Sustainable Development - an Engineering Challenge & Recommended Steps to Take

by Göran Wall*

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10:00-10:45

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http://www.exergy.se

G. Wall, "On Education towards Sustainable Development", Dept. Education, GU, http://www.exergy.se/ftp/oetsd.pdf.

- The present unsustainable situation
- Basic Physical Concepts - Energy & Exergy
- Basic Physical Facts
- Nature's Engineering
- Society's Engineering
- Nature's Response
- Sustainable Development
- Reflections and recommendations
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  - International exchange of on line courses at UIS
  - MSc in Exergy & Sustainable Development
  - Sustainable Projects at UIS
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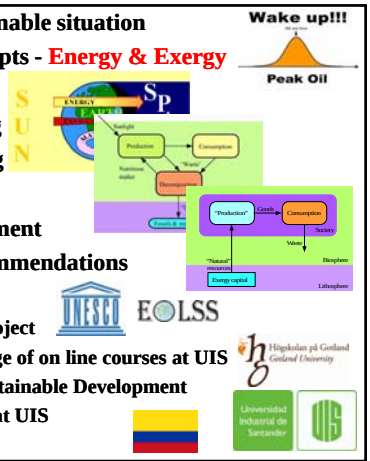
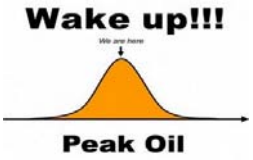
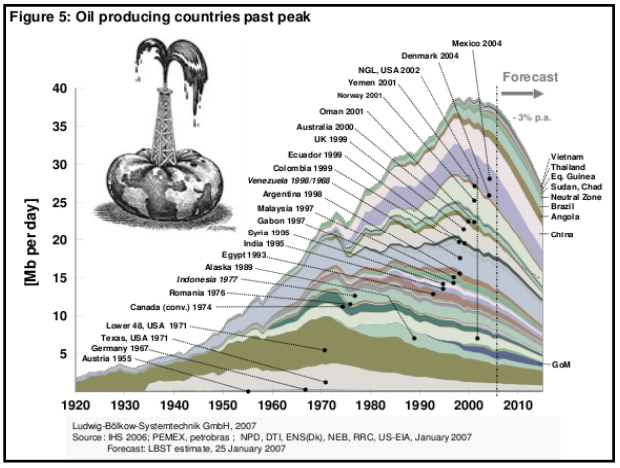


"In a world rapidly running out of fossil fuel, the second law of thermodynamics may well turn out to be the central scientific truth of the twenty-first century."

Prof. David Goodstein, *Nature*, Vol. 368, 14 April, 1994, p. 598.
Department of Physics, California Institute of Techn., Pasadena, California 91125, USA





Basic Physical Concepts

G. Wall, "Exergetics", textbook 151 p., 2009.
http://www.exergy.se/ftp/exergetics.pdf.

Zoran Rant 1953 (publ. 1956):

Exergy from Greek ***ex*** = out or out of and ***ergos*** = work

Energy from Greek ***en*** = internal

Energy = motion or ability of motion

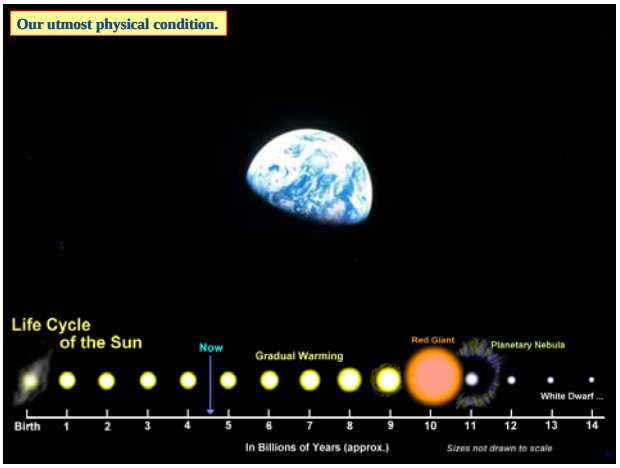
Everything that happens involves conversion and conservation of energy. (1st Law of Thermodynamics)

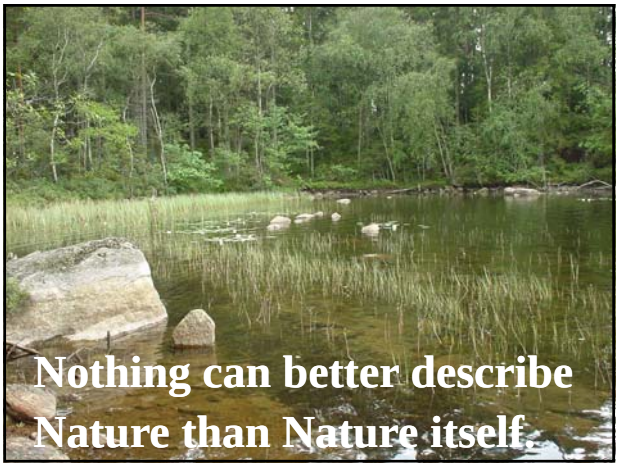
Exergy = work (ordered motion) or ability of work

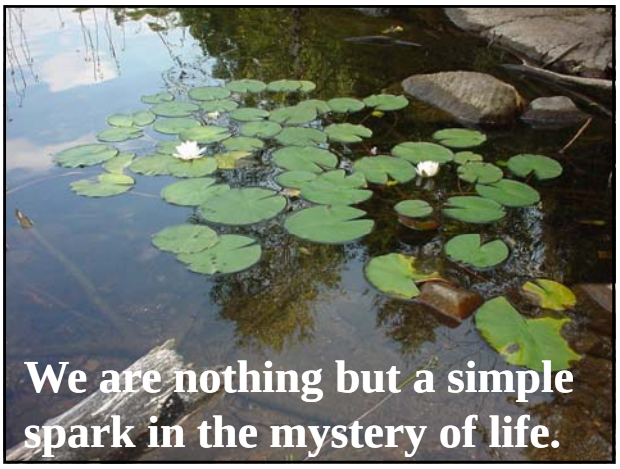
Everything that happens involves destruction of exergy. (2nd Law of Thermodynamics)

Basic Physical Facts

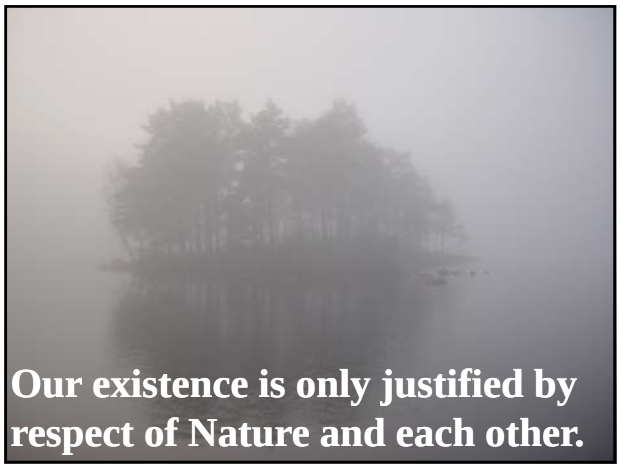
G. Wall, "Exergy and Sustainable Development", draft report 36 p., 2005.
http://www.exergy.se/ftp/easd.pdf.



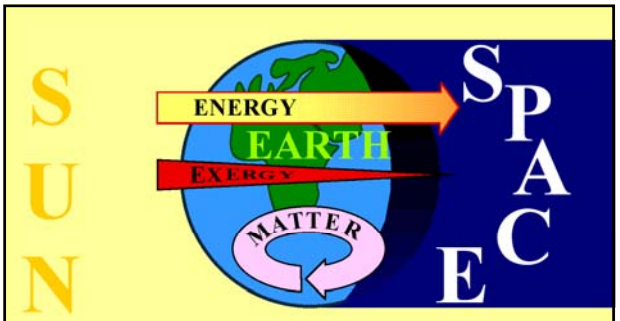




We are nothing but a simple spark in the mystery of life.

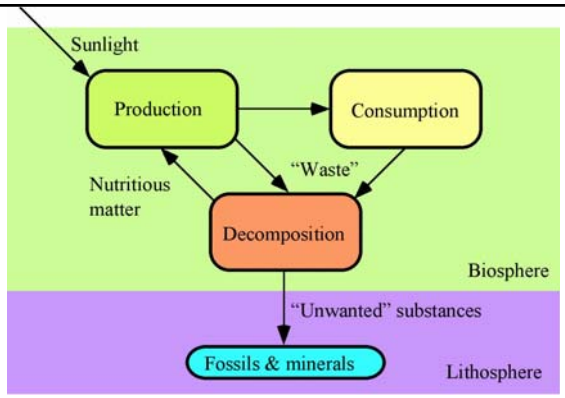


Our existence is only justified by respect of Nature and each other.



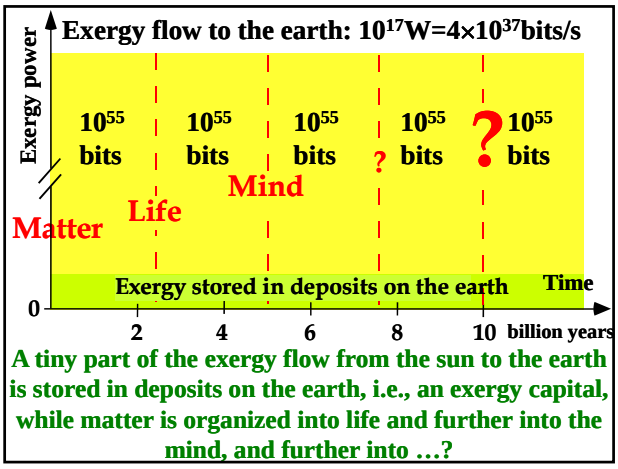
Earth is unique to life due to its size and position in the contrast of Sun and Space.

Nature's Engineering



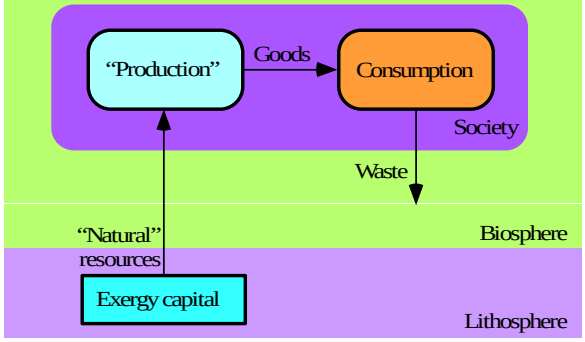
Unwanted substances are sealed in exergy deposits of minerals in the crust - an exergy capital - in order to create vital conditions for life.

Unwanted substances are sealed in exergy deposits of minerals in the crust in order to create vital conditions for life. The increase of the exergy capital of the Earth is of essential importance for the evolution of nature.



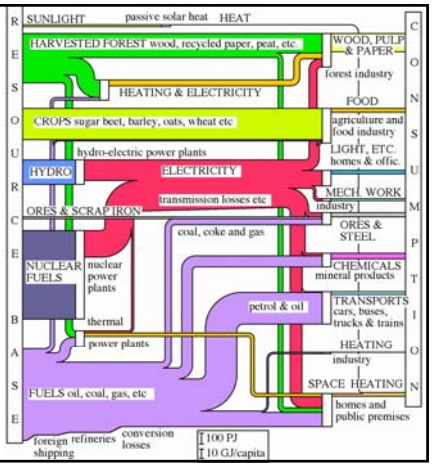
A tiny part of the exergy flow from the sun to the earth is stored in deposits on the earth, i.e., an exergy capital, while matter is organized into life and further into the mind, and further into …?

Society's Engineering

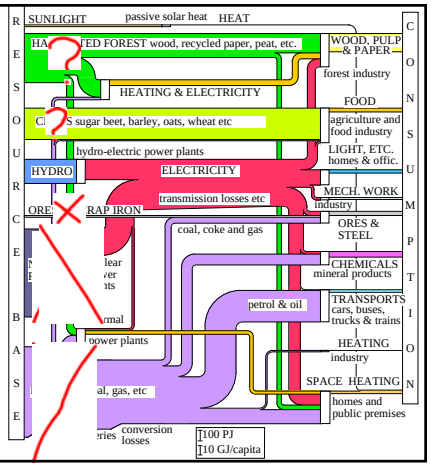


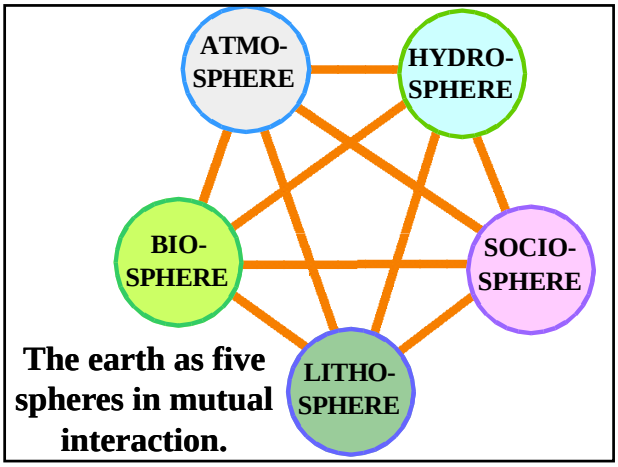
The industrial society exploits and destroys the exergy capital in an unsustainable manner that inevitably leads to an ecological and social catastrophe.

Exergy use in the Swedish society in 1994.

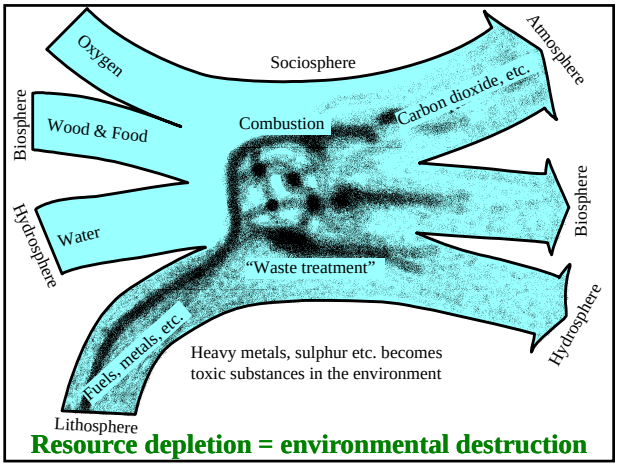


Obviously the present exergy use cannot be made sustainable the only solution is to use less exergy





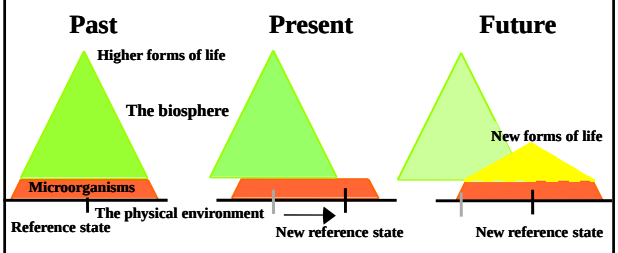
The earth as five spheres in mutual interaction.



Resource depletion = environmental destruction

Nature's Response?

Germs on the tip of a needle

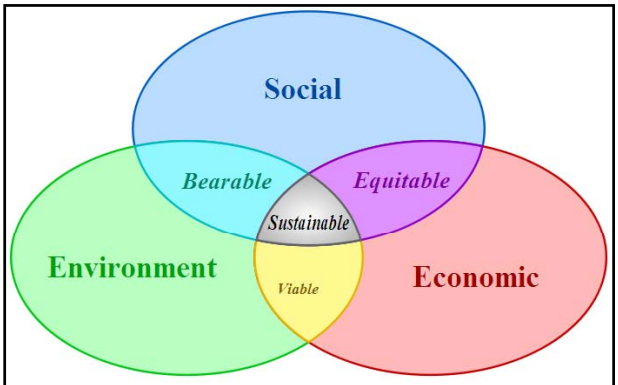


"Survival of the Fittest" is a driving force in natural evolution.
Thus, present industrial society is fertilizing its own extinction.

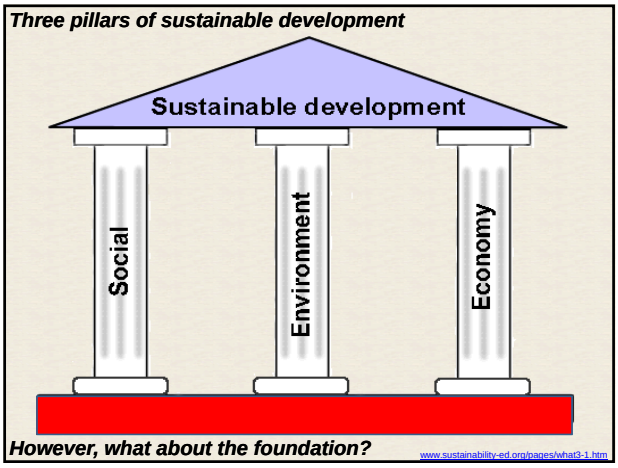
Sustainable Development

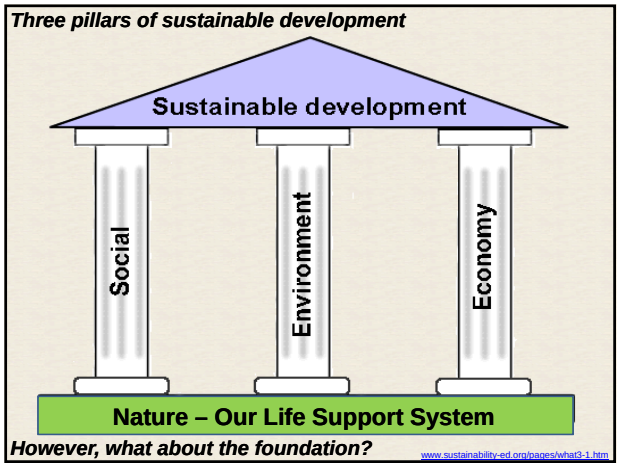
The most used definition on Sustainable development is from World Commission on Environment and Development (WCED). *Our common future*. Oxford: Oxford University Press, 1987 p. 43:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.



Sustainable development as the confluence of the environment, the economy and the society.





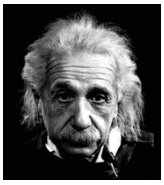
Since: The present unsustainable situation is due to altered physical conditions on earth that is threatening the conditions for human life.

Thus, a relevant question must be: Must we look beyond present religious, economical and political structures to find the conditions for a sustainable development?

Or, what is the dependence between Nature and Society?

Reflections and recommendations

We can't solve problems by using the same kind of thinking we used when we created them.



Albert Einstein

•The problem is not lack of resources.
•The problem is that we use too much.
•The solution is to live with less.

Science and engineering need a paradigm based on morals and respect of Nature.

A new paradigm

Only cultures that live in harmony with Nature will be sustainable. This implies a new engineering paradigm based on caring for Nature instead of exploiting it.

We do not inherit Earth from our ancestors; we borrow it from our children.

Some Small Steps

UNESCO

- ENCYCLOPEDIA OF LIFE SUPPORT SYSTEMS

The Largest On-line Encyclopedia

- An Integrated Virtual Library

A source of knowledge for sustainable development and global security to lead to fulfillment of human needs through simultaneous socioeconomic and technological progress and conservation of the Earth's natural systems.

UNESCO www.eolss.net EOLSS

Högskolan på Gotland
Gotland University

Universidad Industrial de Santander

Present Courses at Gotland University available on line and free of charge (see: exergy.se)

2009/2010

Period 1 Aug24-Nov01	Period 2 Nov01-Jan17	Period 3 Jan19-Mar30	Period 4 Mar30-Jun07
Exergy 7.5 EC	Exergy Analysis 7.5 EC	Exergy Economics 7.5 EC	Environmental Management Systems 7.5 EC

Proposal of an Online Master Program on Exergy and Sustainable Development

1st year

Period 1	Period 2	Period 3	Period 4
Sustainable Development - Introduction 15 EC		Sustainable Energy Systems 15 EC	
Exergy 7.5 EC	Exergy Analysis 7.5 EC	Exergy Economics 7.5 EC	Environmental Management Systems 7.5 EC

2nd year

Period 1	Period 2	Period 3	Period 4
Sustainable Development - Analysis 15 EC		Master Thesis 30 EC	
Life Cycle Exergy Analysis I	Life Cycle Exergy Analysis II		

Solar City Bucaramanga 2048

Visions and Scenarios for Sustainable Energy in the Bucaramanga Region

Monthly solar energy and surface meteorology for Bucaramanga

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	4.58	4.60	4.71	4.19	4.37	4.64	4.82	4.75	4.73	4.33	4.16	4.32
Clearness, 0 - 1	0.50	0.47	0.46	0.40	0.43	0.46	0.48	0.46	0.46	0.44	0.45	0.48
Temperature, °C	19.49	20.64	20.97	20.81	20.66	20.19	20.03	20.48	20.47	20.11	19.79	19.25
Wind speed, m/s	2.60	2.38	2.19	2.05	2.12	2.40	2.44	2.23	2.01	1.94	1.95	2.43
Precipitation, mm	65	89	123	180	173	122	106	126	141	203	139	69
Wet days, d	9.5	10.3	13.3	17.9	19.8	18.3	18.1	20.0	19.1	20.6	15.8	10.5

These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center; New et al. 2002.

Thank you for your attention! Questions?