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CII

Widening the coverage of PAT Scheme

Indian Beverage Industry

December 2013

Disclaimer

This report is part of Shakti Sustainable Energy Foundation (SSEF) and CII – Godrej GBC's effort to highlight energy consumption trends and energy efficiency improvement opportunities of the Indian beverage sector.

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CII would also like extend its sincere thanks to Coca-Cola India for the support extended during the execution of this project.

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List of abbreviations

SSEF	-	Shakti Sustainable Energy Foundation
CII	-	Confederation of Indian Industry
MoP	-	Ministry of Power
BEE	-	Bureau of Energy Efficiency
NMEEE	-	National Mission on Enhanced Energy Efficiency
NAPCC	-	National Action Plan on Climate Change
PAT	-	Perform, Achieve & Trade
SEC	-	Specific Energy Consumption
EE	-	Energy Efficiency
MTOE	-	Metric tons of oil equivalent
CAGR	-	Compound Annual Growth Rate
US	-	United States
CtE	-	Consent to Establish
CtO	-	Consent to Operate
PCB	-	Pollution Control Board
ZLD	-	Zero Liquid Discharge
FO	-	Furnace Oil
LDO	-	Light Diesel Oil
VFD	-	Variable Frequency Drive
DG	-	Diesel Generator

List of Measuring Units

Kg	-	Kilogram
KWh	-	Kilo Watt Hour
kCal	-	kilo Calorie
MTOE	-	Metric Tons of Oil Equivalent
MT	-	Metric Ton

List of Conversion Factors

1 Gcal	=	10^6 kCal
1 kWh	=	860 kCal
1 MTOE	=	10^7 kCal
1 GJ	=	238,846 kCal
1 USD	=	55 Rupees

1. EXECUTIVE SUMMARY

This report is an attempt of CII to provide an overview of the Indian beverage sector's total energy consumption, Specific Energy Consumption (SEC), its variation and the energy reduction potential. The report also highlights the major energy saving opportunities available in the sector and provides an overview of growth opportunities and technology / policy barriers faced by the sector. A set of recommendations which will assist the sector in energy benchmarking and improving energy efficiency have also been highlighted in this report. This report has emerged after a wide stakeholder consultation with sector experts, beverage manufacturing (bottling) plants, and technology suppliers. This report also examines the energy saving possible if a mandatory energy efficiency scheme like Perform Achieve and Trade (PAT Scheme of Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India) scheme is introduced in this sector.

The Indian beverages industry comprises of alcoholic and non-alcoholic beverages. In this report, the non-alcoholic beverage industry, which is categorized into carbonated and non-carbonated beverages, is considered[1]. India accounts for 10% of the global beverage consumption; per capita consumption, however, is quite low compared to the global average. India's non-alcoholic beverage market is estimated to be approximately USD 1.2 billion and is growing at a CAGR of 20%[2].

The study involved secondary research (review of annual reports, data available with CII and other technical reports), visiting various manufacturing facilities and interaction with experts and technology suppliers.

The energy consumption of the sector is estimated by extrapolating the energy consumption data of Coca-Cola.

- **The energy consumption of non-alcoholic beverage industry is estimated to be around 0.13 million MTOE.**
- **The energy consumption of the sector without considering the renewable energy sources is estimated to be 0.11 million MTOE**

From the data available with CII, the energy consumption of one of the largest bottling plants in the country is estimated to be 2,182 MTOE. It is estimated that there are around 100 bottling plants in the country. Considering this and the overall sector's energy consumption number, the MTOE of the bottling plants is estimated to be ranging from 1000-2200 MTOE.

This number is very low compared to the existing PAT sectors. The sector hence is not attractive for consideration into the second PAT cycle.

[1] Tea and coffee are not considered
[2] Ministry of Food Processing Industries

If this sector is included under PAT, it is recommended to set up corporate level targets instead of at individual facility level.

If corporate level targets are set up for a 5% energy reduction over a three year period, the potential energy saving is about 0.006 million (5500) MTOE.

The energy savings potential is estimated to be around 10-15% by implementing the best practices discussed in the report. Along with energy, water is a major concern for the beverage industries and the industries are continuously striving to minimize the specific water consumption (water consumed per litre beverage manufactured).

The recommendations and various measures that need to be taken to further facilitate the sector in improving its energy efficiency include:

1. **Data collection:** Data at individual plant level is not available in public domain. The energy consumption details are not clearly indicated in certain sustainability reports. There are only 5-6 major players in the country which account for a market share of more than 95%. The energy data collection and benchmarking is relatively easy once these players come together.

2. **Setting up of corporate level targets:** Benchmarking can be done at the corporate level for all the major players, and targets can be set up based on year-on-year performance. These major players need to come together and along with BEE can decide on the benchmarks based on their existing energy consumption level and expected future growth. However to ensure the uniformity in energy efficiency across the same company, reporting plant level energy consumption can be made as a mandatory practice.

3. **Energy efficiency at franchise owned bottling plants:** The major players should encourage their franchises to pursue energy efficiency at plant level along with their own bottling plants. Comparison hence can be done across various bottling plants for further improvement. The sharing of best practices across the sector needs to be encouraged.

2 INTRODUCTION

2.1 Sector importance

India contributes to approximately 10% of the global beverage consumption and trails only behind the US and China[3]. India's non-alcoholic beverage market, which comprises carbonated and non-carbonated beverages, is estimated to be approximately USD 1.2 billion and is growing at a CAGR of 20%[4]. The fruit beverage market in India is estimated about USD 0.24 billion[5] and is projected to grow at a CAGR of ~19%. The carbonated beverage market is estimated at USD 0.86 billion and is growing at a rate of 6 to 7% annually[6]. There has been a steady rise in the capacity, production and capacity utilization in the non-carbonated beverage sector.

2.2 International scenario and standing of the sector

The global sales of non-alcoholic beverage industry are at USD 500 billion a year and are expected to touch USD 600 billion[7] by 2015. The global growth rate is at 4-5%.

Though India accounts for about 10%[8] of the global beverage consumption, the per capita consumption is quite low compared to other countries. In terms of per capita volume of sales, India ranked 51 in the world in 2009 in fruit/vegetable juices and bottled water[9].

2.2.1 Non-carbonated beverages

Traditionally, Indians have a fondness for eating fruits or vegetables directly instead of having them in the form of juice. Moreover, people have a preference for fresh juices, sold at juice stalls by local vendors, over packaged drinks. As a result, the annual per capita consumption of packaged juice in India is very low and is estimated at 20 ml[10] compared to China's consumption of 1500 ml.

[3] Draft Red Herring Prospectus, Tunip Agro Limited (derived from CARE research report of May 2010), Sebi.gov.in
[4] Ministry of Food Processing Industries
[5] ASSOCHAM, 2011
[6] Ministry of Food Processing Industries, 2010
[7] http://www.marketresearch.com/First-Research-Inc-v3470/Nonalcoholic-Beverage-Manufacturing-7718186/
[8] Draft Red Herring Prospectus, Tunip Agro Limited (derived from CARE research report of May 2010), Sebi.gov.in
[9] Euromonitor International- Who drinks what, 2nd Edition
[10] Ministry of Food Processing Industries

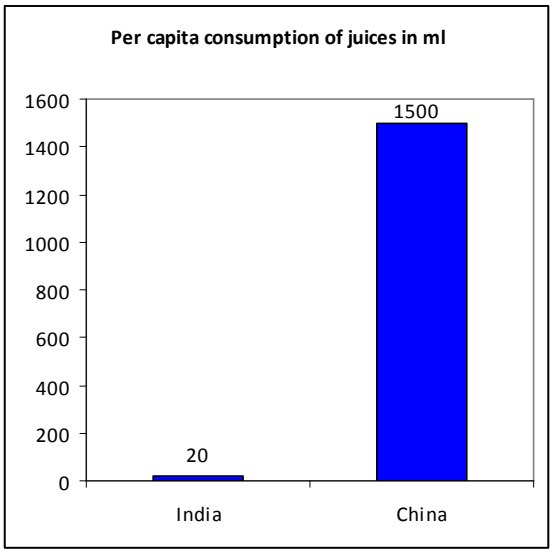

Figure 1: Per capita consumption of fruit juice

2.2.2 Carbonated beverages

The annual per capita consumption[11] of carbonated drinks in India is around 5 to 6 bottles[12] compared to the Philippines (173) and Mexico (605).

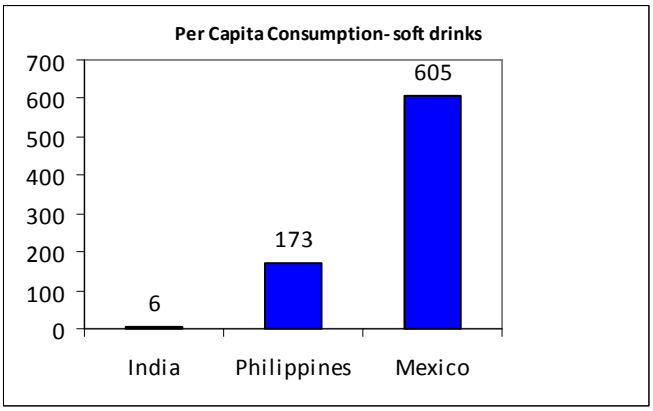

Figure 2: Per Capita Consumption- carbonated beverages

With rising incomes and improving lifestyles, demand for packaged beverages is set to rise. Hence the industry is expected to grow significantly to meet the growing demand.

While the global growth rate is around 4-5%, the non-alcoholic beverage industry in India is growing at a CAGR of 13% since 2009[13]. According to the Ministry of Food Processing Industries, the growth rate is at 20%.

[11] Ministry of Food Processing Industries,2010
[12] Generally US 8 fluid ounces is taken as 1 bottle, which is 1 bottle= 0.24 litres
[13] Indian Beverage Association, http://www.coca-colaindia.com/presscenter/IBA-Growth.html

2.3 Market scenario

In the carbonated beverages segment, according to various estimates, Coca-Cola and PepsiCo hold about 90% market share[14].

The market segmentation for carbonated beverages region-wise is as indicated below[15].

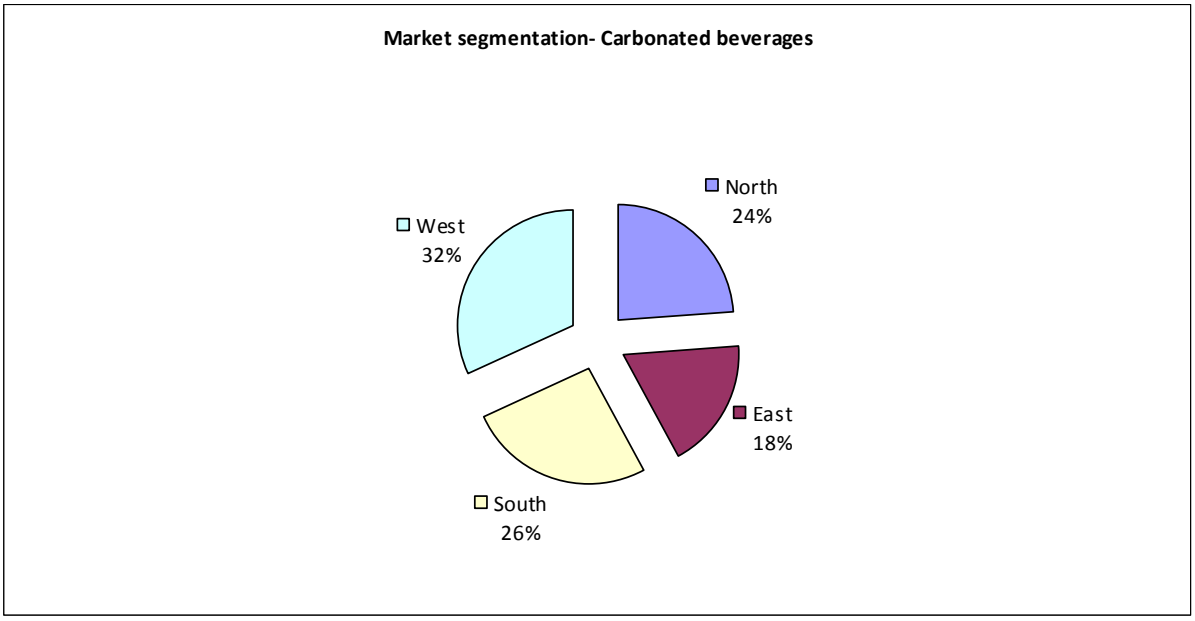

Figure 3: Market segmentation- carbonated beverages

The market segmentation for fruit beverages is as indicated below, with South India accounting for the major share of 65%.

[14] The beverages market for tea and coffee is not considered
[15] Ministry of Food Processing Industries, 2010

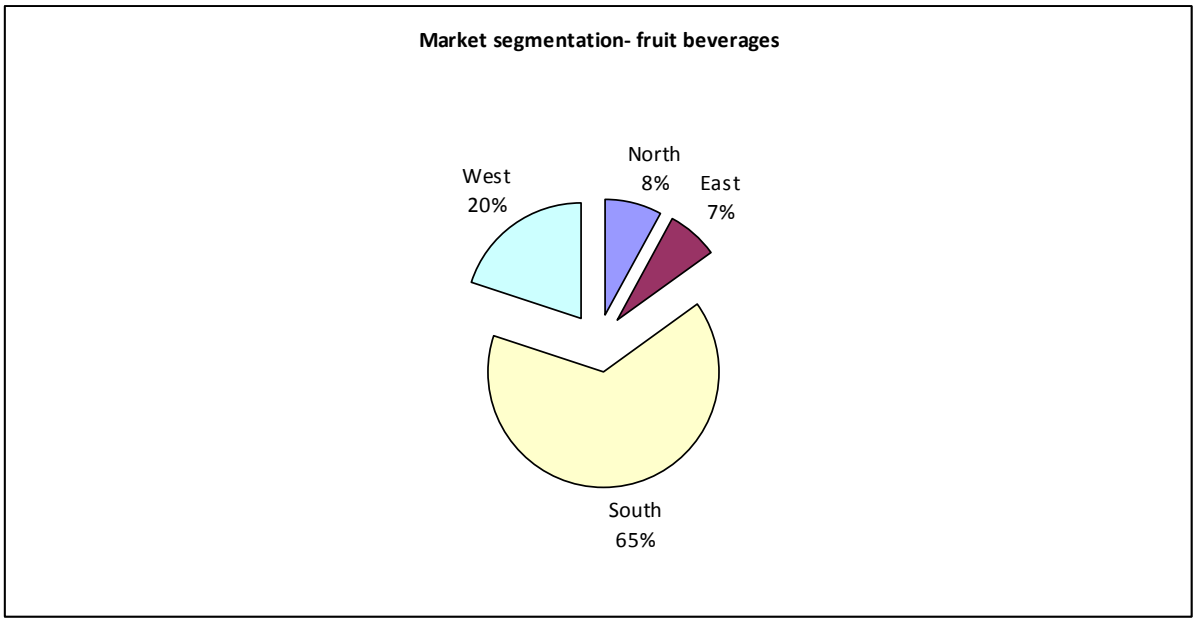

Figure 4: Market segmentation- fruit beverages

2.4 Growth in past & future prospects

In India, the domestic consumption of non-alcoholic beverages was 17.5 billion litres in 2011 and is estimated to reach 35 billion litres by 2015[16].

The growth rates from 1990 to 2010 for carbonated beverages (soft and aerated drinks) and fruit beverages are given below with the projected growth rate for the period 2009 - 2015[17].

Table 1: Growth rates- soft and aerated drinks

Year	Growth rate
1990-91 - 1996-97	9.4%
1996-97 - 2001-02	7.8%
2001-02 - 2006-07	6.5%
2004-05 - 2009-10	5.4%
2009-10 - 2014-15	3.5%

[16] ASSOCHAM, 2011
[17] Ministry of Food Processing Industries, 2010

Table 2: Growth rates: fruit juices & concentrates

Year	Growth rate
1990-91 - 1996-97	40.3%
1996-97 - 2001-02	16.1%
2001-02 - 2006-07	10.3%
2004-05 - 2009-10	9%
2009-10 - 2014-15	8%

2.5 Production data

The demand for soft and aerated drinks and production have been steadily growing over the years as indicated below[18].

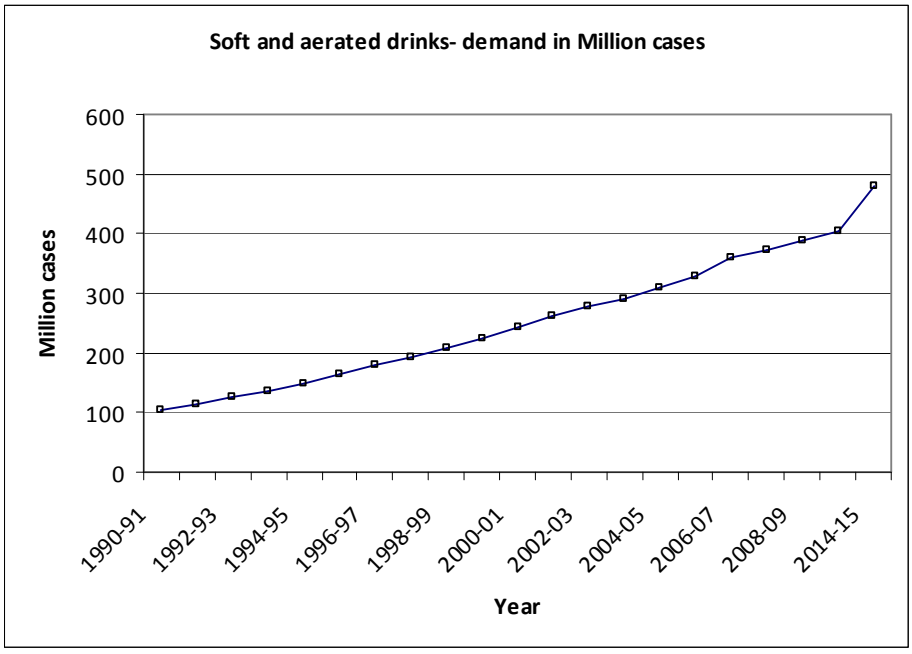

Figure 5: Demand in million cases- Soft & aerated drinks

[18] 1 case = 9 Bulk Litres; Bulk litre is exact volume whereas standard volume is volume at a given temperature

The growth in fruit juices & concentrates over the years, in terms of rupee value is as shown[19].

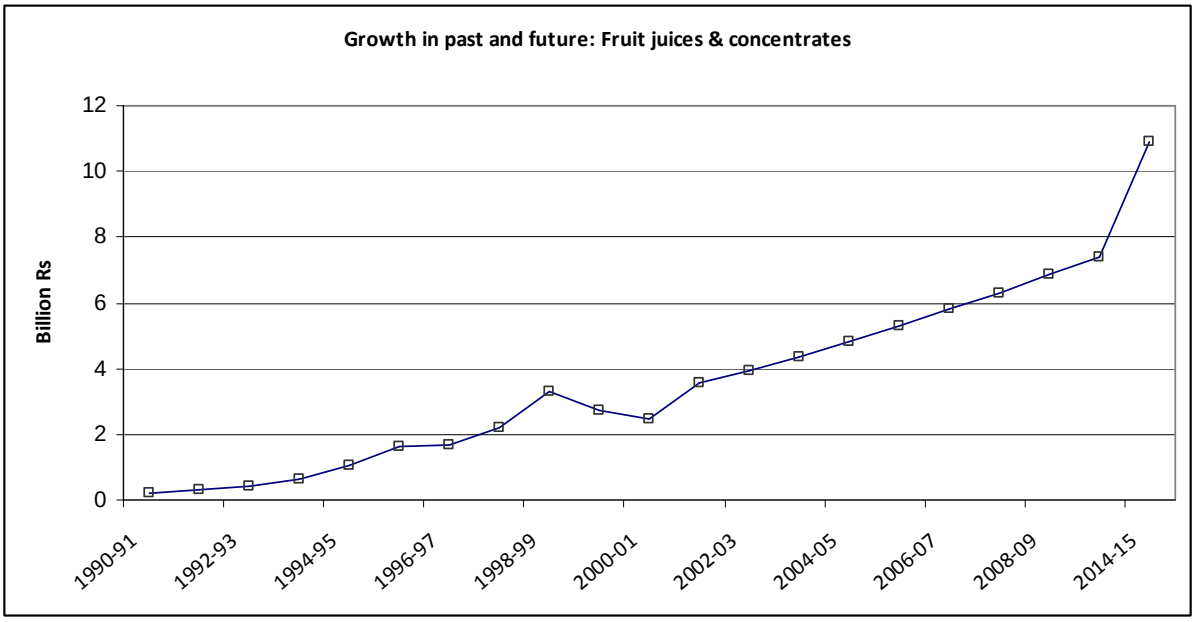

Figure 6: Growth in past and future: fruit juices & concentrates

[19] The production data for non-carbonated beverages is indicated in terms of "billion rupees" in the Ministry of Food Processing Industries data and hence is indicated in the same convention.

The production from fruit processing units in India has gone up from 0.28 million tons in 1990-91 to 0.98 million tons in 1999-00[20]. The production data for the period from December 2011 to may 2012 is as shown below[21].

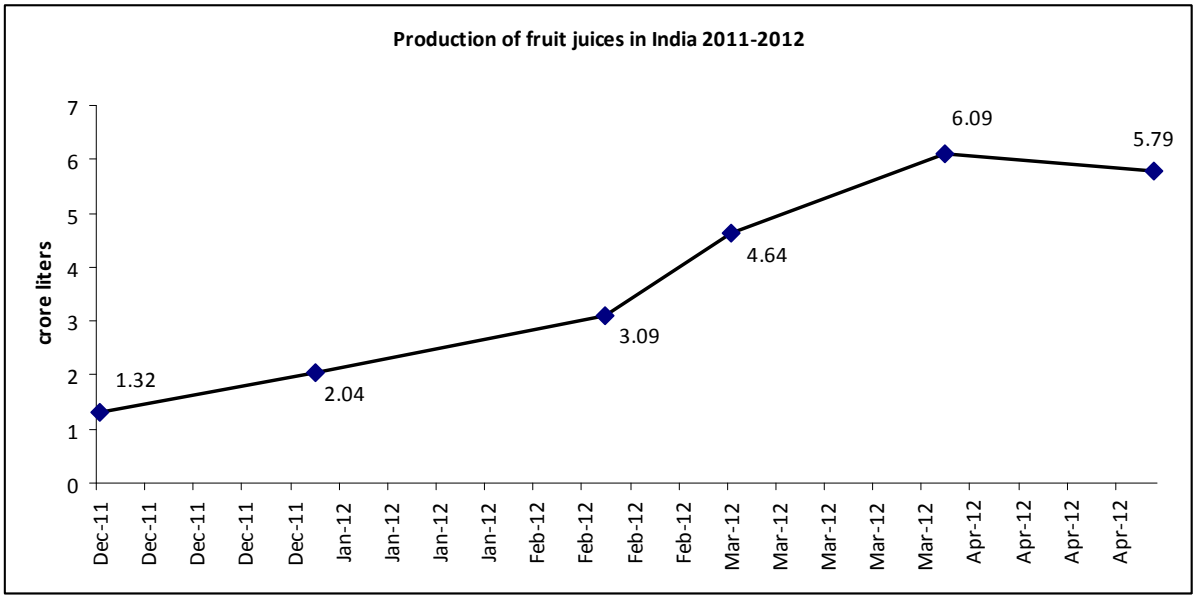

Figure 7: Production of fruit juices in India

2.6 Important stakeholders

The important stakeholders of non-alcoholic beverage industry apart from the manufacturers include

- **Ministry of Food Processing Industries**: The Ministry of Food Processing Industries was established in 1988. The Ministry of Food Processing Industries is concerned with formulation and implementation of the policies & plans for the food processing industries within the overall national priorities and objectives.
- **Indian Beverage Association (IBA)**: The members of IBA include Dabur India Ltd, Red Bull India Pvt. Ltd, Tetra Pak India Pvt. Ltd, Pearl Drinks Ltd, Bengal Beverage Ltd, Jain Irrigation Systems Ltd, Coca-Cola India and Pepsico India Holdings Pvt. Ltd. The Indian Soft Drinks Manufacturers Association (ISDMA) is also a member of the IBA.
- **Bottling units and their franchises**: These units manufacture the beverages in ready to drink form.
- **Local vendors and suppliers**: Local vendors and suppliers hold an important position in the supply chain and distribution channels of the non-alcoholic beverage industry

[20] Ministry of Food Processing Industries
[21] Centre for Monitoring Indian Economy, CMIE

2.7 Product categorization

The non-alcoholic beverages are divided into carbonated and non-carbonated beverages.

❖ **Non-carbonated beverages**

The non-carbonated beverage market comprises mainly of bottled water (with 50% share), packaged juices (29.6% share), functional drinks[22] (10.4% share) and others (9.8% share)[23].

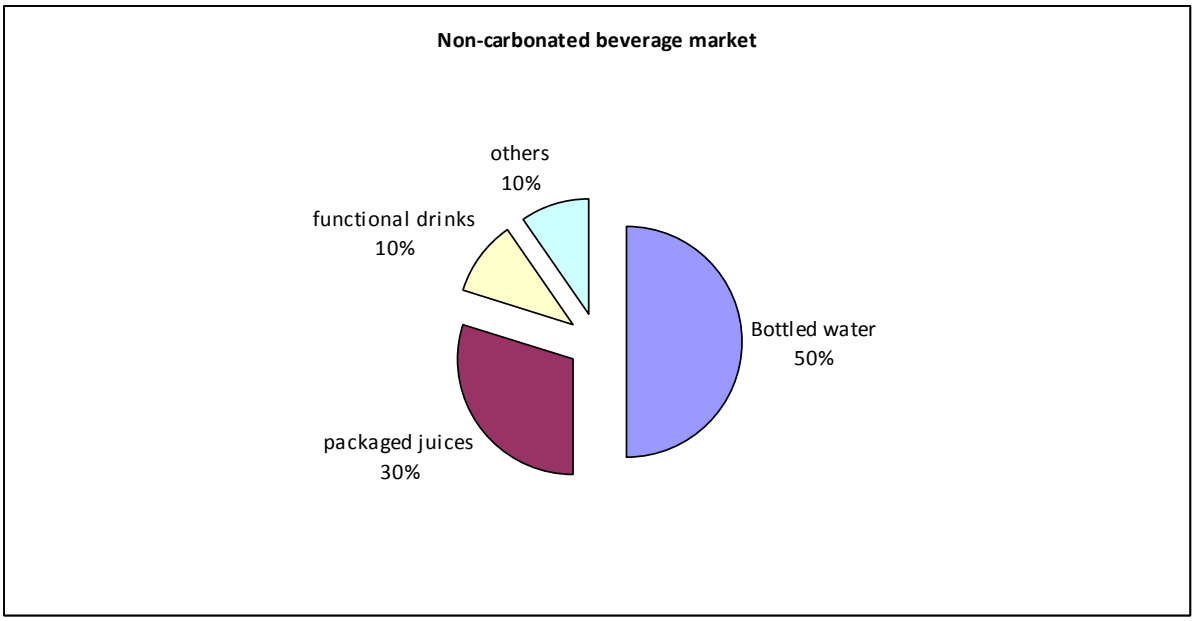

Figure 8: Non- carbonated beverage market

The fruit beverages segment of non-carbonated beverages is again sub-divided into real fruit drinks and synthetic drinks. The real fruit drinks are based on natural fruit pulp or juice. The synthetic drinks are synthetic products containing fruit flavors.

Based on the fruit pulp content in them, the real fruit drinks can be further divided[24] into fruit juices, nectars and fruit drinks. The juices have over 85% pulp content, the pulp content in nectars is between 20% to 85% and in fruit drinks, the pulp content is less than 20%[25].

[22] Energy and sports drinks
[23] Ministry of Food Processing Industries, 2010
[24] According to CODEX general standard for fruit juices and nectars, fruit Nectar is defined as the product obtained by adding water with or without the addition of sugars, honey and/or syrups, and/or food additive sweeteners to fruit juice or fruit concentrate.
[25] Ministry of Food Processing Industries

❖ **Carbonated beverages**

There are two distinct segments of the carbonated beverage market, cola and non-cola drinks. The cola drinks segment holds a share of 62%, while the non-cola segment (soda, clear lime, and cloudy lime) holds the remaining share.

The concentrate is supplied by Coca-Cola and PepsiCo to their own bottling plants and franchise units, where the concentrate is mixed with water and carbon dioxide under pressure and the carbonated beverages are manufactured. A similar process is followed by small manufacturers.

2.8 Major Players

The leading non-carbonated beverage brands include Real, Onjus, Tropicana, Frooti, Jumpin. The major players include Coca-Cola, PepsiCo, Dabur, Pioma industries and Parle Agro.

In India, Coca-Cola and PepsiCo have a combined market share of around 90%, directly or through franchisees. 60% of the bottling units are owned by Indian bottlers in the country, employing about 125,000 people[26]. There are about 21 franchisee bottling operations and 23 company-owned bottling operations of Coca-Cola in India[27]. PepsiCo operates through 20 plants and 23 franchises.[28]

The major independent bottling units include[29]:

Table 3: Major bottling units and their market share

Name of the bottling unit	Market share
Aradhana Beverages	34
Varun Beverages	15
Devyani Beverages	9
Kandhari Beverages	7
Ludhiana Beverages	7
Sri Sarvarya Sugars	6
Pearl Drinks	5
Pearl Beverages	6

[26] Ministry of Food Processing Industries, 2010
[27] Coca-Cola environment report 2009
[28] Ministry of Food Processing Industries
[29] Ministry of Food Processing Industries, 2010

2.9 Current regulatory/policy scenario

The manufacturers have to comply with the following acts and rules[30]:

- Soft drink industries need to obtain license under the Fruit Products Order, 1955. It is a statutory Order issued under the Essential Commodities Act, 1955 and is administered by the Ministry of Food Processing Industries. The standards for Soft drinks have been prescribed under PFA ACT, 1954 and Rules, 1955 under item A.01.01 of Appendix B, under the category of Carbonated Water.

- Apart from these mandatory two standards, the BIS standards are voluntary. The voluntary BIS standard for carbonated beverages (soft drinks) (IS 2346:1992) specifies the quality of water to be used in the manufacturing of soft drinks and its standards for microbiological parameters and heavy metals are for the final product.

- After the finding of residues of pesticide in soft drink samples by Centre for Science and Environment (CSE) a draft notification was issued by the Ministry of Health and Family Welfare specifying the pesticides and heavy metals limits in soft drinks, fruit juice and other beverages. Draft notification no. GSR 685 (E) (Annexure-I) dated 26th August 2003, issued by the Ministry of Health and Family Welfare stipulates the amount of insecticide residues in carbonated water and soft drink concentrates.

- Water is the major concern for bottling plants. The industries need to obtain Consent to Establish (CtE) and Consent to Operate (CtO) as per the Water Act, 1974. The conditions and limits for waste water discharge and pollution control are prescribed under the two consents. The National Water Policy allocates the preference for water usage in the order- drinking water, irrigation, hydro-power, ecology, agro industries and non-agro industries.

- Moreover the bottling plants need to comply with the Zero Liquid Discharge (ZLD) norms of Pollution Control Board (PCB).

Challenges faced by the industry

- With the increasing water scarcity, the availability of water will be a major concern for beverage manufacturers.

- The consumption of beverages depends on the season. As a result, the consumption is not uniform throughout the year.

[30] http://parliamentofindia.nic.in/ls/jpc/chapter2.pdf

3 ENERGY PERFORMANCE

3.1 Sector - level energy performance in recent years

The energy consumption in a typical bottling plant varies widely throughout the year. The major fuel used is furnace oil. In general, energy consumption is monitored and indicated as litres of beverage manufactured per unit of electricity consumed and per litre of furnace oil used.

The energy consumption of an Indian bottling plant is considered in this section. The SEC variation of the plant for the last three years is as shown below[31]. The SEC have been decreasing in the plant over the years owing to adaptation of energy efficient measures like installation of agro waste solid fuel boiler, optimization of blowing pressure for PET bottles, installation of variable frequency drives, improving cooling tower efficiency, energy efficient CFL light fixtures, improvement of power factor, conversion of V- belts to cogged belts etc.

Table 4: Energy performance of a bottling plant

Year	Total energy consumption in kCal/litre	SEC- Electricity in kWh/l of beverage produced	SEC- thermal (FO) in kCal/l of beverage produced
2008-09	179.56	0.083	108.48
2009-10	169.50	0.080	100.15
2010-11	150.86	0.079	82.60
2011-12	122.22	0.076	57.08

Electrical energy contributes to 42% of the total energy consumption whereas thermal energy contribution to total energy consumption is 58%.

3.2 Technological movements

The technological movements in the bottling plants are in the areas of automation and the advancements in the drive systems. Continuous advancements are being carried out in terms of drive technology, control and the logic used. Packaging trends have also been changing. PET bottles have been successful over the years and Tetra Pak is the recent technology adopted in packaging of fruit juices.

The other technological movements include:

- Developments in pasteurizer technology.
- Alternatives to pasteurization such as micro filtration, ultra violet treatment and ultrasonics are being explored.
- Packaging, palleting and transport technology[32]: Generally, different sizes and shapes of empty bottles after use come to the bottling plant without separation at the source.

[31] CII data
[32] http://www5.nord.com/cms/media/documents/bw/PM0001_Abfuell_GB.pdf

The bottles in the crates are automatically identified and moved to the appropriate storage areas. The crates then pass through a crate-washing system. The screw caps, crown caps and other closures are then removed from the bottles. The bottles are then conveyed to washing system, cleaned and defective bottles are rejected. After the filling of these bottles, they are fitted with caps and labeled. They are conveyed to output station where bottles are packed into crates, stacked on pallets and finally transferred to the central storage area. Packaging to ensure beverage quality and avoid contamination is also a major concern.

- Decentralized and integrated drive units and position control: The speed control and drive technology plays a major role in the productivity of the plants. There have been many advancements in this and a drive can be directly controlled with a photoelectric beam detector

3.3 Capacity Utilization

The non-alcoholic beverages market is highly seasonal with peak demand from February to mid-June (summer season). The units operate 24*7 in this period. In the rest of the year, the operation is based on the demand. The average capacity utilization in the industry is estimated to be around 50- 60%.

3.4 Major energy consuming areas

The major processes involved in the production include water purification and de-aeration, mixing of flavor concentrates and sweeteners with water, and addition of carbon dioxide to the drink. The drink mixture is then cooled using ammonia refrigeration and at near saturation level, pressurized carbon dioxide is injected into the liquid. The bottles/cans are then filled under pressure and sealed.

Hence, the major energy consuming process in beverage industry include heating, cooling, refrigeration and energy consumption by bottling units, conveyor belts, motors etc.

The energy consumption breakdown of a typical plant is as follows[33].

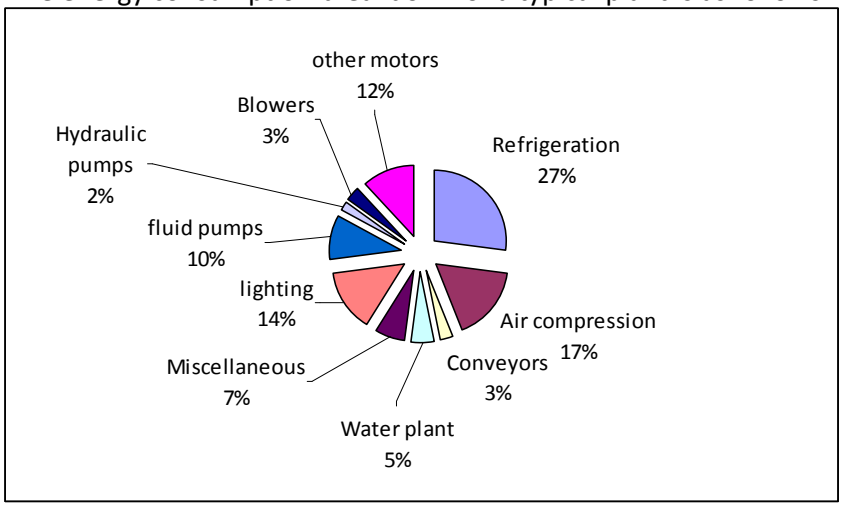

Figure 9: Energy consumption breakdown of a typical plant

[33] Energy Conservation Opportunities in Carbonated Soft Drink Canning/Bottling Facilities, http://repository.tamu.edu/bitstream/handle/1969.1/90981/ESL-IE-02-04-26.pdf

3.5 Energy saving potential

The major energy consuming areas in a bottling plant include heating, refrigeration and drive systems. The energy saving potential, by implementing the possible measures in the areas of conveyors, pumps, refrigeration, water treatment plant and electrical systems, is estimated to be around 10-15%. Equipment is generally designed for the peak load operation, but the design and operating conditions vary widely. This is due to the fact that the operation of the plant is highly seasonal and in off-season, the plant operates at very low capacity.

The possible energy saving measures in a bottling plant are included in this report. Energy saving measures need to be taken up in three areas: process change, maintenance and equipment/plant upgrade. The approach for energy saving is as indicated:

3.5.1 Optimizing the use of existing equipment

a) By effective monitoring and metering of existing equipment, the energy usage at major equipment and sub-processes can be monitored.

b) Intelligent controls need to be installed which switches off the equipment when not in use.

c) Operating temperatures and pressures need to be optimized to avoid un-necessary wastage of energy.

d) Heat gain into refrigeration systems and spaces needs to be minimized.

e) Heat loss from boiler systems, pasteurizers and cooking equipment needs to be minimized.

f) Preventive maintenance measures need to be carried out regularly.

3.5.2 Process innovation and up gradation

a) Alternatives to pasteurization such as micro filtration, ultra violet treatment and ultrasonics can be explored.

b) Recovery of waste heat and its use in the process can be explored.

c) Staged cooling can be used in the process.

The percentage of energy saving by adopting various measures is given below[34].

[34] Australian Industry Group (2010)- Saving energy in the beverage manufacturing industry

Table 5: Energy saving potential

Energy Saving measure	Percentage of energy saving
Reduce chiller energy intensity by: not overloading cool-rooms; loading product when cool; and not overcooling items. Review (and raise if feasible) temperature settings of cool rooms.	>10%
Operate air compressors at the lowest possible settings (e.g. operating at 830 kPa (120 psi) instead of 690 kPa (100 psi) requires 10% more energy but may not be necessary). Locate the compressor air intake where the ambient air temperature is as low as possible.	>10%
Plan longer runs to reduce warm up and cool down time.	5-10%
Turn off air conditioners, compressors, boilers, water heaters when not in use. Use timers to switch them on with sufficient lead time.	<5%
Review air-conditioner settings and widen the temperature band if feasible (e.g. 21-24°C)	<5%
Operate extraction fans only when equipment is in use. Use natural ventilation rather than mechanical ventilation where possible.	<5%
Consider operating costs as well as purchase cost when purchasing new plant and equipment. Energy efficient equipment may be slightly more expensive to purchase, but will cost less over the life of the equipment	<5%
Implement a preventive maintenance program that allocates responsibility for basic lubrication and identification of leaks in air compressors.	<5%
Maintain cool rooms by regularly checking door seals and refrigerant levels of chillers. Turn off compressors when not in use. Insulate pipe work and locate refrigeration heat exchangers away from heat sources such as radiators and air conditioning systems	>10%
Maximise use of natural lighting by installing sky lights with reflective tubes to light areas that are difficult to reach.	<5%
Retrofit variable speed drives (VSD) to motors so that motors can deliver the required loads with less energy and wear and tear.	>10%
Insulate boiler valves, steam and condensate return pipes and storage units to reduce heat loss.	<5%
Capture waste heat from boilers through flue gas heat recovery (~5% energy saving) into incoming water or from boiler blow down flash steam.	>10%
Use sensors for conveyors and other auxiliary plant operation to minimize unnecessary running and energy consumption.	<5%

4 ANALYSIS OF ENERGY CONSUMPTION DATA

4.1 Methodology

The methodology followed in this report for the estimation and analysis of energy consumption data is detailed below:

- Initial desk research was conducted and information was collected from the following secondary sources:
  - Annual reports
  - Sustainability reports
  - Various technical reports
  - Websites of Government Ministries (MOFPI), Associations (IBA, IBEF, etc.) and other stakeholders.
- Interacted with technology suppliers, plant representatives and experts to understand their perspectives & take inputs.
- Since the break-up of energy consumption unit-wise is not available in public domain or through interactions, data from Coca-Cola's annual reports is used to estimate the energy consumption of the sector as a whole.

The following data was considered from the Coca-Cola sustainability report:

- Thermal energy consumption from the following sources:
  - Fuel oil
  - Kerosene
  - Natural gas
  - Propane
  - Bio-fuels/bio-mass
- Electric energy consumption

From the data collected, MTOE is estimated using the following conversion factors:

a) Electrical energy

Total electrical energy in kCal = Total electricity consumed in kWh * 860 kCal/kWh[35]

b) Thermal energy

[35] 1 kilocalorie is equal to 4186.8 joules, and 1 joule/sec = 1 watt. So 1 kWh = 1000 x 3600 watt.secs = 3.6 x 10^6 joules. => 1kWh=860kCal

Thermal energy consumed in kCal= (Fuel 1 X Gross calorific value)+ (Fuel 2 X Gross calorific value) + …….

c) Specific electrical energy consumed per annum

SEC = total electricity (kWh) / L

d) Specific thermal energy consumed

SEC = total thermal energy (kCal) / L

e) Total energy consumption for each plant (MTOE)

$$\text{Total energy consumption} = \frac{\text{Total electrical energy (kCal)} + \text{Total thermal energy (kCal)}}{10{,}000{,}000}$$ [36]

f) MTOE of the entire sector

The Metric tons of oil equivalent (MTOE) is a unit of energy: considered as 10,000,000 kCal.

4.2 Energy consumption of the sector

4.2.1 Coca-Cola

The total direct energy consumption of Coca-Cola in 2011 was 1,920 million mega joules (MJ)[37]. Fuel oil is the major heating fuel. The other fuels that are included are kerosene, propane, natural gas, bio-fuels and bio mass. These account for 45,858 MTOE[38]. If the renewable energy sources are excluded from MTOE calculation, the energy consumption is 1,368 million mega joules and is estimated to be 32,674 MTOE.

The consumption of electricity in 2011 was 785 million mega joules (MJ). This accounts for 18,749 MTOE.

The total MTOE is **64,607 MTOE**[39]. The energy consumption excluding the thermal energy input from renewable sources is 51,423 MTOE.

4.2.2 PepsiCo

Energy consumption data for the other large player in the market, PepsiCo, was not available.

4.2.3 Sectoral energy consumption

The energy consumption of the other companies is available neither in the public domain nor through interactions/questionnaires. Hence Coca-Cola's energy consumption is extrapolated to estimate the overall energy consumption of the sector.

[36] 1 MTOE = 10000000 kCal
[37] Environment Report 2011, Coca-Cola
[38] 1 MJ= 238.846 kCal
[39] Calculated Values on the basis of 1 mega joule= 239 kCal and 1 MTOE (metric tonne of oil equivalent)= 10^7 kCal

Coca-Cola's market share is around 48%. Extrapolating the energy consumption of Coca-Cola to 100% of the market, the MTOE of the non-alcoholic beverages sector is estimated.

The MTOE of the non-alcoholic beverages sector is estimated to be 0.13 million MTOE.

If energy from renewable sources is excluded, the energy consumption is estimated at 0.11 million MTOE.

4.3 Possible EE measures for the sub-sectors

The major energy consuming areas in a bottling plant include heating, refrigeration and drive systems. The energy saving potential, by implementing the possible measures in the areas of conveyors, pumps, refrigeration, water treatment plant and electrical systems, is estimated to be around 10-15%.

4.3.1 Energy saving opportunities for a bottling plant:

The possible energy saving opportunities specific to a bottling plant include:

a) Installation of agro waste solid fuel fired boiler

b) Optimization of blowing pressure for Pet bottles

c) Installation of variable frequency drive for compressors

d) High pressure air leakage reduction & pressure optimization

e) Insulation of chilled water lines and steam lines

f) Conversion of V belts to cogged belts

g) Automation of conveyors & pumps to stop during non-production time

h) Air recovery system to recover blowing machine low pressure return air

i) Installation of energy management system

j) Reducing the size of refrigeration rooms

k) Insulating refrigeration rooms/areas

l) Installing self-locking doors

m) Feeding in beverage at lower temperatures

n) High efficiency chillers

o) Evaporative condensers

p) Combined heat and power systems

q) Manufacturing of CO_2 from the DG / Boiler exhaust

r) Differential temperatures for different aerated drinks depending on the CO_2 absorbed

4.3.2 Pumps and cooling towers

The various energy conservation opportunities in pumps and cooling towers include installation of VFD for pumps (to reduce the impact of harmonics generated in the system by VFD installation, harmonic filters need to be employed along with VFDs), installation of lower size impeller if pump is over capacity, installation of correct size high efficiency pump and avoiding design of pumps with excessive head, optimization of temperature difference across heat exchangers, interlocking the cooling tower fan operation with return water temperature, optimization of range and approach, optimizing cooling water flow, cold well temperature and the operation of cooling tower fans.

4.3.3 Heat & steam distribution- Distribution

Thermal energy accounts for a major share of the energy consumption in a bottling plant. The energy saving measures that can be implemented to optimize the thermal energy consumption include improving and maintaining insulation, monitoring steam traps automatically, recovering flash steam and condensate.

4.3.4 Electrical systems

The energy saving opportunities that can be implemented in transformers include optimization of distribution transformer losses by loading the transformer between (40 %-60 %), isolating the primary of idle–running transformer, increasing the radiators size of power transformers, reducing the tap setting of power/distribution transformer to reduce the voltage, improving the Power factor of transformer, installation of energy efficient amorphous transformer for new installations.

The improvement of power factor by installing capacitor banks, installation of harmonic filters, installation of energy efficient lighting, automation with occupancy & movement sensors, replacing old re-wound motors with new energy efficient motors, installation of soft-starters for lightly loaded motors can offer significant amounts of energy saving.

4.3.5 Boilers & Utilities

The energy saving measures that can be adopted in boilers and utilities include adapting better operational practices like excess air optimization, blow down control & automation, improving insulation in the pipelines and boiler, recovering heat from flue gas to economizers and air-pre heaters and replacing obsolete burners by new optimized boilers.

4.4 Challenges and Recommendations

In terms of energy consumption, when compared to industries like steel, cement and chemicals, the beverages industry is not an intensive consumer of energy. It is estimated that on an average, 10-15% of energy can be saved in bottling plants.

4.4.1 Challenges

The availability of data is a huge concern in the sector. It is estimated that there are around 100 bottling plants in the country, company owned and franchise operated. Except for the consolidated corporate level data of company owned bottling plants, energy consumption at individual facility is not available.

4.4.2 Recommendations

The following recommendations are made to facilitate energy benchmarking and energy efficiency in the sector.

a) Data collection

Data at individual plant level is not available in public domain. The energy consumption details are not clearly indicated in certain sustainability reports. There are only 5-6 major players in the country which account for a market share of more than 95%. The energy data collection and benchmarking is relatively easy once these players come together.

The energy data can be collected in the following format to estimate the consumption and energy reduction potential.

Table 6: Proposed data collection format at individual plant level

Name of the Plant	SEC- electrical in kWh/L or kWh/L	SEC- thermal in kCal/L or furnace oil in kL/L

b) Setting up of corporate level targets

Since 5-6 major players account for more than 95% of the beverage industry, energy reduction targets can be set up at corporate level. These major players need to come together and along with BEE can decide on the benchmarks based on their existing energy consumption level and expected future growth. However to ensure the uniformity in energy efficiency across the same company, reporting plant level energy consumption can be made as a mandatory practice.

c) Energy efficiency at franchise owned bottling plants

The major players should also encourage their franchises to pursue energy efficiency at plant level along with their own bottling plants. Comparison hence can be done across various bottling plants for further improvement. The sharing of best practices across the sector needs to be encouraged.

5. APPLICABILITY OF EXTENDING THIS SECTOR INTO PAT SCHEME

5.1 MTOE threshold and Issues

In the PAT cycle 1 the lowest threshold limit for a plant to become a designated consumer was 3000 MTOE for textile. This was the lowest threshold among the 8 sectors included in the PAT cycle 1.

In PAT cycle 1, the MTOE is estimated based on the energy input to the plant from fossil fuels like coal, furnace oil and their calorific value.

The MTOE of this sector is 0.13 million MTOE and when renewable energy sources are considered, this number further reduces to 0.11 million MTOE. From the data available with CII, the energy consumption of a typical bottling plant, which is one of the largest bottling plants in the country, is estimated. The MTOE of this plant comes around 2,182. Considering this and the overall sector's energy consumption number, the MTOE of the bottling plants is estimated to be ranging from 1000-2200 MTOE.

The MTOE numbers are, therefore, quite low and hence this sector is not attractive for immediate attention in the second cycle of PAT at individual plant level.

However, the consolidated energy consumption of major players at corporate level is high. If this sector is considered under PAT scheme, targets need to be set up at corporate level.

5.2 Potential saving incase extended to PAT scheme

Based on CII's experience and stakeholder consultation in the beverage sector, we believe the sector has energy savings potential of about 10-15% by implementing energy efficiency measures mentioned in this report.

If the sector is included under PAT scheme and corporate level targets are set up for a 5% energy reduction over a three year period, the potential energy saving is about 0.006 million MTOE.

The energy savings are very low and hence the sector is not attractive for immediate consideration into the second PAT cycle. The industry associations (CII, IBA) and BEE can work together with the major players for internal benchmarking to facilitate the sector in further improving its energy efficiency.

6. CONCLUSION

The Indian non-alcoholic beverage market is estimated to be approximately USD 1.2 billion and is growing at a CAGR of 20%[40]. The increasing per capita income, urbanization, shifting of people's preference to packaged drinks and juices is expected to boost the sector further. The present low per capita consumption of beverages in India is expected to increase in the future driving the demand for non-alcoholic beverages.

Thermal energy contributes to significant share of the energy consumption in terms of MTOE. By implementing the energy saving measures detailed in this report, a potential energy saving of 10-15% is possible in the sector.

The energy consumption of the non-alcoholic beverage manufacturing in India is estimated to be 0.13 million MTOE. If the thermal energy input from renewable sources is excluded, the energy consumption is estimated to be 0.11 million MTOE.

The energy consumption at individual bottling plant level is quite low. It is estimated that the energy consumption will range from 1,000 -2,200 MTOE. Hence this sector is not attractive for immediate consideration into the second PAT cycle.

If considered under PAT, it is recommended to set up corporate level targets, as a few major players account for a significant market share. If corporate level targets are set up for a 5% energy reduction over a three year period, the potential energy saving is about 0.006 million MTOE.

[40] Ministry of Food Processing Industries

7. REFERENCES/BIBLIOGRAPHY

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8. ANNEXURE: PROCESS OF MANUFACTURING

Raw materials used:

The raw materials for carbonated beverages manufacturing include concentrate, carbon-dioxide and water. About 94% of the drink is water. The flavor of the drink depends on the balance of sweetness, tartness and acidity (pH). Citric acid is added to enhance the thirst-quenching experience. Other additives and flavors are added to enhance taste aroma and appearance. Preservatives are added to impede the growth of microorganisms and prevent deterioration. Anti-oxidants are added to maintain color and flavor.

The beverages are manufactured at company owned bottling plants or local franchises in India. The manufacturing process includes:

- Clarifying water: The impurities such as suspended particles, bacteria and organic matter which degrade taste and color are removed through a series of coagulation, filtration and chlorination. Alkalinity is adjusted with the addition of lime to reach the desired pH level. The water is filtered, sterilized and dechlorinated. Sterilization is done to destroy the bacteria and organic compounds. Activated carbon dechlorinates the water and removes residual organic matter. Vaccum pump is then used to de-aerate the water before it is passed into a dosing station.

- In the dosing station, the dissolved sugar and flavor concentrates are mixed with the water. The ingredients are carefully mixed and the syrup is sterilized. Sterilization of syrup is done using ultraviolet radiation or flash pasteurization, by quickly heating and cooling the mixture. Pasteurization is done for fruit based syrups generally.

- The syrup and water are then combined in proportioners, by regulating the flow rates and ratios of the liquids. To prevent aeration of the mixture, vessels are pressurized with carbon dioxide.

- To this finished product, carbon dioxide is added. The temperature of the liquid is carefully controlled since carbon dioxide solubility varies with the liquid temperature. The pressure of carbon dioxide depends on the type of soft drink manufactured.

- The finished product is transferred into cans or bottles at extremely high flow rates. The containers are then sealed with pressure-resistant closures.

- The soft drinks must be brought to room temperature before labeling them to prevent condensation from ruining the labels. This is done by spraying the containers with warm water and drying them. The labels are then affixed to the bottles. The containers are then packed into trays or cartons which are then shipped to distributors.

Shakti Sustainable Energy Foundation

Shakti Sustainable Energy Foundation works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency as well as renewable energy. Based on both energy savings and carbon mitigation potential, it focuses on four broad sectors: Power, Transport, Energy Efficiency and Climate Policy. Shakti acts as a systems integrator, bringing together key stakeholders including government, civil society and business in strategic ways, to enable clean energy policies in these sectors.

Shakti is part of an association of technical and policy experts called the ClimateWorks Network. For more information, please visit http://www.shaktifoundation.in

Confederation of Indian Industry (CII)

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative processes. CII is a non-government, not-for-profit, industry led and industry managed organization, playing a proactive role in India's development process. Founded over 116 years ago, it is India's premier business association, with a direct membership of over 8,100 organizations from the private as well as public sectors, including Small and Medium Enterprises (SMEs) and multinationals, and an indirect membership of over 90,000 companies from around 400 national and regional sectoral associations. For more information, please visit www.cii.in

CII - Sohrabji Godrej Green Business Centre (CII - Godrej GBC), a division of CII is India's premier developmental institution, offering advisory services to the industry on environmental aspects and works in the areas of green buildings, energy efficiency, water management, environment management, renewable energy, green business incubation and climate change activities.
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