UK Government

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Bureau of Energy Efficiency
Ministry of Power, Government of India

ASPIRE PROGRAMME

Accelerating Smart Power & Renewable Energy in India

Domestic Study Tour of

UDAIPUR CEMENT WORKS LIMITED (UCWL)

UDAIPUR, RAJASTHAN

March 15, 2023

Hosted by:
Udaipur Cement Works Ltd.
Udaipur

SUMMARY REPORT

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ABBREVIATIONS

Abbreviations	Acronyms
Al_2O_3	Aluminium Oxide
APCS	Advanced Process Control Suite
ASPIRE	Accelerating Smart Power and Renewable Energy in India
BEE	Bureau of Energy Efficiency
CaO	Calcium Oxide
CCR	Cement Control Room
CO_2	Carbon Dioxide
COP26	Conference of the Parties
DCs	Designated Consumers
EE	Energy Efficiency
FCDO	Foreign Commonwealth and Development Office
Fe_2O_3	Ferric Oxide
GESI	Gender Equality Social Inclusion
IDEEKSHA	Industrial Decarbonisation and Energy Efficiency Knowledge-Sharing Platform
IEED	Industrial Energy Efficiency and Decarbonisation
IoT	Internet of Things
IT	Information Technology
MT	Metric Tonnes
$MTCO_2e$	Million Tonnes of Carbon Dioxide Equivalent
MTOE	Million Tonnes of Oil Equivalent
MTPA	Million Tonnes per Annum
MW	Mega Watt
MWp	Mega Watt Peak
OLBC	Overland Belt Conveyor
OPC	Ordinary Portland Cement
OPSD	Online Particle Size Distribution
PAT	Perform Achieve and Trade
RCC	Reinforced Cement Concrete
RTBS	Real-Time Belt Scanning

Abbreviations	Acronyms
SiO_2	Silicon Dioxide
UHF	Ultra-High Frequency
UCWL	Udaipur Cement Works Limited
WHRS	Waste Heat Recovery System

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BACKGROUND

India is the second largest producer of cement in the world, with an installed capacity of **500+** million metric tons per annum (MTPA), i.e., **7+%** of the global installed capacity. In 2022, India produced **370+** million metric tons (MT) of cement (~**9%** of global production). Demand for cement in India is estimated to touch ~**420** MT by **FY 2027** and the industry promises huge potential for growth as India has a high quantity and quality of limestone deposits throughout the country. Cement production in India grew at a CAGR of ~6% between **FY2016-22**, driven by demands in roads, urban infrastructure, and commercial real estate. Private sector companies account for ~**98%** of India's total cement production capacity. The cement industry accounts for ~**8%** of the **total national emissions in India**, making it critical to decarbonizing the sector to aid in achieving India's goal of **net zero by 2070**. As per the Energy Conservation Act of 2001, a cement plant with an annual consumption of over **30,000 MT** of oil equivalent (MTOE) is notified as a designated consumer (DC). Out of the **206** large cement plants, **175** plants/ DCs, accounting for **65%** (~**325 MTPA**) of India's total cement production capacity, are covered under The Perform Achieve Trade (PAT) scheme of the Bureau of Energy Efficiency (BEE). A total of **175** large cement units covered under the BEE's PAT scheme, are offering ~**2.12 MTOE and ~7.2 MTCO$_2$e energy savings and decarbonization potential respectively**. Several leading cement industries in India have announced a wide range of initiatives as a part of their decarbonization commitments.

In view of this, a domestic study tour of Udaipur Cement Works Ltd's unit in Udaipur, Rajasthan was organized on **15th March 2023** under Accelerating Smart Power and Renewable Energy in India (ASPIRE) programme[1]. The purpose of the study tour was to demonstrate and disseminate the various best practices and innovative Industrial Energy Efficiency and Decarbonization (IEED) technologies adopted by the above-mentioned UCWL Unit to enhance its energy efficiency and efforts to decarbonize its operations. The study tour was jointly organized by FCDO and the Bureau of Energy Efficiency (BEE) with the support of UCWL.

Objectives of the Study Tour

- To demonstrate new and innovative IEED measures implemented by UCWL
- To enable other industries in the cement sector, to reduce their overall specific energy consumption and adhere to the compliance requirements under BEE's PAT scheme
- To foster an ambitious, mutually beneficial, and outcome-focused relationship between industry stakeholders

[1]**About ASPIRE Programme**
Accelerating Smart Power and Renewable Energy in India (ASPIRE) is a bilateral programme implemented by Foreign Commonwealth and Development Office, Government of UK in association with Ministry of Power and Ministry of New and Renewable Energy, Government of India. KPMG is the lead delivery partner for the ASPIRE programme. Idam Infrastructure Advisory Private Limited (India) and Carbon Trust (UK) are the key consortium members.

Highlights

40+ **Participants**

Active participation from the government agency, industrial organizations, research institutions, and national technology providers (including senior officials and executives)

Visit to following key areas of the cement plant to understand various IEED measures adopted by UCWL:

- Solar PV Park
- Floating Solar PV plant installed at UCWL mines
- Cement Control Room

40+ **saplings were planted by the delegates during the study tour**

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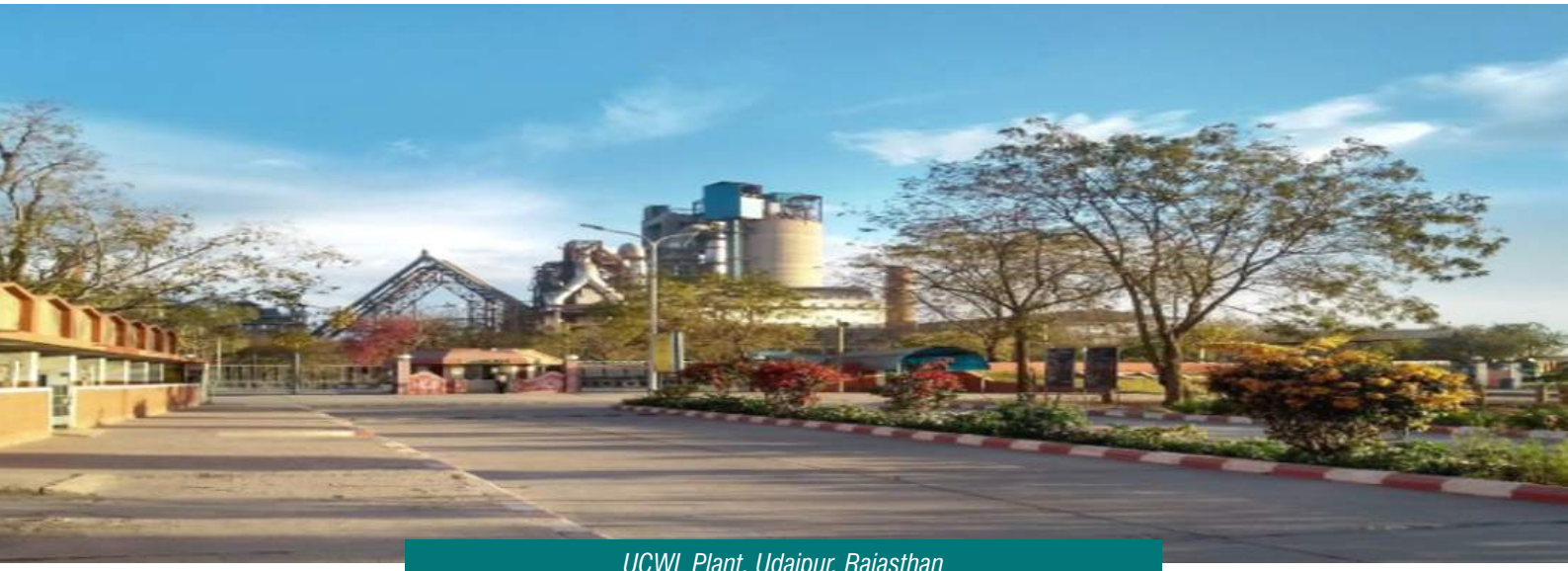
OVERVIEW OF UDAIPUR CEMENT WORKS LIMITED



UCWL Plant, Udaipur, Rajasthan

- Udaipur Cement Works Limited (UCWL), is a subsidiary of J.K. Lakshmi Cement Limited (JKLC), a renowned name in the Indian cement industry for about four decades
- UCWL is located in the beautiful city of lakes, Udaipur, Rajasthan and operates a **2.2** million tons per annum (MTPA) integrated cement manufacturing unit. UCWL has ingrained "Sustainable Development" as a key ethos in its daily business activities, led by its Integrated Sustainable Development Policy
- The company upholds the highest levels of system standards such as ISO Certification for Environment (14001), Occupational Health and Safety (45001), Energy (50001), and Quality Management (15001) Systems. Going beyond the general industry practice, UCWL has also inventoried its carbon and water footprint as per ISO 14064 – 1 and ISO 14046
- With the blend of modern technology and rich legacy, UCWL manufactures world-class cement under the brand name - Platinum Heavy Duty Cement. The company also manufactures Platinum Supremo Cement and is positioned as roof specialist
- UCWL is also identified as a Designated Consumer (DC) as per the norms laid down by the Bureau of Energy Efficiency, Ministry of Power under the Perform, Achieve, and Trade (PAT) scheme. The unit has implemented several measures to enhance its energy efficiency and decarbonize its operations.

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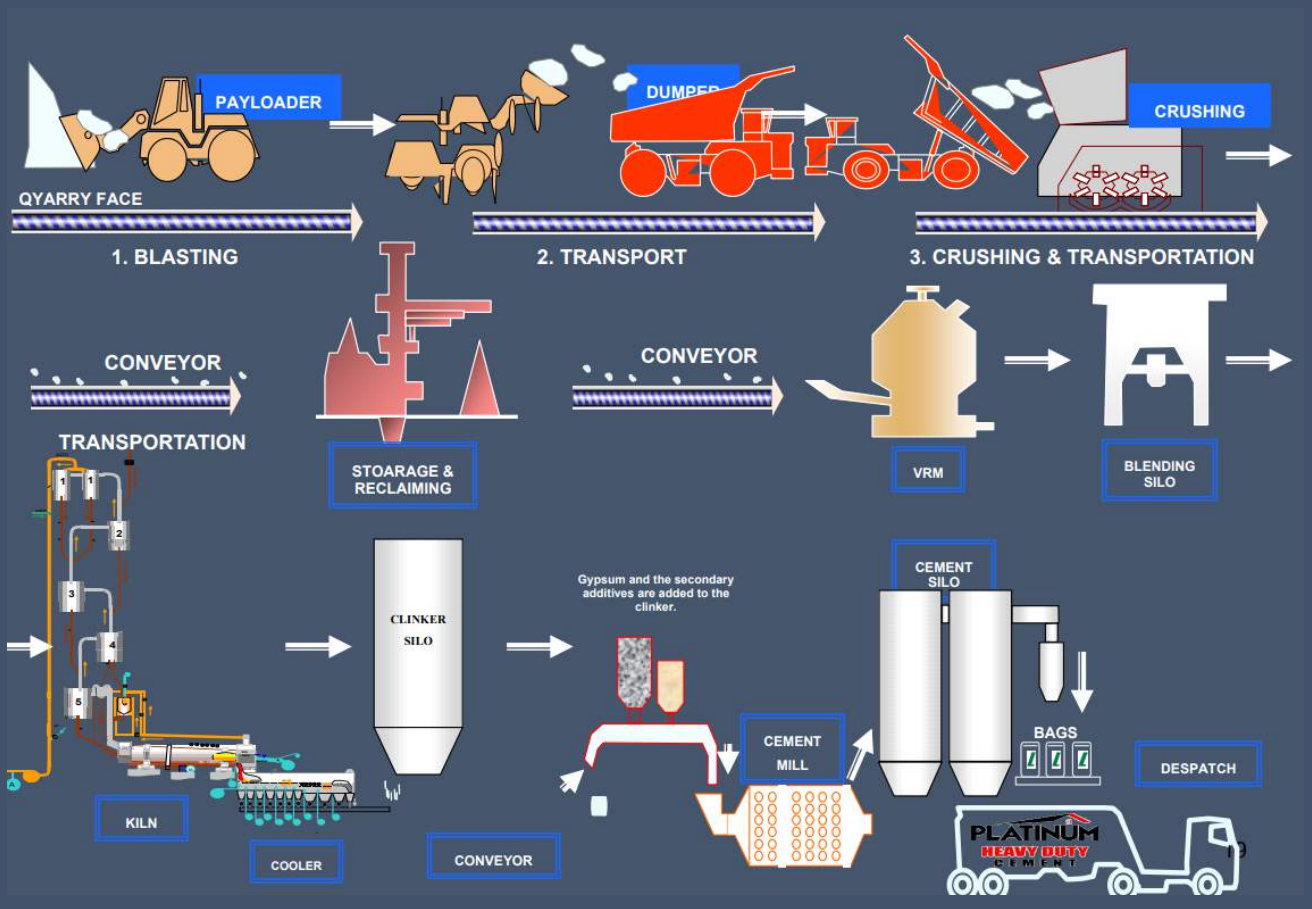
STUDY TOUR/ VISIT OF UCWL

Cement is a commonly used binding agent in construction, consisting mainly of calcium oxide (CaO), silicon oxide (SiO_2), aluminium oxide (Al_2O_3), and ferric oxide (Fe_2O_3). Limestone is the primary raw material used in the production of cement. The UCWL's unit is well equipped with crushing, raw material grinding, coal grinding, pyro-processing, cement grinding, and cement packing departments. An overview of the process followed at UCWL's unit is presented in the diagram below:



Typical Process Flow Diagram of Cement Process

As part of the study tour, participants visited the Cement Control Room to understand the key areas and processes of the plant, including the following:

Crushing:

- Limestone is crushed and discharged onto a conveyor belt to move to the stacker where it is stacked in stockpiles
- Limestone is extracted transversely from the stockpiles by reclaimers and conveyed to raw mill hoppers for grinding

Raw Material Grinding:

- Reclaimed limestone along with additives and corrective material is fed to the raw mill for grinding
- Hot gases generated from the clinkerisation process is used in the raw mill for drying and finally stored and homogenized in the silo
- Extracted raw meal from the silo is called 'kiln feed' which will be fed to the top of the multistage preheater for preprocessing

Pyro-Processing:

- Clinker is made by pyro-processing of 'kiln feed' in the preheater and the rotary kiln
- Fine coal and/or other fuel is fired to provide the necessary heat in the Kiln and the precalciner located at the bottom of the preheater
- Hot clinker discharged from the Kiln is dropped on the grate cooler for cooling
- The cooler discharges the clinker onto the pan/bucket conveyor, and it will be transported to the clinker silo
- The clinker is then taken from the silo to the cement mill hoppers for cement grinding
- The clinker cooling operation recovers up to 30% of kiln system heat, preserves the ideal product qualities, and enables the cooled clinker to be maneuvered by conveyors
- The SF cross bar grate cooler is used for cooling clinker. Hot air sent through the initial stage of the clinker cooler, known as, secondary air, and is directed to the rotary kiln where it nourishes fuel combustion
- The coarse dust collected from clinker coolers is comprised of cement minerals and is restored to operation
- Based on the cooling efficiency and desired cooled temperature, the amount of air used in this cooling process is approximately **2 kg/kg of clinker**
- The cooler exhaust has been used to power generation at waste heat recovery (WHR) plant. Another stream of air called tertiary air from the SF cross bar cooler is used for combustion in pre-calciner

Cement Grinding:

- Clinker, gypsum, fly ash, and mineral components according to the requirement is extracted from their respective hoppers and fed to the cement mill
- Cement mill grinds the feed to a fine powder and the mill discharge will be fed to an elevator, which will take the material to a separator, which separates the fine product and the coarse product
- The cement is then transported to RCC cement silos for dispatch

Cement Packing:

- Upon completion of cement production, the finished product is transferred using elevators and conveyors to large storage silos and loaded into trucks

Key IEED measures adopted by UCWL

Details of key energy efficiency and decarbonization measures adopted by UCWL and the savings realized through the same are provided below:

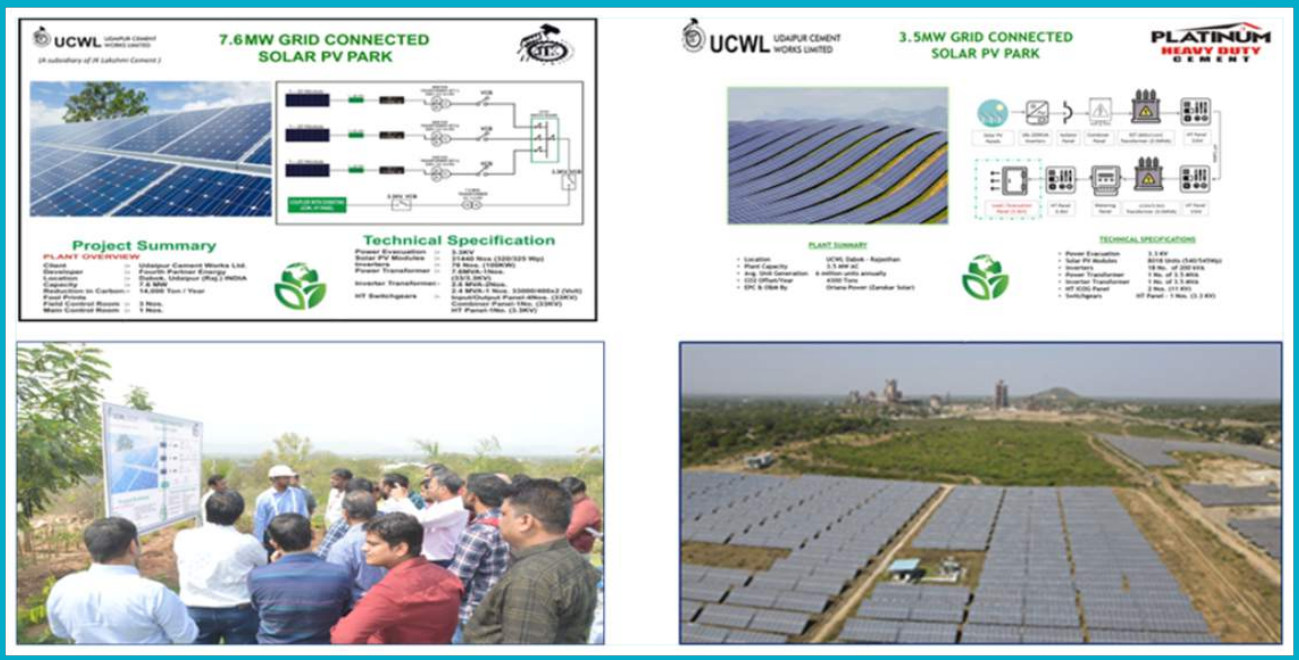
a. Solar PV Park

Implemented ground-mounted Solar PV projects at Hill Top Garden in phase wise manner to increase the share of RE in the overall energy mix:

- Phase I: 7.6 MW (AC) Grid Connected Solar PV Park
- Phase II: 3.5 MW (AC) Grid Connected Solar PV Park

Sr. No.	Description	Phase I (7.6 MW Solar PV Project)	Phase II (3.5 MW Solar PV Project)
1	Capacity	7.6 MW (AC)	3.5 MW (AC)
2	Commissioning Year	February 2020	December 2021
3	Developer	Fourth Partner Energy	Fourth Partner Energy
4	No. of Solar PV Modules	31,440 (320/325 Wp)	8018 (540/545 Wp)
5	No. of Inverters	76 (100 kW)	18 (200 KVA)
6	**Reduction in Carbon**	**14,000 Tonnes per year**	**4300 Tonnes per year**

Solar Phase I Plant



Solar Phase II Plant

b. Floating Solar PV Plant:

Installed the first ever floating solar plant in the cement industry, with a capacity of 1 MW by utilizing an abandoned pit available in the mines area in February 2023. This innovative solution set a new standard for sustainable energy practices in the cement sector.

Sr. No.	Description	Floating Solar PV Plant
1	Capacity	1 MW (DC)
2	Commissioning Year	February 2023
3	No. of Solar PV Modules	1862 (540/545 Wp)
4	No. of Inverters	4 (220 KVA)
5	Average Unit Generation	1.4 Million Units per annum
6	**CO_2 Offset per year**	**1000 Tonnes**
7	**Water Evaporation Savings**	**8000 m^3 per year**

1MW Floating Solar Plant installed at UCWL

c. Impact of implementation of Solar PV project:

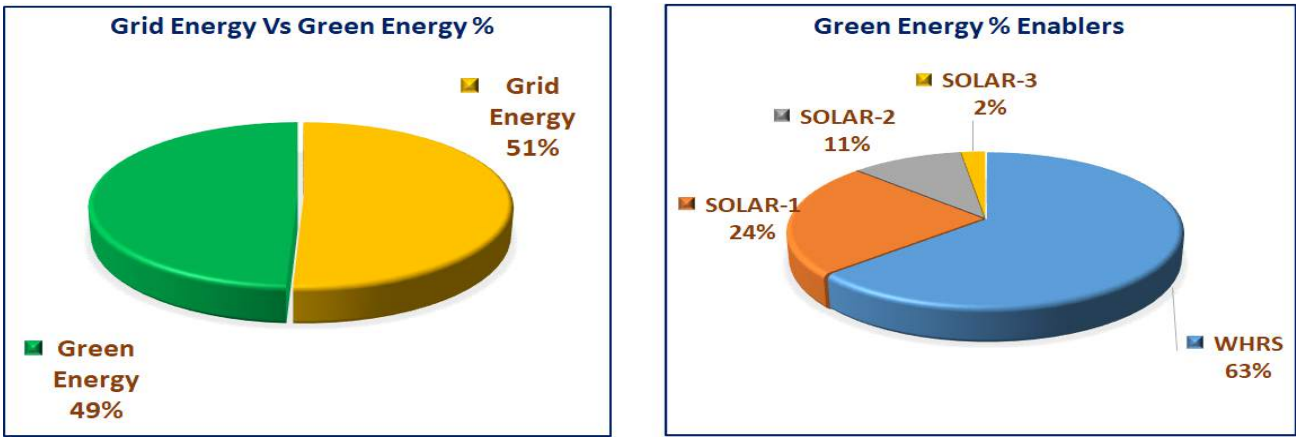
As of now, UCWL has installed around **11.9 MW (AC)** of Solar PV plants including floating solar plant. These solar projects have generated around **100,000 MWh** of green energy that has mitigated around 85,000 tonnes of CO2 emissions, equivalent to **34 lakh** trees during the last two fiscal years i.e., **FY 2020-21** and **FY 2021-22**.

d. Waste Heat Recovery System

UCWL installed a Waste Heat Recovery (WHR) power plant in **2017**. This WHR plant uses the heat generated through rotary kiln preheater (PH) and AQC exhaust hot gases for power generation. These hot gases are used to generate steam in the steam generator which is further used to generate electricity/power through the steam turbo generator. UCWL has installed a **5.8 MW** of WHR plant at their unit.

Impact of Solar PV and WHR on UCWL's Energy Mix

UCWL meets around **49%** of its total electricity requirement from green sources, i.e., Solar and WHRS.



UCWL Energy Mix Chart

e. Cement Control Room (CCR)

The CCR at UCWL uses cutting-edge technology to monitor the energy consumption and process of the complete factory. It provides daily statistics on energy generation from Solar PV projects as well as WHR systems. Additionally, UCWL has also adopted the following IT-based emerging technologies:

- IoT Sensors for real-time condition monitoring of equipment
- Real-time belt scanning system (RTBS) in Overland Belt Conveyor System (OLBC)
- Online Particle Size Distribution (OPSD) system for mills
- AI-based "Advanced Process Control Suite (APCS)" for kiln & mills optimization
- Tracking of Vehicles by UHF (Ultra High Frequency)

Tour of CCR, UCWL

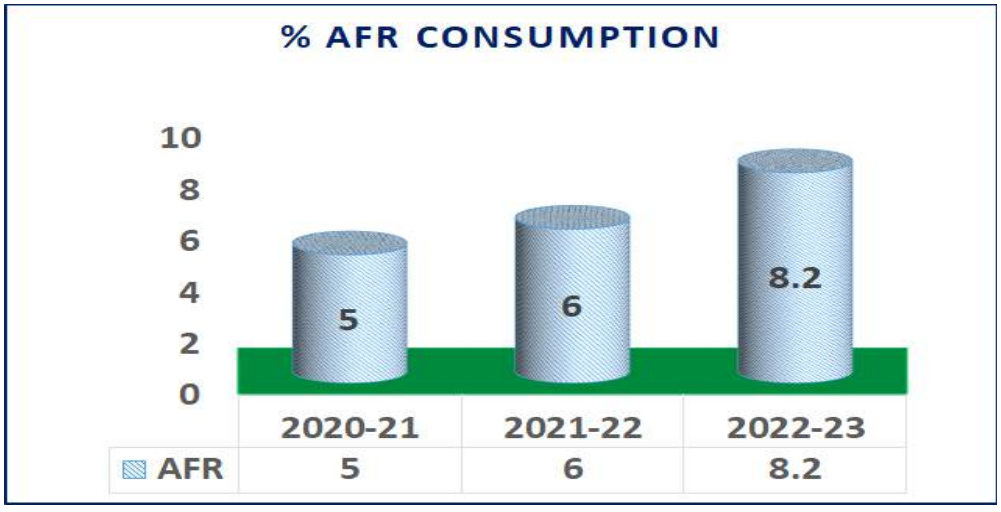
- **Green mode bulk transportation**

  UCWL has initiated an innovative method to transport loose cement by a greener mode of transportation shifting from diesel-based bulkers to electric-based rakes. UCWL has become the first cement company in the North-West region to implement this inventive step towards achieving logistical efficiency and environmental conservation by saving around **20,000Kg** CO_2 per rake movement.

Bulk Loading Infrastructure – Packing Plant

- **Increase in Alternate Fuel and Raw Material Consumption**

  In cement plants, the use of agricultural and industrial wastes is becoming increasingly important, on account of both economic considerations and environmental compulsions. The economic considerations arise from the fact that the costs of raw materials and fuels account for up to **50%** of the total operating costs in most of the plants and thus alternative fuels and raw materials with cheaper cost implications find an important role to play. The environmental compulsions occur due to enormous increases in the generation of wastes that require safe and gainful modes of recycling. UCWL has increased Alternate Fuel and Raw Material (AFR) consumption from **5%** in **FY 2020-21** to **8.2%** in **FY 2022-23**.

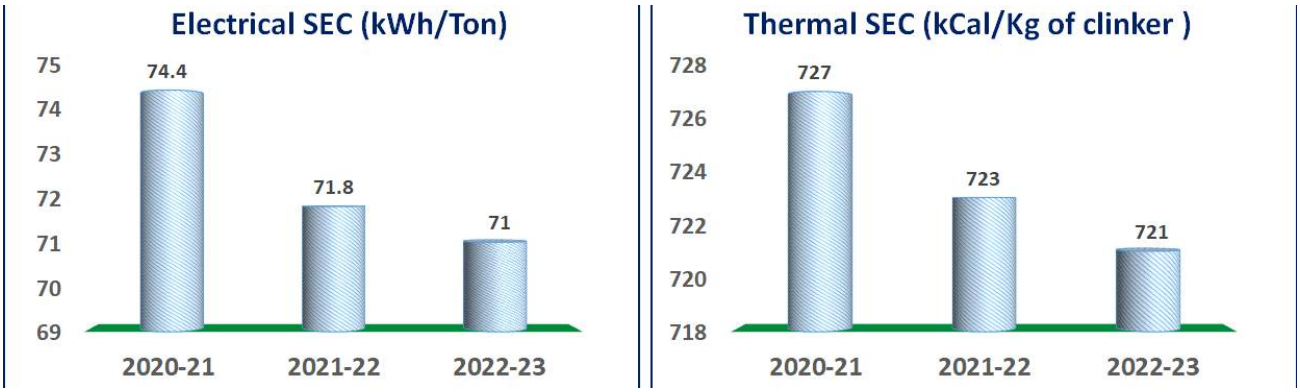


Alternate Fuel & Raw Material Consumption (YoY)

- **Other measures:**
  - PH Top Cyclone modification to reduce return dust across the preheater
  - Reject belt replaced with Air Slide at CM1 & CM2 to eliminate dust emissions and to reduce maintenance costs
  - New Instrument introduced for moisture detection at AQC O/L
- **Target to become carbon neutral by 2040**
  - **UCWL has joined the Science Based Targets Initiative (SBTi)**, a distinguished group of organizations from around the world
  - UCWL has pledged to both 'Near Term Goals' and 'Net Zero Emissions' within the SBTi framework
  - Furthermore, the company aims to achieve Net-Zero emissions by 2040
  - To achieve the target, UCWL will focus on the following:
  - Improving blended cement by **20%**
  - Increasing RE share & EE in the total energy mix
  - Increasing use of AFR – reducing coal consumption by **15%**

Impact

- The impact on Electrical and Thermal specific energy consumption in the last three years due to the implementation of the above-mentioned measures is presented below:



UCWL Energy Intensity (YoY)

- **Tree plantation drive at Hill Top Garden, UCWL**

  Participants planted 50 saplings at Hill Top Garden after touring the Solar PV Parks

Tree plantation by the participants

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FEEDBACK FROM THE PARTICIPANTS

- Around **82%** of the participants responded that they were more than satisfied with the outcomes of the study tour/ visit *(provided an 8+ rating on a scale of 10)*
- About **91%** of the participants rated the quality and content of the delivery as more than satisfactory *(provided an 8+ rating on a scale of 10)*
- Many participants recommended similar study tours/ visits for the cement sector
- The participants suggested the following subjects for future plant visits:
  - Production of Green Cement
  - Waste Heat Recovery Technologies in High and Low-temperature applications
  - Energy Management Systems
  - Emerging IT-based technologies

> *"Understanding the cross learning from best practices and initiatives"*
>
> **- Mr. Pushpendra Garhwal, Assistant Manager**
> *Shree Cement Limited*

> *"Insightful study tour to know about latest and innovative energy saving projects"*
>
> **- Mr. Sumit Kumar, Subject Matter Expert**
> *Chitkara University*

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CONCLUSION

Group photograph of participants

The response to the Study Tour/ Visit has been positive with significant participation from senior officials from BEE, executive leadership of leading Indian cement industries, and technology providers from India. The study tour seems to have achieved its goal of giving national organizations a stage to witness the operations of new and innovative IEED measures implemented and the challenges faced in the implementation of the same. The study tour successfully promoted gender equality and social inclusion (GESI) through the participation of women employees from large energy-intensive cement industries. It is expected that this study tour would have a demonstrable and long-lasting on-field impact in due course of time.

Further, to keep up the momentum, the following activities are envisaged under ASPIRE to enable wider adoption of IEED measures and technologies by Indian cement industries to achieve their net-zero targets.

- Provide handholding support including B2B interactions/webinars to large energy-intensive industries (including the cement sector) to support in identifying technologies & solutions, and technology suppliers for enhanced adoption of IEED interventions.
- Plan and organize international study tours/visits for cement industries in close collaboration with technology suppliers from the UK.
- Create more discussion forums to facilitate the exchange of knowledge and information that will aid in the formulation of policies.
- Organise national-level-policy roundtable on similar lines for hard-to-abate sectors including the cement sector in collaboration with BEE and global technology suppliers including from the UK.

For more information please contact:

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ANNEXURE

ATTENDANCE SHEET

S.No.	Name	Designation	Organisation
1	Mr. Sumit Kumar	Subject Matter Expert	Chitkara University
2	Mr. Chandan Kumar Parasar	Manager-Production	Orient Cement Ltd.
3	Mr. Ketan Goel	Sr. Manager	Invotech Industrial Solutions Private Limited
4	Mr. Sandeep Gautam	Sr. Manager (Mechanical)	JK Cement Works, Nimbahera
5	Mr. Dheeraj Bohra	Assistant Manager (Electrical)	JK Cement Works, Nimbahera
6	Mr. Chandan Srivastava	Manager	Ultratech Cement Ltd. (Unit: Vikram Cement Works), Vikram Nagar, P.O. Khor-458470, Dist: Neemuch (M.P.)
7	Ms. Karishma Rajput	Trainee Process	Ultratech Cement Ltd. (Unit: Vikram Cement Works), Vikram Nagar, P.O. Khor-458470, Dist: Neemuch (M.P.)
8	Mr. Srinivasa Rao	Manager	Ultratech Cement Ltd. (Unit: Vikram Cement Works), Vikram Nagar, P.O. Khor-458470, Dist: Neemuch (M.P.)
9	Ms. Saloni Gupta	Trainee Mech-1	Ultratech Cement Ltd. (Unit: Vikram Cement Works), Vikram Nagar, P.O. Khor-458470, Dist: Neemuch (M.P.)
10	Mr. Rakesh Sharma	Sr. Manager	Ultratech Cement Ltd. (Unit: Vikram Cement Works), Vikram Nagar, P.O. Khor-458470, Dist: Neemuch (M.P.)
11	Mr. Khalid Parwaze	Sr. Manager (E&I)	UltraTech Cement Ltd., Patliputra Cement Works
12	Mr. Hemraj Gadhwal	Asst. Manager	Ultratech Cement Ltd. (Unit: Birla White)
13	Mr. Inder Raj Vyas	Manager	Ultratech Cement Ltd. (Unit: Birla White)
14	Mr. Vikas Garg	Mgr.	UCWL
15	Mr. Ronit Anil Singh	AM	UCWL
16	Mr. Jayraj Thakkar	CEO	Kaishan Machinery India Pvt. Lt
17	Mr. Bhagwat Singh	Dy. Manager - Mechanical	Shree Cement

S.No.	Name	Designation	Organisation
18	Mr. Pushpendra Garhwal	Asst Manager - Energy	Shree Cement
19	Mr. Abhishek Khandelwal	Dy. Manager – Electrical	Shree Cement
20	Mr. Ankit Nagar	Dy. Manager - Process	Shree Cement
21	Mr. Pankaj Sharma	Manager – Power Plant -SMP (Process)	Shree Cement
22	Mr Suresh M Patel	Assistant GM	Tata Chemicals
23	Mr. Dinesh	Director	
24	Mr. Ashok Kumar Singhi	Director	GVS Consulting Engineers LLP
25	Mr. Harendra Kumawat	Sr. Engineer	Shree Cement Ltd Ras
26	Mr. Manoj Khandelwal	Sr. Manager	Shree Cement Ltd.
27	Mr. K. K. Chakarvarti	Senior Advisor	iDEEKSHA, ASPIRE Team
28	Mr. Vivek Negi	Joint Director	Bureau of Energy Efficiency
29	Mr. Rajiv Shukla	Executive Director	Idam Infra, ASPIRE Team
30	Ms. Dhaarna Rawat	Analyst	Idam Infra, ASPIRE Team
31	Mr. Anurag Singh Sirola	Manager	KPMG, APIRE Team
32	Mr. Sunil Shah	MANAGER	UltraTech Cement Ltd, Technical and Performance Monitoring Cell, Mumbai
33	Mr. Prateek Sharma	Manager	NCCBM, Ballabgarh
34	Mr. Bharat Bhushan	Project Engineer	NCCBM, Ballabgarh
35	Mr. Abhijeet Khekale	Sr. Manager-Technical Services	Ultratech Cement – Dhar Cement Works
36	Ms. Pooja Yadav	PF – QC	UltraTech Cement Ltd. (Unit: Vikram Cement Works)
37	Mr. Dhirendra Sankhla		Shree Cement Ltd
38	Mr. Ashish Das	Manager	Shree Cement Ltd
39	Mr. Roheet Badgujar	Dy. Manager	Orient Cement
40	Mr. T. Shreedhar	Asst. Executive	Birla Corporation Ltd.
41	Mr. Kutesh	CEO	REON Energy
42	Mr. A. C. Verma		Centrica
43	Mr. Harsh Vardhan		Centrica
44	Mr. Anand Vardhan	Director	Centrica