The Nature Conservancy's Sustainable Hydropower Initiative Kick-Off Meeting

Introductory Reading

DRAFT—Not for circulation or citation.

April 23 - 24, 2014

Bolger Center

Potomac, MD

The Nature Conservancy

Protecting nature. Preserving life.®

Overview

Responding to rising energy demand, hydropower is projected to increase dramatically in the next several decades. The social and environmental sustainability of hydropower is a critical issue for all stakeholders. For funders, developers and energy ministries, concerns about environmental and social impacts represent one of the largest challenges to deployment of new hydropower. Conservation and social NGOs and environmental agencies recognize that poorly planned hydropower will have significant impacts on rivers and the communities that depend on them. Thus, we all have a strong interest in ensuring that hydropower is as sustainable as possible.

To advance that goal, The Nature Conservancy is greatly increasing its emphasis on sustainable hydropower through collaborative engagement with the sector to find shared solutions. For the upcoming conference, we have asked global hydropower leaders from governments, funders, developers, academia and NGOs to join us and engage in a constructive dialogue.

This concise pre-reading provides an overview of the ideas and hypotheses we will cover during the event. We are primarily focused on learning from you and getting your advice on how we can be most effective and how we can collaborate. Below are the summary set of questions that we have for your initial thoughts - we'll have many more when we meet in person.

Thanks in advance for your contributions.

- Questions For Thought -

1. What are the best examples of sustainability at the level of an individual dam?

2. What sustainability issues cannot be effectively addressed at the level of individual dams?

3. Is there a business case that can be made for better basin or system-scale planning of hydropower?

    a) For developers?

    b) For funders?

    c) For energy planning agencies?

4. If system planning can help address some key issues of hydropower sustainability, what are the primary constraints to broader use of system planning and how can they be overcome?

5. What are the opportunities for positive engagement with the Chinese hydropower sector—how can we help the sector move toward greater sustainability?

6. To advance any of these concepts – individual dam sustainability, system-scale planning, positive engagement with China – what are the key roles that an NGO like The Nature Conservancy can play? What kind of capacity does an NGO need to be effective?

Hydropower Situation Analysis

"The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable — environmentally, economically, socially. But that can — and must — be altered; there's still time to change the road we're on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply.

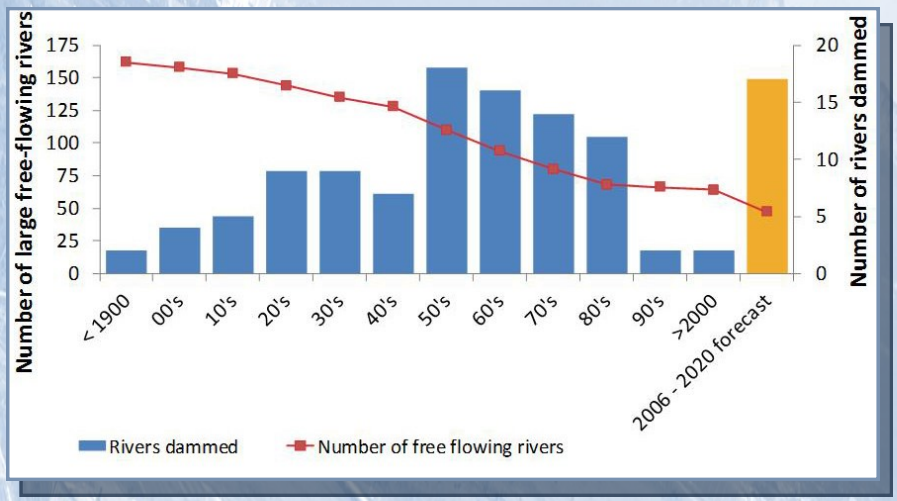
What is needed is nothing short of an energy revolution."

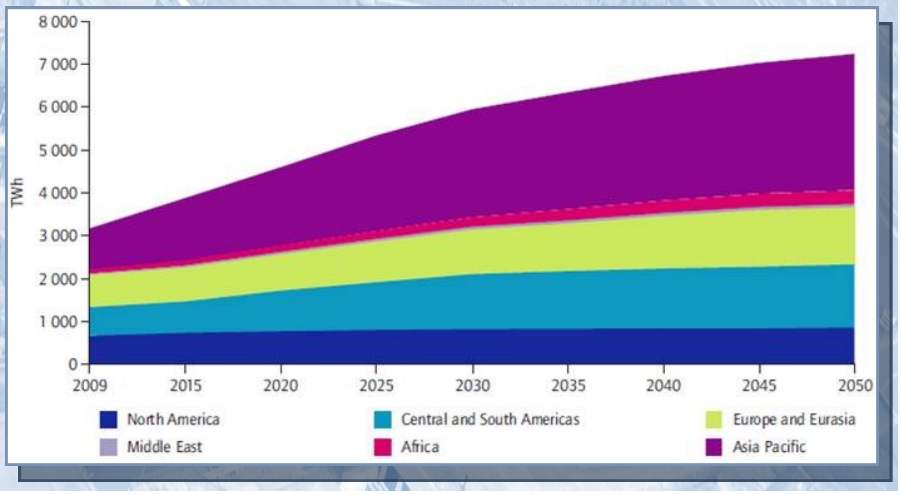
- IEA WEO 2008

⇒ **Historically, capacity growth was largest in the 1950s—1980s, and has been recovering since the 2000s to a level of ~30 GW/year.**

⇒ **At this level, capacity and generation may double until 2050.**

⇒ **A doubling of capacity and generation is also projected by the International Energy Association (IEA) in models that show the most cost-effect means to limit global warming to 2°C.**



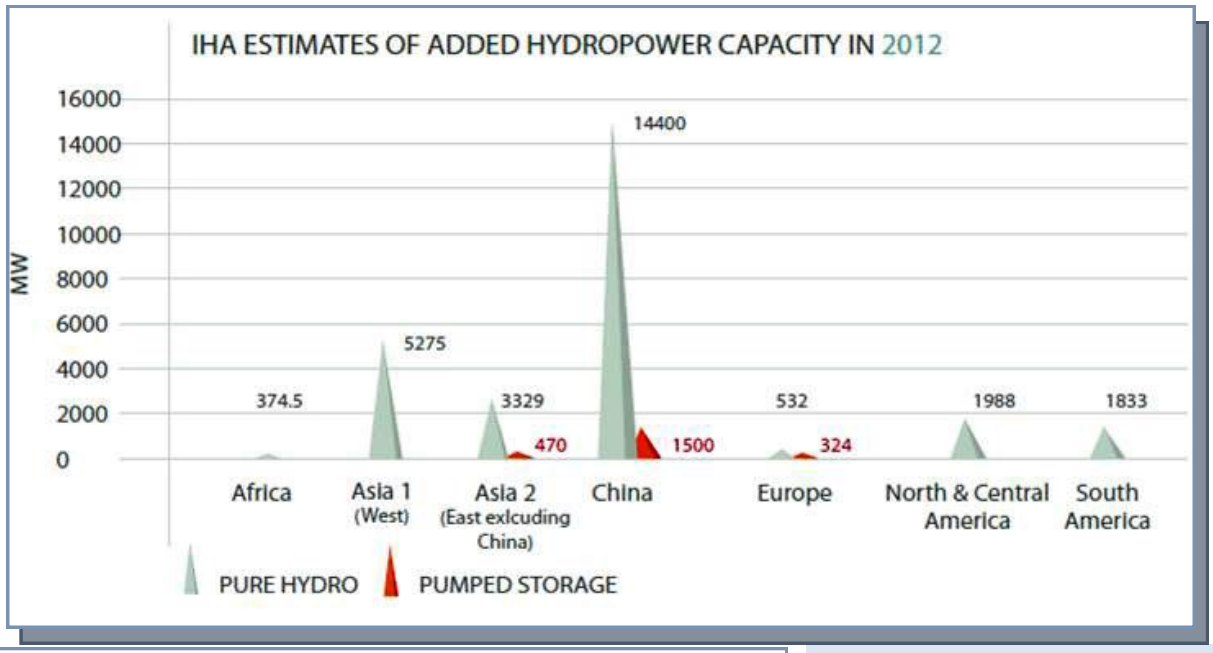


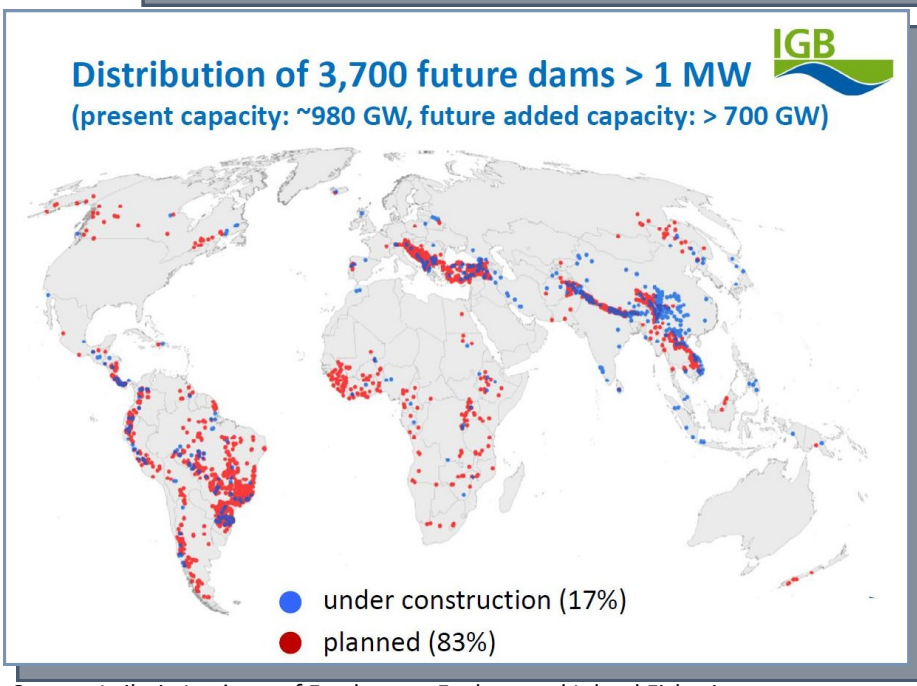
Hydropower Situation Analysis

⇒ **Growth has shifted to China and will continue to spread to other emerging economies.**

⇒ **Hydropower is an attractive low-cost, indigenous, low-carbon, and high-value source of energy, and an economic development opportunity.**

⇒ **The shift to emerging economies also implies a shift in the most important government agencies, developers, contractors and funders behind hydropower.**





Source: Leibniz-Institute of Freshwater Ecology and Inland Fisheries

⇒ Doubling generation requires the construction of approximately 9,000 additional large dams and an investment of $3.3 trillion.

⇒ The river basins where growth will be concentrated contain the greatest diversity of freshwater species and also are the places where local communities depend most heavily on riverine resources.

Hydropower Situation Analysis

⇒ For investments to materialize, a number of constraints have to be overcome, including significant impacts, mixed performance and mixed reputation of hydropower .

⇒ A business-as-usual expansion scenario may run into increasing opposition.

⇒ A sustainable scenario may be slower and costlier initially, but may ultimately obtain more political support.

⇒ Government licensing regimes, voluntary project-level initiatives, and system-scale planning and optimization can all contribute to sustainability.

⇒ Enough is known about how to 'select the right projects and then build them right', but there is still a significant implementation gap.

If we maintain business as usual…

Or instead, promote a sustainable future…

"The significant increase in hydropower capacity over the last 10 years is anticipated in many scenarios to continue… *with various environmental and social concerns representing perhaps the largest challenges* to continued deployment if not carefully managed."

Source: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011

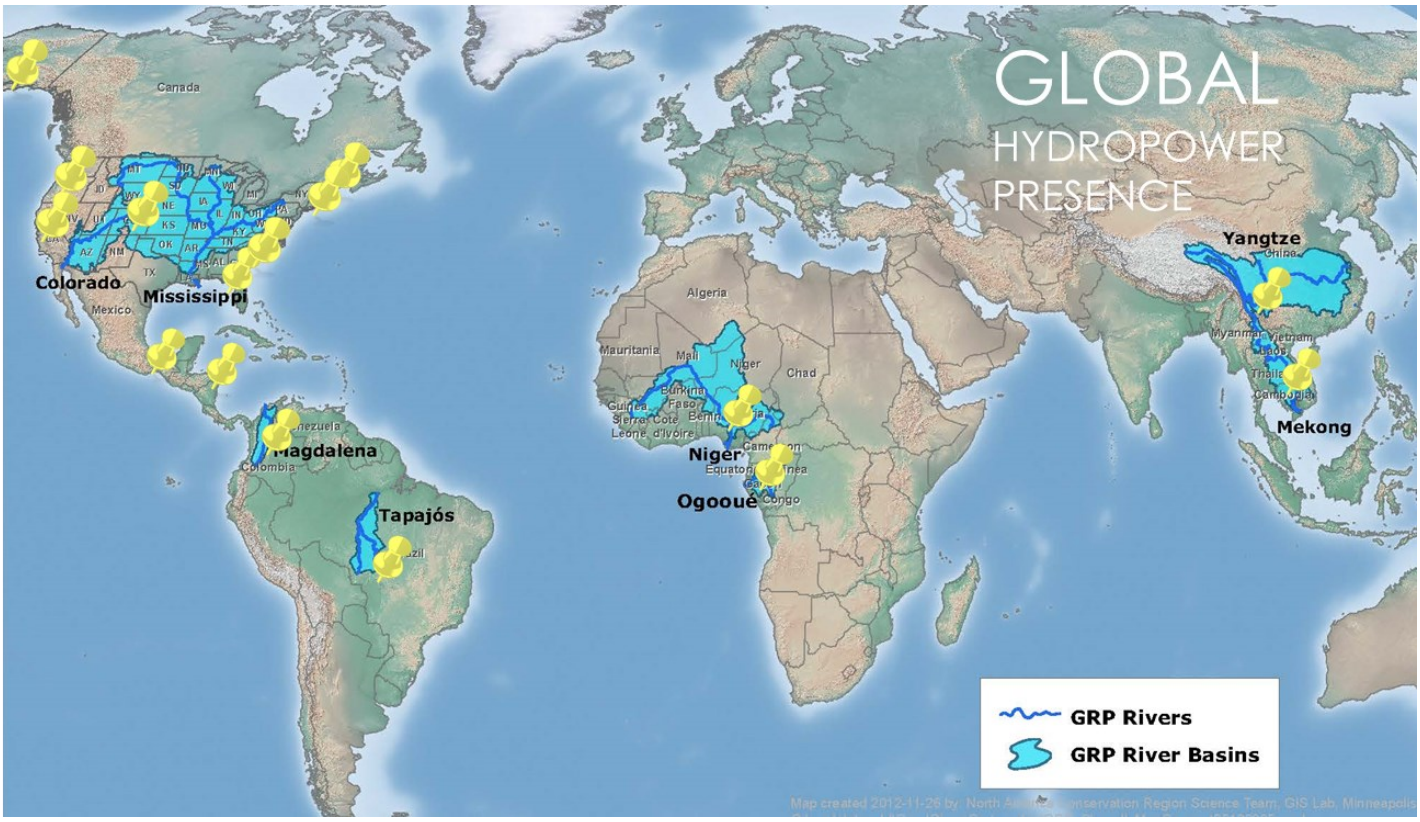
'Select the right projects and then build them right…'

Hydropower Situation Analysis

- Questions For Thought -

- ⇒ **Can we agree on the overarching challenge for hydropower? Can we define it?**
- ⇒ **What does success look like for sustainable hydropower? Can we describe it in terms of processes and outcomes?**
- ⇒ **Does it make sense to think of two alternative pathways for hydropower—ones that is business as usual and one that is sustainable?**

The Nature Conservancy and Hydropower: Strategies, Hypotheses, and Questions



Drop pins represent where The Nature Conservancy and The Great Rivers Partnership is currently working or previously worked on projects on hydropower.

The Nature Conservancy's work on sustainable hydropower is part of **The Great Rivers Partnership** (GRP), one of the Conservancy's 10 global priorities.

The GRP encompasses six river basins with conservation programs lead by the Conservancy: **The Yangtze** (China), **the Ogooué** (Gabon), **the Tapajos** (Brazil), **the Magdalena** (Colombia), and **the Mississippi** and the **Colorado** (United States).

Two other rivers are lead by partners with the GRP: **the Mekong** (World Wildlife Fund and International Union for Conservation of Nature) and **the Niger** (International Union for Conservation of Nature).

The Nature Conservancy and Hydropower: Strategies, Hypotheses, and Questions

The Conservancy's work on hydropower builds on two decades of engaging with water management agencies and dam operators on the environmental performance of dams, including partnerships with the U.S. Army Corps of Engineers, the China Three Gorges Corporation, and Mexico's Federal Commission for Electricity. Our work has focused at multiple scales, including:

⇒ Improving the environmental performance of individual dams through design and operations, including the release of environmental flows (see photo—an environmental flow release from the U.S. Army Corps' Alamo Dam on the Bill Williams River in Arizona), as well as in projects in China, Honduras, and throughout the United States.

⇒ Basin-scale restoration and energy projects (particularly the dam removal and connectivity work in the Penobscot River in Maine) and incorporating environmental sustainability into basin planning for new hydropower, with related projects in Mexico, Colombia, Brazil, and Gabon.

⇒ Developing new science, policies, and implementation tools.

Memorandum of Understanding signing between The Nature Conservancy and Three Gorges Corporation and the environmental flow release at U.S. Army Corps' Alamo Dam on the Bill Williams River in Arizona.

A restoration and hydropower project on the Penobscot River in Maine illustrates a basic principle: that within a river basin, there may be multiple ways to achieve a given energy target. Exploring these alternatives at the scale of whole system can provide optimum balance across the multiple benefits rivers provide.

The work in the Penobscot River increased access to roughly 1,000 miles (1609 km) of fish habitat, while also slightly increasing energy generation on the river.

OUR STRATEGY

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Decisions and actions made in the next decade will largely determine whether hydropower development unfolds in a sustainable manner. Recognizing the critical opportunity, The Nature Conservancy intends to increase the resources it dedicates to sustainable hydropower. Working with a range of partners, we will focus on three main themes:

Lead the way

Increase capacity

Deliver results & build the toolkit

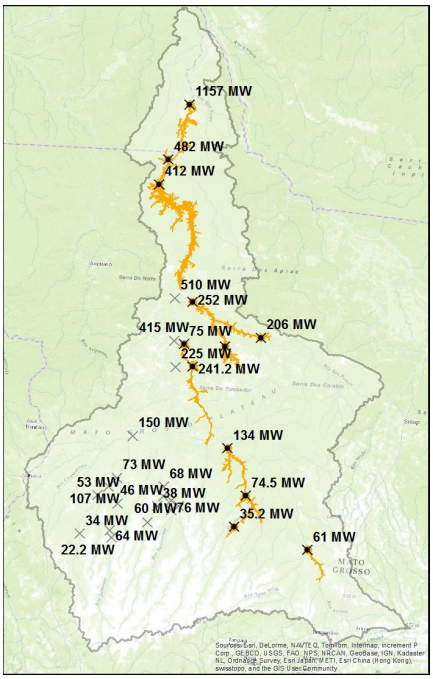
LEAD THE WAY

⇒ Help define a sustainable path for hydropower.

⇒ Identify the most effective interventions.

⇒ Communicate to key audiences what the world will look like if we can foster more sustainable hydropower.

⇒ Through research and synthesis, provide the critical analyses and information and develop and promote new tools and approaches.

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Water hub
From Guardian Sustainable Business

It's a mistake for NGOs not to engage with hydropower companies

Hydropower may be controversial, but NGOs must engage with the hydropower community to ensure the impact is positive

Giulio Boccaletti
Guardian Professional, Monday 19 August 2013 12.32 EDT

Hydropower Sustainability Assessment Protocol

Our Strategy—Lead The Way

- Questions For Thought -

- ⇒ **What types of analyses are needed to help define the sustainability challenge?**
- ⇒ **What types of analyses are needed to overcome constraints or address uncertainty?**
- ⇒ **What role can NGOs play in communicating the value of sustainable hydropower?**

INCREASE CAPACITY

⇒ Raise funds to build the capacity of the Conservancy and partners to deliver solutions in key places, including in Asia, Africa, and Latin America.

⇒ For example, we are proposing to launch a China Center for Sustainable Hydropower to increase the number of people and resources available to promote sustainable hydropower within the Chinese hydropower sector. Potential strategies or roles of the China Center may include:

- ⇒ Serving as a resource for the Conservancy's field programs in regions with major engagement by the Chinese hydropower sector: serve as the "connective tissue" between local conservation staff, in-country hydropower staff, and Beijing headquarters.
- ⇒ Building capacity and promoting the best practices to Chinese companies.
- ⇒ Creating technical collaborations with the Chinese hydropower sector.
- ⇒ Fostering potential partnership with Chinese-based institution or China-focused institution (e.g. the Paulson Institute).

Chinese companies are involved in nearly half of all dam development outside of China, with extensive activity in Southeast Asia and Latin America.

Map Source: International Rivers

Our Strategy—Increase Capacity

- Questions For Thought -

- ⇒ **Globally, what sort of capacity is most needed from NGOs, and located where?**
- ⇒ **What are the opportunities for positive engagement with the Chinese hydropower sector—how can we help the sector move toward greater sustainability?**
- ⇒ **Specifically to engage constructively with the Chinese hydropower sector, what capacity do NGOs need?**
- ⇒ **What are the key companies and agencies we should be engaging with?**

BUILD THE TOOLKIT

Working across the globe, The Nature Conservancy will test and refine interventions to demonstrate what works at three levels:

Individual dams

Basin planning & management of hydropower

Policy and institutional implementation mechanisms

Individual dams

There are numerous ways to improve the sustainability of individual dams, from design features that allow for fish and sediment passage and improve water quality to operations, including environmental flows.

- Questions For Thought -

⇒ **What is the full potential of sustainability that can be realized at the scale of individual dams?**

⇒ **What is the gap; i.e., even with the most sustainable individual dam, what issues or impacts are not effectively addressed?**

⇒ **What are the cost implications of designing and operating the "most sustainable" individual dam?**

⇒ **Are we failing to explore or pursue any opportunities for improved environmental and social performance of individual dams?**

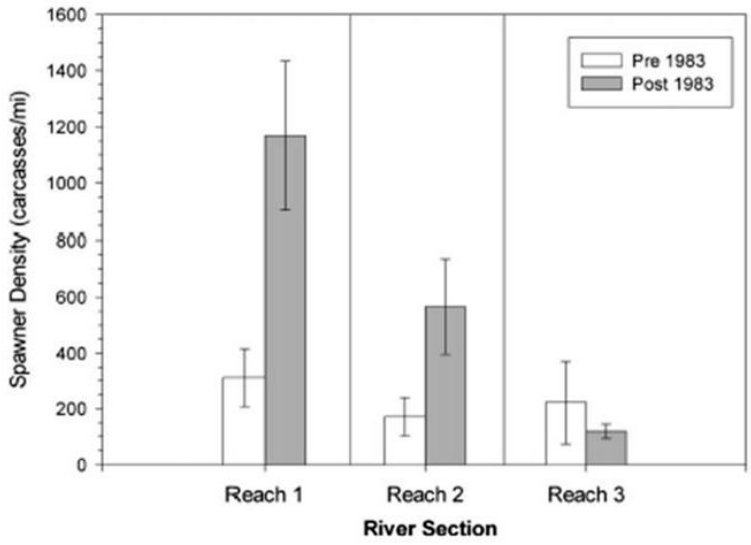


FIGURE 5.—Mean density of pink salmon spawner carcasses (±SE) in odd-numbered years during 1959–1981 (pre-1983) and 1983–2001 (post-1983) within three reaches of the upper Skagit River, Washington, downstream of the Skagit Hydroelectric Project.

At the Skagit Hydroelectric Project (Seattle City Light, Washington state US), dam operations were modified (post 1983) to promote spawning and minimize the dewatering of salmon redds (nests with eggs) and stranding of juvenile salmon. The changed flows resulted in significant increases in the abundance of pink and chum salmon (and significant relative to other rivers in the region). Abundance of Chinook salmon remained consistent in the Skagit, while Chinook populations declined in other rivers in the region. Effects were most pronounced in the reach closest to the project (Reach 1).

Connor, E. J. and Pflug, D. E. (2004). Changes in the distribution and density of pink, chum, and chinook salmon spawning in the upper Skagit River in response to flow management measures. *North American Journal of Fisheries Management*.

Basin Planning & Management of Hydropower

To illustrate the possibility of reaching an optimum design between hydropower development and social and environmental values at the scale of a river basin, we conducted a hypothetical scenario analysis. The Nature Conservancy is currently applying similar analyses in real basins, such as the Coatzalcoalcos basin in Mexico, in a collaboration with the Federal Commission of Electricity. Because these efforts are ongoing, we cannot yet present their results.

The analysis was based on a river basin with a spatial distribution of three value sets: hydropower output and cost, social values, and environmental/ecological values. The indigenous/social value set is represented by a single variable, which is the spatial distribution of indigenous reserves. We acknowledge this is a major simplfication and, in a real-world application, a broader range of values will likely need to be represented. For environmental/ecological values we have used available information from TNC, World Wide Fund for Nature (WWF) and others, and, where necessary, we augmented it with hypothetical, but realistic data.

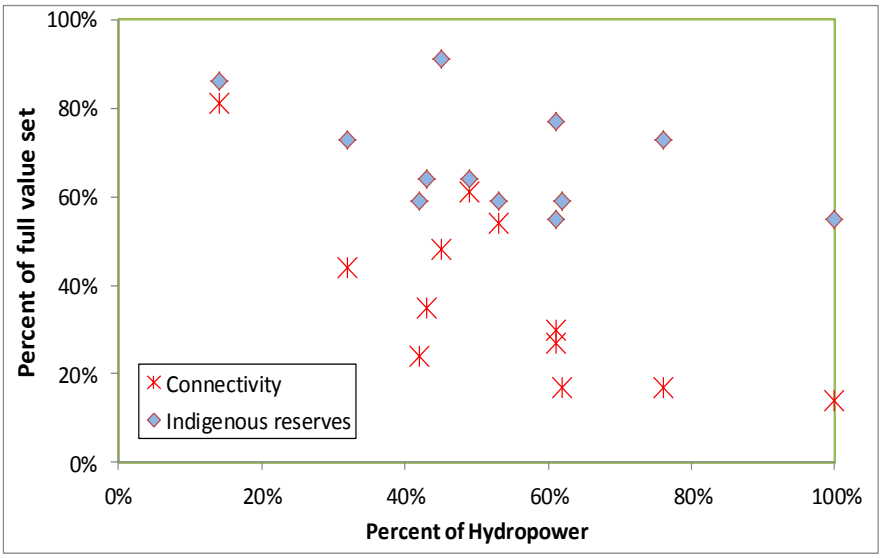
We generated a total of 12 scenarios, starting with a trio of extreme cases: (1) full hydropower devlopment; (2) hydropower development that has minimal impact on indigenous areas; and (3) hydropwer development with minimal impact on envrionmental/ecological values. Next, we developed another trio of scenarios, each intended to produce approximatley 60% of the value of each of the three value sets. We then developed six further scenarios that explored different geographic objectives for development, such as concentrating dams in the lower reach of the river and leaving the majority of the upper basin undeveloped (scenarios 7 and 8) or leaving the southwest tributaries undeveloped (scenario 9).

Scenario	Name	Cost	Hydro	Indig.	Biodiv.	Connect.
1	Full Hydropower Potential	100%	100%	55%	51%	14%
2	Minimize Indigenous Impact	88%	45%	91%	77%	48%
3	Minimize Biodiversity Impact	89%	14%	86%	100%	81%
4	Develop 60% of Hydropower	104%	62%	59%	68%	17%
5	Protect 60% Indigenous	103%	76%	73%	66%	17%
6	Protect 60% Biodiversity	96%	42%	59%	68%	24%
7	Maximum development in lower river (1)	105%	61%	77%	73%	27%
8	Maximum development in lower river (2)	108%	43%	64%	72%	35%
9	Free upper southwest tributaries	110%	32%	73%	82%	44%
10	Free lower and east tributaries (1)	111%	49%	64%	74%	61%
11	Free lower and east tributaries (2)	108%	53%	59%	72%	54%
12	Free east tributaries	110%	61%	55%	61%	30%

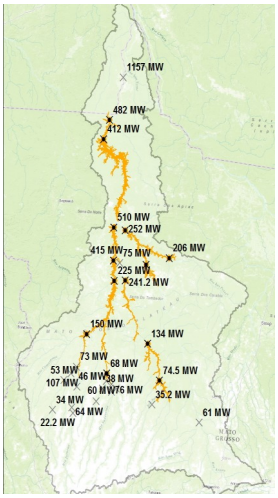
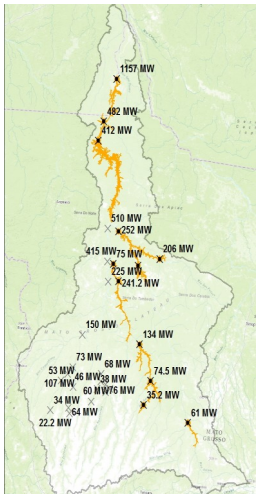
Basin Planning & Management of Hydropower

The results suggest some general trends. First, as the percentage of hydropower increases, the other values generally decrease; this is the obvious expectation .

Within the general trend, however, the results illustrate a key concept underpinning the agrument for system-level planning: for a given energy output, there can be a fairly wide range in the output of other values. For example, compare scenarios 4 & 7 in the table below. Additionally, observe the cluster of scenarios that develop between 40% and 50% of hydropower in the figure above and note the wide spread in connectivity values (24 – 61%) and indigenous values (59 – 91%).



These results support the premise that system-scale planning has a greater likelihood of acheiving a balance of benefits than can be achieved through project-scale planning and development.

Value	Scenario 4 (Developed 60% of hydropower)	Scenario 7 (Max. development of lower river)	% Difference between scenarios 7 and 4
			
Hydropower (% of total)	62	61	-2%
Indigenous intact (% of total)	59	77	+31%
Biodiversity intact (% of total)	68	73	+7%
Connectivity intact (% of total)	17	27	+59%

Basin Planning & Management of Hydropower

- Questions For Thought -

⇒ **What are the best existing examples of basin planning and what can we learn from them?**

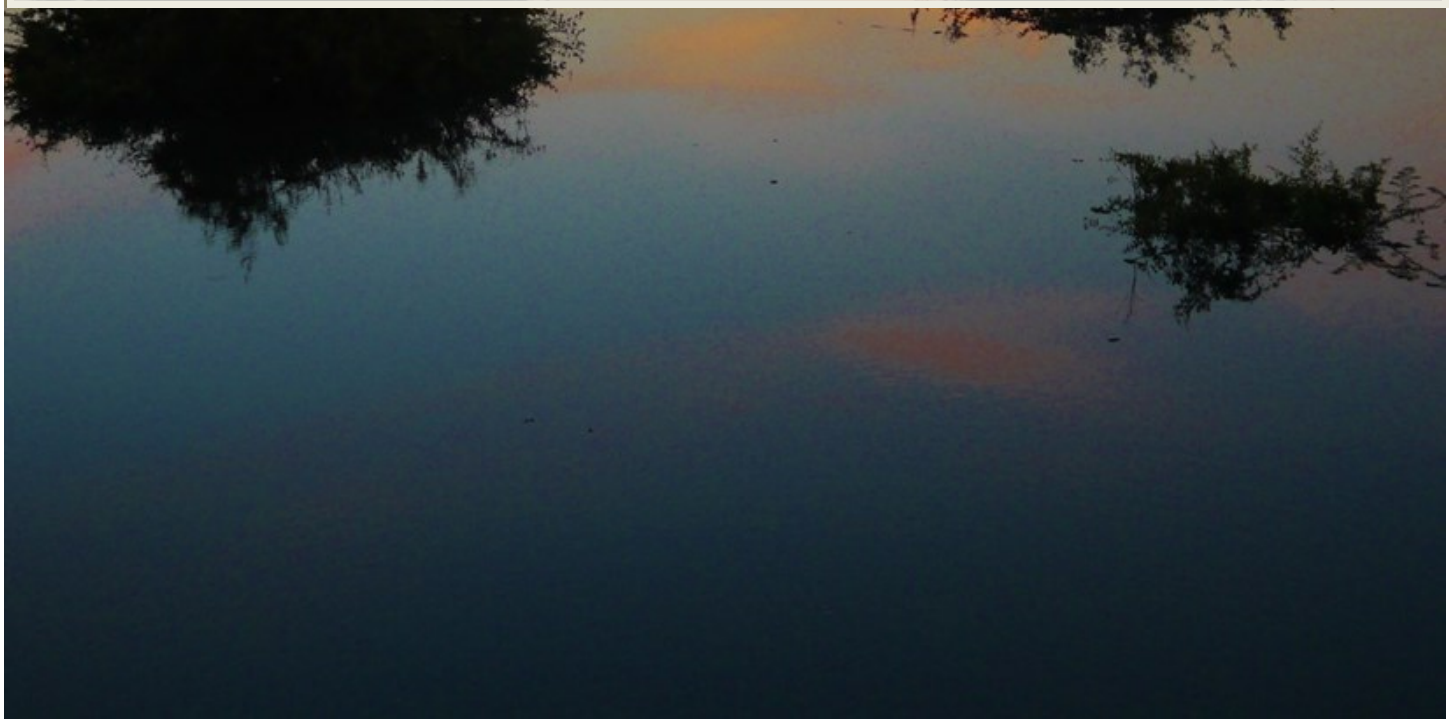
⇒ **Is there a business case to be made for better basin or system planning?**

- **For developers?**
- **For funders?**
- **For planning and licensing agencies?**

⇒ **To increase prevalence of basin planning:**

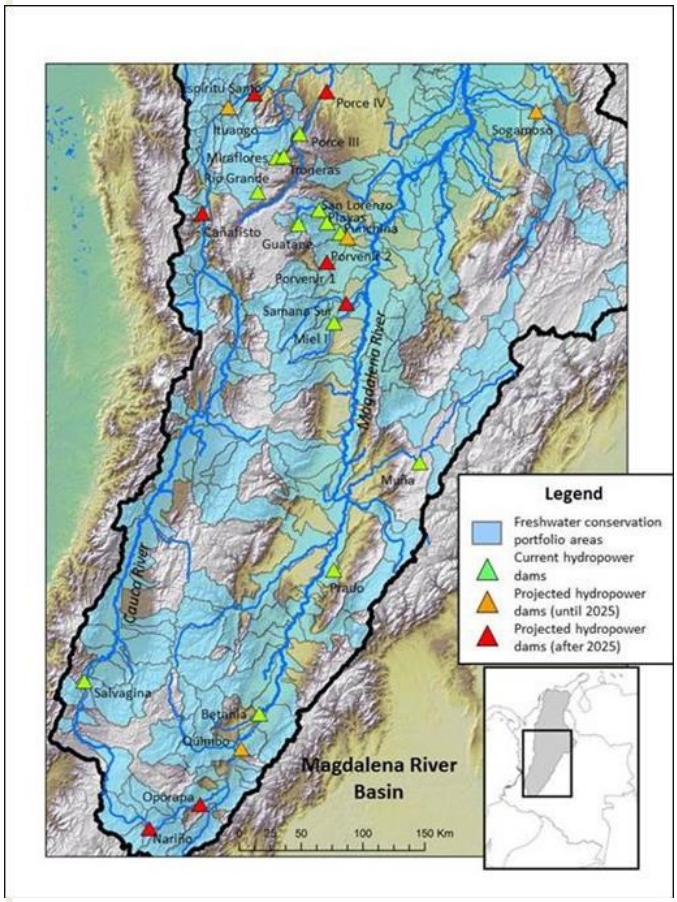
- **What are the constraints and possible solutions to them?**
- **Who should an NGO engage with? What are the best strategies for an NGO to pursue?**

⇒ **How can we link basin-planning to individual-dam planning and development?**



Policy and Institutional Implementation Mechanisms

Advances in either the sustainability of individual dams or system planning require implementation mechanisms to make them real, durable, and more replicable. The Conservancy has worked on a variety of implementation mechanisms intended to advance sustainable hydropower at regional, national or global scales. Examples include:



Licensing and mitigation for infrastructure, including compensation schemes. In Colombia, the Conservancy is developing the methods for applying a compensation scheme as part of licensing and environmental mitigation for major projects. This will link the licensing of new water infrastructure projects in the Magdalena basin to a blueprint of freshwater conservation priorities that was developed previously (see figure at left).

Hydropower Sustainability Fund. We have conducted research-level analysis of a sustainability fund for a cascade of hydropower dams in the upper Yangtze River, focused on the potential to reallocate a large portion of flood-management storage in the reservoirs toward hydropower generation, and to use a portion of the increased hydropower revenue to fund conservation and downstream improvements in flood-risk management (potentially more effective than reservoir-based flood management). We are currently exploring the potential for sustainability funds in other basins and other management contexts.

The Hydropower Sustainability Assessment Protocol. The Conservancy and WWF were the two conservation NGOs that helped write the Hydropower Sustainability Assessment Protocol. We are now part of the Governance Committee and are working to encourage the adoption, use and refinement of the Protocol with a variety of partners in the hydropower sector.

Hydropower Sustainability Assessment Protocol

Policy and Institutional Implementation Mechanisms

- Questions For Thought -

- ⇒ **What is the potential for licensing and compensation schemes to link individual projects with basin-scale solutions to achieve greater sustainability?**
- ⇒ **Are there examples of "sustainability funds" that we can learn from?**
- ⇒ **What is the potential for the Protocol, including its Early Stage, to result in better dams?**