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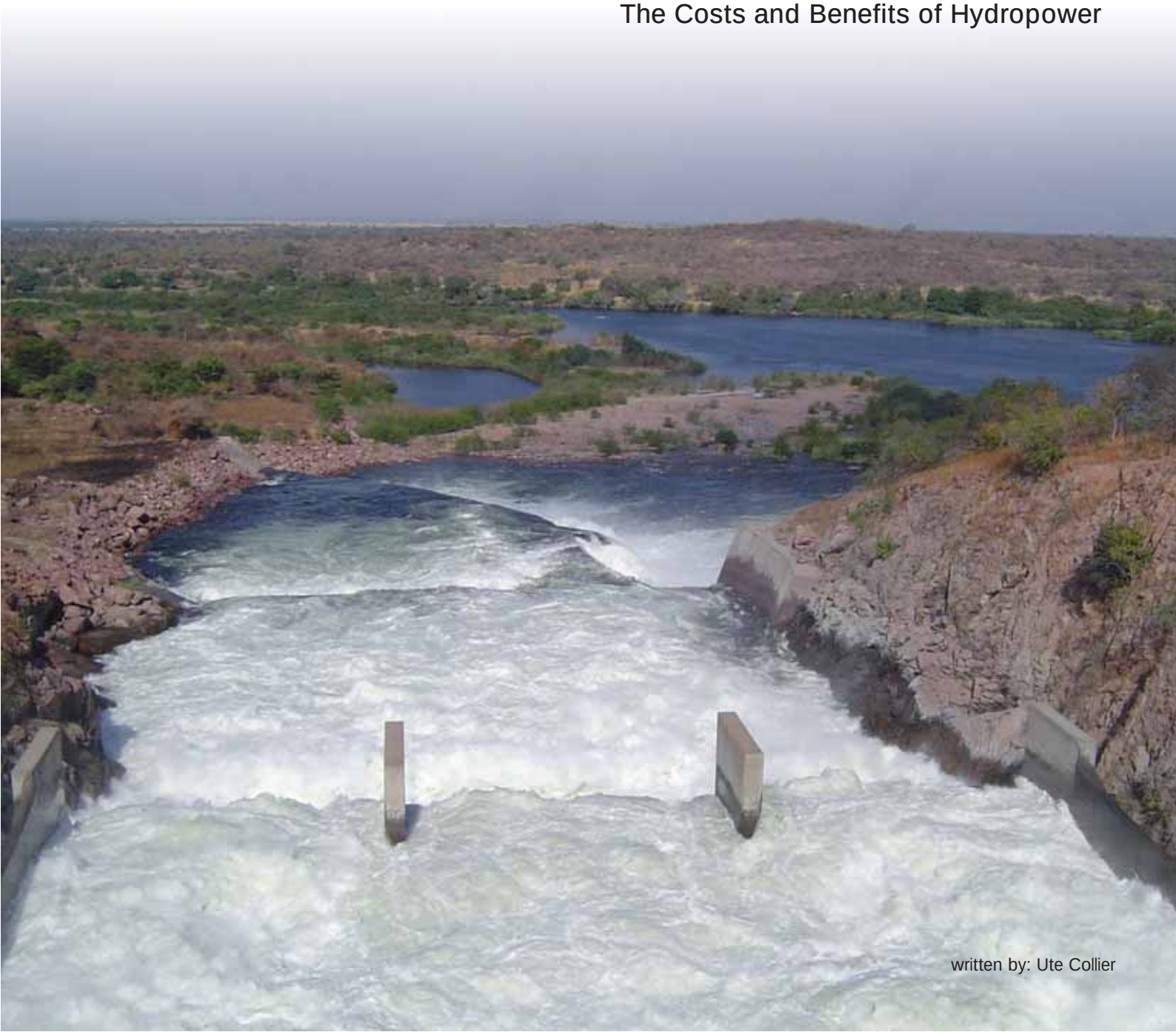
MEETING AFRICA'S ENERGY NEEDS

The Costs and Benefits of Hydropower



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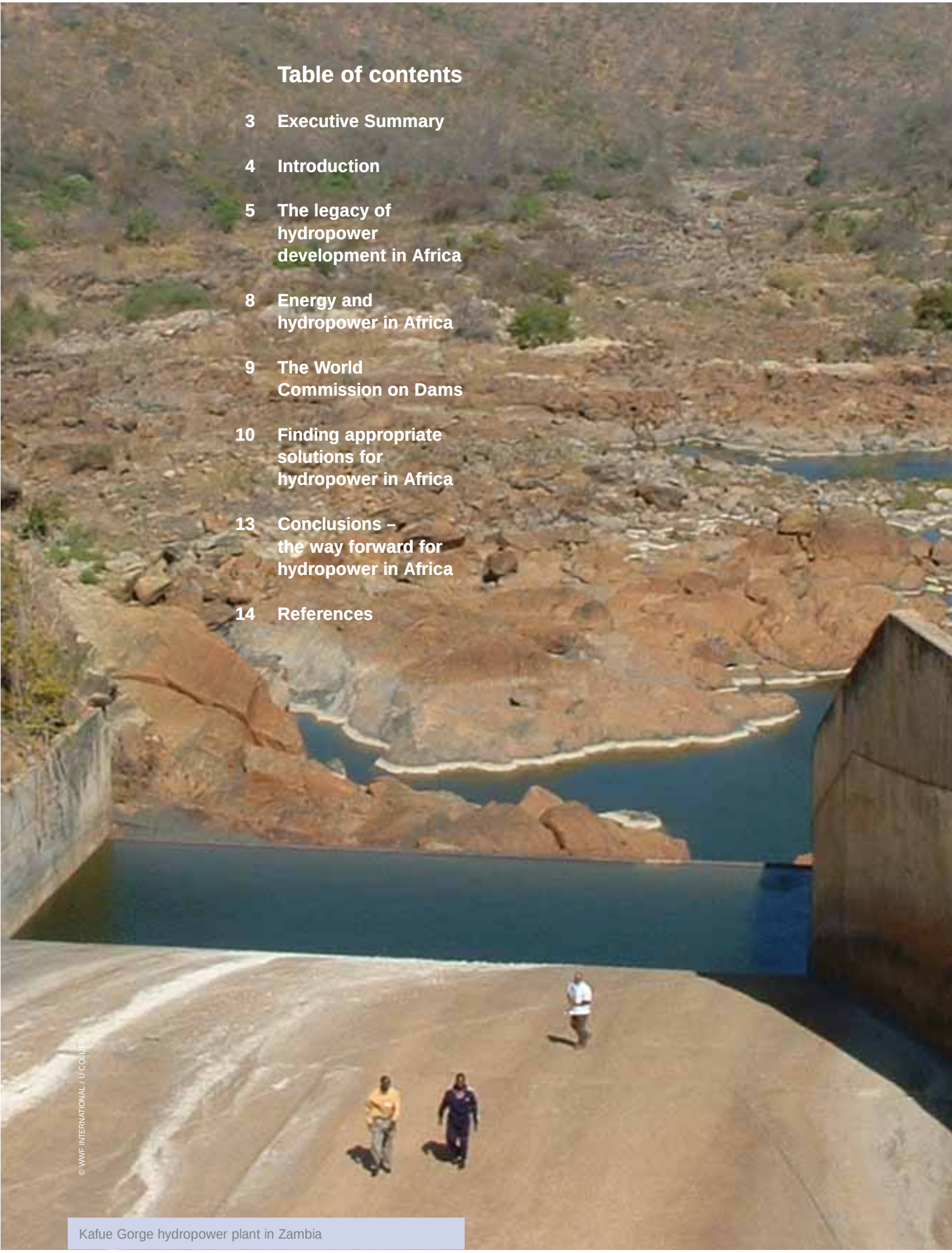


Kafue Gorge hydropower plant in Zambia

Executive Summary

In this report, WWF, Oxfam GB and WaterAid have joined forces to analyse the role hydropower can play in securing a sustainable energy future for Africa. We look at the legacy of hydropower development in Africa, recognizing its benefits but also highlighting the social and environmental impacts of a number of large hydropower schemes which have put an additional burden on hundreds of thousands of poor people. Through two case studies, we seek to demonstrate that under the right circumstances, hydropower schemes can maximize benefits and minimize impacts and we emphasize the scope of small-scale hydropower, along with other renewable energy sources, for meeting rural energy needs.

We conclude that hydropower has a place in Africa's energy supply but needs to be part of a balanced energy portfolio. We find it unacceptable that under current scenarios, the number of people lacking access to modern energy services is set to increase. We thus urge decision-makers to give greater priority to poverty reduction in energy strategies and to ensure that both small and large-scale hydropower development brings direct benefits to those with the greatest need. When large hydropower plants are being considered, they should only be built following the recommendations of the World Commission on Dams (WCD). We also stress the need for addressing the negative impacts of existing hydropower projects through effective mitigation programmes and for protecting rivers that are of particular importance for biodiversity and fisheries.

Children carrying fuel wood to the market.

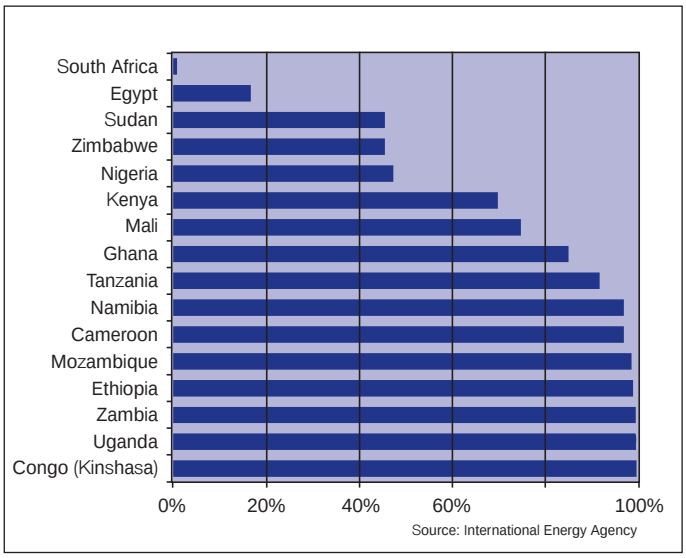
Introduction

Overcoming energy poverty is one of Africa's great challenges. The majority of Africans currently have no access to modern energy services and technologies. This has wide-ranging social and environmental consequences. Lack of access to electricity means no refrigeration for medicines or food, limits on what type of businesses can be developed, as well as no effective lighting. As a result, children cannot easily study in the evenings. Most Africans, even in urban areas, still use firewood, crop residues or charcoal for cooking and cook on inefficient stoves, resulting in a high incidence of respiratory diseases because of smoke. Many women and girls have to spend hours collecting firewood, and cutting trees contributes to deforestation.

Improving Africa's energy situation is vital if we are to achieve the Millennium Development Goals of halving poverty rates and improving health. On the positive side, Africa has a vast, largely untapped, potential of both renewable and non-renewable energy sources. In particular, Africa's large hydropower potential appears an attractive option for meeting energy needs. It has even been suggested that one single hydropower plant, the enormous Grand Inga Scheme on the Congo River, could address the bulk of Africa's energy needs in 'one fell swoop'[1]. In many cases, hydropower dams are also promoted as being suitable for multi-purpose functions, such as supplying water for irrigation and drinking water. Not surprisingly, hydropower has been receiving increasing attention under a variety of initiatives, such as the New Partnership for Africa's Development (NEPAD).

Yet, to date Africa's experience with hydropower has been mixed, as it has been elsewhere in the world. As *Figure 1* shows, many African countries are highly reliant on hydropower for their electricity supply. Large hydropower plants such as Kariba and Cahora Bassa on the Zambezi River have brought electricity to urban and industrial areas but have largely bypassed rural needs. They have also meant resettlement and loss of livelihoods for hundreds of thousands of people. Environmental and social impacts have been closely related, as impacts on freshwater ecosystems have for example resulted in reduced fisheries on which many of the poor depend for their livelihoods. In the case of the Zambezi River, the economic costs of reduced prawn fisheries have been estimated at US$10 to 20 million[2] per annum, without compensation for the affected fishermen. In some cases, the devastating impacts have still not been adequately addressed decades later. However, in other cases attempts have been made to readdress problems and share benefits. Smaller scale hydropower has also shown promise, especially for rural electrification in integration with other renewable energy sources.

Figure 1: Contribution of hydropower to net electricity generation (2002)



Then there is the question to what extent Africa should rely on hydropower development in the face of a changing climate. Already droughts regularly disrupt electricity supplies. For example, at the time of writing (February 2006) a drought had reduced Uganda's hydropower capacity by one third, causing a severe electricity shortage[3]. Climate models suggest that in parts of Africa, river flows will see significant reductions through climate change. Reduced flows, as well as increased competition for water resources (especially from irrigation) are likely to affect the viability of hydropower plants[4]. Clearly, an over reliance on hydropower, as is the case in a number of African countries, carries considerable risk and a more balanced energy portfolio is desirable in those countries, as elsewhere.

Yet, other energy sources bring their own problems. The challenge is thus to find appropriate and reliable solutions for providing both energy for industrial development and meeting the needs of the majority of poor Africans who live in rural areas. Current projections are not encouraging. Despite a growing number of electrification programmes, the International Energy Agency[5] expects the number of Africans lacking electricity to increase from 535 million now to 586 million by 2030, most of them in rural areas. While electrification rates are expected to increase from 36% currently to 58% by 2030, a large proportion of the population is expected to remain without electricity. At the same time, the number of people relying on traditional biomass for cooking and heating is expected to increase by almost one-third.

The legacy of hydropower development in Africa

While hydropower plays an important role in Africa's energy system, its development has brought with it a series of problems. These include inadequate resettlement and a lack of benefit sharing, socio-economic issues including a failure to address rural energy needs, spread of serious diseases and environmental impacts. Often, these impacts had not been foreseen during the planning stage and subsequently, insufficient efforts have been made to address them.

Resettlement and lack of benefit sharing

Many large hydropower projects involve the flooding of extensive areas and the resettlement of thousands of people. Resettlement does not necessarily have to have a negative outcome, especially as in many cases the affected people lived in poor conditions and lack facilities. However, the experience with resettlement in Africa has not been positive, as shown in a recent study by Professor Thayer Scudder[6], an expert on resettlement and consultant on a number of World Bank supported dam projects. Scudder's study included nine African hydropower dams built between 1957 and 1988, involving a total of 345,000 resettled people. In six cases (Akosombo, Cahora Bassa, Kariba, Kpong and Manantali), the living standards of the majority of the displaced people worsened after resettlement. In two cases, Kainji (Nigeria) and Kossou (Ivory Coast), Scudder reports that living standards had been restored. In only one case, the Aswan Dam, was there an improvement of the living standards of the resettled populations. Scudder credits this success to the government providing the resettled people with their own irrigation system. As De Wet[7] notes, this only happened after many initial problems which were eventually resolved two decades after the dam's completion, resulting in a positive outcome.

Kariba Dam

One of the dams used as a case study by Scudder, as well as the WCD, is the Kariba Dam on the Zambezi River at the Zambia/Zimbabwe border. It is notorious for the lack of benefit sharing with the 57,000 people displaced by its reservoir. While the Kariba Dam is vital for regional electricity supply and has brought many economic benefits, efforts to deal with its negative legacy have been inadequate and slow[8]. Almost 50 years after the completion of the dam, many of the affected people still have no access to electricity or running water and are unable to grow sufficient food as they were resettled to less fertile areas.

With so many negative resettlement examples in Africa, one would hope that for newer projects, some lessons would have been learnt. However, the 75 MW Garafiri Dam in Guinea, completed in 1999, has again caused suffering for displaced people. Money for new housing was mishandled resulting in poor quality housing, while displaced people were given compensation for flooded orchards but no training on how to replant and improve their food security. Subsequently, a USAid[9] project has provided funds to improve the situation. Most recently,

in the case of the Merowe Dam, Africa's largest hydropower project currently under construction in Sudan, it appears that all is not well. The affected people are being resettled from the Nile Valley into the Nubian Desert and there have been recent reports of unrest and a refusal of the authorities to recognise a committee formed by the affected people[10].

Flawed economics and failure to meet real energy needs

Hydropower in Africa has not necessarily met economic expectations, either in terms of viability or in terms of meeting energy needs. According to the WCD, a considerable number of hydropower projects fall short of their initial economic targets, although only a smaller number can be classified as economically unprofitable. A 1998 African Development Bank review of its experience with six hydroelectric dams found cost overruns of on average 9% and two of the projects failed an economic viability test[11].

In at least one case, the economics of the project have also been impacted by corruption. The Lesotho Highland Development Project (LHWP) hit the headlines when the Chief Executive of the development authority was convicted of taking more than US$6 million in bribes related to this World Bank supported project. This subsequently led to the conviction of multi-national engineering firm Acres International. The LHWP is mainly a water supply project for South Africa but includes the 72 MW Muela hydropower plant which uses water stored by the Katse Dam.

Furthermore, while large hydropower projects have produced economic benefits by providing for industrial and urban energy needs, they have done little to improve access to electricity of the majority of the population. Cahora Bassa in Mozambique is a case in point. While notionally, this hydropower project produces more than enough electricity to power the whole of Mozambique, in reality a major part of the electricity is exported to South Africa and Zimbabwe and less than 10% of Mozambicans have access to electricity. It is questionable whether the situation will improve if the proposed 1300 MW Mphanda Nkuwa hydropower project, 70 km downstream of Cahora Bassa, is built.

The government's decision to promote the Mphanda Nkuwa Project has been premised on hydropower generation as an export industry, with current excess capacity on the Southern African Power Pool (SAPP) projected to run out by 2007. Furthermore, it would supply power to several large mineral extraction and processing projects. However, according to a report by ITC for WWF[12], past experience in Mozambique casts doubt over the real contribution of such mega projects to poverty reduction. The report suggests that Mphanda Nkuwa will not directly benefit most of Mozambicans, at least in the short term. Instead, Mphanda Nkuwa threatens to further exacerbate the downstream impacts on people and the environment from reduced fisheries production caused by Cahora Bassa.

Destruction of downstream ecosystems and livelihoods

One of the best documented impacts of hydropower and other dams has been that on downstream ecosystems, agriculture and associated livelihoods. Hydropower plants, especially those with large reservoirs, tend to have major impacts on river flows, which in many areas naturally have large seasonal fluctuations. Seasonal flooding is important for freshwater ecosystems which in turn are important fish breeding areas. While some reservoirs, such as Lake Kariba have become important for fisheries, this has rarely compensated for the downstream losses and the benefits do not necessarily accrue to the affected populations. Furthermore, flood recession agriculture and grazing is vital for food production in many areas, such as the Zambezi valley and the Inner Niger Delta. While hydropower development can be linked to the development of irrigated agriculture, this tends to be more expensive and labour intensive than flood recession agriculture. Finally, changes in river flows can also aggravate the incidence of water borne diseases.

For example, in the Inner Niger Delta one million people make a living from agriculture, fisheries and cattle farming, all of which depend on the regular flooding of the area. At present, the Sélingué Dam, completed in 1981 on one of the major tributaries, is the only hydropower dam on the Upper Niger. Sélingué, together with the Markala irrigation dam, withholds 10-20% of the peak flow of the Niger in wet years and as much as 20-30% in dry years. River flow is currently not dissimilar to natural conditions in terms of its seasonality. However, the planned 90 MW Fomi Dam on a tributary of the Niger River in Guinea, which would have a reservoir 2.9 times larger than Sélingué, is expected to cause major negative impacts downstream[13].

Wetlands International has calculated that the Fomi Dam would impose economic costs of €35 million per year through the indirect loss in fisheries, livestock and biodiversity downstream. In addition, the vulnerability of the Inner Niger Delta to droughts would be substantially increased. This loss would be only partly compensated by the additional electricity and agricultural benefits. Furthermore, the Fomi Dam would involve a transfer of benefits from the Inner Niger Delta to the Upper Niger region. It would substantially benefit Guinea at the expense of the economy in Mali. Guinea has a large hydropower potential and has even been called the 'water tower of West Africa[14]. However, development of this potential must proceed very carefully so as to avoid unequal costs and benefits.

In another example, the case of the Diama (completed 1986) and Manantali (completed 1988) Dams in the Senegal basin, changes to river flows have not only caused a reduction in downstream agriculture, fisheries and livestock productivity but there has also been a serious impact on public health. Diama's role is to block salt intrusion, while Manantali was conceived as a multi-purpose irrigation, flood control and hydropower dam (although for financial reasons the hydropower project was not completed until 2001). The dams gave rise to large areas of stagnant water ideal for parasites and other disease vectors.

As a result there was a rapid increase in the prevalence of water-borne diseases that were already known in the area (malaria, urinary schistosomiasis, diarrhoea, intestinal parasitic diseases) and also the appearance of intestinal schistosomiasis, a much more dangerous form of the disease[15]. According to the WCD, in the Senegal basin the health impacts occurred despite the experiences with the transmission of these diseases from earlier African dams. Finally, in 2001, a US$7.25 million Global Environmental Facility Project was approved to address these impacts.

There are concerns that the planned 120 MW Sambangalou hydropower scheme on the Gambia River in Senegal could have similar health impacts. Furthermore, it threatens to flood part of a recently designated Ramsar site in Guinea, Oundou-Liti which in addition to important biodiversity values has a high potential for tourism that to date remains unexploited.

As this section has shown, there have been numerous negative environmental and socio-economic impacts related to hydropower development in Africa. This applies to older plants but also to more recently completed ones. In the last 15 years, only six large hydropower dams have been completed in Africa[16] but at least two, Katse/Muela and Garafiri have had negative impacts, while there are also concerns about the possible impacts of a number of hydropower dams currently under construction and planned. So is there a way forward for hydropower in Africa?

Fisheries are an important source of food in the Inner Niger Delta.

Energy and hydropower in Africa

Africa's energy challenges and opportunities

- 535 million Africans have no access to electricity, 1/3 of the global total
- In South Africa, almost 70% of the population have electricity, in Ethiopia less than 3%[17]
- Electricity generating capacity expected to triple by 2030, with more than 200 GW new capacity[17]
- In sub-Saharan Africa, up to 95% of energy consumption is based on small scale biomass use[17]
- By 2030, smoke from wood fires used for cooking will cause about 10 million premature deaths among women and children[18]
- Africa has large, unexplored potentials for solar, wind power and other new renewable resources. A recent UNEP[19] funded study uncovered for example a 2000 MW wind power potential in Ghana. A geothermal potential of 7000 MW has been estimated, in particular in the Rift Valley in East Africa[20]

Hydropower in Africa – key facts

- 290 GW – economically feasible hydropower potential in Africa[21]
- only 7% of the potential developed – 33% globally, 65% in Europe[21]
- Countries with largest potential: Democratic Republic of Congo, Cameroon, Ethiopia[21]
- 20 GW, 73 large hydro projects in operation, 4020 MW new hydro under construction[21]
- Key rivers proposed for hydropower development: Congo, Nile, Zambezi[21]
- Proposed Grand Inga Project on Congo: 40,000 MW, would be world's largest hydropower project, estimated cost up to US$50 billion[22]
- The Congo River is also the second richest in the world for fish. Fish diversity could be threatened by insensitive hydropower development[23]
- Downstream fisheries and ecosystems have been heavily impacted by large hydropower projects, for example in the Zambezi and Senegal Basins
- 400,000 people displaced by dams in Africa

The World Commission on Dams

Established in 1998 as an independent, international, multi-stakeholder process to address the controversial issues associated with large dams. 350 page report 'Dams and Development – A New Framework for Decision-Making' published in November 2000 www.dams.org

Key findings:

- Dams have made an important and significant contribution to human development, and the benefits derived from them have been considerable.
- In too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment.
- Large hydropower dams tend to perform close to but still below their power generation targets. They generally meet their financial targets but include a number of notable under- and over-performers.
- Some 40-80 million people have been physically displaced by dams worldwide (more than 400,000 in Africa). Many of the displaced were not recognised as such, and therefore were not resettled or compensated.
- Millions of people living downstream from dams – particularly those reliant on natural floodplain function and fisheries – have suffered serious harm to their livelihoods and the future productivity of their resources has been put at risk.
- On balance, the ecosystem impacts have been more negative than positive and they have led, in many cases, to significant and irreversible loss of species and ecosystems.

The WCD and Africa

The WCD was chaired by the then South African Education Minister Kader Asmal who had previously led the overhaul of the South African water management system.

Out of the 8 detailed case studies commissioned by the WCD, two (Kariba Dam and Gariep/Vanderkloof Dams) were in Africa. Out of 125 other large dams surveyed, another 17 African dams were included, most of them hydropower dams.

The Commission found that the impacts of dam-building on people and livelihoods – both above and below dams – have been particularly devastating in Asia, Africa and Latin America, where existing river systems supported local economies and the cultural way of life of a large population containing diverse communities.

It found that in Africa, the changed hydrological regime of rivers has adversely affected floodplain agriculture, fisheries, pasture and forests which are key elements of community livelihood and culture. It lists several examples where dams have negatively impacted on fisheries, including the Senegal River, the lower Volta region, the Nile delta, and the Zambezi in Mozambique.

To take the WCD recommendations forward, South Africa launched its own multi-stakeholder initiative and published its policy recommendations in 2005. Uganda has also launched a stakeholder process while Kenya, Lesotho, Malawi, Namibia and Zambia have hosted follow up meetings, but as yet no African country has made specific policy changes to implement the WCD recommendations.

Recommendations of the WCD

The WCD recommended changing decision-making frameworks in accordance with its five core values (equity, sustainability, efficiency, participatory decision-making, accountability) and seven strategic priorities. While it recommended more specific policy principles and guidelines, it also recognized that individual countries would need to adapt these to meet specific country conditions.

Seven Strategic Priorities of the WCD:

1. Gaining public acceptance
2. Comprehensive options assessment
3. Addressing existing dams
4. Sustaining rivers and livelihoods
5. Recognising entitlements and sharing benefits
6. Ensuring Compliance
7. Sharing rivers for peace, development and security

Finding appropriate solutions for hydropower in Africa

Despite the problems outlined, we believe that hydropower can and should play a role in Africa's energy future. However, governments, developers and financiers must avoid the mistakes of the past and the resulting social and environmental problems. The WCD recommended a series of sensible measures which can and must be implemented, in Africa as elsewhere in the world, to ensure only 'good' hydropower projects get the go-ahead. These include:

1. Informed public consent to all key decisions should be promoted through agreements, with affected people identified through a risks and rights approach. Affected people should be recognized as first amongst the beneficiaries of projects. Furthermore, programmes to restore, improve and optimise benefits from existing large dams should be identified and implemented (WCD Strategic Priorities 1, 3 and 5).

2. Comprehensive options assessment should be carried out to ensure that needs and objectives are assessed clearly and the most appropriate options for water and energy resource development are chosen. Social and environmental aspects should be given the same significance as technical, economic and financial factors in assessing options (WCD Strategic Priority 2).

3. A basin-wide understanding of the ecosystem's functions, values and requirements, and how community livelihoods depend on and influence them, is required before decisions on development options are made. Decisions need to value ecosystem, social and health issues as an integral part of project and river basin development, and the avoidance of impacts is given priority, in accordance with a precautionary approach. Selected rivers with high ecosystem functions and values should be maintained in their natural state (WCD Strategic Priority 4).

There are already a number of positive examples to be found in Africa which are in line with at least some of the WCD's recommendations, showing that win-win solutions are possible.

Niger River, Mali. The multiple functions of rivers need to be considered when decisions about development options are made.

Case Study 1:
Environmental flows for the Kafue Flats

As discussed, changes to river flows and the associated downstream impacts have been a major problem in a number African hydropower projects. However, these impacts can often be mitigated, both in existing and new hydropower schemes, through changes to the volume and timing of water releases of the schemes. The aim is to make regulated water releases from hydropower plants to mimic natural conditions of river flow and flooding, also referred to as 'environmental flows'. Such a flow regime has recently been developed in Zambia where the construction and operation of the Kafue Gorge and Itezhi-tezhi Dams in Zambia in 1971 and 1978 radically changed the water regime in the Kafue Flats, an extensive area of wetlands and floodplains along the Kafue River in the Zambezi Basin.

Under natural conditions the Kafue Flats were subject to a distinct flooding pattern which allowed extensive grazing and cropping in the area. The Flats are also important in biodiversity terms and have been designated as a wetland of international importance under the Ramsar convention. Changes in flooding and vegetation have reduced the area available for grazing and crop production, there has been an increase in cattle disease and the population of the Kafue Lechwe, an endemic species of antelope, has declined by more than half. Fisheries have also been affected negatively. While there have been other contributory factors, the dams are thought to have played a major role.

In 2001, WWF, the Government of Zambia and the Zambian Electricity Supply Company (ZESCO) came together to address the increasing pressure on the area through the development of an Integrated Water Resources Management (IWRM) Project. The project aimed to improve water management through the development of new operating rules for the two dams to allow for the release of environmental flows in the Flats. This included the development of a computer model that can predict water levels in the reservoirs and the hydrodynamic flooding patterns for different release scenarios. The model is now being used by ZESCO as a decision-support tool.

New operating rules were launched in 2004 but because of a drought, it was not possible to release additional water in 2005. However, ZESCO is committed to the new operating rules and it is also implementing the recommendations of the IWRM Project for the planned Lower Kafue Gorge hydropower plant to be built downstream on the Kafue River. ZESCO also plans to incorporate environmental flood releases on a 120 MW generating station to be built at the Itezhi-tezhi Dam.

The Kafue Flats experience is somewhat unusual in that the upstream dam is currently only a storage dam, while power generation happens at the second dam 200 km downstream. As a result, environmental flows can be managed in a way that does not negatively affect power generation. However, even where there is a small power generation penalty, this is often far outweighed by the overall economic benefit due to increased in agricultural and fisheries production. Flood releases have thus also been implemented at a few other African dams, including Manantali[24]. For new schemes, environmental flows should be considered in the initial design.

Environmental flow releases at the Itezhi-tezhi dam will help restore fisheries and wildlife in the Kafue Flats.

Case study 2: Small-scale hydro – appropriate solutions for Africa

According to the European Small Hydropower Association[25], there is still no internationally agreed definition of 'small' hydro but the upper limit is usually taken as 10MW. Also within the range of small hydro power, mini-hydro typically refers to schemes below 1MW, micro hydro below 100kW and pico hydro below 5kW and although all of these technologies could be regarded as small hydro power, they have specific technical characteristics that warrant their own definition

In the last 30 years, China, Nepal, Vietnam and many South American countries have seen the development of a large number of micro and pico hydro projects that have provided electrification for many thousands of households. However, in Africa such projects are few and far between and investments in hydropower have concentrated mainly on large hydro dams. Many utilities and donors prefer large centralised investments because they are considered easier to manage. At the same time, there has been little financial and institutional support to develop smaller scale power projects.

Yet distributed power generation through pico, micro, mini and small hydropower could be an attractive option for meeting rural energy needs in many areas in Africa. Smaller scale hydropower schemes have relatively low capital requirements and through their modular nature, can be sized to meet demand. They also can be integrated with a range of other small scale renewable energy sources such as solar panels or biomass digesters in hybrid systems, designed to suit local resource availability. Micro- and pico hydro in particular offers potential for Africa, as it can be designed involving local materials and labour, while mini and small hydro schemes require traditional engineering approaches[26]. The modular nature of small hydro technologies allows even the poorest countries of the region to begin a phased energy investment programme that does not strain their national financial resources or draw funds from other basic needs[27].

Many African countries have a considerable small scale hydro potential, although this has generally not been well studied. In Uganda estimates suggest that there is good mini hydro potential on 71 rivers with a total capacity of 220 MW[28]. Currently, only 6 small hydropower plants are in operation, with a capacity of 6.8 MW[29]. Exploiting some of this potential could make a significant contribution to rural electrification in a country where only 3% of the population have access to electricity.

Institutional and capacity barriers to successful small hydropower development are clearly a problem in Africa but some successful projects exist. One such project is the Tungu-Kabri pico hydropower scheme in Kenya[30]. Funded by the United Nations Development Programme and developed by ITDG East Africa and the Kenyan Ministry of Energy, the project benefits 212 households (around 1,000 people) in the Mbuiru village river community, which has a very remote chance of ever getting access to grid power. The project is a cheap, sustainable and small-scale technology which also alleviates the environmental problems associated with using wood and dung for cooking, diesel for milling and kerosene for lighting.

As a result of the project's success, the Kenyan government is now beginning to embrace and invest in decentralized community management and renewable energy production and to change government policy to facilitate such initiatives. In the words of Kenyan Energy Ministry official Mr. Nyoike: "The Ministry believes that this project will have significant long-term impacts not only in the project area but country-wide, in terms of the potential for replication."

PRACTICAL ACTION / ZUL

Tungu-Kabiri hydropower scheme in Kenya.

Conclusions – the way forward for hydropower in Africa

Africa's energy needs are urgent and huge investments are needed. While Africa needs reliable electricity supplies to stimulate economic growth and industrialisation, the majority of the population could miss out if no significant and sustained effort is made to reach them. The capital costs of large hydropower projects are huge and can be a real drain on the resources of poor nations. There is a danger that too much reliance is put on what is often a rather elusive 'trickle down' effect from economic development based on large electricity projects. In reality, the poor often see little benefit. The reality is that despite a variety of electrification initiatives, current forecasts are for an increase in the number of Africans without access to electricity, rather than a decrease. We believe this situation is unacceptable. Poverty reduction must be a major focus of energy strategies.

Africa's hydropower potential is considerable, both for centralized and decentralised applications. However, the risks of major social and environmental impacts from badly designed projects, large and small, in the wrong places cannot be neglected. As we have shown, environmental impacts are closely linked to health and livelihoods and addressing them is not a luxury but a necessity. Lessons from past mistakes should be learnt and applied to ensure better projects in the future. We recognize that other energy sources have their own impacts; hence a comprehensive options assessment which weighs up economic, environmental and social costs and benefits is vital. Hydropower projects should not be considered in isolation. A particular, directed effort is needed to reduce people's reliance on burning solid fuels through alternatives such as providing biogas and access to efficient stoves.

There are large institutional, financial and capacity barriers to achieving sustainable energy projects and programmes in Africa but a concerted effort by all relevant actors, be they governments, developers, financiers, NGOs or local communities, can address and overcome these. There are already many positive examples to be found in Africa but a much greater momentum is needed.

In conclusion, to ensure a hydropower is part of a sustainable energy future for Africa, WWF, Oxfam GB and WaterAid call on governments, hydropower developers and financiers to:

1. Develop national energy strategies that integrate a range of power generating options, centralized and decentralized, with a particular focus on renewable energy and energy efficiency. Comprehensive options assessment and strategic environmental assessment procedures provide tools to achieve this.

2. Prioritise poverty reduction in energy strategies and projects, e.g. through setting ambitious targets for access to modern energy services (with a particular focus on reducing the reliance on burning solid fuels).

3. Adapt and apply the recommendations of the World Commission on Dams to hydropower planning. Hydropower planning needs to proceed within a framework of Integrated Water Resource Management.

4. Address the negative environmental and social impacts of existing hydropower projects through effective mitigation programmes. Wherever possible, refurbish existing dams to increase power production.

5. Protect selected rivers or stretches of rivers of particular importance for biodiversity and fisheries as free-flowing.

WWF project in Tanzania, Primary School teacher, Mr Johanna Komba, teaches village women about fuel efficient stoves.

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Dams have impacted on the fisheries yield in the Kafue Flats.

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