Towards a Resource-Index of Nations

Arnold Tukker, based on a project done with Lauran van Oers, Jeroen Guinée and Ester van der Voet

Leiden University, CML

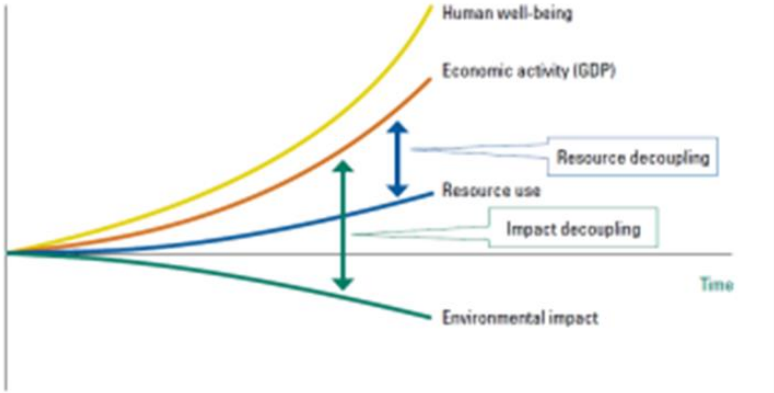
WRF, Wednesday 14 October, 12:00

Universiteit Leiden
The Netherlands

CML
Institute of Environmental Sciences

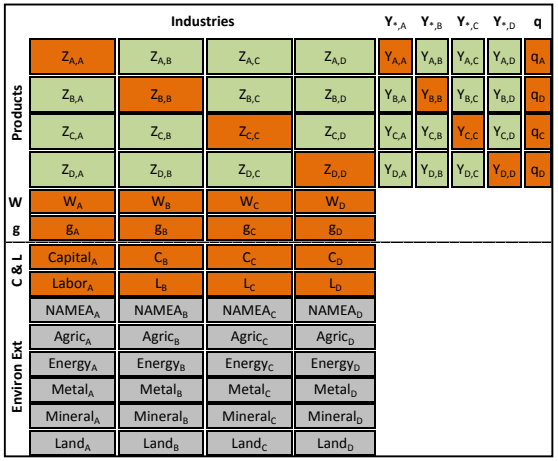
What to measure: Quality of life, GDP and (impacts of) resources

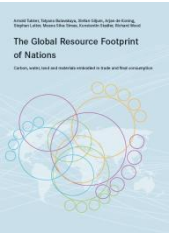
- Three pillars for sustainable development
  - Economic: Gross domestic product (GDP)
  - Social: Human development index (HDI)
  - Environmental: ?????????? (carbon, water, land, material, ecological, phosphorus, nitrogen and other footprints, etc. etc. etc. etc. etc
- Can’t we define a single indicator for resource use?



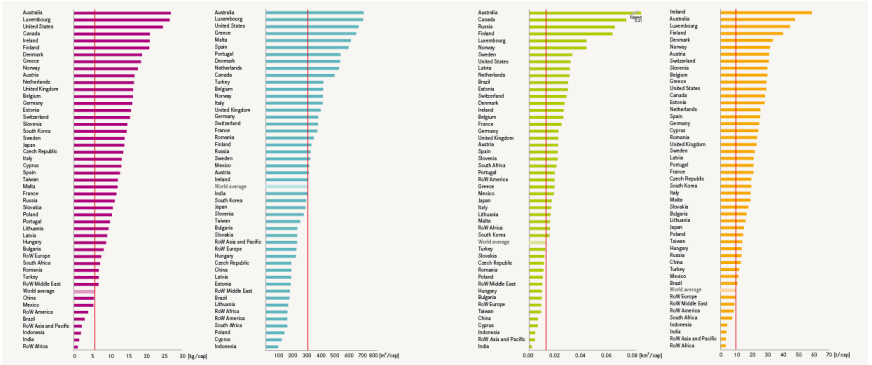
Measuring individual footprints

- Global EE IO has advantages
  - Just re-allocate production impacts to consumption
  - Production total = consumption total at global level
  - Consistent approach for all footprints



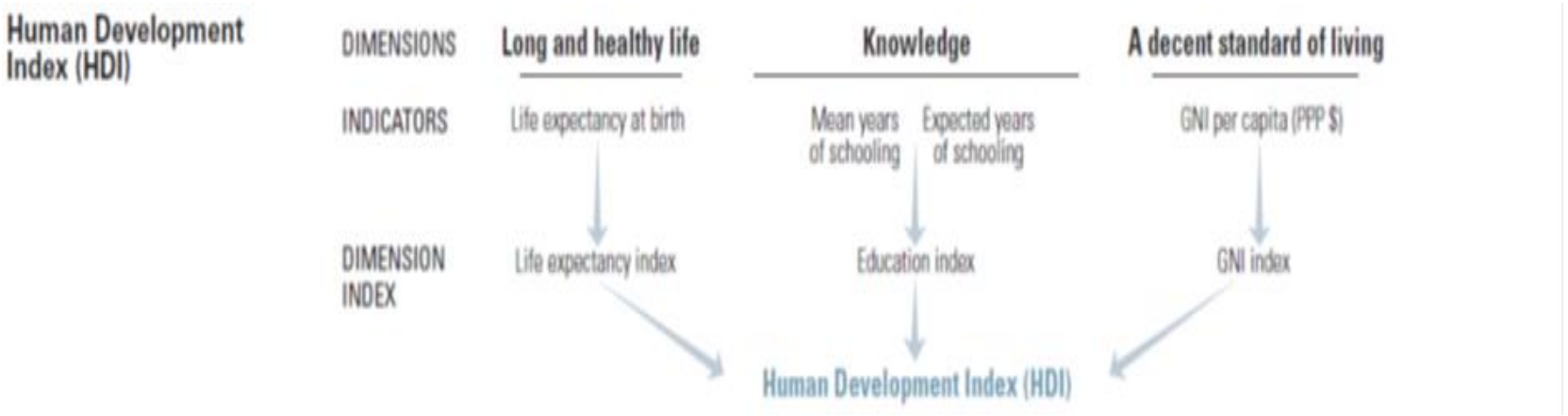


- Allows calculating resource footprints per capita per country
  - Carbon
  - Water
  - Land
  - Materials



- Question: can't we aggregate this to ONE resource footprint as counterpart to GDP and HDI?

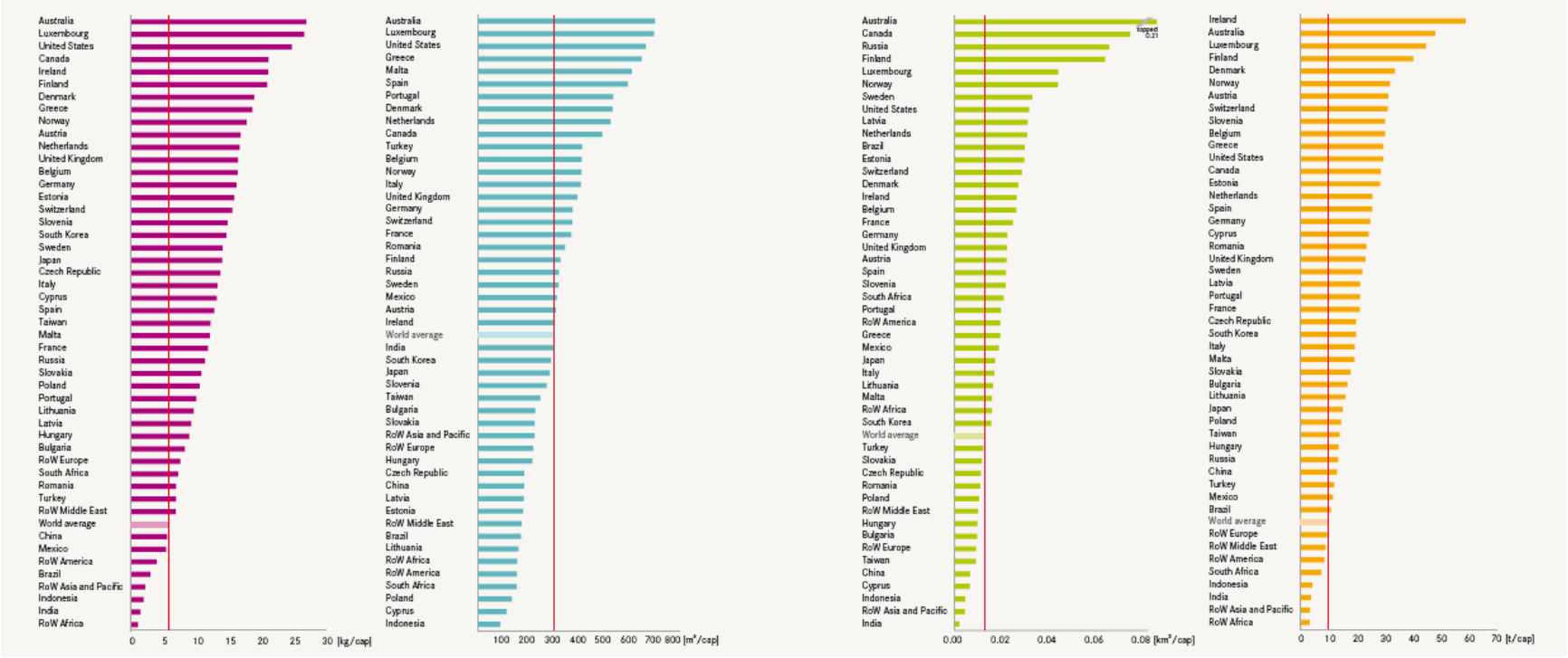
Subjective? Yes. Impossible? No. See HDI



- Developed by Noble Laureate Amartya Sen for UNDP
  - Life expectancy at birth – normalized from 0-1 for 20-85 years
  - Knowledge - normalized from 0-1 for 0 to 18 years of schooling
  - Living standard: normalised from 0-1 for 100$ to 75.000 $ /year
- Multiply the 3 normalised indices…..take the cube root
- PRESTO – we have the HDI, that everybody now happily uses
- What happened in essence: inevitable subjectivity was mitigated by social construction & agreement

Starting point: carbon, water, land, materials

- We used EXIOBASE, since we had footprint results readily available
  - Advantage: consistent and high level of country/product detail, use of Aquastat for water, FAO for land, the IRP resource extraction database for materials
  - But choices for other EE IO databases or footprint methods are possible, too



Starting point: carbon, water, land, materials

- Carbon: in CO2-equivalent/year
  - High consensus on calculation method
  - Low consensus if to be included in a Resource index, since an impact
- Water: blue water (ground, rivers) in km3/year
  - Reasonable consensus that blue, not green/grey water matters most
  - Controversial: adding up m3 without addressing water scarcity at point of extraction.
- Land: occupation in km2/year
  - Simple and often used
  - Controversial: neglects land quality, and issues of land use change
- Materials: total material extraction in ton
  - Simple and often used
  - Controversial: neglects huge difference in scarcity and impacts by material type

Weighting footprints: some options

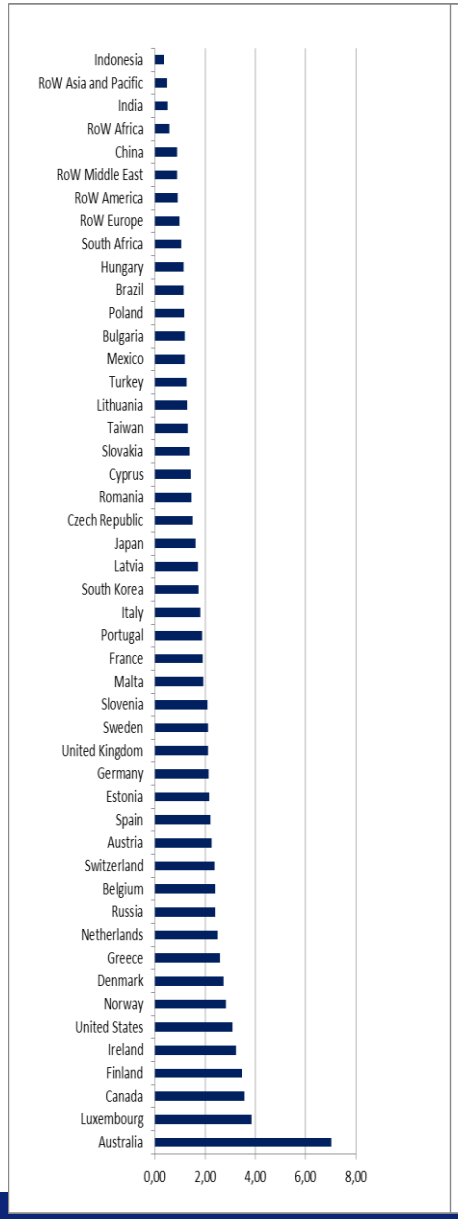
- CML (van Oers, Huppes) did a lot of work on weighting, a.o. for DG JRC IES. We took off the shelf the following approaches
- Step 1: Normalisation; express country footprint as fraction of to global totals
- Step 2: using different weighting sets
  - **All equal**: weight = 1
  - **Panels:** Using existing panel weighting sets and averaging them (US EPA, BEES, NOGEPA)
  - **Shadow prices:** from a handbook written by CE for Dutch government (25 Euro/ton CO2, 0 Euro/ton materials, 1 Euro/m3 water, 940 Euro/ha land)
  - '**Distance to Target**' based on planetary limits pp.
    - 2 ton CO2-eq (UNEP Emission gap report)
    - 500 m3 blue water (McKinsey, Hoekstra/Wiedmann)
    - 5 ton materials (Dittrich, Bringezu, IntRESS),
    - 0,01 km2 land (own calculation based on population growth and no additional land cultivation)

Resulting weighting factors

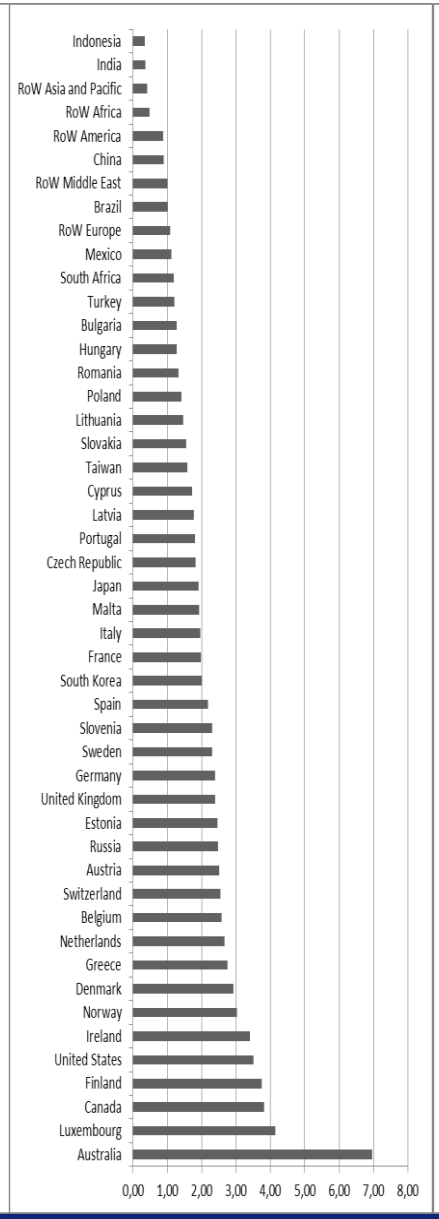
	Carbon	Materials	Water	Land
Equal weight	25%	25%	25%	25%
Weighted panels	51%	16%	11%	22%
DtT	43%	30%	7%	20%
Shadow prices (after normalisation)	9%	0%	15%	76%

Results: rankings

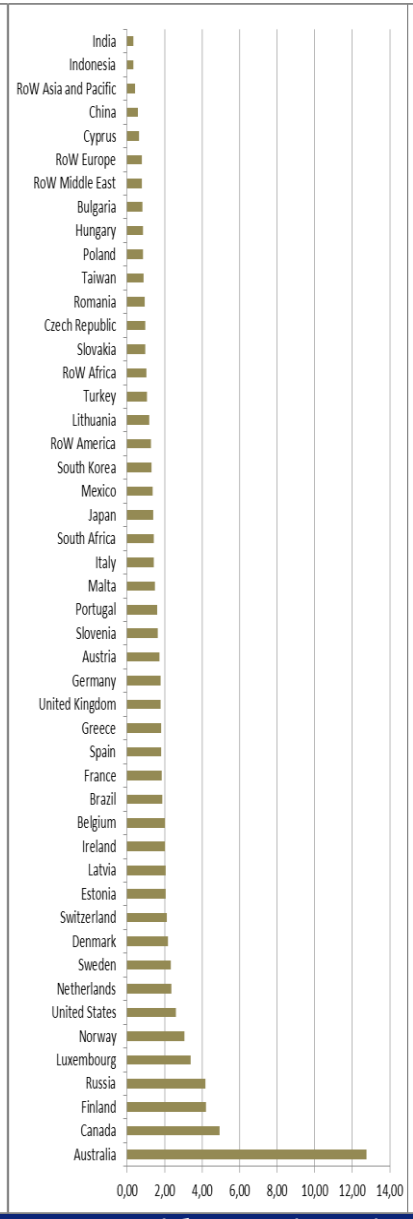
Equal



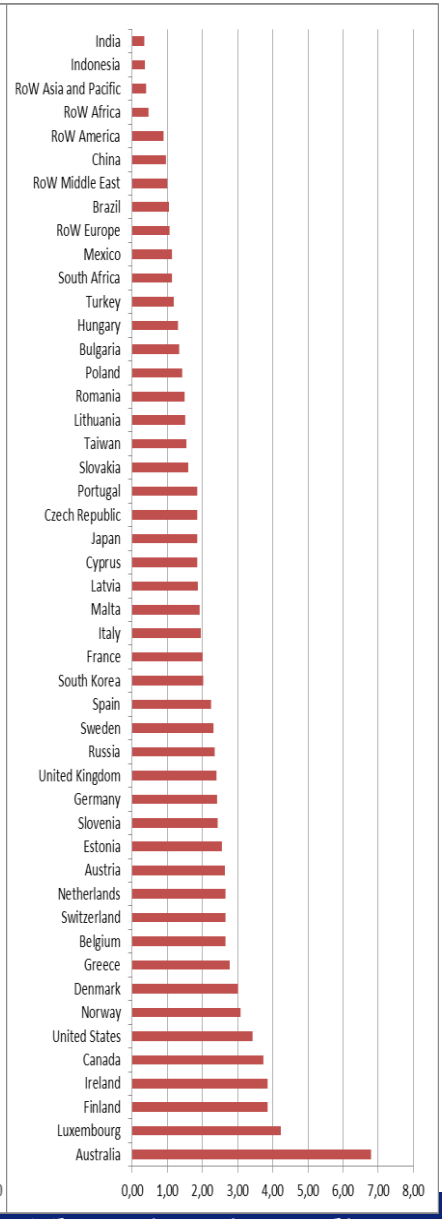
Panels



Shadow costs



DtT



Results: the top - 10

Rank	Country	Equal weight	Country	Weighted panels	Country	Shadow prices	Country	DtT
1	Australia	7,01	Australia	6,96	Australia	12,75	Australia	6,80
2	Luxembourg	3,83	Luxembourg	4,15	Canada	4,93	Luxembourg	4,23
3	Canada	3,56	Canada	3,82	Finland	4,21	Finland	3,85
4	Finland	3,48	Finland	3,74	Russia	4,16	Ireland	3,85
5	Ireland	3,22	United States	3,51	Luxembourg	3,38	Canada	3,72
6	United States	3,10	Ireland	3,40	Norway	3,06	United States	3,43
7	Norway	2,83	Norway	3,02	United States	2,61	Norway	3,09
8	Denmark	2,73	Denmark	2,93	Netherlands	2,36	Denmark	3,01
9	Greece	2,58	Greece	2,75	Sweden	2,32	Greece	2,78
10	Netherlands	2,49	Netherlands	2,66	Denmark	2,18	Belgium	2,66

Per capita score compared to per capita global average =1

Some reflections

- Ireland is high due to resource use (building boom), so not in Shadow prices
- Australia, Canada, Finland, Norway are high due to land use
- Russia is high in shadow prices, which is mainly land use

Results: the bottom - 5

Rank	Country	Equal weight	Country	Weighted panels	Country	Shadow prices	Country	DtT
5	China	0,88	RoW America	0,88	Cyprus	0,65	RoW America	0,89
4	RoW Africa	0,58	RoW Africa	0,48	China	0,58	RoW Africa	0,46
3	India	0,50	RoW Asia and Pa	0,42	RoW Asia and	0,43	RoW Asia and	0,40
2	RoW Asia and Pa	0,49	India	0,36	Indonesia	0,35	Indonesia	0,36
1	Indonesia	0,36	Indonesia	0,35	India	0,33	India	0,34

Reflections

- This was a very low-cost exercise: funding for weeks, not months
- There are clear points for discussion in indicator calculation and weighting
- It is striking however that even this simple exercise gives already quite robust rankings across methods
- Remember that the well accepted HDI is not based on a much more profound basis
- It seems hence feasible to develop an accepted ‘Resource index of nations’ with reasonable effort, if supported by a good stakeholder process.