Climate Change and Energy Vulnerability Country dashboard – Quick View

Uzbekistan - Draft

21 September 2012

Quick View Diagnostic

Uzbekistan

The answers to the Quick View process generated scores for the country's energy sector on three interconnected dimensions: 1) Overall physical vulnerability of the energy sector; 2) Country and sectoral adaptive capacity; and 3) Imperative to adapt the energy sector. The results are summarized in the figure below and described in further detail in later slides.

Exposure of the energy system to climate-related hazards

This depends on the existing climate hazards as well projected future changes in hazards
See Slide 4

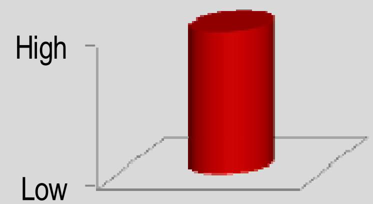
Energy system sensitivity to climate change

This depends on the characteristics of the country's energy sector
See Slide 5

Country energy sector adaptive capacity

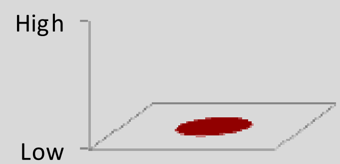
This depends on the potential or capability of the country's energy system to adjust or respond to climate change
See Slide 8

Uzbekistan's level of physical vulnerability



See Slide 6

Uzbekistan's level of adaptive capacity



See Slide 8

Energy system adaptation imperative

GREATEST

This indicates how important adaptation is to energy:
- Adequacy
- Reliability
- Cost-effectiveness
- Sustainability

See Slide 9

Energy Sector Overview

Uzbekistan

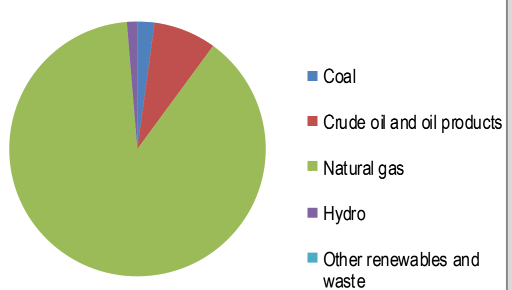
An overview of the country's energy sector is important to understand the context within which climate-related risks will be experienced and how country vulnerability will be assessed.

Key indicators in 2009 (IEA, 2012)	
Total energy production (TEP)	60.7 Mtoe
Total primary energy supply (TPES)	48.8 Mtoe
Energy exports as a percentage of TEP	22.5%
Total final consumption (TFC)	35.9 Mtoe
Energy supply losses as a percentage of TPES	4.1%

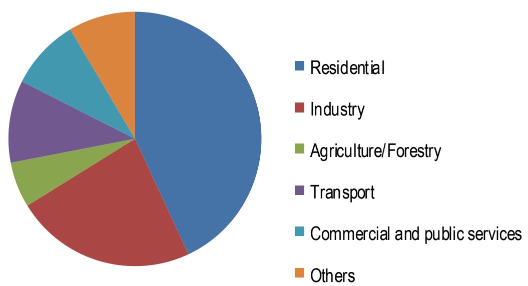
Key recent trends

- Insufficient and unreliable power supply ranked as the 3rd most significant obstacle to doing business in Uzbekistan, up from 8th in 2005 (World Bank, 2009a)
- National economic expansion plans want to maximize natural gas exports by increasing coal use for power generation, promoting energy efficiency and more efficient combined cycle gas turbines, and developing renewable energy (World Bank, 2009b)
- Approved government investment program made of 37 projects to modernize and expand the Uzbek power sector (World Bank, 2012)

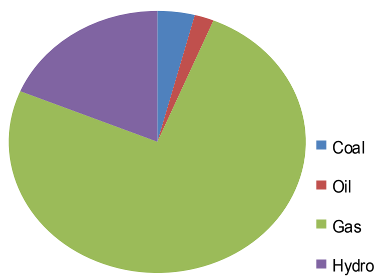
Energy production (ktoe) in 2009 (Source: IEA, 2012)



Final energy consumption (ktoe) by sector in 2009 (Source: IEA, 2012)



Electricity output (GWh) in 2009 (Source: IEA, 2012)



Exposure to Climate-related Hazards Part 1

Uzbekistan

Observed climate-related hazards (country-level). Source: EM-DAT.

Hazard	Present-day average number of disasters per year	Estimated economic impact in 1980-2010 (in thousand USD)	Country energy sector present-day exposure
Storms *Yes if the country is affected by tropical cyclone footprints (World Bank Knowledge Portal)*	Very small number reported	50,000	No
Flood *Yes if floods exceed or are equal to 10% of the annual number of natural disasters (World Bank Knowledge Portal)*	Very small number reported	-	Yes
Mass movement *Yes if landslides exceed or are equal to 10% of the annual number of natural disasters (World Bank Knowledge Portal)*	Very small number reported	-	Yes
Drought *Yes if droughts exceed or are equal to 10% of the annual number of natural disasters (World Bank Knowledge Portal)*	Very small number reported	-	No
Wildfire *Yes if wildfires exceed or are equal to 10% of the annual number of natural disasters (World Bank Knowledge Portal)*	-	-	No

Exposure to Climate-related Hazards Part 2

Uzbekistan

Projections for changes in key climate-related indicators by the 2050s: Annual average change (%) for one or more river basin units and for greenhouse gas emission scenario A2 (high). Map(s) showing the river basin(s) concerned can be found below. Source: World Bank Climate Change Knowledge Portal. To see projections for each climate model and per river basin click here.

Indicators (Envelope of GCM ensemble) (A2)	Basin No1669 'Aral drainage'	Country energy sector exposure by the 2050s
Annual precipitation change	-13.4% / +19.8%	**Uncertain**
'Increase' or 'Decrease' if at least 70% out of the available GCMs project an increase or decrease in annual average rainfall exceeding 5% respectively; 'No change' refers to cases where at least 70% of models project a small change (between -5% and +5%); and 'Uncertain' refers to cases where fewer than 70% models agree (World Bank Knowledge Portal).		
Mean annual runoff change	-10.8% / +19.6%	**Uncertain**
'Increase' or 'Decrease' if at least 70% out of the available GCMs project an increase or decrease in annual average runoff exceeding 5% respectively; 'No change' refers to cases where at least 70% of models project a small change (between -5% and +5%); and 'Uncertain' refers to cases where fewer than 70% models agree (World Bank Knowledge Portal).		
Drought (low river flows) (%)	-16.8% / +23%	**Uncertain**
'Increase' or 'Decrease' if at least 70% out of the available GCMs project an increase or decrease in droughts exceeding 5% respectively; 'No change' refers to cases where at least 70% of models project a small change (between -5% and +5%); and 'Uncertain' refers to cases where fewer than 70% models agree (World Bank Knowledge Portal).		
Flood (high river flows) (%)	-13.1% / +16%	**Uncertain**
'Increase' or 'Decrease' if at least 70% out of the available GCMs project an increase or decrease in floods exceeding 5% respectively; 'No change' refers to cases where at least 70% of models project a small change (between -5% and +5%); and 'Uncertain' refers to cases where fewer than 70% models agree (World Bank Knowledge Portal).		

Energy System Sensitivity to Climate Change

Uzbekistan

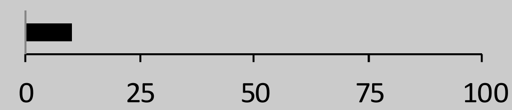
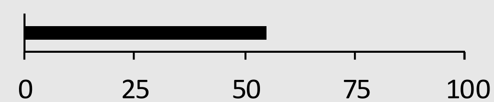
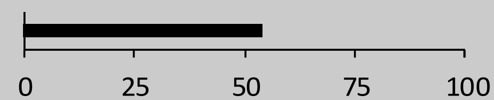
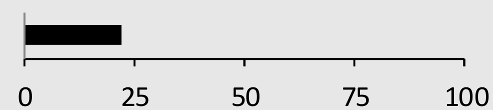
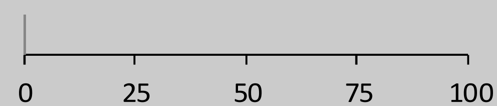
The following table shows areas of climate change sensitivity (in red and orange) in the country's energy system. Orange, white and green represent aspects where there is uncertainty, no obvious sensitivity or opportunity respectively.

Indicators of energy system sensitivity to climate-related changes	Responses and scores
Energy system level concerns	
Energy sector water intensity	No
Energy supply efficiency	High
Country energy intensity	Yes
Fossil fuel resource extraction and processing	
Presence of coastal, offshore or inland extraction/processing plants prone to flooding and storms	Yes
Presence of processing plants in water-stressed areas	Yes
Energy supply	
Contribution of hydropower to power supply	Small
Contribution of small reservoirs or run-of-the-river plants to total hydropower output	-
Contribution of thermoelectric facilities to power supply	Considerable
Contribution of thermal power plants with open-circuit cooling to total thermoelectric output	Unknown
Contribution of woodfuel to household cooking	Unknown
Power transmission & distribution and fuel transport	
Energy imports via climatically-sensitive routes over long distances	No
Proportion of transmission lines crossing areas vulnerable to extreme weather or unstable land	Considerable
Energy demand	
Reserve margin adequate to respond to unusually high demand	Yes

Physical Vulnerability of Energy System to Climate Change

Uzbekistan

It is the combination of responses on the ‘Exposure of the energy system to climate-related hazards’ (Slide 4) and ‘Energy system sensitivity to climate change’ questions (Slide 5) that gives physical vulnerability scores for each element of the energy service chain. The bar charts below represent the percentage of combinations where a vulnerability was identified. For further information on the indicators used to assess physical vulnerability, refer to the Rapid Assessment process document by clicking here.

Energy service chain	Physical vulnerability scores
Energy system-level concerns *Percent out of 21 possible areas of climate change vulnerability**	
Fossil fuel resource extraction and processing *Percent out of 11 possible areas of climate change vulnerability**	
Energy supply *Percent out of 39 possible areas of climate change vulnerability**	
Power transmission & distribution and fuel transport *Percent out of 18 possible areas of climate change vulnerability**	
Energy demand *Percent out of 9 possible areas of climate change vulnerability**	

* The number of possible areas of climate change vulnerability varies according to the degrees of complexity and sensitivity to climatic parameters of each element of the energy service chain. For example, energy supply is overall more sensitive to climate, and the interactions between climatic parameters and different modes of energy generation are more complex than in the case of fossil fuel resource extraction and processing.

Physical Vulnerability Example

Uzbekistan

- In the summer months some thermoelectric plants already suffer from low river flows and a lack of cooling water. For instance, the Syrdarya plant in Samarkand suffers from cooling water constraints, being located at the tail of the river where flows are at their weakest (Acclimatise et al., 2011).

- The Charvak hydropower station, as well as agricultural irrigation, have been hit by the dry winter weather of 2010-11, which was followed by a warm and dry spring. This resulted in sharp water outflow reductions for the reservoir. Similarly, the Tuyamuyn reservoir in the Amu-Darya basin, was left with water volumes well below average levels; as such, the reservoir may be unable to provide the water needed for irrigated agriculture in the lower Amu-Dary basin (Slay et al. 2011).

- Weather variability, in particular heavy downpours and thunderstorms, have been known to result in long-lasting power outages in Uzbek urban areas (Uznews, 2012).

Energy Sector Adaptive Capacity

Uzbekistan

The following table shows the contribution of a number of factors to the country's energy sector adaptive capacity. Green, orange and red indicate positive, uncertain or negative contributions respectively. For further information on the indicators used to assess energy sector adaptive capacity, refer to the Rapid Assessment process document by clicking here.

Adaptive capacity factors	Indicators	Responses and scores
Economic	Level of investment in the country *High if Gross Fixed Capital Formation (GFCF) is higher or equal to 30% of GDP*	Low
Technical	Aging power generation assets and infrastructure *Yes if average age of the country's power generation assets is more or equal to 20 years*	Yes
	Overall quality of country energy assets and infrastructure *High if average annual number of power cut events is lower than 100*	High
	Strong reliance on one form of power generation *Yes if 50% or more of the country's power supply comes from one single form of generation*	Yes
	Member of a regional grid system *Yes if country's power system is part of a transboundary and regional power grid system*	Yes
	Presence of an interconnected network system *Yes if customers are connected to several points of power supply rather than to a single point or a loop*	Unknown
Institutional and informational	Good level of knowledge of location of country's energy assets *Yes if there is geographic information (e.g. maps) available in government or World Bank publications*	Yes
	Availability of good quality data on observed climate, climate-related hazards *Yes if observed climate datasets are available in digital, short-time intervals, high spatial resolution formats, and for long baseline periods*	No
	Good level of knowledge on adaptation of energy sector, and evidence of good intra-government linkages on adaptation issues *Yes if level of knowledge and inter-government linkages are good based on expert knowledge*	No
Environmental & social	Priority water rights over other sectors *Yes if government or World Bank publications indicate that energy has priority over other sectors for water*	No
	Strong country disaster risk management and reduction *Yes if country has strong mechanisms in place to deal with increased extreme weather events based on expert knowledge*	No

Energy System Adaptation Imperative

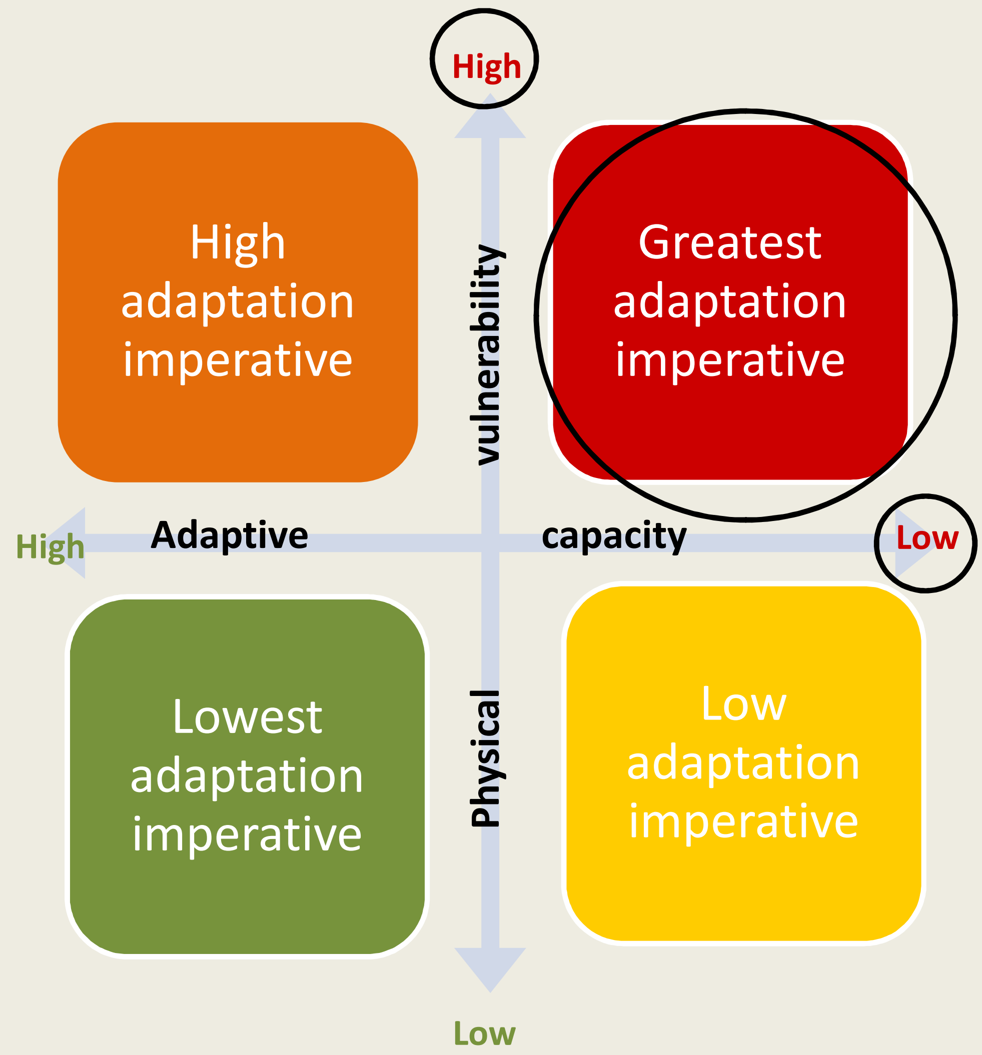
Uzbekistan

As shown in the diagram on the right, Uzbekistan's energy system has the greatest adaptation imperative due to the combination of:

- High physical vulnerability to climate change (see Slide 6).
- Low adaptive capacity (see Slide 8).

This result means that the country has a strong need for assistance to build adaptive capacity, define and implement adaptation measures to reduce vulnerability to climate change impacts, and exploit opportunities within the country's energy system.

Some actions are already underway in different areas of the energy service chain in Vietnam which help to build climate resilience. Due to climate change, the imperative for these actions is increased. This is further described in the following slides.



High-level Adaptations Options 1/4

Uzbekistan

The following 2 tables show a typology of actions which provide the building blocks for an energy sector adaptation action plan. This involves:

1. **Building the adaptive capacity of the energy sector:** Data collection, analysis and monitoring, and research on climate-related impacts in the energy sector; changing or developing regulations, tariffs, standards, codes etc.; awareness-raising and organizational development; and working in partnership.
2. **Delivering adaptation on the ground:** Accept impacts and bear (some) loss; spread/share impacts; avoid negative impacts; and exploit opportunities.

Examples of actions to build adaptive capacity

Responsible body	Type of action	Actions to strengthen standard and existing energy policy and measures	New actions
Ministries of energy and finance	Data collection and monitoring, awareness rising and organizational development, working in partnership		Improve long-term economic projections to help electricity demand projections
			More detailed analysis of transboundary climate change impacts on Uzbek water use for irrigation and power production
	Changing or developing regulations, tariffs, standards, codes etc	Privatisation of low-voltage electricity distribution network (World Bank, 2010b)	Incorporate robustness to climate change and variability in design codes, procurement rules, and site selection and environmental impact assessment obligations
Utilities	Research and analysis		Research and monitoring of the relationships between climate-related factors and the performance of hydropower assets, in collaboration with Uzhydromet
	Data collection and monitoring		Upgrade weather and hydrological monitoring network by replacing obsolete and broken equipment, equipping sites with automatic devices, and increasing the number of observation stations
	Changing or developing regulations, tariffs, standards, codes etc		Review design standards of existing assets against climate change projections (e.g. spillway capacity of hydropower plants, waste water storage of thermoelectric plants, groundwater heave/buyancy of pipelines, etc.)
			Review risks and safety standards off existing plants against climate change projections (e.g. fire, pollution control, etc.)

High-level Adaptations Options 2/4

Uzbekistan

Examples of actions to build adaptive capacity (cont.)

Responsible body	Type of action	Actions to strengthen standard and existing energy policy and measures	New actions
Hydromet office	Research and analysis	Goal to improve hydrometeorological monitoring (SNC, 2008)	Improved observed hydrological and water temperature data in locations close to power plans and at short time intervals
			Upgrade Uzhydromet internet connection in Tashkent to take full advantage of data freely available online for forecasting and other applications
			Implement the exchange of meteorological data with Kabul under the WMO's Global Telecommunications System , and make raw data available to users worldwide
			Improved monitoring of snowpack and glacial retreat
			Compile all climate and hydrological datasets in digital format
			Improve reliability of seasonal and longer-term hydrological forecasting (Note that currently there is good communication of information on daily, 2-5 days and monthly timescales, Acclimatise et al., 2011)
			Develop downscaled climate change projections
Other stakeholders	Research and analysis Cooperation and information exchange	The Interstate Commission for Water Coordination in Central Asia represents a regional information system on water	Strengthen communication and cooperation between water management organisations and hydrometeorological services on the Amudarya and Syrdarya basins

High-level Adaptations Options 3/4

Uzbekistan

Examples of actions to deliver adaptation

Responsible body	Type of action	Actions to strengthen standard and existing energy policy and measures	New actions
Ministries of energy and finance	Avoid negative impacts	• 1995 resolution adopted by the cabinet of ministers to develop small hydropower plants (with a very slow implementation) (Acclimatise et al., 2011) • 'Strategic Program of Oil and Gas Exploration 2005-2020' aims to increase oil stocks and gas condensate up to 70 and 66 million tonnes respectively (SNC, 2008)	• Increase incentives for energy efficiency, especially in the industry and agriculture sectors
Utilities	Avoid negative impacts	• 2007-2012 Expansion Plan of Uzbekenergo promotes energy efficiency and reducing losses in the grid network • Upgrading of thermoelectric plants • Advanced electricity metering project in three Uzbek cities (World Bank, 2012c)	• Identify key assets at risk, and plan risk management actions to build resilience • To manage risk of increased temperatures for thermoelectric plants, consider enlarging condensers, increasing cooling water flow rates or building closed cooling systems as part of asset design or upgrade • To manage risk of runoff changes for hydropower plants, consider improving efficiency by clearing or redesigning trash racks, upgrading turbines and generators, replacing shut-off valves, improving apron below dams, or optimizing operations based on quality hydrometeorological data • Factor climate change projections in site selection for new assets • Continue upgrades to the transmission and distribution system and consider solutions to manage changes in efficiency rates due to hotter weather such as electric line insulation or underground cables

High-level Adaptations Options 4/4

Uzbekistan

Examples of actions to deliver adaptation (cont.)

Responsible body	Type of action	Actions to strengthen standard and existing energy policy and measures	New actions
Utilities	Spread / share /transfer impacts	• 2007-2012 Expansion Plan of Uzbekenergo promotes using coal for thermoelectric plants as an alternative to natural gas, building new combined cycle gas turbines, and investing in renewable energy (World Bank, 2009b) • Planned new power transmission interconnections internally and with Afghanistan (Linn, 2008, and Acclimatise et al., 2011). • Planned wind farm with support from the Asian Development Bank near the Charvak reservoir (Rogers, 2010)	• Continue to implement policies and invest in diversification of energy generation technologies and locations to maximize resilience • Investigate weather insurance for its application to energy sector risk management • Consider weather insurance as a complement to risk management
	Exploit opportunities		• Take advantage of reduced winter demand due to warmer temperature to review plant maintenance and upgrade schedules • Consider solar energy output gains due to increases in annual sunshine duration
Other stakeholders	Avoid negative impacts and exploit opportunities		• Exploit opportunities for new engineering technologies that build resilience to climate change, such as smart meters to reduce demand or alternative cooling to manage water constraints

Definitions

Uzbekistan

Adaptive capacity: Potential or capability of a system to adjust or respond to climate change (IPCC, 2001).

Energy supply losses: Losses incurred between total primary energy supply and final use (TPES-TFC) as a percentage of total primary energy supply (IEA, 2011).

Exposure: Nature and degree of climate stress upon a system; it may include long-term changes in climate conditions, as well as changes in climate variability (IPCC, 2001).

Gross Domestic Product (GDP): Value of all final goods and services produced in a country in one year (World Bank, 2011a).

Metocean: Commonly used in the energy sector to refer to the ensemble of meteorological and oceanographic variables that characterize the physical environment of an asset or a project.

Physical vulnerability: Combination of sensitivity and exposure to climate change of a system; it corresponds to the biophysical effect of climate change on a system (Raleigh et al., 2008).

Reserve margin: Ratio of the difference between installed capacity and annual peak demand to the annual peak demand (World Bank, 2011a).

Sensitivity: Degree to which a system will be affected by or responsive to a change in a climate-related variable. (IPCC, 2001).

Total Energy Production (TEP): Sum of energy production (coal, crude oil and oil products, gas, nuclear, hydro, geothermal, solar, combustible renewables and waste, and others) (IEA, 2011).

Total Final Consumption (TFC): Sum of energy consumption by different end users (industry, transport, residential, commercial and public services, agriculture and forestry, and others) (IEA, 2011).

Total Primary Energy Supply (TPES): Total energy produced and imported minus energy exports and changes in energy stocks (IEA, 2011).

Vulnerability: Degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change (IPCC, 2001).

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Uzbekistan

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