



SMART CITIES

L8 8.5.2017

Spring Semester 2017, ETH Zürich
Gerhard Schmitt

Smart Cities

1 GS ET:
Introduction

Definitions
Context

3 GS: Urban
Big Data

4 GS ET:
Urban
Measuremen
t

5 GS: Urban
Science

6 GS:
Complexity
Science

7 GS: Smart
Governance

8 GS: Smart
Livability

10 GS: From
smart cities
to
responsive
cities

Objectives,
Definition,
MOOC

Smart
Objects,
Smart
Buildings,
Smart Cities

Stocks and
Flows in Urban
Systems

Measurement
and
Simulation

Citizen Design
Science

Complexity
Science

Participatory
Design and
Management

City Livability
Rankings

From smart
cities to
responsive
cities

Exercise 1:
QUA-KIT

Exercise 2:
Urban
Measurement

Exercise 3:
QUA-KIT

Final
presentation
on MOOC
discussion
topics

The story so far:

- 8.5.2016 Smart Livability as decisive factor for urban resilience
- 10.4.2017 Good Urban Governance enabling long-term resilience
- 3.4.2017 Complexity Science as explanation for Smart City growth
- 27.3.2017 Citizen Design Science as a future urban development method
- 13.3.2017 Can you improve what you do not measure?
- 6.3.2017 Big Data as new urban raw material, made useful with Information Architecture and with the Stocks and Flows concept
- 27.2.2017 From smart houses to smart cities – emerging criteria for smart cities as urban systems
- 20.2.2017 Cities are complex systems. Ideally, they are sustainable, resilient, livable, smart, and finally responsive – from production machines to human habitat

New York City goes 11 days without a homicide -- a modern record

By Lorenzo Furlong, CNN

Updated 20:44 GMT (13:44 HK) February 14, 2015



More Top Stories



BIS seizes U.S. weapons



New virus discovered in Kansas



Russian missileing seen from space



MANDAR suspends Ben Bush



Corollations have stopped Cosby's tour



TV show exec dead at 30



Kim Jong Un's new kaedo

Just Watched

NYPD sets 'murder-free' record



NYPD sets 'murder-free' record 01:22

CHINA — New York City has gone 11 days without a homicide, its longest stretch without any on modern record, the New York Police Department said Friday.

The record was broken midnight Thursday. It was the 11th full day without a reported homicide.

The last reported homicide was February 1, or Super Bowl Sunday, in Upper Manhattan, a police representative said Friday.

Police then responded to a 911 call about multiple shots being fired and found five individuals with gunshot wounds, New York police said. One of the victims, Ibrahim Shadash, 26, was pronounced dead at the scene.

The streak has been the longest since the New York Police Department began recording statistics with a computerized program called Compstat in 1994, the police representative said.

Story Highlights

Eleven days without a homicide is longest stretch for city on modern record, police say

The last reported homicide was February 1 in Upper Manhattan, police rep says

[http://
edition.cnn.com/
2015/02/13/us/new-
york-homicide-record/](http://edition.cnn.com/2015/02/13/us/new-york-homicide-record/)

Delhi hat die schmutzigste Luft der Welt

Die Menschen in der indischen Metropole Delhi bezeichnen den Smog über ihrer Stadt als «Nebel». Eine gefährliche Verniedlichung: Indien hat die meisten Toten durch Atemwegserkrankungen.



«Jeder sollte jegliche Anstrengung draussen vermeiden: Fussballspieler im Smog Delhis. (Archivbild)
Bild: Keystone

04.02.2014



Jeden Winter hängt dichter Smog über Peking und Delhi. Die Bewohner von Delhi sehen im Winter oft kaum noch etwas. Sie nennen es Nebel, doch laut Experten ist es Smog. Möglicherweise hat Delhi noch schmutzigere Luft als Peking und damit die schmutzigste Luft der Welt.



Artikel zum Thema

Smog-Alarm in Peking



Der schlimmste Smog dieses Winters hält Peking im Würgegriff. Das erste Mal übersteigen die Luftwerte den Spitzenwert von 500 - wo die Skala normalerweise endet. [Mehr...](#)

<http://www.tagesanzeiger.ch/wissen/medizin-und-psychologie/Delhi-hat-die-schmutzigste-Luft-der-Welt/story/27936592>

China Commits \$36 Billion To Further Build The 110 Million Person Jing-Jin-Ji Megaregion



Wade Shepard, CONTRIBUTOR

I travel to emerging markets around Asia and report on what I find. [FULL BIO](#)

Opinions expressed by Forbes Contributors are their own.

A new \$36 billion rail plan [was recently approved](#) by China's National Development and Reform Commission which will further integrate the cities of Beijing and Tianjin and parts of Hebei province into a sprawling megaregion dubbed Jing-Jin-Ji. This colossal infrastructure building endeavor will include of a total of nine projects that will consist of 1,100 kilometers of new track being laid by 2020.

<https://www.forbes.com/sites/wadeshepard/2016/12/08/chinas-110-million-person-jing-jin-ji-megaregion-gets-a-new-36-billion-railway-plan/#bda5931e45c>



Smart Livability?

Smart Livability?



Smart Livability?



Smart Livability?



Welcome to one of the world's most liveable cities: Zürich



Smart Livability?



Smart Livability?



What is livability? A definition

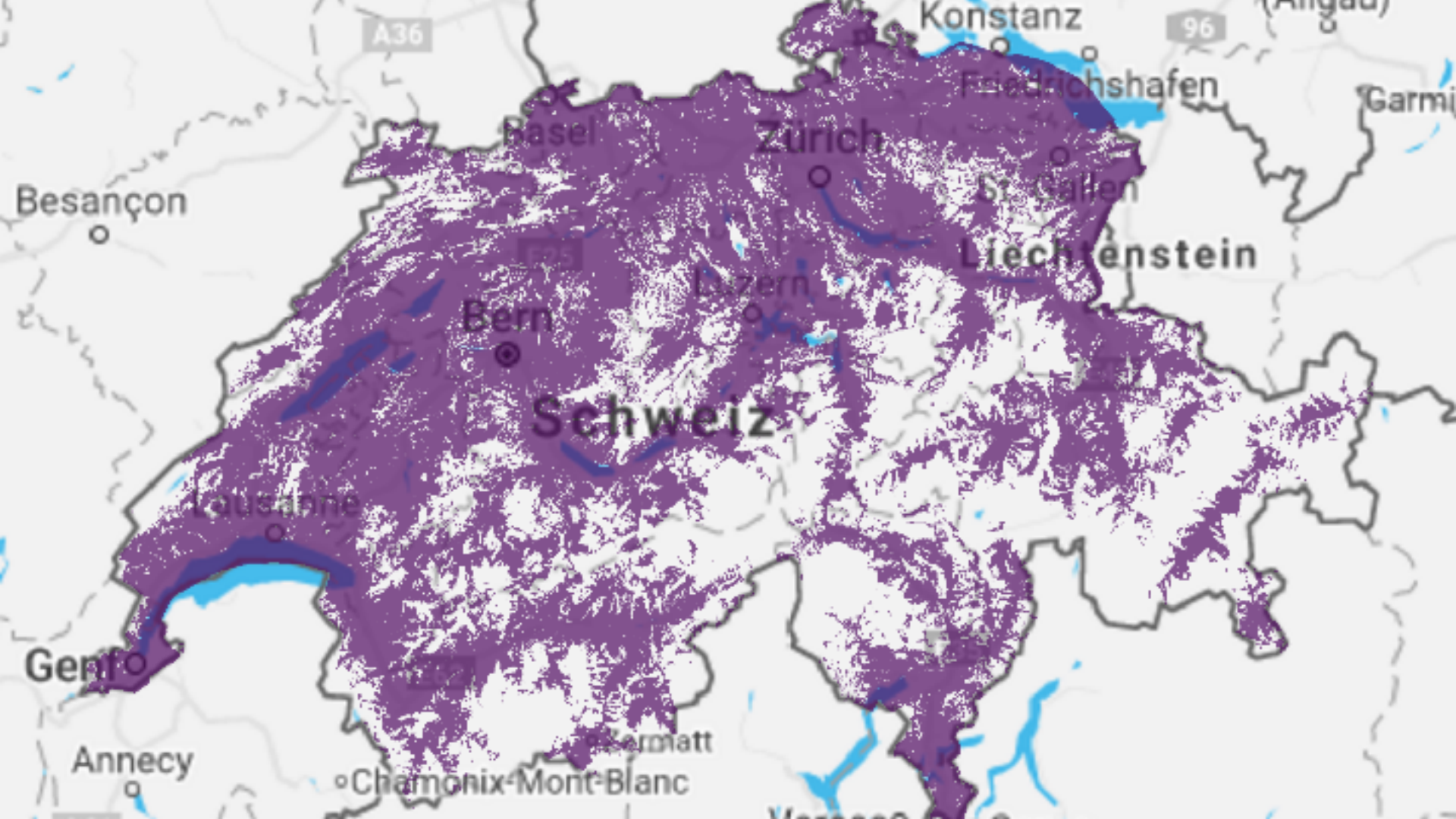
„Livability is the sum of the factors that add up to a community's quality of life—including the built and natural environments, economic prosperity, social stability and equity, educational opportunity, and cultural, entertainment and recreation possibilities.“ <http://livable.org/about-us/what-is-livability>

Korfiati and Gkonos: <http://www.n.ethz.ch/~gkonosc/Layout/Layout.html>



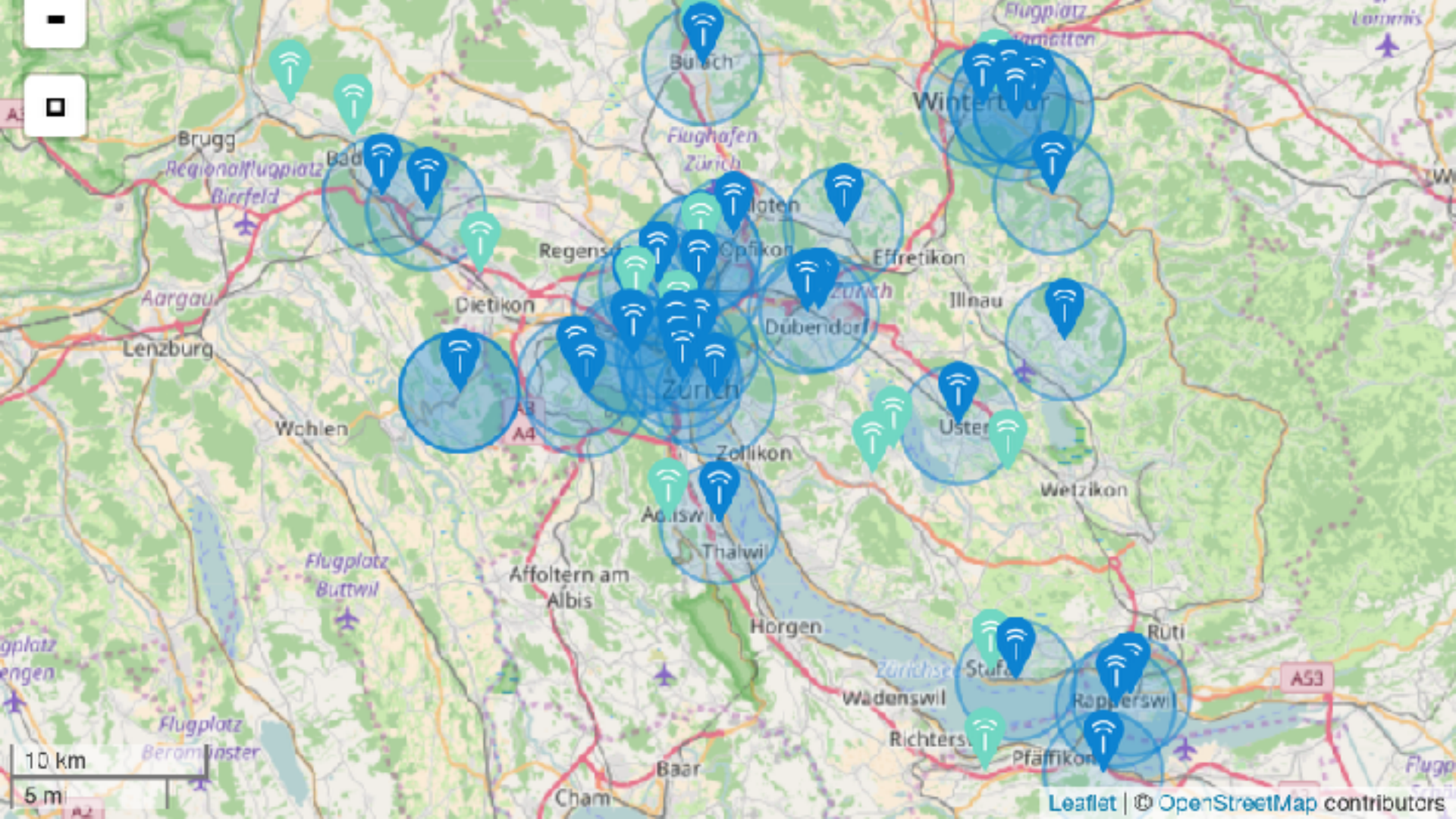
IoT Infrastruktur

1. Low Power Networks (LPN): low range, low power consumption and low bandwidth. A big network of sensors that send small data sets to a central server. The central server can then process the data.
2. Sensors running with batteries that can last several years. No cables or other non-wireless infrastructure is needed.
3. Two main competitors in Europe: LoRa and Sigfox. Competing, non-compatible standards.
4. In Switzerland, LoRa is mostly used. Swisscom and the local The Things Network (TTN) community use its technology and protocols.
5. TTN has good coverage in certain Swiss cities, especially in Zürich.
6. TTN is community driven and free to use for everyone.





THE THINGS
N E T W O R K

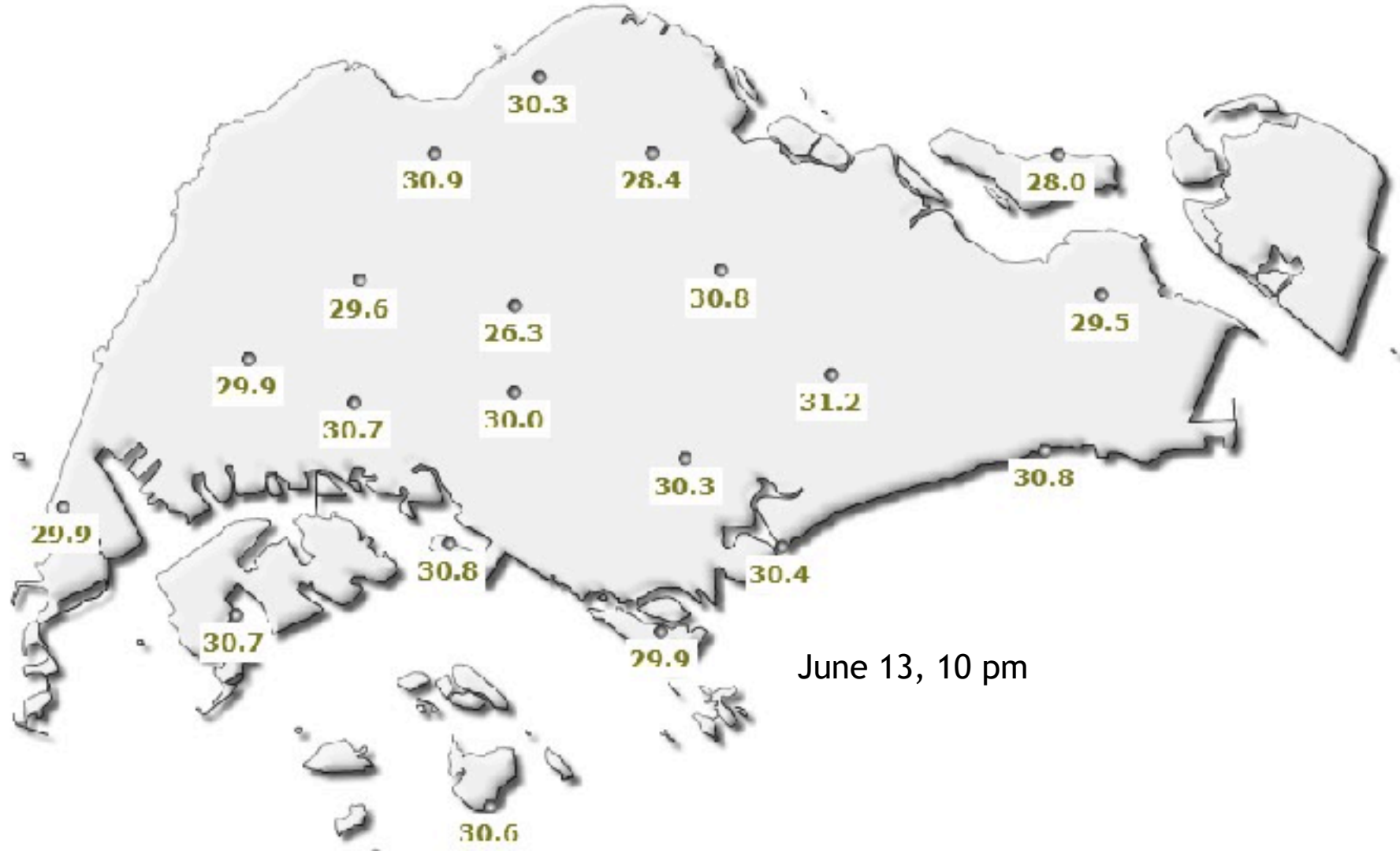




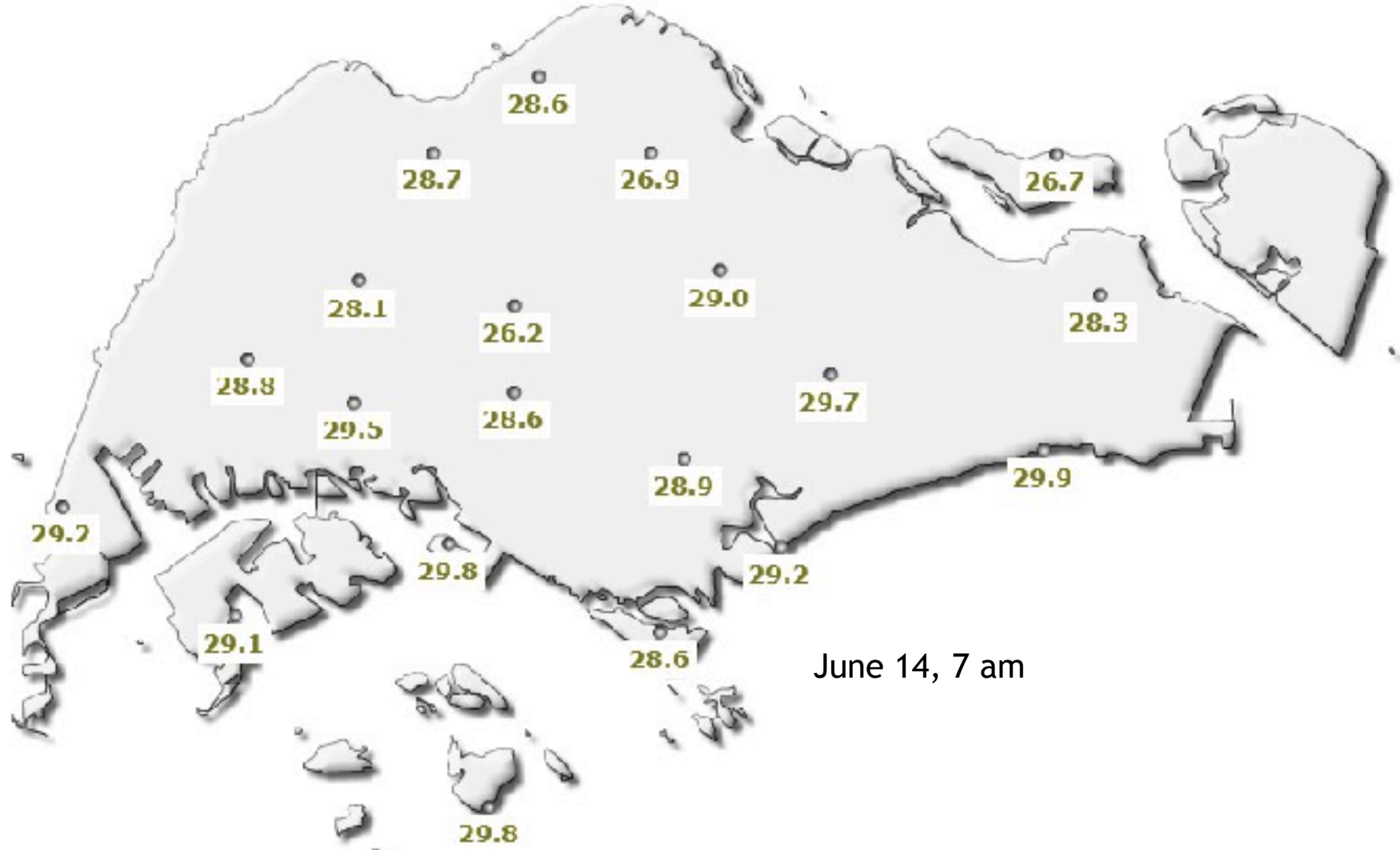


Urban climate and livability: heat islands. Prof. Dr. Jan Carmeliet





June 13, 10 pm



June 14, 7 am

Temperature anomaly: The term temperature anomaly means a departure from a reference value or long-term average. (<http://www.ncdc.noaa.gov/cmb-faq/anomalies.php>)

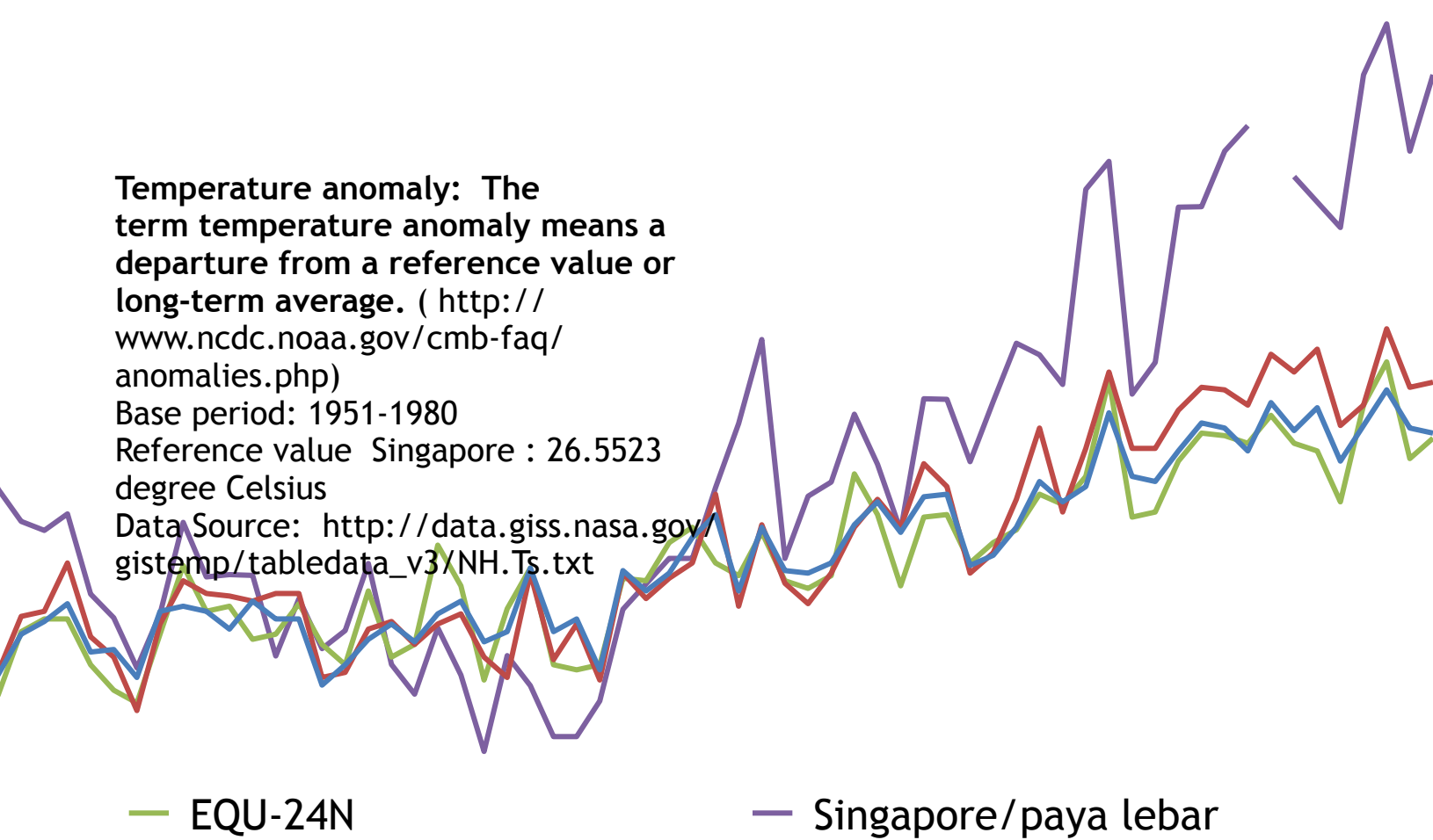
Base period: 1951-1980

Reference value Singapore : 26.5523 degree Celsius

Data Source: http://data.giss.nasa.gov/gistemp/taledata_v3/NH.Ts.txt

— EQU-24N

— Singapore/paya lebar



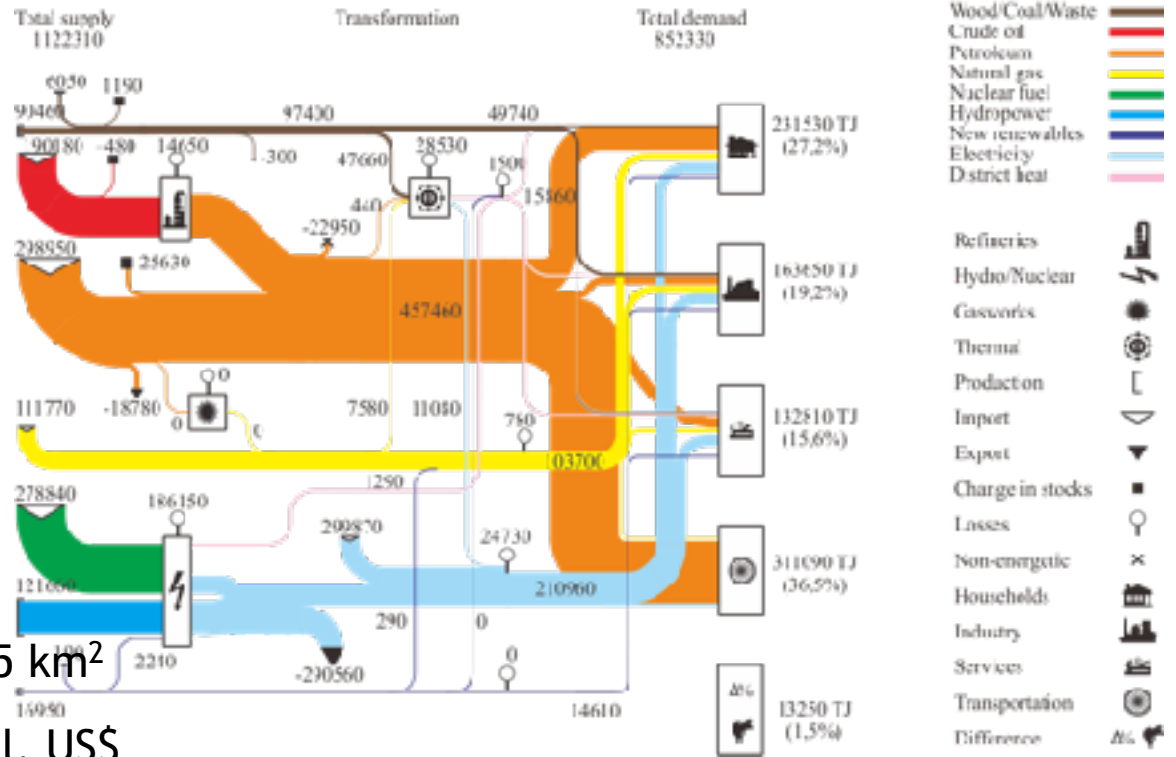
Urban energy and livability: applications and side effects. Dr Matthias Berger



Energy flows in TJ for Switzerland



Population 8'014'000
 Energy dem. 852'330 TJ
 Area 41'285 km²
 Density 194/ km²
 GDP(PPP) 340 bil. US\$



Total Primary Energy Supply (TPES)

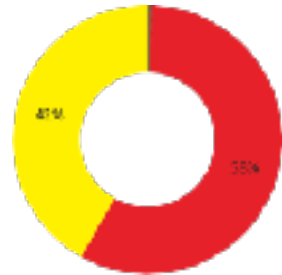
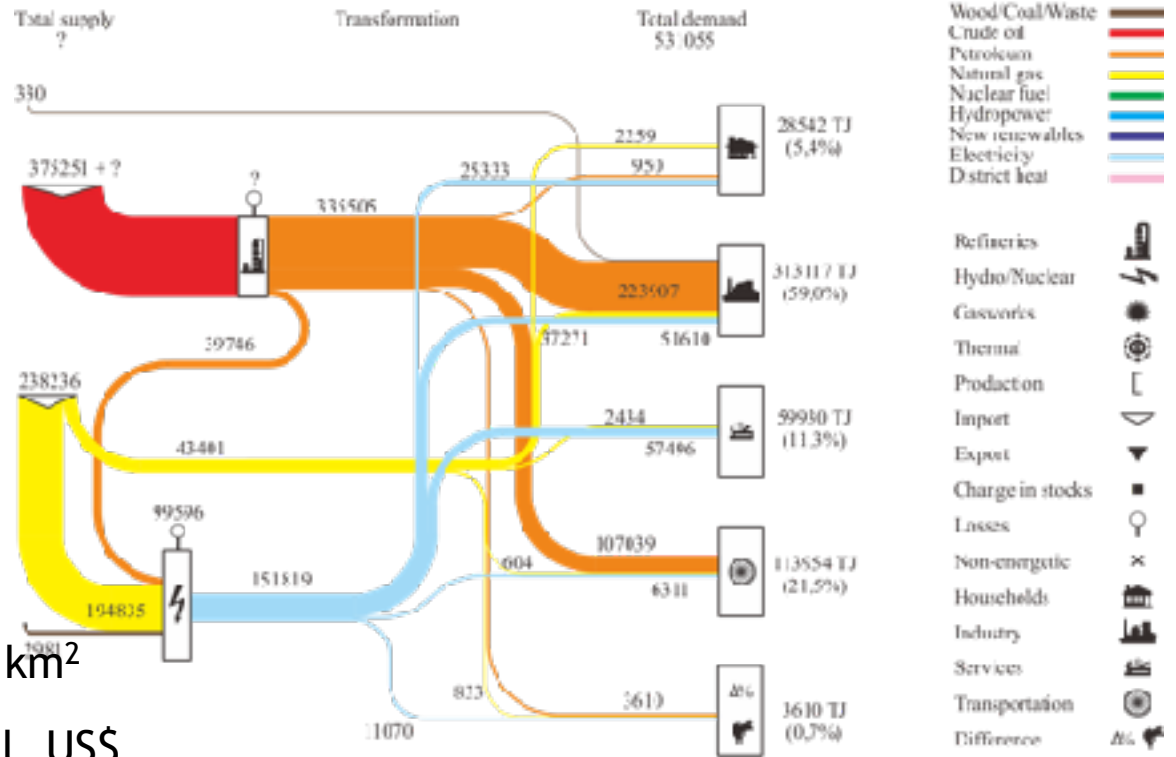
$$dE = \delta Q + \delta W = [J]$$

Energy flows in TJ for Singapore



Population
Energy dem.
Area
Density
GDP(PPP)

5'312'400
531'055 TJ
712.4 km²
7126/ km²
315 bil. US\$



Total Primary
Energy Supply
(TPES)

$$dE = \delta Q + \delta W$$

$$= [J]$$

Water, ecology and livability. Dr. Ulrike Wissen



Mobility and livability. Dr. Alex Erath



Smart Livability – but for whom?

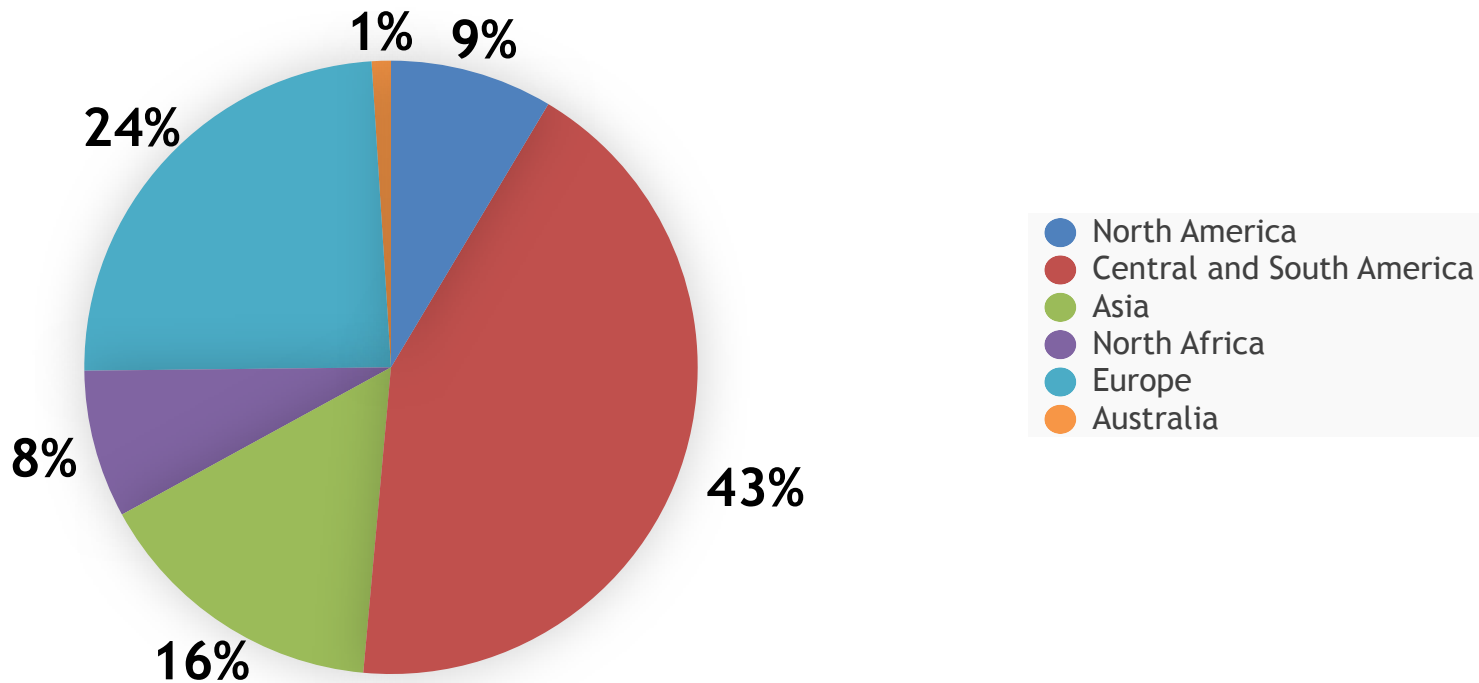




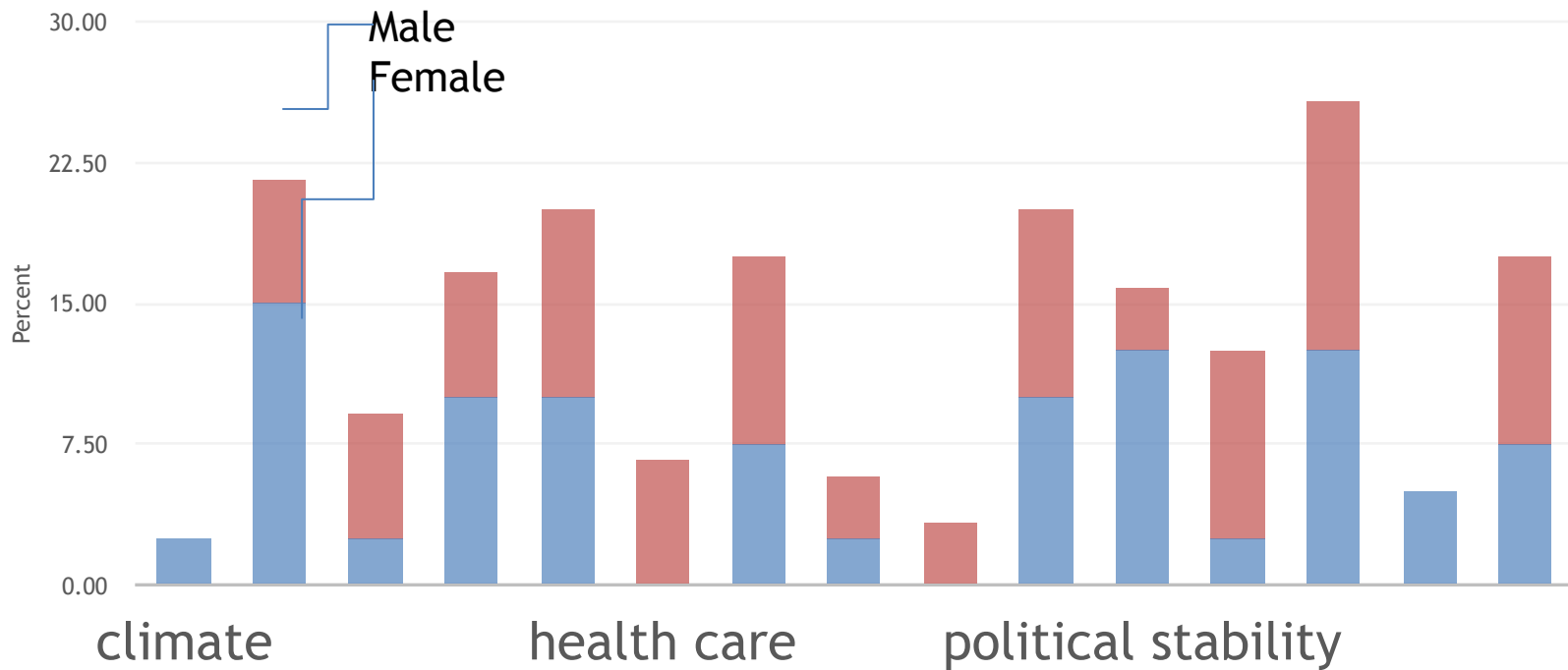
MOOC 2 - LIVABLE FUTURE CITIES: 1ST round:

- September - December 2015
- 10 weeks
- 8'184 registered participants
- Financed by SEC
- 1'115 active students in the last week of the course
- 453 certificates delivered
- 2'500 annotated images submitted by students (as answers to assignments)

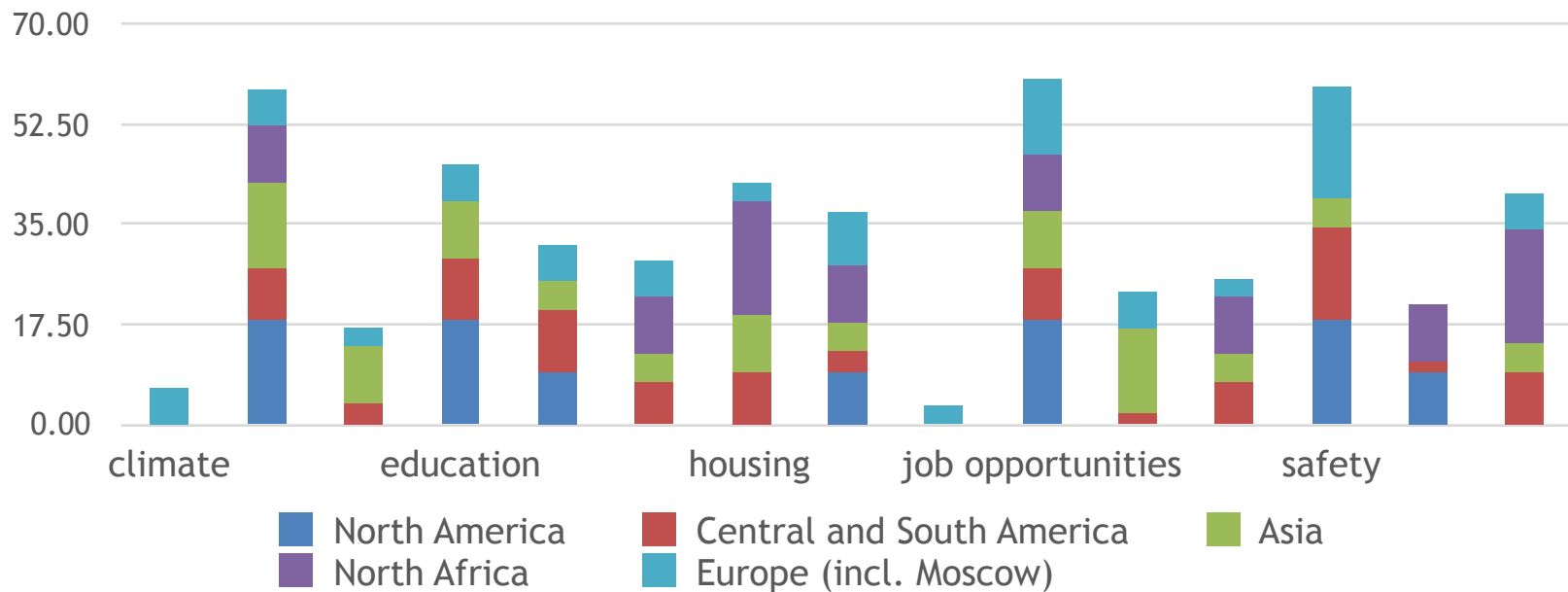
Where do the participants live?



Criteria of Livability



Criteria of livability - by continents



3 Top Criteria

- North America: culture, safety, job opportunities
- Central and South America: safety, job opportunities, culture
- Asia: political stability, culture, economy
- North Africa: housing, transportation, infrastructures
- Europe: safety, job opportunities, infrastructures

3 Top Criteria

- North America: culture, safety, job opportunities
- Central and South America: safety, job opportunities, culture
- Asia: political stability, culture, economy
- North Africa: housing, transportation, infrastructures
- Europe: safety, job opportunities, infrastructures





Urbanisation, 1950

GLOBAL CITY POPULATIONS*

70.4%

Rural

17.7%

Other urban
Fewer than 300,000

7.0%

Smallest cities
300,000 to 500,000

7.5%

Small cities
500,000 to 1m

5.1%

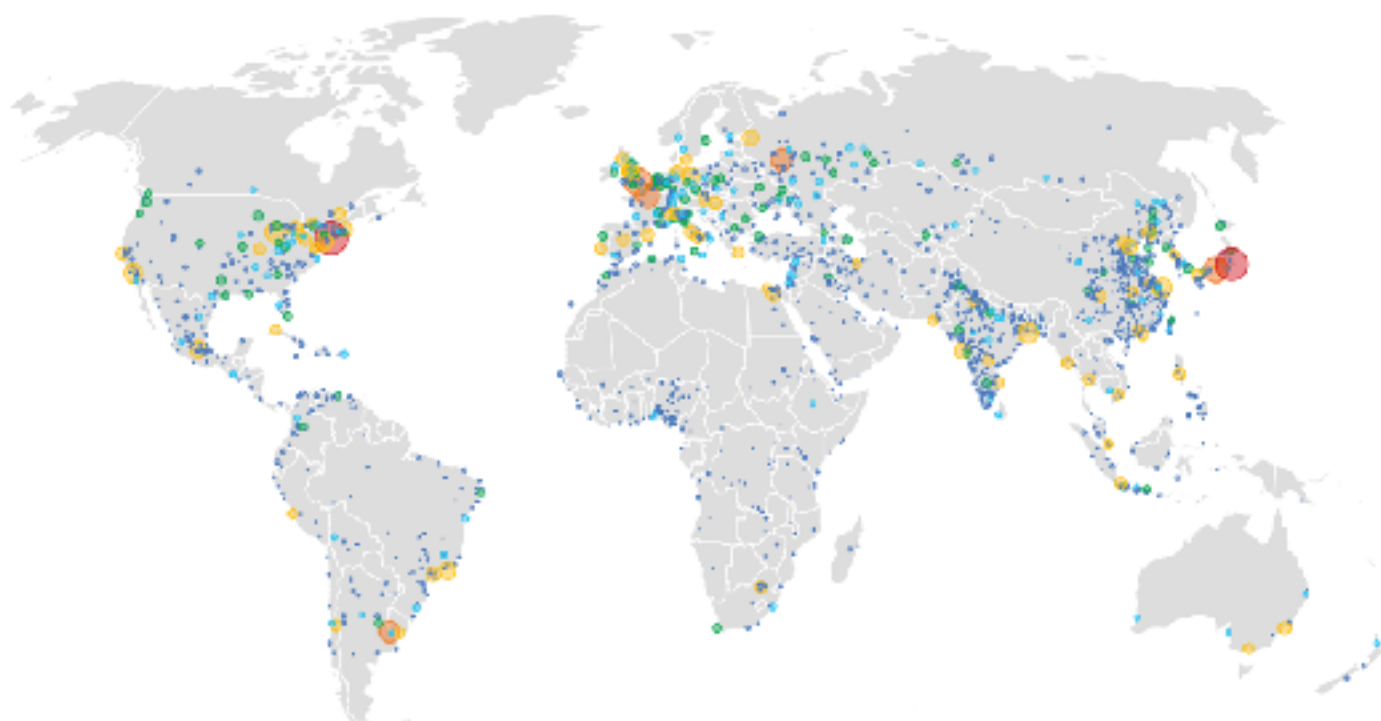
Medium cities
1m to 5m

1.3%

Large cities
5m to 10m

0.9%

Megacities
10m or more



1950

1960

1970

1980

1990

2000

2010

2020

2030

Source: UN

<http://www.economist.com/node/21642053?src=scn/tw/te/dc/ed/brightlightsbigcities>

*Dataset comprises urban agglomerations with 300,000 inhabitants or more in 2014. Data are for countries existing in 2014, mapped on modern borders. Projections from 2014.

Urbanisation, 2030

GLOBAL CITY POPULATIONS*

40.0%

Rural

-

23.0%

Other urban
Fewer than 300,000

3.6%

Smallest cities
300,000 to 500,000

6.1%

Small cities
500,000 to 1m

13.4%

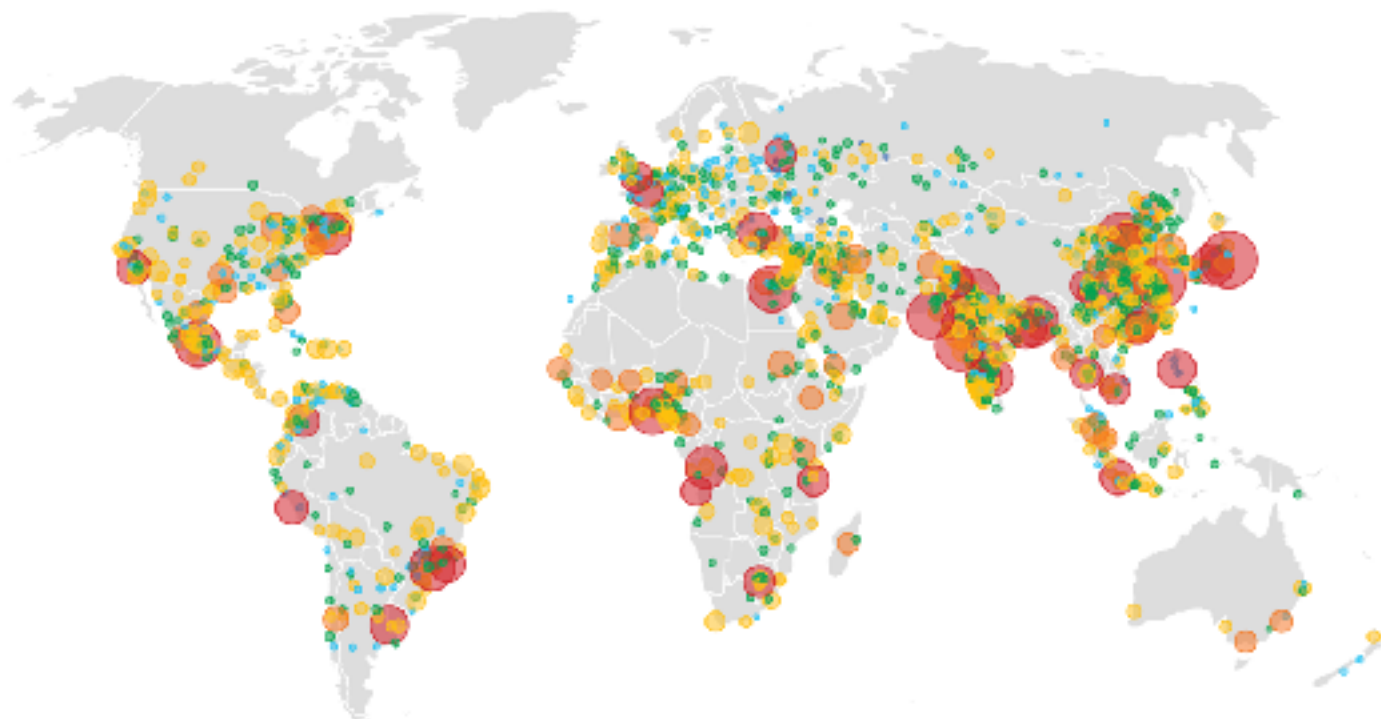
Medium cities
1m to 5m

0.2%

Large cities
5m to 10m

0.6%

Megacities
10m or more



<http://www.economist.com/node/21642053?src=scn/tw/te/dc/ed/brightlightsbigcities>

1950

1960

1970

1980

1990

2000

2010

2020

2030

Sources: UN

*Dataset comprises urban agglomerations with 300,000 inhabitants or more in 2014. Data are for countries existing in 2014, mapped on modern borders. Projections from 2014.

An aerial photograph of a city, likely Zurich, showing a dense urban area with a river (Limmat) flowing through it. The city is surrounded by green hills and mountains in the background. The image is used as a background for the slide.

Measurable criteria of livability. Prof. Dr. Stephen Cairns

MONOCLE

A JOURNAL ON GLOBAL AFFAIRS, BUSINESS, CULTURE & DESIGN

Scanning the horizon: Looking for lands of opportunity

An inspirational tour of the places, people, outfits and opportunities worth adding to your list of best developments. A five-part **SPECIAL REPORT**

Issue 61 • Volume 16
February 2013

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- B BUSINESS** Daffine: a lesson in redefining your image
- C CULTURE** Das Book: Germans are better between the sheets
- D DESIGN** Rocking the perfect wardrobe in Japan and Sweden
- E EVENTS** Cheeking into the Oyster Inn, a 'Jerveto' hotel and a new spread of food and drink
- EXPO** The UK's best-out design hub: Central Saint Martins



It's time
to
start
again

6
5
4
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2
1

THE HOW TO GENERATION

- 1**
BEHIND A MASK: how local businesses can help you find the real parties
- 2**
BEHIND A MASK: meet the Daffine who added a fresh flavor to a European name
- 3**
MAKE IT GLOBAL: the secrets of creating a global TV studio franchise
- 4**
BEHIND A MASK: the Portuguese people who have found success in a field of their own
- 5**
START A WORK LABEL: the women who recorded live podcasts in one of Italy
- 6**
BEHIND A MASK: the top producers who photographed local events

7
BEHIND A MASK: get a lesson in how to build the best year book

PLUS: enter the contest to win a chance to win a new design collection to be a global collection



Introduction

Liveability: Rankings and Indices

1) Mercer (Financial Services Consultancy) — Quality of Life Survey

39 criteria used including: [safety](#), [education](#), [hygiene](#), [health care](#), [culture](#), [environment](#), [recreation](#), political-economic stability and public transportation.

2) Monocle (Style Magazine) — Most Liveable City Index

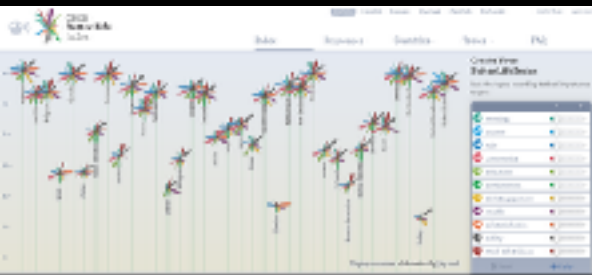
Criteria in this survey are safety/crime, international connectivity, climate/sunshine, quality of architecture, public transportation, tolerance, environmental issues and access to nature, urban design, business conditions, pro-active policy developments and medical care

3) Economist Intelligence Unit (EIU — economic forecasting) — Global Liveability Survey

Criteria include: availability of goods and services, low personal risk, and an effective infrastructure. 'Provides scores for lifestyle challenges in 140 cities worldwide'.

4) OECD (Organisation for Economic Co-operation and Development) — Better Life Index

There is more to life than the cold numbers of GDP and economic statistics – This Index allows you to compare well-being across countries, based on 11 topics the OECD has identified as essential, in the areas of material living conditions and quality of life.



Critiques

1) Bias:

- The Economist Intelligence Unit report is [anglocentric](#): "The Economist clearly equates livability with speaking English (*New York Times*)
- EIU does not take into account the [cost of living](#) as a factor in 'liveability'.
- The Mercer list helps multi-national companies decide where to open offices or plants, and how much to pay employees.

2) Philosophical: Measuring the unmeasurable?

3) Simplistic:

- Amartya Sen saw the development of the Human Development Index (HDI) as incapable of capturing the full complexity of development processes, yet ultimately saw the pragmatic value of estimating a single number for policy purposes (for development).
- 'Boring' cities dominate: Vancouver, Melbourne, Zurich, Calgary — missing the grime, where's the mess? Full complexity of urban experience. Related to Sen's critique of HDIs

Introduction

Liveability: Rankings and Indices

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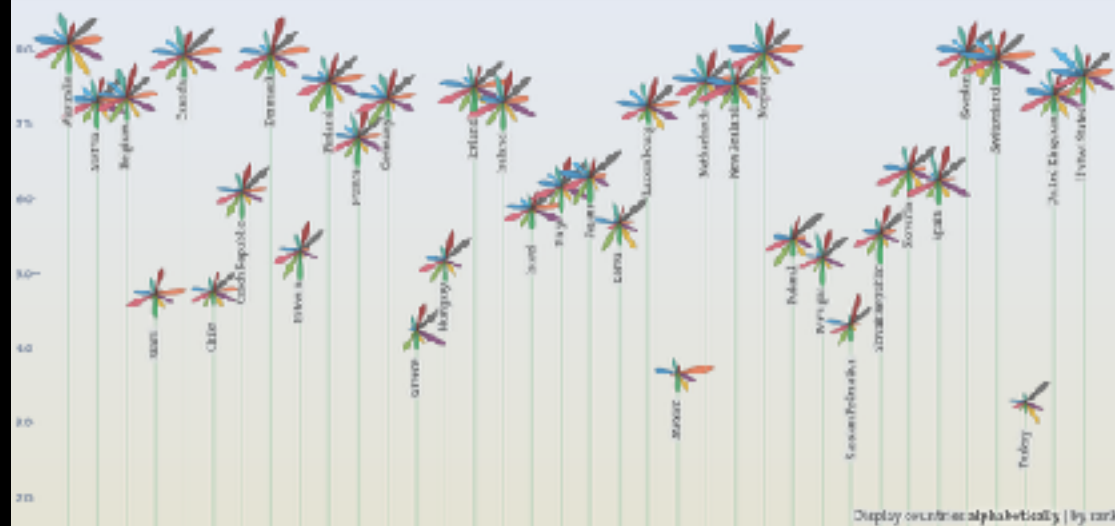
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Create Your Better Life Index

Rate the topics according to their importance to you:

	Housing	<input type="range"/>
	Income	<input type="range"/>
	Jobs	<input type="range"/>
	Community	<input type="range"/>
	Education	<input type="range"/>
	Environment	<input type="range"/>
	Civic Engagement	<input type="range"/>
	Health	<input type="range"/>
	Life Satisfaction	<input type="range"/>
	Safety	<input type="range"/>
	Work-Life Balance	<input type="range"/>

[Reset](#) [Help](#)



Search map

THINGS TO DO

Number of responses

Selected topic

India

115 responses

Gender

Age

Topics



100%

100%

100%

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Compare with

Tell us about you.

Housing	<input type="checkbox"/>
Income	<input type="checkbox"/>
Jobs	<input type="checkbox"/>
Community	<input type="checkbox"/>
Education	<input type="checkbox"/>
Environment	<input type="checkbox"/>
Civic Engagement	<input type="checkbox"/>
Health	<input type="checkbox"/>
Life Satisfaction	<input type="checkbox"/>
Safety	<input type="checkbox"/>
Work Life Balance	<input type="checkbox"/>

Reset map

The data shown...

Number of responses

Favorite topic

Japan

520 responses

Gender



Age



Topics



Compare with

...

Tell us about you.

	Housing	<input type="checkbox"/>
	Income	<input type="checkbox"/>
	Jobs	<input type="checkbox"/>
	Community	<input type="checkbox"/>
	Education	<input type="checkbox"/>
	Environment	<input type="checkbox"/>
	Civic Engagement	<input type="checkbox"/>
	Health	<input type="checkbox"/>
	Life Satisfaction	<input type="checkbox"/>
	Safety	<input type="checkbox"/>
	Work-Life Balance	<input type="checkbox"/>

'Liveability' is an ancient theme

Classical Roots in 'Eudaemonia'

In his *Nicomachean Ethics*, (1095a15–22) [Aristotle](#) says that eudaimonia means 'doing and living well'. The term is sometimes translated as 'happiness' or 'flourishing'

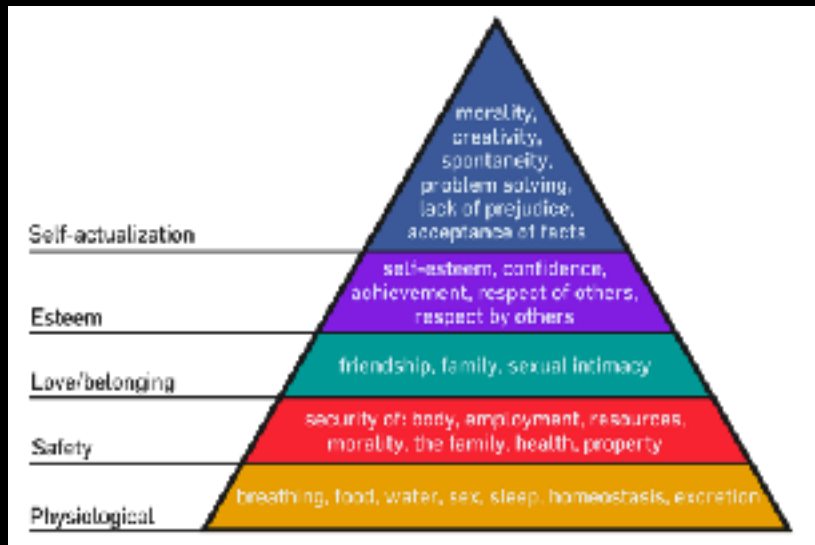
The treatise begins with a discussion of *eudaimonia*; followed by an examination of the nature of *areté* ("virtue," "excellence") and the character traits that human beings need in order to live life at its best. The treatise examines the conditions in which praise or blame are appropriate, and the nature of pleasure and friendship; near the end of the work, we find a brief discussion of the proper relationship between human beings and the divine (dictionary of philosophy

Let us resume our inquiry and state, in view of the fact that all knowledge and every pursuit aims at some good, what it is that we say political science aims at and what is the highest of all goods **achievable by action**. Verbally there is very general agreement; for both the general run of men and people of superior refinement say that **it is happiness**, and identify **living well and doing well with being happy**; but with regard to **what happiness is** they differ, and the many do not give the same account as the wise. For the former think it is **some plain and obvious thing**, like pleasure, wealth, or honour; they differ, however, from one another- and often even the same man identifies it with **different things**, with health when he is ill, with wealth when he is poor; but, conscious of their ignorance, they admire those who proclaim some great ideal that is above their comprehension. Now some **eudaimonia**, **happiness, or flourishing** think that apart from these many goods there is another which is **self-subsistent and causes the goodness of all these as well**. To examine all the opinions that have been held were perhaps somewhat fruitless; enough to examine those that are most prevalent or that seem to be arguable.

Modern Eudaimonia

Models of eudaimonia in psychology emerged from early work on self-actualisation and the means of its accomplishment by researchers such as [Erikson](#), [Allport](#), and Abraham [Maslow](#). The psychologist C. D. Ryff highlighted the distinction between *eudaimonia wellbeing*, which she identified as psychological well-being, and *hedonic wellbeing* or pleasure. Building on Aristotelian ideals of belonging and benefiting others, flourishing, thriving and exercising excellence, she conceptualised eudaimonia as a six-factor structure:

- 1 Autonomy
- 2 Personal growth
- 3 Self-acceptance
- 4 Purpose in life
- 5 Environmental mastery
- 6 Positive relations with others.



Human Development Index

- Life expectancy at birth
- [Education index](#): Mean years of schooling and Expected years of schooling
- Standard of living (GNI per capita)

UNDP began using a new method of calculating the HDI in 2010 — with refinements in Education index

Annual Development Reports of the [United Nations Development Programme](#) (UNDP).
Devised "to shift the focus of development economics from national income accounting to people-centered policies".

To convince the public, academics, and policy-makers that they can and should evaluate development not only by economic advances but also improvements in human well-being.

M

Mahbub Ul Haq (Pakistani economist) proposed the idea. Amartya Sen initially opposed this idea, but he soon went on to help Haq develop the Index in the future. Sen was worried that it was going to be difficult to capture the full complexity of human capabilities in a single index but Haq persuaded him that only a single number would shift the attention of policy-makers from concentration on economic to human well-being.

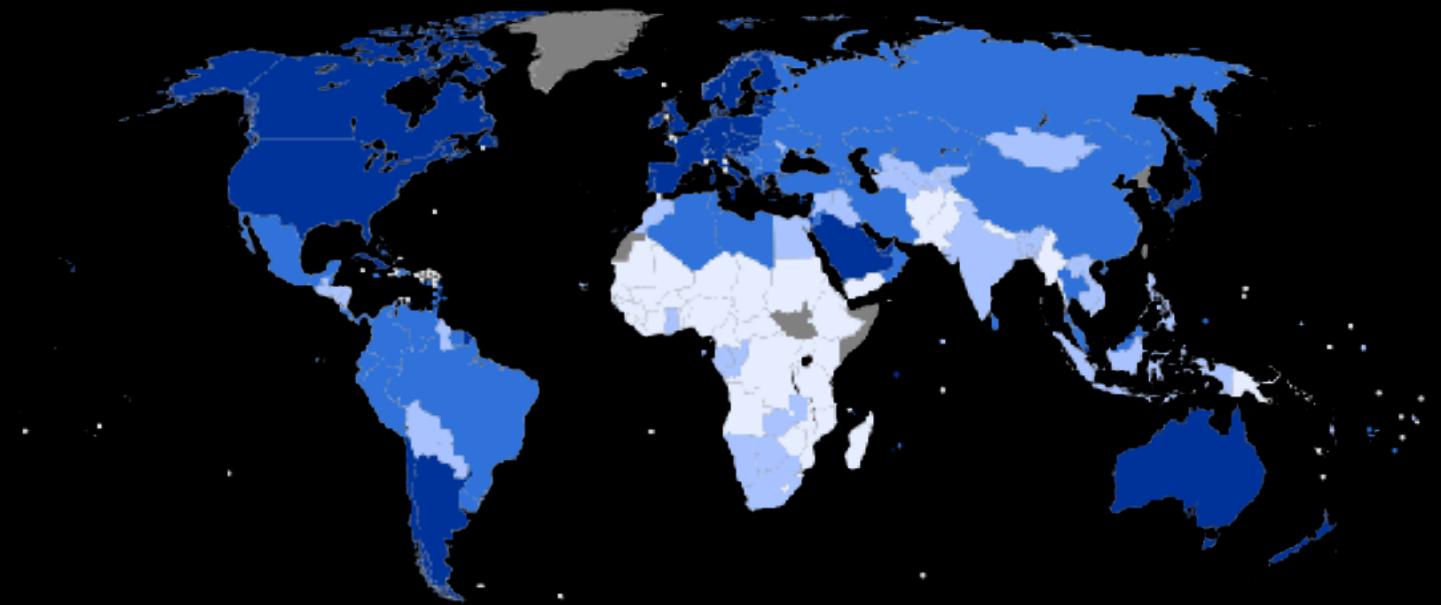
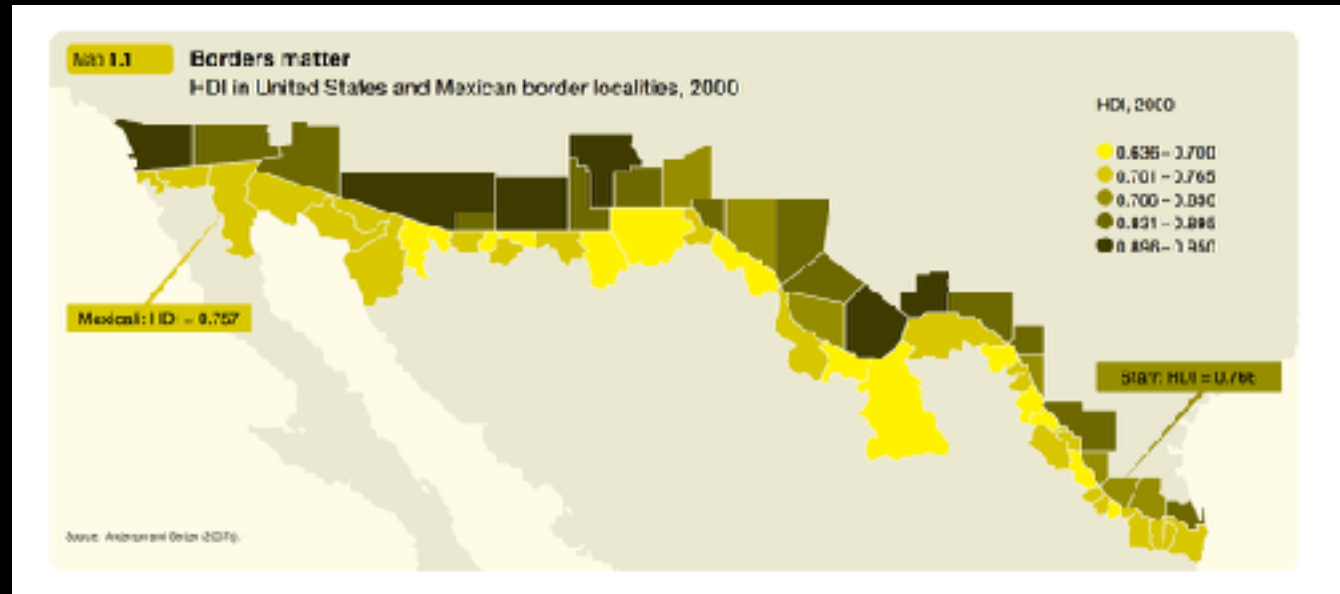


Table 1: Human Development Index and its components

[Download all data](#)

Table 1: Human Development Index and its Components

HDI rank	Country	Human Development Index (HDI) Value, 2013	Life expectancy at birth (years), 2013	Mean years of schooling (years), 2012	Expected years of schooling (years), 2012	Gross national income (GNI) per capita (2011 PPP \$), 2013	Human Development Index (HDI) Value, 2013	Change in rank, 2012-2013
Very high human development								
1	Norway	0.964	81.5	12.5	17.8	62,308	0.963	0
2	Australia	0.953	82.6	12.8	18.8	41,624	0.951	0
3	Switzerland	0.957	82.6	12.2	15.7	62,732	0.955	0
4	Netherlands	0.955	81.0	11.9	17.9	48,587	0.955	0
5	United States	0.954	78.9	12.9	18.5	52,308	0.952	0
6	Germany	0.951	80.7	12.9	18.3	45,648	0.951	0
7	New Zealand	0.950	81.1	12.5	18.4	35,505	0.950	0
8	Canada	0.952	81.5	12.5	15.9	41,697	0.951	0
9	Singapore	0.931	82.3	10.2	15.4	72,381	0.930	3
10	Denmark	0.900	79.4	12.1	18.9	44,696	0.900	0
69	Turkey	0.708	70.3	7.0	14.4	14,281	0.708	9
79	Kazakhstan	0.757	68.5	10.4	15.0	18,441	0.755	0
71	Mexico	0.700	77.0	6.0	2.0	14,604	0.700	-1
71	Romania	0.768	70.0	6.4	11.6	24,810	0.764	-1



Human Development Index Report, 2009 (10)
Overcoming barriers: Human mobility and development. UNDP
<http://hdr.undp.org/en/data-explorer>

Anderson, J. B. and J. Gerber. 2007. "Data Appendix to Fifty Years of Change on the U.S.-Mexico Border: Growth, Development, and Quality of Life." <http://latinamericanstudies.sdsu.edu/BorderData.html>

Conclusions - Smart Livability

- Smart Livability is a function of urban governance
- Smart City technology can support Smart Livability
- “A city does not have to be rich to be livable – it becomes rich by investing in livability” (answer to a question at the Asian Green Cities Index in Singapore)





