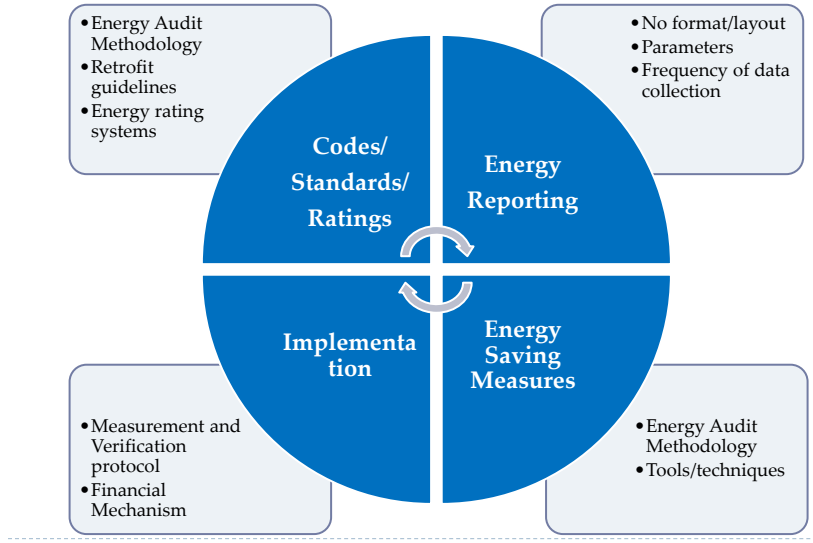
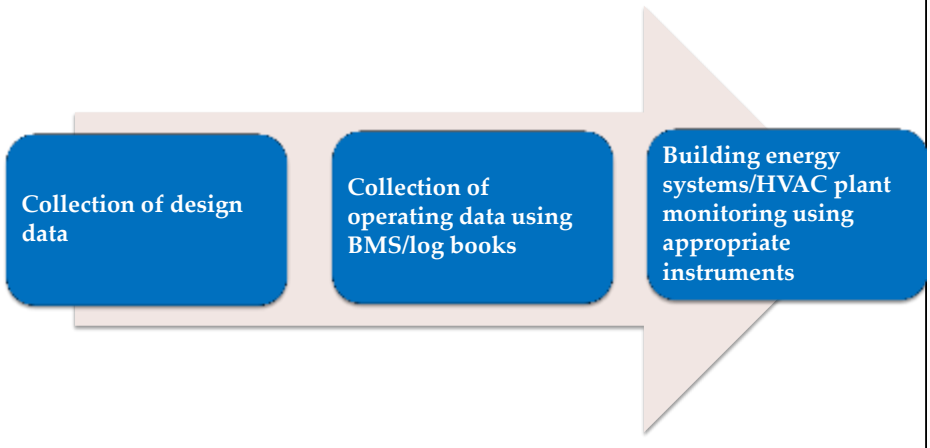
Implementation of energy efficient technologies/measures in existing buildings

Gaps and Barriers



Energy Survey

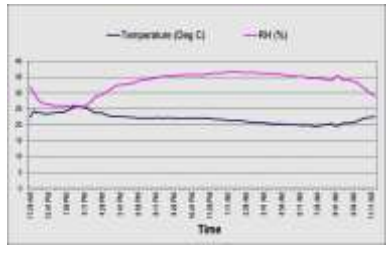


Comfort monitoring

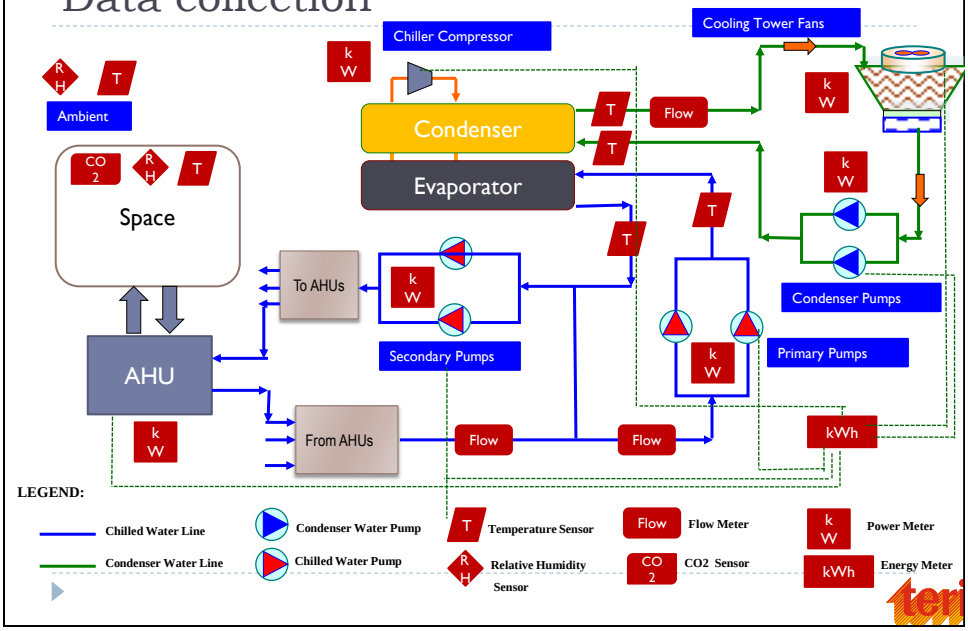
Visual Comfort

Spaces	Illumination level	
	Operating levels	NBC Recommended levels
Office (cabins)	510	300-500-750
Toilets	170	100-150-200
Cafeteria	230	150-200-300
circulation areas	125	50-100-150
Meeting rooms	515	300-500-750

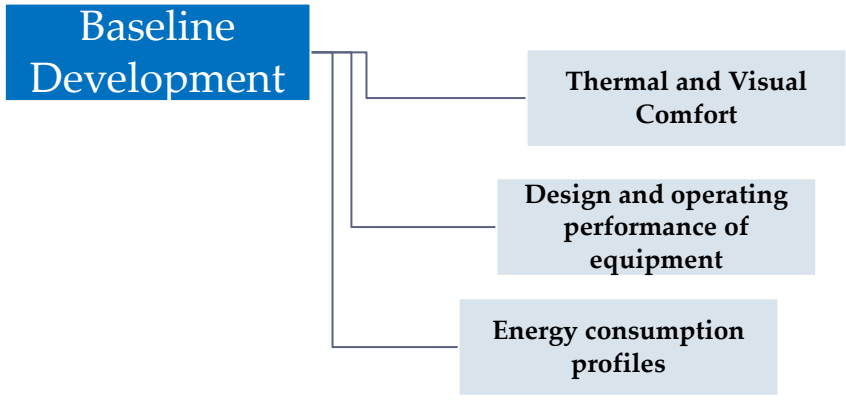
Thermal Comfort



Data collection



Baseline Development



Energy Conservation Measures

Building Envelope	Lighting	Air conditioning	Automation
			
Cool roof Paints Roof insulation Film on glass	Visual comfort Lighting controls Efficient lamps and fixtures	Efficient design Set point temperature Optimization Efficient equipment Energy Recovery Radiant/Geothermal	Demand based control All variable chiller plant

Implementation

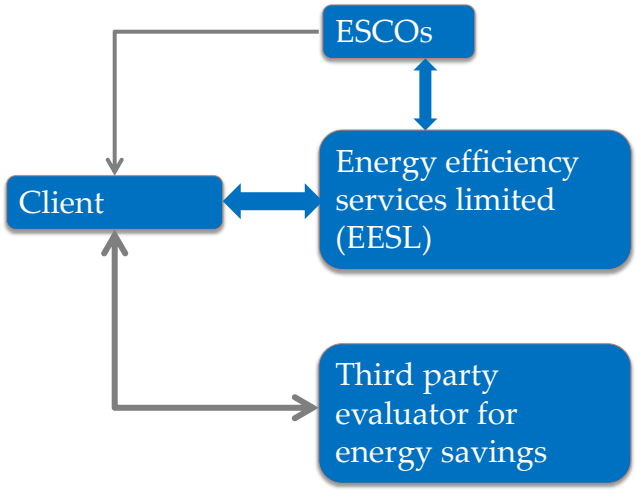
Measurement and Verification Protocol

- Baseline Development
- Monitoring & Instrumentation
- Implementation Schedule
- Retrofitting
- Post retrofit monitoring
- Baseline adjustment
- Verification of energy savings

Baseline development and adjustment- Weather dependent system

CDW in (deg F)	Chiller Loading (%) & Efficiency (kW/TR)									
	100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**15**
70	0.426	0.404	0.388	0.378	0.374	0.382	0.4	0.441	0.5	0.576
75	0.472	0.451	0.438	0.43	0.433	0.44	0.464	0.496	0.578	0.658
80	0.52	0.502	0.492	0.49	0.496	0.507	0.525	0.57	0.661	0.746
85	0.576	0.562	0.549	0.552	0.554	0.576	0.597	0.648	0.75	0.85
89	0.624	0.609	0.604	0.605	0.613	0.627	0.653	0.707	0.817	0.924

Financial Mechanisms



TERI-UTC Centre of Excellence on energy efficient buildings in India

- TERI -UTC CoE_Brochure.pdf

Case Study

Space cooling and heating systems in India

	On grid	Off grid
Space cooling	Space heating	Space heating
		
Window AC Split AC Central plant	Electrical oil type heaters	Wood burning

Environmental Issues in off-grid regions

- **Burning of twigs for heating**
- **Deforestation**
- **Air Pollution (formation of carbon layer in atmosphere)**

Technology option

Space cooling

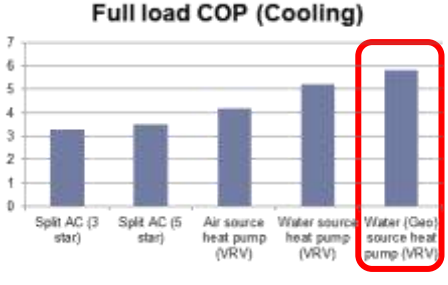
Space heating

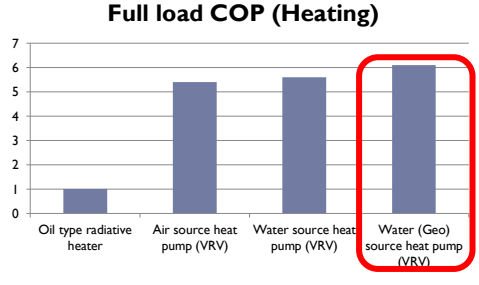
Heat Pump (both space Heating & Cooling)

Technological options for heat pump

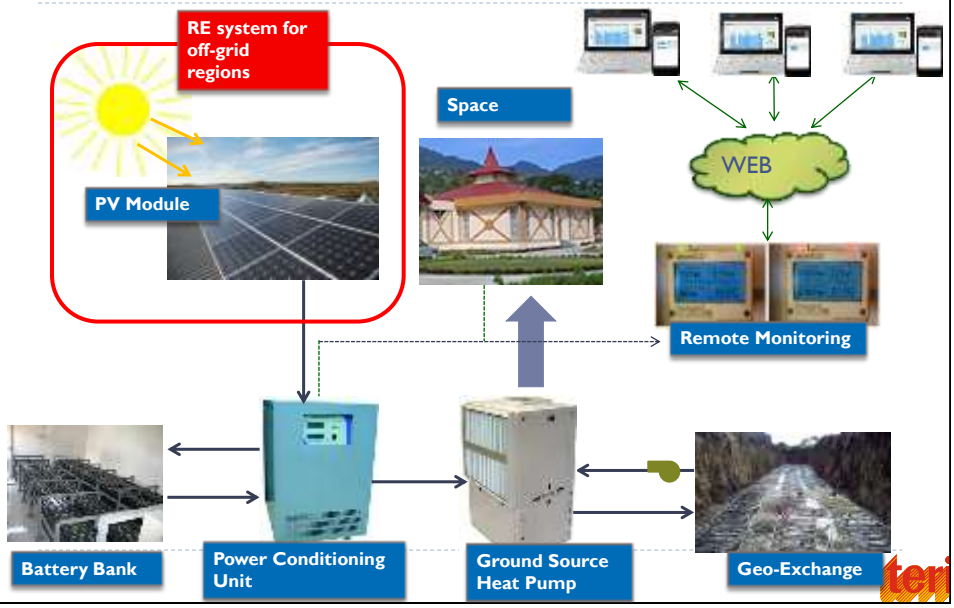
- Air source heat pump
- Water source heat pump
- Geo-source heat pump

Full load COP or Seasonal part load value (SPLV)





Proposed System (on grid and off-grid)



Case Study-Installation of Geothermal based heat pump at Science Centre, Itanagar

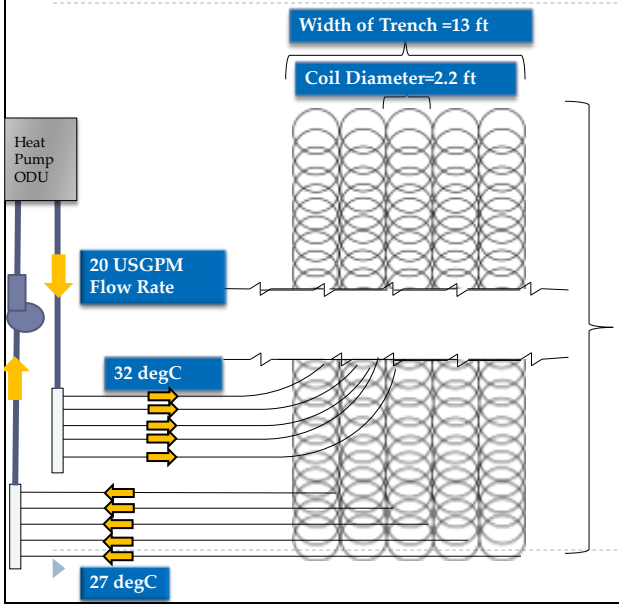
Site for Geothermal based Heat Pump Installation

Science Center, Arunachal Pradesh

Cooling and heating requirement

Cooling load	5 TR
Heating load	7 TR

Geothermal Slinky Design Parameters



Pipe material	HDPE
Outer Diameter	32 mm
Pipe Thickness	2~2.5 mm
No. of Slinky Loops	5
Length of Trench	100 ft
Length of HDPE pipe	5000 ft (1000 ft per loop)
Depth of Trench	7.5 ft

Heat Pump Specifications- Water (Geo) source Variable Refrigerant Flow

Make				Samsung
Type				DVM S WATER
Model Name				AM080FXWANR/EU
Power Supply			Φ, #, V, Hz	3,4,380-415,50/60
Mode			-	HEAT RECOVERY
Performance	**HP**		**HP**	**8.00**
	Capacity (Nominal)	**Cooling**	**TR**	**6.37**
		Heating		**7.17**
Power	Power Input (Nominal)	Cooling 1)	kW	3.84
		Heating 2)		4.12
	Current Input (Nominal)	Cooling 1)	A	6.20
		Heating 2)		6.60
	MFA			20.00
COP	**Nominal Cooling 1)**		-	**5.83**
	Nominal Heating 2)		-	**6.12**
Compressor	Type		-	SSC Scroll x 1
Condenser	Type		-	PHE (Plate Heat Exchanger)
	Water Flow Rate		USGPM	21.0
	Max. Pressure		MPa	1.96
Refrigerant	Type		-	R410A
	Control			EEV - Electronic Expansion Valve
External Dimension	Net Weight		kg	160.0
	Net Dimensions (WxHxD)		mm	770 x 1,000 x 545
Operating Temp. Range (Water)	Cooling		°C	10.0 ~ 45.0
	Heating		°C	10.0 ~ 45.0

System Comparison with Conventional Heat Pump (Energy Simulation Results)

Cooling mode

Energy consumption with conventional heat pump	:	5486 kWh/yr
Energy consumption with geothermal heat pump	:	3924 kWh/yr
% Saving	**:**	**29%**

Heating mode

Energy consumption with conventional heat pump	:	2004 kWh/yr
Energy consumption with geothermal heat pump	:	1382 kWh/yr
% Saving	**:**	**31%**

Digging of trench for geo-exchange

Digging through JCB machine

Digging through manual labour

Preparation of slinky loops

Slinky were prepared manually with the help of a die

Laying of slinky in the trench

Refilling of the trench

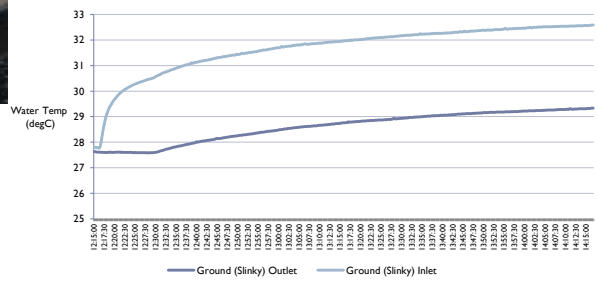
After setting the slinky ends, the trench was refilled and levelled with JCB machine

Connection of slinky ends to inlet/outlet manifolds with appropriate fittings

Pipe ends were connected to the inlet and outlet manifolds through compression fittings

Testing of Geo-exchange System

The testing results at a flow rate of 4.1 USGPM for one of the slinky



The average heat rejection per slinky was calculated to be around 1 TR.

Commissioning of Indoor Units (IDUs) with Refrigerant and Drain Piping

4 No's Indoor Units of 1.6 TR capacity each were installed in the Auditorium. Leak test of drain pipes ; and Vacuum test of refrigerant tubing were also carried out

Commissioning of Outdoor Unit (ODU)

Installation and Testing of Y-strainer, Flow Switch, Air-Vent valve, Pressure & Temperature gauges, Pressure Tank and Water Circulation Pump with ODU.

Satisfactory operation of all the systems was ensured.

Commissioning of Remote Monitoring System (RMS)

DMS-Data Management Server

Internet Modem

PIM-Power Interface Module

RMS Interface

Radiant floor cooling/heating system

Energy and cost analysis-Radiant cooling

Geothermal system

Energy savings	30-40%
Costing	1.2 Lakh Rs/TR
Payback	3 years

Geothermal system

Geothermal system	
Peak Building Load	75 TR
Average Building load	40 TR
Load catered by Geothermal vertical system	20 TR

Resource and cost analysis-Geothermal

Geothermal system

Energy savings	10-15%
Water savings	14L/TR
Costing	40000 Rs/TR


thank
you