

# Tracing Synergies and Trade-off Across Water-Energy Food Nexus: Practical Benefits and Challenges

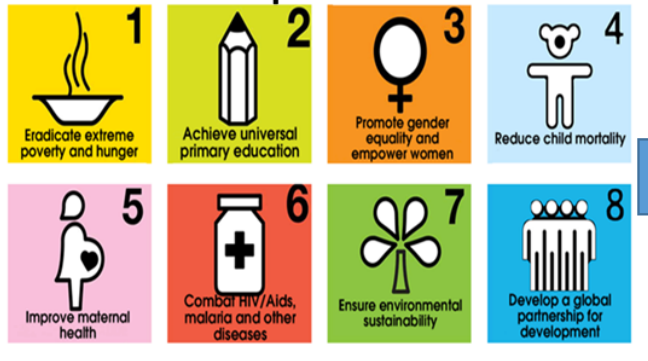
**Knowledge sharing workshop on adopting Water-Energy-  
Food Nexus Approach in India**  
**JSPS (Japan) and DST (India) Joint Research Seminar**

5-9 September, 2017  
NITTTR, Chennai, India

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# Importance of water food energy security have been well acknowledged in SDGs

## Up to 2015



## Beyond 2015

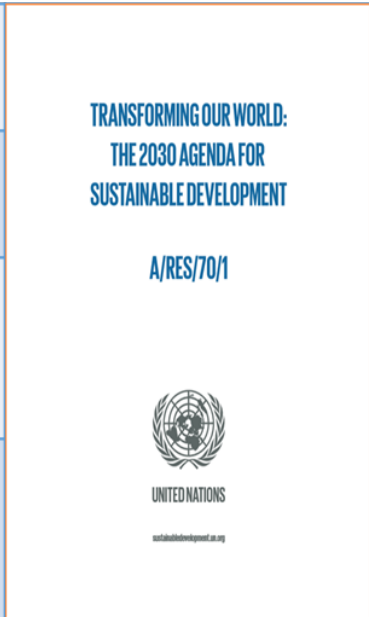


8 Goals, 18 Targets and 48 Indicators

Implementation was donor aiding dependent

monitoring, evaluation and accountability was not well addressed in MDGs

Complexity of sustainable global development was not fully represented in MDGs.



17 Goals, 169 Targets, and 230 Indicators

Applicable to every country

Importance of data revolution is well recognised for SDGs

Comprehensive set of goals has been adopted towards Sustainable development

# Where are we now?

## Food



Globally, 795 million people remain undernourished (FAO, IFAD and WFP 2015)

## Water



Nearly 1 in 10 people live without clean safe water (WHO and UNICEF, 2012)

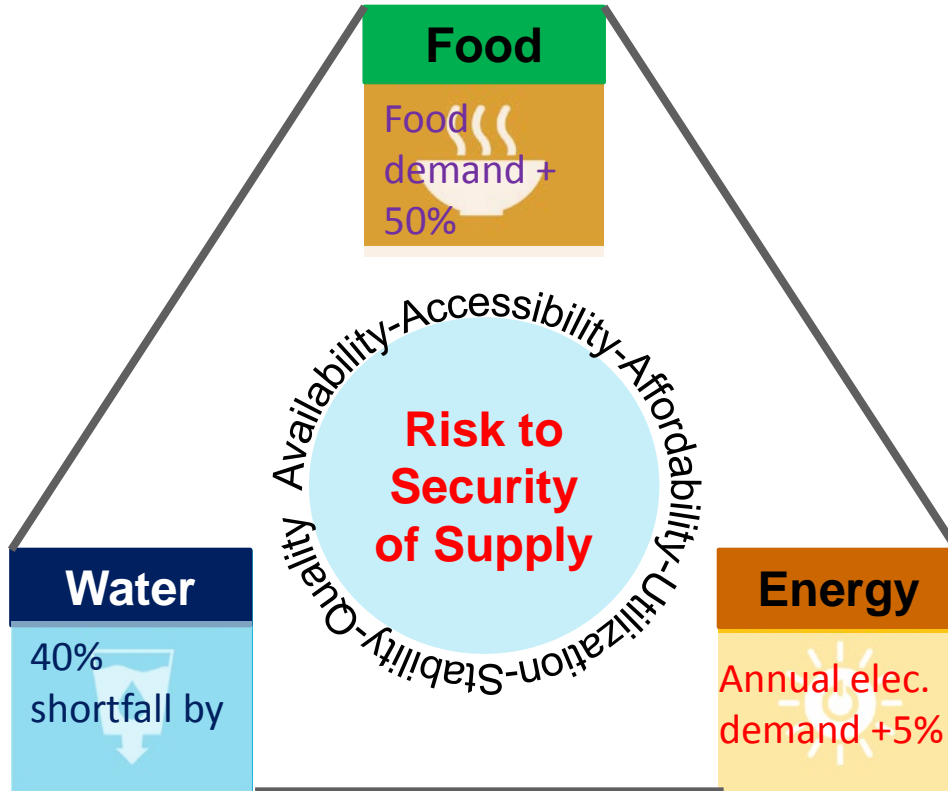
## Energy



Nearly 1.2 million people have no access to Electricity (IEA, 2016)

# where are we heading for?

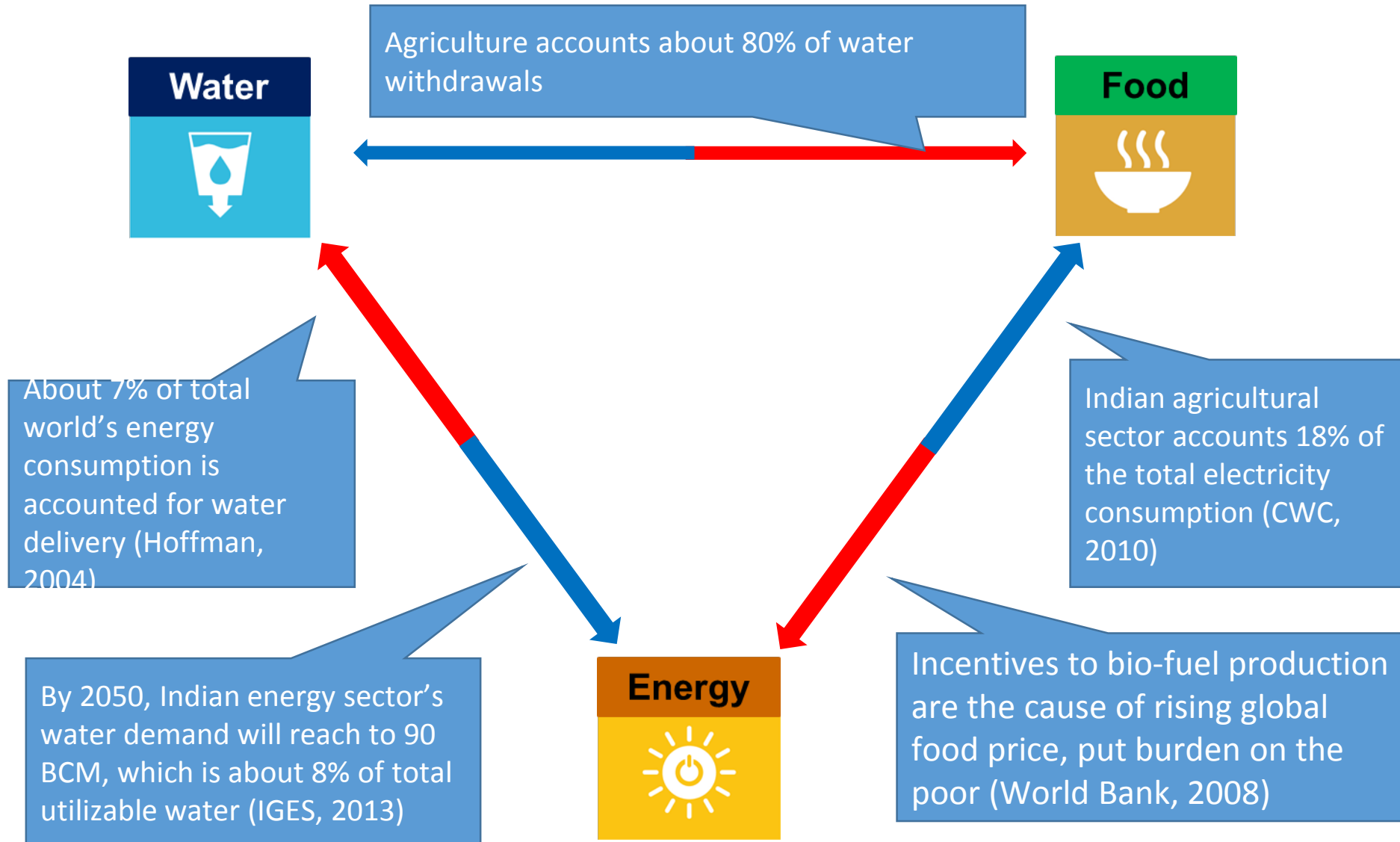
Food, water and energy security are not going to be ensured



## Challenges

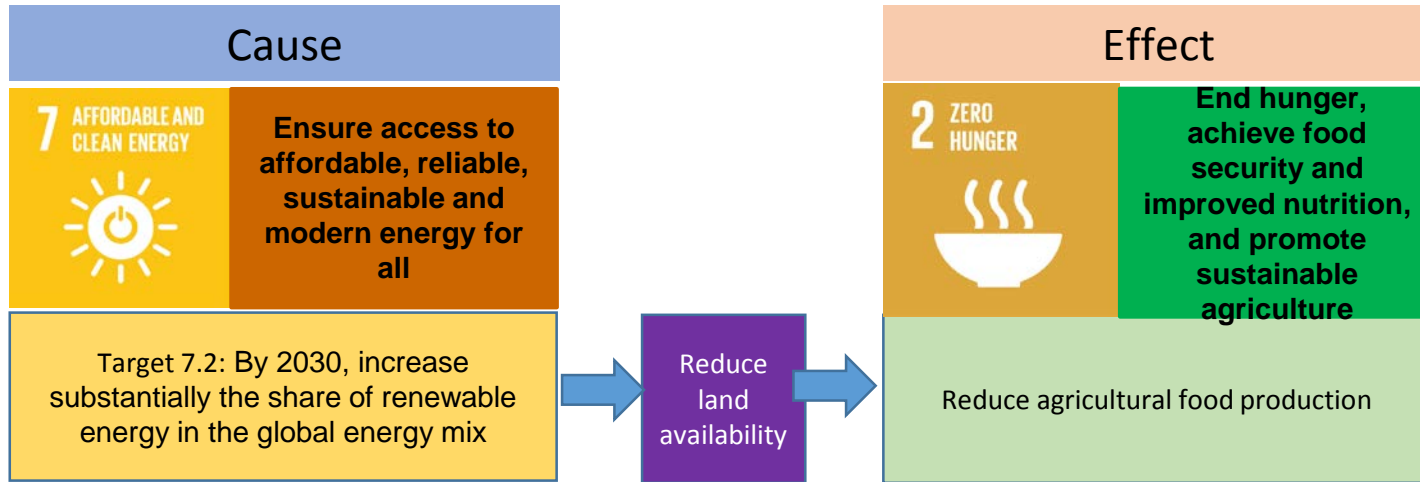
- |                 |                                      |  |               |
|-----------------|--------------------------------------|--|---------------|
| Population      | Resource intensive lifestyle         | Inadequate legislation and enforcement | Finance       |
| Economic growth | Resource intensive production system | Uncoordinated sectoral planning        | Knowledge gap |

# Water, Food and energy security are not in an isolated but nexus manner

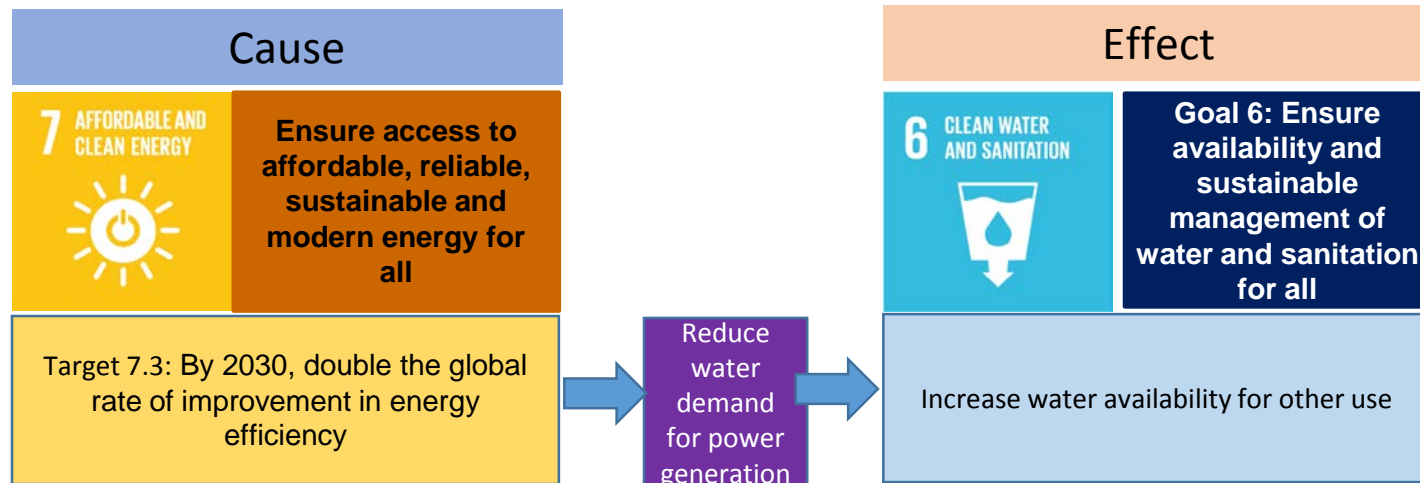


# Trade-off and synergistic relationship in WFEN

## Trade-off relationship



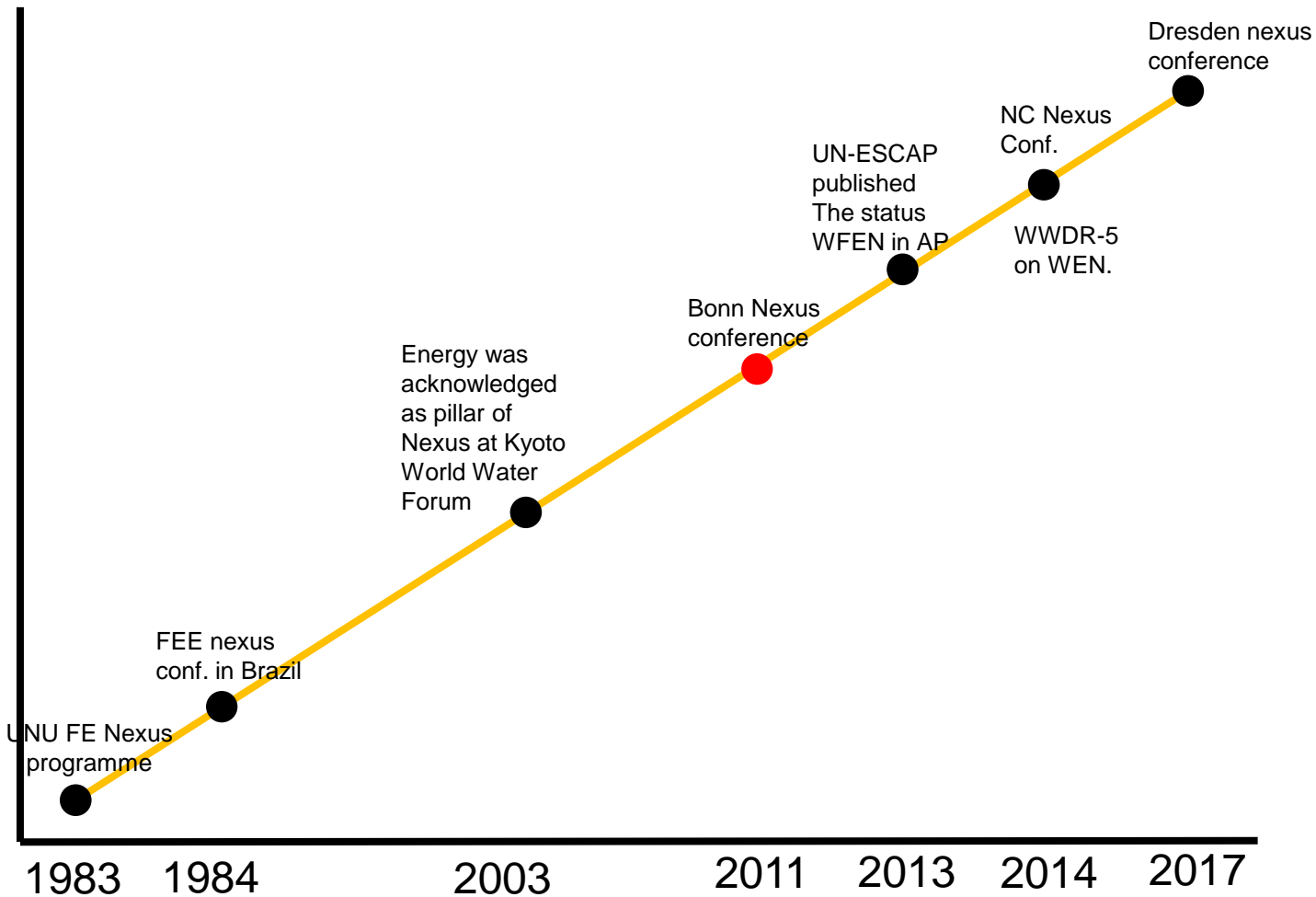
## Synergistic relationship



# Key questions to achieve water, food and energy security

- ✓ What solutions and strategies can be carried out to close identified gaps between resource demand and supply
- ✓ How we can identify and enhance synergies and minimize trade-off within the resource supply-demand systems.
- ✓ What are the key enabling factors and conditions can lead to collective achievement of water, energy and food security

# Nexus thinking and nexus debate are gaining attention in policy and academic circles





# How is the nexus approach different from IWRM

	WFE Nexus	IWRM
Priority	Equal priority to all sectors	Tends to prioritize a particular sector, i.e. water
Principle	Integrated policy solutions principle	Good governance principle
Participation	Promote collaboration through multi-stakeholder platform	Stakeholder involvement in decision making
Decision making	Environmentally and economically rational decision making	Efficient allocation and equitable access
Sustainable development	Resource security	Demand management

# WFEN approach brings opportunity of maximize synergies

Increase policy coherence

Accelerate access

Create more with less

End waste minimize losses

Value natural infrastructure

Mobilize consumer influence

# Our WFEN research in India and South Asia



**POLICY BRIEF**  
Improving Irrigation Water Use Efficiency Holds the Key to Tackling Water Scarcity in South Asia: Technical Potential and Financing Options

July 2013  
Number 25

**Key messages:**

- Water scarcity is becoming to the extent that it has become a limiting factor to the growth of major economies in South Asia, and agriculture is by far the largest water-using sector.
- Overuse of water for crop production is one of the main causes of water scarcity. This overuse results from low irrigation water use efficiency (IUE) associated with water-intensive irrigation systems, use of unimproved irrigation water systems, uneven water distribution in crop fields, and suboptimal practices for supplying irrigation water.
- There is huge potential to improve irrigation water efficiency in South Asia by promoting low water-consuming crops, for example, maize and sorghum (which need about 70% less water than flooded rice cultivation). Therefore, crop diversification is one of the practical options to reduce water scarcity in water-stressed areas by increasing agriculture IUE in the region.
- Water-saving technologies such as micro irrigation (including sprinkler and drip irrigation) and laser-aid leveling can significantly reduce the agriculture sector's water footprint in South Asia if the full potential of these technologies were to be utilized. Bangladesh, India and Pakistan could save 21%, 21%, and 28% of their water respectively, compared with current levels of water use.

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The United Nations World Water Development Report 2014

**FACING THE CHALLENGES**

VOLUME 2

INCLUDES DATA AND INDICATORS ANNEX FOR WATER AND ENERGY

**WWDR 2014**

Institute for Global Environmental Strategies (IGES)

IGES Research Report 2013-01

**Water Availability for Sustainable Energy Policy: Assessing cases in South and South East Asia**

Institute for Global Environmental Strategies, December, 2013

IGES

**POLICY BRIEF**

July 2013  
Number 26

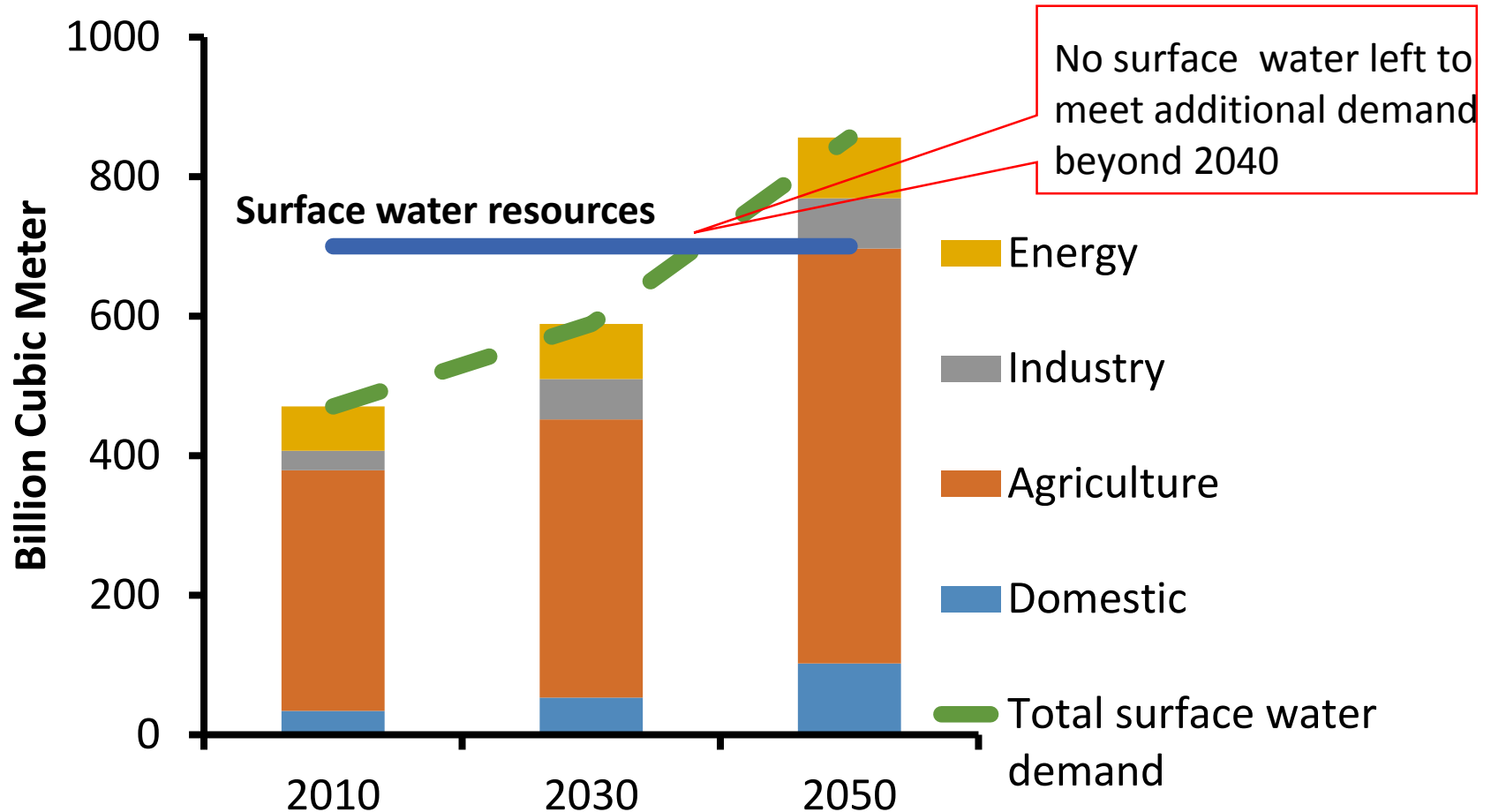
**Long Term Electricity Scenario and Water Use - A case study on India**

**Key Messages:**

- Increasing water demand for electricity generation will intensify inter-sectoral conflicts for freshwater, especially in the countries with water scarcity like India. To mitigate conflicts for freshwater, appropriate policies should be taken in a timely manner. Such policies could be the introduction of water efficient technologies in power plants, promoting low water-consuming renewable energy (wind, solar photovoltaic) and the implementation of water demand management approaches for major water users.
- Water constraint is expected to be a major hindrance for sustainable development of water scarce developing countries such as India to follow the existing projected electricity scenario in four decadal economic growth.
- With the given technological intervention and its mid to long-term projection in India especially in the electricity sector, it is estimated that by 2050 water demand for electricity generation will increase for India compared to 2010. Such an increased use of freshwater for electricity generation will exceed the capacity of total available freshwater to meet total water demand by 2050.

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# Water supply-demand gap scenario- Case of India



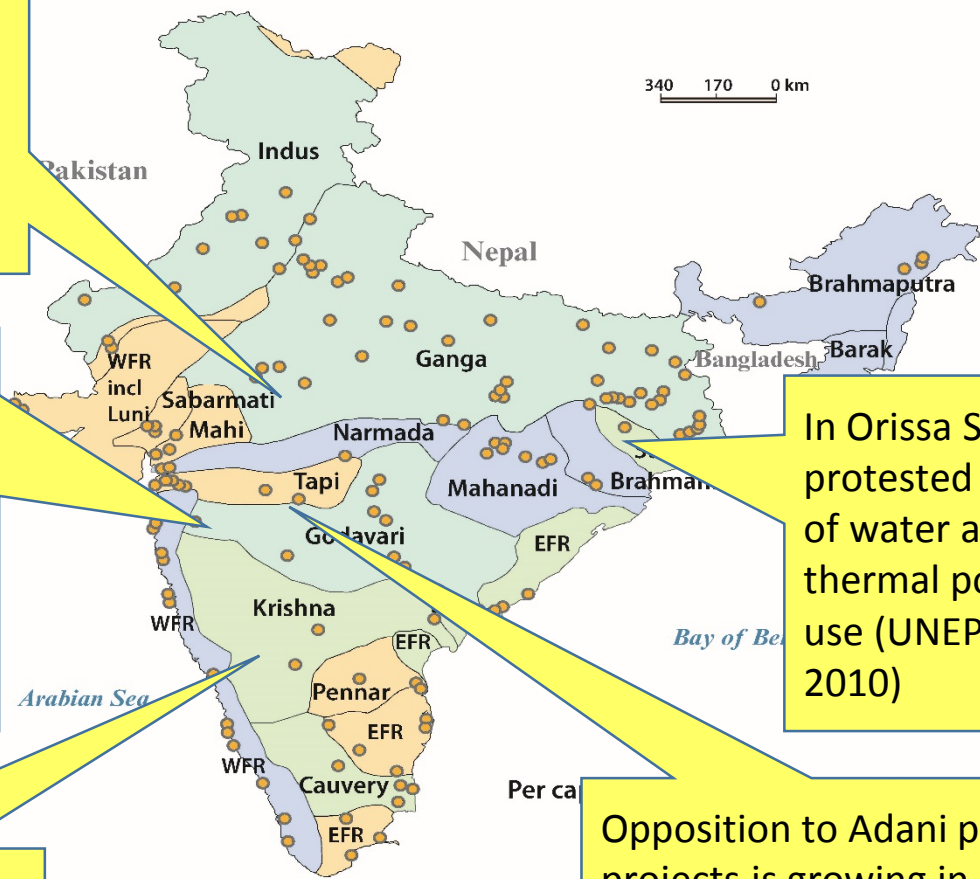
**Overuse of water in the production cycles results from low water use efficiency is the main reason of this large gap**

# Conflict of interest between energy sector and other water users over water (Case of India)

In Madhaya Pradesh, power cuts were made to alleviate the water shortage in the region in 2006 (Source: The Hindustan Times, 2006)

Parli thermal power plant in Maharashtra was shut down because of severe water shortage in the Marathwada region (NDTV, 2013)

In Kerala, power cuts were ordered to deal with water scarcity in 2008 when monsoon rainfall was 65% less than normal (Source: Thaindian News, 2008)

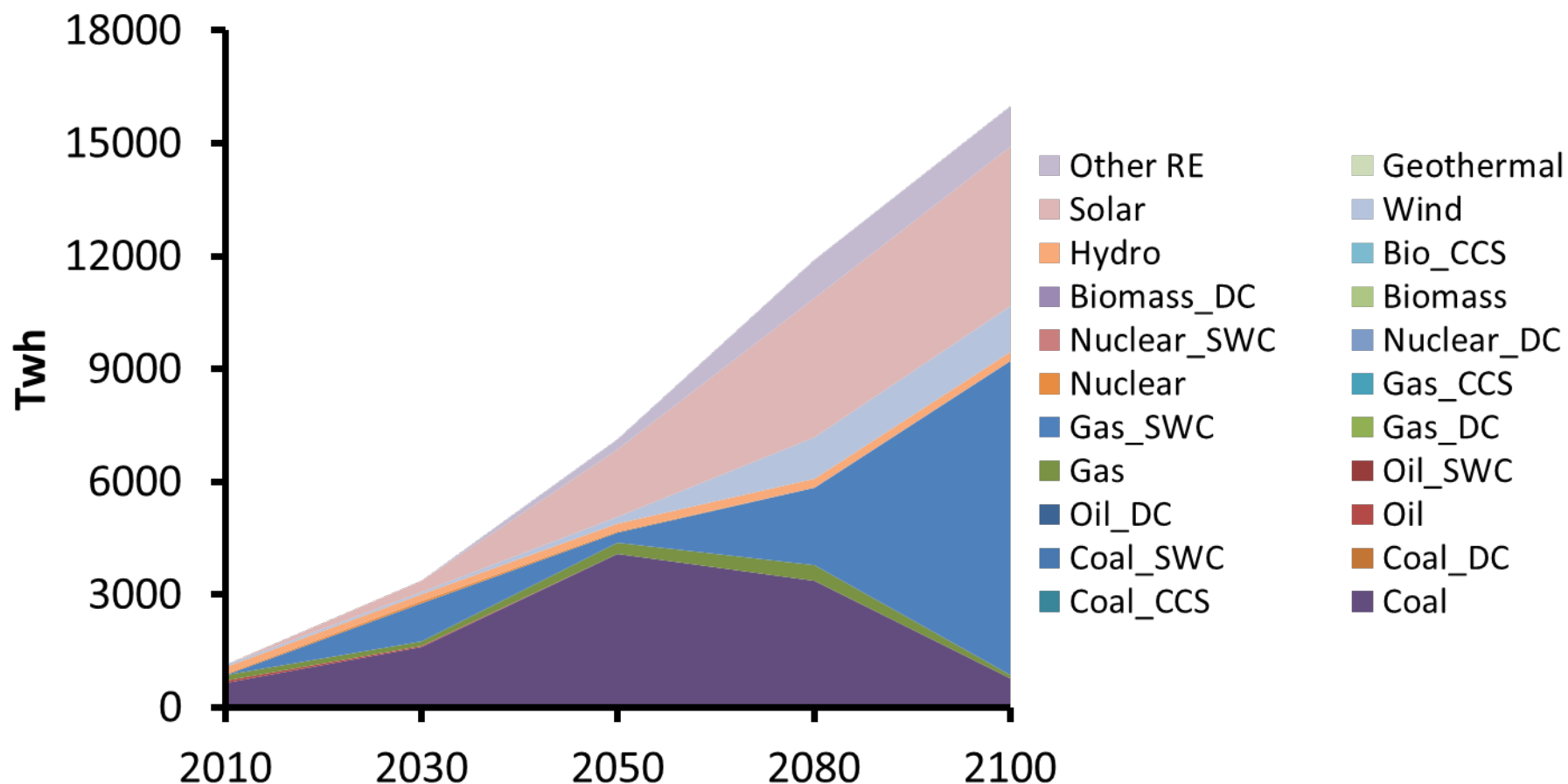


In Orissa State, farmers protested the increasing rate of water allocation for thermal power and industrial use (UNEP Finance Initiative, 2010)

Opposition to Adani power projects is growing in local community due to threats to drinking water and irrigation water availability (The Times of India, 2011)

Legend: WFR: West Flowing River, EFR: East Flowing River. Data derived from Falkenmark Index (based on average annual surface water potential).

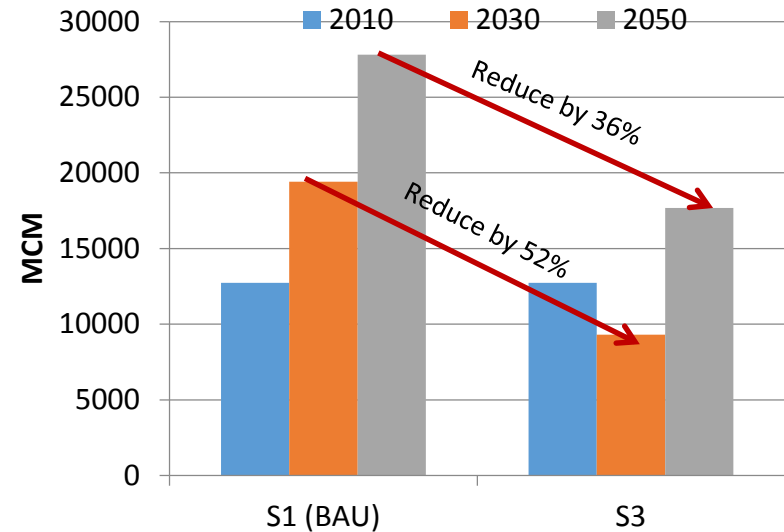
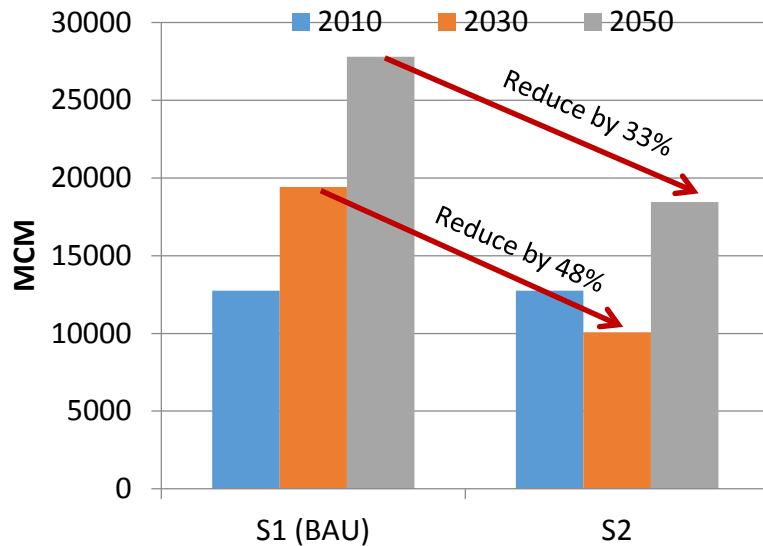
# Potential long-term electricity supply mix to deal with water scarcity in India



Source: IGES, 2013

# Water scarcity mitigation options in energy sector

## Gradual transition to more water efficient cooling technology options



S1: 25% of the thermal power capacity will continue with open loop cooling system

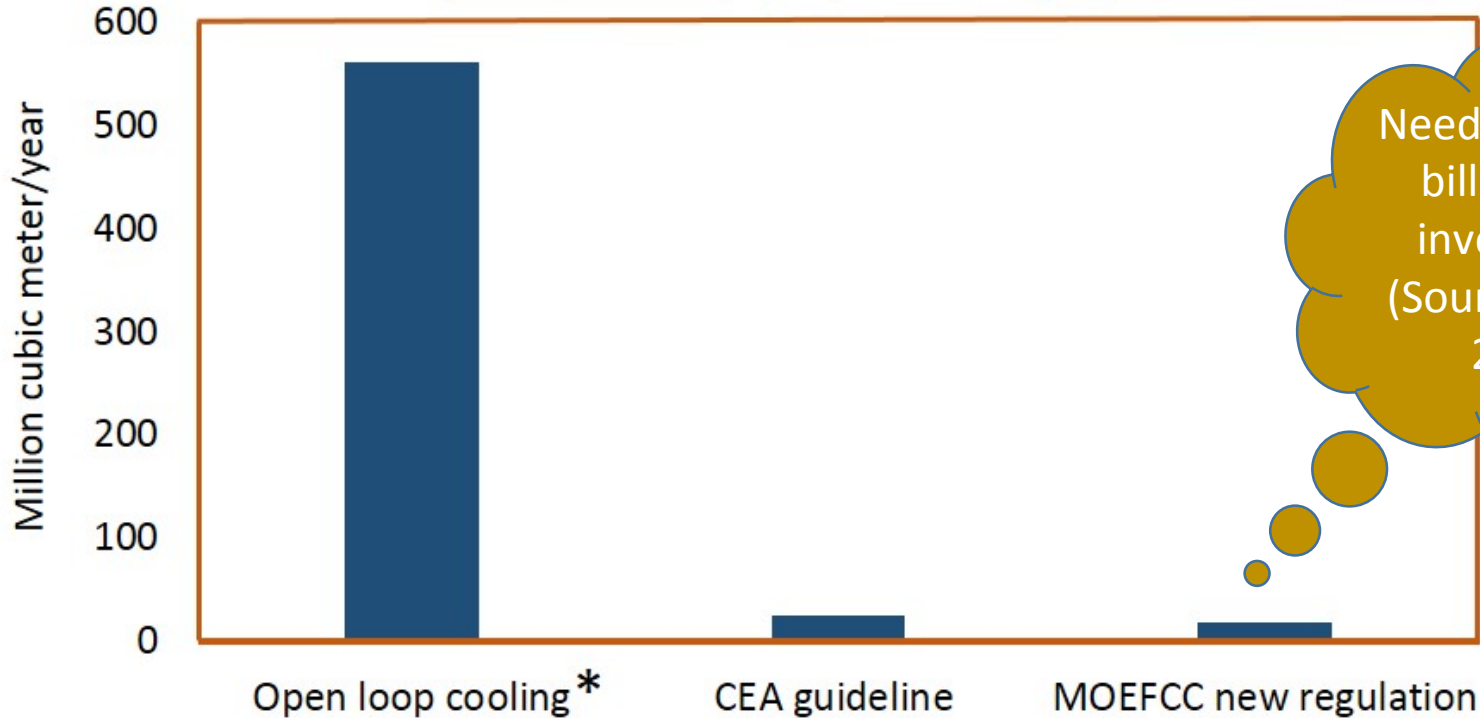
S2: All open loop system will be phase out by 2030

S3: open loop cooling system will be replaced by dry cooling system by 2030

# Policy intervention to restrict water use for thermal power plants-Case of India

## Key policy milestones

1999	2012	2015
Put a ban on open loop cooling system	Released guideline for water use in TPP (3.6 m <sup>3</sup> /MWh)	New regulation to reduce water use limit to 2.5 m <sup>3</sup> /MWh

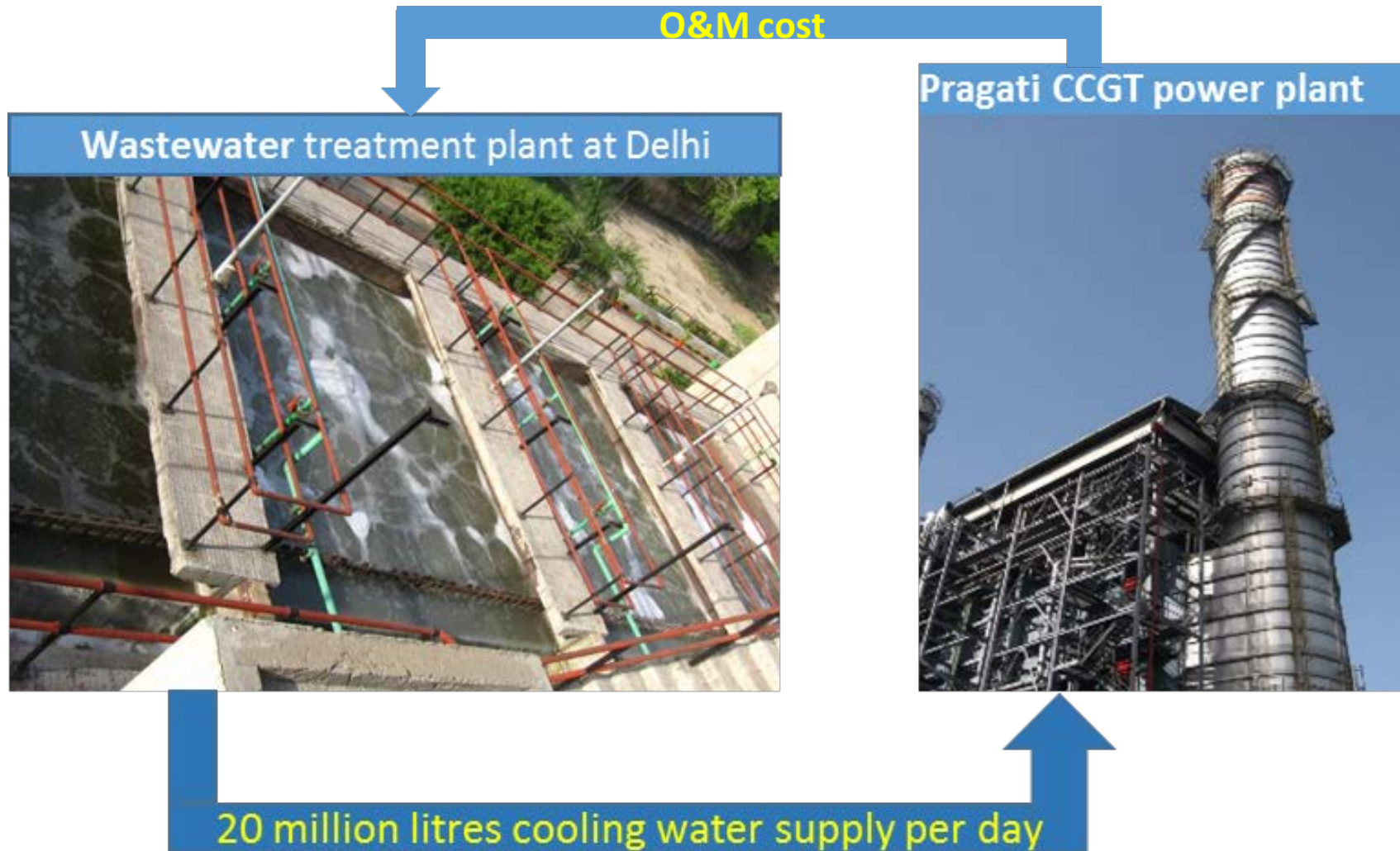


Need approx. 3 billion USD investment (Source: Bosh, 2016)

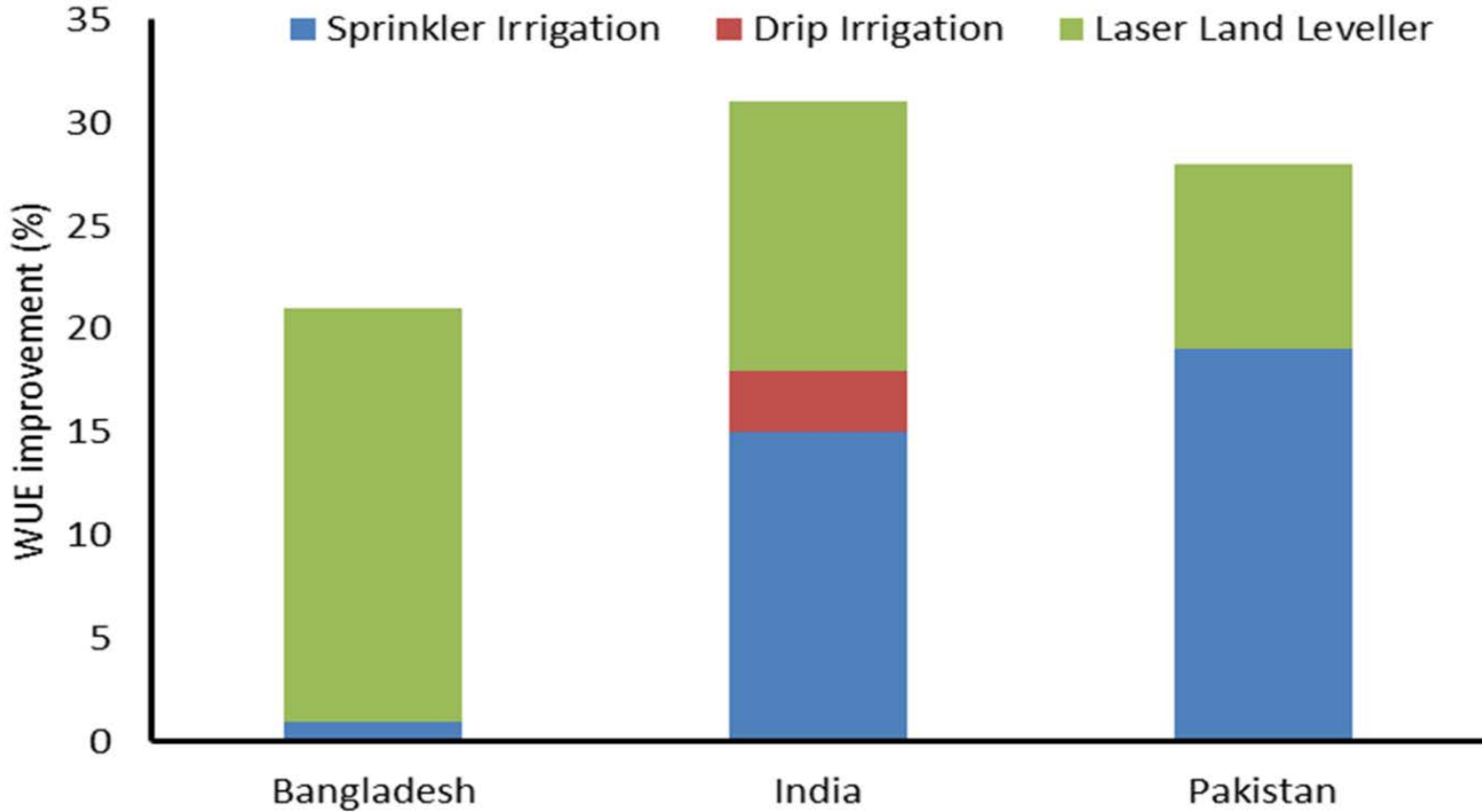
\*Water use intensity in open loop cooling system 80m<sup>3</sup>/MWh



# Lets be hopeful and helpful for positive nexus!



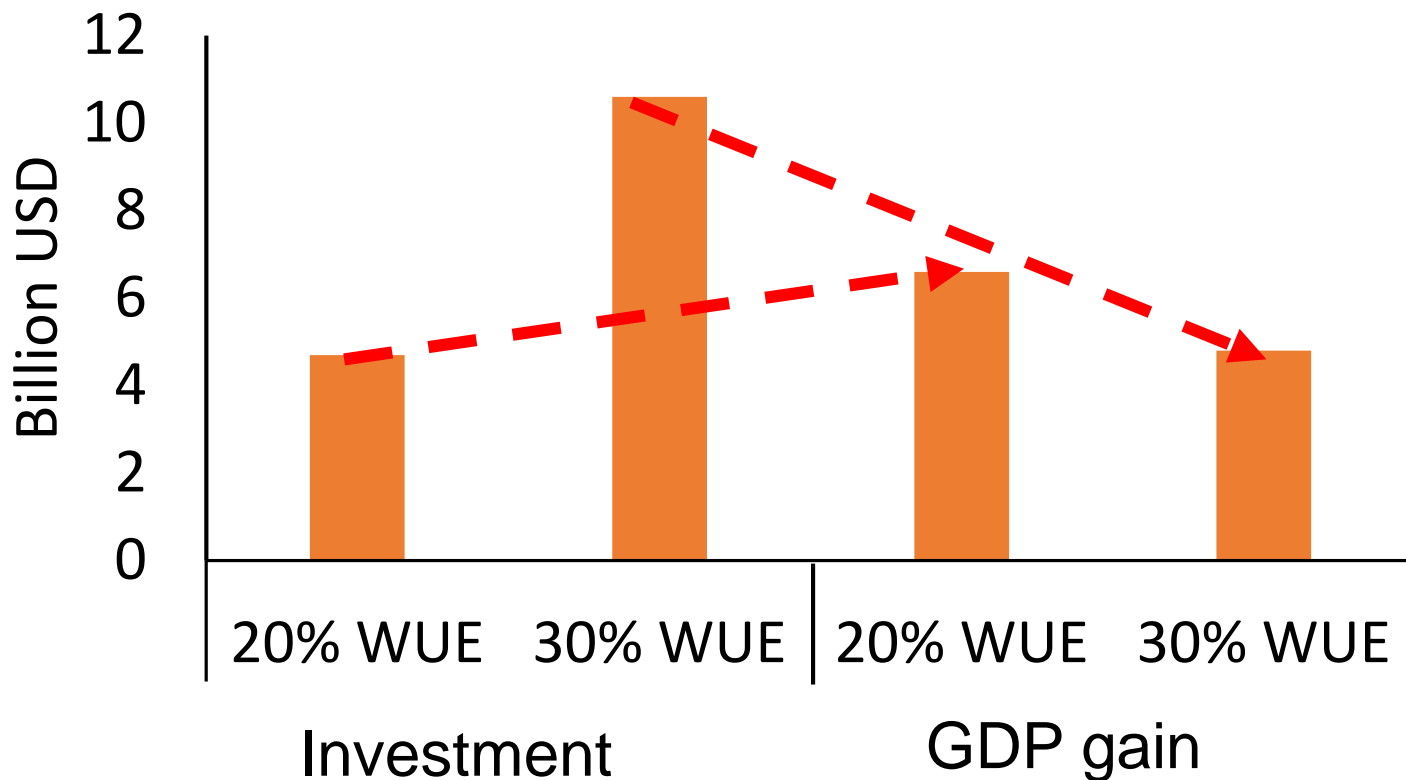
# Potential of irrigation WUE improvement in India



# Huge potential of irrigation WUE- Case of India

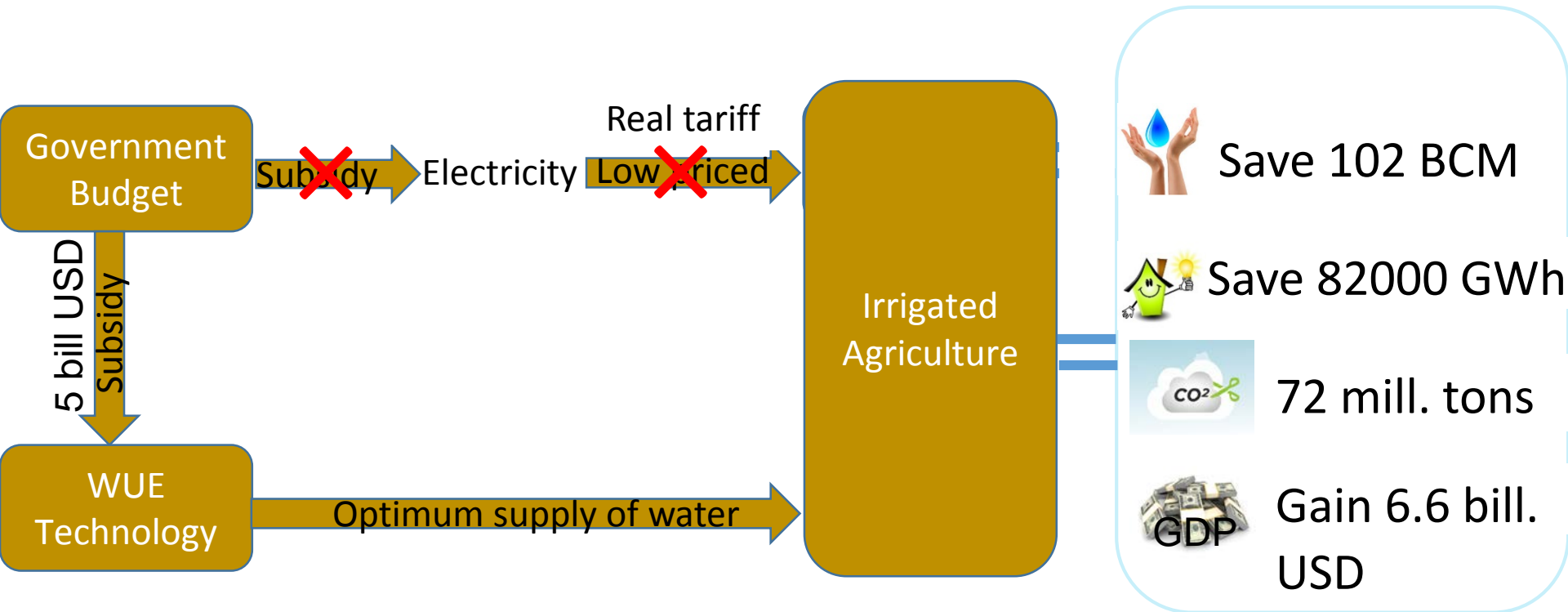
From Current 40% WUE level  to 70% WUE level

But needs billions dollar investment

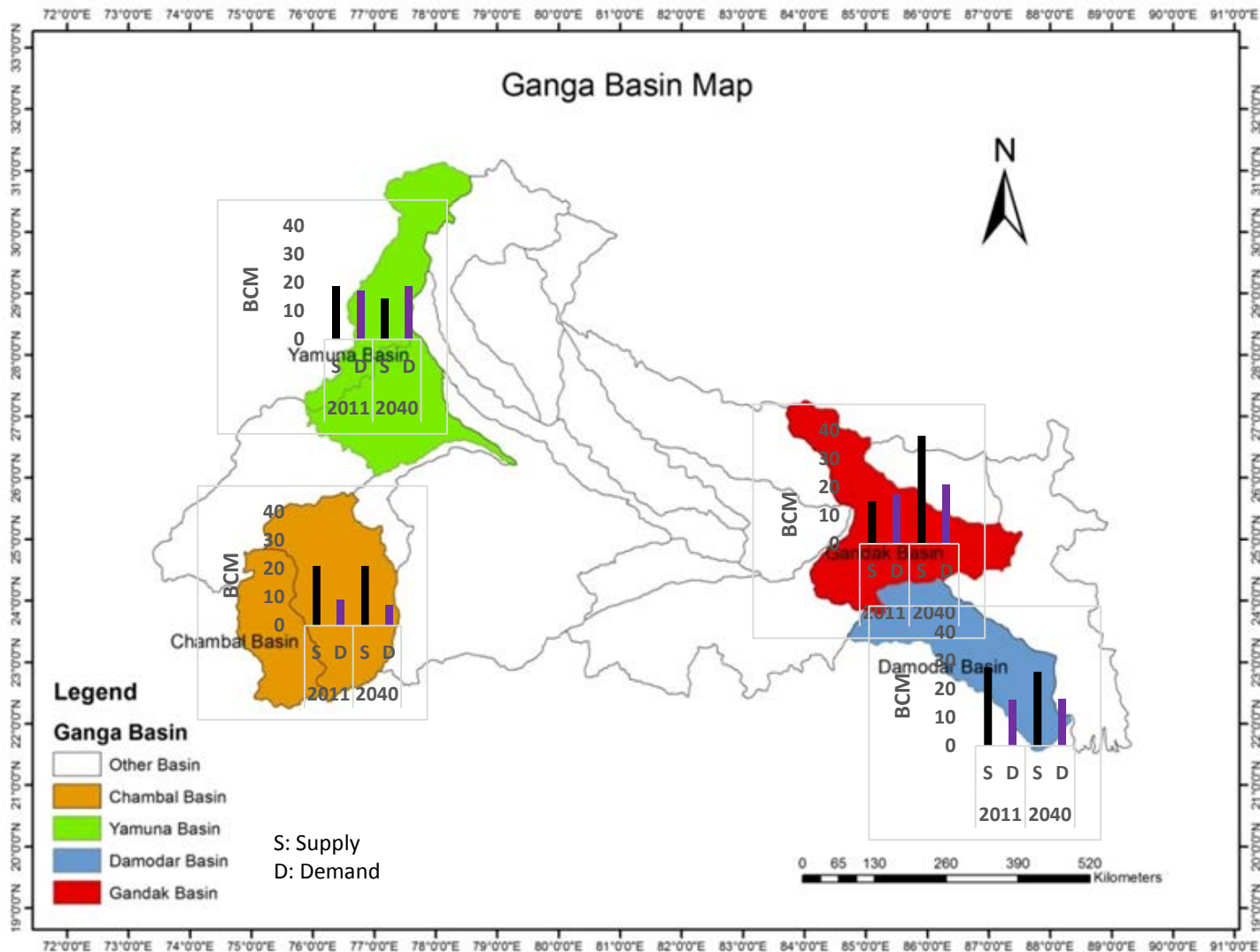


Source: Prepared based on Taheripuri et al. 2016

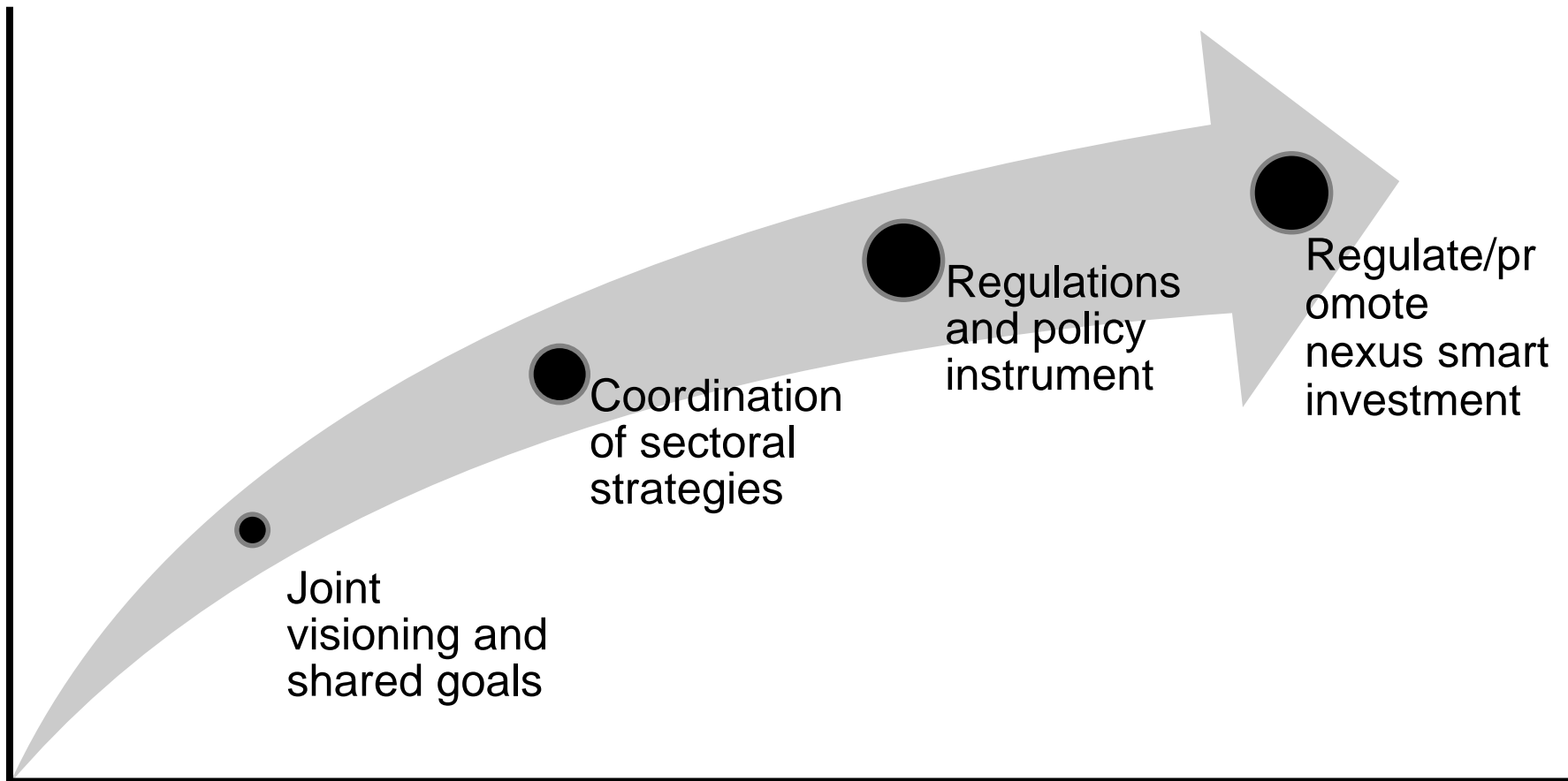
# A nexus solution: Shifts the subsidy amount from power supply to WUE



# Integrating spatial distribution of water resources in development plan -case from Ganga River basin



# Enabling Framework for Operationalization of “Nexus Approach”



# Thank you very much

A scenic view of Mount Fuji, a snow-capped mountain, under a clear blue sky. In the foreground, there is a rocky coastline with a white lighthouse on the left, a red torii gate in the center, and a black bird in flight on the left. The water is a deep blue-green color.

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