



Energy Systems: Vulnerability – Adaptation – Resilience (VAR)

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Regional Focus: sub-Saharan Africa

Burkina Faso



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Executive summary

This report examines the vulnerability, adaptation and resilience of Burkina Faso's energy system.

Burkina Faso is a West African country in the Sahelian climate zone, located between the 10th and 15th northern parallels and between longitudes 2°20' east and 5°30' west. The country's surface area is 274,200 km² with altitudes between 150 and 750 metres above sea level.

Like most sub-Saharan African countries, Burkina Faso's population is increasing rapidly, with an annual growth rate (observed after the most recent population census in 2006) of 3.3 percent (5.5 percent in urban areas and 2 percent in rural ones). The country's economy is predominately based on agriculture with some industrial facilities. GDP is amongst the lowest in the world, although it has experienced relative growth in the past 10 years. With a negative trade balance, Burkina Faso is also dependent on energy imports, notably of oil.



Although projections are still uncertain and forecasting remains problematical, Burkina Faso's vulnerability to climatic conditions is perceptible in the predicted 15 to 30 percent shift in rainfall gradients towards the south of the country. This will result in a loss of 100 mm by 2025–2050, as well as increase the forecast temperature from 2 to 4°C along the same timeline. This situation is prejudicial, and will be all the more so since Burkina Faso depends on ligneous energy sources, already rare in the Sahelian context, for its electricity generating and for its consumption (84 percent of all of consumption) and on oil imports (10 percent of all consumption). Energy dependence has increased by between 120 and 130 percent over the past 10 years. In addition, hydroelectricity, generated locally or supplied over inter-connected grids, provides for 6 percent of total consumption and is generated using water resources which are vulnerable to climate change.

Several programmes are being implemented, with the support of Burkina Faso's technical and financial partners (AFD, GTZ, DANIDA, World Bank, UEMOA, ECOWAS), but also with financing by *SONABEL* (the country's national electricity company) and *SONABHY* (the national hydrocarbons company) and with USD69,280 million of state funding. The aim of these programmes is to increase the country's sustainable energy coverage and the rate of access of the population, including the most vulnerable members, to energy supplies at optimised cost. These projects form part of Burkina Faso's strategy of making energy an important factor for the country's economic growth and for improving the living conditions of its population, including

members in rural areas, where pre-electrification projects and the possibility of obtaining solar panels should be introduced.

Analysis of the structure of production of modern energy indicates that Burkina Faso needs to develop research and development to promote bio-energy and renewables. The current state of renewable energy systems, especially solar, remains negligible with a mere 1,000 kWp in place.

On the basis of indicators characterising the energy situation in Burkina Faso, this study presents recommendations of which the most important include:

- the development of programmes to reduce consumption of ligneous fuels;
- reforestation;
- development of public transport in urban areas;
- diversification of energy supply sources to reduce the country's energy dependence in the face of climate change; and,
- building the capacities of local stakeholders, including civil society and NGOs, in terms of knowledge of the potential of renewable energy sources and their use at low cost.

The aim of the recommendations is to contribute to the resilience of Burkina Faso's energy systems.

Keywords: energy production, energy consumption, biomass energy, hydroelectricity, hydrocarbons, solar energy, energy vulnerability and resilience, climate change.

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List of Abbreviations

Abbreviation/acronym	Meaning
2iE	Institut International d'Ingénierie de l'Eau et d'Environnement de Ouagadougou (Burkina Faso)
ADB	African Development Bank
AEPA	Approvisionnement en Eau Potable et Assainissement
AFD	French Development Agency
CC	Climate Change
CIRAD	Centre International de Recherche Agronomique pour le Développement
CNGE	Conseil National de Gestion de l'Energie
CNRST	Centre National de Recherche Scientifique et Technologique
CSLCP	Cadre Stratégique de lutte Contre la Pauvreté
DANIDA	Danish Cooperation Agency
DBSA	Development Bank of Southern Africa
DGE	Direction Générale de l'Energie
DRE	Decentralised Rural Electrification
ECOWAS	Economic Community of West African States
EIB	European Investment Bank
ENSP	Ecole Nationale Supérieure Polytechnique de Yaoundé (Cameroun)
ERA – CAMEROUN	Environnement – Recherche – Action au Cameroun (NGO providing technical support)
EU	European Union
FCFA	Franc des Communautés Francophones d'Afrique
FDE	Fonds de Développement de l'Electrification
GDP	Gross Domestic Product
GHG	Greenhouse Gas (in kt of carbon dioxide per member of the population)
GTZ	German Cooperation Agency
INSD	Institut National des Statistiques Démographiques du Burkina Faso
IRSAT	Institut de Recherche Scientifique, Agronomique et Technologique
kVA	Kilovolt-ampere (unit of electrical power)
kWp	Kilowatt-peak (unit of power for photovoltaic systems)
LCP-Eau	Laboratoire de Contrôle des Pollutions et des Procédés de traitement des Eaux du 2iE
LESEAU	Laboratoire Environnement et Sciences de l'eau de l'ENSP de Yaoundé au Cameroun
LIPDHD	Lettre d'Intention de Politique de Développement Humain Durable
MABUCIG	Manufacture Burkinabè des Cigarettes
MDG	Millennium Development Goals
NA	Not available
NEPAD	New Partnership for Africa's Development

Abbreviation/acronym	Meaning
NEPAD-IPPF	NEPAD Infrastructure Project Preparation Facility
NGO	Non-governmental Organisation
ORSE	Organe de Régulation du Sous-secteur de l'Electricité
PANA - Burkina Faso	Programme d'Action National d'Adaptation aux changements climatiques au Burkina Faso
PANE	Plan d'Action National pour l'Environnement
PAP - CSLCP	Plan d'Actions Prioritaires du Cadre Stratégique de lutte contre la pauvreté
PASE	Programme d'Appui au Secteur de l'Energie
PBCE	Programme de Développement des Compétences en Environnement
PCACV	Programme Cadre de l'Amélioration du Cadre de Vie
PCGPN	Programme Cadre de Gestion des Patrimoines Nationaux
PCGT	Programme Cadre de Gestion des Terroirs
PNAEPA	Plan National Eau Potable et Assainissement
PNE	Plan National d'Electrification
PNGIM	Programme National de Gestion de l'Information sur le Milieu
PPIT	Projets de Petites Interconnexions Transfrontalières
REn	Renewable Energy
SNV	Dutch Cooperation Agency
SONABEL	Société Nationale Burkinabè d'Electricité
SONABHY	Société Nationale Burkinabè des Hydrocarbures
TFP	Technical and financial partners
TJ	Terajoule
TOE	Tonne of Oil Equivalent
TROFCCA	Projet Adaptation des Forêts Tropicales aux Changements Climatiques
UEMOA	Union Economique et Monétaire Ouest Africaine
US-AID	United States Agency for International Development
USD	United States Dollar
WADB	West African Development Bank
WAPP	West African Power Pool Project
ZACA	Zone d'Activités Commerciales et Administratives

About the Author



Joseph Wethe studied Civil Engineering (urban engineering option) in 1987–1992, at the *Ecole Nationale Supérieure Polytechnique de Yaoundé* (Cameroon). His interest in environmental issues then led him to the *Université internationale de la francophonie au service du développement africain – Université Senghor d’Alexandrie*, in Egypt, from 1997 to 1999, where he obtained a *Diplôme d’Etudes Professionnelles Approfondies en Gestion de l’Environnement* (higher masters in environmental management). He completed his PhD in Environment in 2005, at *Université de Liège* (Arlon Department of Environmental Management, Belgium).

From 1992–2000, Mr. Wethe worked in Cameroon working to improve the conditions of the populations of the country's large and medium-sized cities and towns. Results include the building of urban road systems, stormwater drainage systems, and water supply networks as well as provision for disposal of solid wastes and sewage. Mr Wethe alternated between the public sector (as Engineer in charge of studies for the Ministry of Urban Planning and Housing), as a lecturer and researcher (research in liaison with the *Laboratoire Environnement et sciences de l’eau [LESEAU]* at the *Ecole Polytechnique de Yaoundé*), and private enterprises and NGOs (as National Coordinator for and then Head of Technical Division of the NGO *Environnement Recherche Action au Cameroun – ERA – CAMEROUN*), of which he is also a founder member.

Since September 2000, Mr Wethe has been a Lecturer-researcher responsible for courses on wastewater management, environment and urban planning at the *Institut International d’Ingénierie de l’Eau et d’Environnement (2iE)* in Ouagadougou, Burkina Faso, (ex EIER-ETSHER Group). In January he was appointed Head of the Unit for the Development of Scientific and Technological Information via the 2iE Internet and Intranet websites, the scientific review *Sud Sciences & Technologie*, and a documentation and information centre equipped with both a conventional and an on-line library.

In July 2008, Joseph Wethe became Head of the *Laboratoire de Contrôle des Pollutions et des Procédés de traitement des Eau (LCP-Eau)* laboratory where 2iE's research and doctoral thesis work is carried out on water, sewerage systems and environment. He is an active supporter of ongoing engineering and training for African managers on subjects relating to sustainable management of water, waste, the environment and cities and towns. Mr Wethe has contributed to development of strategic plans for disposal of wastewater and solid waste in several of Burkina Faso's medium-sized towns, in design and monitoring of building of sewerage systems and treatment plants for domestic wastewaters (2iE) and effluents from industrial facilities (breweries, municipal abattoirs, Total-Elf, Mabucig). He has also designed and overseen implementation of management of disposal of municipal solid waste and sludge in Dori, Fada N’Gourma, Koudougou and Ouahigouya amongst other places.

Mr Wethe is also author of several scientific publications and papers presented in reviews and at regional and international conferences.

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Overview of Burkina Faso

*Physical Environment and Climate Data*¹

Burkina Faso is a West African country located between the 10th and 15th northern parallels and longitudes 2°20' east and 5°30' west. The country's surface area is 274,200 km² with altitudes between 150 and 750 metres above sea level.

The nature of Burkina Faso's soils is largely determined by the underlying geology, geomorphological developments and former and present-day climates. There are seven major types of soil found in the country: undeveloped mineral soils, slightly developed soils, montmorillonite weathering complex soils, reworked iron-rich tropical soils, ferralitic soils, hydromorphic soils and slightly leached ferruginous soils.

Burkina Faso's climate is of the semi-arid type, characterised by a dry season lasting between 5 and 9 months and a 3 to 7 month rainy season, both of which are very distinct. Rainfall varies, on average, between 400 mm in the north to 1,200 mm in the south and west, with a number of rainy days varying between 40 and 80. The water balance, expressing the rainfall deficit or drought, is negative throughout the country (i.e. there is more or less severe drought), and average temperatures is 27–28°C.

Annual rainfall has decreased significantly over the past 60 years. This has resulted in a southward shift of over 100 km of isohyets over that period (*PANA du Burkina Faso* Expert Group, 2003).

This high degree of variability, or rainfall irregularity, gives rise to division of the country into five climatic sub-regions (sahelian, sub-sahelian, north-sudanese, south-sudanese and sub-sudanese) associated with three climate regions:

- The south-sudanese region (900–1 100 mm/yr isohyets), in the south of the country; this is occupied by dry forest, wooded savannah and gallery forests. It comprises 38 percent of agricultural lands and is the wettest region.
- The north-sudanese or sudan-sahelian region (700–900 mm/yr isohyets): bushy and tree savannah in the centre of the country. This is the largest climate region; it has a four to five month rainy season.
- The sahelian region (isohyets less than 500 mm/yr): thorn-bush steppe with tufted grass cover. This is the driest region with, sometimes, a two month rainy season.

¹ See references: [3], [4], [5], [8], [9], [10], [12], [17], [A], [B]

Natural Environment²

Steppe lands (predominant in the northern sahelian region) and savannah (predominant in the central and southern parts) are the main forms of vegetation found in Burkina Faso. There are however some deciduous broadleaf and dense dry forests in the south and south-west of the Sudanese region. The country's vegetation is essentially woody savannah and sparse shrubs with few commercially exploitable species.

Burkina's flora is not adequately documented and the inventory needs to be completed or refined. Work to date has identified 1,425 indigenous and cultivated plants, breaking down as follows:

- 304 ligneous forest species,
- 748 herbaceous forest species,
- 256 aquatic plant species (micro-flora),
- 45 aquatic or semi-aquatic plant species (macro-flora),
- 72 agricultural plant species (subsistence, market gardening, fruits, cash crops).

Burkina Faso's forest formations occupy a little over half of the territory and form two main entities: the classified area (25 percent) and the non-classified area (75 percent).

The fauna is relatively diverse, with a large number of species: 35 species of large mammals in the 69 protected areas and several species of birds.

Human Environment³

Burkina Faso's population was estimated at 12,766,396 in 2005, of which 17.3 percent were urban dwellers and 82.7 percent living in rural areas. The country is predominately agricultural with difficult living conditions for the majority of its population: low life expectancy (52 years), inadequate access to water (46 percent), to health care (50 percent), to education (38 percent), to employment (55 percent) and to food.

With annual population growth rates of 5.5 percent and 2.0 percent for the urban and rural populations respectively, the total population was projected to be 13,386,532 in 2007, with 18.3 percent city dwellers and 81.7 percent rural. Forecasts for 2020 and 2025 are around 18.2 and 20.5 million people, with 42 percent living in towns and cities. The population density has increased from 45.6 inhabitants/km² in 2005 to 48.1 inhabitants /km². (Density at the end of the 1990s was 38 inhabitants/km²). Migration, with an incidence of 10 percent, is a phenomenon that is highly characteristic of the Burkinabè.

² See references: [3], [4], [8], [9], [10], [17]

³ See references: ([5], [8], [9], [10], [11], [12], [17], [A], [B])

The economic context—past, present and, according to growth forecasts, that of the future—does not provide sufficient opportunity for employment for the young economically active. The low level of new industrial production facilities and the closing of some units (as a result of the economic recession the country has experienced since the late 1990s) limit the possibilities for recruitment for young qualified people. The overall unemployment level is 77 percent amongst people of economically active age and seeking employment. The labour force directly available for one job in Burkina Faso is estimated at 500,000 people.

Basic Social Services

Access to Water⁴

Access to drinking water in Burkina Faso's urban and rural centres is, overall, 60.2 percent, against less than 10 percent for access to an adequate and efficient sewerage system. Aware of this situation, the government has introduced a *Plan National Eau Potable et Assainissement (PNAEPA* – national drinking water and sewerage plan) to meet the its obligations under the Millennium Development Goals, to which the country is a signatory. The *PNAEPA* aims to increase access to water to 80.1 percent by 2015 and the level of coverage of the population by an adequate sewerage system to 50.4 percent by the same date.

Implementation of this strategy will require:

1. Building of new water supply infrastructure for urban and rural communities: (i) 17,290 modern water supply points with manually operated pumps in households and public buildings; (ii) 520 simple water supply networks feeding 6,500 pay fountains in major settlements in rural areas and secondary urban centres; and (iii) 75 independent water supply points.
2. Rehabilitation of existing plant: (i) replacement of 4,500 manual pumps, for which 900 boreholes will be cleared (blown); (ii) 11,000 superstructures; (iii) 1,000 modern wells (in particular, equipping and protection); (iv) 250 simplified drinking water supply systems; and (v) 75 independent water points.
3. Building of new sewerage infrastructure (grey and black waters) in the country's towns and villages; (i) building of 395,000 household sewerage systems; (ii) rehabilitation of 100,000 existing latrines; (iii) building of 60,000 private pit latrines; and (iv) building of 12,300 public latrines: 5,400 in schools, 1,150 in health centres, and 5,750 in markets and other public gathering places.
4. Implementation of the 'Unified Intervention Framework' covering activities of capacity building for management of drinking water supplies and sewerage, integrated water resource management, monitoring, stakeholder support, management of public water service, management and performance of works and provision of service, and support for the private sector and NGOs.

⁴ See references: [5], [10], [17], [A], [B]

Access to Education and Current Poverty Levels⁵

The overall educational level is low and shows an unequal gender distribution.

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Literacy level (%)	9.2	9.2	36.0	16.6	16.6	16.6	16.6	15.2	15.2

The literacy level, or ratio of males and females aged 15 years and more (primary and secondary school ages) able to read and write is low in Burkina Faso, in spite of progress observed over the past 10 years: 9.2 percent in 2000 to 22.2 percent in 2008.

The State and its partners are making efforts to improve the number of schools: the country has 3, 293 public schools (12,290 classrooms) and 275 private schools (1,242 classrooms). The average teacher/pupil ratio is 55. In spite of these efforts, national school attendance level remains low at 37.72 percent, for all levels (it is only 9.66 percent at secondary level).

There are also gender differences (level of 44.73 percent for boys against 30.38 percent for girls) and also regional disparities (literacy levels are higher amongst the urban population than in the rural areas).

The share of the national budget allocated to education has varied between 10 and 15 percent over the past 10 years. As a result of a pro-active policy, the share of the budget for education and research over the next 5 years will be 20 percent, to provide classrooms, train 2,000 new teachers and develop 4,000 literacy centres.

The incidence of poverty is estimated at 45 percent of the population while depth of poverty was 15.6 percent in 2003 and severity estimated at 7.1 percent (INSD, 2006).

Social-economic Aspects

Primary sector⁶

The focus here is on crop and livestock farming.

Agricultural activity is the main productive element in Burkina Faso's economy, making up around 40 percent of Gross Domestic Product (GDP) and 80 percent of all of the country's exports. Agriculture is therefore the driving force of Burkina Faso's economic and social development. This vital sector is also the main source of income and employment for 85 to 90 percent of the population of economically active age and provides 50 percent of the total of income from exports.

However, this is extensive and subsistence agriculture using the most rudimentary of means and artisanal techniques carried out on plots of land of, on average, 0.5 to 1.5 ha per farmer. Some cultivated lands produce export products e.g., cotton and bring in a significant source of hard currency for the country. Food crops, mainly cereals (millet, sorgho, rice and fonio) occupy around 85 percent of total cultivated areas. Cotton is the

⁵ See references: [5], [10], [17], [A], [B]

⁶ See references: [5], [10], [17], [A], [B]

main source of hard currency, followed by groundnuts, sesame, almonds, cashew nuts, etc., for which a large part of the produce is destined for the domestic market.

Overall, the potential of the agricultural lands is high. Of a possible 13,040,000 ha of cultivable land, only 350,000 ha are actually cultivated. The potential for irrigated land is 160,000 ha, but only 13,000 ha with full water control and 30,000 ha with partial control are in use.

Livestock farming contributes around 10 percent of GDP and occupies about 6 percent of the economically active population. After cotton, it is the country's second source of hard currency. FOB exports of livestock farming produce exceed FCFA33 billion, representing 22.12 percent of all FOB exports. The potential of livestock farming is evidenced by large numbers of stock, by diversity of farming systems resulting from variable eco-agricultural conditions, and by the existence of sturdy disease-resistant breeds.

Generally, Burkina Faso's agriculture is dependent on climate, of which the irregular nature and year-on-year and spatial variability have been marked since the period of severe drought in the 1970s. The effects of climate change on agriculture are perceptible throughout the territory, more acutely however—from both the spatial and temporal points of view—in the northern part, where the climate is predominantly sahelian. The vagaries of the climate affect stability of agro-pastoral production and income from exports, thus weakening the country's economy. These are non-linear effects where agricultural income is concerned. This is a situation which will be aggravated in coming decades if the outlook for climate change in Burkina Faso has been correctly assessed. Scenarios with reduced rainfall and higher temperatures will be very prejudicial for agriculture, given the already difficult climatic conditions. The practice of irrigation and agricultural extension would be viable options for adaptation of Burkina Faso's agriculture to climate change.

Secondary and Tertiary Sectors⁷

These sectors, covering industry, construction (buildings and public works), energy, mines and small trades, contribute around 20 percent to Burkina Faso's GDP and occupy around 4 percent of the economically active population. The secondary sector, especially manufacturing industry, is embryonic. However, the main industrial activities are concentrated in the area of agri-foods, where facilities are mostly located in the country's two major cities (Ouagadougou and Bobo-Dioulasso). Manufacturing industry's contribution to GDP is modest (less than 5 percent).

As in most sub-Saharan African countries, Burkina Faso's industrial fabric is weak. The sector is mainly occupied by agri-food related activities and production and export of cotton. However, overall industrial production has increased over the past 10 years, going from 4.2 percent in 2000 to 5.2 percent in 2008. Production is, however, faced with consumer price inflation, fluctuating each year: 2.5 percent in 2000, 3.5 percent in 2003, 6.4 percent in 2006 and estimated at 0.7 percent in 2008.

Extractive industries represented less than 0.5 percent before the 2000s, made up of small-scale and artisanal mining operations. This contribution is changing rapidly with

⁷ See references [5], [10], [17], [A], [B]

an increasing presence of mining companies in the country in the past five years. The sector is booming in a country with a high mining potential encouraged by gold and basic metal bearing deposits and numerous indications of deposits, as well as the vast Birimian formation covering an area of more than 70,000 km². These formations show strong evidence of possibilities of mineralisation (gold, diamonds, ferrous and non-ferrous metals). The mining sector is therefore experiencing a boom with the setting up of several international mining concerns. In the coming decades, production from mining, especially of gold, should increase considerably. Estimated at 1.5 tonnes per year, it should rapidly increase tenfold.

Although small-scale mining occupies a large part of the uneducated economically active population, it remains in the informal sector. Conversely, the tertiary sector contributes almost 44 percent of GDP, as a result of the development of the goods and services sub-sector.

Other Basic Economic Data⁸

Burkina Faso's GDP was estimated at USD7,136 million in 2007; the per capita GDP was estimated at USD472/yr in that same year. Growth in GDP, in real terms, was 3.3 percent in 2007, against 3.1 percent in 2006, 2.9 percent in 2005 and 4.3 percent in 2002. Per capita GDP was USD255 in 2002. In 2006, over 50 percent of the population was living below the poverty line (estimated at USD420 per person per year). This very low level of economic development is clearly marked in the rural areas (where it is lower by 20 percent than the national level and by 56 percent than the level in urban areas). There is also a clear gender disparity.

Government efforts to stimulate recovery and fiscal reforms (tighter management of the budget, reform of organisation of inland revenue services) have produced regular year-on-year increases in income of 10 to 15 percent since 2005. This corresponds to around FCFA278 billion. Increases are observed from value added tax (+11 percent), taxes on foreign trade (+17 percent), corporation taxes (+10 percent) and taxes on petroleum products. The level of fiscal receipts related to GDP should approach the 14 percent objective planned by the IMF, but has been weakened by a level of taxation (10.6 percent of GDP on average) still lower than the community average of 17.0 percent. This situation is aggravated by the narrowness of the tax base and losses in amounts collected (given the scale of the informal sector). Moreover, budgetary saving has decreased markedly in five years going, for example, from FCFA40.4 billion in 2000 to FCFA22 billion in 2002. This is indicative of more rapid progress in spending (around 12 percent per year) in relation to current income, thus reducing the State's capacity for investment in spite of efforts made over fifteen years to balance these two items.

Burkina Faso is not an oil producing country. Imports of petroleum products therefore weigh heavily in its trade balance. In 2006, hydrocarbon imports were 340,500 (metric) tonnes, i.e. 1.04 times domestic consumption. These imports represented 10 to 20 percent of all of the country's gross imports over the past 10 years, and are increasing in the face of increasing demand to meet social and economic needs.

⁸ See references: [1], [5], [10], [17], [A], [B]

Where basic services are concerned (such as water, sewerage, technologies, housing and transport), Burkina Faso is characterised by:

- Low level of diversity of energy sources with predominance of systems that are vulnerable to climate change (firewood) or to fluctuating oil prices on the world market.
- Low level of drinking water supply service: only three households out of five have access to quality water from the *Office National de l'Eau et de l'Assainissement* (national water and sewerage office) network, pay fountains, wells with manually operated extraction or modern equipped wells. The level is lower in villages than in towns.
- Very low level of access to sewerage system for grey and black waters or for stormwater, or to an efficient solid waste disposal system.
- High dependence on outside sources for technologies and manufactured goods; this is aggravated by the low numbers of technically educated young people (clear lack of specialist technical training establishments) with a predominance of more general education in the areas of management, information and communications technologies (abundance of establishments offering this kind of education throughout the country).
- Predominance of traditional low standard housing and urban fabric concentrating most of the rural and poor populations in shanty towns and informal settlements in urban centres. This is to the detriment of medium or high class housing from which only a few people benefit.
- Inadequacy, or absence, of public transport in most towns: only Ouagadougou has a public transport system. Taxis are insufficient and offer services that are relatively expensive for the mainly poor households. Transport by two-wheeled vehicles (bicycle or motor cycle) is the major mode of urban transport. Nationally, in terms of inter-city and trans-border transport, the sub-sector plays a vital role in terms of the support it lends to trade in agricultural and industrial produce and other forms of trade. Transport is considered as a strategic sub-sector given the country's geographical position but also consumes between 74 and 83 percent of hydrocarbon imports, generating air pollution in the major cities. The road network, although still inadequate, has developed over the past ten years and now covers the country's main needs. It comprises 15,000 km of roads of which 16 percent are paved and 84 percent are earth roads. A strong point is the engineering of earth roads to modern technical standards (permanent road bases).

Country Data⁹

Basic statistics	Indicator	Baseline year
Physical area		
Area of country	Area = 274,222 km ²	2009
Population		
Total population	14,017,262	2006
Rural population	10,835,295	2006
Children under 5 years	2,439,004	2006
Population density	51.8 inhabitants/km ²	2006
Economically active population in the agriculture sector	84.7%	2005
Female	58.0%	
Male	42.0 %	
Economy and development		
Gross Domestic Product (GDP)	USD7,136 million	2007
Value added in agriculture	35.5% of GDP	2006
GDP per capita	472 USD/yr	2007
Balance of trade (millions of dollars) Change from 2000 and current year (2006)	- 8.2% of GDP (- USD585.152 million), from - USD236.0 million to - USD444.2 million (-88.2%)	2006
Human Development Index (and ranking)	0.342 (175/177)	2007
Human Poverty Index	46%	2008
Environmental Sustainability Index *	NA	
GHG emissions (kt of carbon dioxide per inhabitant)	19.18	2007
Access to potable water (less than 500 metres)	58.8%	2007
Infant mortality	86.2 per thousand	2008
Literacy	28.7%	2007
Female	56%	2007
Male	44%	2007

Burkina Faso has introduced a national energy policy with a focus on the country's social and economic development. The scope of the policy is wide, covering energy management strategies, promotion of renewable energy (REn) and substitute fuels as well as the implementation of measures to reduce energy costs, improve energy efficiency and diversify sources. With regard to the latter two aspects, the national energy policy includes initiatives such as drawing up of critical energy balances, participation in development and implementation of national energy management programmes, conducting of planning and strategic studies on energy, promotion of best energy saving practices, development of a legal and regulatory framework for energy management, introduction of fiscal and financial incentives to encourage energy saving, designing of awareness raising, information, education and training on energy saving, support for research and development on energy saving interacting with the country's training and research institutions (Universities of Ouagadougou, Bobo Dioulasso and Koudougou, *Institut International d'Ingénierie de l'Eau et de l'Environnement* (2iE), *Centre National de Recherche Scientifique et Technologique* (CNRST – national centre for scientific and technological research).

⁹ See references: [1], [5], [10], [11], [12], [16], [17], [A], [B]

Energy governance in Burkina Faso is ensured by the state and private and associative institutions. These are:

- The ministry in charge of energy, which plays an important strategic role in designing the nation's energy policy, energy sector planning and monitoring of related activities. It fulfils this mission via the *Direction Générale de l'Énergie* (electricity management dept), the *Fonds de Développement de l'Électrification* (electrification development fund, a facilitator of planning and finance programmes for rural electrification), the *Direction des études et de la Planification* (studies and planning dept.), *Organe de Régulation du Sous-secteur de l'Électricité* (the electricity sub-sector regulator; this independent body, yet to be created, will ensure fair competition between generators and protect consumers), the *Commission de régulation des prix de l'électricité* (electricity price regulating commission) and the *Conseil national de gestion de l'énergie* (national energy advisory council: a framework organisation for consultation and coordination between stakeholders and responsible for energy policy design and electrification planning). It will exercise administrative control over *SONABEL* which has the monopoly on electrification of the country's urban centres. The privatisation of *SONABEL* has been announced.
- The Ministry for economy and finance, collecting levies and taxes.
- Decentralised State entities planning for basic services including water and energy.
- Local authorities competent in the area of local planning, concession contracting and/or supplying electricity.
- Independent power producers (EDENE, GG-Y, BERCODE) which, under concession agreements, can carry out studies, manage energy supply systems and support cooperatives, municipalities and users in the implementation of their projects. The private sector, after privatisation of *SONABEL*, may also become involved in transport and distribution of energy.
- Technical development partners assisting the State, municipalities, and the private and associative sector in implementation of national strategies and policies for energy supply throughout the national territory. Partners include the European Union (MEPRED project), UEMOA, ECOWAS, World Bank (ESDP), Danish Cooperation Agency, DANIDA (PASE project).

Burkina Faso's Key Vulnerabilities

Environmental¹⁰

Biomass provides 84 percent of the energy consumed in Burkina Faso (around 2.412 millions toe). In spite of clear progress on fossil and commercial fuels, use of biomass (fuelwood, charcoal) will predominate for the next 20 years under the combined effects of increasing demand and poverty. This will result in strong pressure

¹⁰ See references: [14], [15], [17]

on forest resources which are decreasing in terms of surface area at a rate of 0.2 to 0.7 percent per year (i.e. annual losses of 15 to 55 km²). The demand for wood, the main ingredient of biomass fuel in Burkina Faso, has grown at an annual rate of around 2.2 percent per year over the past 10 years. Demand developed from 4.464 million tonnes in 2000 to 5.020 million tonnes in 2004. Forecasts for 2009 are for 5.126 million tonnes. Conversely, the production of firewood has been decreasing annually by 0.15 percent since 2000 when it represented 5.691 million tonnes, against 5.650 million in 2004. If this trend continues, firewood production will reach 5.42 million tonnes in 2009.

Economic¹¹

Burkina Faso is neither an oil producer nor an oil exporter; the country is therefore highly dependent on imported hydrocarbons. Imported petroleum products make up 16 percent of total energy consumed. High octane gasoline accounts for 1/3 of imported petroleum products, which are mainly used for purposes other than generating of electricity (transport vehicles, generator sets, boilers and furnaces). Daily consumption is increasing, from 8,000 barrels/day in 2000 to 8,300 barrels/day in 2008. Burkina Faso's dependence on imported hydrocarbons highlights the necessity of developing clean energies and innovative solutions for industry and households. The current level of imports places a heavy burden on national consumption. In 2006, hydrocarbon imports were of 340,500 tonnes, i.e. 1.04 times national consumption. The imports, representing 10 to 20 percent of all of the country's gross imports over the past 10 years, are increasing rapidly in the face of increasing demand to meet socio-economic needs.

Burkina Faso is one of Africa's heavily indebted poor countries with an external debt that increased by 1.94 percent per year between 2000 and 2004 and by 9.41 percent per year between 2005 and 2008. Given the rise in the absolute value of imports (6.542 percent per year) and of exports (6 percent per year) between 2000 and 2008, the current account deficit increased by around 11 percent per year between 2005 and 2008.

Year	External debt (USD billion)	Imports (USD billion)	Exports (USD billion)	Current account balance (USD)
2000	1.3	0.572	0.311	
2001	1.3	0.61	0.22	
2002	1.5	0.58	0.265	
2003	1.3	0.525	0.25	
2004	1.3	0.6336	0.293	-341,000,000
2005	1.3	0.8663	0.4186	-471,700,000
2006	1.85	0.992	0.395	-460,000,000
2007	1.85	1.016	0.5435	-604,600,000
2008	1.33	1.39	0.676	-752,000,000

Source: CIA World Factbook, May 16, 2008 (<http://www.indexmundi.com/>)

¹¹ See references: [1], [5], [10], [17], [A], [B]

Faced with this level of debt, the State introduced a national poverty reduction strategy allowing the country to negotiate debt relief with its creditors to allow investment in infrastructure projects and basic amenities (water, sewerage, agriculture, education, health, etc.).

Social¹²

Access to energy occupies an important position in the national policy for the country's economic development which plans, with the support of development partners, for long-term and far-reaching actions such as:

- reduction of consumption of ligneous fuels, reforestation and reducing the pressure placed on the vegetation cover by human activities in order to arrest the process of desertification;
- development of the hydroelectric potential to improve coverage of urban and rural centres;
- diversification of energy supply sources by wider dissemination of improved stoves with better energy efficiency, promotion of butane gas and interconnection with neighbouring countries producing hydroelectricity, to reduce oil consumption and costs.

Land ownership in Burkina Faso is state controlled.

The state of health of Burkina Faso's population is marked by a birth rate that has stood still for 10 years, a relative reduction in overall and infantile mortality and an improved life expectancy which increased by six years, going from 46.73 years in 2000 to 52.55 years in 2008.

Year	Birth rate (births/1,000 inhabitants)	Death rate (deaths/1.000 inhabitants)	Infant mortality (deaths/1,000 live births)	Life expectancy (yrs)
2000	45.26	17.04	108.53	46.73
2001	44.79	17.05	106.92	46.41
2002	44.34	17.07	105.3	46.11
2003	44.78	18.76	99.78	44.46
2004	44.46	18.79	98.67	44.2
2005	44.17	18.86	97.57	48.45
2006	45.62	15.60	91.35	48.85
2007	45.28	15.31	89.79	49.21
2008	44.68	13.59	86.02	52.55

¹² See references: [5], [17]

The fertility of Burkinabè women is high: an adult woman will have had 6.5 children at the end of her child-bearing period.

The HIV/AIDS epidemic continues in Burkina Faso with a relatively high prevalence rate (4.2 percent), as is the case for the rest of the African continent.

Year	HIV/AIDS – incidence of AIDS (adults) (%)	HIV/AIDS – total number of declared cases of AIDS and HIV	HIV/AIDS – number of deaths per year
2001–2002	6.44	350,000	43,000
2003	6.5	440,000	44,000
2004–2008	4.2	300,000	29,000

The level of people having AIDS and declared in hospital centres is, on average, 10 percent, which explains the significant numbers of orphans having lost one or both parents. Acute respiratory infections (15.6 percent of medical notifications) and diarrhoea are the main causes of deaths amongst children.

The share of the national budget going to public health was 9 to 15 percent in 2000–2008.

Civic: Governance and regulation¹³

The laws on decentralisation and freedom of association, passed in the 1990s, have improved relations between the State and international institutions, the private sector and civil society. Civil society and the NGOs issuing from it participate in development of energy policy.

However, the price of energy products, in spite of being covered by a government publication issued via the media, are fixed without any consultation of consumers, sometimes leading to strikes, as evidenced by the most recent ones which were organised to protest against the high cost of living.

Governance where the energy supply is concerned is intended to be participatory at the local level, where there are mechanisms in place for exchanges of information between stakeholders and meetings to harmonise planning for development of electrification infrastructure.

Evaluating Burkina Faso's Overall Vulnerability

Environment¹⁴

Burkina Faso has always been exposed to marked episodes of drought (1960, 1970). According to the report from the Tropical Forests and Climate Change project (TROFCCA, 2006), rainfall—the most irregular aspect of the climate pattern, both spatially and temporally—has been subject to substantial changes over decades.

¹³ See references: [17]

¹⁴ See references: [2], [3], [4] [6], [9], [12], [14], [17]

Projections to 2025 suggest a reduction of more than 20 percent in the average values, between 600 and 1,100 mm per year.

Indicator 1: change in rainfall patterns

Year	Average rainfall (mm)	Change	Value
1990	850 (650–1,055)	Decrease in rainfall between 1990 and 2006	5.3% on average
2006	800 (600–1,000)	Forecast change in rainfall by 2025	+ 20%

The southward drift in the country's rainfall gradient will affect physical variables such as vegetation, forests and transformation of soils. However, uncertainties regarding the climate change forecasts remain a problem because of lack of full understanding of the interactive dynamics of climate and of geographical variations.

Indicator 2: variation in temperature

Year	Average temperature	Increase
1990	34 °C	1°C, i.e. 0.1 to 3% increase over the period
2006 ¹⁵	35 °C	

Annual average temperature, currently 35°C, could, according to TROFCCA (2006), increase by 2 to 4°C in Burkina Faso, by 2025. This report finds that changes in daily ambient temperatures should be expected to follow similar trends.

Economic¹⁶

Indicator 1: number of households acquiring access to electricity in the past two decades

Percentage of households acquiring access to electricity between 1990 and the current year.

	1990	2002	2005	2008
Number of low-voltage consumers	NA	203,531	255,039	288,475
Percentage of households with electricity	NA	8.5%	10.6%	12%

Total electricity consumption

Sources	1990	2002	2005	2008
Electricity generated with fuel oil (kWh)	ND	300,919,846	415,751,943	321,293,817
Hydroelectricity (kWh)	ND	174,274,730	225,810,494	562,076,210

¹⁵ PAN, op.cit, pp. 7-8.

¹⁶See references: [10], [14], [17], [C]

Total produced (kWh)	ND	475,194,576	641,562,437	883,370,027
Electricity consumption (kWh)	ND	401,759,982	557,940,481	768,230,603

Indicator 2: level of increased energy autonomy

Energy imports: ratio of imported non-renewable energy to non-renewable energy consumption (in joules), relative to 1990

Energy	1990	2002	2005	2008
Crude oil production (TJ)	0	0	0	0
Crude oil exports (TJ)	0	0	0	0
Net petroleum product imports (TJ)		14,903.99	15,494.03	17,109.18
Refining of petroleum products (TJ)	0	0	0	0
Final petroleum product consumption (TJ)		18,873.87	20,185.96	20,942.93
Ratio imports/ petroleum product consumption		127%	130%	122%

Technical aspects¹⁷

Indicator 1: change in amount of energy supplied by renewables

Percentage change in consumption of renewables for generating of electricity and for transport, between 1990 and current year

Consumption	1990	2002	2005	2008
REn consumption (kWh): hydroelectricity and solar power	--	163,775,118	226,293,097	272,227,120
REn consumption (kWh): hydroelectricity, solar power and biomass	-	2,589,260,846	3,355,378,756	3,955,147,717
Total energy consumption (kWh)	-	3,023,569,383	3,996,941,193	4,710,263,994
Change in REn consumption (hydro and solar) in relation to total energy consumption (%)	-	5.4%	5.7%	5.8%
Change in REn consumption (hydro, solar and biomass) in relation to total energy consumption (%)	--	85.6%	83.9%	84.0%

¹⁷ See references: [14], [17], [C]

Indicator 2: percentage contributions of different energy technologies to total renewable energy consumption

Désignation	1990	2002	2005	2008
Generated hydroelectricity (kWh)	-	391,198,989	516,224,848	619,400,534
Imported hydroelectricity (kWh)	-	46,712,321	125,337,589	135,715,743
Total production (kWh)	-	3,023,569,383	3,996,941,193	4,710,263,994
Change in share of hydroelectricity generated in total production	-	12.9%	12.9%	13.2%
Change in share of electricity from renewables in total production	-	14.5%	16.1%	16.0%

Social aspects¹⁸

Indicator 1: changes in prevalence of diseases

Percentage variation in the frequency of appearance of water-related diseases between 1990 and the current year.

Diseases	2000	2004
Prevalence of infantile diarrhoea (%)	27.2%	11.4%

Indicator 2: changes in the employment sector

Percentage change in unemployment rate between 1990 and the current year.

Year	Area of residence (%)		
	Urban	Rural	Total
1998	NA	NA	2.4%
2005	NA	NA	4.2%

Civic aspects: Governance¹⁹

Indicator 1: land reform

Percentage change in number of farmers owning or having permanent access to their own land between 1990 and the current year and percentage of women owners.

	1996	2001
Households owning usable land (%)	NA	NA

¹⁸ See references: [10], [17], [A], [B], [C]

¹⁹ See references: [10], [17], [A], [B], [C]

Burkina Faso's land ownership is unusual in that the State owns the land. Cultivated lands occupy 13 percent of the whole of the country's surface area. Unused land covers 22 percent of the surface and 26 percent is occupied by forests.

Indicator 2: change in public participation in planning process

The starting point for public participation in the planning process for projects for development and improvements in living conditions came during the drought of the 1970s. This event saw the emergence of civil society organisations focusing on environmental issues and which made an appreciable contribution to protection of ecosystems.

This involvement of civil society was augmented when an act was passed by the Parliament and enacted by the government (Law No. 10/92/ADP of 15 December 1992) guaranteeing freedom of association, followed by Law No. 055-2004/AN of 21 December 2004, which introduced a general code for local authorities and an Environment Code, and laws on water and decentralisation.

Other texts specify the roles of the different stakeholders in implementation of programmes for development and improved living conditions (Decree No. 2000-514/PRES/PM/MEE of 3 November 2000 on management of hydraulic infrastructure in rural and semi-urban areas, Law No. 002-2001/AN of 08 February 2001 on orientation of water management and laws on agricultural and land ownership reform, etc.).

These basic texts changed the landscape of civil society in Burkina Faso allowing the creation of thousands of interest groups and organisations and NGOs under Burkinabè law. The range of players also evolved with the adoption by all stakeholders of participatory approaches involving all interested parties at every stage of projects, including the beneficiaries and especially women.

Burkina Faso's Current Energy Situation

Characteristics²⁰

Based on data (2007–2008) from Burkina Faso's ministry for energy and mines, the country's main sources of energy, classified by order of importance in total consumption (which was 3,209 million toe) are as follows:

- Ligneous fuels, or fuelwood: the predominant source at around 84 percent of total energy consumption.
- Thermal hydrocarbon based sources stemming, essentially, from imports and providing 10 percent of total energy consumed.

²⁰ See references: [10], [14], [15] [16], [17], [C]

- Hydroelectric sources from local hydroplants and plants in neighbouring countries with which Burkina Faso is interconnected. Hydroelectricity accounts for around 6 percent of the country's total energy consumption.
- The transport sector consumes more than 75 percent of the imported petroleum products. This is followed by the tertiary sector (11 percent on average), followed in turn by industry (less than 2 percent).
- Renewable sources operating at very low power and using photovoltaic systems. These cover less than 1 percent of Burkina Faso's energy consumption.

The contribution of each system to the energy mix (millions of toe) is detailed below

Source	Total consumption in 2008	% of total consumption in 2008
Biomass	2.663	82.99%
Petroleum products	0.522	16.27%
Hydroelectricity	0.021	0.65%
Solar	0.003	0.09%
Total	3.209	100.00%

From the information above, it can be inferred that Burkina Faso's energy sources are not sufficiently diversified. The country's total consumption was around 2.412 million toe in 2007 and 3.209 in 2008. This total is made up from consumption of biomass, especially firewood and charcoal (accounting for around 84 percent in 2007 and around 83 percent in 2008), imported petroleum products (16 percent in 2007 and 16.27 percent in 2008, used in transport, households and thermal power plants), hydroelectricity (1 percent in 2007 and 0.5 percent in 2008), and renewables, mainly solar (0.09 percent in 2009).

Energy Supply, Demand and Consumption²¹

The energy on offer in Burkina Faso is provided from the sources mentioned above, i.e. fuelwood as the main source, followed by hydrocarbons, hydroelectricity and renewables (mainly solar):

- The potential for ligneous fuels (firewood), estimated to be 5,505,517 tonnes in 2008, has grown, on average, by around 2.4 percent per year. The corresponding energy potential is around 2,424 ktoe, of which 85.82 percent is actually consumed, mainly by households. This energy met more than 83 percent of demand in Burkina Faso in 2007.
- There is no domestic supply of oil, as all of petroleum products are imported from abroad. This represents more than 40 percent of the country's imports and covered more than 16 percent of actual energy consumption in Burkina Faso in

²¹ See references: [10], [13], [14], [15], [17], [C]

2007. The breakdown of demand met by this energy source is as follows: around 77 percent for transport, around 11 percent for the tertiary sector, 10 percent, on average, for households and 2 percent for industry.

- Electricity is generated mainly from thermal sources. Less than 10 percent of the country's population has a connection and consumes 33 percent of the amount on offer. The other electricity consuming sectors are industry (36 percent), government administration (12 percent of electricity) and other major needs taking up around 19 percent of the offer. Electricity demand has been growing throughout the country at an annual rate of 4.4 percent since 2003, when the country's consumption was 0.262 TWh, i.e. 35 kWh per inhabitant. Electricity is provided by:
 - *Société Nationale Burkinabè d'Electricité (SONABEL* –national electricity company) with a capacity of 208,685 kVA of which 83.03 percent (i.e. 173,285 kVA) is generated from thermal sources and 16.97 percent from hydropower;
 - industrial groups generating 16,823 kVA of their own power, mainly from thermal sources.

- REN is mainly solar, with an installed base of 460 kWp, which is very small given the solar potential of 3,000 hours of sunshine per year.

Structure of Modern Energy Production²²

Hydroelectric potential²³

Hydroelectricity is generated in Burkina Faso in the *SONABEL* plants at Bagré (16,00 MW), Komienga (14 MW), Niofila (1.5 MW), Tourni (0.5 MW), and also by some industries (4.92 MW) in the south-west of the country. Total hydropower generation from these plants is increasing sharply, as shown in the table below:

Parameters	2002	2003	2004	2005	2006	2007	2008
Hydroelectricity production (MWh)	63,754.73	95,891.67	101,458.98	100,472.90	80,668.45	111,416.70	135,932.32
% total production	13.4%	18.7%	21.4%	19.5%	14.7%	18.2%	21.9%

It is clear that the potential for hydroelectric generating does not meet all of the population's energy needs. The electricity generating deficit justifies the strategies implemented by the State for interconnection with neighbouring countries such as Côte d'Ivoire, Ghana and Togo. In pursuing this end, the State has had to invest €88 million (USD131.6 million equivalent) for the equipment and networks for interconnection of the closest towns. The interconnection lines, already in place, provide Burkina Faso with energy at prices equivalent to 60 percent of the local price for the same quantity of energy. For example, Burkina Faso has spent USD6.4 billion to import energy from Côte d'Ivoire. This same energy would have cost USD10.3 billion if it had been produced in the country.

²² See references: [13], [14], [15], [17], [C]

²³ See references: [14], [17], [C]

Parameters	2002	2003	2004	2005	2006	2007	2008
Imported hydroelectricity (MWh)	110,520.00	69,149.85	96,183.56	125,337.59	139,323.91	123,910.36	135,715.74
% total production	23.3%	13.5%	16.9%	19.5%	20.3%	16.8%	18.0%

Interconnection with the grids of neighbouring countries contributes around 20 percent to Burkina Faso's total energy production.

Production of hydrocarbons²⁴

Petroleum products consumed in Burkina Faso (butane, gasoline, lamp oil, diesel, fuel oil, etc.) are mainly imports, as the country has no oil deposits.

Petroleum product consumption from 1999 to 2008 was:

Sector of activity	1999	2000	2001	2002	2005	2006	2007	2008
Primary consumption of petroleum products (in ktoe)	321.32	323.33	258.39	351.09	369.79	382.21	395.06	408.33

Butane (gas) is consumed mainly in urban areas and accounts for 2.5 to 5.0 percent of imports and consumption of petroleum products in Burkina Faso. On average, 3 to 5 ktoe of this product are consumed in the country annually.

Predominant production of bioenergy²⁵

Deployment of renewables and the contribution of each existing energy system is as follows:

Parameters	2002		2005		2008	
	Value	%	Value	%	Value	%
Consumption of petroleum products (TJ)	18,73.87	87.9%	20,185.96	85.7%	20,942.93	84.1%
Consumption of electricity (hydroelectricity generated and imported)	2,425.49	11.3%	3,129.09	13.3%	3,682.92	14.8%
Consumption of biomass REn (TJ)	163.78	0.8%	226.29	1.0%	272.23	1.1%
Total energy consumption (TJ)	21,463.13	100.0%	23,541.34	100.0%	24,898.08	100.0%

Situation of renewables²⁶

Most of the renewable energy in Burkina Faso is solar. The country is in a region of high annual solar radiation (between 2,500 and 3,500 hours of sunshine with average production of 5.5 kWh/m²/d). Energy produced from this source is, on average,

²⁴ See references: [15], [17], [C]

²⁵ See references: [14], [15], [17], [C]

²⁶ See references: [14], [15], [17], [C]

2.142 kWh to 7.801 kWh, depending on the region. The potential is high in the north of the country, relatively lower in the south-west.

There are a number of possible ways of harvesting this energy: thermal solar systems (recovery of the energy by concentrating the sun's rays onto a black body to heat water, thereby saving in gas and/or wood), solar concentrating systems (using parabolas) for cooking, or solar panels using the photovoltaic effect to produce electrical energy.

In spite of the country's high solar energy potential, the installed base in Burkina Faso, made up of photovoltaic systems, has gone from 460 kWp to a mere 1,000 kWp. Less than 0.1 percent of inhabitants have access to this form of energy to meet their needs (powering dryers, cooking stoves, water heaters, refrigerators, rural telephone systems and solar lighting, etc.). In Burkina Faso production of electricity, from photovoltaic cells is used in the telecommunications sector (30 percent of cases), socio-communal amenities and for lighting (50 percent of cases). However, efforts made by relevant players—principally the State and its partners but also associations and economic interest groups—mostly active in villages and small urban centres.

In addition to photovoltaic energy, Burkina Faso has, in the past five years, seen the development of pilot biodiesel projects. This is a promising market, still in the experimental stages in centralised training and national (CNRST/IRSAT) or international (2iE/LBEB, CIRAD) research centres. The plant species that could give value added to diesel in Burkina Faso is jatropha. Hundreds of hectares have already been planted. After esterification the products can be used for generators or vehicles, blended up to 50% with ordinary diesel.

There have been experiments with the production of biogas in Burkina Faso in the past two decades (Gampéla, Ouagadougou University, Goundi dans le Sanguie), and at the hospital at Banfora, Bazoulé (CREPA and 2iE). These projects and the viability of the experiments did not live up to expectations and most of the units, other than those in training and research centres, are closed. Various reasons are given for this, including the choice of technology (use of large quantities of water, difficulties in draining residues).

The forest ecosystem is fragile and the demand for fuelwood is growing continually from year to year. To meet this challenge, the government has introduced a policy aiming to protect forest resources in the long term, to combat desertification and ensure preservation of the ecological balance while optimising satisfaction of the population's need for energy.

Diversification of renewables is therefore a necessity for Burkina Faso. A move towards these forms of energy would make it possible to balance consumption at around 95 percent of the country's total energy consumption.

Wind energy is the least favoured form of renewable energy for Burkina Faso, given the low windspeeds. There have, nonetheless, been some attempts to harvest wind energy, most notably at Dori, in the Sahel region.

Major Market Players and Energy Sector Reforms²⁷

Burkina Faso's energy market is determined and operated via interaction between players, of whom the following are the most representative:

- The ministry responsible for energy, responsible for designing, implementing and monitoring the country's energy policy.
- The *Fonds de Développement de l'Électrification (FDE)* –electrification development fund), the body facilitating and financing rural electrification in Burkina Faso, on the basis of five year plans developed and validated at government level.
- The *Organe de Régulation du Sous-secteur de l'Électricité (ORSE)* – electricity sub-sector regulator), a body responsible for monitoring compliance with coherent planning. It is not yet operational.
- *SONABEL*, the main operator with a national monopoly on generating and distribution of electricity in the country's urban centres. This is a para-public enterprise for which the State provided the majority of capital. Its privatisation has been mooted.
- *SONABHY* also a para-public enterprise. It is responsible for supply of imported petroleum products (gas, diesel, gasoline, fuel oil).
- Local authorities that, since decentralisation, have been given additional powers and duties by the central government in the area of electricity supply. This is illustrated in local plans made by the local authorities and validated by the municipal councils.
- The private sector and cooperative groups and associations obtaining concessions to conduct studies, install equipment, manage energy supply systems and support cooperatives in the implementation of their projects.
- Technical and financial partners supporting groups of players from the above in implementation of energy projects and programmes at both national and local level. They include the European Union, UEMOA, ECOWAS, the World Bank, and bilateral cooperation agencies such as DANIDA.

Burkina Faso's petroleum products distribution sector is liberalised. In addition to *SONABHY*, ensuring imports of the essential products consumed in the country, private operators with licences to sell are present in towns. They are mainly multinationals (Total-Elf, Fina, Shell) and national and regional companies (Perofa, Pétrolub, Sky, Lybia Oil, etc.).

With regard to energy sector reform in Burkina Faso, the government is looking, in the short term, to create a national energy agency to support the *DGE* at the ministry responsible for energy in the implementation of its energy strategy. The agency's

²⁷ See references: [14], [15], [17], [C]

mission will be to determine viable national energy management strategies, to implement energy management policies and promote renewables. The agency will also be tasked with improving energy efficiency, diversifying energy sources and promoting best energy saving practices via fiscal incentives.

Setting up of a special parliamentary commission on energy is also being considered, for better management of energy reforms within an appropriate legal framework.

Energy Sector Trends

The outlook for developments in the energy sector at national level can be evaluated via several large-scale projects and programmes either under way or planned for 2010, or even 2025. The most important are:

MEPRED project²⁸

The Burkina Faso MEPRED project covers 13 of the country's administrative regions. There are two target horizons:

1. 2015: which fits with the Millennium Development Goals (MDG) and the goals set in the ECOWAS White Paper, to which Burkina Faso is a signatory and is firmly committed.
2. 2025: coinciding with Burkina Faso Vision 2025 for access to modern energy services and which includes drafting of 13 Regional White Papers that would be brought together to form Burkina Faso's National White Paper.

Danish Support: Burkina Faso's energy sector²⁹

Bilateral cooperation on energy between Denmark and Burkina Faso began in the 1980s with financing of electrification projects for secondary centres such as Gaoua, Fada etc., under a state loans scheme. From the early 1990s cooperation became structured around mini-programmes allowing building of infrastructure such as the Koupéla-Tenkodogo line as well as boosting of *SONABEL*'s capacity by, for example, supportive training. Cooperation intensified and focused on electrification in secondary centres. The master plans for the Bobo-Dioulasso and Ouahigouya supply centres were developed and implemented. Substantial reinforcement of thermal power capacities was also financed for these two cities.

In 2004, Denmark decided to disengage from the energy sector, after 10 years of institutional support and a presence of more than 25 years in the electricity sector. An exit phase was then planned. *DANIDA's Programme d'appui au secteur de l'énergie (PASE – energy sector support programme)*, designed for the agency's phase out from the energy sector, includes institutional support for the sector for the 2006–2008 period, accompanied by support for 'wood fuel' activities in areas where *DANIDA* was formerly engaged. The total budget is FCFA3.5 billion.

²⁸ See reference: [16]

²⁹ See reference: [7]

SONABEL's major electrification projects³⁰

In order to meet its public service remit, including satisfying demand in existing centres and electrification of new ones, *SONABEL* has initiated several projects for the coming years:

Capacity building programme for thermal production and transmission of electricity: this comprises: (i) installation of a 16 MW generator unit in the city of Ouagadougou, (ii) construction of a 15 kVA sub-station at Ouagadougou (Ouaga 1 centre) to ensure better distribution of electricity from the Bobo-Ouaga interconnection.

Interconnection programmes with Burkina Faso's neighbours. Programmes are:

1. The Bobo–Ouaga interconnection with construction of a 225 kV transmission line over some 338 km between Bobo-Dioulasso and Ouagadougou, continuing the Côte d'Ivoire-Burkina Faso interconnection.
2. The Bolgatanga (Ghana)–Ouagadougou interconnection, in line with the recommendations in Burkina Faso's electrification master plan.
3. The WAPP 6 Dorsale Nord 330 kV project for the construction of a 330 kV transmission line connecting the following countries: Nigeria-Niger-Burkina Faso-Bénin. This is part of the ECOWAS West African Power Pool project (ECOWAS – WAPP).
4. The Han (Ghana)–Bobo Dioulasso (Burkina Faso)– Sikasso (Mali)–Bamako (Mali) 225 kV interconnection project.
5. Smaller transboundary interconnection projects to electrify or connect frontier towns in Burkina Faso to towns in neighbouring countries such as Ghana.
6. Internal interconnections to connect isolated *SONABEL* electrical centres to neighbouring main centres. The ultimate aim of this project is to eventually interconnect all of the isolated grids into a national electricity grid and to do away with small-scale thermal generating which is very costly.
7. Extension of electrical grids, partly under *PASE*, forms a part, and investment from *SONABEL's* own financial resources.

Energy's Contribution to National Development³¹

It is clear and amply demonstrated that socio-economic development and the underpinning of economic growth correlate directly with easy access to energy and its consumption at optimised cost.

In this context, Burkina Faso, aware of its extreme energy vulnerability in terms of its imports of petroleum products, has integrated the energy sector into its poverty

³⁰ See reference: [14]

³¹ See references: [5], [14], [15], [17], [C]

reduction strategy which has, since its approval, received the support of the country's technical and financial development partners.

In its implementation, the strategy addresses environmental concerns to ensure that energy can make a sustainable contribution to Burkina Faso's development. The country has been engaged, since the 1990s, in the sustainable management of its natural renewable resources, in the protection of its environment and in sustainable social and economic development, using a variety of mechanisms and resources.

The strong point of this strategy in, for example, the area of agriculture, is the government's increased efforts via programmes that support production and the training of farmers to improve their production. This government intention was given expression in the *Lettre de Politique de Développement Agricole Durable* (sustainable develop of agriculture policy letter) and was implemented in the *Programme d'Ajustement Structurel du Secteur Agricole* (structural adjustment programme for agriculture) of which the targets for 2010 are food self-sufficiency and security, creation or securing of employment in rural areas, improvements in income and standard of living of agricultural producers and the fight against poverty. The intention is also to increase and diversify agricultural production via qualitative and quantitative changes in production techniques and the development of water systems for agriculture in order to reduce its dependence on the vagaries of climate.

For the forests, the intention is to better protect classified areas, to enrich natural forests by planting of local or exotic species of value for the production of timber or wood for other purposes and to intensify the fight against desertification by controlling herd movements, bush fires and abusive cutting of wood.

In industry, especially in the secondary sector, an increase in the number of mining companies is observed in the country.

Given the country's geographical situation, the transport sector plays an essential role in national and regional trade in the produce of farming and industry, and in other forms of trade. Its progressive development (building of new roads and rehabilitation of existing earth road network) observed over the past two decades has been adequate to cover the country's inter-province, regional and transboundary mobility needs.

In the area of energy, there is a need for the State to halt the process of desertification, reduce the consumption of ligneous fuels, increase the productivity of existing forest resources, replant vulnerable areas and reduce the pressure of human activities on vegetation cover. Increased coverage of urban and rural centres with clean forms of energy (hydro, photovoltaic) will help to reduce oil expenditure as well as diminishing Burkina Faso's dependence on petroleum products.

With the support of its partners (SNV, GTZ, World Bank, WADB, ECOWAS, UEMOA, ADB, AFD, etc.) Burkina Faso has and will continue to have the benefit of aid for its major value added projects in the area of energy and for the country's social and economic development.

Energy System Vulnerabilities³²

Vulnerability Indicators	Calculation
Coal	
1. Number of coal mine plants located at less than 1 metre above sea level and within the area that could be flooded by a flood with a current recurrence period of 100 years. <i>Burkina Faso has no coal reserves.</i>	0
Oil and gas	
1. Share of offshore oil and gas installations likely to be hit by a storm of more than 70 m/s gusts within the next 20 years (%) <i>Burkina Faso has no oil or gas reserves. There are therefore no such installations in the country.</i>	0
2. Share/number of refineries likely to be hit by a storm of more than 70 m/s gusts within the next 20 years (%). <i>There are no oil refineries in Burkina Faso.</i>	0
All fossil fuels	
1. Number of thermal (coal, oil and gas) power plants located at less than 1 metre above sea level and within the area that would be flooded by a flood with a current recurrence period of 100 years. <i>There are no (oil-fired) thermal plants at less than one metre below sea level, nor in areas subject to flooding.</i>	0
Additional information: Expected number of droughts that lead to a capacity decrease of thermal power plants by more than 10% within the next 30 years. <i>There are no forecasts of this amplitude for Burkina Faso.</i>	0
Nuclear	
1. Number of nuclear power plants located at less than 1 metre above sea level and within the area that would be flooded by a flood with a current recurrence period of 100 years. <i>Burkina Faso has no plans to build nuclear plants. Moreover, the country has no coastline.</i>	0
2. Number of incidents/accidents since the plant was built. 2b. Describe the most significant incidents: Not relevant	0
Hydro	
1. Expected precipitation change over the next 20–50 years (%) and/or probability of floods in each watershed. <i>Isohyets have shifted from 600 mm to 1100 mm over 100 to 200 km to the south, depending on climate zone.</i>	15 to 30%

³² See references: [9], [14], [15], [17], [A], [B], [C]

Vulnerability Indicators	Calculation																										
<p>2. Number of multiple-use dams in the country today.</p> <p><i>There are more than 2,500 dams and surface water reservoirs for human, agropastoral and hydroelectric needs.</i></p> <p>3. Volume of water (m³) of each dam.</p> <p><i>No data available on total volume nor on part used by each sector.</i></p> <p>4. Describe what % of the water is used for: Agriculture – Energy – Drinking</p> <p><i>No data available at national level for percentages of water taken for the different purposes listed above.</i></p>	<p>2,500</p> <p>NA</p> <p>NA</p>																										
<p>Additional information: Expected additional run-off from glacier melting (million m³)</p>	<p>None</p>																										
<p>Transmission and distribution indicators</p>																											
<p>1. Length of in-country, above-ground transmission and distribution lines (km)</p> <p>1b. Distinguish between (2 sub-indicators):: -- High voltage (transmission) -- Middle + low voltage lines (distribution)</p> <p>1c. Describe any transnational lines</p>	<p>NA</p> <p>High voltage = 1,887.41 km (in 2007)</p> <p>Low voltage = 5,634.23 km (in 2007)</p> <p>None</p>																										
<p>2. Number and length of power cuts (differentiate between failures due to weather or equipment failure and those cuts due to rationing).</p> <p>2b. Average hours of interruption per year</p> <p><i>Comments: the SONABEL report for 2007 gives the following data for cuts in major urban centres, at Ouagadougou and Bobo Dioulasso in particular.</i></p>	<p>In 2007: 1,513 electricity power cuts in cities of Ouagadougou and Bobo Dioulasso, of which 5.1% were due to rationing for 24.4% of the cut-off time recorded and 14.5% for energy not available</p>																										
<table border="1"> <thead> <tr> <th></th> <th>Number</th> <th>Time</th> <th>Energy not available</th> </tr> </thead> <tbody> <tr> <td>Total</td> <td>1,513 units</td> <td>325.1 mn</td> <td>2,985 MWh</td> </tr> <tr> <td>% Incident</td> <td>76.7%</td> <td>8.9%</td> <td>70.8%</td> </tr> <tr> <td>% Works</td> <td>18.2%</td> <td>66.8%</td> <td>14.6%</td> </tr> <tr> <td>% Rationing</td> <td>5.1%</td> <td>24.4%</td> <td>14.5%</td> </tr> <tr> <td>Total</td> <td>100.0%</td> <td>100.0%</td> <td>100.0%</td> </tr> </tbody> </table>					Number	Time	Energy not available	Total	1,513 units	325.1 mn	2,985 MWh	% Incident	76.7%	8.9%	70.8%	% Works	18.2%	66.8%	14.6%	% Rationing	5.1%	24.4%	14.5%	Total	100.0%	100.0%	100.0%
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<p>3. Percentage of energy supply requiring regional transport over 50 km (%):</p> <p>3b. % that is transportation of fossil fuels.</p> <p>3c. % that is transportation of biomass.</p>	<p>16.82% of all electricity consumed</p> <p>68.05% (in 2007)</p> <p>< 1.0% (not including firewood)</p>																										
<p>Biomass</p>																											
<p>1. Proportion of biomass used for energy purposes (%) in total biomass production</p>	<p>NA</p>																										

Vulnerability Indicators	Calculation
2. Expected precipitation change over next 20–50 years (%)	15 to 30% with 200 km southward shift of gradient
3. Probability of temperature increase beyond biological heat tolerance of key biomass crops within the next 20 years (%).	Expected increase of 2 to 4°C by 2025
Wind	
1. Number of wind turbines less than 1 metre above sea level.	0
2. Projected change of average windspeed in the next 20 years based on regional climate models (%).	NA
Solar	
1. Capacity of solar installations already in place (m ² or kWp).	1,000 kWp
2. Expected temperature increase (°C) in the next 20 years (relevant for PV capacity)	From 2 to 4 °C by 2025.
3. Additional information: projected change in rainfall and cloud cover over next 20 years (%)	NA

Energy System Resilience³³

Capacity Indicators	Calculation															
Implementation indicators																
1. Domestic capital formation (USD million per year) -- Domestic savings (USD million per year)	NA															
2. Domestic investment in renewable energy (USD million per year). <i>This amount is FCFA34.640 billion (USD69 million). 33% of pre-electrification spending and 17.8% of all future investment under the MEPRED project (project duration est: 15 years)</i>	USD 69million Approx USD 4.6 million/year															
3. Number of technical engineers graduating annually as a percentage of the total population. <i>SONABEL's staff statistics for 2007 do not include the category 'engineer'.</i>	1,420															
<table border="1"> <thead> <tr> <th>Category</th> <th>Number</th> <th>% total population</th> </tr> </thead> <tbody> <tr> <td>Operatives</td> <td>924</td> <td>0.0066%</td> </tr> <tr> <td>Supervisors</td> <td>274</td> <td>0.0020%</td> </tr> <tr> <td>Executives</td> <td>222</td> <td>0.0016%</td> </tr> <tr> <td>Total</td> <td>1,420</td> <td>0.0101%</td> </tr> </tbody> </table>	Category	Number	% total population	Operatives	924	0.0066%	Supervisors	274	0.0020%	Executives	222	0.0016%	Total	1,420	0.0101%	
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Executives	222	0.0016%														
Total	1,420	0.0101%														
4. Availability of hazard maps for floods/droughts	NA															

³³ See references: [14], [15], [17], [A], [B], [C]

Capacity Indicators	Calculation
<p>5. Existence and enforcement of power plants siting and construction guidelines taking climate change into consideration.</p> <p><i>The Environment Code and the laws enacting it put electrical power plants in the category of facilities for which an environmental impact assessment is required, including the environmental and social management plans of which the modalities are clearly defined in law.</i></p> <p><i>Developed in the 1990s, the codes and laws, do not, unfortunately, address climate change concerns.</i></p>	0
6. Existence of emergency plans to react to meteorological extreme events and availability of local emergency repair teams.	NA
<p>7. Domestic availability of insurance schemes.</p> <p><i>Many of the insurance companies present in Burkina Faso are subsidiaries of multinationals based in France and other European countries. However, given the boom in mining companies in Burkina Faso, attempts are being made to compensate for this lack. There are very few companies proposing policies covering natural disasters.</i></p>	None
<p>8. Existence of citizens' users groups in the energy governance structure (enforcement of participatory decision-making).</p> <p><i>The law on freedom of association is at the origin of the emergence interest groups representing civil society in development projects and in energy projects in particular (e.g. decentralised rural electrification). Civil society participation is perceptible in impact assessments, consultation of the public and submission of progress reports.</i></p>	NA
Wind	
<p>1. Existence and enforcement of national regulations requiring storm proofing of wind power plants to withstand highest anticipated windspeed.</p> <p><i>Burkina Faso has no wind generators and the outlook is not foreseeable.</i></p>	None
2. Existence of siting maps that detail projected changes in windspeed, floodplains, and areas impacted by sea level rise.	None
Solar	
1. Existence of a siting map that details projected changes in cloud cover.	NA
2. Existence and enforcement of national regulation requiring storm proof concentrating solar power plants (CSP) to withstand the highest anticipated windspeed.	NA
Oil and gas	
1. Existence and use of a siting map for mines and power plants taking into account projected storms, floods and drought areas.	None

Capacity Indicators	Calculation
Hydro	
1. Existence of a national plan for optimised operation of hydro plants under projected flow regimes for systems. <i>All of SONABEL's hydroelectric plants have such programmes, but no figures are available.</i>	Yes
2. Number of dams equipped with desilting gates and/or number of upstream land use management and water catchment plans for each hydro installation.	NA
Biomass	
1. Research, development and dissemination budget for heat and drought resistant crops (USD million per year).	NA
2. In-country utilisation of biomass fuels not traditionally used by private enterprises and cooperatives (% of total fuels).	None
Mined fuels	
1. Existence and use of a siting map for mines and power plants taking into account projected storms, floods and drought areas.	NA
2. Implementation of national regulations for thermal power plant siting at sites with sufficient cooling water availability over the next 50 years.	None

Conclusions and Recommendations

This study of energy vulnerability, adaptation and resilience in Burkina Faso highlights the specific nature of the country's natural environment and its degree of vulnerability where energy is concerned, given its landlocked and isolated position, its situation in the sahelian climate zone, its high population growth rate and strong dependence on fuelwood and imported petroleum products.

The recommendations made below are based on the indicators presented in the preceding sections of this report. Their aim is to bring about improvements in Burkina Faso's energy system so as to increase the country's independence to allow it to better withstand the consequences of climate change, for which forecasts are fairly severe for the next fifty years.

The following recommendations are made for **the environment**:

- Programmes should be developed to reduce the consumption of ligneous fuels and to reinforce ecologically viable replanting of areas that have suffered from the pressure induced by people searching for firewood.
- In the short and medium terms, parameters allowing monitoring of climate change indicators relevant to Burkina Faso's energy sector should be taken into account, to better ascertain the effects of change on the economy, on the

environment, on availability of renewables and on the population's social conditions.

The following recommendations are made to improve Burkina Faso's energy resilience **from the economic point of view**:

- Public transport should be developed in urban areas to limit the consumption of fossil fuels (petroleum products) by individual means of transport (motor cycles, private vehicles). Before this can be achieved, it will be necessary to improve the quality of urban roads by paving them, and to introduce coherent urban transport plans.
- Micro-financing programmes should be promoted to finance small enterprises and trades people, to allow them to meet their energy needs and create stable employment.

Recommendations on **technology** are as follows:

- Diversification of energy supply sources to reduce Burkina Faso's dependence on systems that are vulnerable to climate change (petroleum products, fuelwood). The purpose of such an approach is to promote low-cost energy that is accessible to rural populations and to those of small urban centres and of the peri-urban areas of large towns, by increasing the existing infrastructure and diversifying the technologies used to produce energy. Given the increase in public investment in projects to develop renewable energy, this recommendation includes the following:
 - Dissemination of improved stoves with better energy efficiency, to limit excessive use of fuelwood, which is a resource sensitive to climate change.
 - Promotion of use of butane by households, to reduce use of wood and thereby reduce deforestation.
 - Intensification of programmes for interconnection to electrical grids of neighbouring countries (Côte d'Ivoire, Ghana and Togo) generating hydroelectricity, with a view to reducing national expenditure on oil. Interconnection provides an opportunity for development of clean energies.
 - Development of projects for supply of energy from renewable sources, especially solar, for which Burkina Faso has a large and under-exploited potential (2,500 to 3,500 hours of solar radiation able to produce 2,142 to 7,801 kWh). This will require support for research institutions as well as training in the techniques and optimisation of use of solar energy.

Energy governance

The capacities of local stakeholders, including NGOs and civil society, should be strengthened, to allow them to participate fully in local decisions aiming to increase diversification of energy sources that are able to withstand climate change, based on the local potential (promotion of solar and wind power and energy from biomass).

Bibliography

Books and Articles

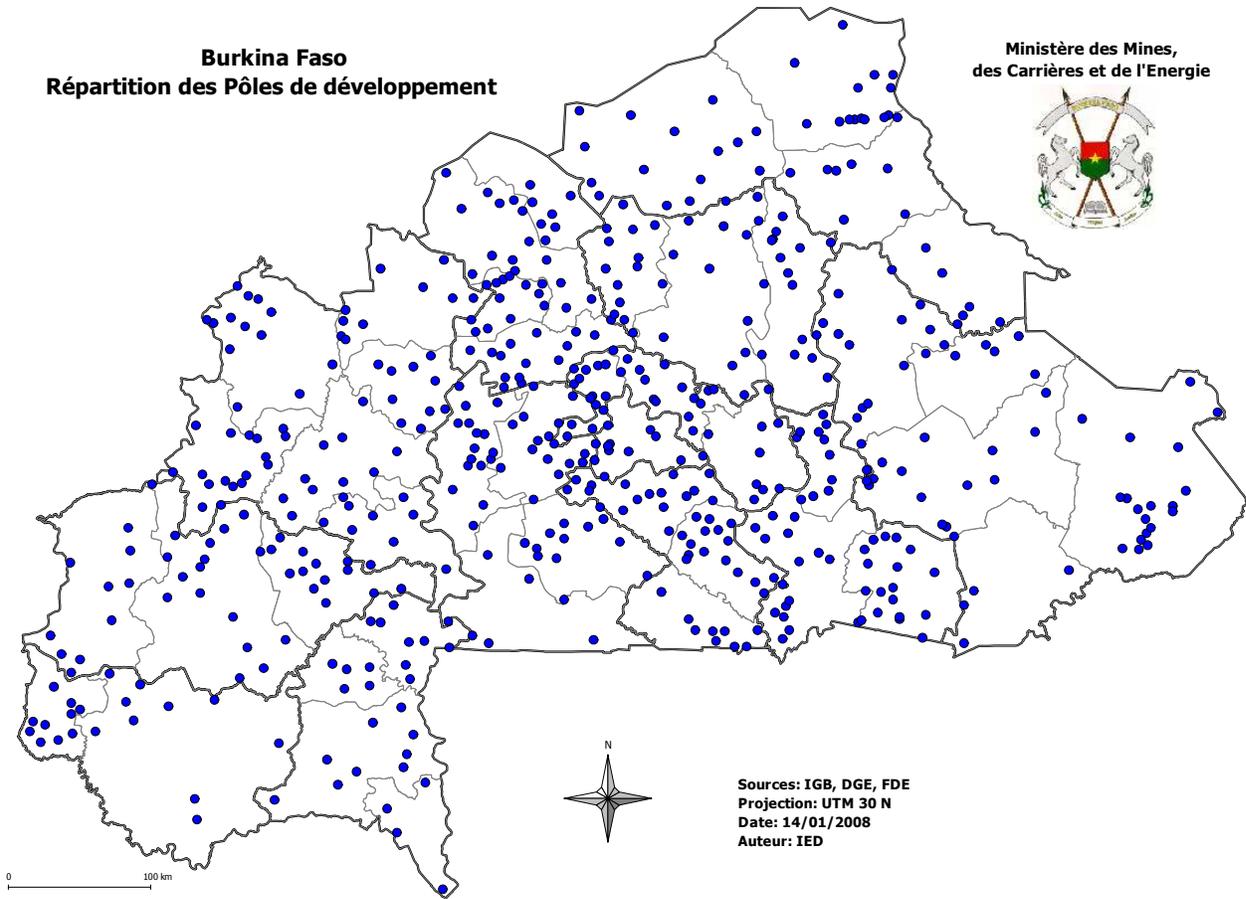
1. Adama Zerbo. (2008). *Emploi, pauvreté et croissance économique au Burkina Faso. Regard sur le marché du travail et l'emploi*. Revue du Bureau d'études pour l'emploi et le développement n°06, pp 1 – 4; December 2008.
2. André T. Kabré et Henri Zerbo. (2003). *Développement et recherche sur l'intégration de l'irrigation et de l'aquaculture au Burkina Faso*. 6p.
3. Baijot, E., Barry, I. et Ratjs, F. (1994). *Peuplements piscicoles des retenues du Burkina Faso*. In E. Baijot, J. Moreau et S. Bouda, eds. Aspects hydrobiologiques et piscicoles des retenues d'eau en zone soudano-sahélienne. Le cas du Burkina Faso. p.65-85. CTA, Wageningen et Commission des Communautés Européennes, Bruxelles. 250 pp.
4. Baijot, E., Moreau, J., Barry, I. et Bouda, S. (1994). *Biologie et démographie des principales espèces de poissons des retenues d'eau du Burkina Faso*. In E. Baijot, J. Moreau et S. Bouda, eds. Aspects hydrobiologiques et piscicoles des retenues d'eau en zone soudano-sahélienne. Le cas du Burkina Faso. p.87-122. CTA, Wageningen et Commission des Communautés Européennes, Bruxelles. 250 pp.
5. [CIA World Factbook](http://www.indexmundi.com/g/g.aspx?v=21&c=uv&l=fr) (2008). Country data: Burkina Faso. <http://www.indexmundi.com/g/g.aspx?v=21&c=uv&l=fr>, As of 16 May, 2008.
6. CIFOR, CATIE. (2006). *Les projections du changement climatique en Afrique de l'Ouest*. Introductory paper to first meeting of TROFCCA partners, 7–8 June 2006, Ouagadougou, Burkina Faso.
7. DANIDA. (2006). *Appui Danois au secteur d'énergie au Burkina Faso*. Summary document, 2006. 4 pages.
8. FAO. (undated). *Caractéristiques socioéconomiques et écologiques du Burkina Faso*. FAO document archive.
9. Groupe d'experts PANA - Burkina Faso (2003). *Etudes de vulnérabilité et d'adaptation aux changements climatiques : étude de cas du Burkina Faso*. Communication to training workshop for national adaptation programme, Ouagadougou, Burkina Faso, 28–31 October 2003. 11 pages.
10. INSD. (2007). *Burkina Faso en chiffres, Données synthétiques*. Ministry of economy and finance. 2007 edition. 8 pages.
11. Institut de la statistique du Québec. (2008). *Profil économique du Burkina Faso*. www.stat.gouv.qc.ca. 3 pages.

12. Ouédraogo Mathieu. (2008). *Impacts des changements climatiques (CC) sur les revenus agricoles au Burkina Faso*. Communication to CTA seminar on the implications of climate change for agriculture, CTA, Ouagadougou, 26–31 October 2008.
13. Pousga Kaboré et Abdoulaye Zonon. (undated). *Bilan énergétique et maîtrise de l'énergie au Burkina Faso*. Connaissance pour le développement. pp 127–148.
14. SONABEL. (2007). *Rapport d'activité pour l'année 2007*. SONABEL. 56 pages.
15. SONABHY. (2007). *Rapport d'activités et statistiques 2000 - 2007*. Summary document. 15 pages.
16. Watchueng Samuel. (2008). *Evaluation de la demande locale et analyse des options d'approvisionnement en énergie Méthode et outils: enquêtes, SIG, GEOSIM*. Communication for l'IEDb – France, to MESWAD Conference, Dakar 2008.
17. Wéthé Joseph. (2007). *Renforcer la résilience des systèmes énergétiques et des écosystèmes au Burkina Faso*. Observatoire de la viabilité énergétique 2007. HELIO International. 44 pages.

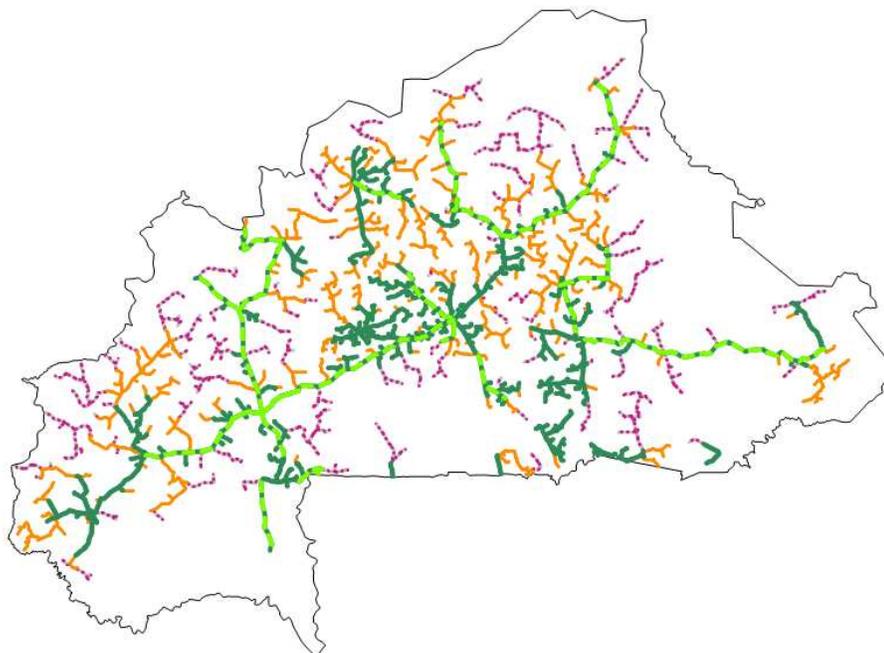
Internet sites

- A. http://www.diplomatie.gouv.fr/fr/pays-zones-geo_833/burkina-faso_338/presentation-du-burkina-faso_942/index.html
- B. <http://www.oecd.org/dataoecd/4/31/40568810.pdf>
- C. http://www.sonabel.bf/perspect/electrif_bf.htm
- D. <http://www.helio-international.org>

Annex 1: Distribution of development centres in Burkina Faso



Annex 2: Simulation of extension of SONABEL MV (33kV) grid



Total cost of MEPRED project in Burkina Faso	FCFA
SONABEL extension 2014 (486 localities)	45,014,249,813
DRE by 2025	
SWER interconnections (1,042 localities)	36,182,147,812
Isolated diesel generators (82 localities)	7,096,262,584
Diesel clusters (20 localities)	1,779,227,712
Total (1,144 localities)	45,057,638,108
Systematic pre-electrification (basic services)	
Isolated diesel generators (29 localities)	3,914,496,000
MFPG (2,578 localities)	59,700,000,000
MFP (1,352 localities)*	6,760,000,000
PV (3,464 localities)	34,640,000,000
Total (6,071 localities)	105,014,496,000
Total Burkina Faso (7,701 localities out of 7,849)	195,086,383,921

Annex 3: Civil society participation via national environment policy

Adoption of a policy on the environment and sustainable development also reinforces the involvement of civil society in management of projects in Burkina Faso. The following are examples worthy of mention:

- The 1991 *Plan d'Action National pour l'Environnement* (national environment action plan), updated in 2002 in the form of the *Plan d'Environnement pour le Développement Durable* (environmental plan for sustainable development). It has been implemented via the *Programme Cadre de Gestion des Patrimoines Nationaux* (framework programme for national heritage management), *Programme Cadre de Gestion des Terroirs* (framework programme for management of the regions), *Programme Cadre de l'Amélioration du Cadre de Vie* (living standards improvement programme), *Programme de Développement des Compétences en Environnement* (environmental skills development programme) and the *Programme National de Gestion de l'Information sur le Milieu* (national programme for environmental information management).
- *Etude Nationale Prospective « Burkina 2025 »* (Burkina 2005 national outlook study) which aims to provide a retrospective analysis of the social, economic, political and cultural situation, to analyse the determining factors for development of Burkinabè society, to shape its desired profile in 2025, and to develop a framework for long-term involvement of all development stakeholders.
- The 200 *Cadre Stratégique de Lutte contre la Pauvreté* (strategic poverty reduction framework), revised in 2003, which is the framework of reference and for harmonisation of development actions. Its objectives are attained via programmes to accelerate growth based on equity, guarantee access to basic social services to the poor and to women, widen opportunities for employment and income producing activities for the poor and for women, and promote good governance.
- The 1995 *Lettre d'Intention de Politique de Développement Humain Durable* (sustainable human development policy letter of intent, focusing on the development strategy for human security to allow each Burkinabè citizen to accede to economic security (education, professional training, paid employment, preventive and curative health care, food and water supply security, etc.).

The participation of civil society in these projects is supported and encouraged by the development partners in Burkina Faso. They operate support programmes for the strategic plans of associations and other non-governmental bodies aiming to foster democratic debate, the equal participation of women with men in political governance, and local democracy. They strengthen their role in promoting freedom of expression of the media in Burkina Faso and in Africa in general, and intensify their activities in the fight against corruption, building of institutional and organisational capacity and reinforcement of strategic partnerships. All of this support is co-financed with Burkina Faso's bilateral partners. Other occasional support is lent to civil society bodies concerned with good governance.