



EXECUTIVE INSIGHTS

Alternative Fuels for Industrial Use in the US: Decision Time

- The U.S. is lagging behind most developed countries when it comes to alternative fuel use, which is critical to the decarbonization road map of the cement and lime industries.
- To reach the desired higher thermal substitution rates in a reasonable time frame, cement and lime operators will need to turn to high-quality refuse-derived fuels and municipal solid waste.
- Internal alternative fuel divisions ensure tight control, while external waste management companies can provide investment leverage and sector expertise to capture valuable fuel volumes while they are still available.
- Interest in alternative fuels is increasing, and many plants are considering installing an alternative fuel feeding system within the next two years.

The use of alternative fuels, a critical lever for decarbonizing the cement and lime industries, is an area where the U.S. is lagging behind most other developed countries. In order to reach the meaningfully higher thermal substitution rates (TSRs) necessary from alternative fuels, cement and lime operators will increasingly need to turn to high-quality refuse-derived fuels (RDFs) and municipal solid waste.

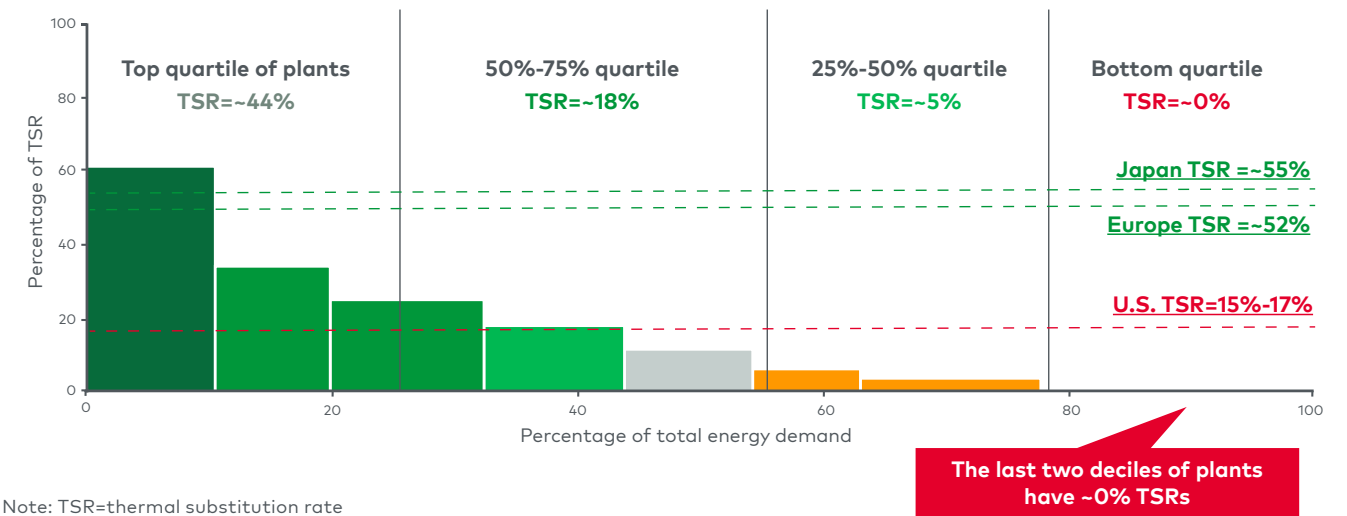
But the availability of these fuels — particularly economically viable RDFs — is not high. That's why cement and lime operators should make evaluating those opportunities a priority in the short term. Moreover, they should be looking to external waste management companies for the RDF sourcing and pricing expertise they will need when it comes to making the necessary, and not insignificant, investment required.

Lagging substitution rates, growing interest

As of 2023, U.S. TSRs were just 15%-17% compared to more than 50% in both Europe and Japan. According to L.E.K. Consulting's estimates, 60 of the 87 cement plants in the U.S. have TSRs of less than 20%, including 39 that are believed to have TSRs of less than 5% (see Figure 1).

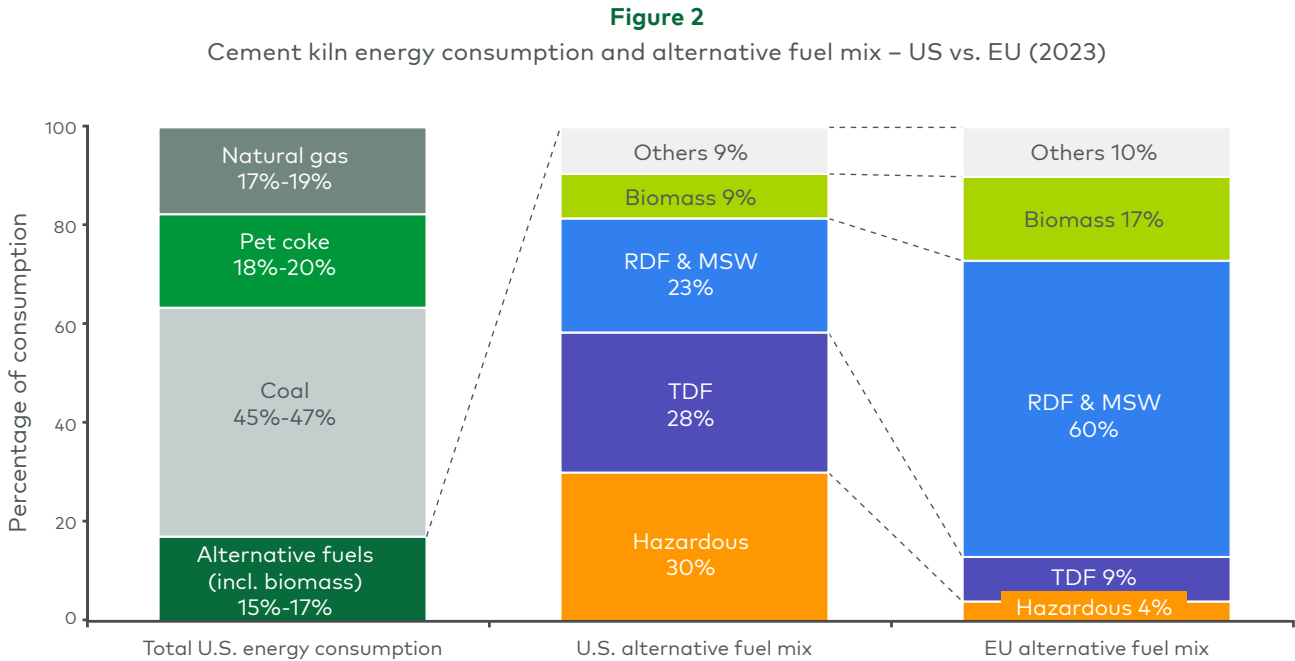
Figure 1

Estimated thermal substitution rates of all cement plants in the US, by decile of performance (2023)



Note: TSR=thermal substitution rate
Source: Company reports; PCA; L.E.K. research and analysis

Hazardous waste and tire-derived fuels (TDFs) have historically been the main sources of alternative fuels in the U.S., while Europe and Japan show much higher levels of use of industrial and commercial waste — also known as RDFs — and municipal solid waste, or MSW. Together, RDFs and MSW were estimated to account for some 60% of alternative fuel consumption in Europe in 2023 versus roughly 23% in the U.S. The combination of TDFs and hazardous waste, on the other hand, was estimated to account for nearly 60% of alternative fuel use in the U.S. compared to just 15% in Europe (see Figure 2).



Note: RDF=refuse-derived fuel; MSW=municipal solid waste; TDF=tire-derived fuel
Source: CEMBUREAU; L.E.K. research and analysis

While lower energy prices and the wider availability of landfilling space create a more challenging environment for the adoption and use of alternative fuels, interest in them is rapidly increasing. A recent study we conducted showed that among a sample representing approximately 25% of U.S. cement plants, half of those without alternative fuel feeding systems as of 2023 were slated to install one in 2024 or 2025 in anticipation of using alternative fuels. This is likely the highest rate of conversion to alternative fuels ever seen in the U.S. cement industry.

The promise of RDF

As demand rises and pressure to increase TSRs continues to build, many plants are expected to run up against the limitations of the main fuel types currently being used: Hazardous waste permitting has become highly difficult, TDF use typically maxes out around 20%-25% of fuel substitution due to sulfur content, and biomass with low-energy density often puts a meaningful strain on clinker production capacity.

As a result, cement and lime operators will increasingly need to turn to higher-quality RDFs – and potentially high-quality MSW-derived fuels – in order to reach the meaningfully higher TSRs that they target. Properly selected and processed RDF can achieve energy density levels consistently close to that of coal, with extremely low and predictable chlorine and sulfur content (e.g., less than 500ppm for chlorine) (see Figure 3).

Figure 3
Alternative fuel performance on key criteria

	Biomass	TDF	MSW	Generic RDF	High-quality RDF
Feedstock availability	Variable	Very high	Typically high	Typically high	Typically high
Feedstock consistency	Variable	Very high	Low	Medium	High
Energy density	4,000-9,500	12,000-15,000	2,500-8,500	5,000-10,000	9,000-12,000
Moisture content	Variable	Low	Typically high	Medium	Medium
Halogenic content	Variable	Low	Typically high	Typically high	Extremely low
Sulfur content	Low	High	Medium	Typically low	Extremely low

Relative criteria desirability

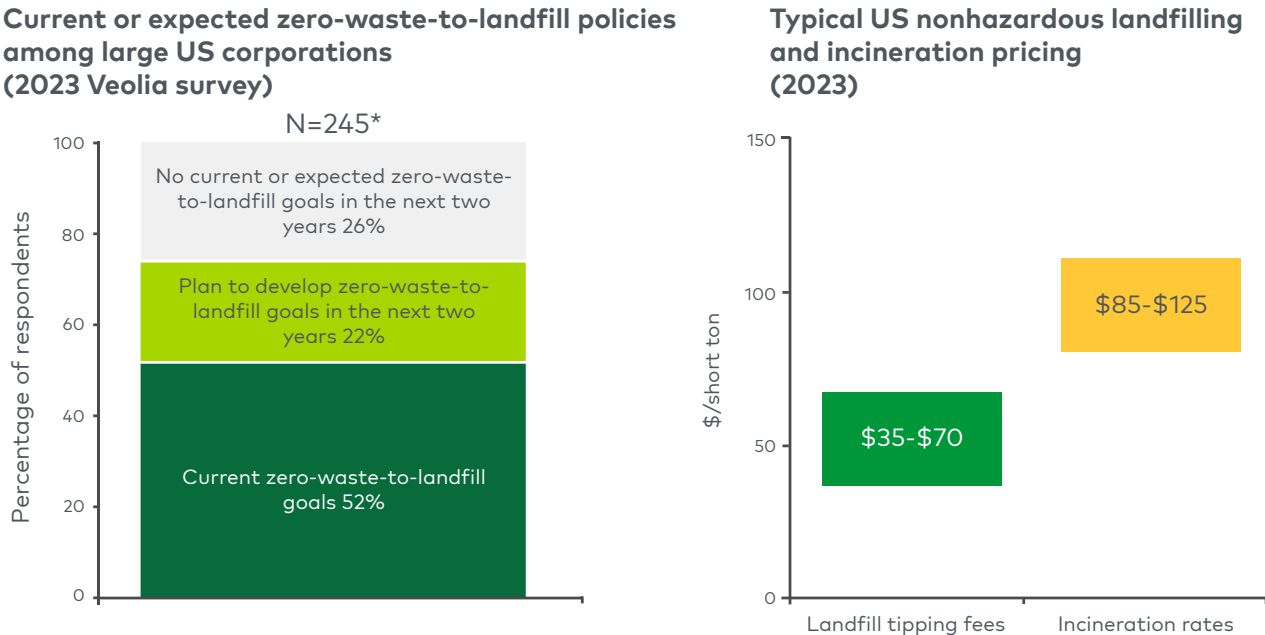
Less desirable
More desirable

Note: TDF=tire-derived fuel; MSW=municipal solid waste; RDF=refuse-derived fuel
Source: L.E.K. research and analysis

Supporting this trend toward high-quality RDFs is the increasing number of commercial and industrial waste generators adopting landfill reduction targets or zero-landfill policies. The existence of no-landfill policies has a significant impact on the economics of RDFs, as they typically render incineration the next-best alternative for waste generators.

A 2023 study by Veolia found that 52% of U.S. corporations with revenues in excess of \$500 million already had zero-waste-to-landfill goals (although they may be long-term), and that another 22% plan on developing such goals in the next two years. As incineration rates are often twice as high as landfill tipping fees, this meaningfully improves the economics of RDF and the volumes of RDF that will need new outlets (see Figure 4).

Figure 4
Overview of US corporate landfill policies and pricing (2023)



*Based on a Veolia North America 2023 study of 225 quantitative surveys and 20 qualitative interviews with large firms (\$500M+ revenue); partial indicates that the generator publicly diverts waste; however, it doesn't publicly specify reduction goal or current diversion percentages
Source: Veolia North America; company reports and websites; L.E.K. research and analysis

That said, the availability of high-quality RDF, particularly RDF that comes from generators with no-landfill policies, is not unlimited. In many U.S. markets that we analyzed, the volumes of RDF generated by companies with more than 50 employees – which are the easiest to collect from – are insufficient to replace even 20% of traditional fuels used by local cement players.

The operating model of RDF and/or MSW sourcing should also be part of the alternative fuel agenda. A number of cement companies have been successful in creating waste management divisions that generate robust returns on capital, but they have done so over long periods of time, and when competition for feedstock was less intense than it is now. Several have faced steep learning curves in the ramp-up of their operations.

Meanwhile, as the competition for feedstock rapidly increases, industry players that do not currently have internal waste management arms may find the use of third-party suppliers to be the fastest and lowest-risk way of reaching the meaningfully higher TSRs that are quickly becoming the industry norm.

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Amar Gujral is a Managing Director and Partner as well as Head of L.E.K. Consulting's Houston office. As a member of the firm's Energy and Environment practice, Amar works with clients on growth strategy, new product commercialization and M&A transaction support. He brings deep expertise in power, renewables, energy transition, oilfield services and downstream fuels. Amar is also a founding member of the firm's Sustainability Centre of Excellence.



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