Everything is a question of timing. This is true for climate change too.

This presents both a problem and an opportunity. Briefly, the problem is that it is difficult to instil a sense of urgency when effects are slow to be felt.

The time horizons are too long for us as individuals and politicians. We are all made to deal with near–term, more immediate problems first, even at the expense of longer-term well-being.
We have spent 40 years developing the environmental laws that have given Europeans cleaner water and air, while providing a more level playing field for businesses. And, of course, we have new technologies at our fingertips.

However, we still need to change our behaviour, as consumers and as producers. The effects of global population growth, our aging societies and many other challenges are having a major impact on our planet.
Andris Piebalgs,
European Commissioner for the Development

We live in a world of unprecedented changes. Since the beginning of the industrial revolution, the activities of mankind have led to increasingly visible alterations in landscape and biosphere.

Over the last 50 years, the world’s population has almost tripled, reaching close to seven billion people. Humans have changed eco-systems extensively to meet the growing demand for food, fresh water, timber, fibre, medicine and fuel.

Further population growth of two billion is predicted by 2030, combined with the goal to pull everyone out of extreme poverty, which will lead to an unprecedented pressure on ecosystems unless effective counteractive measures are taken.
The main message is that we are on the verge of a new such shift of our societies, to introduce a new development paradigm. It is sustainable development.

Developmental dilemmas and challenges are not new. We should remind ourselves that in many times in history, also recent history, our societies have changed the direction, even changed the development paradigm.

Only during the last 100 years, four such changes of direction may be found. Industrialism, introduced even earlier, was revolutionary in terms of transformation of our society and its environmental consequences.

WHAT IS DEVELOPMENT?

What is World development tendencies?

What will happen when natural resources will be depleted?

How will we be influenced by global warming?

What will be our future?

Does our children have clean and safe environment?

Why there are so many disasters in the World?

What will happen when natural resources will be depleted?

The main message is that we are on the verge of a new such shift of our societies, to introduce a new development paradigm. It is sustainable development.
MANKIND DEVELOPMENTS

1600. **The scientific revolution.** Modern natural sciences, resource use.

1700. **The Enlightenment.** Development based on science and intellectual understanding.

1750. **The Industrial Revolution, urbanisation.** Consumer goods produced by large scale manufacturing in industries; use of fossil fuels on a large scale.

1900. **Socialism, Democracy.** A stronger civil society: development for everyone.

1920. **Marxism/Capitalism** (East/West). A new economic order.

1950. **Modernism.** State and market; economic growth.


2000. **Wanted: a new development! Sustainable development!**
James Watt (1736. –1819.)

Steam engine

Model of the spinning jenny in a museum in Wuppertal, Germany. The spinning jenny was one of the innovations that started the revolution.
The environment has rather been understood as a background condition always available, always providing, limitless, robust, not really hurt.

It was not until recently that we had come to an understanding that this improvement has occurred with a cost, an environmental cost. Reformers of our societies, politicians and economists, have not included nature and the environment in their calculations.

During the last decades through new technologies, economic investments and political reforms have improved the lives of many.

We are living better

Material standards are more advanced

Travels are more freely

Communications are easier

Health care is better
Over the 100 years between 1900 and 2000, the world’s population increased over four times, from 1.5 to six billion people.

On top of that, the resources each of these individuals uses have on average quadrupled. Resource use has thus increased close to 16-fold over this period; it varies for different kinds of resources.

- The number of pigs increased 9 times (we eat twice as much meat per capita)
- The global economy increased 14 times
- Industrial production increased 40 times
- Energy use increased 16 times, almost entirely due to fossil fuels
- Sulphur dioxide emissions increased 13 times
- Carbon dioxide emissions increased 17 times
- Ocean fishing catches increased 35 times
- Deforestation was 20%
Overuse of the resources—some examples

Very intensive urbanisation!
Growing transport system and industrialisation

Agricultural fields increased two times
The situation at the beginning of the 21st century is unique and unparalleled in the history of our societies and the Earth.

If we look more carefully at the developments over time, we see that the speed of growth is itself increasing. There is an exponential growth of resource use. Exponential growth is characterised by a constant percentage increase.

We certainly cannot go on like this forever. There are limits to growth. **The limits are set by our planet!**
The present development is most clearly illustrated by the use of energy in our societies. As many other resources, its use has increased many times, but there is an additional dilemma.

In the world as a whole, 85% of the energy supply relies on fossil carbon: solid coal, liquid oil and gaseous natural gas.

These stores of carbon are the result of processes which took the planet millions of years to complete. They are *non-renewable* for the simple reason that we use them about a million times quicker than they were formed.
This means that the stock of these resources will end at some point, just as the money in the bank will be depleted if you take it out a million times faster than you put it in. There is only so much coal, oil and gas on the planet. According to recent estimations, about half of their amount was used up in 2008.

Then we reached the global *peak oil*, i.e., the year of maximum extraction of oil and gas. Now the extraction of coal, oil and gas has started to decline.

There will be ever less of it each year and a large demand will remain. The prices will increase.

**We need to find other energy sources!**
It can be illustrated by a comparison with the energy we need daily for our bodily functions. This is about 2.5 kWh (or about 2,100 kcal).

This means that the effect of an active person is about 100 W or the same as a normal, rather bright lamp bulb.
We use close to 100 times more energy per capita than the body itself. We have about a hundred “energy slaves”, each one of us.

The energy dilemma in our societies is threefold:

- We use mostly non-renewable energy – coal, oil and gas
- We use energy for the most part very inefficiently
- We use too much energy
In the pre-industrial society only renewable resources were used. For example, a mill to grind the wheat was propelled by wind or water, and the household was heated by burning wood.

Access to oil changed things dramatically. One litre of oil can provide very much energy. Life became simpler and the new energy source offered new opportunities.

Industries were built

The car with a motor run on oil was better than a horse fed on barley

Oil was used for fuels, solvents, plastics, to produce crop fertilisers, etc, etc.
Riga’s TES-2 as main fuel is natural gas, (~230 milj.m$^3$/year). Alternative is diesel.

The lignite power plant in Belchatow in Poland is typical of most electricity production. It is presently the largest emitter of carbon dioxide in the European Union. Lignite mining is seen in the foreground.
At present for each barrel of oil found three are extracted. Peak oil, the year of max extraction, was registered in 2008.

The production of fossil oil and gas is predicted to continue up to 2050, at which time the known resources could be depleted.
Using fossil fuels as an energy source is not only connected with the dilemma of using up non-renewables – to the detriment of future generations, which will not have them. It is also connected to the down-stream side of the process, that is, the waste produced.

For any process, we have to look at three stages:

- Where does the resource come from?
- What is its use?
- What kind of waste does it lead to?

In the case of the combustion of fossil carbon, we will always have carbon dioxide, CO$_2$, as the waste product.

CO$_2$ is taken up by plants and algae during photosynthesis.

The problem with the use of fossils is that it is not balanced by an equal amount of uptake. It is a *linear flow*, from source to waste, rather than a *circular* one.
The use of fossil fuels on a massive scale leads to the accumulation of massive amounts of carbon dioxide in the atmosphere!

The use of fossil carbon has continued since the beginning of industrialisation, about mid-1700s. The data shows that from a pre-industrial level of about 280 ppm of carbon dioxide in the atmosphere, we have reached 387 ppm in 2009.

It is clear that the present level of carbon dioxide has not occurred for at least 800 000 years.

It should be compared to data on the atmosphere gathered through analysis of ice cores in the Arctic and Antarctic. It allows us to analyse the composition of air hundreds of thousands of years back.

Correlation between concentration of CO₂ and global temperature.
The increased levels of carbon dioxide have led to an increased average temperature!

Along with water, carbon dioxide is the most important greenhouse gas of the atmosphere and thus a decisive factor for the temperature on the planet.

If we continue to emit carbon dioxide into the atmosphere, we will experience even higher temperatures. Furthermore, we need to add emissions of other greenhouse gases, especially the increasing emissions of methane, to the increased carbon dioxide levels, as well as other effects such as reinforcing feedback mechanisms studied by the climate scientists. Predictions are surely inexact, but who would like to chance that they are wrong? To date, the increase has been about 0.76 °C.

The conclusions are alarming. If the concentration of carbon dioxide stops at the present level, we will have about 2 °C of temperature increase!
As a reference for how much a change of a few degrees means, we may compare the present with the most recent ice age. Back then the global mean temperature was by about 5 °C lower than today.

In 2003, we had the highest mean summer temperature ever recorded in Europe (predicted to be normal about 2025). During that summer there were about 35,000 additional deaths caused by excessive heat, and the economic damages for farmers were about 25%, depending on the crop.

The most serious consequences of increased temperature includes:

- Health impacts, also due to increased incidents of insect-borne diseases
- More frequent extreme weather events which lead to physical destruction
- Landscape changes, e.g. raising sea levels
- Economic impacts because of reduced agricultural production
- Changed patterns of precipitation
Climate change – some consequences

Destruction of polar ice sheets

Forest fires; Greece, 2007.
SOLVING THE ENERGY DILEMMA

We may use renewable energy resources:

• flowing energy resources – wind, water and sun;
• stored energy resources, bio-energy – solid resources such as, e.g., wood, liquid, ethanol made from sugar, and biogas.

The most developed technology is hydropower. Today wind power comes in as the second.

Today in many countries flowing energy is already a cheaper alternative as the necessary investment is paid back after a few years. In some countries the government provides an economic incentive to support the development of alternatives to fossils.
In the long-term we have to create society run on renewable energy either directly, as provided by flowing energy resources, or indirectly, by using bio-energy.
Making economic development independent of fossil carbon is called *decoupling*. It is the first step towards the conversion of an economy to fossil independency, which some countries have slowly begun.

In Europe as a whole, the energy use is often both extensive and inefficient today.

In the short term perspective, the energy efficiency increase is typically the most profitable strategy in the conversion to fossil independency. By improving, e.g., the insulation of buildings or the design of district heating, heat consumption may be reduced dramatically.
Recently a study has been carried out to define the limits for a number of processes on the Earth more exactly. These were called the nine *planetary boundaries*. They have been defined for nine different processes or resources.

It is clear that these trends need to be reversed to protect future life. It is promising that the effects of one boundary transgressed some years back have been reversed – the concentration of ozone depleting gases in the upper atmosphere. This is now within safe limits, and the properties of protection against the UV radiation of the ozone layer are slowly being restored.

Solution – Sustainable Development
Three of the defined boundaries are transgressed today. These are:

- The concentration of greenhouse gases in the atmosphere
- The speed with which biodiversity decreases
- Nitrogen and phosphorus inputs to the biosphere

The alternative – a development which reaches a dynamic balance with the resource base – is sustainable development.
Stimulation of the Growth
Overshoot and collapse

If the growth in a system continues unhampered, it will eventually use more resources than what are produced (overshoot) and will collapse at some point; at the same time, the resource base is degraded. The alternative – a development which reaches a dynamic balance with the resource base – is sustainable development.

What will happen to our world if growth continues, the so-called ‘business as usual’. The answer was that there would be overshoot, a peak and then collapse. In a 2004 update, most parameters were shown to peak around 2025. Nevertheless, it will be different for different parameters.

Overshoot and collapse had happened in some communities, particularly on isolated islands, where boundaries (resources and space) are visible. Planet Earth also is island in the space.
Biodiversity – the variety of life – has become one of the most seriously threatened resources

The estimation is that species extinction is today 100 to 1 000 times faster than “natural”, i.e., before civilisation.

The most dramatic threat to biodiversity occurs in tropical forests where biodiversity is very large, but the Baltic Sea Region is also part of the decreased biodiversity.

The Porpoise in the Baltic Sea.
In the Baltic Sea, our only dolphin species – the Porpoise – is facing extinction.
Nature is thus not only a pleasant fund. It provides for us what is called ecosystem services.

Ecosystem services:

<table>
<thead>
<tr>
<th>Provisioning ecosystem services</th>
<th>Regulating ecosystem services</th>
<th>Cultural ecosystem services</th>
</tr>
</thead>
<tbody>
<tr>
<td>supply of food, water and clean air</td>
<td>climate, nutrient flows, self-cleaning and regulation of water, pollination</td>
<td>beauty of nature and joy of spending time in our living environment when walking, hiking, travelling on water or just resting</td>
</tr>
</tbody>
</table>

It is obvious that all this is priceless in the basic sense – that we would not be able to live without these services. Yet it is possible to estimate the monetary value. The most cited assessment of the price is USD 33 trillion for the global society. This is more than the sum of all goods and services bought and sold over a year. However, we very seldom pay for this; and we need to take better care of ecosystem services.
Sustainable society needs to be economically viable. Obviously the environment needs to be functional to allow for a functioning economy. Otherwise there would be no agriculture, forestry and fishery, production of energy etc, but not only that.

In the industrial sector, an important approach is cleaner production that is resource efficient and does not lead to pollution. Cleaner production has its technical aspects – how to recycle resources, reduce leakage of energy and materials.

“Reduce” - we should make an effort to make without an additional product. “Reuse” often means “repair” - do not waste a product but take care of it. “Recycle” refers to the material the products are made of.

Companies working with environmental management systems may become certified according to one of the international systems, among which the best known is the ISO 14001 certification (ISO – the International Organisation of Standardisation) or EMAS (Environmental management and auditing scheme – EU).
The concern regarding a product does not stop at its production; the extraction of resources needed for the product, the use of the product and its waste, i.e., its entire life cycle is the concern. The cycle needs to be environmentally and economically sound.

Sorting waste

Efficient recycling at the household level is a prerequisite for good waste management in sustainable society (Berlin, Germany).
We need a combination of:

<table>
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<tr>
<th>Technology development</th>
<th>Regulations, taxes and rules supporting sustainable solutions</th>
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- New infrastructures, e.g. for communication and travel
- Life style changes

It is possible to exemplify with the energy sector. To use only renewable energy, we need technology to provide energy from solar cells, solar panels, wind and wave power stations etc. Nevertheless, there is also a need for policy instruments (regulations) that support it. A state policy of tariffs (guaranteed price) for renewable electricity has been pointed out as a key regulation in the energy sector.

A scheme which improves the public transport and supplies renewable fuels, best electricity, for cars; life style changes towards supporting living without using energy unnecessary are all essential.
A sustainable life needs to be more dematerialised – it is fine to do things which do not increase the capital that much, e.g. spending time with one’s family, friends, playing music etc.

A sustainable life leads to less work – this is sometimes referred to as ‘slow life’. This term comes from the ‘slow cities’ and ‘slow food’ movements which started in Italy.

There is a limit to how much we may consume, but it does not necessarily lead to a decreased life quality!

Beddington Zero Energy Development, the United Kingdom, the largest sustainable community in the UK, was completed in 2002. It uses 50% of the electricity and 20% of the heating of the UK average. The design, including solar panels and solar cells, helps the inhabitants solve problems of heating and water use, facilitates walking rather than driving and improves the quality of life.
It is always difficult to see our present situation from a distance. However, some basic facts are obvious. From a distant historical perspective, we, the human society, are in a new and very critical period, well into the Anthropocene, a geological era dominated by man.

With 7 billion inhabitants on the Earth, with the number sure to be going up to at least nine billion, the sheer number of people is threatening. We have moved well outside the envelope of our historical experience in terms of our relationship with our planet.

We need to establish is “ne-planet society”, i.e., society which does not require more resources than the planet we live on can provide. *One Planet Living* is the title of a recent project of the World Wide Fund for Nature. It requires that we reduce our “footprints” to the size available when we begin to share resources in a just way. We will need to rethink our energy management, our nutritional and travelling habits.
A school teacher in Visby, Gotland, the island in the middle of the Baltic Sea, used to ask his pupils to design a spaceship for a very long journey. They had to say what they would like to bring. The ship can only carry so much. The kids may disagree on what is the most important, but after much talking it turns out they agree on basic things needed to secure a reasonable life. Personal items vary. It is only after a long discussion they start to compare the spaceship with our planet Earth.
Baltic University programme

BUP student’s conference “Ecosystems, biological diversity, resources, sustainable development”
Rogow, Poland, April 14-18, 2010.
Uppsala University

Uppsala University (UU), located in Sweden, is one of the oldest universities in the Nordic countries. UU is the coordinator of the Baltic University Programme.

Baltic University Programme-BUP

- Established in 1991,
- BUP is a network of 220 universities and institutes of higher learning,
  - 14 countries in the Baltic Sea Basin are involved,
    - 15 regional centres are selected,
    - 1,500 teachers/researchers are contributors,
    - 9,500 students take part yearly.
CHAPTER VIII. Environmental science, environmental education and education for sustainable development

Section 42. Environmental Education
(1) The matters in respect of environmental education and education for sustainable development shall be included in the mandatory curriculum of the subject or course standard in accordance with the specific character of each subject by co-ordinating and ensuring succession on different education levels.
(2) The environmental protection course shall be included in the mandatory part of all study programmes of authorities of higher education and colleges.
(3) A course regarding sustainable development shall be included in the study programmes of instructors of all authorities of higher education and colleges.

Law approved in Saeima (Parliament) of the Republic of Latvia on November 2, 2006
Development of Environmental Education

Development of concepts of education – mission of environmental education

- Ecology, nature protection etc.
- Environmental education
- Education for sustainable development

by Blewitt and Cullingford, 2004
Development of Environmental Science Study Content and Study Materials

Norway Grants Project LV0044
September 2008 – April 2011
Participating Institutions of the Project
Study Course
"Environment and Sustainable Development" for Universities

1. Introduction  2. Environmental Science
3. Ecosystem Services  4. Ecology
7. Resources  8. Environmental Pollution
9. Climate Change  10. Water Pollution
11. Lithosphere Pollution  12. Environmental Health
23. Wastewater Treatment Technologies  24. Solid Waste Management Systems
27. Students’ Perspective on Sustainable Development

VidZ 1000 (4 CP)
Total amount of the study hours 64
Number of lecture hours: 54
first test, second test, final exam.
Academic text book

"Environment and Sustainable Development"
Textbooks on the Environment

- "Environmental Pollution and Its Impact"
- "Environmental Technologies"
- "Nature Protection"
- "Environmental Management"
- "Ecology"
- "Environment and Economics"
Environmental Simulation Games

EKOPROFIL: www.ekoprofil.com
Educational Films

Films by VIDES FAKTI included in the study course ”Environment and Sustainable Development”
(89 films, 5–7 minutes long each)
Home page

http://www.geo.lu.lv/vidz/via
Presentation of the book

Nordic Conference on Sustainable Development in the Baltic Region
Turku, Finland, 31 Jan–2 Feb, 2011

European Commission and DG Environment

Belarusian State University, Minsk

Moscow State University of Economics, Statistics and Informatics

Opening Ceremony of the Sustainability Index
Thank You for attention!

I would like to live in this beautiful world too!