ARUN®
Solar Thermal Concentrator Technology and its Industrial Heating applications

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THE SOLAR THERMAL COMPANY

Agenda

- About Clique Solar
- About ARUN® Technology
- Installation Case Studies

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About Clique Solar

- Turnkey Solar Thermal Solutions provider – from system design to lifetime AMC support
- First Indigenously developed and patented Solar Concentrator Technology from India
- Pioneer in Solar IPH-First installation in 2006
- MNRE Channel Partner
- Winner of prestigious awards,
  - CII-2013"Innovative Energy Efficient Technology Award"
  - InterSolar-2013 "BEST TECHNOLOGY" Globally.
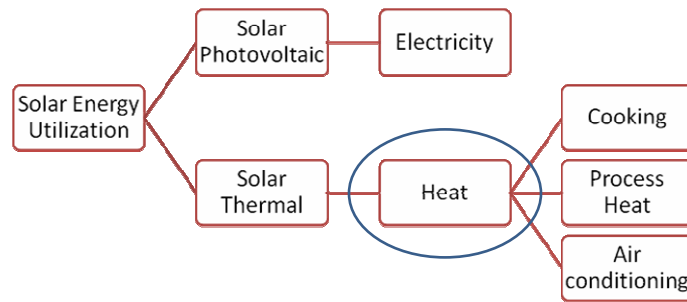 - InterSolar-2012 "BEST SOLAR THERMAL PROJECT IN INDIA"

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Leadership

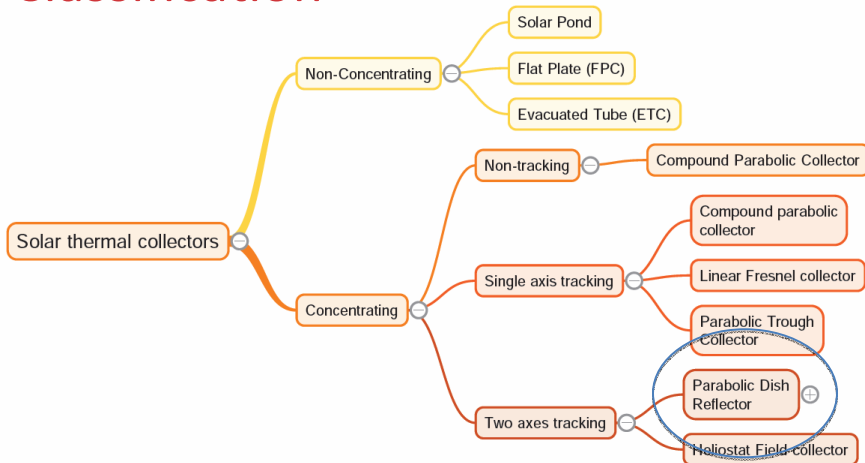Mr. Ashok Paranjape
Managing Director

Dr Shireesh Kedare
Director
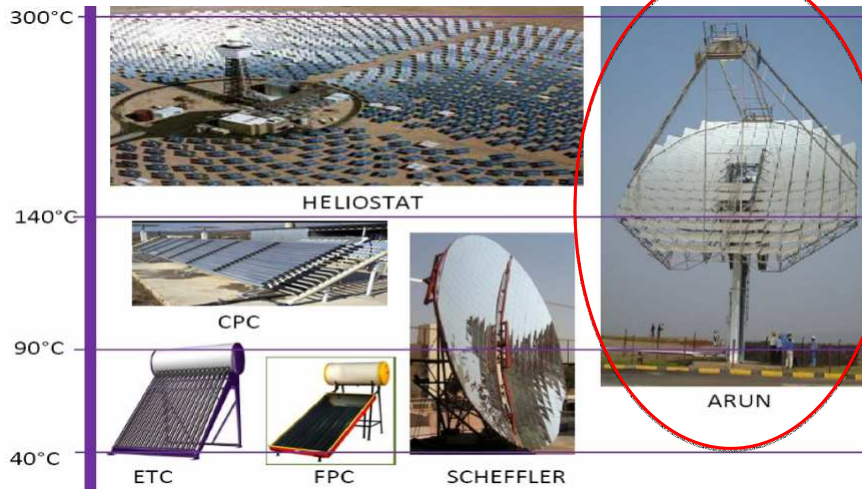Prof at IIT Bombay

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Solar Energy for Industrial Applications

Solar Thermal Technology Classification

Solar Thermal Technologies

ARUN® Technology – How it works?
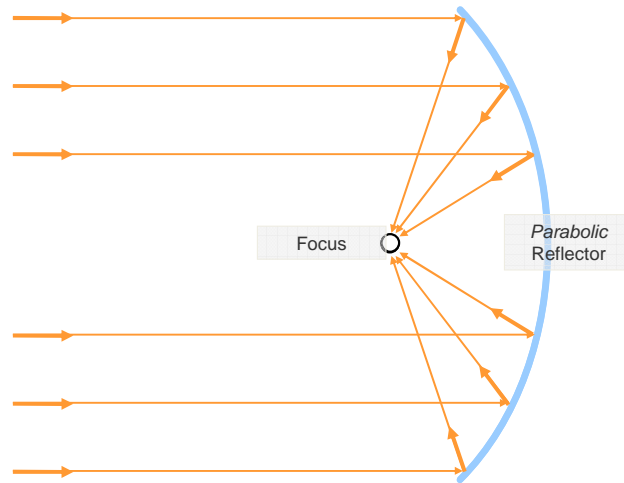

Concentrator   **Sun Tracker**

Concentrating Optics

Focus · Parabolic Reflector

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ARUN® Technology – Fresnel Mirror Arrangement

2D fresnel parabola

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ARUN® Technology – Fresnel Mirror Arrangement

Absorber at focal point

Sun Rays

Reflected Sun rays

2D fresnel parabola

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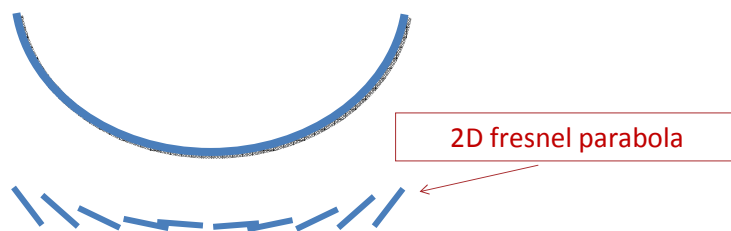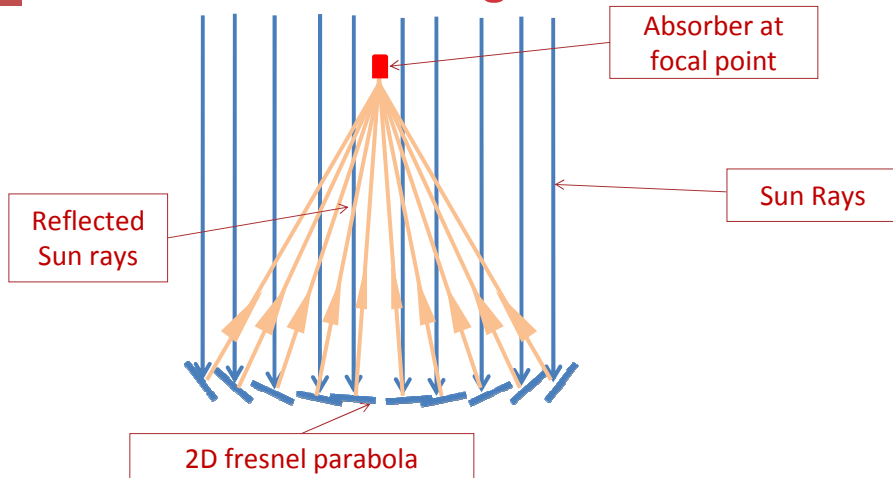
ARUN® Technology - Receiver

- Point focus
  - Maximized intercept factor
- Cavity absorber
  - Minimized thermal losses

2005/12/31

- Delivery of dry saturated steam is possible even at 8-8:30am

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ARUN® Technology:
Automatic 2-axis tracking system

Aperture areas always faces the sun
DNI is captured in full (no cosine loss)

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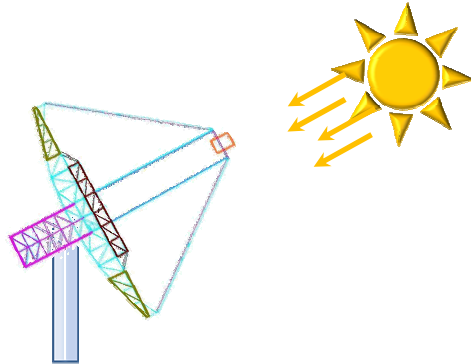
Integration with Existing System

Arun® Solar Concentrator Field

Boiler(s)

Steam Delivery Valve

POV

Common Header

Cooking Vessels

Pump

Condensate Tank/Makeup Tank

Pump

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Need for Storage

Energy Required for Cooking vs Energy available from Solar Energy
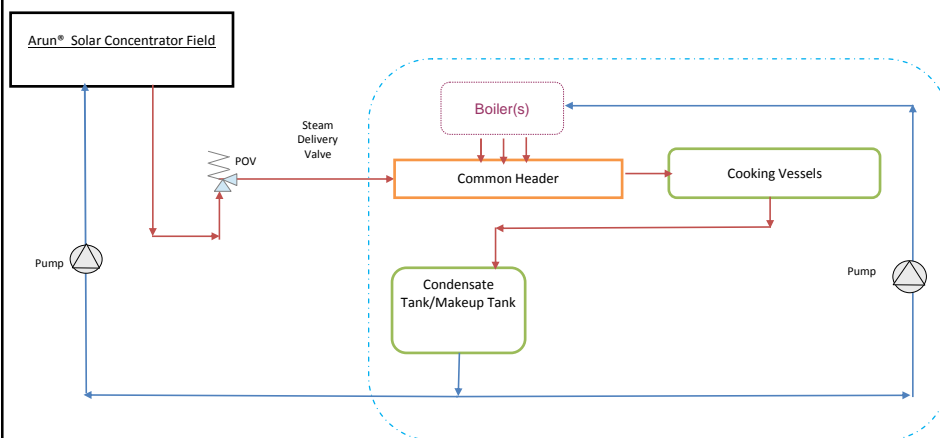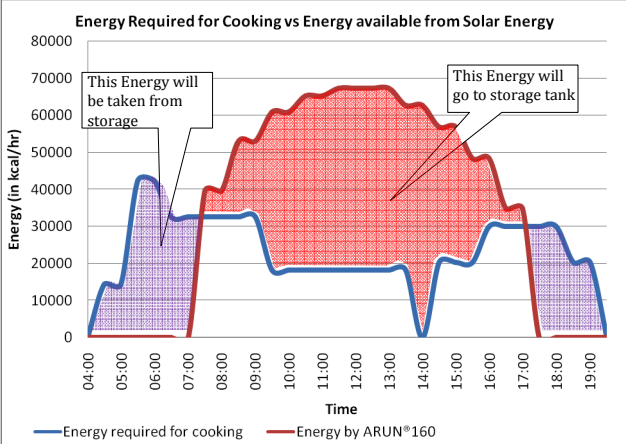
Integration – Including Storage
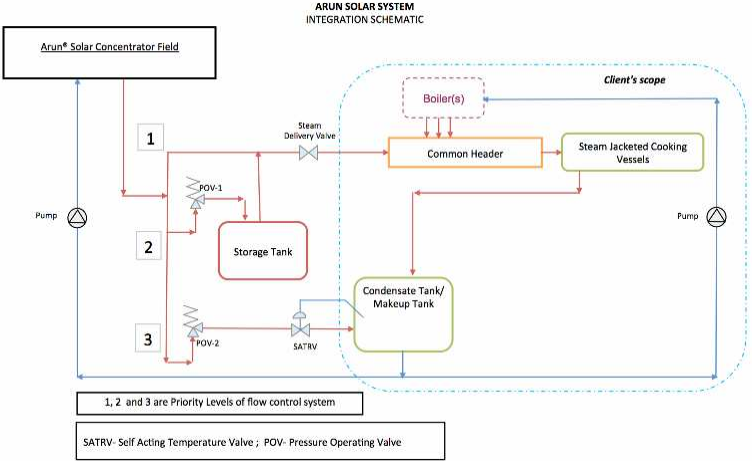
Variants of ARUN® technology

ARUN®160

ARUN®100 & ARUN®30

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ARUN® Technology – Key Features

- Three Variants ARUN®160, ARUN®100,ARUN®30
- Small Footprint Area 3m x 3m
- High Temperature & Pressure 300^0C Oil / 20 bar Steam
- Non-Solar Hours Operations when augmented with a Heat Energy Storage Facility
- Low maintenance
- First IBR-Approved Solar Boiler in India
- High Wind Bearing Capacity, up to 150 km/hr

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Some Installations

Government of India, Heavy Water Board — *Steam, 5bar, Effluent evaporation*

NTPC एनटीपीसी — *Steam, 10 bar, Cooling*

Mahindra — *Hot Water, 150C, Degreasing*

TEL Turbo Energy Ltd A Unit of TVS Group — *How Water, 160C, Cooling*

Chitale — *Steam, 5bar, Milk Pasteurization*

ITC-WELCOMGROUP Hotels, palaces and resorts — *Steam, 8bar, Cooking, Laundry*

MRSDMM — *Hot Water, 180C, Milk pasteurization*

Akshardham Temple — *Steam, 6bar, Cooking*

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Some Installation Case Studies

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Akshardham Temple

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Akshardham Temple, New Delhi (winner of Best Technology Award at InterSolar, Europe, June 2013)
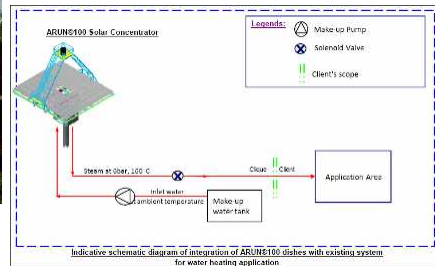
Steam Generation for community cooking

Location	New Delhi
Delivery	6 bar and 160°C
Capacity	48 – 60 kWth per dish
Dish numbers	1 dish
Commissioning	October 2012

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ITC Maurya Hotel, New Delhi

Steam for Hospitality applications like Laundry, Cooking, Bathing

| Location	Delhi
Delivery	8 bar (g) and 175°C
Capacity	80 – 100 kW_{th} per dish
Dish numbers	2 dishes
Commissioning	Nov 2009

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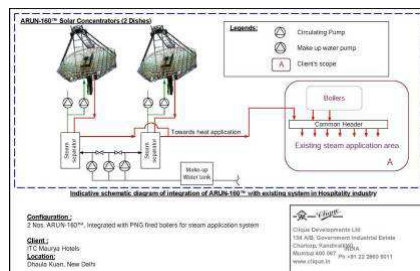
NTPC – Greater Noida (winner of InterSolar, India 2012 – Best Project Award)

Steam for Comfort Cooling

Location	Greater Noida
Delivery	10 bar and 180°C
Capacity	80 – 100 kW_{th} per dish
Dish numbers	2 dishes
Commissioning	July 2012

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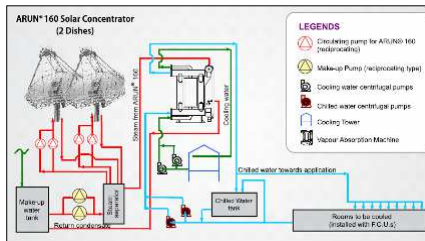
Chitale Dairy

Steam Generation for Milk Pasteurization

Location	Sangli
Delivery	5 bar and 152°C
Capacity	80 – 100 kW_{th} per dish
Dish numbers	2 dishes
Commissioning	October 2009

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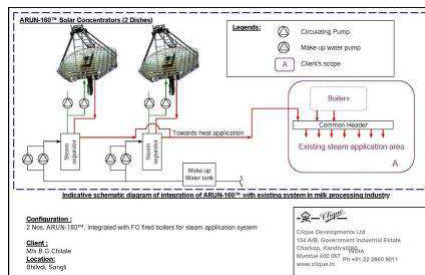
Mahanand Dairy
(100% on ARUN, since 2006)

Mahindra & Mahindra, Pune

Pressurized Hot Water for Milk Pasteurization with storage
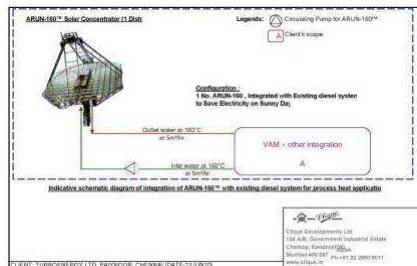
Pressurized Hot Water for Degreasing Process

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TVS Group, Chennai

Pressurized Hot Water for Comfort Cooling

Location	Chennai
Delivery	15 bar and 180°C
Capacity	80 – 100 kW$_{th}$ per dish
Dish numbers	2 dish
Commissioning	March 2011

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Client Testimonials

- *"We are satisfied with the ARUN solar dish because it delivers the output of temperature as committed prior to installation. Also, Clique Solar is very prompt in after-sales service."*

Mr. Umesh Joshi, GM, Business Excellence, Mahindra and Mahindra

- *"Looking at the performance and after sales service, we have ordered one more dish."*

Mr. A. P. Sridhar, VP – Operations, Turbo Energy Limited

- *"ARUN demonstrates excellent technological innovation for dairy industry as the heat generated by solar energy is stored in critical controlled temperature within +/- 0.5°C & can be used any time during day & night."*

- Mr. Arun Ghodke, Mahanand Dairy

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Other Testimonials

- *"This is a great initiative by Akshardham that has been well supported by Clique Solar. Through technical expertise and innovation, Clique Solar has developed the solar thermal technology further. It has also demonstrated the various possible applications of solar energy through its other installations across the country. This will help MNRE's cause of achieving widespread adoption of solar energy."*

- **Shri Tarun Kapoor, Joint Secretary, MNRE**

- *"This is a one-of-its kind installation in the country aimed at establishing technical as well as commercial viability of solar cooling. Such projects have a very important role in opening up newer areas for mass replication and thereby facilitating movement towards achieving the mission objectives in letter and spirit."*

- Dr. Ashvini Kumar, Director, MNRE

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Client Testimonials
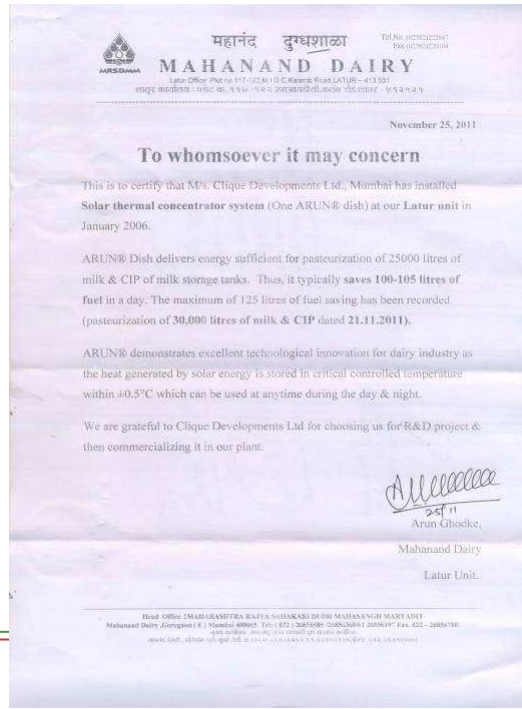
Client Testimonials

Investment Economics

Financial Incentives
- MNRE Subsidy (Rs. 6,000 per sq.m)
- Tax benefit due to 80% accelerated depreciation
- Extra grants under UNDP-GEF project

Project Payback
- Cooking (substituting LPG @ Rs90/kg): <3 years
- Process Heat
  - Substituting Furnace Oil, Diesel, PNG @ Rs 45/lit: 3-4 years
  - Substituting Coal, Biomass, Wood: ~5-7 years
- Cooling: 7-10 years

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A Scenario for

- A process requiring energy 1,00,000 kCal/hour
- oEnergy supplied by burning Furnace Oil (FO)
- Heater/Boiler efficiency of 85%

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Indicative Payback period calculations

Project Cost Item (Values in INR Lakhs)	
Dish Supply (1 ARUN®160+1ARUN®100)	54.00
Dish Erection & Commissioning	5.00
Selling Price	**59.00**
Add: Balance of Plant (Piping, Pumps, Control Panel etc)	5.00
Add: Civil	6.00
Add: Transport	4.00
Total Project Cost	**74.00**
Less: Subsidy (MNRE)	-16.38
Less: Subsidy (UNDP)	-4.00
Less: Tax benefit due to AD (80% during first year)	-15.22
Net Project Cost to user	**38.40 [A]**

Annual Savings		
Furnace Oil Saved (in Jaipur)	27,000	litres
Rate of Furnace Oil	50.00	Rs/litre
Total Fuel savings Rs	**13,50,000**	
Less: R&M	-60,000	
Net Savings per year	**12,90,000**	**[B]**

Simple Payback period = [A] / [B]	= 38.40 / 12.90 = ~3.0 years

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Thank you!

- Website: www.cliquesolar.com
- Email: adb@cliquesolar.com
- Video: http://www.youtube.com/CliqueSolarTV
- Phone: +91 22 2860 9014

inter **solar award**   Winner of the 'Best Solar Project in India' Award at Intersolar, India 2012

CSP today   Amongst the Top 3 at the prestigious CSP Today 2012 Awards, Spain in the 'Best Technology Supplier' Category

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