Leveraging S&T to address sustainable development and global sustainability imperatives in developing countries: The case of energy (and climate)

Ambuj Sagar
Vipula and Mahesh Chaturvedi Professor of Policy Studies
Indian Institute of Technology Delhi

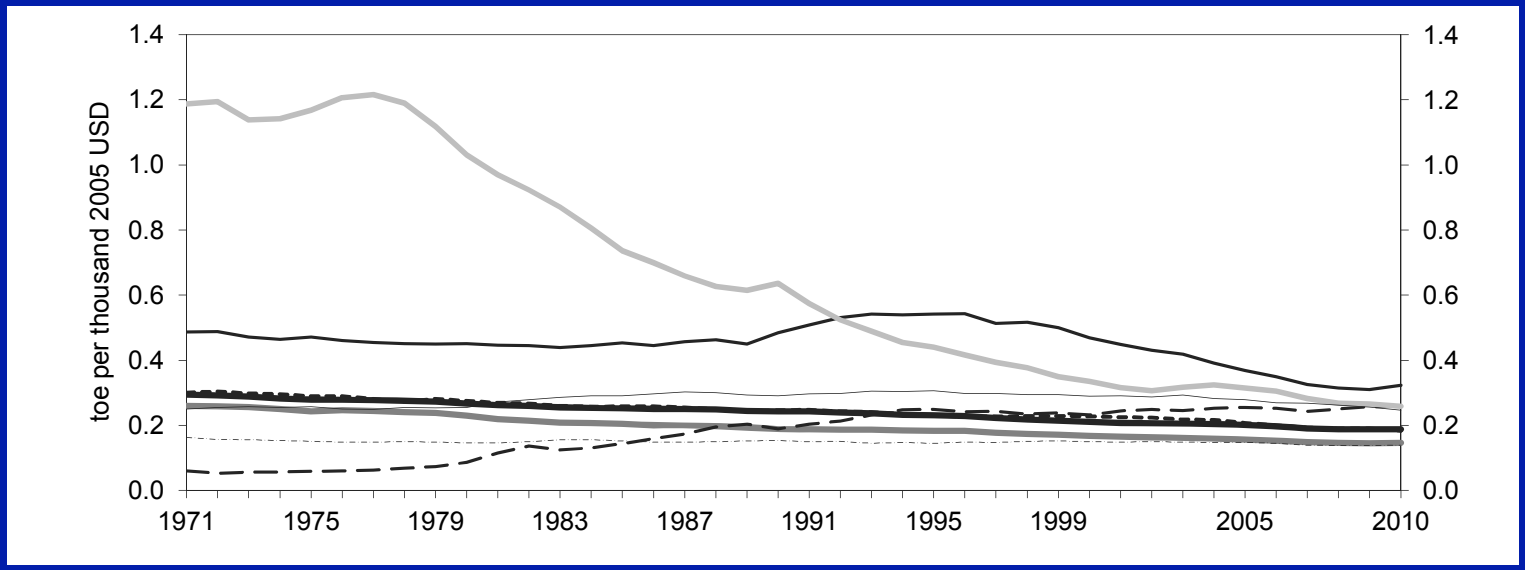
UNGA Consultative Workshop
"Development, transfer and dissemination of clean and environmentally sound technologies in developing countries"

April 30, 2013

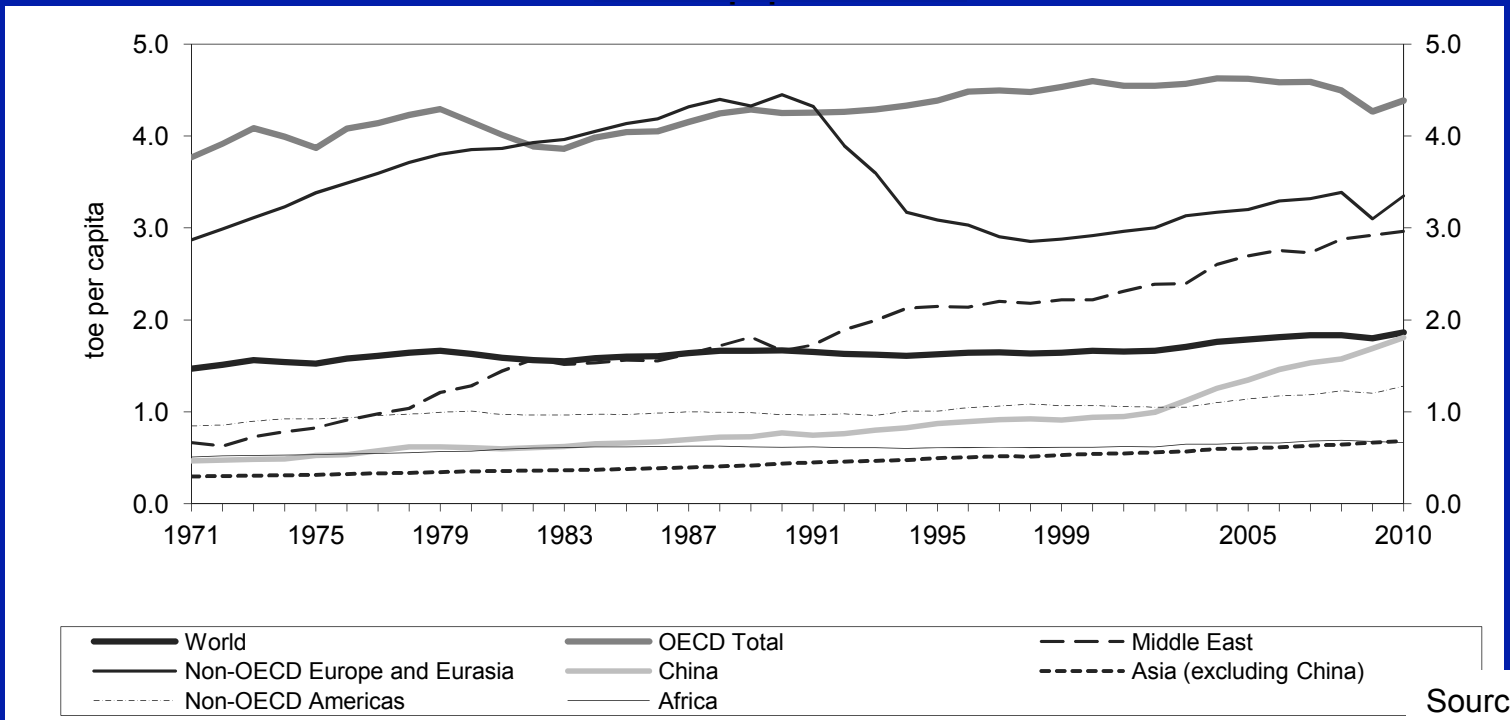
Development needs of developing countries (focus on energy here)

Global energy supply patterns and trends

TPES/GDP PPP



TPES/Population



Source: IEA 2012

Non-OECD countries accounted for about 55% of the world's total primary energy supply (TPES) (with about 80% of the world's population).

- Non-OECD countries rely heavily on fossil fuels (especially coal and petroleum) and this dependence is increasing
(Coal: Non-OECD: 40% of TPES; China 72%; India: 55%)*

- Non-OECD countries still obtain almost 15% of their energy supply from combustible renewables and biomass
(China: ~ 8%; India: ~ 25%; Africa: ~47%).

- Poorer countries generally have less efficient energy economies and systems.
(Africa: 0.25 toe/'000 2005PPP$; OECD: 0.15 toe/'000 2005PPP$)

- Energy poverty widespread.
(1.6 billion people without access to electricity; almost 2.6 billion people rely on biomass for cooking)

Developing country energy needs:

- Expansion of affordable energy supply and services *('adequacy' and 'affordability')*
- Improving the efficiency of conversion of energy supply into energy services *('efficiency')*
- Replacing traditional energy technologies by modern, clean energy technologies *('modernity')*

Different countries have very different needs (e.g., China vs. Kenya vs. Thailand)

Range of needs within a country (e.g., India)

Sustainability-related needs of developing countries (focus on climate here)

Even the most ambitious climate measures cannot avoid future impacts - but if no aggressive mitigation, impacts may be too large to be manageable

=> Need both mitigation and adaptation

Mitigation adds a hard constraint to the energy and other sectors

- Decouple activities from GHG emissions

OR

- ~~Reduce economic activities~~

Key challenge is to meet both the development and sustainability imperatives – in the required time frame and in a simultaneous manner

Leveraging technology to meet development and sustainability imperatives

Energy-technology-related needs in developing countries to advance development and sustainability:

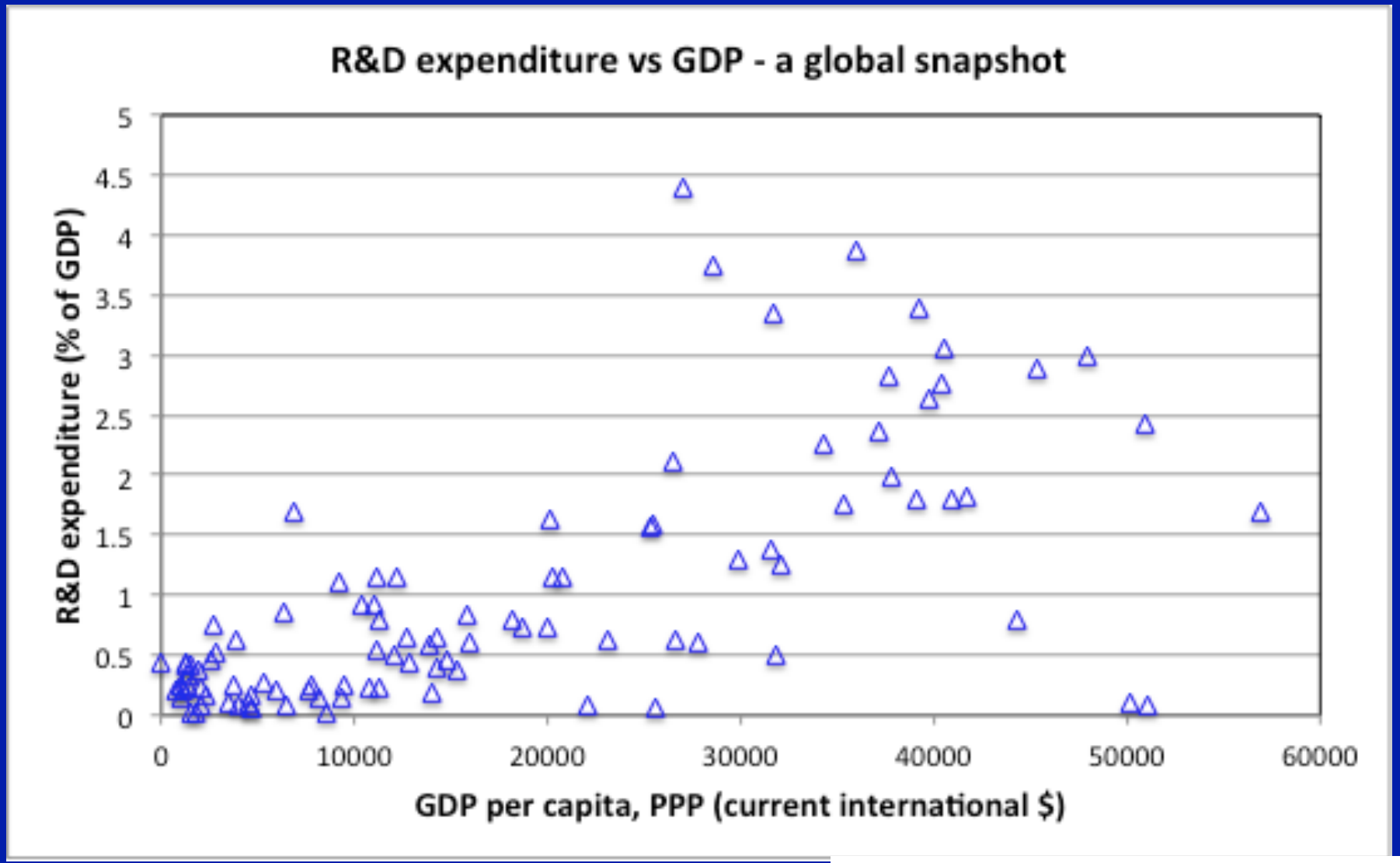
- Accelerating transfer of commercial and emerging technologies (economics, other barriers)
- Adaptation of technologies to local conditions, e.g., building technologies
- Development and diffusion of technologies for "unaddressed" needs, e.g., improved cookstoves, small-scale biomass gasifiers, solar lanterns, etc.
- Long-term technology needs
- Deployment issues (economics, finance, information and trust, market organization, infrastructure, human and institutional capabilities)

Different countries will have different technology needs commensurate with their development needs and context

Key capability 'gaps':

- Assessment and prioritization gap:
  - *Technology assessment and options analysis to map development and sustainability needs to the tech realm*
  - *Prioritization amongst options with different development and sustainability benefits*
- Technological development/adaptation gap:
  - *Developing country STI systems often weak (or almost non-existent) - scale, scope, and coordination*
- Translation (into application) gap:
  - *Translating research into application requires multiple other capabilities*

[+ International approach gap]



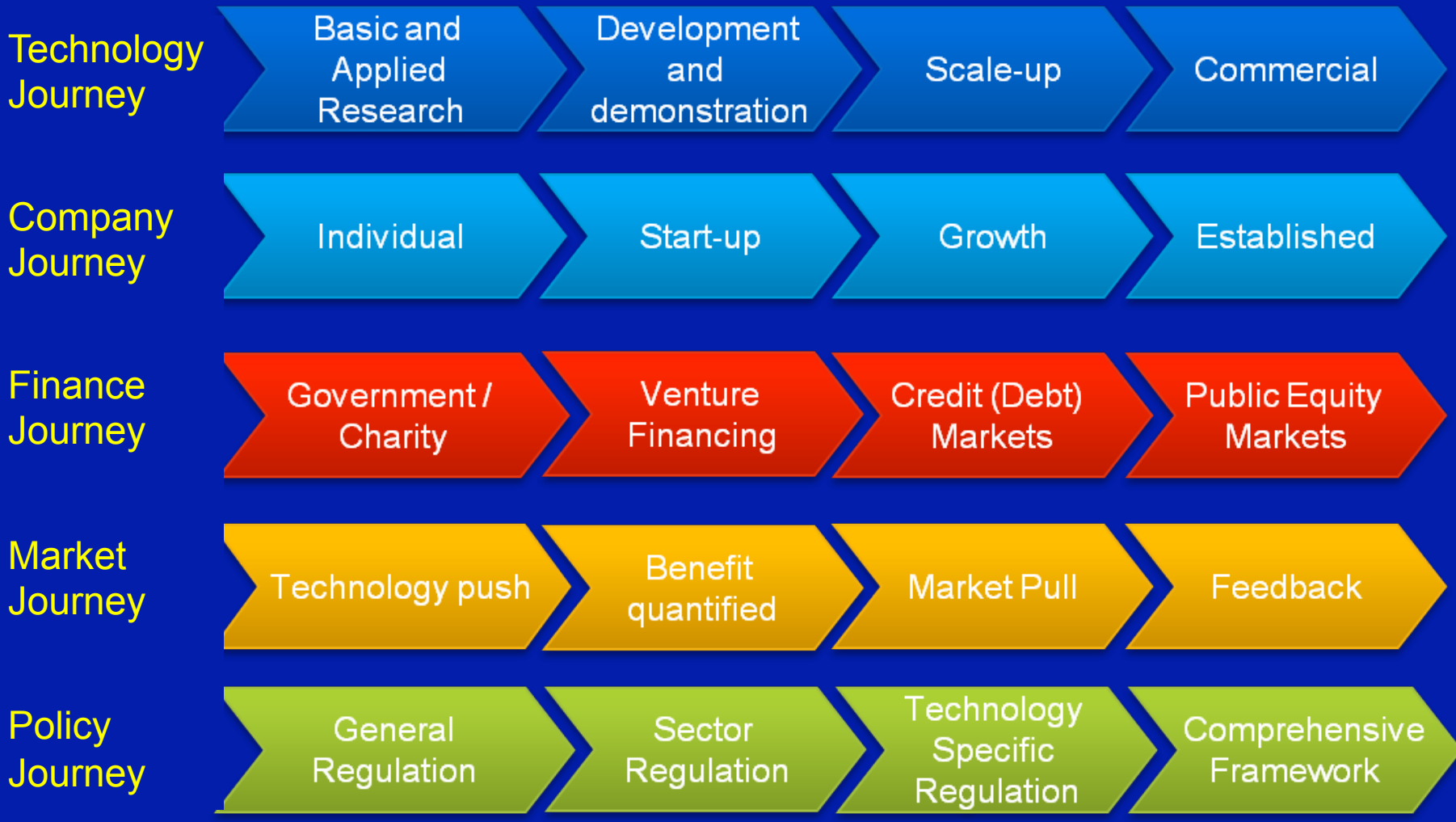
Source: World Development Indicators, World Bank

Key capability 'gaps':

- Assessment and prioritization gap:
  - *Technology assessment and options analysis to map development and sustainability needs to the tech realm*
  - *Prioritization amongst options with different development and sustainability benefits*
- Technological development/adaptation gap:
  - *Developing country STI systems often weak (or almost non-existent) - scale, scope, and coordination*
- Translation (into application) gap:
  - *Translating research into application requires multiple other capabilities*

[+ International approach gap]

Beyond R&D: Translating research into application requires progress on multiple journeys



Source: Carbon Trust 2009; Sagar, Bremner, and Grubb 2000; Sagar and BNEF 2011

Building local capabilities for development and sustainability

- TECHNOLOGY: Help improve the technology development process to ensure the availability of technologies for local markets, e.g., coordinate local players, intl. cooperation
- COMPANY: Support entrepreneurial as well as existing ventures to succeed in the business of energy innovation, e.g., provision of market and technology analyses
- FINANCE: Facilitate the expansion of financing options for technology developers and adopters by both helping deepen the pool of funds available and enhance access for firms
- MARKETS: Promote demand through creation and strengthening of markets, e.g., feed-in tariffs, advanced market commitments. New delivery/business models.
- POLICY/REGULATION: Ensure that the policy/regulatory framework supports innovation for development and sustainability, e.g., standards
- COORDINATION: Facilitate/coordinate implementation and learning (local and global).

System-oriented approach:

- Needs and gaps will differ across sectors, technologies, and countries
  - √ Cannot use "one shoe fits all" approach – *flexibility is key*
- Local and intl. engagement with a range of orgns./experts
  - √ Development professional and practitioners
  - √ Sectoral domain knowledge experts (policy, regulations, tech)
  - √ Technology and product developers (start-ups, large firms, academia..
  - √ Finance (banks, VCs)
  - √ Policy makers
- Focus on scalable opportunities with development & sustainability benefits

Need capacity to identify technological opportunities and innovation gaps (consultation!); coordinate, facilitate, and support existing actors and networks and design strategic interventions to address innovation gaps to accelerate technological change -- "SYSTEMS OPERATOR"

=> Concept of Climate Innovation Centers (CICs)

Tailoring CIC design to local context:

CIC focus by country size and level of development					
Country attributes		Large/medium population countries		Low population countries	
		High GDP	Medium/Low GDP	High/medium HDI	Low HDI
Scale of Center		National	National	Regional	Regional
Scope of Center	Main technology thrust	Technologies for basic energy needs; mitigation; adaptation	Technologies for basic energy needs; adaptation	Mitigation; adaptation	Technologies for basic energy needs; adaptation
	Innovation process	Full range (technology research, development/ modification and deployment)	Emphasis on deployment process and strategies	Full range (technology research development/ modification and deployment)	Emphasis on deployment process and strategies
Need for international resources (finance, human)		Selective	High	Selective	High
Source: Ambuj Sagar					

Sagar and BNEF 2011

International perspectives: Lessons from climate technology cooperation

- Most existing initiatives focused on enabling and facilitating deployment, few focused on actual RD&D
- Global sustainability (climate) concerns key driver
  - Focus mostly on mitigation (and within that, energy
  - Little coverage on non-energy sectors
  - Few technologies for adaptation
- Focus mostly on major developing economies
- Mostly project-oriented; even programmatic efforts have relatively-narrow short-term objectives
- Blurring between bilateral and multilateral objectives

Based, in part, on Sagar et al. 2010

Exploration of international collaborative R&D models

Goals	Innovation stage	R&D Partners	Collaboration model	Funding
Adaptation/ modification of existing technologies and products	Middle-stage; Market-oriented	Industry, dedicated laboratories (some universities and national laboratories)	Industry-industry (horizontal and vertical)	Public/private
			Industry-national labs/universities	Public/private
			CGIAR-type networks	Public
New technologies and products for "unaddressed" needs	Middle-stage (and some early stage); End-user oriented	Industry, dedicated laboratories, universities, national laboratories, NGOs	Product-development partnerships	Public
			CGIAR-type networks	Public
			Innovation-prize- or advanced-market-commitment-induced collaborations	Public, philanthropic
			Industry-national laboratories	Public-private
Long term R&D	Early stage	Universities/national labs, Industry, dedicated facilities	University-University Collaboration	Public (Climate financing; bilateral, multilateral, philanthropy), private
			University- Industry collaboration	
			Industry-industry consortium	
			CGIAR-type networks	
			Global facility	

Sagar et al. 2010

Bringing it all together: The Indian National Biomass Cookstove Initiative

- ✓ Technology: Develop next-generation technology (develop global innovation prize; local R&D centers)
- ✓ Production and delivery chains (partner with existing firms with production or supply networks)
- ✓ Finance (Banks, government, micro-credit)
- ✓ Local support (partner with NGOs, self-help groups..)
- ✓ Market facilitation (standards and certification)
- ✓ Policy evolution (Steering Committee involves key govt officials)

Conclusions (1):

- Technology offers great potential in simultaneously meeting climate and development challenges – but realizing potential of technology non-trivial
- Enormous range of technology needs and options
  - ✓ By sector
  - ✓ By actor (e.g., size of operations)
  - ✓ By implementability in local conrtext
  - ✓ By mix of development and (local + global) sustainability benefits
- No static, one-off, solution to advance SD and global sustainability – dynamic goals
- Limited STI and related capabilities in developing countries

Need capabilities that are responsive to local needs and cognizant of local context to meet developmental AND sustainability challenges

Conclusions (2):

- Need new institutional mechanisms to build local capabilities to assess needs, prioritize options, and address gaps
- Strengthen existing local actors and networks to undertake these activities to accelerate technological change
- Actors with 'systems-level' perspective particularly key for coordination, facilitation, and strategic intervention to ensure progress on journeys in all parts of innovation domain
- New international (bilateral, multilateral) approaches needed – go beyond current approaches; programmatic approach to support institution and capacity building?

Comments/suggestions:

asagar@hss.iitd.ac.in

References:

IEA 2012: Energy Balance of Non-OCED Countries 2012

Carbon Trust 2009: Carbon Trust, Low-Carbon Technology Innovation and Diffusion Centres (2009).

Sagar et al, 2009: A.D. Sagar, C. Bremner, and M. Grubb, "Climate Innovation Centers: A Partnership Approach to Meet Energy and Climate Challenges," *Natural Resources Forum*, 33(4): 274-284 (2009).

Sagar and BNEF 2011: A.D. Sagar and Bloomberg New Energy Finance (BNEF), Climate Innovation Centres : A.D., A new way to foster climate technologies in the developing world?, report prepared for infoDev/UNIDO (2011).

Sagar et al., 2010: A.D. Sagar, D. Ockwell and H. de Coninck "Options to facilitate collaborative R&D relevant to climate technology development and transfer," Background Paper prepared for the UNFCCC Secretariat, Bonn, Germany (2010).