# CONCENTRATED SOLAR THERMAL (CST) IN DAIRY



## ABOUT NDDB

- THE NATIONAL DAIRY DEVELOPMENT BOARD HAS BEEN CONSTITUTED AS A BODY CORPORATE AND DECLARED AS AN INSTITUTE OF NATIONAL IMPORTANCE BY AN ACT OF PARLIAMENT.
- FOUNDED IN 1965, STRIVES FOR TRANSFORMING DAIRYING FOR AN INSTRUMENT FOR DEVELOPMENT OF INDIA'S RURAL PEOPLE ESPECIALLY FARMERS.
- LAUNCHED "OPERATION FLOOD" PROGRAMME WITH WORLD BANK LOAN, TO MAKE INDIA AS THE WORLD'S LARGEST MILK PRODUCING NATION.
- PRESENTLY NDDB EMPLOYS AROUND 450 PROFESSIONALS IN VARIOUS FIELDS RELATED TO ESTABLISHMENT OF FARMER MANAGED CO-OPERATIVE DAIRIES, FEED PLANTS, CO-OPERATIVE DEVELOPMENT, TRAINING, ANIMAL HEALTH, NUTRITION, BREEDING ETC



## **ENGINEERING SERVICES**

ENGG GROUP PROVIDES TECHNICAL CONSULTANCY FROM CONCEPT TILL COMMISSIONING FOR :

- MILK PROCESSING PLANT
- MILK POWDER PLANT
- CATTLE FEED PLANT
- BYPASS PROTEIN PLANT & MINERAL MIX PLANT
- MEGA SEMEN STATION
- HIGH SECURITY ANIMAL DISEASE LABORATORY

WITH THE LATEST TECHNOLOGY FOR MAINTAINING :

ENERGY EFFICIENCY / QUALITY / PRODUCTIVITY / FOOD SAFETY / ENVIRONMENT



CHENNARAYAPATNA FOR KMF

## **GLOBAL ENERGY SCENARIO & INDIA ENERGY SITUATION**

- INDIA USED 5.6 % OF GLOBAL ENERGY IN 2017.
- INDIA IS PRESENTLY THIRD ONLY TO CHINA & USA IN GLOBAL ENERGY CONSUMPTION.
- MORE THAN 92 % OF OUR ENERGY NEEDS ARE MET THROUGH FOSSIL FUELS, COAL 56% & CRUDE OIL 30 %.
- RENEWABLES MEET ONLY 7 % OF INDIA'S ENERGY DEMAND.
- WITH THE PRESENT GROWTH RATE, BY 2035, IT IS ESTIMATED THAT INDIA WILL BECOME THE SECOND HIGHEST ENERGY CONSUMER ACCOUNTING FOR 18 % RISE IN GLOBAL CONSUMPTION.

Source : Wikipedia ENERGY POLICY OF INDIA



# WHY SOLAR ENERGY IS IMPORTANT FOR INDIA?

- GOI HAD COMMITTED TO REDUCE THE EMISSION INTENSITY OF GDP LEVELS BY 30-35 % BY 2030, AS COMPARED TO 2005 LEVELS IN THE UN FRAMEWORK CONVENTION ON CLIMATE CHANGE.
- ACHIEMENT: TILL DATE INDIA HAS ACHIEVED 20% REDUCTION BY DEC 2018 AS PER MINISTER FOR ENERGY.
- INTERNATIONAL SOLAR ALLIANCE (ISA), WAS FORMED AFTER RECOGNIZING THE IMPORTANCE OF COUNTRIES LYING BETWEEN TROPICS, FOR ENERGY SECURITY AND SUSTAINABLE DEVELOPMENT.





## SECTOR EXPOSURE TO SOLAR HEATING FOR INDUSTRIAL PROCESS





# SOLAR TO ENERGY CONVERSION

**SOLAR PHOTOVOLTAIC** 

SOLAR THERMAL

COMBINED HEAT & POWER



# HOW DID IT START ?

IN 2015, FORESEEING THE IMMENSE BENEFITS OF CONCENTRATED SOLAR THERMAL(CST), NDDB DECIDED TO INITIATE PROCESS OF IMPLEMENTATION OF CST IN DAIRIES, CONSIDERING ECONOMIC AFFORDABILITY AND LONGTERM BENEFITS TO FARMERS.

A MEETING WAS CALLED IN NOV 2015 INVITING ALL STAKEHOLDERS I.E. DAIRY FEDERATION, UNIONS AND AFFILIATE ORGANIZATIONS, FOR A CONSENSUS FOR IMPLEMENTATION OF CST.



# DECISIONS OF NOV 2015 MEETING

OVERWELMING RESPONSE FROM STAKEHOLDERS, NDDB DECIDED TO IMPLEMENT CST IN DAIRIES.

DECISION TO INITIATE IMPLEMENTAION SOLAR TECHNOLOGIES FOR **LOW PRESSURE (LP) STEAM** (< 3.5 BAR) GENERATION.

MNRE AND UNDP AGREED TO EXTEND SUPPORT FOR SPEEDY, HASSLE-FREE APPROVAL OF CST PROJECT IMPLEMENTATION WITH FINANCIAL ASSISTANCE



# IMPORTANT QUESTIONS BEFORE IMPLEMENTATION

 WHETHER THERMAL ENERGY DELIVERY IS REQUIRED IN THE FORM OF HOT WATER OR STEAM.





 HOW TO MAKE THE SYSTEM COST EFFECTIVE & COMMERCIALLY VIABLE UNDERSIZING
 OVERSIZING
 OVERSIZING

# TYPICAL THERMAL PROFILE IN DAIRY

### **Temperature Profile for Thermal process in Dairy**



**Butter melting** 



## THERMAL USAGE PATTERN IN DAIRIES

### **STEAM LOAD DISTRIBUTION**





## AVAILABLE CONC. SOLAR THERMAL TECHNOLOGIES



# COMPARISON OF CST TECHNOLOGIES

Parameter	Parabolic trough	Paraboloid / Fresnel Dish	Linear Fresnel	Scheffler Dish	Compound Parabolic Concentrator
Working temp	120 -300° C	120-400°C	Upto 400°C	90 -200°C	Upto 140°C
Aperture Area/ Module	10- 50 m <sup>2</sup>	4 – 250 m <sup>2</sup>	20-50 m <sup>2</sup>	5 - 20 m <sup>2</sup>	2-10 m <sup>2</sup>
Advantages	Long time proven reliability & durability	High temperatures , high efficiency	Simple design, lower investment & operating cost	Many installation in India	Uses diffused radiation in addition to direct
	Storage options available	High tolerance of variation in land slope	Tolerance for slight slopes	Suitable for remote area, easy assembly	Stationary & low maintenance
	Direct steam generation proven	High modularity	Direct steam generation proven		Collectors are concentrators
Application	Process heat, power generation	Process heat, Power generation	Power generation	Steam Cooking, wet steam application	Process heat

# COMPARISON OF CST TECHNOLOGIES

Parameter	Parabolic trough	Paraboloid/ Fresnel Dish	Linear Fresnel	Scheffler Dish	Compound Parabolic Concentrator
Disadvantages	Limited temp of heat transfer fluid	Higher cost/m <sup>2</sup> and high precision required.	Large Area requirement	Higher temp applications not possible	Cannot be defocussed
	Complex structure , precision required during construction	Repair & maintenance relatively expensive	Requires flat land	More area required due to reduced efficiency	Cannot deliver steam continuously
	Requires flat land	Generally ground mount	Low efficiency		
Approx. cost of solar field with <b>BOP</b>	20,000 – 27,000/m²	20,000- 30,000/m <sup>2</sup>	17,000 – 20,000/m <sup>2</sup>	18,000 – 22,000/m <sup>2</sup>	19,000 – 24,000/m <sup>2</sup>

SOURCE : NATIONAL LEVEL WORKSHOP CONDUCTED BY MNRE IN NOV 2015 FOR DAIRY SECTOR, NDDB TENDERS



## SHORTLISTED TECHNOLOGIES FOR 85° C WATER GENERATION



# FEATURES OF CST PROJECT IMPLEMENTATION

- FOR THE FIRST TIME IN INDIA, OPEN TENDER SUITABLE FOR 85°C WATER GENERATION HAS BEEN CALLED.
- TARGETTED AVAILABLE TERRACE AREA TO ARRIVE AT HEAT DELIVERY WAS DEFINED :

## **CAPACITY RANGE 5 – 40 LAKH KCAL/DAY**

- ALMOST FULLY AUTOMATED SYSTEM, EXCEPT FOR CLEANING REFLECTORS
- ELIGIBILITY CRITERIA FINALISED BASED ON ACCREDITATION FROM MNRE FOR SELECTED TECHNOLOGY
- REALTIME PERFORMANCE DATA TRANSMISSION FOR REMOTE MONITORING



## HIGHLIGHTS OF EXECUTED

- IMPLEMENTED OF 15 CST INSTALLATIONS BY DEC 2017
- •ADDED 7800m<sup>2</sup> OF APERTURE AREA, AS AGAINST 40,000m<sup>2</sup> IMPLEMENTED THROUGH MNRE IN LAST 5 YEARS
- •TOTAL PROJECTS ESTIMATE ~ INR 17 CRORES.
- •ALL CST PROJECTS BEING IMPLEMENTED IN EXISTING DAIRIES.
- •ABOUT 5 -15% OF PROCESS THERMAL HEAT FROM BOILER BEING REPLACED WITH HEAT FROM CST (YEARLY AVERAGE).
- •APPROX 30 % OF COST IS FINANCIALLY ASSISTED BY MNRE & UNDP.

•NDDB EXECUTED ALL PROJECTS ON PRO-BONO BASIS.



# FINANCIAL ASSISTANCE

**MNRE** SUBSIDY – 30 % ON BENCHMARK COST#

GOVERNMENT OF INDIA MINISTRY OF NEW AND RENEWABLE ENERGY

**UNDP** SUBSIDY – 20 % ON BENCHMARK COST# (SCHEME ENDED ON 31<sup>ST</sup> MAR 17)

### **#BENCHMARK COST :**

- ► TWO AXIS TRACKING SYSTEMS INR 20,000/m<sup>2</sup>.
- SINGLE AXIS TRACKING SYSTEMS WITH GLASS REFLECTORS INR 18,000/m<sup>2</sup>.
- ▶ SINGLE AXIS TRACKING INCLUDING SCHEFFLER' S DISH INR 15,000/m<sup>2</sup>.
- NON TRACKING SYSTEMS INR 12,000/m<sup>2</sup>.
- CONCENTRATOR WITH MANUAL TRACKING INR 7,000/m<sup>2</sup>.

**UNIDO** (UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION) EXTENDS FINANCIAL ASSISTANCE IN FORM OF LOAN FOR IMPLEMENTATION OF SANCTIONED CST PROJECTS UPTO 75 % OF PROJECT COST.

45% SOFT LOAN @ 7% INTEREST RATE (5% SUBVENTION).

30% BRIDGE LOAN @ 12% INTEREST RATE ON MNRE SUBSIDY.

**REMAINING 25% SHALL BE PROMOTER'S CONTRIBUTION** 

NOTE :SUBSIDY ARRIVED ON INSTALLED APERTURE AREA OF CST OR 30 % PROJECT COST, WHICH EVER IS LOWER





	CST PROJECT DETAILS						
	JAMMU & CHINA	Location	Aperture Area (Sq. M)	Project outlay (Rs Cr)	Approx Subsidy (Rs Cr)	Net Invest. (Rs Cr)	Savings /year (Rs Cr)
PAKISTAN	HIMACHAL PRADESH PUNJAB UTTARKHAND HARYANA Delhi NEPAL ARIMCHAL ARIMCHAL DELHI NEPAL ARIMCHAL UTTAR SIKKIAL BHUTAN PRADESH	<b>Punjab</b> (Mohali, Jalandhar, Ludhiana)	2450	5.32	1.47	3.85	0.82
GILLAR	BIHAR BIHAR BANGLADESH MANDUR	Anand, Gujarat (Vidya Dairy)	380	0.93	0.38	0.55	0.12
ARABIAN SEA	MADHYA PRADESH CHHATTIS GARH ODISHA MAHARASTRA GO ANDHRA PRADESH	Kolhapur Dist. Maharashtra (Gokul, Shirol, Bidri, Gadhinglaj, Gogave, Chandgadh)	2700	6.23	1.6	4.62	1
LAKSHADWEEP	KARNATAKA RETAMIL ROTAMIL NADU A L	<b>Karnataka</b> (Bengaluru (3), Ballari, Vijayapur	2250	4.92	1.57	3.35	0.74
	SRI LANKA	TOTAL	7780	16.87	5.02	11.85	2.68
	PAYBACK PERIOD 4 - 5 YEARS CONSIDERING FURNACE OIL @ 35/LITRE						

## **TYPICAL PROCESS FLOW DIAGRAM**



## CST PROJECTS IN KOLHAPUR (60L KCAL/DAY)

#### CHANDGADH (5L KCAL/DAY)



SHIROL SATELLITE# (10L KCAL/DAY)

### **GOGAVE 5L KCAL/DAY**)



**BIDRI# (5L KCAL/DAY)** 

### GADHINGLAJ (5L KCAL/DAY)



### GOKUL DAIRY (30L KCAL/DAY)





## CST PROJECTS IN KARNATAKA (54L KCAL/DAY)

### **BANGALORE (5L KCAL/DAY)**



BANGALORE (20L KCAL/DAY)

#### **BIJAPUR (5L KCAL/DAY)**



BALLARI (9L KCAL/DAY)



### **BANGALORE (15L KCAL/DAY)**





## CST PROJECTS IN PUNJAB (55L KCAL/DAY)

### MOHALI (15L KCAL/DAY)



### LUDHIANA (25L KCAL/DAY)



### JALANDHAR (15L KCAL/DAY)



## TEMPERATURE, RADIATION CURVES

**Recorded system parameters** 



# CONSTRAINTS DURING IMPLEMENTATION

- INDIGENOUS CST TECHNOLOGIES ARE STILL
  UNRELIABLE FOR A 15 YEAR PERFORMANCE.
- SOLUTIONS FOR STEAM GENERATION IS ECONOMICALLY UNVIABLE FOR SMALL & MEDIUM SIZED INSTALLATION (SMALL MODULE SIZES).
- IMPORTED CST ARE EXPENSIVE & ARE ONLY VIABLE FOR LARGE SCALE IMPLEMENTATION.
- PRESENT SUBSIDIES ARE LESS THAN 20% OF THE PROJECT ESTIMATE



# WAY FORWARD TO SCALE UP IMPLEMENTATION

- SCOUT FOR SOURCES TO GET VIABILITY GAP FUNDING FROM MNRE OR DONORS, TILL THE SOLAR THERMAL INDUSTRY IS VIABLE.
- INCENTIVISE LOCAL MANUFACTURERS/ SYSTEM INTEGRATORS.
- PUSH FOR REDUCTION IN DUTIES/ GST FOR SOLAR CONCENTRATOR INCLUDING IMPORTED ITEMS.
- INDUSTRY SHOULD VOLUNTARILY SET A BENCHMARK FIGURE TO REDUCE EMISSIONS ON YEARLY BASIS WITH RENEWABLES.





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