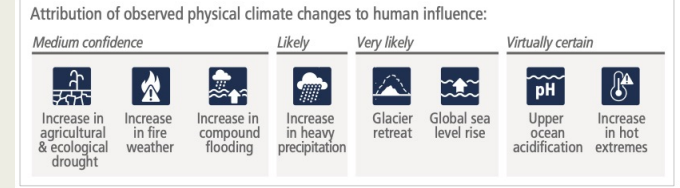


Adverse impacts from human-caused climate change will continue to intensify

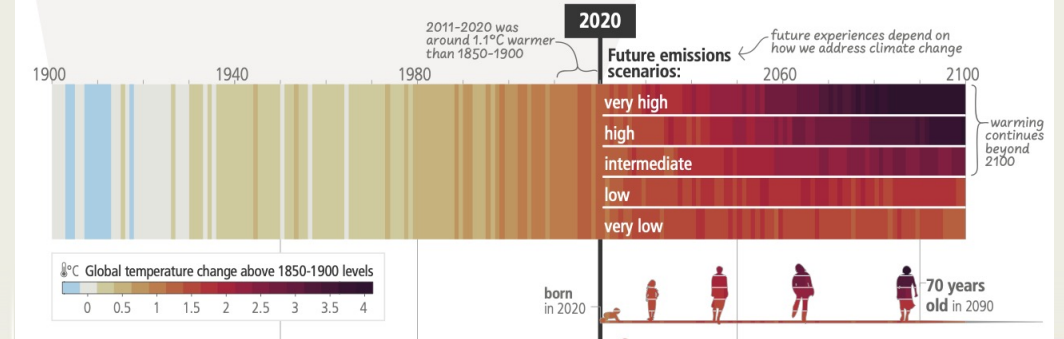
a) Observed widespread and substantial impacts and related losses and damages attributed to climate change



b) Impacts are driven by changes in multiple physical climate conditions, which are increasingly attributed to human influence



c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near term

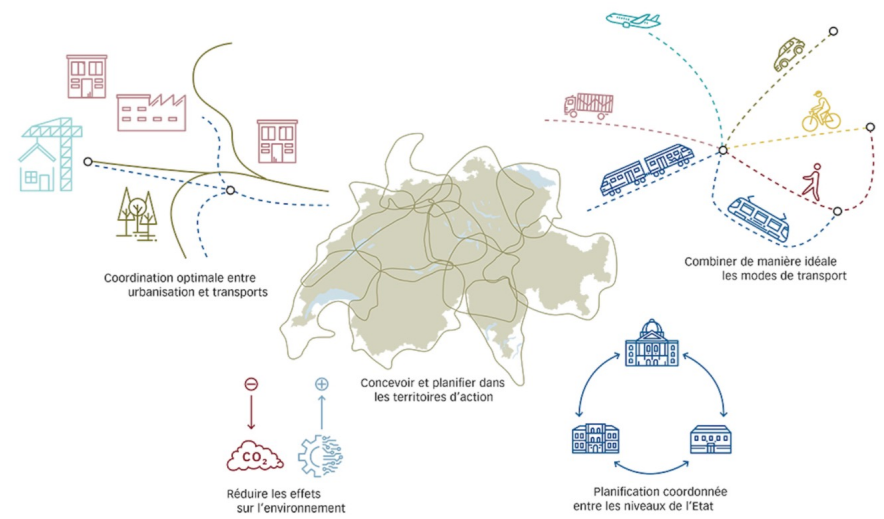


4. Applications to Urban Systems

- **Strategic foresight seems quite popular with the public sector, especially here in Switzerland...**

Mobilité et territoire 2050 – Plan sectoriel des transports – partie Programme

Mobilité et territoire 2050, la partie Programme du plan sectoriel des transports, pose le cadre du développement à long terme d'un système global de transport en Suisse coordonné avec le territoire et l'environnement.



«Mobilité et territoire 2050» est l'instrument de coordination de la Confédération englobant tous les modes de transport, autrement dit la stratégie de mobilité du Conseil fédéral.



GRAND GENÈVE

VISION TERRITORIALE TRANSFRONTALIÈRE 2050

SYNTHÈSE

ADOPTÉE PAR L'ASSEMBLÉE DU GLCT LE 2 JUILLET 2024

Maître d'ouvrage : Canton de Vaud - DGMR

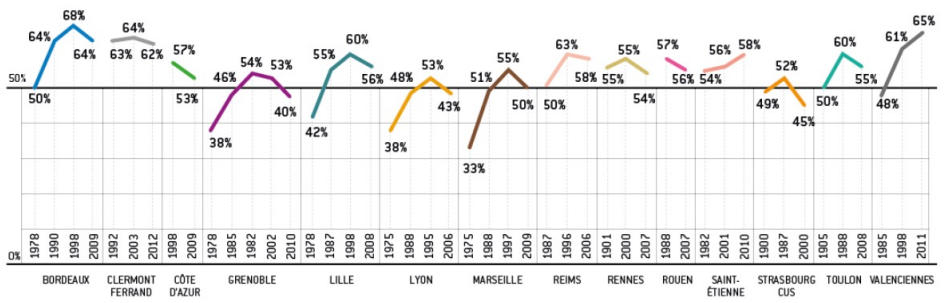
Vision 2050

Etude de planification pour l'élaboration du programme cantonal de développement de l'offre ferroviaire à l'horizon 2050

4. Applications to Urban Systems

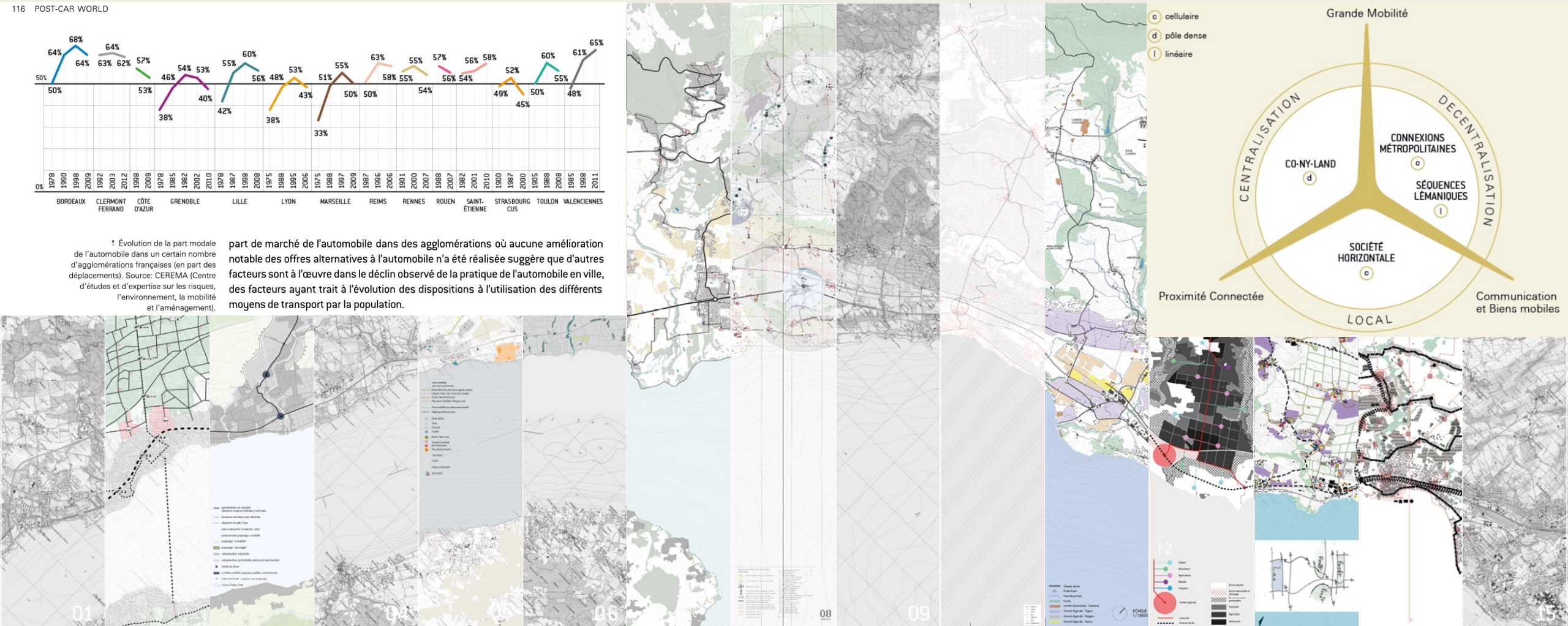
The Post-Car World project: 4 visions for a demotorized lemanic metropolis

116 POST-CAR WORLD



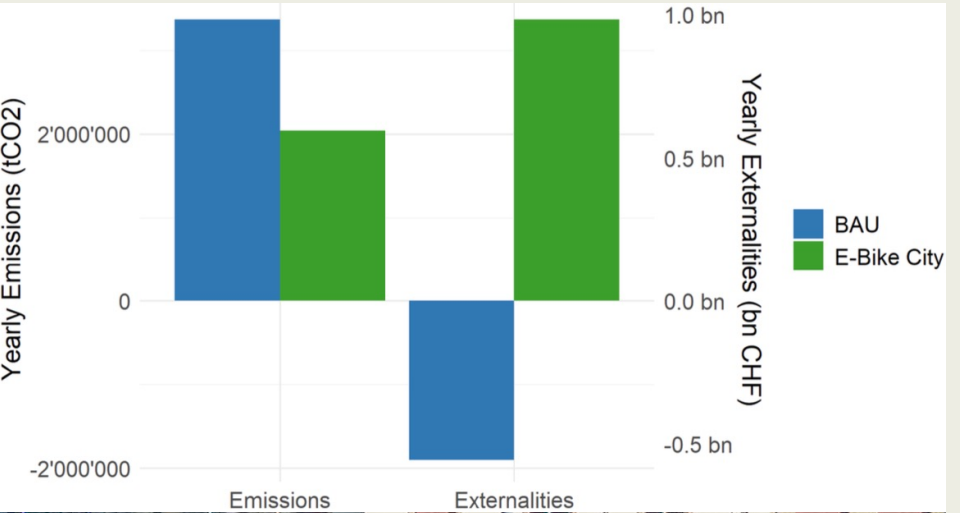
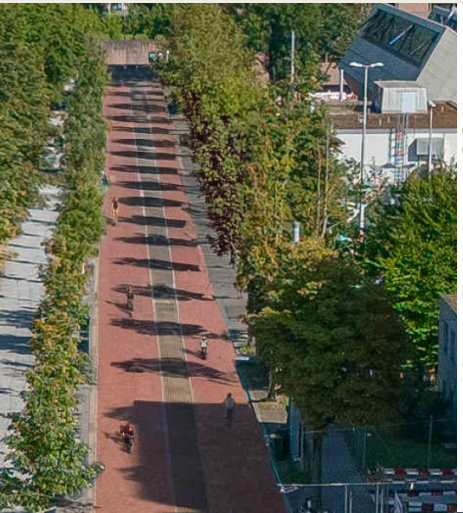
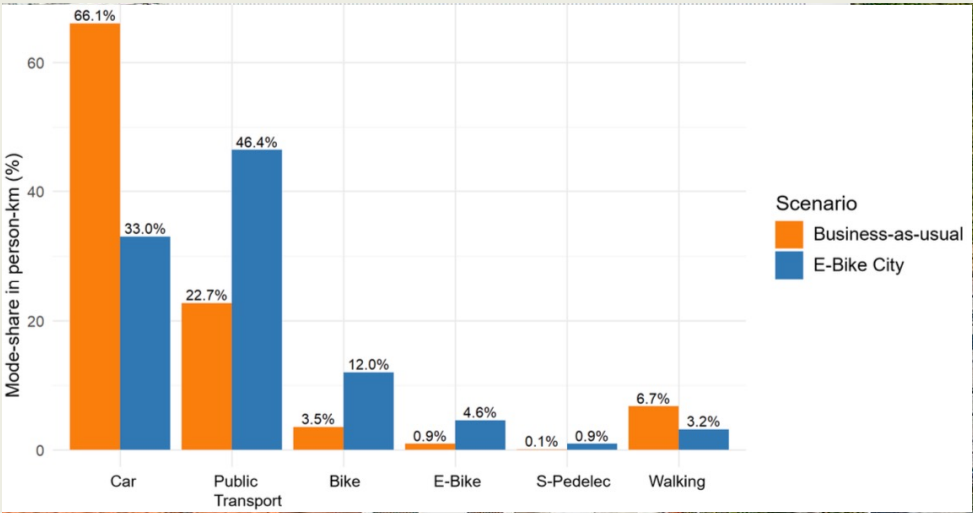
↑ Évolution de la part modale de l'automobile dans un certain nombre d'agglomérations françaises (en part des déplacements). Source: CEREMA (Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement).

part de marché de l'automobile dans des agglomérations où aucune amélioration notable des offres alternatives à l'automobile n'a été réalisée suggère que d'autres facteurs sont à l'œuvre dans le déclin observé de la pratique de l'automobile en ville, des facteurs ayant trait à l'évolution des dispositions à l'utilisation des différents moyens de transport par la population.



4. Applications to Urban Systems

- **The E-Bike Shift project: a transformative vision for sustainable streets in Zürich**



4. Applications to Urban Systems

- **Prefigurative politics: when artistic interventions create desirable futures**



réf.: Manolo Mylonas, Montreuil, 2012 ↑

réf.: Christopher Pillitz, Minhocão, São Paulo ↑



4. Applications to Urban Systems

- **Bottom-up counter-projects to top-down infrastructures: constructive confrontation**

Projet d'autoroute A69

1000 emplois précaires
Emplois pour les géants du e-commerce
Emplois temporaires dans un secteur du BTP inadapté à la transition & destructeur
> Consommation de centaines d'hectares de terres fertiles dans les prochaines années

2000€/an de péage avec l'abonnement pour un salarié amené à utiliser l'autoroute de Castres à Toulouse pour son travail.

17€ aller/retour
Les trois premières années pour 62 kilomètres. Un tarif sûrement revu à la hausse avec le temps

3 centrales à enrobés
inhalation et pollutions sur plusieurs kilomètres alentours
> **Cancers indirects** dans les années à venir

100ha de terres étriquées presque **incultivables** entre les deux routes

2 agglos
Castres & Mazamet aspirées dans la dynamique néfaste de métropolisation

+40 min aller/retour
Sur la **RNI26 déclassée**, privée des 2x2voies existantes privatisées dans l'A69 et déjà payées par nos impôts locaux
Aménagement de 12 ronds-points pour **ralentir et inciter à prendre l'A69**
Passage obligatoire par les centre-villages pour continuer de rouler gratuitement
> Plus de trafic, plus d'accidents dans les villages

450M€ de financements

366ha de terres nourricières détruites de manière **irréversible**

Augmentation massive du nombre de déplacement en voitures individuelles incompatible avec les accords de Paris

Interruption des corridors et des déplacements d'espèces

Inadaptation climatique et agricole
Vallées asséchées par l'impact de l'autoroute sur le cycle de l'eau et sur les bassins versants du Girou et de l'Agout

Une Autre Voie !

1000 emplois durables

250ha d'espaces agricoles démonstrateurs d'une agriculture biologique & locale

315km d'alignements d'arbres et de haies bocagères plantés pour affronter des canicules à 50°C en 2050

5 arrêts de train supplémentaires
un cadencement et une fréquence revus avec trains courts et trains longs

7 grands équipements
neufs ou réhabilités et d'intérêt territorial pour une sensibilisation aux questions écologiques

+30% d'oiseaux & d'insectes en 2035 par rapport à 2020 sur le territoire de projet et ses alentours

100M€ d'investissements publics

50ha d'espaces humides & d'espaces boisés en libre évolution

87km à terme pour la première **Véloroute Nationale française** entre Toulouse & Mazamet

7500 (2020) vs **5500** (2030) **-25%**

Augmentation de la fréquence des bus liO, de l'autopartage et des transports en commun ! Une route qui reste gratuite !

réf.: <https://uneautrevoieorg.wordpress.com> ↑

4. Applications to Urban Systems

Un plan de revitalisation écologique



réf.: <https://uneautrevoie.org.wordpress.com> ↑

1000 emplois directs

- 450 – Nouvelles filières artisanales (dont un pôle d'excellence autour des mobilités douces)
- 200 – Ecotourisme
- 200 – Ecoconstruction & rénovation
- 100 – Agriculture durable
- 50 – Cyclologistique durable

100 M€ d'investissements publics

- 24M€ – Redirection des financements locaux de l'A69
- 50M€ – Plan Vélo, France 2030, Biodiversité 2030, UE
- 26M€ – Nouveaux financements locaux

7 équipements leviers

neufs ou réhabilités et d'intérêt territorial pour une **reconnexion aux réalités écologiques**

- Gragnague** La centrale des fertilités
- Verfeil** L'École de la transmission écologique
- Bourg-Saint-Bernard** La Base aérienne & météorologique
- Villeneuve-lès-Lavaur** Le hameau des lowtechs
- Castres** La cité du vélo
- Saix/Dicosa** Le centre national des oiseaux
- Puylaurens** La plateforme de valorisation des terres

[agriculture durable]

[filière biosourcée & écoconstruction]

[filière du vélo électrique]

[développement de la cyclologistique]

[recherche & développement pour une cyclomobilité innovante]

366ha de chantier participatif!

un mode de faire original s'appuyant sur la réimplémentation citoyenne, qui pourra faire école à l'avenir.

- [Rénovation terre crue]
- [Réalisation des équipements légers]
- [Plantation de haies]
- [Plantation d'arbres d'alignement]

+30% d'oiseaux & d'insectes en 2035

par rapport à 2020 sur le territoire de projet et ses alentours.

- [Hirondelle rustique]
- [Alouette des champs]
- [Huppe fasciée]
- [Rainette méridionale]
- [Triton palmé]
- [Salamandre tachetée]

60mares

une augmentation massive des amphibiens et des milieux humides.

315km d'alignements d'arbres et de haies bocagères plantés à très court terme pour affronter des canicules à **47°C en 2050.**

5. Scenario analysis in practice

- **We're in 2050, the world is 3°C warmer than preindustrial levels (+2°C than today)**
 - Europe has welcomed 100 million climate refugees fleeing desertification and water wars. In particular, Germany is hosting 20 million climate refugees and Switzerland 2 million.
 - The world has (finally) run out of oil and gas, driven by record extraction 2025-2045. As a result, the cities of Geneva, Lausanne, Bern, Zürich & Basel have outlawed automobiles.
 - Traditional political parties have all self-destructed: right-wing parties from corruption and left-wing parties from infighting. The new political spectrum is pro- vs against planet Earth
- **Each group is projected in your respective future, you have to design 3-4 scenarios**
 - Group A is tasked with designing the new German climate refugee resettlement strategy
 - Group B is tasked with planning a post-automobile urban and inter-urban transport system
 - Group C is tasked with drafting the carbon-tax policy for the newly elected pro-Earth party

That's all, folks!

- **Hope you enjoyed this class as much as we did!**
Do give us feedback (we need it for next year)
 - All set for final presentations next Monday?
 - Don't forget your group's research note (10.01.26) and your personal reflection (31.01.26)
 - Do give us feedback on IS-Academia!
 - Stay in touch!

clement.rames@epfl.ch

alexis.gumy@epfl.ch

