



STEELMAKING

CAN PROTECTING THE ENVIRONMENT  
BE ECONOMICALLY PROFITABLE?

Roland V Müller - eco-e AG



# AGENDA

- Eco-e AG – energy saving and the environment
- One step back – what do we know about the present systems?
- Our proposal - ECOSHAFT
- Pollutants or reactions inherent to the scrap
- Foaming slag – carbon or substitutes
- Lance and burner application
- Off-gas – energy carrier or waste
- Environmentally friendly incinerator
- Benefit - the economical effect



We promote environmentally  
friendly and economically  
reasonable solutions for the steel  
industry!

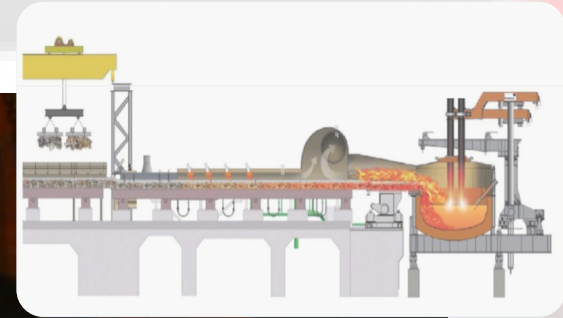
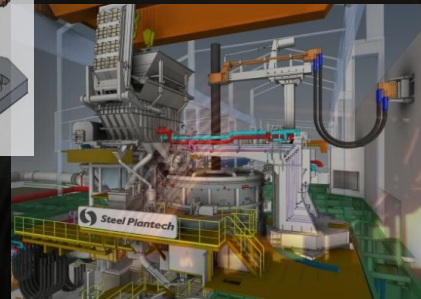
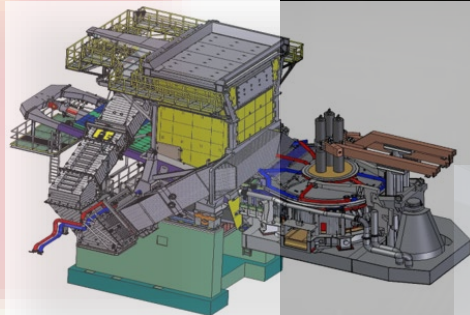
[Energy saving](#)

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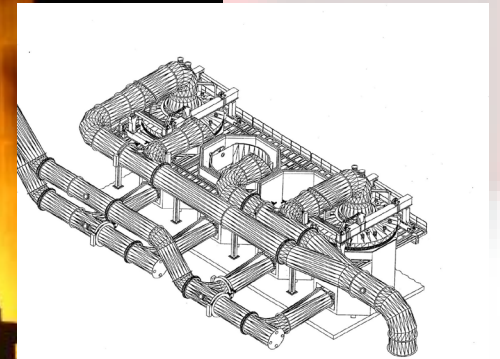
FOR THE SAKE OF THE ENVIRONMENT - IN THE SERVICE OF THE CUSTOMER

# ONE STEP BACK

Shaft and shaft-type systems



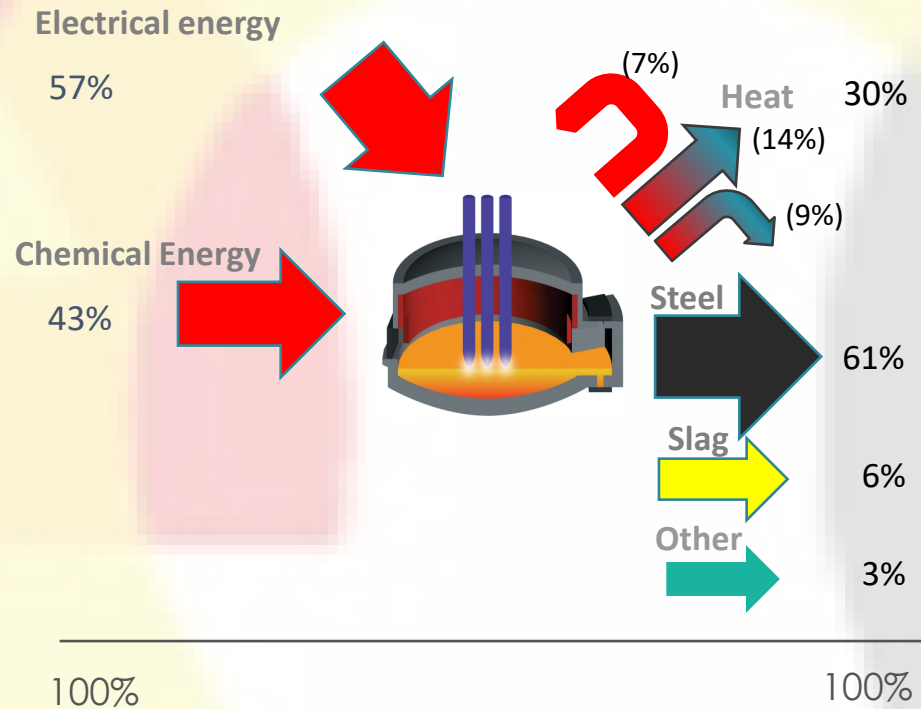
Conveyor systems



Basket preheaters

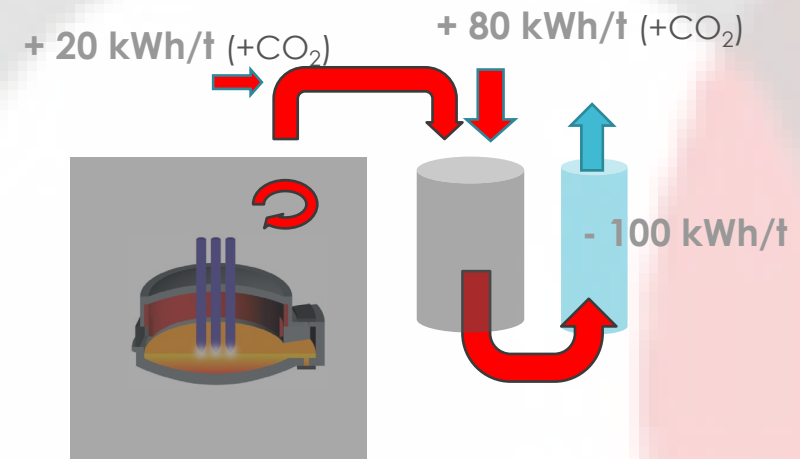
What do these systems have in common?

Environmental problems!



Shaft furnace (equivalent to Quantum, SHARK, COSS, EcoARC, etc.)

Total **apparent** energy input **535 kWh/t**



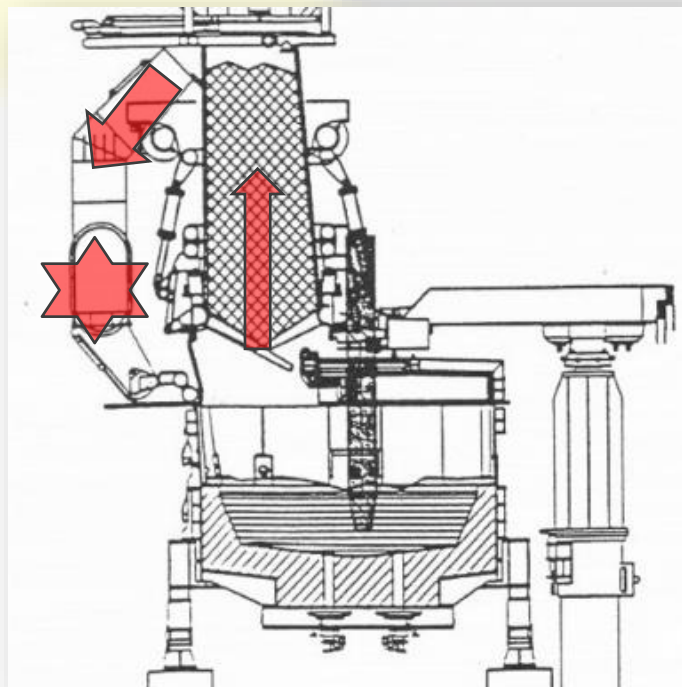
Total energy input **635 kWh/t**





Burn-off of pollutants during loading (**scrap fire**):

- Open EAF (no control, short time)
- Shaft EAF (high draft, limited time)
- Conveyor EAF (constant feed, constant emission)



Uncontrolled **post-combustion** because of fast off-gas flow:

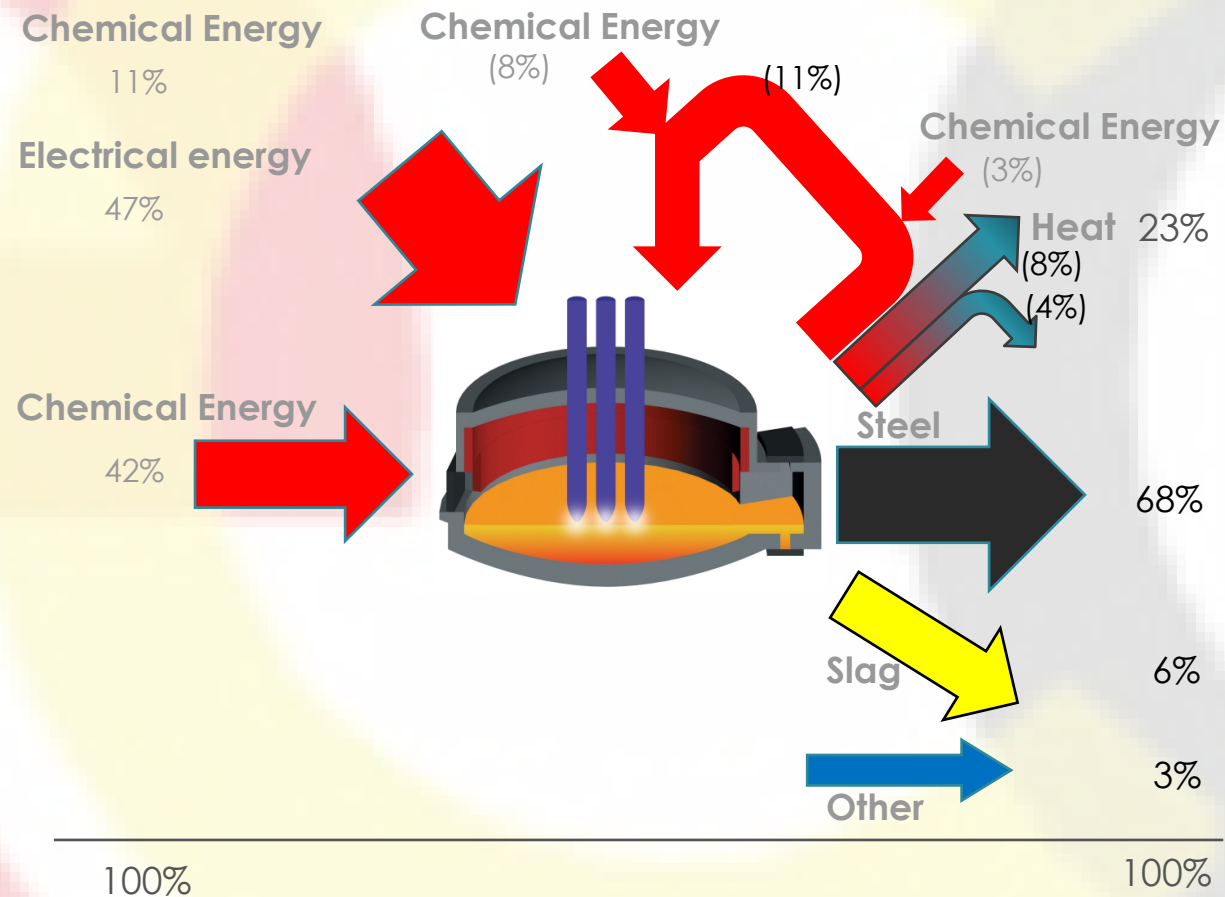
- Untight EAF (high volume)
- Shaft EAF (constant section)
- Conveyor EAF (constant section)



Damage of material due to **high energy impact**:

- Open EAF (housing, canopy)
- Shaft EAF (top and duct)
- Conveyor EAF (housing, basket)

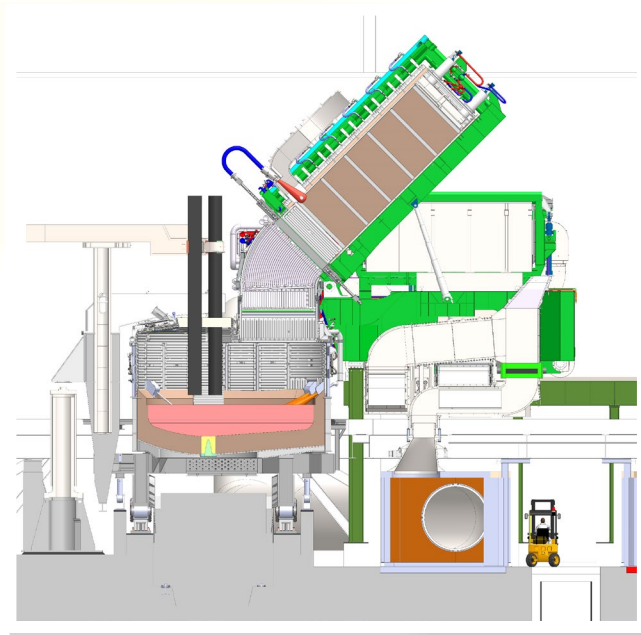
# OUR SOLUTION: ECOSHAFT



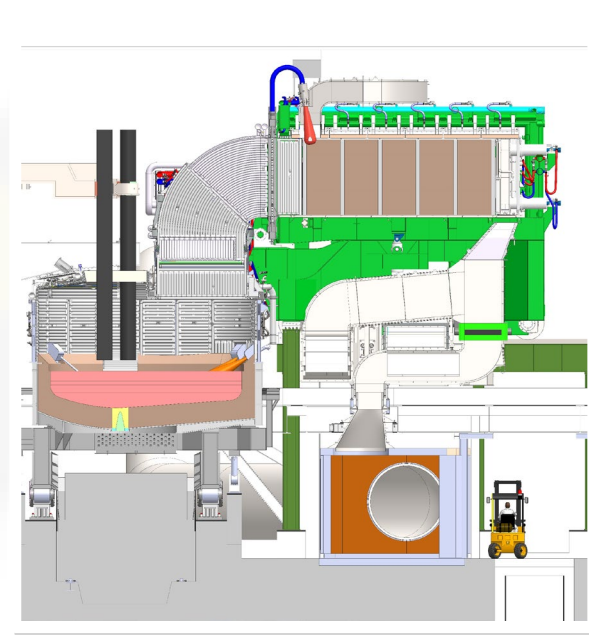
Total energy input < 600 kWh/t



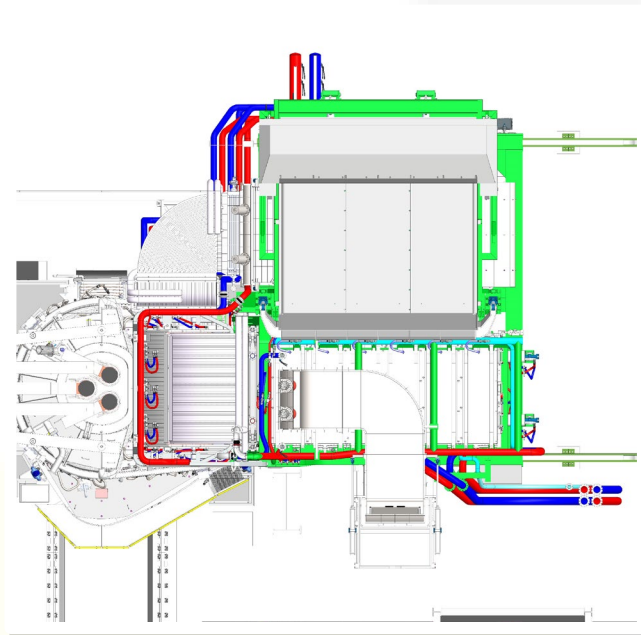
Preheating  
container tilting



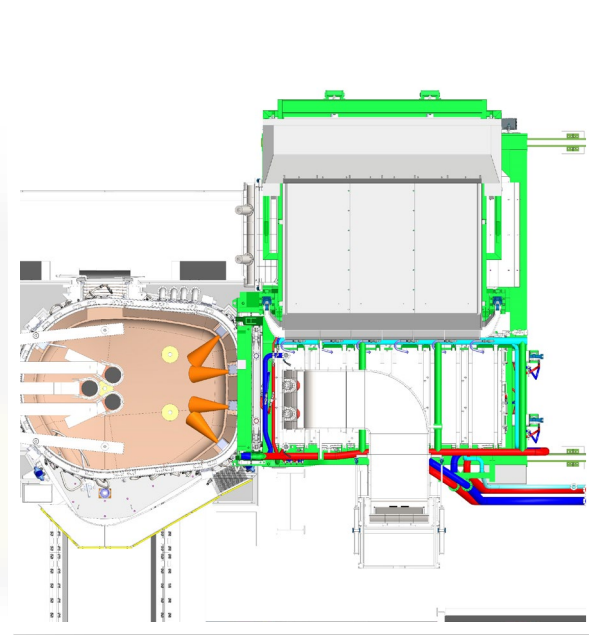
Preheating  
container



Top view ECOSHAFT  
by-pass container  
and preheating  
container



Top view furnace  
and ECOSHAFT





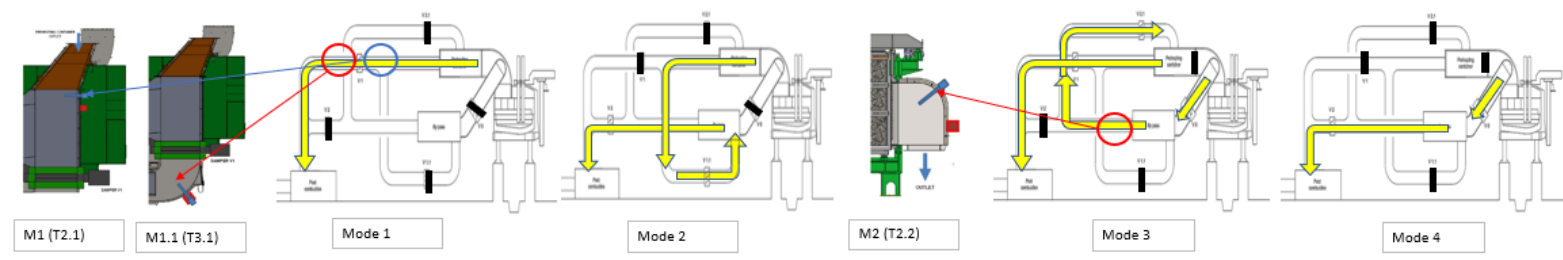
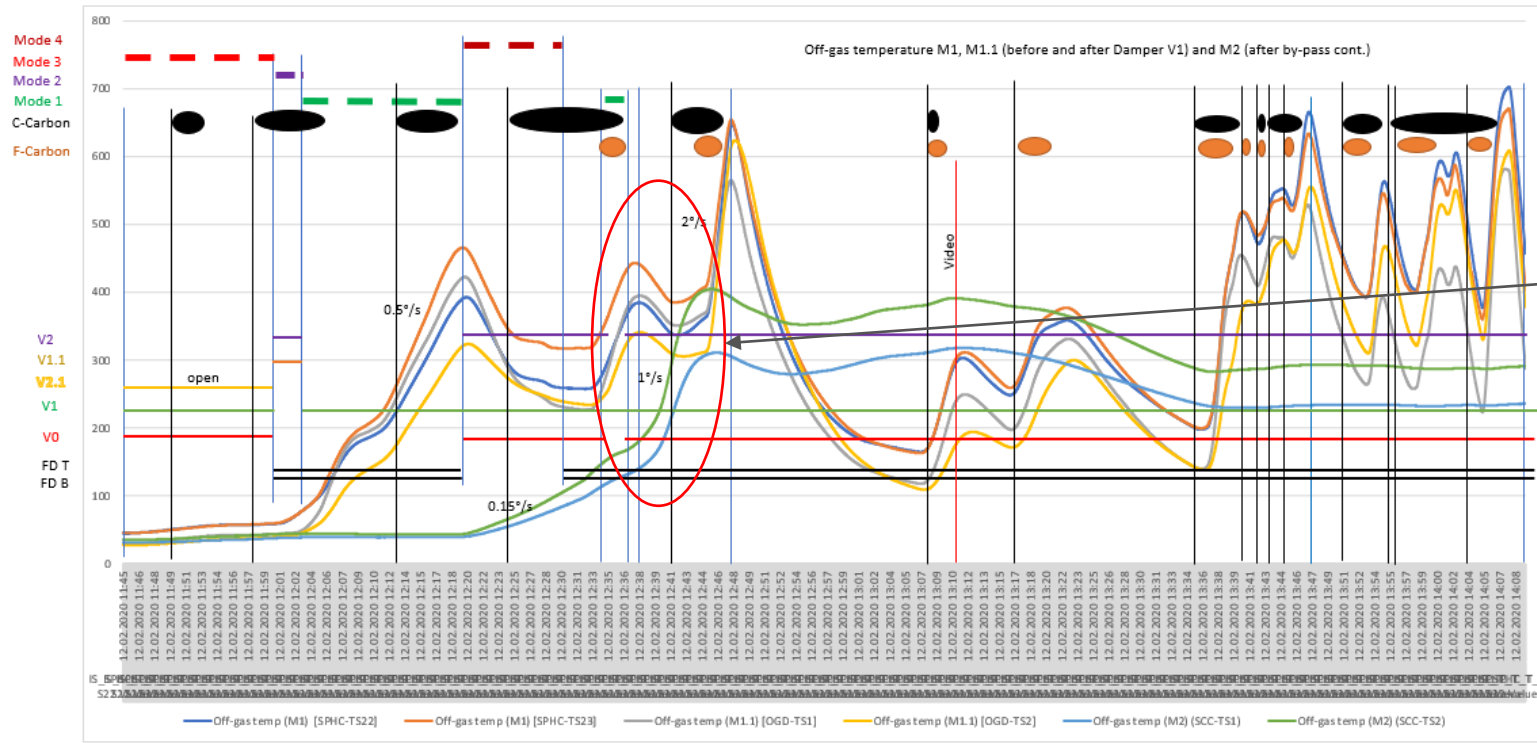


## Scrap charge in the preheating container

Compression factor 14% (by-pass container 81m<sup>3</sup> to preheating container 70m<sup>3</sup>).

This scrap shown on the picture was not warmed.

# BURN-OFF OF REACTIONS (POLLUTANTS)



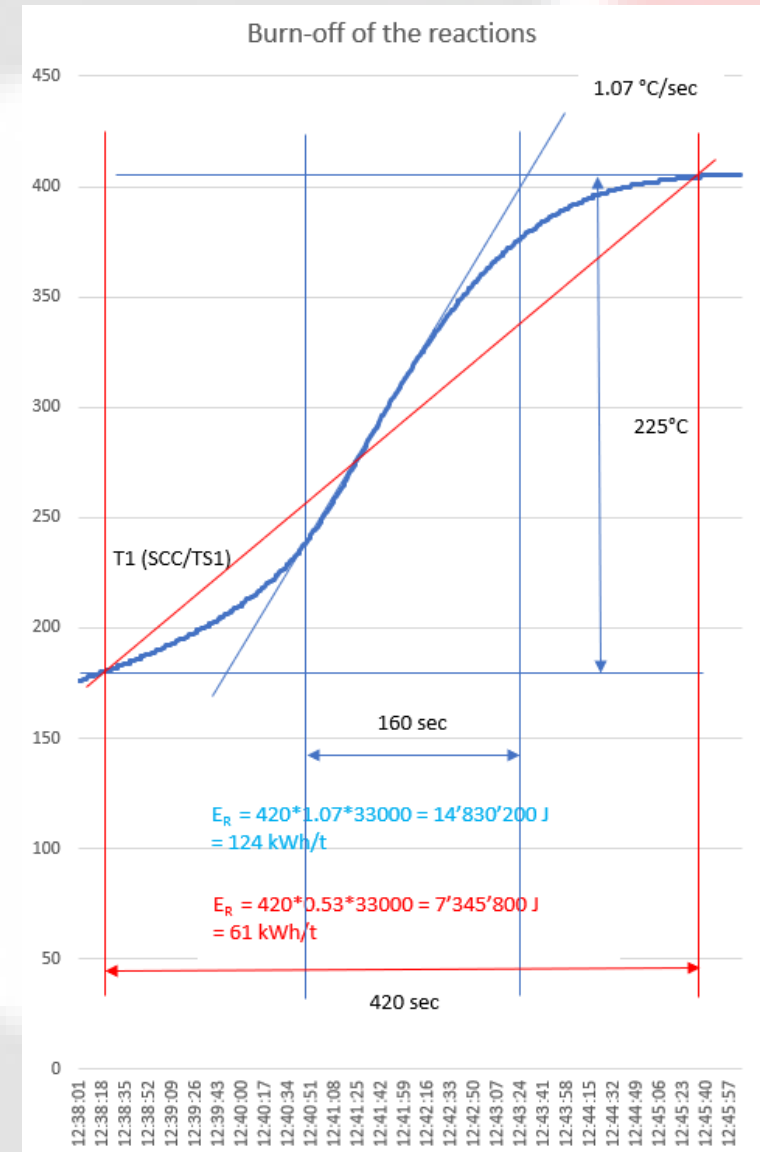
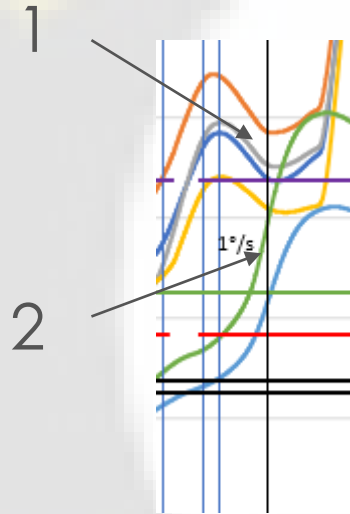
# BURN-OFF OF REACTIONS (POLLUTANTS) II

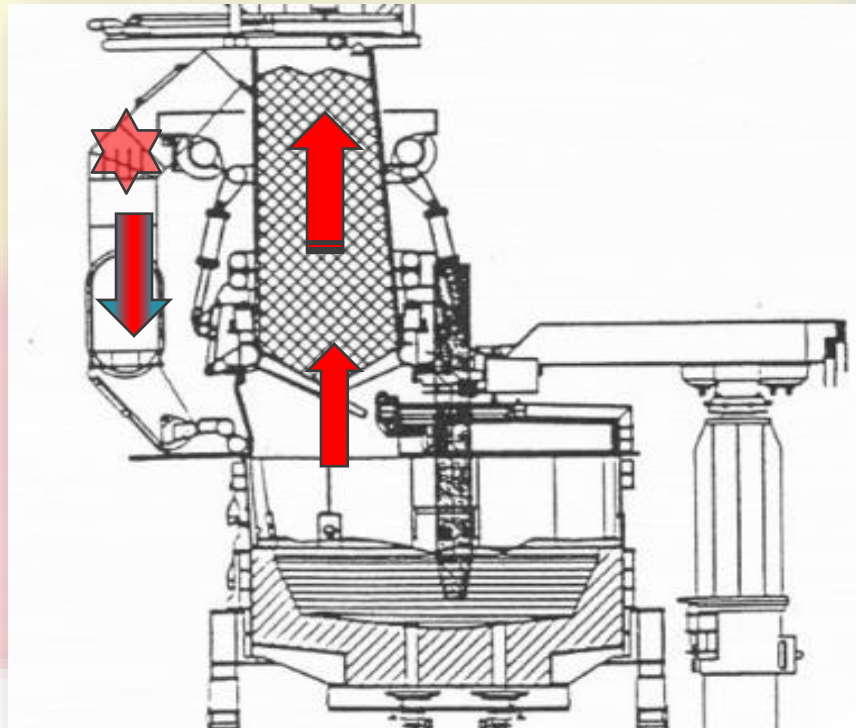
## Observations:

- Temperature drop at the furnace and preheating container (1)
- At the same time a temperature rise at the by-pass container (2)
- No activity whatsoever at the furnace

## Conclusion:

- burn-off of the pollutants or reactions inherent to the scrap



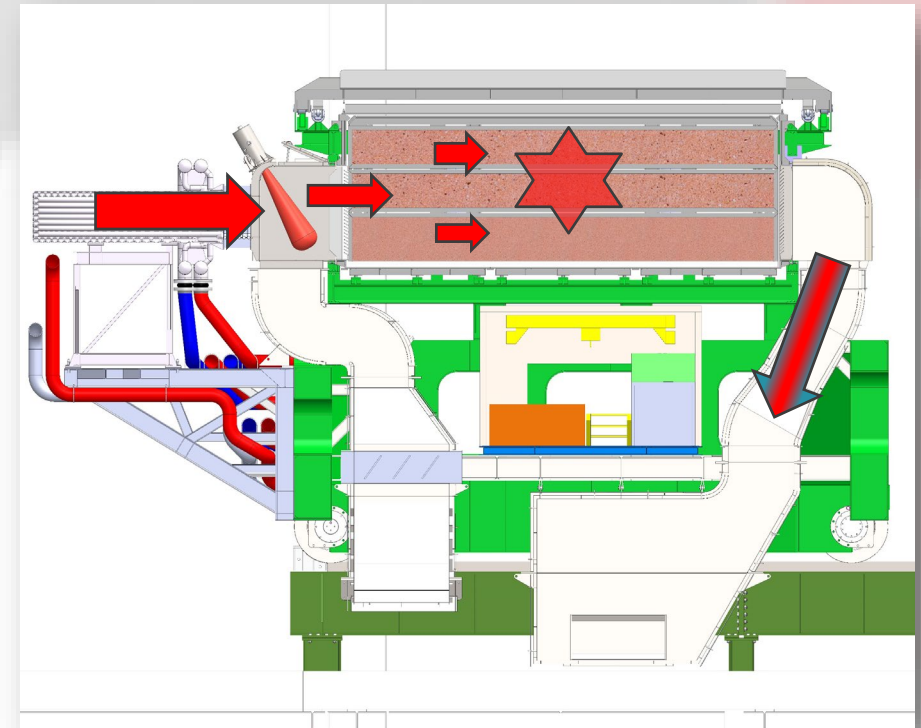


The effect of the chimney keeps the **off-gas speed high**.

The section is ~ constant → high speed 4 m/s.

Post combustion happens in the duct.

**Off-gas cleaning happens in a separate vessel!!**



The **off-gas speed** through the scrap is **low**.  
The section widens strongly → low speed < 1 m/s.

Burning-off of the pollutants and post-combustion in the scrap.

**Off-gas cleaning happens in the preheating container.**



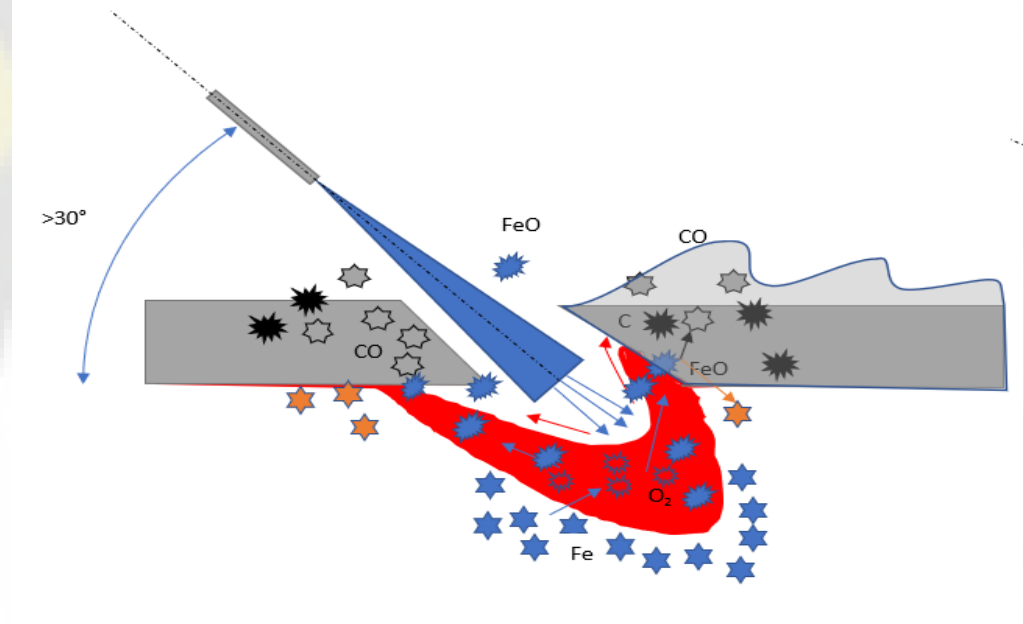
# FOAMING SLAG

To obtain a high efficiency of the electric energy, the arc must be covered by foam.

Is it possible to find a substitute for carbon to produce the foaming slag?

It is more important to get the possibility to adjust and align the lance, in order to be able to find and follow the constantly moving bath level.

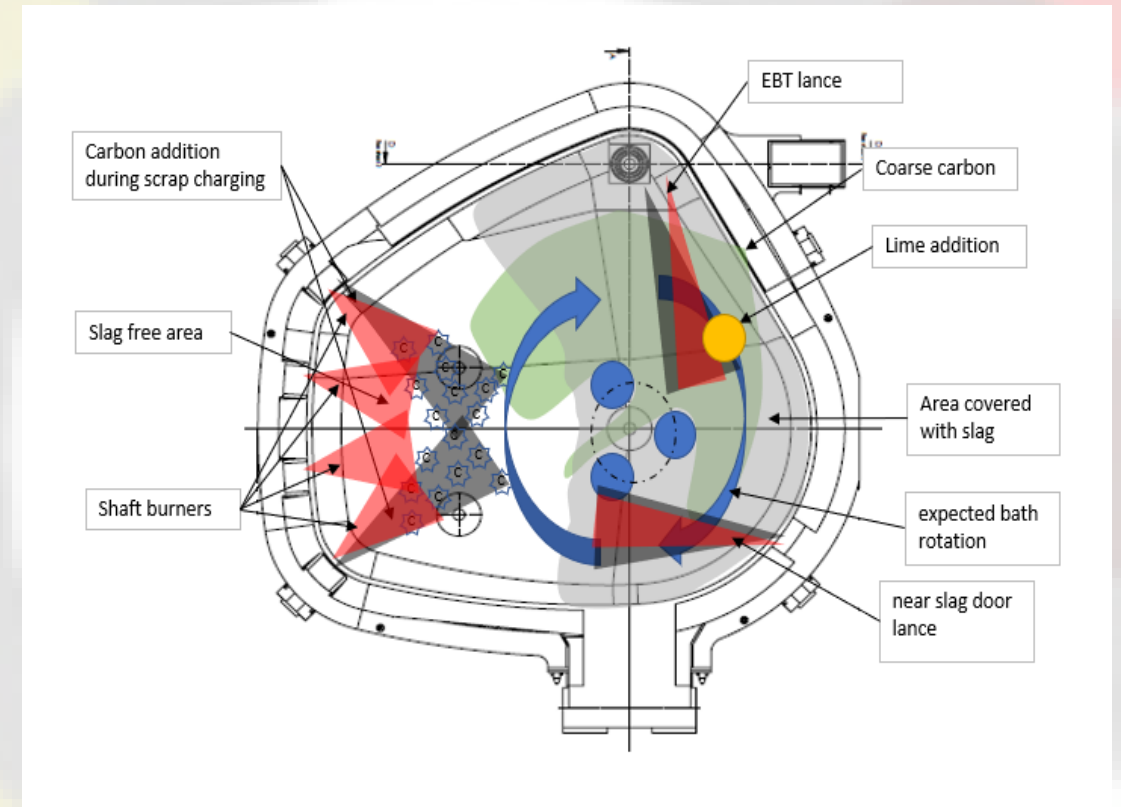
eco-e has the answer.



Isn't it a piece of luck to find the right position of the lance tip?

# EFFICIENT LANCE AND BURNER APPLICATION

There are so many factors which have to coincide, that it's important to have a flexible system to adjust, align, follow and manipulate the lance jet tip and to control the burners in order to get the max out of the application.

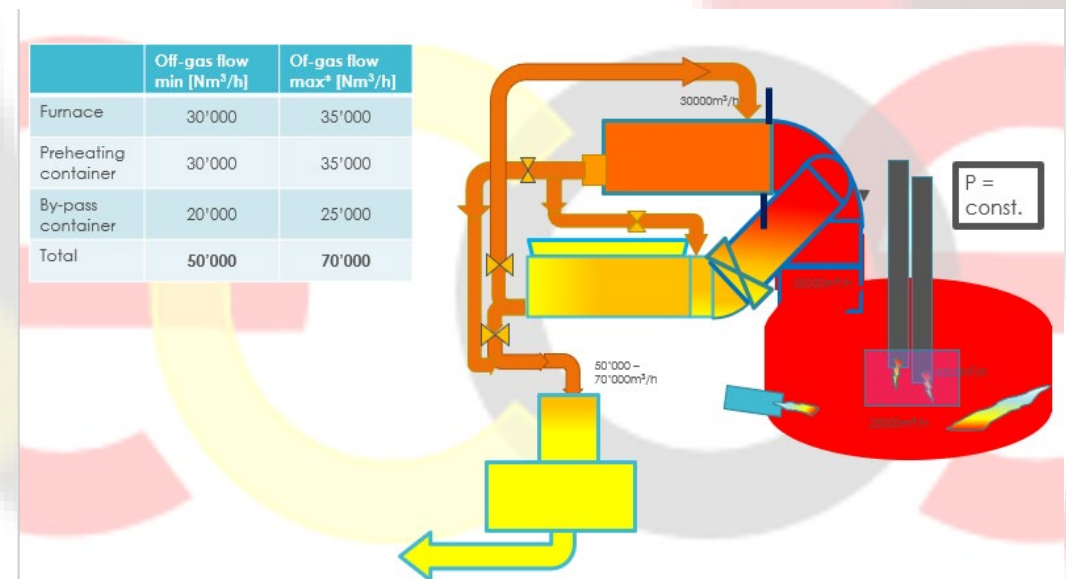
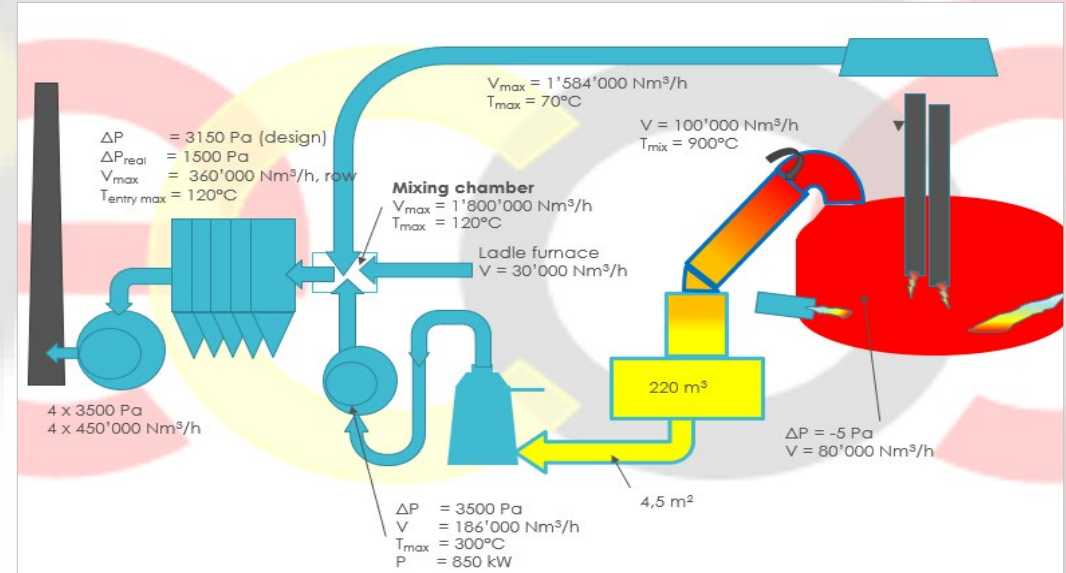


# OFF-GAS – WASTE OR ENERGY?

Off-gas at the traditional EAF = **waste**

Off-gas at the shaft EAF = heating of the content (scrap) with the chimney effect = **unevenly heating**

Off-gas at the ECOSHAFT = **transfer of the heat and the latent energy to the scrap.**

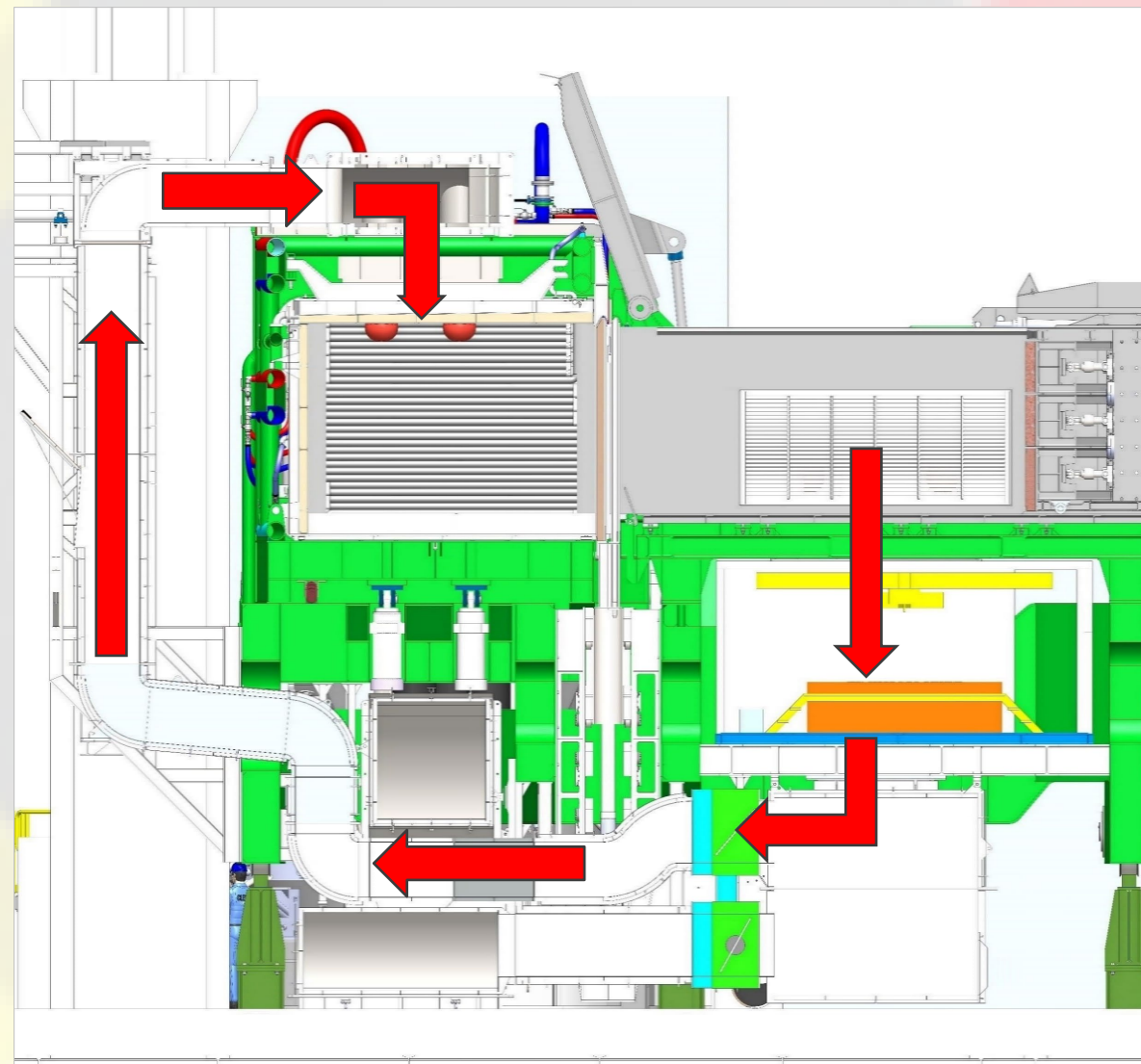


# ENVIRONMENTALLY FRIENDLY INCINERATOR

This scheme shows how the off-gas flows from the burn-off of reactions in the by-pass container to the incineration at the preheating container.

As a comparison remember the separate reheating chamber at the shaft furnace.

Understood?



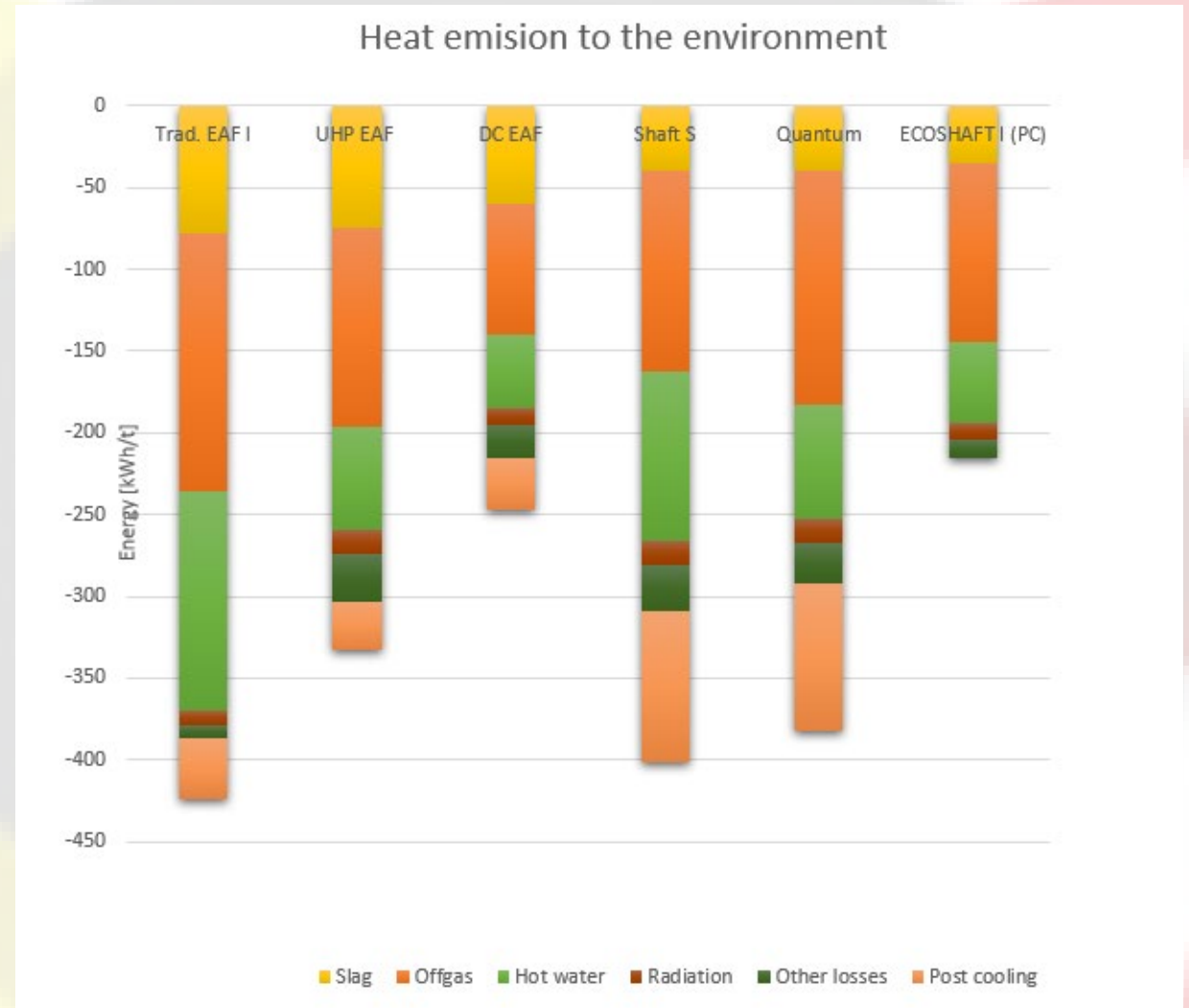


## Heat emission to the environment

The off-gas leaving the traditional furnace systems is such, that there is occasionally a need for cooling to protect the filter bags.

The off-gas leaving the shaft systems is additionally treated (heated-up and then chilled) to respect the air pollution control.

The off-gas leaving the ECOSHAFT® is such, that there is no additional cooling needed.



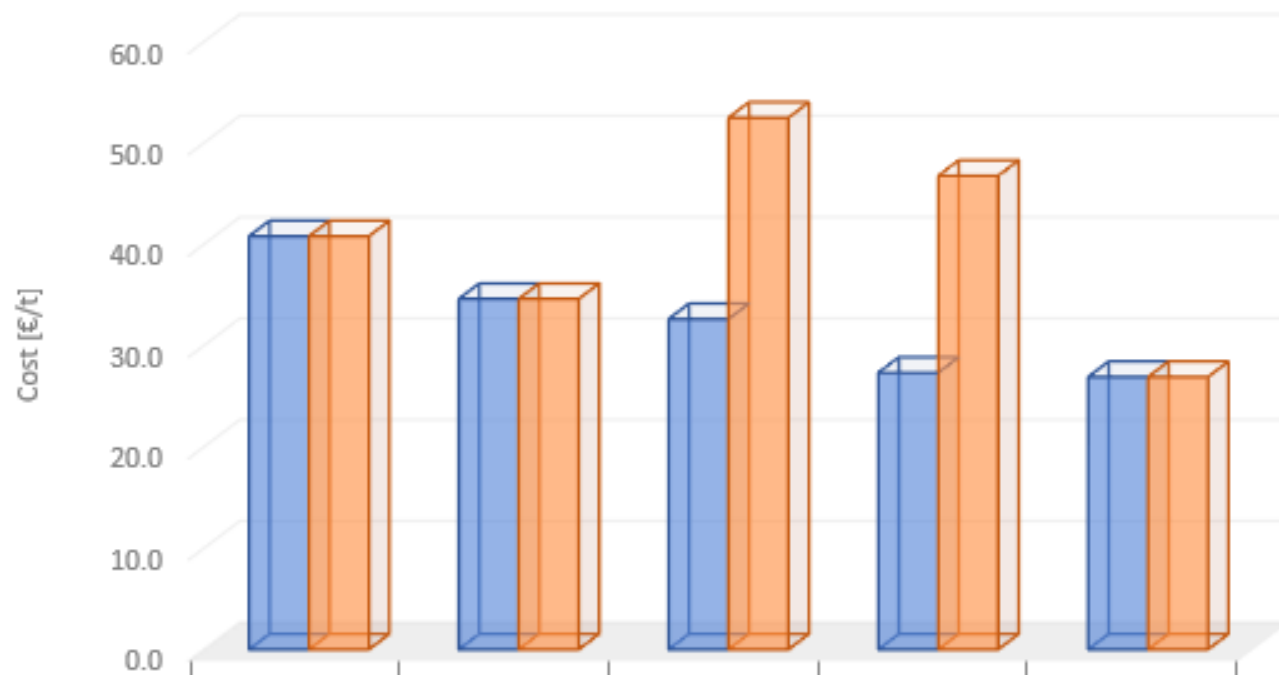


# CONCLUSION ECOSHAFT<sup>®</sup> AND THE ENVIRONMENT

- No uncontrolled burn-off of pollutants and reactions
- No additional energy input for controlling PCDD/PCDF and other toxic compounds
- Enough time for the full reaction from CO to CO<sub>2</sub> within the system
- Less dust waste
- Less FeO in the slag – better yield
- Less emission of heat to the environment
- Less total energy input to produce 1 ton of steel

**For the sake of the environment**

Energy cost (El. & CH<sub>4</sub> & C & O<sub>2</sub>)



Energy cost at furnace	40.8	34.6	32.6	27.3	26.9
Total energy cost (incl. post treatment)	40.8	34.6	52.5	46.8	26.9

## Benefit – the commercial effect

Better than any of the competitors, fits into existing buildings, uses the existing infrastructure.

Environmentally friendly and commercially sound. ECOSHAFT®

Thank you.

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