



Black Gold for Blue Gold? Sudan's Oil, Ethiopia's Water and Regional Integration

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Summary points

- Sudan and Ethiopia (and an independent South Sudan) face similar challenges in poverty reduction, climate change, population growth and food security. They will find it hard to address these because of mutual mistrust and lack of regional integration around oil, water and hydropower. This could even lead to conflicts.
- All three must choose between having a hostile attitude towards each other over the Nile Basin waters and Sudanese oil, and sharing their resource wealth to build better economic relations that lock in political stability and address the ecological pressures confronting their populations.
- Regional cooperation and integration can be built on a revision of the 1959 Nile Treaty and the synergies between Sudan's oil for Ethiopia's water. North and South Sudan have regional comparative advantages in agriculture and can continue to supply Ethiopia with oil, while Ethiopia should be encouraged to make full use of its considerable potential in hydropower on the Blue Nile to export electricity to its neighbours.
- Fundamental obstacles to regional integration include antagonism between the region's leading political movements; North and South Sudan's greater focus on building a new relationship with each other than on broader regional cooperation; North Sudan's insistence on pushing ahead with its own dam programme; and internal factors in Ethiopia constraining its emergence as a regional leader.

Hydropower development in Sudan and Ethiopia



This map is intended to give an indication of the locations of hydropower projects currently under construction or operating in Sudan and Ethiopia, and should not be taken as geographically precise. The map differentiates between dams and hydroelectric power plants, as the former impound river water to create reservoirs for electricity production, water supply or irrigation, while the latter mostly utilize the natural flow of water. Most of the hydropower projects displayed currently produce, or are intended to produce, electricity. For further information on which projects harness water primarily for electricity and which provide water for irrigation, see Appendix. The boundaries, names shown and designations used on this map do not imply endorsement or acceptance by the author or by Chatham House.

The 'new' Sudanese–Ethiopian geopolitics

The Horn of Africa's leading powers, Ethiopia and Sudan, have long been caught in a relationship of mutual suspicion that regularly pulls them into interlocking, regionalized conflicts. But increasingly opportunities are arising that could create a more benign interdependence. After a decade of oil-driven growth in Sudan and the priority that both Khartoum and Addis Ababa accord to harnessing water resources for electrification and irrigation, energy is assuming great importance in discussions about security and development. There is potential for joint natural resource management, agricultural investment projects and free exchanges along the 1600km-long border that would yield mutual benefits.

This briefing paper considers the case for regional economic integration in the Horn of Africa from an energy perspective.¹ This is a critical moment for the region: as part of Sudan's 2005 Comprehensive Peace Agreement (CPA),² Southern Sudan has recently voted for independence, and this presents particular risks and opportunities for the Khartoum–Juba–Addis energy triangle. Sudan's economy has been transformed since it became a significant oil exporter in 1999 with production of some 450–500,000 barrels per day. But it remains dependent on the Nile for irrigated agriculture and for producing electricity through dams. Ethiopia is not an oil producer and in recent years imported about 85% of its fuel oil from Sudan, but it is endowed with substantial water resources. Ethiopia boasts a regional comparative advantage, ecologically and economically, in hydropower and has the potential to generate up to 45,000 megawatts of electricity.

Oil and water resources or 'black and blue gold' could contribute to sustainable growth and more harmonious relations between the two countries if they were managed with an explicitly regional perspective. The urgency of sustainable resource management is underlined by climate

change, which is already harming the livelihoods of millions, with further upheaval forecast.

On the other hand, continuing to exploit oil only to benefit the elites, and constructing hydro-infrastructure without embedding it in a regional framework would not just be wasteful; it could potentially contribute to a resumption of large-scale conflict within and between Sudan and Ethiopia, even sucking in neighbouring states.

There is a strong case for building regional economic interdependence around an energy deal exchanging Sudanese oil for Ethiopian electricity and thus providing a new framework for political relations. Joint energy initiatives could provide a greater, cleaner and more reliable power supply for both Sudan and Ethiopia as each country grapples with providing jobs for burgeoning populations and services to marginalized areas. Yet despite the clear rationale for regional integration, there are significant obstacles in the way of such a step change in cooperation. The security wings of both regimes continue to be distrustful of one another. They favour incremental increases in exchanges but are wary of mechanisms that would lock in regional interdependence. Sudan's National Congress Party (NCP)³ sees dependence on Ethiopian power as a 'national security risk', according to one of its senior intelligence officers. Khartoum calculates that a grand bargain along these lines, implicitly recognizing the superiority of Ethiopia's hydro-strategy, could compromise its own plans for a dam-building strategy intended to recalibrate Sudan's political economy. This is likely to become more significant once South Sudan becomes an independent state in July 2011.

While acknowledging the importance of Egypt in many of the issues discussed, this paper focuses specifically on the Ethiopia–Sudan relationship and the politics of the Horn of Africa. It starts by providing some background to this complex relationship, and then examines the key domestic challenges faced by Ethiopia and Sudan, and the case for economic interdependence as a foundation for

1 Interviews for this paper were carried out in spring and December 2010 in Addis Ababa, Khartoum, Shendi/Al-Mutamma and Europe. Several interviews were not for attribution and the interviewees are not cited by name here.

2 The Comprehensive Peace Agreement was signed by Sudan's government and the Sudan People's Liberation Movement/Army (SPLM/A) in 2005, following agreements in Machakos (2002) and Naivasha (2004).

3 Created in 2000 as a result of a split within the National Islamic Front, the NCP is led by President Omar Al-Bashir and remains Islamist in outlook.

regional peace. The last section focuses on the political calculus, explaining why regional integration is likely to be difficult.

A troubled past

For centuries, Egypt, Sudan and Ethiopia have fought over the Blue Nile Basin through shifting alliances and against the backdrop of global politics and local resource realities. Political and commercial objectives – the thirst for land, trade routes and slaves – were the driving force behind state formation in the nineteenth century. These processes of power and wealth accumulation created strong core-periphery tensions that led to violence inside and outside the territory and still shape societies today. This historical proximity of politics and economics is important; mutual distrust, the fight over resources and the confrontation between riparian states have shaped the mindsets of generations.⁴

The 1998–2000 Ethiopia–Eritrea war altered the regional alliance structure, ending the American-backed

alliance against Khartoum. Internal changes in Sudan led to a palace-coup by Omar Al-Bashir and a riverain security clique ousting Hassan al-Turabi from power. The split inside the ruling National Islamic Front (NIF) coincided with Sudan's emergence as an oil exporter (1999), the Nile Basin Initiative (1999) and the global war on terror (2001), three factors that underscored the importance for the international community of having a Khartoum government with which it could do business. Bashir and Vice-President Ali Osman Taha achieved rapprochement with the Gulf Arab states and Egypt, promising economic engagement, an end to ideological adventurism and support on Nile issues in the face of growing upstream pressure on Cairo.

Addis eyed the Islamist power struggle sceptically but seized the opportunity to improve relations with Khartoum, while continuing to support the Sudan People's Liberation Movement/Army (SPLM/A).⁵ In the context of the changed Eritrea–Ethiopia relationship, Ethiopia's Prime Minister, Meles Zenawi, saw major

Box 1: Key recent events in Ethiopia–Sudan relations

Sudan	Ethiopia
1959: The 1929 Nile Waters Agreement is revised by an independent Sudan and Egypt because of the construction of the Aswan High Dam.	1974–75: The overthrow of Emperor Haile Selassie in a military coup. Mengistu Haile Mariam assumes power.
1951–72: First Sudanese civil war, Ethiopia backs Anyanya rebels.	1991: Forces of the Tigray People's Liberation Front (TPLF) and Eritrean People's Liberation Front oust the Derg with support from Sudan. SPLM/A is expelled from bases in Ethiopia.
1983: Second Sudanese civil war, Ethiopia backs the Sudan People's Liberation Movement/Army (SPLM/A) rebels.	1993: Eritrea gains independence from Ethiopia.
1989: Hassan al-Turabi's National Islamic Front (NIF) takes power in a coup.	1995: Assassination attempt on Egypt's President in Addis Ababa, allegedly with involvement of Sudanese intelligence operatives.
Mid-1990s: SPLM/A military gains, with renewed Ethiopian support.	1995–98: Egypt–Eritrea–Ethiopia–Uganda alliance against Sudan's NIF regime.
1998: US missile attack on Sudan after Al-Qaeda attacks in East Africa.	1998–2000: Ethiopia and Eritrea go to war. Ethiopia restores relations with Sudan.
2005: Signing of the Comprehensive Peace Agreement ends the N/S war.	Early 2000s: Sudan and Ethiopia enter into fuel purchase agreement.
2011: Referendum in Southern Sudan results in vote for independence.	

⁴ Key academic contributions on the history of both countries include Douglas Johnson, *The Root Causes of Sudan's Civil War* (Oxford: James Currey, 2002); Bahru Zewde, *A History of Modern Ethiopia, 1855-1991* (Oxford, James Currey, 2001); John Young, *Peasant Revolution in Ethiopia. The Tigray People's Liberation Front, 1975-1991* (Cambridge: Cambridge University Press, 1997); Christopher Clapham (ed.), *African Guerrillas* (Bloomington: Indiana University Press, 1998); Alex De Waal (ed.), *Islamism and its Enemies in the Horn of Africa* (Bloomington: Indiana University Press, 2004).

⁵ The Sudan's People Liberation Movement/Army was created in 1983 by John Garang de Mabior to fight for a 'New Sudan'. Following the CPA and Garang's death in 2005, the SPLM/A has evolved in a strongly separatist direction.

security and economic benefits from ending the 22-year war. Optimists hoped the CPA, supported by Sudan's neighbours, would transform the armed mistrust between Sudan and Ethiopia into more balanced relationships in the Nile Basin, with regional cooperation replacing mutual destabilization as the dominant form of interaction.

Ethiopia and its 'hydraulic mission': awakening the giant?

The Ethiopian People's Revolutionary Democratic Front (EPRDF), the governing coalition dominated by Meles Zenawi's Tigrayan People's Liberation Front (TPLF), prides itself on three self-proclaimed achievements: the provision of security, settling the nationalities question and economic growth. These achievements are central to its continued domestic dominance and underpin the government's aspiration to play a more prominent regional role. The EPRDF's legitimacy rests on delivering rapid economic growth, while ensuring it is more widely shared than in the past to meet the population's newly raised expectations.

The imperative to deliver tangible economic improvements while maintaining political control explains the massive expenditure on infrastructure and the encouragement of the manufacturing sector. These are vital if Ethiopia is to create employment for its growing population, ranging from the legions of graduates to unskilled labourers. To achieve these objectives, Ethiopia needs more foreign exchange but also requires cheap power for industrial and agricultural expansion. Together these constitute the rationale for a national energy policy that makes the dam programme a major development priority.

The Ethiopian government's flagship development policy is the Agricultural Development Led Industrialization Strategy, succeeded in August 2010 by the Growth and Transformation Plan, which continues to emphasize the same sectoral priorities. This makes economic sense for the 85% of Ethiopians who live in rural areas. It also suits the government's control agenda and helps to mitigate

the risks of political instability associated with uncontrolled urbanization. The UNDP Human Development Index ranks Ethiopia 171st out of 182 countries. On current trends, its population of 82.8 million is forecast to double every 25 years. Millions of Ethiopians depend on outside relief when drought strikes and the country must still import hundreds of thousands of tons of food every year. Budgetary scarcity, regional instability and extreme weather variability make a potent mix. However, with the help of generous donor funding – currently some \$1.5bn annually – Ethiopian policies have resulted in substantial improvements in the country's social indicators.

Energy is an important part of the development challenge. Since falling out with Eritrea in 1998, landlocked Ethiopia has had to depend on access through Sudan and Djibouti for its oil and other valuable imports. Only 1% of Ethiopia's energy requirements comes from electricity (as opposed to 4% from fossil fuels), with just 15–20% of Ethiopians having access to electricity. About 95% of energy use consists of biomass. In tackling energy as a strategic priority, the government aims to expand access to electricity and improve the quality of current connections, encouraging a switch from firewood and petroleum to alternative sources. Between 2002 and 2008 demand for electricity grew on average by 17% annually. This growth is projected to rise to almost 25% annually. Capacity and coverage need to be expanded if the Ethiopian government is to deliver on its promises of job creation, service provision and economic diversification from an agricultural sector affected by climate change.⁶

An ambitious dam programme, formally headed by the Ministry of Water and Energy but politically driven by the Prime Minister's Office, is central to economic thinking and features prominently in Ethiopian foreign policy as the EPRDF tries to improve its weak energy position and develop a more positive regional identity.⁷ Ethiopia's hydro-electric potential of 45,000 MW is enough to meet most of sub-Saharan Africa's current demand. Within Africa, Ethiopia's capacity is surpassed only by that of

6 International Water Management Institute, 'Institutional Settings and Livelihood Strategies in the Blue Nile Basin: Implications for Upstream/Downstream Linkages', Working Paper 132, 2008. According to this paper, 'During] the drought of 2002-2003 [...] each day without the electricity service reduced GDP by up to 15%'.
7 See Ministry of Water and Energy section on 'Plans and Programs', <http://www.mowr.gov.et/index.php?pagenum=4.3&pagehgt=1000px>.

the Democratic Republic of Congo. Ethiopia's water resources extend beyond the Nile and its tributaries; the most productive dam in operation is Gilgel Gibe 2 on the Omo river in the southwest of the country. Meles hopes to nurture a dynamic manufacturing sector as well as a countrywide electrification campaign that would help to shore up support in rural areas. But Ethiopia's capacity is such that even if current consumption levels were to triple or quadruple, there would still be ample room to export power.

Meles' vision is of a strong Ethiopia, exporting hydropower to the east (Djibouti, Somaliland), south (Kenya, Uganda), west (Sudan) and north (Egypt). Addis expects to sell at least 4,000 MW of power to regional partners in the next decade. Such a role – a veritable hydraulic mission – would transform the perception of Ethiopia from that of a poor country, dependent on outside assistance, to that of a leading state with resources that are valuable to the entire region, tying former rivals to Addis through hydropower flows. According to a founder of the TPLF: 'Our internal peace gives us chances [...] We can play a regional role because we've solved most of our internal contradictions.'⁸

The importance of expanding electricity production and distribution is reinforced by climate change. Most climate models predict a sombre future for the region.⁹ Aggregate rainfall could rise, but such an increase would be unevenly concentrated, both geographically and seasonally. A significant rise in the number and frequency of extreme droughts and extreme rainfall could produce a systemic crisis, affecting agricultural production as well as millions of pastoralists.¹⁰ Climate change is altering Ethiopia's agricultural base and water ecology. Systems are already under pressure from human-induced resource degradation, failed past policies and population growth.

Box 2: The 'energy gap' between Africa and Europe

- UK annual electricity production is approximately 380bn kWh – Ethiopia's is 3.46bn kWh.
- British capacity is 83 GWe – Ethiopia's could reach 45 GWe.
- Final British consumption in 2007 was 345bn kWh (or about 5,500 kWh/person) – for Africa as a whole in 2007 it was 515bn kWh in 2007, and for Ethiopia 3.16bn kWh (or about 37 kWh/person).

Note:

kWh: kilowatt-hours, measure used to typically express the consumption of domestic households. An average UK household's consumption – 5500 kWh – is equivalent to a steady power consumption of approximately 1 kW for seven to eight months.

MW: Megawatt, 1000 kilowatt, or one million watt; to put things in perspective, high-powered locomotives have a peak power output of 5 MW.

GWe: Gigawatt – electric

Sources: Most of the comparative energy statistics used in this report come from the US Energy Information Administration. Sources for the specific information on energy statistics in Sudan and Ethiopia are from the relevant ministries.

Climatic shifts could exacerbate the disempowerment of marginalized communities and potentially push them towards violent micro-conflicts and urban migration.¹¹ Ethiopia cannot arrest climate change, but its government sees energy policies as critical in helping its population adapt to new realities.

Ethiopia's aspiration to emerge as a continental energy power is illustrated by the eagerness with which officials talk about the potential of solar, wind and geothermal energy. According to EU experts, this last is probably capable of providing several thousands of MW, again

⁸ Interview with Sebat Nega in Addis Ababa, 6 May 2010.

⁹ Intergovernmental Panel on Climate Change, *Impacts, Adaptation, and Vulnerability: Contribution of Working Group II to the Third Assessment Report of the IPCC* [Martin L. Parry et al., eds] (Cambridge: Cambridge University Press, 2007); Department for International Development, *Climate Change Facts – Ethiopia* (London: DFID, 2009); O. Brown and A. Crawford, *Climate Change and Security in Africa* (Manitoba: International Institute for Sustainable Development, 2009); J. C. Lovett, G. F. Midgely and P.B. Barnard, 'Climate Change and Ecology in Africa', *African Journal of Ecology* 43, 2005: 279–81.

¹⁰ Temesgen Tadesse Deressa and Rashid Hassan, 'Economic Impact of Climate Change on Crop Production in Ethiopia: Evidence from Cross-section Measures', *Journal of African Economies* 18(4), 2009: 529–54.

¹¹ Oxfam International, *Beyond Band Aids. Tackling Disasters in Ethiopia 25 Years after Famine*, Briefing Paper, October 2009; interviews in Addis Ababa with Ethiopian and Western experts, May 2010.

outstripping current demand.¹² Meles' leadership of the African delegations at the 2009 United Nations Climate Change Conference in Copenhagen has given Ethiopia a relatively high profile on the issue with scope to tap into the growing financial and technical assistance available. Ethiopia increasingly presents itself as both a victim of climate change and an important potential provider of clean energy in Africa.

Two further aspects of Ethiopia's hydro-strategy are sometimes ignored. First, dams can produce not only electricity but also a reliable, year-round water supply for irrigation schemes. Well-managed irrigation schemes could contribute to more reliable agricultural production and help to offset the negative impact of climate change. According to the Ministry of Water Resources, the 1959 Nile Treaty is directly responsible for the under-utilization of Ethiopia's irrigation potential. Less than 5% of the total (3.4m hectares) is currently being irrigated, leading to 'artificially low' agricultural productivity. Ethiopia is already seeking to attract foreign investment in commercial agriculture and this could become more attractive with the availability of cheap water to increase the land's productivity. Secondly, the dams are being funded and constructed by numerous international partners, the main protagonists being the World Bank, China and Italy. The Ethiopian government has cleverly leveraged the dam programme and the (increasingly green) developmental discourse to strengthen political ties with Washington, Beijing, Brussels and Rome.

The dam programme is central to the Ethiopian government's plans, with four dams in action, four currently under construction and 15 more planned. The programme combines three aspirations: the goal of reaching middle-income status by 2020–25, the attempt to attract 'green' finance, and the strengthening of Ethiopia's position as a regional economic power and leader.

Sudan: recalibrating the North's political economy

Like Ethiopia's EPRDF, the strongest card of Sudan's NCP – aside from the formidable security services – is a successful economic record. The Islamist leadership is well aware of the strengths and weaknesses of an authoritarian system that depends on oil-funded growth. But it still talks confidently of a 'Sino-Sudanese model of development'.¹³ Sudan's ambitious dam strategy has been the single biggest source of discretionary spending in the last few years and represents a key development priority. The Merowe Dam alone took up almost 40% of *total* public investment in national development projects between 2005 and 2008. The dam programme shares several similarities with its Ethiopian equivalent – the lock-in of partnerships (with Beijing and Emirati, Kuwaiti and other Gulf Arab financiers), the creation of jobs, and a cheap and clean source of power for an increasingly energy-hungry economy.

The 1989 *Al-Ingaz*¹⁴ revolution promised to revive Sudan's fortunes through a combination of militant conservatism, holy war in Central and Southern Sudan, and economic shock therapy. The Programme for Economic Salvation combined liberalizing prices, debt default and command measures to increase food production. This became a survival strategy as Sudan's export of the revolution and its rupture with Washington and Gulf Arab states resulted in real economic hardship that was to continue throughout the 1990s. As intra-regime tensions rose, particularly in the wake of the assassination attempt on President Hosni Mubarak of Egypt in Addis Ababa in 1995 and the 1998 death of Vice-President Zubeir Mohammed Saleh,¹⁵ the regime scaled down its virulent rhetoric and Islamist transformation efforts. It moved to an agenda of economic competence to avoid being consumed by the flames of its own revolution. This de-radicalization was manifested by the downfall of Turabi. An alliance between security hawks and disgruntled Islamists enabled

¹² Interviews with several technical experts working for the European Commission, May 2010.

¹³ Dr Ghazi Salah-ud-Din, Khartoum, April 2010; echoed in interviews with other advisers to President Al-Bashir.

¹⁴ The 'Salvation Revolution', the name given by Dr Hassan al-Turabi and his companions to the Islamist project that was launched through the 1989 coup.

¹⁵ Philip Roessler, 'Internal Rivalry, Threat Substitution and Civil War: Darfur as a Theory-Building Case'. unpublished manuscript, University of Oxford, 2010.

President Bashir finally to emerge at the centre of power. These internal power-shifts allowed Khartoum to restore relationships with Cairo and Riyadh and coincided with the export of oil.

The advent of the petro-era handed a decisive advantage to Bashir and Vice-President Taha, enabling them to contain the resurgence of the SPLA/M. With billions of petro-dollars at its disposal the NCP, as the party of the Islamists, eroded the historical dominance of older Sudanese parties such as Hizb al-Umma¹⁶ and the Democratic Unionist Party.¹⁷ This strategy succeeded in bringing the business elites into the Islamist fold and created a substantial middle class, mostly in Khartoum and adjacent areas, whose pro-NCP loyalty combines nationalism and economic self-interest. As a result of oil revenue and conservative economic policies, Sudan's per capita income has doubled in less than ten years, inflation has been tamed and more roads have been built than at any time since independence (see Tables 1 and 2). It has been suggested that the need to export oil in a stable environment was an important factor behind Khartoum's willingness to sign a peace deal with the South.¹⁸

Yet how long will the oil bonanza last? The period of NCP rule has seen a deepening of Sudan's core-periphery inequalities and their cynical manipulation in regions such as Darfur.¹⁹ The economic model may have pulled Sudan back from the brink. But despite promises that under Islamist rule ethnicity no longer matters, patronage systems in the periphery have not brought meaningful development, in contrast to the riverain core zones where real progress has been made. Prominent figures, notably Vice President Taha, acknowledge that the current model is unsustainable because oil supplies are neither infinite nor always reliable. Sudan's oil revenues rose spectacularly between 2005 (\$3.7bn) and 2008 (\$7bn), only to fall dramatically between 2008 and 2009. This resulted in painful adjustments in government spending plans. Moreover, about three-quarters of the proven reserves (6.3bn barrels) are situated in

Table 1: Comparison of development indicators for Ethiopia and Sudan

	Ethiopia	Sudan
GDP per capita (constant 2000 US\$)	\$280	\$532
Percentage of population with access to national power grid	15–20%	7%
Value added per worker (2006 USD) in manufacturing (productivity)	\$1,509	\$6,682
Hydropower potential	40,000–45,000 MW	2,000–2,500 MW
Total area of irrigated agriculture	c. 160,000 ha	c. 2,000,000 ha

Source: World Bank, 2008 and 2009

Table 2: Sudan and the impact of oil, 2000–08

	2000	2008
GDP (1999)	\$10bn	\$53bn
GDP per capita (constant 2000 US\$)	\$334	\$532
Road network	3,358 km	6,211 km
Children in primary school	3.3 million	5.3 million
Total area of irrigated agriculture	c. 160,000 ha	c. 2,000,000 ha

Source: World Bank, *The Road Towards Sustainable and Broad-Based Growth*, 2009

South Sudan. The uncertainties surrounding the future of North–South relations make it unwise to continue banking heavily on black gold. In this context, a second growth engine has been prioritized and partially funded with oil money, namely Sudan's dam programme.

Electricity generation by hydropower has powerful attractions for Khartoum. Only limited parts of the country are currently electrified, but urban demand for electricity is outpacing the economic growth rate of 7%. Local communities are becoming more vociferous in demanding service

¹⁶ Hizb al-Umma, led by Sadiq al-Mahdi, is one of the two traditional Sudanese political parties; it was dominant in the first decades after independence, but is currently divided.

¹⁷ The Democratic Unionist Party is the other traditional party in Sudan, dominant in the first decades after independence, but currently marginalized.

¹⁸ Interview with an adviser to the Government of National Unity in Khartoum, April 2010.

¹⁹ Julie Flint and Alex De Waal, *Darfur: A New History of a Long War* (London, Zed Books, revised and updated 2008); Roesler, 'Internal Rivalry, Threat Substitution and Civil War'.

delivery. Constructing the Merowe Dam added 1,250 MW to the grid, which at current consumption levels (3.438 bn kWh in 2007) means overproduction, but if the (multi-billion-dollar) plans of the Dam Implementation Unit (DIU) are fully implemented, even more capacity will be added in the next decade. The powerful DIU is headed by Bashir's right-hand man, Usama Abdullah, who has been in charge of Sudan's dam programme and associated projects since 1999. The DIU resides directly under the presidency of the Republic of Sudan (with President Bashir fully in charge), but was recently upgraded to the status of a separate ministry (the Ministry of Electricity and Dams/Dam Implementation Unit).

The DIU says that it might need to increase present production more than fivefold. According to Presidential Adviser Dr Ghazi Salah-ud-Din, 'Our ambition is above 3,000 MW. Alongside hydropower, we want our own nuclear energy too. [In the long term,] we need more than 20,000 MW. Sudan will emerge as a regional power.'²⁰ It should be noted that Sudan's overall energy potential is not restricted to hydropower. It could include thousands of solar MW, although Khartoum seems more interested in civilian nuclear power.

Unlike its counterpart in Ethiopia, the Sudanese government does not see the country's energy potential as a diplomatic instrument. Selling excess production to Eritrea or Egypt is conceived as a business matter, related to cost recovery. Khartoum hopes to emerge as a regional player in the post-CPA era and seeks friends in the neighbourhood through hydropower and agriculture. But Sudan's hydropower potential (2,000 MW) is too limited to change the regional landscape. The logic of the dam programme is primarily domestic, its main purpose being to reconfigure Sudan's political economy – hence the explicit comparison with the Tennessee Valley Authority that some NCP ideologues make.

For the Sudanese authorities the dam–agriculture nexus is an absolute priority, on a par with energy production. The goal of generating export revenue and producing food through huge irrigation schemes has a long pedigree in Sudan, dating back to colonial times. It has been given a new lease through Vice-President Taha's Agricultural Revival Programme. This seeks to diversify an economy that is dangerously dependent on oil revenues that are expected to peak by 2012/13 and then decline.²¹ Remembering the failure of rain-fed mechanized agriculture to turn Sudan into Africa's breadbasket in the 1970s–1980s, Khartoum is counting on the old recipe of large-scale irrigated cultivation along the Nile to revive the sector, with the help of commercial investment from the Gulf states to improve productivity.²²

The push for big dams and the desire for large-scale irrigated agricultural schemes is not based on considerations related to the threat of climate change. Whereas Ethiopia seems set to use the global debate on the environment to leverage more aid, climate change is largely absent from Sudanese political debate. Though characterized by a high degree of uncertainty, the different scenarios for Sudan look bleak.²³ According to the UN Environment Programme, desertification and decreasing precipitation in the Sahelian Belt could result in sorghum production falling by 50–70% by 2060.²⁴ Darfur, North Kordofan and Red Sea State are likely to be seriously affected, already having suffered ecological calamities in recent years. The 2009 drought caused mayhem across Sudan's Eastern flank, with 90% production losses in Gedaref, and the reappearance of famine-like conditions – and associated violence – in Jonglei. Millions of farmers receive almost no assistance to adapt to climate change and Sudan's international isolation deprives it of access to 'green' financial mechanisms to provide resources for sustainable development.

20 Interview with Dr Ghazi Salah-ud-Din, April 2010. See also Reuters, 'Sudan plans four-reactor nuclear power plant', 26 August 2010. <http://europafrica.net/2010/08/26/sudan-plans-four-reactor-nuclear-power-plant/>.

21 IMF, June 2010, 'IMF Country Report No. 10/256', June 2010. <http://www.imf.org/external/pubs/ft/scr/2010/cr10256.pdf>. Oil production might dry up in 15–20 years.

22 Harry Verhoeven, 'Climate Change, Development and Conflict in Sudan: Neo-Malthusian Global Narratives and Local Power Struggles', *Development and Change* 42: 3, May 2011.

23 See note 9.

24 UNEP, *Post-Conflict Environmental Assessment, 2007*. Interviews with climate experts in Khartoum, August 2009 and April 2010.

The case for regional energy integration: blue gold for black gold

The challenges facing Ethiopia and Sudan are remarkably similar. Both need to address core–periphery inequalities, to boost food and energy production, and to develop a new strategy for rural development and stimulate manufacturing while adapting to climate change. Both have poor infrastructure, turbulent political histories and troublesome neighbours. All these factors have hampered efforts to break out of the cycle of insecurity-underdevelopment-bad governance. A strong case can therefore be made for Sudan and Ethiopia to work together on energy security.

The Horn of Africa would benefit from an energy deal involving water and energy that would contribute to sustainable regional development. It might also lead to wider reductions in tensions in the region. A key adviser to Meles put it rather provocatively: 'Ethiopia provides the power, Sudan grows the food and Egypt brings the cash.'²⁵ One might add, 'South Sudan provides the oil.' The argument here centres on Khartoum, Juba and Addis and the case for exchanging Sudanese oil for Ethiopian electricity.

Despite a difficult past, Sudanese–Ethiopian relations are better than they have been for a long time. Surging commercial interactions – including very substantial imports of Ethiopian produce and livestock – have been facilitated by improved communications. Several connecting roads have been built, making it now possible to drive from Addis Ababa to Khartoum, and there are plans to develop railway connections. At the political level, regular summits create trust, and personal relationships between Meles, Bashir and Southern Sudan's President Salva Kiir are said to be good.²⁶ There are also multiple joint commissions, including on border issues and defence. Sudanese businessmen are regular visitors to Addis. Thousands of Ethiopian citizens work in businesses and private homes in Khartoum and Gedarif, sending back remittances. Since the conflict with Eritrea, Ethiopia has been increasingly using Port Sudan's facilities

to diversify from its overdependence on Djibouti (which costs an average of \$700 million in port fees annually).

Though statistics are hard to obtain and rather unreliable, Ethiopia is understood to import 85–90% of its total fuel supply from Sudan. Under a government-to-government deal Sudan sells oil at below global market prices, making Addis dependent on its neighbour's stability to keep petrol flowing. The fuel-trucking business is estimated to be worth \$1.2–2bn annually.²⁷ Ethiopia has been spending over 50% of its total export earnings to meet its fuel demands. The state-owned sole importer, Ethiopian Petroleum Enterprise (EPE), reported in June 2010 that Ethiopia imported 1.8m metric tons of oil from Sudan via Djibouti at a cost of \$1.22bn. Fuel imports have risen by 7.4% on an annual basis. In August 2010 EPE announced that a Sudanese state-owned oil company, Sudapet, was to become Ethiopia's only benzene supplier. EPE anticipates flows worth \$1.42bn, with the volume of imported fuel surpassing that of last fiscal year by 500,000 tonnes. Finally, Addis is eyeing a further lock-in of Sudanese oil links, floating the idea in the past year that South Sudan, which seeks to escape its petro-partnership with Khartoum, could build a new pipeline through Ethiopia to Djibouti to reach world markets. An important part of the exported crude could remain in Ethiopia, further deepening the EPRDF–SPLA/M partnership.

Both countries have also been collaborating on the difficult issue of water through the participation of Ethiopian and Sudanese technocrats in the Nile Basin Initiative (NBI). Projects launched in the Eastern Basin include joint flood prevention, reducing watershed degradation and irrigation management. Under the NBI umbrella there have been regular meetings at ministerial level; the hope is that by taking the basin and not individual countries as the framework of reference, empathy between the leaderships in Addis, Cairo and Khartoum will increase, leading to economically and ecologically rational water development initiatives.

²⁵ Interview in Addis Ababa, May 2010.

²⁶ Meles' presence at the presidential inauguration of Omar Al-Bashir on 27 May 2010 in Khartoum was an important signal; in April 2010 Sudan also offered 20,000 tons of sorghum to combat food insecurity in Ethiopia.

²⁷ Interview with several people at the European Union delegation to Ethiopia, 7 May 2010.

Box 3: Landmarks of international cooperation in the Nile Basin

1929: Nile Waters Agreement signed between Egypt and Britain on behalf of Sudan and other colonies in the basin (Uganda, Kenya, Tanzania). The treaty lists specific volumetric water allocations – 48bn m³ annually to Egypt and 4bn m³ to Sudan. Ethiopia refuses to recognize the treaty.

1959: Under British supervision, a revised Nile Treaty between an independent Sudan and Egypt parcels out 55.5bn m³ for use by Egypt and 18.5bn m³ by Sudan, with 10bn m³ lost due to evaporation at the Aswan High Dam. To this day, other riparian states reject these 'unilaterally established' historical rights.

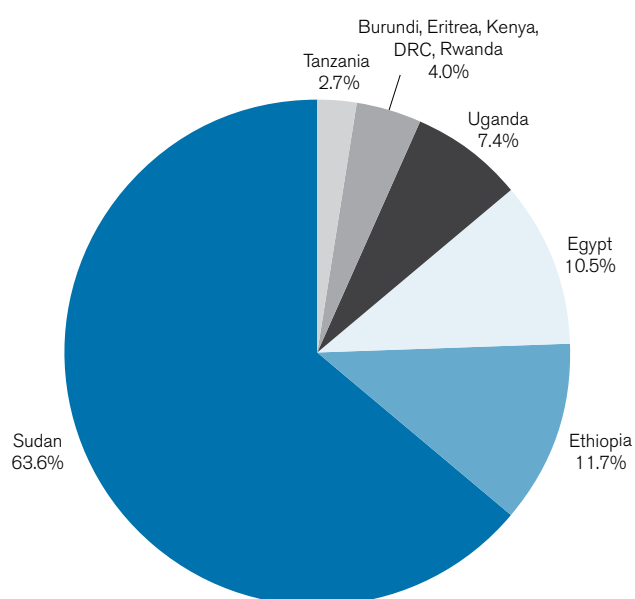
1999: Creation of the Nile Basin Initiative, an intergovernmental mechanism to 'achieve sustainable socio-economic development through equitable utilization of, and benefit from, the common Nile Basin water resources'.^a The NBI serves as a knowledge bank and a multilateral forum that builds political trust, helping to renegotiate Nile quotas.

2010: Ethiopia, Rwanda, Tanzania and Uganda sign the Nile River Basin Cooperative Framework Agreement on 14 May redrawing the Nile landscape under the banner of 'equitable utilization of waters' without Egyptian or Sudanese consent. The agreement is considered open until May 2011, so other riparian states can join – Kenya and Burundi have signed, with Congo likely to follow, but Egypt and Sudan are unlikely to do so: the treaty does not recognize historical rights of use, but emphasizes equitable use of the waters by all ten basin states.

It remains to be seen whether the heated language will actually translate into substantive action (Cairo has repeatedly declared that the Nile is a matter of life and death for it and Sudan has suspended its NBI membership). But this does not bode well for an already divided region entering the dangerous transition period of 2011, especially given South Sudan's sympathies for the 'rebellious' riparian states. It also means that regional integration involving Egypt is highly improbable for the foreseeable future.

^a NBI Vision Statement.

Percentage of Nile Basin in each country



Sources: *Africa Confidential*, 51:17, Nile Basin map; UNESCO, Overview of Sediment Problems in Nile Basin (2005), Table 1

Water is the most important domain for future cooperation, linked as it is to both energy and agriculture. From a technical perspective, Ethiopia has considerable advantages as a location for building hydroelectric dams. Investment in water storage and power generation on the Ethiopian Blue Nile, which is responsible for roughly 70–75% of all Nile water reaching Sudan and Egypt annually, could produce substantial advantages for downstream actors. There are ecological advantages such as better flood control and reduced sedimentation as well as economic advantages in producing electricity more cheaply.²⁸ While the cost-benefit of the multi-billion-dollar Merowe Dam in Northern Sudan has been questioned, Ethiopia's proposed Blue Nile infrastructure would have evaporation rates seven times lower than Sudan's dams²⁹ and cause less displacement than the Merowe or Roseires dam projects. The unique topography of Northern Ethiopia means that most of the ecological and social obstacles associated with the Sudanese dam programme can be prevented, while huge amounts of power (up to 20,000 MW) could be generated.³⁰

Ethiopia's government insists that its plans involve limited quantities of water for irrigation purposes (maximum 5.2bn m³ out of the total 84bn m³) that would hardly affect downstream use.³¹ As Sudanese technocrats admit: 'It makes no sense to build here in Sudan: the opportunity cost is huge. There is no comparison: a dam in Ethiopia has more benefits for Sudan than for Ethiopia.'³²

Experts tend to stress the advantages of harnessing water in the regions that are ecologically and economically best suited for it. Several technocrats have suggested that if Egypt could rely on Ethiopia for flood control, several billion cubic metres of water would no longer be lost to evaporation. A division of labour in which Ethiopia focuses on electricity, Sudan concentrates on sugar, wheat

and cotton, and Egypt supports its farmers by measures outside the country could lead to regional interdependence.

‘Water is the most important domain for future cooperation, linked as it is to both energy and agriculture’

One hopeful development is the regional electricity interconnection project, now in its final stages. This will soon be sending 200 MW of Ethiopian electricity into Eastern Sudan as part of the Eastern African Power Pool framework, which was created in 2005. While several sources confirmed that Khartoum, in turn, intends to sell 200 MW to Eritrea, such projects are important and are likely to become more common as the Power Pool is fully implemented (likely to be in 2012), aiming at a common market for electricity.

Regional integration is particularly pressing because of climate change. Shifting rainfall patterns, uncertainty about the Nile's future and the poor prospects for agriculture in much of Sahelian and Eastern Africa will heighten existing pressures on water consumption. Controversial dam programmes will be harder to justify in the climate change era. Sudanese hydro-development projects have yet to demonstrate a significant return on the approximately \$4 billion of official funding. Despite Ethiopia's growing economy and Sudan's petro-growth, over 80% and 70% of the respective populations continue to depend on agriculture and the natural environment for their daily livelihoods. The frequency of major drought has increased in the past quarter-century, and

28 Sudan spends millions of dollars on sediment removal and flood mitigation annually, possibly more than half of operational costs of its dams and canals. Interviews in April and December 2010.

29 Interview with Professor Asim Al-Moghraby, April 2010.

30 Some of Ethiopia's other dam projects have led to considerable environmental and social concerns from activists. See, for example, International Rivers, 'NGOs Launch Campaign to Stop Man-Made Disaster in Ethiopia', 23 March 2010. <http://www.internationalrivers.org/en/node/5190>.

31 Interview with Seleshi Bekele, director of the International Water Management Institute, May 2010.

32 Interviews with senior sources in the Ministry of Water Resources and Irrigation in Khartoum, April and December 2010.

they now occur every three to five years, with most models predicting this trend to persist.³³ As one senior technical adviser argues, 'Cooperation is not a choice, it's a necessity. Our children will not forgive us if we don't do it.'³⁴

The upcoming independence of Southern Sudan gives added weight to the case for regional integration. South Sudan is one of the world's most underdeveloped regions and will need a great deal of support to overcome the odds stacked against it.³⁵ There is scope for developing economic relations with neighbours whose economies offer some degree of complementarity. South Sudan has substantial agricultural potential in Upper Nile, Unity State and Equatoria, and needs private investment combined with help on public service delivery. Ethiopia–South Sudan relations are already close, and improving transport infrastructure means that Upper Nile, Jonglei and Eastern Equatoria will all be connected to Gambella in Ethiopia. Juba supports Ethiopia's Blue Nile strategy: the SPLM/A has declared its support for a reconfiguration of the water landscape within the NBI framework.³⁶ Over the long term, there is the potential for a deal with Ethiopia, which could export cheap power to an electricity-starved South Sudan in exchange for continued oil supplies.

Most of Sudan's oil originates in the provinces of Unity and Upper Nile, which are in South Sudan, and the Abyei region of South Kordofan, but the oil is exported through the country's sole pipeline running through the North to Port Sudan. South Sudan as an independent state wants to scale down its petro-entanglement with the North. The alternatives include building links to Ethiopia and

Djibouti or constructing a pipeline with regional connections to Lamu,³⁷ and from there connecting to Uganda and Kenya. Such developments would give the region a serious stake in a stable, non-belligerent South.

In the meantime the Port Sudan pipeline serves to hold the CPA together by incentivizing stability. Oil is one of those issues – together with water and citizenship – that could either lead to conflict after South Sudan's independence in July 2011, or be leveraged for peace. If the South is allowed to make some regional arrangements, but keeps oil flowing north during a gradual transition, as is likely according to Minister of Petroleum Lual Deng, this situation does not have to lead to war.³⁸ Post-referendum arrangements, with the SPLM/A generous enough to share and the NCP willing to compromise, could draw the region closer to Sudan.

Too much, too soon? The political Achilles' heel of the energy deal

The case for regional integration is clear: an energy deal exchanging Sudanese oil for Ethiopian electricity should top the agenda. Unfortunately it does not, and this is unlikely to change any time soon. The fundamental problem is one of power and trust: whereas Ethiopia is held back by the contradiction between its dream of regional leadership and uncertainty about the future of Sudan, Sudan itself fears that Ethiopian energy diplomacy will create a dangerous regional imbalance and clash with its own 'hydro-engineering' of the Nile. The shadow of South Sudan's independence hangs ominously over the Horn and makes regional cooperation more pressing than

33 International Water Management Institute, 'Institutional Settings and Livelihood Strategies in the Blue Nile Basin: Implications for Upstream/Downstream Linkages', Working Paper 132, 2008.

34 Dr Seif Hamed, Chief Technical Adviser, Sudanese Ministry of Water Resources and Irrigation, interview in April 2010, Khartoum; also interview with Prof. Yacoub Arsano in Addis Ababa, May 2010.

35 See the ominous November 2010 UN Document, 'Scary Statistics Southern Sudan', accessible via [http://www.reliefweb.int/rw/RWFiles2010.nsf/FilesByRWDocUnidFilename/MUMA-8B82ZG-full_report.pdf/\\$File/full_report.pdf](http://www.reliefweb.int/rw/RWFiles2010.nsf/FilesByRWDocUnidFilename/MUMA-8B82ZG-full_report.pdf/$File/full_report.pdf).

36 An independent South Sudan is likely to be yet another argument for riparian states that have been clamouring for a revision of the anachronistic 1959 Treaty.

37 Japan's Toyota Tshusho Corporation recently offered to construct a 1,400-km pipeline to transport crude oil from Juba to Kenya's Indian Ocean port of Lamu. Toyota Tshusho explained in March 2010 that the pipeline could transport 450,000 barrels per day, and would cost \$1.5bn to construct. After 20 years under Toyota ownership, it would be handed over to the Kenyan and Southern Sudanese governments. <http://www.sudantribune.com/Toyota-proposes-Kenya-Juba-oil,34317>.

38 Commenting on the Lamu pipeline, Lual Deng said that the pipeline 'is not economical and it will be expensive. If you are forced, economy does not make sense, but under peaceful conditions we will continue to use existing facilities,' making reference to the Port Sudan pipeline. See *Sudan Tribune*, 'South Sudan Kenya pipeline is "uneconomical" says oil minister', 4 June 2010. <http://www.sudantribune.com/spip.php?article35567>.

ever, but it could undermine such projects for years to come if NCP–SPLM/A relations turn violent again.

The 1959 Nile Treaty signed by Sudan and Egypt excluded others from enjoying the benefits of water development. What made geopolitical sense to London, Cairo and Khartoum at the time sowed seeds of deep resentment amongst other riparian states, led by Ethiopia. One of the main arguments put forward by Egypt and Sudan to justify using up 85% of all Nile waters is that countries such as Ethiopia have plentiful rainfall and can thus engage in rain-fed agriculture. They also have other rivers that can help irrigate land, whereas Egypt and Northern Sudan depend on the Nile for their survival. These tensions remain unresolved. The 2010 framework agreement has not been fully adopted and Cairo, supported by Khartoum, continues to resist a significant, negotiated redistribution of water quotas, citing historical rights of use, developmental necessity and fears of Ethiopian blackmail.

Khartoum's support for Cairo betrays continuing distrust of Ethiopia. It is also a product of growing ties with the Egyptian government. But Sudan's concerns over the Nile and its own dam programme are above all tied to the domestic political economy. Faced with the likelihood of a diminishing oil economy – particularly following the independence of South Sudan – the NCP government has begun a strategic redeployment of Northern political resources. Like all previous Sudanese regimes, they have over-prioritized Khartoum and other riverain areas, believing that delivering economically in the so-called 'Hamdi Triangle' of Dongola–Kordofan–Sennar is essential for regime survival.³⁹

Sudan's dam programme and its associated opposition to Ethiopian Nile projects illustrate how 'development' in the country is shaped by politics and history, repeatedly consolidating the grip of national elites over key regional economic zones. Building Merowe and Kajbar, and raising the height of the Roseires Dam, have led to specific forms of wealth creation (through employment, electricity generation and irrigation allocations) with benefits for groups

close to the centre of power. It confirms the traditional geographic and political dynamics of economic development while preparing for the departure of the South. The renewed focus on irrigated agriculture in Sennar, White Nile and River Nile State is part of a political-economic reconfiguration that also includes proximity to Gulf Arab capital, a selective embrace of globalization and further economic liberalization.

Khartoum has not given up on oil or exploring potential fields in Darfur and Red Sea State. But both those inside the NCP who favour Southern secessionism and the deeper Islamization of the North, and those who are pro-unity but understand the need for engines of growth other than oil are actively thinking about a future without South Sudan. Water, agriculture and energy are critical in their vision.⁴⁰ In the words of former Minister of Finance Hamdi: 'The areas around us would like to eat wheat, not drink petroleum [...] Sudan can live without oil.'⁴¹

Sudan will continue to oppose Ethiopia's dam programme, or at the very least resist energy-led regional integration. Entering into the energy deal of oil for electricity would undermine the legitimacy and rationale of the Sudanese dams and lead to awkward questions inside Sudan about their purpose. If the NCP needs the 'dam-agriculture' nexus to entrench its hegemony, it is highly unlikely to abandon this vision, whatever technocrats claim about the technical advantages of Ethiopian projects.

Khartoum is also wary of any energy deal that could upset the regional balance of power. According to a senior official in the National Intelligence and Security Service (NISS):

It is one thing for Ethiopia to import all this fuel from Sudan, it's another thing for us to import all that power from across the border [...] They can easily diversify out of our fuel if they needed to; it will cost them lots of money, but they can do it in a crisis. We would be on our knees: they could switch off the lights and there is nothing we could do about it.

³⁹ Interviews with leading NCP figures and economic advisers in Khartoum, August 2009, April and December 2010.

⁴⁰ Interview with officials in the NISS and in the entourage of Second Vice-President Ali Osman Taha, April 2010.

⁴¹ Hamdi was the NIF's economic czar in the early 1990s, designing the Economic Salvation Programme, and is now back at Al Baraka Bank. He remains an extremely influential strategist for the regime.

The nature of electricity production and transmission means that any energy integration would inevitably create a Sudanese dependence on Ethiopia. The Sudanese authorities fear that Addis could hold back the Nile waters or use its power supply to extract concessions from Khartoum. In this 'asymmetrical' context, Ethiopian officials express confidence that, in the event of a crisis, they could shift from Sudanese fuel to other supplies in a matter of weeks. Though costly, it would still be feasible.⁴² However, critics have pointed out that this might be hubris on the part of Addis – assuring supply lines for a rebellion (the TPLF excelled at re-routeing supply lines in the 1980s) is a very different matter from keeping on track an economy of more than 80 million people that is almost entirely dependent on Sudanese fuel. In June 2010 Ethiopia's petroleum reserves fell to just 87,000m³, only 13 days of supply.

‘Ethiopia hopes in the long term to dominate the Horn through energy exports and “responsible international behaviour”...’

A long-term 'electricity-for-oil' deal with Ethiopia is a national security issue for Khartoum. Ethiopia's involvement in technical military assistance to SPLA forces is unlikely to have increased the trust between the two regimes. Ethiopia, Uganda and Kenya train SPLA officers, deliver spare parts and transfer arms.⁴³ Where NCP hawks point out that heavy weapons change the balance of power between the Sudanese Armed Forces (SAF) and the SPLA, Addis

responds that there never was a balance because of lavish spending by SAF on Chinese and Russian weapons. The SPLA/M and Ethiopia deny that their defence partnership has any relationship with potential oil links in the future.

Ethiopia's position in relation to South Sudan's future status impacts on its regional ambitions and energy diplomacy. Ethiopia finds itself confronted by several contradictions: the tension between its desire to lead the region and its unwillingness to openly take the lead in working for peace in Sudan; the tension between keeping Eritrea away from Khartoum, ensuring that South Sudanese oil keeps flowing to Ethiopia and trying to force a breakthrough on the Nile issue; and the tension between its instinctive preference for a united but possibly confederate Sudan and the option that an independent South might be favourable to its political-economic interests.

Ethiopia hopes in the long term to dominate the Horn through energy exports and 'responsible international behaviour', setting it apart from its troublesome neighbours. For two years in a row (2008–09), Ethiopia chaired the Intergovernmental Authority on Development (IGAD), the regional security and development organization for Sudan, Ethiopia, Uganda, Djibouti, Kenya, Somalia and Eritrea. This was a convenient way of advancing its multilateral interests. However, Ethiopia has reacted coolly to international demands to scale up its interventions to save the Sudanese peace and prepare a post-2011 future. According to an official from the Ministry of Foreign Affairs, 'Ethiopia is unable to take up a regional leadership role in Sudan. It would hurt our interests.'⁴⁴ As a result, Western diplomats expressed frustration with Meles' reluctance to capitalize on his unique position among Sudan's neighbours. Addis Ababa publicly restricts itself to insisting on the CPA's implementation and respect for self-determination.⁴⁵ Its official stance was supportive

⁴² Moreover, if an implosion of the South would disrupt petro-flows, it has been suggested that Addis would make individual arrangements with local commanders in production and transit zones to ensure a constant supply, even in the midst of violence; experiences from the late 1990s/early 2000s in Unity State and Upper Nile show that this might not be an impossible strategy.

⁴³ NCP hardliner Nafi Ali Nafi raised the issue of the arms transfers on a recent visit to Meles, while Khartoum is said to have ended several fuel arrangements with Nairobi in retaliation.

⁴⁴ Interview, May 2010.

⁴⁵ There are indications that Ethiopia has begun to scale up its intervention; see for instance the post-2011 discussions organized in Mekele (Tigray) to bring the SPLA/M and NCP closer to one another through Ethiopian mediation, 21–22 June 2010. The MoU concluded in Mekele is important in terms of the procedures it lays out for discussions on post-referendum arrangements.

of a united, secular Sudan, but Ethiopia too expected a vote for secession. Privately, however, TPLF strategists have serious doubts about the viability of an independent South. A top TPLF figure captured the deeply pessimistic sentiment shared by many outside Sudan: 'There will be a situation nobody can control. The South will never be secure; we fear a general meltdown after 2011.'⁴⁶

Despite the complex history between Khartoum and Addis Ababa, and their rival dam programmes, there is mutual respect and both are well aware of the risks involved if Sudan should return to violence. Ethiopia is conscious too of the risks of a Khartoum–Asmara alliance encouraging armed Islamist activity inside Ethiopia. Bashir is reluctant to push Meles into the arms of the SPLA/M. Ethiopia is the SPLA/M's most crucial strategic partner, and unlike Egypt or Kenya, could act as a credible broker for peace between Khartoum and Southern Sudan.

Ethiopia continues to provide discreet advice to both

partners and to develop economic ties, but avoids any public intervention. In Ethiopian government circles opinion seems divided between those who advocate all-out support for an independent South Sudan (and the associated smaller deal of Ethiopian electricity for Southern oil) and those who fear that secession will open a Pandora's box inside Sudan and would have highly unpredictable consequences for regional stability. Ethiopia's caution is understandable, but could become untenable if the security situation worsens. However, safeguarding Ethiopian interests through direct intervention in an escalating conflict will be costly: it would probably derail the regional integration agenda for years to come.

Conclusion

Sudan and Ethiopia have some of Africa's most marginalized populations, and they face colossal challenges in reducing poverty, expanding public services and coun-

Box 4: Blue Nile State and its strategic importance

Sudan's Blue Nile State, which borders both Ethiopia and South Sudan, is highly strategic. It is the only Northern state run by the SPLM/A. Its governor, Malik Agar, is a 'New Sudan' unionist, and despite the absence of a legal right to secession, he has repeatedly said that his state will not remain in an Islamist North that he fought during the civil war. Under the CPA, Blue Nile State is entitled to 'popular consultation', but not a referendum on secession, unlike Abyei. Malik Agar's strong reluctance to stay in Northern Sudan post-referendum was confirmed in a personal interview in September 2009 in Damazin, as well as through follow-up discussions with senior SPLM/A officials in May and December 2010. The controversy over the deeply unpopular heightening of the Roseires Dam, which will displace tens of thousands of people in the state, is a key factor influencing Malik's decision. It would be ironic indeed if the top-down approach to Khartoum's Dam Programme leads to its losing control over Nile waters on which its agricultural revival depends through dams and irrigation.

If Malik carries out his threat – and it is important to remember he still has thousands of soldiers in a parallel force under his control – both Khartoum and Addis would certainly respond, possibly with military means. Blue Nile State is where 70–75% of all Nile waters enter Sudan; it is on this river branch that most big irrigation schemes depend. Malik's SPLM/A somehow 'joining' the South would have major geopolitical implications, changing the hydro-political equilibrium and giving Addis (and possibly Juba) an invaluable strategic advantage over Khartoum and Cairo as the Sudanese Blue Nile is brought into play through Southern secession. Ethiopia, backed by the other riparian states, could then demand a renegotiated quota from a stronger position, leading to a shift in the political economy of the Nile Basin, or a wider regional war. Moreover, a breakaway would not just affect Nile Basin power relations, but would resonate across Northern Sudan, particularly in Darfur and the Nuba Mountains where many people resent Khartoum and Garang's 'New Sudan' remains alive. It is an unlikely but not entirely unrealistic scenario.

⁴⁶ Interview in Addis Ababa, May 2010.

tering ecological degradation, as well as in ensuring these objectives are mutually reinforcing rather than undermining each other. Against a background of frequent conflict, regional integration could go a long way to help avoid the classic pitfalls of natural-resource development such as the resource curse. Resource scarcity can trigger conflict, but it could also stimulate peaceful cooperation.

Energy is a subject closely linked to security concerns and political sensitivities, and sits at the very heart of the sustainable development challenge, internally and regionally. Ethiopia and Sudan both have much to gain from closer cooperation through an energy deal to exchange Sudanese oil and Ethiopian electricity. Such an agreement would lock in integration dynamics, mitigate climate change and help the Horn turn the page on generations of warfare, external manipulation and desperate poverty. With Sudan's CPA, peace has officially returned to the Ethiopian–Sudanese border but given persisting Eritrea–Ethiopia tensions and the impending independence of Southern Sudan, the energy relationship between Addis, Juba and Khartoum seems more vital than ever for the future of the region.

Although water and oil have the potential to bring old rivals together and help their populations achieve more sustainable forms of development, an energy deal is still far off and unlikely to be struck soon between the NCP, EPRDF and SPLA/M. A history of mistrust influences policy-makers; Sudan's 'new' Islamist political economy is antithetical to the idea of ceding hydro-political ground to Ethiopia; and the independence of South Sudan and its probable consequences are hindering progress in the medium term. Ethiopia's foreign policy needs to resolve fundamentally the serious contradictions that constrain its regional dreams, while Sudan is too focused on its bid to stay at peace to engage in a cooperative remaking of the energy landscape in the Horn of Africa.

The convergence of climate change, rising global food prices, South Sudanese independence and the Eritrean dossier make a sensible, long-term Horn-wide strategy regarding energy security and its links to agriculture and the wider economy ever more important for the countries in the region. Regional integration is not an absolute guarantee of peace, but it offers one of the most promising avenues for dealing with the Horn's most intractable development and security problems.






Appendix: Major hydropower projects in Sudan and Ethiopia

compiled by *Adjoa Anyimadu*

This list of major hydropower projects in Sudan and Ethiopia is intended to be as comprehensive as possible. Material has been collected to indicate the range and scale of Sudanese and Ethiopian activity in hydropower. Information is based

on the best secondary data currently available, as shown, and official figures (where publicly available) have been included. Official data, particularly on reservoir capacity, cost and financing, are frequently disputed (including by the author of this paper – see, for example, page 7). This information has been checked to the best of our ability, but Chatham House does not guarantee its reliability.

Key

 Dam primarily used for irrigation	 Under construction	 Proposed
 Operating	 Plans approved/funding secured	[] Denotes potential figures

Hydropower project name	Partners	Status	Cost	Current capacity [potential capacity] (MW)	Reservoir capacity [potential capacity] (m ³) irrigation area (ha)
SUDAN					
RIVER NILE					
Merowe <i>4th Cataract, Nile</i>	<i>Funding: Sudan [\$575 m]; AFESD [\$250 m]; KFAED [\$150 m]; Abu Dhabi [\$150 m]; Saudi Arabia [\$200 m]; Qatar [\$15 m]; Oman [\$106 m]; China Exim Bank [\$519 m]; review of feasibility study, construction: Sinohydro (China); construction supervision, training, technical assistance: Lahmeyer International (Germany); Alstom (France); ABB; construction: CWRH, CIWEC (China)</i>	2009	\$1.8 billion (construction cost)	1,250 [2,000]	12.5 billion 380,000
Kajbar <i>3rd Cataract, Nile</i>	<i>Funding: Sudan [25%], China [75%]; construction: Sinohydro (China); feasibility study & tender design: Lahmeyer International (Germany)</i>	2016 Expected year of commission	\$705 million	[300–360]	8.2 million
Shereik <i>3rd Cataract, Nile</i>	<i>Feasibility study & tender design: Lahmeyer International (Germany); gauging water levels: North China Water Institute (China); construction: CGGC (China)</i>	Construction contract signed	\$711 million	[315–420]	–
Dal <i>2nd Cataract, Nile</i>	<i>Review of previous studies & pre-feasibility study: EDF (France); URS-Scott Wilson (UK)</i>	Feasibility studies ongoing	–	[340–600]	–
Mograt <i>4th Cataract, Nile</i>	<i>Feasibility study & tender design: Lahmeyer International (Germany); ESIA: SMEC (Australia)</i>	Feasibility studies complete	\$1.27 million (SMEC contract)	[240–312]	–
Dagash <i>Main Nile</i>		–		[285–312]	–
Sabaloka <i>6th Cataract, Nile</i>		–		[120–205]	[4 billion]
ATBARA RIVER and tributaries					
Khashm el-Girba <i>Atbara River</i>	<i>Construction supervision: Sogreah (France)</i>	1964	–	0–7 [12.5]	1.3 billion
UPPER ATBARA PROJECT inc. Rumela Dam <i>Atbara River</i> Burdana Dam <i>Setit River</i>	<i>Funding: Sudan; KFAED [\$85 m] (Kuwait); feasibility & design studies: Sogreah (France); construction: CWE-CTGC JV (China)</i>	2015 Expected year of commission	\$838 million	Rumela [120] Burdana [15]	[2.7 billion] Rumela [190,000] Burdana [210,000]

Hydropower project name	Partners	Status	Cost	Current capacity [potential capacity] (MW)	Reservoir capacity [potential capacity] (m ³) irrigation area (ha)
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BLUE NILE

Roseires <i>Blue Nile</i>	<i>Funding:</i> Arab Fund for Economic & Social Development (inc. Islamic Development Bank; OPEC; Abu Dhabi; Saudi Arabia; KFAED); <i>construction:</i> CCMD JV (China); <i>designing & construction supervision:</i> Lahmeyer International (Germany); SMEC International (Australia); Coyne et Bellier (France)	1966; 1971 Hydropower plant added; 2013 Estimated completion of dam heightening	\$396 million (cost of raising the height of dam)	100–250 [275]	2.2 billion [3.7–4 billion] 1.7 million
Sennar <i>Blue Nile</i>	<i>Original construction:</i> British engineers; <i>rehabilitation recommendations:</i> Atkins Global (UK); <i>pre-feasibility study for rehabilitation:</i> Lahmeyer International (Germany)	1925; 1962 Hydropower plant added; Rehabilitation planning ongoing	\$10–16 million (renovation cost)	15 [45]	930 million 870,750

WHITE NILE

Jebel Aulia <i>White Nile</i>	<i>Turbine generating equipment:</i> Andritz Hydro (Austria)	1937; Rehabilitated 2005	€30 million (rehabilitation cost)	30.4–35	3.5 billion 152,280
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BAHR EL JEBEL and tributaries

Yei I, II, III, IV <i>Yei River</i>	–	Yei I – pre-feasibility study complete	–	Yei I [3] [0.3]	–
Kaia/Kayaya <i>Kaia River</i>	<i>Hydroelectric potential study:</i> Bonifica (Italy); <i>feasibility study:</i> Hydroarch s.r.l. (Italy)	Feasibility studies ongoing	–	[13.5]	–
BAHR EL-JEBEL HYDRO ELECTRIC POWER SYSTEM inc. dams at Bedden Rapids; Fula Rapids; Fula II, Shukoli; Lakki <i>Bahr el-Jebel River</i>	<i>Hydroelectric potential study:</i> Bonifica (Italy); <i>feasibility study:</i> Hydroarch s.r.l. (Italy)	Recommended by NELSAP, Nile Basin Initiative feasibility studies ongoing	\$1.8 billion	[1,045]	
Kinyeti I, II, III, IV <i>Kinyeti River</i>	<i>Hydroelectric potential study:</i> Bonifica (Italy); <i>early stage design, feasibility study & on-ground exploration:</i> Sinohydro (China); <i>consulting & design:</i> YREC (China)	Feasibility studies ongoing	\$8.98 million	Inc. dam at Juba [120]	–
BAHR EL-GHAZAL and tributaries					
Sue <i>Sue River</i>					

ETHIOPIA
TEKEZE RIVER

Tekeze <i>Tekeze River</i>	<i>Funding*:</i> Ethiopian govt; EIA: Coyne et Bellier (France); <i>construction:</i> Sinohydro [49%] (China), CWGS [30%] (China), Sur Construction [21%], MWH Global (US)	2009	\$365 million (construction cost)	300	3.1 billion 45,000
Tekeze II <i>Tekeze River</i>	–	2020 Expected year of commission	\$694 million	[450]	N/A

LAKE TANA tributaries

Tana Beles <i>Lake Tana, Beles River</i>	<i>Funding:</i> Italian govt [€400 m]; <i>feasibility study:</i> Lahmeyer International (Germany); <i>contractor:</i> Salini Costruttori, Studio Pietrangeli (Italy); <i>tunnel construction:</i> SELI (Italy); <i>power plant construction:</i> Andritz Hydro (Austria); <i>planning:</i> Euroconsult Mott MacDonald (UK)	2010	\$500 million (construction cost)	460	9.12 billion [140,000–150,000]
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Black Gold for Blue Gold? Sudan's Oil, Ethiopia's Water and Regional Integration

Hydropower project name	Partners	Status	Cost	Current capacity [potential capacity] (MW)	Reservoir capacity [potential capacity] (m ³) irrigation area (ha)
Magech/Megech <i>Megech River</i>	<i>Design:</i> Tahal Consult (Israel); <i>funding:</i> World Bank, Ethiopia; ESIA: World Bank; <i>construction:</i> WWCE (Ethiopia)	–	\$76.5 million	N/A	[181 million] [16,660]
Ribb <i>Ribb River</i>	BRL Ingénierie (France); <i>funding:</i> World Bank; <i>construction:</i> WWCE (Ethiopia)	2014 Expected year of commission	\$82.4 million	N/A	[233 million] [19,500]
Koga <i>Koga River</i>	<i>Funding:</i> AfDB; <i>designing & supervising construction:</i> Mott MacDonald (UK); Metaferia Consulting Engineers & Water Works Design and Supervision Enterprise (Ethiopia)	Construction complete Irrigation scheme being implemented	\$50 million	N/A	[77 million] [6,000–7,200]
Gumera/Gumara <i>Gumera River</i>	–	Feasibility study complete	–	–	[59.7–223 million] [23,000]

ABAY (BLUE NILE) and tributaries [not all of the proposed Blue Nile dams would be possible; observers believe that some may be alternative sites for others]

Tis Abay I & II Hydroelectric Power Plants inc. Chara Chara weir <i>Tis Issat waterfall, Abay River</i>	<i>Funding:</i> CFD (France); <i>feasibility study:</i> Coyne et Bellier (France), Howard Humphreys (UK); <i>tender design, supervision of construction design & works:</i> Coyne et Bellier (France), PB Power, Howard Humphreys & Partners (UK); <i>civil works contractor:</i> Energoprojekt (Serbia), Sur Construction (Ethiopia); <i>equipment contractors:</i> Wanbao Engineering Corp. (China), Alstom (France); <i>transmission line supplier:</i> Spie (France)	Tis Abay I – 1964 Tis Abay II – 2001	–	I – 11.4 II – 68–85	[50,000]
Fincha'a <i>Fincha'a River</i>	<i>Construction supervision for extra unit:</i> MWH Global (US)	1973 Extra unit added – c. 2006	–	128–134	460 million– 2.4 billion
Fincha'a-Amerti-Neshi (FAN) <i>Fincha'a River</i>	<i>Funding:</i> China Exim Bank [\$208m], Ethiopia [\$68 m]; <i>feasibility studies:</i> MWH Global (US); <i>design:</i> HydroChina Zhongnan (China); <i>construction:</i> CGGC (China), Salini Costruttori (Italy)	67% complete as of April 2011	\$276 million	[97]	–
Grand Millennium <i>Blue Nile</i>	<i>Funding:</i> Chinese banks; <i>construction:</i> Salini Costruttori (Italy)	Construction started April 2011 2017 Expected completion date	\$4.7 billion	[5,250]	[63–67 billion]
CHEMOGA-YEDA HYDROPOWER PROJECT inc. dams on Chemoga, Yeda, Sens, Getla, Bogena	<i>Funding:</i> China Exim Bank; <i>feasibility study:</i> Lahmeyer International (Germany); economic, financial ESIA: Knight Piesold (South Africa); <i>EPC consulting:</i> ELC (Italy); <i>construction:</i> Sinohydro (China)	Construction contract signed 2015 Expected completion of Phase I	\$300–555 million	[278]	–
Jema <i>Jema River</i>	–	Feasibility study complete	–	–	[173 million] [7,800]
Mabil <i>Blue Nile</i>	–	2021 Expected year of commission	\$1.8 billion	[1,200]	[13.6 billion]
Mandaya/Mendaia <i>Blue Nile</i>	<i>Pre-feasibility study:</i> Scott Wilson (UK)/EDF (France) JV; <i>funding feasibility study:</i> Norway govt; <i>feasibility study:</i> NORPLAN consortium [inc. NORPLAN, Norconsult (Norway), EDF (France), Scott Wilson (U.K.)]	Proposed under ENSAP, Nile Basin Initiative 2030 Expected year of commission	\$2.1–3 billion	[1,620 - 2,000]	[13 million– 15.9 million]
Beko Abo <i>Blue Nile</i>	<i>Reconnaissance studies:</i> NORPLAN/Multiconsult, Norconsult (Norway)/Lahmeyer International (Germany) JV; <i>funding feasibility study:</i> Norway govt; <i>feasibility study:</i> NORPLAN consortium [inc. NORPLAN, Norconsult (Norway), EDF (France), Scott Wilson (UK)]	Proposed under ENSAP, Nile Basin Initiative	–	[2,100]	10.5 million

Hydropower project name	Partners	Status	Cost	Current capacity [potential capacity] (MW)	Reservoir capacity [potential capacity] (m ³) irrigation area (ha)
Border <i>Blue Nile</i>	<i>Pre-feasibility study:</i> EDF (France); Scott Wilson (UK)	Proposed under ENSAP, Nile Basin Initiative 2026 Expected year of commission	\$1.7 billion	[800–1,400]	[11.1 billion]
Karadobi <i>Blue Nile</i>	<i>Funding pre-feasibility study:</i> Norway govt; <i>pre-feasibility study:</i> Lahmeyer International (Germany) <i>feasibility study:</i> Norplan; Norconsult (Norway)	Proposed under ENSAP, Nile Basin Initiative 2023 Expected year of commission	\$2.4 billion	[1,000–1,600]	[32.5–41 billion]
DIDDESSA IRRIGATION PROJECT <i>Inc. dams on Diddessa; Dabana; Negeso</i>	World Bank, CIDA, UNDP	2038 Expected year of commission	\$523 million (est)	[308–615]	[55,000]
ANGER-NEKEMTE IRRIGATION PROJECT <i>Inc. dams on Anger; Nekemte</i>	–	–	–	[15–20]	[26,000]
Dabus <i>Dabus River</i>	–	Feasibility studies ongoing	–	[425]	–

AWASH RIVER and tributaries

Tendaho <i>Awash River</i>	<i>Funding:</i> India Exim Bank; <i>dam and sugarcane plantation funding:</i> Water Works Construction Enterprise (Ethiopia)	2009	\$12 million (construction cost) \$640 million (from India Exim Bank for sugar factory)	Geothermal potential [180]	1.8 billion 90,000
Koka/Awash I <i>Awash River</i>	–	1960; Undergoing study for dam heightening	–	38.4–43.2	1 billion [1.8 billion] 70,000
Awash II & III <i>Awash River</i>	<i>Consultancy:</i> Electrowatt Engineering (Switzerland); <i>restoration:</i> Ingeah (Czech Republic); Lahmeyer International (Germany)	1966; 1974	–	32; 32–40	30,000
Kessem <i>Germama River</i>	<i>Feasibility study:</i> Mott MacDonald (UK); <i>design of construction details:</i> HydroChina Zhongnan Engineering Corporation (China)	–	–	N/A	20,000

BARO RIVER and tributaries

Sor <i>Sor, tributary of Geba</i>	–	1990	–	5	–
Alwero Irrigation Project <i>Alwero River</i>	<i>Feasibility study:</i> Tahal Consult (Israel)	1995	–	N/A	74,600
Baro I & II <i>Baro River</i>	<i>Pre-feasibility study:</i> Lahmeyer International (Germany); <i>funding pre-feasibility studies:</i> Norway govt; <i>feasibility studies:</i> NORPLAN; Norconsult (Norway)	Proposed under ENSAP, Nile Basin Initiative Feasibility study complete 2034 Expected year of commission	\$914 million	[850–896]	–
Geba I & II <i>Geba River</i>	<i>Feasibility study:</i> NORPLAN-Norconsult JV (Norway)	2016 Expected year of commission	\$593 million	[254–366]	–
Birbir A & B <i>Birbir River</i>	–	Feasibility studies ongoing	\$1.2 billion	[467–508]	–

Black Gold for Blue Gold? Sudan's Oil, Ethiopia's Water and Regional Integration

Hydropower project name	Partners	Status	Cost	Current capacity [potential capacity] (MW)	Reservoir capacity [potential capacity] (m ³) irrigation area (ha)
Tams	–	Feasibility studies ongoing	–	[1,000]	–

OMO RIVER and tributaries

Gibe I <i>Omo River</i>	<i>Funding:</i> World Bank [68%], EIB [16%], EEPCo [16%], Austrian Development Cooperation; <i>construction:</i> Salini Costruttori (Italy) plus 15 international companies	2004	\$300 million (construction cost)	184–192	917 million
Gibe II Power Plant <i>Uses water discharged by Gibe I</i>	<i>Funding:</i> EIB [€50 m], Ethiopian govt [remainder]; Italian Development Corporation [\$277 m] (Italy); <i>construction:</i> Salini Costruttori, Studio Pietrangeli (Italy); <i>construction of tunnel:</i> SELI tecnologie (Italy)	Feb 2010 – Operation halted owing to tunnel collapse Dec 2010 – Operation restarted	\$480 million (construction cost)	420–428	N/A
Gibe III <i>Omo River</i>	<i>Funding:</i> Ethiopian govt [\$572 m], ICBC Bank [\$459 m for mechanical parts sub-contract] (China); <i>feasibility assessment funding:</i> EIB; ESIA: CESI & AgricConsulting (Italy); <i>oversight of ESIA:</i> World Bank, EIB, AfDB; <i>construction & installation:</i> Salini Costruttori, Studio Pietrangeli (Italy); <i>equipment provision:</i> Dongfang Electric Corporation (China) <i>funding considerations withdrawn:</i> EIB, AfDB	2013 Expected year of commission	\$1.7 billion	[1,870]	11.75 billion
Gibe IV <i>Omo River</i>	<i>Funding:</i> China [85%], Ethiopia [15%]; <i>construction:</i> Sinohydro (China); <i>contractor:</i> Salini Costruttori (Italy)	Plans approved & funding secured 2015 Expected year of commission	\$1.22 billion	[1,472]	–
Halele Werabesa <i>Halele Werabesa River</i>	<i>Funding:</i> China [85%], Ethiopia [15%]; Lahmeyer International (Germany); <i>funding and construction:</i> Sinohydro (China)	Plans approved & funding secured 2015 Expected year of commission	\$680 million	[422]	–
Gibe V <i>Omo River</i>	–	Feasibility studies ongoing	–	[560–668]	–
Gojeb Hydropower Project <i>Gojeb River</i>	<i>Funding:</i> European consultants, Middle Eastern private investors, AfDB, EIB; <i>feasibility studies:</i> Coyne et Bellier (France), Lahmeyer International (Germany)	Operational status uncertain	\$300 million (construction cost)	150	–

GENALE RIVER

Genale <i>Genale River</i>	CGGC (China)	2013 Expected year of commission	\$408 million	[254–257]	–
Genale III, IV, VI <i>Genale River</i>	–	2014; 2015; 2018 Expected years of commission	III – \$258 million IV – \$257 million	III [258] IV [456] VI [256]	–

WABE SHEBELE

Melka Wakena <i>Wabe Shebele River</i>	<i>Construction:</i> USSR engineers; <i>reconnaissance survey:</i> BCEOM (France)	1989 Undergoing studies for irrigation development	–	[87–153]	157 million [763 million] 92,000
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Dams producing less than 5MW

Yadot <i>Yadot River</i>	–	1990	–	0.35	[5,395]
Dembi <i>Dembi River</i>	–	1991	–	0.8	–

Abbreviations

AFESD	Arab Fund for Economic and Social Development
BCEOM	Bureau Central d'Etudes pour les Equipements d'Outre-Mer, known since 2008 as Egis BCEOM International
CCMD JV	Consortium of CIWEC and Sinohydro
CFD	Caisse Française de Développement, known since 1998 as Agence Française de Développement
CGGC	China Gezhouba Group Co. Ltd.
CWE/CIWEC	China International Water and Electricity Corporation
CWGS	Joint venture between CGGC and Sinohydro
EDF	Electricité de France
EEPCo	Ethiopia Electric Power Corporation
EIB	European Investment Bank
ENSAP	Eastern Nile Subsidiary Action Programme – a Nile Basin Initiative investment programme headed by the governments of Egypt, Ethiopia and Sudan
EPC	engineering, procurement and construction project
ESIA/EIA	environmental and social impact assessment/environmental impact assessment
ICBC	Industrial and Commercial Bank of China Ltd
KFAED	Kuwaiti Fund for Arab Economic Development
MOWR	Ethiopian Ministry of Water and Energy
MWH Global	formerly Harza Engineering
NELSAP	Nile Equatorial Lakes Subsidiary Action Programme – a Nile Basin programme intended to help eradicate poverty and promote economic growth. Includes Egypt, Sudan, Brurundi, DRC, Kenya, Rwanda, Tanzania, Uganda
OPEC	Organisation of the Petroleum Exporting Countries
YREC	Yellow River Engineering Consulting Company, China

Glossary

installed capacity:	the theoretical annual production capacity of a power plant, usually measured in MW and based on a plant's design data
effective capacity:	the actual annual production capacity of a power plant, usually measured in MW and sometimes up to 20% less than installed capacity
GWh (gigawatt hour):	the unit by which electricity consumption over a space of time is measured. One GWh is equal to 1,000 MW being consumed per hour at constant rate
MW (megawatt):	represents electricity production/output; the unit by which power station energy production is measured

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