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Amar B. Manandhar Executive Director PACE Nepal Pvt. Ltd.

Abbreviations

%	-	Percent
BTK	-	Bull's Trench Kiln
CBS	-	Central Bureau of Statistics
CME	-	Census of Manufacturing Establishments
CO_2	-	Carbon Dioxide
СР	-	Cleaner Production
EE	-	Energy Efficiency
EEC	-	Energy Efficiency Centre
ESPS	-	Environment Sector Programme Support
FG	-	Fixed Chimney
FNCCI	-	Federation of Nepalese Chambers of Commerce and Industry
GDP	-	Gross Domestic Production
GIZ	-	German Agency for International Cooperation
GJ	-	Gigajoule
HAN	-	Hotel Association of Nepal
HP	-	High Pressure
IEMP	-	Industrial Energy Management Project
ISO	-	International Organization for Standardization
KL	-	Kiloliter
MJ	-	Megajoule
kWh	-	Kilo watt hour
MOI	-	Ministry of Industry
MWh	-	Mega Watt Hour
NEA	-	Nepal Electricity Authority
NEEP	-	Nepal Energy Efficiency Programme
NOC	-	Nepal Oil Corporation
PSEP	-	Power Sector Efficiency Project
SAARC	-	South Asian Association for Regional Cooperation
SEC	-	Specific Energy Consumption
S. N./ S. No.	-	Serial Number
TEPC	-	Trade and Export Promotion Center
TERI	-	The Energy and Resource Institute, India
TOR	-	Terms of Reference
VSBK	-	Vertical Shaft Brick Kiln
WECS	-	Water and Energy Commission Secretariat

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Executive Summary

Nepal Energy Efficiency Programme (NEEP) has been agreed upon for the promotion of energy efficiency in the households and the industrial sector between the Government of Nepal and the Government of Germany. Water and Energy Commission Secretariat (WECS) and German Agency for International Cooperation (GIZ) are the implementing partners and Federation of Nepalese Chambers of Industry and Commerce (FNCCI) has also established Energy Efficiency Center (EEC). One of the objectives of NEEP is to improve the energy efficiency in the Nepalese industries and through a bidding process; GIZ has assigned PACE Nepal Pvt. Ltd., a consulting company, to conduct a baseline study of selected eight sectors of Industries to assess the potentials for more efficient use of energy.

The selected sectors are Cement, Pulp & Paper, Food, Metal (Iron & Steel), Soap & Chemicals, Hotel, Brick Production and Cold Storage. PACE Nepal has carried out literature study including reports under Environment Sector Programme Support (ESPS), Industrial Energy Management (IEM) Component of Power Sector Efficiency Project (PSEP), internet search, study of relevant documents sent by officials of GIZ/ NEEP, other cooperating partners and experts; prepared questionnaires for the sectors, conducted interviews as well as walkthrough energy utilization survey of 200 industrial units to prepare this report as per the given terms of reference. Data and information from the interviews and survey were analyzed to determine the energy intensity and to estimate the potential electrical and thermal energy savings as well as CO_2 emission per unit products.

The consumption of electrical and thermal energy were analyzed and compared with the benchmarks from the regional energy intensity, where available and where such figures are not available or not relevant, potentials as seen from ESPS has been used to estimate the potential electrical and thermal energy savings. Based on the calculated saving potentials, production of the surveyed units and overall national production in the country, the total electrical as well as thermal energy savings potentials were projected for the sectors of industries.

The survey results show that there is around 83,660 MWh of electrical and 2,230,837 GJ of thermal energy saving potentials for the surveyed 200 units of industries. The macro-economic projections show that the potential saving for the electrical and thermal energy for the eight sectors in the country as a whole are 156,676 MWh and 8,079,920 GJ respectively. The CO_2 reduction from the improvement of EE is estimated to be 136.938 MT for the 200 surveyed industries and this figure projected for the eight sectors in the country is 507,247.28 MT.

Observations and the areas of potential savings have been highlighted for each sector and subsectors of industries under consideration. Electricity and each type of fuel savings have been compared with the annual electricity sales by Nepal Electricity Authority (NEA) and fuel sales by Nepal Oil Corporation (NOC). Practice of energy efficiency in the eight sectors can save electrical energy equivalent to 4.03% of the sales by NEA and 2.39% of diesel sales by NOC. Finally, recommendations have been given for enhancement of energy efficiency practice in the industrial sector in the country.

1. Background

Energy accounts for a significant share of the manufacturing cost. Nepalese industries are found to be using both electrical and thermal energy very inefficiently and so there are huge possibilities of improvement in the consumption of energy in the industrial sectors. This obviously helps in reducing the production cost of the products and at the same time it enables the industry to come up with more profit and to compete with other industries.

Based on the agreement between the Government of Nepal and the Government of Germany in 2008 it was confirmed by both sides to promote the more efficient use of energy in Nepal. Within this context the implementation of the "Nepal Energy Efficiency Programme" (NEEP) has been agreed upon in 2009. This program is to be jointly implemented by the Water and Energy Commission Secretariat (WECS) and the German Agency for International Cooperation (GIZ) over a first phase of four years. Objective of this development program is to promote energy efficiency in households and the industrial sector. One of the objectives of NEEP is to improve the energy efficiency in the Nepalese industries. The respective component of NEEP draws on results achieved by the 'Environment Sector Programme Support (ESPS)', which was a bilateral program between the Government of Nepal and the Government of Denmark (DANIDA). In response to NEEP a private sector initiative established an Energy Efficiency Centre (EEC) under the umbrella of the Federation of Nepalese Chambers of Commerce and Industry (FNCCI). NEEP cooperates closely with the EEC/FNCCI and other institutions in the implementation of NEEP to enable and support a sustainable institutional development that will provide long term services to the industry.

The support of GIZ/EEC/FNCCI through NEEP to the industry comprise of awareness raising for energy efficiency within the Nepalese industries, the promotion of energy auditing and other energy efficiency services. By this means qualified technical experts will be available to industrial enterprises and banks to support entrepreneurs in the planning, implementation and financing of energy efficiency measures.

In this context, GIZ had a bidding process for the conduction of a baseline study of eight sectors of industries to assess the potentials for more efficient use of energy in the country. The baseline study will be used for the implementation of the activities for improving energy efficiency of the industries.

PACE Nepal Pvt. Ltd., a consulting company working in the fields of Industrial Energy Efficiency, Environment, Productivity and Technology Transfer in the country had submitted the proposal and has been awarded this job after the bidding process. A contract to this effect was signed on 13 September 2011 as contract No. 83092258 between NEEP and PACE Nepal. This final report has been submitted to NEEP/GIZ after incorporating all the comments and suggestions provided and sent on the draft report submitted and presented at a meeting of the stakeholders.

2. Objectives of the Proposed Consulting Service

The main objective of the consulting service is to conduct a baseline study on energy supply / use of representative industries from each eight energy intensive target industrial sectors.

The purpose of the consulting service is to acquire / update information on the energy utilization by industrial sectors and opportunities for its efficient use.

3. Scope of Work

The terms of reference (TOR) of the assignment is presented in the Annex -1. The scope of work of this assignment consists of:

- Industry sectors to be covered by the study:
 - 1) Cement production
 - 2) Pulp & paper production
 - 3) Food (sugar, food and food processing, vegetable oil & ghee, beverages *etc*)
 - 4) Metal (Iron & steel etc.) processing
 - 5) Soap, chemical & allied products
 - 6) Hotels
 - 7) Brick production
 - 8) Cold storages
- Review and update studies on energy supplies and use by sectors.
- o Review previous energy utilization reports on sector.
- Review audit reports produced under ESPS to identify major energy efficiency potentials (electricity and thermal) for the respective industry sectors.
- Review reports on SARRC countries level to identify major energy efficiency potentials (electricity and thermal) for the respective industry sectors.
- Carry out walkthrough energy utilization survey collecting present thermal and electrical energy generation and utilization practices focusing on major energy consuming equipments or systems from the point of view of reducing energy consumption or improving the efficiency of the said equipment or system.
- Collect information on annual energy supply/use both thermal and electrical and assess opportunities for improvement
- Analyze energy intensity (by primary energy sources) per unit product of the respective industries and estimate energy cost and CO₂ emission per unit product.
- Prepare process flow diagram where applicable focused on energy use
- o Cross check with national energy import and supply data
- Regards Brick Industries,
 - investigate if industries are already going for technology change
 - study government statutory directives if any(already in place/ under draft phase) particular technology will have to be phased out within the next years and forecast change future scenario

- Study government statutory directives with regards to shifting of Brick Industries to remote places (away from cities) within the next years and effect thereof.
- Regards Sugar Industries
 - Investigate if there can be surplus power generation with existing turbine/HP turbine installed and possibility of such additional generation to be fed to national grid etc.

4. Outputs

The consulting service will deliver the following outputs:

- 1) Baseline information on the industry sector to be used for the detailed energy auditing of the industry:
 - a. Complete list of industries of the respective 8 sectors with name of company, location (district),
 - b. Contribution of the industry sector to GDP, primary energy consumption by source and CO₂ emission by source.
- 2) List of visited (walkthrough & management interviews) industries with name of company, location (district), and persons interviewed:
 - a. characterizing (last 2 fiscal years) annual turnover, production, production capacity, production share to the sector,
 - b. Analyze energy intensity of production (by primary energy sources) per unit product of the respective industries and estimate energy cost and CO₂ emission per unit product.
 - c. Report on auto producer electricity production (diesel generators and its fuel consumption to keep production operational)
 - d. Report company specific on:
 - availability of energy manager or focal person for further energy activities
 - commitment of management and owner to energy efficiency issues
 - commitment of management and owner to comply with environmental standards
 - interest to participate in further NEEP activities to invest in feasible energy efficiency technologies /good housekeeping
 - e. Quality aspects of products and production; companies certified in ISO 14001 and ISO 9001.
 - f. Based on sector specific efficiency potentials estimate efficiency margins for annual production for regional available technologies in MWh (electricity), GJ (thermal by source), % of unit production cost.
- Summarizing above outputs 1 and 2. baseline information leading to potential savings on national level for primary energy sources, effects on import savings, macroeconomic savings and CO₂ mitigation

5. Methodology

The methodology has taken into consideration actual conditions of industries in the Energy field and gives clear picture about the energy use as well as potentials of energy saving in all eight sectors of industries. The methodology followed is presented below:

- Kick of Meeting of all consultants to review the TOR of the assignment:
- Meeting with concerned officials of GIZ and FNCCI to discuss about the programme schedule, potential industries and their addresses and to know their expectation on completion of the assignment successfully.
- Collection of relevant documents and reports on Energy Efficiency/ Energy audits from FNCCI, GIZ, Central Bureau of Statistics (CBS), Nepal Electricity Authority (NEA), Nepal Oil Corporation (NOC), Sector Industrial Associations, Industrial Energy Management Project (IEMP) under the Ministry of Industry (MOI).

FNCCI provided the list of members that include industrial organization as well as sector industrial associations with their contract addresses. FNCCI also provided help to obtain the reports and literatures relating to Energy Audit reports, progress reports and energy utilization reports for the concerned industrial sectors from the following projects:

- EE reports of the World Bank supported Office of Energy Efficiency Services (OEES), Industrial Energy Management Component of Power Sector Efficiency Project; and
- *EE reports of Environment Sector Programme Support (ESPS)*

NEEP/ GIZ provided the sector-wise energy utilization reports from the SAARC countries relating to the eight sectors under consideration.

CBS has the census of manufacturing establishments and survey of small industries

NEA and NOC have the rates of the electricity and other fuels as well as their consumption by various sectors.

Sector Industry Associations have provided the information on details of their members. IEMP, MOI have provided the reports of Office of Energy Efficiency Services.

- Study the reports collected and review of relevant reports and literature: All collected documents and literature were reviewed and relevant topics and information were noted.
- Formation of four Teams of two consultants for all eight sectors. On the basis of information/data, 240 potential industries in different districts were selected belonging to eight sectors of industries and these were divided into

four groups distributing to the main industrial corridors of Nepal so that two consultants (One for Thermal and One for Electrical) could cover about 50 industries from the selected sectors within the stipulated time frame.

• Preparation of checklist and questionnaires / formats for the eight sectors of industries:

Questionnaires were prepared to cover all information mentions in TOR under the scope of work. Additional information required for Sugar Mills and Brick industries were also incorporated.

• Selection of Industries

As per the scope of work, 200 industries are to be covered under the survey work. The total lists of industries in the eight sectors were collected from different sources. These included mainly the census of manufacturing establishments and industry associations. The total list of industries has been presented in the Annex – 2. The spatial distribution of the industries by sector and districts has been given in the Annex – 3. Zone-wise distribution is presented below:

S. No.	Zone	Cement	Paper	Food	Metal	Soap	Hotel	Brick	Cold- storage	Total
1	Mechi	4	0	1	0	0	2	11	2	20
2	Koshi	1	2	35	12	15	5	33	4	107
3	Sagarmatha	2	0	3	0	0	4	54	0	63
4	Janapkur	1	1	6	0	0	0	45	3	56
5	Bagmati	0	1	20	11	2	130	63	8	235
6	Narayani	10	0	34	22	17	20	64	2	169
7	Lumbini	15	3	14	9	4	4	45	1	95
8	Gandaki	0	0	11	5	0	20	17	1	54
9	Rapti	0	0	2	0	0	0	9	0	11
10	Dhulagiri	0	0	4	1	0	1	1	0	7
11	Bheri	2	0	5	2	0	1	41	1	52
12	Seti	0	0	2	2	0	1	56	0	61
	Total	35	7	137	64	38	188	439	22	930

Table 1: Spatial Distribution of Industries

Source: CME, 2008 Directory and Associations

It is seen from above table and Annex -3 that the eight sector industries are scattered over 12 out of 14 zones and 44 districts out of 75 districts over of the country.

Out of these 200 units were selected using the following statistical process:

Efforts have been made to sample the industries for getting best possible confidence level with least possible error margin with the sample size of 200 industries. The following formula was used to arrive at the number of industries

in each of the eight sectors with 90 percent confidence level and around 5.2 percent error margin.

Sample size (n)¹ =
$$\frac{\chi^2 * N * (1-P)}{ME^2(N-1) + (\chi^2 * P * (1-P))}$$

Where,

n = required sample size

 χ^2 = Chi square for the specified confidence level at 1 degree of freedom N = Population size

ME = Desired Marginal error (expressed as a proportion)

Applying

P = (1-P) = 0.5 $\chi^{2} = \text{Chi square for the specified confidence level at 1 degree of freedom.}$ ME = Desired Marginal error (expressed as a proportion) = 0.052 N = Population size = 929 Confidence Level = 90%n (sample size) is found to be 197

When we check the error margin with the breakdown of the population size of the eight sector industries, the error margin is around 8 to 18 percent with the following sample sizes. Brick kilns and Hotels are comparatively more homogenous and hence the error margins will be less in fact.

S. No.	Sector of Industry	Population	Sample size
1	Cement	35	26
2	Pulp & Paper	7	5
3	Food	137	51
4	Metal	64	21
5	Soap & Chemicals	38	19
6	Hotel	188	39
7	Brick	439	27
8	Cold Storage	22	12
	Total	930	200

		0	
Table 2:	Sampling	of Industria	Secto

Source: CME 2008 and Associations; sample taken

These figures will be satisfactory considering the homogenous nature of industries and limitation on the sample size of 200 industries. The sector-wise and location-wise distribution of the visited industries is as given below:

¹ Krejcie& Morgan in their 1970 article "Determining Sample Size for Research Activities" (*Educational and Psychological Measurement*, #30, pp. 607-610).

	Mechi	Koshi	Sagarmatha	Janakpur	Narayani	Bagmati	Lumbini	Gandaki	Bheri	
Sector/Zone & District	Jhapa	Morang Sunsari Dhankuta	Siraha Udaypur	Sarlahi Dhanusha Mahotari	Bara, Parsa, Makwanpur, Chitwan	Kathmandu Valley, Kavre	Rupandehi, Nawalparasi, Kapilbastu	Kaski	Banke	Total
Cement	4		2	1	4		14		1	26
Pulp & Paper		2		1			2			5
Food		15		2	11	11	3	4	1	51
Metal		7			9	1	3		1	21
Soap & Chemical		7			9		3			19
Hotel	2	4			6	18	1	8		39
Brick		23				2	1		1	27
Cold Storage	2	3				6	1			12
Total	8	62	2	4	43	38	27	12	4	200

Table 3: Number of Visited Industries by Sector and Location

• Preparation for visit to Industries and Preliminary Field Visit

Meeting of all consultants including coordinator was organized in the Office of the PACE Nepal. Filling up of the questionnaires and the work to be carried out in the industry were discussed so that all consultants perform the assignment in the same way and complete it in time.

The consultant teams were mobilized for the field visit after the signing of the agreement, selection of industries, preparation of the questionnaires and discussion and orientation on the approach to be taken for the collection of all required information; and with verbal approval of NEEP.

• Preparation of the inception report and submission.

An inception report was prepared with work plan, list of industries selected and checklists / questionnaires for each sector of industry. This inception report was submitted to NEEP/ GIZ; and presentation was made at the meeting for their feedback and comments. The methodology and work plan was finalized by incorporating the feedback and comments from NEEP/ GIZ.

• Visit to Industries

The four teams visited the industries to cover altogether 200 units from the eight sectors as per their job assignment and collected the data and information as per the approved questionnaires. They filled in the questionnaires and conducted the walkthrough energy utilization surveys for electrical as well as thermal energy consumption and saving potentials for the visited industries. The teams also informed the visited industries about the NEEP activities and opportunities for the units under it. The list of industries visited is presented in the Annex – 4. The list of persons contacted and the questionnaires used have been given in Annex – 5 and Annex – 6.

• Data Entry and Analysis

Data collected were entered using excel sheets from the questionnaires as well as the prepared walkthrough energy survey reports and analysis was carried out to arrive at the energy intensity, energy consumption by source, CO_2 emission by different sectors of industries, sector-wise annual turnover, production, production and consumption of various forms of energy.

• Preparation of the draft report on the baseline study :

This draft report on the baseline study has been prepared and discussion among the consultants was carried out.

• Submission of Draft reports:

Prepared draft report is submitted to GIZ and FNCCI. The consultant will also present and discuss the draft report in an interaction programme organized by GIZ for getting feedback and comments.

• Incorporation of feedbacks and comments:

The consultants will incorporate relevant feedback and comment received from GIZ and FNCCI and other concerned stakeholders.

• Finalizing the reports and submission:

The baseline reports will be finalized after incorporating all relevant comments and feedbacks and the final report will be submitted along with a soft copy including MS word file and excel sheets of all data entry and analysis in a Compact Disk to GIZ

The methodology used is presented in the form of a flow chart below:



Figure 1: Flow Chart of the Methodology Used

6. Methodology for Estimation of Potential Savings

The potentials of energy saving in any industrial unit depend on the existing energy intensity as per the operational figures compared to the best possible energy intensity of the sector. The potential will be higher for poor operational conditions prevailing in the unit compared to one with good operational condition. The data collection and walkthrough survey consist of information and data, which will lead to energy intensity of the industrial unit. Suppose,

Ex is the electrical energy intensity in terms of Mega Joules per MT of the product,

Tx is the thermal energy intensity in terms of Mega Joules per MT of the product
 Eo is the optimum electrical energy intensity in terms of Mega Joules per MT of the product,
 To is the optimum thermal energy intensity in terms of Mega Joules per MT of the product,

Potential electrical energy saving (PE)

$$PE = \frac{1}{n} \times \sum_{x=1}^{n} (Ex - Eo) \times Q$$

Potential thermal energy saving (PT)

$$PT = \frac{1}{n} \times \sum_{x=1}^{\infty} (Tx - To) \times Q$$

Where, n is the number of sample in the sector and Q is the total production (quantity) of the industrial sector in the country. (Ex - Eo) and (Tx - To) are non-negative (≥ 0).

(Ex and Tx will be calculated from the survey findings and Eo and To will be used from the regional benchmarks)

For the concerned sector, the Total Potential Energy Saving (TP) will be obtained using the following equation:

$$TP = PE + PT$$

$$= \frac{1}{n} \times \sum_{x=1}^{n} (Ex - Eo) \times Q + \frac{1}{n} \times \sum_{x=1}^{n} (Tx - To) \times Q$$

$$= \frac{Q}{n} \times \{\sum_{x=1}^{n} (Ex - Eo) + \sum_{x=1}^{n} (Tx - To)\}$$

This potential will be compared with the potentials deduced from the previous projects; namely the Environment Sector Programme Support (ESPS) and Industrial Energy Management Component (IEM Component) of Power Sector Efficiency Project (PSEP).

From the reports of these two projects, electrical and thermal energy consumptions as well as electrical and thermal energy saving potentials will be tabulated. The unit-wise electrical energy saving potential as the percentage of the electrical energy consumption and thermal energy

saving potential as the percentage of the thermal energy consumption can be easily calculated also to get the maximum and minimum figures. The calculation will be as given below:

Unit-wise potential electrical energy saving (Peu),

$$Peu = \frac{Sxe}{Cxe} \times 100$$

Where, Sxe = Saving potential of electrical energy, and Cxe = Consumption of electrical energy

Unit-wise potential thermal energy saving (Ptu),

$$Ptu = \frac{Sxt}{Cxt} \times 100$$

Where, Sxt = Saving potential of thermal energy, and Cxt = Consumption of thermal energy

The average saving potentials can be calculated as follows:

Sector-wise average potential electrical energy saving (Pes) in percentage will be given as

$$Pes = \frac{100}{n} \times \left[\sum_{x=1}^{n} Sxe / \sum_{x=1}^{n} Cxe \right]$$

Similarly, Sector-wise average potential thermal energy saving (Pts) in percentage will be given as

$$Pts = \frac{100}{n} \times \left[\sum_{x=1}^{n} Sxt / \sum_{x=1}^{n} Cxt \right]$$

The proposed comparison of these potentials with the potential savings as calculated on the basis of the regional bench marks as given above will be helpful in confirming the saving potential figures.

7. Limitations and Asumptions

There are a number of limitations to this baseline study. It is important to understand these limitations so that the results of this baseline can be used properly. These are:

- a. The data collection and walk through survey had to be completed within a very short span of time. A significant portion of the information was obtained after the survey from office requiring a lot of follow-up including follow-up visits. Some of the data required are not maintained at the factory site and they had to be requested from the corporate office (top level management).
- b. Almost all industries do not maintain the necessary data and records related to the questionnaires and the information they gave during the interviews were from their best estimates and memory.
- c. Industries are not willing to provide production cost or turnover related data and information readily. Therefore, turnover has been calculated from the sales price in such cases.
- d. Optimal Energy Intensity figures for the region were not available for some of the sectors. Moreover, the types of raw materials and technology used are not similar and hence it was found out that there is a large difference in the actual energy intensity of the surveyed units compared to these optimal figures. Therefore, in such cases, available percentage energy saving potentials has been used.
- e. There is a wide variation in the products, raw materials used, technology used within the sector itself. Energy intensity calculation for different products from the same industry is not possible as the needed records are not maintained. Therefore, single product has been assumed and figures have been collected and analyzed for single product.
- f. The selected private sector brick industries in Kathmandu Valley did not want to provide any data or information as they were having dispute with the Government for requiring them to enroll in the Value Added Tax (VAT) system. To make up for this, additional brick kilns from Sunsari district were surveyed.
- g. During the walk through survey and study visit, brick kilns and the sugar mills were not operational as these industries are seasonal in nature. Therefore, the facilities were observed and not the operational aspects.
- h. For the micro-economic projections, estimates of national productions and import figures are necessary. Such figures are not readily available for some of the products or sectors and some of the available figures are not found to be realistic. Please see the Section 11.2.
- i. Although the process used by all the industries in the sector is not exactly the same, the process flow chart has been prepared for most common process used.
- j. The total production figures for the sectors have been taken mainly from secondary sources. They have been quoted. Where such source is not available, estimation has been done either from extrapolation or discussion with the association executives.

8. Literature Review

8.1 Industrial Development

Although the Government has stated in its plans and programmes that industrial development is given priority and emphasis is given for creating investment-friendly environment, increasing employment, production and productivity, substituting imports and minimizing trade deficit by promotion of export-oriented industries, the industrial development has not been satisfactory for the past few years. This may be attributed to prevailing situation in the country such as insecurity, problem in electricity supply, conflict between the owners and labours. The contribution of Manufacturing Sector to GDP is just 6.1 percent² and this has declined as against 6.4 percent for the fiscal year 2009/10. This value was 9 percent in the fiscal year 2000/01.

Economic Survey for the Fiscal Year 2010/11 has projected that the overall index of manufacturing production for the fiscal year 2009/10 has been 104.9 compared to base year of 2008/09. It has also estimated that the industrial production for the fiscal year 2010/11 rose for most of the food items, beverages, chemical goods, plastic goods, and cement.

The comparison of the Census of Manufacturing Establishments from 1986/87 to 2006/07 shows the following results. The total numbers of industries employing 10 or more employees and the employment provided by such units have not increased. However, the Value additions as well as the indirect tax paid have increased steadily as shown in the graph below:





Source: Various Census of Manufacturing Establishment Reports from CBS

² Economic Survey, 2010/11

³ CBS, Census of Manufacturing Establishments 1986/87, 1991/92, 1996/97, 2001/02, and 2006/07

8.2 Energy and Use

Water and Energy Commission Secretariat (WECS) has analyzed the energy Consumption pattern for the Fiscal year 2008/09⁴. Broadly energy sources are categorized into three broad categories namely traditional non-commercial, commercial and renewable sources. Traditional non-commercial category consists of Fuel wood, agro-residue and animal waste and this category accounts for around 87.1 percent. Commercial category consisting of coal, petroleum products and electricity accounts for around 12.2 percent and the renewable category accounts for around 0.7 percent. The total energy consumption for the fiscal year 2008/09 is 401 Million GJ. The portions of the fuel categories have been shown in the pie-chart below:

Figure 3: Energy Consumption by Category





The sector-wise consumption of energy is presented in the following chart. It clearly shows that the consumption of the industrial sector is only 3.3 percent of the total consumption.



Source: WECS Energy Sector Synopsis Report

⁴ WECS, 2010 Energy Sector Synopsis Report, Water and Energy Commission Secretariat (WECS), July 2010

Electricity Generation and Consumption⁵

As of August 2011, the total installed capacity of electricity generation is 705.566 MW including 477.530 MW of hydro operated by Nepal Electricity Authority (NEA), 174.526 MW from private sector, 53.410 MW of thermal with NEA and 100 KW of solar.

In the fiscal year 2009/10, the total electricity supplied was 3689.27 GWh. Out of these, the share of hydro-electricity production was 2,104.52 GWh, thermal production was 13.12 GWh, power purchased from private sector was 959.74 GWh and electricity imported from India was 612.58 GWh. Out of the supply, 2,603.35 GWh was consumed domestically and 74.48 GWh was exported to India. The percentage of electricity consumption was 37.7 percent by the industries as against 41.4 percent by the household and remaining by the commercial and other sectors.⁶

	Tuble 11 Industrial Consumer and Electricity Sales						
S. No.	Particular	2006	2007	2008	2009	2010	
1	Industrial Consumer of Electricity (Nos.)	23,020	24,089	25,548	28,559	30,567	
2	Sales of Electricity to Industries (in GWh)	785.55	849.13	901.09	845.68	1008.37	
C ·							

Table 4: Industrial Consumer and Electricity Sales

Source: Nepal Electricity Authority – A Year I Review – Fiscal Year 2010/11





Source: Annual Report of NEA 2010/11

⁵ NEA, 2011 Nepal Electricity Authority – A Year in Review – Fiscal Year 2010/11, August 2011 page 116

⁶ Economic Survey – Fiscal Year 2010/11, Vol. I

Petroleum Products

The consumption of Petroleum Products rose by 25.2 percent totaling to 913,198 kiloliters⁷. Majority share of POL consumption has been occupied by Diesel, Kerosene, Petrol and Aviation fuel. The consumption shares of these four oils were 67.1, 6.1, 17.7 and 9.1 percents respectively. Imports of petroleum products for last seven years have been presented in the chart below⁸:



Source: Nepal Oil Corporation

Coal

Coal consumption was seen to rise by 61.8 percent 2009/10 as compared 2008/09. Index mundi has the following data on coal import and production in Nepal:

Table 5: Coal Imports and Production in short tons in Nepa	1 ⁹
--	----------------

Particular	2005	2006	2007	2008	2009			
Coal Import Million Tons	442.03	457.46	472.89	498.24	524.70			
Coal Production	9.92	9.92	9.92	9.92	13.23			
1	4.	1	•					

Source: http://www.indexmundi.com/energy.aMillion

spx?country=np&product=coal&graph=imports date: 11 Dec 2011

The report of WECS shows that the import of coal from India as only 293,760 tons and the coal production in the country is 14,820 tons¹⁰.

⁷ Economic Survey, 2010/11

⁸ Source: NOC

⁹ Source:

http://www.indexmundi.com/energy.aMillion spx?country=np&product=coal&graph=imports date: 11 Dec 2011

 ¹⁰ WECS, 2010 *Energy Sector Synopsis Report*, Water and Energy Commission Secretariat (WECS), July 2010 pp.
 66



Figure 7: Import & Production of Coal in Ton

Industrial Consumption of Energy by Fuel Type

Industries in Nepal consume only 3.3 percent of energy or 13.4 million GJ and this has increased by 3.9 percent annually. The portions of various fuels by the industries are presented in the chart below:



Source: WECS Energy Sector Synopsis Report

8.3 Energy Intensity of various sectors of industries in the region

Energy Intensity or the Specific Energy Consumption (SEC) figures were requested to related organizations including GIZ/ NEEP. The documents sent by the professionals were reviewed and the internet was used to look for relevant documents. Actually a huge amount of documents available in the web were studied and reviewed. Some of the relevant figures have been presented below:

- a. As per The Energy and Resource Institute (TERI)¹¹, the specific energy consumptions (SEC) for various sectors are as given below:
 - For cement plants, the range of SEC is from 665 900 Kcal/Kg of thermal • energy for clinker production and SEC electrical energy is from 66 - 127kWh / T of cement production – means being thermal energy 750 kcal/ kg of clinker production and electrical energy 105 kWh/ T of cement production.
 - For Pulp & Paper plants, the range of SEC is 25.3 121 GJ/T. International bench mark is 1175 kWh/ MT of electrical energy and 3.92 M. kcal/MT of Thermal energy.
 - Milk Product electrical 10 kWh/ KL and fuel 1 lit/KL
 - Sugar Mills steam to cane ratio: 26 45%; and 22 35 kWh/MT of electricity

TERI¹² also has the details of the energy cost and energy saving potentials for some of the sectors as given below:

- Cement Energy cost is 34.5% of cost of production; and saving potentials is 10 - 15%
- Iron & Steel Energy cost is 15.8% of the cost of production; and saving potentials is 8 - 10%
- Pulp & Paper 22.8% of the cost of production; and saving potential is 20 -25%
- Sugar -3.4% of the cost of production; and saving potential is 25 30%
- Fruit & Vegetable Processing Units energy cost is 5 7% of the cost of production and energy saving potential around 10%
- Milk Product energy cost is 5 7% of the cost of production; and energy saving potentials is above 15%
- b. A working paper¹³ of UNIDO published in November 2010 as the following SEC for the sectors mentioned below:

¹¹ Presentations on Energy Intensity and Industries based on TERI Reports Obtained from TERI ¹² Presentation on Food Processing – SEC Figures obtained from TERI

¹³ Global Industrial Efficiency Benchmarking – An Energy Policy Tool Working Paper, UNIDO, Nov 2010

		Energy consumption in GJ/ tonne of				
S. No.	Sector / Product	output				
		Electricity	Thermal	Total		
1	Dairy – butter, ghee	0.5	1.3	1.8		
2	Fluid Milk	0.2	0.5	0.7		
3	Vegetable oil	0.2	2.7	2.9		
4	Sugar	0.6	5.3	5.9		

Table 6: Specific Energy Consumption for Some Sectors

Source: Global Industrial Efficiency Benchmarking – An Energy Policy Tool Working Paper, UNIDO, Nov 2010

Similarly, for the brick kilns, the working paper under Table 8: SECs of different brick making technologies in selected countries have been presented in GJ/ ton as follows:

	Intermittent	BTK	Hoffmann	Tunnel	VSBK Kiln
	Kiln		Kilns	Kilns	
India	3 - 11	1.8-4.2	1.5-4.3	1.5-2	0.7-1.0

Table 7: SEC of Different Brick Making Technologies in India

Source: Global Industrial Efficiency Benchmarking – An Energy Policy Tool Working Paper, UNIDO, Nov 2010

c. Global Overview of Construction Technology Trends: Energy Efficiency in Construction (HABITAT, 1995, 210 p.) - 2. Energy efficiency in the production of high-energy content building materials have given the fuel requirements for brick making using different kiln types as follows:

Type of kiln	Heat requirement	Quality of fuel required (tons/1,000 bricks)			
	(MJ/1,000 Dricks)	Wood	Coal	Oil	
Intermittent					
Clamp	7,000	(0.44)	0.26	(0.16)	
Stove	16,000	1.00	0.59	0.36	
Scotch	16,000	1.00	0.59	0.36	
Downdraught	15,500	0.97	0.57	(0.35)	
Continuous					
Original Hoffmann	2,000	0.13	0.07	0.05	
Modern Hoffmann	5,000	0.31	0.19	0.11	
Bulls's Trench	4,500	0.28	0.17	(0.10)	
Habla	3,000	0.19	0.11	(0.07)	
Tunnel	4,000	(0.25)	(0.15)	0.09	

Table 8: Fuel Requirement for Brick Making by Kiln Type¹⁴

Source: UNIDO/ILO, Technical Memorandum No. 5

¹⁴ Global Overview of Construction Technology Trends: Energy Efficiency in Construction (HABITAT, 1995, 210 p.)

d. Research study¹⁵ has also shown the following production of brick and consumption of coal:

	Estimated brick	Estimated annual	Coal consumption	
Country	consumption	production (billion	for firing bricks in	
	/capita/year	bricks/year)	million tones/year	
India	100	100	15-20	
Pakistan	100	15	NA	
Bangladesh	50	6	NA	
China	650	800	100	
Indonesia	23	5	NA	

Table 9: Consumption of Coal for Brick in Some Countries

NA: Not Available

Source: Maithel, Mueller and Singh, "Experiences in transfer and diffusion of efficient technologies in Indian brick industry

- e. Vertical Shaft Brick Kiln (VSBK) Project supported by SDC in Nepal has recorded the following specific energy (coal) consumption (SEC) in MJ/ kg of fired brick for the different technologies¹⁶:
 - 1.25 for Moving Chimney Bulls Trench Kiln (MC- BTK);
 - 1.1 for Fixed Chimney BTK (FC- BTK); and
 - 0.75 for VSBK

It has also projected the annual brick production of the Kathmandu Valley is 1.2 Billion Bricks per year. The total coal consumption for this is 130,000 tons per year. The energy content in the coal is around 6,000 kcal/kg. It has also estimated that if BTKs in the Valley are transformed into VSBKs, the reduction in CO_2 emission will be 100,000 tons per annum only for the Kathmandu Valley.

f. EOLBNL, 2008¹⁷ has given the world best practice final and primary energy intesnsity values in GJ per ton of steel for electric arc furnace route as given below:

Darticulars	World Best Practice Energy Intensity in GJ/t					
	Fuel	FuelElectricityFinal Energy		Primary Energy		
Hot Rolling - Bars	1.6	0.3	1.8	2.4		
Hot Rolling - Wire	1.7	0.4	2.1	2.9		

Table 10: World Best Practices Energy Intensity Hot Rolling

Source: EOLBNL, 2008

g. Specific Energy Consumption (SEC) for Re-rolling Mills¹⁸

¹⁵ Maithel, Mueller and Singh, "Experiences in transfer and diffusion of efficient technologies in Indian brick industry

¹⁶ <u>http://www.vsbknepal.com/fact_sheet/fact_energy.php</u> date 5 Dec 2011

¹⁷ Source: EOLBNL, 2008. World Best Practice Energy Intensity Values for Selected Industrial Sectors, Eanest Orlando Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, February 2008. (LBNL-62806)

Energy is the major cost in the operation of any re-rolling mill and it accounts for around 40 to 50 percent of the operational cost. SEC for re-rolling mill is 38 to 50 liters of oil (1509 MJ/T) together with 200 kWh of electricity (277 MJ/T) for the production of one tonne of product in India. These figures are 26 liters of oil (1040 MJ/T) and 60 to 85 kWh of electricity per tonne (234 MJ/T) of product in case of developed countries. Therefore the total SEC is 1786 MJ/T for India while it is 1274 MJ/T for developed countries.

h. Energy benchmarking for hotels is complex. There are multiple ways to do benchmarking in the hotel sector, but the difficulties are numerous. Only large hotels have their own laundry service, which implicitly means higher energy consumption. Other hotels outsource their laundry. Some hotels have an indoor swimming pool, others don't. Depending on the influence of the seasons, the occupancy level of the guest rooms can vary throughout the year. Therefore, there is a spread for the energy consumption of hotels, and not just an average number. Niki Hendrikx, 2008¹⁹ gives the following energy benchmarks for the hotel sector:

Hotel Type	Fuel (kWh/m ² *year)			Electricity (kWh/m ² *year)		
noter Type	Mean	Max.	Min.	Mean	Max.	Min.
Small & Medium without complete A/C	238	286	196	77	80	71
Large with A/C and more equipment	266	350	220	143	182	100

Table 11: Energy Benchmarks for Hotel Sector

Source: <u>http://www.scribd.com/doc/9647604/Energy-Efficiency-in-Hotels</u> 11 Dec 2011

The Energy Performance Index (EPI) of Indian hotels has been recorded as 116 kWh per room per day for Luxury hotels²⁰. The figures for budget hotel and classified hotel are 57 and 40 kWh per room per day respectively.

i. Energy Consumption & Conservation Potential in Cold Storage of West Bengal, a study by National Productivity Council (NPC), India has stated that the electrical energy saving potential for cold storage is **20 percent**²¹.

 ¹⁸ Source: Implementation of Energy Efficiency in SME Clusters, Energy Conservation and Commercialization (ECO-III) Project, Contract No. 386C-00-06-00153-00, ISBN No. 978-81-909025-2-6, February 2009 pp. 46.
 ¹⁹ <u>http://www.scribd.com/doc/9647604/Energy-Efficiency-in-Hotels</u> 11 Dec 2011

²⁰ Source: A presentation on Energy Profile and Energy Efficiency Improvement in Indian Hotels by Mr. Pradeep Kumar, Senior Fellow, TERI, New Delhi

²¹ NPC study on Energy Consumption & Conservation Potential in Cold Storage of West Bengal, Bureau of Energy Efficiency, India

From the above literature study, for the purpose of this study, we can consider the optimum energy intensities as given below:

C No	Sector	Sub gooton / Duoduot	Energy	Intensity	
5. NO.	Sector	Sub-sector / Product	Electrical	Thermal	
		Limestone based	105 kWh/ T of	750 kcal/kg	
1	Cement		cement	clinker	
1	Cement	Clinker based	35 kWh / T of cement ²²	-	
2	Pulp & Paper	Bleached Paper	1175 kWh/MT or 4,230 MJ/MT	3.92 M kcal/MT or 16,412.26 MJ/MT	
		Beverage - Non-alcoholic Alcoholic	60 kWh/100 cases 480 kWh/100 cases	0.3 1/100 cases	
3	Food	Dairy	10 kWh/kL	1 lit/kL	
		Vegetable oil & ghee	0.2 GJ/Tonne	2.7 GJ/Tonne	
		Instant Noodles			
		Sugar	0.6 GJ/Tonne	5.3 GJ/Tonne	
4	Metal	Iron Rods/ Bars	200 kWh/T	1.509 GJ/t	
5	Soap & Chemical	Soap			
6	Hotel	Room (kWh/room/day)	116 for luxury 57 for budget, & 40 for classified		
7	Briek	Fixed Chimney	-	1.1 MJ/kg	
/	DIICK	VSBK	-	0.75 MJ/kg	
8	Cold Storage		20% of consmption	-	

Table 12: Summerised Table for Energy Intensity

Source: summarized from above described literature. Values used in the calculation have been made bold

Additionally, where the SEC is not available or widely different, the potential savings found in the region will be considered and the total possible saving for the sector will be calculated.

Such potential savings in percentages from the literature survey given above are:

•	Cement Industries:	10 - 15%
•	Iron & Steel:	8 - 10%
•	Pulp & Paper:	20 - 25%
•	Sugar:	25 - 30%
•	Fruit & Vegetable Processing:	10%
•	Beverages	8%
•	Milk products:	15%

Rest of the sectors for which, the saving potentials are not available, previous energy saving potentials as of consumption from the ESPS will be used.

²² The clinker based cement industry does not require thermal energy and according to expert opinion, the electrical energy consumption for such unit is around one third of the electrical energy consumption by limestone based.

8.4 Energy Saving Potentials Based on ESPS Reports

From 2000 to 2005 June, Cleaner Production and Energy Efficiency interventions were carried out under Environment Sector Programme Support (ESPS) in 322 industries of almost all sectors. The data and information on the consumption and estimated potential savings of energy were entered in Excel sheets for the eight sectors of industries under consideration. Only Techno-economically feasible options with payback period less than three year are recommended these have been considered. This analysis showed the following potential savings:

Cement Sector

ESPS had conducted EE in only one industry and that was also for a clinker based cement plant. The potential seen was 63,831 kWh of electricity could be saved out of the consumption figure of 1,307,615 kWh; i.e. 4.88 percent.

Pulp & Paper Sector

Three large scale industries and one medium scale industry were involved in the intervention programme and the analysis showed that 2.49 percent of the electricity consumption could be saved while under the thermal energy, 22.52 percent saving potential was established.

Food Sector

52 food sector industries were included as taken in the six sub-sectors considered in this report. These are biscuit, beverages, dairy, Vegetable oil refining, instant noodles, and sugar. The numbers of industries in each of these sub-sectors were 9, 3, 26, 3, 10, and 1. The percentage potential energy savings for electrical and thermal energy for the sub-sectors are as given below:

S. No.	Sub sector	Potential energy Saving in %				
	Sub-sector	Electrical	Thermal			
1	Biscuit	29.47%	15.38%			
2	Brewery	9.09%	19.25%			
3	Dairy	6.31%	13.91%			
4	Vegetable Oil, ghee	5.49%	11.07%			
5	Instant Noodle	6.15%	11.38%			
6	Sugar	14.55%	20.73%			

 Table 13: ESPS Potential Energy Saving for Food Sub-sectors

Source: Calculated from ESPS CP reports

Metal Sector

There were 11 metal industries and the analysis of the report shows that the potential saving for electricity and thermal energy are 6.17 percent and 22.97%.

Soap and Chemicals Sector

There were seven industries in this sector and the potential saving for electricity and thermal energy are 9.71% percent and 39.46%.

Hotel Sector

There were 3 units of hotels covered and the potential saving for electricity and thermal energy are 45.24% percent and 16.18%.

Brick Sector

There were six brick sector industries covered and the potential saving for electricity and thermal energy are 0% percent and 22.6%.

Cold Storage Sector

There was only one cold storage covered and the potential saving for electricity and thermal energy are 5.93% percent and 0%.

The saving potentials is presented in the table below:

Table 14: Saving Potential of Various Sectors - ESPS									
		No of	Consumption	Saving	Saving	Consumption	Saving	Saving	
S. N.	S. N. Sector		Electricity	Electricity	Electricity	Fuel MKCal	Fuel	Fuel	
		mu	KWh	KWh	(%)	Fuel WINCal	MKCal	(%)	
	Cement	1	1,307,615	63,831	4.88	56			
	Pulp & paper	4	26,753,508	666,411	2.49	70,440	15,865.6	22.52	
	Food	52	31,543,473	1,748,527	5.54	334,148	52,122.8	15.6	
	Metal	11	16,846,647	1,038,823	6.17	43,751	10,051.2	22.97	
	Soap & Chemical	7	2,602,000	252,560	9.71	47,917	18,910	39.46	
	Hotel	3	294,174	133,072	45.24	76	12.3	16.18	
	Brick	6	6,000	0	0	24,785	5,600.5	22.6	
	Cold storage	1	652,580	38,700	5.93				
Food	Sub-Se	ctor							
1	Biscuit	9	1,986,409	585,421	29.47	7,514	1,156.01	15.38	
2	Brewery	3	2,324,694	211,301	9.09	10,956	5,998.2	19.25	
3	Dairy	26	5,363,835	338,539	6.31	12,234	1,701.2	13.91	
4	Noodles	3	594,297	36,535	6.15	14,099	1,604.5	11.38	
5	Oil	10	29,444,835	1,616,602	5.49	162,173	17,956.9	11.07	
6	Sugar	1	652,720	94,950	14.55	153,747	31,878.4	20.73	
		52							
Sources Coloulated from ESDS CD Deports Figures used for coloulation have been made hold									

 Table 14: Saving Potential of Various Sectors - ESPS

Source: Calculated from ESPS CP Reports. Figures used for calculation have been made bold.

When ESPS carried out the CP assessments, energy efficiency was a major part and only feasible options with payback period less than 3 years were recommended and the potential savings were calculated based on these assumptions.

8.5 Energy Saving Potentials IEMP Reports

The study of the reports of the energy audits under IEMP shows the following potentials:

S. No.	Sector	No. of	Type of Audit	Potential as %	
S. NO. Sector		Units	Type of Audit	Electrical	Thermal
1	Cement	1	Electrical system Audit Report	0.89%	
2	Sugar	4	Electrical system Audit Report	2.94%	
3	Sugar	1	Boiler Audit & Co-generation Study Report		18.93%
4	Veg Ghee	1	Electrical system Audit Report	0.26%	
5	Pulp & Paper	1	Electricity Load Management	2.81%	
6	Metal	1	Furnace Efficiency Improvement Services		14.65%
7	Metal	3	Electrical system Audit Report	0.54%	
8	Hotel	1	Electricity Load Management	0.63%	
9	Brick	2	Kiln Efficiency Improvement Services		14.37%
10	Hotel	1	Detailed Energy Audit Report Hotel Himalya	11.21%	

Table 15: Energy Saving Potentials seen in IEMP

Source: Calculated from EE Reports from IEMP

8.6 Co-generation Potentials

Co-generation from sugar mills using bagasse feedstock is well-established commercial technology. Such technology is around 50 years old and successfully operating in many countries including India and Thailand. Bagasse is fed to a specially designed furnace to produce high pressure and high temperature steam at 40 bars and 440°C and such steam is used to generate much larger amount of electric power from the turbo generator than the power required for the operation of the sugar mill process. Thus generated excess electric power can be supplied to the nearby utility grid or used to supply locally. The excess generation from a sugar mill can be 100 - 140 kWh per ton²³ crushed if high pressure boilers are used. As the sugar mill operates only seasonally, the boiler has to be multifuel type such that besides bagasse, biomass, and coal could be used and the boiler and generator could operate round the year.

²³ Source: Study Report "Bangladesh Roadmap for Energy Efficiency Improvements and Demand Side Management, Sept 2009"; jointly financed by Power Sector Development Technical Assistance project of the World Bank and GTZ, Dhaka.

8.7 Green House Gas (GHG) calculation The following table²⁴ has been used in the calculation of the CO_2 emission from the various fuels used:

Fuel		Energy Basis	Mass Basis	Liquid basis
		kg/GJ	Kg/tonne	Kg/litre
Oil Products	LPG	63.1	2984.63	1.61
	Other Kerosene	71.9	3149.22	2.52
	Petrol/ Diesel	74.1	3186.3	2.68
	Residual Fuel oil	77.4	3126.96	2.94
	Lubricant	73.3	2946.66	2.95
	Other Petroleum Product	73.3	2946.66	
Coal	lignite	101	1201.9	
Biomass	wood	112	1747.2	
	Charcoal	112	3304	
	Other primary solid biomass fuels/ (Rice Husk)	100	1160	

Table 16: Factors for CO₂ Emission from Fuels

Source: UNEP, 2009. United Nations Green House Gas Calculator, User Manual 1.0, April 2009

Purchased Electricity for Nepal

The emission factor for Nepal has been given in the above manual as $0.0014075 \text{ kg CO}_2/$ kWh of Electricity²⁵.

 ²⁴ Source: UNEP, 2009. United Nations Green House Gas Calculator, User Manual 1.0, April 2009
 ²⁵ Source: UNEP, 2009. United Nations Green House Gas Calculator, User Manual 1.0, April 2009 page 44
8.8 Annual Production or Capacity Utilization for Macroeconomic Projection

The annual production or capacity is needed for the projection of potential energy saving from the survey scenario. Therefore, such figures were explored. The most authentic figures of production are available from the Economic Survey 2010/11 published by the Government of Nepal, Ministry of Finance. However, in some cases, very recent data are not available. The available data has been compiled below. The source of the data if not mentioned is from the above economic survey.

S No	Sector	Sub-sector Production		Data for
5. 110.	Sector	Sub-sector	1 I oduction	year
1	Comont ²⁶	Limestone based	709,003 MT ²⁷	2010/11
1	Cement	Clinker based	1,933,518 MT	2010/11
2	Pulp &		32,905 ²⁸ MT	2007/08
2	Paper		39,372 ²⁹ MT	2010/11
		Beverage	2,000,000 KL ³⁰	2010/11
		Biscuit	18,000 ³¹ MT	2010/11
2	Food	Dairy	1,556,000 KL	
5		Instant Noodles	42,840 MT	2010/11
		Sugar	190,650 MT	2007/08
		Vegetable Oil & Ghee	194,319 MT	2007/08
4	Metal	Iron Rods etc.	$600,000^{32} \mathrm{MT}$	2010/11
5	Soap		112,000 MT	2010/11
6	Hotel		15,021 rooms ³³	2010 Dec.
			4 Billion pcs ³⁴	
7	Brick		3.984 Billion for BTK &	2010/11
			16 Million for VSBK	
0	Cold		60 000 MT ³⁵	2010/11
0	Storage		00,900 1/1	2010/11

Table	17:	Annual	Production	Figures
I HOIC		1 111114441	1 I Outetion	I Igui Co

Source: as quoted in the footnote or Economic Survey 2010/11

²⁶ Projected from the production of the visited industries

 ²⁷ From survey of all units based on limestone
 ²⁸ Economic Survey 2010/11

²⁹ Estimated from field survey

³⁰ Estimated from discussion with industries

³¹ Estimated from discussion with industries

³² Estimated from discussion with industries

 ³³ Average beds per room taken as two and projected rooms from no of beds.
 ³⁴ VSBK & CESEF NEPAL External Review, March 2007 ppt presentation

³⁵ From discussion with executives of association - 35 nos X average of 3,000 MT and capacity utilization of 58%

9. Sector Analysis

9.1 Cement Sector

a. Sector Highlights

Cement is one of the basic construction materials. From the aspect of availability of raw material, cement sector is considered as a very important sector in Nepal. It falls under the category of heavy industry. Nepal has good deposits of the main raw materials namely the calcium carbonate or the Limestone and Silica rich clay. In the earlier period, Cement industries were established by the Government, when there was no initiative from the private sector. Himal Cement Company Ltd. of 360 TPD capacity was established in Chobhar area in the Kathmandu Valley. Hetauda Cement Industry Ltd. of 750 TPD capacity in Lamsure, Hetauda and Udapypur Cement Industry Ltd. of 850 TPD capacity in Gaighat of Udayapur by the Government. Himal Cement Company Ltd. has been closed whereas Hetauda Cement Industry and Udayapur Cement Industry are still operational. At present around 59 cement industries in private sector have been registered in Department of Industry. Maruti Cement Industry of 950 TPD capacity and some other small Vertical Shaft Kiln (VSK) technology based cement industries of 30 to 100 TPD capacities have been producing cement in privet sector using limestone deposits. Other cement plants in private sector have been producing cement from clinker, imported mainly from India.

It is estimated that annual gross consumption of cement in Nepal at present is around 2,500,000 MT. and only 70 percent of the total consumption is being produced in Nepal³⁶. Rest is fulfilled by the imported cement from India. Annual increment of demand for cement in Nepal is considered to be around 20 percent. It is estimated that around six billion NPR of investment has been made by private entrepreneurs in cement sector. Couples of big cement industries of 900 to 1,500 TPD based on rotary kiln technology are in pipe line and some of them will come into operation by next couple of months. It is expected that after some years, Nepal will be self sufficient in Cement.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown under Nepal Standard Industrial Classification of 2694, the number of manufacturing of Cement, lime and Plaster was 25 with employment of 2,225 persons with the value of output of NPR 6.962 Billion with the inputs of NPR 5.353 Billion and value added of NPR 1.609 Billion. These 25 units used the following quantities and values different fuels and electricity:

S. No.	Fuel	Quantity	Value in NPR
1	Fire woood MT	72.5	618,000
2	Charcoal MT	62989.6	454,422,000
3	Diesel lit	1,218,336	57,388,000
4	Petrol lit	30,108	1,870,000
5	Kerosene lit	14,835	526,000
6	LPG MT	22.125	1,493,000
7	Others		16,969,000
8	Electricity kWh	61,931,442	390,098,000
	Total		923,384,000

 Table 18: Fuel and Electricity Consumption by Cement Industries

Source: Census of Manufacturing Establishments 2006/07

³⁶ Abhiyan Product Directory, 2068, published by the Ahiyan Economic National Daily, pp 280.

This shows that the cost of energy was around 13.26% of the value of output or the 57.38% of the value added.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of cement over last five fiscal years as given below:

	Table 19: Production of Cement		
Fiscal Year	Cement Production in MT		
2006/07	644,325		
2007/08	71,132		
2008/09	71,000		
2009/10	72,100		
2010/11	84,130		

Table 19: Production of Cement

Source: Economic Survey 2010/11

These figures do not seem to present correct data. Even the total production of the surveyed industries is much more.

b. Observations

There are two types of cement plants. The first one is based on Limestone and the other one is based on clinker.

The plants based on clinker are basically grinding and mixing units and the energy type used is only electricity.

The plants based on limestone use electrical energy as well as coal.

The process flow charts of the limestone based cement plant and clinker based cement plants are given below:



Figure 9: Process Flow Chart of Cement Plant based on Limestone



The observations as seen during the survey have been given below:

- 1. Cement industries in Nepal are either based on limestone as raw materials or clinker based. The majority of the industries are clinker based.
- 2. Limestone based cement industries consume more energy compared to clinker based cement industries. Limestone based industries consume both electrical and thermal energy. The source of thermal energy is coal and it is used for burning (clinkerization) process. Cement industries are found to use better quality coal with higher calorific value compared to other industries. Negligibly some clinker based industries use thermal energy for the dryer used to remove moisture from the raw materials especially in the production of Portland Slag Cement (PSC).
- 3. Clinker based cement industries are either closed circuit or open circuit type.
- 4. The average installed capacity of the limestone based and clinker based cement plants are 645 and 388 TPD and their average productions are 295 and 239 TPD respectively.
- 5. Electrical Energy supplier to the industries is Nepal Electricity Authority through 66/33/11 kV supply with time of day (TOD) metering system.
- 6. All the units have their own DG set to supply the power during power failure from the central grid.
- 7. Heavy motors are used in cement industries for crushing, raw milling and ball milling.
- 8. Old and rewound motors are being used. The plants do not check their motor loadings.
- 9. Cement plants have installed capacitor banks to improve the power factor.
- 10. Around 20 percent of industries complained that they face problems of voltage fluctuation and low voltage supply.
- 11. Production is hampered by load shedding in cement industries. Three of the sampled units are non-operative in lack of the supply from the central grid but others run the industry partially or in full swing as per the demand of the market compromising on heavy energy cost for the production.
- 12. Smooth production is disturbed by the frequent power cuts (non-scheduled) and production is lost due to reset up time.
- 13. Around 50 percent of the industries are installed with devices like programmable logic controllers (PLCs) for automatic raw material feedings.
- 14. Around 70 percent of the plants have never carried out energy audit.
- 15. Maintenance of equipment is not given proper attention.
- 16. In general, the dust emissions are very high in and around the premises of cement industries.
- c. Data Analysis

The data and information collected during the baseline survey was analyzed using Excel Sheets. There were 6 small, 10 medium and 10 large scale units covered under the survey. Eight of them were based on limestone and rest 18 based on clinker.

Figures of fiscal year 2010/11 show that the total capacity of the clinker based plants is 2,095,250 MT per annum while, the actual production was 1,289,012

MT. They consumed 62.75 million units of electricity (kWh) worth NPR 516.385 million. The average SEC is found to be 48.69 kWh of electricity. CO_2 generation is found to be 11,262 MT equivalent to 8.74 kg per MT of production.

Similarly, the total capacity of the limestone based plants was 1,548,250 MT per annum while the actual production was 709,003 MT. They consumed 105.33 million units of electricity (kWh) and thermal energy equivalent to 3,836,602 GJ worth NPR 2,803.06 million. The average SEC is found to be 148.56 kWh of electricity and 5,411.26 MJ of thermal energy per MT. CO₂ generation is found to be 196,628 MT, which is equivalent to 277.33 kg per MT of production.

Sector Cement; Sub-sector: clinker based

Table 20: Results of Survey Clinker based Cement Industries Production and Turnover

S. No.	Particular	Fiscal Year 2009/10	Fiscal Year 2010/11
1	Production Capacity in MT	1,701,250	2,095,250
2	Production in MT	1,003,120	1,289,012
3	Annual Turnover in Million NPR	7,929	10,518.3
4	Production Share to the Sector		66.67%

Energy and Fuel

S No	Particular	Total	Quantity per
5. 110.		Quantity	MT
1	Electrical Energy in kWh	62,757,722	48.68
	a. Purchased Electricity	42,659,093	33.09
	b. DG sets	20,098,629	15.59
2	Thermal Energy in GJ	-	-
	a. Coal Consumption in GJ	-	-
3	CO ₂ generation in kg	11,261,814	8.74
	a. Purchased Electricity	60,043	0.047
	b. Diesel	11,107,691	8.62
	c. FO	94,080	0.073
4	Total DG set capacity in KVA	17,456	-
	a. Diesel consumption liter	4,144,661	3.22
	b. FO consumption liter	32,000	
5	Energy Cost NPR	516,384,777	401

Source: Results of Survey

Thus, the energy cost is around 4.91 percent of the turnover.

Sector Cement; Sub-sector: limestone based

 Table 21: Results of Survey Limestone based Cement Industries

 Production and Turnover

S. No.	Particular	Fiscal Year 2009/10	Fiscal Year 2010/11
1	Production Capacity in MT	1,338,250	1,548,250
2	Production in MT	604,480	709,003
3	Annual Turnover in Million NPR	4,878	5787
4	Production Share to the Sector		100

Energy and Fuel

S. No.	Particular	Total	Quantity per
		Quantity	MT
1	Electrical Energy in KWh	105,332,896	148.56
	a. Purchased Electricity	82,192,750	115.93
	b. DG sets	23,140,146	32.63
2	Thermal Energy in MJ	3,836,602,720	5,411.26
	a. Coal Consumption	3,836,602,720	5,411.26
3	CO ₂ generation in kg	196,628,530	277.33
	a. Purchased Electricity	115,686	0.16
	b. DG sets	11,622,455	16.39
	c. Coal	183,567,389	258.91
	d. FO	1,323,000	1.87
4	Total DG set capacity in KVA	21,650	-
	a. Diesel consumption liter	3,666,737	5.17
	b. FO consumption liter	450,000	
5	Energy Cost NPR	2,803,062,745	3,953.53

Source: Results of Survey

Thus, the energy cost is around 48.43 percent of the turnover.

d. Areas and Potential Savings

From the Excel sheet calculation, For clinker based plants, n = 18; Q = 1,289,012 MT and Eo = 35 kWh or 126 MJ Σ (Ex -Eo) = 0.426874511 MWh/MT

$$PE = \frac{1}{n} \times \sum_{x=1}^{n} (Ex - Eo) \times Q$$

PE = 0. 426874511*1289012/18 = 30,569 MWh = 110,049 GJ PT = 0

Total Potential TP = 30,569 MWh for the surveyed clinker based units

Therefore, the respective fuel savings potentials from the Excel sheet are:

Table 22: Potential Saving of Fuels - Clinker based Cement

S. No.	Electricity / Fuel	Consumption	Saving
1	Purchased Electricity MWh	42,659.093	20,779.050
2	Diesel KL	4,144.661	2,018.845
3	FO KL	32	15.587

Source: Results of Survey

For the limestone based plants, n = 8, Q = 709,003 and Eo = 105 kWh or 378 MJ $\Sigma(Ex - Eo) = 0.39932127$ MWh/MT

To = 750 kcal/kg or 3, 140.1 MJ/Mt; $\Sigma(Tx - To) = 18,035$ MJ/MT

$$PT = \frac{1}{n} \times \sum_{x=1}^{n} (Tx - To) \times Q$$

PT= (1/8)*18035* 709003 = 1,598,358,638 MJ = 1,598,359 GJ

Total Potential TP = PE + PT = 1,725,763 GJ

Therefore, for the total surveyed units the total energy saving potential is 1,835,812 GJ.

Thus the electrical saving potential is 33.60% and thermal saving pot gential is 41.66%

Therefore, the respective fuel savings potentials for Limestone based industries from the Excel sheet are:

S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	82,192.75	27,615.32
2	Diesel KL	4,336.74	1,457.07
3	FO KL	450.00	151.20
4	Coal MT	152,731	63,629
~			

Table 23: Potential Saving of Fuels - Limestone Based Cement

Source: Results of Survey

The areas of potential saving in the sector are:

- Improvement in motor loading
- Installation of more efficient motors
- Replacement of old and rewound motors
- Load management
- Installation of capacitor banks and increasing efficiency of existing capacitor banks
- Improvement in combustion efficiency
- Minimization of heat losses from the kiln
- Regular maintenance of the equipment

9.2 Pulp & Paper Sector

a. Sector Highlights

The Pulp and Paper industry has completed almost four decades of its production life in Nepal. Before that, the requirement of writing and printing paper used to be fulfilled by Indian paper industries. The Nepalese Handmade paper industries are also popular in Nepal but they are produced only a few ton/year and have only the decorative value and are belong to cottage industrial sector. There are seven paper industries in Nepal six of them are located outside Kathmandu valley. The largest of them (Bhrikuti Pulp & Paper Industry) is closed for more than one year.

Presently the paper industries are producing mainly two types of products, the bleached Writing and Printing (W/P) and Newsprint paper and the unbleached Kraft paper. The papermaking fibers in Nepal are locally produced Non-wood pulp, which is consumed about 63% and locally collected recycled papers, which is consumed about 37%.

There are four major process steps for paper production, which include Raw Material Preparation, Pulping, Papermaking and Finishing. Raw material Preparation concerned to cleaning, washing and screening. Pulping concerned to Cooking, Blowing, Washing, Screening, Centri-cleaning, and Decker (thickening). Papermaking concerned to Bleaching, Mixing, Refining, mixing chest, Centri-cleaning, Paper making and finally finishing & Packing. The black liquor generation from Pulping and use of bleaching chemicals for bleaching are the major environmental concerns for paper industry and the industry also used significant amount of electrical as well as thermal energy.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown under Nepal Standard Industrial Classification of 2101, the number of manufacturing of Pulp & Paper and Paper Board was 46 with employment of 2,035 persons with the value of output of NPR 2.945 Billion with the inputs of NPR 1.376 Billion and value added of NPR 1.569 Billion. However, majority of them are handmade paper units and only six of them are mechanized pulp and Paper mills. The seventh one has come into operation only after the census. These 46 units used the following quantities and values different fuels and electricity:

S. No.	Fuel	Quantity	Value in NPR
1	Fire wood MT	816.9	1,576,000
2	Charcoal MT	9	83,000
3	Diesel lit	495,116	22,912,000
4	Petrol lit	6,539	449,000
5	Kerosene lit	22,363	1,106,000
6	LPG MT	2,950	213,000
7	Others		55,985,000
8	Electricity kWh	35,594,032	208,308,000
	Total		290,632,000

 Table 24: Fuel and Electricity Consumption of Pulp & Paper Industries

Source: Census of Manufacturing Establishments 2006/07

This shows that the cost of energy was around 9.86% of the value of output or the 18.52% of the value added.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of paper over last seven fiscal years as given below:

Table 25: Production of Paper		
Fiscal Year	Paper Production in MT	
2001/02	41,000	
2002/03	42,056	
2003/04	42,835	
2004/05	28,958	
2005/06	29,904	
2006/07	31,399	
2007/08	32,905	
	11	

Source: Economic Survey 2010/11

The economic survey does not have production figures for paper after 2007/08.

b. Observations

The process flow chart for pulp and paper industry is presented below:



Figure 11: Flow Chart of Pulp & Paper Industry

The baseline survey shows that the production of the five pulp & paper industries visited had produced 32,012 MT in the fiscal year 2009/10 and 32, 810 MT in the fiscal year 2010/11. As the largest paper mill is closed, the production figure for 2010/11 is similar to that of 2007/08. Assuming the production of one more unit, it can be estimated that the total production is around 32810/5*6 = 39,372 MT.

The field level observations for the sector have been presented below:

- 1. Pulp and Paper industries in Nepal are either produce white writing / printing paper or craft (brown) paper or both. (Cottage and small scale handmade paper producing industries have not been considered in this study for their non-significance energy consumption).
- 2. Paper industries consume both electrical energy and thermal energy in their production processes. All the units are installed with boiler for steam generation. All the units use rice husk as fuel for boiler. Electrical energy is mainly used for the drives and lighting.
- 3. The average installed capacity of the paper plant is 13,680 MT/ annum or 45.6 TPD and average production is 22 TPD.
- 4. Energy supplier to the industries is Nepal Electricity Authority mostly through 11 kV supply with time of day (TOD) metering system.
- 5. All the units have their own DG set to supply power during power failure from the central grid. Forty percent of the industries use generated power for the lighting and maintenance purpose whereas 60 percent of the industries use generated power for their production process as well.
- 6. All the units have installed capacitor banks to improve the power factor. The power factors maintained by all the units are satisfactory. The power factor is maintained at more than 0.9.
- 7. Combustion efficiency is not checked by the industries. Rice husk consumption seems to be in the higher side.
- 8. Leakages of steam are observed in the industries.
- 9. Insulations in the steam distribution system are not satisfactory in about 80 percent of the units.
- 10. Production is hampered by load shedding in pulp and paper industries. Two of the units are non-operative in lack of the supply from the central grid but others run the industry partially or to its capacity to meet the demand of the market by paying a very high cost for the generated energy.
- 11. The cost of production is high due to high energy cost of energy acquired from the DG set. Production is disturbed by the frequent power cuts (non-scheduled). The interruptions result in production loss and other losses due to reset up time.
- 12. The industries generate effluent. Eighty percent of the units have primary wastewater treatment plant within the premises of the industry.

c. Data Analysis

As there was only six operational pulp and paper industries, only five of them were covered in the survey; three large scale units and two medium scale units. These units employed 1071 males and 76 females. Figures of fiscal year 2010/11 show that the total capacity of these units was 68,400 MT and they produced 32,810 MT. They consumed 30.76 million units of electricity (kWh) and total thermal energy equivalent to 506,394 GJ worth NPR 336.48 million. The average SEC is found to be 937.49 kWh of electricity and 15,434 MJ of thermal energy per MT. CO_2 generation is found to be 46,517 MT equivalent to 1,418 kg per MT of production.

Table 26: Results of Survey Pulp & Paper Industries Production and Turnover

S. No.	Particular	Fiscal Year 2009/10	Fiscal Year 2010/11
1	Production Capacity in MT	68,400	68,400
2	Production in MT	32,012	32,810
3	Annual Turnover in Million NPR	1,431	1,697
4	Production Share to the Sector		83.3%

Energy and Fuel 2010/11

S. No.	Particular	Total	Quantity	
		Quantity	per MT	
1	Electrical Energy in MWh	30,759,083	937.49	
	a. Purchased Electricity	26,027,648	793.28	
	b. DG sets	4,731,435	144.21	
2	Thermal Energy in MJ	506,393,723	15,434.00	
	a. Rice Husk	506,393,723	15,434	
3	CO ₂ generation in kg	46,517,079	1,417.78	
	a. Purchased Electricity	36,634	1.12	
	b. DG sets	2,636,134	80.35	
	c. Rice Husk	43,844,311	1,336.31	
4	Total DG set capacity in KVA	5,100	-	
	a. Diesel consumption liter	983,632	29.98	
5	Energy Cost NPR			
		336,486,308	10,255.60	

Source: Results of Survey

Thus, the energy cost is around 19.83 percent of the turnover.

d. Areas and Potential Savings

From the Excel sheet calculation,

Electrical Energy consumption is 937.49 kWh or 3,374.97 MJ and thermal energy consumption is 15,434.10 MJ per MT of the product; totaling to 18,809.07 MJ/MT

N = 5, Q = 32,810 MT and Eo = 4,230 MJ As Ex is less than 4,230 in all the cases, $\Sigma(Ex - Eo) = 0$

This shows, PE = 0

Again, To = 16,412.26 MJ/ MT

 $\Sigma(Tx - To) = 6,492$ MJ; and

PT = 6492/5*32810 = 42,600,504 MJ = 42,600 GJ

Total Potential Energy Saving from five Pulp and Paper Units TP = 42,600 GJ

The specific energy consumption is lower in Nepalese industries due to use of more waste paper and the main raw material is the agro-residue.

If we consider the 20% saving potential from the consumption, the potential saving will be = 0.2 * 18809.07*32810 MJ = 123,425,117 MJ = 123,425 GJ

If we consider the saving potentials from ESPS audits,

the potential will be $= 2.49\%$ of electrical	+ 22.52% of thermal energy
the electrical saving potential will be	= 0.0249*30,759,083 kWh
	= 765,901 kWh
	= 765.901 MWh ; and
The thermal energy saving potential will be	= 0.2252* 506393723 MJ
	= 114,039,866 MJ
	= 114,040 GJ

Therefore, the respective fuel savings potentials for Pulp & Paper Industries from the Excel sheet are:

S. No.	Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	26,027.648	648.088
2	Diesel KL	983.632	24.492
3	Rice Husk MT	37,797	8,511.844
			-

Table 27: Electricity/ Fuel Saving - Pulp & Paper Sector

Source: Results of Survey

The areas of potential saving in the pulp and paper sector are:

- Improvement of combustion efficiency in the boiler
- Steam distribution system including leakage control and insulation improvement
- Electricity load management

9.3 Food Sector

a. <u>Sector Highlights</u>

There are numerous food industries in the country and for this report the following six sub-categories have been considered and hence this sector has been divided into six sub-sectors:

The total number of industries surveyed in this sector is 51.

i.	Beverages:	11
ii.	Biscuit:	6
iii.	Dairy:	9
iv.	Instant Noodles:	4
v.	Sugar: ,	5
vi.	Vegetable Oil & Ghee:	16
	-	51

i. Beverages sub-category Highlight

Total number of industries observed was 11. Presently the Beverage industries are producing different types of alcoholic and non-alcoholic drinks. Except some medium and large beer, distilled liquor, carbonated soft drinks and fruit juices manufacturing industries, majority of small scale units are producing fruit squashes and drinks.

Beverage industries consume both electrical and thermal energy in its production process. Electrical energy used in the industries is for drives, compressors (both air and refrigeration), pumps and lighting. Thermal energy is required for the operation of boiler to get steam for the distillation in distilleries, wort boiling and pasteurization in breweries, pasteurization & cleaning in carbonated and fruit drinks producing industries. Diesel fuel is used in three of the eight boilers.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown under Nepal Standard Industrial Classifications of 1551 (Distilling, Rectifying and Blending of Spirit), 1552 (Manufacturing of Wine), 1553 (Manufacturing of Malt Liquors), 1554 (Manufacturing of Soft Drinks and Mineral Water), Considering these sectors(1551-1554), the number of units manufacturing the beverage products was 32 with employment of 3,324 persons with the value of output of NPR 10.030 Billion with the inputs of NPR 6.122 Billion and value added of NPR 3.897 Billion. However, these figures do not cover the status of the beverage producing unit with fruits as main raw material.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of Beverage, Soft Drinks, Beer and Liquor (Fruit drinks are not included in this Economic Survey report) over last five fiscal years as given below:

Fiscal Year	Beverage Production, KL
2001/02	53,600
2002/03	59,557
2003/04	61,886
2004/05	85,893
2005/06	-
2006/07	-
2007/08	-
2008/09	-
2009/10	32,081*

Table 28: Production of Beverage

Source: Economic Survey 2010/11 (*Projected from 8 months data)

The economic survey does not have production figures for beverage after 2004/05. However, the figure, except in 2009/10, reflects increasing trend of production.

i. Biscuit Sub-Category Highlight

Total number of industries observed was 6. Presently the Biscuit industries are producing different types of baked products. However, except some medium and large biscuit manufacturing industries, majority of small scale biscuits and cookies producing industries also produce other soft baked products like bread, doughnuts, cakes, pastries etc.

There are four major process steps for biscuit production, which include Mixing (Dough making), Sheeting/molding/stamping, Baking and Packaging. Dough making concerned to mixing of ingredients and water and Baking concerned to exposing the molded and stamped green biscuit pieces to heat (inside baking oven) at temperature around 220°C. The industry also used significant amount of electrical as well as thermal energy.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown under Nepal Standard Industrial Classification of 1541 (As Bakery Products), the number of units manufacturing bakery products was 127 with employment of 2,808 persons with the value of output of NPR 1.745 Billion with the inputs of NPR 1.440 Billion and value added of NPR 0.305 Billion. However, majority of small scale bakery units are also producing soft bakery products other than hard baked biscuit and cookies.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of Biscuit over past four fiscal years as given below:

Fiscal Year	Biscuit Production in MT
2001/02	9,440
2002/03	9,836
2003/04	9,590
2004/05	6,157

Table 29: Production of Biscuit

Source: Economic Survey 2010/11

The economic survey does not have production figures for biscuit after 2004/05. However, the figure, except in 2002/03, reflects gradual decrease in trend of production.

iii. Dairy Sub-Category Highlight

Total number of industries observed was 9. Presently the Dairy industries are producing standard milk as well as different milk products. There are three major process steps for milk and milk products production, which include Chilling of raw milk for intermediate storage, Heating of milk (Pasteurization or boiling) and finally cooling for storage and distribution, The industry also used significant amount of electrical as well as thermal energy for operating the motor and drives as well as for compressors of chilling units.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown Dairy under Nepal Standard Industrial Classification of 1520 (As Dairy Products), the number of units manufacturing Dairy products was 39 with employment of 2070 persons with the value of output of NPR 2.854 Billion with the inputs of NPR 2.384 Billion and value added of NPR 0.471 Billion.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of milk and milk products over last five fiscal years as given below:

Fiscal Year	Dairy Products Production in 1,000 MT
2006/07	1351.39
2007/08	1388.73
2008/09	1445.41
2009/10	1497.42
2010/11	1556.50

Table 30: Production Dairy Products

Source: Economic Survey 2010/11

iv. Instant Noodle Sub-Category Highlight

Total number of industries observed was 4. Presently the Noodle industries are producing instant noodles and extruded snacks. There are three major process steps for noodle production, which include mixing of ingredients, flour and water, sheeting/waving and cutting, steam cooking and dip frying of steam cooked noodle cakes.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown Macaroni, Noodles and Similar Products under Nepal Standard Industrial Classification of 1544, the number of units manufacturing these products was 11 with employment of 2,378 persons with the value of output of NPR 2.411 Billion with the inputs of NPR 1.973 Billion and value added of NPR 0.438 Billion.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of Noodle over the last five fiscal years as given below:

Fiscal Year	Noodle Production in MT
2006/07	35,567
2007/08	37,034
2008/09	40,669
2009/10	42,000
2010/11	42,840

Table 31: Production of Noodles

Source: Economic Survey 2010/11

v. Sugar Sub-Category Highlight

Total number of industries observed was 5. Presently the Sugar industries are producing white plantation sugar as main product, while bagasse and molasses are the valuable byproducts are also produced in considerable quantity. Molasses is used as raw material for Spirit production and the bagasse is used by the industries to produce electrical as well as heat energy for the operation of the sugar industries. The major processes involved in the production of sugar are Milling (Juice Extraction), Evaporation, Crystallization and centrifugal separation and washing of the crystallized sugar.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown Sugar under Nepal Standard Industrial Classification of 1542, the number of units manufacturing these products was 55 (including the "Khandsari) with employment of 3,432 persons with the value of output of NPR 3.279 Billion with the inputs of NPR 2.864 Billion and value added of NPR 0.415 Billion.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of Sugar over the last five fiscal years as given below:

Fiscal Year	Sugar Production in MT
2006/07	103,384
2007/08	108,682
2008/09	180,650
2009/10	190,650
2010/11	190,650

Table 32: Production of Sugar

Source: Economic Survey 2010/11

vi. Vegetable Oil and Ghee Sub-Category Highlight

Total number of industries observed was 16. Presently the Vegetable oil and Ghee industries are producing Refined, Bleached and Deodorized (RBD) Vegetable oil and Hydrogenated Vegetable Oil (HVO) also called Vegetable Ghee. There are three major process steps for Vegetable oil production, which include Refining (Degumming and Neutralization), Bleaching and Deodorization. For producing Vegetable Ghee Hydrogenation and Crystallization are done as additional steps. The industry used significant amount of electrical energy for producing hydrogen (Electrolysis of Water), operating the motor and drives as well as for hydrogen and refrigerant compressors. Similarly thermal energy is used for heating of vegetable oil at different stages of production.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown Vegetable & Animal Oils and

Fats under Nepal Standard Industrial Classification of 1514, the number of units manufacturing Oil and Fats of both the origin was 49 with employment of 2,605 persons with the value of output of NPR 14.348 Billion with the inputs of NPR 12.172 Billion and value addition of NPR 2.175 Billion.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of only vegetable ghee for the years as given below:

Fiscal Year	Vegetable Ghee Production, MT
2003/04	72,051
2004/05	199,587
2005/06	179,239
2006/07	188,200
2007/08	194,319

Table 33: Production of Vegetable Ghee

Source: Economic Survey 2010/11

According to the information given by the industries during survey, due to decreasing export trend after the year 2007/2008, total production may not exceed the figure given for the year 2007/08

b. Observations

Beverage Industries

The process flow charts for the beverage industries have been presented below:

Figure 12: Process Flow Chart of Beverage Industry







The observations are presented below:

- 1. Beverage industries in Nepal can be sub categorized as alcoholic and non alcoholic beverage industries. Alcoholic beverage industries, the distilleries, mainly produce distilled and blended liquors and the Breweries produce carbonated beer. Other sector of industries under this sub sector is the industries producing juices, Nectars and the industries producing carbonated cold drinks.
- 2. Beverage industries consume both electrical and thermal energy in its production process. The source of electrical energy is Nepal Electricity Authority through 11 kV and 3-phase 400 V supply with time of day (TOD) and ordinary metering system. Electrical energy used in the industries is for drives, compressors (both air and refrigeration), pumps and lighting.
- 3. Thermal energy is required for the operation of boiler to get steam for the distillation in distilleries, wort boiling and pasteurization in breweries, pasteurization & cleaning in carbonated and fruit drinks producing industries. Diesel fuel is used in three of the eight boilers.
- 4. The average installed capacity of the beverage industry is 27,628 kL and average production is 10,960 KL.
- 5. All the units have their own DG set to supplement the power supply for the production processes during power failure from the central grid.
- 6. Industries are found to be using rewound motors. Motor loading is not checked by the industries.
- 7. Steam leakages are observed at the joints in steam distribution system in the industries.
- 8. Insulations in the steam distribution system are not found satisfactory in the industries.
- 9. Combustion efficiency in boiler is not checked by the industries.
- 10. Steam distribution lines are found to be inefficient.

The Process flow chart of the biscuit industry is presented below:

Figure 14: Process Flow Chart Biscuit



The observations relating to biscuit industries are given below:

- 1. Biscuit industries in Nepal manufacture different cream and non cream qualities of biscuits and cookies having different flavors.
- 2. Biscuit industries consume both electrical and thermal energy in its production process. The source of electrical energy is Nepal Electricity Authority through 11 kV and 3-phase 400 V supply with time of day (TOD) and ordinary metering system. Electrical energy used in the industries is for drives, compressors (both air and refrigeration), pumps and lighting. The major electricity consuming processes are dough making, sheeting, baking and packaging.
- 3. Eighty percent of the industries are using diesel as a source of thermal energy required for baking process in the direct or indirect heating oven.
- 4. The average installed production capacity of the Biscuit industry is 3,463 MT and average production is 2,084 T.
- 5. All the units have their own DG set to supplement the power supply for the production processes during power failure from the central grid.
- 6. Industries use rewound motors. Motor loading is not checked by the industries.
- 7. Insulations over the oven are not found satisfactory.
- 8. Combustion and overall oven efficiency is not checked by the industries.
- 9. Industries do not have the waste heat (generated from baking and cooling) recovery system.

Figure 15: Process Flow Chart - Dairy Industries



The observations relating to dairy industries are given below:

- 1. Dairy industries in Nepal manufacture Standard milk and milk products like yoghurt, Ice-cream, cheese, butter, and other products.
- 2. Dairy industries consume both electrical and thermal energy in its production process. The source of electrical energy is Nepal Electricity Authority through 11 kV and 3-phase 400 V supply with time of day (TOD) and ordinary metering system. Electrical energy used in the industries is for drives, compressors (both air and refrigeration), pumps and lighting. The major electricity consuming processes are cold storage, Homogenization and chilling of water.
- 3. Thermal energy is required for the operation of boiler to get steam for the pasteurization of milk and other hot processes (CIP, Incubation and boiling of milk for further processing in to different products). Fuel used for the boiler, in two third of the cases is diesel.
- 4. The average installed raw milk processing capacity of the Dairy industry is 15,985 KL and average production is 11,504 KL per annum.
- 5. All the units have their own DG set to supplement the power supply for the production processes during power failure from the central grid.
- 6. Industries use rewound motors. Motor loading is not checked by the industries.
- 7. Steam leakages are observed at the joints in steam distribution system in the industries.
- 8. Insulations in the steam distribution system are not found satisfactory in the industries.
- 9. Combustion efficiency in boiler is not checked by the industries.
- 10. Steam distribution lines are found to be inefficient.
- 11. About 80 percent of the industries have not insulated the cold lines properly.

		Process		Output
Input				
Wheat Flour Electricity Manpower	+ + + +	Screening/Shifting	+ + + +	Flour Extraneous matter Sacks
		+	_]	
Gluten Electricity Manpower	+++	Dough Mixing/Kneading	→ →	Spillages Flour Dust Gluten
		+		
Electricity	+	Feeding	_ →	Dough pieces
Electricity	→ [Dough Rolling ↓] →	Dough Scraps
Electricity Manpower	→ →	Dough Sheet Making	→	Dough Scraps
Electricity	+	+ Slitting] →	Dough Scarps
Manpower	7 [+	_]	
	Γ		7	
Steam Electricity	+ +	Steaming	→	Water vapor Heat
	. г	+	٦.	
Electricity	→	Cooling	→	Pieces of steamed Noodles
Flectricity	<u></u> ъ Г	+	-	Steamed Noodles Pieces
Electricity	ŕ	Cutting/Folding	ľ	Steamed Woodles Frees
		+	_	
Seasoning Liquid Electricity Mannower	+ + +	Seasoning	→ →	Left seasoning liquid Pieces of noodle
inalpo ver	, r	+		
Electricity	+	Drying	→ +	Steamed Noodle Seasoning Liquid
Manpower	→	Moulding +	→	Noodle pieces Seasoned liquid
Electricity	→ [] →	Burnt noodle
Manpower	+	Frying	+	Palm oil
Hot palm Oil	→ [Ŧ		
Electricity	→ [Cooling	→	Broken Noodles
	· L	+		
Electricity	→	Sorting /Conveying	+	Broken noodles
Manpower	. ↑		4.	X 7
Coded wrappers	-	XX/	1	Wrappers
Electricity	→	wrapping	→	Seasonings Broken noodles
	-	+	_	
Carton Box, Tape Manpower	→ →	Packaging	→ +	Damaged Box Tapes
		+ Noodles		

Figure 16: Production Process Flow Chart Noodle

Field level observations for the Instant Noodle Sub-sector are:

- 1. Instant Noodle industries in Nepal manufacture steamed or fried noodles to be use as fast food item.
- 2. Instant Noodle industries consume both electrical and thermal energy in its production process. The source of electrical energy is Nepal Electricity Authority through 11 kV and 3-phase 400 V supply with time of day (TOD) and ordinary metering system. Electrical energy used in the industries is for drives, compressors, pumps and lighting.
- 3. Thermal energy is required for the operation of boiler to get steam for the cooking of noodles and other hot processes. Fuel used for the boiler is rice husk.
- 4. The average installed capacity of the instant noodle industry is 31 TPD and average production is 18 TPD.
- 5. All the units have their own DG set to supplement the power supply for the production processes during power failure from the central grid.
- 6. Industries use rewound motors. Motor loading is not checked by the industries.
- 7. Steam leakages are observed at the joints in steam distribution system in the industries.
- 8. Insulations in the steam distribution system are not found satisfactory in the industries.
- 9. Combustion efficiency in boiler is not checked by the industries.
- 10. Industries have inefficient steam distribution lines.



Figure 17: Process Flow Chart Sugar Mill



Field level observations for the Sugar Sub-sector are:

- 1. Sugar industries in Nepal are operational for nearly 3 to 4 months a year during the cane harvesting season (generally from December to March).
- 2. Sugar industries consume both electrical and thermal energy in its production process.
- 3. Sugar Mills are installed with turbine to generate power for their production process. The main source of electrical energy is high pressure turbine that uses bagasse as fuel. Another source of electrical energy is Nepal Electricity Authority mostly through 11 kV supply (except one industry through 33 kV) with time of day (TOD) metering system. NEA supplied electrical energy is used mainly during start up and in off season for lighting and maintenance work.
- 4. Thermal energy is required for the operation of high pressure boilers in the sugar industries and the fuel used for boiler is bagasse generated from the crushing of cane in the mills.
- 5. The average installed capacity of the Sugar Mill is 40,090 MT and average production is 15,727 MT of sugar, the operating days being 120.
- 6. All the mills have their own DG set to supplement the power supply mainly for the lighting and maintenance purposes during power failure from the central grid.
- 7. Heavy motors are used in sugar industries for crushing, pumps, fans, compressors and other motors. Sugar mills use old and rewound motors. The industries have not checked their motor loadings and not carried energy audit in the industries.
- 8. All the mills have installed capacitor banks to improve the power factor.
- 9. One of the sugar mills has surplus turbine capacity and this can be readily utilized for the supply of electricity to grid by co-generation.



TILLIV TOT TTOTOS TTOT CHAIT TOLEVADIO ON OF ONE	Figure 18:	Process	Flow	Chart	Vegetable	Oil &	Ghee
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The field level observations are as given below:

- 1. Vegetable oil refinery industries in Nepal manufacture Refined, Bleached and Deodorized (RBD) oil, Hydrogenated vegetable oil (Veg. Ghee and shortening oil) and acid oil as by product.
- 2. Vegetable oil refinery industries consume both electrical and thermal energy in its production process. The source of electrical energy is Nepal Electricity Authority through 11 kV and 3-phase 400 V supply with time of day (TOD) and ordinary metering system. Electrical energy used in the industries is for drives, compressors (both air and refrigeration), pumps and lighting. Major electricity consuming processes are operation of hydro-electric dissociation to produce Hydrogen gas required for hydrogenation and running the compressors for hydrogen and refrigerant of the cooling system required for crystallization processes.
- 3. Thermal energy is required for the operation of boiler to get steam for the heating of oil at different stages of processing. Fuel used for the boiler, in all the cases is rice husk.
- 4. The average installed production capacity of the Vegetable oil industry is 22,061 MT and average production is 7,627 MT per annum.
- 5. All the units have their own DG set to supplement the power supply for the production processes during power failure from the central grid.
- 6. Industries use rewound motors. Motor loading is not checked by the industries.
- 7. Steam leakages are observed at the joints in steam distribution system in the industries.
- 8. Insulations in the steam distribution system are not found satisfactory in the industries.
- 9. Combustion efficiency in boiler is not checked by the industries.
- 10. Industries have inefficient steam distribution lines.
- 11. Industries have not insulated the cold lines properly.
- c. <u>Data Analysis</u>

Altogether 51 industries were covered during the survey. Twenty three of them were large, twenty of them medium and eight of them were small scale units. These units provided employment to 7,327 males and 2,077 females; totaling to 9,404. These were divided into six categories as given below:

- i. Beverages
- ii. Biscuit
- iii. Dairy
- iv. Instant Noodles
- v. Sugar
- vi. Vegetable Oil & Ghee

Beverages

Eleven beverages were visited and surveyed; five of them large, five medium and one small. Figures of fiscal year 2010/11 show that the total capacity of these units was 304 million liters and they produced 120.6 million liters of beverages. They consumed 15.3 million units of electricity (kWh) and total thermal energy equivalent to 55,623.83 GJ worth NPR 209.21 million. The average SEC is found

to be 126.91 kWh of electricity and 461.38 MJ of thermal energy per KL. CO₂ generation is found to be 7,742 MT or 64.22 kg per KL of beverage production.

 Table 34: Results of Survey - Food Sector (Beverage)

Production and Turnover

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in liter	236,913,000	303,913,000
2	Production in liter	116,615,847	120,561,873
3	Annual Turnover in Million NPR	12,741	15,054
4	Production Share to the Sector		0.75%

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per
			KL
1	Electrical Energy in kWh	15,300,379	126.91
	a. Purchased Electricity	9,506,118	78.85
	b. DG sets	5,794,261	48.06
2	Thermal Energy in MJ	55,623,829	461.38
	a. Firewood	9,176,250	76.11
	b. Diesel	17,795,566	147.61
	c. FO	22,997,036	190.75
	d. Rice Husk in MJ	3,545,382	29.41
	e. LPG	2,109,595	17.50
3	CO ₂ generation in kg	7,741,853	64.22
	a. Purchased Electricity	13,380	0.11
	b. Firewood	1,282,620	10.64
	c. Diesel	4,440,106	36.83
	d. FO	1,631,180	13.53
	e. Rice Husk	306,965	2.55
	f. LPG	67,602	0.56
4	Total DG set capacity in KVA	9,426	
	a. Diesel consumption liter	1,204,586	9.99
5	Energy Cost NPR	209,208,558	121,070

Source: Results of Survey

Thus, the energy cost is around 1.39 percent of the turnover.

Biscuit

Six biscuit units were covered; two large, two medium and two small scale units. Figures of fiscal year 2010/11 show that the total capacity of these units was 20,775 MT and they produced 12,205 MT of Biscuits. They consumed 3.57 million units of electricity (kWh) and total thermal energy equivalent to 56,585 GJ worth NPR 81.34 million. The average SEC is found to be 285.58 kWh of electricity and 3,139.18 MJ of thermal energy per MT. CO₂ generation is found to be 4,754 MT, which is equivalent to 380.19 kg per MT of Biscuit production.

Table 35: Results of Survey - Food Sector (Biscuit)

Production and Turnover					
S. No.	Particular	Fiscal Year 2009/10	Fiscal Year 2010/11		
1	Production Capacity in MT	18,920	20,775		
2	Production in MT	11,506	12,505		
3	Annual Turnover in Million NPR	1,657	1,698		
4	Production Share to the Sector		69.47%		

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per
			MT
1	Electrical Energy in kWh	3,571,208	285.58
	a. Purchased Electricity	2,816,012	225.19
	b. DG sets	755,196	60.39
2	Thermal Energy in MJ	56,584,558	3,139.18
	a. Diesel	15,022,194	1,201.30
	b. FO	18,652,194	105.80
	c. Rice Husk in MJ	22,910,170	1,832.08
3	CO ₂ generation in kg	4,754,282	380.19
	a. Purchased Electricity	3,964	0.32
	b. Diesel	1,443,718	115.45
	c. FO	1,323,000	105.80
	d. Rice Husk	1,983,600	158.62
4	Total DG set capacity in KVA	2,045	
	a. Diesel consumption L	157,000	12.55
5	Energy Cost NPR	81,343,213	6,504.86

Source: Results of Survey

Thus, the energy cost is around 4.79 percent of the turnover.

Dairy

Nine dairy units were visited; one large, 5 medium and 3 small scale units. Figures of fiscal year 2010/11 show that the total capacity of these units was 143.865 million liters and they processed 103.534 million liters of milk. They consumed 7.997 million units of electricity (kWh) and total thermal energy equivalent to 91,914 GJ worth NPR 169.231 million. The average SEC is found to be 77.24 kWh of electricity and 887.76 MJ of thermal energy per KL. CO₂ generation is found to be 8,518.59 MT, which is equivalent to 82.27 kg per KL of production.

Table 36: Results of Survey - Food Sector (Dairy)

Production and Turnover

S. No.	Particular	Fiscal Year 2009/10	Fiscal Year 2010/11
1	Production Capacity in KL	143,865,000	143,865,000
2	Production in KL	101,545,690	103,534,726
3	Annual Turnover in Million NPR	3,341	3,684
4	Production Share to the Sector		6.65%

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per KL
1	Electrical Energy in kWh	7,996,867	77.24
	a. Purchased Electricity	5,260,887	50.81
	b. DG sets	2,735,980	26.43
2	Thermal Energy in MJ	91,913,748	887.76
	a. Coal	75,362	0.73
	b. Kerosene	1,879,036	18.15
	c. Diesel	47,661,751	460.35
	d. FO	1,450,726	14.01
	e. Rice Husk in MJ	40,193,280	388.21
	f. LPG	653,593	6.31
3	CO ₂ generation in kg	8,518,590	82.27
	a. Purchased Electricity	7,405	0.07
	b. Coal	4,327	0.04
	c. Kerosene	133,056	1.29
	d. Diesel	4,769,958	46.07
	e. FO	102,900	0.99
	f. Rice Husk	3,480,000	33.61
	g. LPG	20,944	0.20
4	Total DG set capacity in KVA	2,665	
	a. Diesel consumption L	568,791	5.49
5	Energy Cost NPR	169,231,019	1,634.53

Source: Results of Survey

Thus, the energy cost is around 4.59 percent of the turnover.
Instant Noodles

Four units of instant noodles were covered; one large and three medium scale units. Figures of fiscal year 2010/11 show that the total capacity of these units was 37,245 MT and they produced 21,826 MT of noodles. They consumed 3.95 million units of electricity (kWh) and total thermal energy equivalent to 235,283 GJ worth NPR 82.314 million. The average SEC is found to be 181.28 kWh of electricity and 10,780 MJ of thermal energy per MT. CO₂ generation has been found to be 20,964 MT, which is equivalent to 960.51 kg per MT of production.

 Table 37: Results of Survey - Food Sector (Noodle)

	Table 57:	R
Production and	Turnover	

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in MT	37,245	37,245
2	Production in MT	18,911	21,826
3 Annual Turnover in Million NPR		2,657	3,077
4	Production Share to the Sector		50.94%

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per
			MT
1	Electrical Energy in kWh	3,956,752	181.28
	c. Purchased Electricity	2,803,170	128.43
	d. DG sets	1,153,582	52.85
2	Thermal Energy in MJ	235,282,966	10,779.94
	g. FO	3,390,098	155.32
	h. Rice Husk in MJ	231,875,032	10,623.80
	i. LPG	17,836	0.82
3	CO ₂ generation in kg	20,963,819	960.51
	h. Purchased Electricity	3,945	0.18
	i. Diesel	642,722	29.45
	j. FO	240,460	11.02
	k. Rice Husk	20,076,120	919.83
	l. LPG	572	0.03
4	Total DG set capacity in KVA	2,190	
	b. Diesel consumption L	239,822	10.99
5	Energy Cost NPR	82,313,770	3,771

Source: Results of Survey

Thus, the energy cost is around 2.68 percent of the turnover.

Sugar

Five units of Sugar Mills were covered; four large and one small scale units. Figures of fiscal year 2010/11 show that the total capacity of these units was 200,450 MT and they produced 78,634 MT of sugar. They consumed 5.386 million units of electricity (kWh) and total thermal energy equivalent to 10,107 GJ worth NPR 57.26 million. The average SEC is found to be 68.5 kWh of electricity and 128.53 MJ of thermal energy per MT. The thermal energy does not include the bagasse from the mill themselves. The CO₂ generation is found to be 2,856 MT, which is equivalent to 36.32 kg per MT of sugar production.

Table 38: Results of Survey - Food Sector (Sugar)

Production and Turnover

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in MT	200,450	200,450
2	Production in MT	45,211	78,634
3	Annual Turnover in Million NPR	2,708	4,746
4	Production Share to the Sector		41.24%

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per
			MT
1	Electrical Energy in kWh	5,386,106	68.50
	a. Purchased Electricity	2,443,202	31.07
	b. DG sets	2,942,904	37.43
2	Thermal Energy in MJ	10,106,898	128.53
	a. Firewood	6,358,875	80.87
	b. Rice Husk in MJ	3,748,023	47.66
3	CO ₂ generation in kg	2,856,415	36.32
	a. Purchased Electricity	3,439	0.04
	b. Firewood	888,818	11.30
	c. Diesel	1,639,648	20.85
	d. Rice Husk	324,510	4.13
4	Total DG set capacity in KVA	2,760	
	a. Diesel consumption L	611,809	7.78
5	Energy Cost NPR	57,260,528	728.19

Source: Results of Survey

Thus, the energy cost is around 1.21 percent of the turnover.

Vegetable Oil and Ghee

Sixteen units of Vegetable oil and ghee industries were covered; ten large, five medium and one small scale units. Figures of fiscal year 2010/11 show that the total capacity of these units was 352,974 MT and they produced 122,034 MT of vegetable oil and ghee. They consumed 21.86 million units of electricity (kWh) and total thermal energy equivalent to 705,371 GJ worth NPR 261.94 million. The average SEC is found to be 179 kWh of electricity and 5,780 MJ of thermal energy per MT. CO_2 generation has been found to be 64,908 MT, which is equivalent to 531.88 kg per MT of production.

 Table 39: Results of Survey - Food Sector (Vegetable Oil & Ghee)

Production and Turnover

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in MT	334,724	352,974
2	Production in MT	117,445	122,034
3	Annual Turnover in Million NPR	9,310	11,591
4	Production Share to the Sector		62.87%

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per MT
1	Electrical Energy in kWh	21,863,604	179.16
	a. Purchased Electricity	15,016,243	123.05
	b. DG sets	6,847,361	56.11
2	Thermal Energy in MJ	705,371,030	5,780.12
	a. Rice Husk in MJ	705,371,030	5,780.12
3	CO ₂ generation in kg	64,908,342	531.88
	a. Purchased Electricity	21,135	0.17
	b. Diesel	3,815,028	31.26
	c. Rice Husk	61,072,179	500.45
4	Total DG set capacity in KVA	8,827	
	a. Diesel consumption L	1,423,518	11.66
5	Energy Cost NPR	261,940,497	2,146.46

Source: Results of Survey

Thus, the energy cost is around 2.26 percent of the turnover.

d. Areas and Potential Savings

Beverages

As per literature, the potential energy saving in the region is 8%, the saving potential for the beverage sub-sector for the surveyed industries = 0.08* (15,300,379 kWh + 55,623,829 MJ) = 8,856,415 MJ = 8,856 GJ

From ESPS studies, the potentials are 9.09% for Electrical and 19.25% for thermal energy. This if we convert for the visited 11 industries,

The electrical saving potential	= 0.0909 * 15300379 = 1,390,804 kWh = 1,390.804 MWh
The thermal saving potential	= 0.1925 * 55,623,829 MJ = 10,707,587 MJ = 10,707.587 GJ

Since, the electrical saving potential is 9.09% and thermal saving potential is 19.25%, the respective fuel savings potentials for Beverage industries from the Excel sheet are:

	Tuble for Electricity, Tuer Suring Forentials Deverage				
S. No.	Electricity / Fuel	Consumption	Saving Potential		
1	Purchased Electricity MWh	9,506.118	864.106		
2	Diesel KL for DG	1,204.586	109.497		
3	Diesel KL for Thermal	452.170	83.042		
4	Fire wood MT	734	141.31		
5	Furnace Oil KL	554.823	106.803		
6	Rice Husk in MT	265	50.94		
7	LPG kg	41,989	8,082.88		

Table 40:	Electricity/	Fuel Saving	Potentials -	Beverage
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Source: Results of Survey

The areas of potential saving in the sub-sector are:

- Improvement in motor loading
- Replacement of old and rewound motors by energy efficient motors
- Minimization of energy losses by partition of cooling areas, installation and effective use of air curtains
- Regular cleaning and maintenance of condenser pipes
- Improvement in the efficiency of capacitor banks
- Improvement in combustion efficiency in boilers
- Minimization of heat losses from the boiler
- Minimization of steam leakages
- Insulation of steam pipes, valves and flanges
- Improvement in steam supply system
- Condensate recovery
- Waste heat recovery

Biscuit

ESPS studies have shown that the saving potential for electrical energy is 29.47% and thermal energy is 15.38%. With these figures, for the surveyed six biscuit industries,

The electrical saving potential	= 0.2947 * 3571208 = 1,052,435 kWh = 1,052.435 MWh
The thermal saving potential	= 0.1538 * 56584558 MJ = 8,702,705 MJ = 8,702.705 GJ

Since, the electrical saving potential is 29.47% and thermal saving potential is 15.83%, the respective fuel savings potentials for Biscuit industries from the Excel sheet are:

S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	2,816.012	829.879
2	Diesel KL for DG	157.000	46.268
3	Diesel KL for Thermal	381.701	58.706
4	Furnace Oil KL	450.000	69.210
5	Rice Husk in MT	1,710	263

Table 41: Electricity/ Fuel Saving Potentials (Biscuit)

Source: Results of Survey

The areas of potential saving in the sub-sector are:

- Improvement in motor loading
- Replacement of old and rewound motors by energy efficient motors
- Improvement in combustion efficiency in furnace
- Insulation of oven to minimize heat losses
- Waste heat recovery

Dairy

As the electrical energy intensity is seen to vary from 38 to 234 kWh/KL while the regional SEC is only 10 kWh/KL and thermal energy intensity is seen to vary from 180 to 2,935 MJ/KL while the regional optimal figure is 39 MJ/KL, the energy consumption is exceedingly high and the reason may be production of other products besides the pasteurization only.

From ESPS studies, the potentials are 6.31% for Electrical and 13.91% for thermal energy. This if we convert for the visited 9 industries,

The electrical saving potential	= 0.0631 * 7996867 kWh = 504.602 MWh
The thermal saving potential	= 0.1391 * 91913748 MJ = 12,785.202 GJ

Since, the electrical saving potential is 6.31% and thermal saving potential is 13.91%, the respective fuel savings potentials for Dairy industries from the Excel sheet are:

S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	5,260.887	331.962
2	Diesel KL for DG	568.791	35.891
3	Diesel KL for Thermal	1,211.044	168.456
4	Coal MT	3.600	0.501
5	Kerosene KL	52.800	7.344
6	Furnace Oil KL	35.000	4.869
7	Rice Husk in MT	3,000.000	417.300
8	LPG kg	13,009.000	1,809.552

 Table 42: Electricity/ Fuel Saving Potentials (Dairy)

The areas of potential saving in the sub-sector are:

- Improvement in motor loading
- Replacement of old and rewound motors by energy efficient motors
- Minimization of energy losses by partition of cooling areas, installation and effective use of air curtains
- Improvement in insulation of the cold pipelines, storage room walls and ceiling
- Introduction of modern/efficient belt and pulleys to the drives of compressors
- Regular cleaning and maintenance of condenser pipes
- Improvement in the efficiency of capacitor banks
- Improvement in combustion efficiency in boilers
- Minimization of heat losses from the boiler
- Minimization of steam leakages
- Insulation of steam pipes, valves and flanges
- Insulation of walls and ceiling of incubation room
- Improvement in steam supply system
- Condensate recovery

Instant Noodle

ESPS studies have shown that the saving potential for electrical energy is 6.15% and thermal energy is 11.38%. With these figures, for the surveyed four biscuit industries,

The electrical saving potential	= 0.0615 * 3,956,752 kWh
	= 243,340 kWh = 243.34 MWh
The thermal saving potential	= 0.1138* 235,382,966 MJ
	= 26,786,582 MJ = 26,786.582 GJ

Since, the electrical saving potential is 6.15% and thermal saving potgential is 11.38%, the respective fuel savings potentials for Noodle industries from the Excel sheet are:

S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	2,803.170	172.395
2	Diesel KL for DG	239.822	14.749
3	Diesel KL for Thermal	-	-
4	Fire wood MT	-	-
5	Coal MT	-	-
6	Furnace Oil KL	81.789	9.308
7	Rice Husk in MT	17,307.000	1,969.537
8	LPG kg	355.000	40.399

Table 43: Electricity/ Fuel Saving Potentials (Instant Noodles)

The areas of potential saving in the sector are:

- Improvement in motor loading
- Replacement of old and rewound motors by energy efficient motors
- Installation of capacitor banks
- Load management
- Improvement in combustion efficiency in boilers
- Minimization of heat losses from the pan boiling furnace
- Minimization of steam leakages
- Insulation of steam pipes, valves and flanges
- Improvement in steam supply system
- Condensate recovery

Sugar Mills

The sugar mills in Nepal generate electricity using the bagasse, which is a waste product generated from the crushing of sugar cane. The bagasse is used as fuel in the boiler. The analysis of the electricity as well as other fuels do not account for such generation of electricity or the use of bagasse as fuel. None of the sugar mills keep the record of the electricity generation or the use of bagasse. Therefore the analysis does not provide the correct picture of the used of energy. The regional and international bench marks are found to be much higher in the excel sheet analysis. The saving potentials only for purchased energy have been calculated on the basis of the ESPS saving potential seen as given below:

The saving potentials from ESPS are 14.55% for electrical energy and 20.73% of the thermal energy.

The electrical saving potential	= 0.1455 * 5,386,106 kWh
	= 783,678 kWh = 783.678 MWh
The thermal saving potential	= 0.2073* 10,106,898 MJ
	= 2,095,160 MJ = 2,095.16 GJ

Since, the electrical saving potential is 14.55% and thermal saving potgential is 20. 73%, the respective fuel savings potentials for Sugar industries from the Excel sheet are:

	Tuble The Electricity, Tu	er saving i otentials (sug	541)
S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	2,443.202	355.486
2	Diesel KL for DG	611.809	89.018
3	Diesel KL for Thermal	-	-
4	Fire wood MT	508.710	105.456
5	Coal MT	-	-
6	Furnace Oil KL	-	-
7	Rice Husk in MT	279.750	57.992
8	LPG kg	-	-

Table 44: Electricity/ Fuel Saving Potentials (Sugar)

Besides, the sugar mills have a possibility of co-generation. The literature survey has indicated that the potential of co-generation from sugar mills is around 120 kWh per MT of cane srushed. For the surveyed industries the production capacity of sugar 386,450 MT while the production is 78,634 MT. As the boiler is sufficient for the total capacity, the co-generation potential can be based on this with the addition of necessary turbine and generators for the supply to the grid.

Assuming the recovery of sugar is 9 percent of the cane crushed, the potential from the surveyed industries = 120*78634/0.09 = 104,845,333 kWh.

Distributing this to 365 days and three shift operation, the co-generation potential = 104845333/24/365 = **11,968 kW or 11.968 MW**

The areas of potential saving in the sub-sector are:

- Improvement in motor loading
- Replacement of old and rewound motors by energy efficient motors
- Improvement in the efficiency of capacitor banks
- Improvement in combustion efficiency in boilers
- Minimization of heat losses from the boiler
- Minimization of steam leakages
- Insulation of steam pipes, valves and flanges
- Improvement in steam supply system
- Condensate recovery
- Waste heat recovery

Vegetable oil and Ghee

n=16, Qs = 122,034 MT, Eo = 200 MJ/MT or 55.55 kWh/MT, To = 2700 MJ/MT Σ (Ex-Eo) = 2100 MJ/MT, and Σ (Tx-To) = 52442 MJ/MT

Electrical Saving Potentials = $(Qs/n) * \Sigma(Ex - Eo) = (122034/16)*2100$ = 16,016,963 kWh = 16,017 MWh

Thermal Saving Potentials = $(Qs/n) * \Sigma(Tx - To) = (122034/16)*52442$ = 399,981,689 MJ = **399,982 GJ** From ESPS studies, the potentials are 5.49% for Electrical and 11.07% for thermal energy. This if we convert for the visited 16 industries,

The electrical saving potential = 0.0549 * 21,863,604 kWh = 1,200,312 kWh= 1,200.312 MWhThe thermal saving potential = 0.1107 * 705,371,030 = 78,084,573 MJ= 78,084.573 GJ

The savings using the regional optimal SEC is exceedingly high 73% for electrical and around 55% for thermal. Therefore, ESPS saving potentials have been used.

Since, the electrical saving potential is 5.49% and thermal saving potential is 11.07%, the respective fuel savings potentials for Vegetable oil & Ghee industries from the Excel sheet are:

S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	15,016.243	824.391
2	Diesel KL for DG	1,423.518	78.151
3	Diesel KL for Thermal	-	-
4	Fire wood MT	-	-
5	Coal MT	-	-
6	Furnace Oil KL	-	-
7	Rice Husk in MT	52,648.430	5,828.181
8	LPG kg	-	-

Table 45: Electricity/ Fuel Saving Potentials (Vegetable Oil & Ghee)

Source: Results of Survey

The areas of potential saving in the sub-sector are:

- Improvement in motor loading
- Replacement of old and rewound motors by energy efficient motors
- Introduction of Variable Frequency Drives (VFD) in the motors
- Minimization of energy losses by proper insulation of cold rooms, installation and effective use of air curtains
- Improvement in insulation of the cold pipelines
- Introduction of modern/efficient belt and pulleys to the drives of compressors
- Regular cleaning and maintenance of condenser pipes
- Improvement in the efficiency of capacitor banks
- Improvement in combustion efficiency in boilers
- Minimization of heat losses from the boiler
- Minimization of steam leakages
- Insulation of boiling pans, steam pipes, valves and flanges
- Improvement in steam supply system
- Condensate recovery
- Waste heat recovery from cooling of oil

9.4 Metal Sector

a. <u>Sector Highlights</u>

Metal sector has many types of industries. However, for the present study, only ferrous metal and only hot re-rolling mills, wire drawing and galvanizing industries and sheet galvanizing have only been considered.

The re-rolling mills use imported continuous cast billets to manufacture various diameters and length of iron bars to be used for reinforcing concrete structure. The billet is shared, heated in furnace and rolled using rolling mills.

The wire drawing plants use the wire rods to draw them into smaller diameter wires and some of them are galvanized. These wires are used to make barbed wire; wire gabions that are used extensively used for protection of river banks and slopped land from landslides.

Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown under Nepal Standard Industrial Classification of 2710, 2811 and 2891 the number of units, employment, the value of output value of inputs and value added are as given below:

Table 40: Details of Metail Froducts							
				Value in Million NPR			
NSIC	Items	No.	Emp	Output	Input	Value Addition	
2710	Basic Iron & Steel	17	2,405	9,771.396	7,876.847	1,894.549	
2811	Structural Metal Products	88	4,372	16,923.028	14,317.454	2,605.574	
2891	Forging pressing and stamping of metal	11	824	14,75.381	1,329.967	145.414	
	Total	116	7,601	28,169.805	23,524.268	4,645.537	

Table 46: Details of Metal Products

Source: Census of Manufacturing Establishments 2006/07

These 116 units used the following quantities and values different fuels and electricity:

								v ulu	
		2710)	281 1	l	289	1	Tot	al
S. No.	Fuel	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	Fire woood MT	165	447	257.7	1,016	96.5	427	519.8	1,890
2	Charcoal MT	1,600.3	7,313	17,518.1	116,475	1,387.5	4,074	20,505.9	127,862
3	Diesel lit	2,944,819	103,353	4,524,772	194,669	571,693	26,667	8,041,284	324,689
4	Petrol lit	85	6	36,053	2,257	2,908	216	39,046	2,479
5	Kerosene lit	17,262	811	4,940	233	17,960	972	40,162	2,016
6	LPG MT	14,664	837	41,275	2,941	8,620	546	64,559	4,324
7	Others	0	42,722	0	39,147	0	29,397	0	111,266
8	Electricity kWh	23,402,133	140,521	63,289,810	332,512	4,714,840	31,230	91,406,783	504,263
	Total		296,010		689,250		93,529		1,078,789

Table 47: Fuel and Electricity Consumption of Metal Products

Value in NPR '000

Source: Census of Manafacturing Establishments 2006/07

This shows that the cost of energy was around 3.83% o the value of output or the 23.22% of the value added.

b. Observations

The process flow chart for the metal sector is presented below:



Input Process Output HB wire Pay off loading Spillages → → ∔ Electrical Energy → Lead Ash ✦ → Annealing Smoke Furnace oil → Lead ✦ → Heat Charcoal → ✦ Sand Sand → → Sand Quenching ✦ → Hot air Air cooling ∔ Water Water Partly recycled Electrical Energy → Water → Quenching ✦ Acidic water water ✦ ≯ HCL ≯ Pickling Electricity → ✦ Water Water washing ✦ ✦ Flux Fluxing ≯ ≯ ✦ Hot plate drying Hot Air ≯ → ✦ Zinc ✦ → Zinc Ash lubricant → Zn Dross + ✦ Charcoal Zinc coating → GI Wire Furnace oil ✦ Electricity → ł Coiling & Bundling Electricity ✦ Т Weighing, Tagging Paint→ & Packaging

Figure 20: Process Flow Chart for Wire Drawing and Galvsanizing Plant

The field level observations for the Metal Sector are:

- 1. Fourteen out of 21units of the Iron and Steel industries in Nepal produce mild steel TMT (Thermo Mechanical Treated) bars, CTD (Cold Twisted Drawn) bars and mild steel wires.
- 2. The average installed capacity of the Iron and Steel plant is 113 TPD and average production is 63.7 TPD.
- 3. Iron and Steel Industries consume both electrical and thermal energy.
- 4. Energy supplier to the industries is Nepal Electricity Authority mostly through 66/33 kV and 11 kV supply with time of day (TOD) metering system. Iron and Steel industries are installed with heavy motors and electrical energy is mainly used for the drives of rolling mill, billet sharing, pumps, compressor, blowers and wire plant motors.
- 5. About 80 percent of iron and steel industries use rewound motors. The industries have not checked their motor loadings.
- 6. Thermal energy is required for heating the billets in furnace. Source of thermal energy is coal, furnace oil or diesel. Around 50 percent of the industries use furnace oil while remaining 40 percent of industries use coal as fuel for the furnace.
- 7. All the units have their own DG set to supplement the power supply during power failure from the central grid. The supplies from the DG set are mainly for the lighting and maintenance activities of the industries. The production of almost all the industries is stopped during the load shedding.
- 8. Smooth production is disturbed by the frequent power cuts (non-scheduled) and production is lost due to reset up time.
- 9. All the units have installed capacitor banks to improve the power factor.
- 10. The workplace is very warm. Heat losses are observed at furnace and rolling mill. Furnace insulations are found insufficient
- c. Data Analysis

Twenty one units of Metal industries were covered; thirteen large, six medium and two small scale units. Figures of fiscal year 2010/11 show that the total capacity of these units was 713,510 MT and they produced 401,378 MT of metal products. They consumed 59.874 million units of electricity (kWh) and total thermal energy equivalent to 590,317 GJ worth NPR 1,002.6 million. The average SEC is found to be 149.17 kWh of electricity and 1,470.73 MJ of thermal energy per MT. CO₂ generation is estimated to be 46,015 MT, which is equivalent to 114.64 kg/MT.

Table 48: Results of Survey - Metal Industries

Production and Turnover				
S. No.	Particular	Fiscal Year	Fiscal Year	
		2009/10	2010/11	
1	Production Capacity in MT	684,740	713,510	
2	Production in MT	407,843	401,378	
3	Annual Turnover in Million NPR	30,068	30,902	
4	Production Share to the Sector		66.9%	

S. No.	Particular	Total	Quantity per
		Quantity	MT
1	Electrical Energy in kWh	59,873,513	149.17
	a. Purchased Electricity	48,446,800	120.70
	b. DG sets	11,426,713	28.47
2	Thermal Energy in MJ	590,317,077	1,470.73
	a. Firewood	1,868,750	4.66
	b. Coal	185,724,124	462.72
	c. Diesel	107,795,865	268.56
	d. FO	266,152,094	663.10
	e. Rice Husk in MJ	27,780,255	69.21
	f. LPG	995,989	2.48
3	CO ₂ generation in kg	46,014,810.51	114.64
	a. Purchased Electricity	68,188.87	0.17
	b. Firewood	261,206.40	0.65
	c. Coal	10,663,123.39	26.57
	d. Diesel	13,706,948.91	34.15
	e. FO	18,878,166.30	47.03
	f. Rice Husk	2,405,260.00	5.99
	g. LPG	31,916.64	0.08
4	Total DG set capacity in KVA	12,976	
	a. Diesel consumption liter	2,375,533	5.92
5	Energy Cost NPR	1,002,565,584	2,497.81

Energy and Fuel 2010/11

Thus, the energy cost is around 3.24 percent of the turnover.

d. Areas and Potential Savings

The regional SEC shows that for the electrical energy it is 200kWh per MT and in case of thermal energy it is 1.509 GJ/MT. Comparison with these figures shows that the energy consumption is low in the country. Therefore, these can not be used. TERI presentations also show that there is potential to save 8 to 10 percent of energy. ESPS studies also show that the potentials for electrical energy saving is 6.17% and that for thermal energy saving is 22.97%. These will be more realistic and the use of these figures shows the following potential savings:

Potential Electrical Energy Saving	= 0.0617*59873513 kWh
	= 3,694,196 kWh = 3,694.2 MWh
Potential Thermal Energy Saving	= 0.2297*590317077 MJ
	= 135,595.833 GJ

Since, the electrical saving potential is 6.17% and thermal saving potential is 22.97%, the respective fuel savings potentials for Metal industries from the Excel sheet are:

	Tuble 191 Electricity, Tuer Sur	ing i otontialis filotai li	itaustrites
S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	48,446.800	2,989.167
2	Diesel KL for DG	2,375.533	146.570
3	Diesel KL for Thermal	2,739.000	629.148
4	Fire wood MT	149.500	34.340
5	Coal MT	8,871.900	2,037.870
6	Furnace Oil KL	6,421.145	1,474.937
7	Rice Husk in MT	2,073.500	476.283
8	LPG kg	19,824	4,553.570

Table 49: Electricity/ Fuel Saving Potentials - Metal Industries

The areas of potential saving in the sector are:

- Improvement in motor loading
- Replacement of old and rewound motors
- Installation of more efficient motors
- Improvement in efficiency of capacitor banks
- Improvement in combustion efficiency in furnaces
- Minimization of heat losses from the furnaces
- Reuse of heat of hot air of the working area
- Use of appropriate fuel for the furnace
- Electricity load management

9.5 Soap & Chemical Sector

a. Sector Highlights

Soap is a basic material necessary for cleaning and sanitary purpose. Technically, soap is a metallic salt of a fatty acid, often made with calcium, aluminium and lithium. Production of Soap in Nepal is mainly in the solid form that is made by a reaction of Sodium Hydroxide reacting with the fatty acid from animal or vegetable oil.

According to the Census of Manufacturing Establishments carried out in the fiscal year 2006/07 by the Central Bureau of Statistics (CBS) has shown under Nepal Standard Industrial Classification (NSIC) of 2424, the number of manufacturing of Soap and other Preparation was 31 with employment of 1,704 persons with the value of output of NPR 3.78 Billion with the inputs of NPR 2.43 Billion and value added of NPR 1.35 Billion.

These 31 units used the following quantities and values different fuels and electricity:

S. No.	Electricity / Fuel	Quantity	Value in NPR
1	Fire wood in MT	545.6	1,637,000
2	Diesel liter	342,682	17,667,000
3	Petrol liter	3,139	207,000
4	Kerosene liter	2,560	132,000
5	LPG in MT	1.075	127,000
6	Others		26,312,000
7	Electricity kWh	7,305,454	43,440,000
	Total		89,522,000

Table 50: Consumption of fuels and Electricity - Soap and Other Preparation

Source: CME, 2006/07

This shows that the cost of energy was around 2.37% of the value of output or the 6.63% of the value added.

The Economic Survey of Fiscal Year 2010/11 has estimated the production of Soap over last five fiscal years as given below:

Fiscal Year	Soap Production in MT	Growth
2006/07	47,062	-
2007/08	49,092	4.31%
2008/09	51,092	4.07%
2009/10	52,000	1.78%
2010/11	53,100	2.12%

Source: Economic Survey 2010/11

Soap manufacturing can also be classified into two types. The small scale units do not have washing of the soap after the saponification process while the medium and large units have it. On this basis the two types of process flow charts are given below:

b. Observations

The soap production is of two types. The small units have open pan boiling of oil and caustic with fire wood without any washing system, whereas the larger units have steam generation system and washing process.





Figure 22: Process Flow Chart Soap & Chemicals with Washing ProcessInputProcessOutput

The field level observations for the soap and chemical industry sector are:

- 1. Soap and Chemical Industries in Nepal mainly produce laundry soap. Only around 15 percent industries manufacture toilet soap along with the laundry soap.
- 2. Soap and Chemical industries consume both electrical and thermal energy in their processes. All the units are installed with boiler for steam generation except small scale pan boiling laundry soap manufacturing units. Electrical energy is mainly used for the drives, compressed air generation, refrigeration and lighting. Thermal energy is used for the generation of steam from boiler. All the industries installed with boiler use rice husk as boiler fuel. The pan boiling units use firewood as source for thermal energy in its boiling (saponification) process.
- 3. The average installed capacity of the plant is 27.7 TPD and average production is 15 TPD.
- Energy supplier to the industries is Nepal Electricity Authority through 11 kV supply in large and medium scale industries with time of day (TOD) metering and a 3-phase 400 V supply in the small scale industries with ordinary metering.
- 5. All the large and medium scale units have their own DG set to supplement the power in their production during power failure from the central grid.
- 6. Only about 25 percent of industries have installed capacitor banks to improve the power factor.
- 7. Combustion efficiency in boiler is not checked by the industries.
- 8. Leakages of steam are observed in the units.
- 9. Insulations are not adequate in the steam distribution system in the units. About 50 percent of the industries lack proper insulations of steam supply pipes, flanges and valves.
- 10. Production is hampered by load shedding in soap and chemical industries. During load shedding, the industries receive electrical energy from DG set installed within the factory premises to carry out the productions. The cost of production is high due to high energy cost of energy supplied by DG set.
- 11. Soap and Chemical Industries with closed saponification pan generate effluent.
- a. Data Analysis

Altogether 19 industries are sampled for the baseline study of Soap and Chemical sector. As per the category of the industries, 3 industries are of large scale, 9 industries are of medium scale and 7 industries are of small scale. These units have provided employment to 1,353 persons including 190 female.

As per the surveyed data, the total production capacity of these units is 157,920 MT per annum and these units are found to be producing only 85,407 MT of soap and chemicals in fiscal year 2010/11. They consumed 9.501 million units of

electricity (kWh) and total thermal energy equivalent to 288,587.66 GJ worth NPR 333.68 million. The average SEC is found to be 111.25 kWh of electricity and 3,378.97 MJ of thermal energy per MT. CO_2 generation is estimated to be 27,389 MT equivalent to 320.70 kg/MT.

Table 52: Results of Survey - Soap & Chemicals
Production and Turnover

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in MT	156,520	157,920
2	Production in MT	75,346	85,407
3	Annual Turnover in Million NPR	5,298	6,245
4	Production Share to the Sector		76.26%

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S. No.	Particular	Total	Quantity
		Quantity	per M I
1	Electrical Energy in kWh	9,501,469	111.25
	c. Purchased Electricity	6,014,304	70.42
	d. DG sets	3,487,165	40.83
2	Thermal Energy in MJ	288,587,657	3,378.97
	d. Firewood	18,556,938	217.28
	e. FO	34,216,745	400.63
	f. Rice Husk in MJ	235,813,974	2,761.06
3	CO ₂ generation in kg	27,389,318	320.70
	e. Purchased Electricity	8,465	0.099
	f. Firewood	2,593,814	30.37
	g. Diesel	1,942,885	22.75
	h. FO	2,426,994	28.42
	i. Rice Husk	20,417,160	239.06
4	Total DG set capacity in KVA	5,938	
	b. Diesel consumption liter	724,957	8.49
5	Energy Cost NPR	333,682,527	3,907

Source: Results of Survey

Thus, the energy cost is around 5.34 percent of the turnover.

c. Areas and Potential Savings

The literature study on ESPS reports on energy efficiency interventions in soap and chemical industries has shown that the potential electrical and thermal energy savings are 9.71 % and 39.46 % respectively (Refer Chapter 7.4 of the Report).

The electrical energy saving potential (PE)	= 0.0971*9501469 kWh
	= 922.593 MWh
The thermal energy saving potential (PT)	= 0.3946*288,587,657 MJ
	= 113,876.689 GJ

Since, the electrical saving potential is 9.71% and thermal saving potential is 39.46%, the respective fuel savings potentials for Soap & Chemical industries from the Excel sheet are:

S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	6,014.304	583.988
2	Diesel KL	724.957	70.393
3	Firewood MT	1,485.000	585.805
4	Kerosene KL	1.300	0.513
5	Furnace Oil KL	825.508	325.745

Table 53: Electricity/ Fuel Saving Potentials - Soap & Chemicals

Source: Results of Survey

The areas of potential saving in the sector are:

- Improvement in motor loading
- Installation of more efficient motors
- Replacement of old and rewound motors
- Load management
- Installation of capacitor banks
- Improvement in combustion efficiency in boilers and furnaces
- Minimization of heat losses from the pan boiling furnace
- Minimization of steam leakages
- Insulation of steam pipes, valves and flanges
- Waste heat recovery

9.6 Hotel Sector

a. <u>Sector Highlights</u>

Hotels are basic infrastructural facility needed for the tourism industry. Nepal has emphasized on the promotion of tourism. The tourists visiting Nepal was seen to increase by 18.21 percent in 2009/10 compared to previous year and the average stay period per tourist also increased to 12.67 days from previous 11.32 days. Nepal is celebrating Nepal Tourism Tear (NTY) 2011 with a target to ensure arrival of one million tourists in the year 2011. The government is also promoting internal tourism.

According to Hotel Association of Nepal (HAN) business in the hotel industry has grown by nearly 15% in the Fiscal Year 2009/10 as compared to previous years. The hotel industry is considered to have the highest local private sector investment in Nepal with a recorded investment of around Rs 100 billion. HAN has under its umbrella, 8 five-star, 3 four-star, 12 three-star, 22 two-star and 18 one-star hotels and 165 non-star, four allied and 33 resorts. There are 307 hotels including 42 outside the valley which have 22,661 rooms with 34,958 beds in the country³⁷.

According to Economic Survey 2010/11, the increase of hotel of star and non-star category and the number of beds for last five years are as given below:

Voor	Star 1	Hotel	Non-sta	ar Hotel	Tot	al
i cai	Number	Beds	Number	Beds	Number	Beds
2006	105	9763	502	14497	607	24260
2007	105	9763	512	14897	617	24660
2008	96	9320	573	16743	669	26063
2009	97	9369	647	19124	744	28493
2010	103	9125	686	20817	789	30042

Table 54: Scenario of Hotels and Hotel Beds

Source: Economic Survey 2010/11

b. Observations

The field level observations for the hotel sector are:

- 1. Hotels use both electrical energy and thermal energy to provide services to its guests. Main energy sources of hotels are electricity, diesel and liquefied petroleum gas (LPG).
- 2. The average room availability in the visited hotels is 74 with average occupancy 65.6 percent.
- 3. Energy supplier to the hotels is Nepal Electricity Authority mostly through 11 kV supply with time of day (TOD) metering system and 3-phase 400 V supply in small scale hotels.
- 4. All the hotels are installed their own DG set to supply power during load shedding.
- 5. Major energy consuming equipments of the hotels are air conditions, lighting units, deep freezers, refrigerators, geysers, ovens etc.
- 6. Boilers are used to generate steam that is used for space heating and production of hot water. The fuel used in boiler is diesel.

³⁷ <u>http://www.explorehimalaya.com/blog/nepals-hotel-industry-post-15-growth-in-business/</u> date: 5 Dec 2011

- 7. Laundry equipments are installed only in big hotels of Nepal. Other hotels get laundry services from outside parties on sub-contract.
- 8. All the hotels use compact fluorescent lamps (CFLs) for lighting besides other lighting units.
- 9. About 10 percent of the hotels have initiated to use light emitting diode (LED) lamps for lighting.
- 10. About 25 percent of the hotels use solar energy for water heating.
- 11. The direct loss to the hotels from load shedding is from the high cost of energy from the operation of the DG set. Frequent power cuts create unpleasant atmosphere in the hotels. Frequent power cut also leads to operation and shutting down of DG set many times and shortening life of the equipment.
- 12. The energy supplied from DG sets installed in the hotels is used to provide full fledged or partial services depending upon the capacities and standard of the hotels. Small and non-star hotels are unable to provide air conditioning service in the rooms during load shedding resulting in lower occupancy.
- 13. More than 90 percent of the hotels have neither checked the performance of major energy consuming equipment nor carried out energy audits in their hotels.
- c. <u>Data Analysis</u>

The data and information collected during the baseline survey was analyzed using Excel Sheets. Among the numbers of hotels of wide range located at different parts of the country, 39 hotels are surveyed for the energy efficiency baseline study. Twelve of them are large scale; twenty hotels are of medium scale and rest seven is from the small scale category. These hotels have provided employment to 4,953 persons including 1,089 female. Based on the data of fiscal year 2010/11, these are found to be able to provide accommodation to their guests by 3,017 rooms with an average occupancy of 2,017 rooms.

The energy intensity figures were calculated. The hotels in total consumed 34.947 million units of electricity (kWh) and total thermal energy equivalent to 91,505 GJ worth NPR 517 million. All the hotels are installed with DG set(s) to supply power during the load shedding. Diesel is also used for the operation of boilers and hot water generators in the hotels. Besides diesel, other fuels used for the operation of boilers and hot water generators are furnace oil and kerosene oil. Sixteen of the surveyed hotels are installed with geyser run by electricity to supply hot water in the rooms. Liquefied Petroleum Gas (LPG) is used for the cooking purpose in order to provide food to the guests. The average SEC is found to be 17,326 kWh of electricity and 45,366.71 MJ of thermal energy per room. CO₂ generation is estimated to be 11,529 MT equivalent to 5,715.78 kg/room annually.

 Table 55: Results of Survey - Hotel Industries

 Room Occupancy and Turnover

S. No.	Particular	Fiscal Year 2009/10	Fiscal Year 2010/11
1	Room Capacity in no.	2,885	3,017
2	Occupied rooms	1,892	2,017
3	Annual Turnover in Million NPR	6,445	6,854
4	Share to the Sector		20.09%

Energy and Fuel 2010/11

S. No.	Particular	Total	Quantity
		Quantity	per Room
1	Electrical Energy in kWh	34,946,835	17,326.00
	a. Purchased Electricity	24,540,840	12,167
	b. DG sets	10,405,995	5,159
2	Thermal Energy in MJ	91,504,653	45,366.71
	a. Firewood	6,387,500	3,166.83
	b. Coal	2,240,147	1,110.63
	c. Kerosene	2,116,940	1,049.55
	d. Diesel for boiler	53,732,637	26,639.88
	e. LPG	27,027,429	13,399.82
3	CO ₂ generation in kg	11,528,711	5,715.78
	a. Purchased Electricity	34,541	17.12
	b. DG sets	9,456,736	4,688.52
	c. Firewood	892,819	442.65
	d. Coal	128,615	63.77
	e. Kerosene	149,902	74.32
	f. LPG	866,098	429.40
4	Total DG set capacity in KVA	15,496	
	a. Diesel consumption in liter	2,163,333	1,072.55
5	Energy Cost NPR	517,009,260	256,325.86

Source: Results of Survey

Thus, the energy cost is around 7.54 percent of the turnover.

d. Areas and Potential Savings

The presentation of Mr. Pradeep Kumar from TERI had recorded Energy Performance Index of Indian hotel as 116 kWh per room per day for luxury hotels, 57 kWh per room per day for budget hotels and 40 kWh per room per day for classified hotels. Using these figures and converting all energy into kWh in the excel sheet, we find

n=39, Q=2017, Σ(Ex-Eo)= 600.15 kWh/room/day

Therefore, the Potential Energy Saving =

$$PE = \frac{1}{n} \times \sum_{x=1}^{n} (Ex - Eo) \times Q$$

= 600.15 * 2017 * 365/39

= 11,329,062 kWh = 11,329 MWh

Segregating the saving into electrical and thermal, we find

Electrical saving potential	= 4,153,061 + 1,761,013 = 5,914,074 kWh
	= 5,914.074 MWh
Thermal Saving Potential	= 19,494,048.838 MJ
C	= 19,494.049 GJ

The respective fuel savings potentials for Hotel Sector from the Excel sheet are:

Table 56: Electricity/ Fuel Saving Potentials – Hotel Sector				
S. No.	Electricity / Fuel	Consumption	Saving Potential	
1	Purchased Electricity MWh	24,540.840	4,153.061	
2	Diesel for DG	2,163.333	366.102	
3	Diesel KL for Thermal	1,365.300	231.051	
4	Firewood MT	511	86.477	
5	Coal MT	107	18.109	
6	Kerosene KL	59.485	10.067	
7	Furnace Oil KL	-	-	
8	Rice Husk MT	-	-	
9	LPG kg	538,249	91,088	

Table 56: Electricity/ Fuel Saving Potentials – Hotel Sector

Source: Results of Survey

The areas of potential saving in the sector are:

- Improvement in lighting system
- Improvement in air conditioning
- Improvement in refrigeration and deep freezers
- Load management
- Improvement in combustion efficiency in boilers and hot water generators
- Insulation of the hot water supply pipes
- Conversion of waste to energy (Methane from bio-decomposable waste)

9.7 Brick Sector

a. <u>Sector Highlights</u>

Brick making is one of the traditional crafts in Nepal, as seen in temples and old buildings. Brick is a primary building material in many parts of Nepal, particularly in Kathmandu Valley and in the southern plain of Terai. Brick demand has increased dramatically over recent decades with the demand for housing. With the increasing demand of brick, technology shift took place in early 1950 when traditional clamp kilns (locally known as "Thaado Bhatta") were largely displaced by Bull's Trench Kilns Movable Chimney (commonly known as BTKs or "Chimney Bhatta") technology that was brought from India in the early 1950s.

It is estimated that about 575 Brick kiln are in operation in Nepal. The capacities of these Kilns range from 15,000 to 50,000 bricks per day. Major brick clusters in the Country in mainly are Kathmandu valley and Terai region. Moving Chimney BTKs (MC-BTK) was widely used for brick making. There are also some Hoffman Kilns in operation and a spattering of traditional clamp kilns (locally known as "Thado Bhatta") in operation. Fixed chimney BTKs (FC-BTK) were also introduced by the brick entrepreneurs themselves. The government has banned the MC-BTK in the Kathmandu Valley in 2003. This transformed such units into Fixed Chimney.

Clay is the main raw material for brick making, which is available in very low cost. Coal is the main fuel used which comes from Assam in India. Apart from coal, a small fraction of sawdust/fire-wood is also used as fuel in these kilns.

Brick making is an energy and labour intensive process. Hand moulding of green bricks is widely practiced in Nepal and there is no mechanization of this process (except for large Hoffman Kiln units). The industry is seasonal and operates mostly for about 6 months from December to June again except for large mechanized kilns with shades for storing bricks.

There are distinctly two types of brick industries namely the machine made bricks and handmade bricks. Most of the units (except three of the surveyed units) in the country are handmade green brick making units. The kiln is mostly natural draft system. Three of the kilns have forced or induced draft systems. One time prevalent moving chimney Bull's Trench Kilns are not seen these days. They have been replaced by the fixed chimneys after the Government took steps to ban such units from the Kathmandu Valley.

Government has also promulgated the standards on Chimney Height and Emission for the Brick Kiln Industries on B. S. 13 Falgun 2064 (25 Feb 2008) as given below:

		Suspended	Height of
S. No.	Type of Kiln	Particulate Matter	Chimney
		(maximum limit)	(minimum limit)
1	Bull's Trench Kiln	600 mg/Nm^3	17 meter
2	Bull's Trench Kiln, Natural Draught (Fixed Chimney)	700 mg/Nm3	30 meter
3	Vertical Shaft Brick Kiln	400 mg/Nm3	15 meter

Table 57: Emission Standards and Chimney Height for Brick Kilns

Note:

- 1. Value of suspended particulate matter shall be calculated considering reference oxygen concentration as 10%
- 2. Chimney height shall be measured from ground level.

Source: Nepal Gazatte dated 2064/11/13 BS

b. Observations

The process flow charts for the two types of brick kilns are presented below:





Figure 24: Process Flow Chart for the Machine Made Brick Industry Input Process

The field level observations for the brick sector are:

- 1. Maximum number of brick industries in Nepal is Fixed Chimney Bulls Trench Kiln (BTK). Other brick industries are Mobile Chimney BTK, Hoffman's Kiln and Vertical Shaft Brick Kiln (VSBK).
- 2. The major energy use on brick industries is from coal. Coal is imported from India.
- 3. Electrical energy is used mainly for the lighting purpose and drives such as pug mill operation, water pumping and blowers (for forced draft).
- 4. About 60 percent of the brick industries are installed with DG set of moderate size to run the machines during load shedding.
- 5. The average installed capacity of the brick industry is 5.56 million bricks per year; and the average production is 3.15 million bricks per year.
- 6. Energy supplier to the brick industries is Nepal Electricity Authority mostly through 3 phase 400 V supply.
- 7. There is no significant disturbance in production by load shedding in brick industries.
- 8. About 90 percent of the brick industries adapt ordinary natural draft firing technology.
- 9. Insulations on the top (inadequate RAPISH thickness) and at the doors (inadequate mud plaster at DWARI) are not adequate.
- 10. Coal feeding practices need improvement.
- 11. In general, the brick industry premises are hot workplace and the dust emission in and around industry area is high.
- c. Data Analysis

27 brick industries were visited for the baseline survey. Twenty four of them were fixed chimney units and three of the units were VSBKs. These units provided employment to 3,095 males and 1,628 females totaling to 4,723 in the season. These units had a total capacity of 150,140,000 bricks per annum and produced 88,865,600 in the fiscal year 2009/10 and 84,954,400 in the fiscal year 2010/11.

The energy intensity figures were calculated. Electricity consumption is only for lighting in most of brick units (except three machine made and one additional forced draft units among surveyed units). Only mechanized brick making plants like Bhaktapur Brick, Jay Bageswori brick use electrical energy for the brick making machines; others use manual moulding of bricks. Coal is the main fuel used for firing of the bricks and fire-wood is also used to start the firing process.

In fiscal year 2010/11, the Fixed Chimney Brick Kilns consumed 1.75 million units of electricity (kWh) and total thermal energy equivalent to 325,220 GJ worth NPR 235.46 million. The average SEC is found to be 21.27 kWh of electricity and 3,951.09 MJ of thermal energy per 1000 bricks. CO₂ generation is estimated to be 19,833 MT, which is equivalent to 240.97 kg per 1000 bricks.

Similarly, the VSBK consumed 45,241 units of electricity (kWh) and total thermal energy equivalent to 4,647 GJ worth NPR 4.048 million. The average SEC is found to be 17.07 kWh of electricity and 1,753.72 MJ of thermal energy per MT. CO_2 generation is estimated to be 277.6 MT, which is equivalent to 104.75 kg per 1000 bricks.

Table 58: Results of Survey Brick Sector - BTK

BTK - Fixed Chimney

Production and Turnover

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in pcs.	144,600,000	144,600,000
2	Production in pcs.	86,715,600	82,304,400
3	Annual Turnover in Million NPR	748.833	747
4	Production Share to the Sector		2.06%

Energy and Fuel 2010/11

S. No.	Particular	Total	Quantity per
		Quantity	1000 pcs.
1	Electrical Energy in kWh	1,750,634.00	21.27
	c. Purchased Electricity	740,066	8.99
	d. DG sets	1,010,568	12.28
2	Thermal Energy in MJ	325,219,771.00	3,951.09
	f. Coal	317,969,771	3,863
	g. Fire wood	7,250,000	88.09
3	CO ₂ generation in kg	19,833,304	240.97
	g. Purchased Electricity	1,042	0.013
	h. Diesel	563,041	6.84
	i. Coal	18,255,845	221.81
	j. Firewood	1,013,376	12.31
4	Total DG set capacity in KVA	1,735	-
	b. Diesel consumption liter	210,090	2.55
5	Energy Cost NPR	235,464,685	2860.90

Source: Results of Survey

Thus, the energy cost is around 31.51 percent of the turnover.

VSBK

 Table 59: Results of Survey of Brick Sector - VSBK

Production and Turnover

S. No.	Particular	Fiscal Year	Fiscal Year
		2009/10	2010/11
1	Production Capacity in pcs.	4,340,000	5,540,000
2	Production in pcs.	2,150,000	2,650,000
3	Annual Turnover in Million NPR	17	28
4	Production Share to the Sector		16.56%

Energy and Fuel 2010/11

S. No.	Particular	Total Quantity	Quantity per 1000
1	Electrical Energy in kWh	45,241	17.07
	a. Purchased Electricity	26,000	9.81
	b. DG sets	19,241	7.26
2	Thermal Energy in MJ	4,647,348	1,753.72
	a. Coal	4,647,348	1,753.72
3	CO ₂ generation in kg	277579	104.75
	a. Purchased Electricity	37	0.0138
	b. Diesel	10,720	4.05
	c. Coal	266,822	100.69
4	Total DG set capacity in KVA	20	
	c. Diesel consumption liter	4000	1.51
5	Energy Cost NPR	4,048,000.00	1,527.55

Thus, the energy cost is around 14.41 percent of the turnover.

d. Areas and Potential Savings

From the Excel sheet calculation, for Fixed Chimney Brick Kilns, Electrical Energy consumption is 1,750,634 kWh and thermal energy consumption is 325,219,771 MJ and assuming that a brick weighs 2.5 kg,

n = 24, Qs = 82304400*2.5/1000 = 205,761 MT, To = 1,100 MJ/ MT

 $\Sigma(Tx - To) = 12842.92$ MJ; and

PT = (1/24)*12842.92*205,761 = 110,107,169.255 MJ = **110,107 GJ**

Thus, the thermal saving potential is 33.86%

Therefore, the respective fuel savings potentials for Brick industries (Fixed Chimney) from the Excel sheet are:

Table 00. Fuel Saving I dentials for Brick Kim (BTK/ FC)			
S. No.	Fuel	Consumption	Saving Potential
1	Firewood MT	580	196.37
2	Coal MT	15,189	5,142.48

Table 60: Fuel Saving Potentials for Brick Kiln (BTK/ FC)

Source: Results of Survey

Similarly for VSBK, n = 3, Q = 2650000*2.5/1000 = 6625 MT, To = 750 MJ/MT

 $\Sigma(Tx - To) = 90.98$

PT = (1/3) * 90.98 *6625MJ = 200,914 MJ

Total potential energy saving from the surveyed brick industries = 110,107 + 200.9 GJ = 110,308 GJ. Thus, the thermal saving potential is 4.32% Therefore, the respective fuel savings potentials for Brick industries (VSBK) from the Excel sheet are:

Table 61: Potential Fuel Saving for Brick Sector - VSBK			
S. No.	Fuel	Consumption	Saving Potential
1	Coal MT	222	9.60

Source: Results of Survey

The areas of potential saving in the sector are:

- Improvement in heating system by installation of FD and ID fans
- Improvement in heating system by adaptation of better technology (e.g. zig zag)
- Minimization of heat losses from kiln wall, top coverage, doors
- Improvement in combustion efficiency
- Improvement in fuel feeding practice
- Proper storages of fuel

9.8 Cold Storage Sector

a. Sector Highlights

Being an agricultural country, Nepal produces agricultural products. Cold storages are used to store such products at appropriate cold temperature from the time of their harvesting so that they do not decay and they can be used for longer duration.

Cold storage reduces the rate of biochemical changes in fresh foods and also slows down the growth of contaminating micro-organisms. The reason for storing fruits and vegetables in a cold store is therefore to extend their life beyond the harvest season. This may be because they can achieve a higher sale price out of season or for food security reasons.

Storing of the products in cold storage is expensive due to cost of electricity to operate the chilling or refrigeration plant to maintain the appropriate temperature. Therefore, storing in cold storage is only considered where the price for the stored crop is high enough to cover these costs.

In Nepal, mainly potatoes are stored in the cold storage. Fruits such as orange and apple are also stored. According to the association of cold storage, there are around 35 cold storages; 23 of them are the members of the association and others are not. The average size of the cold storage is 3,000 MT.

The government has required the NEA that the cold storages are given 50 percent subsidy in the electricity bill.

b. Observations

The process flow chart of a cold storage operation is presented below:





Figure 26: Process Flow Chart of Cold Storage with Ice Production

The field level observations for the cold storage units are:

- 1. Cold Storages of Nepal mainly store potatoes and fruits. About 10 percent of the cold storages also produce ice blocks for sale.
- 2. Cold storages consume only electrical energy for its cooling process.
- 3. The average installed storage capacity is 3,393 Tons (at a time) and average annual storage is 1,806 Tons.
- 4. Energy supplier to the industries is Nepal Electricity Authority mostly through 11 kV supply with time of day (TOD) metering system.
- 5. All the cold storages have their own DG set to supplement the power supply in their production during power failure from the central grid.
- 6. Major energy consuming equipment of the cold storage plant is refrigeration compressors.
- 7. The loading of the compressor motors are not checked by the industry.

- 8. The power factor is low in all the cold storages and none of the visited cold storages have installed capacitor bank to improve the power factor.
- 9. Cold Storages face problems of voltage fluctuation and low voltage supply.
- 10. The loss due to load shedding is not significant in cold storages. These enterprises have to pay more energy cost by operation of DG set during load shedding. DG set running time is lesser compared to other industrial sector. Once attainment of the required temperature for cold storage, the temperature has to be maintained throughout. Energy for cooling may require at any point of time, hence installation of DG set is a must in cold storages.
- 11. About half of the cold storages do not use air curtain at the entrance.
- 12. About 60 percent of the cold storages lack proper wall and ceiling insulations.
- 13. About 50 percent of the cold storages lack proper cleaning of the condenser pipes resulting in lesser cooling efficiency.
- c. Data Analysis

Twelve cold storages were visited for the baseline survey. These were one large, six medium and five small scale units. These units provided employment to 191 males and 24 females and stored 20,407 MT in the fiscal year 2009/10 and 21,669 MT in the fiscal year 2010/11. The total capacity of these units was 40,720 MT and thus the capacity utilization was only around 53 percent in the fiscal year 2009/10. The average capacity is 3,393 MT and the actual storage is 1,805 MT.

Electricity is the main energy used for maintaining the temperature of the stored goods (mainly potatoes). The energy intensity figures were calculated. The analysis shows that the electrical energy consumption is 6,143,628 kWh; 5,184,889 kWh is the purchased electricity and 958,739 kWh from DG sets, as the units also have to operate the DG sets during load shedding. The total cost of energy is NPR 31.986 million. Specific energy consumption is 283.53 kWh of electrical energy per MT of the products stored annually. CO₂ generation is estimated to be 541.462 MT, which is equivalent to 24.99 kg per MT of products stored.

Storage and Turnover				
S. No.	Particular	Fiscal Year	Fiscal Year	
		2009/10	2010/11	
1	Storage Capacity in MT	35,720	40,720	
2	Storage in MT	20,407	21,669	
3	Annual Turnover in Million NPR	72.06	84.38	
4	Production Share to the Sector		66.86%	

 Table 62: Results of Energy Survey for Cold Storages
S. No.	Particular	Total Quantity	Quantity per MT
1	Electrical Energy in kWh	6,143,628	283.53
	a. Purchased Electricity	5,184,889	239.28
	b. DG sets	958,739	44.25
2	Thermal Energy in GJ	-	-
3	CO ₂ generation in kg	541,462	24.99
	a. Purchased Electricity	7,298	0.34
	b. Diesel	534,164	24.65
4	Total DG set capacity in KVA	2,090	
	a. Diesel consumption Liter	199,315	9.20
5	Energy Cost NPR	31,985,995	1,476.15

Energy and Fuel 2010/11

Source: Results of Survey

Thus, the energy cost is around 37.91 percent of the turnover.

d. Areas and Potential Savings

From the regional operation, electrical energy saving potential was seen to be 20%.

Annual storage Quantity = 21,669 MT, Specific Energy Consumption (SEC) = 283.53 kWh/MT

Using these figure, the total energy saving potential for the visited industries will be = (saving potential in percentage/100)*SEC*total quantity stored

= 0.2*283.53 *21669 kWh = 1,228,762 kWh = **1,228.762 MWh**

In fact, if improved technologies are used and two sizes of compressors; one for initial cooling and another for maintaining the temperature are used, the potentials could be much higher to the tune of 30%. This could be explored during actual energy audit.

Therefore, the respective fuel savings potentials for Cold Storage industries from the Excel sheet are:

	Table 05: Electricity/ Fuel Saving	rotentials for Surveye	u Colu Storages
S. No.	Electricity / Fuel	Consumption	Saving Potential
1	Purchased Electricity MWh	5,184.889	1,036.978
2	Diesel KL	199.315	39.863

Table 63: Electricity/ Fuel Saving Potentials for Surveyed Cold Storages

The areas of potential saving in the sector are:

- Improvement in compressor motor loading
- Installation of more efficient motors
- Power factor improvement by installation of capacitor banks
- Improvement in insulation of the cold pipelines, storage room walls and ceiling
- Introduction of modern belt and pulleys to the drives of compressors
- Minimization of energy losses by partition of cooling areas, installation and effective use of air curtains
- Regular cleaning and maintenance of condenser pipes
- Replacement of incandescent lamps by more efficient lamps
- Minimization of leakages of compressed ammonia gas

10. Results of Energy Survey

The questionnaires filled up in the survey were used to enter the data and information in an Excel sheet for analysis. The sector-wise analysis is presented in the subsequent sections below. The total annual consumptions of various forms of energy by the surveyed 200 units are presented below:

		2009	/10	2010/11		
S. No.	Items	Quantity	Value in M NPR	Quantity	Value in M NPR	
1	Electricity consumption (GWh)	259.84	1,536.63	273.73	1,653.58	
2	Fire wood (MT)	3,454.77	18.51	3,967.87	24.84	
3	Coal (MT)	142,402.92	1,780.01	177,125.50	2,324.93	
4	Kerosene (KL)	103.25	6.23	113.59	7.21	
5	Diesel (KL)	19,826.60	1,181.87	22,758.00	1,459.39	
6	Furnace Oil (KL)	8,911.99	394.00	9,423.54	588.78	
7	Rice Husk (MT)	132,446.49	367.31	132,681.13	351.78	
8	LPG MT	583.01	45.38	620.31	51.72	

Table	64:	Results	of Energy	Survey

Source: Results of Survey

The survey has also revealed the following:

- Total employment; 29,619 (24,239 male and 5,380 female)
- Total capacity of Generators; 110,372 kVA
- Scale-wise³⁸: 65 Small, 74 Medium, and 61 Large
- No. of units with Energy Manager: 23/200
- No. of units interested in NEEP Activities 193/200
- No. of units ready to invest for energy saving 190/200
- No. of units previously participated in EE Programmes 87/200
- No. of units having ISO certification 45/200 ISO 9001, 8/200 ISO 14001
- No. of units having NS certification 54/200
- No. of units taking Pollution control certification 42/200





³⁸ Classifications of industries are done based on investment in fixed assets as per the Industrial Enterprises Act 1992. Industries are classified as small if the fixed investment is up to NPR 30 Million, they are classified as medium if the investment is more than NPR 30 million but not above NPR 100 million, and large if the investment is more than NPR 100 million.



Figure 28: Energy Consumption by Type in Million NPR

Source: Results of Survey

10.1 **Energy Cost on Product value**

The Energy Cost on the Product Value for the sectors and sub-sectors were calculated by dividing the Total Costs of all fuels and electricity for the sector or sub-sector by Total Turnover for the sector or sub-sector. These figures have been used and presented in a graph below:





Source: Results of Survey

The sector-wise maximum, minimum and average electrical system, boilers and furnaces have been given in the following table. The figures are for those industries which have the facility or the equipment:

S. No.	Item	Cement	Paper	Food	Metal	Soap	Hotel	Brick	Cold- storage
	Transformer capacity kVA								
1	max	30180	3000	6830	10000	1600	2050	2025	650
1	min	500	1000	35	200	50	50	25	100
	average	4170.7	2160	917.8	2371	492	505	510	250
	Approved Dema	nd kVA							
2	max	10000	4000	2182	7000	750	2000	500	410
2	min	300	1000	35	160	50	20	20	16
	average	2570	2050	528.6	1630.8	285.4	400	180	187.6
	Maximum Dema	and kVA							
2	max	7567	2352	2660	3400	450	1500	250	342
3	min	175	700	35	83.5	45	16	18	80
	average	1747.7	1324	392.7	1414	193.6	299	103	148.3
	Power Factor								
4	max	0.99	0.96	0.98	0.98	0.98	0.99	0.91	0.91
4	min	0.67	0.85	0.43	0.78	0.65	0.75	0.68	0.68
	average	0.91	0.93	0.84	0.89	0.82	0.87	0.806	0.81
	Boiler Size T/hr								
5	max		10	32		3	7		
5	min		5	0.3		1	0.2		
	average		6	8		2	0.6		
	Furnace Size MT	ſ/hr							
6	max			1*	70+				
0	min			0.2*	5+				
	average			0.4*	15+				
7	ISO Certificates	17	1	14	18	1			

 Table 65: Electrical System, Boiler, Furnace

Source: Results of Survey * = in million Kcals/hr thermic fluid heaters; + = MT material/hr

The average fuel costs born by the industries are given below:

Table 66:	Average	Fuel	Costs

S. No.	Fuel	Price in NPR
1	Purchased Electricity MWh	6,040.87
2	Diesel KL	64,126.54
4	Fire wood MT	6,261.35
5	Coal MT	13,125.88
6	Kerosene KL	63,480.60
7	Furnace Oil KL	62,479.42
8	Rice Husk in MT	2,651.33
9	LPG kg	83.37

10.2 Saving Potentials

The saving potentials for the surveyed 200 industries by sector / sub-sector as calculated in the section 9 are presented in the following table:

Table 67: Saving Potentials Energy and CO2							
For Surveyed Industries							
Saatan	Energy Sav	ing Potential		CO ₂ Sav	ing in kg		
Sector	Electrical MWh	Thermal GJ	Purchased Electricity	DG electricity	Thermal	Total	
Cement							
Clinker based	30,569	0	29.25	5,456.33	-	5,485.58	
Limestone based	35,390	1,598,359	39	3,302	77,027	80,367.32	
Pulp & Paper	766	114,040	0.91	65.64	9,873.75	9,940.30	
Food							
Beverage KL	1,391	10,708	1.22	293.46	866.38	1,161.06	
Biscuit MT	1,052	8,703	1.17	123.33	666.23	790.73	
Dairy KL	505	12,785	0.47	96.39	971.57	1,068.43	
Noodle MT	243	26,787	0.24	39.47	2,313.11	2,352.83	
Sugar MT	784	2,095	0.50	238.67	251.50	490.67	
Veg. Oil MT	1,200	78,085	1.16	209.39	6,760.73	6,971.28	
Metal MT	3,694	135,596	4.21	392.39	9,093.05	9,489.65	
Soap & Chemical MT	923	113,877	0.82	188.74	10,036.24	10,225.80	
Hotel Rooms	5,914	19,494	5.85	981.15	964.01	1,951.01	
Brick pcs.							
FC	0	110,107	-	-	6,523.82	6,523.82	
VSBK	0	201	-	-	11.54	11.54	
Cold Storage MT	1,229	0	1.46	106.84	-	108.30	
Total	83,660	2,230,837				136,938	

Source: Results of Survey; Note: FC: Fixed Chimney; VSBK: Vertical Shaft Brick Kiln

The saving potential for the surveyed 200 industries by fuel type is presented below:

S. No.	Fuel	Saving
1	Purchased Electricity MWh	61,183.87
2	Diesel KL for DG	4,496.91
3	Diesel KL for Thermal	1,170.40
4	Fire wood MT	1,149.76
5	Coal MT	70,837.56
6	Kerosene KL	17.92
7	Furnace Oil KL	2,157.66
8	Rice Husk in MT	17,575.08
9	LPG kg	105,574.40

Table 68: Saving Potentials by Fuel Type

Source: Results of Survey

10.3 Efficiency Margin

The efficiency margins or the saving in the cost of energy as the percentage of unit product value

= (Total value of energy saving/Annual production)/(Annual Turnover/Annual Production)

= Total value of energy saving /Annual Turnover

Efficiency Margins have been calculated using the excel sheet from the database and the results are presented below:

Sector - Sub-sector	Efficiency Margin
Food - Beverage	0.17%
Food - Sugar	0.18%
Food - Vegetable Oil	0.22%
Food - Noodle	0.25%
Brick VSBK	0.45%
Food - Dairy	0.47%
Soap & Chemicals	0.51%
Metal	0.61%
Food - Biscuit	0.99%
Hotel	1.06%
Pulp & Paper	1.65%
Cement - Clinker based	2.43%
Brick - BTK FC	9.20%
Cold Storage	10.45%
Cement - Limestone based	19.09%

Table 69: Efficiency Margins Sector-wise

The efficiency margins for the sectors and subsectors are given in the following graph:



Figure 30: Efficiency Margin by Sector

Source: Results of Survey

10.4 Interest in Energy Auditing and Payment

A supplementary questionnaire was developed and handed over to PACE Nepal after PACE Nepal had started the survey. The questionnaire is attached as Annex -7. This questionnaire was filled for 196 industries and the detailed results have been given in the Annex – 8. Important results are described below:

179 out of 196 industries are interested to participate in Energy Efficiency Training. The type of training most demanded was Introduction to Energy Efficiency Awareness followed by Industrial Energy Efficiency, good housekeeping and management for particular sectors e.g. boiler, compressor. 99 out of 179 wanted the training to be free. 77 agreed to pay between NPR 1,500 to 2,500. Only 10 agreed to pay NPR 2,500 to 5,000 for one day training. Similarly 136 want to participate in 2-day tailor made training; 109 agreed to pay NPR 5,000 to 10,000. 165 units want to participate in one day walk through energy audit. 103 agreed to pay less than NPR 1,000 and 44 wanted it for free. Only 91 want to participate in detailed energy audit. However, 78 out of 91 want it to be free. Only 13 of these agreed to pay less than NPR 200,000.

11. Macro-economic Projections

11.1 Overall Energy Saving Potentials

a. <u>For the Cement Sector</u>

As the surveyed units produced 1,289,012 MT by the 18 clinker based units and 709,003 MT by the eight limestone based units and as there are 27 clinker based units and 8 limestone based units in the country, the production of the clinker based units can be estimated as 27/18*1,289,012 MT = 1,933,518 MT.

Thus the total production of cement in the country = 1,933,518 + 709,003 MT = 2,642,521 MT

There is only electrical energy consumption for clinker grinding and as the potential of saving is 30,569 MWh or 110,049 GJ for surveyed units, the total electrical energy saving potential for the total production can be projected as

Electrical energy saving potential for total clinker based units = 1933518/1289012*30569 MWh = **45,854 MWh or 165,073 GJ**

Thus,	for	the	total	cement	sector	the	total	electrical	saving	is
,	-									

	= 165,073 + 127,404 = 292,477 GJ or 81,244 MWh
The thermal energy saving	= 1,598,359 GJ
Thus, the total saving potential	= 1,890,836 GJ

b. <u>For the Pulp & Paper Sector</u> Production of surveyed industries = 32,810 MT Estimated Production of all units = 39,372 MT

Using the ESPS studies, for the surveyed industries, the electrical and thermal energy saving potentials have been calculated as 765.901 MWh and 114,040 GJ.

The projected potential electrical and thermal energy savings can be calculated as given below:

Projected Potential Electrical Energy Saving = 3	9372/32810*765.901 MWh
	= 919 MWh
Projected Potential Electrical Energy Saving	= 39372/32810*114040 GJ
	= 136,848 GJ

c. For the Food Sector Industries

The projected energy savings for the food sector industries as classified into six categories have been given below:

Beverage Industries

Eleven units were surveyed and they had production of 120,562 KL with the potential electrical saving of 1,390.804 MWh and potential thermal saving of 10,707.587 GJ. As the national production is estimated to be 2,000,000 KL, the projected energy saving potentials are:

= 2000000/120562*1390.804 MWh
= 23,072 MWh
= 2000000/120562*10707.587
= 177,628 GJ

Biscuit Industries

Six units of Biscuit industries were surveyed and they had production of 12,505 MT with the potential electrical saving of 1,052.435 MWh and potential thermal saving of 8,702.705 GJ. As the national production is estimated to be 18000 MT, the projected energy saving potentials are:

For electrical energy	= 18000/12505*1052.435 MWh = 1,515 MWh
For thermal energy	= 18000/12505*8702.705 MWh = 12,527 GJ

Dairy Industries

Nine units of dairy industries were surveyed and they had production of 103,535 KL with the potential electrical saving of 504.602 MWh and potential thermal saving of 12,785.202 GJ. As the national production is estimated to be 1,556,000 KL, the projected energy saving potentials are:

= 1556000/103535*504.602 MWh
= 7,584 MWh
= 1556000/103535*12,785.202 GJ
= 192,145 GJ

Noodle Industries

Four units of instant noodle industries were surveyed and they had production of 21,826 MT with the potential electrical saving of 243.34 MWh and potential thermal saving of 26,786.582 GJ. As the national production is estimated to be 42,840 MT, the projected energy saving potentials are:

For electrical energy = 42840/21826*243.34 MWh = 478 GJ For thermal energy = 42840/21826*26786.582 GJ = 52,577 GJ

Sugar Industries

Five units of Sugar Mills were surveyed and they had production of 78,634 MT with the potential electrical saving of 783.678 MWh and potential thermal saving of 2,095.16 GJ. As the national production is estimated to be 190,650 MT, the projected energy saving potentials are:

For electrical energy = 190650/78634*783.678 MWh = **1,900 MWh** For thermal energy = 190650/78634*2,095.16 GJ = **5,080 GJ** As per the Economic Survey of 2010/11, the production of sugar is 190,650 MT. The cogeneration potential can be projected = 190650/78634*11.968 MW = 29.017 MW

Therefore, the cogeneration potential from Sugar mills = 29 MW

Vegetable Oil & Ghee

Sixteen units of Vegetable Oil Industries were surveyed and they had production of 122,034 MT with the potential electrical saving of 1,200.312 MWh and potential thermal saving of 78,084.573 GJ. As the national production is estimated to be 194,319 MT, the projected energy saving potentials are:

For electrical energy	= 194319/1220	34*1,200.312 MWh
	= 1,911 MWh	
For thermal energy	= 194319/1220	34*78,084.573 GJ
	= 124,337 GJ	

d. For the Metal Sector Industries

Twenty One units of Metal Industries were surveyed and they had production of 401,378 MT with the potential electrical saving of 3,694.2 MWh and potential thermal saving of 135,595.833 GJ. As the national production is estimated to be 600,000 MT, the projected energy saving potentials are:

For electrical energy = 600000/401378*3,694.2 MWh = 5,522 MWh

For thermal energy	= 600000/401378*135,595.833 GJ
	= 202,695 GJ

e. For the Soap and Chemical Industries

Nineteen units of Soap and Chemical Industries were surveyed and they had production of 85,407 MT with the potential electrical saving of 922.593 MWh and potential thermal saving of 113,876.689 GJ. As the national production is estimated to be 112000 MT, the projected energy saving potentials are:

For electrical energy	= 112000/85407*922.593 MWh
	= 1,210 MWh
For thermal energy	= 112000/85407*113,876.689 GJ
	= 149,334 GJ

f. <u>For Hotels</u>

Thirty Nine hotels were surveyed and they had total of 3,017 rooms and had and average occupancy of 2,017 rooms (66.85%). They have potential electrical saving of 5,914 MWh and potential thermal saving of 19,494 GJ. As the total number of hotels is 789 and the number of beds is 30,042, the number of rooms is estimated at 15,021, the projected energy saving potentials are:

For electrical energy = 15021/3017*5914 MWh

= 29,445 MWh
= 15021/3017*19,494 GJ
= 97,056 GJ

g. For Brick Sector Industries

Twenty Seven units of Brick Kilns other than VSBK and 3 units of VSBK were surveyed and they had production of 82,304,400 pieces and 2,650,000 pieces of fired bricks respectively. For the other kilns, thermal energy saving potentials was 110,107 GJ.

Hence, the projected thermal energy saving potentials = 3984000000/82304400*110107= 5,329,804 GJ Similarly for the VSBKs the potential of thermal energy saving = 16000000/2650000*201 GJ = 1,214 GJ

h. For Cold Storages

The estimated storage capacity of all the cold storages in the country is 60,900 MT. As the total capacity of the 12 surveyed cold storages are 40,720 and the potentials for the electrical energy saving = 1,229 MWh,

the projected electrical energy saving for all the cold storages in the country = 60900/40720*1229 MWh = **1,838 MWh**

The above national saving potential projections have been presented in the table below:

		For Surv	veyed Industrie	es	For the Country			
S No	Castor	Production Saving Potential		Potential	National	Saving Potential		
5. INU.	Sector	Surveyed Industries	Electrical	Thermal	Production	Electrical	Thermal	
		Qs	MWh	GJ	Q	MWh	GJ	
	Cement based on							
1	Clinker	1,289,012	30,569	0	1,933,518	45,854	-	
	Limestone	709,003	35,390	1,598,359	709,003	35,390	1,598,359	
2	Pulp & Paper	32,810	766	114,040	39,372	919	136,848	
	Food							
	Beverage KL	120,562	1,391	10,708	2,000,000	23,075	177,635	
	Biscuit MT	12,205	1,052	8,703	18,000	1,551	12,835	
3	Dairy KL	103,535	504.6	12,785	1,556,000	7,584	192,145	
	Noodle MT	21,826	243.34	26,787	42,840	478	52,577	
	Sugar MT	78,634	784	2,095	190,650	1,900	5,080	
	Veg. Oil MT	122,034	1,200	78,085	194,319	1,911	124,337	
4	Metal MT	401,378	3,694	135,596	600,000	5,522	202,695	
5	Soap & Chemical MT	85,407	923	113,877	112,000	1,210	149,334	
6	Hotel Rooms	3,017	5,914	19,494	15,021	29,445	97,056	
	Brick pcs.							
7	FC	82,304,400	0	110,107	3,984,000,000	0	5,329,804	
	VSBK	2,650,000	0	201	16,000,000	0	1,214	
8	Cold Storage MT	40,720	1,229	0	60,900	1,838	-	
	Total		83,659	2,230,836		156,676	8,079,920	

Table 70: Projection of Energy Saving Potentials

The following charts present the projected nationa potential savings:



Figure 31: Electrical Energy Saving in MWh



Figure 32: Thermal Energy Saving in GJ

Source: Results of Survey



Source: Results of Survey

The Projection of potential national saving of individual fuel or electricity is presented below:

S	<u> </u>	Projected Saving				
No.	Fuel	Quantity	Price	Value in Million NPR		
1	Purchased Electricity MWh	110,084	6,040.87	665.01		
2	Diesel KL for DG	9,502	64,126.54	609.32		
3	Diesel KL for Thermal	6,087	64,126.54	390.32		
4	Fire wood MT	13,355	6,261.35	83.62		
5	Coal MT	315,756	13,125.88	4,144.58		
6	Kerosene KL	161	63,480.60	10.23		
7	Furnace Oil KL	4,772	62,479.42	298.14		
8	Rice Husk in MT	31,717	2,651.33	84.09		
9	LPG kg	621,676	83.37	51.83		
	Total			6,337.14		

Table 71: Projection of Saving Potentials of Electricity and Fuels

11.2 Projected Impacts on National Production or Imports

Comparing the production of electricity and the imports of the coal and proleum products, the savings have been calculated as given below:

Electricity

NEA sales – 2,734.74 GWh in total and 1,043.32 for the industrial consumers

Potential saving projected for eight sectors of industries = 110,084.35 MWh

Therefore, EE in these eight sectors can save 4.03% of the total sales or 10.55% of the electricity sales to industries.

Diesel

Diesel sales by NOC for the fiscal year 2010/11 was 652,764 KL Saving Potential from EE of eight sectors = 15,588.47 KL Therefore, EE in the eight sectors has the potential to save 2.39% of the total diesel sold by NOC equivalent to NPR 999.6 Million

Coal

The import of coal is by private sector. The quantity of import of coal from India has been recorded by WECS as 293,760 Tons and the production as 14,820 tons³⁹ for the fiscal year 2008/09. The saving potentials for coal is seen here to be 315,756.18 MT. This shows that the saving potential is more than the import and production in the country. Index mundi has reported the import of coal in Nepal for the year 2009 as 524.70 million short tons. The difference is very wide. If we use this data, the saving potential is only 0.7% of the import.

Kerosene

Kerosene sales by NOC for the fiscal year 2010/11 was 43,399 KL Saving Potentials from EE of eight sectors = 161.17 KL Thus, the potential to save kerosene by practice of EE in the eight sectors is estimated to be 0.37% of the sales by NOC worth NPR 10.23 Million.

Furnace Oil

The sale of furnace oil from NOC for the fiscal year 2010/11 was 1,434 KL. The consumption of this oil by the surveyed industries for the same fiscal year was 8,850.27 KL. This shows that furnace oil is imported by the industries themselves and record of this is not available.

LPG

The sale of LPG is regulated by NOC and for the fiscal year 2010/11 the sales of LPG was 159,286 MT. The saving potential for LPG has been seen estimated from energy efficiency of eight sectors = 621.7 MT. Therefore EE in the eight sectors can save 0.39% of the sales of LPG worth NPR 51.8 million.

 ³⁹ WECS, 2010 *Energy Sector Synopsis Report*, Water and Energy Commission Secretariat (WECS), July 2010 pp.
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11.3 Greenhouse Gas Reduction Potentials

The reduction of Carbon Dioxide generation for the eight sectors of industries have been calculated using the factors given in section 8.7 in the excel sheets. The calculation process used is demonstrated below for the metal sector:

For the metal sector in the fiscal year 2010/11, Production = 401,378 MT; Purchased Electricity = 48,446,800 kWh; Electricity from DG = 11,426,713 kWh; Thermal Energy = 590,317,077 MJ; CO_2 generation from purchased electricity = 68,189 kg, CO_2 generation from Generated Electricity (DG) = 6,360,024 kg (Diesel use is 46.4% for electricity) CO_2 generation for Thermal energy = 39,586,597 kg Potential electrical energy saving = 3,694 MWh (80.9% purchased electricity and 19.1% generation using DG); and Potential saving of thermal energy = 135,596 GJ Thus. CO₂ saving for purchased electricity =0.809*3694 MWh /48446800 kWh*68189 kg = 4.21 MT CO_2 saving for DG electricity = 0.191*3694 MWh/11426713 kWh*6360024 kg = 392.39 MT CO_2 saving for Thermal energy = 135596 GJ/590317077 MJ*39586597 kg = 9.093.05 MT Total CO₂ saving for metal sector = 9,489.65 MT

Projection for the country with the estimation of total production of 600,000MT = 600000/401378*9489.65 = 14,186 MT

The resulting CO_2 saving is given in the following page for all the sector and subsectors. The CO_2 saving from the sectors are presented below in graphical form:



Source: Results of Survey

G		Sub-sector	Qs	CO ₂ saving in kg					
5. No.	Sector		Production	Purchased Electricity	DG electricity	Thermal	Total	Q	kg
1	Comont	clinker based	1,289,012	29.25	5,456.33	-	5,485.58	1,933,518	8,228.37
1	Cement	Limestone based	709,003	39	3,302	77,027	80,367.32	709,003	80,367.32
2	Pulp & Paper		32,810	0.91	65.64	9,873.75	9,940.30	39,372	11,928.36
		Beverage	120,562	1.22	293.46	866.38	1,161.06	2,000,000	19,260.82
		Biscuit	12,205	1.17	123.33	666.23	790.73	18,000	1,166.17
2	Food	Dairy	103,535	0.47	96.39	971.57	1,068.43	1,556,000	16,057.13
3		Noodle	21,826	0.24	39.47	2,313.11	2,352.83	42,840	4,618.12
			Sugar	78,634	0.50	238.67	251.50	490.67	190,650
		Vegetable oil & Ghee	122,034	1.16	209.39	6,760.73	6,971.28	194,319	11,100.61
4	Metal		401,378	4.21	392.39	9,093.05	9,489.65	600,000	14,185.61
5	Soap & Chemical		85,407	0.82	188.74	10,036.24	10,225.80	112,000	13,409.79
6	Hotel		3,017	5.85	981.15	964.01	1,951.01	15,021	9,713.67
7	Brick	FC	82,304,400	-	-	6,523.82	6,523.82	3,984,000,000	315,790.04
/		VSBK	2,650,000	-	-	11.54	11.54	16,000,000	69.68
8	Cold Storage		40,720	1.46	106.84	-	108.30	60,900	161.96
							136,938.31		507,247.28

Table 72: Projection of CO2 Saving Potentials

Source: Results of Survey

Thus, for the surveyed industries, the potential CO_2 reduction by pursuing energy efficiency is 136,938 MT and the projected figure for the eight sectors in the country amount to 507,247 MT annually.

12. Conclusions and Recommendations

12.1 Conclusion

Analysis shows that cost of energy is significant portion of the cost of operation or the turnover of the industries. But only a small portion of the industries have energy managers (23 out of 200 or 11.5%). Most units (193 out of 200 or 96.5%) have reported that they are interested to join NEEP activities and 95% are desirous of investing in feasible energy saving measures.

Coal, electricity, diesel, furnace oil and, rice husk are the main fuels used in these sectors of industries. The comparison of the energy cost on the value of product shows that it is the highest for the limestone based cement (47.6%) followed by cold storage (37.91%), bricks other than VSBK (31.51%), pulp & paper (19.83%), and VSBK (14.41%). Sugar has the least value. But this is misleading due to the fact that consumption or use of waste product (Bagasse) is not accounted.

Total transformer capacity connected to the surveyed industries is 207,587 kVA.

For the surveyed 200 industries, the electrical energy saving potential has been estimated at 83,600 MWh and the thermal energy saving potential is 2,230,837 GJ. From the implementation of energy efficiency options, the potential reduction in the generation of Carbon Dioxide is estimated to be 136.938 MT.

Energy efficiency margin or the energy saving potential on the product cost is highest for the Limestone based industry (above 19%). This is followed by cold storage (10.45%), Brick other than VSBK (9.20%), clinker based cement (2.43%) and pulp & paper (1.65%). Cold storage has high efficiency margin due to the reason that product value is only the storage charge in this sector.

The projection of the energy saving for all the industries in the selected eight sectors in the country shows that the potential electrical energy saving is estimated at 156,676 MWh and the thermal energy saving potential at 8,079,920 GJ. Cement, Food and Hotel industries are among the highest potentials of electrical energy saving while brick, cement and food industries have highest thermal energy saving potentials. The total potential energy saving for the eight sector amounts to NPR 6,337 million. The coal has the highest value of potential saving followed by diesel and purchased electricity. The saving potential for electricity is 4.03% of the total sales of electricity by NEA and this figure is 10.55% of the sales of electricity to industrial users. Saving potential for diesel is 2.39% of the sale of diesel by NOC.

From the energy efficiency practice in the eight sectors, the potential saving in the CO_2 generation is estimated to be 507,247 MT. The highest contribution to this reduction can be from the Brick sector (62%) followed by cement (17%) and Food industries (11%).

The sugar mills have a significant amount of cogeneration potentials. This potential for the surveyed industries is estimated to be 11.968 MW and projection of potential cogeneration for the country is 29 MW.

With regards to the brick industries, Moving Chimney Bulls Trench Kilns were banned in the Kathmandu Valley in 2003. As per the decision of the Industrial Promotion Board (IPB) in 2009, such Moving Chimney BTKs are no more allowed to operate from 2011. Fixed Chimney BTK, Tunnel Kiln and Vertical Shaft Brick Kiln (VSBK) are only allowed after environmental assessment (IEE or EIA). Such permitted brick industries have to comply with the emission and chimney height standards as given in section 8.7 a. For any other technology, approval of IPB is required.

12.2 Recommendations

On the basis of the above conclusion and from the first hand experience of the involved consultants, ample opportunities have been observed for the improvements in the use of both electrical as well as thermal energy in all the eight sectors of industries. For enhancing the energy efficiency and to realize the saving potentials as given in the preceding sections, the following recommendations have been made:

- Energy audits must be carried out periodically in all the industries so that opportunities are known and understood 113 out of 200 industries (56.5%) of the visited for the baseline study had not carried out energy audit. The managements of the industries are not well aware of the benefits from the energy audits. Energy audits must be carried out periodically in all the industries so that opportunities are known and understood. The industries need to be encouraged for this. In the long run, a mandatory provision for the energy audits in the enterprises can be imposed.
- *Awareness for the management as well as section chiefs* Awareness level in the industries on energy efficiency is still low in the surveyed industries. Responsible persons must be involved in the awareness programme so that all of them are aware and strive to improve the efficiency. Almost all of the employees must be given short awareness programme.
- Training for the responsible members Main persons relating to energy management must be imparted varying duration of the training in energy efficiency. Such training programmes can be organized by sectors. Supervisor level responsible persons including electricians, mechanics can be given two days of EE training as to what they can do by themselves and engineers (mechanical, chemical and electrical engineers) should be given one week training for energy audit and improvement. Moreover short one day trainings for specific issues can also be held; e.g. electricity load management, boiler and steam system efficiency improvement, kiln efficiency improvement etc.
- **Detailed energy audits of interested industries** Some of the interested and committed industries in each sector of industries should be involved in detailed energy audit. This will give a demonstration for all the other industries on the possibilities. Only highly committed industries should be invited to apply and they also should bear part of the audit cost so that the level of commitment for the implementation is strong. Dissemination of successful implementation of such programmes must be carried out so that other similar sector industries can replicate the improvements.
- Financing for the implementation of energy saving options mobilize financial institutes and banks After the energy audit, the options or the

measures identified must be implemented. For cost bearing measures, investment will be required. At present, medium term financing for capital equipment is not easy for operational industries. Here the banks and financial institutions should be motivated to finance such measures. Initially some soft financing will be highly desirable.

- *Institutionalizing energy audit expertise* The center created at FNCCI should be built capacity to manage EE promotion. Certified energy auditors should be trained and consulting organizations involved should also be assisted to enhance their capacities.
- Focus on best practices and best available technology on energy efficiency – Apart from the energy intensity figures for various sectors, manuals and directives or guidelines for the best practices, Best Available Technology and tips on EE should be prepared sector-wise, published and disseminated.
- *Sector-wise Manual Preparation* bench mark establishment and monitoring For some of the more energy intensive sectors, manual preparation will be desirable especially for Cement, Brick Kilns and cold storage, Iron Re-rolling Mills, Sugar Mills etc.
- *Policy with mandatory periodic energy audits and reporting* Government policy with regards to energy efficiency in industries will be updated and reviewed. Government should also adopt such policies formally and these must be promoted and disseminated. Periodic energy audit should be made mandatory at least once in two years to start with. The reports of such audit and status of implementation should be submitted for monitoring.
- *Involve educational institutions for offer course on EE* Educational institutions especially Institutes of Engineering and Technical and Vocational institutions should include courses on EE. For this, the institutions should be provided support to develop course of study and the instructors should be exposed for teaching of such courses.
- *Competition and award for improvement in EE by sector* Annual competitions on energy efficiency implementation can be organized and award system should be initiated to motivate industries in EE practices.
- *Commitment by Cost Sharing* It is also recommended that the energy audits should not be conducted free of charge to the industries. For getting commitment, ownership and sustainability of activities, willingness to pay must be cultivated in industries by developing cost sharing mechanisms and the fees so collected should be given to FNCCI for their capacity building and promotional activities.
- *Further Studies on Cogeneration* In depth study on co-generation should be carried out in the Pulp & Paper and Beverages sectors besides sugar Mills.

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ESPS Cleaner Production Reports relating to the eight sectors and related sub-sectors

IEMP Energy Audit Reports

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- VSBK & CESEF NEPAL External Review, March 2007 ppt presentation
- NPC study on Energy Consumption & Conservation Potential in Cold Storage of West Bengal, Bureau of Energy Efficiency, India
- WECS, 2010 *Energy Sector Synopsis Report*, Water and Energy Commission Secretariat (WECS), July 2010
- A presentation on Energy Profile and Energy Efficiency Improvement in Indian Hotels by Mr. Pradeep Kumar, Senior Fellow, TERI, New Delhi

14. Annexes

Annex – 1: Terms of Reference of the Assignment



Terms of Reference

Baseline Study of selected Sector Industries to assess the Potential for more efficient use of Energy

1. Background and Framework

Based on the agreement between the Government of Nepal and the Government of Germany in 2008 it was confirmed by both sides to promote the more efficient use of energy in Nepal. Within this context the implementation of the "Nepal Energy Efficiency Programme" (NEEP) has been agreed upon in 2009. This program is to be jointly implemented by the Water and Energy Commission Secretariat (WECS) and the German Agency for International Cooperation (GIZ) over a first phase of four years. Objective of this development program is to promote energy efficiency in households and the industrial sector.

One of the objectives of NEEP is to improve the energy efficiency in the Nepalese industries. The respective component of NEEP draws on results achieved by the 'Environment Sector Programme Support (ESPS)', which was a bilateral program between the Government of Nepal and the Government of Denmark (DANIDA).

In response to NEEP a private sector initiative established an Energy Efficiency Centre (EEC) under the umbrella of the Federation of Nepalese Chambers of Commerce and Industry (FNCCI). NEEP cooperates closely with the EEC/FNCCI and other institutions in the implementation of NEEP to enable and support a sustainable institutional development that will provide long term services to the industry.

The support of GIZ/EEC/FNCCI through NEEP to the industry comprise of awareness raising for energy efficiency within the Nepalese industries, the promotion of energy auditing and other energy efficiency services. By this means qualified technical experts will be available to industrial enterprises and banks to support entrepreneurs in the planning, implementation and financing of energy efficiency measures.

2. OBJECTIVE OF ASSIGNMENT

The objective of this Assignment TOR is to conduct a baseline study on energy supply/use of representative industries from each eight energy intensive target industrial sectors. The purpose of this assignment is to acquire/update information on the energy utilization by industrial sectors and opportunities for its efficient use.

3. SCOPE OF WORK

The scope of work of this assignment consists of:

Industry sectors to be covered by the study:

- 1. Cement production
- 2. Pulp & paper production
- 3. Food (sugar, food and food processing, veg oil & ghee, beverages etc)
- 4. Metal (Iron & steel etc.) processing
- 5. Soap, chemical & allied products
- 6. Hotels
- 7. Brick production
- 8. Cold storages

- Review and update studies on energy supplies and use by sectors.
- Review previous energy utilization reports on sector.
- Review audit reports produced under ESPS to identify major energy efficiency potentials (electricity and thermal) for the respective industry sectors.
- Review reports on SARRC countries level to identify major energy efficiency potentials (electricity and thermal) for the respective industry sectors.
- Carry out walkthrough energy utilization survey collecting present thermal and electrical energy generation and utilization practices focusing on major energy consuming equipments or systems from the point of view of reducing energy consumption or improving the efficiency of the said equipment or system.
- Collect information on annual energy supply/use both thermal and electrical and assess opportunities for improvement
- Analyze energy intensity (by primary energy sources) per unit product of the respective industries and estimate energy cost and CO2 emission per unit product.
- Prepare process flow diagram where applicable focused on energy use
- Cross check with national energy import and supply data
- Regards Brick Industries,
 - investigate if industries are already going for technology change
 - study government statutory directives if any(already in place/ under draft phase) particular technology will have to be phased out within the next years and forecast change future scenario
 - Study government statutory directives regards shifting of Brick Industries to remote places (away from cities) within the next years and effect thereof.
- Regards Sugar Industries
 - Investigate if there can be surplus power generation with existing turbine/HP turbine installed and possibility of such additional generation to be fed to national grid etc.

4. METHODOLOGY

The consulting company shall use an appropriate methodology to visit/review 200 industries with a relevant share to national production, but not limited to:

- 1. Review existing energy utilization report on the sector,
- 2. Identification of the key energy data requirement and data source both thermal and electrical for the baseline study
- 3. Prepare study methodology comprising sector specific check lists
- 4. Present and discuss methodology with GIZ and EEC/FNCCI for necessary comments and suggestions.
- 5. Select industries/companies for approx 200 visits so that selected companies represent at least 50 % share of production (last 2 fiscal years) of the respective industry sector.

- 6. Inform and secure cooperation of the sector associations and district chambers through EEC/FNCCI
- 7. Carry out industry visits
 - a. Information on NEEP process and opportunities for the industries
 - b. walkthrough for observation, interaction and information collection
 - c. identify energy managers in Industries, if any
 - d. propose to nominate focal persons/energy managers if company is interested to participate in NEEP activities
 - e. Conduct consultation meeting with production- and top management to collect inputs on issues and energy efficiency opportunity in the sector

5. EXPECTED OUTPUT

The following outputs are expected from this assignment for the specified industry sectors:

- 1. Baseline information on the industry sector to be used for the detailed energy auditing of the industry:
 - a. Complete list of industries of the respective 8 sectors with name of company, location (district),
 - b. Contribution of the industry sector to GDP, primary energy consumption by source and CO2 emission by source.
- 2. List of visited (walkthrough & management interviews) industries with name of company, location (district), and persons interviewed:
 - a) characterizing (last 2 fiscal years) annual turnover, production, production capacity, production share to the sector,
 - Analyze energy intensity of production (by primary energy sources) per unit product of the respective industries and estimate energy cost and CO2 emission per unit product.
 - c) Report on autoproducer electricity production (diesel generators and its fuel consumption to keep production operational)
 - d) Report company specific on:
 - o availability of energy manager or focal person for further energy activities
 - o commitment of management and owner to energy efficiency issues
 - o commitment of management and owner to comply with environmental standards
 - interest to participate in further NEEP activities to invest in feasible energy efficiency technologies /good housekeeping
 - e) Quality aspects of products and production; companies certified in ISO 14001 and ISO 9001.
 - Based on sector specific efficiency potentials estimate efficiency margins for annual production for regional available technologies in MWh (electricity), GJ (thermal by source), % of unit production cost.
- 3. Summarizing 5.1 and 5.2. baseline information leading to potential savings on national level for primary energy sources, effects on import savings, macroeconomic savings and CO2 mitigation.

6. REPORTING REQUIREMENTS

The consulting company may report to GIZ and EEC/FNCCI the progress of work during the different stages. However, in order to meet the objectives of the study, there would be three stages of reporting:

- 1. Inception study to discuss approach and methodology with GIZ and EEC/FNCCI within 2 weeks from the date of contract signing.
- 2. **Draft report review:** The consulting company shall submit three copies of draft report within **ten weeks** from the date of contract signing. The draft report shall contain data/information collected along with the finding from the field work. The consultant should, if necessary, present the draft findings in an interaction session to be organized by GIZ and EEC/FNCCI to get comments and suggestions for finalization of the report.
- 3. Final report:

The final baseline survey report including detail description of survey and information collection methods shall be delivered in 5 print copies, 1 MS-Word file of the report; excel sheets of all relevant calculations to GIZ within **twelve weeks** from date of contract signing.

The consulting company incorporates all the comments and suggestion of GIZ EEC/FNCCI draft report review.

7. Core Team Composition

The consulting firm shall propose up to 4 professional teams that survey the different industry sectors having strong practical experience of industrial energy auditing. Each team shall consist of:

- **Thermal Expert** (one person): Should have minimum bachelor degree in mechanical engineering with 5 years work experience in industrial energy management field particularly in thermal sector. Master degree in engineering, or environmental management or any other field could be an added advantage.
- Electrical Expert (one person): Should have minimum bachelor degree in electrical engineering with 5 years work experience in industrial energy management field particularly in electrical sector. Master degree in engineering, or environmental management or any other field could be an added advantage.

8. Duration

The duration of this assignment will be twelve weeks from the date of contract. The exact timing shall be fixed during the Contract Agreement between GIZ and the consulting company.

Annex – 2: Complete List of Industries

A. List of Cement Industries

S. No.	Name of Industry	District		
1	Agni Cement Industries	Rupandehi		
2	Aarghakhanchi Cement Pvt. Ltd.	Ltd. Rupandehi		
3	Aarghakhanchi Cement Pvt. Ltd.(Birpur Unit)	Kapilbastu		
4	Ambe Cement Pvt. Ltd.	Bara		
5	Bijay Cement Udhyog Pvt. Ltd.	Banke		
6	Brij Cement In. Pvt. Ltd.	Rupandehi		
7	Buddha Cement Pvt. Ltd.	Kapilbastu		
8	Butwal Cement Mills Pvt. Ltd.	Nawalparasi		
9	Chitwan Cement Pvt. Ltd.	Nawalparasi		
10	Cosmos Cement Industries Pvt. Ltd.	Dhanusha		
11	Goenka Cement Pvt. Ltd.	Rupandehi		
12	Gorakhkali Cement Udhyog Pvt. Ltd.	Jhapa		
13	Hetauda Cement Ind. Ltd.	Makwanpur		
14	Himalaya Cement Pvt. Ltd.	Jhapa		
15	Jagadamba Cement Ind. Pvt. Ltd.	Rupandehi		
16	Jay Mangalam Cement Pvt. Ltd.	Banke		
17	Krishna Cement Company Pvt. Ltd.	Parsa		
18	Manosha cement Ind. Pvt. Ltd. Jhapa			
19	Maruti Cement Ltd.	Siraha		
20	Mittal Cement Ind. (P) Ltd.	Jhapa		
21	Narayani Cement Udhyog Pvt. Ltd.	Parsa		
22	Nepal Ambuja Cement Udhyog Pvt. Ltd.	Rupandehi		
23	Nepal Shalimar Cement Pvt. Ltd.	Bara		
24	Nirman Cement Mills Pvt. Ltd.	Rupandehi		
25	Nligale Cement Pvt. Ltd.	Dhankuta		
26	Om Cement Pvt. Ltd.	Chitwan		
27	Pashupati Cement Pvt. Ltd.	Kapilbastu		
28	Reliance Cement Pvt. Ltd.	Rupandehi		
29	Shivam Cement Ind. Makwanpur			
30	Shree Cement Ind. Pvt. Ltd	Parsa		
31	Star Cement Udhyog Pvt. Ltd.	Parsa		
32	Supreme Cement Pvt. Ltd.	Rupandehi		
33	Udaypur Cement Industries Ltd.	Udaypur		
34	Vijaya Cement Pvt. Ltd	Kapilbastu		
35	Vishwokarma Cement Pvt. Ltd.	Parsa		

S. N.	Name of Industry	District	
1	Arbind Pulp & Paper Pvt. Ltd.	Sunsari	
2	Baba Paper Mill Pvt. Ltd.	Sunsari	
3	Everest Paper Mills Pvt. Ltd.	Dhanusha	
4	M.K. Paper Mills Pvt. Ltd.	Nawalparasi	
5	Reliance Paper Mills Pvt. Ltd.	Rupandehi	
6	Bhrikuti Pulp and Paper Nepal Ltd.	Gaidakot, Nawalparasi	closed for more than 1 year
7	Baba Cardboard	Duwakot, Bhaktapur	_

B. List of Pulp & Paper Industries

C. List of Food Industries

S. No.	Name of Industry	District
1	Asian Distillery Pvt. Ltd	Parsa
2	Bahini Beverages	Parsa
3	Bottlers Nepal Limited	Kathmandu
4	Bottlers Nepal Terai Ltd.	Chitwan
5	C.M. Aqua Beverage	Sunsari
6	Chandika Distillery Pvt.Ltd.	Morang
7	Chhinnamasta Distillery Pvt. Ltd.	Dhanusha
8	Dabur Nepal Pvt. Ltd.	Bara
9	Dugar Food and beverage	Kathmandu
10	Golden Glove Liquors Pvt.Ltd.	Morang
11	Gorkha Bruawary	Nawalparasi
12	Himalayan Brewery Ltd.	Lalitpur
13	Himalayan Distrilari Ltd.	Parsa
14	J. B. S. Industries	Sunsari
15	Karnali Distillery Pvt.Ltd.	Banke
16	Makalu Wine Industry	Sankhuwashabha
17	Nepal Distilary Pvt.Ltd.	Kathmandu
18	Nilgiri Distilary	Mustang
19	Om Distilary	Nawalparasi
20	Pradhan Mineral Water And Beverage	Chitwan
21	Purbanchal Distillary Pvt.Ltd.	Sunsari
22	Rijal Tashi Industries Pvt. Ltd.	Sunsari
23	Sarada Distillary Pvt. Ltd.	Siraha
24	Shreeram Laxmi Distilary	Mustang
25	Sumi Distillary	Kapilbastu
26	Sungold Bruwari (Nepal) Pvt.Ltd.	Nawalparasi
27	Trishakti Distilari Pvt.Ltd.	Lalitpur
28	Tukuche Distilary	Mustang
29	Udyapur Distilari Pvt.Ltd.	Parsa
30	United Brewery Pvt. Ltd.	Makwanpur
31	United Sprits Nepal Pvt. Ltd.	Morang
32	Valley Food Product	Sunsari
33	Varun Beverage Pvt. Ltd.	Kathmandu
34	Wonder Products Of Nepal	Sunsari

I. Beverage Industries

II. Biscuit Industries

S. No.	Name of Industry	District
1	Ananda Biscuits Company	Rupandehi
2	Antartic Biscuits Pvt. Ltd.	Makwanpur
3	Balaji Biscuits Industries Pvt.Ltd.	Banke
4	Bhagawati Biscuit Pvt.Ltd.	Kaski
5	Bobby Biscuits Udhyog	Morang
6	Chutari Food & Confectionary Ind.	Sunsari
7	Gokul Diet Food Ind. Pvt. Ltd.	Morang
8	Hulas Biscuit And Confectionary Pvt.Ltd.	Parsa
9	Khajurico Nepal Pvt.Ltd.	Kathmandu
10	Krishna Pauroti Tatha Biscuits Udhyog	Surkhet
11	Makawanpur Biscuits Pvt.Ltd.	Makwanpur
12	Mohan Biscuits Udhyog	Dhankuta
13	Nebico Pvt. Ltd.	Kathmandu
14	Pashupati Biscuit Ind. Pvt. Ltd.	Sunsari
15	Pokhara Food Pvt. Ltd.	Kaski
16	Shiv Shanker Biscuit Ind. Pvt.Ltd	Kaski

III. Dairy Industries

S. No.	Name of Industry	District
1	Adhunik Dairy Product	Kathmandu
2	Baglung Dugda Utpadak Sahakari Sangh	Baglung
3	Bhaktapur Dairy Pvt.Ltd.	Bhaktapur
4	Bijaya Dudh Utpadak Sahakari Sanstha L.	Chitwan
5	Binni Foods Industries Pvt.Ltd.	Lalitpur
6	Biratnagar Milk Supply Scheme	Morang
7	Brindaban Dairy Pvt.Ltd.	Parsa
8	Cheese Utpadan Kendra	Rasuwa
9	Dairy Development Corporation	Kathmandu
10	Dharan Dairy Food Products	Sunsari
11	Dolakha Milk Industries Ltd.	Dolakha
12	Dugda Padartha Utpadan & Bikri Bitaran	Makwanpur
13	Ekikrit Dugdha Tatha Krishi Utpadan Ltd	Kavrepalanchowk
14	Ghedung Bahuudesiya Sahakari Sanstha	Panchthar
15	Gopal Dairiy Pvt. Ltd.	Parsa
16	Gourishankar Dairy Firm	Dolakha
17	Hetauda Dairy Industries Pvt.Ltd.	Makwanpur
18	Hetauda Milk Supply Scheme	Makwanpur
19	Jilla Dugda Utpadak Sahakari Sangh	Palpa
20	Kalaiya Dairy Center	Bara
21	Kamadhenu Dairy Udhyog Pvt.Ltd.	Kaski

S. No.	Name of Industry	District
	Kamdhenu Dairy & Development Co-Operative	
22	Ltd.	Sunsari
23	Kathmandu Dairy Pvt.Ltd.	Kathmandu
24	Maitri Dugdha Prashodhan Kendra	Gulmi
25	Milan Dairy Udhyog	Saptari
26	Nepal Dairy Pvt. Ltd.	Lalitpur
27	Novel Dairy Pvt. Ltd.	Morang
28	Pabitra Dairy Udhyog	Rupandehi
29	Panthi Dairy Pvt. Ltd	Kaski
30	Pathibhara Yak Cheese Dairy Udhyog	Ramechhap
31	Ramjanaki Dairy Udhyog	Kaski
32	Shree Ganesh Dairy Udhyog	Morang
33	Shreeram Janaki Dairy Udhyog	Sunsari
34	Sitaram Gokul Milks Ktm. Ltd.	Kathmandu
35	Sujal Dairy Pvt. Ltd.	Kaski
36	Tanahu Dugdha Utpadak Sahakari Sangh	Tanahu
37	Umadiva Mahalangur Yak Cheese Dairy	Ramechhap

IV. Instant Noodle Industries

S. No.	Name of Industry	Address
1	Bajarangabali Noodles	Sunsari
2	Himalayan Snacks And Noodles Industry	Kathmandu
3	Baishano Debi Noodles Industries	Rupandehi
4	Bibek Sweet And Noodles Industries	Surkhet
5	Asian Thai Foods (P). Ltd.	Sunsari
6	C.G. Foods Nepal Pvt. Ltd	Lalitpur
7	Him-Shree Foods Pvt. Ltd.	Kaski
8	Pokhara Noodles pvt. Ltd.	Kaski

V. Sugar Industries

S. No.	Name of Industry	Address
1	Eastern Sugar Mills Pvt. Ltd.	Sunsari
2	Everest Sugar & Chemical Ind. Pvt. Ltd	Mahotari
3	Indira Sugar And Agro Ind. Pvt. Ltd.	Nawalparasi
4	Indu Shankar Chini Udhyog Ltd.	Sarlahi
5	Lumbini Sugar Ind. Pvt. Ltd.	Nawalparasi
6	Mamkur Sugar & Chemical Industry Pvt.Ltd	Parsa
7	Om Laxman Sugar And Agro Company Pvt. Ltd.	Parsa
8	Shree Mahalaxmi Sugars Limited	Kapilbastu
9	Shree Ram Sugar Mills Limited	Rautahat
VI. Vegetable Oil & Ghee Industries

S. No.	Name of Industry	Address
1	Aarati Vegetable Pro. Pvt. Ltd.	Parsa
2	Adarsh Oil Industries	Parsa
3	Annapurna Vegetable Product Pvt. Ldt	Bara
4	Baba Vegetable Oil Industries Pvt. Ltd.	Morang
5	Bagmati Oil Industries	Morang
6	Bindha Basini Oil Mills	Chitwan
7	Dinesh Oil Industries Pvt. Ltd.	Kailali
8	Durga Modern Oil Mills	Morang
9	Everest Oil Industries	Morang
10	Ganapati Oil And General Mills	Dang
11	Gandaki Oil Mill Pvt.Ltd.	Kaski
12	Ganapati Vanaspati Pvt. Ltd	Bara
13	Grihalaxmi Gharelu Adhunik Tel Udhyog	Sunsari
14	Hanuman Aadhunik Khadya Tel Udhyog	Parsa
15	Krishna Oil Refinary & Veg.Ghee Ind.Pvt.Ltd.	Parsa
16	Manokamana Vegetable Ghee And Oil Ind.	Morang
17	Nandan Ghee And Oil Industries Pvt. Ltd.	Parsa
18	Narayani Oil Refinary Udhyog Pvt.Ltd.	Parsa
19	Nidhi Oil Industries	Bara
20	Nirvan Vanaspati Udhyog Pvt. Ltd.	Kathmandu
21	Pashupati Khadhya Tel Udhyog Pvt. Ltd.	Sunsari
22	Radhakrishna Oil Mills	Morang
23	Raunak Adhunik Tel Udhyog	Rupandehi
24	Ruchi Khaddya Tel Udhyog	Morang
25	Saurabh Oil Mill	Banke
26	Shree Krishna Oil Refinery Veg. Ind Pvt. Ltd	Parsa
27	Shree Ram Refine Oil Product Pvt. Ltd	Morang
28	Shree Shiv Shakti Ghee Udyog Pvt. Ltd	Bara
29	Shreeram Oil Mills	Kailali
30	Siddhartha Oil Industries	Rupandehi
31	Sushil Vanaspati Pvt. Ltd	Parsa
32	Swastik Oil Industries	Morang
<u>3</u> 3	Tulsi Tel Mills	Dang

D. List of Metal industries

S. No.	Name of Industry	Address
1	Aarati Strips (P) Ltd.	Morang
2	Agrani Almunium	Parsa
3	Agro Engineering Works Pvt.Ltd.	Nawalparasi
4	Altech Pvt.Ltd.	Kathmandu
5	Annapurna Aluminium Industry	Lalitpur
6	Ashesh Metal Industry	Lalitpur
7	Ashok Steel Ind. Pvt. Ltd.	Parsa
8	B.A.C.Metal Workshop	Kaski
9	Bageshwori Iron & Steel Pvt. Ltd.	Banke
10	Balaju Yentrashala Pvt.Ltd.	Kathmandu
11	Bandana Steel. Pvt. Ltd.	Bara
12	Bansal Nepal Pvt. Ltd.	Sunsari
13	Bhagabati Steel Industries	Parsa
14	Bhagawati Rolling Nails Pvt . Ltd	Bara
15	Chandra Metal Udhyog	Kaski
16	Diamond Steel Industries	Sunsari
17	Everest Auto Works Pvt. Ltd.	Chitwan
18	Everest Rolling Industires Pvt. Ltd.	Rupandehi
19	Galaxy Engineering & Energy Development	Baglung
20	Goenka Steels Pvt. Ltd.	Rupandehi
21	Hama Iron & Steel Industry Pvt.Ltd.	Parsa
22	Hanuman Metal Pvt. Ltd.	Bara
23	Hilton Wrougmt Iron And Eng.Ind.	Kaski
24	Himal Iron & Steel Pvt.Ltd.	Parsa
25	Himal Wires Pvt.Ltd.	Parsa
26	Hulas Wire Industries Limited	Sunsari
27	Hulash Steel Industries Ltd.	Parsa
28	Intertek Pvt. Ltd.	Nawalparasi
29	Jagadamba Steel Pvt. Ltd.	Bara
30	Jai Nepal Auto Industry Pvt.Ltd.	Kathmandu
31	Jaya Bageswori Metal Udhyog	Kailali
32	Jaya Mata Di Iron Ind.	Parsa
33	Junkiri Industries Pvt.Ltd.	Nawalparasi
34	Kamala Rolling Mills Pvt. Ltd.	Morang
35	Kb-Sam Aluminium Ind. Pvt.Ltd.	Parsa
36	Kohinoor Metal Udhyog	Nawalparasi
37	Krishna Engineering Industries	Sunsari
38	Kuber Metal Industries	Kathmandu
39	Laxmi Steels (P) Ltd.	Nawalparasi
40	Machhapuchhre Metal And Machinary	Kaski
41	Mainawati Steel Industries Pvt.Ltd.	Sunsari
42	Maruti Nandan Rolling Mills Pvt. Ltd.	Parsa
43	Muktinath Wood Iron And Aluminium Ind.	Lalitpur
44	Narayani Rolling Mills Pvt. Ltd.	Parsa
45	National Steel Industry	Parsa

S. No.	Name of Industry	Address
46	Nepal Hydro And Electric Limmited	Nawalparasi
47	Nepal Structure And Engineering Pvt.Ltd	Lalitpur
48	Panchakanya Steel Pvt. Ltd.	Rupandehi
49	Pashupati Iron & Steel Pvt. Ltd.	Sunsari
50	Pashupati Tube Mills Pvt.Ltd.	Morang
51	Pathibhara Iron Works Shop	Morang
52	Pioneer Wire Ind. Pvt. Ltd.	Morang
53	Premier Wires Pvt. Ltd.	Sunsari
54	Radha Structure & Engineering Pvt. Ltd.	Bhaktapur
55	Rajesh Metal Crafts Ltd.	Bara
56	Ranjit Gharelu Metal Industries	Kaski
57	Rb Metal Industries	Dailekh
58	Sakha Steel Ind. Pvt.Ltd.	Parsa
59	Shree Krishna Steel Industries Pvt. Ltd.	Parsa
60	Sun Ind. Pvt. Ltd.	Parsa
61	Sundar Wires And Nails	Parsa
62	Thongnagawa Iron Factory	Lalitpur
63	Urgan Steel Industry	Kathmandu
64	Yojana Metal Udhyog	Kailali

S. No.	Name of Industry	Address
1	Arati Soap & Chemical Ind. Pvt. Ltd	Bara
2	Baba Soap Ind. Pvt. Ltd.	Morang
3	Bajaj Perfumari Udhyog	Morang
4	Balajee Soap And Chemical Industries	Morang
5	Bhagwati Soap Ind. Pvt. Ltd.	Morang
6	Colgate Palmolive (Nepal) Pvt. Ltd.	Chitwan
7	Dibya Herbal Product	Bhaktapur
8	Ganga Soap & Chemical Ind.	Makwanpur
9	Golden Stra Soap Ind.	Morang
10	Himal Perfumary And Chemicals	Parsa
11	Himgiri Soap & Chemical Ind. Pvt. Ltd.	Morang
12	J. K. Soap & Chemical Pvt. Ltd.	Rupandehi
13	Mahabir Soap Ind.	Parsa
14	Mahakali Oleo Chemical Pvt. Ltd.	Rupandehi
15	Mahalaxmi Soap & Chemical Ind.	Makwanpur
16	Mahavir Soap Industry	Parsa
17	Megha Soap & Chemical Ind Pvt. Ltd	Bara
18	Moti Soap & Chemical Ind.	Morang
19	Narayan Soap And Chemicals	Nawalparasi
20	Narayani Chemical & Perfumory Works Pvt. Ltd	Parsa
21	National Soap & Chemical Ind.	Makwanpur
22	Nepal Chemical & Soap Ind. Pvt. Ltd.	Parsa
23	Poudyal Perfumery Products	Morang
24	Puja Soap & Chemical Ind Pvt. Ltd	Bara
25	Quality Soap & Chemical Ind.Pvt.Ltd.	Morang
26	Sagarmatha Sabun Udhyog	Morang
27	Shivshakti Soap Industries	Rupandehi
28	Shree Agarbatti	Parsa
29	Shree Himgiri Soap And Chemical Industry	Morang
30	Shree Raj Soap Industry	Morang
31	Shrestha And Son Perfium Work	Morang
32	Star Soap And Chemical Industries	Morang
33	Sushil Soap & Chemical Ind Pvt. ltd	Parsa
34	Suvakamana Sabuna Udhyog	Kathmandu
35	Swadeshi Sabun Udhyog Pvt. Ltd.	Sunsari
36	Unik Soap And Chemical Industries	Makwanpur
37	Unilever Nepal Ltd.	Makwanpur
38	Unique Soap & Chemical Ind.	Makwanpur

E. List of Soap and Chemical Industries

S. No.	Name of Hotel	District
1	Acme Guest House	Kathmandu
2	Aloha Inn	Lalitpur
3	Amar Hotel	Kathmandu
4	Ambassdor Hotel	Kathmandu
5	Annapurna Guest House	Kathmandu
6	Arniko Village Resort Pvt Ltd.	Kathmandu
7	Baghmara Wildlife Resort	Chitwan
8	Base Camp Resort	Kaski
9	Café De Patan	Lalitpur
10	Chitwan Adventure Resort	Chitwan
11	Chitwan Jungle Lodge	Chitwan
12	Chitwan Paradise Resort	Chitwan
13	Club Himalaya Nagarkot Resort	Lalitpur
14	Dhulikhel Lodge Resort	Kavrepalanchok
15	Dhulikhel Mount Resort	Kavrepalanchok
16	Dwarikas Hotel	Kathmandu
17	Fishtail Lodge	Kaski
18	Gaida Wildlife Camp Pvt. Ltd.	Chitwan
19	Godavari Village Resort	Kathmandu
20	Grand Hotel	Kathmandu
21	Himalayan Height Resort	Kathmandu
22	Himalayan Horizon Hotel Sun-n-snow Pvt. Ltd.	Kavrepalanchok
23	Hira Plaza	Parsa
24	Hotel Amadablam	Kathmandu
25	Hotel Ambassador	Kathmandu
26	Hotel Anand	Kaski
27	Hotel Ashoka Pvt. Ltd.	Kathmandu
28	Hotel Barahi	Kaski
29	Hotel Blue Diamond	Kathmandu
30	Hotel Blue Horizon	Kathmandu
31	Hotel Centre Point	Kathmandu
32	Hotel Clarion Pvt. Ltd.	Lalitpur
33	Hotel Classic Pvt. Ltd.	Kathmandu
34	Hotel Country Villa Pvt. Ltd.	Bhaktapur
35	Hotel Courtyard	Kathmandu
36	Hotel Daniel Pvt. Ltd.	Jhapa
37	Hotel De'l Annapurna Pvt. Ltd.	Kathmandu
38	Hotel Diplomat Pvt. Ltd.	Kathmandu
39	Hotel Diyalo Pvt Ltd	Parsa
40	Hotel Eastern Star Pvt. Ltd.	Morang
41	Hotel Elite Pvt. Ltd.	Kathmandu
42	Hotel Encounter Nepal	Kathmandu
43	Hotel Excelsior Pvt. Ltd.	Kathmandu
44	Hotel Fewa Prince Pvt. Ltd.	Kaski
45	Hotel Ganesh Himal	Kathmandu

F. List of Hotels

S. No.	Name of Hotel	District
46	Hotel Gangjong Pvt. Ltd.	Kathmandu
47	Hotel Gautam	Kathmandu
48	Hotel Greenwich Village	Lalitpur
49	Hotel Harati	Kathmandu
50	Hotel Heaven Grand Pvt. Ltd.	Jhapa
51	Hotel Himalaya	Lalitpur
52	Hotel Holiday Taj	Kathmandu
53	Hotel Holy Heaven	Kaski
54	Hotel Horizon	Kathmandu
55	Hotel Hungry Eye	Kaski
56	Hotel Impala Pvt. Ltd.	Kathmandu
57	Hotel Jagat	Kathmandu
58	Hotel Kailash	Parsa
59	Hotel Kamal	Kathmandu
60	Hotel Karma	Kathmandu
61	Hotel Kido House Pvt. Ltd.	Kathmandu
62	Hotel Landmark Pokhara	Kaski
63	Hotel Lion	Kathmandu
64	Hotel Lucky Star Pvt. Ltd.	Kathmandu
65	Hotel Lumbini Garden New Crystal Pvt. Ltd.	Rupandehi
66	Hotel Maharaja Palace	Kathmandu
67	Hotel Makalu Pvt. Ltd.	Parsa
68	Hotel Manang	Kathmandu
69	Hotel Manaslu	Kathmandu
70	Hotel Mandap	Kathmandu
71	Hotel Marshyangdi Pvt. Ltd.	Kathmandu
72	Hotel Metropoliton Kantipur Pvt. Ltd.	Kathmandu
73	Hotel Monalisa	Kaski
74	Hotel Moonlight	Kathmandu
75	Hotel Mount Annapurna	Kaski
76	Hotel Mountain Pvt. Ltd.	Kathmandu
77	Hotel Mustng Holiday Inn	Kathmandu
78	Hotel Namaskar	Morang
79	Hotel Nature Pvt. Ltd.	Kathmandu
80	Hotel Nepa International	Kathmandu
81	Hotel Nirvana	Rupandehi
82	Hotel Norbu Linka	Kathmandu
83	Hotel Norbu Sangpo	Kathmandu
84	Hotel Norling Pvt. Ltd.	Kathmandu
85	Hotel Northfield Pvt. Ltd.	Kathmandu
86	Hotel Ocean	Kathmandu
87	Hotel Orchid Pvt. Ltd.	Kathmandu
88	Hotel Paradise Plaza	Kathmandu
89	Hotel Pawan International	Rupandehi
90	Hotel Phewa Prince	Kaski
91	Hotel Planet Pvt. Ltd.	Kathmandu

S. No.	Name of Hotel	District
92	Hotel Pokhara Grade	Kaski
93	Hotel Poon Hill	Kathmandu
94	Hotel Ratna	Morang
95	Hotel samjhana	Parsa
96	Hotel Sangri-la	Kathmandu
97	Hotel Seema	Makwanpur
98	Hotel Seven Corner Pvt. Ltd.	Kathmandu
99	Hotel Shahanshah Intl.	Kathmandu
100	Hotel Shakti Pvt. Ltd.	Kathmandu
101	Hotel Shree Jagadamba	Kailali
102	Hotel Shree Tibet	Kathmandu
103	Hotel Sneha Pvt. Ltd.	Banke
104	Hotel Snowland	Kaski
105	Hotel Sunset View Pvt. Ltd.	Kathmandu
106	Hotel Swagatam	Morang
107	Hotel Tashi Dhargey Pvt. Ltd.	Kathmandu
108	Hotel Tayoma	Kathmandu
109	Hotel Tenki	Kathmandu
110	Hotel Thamel	Kathmandu
111	Hotel The Kantipur	Kaski
112	Hotel Tibet Pvt. Ltd.	Kathmandu
113	Hotel Tradition Pvt. Ltd.	Kathmandu
114	Hotel Trek-o-tel	Kaski
115	Hotel Utse Pvt. Ltd.	Kathmandu
116	Hotel Vaishali	Kathmandu
117	Hotel Vajra	Kathmandu
118	Hotel Valley View	Kathmandu
119	Hotel View Bhrikuti	Lalitpur
120	Hotel Vishuwa	Parsa
121	Hotel Xenial	Morang
122	Hotel Yak & Yeti	Kathmandu
123	Hotel Yanki	Kathmandu
124	Hyatt Regency	Kathmandu
125	International Guest House	Kathmandu
126	Island Jungle Resort	Chitwan
127	Jomsom Mountain Resort	Mustang
128	Kantipur Temple House	Kathmandu
129	Kathmandu Guest House Pvt. Ltd.	Kathmandu
130	Kathmandu Prince Hotel	Kathmandu
131	Khangri Resort	Solukhumbu
132	Khangsar Guest House	Kathmandu
133	Khusi Khusi Hotel	Kathmandu
134	Kongde Hotel	Solukhumbu
135	Kongde View Resort	Solukhumbu
136	Lama Intl. Guest House	Kathmandu
137	Le Meridien Kathmandu Gokarna Forest Golf Resort & Spa	Kathmandu

S. No.	Name of Hotel	District
138	Lumbini Hokke Hotel	Rupandehi
139	Machan Paradise View	Chitwan
140	Machan Wildlife Resort	Chitwan
141	Madhuban Guest House	Kathmandu
142	Marcopolo Business Hotel	Kathmandu
143	Mirabel Resort Hotel Pvt. Ltd.	Kavrepalanchok
144	Motel Avocado & Orchid Resort	Makwanpur
145	Mt. Annapurna Guest House	Kathmandu
146	Mums Garden Resort Pvt. Ltd.	Kaski
147	Nagarkot Cottage	Bhaktapur
148	New Hotel Crystal Pokhara Pvt. Ltd.	Kaski
149	Nirvana Garden Hotel	Kathmandu
150	Pal Rabten Khangsar Guest House Pvt. 1Td.	Kathmandu
151	Pancha Pandav Guest House	Kathmandu
152	Park Village Resort And Spa	Bhaktapur
153	Pension Vansa Guest House	Kathmandu
154	Pilgrims Guest House	Kathmandu
155	Potala Guest House	Kathmandu
156	Potala Tourism Home	Kathmandu
157	Radission Hotel	Kathmandu
158	Riverside Springs Resort	Chitwan
159	Royal Park Hotel	Chitwan
160	Royal Singi Hotel	Kathmandu
161	Safari Adventure Lodge	Chitwan
162	Samsara Resort (Hotel)	Kathmandu
163	Sangri-la Village Resort	Kaski
164	Siesta House Pvt. Ltd.	Kathmandu
165	Soaltee Crown Plaza	Kathmandu
166	Souvenir Guest House	Kathmandu
167	Sukeyasu Hotel Pvt. Ltd.	Kathmandu
168	Summit Hotel	Lalitpur
169	Syangboche Panorama Resort	Solukhumbu
170	Tara Gaon Resort	Bhaktapur
171	Temple Tiger Jungle Lodge & Resort	Chitwan
172	The Dwaika's Himalayan Sangri-la Village Resort	Kavrepalanchok
173	The Dwarika's Hotel	Kathmandu
174	The Everest Hotel	Kathmandu
175	The Fort Resort	Bhaktapur
176	The Fulbari Resort	Kaski
177	The Garden Hotel Pvt. Ltd.	Kathmandu
178	The Malla Hotel	Kathmandu
179	The Shankar Hotel	Kathmandu
180	Thorong Guest House	Kathmandu
181	Tibet Guest House	Kathmandu
182	Tibet Peace Guest House	Kathmandu
183	Tiger Tops Jungle Lodge	Kathmandu

S. No.	Name of Hotel	District
184	Tirupati Holiday Inn	Kathmandu
185	Top Of The World Pvt. Ltd.	Kathmandu
186	Valley Inn Pvt. Ltd.	Kathmandu
187	Welcome Guest House Pvt. Ltd.	Kathmandu
188	Wind In Nepal Pvt. Ltd	Kaski

G. List of Brick Industries

S. No.	Name of Industry	Address
1	Mahalaxmi Chimni Bhatta Udhyog	Baglung
2	Ganga Chimni Intta Udhyog	Banke
3	Abdul Majid Khan Intta Bhatta	Banke
4	Bageshowari Intta Udhyog Pvt. Ltd.	Banke
5	Chand Intta Bhatta Udhyog	Banke
6	Chartara Intta Bhatta Udhyog	Banke
7	Durga Intta Bhatta	Banke
8	Jay Bageshwori Paschimanchal Itta & tile Factory P. Ltd.	Banke
9	New Kisan Intta Udhyog	Banke
10	Shradhha Intta Bhatta Udhyog	Banke
11	Meraj Intta Bhatta Udhyog	Banke
12	Khadka Intabhatta Udhyog	Banke
13	Malla Intta Bhata Udhyog	Banke
14	Ram Intta Bhatta Udhyog	Banke
15	Samshul Intta Bhatta Udhyog	Banke
16	Phakir Intta Bhatta	Banke
17	Khadka Tile And Intta Udhyog	Banke
18	Pashupati Intta Udhyog	Banke
19	Pathak Intta Bhatta Udgyog	Banke
20	Naba Durga Intta Udhyog Pvt.Ltd.	Banke
21	Jaynepal Intta Bhatta Udhyog	Banke
22	Jay Nepal Intta Udhyog	Banke
23	Ramcharan B.C. Intta Udhyog	Banke
24	Khan Intta Udhyog	Banke
25	Guras Intta Udhyog	Banke
26	Ramshankar Madhabdas Intta Udhyog Pvt.Ltd	Banke
27	Manakamana Tile Udhyog	Banke
28	Shibashakti Jaisawal Intta Udhyog	Banke
29	Guddu Intta Bhatta Udgyog	Banke
30	Janta Intta Udhyog	Banke
31	Kisan Intta Bhata Udhyog Pvt. Ltd	Banke
32	Ajit Intta Udhyog	Bara
33	Anamol Brick Industries	Bara
34	Baba Itta Udhyog	Bara
35	Bajaj Intta Udhyog	Bara
36	Bibek Brick Fild	Bara
37	Bishal Intta Udhyog	Bara
38	Boudha Intta Udhyog	Bara
39	Shree B. K. Intta Udhyog	Bara
40	Na.Ba.Di. Intta Udhyog	Bara
41	Shibashakti Intta Udhyog	Bara
42	Shah Intta Udhyog	Bara

S. No.	Name of Industry	Address
43	Raja Intta Udhyog	Bara
44	Om Intta Udhyog	Bara
45	Sahil Intta Udhyog	Bara
46	Ganga Intta Udhyog	Bara
47	Ghrelu Grihasova Inta Udhyog	Bara
48	Himal Intta Udhyog	Bara
49	Rajesh Intta Udhyog	Bara
50	Sabitri Intta And Tiles Udhyog	Bara
51	Sona Intta Udhyog	Bara
52	Shiv Sakti Inta Udhyog	Bara
53	Manoj Inta Udhyog	Bara
54	Burma Intta Udhyog Kothiya	Bardiya
55	Ganesh Intta Bhatta	Bardiya
56	Taratal Intta Udhyog	Bardiya
57	Himali Intta Udhyog	Bardiya
58	Kotahi Intta Udhyog	Bardiya
59	Agni Intta Udhyog	Bhaktapur
60	Ajima Intta Udhyog	Bhaktapur
61	B.K. Brick Industry	Bhaktapur
62	Bhairab Chimni Bhatta Udhyog	Bhaktapur
63	Bhaktpur Itta Tatha Tile Udhyog Pvt. Ltd.	Bhaktapur
64	Brahmayani Mahabir Chimni Bhatta	Bhaktapur
65	Changu Narayan Bhakti Intta Udhyog	Bhaktapur
66	Changunarayan Chimni Bhatta	Bhaktapur
67	Chhuma Ganesh Chimni Bhatta	Bhaktapur
68	Chunadevi Chimni Bhatta	Bhaktapur
69	Yeti Ceramics Industry Pvt.Ltd.	Bhaktapur
70	Jaya Shanker Intta Udhyog	Bhaktapur
71	Maitri Chimni Bhatta Udhyog	Bhaktapur
72	Shree Krishna Intta Udhyog	Bhaktapur
73	Jaya Guru Chimni Intta Udhyog	Bhaktapur
74	Phaidhoka Ganesh Intta Udhyog	Bhaktapur
75	Yapi Bhairab Chimmi Intta Udhyog	Bhaktapur
76	Kumarimata Chimni Bhatta	Bhaktapur
77	V.I.P. Intta Udhyog	Bhaktapur
78	Mahakali Shakti Chimni Intta Udhyog	Bhaktapur
79	Mahakali Chimni Intta Udhyog	Bhaktapur
80	Mili Hanuman Chimni Intta Udhyog	Bhaktapur
81	Jaya Dibyashwori Chimni Intta Udhyog	Bhaktapur
82	Mata Chimni Intta Bhatta Udhyog	Bhaktapur
83	K.P.Itta Udhyog	Bhaktapur
84	Hanuman Shakti Chimni Bhatta	Bhaktapur
85	Nandikeshor Fix Intta Udhyog	Bhaktapur
86	Jaya Hunuman Nankhel Mahadev Chimni Bhatta	Bhaktapur
87	Maheshori Mahashakti Chimni Bhatta	Bhaktapur

S. No.	Name of Industry	Address
88	Jaya Maheswori Mahashakti Chimni Intta	Bhaktapur
89	Mahamangu Shree Intta Bhatta Udhyog	Bhaktapur
90	Saraswati Mata Chimni Bhatta	Bhaktapur
91	Shanker Intta Udhyog	Bhaktapur
92	Yabu Mahadev Chimni Bhatta	Bhaktapur
93	Maheswari Chimni Intta Udhyog	Bhaktapur
94	Laxmi Ceramics Udhyog	Bhaktapur
95	Mahashakti Intta Udhyog	Bhaktapur
96	Jaya Brahmashakti Intta Udhyog	Bhaktapur
97	Jaya Shree Mahakali Intta Udhyog	Bhaktapur
98	Laxmi Intta Udhyog	Bhaktapur
99	S.K. Chimni Intta Udhyog	Bhaktapur
100	Shree Saraswati Fix Chimni Bhatta Udhyog	Bhaktapur
101	Majhi Bhirab Intta Udhyog	Bhaktapur
102	Saraswati Fix Intta Udhyog	Bhaktapur
103	New Sangam Intta Udhyog	Chitwan
104	Nava Durga Intta Udhyog	Chitwan
105	Nirman Intta Udhyog	Chitwan
106	Anmol Intta Udhyog	Chitwan
107	Bikash Intta Udhyog	Chitwan
108	Dharel Intta Udhyog	Chitwan
109	Ganesh Intta Udhyog	Chitwan
110	Manakaman Intta Udhyog	Chitwan
111	Khanal Intta Udhyog	Chitwan
112	Sdb Bricks And Tile Industires Pvt.Ltd.	Chitwan
113	Joshi Intta Udhyog	Chitwan
114	Panchakanya Intta Udhyog	Chitwan
115	Indra Intta Udhyog	Chitwan
116	Roshan Intta Udhyog	Chitwan
117	Shiba Intta Udhyog	Chitwan
118	Shree Intta Udhyog	Chitwan
119	Ujjawal Intta Udhyog	Chitwan
120	Trishul Intta Udhyog	Chitwan
121	Hinika Bhuse Intta Udhyog	Dang
122	Pankaj Intta Udhyog	Dang
123	Rapti Chimney Intta Udhyog	Dang
124	Shubham Chimney Intta Udhyog	Dang
125	Chhampali Chimni Intta Udhyog	Dang
126	Dainik Chimney Intta Bhatta Udhyog	Dang
127	Ganga Chimney Intta Udhyog	Dang
128	Swikrit Bhuse Intta Udhyog	Dang
129	Manakamana Chimney Intta Udhyog	Dang
130	Pann Brick Pvt. Ltd.	Dhankuta
131	Pashupati Intta Udhyog	Dhanusha
132	Sudha Intta Udhyog	Dhanusha

S. No.	Name of Industry	Address
133	Ma Intta Udhyog	Dhanusha
134	New Intta Udhyog	Dhanusha
135	Ma Jagadamba Intta Udhyog	Dhanusha
136	Ram Nandan Mato Ko Dali Udhyog	Dhanusha
137	Anand Jindta Udhyog	Dhanusha
138	Bhawani Intta Udhyog	Dhanusha
139	Bikash Intta Bhatha	Dhanusha
140	Chand Intta Udhyog	Dhanusha
141	Ganesh Intta Udhyog	Dhanusha
142	Sakambari Intta Udhyog	Dhanusha
143	Shubhasabh Intta Udhyog	Dhanusha
144	Jay Hanuman Intta Udhyog	Dhanusha
145	Ma Durga Intta Udhyog	Dhanusha
146	Ma Janaki Intta Udhyog	Dhanusha
147	S N S Intta Udhyog	Dhanusha
148	Ma Shanti Intta Udhyog	Dhanusha
149	Jay Ma Intta Udhyog	Dhanusha
150	Mala Intta Udhyog	Dhanusha
151	Omsanti Intta Udhyog	Dhanusha
152	Basnet Intta Bhatta	Gorkha
153	Heera Intta Bhatta	Gorkha
154	R.K. Intta Bhatta	Gorkha
155	Om Intta Bhatta	Gorkha
156	Bhim Intta Bhatta	Gorkha
157	Rana Intta Bhatta	Gorkha
158	Pathibhara Intta Udhyog	Jhapa
159	Pradeep And Company	Jhapa
160	Ram Intta Udhyog	Jhapa
161	Shubham Intta Udhyog	Jhapa
162	Laxmi Intta Udhyog	Jhapa
163	Madhab Intta Udhyog	Jhapa
164	K.B.C. Intta Udhyog	Jhapa
165	Barun Intta Udhyog	Jhapa
166	Pancheswor Intta Tatha Bahuuddesiya Co.	Jhapa
167	Hareshiba Intta Udhyog	Jhapa
168	Pashupati Intta Udhyog	Jhapa
169	Shree Ram Tile Udhyog	Kailali
170	Surat Intta Tile Udhyog	Kailali
171	Jogiram Intta Udhyog	Kailali
172	Lokrah Intta Bhatta	Kailali
173	Yash Bhuse Intta Bhatta Udhyog	Kailali
174	Tejraj Abasthi Intha Udhyog	Kailali
175	Shiba Parbati Intta Udhyog	Kailali
176	Simrik Intta Tile Udhyog	Kailali
177	Jaya Guru Ganesh Intta Udhyog	Kailali

S. No.	Name of Industry	Address
178	Parasu Intta Bhatta	Kailali
179	Raj Intta Tile Udhyog	Kailali
180	Pushparaj Joshi Intta Udhyog	Kailali
181	Rana Bhushe Intta Bhatta Udhyog	Kailali
182	Bhageswori Intta Udhyog	Kailali
183	Bogati Intta Tile Bhatta Udhyog	Kailali
184	Deep Intta Udhyog	Kailali
185	Ganesh Intta Udhyog	Kailali
186	New Ganesh Intta Udhyog	Kailali
187	Shahi Intta Bhatta	Kailali
188	Thapa Cement Tile And Blocks Udhyog	Kailali
189	Goura Intta Bhatta Udhyog	Kailali
190	Shree Ugratara Intta Udhyog	Kailali
191	Jaya Mahakali Udhyog	Kailali
192	Parash Intta Udhyog	Kailali
193	Thanapur Intta Bhatta Udhyog	Kailali
194	Karnali Intha Bhatta	Kailali
195	Namuna Intta Udhyog	Kanchanpur
196	Kalika Intta Tatha Tile Udhyog	Kanchanpur
197	Royal Intta Udhyog	Kanchanpur
198	Kishan Intta Udhyog	Kanchanpur
199	Sandesh Intta Tatha Tile Udhyog	Kanchanpur
200	Labdeb Tile Udhyog	Kanchanpur
201	New Janata Intta Tile Udhyog	Kanchanpur
202	Shiba Shankar Intta Tile Udhyog	Kanchanpur
203	Shree Dilasaini Tile Udhyog	Kanchanpur
204	Purnagiri Intta Tile Udhyog	Kanchanpur
205	Sarada Intta Udhyog	Kanchanpur
206	Mahakali Tile Udhyog	Kanchanpur
207	Jagadamba Intta Tatha Tile Udhyog	Kanchanpur
208	Gomati Khapda Udhyog	Kanchanpur
209	Ganesh Tile Tatha Intta Udhyog	Kanchanpur
210	Pashupati Intta Udhyog	Kanchanpur
211	Purnagiri Rile Udhyog	Kanchanpur
212	Shree Ganesh Tile Udhyog	Kanchanpur
213	Sidhanath Tile Udhyog	Kanchanpur
214	Baijanatha Intta Udhyog	Kanchanpur
215	Bajarangi Intta Tatha Tile Udhyog	Kanchanpur
216	Betal Intta Tile Karkhana	Kanchanpur
217	Bhageswor Tile Udhyog	Kanchanpur
218	Chaudhary Khapada Tile Udhyog	Kanchanpur
219	Devbisnu Adhunik Intta Udhyog	Kanchanpur
220	Dumber Dutta Bhatta Bhusi Intta Udhyog	Kanchanpur
221	Suraj Intta Udhyog	Kanchanpur
222	Malikaarjun Intta Udhyog	Kanchanpur

S. No.	Name of Industry	Address
223	Kedar Tile Udhyog	Kanchanpur
224	New Betal Intta Tile Karkhana	Kanchanpur
225	New Banganga Crushar Udhyog	Kapilbastu
226	I.S.K. Intta Udhyog	Kapilbastu
227	S.K. Intta Udhyog	Kapilbastu
228	Kashiram Intta Udhyog	Kapilbastu
229	Triloki Intta Bhatta Udhyog	Kapilbastu
230	Lokpriya Intta Udhyog	Kapilbastu
231	Manokamana Intta Udhyog	Kapilbastu
232	Maya Intta Udhyog	Kapilbastu
233	Kapilbastu Intta Udhyog	Kapilbastu
234	Sheela Intta Udhyog	Kapilbastu
235	Manju Intta Udhyog	Kapilbastu
236	Abdul Latif Intta Udhyog	Kapilbastu
237	Shree Laxmi Intta Bhatta Udhyog	Kapilbastu
238	Jayakali Intta Udhyog	Kapilbastu
239	Sona Intta Bhatta Udhyog	Kapilbastu
240	Karki Intta Udhyog	Kapilbastu
241	Khursed Intta Udhyog	Kapilbastu
242	Kaushiki Intta Bhatta Udhyog	Kapilbastu
243	Mahalaxmi Intta Bhatta	Kapilbastu
244	Stone Aggrigate And Blocks Udhyog	Kaski
245	Riddiko Tayal Udhyog Pvt.Ltd.	Kathmandu
246	Om Shree Bricks Udhyog	Lalitpur
247	Jaya Santishi Ma Intta Bhatta Udhyog	Lalitpur
248	Trishkti Intta Udhyog	Lalitpur
249	Sidhi Binayak Chimni Bhatta Udhyog	Lalitpur
250	Gautam Boudha Intta Udhyog	Lalitpur
251	Uttam Intta Industries	Lalitpur
252	Satya Narayan Intta Bhatta Udhyog Pvt.Ltd.	Lalitpur
253	Manakaman Intta Udhyog	Lalitpur
254	Shivashakti Chimni Intta Bhatta Udhyog	Lalitpur
255	Arati Intta Udhyog	Lalitpur
256	Bhairab Intta Bhatta Udhyog	Lalitpur
257	Dakshinakali Chimni Bhatta Udhyog	Lalitpur
258	H.B. Intta Udhyog	Lalitpur
259	New Bhairab Brick Factory	Lalitpur
260	Yeti Brick Industry Pvt.Ltd.	Lalitpur
261	Maharjan Itta Udhyog	Lalitpur
262	Jaya Nepal Fix Intta Udhyog	Mahottari
263	Hira Intta Udhyog	Mahottari
264	Narsing Intta Udhyog	Mahottari
265	Janaki Intta Udhyog	Mahottari
266	Bhukali Intta Udhyog	Mahottari
267	Dipesh Intta Udhyog	Mahottari

S. No.	Name of Industry	Address
268	Royal Intta Udhyog	Mahottari
269	Shiba Diva Intta Udhyog	Mahottari
270	Nabin Intta Udhyog	Mahottari
271	Mishra Intta Udhyog	Mahottari
272	Kalika Intta Udhyog	Makwanpur
273	Koshi Intta Udhyog	Morang
274	New Pranam Intta Udhyog	Morang
275	Pranam Intta Udhyog	Morang
276	Ajanta Itta Udhyog Pvt. Ltd.	Morang
277	Annaya Intta Udhyog	Morang
278	Avi And Shabi VSBK Brick Ind. Pvt. Ltd.	Morang
279	Bagale Thapa Intta Udhyog	Morang
280	Birat Itta Udhyog	Morang
281	New ACC Itta Udhyog Pvt. Ltd.	Morang
282	Hari Inta Udhyog	Nawalparasi
283	Kalika Chimni Intta Udhyog	Nawalparasi
284	Manakanana Intta Udhyog	Nawalparasi
285	Siva Shankar Intta Udhyog	Nawalparasi
286	Nepal Intta Udhyog	Nawalparasi
287	K.C.Inta Udhyog	Nawalparasi
288	Pashupati VSBK Brick Ind.	Nawalparasi
289	Saraswoti Chimni Intta Udhyog	Nuwakot
290	Aakash Enterprises Bricks Udhyog	Nuwakot
291	Nepal Intta Udhyog	Parsa
292	Patel Intta Udhyog	Parsa
293	Puja Intta Udhyog	Rautahat
294	Jaya Nepal Intta Udhyog	Rautahat
295	Sita Intta Udhyog	Rautahat
296	Udaya Intta Udhyog	Rautahat
297	Thapa Intta Udhyog	Rautahat
298	Nepal Intta Udhyog	Rautahat
299	Kamal Intta Udhyog	Rautahat
300	Kankai Intta Udhyog	Rautahat
301	Shiva Intta Udhyog	Rautahat
302	Yadab Intta Udhyog	Rautahat
303	Giri Intta Udhyog	Rautahat
304	Ramnathshah Hema Prabin Intta Udhyog	Rautahat
305	Jaisawal Intta Udhyog	Rautahat
306	Shree Ram Intta Udhyog	Rautahat
307	Rahul Intta Udhyog	Rautahat
308	Raja Intta Udhyog	Rautahat
309	Saheb Intta Udhyog	Rautahat
310	Abdula Intta Udhyog	Rautahat
311	Alam Intta Udhyog	Rautahat
312	Ohm Intta Udhyog	Rautahat

S. No.	Name of Industry	Address
313	Om Intta Udhyog	Rautahat
314	Jaya Om Bricks	Rupandehi
315	Trimahesh Intta Udhyog	Rupandehi
316	Sona Intta Udhyog	Rupandehi
317	Om Intta Udhyog	Rupandehi
318	Tata Intta Udhyog	Rupandehi
319	New Heera Intta Udhyog	Rupandehi
320	Lbb Intta Udhyog	Rupandehi
321	Siddhartha Intta Tile Karkhana	Rupandehi
322	Heera Intta Udhyog	Rupandehi
323	P And P Intta Udhyog	Rupandehi
324	Ajaya Intta Udhyog	Rupandehi
325	Asha Intta Udhyog	Rupandehi
326	Erwin Crusher Udhyog	Rupandehi
327	Ganesh Intta Bhatta	Rupandehi
328	Kamana Intta Bhatta Udhyog	Rupandehi
329	Mahesh Intta Udhyog	Rupandehi
330	New Manakamana Intta Karkhana Pvt. Ltd.	Rupandehi
331	Siddhartha Intta Udhyog	Rupandehi
332	Suraj Concrete Udhyog	Rupandehi
333	Hanuman Intta Udhyog	Dhanusha
334	Krishna Intta Udhyog	Saptari
335	Krishna Intta Udhyog	Saptari
336	Surya Intta Udhyog Kushaha	Saptari
337	Yedubanshi Intta Udhyog	Saptari
338	Himal Intta Udhyog	Saptari
339	Sabanam Intta Udhyog	Saptari
340	Saptari Intta Udhyog	Saptari
341	New Steel Intta Udhyog	Saptari
342	Purnima Intta Udhyog	Saptari
343	Raj Intta Udhyog	Saptari
344	Shakti Intta Udhyog	Saptari
345	Ma Kali Intta Udhyog	Saptari
346	Jaya Shree Chhamal Tayal Udhyog	Saptari
347	New Kapoor Intta Udhyog	Saptari
348	Shree Shankar Intta Udhyog	Saptari
349	Jaya Shantoshi Ma Intta Udhyog Kushaha	Saptari
350	New Bismila Tile Udhyog	Saptari
351	Parbati Tile Udhyog	Saptari
352	Ma Laxmi Intta Udhyog	Saptari
353	Jaya Shiba Intta Udhyog	Saptari
354	Jaya Durge Intta Udhyog	Saptari
355	Pashupati Intta Udhyog	Saptari
356	Bajaranga Tile Udhyog	Saptari
357	Bijaya Intta Udhyog	Saptari

S. No.	Name of Industry	Address
358	Bishwakarma Intta Udhyog	Saptari
359	Chaudhary Tile Udhyog	Saptari
360	Chhinnamasta Intta Udhyog	Saptari
361	Das Intta Bhatta	Saptari
362	Everest Intta Udhyog	Saptari
363	Ranjeet Intta Udhyog	Sarlahi
364	Raj Intta Udhyog	Sarlahi
365	Niva Intta Udhyog	Sarlahi
366	Shiba Shankar Intta Udhyog	Sarlahi
367	Intta Udhyog Motipur	Sarlahi
368	Yadab Intta Udhyog	Sarlahi
369	Prem Intta Udhyog	Sarlahi
370	Janaki Intta Udhyog	Sarlahi
371	Jayamata The Intta Udhyog	Sarlahi
372	Radhadevi Intta Udhyog	Sarlahi
373	Amber Adhunik Intta Udhyog	Sarlahi
374	Ambika Intta Udhyog	Sarlahi
375	Tulsi Intta Udhyog	Sarlahi
376	Sagar Intta Udhyog	Siraha
377	Nagendra Mato Tile Udhyog	Siraha
378	Shankar Intta Udhyog	Siraha
379	Swami Intta Udhyog	Siraha
380	Shree Ram Intta Udhyog	Siraha
381	Laxmi Intta Udhyog	Siraha
382	Suman Intta Udhyog	Siraha
383	He Hanuman Intta Udhyog	Siraha
384	Satyadeb Intta Udhyog	Siraha
385	Pashupati Intta Udhyog	Siraha
386	Kamala Intta Udhyog	Siraha
387	New Ganesh Intta Udhyog	Siraha
388	Sabanam Intta Udhyog	Siraha
389	Shyam Intta Udhyog	Siraha
390	Shibam Intta Udhyog	Siraha
391	Shambhu Intta Udhyog	Siraha
392	Shakha Intta Udhyog	Siraha
393	Bajaranga Intta Udhyog	Siraha
394	Chandra Intta Udhyog	Siraha
395	Dhamani Intta Udhyog	Siraha
396	Dhangadi Intta Udhyog	Siraha
397	Five Star Intta Udhyog	Siraha
398	Gulab Intta Udhyog	Siraha
399	Rahul Intta Udhyog	Sunsari
400	A.B.I. Intta Udhyog	Sunsari
401	Anand Itta Bhatta Udhyog Pvt. Ltd.	Sunsari
402	Ananta Itta Udhyog	Sunsari

S. No.	Name of Industry	Address
403	Bajadranga Udhyog	Sunsari
404	Himalaya Intta Udhyog	Sunsari
405	Jay Baba Itta Udhyog Pvt. Ltd.	Sunsari
406	Jay Shree Hari Itta Udhyog Pvt. Ltd.	Sunsari
407	Jay Nepal Intta Udhyog	Sunsari
408	Jay Shree Intta Pvt.Ltd.	Sunsari
409	Jyoti Intta Udhyog	Sunsari
410	Kailash Itta Udhyog	Sunsari
411	LB Brick Industry	Sunsari
412	Matadebi Intta Udhyog	Sunsari
413	New Jay Nepal Itta Udhyog	Sunsari
414	New Jaya Baba Intta Udhyog	Sunsari
415	Pabitra Intta Bhatta	Sunsari
416	Pashupati Intta Udhyog	Sunsari
417	Prabhu Itta Udhyog	Sunsari
418	Puja Intta Uhyog	Sunsari
419	Shambhu Intta Udhyog	Sunsari
420	Shree Jay Nepal Itta Udhyog	Sunsari
421	Tawachhe Brick & Tile Industries Pvt.Ltd.	Sunsari
422	Puja Intta Udhyog	Surkhet
423	Ashisi Bhuse Intta Bhatta Udhyog	Surkhet
424	Bhandari Intta Udhyog	Surkhet
425	Deuti Intta Udhyog	Surkhet
426	Malika Intta Udhyog	Surkhet
427	Surya Intta Udhyog	Surkhet
428	MP Intta Udhyog	Syangja
429	Shree Intta Udhyog	Tanahu
430	Pokhreli Intta Udhyog Pvt. Ltd.	Tanahu
431	T Intta Bhatta Udhyog	Tanahu
432	Jamune Chimni Intta Udhyog	Tanahu
433	Machhapuchre Brick Factory Pvt. Ltd.	Tanahu
434	Shreeram Intta Udhyog Pvt. Ltd.	Tanahu
435	Tanahu Intta Udhyog	Tanahu
436	Mbi Intta Udhyog	Tanahu
437	Abi Bricks Industry	Tanahu
438	Indra Bricks Industry	Udaypur
439	Udayapur Ceramix	Udaypur

S. No.	Name of Industries	District
1	Bagmati Cold Storage Pvt. Ltd.	Bhaktapur
2	Bheri Coldstorage Co-operative Society	Banke
3	Budhathoki Cold Storage Pvt. Ltd.	Kathmandu
4	Durga Cold Storage	Kathmandu
5	Eastern Cold Storage Pvt. Ltd.	Morang
6	Ganesh Cold Storage Pvt. Ltd.	Morang
8	Geeta Cold Storage Pvt. Ltd.	Dhanusha
9	Him Shikhar Cold Storage Pvt. Ltd.	Bhaktapur
10	Himalaya Cold Storage Pvt. Ltd.	Bhaktapur
11	Kavre Panchkhal Cold Storage Pvt. Ltd.	Kavrepalanchok
12	Kohinoor Cold Storage Pvt. Ltd.	Kathmandu
13	Malangawa Cold Storage Pvt. Ltd.	Sarlahi
14	Manakamana Cold Storage Pvt. Ltd.	Kaski
15	Morang Cold Storage Pvt. Ltd.	Morang
16	Palanchowk Bhagwati Cold Storage Pvt. Ltd.	Kavrepalanchok
17	Pradhan Mini Cold Storage Pvt. Ltd.	Makwanpur
18	Ram Janaki Cold Storage Pvt. Ltd.	Morang
19	Ram Janaki Cold Storage Pvt. Ltd.	Dhanusha
20	Royal Cold Storage Pvt. Ltd.	Jhapa
21	Shanti Cold Storage Pvt. Ltd.	Jhapa
22	Siddhartha Cold Storage & Ice Ind. Pvt. ltd	Rupandehi
23	Yadav Cold Storage Pvt. Ltd.	Parsa

A. List of Cold Storages

S. No.	Zone	District	Cement	Paper	Food	Metal	Soap	Hotel	Brick	Cold- storage	Total
1	Mechi	Jhapa	4		0	0		2	11	2	19
2		Panchthar	0		1	0			0		1
3	Koshi	Morang	0		17	5	14	5	9	4	54
4		Sunsari	0	2	16	7	1		23		49
5		Dhankuta	1		1	0			1		3
6		Sankhuwasava	0		1	0			0		1
7	Sagarmatha	Siraha	1		1	0			23		25
8		Saptari	0		2	0			29		31
9		Udayapur	1		0	0			2		3
10		Solukhumbu	0		0	0		4	0		4
11	Janapkur	Dhanusha	1	1	1	0			22	2	27
12		Mohattari	0		1	0			10		11
13		Sarlahi	0		0	0			13	1	14
14		Ramechhap	0		2	0			0		2
15		Dolkha	0		2	0			0		2
16	Bagmati	Kathmandu	0		12	5	1	112	1	3	134
17		Lalitpur	0		5	5		8	16		34
18		Bhaktapur	0	1	1	1	1	5	44	3	56
19		Kavrepalanchowk	0		1	0		5	0	2	8
20		Nuwakot	0		0	0			2		2
21		Rasuwa	0		1	0			0		1
22	Narayani	Rautahat	0		1	0			21		22
23		Bara	2		6	5	3		22		38
24		Parsa	5		17	16	7	6	2	1	54
25		Makwanpur	2		6	0	6	2	1	1	18
26		Chitwan	1		4	1	1	12	18		37
27	Lumbini	Nawalparasi	2	2	5	6	1		7		23
28		Rupandehi	9	1	5	3	3	4	19	1	45
29		Kapilbastu	4		2	0			19		25
30		Gulmi	0		1	0			0		1
31		Palpa	0		1	0			0		1
32	Gandaki	Tanahun	0		1	0			9		10
33		Syangja	0		0	0			1		1
34		Kaski	0		10	5		20	1	1	37
35		Gorkha	0		0	0			6		6
36	Rapti	Dang	0		2	0			9		11
37	Dhulagiri	Banglung	0		1	1	0		1		3
38		Mustang	0		3	0		1	0		4
39	Bheri	Banke	2		3	1	0	1	30	1	38
40		Bardia	0		0	0	0		5		5

Annex – 3: District-wise Distribution of Industries

S. No.	Zone	District	Cement	Paper	Food	Metal	Soap	Hotel	Brick	Cold- storage	Total
41		Surkhet	0		2	0			6		8
42		Dailekh	0		0	1			0		1
43	Seti	Kailali	0		2	2		1	26		31
44		Kanchanpur	0		0	0			30		30
		Total	35	7	137	64	38	188	439	22	930

Annex – 4: List of Industries Visited along with Interest in NEEP & Env Commitment

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S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC
1	Nepal Shalimar Cement Pvt. Ltd.	Cement	Medium	Bara	Ν	Y	Y	Ν
2	Vishwokarma Cement Pvt. Ltd.	Cement	Medium	Parsa	N	Y	N	Ν
3	Siddhartha Cement Udhyog	Cement	Large	Rupandehi	N	Y	Y	Ν
4	Butwal Cement Mills Pvt. Ltd.	Cement	Medium	Nawalparasi	N	Y	Y	Ν
5	Aarghakhanchi Cement Pvt. Ltd.	Cement	Large	Rupandehi	N	Y	Y	Ν
6	Chitwan Cement Pvt. Ltd.	Cement	Small	Nawalparasi	N	Y	Y	Ν
7	Supreme Cement Pvt. Ltd.	Cement	Large	Rupandehi	N	Y	Y	Ν
8	Aarghakhanchi Cement Pvt. Ltd.(Birpur Unit)	Cement	Large	Kapilbastu	N	Y	Y	Ν
9	Jagadamba Cement Ind. Pvt. Ltd.	Cement	Large	Rupandehi	N	Y	Y	Ν
10	Nepal Ambuja Cement Udhyog Pvt. Ltd.	Cement	Medium	Rupandehi	N	Y	Y	Ν
11	Goenka Cement Pvt. Ltd.	Cement	Medium	Rupandehi	N	Y	Y	Ν
12	Brij Cement In. Pvt. Ltd.	Cement	Large	Rupandehi	N	Y	Y	Ν
13	Reliance Cement Pvt. Ltd.	Cement	Large	Rupandehi	N	Y	Y	Ν
14	Cosmos Cement Industries Pvt. Ltd.	Cement	Medium	Dhanusha	N	Y	Y	Ν
15	Himalaya Cement Pvt. Ltd.	Cement	Medium	Jhapa	N	Y	Y	Ν
16	Mittal Cement Ind. (P) Ltd.	Cement	Small	Jhapa	N	Y	Y	Y
17	Manosha cement Ind. Pvt. Ltd.	Cement	Small	Jhapa	N	Y	Y	Y
18	Gorakhkali Cement Udhyog Pvt. Ltd.	Cement	Medium	Jhapa	N	Y	Y	Y
19	Pashupati Cement Pvt. Ltd.	Cement	Medium	Kapilbastu	N	Y	Y	Ν
20	Vijaya Cement Pvt. Ltd	Cement	Medium	Kapilbastu	N	Y	Y	Ν
21	Om Cement Pvt. Ltd.	Cement	Small	Chitwan	N	Y	Y	Ν
22	Buddha Cement Pvt. Ltd.	Cement	Small	Kapilbastu	N	Y	Y	Ν
23	Jay Mangalam Cement Pvt. Ltd.	Cement	Small	Banke	N	Y	Y	Ν
24	Udaypur Cement Industries Ltd.	Cement	Large	Udaypur	Y	Y	Y	Ν
25	Maruti Cement Ltd.	Cement	Large	Siraha	Y	Y	Y	Ν
26	Hetauda Cement Ind. Ltd.	Cement	Large	Makwanpur	N	Y	Y	Ν
27	Baba Paper Mill Pvt. Ltd.	Paper	Large	Sunsari	Y	Y	Y	Y

a 11		<u> </u>				NEEP activities		Env Com
S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC
28	Arbind Pulp & Paper Pvt. Ltd.	Paper	Medium	Sunsari	N	Y	Y	Ν
29	Reliance Paper Mills Pvt. Ltd.	Paper	Large	Rupandehi	Y	Y	Y	Ν
30	M.K. Paper Mills Pvt. Ltd.	Paper	Medium	Nawalparasi	N	Y	Y	Ν
31	Everest Paper Mills Pvt. Ltd.	Paper	Large	Dhanusha	N	Y	Y	Y
32	Asian Distillery Pvt. Ltd	Food	Large	Parsa	N	Y	Y	Ν
33	Arati Vegetable Product Pvt. Ltd	Food	Medium	Bara	Y	Y	Y	Ν
34	Sushil Vanaspati Pvt. Ltd	Food	Medium	Parsa	N	Y	Y	Ν
35	Nidhi Oil Industries	Food	Medium	Bara	N	Y	Y	Ν
36	Nandan Ghee & Oil Ind. Pvt. Ltd	Food	Large	Bara	Y	Y	Y	Y
37	Narayani Oil Refinery Udyog	Food	Large	Bara	N	Y	Y	Y
38	Ganpati Vanaspati Pvt. Ltd	Food	Large	Bara	N	Y	Y	Y
39	Hanuman Adhunik Tel Udyog	Food	Small	Bara	N	Y	Y	Ν
40	Shree Krishna Oil Refinery Veg. Ind Pvt. Ltd	Food	Large	Parsa	N	Y	Y	Ν
41	Annapurna Vegetable Product Pvt. Ldt	Food	Large	Bara	N	Y	Y	Ν
42	Dabur Nepal Pvt. Ltd.	Food	Large	Bara	Y	Y	Y	Ν
43	Shree Shiv Shakti Ghee Udyog Pvt. Ltd	Food	Large	Bara	N	Y	Y	Ν
44	Shree Ram Refine Oil Product Pvt. Ltd	Food	Large	Morang	N	N	N	Y
45	Biratnagar Milk Supply Scheme	Food	Large	Morang	N	N	N	Y
46	Gokul Diet Food Ind. Pvt. Ltd.	Food	Small	Morang	N	Y	Y	Ν
47	Pashupati Khadhya Tel Udhyog Pvt. Ltd.	Food	Large	Sunsari	N	Y	Y	Y
48	Asian Thai Foods (P). Ltd.	Food	Medium	Sunsari	N	Y	Y	Y
49	Kamdhenu Dairy Development Co-Operative Ltd.	Food	Medium	Sunsari	N	Y	Y	Y
50	Pashupati Biscuit Ind. Pvt. Ltd.	Food	Medium	Sunsari	N	Y	Y	Ν
51	Rijal Tashi Industries Pvt. Ltd.	Food	Medium	Sunsari	Y	Y	Y	Y
52	Chutari Food & Confectionary Ind.	Food	Small	Sunsari	Ν	Y	Y	Ν
53	United Sprits Nepal Pvt. Ltd.	Food	Large	Morang	N	Y	Y	Ν
54	Bagmati Oil Industries	Food	Medium	Morang	Ν	Y	Y	Ν

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S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC
55	Nobel Dairy Pvt. Ltd.	Food	Small	Morang	N	Y	Y	Y
56	J. B. S. Industries	Food	Small	Sunsari	N	Y	Y	Ν
57	Lumbini Sugar Ind. Pvt. Ltd.	Food	Large	Nawalparasi	N	Y	Y	Ν
58	Shree Mahalaxmi Sugars Limited	Food	Large	Kapilbastu	N	Y	Y	Ν
59	Siddhartha Oil Industries	Food	Large	Rupandehi	N	Y	Y	Ν
60	Sitaram Gokul Milks Ktm. Ltd.	Food	Medium	Kathmandu	N	Y	Y	Ν
61	Kathmandu Dairy Pvt. Ltd	Food	Small	Kathmandu	N	Y	Y	Ν
62	Bottlers Nepal Limited	Food	Medium	Kathmandu	N	Y	Y	Y
63	The Nepal Distillary Pvt. Ltd.	Food	Medium	Kathmandu	N	Y	Y	Ν
64	Nebico Pvt. Ltd.	Food	Medium	Kathmandu	N	Y	Y	Ν
65	Dairy Development Corporation	Food	Medium	Kathmandu	N	Y	Y	Ν
66	C.G. Foods Nepal Pvt. Ltd	Food	Medium	Lalitpur	Y	Y	Y	Ν
67	Nepal Dairy Pvt. Ltd.	Food	Small	Lalitpur	N	Y	Y	Ν
68	Dugar Food and beverage	Food	Medium	Kathmandu	N	Y	Y	Ν
69	Everest Sugar & Chemical Ind. Pvt. Ltd	Food	Large	Mahotary	N	Y	Y	Ν
70	Eastern Sugar Mills Pvt. Ltd.	Food	Large	Sunsari	Y	Y	Y	Y
71	Baba Vegetable Oil Industries Pvt. Ltd.	Food	Large	Morang	N	Y	Y	Y
72	Pokhara Food Pvt. Ltd.	Food	Large	Kaski	N	Y	Y	Ν
73	Him-Shree Foods Pvt. Ltd.	Food	Medium	Kaski	N	Y	Y	Ν
74	Pokhara Noodles pvt. Ltd.	Food	Large	Kaski	N	Y	Y	Ν
75	Sujal Dairy Pvt. Ltd.	Food	Medium	Kaski	N	Y	Y	Ν
76	Saurabh Oil Mill	Food	Medium	Banke	N	Y	Y	Y
77	United Brewery	Food	Medium	Makwanpur	N	Y	Y	Ν
78	Hetauda Milk Supply Scheme	Food	Medium	Makwanpur	N	Y	Y	Ν
79	Antartic Biscuits Pvt. Ltd.	Food	Large	Makwanpur	N	Y	Y	Ν
80	Indu Shankar Chini Udhyog Ltd.	Food	Small	Sarlahi	N	Y	Y	Ν
81	Varun Beverage Pvt. Ltd.	Food	Large	Kathmandu	N	Y	Y	Ν

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S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC	
82	Himalayan Brewery Ltd.	Food	Large	Lalitpur	N	Y	Y	Ν	
83	Ashok Steel Ind. Pvt. Ltd.	Metal	Large	Bara	Y	Y	Y	Ν	
84	Bhagawati Steel Ind. Pvt . Ltd	Metal	Large	Bara	N	Y	Y	N	
85	Jaymatadi Wire Ind.	Metal	Small	Parsa	N	Y	Y	N	
86	Narayan Rolling Mills Pvt. Ltd.	Metal	Medium	Bara	N	Y	N	Ν	
87	Hanuman Metal Pvt. Ltd.	Metal	Large	Bara	N	Ν	Y	Ν	
88	Hama Iron & Steel Ind. Pvt. Ltd./Hama Wire Ind. Pvt. Ltd.	Metal	Large	Bara	Ν	Y	Y	Y	
89	Saakha Steel Ind. Pvt. Ltd.	Metal	Medium	Bara	N	Y	Y	Ν	
90	Rajesh Metal Crafts Ltd.	Metal	Large	Bara	N	Y	Y	Y	
91	Bhagawati Rolling Nails Pvt . Ltd	Metal	Large	Bara	Y	Y	Y	Ν	
92	Hulash Wire Ind. Ltd.	Metal	Large	Morang	Y	Y	Y	Y	
93	Pioneer Wire Ind. Pvt. Ltd.	Metal	Medium	Morang	N	Y	Y	Y	
94	Mainbati Steel Ind. Pvt. Ltd.	Metal	Large	Sunsari	N	Y	Y	Ν	
95	Premier Wires Pvt. Ltd.	Metal	Medium	Sunsari	Ν	Y	N	Y	
96	Pashupati Iron & Steel Pvt. Ltd.	Metal	Medium	Sunsari	N	Y	Y	Ν	
97	Pashupati Wire Product	Metal	Small	Sunsari	Ν	Y	Y	Ν	
98	Aarati Strips (P) Ltd.	Metal	Large	Morang	N	Ν	N	Y	
99	Everest Rolling Industries (P) Ltd.	Metal	Large	Rupandehi	Ν	Y	Y	Ν	
100	Goenka Steels Pvt. Ltd.	Metal	Large	Rupandehi	Ν	Y	Y	Ν	
101	Panchakanya Steel Pvt. Ltd.	Metal	Large	Rupandehi	Y	Y	Y	Ν	
102	Bageshwori Iron & Steel Pvt. Ltd.	Metal	Medium	Banke	Ν	Y	Y	Ν	
103	Radha Structure & Engineering Pvt. Ltd.	Metal	Large	Bhaktapur	Ν	Y	Y	Ν	
104	Narayani Chemical & Perfumory Works Pvt. Ltd	Soap & Chemical	Small	Parsa	Ν	Y	Y	Ν	
105	Mahavir Soap Industry	Soap & Chemical	Small	Parsa	N	Y	Y	N	
106	Nepal Chemical & Soap Ind. Pvt. Ltd.	Soap & Chemical	Small	Parsa	N	Y	Y	Ν	
107	Arati Soap & Chemical Ind. Pvt. Ltd	Soap & Chemical	Medium	Bara	Y	Y	Y	Ν	

G . N		G i		District	F 14	NEEP activities		Env Com
S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC
108	Puja Soap & Chemical Ind Pvt. Ltd	Soap & Chemical	Medium	Bara	Ν	Y	Y	Ν
109	Golden Star Soap Ind.	Soap & Chemical	Small	Morang	Ν	Y	Y	N
110	Baba Soap Ind. Pvt. Ltd.	Soap & Chemical	Medium	Morang	Ν	Ν	N	Y
111	Himgiri Soap & Chemical Ind. Pvt. Ltd.	Soap & Chemical	Large	Morang	Ν	Y	Y	Ν
112	Bhagwati Soap Ind. Pvt. Ltd.	Soap & Chemical	Large	Morang	N	Y	Y	N
113	Sagarmatha Sabun Udhyog	Soap & Chemical	Medium	Morang	N	Y	Y	N
114	Moti Soap & Chemical Ind.	Soap & Chemical	Medium	Morang	N	Y	Y	N
115	Swadeshi Sabun Udhyog Pvt. Ltd.	Soap & Chemical	Small	Sunsari	N	Y	Y	Y
116	Shivshakti Soap Industries	Soap & Chemical	Small	Rupandehi	N	Y	Y	N
117	J. K. Soap & Chemical Pvt. Ltd.	Soap & Chemical	Medium	Rupandehi	N	Y	Y	N
118	Mahakali Oleo Chemical Pvt. Ltd.	Soap & Chemical	Large	Rupandehi	N	Y	Y	N
119	Ganga Soap & Chemical Ind.	Soap & Chemical	Medium	Makwanpur	N	Y	Y	N
120	National Soap & Chemical Ind.	Soap & Chemical	Medium	Makwanpur	N	Y	Y	N
121	Unique Soap & Chemical Ind.	Soap & Chemical	Medium	Makwanpur	N	Y	Y	N
122	Unilever Nepal Ltd.	Soap & Chemical	Small	Makwanpur	N	Y	Y	Y
123	Hotel Kailash	Hotel	Medium	Parsa	Y	Y	Y	N
124	Hira Plaza	Hotel	Medium	Parsa	Y	N	N	N
125	Hotel samjhana	Hotel	Medium	Parsa	N	Y	Y	N
126	Hotel Diyalo Pvt Ltd	Hotel	Small	Parsa	N	Y	Y	N
127	Hotel Makalu Pvt. Ltd.	Hotel	Medium	Parsa	N	Y	Y	N
128	Hotel Swagatam	Hotel	Small	Morang	N	Y	Y	N
129	Hotel Eastern Star Pvt. Ltd.	Hotel	Small	Morang	N	Y	Y	N
130	Hotel Xenial	Hotel	Medium	Morang	N	Y	Y	N
131	Royal Singi Hotel	Hotel	Small	Kathmandu	N	Y	Y	Y
132	Hotel Himalaya	Hotel	Medium	Lalitpur	Ν	Y	Y	Y
133	Hotel Yak & Yeti	Hotel	Large	Kathmandu	N	Y	Y	Y
134	Ambassdor Hotel	Hotel	Small	Kathmandu	Ν	Y	Y	N

a 11	Nome of the Industry	a				NEEP ac	tivities	Env Com	
S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	РСС	
135	Radission Hotel Kathmandu	Hotel	Medium	Kathmandu	N	Y	Y	Y	
136	Grand Hotel	Hotel	Small	Kathmandu	N	Y	Y	Y	
137	Soaltee Crowne Plaza	Hotel	Large	Kathmandu	Y	Y	Y	Y	
138	Hotel Orchid Pvt. Ltd.	Hotel	Small	Kathmandu	N	Y	Y	N	
139	Summit hotel	Hotel	Medium	Lalitpur	N	Y	Y	Y	
140	The Everest Hotel	Hotel	Large	Kathmandu	N	Y	Y	Y	
141	Hotel Sunset View	Hotel	Small	Kathmandu	N	Y	Y	Y	
142	Hotel Gangjong	Hotel	Small	Kathmandu	N	Y	Y	Y	
143	Shangrila hotel	Hotel	Medium	Kathmandu	Y	Y	Y	Y	
144	Hotel Maharaja Palace	Hotel	Small	Kathmandu	N	Y	Y	Y	
145	Hotel Ratna	Hotel	Medium	Morang	N	Y	Y	N	
146	Hotel Heaven Grand Pvt. Ltd.	Hotel	Small	Jhapa	N	Y	Y	N	
147	Hotel Daniel Pvt. Ltd.	Hotel	Medium	Jhapa	N	Y	Y	N	
148	Hotel Pawan International	Hotel	Medium	Rupandehi	N	Y	Y	N	
149	Hotel The Kantipur	Hotel	Medium	Kaski	N	Y	Y	N	
150	Hotel Pokhara Grande	Hotel	Large	Kaski	Y	Y	Y	Y	
151	Sangrilla Village Pokhara	Hotel	Medium	Kaski	N	Y	Y	N	
152	The Fulbari Resort	Hotel	Large	Kaski	N	Y	Y	N	
153	Hotel Phewa Prince	Hotel	Medium	Kaski	N	Y	Y	N	
154	Hotel Landmark Pokhara	Hotel	Medium	Kaski	Y	Y	Y	N	
155	Fisti Tail Lodge	Hotel	Small	Kaski	N	Y	Y	N	
156	Hotel Barahi	Hotel	Medium	Kaski	Y	Y	Y	Ν	
157	Motel Avocado & Orchid Resort	Hotel	Medium	Makwanpur	N	Y	Y	Ν	
158	The Malla Hotel	Hotel	Large	Kathmandu	N	Y	Y	N	
159	Hotel De'l Annapurna Pvt. Ltd.	Hotel	Large	Kathmandu	Ν	Y	Y	Ν	
160	Kathmandu Guest House Pvt. Ltd.	Hotel	Medium	Kathmandu	N	Y	Y	Ν	
161	Dwarikas Hotel	Hotel	Medium	Kathmandu	Ν	Y	Y	Ν	

a 11	Nome of the Industry	a	~ .	D: / : /		NEEP ac	tivities	Env Com
S. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC
162	Birat Itta Udhyog	Brick	Small	Morang	N	Y	Ν	Ν
163	Anand Itta Bhatta Udhyog Pvt. Ltd.	Brick	Small	Sunsari	N	Y	Y	Ν
164	Ajanta Itta Udhyog Pvt. Ltd.	Brick	Small	Morang	N	Y	Y	Ν
165	LB Brick Industry	Brick	Small	Sunsari	N	Y	Y	Ν
166	Prabhu Itta Udhyog	Brick	Small	Sunsari	N	N	N	Ν
167	Jaya Baba Itta Udhyog Pvt. Ltd.	Brick	Small	Sunsari	N	Y	Y	Ν
168	New ACC Itta Udhyog Pvt. Ltd.	Brick	Small	Morang	N	Y	Y	Ν
169	Shree Jay Nepal Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	Ν
170	Avi And Shabi VSBK Brick Ind. Pvt. Ltd.	Brick	Small	Morang	N	Y	Y	Ν
171	Bhaktpur Itta Tatha Tile Udhyog Pvt. Ltd.	Brick	Large	Bhaktapur	N	Y	Y	Ν
172	Pashupati VSBK Brick Ind.	Brick	Small	Nawalparasi	N	Y	Y	Ν
173	Jay Bageshwori Paschimanchal Itta & tile Factory P. Ltd.	Brick	Medium	Banke	N	Y	Y	N
174	Pann Brick Pvt. Ltd.	Brick	Small	Dhankuta	N	Y	Y	Y
175	Ananta Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	Ν
176	Himalaya Brick Ind.	Brick	Small	Sunsari	N	Y	Y	Ν
177	Pashupati Brick Ind.	Brick	Small	Sunsari	N	Y	Y	Ν
178	Tawache Brick Ind. Pvt. Ltd.	Brick	Small	Sunsari	N	Y	Y	Ν
179	New Jay Nepal Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	Ν
180	Jay Shree Hari Itta Udhyog Pvt. Ltd.	Brick	Small	Sunsari	N	Y	Y	Ν
181	Puja Itta Udhyog	Brick	Small	Sunsari	Ν	Y	Y	Ν
182	Pabitra Itta Bhatta Udhyog	Brick	Small	Sunsari	N	Y	Y	Ν
183	Shambhu Itta Udhyog	Brick	Small	Sunsari	Ν	Y	Y	Ν
184	Kailas Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	Ν
185	Jay Nepal Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	Ν
186	Jay Shree Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	N
187	Jyoti Itta Udhyog	Brick	Small	Sunsari	N	Y	Y	N

C N	Name of the Industry	S. 4	G 1	District	E M	NEEP ac	ctivities Env Com	
5. No.	Name of the Industry	Sector	Scale	District	Energy Mgr	Interest	Invest	PCC
188	Maharjan Itta udhyog	Brick	Small	Lalitpur	N	Y	Y	N
189	Ganesh Cold Storage Pvt. Ltd.	Cold Storage	Small	Morang	N	Y	Y	N
190	Ram Janaki Cold Storage Pvt. Ltd.	Cold Storage	Medium	Morang	N	Y	Y	Ν
191	Eastern Cold Storage Pvt. Ltd.	Cold Storage	Small	ll Morang N		Y	Y	N
192	Kavre Panchkhal Cold Storage Pvt. Ltd.	Cold Storage	Medium	Medium Kavre p.c. N		Y	Y	N
193	Palanchowk Bhagwati Cold Storage Pvt. Ltd.	Cold Storage	Medium	Kavre p.c.	N	Y	Y	Ν
194	Royal Cold Storage Pvt. Ltd.	Cold Storage	Small	Jhapa	N	Y	Y	N
195	Shanti Cold Storage Pvt. Ltd.	Cold Storage	Small	Jhapa	Y	Y	Y	Ν
196	Siddhartha Cold Storage & Ice Ind. Pvt. ltd	Cold Storage	Medium	Rupandehi	N	Y	Y	Ν
197	Himalaya Cold Storage Pvt. Ltd.	Cold Storage	Small	Bhaktapur	N	Y	Y	N
198	Bagmati Cold Storage Pvt. Ltd.	Cold Storage	rage Large Bhaktapur		N	Y	Y	N
199	Budhathoki Cold Storage Pvt. Ltd.	Cold Storage	Medium	Medium Kathmandu N		Y	Y	Ν
200	Kohinoor Cold Storage Pvt. Ltd.	Cold Storage	Medium	Kathmandu	N	Y	Y	N

Annex – 5: List of Persons Interviewed with contact

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
1	Bijay Kr. Nidhi	H.R. Manager	Nepal Shalimar Cement Pvt. Ltd.	9854100813/528091	Bara
2	Ishwor Sharma/ Ramjanam Khuswah	Factory Inchrge/Electrical Incharge	Vishwokarma Cement Pvt. Ltd.	9804209256/051-533633/051531453	Parsa
3	Suman Paudel/ Rajesh Agrawal	Marketing Manager / Director	Siddhartha Cement Udhyog	9857023492	Rupandehi
4	L.P. Pandey	Factory Manager	Butwal Cement Mills Pvt. Ltd.	9857023517/01-4215188	Nawalparasi
5	Krishna Pandey / Rajesh Agrawal	Manager / Director	Aarghakhanchi Cement Pvt. Ltd.	9857026938/01-4266140	Rupandehi
6	Nirakar Thapa	Asst. Manager	Chitwan Cement Pvt. Ltd.	9847276436/01-5532460	Nawalparasi
7	Saroj Poudel	Factory Manager	Supreme Cement Pvt. Ltd.	9857021686/01-4260056	Rupandehi
8	Vishal Chetry	Factory Manager	Aarghakhanchi Cement Pvt. Ltd.(Birpur Unit)	9857022774/076-620227	Kapilbastu
9	Bidur Dhungana	G.M.	Jagadamba Cement Ind. Pvt. Ltd.	9857023421/071-622246	Rupandehi
10	Raj Kumar Gupta / G.C. Sukla	General Manager / Production Manager	Nepal Ambuja Cement Udhyog Pvt. Ltd.	9857020252	Rupandehi
11	Rajesh Sharma	General Manager	Goenka Cement Pvt. Ltd.	9727175213/071-520481	Rupandehi
12	Ravi Ranjan Kumar / Swetamber jha	Administrator / G.M.(Tech)	Brij Cement In. Pvt. Ltd.	9857020070/071-621032/521570	Rupandehi
13	Rishi Agrawal	Director	Reliance Cement Pvt. Ltd.	071-622527/620365	Rupandehi
14	Mem Bahadur Singh/ Prasanna Man Shrestha	Mechanical Engineer	Cosmos Cement Industries Pvt. Ltd.	01-4436328/9854020464/	Dhanusha
15	Alok Banjare	Production Manager	Himalaya Cement Pvt. Ltd.	9804936026/023-460110	Jhapa
16	B.S. Shekhawat	G.M.	Mittal Cement Ind. (P) Ltd.	023-456987/023-455987	Jhapa
17	Sndeep Singh Chaudhary	Production Manager	Manosha cement Ind. Pvt. Ltd.	9815962551/023456058	Jhapa
18	Surendra Mahato/ N.P. Sahu	G.M.	Gorakhkali Cement Udhyog Pvt. Ltd.	023-460109	Jhapa
19	Nanda Kishor Sharma	G.M.	Pashupati Cement Pvt. Ltd.	9857022644/076-520344	Kapilbastu
20	Vijaya Kedia	G.M.	Vijaya Cement Pvt. Ltd	076-520026	Kapilbastu
21	Shankar Bhandari	Marketing Manager	Om Cement Pvt. Ltd.	9845029357/01-4240863	Chitwan
22	Raj Kumar Mittal	M.D.	Buddha Cement Pvt. Ltd.	9851025321/076-520340	Kapilbastu
23	Shyam Sundar Sah / Mukhtar Hussain	Accountant / Electrical Incharge	Jay Mangalam Cement Pvt. Ltd.	9848026740/9804550225/9743003198	Banke

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
24	Suman Shrestha / Rabi Chandra Pouel	Production Chief / Mechanical Engineering	Udaypur Cement Industries Ltd.	035-420275/9842827145	Udaypur
25	Anuj Rathi	Director	Maruti Cement Ltd.	9852020643/021-538456	Siraha
26	S.K. Shrivastav / Nabin Kr. Karn	D.G.M./ Asst. Manager	Hetauda Cement Ind. Ltd.	9855067224/9845032291	Makwanpur
27	Sukh Dev Yadav	Senior Staff	Baba Paper Mill Pvt. Ltd.	9852022078/021-526610	Sunsari
28	Arbind Rathi	Asst. Director	Arbind Pulp & Paper Pvt. Ltd.	9852021440/021-524253	Sunsari
29	Shyam Sundar Agrawal	Director	Reliance Paper Mills Pvt. Ltd.	9857020026/01-4230356/4227831	Rupandehi
30	Dhruba Pokhrel	G.M.	M.K. Paper Mills Pvt. Ltd.	9851109886/078-620222	Nawalparasi
31	K.K Saraff/ J.N. Rajak	M.D./Asst. Chief Electrical Engg.	Everest Paper Mills Pvt. Ltd.	041-520512/9801620041	Dhanusha
32	Uday Bista	Factory Manager	Asian Distillery Pvt. Ltd	5522010	Parsa
33	D.K Rai/ Yadav Ji	Manager	Arati Vegetable Product Pvt. Ltd	4430976/97	Bara
34	Mansur Alam	Electrical Incharge	Sushil Vanaspati Pvt. Ltd	9845040198/051533870	Parsa
35	Hanuman Man Pugalia	Admin. Manager	Nidhi Oil Industries	051-52397	Bara
36	U. C. Rakhecha	G.M.	Nandan Ghee & Oil Ind. Pvt. Ltd	01-4420228	Bara
37	Ganesh More	Manager	Narayani Oil Refinery Udyog	051-531364/-521864	Bara
38	Pramod Kumar	G.M.	Ganpati Vanaspati Pvt. Ltd	051-527534, 01-4260785	Bara
39	Sanjeev Agrawal	Proprieter	Hanuman Adhunik Tel Udyog	051-523718	Bara
40	Manoj Agrawal	Director	Shree Krishna Oil Refinery Veg. Ind Pvt. Ltd	521106	Parsa
41	Suresh Kr. Sharma	G.M.	Annapurna Vegetable Product Pvt. Ldt	051-522668/9725130630	Bara
42	Pankaj Mallik	Utility Incharge	Dabur Nepal Pvt. Ltd.	01-2054533/9845256866/9804244610	Bara
43	G.K. Das	Production Manager	Shree Shiv Shakti Ghee Udyog Pvt. Ltd	01-4100041/42	Bara
44	Brijbhusan Tiwari/ Ashok Somani	Production Incharge	Shree Ram Refine Oil Product Pvt. Ltd	9852020045/9802700147	Morang
45	Parmeshwor Chaudhary/ Ishwori Pd. Adhikari	Asst. Engineer	Biratnagar Milk Supply Scheme	9852028644/9852025661	Morang
46	Binod Jha/ Nandu Acharya	Accountant / Admin Chief	Gokul Diet Food Ind. Pvt. Ltd.	9842230036/9852025543	Morang
47	Ajit Kr. Karn	General Manager	Pashupati Khadhya Tel Udhyog Pvt. Ltd.	9852025693/021-524248	Sunsari

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
48	Ganesh Pyakurel	G. M.	Asian Thai Foods (P). Ltd.	9852020224/021-532812	Sunsari
49	Tika Bd. Katuwal/ Bishnu Bohara	Deputy M.D. / Factory Head	Kamdhenu Dairy & Development Co-Operative Ltd.	025-475507/9841537023	Sunsari
50	Krishna Pd. Neupane	Production Manager	Pashupati Biscuit Ind. Pvt. Ltd.	9842096500/01-4221259	Sunsari
51	K. D. Sharma	Senior Manager	Rijal Tashi Industries Pvt. Ltd.	025-581247/580623	Sunsari
52	Keshab Giri / Sekhar Poudel	Staff	Chutari Food & Confectionary Ind.	9842093558/9852026769	Sunsari
53	Chintamani Upreti	G.M.	United Sprits Nepal Pvt. Ltd.	9852024161/021-420865	Morang
54	P.K. Tripathi	Technical G.M.	Bagmati Oil Industries	021-538159	Morang
55	Dhiraj Shrestha / Pratik Shrestha	M.D./Production Manager	Nobel Dairy Pvt. Ltd.	021-463270/9804324376	Morang
56	Ananta Bista	Deputy Director	J. B. S. Industries	9852046018	Sunsari
57	Bijay Kr. Gupta	Director	Lumbini Sugar Ind. Pvt. Ltd.	9802031723/01-4273401/2	Nawalparasi
58	Zahaid Hai Khan	Manager	Shree Mahalaxmi Sugars Limited	9847042603/9847370680/01-4033292	Kapilbastu
59	Raj Kumar Singh	Factory Manager	Siddhartha Oil Industries	985721280/071-621481	Rupandehi
60	Satendra Singh / Raj kumar Sah	Maintenance Incharge / QC	Sitaram Gokul Milks Ktm. Ltd.	9804342151/9841403151	Kathmandu
61	Pradeep Maharjan	M.D.	Kathmandu Dairy Pvt. Ltd	9851035447/4244155	Kathmandu
62	Shailesh Mishra	Plant Engineer	Bottlers Nepal Limited	4350602	Kathmandu
63	J. Mohan Kumar	Mechanical Engineer	The Nepal Distillary Pvt. Ltd.	4350725	Kathmandu
64	Rajendra Bhandari	Production Manager	Nebico Pvt. Ltd.	9803790628/01-4350130/9842288996	Kathmandu
65	Prem Krishna Nidar	Engineer	Dairy Development Corporation	9841461192/414841	Kathmandu
66	Sanjay Bhandari	Operation Manager	C.G. Foods Nepal Pvt. Ltd	9841225194/5590163	Lalitpur
67	Arniko Rajbhandari	Director	Nepal Dairy Pvt. Ltd.	9851040572/5250368	Lalitpur
68	S.V.S. Rao	Production Manager	Dugar Food and beverage	9801012197/4244352	Kathmandu
69	Bimal Chandra Thakur/ Rana Pratap Singh	Manager / Chief Electrical Engineer	Everest Sugar & Chemical Ind. Pvt. Ltd	9854024652/9854025001/041-520472	Mahotary
70	P.K. Jha	G.M. (Tech.)	Eastern Sugar Mills Pvt. Ltd.	9805331355/025-521029	Sunsari
71	Lalit Raman Chaudhary / Krushna Chandra Swain	Chemist / G.M.	Baba Vegetable Oil Industries Pvt. Ltd.	9722148457/9852023161/021-536872	Morang
72	Krishna Pd. Bashyal / Tika Ram Adhikari	Director / Production Manager	Pokhara Food Pvt. Ltd.	9856023550/9846047706	Kaski
73	Laxman Gauchan	Production Manager	Him-Shree Foods Pvt. Ltd.	9746026099/061-520365	Kaski

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
74	Brihaspati Bhandari	Purchase/ HRD Manager	Pokhara Noodles pvt. Ltd.	9846025559	Kaski
75	Narayan Pd. Bastola	Admin. Manager	Sujal Dairy Pvt. Ltd.	9856027343/061-520460	Kaski
76	P.K. Sharma	Production (G.M.)	Saurabh Oil Mill	9858020211/081-691737	Banke
77	Bikash Basnet / DB Rai	Asst. Manager	United Brewery	9841479845/9845027939	Makwanpur
78	Anjin Giri / Arjun Pd. Humagain	Dairy Engineer	Hetauda Milk Supply Scheme	9745007231/9845106226/057521094	Makwanpur
79	Ramhari Neupane	Admin Chief	Antartic Biscuits Pvt. Ltd.	9855067738/057-521595	Makwanpur
80	Nandlal Chaudhary / Ashok Thakur	Chief Engineer / Deputy Chief Engineer	Indu Shankar Chini Udhyog Ltd.	9802922706/9802922707/046530412	Sarlahi
81	Tek Raj Sharma / Manish K Das	HR Manager / Mfg. Manager	Varun Beverage Pvt. Ltd.	985111180/9851110871	Kathmandu
82	Shyam Malla / Neel Kamal Kaushal	Factory Manager / Head Brewer	Himalayan Brewery Ltd.	9851075922/9841128593/015560557/555	Lalitpur
83	G. S. Shrivastav(HR)/ Dharmendra Jha	Electrical Engineer	Ashok Steel Ind. Pvt. Ltd.	01-4242023/053-520041/45	Bara
84	Laxman Chaudhary/ Rajesh Chaudhary	Electrical Incharge	Bhagawati Steel Ind. Pvt . Ltd	9855026273/01-4241504	Bara
85	Deepak Agrawal	Manager	Jaymatadi Wire Ind.	9855021907/051-521509	Parsa
86	Satya Narayan Keyal/ Prahlad Ray Yogi	Chairman	Narayan Rolling Mills Pvt. Ltd.	580499 (F)/521405(O)	Bara
87	S.B. Thapa	Electrical Incharge	Hanuman Metal Pvt. Ltd.	051-621787; 01-4411187	Bara
88	T. P. Jaisi	Plant Manager	Hama Iron & Steel Ind. Pvt. Ltd./Hama Wire Ind. Pvt. Ltd.	051-520088; 01-4261716	Bara
89	Prem Bd. Shrestha	Admin. Manager	Saakha Steel Ind. Pvt. Ltd.	5200322/4311598	Bara
90	Matadin Verma	G.M.	Rajesh Metal Crafts Ltd.	580495/580490	Bara
91	Sankar Agrawal/ Biswombhar Yadav	G.M.	Bhagawati Rolling Nails Pvt . Ltd	051-580159	Bara
92	Sanjeev Kr. Jha/ Sant Kr. Shrestha	Marketing Representative / Electrical Head	Hulash Wire Ind. Ltd.	9852024029/9842031380	Morang
93	Birendra Dev	Plant Engineer	Pioneer Wire Ind. Pvt. Ltd.	9841351188/021-530934/5	Morang
94	T.C. Gupta	Director	Mainbati Steel Ind. Pvt. Ltd.	9852021986/021-527210	Sunsari
95	Raghubir Pandey	Plant Manager	Premier Wires Pvt. Ltd.	021-524075	Sunsari
96	Dinesh Khadgi/ Sanjay Sharma	Technical Manager/ Factory Manager	Pashupati Iron & Steel Pvt. Ltd.	021-527275/523965	Sunsari
S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
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97	Krishna Nepal / Dinesh Khadgi	Production Maanager / Technical Manager	Pashupati Wire Product	9842179695/9852020132	Sunsari
98	Rajeev Shukla	Deputy G.M.	Aarati Strips (P) Ltd.	9852024922/021-421258/261/2	Morang
99	Pradeep Agrawal/Arun Goenka	G.M./ Director	Everest Rolling Industries (P) Ltd.	9857024221/071-520361/521624	Rupandehi
100	Binit Upadhyay / Arun Goenka	Factory Inchrge/Director	Goenka Steels Pvt. Ltd.	071-520361/521481	Rupandehi
101	Bindu Pd. Shrestha	Chief Manager	Panchakanya Steel Pvt. Ltd.	071-562152/01-5526357	Rupandehi
102	Tara Chandra Sharma	G.M.	Bageshwori Iron & Steel Pvt. Ltd.	9858020080/01-4260574	Banke
103	Purna Prasad Singdel/ Matrika Pd. Baral	Maintenance Inchare/Supervisor	Radha Structure & Engineering Pvt. Ltd.	9841561388/9849217270	Bhaktapur
104	Phadindra Dahal	Manager	Narayani Chemical & Perfumory Works Pvt. Ltd	9851129789/051-201056	Parsa
105	Anil Kumar Barnawal	Proprieter	Mahavir Soap Industry	985022920/051-521320/527303	Parsa
106	Umesh Kumar Agrawal	Director	Nepal Chemical & Soap Ind. Pvt. Ltd.	9855020141/051-522141/524687	Parsa
107	D.K. Rai	Manager	Arati Soap & Chemical Ind. Pvt. Ltd	051-580169/70	Bara
108	Madhukar Pandey/ Ajay Upadhyay	Manager	Puja Soap & Chemical Ind Pvt. Ltd	9845253770/053-520096	Bara
109	Jivan Trital	Production Incharge	Golden Star Soap Ind.	98520-27035/021-524571	Morang
110	Shyam Atal/ Narayan Tapedia	G.M./M.D.	Baba Soap Ind. Pvt. Ltd.	9852021551/9852021351/021-534532	Morang
111	Bhuwan Nepal/Dilip Singh	Admin. Manager / Technical Manager	Himgiri Soap & Chemical Ind. Pvt. Ltd.	021-528802/98520-23118	Morang
112	Basudev Karki	Admin. Manager	Bhagwati Soap Ind. Pvt. Ltd.	9852026762/021-421272	Morang
113	Krishna Pd. Sigdel	Proprieter	Sagarmatha Sabun Udhyog	9852021844/021-463499	Morang
114	Dhani Lal Kamat	Production Incharge	Moti Soap & Chemical Ind.	9842354419/021-463120	Morang
115	Akhil Kr. Karn	Production Manager	Swadeshi Sabun Udhyog Pvt. Ltd.	9852024067/021-524248	Sunsari
116	Laxman Bd. Karki	Accountant	Shivshakti Soap Industries	9847047495/071541428	Rupandehi
117	Anish Kasaudhan	Manager	J. K. Soap & Chemical Pvt. Ltd.	9857030600/071-543628	Rupandehi
118	Santosh Kasaudhan	Marketing Manager	Mahakali Oleo Chemical Pvt. Ltd.	9857029140/071-560856	Rupandehi
119	D.D. Sapkota	Plant Manager	Ganga Soap & Chemical Ind.	9845104945/057-521001	Makwanpur
120	Narayan Singh Basnet	Factory Manager	National Soap & Chemical Ind.	9725739279/057-521609	Makwanpur

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
121	Shankar Adhikari	Production Incharge	Unique Soap & Chemical Ind.	9845125041/057-522033	Makwanpur
122	Sanjay Kr. Yadav / Bishnu Pd. Chaulagai	Electrical Incharge / Production Manager	Unilever Nepal Ltd.	9845022845/9855067668	Makwanpur
123	Sudip Kr. Pandit	Front Office Manager	Hotel Kailash	9854215698/051-522384	Parsa
124	Hari Pd. Giri/ Pramod Paudel	Proprieter / Accountant	Hira Plaza	9845062029/523988	Parsa
125	Mrs. Usha Shah	M.D.	Hotel samjhana	9855022245/522122	Parsa
126	Mr. K.M. Shrestha	M.D.	Hotel Diyalo Pvt Ltd	522370	Parsa
127	Mohan Pradhan	Manager	Hotel Makalu Pvt. Ltd.	972513050/051-528500/526932	Parsa
128	Rajan Shrestha	Proprieter	Hotel Swagatam	9852020177/021-470599	Morang
129	Uttam Bir Pandey	M.D.	Hotel Eastern Star Pvt. Ltd.	98520-20056/021-472626	Morang
130	Kishor Niraula	Manager	Hotel Xenial	9842130120/021-472950/51/52/53	Morang
131	Rabindrta Biswan	Engineering Supervisor	Royal Singi Hotel	9841510544/4424190	Kathmandu
132	Kadam Joshi / Srawan Tamrakar	Chief Engineer / Accountant	Hotel Himalaya	5523900	Lalitpur
133	Sanjay Yadav	Asst. Chief Engineer	Hotel Yak & Yeti	9841497228/01-4248999	Kathmandu
134	Uttam Bajracharya / Gopal Shrestha	Manager / Electrical Incharge	Ambassdor Hotel	4414432	Kathmandu
135	Kiran Joshi	Chief Engineer	Radission Hotel Kathmandu	4411818	Kathmandu
136	Sudeep Maharjan	Executive Engineer	Grand Hotel	9803206893/4282482	Kathmandu
137	Vikash Kr. Karna	Asst. Chief Engineer	Soaltee Crowne Plaza	9851125388/4273999 ext. 6700	Kathmandu
138	Rajesh Kr. Sharma	Director	Hotel Orchid Pvt. Ltd.	9851062791/4260706	Kathmandu
139	Chandan Roka	Maintenance Manager	Summit hotel	9851051747/521810	Lalitpur
140	Lalit Garg	Chief Manager	The Everest Hotel	9801087075/4780100	Kathmandu
141	Gautam Joshi	Manager	Hotel Sunset View	4783172	Kathmandu
142	Narendra Malla	G.M.	Hotel Gangjong	4439888	Kathmandu
143	Khalid Kamal / Yuvraj Dulal	Chief Engineer / Asst. Engineer	Shangrila hotel	9849628670/9851042062	Kathmandu
144	Anil Agrawal	Proprieter	Hotel Maharaja Palace	4113677/76	Kathmandu
145	Rewat Bd. Thapa / Shambhu Budhathoki	M.D./ Accountant	Hotel Ratna	9841462603/9842073953	Morang
146	Tika Bhattarai	Manager	Hotel Heaven Grand Pvt. Ltd.	9852673147/023-540625	Jhapa

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
147	Bishnu Acharya	Manager	Hotel Daniel Pvt. Ltd.	9842624538/023-543529	Jhapa
148	Pawan Kumar	M.D.	Hotel Pawan International	9857020680/071-523680/523780	Rupandehi
149	Sundar Kr. Shrestha	M.D.	Hotel The Kantipur	9856020170/061-461004	Kaski
150	Tulsi Pd. Lamichne / Din Bandhu Gautam	Asst. F & B Manager / Chief Engineer	Hotel Pokhara Grande	9856030226/9746026155/061-460210	Kaski
151	Gupta Bd. Singh Giri	Front Office Manager	Sangrilla Village Pokhara	9846022272/01-4435743	Kaski
152	Dhan Raj Puri	Maintenance Manager	The Fulbari Resort	9804192534/4462248/4461918	Kaski
153	Kewal Giri	Marketing Manager	Hotel Phewa Prince	9856028618/061-524701	Kaski
154	Laxman Khadka	G.M.	Hotel Landmark Pokhara	9851103347/061-462908/463096	Kaski
155	Anil Shrestha	A/C Manager	Fisti Tail Lodge	9846025026/9801025026	Kaski
156	Raj Kumar KC	Operation Manager	Hotel Barahi	9846038159/061-460617	Kaski
157	Ohm Chaulagai	Front Office Manager	Motel Avocado & Orchid Resort	9845025526/9845025518	Makwanpur
158	Dambar Sharma	Admin. Manager	The Malla Hotel	4418385/4410966	Kathmandu
159	Prachanda Manandhar / Anjan Badgami	Chief Accountant / Chief Engineer	Hotel De'l Annapurna Pvt. Ltd.	9801012551/9801001093	Kathmandu
160	Rajendra ManSing Suwal	G.M.	Kathmandu Guest House Pvt. Ltd.	4700632/114	Kathmandu
161	Ravi nakarmi	Electrical Engineer	Dwarikas Hotel	4479488/319	Kathmandu
162	Mani Ram Parajuli	Proprieter	Birat Itta Udhyog	9752003232/021-526541	Morang
163	Dilip Kr. Agrawal	M.D.	Anand Itta Bhatta Udhyog Pvt. Ltd.	9852020105/021-524595	Sunsari
164	Murari Prasad Regmi	M.D.	Ajanta Itta Udhyog Pvt. Ltd.	9842024205/021-460877	Morang
165	Lilam Basnet	CEO	LB Brick Industry	9852046484/025-581128	Sunsari
166	Lilam Basnet	Proprieter	Prabhu Itta Udhyog	9852046484/025-581128	Sunsari
167	Khagendra Shrestha	Director	Jaya Baba Itta Udhyog Pvt. Ltd.	9852040019/025-580597	Sunsari
168	Santosh Kr. Bhagat/ Ramesh Kr. Bhagat	Director / M.D.	New ACC Itta Udhyog Pvt. Ltd.	9852020308/9842361575	Morang
169	Mahendra Pd. Shah	Proprieter	Shree Jay Nepal Itta Udhyog	98520-21778/021-527861	Sunsari
170	Mukesh Upadhyay	Managing Director	Avi And Shabi VSBK Brick Ind. Pvt. Ltd.	98520-20239/021-531225	Morang
171	Durga Pd. Malla	Managing Director	Bhaktpur Itta Tatha Tile Udhyog Pvt. Ltd.	9851086602	Bhaktapur

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
172	Thakur Pd. Sharma	Proprieter	Pashupati VSBK Brick Ind.	9857030148/9814266694/078-545060	Nawalparasi
173	Mana Nath Duwadi	Manager	Jay Bageshwori Paschimanchal Itta & tile Factory P. Ltd.	9848180192/01-4229495	Banke
174	Narayan Jun Rai	Director	Pann Brick Pvt. Ltd.	9841439565	Dhankuta
175	Dilip Kr. Agrawal	Proprieter	Ananta Itta Udhyog	9852020105	Sunsari
176	Shiva Kr. Limbu	Proprieter	Himalaya Brick Ind.	9852049126	Sunsari
177	Nawaraj Kafle	Proprieter	Pashupati Brick Ind.	9852045154	Sunsari
178	Mahendra Agrawal	Proprieter	Tawache Brick Ind. Pvt. Ltd.	9842105511	Sunsari
179	Binod Agrawal / Khagendra Basnet	Proprieter / Manager	New Jay Nepal Itta Udhyog	025-582388	Sunsari
180	Purushowtam Manandhar	Proprieter	Jay Shree Hari Itta Udhyog Pvt. Ltd.	9852020265	Sunsari
181	Prem Basnet / Ram Lal Chaudhari	Proprieter / Manager	Puja Itta Udhyog	9852048981	Sunsari
182	Laxman Rai / Bhotu Rai	Proprieter / Manager	Pabitra Itta Bhatta Udhyog	9852047620	Sunsari
183	Sambhu B. Thapa / Domi Chaudhari	Proprieter / Manager	Shambhu Itta Udhyog	9842437555	Sunsari
184	Krishna Khatiwada / Kumar Neupane	Proprieter / Manager	Kailas Itta Udhyog	9852054012	Sunsari
185	Mahendra Shah / Padam Pokharel	Proprieter / Manager	Jay Nepal Itta Udhyog	9852021778	Sunsari
186	Chandra Bd. Basnet / Hiranya Ghimire	Proprieter / Manager	Jay Shree Itta Udhyog	025-581023	Sunsari
187	Jyoti Jung Basnet / Dwarika Prasad Shah	Proprieter / Manager	Jyoti Itta Udhyog	9852048173	Sunsari
188	Shyam Maharjan	Proprieter	Maharjan Itta udhyog	9851032642	Lalitpur
189	Keshar Bd. Kathet	M.D.	Ganesh Cold Storage Pvt. Ltd.	9852020263/021-462016/1468	Morang
190	Bijay Sharma	Manager	Ram Janaki Cold Storage Pvt. Ltd.	021-460890	Morang
191	Kishan	Director	Eastern Cold Storage Pvt. Ltd.	9852024813/524027	Morang
192	Badri Tandukar	M.D.	Kavre Panchkhal Cold Storage Pvt. 9851065505/011-664258 Ltd.		Kavre p.c.
193	Ram Prasad Koirala	Manager	Palanchowk Bhagwati Cold Storage Pvt. Ltd. 9841947492/011-499168		Kavre p.c.
194	Hari Upreti	Manager	Royal Cold Storage Pvt. Ltd.	9852672620/023-541933	Jhapa

S. No.	Contact Person	Designation	Name of the Industry	Contact No.	District
195	Khem Kafle / Narayan Neupane	Manager/Director	Shanti Cold Storage Pvt. Ltd.	9842649124/9722345658/023-584467	Jhapa
196	Zakir Hussain	Technical Manager	Siddhartha Cold Storage & Ice Ind. Pvt. ltd	9847111735/01-4221360	Rupandehi
197	Mahendra Man Munangkarmi	Accountant	Himalaya Cold Storage Pvt. Ltd.	9841257170/6610445	Bhaktapur
198	Ram Chandra Thapa	Accountant	Bagmati Cold Storage Pvt. Ltd.	9841217692/6614745	Bhaktapur
199	Tamib Budhathoki	Proprieter	Budhathoki Cold Storage Pvt. Ltd.	9851082659/4278645	Kathmandu
200	Subhag Mal Jammar	G.M.	Kohinoor Cold Storage Pvt. Ltd.	9851090260/4350088	Kathmandu

Annex – 6: Questionnaires

GIZ Nepal

Nepal Energy Efficiency Programme (NEEP)

Questionnaires for

Baseline Study – Cement Sector

Name of In	dustrv					
Sector		Cement				
Scale		1. Small	2.Medium	3. Large		
Year of Est	ablishment					
Year of Op	eration					
Location	Place					
Location	District					
Corporate Name a	Office Address and designation					
		Tel:	Email:			
Name of co interviewed	ntact person I, Designation					
Contact Te	l No.					
		Working Hour per	day:			
Operation		Number of shift:				
		Annual operation days:				
Employment		Male:Female:Total:Any focal person or energy manager for energy activities:YesNoIf Yes, name, qualification and contact number of the person				

1. General information

2. Production Flow Diagram focusing on Energy
Starting from a) Limestoneb) Clinker

3. Production/ Turnover and Production Capacity

			Annual Production						
	Unit	2009/10			2010/11				
Product		Capacity	Quantity	Turnover NPR	Prod ⁿ share %	Capacity	Quantity	Turnover NPR	Prod ⁿ share %

4. Energy Aspects

Type of Energy Used		Unit	Annual Consumption 2066/067		Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	ricity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/ V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. **Diesel Generator**

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

SN	Fauinment	Canacity	Ele	ctrical Drive	e (kW/hp)	Т	hermal
5.11.	Equipment	Capacity	No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

a) Obtained Pollution Control Certificate?

Yes / No.

b) If Yes, Type of Certificate:

Provisional / Permanent

c) Human resources for Environmental Aspects -

S N	Equipment /	Yes/N	Operation Condition		Domarks	
5. IV.	System	0	Good	Satisfactory	Poor	пешатку
Ther	mal		[1 1		1
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Others					
Elect	rical					
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Others					

* mention the type of energy used in the process e.g. electricity, rice husk, FO

10. Estimation of Loss due to load shedding -

11. GIZ Nepal Nepal Energy Efficiency Programme (NEEP) Questionnaires for Baseline Study – Pulp & Paper Sector

1. General information

Name of In	dustry			
Sector				
Scale		1. Small	2.Medium	3. Large
Year of Est	ablishment			
Year of Op	eration			
Location	Place			
Location	District			
Corporate Name a	Office Address and designation			
		Tel:	Email:	
Name of contact person interviewed, Designation				
Contact Te	l No.			
		Working Hour per da	ly:	
Operation		Number of shift:		
		Annual operation day	/S:	
Employment		Male: Any focal person or e If Yes, name, qualific	Female: energy manager for e cation and contact nu	Total: nergy activities: Yes No mber of the person

2. Production Flow Diagram focusing on Energy

3. Production/ Turnover and Production Capacity

			Annual Production								
	Unit	2009/10				2010/11					
Product		Capacity	Quantity	Turnover NPR	Prod ⁿ share %	Capacity	Quantity	Turnover NPR	Prod ⁿ share %		

4. Energy Aspects

Type of Energy Used		Unit	Ann Consur 2066	ual nption /067	Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	·icity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. Diesel Generator

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

S N	Fauinment	Canacity	Eleo	Electrical Drive (kW/hp)			hermal
5.11.	Equipment	Capacity	No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities -Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- Yes / No c) QMS/ISO 9001
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

- a) Obtained Pollution Control Certificate?
- b) If Yes, Type of Certificate:

Yes / No.

c) Human resources for Environmental Aspects -

Provisional / Permanent

S N	Equipment /	Yes/N	Ор	eration Cond	ition	Bomarks
3. 1 1.	System	0	Good	Satisfactory	Poor	ixtilial KS
Ther	mal	Γ	1	1	[1
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Others					
Elect	rical		-			
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Others					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding -

11. GIZ Nepal Nepal Energy Efficiency Programme (NEEP) Questionnaires for Baseline Study – Food Sector

1. General information

Name of In	dustry					
Sector		Food	Subsector:			
Scale		1. Small	2.Medium	3. Large		
Year of Est	ablishment					
Year of Op	eration					
Location	Place					
Location	District					
Corporate Office Address Name and designation						
		Tel:	Email:			
Name of co interviewed	ntact person I, Designation					
Contact Te	l No.					
		Working Hour per	day:			
Operation		Number of shift:				
		Annual operation days:				
Employment		Male: Any focal person If Yes, name, qua	Female: or energy manager for energy lification and contact number	Total: activities: Yes No of the person		

2. Production Flow Diagram focusing on Energy

3. Production/ Turnover and Production Capacity

			Annual Production							
	Unit	2009/10				2010/11				
Product		Capacity	Quantity	Turnover NPR	Prod ⁿ share %	Capacity	Quantity	Turnover NPR	Prod ⁿ share %	

4. Energy Aspects

Type of Energy Used		Unit	Ann Consur 2066	ual nption /067	Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	ricity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. Diesel Generator

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

S N Equipment Canaci			Eleo	ctrical Drive	Thermal		
5. 11.	Equipment	Capacity	No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

b) If Yes, Type of Certificate:

- a) Obtained Pollution Control Certificate? Yes / No.
 - Provisional / Permanent
- c) Human resources for Environmental Aspects -

S N	Equipment /	Yes/N	Ор	Operation Condition		Domantia
5. IN.	System	0	Good	Satisfactory	Poor	Kemai ks
Ther	mal		1			1
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Others					
Elect	rical					
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Others					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding –

11. Co-generation Potentials (only for Sugar Mills)

	Capacity	Operating hours/day	Operating days/year
Boiler 1			55
Boiler 2			
Generator 1			
Generator 2			
Sugarcane crushing			

- a. % of Bagasse generated from sugarcane -
- b. Total Production of Bagasse
- c. Current Use of Bagasse
- d. Potential surplus of Bagasse

GIZ Nepal Nepal Energy Efficiency Programme (NEEP) Questionnaires for

Baseline Study – Metal Sector

1. Ocnera				
Name of In	dustry			
Sector		Metal	Subsector:	
Scale		1. Small	2.Medium	3. Large
Year of Est	ablishment			
Year of Op	eration			
T	Place			
Location	District			
Corporate Name a	Office Address and designation			
		Tel:	Email:	
Name of co interviewed	ntact person l, Designation			
Contact Te	l No.			
		Working Hour per	r day:	
Operation		Number of shift:		
		Annual operation	days:	
Employme	nt	Male: Any focal person If Yes, name, qua	Female: or energy manager for energy lification and contact number	Total: y activities: Yes No t of the person

General information 1

2. Production Flow Diagram focusing on Energy

3. Production/ Turnover and Production Capacity

	Unit		Annual Production							
			2009/10			2010/11				
Product		Capacity	Quantity	Turnover NPR	Prod ⁿ share %	Capacity	Quantity	Turnover NPR	Prod ⁿ share %	

4. Energy Aspects

Type of Energy Used		Unit	Annual Consumption 2066/067		Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	ricity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. **Diesel Generator**

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

S N	Fauinmont	Canacity	Elec	ctrical Drive	e (kW/hp)	Т	hermal
5.11.	5. IV. Equipment Capacity	No.	Range	Total Load	Fuel	Consumption	
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

a) Obtained Pollution Control Certificate?

Yes / No.

b) If Yes, Type of Certificate:

Provisional / Permanent

c) Human resources for Environmental Aspects -

S N	Equipment /	Yes/N	Ор	Operation Condition		Bomarks
5.14.	System	0	Good	Satisfactory	Poor	Kennar Ks
Ther	mal			Т	[Γ
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Others					
Elect	rical			·		•
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Others					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding -

GIZ Nepal Nepal Energy Efficiency Programme (NEEP) Questionnaires for Baseline Study – Soap & Chemical Sector

1. Genera	l information							
Name of In	dustry							
Sector		Soap & Chemical						
Scale		1. Small	2.Medium	3. Large				
Year of Est	ablishment							
Year of Op	eration							
T 4 ²	Place							
Location	District							
Corporate Name a	Office Address and designation							
		Tel:	Email:					
Name of co interviewed	ntact person I, Designation							
Contact Te	l No.							
		Working Hour per day:						
Operation		Number of shift:						
		Annual operation da	ays:					
Employment		Male: Any focal person or If Yes, name, qualif	Female: energy manager for e fication and contact nu	Total: energy activities: Yes No umber of the person				

2. Production Flow Diagram focusing on Energy

3. Production/ Turnover and Production Capacity

	Unit	Annual Production								
		2009/10			2010/11					
Product		Capacity	Quantity	Turnover NPR	Prod ⁿ share %	Capacity	Quantity	Turnover NPR	Prod ⁿ share %	

4. Energy Aspects

Type of Energy Used		Unit	Ann Consur 2066	ual nption /067	Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	ricity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. **Diesel Generator**

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

S N	Equipment	Canacity	Eleo	ctrical Drive	Thermal		
5.11.		Capacity	No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

- a) Obtained Pollution Control Certificate? Yes / No.
- b) If Yes, Type of Certificate:

Provisional / Permanent

c) Human resources for Environmental Aspects -

C N	Equipment /	Yes/N	Ope	Operation Condition		Domoulus
5. IN.	System	0	Good	Satisfactory	Poor	кешагкя
Ther	mal		1	1		Γ
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Others					
Elect	rical					
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Others					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding –

GIZ Nepal

Nepal Energy Efficiency Programme (NEEP)

Questionnaires for

Baseline Study – Hotel Sector

Name of In	dustry			
Sector		Hotel		
Scale		1. Small	2.Medium	3. Large
Year of Est	ablishment			
Year of Op	eration			
Lastian	Place			
Location	District			
Corporate Office Address Name and designation				
		Tel:	Email:	
Name of co interviewed	ntact person I, Designation			
Contact Te	l No.			
		Working Hour per o	lay:	
Operation		Number of shift:		
		Annual operation d	ays:	
Employment		Male: Any focal person of If Yes, name, qualit	Female: energy manager for er fication and contact nur	Total: nergy activities: Yes No nber of the person

1. General information

2. Facilities Available:

- a. Restaurant
- b. Swimming Pool
- c. Convention Halls

Rooms	Unit	Annual Production								
		2009/10				2010/11				
		NO.	Average Occupan cy	Turnover NPR	share %	No.	Average Occupan cy	Turnover NPR	share %	
Rooms	Nos.									

3. Production/ Turnover and Production Capacity

4. Energy Aspects

Type of Energy Used		Unit	Ann Consur 2066	ual nption /067	Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	ricity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. Diesel Generator

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

SN	Fauinment	Canacity	Eleo	ctrical Drive	Thermal		
5. 11.	Equipment	Capacity	No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No

8. Environmental Consideration

- a) Solid waste management:
- b) Waste water management:
- c) Human resources for Environmental Aspects :

S. N.	Equipment / System	Yes/No	Operation Condition			Romarks
			Good	Satisfactory	Poor	Kemarks
Thermal						
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Kitchen Equipment					
Electrical						
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Electrical Kitchen Equipment					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding –
GIZ Nepal Nepal Energy Efficiency Programme (NEEP) Questionnaires for Baseline Study – Brick Sector

1. Genera	l information			
Name of In	dustry			
Sector		Brick		
Scale		1. Small	2.Medium	3. Large
Year of Est	tablishment			
Year of Op	eration			
Leastion	Place			
Location	District			
Corporate Office Address Name and designation				
		Tel:	Email:	
Name of co interviewed	ntact person l, Designation			
Contact Te	l No.			
		Working Hour per day:		
Operation		Number of shift:		
		Annual operation days:		
Employment		Male: Any focal person or end If Yes, name, qualificat	Female: ergy manager for energy ion and contact number	Total: activities: Yes No of the person

2. Production Flow Diagram focusing on Energy

Type of Technology:

- a) Traditional Thado Bhatta
- b) Moving Chimney Bull's Trench Kiln
- c) Fixed Chimney Natural Draft
- d) Fixed Chimney Forced Draft
- e) Vertical Shaft Brick Kiln

3. Production/ Turnover and Production Capacity

			Annual Production							
	Unit		2009/10			2010/11				
Product		Capacity	Quantity	Turnover NPR	Prod ⁿ share %	Capacity	Quantity	Turnover NPR	Prod ⁿ share %	
Bricks										

4. Energy Aspects

Type of Energy Used		Unit	Annual Consumption 2066/067		Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	ricity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. <u>Diesel Generator</u>

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

S N	N Equipment Capacity		Eleo	ctrical Drive	Thermal		
5.11.		Capacity	No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

a) Obtained Pollution Control Certificate?

Yes / No.

b) If Yes, Type of Certificate:

Provisional / Permanent

c) Human resources for Environmental Aspects -

S N	Equipment /	Yes/N	Ope	eration Condit	Domorks	
5. IV.	System	0	Good	Satisfactory	Poor	Kennar Ks
Ther	mal	[[1		1
1	Boiler					
2	Steam distribution					
3	Furnace/ Kiln					
4	Insulation					
6	Heat exchanger					
7	Fuel combustion					
8	DG set					
9	Others					
Elect	rical			•		
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapour					
9	Others					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding –

GIZ Nepal Nepal Energy Efficiency Programme (NEEP) Questionnaires for **Baseline Study – Cold Storage Sector**

<u> </u>	l information			
Name of In	dustry			
Sector		Cold Storage		
Scale		1. Small	2.Medium	3. Large
Year of Est	ablishment			
Year of Op	eration			
Lastin	Place			
Location	District			
Corporate Name a	Office Address and designation			
		Tel:	Email:	
Name of co interviewed	ntact person I, Designation			
Contact Te	l No.			
		Working Hour per	day:	
Operation		Number of shift:		
		Annual operation	days:	
Employment		Male: Any focal person of If Yes, name, qual	Female: or energy manager for en ification and contact num	Total: nergy activities: Yes No mber of the person

2. Subsidy for Electricity, if any:

	Annual Production								
G •	Unit		2009/10			2010/11			
Service		Capacity	Quantity	Turnover NPR	Storage share %	Capacity	Quantity	Turnover NPR	Storage share %
Storage									

3. Storage/ Turnover and Storage Capacity

4. Energy Aspects

Type of Energy Used		Unit	Annual Consumption 2066/067		Annual Consumption 2010/11	
			Quantity	Value	Quantity	Value
Electr	·icity	kWh				
	Firewood/wood chips					
	Coal					
	Rice Husk					
	Diesel					
Fuel	Furnace Oil					
	Kerosene					
	LP Gas					
	Waste Lubricant					
	Others					

a. Electrical System

2.000.0000 29.0000		
Electricity Supplier	NEA/Self	
Transformer Capacity	kVA/V Ratio	
Approved Load	kVA	
Maximum Billing	kVA	
Power factor	Power Factor	
Capacitor Bank	kVAR	
Cost per kVA	NPR/Month	
Type of Energy meter	Ordinary/TOD	

b. Diesel Generator

S. N o.	1	2	3
Capacity (kVA)			
Type of Fuel used			
Operating Hours/day			
Operating days/year			
Fuel consumption/ hour			

S. N.	Equipment	Capacity	Eleo	ctrical Drive	Thermal		
			No.	Range	Total Load	Fuel	Consumption
1							
2							
3							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

5. Major Plant Machinery and Equipment (focusing on energy use)

6. Energy Saving Programme

- a. Have you taken part in EE or CP Yes / No;
- b. If yes, when and with which organization
- c. Major Options generated and implemented
- d. Interest to join NEEP activities Yes / No
- e. Interest to Invest for feasible EE technology / Good housekeeping Yes/ No.

7. Quality/ Management Systems

- a) Quality Lab/ Section Yes/No
- b) Human resource for quality Yes / No
- c) QMS/ISO 9001 Yes / No
- d) EMS/ISO 14001 Yes / No
- e) Nepal Standard (NS) Yes / No

8. Environmental Consideration

- a) Solid waste management
- b) Wastewater Management:
- c) Human resources for Environmental Aspects -

S N	Equipment /	Yes/N	Ор	eration Cond	ition	Domontes
5. IV.	System	0	Good	Satisfactory	Poor	Кешатку
Ther	mal	1		T		Γ
1	Insulation					
2	Heat exchanger					
3	DG set					
4	Others					
Elect	rical		1	1		I
1	Electrical system					
2	Electrical Motor					
3	Compressor					
4	Refrigeration & A/C					
5	Fan /blowers					
6	Pumps					
7	Cooling Tower					
8	Lighting a. Incandescent b. Tube lights c. CFLs d. Sodium Vapor					
9	Others					

9. Observation Remarks

10. Estimation of Loss due to Load Shedding –

Annex – 7: Questionnaire on Interest to Audit and Payment

FNCCI/GIZ – Nepal Energy Efficiency Programme Interest for Energy Audit and Training

Are you interested in Energy Efficiency Training for you or your employees?

- Yes
 If yes, please, indicate in what areas (more than one answer is possible):
 - □ Introduction to Energy Efficiency Awareness
 - Energy Efficiency Policy
 - Energy Management Systems
 - Energy Auditing
 - Industrial Energy Efficiency
 - Energy Efficiency in Buildings
 - □ Energy Efficient Equipments
 - □ Good House Keeping
 - Energy efficiency for plant operators
 - Energy efficiency and management for the particular sectors (e.g. boiler, compressor)

How much would you pay for a 1 day training program?

- □ 1,500 to 2,500 Rs
- □ 2,500 Rs to 5,000 Rs
- 5,000 Rs to 10,000 Rs
- □ More than 10,000 Rs

FNCCI's Energy Efficiency Centre (EEC) can provide for your company professional tailor made 2-days trainings for energy efficiency?

- □ Not interested
- If interested: I would pay per employee?
 - \Box Less than 5,000 Rs
 - □ 5,000 Rs to 10,000 Rs
 - □ 10,000 Rs to 15,000 Rs
 - \Box More than 15,000 Rs

FNCCI's Energy Efficiency Centre (EEC) can provide for you a 1 day walkthrough energy audit to identify the areas for energy savings in your production facility.

- □ Not interested
- Interested If interested: I would pay per employee?
 - Less than 1,000 Rs
 - □ 1.000 Rs to 5,000 Rs
 - □ More than 5,000 Rs

FNCCI's Energy Efficiency Centre (EEC) can provide you professional energy auditors to conduct a detailed Energy Audit in your production facility to bring down your energy costs.

- □ Not interested
- If interested: I would pay per detailed audit?
 - Less than 200,000 Rs
 - □ 200,000 Rs to 500,000 Rs
 - □ More than 500,000 Rs

Annex – 8: Results of Interest Survey

Results of the Interest Survey

		Brick	Cement	Cold Storage	Food	Hotel	Metal	Paper	Soap & Chemical	Total
Are you interested i	n Energy Efficiency Training for you or y	our emplo	yees?							
□ Yes		26	25	11	41	36	21	5	14	179
	If yes, please, indicate in what areas (more	e than one	answer is po	ossible):			-	-		
	 Introduction to Energy Efficiency Awareness 	25	23	10	39	33	21	5	14	170
	Energy Efficiency Policy	1	0	1	1	1	0	0	0	4
	Energy Management Systems	0	2	0	4	1	0	0	1	8
	Energy Auditing	2	4	1	3	2	1	0	1	14
	Industrial Energy Efficiency	8	23	6	38	23	21	5	9	133
	Energy Efficiency in Buildings	0	1	0	1	7	0	0	1	10
	Energy Efficient Equipments	0	9	0	6	4	2	1	0	22
	Good House Keeping	3	13	3	8	5	7	5	4	48
	Energy efficiency for plant operators	0	6	0	5	1	2	1	0	15
	 Energy efficiency and management for the particular sectors (e.g. boiler, compressor) 	0	1	0	30	0	3	4	1	39
How much would you pay for a 1 day training program?										
	Free Free	20	10	7	21	24	8	1	7	98
	□ 1,500 to 2,500 Rs	7	15	4	20	14	11	4	2	77
	□ 2,500 Rs to 5,000 Rs			1		1	2		6	10
	□ 5,000 Rs to 10,000 Rs								1	1
	□ More than 10,000 Rs									

		Brick	Cement	Cold Storage	Food	Hotel	Metal	Paper	Soap & Chemical	Total
FNCCI's Energy Efficiency Centre (EEC) can provide for your company professional tailor made 2-days trainings for energy efficiency?										
□ Yes		\13	20	9	39	30	21	4	13	136
	If interested: I would pay per employee?									
	□ Free		7	7	7	4	2	4	2	33
	Less than 5,000 Rs	12	12	1	29	25	19		11	109
	5,000 Rs to 10,000 Rs	1		1		1				3
	□ 10,000 Rs to 15,000 Rs									
	□ More than 15,000 Rs									
FNCCI's Energy Ef	ficiency Centre (EEC) can provide for you	ı a 1 day v	valkthroug	h energy at	ıdit to ide	ntify the a	reas for e	nergy savi	ings in your	
production facility.									, ,	
□ Yes		26	20	7	39	35	21	4	13	165
	If interested: I would pay per employee?									
	□ Free	13	8	2	9	8	2		2	44
	Less than 1,000 Rs	1	10	5	29	26	18	4	10	103
	□ 1,000 Rs to 5,000 Rs	12	1		1	2	1		1	18
	□ More than 5,000 Rs									
FNCCI's Energy Ef	ficiency Centre (EEC) can provide you pr	ofessional	energy aud	litors to co	nduct a d	etailed En	ergy Audi	it in your p	production fa	cility to
bring down your en	ergy costs.					1			II	
□ Yes		3	17	1	19	25	16	1	9	91
	If interested: I would pay per detailed audit?									
	□ Free	3	11	1	18	24	13		8	78
	□ Less than 200,000 Rs		6		1	1	3	1	1	13
	□ 200,000 Rs to 500,000 Rs									
	More than 500,000 Rs									