



European Institute of
Innovation & Technology

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Sustainable mining and the digital mine role in the digital age

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INTRODUCTION

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A day in your life with raw materials



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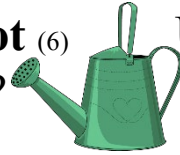
Day starts. The **radio clock** (1-3, 14)  plays music.
You turn on the **light** (1,2,4).  In the **bathroom** (1-4,14)  you look into the **mirror** (4,14)
there is the **central heating** (1,3,5)  it is comfortably warm. **toothpaste** (7)  
Fresh **coffee** (15)  is ready. Some **salt** (14)  on the **breakfast egg** (15)  ?
You take some **marmalade** (15)  out of the **glass** (4,15).  and put it with your **knife** (2) 
on the small **bread**. (14,15)  The little **oven** (1,2,4,14)  and the **micro wave** (1,2,4, 14) 
The **radio** (1-3)  is broadcasting the news. A piece of **bread** (15)  and 
some **sausage** (15) on it?  **Fruit** (15)  is healthy. One **apple** (15)  to take away.
 You look at your **fridge**, your **dish-washer** , your **pictures** (1-4,14,15) 
to the **window** (2-4,14)  and finally to the **door** (2).  All in all a practical,
but comfortable **kitchen** (1-4,6,14,15). 
A **plane** (2-4,8,14,15)  is flying above the **residential area** (1-6,11,13-15).
How will the weather be today? Do I need the **umbrella** (2,3)  do I take the **train** (2,3,8)
or the **bike** (1-4,8,14,15)  to go to work? or the **bus** (2-4,8,14,15)  

A day in your life with raw materials (ctd)



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Fertilize ⁽¹⁵⁾ the flower in the **pot** ⁽⁶⁾
– where is the **watering can** ⁽²⁾?




Uh, the **newspaper** ⁽¹⁵⁾ on the way.
You decide to go by bus to work.



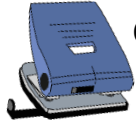
You take out your **mobile** ^(2,3).

Phone ⁽¹⁻³⁾ is ringing. Signing off the mail, some **glossy brochures** ^(9,15) beneath.

Traffic problems, you call you will be late! In the office: “Good morning, how do you do?”

Turn on the **lights** and the **PC** ^(1-4,14,15) during summer times,  also the **air con** ⁽¹⁻³⁾ and the **ventilator** ⁽¹⁻³⁾

with my **pencil** ⁽¹⁰⁾.  I write down some notes and remarks with my **pen** ^(2,3) 
Where are my **paper clips** ⁽²⁾?  The **hole puncher** ^(2,3) is already

In the canteen the **legs of the tables and chairs** ^(2,3) are blinking.  old, will come to its end.

Again delicious meals offered! There are the **drinks** ^(1,14,15).

What about a **glass of juice** ⁽¹⁵⁾?

Shape and décor of the **soup bowl** ⁽⁶⁾
and the **plate** ⁽⁶⁾ seem to be timeless .



No more **eating irons** ⁽²⁾ available?
Ah, new one is arriving. 

“Did you enjoy your holidays?”-“Yes, relaxing!”. We changed drivers during our **car** ^(2,4,8) ride.
Taking the **ferry** ^(2,4,8) was without any problem.

The ride through the landscape was unforgettable.



Huge forests were changing with
fertile agricultural fields.

We heard that the supply has significantly changed in the country due to usage of **fertilizers** ⁽¹⁵⁾.

A day in your life with raw materials (ctd)



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Back to office by taking the **lift** (1-4).



Working time over, going back home.

The **lights** (1,2,4) are red, the bus stops. Over there they are repairing the road.



On the other side they are installing new **pipes** (2,3,6,14), hopefully well-coordinated

and quick. The noise of the **compressor** (1,2,8)



and the **air hammer** (2,8)

do not contribute too much to relax.



How late is it? The **watch** (2,4)



Tonight you do not want to watch **TV** (1-4)



instead you do some **pottery** (6)?



Put some more **tiles** (13)



Go taking some **photos** (2-4,14,15) with a **tripod** (2,3),



because of the sun set you drive to the **channel** (13) or

go by **bike** (2,3,8) to the **watergate** (1,2,13)



Maybe there is an interesting **boat** (2-4,8).

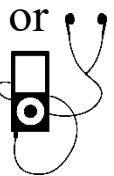


Finally a **glass of wine** (15).



On top some music: **Radio** or

CD-player (1-4) to relax?



Question: What kind of raw materials have you used during your day?

A day in your life with raw materials (ctd)



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- 1 Power from coal, lignite etc.
- 2 Metals, such as iron (plus coke from metallurgical coal)
copper, aluminium, nickel, tin, silver, gold etc. from ore
- 3 Plastics out of oil and salt
- 4 Glass out of quartz, metal oxides etc.
- 5 Gas from natural gas, oil made out of oil
- 6 Ceramics out of fire-resistant clay, talc etc
- 7 Feldspar
- 8 Kerosene, gasoline, lubricants made out of nat. gas and oil
- 9 Barite , calcite, kaolin (China clay)
- 10 Graphite
- 11 Crushed stones made out of rock, asphalt, gravel, sand
- 12 Clay
- 13 Rocks, gravel, sand, gypsum, slate
- 14 Rock salt
- 15 Potassium and magnesium salt

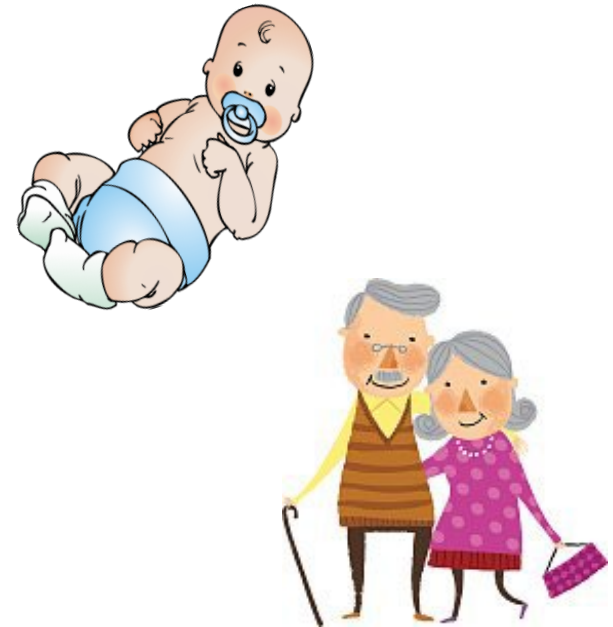
Life Time consumption



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Question: How many raw materials will you use during your life-time of 78 years?

Aggregates and construction materials:	547 t
Hard coal and lignite:	225 t
Oil:	116 t
Steel and metals:	43 t
Kaolin:	4 t
Rock salt and potash:	13 t
+ other raw materials:	2 t



In total: 950 t of raw materials

Significance of raw materials



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Stone age (4.500 – 2.500 BC.): extraction of flint stones and obsidian in Europe

4.000 BC: copper in Bulgaria and Serbia

3.000 BC.: gold in Georgia

2.500 BC.: copper in Middle-Germany and in Spain

2.000 BC.: copper in Austria

800 BC.: iron ore in the Alps

500 BC.: iron ore in Germany

900 coal in England

1185 first mining regulation in Germany

1200 coal in the Ruhr area

Middle Age (1300 – 1500): salt, silver, copper, iron, lead, tin

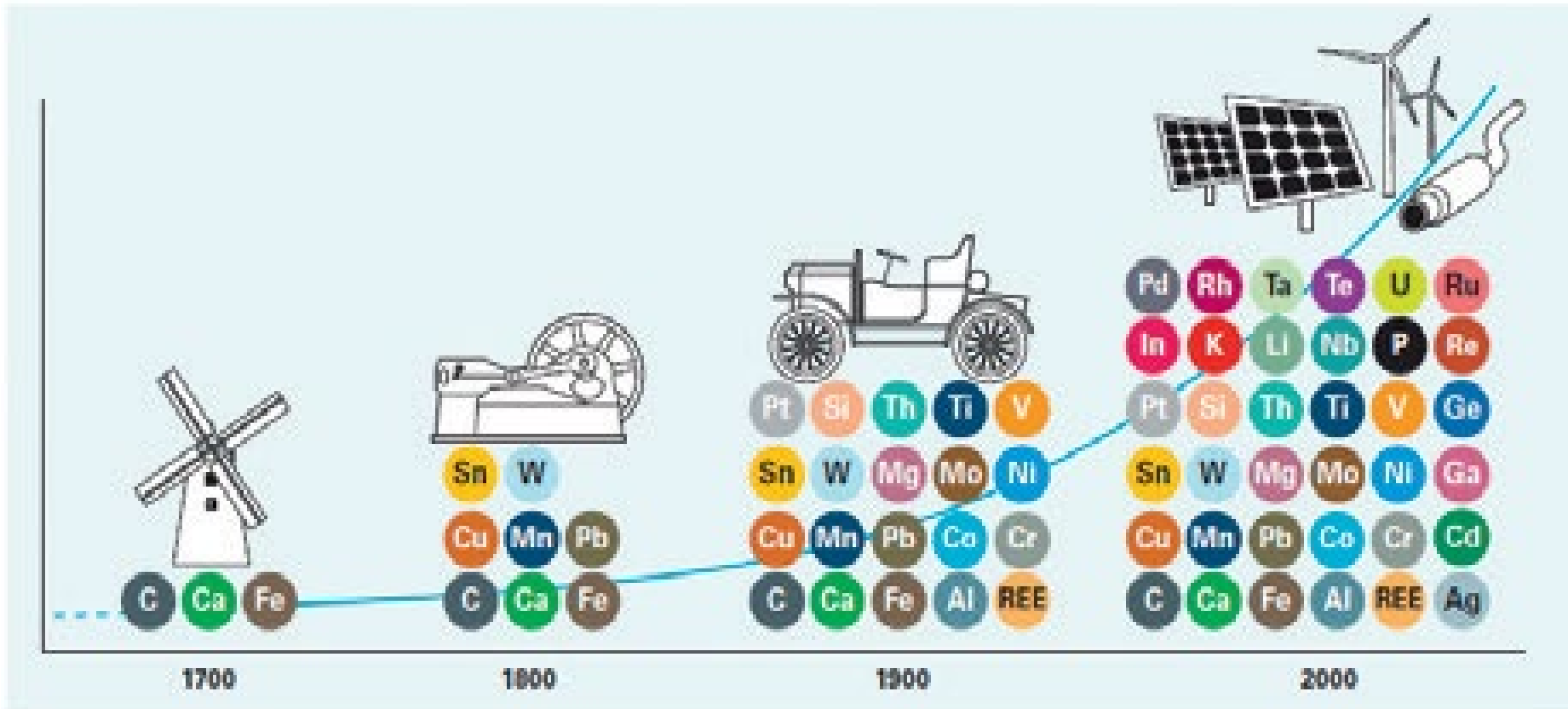
1576 publication of “De re metallica XII” written by Georg Agricola



Materials widely used in energy technologies (1700-2000)



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Source: Volker, Z., Simons, J., Reller, A., Ashfield, M., Rennie, C. (BP), 2014, 'Materials critical to the energy industry — An introduction'.



Challenges



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Our consume and throwaway models of consumption have had devastating impacts on our planet. 90 per cent of biodiversity loss and water stress are caused by resource extraction and processing. These same activities contribute to about half of global greenhouse gas emissions.



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Sustainable development

What does it mean?



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Definition of sustainable development



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“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” –
the Bruntland Commission “Our Common Future”, 1987

Effort to link the issues of economic development and environmental stability.

Important Milestones



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1972 Stockholm Conference on the Human Environment

1980 World Conservation Strategy of the IUCN

1982: World Commission on Environment and Development

1987: Brundtland Commission Report “Our Common Future”

1992 “Earth Summit” in Rio + Adoption of Agenda 21

1997 “Kyoto Climate Change Protocol”

2000 Millennium Development Goals (2000 – 2015)

2002 “Rio+10”

2012 “Rio+20”

2015 Adoption of the 2030 Agenda for Sustainable Development (2015 – 2030)

Stockholm agreement 1972



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United Nations' Conference on the Human Environment in Stockholm, Sweden.
start of the global efforts to tackle environmental problems. :

- *the human impact on the environment;*
- *population growth;*
- *social and economic development;*
- *help to developing nations;*
- *the part that governments should play in developing their own countries without harming the environment for other countries;*
- *the contributions that technology and education can make to tackling environmental issues.*



The conference made the link between securing a good quality of life for all the people on the planet. This needed to be considered for future generations as well as the present.

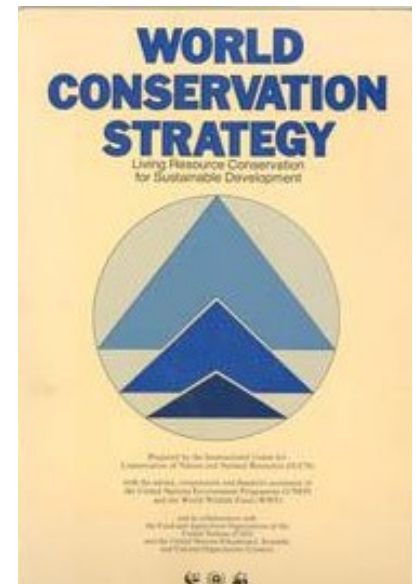
The conference led to the establishment of the United Nations Environment Programme (UNEP) and other environmental organisations

World Conservation Strategy of the IUCN



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1980 World Conservation Strategy of the International Union for the Conservation of Nature (IUCN), arguing for conservation as a means to assist development and specifically for the sustainable development and utilization of species, ecosystems, and resources.



Brundtland report 1987

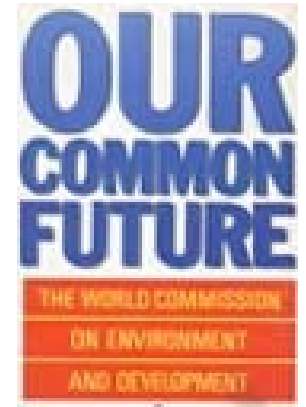


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1983 start of the Brundtland commission headed by the former Norwegian Prime Minister, Gro Harlem Brundtland.

known as the Brundtland report.

The Brundtland commission researched into environmental and economic issues before publishing its final report, “Our Common Future”, in 1987. The report highlighted the idea of sustainable development and defined it as:



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

The report suggested that international governments should meet to look at how to best reduce the effects of human activities on the environment for future generations. This led to the first Earth Summit, held in Rio, Brazil in 1992.

Rio Earth Summit 1992



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First global conference on environmental issues. 30,000 delegates including more than 100 heads of state brought together governments, environmental groups, businesses and individuals from all over the world.

Agreements on:

- *retaining the biodiversity of the planet;*
- *reducing climate change;*
- *management of the worlds forests and rainforests;*
- *declaration on environment and economic development;*
- *Agenda 21*
 - plan for governments to implement actions to address a wide range of environmental issues. It still influences local and national sustainable development policies today.
 - committed governments to seek ways to move towards a more sustainable future such as.
 - tackling environmental issues by looking at how making improvements at a local level can have an effect on a global scale.



Kyoto Protocol 1997



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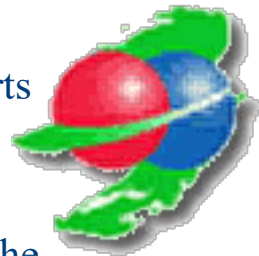
Kyoto conference

Issue of global warming and how to reduce the emissions of gases set up a framework that required countries to reduce their emissions of greenhouse gases to an average of 5% below the levels of 1990.

This reduction should be reached by 2012. The Kyoto treaty assigned countries with a level of greenhouse gases that they were permitted to produce. Low CO₂ producers can sell their allowances to high CO₂ producers. This is called 'carbon trading'.

The treaty was never implemented. Not enough countries would agree to it. Finally, in 2005, a scaled-down version of the treaty was agreed with 134 countries. This included industrialised countries like the UK and Russia. However the USA, a major producer of greenhouse gases, is still not part of the agreement.

Government groups in the USA argue that the Kyoto agreement is out of date and that efforts should be concentrated onto finding alternatives to carbon-based fossil fuels.



Some organisations, such as the Intergovernmental Panel on Climate Change, believe that the reductions in emissions are not large enough and argue that they should be cut by 60%. But others argue that such big cuts would have a harmful effect on economic sustainability.

Millennium Development Goals 2000

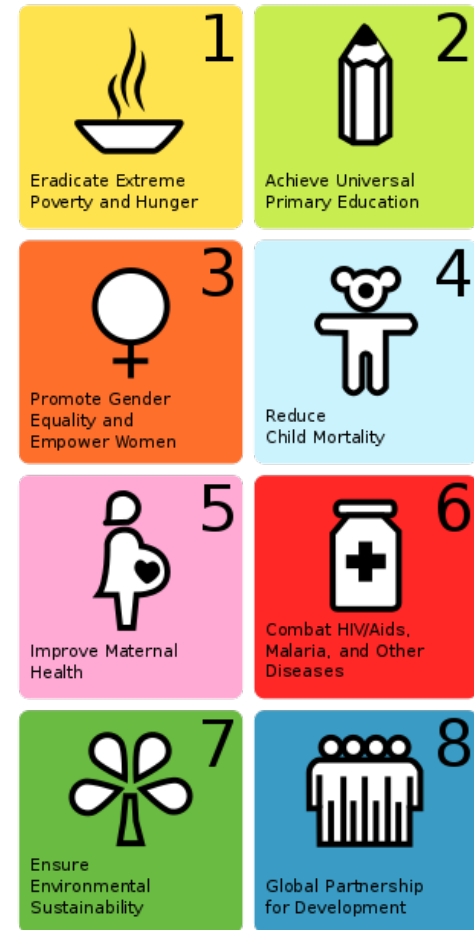


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Adoption of the Millennium Declaration and the Millennium Development Goals

8 international development goals:

- 1. To eradicate extreme poverty and hunger*
- 2. To achieve universal primary education*
- 3. To promote gender equality and empower women*
- 4. To reduce child mortality*
- 5. To improve maternal health*
- 6. To combat HIV/AIDS, malaria, and other diseases*
- 7. To ensure environmental sustainability*
- 8. To develop a global partnership for development*



Rio + 10 in Johannesburg 2002



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The Johannesburg Declaration created “a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development—economic and social development and environmental protection at local, national, regional and global levels

Major agreements were:

- *to half the amount of people without access to safe drinking water and good sanitation;*
- *set up a fund to reduce poverty;*
- *increase the fairness of world trade*
- *recognise that access to adequate healthcare is a human right;*
- *reduce the loss of species by 2015.*

The Johannesburg conference looked at how to improve the living conditions for billions of people on the Earth.



Rio+20 2012



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Final document "The Future We Want", International community committed itself to the concept of a "green economy".

Underlying idea is to make economic growth environmentally and socially compatible. However, Rio+20 failed to define measurable, time bound objectives.

Participants decided to draft proposals for universal Sustainable Development Goals (SDGs).



RIO+20
United Nations
Conference on
Sustainable
Development

Agenda for Sustainable Development 2030



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2015 UN summit in New York:

Adoption of the 2030 Agenda for Sustainable Development (2015 – 2030) with a set of 17 Sustainable Development Goals.

SUSTAINABLE DEVELOPMENT GOALS



Concept



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The concept of sustainable development aims to maintain economic advancement and progress while protecting the long-term value of the environment.

“Provides a framework for the integration of environment policies and development strategies”
– United Nations General Assembly, 1987.

Concept



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1920, Arthur Pigou “The Economics of Welfare”

- presence of incidental, uncharged services act as a barrier to achieving equilibrium in the market.
- the divergence between marginal private costs and benefits and marginal social costs and benefits create what we now call “**externalities**”. These externalities are conceived as transaction spillovers, or costs and benefits unaccounted for in the given price of a good or service.
- Pigouvian tax: tax on those activities that produce negative externalities at a rate equal to those external costs => the market price will more accurately reflect the comprehensive costs and benefits of the activity.

Concept



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Dernbach 1998

“Effective governance requires a nation to consider and protect the environment and natural resources on which its current and future development depend. Any other approach is self-defeating.

The connections between the environment and development thus provide a powerful rationale for environmental protection: enlightened self-interest”.

Concept



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Porter and van der Linde, 1999

- pollution is a sign of inefficient resource use;
- Porter Hypothesis: properly designed environmental policies that make use of market incentives can encourage the introduction of new technologies and reduce production waste.

Principles of Sustainable Development



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- *Importance of intergenerational equity*
- *Conserving resources for future generations*

Overall goal of sustainable development: Long-term stability of the economy and environment.

Achievable through the integration and acknowledgement of economic, environmental, and social concerns throughout the decision making process.

Principles of Sustainable Development



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Substitutability of capital: social, natural, and man-made capital.

Weak sustainable development: man-made, or manufactured, capital is an adequate alternative to natural capital.

Strong sustainable development: unique features of natural resources cannot be replaced by manufactured capital.

Principles of Sustainable Development



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- **Intergenerational equity:** recognizes the long-term scale of the needs of future generations.
- **Polluter Pays Principle:** Governments should require polluting entities to bear the costs of their pollution rather than impose those costs on others or on the environment.
- **Precautionary Principle:** threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measure to prevent environmental degradation (United Nations Conference on the Human Environment, 1992).

Principles of Sustainable Development



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Polluter Pays Principle

The Polluter Pays principle is used to ensure third parties do not bear the external costs of other people's activities, such as air pollution or the impacts of climate change, where these are a by-product of certain business activities. The EU Emissions Trading Scheme is an example of a solution that addresses this principle, as it puts a price on carbon, which is paid by industries that make their money from carbon emitting activities.

Principles of Sustainable Development



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Precautionary Principle

The Precautionary Principle is used when a risk has been identified that human activities may cause ‘morally unacceptable harm’.

In this case, lack of full scientific certainty (of cause or effects) should not be used as a reason for inaction, so long as that action is proportionate and the costs and benefits of action versus inaction have been evaluated. It is commonly used in arguments for taking action on climate change.

Principles of Sustainable Development



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Common but differentiated responsibilities:

- each nation must play their part on the issue of sustainable development.
- acknowledges the different contributions to environmental degradation by developed and developing nations.
- appreciating the future development needs of these less developed countries.

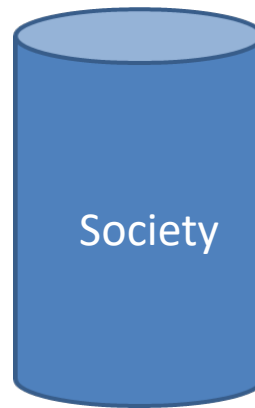
Principles of Sustainable Development



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Key principle of sustainable development-
integration of *environmental*, *social*, and *economic*
concerns into all aspects of decision making.

3 Pillars of sustainable development



Challenge of Sustainable Development



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Sustainable development in practice are negotiations in which workable compromises are found that address the environmental, economic, and human development objectives of competing interest groups.

This is why so many definitions of sustainable development include statements about open and democratic decision-making.

The concept of sustainable development attempts to couple development aspirations with the need to preserve the basic life support systems of the planet.

Mining and SDG



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How can mining contribute to the
Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOALS





Major issue areas for mining and the SDGs





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THANK YOU FOR ATTENTION!

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