



Fly Ash use in roads & flyover embankment

Welcome

NTPC@50: Towards Zero Waste: Fly Ash Management and Utilization

CEE National Waste Management Summit & Awards 2025

October 06, 2025

Outline:



Ash Utilisation Scenario - India

NTPC – A Brief Overview

Ash Utilization Progress at NTPC

Key Findings & Challenges

Strategic Recommendations

Conclusion



Understanding Fly Ash: The Power Generation By-product



01

Coal Preparation

High-quality coal is prepared and fed into boilers for combustion. The coal's mineral content determines the characteristics of the resulting fly ash.

02

Combustion Process

During high-temperature combustion (1,400-1,700°C), organic matter burns away while inorganic minerals form fine particles that become fly ash.

03

Collection & Storage

Electrostatic precipitators capture fly ash particles from flue gases. The collected ash is then stored in silos, ready for quality testing and utilization.

Fly ash is a fine, powdery residue comprising primarily silica, alumina, and iron oxide. Its pozzolanic properties make it invaluable in construction applications, effectively replacing virgin materials in various industrial processes.



Comprehensive Fly Ash Value Chain



Coal Input

Quality coal selection and preparation ensure optimal fly ash characteristics for downstream applications.



Combustion

High-efficiency boilers maximize energy extraction while producing consistent fly ash quality.



Collection

Advanced electrostatic precipitators capture 99.9% of fly ash particles from flue gases.



Storage

Modern silo systems maintain ash quality and enable efficient inventory management.



Transportation

Multi-modal transport network ensures timely delivery to end users across India.



Utilization

Diverse applications from cement production to road construction maximize resource value.



This integrated value chain transforms a thermal power by-product into a strategic resource for India's construction and infrastructure sectors. Each stage is optimized for quality, efficiency, and environmental compliance, ensuring maximum value extraction from this abundant resource.



Ash Scenario - India



ASH GENERATION

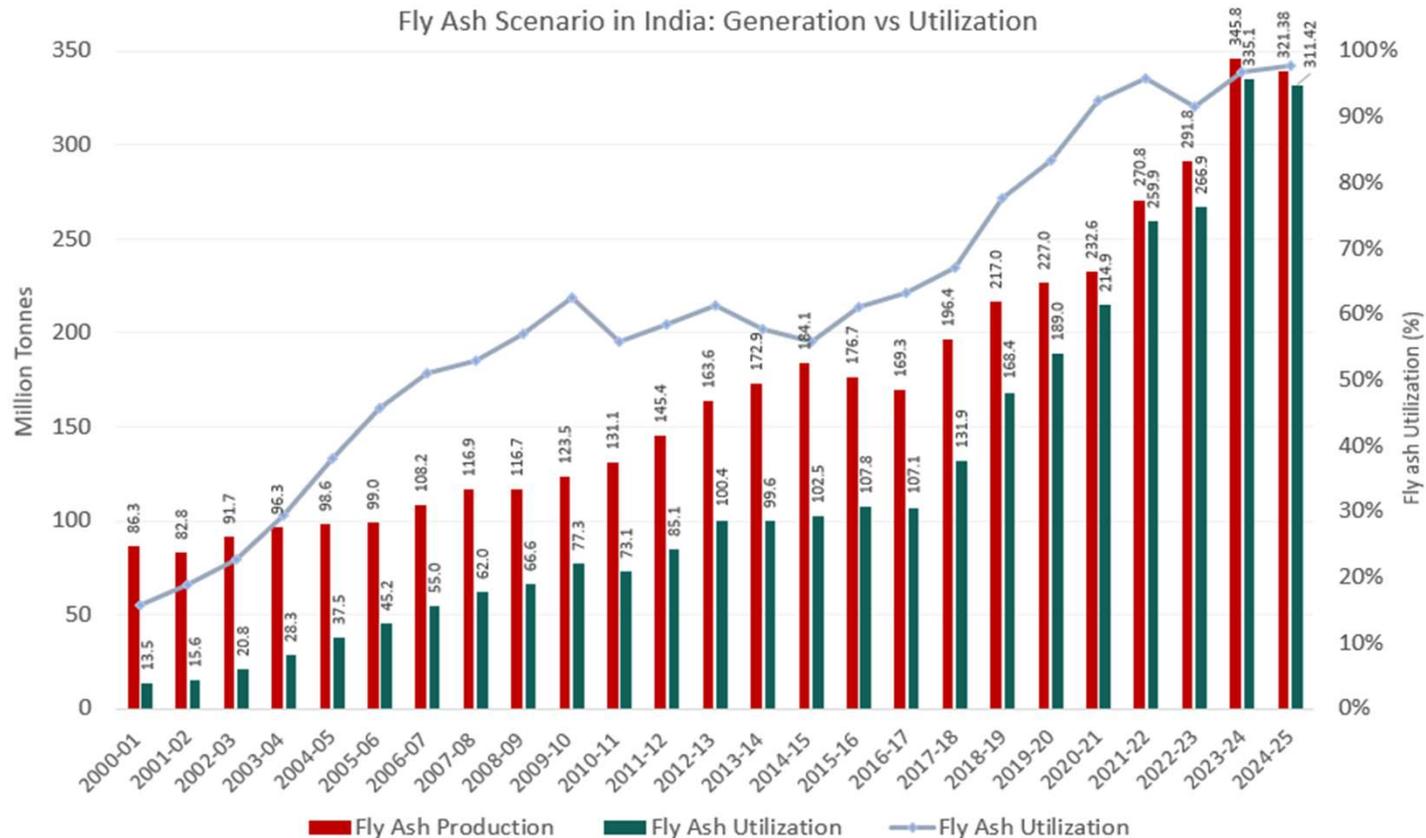
86 MMT (2000-01) **3.9X** 322 MMT (2024-25)

Ash utilization in 2024-25 was 96.90%

FLY-ASH UTILIZATION

13.5 MMT (2000-01) **24X** 312 MMT (2024-25)

Fly Ash Scenario in India: Generation vs Utilization





NTPC – India's Energy Giant

India's Premier Power Company



Vision

To be the World's
Leading Power Company,
Energizing India's Growth



Mission

Provide Reliable Power and Related Solutions in
an Economical, Efficient and Environment
friendly manner, driven by Innovation and Agility

Core Values



INTEGRITY

I



CUSTOMER FOCUS

C



ORGANISATIONAL
PRIDE

O



MUTUAL TRUST
AND RESPECT

M



INNOVATION
AND LEARNING

I

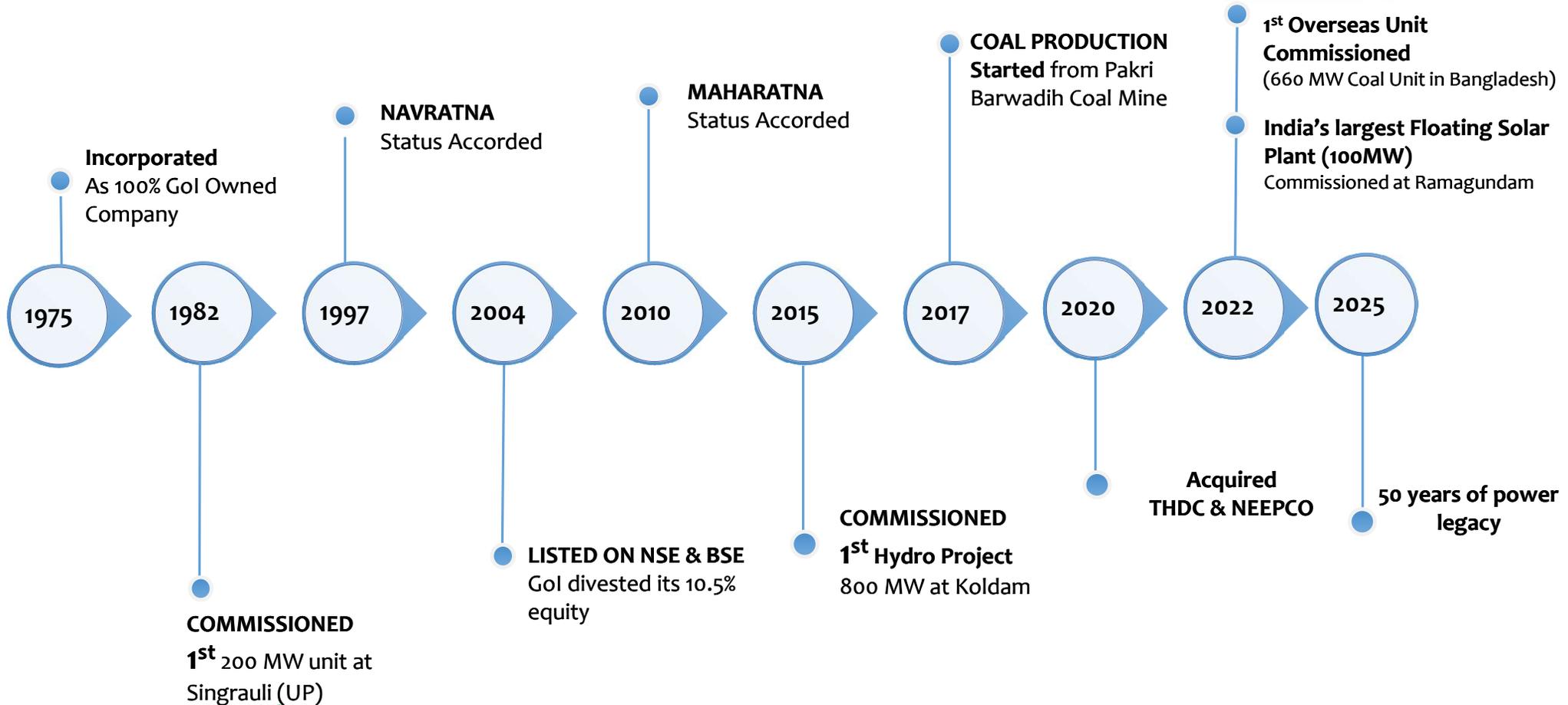


TOTAL QUALITY
AND SAFETY

T



NTPC Journey- Major Milestones



NTPC: A Legacy of Power and Responsibility



Pioneering Power Since 1975

Established as India's premier public sector power generator, NTPC has been the backbone of the nation's electricity infrastructure. Today, it stands as a symbol of India's energy independence.



Expanding Capacity

From its initial capacity, NTPC has grown to generate **64,394** MW of coal-based power. The company's ambitious vision targets nearly **87,754** MW thermal based capacity to meet India's growing energy demands.



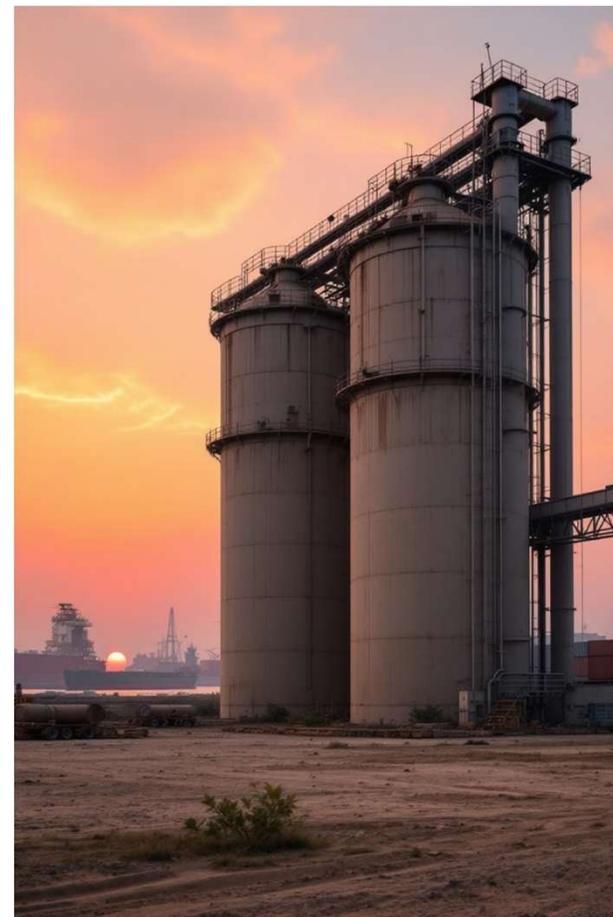
Environmental Stewardship

Managing environmental impact is crucial as ash generation is around **1,000 LMT** now and is projected to reach **1,400 LMT**. NTPC is committed to responsible ash disposal practices.





Ash Utilization at NTPC



Ash Utilization Team (CC-EOC Noida)



Overall Coordination, Policy related matters, Liaison with Ministries and Govt. Depts, MIS of ash data, Road Projects and related matters, Sale of Ash, Long term Tie-Ups, yearly targets for stations in AU, Focus on increasing the ash utilization percentage of stations. Coordination with Stations, External & Internal audits.

G Rajashekar GM



Policy related matters, Liaison with Ministries and Govt. Dept., BTAP Rake related matters, Road Projects status update and related matters, Parliament Questions, Sale of Ash, Long term Tie-Ups, Coordination with Stations.

P K Shrivastava DGM



S K Shrotri AGM

Ash utilization Reports and related Follow Ups Reviews through VC, Sale of Ash / Cenosphere, EoI, MoUs - Internal & External, Parliament Questions, QPR, MBR, RMC etc. inputs, Submission of CEA formats, ACRs, Coordination with Stations, External & Internal audits.

Daily Ash generation and utilization reports, MIS database, Drafting and presentation preparation, Coordination and follow up with stations for ash utilization related activities.

Tushar Srivastava FTE



Akash Gupta MGR

Mine Backfilling, Ash Management Associated Budget, Departmental Budget, Parliament Questions, RTI, MIS, MoUs - Internal & External, QPR, MBR, RMC etc. inputs, Workshop / Awareness Programmes.



NTPC Vision Mission & Objectives for AU



- Strive towards maximum ash utilization possible.
- 100% adherence to statutory compliances.
- Explore efficient and cost-effective methods/modes/ technologies towards ash utilization.
- Coordination and team building.



OBJECTIVES

To enable stations to achieve 100% AU in a sustainable manner conforming to the statutory compliances and norms.



MISSION

**No ash to Dykes.
Reclamation of existing dykes.**



VISION



Strategic Goals for Ash Utilization (2024-2034)



Short term 2024 - 2028

- ✓ Focus on achieving 100% utilization.
- ✓ 100% DAES infrastructure completion.
- ✓ No ash to dykes.
- ✓ Expansion into enhanced usage patterns, particularly in cement sector applications and mine void reclamation projects.



Long term 2029 - 2034

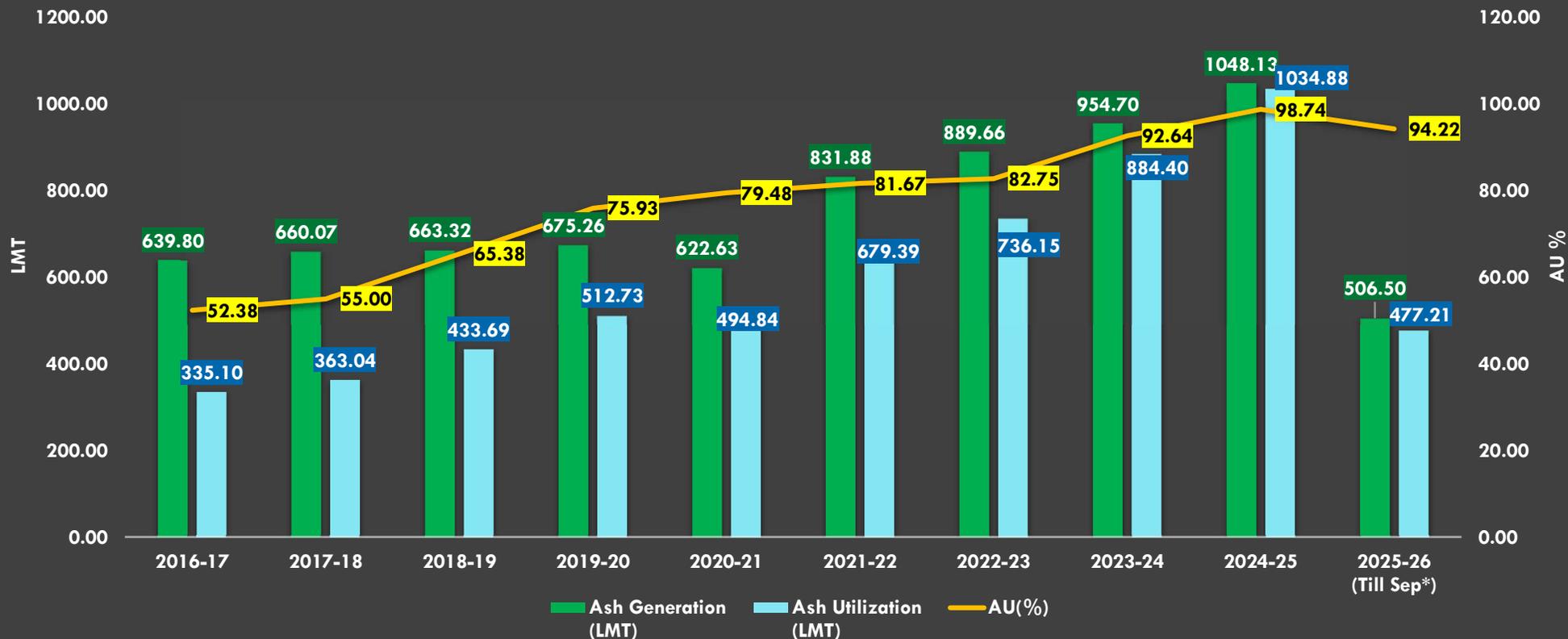
- ✓ Development of high-value products and promoting widespread infrastructure adoption with the help of NI group, marking our most utilization through high end value-based usage.



Ash Utilization Overview



NTPC Group Ash Utilization Over the Years



NTPC's Leading Role in National Ash Utilization



32%

National Share

NTPC contributes approximately 32% of India's total fly ash generation, making us a crucial player in the national ash utilization ecosystem.

100%

Utilization Target

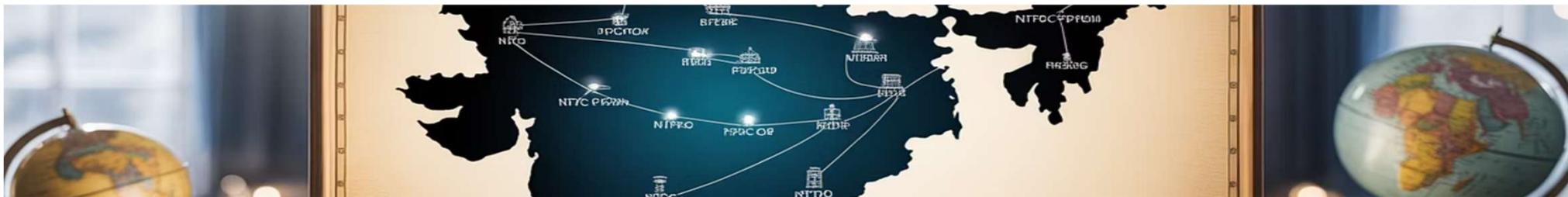
Aligned with India's ambitious 100% fly ash utilization goal, NTPC consistently exceeds national benchmarks through innovative partnerships and strategic initiatives.

>100M

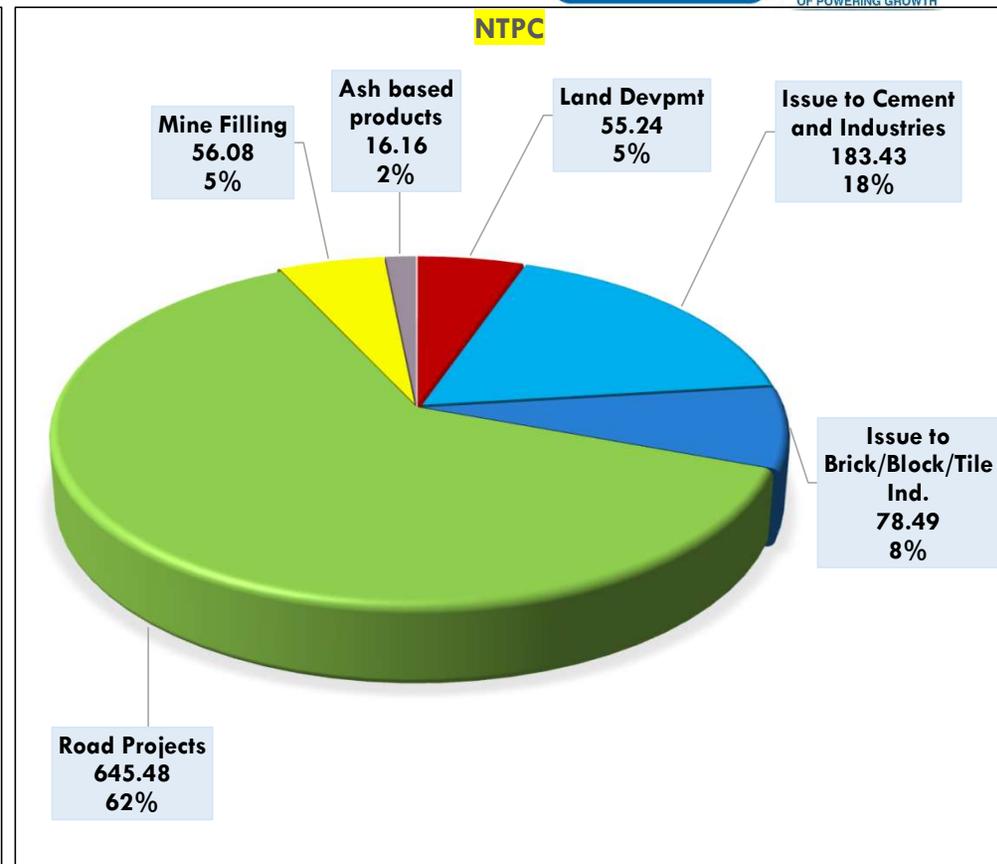
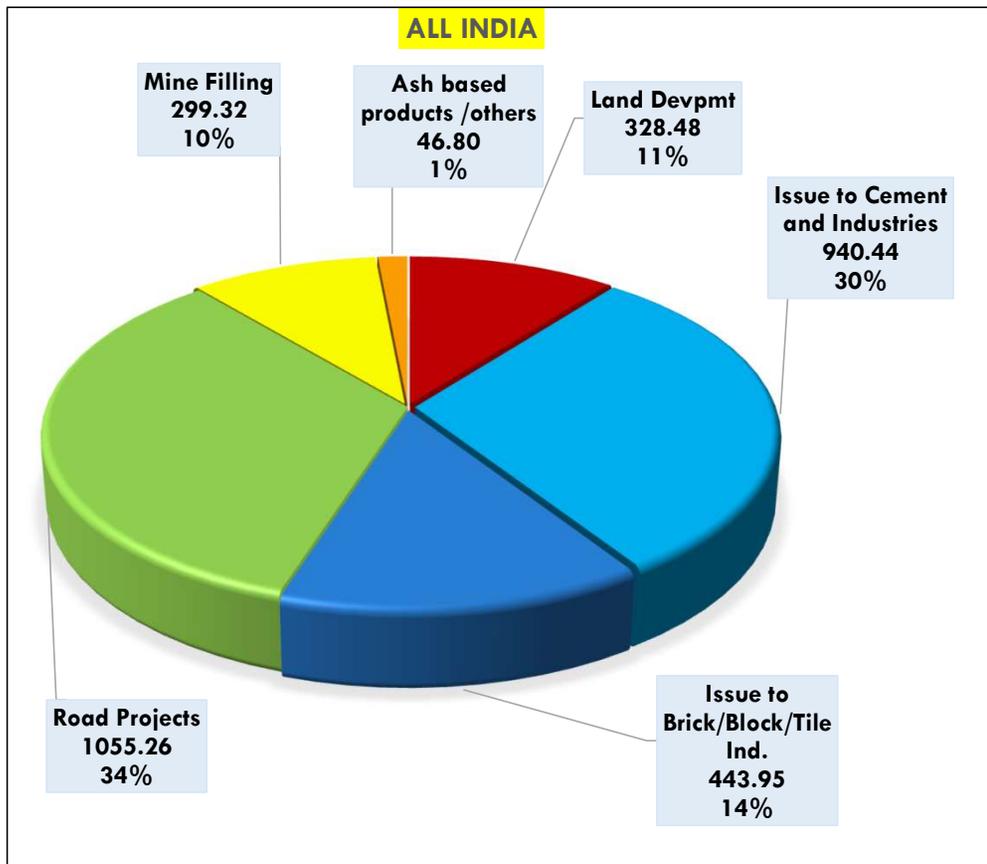
Annual Generation

NTPC generates > 100 million tonnes of ash annually across all thermal power station network, representing significant resource potential.

Our extensive network of thermal power stations across India positions NTPC as a cornerstone of the national fly ash utilization strategy. Through strategic plant locations and robust transportation infrastructure, we ensure consistent supply to key industrial clusters and infrastructure projects nationwide.



Avenue wise Ash Utilization **All India** (FY24-25) vs **NTPC** (FY24-25)



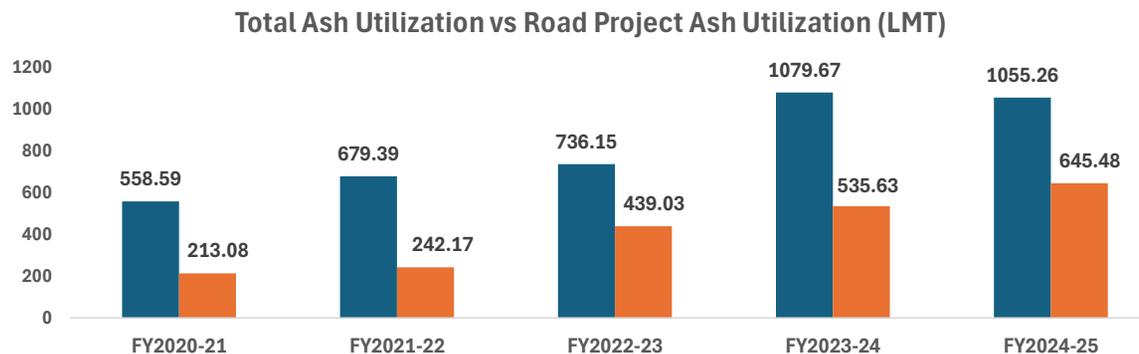
Ash Gen(LMT)	Ash Utilized(LMT)	AU %
3213.87	3114.25	96.90

Ash Gen(LMT)	Ash Utilized(LMT)	AU %
1034.88	1048.13	98.74

Initiatives for Ash Utilisation in Road Projects



Description	Initiatives
Ash utilization in Road Projects	<ul style="list-style-type: none"> ❖ NTPC has significantly improved Ash Utilization in Road Construction Projects /Flyover Embankment. ❖ For the year 24-25 NTPC has supplied ~60% of the total ash supplied by all TPP's in Road construction projects (645.48 LMT).



Transportation of ash through rail



DFA Transportation through Rail

DFA Transportation through rail with Closed Containers on BLC rake started in Khargone.



BTAP Rake from Sipat

1st BTAP Rake from NTPC Sipat to MP Birla Cement Maihar successfully dispatched on 28.04.2024.



BCCW Rake from Meja

BCCW Rake from NTPC Meja to Ambuja Raebareli started on 02/12/2024.



BOXN Rake from Khargone

1st BOXN Rake dispatched by NTPC Khargone with conditioned fly ash.

Total 360 Rakes



Rail Infrastructure for Ash Transportation



Operational Rail Loading Infrastructure – 12stns

Kahalgaon, Ramagundam, Rihand, Mouda, Simhadri, Korba, Vindhyachal, Talcher Kaniha, Sipat, Khargone, Barauni, Meja

Planned Infrastructure

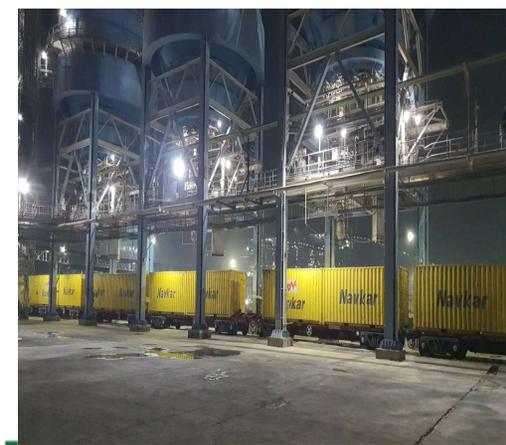
At all upcoming stations and under construction at existing stations as per feasibility

Total Ash Transported (FY 24-25)

12.66 LMT through 360 Rail rakes

Ash Transport by Location (Rakes)

Kahalgaon – 175, Barauni – 51, Khargone – 39, Ramagundam – 30, Sipat – 25, Meja – 18, Rihand – 16, Vindhyachal – 06



BLC wagons from NTPC Khargone



BTAP wagons Rake at NTPC Rihand



NTPC Ramagundam



NTPC Kahalgaon



Untapped Potential : Clay Ash Bricks in India

India's Brick Industry: Current State & Future Projections



250-300B

Annual Brick Production

India produces 250-300 billion bricks annually (440-530 million m³), with 85% being traditional burnt clay bricks.

Weight Profile

Conventional bricks average 3-3.5 kg each, with millions produced daily across India's thousands of kilns.

3-4x

Projected Growth

Demand expected to multiply 3-4 times in the next two decades, reaching 750-1,000 billion bricks per year.

Ash Utilization Opportunity

Replacing just **25%** of clay content with ash could utilize approximately **2,200* LMT** (220 million tons) of ash annually.

*Considering Annual Production – 300B
% of clay bricks – 85%
Avg weight of clay bricks – 3.5 kg

60-80%

Future Clay Market Share

Based on experiences in Europe, China, and Vietnam, burnt-clay bricks likely to maintain dominant position despite alternatives.

Environmental Benefits

Reduced clay extraction preserves topsoil, while ash incorporation drives way for circular economy.

The integration of ash into traditional clay bricks represents a pragmatic pathway toward more sustainable construction materials that aligns with existing production capabilities and market preferences.





Ash Export Potential

Global Fly Ash Demand & Opportunity



Climate Challenge

Cement industry emits ~8% of global CO₂; demand for low-carbon materials is rising

Supply Shortage

Developed economies (EU, North America) are shutting coal plants → **shortage of quality Class-F fly ash**

Market Growth

Global market projected to grow from **USD 8.54 B (2019) to USD 13.33 B by 2027 (CAGR 5.83%)**

Key Demand Drivers



EU Decarbonisation Goals

COP26 targets driving sustainable construction materials adoption across European markets



US Infrastructure Bill

\$1 trillion investment boosting construction demand for supplementary cementitious materials



Middle East Mega-Projects

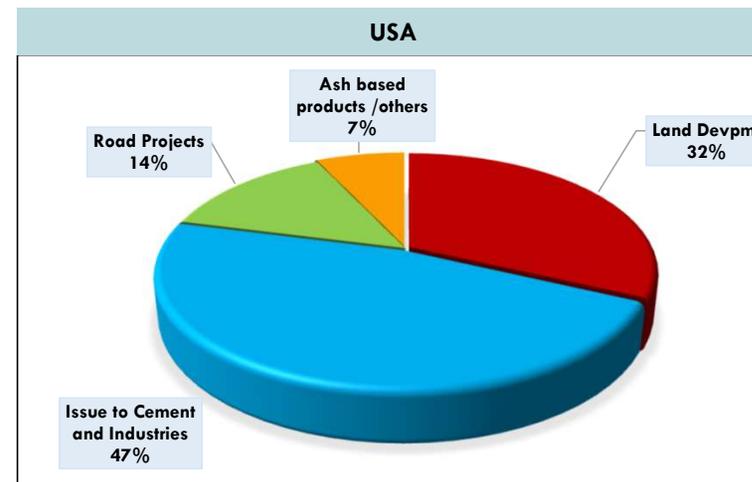
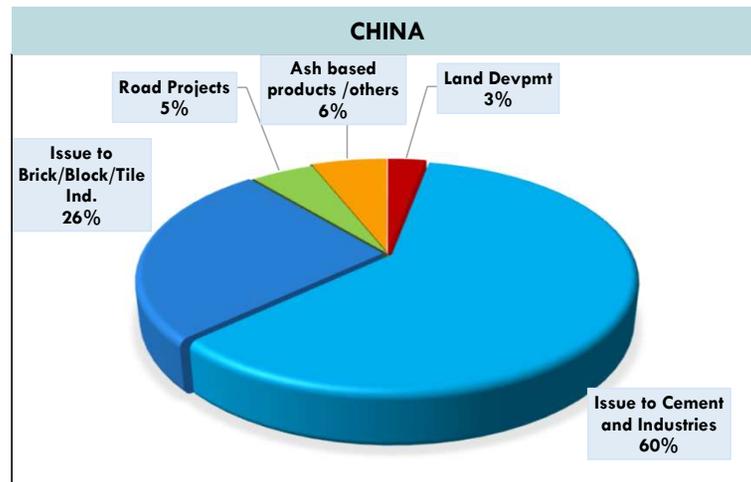
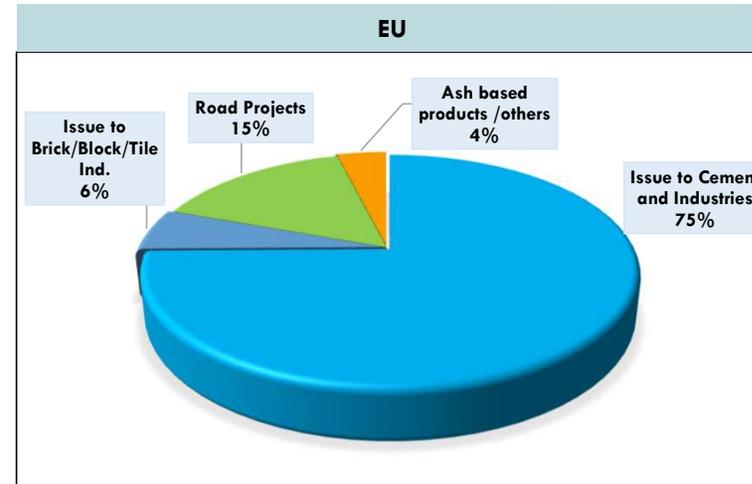
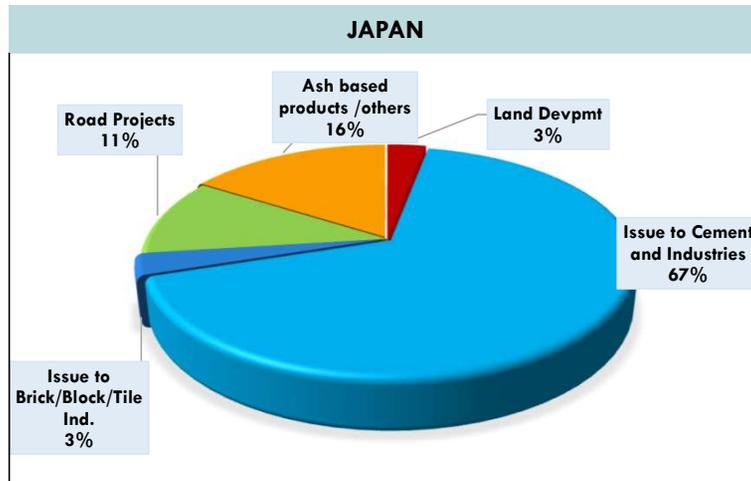
Ambitious developments like Saudi NEOM creating massive demand for quality fly ash





Ash Utilization – The Big Picture

AU utilization avenues abroad



Demand Market for Ash



S.No.	Product	Current Annual Demand/Production in India	Replacement of cement with ash (%)	Ash utilization potential (LMT)
1	Cement	3746.00 LMT (PPC 2360.00 LMT)	35	826
2	RMC	35-40 million cum	Average fly ash content per cubic meter of concrete ~ 120 kg	48
3	Bricks	300 billion bricks	With ash as replacement of clay in conventional bricks (~25%)	2200
			With BA	8100
			Without BA	4500
4	Export	35 LMT	-	35
5	Aggregates/New Products	700 LMT	-	300

Key Findings: India's Ash Landscape



Exceptional Utilization Achievement

India has achieved remarkable 96% ash utilization, positioning as global leader in industrial waste management. This success reflects coordinated policy, industry innovation, and growing market acceptance.

- Consistent year-over-year improvement
- Policy-driven transformation
- Industry collaboration success

Cement Industry Leadership

Cement sector drives fly ash consumption, utilizing millions of tonnes as Portland cement replacement. This partnership reduces carbon footprint while lowering cement production costs significantly.

- 30% of total utilization
- Environmental benefits
- Cost optimization

Transportation Optimization Opportunity

Rail transport remains underutilized despite significant long-distance potential. This represents massive opportunity for cost reduction and environmental improvement.

NTPC and Ministry of Railways jointly organized the first-ever National Conference on Fly Ash Utilization and Transportation on 25th August 2025 at PMI Noida, bringing together key stakeholders to deliberate on sustainable, large-scale fly ash management through rail-based logistics.

Regional Supply-Demand Clusters

Strategic clustering of generation and consumption creates efficient local markets while some regions demonstrate inter-state trading potential for optimized resource allocation.

- Local market efficiency
- Inter-state trade opportunities
- Strategic location advantages

National Conference on Fly Ash Utilization and Transportation



The National Conference on Fly Ash Utilization and Transportation was jointly organized by Ministry of Railways and NTPC on **25th August** at PMI, Noida. This first-of-its-kind conference served as a platform to deliberate on sustainable and economically viable solutions for large-scale fly ash utilization through the rail network.

1

Policy Perspectives

Insights from CEA, CPCB, and key ministries on regulatory frameworks

2

Logistics Innovation

Railways as a sustainable transport mode with futuristic wagon designs

3

Utilization Insights

Challenges and opportunities from generator and user perspectives

Key Leadership

- Shri Ghanshyam Prasad, Chairperson, CEA
- Shri Hitendra Malhotra, Member (Operations & Business Development), Ministry of Railways
- Shri Gurdeep Singh, CMD, NTPC
- Shri Piyush Singh, Additional Secretary, Ministry of Power

The conference witnessed active participation from executives of public and private GENCOs, power, coal, environment and infrastructure sectors, fly ash brick manufacturers and research groups. With **TERI as the Knowledge Partner**, the event paved the way forward for environmentally sustainable and economically efficient fly ash management through the railway network.



Current Challenges in Ash Transportation



1

Rake Availability Constraints

Limited railway rake availability for dedicated fly ash transport creates delivery delays and constrains market development. Competition with other bulk commodities affects scheduling consistency and reliability.

2

Specialized Wagon Shortage

Insufficient covered wagons designed for powder transport leads to quality degradation and weather-related losses. Standard open wagons are unsuitable for maintaining fly ash integrity during long-distance transport.

3

Unloading Infrastructure Gaps

Many cement plants and construction sites lack dedicated rail unloading facilities, forcing reliance on road transport for final delivery. This infrastructure deficit limits rail transport adoption despite economic advantages.

4

Supply Agreement Volatility

Short-term contracts and price fluctuations create uncertainty for long-term rail transport investments. Market volatility discourages infrastructure development and dedicated service commitments from transport providers.

Impact Assessment: These challenges collectively limit rail transportation for ash movement, despite significant cost and environmental advantages for distances exceeding 300 kilometers.



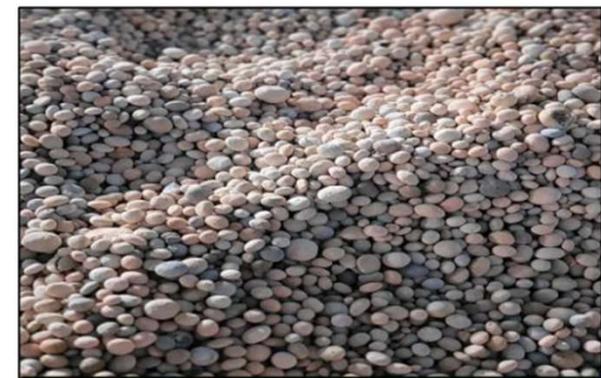
Innovative Fly Ash Utilization Pathways



Geopolymer Coarse aggregates



Nano Concrete aggregates



Sintered aggregates



Environmental Benefits of Ash Utilization



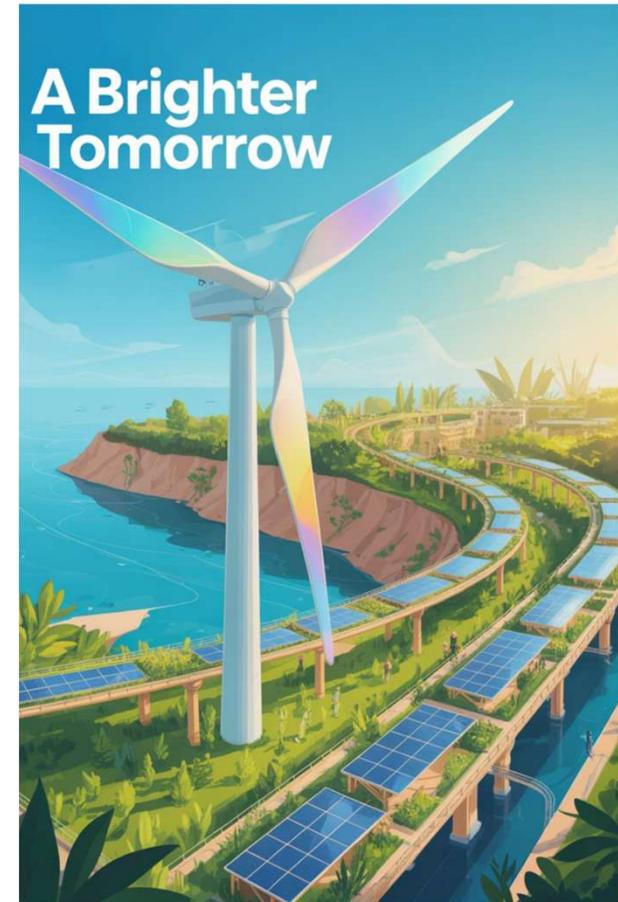
Land Conservation Impact

Every million tonnes of ash utilized prevents the need for 640 acres of landfill space. This conservation supports agricultural land preservation and reduces environmental pressure from waste disposal requirements.



Carbon Footprint Reduction

Replacing Portland cement with ash reduces CO₂ emissions by approximately 0.8 tonnes per tonne of cement substituted.



Energy Savings

Cement production energy requirements reduced when using ash as partial replacement material

Water Conservation

Reduced water consumption in concrete production due to ash's improved workability characteristics

Waste Diversion

Prevention of industrial waste requiring landfill disposal through productive utilization applications



100% AU & Unlocking Solar Potential on NTPC Ash Dykes



2100MW

Total Potential

Clean energy capacity

100%

Area Utilized

Efficient land use

0.1

Hectare/MW

Minimum Compliance standard



100% AU ~ ZERO EC



LAND RECLAMATION



Conclusion: Leadership in Circular Economy



"NTPC's journey from waste generator to resource provider exemplifies transformative leadership in India's transition towards a circular economy."

Achievements to Celebrate

- 98% ash utilization across all thermal stations
- Leading India's transformation from 20% to 98% national utilization
- Creating economic value from over 100 million tonnes annually
- Supporting thousands of small businesses through free supply programs
- Pioneering digital platforms for transparent market operations

Vision for Tomorrow

NTPC remains committed to innovation, sustainability, and stakeholder value creation. Our future initiatives will expand rail transport, enhance digital platforms, and explore advanced applications that position fly ash as a strategic resource for India's continued development.

Together, we build a waste-free future where every by-product becomes a valuable input for sustainable growth.





Thank You

Towards Zero Waste: Fly Ash as a Resource



Presented by:

G. Rajashekar General Manager (Ash Management) NTPC Limited **+91 - 9440918294**

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