OPERATIONAL TIPS:
THE ROAD FORWARD
TO LOWER EMISSIONS
AND HIGHER PROFITS

ASPHALT MIX PLANTS: BURNER TUNING

The Road Forward

CONSTRUCTION MATERIALS LIFE CYCLE

Production Stage
(Cradle-to-Gate)

Extraction
A1

Transport
A2

Manufacturing
A3

Many public agencies now require low embodied carbon construction materials. Embodied carbon refers to the greenhouse gas emissions produced during a product's entire life cycle.

As embodied carbon thresholds become more stringent over time, manufacturers will need to optimize their operations and supply chains. An effective way to both reduce embodied carbon of asphalt pavements and achieve a positive return on investment is by enhancing the energy efficiency of asphalt manufacturing plants. This case study highlights how Construction Partners Inc. (CPI) reduced the embodied carbon of asphalt mixes at one of its plants by tuning the plant's burner.

EMBODIED CARBON OF ASPHALT MIX

The up-front embodied carbon of an asphalt mix is derived from the asphalt binder, aggregate, and additives; the transportation of these materials to the plant; and the energy used in manufacturing the asphalt mix. These sources are categorized as A1, A2, and A3 emissions, respectively, within a life cycle assessment. Collectively, they are known as "cradle-to-gate" or production stage emissions. The breakdown of cradle-to-gate emissions for an average asphalt mixture typically is 52% from raw material inputs, 5% from the transportation of raw materials to production facilities, and 43% from the production of asphalt mixtures.[1]

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REDUCING EMBODIED CARBON WITH BURNER TUNING

CPI reduced the embodied carbon of asphalt mixes at one of its Alabama hot mix asphalt plants by optimizing its burner. This improvement reduced the amount of energy needed to make the mix, giving that plant a competitive advantage. Specifically, this improvement reduced the embodied carbon of the manufacturing component of the mix by 10%, shifting it to a higher environmental performance category.

Asphalt mix plants use burners to dry aggregate and heat the binder using fossil fuels such as natural gas, recycled fuel oil, or propane. "At our plants, around 80% of our energy is used in the burner, which is common across the industry," said Heather Dylla, Ph.D., Vice President of Sustainability and Innovation at CPI. Burners must be carefully calibrated and maintained to ensure efficient and consistent operation. Over time, the burner can lose efficiency and require more fuel due to wear and tear, residue buildup, misalignment, and other factors.

An improperly adjusted burner can cause various operational and environmental issues, such as increased greenhouse gas emissions, blue smoke, hydrocarbon buildup in the baghouse, and fire hazards.

HOW SAVINGS ACCUMULATE

On average, fine-tuning the burner lowers fuel costs by 3% each year.[2]

- **Annual Fuel Cost:** Assume a plant spends $1 million on fuel annually.
- **Savings:** A 3% reduction would translate to $30,000 saved per year.
- **Long-Term Impact:** Over 10 years, savings would amount to $300,000, not accounting for possible increases in fuel prices, which could further increase savings.

CPI makes energy efficiency a key focus of its Environmental Sustainability Program. Each of its operating companies is responsible for tracking energy use, setting goals, and identifying strategies to reduce the energy intensity of its operations.

One strategy is to tune the asphalt burner at each plant at least once a year, ideally in the spring, before the high-production season begins. Tuning the burner involves adjusting settings such as air and fuel flow rates, combustion temperature, and burner positioning to optimize performance. When the time came for an annual tuning at the Alabama plant, operators contracted a technician known to be reliable, thorough, and consistent. Prior to and after the technician's arrival, the plant took readings of the amount of natural gas consumed by the burner over several days. Following the burner tuning, the plant experienced an 11% decrease in average energy intensity, equating to a savings of approximately $0.21 per short ton of mix.

"By enhancing burner efficiency," said Dr. Dylla, "asphalt plants can achieve significant energy savings and reduce their environmental impact."

HOW THE PLANT MEASURES UP AGAINST INDUSTRY AVERAGES

An A3 emission intensity of 23.02 kilograms of carbon dioxide equivalent (kg CO_2e) per short ton of mix was calculated before the tuning, landing between the 40th to 50th NAPA quintiles. This means that 40% to 50% of plants in the industry were manufacturing their mixes with fewer emissions than the Alabama plant.[3]

After the tuning, it was calculated that the plant was able to reduce its A3 emissions to 20.71 kg CO_2e, a reduction of 10%, which improved the plant's performance to between the 20th and 40th NAPA quintiles for A3 emissions. In other words, the burner tuning brought CPI's plant emissions into the top 20th-40th percentile performance range in the National Asphalt Pavement Association's (NAPA) Environmental Product Declaration Benchmark for Asphalt Mixtures.[4]

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TIPS FOR MAINTAINING AN OPTIMAL BURNER SETUP

- **Tune burners at least once a year.** The timing will vary according to fuel type, time of year, and production cycle. It may be best to tune right before paving season or during a slow period. Some states require tuning once a year.

- **Work with a trained burner technician.** Technicians should use an exhaust gas analyzer to measure levels of various gases, such as oxygen, carbon monoxide, carbon dioxide, nitrogen oxides, sulfur dioxide, and sometimes hydrocarbons. Ask for a report showing efficiency percentages before and after tuning. One critical metric is Btu per ton, which indicates the amount of energy consumed to produce one ton of asphalt.

- **Clean your burner as needed.** Burners using recycled fuel oil and cone-shaped burner nozzles may need cleaning more than once a year. You can often work with a single contractor to both clean and tune your burner at the same time.

Plant Type: Asphalt Mix
Intervention: Burner Tuning

11%	10%	21¢
Energy Intensity Reduction	Emission Reduction	ROI/Short Ton of Mix

40th–50th	20th–40th
NAPA A3 Quintile (Before)	NAPA A3 Quintile (After)

Payback: < 1 Year

These results are from a single asphalt mix plant. Savings may vary at different plants.

SCALED SAVINGS

U.S. states each have an average of 70 asphalt plants.[5] If half of these plants tuned burners as the CPI Alabama plant did, greenhouse gas emissions per state could drop by 8 million kg CO_2e annually. That is equivalent to the carbon emissions from 2,800 gas-powered vehicles.[6] This calculation is based on an assumed average annual production of 147,000 tons of asphalt mix per plant[7] and a reduction of 2.3 kg CO_2e per ton.

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[1] Greenhouse Gas Emissions Inventory for Asphalt Mix Production in the United States (June 2022).
[2] Applying QIP-126 & QIP-127: Production Strategies for Saving Money and Reducing Emissions).
[3] See Table 4 in the NAPA benchmarking document. The plant in this case study is part of the "Wet No Freeze" geographical division used by the American Association of State Highway and Transportation Officials.
[4] EPD Benchmark for Asphalt Mixtures (Revised August 2, 2024).
[5] The Asphalt Pavement Industry Fast Facts.
[6] CO_2 equivalents calculated from the U.S. Environmental Protection Agency Greenhouse Gas Equivalencies Calculator.
[7] Table 2 of Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage (2022).

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