Long-term water-energy nexus: Towards practical approach for sustainable water and electricity supply in India

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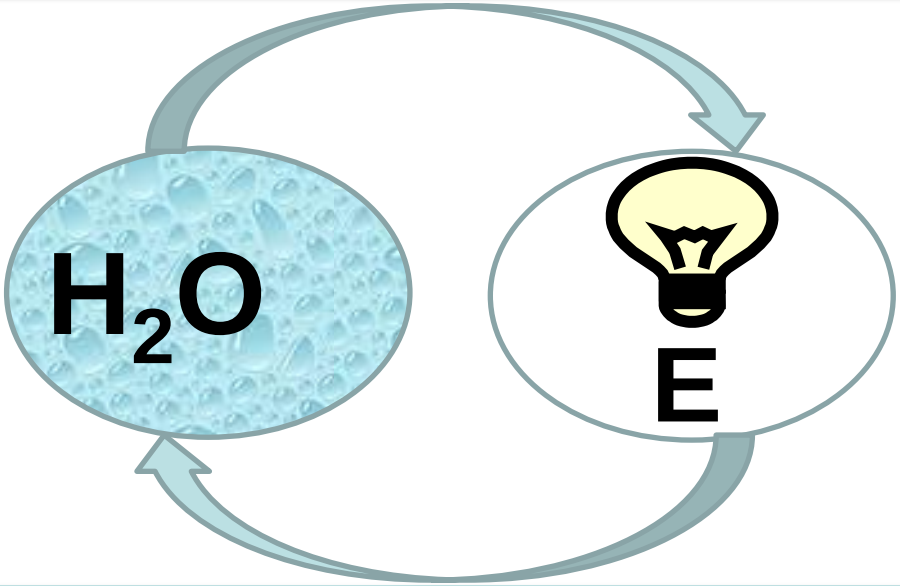
Basic facts

- In India per capita water availability has dropped from 5177 m^3 in 1951 to 1600 m^3 as per 2011 census, which is defined as water stress conditions
- Only 1122 billion cubic meters (BCM) of water is utilisable per year. But water demand will grow to 1300 BCM by 2050
- Water requirement for thermal power generation in India is around 6% of total national water requirement.
- Projected annual growth rate of electricity generation is 5% for coming years.
- During last decade thermal power plant constitute 75% of total power generation and expected to be 90% in coming decades.

The Water-Energy Nexus

Water for energy

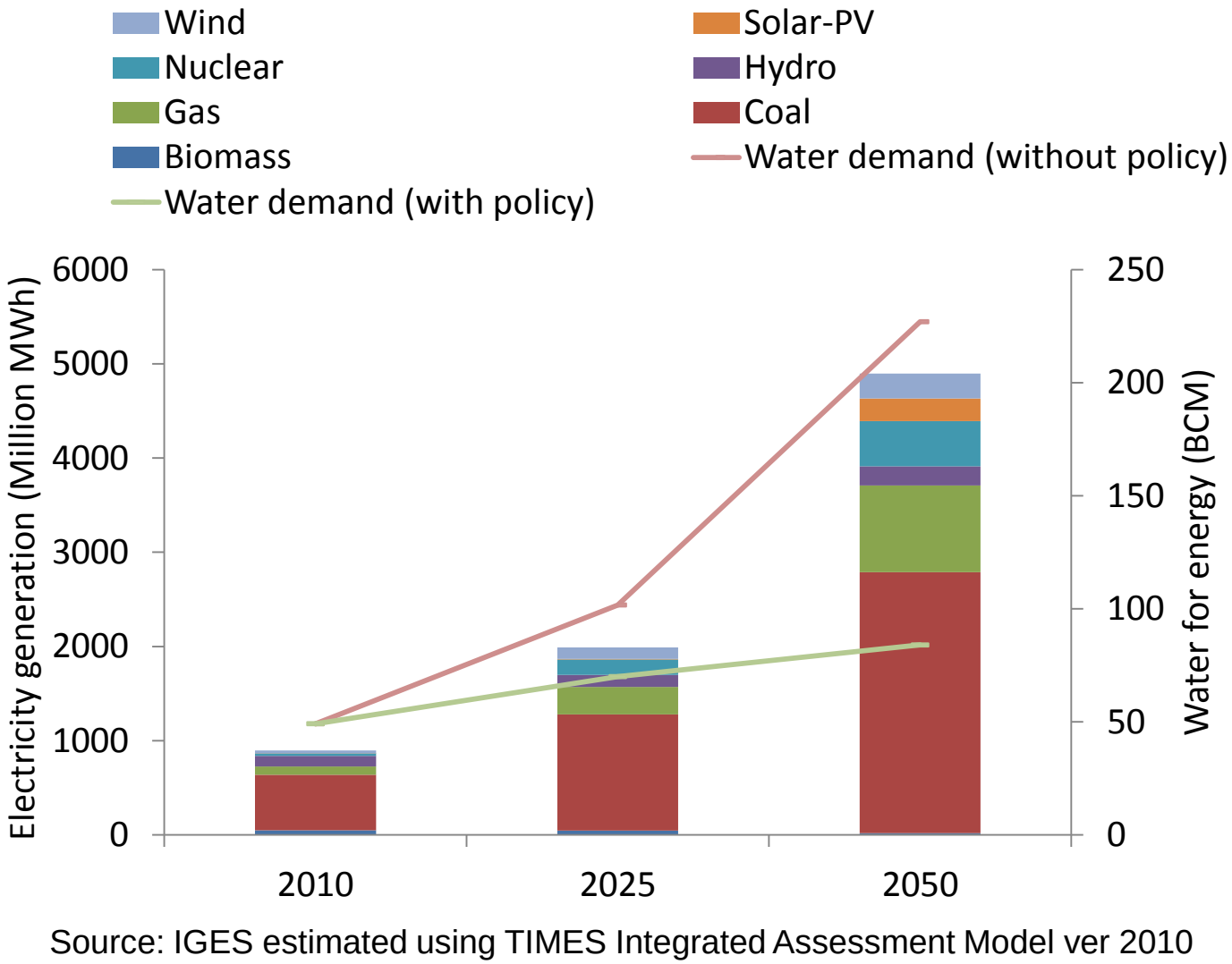
- extraction/production of primary energy
- hydropower
- cooling of thermal power plant
- clean energy generation



Energy for water

- water extraction
- water and wastewater treatment
- supply of water

Electricity generation and corresponding water demand in India (until 2050)



Source: IGES estimated using TIMES Integrated Assessment Model ver 2010

Note: Estimated water demand with policy intervention basically considers the closed loop wet cooling system installed after June 1999 and without policy water demand is a reference estimate of continuation of use of open loop wet cooling system.

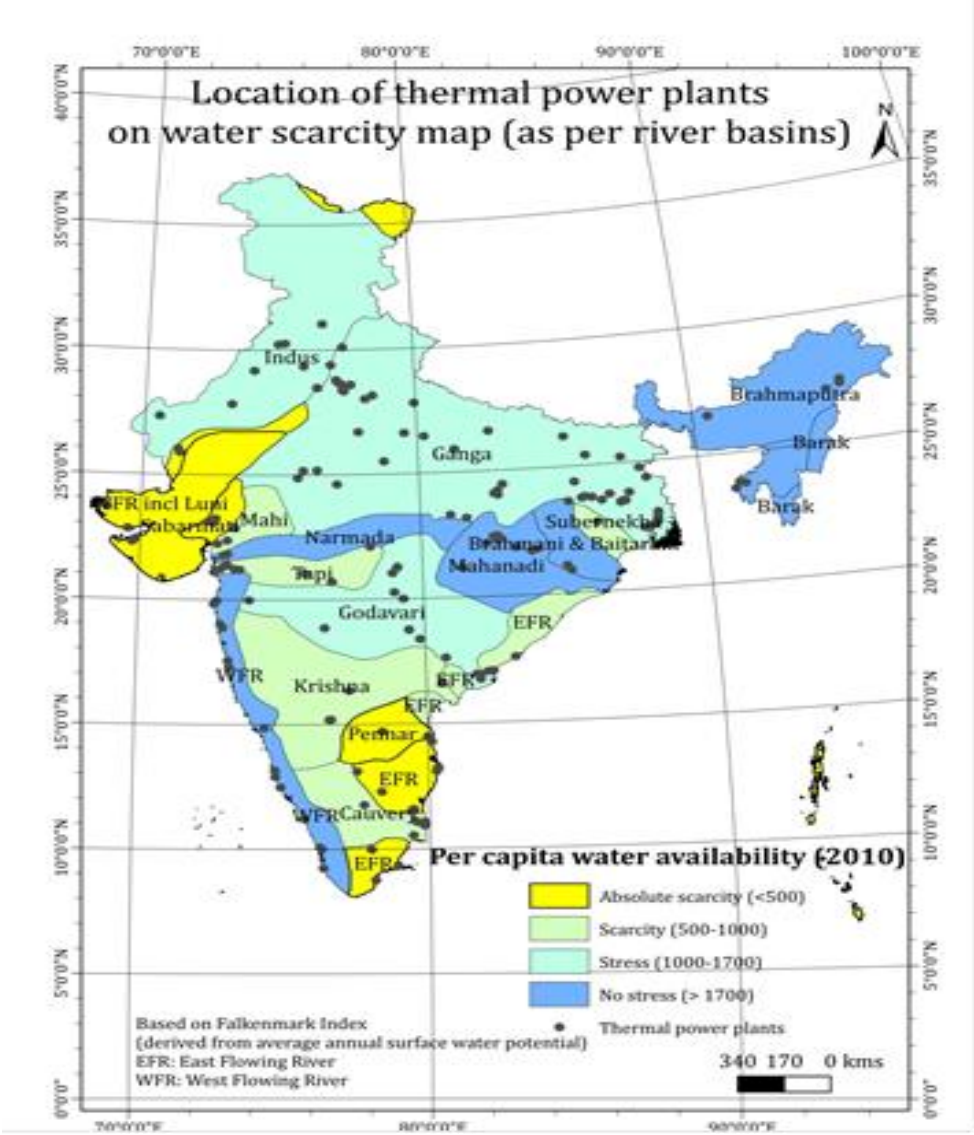
State of water resources in major river basins

River basin	Utilisable water resources (BCM)	Per capita water availability (m^3)	Level of water stress	Water requirement in 2050
Ganga	422	1039	Stress	494
Indus	73	1242	Stress	77
Luni	26	486	Absolute scarcity	29
Mahanadi	66	1786	No stress	61
Brahmani and Batarni	22	2063	No stress	21
Godavri	116	1454	Stress	99
Tapi	22	714	Scarcity	18
Krishna	84	912	Scarcity	92
EFRs	67	937	Scarcity	58
WFRs	54	4879	No stress	51
Brahmaputra	59	11782	No stress	56
Others	131	-	-	-

Source: ADB 2011

Distribution of Thermal power plants in river basins

River basin	Thermal power capacity distribution (%)
Ganga	35
Indus	7
Luni	6
Mahanadi	9
Brahmani and Batarni	3
Godavri	11
Tapi	6
Krishna	5
EFRs	7
WFRs	6
Brahmaputra	0.5
Others	5.5



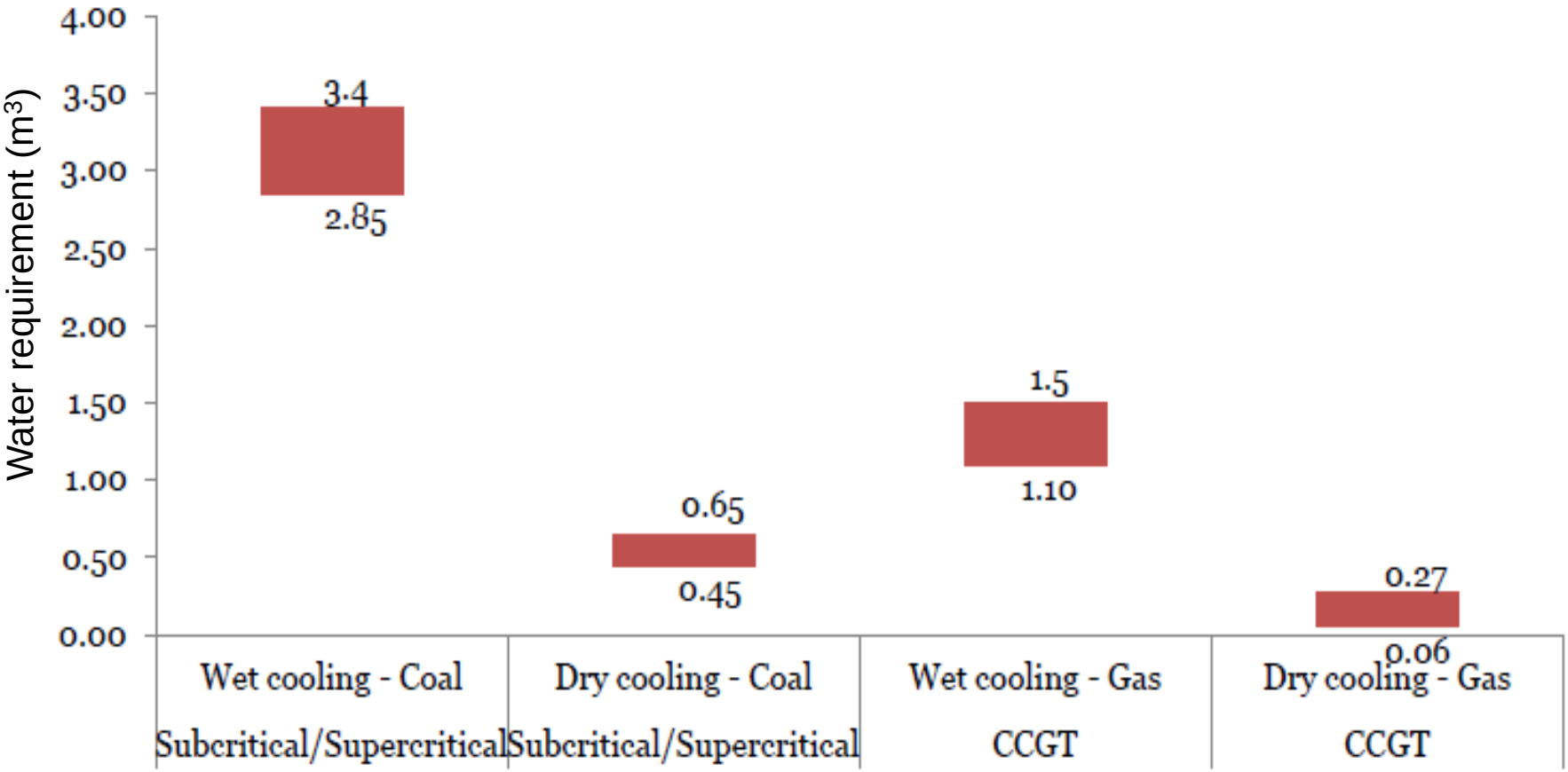
Relevant national policy to cope with water energy trade off conflict

- The Ministry of Environment and Forests (MoEF), Govt. of India, put a ban on using open loop wet cooling system in any inland power plants using fresh water from 1 June 1999.
- Power plants setup in the coastal areas are allowed to use open loop wet cooling system provided they use sea water as a coolant.
- Power plant Zero Discharge Policy is promoted and encouraged.
- Having secured water supply for the power plant operation is now crucial for approval.

Objectives of our study

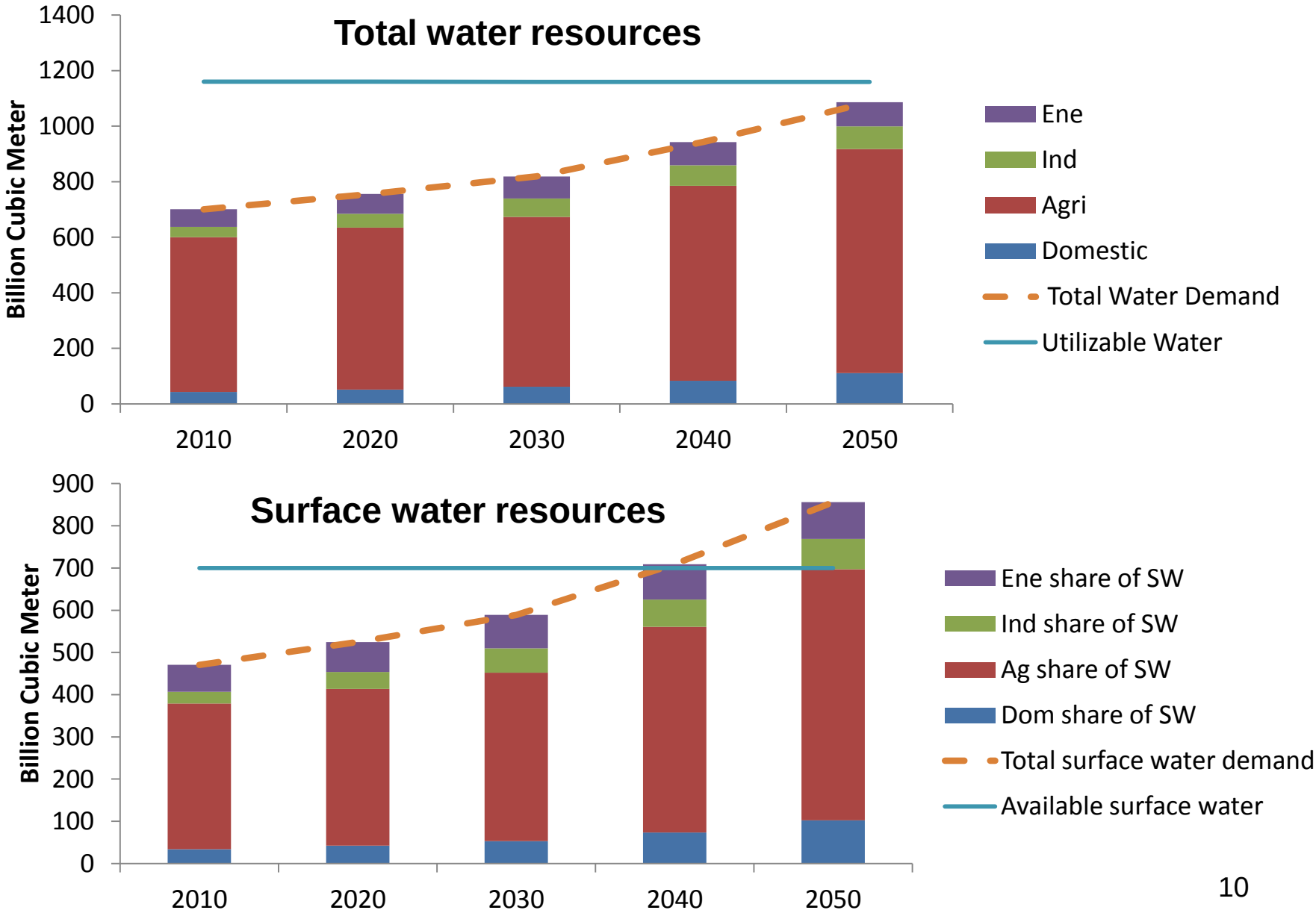
- To estimate the long term water demand of power sector in India
- To demonstrate the importance of water-energy integrated assessment in energy planning for sustainable development

Water requirement of different type of power plants

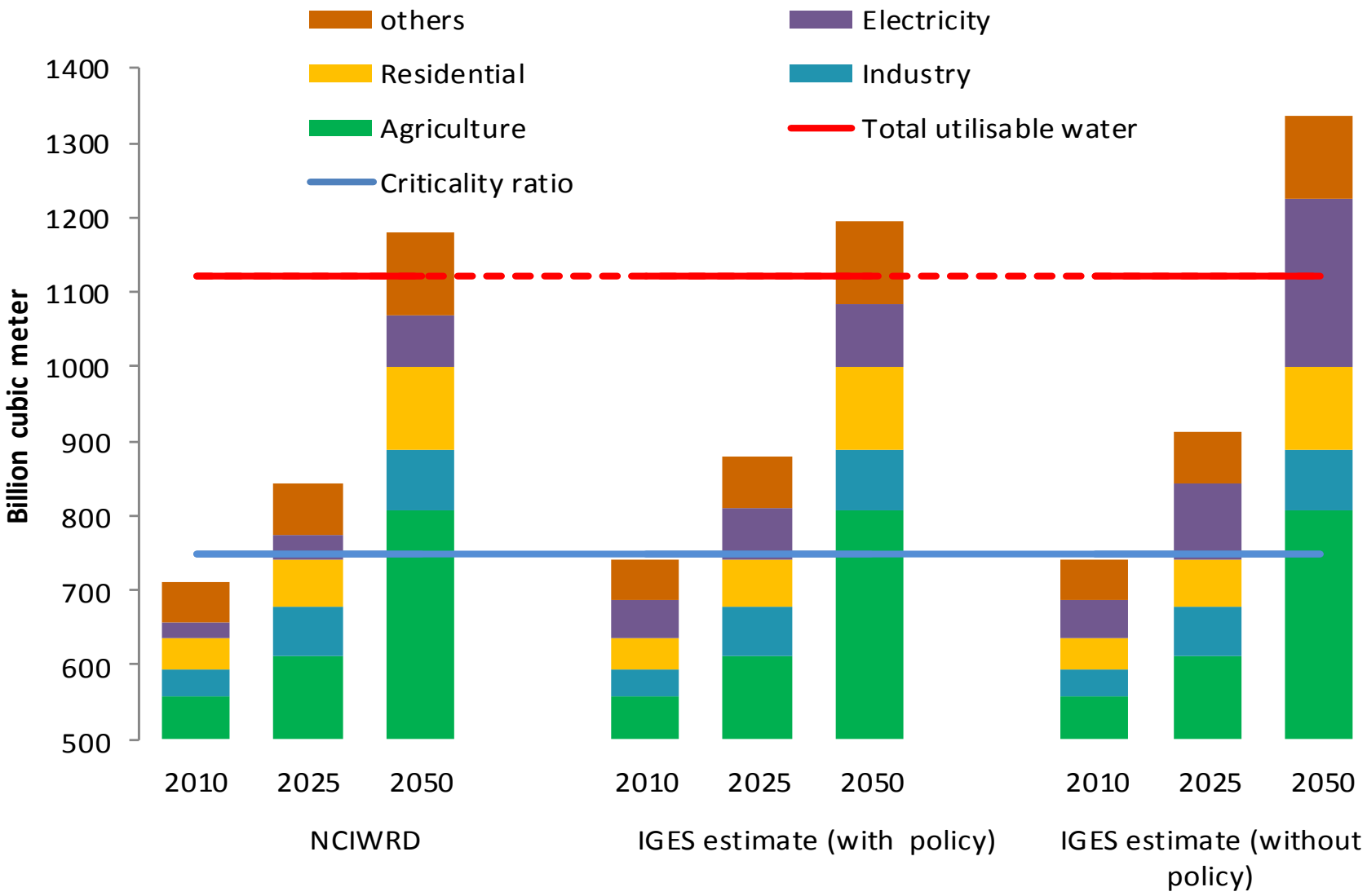


Source: Based on IGES survey on Indian power plants conducted during 2012.

Long term water supply-demand gap scenario



Long term water availability scenarios: Impact of power sector water demand



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Key messages

- With high uncertainty of future water availability, Indian long term energy supply might get negatively affected due to lack of water and energy sector investment can be jeopardized.
- Acute inter sectoral water demand conflict is envisaged in the near future due to increasing population, agricultural demand, rapid modernization.
- It is important to consider spatial distribution of water resources for selection of Go and No Go areas in future power plant construction planning.
- End-use efficiency improvement has potential to complement significant volume of water for other users.
- Water efficient energy technology development (wind, solar photovoltaic) can be considered as energy sector's investment as well as climate change risk hedging instrument.

Thank you for your attention!

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