

Constructieve Flexibiliteit

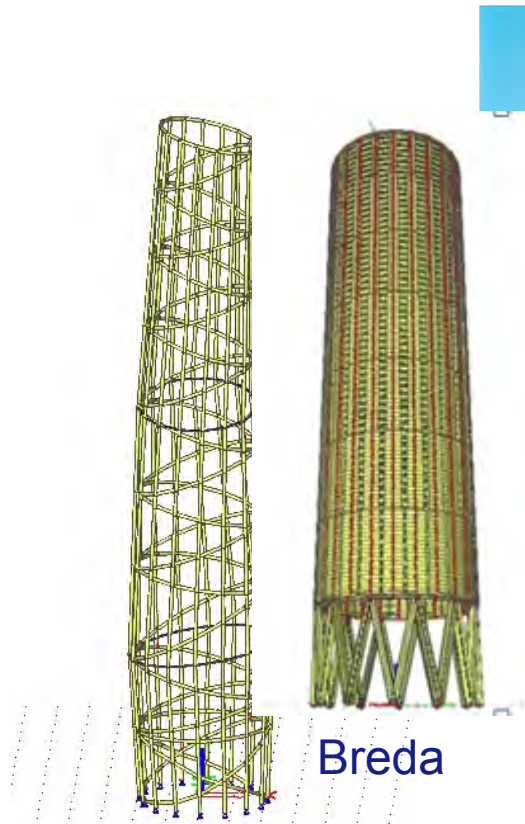
Rijk Blok

TU / **e** Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

Rijk Blok

- Constructief Ontwerper
- Part Time Universitair Docent Constructief Ontwerpen
Department for the Built Environment
TU/e Eindhoven University of Technology



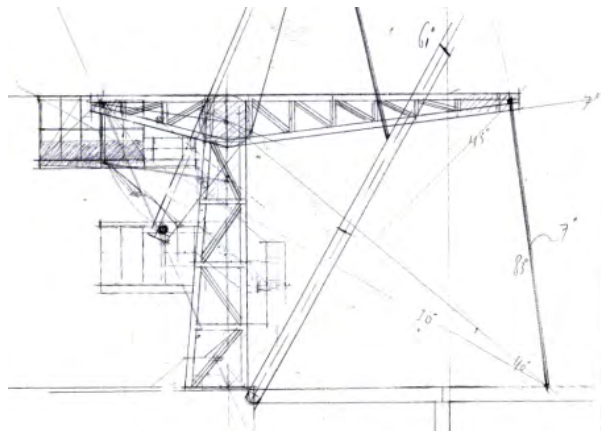
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Tilburg 2013
John Körmeling
Witteveen+Bos



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Department for the Built Environment
TU/e Eindhoven University of Technology

Onderwijs: Courses in Structural design, High Rise Structures

Onderzoek: Relation Flexibility and Service Life of Structures



Cost C25 Chair Working group 1 Sustainable Constructions



Member ECCS TC 14 Sustainable Steel Structures



Member BmST
TC1 Sustainable Steel Structures

Constructieve Flexibiliteit

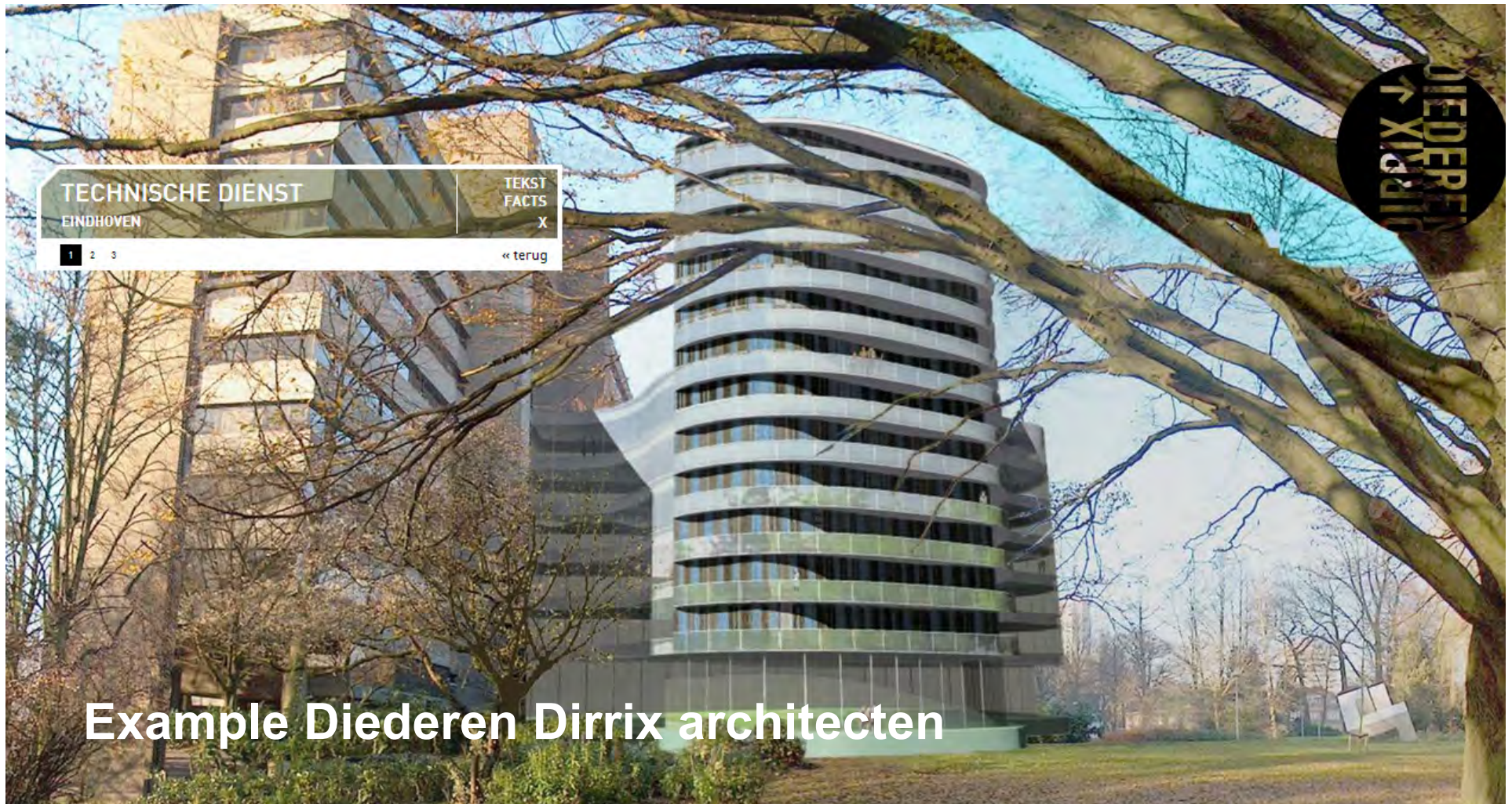
- **Relatie Flexibiliteit en Duurzaamheid**
- **Meten van Constructieve Flexibiliteit?**
- **Flexibiliteit en Levensduur?**
- **Conclusies**

Eindhoven 2014 TD gebouw



Gebouw gereed 1973 Ongebruikt sinds 2007: “Functional Service Life”: 34 jaar

Eindhoven 2014 TD gebouw



Example Diederix architecten

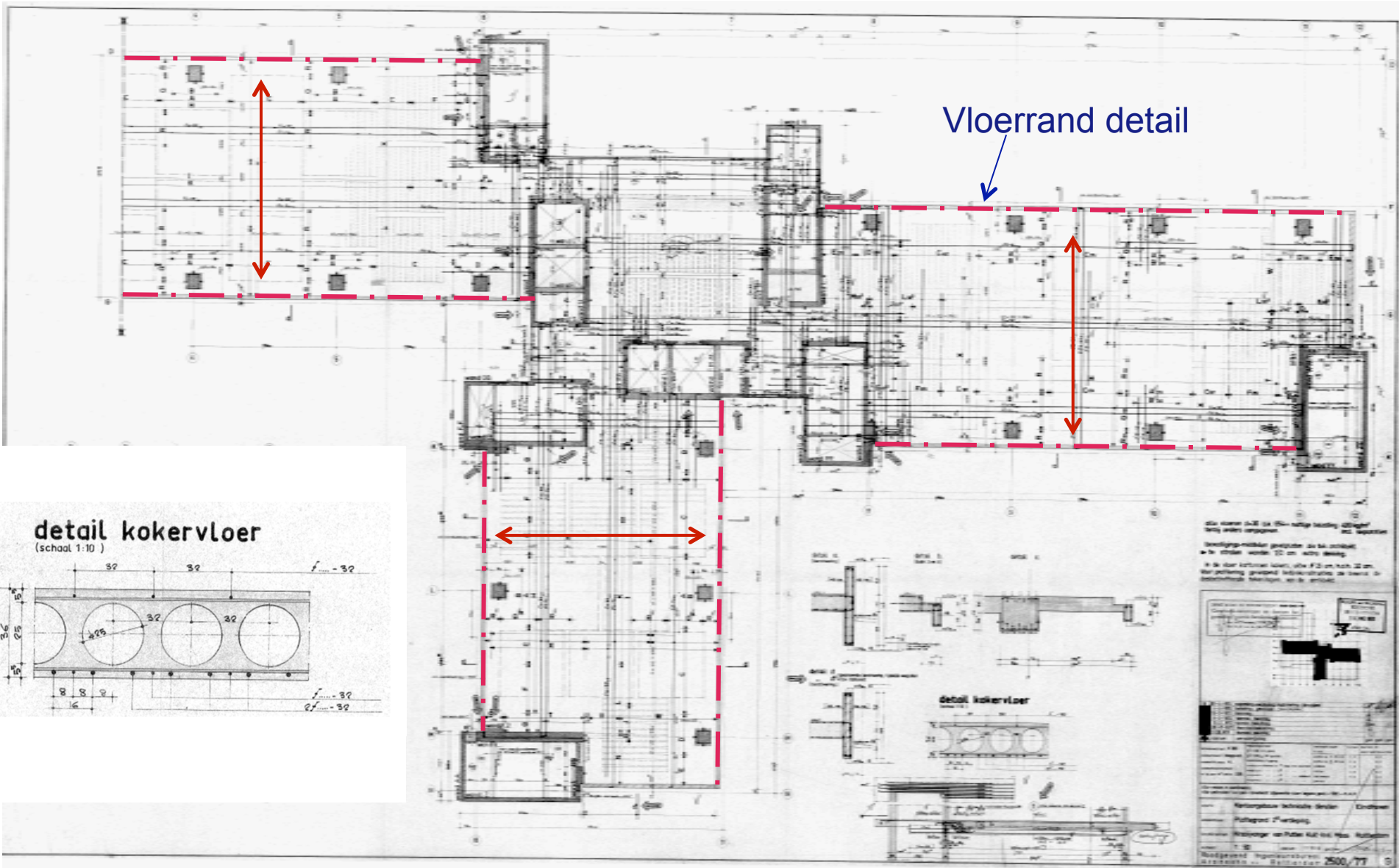
<http://www.diederendirix.nl/nl/projecten/technische-dienst/>

Eindhoven 2014 TD gebouw

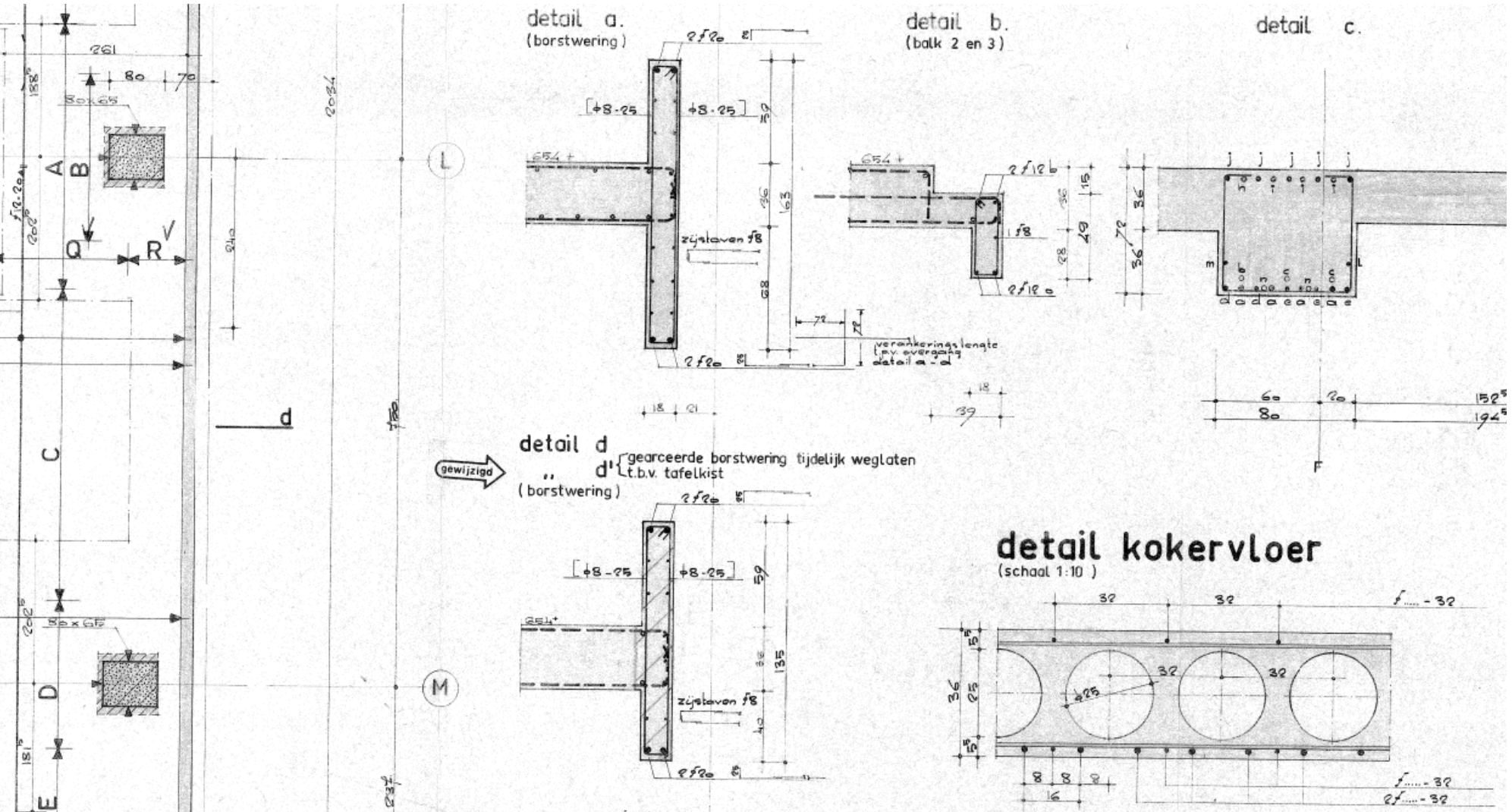


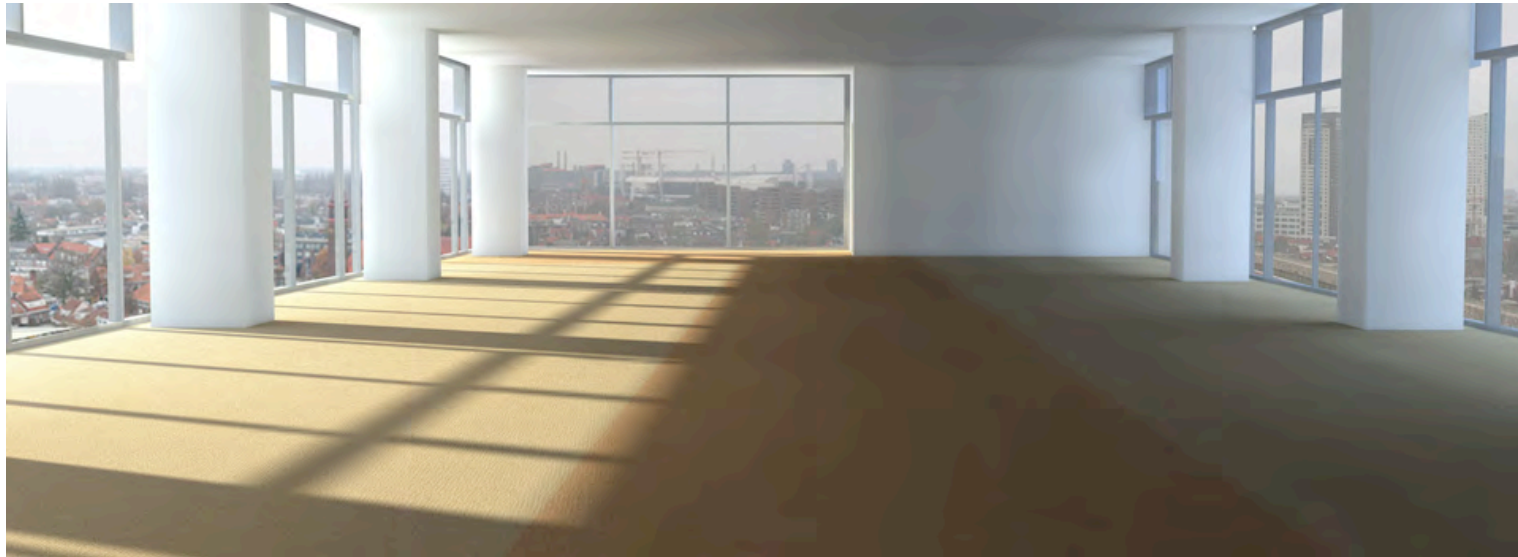
Example Boonstra-van
kruysbergen architecten

Eindhoven 2014 TD gebouw



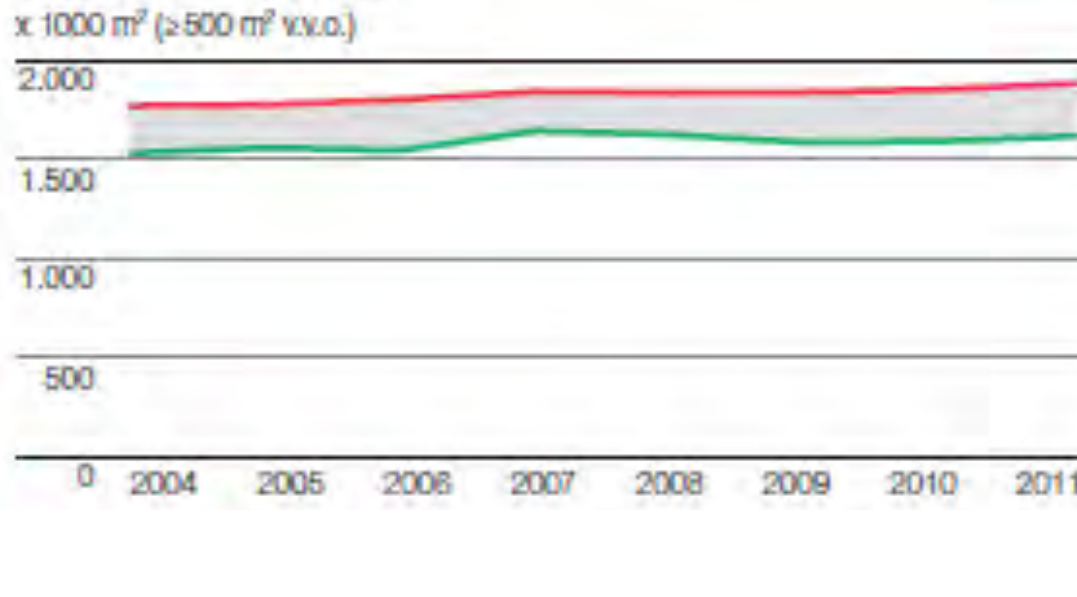
Structure details





Functionele levensduur \neq Technische levensduur

Office Space Eindhoven



Bron: Bak, DTZ Zadelhoff

- Total Available Area Office Space
- Area Office Space In Use
- Area not in Use (14 % in 2011)



vastgoedadviseur DTZ Zadelhoff. In Eindhoven nam het leegstandspercentage toe van 13 naar 16,2 procent. Het landelijk gemiddelde steeg van 14,6 tot 15,8 procent.

Adaptief Vermogen

(www.adaptiefvermogen.nl)



Bepalingsmethode adaptief vermogen van gebouwen ter bevordering van flexibel bouwen

Programma van eisen

- **Stuurgroep:**

- VNO-NCW, MKB-Nederland
- Brancheorganisaties
- Rijksoverheid: BZK, I&M en EZ

Definitie adaptief vermogen:
Het adaptief vermogen van een gebouw is de mate waarin een gebouw in staat is te reageren op veranderend gebruik

Vraag versus aanbod benadering

Geen absolute meetmethode

Beschouwing op basis van bestaande meetlatten

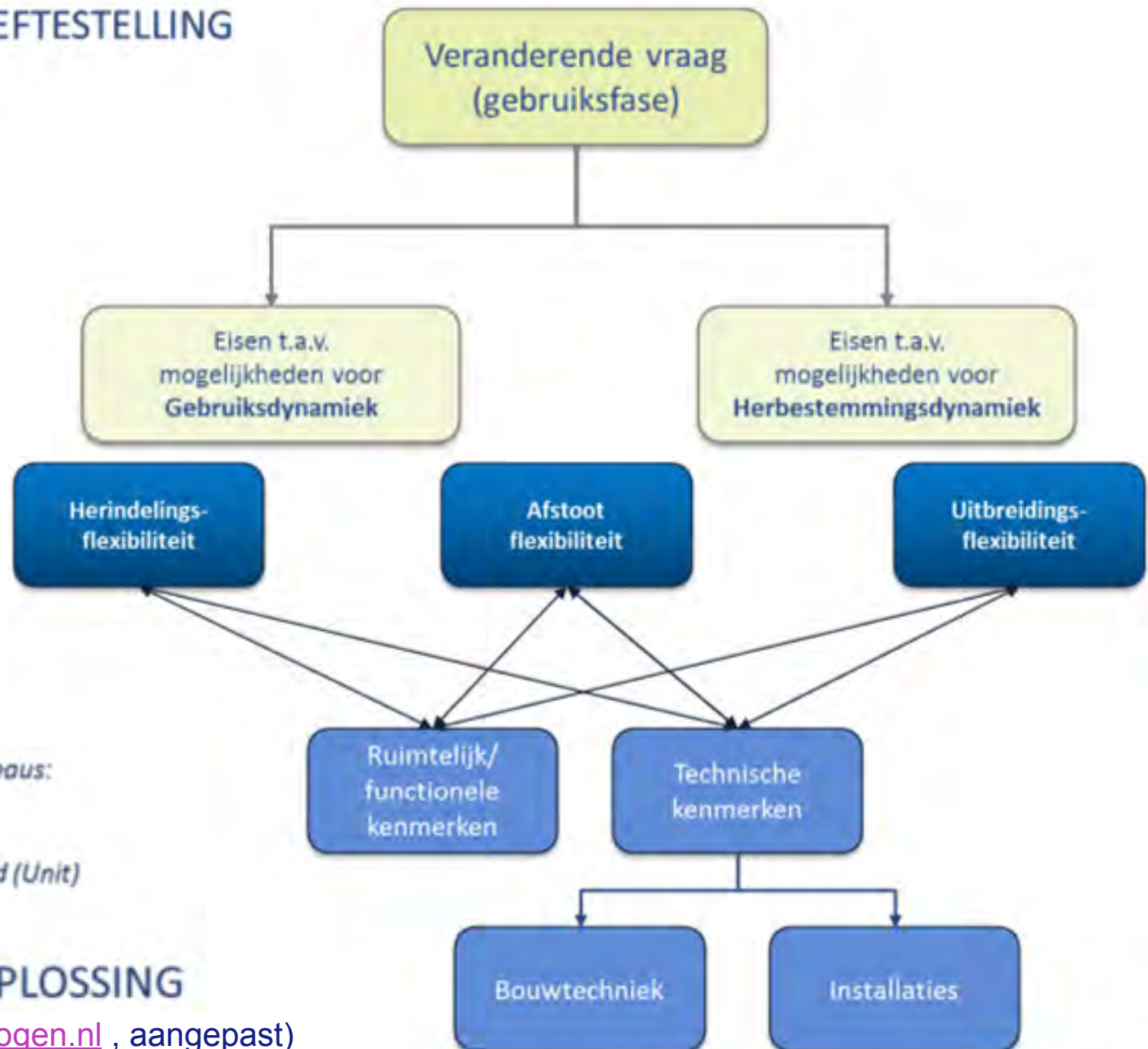
Past het ontwerp, het aanbod bij de vraag naar adaptief vermogen..

Optimalisatie voor huisvesting organisaties....

VRAAG / BEHOEFTESTELLING

Behoeftestelling vanuit:

- Maatschappij
- Eigenaar
- Gebruiker



Beoordeling op 3 niveaus:

- Locatie
- Gebouw
- Gebruikseenheid (Unit)

AANBOD / OPLOSSING

(www.adaptievermogen.nl , aangepast)

Van Eindhoven naar de Wereld..

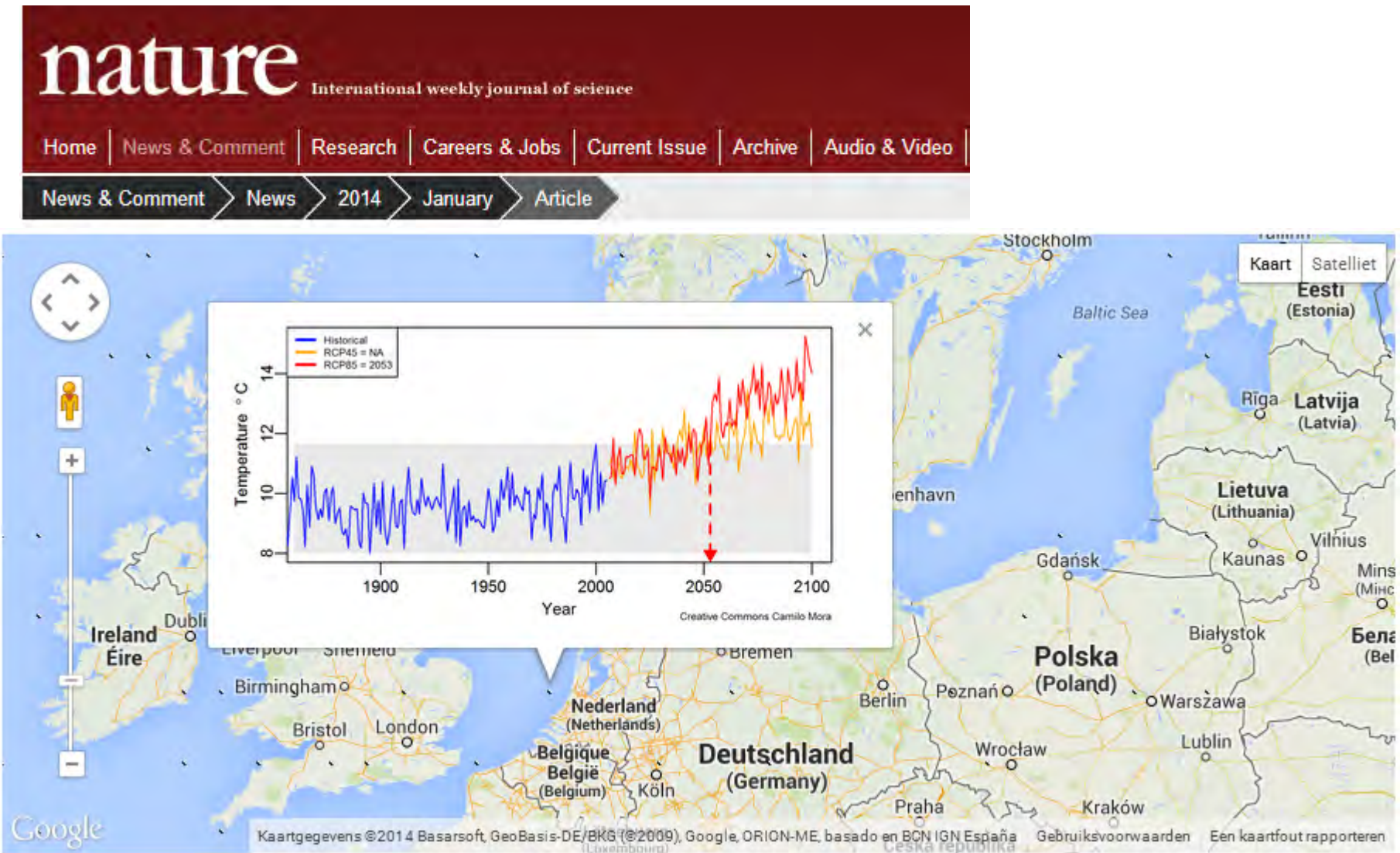


Energie
Materialen
Levensduur

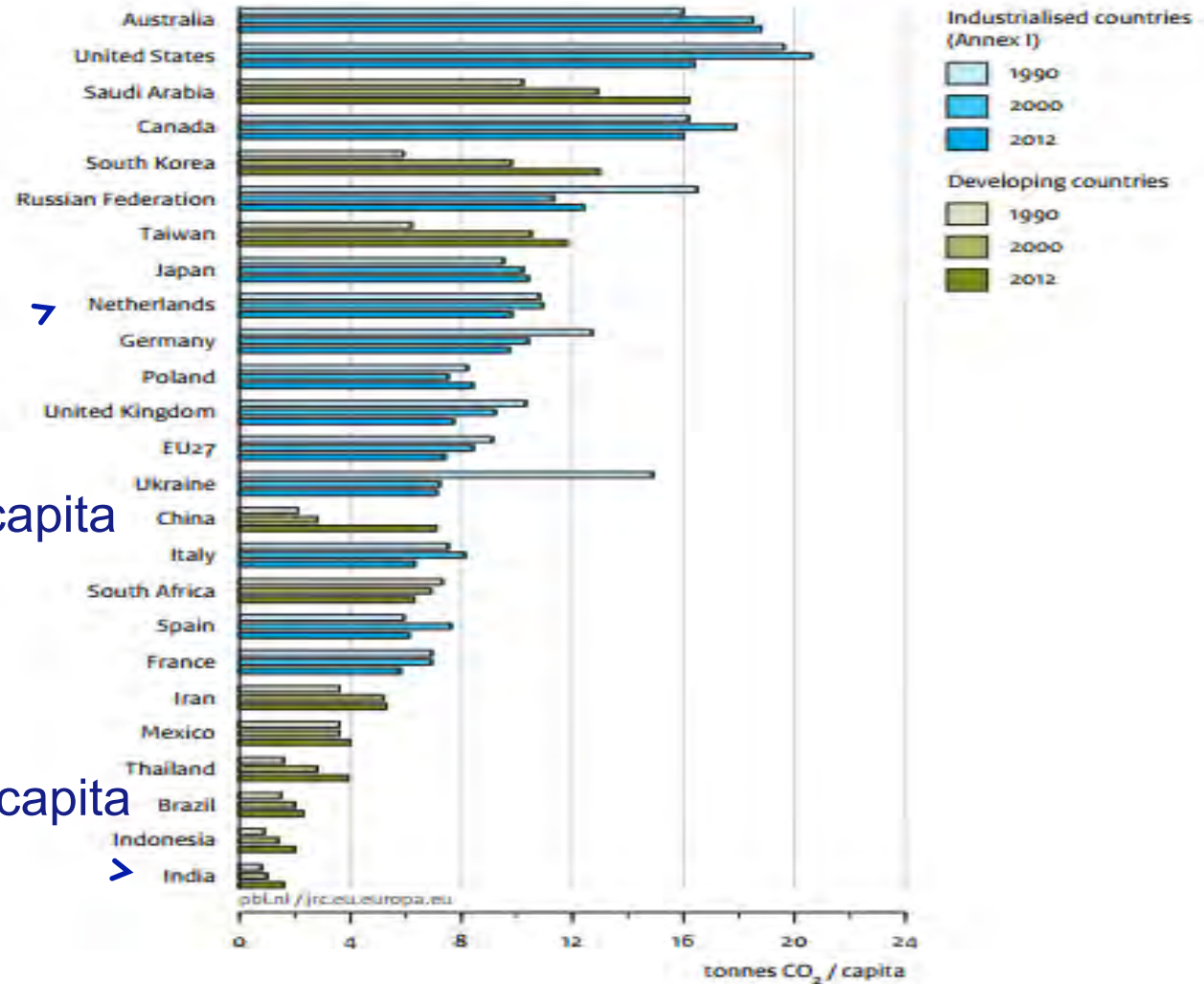


Foto Bart Kamerling [www. Ed.nl](http://www.Ed.nl)

Wanneer zijn onze gemiddelde temperaturen hoger dan de historische extremen?



Co2 emmissions/ capita, Fossil Fuel use



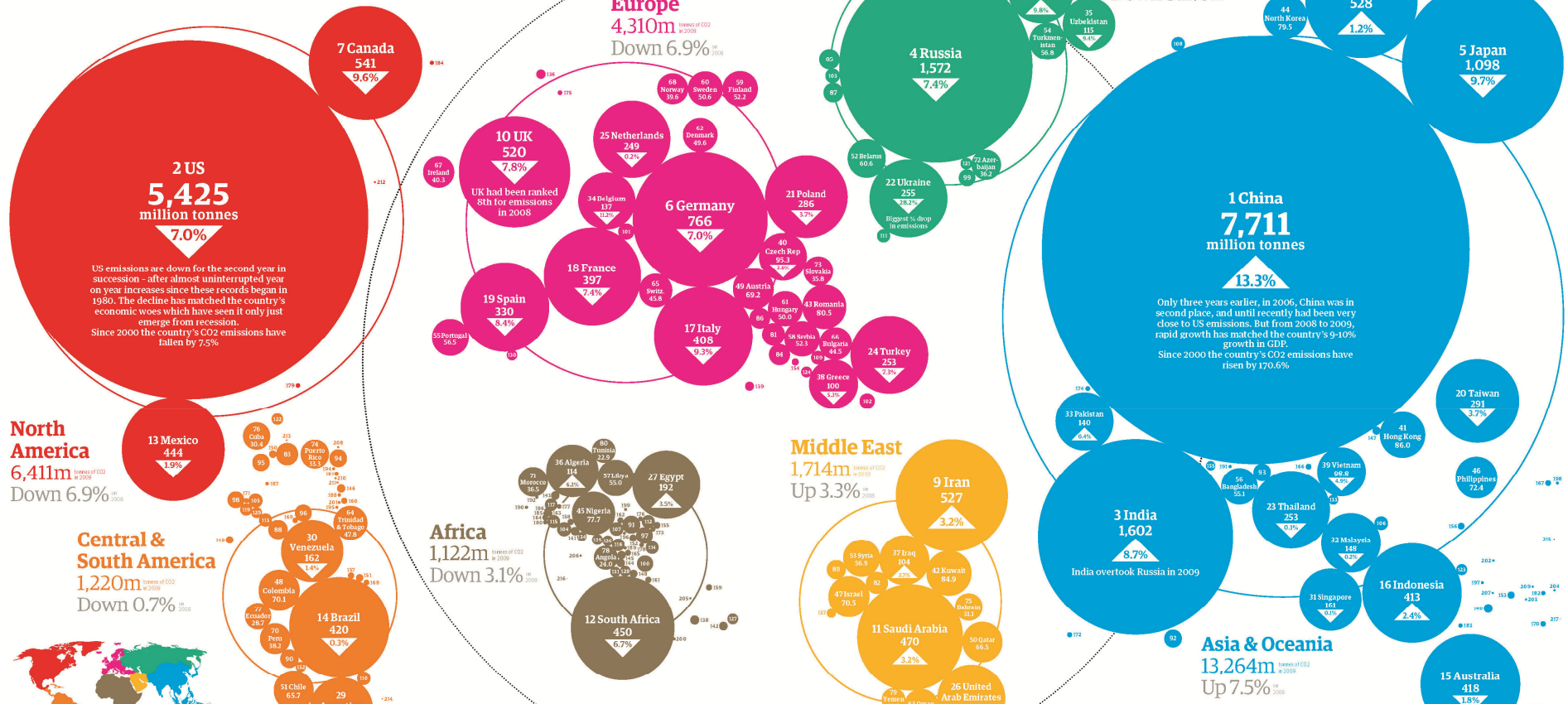
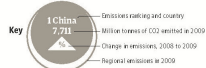
Nederland:
Ca. 10 Ton CO₂ / capita

India:
Ca. 1,5 Ton CO₂ / capita

Source: EDGAR 4.2FT2010 (1990–2010); UNDP, 2013 (WPP Rev. 2012); BP, 2013; NBS China, 2013; USGS, 2013; WSA, 2013; NOAA, 2012

An atlas of pollution: the world in carbon dioxide emissions

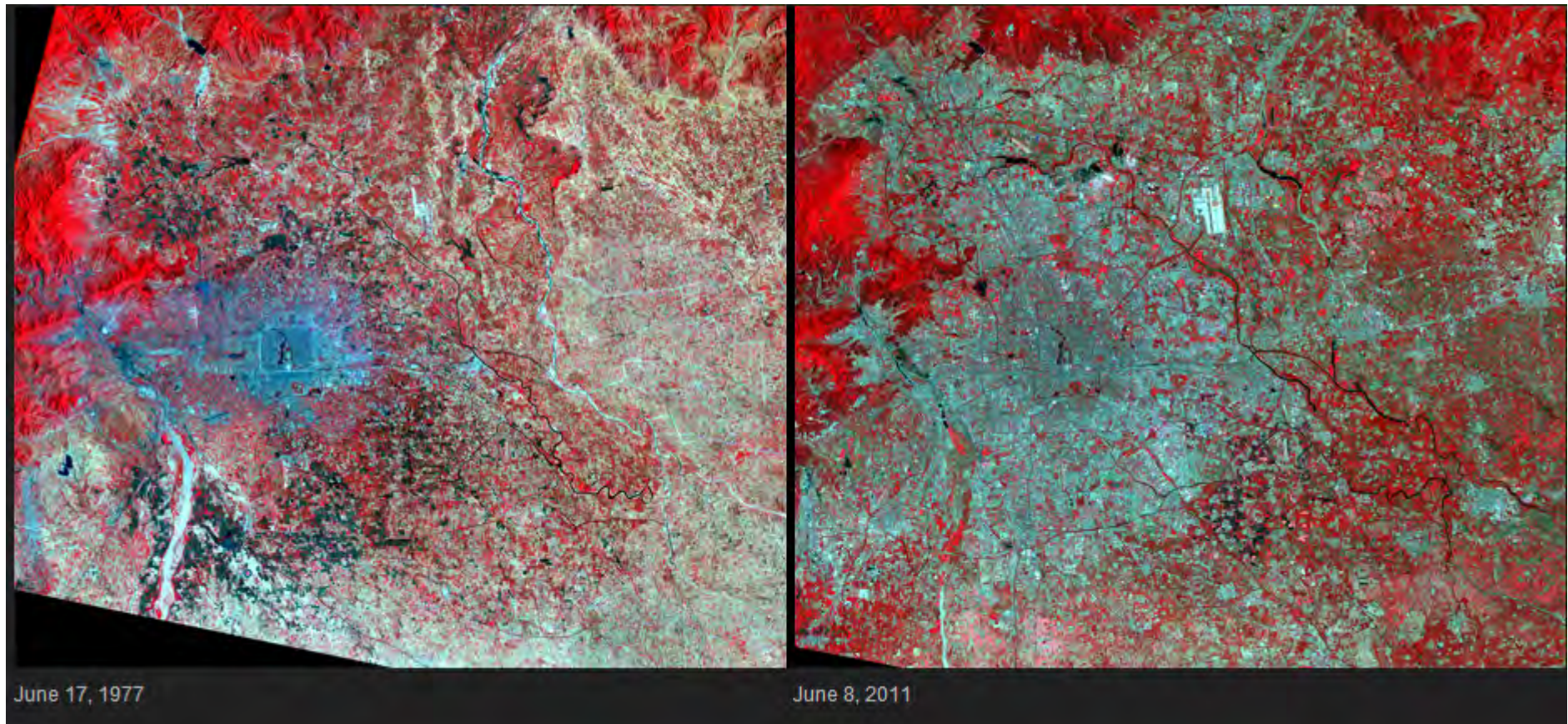
Latest data published by the US Energy Information Administration provides a unique picture of economic growth - and decline. China has sped ahead of the US, as shown by this map, which resizes each country according to CO2 emissions. And, for the first time, world emissions have gone down



Detailed data
 Full list of each country's CO2 emissions and movement in the world emissions league table

Rank	Country	Million tonnes	Percent change on 2008	Rank	Country	Million tonnes	Percent change on 2008	Rank	Country	Million tonnes	Percent change on 2008	Rank	Country	Million tonnes	Percent change on 2008	Rank	Country	Million tonnes	Percent change on 2008
1	China	7,711	13.3%	11	Moldova	71	-4.1%	111	Dominica	0.1	0.0%	201	San Marino	0.1	0.0%	211	Chad	0.2	0.0%
2	US	5,425	-7.0%	12	Ethiopia	6.9	7.1%	112	Benin	3.5	4.3%	116	Gum	1.7	0.0%	212	Lesotho	0.2	5.9%
3	India	1,602	8.7%	13	Cuba	6.8	-4.3%	113	Niger	3.4	-3.8%	117	Guinea	1.5	0.0%	213	Swaziland	0.2	17.6%
4	Russia	1,572	-7.4%	14	Guatemala	6.7	7.1%	114	Togo	2.8	-5.6%	118	Sierra Leone	1.4	2.1%	214	South Africa	0.2	0.0%
5	Japan	1,098	-9.7%	15	Costa Rica	6.6	-2.2%	115	Yemen	2.7	5.3%	119	Palau	1.4	6.1%	215	Togo	0.1	-23.1%
6	Germany	766	-7.0%	16	Congo	6.3	3.5%	116	Madagascar	2.1	13.4%	120	Barbados	1.4	4.8%	216	Cook Islands	0.1	66.2%
7	Canada	541	-9.6%	17	Sri Lanka	6.2	1.8%	117	Switzerland	2.1	13.4%	121	East Timor	0.6	8.7%	217	Guam	0.1	-25.0%
8	South Korea	528	-1.2%	18	Algeria	6.1	-3.0%	118	Spain	3.0	0.0%	122	Nicaragua	1.3	3.5%	218	Vanuatu	0.1	0.0%
9	Iran	527	3.2%	19	Morocco	5.8	-2.3%	119	Belgium	2.8	0.0%	123	Guatemala	1.3	5.9%	219	Guinea-Bissau	0.1	0.0%
10	UK	520	7.8%	20	Chad	5.7	-0.4%	120	France	2.8	0.0%	124	Sierra Leone	1.4	1.4%	220	British Virgin Islands	0.1	35.0%
11	Saudi Arabia	470	3.2%	21	Ukraine	2.9	1.7%	121	Russia	2.7	5.3%	125	Maldives	0.2	11.8%	221	Turks and Caicos Islands	0.1	0.0%
12	South Africa	450	6.7%	22	Belarus	2.8	1.8%	122	Belarus	2.7	5.3%	126	Laos	0.4	0.0%	222	Falkland Islands	0.0	0.0%
13	Mexico	444	1.9%	23	Thailand	2.7	-2.6%	123	Switzerland	2.1	13.4%	127	Wales	1.2	-4.3%	223	Comoros	0.1	-25.0%
14	Brazil	420	0.3%	24	Turkey	2.6	0.3%	124	Iran	2.6	0.3%	128	Niger	3.4	-3.8%	224	Samoa	0.1	0.0%
15	Australia	418	1.8%	25	Netherlands	2.4	-0.2%	125	Guinea	1.5	0.0%	129	Guinea	1.5	0.0%	225	Timor-Leste	0.1	0.0%
16	Indonesia	413	2.4%	26	United Arab Emirates	1.9	-1.5%	126	Maldives	0.2	11.8%	130	Sierra Leone	1.4	1.4%	226	Maldives	0.1	0.0%
17	Italy	408	9.3%	27	Egypt	1.9	-1.5%	127	Maldives	0.2	11.8%	131	Sierra Leone	1.4	1.4%	227	Maldives	0.1	0.0%
18	France	397	7.4%	28	Nigeria	1.8	-1.5%	128	Maldives	0.2	11.8%	132	Sierra Leone	1.4	1.4%	228	Maldives	0.1	0.0%
19	Spain	330	8.4%	29	Argentina	1.7	-3.2%	129	Maldives	0.2	11.8%	133	Sierra Leone	1.4	1.4%	229	Maldives	0.1	0.0%
20	Taiwan	291	3.7%	30	Venezuela	1.6	-2.4%	130	Maldives	0.2	11.8%	134	Sierra Leone	1.4	1.4%	230	Maldives	0.1	0.0%
21	Poland	285	8.7%	31	Colombia	1.6	-2.4%	131	Maldives	0.2	11.8%	135	Sierra Leone	1.4	1.4%	231	Maldives	0.1	0.0%
22	Ukraine	255	-7.2%	32	Peru	1.5	-3.2%	132	Maldives	0.2	11.8%	136	Sierra Leone	1.4	1.4%	232	Maldives	0.1	0.0%
				33	Chile	1.5	-3.2%	133	Maldives	0.2	11.8%	137	Sierra Leone	1.4	1.4%	233	Maldives	0.1	0.0%
				34	Belgium	1.4	0.0%	134	Maldives	0.2	11.8%	138	Sierra Leone	1.4	1.4%	234	Maldives	0.1	0.0%
				35	Uzbekistan	1.4	0.0%	135	Maldives	0.2	11.8%	139	Sierra Leone	1.4	1.4%	235	Maldives	0.1	0.0%
				36	Algeria	1.4	0.0%	136	Maldives	0.2	11.8%	140	Sierra Leone	1.4	1.4%	236	Maldives	0.1	0.0%
				37	Israel	1.4	0.0%	137	Maldives	0.2	11.8%	141	Sierra Leone	1.4	1.4%	237	Maldives	0.1	0.0%
				38	Greece	1.4	0.0%	138	Maldives	0.2	11.8%	142	Sierra Leone	1.4	1.4%	238	Maldives	0.1	0.0%
				39	Vietnam	1.4	0.0%	139	Maldives	0.2	11.8%	143	Sierra Leone	1.4	1.4%	239	Maldives	0.1	0.0%
				40	Czech Rep	1.4	0.0%	140	Maldives	0.2	11.8%	144	Sierra Leone	1.4	1.4%	240	Maldives	0.1	0.0%
				41	Hong Kong	1.4	0.0%	141	Maldives	0.2	11.8%	145	Sierra Leone	1.4	1.4%	241	Maldives	0.1	0.0%
				42	Kuwait	1.4	0.0%	142	Maldives	0.2	11.8%	146	Sierra Leone	1.4	1.4%	242	Maldives	0.1	0.0%
				43	Romania	1.4	0.0%	143	Maldives	0.2	11.8%	147	Sierra Leone	1.4	1.4%	243	Maldives	0.1	0.0%
				44	North Korea	1.4	0.0%	144	Maldives	0.2	11.8%	148	Sierra Leone	1.4	1.4%	244	Maldives	0.1	0.0%
				45	Nigeria	1.4	0.0%	145	Maldives	0.2	11.8%	149	Sierra Leone	1.4	1.4%	245	Maldives	0.1	0.0%
				46	Philippines	1.4	0.0%	146	Maldives	0.2	11.8%	150	Sierra Leone	1.4	1.4%	246	Maldives	0.1	0.0%
				47	Ireland	1.4	0.0%	147	Maldives	0.2	11.8%	151	Sierra Leone	1.4	1.4%	247	Maldives	0.1	0.0%
				48	Norway	1.4	0.0%	148	Maldives	0.2	11.8%	152	Sierra Leone	1.4	1.4%	248	Maldives	0.1	0.0%
				49	New Zealand	1.4	0.0%	149	Maldives	0.2	11.8%	153	Sierra Leone	1.4	1.4%	249	Maldives	0.1	0.0%
				50	Sweden	1.4	0.0%	150	Maldives	0.2	11.8%	154	Sierra Leone	1.4	1.4%	250	Maldives	0.1	0.0%
				51	Finland	1.4	0.0%	151	Maldives	0.2	11.8%	155	Sierra Leone	1.4	1.4%	251	Maldives	0.1	0.0%
				52	Belarus	1.4	0.0%	152	Maldives	0.2	11.8%	156	Sierra Leone	1.4	1.4%	252	Maldives	0.1	0.0%
				53	Portugal	1.4	0.0%	153	Maldives	0.2	11.8%	157	Sierra Leone	1.4	1.4%	253	Maldives	0.1	0.0%
				54	Trinidad & Tobago	1.4	0.0%	154	Maldives	0.2	11.8%	158	Sierra Leone	1.4	1.4%	254	Maldives	0.1	0.0%
				55	Syria	1.4	0.0%	155	Maldives	0.2	11.8%	159	Sierra Leone	1.4	1.4%	255	Maldives	0.1	0.0%
				56	Bulgaria	1.4	0.0%	156	Maldives	0.2	11.8%	160	Sierra Leone	1.4	1.4%	256	Maldives	0.1	0.0%
				57	Uzbekistan	1.4	0.0%	157	Maldives	0.2	11.8%	161	Sierra Leone	1.4	1.4%	257	Maldives	0.1	0.0%
				58	Norway	1.4	0.0%	158	Maldives	0.2	11.8%	162	Sierra Leone	1.4	1.4%	258	Maldives	0.1	0.0%
				59	Sweden	1.4	0.0%	159											

Groei wereldbevolking en Urbanisatie



Beijing China 1977 >> 2011

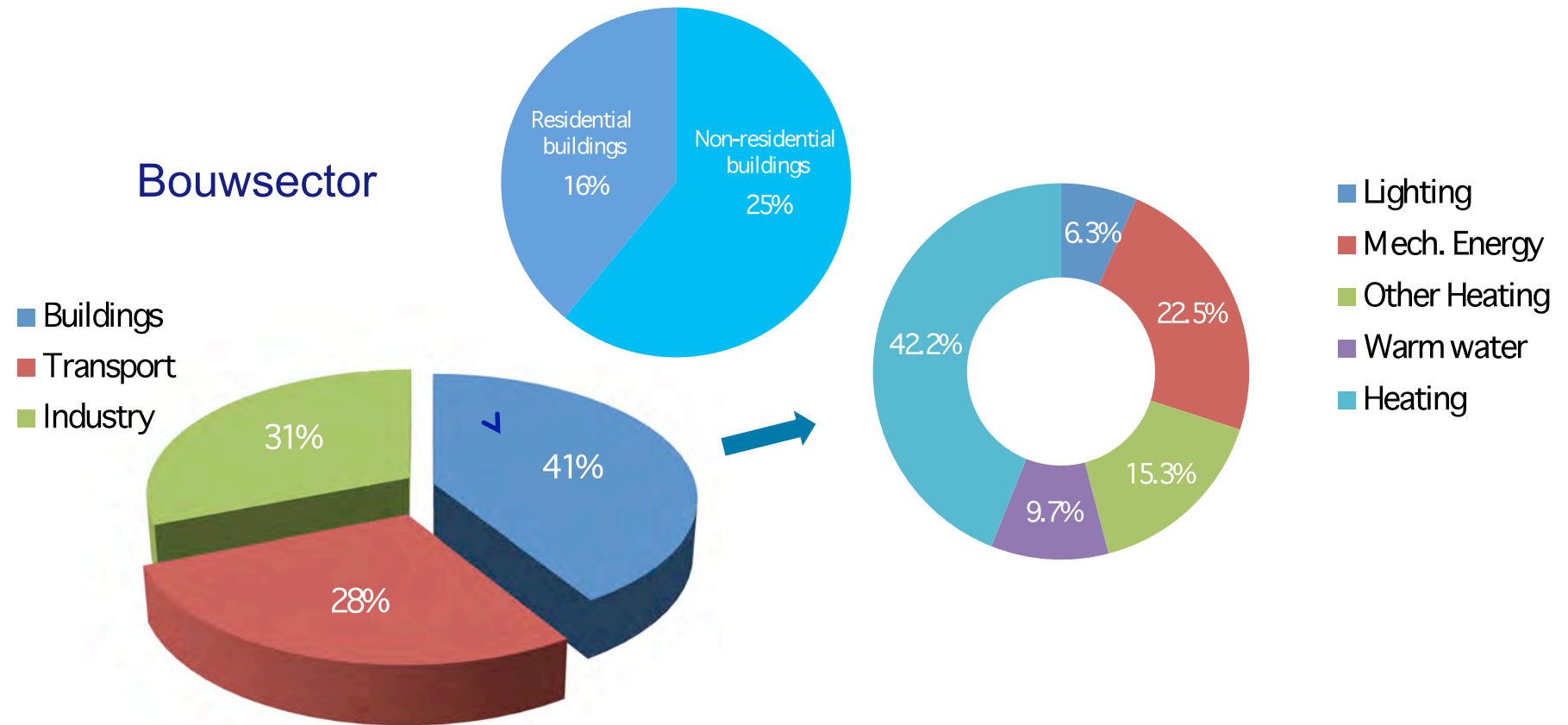
http://climate.nasa.gov/state_of_flux#Beijing_China_930x396.jpg

EU Primary Energy Consumption (PEC)

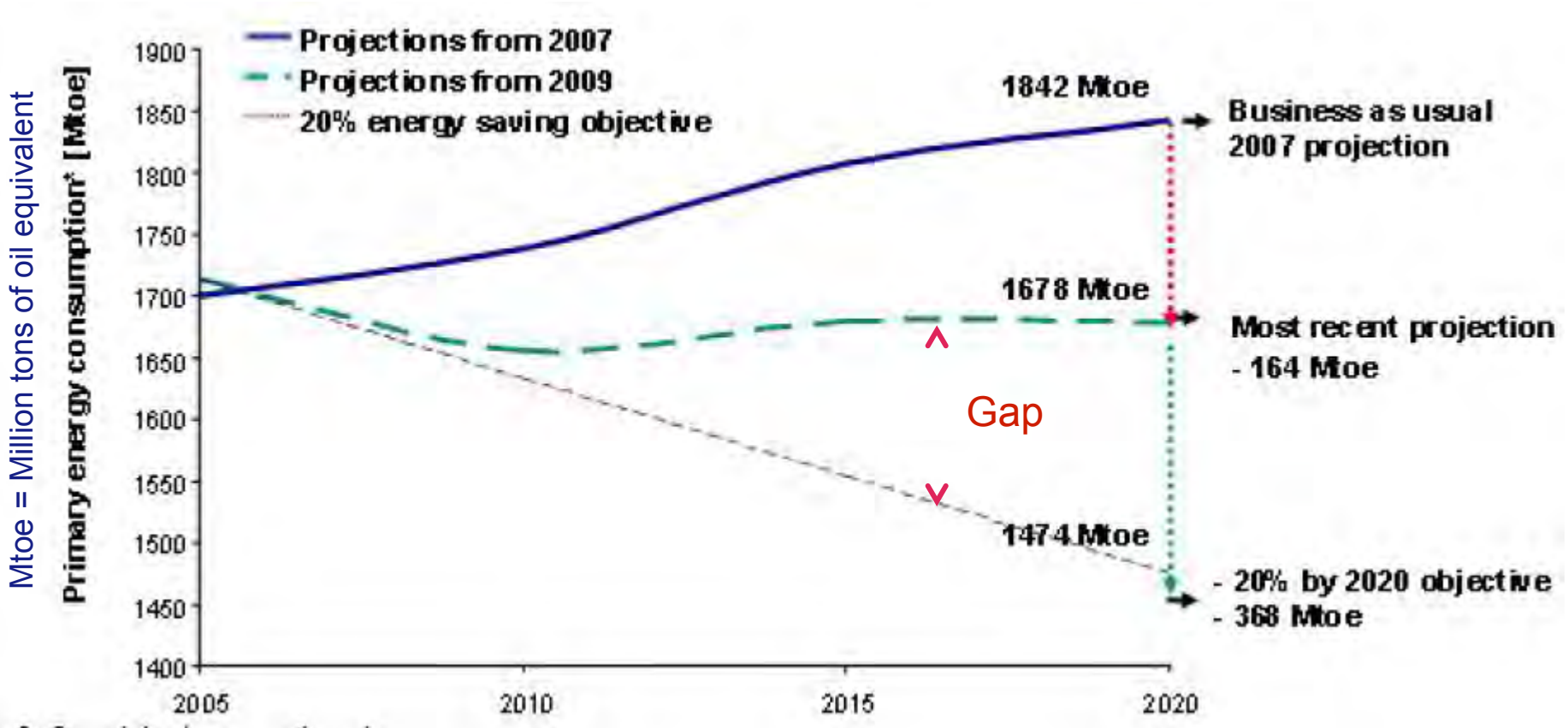
160 miljoen gebouwen in EU

> 40% van EU PEC

≈ 35% van Green House Gas Emissions



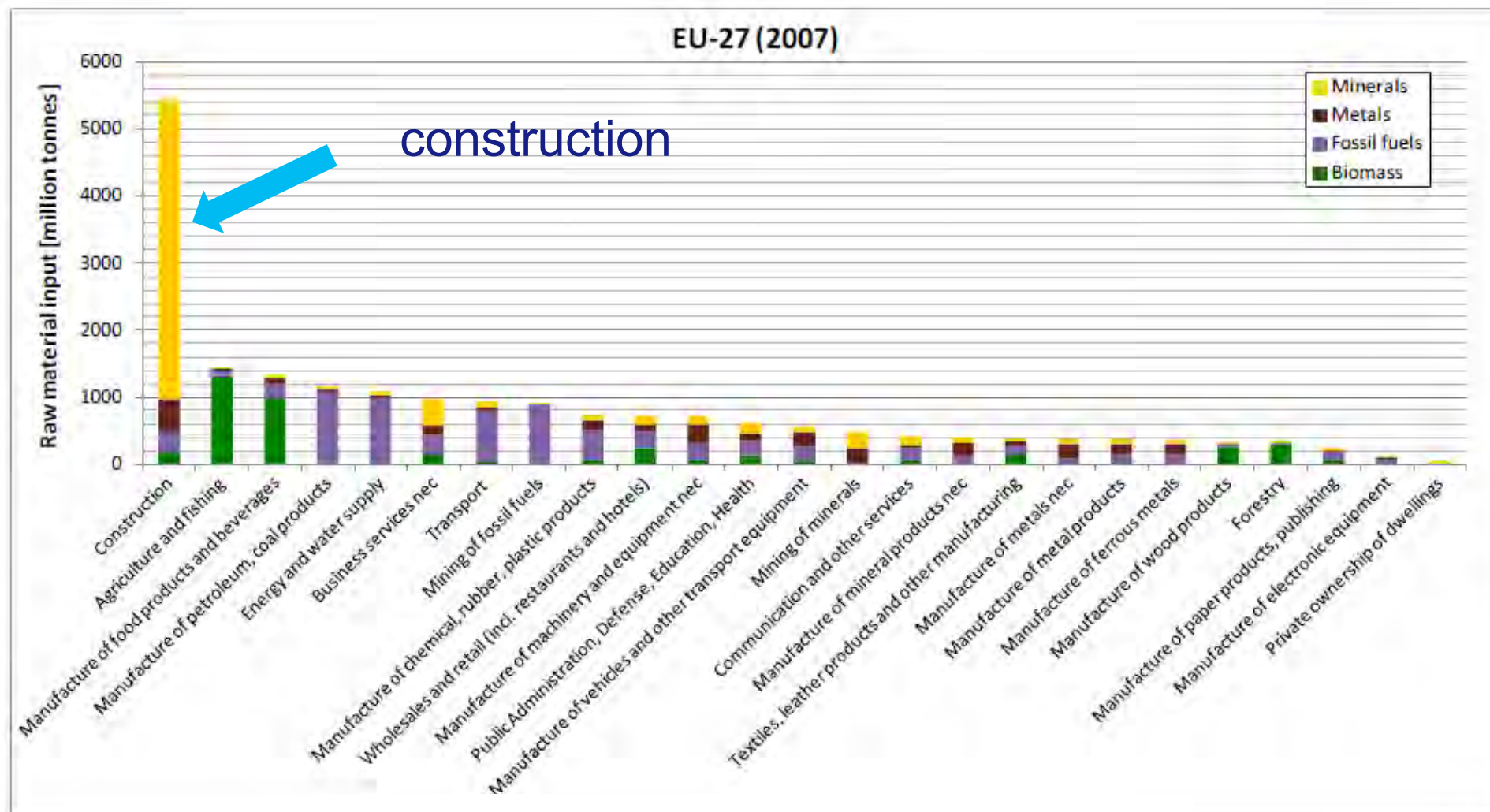
2020 20: EU Commission's new Energy Efficiency Plan



<http://ec.europa.eu/energyefficiency/action>

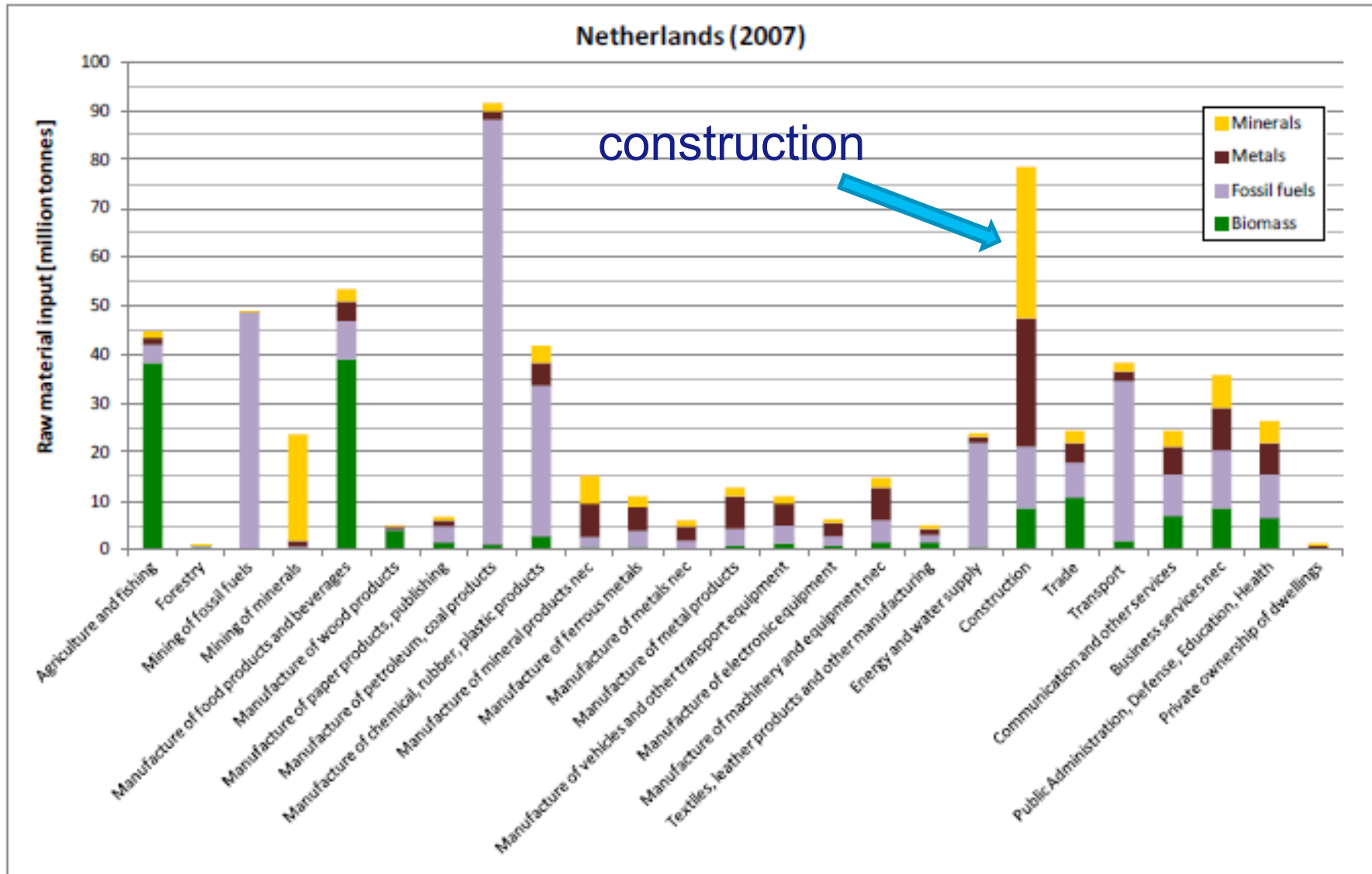
2009 projection: EU will only achieve 9 % reduction in stead of 20% target

EU, Materiaal verbruik per sector



Annual Material resource use economic sectors EU-27

Nederland, Materiaal verbruik per sector



IJzererts reserves

	Mine production		Reserves ⁶	
	2011	2012 ^e	Crude ore	Iron content
United States	55	53	6,900	2,100
Australia	488	525	35,000	17,000
Brazil	373	375	29,000	16,000
Canada	34	40	6,300	2,300
China	1,330	1,300	23,000	7,200
India	240	245	7,000	4,500
Iran	28	28	2,500	1,400
Kazakhstan	25	25	2,500	900
Mauritania	12	12	1,100	700
Mexico	15	13	700	400
Russia	100	100	25,000	14,000
South Africa	60	61	1,000	650
Sweden	25	25	3,500	2,200
Ukraine	81	81	⁷ 6,500	⁷ 2,300
Venezuela	17	20	4,000	2,400
Other countries	59	61	12,000	6,000
World total (rounded)	2,940	3,000	170,000	80,000

http://minerals.usgs.gov/minerals/pubs/commodity/iron_ore/mcs-2013-feore.pdf

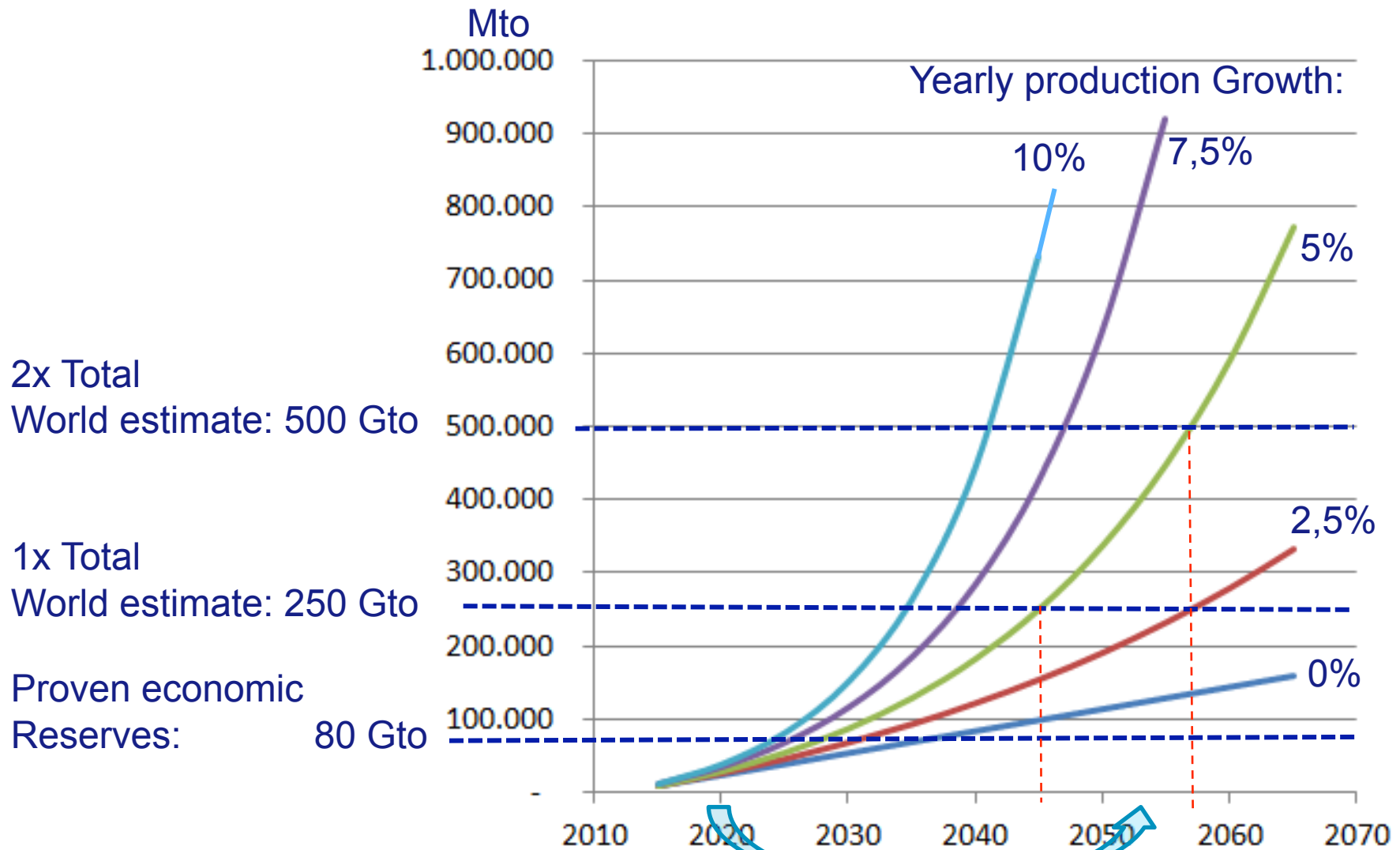
IJzererts reserves

Jaar	WereldStaal- productie Mto	Bewezen IJzererts - reserve (Mto Iron content)	Voorraad Bij constante productie (jr)
2006	1800		
2007	2000		
2008	2220	73.000	33
2009	2240	73.000	32,5
2010	2590	77.000	30
2011	2940	87 000	29,6
2012	3000*	80.000	26,7
2013		80.000	

Wereld voorraad in 2013
 geschat op meer dan 230.000 Mto IJzer

http://minerals.usgs.gov/minerals/pubs/commodity/iron_ore/mcs-2013-feore.pdf

Verbruik wereld IJzerertsvoorraad



Eén gebouwgeneratie?

IJzererts reserves

verschillende scenario's :

Verschillende groeipercentages versus wereldvoorraad

Jaarlijkse groei Staalproductie	Beginvoorraad 250.000 Mto IJzererts voorraad tot:	Begin voorraad 1,5 x 250.000 Mto IJzererts voorraad tot:
2%	2061	2075
3%	2054	2064
4%	2049	2057
5%	2045	2052
8%	2038	2043

Ertsen met lager ijzergehalte >> meer energie noodzakelijk>>

Hogere prijs,
Hogere milieu impact

Reserves IJzererts

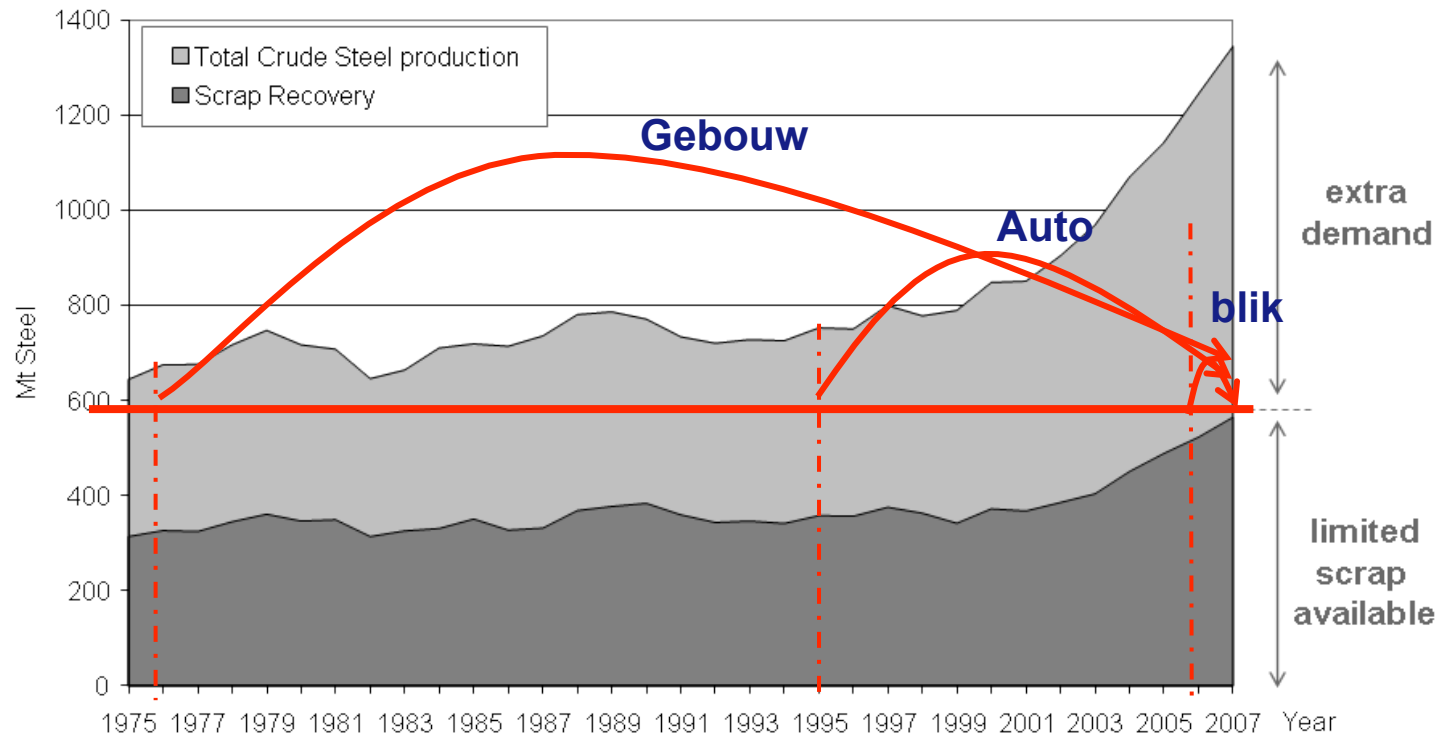
Verbruik van Ertsen met lager ijzergehalte

- meer energie noodzakelijk voor grondstofwinning
 - Hogere prijs,
 - Hogere milieu impact
 - Groeiende vraag naar schroot
 - Nieuwe gebouwen worden grondstofvoorraad
 - >> Groeiende restwaarde staalconstructies

Reserves IJzererts

Shroot: Groeiende vraag versus beschikbaarheid

- Lengte van levenscycli



(O. Hechler)

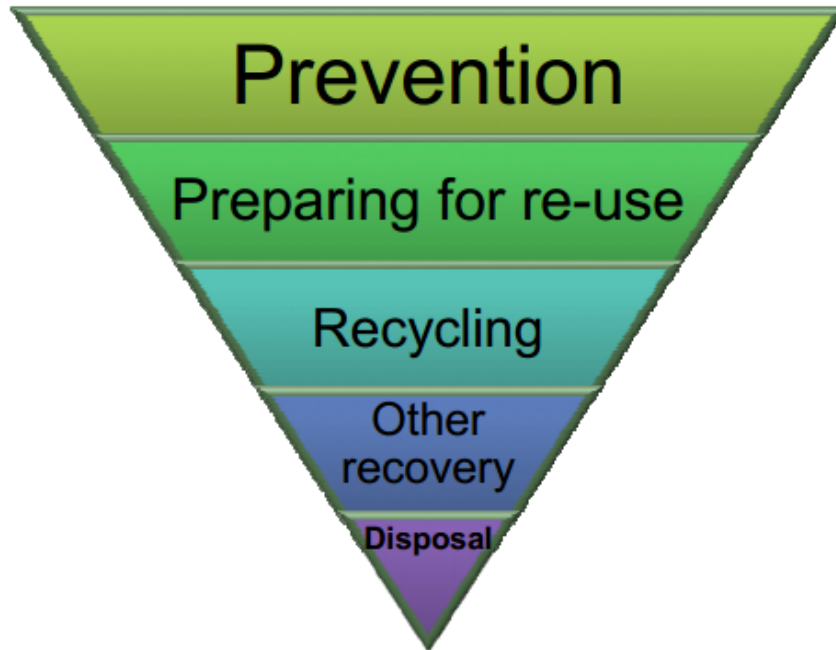
Materiaal recycling



Gebouwen als (toekomstige) Materiaal bron



Constructie afval (C&D waste)



Voorkomen op gebouwniveau:

Langer gebruik/ Hergebruik gebouw

**Hergebruik van gebouwelementen
gebouwcomponenten**

Hergebruik van materialen



Ladder van Lansink

Verschuiven van Sloop en recycling op materiaalniveau

Naar Hergebruik / deconstructie op gebouwniveau

Levensduur, Energie, Materialen

