# POWDER CHARCOAL AS A RENEWABLE ALTERNATIVE IN THE ENERGETIC MATRIX OF VALLOUREC

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# Global Sustainable Technology Roadmap for Iron & Steel



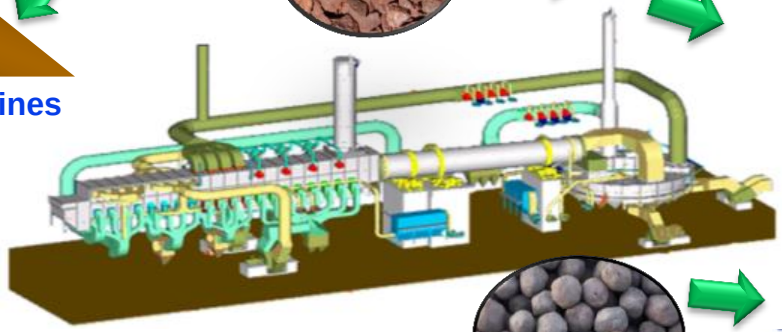
Iron ore mine



Lump Ore



Iron ore fines



Pelletizing



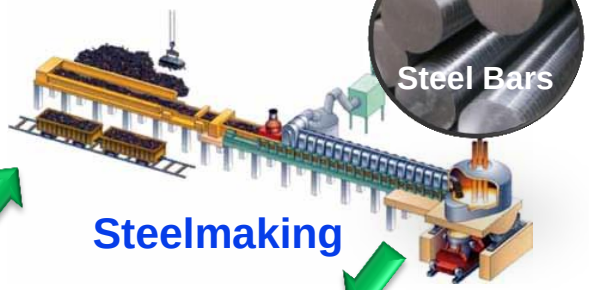
Pellets



Blast Furnace



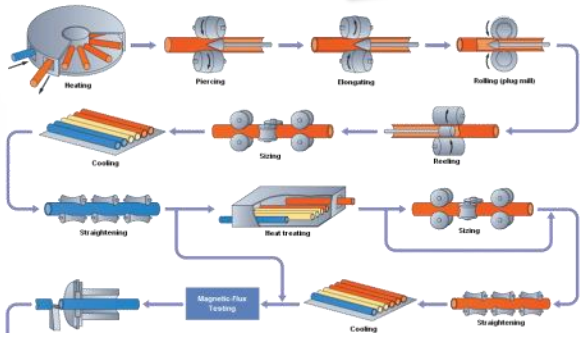
Hot metal



Steelmaking

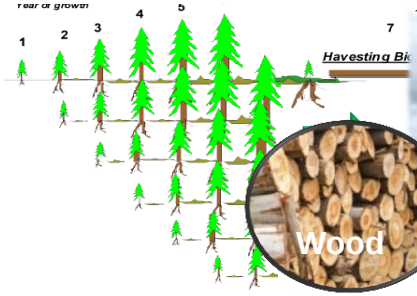


Steel Bars



Rolling Mill

Renewable Forest





Charcoal Fines



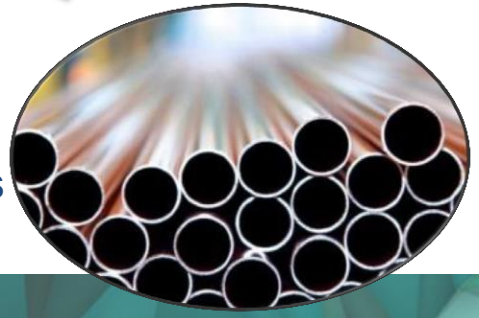
Lump Charcoal



Wood

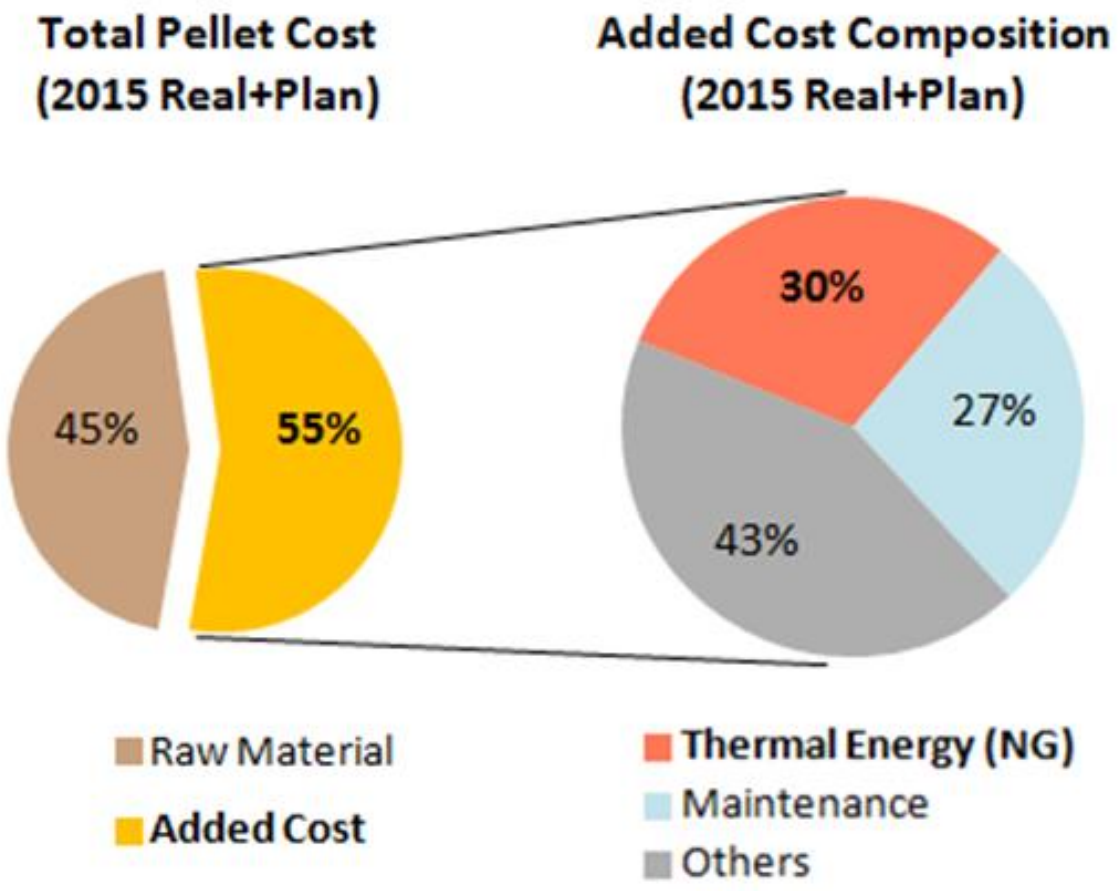
Charcoal making

Premium Seamless Pipes



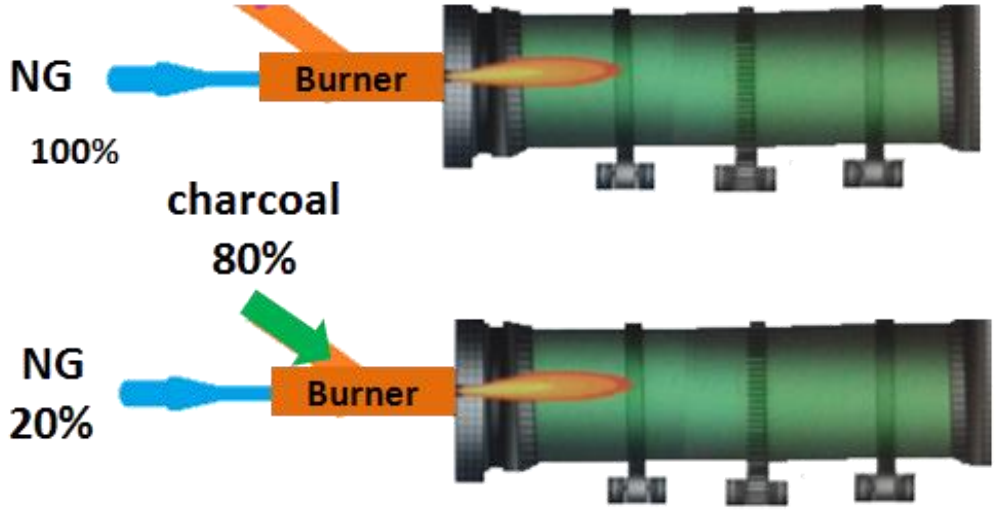
## Motivation for Improvement

- ✓ **Thermal energy** is the ***major added cost*** for pellets;
- ✓ From startup in 2013 to 2016, natural gas was the main fuel;
- ✓ **Natural gas** prices had wide **price variation** at that period;
- ✓ Vallourec had surplus of **CHARCOAL FINES** being sold for low prices at local market.



## Work Goals

- ✓ Exchange from natural gas to charcoal and reach substitution rate of 80% in main burner;
- ✓ Adapt/assembly equipment to receive, storage and inject pulverized charcoal to rotary kiln;
- ✓ Reduce pellet added cost and reduce emissions of CO2 from fossil origin.




Old Scenario

New Scenario

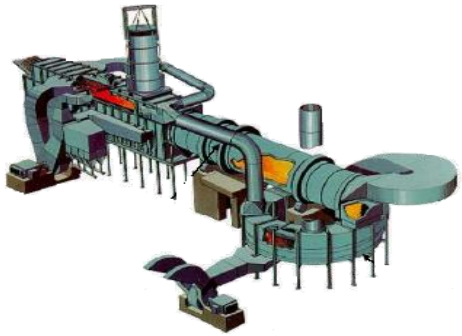
NOTE: % are related to total thermal energy consumption of main burner

## Remarkable Innovation

- ✓ Mineral Coal is the standard main fuel in GRATE-KILN around the World;
- ✓ Some GRATE-KILN runs with 100% Natural gas, previously including Vallourec;
- ✓ From research and information from peers, **NO OTHER GRATE-KILN** runs on Charcoal;
- ✓ Industrial tests were performed successfully at VSB to confirm feasibility of Charcoal use.

**Fossil Mineral COAL**





**GRATE-KILN Pelletizing Process**

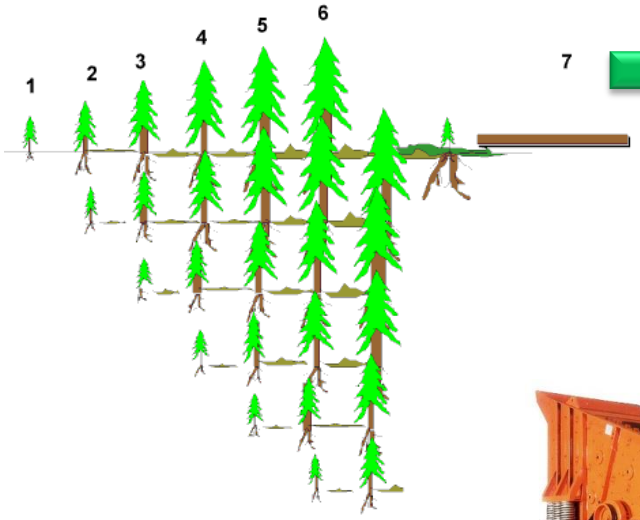


**Renewable Forest CHARCOAL**

## Vallourec Renewable Charcoal Production Route

✓ Gross charcoal feed blast furnaces, charcoal fines (< 12mm) goes to pulverization;

**Renewable Forest**

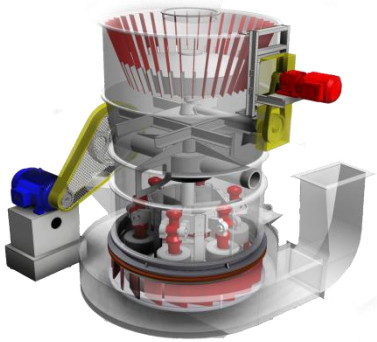



**Wood Carbonization**





**Sieving Separation**



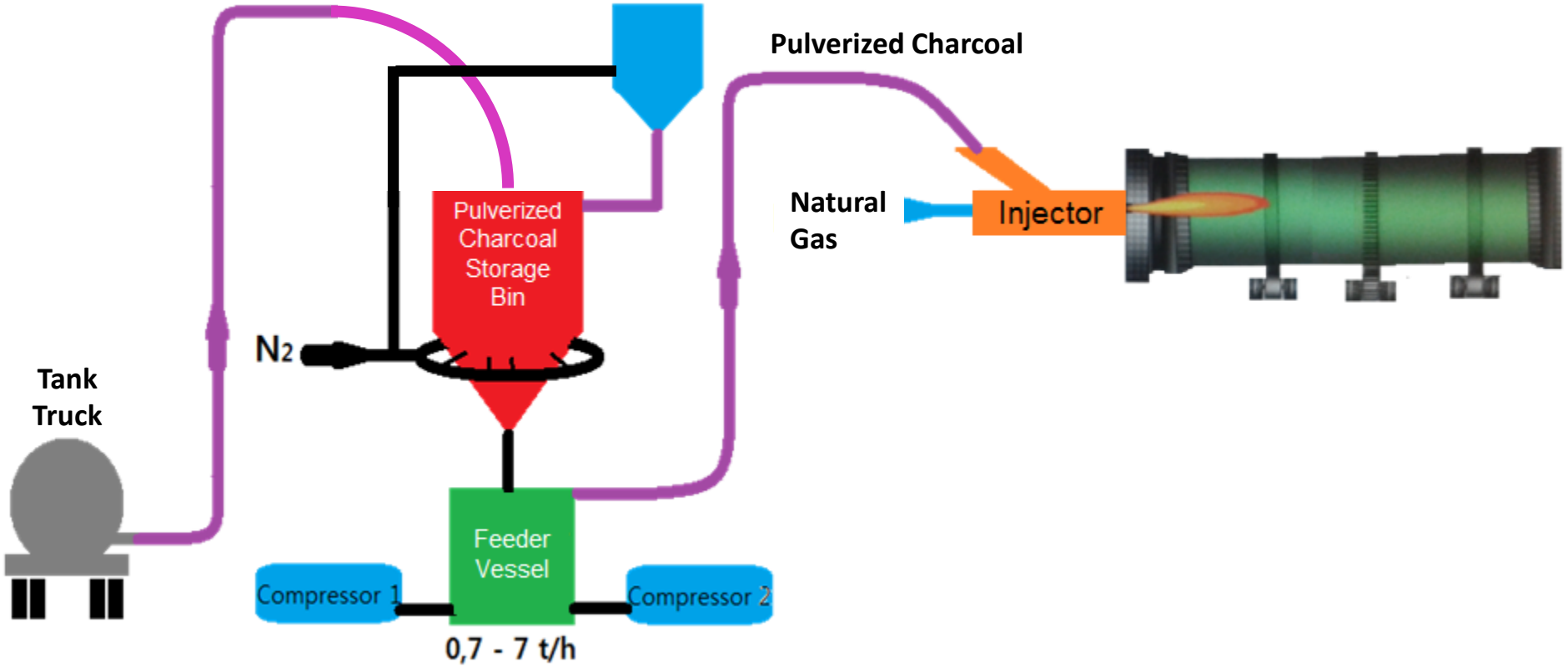
**Pulverization**



**Tank Truck**

## Pelletizing Plant Installation for Charcoal injection and burning

✓ New installation enables receiving, storing, fluidization and injection of powder charcoal;



## Charcoal burning Test

✓ Three quick tests were performed before full scale commissioning test, pictured below;



## Results

- ✓ Ramp up of charcoal use started in Jan/17;
- ✓ From Jan to May 2017, average substitution rate was 53% with same or slightly increased pellet resistance (quality);
- ✓ As daily averages, 80% substitution rate could be reached.

Table 1. Comparison of Thermal energy and pellet quality *

| Period | Thermal energy (Mcal/tp)** | | | Average Substitution Rate | Pellet Resistance (daN/p)*** |
|---|---|---|---|---|---|
| | Natural Gas | Charcoal | Total | | |
| Oct - Dec 2016 | 245 | 0 | 245 | 0% | 319 |
| Jan - May 2017 | 115 | 127 | 242 | 53% | 338 |

** Including natural gas data to keep heating at preventive and corrective production stops*
*** Natural Gas 8.5 Mcal/Nm³ and Charcoal 6.5 Mcal/kg;*
**** Average value of each period evaluated as Standard ISO 4700*

## Conclusion

- ✓ Charcoal is feasible as renewable energy source with lower cost than natural gas.
- ✓ Charcoal use kept or even improved the physical quality of the pellets.
- ✓ There was a reduction of 53% in the emission of CO2 from fossil sources.
- ✓ There was increase of bonding of materials on the internal surface of the rotary kiln.
- ✓ Vallourec will continue in the use of renewable fuels with a view to achieving highest replacement so as to evolve into sustainable steel production.

# Thank You for your Attention

Doubts, questions and additional information:

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