

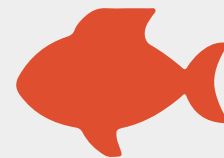
# THE TRUE COST OF HYDRO

**HYDROPOWER** is considered by many as a cheap, low-carbon energy option that can help China to reduce emissions affordably. A number of important energy scenarios have been published in recent years, anticipating a large increase in the development of hydropower as part of China's energy mix. One study proposed that hydropower capacity increase to **510GW** of installed capacity, from current government forecasts of **280GW**.

## **HOWEVER, HYDROPOWER IS NOT A CHEAP SOURCE OF ENERGY**

The true costs of hydropower in China are consistently being underestimated or ignored, including the environmental and social costs, infrastructure costs and implications of high seasonal variability.

# ENVIRONMENTAL COSTS



The environmental impacts of large dams are numerous and include direct impacts on the biological, chemical and physical properties of rivers and riparian environments.

## YANGTZE RIVER FISHERIES IN DECLINE

1950s

**450K** TONS/YR  
FISH HARVEST RATE

**143** FISH SPECIES  
HISTORICALLY REPORTED

21ST CENTURY

ONLY

**60K** TONS/YR  
FISH HARVEST RATE

ONLY

**17** FISH SPECIES  
WERE FOUND IN 2013 SUMMER  
WWF FIELD SAMPLING

**3** DAMS UNDER  
CONSTRUCTION

**16** MORE DAMS  
PLANNED

**6.4GW**  
XIANGJIABA DAM  
2006-2013

**1.8GW**  
LONGKAIKOU DAM  
2007-2013

**2.2GW**  
LUDILA DAM  
2007-2013

**13.9GW**  
XILUODU DAM  
2005-2013

**22.5GW**  
THREE GORGES DAM  
1994-2006

**2.4GW** GEZHOUBA DAM 1970-1988

In addition, **HUNDREDS** of hydropower dams have been built on the tributaries in the Yangtze River Basin

# THE FISH ECOSYSTEM IS ON VERGE OF COLLAPSE

# SOCIAL COSTS

**DISPLACEMENT OF PEOPLE** due to hydropower projects can result in the loss of livelihoods, disappearance of local cultures, increased social conflicts, corruption in resettlement compensation implementation, and infringed legal rights. Resettlement mitigation and compensation are often inadequate or poorly managed. Hydropower projects planned over the next few years are mostly located in the areas where ethnic minorities live and will result in what some experts predict will be the biggest migration of ethnic minorities ever witnessed in China.



IN THE LAST SIXTY YEARS,  
CHINA BUILT MORE THAN

**86,000**

**DAMS,**

**22,000**

OF WHICH ARE  
LARGE DAMS.



THE NUMBER OF DISPLACED PERSONS CAUSED  
BY THESE DAMS IS GREATER THAN

**23,000,000**


 THAT'S THE SAME AS THE WHOLE  
POPULATION OF AUSTRALIA

**> 8,000,000** OF THEM  
ARE STILL IN POVERTY

# INFRASTRUCTURE COSTS

Plans to add 160GW over the next 15 years mostly in Southwest China will require large investments in transmission lines and large maintenance bills due to seismic hazard. China has a poor record on cost overruns in hydropower.

**XIANGJIABA DAM**  
(7,750MW)

DAM CAPITAL COST (RMB) TO DATE + TRANSMISSION CAPITAL COST (RMB)

**54.1 BN\***

**23.3 BN**

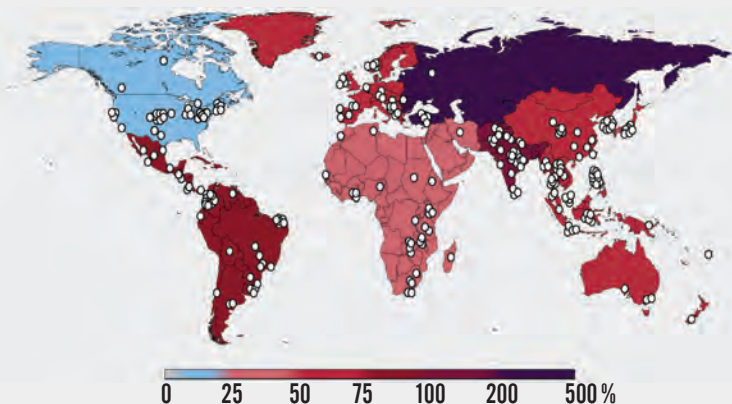
**XILUODU DAM**  
(13,860MW)

**79.2 BN\***

**40 BN**

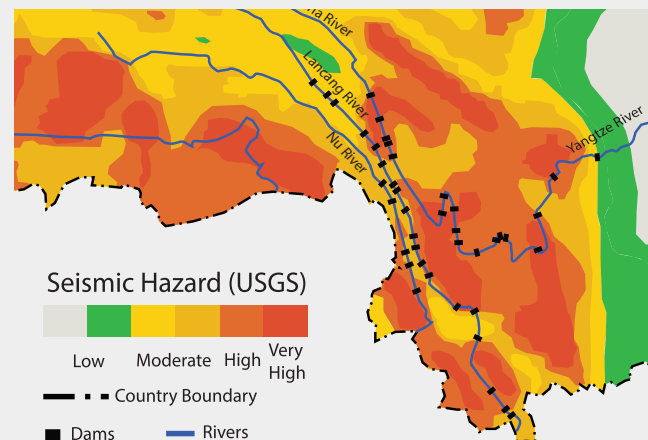
\*BUDGETED COST ONLY

## AVERAGE COST OVERRUN OF LARGE DAMS BY GEOGRAPHY



IN CHINA, THE  
ACTUAL COSTS  
ARE ON AVERAGE  
**75%**  
HIGHER THAN BUDGETED COSTS

## LOCATION OF SOUTHWEST DAMS AND SEISMIC HAZARD



## AFTER WENCHUAN EARTHQUAKE

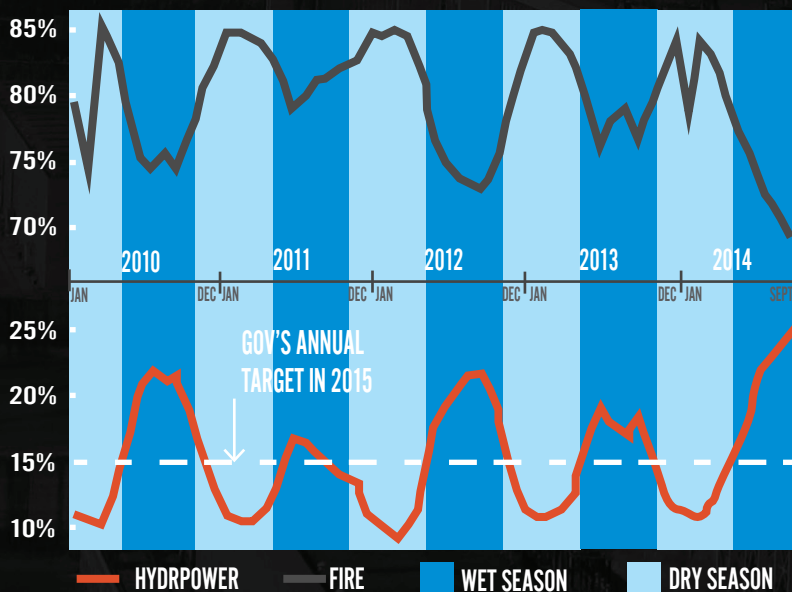
**2,380 DAMS**  
**AT RISK**

**36 BN** RMB  
**REPAIR BILL**




# VARIABILITY

Electricity generated from hydropower varies with the availability of water resources. For example, twice as much hydropower is generated in the wet season compared with the dry season. Additional hydropower capacity will only increase China's dependency on energy sources like coal, gas and nuclear. High seasonal variability also means that hydropower is not an alternative to coal.

THE CONTRIBUTION OF **HYDROPOWER** AND **COAL POWER** TO TOTAL ELECTRICITY GENERATION



DURING THE 2010 DROUGHT IN SOUTHWEST CHINA, HYDROPOWER ELECTRICITY GENERATION FROM THE FOUR SOUTHWEST PROVINCES DROPPED **OVER 30%**. EXPERTS PREDICT THAT THE VARIABILITY OF HYDROPOWER WILL BE INCREASED BY CLIMATE CHANGE IN COMING DECADES.

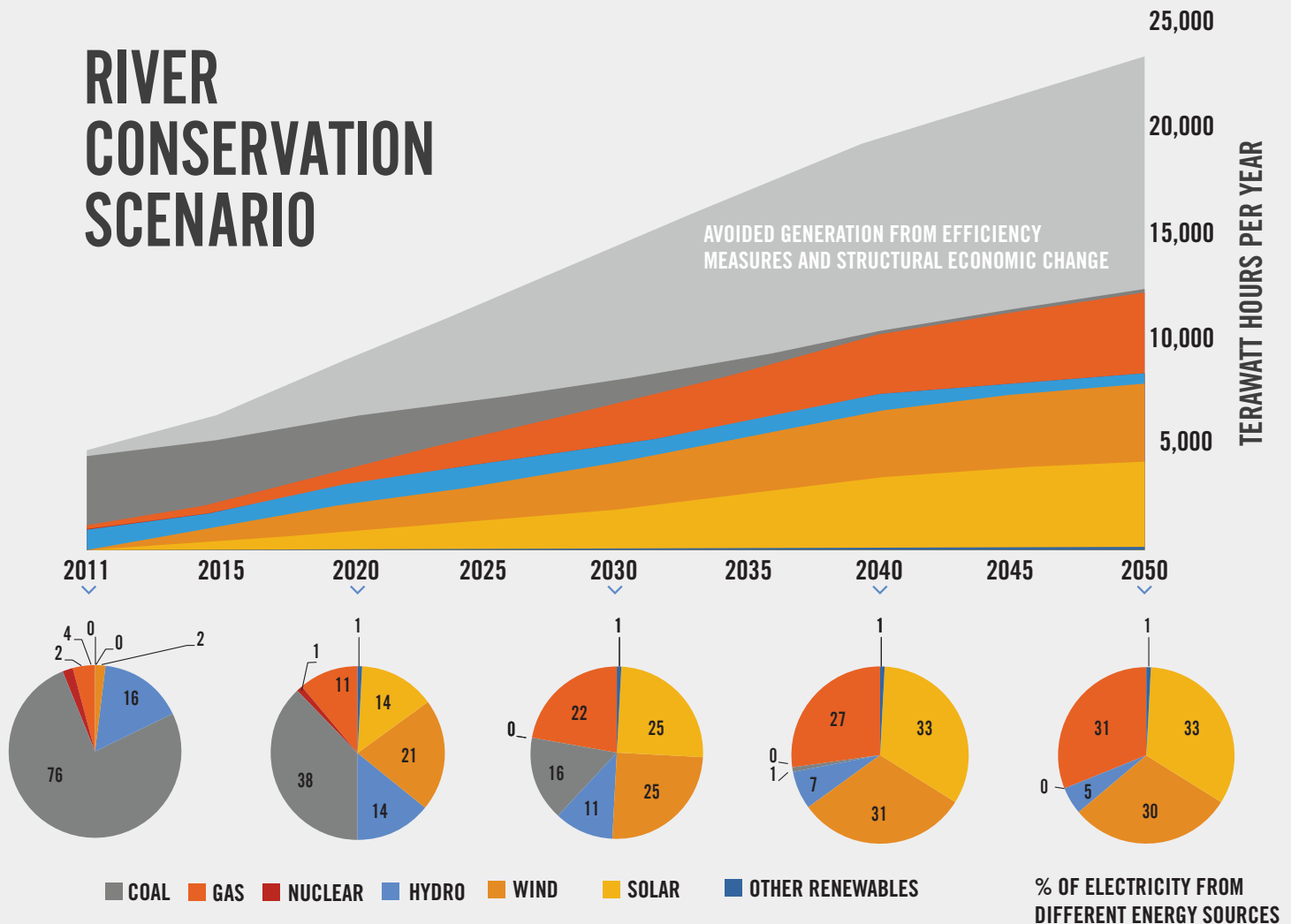
	2010	2015	2020
 of targeted hydropower electricity generation	676*	910	1,200 TWH
 of estimated seasonal difference (May-Oct vs Nov-Apr)	184*	224	271 TWH
	180	220	270
<p><b>EQUIVALENT TO HALF-YEAR GENERATION CAPACITY FROM LARGE COAL FIRED PLANTS</b></p>			
<p><b>MORE HYDROPOWER = INCREASED DEPENDANCE ON COAL, GAS OR NUCLEAR!</b></p>			

\*HISTORIC DATA

# ALTERNATIVE ENERGY PATHWAYS

MODELING SHOWS CHINA CAN ACHIEVE AMBITIOUS GHG EMISSIONS REDUCTION GOALS, WITH VERY LIMITED HYDROPOWER DEVELOPMENT, MEETING GROWING ENERGY DEMAND AT THE SAME TIME.

## RIVER CONSERVATION SCENARIO



# ALTERNATIVE ENERGY PATHWAYS

## BASELINE SCENARIO

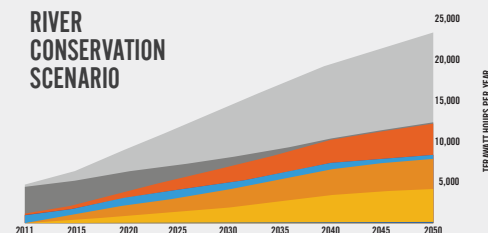
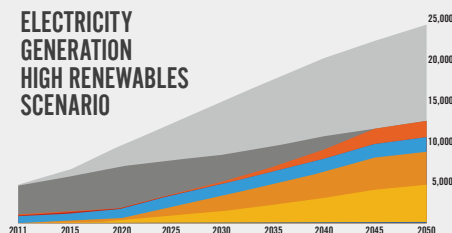
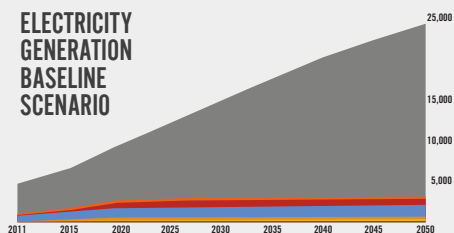
China implements no specific clean energy or efficiency policies other than those currently proposed and does not undertake major structural economic reforms.

## HIGH RENEWABLES SCENARIO

Building off of a High Efficiency Scenario, China meets its electricity demand with renewable sources and hydropower.

## RIVER CONSERVATION SCENARIO

China meets its electricity demand with renewable sources, excluding new large hydro dams. Instead of vastly expanding China's hydropower from the roughly 215 GW in 2011, damming of China's rivers would end by 2020 and capacity would not breach 270 GW.

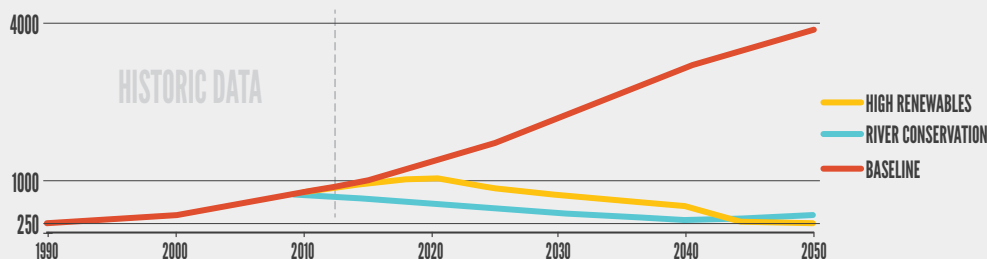


■ AVOIDED GENERATION FROM EFFICIENCY MEASURES AND STRUCTURAL ECONOMIC CHANGE

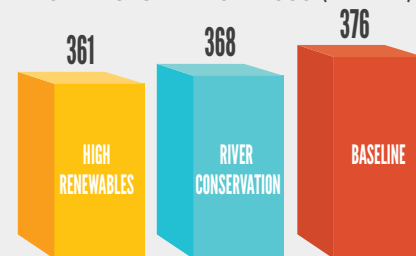
■ COAL ■ GAS ■ NUCLEAR ■ HYDRO ■ WIND

■ SOLAR ■ OTHER RENEWABLES

## CARBON EMISSIONS (MILLION TONNES PER YEAR)



## TOTAL ECONOMIC COST OF THE ELECTRIC POWER SYSTEM 2011-2050 (TRILLION RMB)



# METHODOLOGY

This research paper explores:

- external costs of hydropower development in China;
- the issue of seasonal variability of supply from hydro;
- alternative scenarios to large hydropower development for China's electricity sector mix until 2050.

That the external costs, high seasonal variability and alternative renewable energy models exist is beyond doubt and warrants further investigation by energy and climate experts currently advocating and proposing low carbon emissions scenarios for China.

For the infrastructure and resettlement costs, this research relies on both a literature review of publicly available information on dam costs, as well as data collected by International Rivers and provided online in its Spreadsheet of Major Dams in China.

For biodiversity costs, the research draws on a range of key studies on the Yangtze River documenting the severe environmental costs associated with hydropower development in the watershed. These costs provide an indication of the high stakes associated with further development of China's rivers, rather than a monetization of these costs.

The analysis of the variability of supply from hydropower relies on a comparison of published data on the installed capacity and

generated electricity of hydropower in China over the past 10 years, as well as the various assumptions taken by various energy modelling efforts.

Alternative solutions were explored and one of the alternatives presented as the river conservation scenario model in this research was prepared by the Energy Transition Research Institute (Entri). Further study will be required to examine how to optimize the future energy plan while protecting the rivers in China. Entri developed a model for China's electric power system, which was used to produce a comprehensive study of energy scenarios to 2050 for a report published by WWF China titled "China's Future Generation" (February 2014). The river conservation scenario was based on the Entri model. The key constraints were:

- Hydro was limited to 270 GW total at its maximum level in year 2020 and maintained until 2035.
- The expected lifetime of hydroelectric power dams was set at 50 years.
- Gas fired capacity had a 60% capacity factor which is economically and financially viable.
- No nuclear capacity was permitted.

International River's work for this research was supported by Rockefeller Brothers Fund. We are also grateful to Entri for its contribution to our research.



[www.internationalrivers.org](http://www.internationalrivers.org)