Energy Efficiency in Diary Sector

Program Overview

A.M. NARAYANAN

Energy Management Centre-Kerala

About EMC
www.keralaenergy.gov.in

- Energy Management Centre-Kerala, autonomous organization under the Department of Power, Government of Kerala; established in February **1996**
- The United Nations Industrial Development Organization (**UNIDO**) opened its first Regional Centre for Small Hydro Power in EMC on April 2003
- Government of Kerala designated EMC as the State Designated Agency **(SDA)** in December , 2003 **to coordinate, regulate and enforce the provisions o**f the **Energy Conservation Act, 2001** within the State of Kerala, as per Section 15(d) of the Act
- Secured **Best SDA Award of Govt. Of India in 2008**
- Active since 1996; many pioneering programmes/projects and FIRSTs in EE/EC

FOCUSSED PROGRAMMES AND PROJECTS

SDA ROLES: Facilitator, developer, regulator

- EE & ECO PSUs
- ECC _ EDUCATIONAL INSTITUTIONS
- FACILITATE EA CELL / RESOURCE CENTER
- PROJECTS/THESISIS:ENGG/MANAGEMENT
- ECV – DOMESTIC SECTOR, OTHER CONSUMERS: AWARENESS, SURVEYS
- "OORJA STORE"
- LIGHTING EE: LED BASED LIGHTING
- MUNICIPAL LIGHTING UPGARDE EE
- STAR LABELLING SENSITISATION_MNUFACTURINERE SIDE AND USER- END
- EE EQUIPMENT PENETRATION
- ECBC COMPLIANCE /IMPLEMENTAION
- BLY
- SECONDARY DISTRIBUTION LOSS EVALUATION, MINIMISATION
- PROPOSED EE COMPANY
- ENERGY AUDITS
  - HOTEL
  - HOSPITAL
  - IGEA
  - MSME
- EC POLICY FOR STATE
- ENERGY SAVING PLAN FOR STATE
- WATER PUMPING_ KWA
- DCs
- IMPACT OF EC ACT, 2001

DAIRY SECTOR

"in order to meet the projected demand of 180 million tonnes of milk by 2021-22, milk production in the country has to grow by five million tonnes annually double than the present growth which is 2.5 million tonnes per annum"

Of the total milk produced:

- 50 percent consumed by the village households
- remaining 50 percent marketable surplus.
  - organized sector accounts for 30 percent of marketable surplus.
  - [i.e., 15% of total milk output processed by organized sector]

The national dairy plan to:

- increase share of the organized sector to 65 percent
- to ensure proper payment to producers and stimulate production

Dr. Amrita Patel, Chairperson, National Dairy Development Board (NDDB), 17.2.2010, 38th Dairy Industry Conference (IDC),Bangalore

2007-08

All India :

- Production: 104.8 milion tonnes
- Per capita consumption: 252 gms per day

Kerala:

- Production :2.25 milion tonnes
- Per capita consumption : 181 gms per day

Source:
Department of Animal Husbandry, Dairying & Fisheries,
Ministry of Agriculture, GoI

Milk Procurement and Sales (Ltrs in Lakhs)

In 2009:

Milma

Procured: 2776.92 Lakh Liters of Milk

Sold: 3875.65 Lakh Liters of Milk

Source: http://www.milma.com

Major energy consumption centers:

- Milk Pasteurizer, Cream Pasteurizer, Wash Water Pasteurizer
- Refrigeration System
- Incubator Room having electrical heaters
- Spray Dryers
- Blowers, Air Compressors, Pumps
- Lightings Systems
- Other motive Loads
- Boilers
- DG Sets

Energy used:

Electricity, HSD, FO

%Share of energy in cost: 5 to 7

Potential ECOs identified:
10 % to 15 % of total energy consumption

- Refrigeration System
- Powder Plant
- Compressed Air System
- Dryers
- Boiler and Steam Service
- Powder Packing
- Lighting
- Electrical Demand Management
- Buildings in general

technologies for energy efficiency improvement

- RE: Solar Water Heating System
- Tri-generation system / VAM
- Installation of De-super heater for refrigerant.
- Installing hot water fan coil unit in place of electrical heaters & ceiling fans
- installing VFD on ID & FD fans of Spray dryers
- DG Set performance optimization
- Optimization of compressed air generation and utilization,
- Improvement in Lighting [Lay out/ Lamp/ Luminaire]
- Use of energy efficient pumps
- Improvement in Regeneration ratio of pasteurizers
- introduction of 2 temperature levels for different usage

WHAT IS EE&EC ?

EC :

•Reduce energy consumption

•Minimize wastage

e.g.: switch off

EE:

Reduce energy intensity without affecting output or comfort levels.

e.g.: energy efficient pumping system

EE contributes to EC

EE integral part of energy conservation policies, programs and projects.

Understanding Energy Use Pattern

Process and Equipments, Auxiliaries, with layout and specifications

- EC Profile
  - Purchased Quantity; source; price
  - Self generation
  - Break up w.r.t;
  - Major consumption center, system, equipment [Heads]
  - Data collection, documentation
  - Metered, measured, estimated

How to go about?

ENERGY AUDIT :

Sec. 2, Definition (i) of Energy Conservation Act, 2001

"EA means the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption"

Benchmark Energy Usage: Stage of Production and Plant Services [Bring to common Energy Unit, *except RE*]

Stage of Production	Energy Use (kWh/L)
Receiving	xx
Separation	xx
Homogenization/ Pasteurization	xx
Filling	xx
Cooler*	xx
Plant Services	
Cleaning-in-Place (CIP)	xx
HVAC	xx
Other**	xx
TOTAL	XXX ← Plant Benchmark

* Cooler use differs significantly between plants; comparisons between plants should therefore be made with caution.

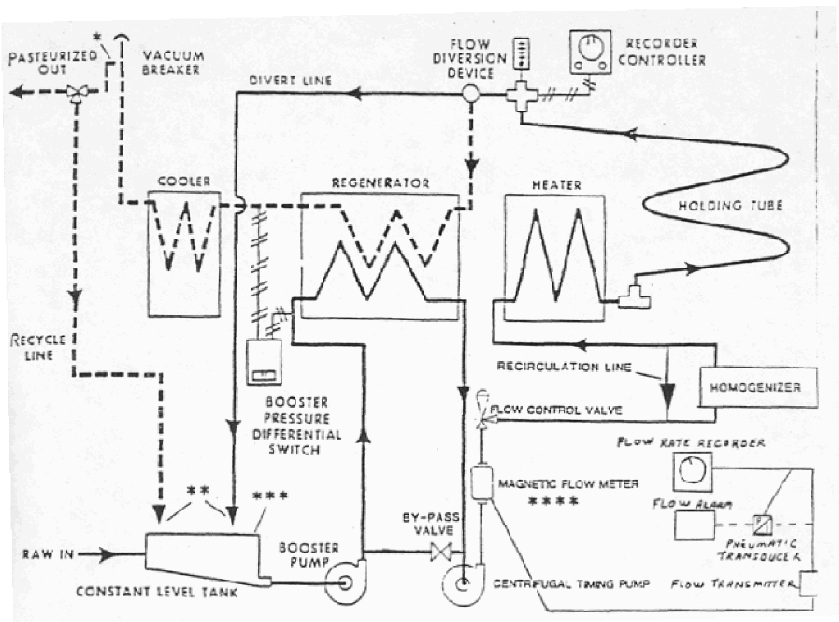
** Includes ice coil, transfers, and case receiving and washing.

Regenerator: Heating and cooling energy can be saved by using a regenerator which utilizes the heat content of the pasteurized milk to warm the incoming cold milk;

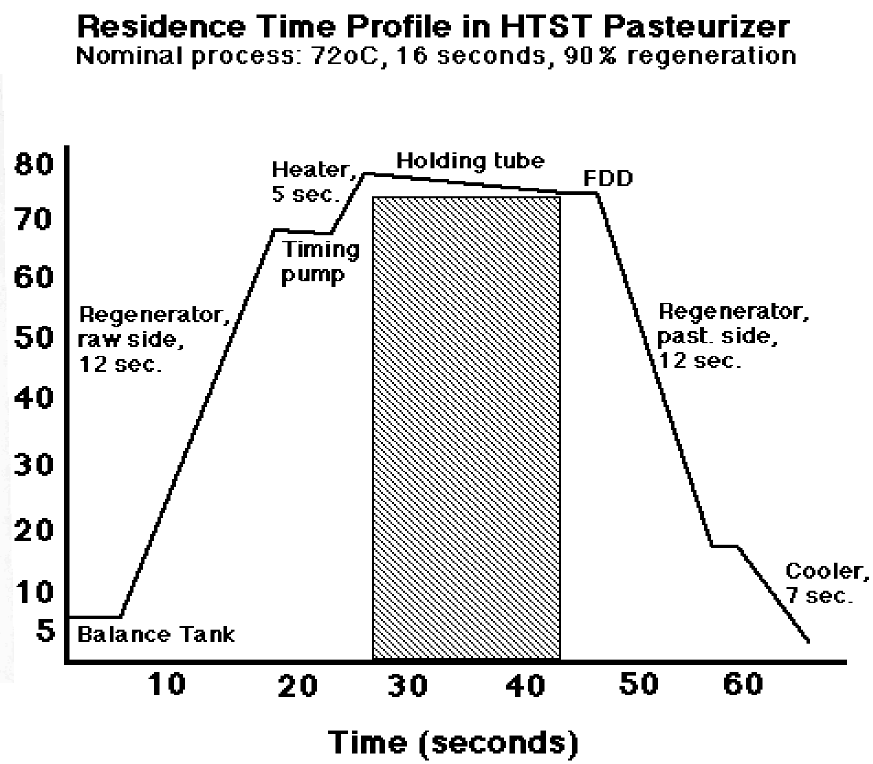
% regeneration = (temp. increase due to regenerator)/(total temp. increase)

For example: Cold milk entering system at 4° C, after regeneration at 65° C, and final temperature of 72° C would have an 89.7% regeneration

HTST pasteurization incorporating magnetic flow meter and centrifugal pump rather than a positive displacement timing pump



high temperature short time (HTST)



Energy-efficient pasteurizer (plate heat exchanger) with 93 percent regeneration

Status : A milk pasteurizer with 30,000 LPH capacity was installed.

Observations

- Low regeneration efficiency (90% regeneration efficiency)
- Higher coli form bacteria content
- Higher steam and chilled water requirements

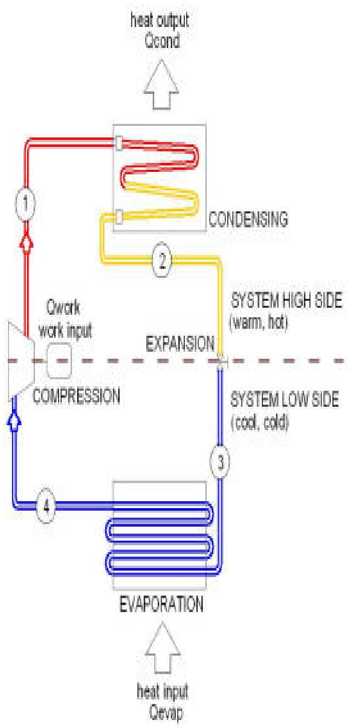
Action taken

- Existing pasteurizer was replaced by a new 30,000 LPH capacity and 93% regeneration efficiency.
- Reduction in steam (gas) consumption was 241.8 tons/year (Rs 241,776 per year); and reduction in refrigeration load due to higher regeneration efficiency - TR.

Payback

- Annual steam (gas) savings ; 365.41 tons, Rs 3.64 lakh
- Annual refrigeration load reduction: 161 ton/day, Rs 2.93 lakh
- Investment: Rs 13.50 lakh
- Payback period: 6 months

Replacement of old ammonia condenser unit, with new one so as to reduce head pressure (discharge pressure) from 200 – 210 psi to 170 – 180 psi.



Suction Pressure = low side pressure or evaporator pressure

Compressor power drops 2% - 3% for each degree F of suction temperature increase.

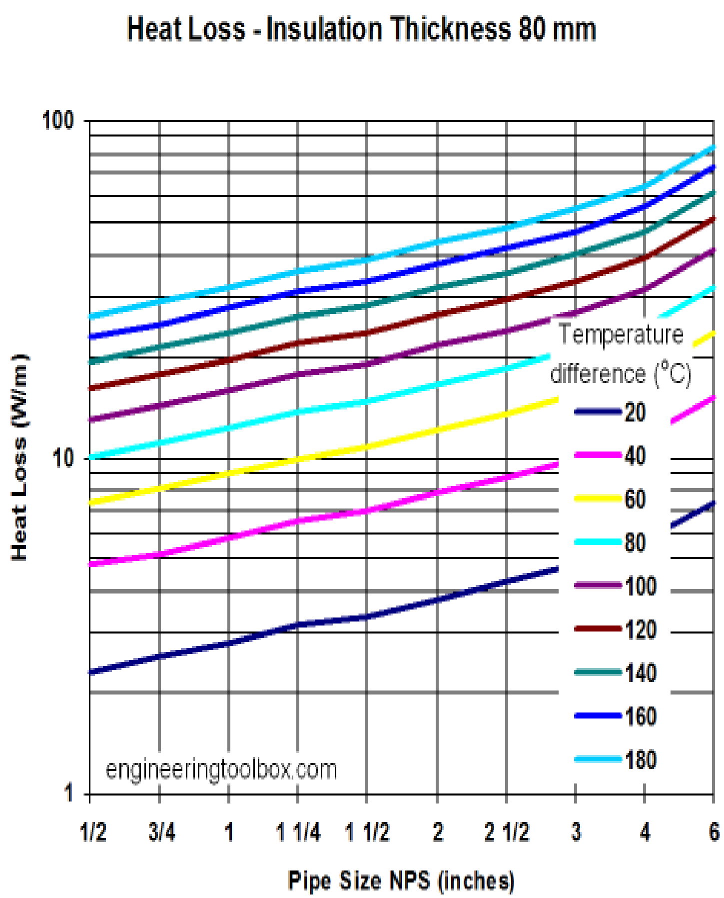
Compressor power drops 1%-1.5% for each degree F of condensing temperature drop.

Reduce "lift" (maximize suction pressure and minimize condensing pressure) to reduce power Condensers are hot (or wet) - outside the refrigerator

The minimum condensing pressure for 60 degree condensing temperature varies with refrigerant.

1) **Ammoniz: 93 psig 2) R12: 72 psig**
2) **3) R134a: 72 psig 4) R22: 116 psig**

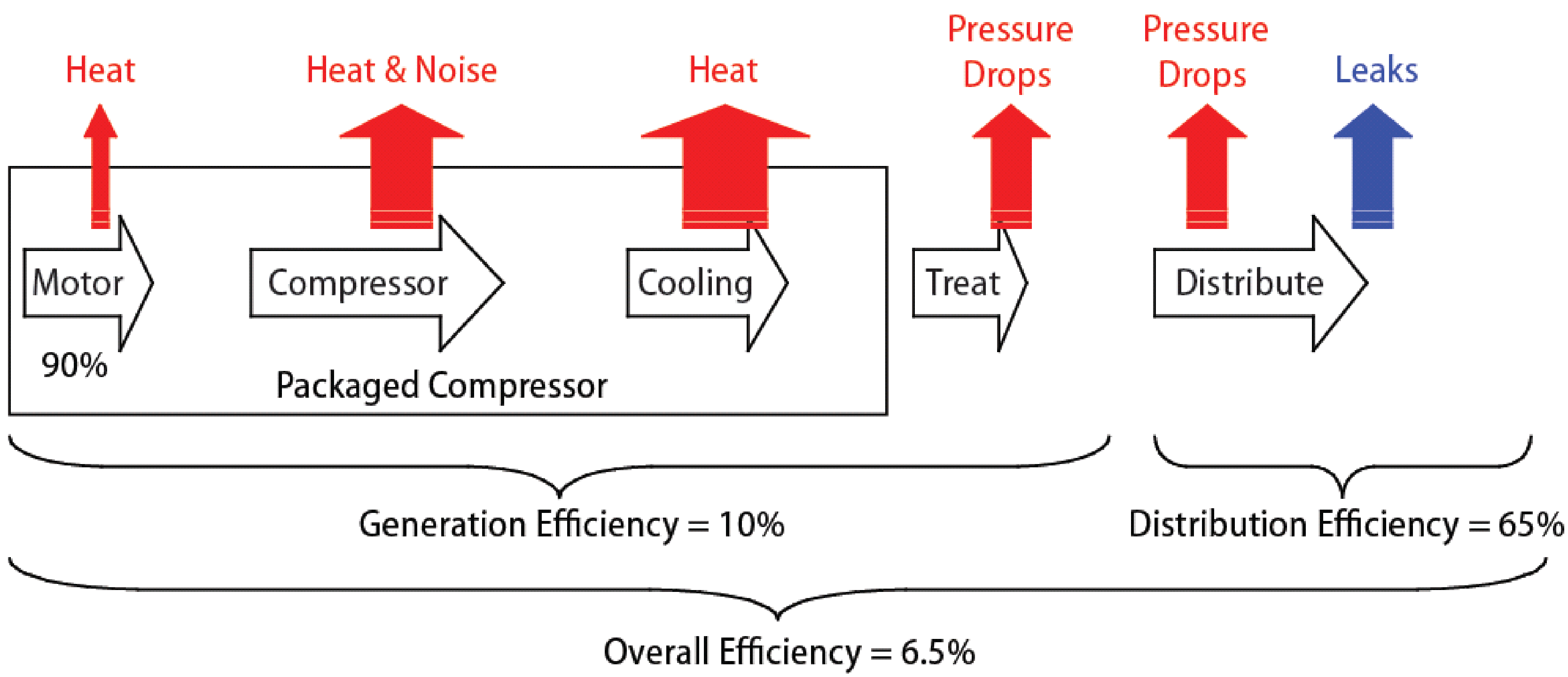
Leakage and Insulation



- proper insulation of steam line; heat transfer area; Ghee boiler ; boiler (reinsulation), outlet pipeline of milk from heating section of Pasteurization Unit, etc.
- Nomograms

timely arresting of steam leakages, compressed air leakages, hot water leakages, etc.

Energy Flow diagram of Compressed air system Energy Flows



solar water heating system

- assistance of MNRE
- Water heated from ambient water temp. to Say, about 85° C which is used for boiler as feed water, etc.
- result into saving furnace oil (or other fuel oil which is used to generate steam) per day, with monetary savings

efficient effluent treatment process

- based on Anaerobic Treatment followed by Aerobic Treatment
- UASB [UPFLOW ANAEROBIC SLUDGE BLANKET] technology

UASB uses anaerobic process whilst forming a blanket of granular sludge which suspends in the tank. Wastewater flows upwards through the blanket and is processed (degraded) by the anaerobic microorganisms. Biogas with a high concentration of methane is produced as a by-product

- BOD reduction of the tune of 18 – 19 % achieved
- gives BOD as low as 7 – 10 BOD (mg/liter), with almost 25 % power consumption as compared to conventional aerobic treatment plant
- in addition bio-gas generated is used for electricity generation.

maximum treated waste water for recycling

- tertiary water treatment technology *(comprising activated carbon filters, sand filters, water softener, ultraviolet treatment, chlorination arrangement, etc.)*
- The water treated used for gardening, drainage cleaning, floor cleaning, crate cleaning, etc.
- Pay back less than a year?

Tertiary Wastewater Treatment : Work out techno-economics

Tertiary treatment after secondary treatment.

- This step removes stubborn contaminants that secondary treatment was not able to clean up.
- Wastewater effluent becomes even cleaner

What if further treatment is needed?

- Treatment levels beyond secondary are called advanced or tertiary treatment.
- Tertiary treatment technologies can be extensions of conventional secondary biological treatment to further stabilize oxygen-demanding substances in the wastewater, or to remove nitrogen and phosphorus.
- Tertiary treatment may also involve physical-chemical separation techniques such as carbon adsorption, flocculation/precipitation, membranes for advanced filtration, ion exchange, and reverse osmosis.

Tertiary Treatment Technologies:

- Membrane Filtration and Separation
- Ultraviolet (UV) Disinfection Systems
- Reverse Osmosis (RO) Systems
- Ion Exchange
- Activated Carbon Adsorption
- Physical/Chemical Treatment

Contamination of ammonia in a refrigeration system

- Contamination of ammonia in a refrigeration system with water, changes thermodynamic and physical properties of ammonia-water solution so that a lower pressure in evaporator has to be maintained to get the same temperature.

- Thus capacity of the system is reduced leading to higher power consumption by the compressors.

- Moreover, chemical properties of aqueous ammonia solution degrades oil forming sludges and causes corrosion in metallic parts and components.

measure the impact of such contamination

- first detect and test the water content actually found in the system
- measure the impact of such contamination on the system capacity and power consumption.
- Such studies revealed that apart from power consumption, there are many other problems associated with water contamination

determine water in ammonia

suitable kit with indigenous components which can determine water in ammonia accurately to a fair degree of reproducibility?

Sample taken	from Pump Separator (-) 10 Deg.C
Time taken in evaporation (minutes)	40
Volume of sample (ml)	100
Volume of residual left (ml)	5
Operating pressure (psig)	28.5
Evaporation factor (EF)	0.92
%age of water	4.5

Any ECO by utilizing steam from sterilizer (of flavored milk)?

new technologies relevant to energy/water efficiency improvement in dairy processing plants ; Pasteurization and Bacterial Control

Non-thermal pasteurization methods and bacterial control:
Benefits: **Primarily Fluid Milk**

- ❖reduced energy use and extended product shelf-life.

❑ Three potential pasteurization technologies at varying stages of development are identified:

- ➢microfiltration
- ➢high hydrostatic pressure
- ➢electrical field effects

new technologies relevant to energy/water efficiency improvement in dairy processing plants ; Pasteurization and Bacterial Control

Ultraviolet light non-thermal bacterial control: **Primarily Fluid Milk and whey(cheese)**

Ultraviolet light systems are already commercialized for such processes as water disinfection in breweries, but are not used extensively in dairies.

Although not directly applicable to milk streams, UV systems of different types are applicable to bacterial control for disinfection of whey and water, such as for re-circulated water flows

Cogeneration

Basic heat-to power ratios of the cogeneration system variants

Cogeneration System	Heat-to-power ratio (kW_{th}/kW_e)	Power Output (as percent of fuel input)	Overall Efficiency %
Back-pressure steam turbine	4.0 – 14.3	14 – 28	84 – 92
Extraction-condensing steam turbine	2.0 – 10	22 – 40	60 – 80
Gas turbine	1.3 – 2.0	24 – 35	70 – 85
Combined cycle (Gas plus steam turbine)	1.0 – 1.7	34 – 40	69 – 83
Reciprocating engine	1.1 – 2.5	33 - 53	75 - 85

- Heat-to-power ratio is one of the vital technical parameters influencing the selection of cogeneration system optimization
- Definition of heat-to-power ratio is thermal energy to electrical energy required by the industry.
- The steam turbine based cogeneration system can be considered over a large range of heat-to-power ratios

new technologies relevant to energy/water efficiency improvement in dairy processing plants
Dried milk and whey(cheese)

Vacuum superheated steam drying:

- This highly efficient drying method, allows for the reuse of recovered evaporation as useful steam.

- Vacuum operation is used to ensure adequately low operating temperature.

- The technology is commercially applied in Europe in other industries.

new technologies relevant to energy/water efficiency improvement in dairy processing plants

Enzyme-based cleaners:

The use of enzyme-based cleaners allows for a reduction of heating requirements for CIP operations.

Enzyme-based cleaning chemicals are now being introduced into the market.

NOW, IN THE LIGHT OF YOUR EXPERIENCE, PRESENT, LISTEN AND INTERACT

- DEBATE AND DEVISE IDENTIFICATION OF ECOs; PROCESS AND METHODS IMPROVEMENT; ANALYSE REPLACEMENT, UPGRADE AND RETROFIT
- GO FOR BEST PRACTICE DOCUMENTATION INCLUDING BEST TOOLS FOR EE EVALUATION
- LET US IDENTIFY AND IMPLEMENT THE MOST SALIENT, HIGH IMPACT ECOS TO PROVE OUR FINDINGS AND FOR ADOPTION OR REPLICATION
- CONDUCT ENERGY AUDIT PERIODICALLY AND KEEP UPDATING

PUBLISH THE SEC / NORMS/ BENCHMARKS AND ALL THE ABOVE IN *MILMA WEB SITE*

SCALE UP AND ELEVATE OUR PROFESSIONAL IDENTITY


Save Energy Save our Planet


Thank You!