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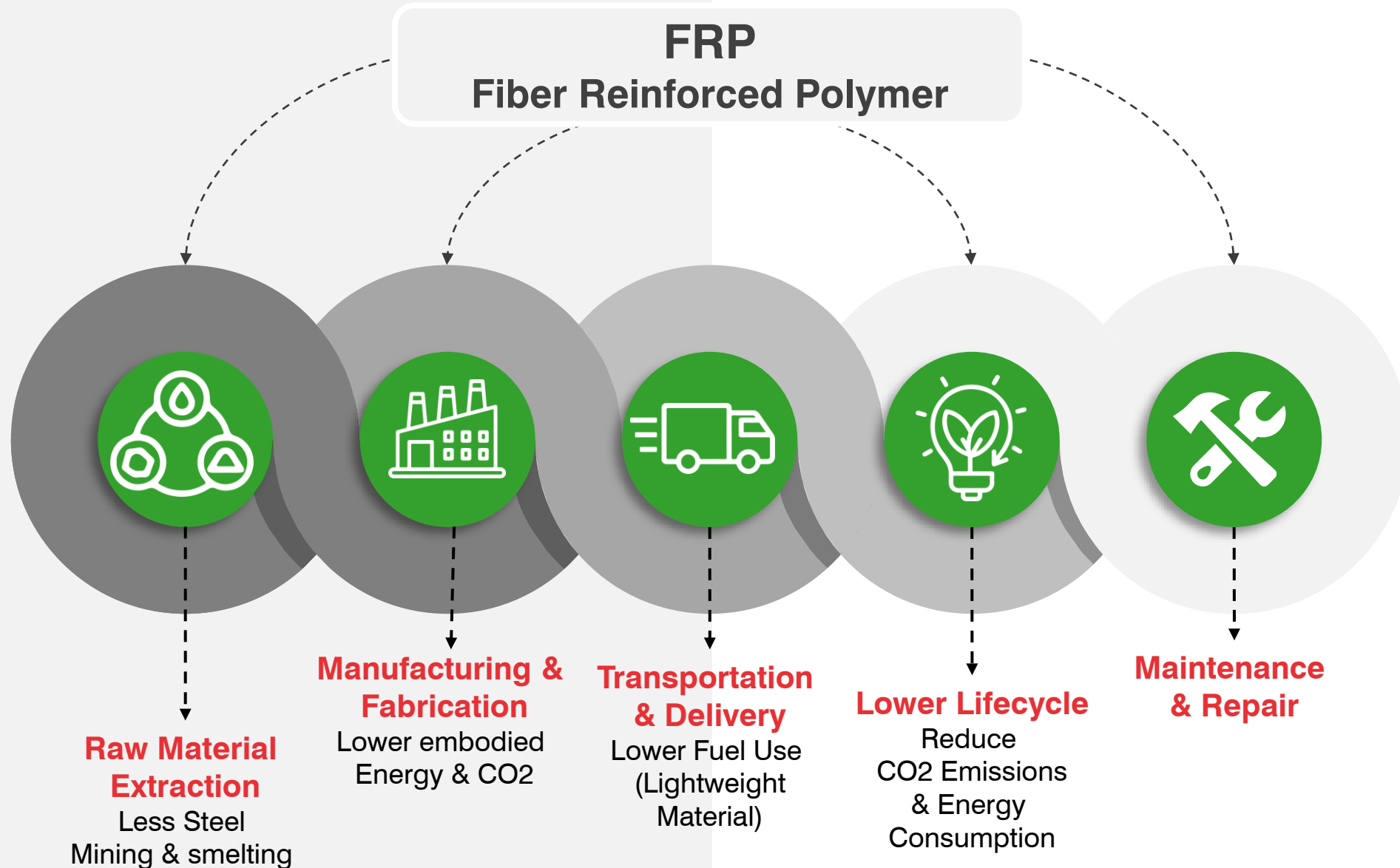


Sustainability in Caustic Chlorine Plants using **Advanced Composite Materials**

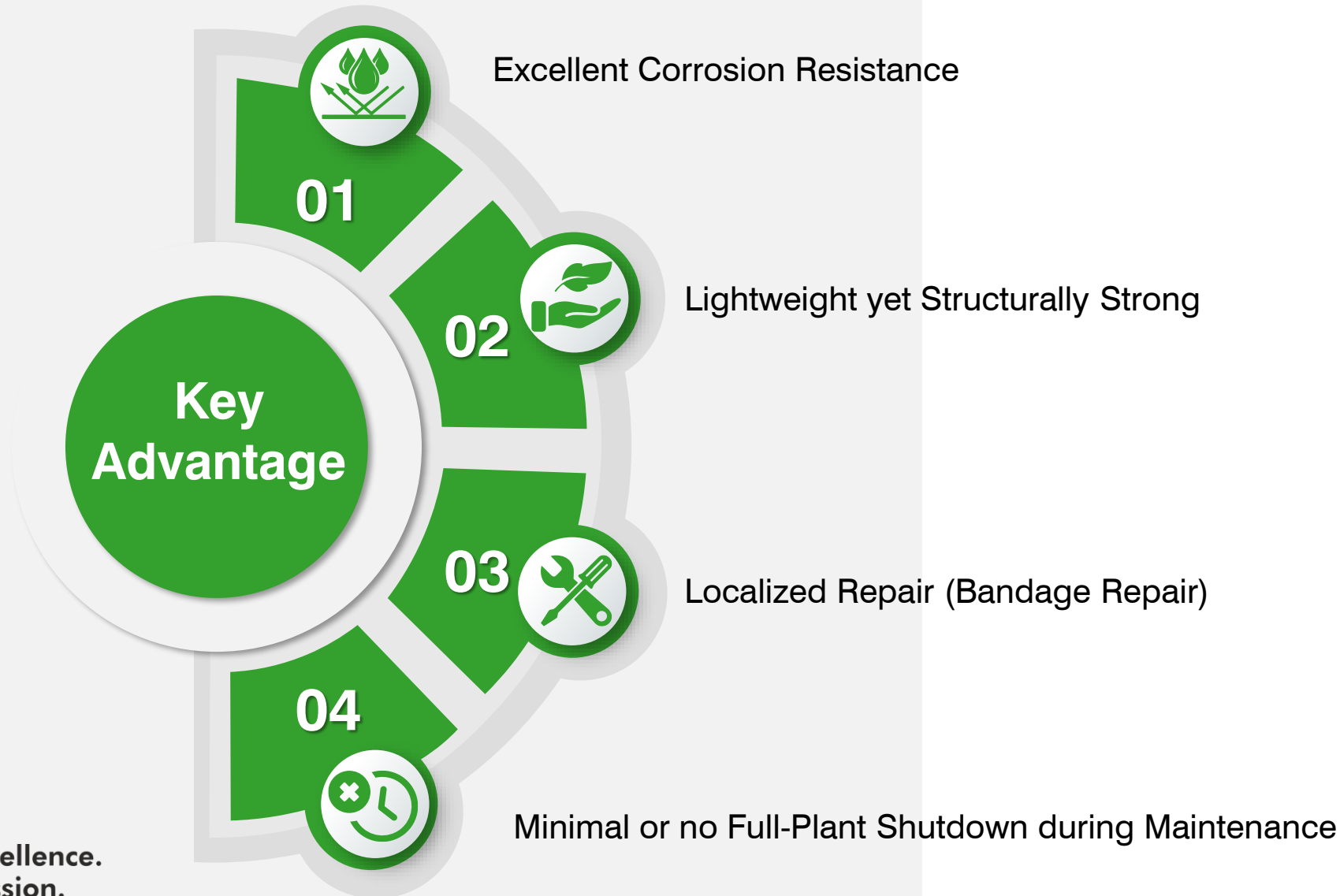
By

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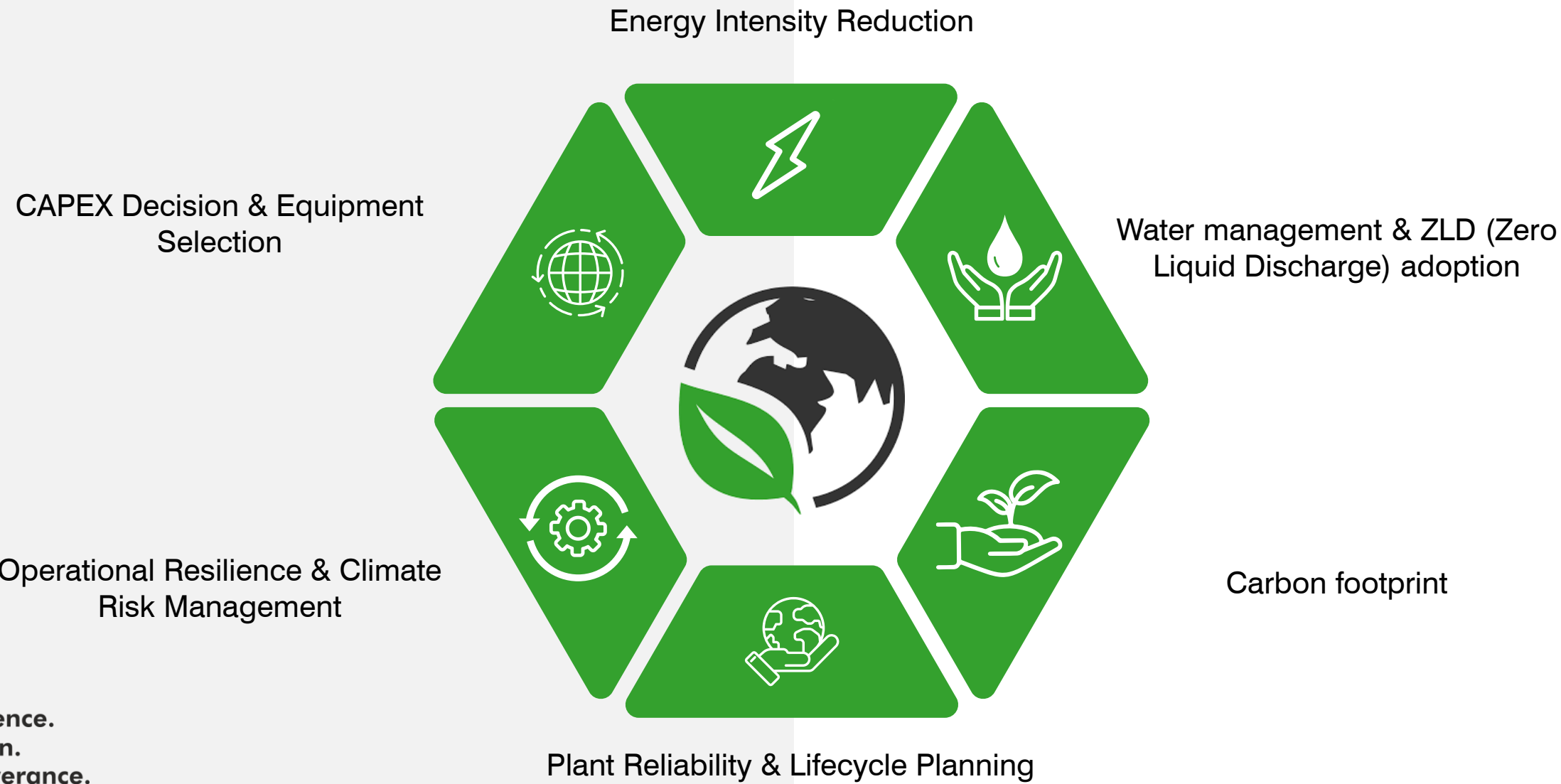
FRP Enables Sustainability



Protection of **Production Continuity**



Sustainability at Equipment Level



Energy & Carbon Efficiency



Lower embodied energy compared to metals



Reduced welding, rework & emergency maintenance



Lower transport emissions due to better strength-to-weight ratio

Water & ZLD Support



Longer Service Life in high-chloride environments



Reliable Performance in recycling & reuse systems



Corrosion-free pipelines reduce leakage and contamination

Operational Continuity



Lower lifecycle cost and reduced risk exposure



Improved plant uptime and productivity



Faster repairs without full shutdown

Challenges with Conventional Materials



Corrosion & Leakage



Typical Consequences



Line or Plant Shutdown



Complex Repair Cycle



Welding, NDT, re-testing, and logistics delays



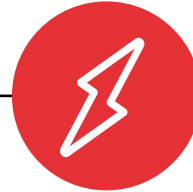
Restart cycles extending into days



Impact of

Unplanned Shutdowns

Metal vs FRP

	 Shutdown Type	 Repair Duration	 Restart Time	 Production lost	 Energy Start Penalty
Metal-based Systems	Line / Plant Level	48 - 72 Hours	24 - 96 Hours	High	High
FRP Systems	Localized	1–3 Hours	Minimal	Significantly reduced	Low

Indicative ranges based on typical chlor-alkali plant maintenance practices and industry experience.

Metal System

Failure

Repair

NDT

Restart

Stabilization

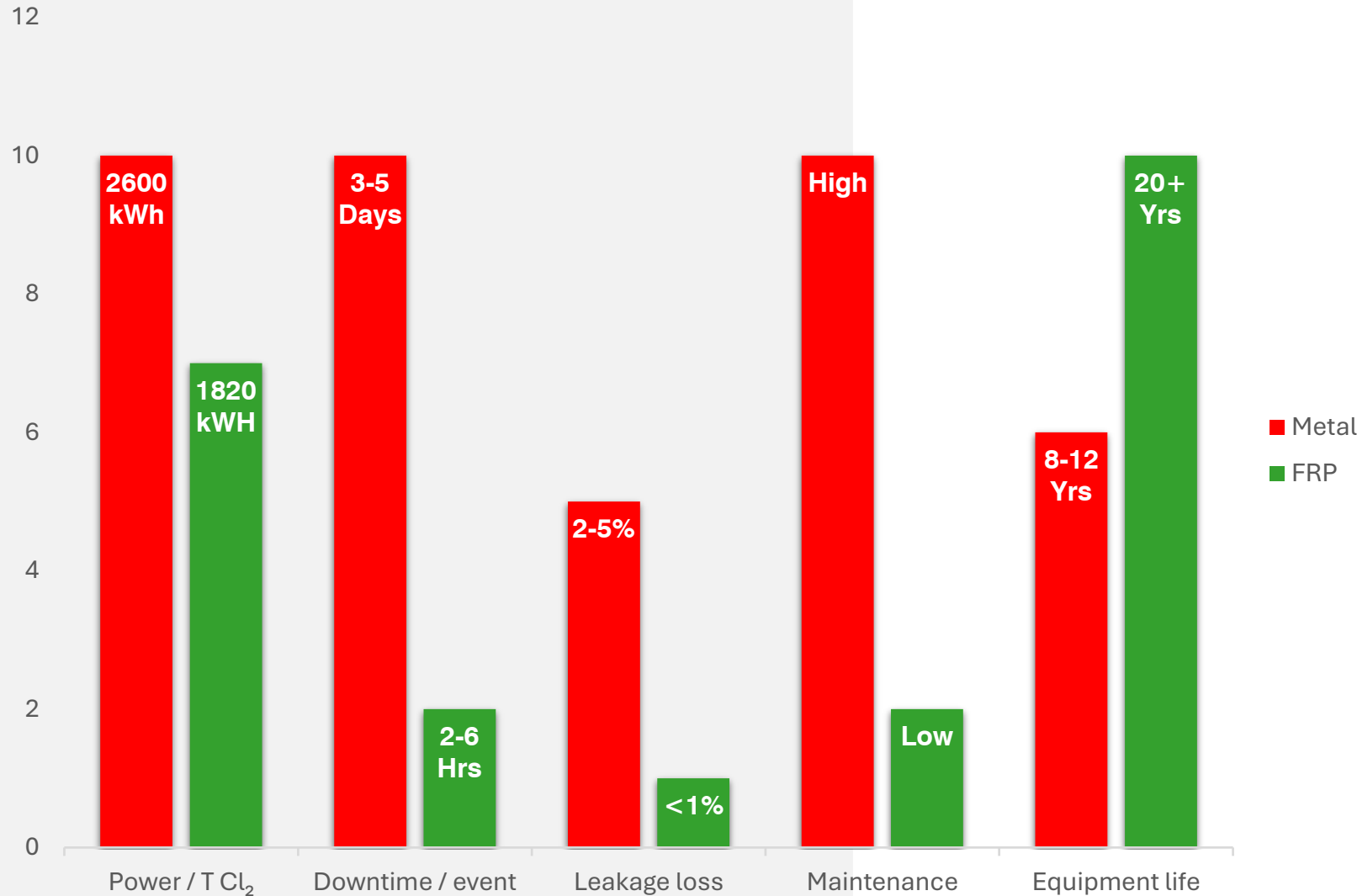
FRP System

Failure

Local Repair

Resume

FRP Impact on Process Losses & Operating Cost



1.5–2.0 Cr / Yr
Energy Saving



₹40–80 Lc / Yr
Maintenance &
Leakage avoided



90%+
Downtime Reduction

FRP Impact on Emissions, Recoverable Revenue & Lifecycle Value

Emissions



30-45%
CO2 reduction



↓ 20-40%
Stack /Vent
Emission

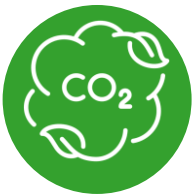


Reduced fugitive
chlorine release

Recoverable Revenue



₹1.2-1.6 Cr / Yr
Hydrogen
recovery potential

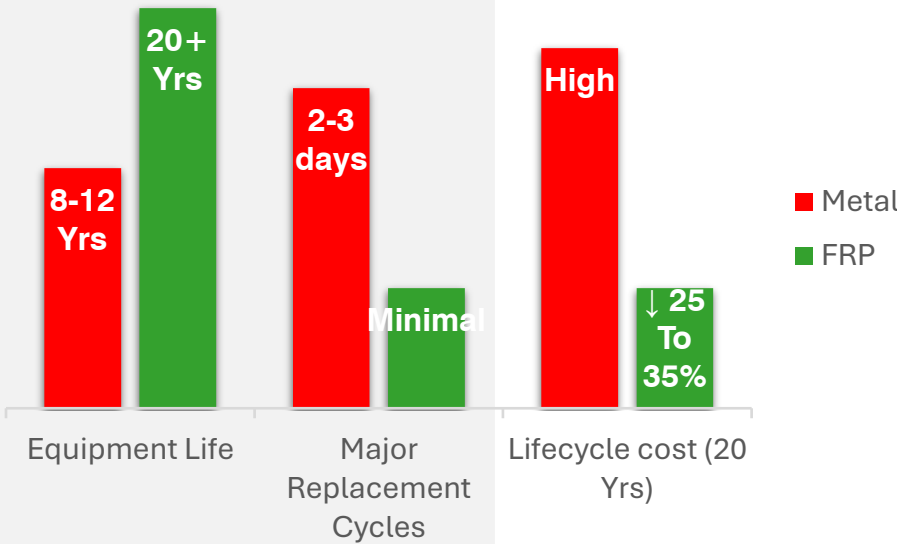


₹4-8 L / Yr
Carbon Credits



25-35%
Lower Lifecycle
Cost
(20-year horizon)

Life Cycle Value





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Where FRP Creates **Measurable Value** in Chlor-Alkali Plants



Plant Stage	FRP Application	Key Improvement	Measurable Result
Brine Storage	FRP Tanks	No corrosion, zero leakage	₹40–60 lakh/year spill & cleanup avoidance
Electrolysis	FRP Headers	No Cl ₂ corrosion	35–40% lower replacement cost (₹30–50 lakh/year)
Purification	Scrubbers / FRP Towers & Ducts	Better absorption efficiency	20–40% emission reduction; ₹20–30 lakh/year ESG value
Output	Transfer Lines / FRP Piping	No shutdown welding	2–4 days downtime avoided = ₹50–80 lakh/year

Key FRP Applications in Chlor-Akali Plant



Brine Storage



Scrubbers, Vents & Utility Systems



Electrolysis Headers
(Anolyte & Catholyte)



Output Product & Utility Handling
System

Key FRP Applications in Chlor-Akali Plant

Problem with Conventional Materials



Corrosion Resistance



Compatibility & Welding



Precision & Scalability



Sealing & Pressure
Management



Thermal Cycling &
Mechanical Stress



Iron Contamination
Mitigation



FRP (Electrolysis Head – Anolyte & Catholyte)



Key FRP Applications in Chlor-Akali Plant

Process Piping Systems



Key FRP Applications in Chlor-Akali Plant

Blowers, Scrubbers & Vent Systems



Key FRP Applications in Chlor-Akali Plant

Output Product & Utility Handling System





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Case Study: Enhancing Reliability in Chlor-Alkali Plant using Advanced FRP Systems



Project Overview

- **Plant Type:** Membrane-based Chlor-Alkali Facility
- **Capacity:** 100 -120 KTPA Caustic Soda
- **Environment:** Coastal | High Humidity | Saline Exposure
- **Critical Section:** Electrolysis – Anolyte & Catholyte Headers

High corrosion exposure + shutdown sensitivity = High lifecycle cost

Problem with Conventional Material

Wet Chlorine Corrosion : 75–85°C moist chlorine highly aggressive

Weld Joint Leakage Risk : Frequent seal & joint failures

Shutdown Duration : 48–72 hrs per corrosion event

High Restart Energy Penalty: 10–15% excess energy consumption





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Case Study: **Enhancing Reliability** in **Chlor-Alkali Plant** using **Advanced FRP Systems**



Engineered FRP Intervention

Novolac Vinyl Ester Resin : High resistance to wet chlorine

Synthetic Surface Veil : Prevents alkali attack on fibers

Dual Laminate Technology : PVC liner + Structural FRP

Post Cure Processing : Improved chemical & thermal resistance

ESG & Sustainability Impact

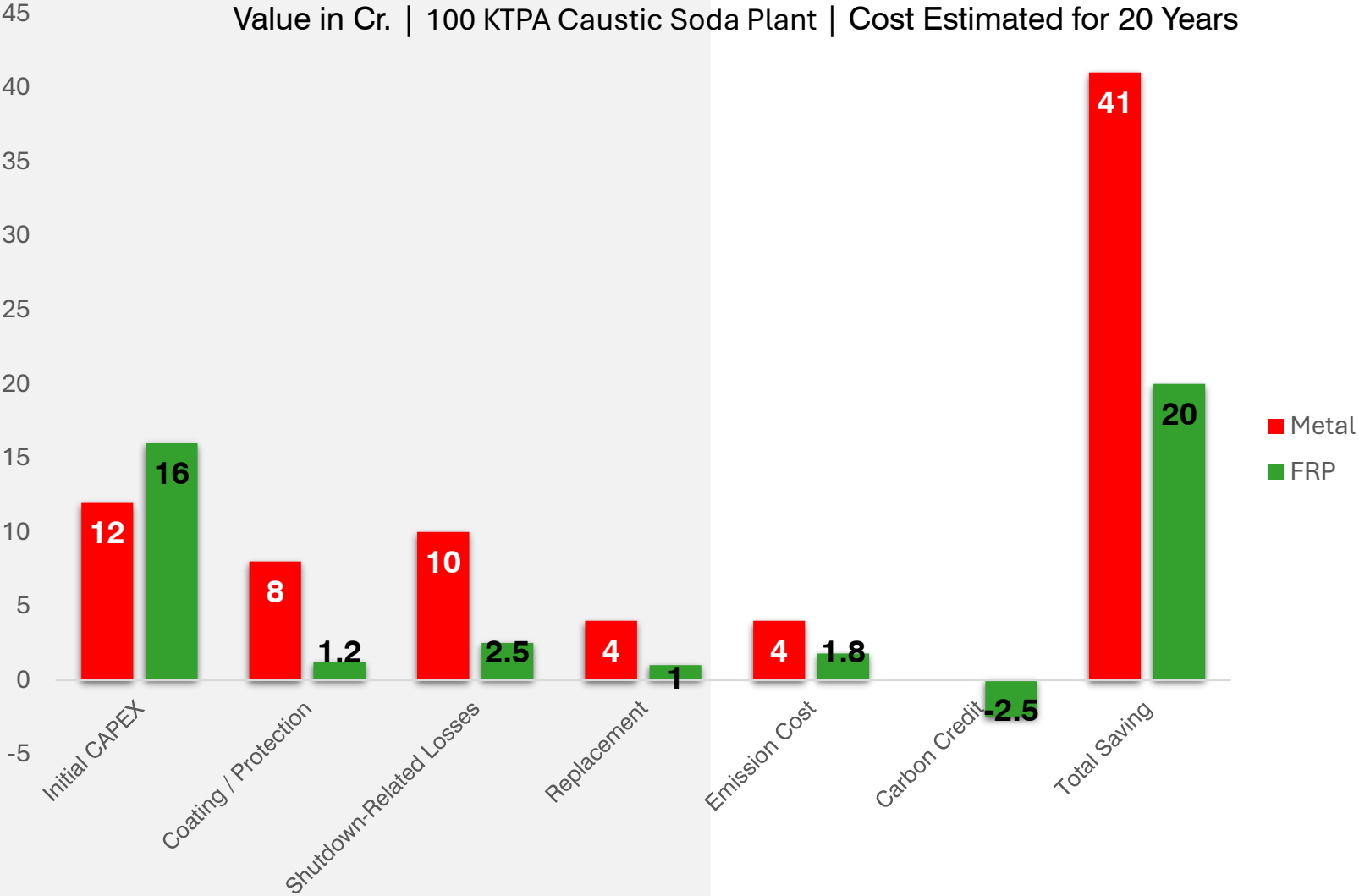
- Reduced **coating waste**
- 30–45% reduction in **restart-related emissions**
- Lower restart **energy consumption**
- Improved **chlorine containment safety**



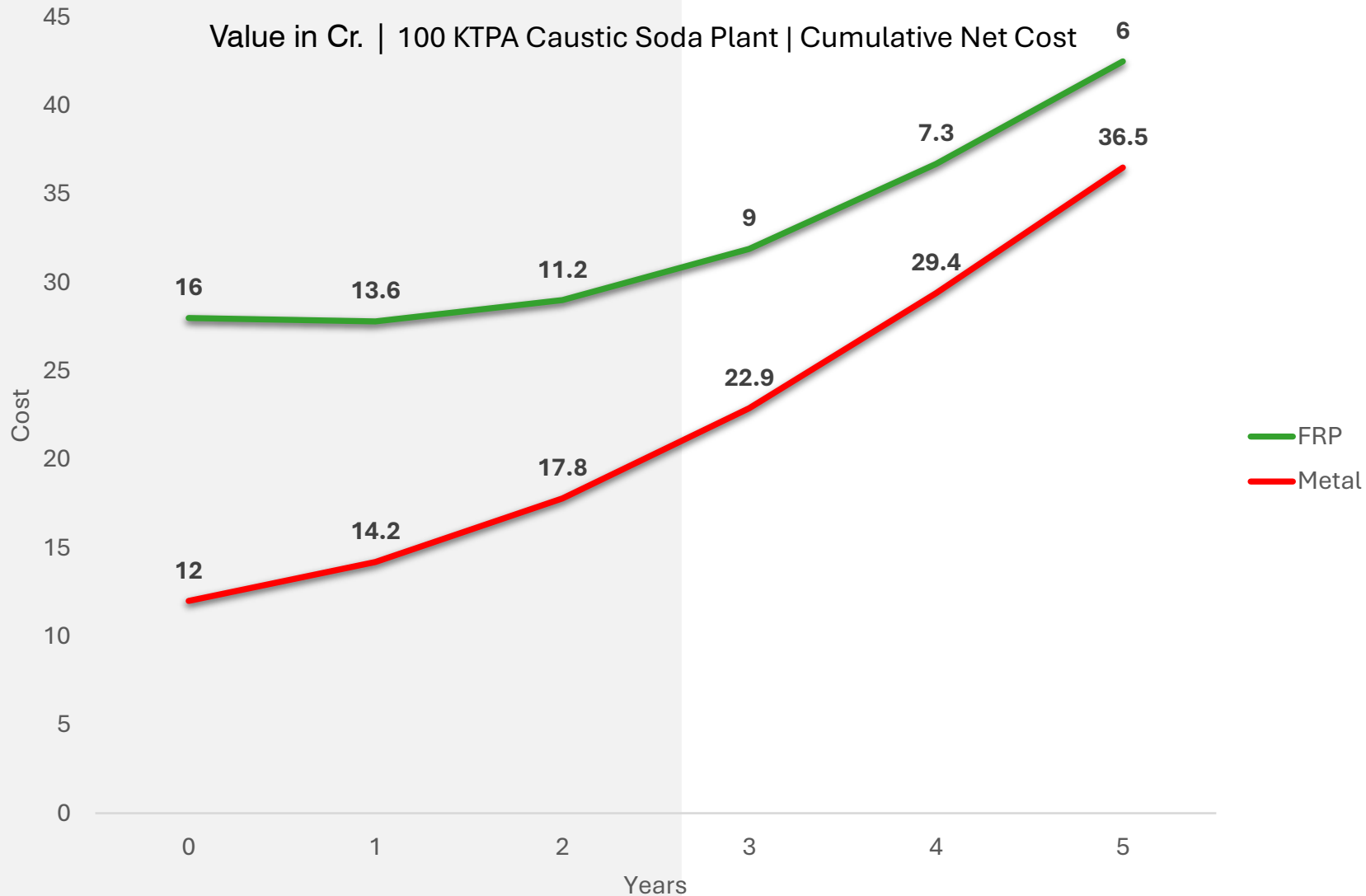
Lifecycle Cost Saving



Value in Cr. | 100 KTPA Caustic Soda Plant | Cost Estimated for 20 Years

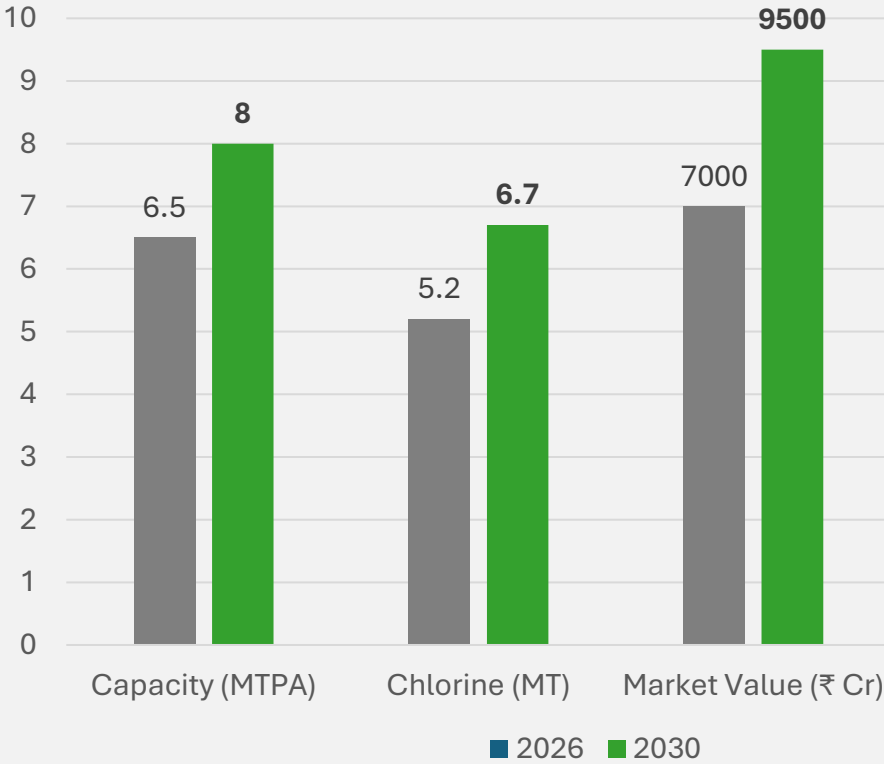


Investment **Payback** Period



Despite higher initial CAPEX, FRP systems recover additional investment within ~2-3 years through reduced maintenance, shutdown losses, and replacement costs.

Projection & Recommendation



By 2030, material selection directly impacts plant scalability, sustainability compliance, and operating profitability.

FRP Enables Sustainable Scale Up



700–1,000 Cr
cumulative Industry
savings by 2030



35–45% emission
reduction



60–70% reduction
in corrosion
shutdown risk



30–40% lifecycle
cost reduction

Future Projection & Recommendation

Metric	2026	2030	CAGR	Industry Impact	FRP Opportunity
Caustic Capacity (MTPA)	6.5	8.0	4.5%	+ 1.5 MTPA expansion	Larger corrosion-prone networks
Chlorine Production (MT)	5.2	6.8	6–7%	Higher brine & header load	Dual laminate FRP adoption
Market Value (₹ Cr)	7,000	9,500–10,000	4–5%	Strong capex cycle	Lifecycle-based procurement
Renewable Integration	30%	50%	↑	Energy cost volatility	FRP reduces restart penalties
FRP Adoption in Corrosive Zones	25–30%	45–50%	Accelerating	Material shift underway	₹500–1,000 Cr cumulative industry savings

Future Projection & Recommendation

Higher Capacity = Higher Corrosion Exposure

- +1.5 MTPA adds 20–25% more piping & header length
- Increased brine concentration load
- Greater leak-risk in welded systems

Increased Chlorine Output = Higher Downtime Cost

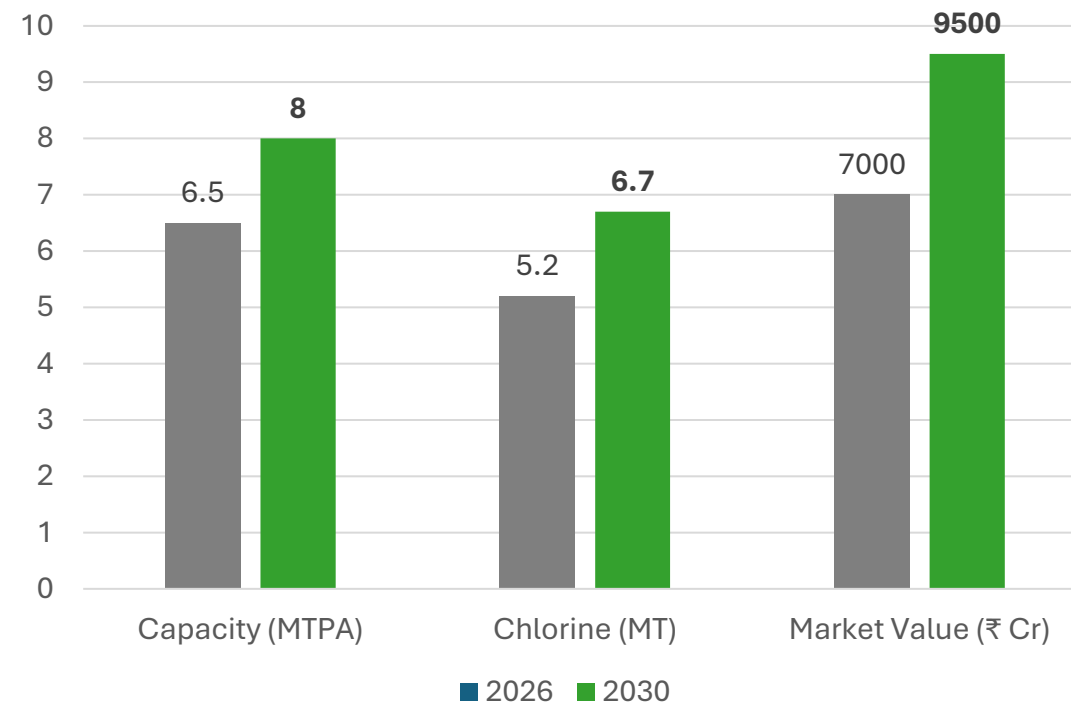
- Restart penalties ₹15–30 lakh/event
- Emission compliance tightening
- 35–45% lifecycle emission advantage with FRP

Market Expansion Drives Lifecycle Procurement

- ₹3,000 Cr incremental industry value by 2030
- Plants shifting from Capex-focused to LCC-focused buying
- FRP shows 30–40% lifecycle savings

Industry-Level FRP Savings Potential

- If 50% of corrosive assets shift to FRP by 2030:
- ₹500–1,000 Cr cumulative savings
- 20–30% GHG reduction
- 60–70% corrosion shutdown reduction



By 2030, material selection directly impacts plant scalability, sustainability compliance, and operating profitability.



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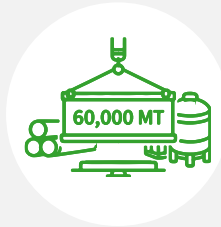
Scale, Capability & Global Presence



1.45+ Mn Sq.ft.
Manufacturing
Area



8+ Advanced
Manufacturing
Campuses



60,000 MT
Annual Capacity



American &
European Quality
Standard



100+
Engineering
Solutions



Integrated
Manufacturing
Under **1 Roof**



2300+ Skilled
Professionals



In-House Testing
Facilities



In-House R&D
Facilities



60+ R&D
Engineer Teams



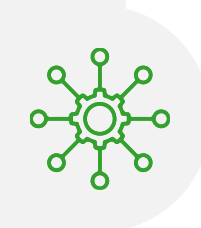
10+ National &
International
Award



Export Up to **43+**
Countries



5500+ Global
Clients



Serving **21+**
Industry Sectors



Make In India



40+ Years of
Excellence



World's Largest
Composites
Manufacturer



**4 Times "Top
Shop" Composite
World Winner**

Excellence.
Passion.
Perseverance.



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Plant Tour Video



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*Thank
you!*

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Passion.
Perseverance.