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Development Progress

Discussion Paper 02

Advancing hydropower sustainability

From project design to sector planning

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1. Introduction

Hydropower is experiencing a boom. Reports of new hydropower plants appear daily on the internet. The International Energy Agency has predicted, for the medium term, a major expansion in hydropower generation, especially from large dams in the developing world (IEA, 2012). Gaps in electricity supply in many developing countries underline the importance of increasing electricity production, including for household electricity access – the first of three objectives under Sustainable Energy for All (SE4ALL), a global initiative launched by the UN in 2010. Where appropriate, hydropower can make a contribution to that.

The resurgence in dam building has, however, other sustainability implications. Large hydropower schemes commonly give rise to negative social and environmental impacts. These may be substantial – where, for example, people are displaced and their livelihoods affected, or where a dam causes significant damage to ecosystems. The financial cost of a large dam is also significant.

In this context, two key issues arise. First, what progress is being made in improving the environmental and social sustainability of large hydropower projects? Second, how much of a role in electricity generation in any given country is hydropower to play, as compared with other energy sources (e.g. wind and solar, geothermal or fossil fuels)? The two issues are related. The more a country's electricity supply is sourced from hydropower, the greater, potentially, the accumulation of negative impacts on rivers and riverine communities, alongside the benefits (for example, lower levels of greenhouse gas emissions from hydropower, as compared with fossil fuel plants). Increasing the share of renewables in the energy mix is the second of the SE4ALL objectives.

Brazil is a leading country for hydropower, providing more than 70% of national electricity supply from this source. Between 1990 and 2010, the contribution doubled in absolute terms. The Brazilian ministry of energy continues to advance a major programme of large hydropower development.

It is that plan to greatly expand hydropower – the manner of its deciding and the potential consequences if it is pursued – which is the focus of this discussion paper. First, the place of sustainability in the design and construction of large hydropower schemes in Brazil is considered – the *project* design issue mentioned above. Second, the way the Brazilian government conducts energy planning and makes energy investment decisions is examined. That *sector* process determines the answer to the second issue listed above, regarding the chosen proportion of hydropower in the national energy mix. Below, an alternative approach to decision-making on major energy investments in Brazil is proposed, allowing for greater scrutiny of energy policies and plans, and more open and transparent debate of proposals of new power plants, including hydropower.

2. Design of large hydropower projects: continuous improvement?

The Jirau project in Brazil has been evaluated according to the Hydropower Sustainability Assessment Protocol (HSAP), a tool designed by an international multi-stakeholder group to score the performance of hydropower projects against a wide range of criteria – technical, financial, environmental and social. The Jirau dam and hydropower plant is a large project, at 3.75 gigawatts (GW) of electricity generation capacity, located on the Madeira River, an Amazon tributary, in Rondônia state. The team of assessors who visited Jirau and reviewed its implementation in 2012, according to this international protocol, reported favourably on the efforts of its project developers and construction managers to reduce and compensate for local impacts (Locher at al., 2013). The horizontal 'bulb' turbine design allowed a lower dam and reduced reservoir size for operation of this 'run-of-river' plant – resulting in less land flooded and fewer people displaced. The project budget included an allocation of 1.2 billion Brazilian reals (around $500 million) to a range of socio-economic and environmental activities, equivalent to 12% of the total (initial) budget.

The assessors were not asked to judge whether Jirau was typical, or not, of large hydropower projects in Brazil. Jirau does compare favourably with the record of the Tucuruí project in the 1980s – the subject of the Brazilian case study for the 2000 report of the World Commission on Dams. The reviewers of Tucuruí noted that it had failed to take account of the 'profound socio-economic transformation' caused by the dam and reservoir (La Rovere and Mendes, 2000). Two decades later, Jirau points to a significant evolution of practice – or at least the *capacity* to deliver improved practice – in the building of large hydropower plants in Brazil, albeit through a joint venture comprising external as well as Brazilian expertise.

Mitigating and compensating for impacts is not, however, the same as avoiding those impacts altogether. Improved practice, such as that at Jirau, does not mean that there are no 'losers' in hydropower projects, alongside the 'winners', including those who benefit from electricity (as to the different categories of recipient of electricity, by sector type, this is discussed below). At Jirau, the assessors highlighted 'significant questions on the economic sustainability of the new settlement' where the about 500 displaced families have been re-housed. Meanwhile, it remains to be seen whether the fish-transposition scheme at Jirau is able to maintain the species diversity of the Madeira River (459 species recorded). In contemplating hydropower projects, the starting point is that, where placing a large dam on a river is not *necessary*, the disruption to lives/livelihoods and the damage to the local environment can be avoided. For policy- and decision-makers in Brazil, the question arises, therefore, of how many hydropower plants are necessary, including in the Amazon – in the language of the HSAP, what is their 'demonstrated need' and 'strategic fit' (IHA, 2010: 55)? That will depend on the direction of energy policy and hydropower's place in it. At the Rio+20 conference in

Hydropower in Sierra Facão, São Marcos. Photo: © Divulgação Furnas/Eletrobrás

June 2012, the Brazilian government committed to the objectives of SE4ALL. How do its energy plans and energy record match up?

3. Energy sector planning and decision-making in Brazil today

Long lead times for planning and construction of power plants, particularly large dams, make it essential to forecast future electricity needs. Typically, forecasts are based on modelling – of demography and of economic and social futures. Given the inherent uncertainties of 'predicting' the future, the forecasts that emerge are, at best, estimates, based on a combination of trends derived from historic data and variables expressing future contingencies. The latter will inevitably include some subjective value judgments as to the likely/preferred direction of national development, including the future shape of the economy and the relative energy demands of agriculture, industry and services, alongside the residential sector. Whatever doubts there may be as to how such forecasts are arrived at, having been produced by leading actors with privileged access to information, they tend to be influential. The figures on future electricity demand set the targets for electricity production, which are then translated into a quantified number of power plants of a defined capacity. Forecasting thereby becomes a driver of national energy development.

So it is in Brazil. In its energy plan for 2005 to 2030, the Brazilian energy ministry, the MME, presents its proposal of the 'strategic direction for expansion of energy supply' (MME, 2007). It bases its estimate of future electricity needs on a forecast percentage growth in demand per annum corresponding to an average GDP growth per annum (one of four scenarios of Brazil's future development trajectory). As a contribution to meeting that future estimated demand, the MME proposes 164 gigawatts (GW) as the country's 'exploitable, but as yet unrealised' hydropower 'potential'. Of that 164 GW, the MME says that 90% (about 147 GW) is in the Amazon region. On that basis, construction in the region has begun with some 38 GW of new hydropower plants announced. As for the 164 GW figure: if realised, it would amount to more than a doubling of the total installed national electricity generation capacity in Brazil – 121 GW in 2012 (from all generation sources).

Such energy forecasts and proposals need to be subject to open and transparent debate. Yet, in Brazil, the discussion is currently confined to a restricted circle of government comprising the MME and its research and planning arm (the EPE), plus the energy minister, and above. The 2030 plan was, the MME states (2007: 21), accompanied by the holding of 'public seminars' and 'thematic meetings' with invited experts. Yet, those occurred, according to a Brazilian energy specialist, 'after the definition of what is required had been determined,

in a kind of mandatory validation step – more for show than for really discussing alternatives'. In the plan only brief statements on modelling and conclusions of models are presented. The choices of scenarios of future national development, as well as modelling designs and content, remain with the MME/EPE and one specified research centre. Their take on Brazil's future is that electricity consumption per capita will double from 2005 to 2030 with industry the largest electricity-consuming sector (at 42% of total consumption) as compared with, proportionately, an only marginally increasing services sector (23% in 2005 to 24.6% in 2030) (MME, 2007: 46). Where do those figures come from? A pointer is provided by the EPE's 2013 'national energy balance' which notes that key energy-consuming industrial activities in Brazil are cement and ceramics, mining, aluminium, steel, and civil construction. Production of aluminium, for example, doubled in the 10 years from 2004 to 2013, as recorded by the Brazilian Aluminium Association. These types of energy use are evidently weighing heavily in the consumption forecasts.

By comparison, the forecast amount of energy savings in the MME plan is modest. In the 1990-2010 period, Brazil's energy policy-makers and engineers showed themselves to be much more effective in expanding energy production than managing demand. Energy intensity – energy used per unit of production – marginally *increased* over those two decades. Brazil is going in the *opposite* direction to the global objective of improvement in energy intensity for greater energy efficiency (SE4ALL, 2013). On the basis of previous performance, a serious question arises as to the effectiveness of the efficiency measures outlined in the plan. Yet, management of (reductions in) future demand could mean that less installed capacity would be needed – fewer or smaller power plants would need to be built.

As for consultation on energy planning, a process of the kind employed, for example, by the energy regulator in the UK (see box) has not, to date, been developed in Brazil.

Reading the UK consultation documents, the clear impression is that the electricity regulator is pleased to invite the views of its peers, energy specialists – essentially an expert-to-expert dialogue at that stage – for their support in the task of forecasting.

In comparison, in Brazil, the MME, observed the above energy specialist, 'has clearly been reluctant to share decisions with energy experts and other government ministries'. The MME is 'neither willing, nor organised, to open up and manage a debate on the country's energy path'. This mode of decision-making, as currently employed in relation to the construction of large hydropower plants, is portrayed in the infographic on page 5 in the left-hand column under 'How it is'.

As shown in the infographic, according to the licensing procedure in Brazil – mandatory in law – assessments of hydropower schemes are conducted by the national environmental regulator, IBAMA. IBAMA's role is essentially reactive, responding to proposals, project by project. The outcome of the procedure is, generally, the placing of licence conditions aimed at reducing negative impacts on the river and local people. Similarly, the 'integrated environmental assessments' in Brazil, as applied to, for example, the Tocantins basin in the Amazon, take effect to reduce environmental impacts in fragile areas without calling into question whether or not the projects in question go ahead: 'planned dams are often decided upon by the power sector without considering the results of IEAs or strategic environmental assessments' (Fortes Westin et al., 2014).

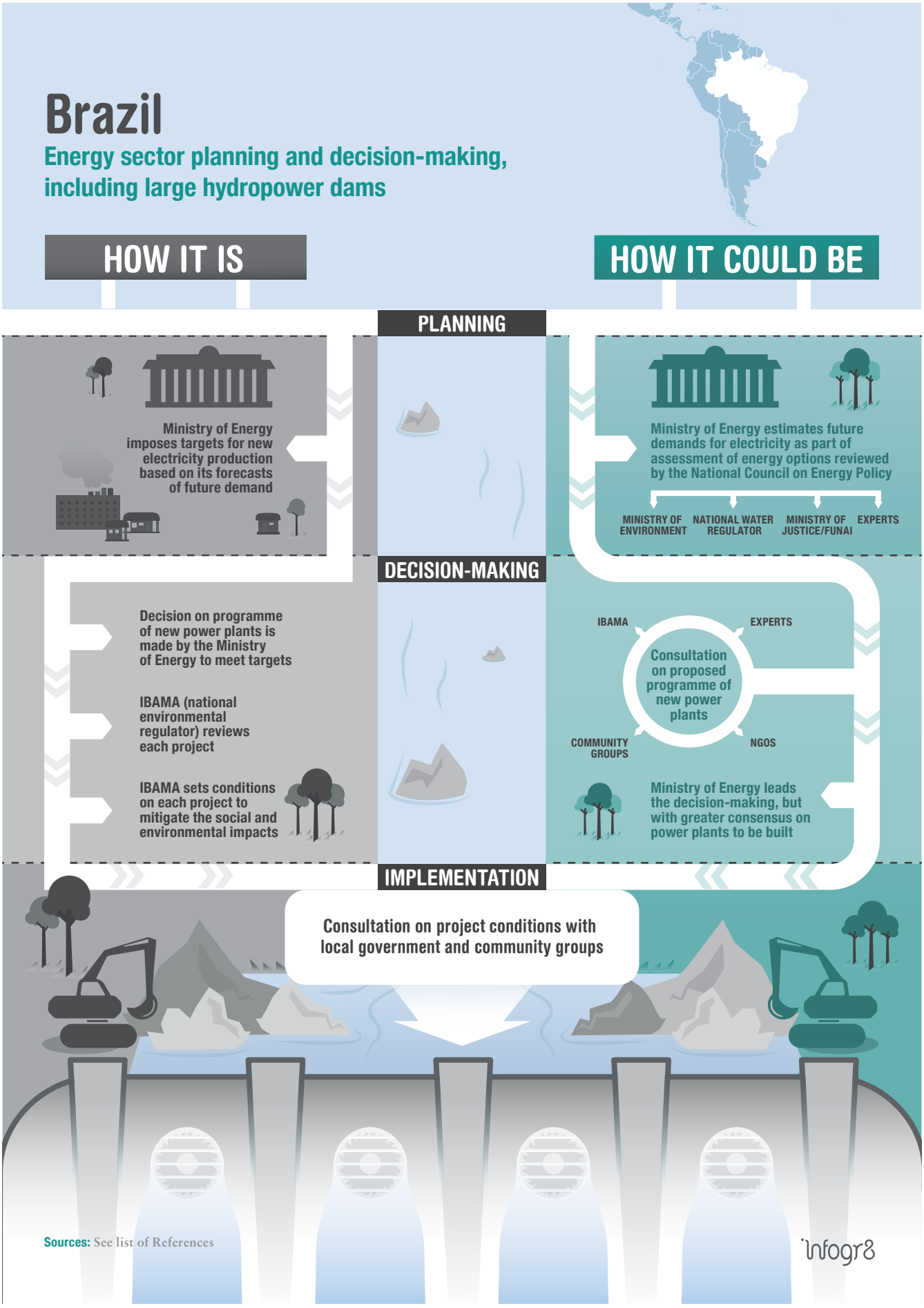
The political context in Brazil is, however, evolving. In a significant change from the previous eras of military and authoritarian governments, including those responsible for building large hydropower dams between the 1960s and 1980s, there is more and more overt resistance to attempts by the government to impose measures on its citizens. That driving through energy policy by wilful imposition cannot continue has recently been acknowledged by the head of the EPE, who said that 'hydropower cannot be constructed by steel and fire' (*Valor Econômico*, 2013). In line with the changing context, the decision-making process on major energy infrastructure in Brazil needs to change.

4. Energy sector planning and decision-making in Brazil: an alternative proposal

The infographic shows – in the right-hand column – what an alternative approach to decision-making in Brazil could look like. This proposal emerges from analysis by ODI and Brazilian energy specialists as part of this research study. Decision-making would still be led by the MME as the responsible ministry, while providing for more discussion within government and more consultation beyond it. According to this model, the MME would actively involve the National Council on Energy Policy (CNPE), in the discussion of energy plans, including scrutinising the forecasts of future electricity demand.

UK consultation on energy forecasting

By law, Ofgem, the UK electricity regulator is required to produce an annual report providing 'plausible forecasts of demand and installed capacity' over (most recently) five years. (The modelling is actually undertaken by the operator of the national grid.) In its 2011 consultation, Ofgem stated (Ofgem, 2011: 5): 'we are keen to get views on our proposals from key stakeholders and industry experts', and in particular 'comments on our approach and which of our specific modelling and data proposals would be most appropriate'. Eight weeks is given for replies. Ofgem says that it 'received nine responses, five from industry participants and four from academics and other institutions' (Ofgem, 2013: 4). Thereafter, Ofgem published a decision document based on consideration of views arising from the consultation.


Brazil
Energy sector planning and decision-making, including large hydropower dams
HOW IT IS
HOW IT COULD BE
PLANNING
Ministry of Energy imposes targets for new electricity production based on its forecasts of future demand
Ministry of Energy estimates future demands for electricity as part of assessment of energy options reviewed by the National Council on Energy Policy
MINISTRY OF ENVIRONMENT
NATIONAL WATER REGULATOR
MINISTRY OF JUSTICE/FUNAI
EXPERTS
DECISION-MAKING
Decision on programme of new power plants is made by the Ministry of Energy to meet targets
IBAMA (national environmental regulator) reviews each project
IBAMA sets conditions on each project to mitigate the social and environmental impacts
IBAMA
EXPERTS
Consultation on proposed programme of new power plants
COMMUNITY GROUPS
NGOS
Ministry of Energy leads the decision-making, but with greater consensus on power plants to be built
IMPLEMENTATION
Consultation on project conditions with local government and community groups
Sources: See list of References
Infogr8

Currently, the CNPE is almost completely ignored in the process despite its formal mandate as a key advisor to the government (the Presidency). IBAMA would retain its mandate to assess each individual dam project, while the ministry of environment (including its forests department) would participate in the consideration by the CNPE of the 'strategic' objectives of energy policy and the options to meet those objectives. Additionally, the Brazilian national water regulator (ANA) would have an active voice, since hydropower depends, of course, on the utilisation of water resources. To date, ANA has been weakly represented in the planning process. The National Indian Foundation (FUNAI) would also have an active role in the CNPE, either directly or through its responsible ministry (justice).

As for the criteria for options assessment, those would be made public, after being themselves drawn up and decided upon by a consultative process. The 'do nothing' option would be included, allowing the possibility for choosing not to build a given power plant. The other features of a more open and transparent process beyond government would be public hearings and consultations *prior to* the making of key decisions, with, throughout, publication of information, including access online and via the media, about what was being proposed by government and other parties.

The purpose of this alternative process would be to generate *greater* consensus around the direction of energy policy and the major energy investments required to implement it. This would reflect a move away from wilful imposition (as noted by the head of the EPE), while not preventing a dynamic process of planning for major energy projects. More open and transparent processes do not of course eliminate controversy and, if badly handled, can become ragged and messy. Nevertheless, the task for elected leaders in a democracy is to *lead* government and public debate, rather than trying to deliberately avoid or bypass it. As one Brazilian expert has said: 'Consultation entails informing the public of different options and their implications (economic, social and environmental), including the positive benefits, and negative impacts, at local and regional/state level'.

As set out above, the focus in this paper is on the nature of the decision-making *process* in Brazil, rather than the substantive *content* of policy and plans decided upon by that process. The task of the alternative mode of decision-making proposed here would be to examine, objectively, how many hydropower plants, and of what size, would be needed and for whom – for which priority users? For example, how far would the plan to provide increased energy for 'mining, aluminium, steel, and civil construction' be retained, as proposed by the MME, or would the seemingly common agenda of the energy sector and those industries be reassessed?

5. Conclusion

A key conclusion is that, although attention to advancing continuous improvements in the environmental and social sustainability of hydropower project design is valid and (very) important, good management of individual projects in accordance with international protocols or standards is only part of the picture. A well-managed hydropower project may be part of an energy strategy and energy implementation, nationally, that does not meet international objectives for sustainability (e.g. energy efficiency). As acknowledged in the SE4ALL Global Action Agenda, the sustainability challenge begins with sector 'planning and policies' (2012: 26).

In Brazil, the current energy plan to 2030 refers to the need to evaluate sustainability taking into account 'social, economic, energy and environmental parameters' (MME, 2007: 305). That, however, leaves out the crucial political dimension. A more open and transparent decision-making process would take Brazilian energy development into a more democratic era. The politics as well as the practice of sustainability need to advance in line with international practice. That matters very much for shaping the future of hydropower in Brazil, particularly in the Amazon region with its great environmental and social diversity.

Working on the Santo Antônio hydroelectric plant, Madeira River at Porto Velho, Rondônia. Photo: © Programa de Aceleração do Crescimento

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Cover image: Powerhouse and spillway, Jirau hydroelectric plant, Madeira River, Rondônia, Brazil. Photo: © Programa de Aceleração do Crescimento