

India's Water-Energy-Food- Climate Nexus

Can strategic emerge out of the chaotic?

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

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Energy Access



Renewables



Low-Carbon Pathways



Greenhouse Gases and Monitoring, Reporting, Verification



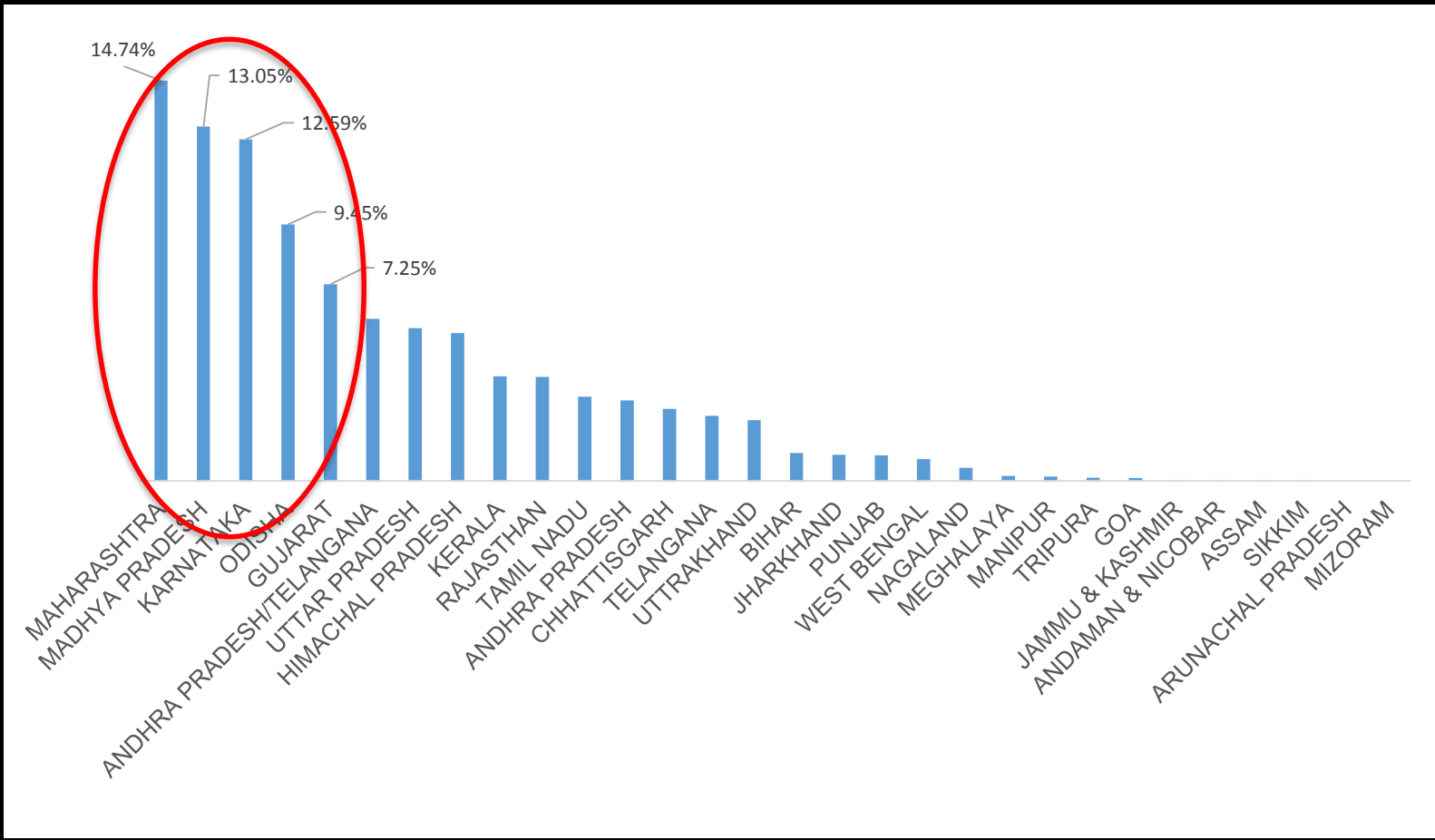
Risks and Adaptation



Technology, Trade & Finance

Innovations in institutions

Only five states with nearly 60% of reservoir storage capacity

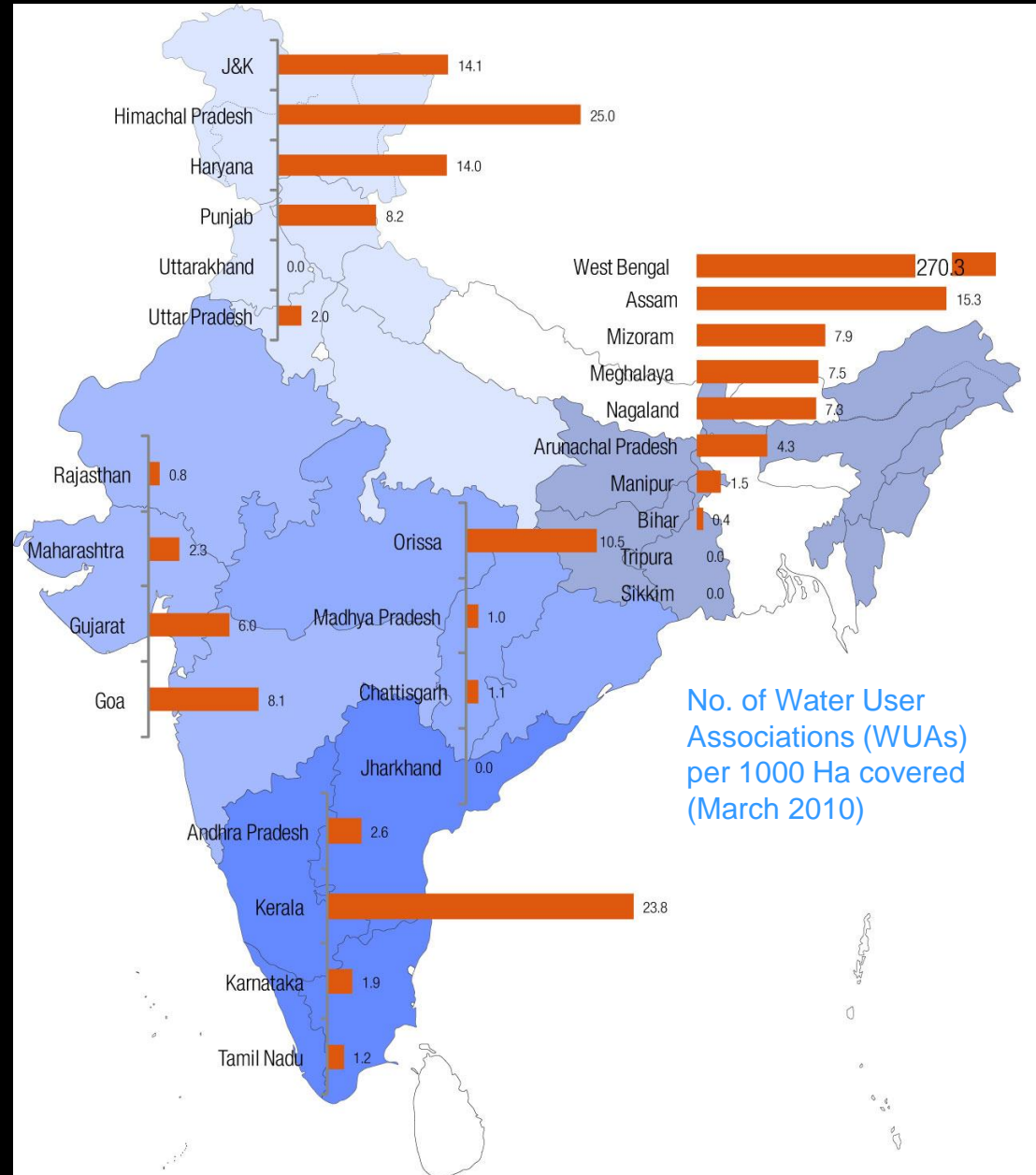


SOURCE: Adapted from CWC (2015)

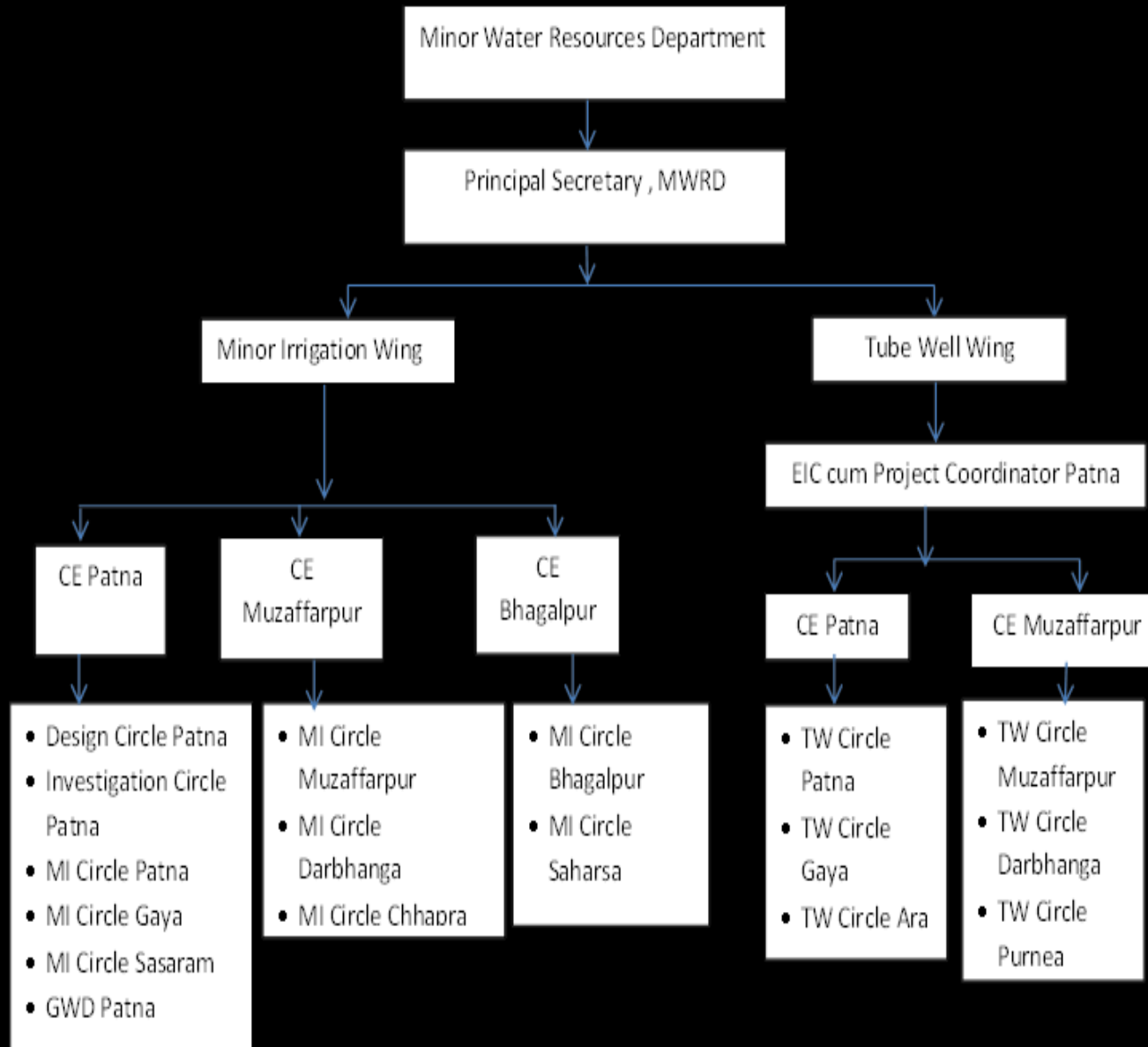
Empowering water user associations in India

Functions

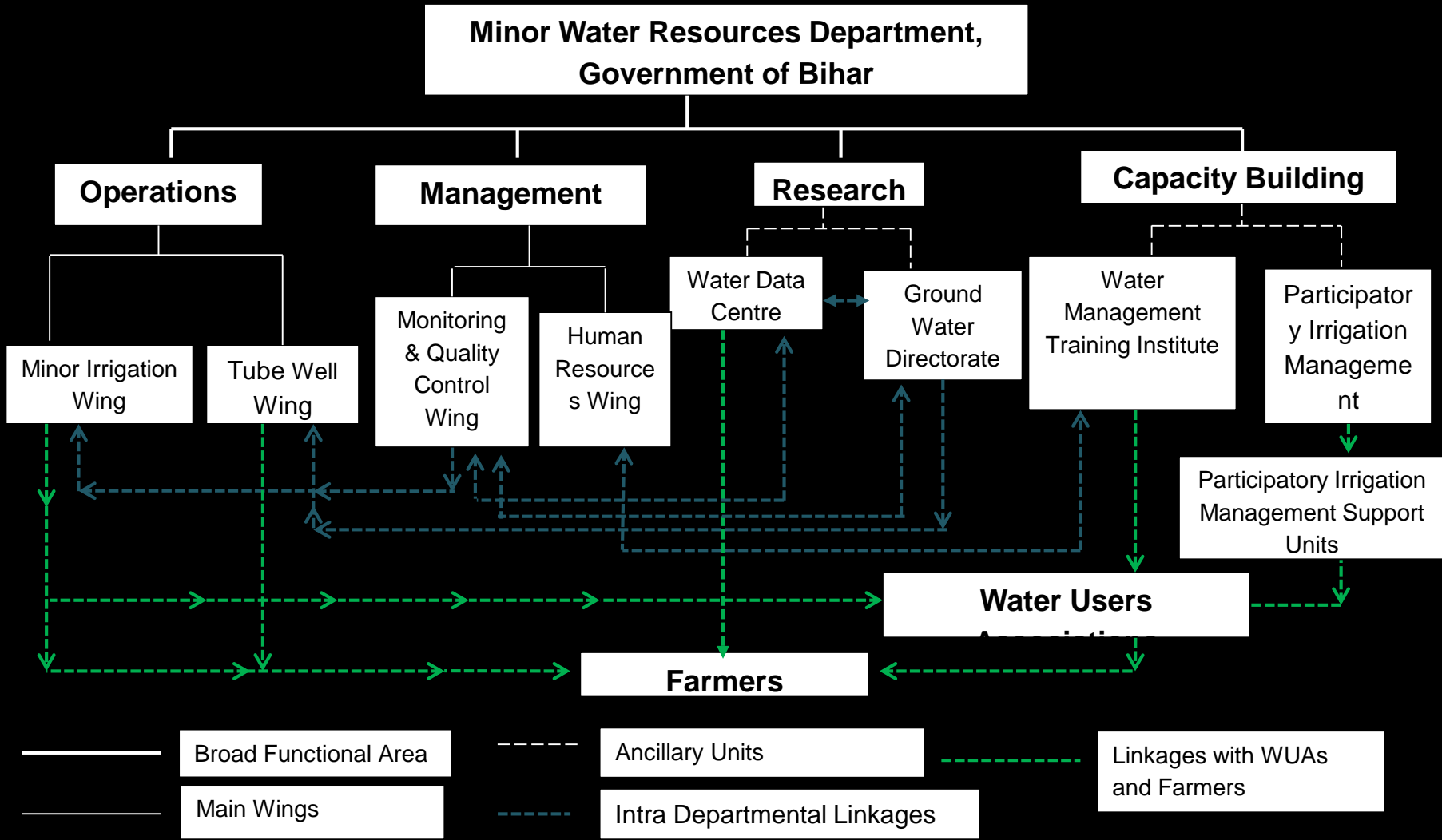
- Implementing O&M
- Crop planning, crop water budgeting & raising irrigation water demand
- Implementing water distribution
- Support in estimating and collecting water charges



Bihar: how institutions looked

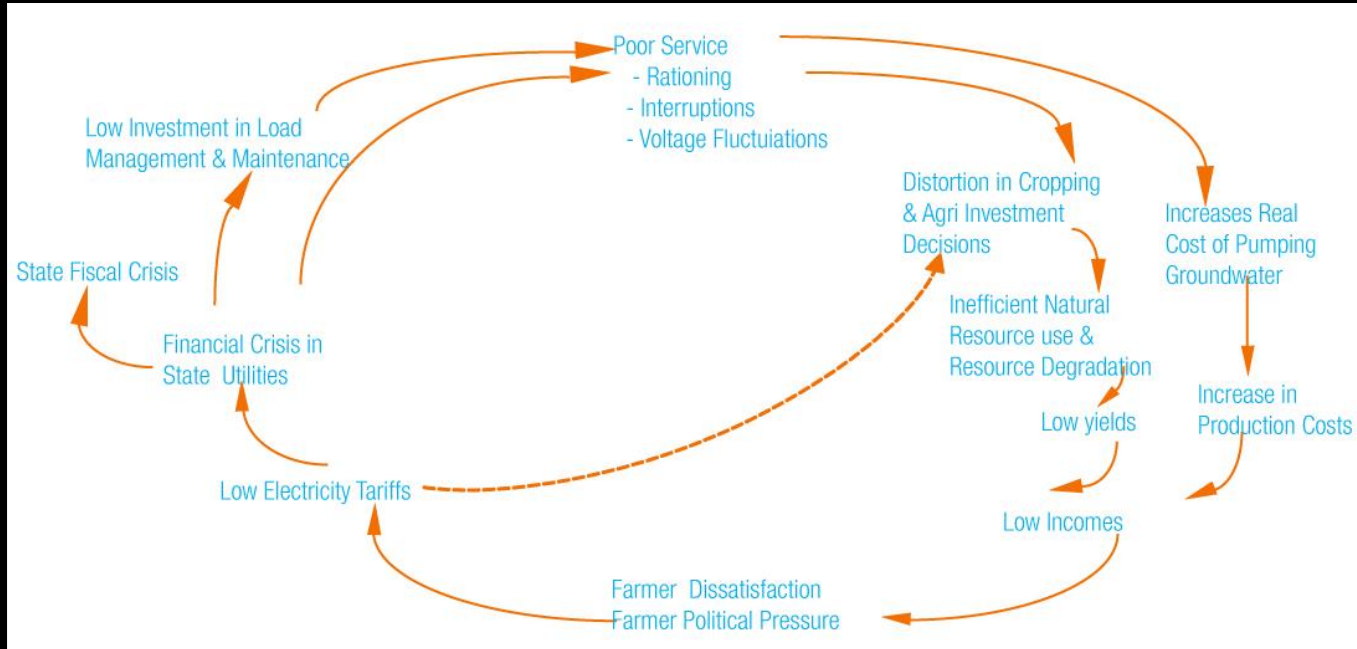


Bihar: focusing on service delivery



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

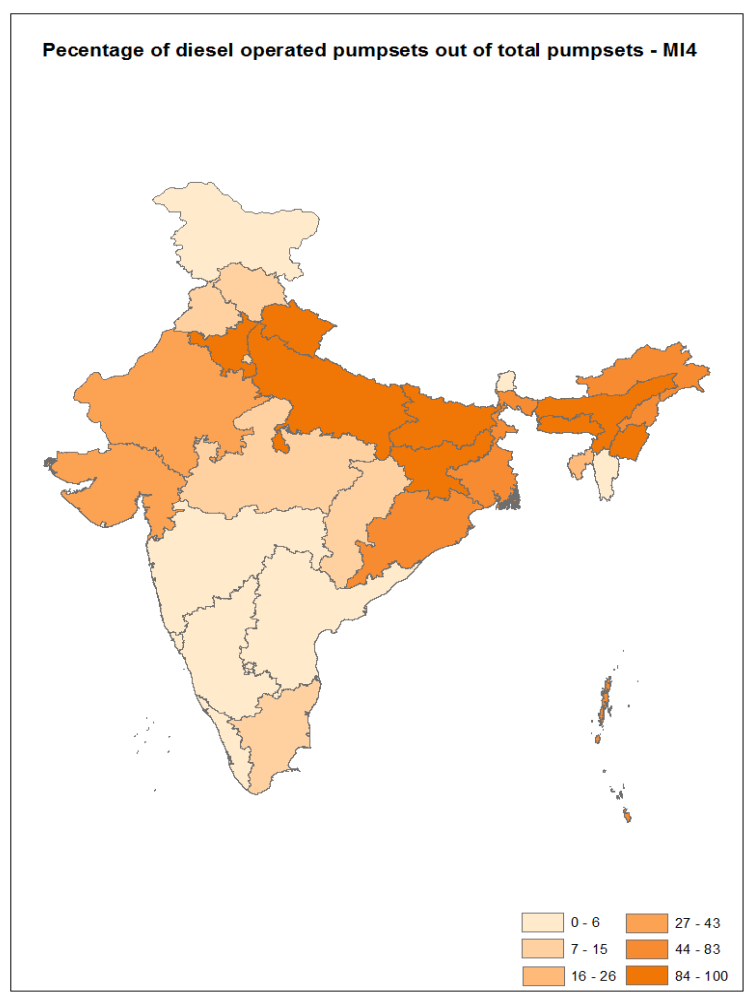
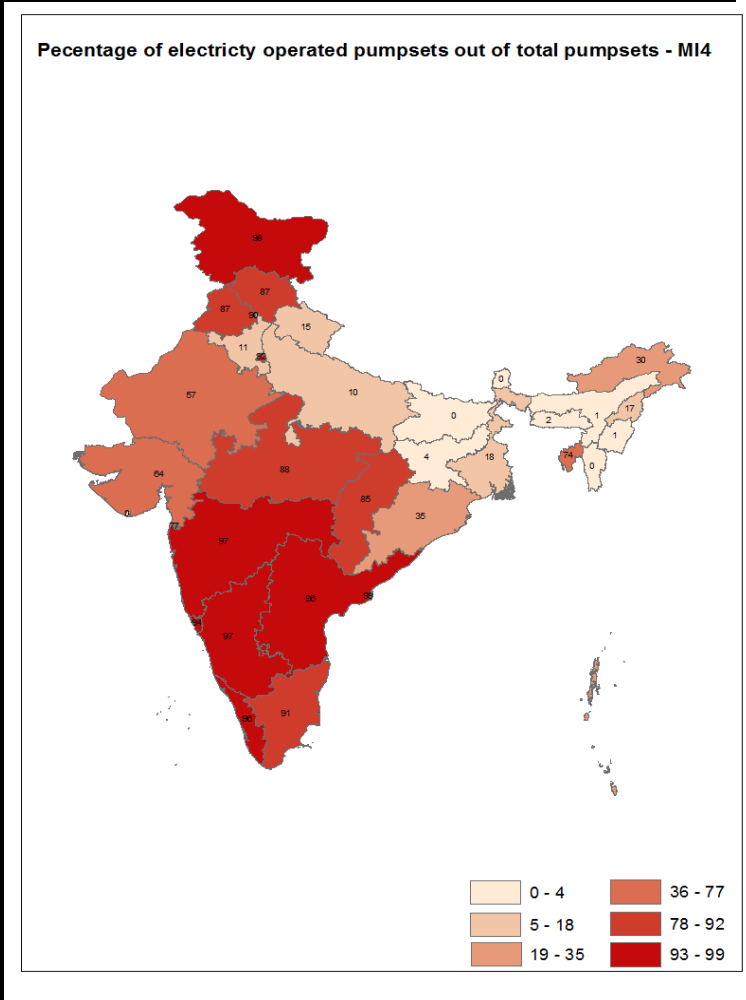
Technology - Extension
Services - FFS

Expansion of Financial
services

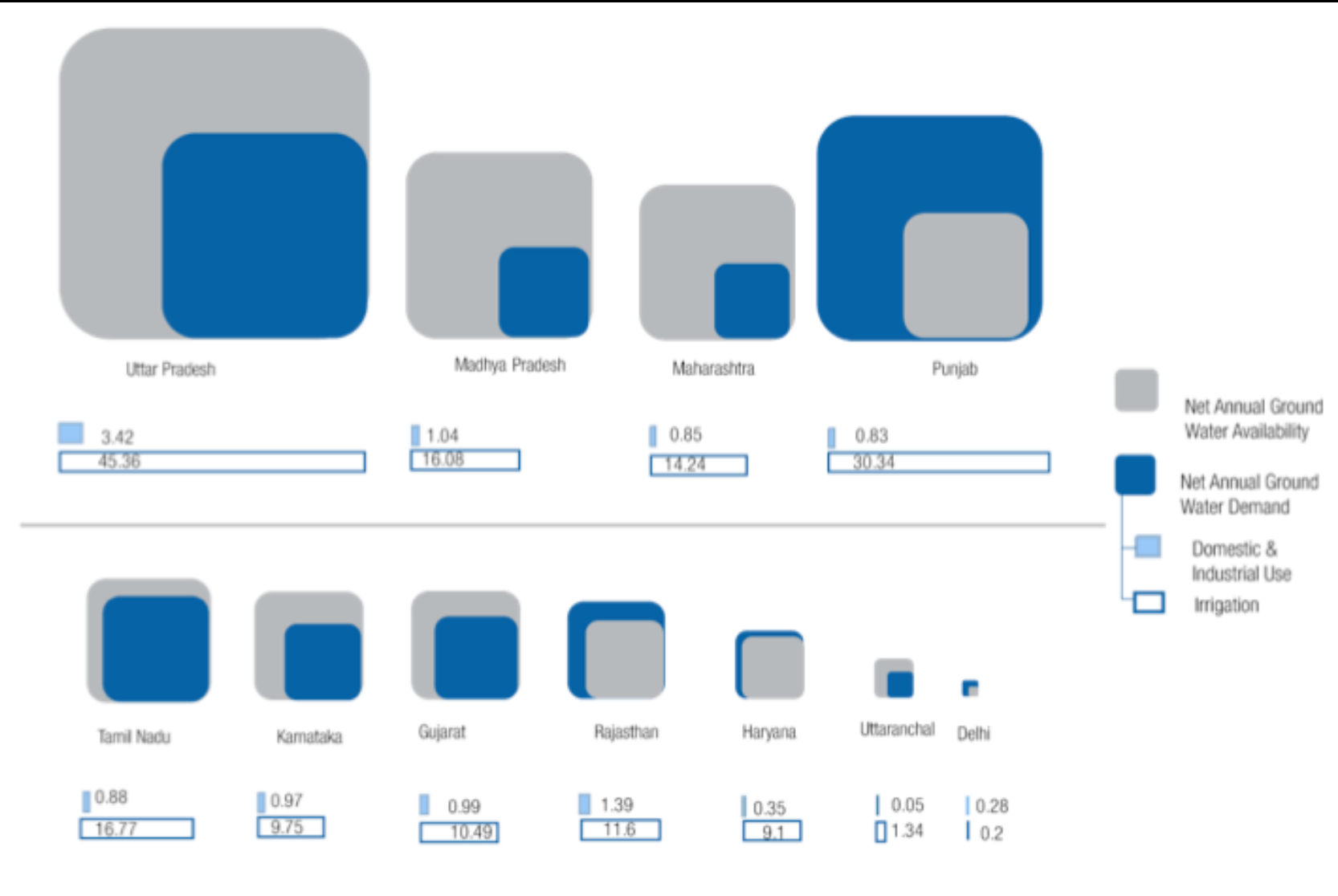
Electricity vs diesel pumpsets

Percentage of electricity operated pumpsets out of total pumpsets

Percentage of diesel operated pumpsets out of total pumpsets

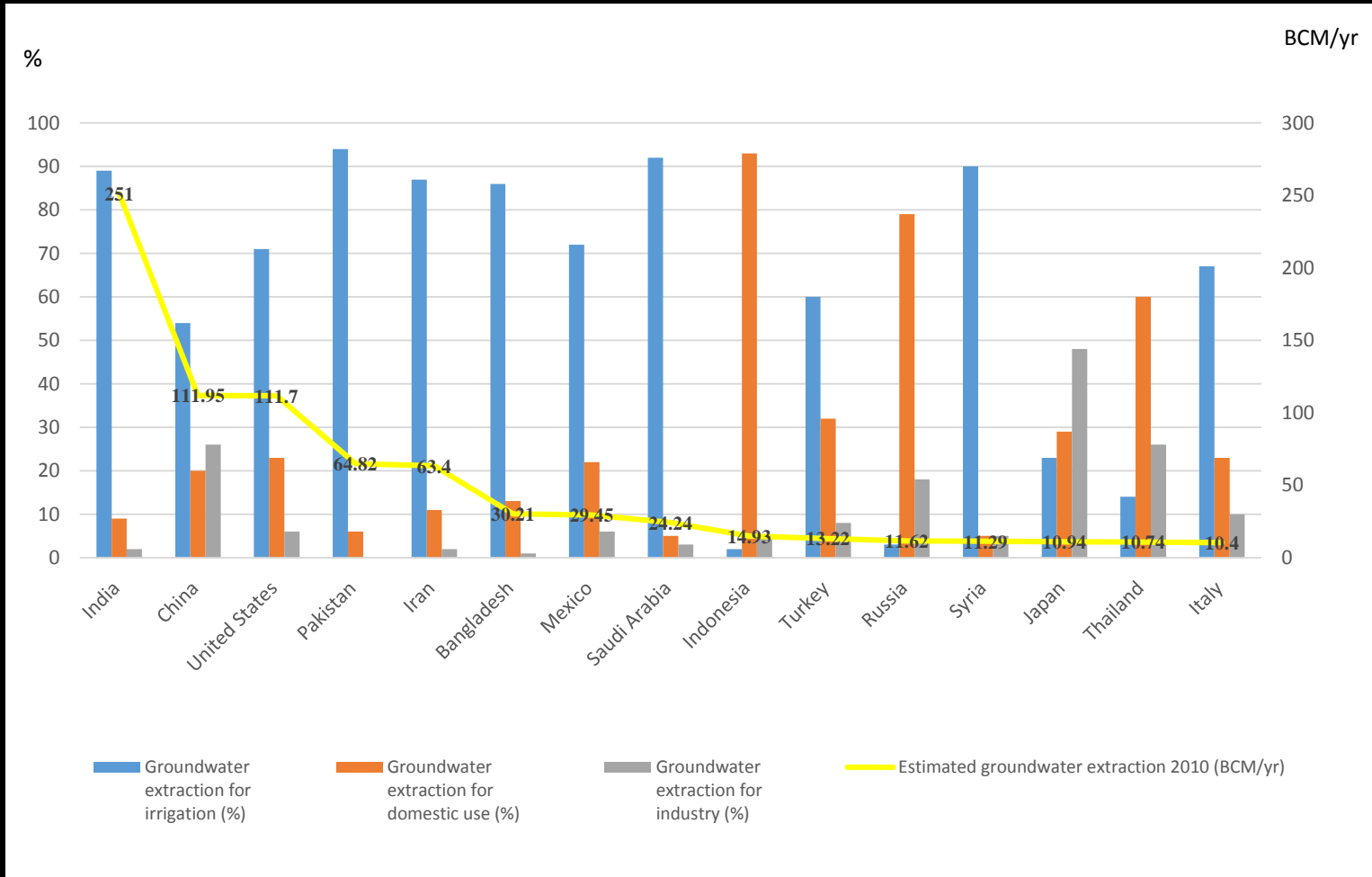


Groundwater stress in several states



SOURCE: Ghosh et al/ CEEW (2011)

India leads in groundwater extraction



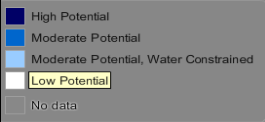
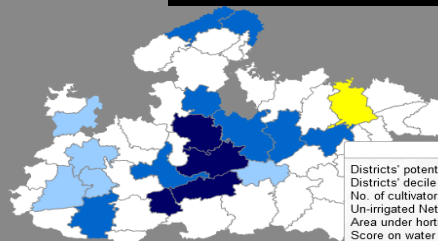
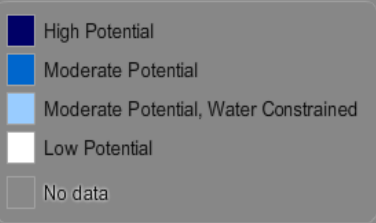
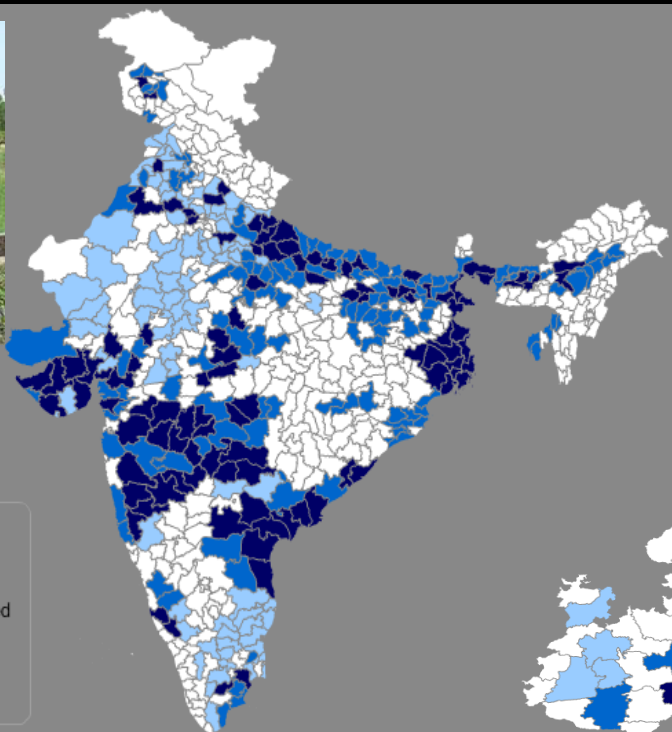
Can we deploy solar pumps at scale, within budget and sustainably?



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

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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 m³/h/MW**
- New guidelines limit water use to **2.5 m³/h/MW** in new plants and **3.5 m³/h/MW** in existing plants

Specific water consumption(m³/h/MW) in upcoming Thermal Power Plants

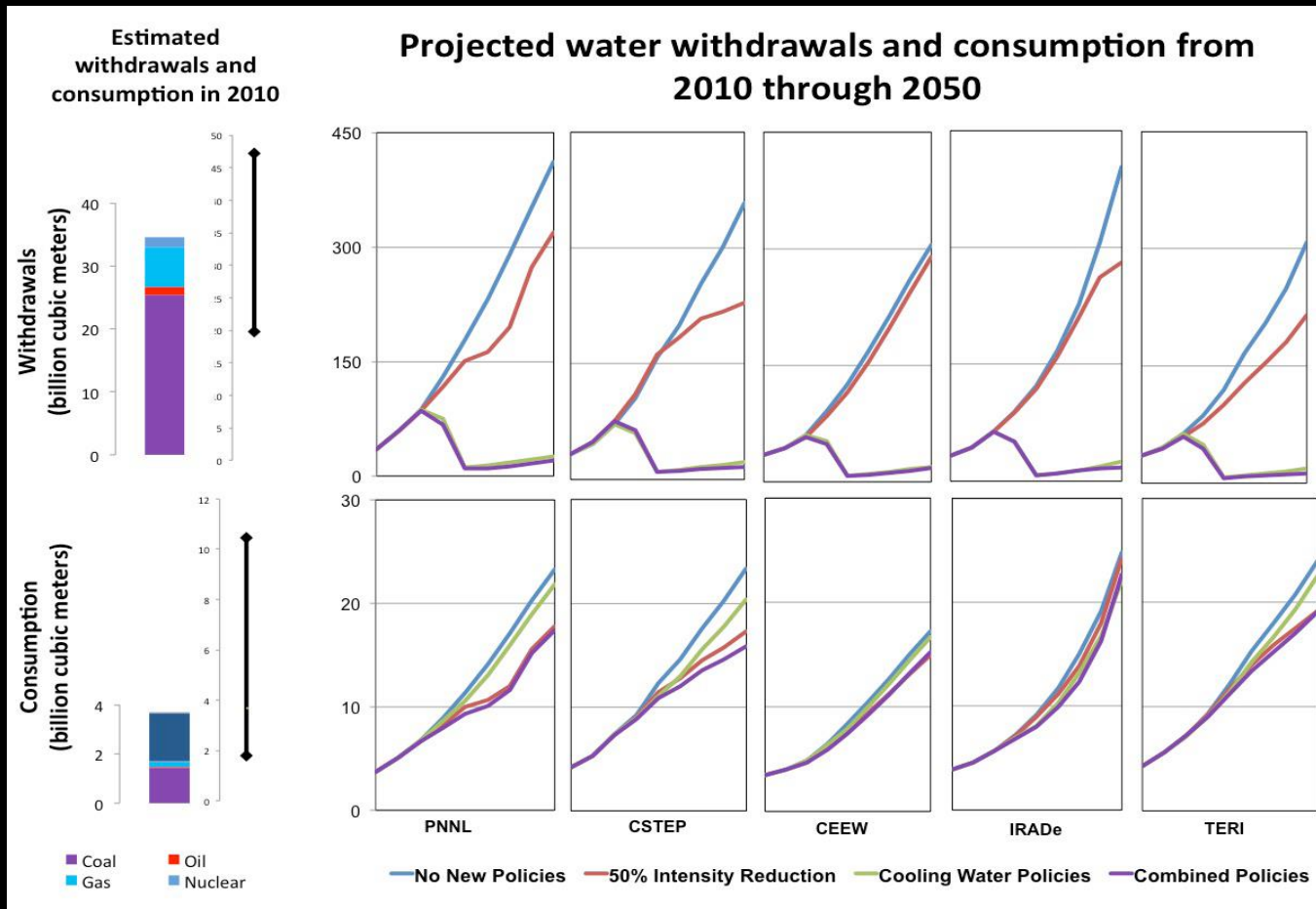


Sustainable Growth Working Group Scenarios: Insights from US-India Inter-Model Comparison Exercise



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

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



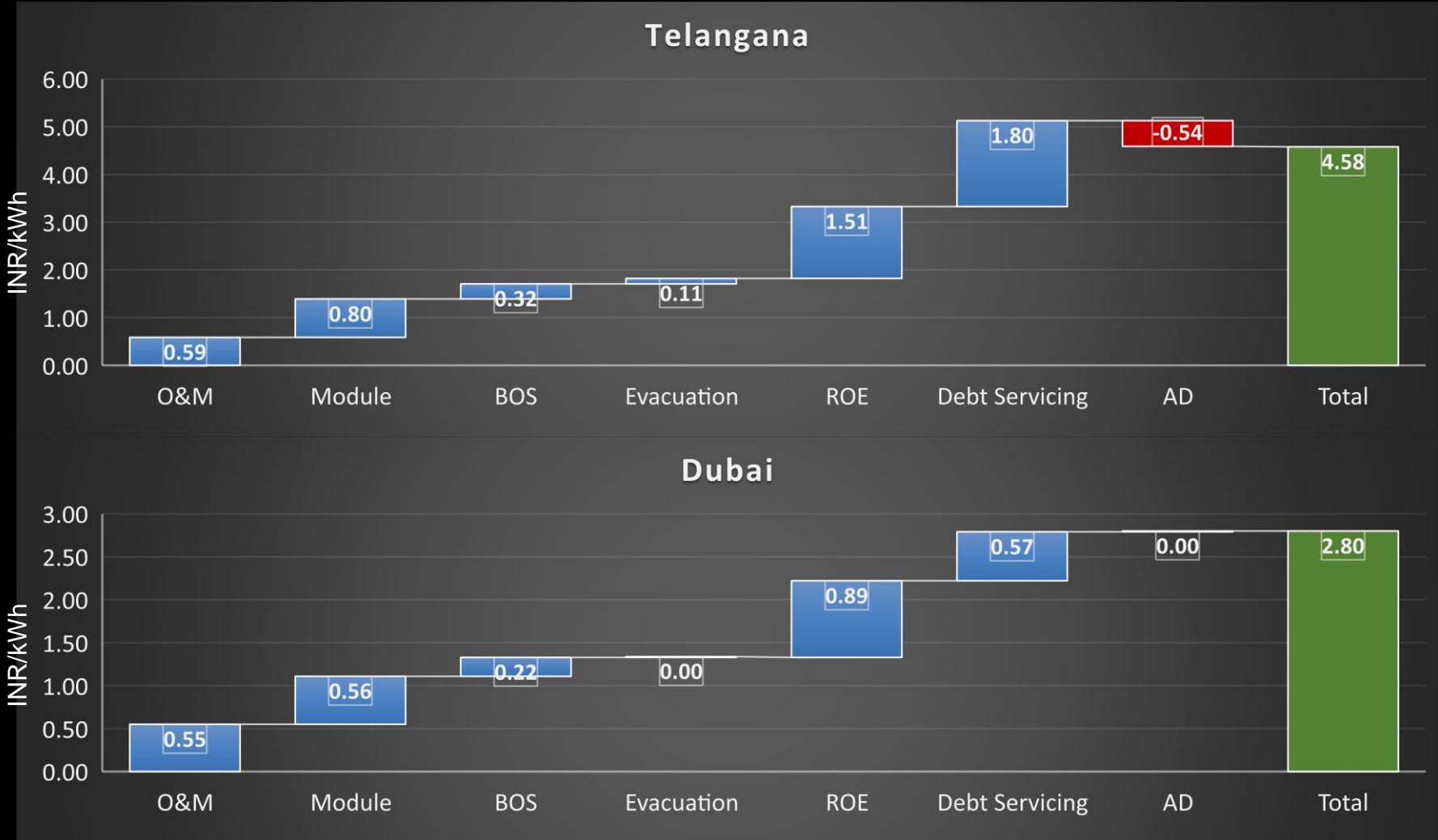
- Lower emission intensity also lowers pressure on water resources: 9-fold increase in water withdrawal and 5-fold increase in water consumption by 2050 under BAU
- 50% of implementation of water-saving technologies reduces water consumption by 7%–28% and water withdrawals 40%–67%
- Full implementation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

Solar tariffs have fallen rapidly



SOURCE: CEEW; MNRE

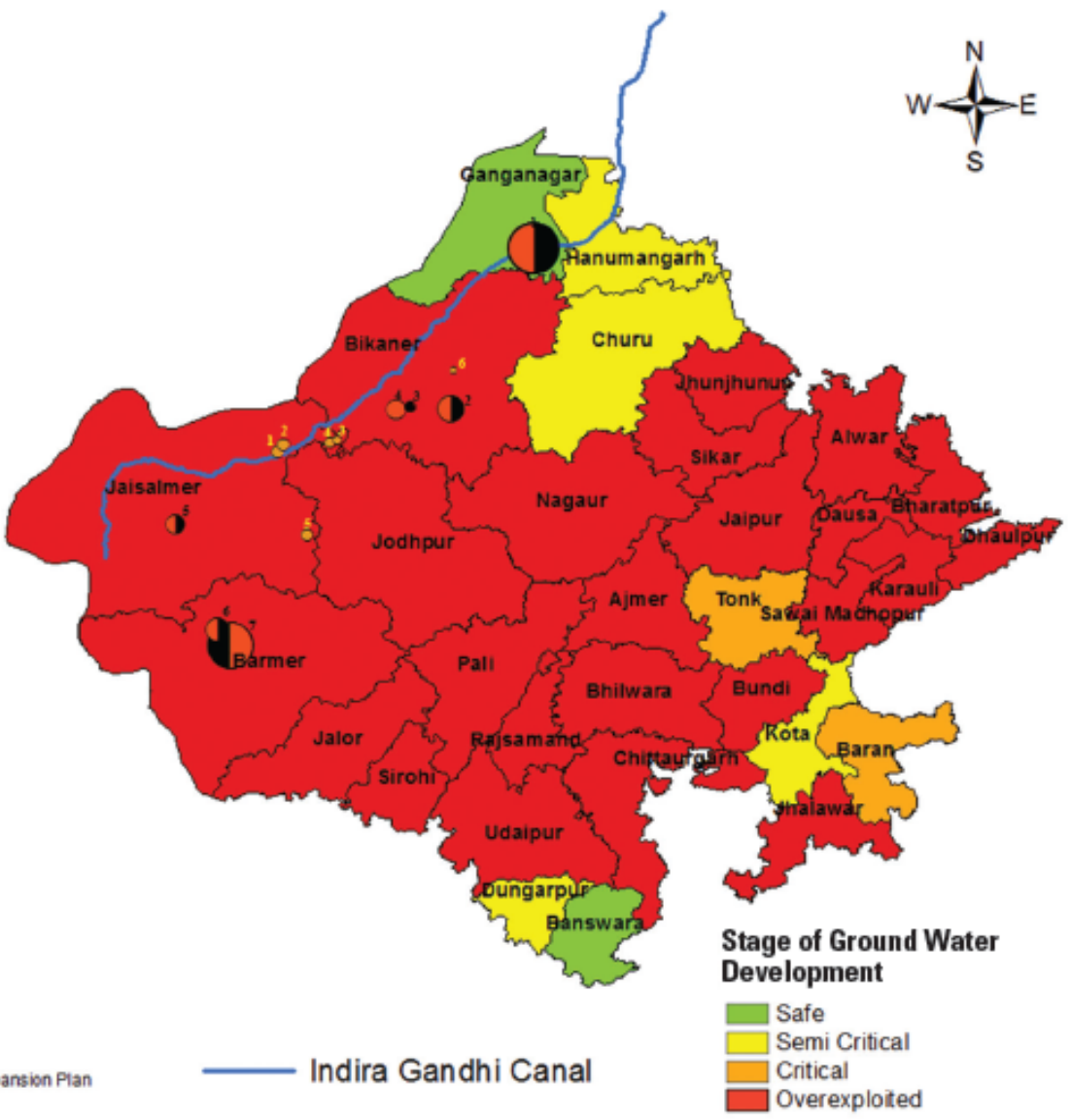
The cost of capital is the principal barrier to scaling renewables



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

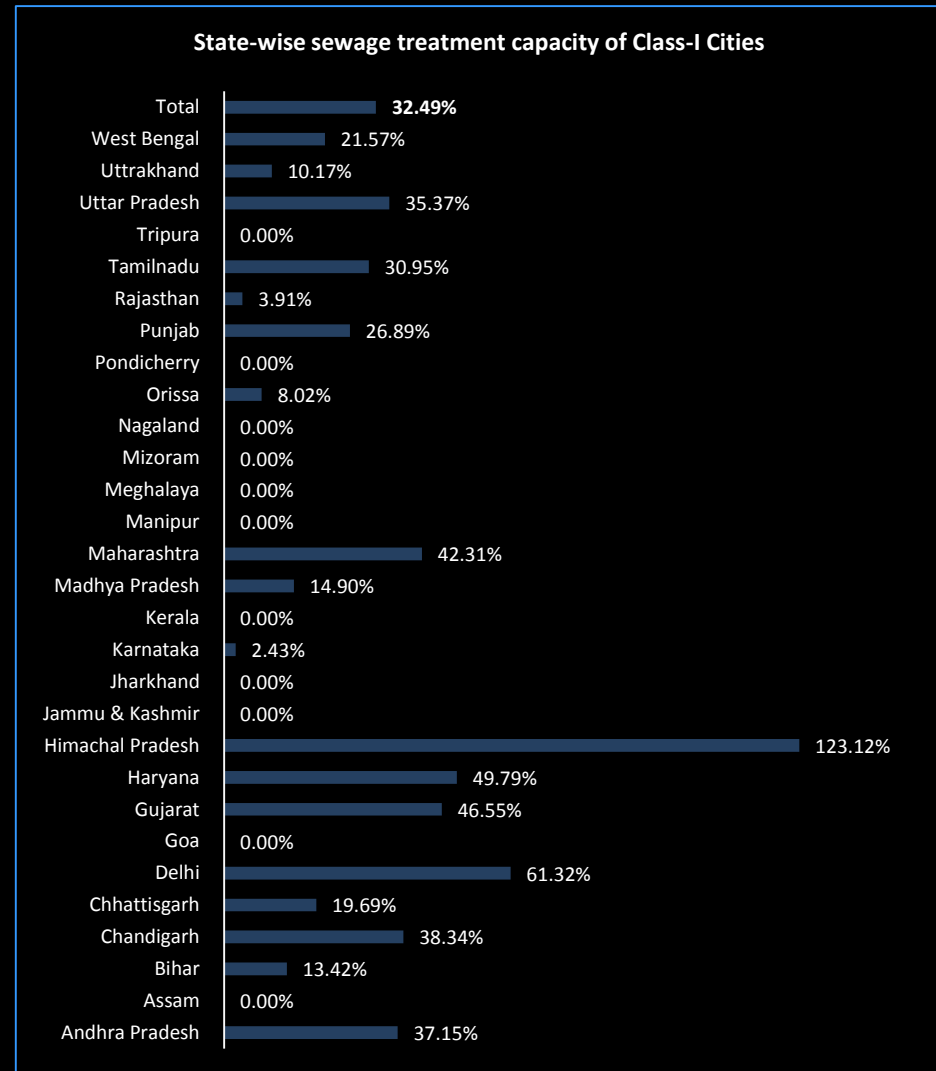
- Safe
- Semi Critical
- Critical
- Overexploited

— Indira Gandhi Canal

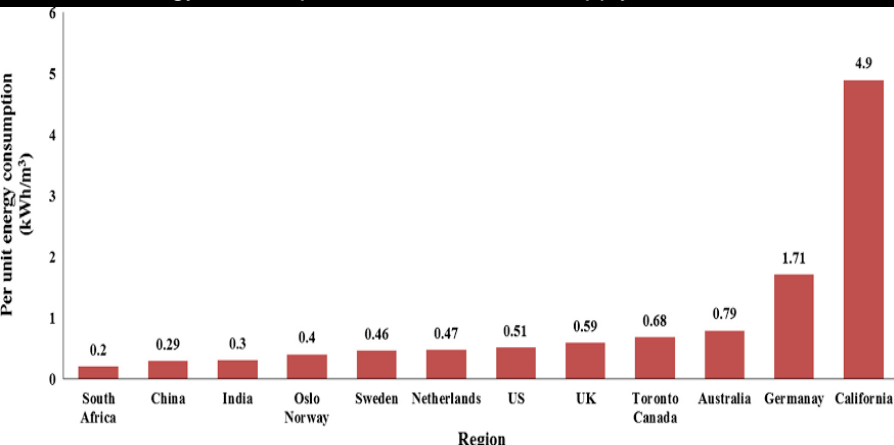
Innovations in urban service provision

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 Bharat¹

- 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 crore²

National Mission for Clean Ganga³

- 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 Cities⁴

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

Smart cities – 100 cities⁵

- 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

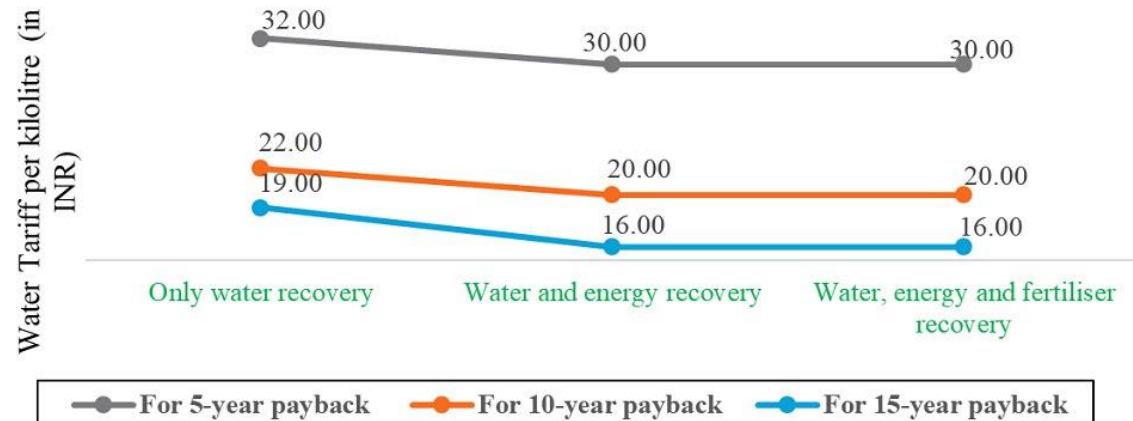
SOURCE: ¹ MouD, Gol; ²Modi govt allocates Rs 1700 crores for Swachh Bharat Abhiyan, Firstpost, Available at: <http://www.firstpost.com/business/modi-govt-allocates-rs-1700-crores-swachh-bharat-abhiyan-2077149.html>; ³ Ganga cleaning mission gets Rs 20,000 crore boost, The Times of India, Available at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

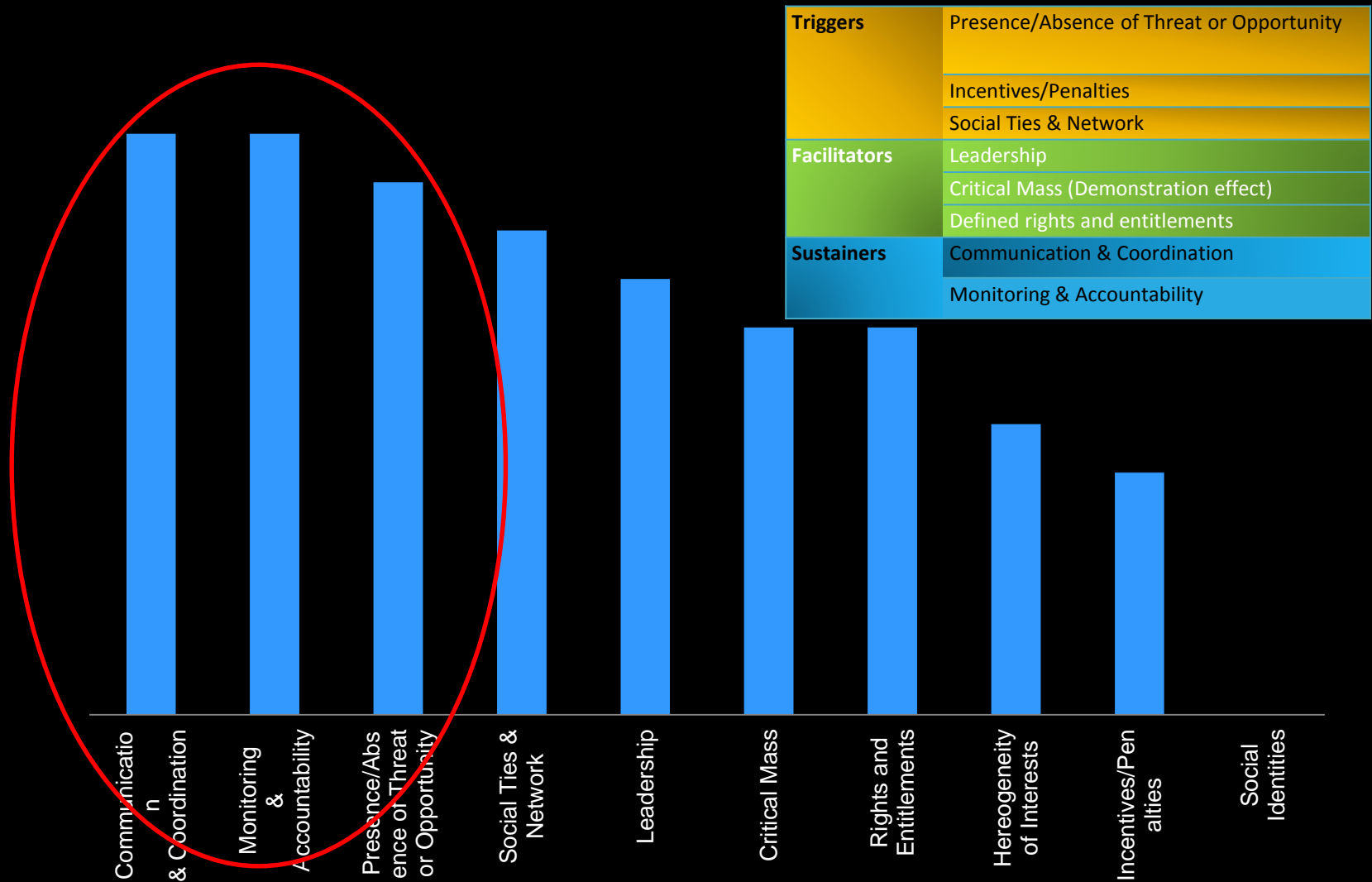
Water tariff for different payback periods and modes of revenue generation



Source: CEEW

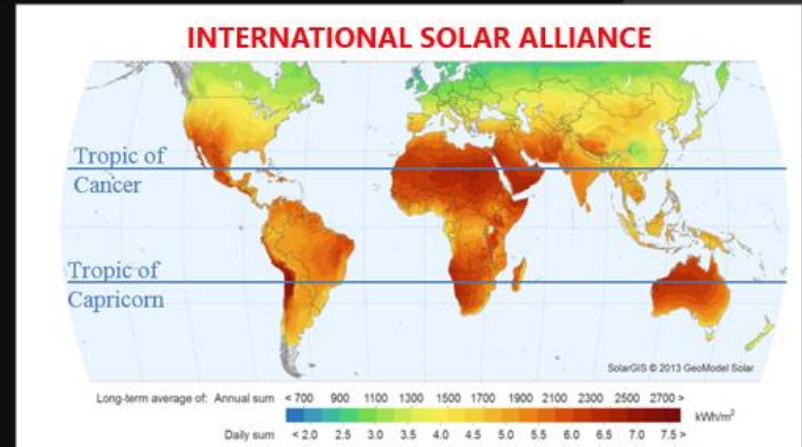
Innovations in collective action

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

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Council on Energy, Environment and Water

<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

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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

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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
Sponsors: JICA, Ministry of Environment and Forests, Government of India, etc.

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
Department of Agricultural Economics | Indian Institute of Management, Bangalore

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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