Sustainable & Efficient Industrial Development

Examples of Best Practice & Results

There is great development potential in the agro-based and tourism sectors in Bhutan and Nepal, considering their climate and topography and their rich cultural and historical heritages. However, there are all sorts of problems in these sectors, such as inefficient or excessive use of resources, overlooking environmental pollution, and little awareness of green technologies and solutions based on renewable sources of energy. With support from the European Union (EU) SWITCH-Asia Programme and Austrian Development Cooperation (ADC), the "Sustainable and Efficient Industrial Development (SEID)" project was implemented from February 2012 to December 2015 for 47 months to address these problems, and to contribute to the sustainable growth of Nepal and Bhutan.

The beneficiaries and stakeholders include industries (micro, small and medium-sized enterprises), industry associations and industrial parks, governmental institutions, universities and schools, NGOs, green technology & service providers, and local environmental consultants.

The SEID project was led by GrAT (Center for Appropriate Technology) at TU Wien, with the following partners: ASSIST (Asia Society for Social Improvement and Sustainable Transformation), FNCCI (Federation of Nepalese Chambers of Commerce and Industry), BCCI (Bhutan Chamber of Commerce & Industry), GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), AREC (Austria Recycling), and Stenum ASIA Sustainable Development Society.

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Foreword

Sustainable Production and Consumption can provide inspiration to balance the aims of economic growth, job creation and consumer satisfaction with environmental demands, a safer and better work environment and smarter use of resources. Innovation drives this process, to which the € 2 million EU-funded SEID project is contributing with appropriate and practical ideas.

This publication covers more than 40 examples of best practice intended to encourage entrepreneurs in the tourism and agro-based industries in Nepal and Bhutan to explore avenues towards more sustainable, innovative production. This information is especially relevant for the real drivers of any economy, i.e. the small and medium-sized businesses. Practical tips in this booklet cover themes such as resource and energy saving, the use of renewable energy technologies, means of effective waste reduction and management and how to improve the work environment. All this can ultimately contribute to reducing the costs of production, enhancing productivity and profitability and fostering a cleaner, safer and healthier work and living environment.

This paper shares examples of best industrial practice in an illustrative, easy-to-read format, and offers locally adapted suggestions for improvements. We hope it will contribute to the ongoing dialogue in Nepal and Bhutan on how to bring development to a new level, creating an enabling environment for sustainable industrial practices.

I would like to congratulate the whole project team on their efforts in producing this piece of work, and wish you happy and beneficial reading.

Andreas ROETTGER
Head of Cooperation
Delegation of the European Union to Nepal
Kathmandu, Nepal

Message from Senior Program Manager

It gives me great pleasure to write this message on showcasing examples of best practice, an achievement of the SEID project funded within the European Union's SWITCH-Asia programme.

The manufacturing sectors in Nepal are yet to be transformed into sustainable, economically viable and environmentally friendly fields. Most of them are still operating inefficiently with obsolete and polluting technologies, which have given rise to high emission levels, especially Greenhouse Gases (GHGs). The scientific evidence indicates that increasing emissions from industries, especially GHGs, have great potential for contributing to climate change, which poses a serious risk to human life and the environment.

There have been plenty of debates and discussions in any number of forums about finding ways to decouple economic growth from the environmental problems associated with it, in order to protect human health and the environment, aligned with slogans such as the green economy, green growth, low-carbon development path, resource efficiency, energy efficiency, responsible production, climate smart planning and technologies, global greening value-chains, clean development mechanisms, emission trading, climate change adaptation and mitigation, etc. Undoubtedly, the ultimate aim behind these terms is to reduce pollution during consumption and production processes by adopting cost-effective and environmentally friendly technologies.

The European Union has designed its SWITCH-Asia programme to address the issues related to economic growth and its adverse environmental consequences. The SWITCH-Asia programme promotes Sustainable Consumption and Production practices, offering an integrated approach to reducing economic, social, and environmental costs and strengthening economic competitiveness. In line with the objectives of the SWITCH-Asia programme, the SEID project has been funded to transform industries from using conventional polluting and resource-intensive technologies to non-polluting and resource-efficient technologies in tourism and agro-based industries in Nepal and Bhutan. The project mainly promotes activities such as improving energy efficiency in end-use and industrial processes, energy supply and demand management leading to reductions in energy consumption and emission reduction, adopting renewable energy technologies, optimising processing for better water use and less waste generation, reducing use and disposal of hazardous chemicals, improving working conditions, adopting a responsible approach to production, etc. for cost-effective production of goods and services.

I personally believe that this publication will provide a roadmap for other industries which will benefit in terms of understanding, learning from and replicating these examples of best practice, maximising company profit and thus contributing to economic prosperity in both countries.

The project could not have succeeded without the active involvement of all the stakeholders. I therefore wish to extend my appreciation and thanks to all the project stakeholders, especially the Center for Appropriate Technology – GrAT, which has been a leader in implementing the actions and making it possible to produce this pleasing work.

Ranjan Prakash SHRESTHA
Senior Programme Manager
Delegation of the European Union to Nepal
Kathmandu, Nepal

AUSTRIAN DEVELOPMENT COOPERATION

Message from ADC

The Himalayas are among the most vulnerable regions worldwide with respect to the impact of climate change. However, it should not be forgotten that the Himalaya states are not helpless victims, but also responsible states which want to, can and must contribute to reducing greenhouse gas emissions worldwide. The SEID project in Bhutan & Nepal is a valuable step in this direction. Apart from greenhouse gas emissions, the project activities aim at a more sustainable use of natural resources, in order to conserve them in their function as the basis of local livelihoods on a long-term scale. Last but not least, a healthy environment is the best and most cost-efficient way of disaster risk reduction, to avoid harm to the lives and property of people in Bhutan and Nepal.
The Austrian Development Agency, as one of the institutions funding this valuable project, congratulates both the Austrian partner GrAT (Center for Appropriate Technology) and the local partners and all stakeholders involved in the successful implementation.

Andrea Schmid
Head of Unit, Civil Society International
Austrian Development Agency

Introduction

Challenges & Opportunities

Nepal and Bhutan are among the least developed countries, with 77% of the population in Nepal and 49% in Bhutan living on an income of less than 2 USD per head and day (2010, ADB). People in urban and rural areas of Nepal suffer from an acute energy crisis. Nepal is also facing challenges in reviving its tourism industry, which has been hard hit by the recent earthquakes. Bhutan's economy depends very much on imported goods and services, and it is difficult for local enterprises to create their own competences, which are decisive for the future sustainability of the country's economy and society. The agro-based and tourism sectors in Bhutan and Nepal serve as an important engine for economic growth and poverty alleviation through acquiring foreign currencies and creating domestic employment. However, these industries still rely on energy-intensive, outdated and polluting technologies & practices. Inefficient resource utilization has led to excessive waste generation and burdened small and medium-sized enterprises, not to mention micro cottages, financially. The main reason for these problems is a lack of awareness and systematic guidance in implementing technical solutions that can greatly improve energy and resource efficiency, contribute to cost savings and improve the work environment. There is a great demand for such appropriate technologies and practices.

Message from Lead Project Managers

The project SEID has tackled over four years a wide range of activities to improve the environmental, social and economic situation in Nepal and Bhutan in SME companies and beyond. A strong capacity building component has trained a large number of national experts and it was linked with direct in-house consulting for companies. At the same time the policy level was addressed to create an increased awareness and in the long run an enabling policy environment that supports SCP practices. Specific Appropriate Technology solutions have been developed especially in the field of renewable energy utilization. This was only possible due to the funding from the European Union and the co-funding from Austrian Development Cooperation. SEID has provided consulting services to 200 companies in Bhutan and Nepal. Its holistic approach embraced improvement of resource and energy efficiency, chemical and waste management, and the work environment, as well as making use of renewable resources. At the same time the programme aims at generating economic savings and guiding every stakeholder to more environmentally aware behavior.

With the aim of spreading valuable knowledge and information for Sustainable Consumption and Production (SCP), we have published this "best practice paper". You will find 45 spotlights on practices that have been implemented in one or more of the SEID member companies, grouped in 7 categories, showing their environmental, economic, and social benefits.

We hope that this paper will contribute to spreading the knowledge about a diverse range of improvement possibilities to make businesses more sustainable. As we all know, one of the best ways to learn about something is to do it. We hope that you start to do whichever practice you find applicable for your company and home right away. If you like your new learning experience, please pass your lessons on to your colleagues, friends, families, and neighbors. By doing so, you will all benefit from cost savings and a better environment. Moreover, you will become global citizens who contribute to sustainable development.

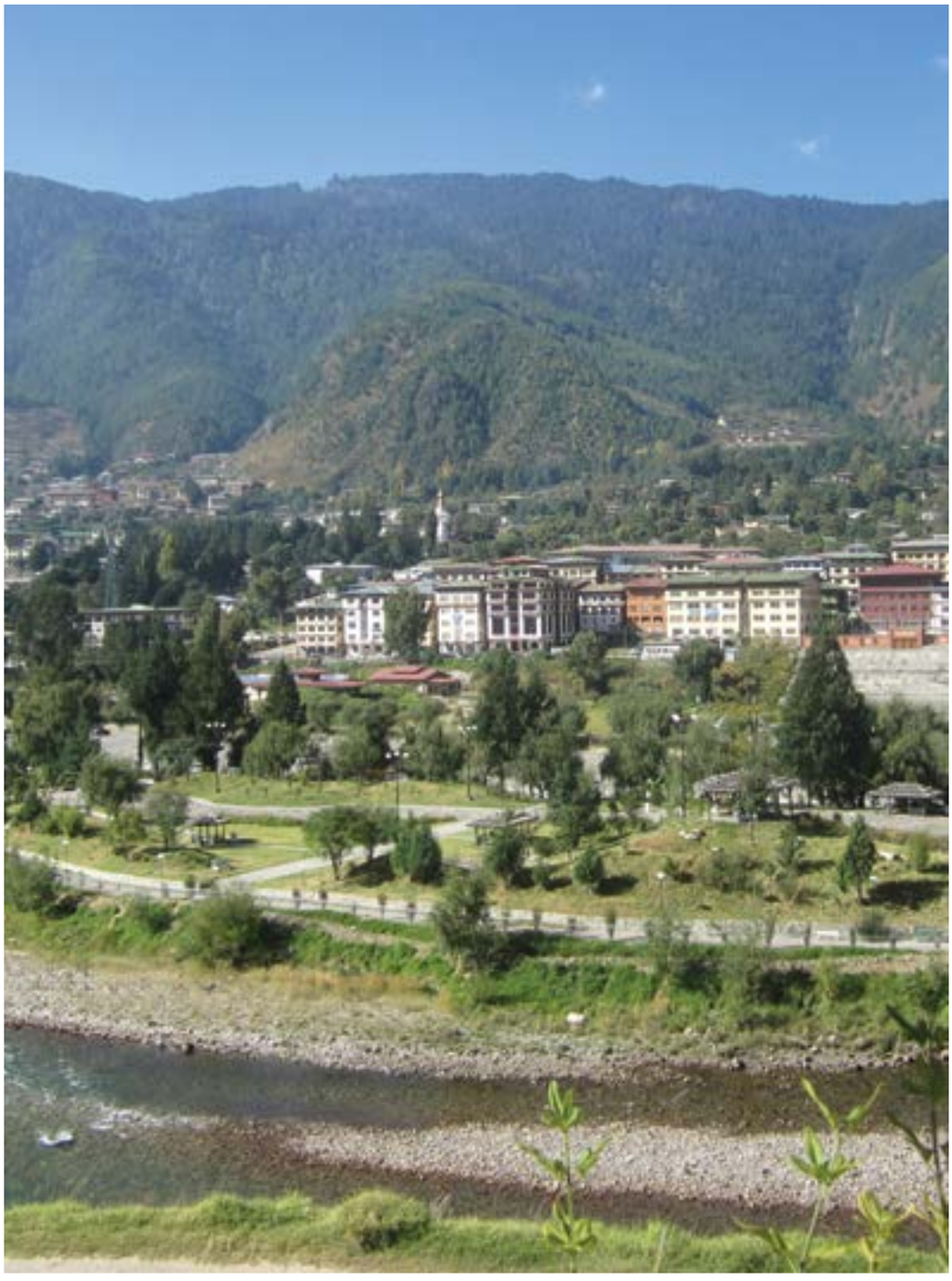
Many of us will remember the year 2015 as the year of major earthquakes in Nepal, which took many lives and affected the economy of the country as a whole. It was heartbreaking to hear the soaring number of lost lives and the stories from the badly damaged communities. On behalf of the project team, we express our heartfelt condolence to all those who lost relatives and friends in the calamity. We wish this paper can contribute to a better and more sustainable future for all of us. And we would be glad to hear about your own success stories. Please share them with us and the SEID team.

Robert Wimmer
Myung-Joo (MJ) Kang
Lead Project Managers of SEID
GrAT (Center for Appropriate Technology)
TU Vienna, Austria

Objectives

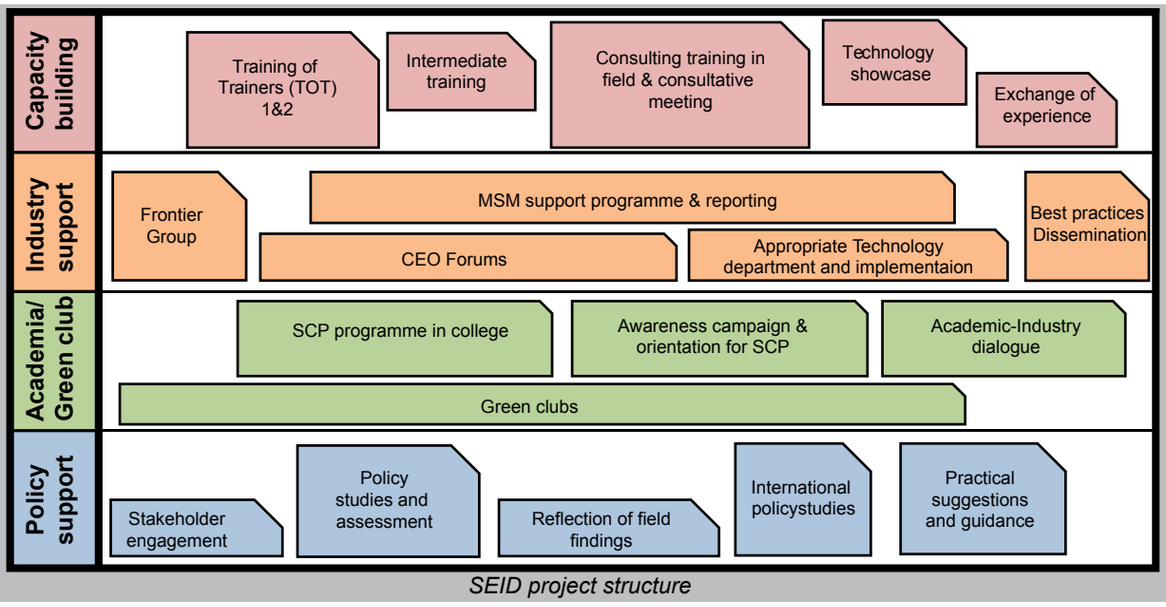
The project aims to contribute to sustainable development in Nepal and Bhutan by reducing the environmental impact of the industries, generating employment and alleviating poverty, particularly in the tourism and agro-based industrial sectors. The specific objectives are:

- To reduce costs by saving resources with more efficient production and operation of facilities;
- To lessen environmental pollution and improve health and safety standards for workers;
- To enhance the capacity of national consultants through training and field work;
- To provide access to the knowledge and practice of Sustainable Consumption and Production (SCP) from inter/national initiatives and to Appropriate Technology (AT) solutions; and
- To support key stakeholders, including government, industry associations and academia, in creating the institutional and educational environment that will foster sustainable industrial practice.



Activities & Results

The SEID project was designed and implemented in a highly sophisticated manner, in order to maximize the impact of the actions taken. This inclusive development programme encompassed capacity-building and awareness-raising components, policy interventions, direct consulting activities, engaging educational institutions, and technology development and transfer. Most of the components are interlinked; the outcome of one component becomes an input to another.



SEID project structure

Capacity Building of Local Consultants and Institutes

More than 80 Local Consultants (LC) and representatives from industries and academia have acquired new capabilities by means of intensive series of theoretical and practical training on resource & energy efficiency, waste management, renewable sources of energy, and building energy performance, plus occupational health and safety topics. Soft skills required for consulting, such as technical reporting & presentation and business communication were also taught. These enhanced the LCs' knowledge and competence as environmental consultants by showcasing advanced green technologies implemented in a wide range of industrial sectors. 12 LCs in Nepal and 10 LCs in Bhutan continued their long-term engagement to receive a Certificate as an SEID Consultant. Throughout the SEID project the concept of environmental consulting has been introduced in the industries concerned, which makes their investment worthwhile by delivering economic, environmental, and social benefits. It is anticipated that the environmental consulting business will grow in the near future.

MSME Support for Resource Efficiency and Cleaner Production

Through CEO Forums and stakeholder conferences in different regions, more than 500 enterprises and business associations are encouraged to participate in the SEID company support programme. Over 200 MSMEs have completed the SEID consultation programme, and most of them are benefitting from reduced operating costs, optimized resource efficiency and an improved working environment. The MSME support programme consisted of three phases at large, as explained below.

I. Initial Assessment

The project analyses the current business operation and collects consumption data from individual companies through on-site visit(s), data collection/ metering and interview(s). Volume/ amount of input and output materials, energy demand and consumption, waste, work environment, and staff behavior are investigated with the help of consulting guidelines and forms.

II. Implementation

A number of recommendations are made to individual companies in line with their problems and improvement potential as identified during assessment. Companies and the project team agree upon a work plan for gradual implementation of the selected measures. Additional guidance and support are provided if the company actively implements advanced technologies or practices.

III. Monitoring

Once the SCP measures have been implemented, the economic, environmental and social benefits are monitored (compared to the initial status) after some time. In some cases reusing waste and making better use of utility services create additional value.

Also, the amount of waste going to landfill or combustion has been reduced. Utilizing renewable sources of energy, particularly solar, and renewable materials has spread. A set of instructional guidelines in English (and in Nepalese for Nepal member companies), training handbooks, and awareness-boosting materials have been published and disseminated.Savings from 55 representative companies are presented in the next page.

Showcasing Appropriate Technology Solutions

Appropriate Technology solutions have been developed and/or demonstrated, in line with the needs of the participating MSMEs and the resources available in the region. A solar water heating system for hotels, natural solar lighting techniques and prefabricated products have been installed and tested. A dust collection system for beaten rice mills and an improved cooking stove for restaurants and food processing companies have been developed, and promoted. For effective use and independent maintenance of the installed technologies and devices, knowledge-transfer seminars were provided.

Savings achieved by SEID project member companies

The breakdown of annual savings in energy (electricity & fuel), water, material, and CO_2 emission actually achieved and computed for 94 out of 200 project member companies is shown below.

94 x

in Nepal & Bhutan

Energy (electricity & fuel)	**8,880,000 kWh/year**
Water	**73,000 m³/year**
CO² emission avoided	**1,854,000 kg/year (17% reduction in average)**
Saving in energy cost	**Euro: 360,800 /year (= BTN: 25,932,600 = NPR: 41,492,129)**
Saving in material costs	**Euro: 1,560,750 /year (= BTN: 112,172,900 = NPR: 179,476,600)**

Improvements in insulation of boiler systems in industries yield the highest energy savings, while water heating and improvements in the use of air conditioners also contributed to the reduction of electricity and fuel consumption. The rest of energy savings can be attributed to replacement of inefficient lightings and installation of solar water heaters and PV panels.

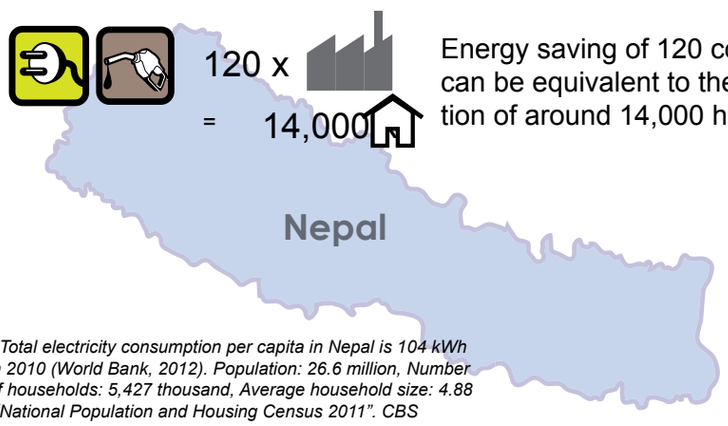
The total carbon footprint avoided by the representative 94 project sample companies amounted to 1.854 tons of CO_2. This means that each of the companies in the sample has avoided an average of 17% of CO_2 emission every year. The result was achieved mostly by reducing amount of fuel consumption (e.g. firewood, diesel, and LPG). As both countries generate electricity from hydroelectric sources, the carbon emission from electricity saving is negligible.

Equivalent potential of savings

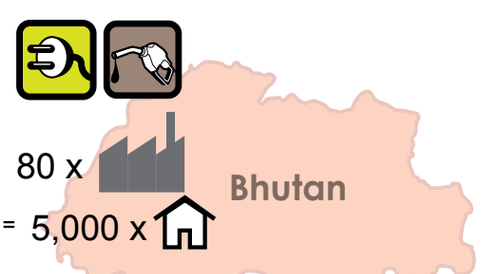
Translated into practical terms, the energy savings achieved by the 42 sample companies in Nepal are equivalent to the total electricity consumption of 4898 average households in Nepal. If this representative result is projected for the total 120 MSMEs in Nepal, the energy saving will cover the electricity consumption of about 14,000 average households every year*.

The energy savings achieved by the 52 SEID member companies in Bhutan are equivalent to the total electricity consumption of 2,513 average households in Bhutan. This indicates that electricity required for around 5,000 average households can be covered by the savings from 80 SEID member companies every year**.

The energy and material cost savings, and the reduction of carbon emission presented above will be multiplied and accumulated over years. Total cost saving of EUR 1,921,550 per year has been achieved by 94 sample companies.



Energy saving of 120 companies can be equivalent to the consumption of around 14,000 households.



Energy saving of 80 companies can be equivalent to the consumption of around 5,000 households.

**Total electricity consumption per capita in Nepal is 104 kWh in 2010 (World Bank, 2012). Population: 26.6 million, Number of households: 5,427 thousand, Average household size: 4.88 ("National Population and Housing Census 2011". CBS*

***Households in urban areas in Bhutan consume an average of 3,600 kWh of electricity per year (Tshering Lhendupa, et al. ""Domestic energy consumption patterns in urban Bhutan" (2010). doi:10.1016/j.esd.2010.04.004)*

Alliance Building with Key Institutions and Programmes

The SEID project looked for synergic effects among industry associations, NGOs, academia, and inter/national projects for SCP (Sustainable Consumption and Production). Examples of global best practice were introduced to local companies and institutions. Strategic partnerships with ongoing/upcoming inter/national projects have been established to exchange knowledge, information and materials. Formal agreements were signed with a number of selected academic, governmental, and business institutions, such as College of Science and Technology (CST), Department of Renewable Energy (DRE) in Bhutan, and Hotel Association Nepal (HAN).

Awareness Campaign for Pupils and Students

10 Green Clubs, with a total of 745 members in Bhutan and Nepal, have been established in schools and colleges to promote the concept of environmental conservation and sustainable development. The SEID project carried out various activities such as a demonstration seminar about vermin composting, and competitions for upcycling waste into useful products. Awareness campaigns using games and plays helped to create an atmosphere which further nurtures the creative minds of youth in promoting sustainability. Green Club activities contribute to spreading environmentally friendly ways of living to the household level.

Support for Policy Instruments

With assessment studies on policy and institutional frameworks, as well as the lessons learned from field experience, the project provided governmental institutes and business associations with practical suggestions for implementing or revising existing institutional instruments.

Suggestions for hotel rating standards, a cleaner production policy paper in Nepal, green building guidelines, and a subsidy programme for renewable energy technology in Bhutan were generated. High-level officials and policymakers from government agencies and partner agencies have further been supported through workshops on implementing the various strategies and instruments in order to facilitate the acceptability and competitiveness of SCP practices in the industries.

Best Practice for Resource Efficiency

Resource efficiency (RE) has been explained as “using the Earth’s limited resources in a sustainable manner while minimizing impacts on the environment. It allows us to create more with less and to deliver greater value with less input”*. Resources include raw materials such as fuels, minerals and metals, but also food, soil, water, air, biomass and ecosystems. Given the increasing concern with resources both globally and locally, resource efficiency can be a smart strategy to reduce the pressure on industries while achieving sustainable development with its economic, environmental, and social benefits:

- Economic benefit: RE saves costs for production and services, because companies need to pay less for resources and utility bills.

- Environmental benefit: RE contributes to the mitigation of resource scarcity and climate change with higher productivity, less emission, and resource circulation.

- Social benefit: RE has the potential to create new employment as companies and Local Consultants become more competitive.

In this paper the SEID project features 45 selected examples of best practice which directly or indirectly support RE. The examples were implemented by participating companies with the guidance and help of the SEID team. They are grouped in 7 categories, according to:

- Types of resources: (1) energy, (2) materials and chemicals, (3) water;

- (4) Utilisation of renewable resources; and

- Environmental, social, and economic benefits: (5) environmental management, (6) improvement of the work environment, and (7) creation of additional value.

All of the practices to be introduced are real-life cases from industries in Bhutan and/or Nepal, so the solutions are highly practical and affordable. Why not implement them in your business, too?

** http://ec.europa.eu/environment/resource_efficiency/*

Saving Energy

By saving energy, companies can lower their energy bills, reduce their reliance on external suppliers of oil and gas, and help protect the environment. Energy consumption in companies can be reduced at all stages of the energy chain, from selection of fuel, to storage of fuel, to generation of heat and power, to use of energy-efficient products or more effective use of products, and to recovery of waste energy. However, the demand for energy can be minimized from the start. The following examples illustrate how demand can be minimized.

Better Insulation of Timber Seasoning Kiln

Company: Wood Craft Centre Limited (WCCL)
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

The two old seasoning kilns in the plant were not insulated properly. Heat was being lost from the kilns, so electricity consumption was high at 326,400 kWh per year for a capacity of 600 cft (approx. 17 cubic metres) each, while the lumber was not seasoned properly. The process took longer, too.
On the advice of the project team WCCL built a new kiln, using better insulation materials such as hollow blocks, rock wool and mild steel sheet. This helped to lower the specific energy demand for seasoning lumber by 81,600 kWh per year, which has resulted in cost savings, while the number of days required to season the wood has gone down.

Rock wool sandwiched between two layers of hollow block

Investment: BTN 165,000 (including labour charges and raw materials)
Savings and benefits: 25% of saving (81,600 kWh per year)
Annual cost saving: BTN 244,800 per year (approx. EUR 3,264)
Pay-back period: 8 months

Insulation of Steam Pipeline

Insulation of 15 m of steam pipeline behind seasoning kiln

GWMC has a wood-fired boiler with a capacity of 3 TPH (ton per hour). The steam from the boiler is used in plyboard production; in the hot press, seasoning kiln and drying processes. Some steam pipes were not insulated, and the insulation on some was wet. Out of a total of 90 m of uninsulated pipeline, 42 m are 3” in diameter, 42 m are 2” in diameter, 3 m are 1.5” in diameter and 3 m 0.5” in diameter. Heat loss due to wet insulation is more than that with no insulation, and it may crack the pipes. The management was strongly advised to insulate all the steam pipes properly. The surface temperature of the bare pipeline was 90°C. The insulation not only saves fuel (firewood) and money, but also improves the environment for the workers.

The company started by insulating the first 15 m of the pipeline behind the seasoning kiln, because a huge investment would be required to insulate the entire line. The surface temperature of the insulated pipeline has been reduced to 38°C. The reduction of heat loss indicates a reduction in fuel consumption to produce the same amount of steam. 2,618.47 kg of wood are saved annually as a result of insulating 15 m of pipe. The annual CO_2 reduction achieved by this measure will be 4,085 kg. The savings will be multiplied if the rest of the line is insulated.

Investment: BTN 12,000 (approx. EUR 164) for 15 m of insulation, including procurement and labour charges
Savings and benefits: 2,618.47 kg of firewood per year, which will reduce carbon dioxide emission by 4,085 kg per year
Annual cost saving: BTN 28,203 (approx. EUR 386) from firewood saving
Pay-back period: 5 months

Insulation of Steam Pipelines to Reduce Heat Loss

Company: Bhutan Agro Industries, Ltd.
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

The unit had an uninsulated steam pipeline 15 m long from which a lot of heat was being lost. The surface temperature of the uninsulated pipeline was 89°C. It was clear that boiler fuel consumption could be reduced by eliminating the heat loss. The heat from the pipeline also made things more uncomfortable for the workers during summer.
The company insulated the pipe immediately with 2" thick glass wool. This simple measure helped to reduce the energy loss by 5,670 kWh per year, and made the shop more pleasant for the workers to work in.

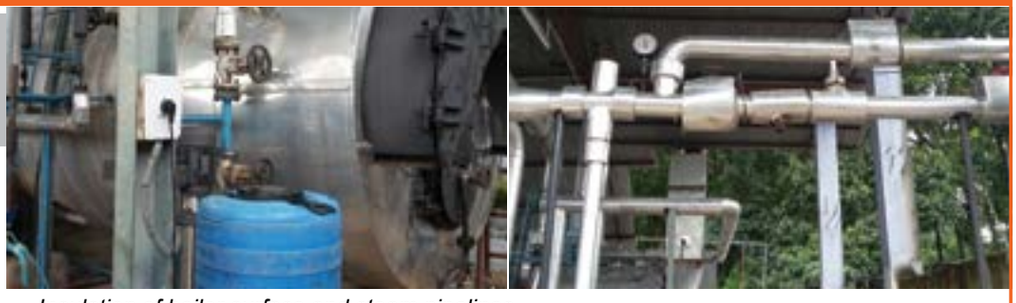
Insulation of the steam pipelines

Investment: BTN 8,000 (excluding labour charges, as in-house technicians were engaged)
Savings and benefits: reduction of energy loss - convective and radiant (5,670 kWh per year)
Annual cost saving: BTN 17,010 per year (approx. EUR 233)
Pay-back period: 5 months

Insulation of Steam Pipeline and the Boiler Surface

Company: Bhutan Fruit Product Private Limited (BFPPL)
Country/Region: Bhutan/Samtse
SEID Local Consultant: Rozal Adhikari

BFPPL has a diesel fired boiler with a capacity of 4 TPH (ton per hour). The steam from the boiler is used in juice, jam and ketchup production. The surface of the boiler and some of the steam pipelines were uninsulated. A total of 124 m of steam carrying pipeline was uninsulated. The surface temperature of the steam pipeline was 102°C and that of the uninsulated boiler was 128°C. The management was strongly advised insulating the pipes of 124 m, the boiler with surface of 3.53 m^2 and the tank where fuel is stored and preheated. The insulation with glass wool not only saves fuel and cost but also makes the working environment safer.



Insulation of boiler surface and steam pipelines

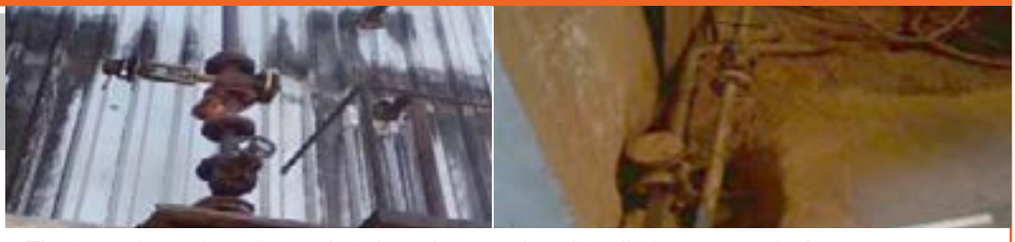
The annual fuel saved from insulating is 7,003 kg, which cost BTN 210,090. The CO_2 reduction achieved by this measure will be 21,709.3 kg per annum.

Investment: BTN 40,000 (approx. EUR 548), including procurement and labour charges
Savings and benefits: 7,003 kg of furnace oil per year, which will reduce carbon dioxide emission by 21,709.3 kg per year
Annual cost saving: BTN 210,090 (approx. EUR 2,878)
Pay-back period: 2.3 months

Repaired Steam Leakage from the Valves

Company: Green Wood Manufacturing Corporation
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

When the SEID team first visited the plant, steam leakage was observed from two valves due to broken gaskets in the boiler section. The plume lengths of the steam leakage were 0.2 m and 0.4 m respectively. The steam leakages associated with 0.2 m and 0.4 m plume length are 3 kg/hour and 5 kg/hour respectively.* The total steam loss comes to 7 kg/hour, which means that the boiler consumes more fuel (firewood). At the suggestion of the SEID team the management fixed all the steam leakages by replacing the gaskets with new ones. This helped reduce not only fuel (firewood) consumption, but also the CO_2 emission from combustion. It also makes the working environment safer for the workers, as the high-temperature steam could accidentally burn their skin. With this repair the plant saves 4,920 kg of firewood annually. The annual reduction in carbon dioxide emission is 7,675 kg.



The two valves where the gaskets have been replaced to eliminate steam leakages

** Kumar, P. (2010). Training Manual on Energy Efficiency for Small and Medium Enterprises. Asian Productivity Organization.*

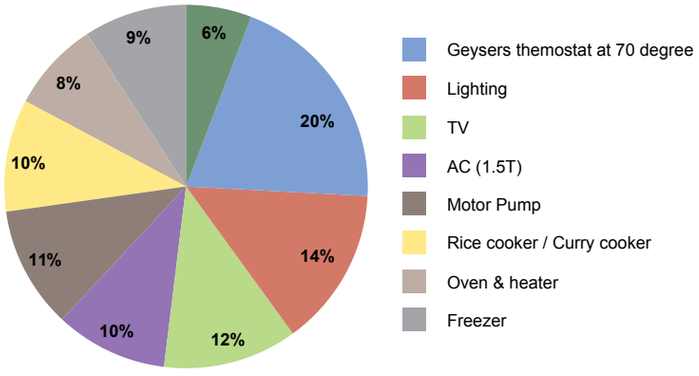
Investment: BTN 1,000 (approx. EUR 14) for purchasing and installing two gaskets
Savings and benefits: 4,920 kg of firewood per annum
Annual cost saving: BTN 54,120 (approx. EUR 741)
Pay-back period: 7 days

Not only large industries but **also small companies** can take the same approach to reducing the energy demand for heating and lighting. The examples from hotels and a bakery company demonstrate how small changes can still contribute to saving significant amounts of energy.

Setting Temperature of Heaters and Geysers

Company: Bhutan Hotel
Industrial Sector: Tourism Based industry
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Mani Kumar Puri

There are 22 geysers in all the guest rooms of Bhutan Hotel with a rating of 2000 W and a 25-liter tank each. The temperature of the geysers was set at 70°C, while 55°C suffices for a hot shower and meets the hygienic standard. The excessively hot water at 70°C could be dangerous if released before being mixed with cold water. The energy required to heat 25 litres of water from 20°C (cool water temperature) to 70°C is about 1.45 kWh; so the total energy required for taking two showers/baths per day, multiplied by the annual overnight stay of 4493, was 13,060.25 kWh per year, which cost BTN 36,569 (approx. EUR 494). Bhutan Hotel also uses one 50-litre geyser with a rating of 2000 W. The thermostat is set at 65°C for supplying hot water to the laundry for 100 minutes a day. The annual energy consumption of this geyser is 50 * 4.2 * (65-20) / 3600 * 608 (hrs.) = 1,596 kWh, which cost BTN 4,468.8.



Electricity consumption of different appliances, based on measured data

Following advice from the SEID team, the hotel management adjusted the thermostats for the geysers to 55°C. The housekeeping staffs also switch off the geysers if they are not in use for a long time. They are switched on when guests check in. The bigger the temperature difference between the hot water in the storage tank and the ambient temperature, the more radiant heat is lost. The total energy saved this way is estimated to be about 3,918 kWh/yr, for a cost saving of BTN 10,970 (EUR 148) per annum. The thermostat on the 50-litre geyser is also set to the minimum temperature of 55°C. The total energy saved with this setting is 354.67 kWh/yr, and the cost saving is BTN 993 (EUR 13.4) per annum. With this practice, the geysers now operate for less time, and their life span will also be prolonged.

Investment: BTN 1,000 (approx. EUR 14) for setting the internal 8 geyser thermostats to 55°C
Total energy saving from the geysers/year: 4,272.57 kWh (20-30% of energy saving per appliance)
Total cost saving/year = BTN 11,963.2 (approx. EUR 164)
Pay-back period: 1 month

Geyser thermostat set to 70°C

Geyser thermostat set to 55°C

Painting Dark Ceilings and Walls White

Company: Shakti Hotel
Country/Region: Nepal/Kathmandu
SEID Local Consultant: Khimananda Sharma

Before the SEID intervention Hotel Shakti in Kathmandu, Nepal, had dark-coloured ceilings in the guest rooms and the kitchen. 40 W fluorescent tube lights were used at least 5 hours per day to illuminate the premises. One of the simple and low-cost measures to reduce the demand for lighting indoors is to paint the interior in bright colours like white or a light cream colour. With the ceilings painted white, the kitchen and guest rooms in Shakti Hotel now appear brighter with the reflected natural light during the daytime, and they also require less lighting even at night for the same reason. The hotel also replaced 40 W fluorescent tube lights with 9 W CFL lights. These few simple actions alone reduce electricity consumption noticeably.

Black painted ceiling

Newly painted ceiling in white

Switching to Baking Trays with Less Thermal Mass & Reduced Baking Time

Company: Bagale Bakery Udhyog
Country/Region: Nepal/Pokhara
SEID Local Consultant: Samita Duwal

The bakery uses a baking stand with 18 trays (layers) as shown in the picture. It was observed that not all trays were fully stocked when used in the oven. The oven was operated for 5 batches (approximately 1 hour per batch) every day, consuming 175 kWh. The bakery was using trays without holes (i.e. high thermal mass of 2 kg).

After SEID's intervention, the bakery started to fill every tray in the stand with bakery items before putting it in the oven. With this practice, the bakery reduced the number of batches from 5 to 4, which directly leads to a 20% reduction in electricity consumption. The saving in electricity is 35 kWh daily. Annually the bakery saves 10,150 kWh. The bakery also uses perforated trays for better heat penetration. The new trays weigh 1.7 kg each. Their thermal mass has been reduced by 15%, which cut the energy consumption of the oven by 2% (812 kWh) annually.


Try to fill every tray in the baking stand


Use of perforated tray

Investment: NPR 5000 for perforated trays (approx. EUR 40)
Savings and benefits: about 11,000 kWh per year
Annual cost saving: NPR 19,183 (EUR 153)*
Pay-back period: 3 months

** The price of electricity in this area (Syangja) is abnormally low, due to the hydropower plant.*

Once the demand is defined and reduced, you need to choose a suitable type of energy source to meet the demand. Renewable sources of energy such as solar thermal, solar PV, and biomass can be effectively utilized. These solutions will be presented on page 24 to 26. In this section we focus on conventional energy sources like electricity from the grid, diesel, LPG, coal and firewood.

Improving Coal Storage for Better Combustion

Company: Star Tea Industry Pvt. Ltd
Country/Region: Nepal/Jhapa
SEID Local Consultant: Harish Chandra Bhusal

If coal is stored in the open, its moisture content goes up. Especially during the rainy season, the accumulated water and increased moisture content reduce combustion efficiency substantially. About 7%* of the fuel heat input into the boiler is used to evaporate and superheat the moisture in the fuel.

A transparent awning has now been constructed with water drainage at the bottom to protect coal from rain. The efficiency of the furnace/boiler will be increased as the moisture content of the fuel is reduced.

** http://cornerstonemag.net/improving-the-efficiency-of-power-plants-firing-high-moisture-coal/*

Total coal consumption (2014/2015): 874,340 kg/year
Savings (7%): 61,203 kg/year
Cost savings (kg*Rs 20): Rs. 1,224,060/year
Thermal energy savings (kg*5 kWh): 306,019 kWh/year
Total cost for the installation of the awning: Rs 500,000
Pay-back time: 0.4 year = about 5 months


Construction of an awning to protect coal from rain (above: before; below: after)

Optimized Air-fuel Ratio of Boiler to Save Firewood

Company: Green Wood Manufacturing Corporation (GWMC)
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

The 3 TPH (ton per hour) capacity boiler installed in the plant is wood-fired, with a forced-draught (FD) fan and an induced-draught (ID) fan. The fuel is put in the furnace through two doors. The quality, size, moisture content, and species of the firewood vary. During combustion both stoking doors used to be open. When both the FD and ID fan were turned on, the oxygen content of the flue gas was abnormally high.

SEID advised switching off the FD fan, which resulted in the oxygen content dropping to 5.3%; and the furnace doors were closed after the firewood had been put in – this lowered the oxygen content in the flue gas further, to 4.2%. In the light of these results the company started switching on the FD fan for 5 to 10 minutes only when necessary and also started closing the furnace doors during combustion. This ensures efficient combustion and prevents heat loss through the open doors.

The percentage fuel saving achieved from this implementation is 0.325%, equivalent to 4.7 t per year. This fuel saving also implies a reduction of 7,332 kg in CO_2 emission.

The furnace doors are closed during combustion

Investment: No expenditure was involved.
Savings and benefits: 4.7 ton of fuel (firewood) is saved per year
Annual cost saving: BTN 51,700 (approx. EUR 708)
Pay-back period: immediate

Improving Power Factor

Company: Morden Tea Estate Pvt. Ltd
Country/Region: Nepal/Pokhara
SEID Local Consultant: Khimananda Sharma/Ashish Raj Dhungana

Morden Tea Estate has a 1000 kVA approved load and transformer. The peak load observed was 304 kVA when the SEID team made an initial assessment. The firm also has three diesel generators rated at 500, 320 and 75 kVA, respectively. The power factor during the assessment was documented as 0.7 lag (inductive) which is inefficient practice in industries.* At a power factor of 0.7, 100 kW usable power equals 142 kVA (of which 42 kVA are not usable, but the company has to pay for 142 kVA).

SEID suggested improving the power factor by installing a capacitor bank to level out the inductive power factor. The demand charge per kVA is NPR 230. The company had saving potential through improving the power factor up to 0.99 lag. By implementing the SEID team's suggestion, the company has increased the power factor to 0.97 lag. Now that the power factor has been improved, the company's peak load has been reduced by 85 kVA for a month.

Peak demand 304 kVA at 0.7 lag (recorded for August 2014)
Demand in kW = 304*0.7 kW = 212.8 kW
Power factor improved to 0.97 by installing capacitor bank
Corrected demand = 212.8/0.97 kVA = 219 kVA
Reduction in demand = (304 – 219) kVA = 85 kVA
Reduction in demand charge = 85 kVA*NPR 230 = NPR 19,550 per month
Size of capacitor required = multiplier (0.81)* kW load (212.8 kW) = 172.36 kVAR
Savings and benefits: improving the power factor has saved NPR 19,550 per month in demand charges. The company operates 8-9 months a year, so the annual saving achieved in electricity bill was estimated to be at least NPR 175,950.

** Depending on payment details in the contract with the power company*

1 Power factor during initial assessment. 2 Corrected power factor. 3 After maintenance of electrical connections

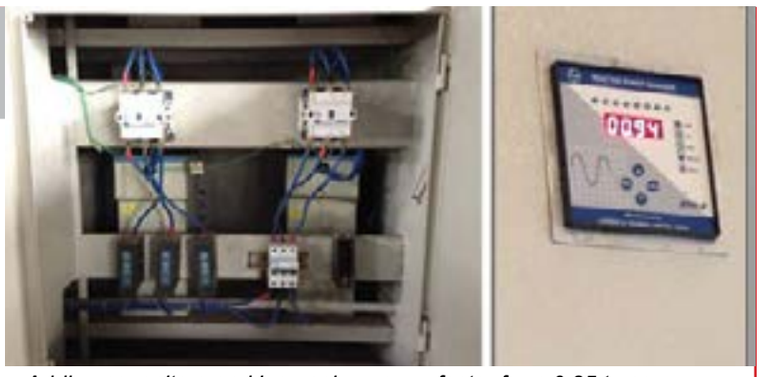
Investment: NPR 85,000 (approx. EUR 680) for repair and maintenance of the existing capacitor bank and adding a 50 kVAR capacitor bank
Annual cost saving: NPR 175,950 (approx. EUR 1,345)
Pay-back period: 6 months

Company: Star Tea Industry Pvt. Ltd
Country: Nepal/Jhapa
SEID Local Consultant: Harish Chandra Bhusal/Pushkar Thapa

This tea company was operating with a power factor of 0.85 lag. There was a loss on the electricity bill due to the high demand charge with this low power factor.

- Recorded peak demand = 350 kVA, Voltage = 420 V, previous pf = 0.85 lag, cost per month = Rs 230/kVA, present pf = 0.94 lag
- Actual demand = 350 kVA*0.85 = 297.5 kW, corrected billing demand = 297.5 kW/0.94 = 316.5 kVA
- Reduction in demand = (350 – 316.5) kVA = 33 kVA
- Reduction in demand charge per month = 33 kVA*NPR 230 = NPR 7,590/-
- Annual reduction in demand charge = 12*NPR 7590 = NPR 91,080
- Capacitor required = multiplier (0.29)* kW load (297.5 kW) = 86.27 kVAR

4 capacitors (25 kVAR) have been added in Star Tea Industry, to increase the power factor and reduce the demand charge cost.



Adding capacitors and increasing power factor from 0.85 to as much as 0.95

Total cost of the installation (4*25 kVAR*NPR 1,500) = NPR 150,000
Savings and benefits: NPR 91,080
Pay-back period: 1 year 7 months

Shading AC Compressor Unit in Split AC Unit

Company: Sapana Village Lodge
Country/Region: Nepal/Pokhara
SEID Local Consultant: Ashish Dutta Bhatta

5 AC compressors were placed on a rooftop where they were exposed to direct sunlight, causing high energy consumption. 5 to 9% of rated power of the AC (1 ton of thermal capacity each, with 1.2 kW power consumption), equivalent to 0.1 kW/ton, are required to cool down the overheated compressors. With the compressors operating for 8 hours per day on average during the three months of summer, the extra energy consumption can be 360 kWh per annum.

At the SEID team's suggestion the AC compressors have been moved to the North side of the building to avoid direct exposure to sunlight. In general, the climate is cooler on the north side of buildings. With better ventilation and no hot air trapped, this measure has decreased the load on the compressor unit and around NPR 3600 is saved per year.

AC compressor placed on rooftop and exposed to direct sunlight (on left) & AC compressor placed on the north wall, avoiding direct sunlight (on right)

Investment: only labour cost
Savings and benefits: savings of 360 kWh per year
Annual cost saving: NPR 3,600 (EUR 30)
Pay-back period: one summer season

Save Fuel by Reusing Waste Heat

Waste heat captured from the dryer is reused as secondary air intake in the furnace to increase combustion efficiency.

Company: Star Tea Industry Pvt. Ltd
Country/Region: Nepal/Jhapa
SEID Local Consultant: Harish Chandra Bhusal/Pushkar Thapa

Cyclones are connected to the CTC tea dryer to remove fibre from the tea. During the process, large amounts of heat from the dryer are also exhausted. However, the fuel consumption of the boiler furnace can be decreased if the waste heat is captured and directed back to the furnace as secondary air supply. A corrugated steel duct was connected to the cyclones and the furnace secondary air inlet. As a result, the intake secondary air temperature rose by 30°C (T_{before} = 29°C and T_{after} = 59°C). This increases efficiency and saves 0.5% of the fuel required for combustion. The work environment has also been improved, as the heat emitted from the dryer is captured.

Waste heat from the dryer is reused to heat up the secondary intake air for the furnace

Total coal consumption (2014/2015): 874,340 kg/year
Savings (0.5%): 4,371.7 kg/year
Cost savings (kg*NPR 20): NPR 87,434/year
Thermal Energy savings (kg*5 kWh): 21,858.5 kWh/year
Total cost of installation = NPR 50,000
Pay-back period = 0.5 year = 6 months

Material & Chemical Saving

With simple and smart measures, not only energy but also valuable materials can be saved.

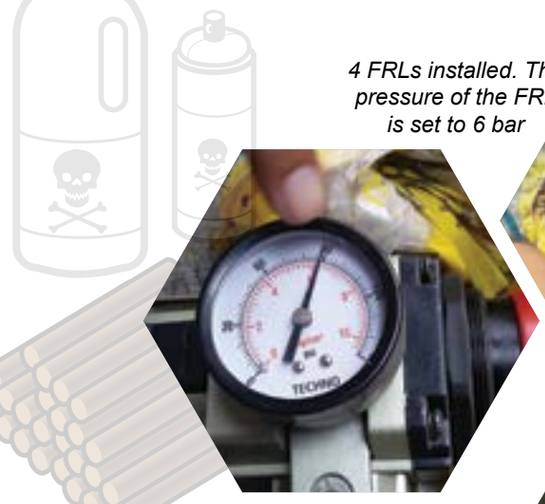
Optimize Spraying Technique/Practices to Save Paint and Solvent

Company: Staples & Jattu Wood Industry
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

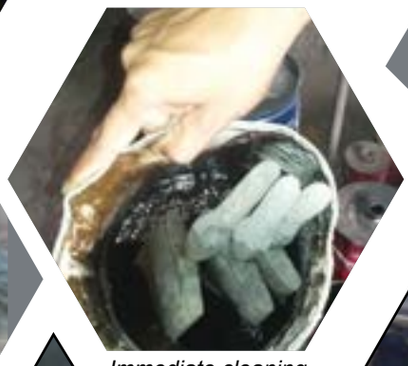
The plant used the conventional method of spraying paint using compressed air (12 bar), which produces a great deal of overspray, resulting in low transfer efficiency (i.e., 30 to 60%) and causes air pollution. Many spray guns (worth BTN 2,500) and heavy-duty stapler guns (worth BTN 6,000) were damaged every month and every two months, respectively, because of the moisture content. The spray guns were not cleaned immediately after finishing work, and the solvent was thrown away after one-time use.

Following the SEID team's advice, the company installed four FRLs (Filter Regulator Lubricators) to filter the impurities in the compressed air, regulate the air flowrate at the point of utilization and protect the equipment from damage. Adopting advanced technologies eliminated disturbances in work flow and frequent damage to spray and stapler guns. The technicians in the spraying section now clean the nozzles immediately after painting work, before the coating hardens and becomes more difficult to remove. Also, the used solvent is filtered and stored separately in a container, to be reused 3 to 4 times.

Investment: BTN 10,000 (approx. EUR 137) for four FRLs (BTN 2,500 each)
Savings and benefits: 20% of total paint & thinner (527 litres per year), 6 stapler guns and 12 spray guns every year, and 20 litres of solvent saved per year, 50% of energy saving with FRL (3.7 kW*1,200 hours per year*50 % = 2,200 kWh
Annual cost saving: BTN 152,000 (approx. EUR 2,082)
Pay-back period: 25 days



4 FRLs installed. The pressure of the FRL is set to 6 bar



Immediate cleaning of nozzles

Reconfiguration of saw (above); less sawdust at planer and sanding machine (below)

At Staples and Jattu Wood Industry, more material is being saved in the material processing units. When the SEID team first evaluated the processes in 2013, 75,697.2 kg of sawdust was generated per year. Just by reconfiguring the vertical and horizontal bench saws, and by cutting logs into slabs as close as possible to the sizes required to make furniture, the amount of sawdust in 2015 has been reduced by 3.14%, with an annual saving of 2,377 kg of wood. Less dust pollution is another benefit for the workers. The company was further advised to change the thickness of the saw blade from 2.5 mm to 1.5 mm, in order to reduce the amount of sawdust.

Investment: no cost
Savings and benefits: 2,377 kg of wood is saved per year
Annual cost saving: BTN 26,147 (approx. EUR 358)

Similarly, just by reducing the pressure of the compressed air from 9 bar to 5 bar (i.e. zero monetary investment), **Wood Craft Centre Limited (WCCL)** in **Bhutan/Thimphu** was able not only to save **20% of the paint (3,083 kg per year)** and **1,072 kWh energy,** but also to reduce air pollution significantly.

SEID Local Consultant: Nim Dem Hingmang
Annual cost saving: BTN 761,634 per year in all (electricity and paint - approx. EUR 10,433)

Reducing Consumption of Caustic Soda in Water Treatment

Company: Tibet Guest House (TGH) Pvt. Ltd
Country/Region: Nepal/Kathmandu
SEID Local Consultant: Anita Bohara

TGH used caustic soda (NaOH) to co-agulate matter in suspension, and alum ($KAl(SO_4)_2.12(H_2O)$) and bleaching powder ($Ca(ClO)_2$) to reduce the iron colour and disinfect water from a bore well. Caustic soda is a corrosive and reactive alkali which, when splashed on the skin, can burn the skin and cause permanent eye damage if it gets in contact with one's eyes. The hotel had used these three chemicals for water treatment in the proportion 1:1:1. The hotel had used 1 kg each of caustic soda, alum and bleaching powder every day.

The SEID team advised the hotel to stop using caustic soda in treating the water and to observe water quality. The result showed that the water was less pure than it had been previously. Then the SEID team advised the hotel to reduce the amount of caustic soda. Following the advice of the SEID team, the hotel halved the amount of caustic soda without changing the other two chemicals. The result was that the hotel still maintains the quality of water that it used to have previously, when they used 1 kg of caustic soda. Previously the hotel had used 365 kg of caustic soda in a year, but now they have reduced this to 182.5 kg. The hotel is saving nearly NPR 900 per month by reducing the amount of caustic soda used. The chemicals are handled by the trained staff while mixing in stored water. After 1 hour of mixing the water is sent to the water treatment plant for further treatment. All the required materials, such as gloves, masks and goggles, have been provided to the staff by the hotel for mixing the chemicals in the water.

Investment: no investment cost
Savings and benefits: NPR 900 per month
Annual cost saving: NPR 10,950 (approx. EUR 88)
Pay-back period: immediate

Reduction of brick wasted from production

Company: DrukSoednam Enterprise
Country/Region: Thimphu
SEID Local Consultant: Tshering Wangmo

Druk Soednam Enterprise manufactures mud bricks. During the initial assessment it was observed that the amount of broken bricks was very high. The Local Consultant and Technical Expert identified that many bricks were breaking, while the bricks are moved from the manufacturing area to the curing area. One of the recommendations to reduce the huge wastage was shifting the curing area to be closer to the manufacturing section.

The unit accepted the recommendation, and this has helped reduce the wastage from 380 kg per ton output to 30 kg per ton output, resulting in an overall 92% reduction in brick wastage.

Investment: nil
Annual cost saving: Nu 111,520 (EUR 1,528)
Pay-back period: immediate

12 Tips for resources efficiency

Seal air gaps around windows and doors to keep the space cool or warm.

Turn off appliances such as TV sets, air-conditioning, lights, fans, etc., if you are not using them.

Set air-conditioning temperature to a suitable value (24 to 26 degree Celsius)

Use natural sunlight as much as possible.

Clean and maintain solar panels regularly and frequently.

Reuse grey water from final rinsing for pre-soaking in laundry and dish washing.

Place a filled water bottle in flushing cistern.

Check and clean gas burners regularly to maintain blue flame.

Reduce water flowrates with aerator.

Use personal protective equipment wherever and whenever needed.

Replace inefficient light bulbs with more efficient ones such as LEDs.

Collect rainwater.

switchasia
European Union's Switch-Asia Program

Applicable for Hotels:

a)Electricity

1 .Seal air gaps in a room(windows, doors) to maintain thermal energy (heating/cooling)
2 .Provide thick curtains, which help insulation.
3 .Install an automatic door closer (e.g. spring) for bathroom to ensure that it is always closed (in case of air conditioned rooms)
4. Turn off exhaust fan while heating/cooling of the guest room
5. Provide shed/shade to the outdoor unit of Split AC, and chest freezer standing outside
6. Run washing machine at full load
7. Optimize the use of dryers in laundry. If feasible, dry laundry in the sun.
8. Replace CRT TV sets with LCD/LED ones
9. Turn off standby appliances like TV sets, hand dryer, oven etc. when not in use.
10. Use electronic key card/occupancy sensors
11. Set temperature of refrigerator according to the food items
12. Set temperature of geysers/heaters to be appropriate (55 to 60 degree Celsius)
13. Set temperature of ACs to be appropriate (24 to 26 degree Celsius)
14. Remove mini bars from guest rooms

b) LPG Saving

15. Check-up gas burners regularly to maintain blue flame
16. Cook with closed lids
17. Pre-soak rice before cooking to reduce cooking time
18. Place LPG cylinders in an appropriate place (cool, ventilated, shaded)
19. Shift part of cooking load to induction/electric cooker (applicable in low-tariff regions)

c) Water

20. Replace conventional shower heads with low flow shower heads
21. Replace faucets with aerator to save water
22. Replace old cistern (10 litre) with a more efficient toilet (6 litre)
23. Place a water filled bottle inside cistern
24. Provide drinking water dispenser as replacement for small-sized plastic water bottles
25. Presoak dishes before washing
26. Wash towels and linens on request of the guests
27. Reuse grey water from final rinsing for pre-rinsing in laundry and dish washing

d) Material & Waste

28. Reuse left over bath soaps for laundry use or floor cleaning
29. Reuse plastic bottles for indoor gardening
30. Lower food wastage
31. Use liquid soap dispenser/shampoo dispenser
32. Reuse cooking oil for lighting lamps / warming up food at buffet
33. Reduce napkin size
34. Reuse old linen bedsheets for cleaning
35. Cover food inside refrigerator

e) Environmental Management

36. Maintain log book for overnight stays, walk in guests for restaurants, banquet hall users
37. Use eco-friendly homemade disinfectants and mosquito repellents

Applicable for other manufacturing/processing industries (exemplary industrial sectors in bracket):

a) Electricity

38. Improve efficiency of industrial diesel burner (bakery/food processing)
39. Improve power factor of plant
40. Clean the filters, tubes of boiler frequently and regularly (tea/dairy/noodle)
41. Optimize and control process temperature(noodle/bakery)
42. Insulate oven/furnace/boiler/kiln surfaces/top surface/walls of heated tanks/ chilled water pipe line(fruit processing/tea/dairy/noodles/hotels)
43. Reduce furnace charging time (steel/rolling mill)
44. Change diesel fired boiler to electric boiler (depending on tariff and availability, for companies in Bhutan)
45. Optimize steam pipe line system (beverage/food production/wood manufacturing)
46. Optimize fuel to air ratio for boilers and furnace (dairy, beaten rice)
47. Recover steam condensate (dairy/tea/fruit processing/beverage)
48. Use economizer(tea/dairy/others)
49. Recover and reuse process waste heat (air/water)(steel/tea)
50. Use / improve soft water as boiler feed (noodle/tea)
51. Reduce spillage and losses of raw and process materials (noodles/tea/bakery/poultry feed/beaten rice/oil)
52. Replace V-belt with flat belts and correct tensions in the belt drive (dairy/noodle/oil)
53. Reduce pressure set at air compressor, inlet air temperature for air compressor (dairy/noodle)
54. Reduce compressed air leakage, steam leak of pipes (dairy/noodle)
55. Reduce line losses in air ducts
56. Use variable frequency drive (VFD) (noodle/tea/steel)
57. Improve air circulation and clean cooling pads in cooling tower (dairy/noodle/food processing)
58. Install temperature indicators to control cooling tower (dairy/noodles/food processing industry)
59. Clean process equipment to prevent overheating
60. Eliminate use of redundant pumps
61. Monitor feed water quantity to boiler (industries having boiler)
62. Use of appropriate size of wood log for firing oven (bakery/dairy)
63. Reduce moisture in fire wood prior to combustion (bakery/dairy/food processing companies with firewood boiler)
64. Recover waste heat from boiler (industries with boiler)
65. Provided shade to ammonia compressor tank (dairy)
66. Reduce power supply during de-slagging (steel)

b) Water

67. Reduce leakage of water in process (applicable for all industries)
68. Treat and reuse waste water in process (applicable for all industries using water)
69. Reuse reverse osmosis (RO) rejected water in other processes (e.g. cleaning floor)

c) Material

70. Optimize raw material recipes for cost reduction while maintaining the standard quality of final produce
71. Inspect quality of raw material according to a standard before processing
72. Recover and reuse material within the process (e.g. saw dust, rice husk as fuel)
73. Optimize spraying technique/practices to save paint by using FRL and HVLP gun (wood)
74. Improve product storage to reduce material loss
75. Modify process to reduce waste (e.g. blade thickness reduction/ink reduction) (wood, polythene)
76. Reduce waste of packaging material (e.g. reducing the dimension of packet)
77. Generate economic value from alternative product from waste (e.g. apple boxes with scrap plates in wood industry)
78. Improve flooring and material handling skills to reduce breakage/leakage/loss of process material (marble company/others)
79. Practice First-In, First-Out (FIFO) to reduce losses due to expiry
80. Reduce fumes from process tanks

d) OHS

81. Practice regular controlling and maintenance of all employees at overall working areas
82. Use personal protective equipment (PPE), Institute OHS system
83. Connect process equipment (point of dust generation) to dust collectors (wood/beaten rice)
84. Handle and store chemicals safely
85. Prevent corrosion of process accessories
86. Consider alternative materials for corrosion protection (e.g. acid resistant pain for battery)

Applicable for all industries:

a) Energy

87. Replace less efficient light bulbs with more efficient ones
88. Turn off lights during day time and when not needed
89. Proper clearance of refrigerators and freezers to walls
90. Paint interior in white to reflect light
91. Use reflectors and reduce the number of lights
92. Use translucent roofing panel to allow natural daylight
93. Install solar PV
94. Use solar cookers and driers
95. Install solar water heater and maintain regularly the surface of panels from dust and cracks
96. Insulate hot water pipes and replacing GI pipe with PVC pipe
97. Adjust inclination of solar water heater panels and PV panels to maximize yield
98. Use of appropriate size of DG set/downsizing
99. Change the electrical connection from delta to star for motors
100. Replace with high efficiency motor
101. Optimize motor size based on load
102. Fix the electric sockets and practice proper wiring, protect electrical panels from dust
103. Reduce peak load
104. Monitor fuel use per unit distance travelled
105. Train drivers on best driving practices

b) Water

106. Install flow meter for water consumption analysis
107. Inspect regularly water pipes for leaks and related problems
108. Install cistern for rainwater collection
109. Use floating valves for water tanks
110. Proper layout of plumbing line
111. Reduce leakage of water in toilets
112. Modify floor cleaning process to save water use (applicable for all industries)

c) Waste

113. Composting of solid waste
114. Lower paper use, and if possible, digitalise management data (e.g. guest files in computer)
115. Segregate wastes for recycling and proper treatment
116. Generate economic value from sale of waste
117. Quantify actual waste generation and design a waste collection system

d) OHS

118. Conduct awareness programs for all staff and management
119. Place rechargeable torches for safety in case of blackout
120. Place fire extinguisher at public areas according to the national rules and guidelines

Water Saving

Both Nepal and Bhutan have ample water resources. However, with the population growing in the urban areas and groundwater being tapped more and more in recent years, the water table has gone down significantly and fresh water is in short supply, especially during the dry season. Many of the SEID member companies have adopted water-saving measures, ranging from installing simple devices to harvesting rainwater.

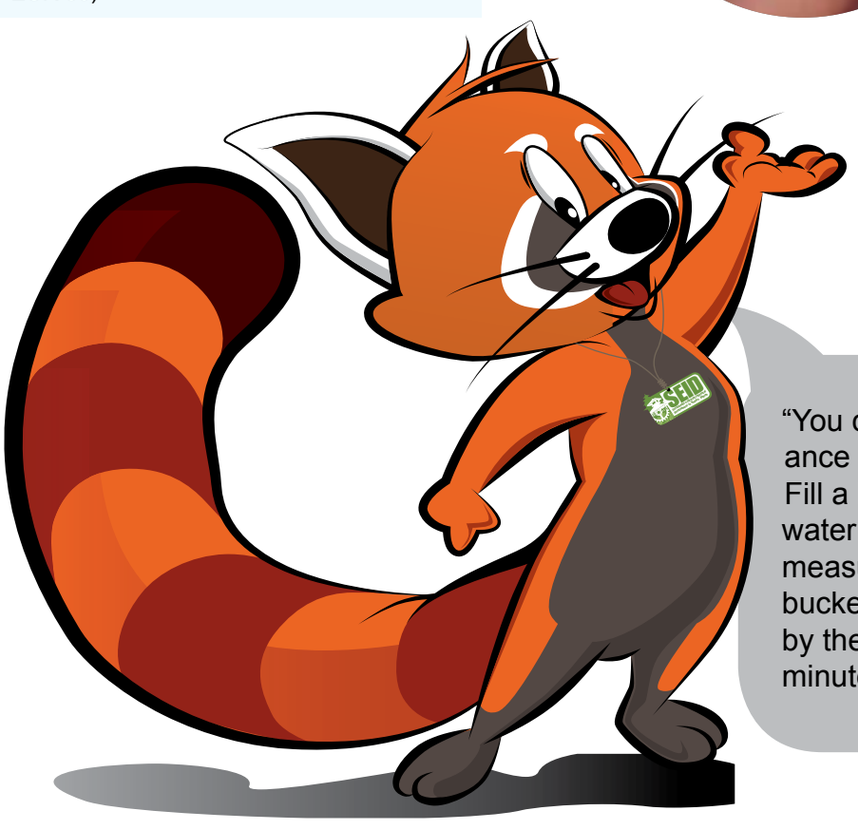
Installing Aerators

Company: Tibet Guest House Pvt. Ltd (TGH)
Country/Region: Nepal/Kathmandu
SEID Local Consultant: Anita Bohara

The hotel had been consuming 7,300 m^3 of water per year for cleaning, washing dishes and gardening, plus bathing and flushing toilets in the guest rooms. Since the hotel has its own borewell as a source for meeting the water demand, expenditures occur mainly for pumping. In line with the SEID recommendation, TGH installed aerators in 50% of the guest bathrooms and in the kitchen, in order to reduce water consumption and wastewater generation. Installing aerators has saved about 87 m^3 of water within a month - a reduction of 14%. Along with this, pumping time has gone down from 5 hours to 3-4 hours per day (saving 25%). If the hotel had to buy the volume of water saved, it would cost around NPR 14,480 per month.

Investment: NPR 32,550 (approx. EUR 260) for 93 faucets
Savings and benefits: 87 m^3 of water is saved per month, energy required for pumping is down 25%
Annual cost saving: NPR 6,210 (approx. EUR 50)

Aerators installed in bathrooms and kitchen



"You can also demonstrate the water saving performance of an aerator with the simple bucket method." Fill a bucket with a known volume (e.g. 10 litres) with water through the tap or hose of which you want to measure the flow rate. Count the time taken to fill the bucket in seconds. Divide the volume of the bucket by the time and convert into a flow rate of litres per minute.

Effective Use of Three Sinks for Dishwashing

Company: Hotel Pedling
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

Although Hotel Pedling already had 3 sinks in the kitchen, which is optimal for cascading water, the kitchen staff were washing dishes under running water. This resulted in excessive use of water, leading to water shortages during the peak season.

The SEID team made the kitchen staff understand the benefits of saving water and how it can be saved by using the 3 sinks effectively:

- The first sink is filled with warm water and the dishes are simply soaked in it. This helps to remove grease from the plates.
- The second sink is filled with warm soapy water and the dishes from the first sink are transferred to this sink. Here the dishes can be scrubbed. This method helps to reduce soap usage too.
- The third sink is used for final rinsing of the dishes. The running water should not be drained, but captured in the sink. This water is not very soapy. This sink is used as the first sink to soak the next batch of dirty dishes.

In this way Hotel Pedling managed to save around 25% of water, equivalent to 395 m^3 of water saved per year.

Investment: no investment
Savings and benefits: 25% of water used for dishwashing (395 m^3 per year)
Annual cost saving: BTN 4,345 (approx. EUR 60), excluding indirect savings such as less pumping and less extra heating of water in the geyser

The hotel staff started making effective use of the sink system which was already in place

Installing Aerators in Water Taps

Company: Hotel Green Valley (HGV)
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

20 taps in all were retrofitted with aerators at HGV. The flowrate from the taps was measured as having gone down from 9.5 litres/min to 7 litres/min. Approximately 30% of water is saved. The management and the staff were also briefed on other water saving practices.

With this measure the hotel saves 1,523,000 litres of water per year. The saving from this measure is guaranteed and can be replicated in all hotels and industries.

Investment: BTN 6,000 (approx. EUR 82)
Savings and benefits: 30% of the water is saved (1,523,000 litres per year)
Annual cost saving: BTN 9,900 (approx. EUR 136)
Pay-back period: 7.3 months

Conserving Water by Installing Tap to Regulate Free Flowing Water

Company: Hotel Migmar
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Suneeta Chhetri

Fresh water was flowing into an unused pool at the rate of 40 litres per minute, directly flowing out into the municipal drain; an enormous amount of fresh water was being wasted.

Following the SEID team's advice, a tap was installed to stop and regulate the flow of water. Now the stored water is used as necessary. A very simple action resulted in saving huge quantities of water and cutting water bills.

Investment: BTN 250 (approximately EUR 3.5) for one water tap
Savings and benefits: 40 litres per minute
Annual cost saving: BTN 6,480 (EUR 89)
Pay-back period: 2 weeks

Before: free flowing water

After installation of water tap

Rainwater Harvesting

Rainwater harvesting can be a very useful and eco-friendly way to compensate water shortages. A number of SEID member companies, such as Jungshi Paper and Peling Resort in Bhutan, and Hotel Legacy, Hotel Noor and Hotel Meera in Nepal, have adopted simple rainwater collection techniques.

Company: Jungshi Paper
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

Jungshi Paper was using municipal water as its main water source, but there were often water shortages during the dry season. Sometimes these water shortages became a bottleneck, preventing the firm from meeting demand for its products, thus the company's business was affected.

The SEID team showed the staff how to collect rainwater, and the unit started to store the water from the weepholes in a retaining wall. Weepholes are small openings that allow water to drain from a retaining wall, so water can escape from the retained earth, thus lessening the hydrostatic load on the wall and preventing damage from freeze/thaw cycles.*

The volume of collected rainwater came to about 30% of the water needed for production. This simple technique has not only saved costs but also generated economic gains, since the volume of production has increased with an adequate water supply.

** https://en.wikipedia.org/wiki/Weep*

Harvesting rainwater from the weepholes in a retaining wall

Investment: BTN 300 (existing pipes were used, thus only labour charges were incurred)
Savings and benefits: 30% of water for making paper was replaced by harvested rain water (198 m^3 per month) and additional savings in pumping costs and sewerage charges resulted
Annual cost saving: BTN 3,500 (approx. EUR 47)
Pay-back period: 1 month

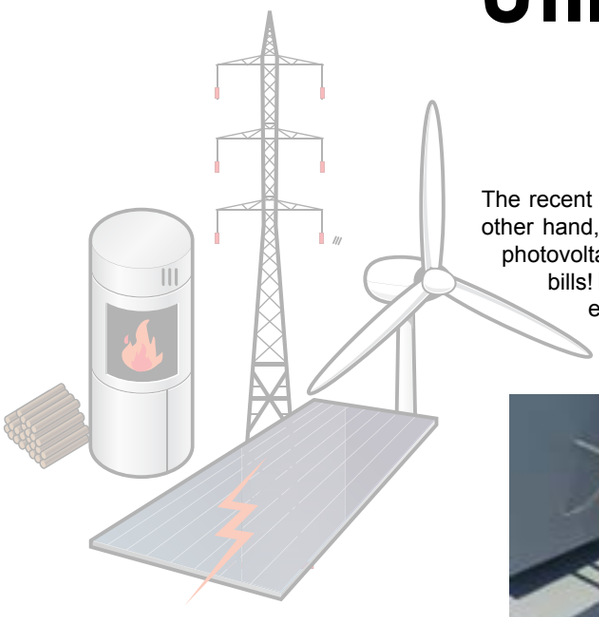
Company: Peling Resort
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

Similarly, Peling Resort in Phuentsholing started to utilize the existing gutter line and a 3,000-litre water tank to collect rainwater falling on the roof, which used to be directly connected to the drainage. The municipal water costs BTN 6.5 per 1,000 litres, including sewerage charges.

During the monsoon in 2015, the water stored was enough for gardening, washing vehicles, cleaning and swabbing. This simple implementation has brought huge water savings, i.e. 315,000 litres in one year.

Investment: BTN 500 (existing pipes and water tank used, only labour charge invested)
Savings and benefits: 315,000 litres of water are saved annually
Annual cost saving: BTN 2,048 (approx. EUR 28)
Pay-back period: 3 months

Utilization of Renewable Sources of Energy



No to Fossil Fuel, Yes to Renewables!

The recent fuel blockage issue in Nepal again proved how dependent we are on fossil fuels. On the other hand, it also showed us how much you can benefit from renewable resources. Solar thermal, photovoltaic (PV) and lighting options provide us with satisfactory energy services without sending bills! Learning from the real-life cases introduced here, you too can become a user of renewable energy. A typical domestic solar water-heating system is composed of two circuits: a 'primary' circuit that collects solar energy and transfers it to a water tank for storage, and a 'secondary' circuit that transfers the heat stored in the tank to the domestic hot-water supply.

We do not need solar concentration and tracking of the sun for thermal applications up to 150°C. For this temperature range, static solar collectors which use both direct and diffuse solar radiation can be used. They are inexpensive, mechanically simple, and easy to maintain.

Due to the instable electricity supply and its high tariff in Nepal, solar water heaters have already been used in many hotels and industries. A solar water heater system is normally combined with an electric geyser for additional heating, and as a back-up, in case of unfavourable weather conditions.

In some companies, SEID consultants recognised that the orientation, inclination, and/or the condition of the solar panels were not ideal for the location. It was often observed that panels were damaged, or covered with dust, pollen, and dirt, which lower the efficiency of the device, resulting in lower thermal yield. Frequent and regular cleaning and maintenance was advised in most companies that operate solar water heaters and PV panels.

Optimal Use of Solar Water Heater

Company: Hotel Migmar
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Suneeta Chhetri

Hotel Migmar had a solar water heating system for its swimming pool. With 12 unglazed collectors (total surface area 9 m^2), a peak temperature of 85°C was achieved, which indicates how much solar energy there is in the region. At the time of initial assessment, however, it was found that the system was kept idle, as the pool was closed.

The project team advised the hotel to use the heated water for doing laundry, where a good deal of hot water (3.2 m^3) is required every day. The unit channelled the hot water to the laundry section with extra plumbing work. This retrofit helped the unit save electricity to heat water in the laundry.

Solar thermal system at Hotel Migmar

Laundry room, connected to hot water from the solar thermal system

Investment: BTN 4,800 (approx. EUR 66) for piping work
Savings and benefits: 3.3 m^3 of water is heated each day. 20 kWh of grid electricity is saved every day
Annual cost saving: BTN 18,000 (approximately EUR 247)
Pay-back period: 3.5 months

Company: Legacy Hotel
Country/Region: Nepal/Pokhara
SEID Local Consultant: Ashish Dutta Bhatta

On the assumption that each of 30 guests consumes about 60 litres of water to take a shower, the amount of energy required to heat 1800 litres of water from 15°C to 60°C is 94.18 kWh. With 20 solar water heater panels (2 m^2 surface area each), the total yield was 87.04 kWh per day. The solar panels did not produce enough hot water, so electric geysers were used in combination with the solar water heater.

At the SEID team's suggestion, the hotel installed 10 extra new solar thermal panels. With the additional energy generated, the average demand for hot water is met without operating the electric geyser. Energy saved by installing new solar panels is 13,056 kWh per year.

Front view of additional thermal solar water heater (on left) & Back view of additional solar water heater (on right)

Investment: NPR 170,000 (EUR 1,360)
Savings and benefits: savings of 13,056 kWh per year
Annual cost saving: NPR 130,560 (EUR 1,044)
Pay-back period: 16 months

Company: Tenzingling Resort
Country/Region: Bhutan/Paro
SEID Local Consultant: Jigme Tenzin and Dhan Kumar Shyangden

Although solar radiation is abundant in Bhutan throughout the year, solar water heaters are rarely used in industries such as hotels. Instead, almost all hotels have inefficient electric geysers in guest rooms to heat up water, because electricity is very cheap in Bhutan, i.e. 1.28-3.68 BTN/kWh (as of August 2015).

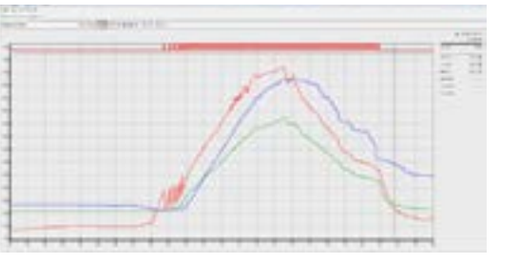
In line with the energy diversification policy of the Department of Renewable Energy (DRE) and the sustainable development goals of the country, solar-based alternative technologies – especially direct use of solar thermal energy for thermal needs (e.g. hot water) – are worth being promoted among the industries. Apart from the environmental benefit of solar energy, the large heating demand in winter can be economically met by the smart use of solar thermal energy, since electricity becomes scarce in the dry season. There are also indirect economic benefits to the government, as during winter energy has to be bought back from India.

The thermosyphon type of SWH (direct solar thermal use; water runs through the solar collector to be heated) is commonly known and used in the southern areas in Bhutan, such as Phuentsholing. However, thermosyphon SWH cannot be utilized in colder areas like Thimphu and Paro, due to frost in winter. In view of the climate conditions, the indirect solar thermal type of SWH was recommended for the SEID project.

In an indirect solar thermal system, thermal media run through the solar collector and circulate in a closed loop. The thermal media at about 75 to 80°C (on sunny days) will enter the insulated storage tank through the circulating inlet, and then transfer heat to the cold domestic water incoming at about 4-25°C. As a result the thermal media will be cooled down and flow out through the circulating outlet to be pumped back to the collector, and the cycle continues. How the collectors perform depends on the weather, but they should help in transferring heat to the incoming cold water which is heated and used for various applications, such as showers and dishwashing.

The main purpose of installing the solar water heater was to demonstrate the use of alternative energy, i.e. solar energy, to heat water and save the cost of consuming conventional grid electricity. It was installed on the roof above the kitchen area so that hot water can be channelled for kitchen use. The solar angle and azimuth angle were carefully considered in finalizing the location of the collectors. The system was installed with financial support from the three parties: the SEID project, JSB (the supplier) and Hotel Tenzinling, as a pilot feasibility case for a public-private partnership model.

Installing a closed-loop hybrid SWH with 300 litre capacity and 3 collectors (measuring 2.07 m by 1.12 m each) connected to the geyser used in the kitchen resulted in savings of 4.8 MWh of electricity in 2 months (September and October 2015). This extrapolates to savings of 12 to 15 MWh/annum, considering the climate conditions over a full year. The graph shows the temperature of the thermal fluid at the top of the solar absorber (red), the temperature of the thermal fluid returning from the thermal tank (green) and the temperature of the heated water for use (blue). On a sunny day, the solar absorber reaches over 70°C, to heat the water above 65°C. If the hot water is used cautiously, warm water at 30°C can be stored to be used next morning.



Solar panels installed on the roof

Control panel showing thermal power generated by the solar water heater

In order to sustain proper and effective utilization of the installed SWH technology, the technical staff of the technology provider and those of the hotel were trained by the experts. The basics of the solar water heating mechanism, key components, and frequently occurring errors in installation and operation were taught in a knowledge transfer seminar.

Demand-side awareness programme is equally important. First staff need to be aware of the current consumption of (hot) water, and suggestions how to reduce it need to be followed. Guidelines for water saving were provided. Constant logging and monitoring of the performance of SWH will enable the company to utilize the hot water generated in the most efficient way. Washing and cleaning practices can be scheduled and coordinated in line with the volume and temperature of the hot water.

300 litre hot-water storage tank

Investment: BTN 370,000 [total cost including parts, materials, and labour] (approx. EUR 5,160)
Savings and benefits: 15 MWh energy saved per year
Annual cost saving: BTN 45,000 per year (approx. EUR 616)
Pay-back period: 2.75 years (on cost-sharing basis) / 8 years if the company invests without any subsidy

Installation of Solar PV, Eliminating Diesel Generator Use

Company: Fairmount Hotel
Country/Region: Nepal/Pokhara
SEID Local Consultant: Khimananda Sharma/ Ashish Raj Dhungana

The hotel used to supply electricity by operating a diesel generator rated at 20 kVA during load shedding and the peak tourist season. The average diesel consumption of the generator is 2.5 litres per hour, and Fairmount Hotel had consumed 1,063 litres of diesel in 2012 in providing services to 778 guest night stays. Without an alternative source of electricity the hotel had to run the generator, even if occupancy was low. The continuous sound pollution was another problem for guests staying near the generator area.

After consultation with the SEID team, the hotel installed two solar panels with 140 watts each. It now supplies electricity to 18 guest rooms, the lobby, the balcony and the reception. Altogether there are 58 LED bulbs lit by solar electricity. The installation of solar PV has subsequently reduced diesel consumption in the hotel. The electricity bills have also been lowered. Now they have hardly any problem with noise, and the fossil fuel shortage which repeatedly happens in Nepal does not affect service quality and guests' satisfaction.

Investment: NPR 160,000 (approx. EUR 1,280)
Savings and benefits: The use of solar PV has reduced diesel generator operation a great deal. It is estimated to save 963 litres of diesel and 6,637 kWh electricity from the grid per year. This saving is equivalent to NPR 149,188.
Annual cost saving: NPR 149,188 (approx. EUR 1194)
Pay-back period: 1 year

Solar PV (2 x 140 watt) installed at Fairmount Hotel, Pokhara

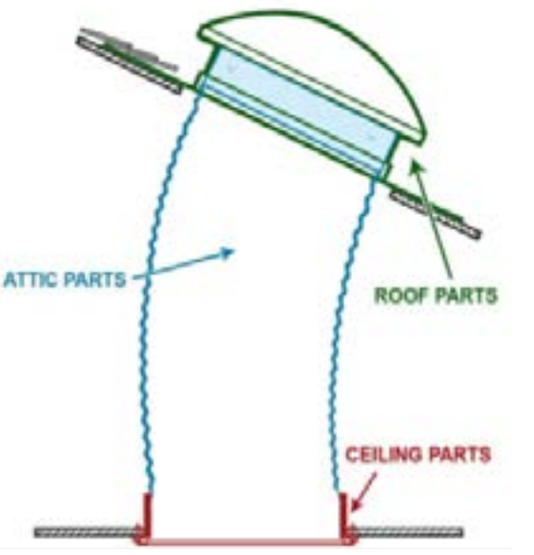
SEID local consultant checking the orientation of solar PV at Fairmount Hotel, Pokhara

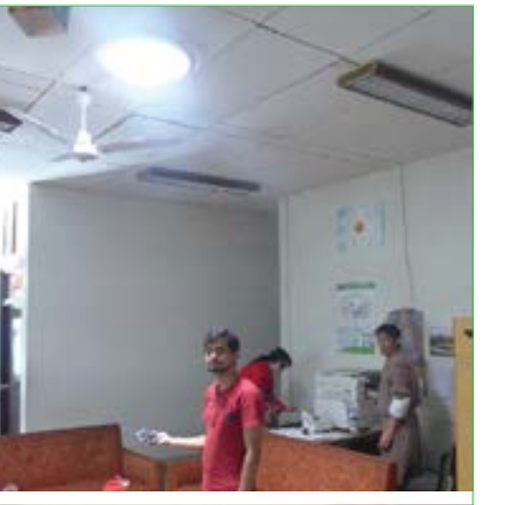
As long as sunlight is available, **daylighting** is the best option to brighten the workspace. Even if there are no windows, daylighting is possible with the help of some solar-lighting products available in the market. One of these products has been installed at Bhutan Agro Industries in Thimphu. The device captures daylight from the roof and directs it into the room. Daylight tubes can be installed in public areas such as kitchen, reception or in the lobby, where lights are often used even during daytime. Although the payback period for a single-unit demonstration seems long, the cost per unit will decrease as the number of units increases.

Solar Daylighting

Company: Bhutan Agro Industries Ltd
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

As a showcase demonstrating the effect and the installation processes, a solar tubular day lighting device called “Sky tunnel” has been imported and fixed in the main administration area, where the use of the space is limited to office hours from 9 A.M. till 5 P.M. The space was previously lit with 12 fluorescent tube lights all day long (8 hours) and gave an illuminance level of 250 lux. Now the daylighting system has eliminated the need for 10 tube lights, while providing illuminance of 1500 lux right beneath the tubes and dissipating light to 400 lux in the perimeter. The natural light creates a livelier atmosphere in the workspace, which is believed to encourage satisfaction among workers and results in increased productivity.





Investment: BTN 19,500 (excluding the labour charges)
Savings and benefits: 1,440 kWh energy saved per year, satisfaction among workers with better work environment
Annual cost saving: BTN 4,320 per year (approx. EUR 59)
Pay-back period: 4 years

Environmental Management

“We are the heroes. Let’s save the world together!”

Green Committee created at Hotel Pedling

Company: Hotel Pedling
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

Inspired by the SEID activities, the staff at Hotel Pedling created a ‘green committee’ by themselves, to put the recommended solutions into practice and to continue resource efficiency programmes. The SEID team helped the committee by giving them more knowledge and ideas about how to achieve the goals they had set. There are 9 members from different departments and each of them is responsible for monitoring a particular area in the hotel. The templates provided by the SEID project helped them to monitor resource use, waste generation, occupancy rate and LPG consumption. By recording and monitoring, as well as implementing a few basic recommendations, the hotel managed to save BTN 56,180, equivalent to EUR 750, within a year. The committee meets once a week to discuss their findings and solve problems together, if any. The committee not only works within the hotel but also joins in other environmental campaigns run by NGOs and government organizations, and members clean touristic sites in their spare time. They are ambassadors disseminating their lessons from the SEID project.

Green committee members at Hotel Pedling

Investment: no investment
Savings and benefits: social, economic and environmental benefits
Annual cost saving: BTN 56,180 (approx. EUR 770)

There is another way to promote SCP practices:

Why don't we engage our guests from all over the world? Good housekeeping can bring changes.

Post signs in the reception and restaurant areas encouraging them to conserve water and electricity.

Engaging Guests to Participate in SCP Practices

Company: Nirmal Lodge
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Suneeta Chhetri

Some guests leave appliances like lights, heaters and TV sets on even when not in use. This lack of awareness increases electricity consumption and cost for the hotel. As hotel industries gear up to provide better facilities and services, it is equally important that the users are actively engaged to contribute to resource-saving options for a better world.

In line with the SEID team's advice, the hotel installed posters and signs in the reception and restaurant areas to encourage guests to participate in the water and electricity conservation approaches. This has helped the hotel immensely in bringing down its specific water and energy consumption, while also reducing the amount of waste generated.

Mr. Tshering Wangchuk, owner of Nirmal Lodge, with sample signs (above); sign at the reception (below)

Investment: BTN 800 (approximately EUR 11) for one post sign
Savings and benefits: 1,805 kWh of energy saved and water usage is reduced by 100 m^3 annually
Annual cost saving: BTN 6,500 (approximately EUR 89)
Pay-back period: 1.5 months

Washing Towels & Linen at Guests' Request

Company: Hotel Kuenga
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

The hotel outsources its laundry service to a private firm in Jaigaon, India. The hotel used to send all the pillow covers, towels, bedsheets and blankets daily for washing, even if used for one night only. The washing cost per room is BTN 20. The annual cost of outsourcing the laundry service was BTN 116,800 (approx. EUR 1,600). This daily washing practice not only pushed running costs up, but also caused excessive water consumption and pollution because of the excessive use of detergent and soap.

As a means to activate the savings potential, the SEID team provided the hotel management with guest messages in the form of posters. The posters are placed in all the rooms, as shown in the picture. The bed linen and towels are now washed only at the guest's request and when the guest checks out. In the last five months the hotel has saved BTN 24,480 (approx. EUR 335). This will also yield a huge environmental benefit by reducing water and soil pollution, plus carbon emission from transport.

The guest messages are displayed in all the hotel rooms

Investment: the total cost of printing and adhesive is BTN 500 (approx. EUR 7)
Savings and benefits: as the hotel outsources the laundry service, there is no direct saving in water/energy/raw material for the hotel. But there is a huge reduction in environmental pollution at the service company. This is good value-chain management for better environmental performance.
Annual cost saving: the equivalent annual monetary saving is BTN 58,752 (approx. EUR 805)
Pay-back period: within a few days

Setting Room Heaters to Lower Temperature in the Guest Rooms

Company: Peaceful Resort
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Jigme Tenzin and Dhan Kumar

Good housekeeping plays a critical role in achieving resource efficiency in hotels. If cleaning staff leave guest rooms with all appliances switched on, a lot of energy is wasted. Furthermore, new guests entering such a room tend to leave the appliances switched on. Appropriate setting of the appliances needs to be learnt through regular training in good housekeeping.
Space heating contributes to over 40% of overall energy consumption in Bhutan.* Setting the room heaters to an appropriate temperature, and periodic checks on usage, will allow energy consumption at Peaceful Resort to be lowered by 6%. Lowering the temperature setting of four 2-kW heaters in each room used for 10 hours for 180 days per year at 50% occupancy of the 18 rooms will save 6% of the total electricity consumed, equivalent to 7,776 kWh per annum. At BTN 2.46 per kWh, the monetary savings come to BTN 19,129.
** EY analysis*

Investment: no investment required
Savings and benefits: 7,776 kWh saving per annum in electricity consumption
Annual cost saving: BTN 19,129 (EUR 262)

Log Book for Guest Arrival and Walk-in Guests

Company: Hotel Green Valley, Hotel AV, and many more
Country/Region: Bhutan/Phuentsholing & Thimphu
SEID Local Consultant: Nim Dem Hingmang, Rozal Adhikari

Many hotels in Bhutan and Nepal did not have a proper logging system for guest arrivals. The exact number of guests staying overnight and of walk-in guests plays an important role in analysing overall resource consumption and business status – occupancy rate, meals served, etc. It also helps to understand resource efficiency (i.e. input needed to generate output). The same practice is required in other industries with regard to materials purchased and product yield over time.

As suggested by the SEID team, the management team of many hotels and industries have now started monitoring their resources and outputs. For some hotels, a monitoring chart has been provided as part of the SEID project. The monitoring chart covers overnight stays, walk-in guests, bio waste produced for each day, and energy, water and LPG consumption for each month. Through the monitoring chart the management can compare the current consumption figures with previous months. From metering and monitoring of the resources from the implementations carried out in the company, the annual saving can be computed. This practice has been implemented in most of the member companies in Nepal and Bhutan.

Investment: printing and binding cost for monitoring chart is BTN 150
Savings and benefits: saving raw material, energy and water

Local technical expert explaining the monitoring chart to the hotel manager. Hotel Green Valley started filling up the chart

Log book for guest arrival at Hotel AV

Textile Laundry Bag instead of Disposable Plastic Bag

Company: Hotel Ganesh Himal
Country/Region: Nepal/Kathmandu
SEID Local Consultant: Khimananda Sharma

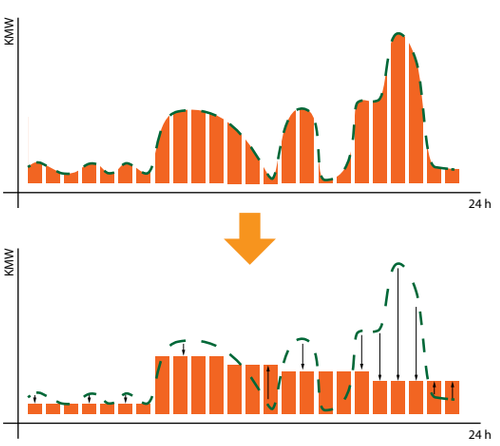
Hotel Ganesh Himal changed the material of its laundry bag for the guests, from plastic to textile. Reduced use of disposable plastic bags contributes to reduction of environmental impact. Use of durable and renewable material also gives an environmentally friendly image to the guests.

Peak Load Management

Company Tashi Beverages Ltd.
Country/Region: Bhutan/Pling
SEID Local Consultant: Chandra Prasad Dahal

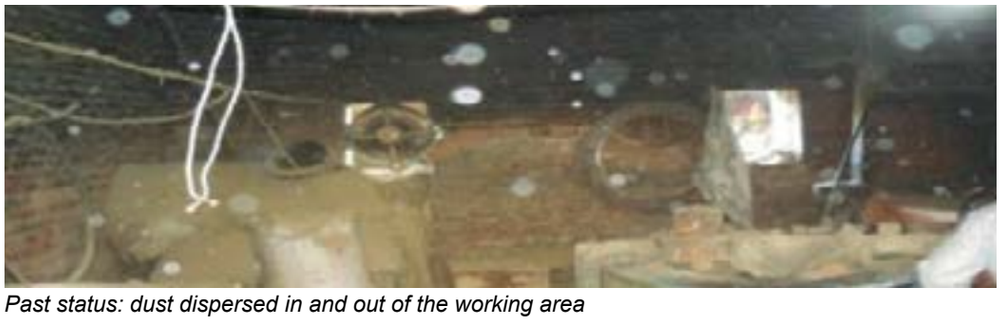
The SEID consulting team recognised that the electricity bills showed great fluctuations in load factor, and advised to optimise the operation time of machines. This supply-demand matching is a very effective measure to save utility costs without any monetary investment. Based on the observation and power requirement of individual machines, the company scheduled their operation time, to begin with
1) the utility section, including air, CO_2, refrigeration and boiler; 2) blowing machine with 40 bar and 8 bar; 3) blowing section; 4) para mix; 5) rinser, filler and capper; 6) date code; 7) warmer; 8) labeller; and 9) carton sealer. With this measure, the maximum demand was reduced from 540 kW in 2014 to 470 kW in 2015 in average. The saving for 5 months (Jan – May 2015) was BTN 68,250. Yearly saving will be BTN 163,800.

Investment: no capital investment but organisational measure
Annual cost saving: BTN 163,800 per year



Improving the Working Environment

SEID team worked closely with the companies and made frequent on-site consultation to interact with the management and workers and to observe their physical and mental satisfaction on the measures implemented to improve the working environment. A survey for 55 representative companies revealed that the employees experienced enhancement of the conditions such as temperature, noise, lighting, use of hazardous materials, safety and availability of drinking water.

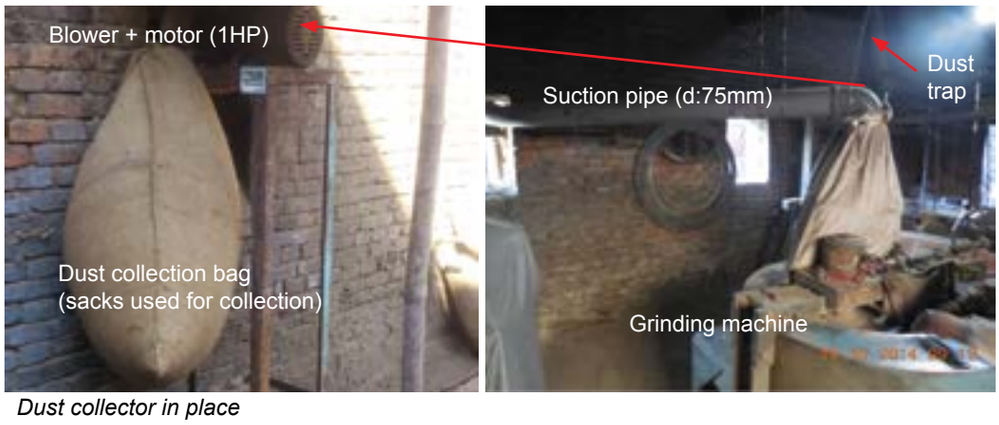


Past status: dust dispersed in and out of the working area

Installing dust collector

Company: Laxmi Chiura Mill
Country/Region: Nepal/Bhaktapur
SEID Local Consultant: Pushkar Thapa

Laxmi Chiura Mill is one of the well-established agro-based companies producing an average of 240 metric tonnes of beaten rice (chiura) per annum. The industry uses rice husks as a fuel for the oven to process paddy. The main problem in this company was the large amount of dust dispersed from the grinding machine, which made it uncomfortable for the staff to work nearby. The dust also affected the surrounding environment, and there were also complaints from the neighbours.



Dust collector in place

The main intervention in the SEID project was installing a simple and inexpensive dust collector. A conical dust trap (hood) is fixed above the grinding machine to prevent dust from dispersing. The trapped dust then passes through a suction pipe connected to a blower with a 1-HP motor, and is finally collected in a sack fitted at the blower outlet. After the dust collector had been installed, the owner reported up to 80% dust reduction. The working environment in the company became cleaner, and the workers and the neighbours are satisfied with the reduction in emissions. 1,500 kg of dust are collected per year. The dust collected is used as an additional fuel for processing the beaten rice.

Investment: NPR 20,000 (approx. EUR 160) for dust hood and motor blower
Savings and benefits: fuel saving, reduction of dust up to 80%, comfortable working area and improved surrounding environment
Annual cost saving: NPR 21,000 (approx. EUR 168)
Pay-back period: 1 year

Present status: improved working environment with less dust after installation of dust collector

Change in Roasting Facilities: Electric & LPG Roaster instead of Traditional Three Stone Fire and LPG Stove

Company: Panchbhaiya Deurali Coffee Yudhog
Country/Region: Nepal/Pokhara
SEID Local Consultant: Ashish Raj Dhungana & Khimananda Sharma

Deurali Coffee used to use a traditional three-stone fire for roasting parchment beans. To roast 6 kg of beans would require 3 people for 4 hours and consume 25 kg of firewood. This means 4.12 kg of firewood is consumed in processing 1 kg of product. Firewood costs NPR 8 per kg. Therefore, the firewood for processing 1 kg of product costs NPR 33. Sometimes LPG was used (e.g. during the rainy season). To produce 1 kg of product 0.51 kg of LPG was needed, which cost NPR 52.8.

An electric & LPG combo roaster machine was installed after consultation with the SEID team. The government of Nepal contributed 28% of the investment cost. This newly installed roaster machine consumes 0.33 kWh electricity per kg processed. It is operated by one person, to deal with 10 kg per batch within 40 minutes. With this machine production capacity has been increased about 10 times. Since installation in June 2015, 900 kg of final product was produced in 3 months (according to the orders taken), and the total energy cost for this amount was NPR 4,200. Worker health has improved since the use of firewood had been stopped. Indoor air pollution has been significantly decreased.

Investment: NPR 1,800,000 (approximately EUR 14,400). The governmental subsidy was NPR 500,000.
Savings and benefits: improvement of workers' health with improved indoor air quality; environmental improvement (less carbon emission, reduced deforestation); and revenue of NPR 57,715 from selling 900 kg product.
Annual cost saving: NPR 64 are saved per kg product (according to data for October 2015). If production is increased to 3,000 kg per year, the saving will increase by NPR 192,000 (EUR 1,536)
Pay-back period: 6.8 years

Traditional three-stone firewood stove used for roasting parchment

Newly installed electric and LPG combo coffee roaster machine

Installing Fire Extinguishers

Company: Wood Craft Centre Limited (WCCL)
Industrial Sector: Other industries
Country/Region: Bhutan/Thimphu
SEID Local Consultant: Nim Dem Hingmang

WCCL had no fire extinguishers in their production facilities, even though a great deal of inflammable chemicals and wood materials are being handled. In case of fire, it could be a critical hazard to the unit.

The SEID team made the staff understand the necessity and benefit of having fire extinguishers in place, which was tackled immediately. The unit purchased four fire extinguishers and placed them in the main fire-prone areas. The adoption of this simple advice has brought about a huge change in the working environment: the staff are more cautious in dealing with materials, being alerted by the presence of fire extinguishers, and they feel safer.

Investment: BTN 8,000-10,000 per extinguisher
Savings and benefits: social benefits with safer work environment
Annual cost saving: no monetary gain but better working environment and Emergency Response Plan (ERP) in place

Fire extinguisher in place

Economic Value Creation

There is no waste in our eco-system: someone's waste becomes someone else's food. The same principle can be applied in resource management. Staples & Jattu Wood Industry demonstrates that economic value can be created by smart utilization of its intermediary waste material.

Company: Staples & Jattu Wood Industry
Country/Region: Bhutan/Phuentsholing
SEID Local Consultant: Rozal Adhikari

Waste to Wealth - Apple Boxes Made from Waste Offcuts

For the manufacture of furniture, the logs are cut into planks of the required sizes, which produces a great deal of waste is in the form of sawdust and offcuts. Previously the offcuts were burnt directly in an open yard or taken by the workers for personal use. The management was advised to make apple/orange boxes out of the offcuts. This will not only add value to the waste, but also reduce the carbon dioxide emission into the atmosphere from burning the offcuts.

The offcuts are collected and boxes are fabricated a few days before the main market season for fruit. Up to July 2015, the plant produced and sold over 1,230 boxes, each costing BTN 66. This adds to the company's profit and also serves as an example to other similar industries. The costs for carpenter and other expenses was paid BTN 25 per box.

Value creation: BTN 50,430 (approx. EUR 691) for 7 months (January to July 2015)
Annual value: following the same trend of box production, the annual value will be BTN 86,451 (approx. EUR 1,184)

The offcuts are upcycled into fruit containers

Sawdust Generated is Sold instead of Being Burned in an Open Pit

The sawdust and shavings are mainly produced by the vertical & horizontal gang saw, planer and sanding machine. Previously, the sawdust was burned in an open area outside the plant, causing a great deal of carbon dioxide emission, which contributes to climate change. The SEID team advised the management to sell the sawdust and shavings to Green Wood Manufacturing Corporation (GWMC), where these wastes can be used as a fuel for a wood-fired boiler. This also adds value to the waste and benefits the company and the environment.

Now the sawdust is sold to GWMC. For seven months (from January to July 2015), the plant sold 42,770 kg of dust and shavings, at BTN 2.5/kg. The resulting reduction in carbon dioxide emission comes to 66,721 kg. This is a win-win business model, as GWMC also saved the cost of fuel. Since the two companies are located close to each other (about 2 km), the transportation cost is negligible.

Investment: investment mainly involved purchasing sacks with a capacity of 25 kg. To transport 42,770 kg of dust, 1,711 sacks are required. Each sack costs BTN 5, so the total cost was BTN 8,555 (approx. EUR 117)
Savings and benefits: 42,770 kg of dust were sold in seven months and carbon dioxide emission went down by 66,721 kg. Cash earnings from selling the waste for seven months: BTN 98,370 (approx. EUR 1,348).
Annual value: the annual equivalent earning from selling the waste is BTN 168,634 (approx. EUR 2,310)
Pay-back period: 1 month

Previously the dust and shavings were collected and burned in an open pit (above). Now the dust and shavings are collected and sold to other industries (below)

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Are you interested in implementing examples of best practice, too? Please contact the listed SEID Consultants and Local Technical Experts in line with the needs of your business. S/he will show you how to achieve economic, environmental, and social benefits, as one of the pioneers creating a market for sustainable consumption and production in your country. Please note that some of the listed consultants have taken part in the SEID project on a part-time basis, thus they may not be unrestrictedly available.

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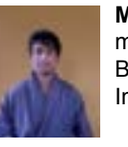

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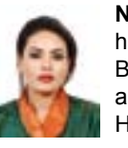

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SEID Implementing Partners

GrAT (Center for Appropriate Technology) TU Wien

Center for Appropriate Technology (GrAT),TU Wien is a scientific association for researching and developing Appropriate Technology. Since 1986 GrAT has been proactively engaging with a wide range of relevant issues, encompassing sustainable building, renewable materials, renewable sources of energy, appropriate technology and product-service systems. Its strength lies in demonstrating and disseminating knowledge and visions for sustainable development for both developing and developed countries.

ASSIST

Asia Society for Social Improvement and Sustainable Transformation (ASSIST) is an international non-government organization focused on capacity-building. It seeks to promote sustainable practices to address social problems in the developing world, with a focus on Asia and Africa. ASSIST takes pride in its process-oriented approach to capacity-building towards social improvement and sustainable transformation

FNCCI

The Federation of Nepalese Chambers of Commerce and Industry (FNCCI) is an umbrella organization of the Nepalese private sector. FNCCI plays a catalytic role in business, industrial development and establishing sound industrial relations in the country, reinforcing the business community's commitment to society. It provides, inter alia, information, advisory, consultative, promotional and representative services to business and government and organizes training/workshops/seminars on a regular basis.

BCCI

Established at the Royal Command of His Majesty the fourth King in 1980, the Bhutan Chamber of Commerce & Industry (BCCI) is a non-profit making private-sector organization made up of business community members from all around the country. The BCCI provides a linkage between the government and the private sector, and works closely with all the government agencies, autonomous organizations, international organizations and donor agencies on facilitating and promoting trade & industrial development.

GIZ

The services delivered by the Deutsche Gesellschaft fur InternationaleZusammenarbeit (GIZ) GmbH draw on a wealth of regional and technical expertise and tried and tested management know-how. GIZ offers demand-driven, tailor-made and effective services for sustainable development. To ensure the participation of all stakeholders, it applies a holistic approach based on the values and principles upheld in German society.

AREC

Austria Recycling (AREC) is working in sustainable industrial development at the interface between economy and environment, acting as a bridge between industry and environment. AREC supports enterprises and communities, in particular in the process of implementing management systems, by technical and organizational consulting, empowering people and training for an eco-efficient, sustainable economic approach as well as in financial and social matters.

STENUM ASIA

STENUM Asia Sustainable Development Society is a training and consultancy organization registered in Gurgaon, India since 2007. Its objective is to promote sustainable development by helping enterprises to achieve greater resource efficiency, minimize waste and expand output. It has reached more than 100 enterprises across various sectors in India and helped them to save money while conserving the environment. Benefitting from the optimum combination of training, consultancy and support in implementing and evaluating the solutions chosen, participating enterprises achieved greater efficiency, leading to lower-cost operation for no or minimal investment.

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switchasia

AUSTRIAN DEVELOPMENT COOPERATION

European Union's Switch-Asia Program

The European Union (EU) SWITCH-Asia programme was launched in 2008 to promote economic prosperity and help reduce poverty in Asia by encouraging a sustainable growth with low environmental impact from industries and consumers, in line with international environmental agreements and processes. There have been 86 grant projects in 16 Asian countries, with an average grant size of 1.7 million EUR.

ADC supports countries in Africa, Asia, South-Eastern and Eastern Europe and the Caribbean in their sustainable development. The Federal Ministry for Europe, Integration and Foreign Affairs (MFA) plans ADC strategies. ADC aims at reducing poverty, conserving natural resources and promoting peace and human security in partner countries. Long-term programmes and projects provide help towards self-help.

Tshering Wangmo: "Every Human Being is a trustee of Natural Resources & Environment for the benefit of present and future generations, who should contribute to protection and Efficient Use of Resources and Environment".

Christina Krenn: "A guest sees more in an hour than the host in a year".

Rozal Adhikari: "The best-practice paper not only shows the success stories from the SEID project, but is also a procedure for achieving sustainable consumption and production for companies around the world."

Rajat Batra: "The SEID project has made a pool of young people competent in topics like resource efficiency and SCP. I look forward to the positive impact these young people can have on the economy in their own towns and cities."

Kesang Wangdi: "The SEID project complemented the government efforts in many ways - starting from sensitization and capacity-building to the policy formulation of Resource Energy Efficiency"

Robert Wimmer: "Going green is expensive" is a widespread myth that can be falsified with thousands of good practise examples in every country.

Nitesh Patel: "Sustainable & Efficient Industrial Development" will be achieved through resource efficiency at every level of production and with contribution of all through knowledge exchange.

Johannes Fresner: "It is our money and the environment of the next generation".

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