

School Case Study “Urban Sustainability Assessment”

**EURO PHD SUMMER SCHOOL ON MCDA / MCDM
CHANIA, 3RD AUGUST 2018**

BY: ANNA CRIVELLARI,
GILLES DEJAEGERE
ZOUμποULIA DIKOUPOULIO,
JEAN-PHILIPPE HUBINONT
FRANCIS MARLEAU DONAIS
PARISA RAFIAANI
FERNANDO SITORUS



1 Conceptualizing sustainable cities

Sustainable development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

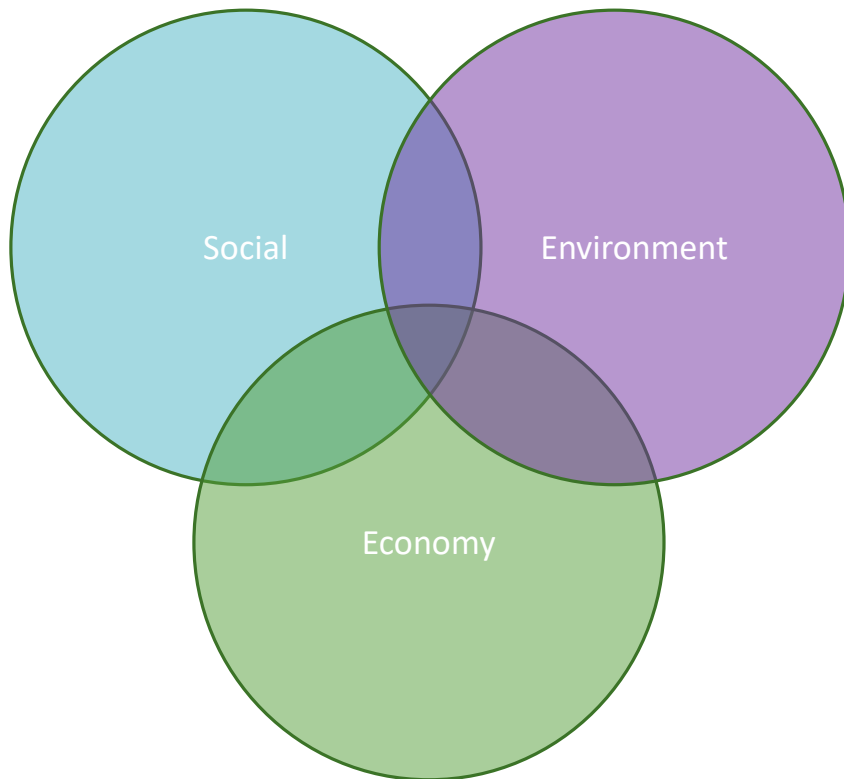
It contains within it **two key concepts**:

- the concept of '**needs**', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of **limitations** imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

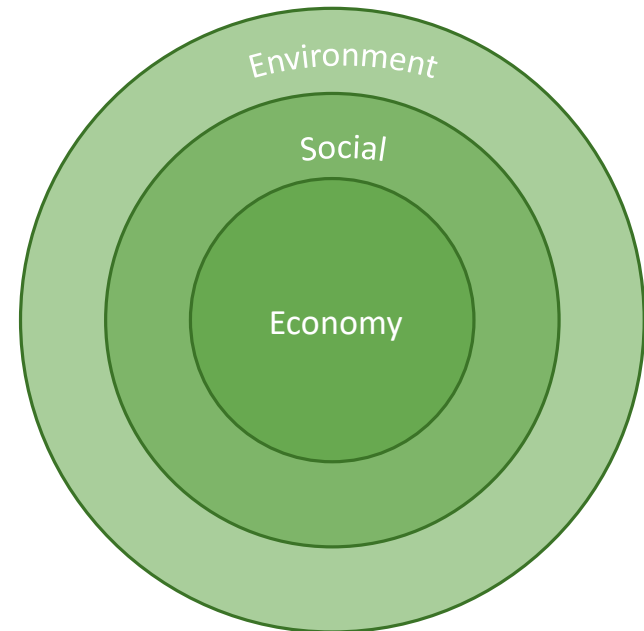
(Brundland Report, 1988)

Conceptualizing sustainable development

Triple-Bottom Line model

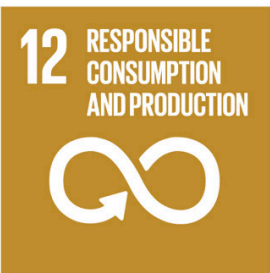
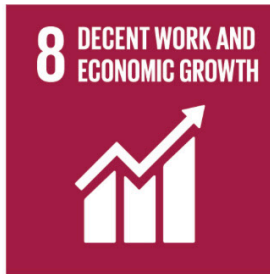


Nested model



Adapted from Gudmunsson et al. (2015)

Sustainable development goals (SDGs) of United Nations



<https://sustainabledevelopment.un.org/?menu=1300>

Sustainable countries or sustainable cities?

« It is no exaggeration to say that the **21st century will be the century of cities**. Billions of people throughout the developing world leave the countryside and become urban dwellers. Humanity will spend tens, even hundreds of trillions of dollars to build new cities and revitalize existing cities to accommodate them. »

Richard Florida



Sustainable countries or sustainable cities?

*...generation to say that the 21st century will be the century of
...throughout the developing world leave the
...munity will spend tens, even
...ize existing*

**Paris agreement: US states and mayors
fight climate change after Donald Trump
pulls US out of deal**

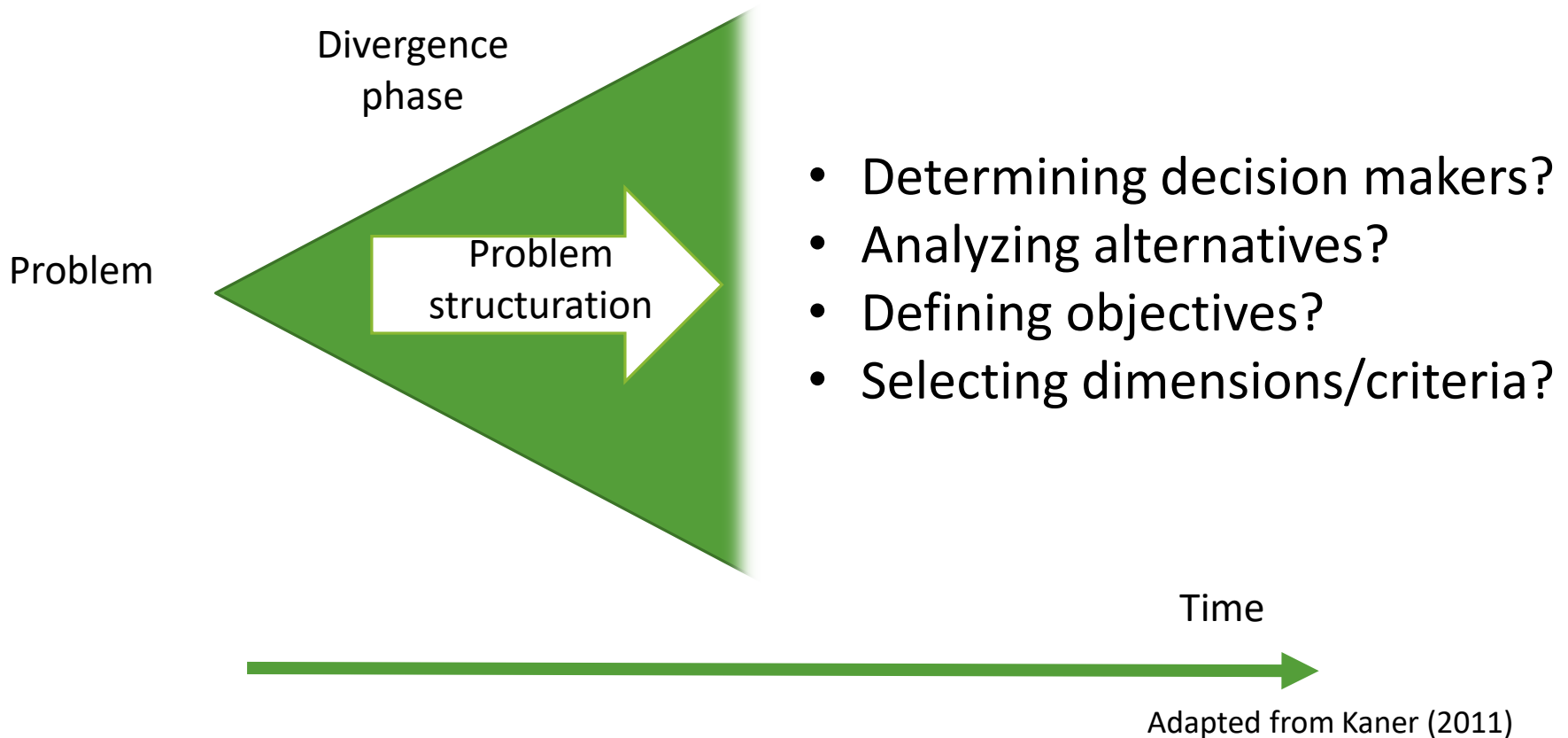
From coast to coast and beyond, American politicians are taking on the challenge at a local level

Clark Mindock New York | @ClarkMindock | Saturday 17 June 2017 19:51 |  26 comments



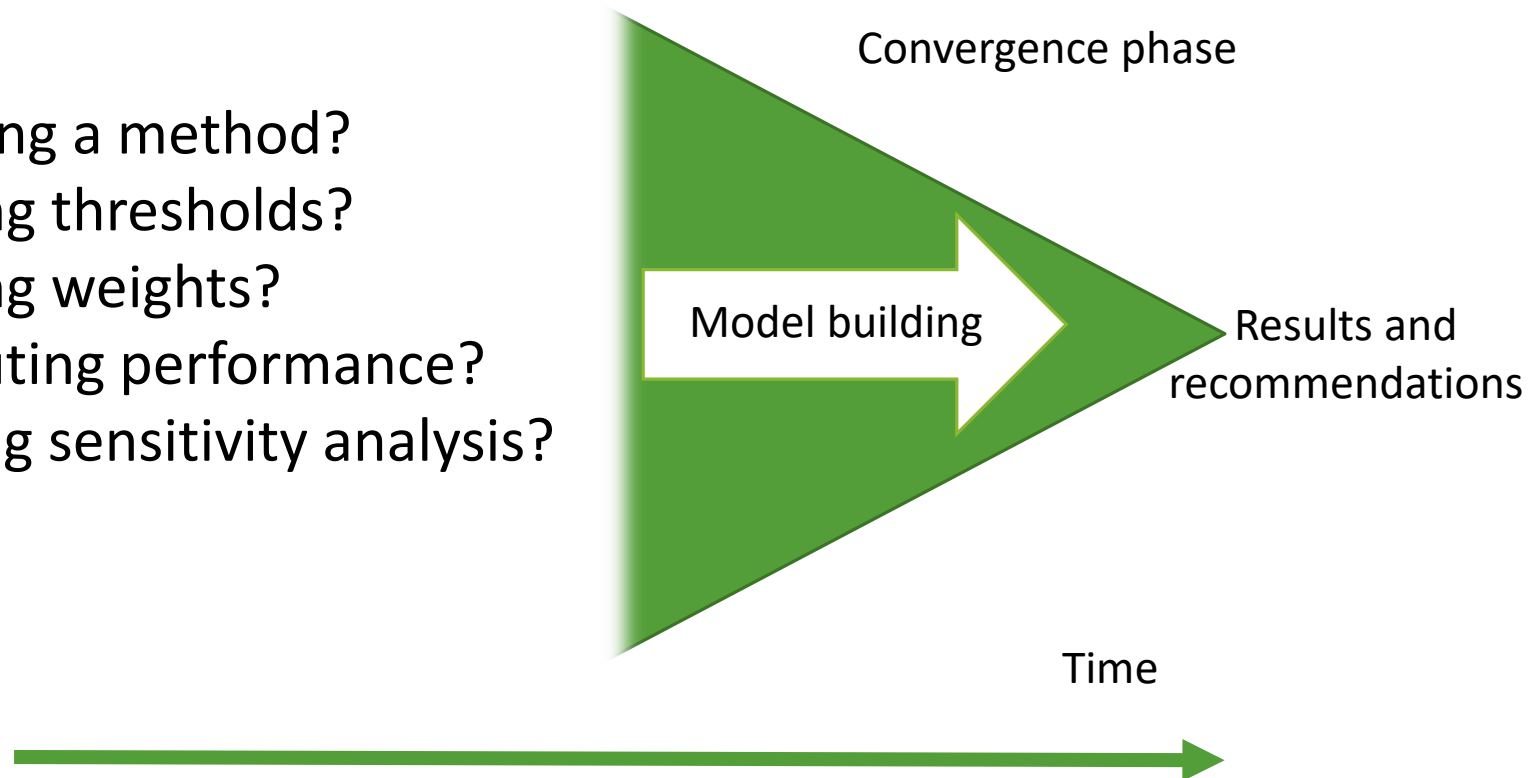
2 Methodology

Decision process



Decision process

- Choosing a method?
- Defining thresholds?
- Defining weights?
- Computing performance?
- Running sensitivity analysis?



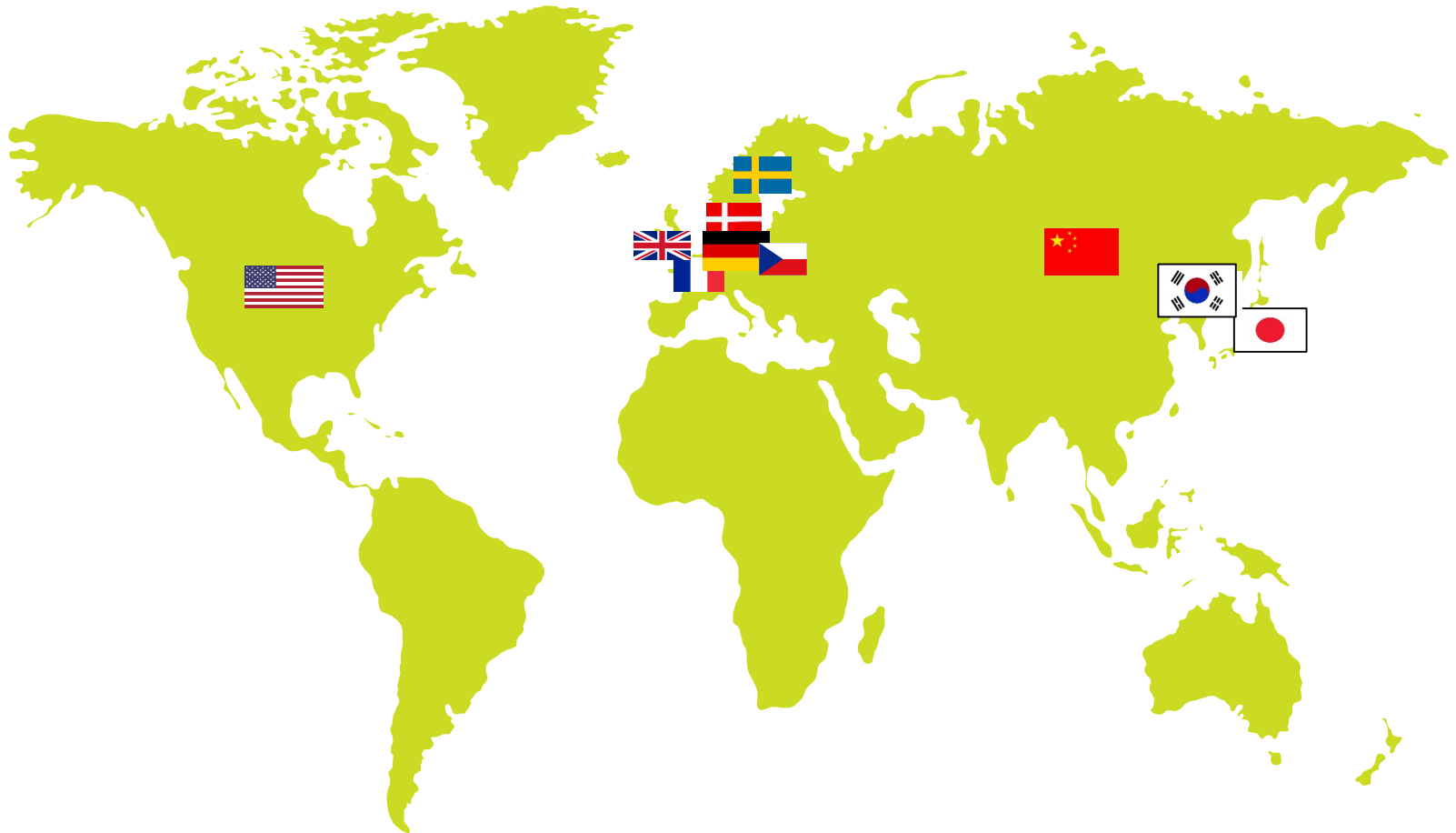
Adapted from Kaner (2011)

Decision makers

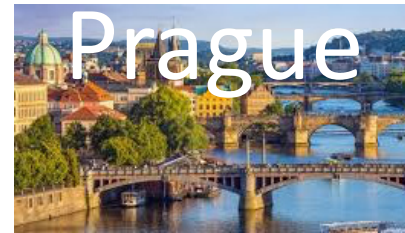
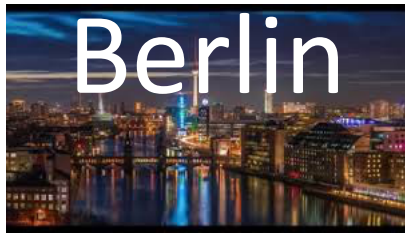


United Nations

World Map of the Alternatives



Alternatives



Objectives

1

Assessing the cities' sustainabilities according to SDGs

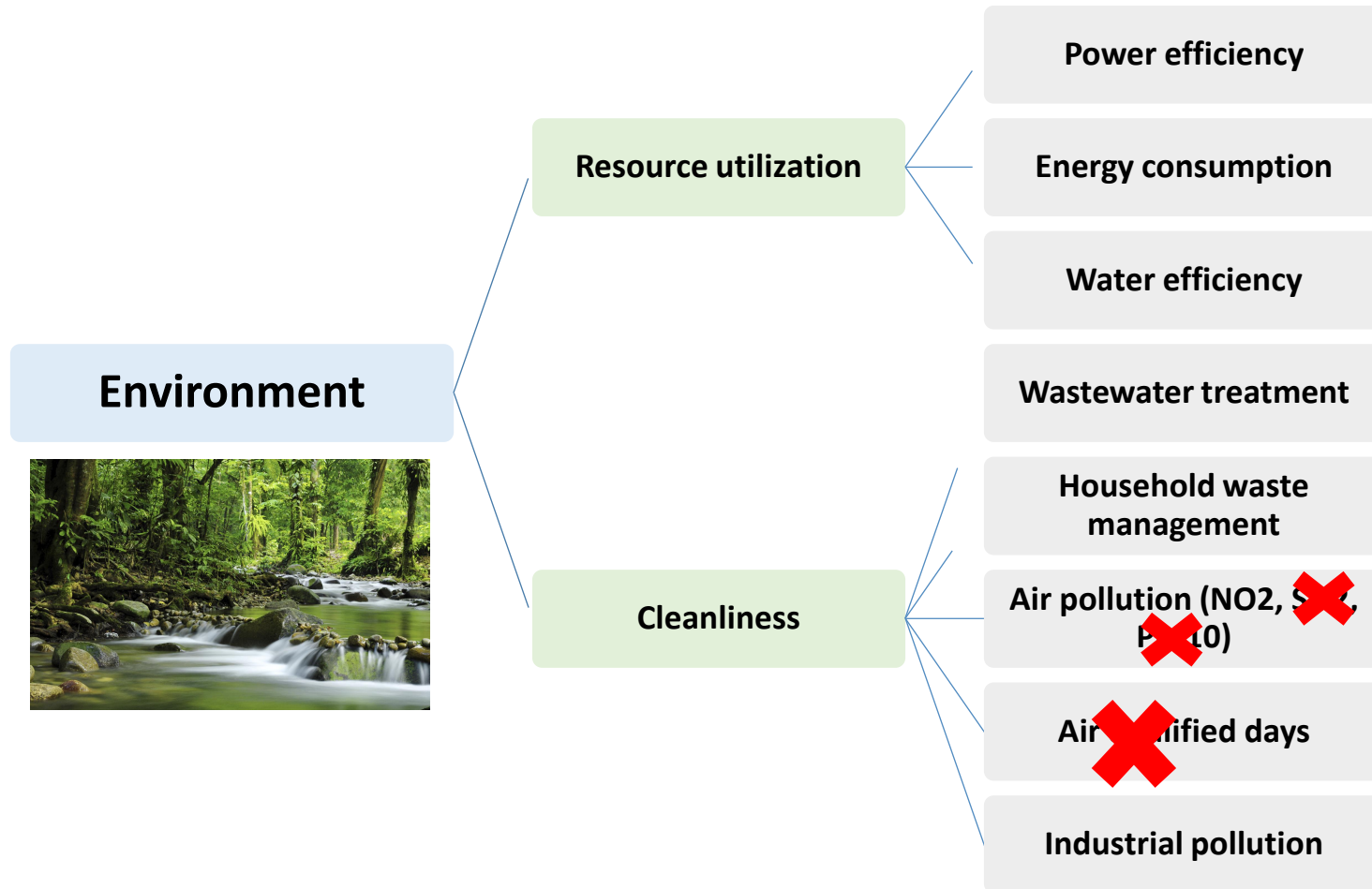
2

Ranking and scoring the cities with respect to sustainability pillars (Nested model)

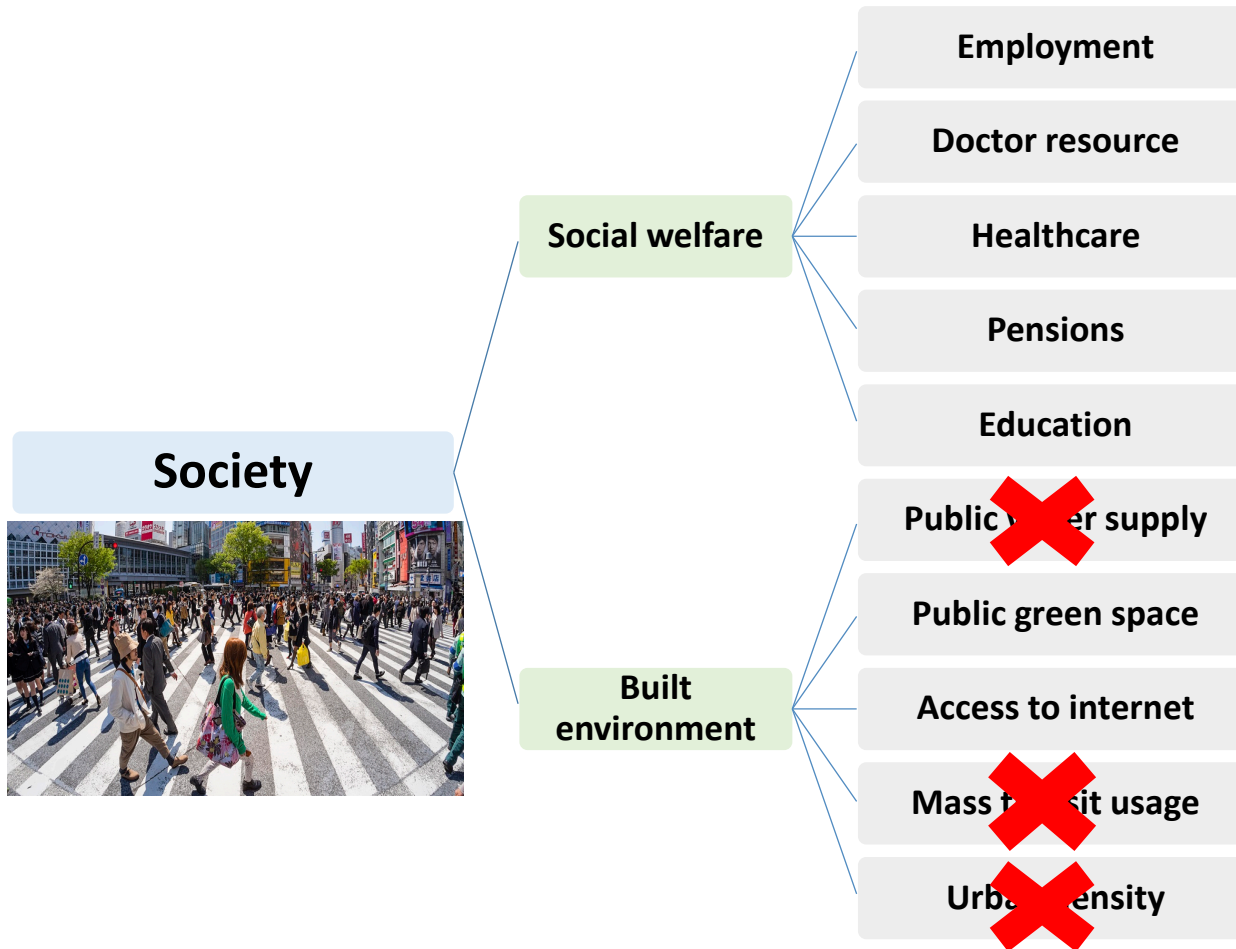
3

Clustering the cities and providing recommendations to improve cities' sustainability

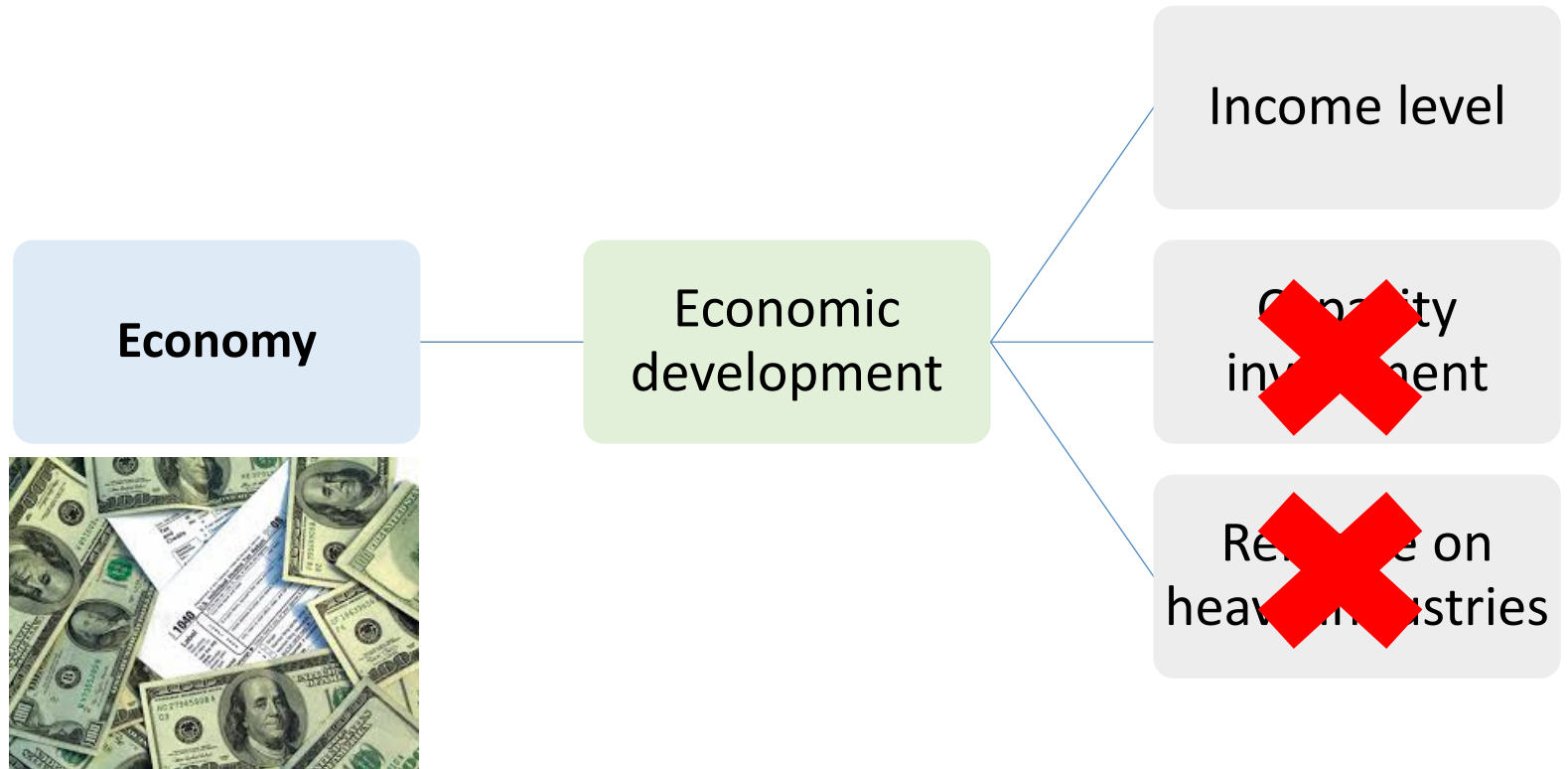
Criteria/Indicators for Environment pillar



Criteria/Indicators for Society pillar



Criteria/Indicators for Economy pillar



PROMETHEE II method

High potentiality and applicability

- 👍 Processes the quantitative and qualitative data
- 👍 Pairwise comparison
- 👍 Provides scores divided into advantages and disadvantages
- 👍 Supported by a software with graphical representation (GAIA)
- 👍 Does not require the normalization of values

Stage 1: Building an evaluation matrix

Stage 2: Determining differences' performance

Stage 3: Building the preference functions

Stage 4: Calculating the aggregated preferences

Stage 5: Calculating the positive and negative outranking flows

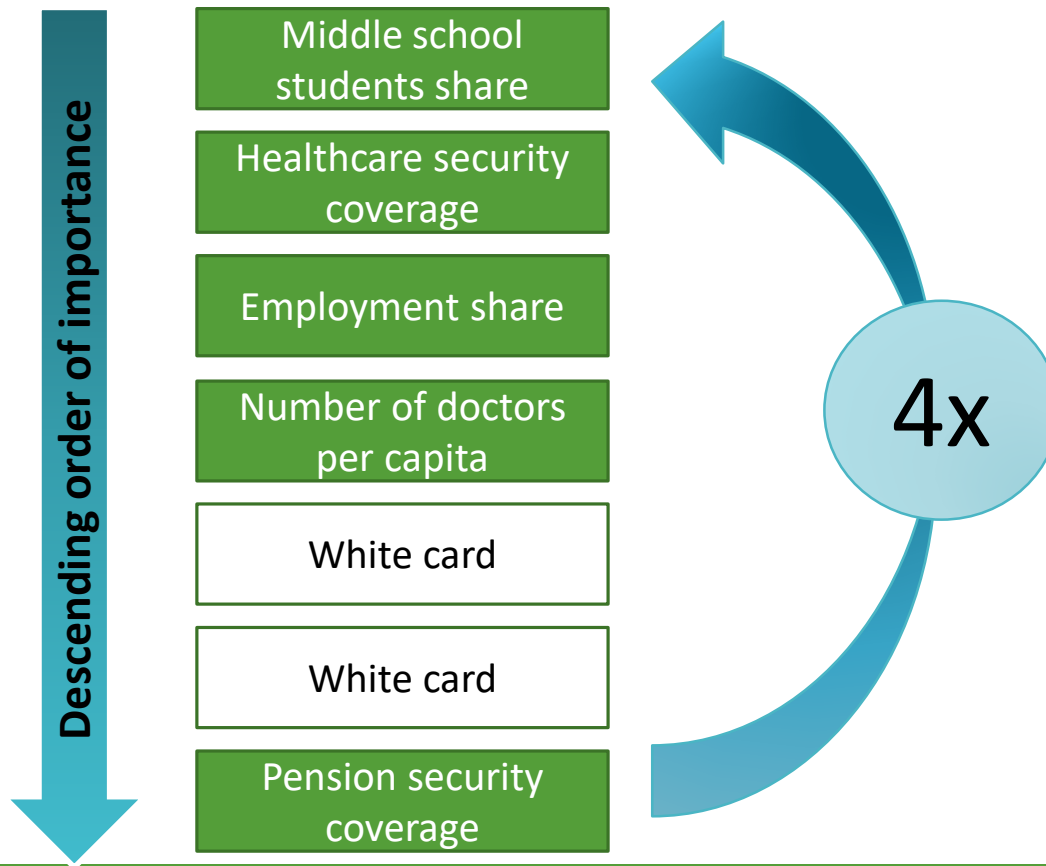
Stage 6: Calculating the net outranking flows

Indicator weights

Revised SIMOS method



Example: Social Welfare criterion



Results

$$W_1 = 0.308$$

$$W_2 = 0.269$$

$$W_3 = 0.231$$

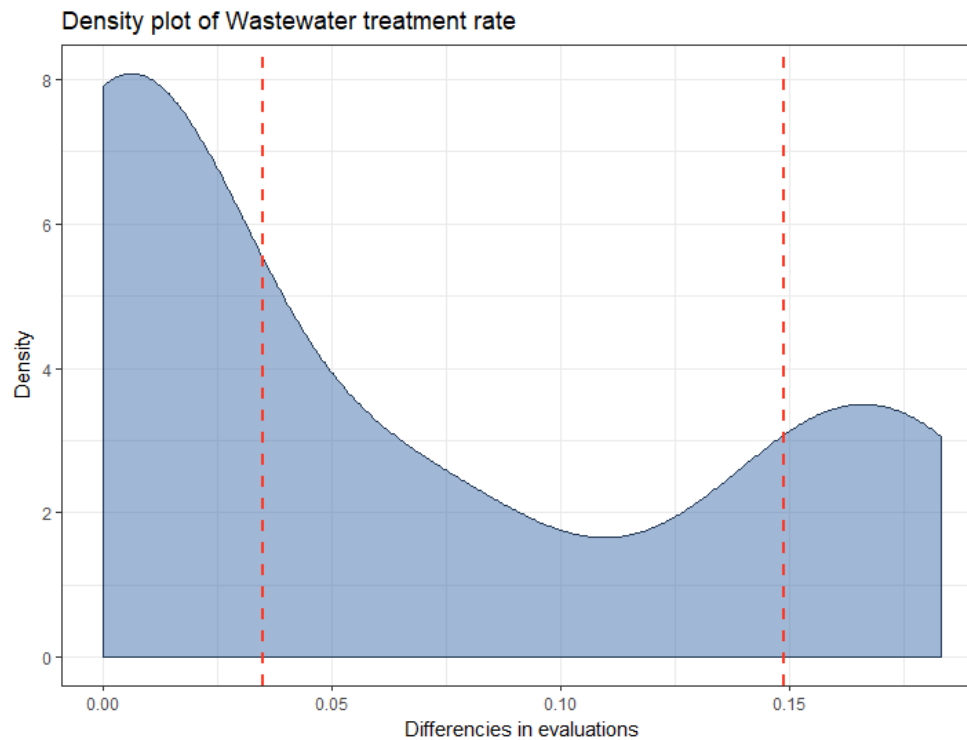
$$W_4 = 0.115$$

$$W_5 = 0.077$$

Defining thresholds

Lack of access to decision makers

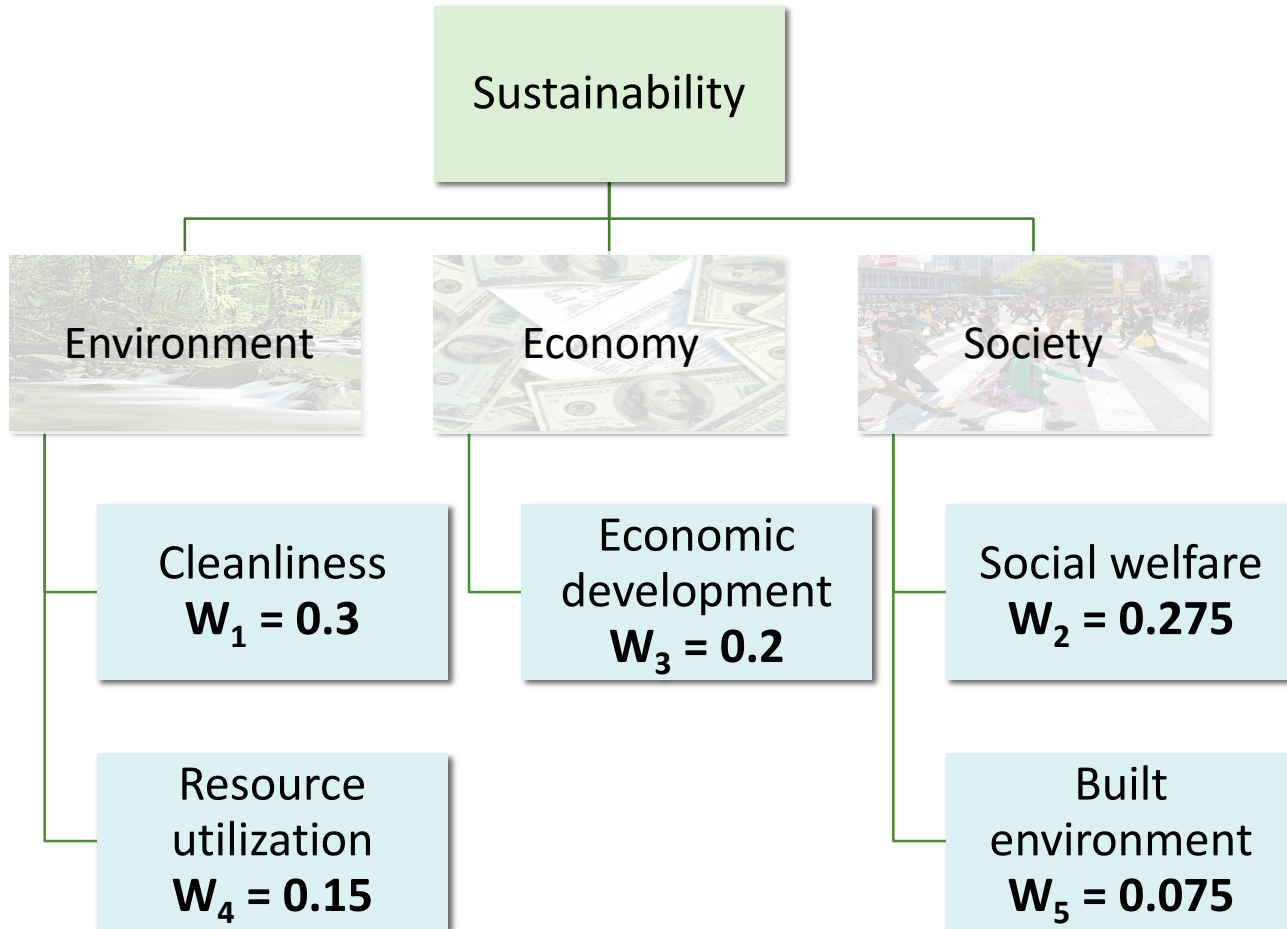
Define theoretical thresholds (q=25th percentile, p=75th percentile)





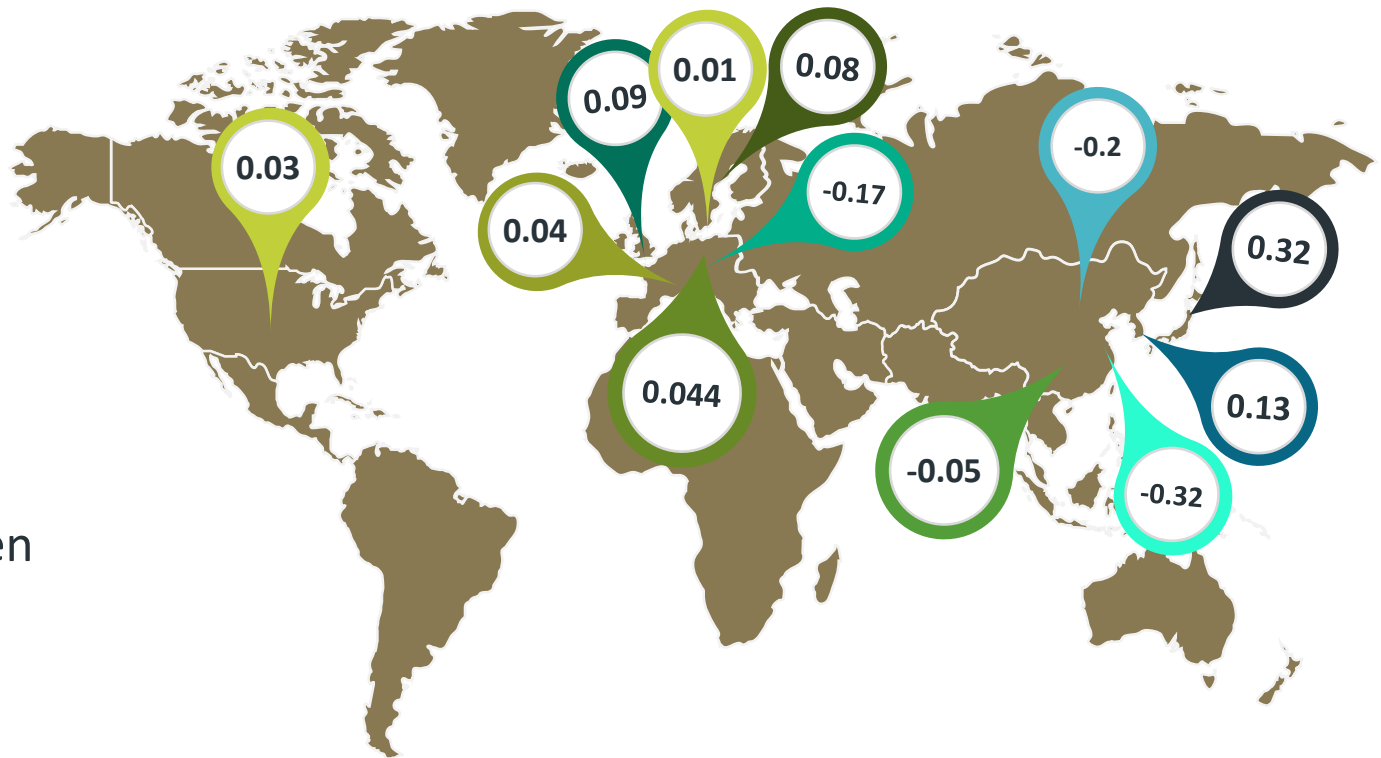
3 Results

Criteria weights



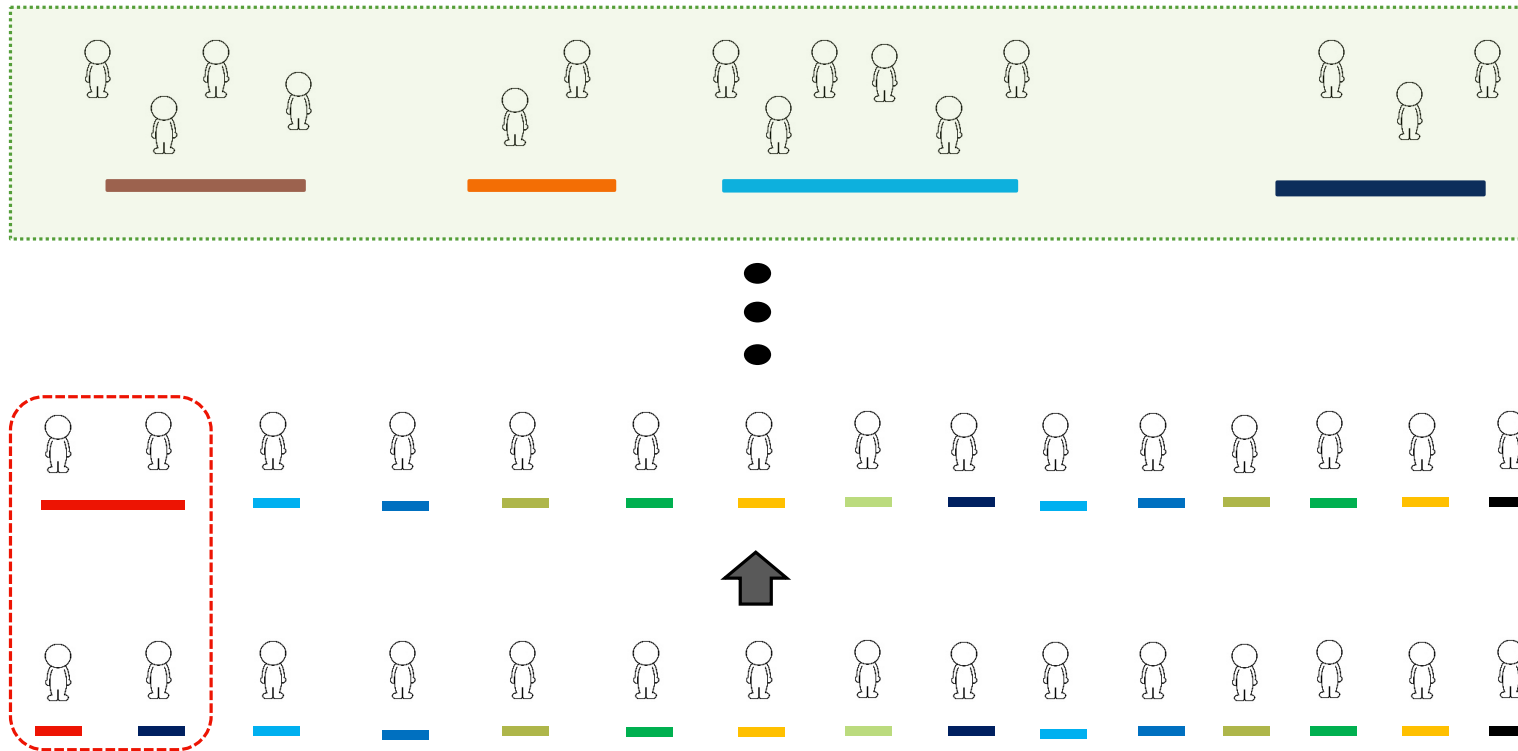
Final ranking

- Tokyo
- Seoul
- London
- Stockholm
- Berlin
- Paris
- New York
- Copenhagen
- Hong Kong
- Prague
- Beijing
- Shanghai














Hierarchical clustering

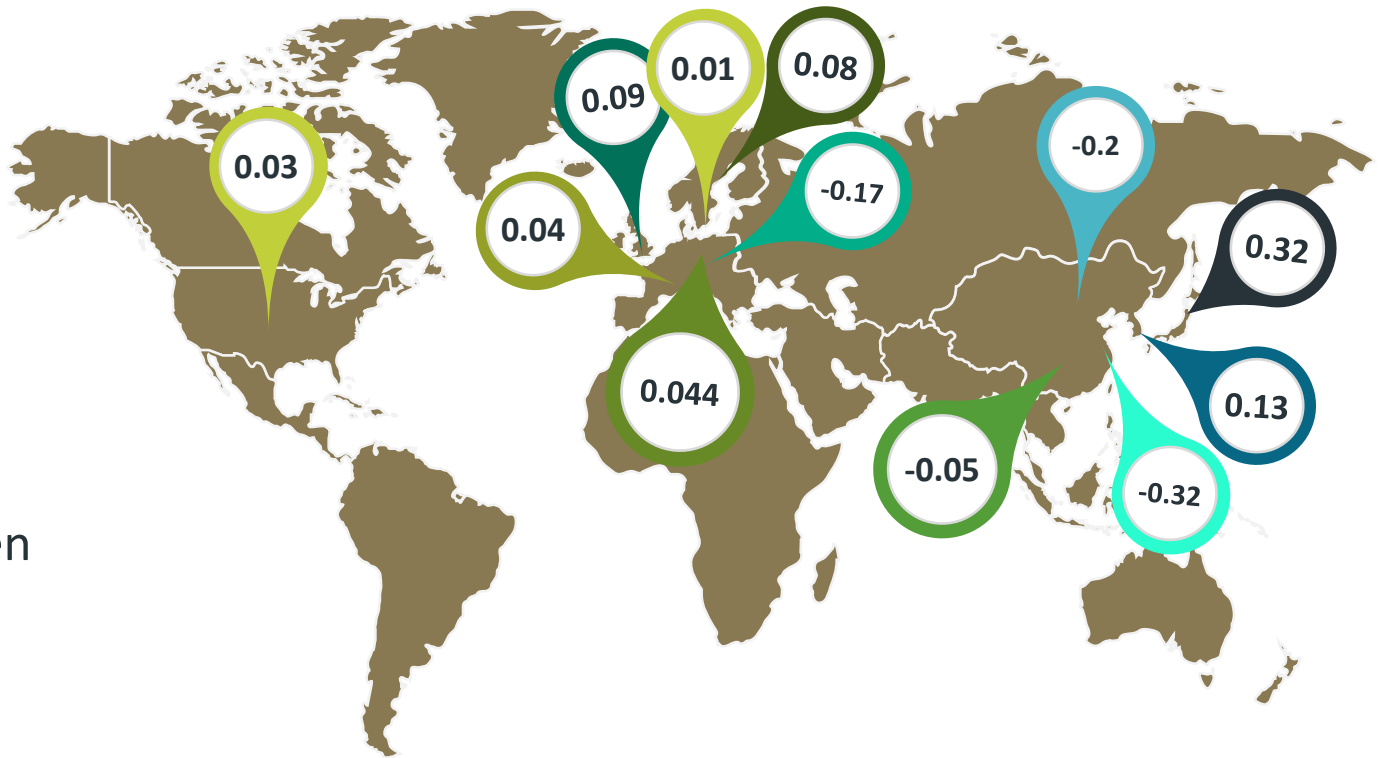
Bottom-up approach



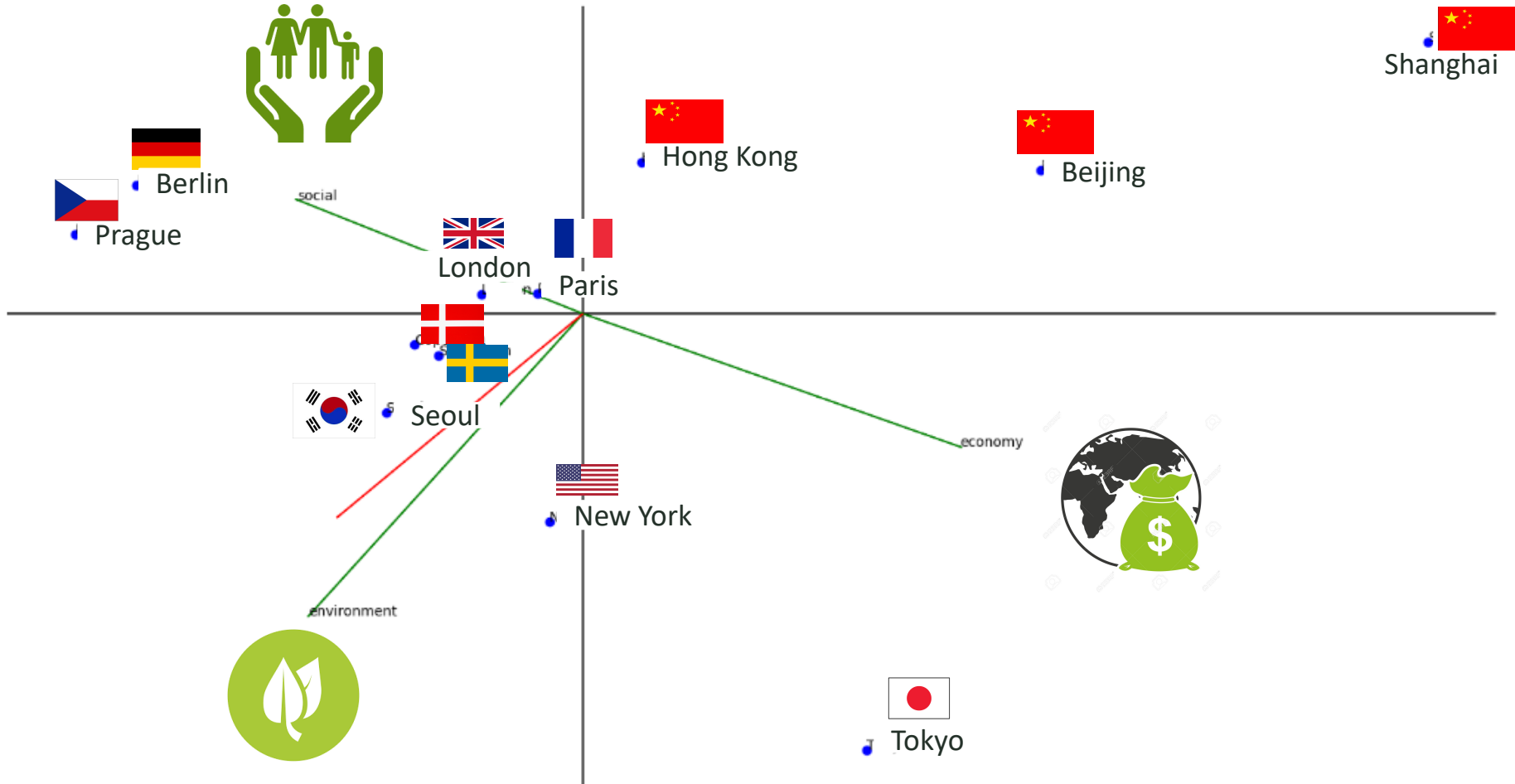
An extension to Promethee to hierarchical multicriteria problem, J. Rosenfeld, Y. De Smet, (waiting for acceptance)

Final clustering

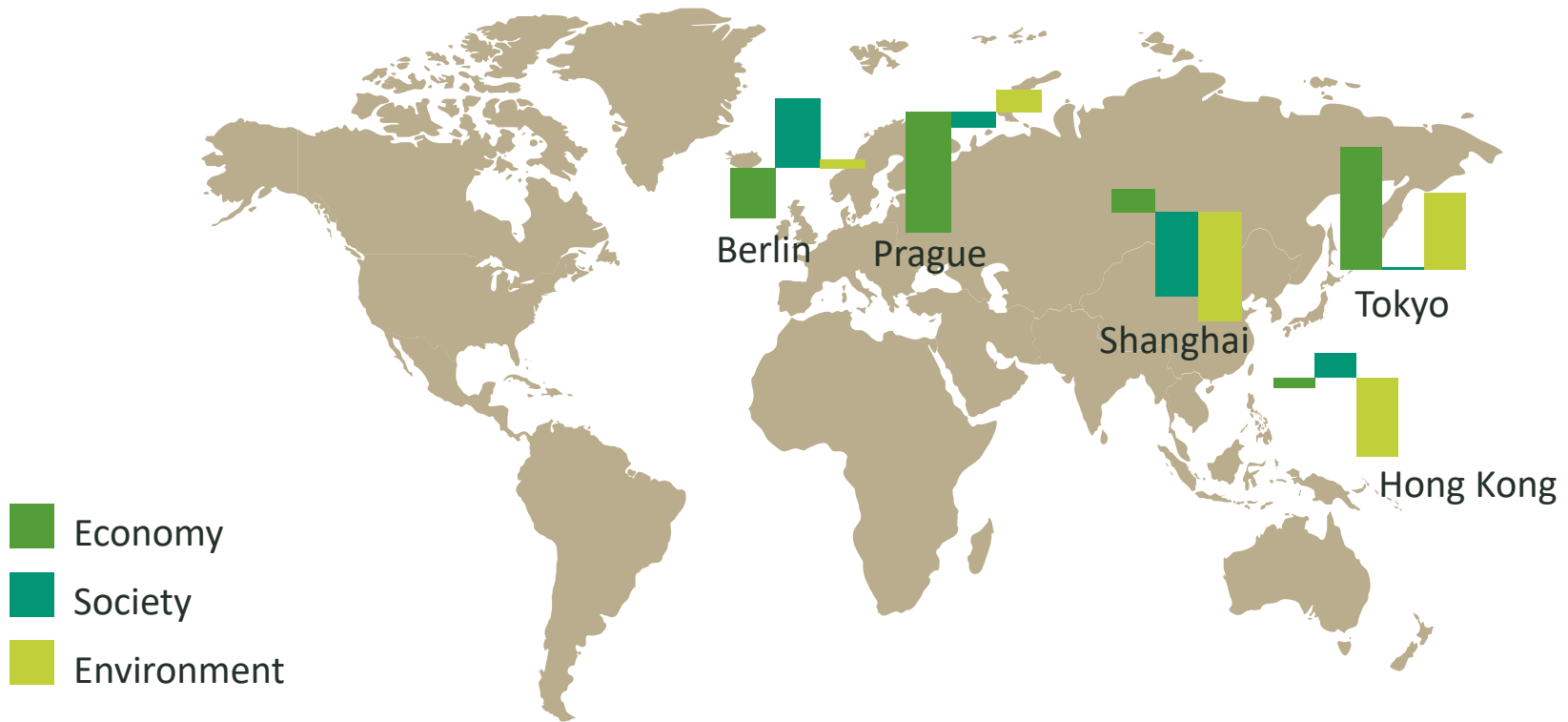
- 1  Tokyo
-  Seoul
-  London
-  Stockholm
- 2  Berlin
-  Paris
-  New York
-  Copenhagen
-  Hong Kong
- 3  Prague
-  Beijing
- 4  Shanghai



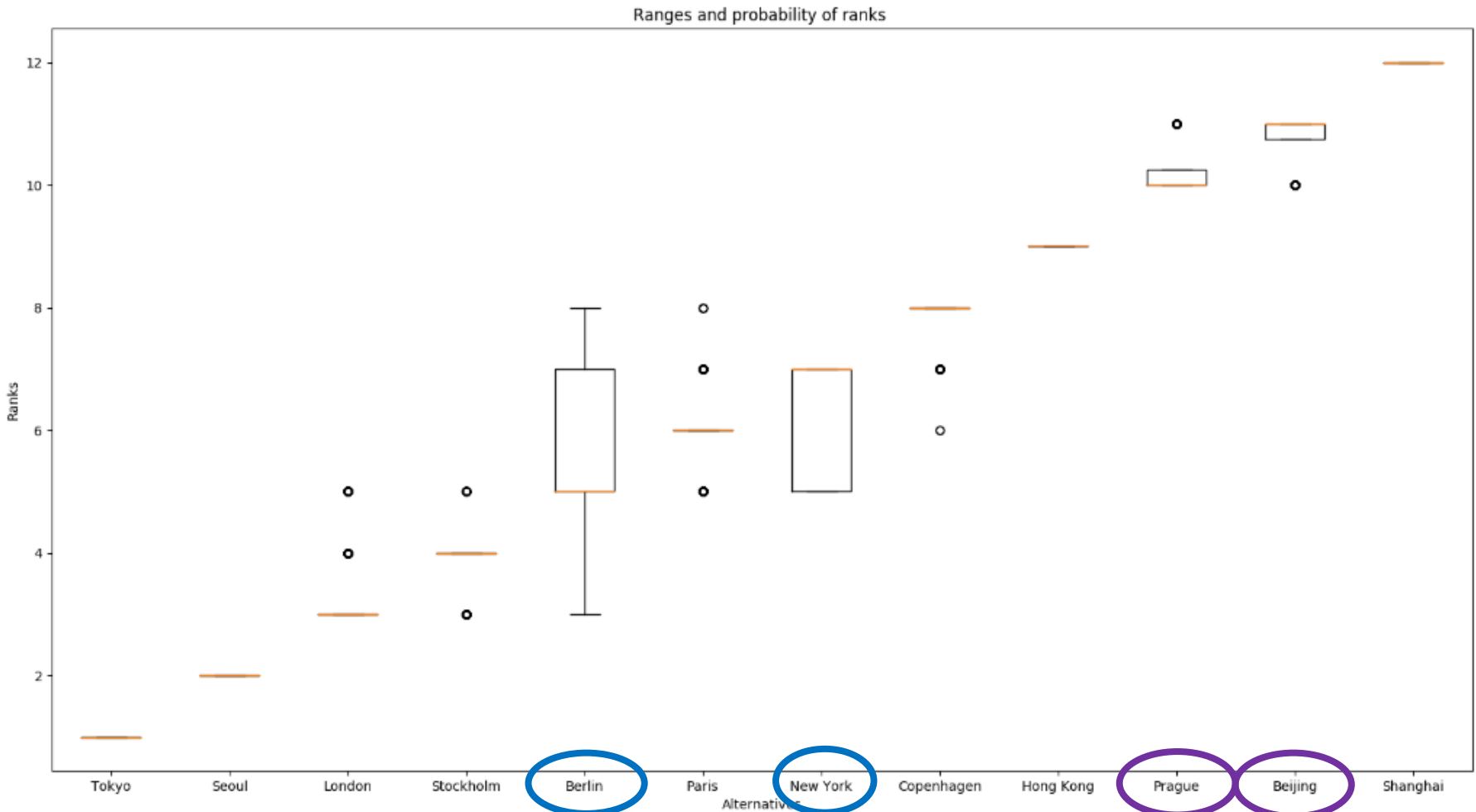
Visual representation GAIA



Sustainability pillars' scoring



Sensitivity analysis +/-20% criteria weights variation





4 Conclusion and recommendations

Conclusions

- PROMETHEE II method provides a complete ranking and scoring of 12 cities with respect to three different sustainability pillars
- An extended PROMETHEE II (Clustering) allows to classify the cities into 4 classes
- By using GAIA, the social pillar is opposite to the economy pillar, while the environment pillar seems to be independent from the others
- Sensitivity analysis based on changing criteria weights demonstrates the ranking variation of only 4 cities (Berlin and New York, Prague and Beijing)
- The model helps decision makers to decide where to put their available resources for sustainability improvement of the cities

« Having the knowledge to develop indicator frameworks that can respond to contextual factors while attempting to make connections with theory (e.g., weak vs. strong sustainability) and overarching frameworks (such as the post-2015 agenda) is likely to be more important than having access to lists of indicators »

(Gudmunsson, 2015)

