Climate change and renewable energy (an adaptation perspective)

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Introduction

- The world continues to emit greenhouse gases, a 4 degree scenario is likely
- More evidence and understanding of the impacts of climate change
- Financial resources for adaptation can be as high as USD 100 billion per year up to 2050
- Urgency to prevent maladaptation

Impacts in broad terms

- **Production:** uncertainties with endowment (changes in hydrology, temperature and other weather patterns, extremes)
- **Transmission:** infrastructure and efficiency
- **Demand:** less cooling, more heating and pumping. Shift from heating to cooling implies more demand for electricity
- **Cross-sectoral:** water use in other sectors

Some figures: expected changes in energy demand

Country	For heating	For cooling
Switzerland (2050-2010, office buildings)*	33 to 44 % reduction	225-1050 % increase
USA commercial buildings **	12 % reduction by 2020 22 % reduction by 2050 33 % reduction by 2080	17 % increase by 2020 36 % increase by 2050 53 % increase by 2080
USA Residential **	12 % reduction by 2020 24 % reduction by 2050 34 % reduction by 2080	38 % increase by 2020 89 % increase by 2050 158 % increase by 2080

* Christenson, M., Manz, H., Gyalistras, D. (2006), "*Climate warming impact on degree-days and building energy demand in Switzerland". Published in Energy Conversion and Management 47 (2006) 671-686*

*** Huang, 2006 in: Wilbanks et al., 2008. Effects of Climate Change on Energy Production and Use in the United States. US Climate Change Program, Synthesis and assessment product 4.5*

Some specific examples

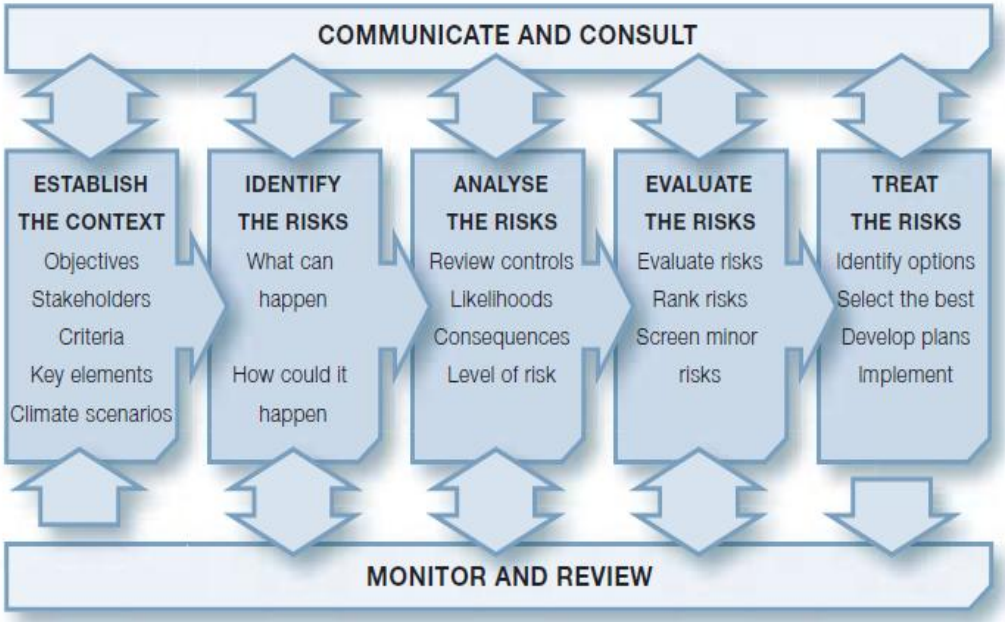
Technology	Temperature	Rainfall	Other
Hydropower	Evaporation	Water availability, changes in runoff, siltation, erosion	Extreme events, conflicts for other uses of water
Geothermal	Generation efficiency	Availability of water for cooling	Extreme events
Wind			Changes in wind density, uncertainty, extreme events
Solar			Changes in cloudiness, extreme events

Assessing climate risk

- How significant is the exposure? Where are the gaps in knowledge?
- What implications are there for planning of investments in the short, medium and long term?
- What linkages are there with other sectors? And other risks (e.g. oil price)?
- What are the alternatives?
- How much will it cost?

Assessing climate risk

- Risk assessment
- Risk management
- Cost benefit analysis



Helping pilot countries

- Initial profiles
- Screening tools
- Risk assessment and risk management methodologies (flexible, situation specific)

Additional slides

Climate Change Knowledge Portal - Windows Internet Explorer

http://sdwebx.worldbank.org/climateportal/home.cfm?page=country_profile&CCode=ETH

WB: People Directory Provider

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Climate Change Knowledge Portal

Page Tools

Overview | Climate Baseline | Natural Hazards | Climate Future | Impacts & Vulnerabilities | Adaptation | Energy & Climate | References

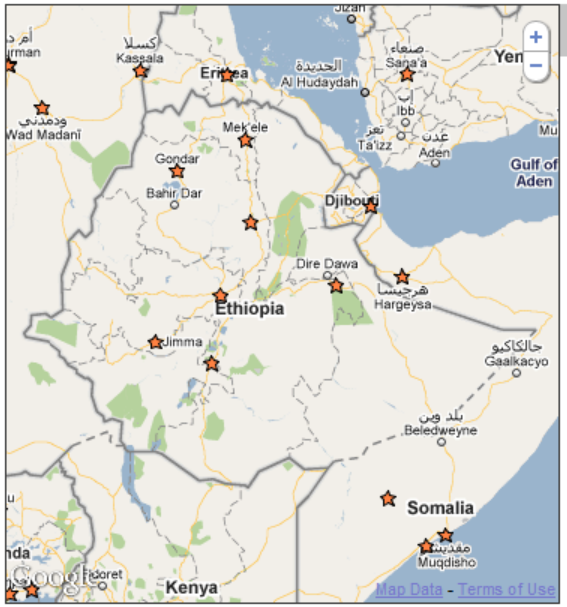
Recent Trends

Mean annual temperature	1.3 C ▲
'hot' days per year	73 days ▲
'hot' nights per year	137 days ▲
'cold' days per year	21 days ▼
'cold' nights per year	Explore Further

Key Sectors

- Agriculture
- Health
- Water Resources
- Infrastructure

Explore Further



Select a layer to visualize it on the map.

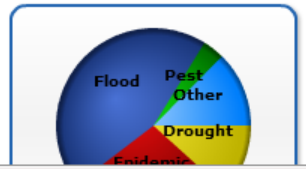
Legend

Major Cities

Layers

- Major Cities
- Major Rivers
- Water Bodies
- Dams
- Roads
- Wetlands
- Elevation

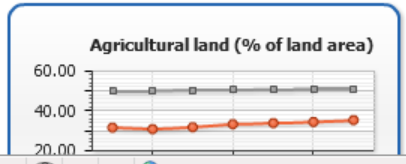
Natural Hazards



Overview

Covering 1.2 million kilometers on the Horn of Africa, Ethiopia is considered to be one of the poorest countries in the world with an average GDP of US$350 and significantly high rates of poverty. The population in 2010 numbered 81 million, and with an annual growth rate of 3.2%. Such a rapid increase will result in great strain on the country's natural resources. In addition to the widespread poverty and population pressures, a number of socio-economic factors excacerbate the development challenges in Ethiopia, thus increasing the country's vulnerability to climate variability and climate change. Foremost amongst these burdens are the inadecuately developed water resources; sparse availability of health services; inadequate road infrastructure (particularly in drought prone areas), and weak

Selected Indicators for Impacts and Vulnerabilities



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At a Glance

Temperature	Expected to increase by 2060 by 2090	▲	 1.1 to 3.1°C 1.5 to 5.1°C
Rainfall	Expected to increase throughout the country October-December	▲	10 - 70%
Extreme	'hot' days are projected to occur more frequently by 2060	▲	19 - 40%
	'hot' nights are projected to occur more frequently by 2060	▲	26 - 69%
	Proportion of total rainfall that falls in 'heavy' events	▲	-1 - +18%

Key Climate Changes

- Large, proportional increases in October-December rainfall are predicted to occur in the driest, eastern most parts of Ethiopia.
- Model data are broadly consistent in indicating increases in the proportion of total rainfall that falls in 'heavy' events, with annual changes ranging from -1 to +18%. The largest increases are seen in July-September and October-December rainfall.
- Projections from different models are broadly consistent in indicating increases in annual rainfall for Ethiopia as a whole. These increases are largely a result of increasing rainfall during the 'short' rainfall season (October-December) in southern Ethiopia.
- All projections indicate decreases in the frequency of days and nights that are considered cold in the current climate. Cold nights decrease in frequency more rapidly than cold days, and do not occur at all in most model projections by the 2090s under the highest emissions scenario (A2).

Climate Charts

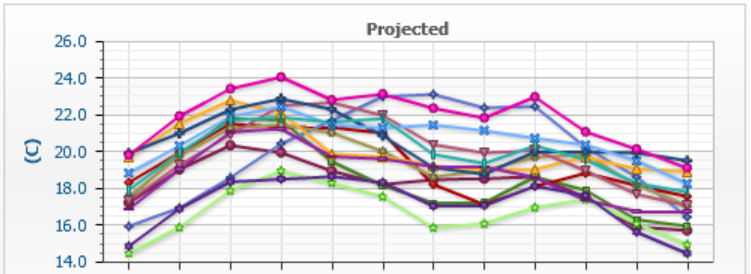
Move the marker to view the projected climate charts.

What does the chart show?

This chart shows how well the best available climate models capture the seasonal cycle of climate rainfall and/or

Choose your variable Temperature | **Choose your time period** Future 2020-2039 | **View mean or change** Mean | GRAPH IT | PRINT IT

Historical (1980-1999) and Future (2020-2039) Temperature mean Projections



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Global Climate Models

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Energy Overview

Overview | Consumption by Sector | Electricity Supply & Demand | Access to Electricity

- The state owned Ethiopian Electric Light and Power Authority (EELPA) was established in 1956 and renamed Ethiopian Electric Power Corporation (EEPCo) in 1997. EEPCo is responsible for the generation, transmission, distribution and and sale of electric energy throughout the country. The corporation has two electric energy supply systems - the Interconnected System (ICS) and the Self Contained System (SCS). The main energy source of ICS is hydropower. SCS generates electricity through mini hydropower plants and diesel generators . Ethiopian Electric Power Corporation (EEPCo) is responsible for the execution of the Universal Electricity Access Program (UEAP), an aggressive grid network extension program which was able to increase access to electricity from 13 percent in 2002 to 32 percent in 2010. A sustained expansion of national and foreign demand for power will be critical for the expansion of Ethiopia's hydropower sector, which in turn will be vital to support the country's accelerated economic growth .

Renewable Energy Sectors

Wind | Solar | Hydropower | Geothermal | Biofuels

Projected Impacts

- Shifts in the geographical distribution and the variability of wind fields are the main mechanisms by which global climate change impacts wind energy endowments . Climate change is likely to bring changes in wind density, speed and pattern. Since energy contained in wind is proportional to the cube of the wind speed, alterations in the wind speed can have significant impacts on the generation of wind energy . Wind energy production may be reduced if wind speeds increase above or fall below the acceptable operating range of the existing technology. This may lead to increased uncertainty on wind energy output. However, short life span of wind power generation systems reduces the risk associated with climate change.

Risk Management Response

- Wind blows strongly in the dry season; therefore, wind energy could be an ideal complement to hydropower. Wind energy farms should be established after proper site analysis so that projected changes in wind speeds, direction and probable flash floods and river floods are accounted for.

Renewable Current Status & Potential

- With just 2% rural access to electricity Ethiopia has enormous potential for hydro, geothermal and solar energy generation. The Renewable Energy Development Component of the Energy Access project supports development of solar technology and small hydro plants. This component is implemented by the Rural Electrification Fund Secretariat (REF) under the Ethiopia Renewable Energy Development and Promotion Centre (EREDPC). The GOE has taken several steps that indicate a long-term commitment for off grid rural electrification and renewable energy development through the REF. They passed the Proclamation of the Rural Electrification Fund in 2003, established a Rural Electrification Board and have hired staff for the Rural Electrification Executive Secretariat.
- The Ethiopian Government is interested in utilizing available geothermal resources to diversify its overall generation resource mix and maintain an affordable level of electricity generation cost. Geothermal energy can provide a major backup to an uncertain hydropower supply and also serve the arid and semi-arid areas of the country where

Consumption By Sector