# Clean Combustion Vortex Injection Technology in Large Industrial Burners Approaches Optimised Combustion with Minimal Emissions

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## ABSTRACT

A sustaining trend of increasing energy prices and stricter governmental policies make large producing companies inevitably face larger costs. However, investing in more energy efficient technology could help convert foreseen costs to operational benefits. We present an efficient energy extractiontechnology that reduce production costs, environmental impact, and achieves improved growth in comparison to existing technology. Our installation observations show that transitioning from static to dynamic production result in synergies within the combustion process and related activities.

## Introduction

Increasing costs of energy and resources require improved efficiency and energy extraction to generate a more desirable energy per dollar out of resources purchased. Today's types of gas, liquid, and solid fuels bring the possibility to explore the variety of fuels within operations to consume the fuel generating highest energy per dollar at the time provided supportive technology is available. A controlled and varying demand of production require an optimised performance at variable flows of fuel. This is where the current and demanded technology part. Present technology is mainly operating at static flows and single fuels, concluding that the static equipment does not support dynamic production in an efficient way, when what you need is the dynamic production.

Dynamic Performance guided Clean Combustion to development of dynamic key components for different operations within the pulp and paper industry that give our client a strategic advantage. To maximise the efficiency Clean Combustion supplies equipment, education, training and expertise within efficiency management, operations, and equipment. This paper will overall cover one of our well-reviewed core technologies the Vortex Combustion Burner.

## Combustion Technology

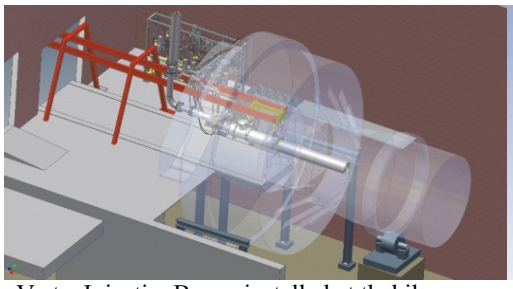
New equipment, invested for long-term, should suggestively face stricter requirements to meet the future governmental and corporate policies, desired efficiency rates, and other expectations (in example turn-down-ratio and up-time) to avoid locking the organisation in limited production flexibility with static technology. Through the most efficient extraction of energy out of the fuel with none or close to none loss of energy reduces the greenhouse gases and other emissions when a complete combustion occurs, and only $H_2O$ and $CO_2$ are released. This is achieved through an optimized balance between fuel, air and atomization medium.

### a. Old Combustion Technology

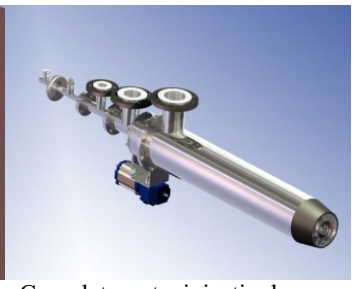
Older technology are often operating static in an 'on or off' mode. This means that optimal efficiency of the equipment can only be achieved at a given flow of the fuel. The restraint damages the alignment between management demands and operative outcome. More recent technology works in semi-dynamic stages.

### b. New Combustion Technology

New technology strives to be more efficient than its previous generation. Combustion technology offers dynamic performance to operate in different situations suitable of its demand, and to do so in an efficient manner. The requirement of new technology investments should considerably concern; cost efficient use of fuel resources and plant, reduced emissions and environmental impact, reduced and simplified maintenance, and modernized operation.



VortexInjectionBurnerinstalled at thekiln



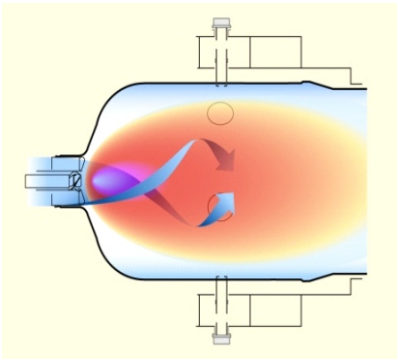
Completevortexinjectionburner

## Dynamic Fuel Injection

Dynamic fuel injection applied abundantly into the production empowers the operator with instant choice of most suitable fuel; strategically, financially, and/or environmentally. Injecting the chosen fuel in a centralized position without interaction from other burners engenders the most efficient heat exchange, and a stable controllable flame.

The rotating fuel combusted by the Vortex Combustion Burner result more control and stability to the homogeneous flame. Further control is given through the turbulator. The operation is remote from the control room with help of cameras installed in the kiln, this aids the operator to monitor values and flame shape related to changes made.

Optimal oxidation and atomization can reach complete combustion of the fuel and will only produce $H_2O$, $CO_2$ and thermal energy. The location of the combustion within the operation is of highest importance to avoid escape of uncombusted fuel and combustion outside of the flame zone. A vortex combustion controls the flame zone and is most likely to achieve this.

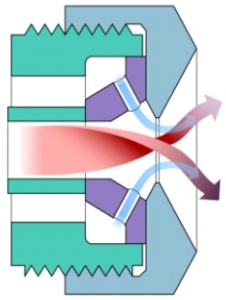


Illustratesa homogeneous flamerotating in aboiler

## Technological Breakdown

The Vortex Combustion Burner does not have the classic mixing chamber for atomization. Atomization is made in the tip of the oil-lance and in the flame zone by adding steam to the already rotating fuel, leading to the rotating flame which will become more homogenous; the rotation is amplified by the turbulator, which also provides the possibility to adjust the flame width and depth in the process. A flame that behaves this way enhances control and can be adjusted after desire.

A Vortex Injected Burner does not get affected by particles in the fuel that have the tendency to clog mixing chambers. This is typical for the old type of burners, which in turns result in higher pressure of the fuel and you will get a flame that is no longer homogeneous and decreased control, this leads to increased and irregular wear on the surrounding environment of the flame. Eliminating clogged equipment will achieve greater uptime and reduced wear costs. Constant steam that passes through provides a self-cleaning effect and eliminates the need for regular maintenance stops on this matter. This type of technology will be able to achieve an efficient turndown ratio of 1:20 on furnace oils.



Oilinjection nozzle forVortex Combustion Burners

The advantages of a Vortex Combustion Burner to a traditional burner are:

- Maximized control
- Stable homogeneous flame
- Low energy consumption
- Reduced emissions
- Increased up-time and control
- Heavy fuel High Turn Down 1:20
- Self-cleaning

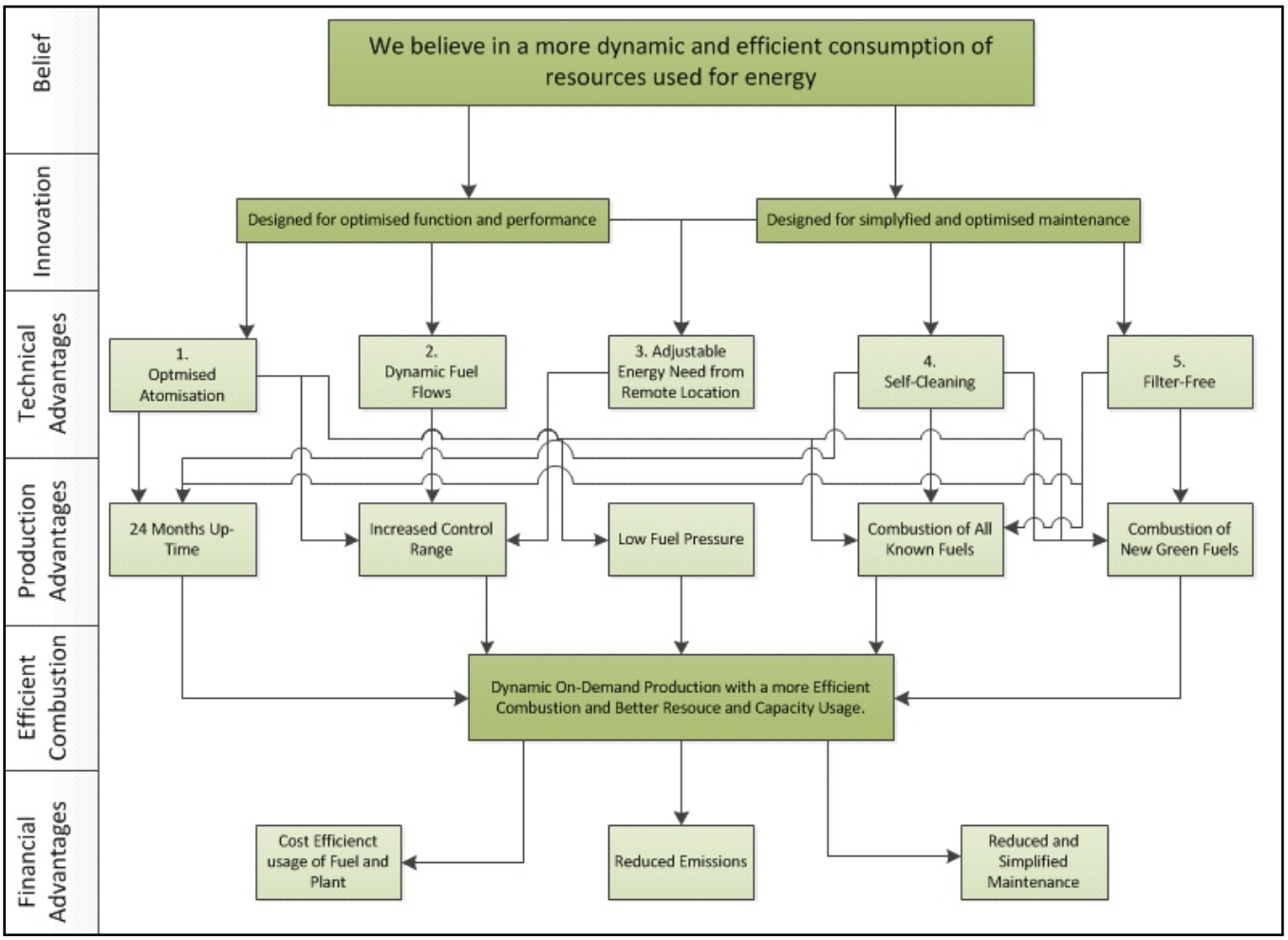
## Results

The result of more than 60 installations in various equipment within this concept is direct fuel savings of 10% through change of equipment. A reduction of fuel consumption at a level of 15-30% has been achieved when a higher level of involvement from the organization has been present. For this to be possible, the organization had to undergo core team operating training, process tuning workshops and have their maintenance routines updated.

The table presented below contains observed results within Swedish Pulp and Paper Mills. The results are confirmed by different sources involved with operations or management of the burner. This table is limited to installations of the Clean Combustion Vortex Injection Technology. Experiments co-

Table 1 Observed Results after Installation of Clean Combustion Vortex Technology

| Client/Plant | Facility | Result |
|---|---|---|
| BillerudSkärblacka AB | Lime kiln Burner | Less steam and oil pressure needed, Increased efficiency, increased possibility to regulate the oil combustion. Easy to start the burner. Possibility to use the same burner for drying the bricks and warming up the oven |
| Korsnäs AB | Lime kiln Burner | Start-up burners and methanol burners: Increased efficiency, Reducing oil flow and H2S in outlet, Increasing methanol flow |
| SCA Packaging Munksund | Lime kilnBurner | 20% higher efficiency. No H2S. Perfect flame. Possibility to burn oil from 50l/h-2000l/h. Possibility to adjust gas pressure |
| BillerudKarlsborg | Lime Kiln Burner | 10% higher efficiency. No H2S. Perfect flame. Possibility to burn oil from 50l/h-2500l/h. Possibility to adjust gas pressure |
| BillerudSkärblacka | Lime kiln Burner -2 | Higher capacity, increased efficiency (20%), easier to use. |
| BillerudSkärblacka | Lime kiln Burner -1 | Higher capacity, increased efficiency (20%), easier to use. |




Advantages and effects from our Fuel Injection System Design for application within paper, power, process, shipping and petrochemical industries

funded by VINNOVA the Swedish Governmental Agency for Innovation Systems analyzing stated observations through life scale tests are at present being conducted.

### *Tested, Approved and Recommended*

Clean Combustion Vortex Combustion Technology has improved the capacity from 6MW to 15MW with the existing boiler in the MetsäSärleHusum Mill, Sweden. It also extended their uptime to 99.98%. BillerudKorsnäsFrövi Mill reduced their fuel consumption after installing a Vortex Injected Burner in their lime kiln.

## Conclusion

A proactive approach that challenges not only current but future energy and emission policies lets a larger corporation discover the advantages of newer, greener, and more efficient technology. Corporate environments are increasingly competitive with unpredictable demands and new advantages needs to be explored within already established parts of the process. Large challenges arise in transition from continuous/static production to dynamic matching demand, where efficient green technology and efficient financial investments meet proactive policies allows the discovery of new production advantages. With focus on dynamic performance a plant can create the ability to meet varying demand and achieve efficiencies in consumption of resources. A vortex injection burner will reach a reduction of fuel consumption, reduction in emissions and various greenhouse gases, and improved control; Dynamic Performance.

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