# CLUSTER PROFILE

## GUJARAT DAIRY CLUSTER

### Background

The Indian dairy industry traditionally comprised unorganized milk producers who were scattered in rural areas and depended on middlemen to sell their produce. On the eve of Independence, the rural milk producers in the state of Gujarat were motivated to organize themselves as cooperatives and thereby obtain control over production, processing and marketing of milk and milk products. This cooperative dairy movement was later institutionalized under an ambitious and innovative nation-wide project called 'Operation Flood', thanks to which India has become the largest milk producer in the world. According to the National Dairy Development Board (NDDB), India produced 132.4 million tonnes of milk in 2012–13. There are currently over 15 million milk producers across the country, organized into 144,500 dairy cooperative societies. The milk is processed in 184 District Co-operative Unions and marketed by 22 State Marketing Federations.

Gujarat is now the fourth largest milk producing state (contributing to about 8% of total production) in the country; in 2012–13, the state produced 10.3 million tonnes of milk (*source*: NDDB). Almost all the districts in the state have milk processing units. Most of these units are identified as SMEs, and members of the Gujarat Cooperative Milk Marketing Federation (GCMMF), the sole agency for marketing the products manufactured by the different milk co-operative member societies in Gujarat under the brand name of 'Amul'. According to GCMMF, Gujarat has 17 District Cooperative Milk Producers' Unions and 17,025 village-level milk cooperative societies with 3.23 million members. The sales turnover in 2013–14 was 181,430 million rupees (USD 3.0 billion).

**Chillling section**

### Technology status and energy use

The basic raw material in the dairy industry is milk (from cows and/or buffalo). As fresh milk is highly perishable, it needs to be chilled to about 4° C and retained at this temperature so that it does not get spoiled during storage and transport for further processing. There are two broad categories of milk processing units: (1) chilling centres; (2) dairies.

Chilling centres are located in remote villages to collect the fresh milk from various local cooperatives. The fresh milk is graded, weighed, chilled, sampled, loaded in tankers and dispatched to processing plants (dairies). Often, chilling centres may have bulk milk cooling tanks (BMCs), which are large storage tanks for chilling and holding the milk at a low temperature till such time as it can be transported to the dairies.

Dairies receive chilled milk from chilling centres and process it to make packaged milk for distribution, as well as to manufacture various products like butter, cheese, curd, ghee, paneer (cottage cheese), milk powders, ice cream, flavoured milk, sweets, etc. In all cases, the first and most important step is pasteurization of the milk to destroy the microbes that would otherwise spoil it. Pasteurization is carried out by heating the milk rapidly to around 80 °C, and holding it at that temperature for about 15 seconds.

#### *Energy use*

Milk processing in a dairy requires both heating and chilling. The major energy consuming equipment and machinery in a typical milk processing unit include:

- Ammonia vapour compression systems (for chilling)
- Boilers (for heating)
- Other auxiliaries like pumps and electric motors
- Dryers (milk powder units)

Pasteurization plant

The major energy sources in milk processing units include electricity, natural gas, furnace oil, light diesel oil, castor oil, de-oiled cake and biomass fuels like wood and saw dust. The total annual energy consumption of dairy industries in Gujarat is about 9344 tonnes of oil equivalent (Table 1) of which about 16% is consumed by chilling centres and 84% by dairies.

The specific energy consumption (SEC) depends on the final product being manufactured by the concerned dairy unit. The SEC for chilling centres is estimated at 0.003 toe/t, and that of dairy units at between 0.084–0.097 toe/t.

**Table 1. Annual energy consumption in Gujarat dairy cluster**

| *Energy source* | *Unit* | *Annual consumption* | | | *toe*⋆ |
|---|---|---|---|---|---|
| | | *Chilling centres* | *Dairies* | *Total* | |
| Electricity | kWh | 7838891 | 27607940 | 35446831 | 3048 |
| FO | GJ | 25182 | 113485 | 138667 | 3312 |
| NG | GJ | – | 108919 | 108919 | 2601 |
| Wood | GJ | 6234 | 6072 | 12306 | 294 |
| LDO | GJ | 344 | 2325 | 2669 | 64 |
| HSD | GJ | 1066 | – | 1066 | 25 |
| | | | | Total | 9344 |

⋆ toe—tonnes of oil equivalent

## Options for energy saving

Various energy audit studies in dairy units (undertaken as a part of the BEE-SME program) in the state of Gujarat indicated a number of energy conservation measures that could be considered by the units through technology upgradation and adoption of better operating practices (Table 2). The total annual energy saving potential through adoption of these measures is estimated at 920 toe (about 10% of the total annual energy consumed by the cluster). An investment of about 89 million rupees is required for implementation of energy conservation measures. The simple payback period on the investments ranges from 5 months to 9 years.

**Table 2. Selected energy conservation measures for units in Gujarat dairy industries**

| *No.* | *Existing system* | *Proposed system* | *Replication potential (units)* | *Total annual energy saving potential* | | *Total investment (Rs million)* |
|---|---|---|---|---|---|---|
| | | | | *Energy/fuel units* | *toe* | |
| *Best available technologies (BAT)* | | | | | | |
| 1 | Hot water generation | Solar energy based hot water generation system | 12 | 95 tonnes FO | 95 | 4 |
| 2 | Refrigeration system | Waste heat recovery by providing de-superheater in ammonia vapour compression based system | 14 | 1050782 kWh | 90 | 6 |
| 3 | Reciprocating compressors | Replacement of reciprocating compressors with screw compressors | 5 | 91332 kWh | 8 | 3 |
| 4 | Ammonia compressor | Soft starter in ammonia compressor for part load operation | 21 | 232344 kWh | 20 | 1 |

**Table 2. Contd...**

| *No.* | *Existing system* | *Proposed system* | *Replication potential (units)* | *Total annual energy saving potential* | | *Total investment (Rs million)* |
|---|---|---|---|---|---|---|
| | | | | *Energy/fuel units* | *toe* | |
| 5 | Condenser water circulation pumps | Providing glass flake coating in impellers and casing of condensate water circulation pumps | 12 | 90461 kWh | 8 | 1 |
| 6 | Pneumatic pouch filling machine | Replacing conventional machine with PLC based mechanical pouch filling machine | 6 | 63360 kWh | 5 | 3 |
| 7 | Refrigeration system | Replace ice bank tank (IBT) system with thermal storage system | 22 | 569160 kWh | 49 | 28 |
| 8 | Cooling tower | Replace metallic blades with FRP blades in cooling towers | 7 | 16200 kWh | 1 | – |
| 9 | Old and conventional motors | Replace with energy efficient motors | 15 | 332899 kWh | 29 | 4 |
| *Best operating practices (BOP)* | | | | | | |
| 1 | Boiler | Improve condensate recovery | 4 | 25.4 tonnes FO | 26 | 0.9 |
| 2 | Steam and hot water lines | Insulation improvements in steam and hot water lines | 22 | 187 tonnes FO | 188 | 1 |
| 3 | Compressor | Reducing operating pressure of compressed air system with proper size of compressed air pipelines | 5 | 17510 kWh | 2 | 0.4 |
| 4 | Lighting | Use of energy efficient lighting system | 22 | 62287 kWh | 5 | 0.9 |
| 5 | Chilled water pipeline | Insulation improvements in chilled water pipeline | 22 | 263376 kWh | 23 | 2 |
| 6 | Chiller compressors | Use of cogged belts in place ofV-belts for reciprocating compressors | 21 | | 13 | – |

*Compiled by TERI from (i) 'Manual on energy conservation measures in Gujarat dairy (SME) cluster, Ahmedabad' under the BEE-SME Program, 2011; (ii) 'Benchmarking and mapping Indian MSMEs energy consumption': a BEE–AfD–TERI study, 2012*