Energy-Food-Water-Climate Nexus

Seeking innovations in policy, technology, and business models

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- Sustainability finance
- Energy-trade-climate linkages
- Technology horizons
- International co-operation

National
- Resource efficiency & security
- Renewables
- Water

Local/State
- Integrated energy, environment and water plans
What does the nexus mean to you?

PHOTO CREDIT: Arunabha Ghosh
Irrigation-energy nexus means pressures on food, water and energy

SOURCE: Chaturvedi et al. (2013)
Hindu-Kush – Himalayas (HKH) : 4.2 mn km², 8 countries, 10 rivers

Portion of HKH glaciers in each country:
- Afghanistan: 4.28%
- Bangladesh: 11.74%
- Bhutan: 11.35%
- China: 0.38%
- India: 14.03%
- Myanmar: 9.23%
- Nepal: 4.28%
- Pakistan: 11.74%

SOURCE: National Research Council (2012); Sharma and Pratap (1994)
China and India are already among the largest importers of coal.

*Source: CEEW (2012)*
Climate changes further complicates the energy-water nexus

- Electricity consumption expected to increase by over 8 times between 2005 and 2050 and further by two times till century end
- Further increase in electricity consumption by 40% in 2095 under climate policy
- Shift toward more water intensive technologies

Climate – bioenergy – water interactions: A global perspective

SOURCE: Chaturvedi et al. (2013)
Resource pressures and price volatility: signs of the times

A New Commodity Boom

Food price index
Imported Crude Oil Price ($/barrel)

Sources: EIA, FAO

SOURCE: Steven and Ghosh (2013); EIA; FAO
Integrating issues reveal many tradeoffs

Integrated plans also offer many opportunities

Innovation in policy: Empowering water user associations

Functions

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

No. of Water User Associations (WUAs) per 1000 Ha covered (March 2010)

SOURCE: CEEW (2011)
Innovation in technology: renewable energy beyond electricity
Innovations in technology: RE for heating

**Water heater**
- 7.27 million square metres of solar water heating collector area installed
- Potential of over 35 to 40 million square metres
- Payback in less than 5 years compared to electrical geysers even without subsidy

**Milk pasteuriser**
- India is the largest producer of milk; organised sector produces 15%-20% of total production
- Handful of solar pasteurisation systems installed; payback period 5-6 years (with subsidy)

**Solar food dryer**
- 33 million tonnes of fruits and vegetables lost annually due to lack of storage, transportation and processing facilities
- Solar dryer can easily operate for 290 days per year; farmers can process their produce

SOURCE: CEEW-WWF (2013)
Innovations in technology: RE for heating

Solar water purifier
- One-third of India’s districts has water unfit for drinking: fluoride, iron, salinity and arsenic

Solar space heating system
- 3.5 tonnes of CO2 emissions per household can be reduced with energy efficient building design integrated with passive solar architecture

SOURCE: CEEW-WWF (2013)
Innovations in technology: RE for cooling

Solar air-conditioning system
- Market potential in India ~130000 square metres of collector area (INR 200 crore; USD 32 mn)

Geothermal cooling system
- In commercial buildings HVAC consumes 55% of total energy used
- Emissions from the commercial building sector projected to be 1,370 MT of CO2 in 2030

SOURCE: CEEW-WWF (2013)
Innovations in technology: RE for cooking

Solar cooker
• Cooking accounts for about ~36% of India’s primary energy consumption

Biogas digester
• One cubic metre biogas plant can save roughly 1.25 tonnes of fuelwood every year

Improved biomass cookstoves
• Almost 85% of rural households depend on traditional biomass fuels for cooking energy

SOURCE: CEEW-WWF (2013)
Innovations in technology: RE for mechanical power

Solar water pumps

- ~10 million water pumps run on diesel whereas less only 10,000 pumps are solar based
- Replacing 5 million diesel pumps with solar can save 10 billion litres of diesel & cut 26 MT of CO2 emissions

SOURCE: CEEW-WWF (2013)
Innovations in technology: joint R&D rather than mere transfer
Innovations in business models: finding decentralised energy firms

NOTE:
1. Sample size: 250 companies including 190 MNRE solar off-grid channel partners
2. In Delhi/NCR, Tamil Nadu & Karnataka one company implementing more than one technology means that the breakdown does not equal the total
3. The figure in Himachal Pradesh and Tamil Nadu relates to a HQ located in Chandigarh and Puducherry

SOURCE: CEEW analysis
Distributed generation: combining productive & consumptive uses

PHOTO CREDITS: Gram Power; Dalberg
Distributed generation: portfolio investments

PHOTO CREDIT: Arunabha Ghosh
Innovations in business models: Collaboration amidst competition

SOURCE: CEEW (2013)
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