



'Cost Benefit Analysis'- A study for the environmental, economic and social impacts of climate change in Greece

Thematic seminar Aveiro October 2011



- In February 2009 the Bank of Greece took the initiative for the preparation of a study on environmental, economic and social impacts of climate change in Greece.
- The purpose of the study is to set the strategic frame for the actions that should be taken in order to mitigate those impacts.
- The overall conclusions of the study emphasize the costs/benefits regarding:
 - Human casualties/injuries
 - Public health
 - Biodiversity, forests, ecosystems, water resources
 - Areas of natural beauty/monuments
 - Social cohesion
 - Construction of buildings, critical infrastructure
 - Transportations
 - Sectors of the economy like agriculture, fisheries, tourism, mining





Study ID

Instruments used: Different scenarios were made and simulations were used in order to estimate the costs and the benefits in terms of money for each alternative scenario. Specific cases were examined and mathematical models were used in order to scale the cost/benefit of a single action to national level.

The study in numbers: 19 individual studies, 26 months of research, 112 scientists, 25 members of the Climate Change Impacts Study Committee, 19 external experts, 80 writers, 21 judges

Expertise: The scientists who participated were experts in various fields

- physics of the atmosphere
- climatologists
- geophysicists
- experts in agriculture
- experts in forestry
- experts in fisheries
- experts in water resources
- experts in built environment
- experts in tourism, experts in energy, economists, sociologists





Climate change in Greece

Temperature will rise till year 2100: 2-4,5 °C

- Increase of the number of days with temperature more than 35°C
- Increase of the number of tropical nights

Sea level will rise till year 2100: 0,2- 2 m

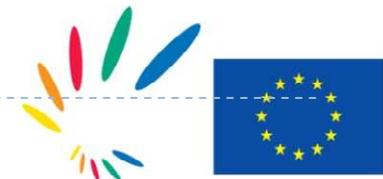
- Length of Greek coastline: about 16,300 km
- Medium or high vulnerability: 20% of the coastline

Decrease of the average rainfall

- Major problems in eastern Greece and Crete
- Cases of extreme rainfalls

Change of other climatic parameters

- Increase of the average strength of winds
- Decrease of the average time the sky is covered with clouds





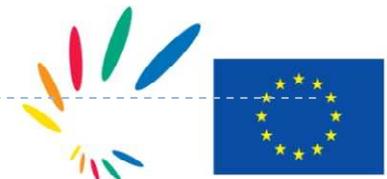
Impact on water resources and proposed mitigation measures

Impact

- Decrease of available water resources
- Problems in the enrichment of underground water resources (rapid/fewer rainfalls)
- Entry of salty water in underground water resources
- Transformation of areas to “desert zones”
- Less water in rivers/lakes results to the increase of the amount of dangerous substances per litter
- Lack of water appropriate for drinking (weakest layers of the society will be affected more)
- Lack of water for the needs of agriculture

Mitigation measures

- Campaigns for the awareness of the people, in order to reduce consumption and motives to that direction
- Prohibitions for high-consuming water uses (e.g. swimming pools)
- New water supply networks in order to reduce leaks
- New underground irrigation systems that minimise possible losses
- Works for the enrichment of water resources (e.g dams)
- Establishment and protection of an ecological safe minimum amount of water in the case of lakes, rivers and underground waters
- Creation of a legal frame about the use of water resources





Impact on fisheries/aquacultures and mitigation measures

Impact

- Species from warmer seas “migrate” putting pressure on local species
- Very low level of water in rivers and lakes puts in danger fish populations
- Places rich in food for fishes (delta of rivers) are destroyed
- Extreme weather phenomena (e.g. tornadoes) put in danger aquacultures

Mitigation measures

- Measures that protect marine life (e.g. about the methods used for fishing)
- Creation of sea parks
- Relocation of aquacultures
- New species, able to live in warmer climates, in aquacultures





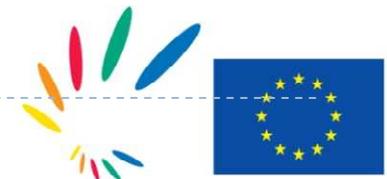
Impact on agriculture and mitigation measures

Impact

- Decrease of production in the south due to heat waves
- Increase of production in the north
- Damages in crops due to extreme weather conditions
- Lack of water resources
- Decrease of land appropriate to be cultivated due to desertification

Mitigation measures

- Change the kinds of crops depending on the climate conditions of each area / introduction of new kinds of crops
- Change the periods of sowing and harvest
- Introduction of environmental friendly techniques in order to keep the soil fertile
- Better use of the available water resources
- Works for the protection/enrichment of water resources

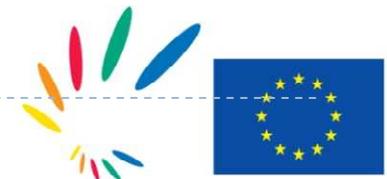




Impact on forests/ecosystems/biodiversity and mitigation measures (1)

Impact

- Decrease of the forests with firs (4%-8%)
- Increase of the forest with trees living in lower altitude e.g. broadleaf trees (2%-4%)
- Desertification of forests in the lowest zone (1%-2%)
- Decrease of the wetlands along the coastline (7%-15%). Major problem at deltas
- Decrease in the production of wood and goods from the forest (herbs, honey mushrooms)
- Decrease of the grass available for animals. Consequences in all the food chain. - Extinction of species
- More forest fires (increase of the cost to prevent them)/shortest time between two fires.
- Floods/soil erosion
- Difficulties in the enrichment of underground water resources
- Decrease of the ability of forests to capture CO₂
- Pressure on the ecosystems of the lakes/rivers due to the low level of water
- Loss of places of natural beauty/local culture
- Appearance of new species than put pressure on local species

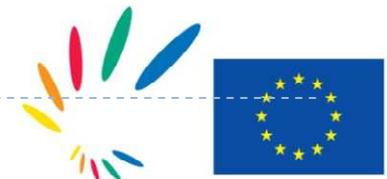




Impact on forests/ecosystems/biodiversity and mitigation measures (2)

Mitigation measures

- Policies mitigating forest fires
- Precise marking of forest areas (preventing the change in the use of land in the future)
- Reforestation (use of trees tolerant to climate change)
- Works against soil corruption
- Works that help the procedure of enriching underground water resources
- Creation of “banks of seeds”
- Regulations for the use of water of lakes/ivers
- Protection of local species from “intruders”
- Works for the protection of the ecosystems near the coastline





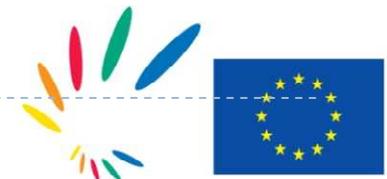
Impact on tourism and mitigation measures

Impact

- Increase of temperature during summer (peak season)
- Decrease of tourist climate index (TCI) during summer (fewer tourists)
- Increase of tourist climate index during autumn/spring (potentially more tourists)
- Increase of the cost for air-conditioning and maintenance of outdoor facilities for the hotels

Mitigation measures

- New target groups (able to travel during spring and autumn)
- New strategy in the promotion of the “Greek Touristic Product”
- Develop touristic facilities in the North/promote alternative activities
- New approach in the creation of new touristic facilities and improvements in the old ones in order to save energy.





Impact on built environment and mitigation measures (1)

Impact

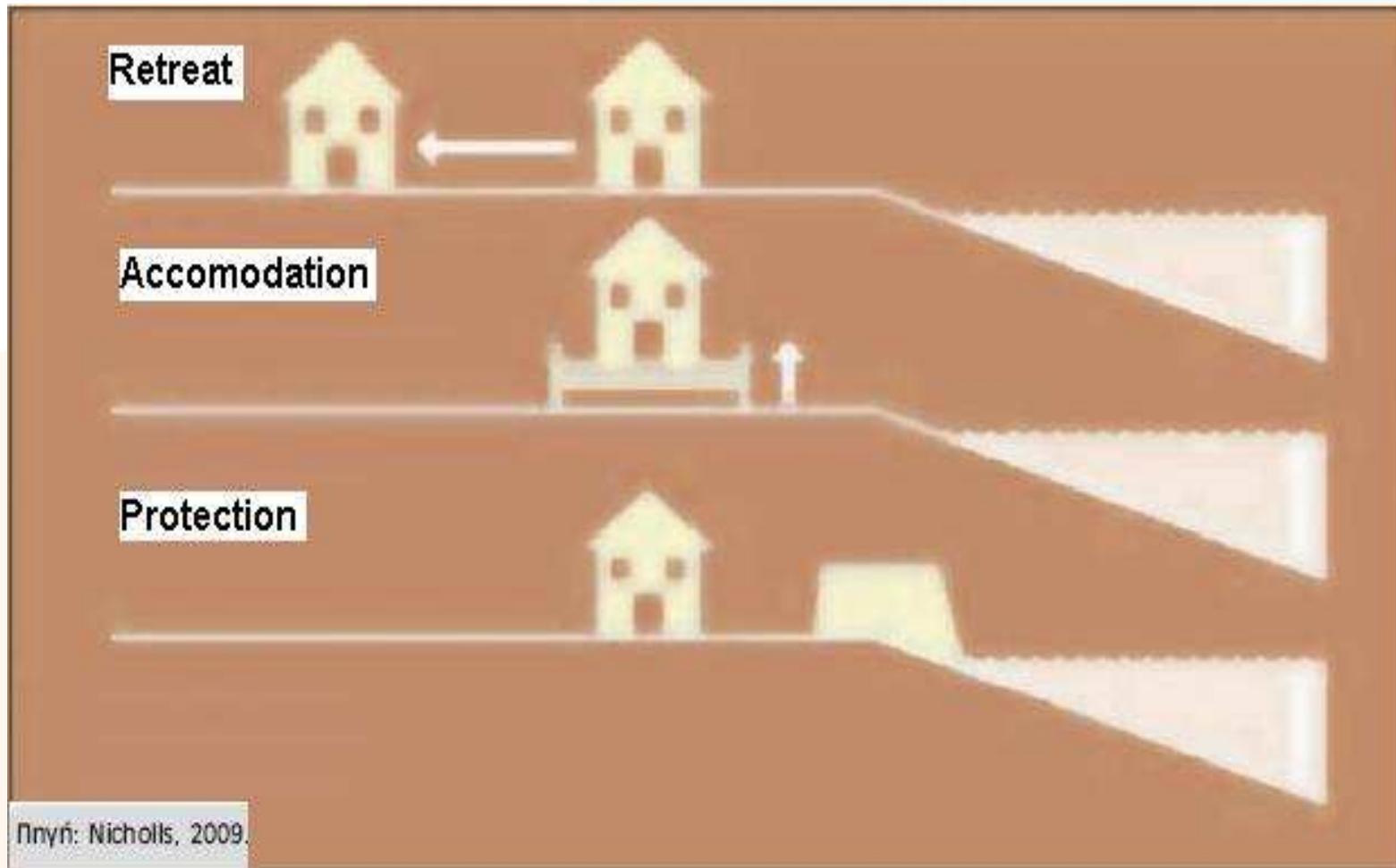
- Increase of the cost for air conditioning in buildings
- Decrease of the cost for heating
- Damages due to extreme weather conditions (e.g. floods, tornadoes) or forest fires
- The rise of the sea level will affect public and private buildings, critical infrastructure (e.g. ports, roads, energy and telecommunication networks) and monuments

Mitigation measures

- Creation of better insulation shells in new buildings (15 cm thick), improvement of the insulation in old buildings
- Systems that make the buildings autonomous from the aspect of energy (e.g. photovoltaic)
- Works that prevent floods in inhabited areas
- Measures for the protection from forest fires
- Generally, the proposed strategies against the rise of sea level are retreat, accommodation and protection.



Impact on built environment and mitigation measures (2)





Impact on transportation and mitigation measures

Impact

- Depending on the area: 2%-7% of the road network and 1%-3% of the railway network potentially will be affected by the rise of sea level (less than 2m higher than the sea level and 50m from the coastline)
- Increase of the cost for repairs/maintenance due to extreme weather conditions
- Cost due to delays (bigger than the cost for repairs/reconstructions)

Mitigation measures

- Not constructing transport infrastructure to areas vulnerable to the rise of sea level
- Taking into consideration climate change to constructions (e.g higher waves for ports)
- Assess the vulnerability of the transport network and set priorities for the actions that should be taken
- Development of mechanisms and systems for tackling cases of emergencies due to extreme weather conditions
- Increase the use of sea and railway transports for goods/decrease the use of road network





Impact on society and mitigation measures

Impact

- In 2050 it is calculated that 200 million people worldwide will be “environmental refugees” (50 today). Greece will be influenced.
- These people will face problems relevant to shelter, food and access to vital facilities (education, health)
- Inner “environmental immigration” from areas with low altitude to areas with higher altitude
- Sectors of the economy will be affected by the climate change (e.g. agriculture).
Possible loss of jobs
- Worse living conditions for the weakest parts of the society. Lack of money for insulation and systems that produce energy results to increase of the cost of life in the future. A circle where poverty results to lack of access to energy and technology (little protection against climate change) and this brings more poverty is created.

Mitigation measures

- Initiation of a policy for the “environmental refugees”
- Prevent a situation where the weakest are put to the margin of the society
- Provisions for poor households and enabling them to have access to technology/measures against climate change
- Involvement of the state for access of all people to electricity and water





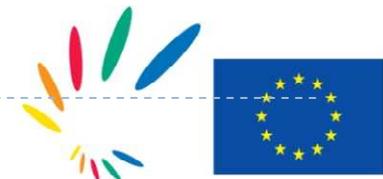
Impact on health and mitigation measures

Impact

- Casualties due to extreme weather phenomena (floods, fires)
- Increase of deaths due to weather conditions (21 more deaths daily during summer and 3 deaths daily less during winter the decade 2091-2100)
- More pressure on health system during summer
- Natural disasters affect the quality of products/water
- "Tropical" diseases will appear
- Diseases due to migration

Mitigation measures

- Measures that prevent floods, fires etc.
- Awareness of the people for their actions in cases of emergency due to natural disasters/heat waves
- Access of all citizens to the health system
- Preparedness of the health system for more incidents during summer
- Creation of "emergency plans" in the hospitals
- Awareness of the staff in the system of health for the new diseases that appear in the country
- Measures for the population of mosquitoes/rats
- Works for the quality of water





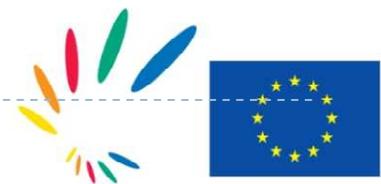
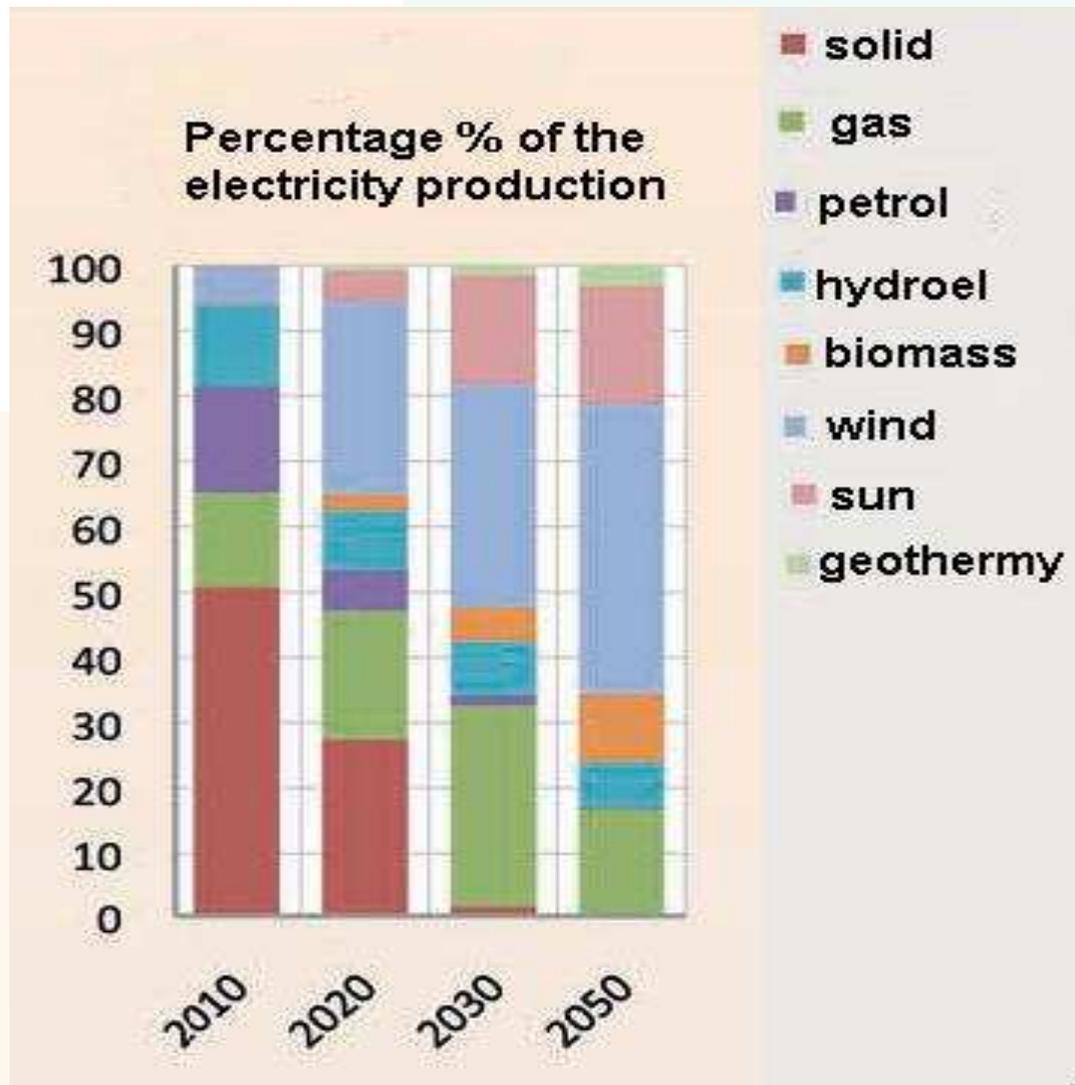
Policy to reduce green house gas emissions

- Buildings** consume 36% of total energy in Greece and produce 1/3 of CO₂.
Decrease energy consumption (e.g insulation shells, systems consuming less energy).
Systems (per building) that produce energy from renewable resources
- Transports** produce 27% of CO₂. Actions proposed: promotion of means of public transport, use of alternative types of fuel (biodiesel, gas, electric cars)
- Industry**: Replacement of diesel and mazout by gas. Installing systems for the production of energy (sun, biomass etc). Using systems that minimize energy consumption.
- Effective management of **waste** management in order to decrease the production of CH₄ which contributes 21 times more than CO₂ to the greenhouse effect (for the same amount of gas)
- Decrease the use of fertilizers in **agriculture** (produce N₂O)
- Production of **electrical energy**: wind parks, hydroelectric dams, centralized and decentralized photovoltaic systems, more extensive use of gas, geothermic energy, use of biomass





Scenario for the production of electricity till 2050





Scenarios of cost of the climate change for the Greek economy

Scenario of no action: No effort is made on a global level to reduce greenhouse gas emissions and Greece takes no measures to reduce the impact. Total cost till 2100 for Greece **701 billion Euros**.

Scenario of mitigation: Countries in global level reduce greenhouse effect gas emissions in 2050 to 50% in comparison to 1990. As a result the temperature rises 2 °C. Total cost for Greece till 2100 **436 billion euros** (142 billion for reducing greenhouse emissions+294 billion cost due to the impacts of the rise of temperature 2 °C)

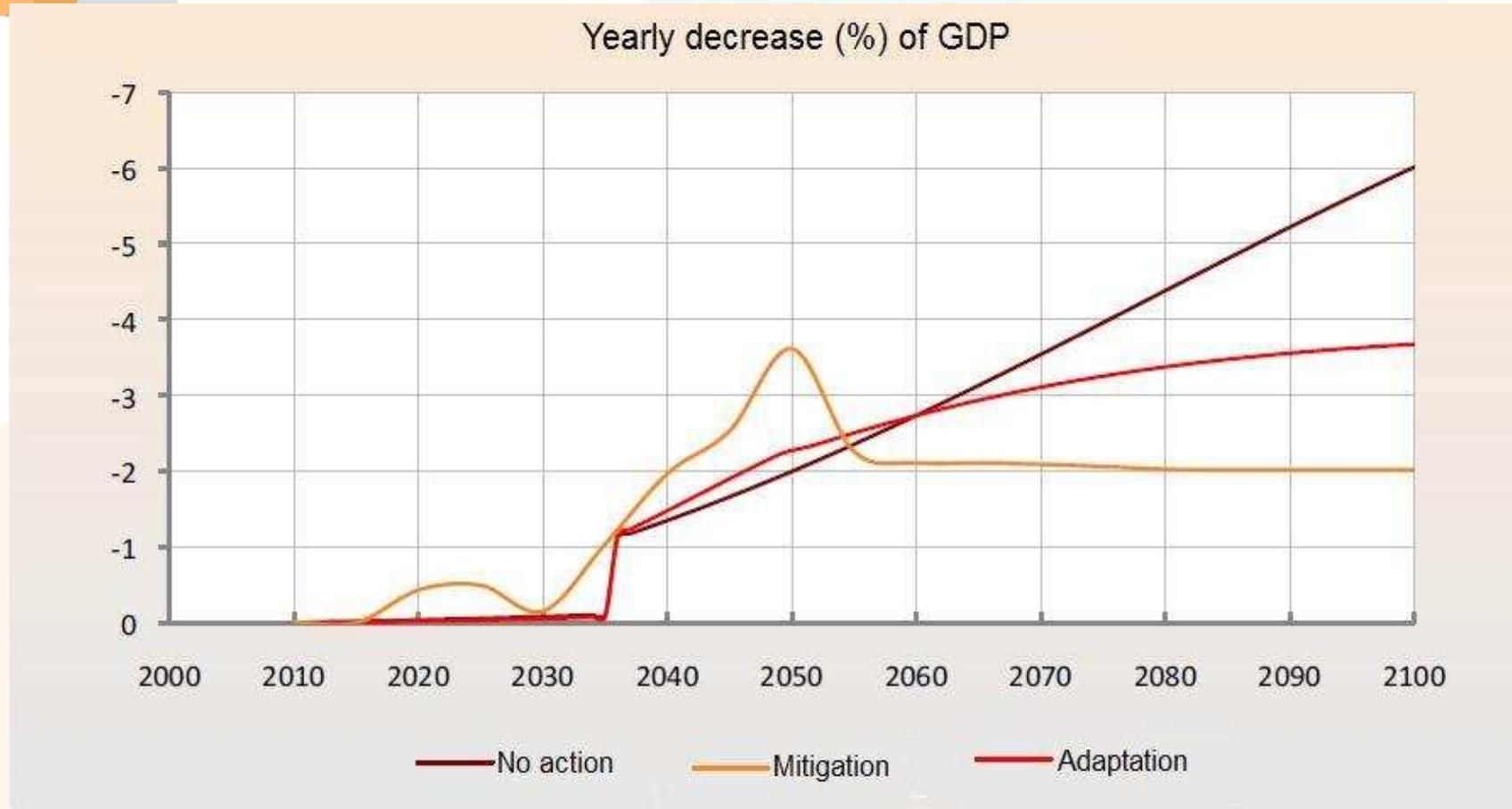
Scenario of adaptation: The global community does not reduce greenhouse emissions. Greece decides to take adaptation measures in order to reduce the impact. Total cost for Greece till 2100 **577 billion euros** (67 billion for adaptive measures+510 billion cost due to significant climate change)

* The overall estimations in terms of money took into consideration the following: agriculture, forests, fisheries, tourism, transportation, impacts at the coastline, built environment

**base year for the cost in terms of money is 2008 (GDP of that year)



Comparing the cost of the scenarios (1)



- The cost of the scenario of no action is yearly smaller than the cost of the other scenarios till 2055. From that point we have a tremendous increase.
- The benefits from the scenario of mitigation are obvious after 2060.





Comparing the cost of the scenarios (2)

Cost in billion euros (base year for GDA 2008)	No action	Adaptation			Mitigation			Adaptation vs no action	Mitigation vs no action
		Total cost	Adaptation measures	Remaining consequences	Total cost	Mitigation Measures	Remaining consequences		
2011 - 2050	79	86	36	50	130	113	17	-7	-51
2051 - 2070	182	178	24	154	125	26	99	5	57
2071 - 2100	439	314	8	306	181	3	177	125	259
2011 - 2100	701	578	67	510	436	142	294	123	265



Presentation of the study

- The study was presented in Athens on the 1st of June 2011
- The Prime Minister and the Minister of Environment, Energy and Climate Change were present
- The Minister of Environment in her speech said that the results of the study will be taken into consideration for all the actions concerning climate change in the future. Moreover, the National Committee of Energy Planning will take into consideration the study during the creation of the “energy road map” of the country till 2050. Some of the goals of the “energy road map”, will be in accordance with the study e.g.
 - .Increase of the power of systems of renewable energy sources to 15GW in 2020 and 40 GW in 2050
 - .Power almost 100% of needs for electricity with RES in 2050
 - .Stabilize the need for energy in today’s numbers (measures to save energy)
 - .Improvements in old buildings and the way of constructing new ones to the direction of saving energy.
- The Prime Minister put emphasis on the international cooperation for the achievement of the necessary goals about reducing greenhouse gas emissions





The actions that will be taken in the next decades will show how much the proposals of the study have influenced the decisions of policy makers

THANK YOU FOR YOUR ATTENTION

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