MINISTRY OF ENVIRONMENT & ENERGY
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DIRECTORATE OF CLIMATE CHANGE AND ATMOSPHERIC QUALITY

NATIONAL
CLIMATE CHANGE ADAPTATION STRATEGY
(EXCERPTS)

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Table of contents

1. Introduction
2. The NASCC reference framework
2.1 Objectives and guiding principles
2.2 Weather and climate issues
2.3. Economic conjuncture and adaptation
2.4 Legislative and institutional framework
2.5 Implementation of the strategy
3. Risk and vulnerability assessment
3.1 The impacts of climate change and the domestic adaptation deficit
3.2 Climate risk and vulnerabity at the regional level
3.3 Extreme weather events
3.4 Some preliminary conclusions and priority areas for intervention
4. Sectoral adaptation policies
4.1 Agriculture and stock-breeding
4.2 Forestry
4.3 Biodiversity and ecosystems
4.4 Fisheries
4.5 Aquaculture
4.6 Water resources
4.7 Coastal zones
4.8 Tourism
4.9 Energy
4.10 Infrastructure and Transport
4.11 Health
4.12 The built environment
4.13 Mining and quarrying
4.14 Cultural heritage
4.15 Insurance sector
5. Adaptation in practice
5.1 Prioritisation and assessment of adaptation measures
5.2 Specificities and types of adaptation investment
5.3 Methods for assessing and ranking investment
5.4 Integration of adaptation policies into broader policies
5.5 The international (cross-border) dimenions of adaptation
5.6 Building adaptation capacity: research, education and awareness
5.7 Consultation with social partners on adaptation
5.8 Prevention and risk management
5.9 The European climate change adaptation efforts
5.10 Adaptation to climate change and international security
6. Summary and conlusions
References
Annexes
1 Editorial team
2 The costs of climate change and adaptation, in tables and charts
3 Climate data

1 Introduction

As the effects of climate change are increasingly being felt, European countries are embarking on efforts to develop national strategies and implement national plans for adaptation, prioritising on health, agriculture, water resources and sea level rise (see http://climate-adapt.eea.europa.eu/ – the EU's main information web portal on adaptation to climate change).[1] Meanwhile, the more we gain experience with adaptation capacities, the more we realise the difficulties in bringing about the *institutional* changes that are required as a precondition for these options. This is so because the problem of how to adapt to climate change is structurally quite different from the problem of how to reduce greenhouse gas emissions. While greenhouse gas mitigation policies have a long-term effect on climate –a typical public good– most adaptation policies would have a relatively short-term effect on citizens' welfare – a typical private and local good. It is therefore logical to expect government intervention to protect public goods such as climate, but it is less obvious to expect it to take initiative for adaptation policies.

The Climate Change Impacts Study Committee (CCISC) of the Bank of Greece has assessed the expected –environmental, economic and social– impacts of climate change in Greece. Drawing on cost data from the international literature, that first attempt estimated the macroeconomic costs of adaptation under the extreme climate conditions of the Inaction Scenario (Scenario A2). The analysis showed that the cost of adaptation measures would correspond to 1.5% of GDP over the period 2025-2050, 0.9% of GDP in 2051-2017 and 0.1% of GDP during the period beyond 2070. Cumulatively until 2100, adaptation to climate change would cost the Greek economy €123 billion (at 2008 prices) (CCISC 2011, and Sections 3.1, 3.2 of the present).

[1] Up until 2014, according to the European Environment Agency (EEA 2014), 21 European countries had adopted national adaptation strategies, while twelve among them have already developed national adaptation plans as well. Updated information available on the Climate-ADAPT web portal (http://climate-adapt.eea.europa.eu) show that only nine European countries have not yet adopted a national adaptation strategy, namely Greece, Cyprus, Bulgaria, Lithuania, Estonia, Czech Republic, Iceland, Croatia and Slovenia.

The present "National Adaptation Strategy to Climate Change" (hereinafter "NASCC") sets out the general objectives, guiding principles and implementation tools of a modern, effective and growth-oriented adaptation strategy in line with EU directives and the international experience.

The NASCC is the first step in a continuous and flexible process for planning and implementing the necessary adjustment measures at national, regional and local levels and aspires to leverage the capabilities of Greece's public authorities, economy and society at large, in an aim to address the impacts of climate change in coming years.

2 The NASCC reference framework

2.1 Objectives and guiding principles

The overarching objective of the present NASCC is to contribute to the country's resilience against climate change impacts. To this end, the necessary conditions must be created for well-informed and far-sighted (both public and private) decisions that will determine the productive and consumption fabric of the Greek society, by addressing risks and opportunities resulting from a changing climate. The NASCC outlines Greece's strategic orientation aimed at providing guidelines. As such, it does not analyse in depth the required sectoral policies, nor does it judge the feasibility of individual adaptation measures and actions at the local/regional level or attempt to rank the suggested measures and actions. Such issues fall within the scope of Regional Action Plans which will elaborate on the NASCC guidelines, by setting the immediate adaptation priorities at the local level.

Key objectives of the NASCC are to:

1. establish and enhance the (short-term and long-term) decision-making procedure regarding adaptation issues;
2. link adaptation with the promotion of a sustainable growth model through the implementation of regional/local action plans;

3. promote adaptation actions and policies in all sectors of the Greek economy, with emphasis on the most vulnerable ones;
4. create a monitoring, evaluation and update mechanism for adaptation actions and policies; and
5. build adaptation capacity and raise public awareness.

Adaptation to climate change requires a comprehensive, interdisciplinary approach that will involve inter-sectoral measures, whose implementation would rely on specific institutions of a national and regional scope. In particular, the guiding principles of the NASCC are the following:

- **Compatibility:** Adaptation policies and measures should be compatible with the strategies and priorities of the general and sectoral national environmental policies.
- **Scientific accuracy and completeness:** Adaptation policies and measures should be scientifically substantiated with up-to-date information derived from authoritative research in Greece and the rest of the world. Any such policies and measures should be (re)evaluated in the light of new scientific evidence.
- **Stakeholder involvement and consultation**: an important factor for a successful adaptation strategy is the involvement of, and consultation with, all parties concerned, including pubic administration, the scientific community and civil society.
- **Social acceptance**: Adaptation policies and measures should entail the lowest possible costs for society/the economy, reduce regional disparities and ensure a more equitable distribution of adaptation costs across social groups.
- **Growth:** adaptation policies and measures should be designed in a manner that fosters long-term economic growth.

In order to contain costs and secure the necessary financial resources, adaptation policies should be developed gradually and not in a short period of time. As these policies are implemented on the government's initiative (public investment) or with its involvement (by imposing standards or requirements on private investment), their effectiveness is maximised when they are based on comprehensive, forward-looking studies and when the policy options are decided upon in consultation with all relevant stakeholders.

The NASCC should fulfill the following requirements:

- it should cut across all current policies (integration);
- it should be based on long-term planning and phased implementation over the planning horizon and be able to adapt flexibly to new developments (adaptability);
- it should have an optimal size and scope for the expected risks (optimisation);
- it should promote fairness and social justice, and prioritise the more vulnerable geographic areas and social groups; and
- it should contribute to strengthening all the aspects of the growth process (modernisation of infrastructures and networks, openness, smart regional specialisation and innovative finance and insurance products).

In broad terms, the tools to implement the strategy are:

- **Scientific research and documentation.** Emphasis should be given to scientific research, in order to obtain the raw data necessary for a deeper understanding of the problem of climate change and its individual impacts, by type, sector and activity.
- **Follow-up.** The implementation of the adaptation strategy will be followed up by a monitoring mechanism and appropriate indicators and tools.
- **Stakeholder awareness.** Citizens' and all stakeholders' awareness of climate change, of its impacts on the natural environment and everyday lives of people and of the benefits of a coordinated effort to address them, represents the first step towards the mitigation of any residual effects and climate change in general.
- **Deliberation and dialogue.** The impacts of climate change will affect all productive activities at the local and national levels. The government should establish a framework for ongoing deliberations and dialogue with key economic and social actors and local communities.

2.3 Economic conjuncture and adaptation

The NASCC will need to identify adaptation actions that can and should be initiated

now. These include actions that have early and robust benefits, despite the range of climate change impacts, such as water efficiency and better environmental management. Priority should be given to adaptation policies that have a high impact on employment and growth, (for instance, the use of green infrastructure, like green roofs), and can bring adaptation in the form of reduced flood risk and moderation of the heat-island effect.

2.4 Legislative and regulatory framework

The establishment of an institutional framework for adaptation in Greece necessitates proper organisation and interlinking of existing institutions and working groups, so that the NASCC can be best integrated in the various policies. To this end, it is proposed to establish a National Council on Climate Change, coordinated / chaired by the Ministry of Environment and Energy, bringing together representatives from the Ministries of Interior and Administrative Reconstruction, Health, Finance, Economy, Development and Tourism, Infrastructure, Transport and Networks, Rural Development and Food, Environment and Energy, National Defence (which heads the Hellenic National Meteorological Service), regional and local Authorities, business world, professional associations, environmental NGOs, the scientific community, etc. The exact method, the Council's operating procedures, the responsibilities, the way of monitoring the implementation of adaptation policies, their updating, based on the continuously changing economic, social, technological, climatic etc. conditions, should also be determined through appropriate institutional settings.

Furthermore, the effective prevention and management of the risks entailed by climate change and volatility also requires setting up, within the Ministry of Environment and Energy, a ***Department for Adaptation to Climate Change,*** which will be subordinated to the Directorate for Climate Change and Atmosphere Quality of the General Directorate of Environmental Policy, in close cooperation with the General Secretariat for Civil Protection.

It is also necessary to create a mechanism for the monitoring and support of the implementation of both the NACCS and the Regional Adaptation Plans.

2.5 Implementation of the strategy

As already mentioned in Section 2.1, the NASCC forms the basis for the specification of adaptation policies and actions for each of the 13 administrative regions of Greece. Region-specific vulnerability assessments (at least until the year 2050) for ecosystems, economic sectors and population groups will be conducted, on the basis of which the main adaptation measures for each sector will be selected, as set out in Chapter 4 below. Vulnerability assessments, the prioritisation and selection of measures and actions, scheduling and potential means of financing/implementation will constitute the main pillars of Regional Adaptation Plans. The same will hold for the implementation of indices and other tools for monitoring adaptation outcomes.

The financing of adaptation investments and policies will mainly rely on the Public Investment Programme. Given the current juncture and adopting an outward-looking attitude to financing, adaptation investment will, to a great extent, depend on the authorities' ability to raise funds from international sources of financing (e.g. European Investment Bank) and EU Funds. Implementing the programmes of the Partnership Agreement (NSRF 2014-202) provides a golden opportunity for the competent authorities to fund their Adaptation Plans.

3 Risk and vulnerability assessment

3.1 The impacts of climate change and the domestic adaptation deficit

The Bank of Greece report (CCISC 2011) on the impacts of climate change has highlighted the wealth of Greece's natural resource but also the risks to the country's natural and human environment. Greece has a very long coastline of some 16,300 km (equal to roughly one-third of the Earth's circumference), of which around 1,000 km are areas highly vulnerable to climate change. This vulnerability is associated

with a rise in Greece's average sea level by an estimated 0.2-2 m by the year 2100. Of course, the vulnerability of the coasts is determined not only by the risk of a mean sea level rise and extreme wave events, but also by local factors (tectonics, geomorphology, etc.). Of the total coastline of the Aegean, about 58% is coasts of high vulnerability to the projected developments. The effects of both the long-term change in sea level and transient extreme events impact on several sectors of the economy, including tourism, land use and transportation.

Overall, the impact of climate change on all sectors of the national economy that were examined in the Bank of Greece report (CCISC 2011) was found to be adverse and often extremely adverse. For instance, the impact on fir, beech and pine forests would be considerable, while fire-fighting costs are expected to shoot up on account of the increasing number and extent of forest fires. Meanwhile, species abundance and biodiversity are expected to decline. Furthermore, climate change, as measured by its projected impact on the tourism climatic index (TCI) by the end of this century, is expected to have serious repercussions on Greek tourism – mainly on the seasonal and geographical patterns of tourist arrivals, hence also tourism receipts. Given that tourism receipts are a crucial resource for Greece, long-term strategic planning is needed in order to upgrade the country's tourism product in the context of ongoing human-induced climate change. The consequences of climate change on the built environment, transportation, health, mining and other sectors are also important. The Bank of Greece report (CCISC 2011) clearly identified a need for a concrete adaptation policy that would cover all sectors. This should also incorporate a revised foreign policy regarding aspects of particular relevance for Greece.

With regard to the assessment of the economic impact, specific studies were carried out using three scenarios: the worst-case scenario of anthropogenic climate change assumes no action to reduce greenhouse gas emissions **(Inaction Scenario)**. Under this scenario, it was estimated that Greek GDP would drop by an annual 2% by 2050 and 6% by 2100, and the total cumulative cost for the Greek economy over the period extending till 2100, expressed as GDP loss relative to base year GDP, would amount to €701 billion (at constant prices of 2008). The second scenario, called the **Mitigation Scenario**, assumed a constant and drastic reduction in Greece's green-

house gas emissions as part of a broader global effort, resulting in containing the rise in average global temperature to no more than 2º C. The total cumulative cost of the Mitigation Scenario for the entire period till 2100, expressed in terms of GDP loss, comes to €436 billion (at constant prices of 2008). In other words, the total cost for the economy under the Mitigation Scenario is €265 billion less than under the Inaction Scenario, implying that the mitigation policy would reduce the cost of inaction by 40%. Finally, given that an adaptation policy is also necessary as a damage control measure, an **Adaptation Scenario** was also considered. Under this scenario, Greek GDP would drop by 2.3% and 3.7%, respectively, in 2050 and 2100, while the cost of adaptation policies would total €67 billion. However, the adaptation measures do not fully eliminate but merely contain the damage from climate change. Thus, the cumulative cost for the Greek economy of the residual damage from climate change was estimated at €510 billion (at constant prices of 2008) over the period till 2100. As a result, the total cost for the Greek economy under the Adaptation Scenario is the sum of the cost incurred by the economy on account of the adaptation measures and the cost of the (reduced) damage from climate change; this sum (total cumulative cost through 2100) was estimated at €577 billion (at constant prices of 2008 – see Annex 1: The costs of climate change and adaptation in tables and charts.

3.2 Climate risk and vulnerability at the regional level

According to the CCISC study, total estimated damages from climate change, by economic activity, is shown in the last row of Table 1 “DAMAGES/ECONOMIC ACTIVITY, EUR millions (CCISC 2011)”. These damages must be broken down by geographic region to provide an indication of each region’s vulnerability to climate change on the basis of the relative intensity of its economic activity. Given that climate change is expected to impact mainly on productive activities, a reasonable allocation formula would be the relationship between the output of a specific activity/sector in a region and total output from all activities/sectors in the same region.

Thus, the ratio $\varepsilon_{ij} = \frac{Y_{ij}}{Y_j}$ can be used as an allocation formula where Y_j is total output in region j =1,13 and Y_{ij} is the output of activity i in region j.

As a sectoral or geographical breakdown of output data from ELSTAT or any other reliable source is not available, this ratio was approximated by the ratio of total regional output to total national output and by the employment share of activity *i* in region *j* (Source: Labour Force Survey, ELSTAT). Table 1 "DAMAGES/ECONOMIC ACTIVITY, EUR millions (CCISC study)" provides a breakdown of damages by economic activity and sector based on this approach, while Table 2 "BREAKDOWN OF VULNERABILITY BY REGION AND ECONOMIC SECTOR" ranks damages for individual activities and sectors on a scale from 1 (the smallest damage) to 13 (the greatest damage).

These estimates represent a first attempt at quantification, given the time and resource constraints of the present study. For the purposes of strategic planning, an approach for assessing vulnerabilities would be to identify three levels of vulnerability, e.g. low (L) 1-3, medium (M) 4-7 and high (H) 8-13, and classify regions by vulnerability and activity. In agriculture for instance, the regions of CENTRAL MACEDONIA, PELOPONNESE, WESTERN MACEDONIA, THESSALY, EASTERN MACEDONIA AND THRACE, and CRETE exhibit a high level of vulnerability. Another approach would consist in estimating total damage from climate change in each region (Table 1, last column) relative to the value added in each region. Vulnerabilities under this approach are shown in Table 3 "BREAKDOWN OF VULNERABILITY BY REGION".

1. DAMAGES / ECONOMIC ACTIVITY BY REGION AND ECONOMIC SECTOR, EUR millions (CCISC Study)

Geographical region	Agriculture	Forestry	Fisheries	Mining and quarrying	Water supply	Built environment	Transportation	Tourism	Health	Total damage (D)	Value added (2011) (VA)	D/VA
NATIONAL AGGREGATE												
EASTERN MACEDONIA AND THRACE	105.246	3.747	0.857	25.938	15.276	1.518	2.128	32.876	3.274	190.859	7216.00	0.026449
CENTRAL MACEDONIA	169.858	6.048	1.382	133.897	31.543	3.870	9.212	145.160	12.906	513.876	24992.00	0.020562
WESTERN MACEDONIA	33.845	1.205	0.275	348.744	3.496	1.078	1.021	24.133	1.226	415.023	4021.00	0.103214
EPIRUS	40.196	1.431	0.327	7.146	4.209	1.193	1.626	26.660	2.624	85.413	4055.00	0.021064
THESSALY	110.471	3.933	0.899	16.246	19.136	2.113	2.150	48.175	4.250	207.372	8812.00	0.023533
IONIAN ISLANDS	31.899	1.136	0.260	0.000	0.685	0.782	1.477	41.447	0.854	78.539	3098.00	0.025352
WESTERN GREECE	114.731	4.085	0.934	0.000	9.359	1.998	3.616	53.965	4.522	193.211	8555.00	0.022585
CENTRAL GREECE	79.861	2.843	0.650	172.094	13.514	1.834	3.036	68.592	2.501	344.926	7984.00	0.043202
ATTICA	35.889	1.278	0.292	160.317	113.300	13.901	57.696	429.395	52.979	865.046	88921.00	0.009728
PELOPONNESE	117.335	4.178	0.955	55.721	3.282	1.933	2.875	45.973	2.685	234.936	7755.00	0.030295
NORTHERN AEGEAN	19.077	0.679	0.155	0.000	2.185	0.603	1.055	17.745	1.000	42.501	2592.00	0.016397
SOUTHERN AEGEAN	29.047	1.034	0.236	48.506	15.998	1.914	2.054	69.599	2.672	171.060	5747.00	0.029765
CRETE	95.545	3.402	0.778	31.181	11.018	2.264	3.053	81.280	3.506	232.028	8623.00	0.026908
Total	983.000	35.000	8.000	999.790	243.000	35.000	91.000	1085.000	95.000			

2. BREAKDOWN OF VULNERABILITY BY REGION AND ECONOMIC SECTOR									
Geographical region	Agriculture	Forestry	Fisheries	Mining and quarrying	Water supply	Built environment	Transportation	Tourism	Health
EASTERN MACEDONIA AND THRACE	9	9	9	4	10	5	6	4	8
CENTRAL MACEDONIA	13	13	13	8	12	12	12	12	12
WESTERN MACEDONIA	4	4	4	11	4	3	1	2	3
EPIRUS	6	6	6	2	5	4	4	3	5
THESSALY	10	10	10	3	11	10	7	7	10
IONIAN ISLANDS	3	3	3	1	1	2	3	5	1
WESTERN GREECE	11	11	11	1	6	9	11	8	11
CENTRAL GREECE	7	7	7	10	8	6	9	9	4
ATTICA	5	5	5	9	13	13	13	13	13
PELOPONNESE	12	12	12	7	3	8	8	6	7
NORTHERN AEGEAN	1	1	1	1	2	1	2	1	2
SOUTHERN AEGEAN	2	2	2	6	9	7	5	10	6
CRETE	8	8	8	5	7	11	10	11	9

3. BREAKDOWN OF VULNERABILITY BY REGION				
Geographical region	Total damage (D)	Value added (2011) (VA)	D/VA	Vulnerability
EASTERN MACEDONIA AND THRACE	190.859227	7216.00	0.026449	8
CENTRAL MACEDONIA	513.875714	24992.00	0.020562	3
WESTERN MACEDONIA	415.023342	4021.00	0.103214	13
EPIRUS	85.412628	4055.00	0.021064	4
THESSALY	207.372312	8812.00	0.023533	6
IONIAN ISLANDS	78.539272	3098.00	0.025352	7
WESTERN GREECE	193.210767	8555.00	0.022585	5
CENTRAL GREECE	344.925957	7984.00	0.043202	12
ATTICA	865.046080	88921.00	0.009728	1
PELOPONNESE	234.936493	7755.00	0.030295	11
NORTHERN AEGEAN	42.500782	2592.00	0.016397	2
SOUTHERN AEGEAN	171.059590	5747.00	0.029765	10
CRETE	232.027837	8623.00	0.026908	9

3.4 Some preliminary conclusions and priority areas for intervention

The above vulnerability assessment is a first attempt to quantify and rank the anticipated climate risks for the Greek territory. It is clear that priority should be given to those sectors expected to be most negatively affected by climate change, and to averting those impacts that would entail the highest costs for the economy. According to the analyses in the Bank of Greece report (CCISC 2011), **agriculture is the sector expected to be most severely affected by climate change in Greece, while the impacts on tourism and coastal systems should have major consequences on household incomes and the economy as a whole. Of particular significance is also the water reserves sector**, given its implications for agriculture and water supply. The adaptation policies need therefore to be focused on the above areas and the implementation of appropriate actions must be planned in timely manner, so as to mitigate the likely adverse impacts.

Furthermore, it is advisable to maintain strategic food and water reserves in order to meet the basic needs of the country's population in case of large-scale extreme weather events, such as prolonged drought.

4 Sectoral adaptation policies

Taking account of the risk and vulnerability assessment, this section explores the available adaptation technologies and policies by sector. Alternative adaptation options are outlined on the basis of their main features, to the extent possible.

Given that NASCC is a strategy orientated document which aims to establishing guidelines, this chapter is not taking position on the feasibility of individual actions and adaptation measures at regional / local level and does not attempt to prioritize the indicative proposed measures and actions, both at field level and at regional / local level. The final selection, the prioritisation and scheduling of the appropriate

actions and measures are the content and essence of the thirteen (13) Regional Adaptation Plans which will be composed based on the particularities of each region.

5.6 Building adaptation capacity: research, education and awareness

The peculiar and critical nature of climate phenomena calls for institutions and citizens that are well informed and capable of planning for their future over a horizon spanning several decades. However, our current ability to respond to extreme climate events and to the gradual, irreversible changes that these are expected to bring to our lifestyle is limited. They key to the NASCC's success is to enhance our adaptation capacity to climate change in order to avert, to the extent possible, its adverse effects on the Greek society and economy.

Adaptation capacity building is a multi-dimensional concept that includes soft (e.g. education and training) and hard (e.g. adjustments to buildings) interventions.
In general, adaptation capacity is seen as closely linked with the ability (of citizens and institutions) to access financial resources and information. It should be noted that, by its nature, adaptation capacity building is an ex ante action rather than a reaction to the occurring weather and climate events. The NASCC can play a coordinating role in adaptation capacity-building actions, linking them with its broader targets.

Education is a key driver of raising "climate awareness and adaptation capacity", especially when it is addressed to young people. To this end, primary and secondary education curricula should be enriched to include environmental education courses on topics relating to current environmental issues. Turning to higher education, emphasis should be placed on similar subjects, as part of curricula, and research projects with the support of various institutions that study climate change, the atmosphere and the environment in general.
Vocational guidance should also highlight career opportunities that are associated with the green economy, with emphasis on new jobs in the areas of civil protection, infrastructure protection, etc.

Possible ways to build the adaptation capacities of professionals, government agencies and other stakeholders could include:

1. early warning systems;
2. dissemination of information and accessibility to climate data;
3. linking and partnerships between the academic scientific community of universities and the private sector;
4. training and lifelong learning.

Progress in adaptation capacity building must be monitored using appropriate indicators which follow the six (6) stages of adaptive management:

Stage 1 – Evaluation of the problem: management targets, success indicators, options for action, assumptions, significant uncertainties and alternative scenarios;

Stage 2 – Action planning to validate assumptions and anticipate outcomes on the basis of existing knowledge;

Stage 3 – Implementation of planned actions;

Stage 4 – Follow-up: possible deviations from the plan and targets fulfilled;

Stage 5 – Assessment of outcomes: which actions were more effective and which assumptions must be accepted (or rejected);

Stage 6 – Address and revise uncertainties and assumptions, and repeat procedures; communication of findings to all stakeholders.

Strengthening resilience and building adaptation capacity through the enhanced ability of social, economic and natural systems to tackle climate change without collapsing will be crucial to the NASCC's successful adaptation.

6 Summary and conclusions

The main objective of the National Adaptation Strategy to Climate Change (NASCC) is to document the need to develop an appropriate institutional and financial framework that will support public and private action for adaptation to the impacts of cli-

mate change. International experience and available information from EU Member States provide sufficient input for identifying the key pillars on which our national strategy should rest: a climate risk and vulnerability assessment for the Greek territory; a critical review of alternative adaptation measures in 16 areas of interest; an overview of the main tools available for assessing adaptation investments and policies; tools for integrating adaptation policy into broader policies; the international dimension of adaptation; adaptation capacity building; deliberations with social partners on adaptation; and monitoring and revision of adaptation policies.

The overall framework of the NASCC must become functional for public and private sector partners that will be called upon to implement it. Functionality implies refinement, which in turn requires geographically detailed information as well as targeted consultation with social partners.
It is of the utmost importance to ensure the constant monitoring of the strategy's implementation through the establishment of an observatory and a special monitoring mechanism using the appropriate indicators and tools.

In addition to the observatory, the next steps towards the implementation of the strategy should focus on the following:

- expanding our knowledge and information base on climate change issues;
- linking the strategy with the existing framework for the management of natural disasters;
- assessing and prioritising the measures suggested by the authorities;
- exploring funding possibilities from national and international sources;
- developing sector-specific scenarios for the Greek economy and its most vulnerable sectors;
- including all of the above in specific action plans and roadmaps for each geographic region and area of interest;
- identifying concrete measures to build the adaptation capacities of institutions and citizens; and
- establishing a plan for reviewing and adjusting the NASCC.