

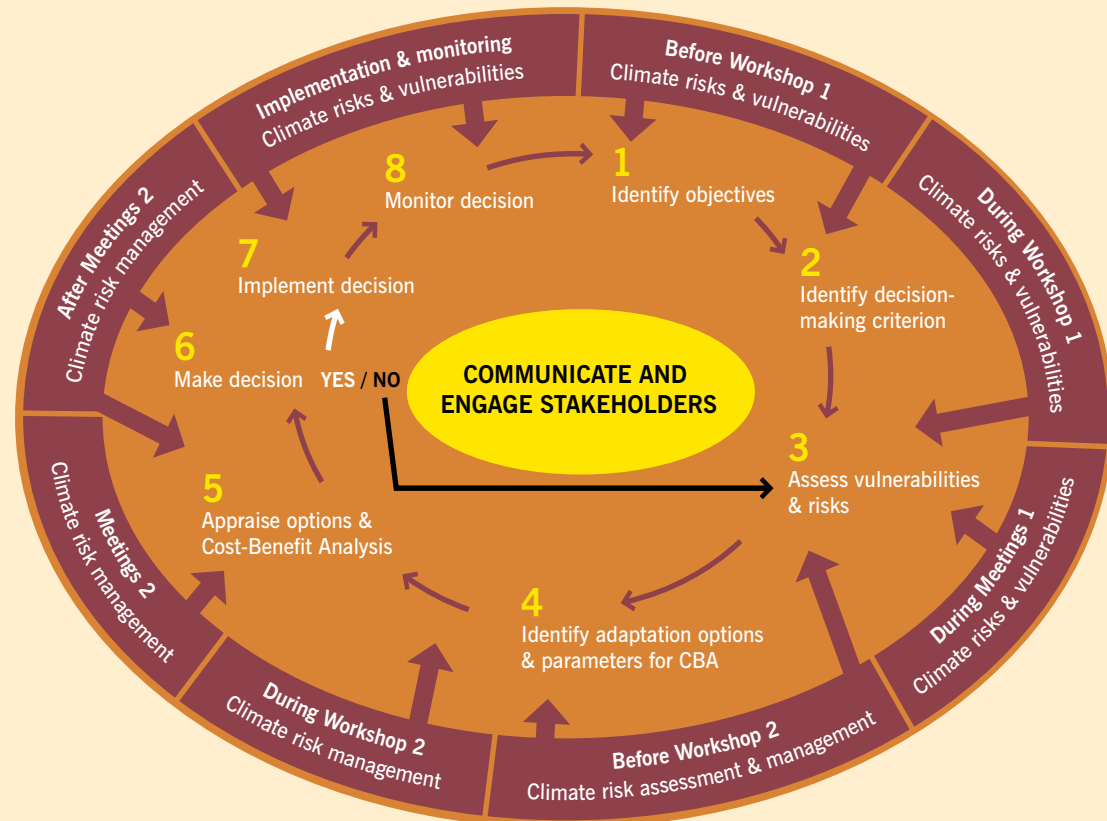
# Climate Vulnerability Assessments

An Assessment of Climate Change Vulnerability, Risk, and Adaptation in Albania's Energy Sector

**Country Energy Sector Vulnerability Assessments Program**  
Helping Countries Prepare an Effective Energy Sector Response



Figure 1: Decision-making Framework for Adapting Vulnerable Energy Infrastructure to Climate Change



## Understanding Energy Sector Vulnerability

Many countries are increasingly vulnerable to destructive weather events — floods, droughts, windstorms, or other parameters. The vulnerability is driven in part by recent extremes in climate variability but also by countries' sensitivity to events exacerbated by past practices, socioeconomic conditions, or legacy issues. The degree to which vulnerability to weather affects the countries' economies is driven by their coping or adaptive capacities.

Seasonal weather patterns, weather variability, and extreme events can affect the production and supply of energy, impact transmission capacity, disrupt oil and gas production, and impact the integrity of transmission pipelines and power distribution networks. Climate change also affects patterns of seasonal energy demand. It is important to explore these vulnerabilities for the energy sector given its major contribution to economic development, the long life span of energy infrastructure planning, and the dependence of supply and demand on weather.

In response to these challenges, the Energy Sector Management Assistance Program (ESMAP) has developed a framework for decision-making to support adaptation of energy infrastructure vulnerable to climate change, specifically the Climate Vulnerability Assessment Framework (Figure 1). A bottom-up, stakeholder-based, qualitative/semi-quantitative risk-assessment approach is used to discuss and identify risks, adaptation measures,

and their costs and benefits. It draws on experience and published guidance from the United Kingdom and Australia, as well as existing research and literature. The climate vulnerability assessment framework puts stakeholders at the heart of the decision-making process and involves:

- Climate risk screening of the energy sector to identify and prioritize hazards, current vulnerabilities, and risks from projected climate changes out to the year 2050
- Identification of adaptation options to reduce overall vulnerability
- A high-level cost benefit analysis of key physical adaptation options

This overview showcases a pilot vulnerability, risk, and adaptation assessment undertaken for Albania's energy sector to raise awareness and initiate dialogue on energy sector adaptation. This pilot assessment demonstrates an approach that can be used to help countries and energy sector stakeholders develop policies and projects that are robust in the face of climatic uncertainties, and assist them in managing existing energy concerns as the climate changes. It identifies key direct risks to energy supply and demand and options for adaptation to establish where to focus subsequent in-depth analyses. It also identifies additional research needed to better understand the implications of extreme climatic events for the energy sector as well as potential indirect impacts — such as possible adaptation actions in the agriculture sector that may affect energy supply.

"Europe and Central Asia suffers from an 'adaptation deficit' that is already challenged by recent climate variability, which will only worsen with the consequences of projected trends in climate in the coming decades."

Marianne Fay, Director of the World Bank's *World Development Report 2010*, and author of the report *Adapting to Climate Change in Europe and Central Asia*



# Albania's Energy Sector is Vulnerable to Climate Change

## Water Resources are a National Asset

The River Drin is the main source of electricity for Albania; delivering power for local industry and households, and providing about 90% of domestic electricity generation.<sup>1</sup> Meanwhile, Albania's rainfall and snow is among the more variable in Europe.<sup>2</sup> As efforts to counter the impacts of climate change accelerate and as other countries struggle to reduce their greenhouse gas emissions, Albania's ability to produce renewable energy will only increase in importance as a national asset.

## But the High Dependence on Hydropower Brings Challenges

Albania already finds it difficult to meet energy demand and maintain energy supply due to the fluctuations in the country's rainfall and other precipitation on which hydropower depends. As a result, hydropower production can vary between almost 6,000 GWh in very wet years to less than half that amount in very dry years. In 2007, a drought in the Drin's watershed led to severe electricity shortages and blackouts, affecting businesses and citizens alike.

Figure 2 clearly shows lower domestic power production linked to low rainfall in 2002 and again in 2007 with resultant associated high energy imports. It is worth noting that, even with imports, load shedding is still required so the energy consumption data in Figure 2 do not represent the true energy demand.

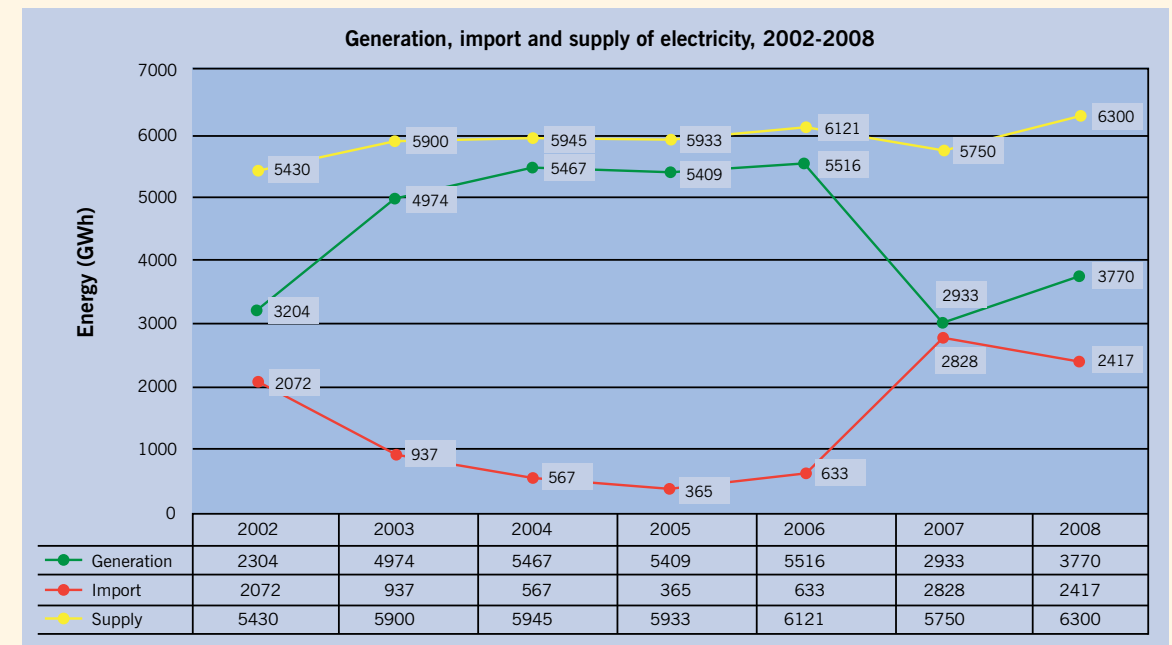
Other factors constrain Albania's ability to manage these challenges, such as limited regional electricity interconnections and inefficiencies in domestic energy supply, demand, and water use. Losses in the electricity distribution system were about 33% in 2008. Together, these factors create frequent load shedding and adversely impact Albania's economic development.

Meanwhile, small hydropower plants compete for limited water resources with the irrigation needs of the agriculture sector.<sup>3</sup> This is exacerbated during summer when rainfall is the lowest and agriculture requires greater water supply. Improving the efficiency of water use in Albania's irrigation system, where 10% to 20% of water resources are lost, is an adaptation mechanism that can help both sectors.

Currently, efforts are underway to address these challenges and improve resource use efficiency. For instance, the Albanian government has recently decided to eliminate load shedding from 2009 onwards and committed to provide 24 hours of electricity supply. Electricity losses from the distribution system were reduced by 5.5% in 2008 compared to 2007 and losses from the transmission system were 3% in 2008, down from 4% in 2006. The efficiency of water use in energy generation has also improved due to better monitoring and management.

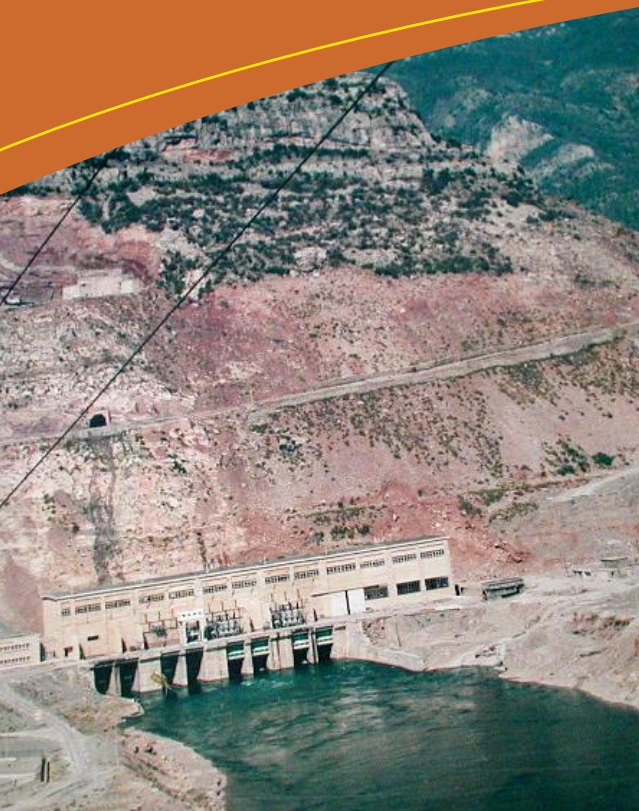
1 The remaining domestic generation comes from the Mati River and other smaller hydropower plants. A new thermal power plant is expected to come into operation in late 2009 that will add about 10–15% of domestic generation capacity in the country.  
 2 There are several factors that contribute to Albania's variable rainfall: it is mountainous; it is located to the northeast of a body of water; and it receives a considerable amount of its moisture from irregularly occurring cyclones.  
 3 Agriculture accounts for 20% of GDP and almost 60% employment. Irrigated agriculture is key for high value and export crops (fruit and vegetables).

Figure 2: Generation, Import, and Supply of Electricity in Albania from 2002 to 2008

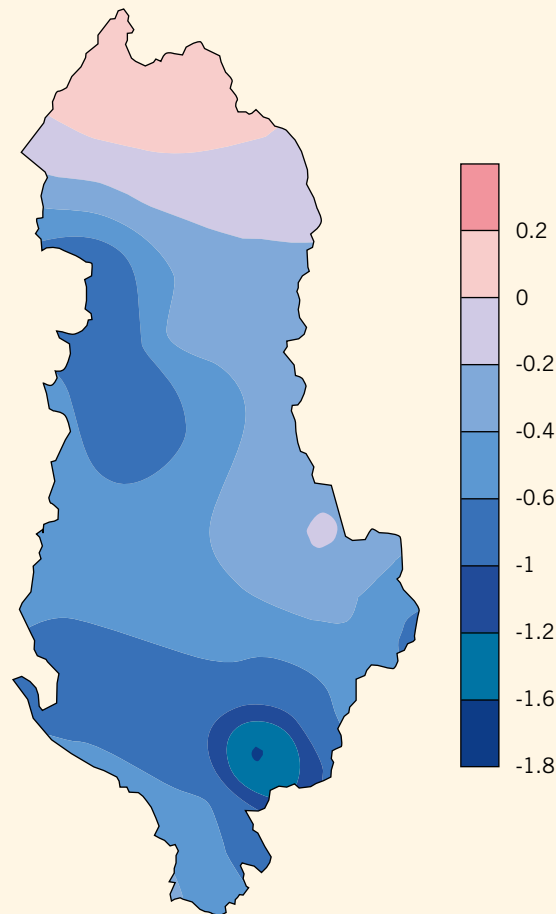


Source: Authors





**Figure 3: Annual Precipitation Trends (%) over Albania, 1961–1990**  
*(Blue colours are areas that became drier)*



Source: Bruci, E. (2008). *Climate variability and trends in Albania*. IWE, Tirana Polytechnic University, Tirana, Albania.

### Climate Change Looks Likely to Make Matters Worse, Unless Prompt Action is Taken

Climate forecasts project an increase in droughts resulting from global warming and changing hydrology. These changes could reduce annual average electricity output from Albania's large hydropower plants (LHPPs) by about 15% and from small hydropower plants (SHPPs) by around 20% by 2050. Most of the country has already seen decreases in precipitation (Figure 3).

Other energy assets are not immune from climate impacts. Rising temperatures can reduce the efficiency of transmission and distribution lines, as well as the power produced by thermal power plants (TPPs) by about 1% each by 2050. If river-water cooled TPP were developed in future, these would be affected by changes in river flows and higher river temperatures, further reducing their efficiency. Owing to uncertainties in current and future wind speeds, estimates of changes in wind power generation cannot be made. Solar energy production in Albania may, however, benefit from projected decreases in cloudiness as it is estimated that output from solar power could increase by 5% by 2050.

Higher temperatures due to climate change may reduce the demand for heating in winter, but will increase demand for air conditioning and refrigeration in the summer. The seasonality of Albania's supply-demand imbalance raises this exposure: summer temperatures increase the demand for cooling and refrigeration at the same time hydropower production is most constrained by reduced rainfall. Summer temperatures also coincide with a greater irrigation need in agriculture, which may compete directly with small hydropower plants for the limited water supplies.

### Adapting to Climate Variability will become Increasingly Important for the Albanian Energy Sector

A wide range of Albanian stakeholders met regularly over eight months to tackle these questions through a collaborative assessment of vulnerability, risk, and adaptation for the energy sector. Through a series of structured workshops and meetings, they collectively identified and prioritized 20 key risks and options for managing them.

Albania's draft National Energy Strategy (NES) sets out an 'active scenario' to improve energy security in the decade to 2020. It targets a majority of identified adaptations and describes plans to **diversify the energy system** by encouraging development of renewable energy generation assets (e.g., solar, small hydropower plants, wind, biomass) and thermal power. It notes the importance of new electricity interconnection lines, some already under construction, to facilitate Albania's active participation in the South East European energy market. As currently drafted, the NES does not account for future climate impacts on the performance of new energy assets — neither generation nor transmission.

The draft NES does emphasize the need for **improved energy efficiency** through greater use of domestic solar water heating, improved building standards, use of lower energy appliances, and alternative heating sources other than electricity. These energy efficiency measures are critical and will become increasingly essential as the climate changes.

### Illustrating Climate Adaptation — Two Ongoing Efforts

**Better weather forecasting.** Knowing that droughts occur and will recur in the Drin watershed, Albania's hydropower managers are adapting their operations. Working with weather and climate experts, managers plan to install a network of river-level sensors and a system for collecting regional weather forecasts. Managers will be able to more accurately forecast the river to time the filling and release of water from reservoirs and more efficiently utilize the river flows with due consideration to flood handling. They are also working with regulators to improve the efficiency of how the water is used to generate electricity. This includes setting minimum water levels for each reservoir and managing

imports and exports of power. For example, hydropower is exported at daytime peak periods to neighboring countries and imported at night time off-peak hours from thermal power producers.

**Re-dimensioning small hydropower systems.** The owner of several small “run-of-the-river” hydropower facilities, has seen decreasing accumulation of snow over the past few years and melting start earlier each year. The earlier melting and less snow accumulation means that rivers swell sooner, stronger, and for shorter periods. The risk of flooding has increased and the operating window of his plants has shortened. To adapt to the changing circumstances, he has adjusted turbine capacity and widened the river channel at one facility to produce more energy during periods of high flows.



However, the draft NES should also take into account the fact that the wider region on which Albania depends for energy imports is also facing emerging climate impacts. About one quarter of the region's electricity is generated by hydropower and regional summer energy demand will rise along with temperatures and economic development. This could increase import prices and reduce supply unless region-wide coping strategies are also devised.

### Albania's Climate Vulnerability Assessment Reveals an Energy Shortfall by 2030

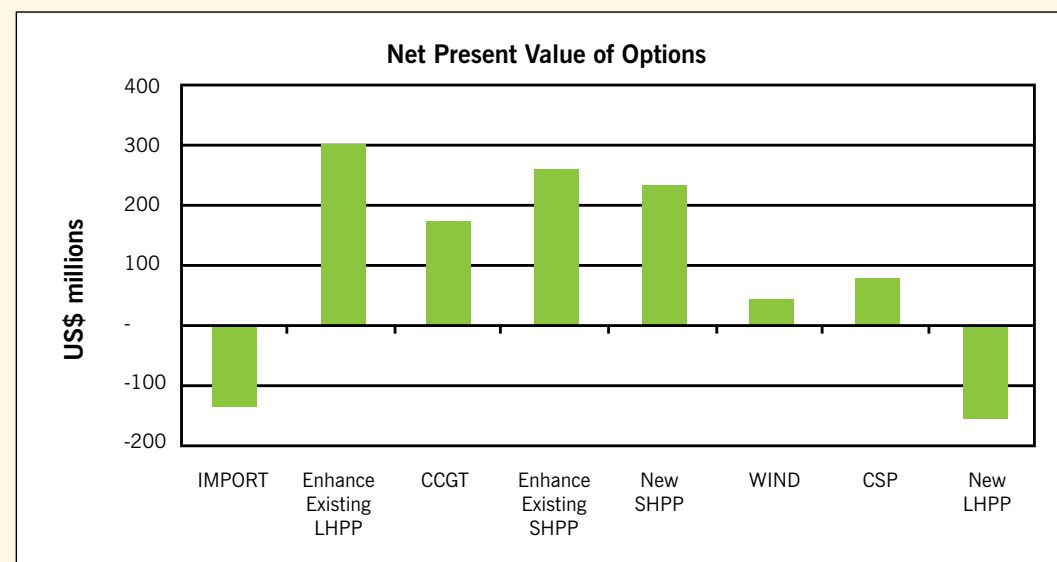
Together with Albanian energy practitioners, the Climate Vulnerability and Adaptation Assessment team extrapolated the energy planning scenarios to 2050, as outlined in the 'active scenario' of the draft NES, to illustrate potential longer term impacts of climate change on energy supply and demand. Assuming full implementation of the measures already identified in the extrapolated 'active scenario,' the potential supply-demand gap was estimated at 350 GWh per year by 2030, equivalent to power generation of 50 MW. By 2050, the shortfall rises to 740 GWh per year (105MW) or 3% of total demand. Embedded within these figures are the more

significant seasonal impacts on energy security due to changing demand and production over the year, with summer peak demand increasing when hydropower production is at its lowest.

A high-level cost benefit analysis (CBA) was undertaken to estimate the relative costs and benefits to Albania of supplying the shortfall in its electricity production attributed to climate change impacts. Using financial (capital and operational costs), environmental (water value, greenhouse gas and other emissions, and ecosystem values), and social (disturbance to people and property) parameters identified by Albanian stakeholders, the CBA ranked the sustainability of their options, such as increased energy trade and different types of domestic energy generation (Figure 4).

Figure 4 presents the Net Present Value results in current (2010) US\$ terms for each of the options tested, under a 'base case' set of assumptions for the period to 2030. Based on this analysis, the most economic options for Albania are to upgrade existing LHPPs and SHPPs in the medium term, followed by development of new SHPPs and TPPs (shown as combined cycle gas turbine, CCGT). Sensitivity analyses confirmed that upgrading existing LHPPs and SHPPs were the most economic options for discount rates in the range of 2% to 20% and, as expected, are insensitive to the value of greenhouse gas emissions.

Figure 4: Net Present Value of Diversification Options to 2030  
(To fill the energy shortfall due to climate change)



Source: Authors



**Coordination with Other Sectors Offers Adaptive Opportunities**

**Albania's unique asset for water management.** Across Albania there is a high density of small rural dams; 640 small- to medium-size reservoirs with a cumulative storage capacity of about 0.6 billion m<sup>3</sup>. Developed for irrigation from the 1960s–80s, there are important opportunities today to rationalize and modernize the dams, improve their use, and raise Albania's capacity to manage increasing hydrological variability. Such measures could be further supported through rehabilitation of main irrigation canals and better incentives for the adoption of efficient irrigation systems.

**A synergy between quarrying and dredging for river basin management.** Strong soil erosion, while a natural phenomenon in mountainous territory with heavy rainfall, has been exacerbated in Albania by human activities, particularly deforestation during the 1990s. Large sediment volumes end up in rivers and reservoirs, requiring strategies for sediment management. Encouraging quarrying of alluvial soils in river areas at the entrance to reservoirs could support adaptation.

## Albania Has Options for Managing Weather and Climate Vulnerability

There are several critical actions that Albania could take now to support optimal use of energy, water resources, and operation of hydropower plants today. Enacting these steps now will help Albania better manage climate variability and build the country's future resilience to climate change.

- **Improving the way that institutions monitor, forecast, and disseminate information on meteorological and hydro-meteorological conditions.** Albania could develop (in-country) or obtain (from elsewhere) weather and climate forecasts appropriate for energy sector planning, covering short-range forecasts (1-3 days), medium-range forecasts (3-10 days), seasonal forecasts, and regional downscaled climate change projections. This information could support energy sector stakeholders to undertake joint climate risk assessments across shared water resources and regional energy networks, and devise agreed strategies to manage identified climate vulnerabilities and risks.
- **Improving energy efficiency by reducing system losses and encouraging and helping end users to manage their demand for power.**
- **Upgrading Emergency Contingency Plans (ECPs) for hydropower plants** where needed, to account for expected increases in precipitation intensity due to climate change. Power producers and local authorities may also need to improve their capacities to implement ECPs, ensuring that they provide sound

mechanisms for monitoring weather and its influence on river flows and reservoir levels, as well as communication with downstream communities, and contingency plans for evacuation.

- **Ensuring the management and development of water resources integrates all sectors energy, agriculture, water supply and sanitation, and cross-border concerns along with environmental and social concerns.**
- **Exploring further adaptation opportunities.** Climate change emphasizes the imperative to increase the diversity of its energy supplies through increased regional energy trade and a more diverse portfolio of domestic generation assets. With major investments in upgrading new energy assets on the horizon, and the privatization of assets, the earlier climate risks are considered, the greater the opportunities to identify and implement solutions that make the energy system more robust and resilient for coming decades.

## ACRONYMS AND ABBREVIATIONS

CBA	cost benefit analysis
CCGT	combined cycle gas turbine
CSP	concentrated solar power
ECP	emergency contingency plans
GDP	gross domestic product
GWh	gigawatt hours
LHPP	large hydropower plant
m <sup>3</sup>	cubic meters
MW	megawatts
NES	National Energy Strategy
SHPP	small hydropower plant
TPP	thermal power plant

The Energy Sector Management Assistance Program (ESMAP) is a global knowledge and technical assistance trust fund administered by The World Bank and assists low- and middle-income countries to increase know how and institutional capability to achieve environmentally sustainable energy solutions for poverty reduction and economic growth.

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**The Climate Change Vulnerability, Risk, and Adaptation Assessment of Albania's Energy Sector** will be available at [www.esmap.org](http://www.esmap.org).

For more information on the **Country Energy Sector Vulnerability Assessments Program** or about ESMAP's climate vulnerability assessments, please visit us at [www.esmap.org](http://www.esmap.org) or write to us at:



Energy Sector Management Assistance Program

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