

CLIMATE CHANGE, ECONOMY AND

ENERGY CONSUMPTION

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Let's take a look at the problem....

...**Globally.** The high concentration of greenhouse gases (GHG) in the atmosphere, which is mostly coming from energy use; transportation, power plants and industry, is a main cause of the Global warming. However, energy consumption can act as a feedback on the climate change. In regions where the temperature increases, the consumption of energy for heating will reduce but energy used for cooling will increase. In regions where the temperature decreases the opposite result will be observed. The net effects of these changes on energy production will vary by region and by season and thus the costs of energy use. Most countries do not pay much attention of the economic impact coming from climate change and energy consumption but they are mostly focusing on controlling the energy production in a way that they can reduce the greenhouse gases emissions.

The Environmental Protection Agency on its website for climate change and energy use (1), hints that '*Hydropower generation is the energy source that is likely to be most directly affected by climate change* because it is sensitive to the amount, timing and geographical pattern of precipitation and temperature. *Infrastructure for energy production, transmission and distribution could be affected by climate change.* *Power plant operations* can be affected by extreme heat waves. Finally, some *renewable sources of energy could be affected by climate change*, although these changes are very difficult to predict.' An analysis on the [Effects of Climate Change on Energy Production and Use in the United States](#) is PROVIDED FROM the U.S. Climate Change Science Program (CCSP), which was directed by the U.S. Department of Energy and was published in October 2007.

The **International Energy Agency (IEA)** is an autonomous body which was established within the framework of the Organization for Economic Co-operation and Development (OECD) in order to implement an international energy program.(2) IEA member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA. The agency is dealing, among others topics, the [climate change with policies and measures](#) with all the [IEA member countries take action](#) . It analyses the energy dimension of climate change and the energy implications of the United Nations Framework Convention on Climate change (UNFCCC) and Kyoto Protocol.

IPCC (Intergovernmental Panel of Climate Change) is a scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Program (UNEP), which was created in order to provide scientific technical and socio-economic information in a policy-relevant but policy neutral way to decision makers. (3) According to Climate Change 2001: Working Group II: Impacts, Adaptation and Vulnerability, on the chapter 7.3. Energy, Transportation, and Other Climate-Sensitive Industry- [7.3.1. Energy Supply and Demand](#) , it is described the climate change on the energy demand and supply field in many regions of the world.

UNEP (United Nations Environment Program) is another program working on climate change, which collaborates with The United Nations Framework Convention on Climate Change (UNFCCC) Secretariat, The United Nations Development Programme, World Bank and Intergovernmental Panel on Climate Change (IPCC). It participates on the implementation of climate change strategies for many regions like West Asia, Europe, Asia and the Pacific, Atmospheric Brown Cloud, Africa, Latin America and the Caribbean. (5)

...in the Mediterranean

During the 20th century, air temperature in the Mediterranean basin was observed to have risen by 1.5-4°C depending on the sub-region. Over the same period, temperatures in south-western Europe (Iberian peninsula, south of France) rose by almost 2°C. The same warming effect can also be seen in North Africa, although it is more difficult to quantify the increase due to lack of reliable observation system. The increased frequency of extreme climatic events would result to a drop in hydro-electric potential and the cooling potential of thermal plants. Between 2000 and 2025, total demand for primary commercial energy could rise by 65% throughout the Mediterranean region.

According to the Observatoire Méditerranéen de l'Énergie (OME) trend scenario (2007), the primary energy demand in the Mediterranean will be 1.5 times higher in 2025 compared to 2006. Over the same time, the Southern and Eastern Mediterranean Countries (SEMCs) could experience growth rates of their energy demand four times higher than those of the Northern Mediterranean Countries (NMCs). Between 2006 and 2025, primary energy demand in the SEMCs—which are in full development process and whose population is increasing significantly—could thus multiply by 2.2. The SEMCs would, then, account for 42% of the total energy demand of the Mediterranean basin, as against 29% in 2006, the remainder being claimed by the NMCs. (6)

PLAN BLEU is a Regional Activity Centre for the Environment and Development in the Mediterranean. Energy and climate change is one of the issues that it is working on. Recently, during 2007-2008 period, Plan Bleu is carrying out a study on the topic [« Energy and climate change in the Mediterranean »](#). (7)

...and in Cyprus. In general, it is noticed an increase in the temperature which will decrease the needs for heating during winter but will increase the demand for cooling during summer.

The [Economics Research Centre of the University of Cyprus](#) (CypERC) is an independent non-profitable research institution aiming at high quality policy oriented research in economics. A study with the title [‘Long term prediction of the electricity consumption in Cyprus: the impact of the climate change’](#) was carried out from Dr. Theodoro Zachariadi, supported from the Economics Research Centre of the University of Cyprus. The report is available only in Greek, coming with a summary of it in English version. Below, it is given a part of this summary (8):

‘According to projections by international organisations, average temperature in the Eastern Mediterranean is expected to rise by about 1°C by the year 2030. Using our econometrically

*estimated model, we calculated that **electricity consumption in Cyprus will be 2.9% higher in 2030 than in the reference scenario.** This will lead to a welfare loss because of **higher electricity costs faced by both households and enterprises.** These costs are estimated at **15 million Euros in 2020 and 45 million Euros in 2030; for the entire period 2008-2030 the present value of costs may exceed 200 million Euros** (all amounts expressed in constant Euros of 2007). Households are most likely to bear the largest share of these costs: average costs per household may amount to about 30 Euros'2007 per year in 2020 and 80 Euros'2007 per year in 2030. Moreover, we estimated econometrically the evolution of peak electricity load during the 2000-2007 period, and then assessed the additional load requirements in the **future because of climate change: extra electricity load may amount to 65-75 Megawatts (MW) in the year 2020 and 85-95 MW in 2030. This will lead to additional costs for investing in additional power reserve capacity.** It should be noted that these projections are the result of a relatively low temperature increase in Cyprus because the forecast horizon is the year 2030, while climate change projections foresee that the sharpest temperature increase will most probably be observed in the second half of the 21st century.'*

According to this report, the increase in temperature will increase the electricity costs, as the electricity demands are expecting to be higher in the future years. However, it is not given a high attention on the economic impact of the climate change in Cyprus.

But let's be more specific and take a look at some examples in the world....

California

California's climate is mild cooling, which is highly sensitive to climate change whereas small increases in temperature can lead to a high use of air-conditioning system. However, California's electricity system is so large, that a moderate percentage temperature increase will result in a relatively sizeable impact on energy system use.

California Energy Commission, supported by **Electric Power Research Institute**, the **University of California–Berkeley**, and the **Scripps Institution of Oceanography**, are studying the possible effects of climate change on the energy production and use.

Generally, the analyses show that electricity demand will grow due to climate change and the overall economic impacts will depend on the effectiveness of response measures.

The [Public Interest Energy Research \(PIER\) Program](#) supports energy research and development in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

PIER funding efforts are focused on the following RD&D program areas:

- Buildings End-Use Energy Efficiency
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy Technologies

The California Climate Change Center (CCCC) is sponsored by the PIER program and coordinated by its Energy-Related Environmental Research area. The Center is managed by the California Energy Commission, Scripps Institution of Oceanography at the University of California at San Diego, and the University of California at Berkeley.

The California Climate Change Center Report Series details ongoing Center-sponsored research. (9,10)

Australia

As in all cases, Australia will experience the same thing. In the warmer seasons, the more tropical parts of Australia which they are highly depended on air conditioning, the energy demand will increase. However, global warming will reduce the demand for heating during the winter. The trends are expected to be different between the cities, where for some of them the net demand is expected to be less (e.g., Sydney and Melbourne) than others (e.g., Brisbane and Adelaide), but with substantial increases in overall per capita energy demand with temperature increases (Howden and Crimp, 2001). The effect of higher temperatures is likely to exceed the energy demand peak and additional generating capacity is needed. This increase in demand is due to economic growth and to greater usage of air conditioners in residential and commercial situations (Howden and Crimp, 2001). (11,12)

In Australia, transportation and manufacturing are sectors that have a high energy consumption. The demand in transport is expected to increase because of the population growth across the continent, while this growth may be affected by the climate change. However, possible impacts on the electricity generation from climate change are considered to be:

- warming by 1 °C can lead to a 3% decrease in thermal efficiency in some facilities, and a decrease in transmission line efficiency
- changes in demand required for air conditioning
- changes in rainfall and snowmelt affecting the supply and competition for water for power generation
- changes in cloud cover affecting solar generation
- changes in winds affecting wind power
- changes in plant growth affecting bioenergy production and carbon sequestration in soils and forests
- heightened storm events affecting wave and tidal power generation storms, strong winds and floods affecting infrastructure performance and security, including shipping, pipelines, transport and distribution systems. (11)

The [Australian Greenhouse Office](#), is the agency, in the climate change department of Australian Government, dedicated on reducing the greenhouse gas emissions, adapting renewable energy uses, even if coal is the main source of energy in Australia, and it is responsible for the energy star (<http://www.energystar.gov.au>) and energy rating (<http://www.energyrating.gov.au>) mandatory programs for buildings, domestic appliances and industrial equipment.

Australian Government provides information [in Australians to use energy efficiently](#) and in amore broad way, it is responsible for programs such as(13):

Department of Climate Change

- [Australian Climate Change Science Program](#)
- Adapting to climate change
 - [Climate Change Adaptation Skills for Professionals Program](#)
 - [Local Adaptation Pathways Program](#)
 - [National Climate Change Adaptation Program](#)

- [Carbon Pollution Reduction Scheme](#)
- [Greenhouse Action in Regional Australia](#)
- [Greenhouse and Energy Reporting](#)
- [Greenhouse Friendly™](#)
- [20% Renewable Energy Target](#) - Mandatory Renewable Energy Target

Department of the Environment, Water, Heritage and the Arts

- [Grants](#)
- [Rebates](#)
- [Renewable energy](#)
- [Solar Cities](#)

Legislation administered by the Minister

- [National Greenhouse and Energy Reporting Act 2007](#)
- [Renewable Energy \(Electricity\) Act 2000](#)
- [Renewable Energy \(Electricity\) \(Charge\) Act 2000](#)

Moreover, different scenarios for electricity generation technologies are proposed on a bare research report 06.7 by Helal Ahammad, Anna Matysek, Brian s. Fisher, Robert Curtotti, Andrew Gurney, Guy Jakeman, Edwina Heyhoe and Don Gunasekera , [‘Economic impact of climate change policy: the role of technology and economic instruments’](#), July 2006

China

China is another region, where global warming will exacerbate the increasing trend of electricity consumption for air conditioning and impose greater pressure to electric power supply. (14)

China will be guided by the following principles (14):

— To address climate change within the framework of sustainable development.

As early as in 1994, the Government of China formulated and published its sustainable development strategy --- *China’s Agenda 21 --- A White Paper on Population, Environment and Development in the 21st Century*.

In 2003, the Government of China further formulated the *Programme of Action for Sustainable Development in China in the Early 21st Century*.

— To follow the principle of “common but differentiated responsibilities” of the UNFCCC.

— To place equal emphasis on both mitigation and adaptation. China will strengthen its policy guidance for energy conservation and energy structure optimization to make efforts to control its greenhouse gas emissions. Meanwhile,

— To integrate climate change policy with other interrelated policies.

— To rely on the advancement and innovation of science and technology.

— To participate in international cooperation actively and extensively.

China will continue to actively participate in the international negotiations of the UNFCCC and relevant activities of the IPCC.

In the energy and climate change issues the agencies who are involved are:

- [Department of Climate Change, National Development and Reform Commission](#)
- [Ministry of Foreign Affairs \(MoFA\)](#) as Climate is a foreign policy

- [National Development and Reform Commission \(NDRC\)](#), Department of Climate change is responsible for the impact of climate change on social-economic development; key strategies, plans and policies dealing with climate change, implementation of United Nations Framework of Climate Change Convention, clean development mechanism (CDM) and responsible to do work assigned by the National Leading Group Dealing with Climate Change, Energy Conservation and Emission Reduction.
- Energy focus: Energy policy, National Energy Agency
- [Ministry of Science and Technology \(MOST\)](#)

From Meditteranean....

The Mediterranean, and more especially the Southern and Eastern rim, will be more affected by climate change and energy consumption than most other regions of the world in the course of the 21st century.

Energy demands in the Mediterranean (15):

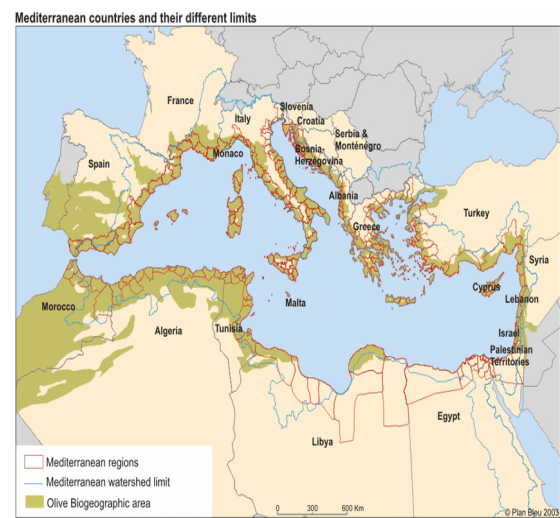
In general, more cooling will be required.

Over the year, the increase in Cooling Degree Days (CDD), meaning days whereas cooling is necessary, will be large in South Mediterranean (from Gibraltar to Lebanon), i.e., in the Middle East and the North African part of Mediterranean Region. In northern side, the main increase will be in the SouthIberian Peninsula, North-Italy-Balkans-Greece, and South Turkey.

The demands for cooling are expected mostly during summer time, with no increase in winter, and a very small increase in fall and spring. The requirements for cooling are not as significant for south Italy (including Sicily and Sardinia), south of France, Cyprus, northern part of Turkey (because of Black Sea), and the North Western tip of Spain, as it is in the south side of the Mediterranean Sea, from the southern part of Iberian Peninsula and the North African coast to Syria, which an additional month of heavy cooling will be required. The 2-3 week increase in the north Aegean area is also worth mentioning.

In general, less heating will be required.

The largest decrease occurs in the northern side of the region, from Turkey to North Italy. Spain and France will see a smaller but still noteworthy decrease, the South-East MR exhibits the lowest decrease, mainly because it is already a warmer region. Of course, winter will be the season that will require much less heating. The largest changes will happen along and above the axis North-Italy-Balkans-Greece-Turkey.



Summarising about the Cooling Demands and the Heating Demands, three areas can be identified:

- South Side of the Mediterranean (North Africa to Syria): very large rise in CD, small drop in HD
- North Side of the Mediterranean (Italy-to-Turkey): small rise in CD, very large drop in HD
- Atlantic Side (Spain / France): small rise in CD, large drop in HD

Countries of the Mediterranean that are members of the European Union, have to participate in the [European Climate Change Program](#). As we mentioned and before the Plan Bleu, is a research center for climate change issues. Morocco, Egypt and Tunisia are three countries where economic simulation of energy development strategies was given from this plan (16). Morocco, now is one of the Mediterranean countries that has adapted an [Energy Efficiency and Renewable Energy National plan](#) under Plan Bleu, participates in symposium for renewable energy and is more active on [climate change activities](#). Of course, this will have an impact on the economy of the country while it is trying [to invest](#) on energy generation. However, the government of each country is responsible for the country's future.



Research plan

Climate change and especially economic impacts in Cyprus is an issue which is not adequately studied. From my research Dr. Theodoros Zachariadis, is one of the few, maybe the only one that I found to work on the economy impacts of climate change in Cyprus.

Moreover, as the temperature is increasing the energy use in Cyprus is getting higher, especially during summer period whereas the needs of air conditioning are high. The economy costs from the increase on energy demands will get high enough and it will affect households and industries.

Economy and technology are the main means with which handle the economy impacts of climate change. In my opinion, a good research project on economic impacts from climate change can be carried out from the collaboration of [The Ministry of Finance](#) in Cyprus, [The Ministry of Agriculture, Natural resources and Environment](#), the [Electricity Authority of Cyprus](#), [Meteorological Service](#), [Economics Research Centre of the University of Cyprus](#) (CypERC) and [Cyprus University of Technology](#) (Faculty of Management and Economics, Faculty of Geotechnical Sciences and Environmental Management).

One of the Ministry of Agriculture, Natural resources and Environment 's topics that is involved is Climate change. The climate changes and especially the changes in temperature can be studied from both the ministry and the Meteorological Service. The pattern of these changes can be examined with the economic status of the island from the Ministry of Finance. However, the economic costs coming from the high temperatures and energy consumption can be examined especially from the Ministry of Finance, Economics Research Centre of the University of Cyprus and the Electricity Authority of Cyprus. The Electricity Authority can move on adapting new, renewable and less costly energy sources. The R&D department of the Authority with the association of the Cyprus University of Technology, can carry out projects, plans and studies for actions to handle the economic impact of climate change and energy use.

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