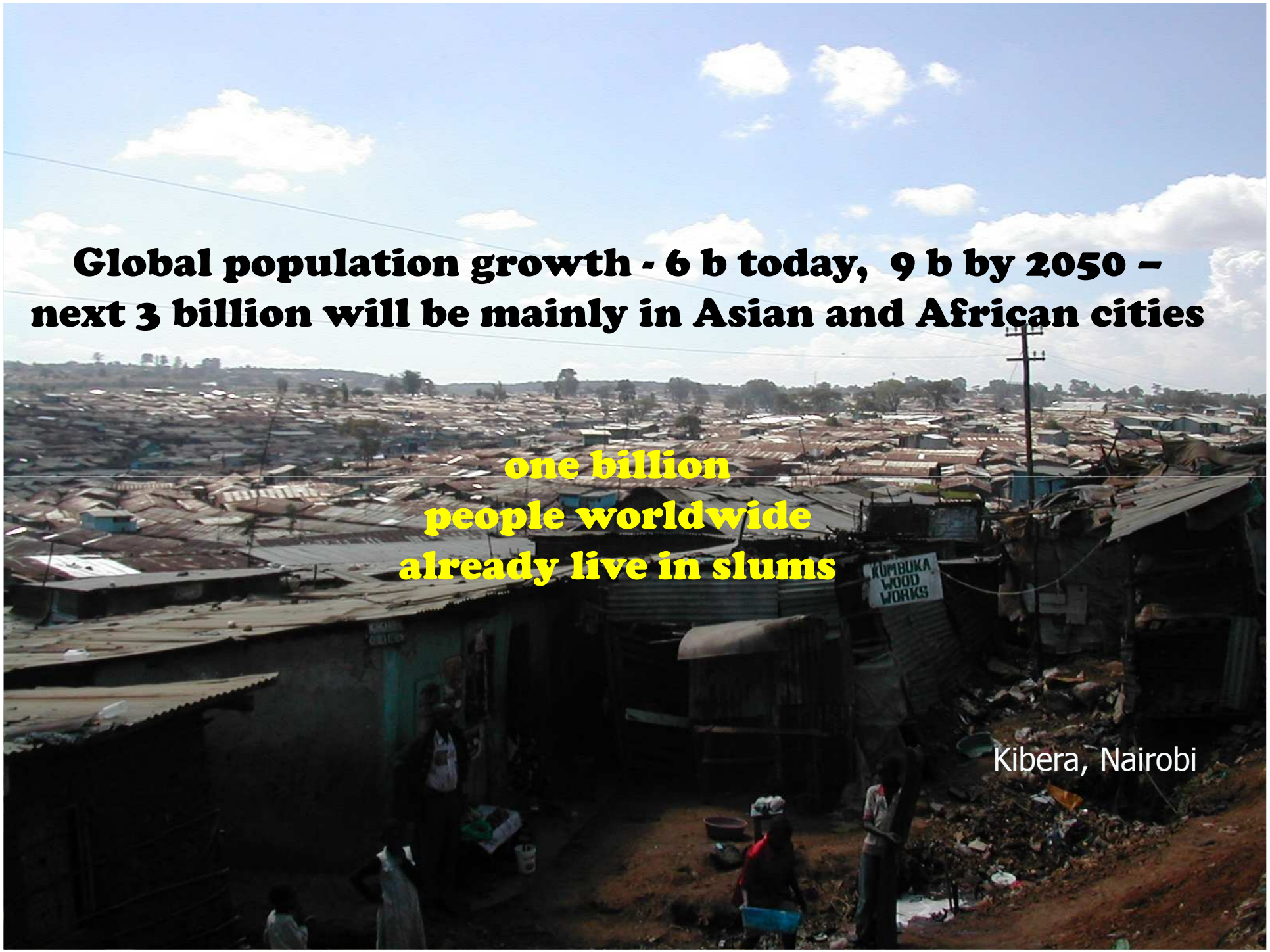
Sustainability , Cities, Human Settlements

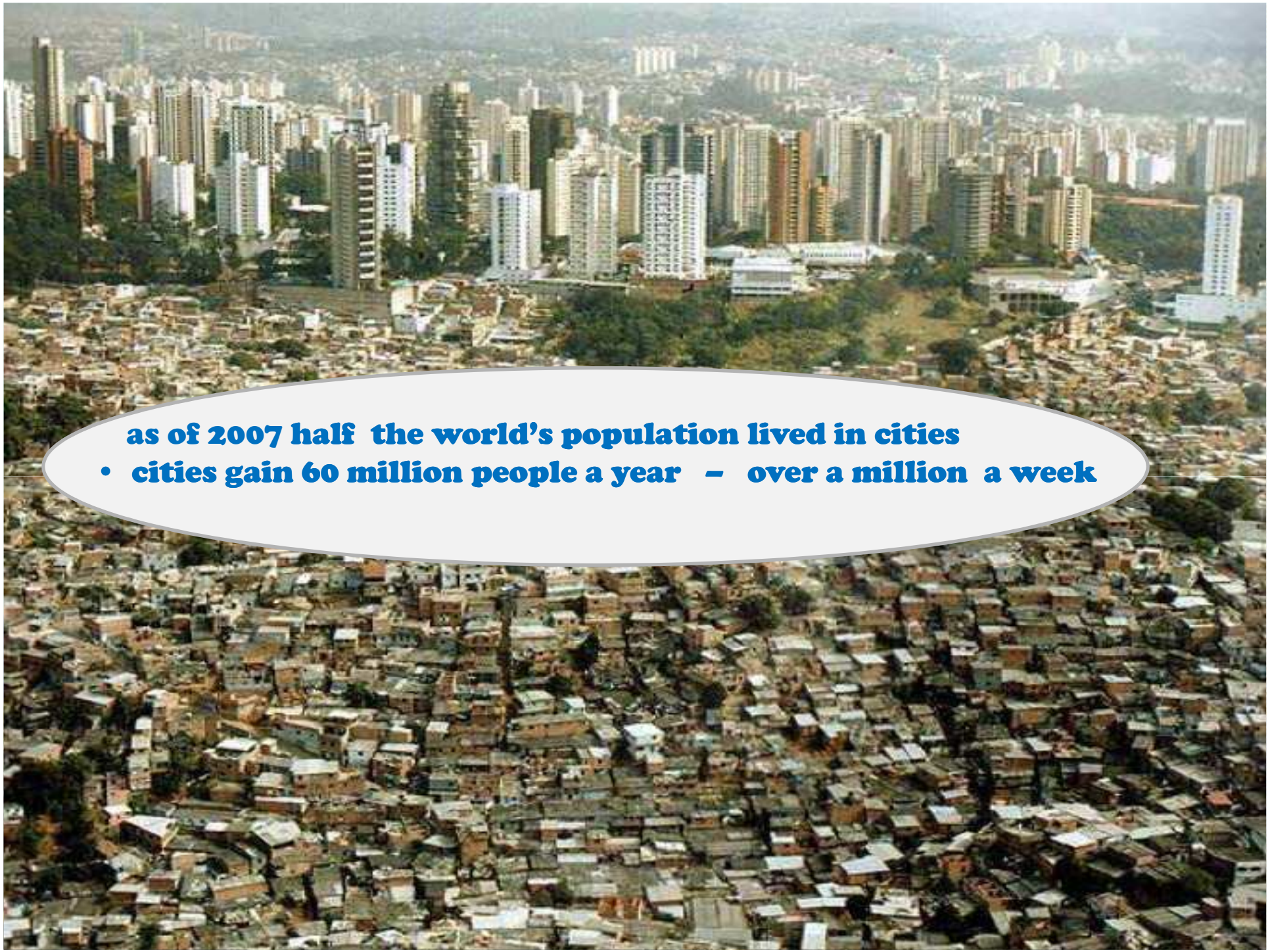
Professor Mark Swilling, Sustainability Institute
School of Public Management and Planning
Stellenbosch University
South Africa

Global population growth - 6 b today, 9 b by 2050 – next 3 billion will be mainly in Asian and African cities



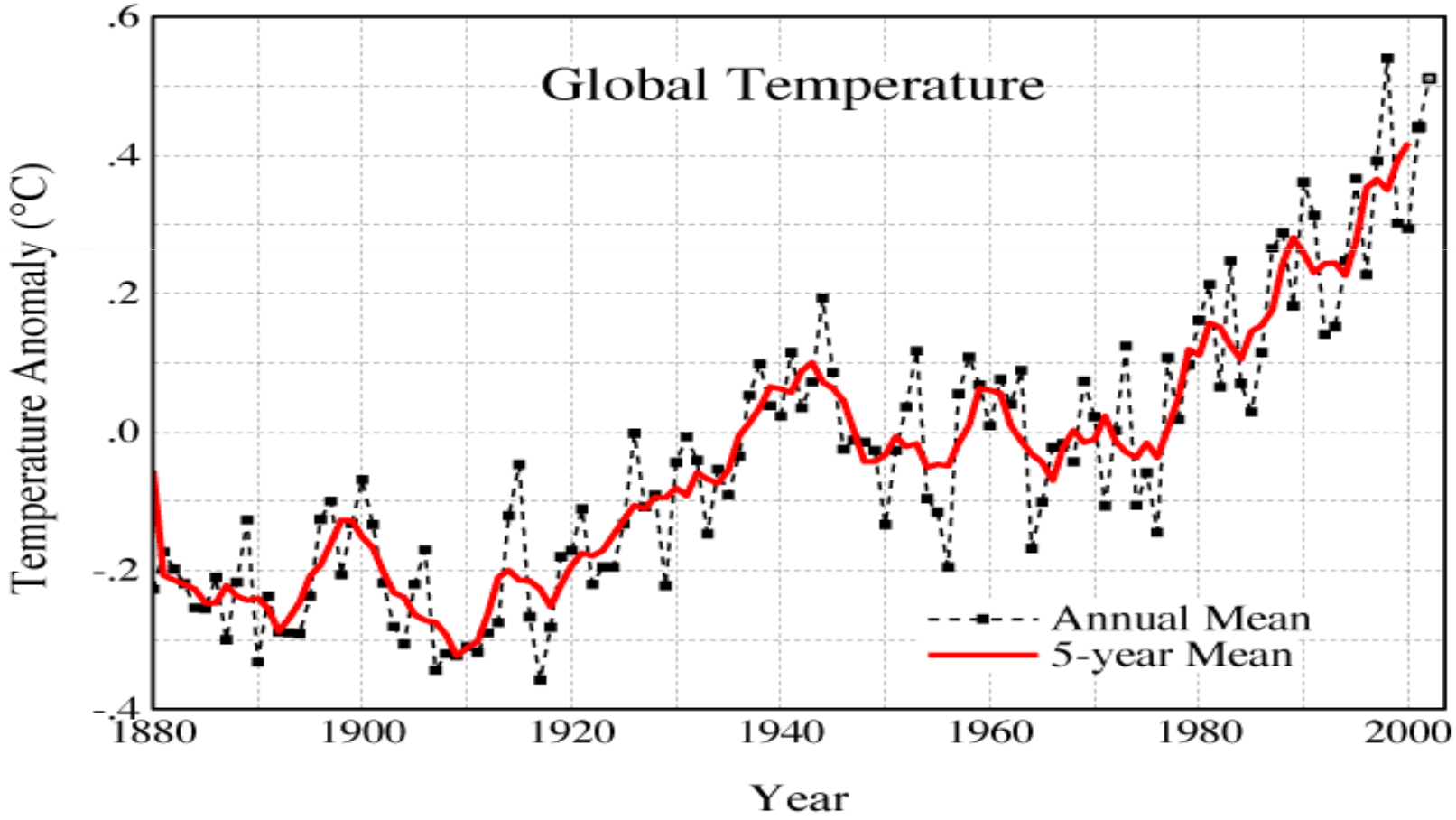
one billion people worldwide already live in slums

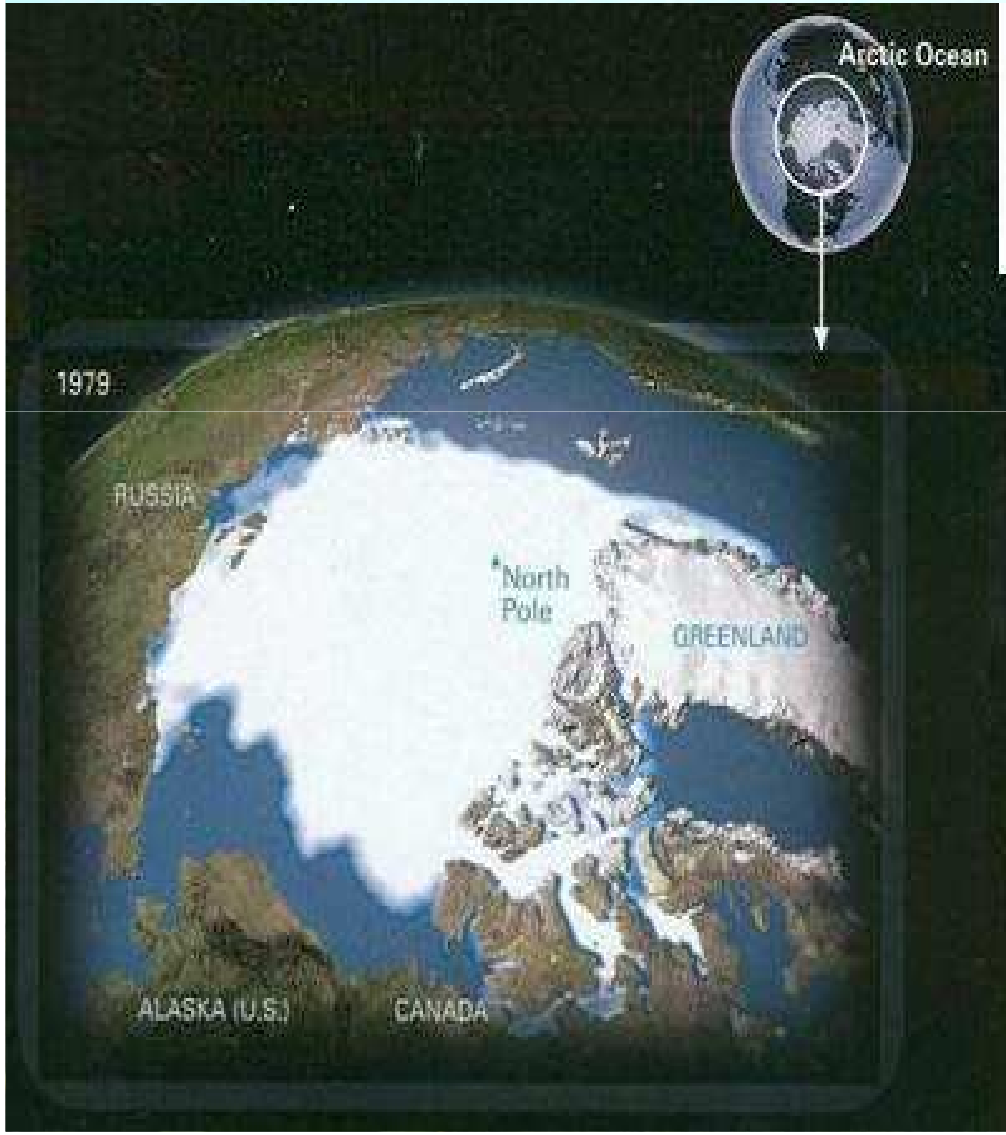
Kibera, Nairobi


as of 2007 half the world's population lived in cities
• cities gain 60 million people a year – over a million a week

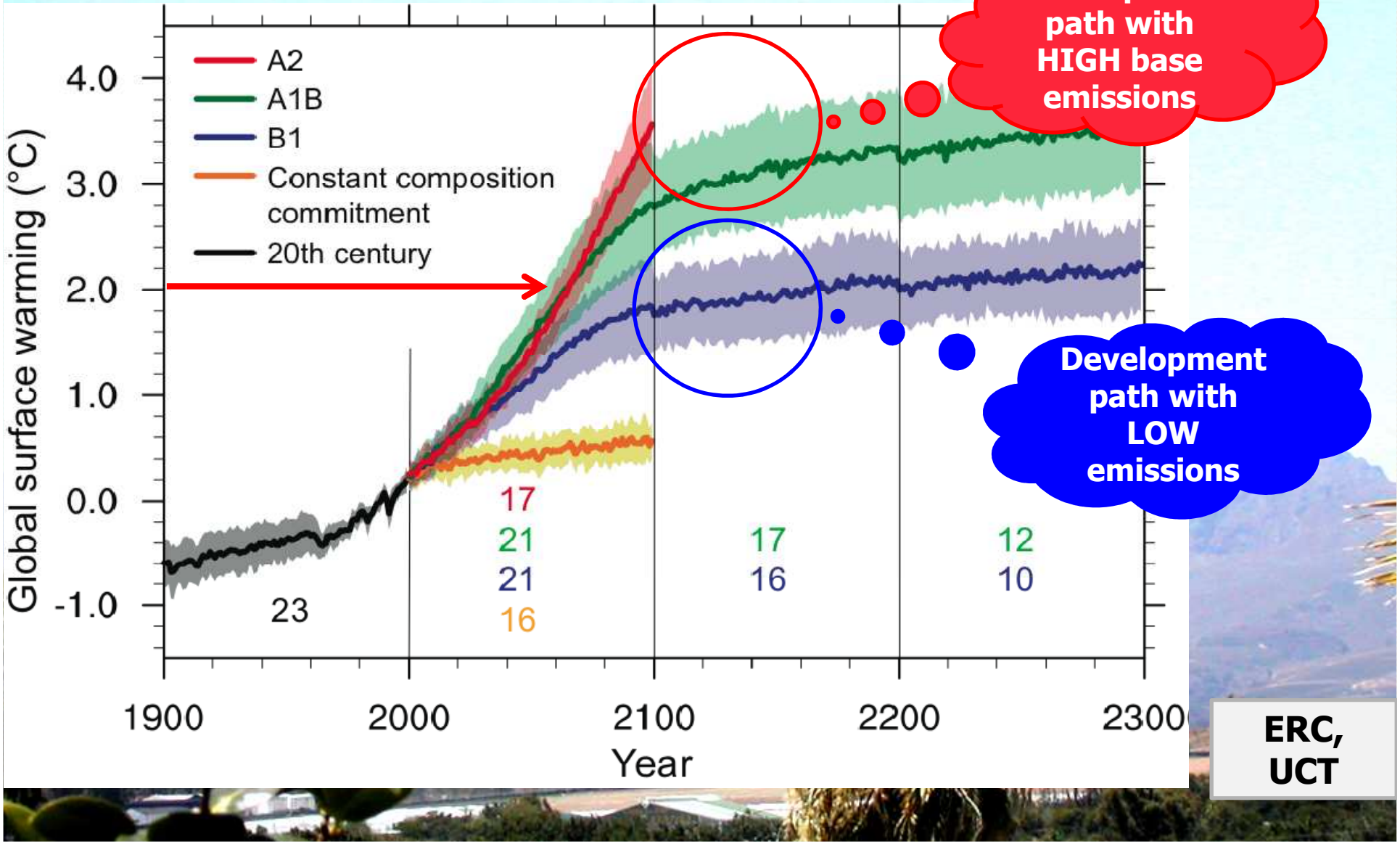
Global economic crisis...

3rd Report: IPCC on Global Warming



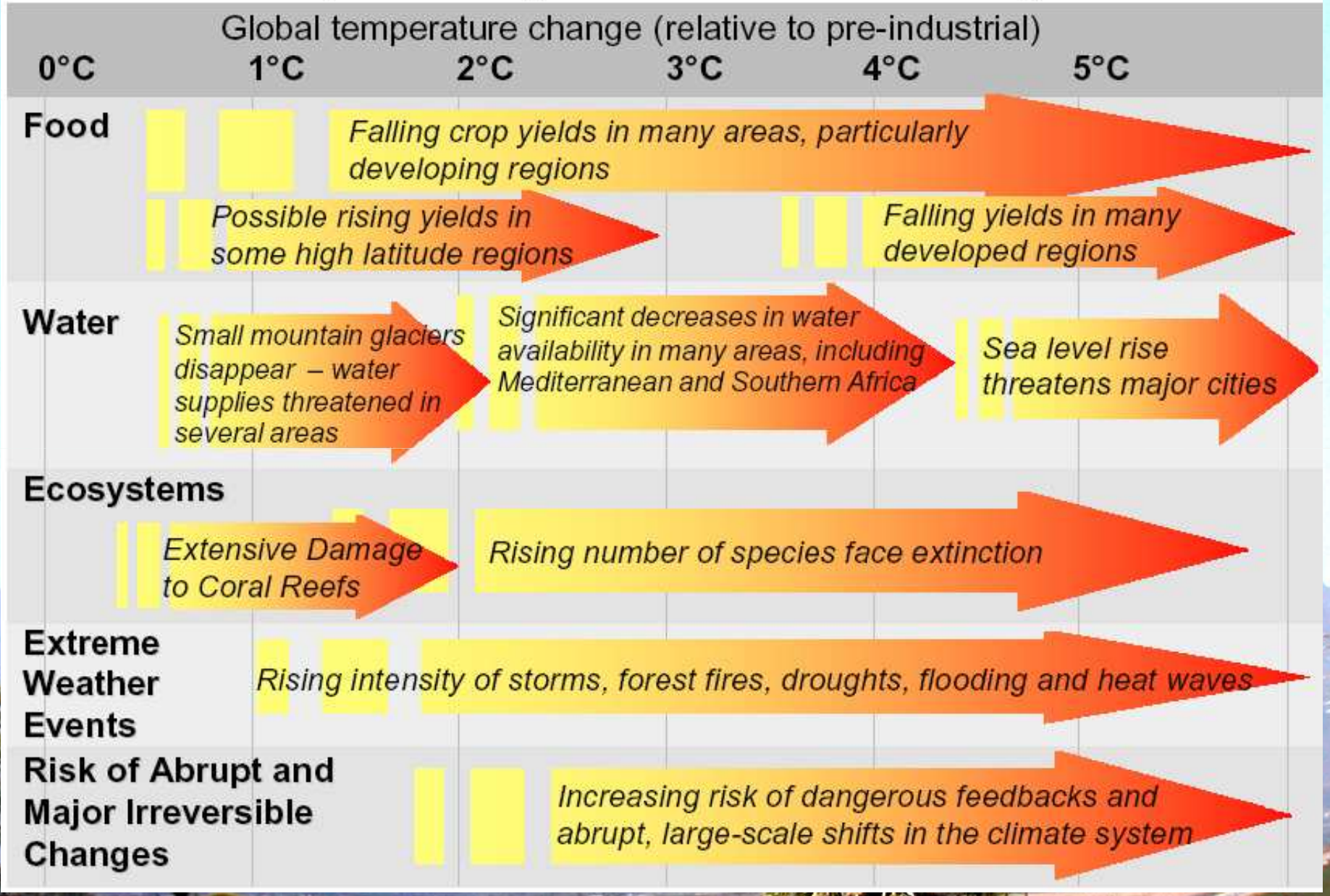

Arctic Ocean
1979
RUSSIA
North Pole
GREENLAND
ALASKA (U.S.)
CANADA

Globar warming scenarios



ERC, UCT

Projected Impacts of Climate Change



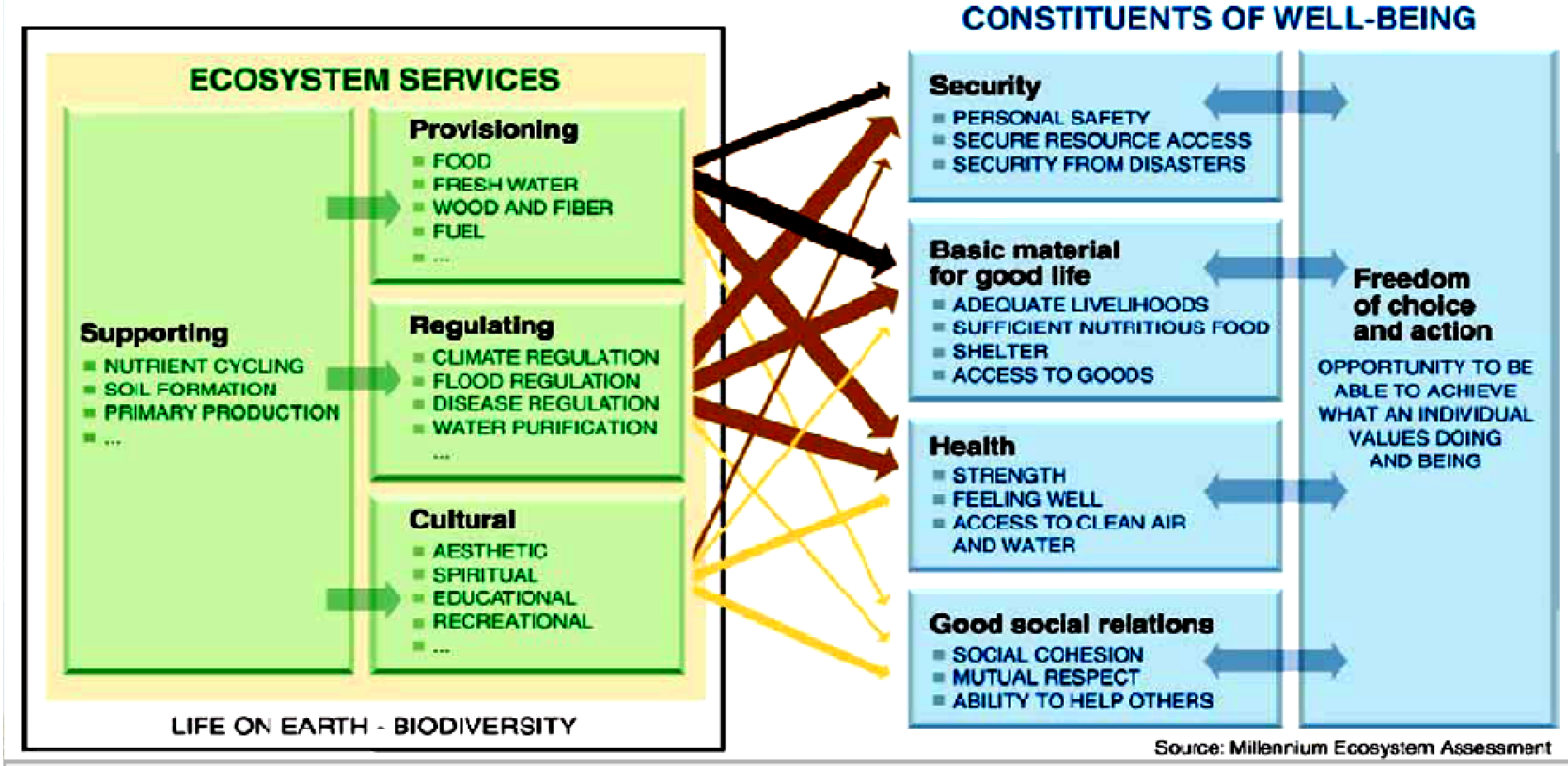
Source: Stern review on the economics of climate change, 2006

Appendix table 1 Measuring the global carbon footprint—selected countries and regions

Top 30 CO_2 emitters	Carbon dioxide emissions[a]								
	Total emissions (Mt CO_2)		Growth rate (%)	Share of world total (%)		Population share (%)	CO_2 emissions per capita (t CO_2)		CO_2 emissions or sequestration from forests[b] (Mt CO_2 / year)
	1990	2004	1990–2004	1990	2004	2004	1990	2004	1990–2005
1 United States	4,818	6,046	25	21.2	20.9	4.6	19.3	20.6	-500
2 China [c]	2,399	5,007	109	10.6	17.3	20.0	2.1	3.8	-335
3 Russian Federation	1,984 [d]	1,524	-23 [d]	8.7 [d]	5.3	2.2	13.4 [d]	10.6	72
4 India	682	1,342	97	3.0	4.6	17.1	0.8	1.2	-41
5 Japan	1,071	1,257	17	4.7	4.3	2.0	8.7	9.9	-118
6 Germany	980	808	-18	4.3	2.8	1.3	12.3	9.8	-75
7 Canada	416	639	54	1.8	2.2	0.5	15.0	20.0	..
8 United Kingdom	579	587	1	2.6	2.0	0.9	10.0	9.8	-4
9 Korea (Republic of)	241	465	93	1.1	1.6	0.7	5.6	9.7	-32
10 Italy	390	450	15	1.7	1.6	0.9	6.9	7.8	-52
11 Mexico	413	438	6	1.8	1.5	1.6	5.0	4.2	..
12 South Africa	332	437	32	1.5	1.5	0.7	9.1	9.8	(.)
13 Iran (Islamic Republic of)	218	433	99	1.0	1.5	1.1	4.0	6.4	-2
14 Indonesia	214	378	77	0.9	1.3	3.4	1.2	1.7	2,271
15 France	364	373	3	1.6	1.3	0.9	6.4	6.0	-44
16 Brazil	210	332	58	0.9	1.1	2.8	1.4	1.8	1,111
17 Spain	212	330	56	0.9	1.1	0.7	5.5	7.6	-28
18 Ukraine	600 [d]	330	-45 [d]	2.6 [d]	1.1	0.7	11.5 [d]	7.0	-60
19 Australia	278	327	17	1.2	1.1	0.3	16.3	16.2	..
20 Saudi Arabia	255	308	21	1.1	1.1	0.4	15.9	13.6	(.)
21 Poland	348	307	-12	1.5	1.1	0.6	9.1	8.0	-44
22 Thailand	96	268	180	0.4	0.9	1.0	1.7	4.2	18
23 Turkey	146	226	55	0.6	0.8	1.1	2.6	3.2	-18
24 Kazakhstan	259 [d]	200	-23 [d]	1.1 [d]	0.7	0.2	15.7 [d]	13.3	(.)
25 Algeria	77	194	152	0.3	0.7	0.5	3.0	5.5	-6
26 Malaysia	55	177	221	0.2	0.6	0.4	3.0	7.5	3
27 Venezuela (Bolivarian Republic of)	117	173	47	0.5	0.6	0.4	6.0	6.6	..
28 Egypt	75	158	110	0.3	0.5	1.1	1.5	2.3	-1
29 United Arab Emirates	55	149	173	0.2	0.5	0.1	27.2	34.1	-1
30 Netherlands	141	142	1	0.6	0.5	0.2	9.4	8.7	-1

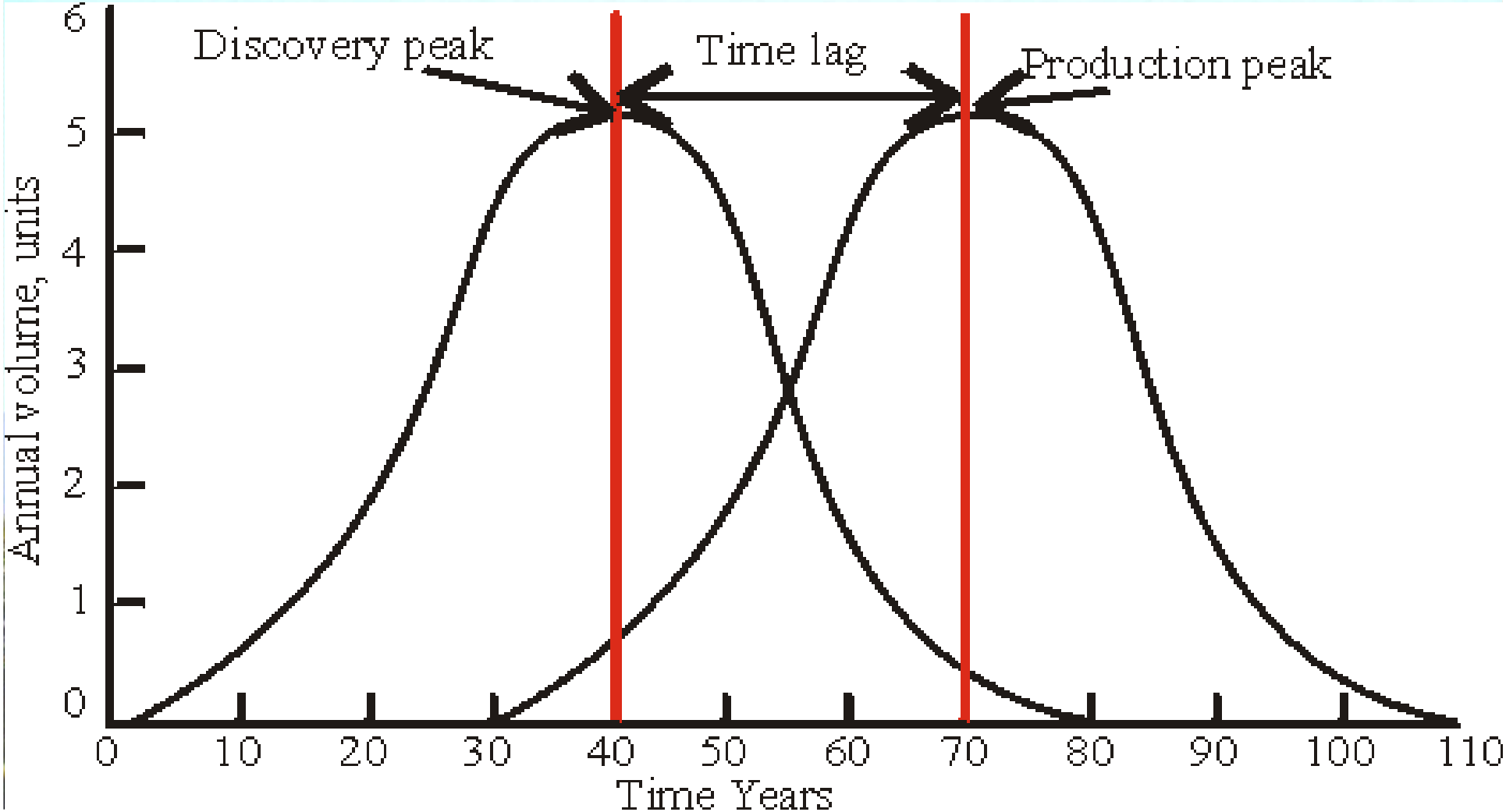
Cape Town 2010 - Current Seawater Levels

Millennium Eco-System Assessment

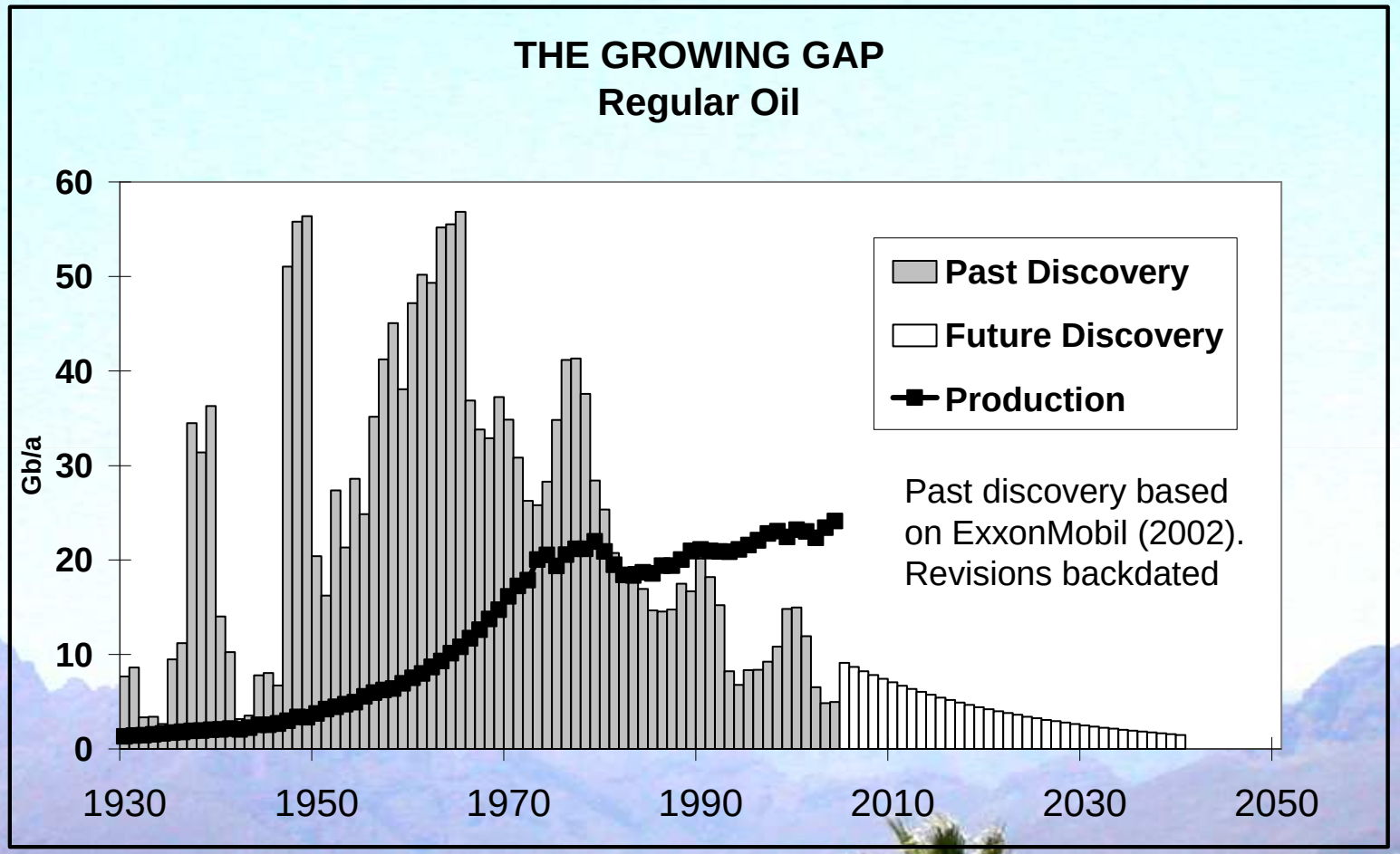


60% of the eco-system services we depend are degraded/used unsustainably

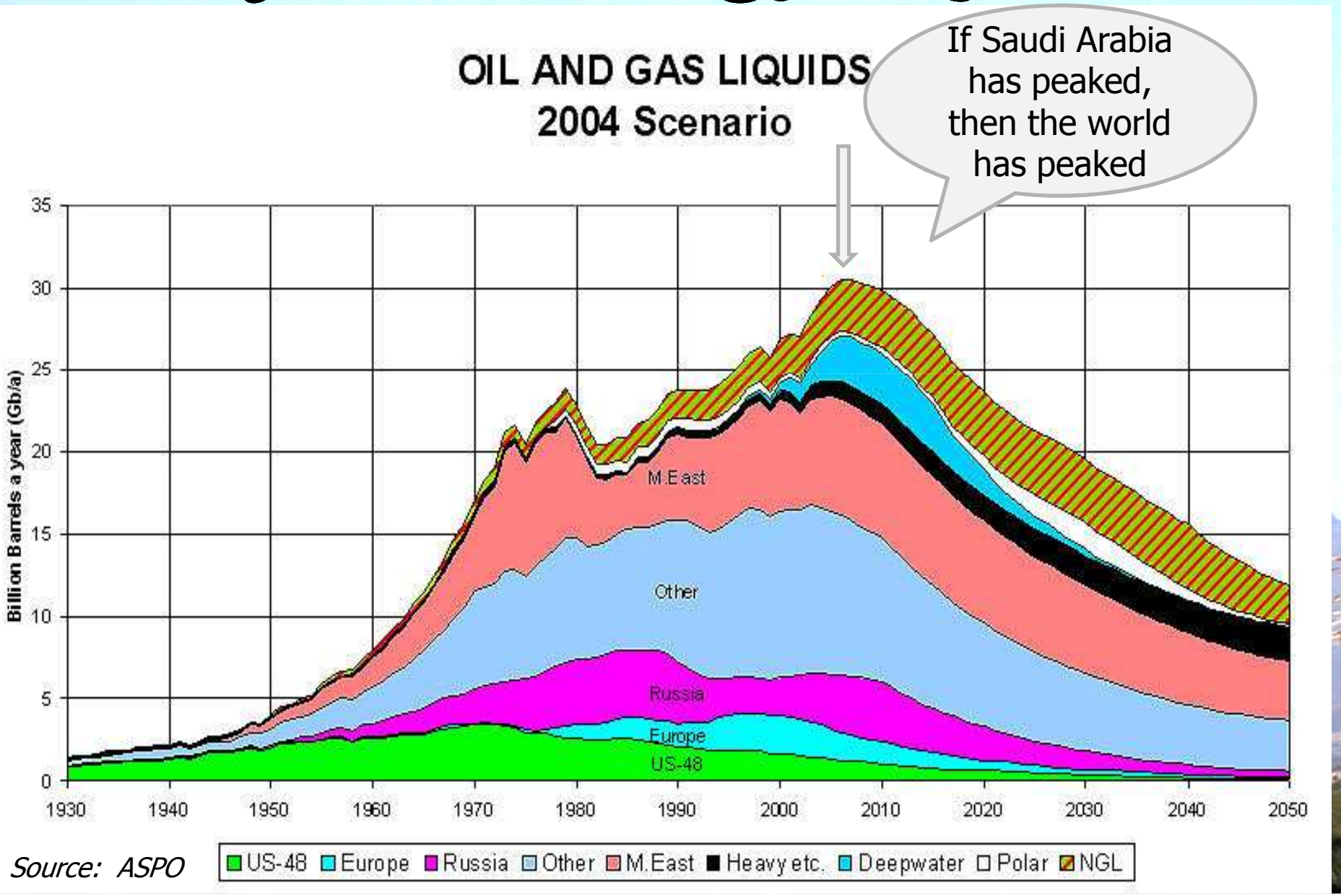
Oil Peak


Discovery peak
Time lag
Production peak
Annual volume, units
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
80
90
100
110
Time Years

Campbell's Gap

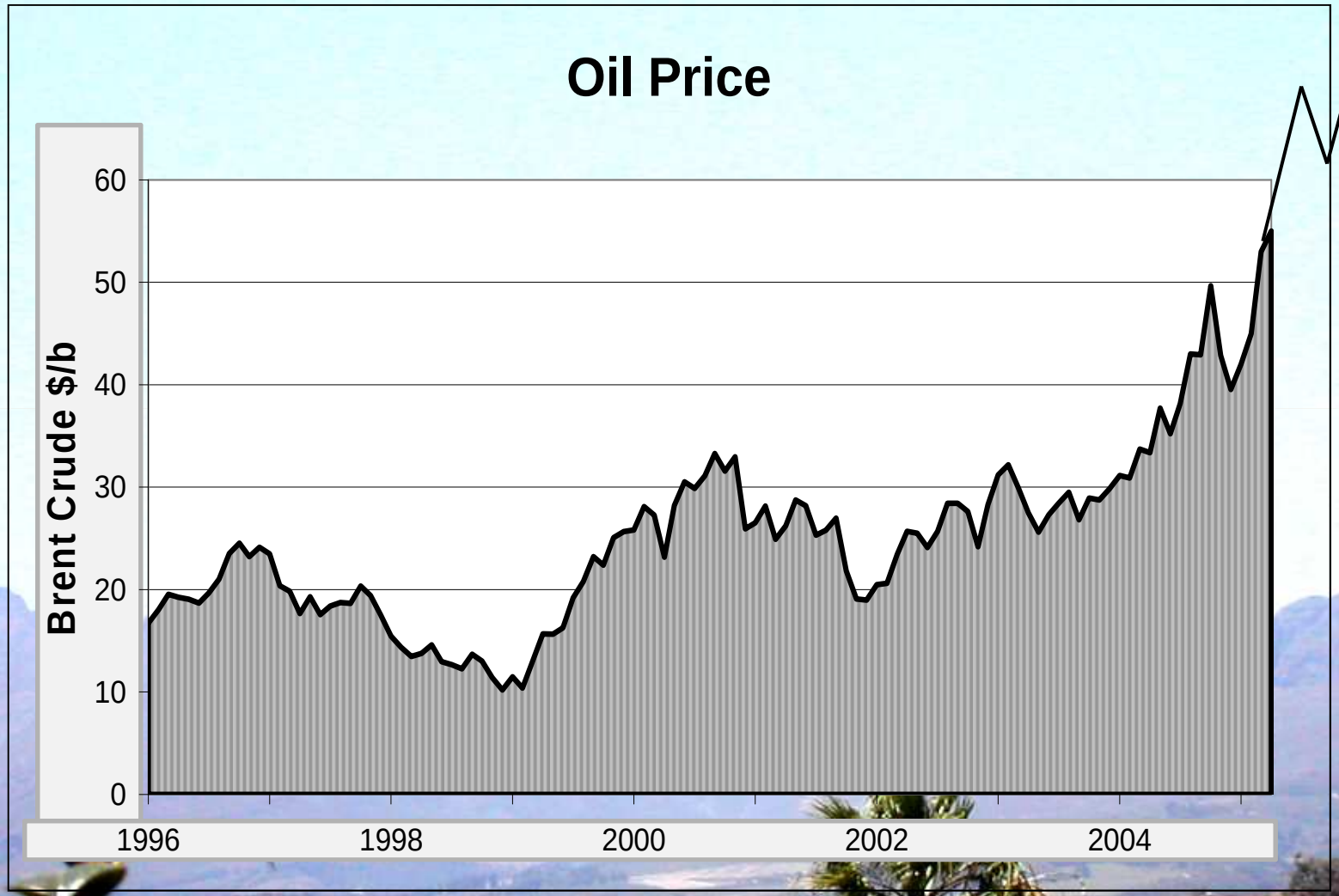


Projected energy depletion



Source: ASPO

Oil Price

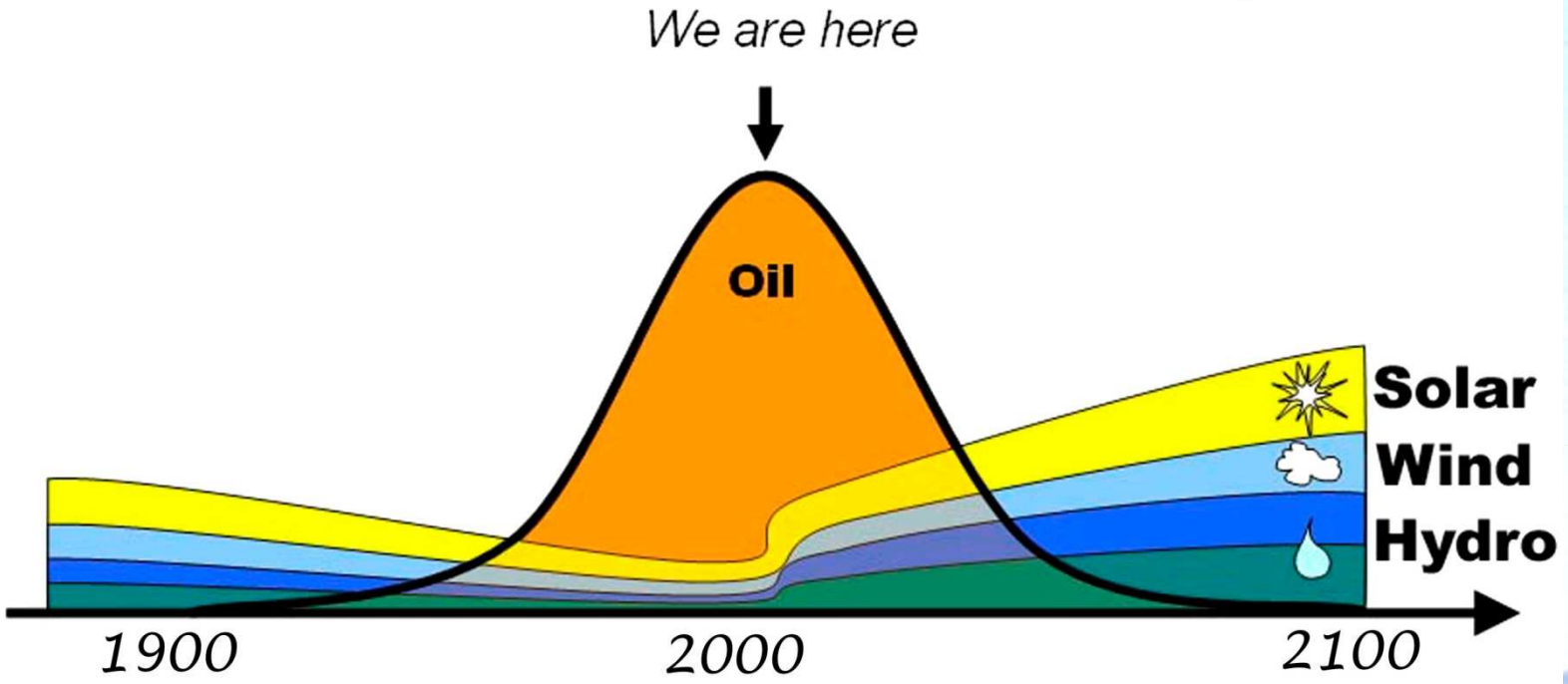

Oil Price
Brent Crude $/b
60
50
40
30
20
10
0
1996
1998
2000
2002
2004

Car First Planning

All based on cheap oil…….oil meets 60% of world energy needs. Can we design cities on the assumption that oil will be cheap forever?


Other side of the coin

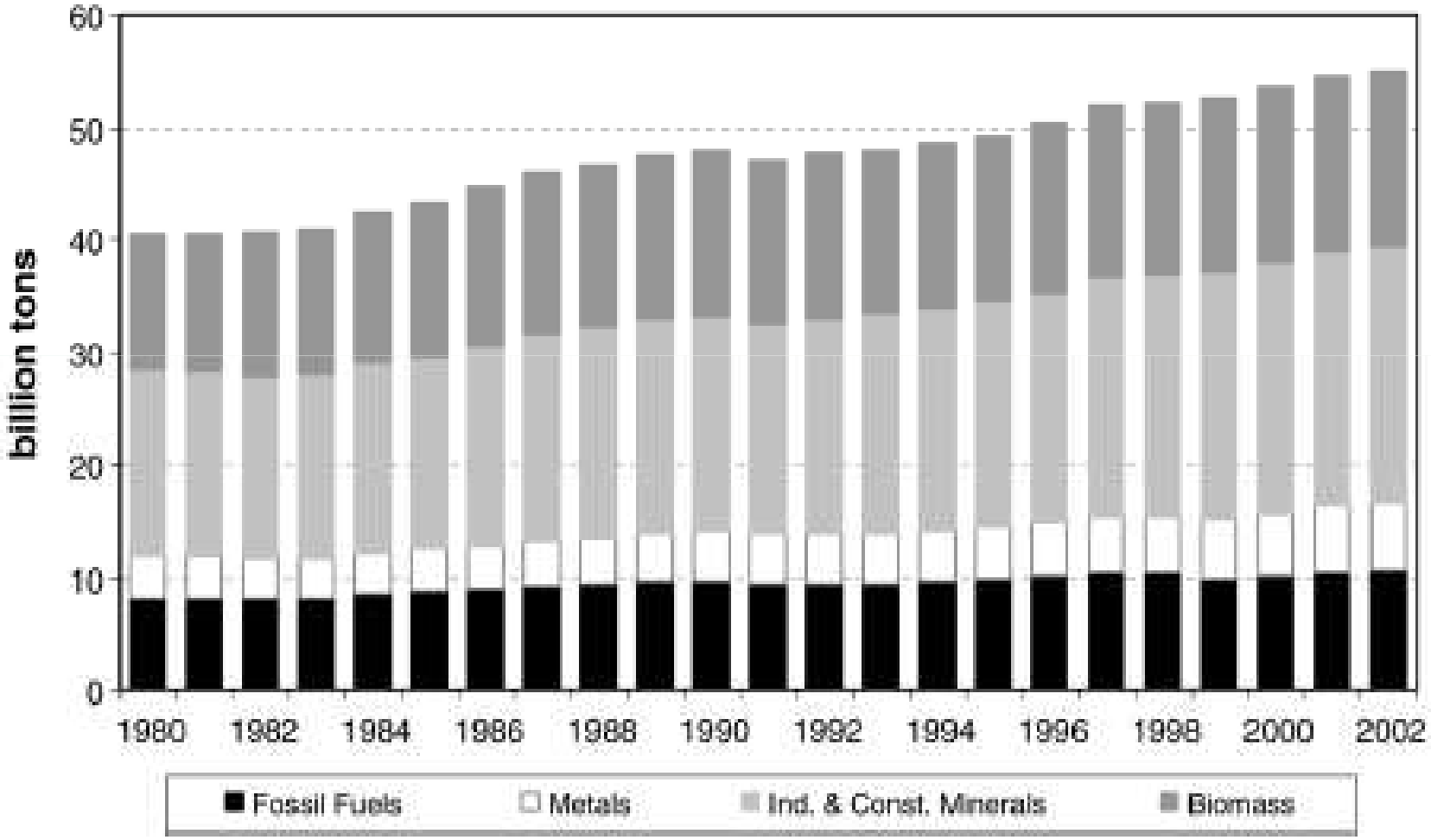
Get ready



for a low energy world

www.oilcrisis.com

Material Flows – the missing factor

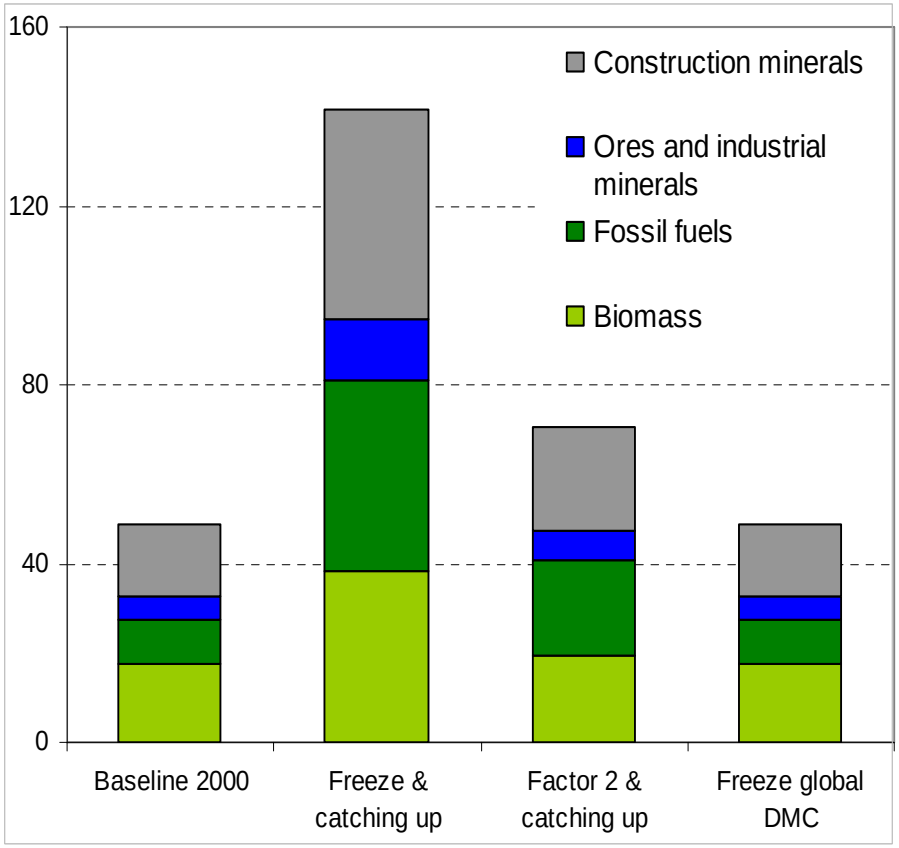


Behrens, 2007

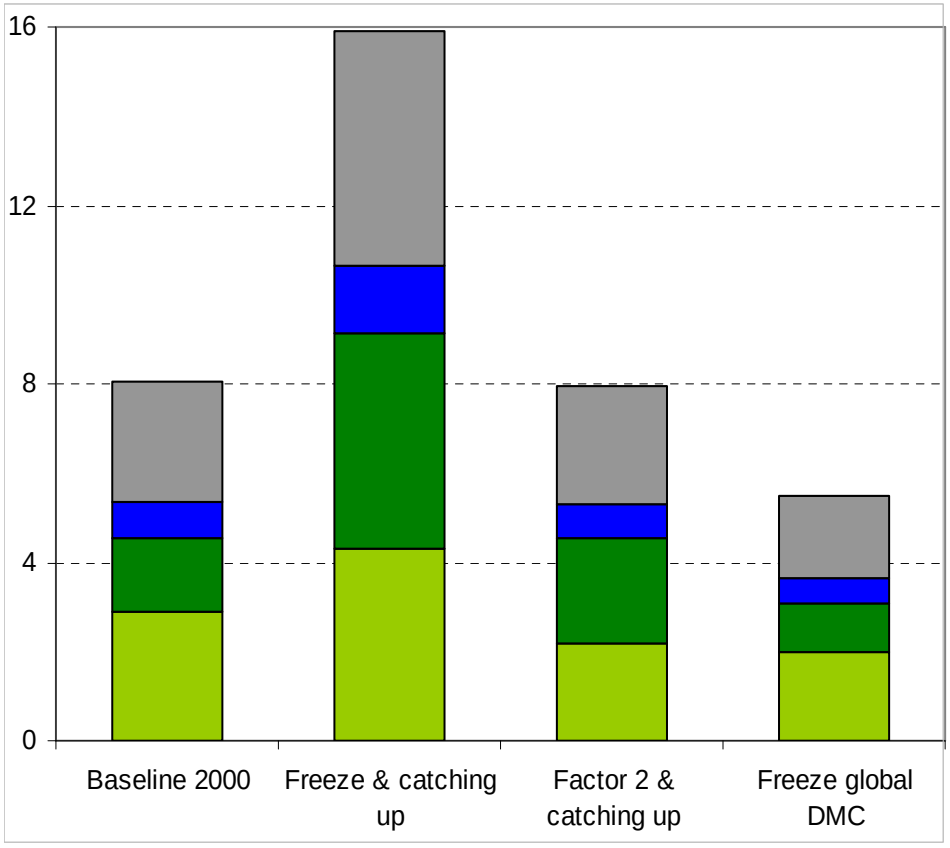
Fig. 1 – Global used resource extraction by material category (in billion tons).

Three forced future scenarios for 2050

Global metabolic scales in billion tonnes



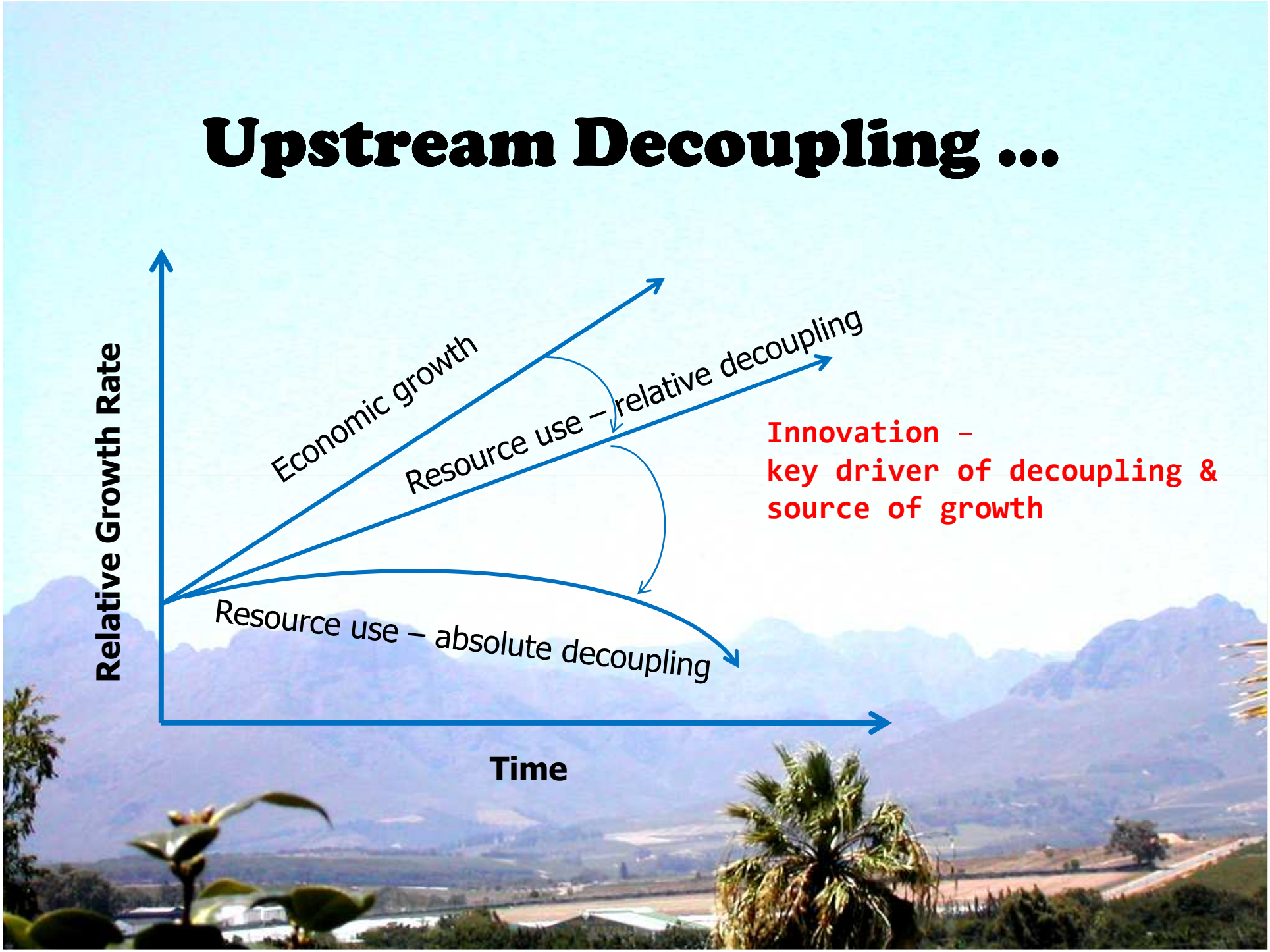
Global metabolic rates in t/cap



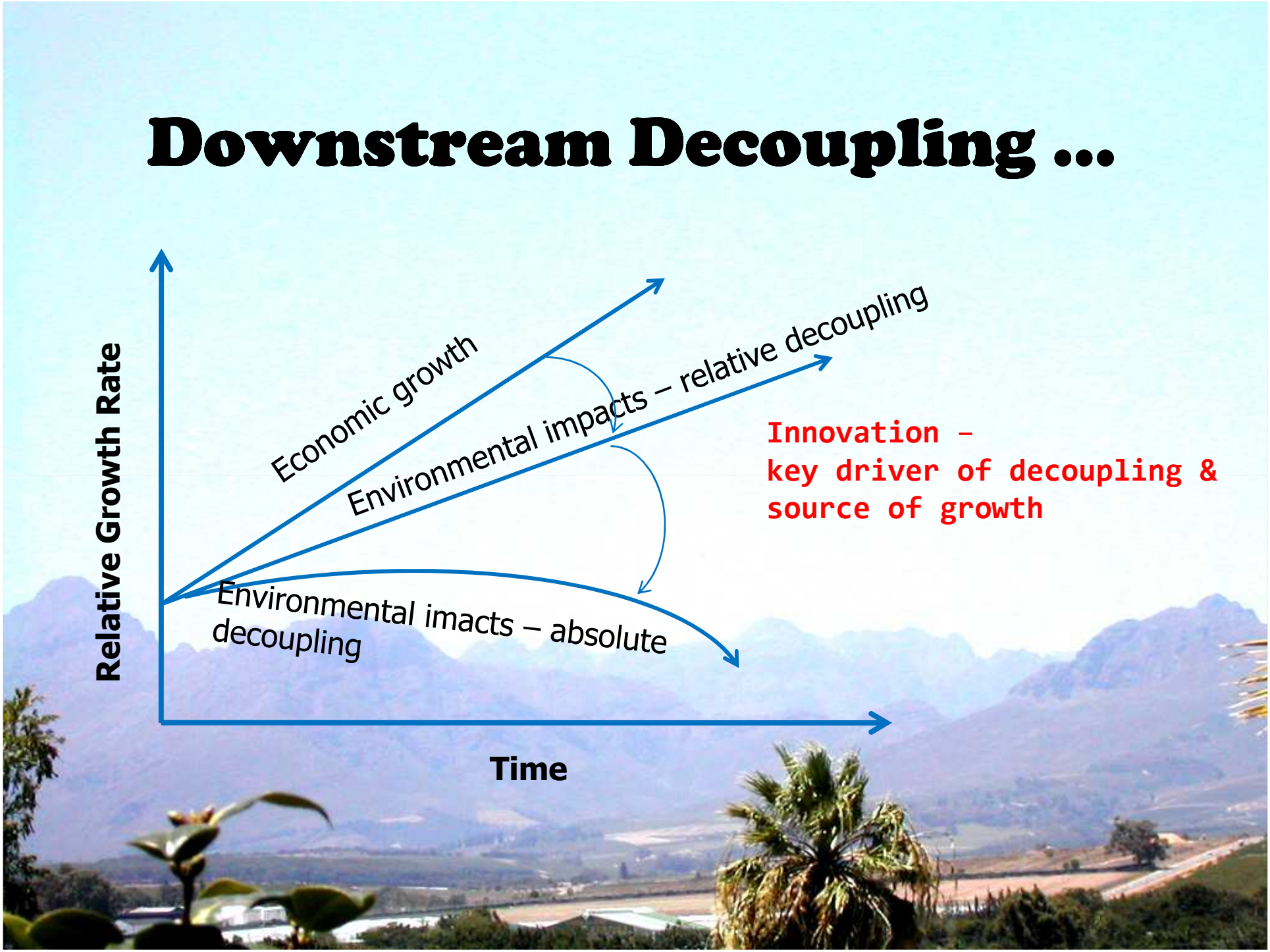
Material & Energy Flow Analysis

- Materials:
  - Ave = 8.8 tons/cap in 2002
  - New global target? ~ 6
- Energy:
  - World average is 4.5 tons/cap in 2004
  - should be 2.25 t/cap to save billion plus lives

Upstream Decoupling …



Downstream Decoupling …



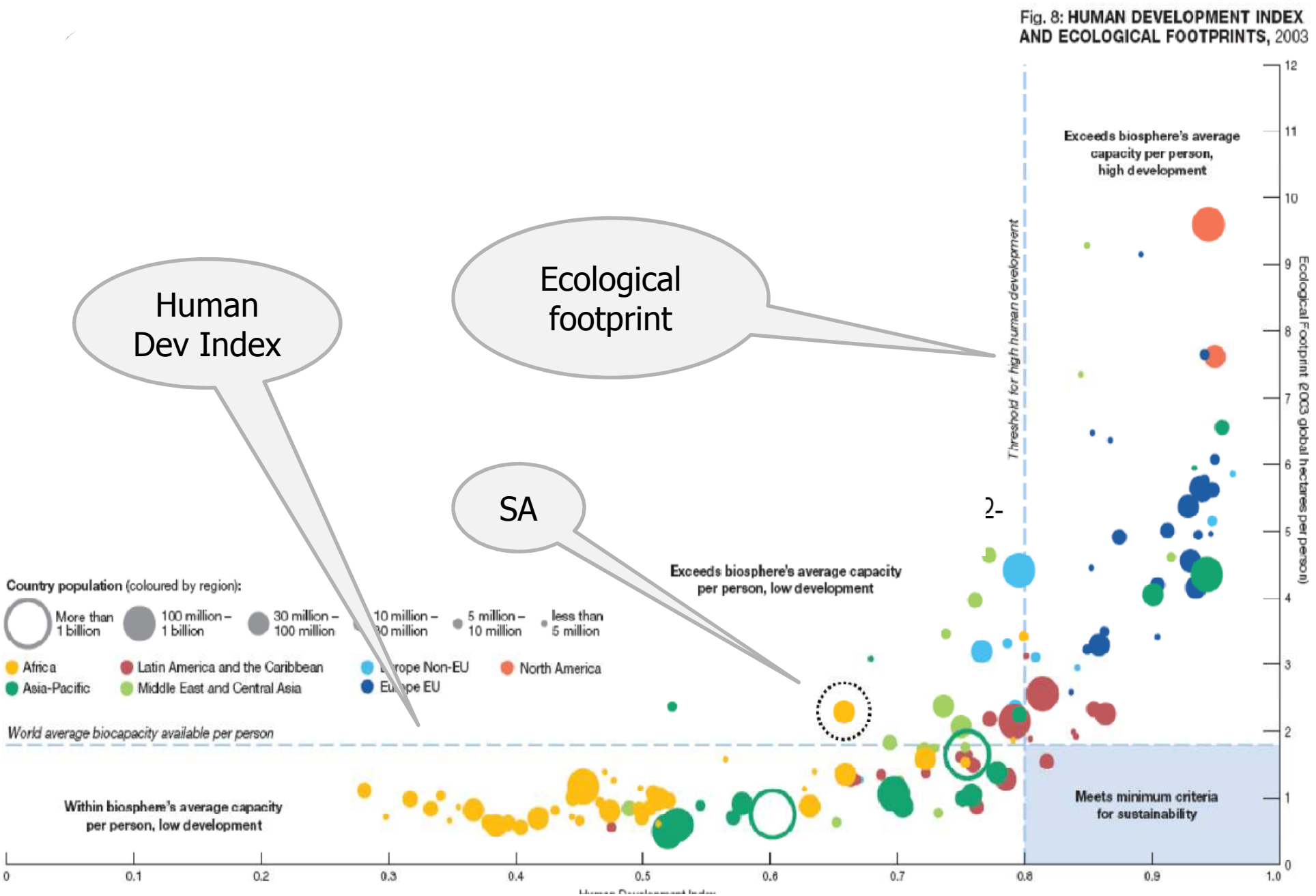
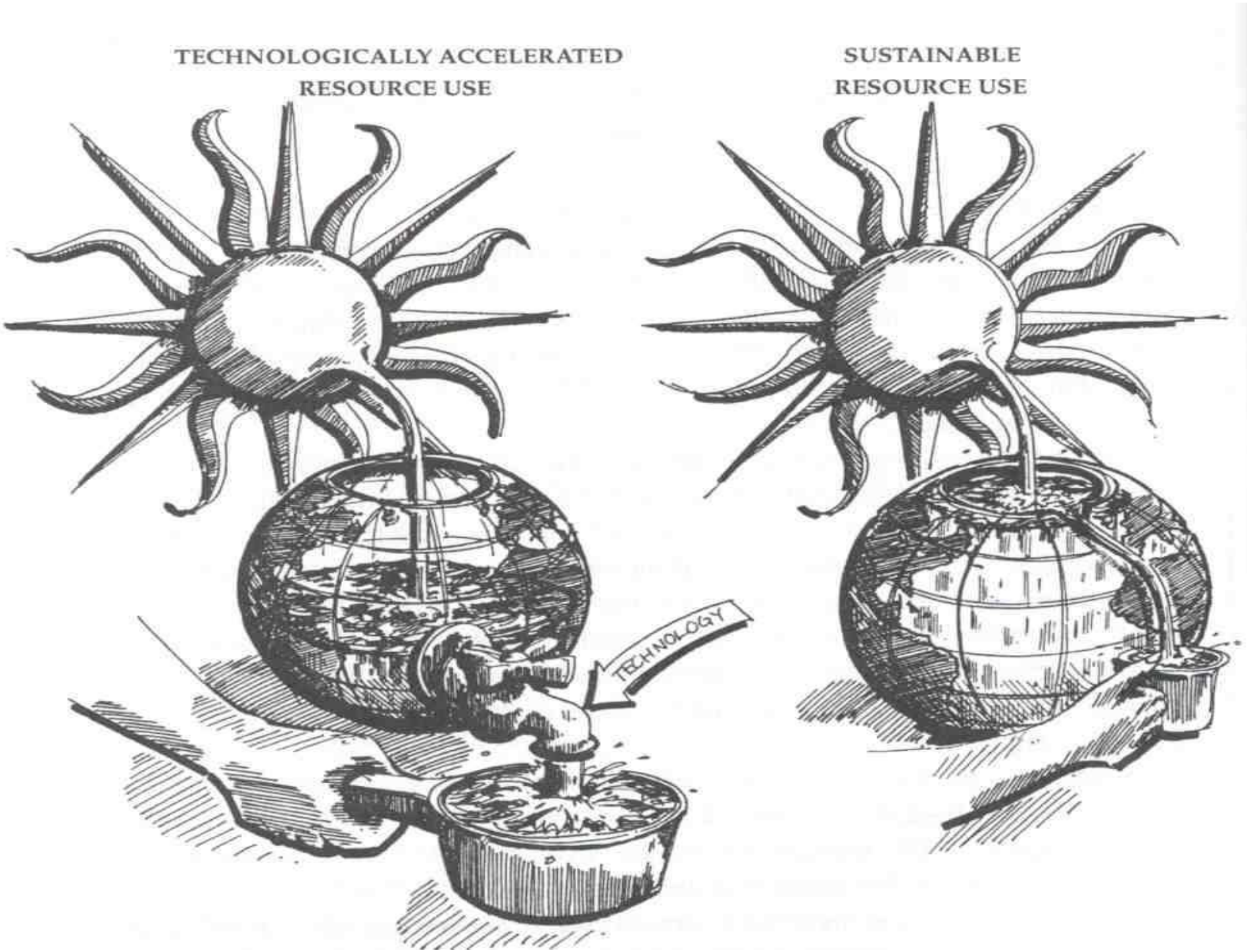


Fig. 8: HUMAN DEVELOPMENT INDEX AND ECOLOGICAL FOOTPRINTS, 2003
Human Dev Index
Ecological footprint
SA
Exceeds biosphere's average capacity per person, high development
Threshold for high human development
Ecological Footprint (2003 global hectares per person)
Exceeds biosphere's average capacity per person, low development
Country population (coloured by region):
More than 1 billion
100 million – 1 billion
30 million – 100 million
10 million – 30 million
5 million – 10 million
less than 5 million
Africa
Asia-Pacific
Latin America and the Caribbean
Middle East and Central Asia
Europe Non-EU
Europe EU
North America
World average biocapacity available per person
Within biosphere's average capacity per person, low development
Meets minimum criteria for sustainability
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Human Development Index
0
1
2
3
4
5
6
7
8
9
10
11
12


TECHNOLOGICALLY ACCELERATED
RESOURCE USE
SUSTAINABLE
RESOURCE USE
TECHNOLOGY

UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
ECONOMICS AND TRADE BRANCH

towards a green economy

A Global Green New Deal

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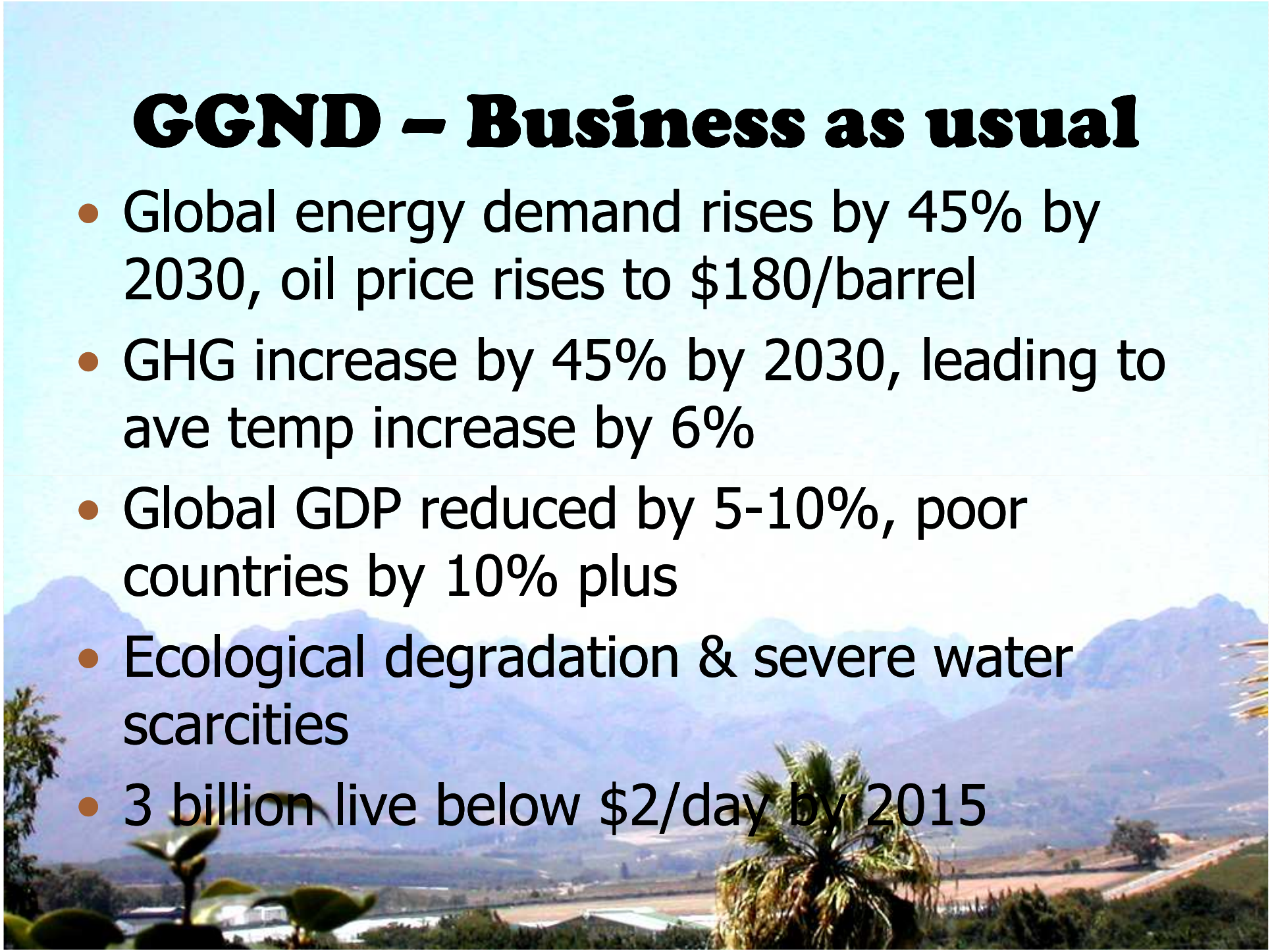
Report prepared for the Economics and Trade Branch, Division of Technology, Industry and Economics, United Nations Environment Programme

GGND – Business as usual

- Global energy demand rises by 45% by 2030, oil price rises to $180/barrel
- GHG increase by 45% by 2030, leading to ave temp increase by 6%
- Global GDP reduced by 5-10%, poor countries by 10% plus
- Ecological degradation & severe water scarcities
- 3 billion live below $2/day by 2015



Goals of a GGND

$2 - $3 trillion economic recovery package over next 2-3 years must be guided by the following 3 objectives:

- *Revive world economy, create employment & protect vulnerable groups*
- *Reduce carbon dependence, ecosystem degradation and water scarcity*
- *Further MDG of ending extreme world poverty by 2025*

Obama's 'Green New Deal'

$100 b of the $827 to create 2 million new jobs by:

- Retrofitting buildings – energy efficiency
- Expanding mass transit & freight rail
- Constructing a 'smart' electrical grid transmission system
- RE – wind, solar, 2nd-gen biofuels & bio-based energy
- Which transition?

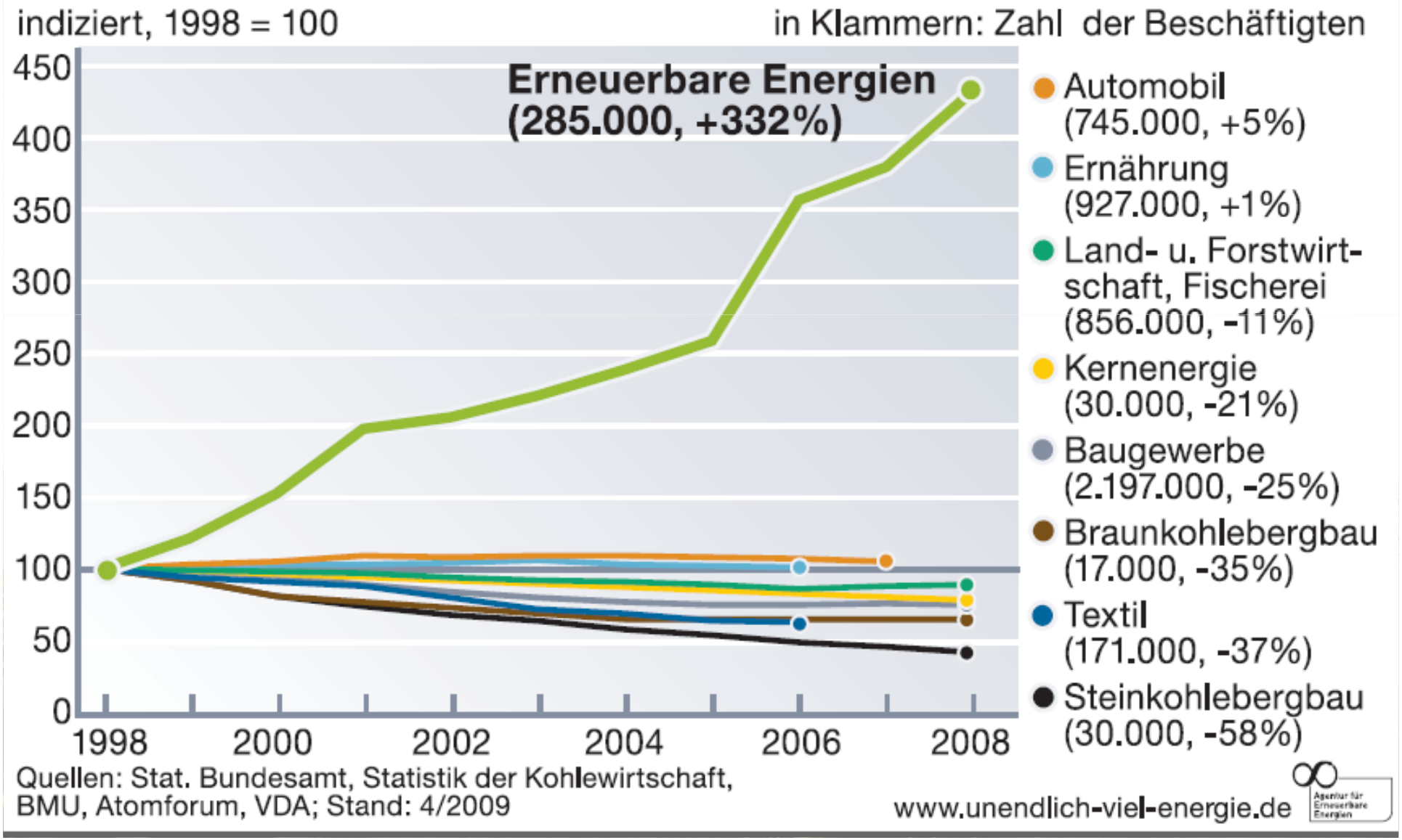
South Korea's GND

South Korea's Green New Deal		
Project	**Employment**	**US$ million**
Expanding mass transit and railroads	138,067	7,005
Energy conservation (villages and schools)	170,702	5,841
Fuel efficient vehicles and clean energy	14,348	1,489
Environmentally friendly living space	10,789	351
River restoration	199,960	10,505
Forest restoration	133,630	1,754
Water resource management (small and midsize dams)	16,132	684
Resource recycling (including fuel from waste)	16,196	675
National green information (GIS) infrastructure	3,120	270
Total for the nine major projects	**702,944**	**28,573**
Total for the Green New Deal	**960,000**	**36,280**

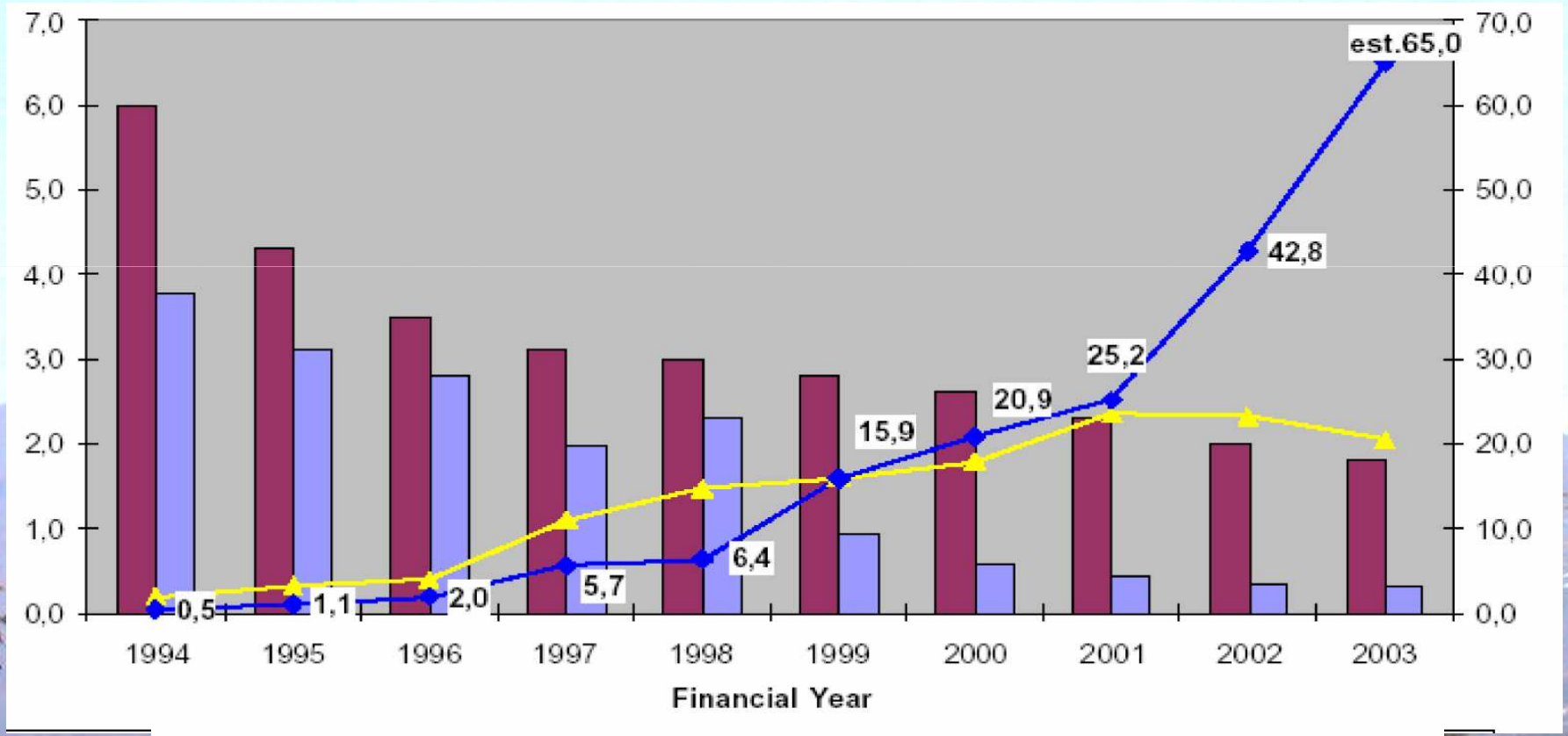
Green Jobs:

Towards decent work in a sustainable, low-carbon world

Job creation in Germany, 1998-2008

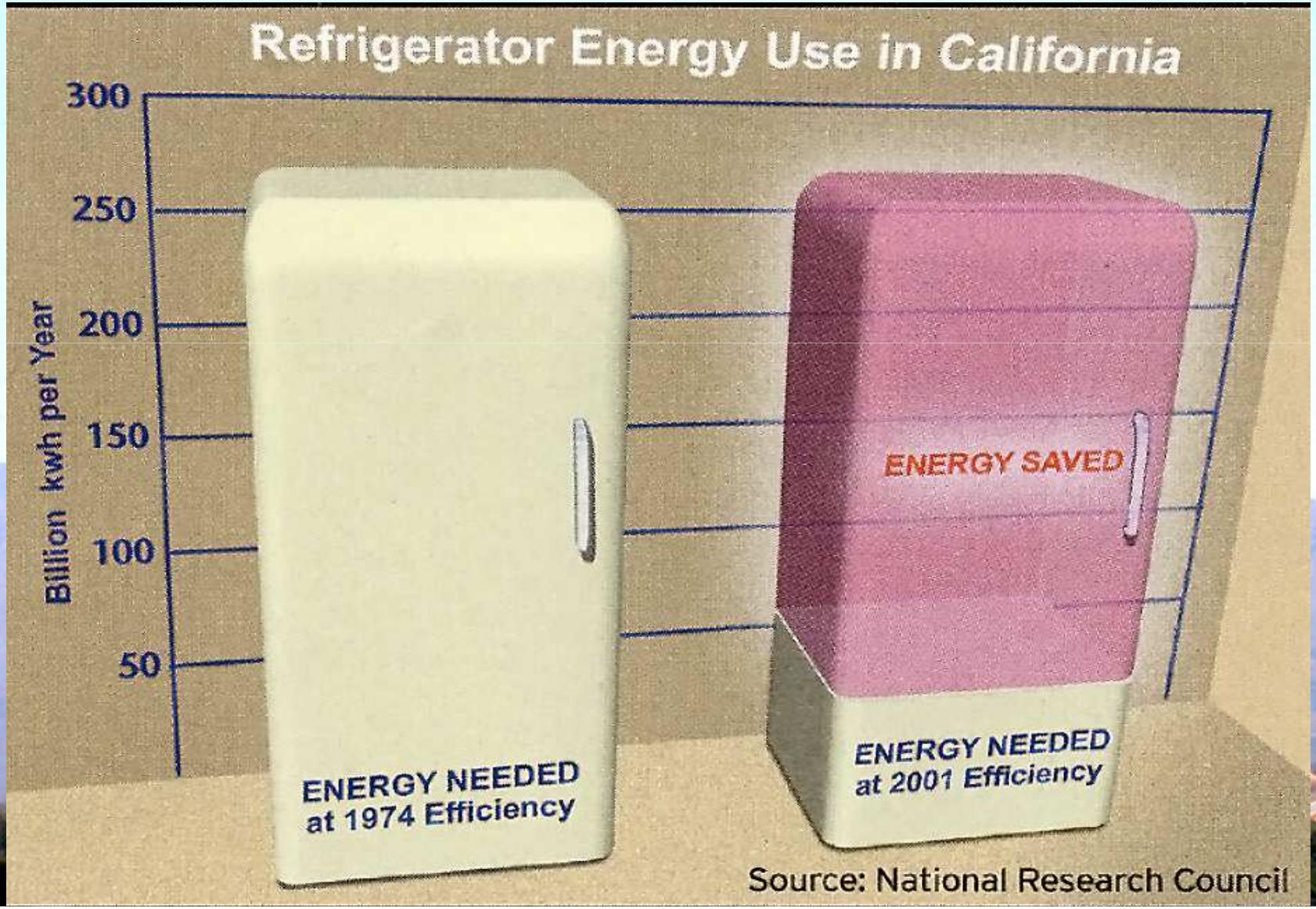


Japan: $1B, 10 years= Self-Sustaining Industry



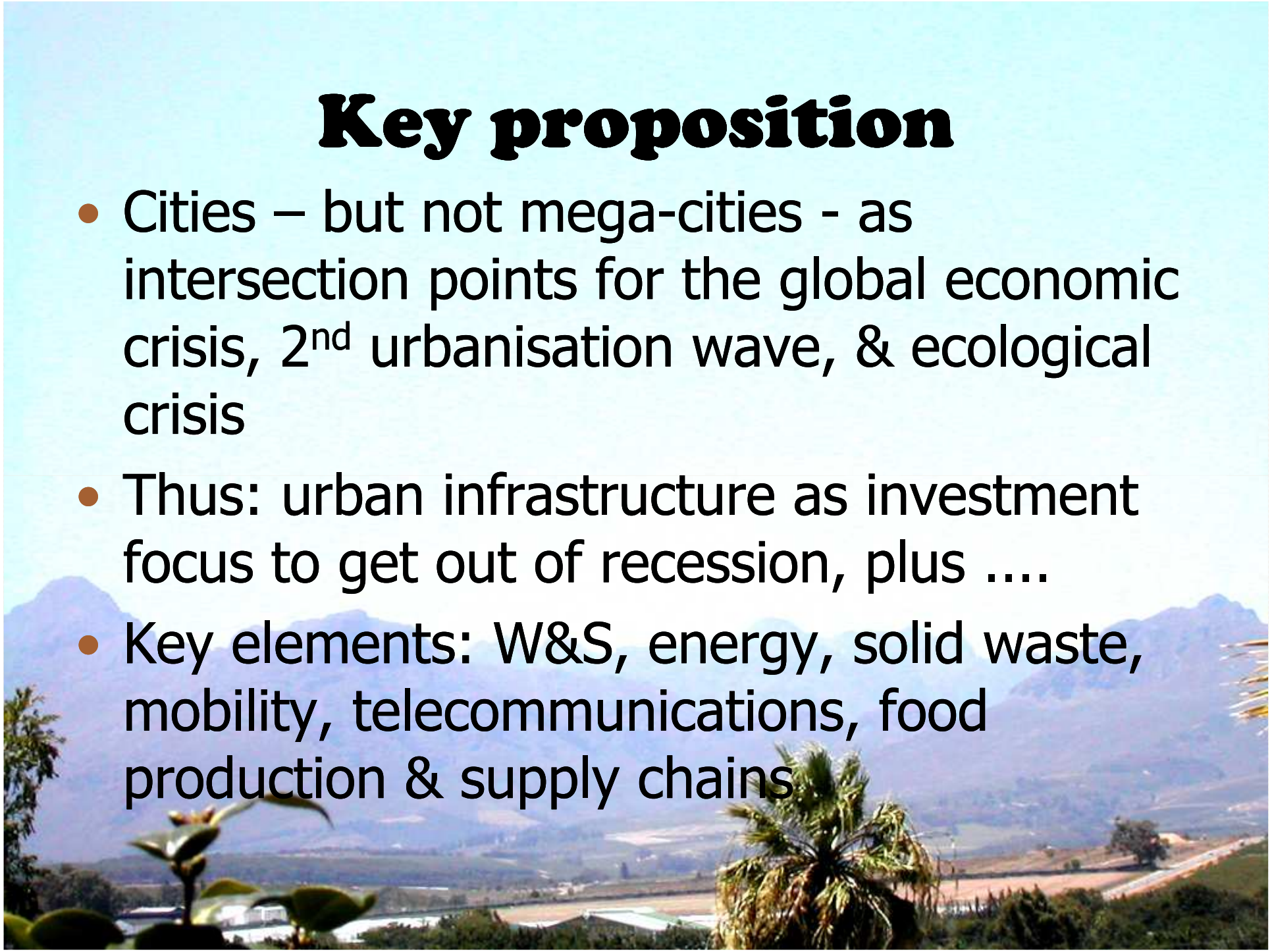
Sou

Efficiency revolution….



Key proposition

- Cities – but not mega-cities - as intersection points for the global economic crisis, 2nd urbanisation wave, & ecological crisis
- Thus: urban infrastructure as investment focus to get out of recession, plus ....
- Key elements: W&S, energy, solid waste, mobility, telecommunications, food production & supply chains



Million and MEGA Cities

- "Million" Cities:
  - 1950: 76
  - 1990: 276
  - 2015: 511
- 26 MEGA Cities (above 10 million people) by 2015, of which Tokyo, Mumbai, followed by equals Delhi, Mexico City, & San Paolo will be the largest
- No. of million cities will grow, but most megacities will not, some even declining – Mexico City, San Paulo, Buenos Aires, Calcutta & Seoul

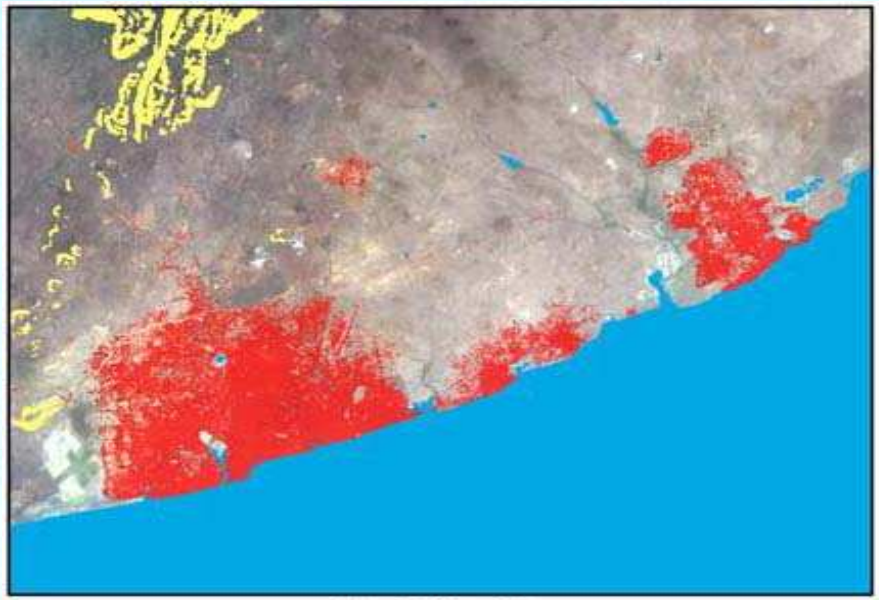
Future growth by 2015:

- Nearly 60% of the total urban population across high, low and middle income countries will live in cities of less than million people
- Around 25% will live in cities of 1 – 5 million people
- About 5% will live in cities of 6-10 million people
- 10% will live in cities of 10 million plus

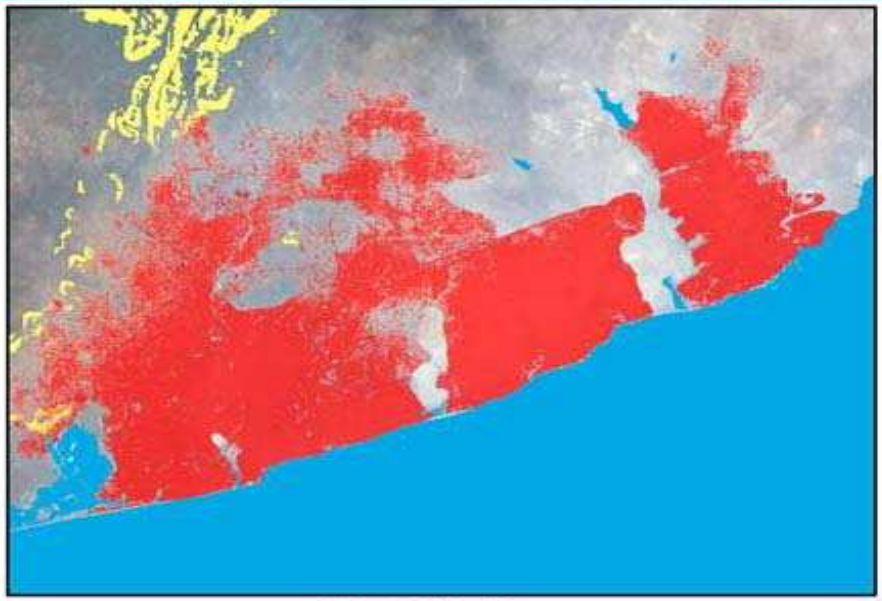
Urbanisation markers for Africa

- In 1900 Africa had no 'million cities', by 2000 it had 35
- 8 of the largest 100 cities in 2000 were in Africa
- Largest cities in Africa are now in SSA, rather than North Africa where they traditionally used to be
- 27 of the 100 fastest growing cities for the period 1950-2000 are in Africa (21 being national capitals)

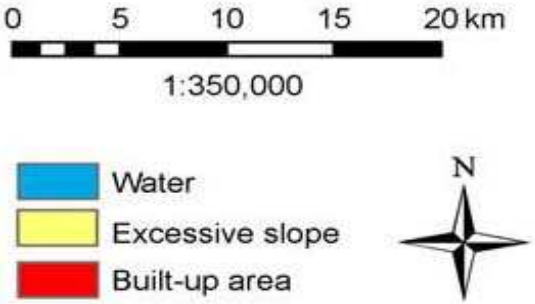
Accra, Ghana



T_1: 6-Mar-85



T_2: 4-Feb-00



Measure	T_1	T_2	Annual % Change
Population	1,882,990	2,789,380	2.67%
Built-Up Area (sq km)	133.35	344.26	6.56%
Average Density (persons / sq km)	14,120.39	8,102.64	-3.66%
Built-Up Area per Person (sq m)	70.82	123.42	3.79%
Average Slope of Built-Up Area (%)	3.11	3.11	0.01%
Maximum Slope of Built-Up Area (%)	12.28	12.28	0.00%
The Buildable Perimeter (%)	0.71	0.73	0.15%
The Contiguity Index	0.69	0.80	1.01%
The Compactness Index	0.68	0.61	-0.75%
Per Capita Gross Domestic Product	$1,325.50	$1,836.23	2.21%

Source: *The Dynamics of Global Urban Expansion*, Solly Angel et al, 2005

Urban Infrastructure

- $41 trillion – energy, water, transport
- Water = $22.6 trillion
- Energy = $9 trillion
- Road and rail = $7.8
- Air/sea ports = $1.6

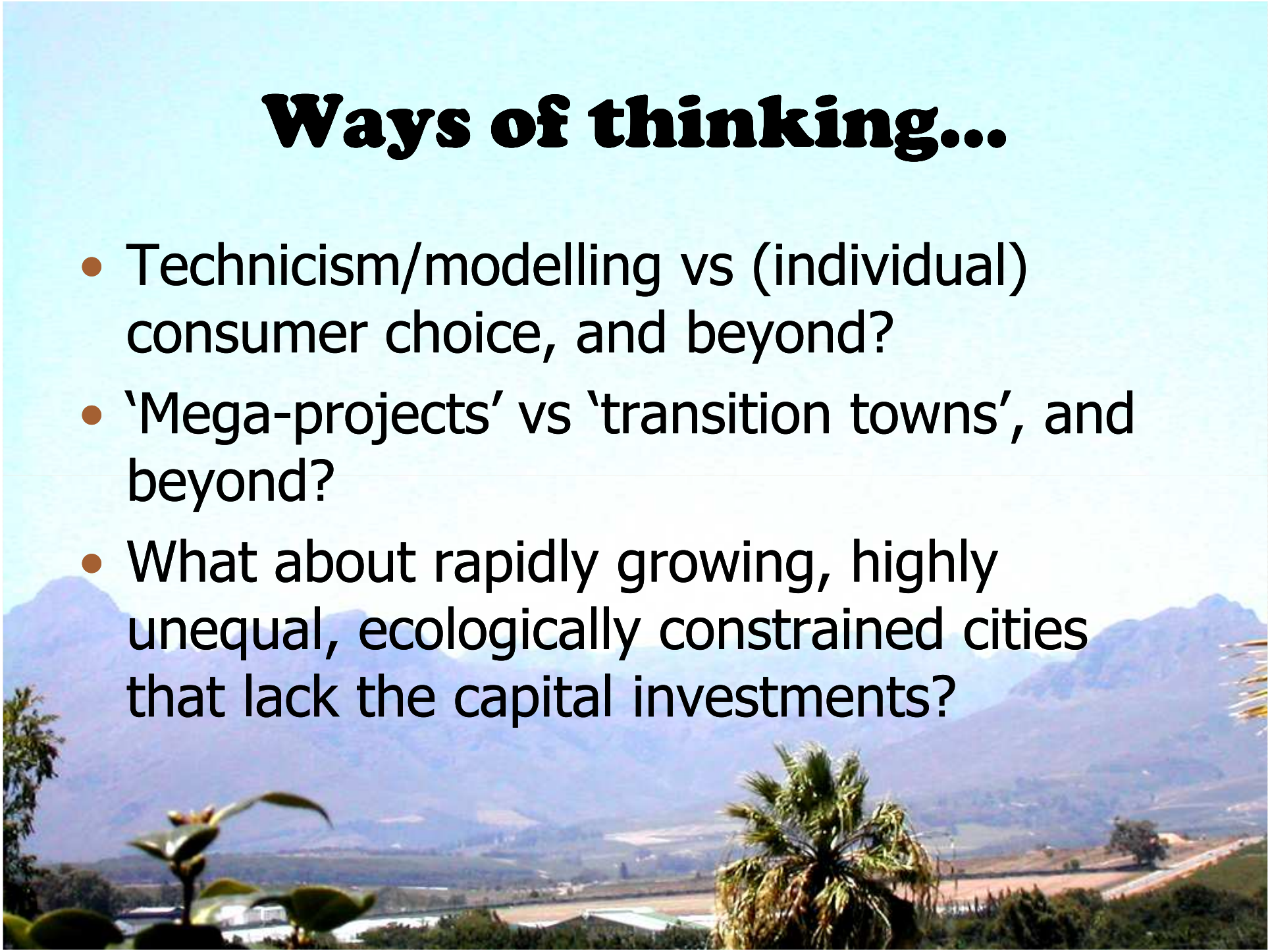
…more than the value of listed wealth in 2007

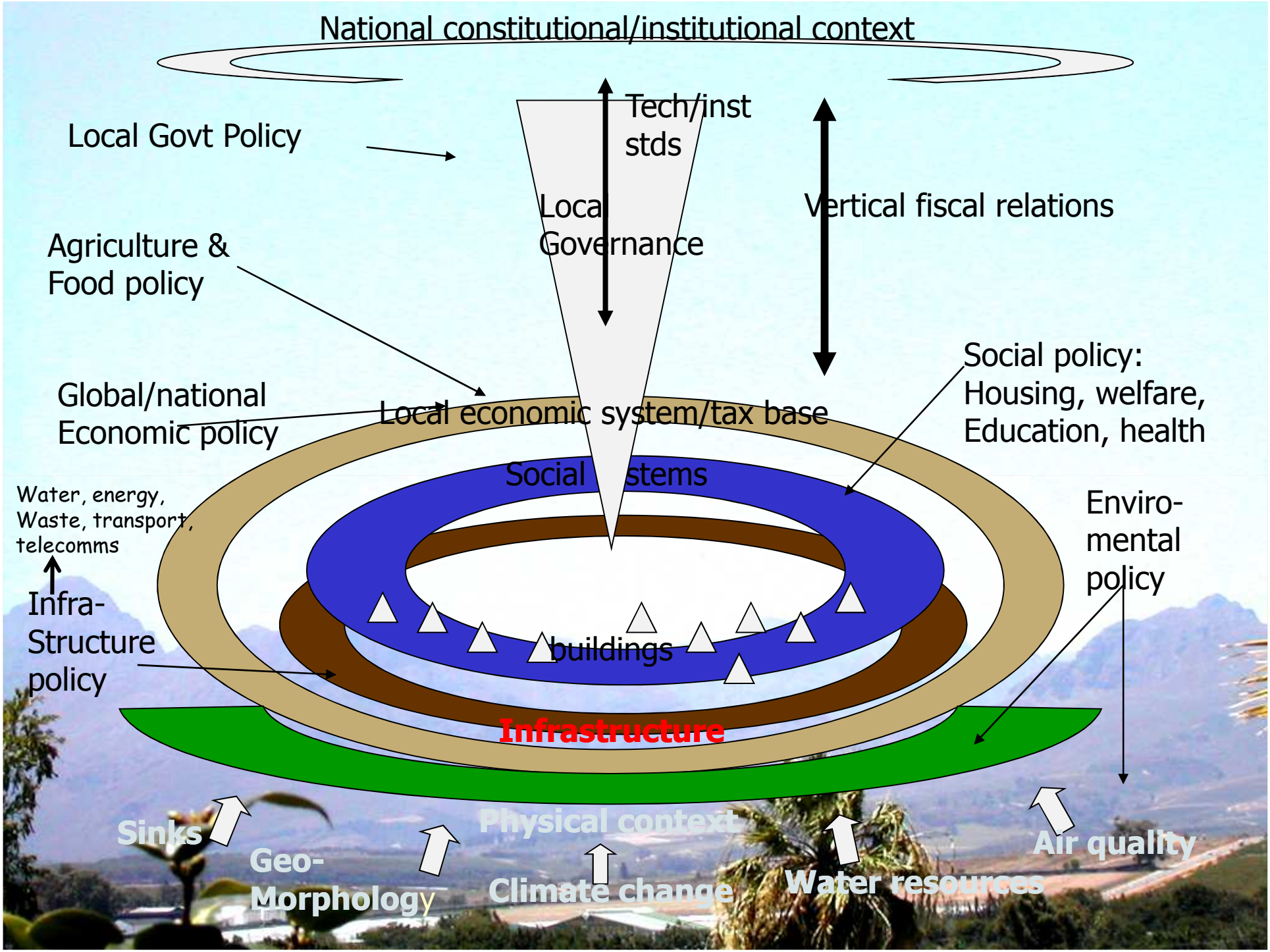
What kind of urban infrastructure? What technologies? Who sets the criteria?

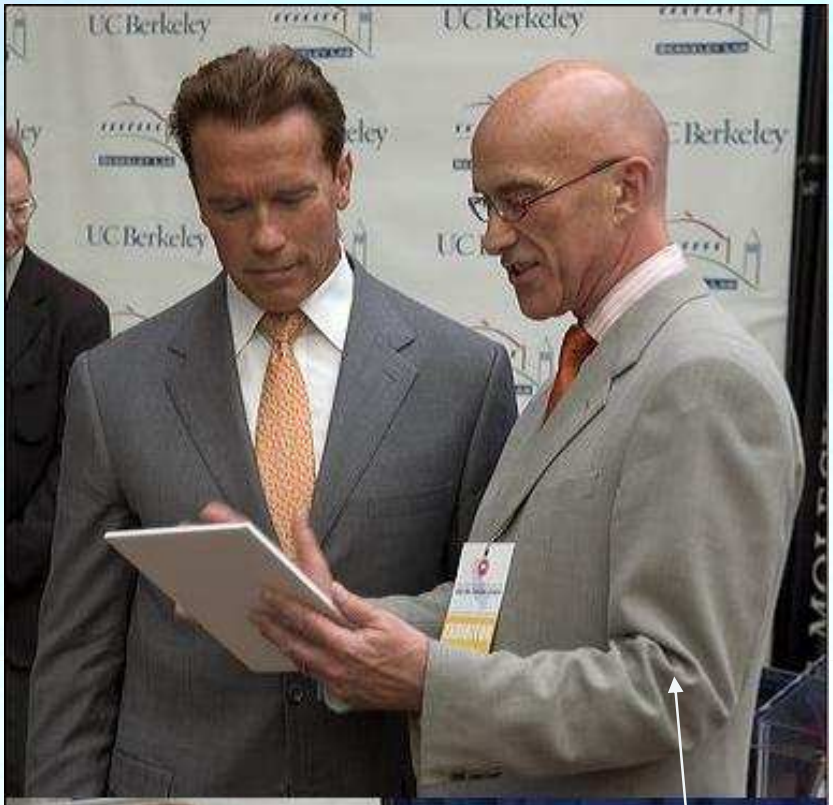
"…cities that ignore environmental impact will themselves face another collapse of infrastructure 30 or 40 years from now …" Booz Allen Hamilton, ***Strategy and Business***, 2007

Ways of thinking…

- Technicism/modelling vs (individual) consumer choice, and beyond?
- 'Mega-projects' vs 'transition towns', and beyond?
- What about rapidly growing, highly unequal, ecologically constrained cities that lack the capital investments?




National constitutional/institutional context
Local Govt Policy
Tech/inst stds
Local Governance
Vertical fiscal relations
Agriculture & Food policy
Social policy: Housing, welfare, Education, health
Global/national Economic policy
Local economic system/tax base
Social systems
Water, energy, Waste, transport, telecomms
Enviro-mental policy
Infra-Structure policy
buildings
Infrastructure
Physical context
Sinks
Geo-Morphology
Climate change
Water resources
Air quality



Gov. Arnold Schwarzenegger visits Berkeley Institute for the Environment – think tank for his ‘million solar rooftops’ campaign


Treasure Island, San Francisco, CA
- Total Conversion Plan


Kibera, Nairobi
Shackdwellers Internationa

Nairobi homeless federation – self-built housing, local stone

Curitiba – Quest for Sustainable Transit

Curitiba – Preserving City Greenspace

Dongtan/Chongming Island – Arup - "world's first ecocity"

Dongtan suburb

Ecological suburbia?

Old Chongming – 200 000 get relocated

Masdar – Norman Foster

Malawi homeless federation

Malawi – double story adobe


Sakhasonke, PE
4 4 2006

Lynedoch EcoVillage

The SA Case

"We have an opportunity over the decade ahead to shift the structure of our economy towards greater energy efficiency, and more responsible use of our natural resources and relevant resource-based knowledge and expertise. Our economic growth over the next decade and beyond cannot be built on the same principles and technologies, the same energy systems and the same transport modes, that we are familiar with today."

- South African Finance Minister Trevor Manual, Budget speech, Parliament February 20th, 2008

What proportion of the R800 m infrastructure investment package is green?

SA Trends

- Long-Term Mitigation Scenarios (LTMS) – July 2008
- National Framework for Sustainable Developme
  2008
- Renewable Energy Feed-In Tariff – 2009
- Sustainable water strategy – run out by 2013
- National Waste Management Act passed – 2009
- Air Quality Management Act passed – 2009
- DST's 10 Year Science Plan
- Green Budgets in 2008 and 2009 – new carbon taxes in 2010
- Commitment to public transport – BRT/Rail/etc
- DBSA's 'sustainable communities' programme
- 'greening' of the IDPs
- Incorporating sustainability into BNG

"South Africa simply has no more surplus water …"
Turton, CSIR

Sustainability Challenges in SA Cities

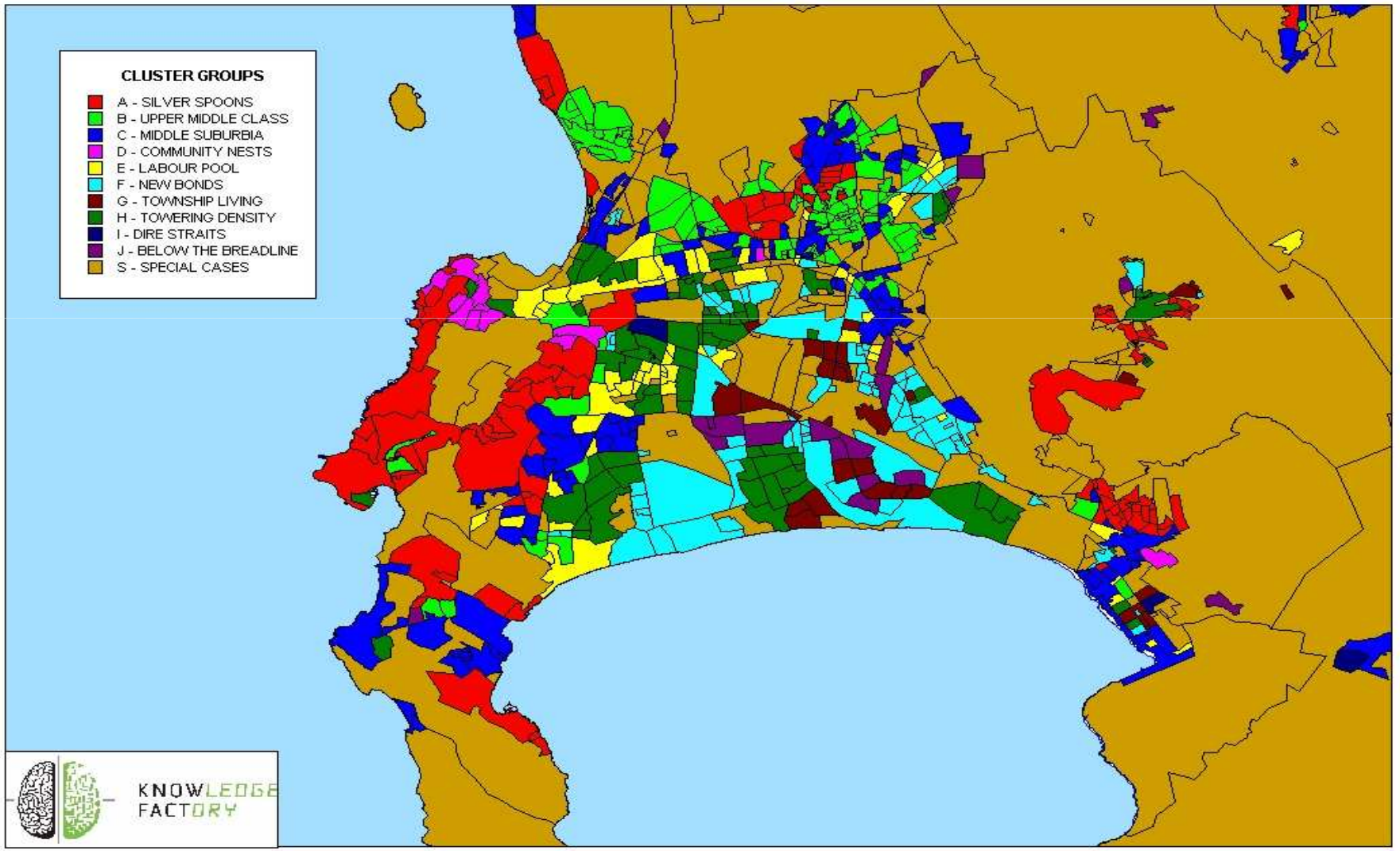
- Low density sprawl – subsidies & land
- Under-investment in public transport
- Energy inefficient & oil dependent
- Very little waste recycling
- Traditional sewage treatment technologies
- Water inefficient & wasteful
- Conventional building designs
- Fragmented urban infrastructure governance

Cape Town's footprint

- **Total footprint per capita – 4,28 ha**
- **South Africa – 4,02 ha**
- **Global fair share – 1,8 ha**
- **But highly unequal…**

Cluster Group	% of suburbs	No of households	% of total households
Silver Spoons	14	54 630	7
Upper Middle Class	19	68 129	9
Sub-total	*33*	*122 759*	*16*
Middle Suburbia	20	77 380	10
Community Nests	1.5	17 564	2
Labour Pool	9.5	42 404	6
New Bonds	13.5	101 638	13
Sub-total	*44.5*	*238 986*	*31*
Township Living	4.5	80 980	11
Towering Density	13	170 752	22
Dire Straits	2	26 108	3
Below the breadline	3	111 770	15
Sub-total	*22.5*	*389 610*	*51*

Cape Town by class



Cluster group	Key characteristics	% of total households in Cape Town	Planets required before/after eco-efficiency	
			before	*after*
Silver Spoons	elite, largest consumers, getting richer	7	14.8	2 - 3.8
Upper Middle Class	established, mature, conservative, professionals, gated	9	5.8	2
Middle Suburbia	tight budgets, mid-level jobs, bargain hunters, big spending on educating children	10	4.7 - 5.2	1.7
Community Nests	mixed, Afro-cosmo, shifting, small spaces, stylish, café culture, dense	2	2.4 - 2.7	1.1
Labour Pool	high density family neighbourhoods, stable jobs, secondary education, struggling	6	1.5	1
New Bonds	new SA families, youngish, targets of the developers	13	1 - 2	1
Township Living	old places, few jobs, youth cultures, soul of the new SA, buzzy, vulnerable	11	1	1
Towering Density	teetering, high hopes, few options, the educated leave as soon as possible, limited reinvestment	22	1	1
Dire Straits	old places, overcrowded, services collapsing, high unemployment, decaying	3	1	1
Below the breadline	shack settlements, desperation, insecurity	15	1	1

Energy Capacity for CT

- Total: 4939 MW of installed capacity
- 2006 peak use: 10 m MWh
- 2400 MW: coal via grid, transmission lines
- 1800 MW: nuclear- Koeberg
- 739 MW: pumped storage & gas

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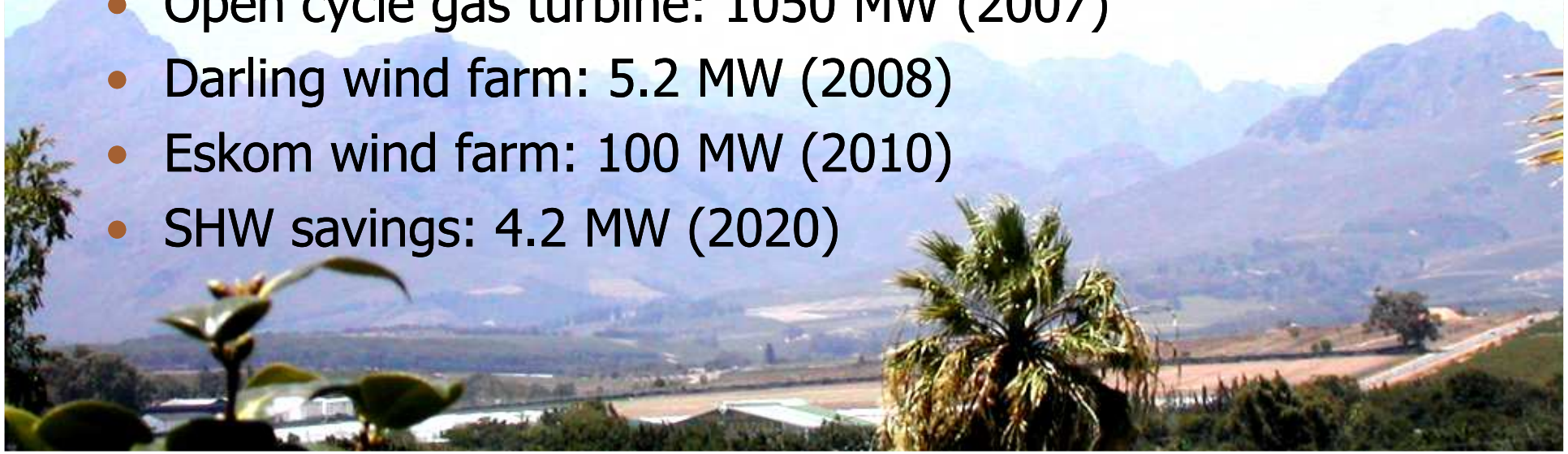
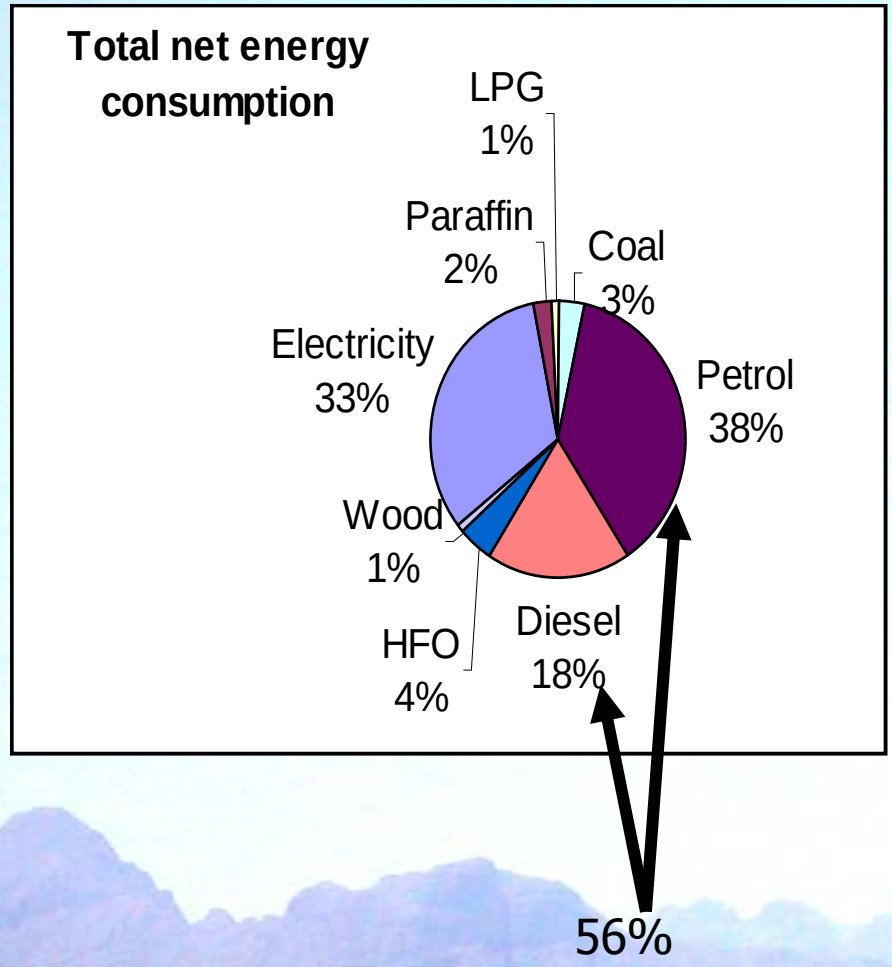
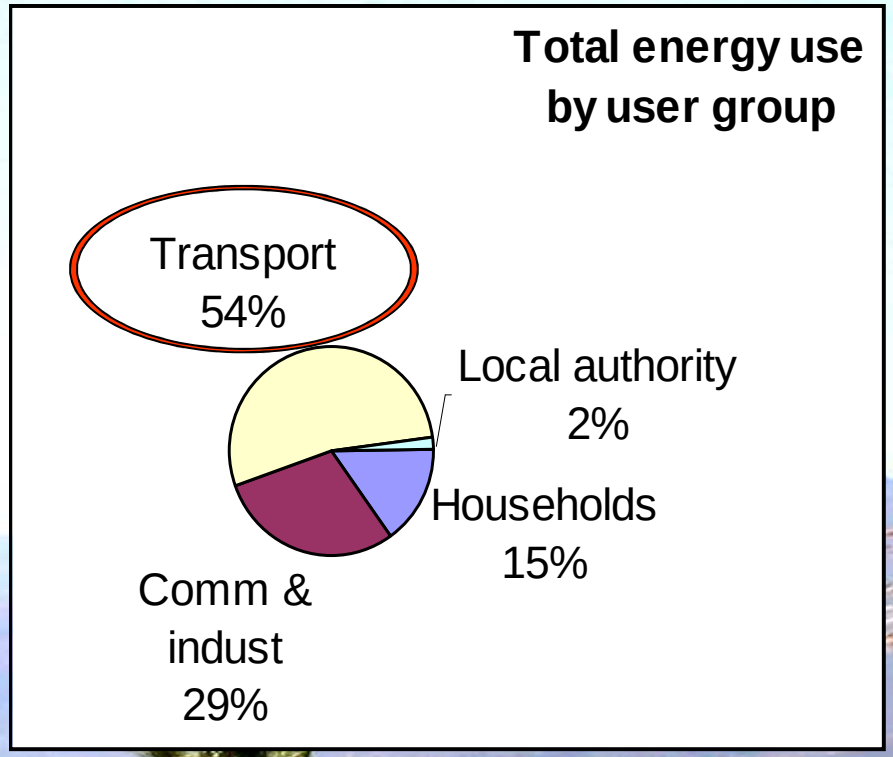
- Open cycle gas turbine: 1050 MW (2007)
- Darling wind farm: 5.2 MW (2008)
- Eskom wind farm: 100 MW (2010)
- SHW savings: 4.2 MW (2020)



Cape Town

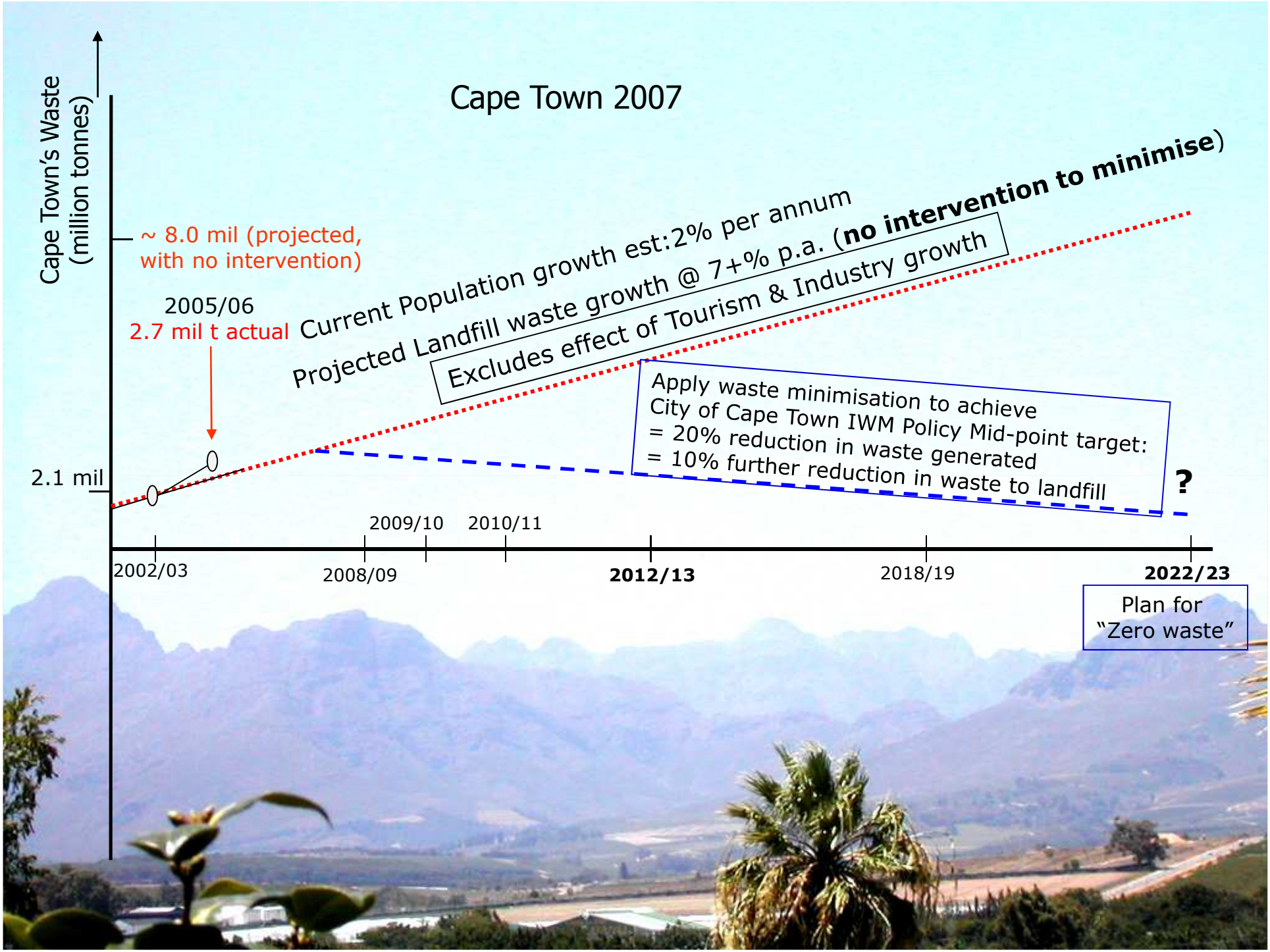

Total net energy consumption
LPG 1%
Paraffin 2%
Coal 3%
Electricity 33%
Petrol 38%
Wood 1%
HFO 4%
Diesel 18%
56%


Total energy use by user group
Transport 54%
Local authority 2%
Households 15%
Comm & indust 29%

Waste crisis threatens to engulf city

Landfill sites filling up too rapidly

Cape Argus 12-Apr-2007 p. 4


Cape Town 2007
Cape Town's Waste (million tonnes)
~ 8.0 mil (projected, with no intervention)
2005/06
2.7 mil t actual
Current Population growth est:2% per annum
Projected Landfill waste growth @ 7+% p.a. (no intervention to minimise)
Excludes effect of Tourism & Industry growth
Apply waste minimisation to achieve
City of Cape Town IWM Policy Mid-point target:
= 20% reduction in waste generated
= 10% further reduction in waste to landfill
?
2.1 mil
2002/03
2008/09
2009/10
2010/11
2012/13
2018/19
2022/23
Plan for "Zero waste"

Water in CT

- Water: unrestricted demand = 510 million m3 p.a., max supply – 475; R1.4 b for Frhk dam,
- 61% of fresh water flushes sewerage, no investment in recycling
- Most polluted rivers in SA
- Signs of decoupling since 2001, i.e. total consumption growth slower than econ growth and population growth

Trends in demand for EWWS

- Economy growing at 4-5%
- Population rate of growth declining but
  - Mainly in-migration of poor people
  - Housing backlog - 300 000 units and growing, 120 000 in informal settlements
- Decreased water use per capita
- Decreased rate of growth in electricity use
- Explosion in solid waste generation

Figure 4: Water use, City of Cape Town, 1996-2006 (l/pp/day)

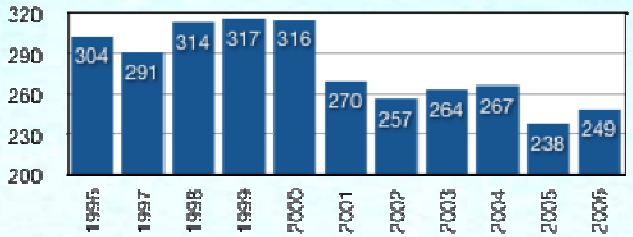


Figure 6: Growth in electricity use, City of Cape Town (YoY%)

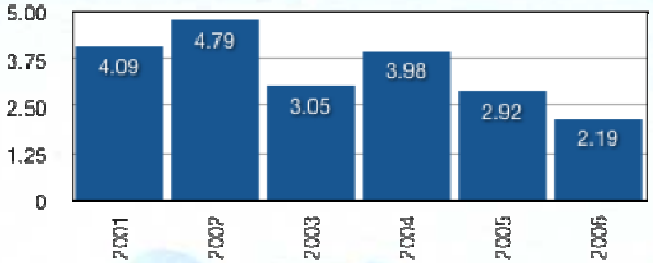
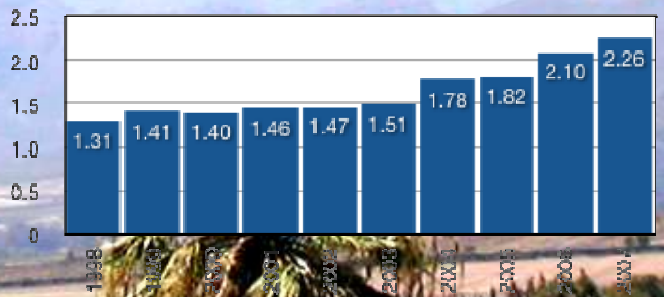
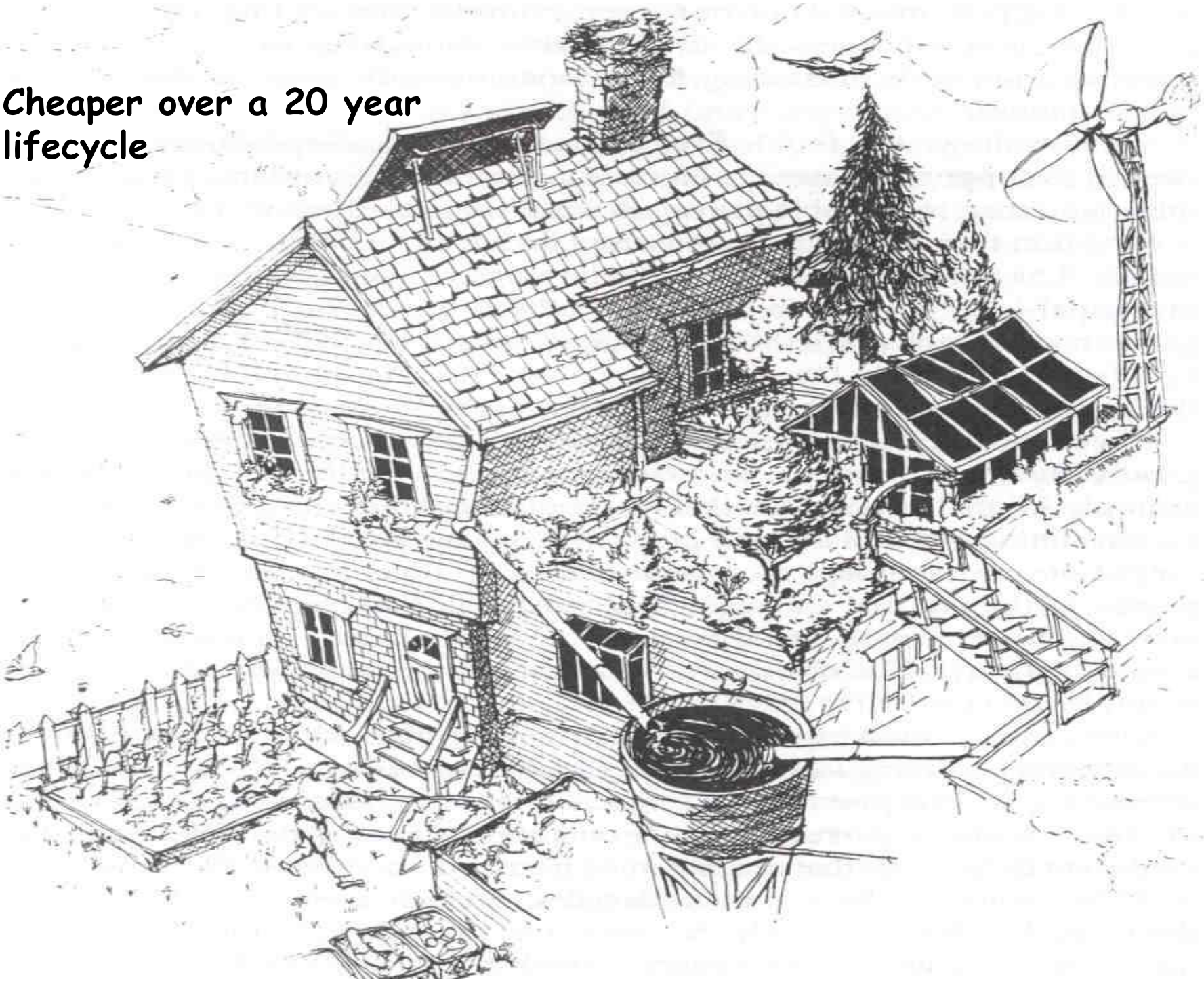


Figure 7: Solid waste generation, City of Cape Town (kg/pp/day)

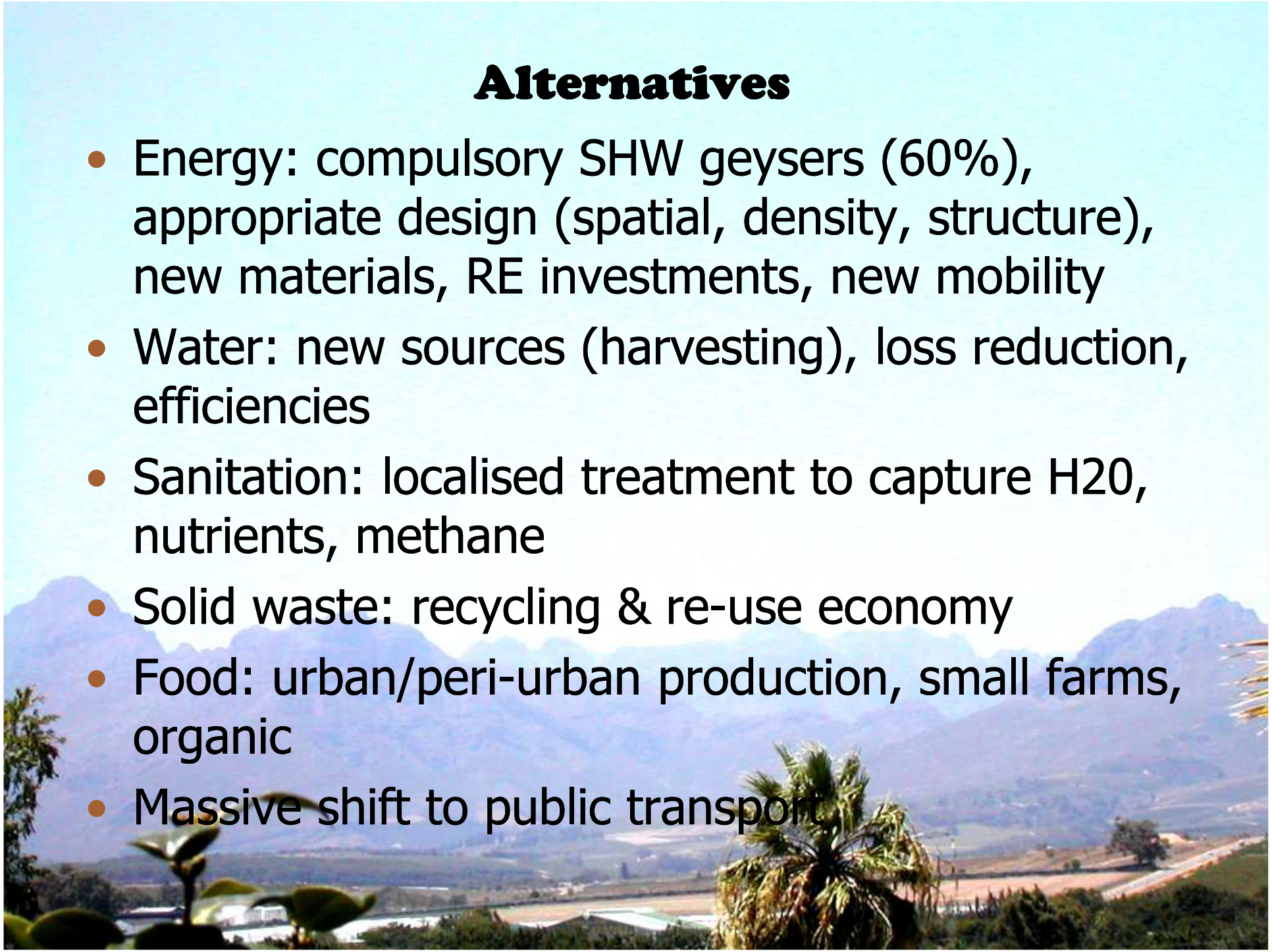


Cheaper over a 20 year lifecycle



Alternatives

- Energy: compulsory SHW geysers (60%), appropriate design (spatial, density, structure), new materials, RE investments, new mobility
- Water: new sources (harvesting), loss reduction, efficiencies
- Sanitation: localised treatment to capture H20, nutrients, methane
- Solid waste: recycling & re-use economy
- Food: urban/peri-urban production, small farms, organic
- Massive shift to public transport



Some key CT projects

- BRT
- Cape Town Station
- Kosovo upgrade
- Oude Molen
- Philippi Cement Factory
- CBD development strategy
- New buildings
- Wind farm
- Energy efficient buildings drive
- Green building by-laws?
- SHW by-law?