






Sustainability Assessment of Urban Systems

(ENV-461) – BS 170

3: Key steps in sustainability assessments

Lecturers:

Claudia R. Binder

Glòria Serra Coch

Assistants:

Ankita Singhvi, Giulia Frigo, Simon Ladino Cano, Hanbit Lee

Lecture was supported by Dr. Albert Merino-Saum, Dr. Anna Pagani and Dr. Livia Fritz

Project Outline (due 19.03.2025)

Guidelines

1. General motivation for the study
   - Explain why sustainability assessment is relevant in the chosen cities.
   - Define the thematic focus (e.g., “Mining Cities,” “Drought-Prone Cities”).
2. Selection of cities for comparison
   - Make explicit the criteria for the selection of the four cities
   - Provide an overview of key sustainability issues specific to each city, supported by sources (news articles, policy reports, scientific literature). You can summarize them, for instance in a table.
3. Research question
4. Definition of a “sustainable city” assumed for the study
   - Use an established sustainability definition (from Lecture 1 or scientific literature) and adapt it to your study context (e.g., “A sustainable drought-prone city is a city in which…”).
5. Conceptual framework:
   - Develop a domain-goal conceptual framework as discussed in Lecture 3. Your domain-goal framework offers a backbone for the indicator set you will develop.
1. Bibliography

The outline should be approximately 2 pages (excluding bibliography)

Referencing and Formatting

Referencing

- You need to cite every data source and external statements, opinions you refer to in your project, this holds also true for research methods you use.
- For in-text citation:
  - Direct quotes you need to cite in quotes: *"citation" (author year: page)* (=Harvard Style)
  - Indirect quotes you need to reference at the end of the sentence with *(author year: page)* or: *According to Author (year: page), ...*
- Please add a reference list (Harvard style)
  - *Barker, R., Kirk, J. and Munday, R.J., 1988. Narrative analysis. 3rd ed. Bloomington: Indiana University Press.*
  - *Boughton, J.M., 2002. The Bretton Woods proposal: a brief look. Political Science Quarterly, 42(6), p.564.*
- Harvard citation style: http://libweb.anglia.ac.uk/referencing/harvard.htm

Formatting of the Outline

- Title, group number, student names and Sciper numbers.
- Number and label all tables/figures.
- Submit as **PDF**, titled: **GroupX_outline.pdf**, via Moodle. Substitute the **X** with your group number.

Program of the course

Lectures : BS 170 on Wednesdays, 13:15 – 16:00 (Lecture + Exercise)

n°	Date	Session	Milestones Project
1	19/02/2025	**Introduction** into sustainability and SA	
2	26/02/2025	**Sustainability issues** in **urban systems**	
3	05/03/2025	**Key steps in SA #1**: SSP, normative dimension, frameworks	**Groups formed**
4	12/03/2025	**Key steps in SA #2**: Systemic dimension	
5	19/03/2025	**Key steps in SA #3**: Participatory dimension	**Submission - Outline 19.03**
6	26/03/2025	**Deriving indicators (1/2)**	
7	02/04/2025	**Deriving indicators (2/2)**	
8	09/04/2025	**Influence matrix**	
9	16/04/2025	**Multi-Criteria Analysis**	
	23/04/2025	**Easter break**	
10	30/04/2025	**Deriving policy recommendations**	
11	07/05/2025	**Policy implications**	
12	14/05/2025	**Sustainability Assessment in practice**	
13	21/05/2025	**Exam**	
14	28/05/2025	**Presentation of semester work_2**	

* May be updated depending on the number of students enrolled

References on theory of city form

- Jacobs, Jane *The Death and Life of Great American Cities.* 1961
- Alexander, Christopher. *A Pattern Language.* 1977
- Munford, Lewis. *The City in History.* 1961
- Bacon, Edmund. *Design of Cities.* 1967
- Lynch, Kevin. *The Image of the City.* 1960
- Lynch, Kevin. *Good City Form.* 1990
- Koolhas, Rem. *Delirious New York: A Retroactive Manifesto for Manhattan.* 1978
- Graham Steve & Marvin, Simon. *Splintering Urbanism: Networked Infrastructures, Technological Mobilities, and the Urban Condition. Routledge* 2001, 217–242, 253–266, 92–93, 301–303.
- Sennett, Richard. *The Conscience of the Eye: The Design and Social Life of Cities*. W. W. Norton & Company, 199
- Howard, Ebenezer. *Garden Cities of ToMorrow.* MIT Press, 1970, 50-69.
- Montgomery, Charles. *Happy City: Transforming our Lives Through Urban Design.* 2013
- Gras Alomà, Ramon. *City Science: Performance Follows Form.* 2024
- *Metropolis* (1927), directed by Fritz Lang.

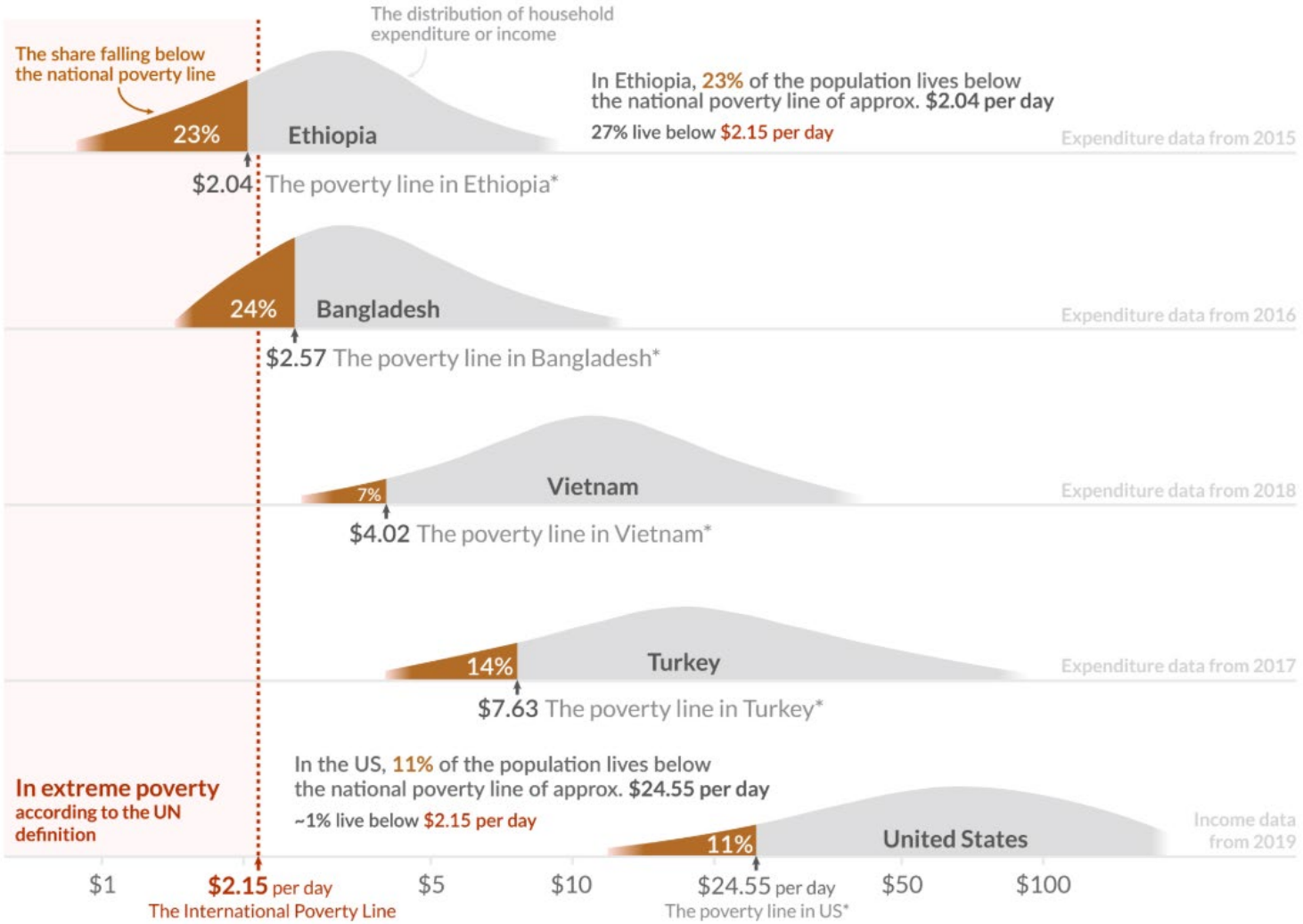
More specific readings are available as a separate pdf on moodle

Poverty

National poverty lines, poverty rates & incomes in five countries

All figures are adjusted to account for differences in the cost of living across countries.

Our World in Data

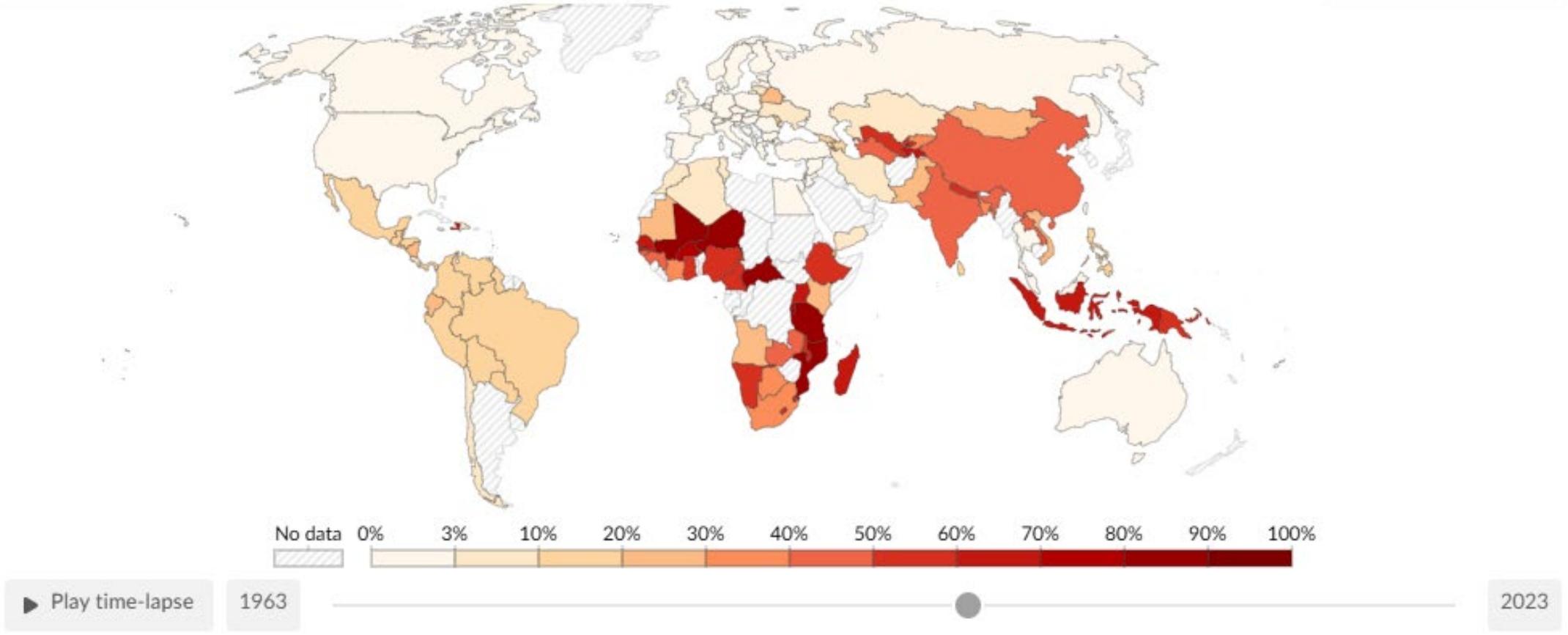


Note: All figures are expressed in 2017 international-$. The tails of the distribution are not shown since they tend to be poorly captured by household surveys on which this data is based.
*Poverty lines are approximations of national definitions, harmonized to allow comparisons across countries. All poverty lines are from Jolliffe et al. (2022), except for US – which we calculate from the value that in the World Bank's poverty data yields the same rate as the offical US Census Bureau poverty rate in 2019.

Source: Jolliffe et al. (2022); US Census Bureau; World Bank Poverty and Inequality Platform.
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Poverty development over time

Share of population living in extreme poverty 1995



Data source: World Bank Poverty and Inequality Platform (2024) – Learn more about this data

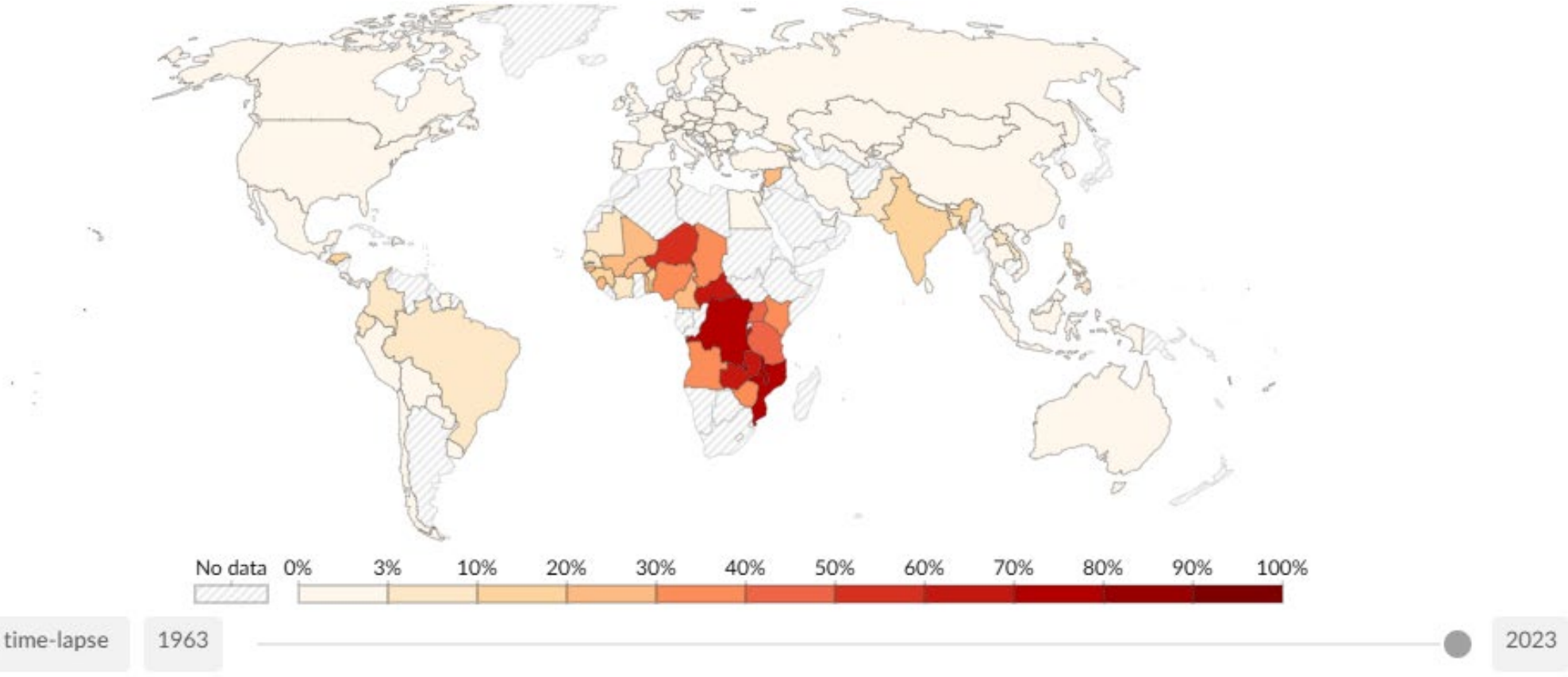
CC BY

Note: This data is expressed in international-$ at 2017 prices. Depending on the country and year, it relates to income measured after taxes and benefits, or to consumption, per capita.

*Extreme poverty is defined as living below the International Poverty Line of $2.15 per day. This data is adjusted for inflation and for differences in living costs between countries

Poverty development over time

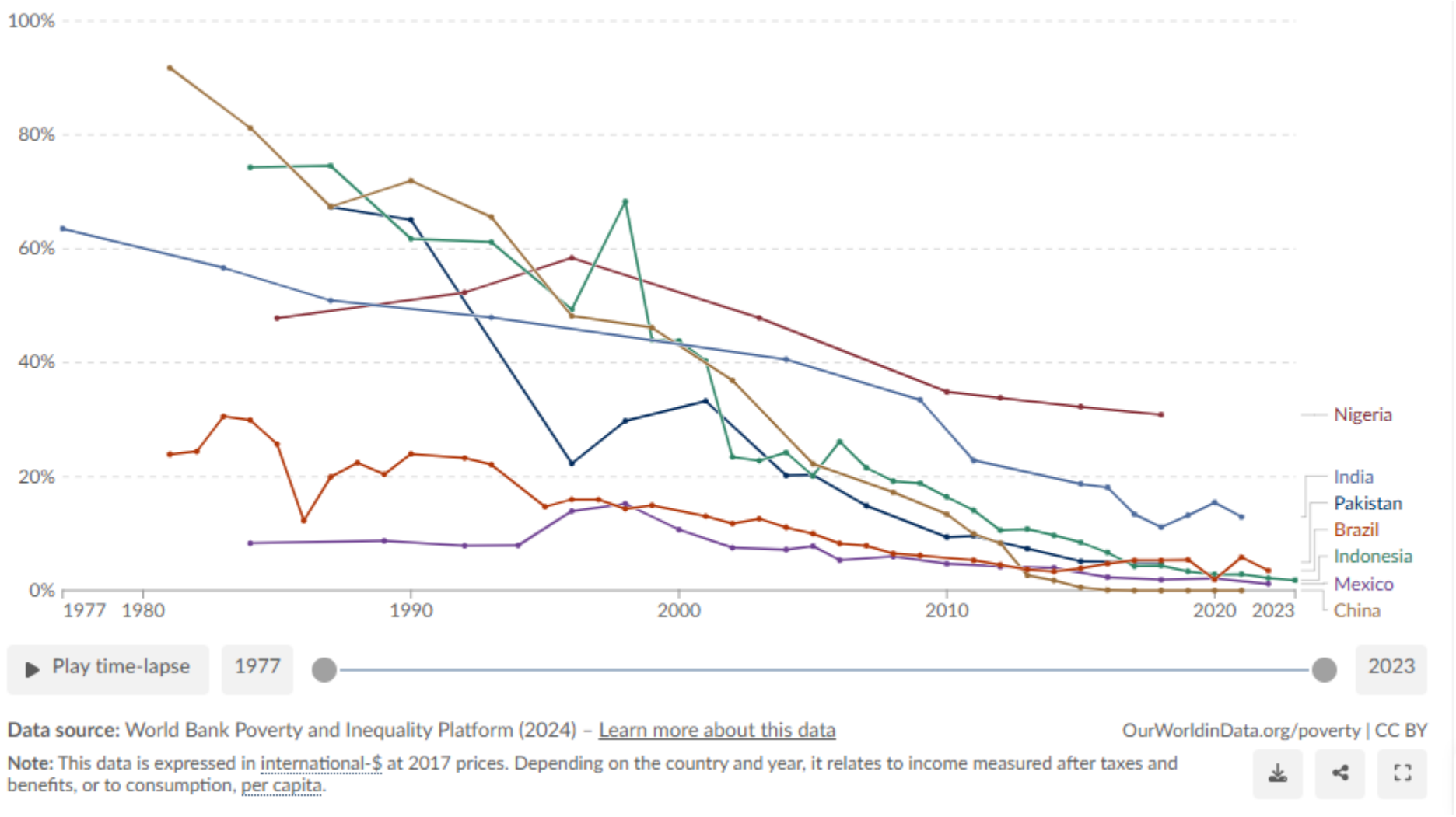
Share of population living in extreme poverty 2023



*Extreme poverty is defined as living below the International Poverty Line of $2.15 per day. This data is adjusted for inflation and for differences in living costs between countries

Poverty development over time

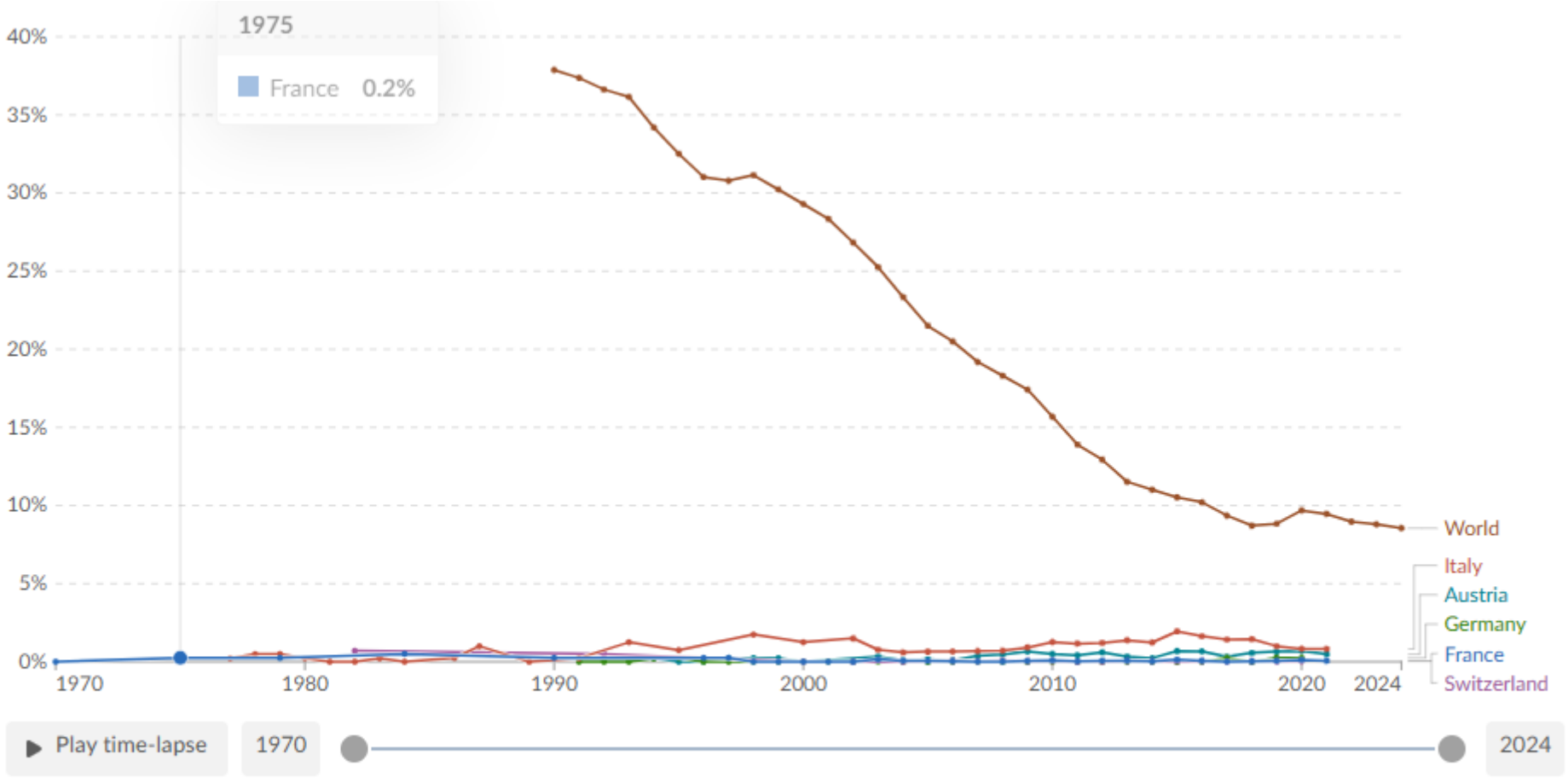
Share of population living in extreme poverty 1977-2023



*Extreme poverty is defined as living below the International Poverty Line of $2.15 per day. This data is adjusted for inflationand for differences in living costs between countries

Poverty development over time

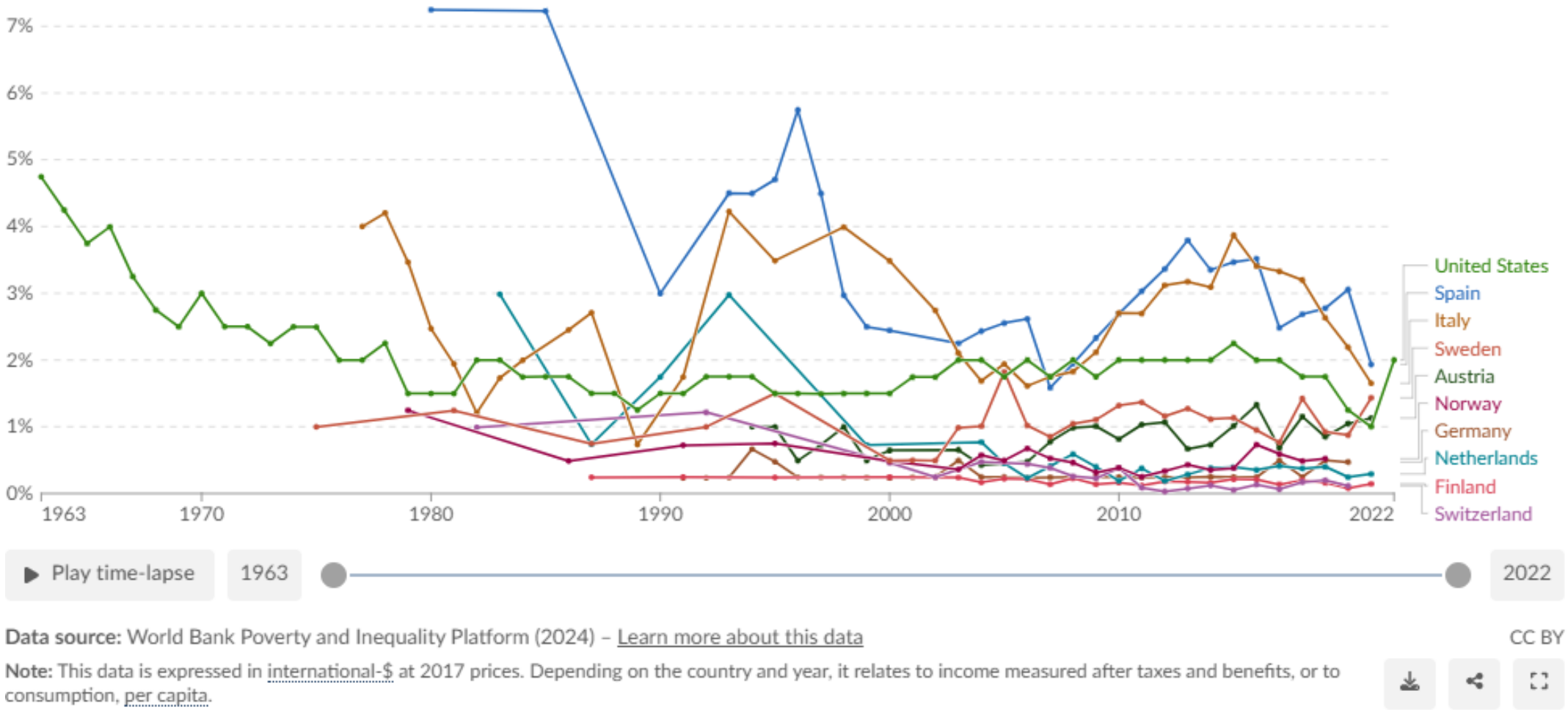
Share of population living in extreme poverty 1977-2023



*Extreme poverty is defined as living below the International Poverty Line of $2.15 per day. This data is adjusted for inflationand for differences in living costs between countries

Poverty development over time

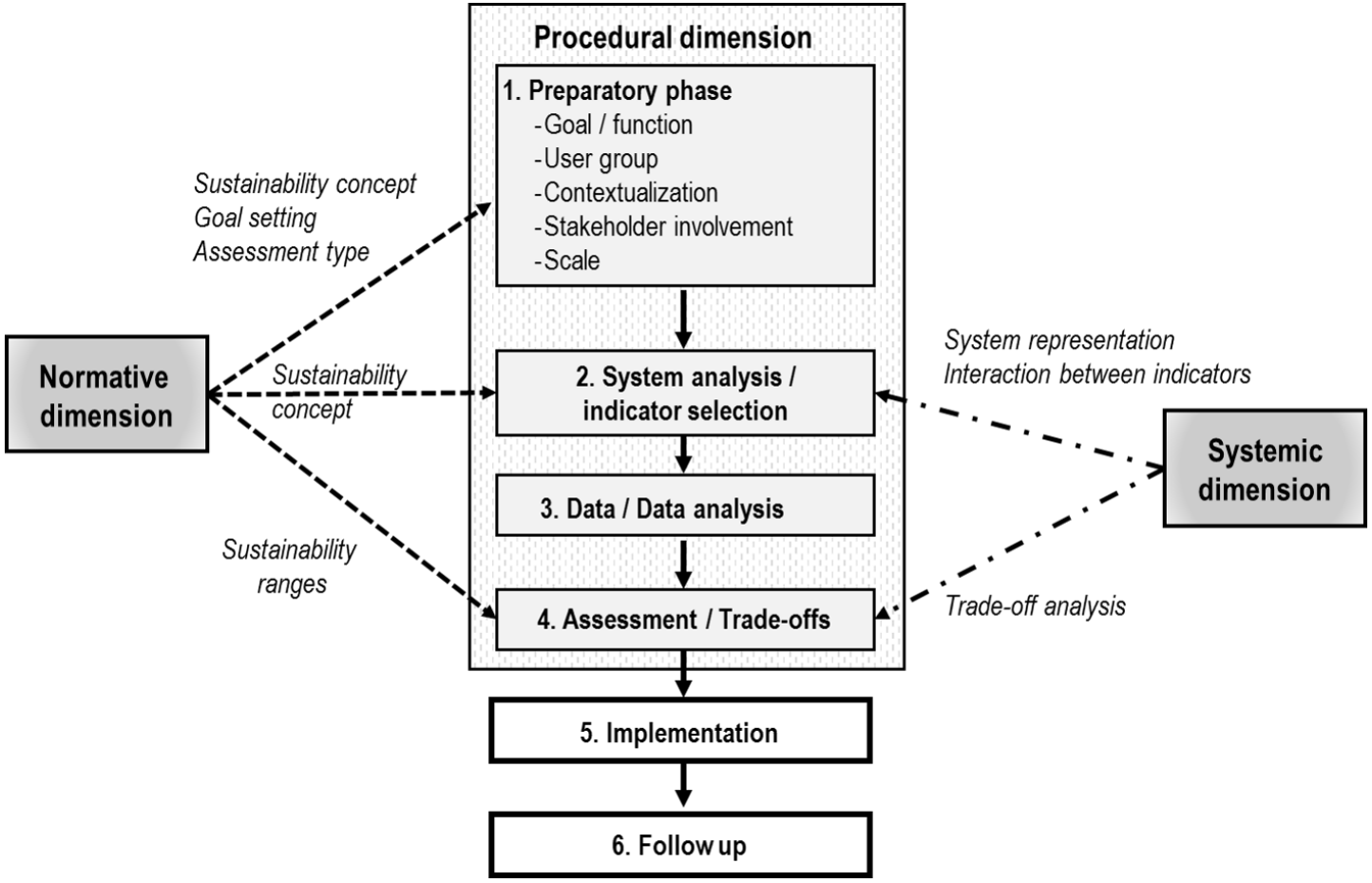
Share of population living in moderate poverty 1963-2023



*Extreme poverty is defined as living below the International Poverty Line of **$6.85 per day**. This data is adjusted for inflationand for differences in living costs between countries

Goals of this lecture

- Get to know the **key steps of a sustainability assessment**
- Understand what an **indicator framework** is and what it is used for.

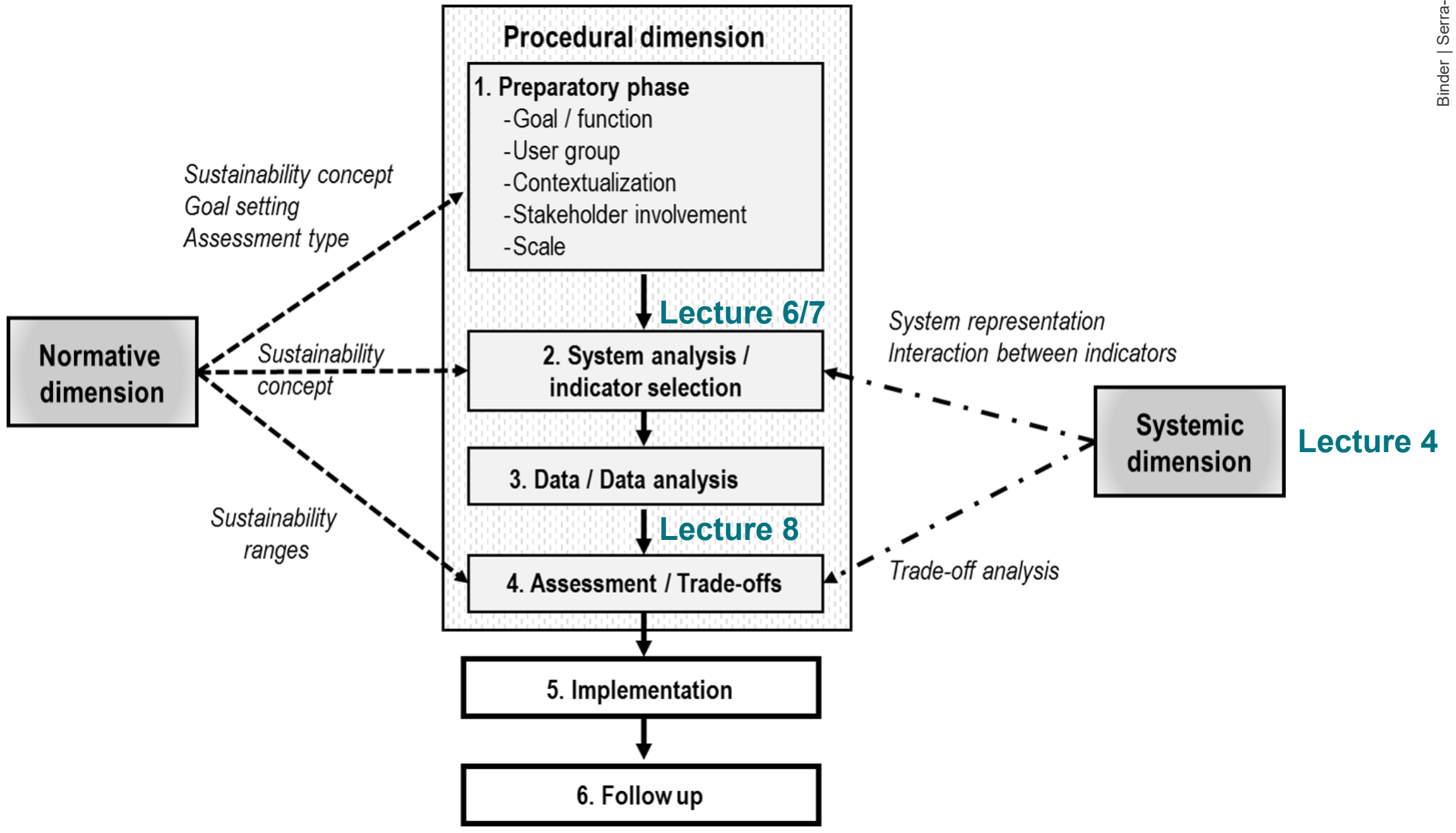


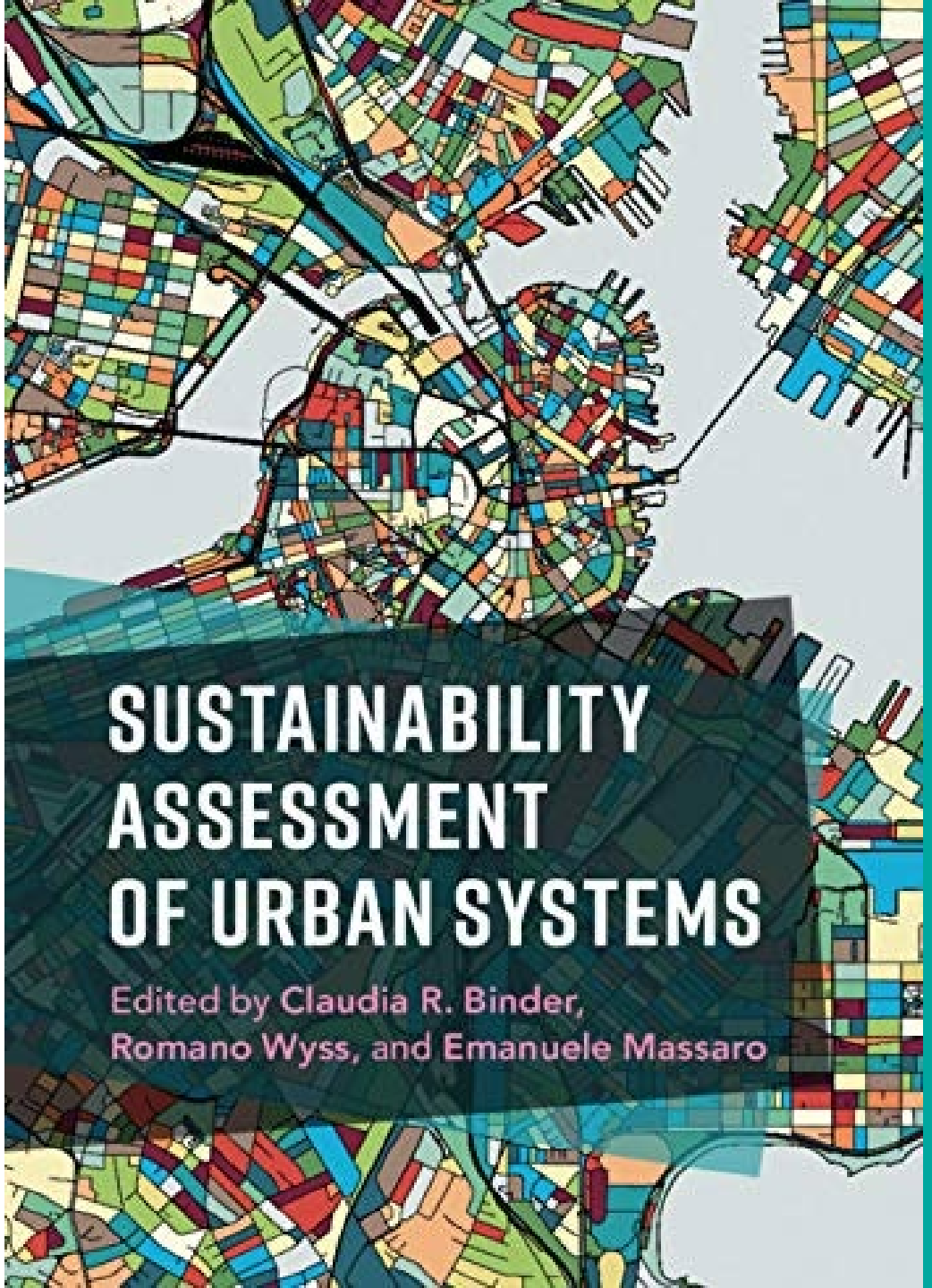
Sustainability Solutions Space: a method to assess urban sustainability

Issues in assessing sustainability of urban systems

- Procedural issues
- Normativity
- Systemic perspective
- Role of participation

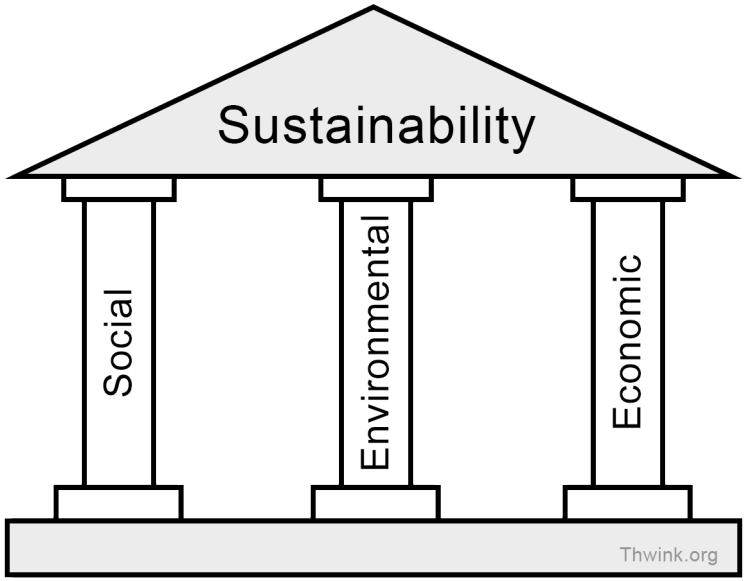
Sustainability Solutions Space





Procedural dimension

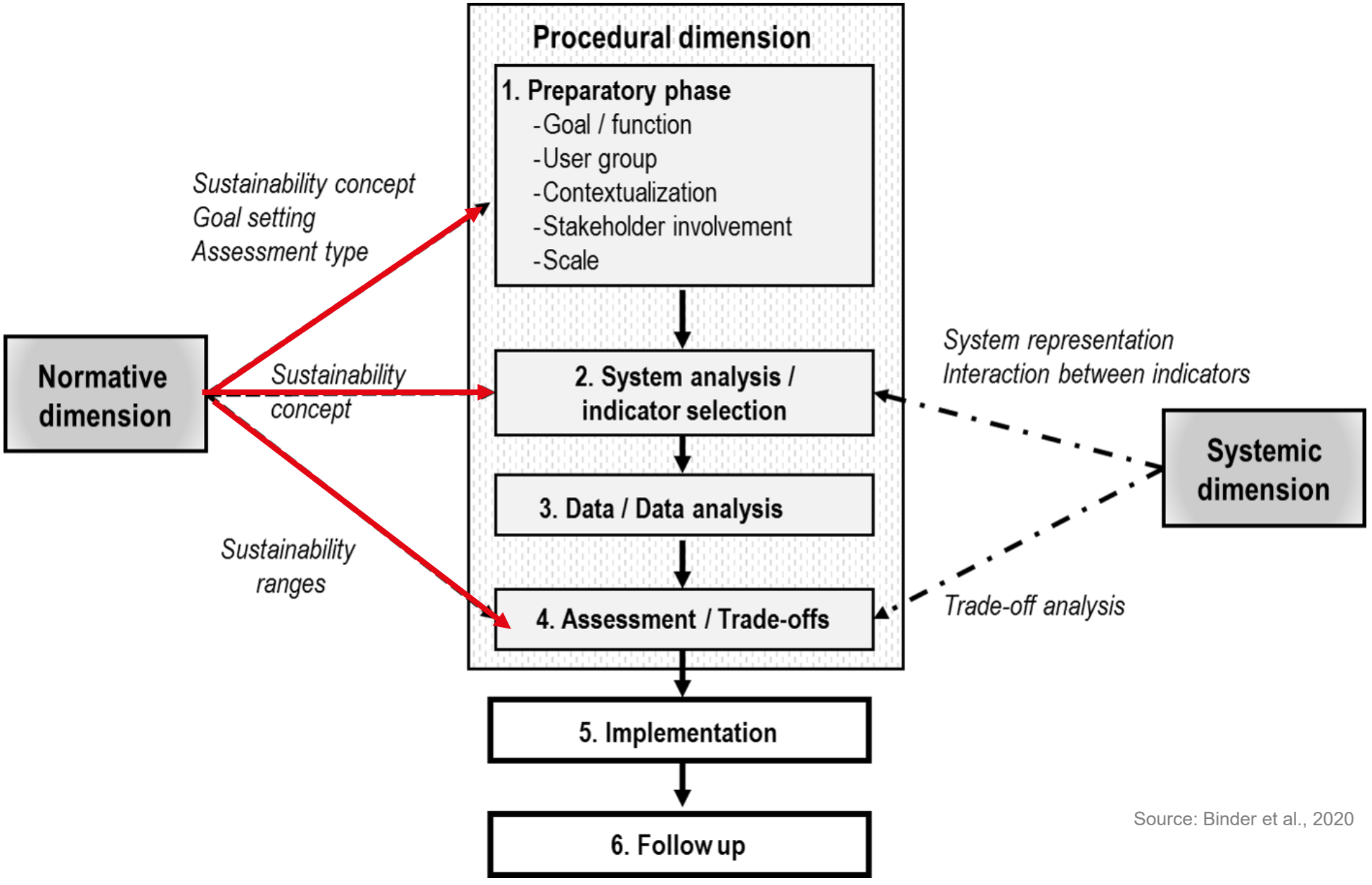
	Expert Approach	Participatory Approach
1. Preparatory phase		
Goal	Assessing the sustainability of a city and identifying points of action	
User group	Policymakers and city planners	
Function	**Benchmarking**, evaluating, monitoring	Evaluating, steering, monitoring
Participation	Informative, consultative	Co-development
Actors	Experts	Experts and stakeholders
2. System analysis		
System boundaries	**Data-dependent**	**Problem-dependent**
Indicator selection	Sustainability concept and system-based	
System representation	Clustering and scoring of cities	Causal loop diagrams
3. Data measurement and analysis		
Data	Official statistics, longitudinal data	Also qualitative data for one year possible
Method	Data Analysis	Interviews, workshops, system analysis
4. Assessment		
Thresholds	Scientific, international goal-setting	Contextualised goal representation
Trade-offs	Correlations	Impact matrix, workshops
Weighting	Stakeholder involvement	Stakeholder involvement



Normative dimension

Normative Dimension is related to ethical and value judgements that reflect societal or individual preferences.

Sustainability Solutions Space



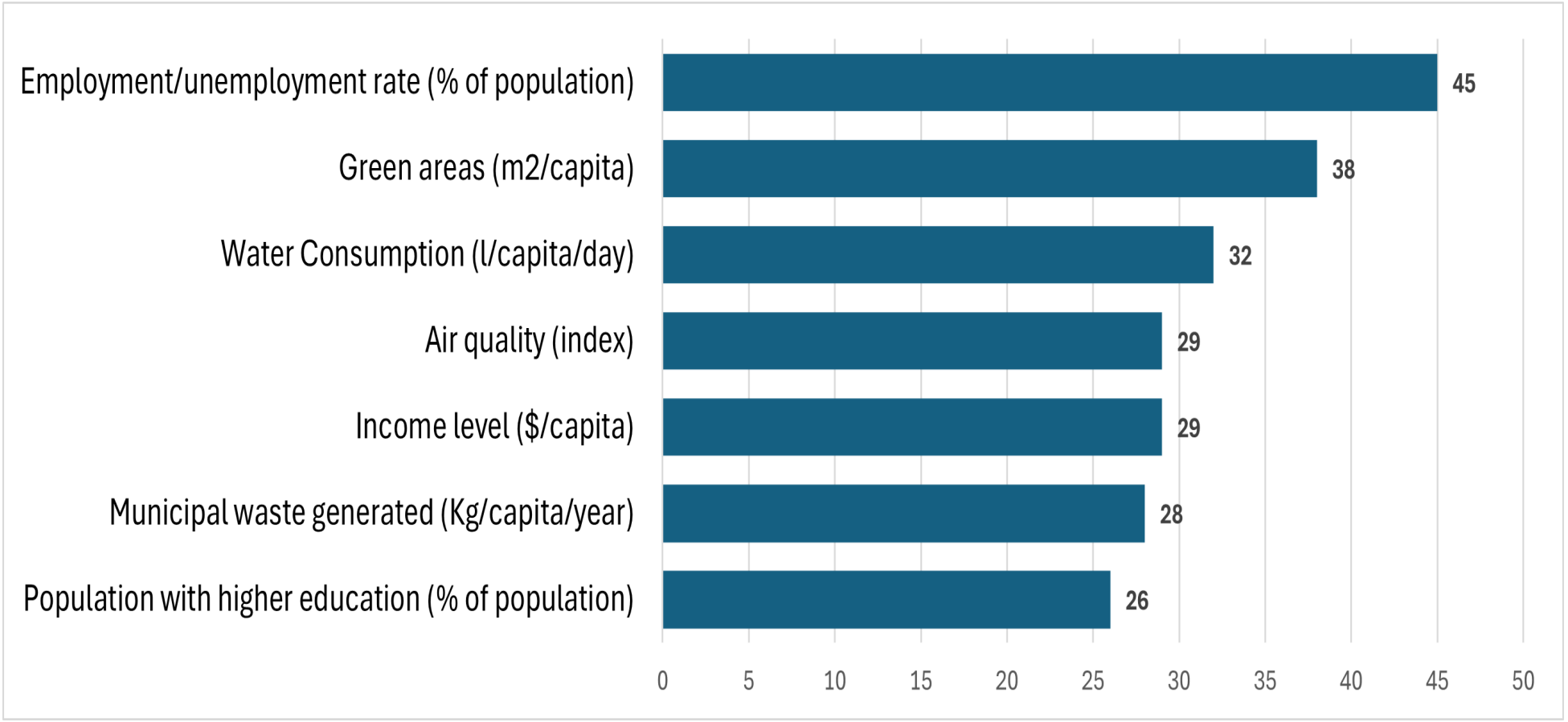
Source: Binder et al., 2020

How do the indicator sets measure urban sustainability?

To which extent do they differ from each other?

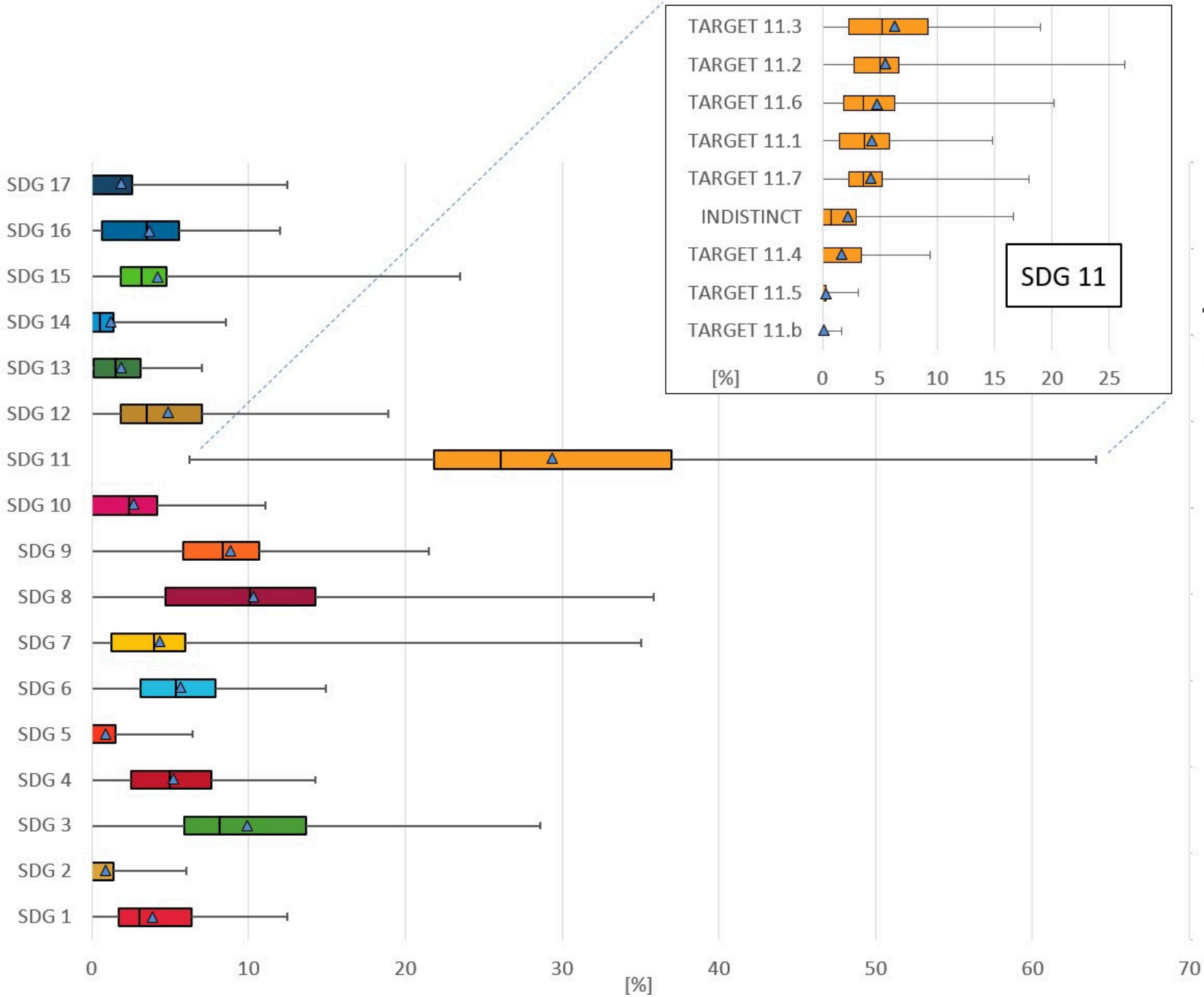
Indicator sets measuring urban sustainability differ in their selected indicators

N = 67



Most frequent (net) indicators ranked by the number of indicator sets in which they appear. Brackets enclose exemplified measurement units for each indicator based on the most frequent unit used in the indicator sets.

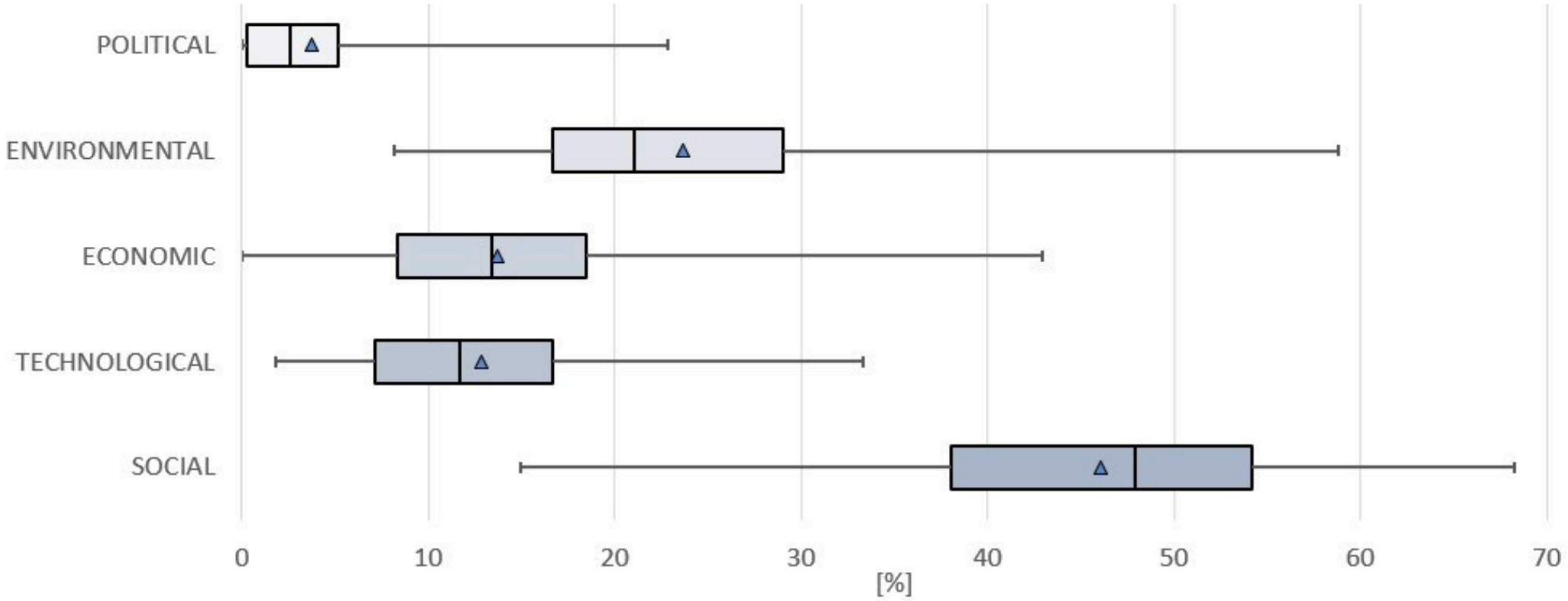
Source: Merino -Saum et al., 2020



The SDGs target are unevenly represented

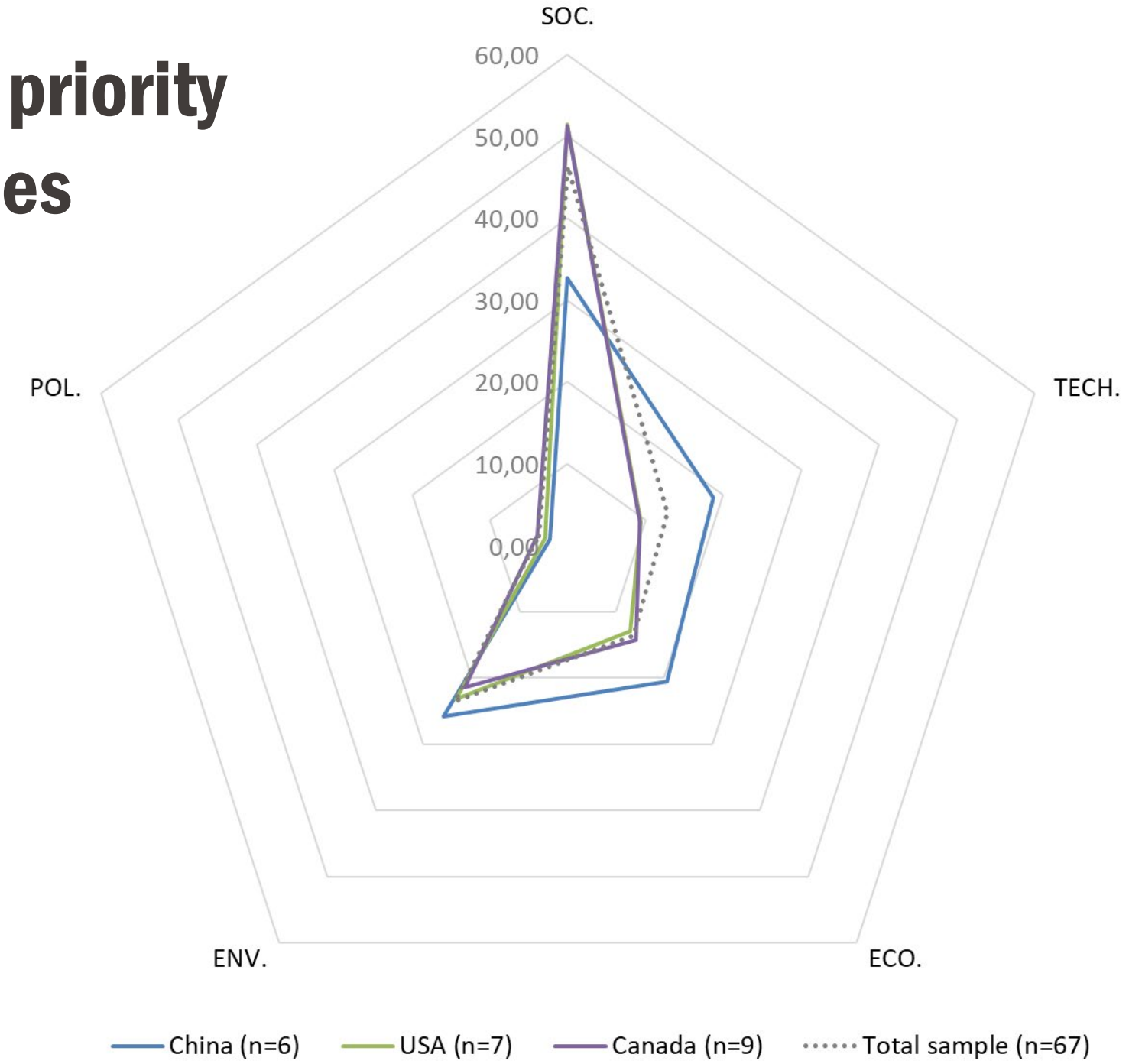
Merino -Saum et al., 2020

Uneven representation of indicators regarding different dimensions



Source: Merino-Saum et al., 2020

Indicators reveal priority setting of countries



Source: Merino -Saum et al., 2020

Making normativity explicit

Phase	Tasks	Ex. of approaches
Before starting the assessment	Making explicit researchers sustainability understandings	• Reflexive discussion of researchers own values
Preparatory phase **System analysis** and indicator selection	Spelling out what **sustainability values guide the assessment**	• Existing sustainability definitions of legitimate societal actors Sustainability values of societal actors
Preparatory phase (Goal setting) **System analysis** and indicator selection (indicator selection) **Assessment phase** (Trade-offs)	Finding a **common ground for the sustainability assessment** in a given context	• Transdisciplinary problem framing and vision development
Assessment phase (Trade-offs)	Including the values of **societal actors** in the final assessment	• Transdisciplinary weighting of preferences

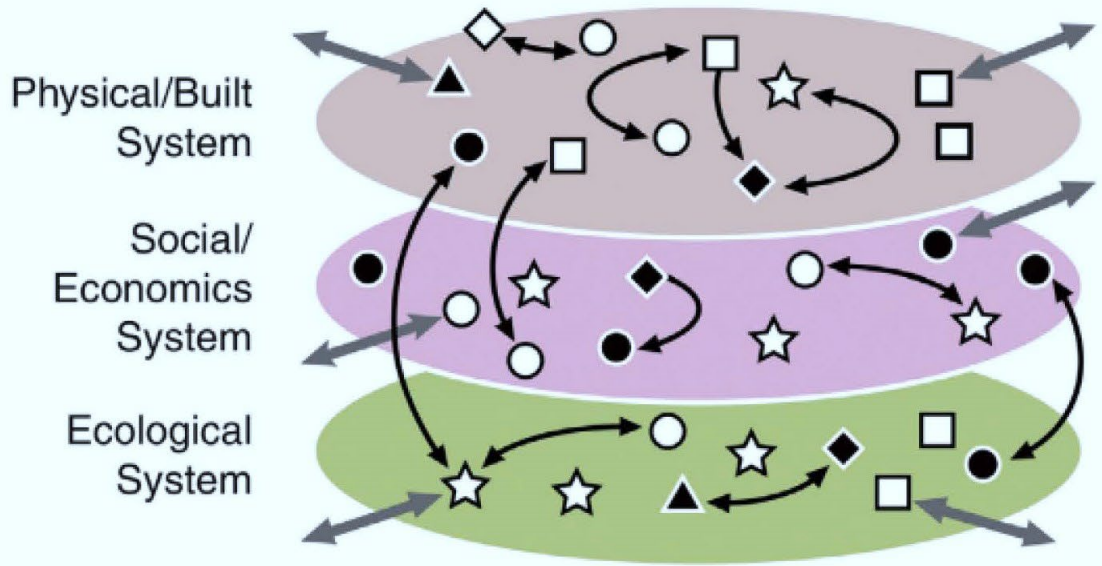
Systemic dimension

A system is anything that is composed of system elements connected in a specific structure, which allows it to perform specific functions in a system environment. They produce their own pattern of behavior over time.”

After Bossel, 1999, p. 20;Meadows, 2009, p. 2

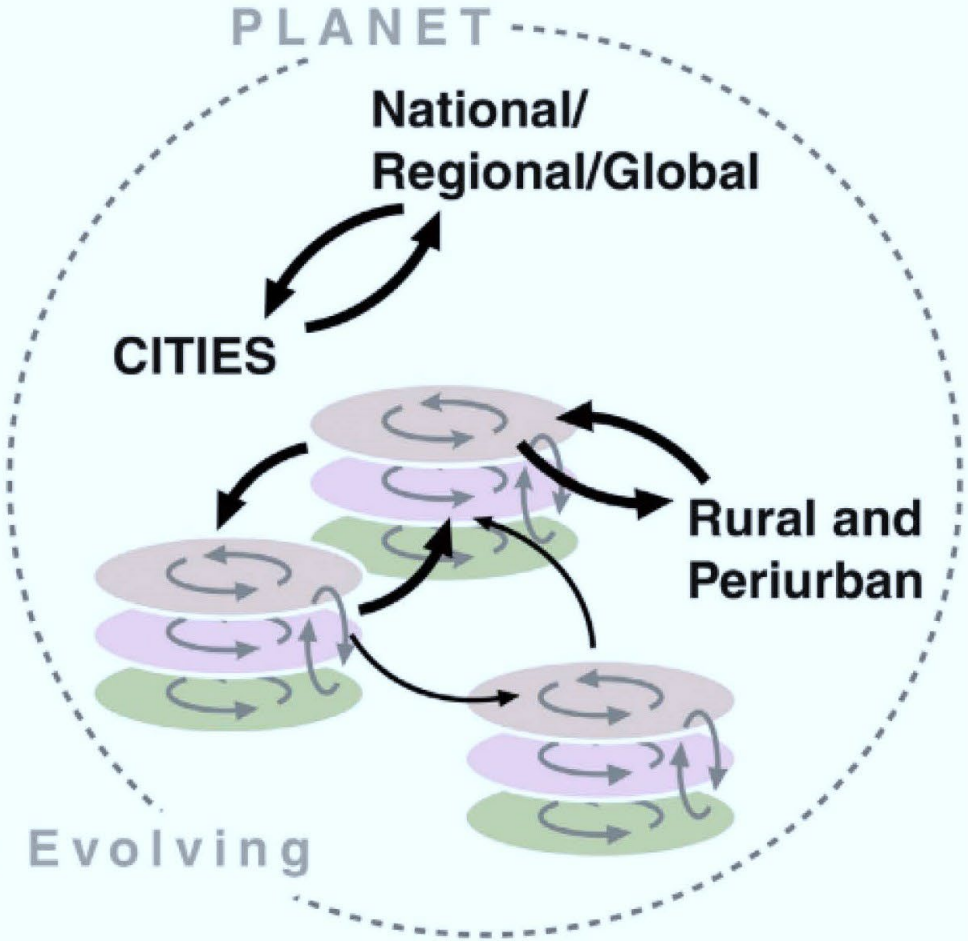
URBAN SYSTEM

Multiple
- actors/constituents
- structures
- processes
- linkages
- functions



CITIES AS OPEN SYSTEM

Cities are open systems, influencing and influenced by the external world via complex linkages and feedbacks.

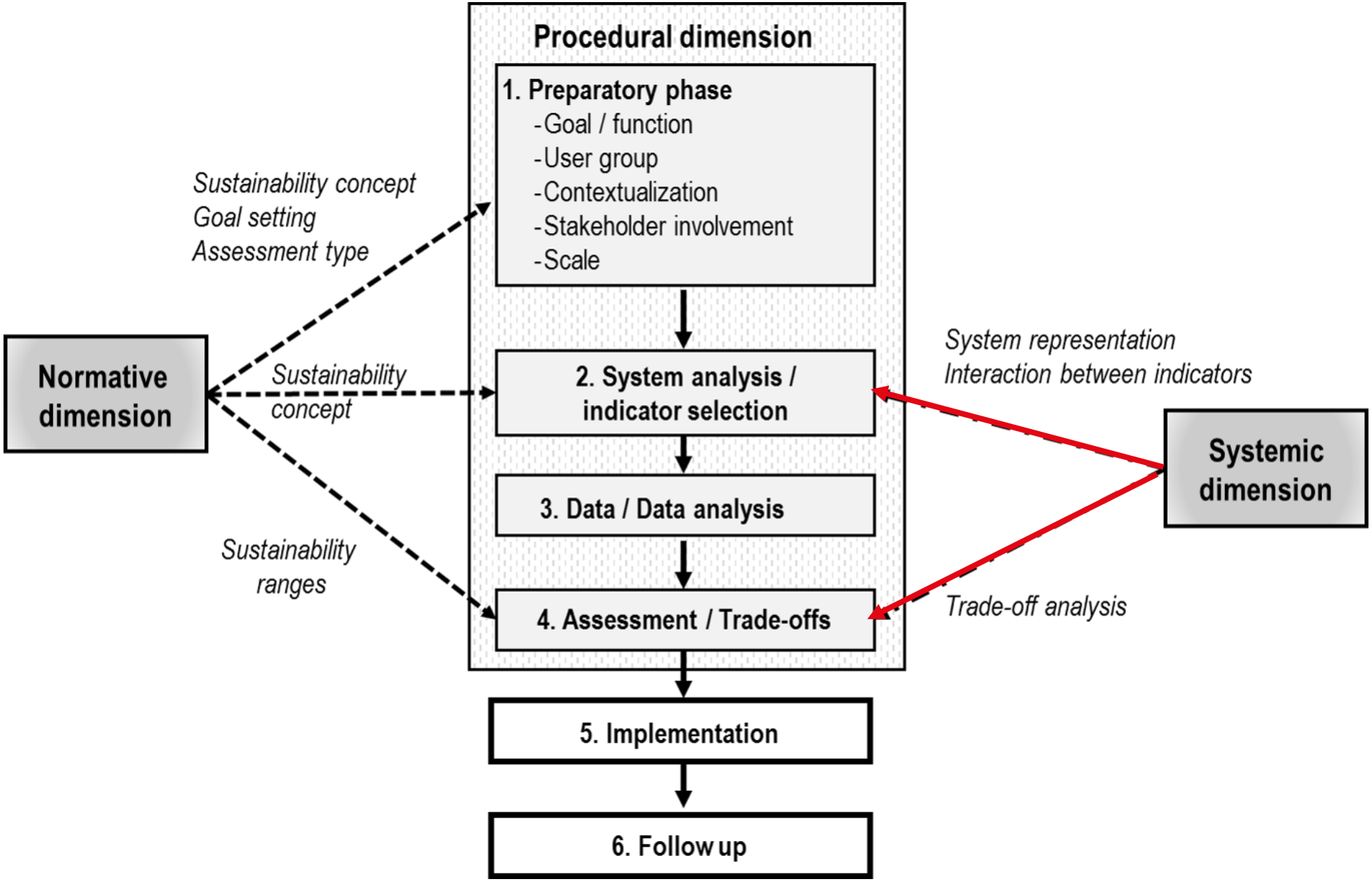


Current Opinion in Environmental Sustainability

Bai et al. 2016

→ **suites of linked responses rather than singular silver bullets**

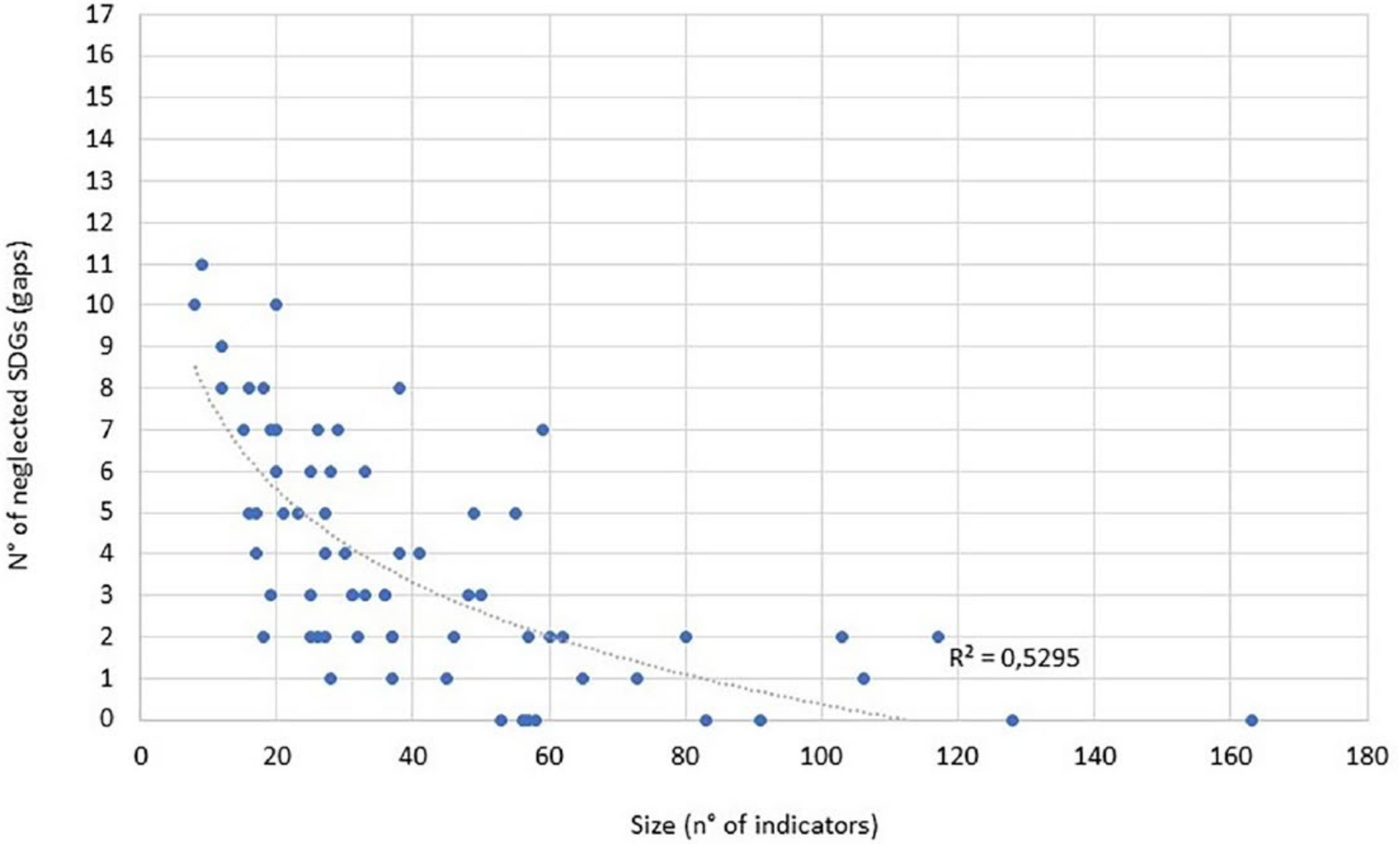
Sustainability Solutions Space



Criteria for selecting indicators

1. Underlying sustainability framework
2. **Parsimony**
3. **Sufficiency**
4. Context specificity
5. Data availability

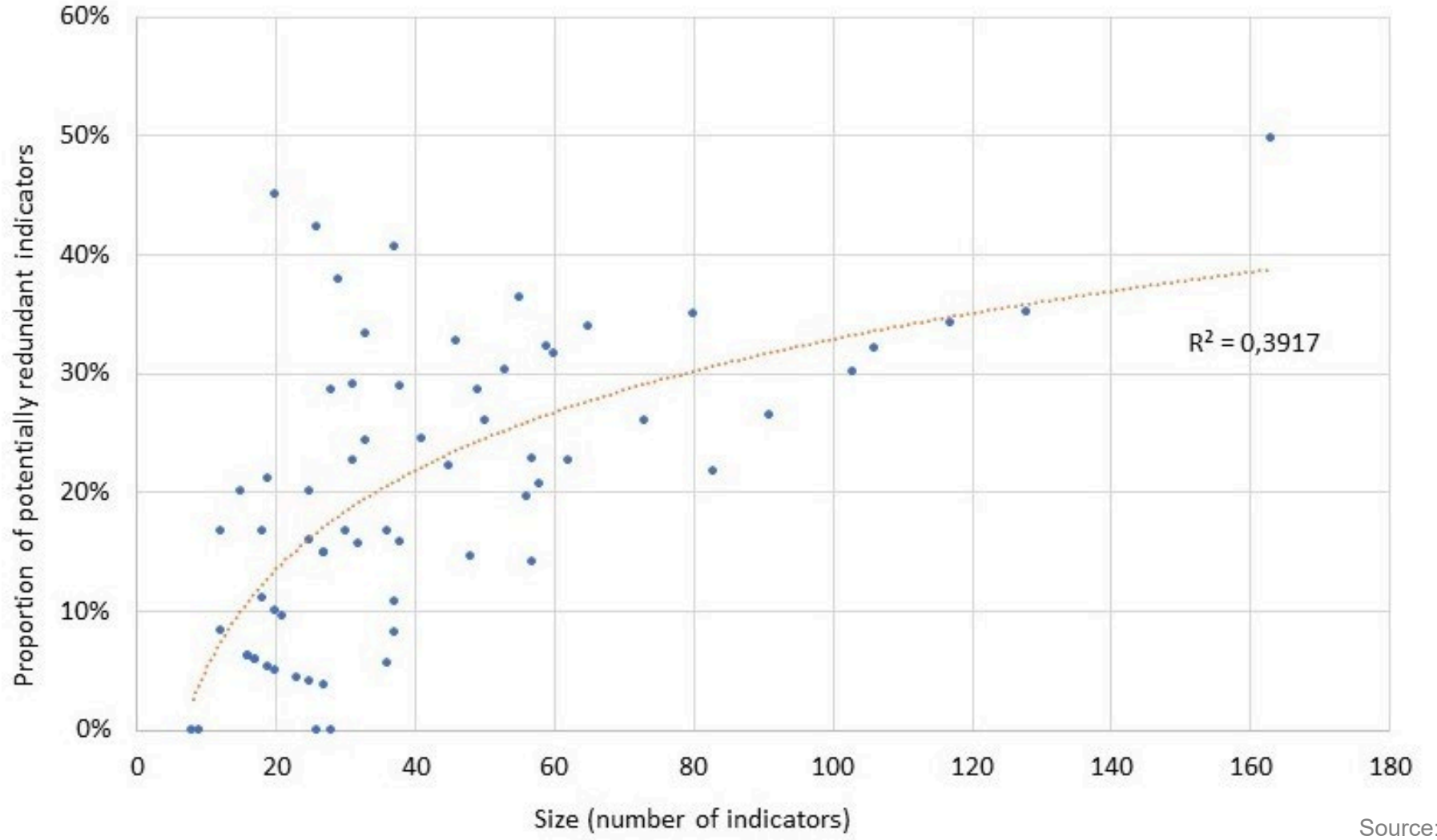
Number of neglected SDGs and total number of indicators per indicator set.



Each point in the figure represents a set.

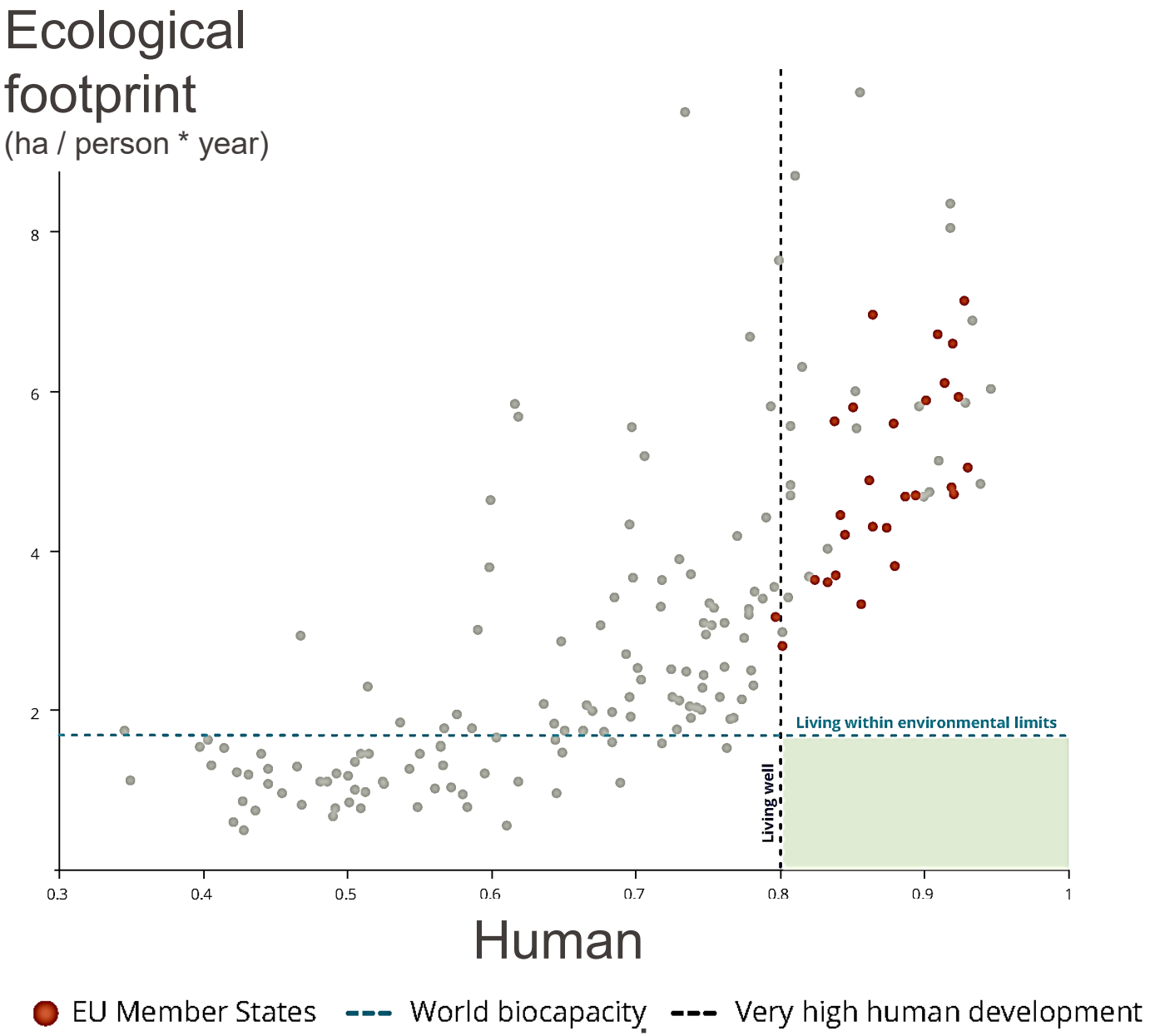
Merino-Saum et al. 2021

Proportion of potentially redundant indicators and number of indicators per set



Source: Merino -Saum et al., 2020)

Trade-offs between ecological footprint and HDI



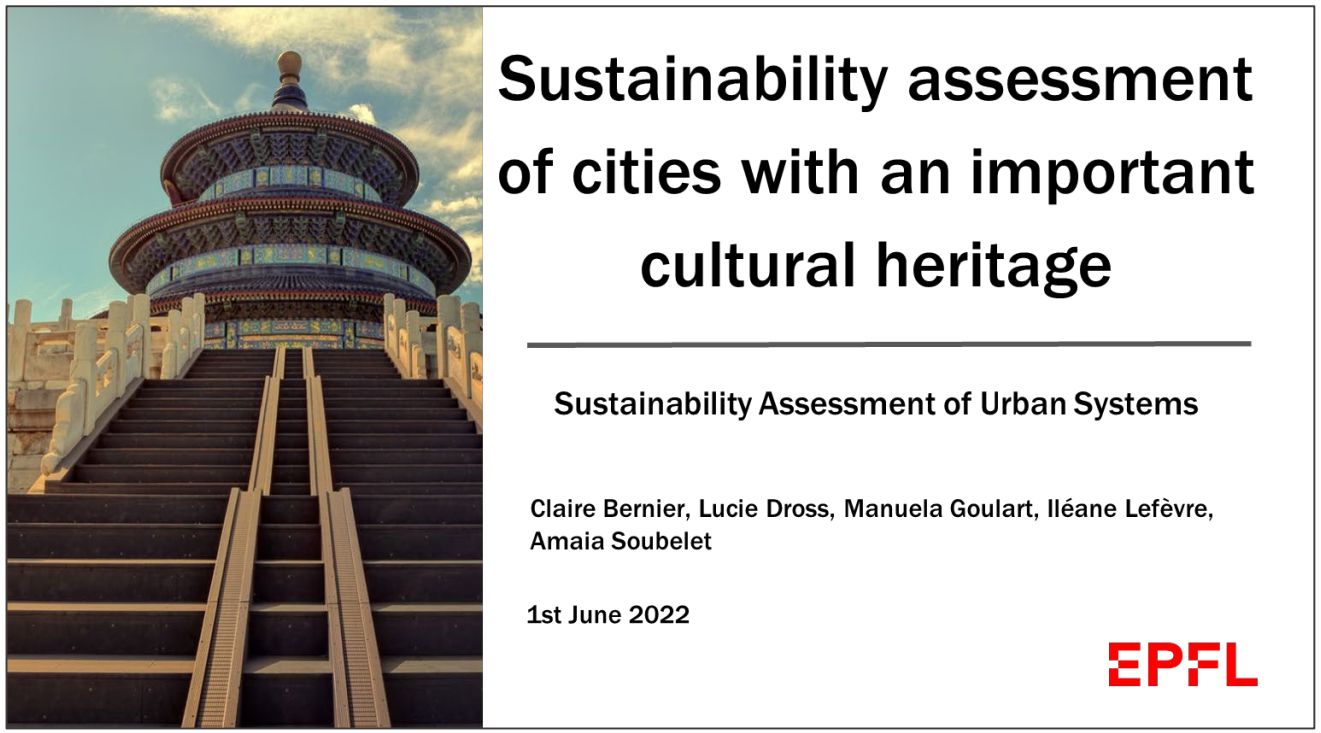
https://www.eea.europa.eu/data-and-maps/figures/correlation-between-ecological-footprint-and

Conclusions

1. **Consider three dimensions for sustainability assessment**
   - Procedural
   - Systemic
   - Normative
2. **Choose between participatory or expert approach**
3. **Make normativity explicit**
4. **Analyze trade-offs among indicators to be aware of unintended effects**

EPFL

Group project



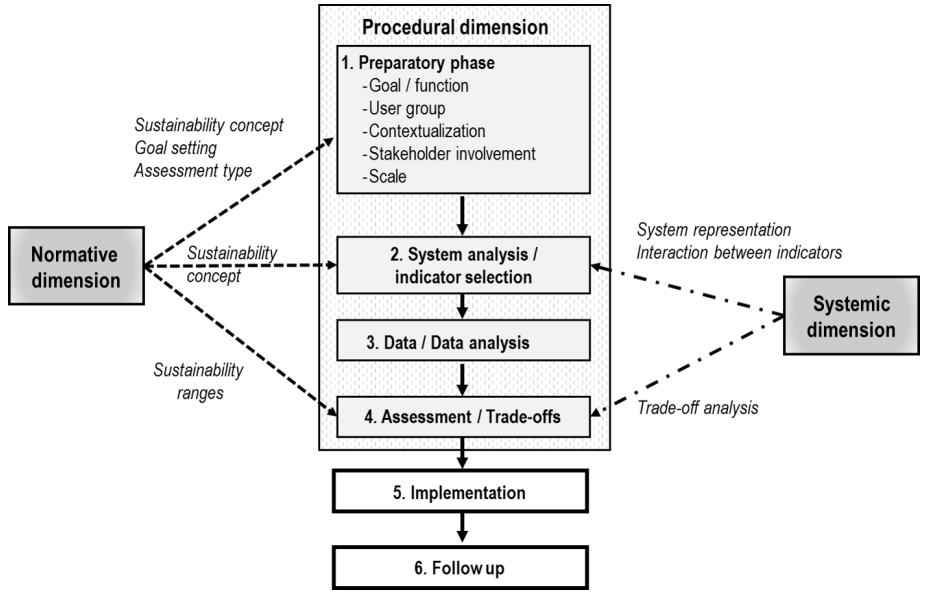
Sustainability assessment of cities with an important cultural heritage

Sustainability Assessment of Urban Systems

Claire Bernier, Lucie Dross, Manuela Goulart, Iléane Lefèvre, Amaia Soubelet

1st June 2022

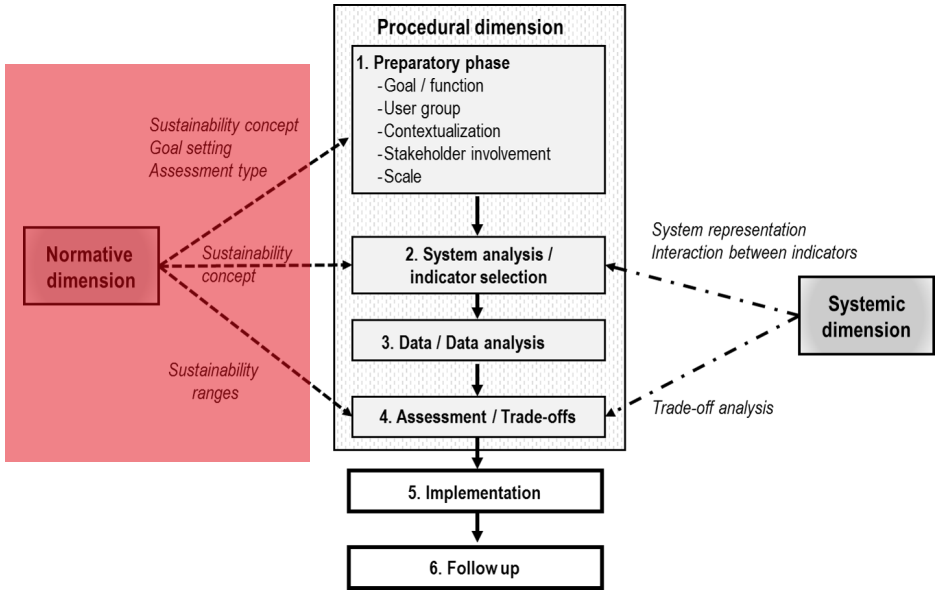
EPFL



Group project 2022: Claire Bernier, Lucie Dross, Manuela Goulart, Iléane Lefèvre, Amaia Soubelet

Introduction

Which of the selected cities, characterised by a rich cultural heritage, is the most sustainable ?



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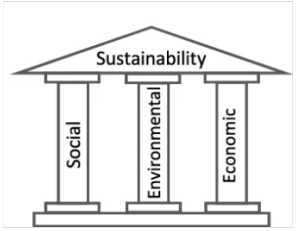
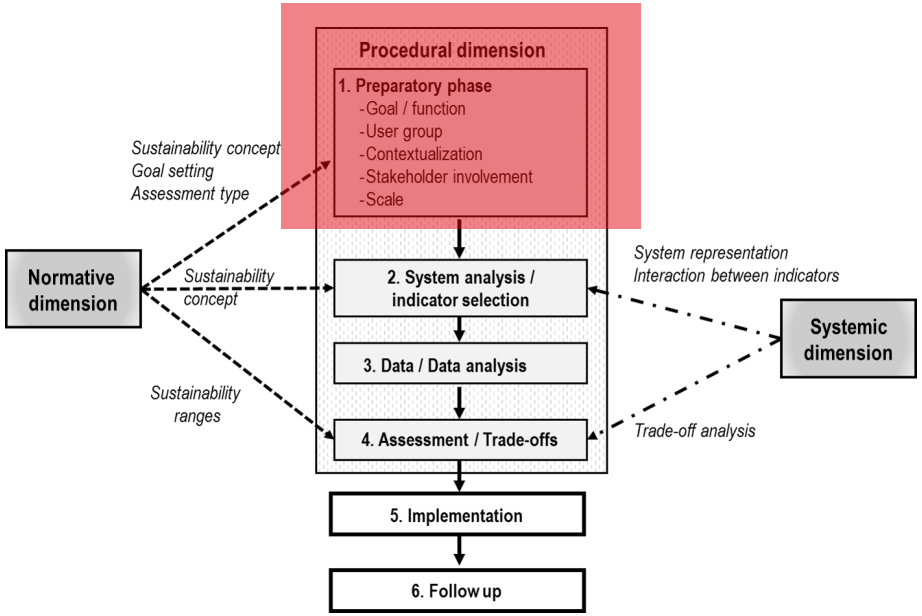
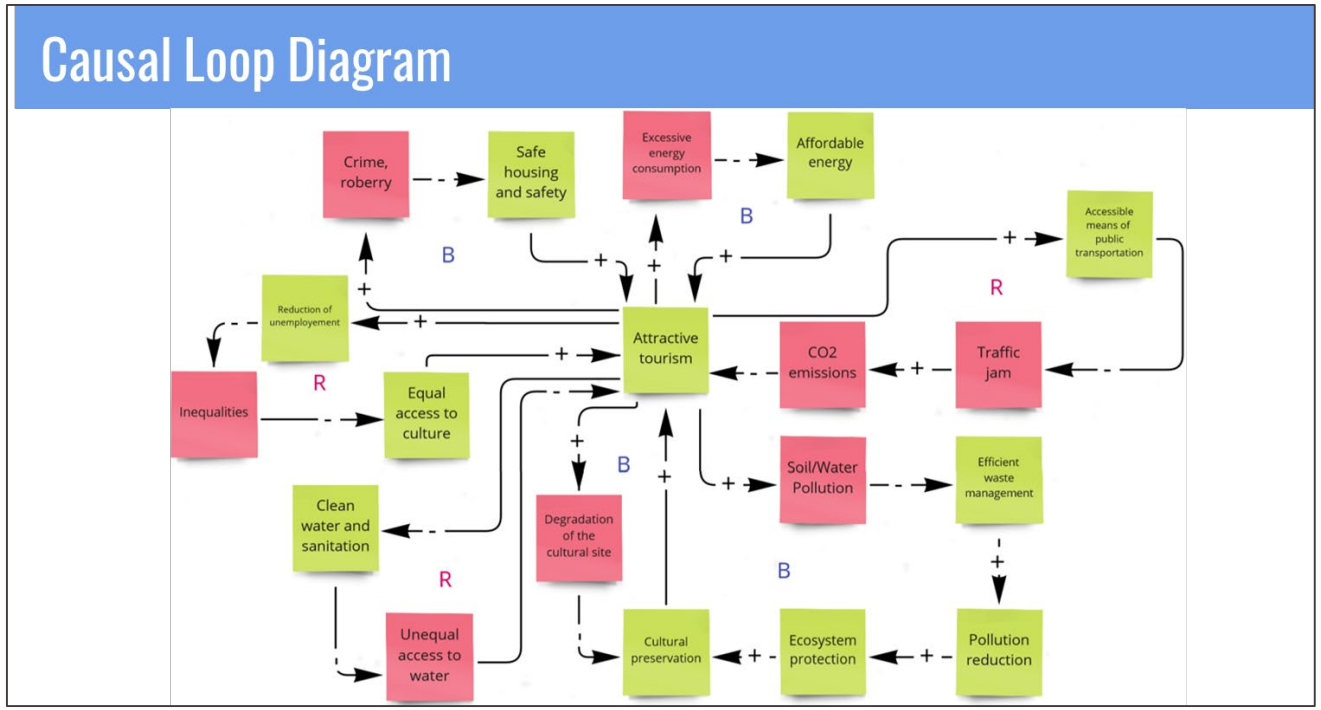
Definition of sustainability

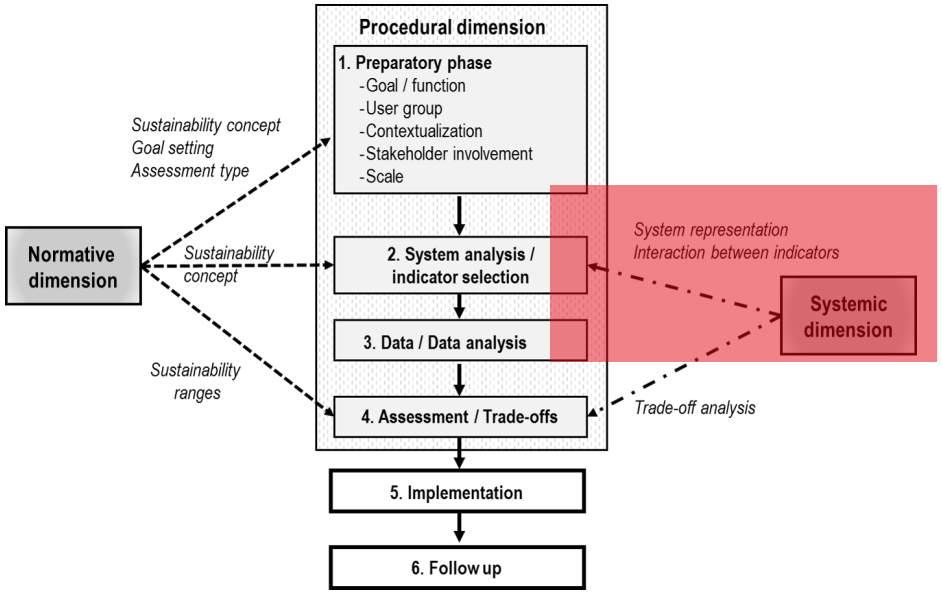
- Manage and optimise resources while keeping in mind future generations
- Preserve, protect and highlight the cultural wealth
- Welcoming tourists while keeping inhabitants a priority



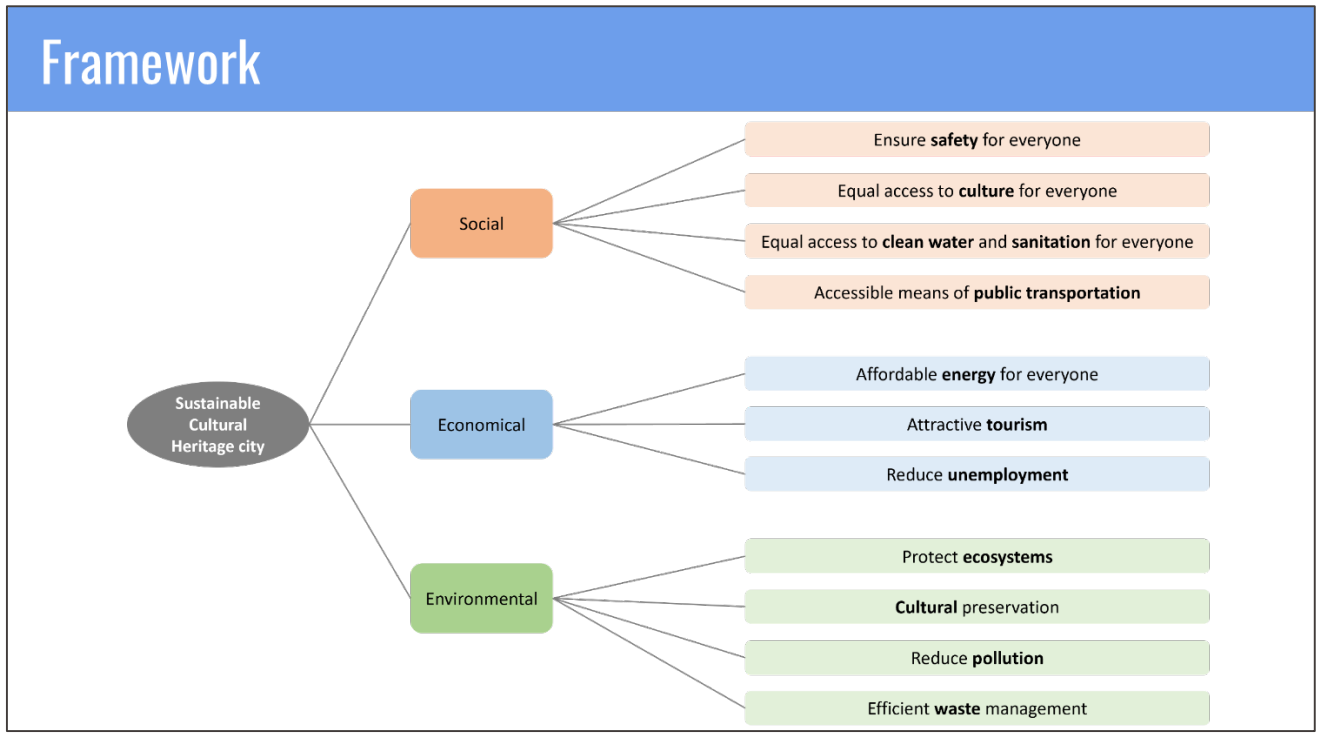


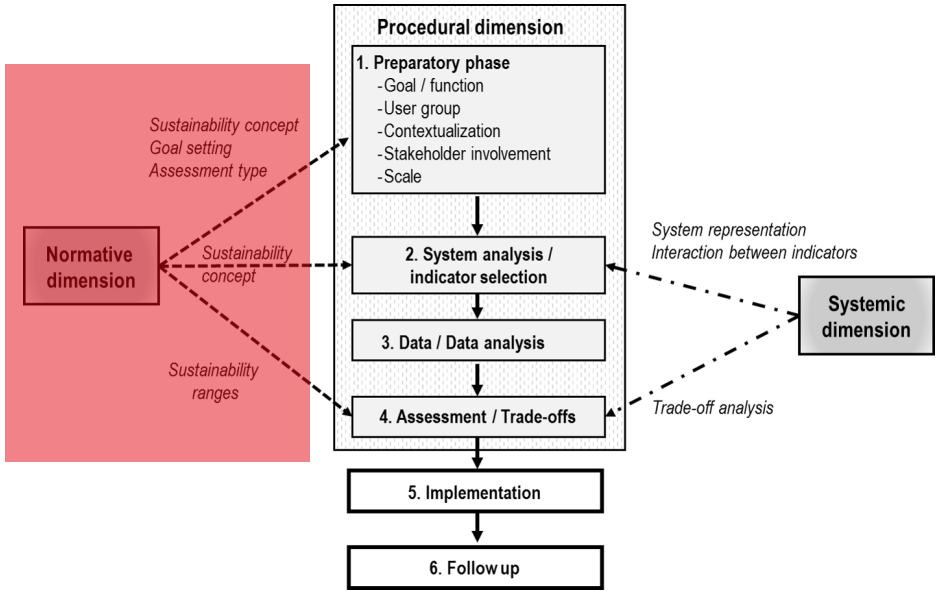
Group project 2022: Claire Bernier, Lucie Dross, Manuela Goulart, Iléane Lefèvre, Amaia Soubelet





Group project 2022: Claire Bernier, Lucie Dross, Manuela Goulart, Iléane Lefèvre, Amaia Soubelet





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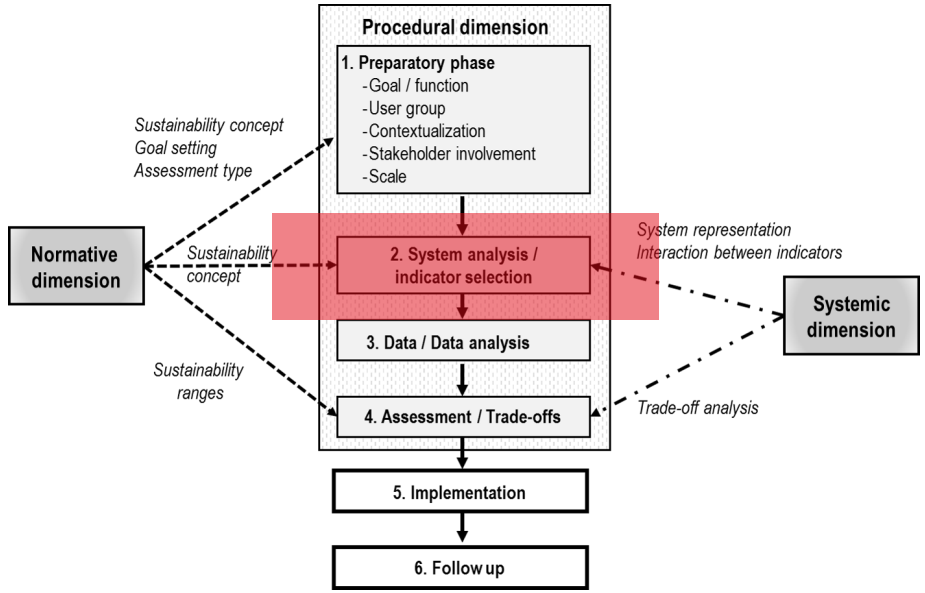
Final Indicators

Goals	Indicators		Unit
Accessible means of public transportation	Number of metro lines and buses/over the city area	↑	[-/km²]
	Monthly price of public transport	↓	[-]
Protect ecosystems	green areas in m2	↑	[m²/capita]
Attractive tourism	Number of tourists in 2019	↑	[million people]
	Number of Hotels	↑	[-]
Cultural preservation	Number of art/culture-related infrastructures	↑	[-]
	Budget allocated to culture	↑	%
Equal access to clean water and sanitation for everyone	Water scarcity in the country	↓	[score]
	Treatment of waste water	↑	[%]
Reduce unemployment	Gini Indicator	↓	[%]
	Unemployement rate	↓	[%]
Affordable energy for everyone	Energy consumption per capita	↓	[TJ/capita]
	Price of energy (per country)	↓	[-/kWh]
Ensure safety for everyone	Number of homicides	↓	[-/100'000 inhabitant]
	Number of homeless people	↓	[%]
Efficient waste management	Quantity of waste per capita	↓	[tons/capita]
Equal access to culture for everyone	Average price of museums	↓	[-]
	Statistics on who benefits of culture	↑	[%]
Reduce pollution	CO2 emission	↓	[tCO2/capita]



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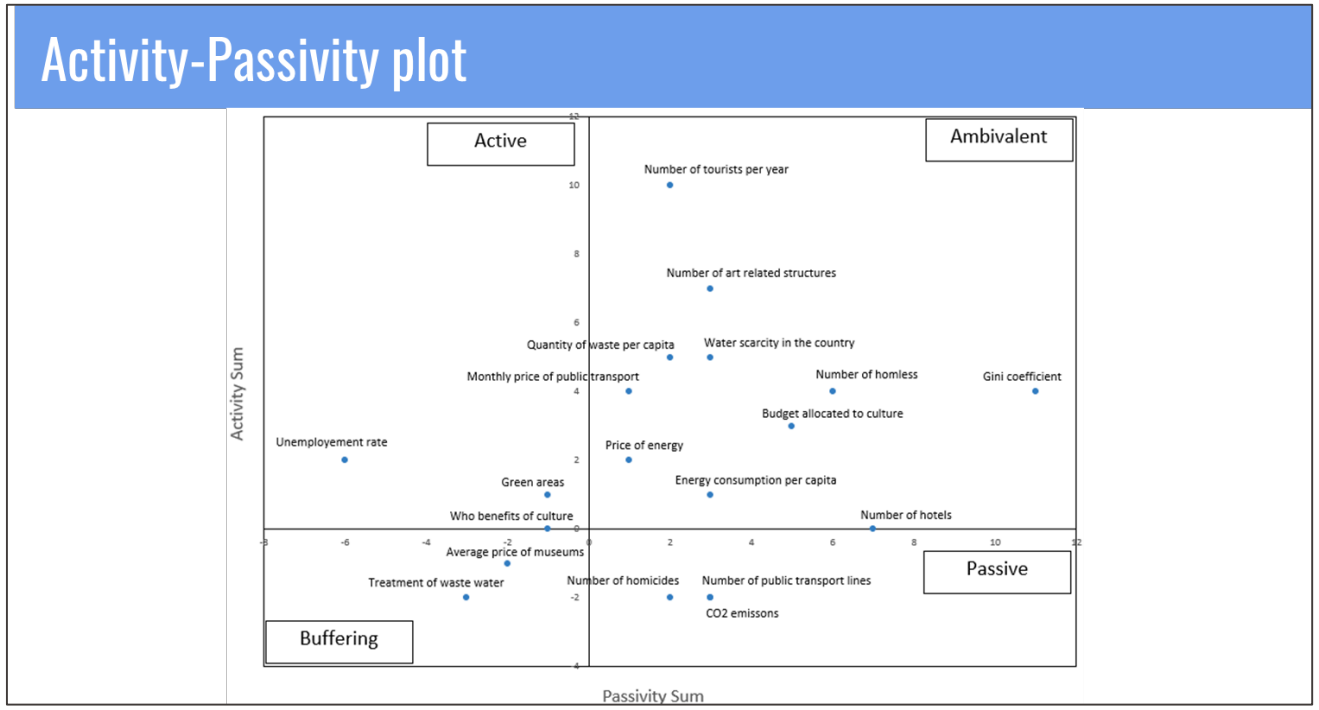
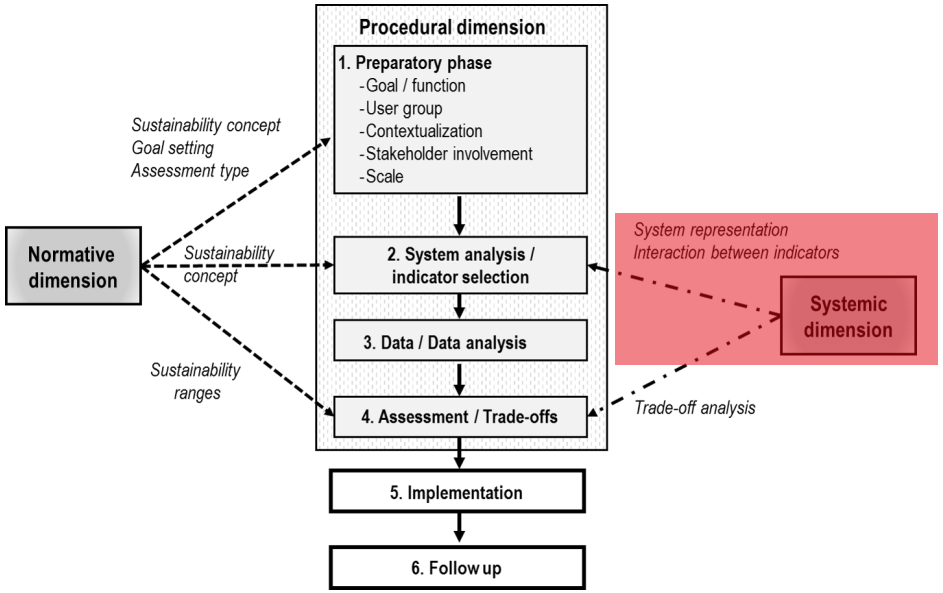
Activity-Passivity plot



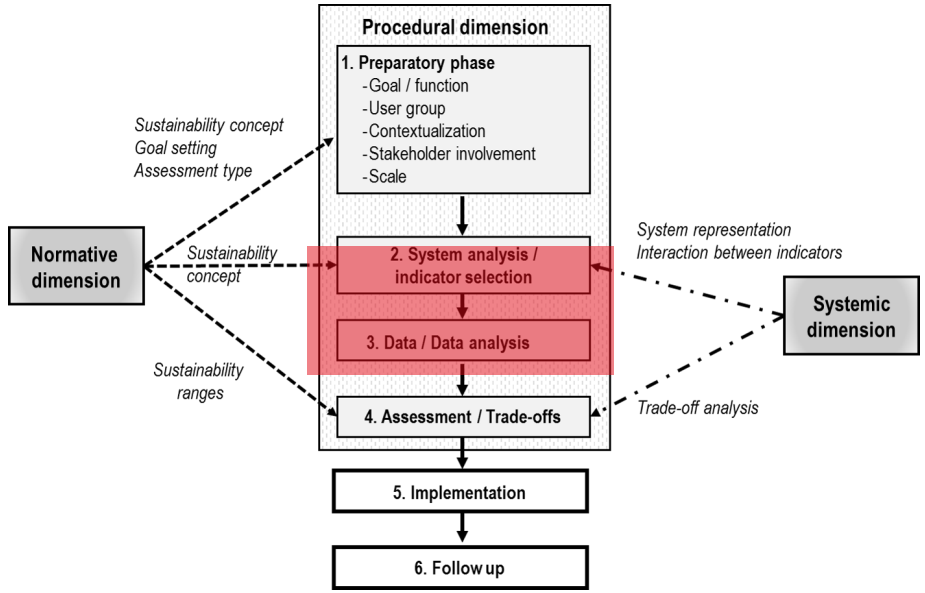


Group project 2022: Claire Bernier, Lucie Dross, Manuela Goulart, Iléane Lefèvre, Amaia Soubelet

Annex

Data table:

Goals	Indicators		BEIJING	CAIRO	CORDOBA	MEXICO CITY	Unit
Accessible means of public transportation	Number of metro lines and buses/over the city area	↑	0,059	0,138	0,018	0,332	[-/km²]
	Monthly price of public transport	↓	0,002	0,003	0,002	0,008	[-]
Protect ecosystems	green areas in m2	↑	14,110	1,700	34,010	6,000	[m²/capita]
Attractive tourism	Number of tourists in 2019	↑	3,770	6,810	12,100	50,300	[million people]
	Number of Hotels	↑	872,000	492,000	381,000	1065,000	[-]
Cultural preservation	Number of art/culture-related infrastructures	↑	119,000	26,000	22,000	153,000	[-]
	Budget allocated to culture	↑	0,840	2,500	0,500	0,200	%
Equal access to clean water and sanitation for everyone	Water scarcity in the country	↓	3,000	4,000	4,000	4,000	[score]
	Treatment of waste water	↑	77,500	50,000	100,000	15,000	[%]
Reduce unemployment	Gini Indicator	↓	0,378	0,397	0,370	0,450	[%]
	Unemployement rate	↓	1,300	12,000	8,400	3,700	[%]
Affordable energy for everyone	Energy consumption per capita	↓	652342,880	250964,100	7030,170	119262,150	[TJ/capita]
	Price of energy (per country)	↓	0,000	0,000	0,000	0,000	[-/kWh]
Ensure safety for everyone	Number of homicides	↓	1,000	3,000	1,000	29,000	[-/100'000 inhabitant]
	Number of homeless people	↓	0,400	7,700	0,080	0,150	[%]
Efficient waste management	Quantity of waste per capita	↓	0,499	0,267	0,378	2,038	[tons/capita]
Equal access to culture for everyone	Average price of museums	↓	0,000	0,001	0,000	0,001	[-]
	Statistics on who benefits of culture	↑	98,000	69,000	77,000	81,070	[%]
Reduce pollution	CO2 emission	↓	4,200	0,001	12,900	2,800	[tCO2/capita]



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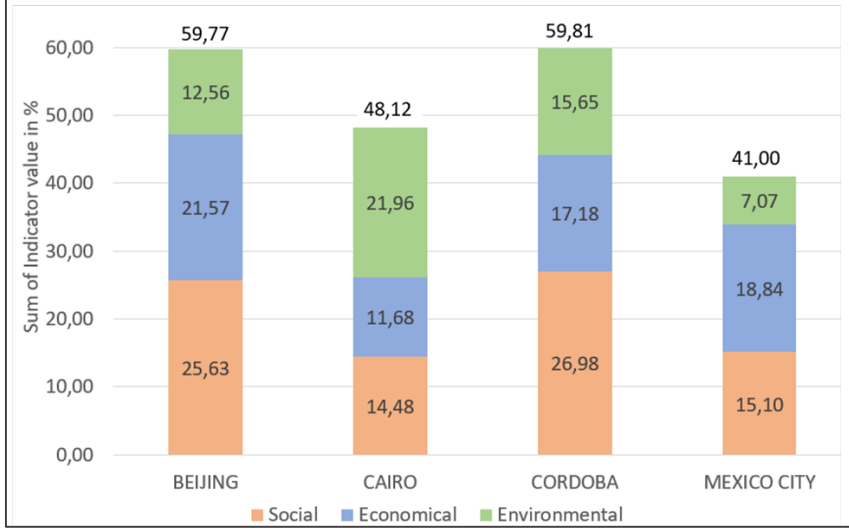
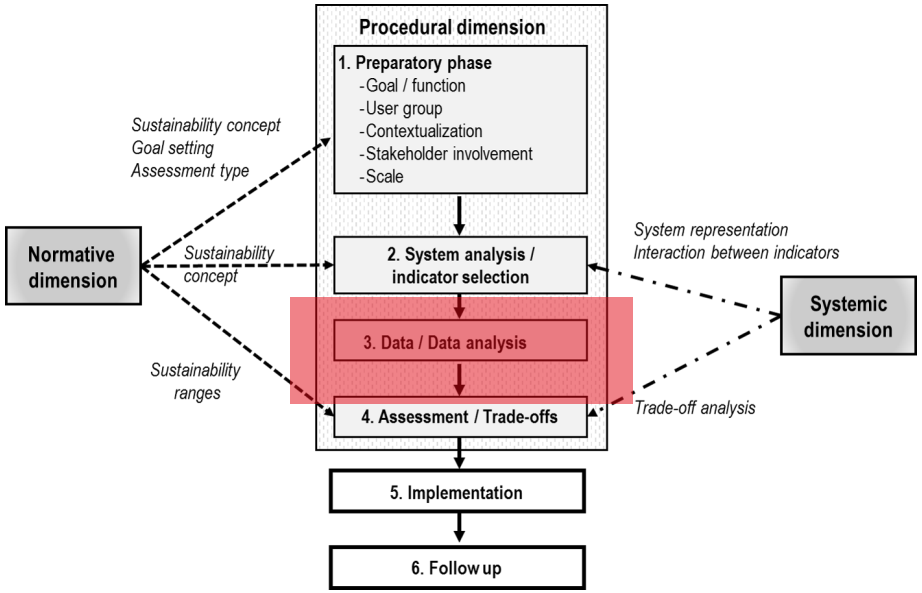
Multi-Criteria Assessment



Which of the selected cities, characterised by a rich cultural heritage, is the most sustainable?

From the most sustainable city to the worst:

- Cordoba
- Beijing
- Mexico City
- Cairo



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Policy implication

Beijing

- Reduce pollution
- Efficient waste management

Cordoba

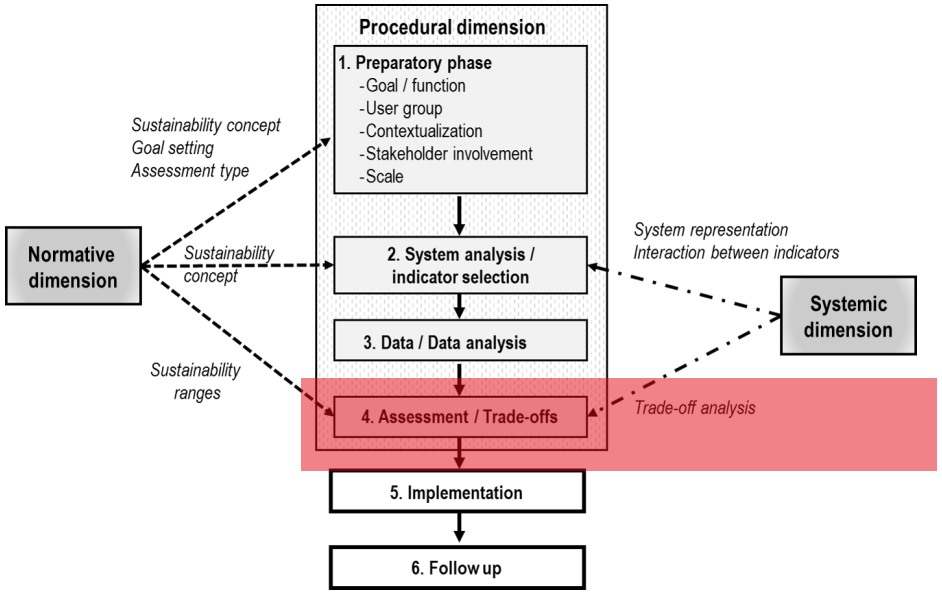
- Cultural preservation
- Attractive tourism

Cairo

- Equal access to culture for everyone
- Ensuring safety and housing for everyone
- Protecting ecosystems
- Equal access to clean water and sanitation

Mexico City

- Protecting ecosystems
- Efficient waste management
- Affordable energy for everyone
- Ensuring safety and housing for everyone



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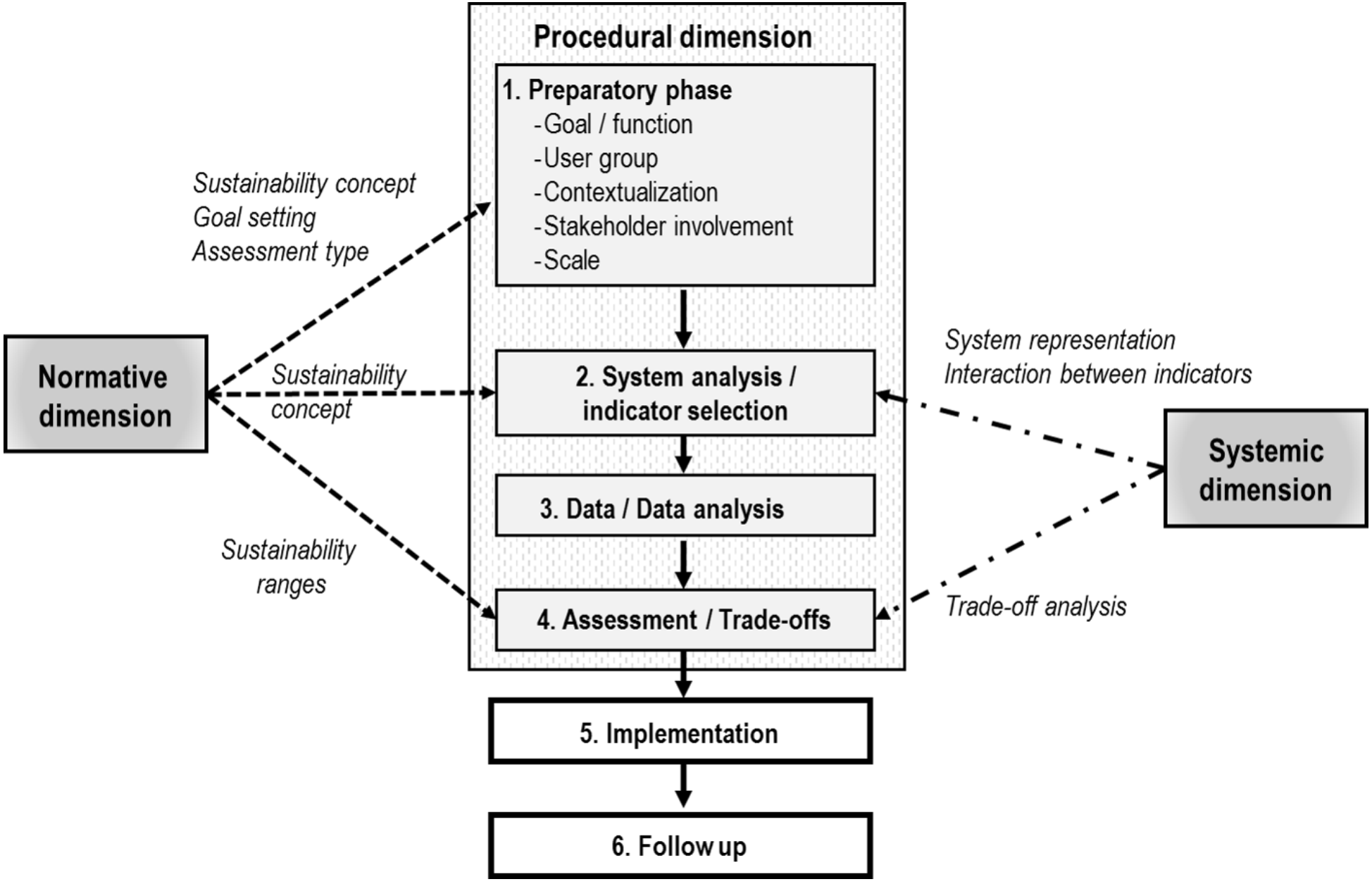
Preparatory phase

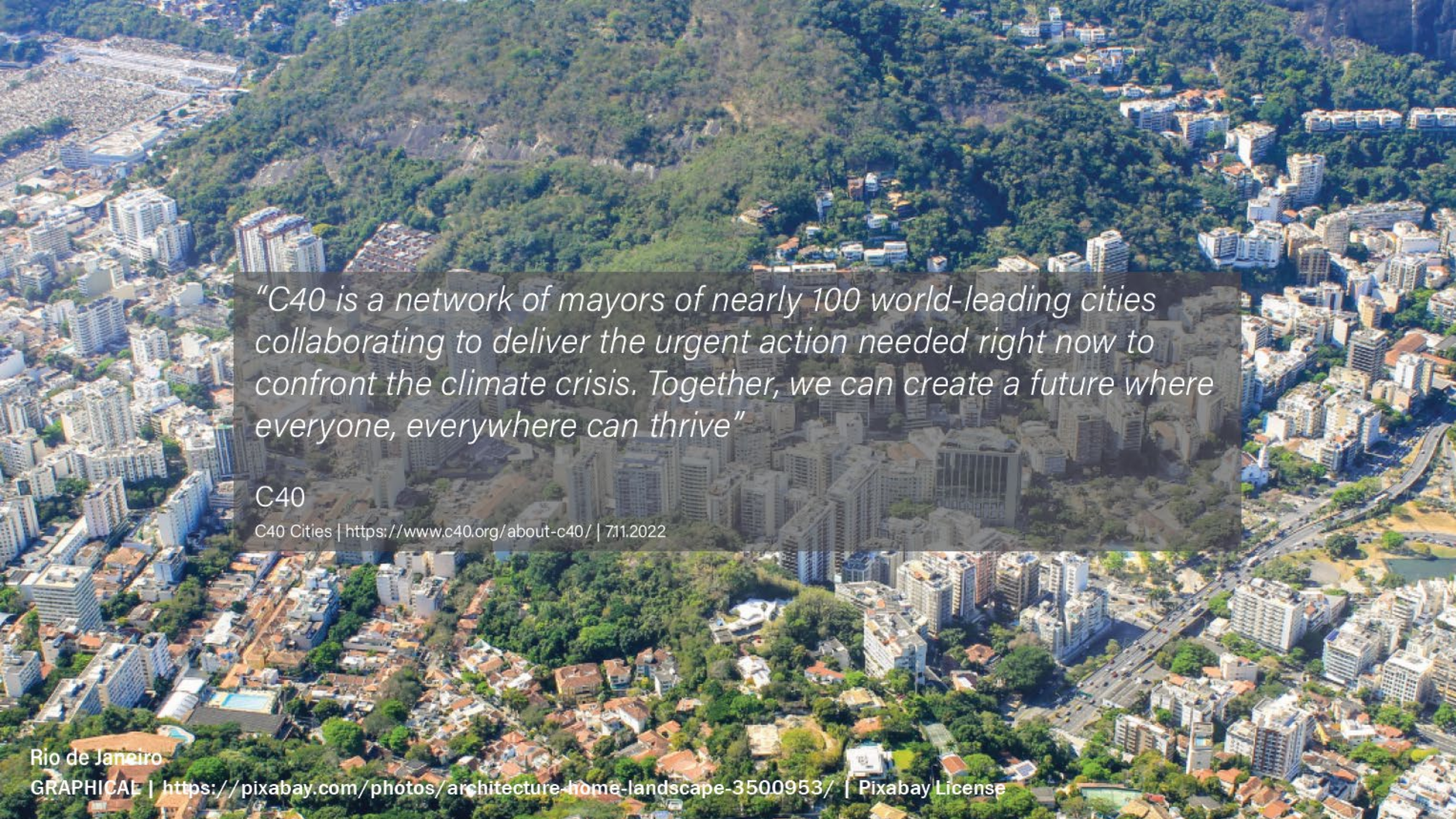
Sustainability Solutions Space



Preparatory phase

1. **Goal, function and user group**
2. Contextualisation
3. Stakeholders
4. Scale (System boundaries)

C40 Cities Climate Leadership Group Logo
By C40 Cities Climate Leadership Group | https://commons.wikimedia.org/wiki/File:C40_Cities_Climate_Leadership_Group_logo.svg | Public Domain
Rio de Janeiro
GRAPHICAL | https://pixabay.com/photos/architecture-home-landscape-3500953/ | Pixabay License



“C40 is a network of mayors of nearly 100 world-leading cities collaborating to deliver the urgent action needed right now to confront the climate crisis. Together, we can create a future where everyone, everywhere can thrive”

C40

C40 Cities | https://www.c40.org/about-c40/ | 7.11.2022

Rio de Janeiro

GRAPHICAL | https://pixabay.com/photos/architecture-home-landscape-3500953/ | Pixabay License

1. Establish goals, function & users

Identifying key sustainability issues/goals

Heidelberg

- Education
- Primary care
- Public security
- Health
- Social cohesion
- Soil protection
- Noise pollution / air quality
- Climate protection
- Water quality
- Biodiversity /
- Economic performance
- Employment / Innovation

Bogotà

- Society
- Economy
- Air quality
- Food security
- Transportation
- Climate & Energy
- Resource Management
- Waste Management

Calgary

- Community
- Economy
- Education
- Natural Environment
- Resource use
- Wellness

How to identify these issues?

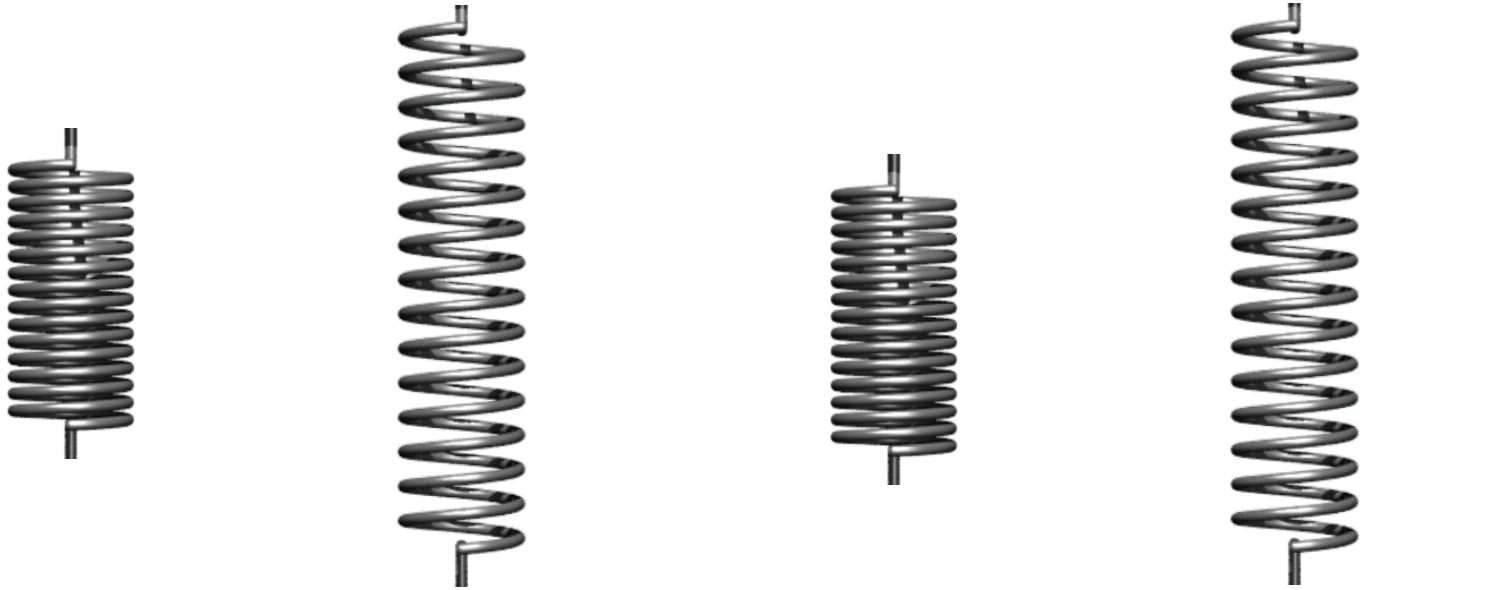
Who decides what is a key issue and what is not?

Who will use the results?

1. Establish goals, function & users (II)

(i) How to identify a finite set of key issues?

Combining '***opening up***' and '***closing down***' steps…



Research question	Heuristic exploration of potential stakes	Clustering, prioritization, etc.	Using indicators as "message carriers"

Stirling (2008)

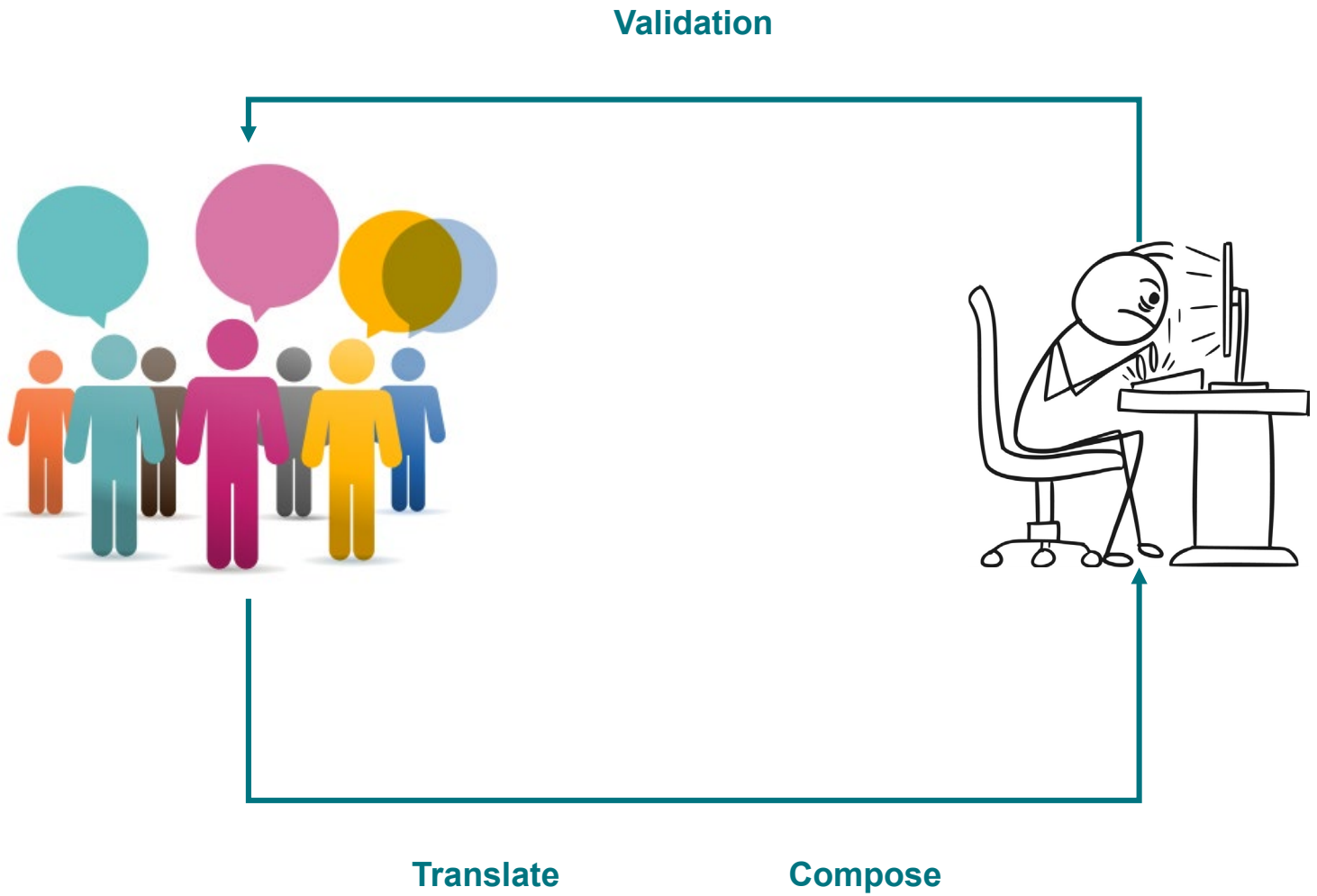
1. Establish goals, function & users (III)

(i) How to identify a finite set of key issues/goals?

- Institutional analysis
- Surveys
- Focus groups, interviews, etc
- Scientific literature

1. Establish goals, function & users (IV)

(ii) Who decides what is a key issue and what is not?



Preparatory phase

1. Goal, function and user group
2. **Contextualisation**
3. Stakeholders
4. Scale (System boundaries)

2. Contextualization

- Which context is the sustainability issue related to
- Necessary because:
  - We are dealing with an **open system** that cannot be studied in isolation from its environment;
  - **every improvement in one system**, in terms of its sustainability, **has an effect on its surrounding systems** (see also first- and second-order cybernetics, and resilience)

What is the context in our three cities?

Heidelberg

- Education
- Primary care
- Public security
- Health
- Social cohesion
- Soil protection
- Noise pollution / air quality
- Climate protection
- Water quality
- Biodiversity
- Economic performance
- Employment / Innovation

Bogotà

- Society
- Economy
- Air quality
- Food security
- Transportation
- Climate & Energy
- Resource Management
- Waste Management

Calgary

- Community
- Economy
- Education
- Natural Environment
- Resource use
- Wellness

Preparatory phase

1. Goal, function and user group
2. Contextualisation
3. **Stakeholders**
4. Scale (System boundaries)

3. Stakeholders

How to identify key stakeholders?

- **Institutional analysis** (examination of regulatory context, analysis of national and local press, study of grey literature, etc.)
- **In-depth interviews** (snow-ball sampling method)
- **Participant observation**
- **(scientific) Literature review**

De Marchi et al. 2000; Corral-Quintana 2001; Salgado et al. 2009; etc.

3. Stakeholders: case of energy transition

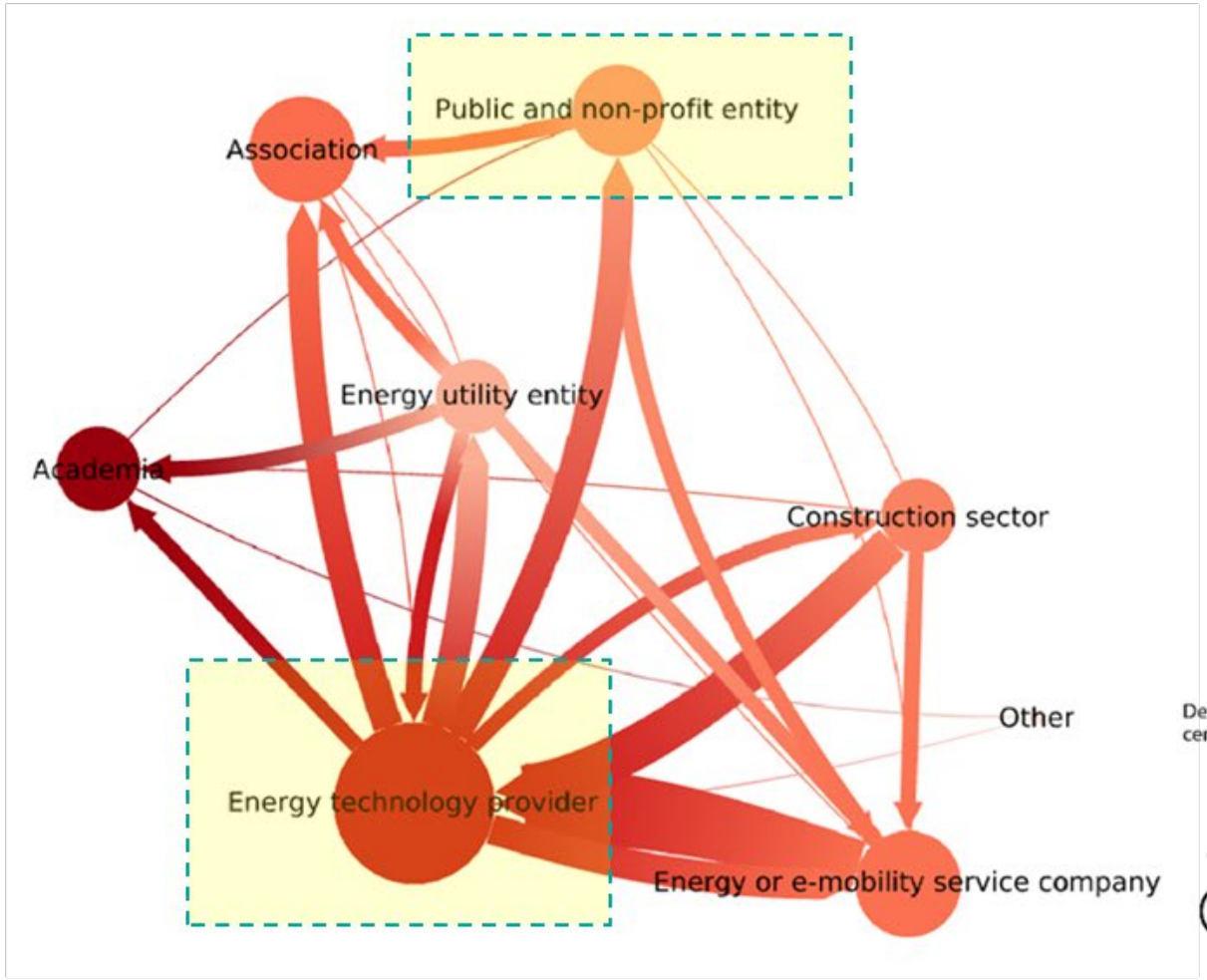
Mapping key stakeholders: illustration 1 *(Energy transitions – Austria)*

Characteristics \ Social Arena	Industry	Associations	Research	Politics	Media
Core Actors	Energy producers, cooperatives, construction and production firms	Regional energy associations, LEADER groups, Industry associations	Regional innovation centre, Universities, research institutions, Research departments in firms	Municipalities, the provinces, the EU	Regional newspaper
Coordination of Actors	Market	Network	Network	Hierarchy	Market
Main Goals within the Arenas	Investing in renewables, providing energy and energy-related products	Coordinate and represent regional actors, provide funding, integrate external actors	Developing and testing of new technologies, introducing new knowledge in the region	Regulating, subsidizing, investing in energy plants/research projects	Informing the public, opinion building on political decisions and observed behaviour in industry
Time Horizon for Activities	Medium-term	Long-term	Medium-term	Short-term	Short-term
Spatial Reference of Actors	Local–international	Local–regional	Regional -national	Local—international	Local–regional

Wyss et al. (2018)

3. Stakeholders: case of energy transition

Mapping key stakeholders: illustration 2 *(Energy transitions – Switzerland)*



Energy technology providers are key for the energy transition and tipping:

- foster the spread of rather homogeneous thinking
- accelerate diffusion of innovative technologies
- block the emergence of alternative ideas

Reference network aggregated by supply-side categories. The arrows point to which the category was referenced by the respondent

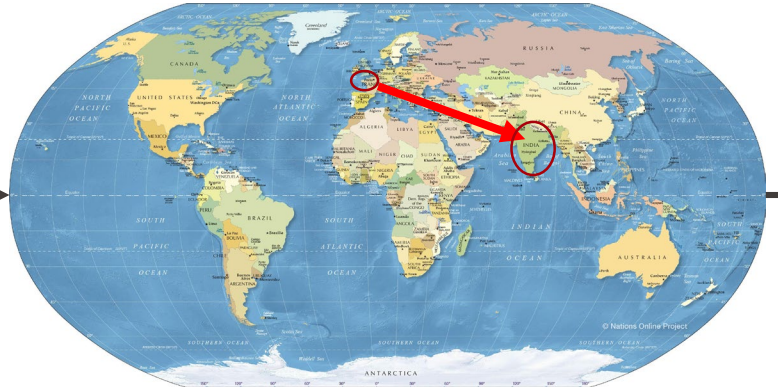
Source: Serra Coch et al., submitted

Preparatory phase

1. Goal, function and user group
2. Contextualisation
3. Stakeholders
4. **Scale** (System boundaries)

4. Scale

Defining (geographical) scales…

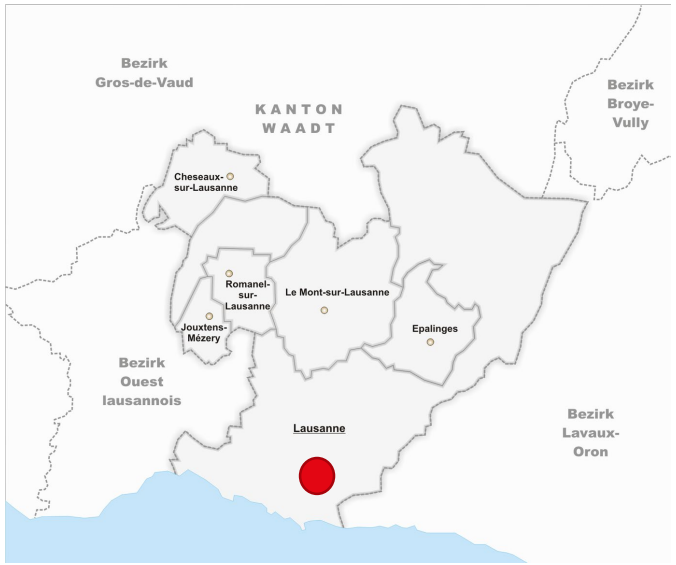


"Internationalization" of environmental externalities…

Martinez-Alier (1997)

4. Scales

Defining scales…



District

Canton

Confederation

Giampietro & Mayumi (2000)

4. Scales / temporal dimension

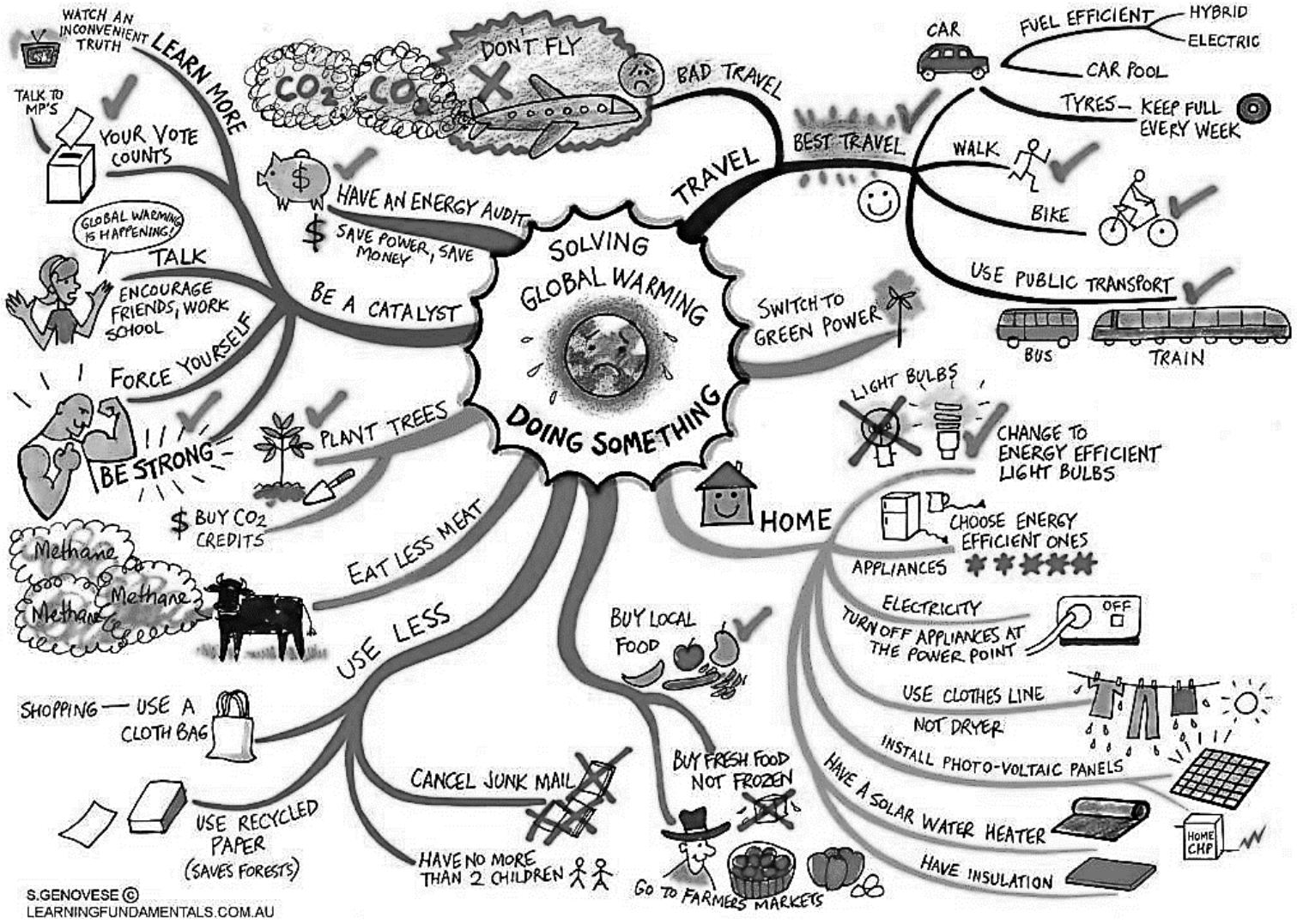
Defining (temporal) dimension…

…How to integrate very long-term impacts into the assessment?

NET PRESENT VALUE (NPV):

$$\sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$$

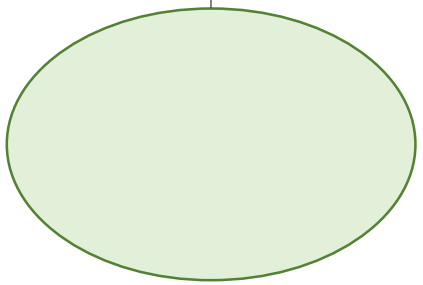
- n: Time horizon
- C_t: Net Cashflow for period *t*
- r: Discount rate



Frameworks for Urban Sustainability

Where do we start to measure sustainability?

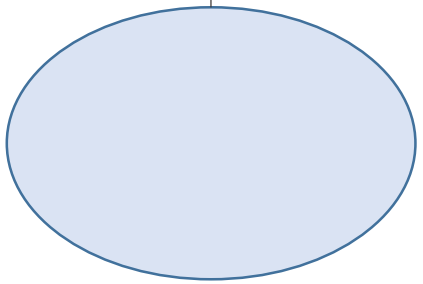
Conceptual frameworks



What is a sustainable city?

Conceptual frameworks are **centered on the concept itself**, its representation and its subsequent translation into metrics

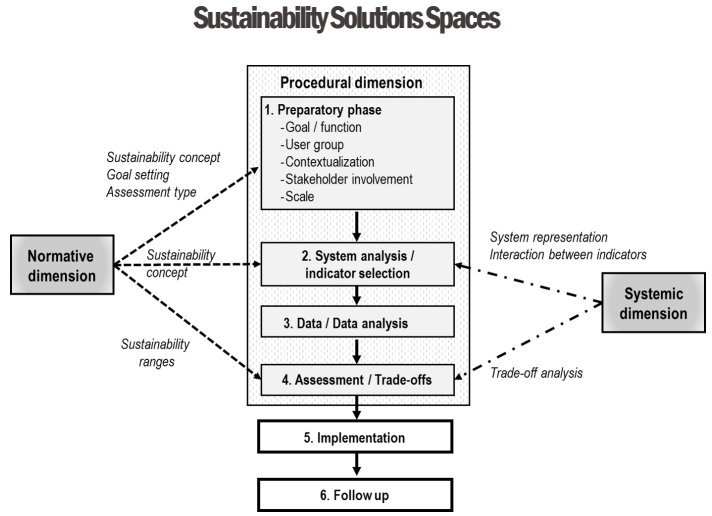
Procedural frameworks



How can urban sustainability be measured?

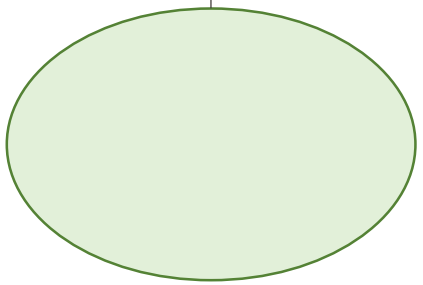
Procedural frameworks depict the **methodology** implemented to measure a particular concept

They most often consist of a **sequence of stages with dedicated tools**



What is a framework?

Conceptual frameworks



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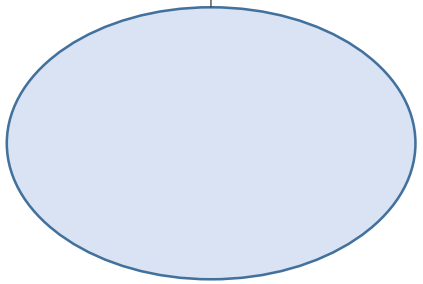

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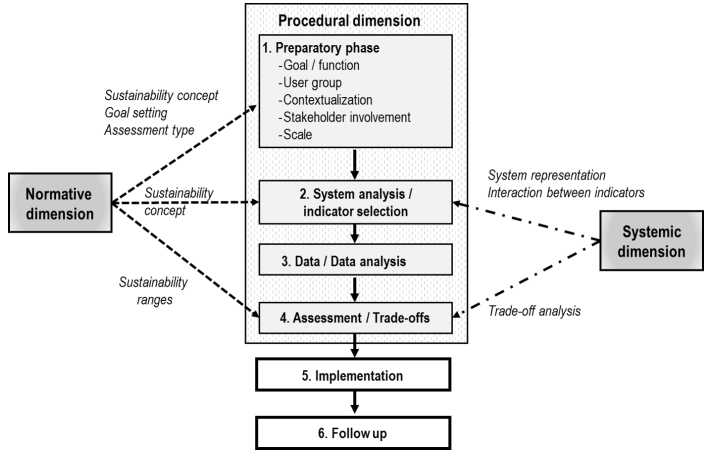
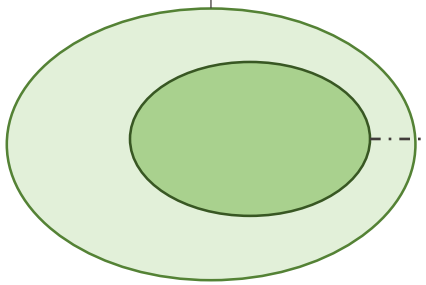


What is a framework?

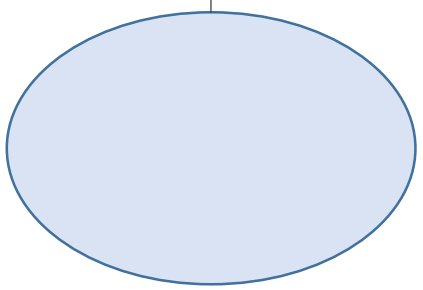
Conceptual frameworks



What is a sustainable city?

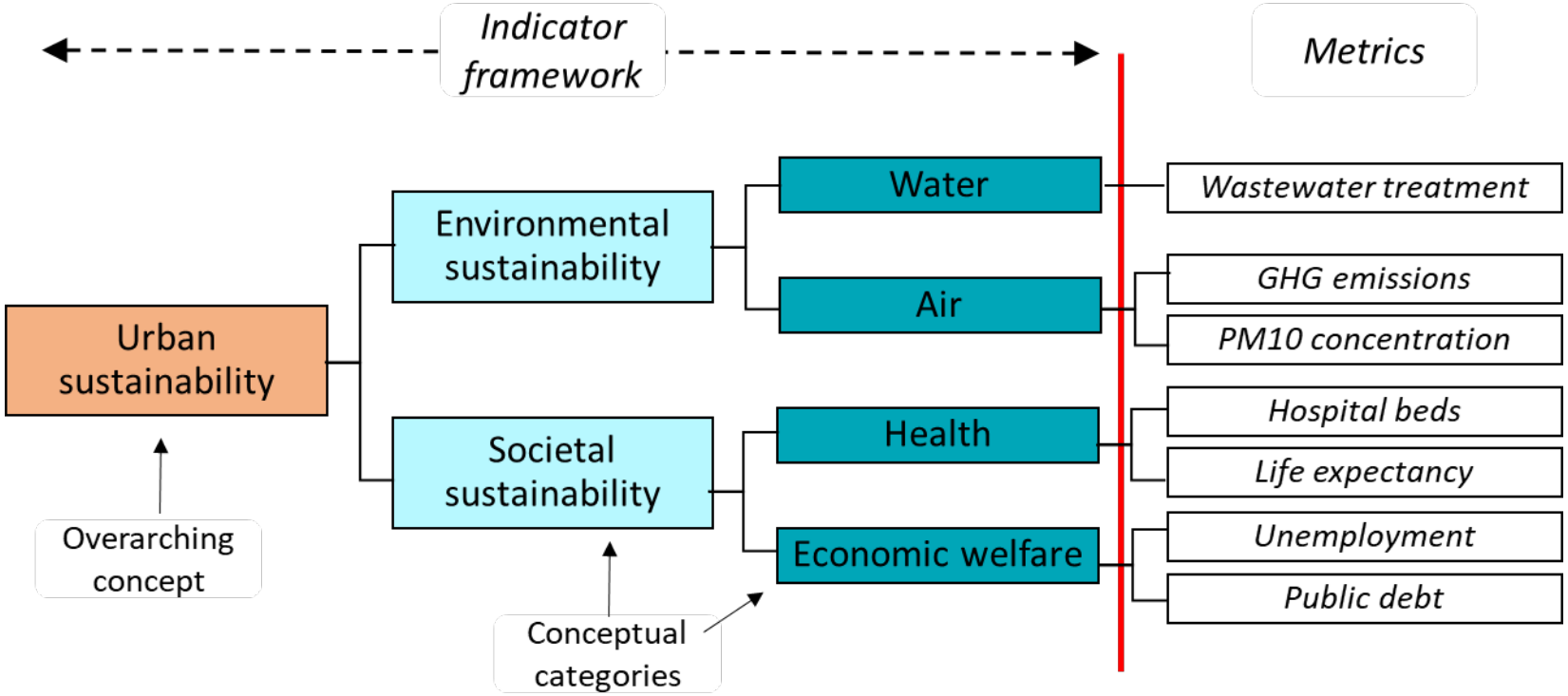
Indicator frameworks

Procedural frameworks



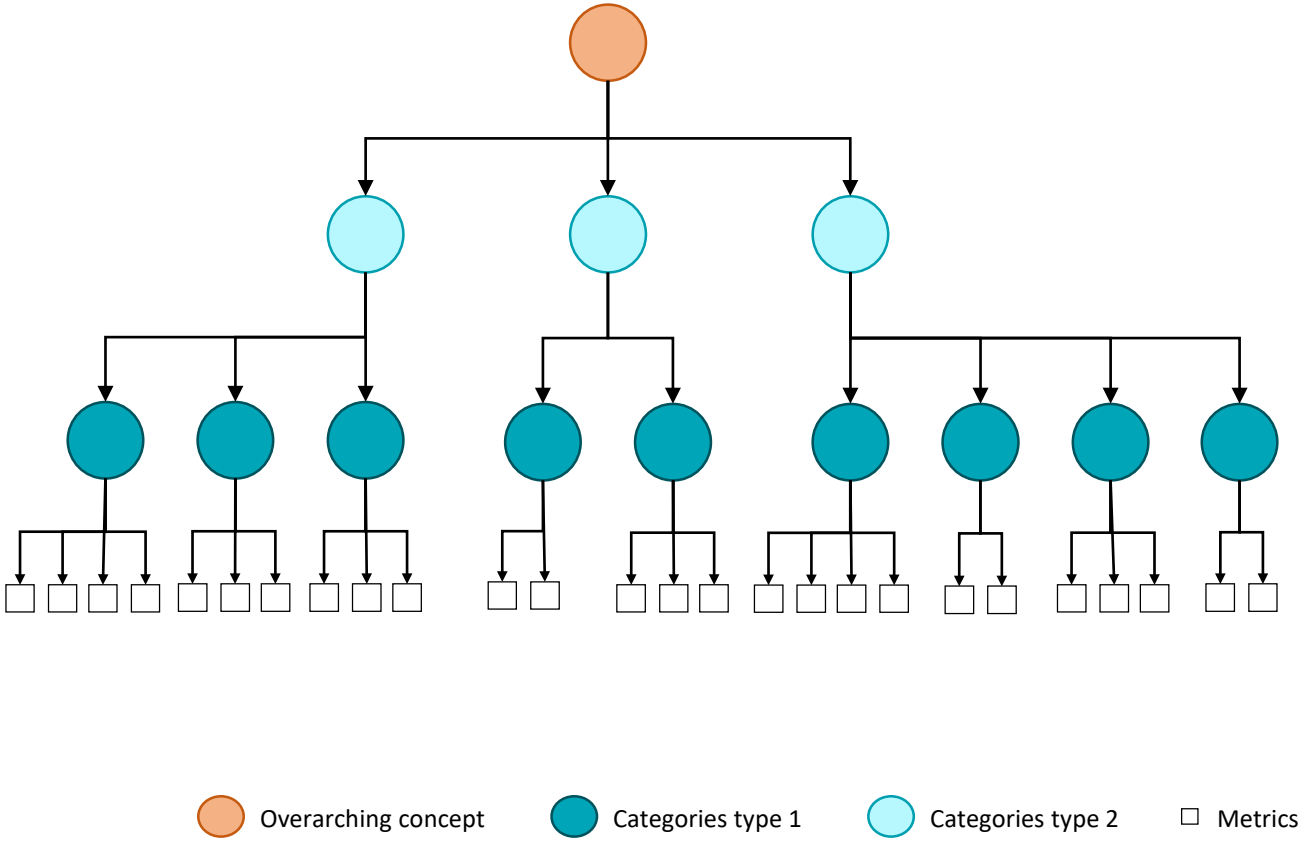
How can urban sustainability be measured?

What is a framework?



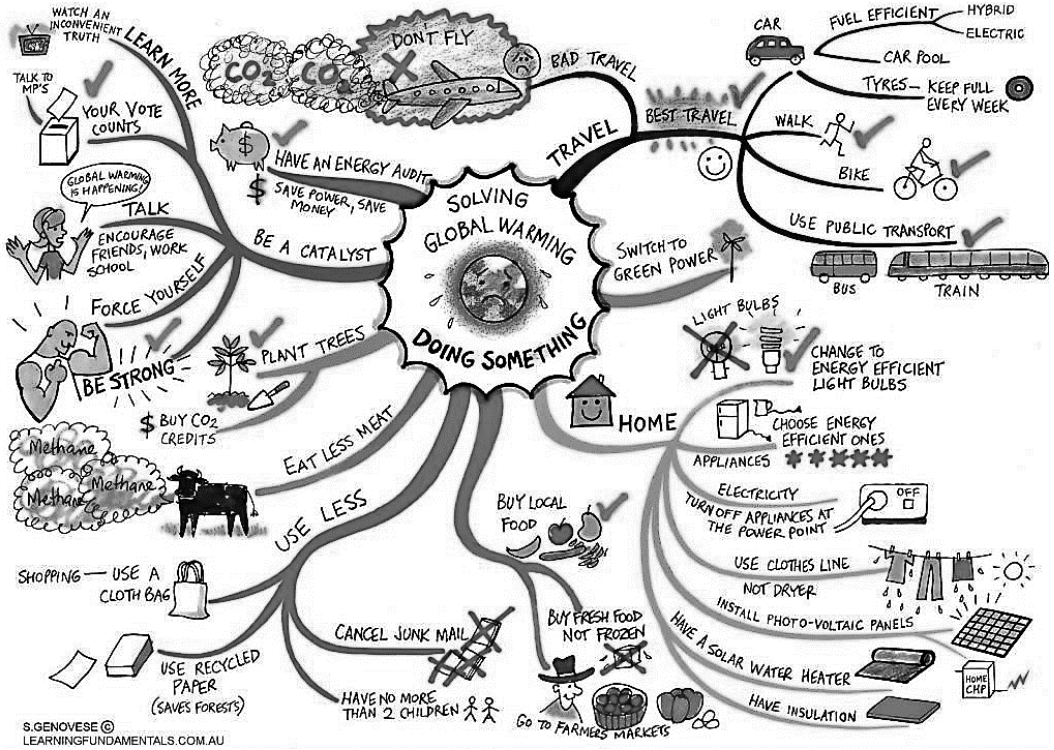
Halla & Merino-Saum (2021)

What is a framework?



What are frameworks for?

1. (re)Defining the overarching concept to be monitored



indicator frameworks as **mind maps**

By breaking abstract concepts into specific categories, indicator frameworks *de facto* **(re)define the concept** under analysis.

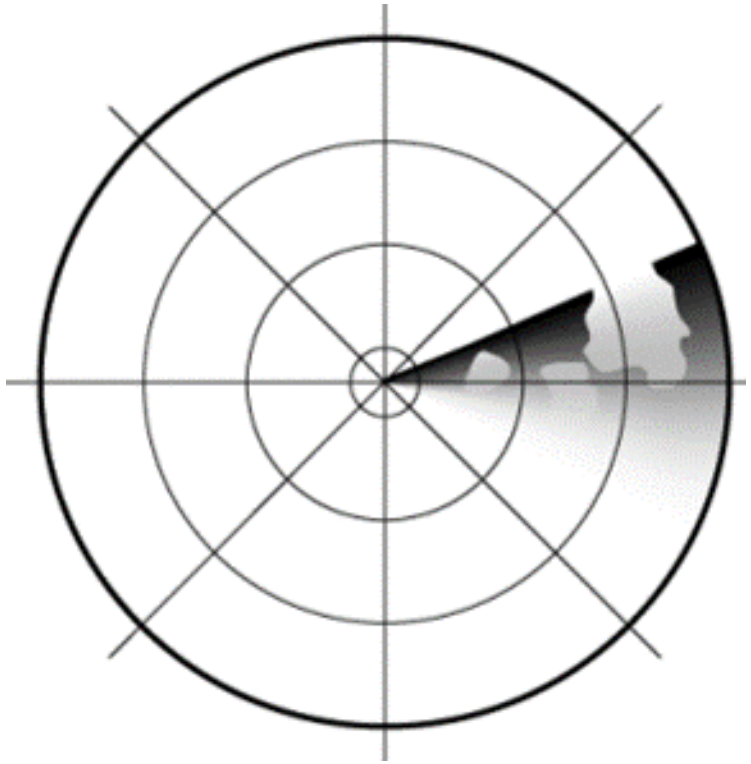
→ **Definition of sustainability!**

Every indicator framework crystallizes a particular "**sustainable city imaginary**" (Elgert 2018)

Halla & Merino-Saum (2021)

What are indicator frameworks for?

2. **Guiding indicator selection** and development



indicator frameworks as **radars**

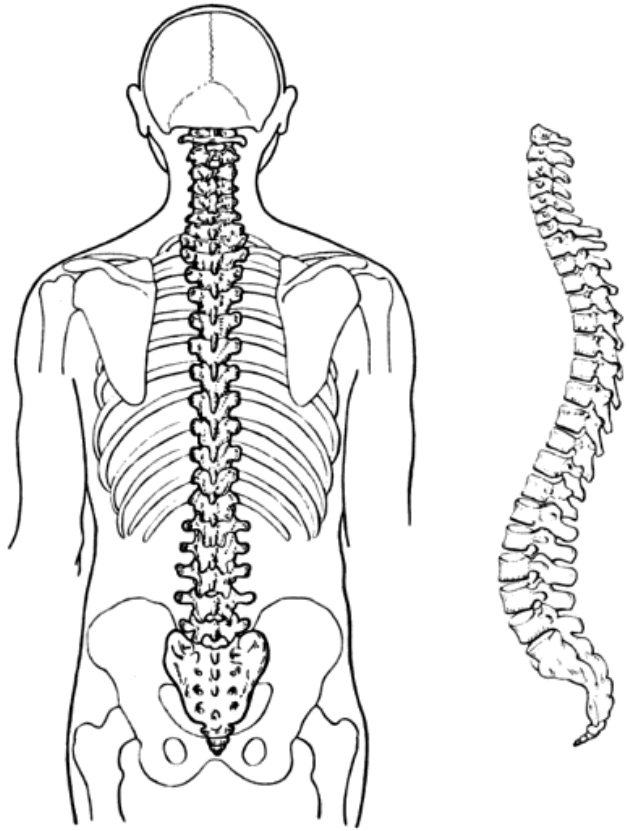
Areas that need to be covered with indicators are identified

Potential **gaps and/or redundancies** among candidate indicators are spotted and made explicit

Halla & Merino-Saum (2021)

What are indicator frameworks for?

3. Structuring information



indicator frameworks as **backbones**

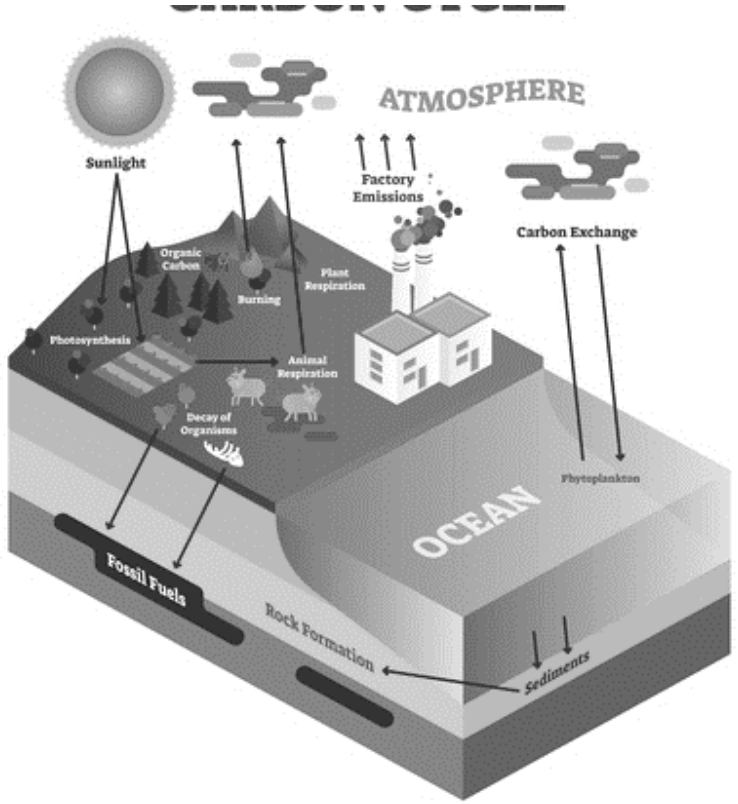
Indicator frameworks help to **organize and classify the diverse and most often complex information** embedded in any sustainability indicator set

Indicator frameworks constitute the **central supporting part** in any indicator set without which the set would collapse and become a mere conglomeration of disconnected items

Halla & Merino-Saum (2021)

What are indicator frameworks for?

4. Making interrelations explicit between indicators



Indicator frameworks express in a simple (yet not simplistic) manner **how the assessed system functions**, thereby providing insights as to how it can get closer to sustainability.

indicator frameworks as educational **scale models**

Halla & Merino-Saum (2021)

What are indicator frameworks for?

4. Putting metrics into context

indicator frameworks as **anchors**

Indicator frameworks **explain how generic metrics are linked to concepts**, thus elucidating the particular signification they carry in the context of a specific indicator set.

Indicator frameworks provide generic metrics with specific meaning, thereby **mutating them from raw statistical data to complete indicators with a precise meaning**.

Halla & Merino-Saum (2021)

What are indicator frameworks for?

5. Communication

Indicator frameworks can also be used as **communication tools** summarizing key information and providing a visual identity to the measurement initiative at hand.

indicator frameworks as **business cards**

Halla & Merino-Saum (2021)

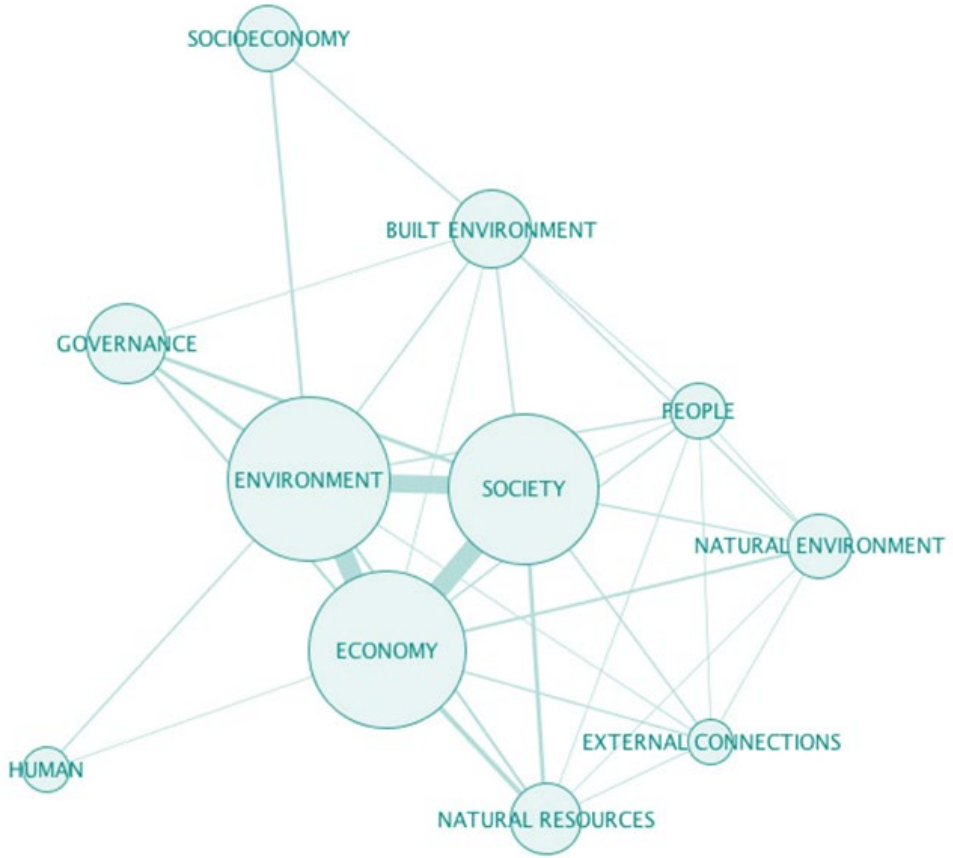
Logic to define indicator frameworks

Six basic types:

- **domain**-based frameworks
- **theme**-based frameworks
- **goal**-oriented frameworks
- **systemic** frameworks
- (**emerging** logics)
- **hybrid** frameworks

1. Domain-based frameworks

Def: Domain-based frameworks categorize indicators across the **most general perspectives** or sub-systems pertinent to sustainability and **reducible only to the overarching concept** (i.e. urban sustainability).

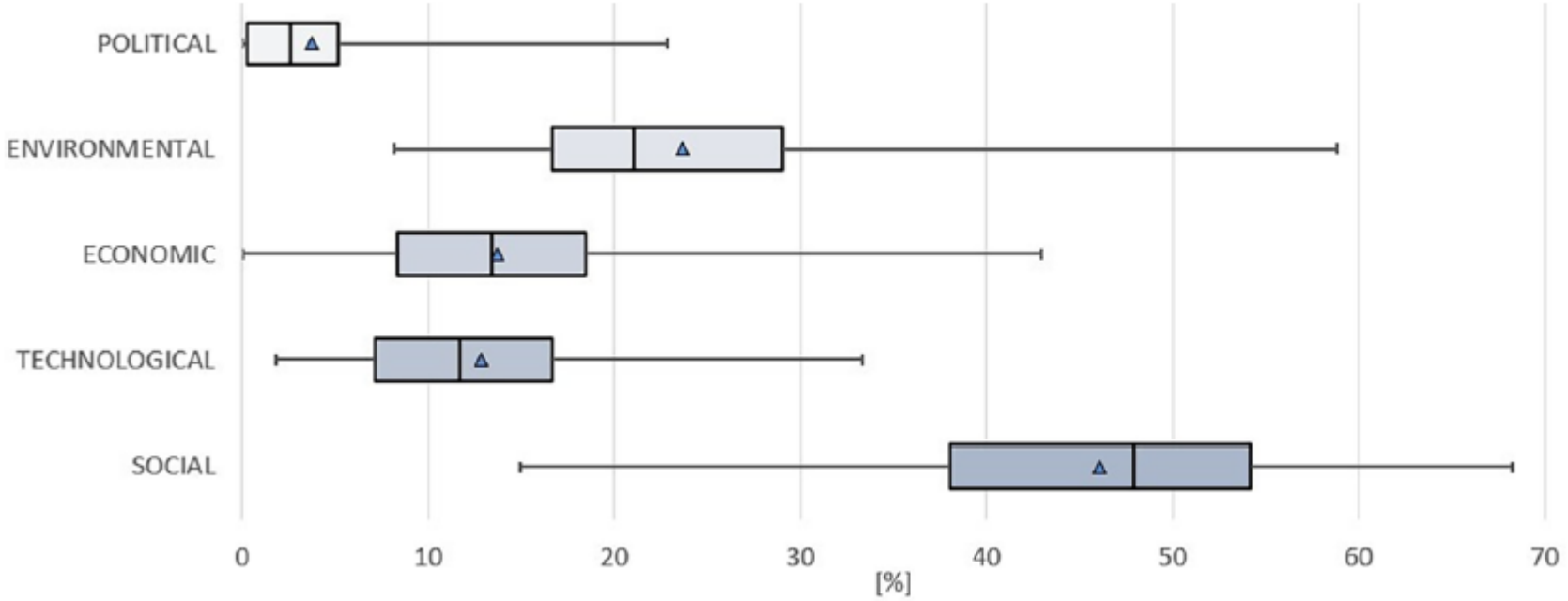


Halla & Merino-Saum (2021)

1. Domain-based frameworks

Which domains receive more attention in indicator-based sustainability assessments?

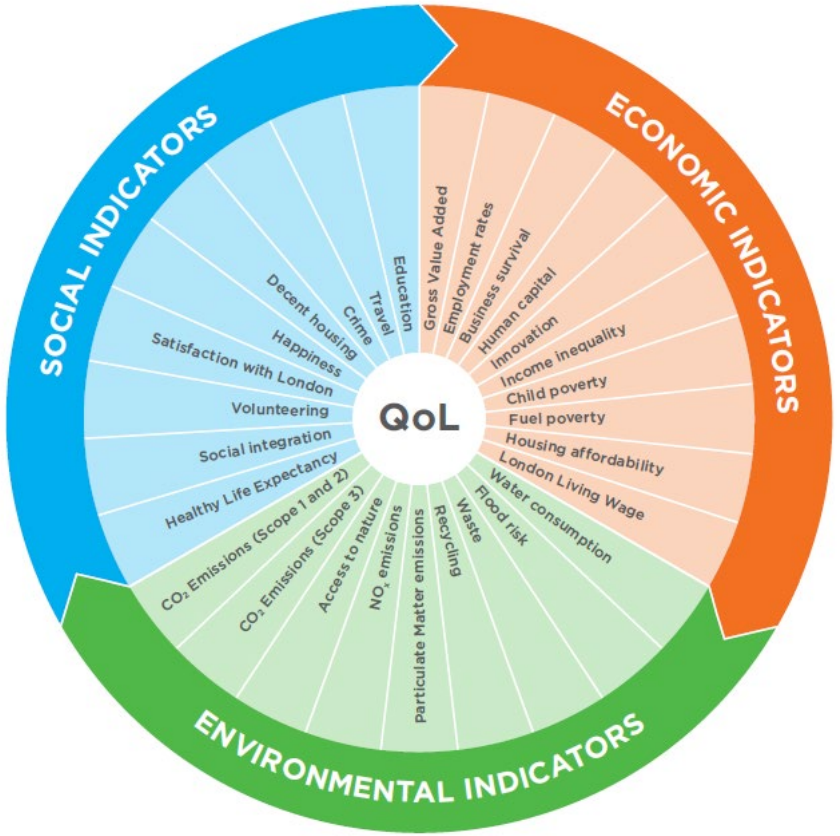
Ecological Indicators 119 (2020) 106879



1. Domain-based frameworks

Illustration 1: London – Sustainable Development Commission

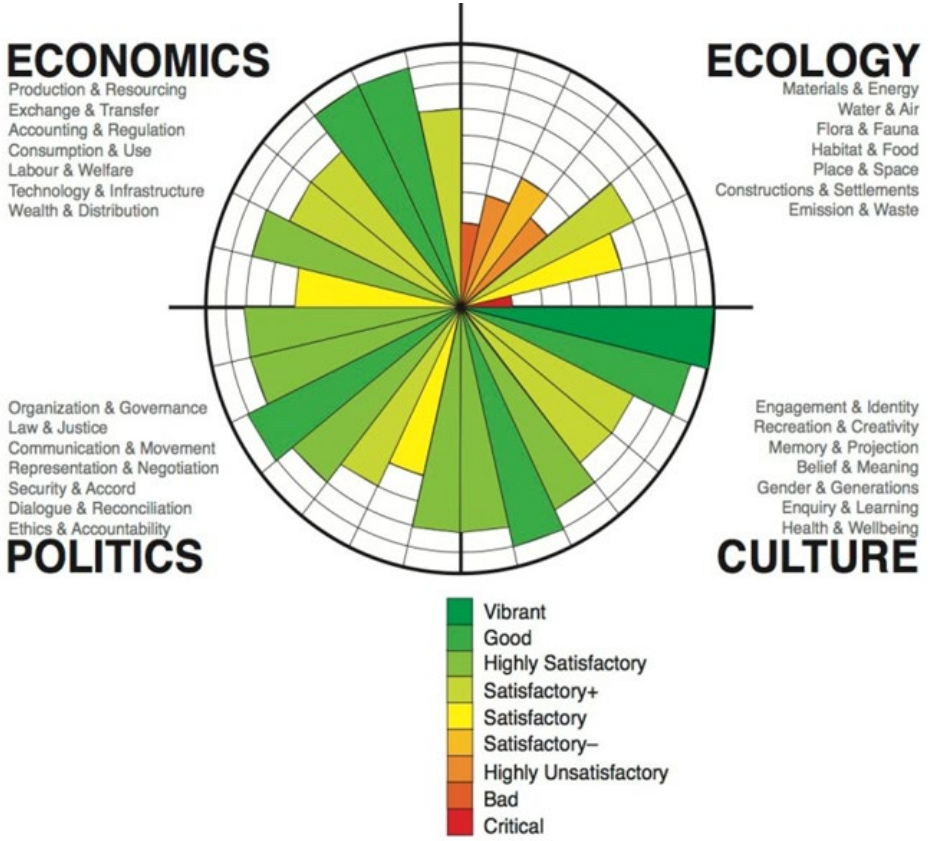
Where would you locate water-related metrics?



City of London (2017)

1. Domain-based frameworks

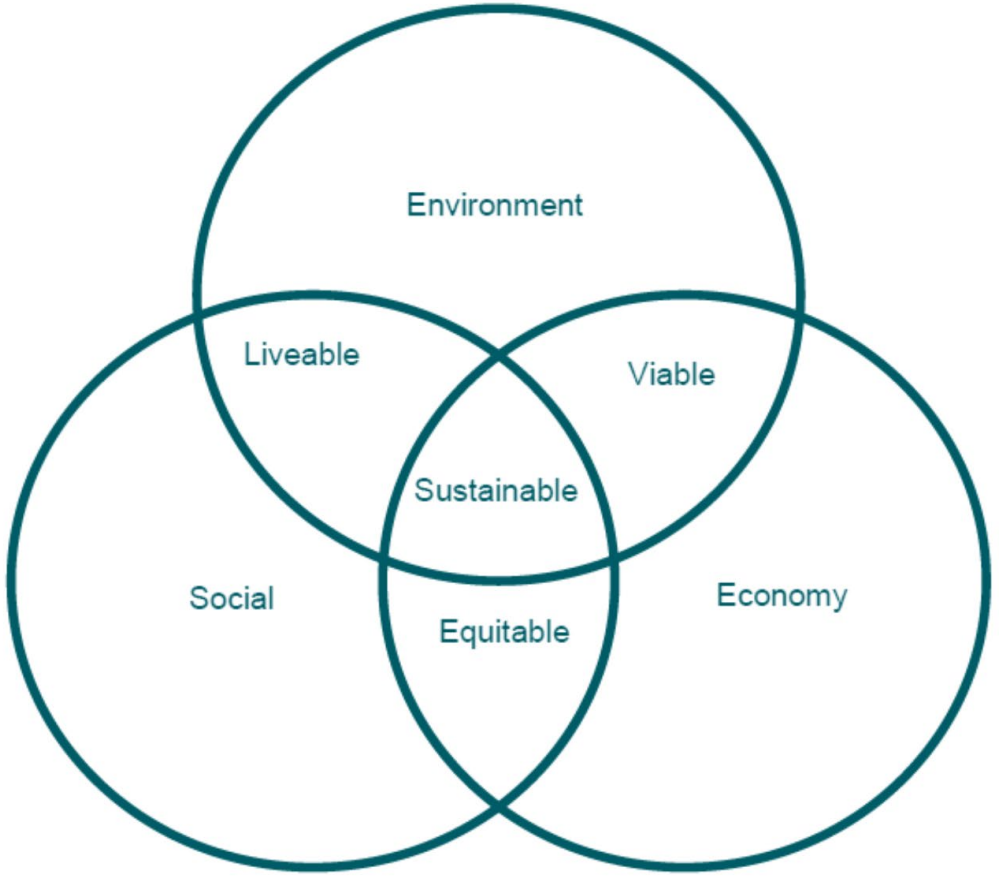
Illustration 2: Circles of Sustainability



James (2015: xii)

1. Domain-based frameworks

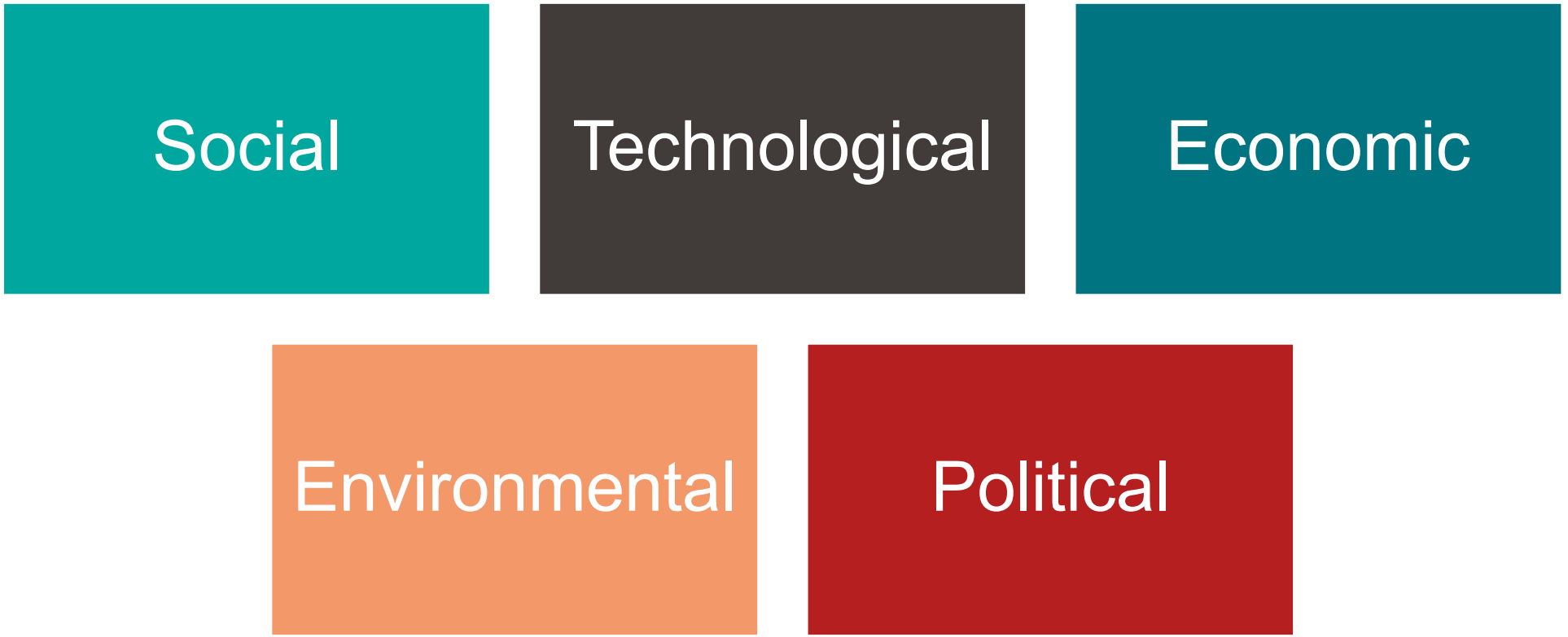
Illustration 3: Venn diagrams



Tanguay et al. (2010)

1. Domain-based frameworks

Illustration 4: STEEP framework



1. Domain-based frameworks

Advantages

- They are easily understood
- They are helpful to check the relative importance of each sustainability dimension

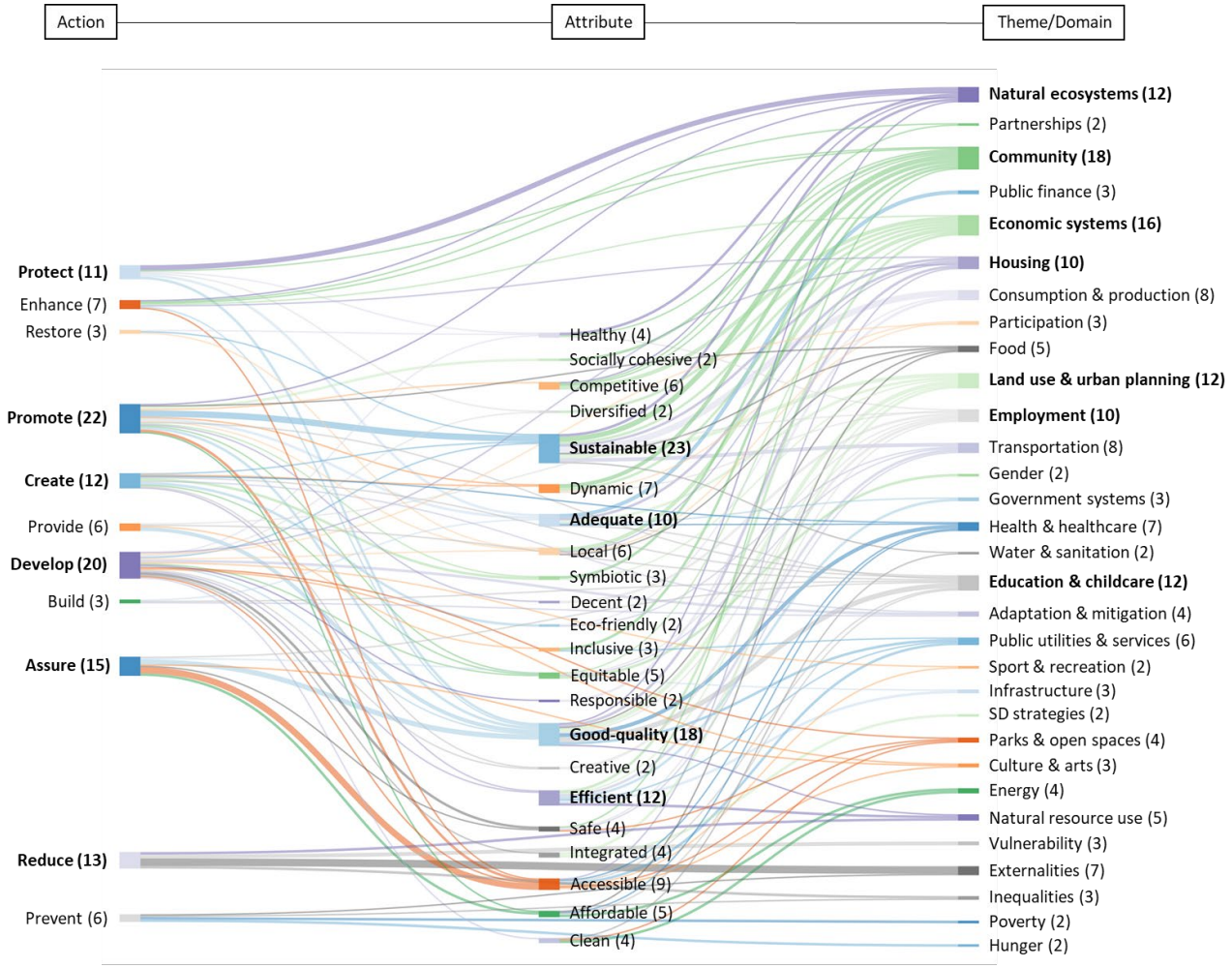
Disadvantages

- They often ignore what is happening at the interfaces between dimensions!
- In some cases, they might oversimply reality…

Merino-Saum, A. & Pineda, J. (2020)

3. Goal-oriented frameworks

Def: Goal-oriented frameworks categorize indicators across **outcomes seen as desirable for sustainability**.



Halla & Merino-Saum (2021)

3. Goal-oriented frameworks

Illustration 1: Sustainable Development Goals (SDGs)

2030 Agenda for Sustainable Development UN (2015)

3. Goal-oriented frameworks

Illustration 2: Sustainability of European Port Cities

3. Goal-oriented frameworks

Advantages

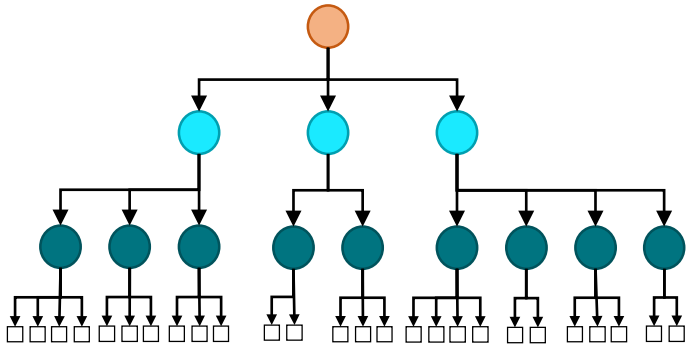
- They relate indicators to specific sustainability goals.
- They are particularly supportive when the assessment's goal is to measure progress.

Disadvantages

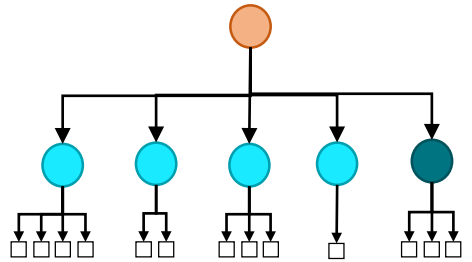
- They involve high doses of normativity.
- They might hide value conflicts.

Merino-Saum, A. & Pineda, J. (2020)

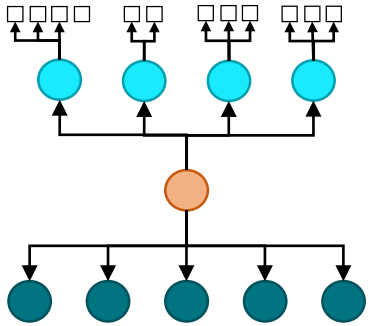
5. Hybrid frameworks



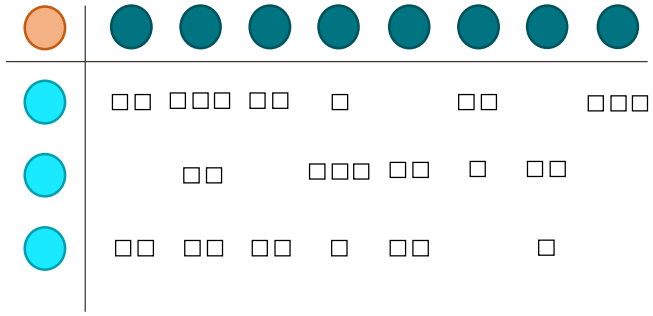
Hierarchization



Assimilation



Juxtaposition

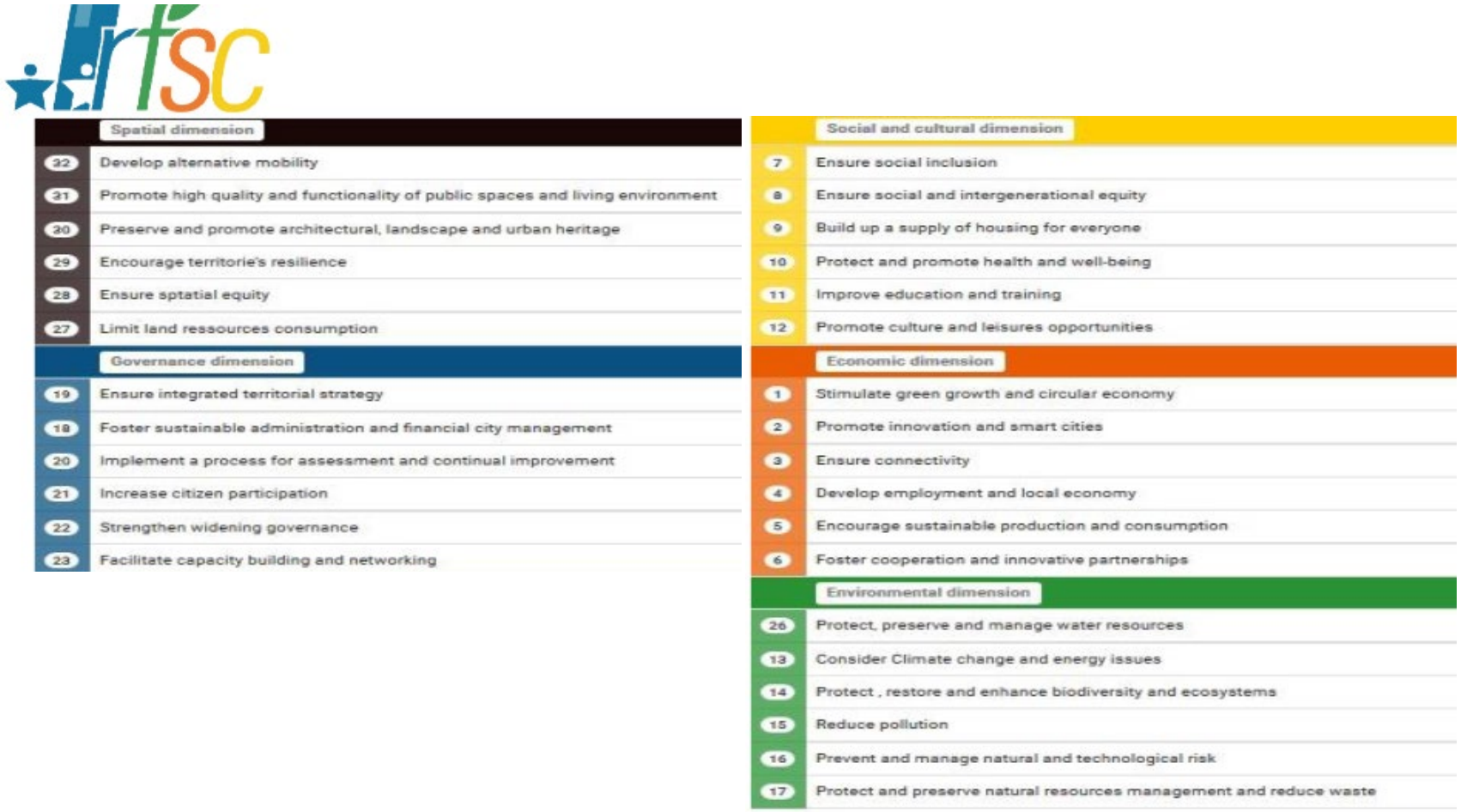


Matrix-like integration

Halla & Merino-Saum (2021; forthcoming)

5. Hybrid frameworks

Illustration 1: Reference Framework for Sustainable Cities (RFSC)



RFSC (2014)

5. Hybrid frameworks

Illustration 2: Swiss Indicator System for Sustainable Development

Topic \ Type of indicator	Level (L) Degree to which needs are met	Capital (C) Status and potential of resources	Input/Output (Δ) Use and influencing of capital	Structural criteria (S) Efficiency, disparities	Response (R) Social and political measures
Mobility	Annual per capita distance travelled in km (1)	Number of private motor vehicles Public transport infrastructure (e.g. number of kilometres of track)	Per capita fuel consumption in road transport	Modal split (proportion of annual per capita distance travelled on public transport in km) Average fuel consumption per 100 km	Revenue from the heavy vehicle fee
Education	Measurement of skills Average school life expectancy (2)	Total library provision Number of places in tertiary education	Annual number of lessons given Proportion of GDP spent on education	Proportion of women completing tertiary education Comparison of educational grants between regions	Expenditure on educational campaigns
Competitivity	GDP per capita (3)	Average school life expectancy (2) Number of patents in force Ratio of foreign debt to GDP	Net investment New patent applications per annum New borrowing	Regional GDP (3) Labour productivity (GDP/working hour) Comparison of borrowing between regions	
Soil	Living space per person	Proportion of undeveloped land	Annual soil sealing in m^2	Population density factor (living space per built-up area)	
Water	Daily water consumption per capita	Quality of watercourses ppm nitrate in drinking water	Annual nitrogen input per hectare	Proportion of households connected to sewage treatment plants	Permitted head of cattle per hectare
Air	Annual per capita distance travelled in km (1) (4)	Average annual values for NO_x immission concentrations	Annual NO_x emissions in tonnes (3)	NO_x emissions/km journeys made (3) Proportion of cars with catalytic converter	Level of supplementary petrol duty

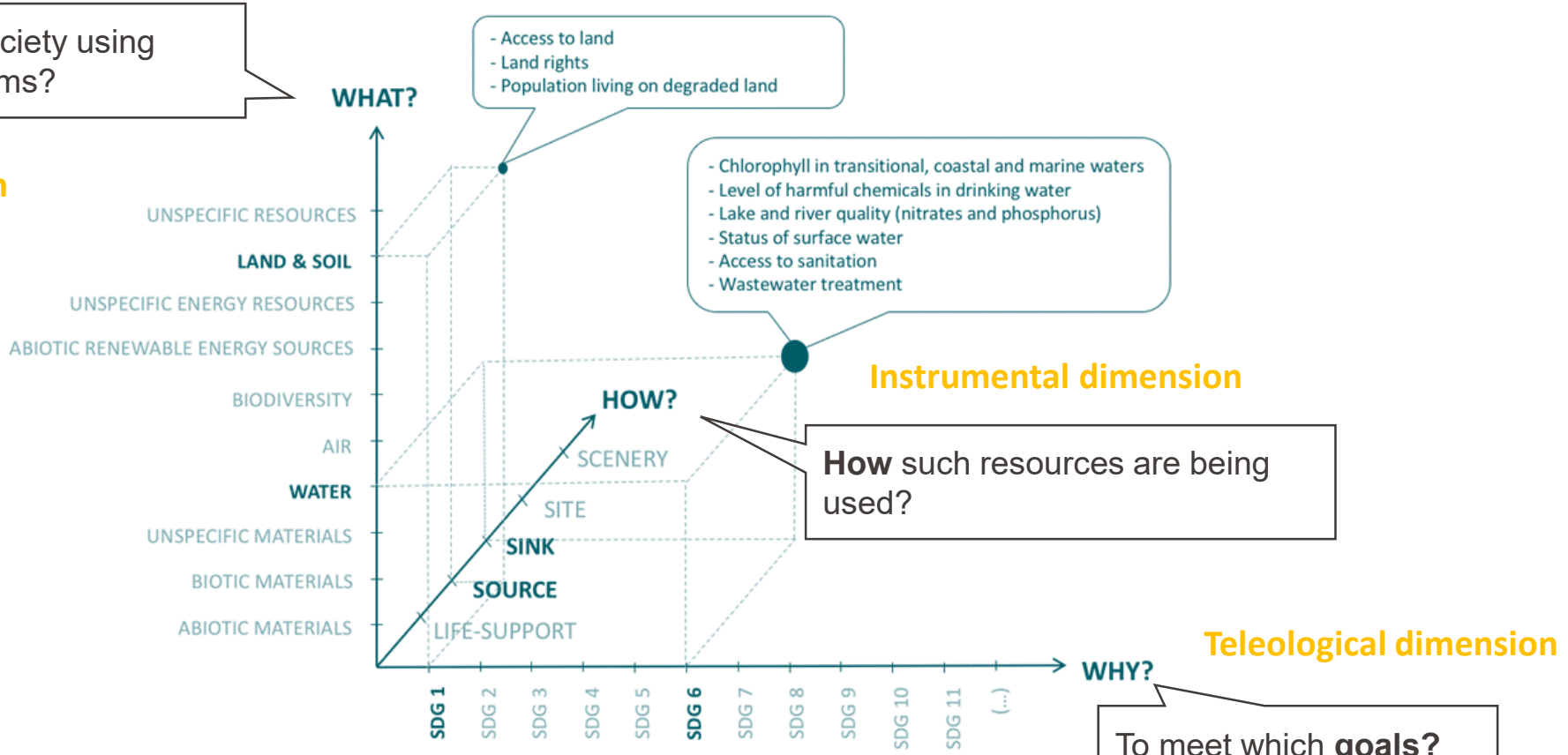
FSO (2004)

5. Hybrid frameworks

Illustration 3: The “Green Cube”

What is human society using from natural systems?

Substantive dimension



Instrumental dimension

How such resources are being used?

Teleological dimension

To meet which **goals?**

Merino-Saum et al. (2018)

5. Hybrid frameworks

Advantages

- They make it possible to exploit synergies between different kinds of frameworks.
- They force set developers to work at a meta-level.

Disadvantages

- They are time-consuming!
- They involve higher degrees of complexity…

To keep in mind…

Conceptual frameworks determine **a particular understanding** about what Urban Sustainability is or should be.

Unavoidably, they impose a certain degree of **normativity**, which needs to be clearly described in the assessment!

- Developing frameworks is more a process of **invention** than of ~~discovery~~; they are **built** rather than ~~found~~ (Turnhout 2009).

Take away messages

• No fit-to-all framework exists. It is critical to build a framework that is tailored to the goals, needs and context of the indicator initiative. **Do NOT merely replicate the blueprints** of earlier initiatives!!

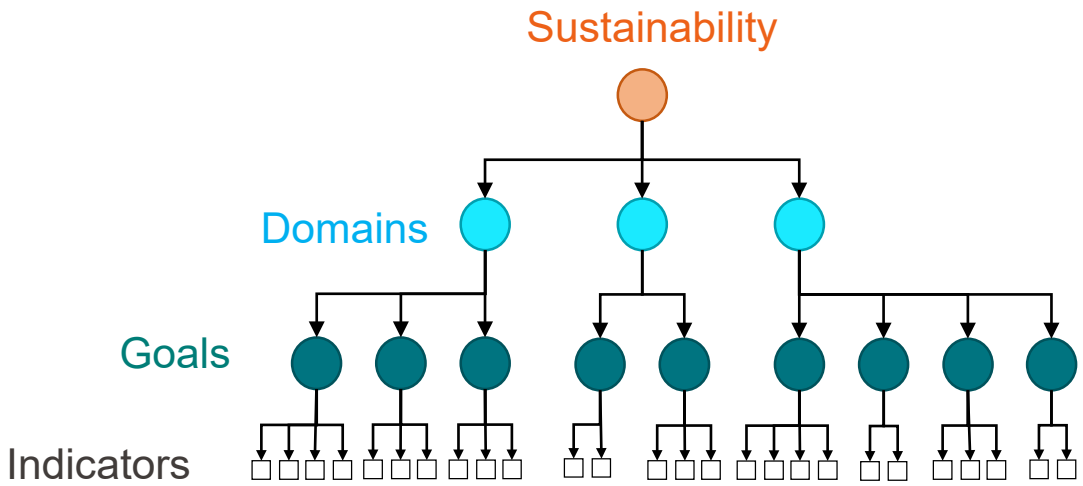
• An equilibrium must be found between **realism** and **usability**.

• If you target simultaneously several **purposes** with your indicator framework, hybrid solutions combining elements from several **types** are recommended.

Group project

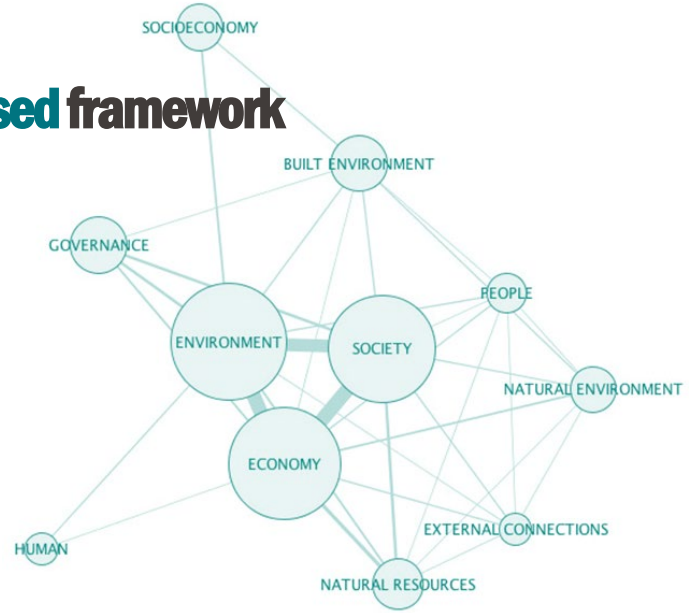
For your project

Hybrid framework

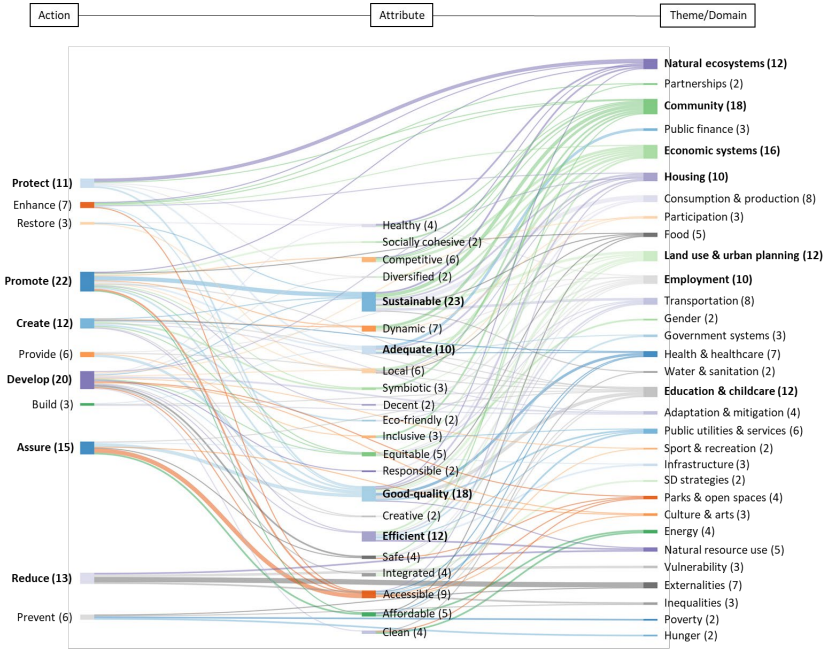


Hierarchization

Domain-based framework



Goal-based framework



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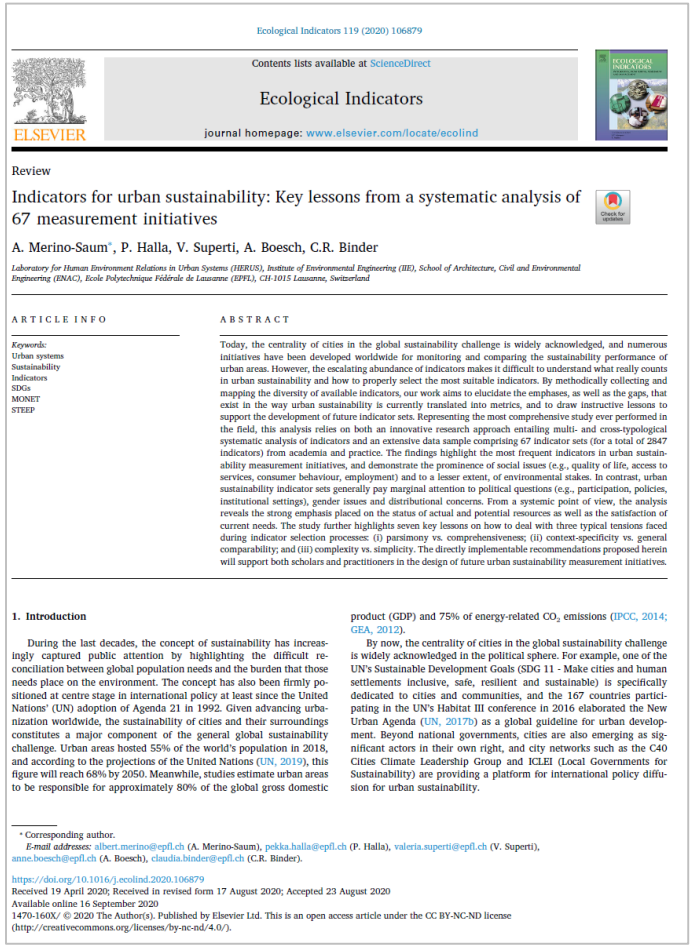


Ecological Indicators 119 (2020) 106879

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Review

Indicators for urban sustainability: Key lessons from a systematic analysis of 67 measurement initiatives

A. Merino-Saum*, P. Halla, V. Superti, A. Boesch, C.R. Binder

Laboratory for Human Environment Relations in Urban Systems (HERUS), Institute of Environmental Engineering (IIE), School of Architecture, Civil and Environmental Engineering (ENAC), Ecole Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland

ARTICLE INFO

Keywords:
Urban systems
Sustainability
Indicators
SDGs
MONET
STEEP

ABSTRACT

Today, the centrality of cities in the global sustainability challenge is widely acknowledged, and numerous initiatives have been developed worldwide for monitoring and comparing the sustainability performance of urban areas. However, the escalating abundance of indicators makes it difficult to understand what really counts in urban sustainability and how to properly select the most suitable indicators. By methodically collecting and mapping the diversity of available indicators, our work aims to elucidate the emphases, as well as the gaps, that exist in the way urban sustainability is currently translated into metrics, and to draw instructive lessons to support the development of future indicator sets. Representing the most comprehensive study ever performed in the field, this analysis relies on both an innovative research approach entailing multi- and cross-typological systematic analysis of indicators and an extensive data sample comprising 67 indicator sets (for a total of 2847 indicators) from academia and practice. The findings highlight the most frequent indicators in urban sustainability measurement initiatives, and demonstrate the prominence of social issues (e.g., quality of life, access to services, consumer behaviour, employment) and to a lesser extent, of environmental stakes. In contrast, urban sustainability indicator sets generally pay marginal attention to political questions (e.g., participation, policies, institutional settings), gender issues and distributional concerns. From a systemic point of view, the analysis reveals the strong emphasis placed on the status of actual and potential resources as well as the satisfaction of current needs. The study further highlights seven key lessons on how to deal with three typical tensions faced during indicator selection processes: (i) parsimony vs. comprehensiveness; (ii) context-specificity vs. general comparability; and (iii) complexity vs. simplicity. The directly implementable recommendations proposed herein will support both scholars and practitioners in the design of future urban sustainability measurement initiatives.

1. Introduction

During the last decades, the concept of sustainability has increasingly captured public attention by highlighting the difficult reconciliation between global population needs and the burden that those needs place on the environment. The concept has also been firmly positioned at centre stage in international policy at least since the United Nations' (UN) adoption of Agenda 21 in 1992. Given advancing urbanization worldwide, the sustainability of cities and their surroundings constitutes a major component of the general global sustainability challenge. Urban areas hosted 55% of the world's population in 2018, and according to the projections of the United Nations (UN, 2019), this figure will reach 68% by 2050. Meanwhile, studies estimate urban areas to be responsible for approximately 80% of the global gross domestic product (GDP) and 75% of energy-related CO_2 emissions (IPCC, 2014; GEA, 2012).

By now, the centrality of cities in the global sustainability challenge is widely acknowledged in the political sphere. For example, one of the UN's Sustainable Development Goals (SDG 11 - Make cities and human settlements inclusive, safe, resilient and sustainable) is specifically dedicated to cities and communities, and the 167 countries participating in the UN's Habitat III conference in 2016 elaborated the New Urban Agenda (UN, 2017b) as a global guideline for urban development. Beyond national governments, cities are also emerging as significant actors in their own right, and city networks such as the C40 Cities Climate Leadership Group and ICLEI (Local Governments for Sustainability) are providing a platform for international policy diffusion for urban sustainability.

* Corresponding author.
E-mail addresses: albert.merino@epfl.ch (A. Merino-Saum), pekka.halla@epfl.ch (P. Halla), valeria.superti@epfl.ch (V. Superti), anne.boesch@epfl.ch (A. Boesch), claudia.binder@epfl.ch (C.R. Binder).

https://doi.org/10.1016/j.ecolind.2020.106879
Received 19 April 2020; Received in revised form 17 August 2020; Accepted 23 August 2020
Available online 16 September 2020
1470-160X/

https://doi.org/10.1016/j.ecolind.2020.106879

Glòria Serra Coch

2. Theme-based frameworks

Def: Theme-based frameworks categorize indicators based on **topics and challenges** pertinent to sustainability.

As a general rule, thematic frameworks go to a **deeper level of detail than domain-based** classifications do (actually, the two schemes are usually combined into hierarchical systems – a basic domain-based classification further broken down into several issue-based categories in each domain).

Themes represent the **most common categorization logic**.

Halla & Merino-Saum (2021; forthcoming)

Glòria Serra Coch

2. Theme-based frameworks

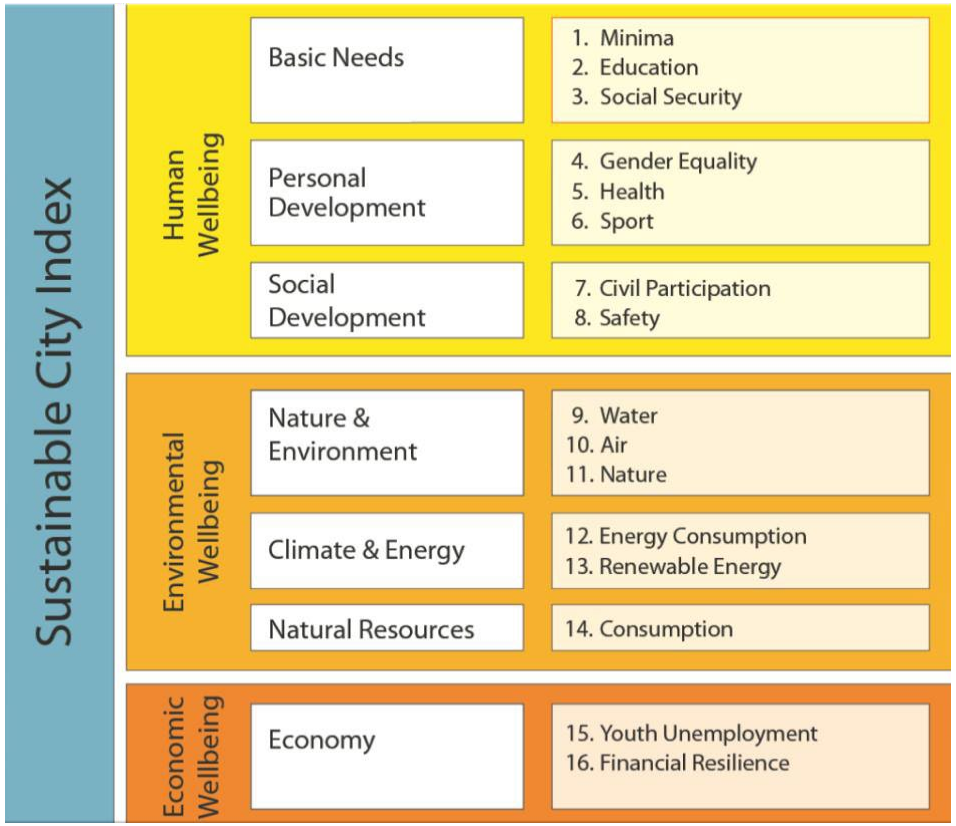
Illustration 2: Orlando – Sustainability City Plan

City of Orlando (2018)

Glòria Serra Coch

2. Theme-based frameworks

Illustration 1: Sustainable City Index (SCI)



Sustainable Society Foundation (2014)

Laboratory on Human-Environment Relations in Urban Systems

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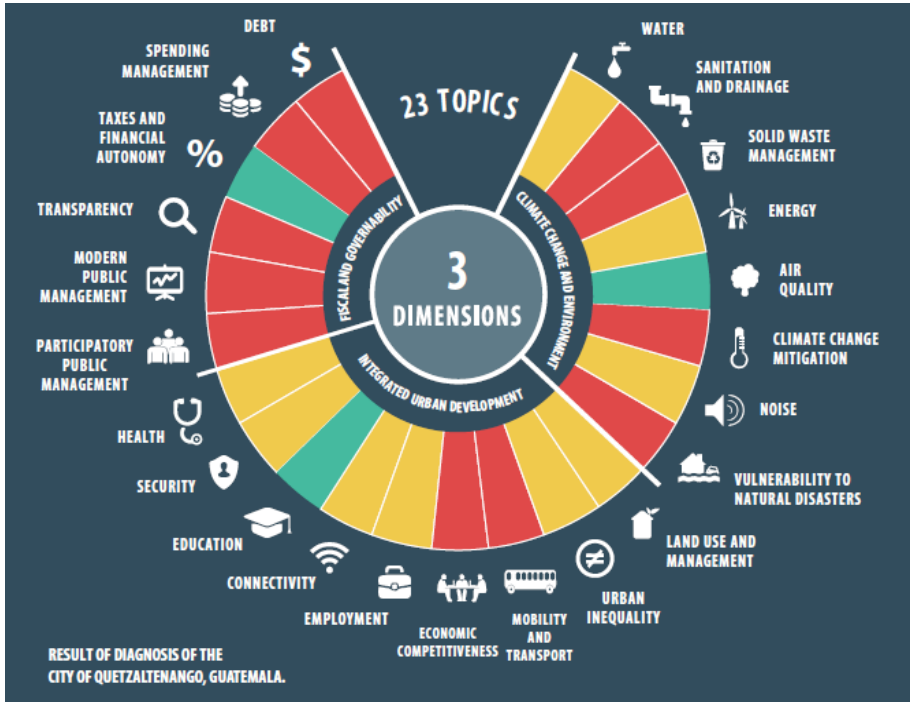
2. Theme-based frameworks

Illustration 3: Emerging and Sustainable Cities Initiative



2. Theme-based frameworks

Advantages

- They are readily understandable.
- They are used worldwide (i.e. comparability).

Disadvantages

- In some cases, coverage of sustainability domains might be unbalanced.
- Indicators might lack a clear link with sustainability goals.

Merino-Saum, A. & Pineda, J. (2020)

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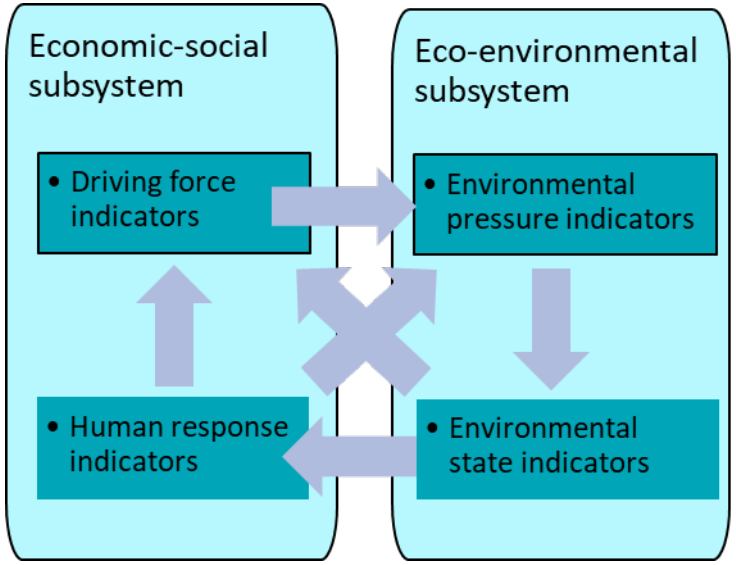
4. Systemic frameworks

Def: Systemic frameworks categorize indicators based on a model that explicitly defines the **relationships between indicator categories**.

Generally speaking, there are **three different manners** of defining the relationships between categories

1. In terms of the **functional roles** that indicator categories play vis-à-vis each other within the system

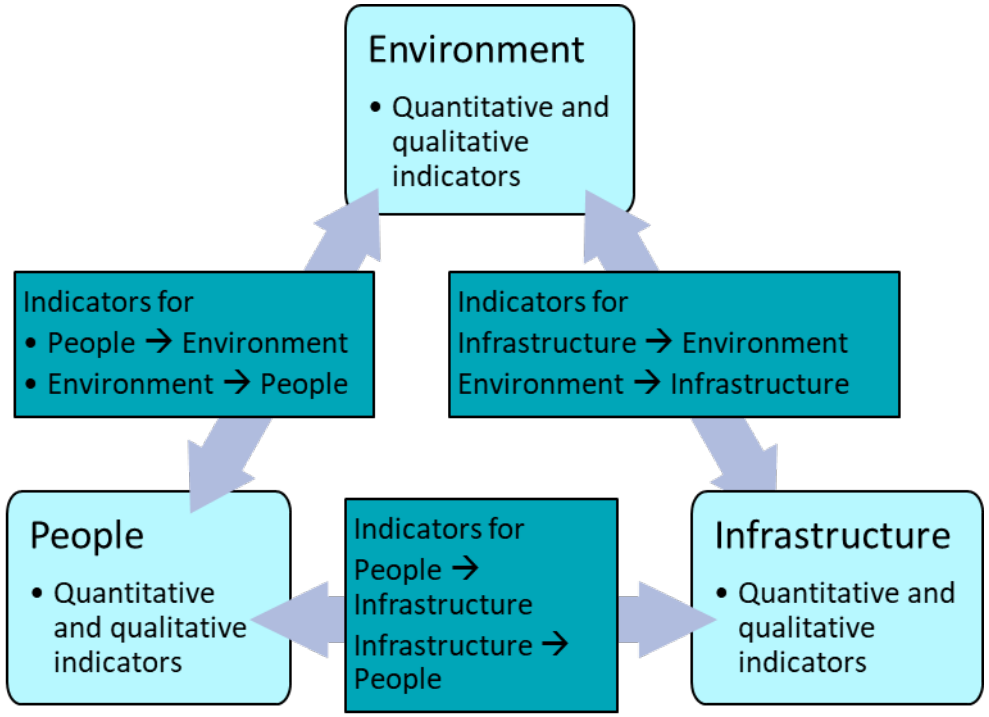


Halla & Merino-Saum (2021)

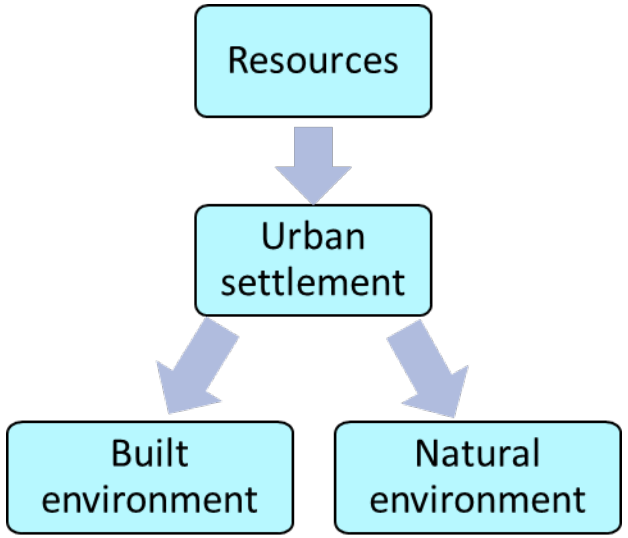
Glòria Serra Coch

4. Systemic frameworks

2. Via dedicated indicator categories placed at the **interfaces** of primary categories



3. Sequential ordering of categories



Halla & Merino-Saum (2021)

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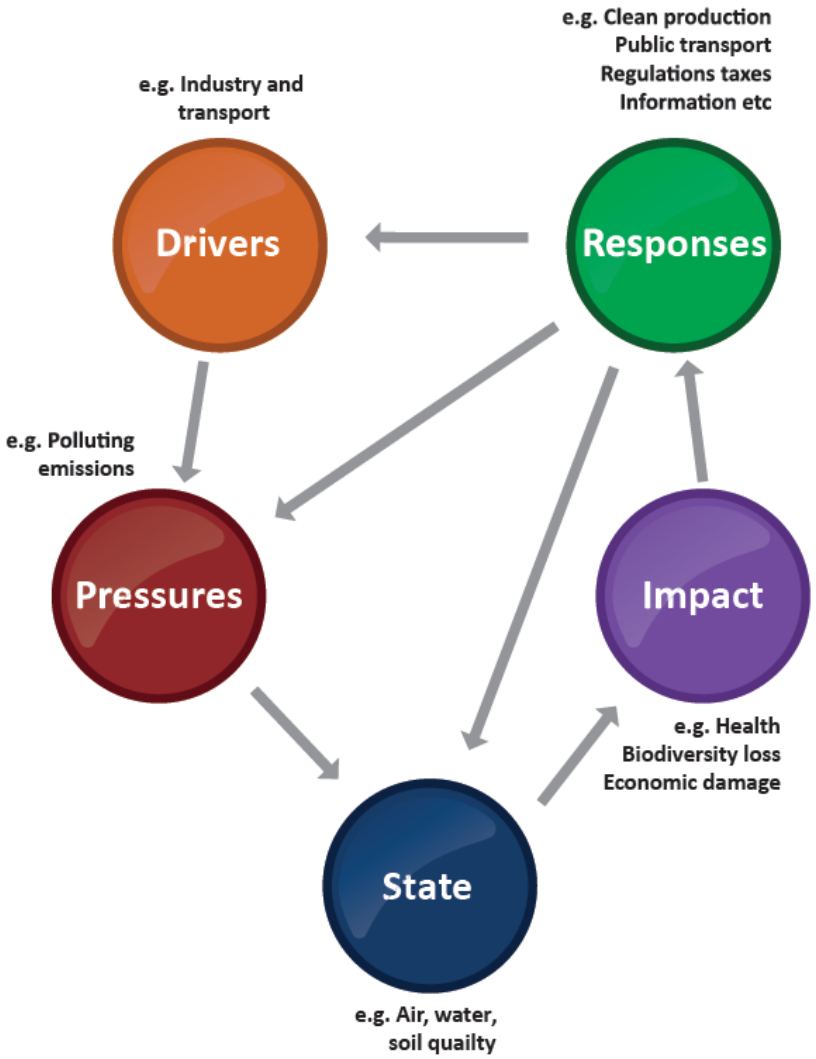
4. Systemic frameworks

Illustration 1: DPSIR Model

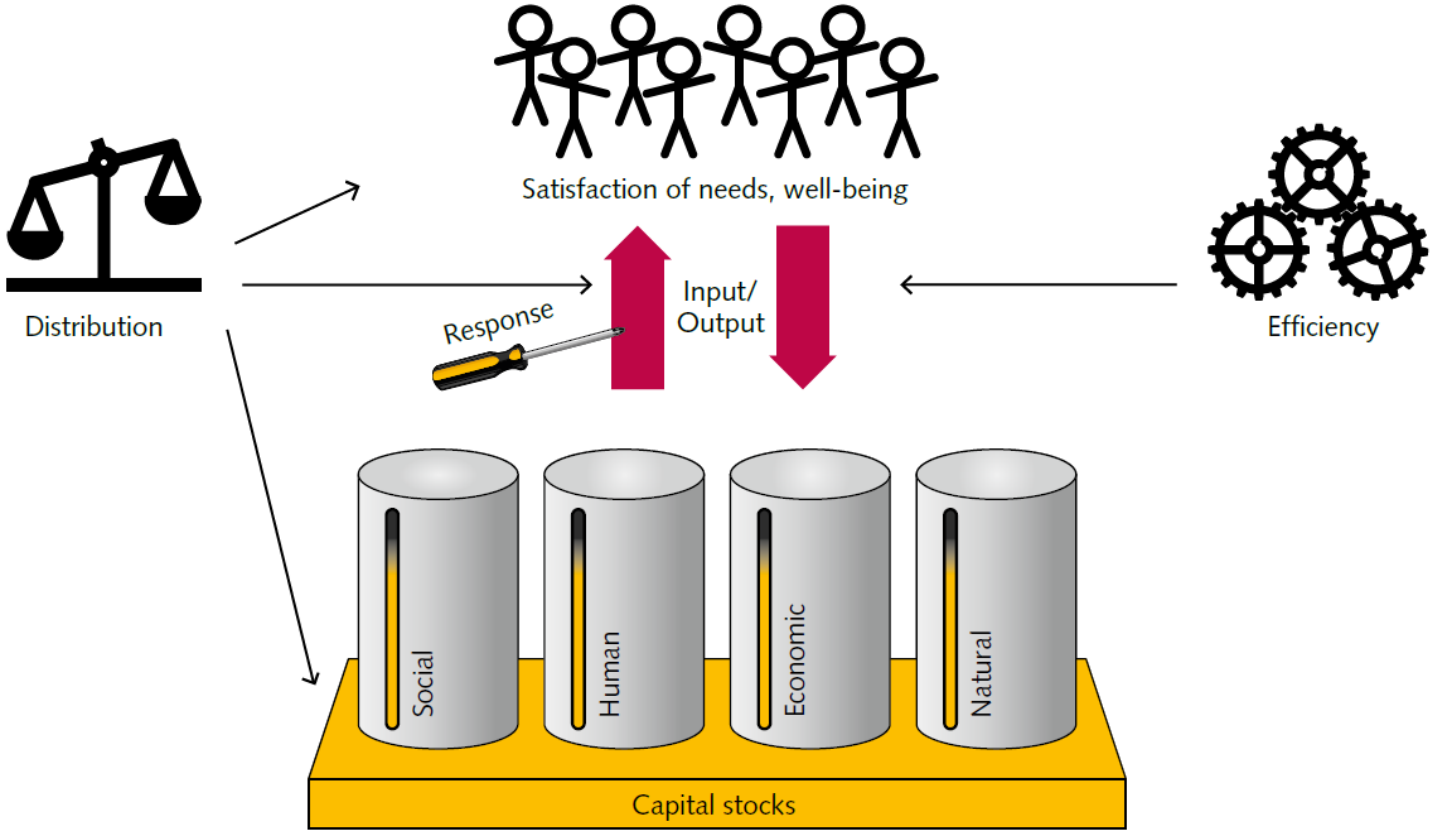


EEA (1999)

Glòria Serra Coch

4. Systemic frameworks

Illustration 2: MONET Typology

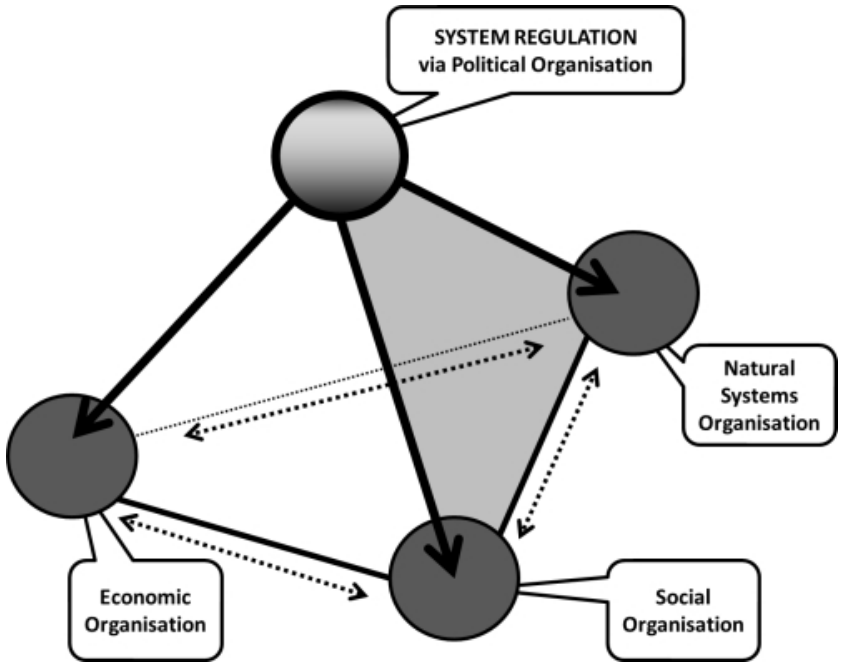


FSO (2012)

Glòria Serra Coch

4. Systemic frameworks

Illustration 3: Tetrahedral model of Sustainability



	SOCIAL	ECONOMIC	ENVIRONMENTAL	POLITICAL
SOCIAL	Forms of Collective Identity and Community: THE SOCIAL SPHERE			
ECONOMIC	OPPORTUNITIES & IMPACTS: "The economy versus the community"	Performance, Products and Output: THE ECONOMIC SPHERE		
ENVIRONMENTAL	LIVING WITH (IN) NATURE Meanings, Values & Risks: Sustaining what & for whom?	ENVIRONMENTAL FUNCTIONS: Pressures on & services of the envi-ronment	Energy, Matter, Natural Cycles & Biodiversity: THE ENVIRONMENTAL SPHERE	
POLITICAL	SOCIAL POLICY: (Capacity of communities; citizen/ public participation)	ECONOMIC POLICY: (Shaping the rules and limits of markets)	ENVIRONMENTAL POLICY: (Regulation of what counts as environmental value)	Coordination, Power & Governance: THE POLITICAL SPHERE

O'Connor (2006)

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4. Systemic frameworks

Advantages

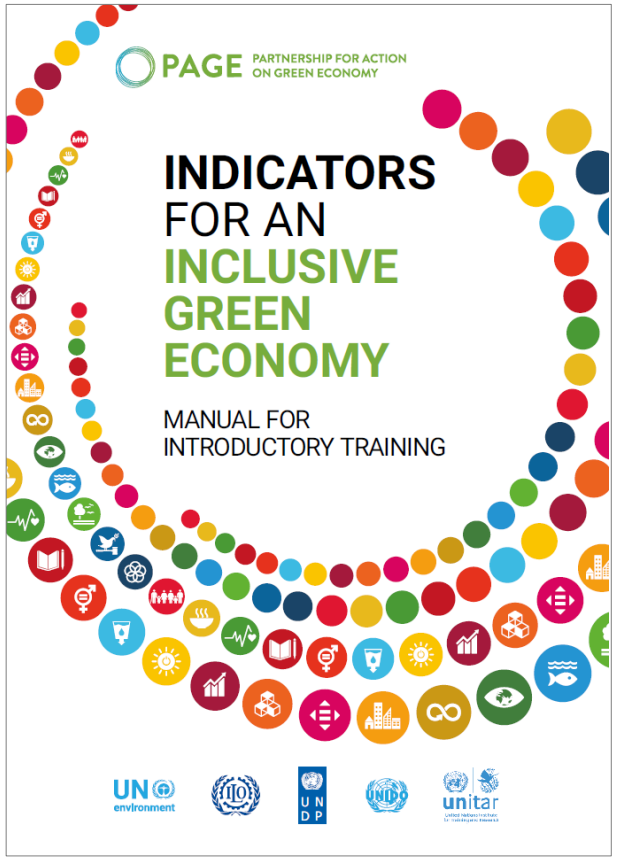
- They pay attention to the way that indicators are linked to each other.
- They force set developers to think in a systemic way.

Disadvantages

- In some cases, asserted causal relationships between indicators are not based on empirical evidence!
- Indicator interactions often involve uncertainties, complexity and ambiguities, which are difficult to operationalize…

Merino-Saum, A. & Pineda, J. (2020)

Key reading(s) for this presentation:



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Merino-Saum, A. & Pineda, J. (2020), "Choosing Appropriate Frameworks for Green Economy Indicators", pp. 17-35.

https://www.un-page.org/resources/green-economy-learning/training-manuals-indicators-green-economy-policymaking