



Netherlands Commission for Environmental Assessment

May 2018

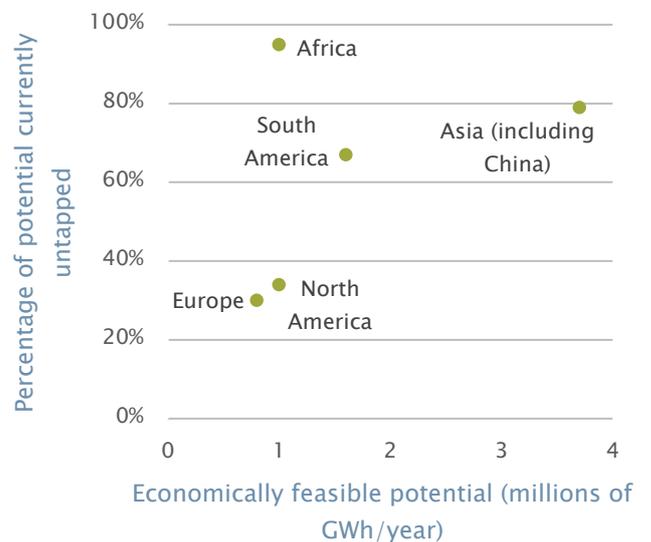


# ESIA and SEA for Sustainable Hydropower Development

Presently, hydropower is the most widely used form of renewable energy, accounting for 17% of global electricity generation, expected to increase by approximately 3% each year for the next 25 years. Over the last two decades the global hydropower generation has increased by 50%. This includes all types and sizes of hydropower, micro-hydro as well as large dams<sup>1</sup>.

Since 1993, the NCEA has been involved in several hydropower projects and energy policies. Nowadays, the role of environmental and social impact assessment (ESIA) in assessing, avoiding, mitigating and compensating the impacts of large hydropower projects, is fairly well known. Less known is the positive role of strategic environmental assessment (SEA) in developing a more sustainable energy sector vision, including a possible role for hydropower. Based on our experiences, in this

Figure 1: Potential and actual hydropower generation in different regions. Source: IEA, 2015



document we share some examples and findings on the added value of environmental assessment and how to get the most out of it.

<sup>1</sup> International Energy Agency/IEA, 2017

## The hydropower sector

Globally, around 20% of the technically exploitable hydropower potential has been developed (see Figure 1). Africa has the largest percentage of untapped potential. Although climate change may affect water resources and may lead to significant variations of the potential for hydropower at country level, these variations are expected to level out at global scale, leaving the overall potential virtually unaffected.

### Issues linked to hydropower

Hydropower projects can range from micro-hydropower facilities that hardly occupy land and have virtually no influence on river hydrology, to large mega-dams with reservoirs covering up to hundreds of square kilometres. Moreover, energy generation can be the only objective, but a reservoir dam can have other purposes as well such as provision of water for drinking and irrigation or water management to avoid flooding.



**Cahora Bassa dam, Mozambique, 2018**

In this document we will focus on larger interventions. The nature of the impacts of large dams on ecosystems is generally well known. For example, in 2011 the World Commission on Dams described two categories of impacts of large hydropower projects, listed in Table 1.

**Table 1: Common impacts of large hydropower projects**

Environmental impacts	Social and economic impacts
<ul style="list-style-type: none"> <li>• Impacts of reservoirs on terrestrial ecosystems and biodiversity, leading to potentially irreversible loss of species populations and ecosystems;</li> <li>• Emission of greenhouse gases associated with reservoirs (strongest in tropical areas);</li> <li>• Impacts of altered downstream flows on aquatic ecosystems, on the natural flood cycle of downstream floodplains and on the salt/freshwater balance in estuaries;</li> <li>• Upsetting of sediment balance of rivers and coastal ecosystems leading to coastal erosion;</li> <li>• Barrier effect of dams on migratory species and fisheries in the upstream, reservoir and downstream areas;</li> <li>• Cumulative impacts of a series of dams on a river system.</li> </ul>	<ul style="list-style-type: none"> <li>• Delay between the start of planning and (uncertain) construction, leading to reluctance to invest in potentially flooded (dam-designated) areas;</li> <li>• Temporary influx of construction workers during construction; related social tensions;</li> <li>• Displacement of people and livelihoods: the larger the number of displaced people, the less likely it is that livelihoods can be restored; disruption of downstream livelihoods through changes in provision of ecosystem services;</li> <li>• Disproportionate levels of displacement and negative impacts on livelihood, culture and spiritual existence of indigenous peoples and vulnerable ethnic minorities;</li> <li>• Numerous vector-borne diseases, associated with reservoir development in tropical areas, such as malaria, schistosomiasis, Rift Valley fever, Japanese encephalitis;</li> <li>• Loss of cultural heritage;</li> <li>• Unequal distribution of the gains and losses of a project across different societal groups and sometimes across borders.</li> </ul>

In addition to negative impacts, hydropower dams may also have positive impacts such as better access to electricity and enhancement of ecosystem services through reservoir creation, e.g. fisheries, dry-season agriculture and drinking water.

## Addressing issues linked to hydropower: ESIA / SEA

Negative impacts can (partly) be avoided, mitigated and compensated, and positive impacts can be enhanced, by making use of ESIA for individual projects. One example of the level of individual projects is the use of fish ladders that can partly mitigate the negative effects of migration by some fish species. However, most impacts are the result of the *location* of a hydropower project, for

example tributaries located in a national park are more sensitive to the effects of a hydropower project, than tributaries outside such a park. And the cumulative impacts of a number of these projects in a river basin can be considerable. Cumulative and negative impacts can (partly) be avoided or mitigated by applying SEA to support strategic planning of hydropower projects (see Table 2).

**Table 2: Examples of main decisions in energy/hydropower planning, and issues to be addressed in related SEA or ESIA (not exhaustive)**

Main decisions	Main issues for decision making
National energy plan	To be addressed in SEA
<ul style="list-style-type: none"> <li>• Energy demand and supply</li> <li>• Composition of the combination of energy resources</li> <li>• Import and export of energy resources</li> <li>• Cost benefit analysis</li> <li>• Priority setting of investments</li> </ul>	<ul style="list-style-type: none"> <li>• Scenarios</li> <li>• Alternatives for composition of the combination of energy resources</li> <li>• Social, environmental and economic analysis of the main alternatives</li> <li>• Consistency analysis with other relevant policies such as for food security, water and biodiversity.</li> </ul>
Hydropower plan	To be addressed in SEA
<ul style="list-style-type: none"> <li>• Assessment of technical potential</li> <li>• Capacity to be developed for each river basin</li> <li>• Composition of the capacity divided in micro, small, meso and macro hydropower projects.</li> <li>• Preliminary selection of sites for hydropower development</li> </ul>	<ul style="list-style-type: none"> <li>• Alternatives for purpose (single hydropower or multi-purpose); capacity (macro to micro); location, size and type for each river basin</li> <li>• Social, environmental and economic analysis of the main alternatives</li> <li>• Comparison of the main alternatives between the river basins.</li> </ul>
Hydropower project	To be addressed in ESIA
<ul style="list-style-type: none"> <li>• Purpose, capacity, location and type</li> <li>• Environmental and social impacts &amp; opportunities</li> <li>• Cost benefit analysis</li> </ul>	<ul style="list-style-type: none"> <li>• Alternatives</li> <li>• Mitigation, compensation and offset measures</li> <li>• Social, environmental and economic analysis of the main alternatives</li> </ul>



**Community participation in ESIA for Adjarala dam, Benin and Togo, 2014**

## The NCEA's view on hydropower development

Based on our experiences with energy plans and hydropower development in the past 25 years, we think that hydropower development should ideally start with a long-term societal vision for energy. In practice, we have seen that negative impacts of individual projects could often have been avoided or reduced, if earlier strategic decisions had been better substantiated. We understand that governments might feel an urgency to take care of increased energy supply and irrigation needs, however hasty decisions, could result in (expensive) individual hydropower projects that carry major negative impacts. Therefore, the first question governments should ask themselves is whether there is a need for hydropower at all. What are possible energy resources and how does hydropower fit in that scenario? In cases where hydropower is considered an option, possible locations with the least environmental, social and economic negative impacts may be compared.<sup>2</sup> At the same time, SEA may also help in optimizing the positive impacts of hydropower, e.g. as to energy production, irrigation and food security.

To support decision making, SEA is a very suitable – and in a growing number of countries mandatory – instrument for assessing negative and positive impacts, comparing scenarios and securing participation. Not only for supporting the strategic decision itself, but also for guiding individual project decisions and accompanying ESIA in a later stage.



**Community participation in ESIA for Khudoni hydropower project, Georgia, 2013**

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<sup>2</sup> A view also shared by the International Hydropower Association as mentioned at their World Hydropower Congress in 2017, where they have adopted the idea of strategic basin planning for hydropower development.

## *SEA for energy & hydropower planning*

We have noticed that authorities are becoming more and more interested to start with strategic planning and apply SEA to enhance the quality, credibility and acceptability of these plans. For example, as a result of civil unrest over hydropower projects, as is the case in Myanmar and Georgia (see Box 1). Vietnam is also a good example of a country where SEA is starting to be more widely applied. It supports the National Power Development Plan and some Provincial Development Plans such as the Quang Nam Province hydropower plan covering the Vu Gia–Thu Bon River Basin. Currently, a large number of hydropower SEAs are funded by donors such as IFC, World Bank, ADB and AusAid. These are important experiences to share and build upon for future development and application by countries themselves.

## *SEA for national energy plans*

In a national energy plan, the energy demand and supply of a country is estimated and decided upon for the long term. Such a plan nearly always has an international component as most countries import and/or export energy. The plan provides information concerning the possible combination of energy resources (energy mix), including the estimated contribution of hydropower, based on a general assessment of the technical hydropower potential. An SEA of hydropower potential can warrant the inclusion of other national priorities, for example those related to irrigation, biodiversity and cultural heritage. For biodiversity, for example, these priorities are usually represented in a national biodiversity strategy and action plan (NBSAP) (see Box 2 for an example).



**Construction of the Bujugali Hydropower dam, Uganda, 2011**

## **Box 1: Hydropower development in Georgia**

In the first half of 2013, the NCEA was asked by the Georgian Minister of Environment to review the quality of the ESIA report for the 700 MW Khudoni hydropower project, located in the Enguri Basin, downstream of a UNESCO World Heritage Site bordering Abchazia in Western Georgia. The NCEA's advisory report was publicly discussed and has impacted decision making on the Khudoni project.

In its advisory report the NCEA provided project level and strategic level recommendations. Given the ratio between loss of land and the potential power generation capacity, the dam site was considered to be suitable, yet, significant improvements in resettlement planning were needed. Also, the loss of biodiversity by the reservoir should be better compensated. The forested upstream parts of the basin were unprotected. Unsustainable activities in this area resulted in a significant flow of sediments into the planned reservoir. To compensate the loss of biodiversity and to curb the increasing erosion problem it was suggested to restore and protect the forested hillsides in the upstream catchment as part of the existing world heritage area. Funding should be guaranteed by the hydropower project.

At strategic level the NCEA recommended to develop a national hydropower plan and initiate a strategic discussion with all stakeholders at national level on the actual need for hydropower development, including a discussion on the scale of interventions in the fragile Caucasus environment. For example, to assess the alternative of many small hydropower projects to one large project. Based on such a national (hydro)power strategy, optimal choices can be made on project investments. In 2013, the Ministries of Energy and Environment, jointly started the development of such a plan, supported by an SEA and funded by the World Bank. The plan will be ready in 2018.

## Box 2: SEA for the hydropower plan of Azad–Jammu–Kashmir State in Pakistan

The government of Azad–Jammu–Kashmir State (AJK) agreed to volunteer its hydropower plan (the ‘Plan’) for SEA piloting. In 2014, there were 12 operational hydropower projects in the state. An additional 13 are under construction while 37 more sites have been identified for detailed feasibility (total technical capacity ~9000 MW). The SEA took the form of an ex–post assessment based on the collection of 62 existing or proposed projects that make up the de facto Plan. The main objectives of the pilot SEA of the hydropower plan was to:

- Assess the potential environmental and social risks and benefits associated with the current hydropower plan;
- If necessary, suggest alternative plan options that better optimize economic, environmental, and social outcomes.

Based on ecological criteria, the rivers in AJK were divided into nine zones. The ecological sensitivity of each river zone was assessed and discussed, followed by a determination of the sensitivity of river sections to the development of hydropower projects (HPPs). A similar analysis of socio–economic conditions was undertaken for each of the section and rated as Least, Moderate or Highly sensitive to HPP development. Finally, both analyses have been combined, that showed that the nine proposed HPPs in the Poonch River basin all rank highest for potential ecological and social impact and therefore this section is indicated as a highly sensitive zone.

### *Influence of SEA*

One of this nine projects in the Poonch river is the Gulpur project that was initially rejected by the funding agencies (IFC, ADB) because the proponents had not taken into account the specific requirements in relation to its location in a planned National Park. This National Park was not yet approved due to opposition by government planners who were afraid that its protected status would prevent the use of hydropower from the river. Then the pilot SEA was conducted and subsequently IFC requested to carry out a EIA of four combined hydropower projects in Poonch River including the 100MW Gulpur HPP. This EIA could be carried out very quickly, as it could be based on the SEA pilot. As a result of the EIA and described alternatives, the impacted area of river flow could be reduced from 7 km to 0,5 km. Furthermore, the proposed Gulpur hydropower dam was changed from a dam including a large reservoir, into a run–of–the–river project, providing the same hydropower yield as the dam initially planned. A Biodiversity Action Plan for the project impact area was prepared for investments in biodiversity conservation. An important secondary result of this process was that the resistance against the establishment of Poonch National Park by the authorities ceased and the protected status of the park was approved. A biodiversity management plan for the entire river will be prepared taking into account the accumulated impacts of the four dams. In sum, the influence of the SEA was:

- The proposed Gulpur reservoir dam was changed into a run–of–the–river project;
- Poonch National Park was established and investments in conservation were made.



Wikimedia, 2008: Poonch river in AJK

### *Lessons learnt*

- The pilot did not have a budget for primary data collection. Fortunately, the consulting team had access to excellent primary environmental and social data from previous impact assessment studies undertaken in the State. Without this information, the pilot SEA would not have been able to produce the river sensitivity and HPP ranking, that was a crucial outcome of the study.
- Maps produced as part of the SEA study were of significant value. These were used for discussions with public officials in AJK, who often do not have enough time to read long, technical reports. At consultation meetings with government officials, the maps engendered spirited engagement that clearly led to organisational learning.

## *SEA for hydropower plans*

A hydropower plan can be developed for different jurisdictions: (i) on an international scale (transboundary) for those countries that share a river basin; (ii) on a national scale for all river basins located within the jurisdiction of one country; (iii) on a provincial scale or for one river basin. In a hydropower plan, decisions are made on the basis of potential for hydropower development for the short, medium and long term. In general, this plan will be revised every 5 to 10 years. In such plans all potential hydropower sites and capacities are identified and compared in a participative process with all relevant stakeholders. Ideally, the hydropower potential for each basin is developed as part of a basin or catchment plan. Depending on the existing planning framework in a country, a basin plan can be developed as part of an integrated water resources management (IWRM) plan, an integrated regional land use plan, or a regional development plan. For a growing number of transboundary river basins, river basin authorities have been established representing the national authorities. They often have a mandate to advise or decide on the allocation and use of water. In addition, they ideally have a key role in decision-making with regard to hydropower development. It is also their responsibility to take stakeholder needs into consideration.

An SEA can support the development of national as well as international hydropower plans. In a consistency analysis each potential site can be assessed against applicable national and international policies and regulations. Environmental, social and economic values of the basin(s) are taken into consideration. If an SEA process is executed in a participatory and transparent manner, the ultimate decisions may be more acceptable to affected stakeholder groups (see example in Box 2).



Stakeholders in Memve'ele hydropower project, Cameroon, 2008

## *ESIA for (inter)national hydropower projects*

Ideally, the above plan or plans have resulted in the selection of potential hydropower projects. The ESIA can identify alternatives for the purpose, capacity, location and type of hydropower project river run off or reservoir dam. ESIA and its resulting environmental management plan can serve to apply international good practice standards, such as:

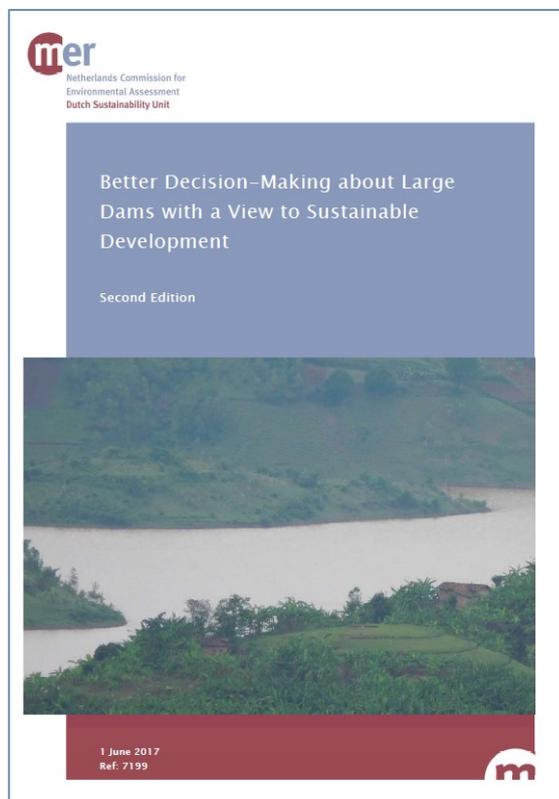
- A participatory process to involve the affected communities;
- Compensation of affected persons and communities for example through payment for ecosystem services, establishing management and tenure by affected people;
- Compensation of biodiversity loss, for example through strengthening or extension of existing protected areas and conservation offset measures.

## To sum it all up: Advantages of SEA and ESIA

- SEA: Better understanding of the cumulative impact of a series of individual hydropower projects, and options to prevent costly and unnecessary mistakes;
- SEA: Better insight in the trade-offs between environmental, economic and social issues, enhancing the chance of finding win-win options;
- SEA: Easier ESIA's for hydropower projects because strategic discussions, for instance about locations and power generation capacity needs, have already been decided upon;
- SEA & ESIA: More efficient assessments due to better alignment of decisions and specific information required;
- SEA & ESIA: More inclusive decision making, leading to enhanced credibility of decisions in the eyes of affected stakeholders, leading to swifter implementation;
- SEA & ESIA: Easier government access to IFI funding, as environmental and social assessments are part of their safeguard requirements.

To improve the credibility and acceptability of assessments in the eyes of affected stakeholders, an independent panel of experts can be established to advise on the quality of the process and the project outcomes.

## NCEA Publication: Better Decision making about Large Dams



Upon request of the Dutch Ministry of Foreign Affairs, the NCEA has analysed the effectiveness of the current dam planning and assessment systems. Based on this analysis, the NCEA has developed options for donors to improve the quality of these processes, so that their outcomes may contribute more to sustainable development. This publication can be found on our website.

### The NCEA

The Netherlands Commission for Environmental Assessment is an independent body of experts. It gives advice to national and international governments on the quality of environmental assessment reports in order to contribute to sound decision making. In addition, the NCEA supports the strengthening of EA systems in low and middle-income countries. The NCEA publicly shares its extensive knowledge of environmental assessment.

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## Box 3: NCEA experiences with SEA and ESIA for hydropower, since 1993

### International hydropower plans & SEA:

- SEA Nile Basin Initiative, SESA of power development options in The Nile Equatorial Lakes Region
- SEA Omo-Gibe, Ethiopia – Kenya – planned

### International hydropower projects & ESIA:

- ESIA Choru-Chorokhi, Turkey – Georgia
- ESIA transboundary multi-purpose dam, Benin – Togo
- ESIA Fomi, Guinea – Mali

### National / provincial hydropower plans & SEA:

- SEA AJK province hydropower plan, Pakistan
- SEA National hydropower plan, Georgia
- SEA Rio Madera, Bolivia

### National hydropower projects & ESIA:

- ESIA Pak Mun, Thailand
- ESIA Arun III, Nepal
- ESIA Ghazi-Barotha, Pakistan
- ESIA Nam Theun II, Lao PDR
- ESIA Bujagali, Uganda
- ESIA Memve'ele, Cameroun
- ESIA Khudoni, Georgia
- ESIA Inga III, Democratic Republic of Congo
- ESIA mini-hydro project, Western Uganda

## Box 4: Examples of other SEAs for hydropower development

### International hydropower plans & SEA:

- SEA Hydropower on the Mekong River
- SEA Sino-Russian hydropower development in the Amur basin
- SESA for Eastern Nile joint multipurpose programme

### National hydropower or basin plans & SEA:

- SEA National hydropower plan, Vietnam
- SEA Quang Nam province hydropower plan, Vietnam
- SEA Uttarakhand basin plan, India
- SEA National hydropower plan, Lao PDR
- SEA Ayeyarwaddy hydropower plan, Myanmar