

# India's Water-Energy-Food- Climate Nexus

*Can strategic emerge out of the chaotic?*

**Dr Arunabha Ghosh**  
CEO  
Council on Energy, Environment and Water

Innovation Strategies for Sustainable Development through WEF Nexus  
UNESCAP APCTT, TISTR, MOST  
Bangkok, 28 June 2017

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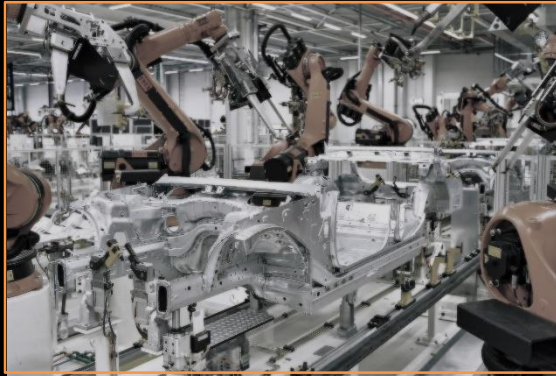
STRICTLY NOT FOR CIRCULATION



Energy Access



Renewables



Low-Carbon Pathways



Greenhouse Gases and Monitoring, Reporting, Verification



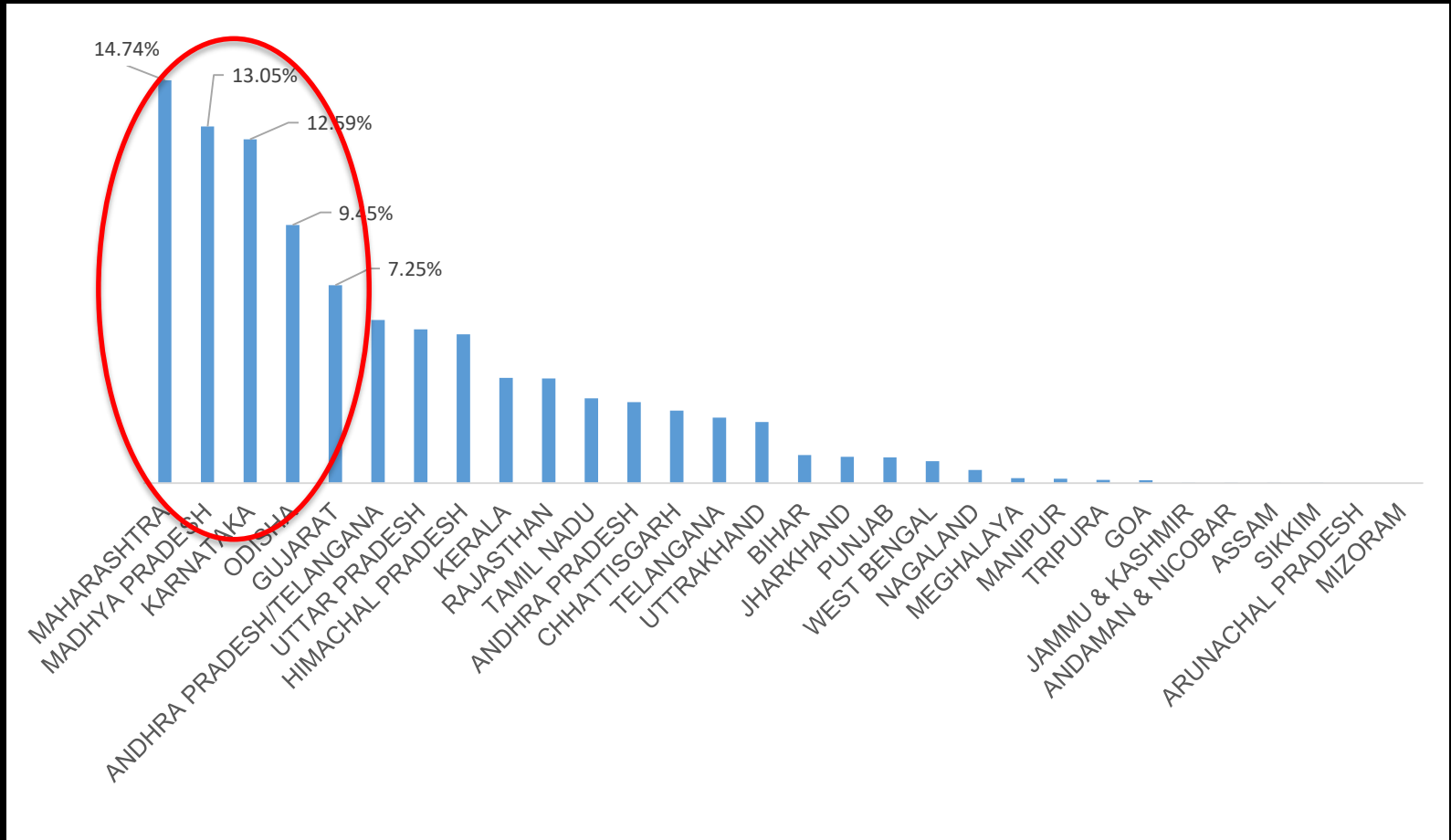
Risks and Adaptation



Technology, Trade & Finance

# Innovations in institutions

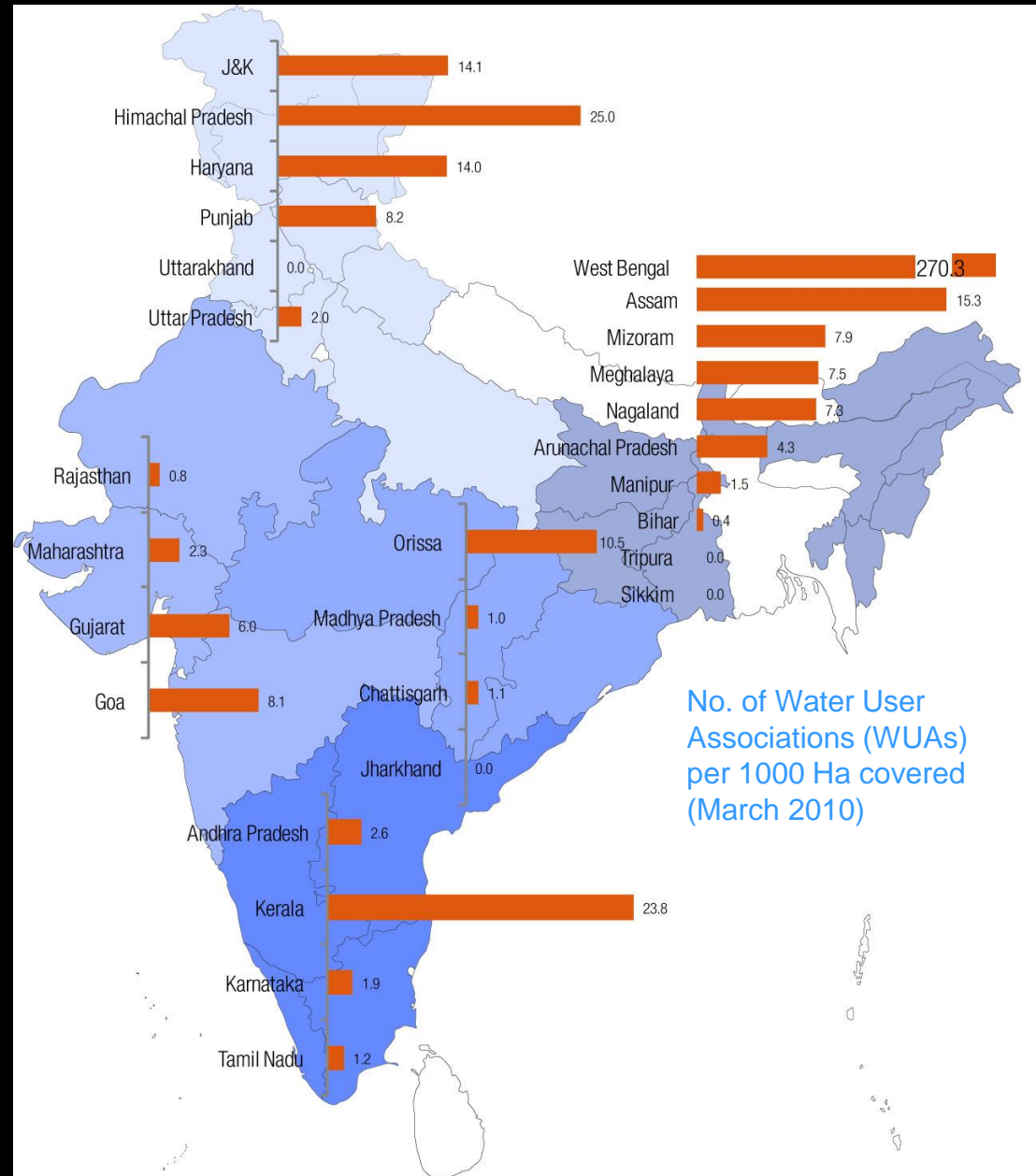
# Only five states with nearly 60% of reservoir storage capacity



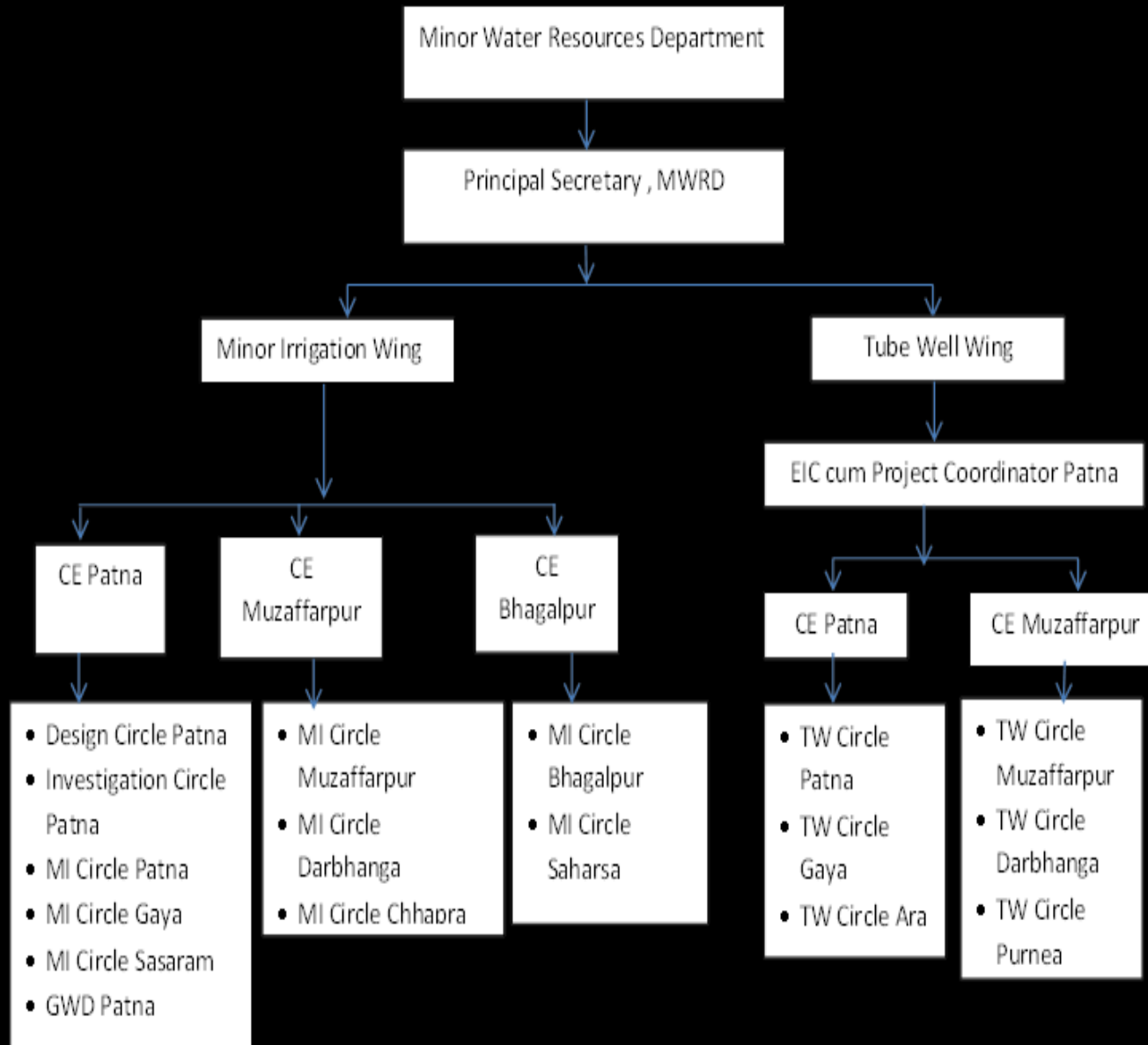
# Empowering water user associations in India

## Functions

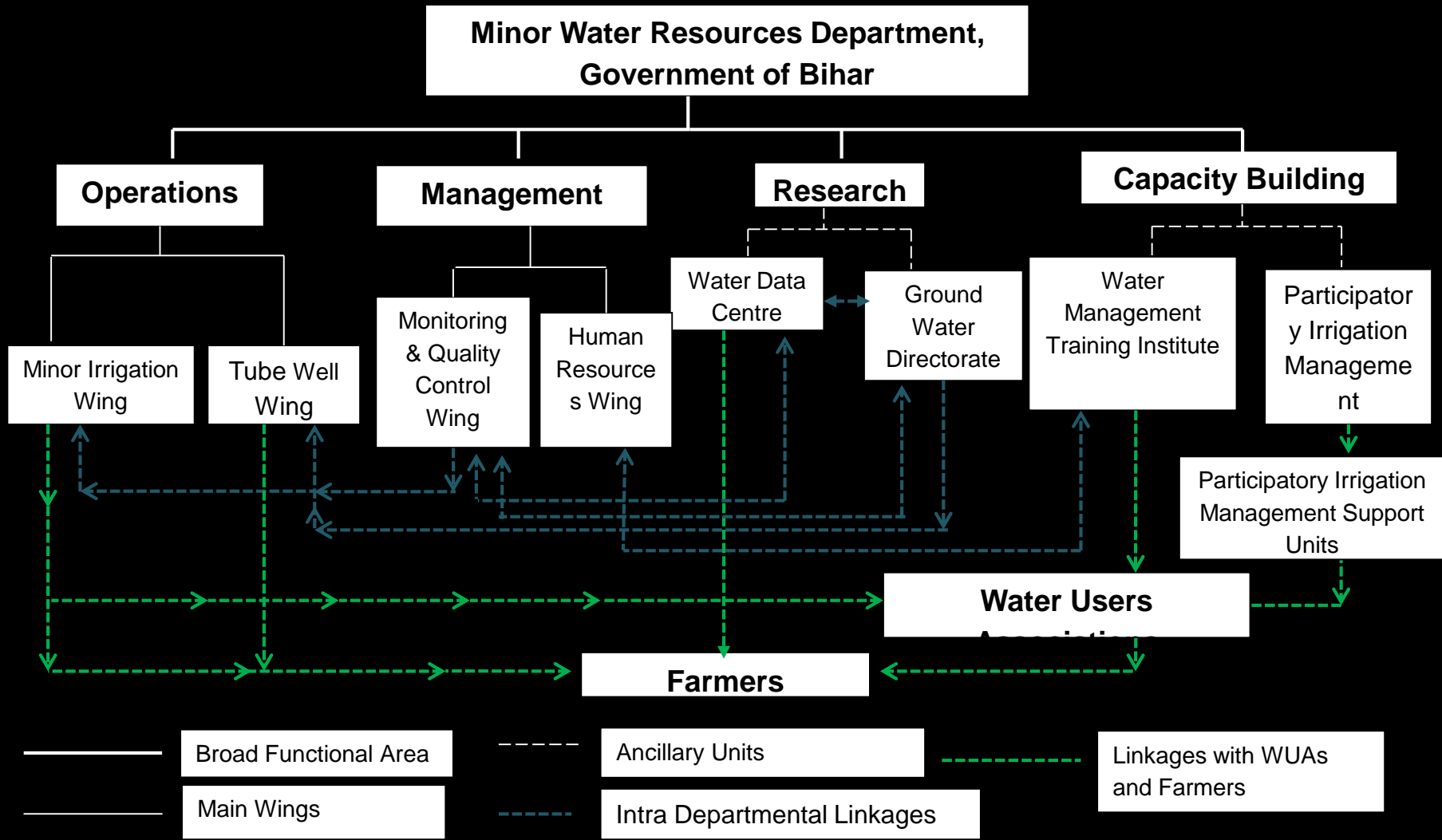
- Implementing O&M
- Crop planning, crop water budgeting & raising irrigation water demand
- Implementing water distribution
- Support in estimating and collecting water charges



# Bihar: how institutions looked

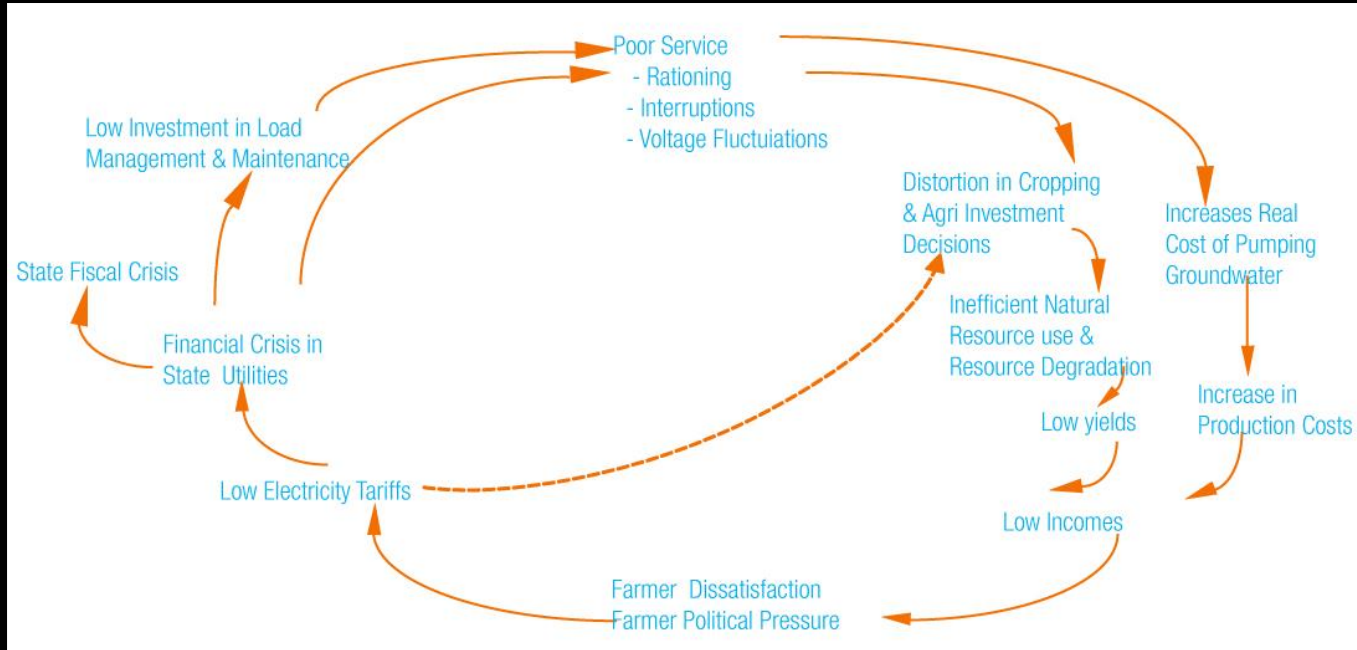


# Bihar: focusing on service delivery



# Innovations in irrigation

# Energy for irrigation: vicious cycle persists



## Groundwater

Basin wide Assessment

Participatory  
Hydrological Monitoring

Environmental Viability  
Assessment

Application efficiency  
Drip/ Sprinkler

## Energy

**HVDS, Feeder  
Separation & other  
activities**

**Energy Efficient Pumps**

Participation in Agri  
Power Management

## Agriculture

Crop Water Budgeting

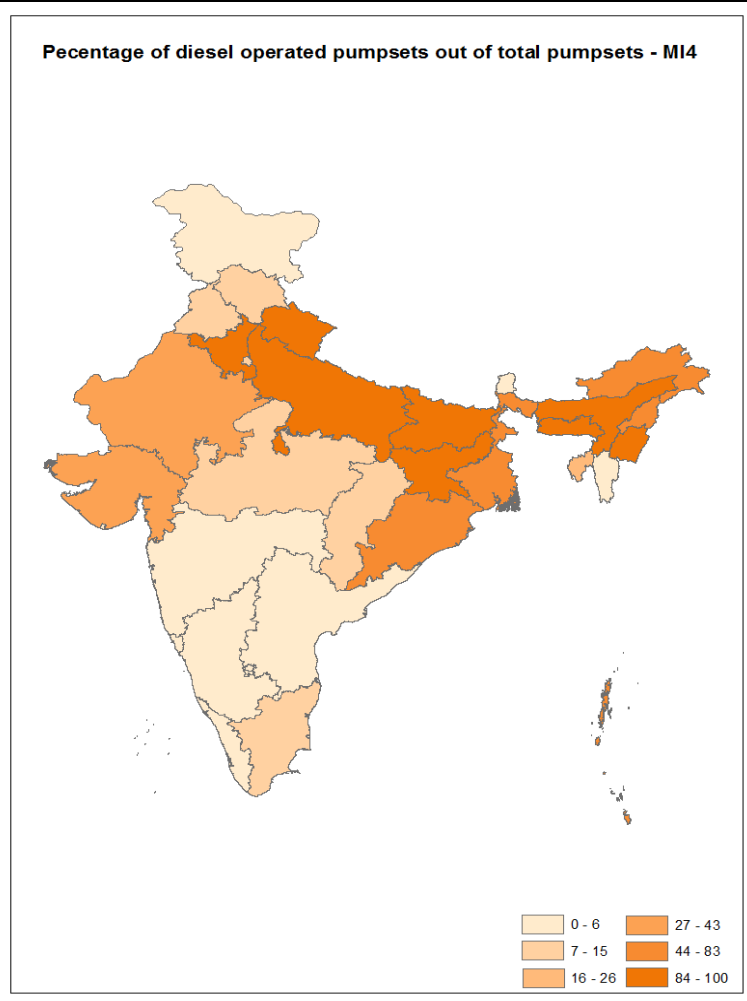
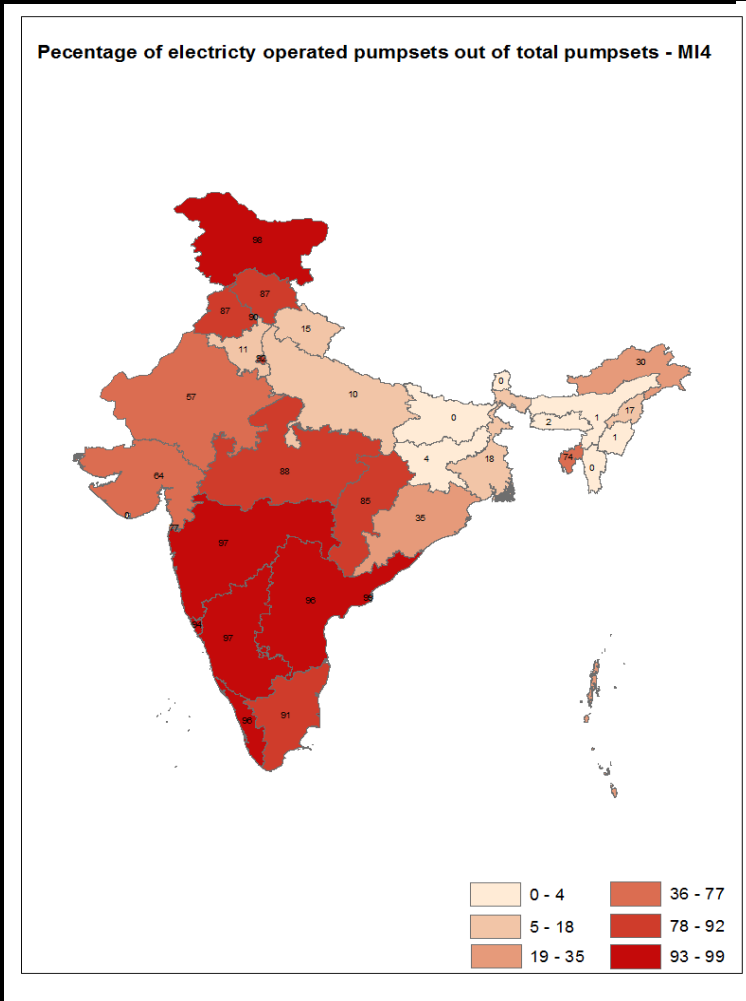
Technology - Extension  
Services - FFS

Expansion of Financial  
services

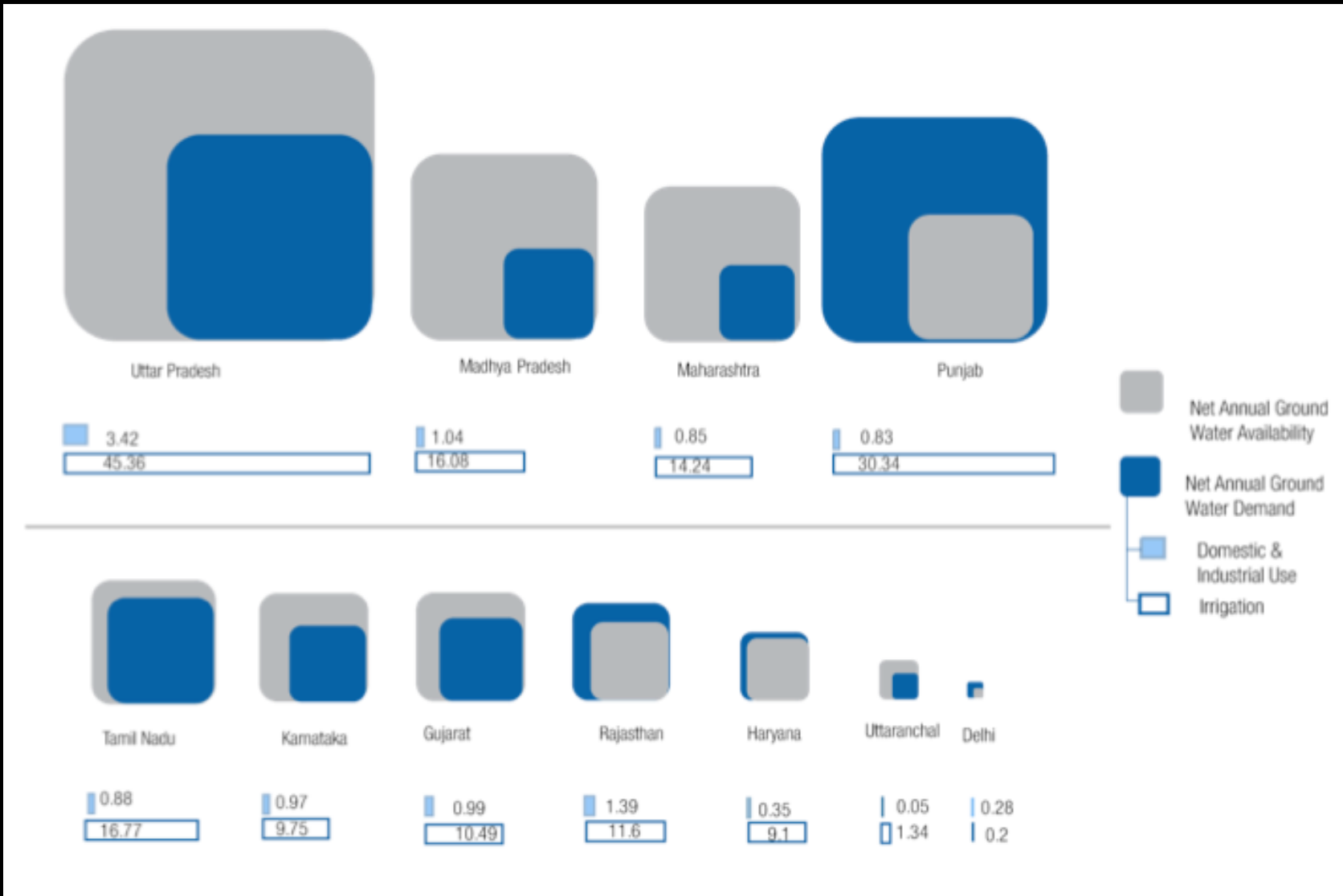
# Electricity vs diesel pumpsets

Percentage of electricity operated pumpsets out of total pumpsets

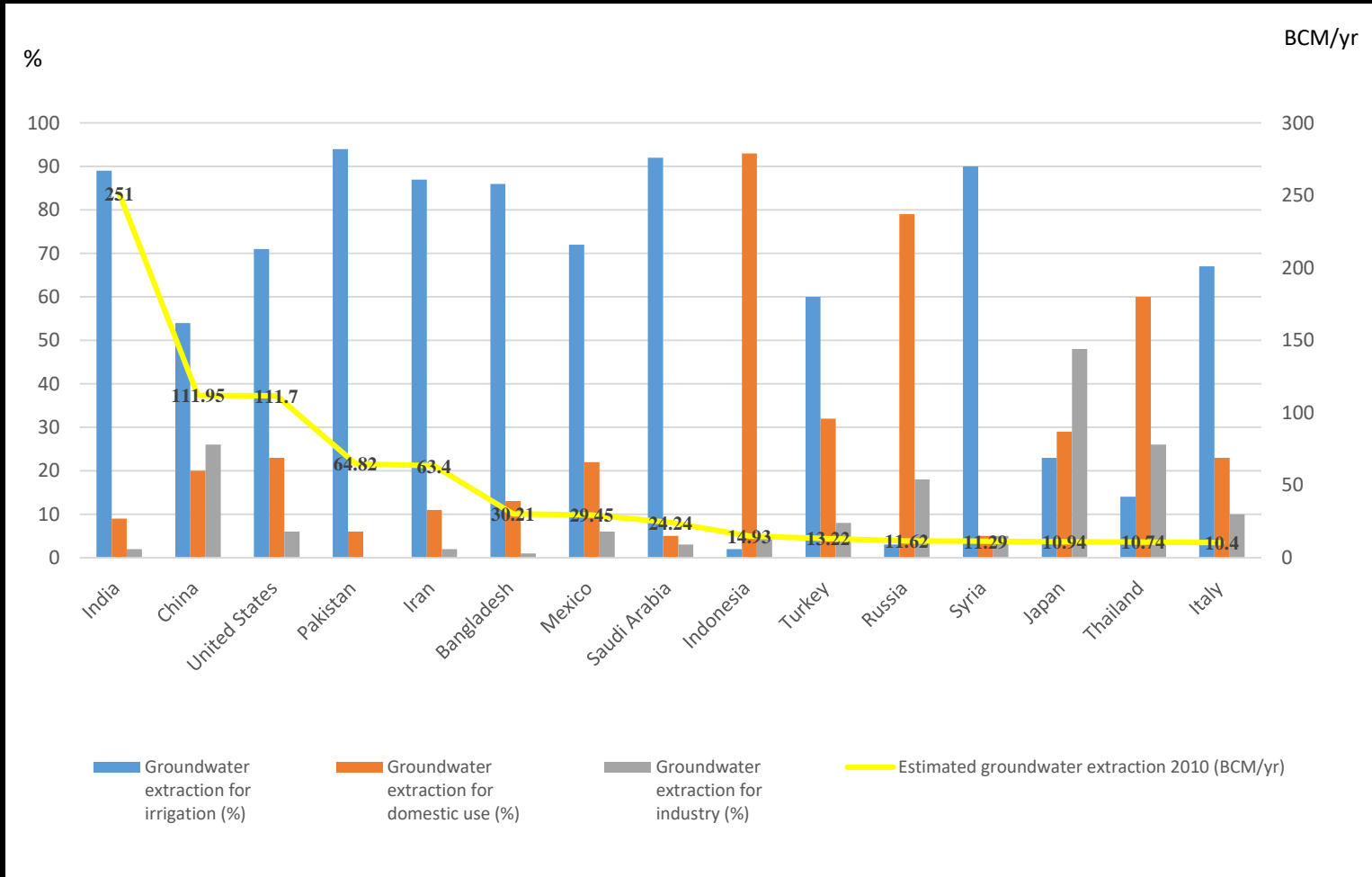
Percentage of diesel operated pumpsets out of total pumpsets



# Groundwater stress in several states



# India leads in groundwater extraction



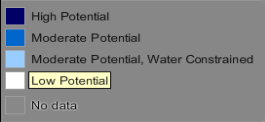
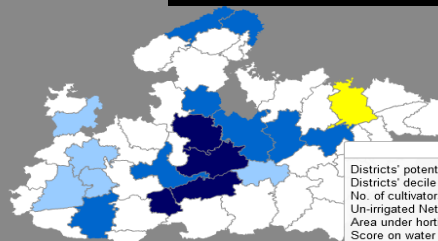
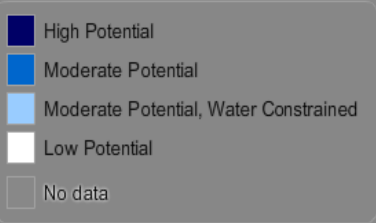
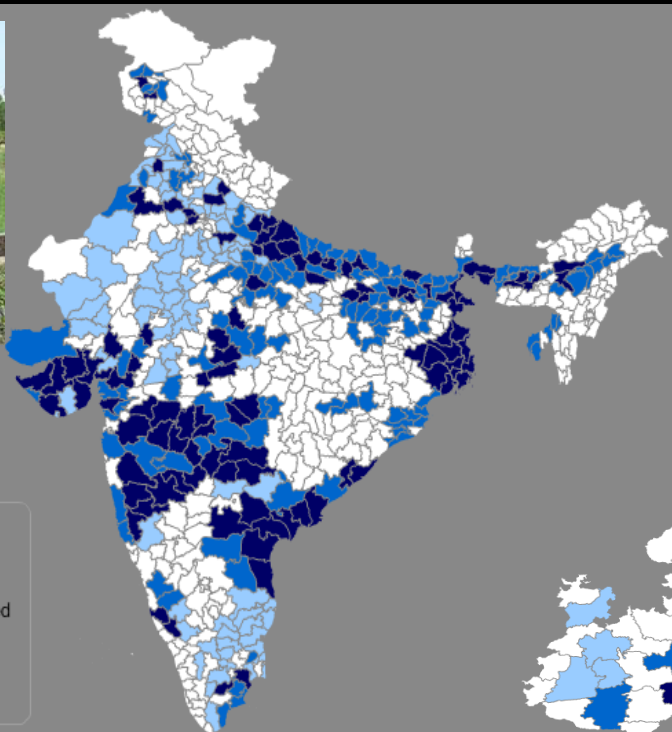
# Can we deploy solar pumps at scale, within budget and sustainably?



Approach



PHOTO CREDIT: Claro Ventures



December 2016 | New Delhi, India  
**CEEW Working Paper**  
**Sustainability of Solar-based Irrigation in India**  
 Key determinants, challenges and solutions  
 SHALU AGRAWAL AND ABHISHEK JAIN

ceeew/publications  
 Theopar House  
 124, Jansath  
 New Delhi 110001  
 India  
 Tel: +91 11 40783300  
 info@ceew.in

**Satna**  
 Districts' potential for solar pump adoption: 1  
 Districts' decile based on final scores: 1  
 No. of cultivators reporting use of diesel pumps (No.): 22,081  
 Un-irrigated Net Sown Area (Ha): 232,775  
 Area under horticulture crops as a share of gross cropped area (%): 3.2  
 Score on water scarcity index: 0.44  
 Monthly per capita expenditure of rural agricultural households (INR): 800.4  
 Crop revenue per holding (INR): 28,665.9  
 No. of rural and semi-urban bank branches per 10,000 cultivators: 3.8  
 Medium and long term institutional credit disbursed in a year (in INR Crore): 0  
 No. of calls made to Kisan Call centre (between 1/1/2011 - 31/12/2015): 5,434  
 Level of farm mechanisation (tractors, harvesters, threshers per ha): 0.3

# Innovations in energy provision

# Energy choices will impact water demand

- Current specific water consumption **4-5 m<sup>3</sup>/h/MW**
- New guidelines limit water use to **2.5 m<sup>3</sup>/h/MW** in new plants and **3.5 m<sup>3</sup>/h/MW** in existing plants

Specific water consumption(m<sup>3</sup>/h/MW) in upcoming Thermal Power Plants

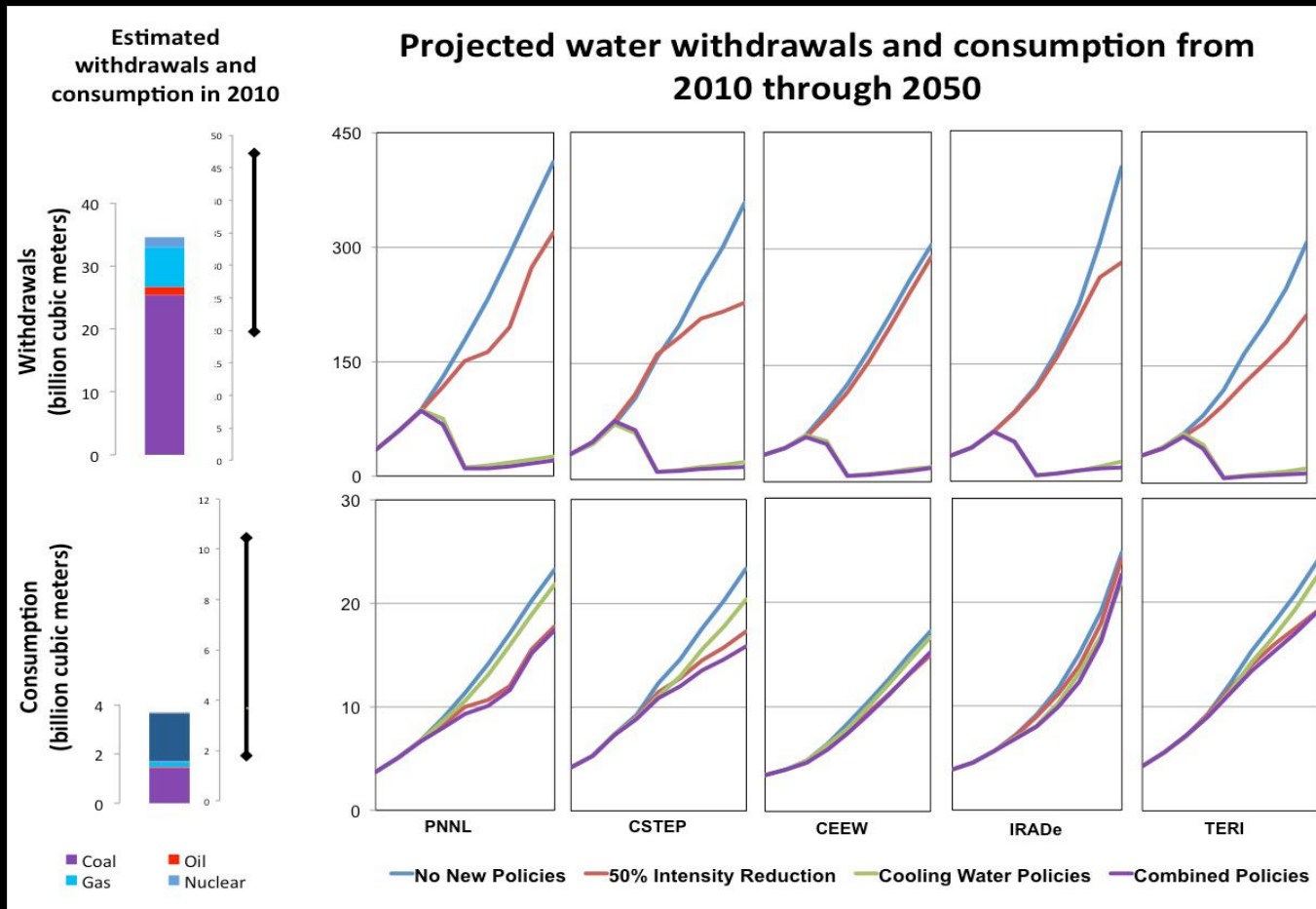


# Sustainable Growth Working Group Scenarios: Insights from US-India Inter-Model Comparison Exercise



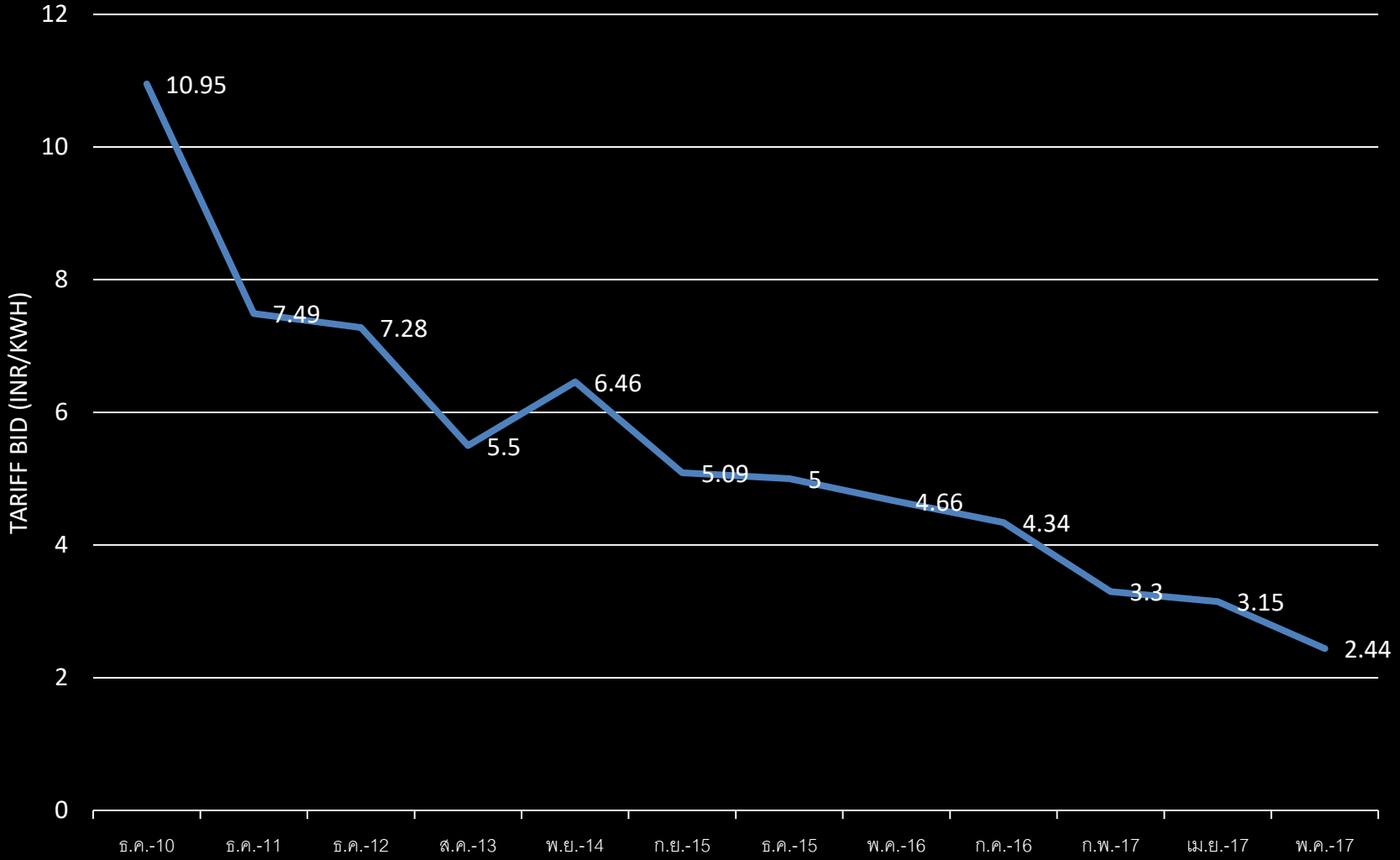
Scenario	Description
Reference	<ul style="list-style-type: none"><li>▶ Business-as-usual</li><li>▶ No further policy control on the power sector in terms of emissions reduction and water consumption limits</li></ul>
Policy50	<ul style="list-style-type: none"><li>▶ 50% decrease in carbon intensity of power production by 2050, compared to the 2010 level</li><li>▶ Start in 2018, the beginning of India's 13th Five-Year Plan</li></ul>
LWC	<ul style="list-style-type: none"><li>▶ Low water consumption</li><li>▶ Recently proposed rules on limiting water consumption from coal-fired thermal power plants</li><li>▶ Phase out once-through cooling system and achieve the lowest water consumption limits by 2030</li></ul>

# Can we make our power plants emit GHGs less and use less water?



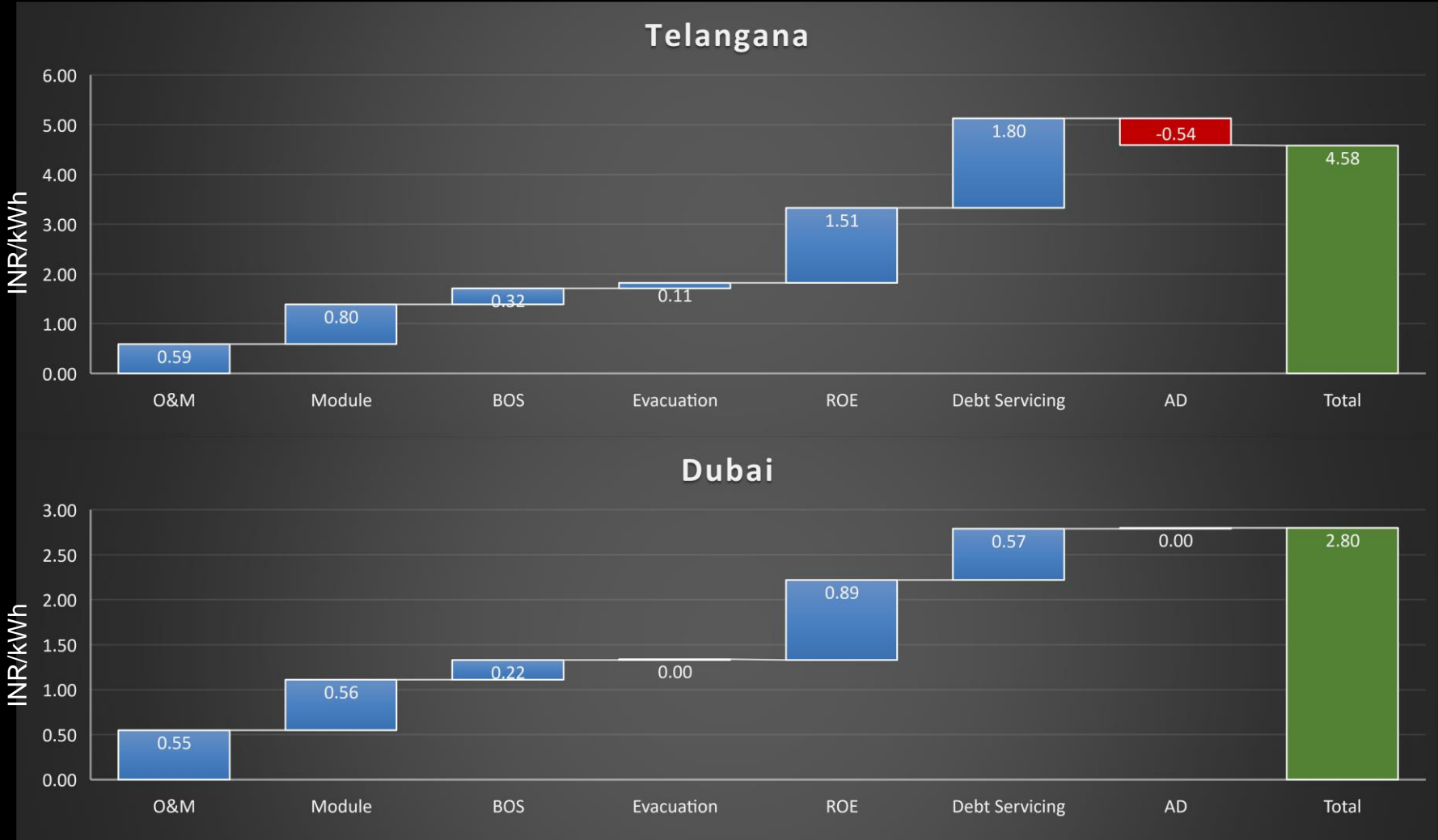
- Lower emission intensity also lowers pressure on water resources: 9-fold increase in water withdrawal and 5-fold increase in water consumption by 2050 under BAU
- 50% of implementation of water-saving technologies reduces water consumption by 7%–28% and water withdrawals 40%–67%
- Full implementation reduces water consumption by 12%–36% and water withdrawals by as much as 97%

# Solar tariffs have fallen rapidly



SOURCE: CEEW; MNRE

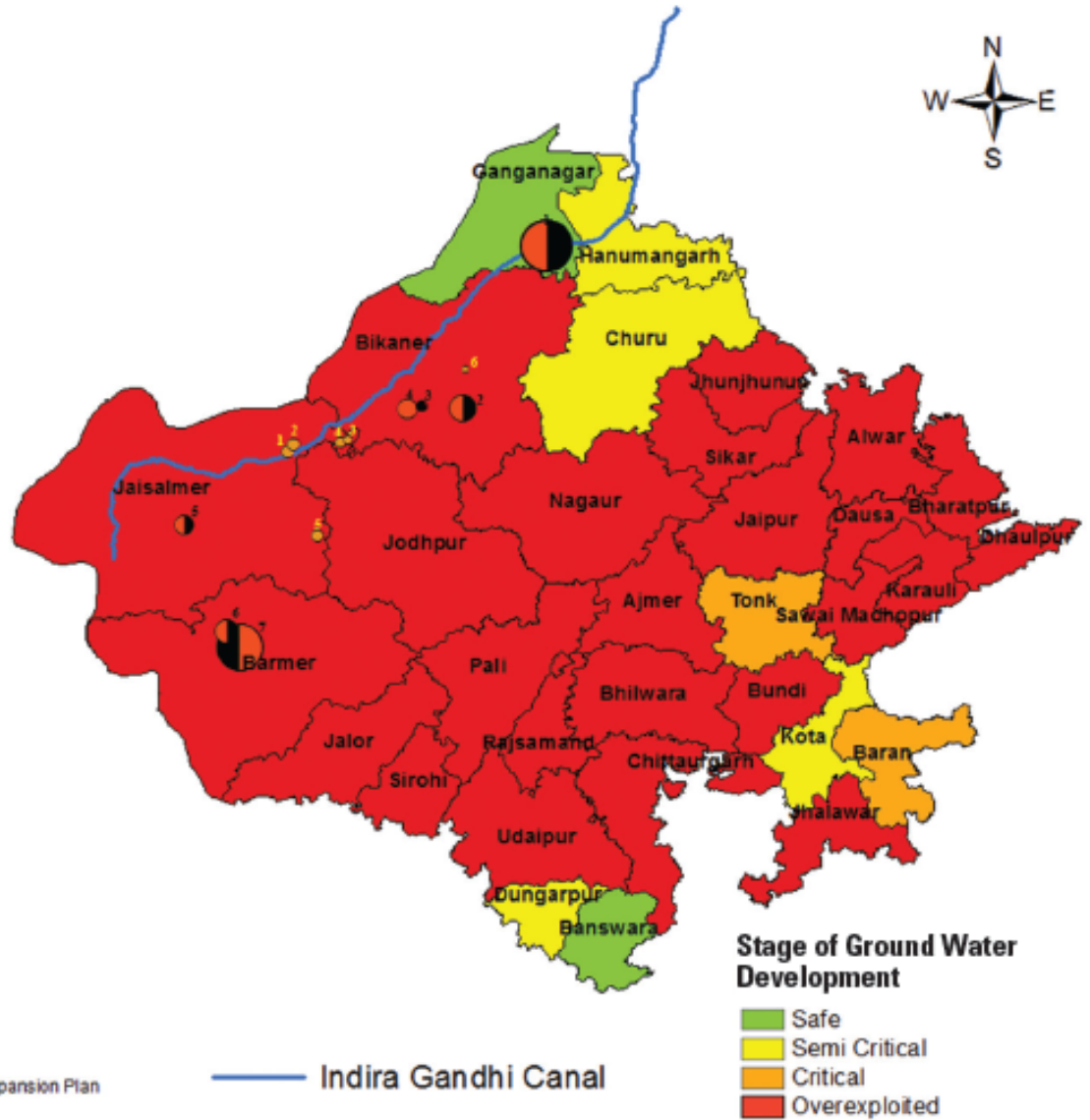
# The cost of capital is the principal barrier to scaling renewables



SOURCE: CEEW analysis; CEEW estimates have been used for the different cost components

# Even clean energy needs water

Plant	Present MW	Proposed MW	Cusec
1 Suratgarh Super Thermal Power Plant	1500	1320	100
2 Barsingsar Thermal Power Plant	250	250	45
3 KSK Energy Ventures	135	Nil	13.5
4 Bithnok Thermal Power Plant	Nil	250	25
5 Ramgarh Gas Thermal Power Plant	113.5	160	25
6 Giral Lignite Thermal Power Plant	250	250	24
7 JSW Lignite Power Plant	1080	Nil	80
SOLAR THERMAL POWER PLANTS			
1 Dikwakar Solar Projects Pvt Ltd	Nil	100	2.9
2 KVK Energy Ventures Pvt Ltd	Nil	100	2.9
3 Godawari Green Energy Ltd	Nil	50	1.6
4 Corporate Ispat Alloys Ltd	Nil	50	2.02
5 Rajasthan Sun Technique Energy Pvt Ltd	Nil	100	2.5
6 ACME Solar Thermal Power Plant	10	Nil	0.8



## Legend

- Solar Thermal Power Plants
- Working Thermal Power Plants
- Proposed Thermal Power Plants
- Working Thermal Power Plants with Proposed Expansion Plan

## Stage of Ground Water Development

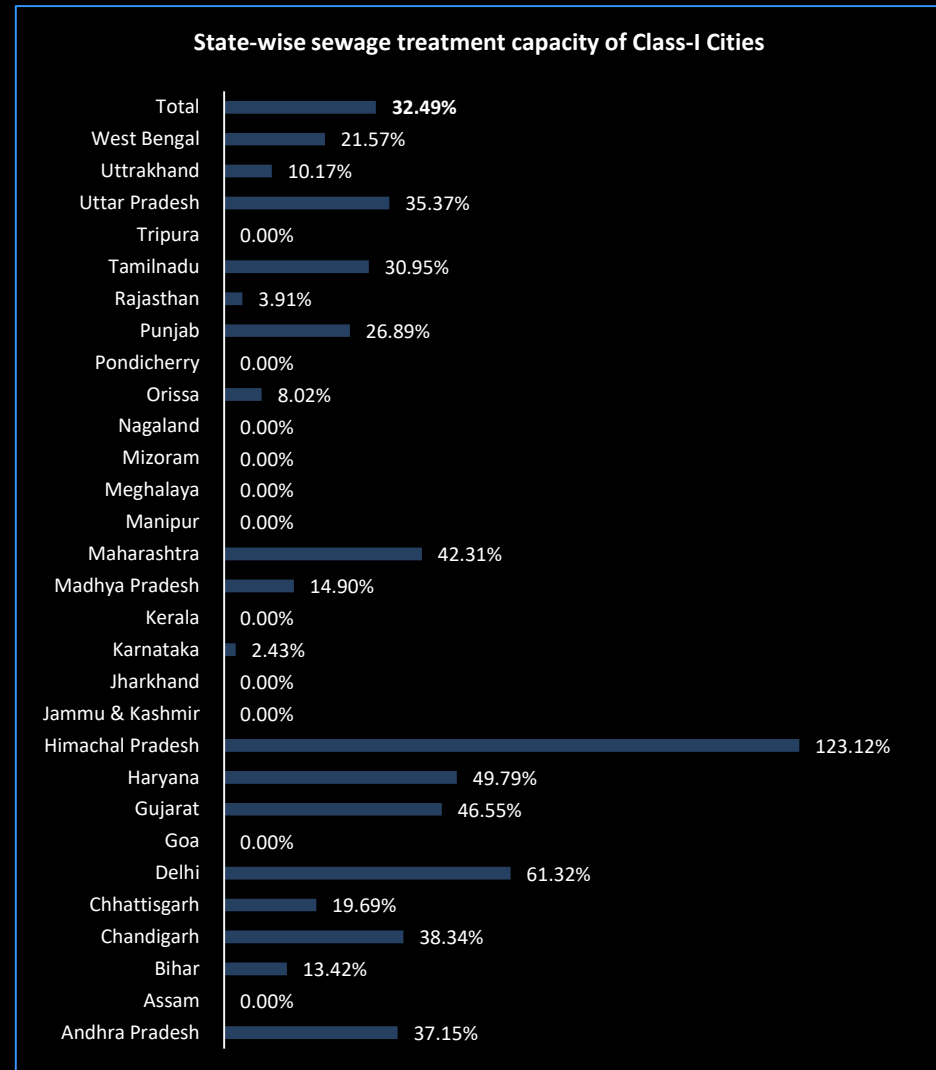
- Safe
- Semi Critical
- Critical
- Overexploited

— Indira Gandhi Canal

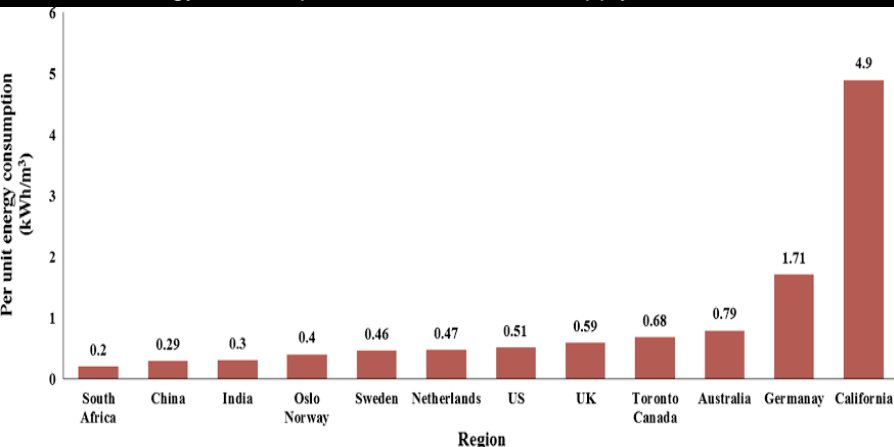
# Innovations in urban service provision

# Energy demand for urban water...is likely to increase

- Water and wastewater infrastructures were found to contribute 3%-16% of community-wide electricity use and GHG emissions for 16 cities in India
- End-use energy intensity for drinking water provision was more than double that for wastewater treatment (reverse of cities in developed countries)



Per unit energy consumption for urban water supply



# Government initiatives: Promising but need a lot of external support



## Swachh Bharat<sup>1</sup>

- Eliminate open defecation and manual scavenging and promote scientific SWM
- Create an enabling environment for private sector participation in Capex and Opex
- Allocated Rs. 1700 crore<sup>2</sup>

## National Mission for Clean Ganga<sup>3</sup>

- Abatement of pollution and rejuvenation of Ganga
- Maintain minimum ecological flows in the river Ganga
- Sanctioned Rs. 20,000 crore

## Amrut (Atal Mission for Rejuvenation & Transformation) – 500 Cities<sup>4</sup>

- Ensure that every household has access to tap water and a sewerage connection
- Funds allocated Rs. 50,000 crore

## Smart cities – 100 cities<sup>5</sup>

- More liveable and inclusive cities, besides driving economic growth
- Sanctioned Rs. 48,000 crore

**PM has stressed need for Foreign Direct Investment for all these missions**

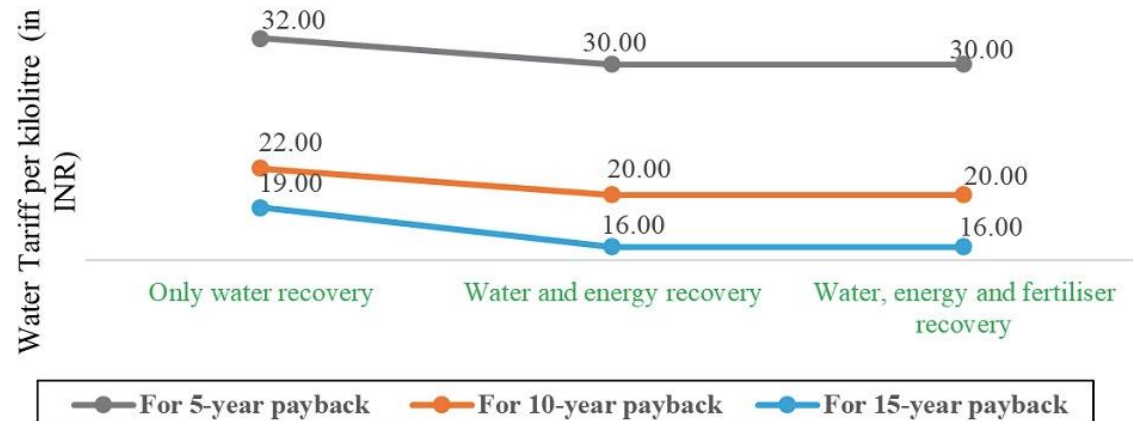
SOURCE: <sup>1</sup> *MouD, Gol*; <sup>2</sup> *Modi govt allocates Rs 1700 crores for Swachh Bharat Abhiyan*, Firstpost, Available at: <http://www.firstpost.com/business/modi-govt-allocates-rs-1700-crores-swachh-bharat-abhiyan-2077149.html>; <sup>3</sup> *Ganga cleaning mission gets Rs 20,000 crore boost*, The Times of India, Available at <http://timesofindia.indiatimes.com/india/Ganga-cleaning-mission-gets-Rs-20000-crore-boost/articleshow/47262364.cms>, <sup>4</sup><http://amrut.gov.in/writereaddata/The%20Mission.pdf>; <sup>5</sup><http://smartcities.gov.in/writereaddata/Financing%20of%20Smart%20Cities.pdf>

# Turning wastewater into an economic resource



- Water from operational STPs could service 53 GW of TPP capacity
- If all STPs were functioning, 64 GW of capacity could be supported
- If all sewage were treated, 194 GW of capacity could be supported

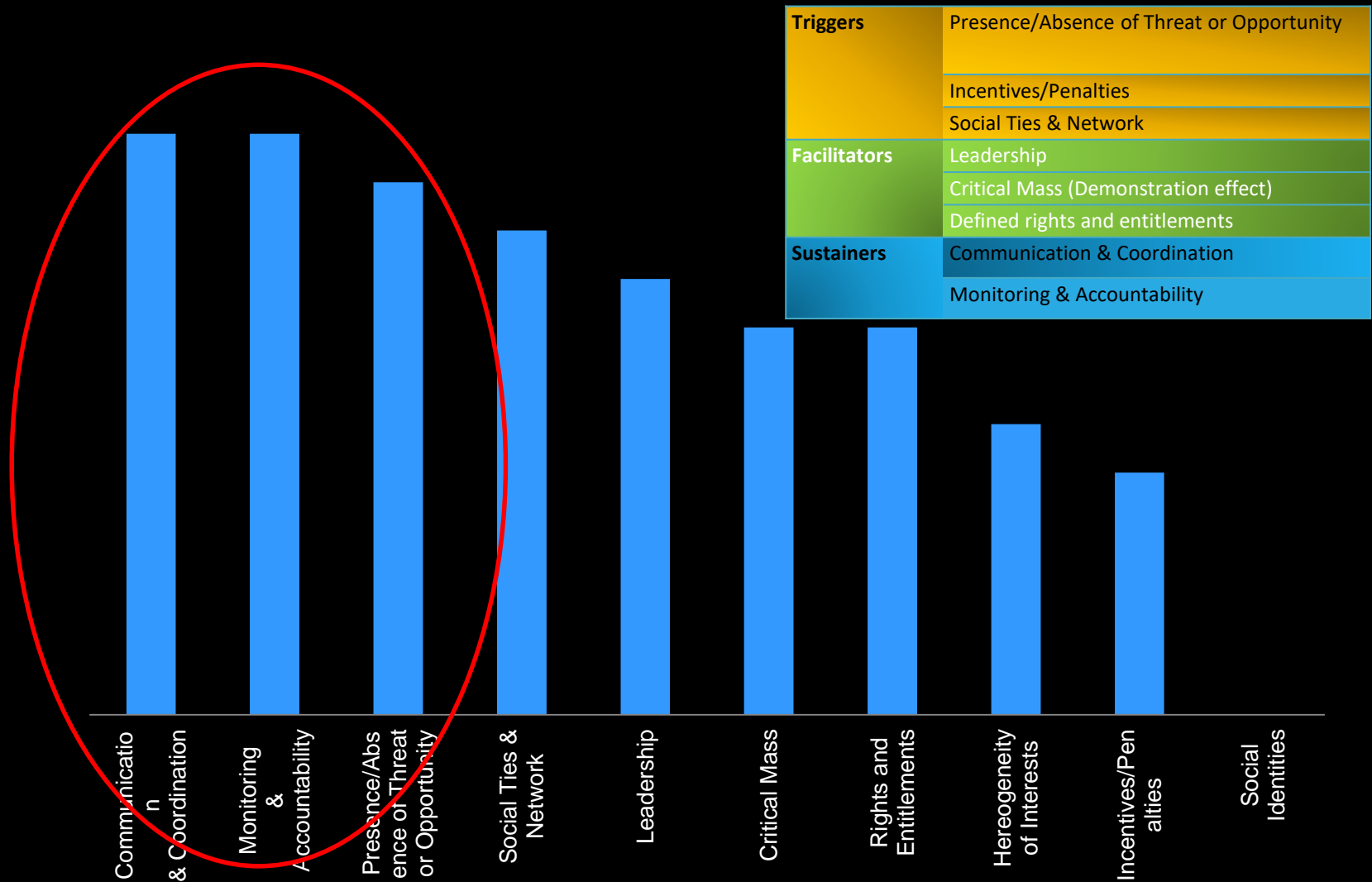
Water tariff for different payback periods and modes of revenue generation



Source: CEEW

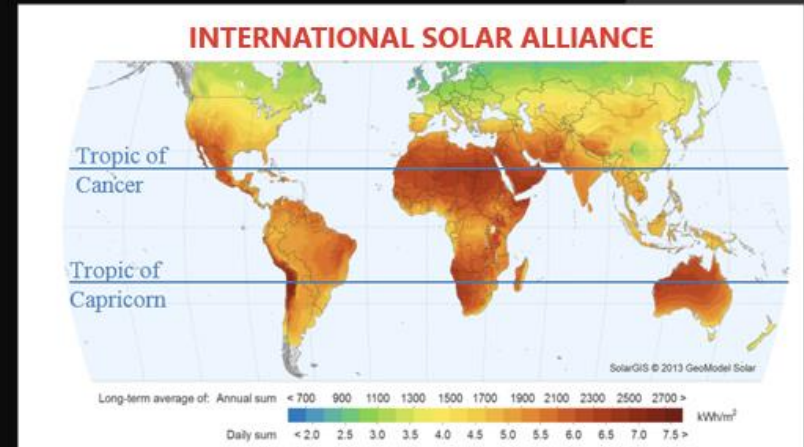
# Innovations in collective action

# What will drive collective action?



# Innovations in WEFC partnerships

# International Solar Alliance: a new kind of energy partnership



*Recognizing that sustainable development, universal energy access, and energy security are critical to the shared prosperity and future of our planet, and acknowledging that clean and renewable energy needs to be made affordable for all, we do hereby declare our intention to support India's proposal to launch an international solar alliance as a common platform for cooperation among solar resource rich countries lying fully or practically between the Tropics of Cancer and Capricorn.*

# URBAN WATER AND SANITATION IN INDIA

Multi-stakeholder Dialogues for Systemic Solutions

Rudresh Sugam and Arunabha Ghosh

CEEW Council on Energy, Environment and Water

# National Water Resources Framework Study

CEEW COUNCIL ON ENERGY, ENVIRONMENT & WATER

2030 WATER RESOURCES GROUP

the 12th Five Year Plan

# ENERGIZING INDIA

Towards a Resilient and Equitable Energy System

Suman Bery  
Arunabha Ghosh  
Ritu Mathur

Subrata Basu  
Karthik Ganesan  
Rhodri Owen-Jones

<http://ceew.in/water>

<http://ceew.in/resources>

April 2012 | New Delhi, India

CEEW Report

## Institutional Reform for Improved Service Delivery in Bihar

Economic Growth, Agricultural Productivity, and a Plan for Reorganising the Minor Water Resources Department

Research Judge: RUDRESH K SUGAM

Principal Investigator: ARUNABHA GHOSH

Publications: 11-492927071

August 2013 | New Delhi, India

CEEW Report

## 2030 Water Resources Group National Water Platform

Preliminary investigation of the possible roles, functions and potential governance

NIRMALYA CHOUDHURY,  
RUDRESH K SUGAM,  
ARUNABHA GHOSH

Stakeholder Diagram: Multi-level National Decision Makers, Government, Private Sector, Civil Society, Academia, International Development Partners, Donors, and the 2030 Water Resources Group.

CEEW Publications  
Thapar House, 124, Jorhat, New Delhi 110001, India  
Tel: +91 11 40723300  
info@ceew.in

## CLIMATE CHANGE A RISK ASSESSMENT

David King, Daniel Schrag, Zhou Dadi, Qi Ye and Arunabha Ghosh

Project Manager: Simon Sharpe

Edited by James Hynard and Tom Rodger, Centre for Science and Policy

Hosts of the project workshops: Tsinghua University, EEW, and others.

Sponsors: AEC, Finance & Environment Group, and others.

April 2012 | India

CEEW Working Paper 2012

## Institutional Reform for Water Use Efficiency in Agriculture

International Best Practices and Policy Lessons for India

SACHIN SHAH

## Collective Action for Water Security and Sustainability

Preliminary Investigations

GLOBAL INSTITUTIONS

## Human Development and Global Institutions

Evolution, Impact, Reform

Richard Ponzio & Arunabha Ghosh

December 2013 | New Delhi, India

CEEW Working Paper 2013/5

## Responsible Hydropower Development in India

Challenges for the Future

NIRMALYA CHOUDHURY AND ARUNABHA GHOSH

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