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LBNL Report

THE HUNDRED BILLION DOLLAR BONUS: Global Energy Efficiency Lessons from India

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THE HUNDRED BILLION DOLLAR BONUS: GLOBAL ENERGY EFFICIENCY LESSONS FROM INDIA

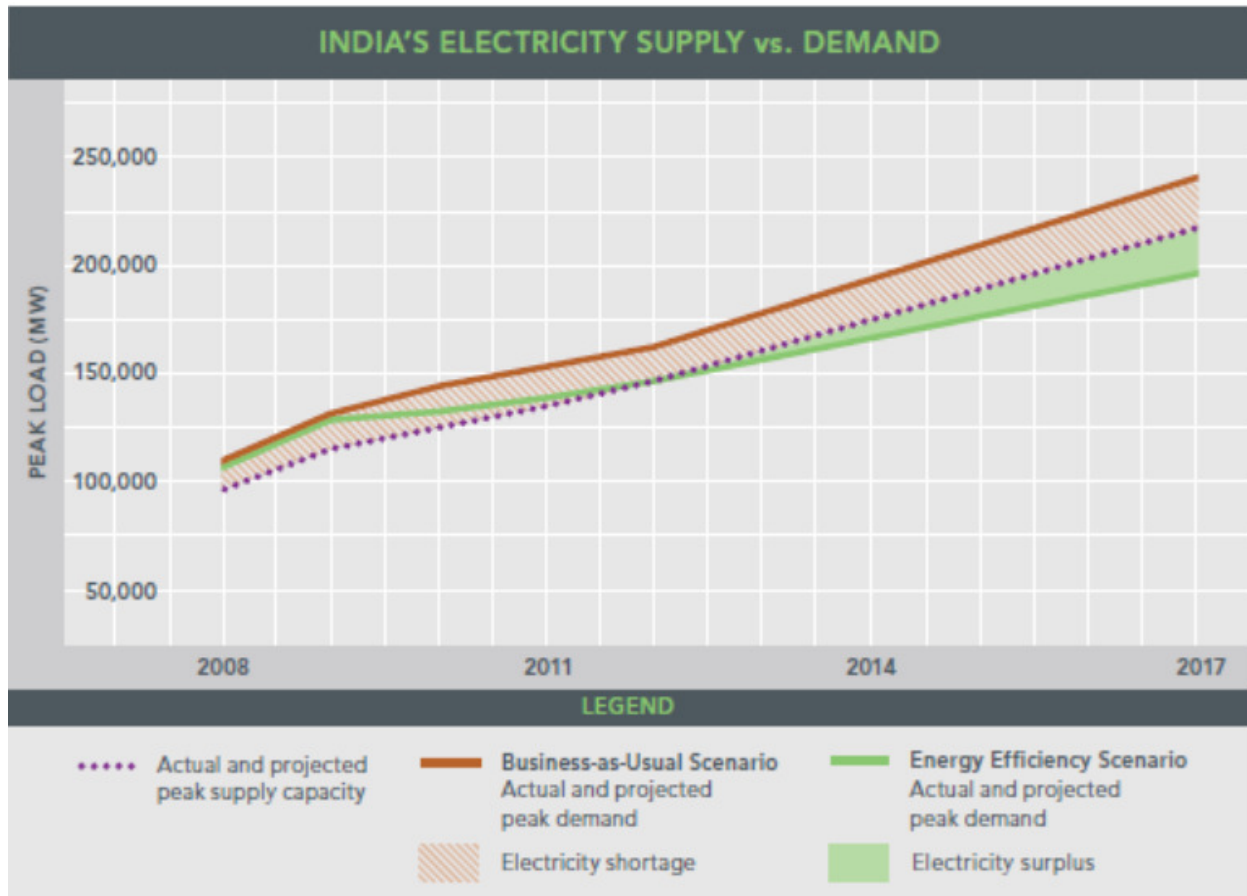
What if an engineering whiz came up with a device that could eliminate India's crippling blackouts, boost its GDP by several hundred billion dollars, slash its burgeoning greenhouse gas emissions, and save money for consumers?

India would no doubt leap at the chance to use such a device. But no engineering genius or futuristic technology is required to reap these benefits. Studies show that currently available energy efficient appliances and other technologies, properly deployed, could help India achieve these gains in just a few years.

At a time when India and other nations are grappling with myriad energy-related challenges, including unstable, costly power sources and growing greenhouse gas emissions, energy efficiency offers an alternative at a fraction of the cost of other new sources of energy. A consortium of leading Indian regulators, nongovernmental organizations, and international experts has recognized this opportunity and is working to develop effective policies that will bring significant domestic benefits to India while accelerating the global transition to energy efficiency.

1 INDIA'S ELECTRICITY SUPPLY CHALLENGE

India is at a critical stage of development. Its economy has grown, on average, more than 7 percent per year since 1997; in 2010, growth exceeded 8 percent. The country is rapidly industrializing and incomes are rising, but India is struggling to keep up with the mounting electricity demand associated with its strong growth. Its electric utilities are building new power plants, but new energy supply alone will not solve India's power problems. Only about two-thirds of India's people have access to electricity, and those with access face frequent blackouts. Electric utilities must often cut power to many areas when demand strains capacity. The electricity shortage is growing, from 7.7 percent in 1990–91 to 10.1 percent in 2009–10; meanwhile, energy demand is expected to double or triple over the next 20 years.



Jayant Sathaye and Arjun P. Gupta, “Eliminating Electricity Deficit Through Energy Efficiency in India: An Evaluation of Aggregate Economic and Carbon Benefits,” April 2010.

Frequent power failures greatly restrict business productivity by idling workers and impairing merchandise quality. When a clothing manufacturer loses power, for instance, all the sewing machines stop. When power is restored and the machines start up again, the stitches are often misaligned. Shirts with uneven seams or topstitching must be sold as seconds or discarded, reducing profits.

Such damages accrue across industries; continuous-process industries are especially hard-hit. To contend with the power outages, many Indian businesses buy inverters to charge batteries or resort to expensive, polluting diesel generators. This self-generation is pricey —25 cents or more per kilowatt-hour —and worsens the local air pollution that blankets many cities.

India’s leaders are acutely aware of the need to expand the power supply while addressing related issues such as energy security, air pollution, public health risks, and greenhouse gas emissions. While India’s per capita emissions are low —only 1.4 metric tons, versus 17.7 for the United States —the country is the world’s third-highest emitter of greenhouse gases,

responsible for over 5 percent of the world's annual total.¹ Energy efficiency can play a significant role in addressing India's growing energy challenge while reducing its emissions.

2 THE DEMAND-SIDE SOLUTION

In a report released last year, analysts with California's Lawrence Berkeley National Laboratory (LBNL) found that readily available energy efficient appliances and equipment could increase India's wealth and end its blackouts in less than five years. The report, "Eliminating Electricity Deficit Through Energy Efficiency in India: An Evaluation of Aggregate Economic and Carbon Benefits,"² measures the effects of shifting all new sales of several products —such as light bulbs, refrigerators, fans, air conditioners, televisions, agricultural pumps, and industrial motors —to the most energy efficient options.

The report analyzes available data to determine the technical economic potential of such a shift; the actual benefits depend on how quickly Indian leaders enact policies that transform the market for these products. It shows that such a transition to energy efficiency could:

- Eliminate India's energy deficit by 2014
- Add approximately \$500 billion to its GDP between 2009 and 2017
- Reduce local air pollution, including emissions of sulfur dioxide and nitrogen oxides
- Prevent 65 million tons of carbon dioxide emissions by 2017

By 2020, the switch to such energy efficient products could add more than \$600 billion to India's GDP and avoid 333 million tons of CO₂ emissions.

"What the report shows is that reducing emissions would benefit the economy," says Chinmaya Acharya, head of power demand-side management at the Shakti Sustainable Energy Foundation in New Delhi. "More companies would have access to electricity and could then increase their output significantly."

The LBNL study has found that investing in efficient devices would save \$900 million over eight years, compared with a business-as-usual approach focused solely on expanding the electricity supply. The main economic benefit, however —the half- trillion-dollar bonus —derives from the surge of business output that is possible when power shortages are eliminated.

Acharya points out that the same measures that would save money, increase productivity, and prevent blackouts would also reduce local air pollution and improve public health. "There is no downside to pursuing energy efficiency as a matter of energy, economic, and environmental policy," he says. "And India is quite committed to pursuing these options

¹ U.S. Energy information Administration, international Energy Statistics, 2009.
<http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8>

² Jayant Sathaye and Arjun P. Gupta, April 2010.
<http://ies.lbl.gov/drupal.files/ies.lbl.gov.sandbox/3381E.pdf>

" Energy efficiency is the fastest, cheapest way to increase energy supplies while reducing pollution."

LBNL's analysis has been well received in government and NGO circles. But the report stops short of providing a plan for implementation, and many stakeholders have asked how they could realize this potential. One answer to that question focuses on a shift to efficient appliances, the source of much of the energy savings identified in the report. (Similar efforts could also spur a transition to more-efficient industrial motors, water pumps, and other processes.)

The proven solution, one that India's leaders are actively pursuing, is to adopt efficiency standards and labels to reduce the energy used by common electric appliances. In addition, energy efficiency experts from within India and beyond are collaborating to expand such efforts, both domestically and internationally.

3 MAKING EFFICIENCY THE STANDARD: A Look At Appliances

In 2001 India created a high-level agency called the Bureau of Energy Efficiency (BEE), charged with reducing the energy intensity of the country's economy. The formation of BEE was a turning point in establishing a national mandate for energy efficiency. Another milestone was the 2008 passage of India's National Action Plan for Climate Change, which includes a "national mission on enhanced energy efficiency" requiring market-based measures to promote energy efficiency.

BEE quickly targeted some of the most ubiquitous electric appliances because the energy used by similar appliances can vary wildly by manufacturer and even by region. To help consumers choose the less wasteful products, BEE launched a voluntary appliance-labeling program in 2006 that identifies the energy these products use.

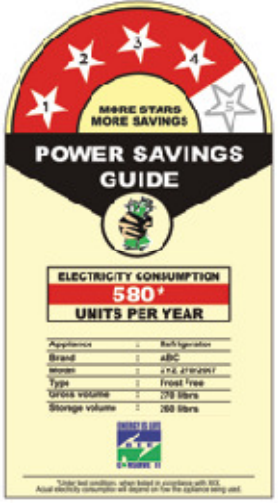
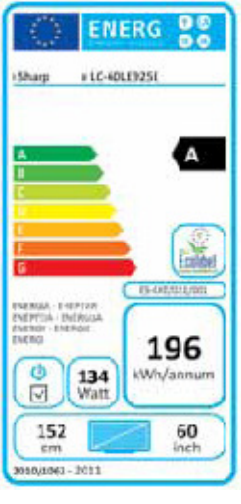

By 2009 manufacturers were voluntarily labeling 75 percent of refrigerators and 50 percent of air conditioners—a sign that efficiency was becoming a selling point. Ajay Mathur, BEE's director general, told an audience at LBNL in the spring of 2010 that healthy sales of those products sent "an unambiguous signal to manufacturers that people are willing to pay more for energy efficient products."

4 WHAT'S IN AN ENERGY LABEL

Labeling became mandatory in 2010 for four products: frost-free refrigerators, room air conditioners, tubular fluorescent lights, and distribution transformers. These products must achieve the mandatory minimum energy performance standard, BEE's one-star rating. Overall, BEE says, its efforts have reduced electricity demand by 4,700 megawatts since 2007, equivalent to the output of several coal-fired power plants. As in many countries, however, such progress is dwarfed by the enormous remaining potential.

Using their complementary skills and experience, Prayas Energy Group, a think tank and advocacy organization based in Pune, India, and LBNL have been researching ways that India's leaders can accelerate this progress and capture more of the "low-hanging fruit" of energy

efficiency. As they look for appropriate strategies, a primary theme has emerged: Keep it simple. Complicated programs are less likely to succeed.

		
<p style="text-align: center;">India</p>	<p style="text-align: center;">European Union</p>	<p style="text-align: center;">United States</p>
<ol style="list-style-type: none"> 1. The highlighted stars indicate the relative efficiency of the appliance. 2. The average amount of electricity used by the appliance in a year. 3. The make, model, size, and key features of the appliance. 	<ol style="list-style-type: none"> 1. The make and model. 2. The energy rating ranges from A, the most energy efficient, to G, the least efficient. 3. Additional information about the appliance's energy use. 	<ol style="list-style-type: none"> 1. The make, model, size, and key features of the appliance. 2. The estimated cost to run the appliance for a year; the range shows costs for similar appliances. 3. An estimate of how much electricity the appliance uses in a year. 4. Energy Star logo identifies products that use less energy than standard models.

THE VIRTUOUS CYCLE OF STANDARDS, LABELS, AND INCENTIVES

By Christine Egan, executive director, and Frank Klinckenberg, technical director, Collaborative Labeling and Appliance Standards Program

Scaled up globally, energy efficiency would cost 2 cents to 5 cents per kilowatt-hour saved, making it a fraction of the cost of clean energy from other sources.

Shifting to energy efficient technologies makes so much economic sense that it might appear that governments could sit back and watch the “negawatts,” or energy savings, grow. But several roadblocks can hinder the market penetration of energy efficient products. In some cases, these products aren’t available to consumers; in others, consumers don’t understand their benefits or can’t afford the higher up-front costs. Businesses must sometimes be convinced that investments in efficient new equipment and processes will benefit their bottom line. Appliance manufacturers want proof that customers will buy these new products, in order to justify the time and expense of retooling their manufacturing lines.

For all of these reasons, government programs are needed to nudge the market. Most effective programs are a combination of “push” and “pull,” or carrot and stick.

The carrot: Energy labels, incentives, advertising, investments in R&D, and awards for high-performing products all pull manufacturers and consumers to shift to energy efficient options.

The stick: Minimum energy performance standards push manufacturers to produce energy efficient goods.

In a balanced policy mix, energy performance standards are the primary policy because they mandate that products use less energy. Labels are secondary, because they encourage — but don’t guarantee — energy savings. Incentives come third, given their relatively high cost.

Standards have a unique benefit: They require that all products on the market are energy efficient. They are typically set at levels that are cost-effective for end users, often resulting in substantial financial savings for individual and business consumers.

Energy Labels supplement standards, educating consumers about the benefits of efficient products and enabling those who want to invest in more-efficient choices to do so. **Incentives** can build on the foundations laid by standards and labels by promoting the most efficient products, especially if they are not yet cost-effective for the average user. This then speeds the transformation of the market toward more energy efficient products. As the cost of these products goes down (through streamlined production and economies of scale) incentives can be phased out. The efficiency gains can then be cemented by more-ambitious standards, in a virtuous cycle of improvement.

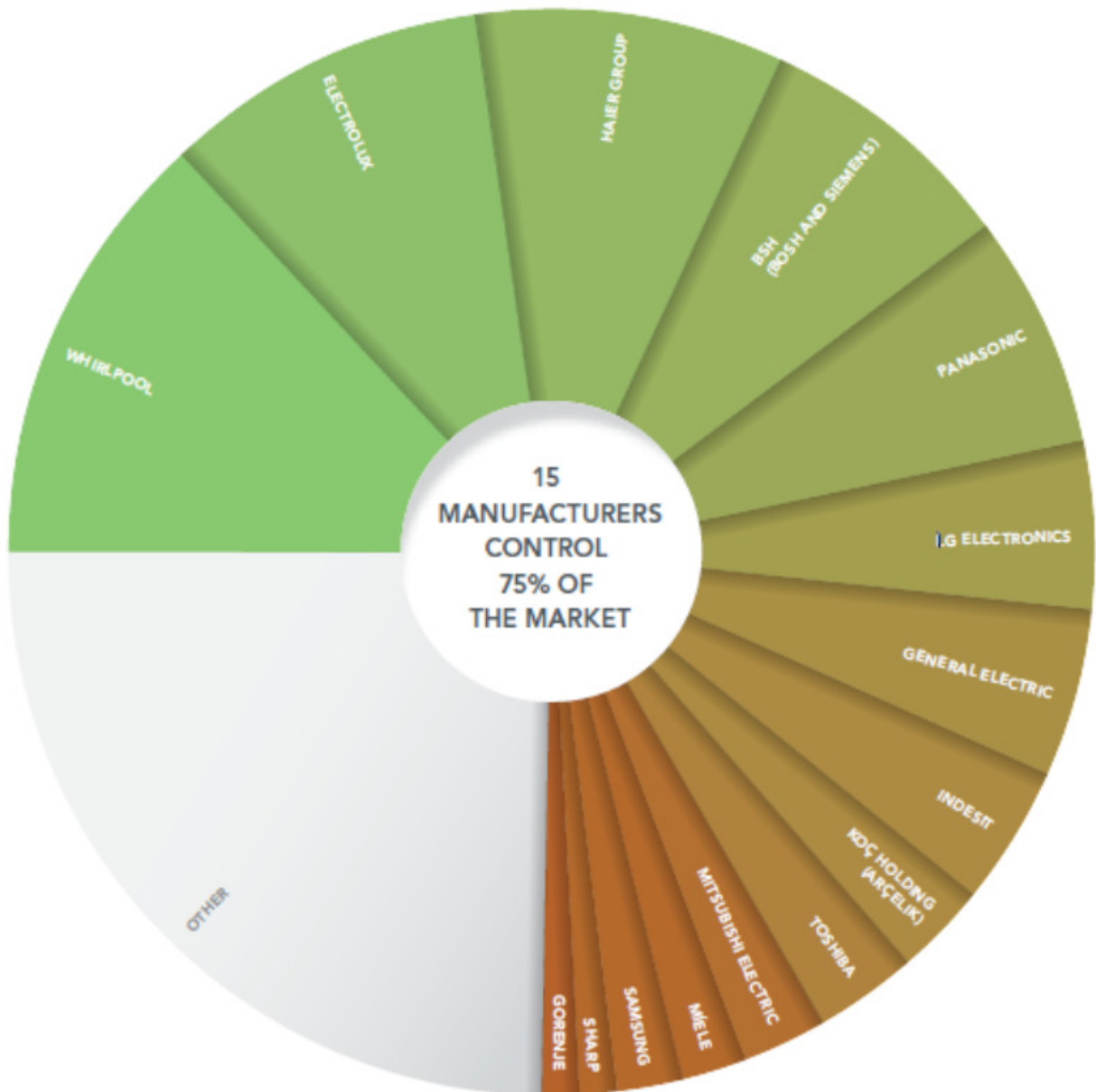
5 A GLOBALIZED APPLIANCE MARKET, A Global Opportunity

In the past, energy efficiency projects in India have involved “downstream interventions,” in which public electric utilities offer rebates and incentives to customers to get them to purchase more-efficient goods. More recently, Prayas has been working with LBNL to promote a simpler, less costly approach: moving the incentives upstream to a few dozen manufacturers, rather than trying to reach millions of individual customers.

In addition, expanding the geographic coverage of incentive programs can realize further gains in energy efficiency. Although appliance standards and regulations vary from country to country—and even from state to state—the number of manufacturers serving those varied markets has dropped over the past few years as appliance manufacturing has globalized. Just 15 manufacturers are responsible for 75 percent of the world’s production of “white goods” such as refrigerators and air conditioners; five manufacturers produce 60 percent of the world’s TVs.

Despite this consolidation, the efficiency of products varies widely by region. But if countries work together, they can ensure that they don’t miss out on energy-saving advances available elsewhere. Because production is highly concentrated, countries can share analysis of appliances’ energy use. Coordinated programs targeted at the top producers would allow manufacturers, including makers of component technologies, to plan better, lower costs, and find wider markets for their top products.

MARKET CONCENTRATION OF APPLIANCE MANUFACTURERS



Source: the Freedonia Group, inc.

HOW TO SCALE UP INCENTIVES

By Girish Sant, coordinator, Prayas Energy Group

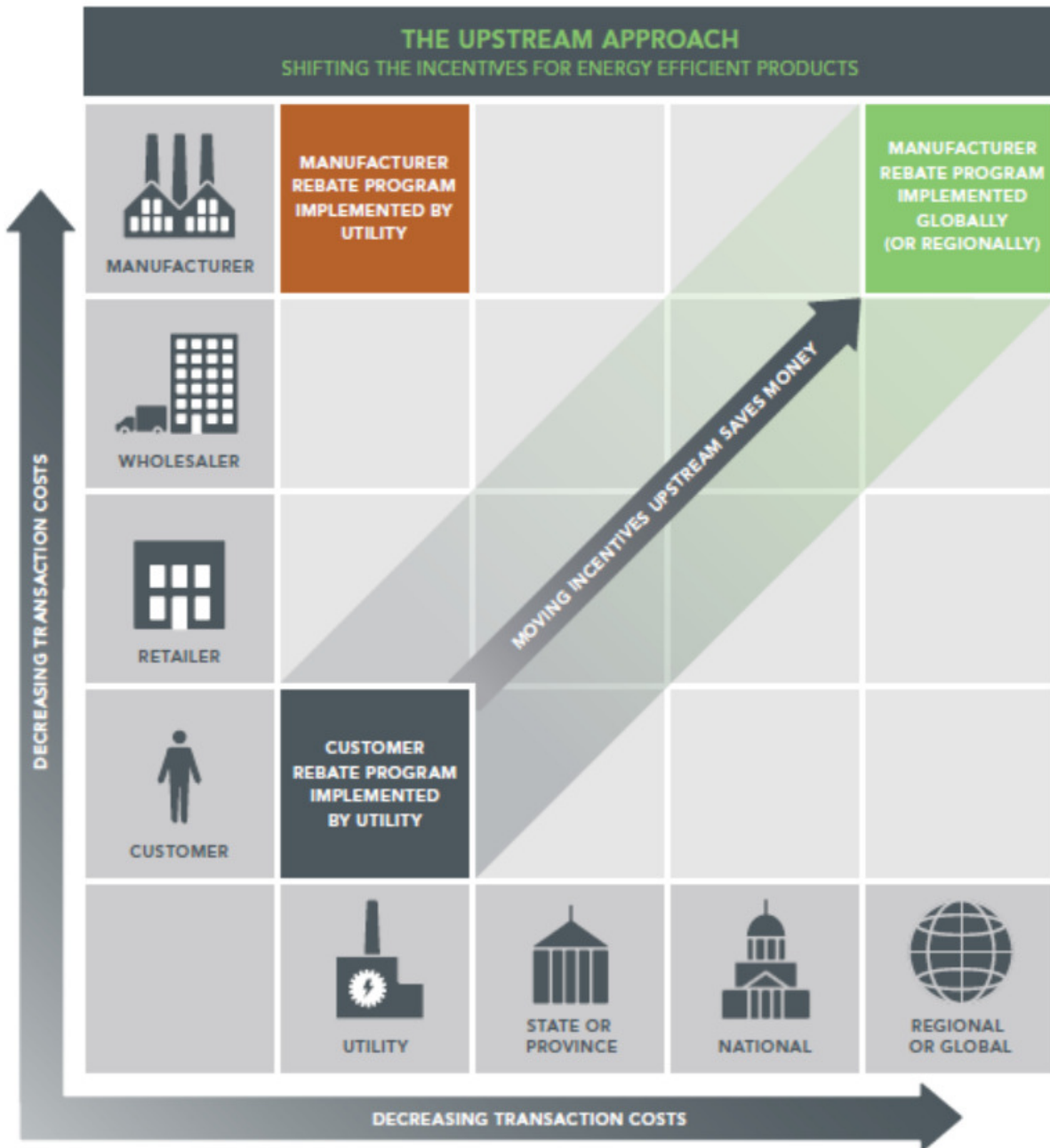
Shifting the incentives for energy efficient products from consumers to manufacturers has several advantages. This upstream approach:

- Reduces transaction costs: Administering incentive payments to a small group of manufacturers costs less than dealing with millions of individual consumers.
- Lowers incentive cost: Because they're applied to the manufacturers' costs, before manufacturer and retailer markups and sales taxes are added, the incentives can be smaller.
- saves consumers money: By lowering the manufacturers' costs, the incentives also reduce manufacturer and retailer markups and sales tax, resulting in greater savings for the customer.
- Covers more of the market: It's easier to influence a handful of manufacturers than to change the behavior of millions of consumers.

The size of the manufacturer's incentive can be linked to the cost of retooling, increased material costs, and the number of products sold. Once sales reach a certain volume, manufacturers' costs go down, and incentives are no longer necessary. Then the energy savings can be locked in by stronger standards.

Another way to improve efficiency programs is to expand their reach. Instead of regulating appliances utility by utility, a government could apply the same model to a broader geographic area —many states or even the whole nation. The air conditioners for sale in Mumbai are similar to those available in Chennai; there's no reason for the utilities in those cities to have different programs.

- Despite their benefits, these upstream, national programs do face barriers:
- Capacity: Countries often have limited capacity to implement such programs.
- scale: Previous efforts in India and most other countries involved relatively small-scale programs, so manufacturers may be leery of shifting their entire product line to efficient models until they perceive the benefits of a national program.
- Jurisdiction: Because many utilities are regulated at the state level, it may be difficult to get them all to agree on a nationwide program.
- Cost obligation: It makes economic sense for electricity consumers to pay for incentives, but given the dispersed oversight of the utilities, it may be simpler for the government to cover the initial costs.



6 SAVING ENERGY BY SHARING WHAT WORKS

In 2009 Prayas and LBNL developed the idea for a multistate Indian program of standardized, upstream interventions. Now known as the Super Efficient Equipment Programme (SEEP), it has won preliminary approval from Indian officials; the implementation details are being hammered out. One of the first steps will likely be to offer manufacturers incentives to produce more-efficient ceiling fans, with similar programs for lighting, televisions, and refrigerators to follow.

Coordinated, or “harmonized,” efficiency standards can offer manufacturers a bigger market for their best products.

The long-range goal is to convince the appliance industry to make products that are 50 percent more efficient than those available today. “That’s easier said than done,” BEE’s Mathur told LBNL in early 2010. “A lot of corners need to be rounded, but this is something that we have now moved to the regulators, and the regulators have agreed to go ahead.” Coordinated, or “harmonized,” efficiency standards can offer manufacturers a bigger market for their best products.

In the next three to five years, supporters of India’s energy efficiency efforts hope to go even further, establishing mandatory national energy performance standards. Rather than relying on labels and incentives to change behavior, such a legal mandate would provide quantitative energy savings targets that regulators and utilities would have to reach.

A superefficient device features the most energy efficient commercially available technology. Superefficient refrigerators, for example, typically have vacuum-insulated panels and a compressor with a variable-speed

Appliance and energy experts around the world are exploring ways to encourage these efforts and capture additional opportunities. In 2009, Rick Duke, currently the deputy assistant secretary for climate policy at the U.S. Department of Energy (DOE), proposed a coordinated national program of incentives called Super Efficient Appliance Deployment.³ At the U.N. Climate Change Conference in Copenhagen later that year, U.S. Secretary of Energy Steven Chu talked of transforming the appliance marketplace worldwide and introduced a Super-efficient Equipment and Appliance Deployment plan as part of his \$350 million Renewable and Efficiency Deployment Initiative. Then, at the July 2010 Clean Energy Ministerial in Washington, D.C., energy ministers from more than a dozen countries —representing 80 percent of the world’s energy consumption — officially launched an expanded Super-efficient Equipment and Appliance Deployment (SEAD) initiative. This international government initiative was organized by national ministries such as the DOE and BEE, with technical support from NGOs such as the Collaborative Labeling and Appliance Standards Program (CLASP) and Prayas Energy Group, and research laboratories including LBNL.

At the Clean Energy Ministerial, Chu underlined the program’s potential impact: “Many countries have stepped up to the plate. Many scientists and engineers today are realizing that this issue is so important it is perhaps the defining challenge of today.”

³ Natural Resources Defense Council, “kick-Starting Building Efficiency: A Policy Workplan for Maximizing the Economic Benefits of Energy Efficiency in Buildings,” January 2009. www.nrdc.org/globalWarming/cap2.0/files/kick.pdf

If all the major energy-consuming appliances sold from 2014 –2018 were 30% more efficient, the net savings would be about \$910 billion and 13 billion tons of CO₂ over the lifetime of the appliances.

SUPER-EFFICIENT EQUIPMENT AND APPLIANCE DEPLOYMENT (SEAD)

By Rick Duke, Deputy Assistant Secretary for Climate Policy, U.S. Department of Energy

By sharing information and expertise among participants, the SEAD program aims to transform the world market for appliances. The DOE is actively collaborating with different governments to advance this initiative, using multiple approaches to promote energy efficient appliances and equipment.

SEAD partners are working together to pull energy efficient products into the market by cooperating on incentives, procurement, awards, and R&D investments; push energy-guzzling products out by bolstering minimum efficiency standards; and strengthen energy efficiency programs by coordinating technical work. The program will:

- Focus initially on television and lighting, which account for about 15 percent of household electricity use worldwide
- Establish SEAD Global Efficiency Awards to highlight the world's most efficient appliances
- Strengthen and expand efficiency standards, labeling, and incentive programs throughout the world
- Develop policy toolkits for countries that want them, including a Municipal Advanced Street Lighting Policymaker Toolkit, which will describe successful moves to solid-state and other advanced street lighting in Kolkata (formerly Calcutta), Seattle, and Toronto

SEAD participants include Australia, Canada, the European Commission, France, Germany, India, Japan, Mexico, Russia, South Africa, South Korea, Sweden, the United Kingdom, and the United States.

What can SEAD achieve? Financial incentive programs for lighting, televisions, refrigerators, air conditioners, and electronics could obviate the need for about 300 midsize power plants by 2030. With broader global collaboration to improve appliance efficiency, it could stave off demand for some 1,300 plants by 2030.^a If all the refrigerators sold from 2014 to 2018 were about 30 percent more efficient than current models, the world would save about \$91 billion and 1.3 gigatons of CO₂ over the refrigerators' lifetime — equivalent to taking almost 250 million cars off the road for a year. If expanded to sales of all major energy-consuming appliances, the same boost in efficiency would save about 10 times more money and CO₂ emissions.^b

a. "Fact Sheet: Super-Efficient Equipment And Appliance Deployment Initiative," July 2010. www.energy.gov/news/documents/SEAD-Fact-Sheet.pdf

b. Amol Phadke, Girish Sant, ranjit Bharvirkar, Bob Lieberman, and Jayant Sathaye, "Summary: Accelerating Super-efficient Equipment and Appliances Deployment in a Globalized Market through Multi-country coordination: Analysis of the SEAD Program," December 2009. <http://bit.ly/g30ftu>

Both SEAD and SEEP aim to rapidly accelerate deployment of superefficient equipment and appliances. Whereas SEEP is a national program that will use specific incentives and regulations, the global SEAD program is mainly an information-sharing program. But such global information sharing could go quite far, including initiating specific working groups to coordinate across countries. It could also:

- Enable the best products to be sold worldwide more easily, offering manufacturers a bigger market
- harmonize the test procedures regulators use to measure a product's efficiency
- Coordinate the requirements for labels and minimum efficiency standards
- Embolden participating countries to enact more stringent standards than they could manage on their own

7 FROM APPLIANCES TO ALLIANCES

A decade ago, striving for energy efficiency was still a marginalized endeavor. Reducing the energy appetites of ceiling fans and refrigerators wasn't taken as seriously as beefing up the energy supply, though both could achieve the same goal. But that's changing, as governments and utilities take a new look at energy efficiency as a faster, cheaper solution than investing in new supplies.

While there's already momentum —particularly among nations enacting efficiency standards, labels, and incentives —the SEAD program is giving efficiency another big push and is helping policymakers and technical experts collaborate across national boundaries.

This international teamwork allows organizations to approach problems from a variety of angles and devise solutions that work for consumers and manufacturers. Local institutions are tapping into a network of technical experts to design effective policies, based on global best practices and tailored to suit local conditions. With additional effort, these proven policies could be propagated worldwide. It's the kind of bold new enterprise that could significantly reduce greenhouse gas emissions— and put India and other nations that much closer to the hundred billion dollar bonus.

Moreover, initiatives like SEEP and SEAD offer evidence of real progress in the effort to head off the most damaging effects of climate change. Despite the limited progress at recent climate talks in Copenhagen and Cancún, countries can achieve significant greenhouse gas savings through focused, proven efforts to improve energy efficiency at home.

The ClimateWorks Foundation supports public policies that prevent dangerous climate change and promote global prosperity. ClimateWorks' goal is to limit annual global greenhouse gas emissions to 44 billion metric tons by the year 2020 (25 percent below business-as-usual projections) and 35 billion metric tons by the year 2030 (50 percent below projections). These ambitious targets require the immediate and widespread adoption of smart energy and land use policies. ClimateWorks and its network of affiliated organizations promote these policies in the regions and sectors responsible for most greenhouse gas emissions.