



*Empowered lives.
Resilient nations.*



GAMES ABOUT CHANGE

**AN ACTIVITY BOOK HIGHLIGHTING THE IMPACTS OF
ENERGY • INFRASTRUCTURE • TRANSPORT • TECHNOLOGY PROJECTS
IN ASIA AND THE PACIFIC**

WHY WE DID IT THIS WAY

We wanted to make reading about solar concentrated heating systems (and other related technologies) fun.

FUN? YOU ASK. YES.

Poverty reduction sits at the core of the United Nations Development Programme's mission. But we take the well-being of the planet equally seriously. We are concerned about the poverty of resources as well as the state of financial poverty we are passing on to our children. We know that household poverty goes hand in hand with energy poverty—and that sustainable energy is essential for sustainable development. To help families move out of poverty while protecting the planet from an impoverishment of resources, we need to learn to live more efficiently. We need to learn different ways of doing basic things, like the construction of buildings and the type of cooking equipment we use.

Sometimes the technology and all the technical talk of change seem overwhelming. Yet, we all need to learn new things—and we need to make huge changes—if our planet is going to survive us.

This book of impact stories combined with games aims to help people understand some of the terminology and the simple changes we can make now in the way we use energy resources that could make a healthier world for our children. We are using these games to tell you about UNDP's work and how this work is changing government policies and the decisions of energy end users (industries and households). We even hope you will play these games with children so they can remind you of the importance of what needs to be done, and so you can have a little fun while learning something new.



Adriana Dinu
Executive Coordinator
UNDP Global Environmental Finance



Haoliang Xu
UNDP Assistant Administrator and Director of
the Regional Bureau for Asia and the Pacific

UNDP partners with people at all levels of society to help build nations that can withstand crisis and drive and sustain the kind of growth that improves the quality of life for everyone. In more than 170 countries and territories, we offer a global perspective and local insight to help empower lives and build resilient nations. www.undp.org

The Global Environment Facility (GEF) was established on the eve of the 1992 Rio Earth Summit to help tackle our planet's most pressing environmental problems. Since then, the GEF has provided US\$14.5 billion in grants and mobilized \$75.4 billion in additional financing for almost 4,000 projects. The GEF has become an international partnership of 183 countries, international institutions, civil society organizations and private sector to address global environmental issues. www.thegef.org



CONNECTING THE DOTS

Alleviating poverty through access to energy, infrastructure, transport and technology

Building a better life. It is possibly the single most universal ambition connecting all of us. But it has implications for households, communities, cities, nations and, ultimately, the planet. Our built world—the things we create—can help overcome poverty and social injustice, or it can exacerbate the inequities.

Poverty is now recognized as encompassing income as well as energy, nutrition and knowledge poverty

and even the poverty of natural resources driven by degradation and the impacts of climate change.¹ The presence of one form of poverty can mean the presence of many other forms of poverty. It takes knowledge, experience and resources for people to build a better life for themselves. The United Nations Development Programme (UNDP) works to connect countries to opportunities that build their ability to reduce poverty and inequality through sustainable development.

Which is why UNDP includes the environment in its programming. Projects that address biodiversity loss, ecosystem degradation or climate change, for example, also address critical development issues, such as food security, poor health and income poverty. One issue cannot be sustainably tackled without investing in the other.² Climate change mitigation is central to these efforts. By supporting access to clean and affordable energy systems and services and promoting low-emission and climate-resilient urban

and transport infrastructure, UNDP is simultaneously supporting the eradication of poverty and a significant reduction in inequalities and the exclusion of millions of households. Sustainable development enables both the planet and people to thrive.

UNDP works with many partners on sustainable energy and climate change mitigation, including the Global Environment Facility (GEF). UNDP works with the GEF as an implementing agency to channel financing into developing countries to reduce environmental degradation while building better lives. The work we do contributes not only to achieving the ambitions of the Paris Agreement towards climate change mitigation but also towards achieving the Sustainable Development Goals. Sustainable energy and climate change mitigation have strong connections with poverty reduction, social progress, equity, enhanced resilience, economic growth and environmental protection.

At the global and regional levels, UNDP advocates for efficient and clean energy use as necessary for both the world's development and for poverty alleviation. Development that harms the environment can prolong the poverty of individuals.

Development thus needs to be healthy for people and the planet—people must be good for the planet so that the planet can be good for people. It's development karma—making sure that we all give what we want to get back. The UNDP sustainable energy portfolio spans more than 110 countries, with close to 260 sustainable energy projects representing around \$1 billion in grant financing and leveraging nearly \$6 billion in co-financing from the public and private sectors. Over the past 20 years, UNDP has mobilized around \$2 billion in grant financing for sustainable energy projects in addition to 4,000 community-level small grant projects, totalling more than \$130 million in grant financing.³

UNDP-GEF's work on sustainable, affordable and efficient energy services and climate change mitigation links with every one of the 17 Sustainable Development Goals, which nearly 200 countries agreed to in 2015 for achievement by 2030. These goals are intended to balance the growth needs of the global population with the environment's need for protection. For example, efficiency in transport or the production of goods means a heavy reduction of required energy and financial resources.

These types of transformations benefit the planet and thus all of us who will always depend on resources to sustain our lifestyle choices. But we all need to make adjustments in those choices—to more efficient and cleaner systems. So connecting the dots eventually goes full circle, benefiting everyone.

1. See UNDP, 2016, *Delivering Sustainable Energy in a Changing Climate Strategy Note on Sustainable Energy 2017–2021*, New York. | 2. See, for example, www.iea.org/topics/energypoverty/ www.iea.org/topics/energypoverty/; T. Addison, D. Hulme and R. Kanbur, eds, *Poverty Dynamics: Interdisciplinary Perspectives* (New York, Oxford University Press, 2009), pp. 85–89; M. Bielenia-Grajewska, "Attention Crash", in *Encyclopedia of Social Media and Politics*, K. Harvey, ed. (Thousand Oaks, California, Sage, 2014), pp. 882–884. | 3. Adrian Dinu, GEF Executive Coordinator, in *2015 Annual Performance Report* (New York, UNDP-Global Environment Finance Unit, 2016).

HOW WE WORK TO MAKE A DIFFERENCE

For nearly three decades, UNDP's global Energy, Infrastructure, Transport and Technology (EITT) team has worked to attract and direct public and private investment to help communities develop and sustainably use energy, climate-resilient infrastructure and low-carbon transport to overcome all forms of poverty while reducing dirty and dangerous emissions. That seems like a mouthful of ambition. But there is true change taking place.

Through the EITT projects, UNDP helps governments and agencies spot the barriers to reaching their targets for reducing emissions goals and making interventions attractive for investment. We help unscramble systems or find new technologies to put in place, with the training to know how it works best. We connect governments and agencies with funding sources and knowledge so they can build towards self-sufficiency.

We partner with different sectors of an economy to help them cross long-held boundaries and work together to build multidimensional projects that promote equity between the sexes, between geographical regions and between economic strata. And in the maze of climate change challenges, we help governments in the transformation of their energy sector to create employment and livelihood opportunities while delivering basic services. In nearly all project sites, the projects go beyond training and set up demonstration models to illustrate how new ideas would actually play out.

The EITT projects seek to transform energy and urban transport systems in developing countries—though market-based principles while

taking into account the needs of the poor and pay attention to gender equality and social inclusion by being affordable and fair. Through technical assistance, the projects help governments put in place the needed policy framework and regulatory environment. This then enables governments to overcome a range of technical, informational, financial and legal barriers that inhibit investment in or expansion of sustainable energy.⁴

This book features projects in Asia and the Pacific that began at various times over the past decade and vary in how they have impacted: Some directly improved household income and indirectly expanded children's education, women's empowerment, family health and thus national development. Some encouraged small-scale entrepreneurship while others helped large businesses cut costs while leaving a smaller carbon footprint. And some contributed towards governments achieving their clean energy goals and even their Sustainable Development Goals. Some have done all of the above.

Through a variety of simple games, this book highlights some of the EITT work on reducing poverty and greenhouse gas emissions by promoting energy access, renewable energy, energy efficiency, sustainable cities and clean energy transport across Asia and the Pacific.

Although only a sample of the tremendous transformation taking place, the stories showcase the work of the EITT projects and how they are changing lives and helping governments.

4. Based on UNDP, *Energizing Sustainable Framework* (New York, 2016).

**CHANGE A LIGHT, CHANGE A BRICK,
CHANGE A LANE, CHANGE THE PLANET**

**AND CHANGE
COUNTLESS LIVES**



OUR MOBILITY

To move out of poverty, most people need to move. Get somewhere. But the hustling and bustling to and from jobs, livelihoods, health care and markets for basic needs has created chaos on our roads and pollution above the fray.



In turn, that pollution is harming people, creating more need for health care and sending households into debt. Economies are dependent on, maybe even synonymous with, transport to provide access to raw materials, employees, suppliers, customers and consumers. But the transport sector accounts for 13 per cent of all greenhouse gas emissions and 23 per cent of energy-related emissions. Road transport is responsible for 74 per cent of all transport emissions globally; private cars account for a large portion of that.⁵

Unless the way we move through cities changes, experts⁶ predict a 120 per cent growth of global transport emissions by 2050 (from 2000 levels). Transport-related CO₂ emissions are expected to increase 57 per cent worldwide between 2005 and 2030.

Even though the largest contribution comes from transport in industrialized countries, much of the growth in emissions will come from developing countries (approximately 80 per cent of the predicted increase). There is a need for urban centres to reduce the number of private vehicles with single or even double occupants. Public transport that is clean, efficient, reliable and safe is considered integral to a country's sustainable development goals. Giving people access to energy-efficient mass transit will help them move to where they need to go without impacting their health and will add to the reduction of dangerous emissions. Governments with the private sector need to provide modern, clean, safe and reliable mass transit options. But individuals also need to shift away from dependency on their automobiles. Some cities are experimenting with different approaches to encourage people to reduce the number of cars on the road through car-sharing or bicycle-sharing schemes.

**PROJECT
IMPACT**

BANGLADESH | BHUTAN | CHINA | FIJI | INDIA | INDONESIA | MALAYSIA | MALDIVES
MARSHAL ISLANDS | MONGOLIA | NEPAL | PAKISTAN | PALAU | PHILIPPINES | SAMOA | VIET NAM

5. G. Jennings, *A Guide to Low-Carbon Transport* (Durban, GEF, UNDP, Government of South Africa, 2011). | 6. OECD, 2011, in *ibid.*

FIND THE BENEFICIARIES OF THIS CHANGE...



...SOME OF THE PEOPLE TO BE FOUND



“It brought a huge difference to my life.”

In Pakistan, Nimra Javed often was late to class and uncomfortable in the crowded Hiace van she took from home to National Defence University in Islamabad, where she was studying management and leadership sciences. Some days the wait was unbearable or she could not get a seat and missed a class altogether. But it was her only option because she could not afford a taxi. Nor was it a comfortable option because although the van had a women’s section, men were allowed to sit there if no other seat was available. If the women’s section was full, Nimra would have to sit next to a man, something not encouraged in her culture. Then in 2014 a transit miracle appeared on the road: The Rawalpindi-Islamabad Metro Bus Service. “It brought a huge difference to my life,” says Nimra. “There is a large number of buses available and every 5 minutes a bus comes to my stop—I do not wait for long. It is comfortable in that it has a separate section dedicated for women so I can travel in a dignified manner.” Plus, with a fare lower than the vans charge, Nimra has cut her monthly travel expenses in half. The Metro Bus Service is a product of a UNDP-GEF PAKSTRAN Project with the Government of Pakistan to also help reduce vehicle emissions. Through the window over the year that she has been riding the new bus, Nimra has seen traffic congestion reduce.



“It has been so convenient that now I am fully dependent on the bus service.”

In India, Dr. Humera Aiman feared driving in Mysore’s traffic to and from her work in hospital and relied on a brother, which wasn’t always reliable, or a car service that was not safe in the evenings. After an LED sign at a bus stop caught her eye with a phone number for information on routes of the new Mysore ITS (intelligent transport system), she learned she could send an SMS message for what has turned out to be dependable arrival time of the next bus near her work or home. “It has been so convenient that now I am fully dependent on the bus service,” says the doctor, especially with luxury buses that are now available she adds. The UNDP-GEF Sustainable Urban Transport Project helped Mysore set up the bus system. “It makes travel so easy and safe in public transport. It is economical also; before I used to spend around 180 rupees for daily commuting and now I hardly spend 30 rupees.”



“Most people feel better off, and they feel they have a better life with this bus system.”

In Pakistan, traffic police officer Jamil Ahmad finds less chaos and less pressure in the streets on the special times he is called out to the road these days. “My job is easier,” he says. “I have been a police officer involved in traffic management in the cities and highways for the past two decades. I know about changes in traffic flows. I know about changes in traffic management. I know about changes in road safety. This Metro Bus system has made a great impact on your life,” he tells people who question whether the government priority to tackle traffic congestion in Islamabad and Rawalpindi was worth it. He says traffic violations and traffic crime rates have gone down with the massive reduction in vehicles on the road since the Metro Bus system was instituted through the UNDP-GEFPAKSTRAN Project. “Most people feel better off, and they feel they have a better life with this bus system. They are feeling comfort in their life, feeling advancement in their life.” Ahmed refers to a commuter he knows who has saved \$200 a month by relying on the bus rather than the previous private vanservice. Since he first participated in a PAKSTRAN training of traffic wardens city traffic police officers, government transport officers, motor vehicle examiners and bus drivers on traffic management, Ahmed has joined the project to lecture on sustainable transport with university students. “We are telling them that the increase of vehicles is impacting on the environment as well as on our social and economic values. It is impacting our lives.”

TRACK DOWN ENERGY EFFICIENCIES

Find the 7 bold words from the story

C	I	M	L	K	J	H	G	M	D	N	M	N	O	R	C	I	R	L	K	J	H	G	T
I	U	Y	T	R	E	C	O	M	M	U	T	E	R	S	I	U	A	T	R	E	W	Q	E
L	I	H	O	O	D	H	J	N	L	I	L	I	V	E	L	I	O	O	D	H	J	C	
G	A	S	E	S	J	H	G	S	D	X	Z	X	C	V	B	N	L	L	K	J	H	G	H
I	X	F	O	L	D	W	Q	O	T	A	S	A	P	S	I	X	W	O	L	D	W	Q	N
O	P	O	W	E	E	N	G	I	N	E	E	R	S	R	O	P	A	W	E	R	H	J	O
C	X	E	N	V	I	N	M	E	N	T	M	N	B	V	C	X	Y	L	K	J	H	G	L
E	N	E	R	G	Y	W	Q	W	T	A	S	A	P	O	E	N	S	R	G	Y	W	Q	O
I	R	R	I	G	A	T	I	O	N	Y	L	I	F	T	I	R	R	I	G	A	T	I	G
R	E	W	O	P	O	R	D	Y	H	X	Z	X	C	V	R	E	W	O	P	O	R	D	Y

TRACKING DOWN ENERGY INEFFICIENCIES IN INDIA

He went to Barcelona, Madrid and London to look at trains and how other countries handle mass transit. He came home, to India, knowing what was possible. He also came back aware of how 8.4 billion **commuters**—23 million people daily—could help make the Indian air a bit cleaner and their country’s resources stretch further. And he knew how the government-owned Indian Railways could make a difference.

As the Director of Energy Management within the Research, Designs and Standards Organization (RDSO) for Indian **Railways**, one of the world’s largest rail networks at 115,000 km of track over a route of 65,436 km, A. K. Maurya issues RDSO’s directives to all 8,495 stations across the country. Based on RDSO guidelines, Indian Railways has embarked on an ambitious plan to replace highly inefficient incandescent lamps with compact fluorescent lamps or LED bulbs. It is also switching to locomotives that are equipped with a three-phase propulsion system that can save about 30 per cent of electrical energy due to the use of regenerative brakes instead of mechanical brakes. Regular energy audits conducted on railway installations help detect energy wastage.

Maurya says he learned through UNDP-GEF’s Improving Energy Efficiency in Indian Railways System Project of the “immense possibility” of energy savings due to technological advancements. “**Technology** has provided us many options. If we are aware of what to choose, we can make a significant impact in the way we use energy and save a tremendous amount of energy,” says Maurya.

The vast network, which also moves an around 1 billion tonnes of **freight** a year, consumed around 17.5 billion kWh during 2014–2015, or around 2 per cent of the electricity generated in the country. But only about 40 per cent, or 26,000 km, of track has been electrified thus far. With traffic growth estimated at 8–9 per cent in the next decade, the projected electricity demand is estimated to grow at about 9 per cent annually.

Because of the railways’ massive energy requirement, the Government wanted to launch a long-term Energy Efficiency and Conservation Programme (2010–2032) to reduce energy consumption by 10 per cent, with an overall goal to also reduce emissions of greenhouse **gases** by 8.5 per cent. It will contribute towards attaining national targets on energy efficiency.

UNDP-GEF helped the Government develop guidelines, manuals and procedures for training on conducting an energy audit of the energy-intensive operations (production units, traction substations, workshops, production units, maintenance depots and buildings), with which the Indian Railways trained its **engineers**. Energy auditing is the inspection, survey and analysis of energy flows for the purpose of energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the outputs. UNDP-GEF helped set up laboratories for testing equipment and in developing energy management software, with which the Indian Railways has just begun to collect data from all parts of the country for its diesel and electric trains.

“My role was to increase awareness about the necessity of energy savings among the Railways employees who maintain the electrical system and provide the power supply to other uses,” says Maurya. Employed by Indian Railways for 16 years as an electrical engineer, Maurya says the UNDP-GEF project “certainly enlarged my perspective”. Energy efficiency, he says, is at the core of all decision-making now. “We feel it is our responsibility. If you save energy, you are helping the nation grow and helping people in far-flung areas who have no electricity. Energy efficiency helps us to protect our environment. The more efficient we are, the more we are saving our **environment** from global warming.”

PROJECT IMPACT The efficiency in energy use allowed the Indian railways to make the transport system more comfortable, and easier and safer for commuters. Escalators, elevators, better lighting, better ventilation and improved air conditioning without increasing its energy consumption.

HOW MUCH CAN THE TRUCK HAUL

To follow weight rules and be efficient?

An importer rented a heavy-duty dual compartment truck to transport imported equipment to a buyer. There are 3 types of equipment to transport each at different weights and sizes.

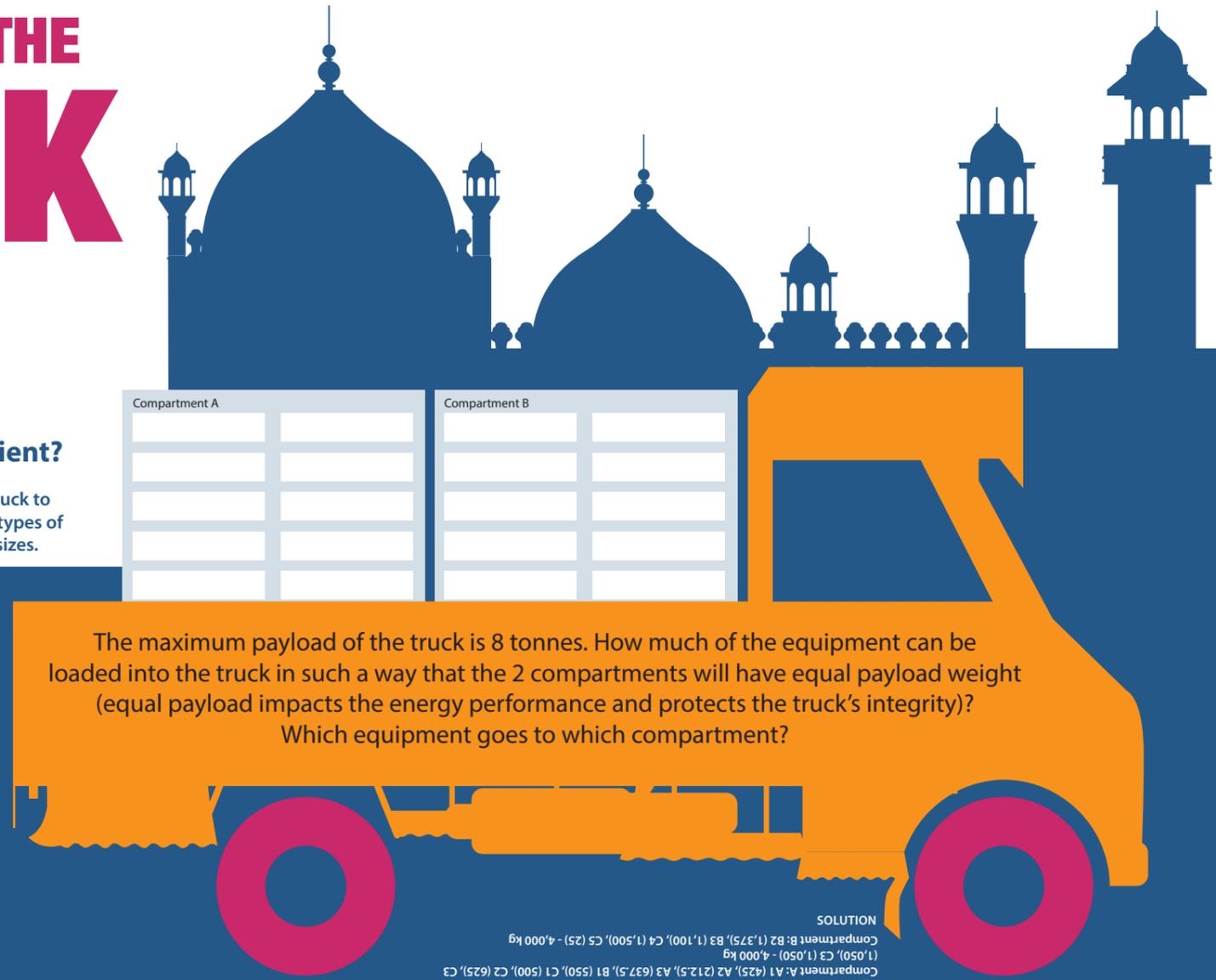
The following are the standard weight of the basic model of each type of equipment.

Type and standard weight (kg)
A: 425kg , B: 550 kg , C: 500 kg

The following lists all equipment to transport and their corresponding weight.

Equipment number and weight (% of standard)

Type A	Type B	Type C
A1: 100%	B1: 100%	C1: 100%
A2: 50%	B2: 250%	C2: 125%
A3: 150%	B3: 200%	C3: 210%
A4: 120%		C4: 300%
		C5: 5%



The maximum payload of the truck is 8 tonnes. How much of the equipment can be loaded into the truck in such a way that the 2 compartments will have equal payload weight (equal payload impacts the energy performance and protects the truck's integrity)? Which equipment goes to which compartment?

SOLUTION
Compartment A: A1 (425), A2 (212.5), A3 (637.5), B1 (550), C1 (500), C2 (625), C3 (1,050), C3 (1,050) - 4,000 kg
Compartment B: B2 (1,375), B3 (1,100), C4 (1,500), C5 (25) - 4,000 kg

TRANSPORT IS THE BACKBONE OF PAKISTAN'S ECONOMY

"Oh, you mean the mafia doesn't have complete control over the country's transport?," joked the General Secretary of the Supreme Council of All Pakistan Transporters, M. Hanif Khan Marwat, after he joined a UNDP-GEF workshop on the engineering science for improving transport efficiency. In a more serious tone during that training, he pointed out the lifeblood nature of transport and its moving of people and products from one place to another: "Transport is the backbone of our economy. All the industries are dependent on transport."

After years of battling the Government, especially on heavy taxation, Marwat no longer thinks of the Government as the "opposition". After sitting at the same table with government officials in workshop after workshop organized by the UNDP-GEF Pakistan Sustainable Transport Project to arrive at a trucking policy, Marwat feels the once-foes are now partners. He recognizes that his industry is fraught with problems. Beginning with the lack of literacy among

many transport drivers and their disregard for maximum weight and speed limits to the lack of truck maintenance, and the industry's inability to compete with more professionalized vehicles from neighbouring countries and to the corruption within weigh stations, Marwat knows there is drastic need for improvement.

He is optimistic that change is coming. He knows it is necessary. The excess loads are destroying roads and drivers are not safe. But through the UNDP-GEF workshops, his industry and government officials have discussed the problem, and both sides know what needs to change and both sides have committed to changing for the sake of safety, the economy and the environment. "With this trucking policy, we will solve so many problems. It's good for our side and good for the government, too."

In particular, Marwat sees that the trucking policy will help strengthen the transport sector to compete with

forthcoming competition for the movement of cargo across the region. "We are a poor country with a poor transport system and this competition we can't face," he says referring to the China-Pakistan economic corridor development, which is a mass of projects to expand and upgrade Pakistani infrastructure and broaden the economic links between Pakistan and China. Pakistani officials predict that the project will result in the creation of upwards of 700,000 jobs between 2015 and 2030 and add 2–2.5 per centage points to the country's annual economic growth. Chinese trucks as well as trucks from the Islamic Republic of Iran and India are more modern, better running and better for the environment. Without Government investment, Pakistan's trucking industry cannot modernize. Without UNDP-GEF support, he says, agreement on this need would have been a long hard drive that never arrived.



The project helped prepare policies on energy efficiency in truck freight transport in Pakistan, beginning with

- assistance on developing a trucking policy for the country,
- applicable energy-efficiency options for truck freight transport,
- guidelines and technical standards for energy efficiency in truck freight transport and
- rules and regulations to enforce the policies and technical standards.

7. Reporting from PAKSTRAN Newsletter.

TRANSPORT IN THE CROSS HAIRS

Looking through a sniper rifle scope, five different modes of transport can be seen, which form the cross pattern:



Each mode of transport is found within this pattern in the formation below. Time yourself in finding this pattern.



RATE YOUR PERFORMANCE
 Less than a minute: You are a very spot-on person.
 Up to 2 minutes: You are quicker to locate things than most.
 Up to 3 minutes: You are in pace with the pack.
 More than 3 minutes: You need a ride to the eye doctor.



LEARNING TO QUESTION WHAT IS GOOD FOR THE PEOPLE, THE ENVIRONMENT AND THE ECONOMY IN INDIA

What has three wheels and at least two dozen arms and legs? The obvious answer (to someone in India) is an auto rickshaw in India's rush-hour traffic. But because there are heaps of them scuttling along the congested roads, with young office workers clinging to the vinyl rooftops or standing on a poor excuse for a bumper once the tiny space inside is stuffed, and because they still pollute despite the use of natural gas, the question represents a dilemma: Is it possible for the country to provide transportation that is affordable, safe and good for the environment?

This type of question is becoming stock study in the new curriculum at the Institute of Urban Transport (IUT), which was established in 1997 under the Ministry of Urban Development but strengthened through the UNDP-GEF Sustainable Urban Transport Project (2009–2015). According to Kamal Nagar, Officer on Special Duty (Transport) for the city of Bhopal, Madhya Pradesh State, who represents the IUT as a project partner,

the project has changed not only India's institutional approach to urban transport, it is now trickling down across state planning.

Nagar describes transport planning prior to the project as "unsophisticated". Before 2006, he says, "we never had a policy on urban transport."

In 2005, for instance, when Kanika Kalra received a Master's degree in urban transport planning in 2005—from the country's only college offering such a specialty, there was no position anywhere within India. Since the UNDP project and other partners' contributions, she says, "Things are different. There is a huge demand for these skills now."

From a study visit to Singapore Land Transport Authority for high-level state officials, Nagar brought back to India a new perspective on the "crucial" integration of transport planning with land use planning. "We are now doing

something similar in our state but customizing, trying to adapt it to local conditions," he says. Among the many changes he has initiated so far is the Madhya Pradesh Metro Rail Corporation Ltd, a state company to manage the Mass Rapid Transit System in Bhopal and Indore cities.

Nagar says he learned from the study visit the importance of sustainability in all terms: "environmental, social and economic. We are trying our level best but still have many targets to achieve."

The project also helped IUT transition into a knowledge management centre, which Kalra now heads, to train state officials on urban transport planning and to research how good practices from around the world can be adapted into appropriate climate change mitigation strategies for India. IUT has also launched the country's first database on urban transport statistics, the lack of which previously had severely constrained the ability to make viable urban transport plans or assess the impact of different initiatives. Says Nagar, "IUT has done three important things: First, they have become the training arm of the Ministry of Urban Development and are running capacity building and training workshops, and second, they have prepared analysis on policies and best practices globally and in India that have been a catalyst for people in public transport. And they bring together all urban mobility officials to brainstorm on issues regarding urban transport."

PROJECT IMPACT

- The SUTP Project has led to dramatic changes in urban transport planning across states:**
- The Institute of Urban Transport transitioned into a knowledge centre and crucial capacity-building institute on urban transport for state officials.
 - More than a thousand city officials have participated in the Institute's four- and five-day courses, building up sensitization to the importance of urban transport within the whole of urban planning.



OUR SHELTER & LIFESTYLES

According to the International Energy Agency, the building sector (commercial and residential) is the biggest consumer of the world's energy use, at 41 per cent. Industry consumes 31 per cent, while the mobility sector uses 28 per cent.



Globally, the sector's final energy consumption doubled between 1971 and 2010 to reach 2,794 million tonnes of oil equivalent, driven primarily by population increase and economic growth. Although primary energy demand is expected to increase by about one third by 2030, the energy demand globally is predicted to grow by two-thirds – three times as fast as the world's population. The building sector is the largest contributor to global greenhouse gas emissions.

As noted in “smart buildings in smart grids”, a smart building with its own energy generation and storage that interacts with a smart grid can manage its own energy demand and generation to minimize energy costs and CO₂ emissions. Additionally, efficient light bulbs and management can save up to 82 per cent of energy used, while modern boilers can save up to 40 per cent of fuel used.

How we build, heat and cool our shelters (residential and tourist), how we operate within them (cooking, washing, bathing and disposing), and how we light our homes and communities can change the future of the planet—energy efficient and sustainable standards and habits can work towards a healthier future.

PROJECT
IMPACT

PROJECT SITES
CHINA | BANGLADESH | DPR KOREA | INDIA | INDONESIA | MALAYSIA | MALDIVES
PAKISTAN | PHILIPPINES | SRI LANKA | TIMOR-LESTE | VIET NAM

FIND THE BENEFICIARIES OF THIS CHANGE...

...SOME OF THE PEOPLE TO BE FOUND



“Access to 24-hour power will mean we can treat our patients immediately.”

In Tuvalu, senior nurse Mamaha Viliamu, from the Nui Health Clinic, is looking forward to the 24-hour solar power that is being installed currently through the UNDP-GEF Pacific Islands Greenhouse Gas Abatement Through Renewable Energy Project. “In urgent cases, such as when the ventolin nebulizer is required for acute asthma, we lose valuable time walking around the island in darkness to notify the mechanic to switch on the emergency generator for us. In peak times, such as when there is an influenza outbreak, the generator has to be switched on as often as three times a week. Access to 24-hour power will mean we can treat our patients immediately. It may even save lives.” Electricity is required to store life-saving vaccines and medicines at the appropriate temperature. It is also essential to power the equipment used for the treatment of acute medical issues. While the Nui Health Clinic has a back-up generator for such emergencies, Viliamu, explains that a mechanic has to be called upon to switch on the generator when it’s needed, a process that can take around an hour or longer. With many water pumps requiring electricity to operate, another health benefit stemming from the project is improved access to clean water for cooking, bathing and sanitation. With the island’s previous diesel sometimes out of order for up to two weeks, schoolchildren will soon have lights at night to study by and access to the internet.⁸



“A new hope for life.”

In Bangladesh, Md. Nasiruddin said a solar lantern gave his family “a new hope for life”. For 47 years, his village had no electricity. His three children were used to kerosene or hurricane lamps for studying, which are inefficient, potentially dangerous and a major source of greenhouse gases. “I was very worried when I saw that my children were studying with a small lamp or candle with difficulties.” The darkness, he said, was very expensive. “We could not go out for any work at night. In short, all our work just stopped when the sun went down.” In 2015, he bought a solar lantern system for 3,000 taka. The system has a 4.9 Wp Panel, 3 No of LED bulbs, a torchlight and a mobile charging facility, made possible through the UNDP-GEF Development of Sustainable Renewable Energy Generation Project. “After buying this lantern, my children could easily continue their study with the powerful LED bulbs,” he said, adding that it had a positive influence on their performance in school.⁹



“No one in the village has ever done anything like this.”

In India, the once unthinkable was achieved when four families in Rajasthan State allowed their daughters to leave home and live among strangers. The four women had only attended school up to class five or eight; none had ever travelled much further than a neighbouring village and never without a male escort. Now, thanks to training through the UNDP-GEF Scale Up of Access to Clean Energy for Rural Productive and Domestic Uses Project, they are “barefoot solar engineers”. “No one in the village has ever done anything like this, said Bhagwati. “People said that boys should get the training. Then we were told that the project would only train girls. It took people a long time to accept this.” After two months of campus courses and a month of field training, the four young women, all married, learned to assemble and install solar-powered lights and lanterns. Now, they undertake regular checks in the village, respond to complaints, repair faulty lights and maintain the batteries that power them. Each family with a light contributes to a village fund from which their woman barefoot engineer is paid a salary ranging from 1,000 rupees to 1,350 rupees a month. And the villages are full of little girls who trail the barefoot engineer and watch in awe as she fiddles with wires and fuses, hoping to someday be an engineer.¹⁰

8. Story from Apia, Samoa, SPREP: Powering Up Remote Tuvalu through Solar: Sustainable energy for Nukufetau, Nui and Nukulaelae, Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (2015). | 9. Story from UNDP website. | 10. Story from UNDP website, “Rural energy for rural livelihoods”, see www.in.undp.org/content/india/en/home/ourwork/environmentandenergy/successstories/renewable_energyforrurallivelihoods.html

BUILD 'N' SCRABBLE

You were dealt 7 letter tiles. Each of these tiles can be placed at the intersections (yellow colored) of each grid of tiles shown in the figure.

Fill in the missing tiles in these grids to form commonly used words in the building sector.

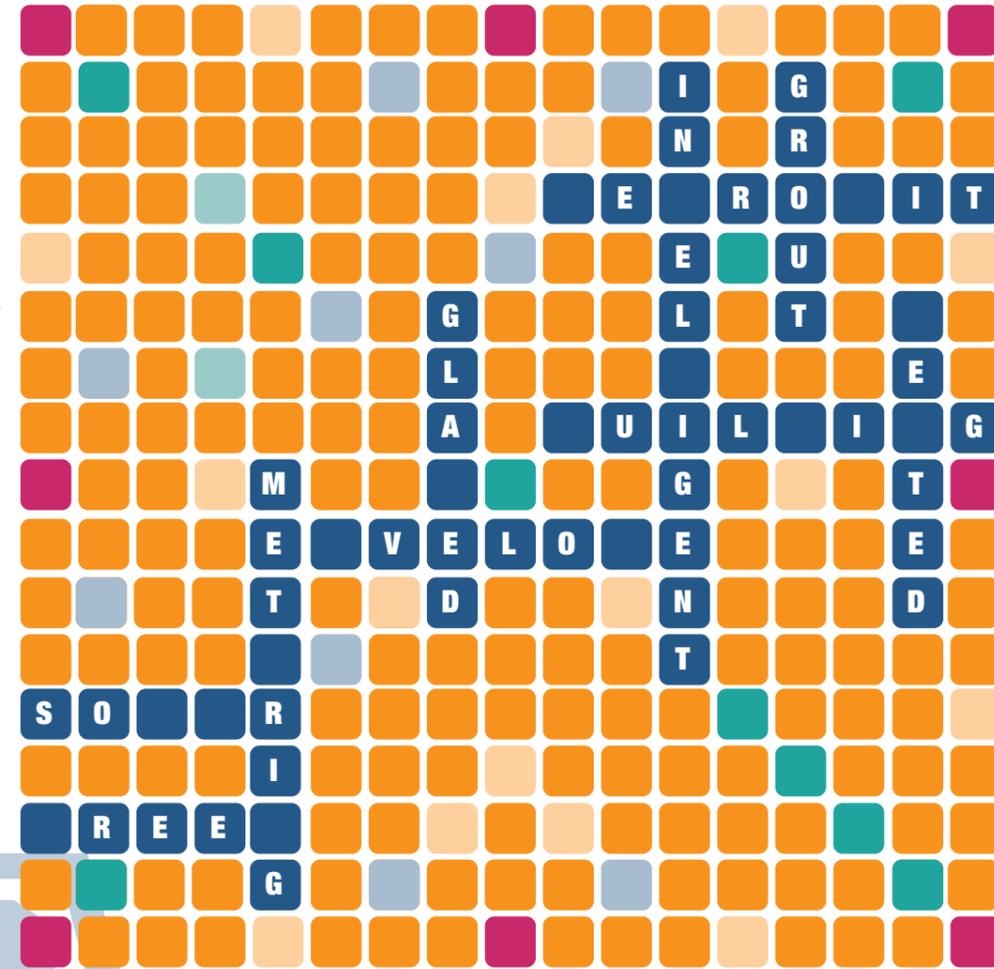


ACROSS

- 3 To furnish an existing building with new or modified parts or equipment not available or considered necessary at the time of installation or construction.
- 6 An edifice; a usually roofed and walled structure constructed for occupancy and use.
- 8 Collective term used to describe the building shell consisting of the walls, windows, doors and roof.
- 9 Closed with a latch.
- 10 Place or means of going out of buildings; building codes have minimum requirements for this.

DOWN

- 1 Another term for smart buildings.
- 2 A mortar or paste for filling crevices, especially the gaps between wall or floor tiles.
- 4 Windows fitted with glass are like this.
- 5 Expelled out of an enclosed space, as in stale air.
- 7 Measurement of specific parameters using fixed or hand held instruments.



SOLUTION
 1. INTELLIGENT 2. GROUT 4. GLAZED 5. VENTED 7. METERRING
 Down
 3. RETROFIT 6. BUILDING 8. ENVELOPE 9. SOLAR 10. GREEN

BREAKING THROUGH THE BUILT CEILING ON ENERGY EFFICIENCY IN MALAYSIA

“Watch your step” warns a notice on the atrium stairway in the GreenTech Malaysia building. It seems too many visitors coming to marvel at what has been accomplished can’t stop looking up as they descend the stairs. Because geometrically arranged in the stylized glass ceiling are small solar photovoltaic squares that generate (along with solar panels over the parking lot) half the power needed by the building’s occupant—GreenTech, which is a government corporation committed to replicating energy efficiency across the country.

Constructed as a demonstration of energy efficiency and solar technology, the GreenTech Malaysia building houses 80 people working to help policy makers, politicians, government procurement officers, manufacturers and homeowners build reliance on renewable and sustainable energy. “We don’t work here for the money,” says their CEO, Ahmad HadriHaris,

once the project manager for the UNDP-GEF Malaysian Building Integrated Photovoltaic (MBIPV) Project that helped build the building who went to a high-paying private sector solar energy job when the Project ended but has since crossed back to work for the Government. “We work here because we have purpose.” That purpose, he says, is to “green Malaysia”. The government corporation continues the work of the MBIPV project: building new markets for green products, addressing the energy industry’s competency, addressing the policy perspectives and promoting renewable energy. “A lot of the knowledge and lessons of the MBIPV Project were translated into the operations of this organization,” says Haris. The MBIPV Project, he adds, dramatically changed what was possible in the country’s commercial and home building industry.

The MBIPV Project was pivotal in putting an enabling and regulatory framework in place to promote renewable

energy and photovoltaic technology that is centred on a feed-in tariff scheme (generators of renewable power are paid for solar energy they channel into the national power supply) and established an agency to administer the scheme. The project catalysed solar technology acceptance among the public, policy makers, financiers and the building industry. The Project helped develop the Renewable Energy Bill, gazetted in 2011, that specified the feed-in tariff and the establishment of a Renewable Energy Fund (a levy of 1 per cent on top of the normal electricity tariff) to cover the feed-in tariff.

Introduced by the project, the SURIA 1000 Programme became a pioneering financial incentive scheme for solar energy. It provides attractive financial discounts on the photovoltaic system, at 25-75 per cent to home owners. The scheme requires the photovoltaic system be installed (integrated) as part of the building and energy generated was sold to the utility via a net-metre. The goal of Suria 1000 is to allow anyone in Malaysia to have a BIPV system in their house, to generate their own electricity and to connect it to the national grid (power supply). Unfortunately—in a good way—the solar power take-up under the feed-in tariff scheme was so successful, the quotas were soon reached, and the Government had to switch back to the net-metring scheme to allow homeowners to benefit from solar energy.

“Our satisfaction is seeing things happening in Malaysia,” says Haris, sitting in the demonstration building that is considered unique in the region with its slab cooling system and heavy use of daylight along with the solar ceiling. “When we go to the airport and see all the energy efficiency applications, we see solar panels on the roof—if we did not do all the work we did through the [MBIPV] Project, it would just be a normal airport today. Everywhere I drive I see solar panels on the roof of houses. I know if we didn’t do the work in 2005, 2006, 2007, it wouldn’t have happened.”

PROJECT IMPACT

- **The MBIPV Project helped remove barriers for building integrated photovoltaic, focusing on awareness raising and skills training in benchmarking, good practices, monitoring and demonstration of technology and demonstration of cost reduction.**
- **The project exceeded expectations by higher sales of photovoltaic installations, by 440 per cent above target.**
- **The associated annual greenhouse gas emission reduction was estimated at 1,533 tonnes (or some 150 passenger car round trips around the world) against a target of 1,168 tonnes for the project lifetime.**

WATTS OUT

WHEN YOU CROSS

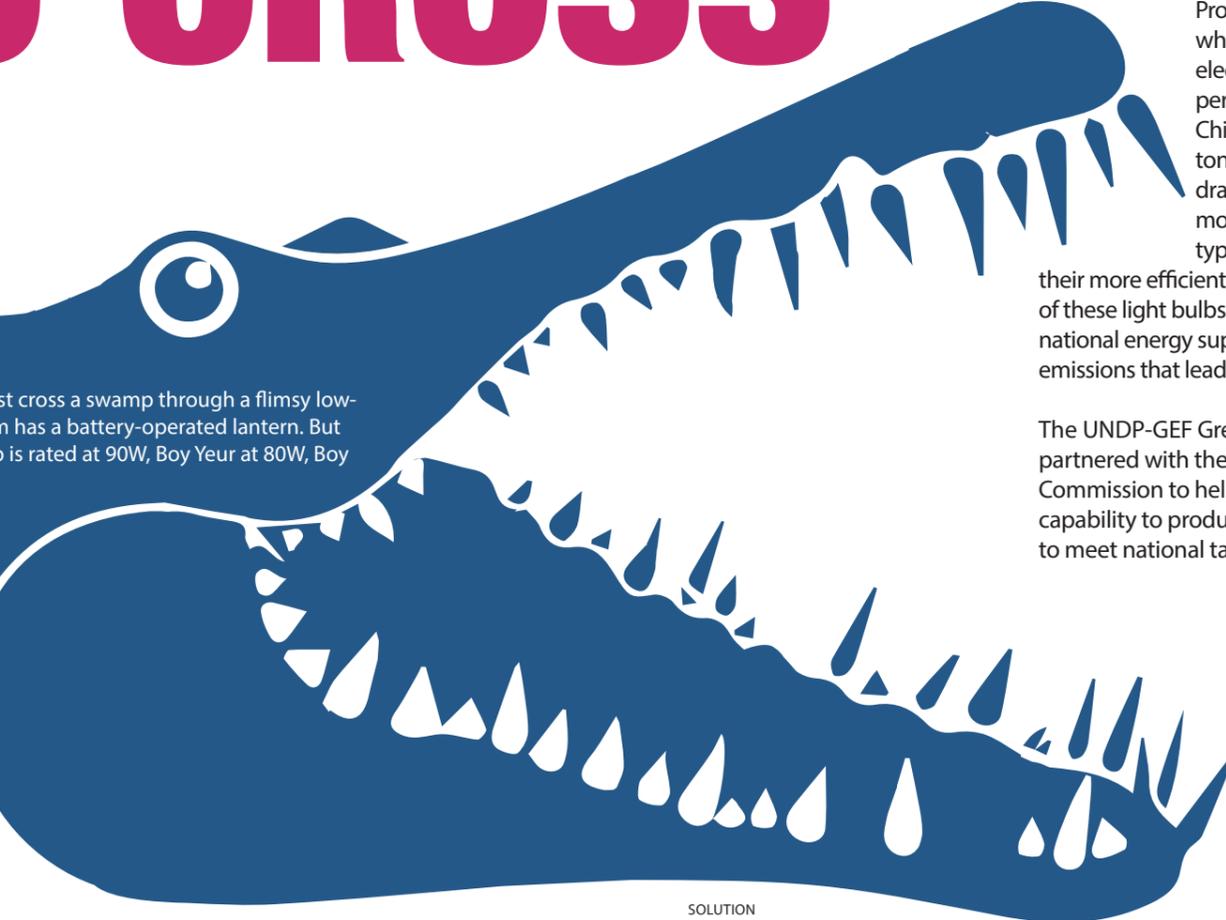


Five adventurous boy scouts (Boy George, Boy Yeur, Boy Cott, Boy Hood and Boy Friend) trekking inside a forest must cross a swamp through a flimsy low-hanging rope bridge that can carry only two persons at a time. It is pitch black in this part of the forest. Each of them has a battery-operated lantern. But each lantern has a different lamp wattage. The higher the wattage, the higher is the illumination. Boy George's lamp is rated at 90W, Boy Yeur at 80W, Boy Cott at 60W, Boy Hood at 40W and Boy Friend at 20W.

If one or two of the scouts use their lantern, the resulting intense light may attract the crocodiles in the swamp and attack them. Their scout master had earlier advised them to use lanterns with total lamp wattage of at least 40W but not more than 100W.

For added safety, one of them has to carry a rifle while crossing the bridge just in case of a crocodile attack. They only have one rifle.

How do the boy scouts get across the swamp?



SOLUTION
 BC+BH on (100W); BH back (40W); BH on (100W); BC back (60W); BC+BH on (100W); BH back (40W); BY+BF on (100W); BC back (60W); BC+BH on (100W); BC back (60W); BC on (90W); BC back (60W); BC+BH on (100W); BH back (40W); BY+BF on (100W); BC

ONE LIGHT BULB AT A TIME IN CHINA

Imagine if a city like New York or Paris decided to eliminate all its cars and factories or to switch off its entire energy use to avoid its carbon emissions. Something akin to that is what China's transformational UNDP-GEF Green Lights Project set out to achieve—but for the whole country, and thus cutting China's electricity consumption by 48 billion kWh per year. The bold move aimed to reduce China's CO₂ emissions by up to 48 million tonnes annually. One of the most significant drains on energy demands is lighting, with most conventional incandescent light bulbs typically requiring four times the energy of their more efficient counterparts. In China, continued use of these light bulbs translates into some 12 per cent of the national energy supply and generates high levels of carbon emissions that lead to tremendous pollution.

The UNDP-GEF Green Lights Project (2009–2012) partnered with the National Development and Reform Commission to help Chinese manufacturers increase their capability to produce energy-saving lamps and help them to meet national targets on phasing out the production

and sale of incandescent lamps. To achieve this, the project assisted in the development of energy-efficient industrial supply chains by working with light bulb production companies to replace or modernize outdated technologies. To complement the process, imports and sales of incandescent light bulbs were to be eliminated over a period of a three-year phase-out, beginning in 2012 and including the banning of incandescence light bulbs that exceed 100 watts. Those of 60 watts and above were banned as of October 2014, while incandescent lights of 15 watts or higher were banned as of 2016.

On an individual scale, the impact is likely a replacement of five light bulbs per household. For institutions, the number will be larger, such as Beijing Jiaotong University, which joined the project as a demonstration of the impact changing light bulbs can make. The university has since replaced 100,000 T8 light bulbs with the new energy-efficient LED T5 models.

"We had a limited budget for light bulb replacement," explains Wang Haidong, Energy Management Department Head of the University's Logistics Group. With subsidies

provided by the Project, the school could begin to think about energy efficiency it was not in a position to do otherwise. Its priorities have since changed. "We have learned to prioritize such projects in the budget allocations because we have seen the real benefits from the increasing energy efficiency and decreasing electricity bill," says Wang. One T5 light bulb saves 23.36 kWh of electricity per year. The university's energy consumption required around 23,000 tonnes of coal in 2010. Even though the university has been expanding since, its energy consumption has steadily declined, to 13,900 tonnes of coal in 2015.

"Our students are immersed in an environment where great importance is placed on energy efficiency," says Wang. "Whether they are in their dormitories or in the public areas like classrooms, arenas or libraries, we have energy-saving devices like automatic lights and faucets and other water-saving devices." In total, the project helped installed 4 million energy-efficient light bulbs in schools in China. "Not only has the project helped schools to increase their energy efficiency and save their bills on electricity, but the students are able to acquire the habit of using energy efficiently through living in such environment," says Wu Yue, from the National Government Office Administration. "I think that's how the impact of the project can be sustained."¹²

PROJECT IMPACT

- Throughout the project implementation, 4 million energy-efficiency light bulbs were installed in schools in China, leading in certain cases to a reduction of 40% of coal used.
- Switching to LED lights lowered small business and household utility bills, improved business opportunities and even helped reduce poverty in some areas.
- For companies interested in developing their corporate social responsibility strategies, the project provided advice on balancing environmental sustainability with the demands of modern business practices. Transforming China's lighting industry has assumed international significance.

12. Reporting from Ruoqi Zhu and Teng Yue, and based on a story from UNDP China website, "A light bulb moment: Promoting energy efficient lighting", see www.cn.undp.org/content/china/en/home/ourwork/environmentandenergy/successstories/a-light-bulb-moment-promoting-energy-efficient-lighting.html

ENVIRONMENT CARE

Find the device and its benefits in this energy-saving hospital

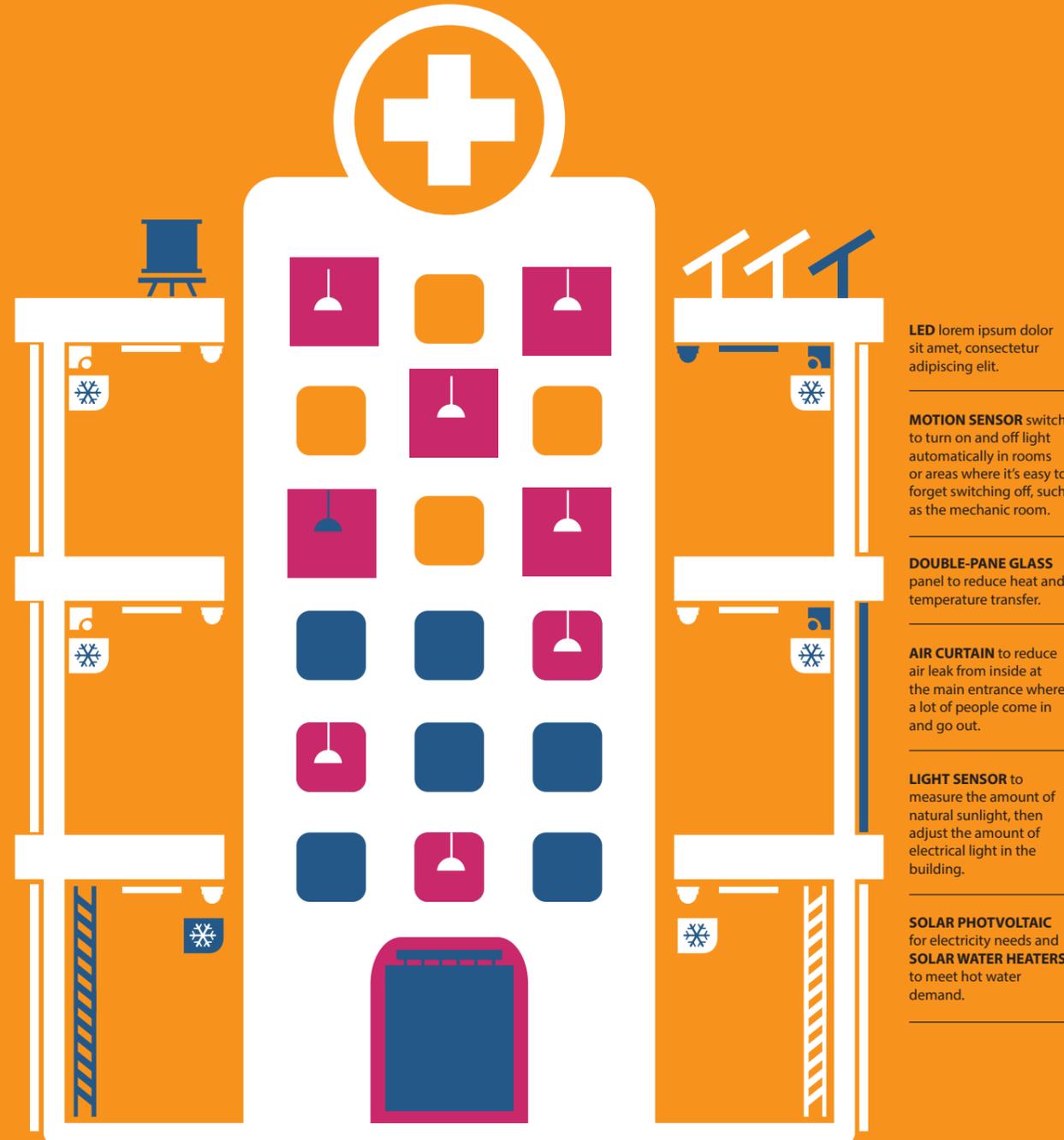
WATER TANK to store on rooftop and use gravity to deliver the water down throughout the building instead of using energy to pump water up to each floor each time it is needed.

INSULATED WALL for a temperature controlled room to reduce heat transfer from outside.

DIVIDE AREA IN SECTIONS to control the amount of air conditioning that needs to be turned on.

INDIVIDUAL LIGHT switch per working station.

Find the devices in green and proceed to know its benefits



LED lorem ipsum dolor sit amet, consectetur adipiscing elit.

MOTION SENSOR switch to turn on and off light automatically in rooms or areas where it's easy to forget switching off, such as the mechanic room.

DOUBLE-PANE GLASS panel to reduce heat and temperature transfer.

AIR CURTAIN to reduce air leak from inside at the main entrance where a lot of people come in and go out.

LIGHT SENSOR to measure the amount of natural sunlight, then adjust the amount of electrical light in the building.

SOLAR PHOTVOLTAIC for electricity needs and **SOLAR WATER HEATERS** to meet hot water demand.

CARING FOR THE ENVIRONMENT WHILE CARING FOR PATIENTS IN THAILAND

As a child, Siriphot Manoch hiked the mountains and walked the beach not far from the hospital his grandfather set up outside of Bangkok, Thailand. When his mother took control of the hospital, Siriphot took off for America to study lighting design in New York City, after which he worked for an interior designer who attracted jobs across the country. In America, all those jobs had to follow the Leadership in Energy and Environmental Design, or LEED, standard that encourages energy- and resource-efficient buildings. When his mother asked him to come home and help expand the hospital, Siriphot was agreeable. But when he walked the nearby beach again, a clutter of never-before-seen garbage floating on the water's edge told him the environment was stressed. He looked at his family's hospital in a different light.

"When I was a kid, I never saw the ocean dirty. So I think it's time to do something about it," he says, insinuating the everyone-needs-to-do-their-bit principle. Specifically, he looked at how the hospital could reduce the energy it wastes.

Reducing a hospital's energy consumption can be a bit tricky, considering it is a building in which lives are at stake (surgery rooms need to be a constant 18°C when in use) and energy is a life line. But all those years of studying lighting and standards steered Siriphot to a starting point. He spearheaded an energy conservation programme in the hospital that constituted awareness and training of the staff and switching to more energy-efficient light bulbs. The hospital now has a policy in place that requires staff to switch off lights, computer and other equipment when not in use.

Connecting with the UNDP-GEF Energy Efficiency in Commercial Buildings Project (PEECB) took him beyond switching to energy-efficient lights. The project's detailed energy audits gave Siriphot mathematical models that showed where the hospital was wasting energy and how the hospital could lower its electricity bills by saving power. He also learned how the hospital could rely on solar power without jeopardizing health care. The first recommended change was updating the chiller that provides the air conditioning, which he said was not an easy change to make due to the heavy reliance of hospital

units in maintaining certain temperatures. "I talked with my engineers a lot but the PEECB assistance gave me peace of mind," says Siriphot. The project provided a menu of high-quality technological options from which the hospital could select, including the ratings on performance.

The family hospital has two locations, and they are now planning a third facility that will add 362 beds. Encouraged by the results of the PEECB, Siriphot is now working with an architect to make it LEED-certified, or as energy efficient as possible.

Saving money was incentive for the hospital's board, which also liked prioritizing the environment-friendly new direction and approved the energy-efficient plan for the new facility. But the staff, Siriphot admits, have no incentive to help save energy. Yet, they became committed once he explained the impact on the environment, although admittedly they were scared to go into a dark basement at first. Patients don't mind the recycled toilet paper (and other eco-friendly measures) once the hospital's energy policy is explained, he says.

"You see eco-friendly hotels, but I've never seen an eco-friendly hospital [in Thailand]. As a designer, I want to see if we can do it," explains Siriphot. "I did it for other people [in the United States], so I want to do it for myself now." Does he think patients will choose his hospital because of its responsibility to the environment? Probably not. But never mind, he "wants it to matter".

PROJECT IMPACT

- The 3,000 light bulbs in Aikchol Hospital's two facilities are gradually being replaced with efficient LED lights, at a cost of 3 million baht (\$90,000) that will lead to 20 per cent energy savings in consumption and 117,187 baht (\$3,363) per month.
- Just turning lights, computers and other appliances off when unused saved the hospital around 50,000 baht (\$1,500) per month.
- Changing to high-efficiency air chillers in both locations led to a savings of 586,185 kWh a year and a reduction of 341 tonnes of CO₂ equivalent per year (or some 35 passenger-car round trips around the world).



OUR FOOD AND WATER

Most households in rural areas are without access to modern forms of energy to meet cooking, lighting and heating demands. Almost 90 per cent of people in Bangladesh, for instance, cook with traditional fuels, such as firewood, jute sticks and agriculture waste.



In Bhutan, more than 80 per cent of rural households (where 70 per cent of the population resides) are largely dependent on traditional fuels, such as firewood and kerosene. As much as 60 per cent of the rural population in Timor-Leste spend one to three hours a day searching for fuelwood.¹³

Lack of access to electricity from the national grid from the national grid limits the productive hours of each day for business owners, household livelihoods and children's studies. The provision of electricity through grid extension, mini-grids or off-grid systems can help to expand income-generating activities that contribute to human development and help to diversify the livelihood options.

It can further help economies of developing countries against fossil fuel shocks and price spikes.¹⁴ Grid electrification, combined with appropriate government, financial and technical training, can make a variety of income-generating activities possible, including mechanical power for milling grain, illumination for factories and shops, heat for processing crops and refrigeration for preserving products. In the Philippines, for example, households typically see income gains of \$81 to \$150 per month when they become connected to the grid. 2002 data: possible to update?

PROJECT
IMPACT

BHUTAN | INDIA | NEPAL | TIMOR-LESTE

13. Taken from UNDP, *Achieving Sustainable Energy for All in the Asia-Pacific* (Bangkok, 2013). | 14. Taken from *Achieving Sustainable Energy for All*, p 39.

FIND THE BENEFICIARIES OF THIS CHANGE...



...SOME OF THE PEOPLE TO BE FOUND



“The women have grown as entrepreneurs.”

Meet Ranjani, the 35-year-old wife of a fisherman in Mirissa village in Sri Lanka’s Matara district. Through the UNDP-FAO-GEF Biomass Energy Project (providing technical and financial requirements), the Sri Lanka Sustainable Energy Authority provides villagers with energy-efficient SaviruJeewa biomass dryers that are manufactured by local entrepreneurs. With a single dryer, Ranjani and four women from her village now produce dried fish and maldive fish (a cooking additive) without having to bother about the stray dogs, crows or the weather. The demand for their product is high. Excess fish during peak harvest time are no longer wasted. The five women have signed an agreement to share the labour, cost and profit of working with the machine. The new dryer helps Ranjani and her group produce around 500 kg in one drying cycle. Boosting her income by 200 per cent—she now earns about 40,000 rupees a month (having previously earned 10,000–15,000 rupees), which is sufficient to buy nutritious food for three daily meals plus put a portion into a savings account. Through exposure to the project’s training, the women have a new appreciation for resource protection and clean living and thus environmental conservation. The village’s living conditions have improved. The women have grown as entrepreneurs with new skills in marketing and understanding of product diversification to generate more income. The women get along better working with the dryer because it is easy to handle and their incomes have increased. Other villagers have learned from the women how to better organize businesses.¹⁵



“Our living conditions in the village have improved greatly from this project.”

In China, Cai Yaling lives in a demonstration model village in Hebei Province that was transformed through the Market Transformation of Energy Efficient Bricks and Rural Buildings Project. She says that the project has changed her life immensely. “Our living conditions in the village have improved greatly from this project. Before, some of us had to go into the mountains to get wood for fire; it was so tiring and wasted a lot of time. The smoke got everywhere and the fires could be dangerous. Now we can spend much more time on other things. In addition, using the liquid from the biogas on our field is very effective. We’ve saved on fertilizers and our produce are better quality. It also helps to lower the levels of pollution in our land. I haven’t counted exactly how much we have saved, but roughly every month we spend at least 50 yuan (\$8) less.”¹⁶



“The old stoves wasted a lot of time, fuel and energy.”

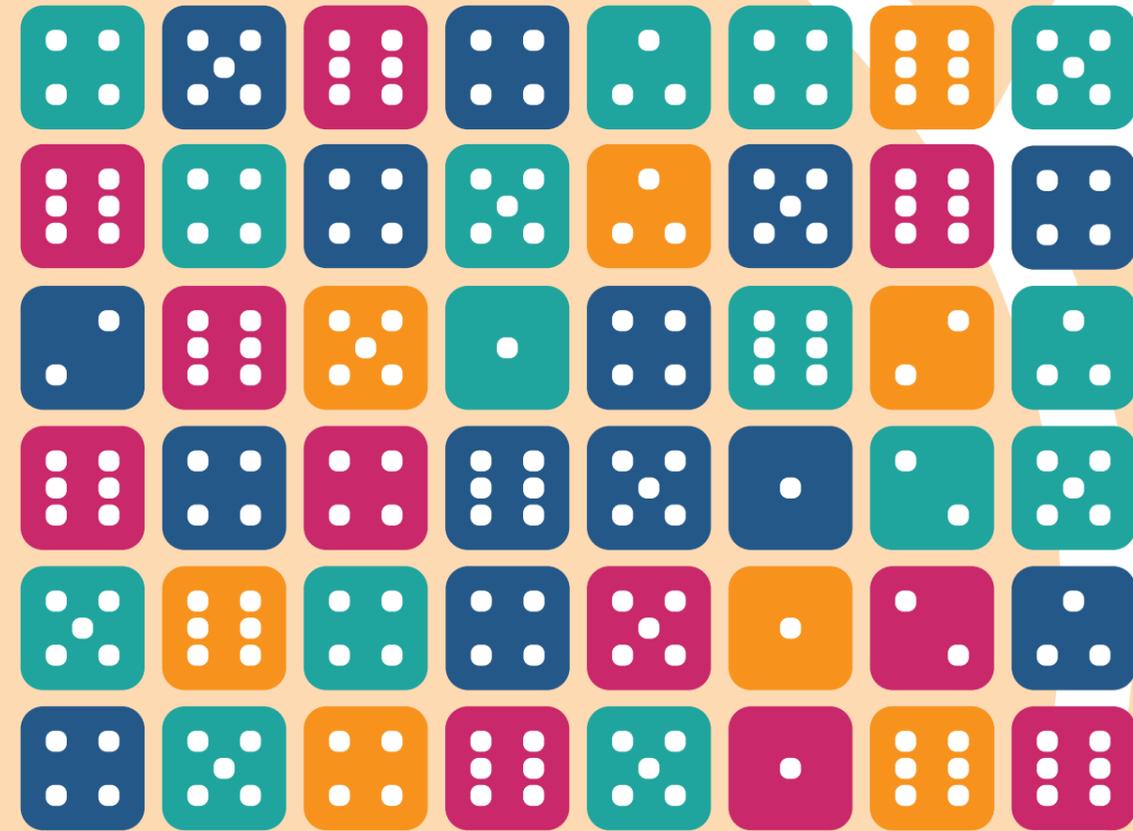
In India, Kumaresan makes rotis to serve with dahl and other specialties at his small eatery on a lane in Tamil Nadu. He used to take two days’ leave every week to fetch the wood he needed for burning in his conventional stove, which was not safe or healthy for him or any worker using it. “The old stoves wasted a lot of time, fuel and energy,” he says. Through the UNDP Access to Clean Energy project, Technology Informatics Design Endeavour, up to 300 energy-efficient Pyro stoves were supplied to small artisans and cooks in semi-rural areas and thus increase the profit margin and reduce the carbon footprint. In southern India, some 800,000 of eateries consume about 130 million tonnes of fuel wood a year and emit 200 million tonnes of CO₂ per year. Kumaresan still uses wood but far less, reducing his cost of fuel per hour from 32 rupees to 6 rupees. The burning rate has gone from 13 per cent of 8 kg of wood per hour to 35 per cent of 2 kg of wood per hour. “It’s a big saving. Isn’t that positive? And it’s the most comfortable stove.”¹⁷

15. Reporting by Sampath Aravinda Ranasinghe, Project Manager, Biomass Energy Project, FAO. | 16. Reporting from Jin Ni, UNDP. | 17. Story from UNDP India. | 16. Story from Anuruddha Kariyawasam, SLSEA and Stanley Prashanthan, UNDP.

FIND OUT

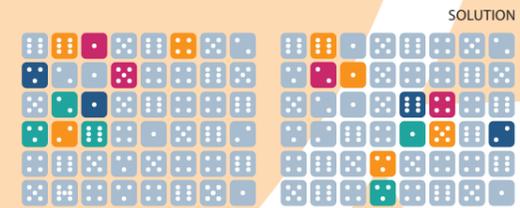
What did the Tongan villagers do to solve the problem of contaminated water? Find out what village life was like before and now after solar pumps were installed.

Cross out for BEFORE and tick mark for AFTER. There are nine for before and nine for after.



- BEFORE**
- Fuel oil contamination
 - Contaminated drinking water
 - Unreliable water supply
 - Potential droughts
 - Increasing variance in rainfall
 - Pumps breaking down
 - No community involvement
 - Diesel spill and leaks
 - 80% of the pumps remain diesel powered

- AFTER**
- Dugout wells installed in 13 remote villages
 - 65 people trained on how to operate the pumps
 - Less chance for contamination
 - Each village contributed an agreed monthly fee
 - Fuel and electricity use reduced by more than half
 - Water supply now lasts until around midnight in all villages
 - Reduced usage of diesel and cost
 - Villagers witness solar pump capability
 - Money saved is used for other community work



USING THE SUN TO BRING CLEAN WATER TO VILLAGES IN TONGA

Tiny drips of fuel oil often contaminated the drinking water in Ha’apai, a district in the north-western part of Tonga. The increasing variance in rainfall and potential droughts was compounding the problem of an unreliable water supply. Pumps often broke down. And there was no community involvement in managing the water source. Ha’apai thus became a good spot for the UNDP-GEF Pacific Islands Greenhouse Gas Abatement Through Renewable Energy (PIGGAREP) project.

Through the project, solar pump systems on water dugout wells were installed in 13 remote villages. Sixty-five people were trained on how to operate the pumps, with the Geology Department of Tonga officers trained on monitoring the water to ensure its quality. The move away from diesel pumps has distinctly lessened the chances for contamination through diesel spill or leaks.

Each village contributes an agreed monthly fee, paying into a designated bank account to be used for future maintenance. Two youths were trained, provided them

with complete set of appropriate tools and employed to look after each system and provide reporting obligations to the department of energy. A renewable energy service company was set up to manage the operation of all government off-grid initiatives, which include solar pump systems, a solar streetlight system, solar home systems, solar freezer systems and solar micro-grid systems.

Most remote villages in Tonga, especially in the outer islands, are heavily dependent on underground water. Around 80 per cent of the pumps in Ha’apai villages remain diesel powered, 11 per cent are powered by electricity and 9 per cent powered by solar power, excluding those that were recently commissioned under the project. For back-up, diesel based engines remain on standby for cloudy days.

Since December 2014 when the pumps were installed, the fuel and electricity use in these 13 villages is estimated to have been reduced by more than half. This

project was funded by Denmark through an initiative called SIDS DOCK that works to connect the energy sector in small island developing states with the global market for finance and sustainable energy technologies.

Diesel use has reduced dramatically in the Tonga project area, with one village avoiding it completely by waiting until the pump turns on at 8 a.m. to 9 a.m. and by using rain water harvested during rainy days. The water supply usually lasts until around midnight in all villages (less so in a few villages that have leaks in their village piping network). “We usually use 20 litres of diesel in two days but now 20 litres is used for more than a week,” says Vaea Taufuou, the Town Officer of Faleloa village. “We only use diesel one hour every morning and solar takes over till sunset.”

Alani Kavakiholeva, the town officer of Fotua village echoes a similar impact. “We only heard about solar pumps but now we’ve witnessed its capabilities. The money we saved from diesel is now used for other community needs, particularly for fittings for the water supply network.”¹⁸

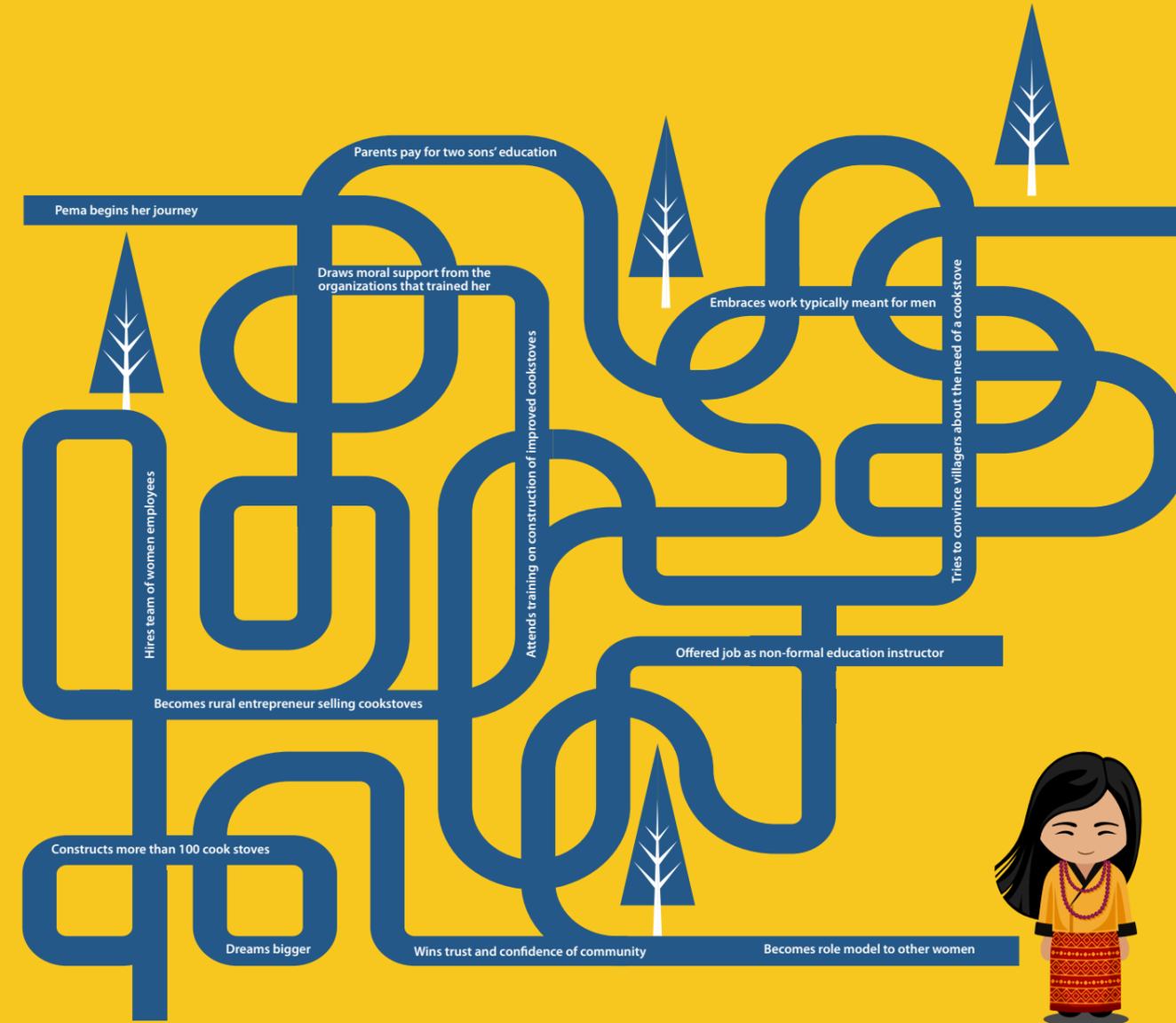
PROJECT IMPACT

- The PIGGAREP project helped 14 Pacific countries remove barriers to installing renewable energy technologies.
- The project changed life within villages by reducing reliance on diesel fuels, which had to be transported to each island, while creating job opportunities.
- The new pumping systems allow villagers to enjoy clean drinking water and they ensure self-reliance through the use of renewable energy.

18. Reporting by Thomas Gillman, UNDP Samoa MCO intern and quotes from ‘Tonga Solar Pump System Initiative Part 1’ film, by OfaSefana, UNDP Samoa.

WORK PEMA'S WAY OUT

Track her life from being an abandoned mother to becoming a role model to others



FROM COOKSTOVE PROMOTER TO LOCAL POLITICIAN AN ABANDONED MOTHER CHANGES THE FUTURE FOR HER FAMILY AND COMMUNITIES IN BHUTAN

When Pema Choki was 22 and a mother of two boys, her husband from an arranged marriage walked out on them. They never heard from him again. She had a tenth grade education and had never worked. For 12 years she struggled with her meagre earnings to afford the basic necessities for her and the two boys. Then she heard about a project looking for rural entrepreneurs to make, sell and repair improved cookstoves.

Bhutan has one of the highest per capita consumption of fuel wood in the world, at almost 1.3 tonnes per person. The Sustainable Rural Biomass Energy (SBRE) Project (2013–2016) was initiated to reduce the fuel wood consumption and greenhouse gas emissions and help improve the health, income and productive time for rural

households. Nearly 70 per cent of Bhutanese who live in rural areas use fuel wood as a main source of energy.

Women in Bhutan typically stay at home. Pema Choki had two boys and no choice. She embraced the work typically meant for men. She travelled around her village, walking up to two days to reach households and convince them that they needed a cookstove to improve their welfare. In the evening hours, she continued her previous teaching work before returning home to her chores. "It was a challenging job in the beginning, as I lacked technical background. But I picked it up so easily because I took keen interest in it. I persevered, drawing moral support from the organizations that trained me," she said.

PROJECT IMPACT

- The SRBE Project contributed towards reducing the annual natural energy consumption and greenhouse gas emissions through the promotion of efficient cook stoves in rural Bhutan and the implementation of demonstration biomass energy technologies in relevant industries.
- As of February 2016, around 13,000 improved stoves (cook stoves, heating stoves and fodder stoves) had been sold across 20 districts.

19. Story by Minjur, UNDP Bhutan.

"I have now constructed more than 100 cook stoves in my community and people are impressed with my work. They even come from distant villages for a stove. I am happy that people are becoming aware and that traditional concepts are gradually changing.

"Her monthly income increased by 3,000–4,000 ngultrum (\$45–\$60). "I am hopeful that a day will come when the government will provide good facilities to and space for women like me. I believe that we have equal rights to live, and share the same roof of the world with other living beings. We are strong and independent, so we can work and act for ourselves. It is not by birth that the fate of women gets sealed but by lack of opportunity.

"She challenges for her rights and she pleads with other fellow men to respect, support and empower women".¹⁹

LIFT OUT

Renewable energy changes lives—find the 6 bold words from the story

M	N	O	R	C	I	M	L	K	J	H	G	M	D	N
S	A	P	O	I	U	Y	T	R	E	W	Q	O	T	A
L	I	V	E	L	I	H	O	O	D	H	J	N	L	I
Z	X	C	V	B	N	M	L	K	J	H	G	S	D	X
S	A	P	S	I	X	F	O	L	D	W	Q	O	T	A
H	Y	D	R	O	P	O	W	E	R	H	J	O	L	U
M	N	B	V	C	X	Z	L	K	J	H	G	N	D	N
S	A	P	O	E	N	E	R	G	Y	W	Q	W	T	A
L	I	F	T	I	R	R	I	G	A	T	I	O	N	Y
Z	X	C	V	R	E	W	O	P	O	R	D	Y	H	X

LIFT-IRRIGATION LIFTS FAMILIES OUT OF POVERTY IN NEPAL

Going to school for Parbati, Magar's three children used to require a slightly perilous crossing of the Malekhu Khola River. There was no bridge and the young children had to gauge the current and quantity of water to find the right place to cross. In the dry season, it was easy. But the **monsoon** period left their mother extremely anxious.

They lived on the slope of a hill, opposite to their school in central Nepal. They wanted to relocate their home to the same side of the river as the school. There was never enough money to make the move to safer conditions.

That dangerous situation changed in 2013 with the installation of a **lift-irrigation** system. Irrigation was only possible because of a micro **hydropower** plant that UNDP had helped install in the district five years earlier. While the power it supplied had a dramatic impact on

many households, they were largely the families that lived near the town market and could set up or increase their milling, carpentry, cold stores, poultry raising, restaurant or lodging businesses.

Ability to irrigate let the Margars grow three crops of vegetables a year instead of just one. They could shift from subsistence to a livelihood selling vegetables. The family went from growing only beans once a year to diversifying into cauliflower, cabbage, peas, tomatoes, green leaves along with their beans. Earnings of all the households increased, but for some it jumped **sixfold**, to NPR120,000 a season, with up to three seasons of crops now possible.

The first thing the Margars did with the additional income was to build a home safely near the children's school.

Since 1996 and first through the Rural **Energy** Development Programme, UNDP has helped communities install 445 micro hydropower plants, with a total capacity of 10 megawatts providing electricity access to more than 100,000 households. Four **micro** hydropower plants have been installed in the Malekhu Khola River Basin and now provide electricity to more than 700 households (of 900 in total). In addition to domestic purposes, electricity is being used for various productive purposes like milling, poultry raising, carpentry, cold stores and, since 2013, for lifting water for irrigation.²⁰

PROJECT IMPACT

- There are more than 2,000 such micro hydropower plants in Nepal. If all were used to power lift-irrigation systems to provide water to small landholders, the impact would transform the country's agriculture sector.
- At 1 million rupees (around \$9,000) per system, it would be possible to lift water with every micro hydropower plant currently in the country for domestic and irrigation uses to the more than 100,000 households.

20. Story by Satish Gautam, AEPC.

LIFE ON THE BEACH

Who among the five friends lives in which house and what EE appliances are found in each house?



Five friends (Rakshya, Manuel, Butchaiah, Karakate and Milou) are great advocates of energy efficiency. They live on a Pacific island community that is energy self-sufficient. Electricity in this tropical island is supplied 24/7 by a solar PV power generation system (with battery storage). Their houses are along the beach and are adjacent to each other. They each own energy efficient appliances, which are of three different categories: white goods (air conditioner, refrigerator, cooking stove, and washing machine), brown goods (TV, radio, DVD player and desktop computer) and lighting devices (LED bulb, LED tube, compact fluorescent tube, or light (CFL), and T5 fluorescent tube (FL)).

- Among the five friends, they have all 12 types of EE appliances.
- Each of them has 4 types of EE appliances.
- One of them owns each EE appliance of one category.
- Four of them have one type of EE appliance.
- Three of them have 3 types of EE appliances.
- Only one of them has all 4 types of EE appliances of one category.
- Two of them whose houses are at each end of the row of 5 houses have refrigerators.
- Butchaiah's house is in the middle of the 5 houses and he does not use T5 fluorescent tube.
- The one who uses LED lamp bulbs does not have brown goods.
- Those who use LED lamp tubes do not have a radio.
- Only one of them has a cooking stove, a DVD player and a radio.
- The first house in the row has an air conditioner and washing machine.
- Only 2 houses have washing machines.
- Manuel has a desktop computer and washing machine
- Milou has 2 kinds of white goods.
- CFL bulbs are used in only 2 houses.
- Only one of the 5 friends has an air conditioner.
- Only in the house next to Karakate can one find a radio.
- Manuel's house is not on either end of the row of 5 houses.
- Rakshya does not have brown goods nor LED lamp bulbs.
- Butchaiah has three types of brown goods.

SOLUTION

Name	Appliances
Milou	Refrigerator (built-in), LED lamp, Radio, Cooking stove, DVD player
Karakate	LED lamp (tube), CFL, Radio, T5 FL
Butchaiah	TV, DVD player, Desktop computer (tube), LED lamp (tube)
Manuel	Washing machine, Desktop computer (tube), LED lamp (tube), CFL
Rakshya	Refrigerator (air conditioner), Washing machine, LED lamp (tube)

SOLAR POWER REPLACES FUEL AND PRAYERS IN THE COOK ISLANDS

"It is fair to say," begins Joshua Simon, a teacher in the Palmerston Island Lucky School, "that every individual on the island benefits daily by the consistent and reliable 24-hour solar power." It is his way of sizing up the impact of the UNDP-GEF Pacific Island Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP) Project. The Palmerston Island Solar Power Site, one of the project's activities, began operating in February 2015, replacing an unreliable 30-year-old 32kW HR3 Lister diesel generator. In total, 53.55 kW of solar power was installed through 210 panels.

The tiny island located in southern Cook Islands has gone quiet, says Simon, except for "the sound of the waves crashing, the wind blowing through the coconut palms, the joyful song of children at play and the church bell ringing". With that silence has come a sense of confidence and peace of mind to the inhabitants who can, for the first time, rely on the power that has become so important to their lives and survival.

The old diesel generator was located in the midst of several families' homes. In addition to constant concern over the fumes and noise, spoilage was a regular worry. An isolated atoll like Palmerston is short of resources. There is little arable land for

farming fresh vegetables or raising livestock. To balance their diets, families order frozen food in bulk from stores in Rarotonga and then have it shipped on the interisland boats that come every three to four months. Both the groceries and the added freight costs represent a significant expense to the majority of the households, whose only source of income is the sale of frozen fish. With only 12 hours of power per day coming from the main island diesel generator, only available in the mornings (6 hours) and evenings (6 hours), a large amount of the limited household budget was spent on fuel to run small generators to keep away both their food and livelihood from spoiling. The loss of a single freezer would be devastating and would threaten a family's immediate and future survival.

The island's power generator broke down often. Sometimes for a few hours and sometimes for however long it took for the next boat to arrive with the necessary parts, which could be several weeks. Families would combine their food and fish into as few freezers as possible and contribute fuel towards running a few small generators. Power, a basic amenity that is taken for granted by so many people worldwide, wasn't something the residents of Palmerston could count on.

Mama Aka, an 83-year-old great-grandmother recalls in her whispered voice, "There was a lot of prayer in those times, my dear."

Before the solar power project, there were huge costs and logistical concerns involved with the purchase, shipping and storage of fuel for both the island and household generators. The main power generator consumed between 18,000 and 22,000 litres of diesel fuel annually. In the first year of the solar plant's operation, total diesel use was about 1,000 litres, a savings of nearly \$18,000, with efforts being made to save power by introducing energy-efficient appliances (freezers, lights, etc.). The island's 60 families still buy fuel, albeit in much smaller quantities, and what they used to store for their home generators can now be used in their boats. This means that they can spend more time fishing and thus bring in more income. Because the power is now constant and their freezers are always cold enough to freeze their catch properly, they no longer have to schedule when they go fishing around when the power is on. Jock, an ever-smiling mother of eight children who lives in a bright blue house by a beach, says, "We used to have to hurry and try to get the fish cleaned and prepared before the power went out so that they would freeze right. We can catch so much more fish now. "Consistent solar power has brought both savings and new financial opportunity to the people of Palmerston. Across the island, everyone has something different to say about how the new solar project has benefited and improved their quality of life.²¹

PROJECT IMPACT

- The PIGGAREP Project helped replace the Palmerston Island's diesel generator with solar power, saving nearly \$18,000 a year on diesel fuel.
- The island's administration council intends to use the saved funds towards the development of agricultural, environmental, health and human resource development as well as the maintenance of the solar energy station and the future replacement of the solar energy battery banks and other components.

21. Story by Joshua Simon.

A NEW WAY WITH SOLAR POWER

Pick up a pencil and help SolBot cross the maze of panels in the solar farm and reach the solar power plug before his battery runs dry



REDUCING RISK FOR ENTREPRENEURS IN THE PHILIPPINES

Leandro Leviste was only 12 years old when UNDP began a long series of trainings to convince politicians and government officials on the policies required for power sector transformation in the Philippines. The goal was to secure the use of renewable energy to replace dependence on fossil fuels for economic growth and coping with constant power shortages. The Capacity Building to Remove Barriers to Renewable Energy Development (CBRED) Project supported by UNDP-GEF had a profound impact. Although it is credited with helping lawmakers adopt the Renewable Energy Act in 2008, its more dazzling influence led to the creation of a feed-in tariff system that better enabled a 21-year-old Leandro Leviste to set up a solar business that installed the largest solar powered rooftop in a commercial establishment in South-East Asia in 2014.

Unlike other solar rooftop plants that are dedicated for self-use by a single building, the rooftop of the SM North Edsa shopping mall connects to the Luzon grid, thus contributing additional capacity to the power supply for a large area surrounding Metro Manila. Composed

of 5,760 solar panels and 60 inverters covering more than 12,000 square metres, the solar rooftop produces enough power to energize 1,000 households or 150,000 10-watt light bulbs or charge 214,285 cellular phones. The power generated could offset 1,200 tonnes of CO₂—the equivalent of planting 6,000 trees per year.²² Within the shopping mall, the solar panels power 16,000 light fixtures, 59 escalators and 20 elevators, or 5 per cent of the total electricity required.

Electricity rates in the Philippines are among the highest in Asia, and Leviste was convinced that solar power could bring them down. “In terms of innovation, solar power is nothing new,” he told Forbes magazine, adding that it’s more important to find a business model that works. His company, Solar Philippines Commercial Rooftop Projects, buys its panels from many suppliers and provides its customers with financing, engineering and installation.²³

The Renewable Energy Act established a feed-in tariff system as an incentive that requires electric

power industry companies to source electricity from renewable energy at a guaranteed fixed price for a given period of time. With a variety of other fiscal and non-fiscal incentives, the renewable energy law encourages national and local interest in the use of renewable energy.

To help developers with insufficient collateral or inadequate capital, the CBRED Project set up a Loan Guarantee Fund to serve as collateral for a bank loan for renewable energy projects. During the project period, only two developers advanced quickly enough beyond their inception phase to rely on the fund (and due to the small capital available). But the fund, which the Government now manages and with partnership with other guarantee programmes, has since grown in available collateral and in projects, currently at five but with an additional 10 projects in the pipeline for a loan guarantee.

Solar Philippines, which now employs 200 people, has received \$100 million in backing from local banks and in January it completed the largest solar farm on Luzon, a \$150-million, 63-megawatt project. The company generated \$125 million in revenue in 2015, and Leviste told Forbes it expects to make \$750 million this year. Now 23, he said, “My generation looks at how Silicon Valley is changing the world and sees business as the best way of making an impact at scale.”

PROJECT IMPACT

- The CBRED Project supported Philippine lawmakers to adopt the Renewable Energy Act in 2008, leading to a feed-in tariff system for renewable electricity and a Loan Guarantee Fund to back private sector lending for renewable energy project development.
- The Department of Energy took over the Loan Guarantee Fund after the project ended and partnered with the country’s first private corporation devoted to loan development financing, the LGU Guarantee Corporation.
- The fund has since grown in available collateral and in projects, currently at five but with an additional 10 projects in the pipeline for a loan guarantee.

²² See <http://technology.inquirer.net/45884/sm-north-solar-rooftop-lists-on-energy-spot-market>. | ²³ See www.forbes.com/pictures/hdf145j/leandro-leviste/.



PRODUCING ALL OUR STUFF

By 2030, the world's energy consumption is predicted to increase by 30–50 per cent. In developing countries, energy consumed by the industrial sector is frequently in excess of 50 per cent of the national energy supply. Energy efficiency measures contribute to development and reduce costs both for the public and private sector.



Adopting energy-efficient technologies could, by 2030, reduce global projected electricity consumption of building and industry by 14 per cent. Investments in energy productivity can contribute to job creation.

Energy efficiency is an opportunity that is not capital intensive, reduces consumption of water and other resources, contributes to reducing greenhouse gas emissions and is not prone to catastrophic failure. Energy efficiency can reduce the financial burden of energy consumers, decrease net import dependency for importers or enhance exports for exporters and improve local economic competitiveness and employment.²⁴

The unreliability of energy production and distribution and the cost of fossil fuels impact country finances greatly. Regular power blackouts disrupt industry and lead to reduced and inefficient production and increasing expenses. The dependence on imported fossil fuels leaves least developed countries and small island developing States particularly vulnerable to volatile prices. There is an urgent need for our daily-use products to be produced more efficiently through low-carbon and sustainable technologies.



BANGLADESH | CHINA | INDIA | INDONESIA | MALAYSIA | MONGOLIA | SRI LANKA | VIET NAM

24. See UNDP, *Achieving Sustainable Energy for All in Asia-Pacific* (Bangkok, 2013), p. 45.

FIND THE BENEFICIARIES OF THIS CHANGE...

...SOME OF THE PEOPLE TO BE FOUND



“I was sceptical, women don’t usually work in brickfields...”

In Bangladesh, Razia Bewa says green bricks changed her family’s lives. As a 30-year old widow with four daughters, she struggled in extreme poverty after their hand-to-mouth existence disintegrated when her landless farming husband died. With no education, skills or options she tried working as a housemaid, but it paid so little her daughters often went hungry. Then the Improving Kiln Efficiency in the Brick Making Industry Project worked with Banalata Refractory to promote the Hybrid Hoffman Kiln (HHK) technology as an energy efficient alternative for brick production because it reduces air pollution and enhances profit by lessening energy use and allowing year-round production. The project set out to hire women workers. “At first I was sceptical, women don’t usually work in brickfields and it’s not safe for them. “But, in just four years, her salary increased from the starting 2,500 taka a month to 3,500 taka. Three daughters have now married and the fourth dreams of being a doctor. And Razia is no longer looked at as the widow of her village, but instead as a respected senior member of her community sought out for advice. The brickmaking technology introduced by UNDP reduces carbon emissions by 40 per cent compared with traditional brick manufacturing.²⁵



The annual energy bill per household is now more affordable than it used to be.

In China, Wang Jingli and her family moved into a rural house made of energy-efficient bricks after nearly 30 years in her mountainous Wangyu village in Hebei Province, much of it without adequate drainage, central heating and public green spaces. Like the other residents, Wang Jingli relied on firewood and coal to stay warm, to cook and to keep electricity bills manageable. Through the Market Transformation of Energy Efficient Bricks and Rural Buildings project, the energy-efficient bricks help retain warmth during the winter and cool the house during the summer. At no more than 1,200 yuan, the annual energy bill per household is now more affordable than it used to be. Which is an utter delight for Wang Jingli’s 90-year-old mother who can’t bear cold weather. The energy-efficient bricks have reduced the overall energy demand in Wangyu village by nearly 50 per cent.²⁶



Bangladesh bank “is aiming at rechanneling... Financing away from polluting... Practices...”

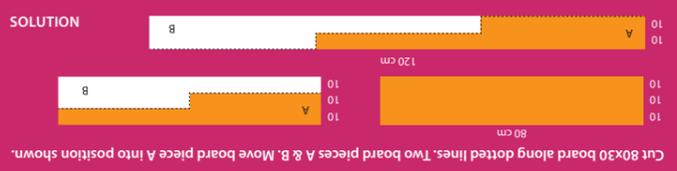
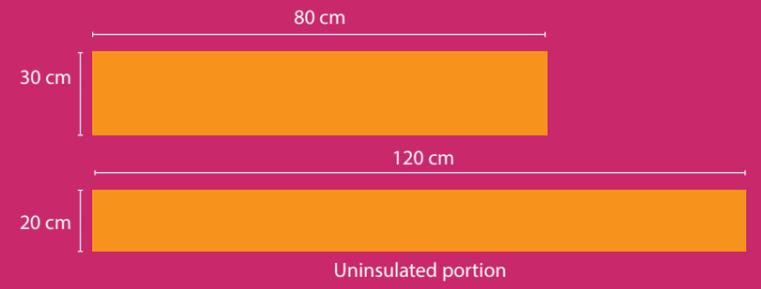
In Bangladesh, Central bank Governor Atiur Rahman told a group of representatives from banks, financial institutions and brick manufacturers in April 2015 that brick-making contributes about 1 per cent to the country’s GDP and provides employment for around one million people. But the mostly coal-based traditional brick making kilns are highly polluting and wasteful in energy use, which is why Bangladesh Bank joined the UNDP-GEF as a major lender in the Improving Kiln Efficiency for the Brick Industry Project. According to the governor, Bangladesh Bank “is aiming at rechanneling all domestic financing away from polluting high-carbon, traditional output practices and lifestyles towards the environmentally sustainable energy efficient, low-carbon ‘green’ alternatives”. The central bank, with support from the Asian Development Bank, is supporting energy-efficient green brick manufacturing projects with a refinancing scheme of 4 trillion taka. The Infrastructure Development Company Limited (IDCOL) also joined the initiative also with 4 trillion taka. The central bank governor added that in addition to funding, UNDP expertise and other resources would also help make brick kilns more energy efficient and eco-friendly.²⁷

25. Story from UNDP website. “Cleaner bricks lay foundation for green economy.” See <http://www.bd.undp.org/content/bangladesh/en/home/ourwork/environmentandenergy/successstories/cleaner-brickmaking-lays-foundation-for-green-economy/> | 26. Story from UNDP website, “Not just another brick in the wall”. See <http://www.cn.undp.org/content/china/en/home/ourwork/environmentandenergy/successstories/not-just-another-brick-in-the-wall.html> | 27. See XXXX

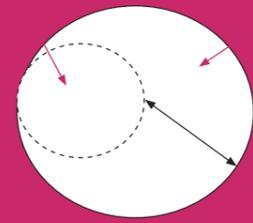
PATCH UP THE HEAT LEAK



During a routine inspection of the plant maintenance unit, an uninsulated portion of the rectangular ductwork of a hot air system was found. Apparently, part of the insulation fell off, leaving a 120 cm x 20 cm portion without insulation. The insulation material is ceramic fibre. The warehouse informed the inspection team that the insulation material is out of stock, but there is a leftover ceramic fibreboard measuring 80 cm x 30 cm that can be used. How will the ceramic fibre board be divided by just making one cut to cover the entire uninsulated portion of the hot air system ductwork? No two parts of the cut board may overlap, and the board should not overlap the edge of the uninsulated portion.



The inspection team also discovered that some of the insulation of the end plate (circular) of one of the hot air ductworks had crumbled and fell off. The exposed end plate is approximately circular with a diameter that is equal to the radius of the endplate. What percentage of the endplate surface area was uninsulated?



SOLUTION: The radius of the big circle is R. So its surface area is: $\text{area} = \pi R^2$. The diameter of the small circle is R. So its radius is R/2. Its surface area is $\pi (R/2)^2$. Thus, the portion of the end plate surface area that was uninsulated is: $\pi (R/2)^2 / \pi R^2 = 1/4$. Thus, the percentage of the end plate surface area that was uninsulated is: 25%.

ROLLING IN BIG CHANGES IN STEEL PRODUCTION IN INDIA

“It was really tough—we were not able to recover costs. We had not been making any profit for a year,” says Sandeep Goel, the director of a family-run steel mill in Raipur State in central India. “The direct rolling saved us from dying down.”

While Goel was staring day after day into the dark abyss of possible mill closure and the loss of jobs for some 200 workers, he looked for ways to dramatically cut expenses. Then he found the answer in the furnace. Rather, the solution was to eliminate the furnace and all the pollution it caused. It was an immensely innovative and costly consideration, and not something that had been done before. “We had no clue if it was even possible to eliminate the reheating furnace,” he says. But it was necessary—the furnace required 40 litres of oil to heat 1 tonne of ballast and consumed up to 30 per cent of the operating expenses. He and his engineers could not find any documentation on shifting from diesel-fired steel. Nor could they find any technical consultant who knew what to do. In their research, they came across the

UNDP-GEF projects on cleaner energy and blindly sent an email asking for help.

Many more exchanges later, they revolutionized India’s steel industry, at least for small-scale mills. And Goel not only saved the jobs of his workers, he created more than twice as many new jobs—while cutting out the polluting portion of his operations and reducing his need for diesel fuel.

“It not only saved us but saved many others,” says Goel, who has opened his door to any mill owner who wants to see how he operates without a heavily polluting furnace. “We want every steel mill to be conscious of the cost of the product and the impact on the environment,” he explains.

Direct rolling is a technological breakthrough that uses an induction furnace, continuous casting machine and a rolling mill. With this system, hot billets from the casting machine are transferred by high-speed conveyors to

the rolling mill, without the intervention of a re-heating furnace. Due to the absence of a re-heating furnace in the production process, there is zero fuel consumption and significant reduction of burning loss.

Not only have they cut out their emissions completely, but workers have a healthier environment and the thick steel wire and construction beam products are of better quality. The continuous-castor method heats the ballast from the inside and thus it is smoother, more uniform and stronger because the grains of steel are more compact. The previous method only heated the outside surface. Without the need to reach an extreme high temperature, there are far fewer breakdowns in the mill, so production costs have reduced as well.

With the savings and increase in demand due to a better quality product, Goel has more than doubled his employees to 500. “In the early days it was a tough job to find workers and now it’s much easier—they line up to work here.” I hear from workers that there are much healthier conditions across the plant. “Goel is also looking at backward integration to cut costs further by venturing into iron ore milling to create the raw material he needs, something he could never consider in his previous operations.

PROJECT IMPACT

- With the elimination of their oil-fired furnace, the family-run steel mill reduced their energy consumption by about 84 per cent. At the same time, productivity increased from 10.5 tonnes of steel per hour to more than 13 tonnes and annual greenhouse gas emissions reduced by more than 63 per cent from 8,400 tCO₂ to about 3,000 tCO₂.
- Against an investment of 150 million rupees (about \$231,000), the company saved 58 million rupees (about \$89,000) a month (at 2013 prices): a payback period of just about three months.
- The project enabled Indian steel mills to compete in the global market, which not only means survival of the industry but job security for tens of thousands of workers.



Solve the puzzle to know more about Indonesia's wind power prowess

ACROSS

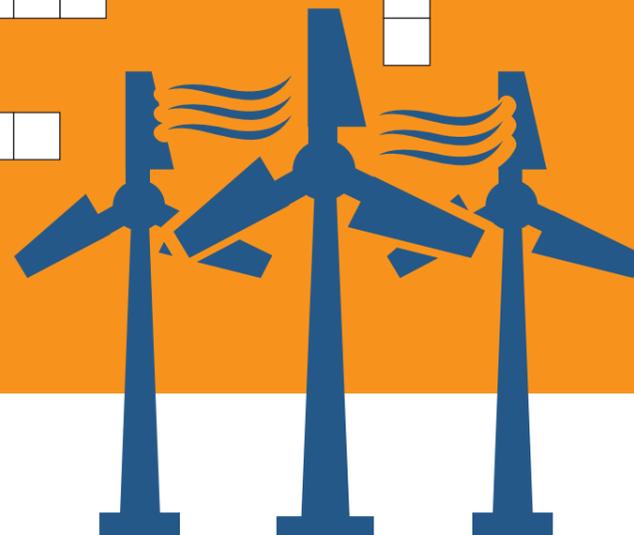
- 2. Provided it for 26 potential locations
- 3. Windpower is --- energy
- 7. The process for which is lengthy
- 12. The country WHyPGen Project provided feasibility studies for
- 13. Wind power industry is --- field is Indonesia
- 14. Building wind farms with technology to - low-speed wind
- 15. 30 turbines have been installed here
- 16. Currency in Indonesia
- 17. WhyPGen Project has also developed

DOWN

- 1. Wind Power Holdings are making
- 4. Place where PACE Energy is targeting first wind farm
- 5. WhyPGen Project has helped state officials learn about wind project proposals
- 6. Used for harnessing wind power
- 8. They signed huge deals with the Government of Indonesia
- 9. The Dutch did not build in 350 years in Indonesia
- 10. Windpower encourages this
- 11. Costs of interest rates on loans for renewable energy project

SOLUTION

ACROSS : 2. RENEWABLE 7. MINIRING 9. MICROHYDRO 10. HYDROELECTRIC 11. BIOMASS 13. HAZARDOUS
DOWN : 1. GEOTHERMAL 3. TURBINE 4. BIND 6. MICROGRID 8. PHOTOVOLTAIC 12. SOLAR



BLOWING CHANGE INTO INDONESIA'S ENERGY SECTOR

Sceptics like to say that in 350 years the Dutch could not build a windmill in the Indonesian colony so why should wind turbines work now. The wind blows differently for Nila Murti. She went from working on the UNDP-GEF Wind Hybrid Power Generation (WHyPGen) Project to manager in a private company that is now investing in wind and solar power for Indonesia because of that project.

The WHyPGen Project provided wind measurement data and feasibility studies in 26 potential locations for wind power generation in 17 provinces of Indonesia. The results convinced PACE Energy and another company, Indo Wind Power Holdings, to make major investments. In August 2015, both foreign investors signed huge deals with the Government of Indonesia to commit to the development of wind power projects worth \$657 million.

They are building wind farms with technology designed to harness low-speed wind, which is the nature of air flow at the equator. PACE Energy is targeting the construction on its first wind farm in 2018, installing around 50 turbines (at 150 MW) in

Banten Province, followed by smaller farms, at around 30 turbines (100 MW) in South Sulawesi Province and 15 turbines (50 MW) in Nusa Tenggara Timur Province. These are all areas that have limited grid-supplied electricity currently.

WHyPGen's work influenced the government electric company, PLN, and Directorate-General of New Renewable Energy and Energy Conservation, ESDM-EBTKE, to be more open to renewable energy, particularly wind power, and confident in signing power purchase agreements with private companies in 2015. Murti says the WHyPGen Project helped state officials learn how to evaluate the economics of a wind project proposal.

"In 2010 to 2012, almost no one believed Indonesia had the potential to develop wind power," says Murti, now Project Manager at PACE Energy. The lack of wind data measurement and failure of the pilot projects stoked wind energy scepticism. There seemed to be no potential for a wind power industry. Now it's a "crowded" field with more than five companies investing in wind power, says Murti. She also says that project developed

the training curriculum so that when the wind industry finally emerged, local experts would be ready to be involved in the industry. Of the 14 employees at PACE, for example, 12 are Indonesian.

Murti joined the WHyPGen Project after working in energy conservation because "I realized it's very exciting to see something new happening in Indonesia. Promoting renewables means we can have more sustainable power in the future and not be dependent on oil imports," says Murti. "This is my vocation. I want to see a real wind farm in Indonesia. All that we were working for with WHyPGen I want to come to pass."

The main obstacles to improving the renewable energy sector in Indonesia are the high initial costs, high interest rates for loans for renewable energy projects because they are considered high risk and a lengthy permit process. In 2015, the Government of Indonesia raised its target to increase the share of renewable energy in the total energy mix to 23 per cent by 2025 from the then 6 per cent.

In addition to providing jobs for the construction of turbines, wind power encourages tourism. In a Yogyakarta Province fishing village, where a demonstration farm was built, Jumali, a shop owner, says the new electricity has encouraged tourism: "Before we had this local power, this beach area had an income of 25 million rupiah [a year]. Now it has soared to 300 million rupiah."

PROJECT IMPACT

- The WHyPGen Project contributed to wind measurements and mini wind farms in Indonesia demonstrating the low-speed window turbines. It also helped the Government to develop a wind power curriculum for creating a cadre of local wind experts across the country.
- The first privately invested wind farm (by UPC Renewables, an American company) is slated to begin operating in 2017 in South Sulawesi.

ENERGY EFFICIENCY MEASURES FOR THE CUP THAT CHEERS



Starting with 45% and moving clockwise, connect the facts to see how many grams of CO₂ this project reduced per cup of tea

SOLUTION
grams

- 45% of India's tea exports are produced in the Nilgiri hills of South India
- 2 India's rank in tea exports worldwide (after China)
- 3.8 kg CO₂ was emitted per kg of tea processed prior to this energy-saving initiative
- 60% of the local economy in this project area relies on revenue from tea
- 300,000 people are employed in tea production in the Nilgiri hills of south India
- 60,000 small tea growers are involved in this supply chain
- 100 small-scale factories now process leaves into tea
- 30% of production costs of tea attributed to energy requirements
- \$2.5 million (much of it private equity) channeled into a range of energy-saving measures
- 265 tea processing units in south India were involved in this project
- 4 years taken by the project to introduce energy conservation measures in small tea processing units
- 24.6 million units of electricity saved per year through this project
- 62 million kg of wood did not have to be burned because of the energy-saving methods introduced.
- 130,000 tonnes of CO₂ emissions reduced per year due to this project.

PROTECTING JOBS WITH ENERGY EFFICIENCY IN INDIA

The hills of southern India are alive with luminous green tea estates often described as serene and majestic. For workers on those estates, however, the undulating hills have not always been serene for job security. In 2008, tea estate workers like Manogaran, the supervisor of the Kaikatty Tea Industrial Cooperative Society in the Nilgiri hills, were extremely worried. Employed at the cooperative for more than 30 years, he had known no other job but had recently heard the cooperative would shut down amid rising losses. He was not alone—spread over 2,000 acres, the cooperative is a lifeline for 1,500 members, most of them women. But Indian tea companies were losing out in the global market on price for Oolong and black tea, which the Nilgiri hills are known for. Many companies feared extinction.

More than 60 per cent of the local economy relies on revenue from the tea sector, which employs more than 300,000 people. South India, where the Nilgiri hills are located, contributes more than 45 per cent to India's tea exports; India is the world's second-largest producer and exporter of tea (after China). Much of the region's tea comes from 60,000 small tea growers who own

one hectare of land and sell tea leaf to 100 small-scale factories nearby that process the leaf into tea. On average, these bought-leaf factories consume 9 million kg of firewood annually, much of it transported to the Nilgiri hills from more than 400 km away. Roughly 30 per cent of production costs are attributed to energy requirements.

Through a UNDP-GEF Energy Conservation in Small-Sector Tea Processing Units Project with the Tea Board of the Ministry of Commerce, the cooperative underwent an energy audit that highlighted many opportunities where greater energy efficiency could reduce production costs. Accepting the recommendations, the cooperative turned its prospects around within two years by saving tremendously on its energy bill.

According to V. Arunachalam, the head of the Kaikatty cooperative, "Before we began investing in energy conservation measures, we viewed it as an exercise that meant choosing between profitability and the climate." Today his view is different. "Energy efficiency in the tea

sector has meant we can do justice both to the hills and the local community, which thrives on tea."

Added R. Ambalavanan, the Executive Director of the Tea Board of India, "The growing shortage of fuel and climate change has created a sustainability challenge for the tea sector. Translating findings from energy audits into actual concrete measures is the key to the adoption of energy conservation practices as part of business strategy." More than \$2.5 million, much of it as private equity, was channelled into a range of energy-saving measures, both in thermal and electric energy. This included installing more efficient motors, investing in wood chippers to enhance efficiency in burning firewood, modifying blades in the drying process and using renewable energy sources, such as biomass and hydropower. Carbon dioxide emissions were reduced by around 263,952 tonnes during the project duration. On average, the tea produced with energy conservation measures generate 0.27 kg CO₂ less (10 per cent) than previously (3.8 kg CO₂ per kg of tea processed).

The experiences of small tea processors have resonated with the larger, export-oriented tea estates. Shailajit Roy, manager at one of the region's largest tea exporters, acknowledges, "This year, we budgeted over \$40,000 in energy saving measures—last year, we had no budget for these activities."²⁸



- The four-year project introduced energy conservation measures in small tea processing factories that helped them realize between 15 and 30 per cent savings in energy costs and ultimately their survival as thriving businesses capable now of competing globally.
- If energy conservation measures were adopted by all 265 tea processing units in south India, there would be an annual savings of 24.6 million units of electricity and 62,000 tonnes of wood, which would translate to a reduction of 130,000 tonnes of CO₂ emissions per year.

28. Story from UNDP website, see www.undp.org/content/india/en/home/ourwork/environmentandenergy/successstories/a_green_label_forindiantea/_jcr_content/contentPar/successstorycomponent.html

HOP'S VASE

SPOT 10 DIFFERENCES IN THESE
TWO VASES



A LOAN FUND TO CHANGE A SEVEN-CENTURY PRACTICE IN VIET NAM

With a non-coal-burning kiln that he never could afford previously, Nguyen Van Hop began making ceramic vases taller than he is and his business blossomed. But more importantly, the air his village breathes became safer—clear and fresh. Before, the village was covered with dust and filled with smoke to the point people could hardly see each other.

Hop owns a small-scale ceramic workshop in northern Viet Nam's Bat Trang village, an ancient centre of traditional porcelain and pottery that is a popular tourist attraction. The production in this village has grown rapidly in this, the seventh, century—but at the expense of the environment. Hop's workshop and all others around used only coal-burning kilns, causing serious air pollution. More than 70 per cent of the villagers were diagnosed with respiratory diseases. "I felt so scared each time I started the kiln, dust was everywhere," Hop says.

The small and medium-sized enterprises within Viet Nam's industrial sector account for more than 96 per cent of all enterprises and half of all employment (and

around 40 per cent of GDP). When the Government asked UNDP-GEF to help SMEs transform from highly energy-inefficient and polluting businesses to energy efficient enterprises with greatly reduced pollution emissions, what it got in return was a transformational component targeting the banking and financial sector.

The Viet Nam Promoting Energy Conservation in Small and Medium Enterprises (PECSME) Project (2006-2011) offered training and technical know-how to SMEs making bricks, ceramics, textiles, paper and food products; energy efficiency equipment manufacturers; and local communities making ceramics and bricks. The project's specialists worked not only with businesses but government agencies, financial institutions, universities, NGOs and energy efficiency service providers to remove barriers to the widespread adoption of energy conservation measures and practices.

In the banking and financial sector, for instance, credit officers were trained on the risk, benefits and evaluation of energy-efficient and energy conservation projects so that they would be willing to finance SMEs through loan

guarantees. The project's transformational elements included tax and financial incentives used by 543 SMEs, training for 350 Department of Science and Technology officers from selected provinces on the economic and environment benefits of energy efficiency and energy conservation and training for 895 SME entrepreneurs from five industrial sectors on benefit-cost and financial analysis of energy efficiency and energy conservation.

Hop was one of those SME entrepreneurs. As a demonstration to bankers of what could be achieved, the project also provided short-term loans to Hop and the other entrepreneurs in the village to switch to kilns that use liquefied petroleum gas. This has helped reduce the overall energy consumption in Bat Trang by 10–15 per cent. The more modern kilns have significantly reduced air pollution and improved the quality of ceramics produced.

Hop said that as a result of the switch, there is now a lot less smoke in his workshop and he feels his health and that of his family has improved. As has his business. "Since we changed to the gas kiln, our house is cleaner and we breathe in fresh air," Hop says. "The gas kiln requires higher technique and skills but it gives more stable and quality products—I am now able to produce big vases," he says with a grin the size of, well, a crown. Because, since the gas kiln let Hop go huge he has become the "king of big vases."²⁹

PROJECT IMPACT

- The PECSME Project has been the catalyst for influencing government policymakers and SME owners to support energy-efficient and energy-conservation investments in Viet Nam, leading to a high rate of replication of PECSME demonstration models.
- A total of 543 SMEs invested \$24 million of their own funds into energy-efficient technology, helping them to reduce their energy consumption. A Loan Guarantee Fund set up through the project issued a total of \$1.7 million in loans to 50 SMEs.
- Profits of the participating businesses have increased—both through the direct energy savings and through an improvement in product quality.

29. Story from Nguyen Viet Lan, UNDP Viet Nam.



THE FINAL WORD ON IMPACT

Our work is technical. But every story about technology or financing or de-risking investment is a story about people. Ultimately, our work is about connecting innovative technologies with people to change the way that we live our lives.

The stories in this book are about those connections—access to an affordable energy source for those without, access to renewable energy (wind, water or solar), or the efficient use of any type of energy (preferably cleaner sources). While much of the work has been and remains technical, it has always set out to reinforce the UNDP human development mission of “helping people build a better life” by providing knowledge about what works, under what circumstances and how to access sustainable sources of finance.

These stories are also about how all sizes of countries and types of polluters are eager to lower their carbon emissions, with energy efficiency and renewable energy recognized as significant solutions. Whether it’s the countries with increasing carbon emissions or countries with a negligible contribution of greenhouse gas emissions (that are even already suffering from climate change impacts), all indicate through their engagement with the UNDP-GEF projects that they want to become

more efficient in their use of resources and contribute in their own ways towards reducing the impacts from climate change.

The connections featured here are only a few of the many ways our work on climate change mitigation and sustainable energy are changing the way people live, use resources and work their way out of poverty. Although it’s difficult to total up the impact on people’s lives or even greenhouse gas reductions from the projects singled out in this book (some of them remain ongoing), the numbers from just the past four years alone give a glimpse of the magnitude of change taking place:

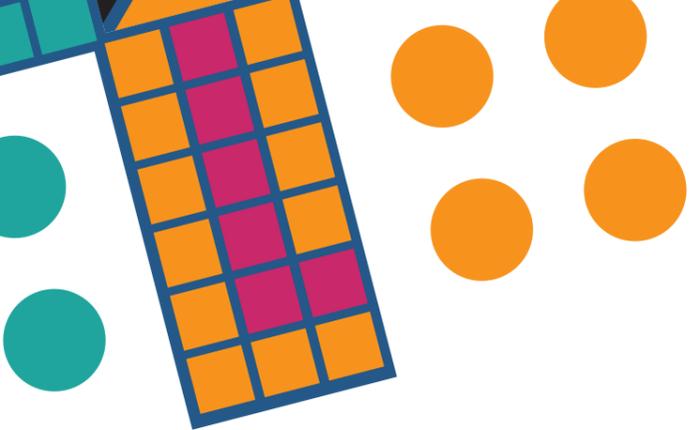
But this work began nearly three decades ago the world over. Change to date is exceptionally greater. Over the past 16 years, UNDP has invested a total of \$1.9 billion into sustainable energy projects in 153 countries or territories.

To help governments in Asia and Pacific reach their climate change commitments and their 2020 targets, GEF has currently committed to providing \$355 million to UNDP-supported energy projects. With this exponential growth in investments, forthcoming change should be staggering.

With each phase of the funding to date, what governments and private sector businesses have wanted in terms of support has evolved. These days, for instance, there is little need for awareness on why change is necessary. Instead, they now want to know their technological options. What is particularly rewarding to see is the integration of energy plans within development plans (rather than the previous stand-alone strategies) in most of the countries where we work.

UNDP’s portfolio of mitigation and adaptation projects supports all the mechanisms under the United Nations Framework Convention on Climate Change process, including nationally appropriate mitigation actions, national adaptation programmes of action, national adaptation plans, low-emission development strategies and climate finance readiness plans. By scaling up resources and tools to strengthen developing country capacities, the Paris Agreement can promote lasting, country-driven change. Although the current low oil prices that threaten the incentives to take action against fossil fuel use have become a new challenge in our work, the speed at which the Paris Agreement is moving towards becoming a ratified treaty reflects





countries' acceptance of the problems and the need for immediate solutions. UNDP has developed an exceptional understanding of the challenges that developing countries face from the changing climate and the solutions needed to implement the historic and game-changing Paris Agreement, within the context of their development goals.

Equally significant is having a specific goal among the new Sustainable Development Goals that targets universal access to affordable and clean energy by 2030 (SDG 7) and taking action to combat climate change and its impacts (SDG 13). That means the provision of electricity and cooking energy to the 1.1 billion people

currently without (and contributes towards SDG 10 on reduced inequalities).

Achieving that goal will have profound impact on nearly all the other 16 goals. As our stories illustrate, providing homes with electricity helps young people study better and stay in school (SDG 4 on quality education) and helps their parents increase their income with more productive livelihoods (SDG 1 on poverty and SDG 2 on no hunger); it helps reduce pollution in homes and thus the related illnesses that kill more than 4 million people each year (SDG 3 on good health and well-being) and it helps improve households' access to a safe water supply or improved sanitation (SDG 6 on clean water

and sanitation); it helps reduce pollution in cities (SDG 11 on sustainable cities and communities); and it helps industries save money on their energy bills and create jobs (SDG 8 on decent work and economic growth). By helping industries, hotels, hospitals and even shopping malls create products or services with heavily reduced carbon emissions helps individuals contribute towards climate change mitigation (SDG 12 on responsible consumption and SDG 13 on combatting climate change and its impacts).

With UNDP committed to helping governments reach those goals, we hope the next book will tell a bigger story about our changed world.

PROJECT IMPACT

- From 2012 to 2015, the GEF alone channeled \$101 million through UNDP to fund 97 climate change mitigation and sustainable energy projects in 27 countries in Asia and the Pacific, reaching 933 communities, impacting more than 1.7 million people and leading to the direct reduction of 422 million tonnes of CO₂ equivalent.

ENERGIZING SUSTAINABLE DEVELOPMENT

HOW SDG 7 CONTRIBUTES TO ACHIEVEMENT OF THE OTHER SDGs



Two hotels diverged in an urban hood
And sorry I could not sleep in both,
And be one traveller, long I stood
And looked down one as far as I could ...
Two hotels diverged in an urban hood
And I—I took the one more efficient
And that has made all the difference.

Apologies to Robert Frost

Acknowledgements

This publication is indebted to the unique quirk of each team member: Karen Emmons, who brought creativity and fun to our technical work through the activity concept and pulled the words, games and design all together; Rakshya Thapa, who pushed relentlessly for the human element and coordinated the process from beginning to end; Butchaiah Gadde, who insisted on something “out of the box”; Noel Soriano, who created most of the games; Milou Beerepoot, who brought a bird’s eye view to the presentation of facts; Karakate Bhamornbutr, who kept the process flowing smoothly; Gordon Johnson, who made the funding possible for something creative; Marcel Alers, for remaining open to the creative direction; Cedric Monteiro, for leading the publication to the design team; and the design team at Roots Advertising (in New Delhi) for making our imaginations colourful on the page.



*Empowered lives.
Resilient nations.*

