

Sustainable Production and Consumption: Integrating environmental, economic and social aspects of sustainability

Adisa Azapagic

The University of Manchester, UK

adisa.azapagic@manchester.ac.uk

Plenary talk 17th European Roundtable on Sustainable Consumption and Production, Portoroz, 14-16 Oct 2014



Sustainability challenges

OPopulation growth ORapid urbanisation • Food supply OWater access OEnergy demand OClimate change OResource scarcity OProfligate consumption







Population growth (1992-2010)



UNEP, 2011



Food supply





Water access

3 bn people will be living in water scarce areas by 2025



CAWMA, 2007. Earthscan, and Colombo, London.



Providing energy: Primary energy demand





IEA, 2012. World Energy Outlook

Climate change: GHG emissions doubled since 1970



Sustainable Industrial Systems

UNEP, 2012

Systems approach and life cycle thinking: Integrating sustainability aspects



Some sustainability issues

Resource depletion

Energy

Air pollution

Water pollution

Shareholder value

Costs

Investments

Waste

Contribution to GDP

Profits

Value added

Employment

Health and safety

Equal opportunities Stakeholder involvement **Customer satisfaction**

Global warming

Ozone depletion

Acidification

Biodiversity

Toxicity

Education

Wages and benefits



Some examples



Energy: The life cycle





Key sustainability issues for energy

Fossil fuels

OClimate change

OSecurity of supply

OFuel poverty









Drivers: Fossil fuels and climate change





Some other environmental impacts



Stamford & Azapagic (2012). Int. J. Energy Res. 36 1263–1290.



Some techno-economic aspects





Social impacts





Stamford & Azapagic (2012). Int. J. Energy Res. 36 1263–1290.

The life cycle of resources



Key sustainability issues for resources

OProfligate and inequitable use



Lack of/low reuse and recycling
 90% of products become waste within 6 months

Increasing scarcity

OThe number of chemical companies affected by resource scarcity may triple by 2020 (IChemE)



Resource scarcity: Critical elements



[243

[247]

[247]

[251]

Adapted from Mike Pitts, TSB/CIKTN and Hunt et al. (2013)

232.04

231.04



[259]

How much is recycled?

Recycling rates



*Lanthanide series	lanthanum 57	cerium 58	praseodymium 59	neodymium 60	promethium 61	samarium 62	europium 63	gadolinium 64	terbium 65	dysprosium 66	holmium 67	erbium 68	thulium 69	ytterbium 70
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Но	Er	Tm	Yb
	138,91	140.12	140.91	144.24	[145]	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.04
* * Actinide series	actinium	thorium	protactinium	uranium	neptunium	plutonium	americium	curium	berkelium	californium	einsteinium	fermium	mendelevium	nobelium
	89	90	91	92	93	94	95	96	97	98	99	100	101	102
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
	[227]	232.04	231.04	238.03	12371	[244]	12/121	[247]	12471	[251]	[252]	12571	[258]	[259]



Adapted from Hunt et al. (2013)

Sustainable resource management

Catalysis: many of the critical elements used as catalysts: e.g. PGMs, Co, Ce, Ge, Sb, In

- O Use of non-critical metals
- Use of non-metallic catalysts, e.g. enzymes

- WEEE (50 million t/yr)
- MSW (1.6 bn t/yr)
- ORoad dust (PGMs)
- Landfills



Delivering service rather than product



The life cycle of food



Key sustainability issues for food

GHG emissions
Eutrophication
Waste
Land competition
Food security
GMO and stem cells





Meet production

- 300 million tonnes of meat worldwide (2012)43 kg of beef per capita
- 1 kg of beef:
 50 kg of feed
 15,400 litres of water
 15-30 kg CO₂ eq.



OBeef production: 66.7 million tonnes/yr...



Meat replacement: Stem cells?



Research by Mark Post, Maastricht University, 2013



Environmental impacts of meat vs meat from stem cells



Tuomisto et al. Env. Sci.&Tech. 2011



Other sustainability issues

Taste
Appearance (white!)
Health impacts
Consumer acceptance
Ethical issues





Sustainable production and consumption

Requires systems approach and life cycle thinking

Integration of economic, environmental and social trade offs is essential

OProviding robust evidence for policy makers

OUnderstanding consumer behaviour



New journal on Sustainable Production and Consumption

Published by Elsevier
 Editor-in-Chief:
 Adisa Azapagic



