Hydropower Status and Trends
What makes hydropower so attractive?

- **lowest-cost source in many countries**  
  → can facilitate access to electricity for the 1.3 bn people still without

- **low-carbon source**  
  → if it all replaced coal, could reduce CO₂ emissions by 3.8 bn t/year; value at a 'social cost of carbon' of USD 40/t: USD 152 bn/year

- **high-value, dispatchable source**  
  → can enable energy storage and integration of wind and solar

- **indigenous source**  
  → can reduce requirements for fuel imports and increase energy security

- **economic development opportunity**  
  → exports of power or of power-intensive aluminium, hydrogen etc.
Who is engaged in hydropower?

Governments
Developers
Contractors
Funders
**Governments**

- **Government prepared & implemented**
- **Government prepared and financed & utility implemented**
- **Utility prepared, financed and implemented, & government permitted**

**Examples from Latin America**

**Mexico**: Comisión Federal de Electricidad (CFE) prepares 15-year masterplans and prepares, implements (with funds from the MoF), and operates almost all projects.

**Brazil**: Public agencies prepare almost all projects, basin by basin, including environmental assessments, up to the point of auctioning development licenses off to private or public developers.

**Chile**: no masterplan, private developers obtain water rights and prepare projects for environmental approval, funding from private banks and private equity.
Developers

• The largest hydropower companies are all state-owned: Hydro Québec, RusHydro, Itaipu, Three Gorges Corp., Huaneng, U.S. Army Corps of Engineers, Statkraft, CFE Mexico, Eletrobras...
• Main reasons are financial commitments and political risks
• Most of these companies are domestically oriented and are implementing their governments’ development agenda
• Companies that are investing in projects abroad are mostly from the private sector and from developed countries: Brookfield, SN Power, AES, GDF Suez, Sithe, Endesa, Origin...
• Some power companies from emerging markets are starting international engagements, often in neighboring countries
### Contractors

**Top 10 by international revenue**

<table>
<thead>
<tr>
<th>Rank</th>
<th>2012</th>
<th>2011</th>
</tr>
</thead>
</table>
| 1    | HOCHTIEF AG | ** |}
| 2    | GRUPO ACS | ** |}
| 3    | IMPREGILO SPA | 3 |}
| 4    | CONSTRUTORA NORBERTO ODEBRECHT | 4 |}
| 5    | CHINA NATIONAL MACHINERY INDUSTRY CORP. | ** |}
| 6    | SALINI COSTRUTTORI SPA | 7 |}
| 7    | CHINA INT’L WATER & ELECTRIC CORP. (CWE) | ** |}
| 8    | VINCI | 5 |}
| 9    | SKANSKA AB | 8 |}
| 10   | SINOHYDRO GROUP LTD. | ** |}

**POWER**

- Top 10 Revenue: $22,251.1 million
- Sector’s Revenue: $47,043.1 million

<table>
<thead>
<tr>
<th>Rank</th>
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</thead>
</table>
| 1    | GRUPO ACS | 2 |}
| 2    | ABEINSA SA | 1 |}
| 3    | CHINA NATIONAL MACHINERY INDUSTRY CORP. | 4 |}
| 4    | SINOHYDRO GROUP LTD. | 3 |}
| 5    | VINCI | 7 |}
| 6    | SEPCOIII ELECTRIC POWER Constr. Corp. | 6 |}
| 7    | SEPCO ELECTRIC POWER Constr. Corp. | ** |}
| 8    | SHANGHAI ELECTRIC GROUP CO. LTD. | ** |}
| 9    | METKA | ** |}
| 10   | DONGFANG ELECTRIC CORP. | ** |}
**Funders**

- Traditionally national budgets and multilateral development banks, now increasing diversification of sources

- Brazil – largely BNDES
  Malaysia – Islamic bonds sold to local and Middle Eastern investors
  Myanmar – largely China Dev’t Bank and China Exim Bank
  Chile – equity from foreign investors and loans from private banks

- Bank experience can be important contribution to quality

- More than 50% of international project finance transactions are subject to Equator Principles
Chinese companies and banks are involved in nearly half of all hydropower development outside of China, with extensive activity in Southeast Asia, Africa and Latin America.
Capacity, potential, and expected growth
# Top 10 hydropower producers

<table>
<thead>
<tr>
<th>Country</th>
<th>Hydro electricity (TWh)</th>
<th>Share of electricity generation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>694</td>
<td>14.8</td>
</tr>
<tr>
<td>Brazil</td>
<td>403</td>
<td>80.2</td>
</tr>
<tr>
<td>Canada</td>
<td>376</td>
<td>62.0</td>
</tr>
<tr>
<td>United States</td>
<td>328</td>
<td>7.6</td>
</tr>
<tr>
<td>Russia</td>
<td>165</td>
<td>15.7</td>
</tr>
<tr>
<td>India</td>
<td>132</td>
<td>13.1</td>
</tr>
<tr>
<td>Norway</td>
<td>122</td>
<td>95.3</td>
</tr>
<tr>
<td>Japan</td>
<td>85</td>
<td>7.8</td>
</tr>
<tr>
<td>Venezuela</td>
<td>84</td>
<td>68</td>
</tr>
<tr>
<td>Sweden</td>
<td>67</td>
<td>42.2</td>
</tr>
</tbody>
</table>
Technical potential

- North America: 388 GW, 61%* Capacity, 1,659 TWh/yr, 74%* Generation
- Latin America: 608 GW, 74%* Capacity, 2,856 TWh/yr, 47%* Generation
- Europe: 338 GW, 47%* Capacity, 1,021 TWh/yr, 92%* Generation
- Africa: 283 GW, 92%* Capacity, 1,174 TWh/yr, 80%* Generation
- Asia: 2,037 GW, 80%* Capacity, 7,681 TWh/yr
- Australasia/Oceania: 67 GW, 80%* Capacity, 185 TWh/yr

World hydropower technical potential: 14,576 TWh/yr

Technical potential:
- Green: Capacity (GW)
- Red: Generation (TWh/yr)
- Blue pie chart: Installed (%)
- Blue pie chart: Undeveloped (%)

* Estimated percentages.
Historical trends in large dams construction

Number of large free-flowing rivers

- <1900
- 00's
- 10's
- 20's
- 30's
- 40's
- 50's
- 60's
- 70's
- 80's
- 90's
- >2000
- 2006-2020 forecast

Rivers dammed

Number of free flowing rivers

0 25 50 75 100 125 150 175

0 5 10 15 20

Number of rivers dammed
IEA 2°C scenario: Hydropower generation may double by 2050

1,100 GW of additional capacity ≈ 9,000 large dams ≈ $3.3 trillion investment
Capacity growth in 2012: More than half in China, more than 80% in Asia

IHA ESTIMATES OF ADDED HYDROPOWER CAPACITY IN 2012

- Africa: 374.5 MW
- Asia 1 (West): 5275 MW
- Asia 2 (East excluding China): 3329 MW
- China: 14400 MW
- Europe: 532 MW
- North & Central America: 1988 MW
- South America: 1833 MW

Types of hydropower:
- Pure Hydro
- Pumped Storage
What will determine growth?

- Remaining technical hydro capacity
- Relative costs of power sources
- Growth in power demand
- Investment climate

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.
Possible hydropower expansion in GRP basins until 2050: total of 110 GW (10% of the current global total or 5% of the 2050 global total, according to the IEA 2°C scenario).
Two growth scenarios

Main constraint: continuing conflict?

Sustainable scenario

- projects are chosen based on multiple criteria
- impact and sustainability assessments are integral parts of development
- negative impacts are avoided, minimized, mitigated and/or compensated for
- benefits are shared, and projects are welcomed by communities

Main constraint: development slower, costlier?
Sustainability is about core siting, design and operational decisions. Government licensing, voluntary project standards, and system-scale planning and optimization can all contribute to sustainable projects.
Current Trends & Global Status of Hydropower

Questions For Thought

1. Can we agree on the overarching challenge for hydropower? Can we define it?

2. What does success look like for sustainable hydropower? Can we describe it in terms of processes and outcomes?

3. Does it make sense to think of two alternative pathways for hydropower—ones that is business as usual and one that is sustainable?