Adapting Your Asphalt Plant to Reduce GHG Emissions and Save Money

The danger of Power Point dependency…

A meal + Dark room + Chair that reclines =

Asphalt Plant Efficiency

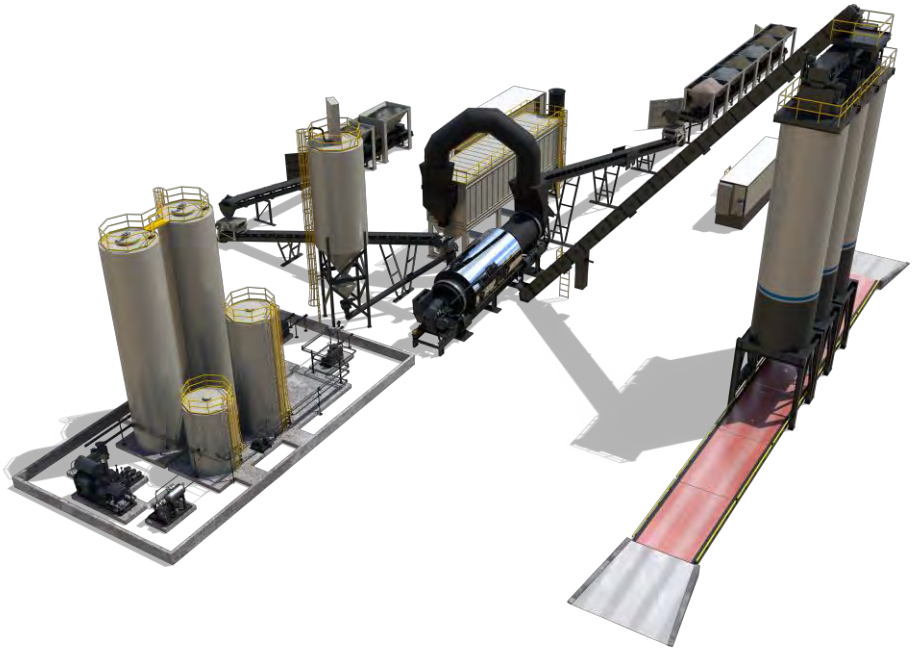
Asphalt Plant Profitability

Reducing Asphalt Plant Carbon Footprint

Reducing Asphalt Plant GHG Emissions

Efficiency is…

- Low Carbon
- Less fuel per ton
- Low GHG per ton
- Profitability
- Clean
- Good Neighbor
- High RAP
- Great Roads
- Plant Maintenance



DEFINING “**EFFICIENCY**”

EFFICIENCY = $\frac{\text{Mix}}{\text{Energy + materials}}$

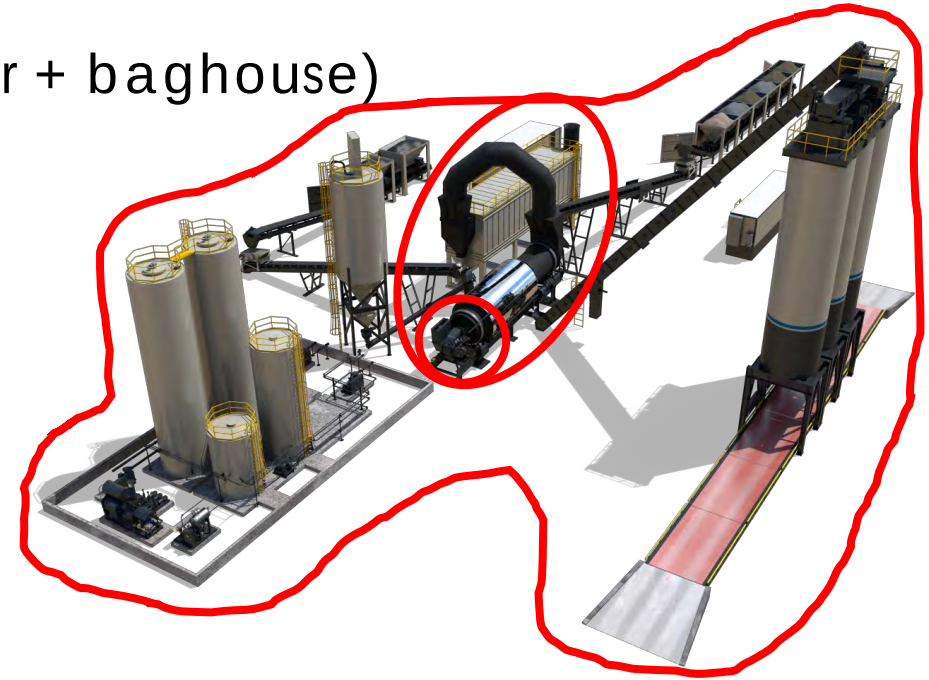
(Fuel + Electricity)

- **Radiation**
- **Emissions**
- **Stack gas heat**

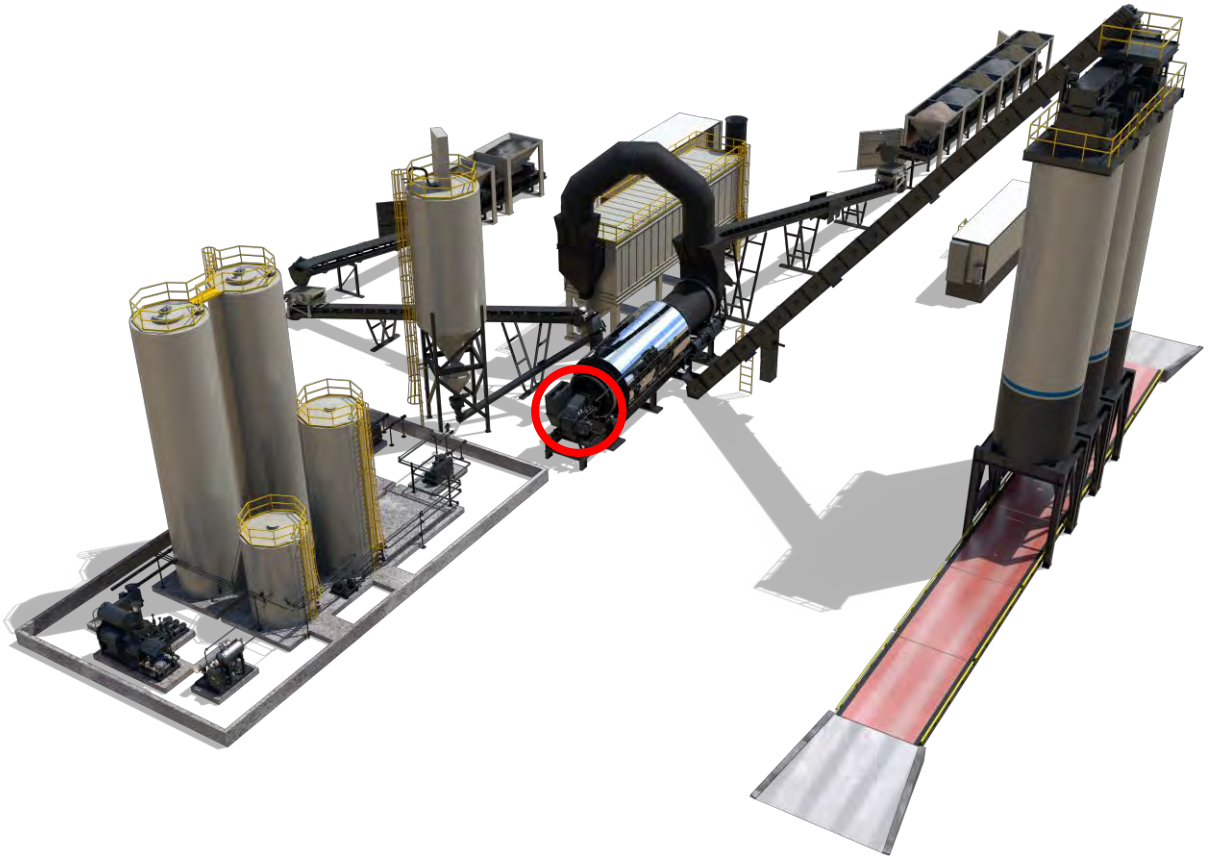
- Dust
- **Water**
- **Stockpile**

Different “Levels” of Efficiency

- Component efficiency (burner)
- System efficiency (burner + dryer + baghouse)
- Operation efficiency



Component Efficiency



DEFINING Burner “**EFFICIENCY**”

Burner EFFICIENCY = $\frac{\text{Heat}}{\text{Fuel + air + electricity}}$

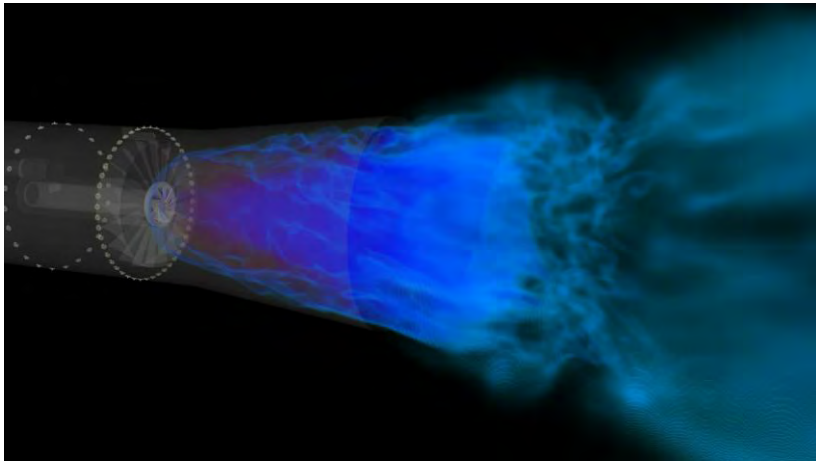
- Carbon Monoxide (CO)

Component Efficiency – Burners

$$C_XH_Y + O_2 \rightarrow H_2O + CO_2 \text{ or } CO$$

Fuel (Hydrocarbon)	Oxygen (Air)	Water	Carbon Dioxide	Carbon Monoxide

3 cu ft CO = 1 cu ft nat gas



A definition for "efficiency" is important!

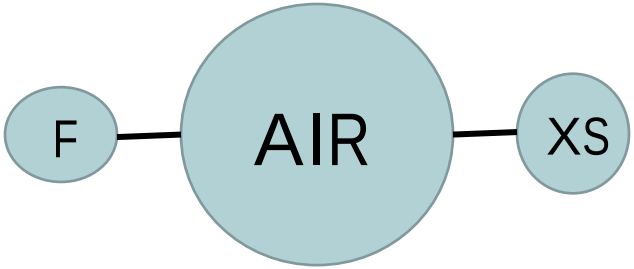
How much CO to too much?

10,000 ppm = 1 %

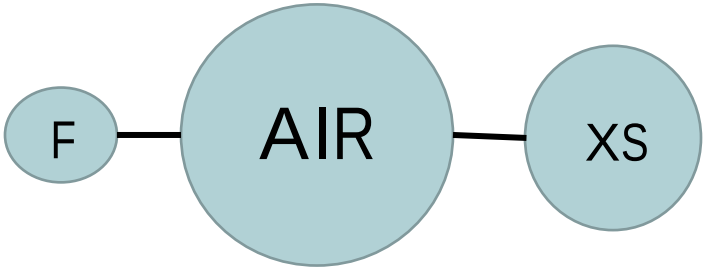
1. 300 ppm is ok with respect to heat loss

2. Above 1000 ppm – Burner adjustment recommended

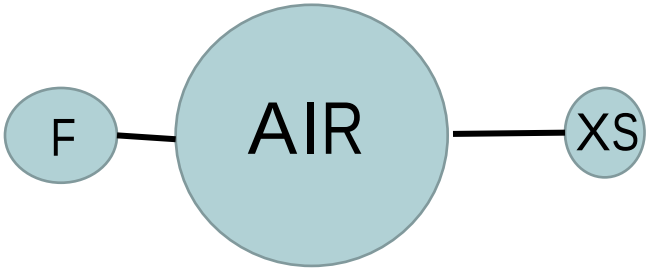
Excess Combustion Air



Stoichiometric air – just enough - textbook



"Lean" – cool – emissions? – low tph - More material carry out



"Rich" – hot – emissions? - large dia. flame - Drum heat damage possible

Burner Adjustment Goal

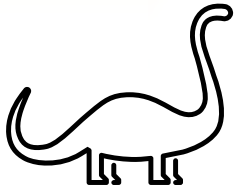
1. Be compliant with the air permit.
2. Maximize plant production rate (not too lean).
3. Not too rich (hot).

Burner technologies

TOTAL AIR BURNER

ETA

OPEN-FIRED BURNER

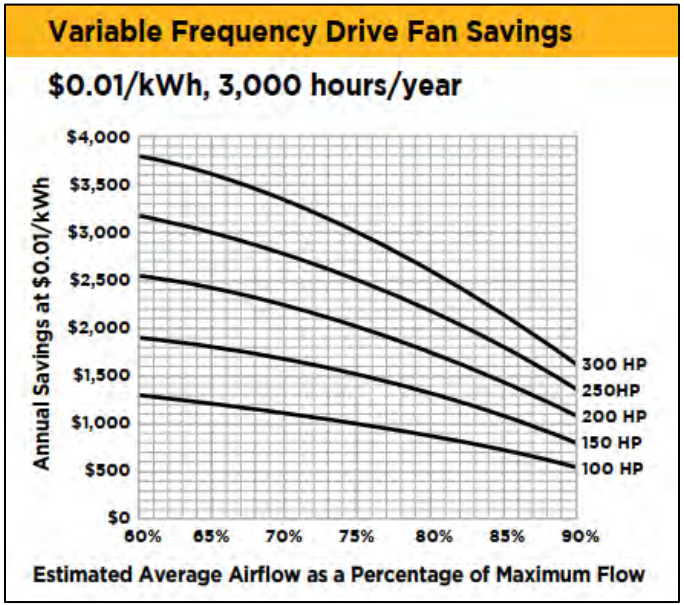


- Total Air burner – **Do not oversize the burner !**
- Open fired burners were overrated.

Component Efficiency – VFD

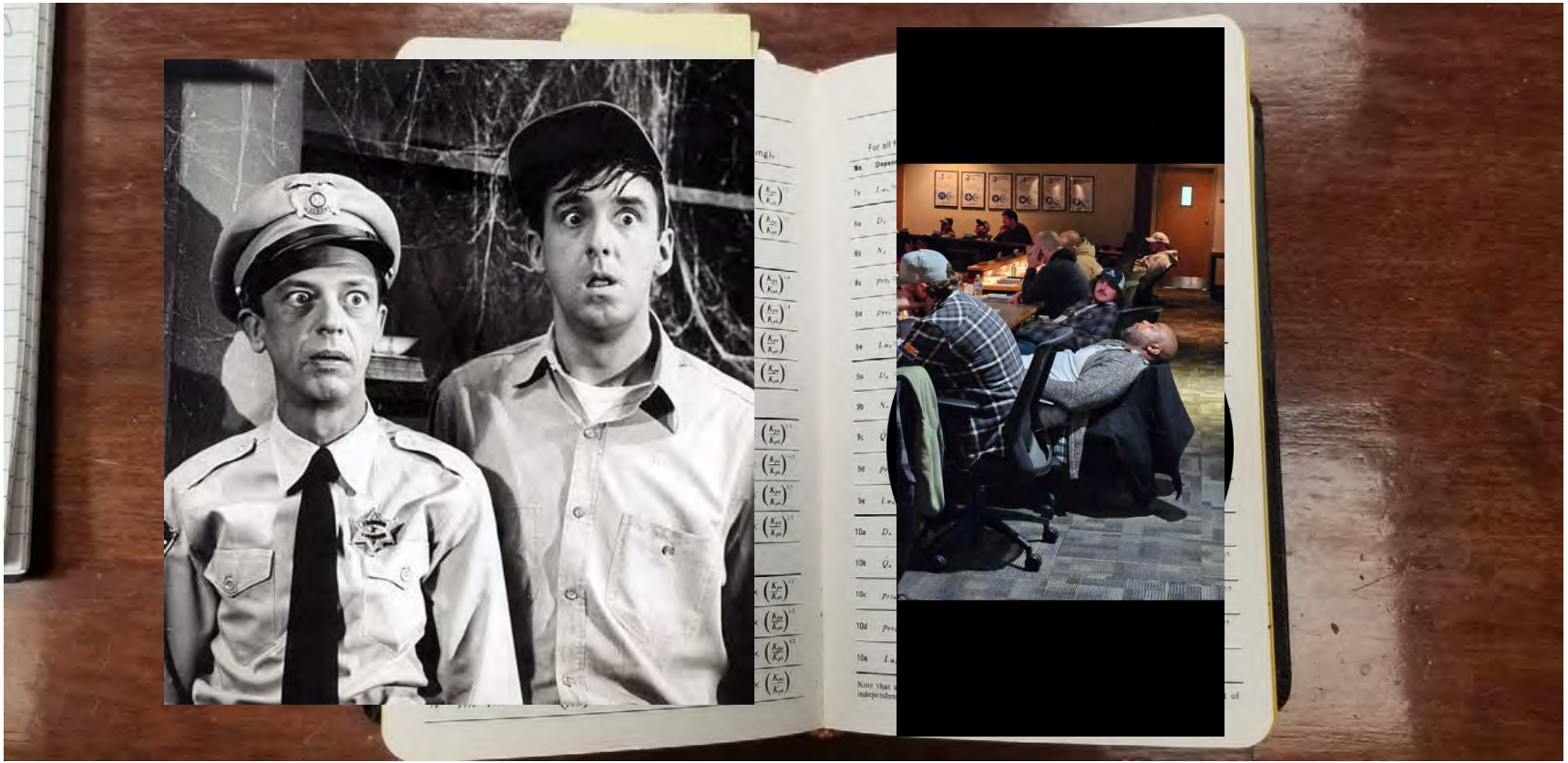
Variable Frequency Drive (VFD)

- Fans: Can save a lot of energy compared to a damper
- Drum: Helps reduce energy loss
- Drag: Reduces chain wear



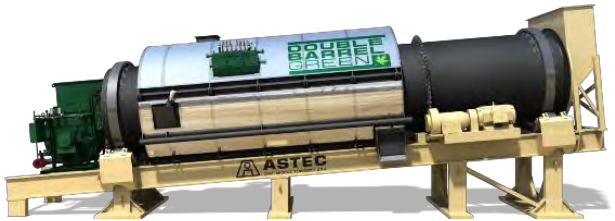
Source: NAPA Publication QIP-132 / Alliant Energy

Fan Laws

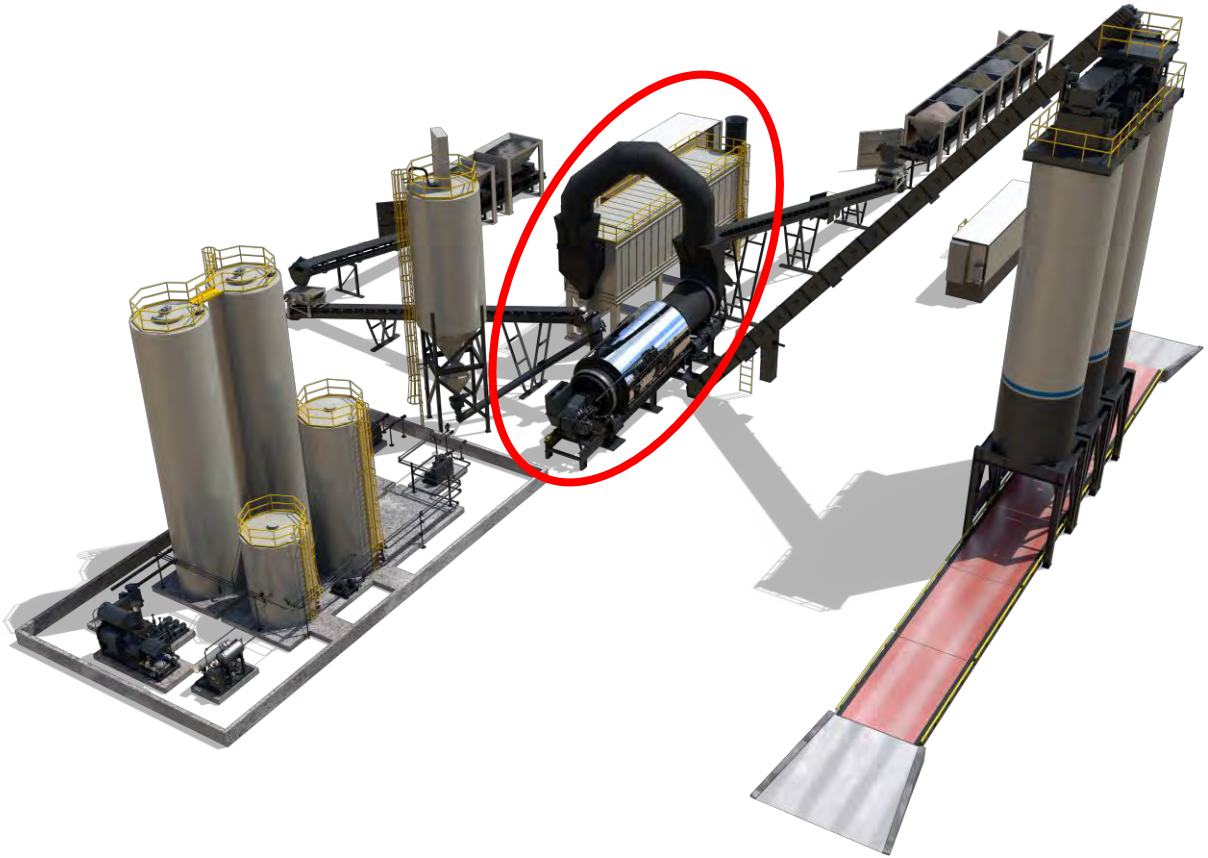


What are VFDs good for?

- **Energy savings:**
  - Baghouse exhaust fan **(80% speed = 50% energy)**
  - Burner fan **(50% speed = 12.5% energy)**



System Efficiency



System efficiency

- Good burner performance doesn't mean good heat transfer – WHAT ?!?!?
- The burner, dryer, and baghouse comprise a **system**
- The components must be **matched** and **work together**

The Difference between thermodynamics and Heat Transfer

- **Thermodynamics** is how much energy (heat) is needed.
- **Heat transfer** is how the heat is delivered to where it is needed.

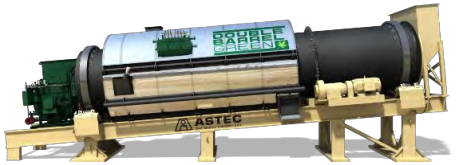
This is Thermodynamics

This is Heat transfer

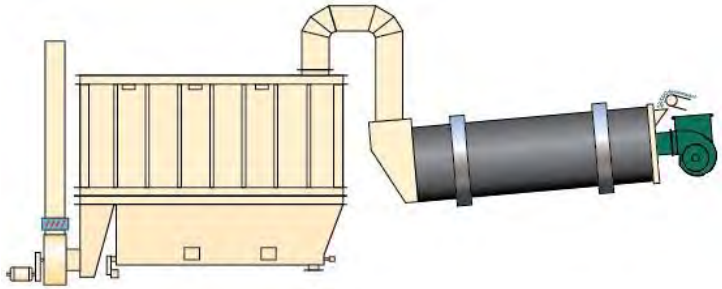
System efficiency

– The burner produces the heat

– The dryer gets the heat into the aggregate



– The exhaust system pulls the gases out of the drum



System Efficiency Quiz

Suppose we have two plants…

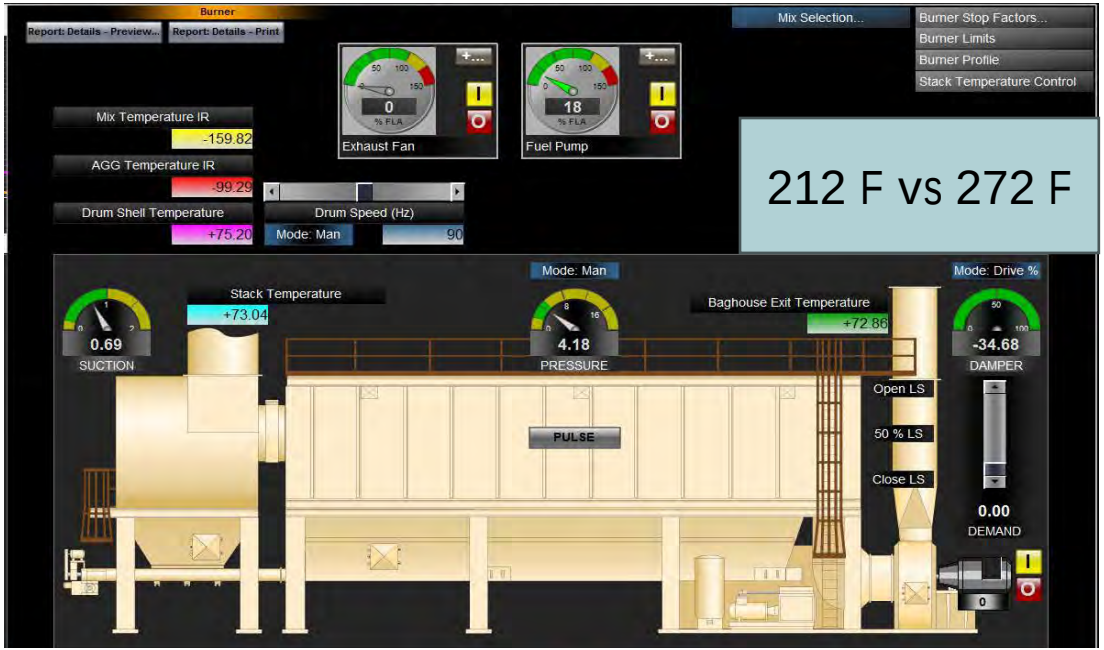
- Same mix
- Same aggregate and RAP source
- Same mix temperature
- Same production rate
- Same moisture contents
- Same fuel
- Same burner

What number on the console indicates which plant is drying **more "efficiently"?**

Hint: Which plant has more heat going into the aggregate?

System Efficiency

The ONE thing you see *every day*...

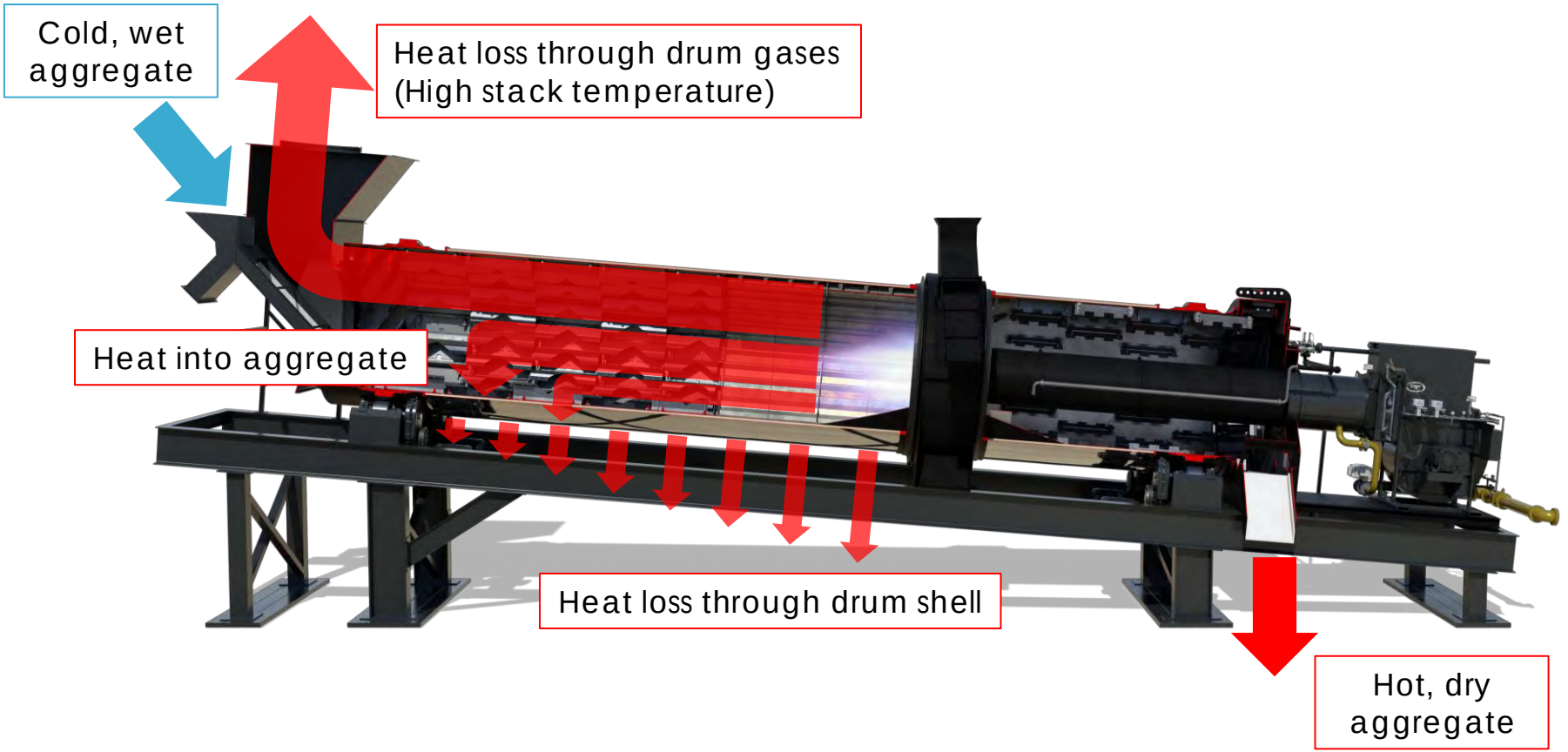


STACK TEMPERATURE!

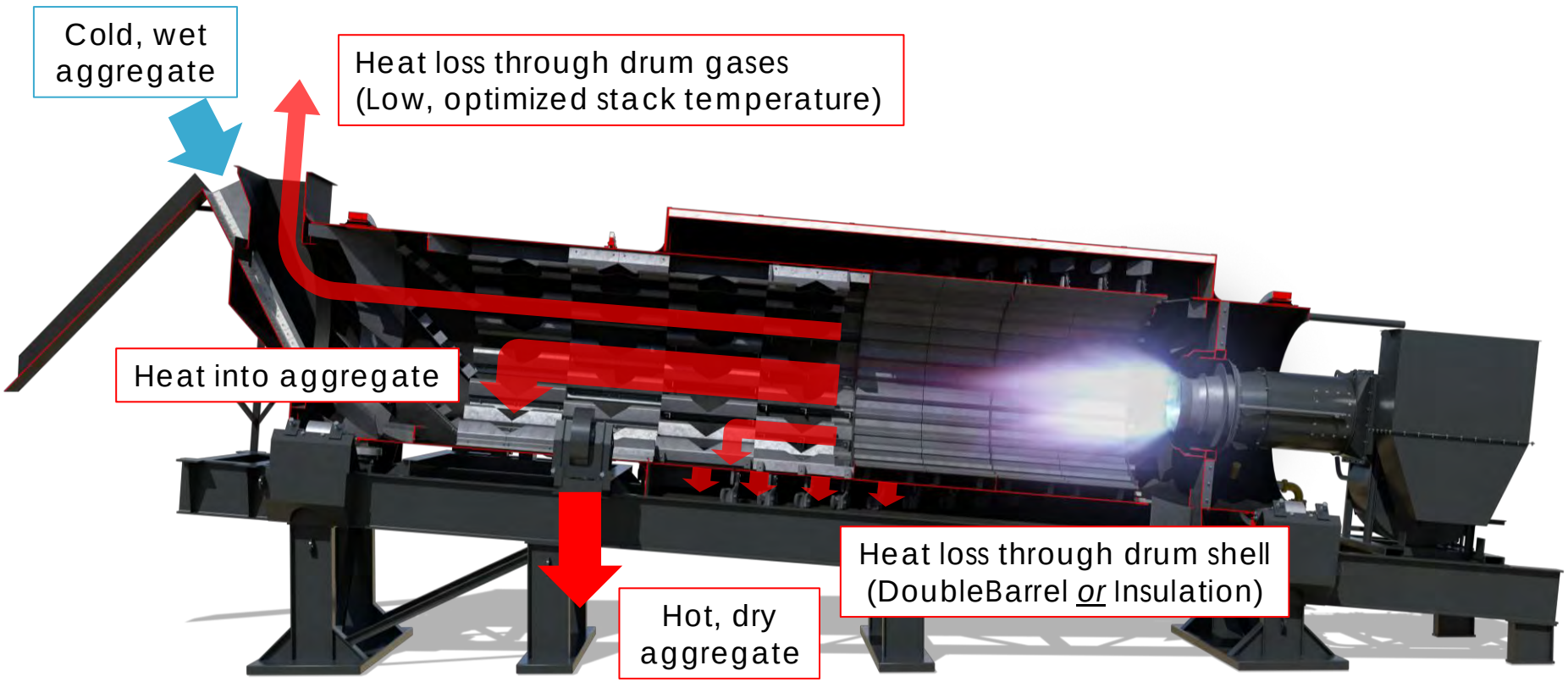
60 F Difference

Is it significant?

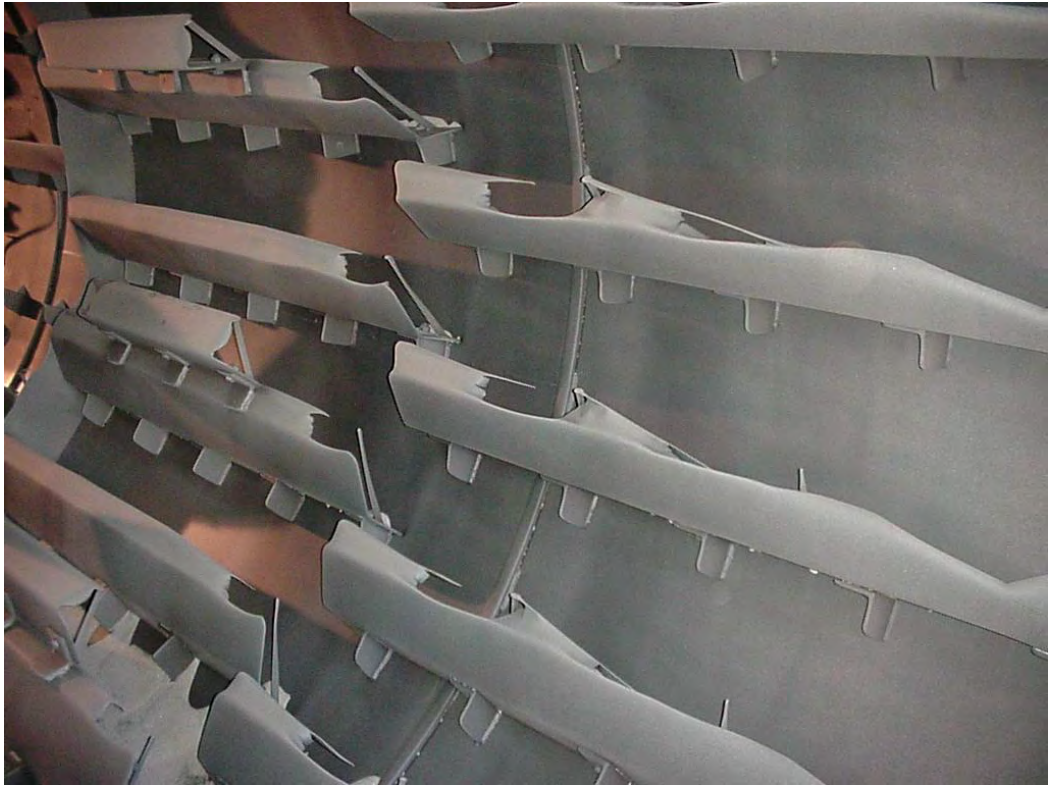
System Efficiency



System Efficiency



Drum flighting and EFFICIENCY



Do these flights veil properly?

Probably not, but it depends…

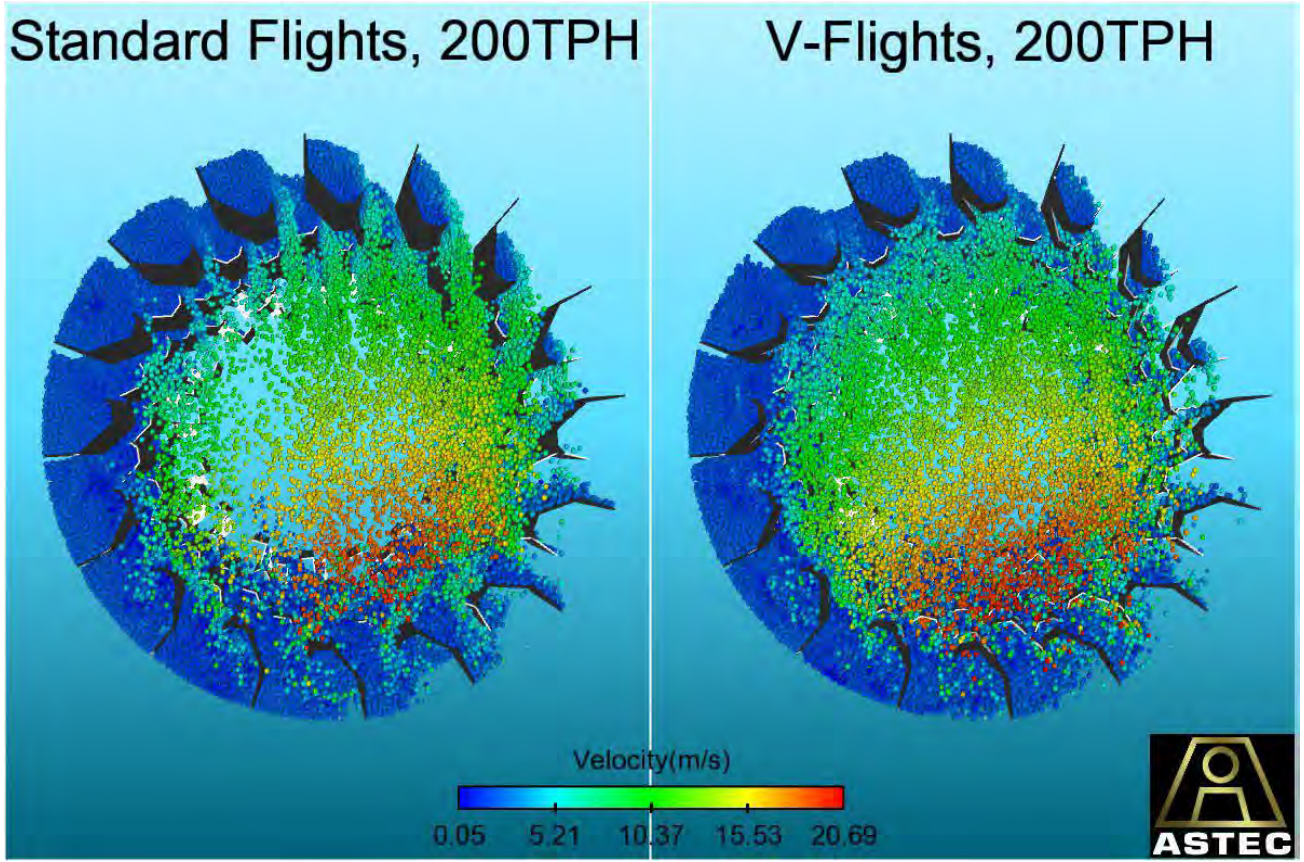
Maintenance Affects Efficiency!

GHG

Stack ~~Temperature~~ Control

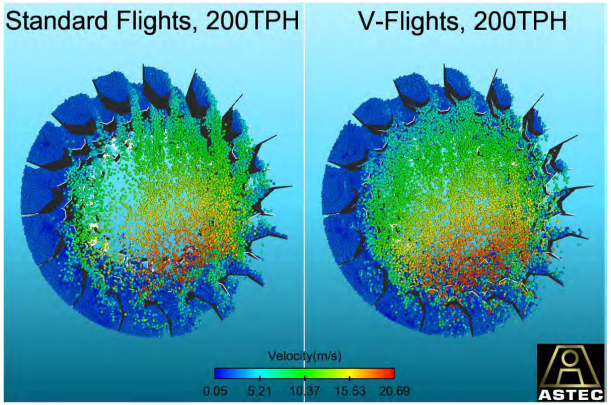
- How can the stack temperature be adjusted?
  - ~~Add or remove aggregate showering flights in the drum~~
  - ~~Modify drum flights – cut / weld~~
  - ~~Modify flight system~~ (Add dams, etc.)
  - Press a button in the control house – **Variable speed dryer**

Is there a winner?



Fuel or Cost or GHG

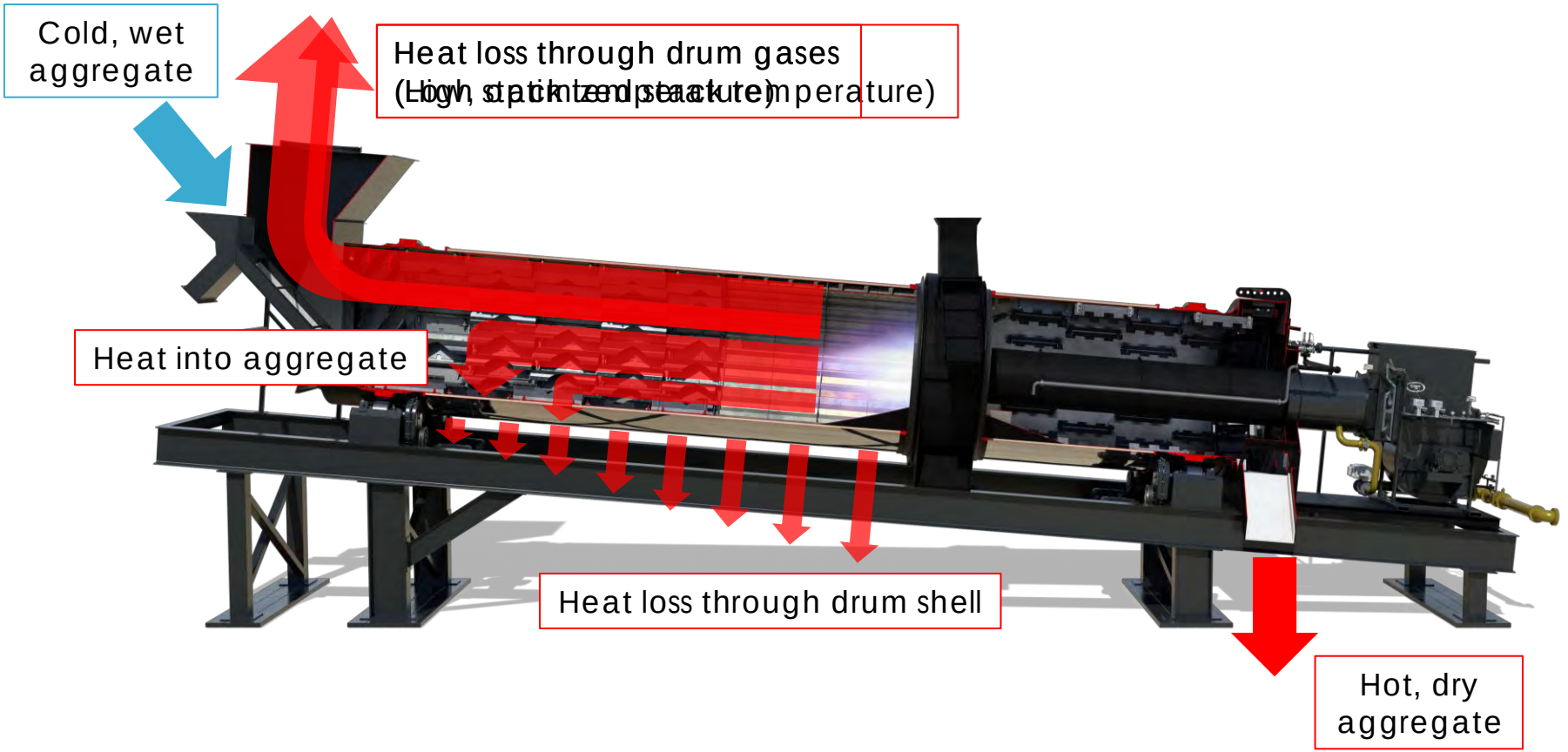
V-Pack™ Stack ~~Temperature~~ Control



VFD and Controls

The VFD changes the drum speed. Controls determines how much.

System Efficiency



Stack Temperature Effect on Production

60F = 10% production

4% effect on fuel required

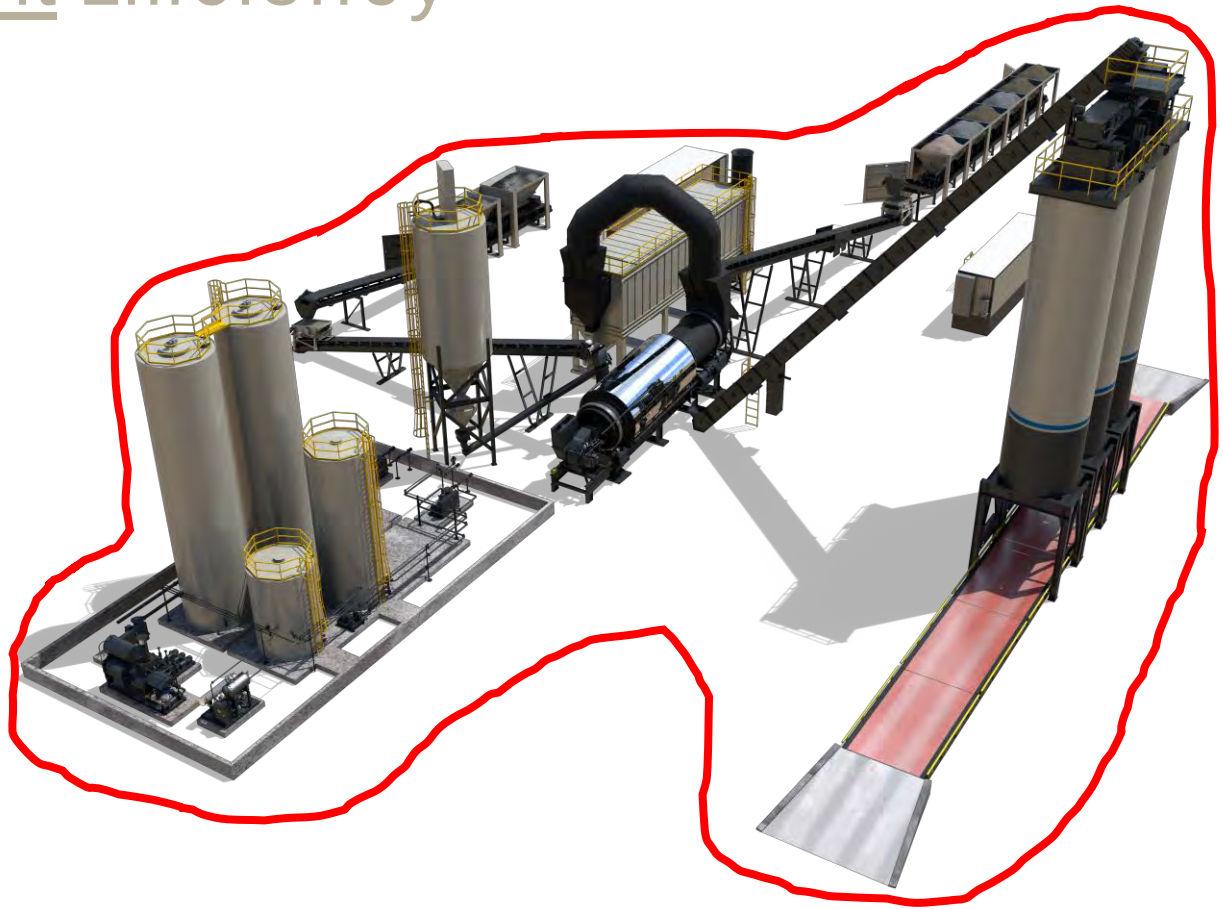
60-10-4

Stack temperature

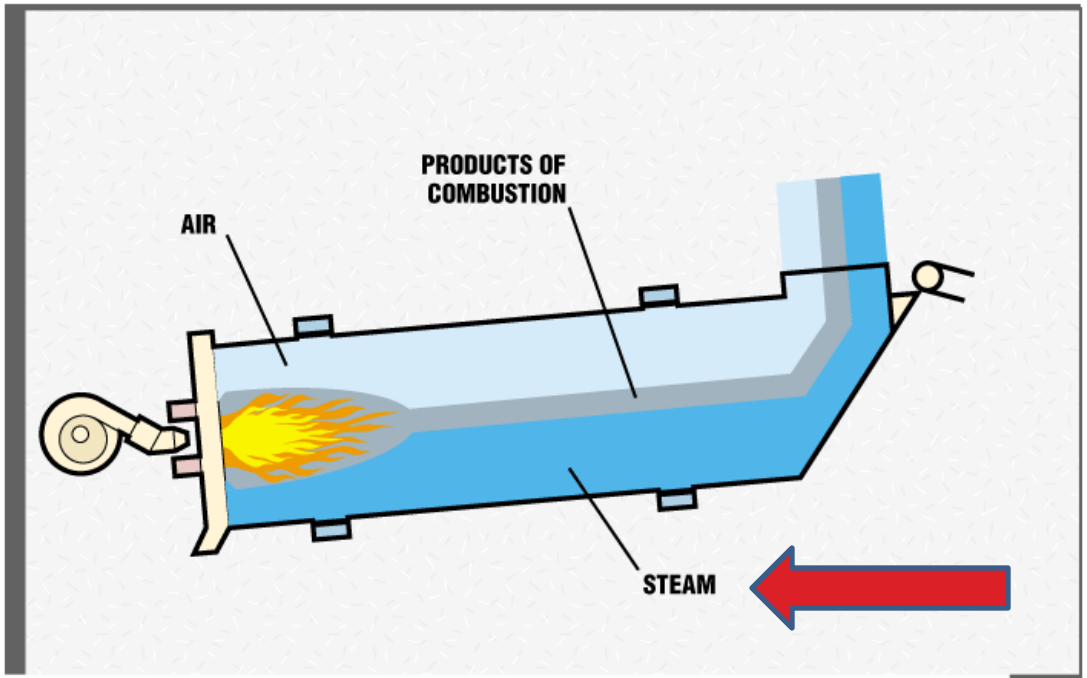
- **Can the stack temperature be too low?**
- **What temperature is too low?**
- **What is the dew point?**
- **Bad things can happen if you go too low…**
- mudding on the bags – won't pulse off – high delta P – low tph
- Plug up augers – hopper full of dust – plant down
- Corrosion – Waste Oil - Sulfur

High Baghouse ΔP

Plant Efficiency



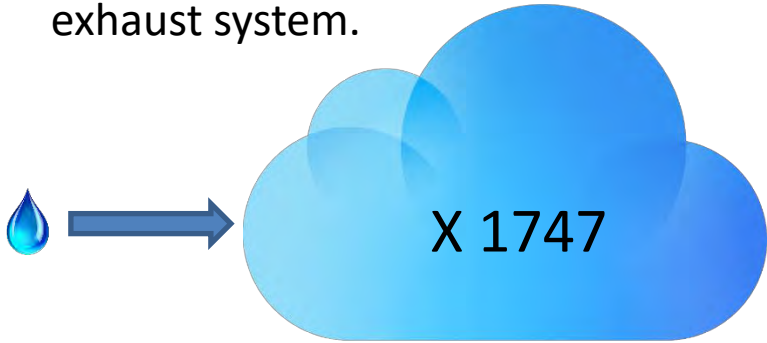
HOW DOES MOISTURE AFFECT PLANT CAPACITY?



EXHAUST COMPONENTS IN A TYPICAL DRYER

As water turns to 240 F steam it expands 1747 times.

That is why a small percentage of water makes a big difference to the exhaust system.

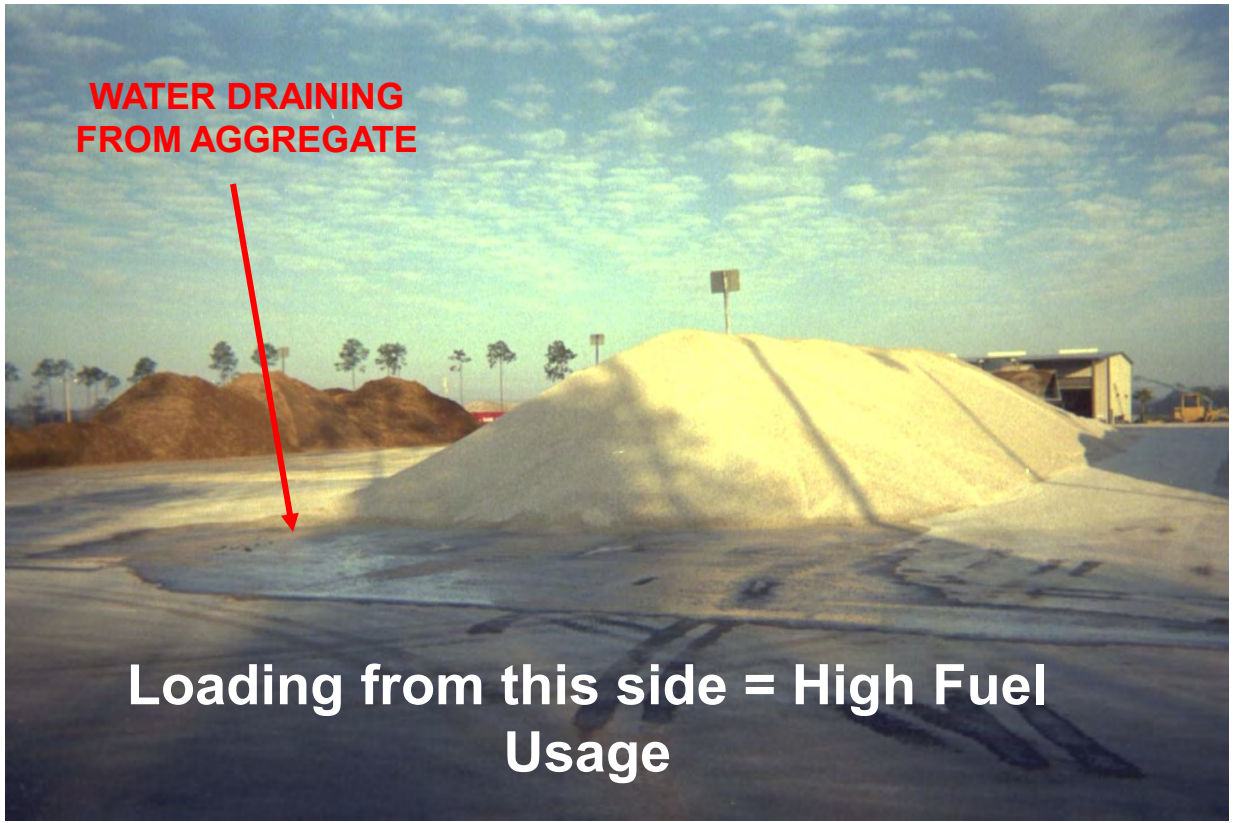


Moisture's Effect on Fuel Consumption and Production

- Water 70F to 212F 142 BTU/lb
- Water to Steam (no temperature change) 972 BTU/lb
- 52% of fuel for dryer is to evaporate water
- 1% moisture = 11% change in fuel
- 1% moisture = 11% change in production

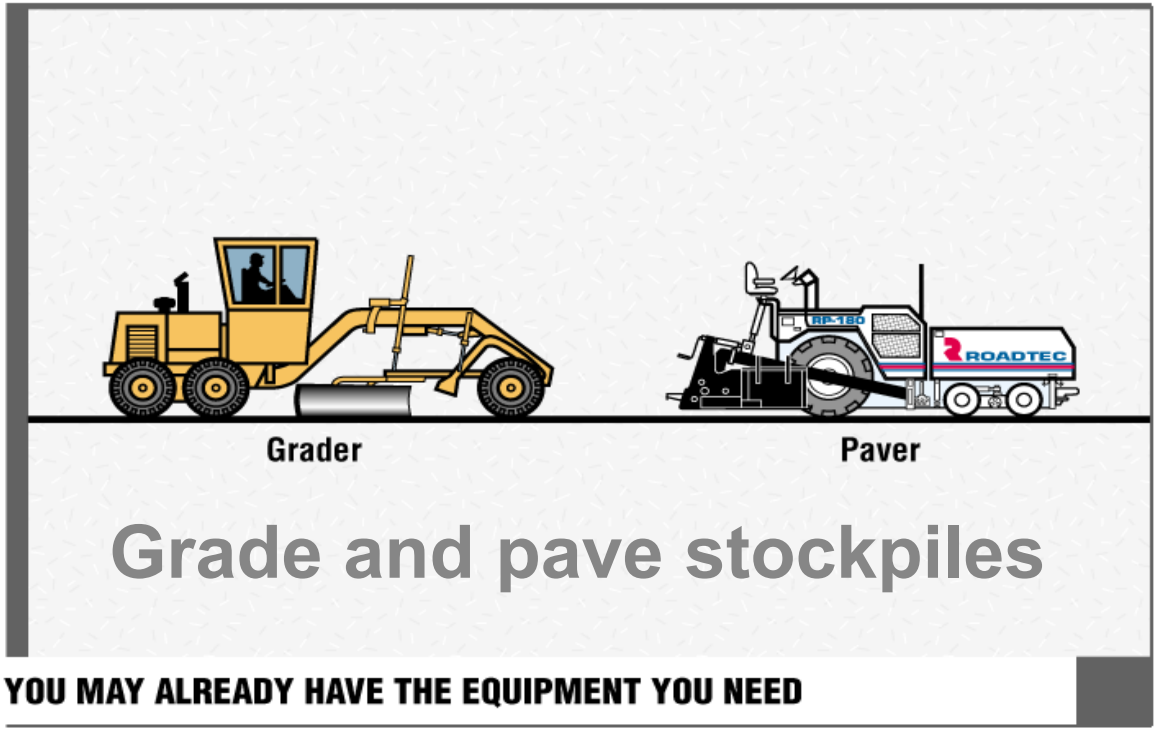
1 – 11 - 11

Small things = Big effect



Controlling Emissions, $/ton, and tons/day

What can we do about it?



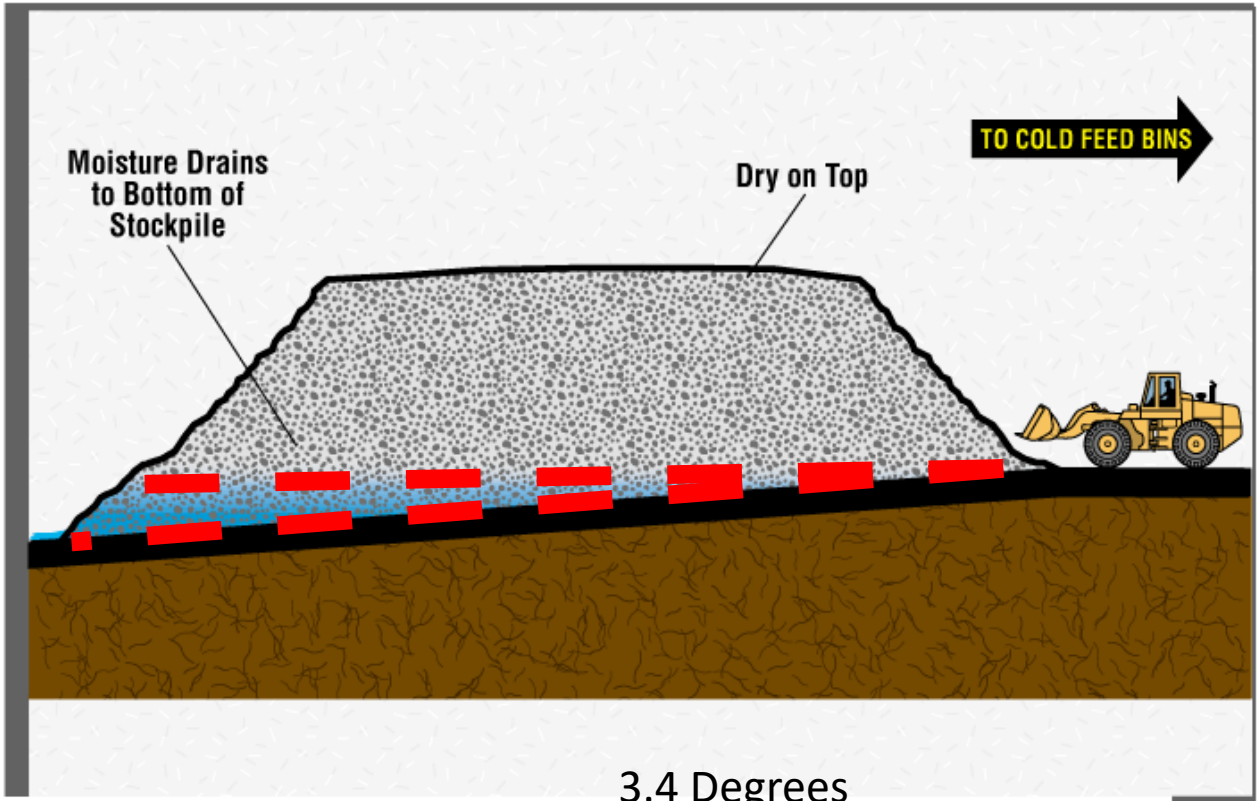
Plant Efficiency – Moisture

Good stockpile management practices can have an oversized effect on plant efficiency.

- Slope & Pave
- Cover (sometimes)
- Load from the dry material

A 2% reduction in moisture can reduce the burner energy requirement by 21%*.

*Based on Astec internal calculations. Third party verification in progress.



3.4 Degrees

STOCKPILES WITH IDEAL 6% SLOPE

Managing Moisture …

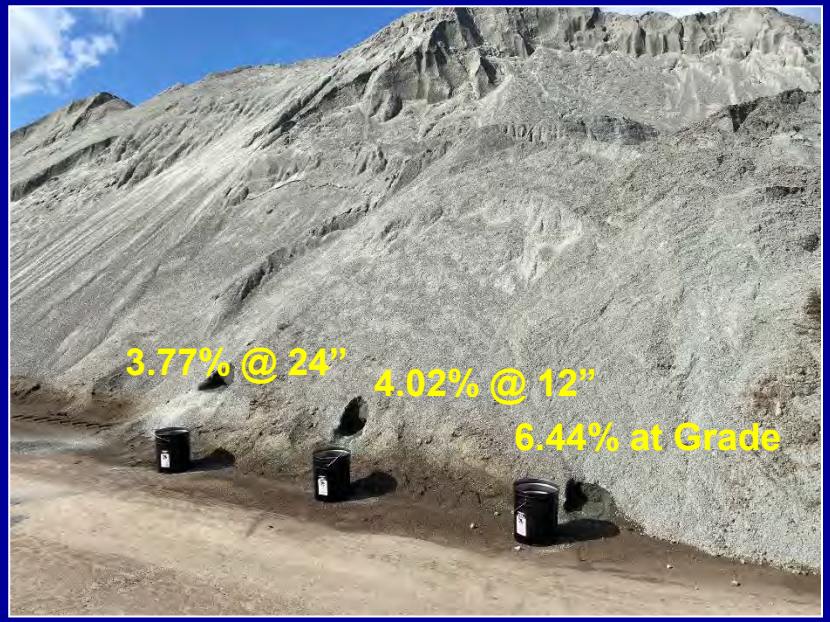
Natural Sand

4.2% less up 12”

Managing Moisture …

Stone Screenings

2.4% less up 12”



Managing Moisture …

3/8” (9.5mm) Stone

1% less up 12”

Cold feed bins covered too

Material inside and outside

Feed bin rain covers - Australia

Cold Feed bin covers – Colombia, South America

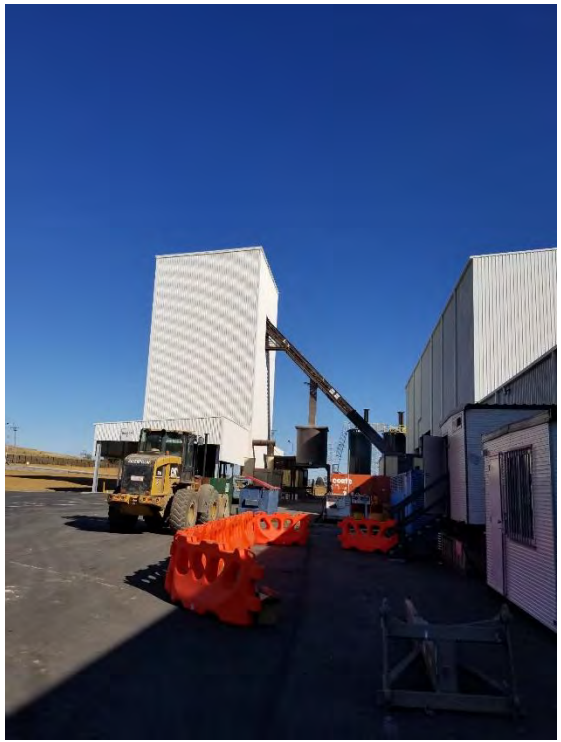
High operational Efficiency trumps component / system efficiency

Parallel flow drum mixer (obsolete - high stack temp)

Old burner technology

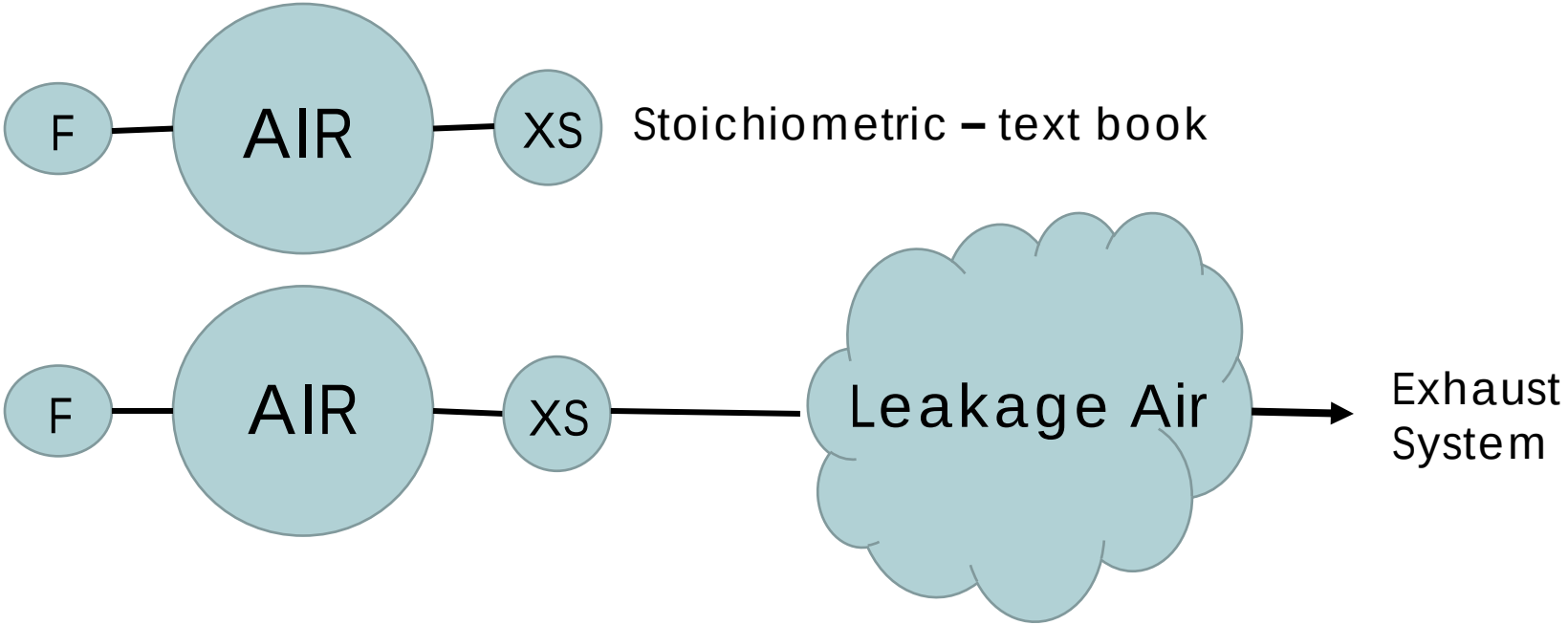
Low component / system efficiency – High plant efficiency

Welcome to the future – Covered everything!



Sydney, Australia

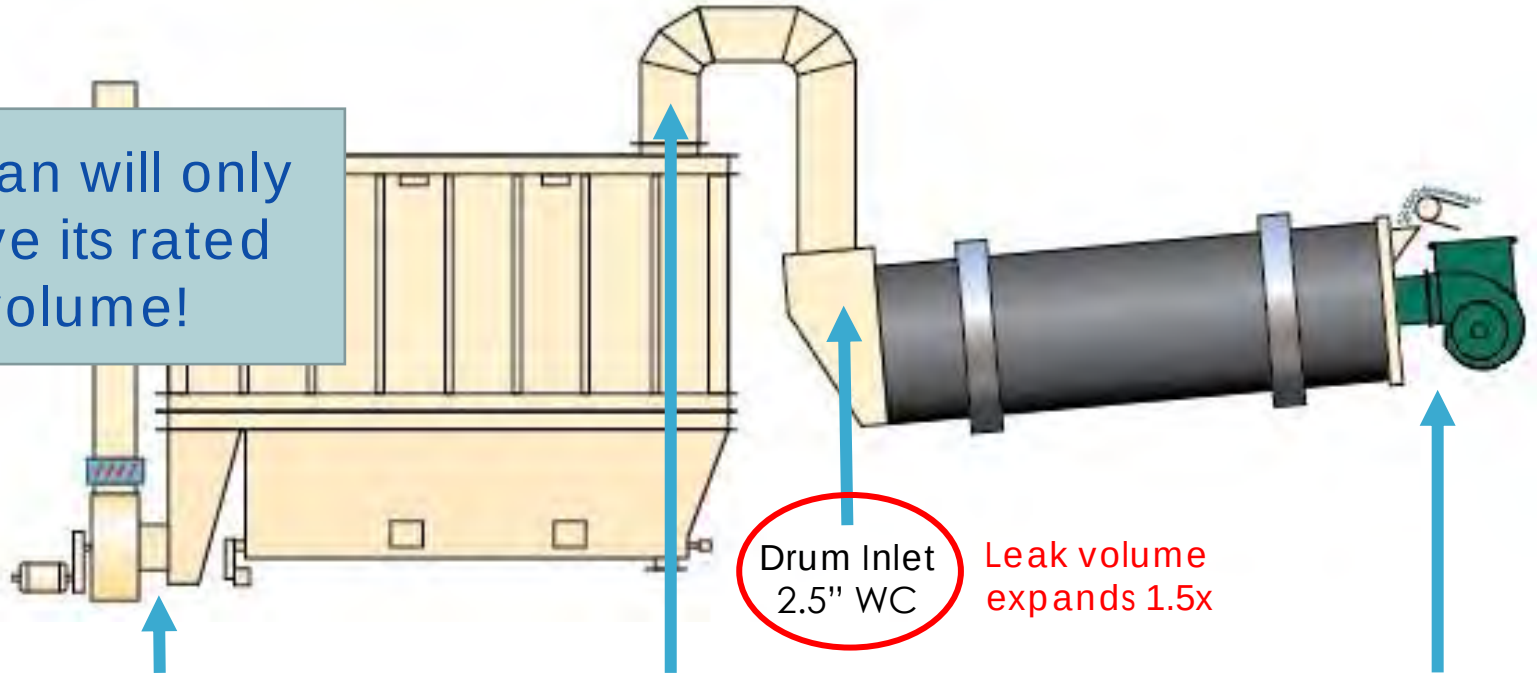
Leakage Air – Is it a big deal?



Production Rate Killer

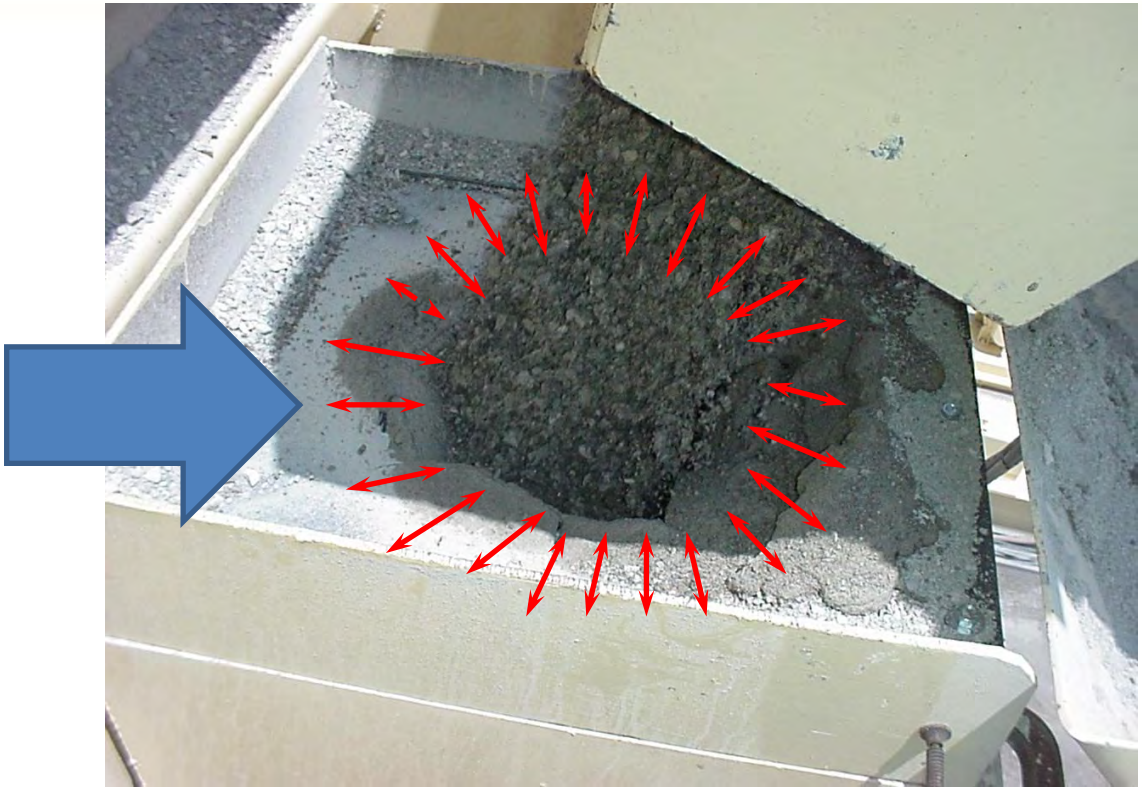
Plant Efficiency – Leakage Air

The fan will only move its rated volume!

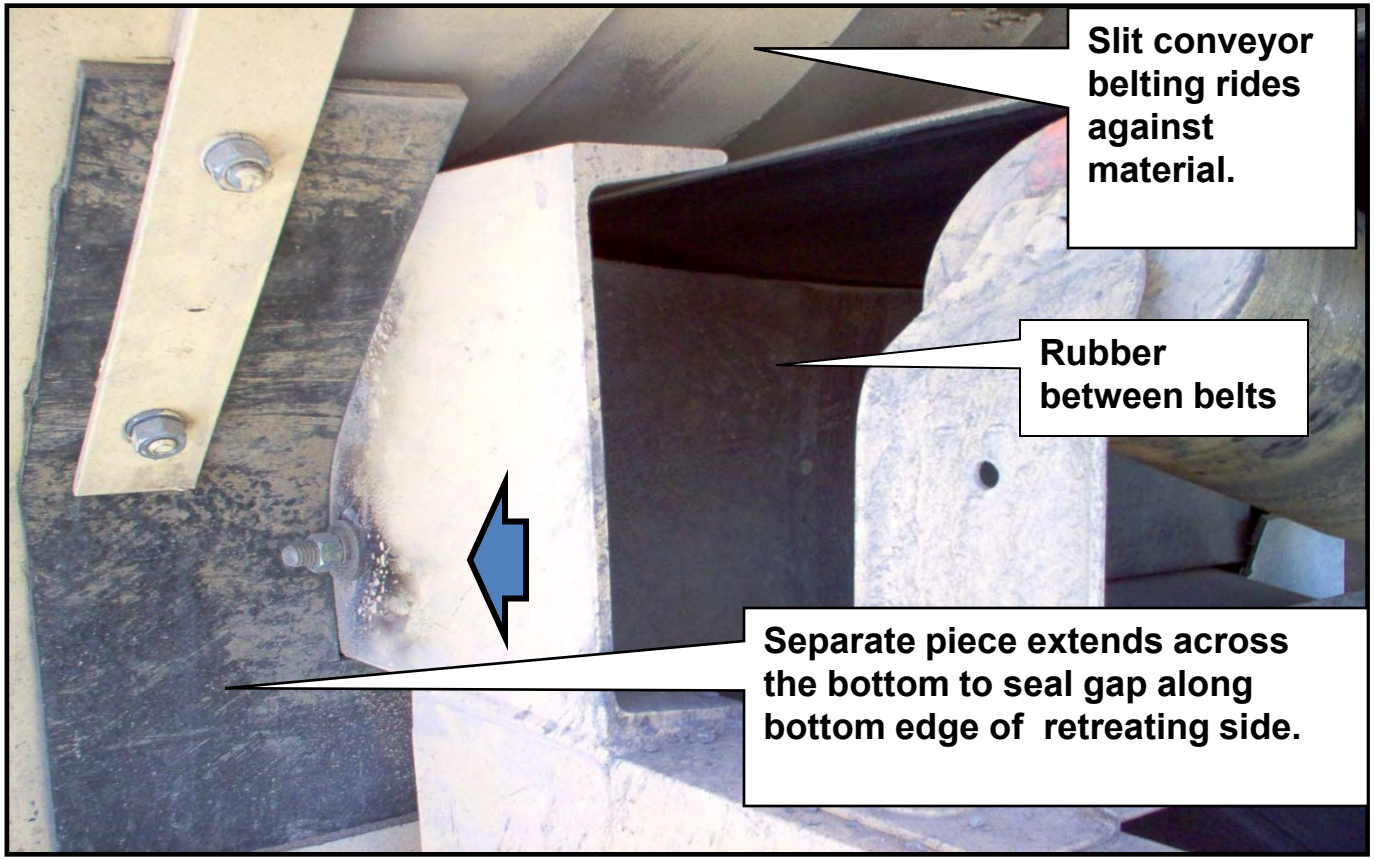


Air Leakage – Drum inlet chute

Drum inlet chute seal made from conveyor belting



Air Leakage – Slinger conveyor to drum

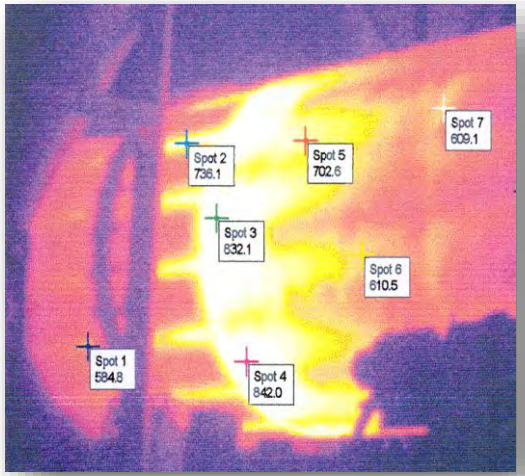


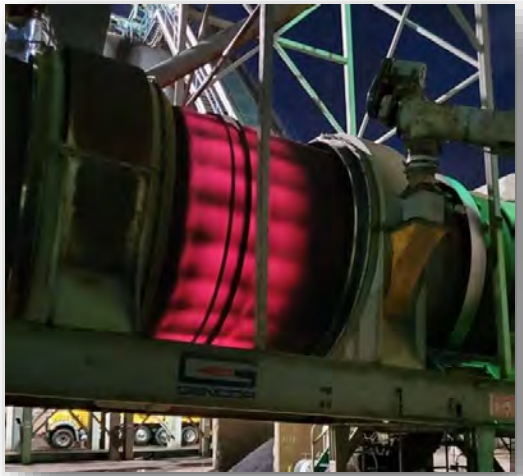
To insulate or not, that is the question!

Everything that gets hot besides the mix is a waste of energy, but what does it make sense to insulate?

Insulating Your Plant

- Dryer drum → Insulate?
- Duct work → Insulate?
- Baghouse → Lots of surface area – It depends





Insulating Your Plant

- AC tank farm → Yes!
- AC piping → Yes!
- Pipe flanges → Yes!

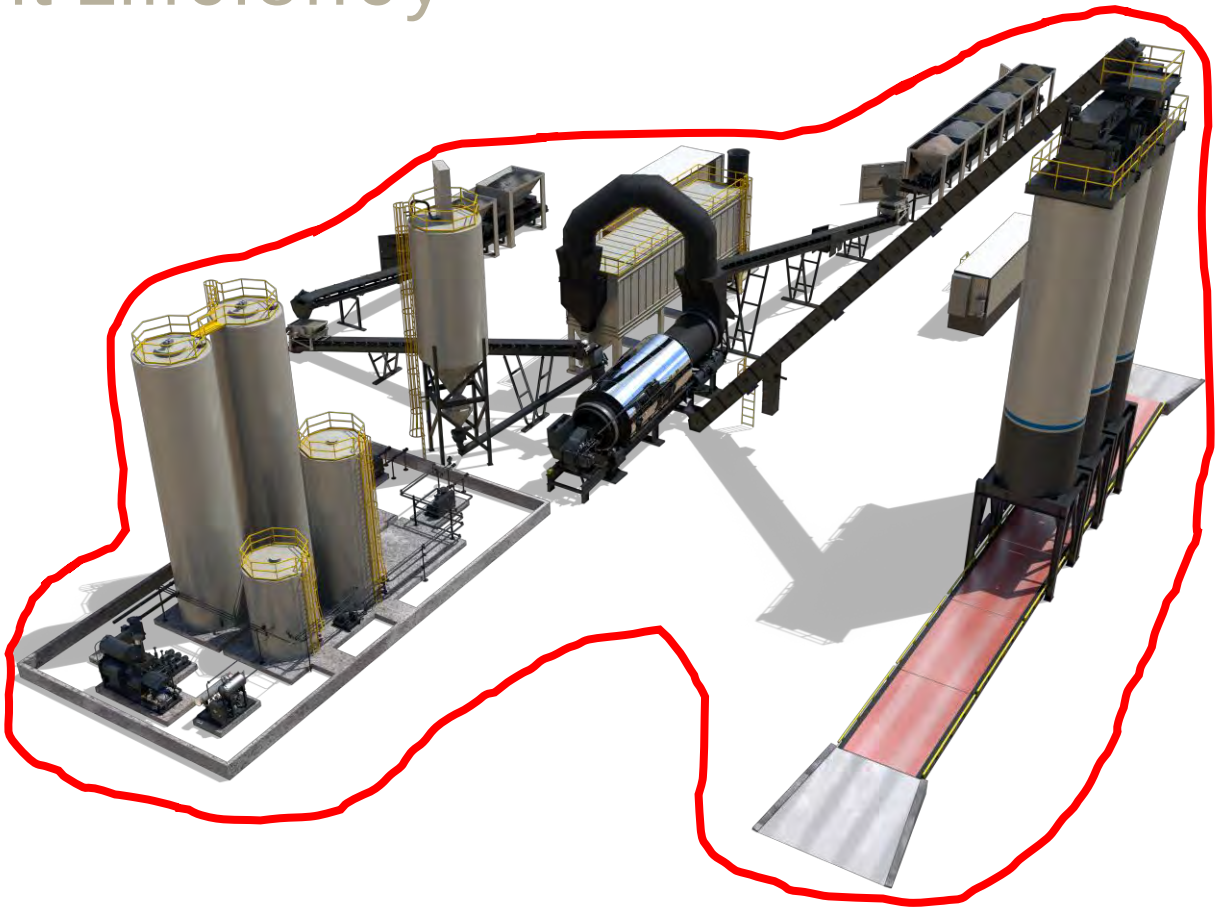
Jacketed Asphalt Piping					
Asphalt Pipe Nominal Size	Hot-Oil Jacket Nominal Size	Loss Per Linear Foot BTU Per Hour		Loss Per Flange BTU Per Hour	
		Un-insulated Jacket	Insulated Jacket	Un-insulated	Insulated
3 inches	4 inches	1598	86	1890	120
4 inches	6 inches	2349	122	2600	134
5 inches	8 inches	3057	148	3240	178

Hot Oil Piping				
Pipe Diameter	Loss Per Linear Foot BTU Per Hour		Loss Per Flange BTU Per Hour	
	Un-insulated	Insulated	Un-insulated	Insulated
1-1/2 inches	676	47	1205	97
2 inches	846	54	1660	115
2-1/2 inches	1024	55	2155	125
3 inches	1243	72	2485	130

Source: NAPA Publication QIP-132 & Astec Technical Paper T-140

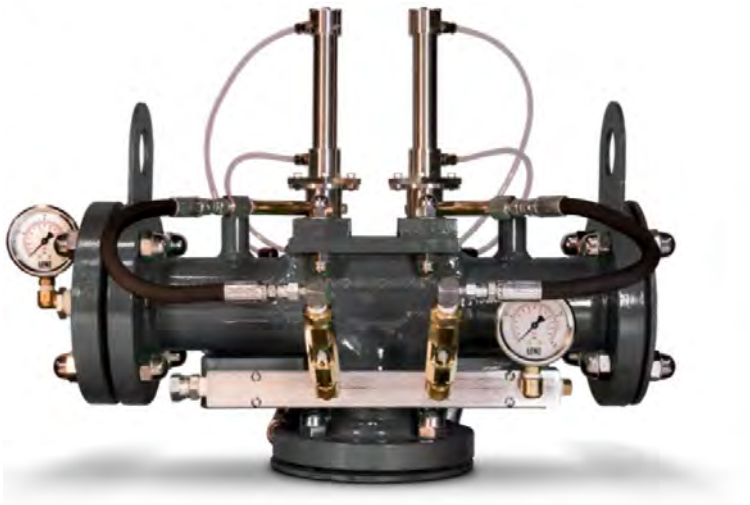
This will become more important as producers look to pick all the **"low hanging fruit"**

Plant Efficiency



Plant Efficiency – Mix Temperature

Pick a Warm Mix technology and sell it!



A 50° F reduction in production temperature can reduce fuel consumption by 11%*

*Based on Astec internal calculations. Third party verification in progress.

Do you see the asphalt plant?

As seen from the 3rd floor parking at the Chattanooga airport.

See it now?

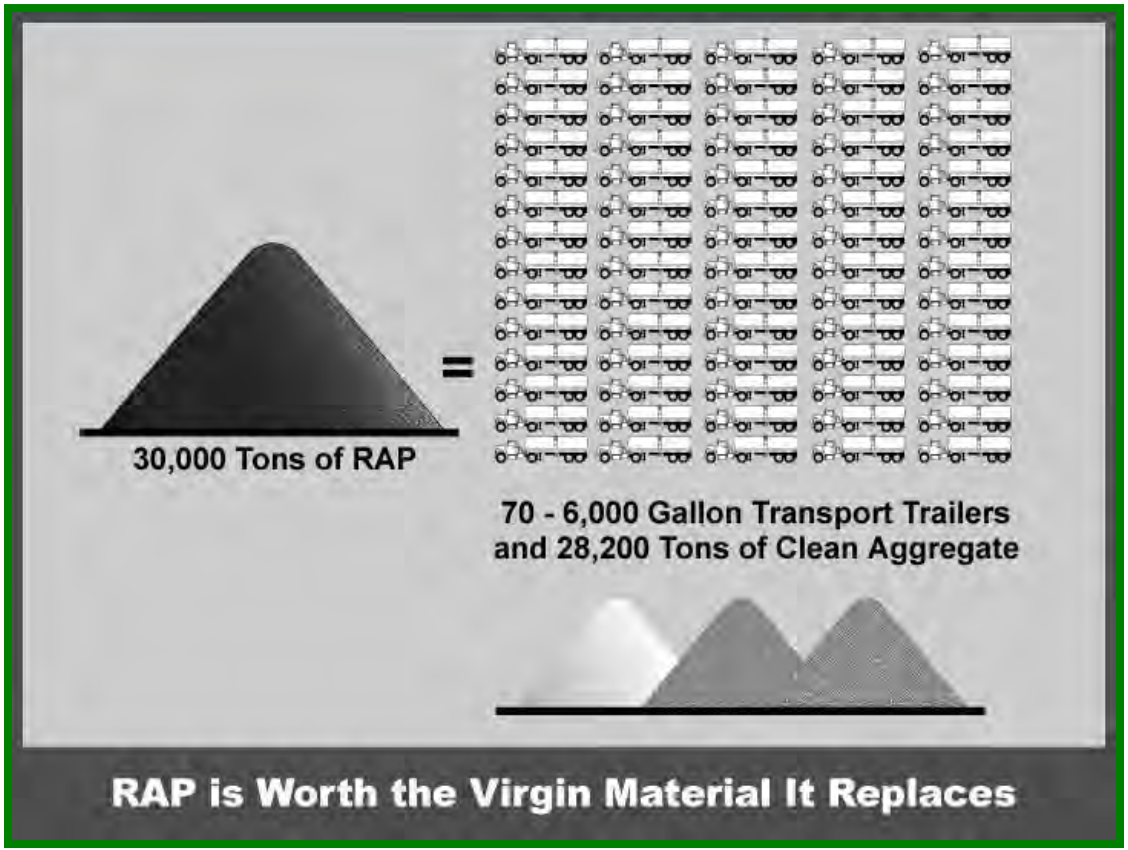
What is steam and what is smoke?

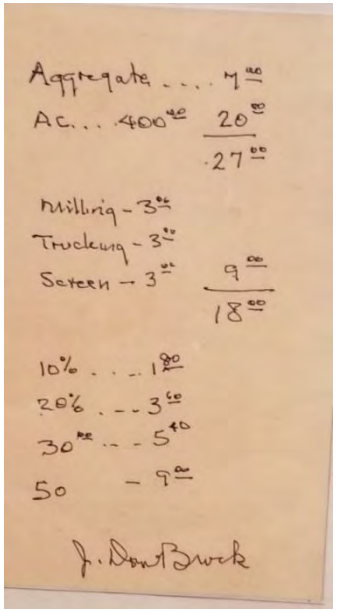
This is what hot mix can look like

Steam quickly dissipates
No smell

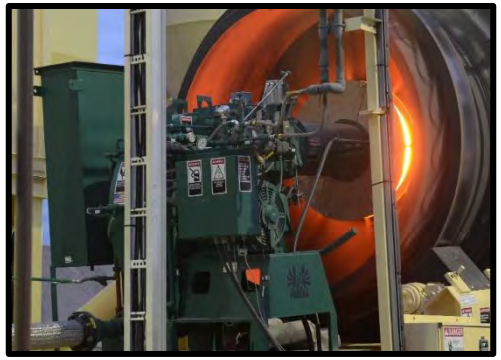
Blue smoke drifts
Has odor

RAP – What does it replace?





Which plant is more profitable / sustainable? Was it luck?



Old Technology

- Starts at 6am loading out of pre-filled silos
- Starts up at 8:30am
- Runs 2 to 3 mixes, has enough trucks
- Runs ALL DAY (changeovers, no mid-streams)
- Fills the silos at end of day

New Technology

- Starts at 6am making mix
- Runs 2-3 mixes on various jobs, short of trucks
- Mid-streams at 8:30 for 45min
- Runs another 300 tons (finished for the day)
- Cleans out
- Gets a call at 10:15am for a 150ton parking lot job for afternoon.
- Fires back up at 11:00am
- Runs 147 tons, then midstream while paving foreman figures the last bit needed.

Start-up waste

Start-up Waste

Surge and Storage

How does silo use affect plant efficiency?

Plant Efficiency – Operations

- Plants that start and stop more than 3 times per shift use up to 20 - 35%* more fuel

The solution: Storage silos.

Operate your continuous **plant**...continuously!

*When compared to theoretical steady-state operation. Percentages from NAPA Publication QIP-132.

“Reasons” Not to Store Mix

- Lack of planning. “I never know what mix we are going to need tomorrow.”
- Mix temperature loss
- Mix not coming out of the silo
- Internal moisture effects (temperature, “brown out”)
- Fear of storing polymer

Operational Strategy for maximum quality, profitability and, Sustainability.

Not only keep the plant running continuously but strive to stay at a constant production rate.

Let the trucks back up empty at the plant instead of full of mix behind the paver.

Operate for Efficiency & Profitability

- Keep the plant running and run at the same production rate as much as possible.
- Maximize the percent RAP the right way (equipment and behavior).
- Minimize mix temperature – Use a WMA technology, sell tech to customers.
- Manage moisture content – Slope and pave under wettest stockpiles if in wet climate.
- Use storage silos for storage, not just surge – Know what is needed the next day.
- Minimize waste mix – Measure, train, manage.

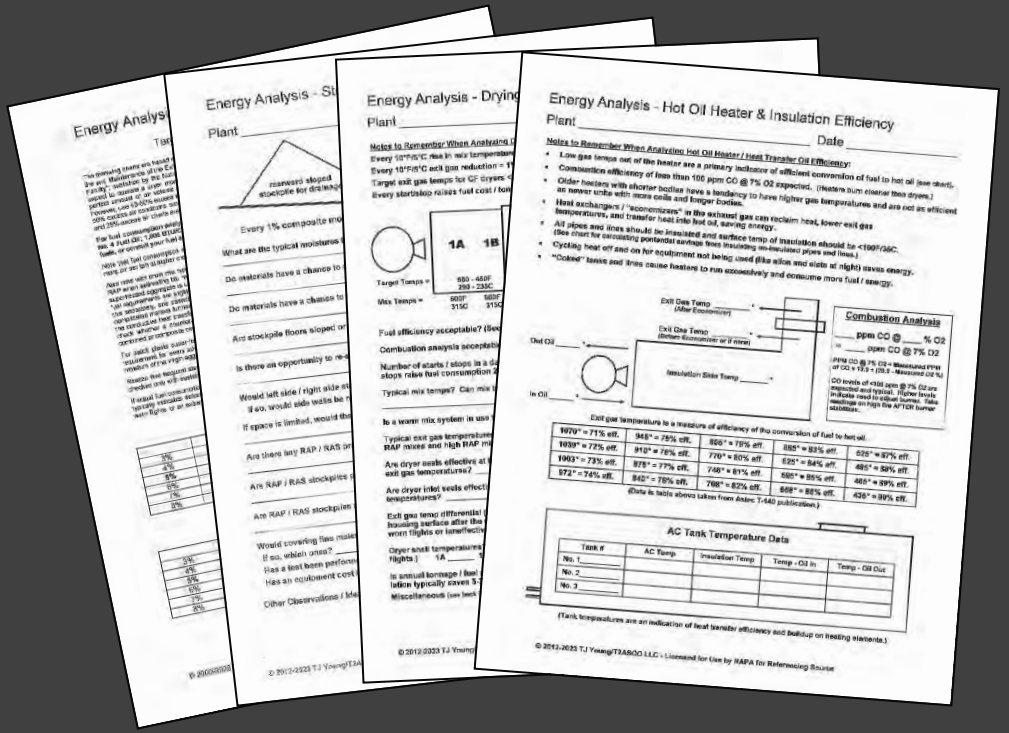

The Road
Forward
A Vision for Net Zero Carbon Emissions
for the Asphalt Pavement Industry
Production Strategies for
Saving Money and
Reducing Emissions

List of Topics Covered

- Mix Temperature
- Moistures
- Flighting/Exit Gas
- Insulating Drum
- Burner Tuned
- Alternative Fuels
- Production Start/Stops
- Production Rate
- Hot Oil System
  - Design
  - Fuels/Electric
  - Efficiency/Exit Gas
- Storage Tanks
- Pipes/Valves
- Peak Load/Demand
- VFDs
- Equipment Idle Shut-off

Self Audit Worksheets

- Stockpile Management
- Dryer Efficiency
- VFD Exhaust Fan
- Hot Oil System



ABOUT ASTEC

- Based in Chattanooga, TN USA and founded in 1972
- Unique vision to bring state-of-the-art technology to traditionally low-tech industries
- Built on the legacy of putting customer service first.
- Market-leading brands have become a global leader in the manufacture of equipment from Rock to Road.

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