

# Innovative Solar Water and Space Heating Systems for Mountains-A Case Study of the Indian Himalayas

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***Core Group***

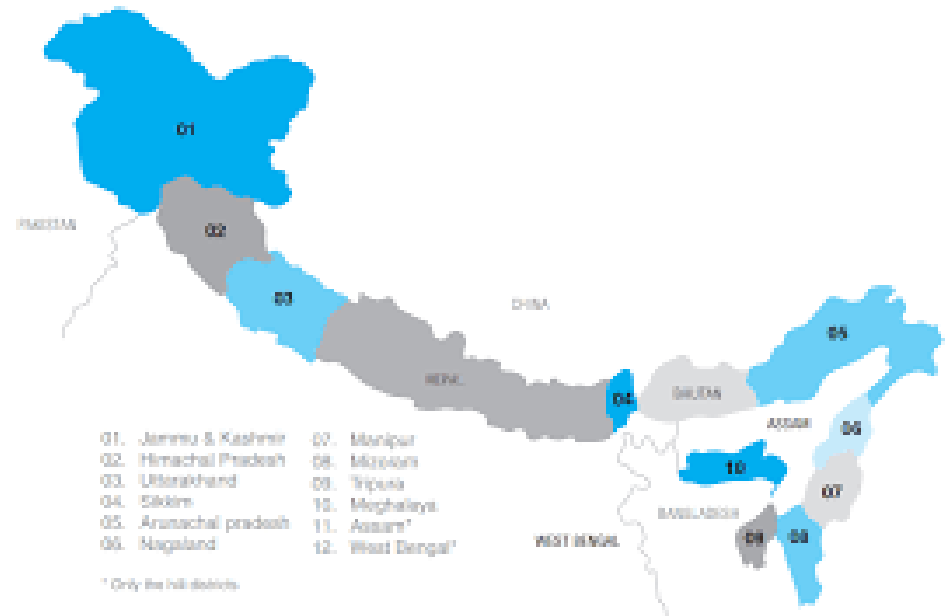
***(Department of Science & Technology, Govt. of India)***

**UMESH BHAVAN, CHOTTA SHIMLA**

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# Indian Himalayan Region (IHR)



# **Domestic Solar Water Heating Panel for Mountains (Solar Hamam)**

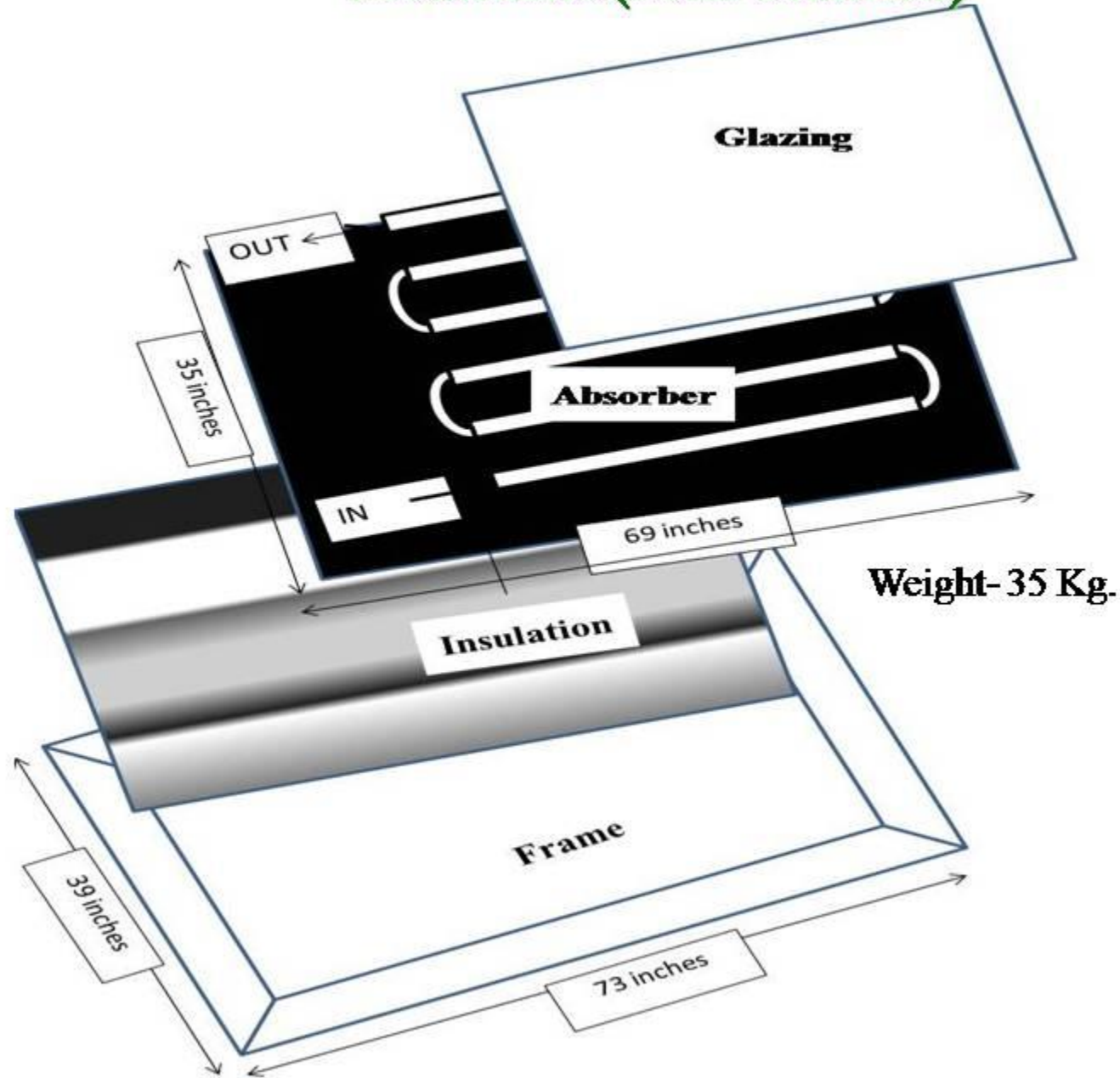


**Domestic Solar Water Heating System**



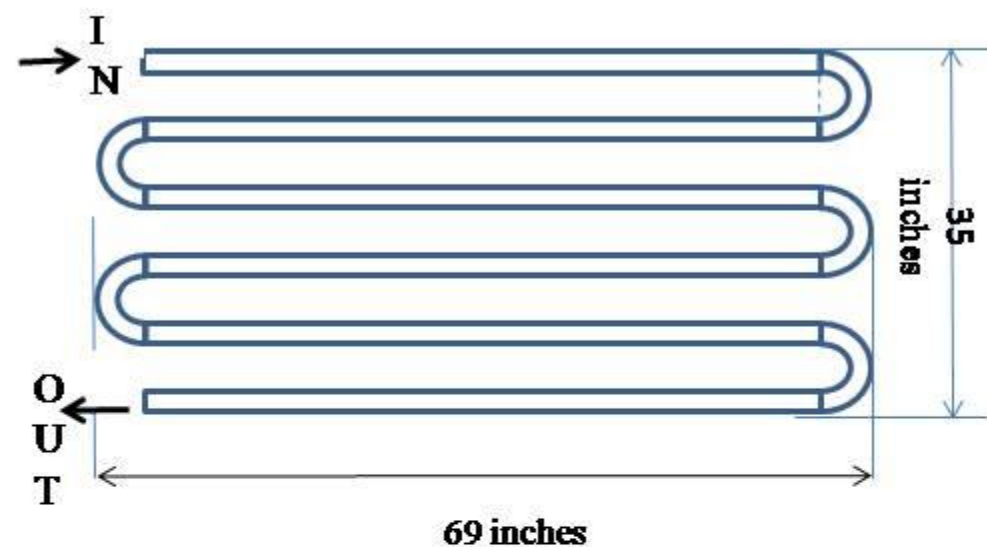
**Domestic Solar Space Heating System**

# Schematic Detail of the Domestic Solar Water Heating Panel for Mountains (Solar Hamam)

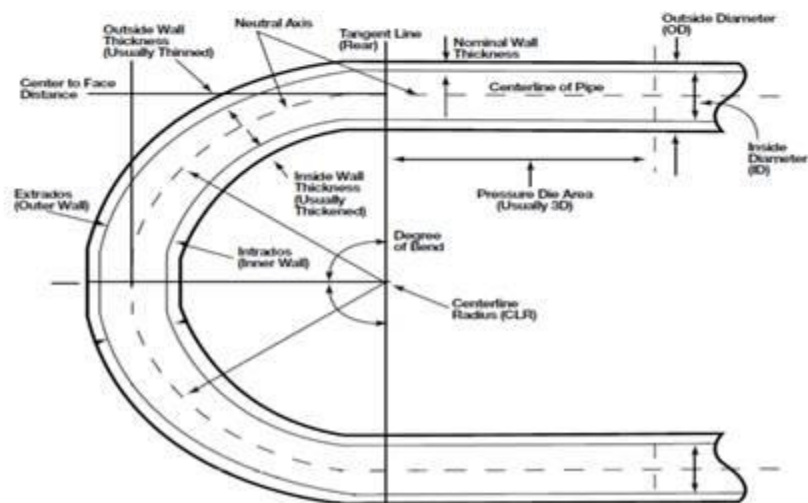




# Technical Specifications of Water Coil used in Domestic Solar Water Heating Panel for Mountains (Solar Hamam)



**Water Capacity- 18.5 liters**



Factor	Unit	Alloy code <b>6063-T4</b>
Density	g/cm <sup>3</sup>	2.7
Melting Point	°C	600
Thermal Expansion	M/K	0.0000235
Elasticity	GPa	68.9
Thermal Conductivity	W/mK	<b>200</b>
Electrical Resistivity	Ohm.m	3.30E-08
Proof Stress	Min MPa	90
Tensile Strength	Min MPa	170
Elongation A50 mm	Min %	12
Hardness Brinell	HB	<b>46</b>
Elongation A	Min %	12
Weldability -Gas		<b>Excellent</b>
Availability		<b>Yes</b>

- **Glazing- Normal Window Glass**
- **Absorber Sheet- GI Sheet**
- **Insulation- Thermocol**
- **Insulation Cover- Aluminum Sheet**
- **Innovative Paint- Black with amendments to improve solar absorption**

# **Domestic Solar Water and Space Heating Systems**

## **Innovation & Novelty:**

- Fabricated of locally available material by the rural artisan (carpenter).
- Fabricated on wood frame with window glass available in local households with innovative paint to absorb maximum sun energy for water heating.
- In high altitude mountains sun is more bright (>250 sunny days/year) and intense in winter than plains.

## **Process :**

- Water heating panel is installed at 45° angle on the premises facing south.
- Water heater coil hold 18.5 liters of water and is heated to 80-90°C within 30-45 minute of solar illumination .
- Household member can draw 100-120 liters of hot water in clear sunny day for sun rise to sun set for household purpose without burning fire place for water heating.
- Solar heated water is of potable quality and used for cooking as well. This reduced cooking time and save LPG.
- Space heating panel installed in south facing wall of the house and heat air and blow in living space
- Save 40% Fuel wood



# Rural Artisan fabricating Domestic Solar Water Heating Panel for Mountains (Solar Hamam)



**Wood Frame**



**Fixing of Water Coil**



**Insulation**



**Glazing**



# Installation in different places of Domestic Solar Water Heating Panel for Mountains (Solar Hamam)



**Buchair Anni Kullu, H.P.**



**Padum Zanskar, Kargil J&K**



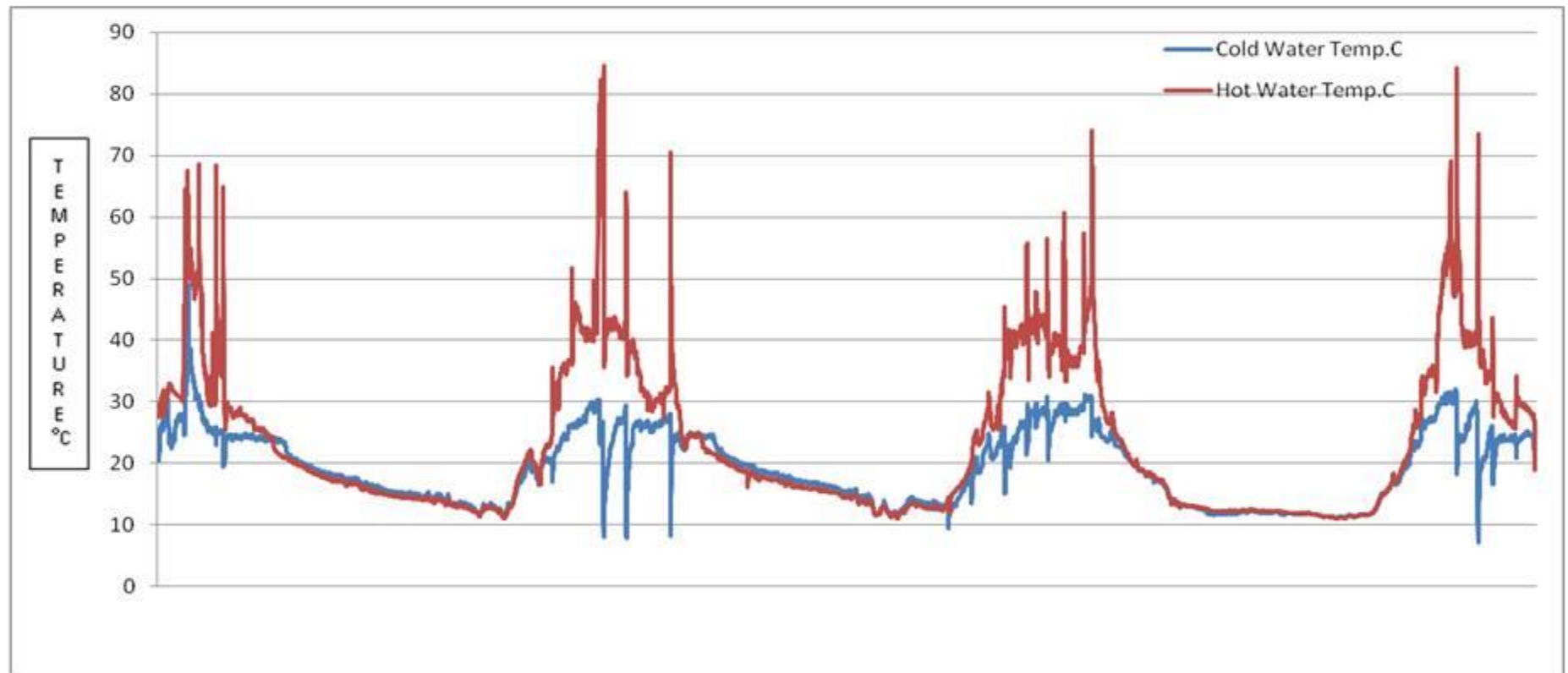
**Shila Zanskar, Kargil J&K**



**Ladhagi, Anni Kullu H.P.**



# Explanation of Performance Evaluation of Domestic Solar Water Heating System for Mountains



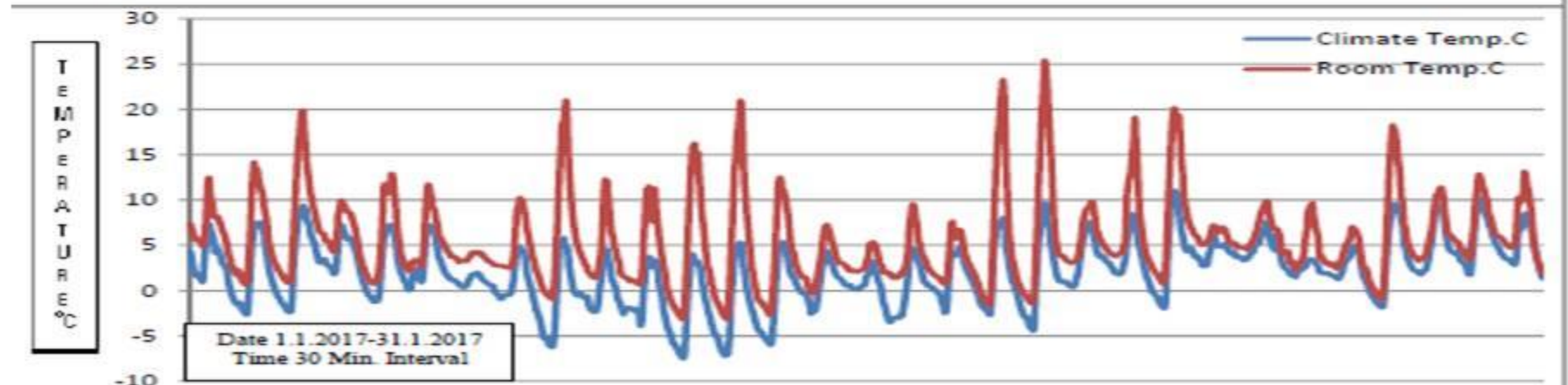
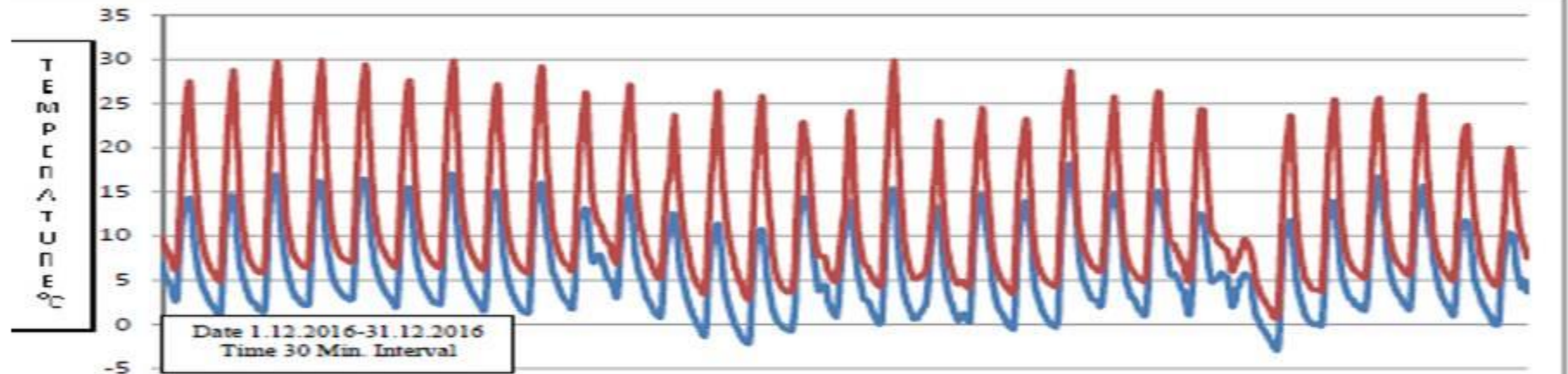
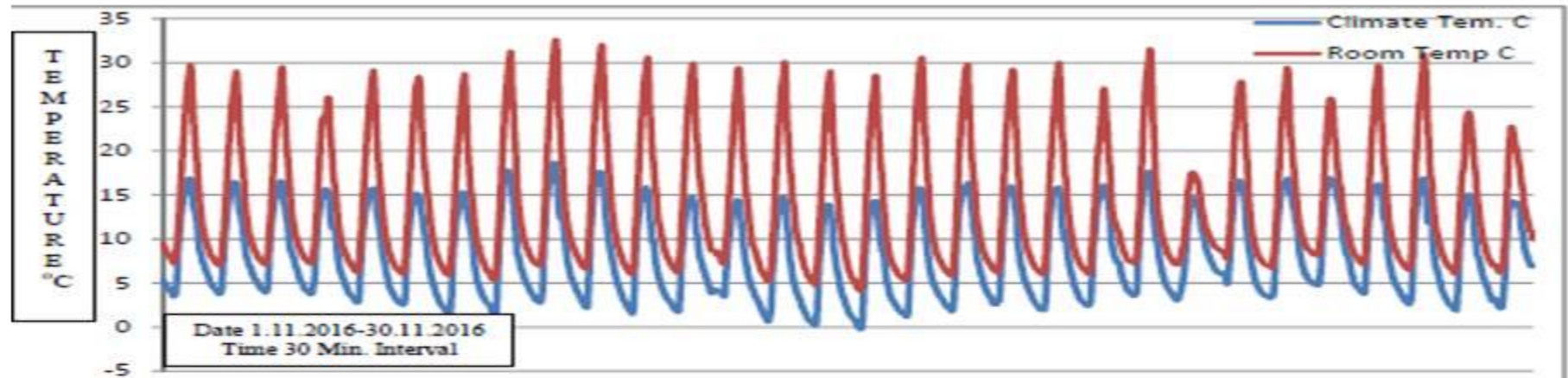
**Sample Performance Testing of Mountain Solar Water Heating Panel in July 2017 with 30 Second Recording Interval for four days at Padum, Zaskar Valley Kargil, J&K**

## Rural Artisan fabricating Domestic Space Heating System





# Performance of Mountain Solar Room Heating System at Village Sarahan Altitude 7800 Feet





# Display of HRG Domestic Solar Water and Space Heating Systems for Mountains



**Dr Lal Singh, Director, HRG explaining details of solar water heating panel to the Secretary, DST (GoI), at BAIF Pune in May 2016**



**HRG Team, explaining details of panels to the officials and visitors in Unnat Bharat Pavilion, IISF 2016 at CSIR NPL, New Delhi, December 2016**



Department of Science & Technology  
Ministry of Science & Technology  
Government of India

## Cost-Effective Solar Water & Space Heating System for Mountain areas

Traditional Practice of Fuel wood Collection



### Innovative Cost Effective Solar Water & Space Heating System



#### Impact Benefits

- Reduce carbon emission,
- Less indoor pollution,
- Livelihood gain for local artisans and
- Reduction in women drudgery

Innovation, design, fabrication and installation with rural artisan by  
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**DST GoI Displayed HRG Technology in Exhibition at Delhi from 11.1.2018-31.1.2018 at Minister of ST and MoEF Dr Harsh Wardhan's Residence, New Delhi**



# **Traditional Domestic Water and Space Heating Systems & Practices in for Mountains**



**Village Sias, Chachyot, Mandi H.P.**



**Water Heating Dhlair Kullu H.P.**



**Village in Zankar Valley, Kargil , J&K**



**Emission from Kitchen and Haman.**



# **Women Collecting Fuel Wood and Dung Cakes in Mountains**



**Women Collecting fuel wood at village Sarahan, Nirmand Kullu H.P.**



**At Village Moolkoti, Shimla**



**Dung cake at Zanskar Valley J&K**



## Scope and Justification of Innovation for Mountains

- Modern water heating devices like solar water heating systems and electric geysers fail to address need of mountain communities dependent on fuel wood and dung due to high installation and recurring operational and maintenance cost.
- Areas above 2000 meters and above altitude are cold throughout the year and 50% of the fuel is consumed for water and space heating.
- Fuel collection is one of the major reasons for forests degradation and cause of women drudgery in mountains.
- This innovation will save around 40% fuel wood and mitigate around 5.00 MT/annum/panel of Household Carbon Emission.
- Women save average 3 hours/ day of fuel wood collection and significant reduction in indoor level of pollution.
- Himalayan mountain region is inhabited by about 7.00 million households and are dependent on natural resourced to meet their demand of fuel.



**Commercial Water Heating System**



**HRG Solar Hamam**



# Popularization of Innovations and Providing New Skills to Rural Artisans



Display and Demonstration to School Children



Display and Demonstration to Community

## Effective Extension Needs

- i. Socially Acceptable
- ii. Need Based
- iii. Cost Effective
- iv. Minimum Post Installation Maintenance
- v. Long Life of Product







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**Thank you INSIC for Inviting and Making us Participate in this Conference**