

Perspectives for Hydropower in Colombia



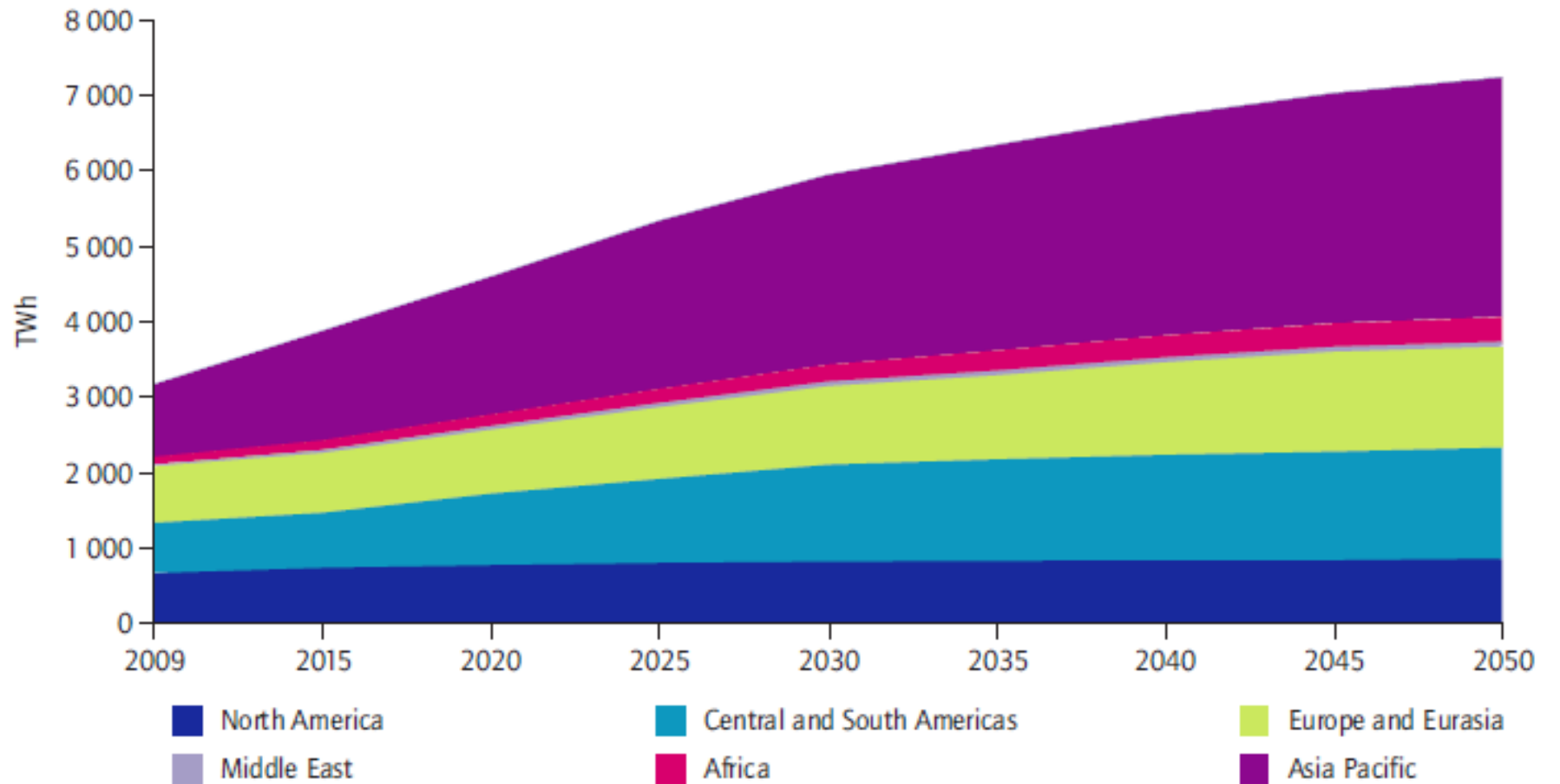
Joerg Hartmann
Encuentro Anual del Sector Energético Colombiano
Bogotá 7 de Octubre 2014

Arguments for More Hydropower

- lowest-cost source of power in many countries → can facilitate access to electricity and improve competitiveness
- economic development opportunity → exports of power, or of power-intensive products such as aluminium
- domestic source → can reduce fuel imports and increase energy security
- low-carbon source → if it all displaced coal, would reduce CO₂ emissions by ~ 3.8 bn tons per year
- high-value, dispatchable source → can enable energy storage and integration of wind and solar

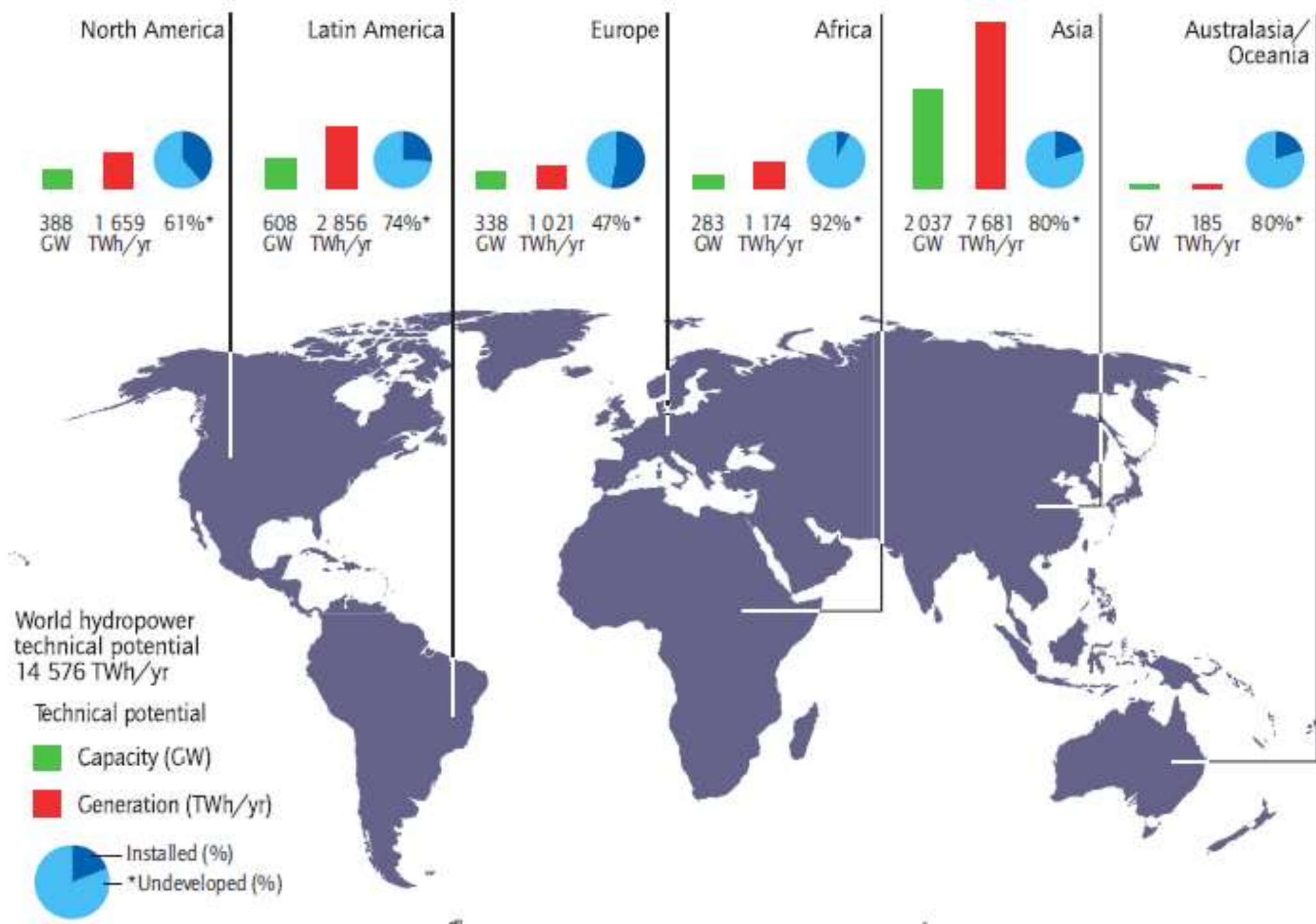
- **Potential for Investment**
- **Barriers to Investment**
- **Overcoming Barriers**

Projected Global Growth



- IEA projects doubling of generation by 2050
- Requires ~ 9,000 large and many more small projects;
~ USD 3 trillion investment

Global Technical Potential

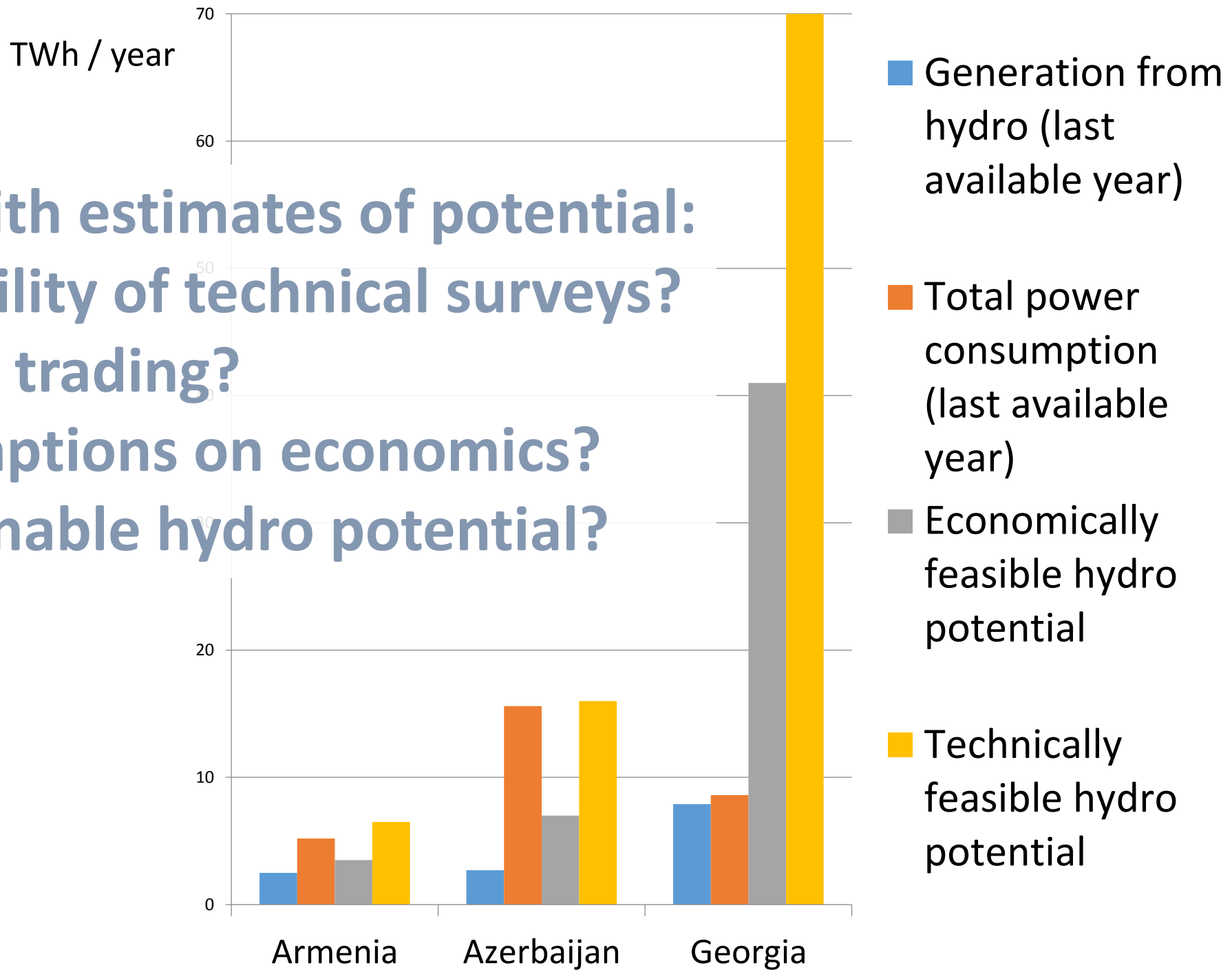


Potential in Colombia

- Estudio del Sector de Energia Eléctrica (1979), Inventario de los Recursos Hidroeléctricos (DNP – ISA): 308 projects above 100 MW, with an installed capacity of 93 GW
- IDEAM-UPME, synthetic potential calculations:
average annual potential of 53 GW in large basins, between 74 GW in July and 29 GW in January
- UPME, Plan de Expansión 2010-2024:
avoiding intervention of protected areas reduces potential from 93 GW to 79 GW

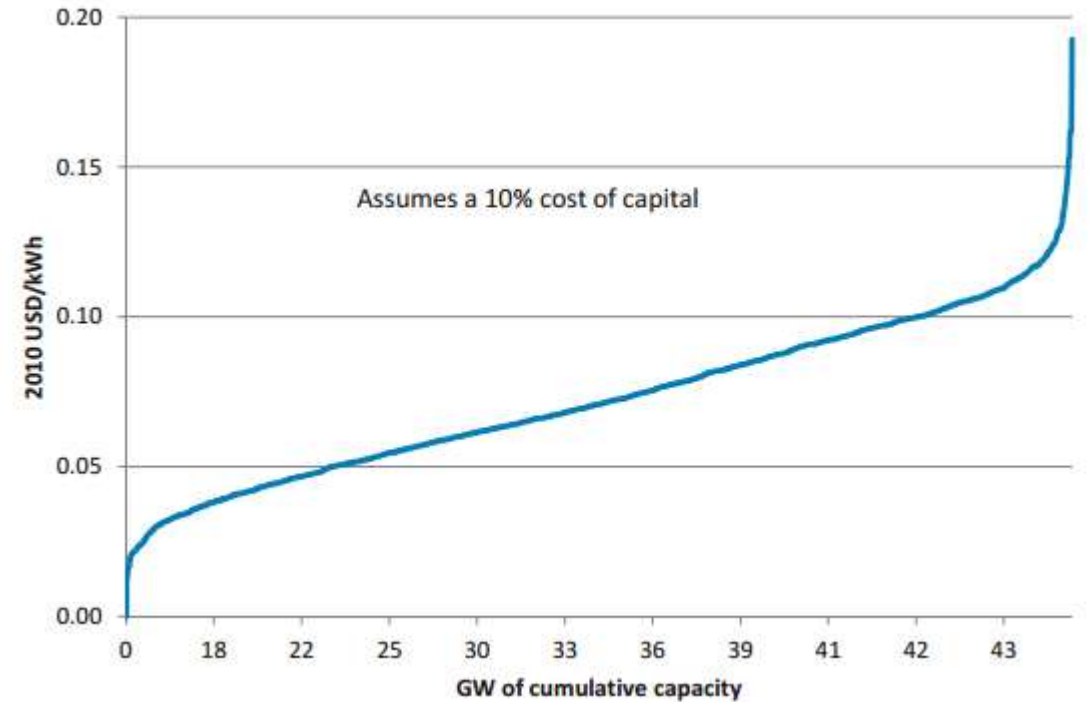
Issues with estimates of potential:

- Reliability of technical surveys?
- Power trading?
- Assumptions on economics?
- Sustainable hydro potential?



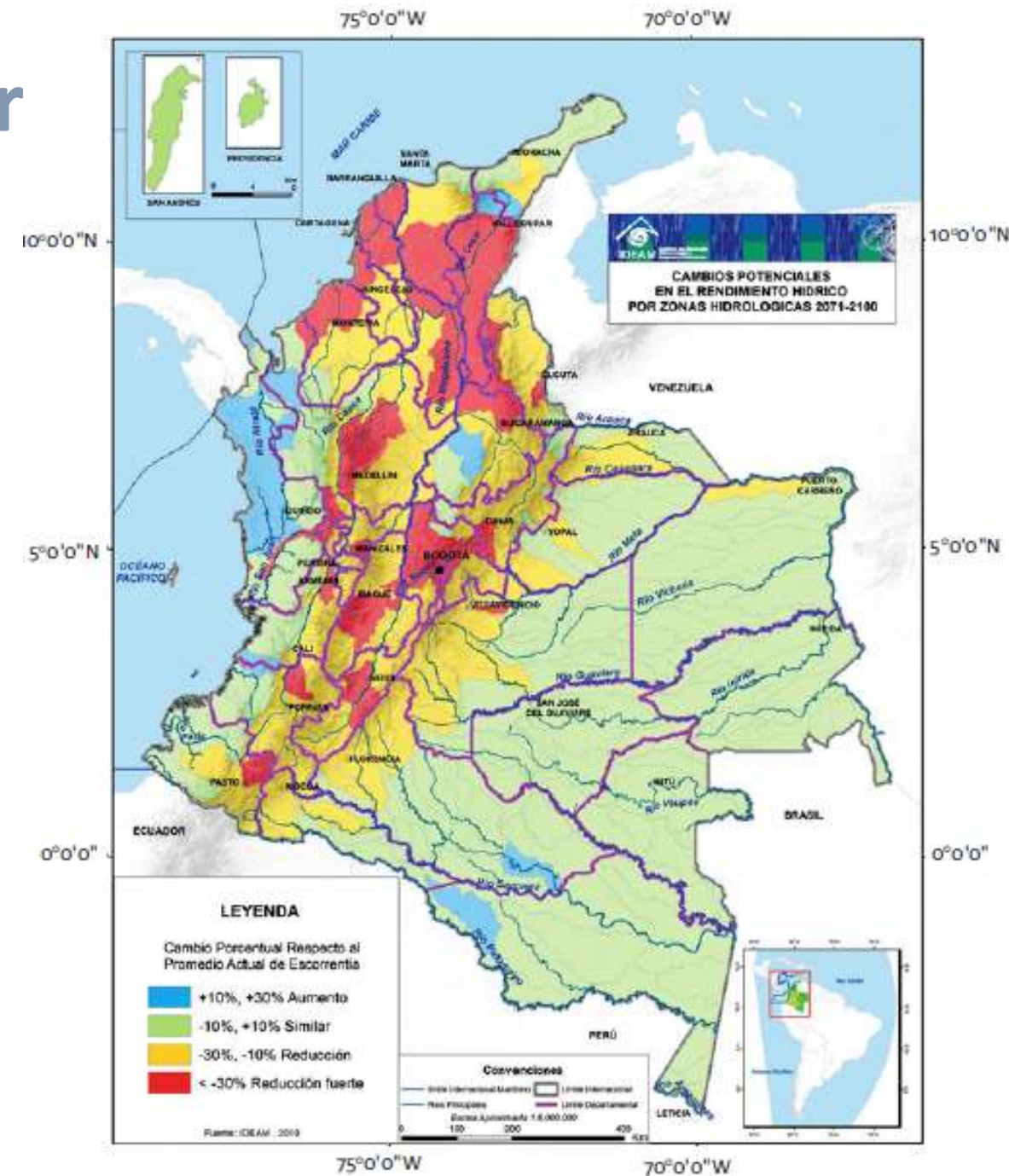
Cost Competitiveness as a Barrier

- Hydropower is a mature technology and costs are expected to increase in line with inflation
- Costs of new hydro projects will increase as best sites get developed first
- Costs of fossil fuels are expected to rise; costs of new renewables (solar, wind) are expected to decrease
- Expansion of new renewables creates new opportunities for hydro



Water Availability as a Barrier

Population growth, economic development and climate change affect runoff and water demand by different sectors in multiple ways



Public Acceptance as a Barrier

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

IPCC (2012)

Role of Planning and Assessment: Ensuring Quality

- Project quality matters more for hydropower than for any other source of electricity
- Each site is unique and calls for unique technical, environmental and social solutions
- Quality depends on selecting the right projects and implementing them correctly
- Quality is a balancing act between multiple dimensions (technical, financial, economic, environmental, social)
- Every project is an ambassador for the sector

Best Practices

Avoidance, Minimization,
Restoration, Offsetting

“New projects will only be built if they are

- profitable under market conditions
- environmentally acceptable, and
- **well received** by the local communities”

→ Stakeholder Support,
Social License to Operate

Good Practices

Damage Limitation

→ Reluctant Acceptance
by Stakeholders

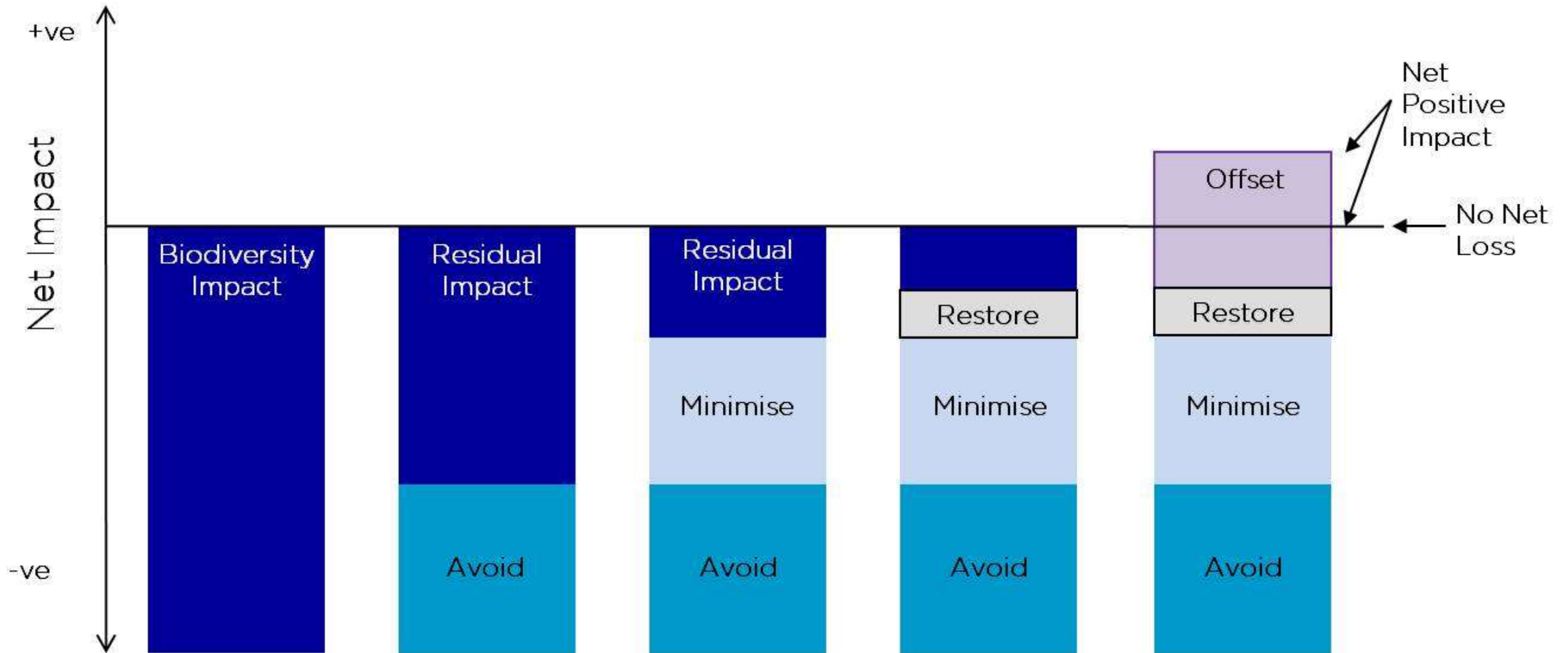
Bad Practices

Some Mitigation

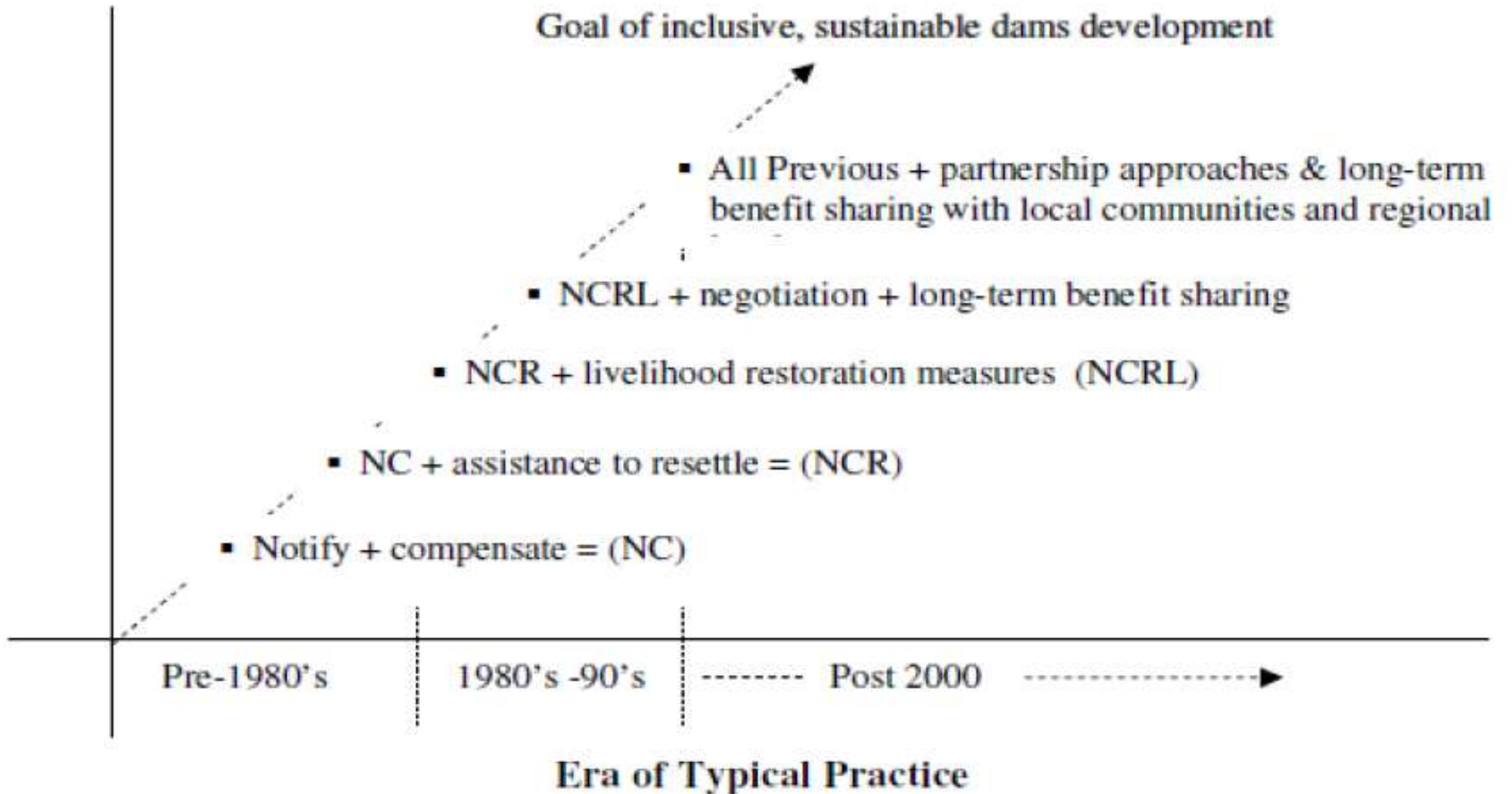
“While dams have made an important and significant contribution to human development, in too many cases an **unacceptable and often unnecessary price** has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment.”

→ Stakeholder Resistance

The Mitigation Hierarchy: Net Environmental Gains

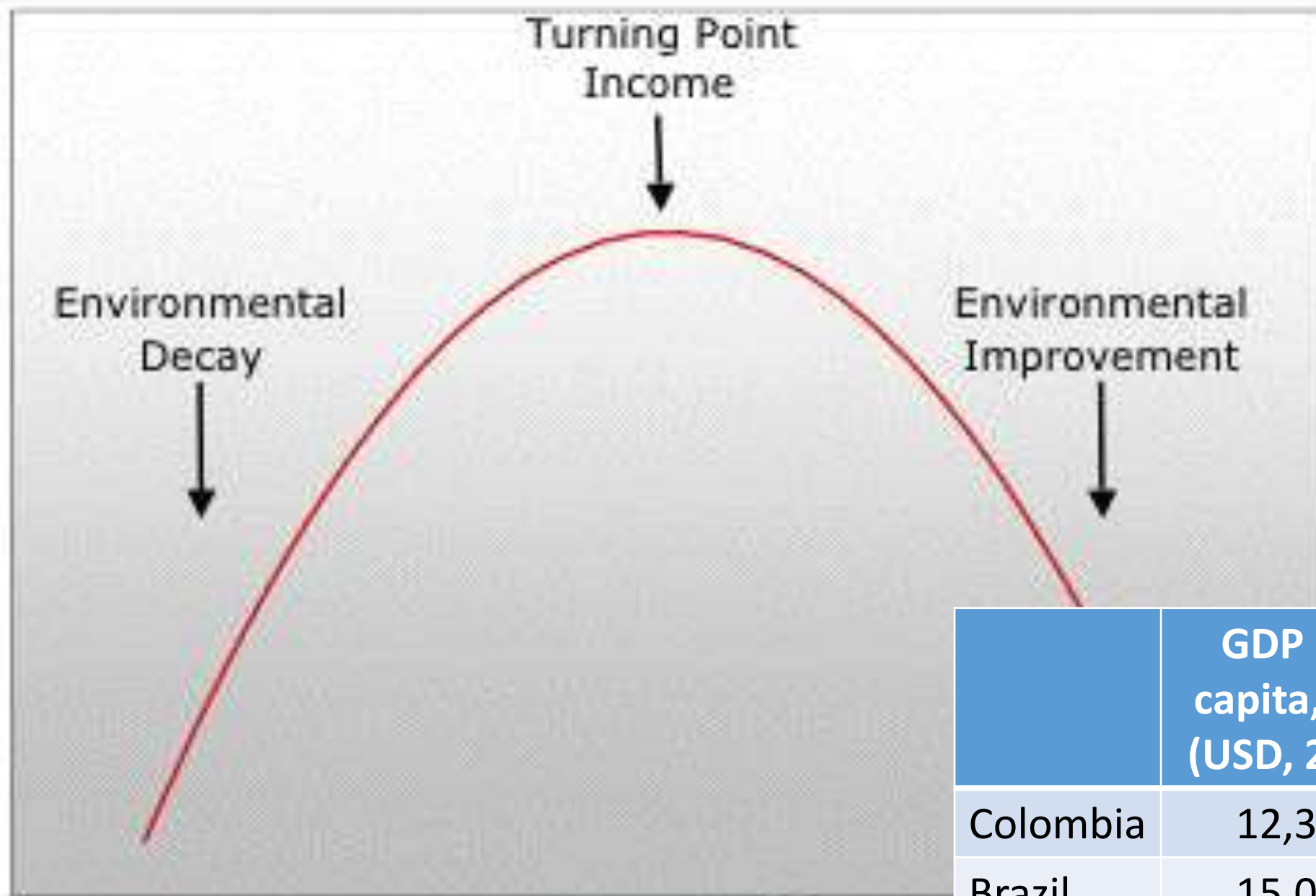


The Mitigation Hierarchy: Net Social Gains



Changing Barriers over Time

Environmental Deterioration



Per Capita Income

	GDP per capita, PPP (USD, 2013)	GDP growth, 2014
Colombia	12,371	4.5%
Brazil	15,034	1.8%
Chile	21,911	3.6%



 **REUTERS**

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Chile presidential favorite says HidroAysen project not viable

Mon, Jun 24 2013

SANTIAGO (Reuters) - Chilean presidential favorite Michelle Bachelet said on Sunday night she is against the planned 2,750-megawatt HidroAysen hydropower project, suggesting the controversial complex still faces an uphill battle.

Bachelet, a popular center-leftist who served as president of the world's top copper-exporting nation from 2006 to 2010, is widely expected to win a November 17 presidential election against a weakened right-wing bloc.

"I'm not in favor of HidroAysen and I don't think it's viable," Bachelet said during a televised debate with three other presidential candidates vying for the left-wing bloc's nomination. "It shouldn't go forward," she added.

Chile's supreme court approved HidroAysen's five generating units, but environmentalists then brought the project to a special ministerial group for review.

Opponents slam HidroAysen on the grounds it would harm pristine Patagonia's environment and tourism.

Many analysts say the project, a political hot potato, is likely to remain in limbo until after the election.



Bachelet apaga la luz a HidroAysén

En conjunto, Endesa y Colbún han invertido más de US\$ 320 millones en sacar adelante durante siete años el proyecto que pretendía generar 2.700 megawatts en hidroelectricidad, y aunque parte de esa cifra la constituyen activos como derechos de aguas, terrenos, estudios y prospecciones, un monto significativo tendrá que ser asumido como pérdida.

Agenda de Energía, Gobierno de Chile, 2014:

“Se hace necesario llevar a cabo un proceso de planificación territorial energética para el desarrollo hidroeléctrico futuro [...]. Este proceso partirá desde un mapeo y análisis de cuencas, basado en criterios técnicos hidrológicos y geológicos, ambientales, económicos y socioculturales”

Increasing Calls for System-Level Information

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More than 120 Brazilian hydro projects could be stalled by environmental assessment concerns

A Brazilian federal court has ruled that environmental permits for 126 hydropower proposals in the Upper Paraguay River Basin cannot be issued without completing environmental impact assessments, HydroWorld.com has learned.

The injunction is a response to a request from state and federal prosecutors in the Brazilian states of Mato Grosso do Sul and Mato Grosso -- both located in the country's western region.

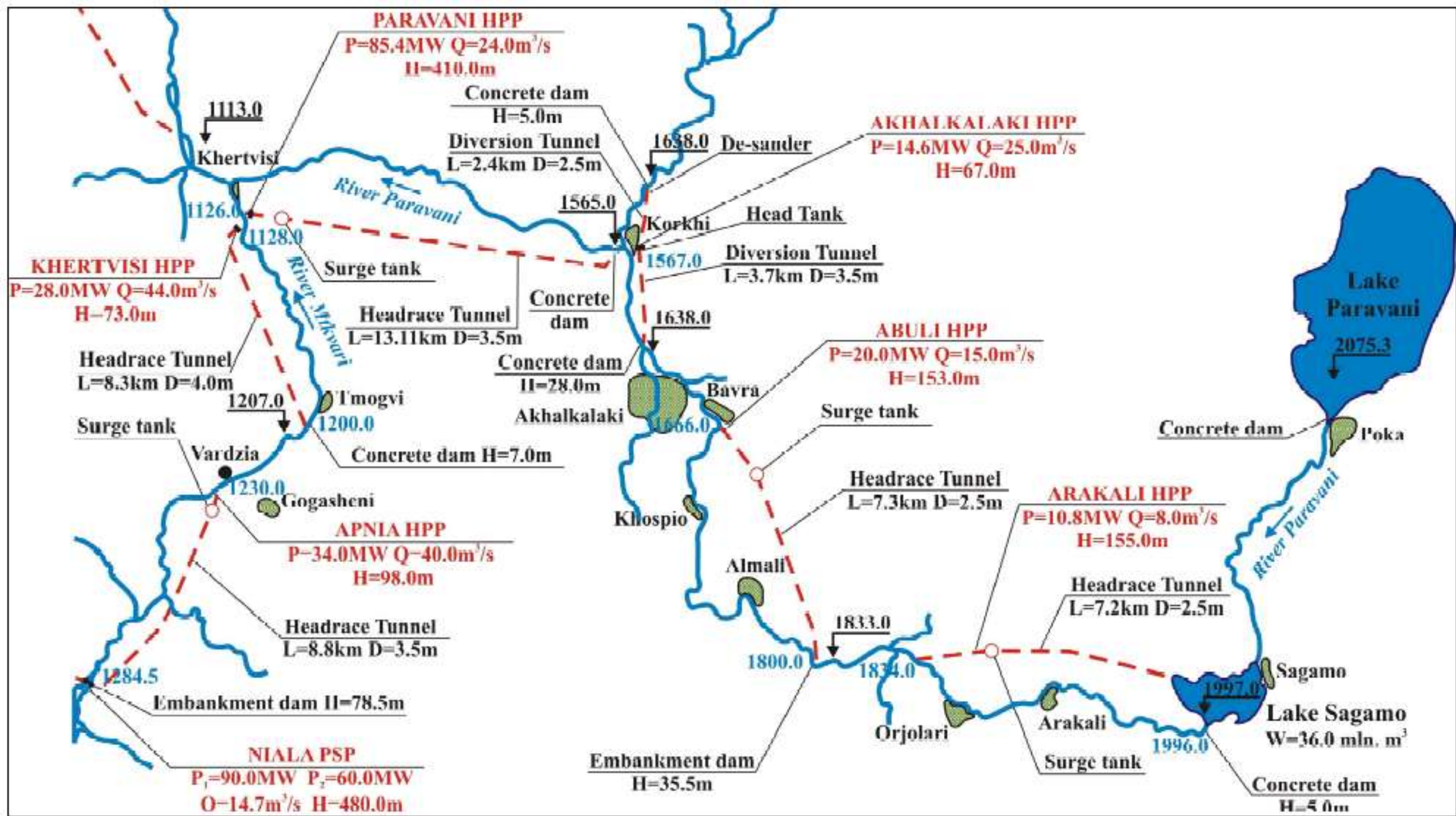
The affected region is significant in that it contains more than 200,000 square kilometers of the Pantanal wetlands, making it one of the largest wetland areas remaining in the world.

The Pantanal is home to myriad wildlife, further encouraging Brazil's 1st Federal Court to order environmental agencies to suspend all environmental licensing processes until a strategic assessment of the entire basin can be completed.

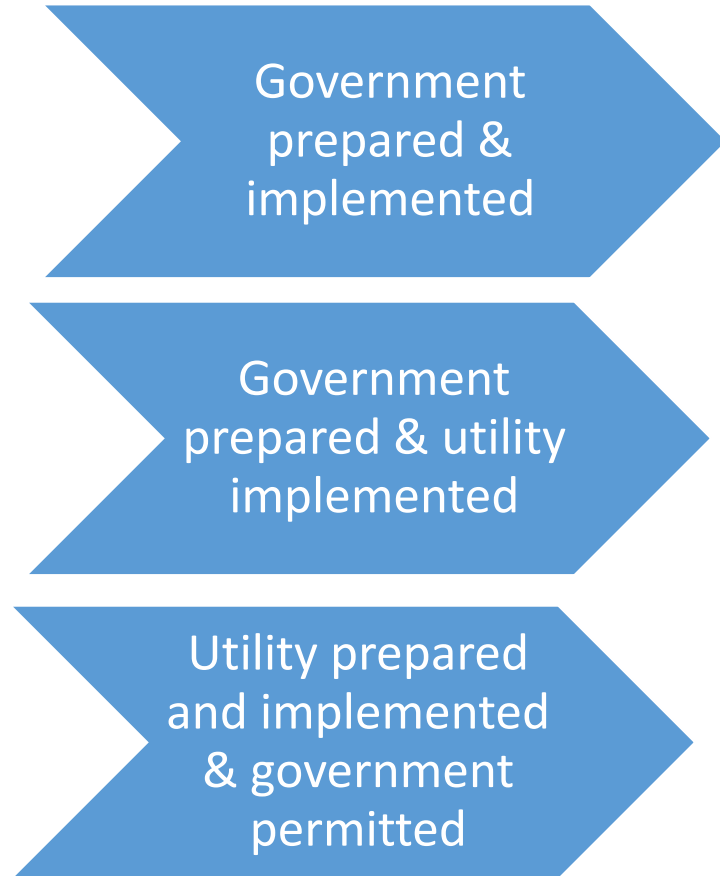
Hydropower projects already in operation may continue generating power, but their licenses cannot be renewed until the assessment is completed, as per "clear evidence" found by the court that says new developments are being installed without observing basic protective standards.

Sustainability at the System Level

- Most countries have moved away from comprehensive planning of their power sectors
- There are opportunities to improve the quality of individual projects
- However, the next frontier for improving sustainability is to consider resources, impacts, and solutions at a system scale (e.g., a river basin, a region, or an energy grid)
- System-scale planning can produce multiple benefits: greater certainty, lower controversy, reduced costs, reduced operational constraints, streamlined review, and improved confidence in securing financing



Frameworks and Tools



System Level Tools:

- Master plans
- Options analysis
- Integrated resource planning
- River basin plans
- Cumulative impacts analysis
 - Shared vision planning
- Strategic environmental assessment

Project Level Tools:

- Pre-feasibility and feasibility studies
- E&S impacts studies and management plans
- Sustainability assessments, panels of experts, peer reviews



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Hydropower Investment

CEPEL
Grupo Eletrobrás

Public Disclosure Authorized

Public Disclosure Authorized

Sample Guidelines: Cumulative Environmental Impact Assessment for Hydropower Projects in Turkey



Early Stage Assessment Tool

November 2010

Published by the
International
Hydropower
Association



Harnessing Hydropower for Development

A Strategic Environmental
Assessment for Sustainable
Hydropower Development
in Viet Nam



Policy Summary
January 2009



ADB

Power Sector Planning in Practice – Latin America

- Planning is the process of contributing technical expertise to decisions
- A plan is a statement of the choices made by decision-makers at one point in time
- “In preparing for battle I have always found that plans are useless, but planning is indispensable.”
— Dwight D. Eisenhower

Following is an overview of current practices in Latin America – how are E&S issues integrated into power sector plans?

Group I: No E&S Considerations

Bolivia	Plan Óptimo de Expansión del Sistema Interconectado Nacional 2012-2022	None (“The plan is an instrument for ... rational and efficient use of natural energetic resources, development of infrastructure and logistics, and of the hydroelectric potential of the country.”)
Dominican Republic	Plan Energético Nacional 2004-2015	None
Guatemala	Plan de Expansión Indicativo del Sistema de Generación 2012-2026	None
Nicaragua	Plan Indicativo de la Expansión de la Generación 2005-2016	None
Peru	Plan Referencial de Electricidad 2006 – 2015; Portafolio de Proyectos de Centrales de Generación en el SEIN 2008	None
Mexico	Programa de Obras e Inversiones del Sector Eléctrico 2011-2025 (POISE) (annual)	None, other than reference to environmental norms that have to be respected by each individual project

Group II: Some E&S Considerations

Central America	Plan Indicativo Regional de Expansión de la Generación 2011-2025	Local impacts make hydropower projects vulnerable to attacks by environmental groups.
Ecuador	Plan Maestro de Electrificación 2012-2021	Emphasis on environmental impact and sustainable development, commitment to include mitigation measures such as environmental flows and fish passage in future projects, but no specific relevance for siting.
Guyana	Power Sector Policy and Implementation Strategy 2010	Two priority basins have been identified; safeguards for environmental protection will be established.
Jamaica	Generation Expansion Plan 2010	In the optimization modeling, renewable resources carry an additional premium for external benefits of up to 15% of their cost, but siting constraints are not considered. Permitting risks are mentioned.
Panama	Plan de Expansión del Sistema Interconectado Nacional 2012-2026	Risk of late entry of hydropower projects. Awareness that Cost Benefit Analyses as performed in the expansion plan does not include all externalities.
Uruguay	Política Energética 2005-2030	Hydropower potential largely exhausted, but some references to spatial planning

Group III: More E&S Considerations

Brazil	Plano Decenal de Expansão de Energia – PDE 2021	Analysis of 34 planned hydro projects to be commissioned over next 10 years for duration of licensing process and high-level comparison of E&S impacts. The general result is that projects in Amazon have higher costs and benefits, and that none of the projects are in the high cost/low benefit category. Results are not linked to project names, and the further use of the ranking is unknown.
Costa Rica	Plan de Expansión de la Generación Eléctrica 2014-2035	Each proposed project has to consider E&S impacts in its planning and design. The development of the sector should minimize negative and maximize positive impacts. Limitation of the proportion of the hydro potential that can be developed (best sites already taken, impacts on protected and indigenous areas).
Colombia	Plan de Expansión de Referencia Generación-Transmisión 2010-2024	Protected areas reduce hydro potential from 93 GW to 79 GW. Costs include predicted costs of environmental mitigation, based on indicator-based empirical model. A strategic environmental assessment of the plan is ongoing.
Chile	Estrategía Nacional de Energía 2012-2030	“The strategy will .. improve siting decisions, protect our environmental heritage, generate informed debates, and bring more legal certainty to approvals processes.” For Patagonia, a plan for exclusion of large areas will be prepared.

Conclusions (I)

- Most LAC countries undertake systematic expansion planning. Exceptions may be explained by style of government (Venezuela, Argentina), lack of institutional capacity (particularly in small countries) or a lack of motivation (as in Paraguay, with an abundance of existing capacity).
- A number of countries have fully institutionalized planning processes with regularly updated plans.
- Most plans use least-cost planning methodologies; some leave the identification of least-cost projects to the private sector.

Conclusions (II)

- The environmental issue of most interest is climate change mitigation, and many plans argue for an expansion of renewables. A few value the avoidance of externalities in the least-cost model.
- Many plans do not mention hydro-specific E&S issues at all. It is possible that these are implicitly taken into account in the underlying project catalogues, but these are often from old master plans.
- Several plans recognize the risks of projects not obtaining approvals, or investors not taking up projects because of regulatory risks.
- Few plans address these risks (for example, by avoiding protected areas).

OPINIÓN



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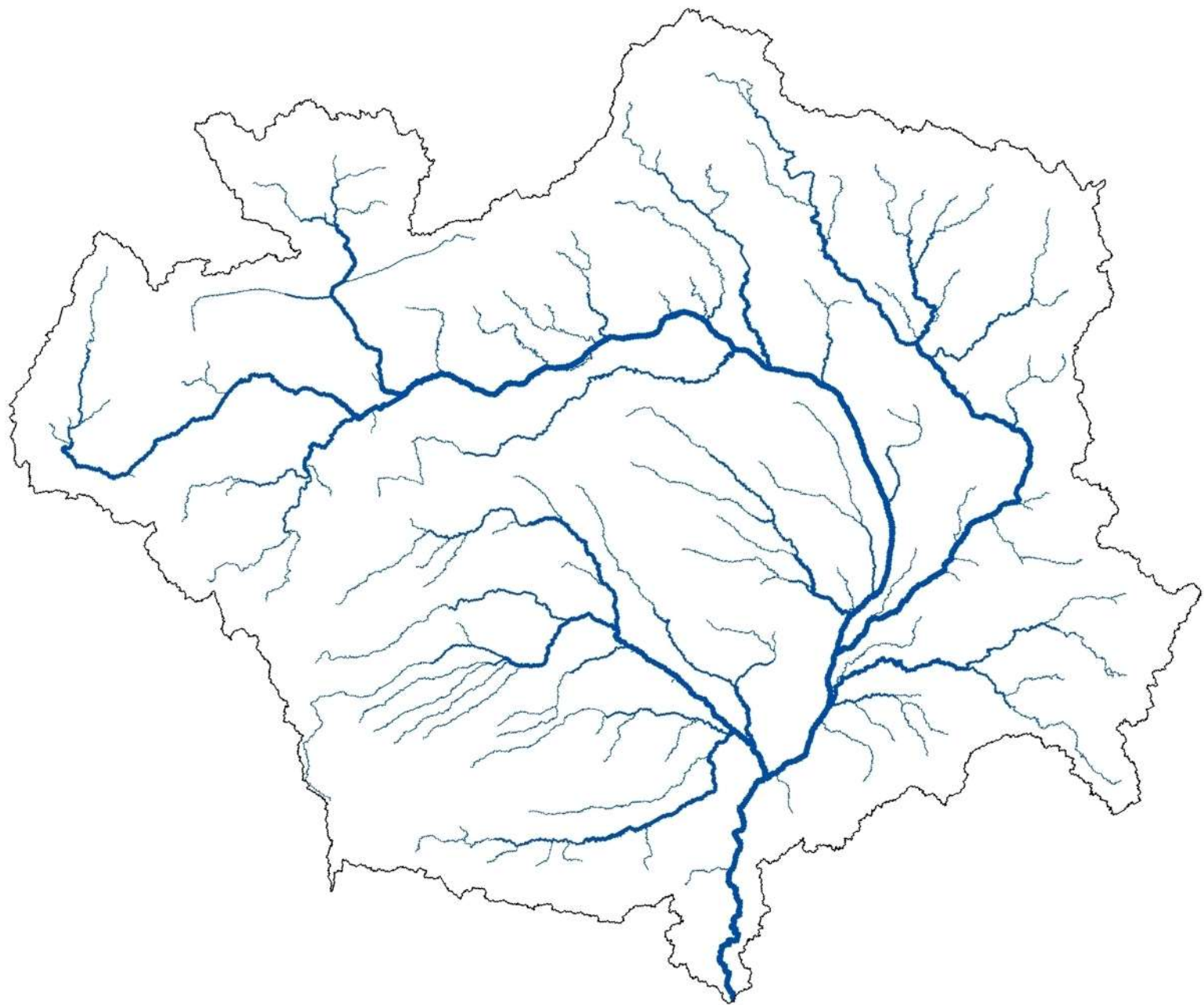


CAMBIO NECESARIO

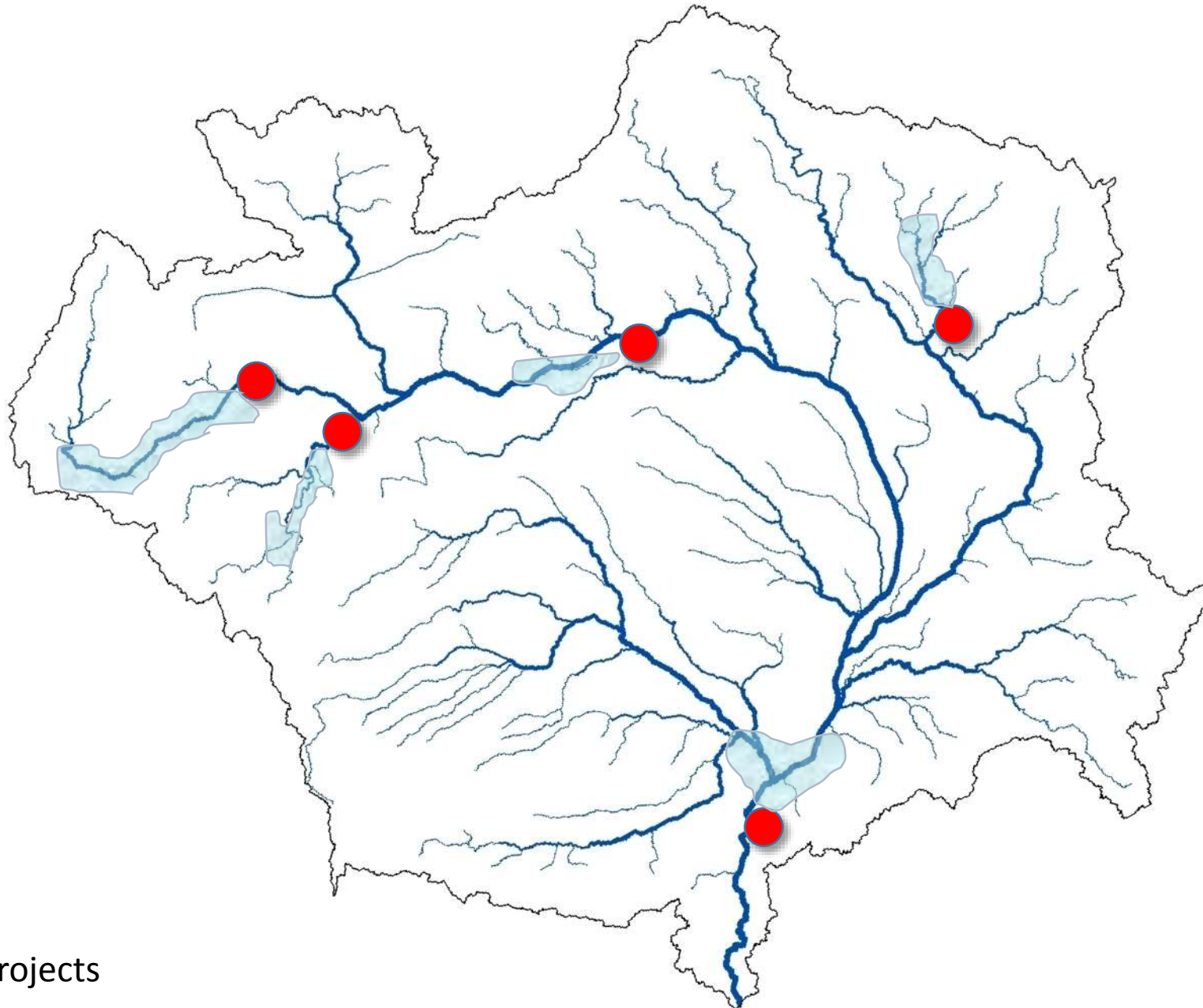
El problema del sector eléctrico está en su diseño: Marcelo Antinori

MARCELO ANTINORI
opinion@prensa.com

17/03/2012 - Las reformas del sector eléctrico delegaron al sector privado el rol de construir y operar los proyectos de generación, lo que está bien, pero a los inversionistas privados también se les delegó la decisión de dónde y cuándo hacer esos proyectos, lo que fue un equivoco, pues la lógica de las decisiones privadas no es la misma de los intereses nacionales. Lo afirmo, no por diablo, pero sí por viejo. Participé directa o indirectamente de casi todos los procesos de reforma del sector eléctrico latinoamericano de las últimas

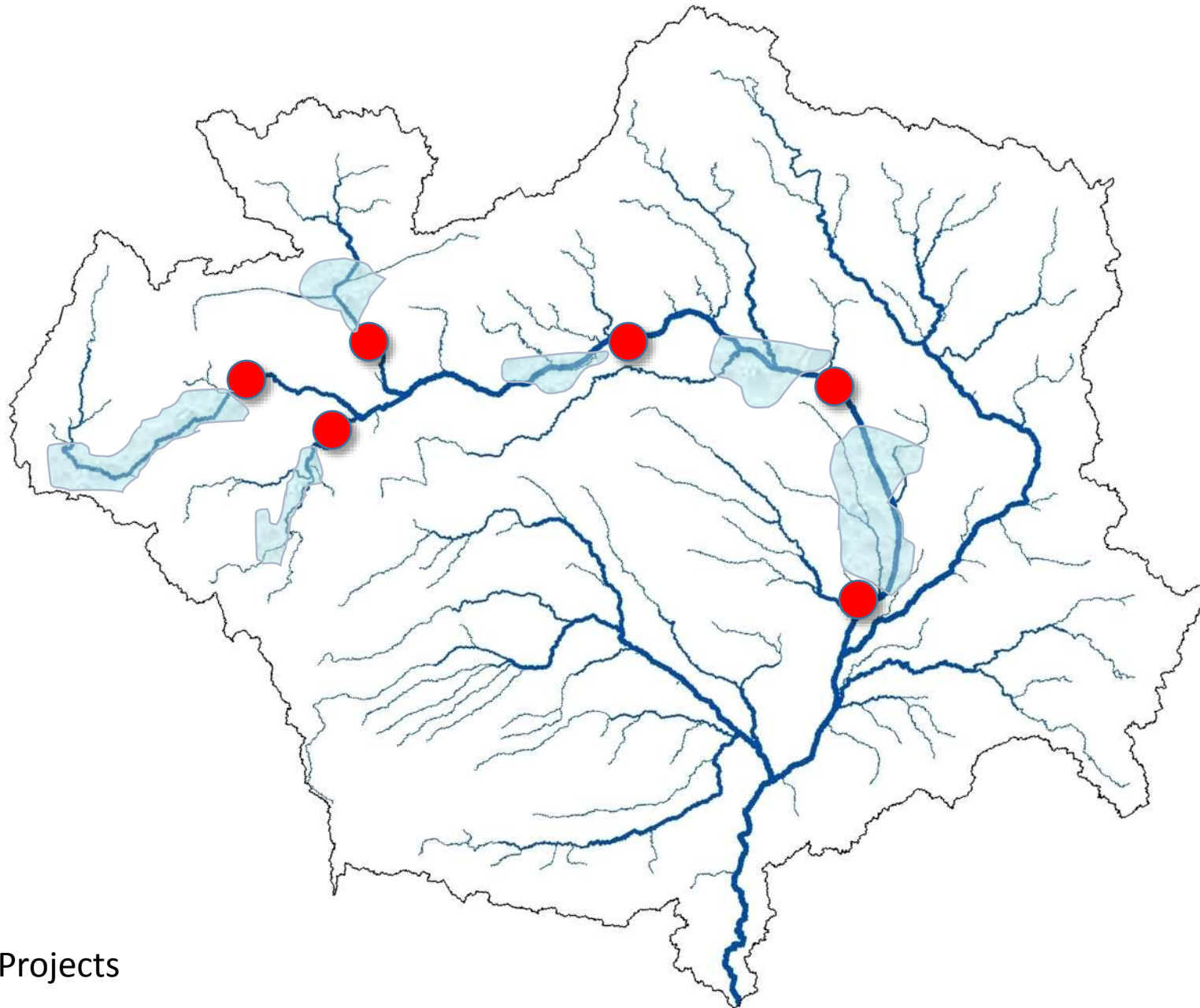


Scenario 1



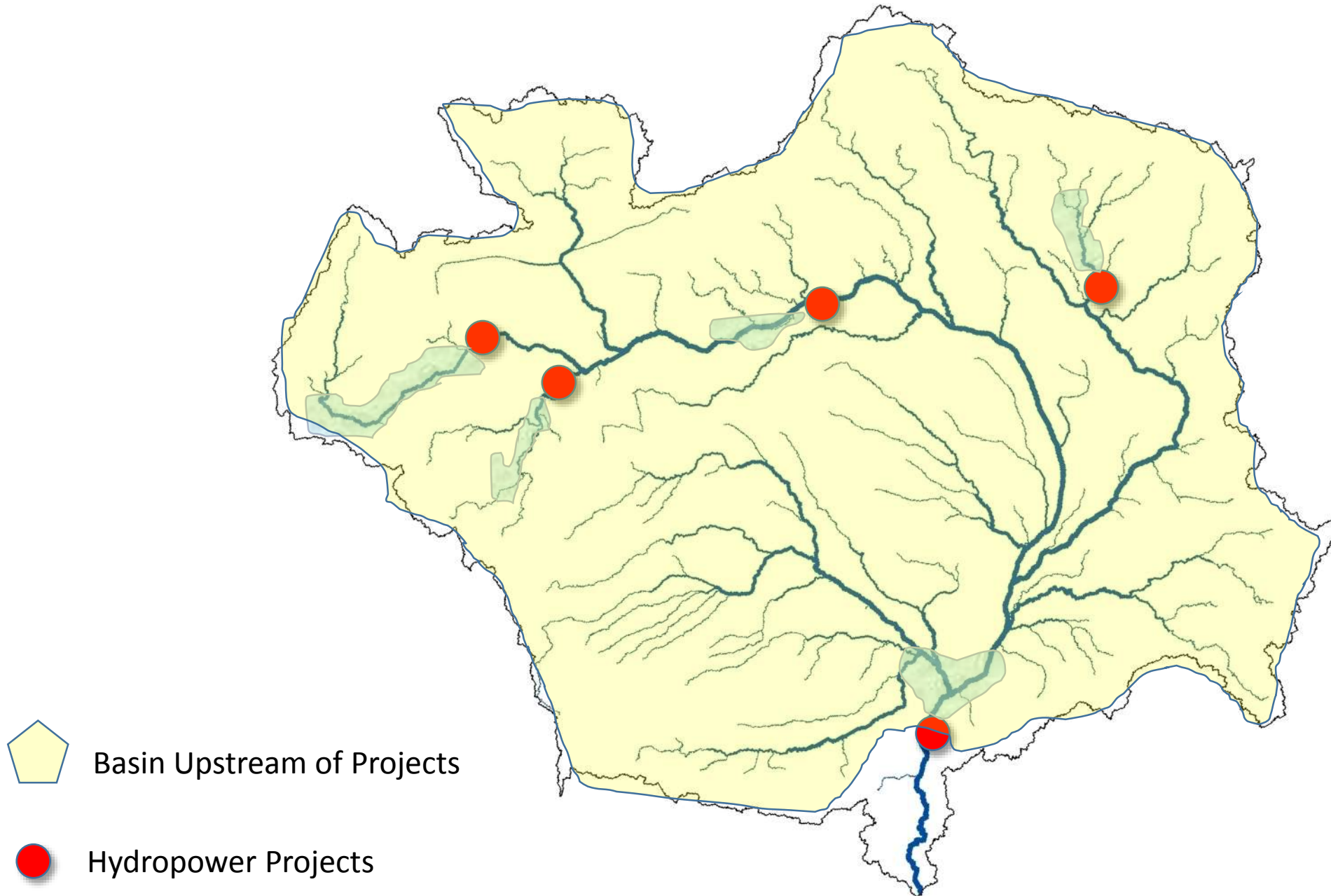
Hydropower Projects

Scenario 2



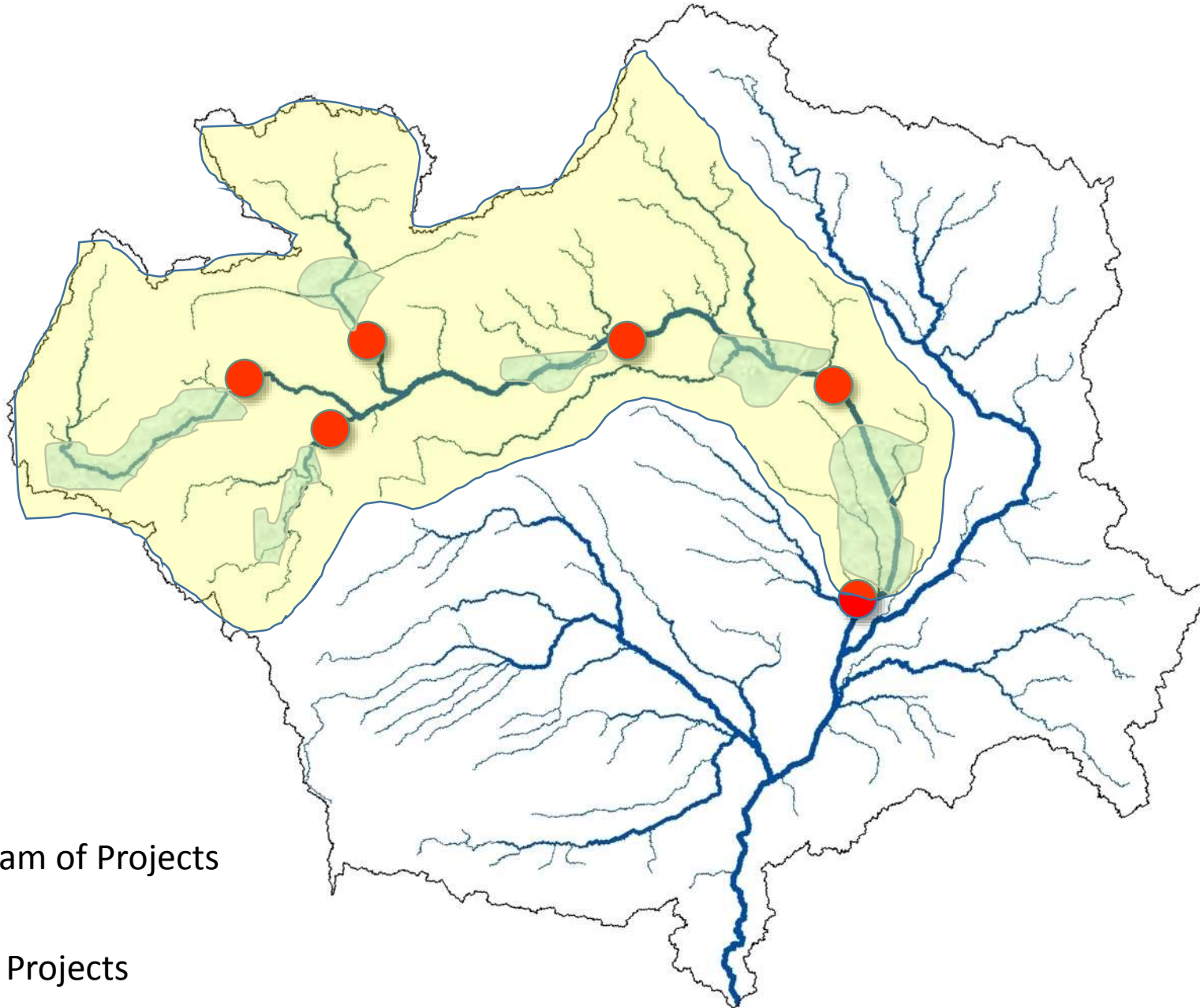
Hydropower Projects

Scenario 1



Scenario 2

-  Basin Upstream of Projects
-  Hydropower Projects



How to
compare
outcomes of
scenarios?

Permanent or temporary decisions?

- A decision to build is (largely) irreversible
- A decision not to build can be reversed; more can be learned and decisions can be improved over time
- Most plans are not about a final configuration, but about sequencing in the medium terms
- Some options should be taken out of subsequent analyses and put under permanent protection

Protecting High-Value Rivers

"The Congress declares that the established national policy of dams and other construction at appropriate sections of the rivers of the United States needs to be complemented by a policy that would preserve other selected rivers or sections thereof in their free-flowing condition."

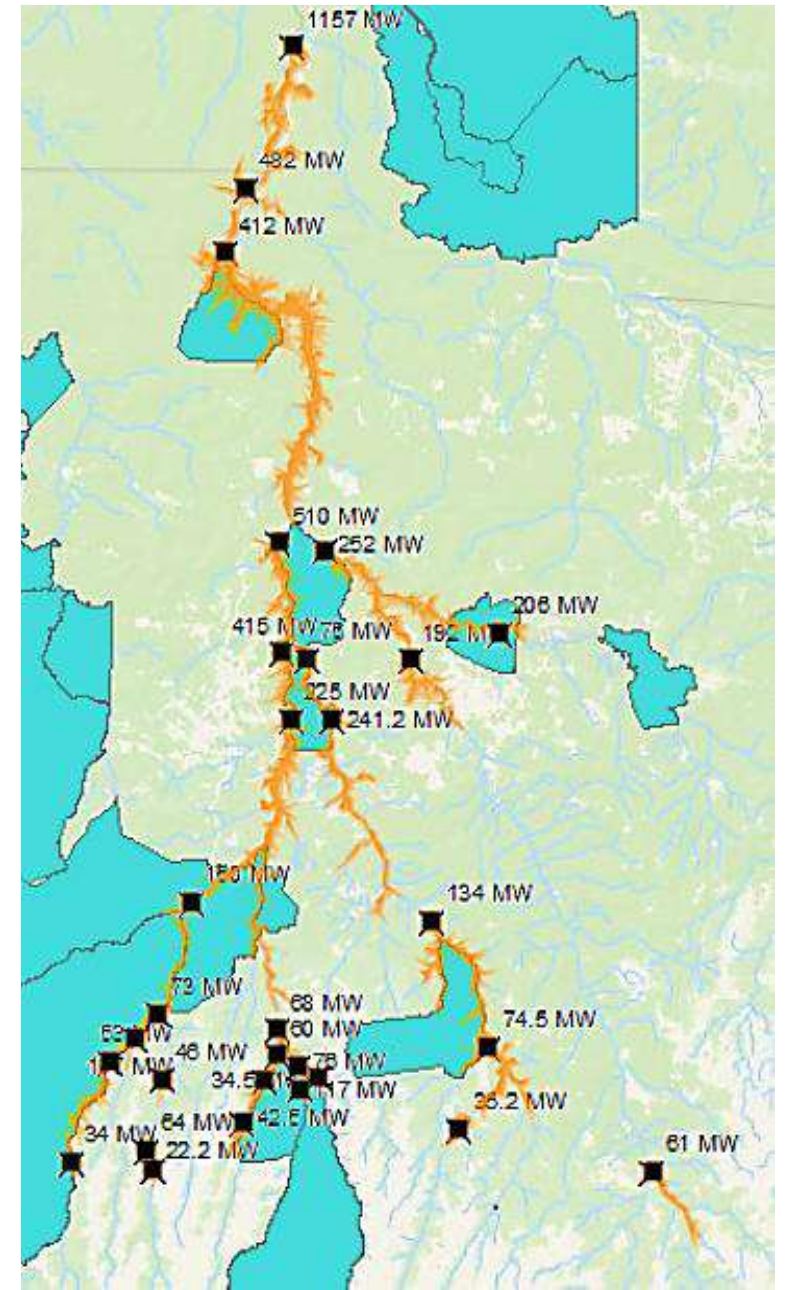
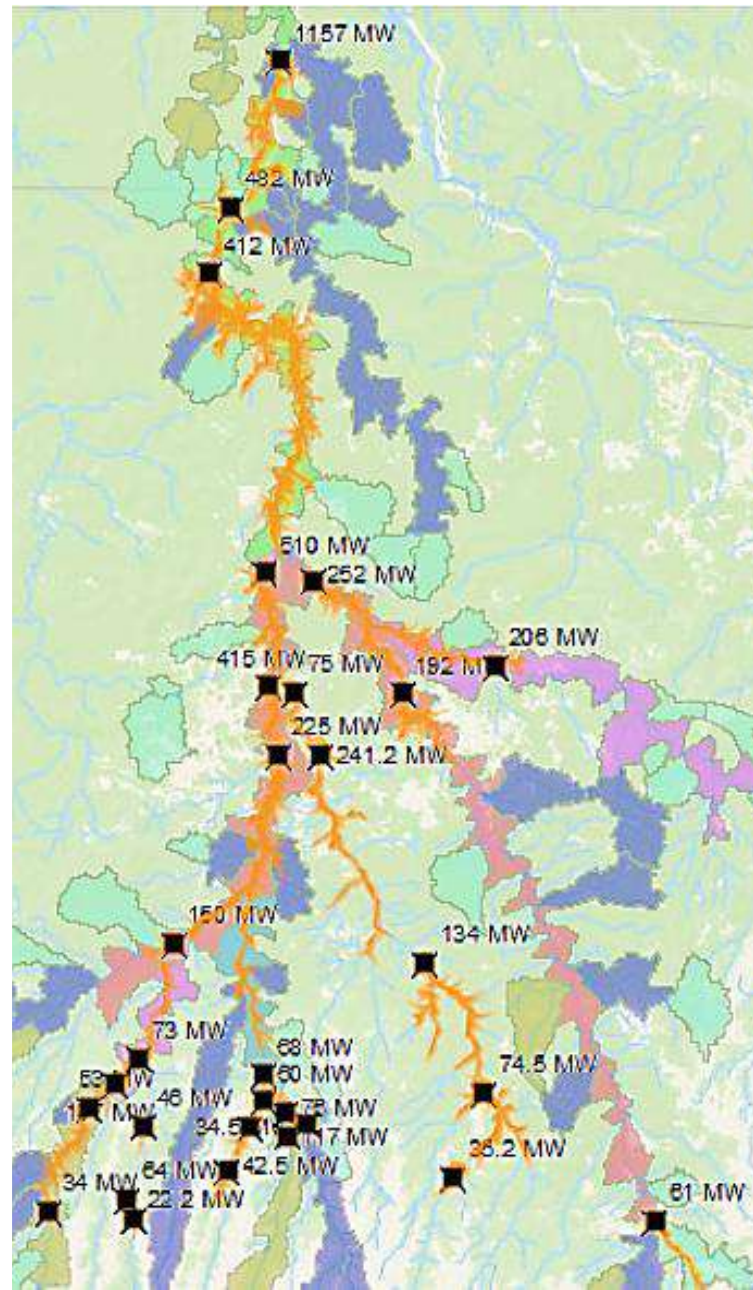
(United States Wild & Scenic Rivers Act, October 2, 1968)



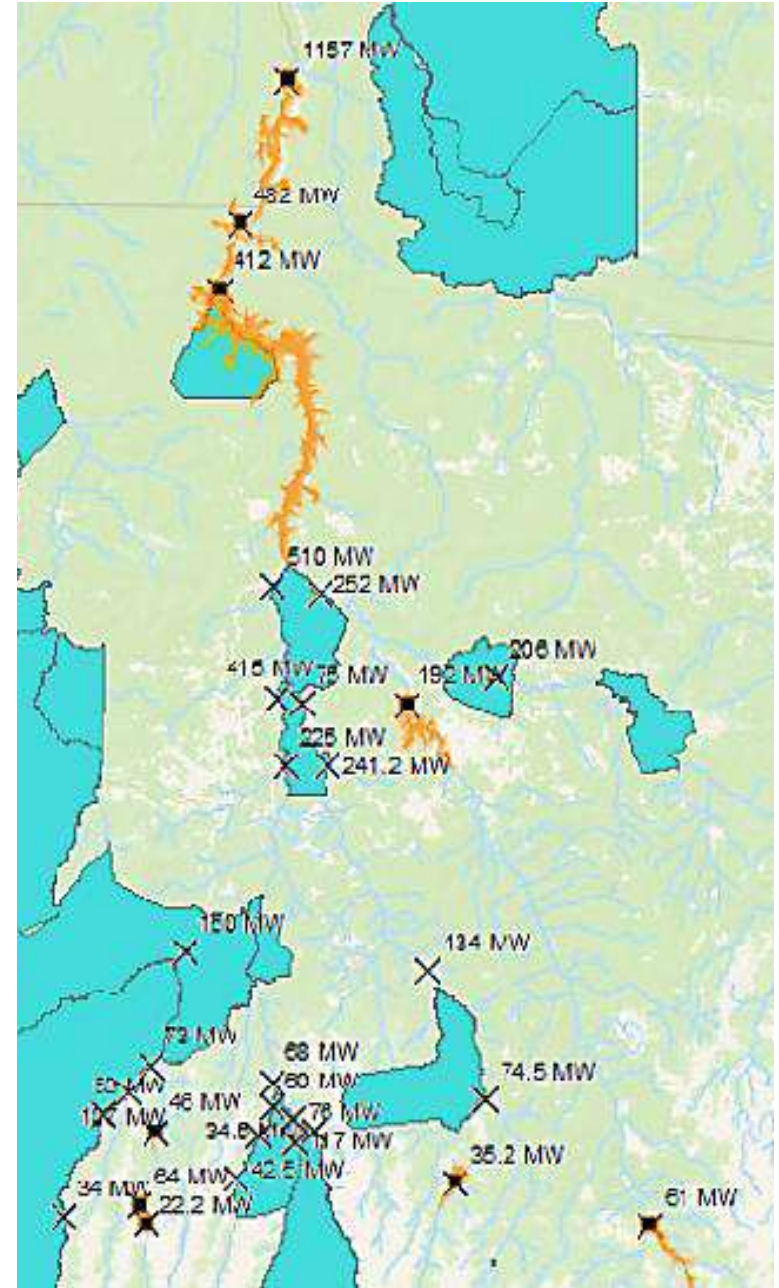
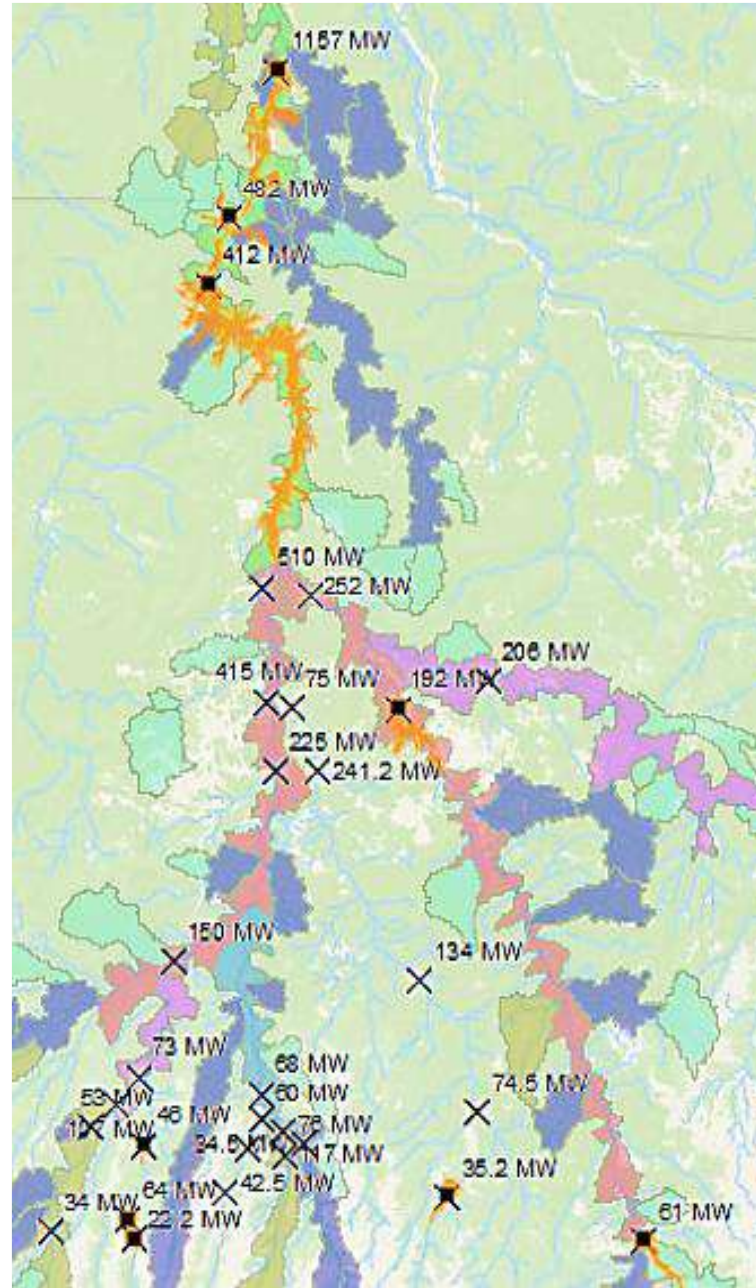
National System now protects 20,275 km of 203 rivers (0.25% of all rivers).

More than 75,000 dams across the country have modified ca. 965,600 km (17% of all rivers).

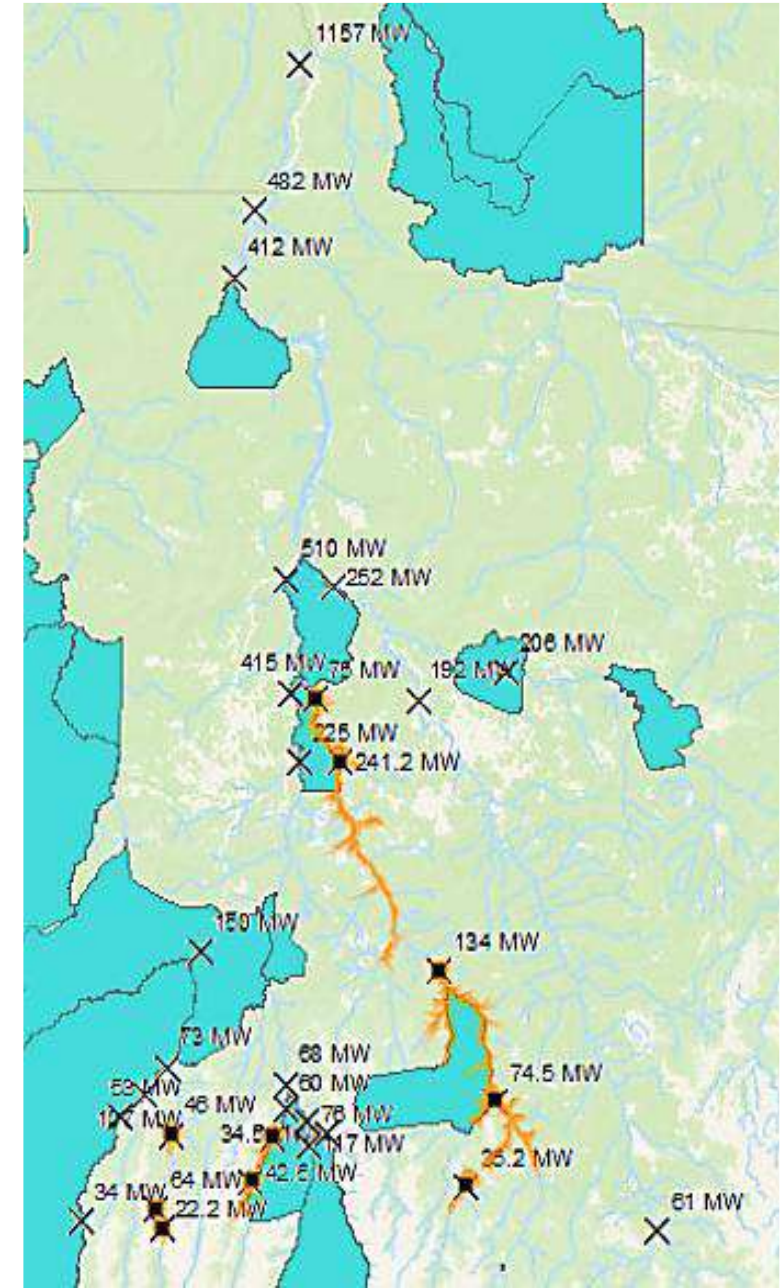
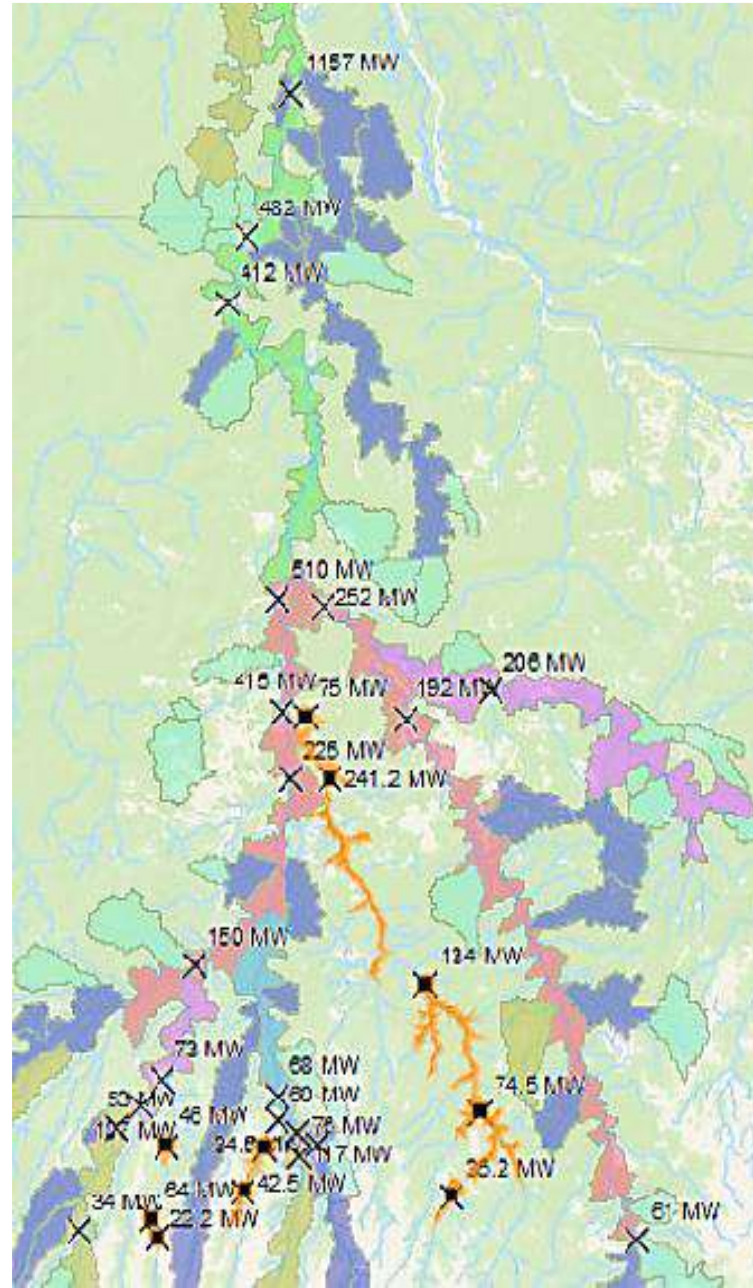
Scenario 1. Full Hydropower Potential Development



Scenario 2. No Impact on Indigenous Lands



Scenario 3. No Impact on High Conservation Values



	Scenario 1 Full Hydropower Development	Scenario 2 Full Protection of Indigenous Lands	Scenario 3 Full Protection of High Conservation Values	Scenario 4 Development of 60% of Hydropower	Scenario 5 Protection of 60% of Indigenous Lands	Scenario 6 Protection of 60% of High Conservation Values
Share of hydropower potential developed	100%	45%	14%	62%	63%	72%
Share of indigenous lands not affected	60%	96%	88%	68%	84%	68%
Share of high conservation values not affected	59%	76%	100%	65%	68%	65%
Total Shares	219%	219%	202%	195%	215%	205%
Weighted average LCOE	100%	88%	90%	104%	103%	93%

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Strengths in Colombia

- Companies with commitments to global best practices; initial project assessments with the Hydropower Sustainability Assessment Protocol (ISAGEN, EPM)
- Strong power planning and environmental licensing agencies
- Benefit sharing well established
- Environmental analysis of alternatives well established
- Initial steps for offsets, environmental valuation, climate change adaptation

Room for Improvement in Colombia: Bottom Up

In preparing individual projects-

- Anticipate evolving barriers to development
- Improve options and alternatives analysis – make the case for your preferred alternative
- Aim for best practices and a social license to operate
- Improve treatment of cumulative impacts
- Plan for multiple uses of reservoirs
- Coordinate between companies

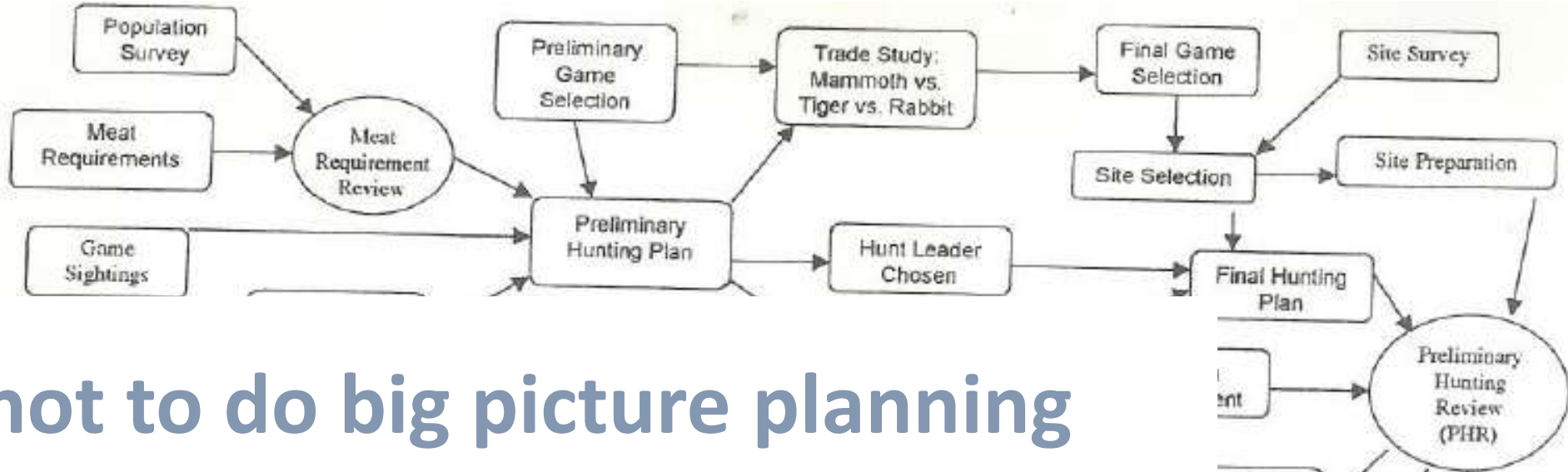
Room for Improvement in Colombia: Top Down

In preparing sector plans and licensing individual projects-

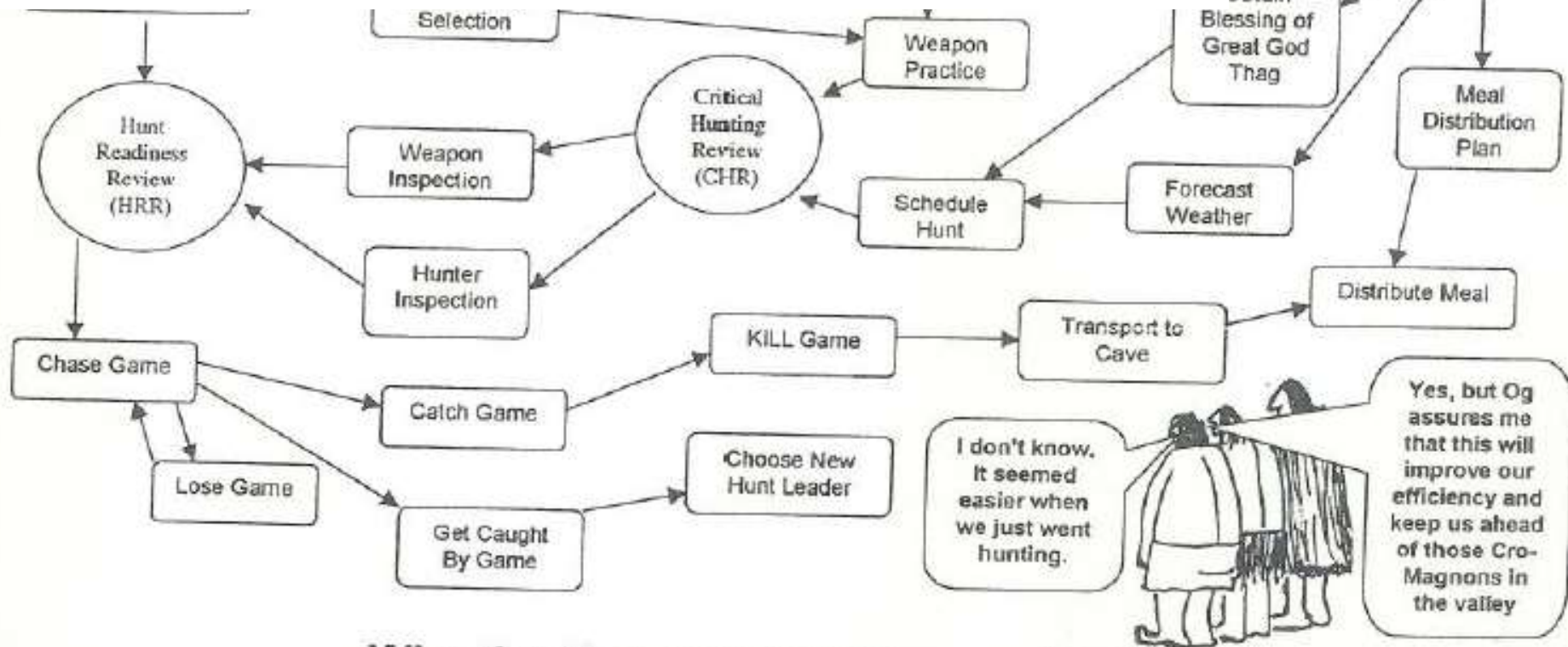
- Improve coordination and compatibility between planning by different agencies (water, energy, local development, conservation etc.)

Examples – hydro projects in municipal development plans and in basin management plans

- Consider government to choose basins for development
- Consider Brazilian model (prepare projects by government, auction development rights to companies)



How not to do big picture planning



Why the Neanderthals Became Extinct

Thank You

Comments and Questions?

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