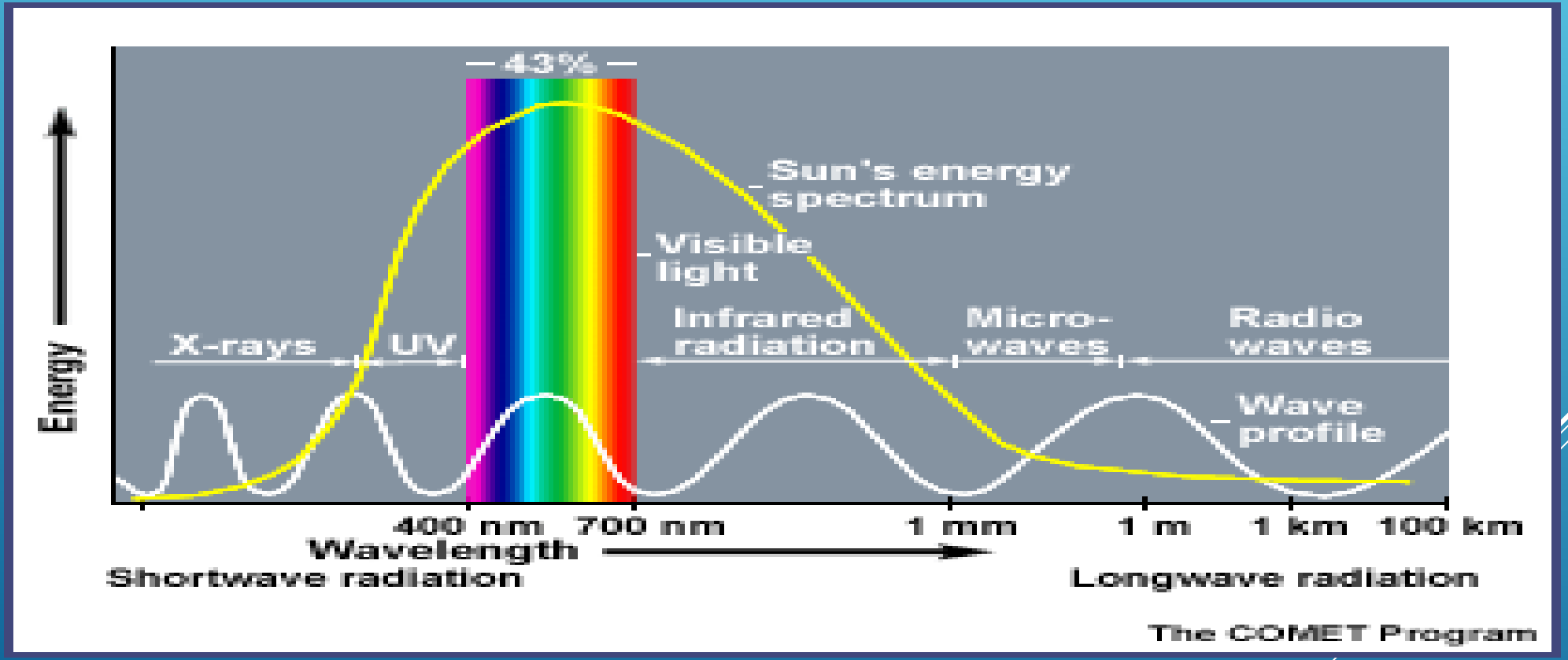
APPLICATION OF SOLAR ENERGY IN DAIRY INDUSTRY

INITIATIVE BY NDDB #

#SUPPORTED BY MNRE, UNDP

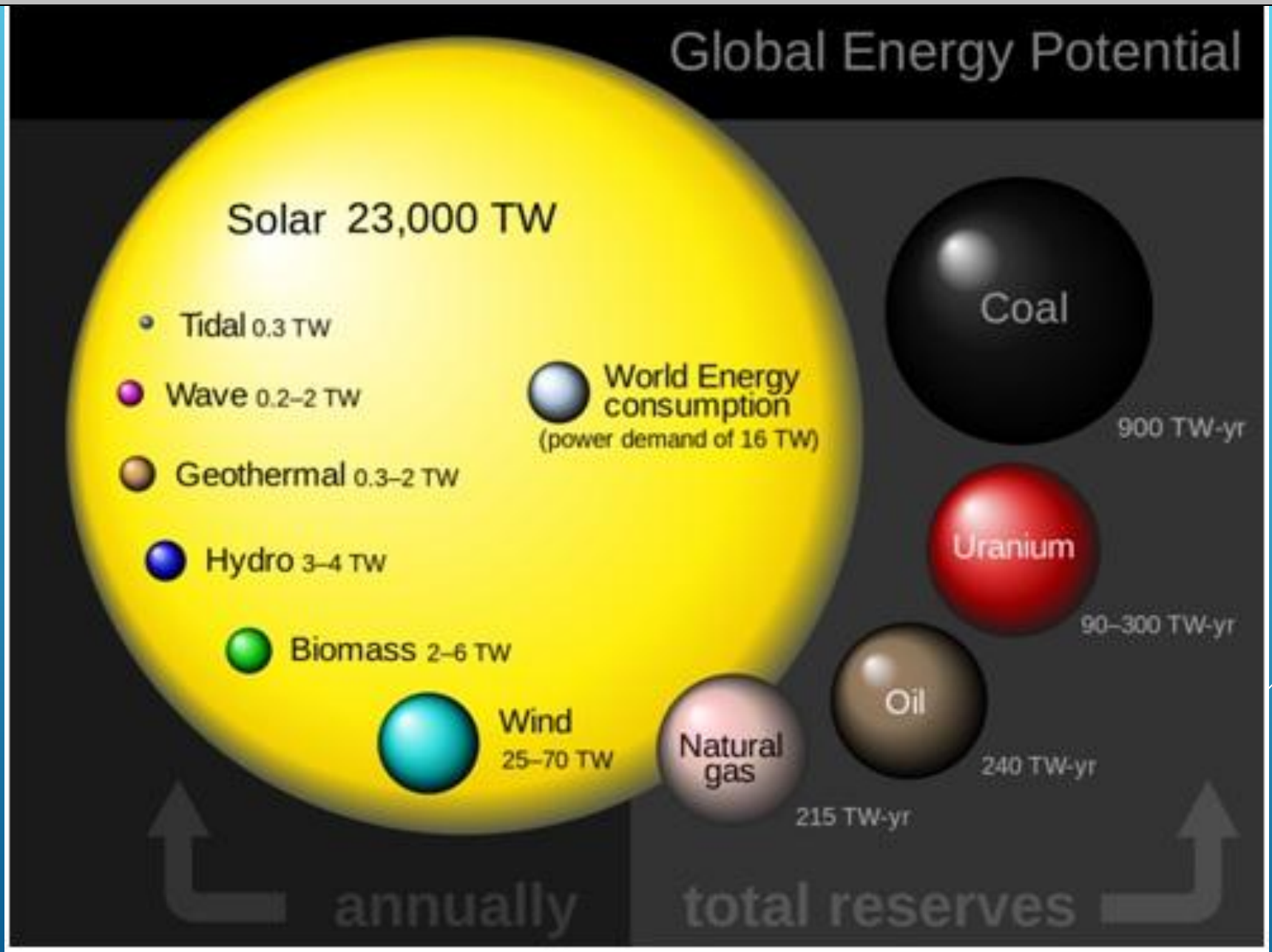
UNDERSTANDING SOLAR ENERGY

SOLAR ENERGY ORIGINATES DUE TO THERMONUCLEAR FUSION REACTION OCCURING IN THE SUN.

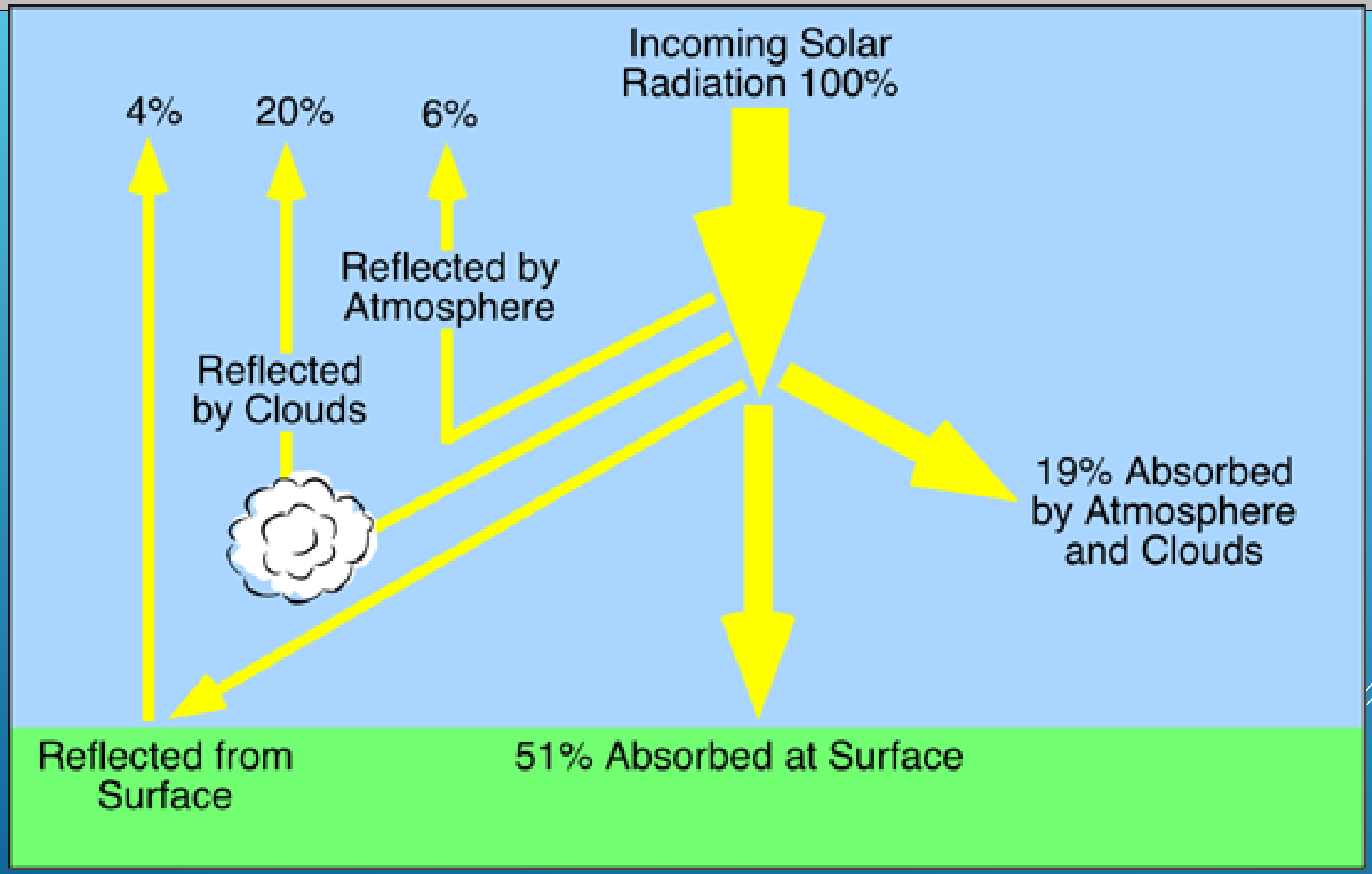


SPECTRUM OF SOLAR INCIDENCE AT EARTH SURFACE IS SPREAD MOSTLY FROM INFRARED RANGE, VISIBLE AND SMALL PART IN ULTRA-VIOLET REGION.

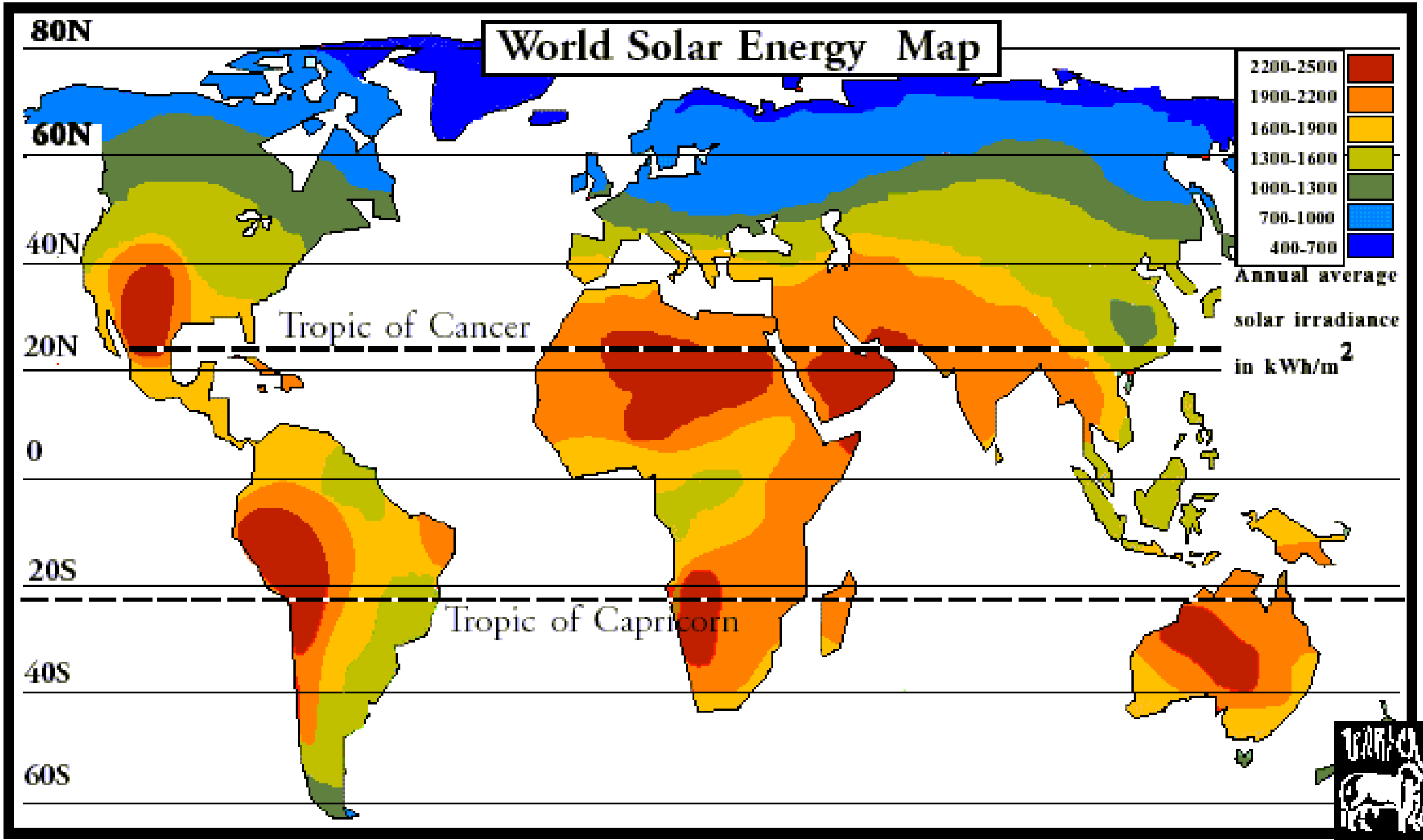
HOW MUCH SOLAR ENERGY?



HOW MUCH SOLAR ENERGY?

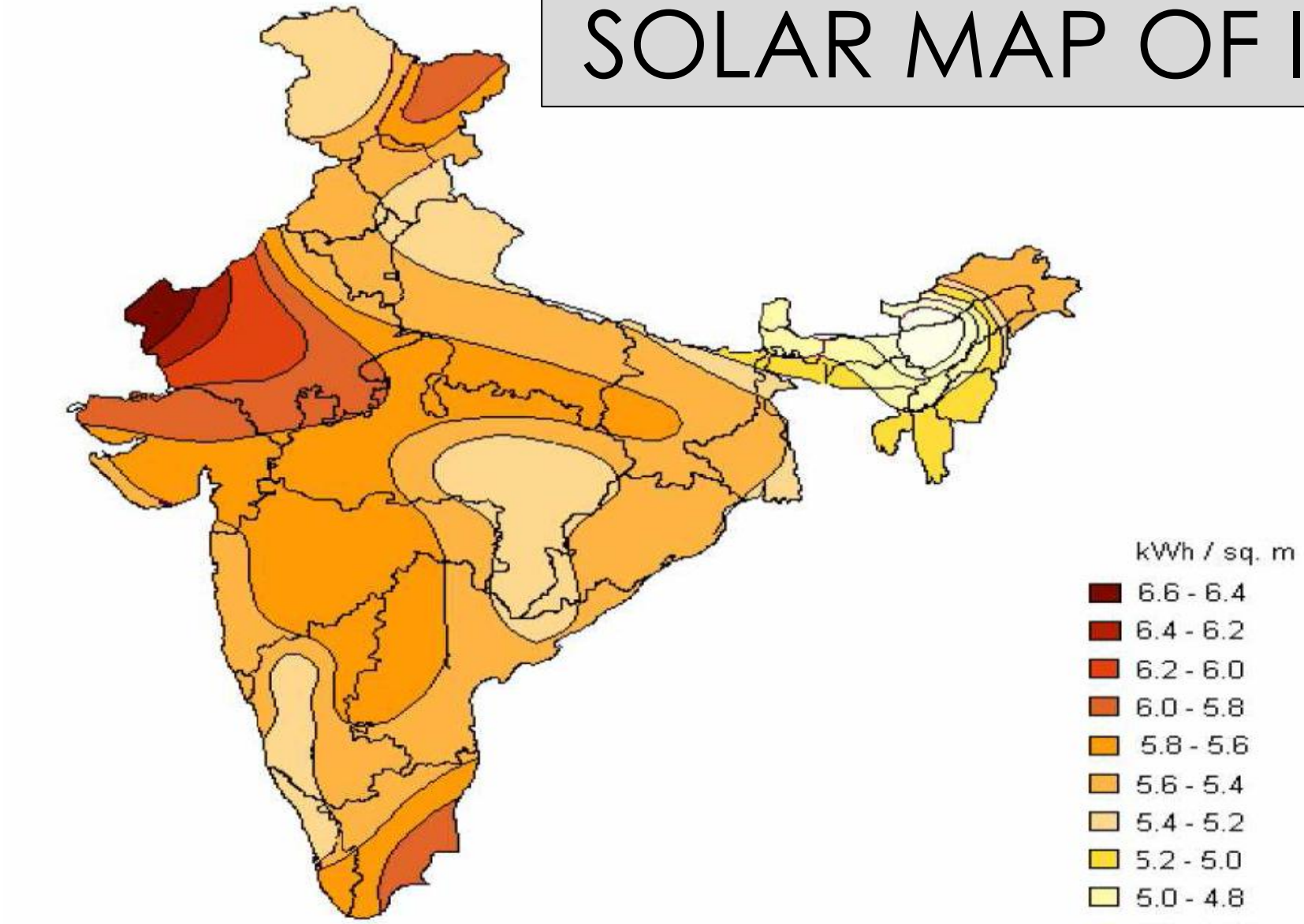


- ABOUT HALF THE INCOMING SOLAR ENERGY REACHES THE EARTH'S SURFACE.


World Solar Energy Map
80N
60N
40N
20N
0
20S
40S
60S
Tropic of Cancer
Tropic of Capricorn
2200-2500
1900-2200
1600-1900
1300-1600
1000-1300
700-1000
400-700
Annual average solar irradiance in kWh/m2

SOLAR MAP OF INDIA

ABOUT 5,000 TRILLION KWH PER YEAR ENERGY IS INCIDENT OVER INDIA'S LAND AREA WITH MOST PARTS RECEIVING 4-7 KWH PER SQUARE METER PER DAY.

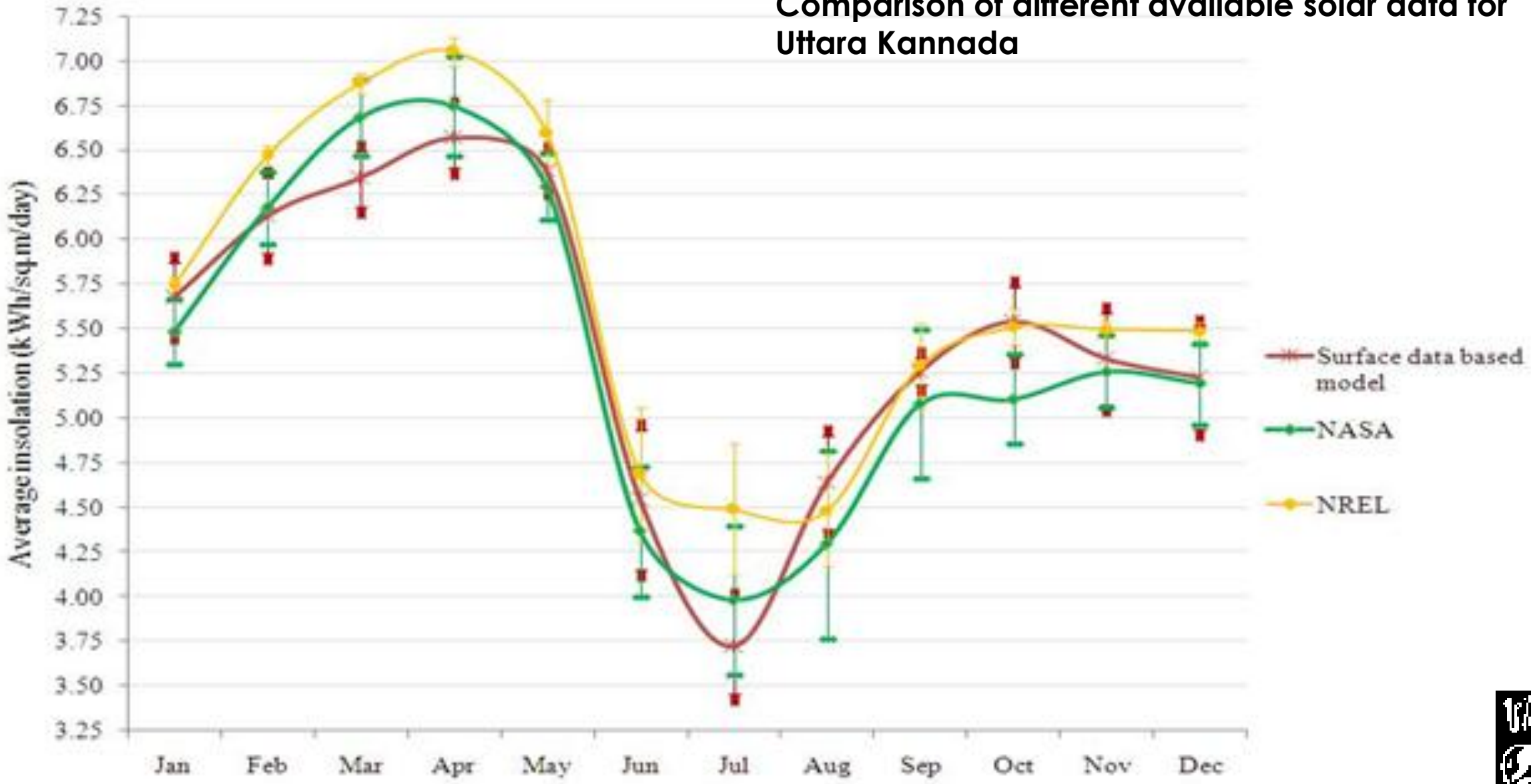


Solar radiation on India

Source: TERI

VARIATION OF SOLAR RADIATION IN A YEAR

Comparison of different available solar data for Uttara Kannada



TECHNOLOGIES FOR CONVERSION OF SOLAR ENERGY

SOLAR PHOTOVOLTAIC

ή ~ 16-20%

SOLAR THERMAL

ή ~ 50-65%

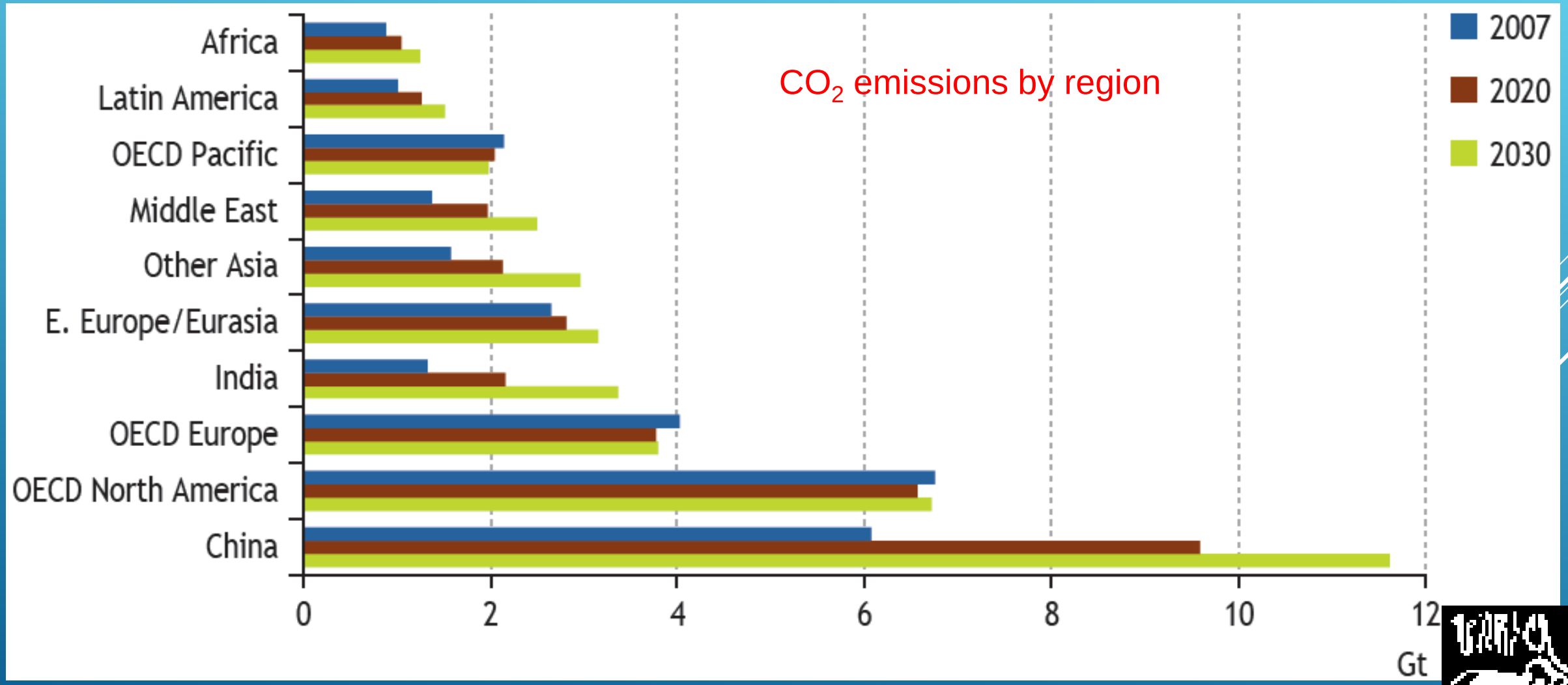
COMBINED HEAT & POWER

ή ~ 75%

WHY RENEWABLE ENERGY FOR THERMAL REQUIRED ?

- DEPLETING FOSSIL FUEL.
- SIDE EFFECT FOR GENERATION OF GHG CAUSING GLOBAL WARMING.
- CLEAN ENERGY WITH NO SIDE EFFECTS LIKE EMISSIONS.
- ALWAYS AVAILABLE FOR NEXT MILLION YEARS
- HIGHER OPERATING EFFICIENCY & PROFITABLE

COMBUSTION OF FOSSIL FUEL IS THE LARGEST SOURCE OF GREENHOUSE GAS EMISSIONS



Source : International energy agency (IEA) 2009

WHY SOLAR ENERGY IS TO BE UTILIZED IN INDIA ?

GOI HAS COMMITTED TO REDUCE THE EMISSION INTENSITY OF GDP LEVELS BY 30-35 % BY 2030, AS COMPARED TO 2005 LEVELS.

- GOI THROUGH SOLAR MISSION IS TRYING TO INVOLVE/ ENGAGE ALL INDUSTRY/ SECTORS FOR REDUCTION IN FUEL DEPENDENCE FOR THERMAL REQUIREMENTS .
- MNRE IS THE MINISTRY GIVEN THE RESPONSIBILITY FOR IMPLEMENTATION.
- NDDB HAS AGREED TO PROACTIVELY INITIATE DISCUSSIONS WITH MILK UNIONS & FEDERATIONS FOR IMPLEMENTATION.

HOW DID IT START ?

- IN 2015, LOOKING INTO THE IMMENSE BENEFITS OF CONCENTRATED SOLAR THERMAL(CST), NDDB DECIDED TO INITIATE PROCESS OF IMPLEMENTATION OF CST IN DAIRY INDUSTRY, CONSIDERING AFFORDABILITY OF THE TECHNOLOGY AND LONGTERM BENEFIT TO FARMERS.

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

20TH NOV 2015 MEETING

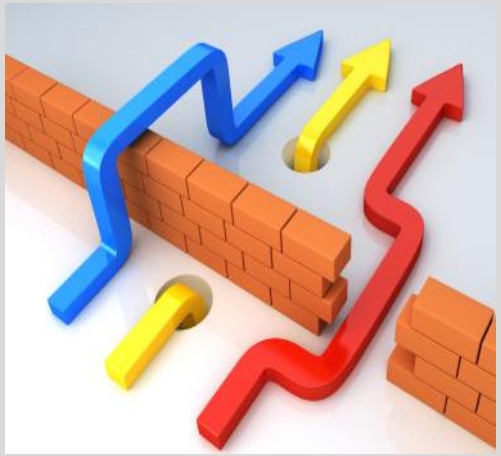
DECISIONS OF NOV 2015 MEETING

- OWING TO AN OVERWELMING RESPONSE FROM STAKEHOLDERS, NDDB DECIDED TO IMPLEMENT CST IN DAIRIES.
- TO START WITH, GENERATION OF LOW PRESSURE STEAM (< 3.5 BAR) WAS CONSIDERED FOR IMPLEMENTATION IN DAIRY.
- MNRE AND UNDP AGREED TO EXTENDED SUPPORT TO PROJECT IMPLEMENTATION FOR SPEEDY, HASSLE-FREE APPROVAL WITH FINANCIAL ASSISTANCE

IMPORTANT QUESTIONS

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

- HOW TO MAKE THE SYSTEM COST EFFECTIVE & COMMERCIALLY VIABLE

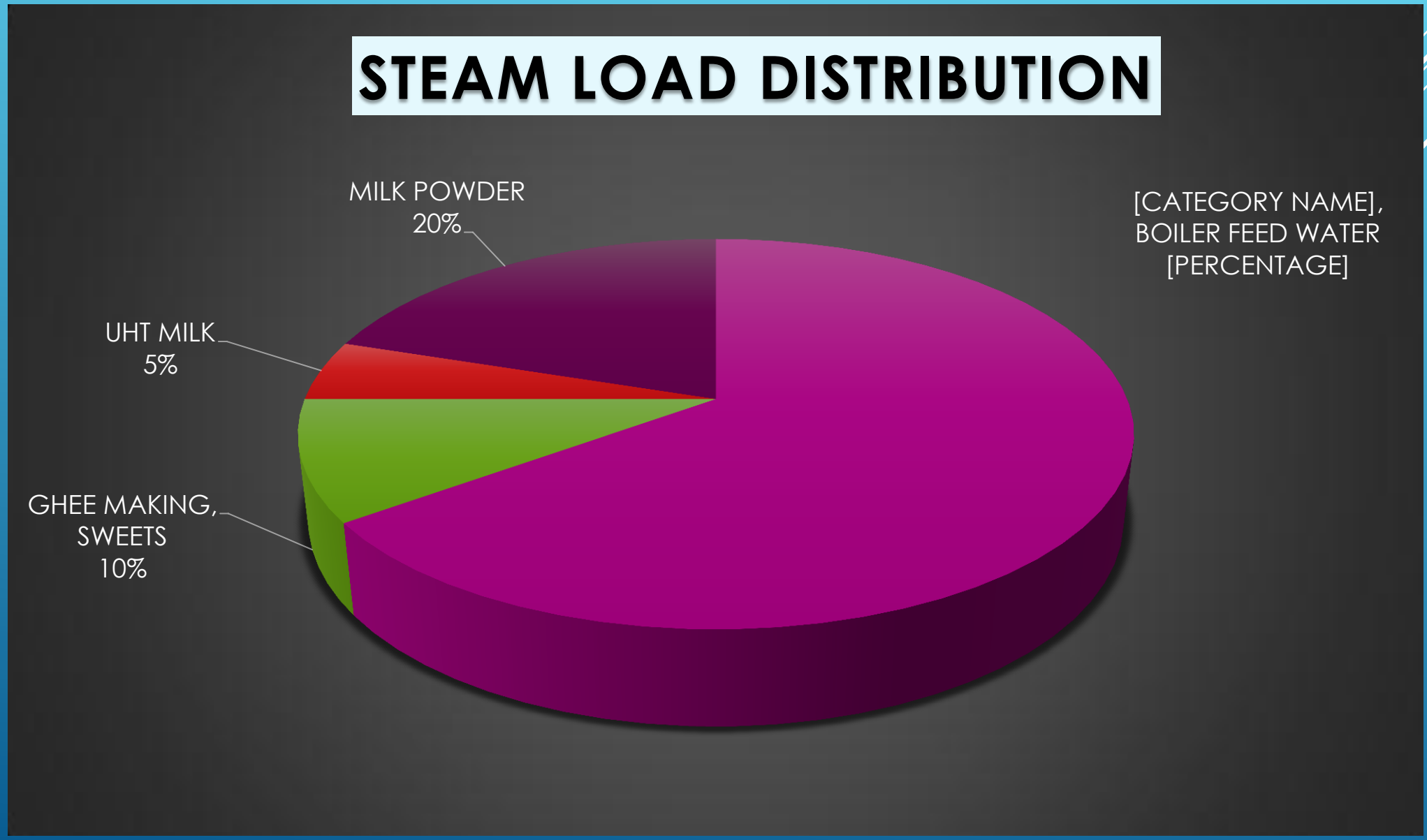


UNDERSTANDING REQUIREMENT

GENERALLY, DAIRY REQUIRES THERMAL ENERGY FOR FOLLOWING APPLICATIONS ;

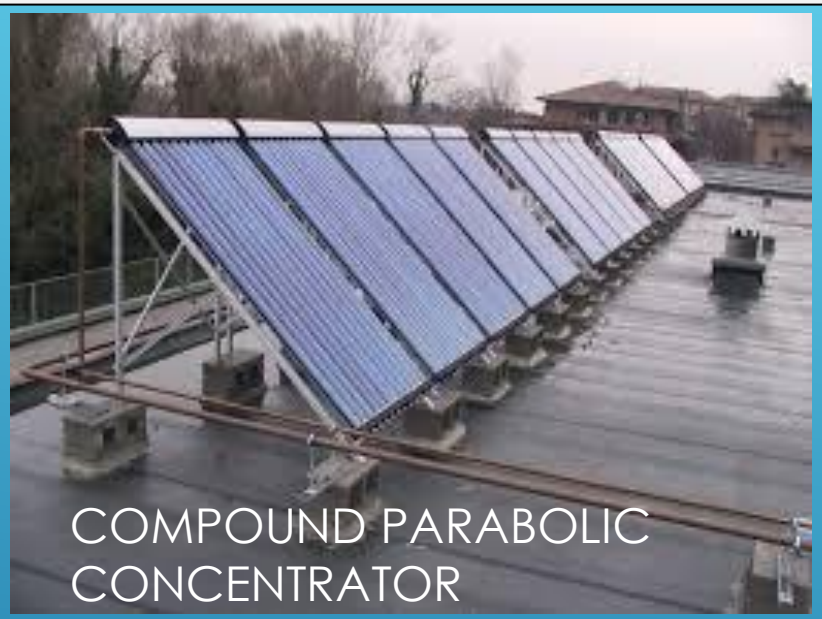
S NO.	TEMPERATURE / MEDIA	APPLICATION	SOURCE OF HEAT
1.	85° C / WATER	CAN WASHING, CRATE WASHING, CIP SYSTEM, BOILER FEED WATER TANK, PASTEURIZATION, BUTTER MELTING, INDIGENOUS PRODUCTS	LP STEAM
2.	140° C / STEAM	GHEE BOILING, SWEETS	LP STEAM
3.	165° C/ STEAM	UHT MILK	HP STEAM
4.	200° C/ AIR	AIR HEATER FOR SPRAY DRIER	HP STEAM

APPROXIMATE THERMAL USAGE PATTERN IN DAIRIES

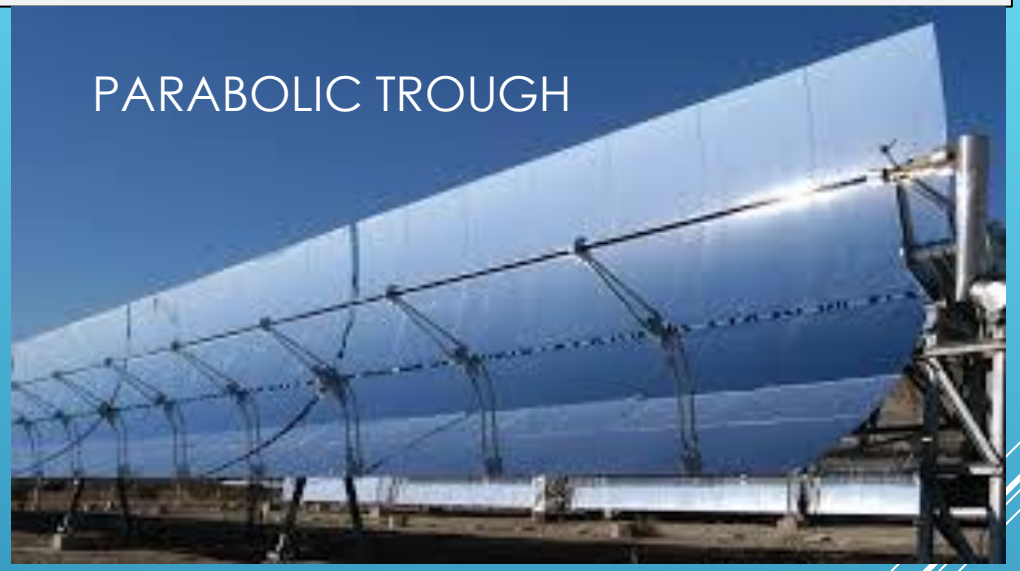


CONCENTRATING SOLAR THERMAL TECHNOLOGIES

PARABOLOID DISH



COMPOUND PARABOLIC CONCENTRATOR



PARABOLIC TROUGH

LINEAR FRESNEL COLLECTOR

SCHEFFLER DISH

FRESNEL DISH

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^2	4 – 250 m^2	20-500 m^2	5 - 20 m^2	2 -10 m^2
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^2 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		More area required due to reduced efficiency	Cannot deliver steam continuously
	Requires flat land		Low efficiency		
Approx. cost of solar field with BOP	20,000 – 27,000/m^2	20,000-30,000 /m^2	17,000 – 20,000/m^2	18,000 – 22,000/m^2	19,000 – 24,000/m^2

SOURCE : NATIONAL LEVEL WORKSHOP CONDUCTED BY MNRE IN NOV 2015 FOR DAIRY SECTOR AND TENDERS RECEIVED

SHORTLISTED TECHNOLOGIES FOR 85° C WATER GENERATION

PARABOLOID DISH (DUAL AXIS TRACKING)

PARABOLIC TROUGH (SINGLE AXIS TRACKING)

COMPOUND PARABOLIC CONCENTRATOR (NON TRACKING)

FEATURES OF CST PROJECT IMPLEMENTATION

- FOR THE FIRST TIME IN INDIA, OPEN TENDER SUITABLE FOR 85°C WATER GENERATION HAS BEEN CALLED.
- BASED ON AVAILABLE TERRACE AREA AND THE PROCESS HEAT UTILIZATION, 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

SOME HIGHLIGHTS

- IMPLEMENTATION OF 13 CST PROJECTS BY SEPTEMBER 2017
- ADD 7800m^2 OF APERTURE AREA IN NEXT 4 MONTHS , AS AGAINST 40,000m^2 IMPLEMENTED THROUGH MNRE IN LAST 5 YEARS
- TOTAL PROJECTS ESTIMATE ~ INR 16 CRORES.
- ALL CST PROJECTS BEING IMPLEMENTED IN EXISTING DAIRIES.
- ABOUT 5 -15% OF PROCESS THERMAL HEAT FROM BOILER BEING REPLACED WITH HEAT FROM CST ON YEARLY AVERAGE.
- ABOUT 30 % OF ESTIMATED COST IS FINANCIALLY ASSISTED BY MNRE & UNDP.
- NDDB EXECUTING PROJECTS ON PRO-BONO BASIS.

FINANCIAL ASSISTANCE

MNRE SUBSIDY – 30 % ON BENCHMARK COST

UNDP SUBSIDY – 20 % ON BENCHMARK COST (SCHEME ENDED ON 31ST MAR 17)

BENCHMARK COST :

- TWO AXIS TRACKING SYSTEMS – INR 20,000/m^2.
- SINGLE AXIS TRACKING SYSTEMS – INR 18,000/m^2.
- NON TRACKING SYSTEMS – INR 12,000/m^2

GOVERNMENT OF INDIA
MINISTRY OF NEW
AND RENEWABLE ENERGY

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

40% SOFT LOAN @ 7% INTEREST RATE (5% SUBVENTION).

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

REMAINING 25% SHALL BE PROMOTER'S CONTRIBUTION

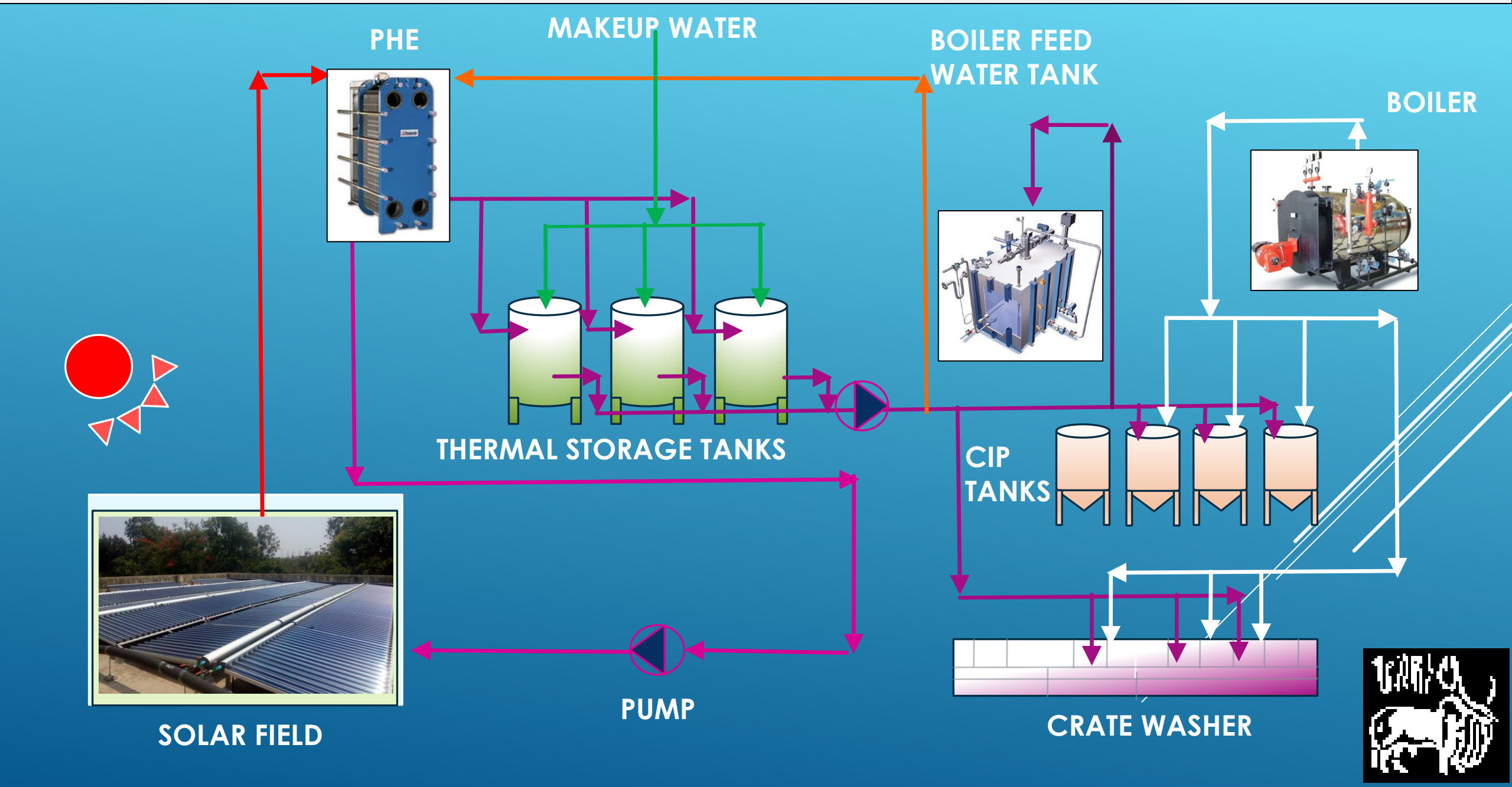
NOTE :SUBSIDY BASED ON INSTALLED APERTURE AREA OF CST

PROJECTS DETAILS

Location	Total Aperture Area	Total project estimate	Approx. subsidy	investment	Payback
Kolhapur (6 projects)	2700 m^2	INR 6.23 Crores	INR 1.6 Crores	INR 4.62 Crores	4– 5 years (FO as fuel)
Punjab (Mohali, Jalandhar, Ludhiana)	2450 m^2	INR 5.32 Crores	INR 1.47 Crores	INR 3.85 Crores	4– 5 years (FO as fuel)
Gujarat (Vidya Dairy)	380 m^2	INR 93 Lakhs	INR 38 Lakhs	INR 55 Lakhs	4 – 5 years (FO as fuel)
Karnataka (3 projects)	2250 m^2	INR 4.92 Crores	INR 1.57 Crores	INR 3.35 Crores	4 – 5 years (FO as fuel)

NOTE : FO COST @ 32/LITRE

PROCESS FLOW DIAGRAM OF CST



PERFORMANCE OF 5 LAKH KCAL/DAY CST INSTALLATION

FURNACE OIL CONSUMPTION PER DAY (PRIOR TO CST) : ~ 320 LITRES/DAY

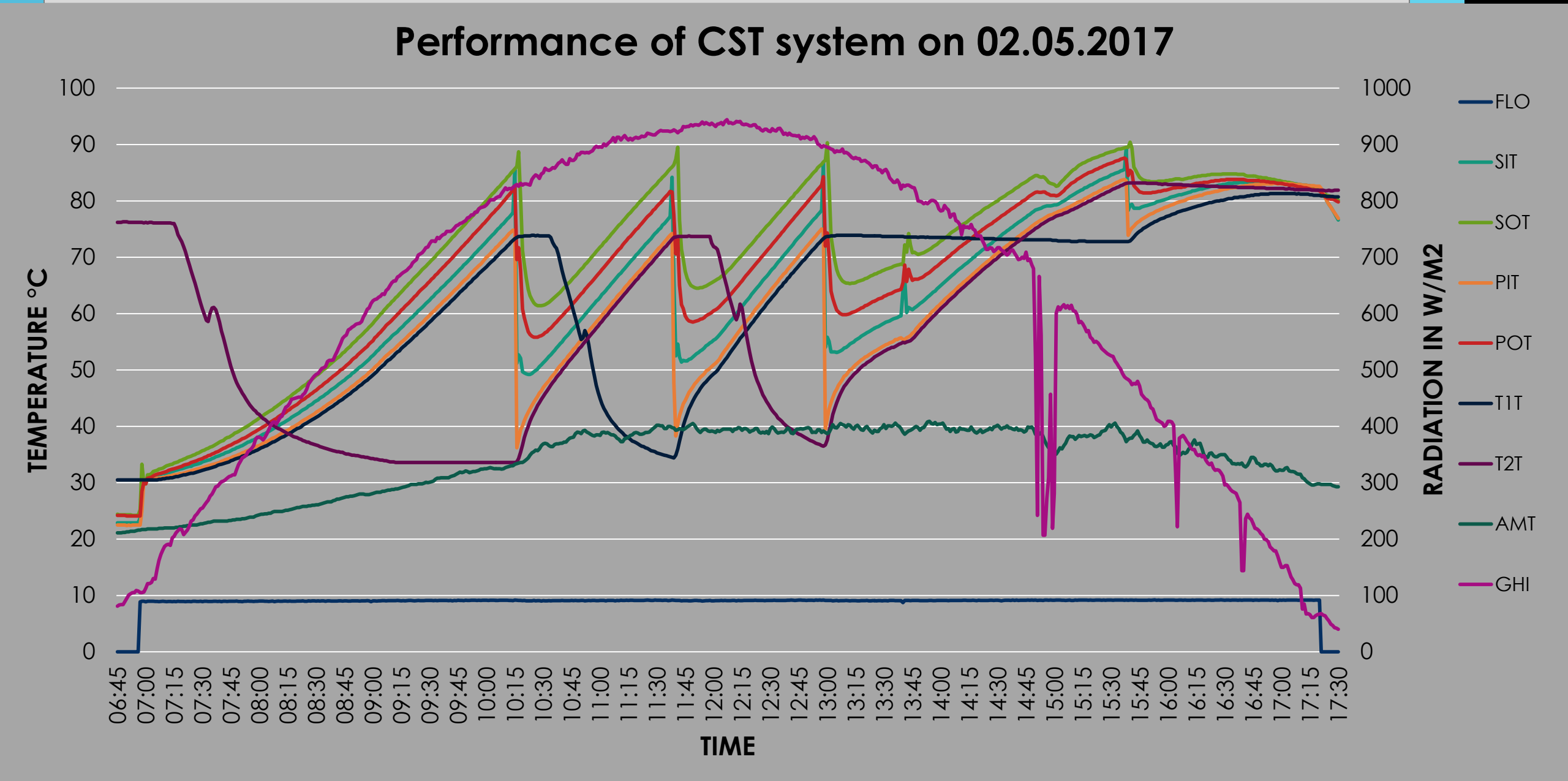
RESULTS OF LAST 15 DAYS

AVERAGE HEAT DELIVERY : 5,80,000 KCal/day

FURNACE OIL SAVING WITH CST : (80 – 100 LITRES/DAY)~ Rs. 3000/Day

INSTALLATION AT CHANDGADH CHILLING CENTRE (KOLHAPUR)

TEMPERATURE ,RADIATION CURVES



OTHER INITIATIVES IN SOLAR

Solar PV for Rooftop

Solar PV for BMC

Solar PV for Village level Solar Co-operative

CONCLUSION

- INDIA DUE TO GEOGRAPHICAL LOCATION IS SUITABLE FOR IMPLEMENTATION OF CST & SOLAR PV SYSTEMS.
- CST , SPV IMPLEMENTATION IS ECONOMICALLY VIABLE IN DAIRY INDUSTRY
- IMPLEMENTATION OF CST , SOLAR PV SYSTEM IN DAIRY IS BECOMING A NECESSITY TO BRING DOWN OPERATING COST & BEING MARKET COMPETITIVE


THANK
YOU