Bundling Improved Cooking and Lighting Technology for Energy Access

Background

There is no definitive understanding of what energy services are entailed in ‘access to energy’ for a household. The Global Tracking Framework of SE4All\(^1\) provides a comprehensive definition of energy access—positing that a household in the basic ‘tier’ of energy access has ‘task lighting and phone charging’ and a ‘manufactured solid-fuel cookstove with conformity, convenience, and adequacy’. India has 75 million households without access to electricity.\(^2\) The situation with regard to cooking energy is more overwhelming—166 million households depend on solid fuels\(^3\) for their cooking needs. Small-scale, cost-effective solutions, such as solar home lighting systems and improved biomass cookstoves are being promoted by national and State governments to help rural households rise above energy poverty. However, these solutions face the following challenges that limit their scaling-up:

- Willingness to pay for well-performing improved cookstoves is low, as their benefits are not perceived to be significant by rural households\(^4\)
- The rate of adoption of improved cookstoves by rural households is poor, due to social, economic, and behavioural issues\(^5\)
- Banks are generally unwilling to finance the purchase of solar home lighting systems or improved cookstoves due to their small ‘ticket-size’. It means that the amount of loan is low, and yet the transaction costs and repayment risks are high

---

\(^{1}\) Global Tracking Framework (2013), Sustainable Energy for All.

\(^{2}\) Census of India, 2011: Source of lighting.

\(^{3}\) Solid fuels include fuel wood, crop residue, coal, animal dung cakes, and charcoal.


As households move up the energy ladder\(^6\), these solutions do not permit addition of more features, such as phone charging, adding another light point, operating a fan, etc.

Repair and maintenance of these systems is difficult in rural areas due to complexity in design and lack of skilled technicians.

Solar lighting and improved cooking solutions are currently promoted by two different policies of the national government. Consequently, rural energy access projects adopt disparate programmes and strategies for disseminating these technologies. TERI, in a nation-wide energy access programme supported by the Department for International Development (UK), attempted to converge the strategies and technologies for addressing access to electricity and clean cookstoves in rural areas. It was found that this approach helped in finding solutions to many of the challenges described above. This policy brief discusses this approach, advocating the bundling of cooking and lighting technology to tackle the problem of lack of access to energy in an integrated manner.

**Policy Issue**

The Government of India recognizes renewable energy as a viable solution to address the issue of lack of energy access in rural households. However, solar lighting and improved biomass cookstoves, which are promoted as energy access solutions, are promoted in a disintegrated manner. While the Jawaharlal Nehru National Solar Mission promotes solar lighting in rural households, the Unnat Chulha Abhiyan (UCA) promotes the dissemination of improved biomass cookstoves. The same strategy is replicated by state governments and corporates that promote these technologies under corporate social responsibility. As a result of this piecemeal approach to addressing the energy access problem, there is lopsided success, duplication of expenditure, asymmetrical priorities of State governments in addressing lighting and cooking energy access. Consequently, rural households do not attain ‘basic energy access’ in its entirety. This policy brief presents a new thinking and approach for providing access to energy to rural households in an integrated manner as opposed to the current piecemeal approach.


**A New Approach**

In response to demand from rural households for additional light points and mobile charging facility in course of the TERI-DFID programme, TERI designed a flexible and adaptable domestic energy solution called the Integrated Domestic Energy System (IDES). Essentially, the IDES has a lithium-ion battery, solar PV module, and a charge controller, which powers a combination of devices including an improved forced-draft cookstove, LED lights, and a mobile charging point. The configuration of the battery and solar PV module can be changed to accommodate more devices, or devices with different power input requirements. Integrating devices reduces the total cost of the system by at least a fifth of the total cost of buying each device separately (due to sharing of battery and peripherals, such as wires, solar PV module, and charge controller). Since these components are freely available in the market, energy enterprises set up by TERI were trained to design IDES on their own to match buyers’ requirements. Owing to the flexibility and simplicity of the technology, entrepreneurs have designed innovative IDES with a variety of devices on their own. A schematic diagram of the IDES is provided in Figure 1.

![Schematic diagram of an Integrated Domestic Energy System](image)

**Why Bundle?**

*Enhancing uptake and adoption*

One of the primary challenges of improved biomass
cookstoves programmes, particularly in India, is the poor uptake and adoption of clean cooking products by rural households. Even after 30 years of policies for dissemination of improved biomass cookstoves, a viable market for these stoves is not in place.⁷ On the other hand, stand-alone solar lighting systems (home-lighting systems) are a popular pre-electrification option in India, with well-developed local markets for such products in rural areas.⁸ Ease of use and flexibility in design have made solar home lighting systems a popular choice for lighting in low-income rural households.⁹ TERI has observed that bundling home-lighting systems with improved cookstoves enhances the uptake and adoption of the integrated system, as opposed to the poor adoption observed in the case of improved cookstoves when disseminated alone. Evidence from three districts of Uttar Pradesh, where TERI set up ‘energy enterprises’ that sold both integrated systems (improved biomass cookstoves + two light points + mobile charging point) and improved cooking and solar lighting products individually showed that the sale of integrated systems was much higher than the sale of either of the individual products (see box). Dip-stick surveys conducted among buyers revealed that integrating solar and improved cooking systems had an additive effect on the preference of buyers for either of these products.

While users preferred home-lighting systems more than improved cookstoves, the additional option of an improved biomass cookstove and a mobile charging point made the product more attractive for purchase than an individual home-lighting system. Owing to the flexibility of design, it is possible to add features to integrated system that find favour locally (e.g., mobile charging point, fan, additional light, etc.).

Cost effectiveness

The major motivating factor for TERI to develop an integrated domestic energy system was to reduce the cost to the end user to attain basic energy access. Integration of lighting and improved cooking systems allows the two products to share batteries and peripherals (solar photovoltaic module, wires, switches, etc.), bringing down the overall cost of the system compared to purchasing lighting and improved cooking products individually. To cite an example, a solar home lighting system with two light points and a mobile charging point (operating on a 10 Ah battery) costs around ₹7,000 in the open market. An improved forced-draft cookstove with a power pack costs around ₹4,500. However, bundling these two products together brings down the overall cost of the system to ₹9,500 (compared to ₹11,500, when purchased individually). Furthermore, since the whole system is serviced as a whole, the service expenses of routine after-sales repair is halved compared to repairing each of these systems individually.

Ease of finance

To enhance affordability of clean energy products being sold in a commercial mode, TERI facilitated the provision of end-user finance to interested buyers from low-income households. However, it was seen than commercial and regional rural banks were less forthcoming to provide personal loans for purchase of improved cookstoves for three reasons: (a) consumptive nature of the product, which increases the risk of repayment for the bank, (b) low ‘ticket-size’ of the loan, increasing the transaction costs per loan, and (c) improved cookstoves not being considered for ‘priority lending’ as in the case of solar lighting products. However, integrating improved cookstoves and solar lighting system offered a solution to this problem in two ways: (a) the ‘ticket-size’ of the loan provided for integrated systems was higher than either of the two clean energy products individually, and (b) integrating solar lighting with improved cookstoves made the product eligible for ‘priority lending’, as opposed
to improved cookstoves being sold individually. An added benefit of integrating the lighting and clean cooking products was that the subsidies offered to both of these products by the government and under corporate social responsibility could also be bundled, making it an attractive and cost-effective proposition for dissemination in rural communities.

**Design flexibility**

The energy needs of rural communities are greatly influenced by individual preferences and local contexts. For instance, with increased penetration of mobile phones in Indian villages, TERI has anecdotal evidence of project beneficiaries demanding a mobile charging facility in solar home lighting systems. Provision of mobile charging facility is also one of the components of the basic tier energy access under the Global Tracking Framework. In some cases, energy enterprises set up by TERI have reported that end-users have expressed a demand for DC fans and additional light points with solar lighting systems. Integrated systems designed by TERI have a simple architecture that provides entrepreneurs with basic skills to design their own systems according to local demand. The peripheral components of integrated domestic energy systems (batteries, solar PV modules, wires, DC fan, LED luminaries, etc.) can be easily procured from local markets and assembled by entrepreneurs. TERI has trained more than 220 rural entrepreneurs to design integrated domestic energy systems, who are actively engaged in designing such systems according to local requirements and demand. Not only does this help in fulfilling the local energy needs of the target community, but it also renders greater acceptability to the clean energy product to interested buyers.

**Combined environmental benefits**

Traditional biomass cookstoves and kerosene lamps are significant sources of greenhouse gases and climate forcing agents (e.g., black carbon) in rural India. Replacing traditional biomass cookstoves with improved cookstoves and kerosene lamps with LED lamps are effective strategies to mitigate greenhouse gas emissions. This presents an opportunity for certification of solar lighting and improved cookstove projects for carbon credits in emissions reduction markets. However, the scaling-up of such projects is challenging, owing to substantial certification and monitoring costs compared to returns in the form of carbon credits. On the other hand, the carbon mitigation potential of a combined improved cooking and solar lighting product is much higher than either of these technologies individually, yielding higher returns from the carbon market. At a time when carbon financing is seen as a potential opportunity to make clean energy technologies affordable, bundling lighting and cooking products to harvest higher credits from the carbon market makes this approach practical and remunerative.

**Policy Recommendations**

**Policy convergence**

At present, improved cooking and solar lighting projects are implemented in a disparate manner through different national and state policies. So much so, that the mode of finance and dissemination for these systems are also separate. There should be convergence both at the level of national policy and programme implementation that encourages integrated approaches to addressing lack of domestic energy access. Programmes and schemes that address the issue of energy access must approach the problem in its entirety, instead of addressing lighting and cooking energy separately at the household level. To start with, independent task forces can be set up in each state to recommend how interventions and funds under the Jawaharlal Nehru National Solar Mission and the National Biomass Cookstoves Initiative can be merged to provide holistic energy access solutions to rural communities.

**Bundling subsidies and finance**

Bundling subsidies and loans offered to clean energy products can help in increased affordability and better availability of finance for integrated domestic energy systems. Integrated systems must be made eligible for ‘priority lending’ by rural banks, so that loans are offered more readily. Simultaneous efforts must be made to certify such systems for payments from the carbon market, so that new streams of finance can be made to end users.

**Promoting technological innovation**

As discussed in sections above, there is immense scope for designing need-specific configurations of integrated domestic energy products. Training rural entrepreneurs...
and technicians to design such technology would help in large-scale replication of such systems, simultaneously catering to local requirements of the rural community. There have been technological advances in integrated systems that allow alternative sources of power and diversity in configuration in their design. For instance, the development of forced-draft stoves with thermo-electric generators\textsuperscript{12} helps in generation of around 6 watts of power for operating the cookstove’s fan as well as task lighting just by burning fuel in the cookstove. Another example is the design of community level micro-grids, piloted by TERI, which can provide light points, a mobile charging point and operate a forced-draft cookstove to a cluster of households through a centrally-operated solar power micro-station. National and State governments must invest in both skill development at the local level, and research and development at the central level to design and develop systems that can address the basic energy needs of a rural household in an integrated manner.

This is part of a series of policy briefs by TERI based on its research work in specific areas. These briefs are made available to Members of Parliament, policymakers, regulators, sectoral experts, civil society, and the media. The briefs are also accessible at http://www.teriin.org/policybrief/. The purpose is to focus on key issues and list our policy recommendations to encourage wider discussion and debate. We would very much value your comments and suggestions.

### Policy Briefs and Discussion Papers of TERI

<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mainsstreaming Gender in Improve Cookstove Value Chain</td>
<td>June 2015</td>
</tr>
<tr>
<td>2. Biofuel Promotion in India for Transport: Exploring the Grey Areas</td>
<td>February 2015</td>
</tr>
<tr>
<td>3. Crisis in India’s Electricity Distribution Sector: Time to Reboot for a Viable Future</td>
<td>January 2015</td>
</tr>
<tr>
<td>5. What would India need for moving to a 100% renewable energy scenario by 2050?</td>
<td>December 2014</td>
</tr>
<tr>
<td>6. Perspectives on a Water Resource Policy for India</td>
<td>October 2014</td>
</tr>
<tr>
<td>7. Advancement of Fuel Quality and Vehicle Emissions Norms to Improve Urban Air Quality in India</td>
<td>September 2014</td>
</tr>
<tr>
<td>8. Tax Regime for Improved Cookstoves and Its Implications</td>
<td>September 2014</td>
</tr>
<tr>
<td>9. Proliferation of Cars in Indian Cities: Let Us Not Ape the West</td>
<td>June 2014</td>
</tr>
<tr>
<td>10. Climate Proofing Indian Cities: A Policy Perspective</td>
<td>March 2014</td>
</tr>
<tr>
<td>11. India and Sustainable Development Goals</td>
<td>December 2013</td>
</tr>
<tr>
<td>12. Engagement with Sustainability Concerns in Public Procurement in India: Why and How</td>
<td>August 2013</td>
</tr>
<tr>
<td>15. Enhancing Water use Efficiency of Thermal Power Plants in India: Need for Mandatory Water Audits</td>
<td>December 2012</td>
</tr>
<tr>
<td>16. Governance of Mining in India: Responding to Policy Deficits</td>
<td>June 2012</td>
</tr>
<tr>
<td>17. Don’t Tinker with the Clock to Save Energy</td>
<td>August 2011</td>
</tr>
<tr>
<td>18. India’s Coal Reserves are Vastly Overstated: Is Anyone Listening?</td>
<td>March 2011</td>
</tr>
<tr>
<td>19. Critical Non-fuel Minerals Security: Why India Urgently Needs to have a Policy in Place</td>
<td>December 2010</td>
</tr>
<tr>
<td>20. Strengthening Agricultural Biotechnology Regulation in India</td>
<td>September 2010</td>
</tr>
</tbody>
</table>

For more information contact:

**S Arun**, Area Convener and Associate Fellow

The Energy and Resources Institute (TERI)

Darbari Seth Block,

IHC Complex, Lodhi Road,

New Delhi- 110003

Tel: 24682100 or 41504900  
Fax: 24682144 or 24682145  
Web: www.teriin.org  
E-mail: s.arun@teri.res.in