# GASIFICATION SOLUTIONS

## INTEGRATED PRIMARY GAS CLEANUP AND HEAT RECOVERY

SCHMIDTSCHE SCHACK

ARVOS GROUP

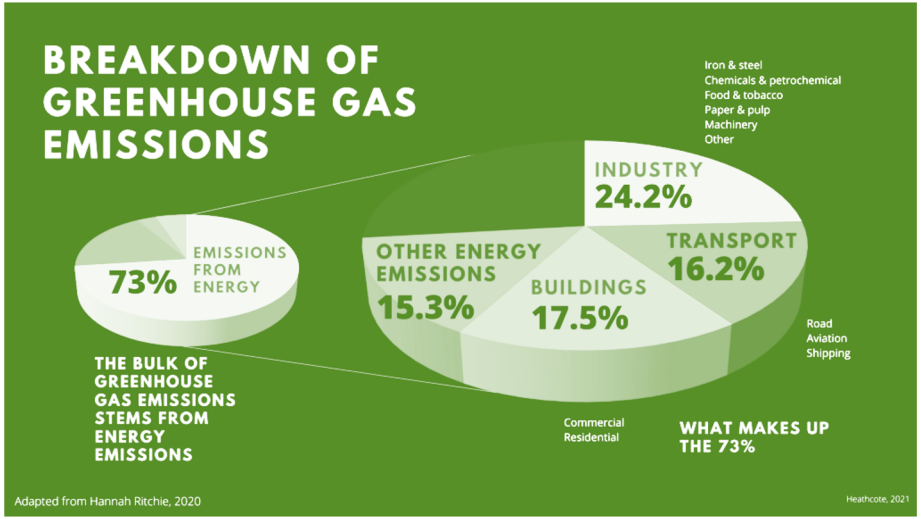
John Winter | GSTC 2022 | October 2022

# 1 Biomass & Waste Gasification demand

# DRIVERS ARE DIFFERENT

## FOR BIOMASS GASIFICATION

- Circular Economy & Sustainability
- **Greenhouse Gas Emission Reduction**
- Bio Diversity and Nature
- Waste Management
- Plastic recycling and re-usage
- **Ease of CCS**

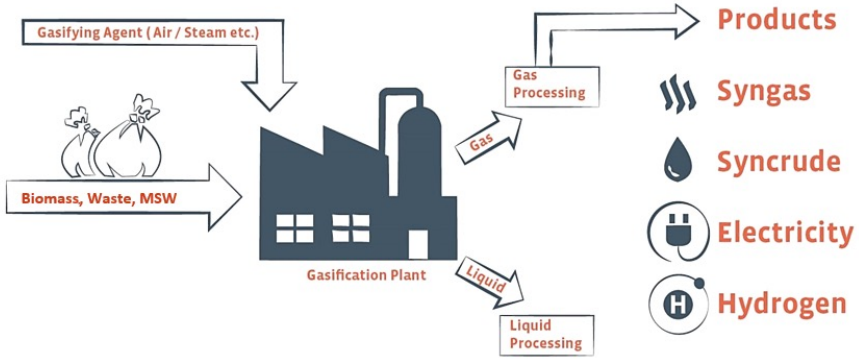



https://planet-lean.com/lean-sustainability-emissions/

# UNDERLYING MARKET

## BIOMASS & WASTE GASIFICATION PROCESSES

- Biomass gasification is receiving increasing attention
- Political, economical and social awareness and efforts are pushing the process technology
- Potential source of sustainable development is obvious
- For the production of power, chemicals, and transportation fuels
- Numerous projects for commercial operation have been announced worldwide today
- Technical challenges introduced from these feeds




Announced biomass & waste gasification projects

# MOTIVATION

## CORE PROCESS EQUIPMENT IMPORTANCE

Thermal oxidation solutions play an **increasingly important role** in the sustainable production of syngas and derived products such as chemicals, fuel oils and SAF derived from biomass and waste.

The different feedstocks available pose **special challenges to the equipment** used in the plants for the production of high-quality syngas.

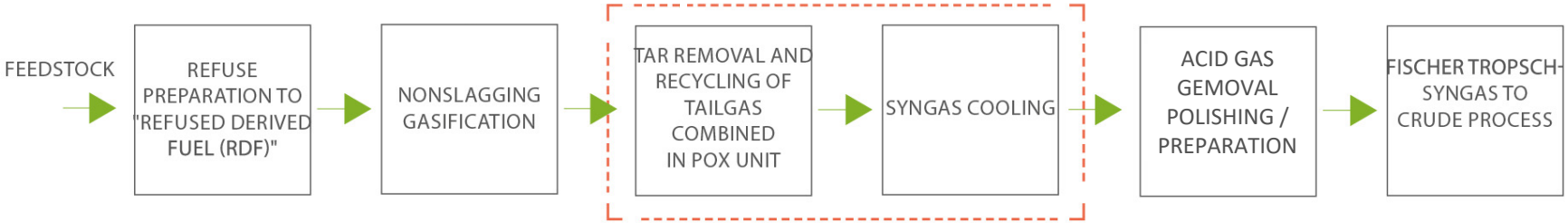
The overall profitability of the plants is the **most important factor**, on which the process reliability and the quality of the generated syngas have a major influence.

The use of the appropriate, individually developed and well thought-out core components such as reactor, heat exchanger and gas cleanup enables the overall **efficiency of the system to be maximized**.

# 2 Handling technical hurdles

# GASIFICATION PROCESS

## FROM A SOLID TO A CLEAN GAS



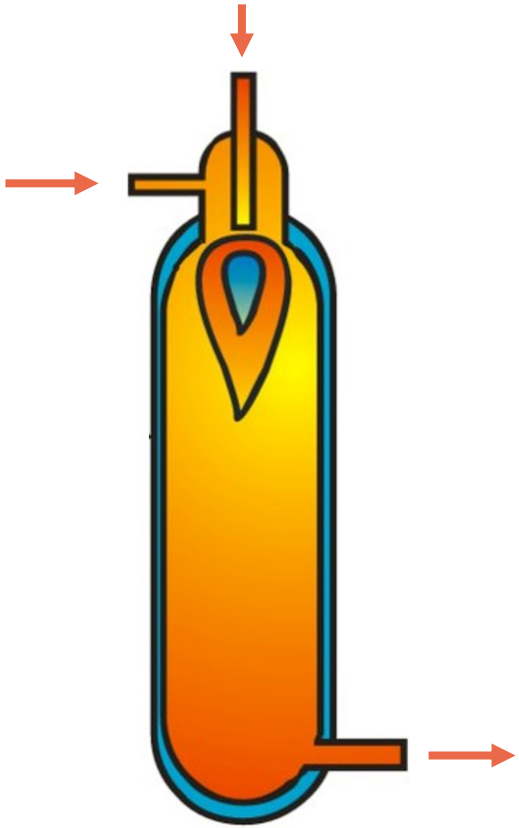

- MSW – varying composition
- Keeping reaction temperatures stable
- **Dust and by-product (e.g. tar) laden syngas**
- Corrosive equipment damage
- Slagging and slag handling
- Plant energy efficiency at high levels

- Defined stable and pure syngas output
- Keeping pollution control limits
- Ash, fly ash handling and disposal
- High gas temperatures and pressures
- High mechanical stress for critical equipment parts

# THERMAL OXIDATION

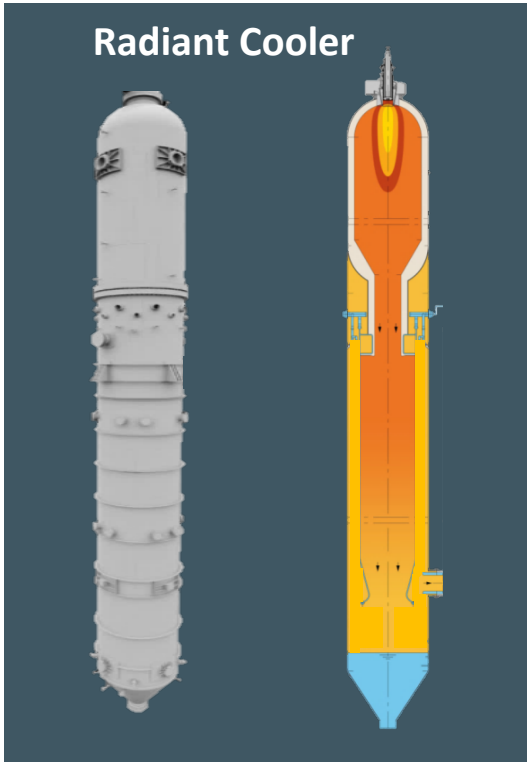
## IN BIOMASS & WASTE GASIFICATION PROCESSES

- Synthesis gas from gasification can be further upgraded to renewable fuels and chemicals provided that the gas is ultra clean
- In the past, a major hurdle, however, has been the removal of tar formed during the biomass gasification process
- Nowadays, impurities, such as light hydrocarbons and tar compounds present in the gasification gas can be converted to syngas by reforming
- Noncatalytic thermal oxidation is
    1. Robust with respect to the wide variation found in these feedstocks
    2. Allows additional syngas generation from other hydrocarbon sources and recycled streams



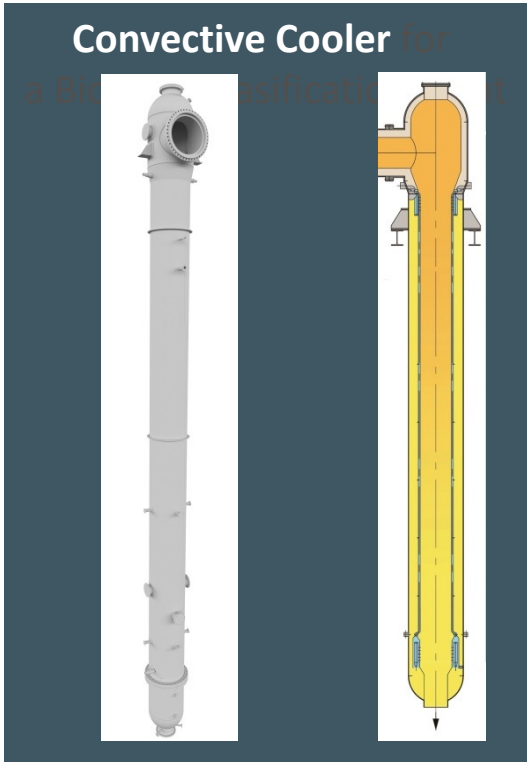
# DESIGN FEATURES

## MSW & BIOMASS (with and w/o slag) GASIFICATION




The Radiant (RSC) and Convective Syngas Cooler (CSC) design principle put into service in several coal and slagging gasification plants.

The design concept has been developed further and can be adapted to the individual needs of renewable processes. Typical process and operation challenges can be manged by featured equipment fit for purpose.

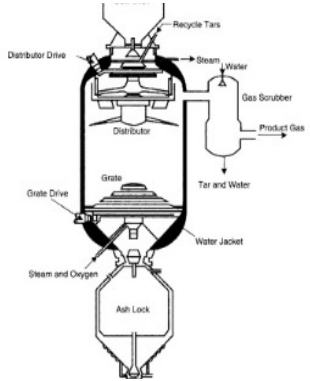


# 3 — Solutions

# SOLUTIONS

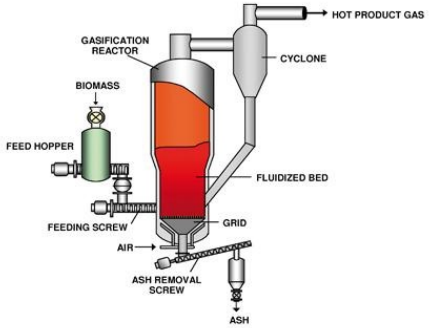
## SERVING A VARIETY OF PROCESS TECHNOLOGIES

### Fixed bed
(moving)



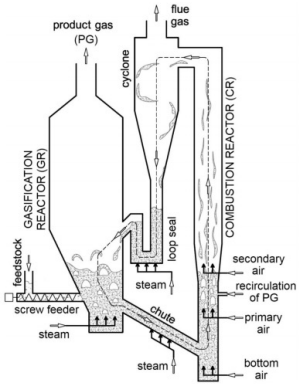

Solid feed – structure permeable
difficult to pressurize
Non-slagging
Tar in syngas

### Fluidized bed
(CFG/BFB)



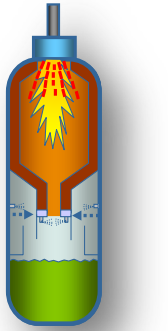

Solid feed
Scalable
Difficult to pressurize
Non-slagging
Tar in syngas

### Dual fluidized bed




Solid feed
Does not need oxygen
Difficult to pressurize
Non-slagging
Tar in syngas

### Entrained flow



Liquid feed (solid)
Scalable
Easy to pressurize
Slagging
Feed need to be finely ground if solids

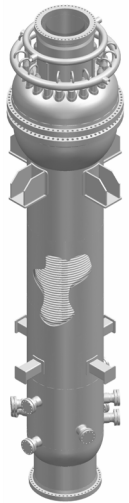
# SOME OF THE SOLUTIONS – TODAY!

## PRODUCT PORTFOLIO FOR GASIFICATION PLANTS

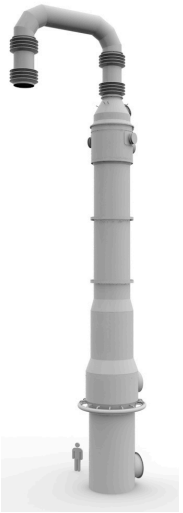
SCHACK®
Primary/Secondary
Gasification and Partial
Oxidation Reactors

SCHACK® Syngas
Cooler

SCHMIDT'SCHE®
Syngas Cooler



SCHMIDT'SCHE®
Steam
Superheater



SCHACK® Gas
Preheater

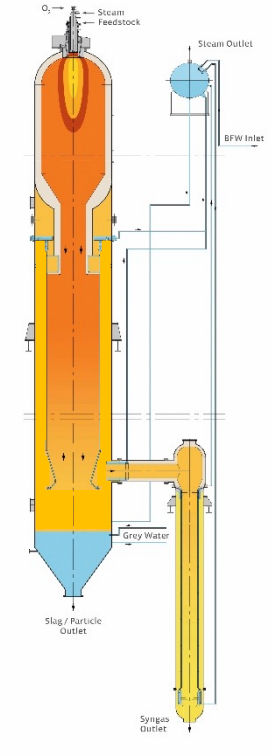
Additional
equipment

# MSW SCHACK® REACTOR & COOLER

**Our Scope of Supply**:

- Burner
- POX
- Refractory
- RSC with Sump, CSC
- Steam Drums
- Separate Superheater with internal bypass
- Ash & Slag Handling
- Ducting & Piping
- Interface Management
- Services

## MSW GASIFICATION



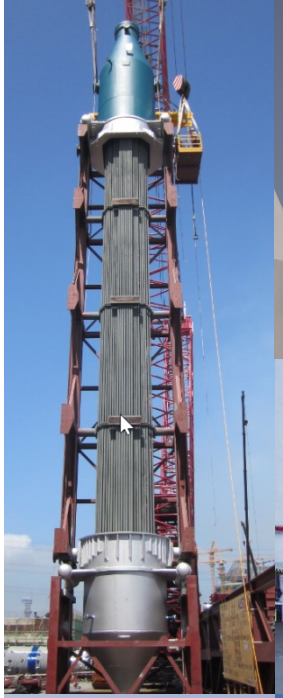

# SCS INSIGHTS

## REALIZED WEIGHTS AND DIMENSIONS

**Syngas Coolers**
up to 700 t

**Reformer/Gasifiers**
up to 300 t

**Plant sizes**
from single-digit MWth
up to 10 GWth




# 4 — Proof of practice

# SCHACK® REACTOR & SYNGAS COOLER

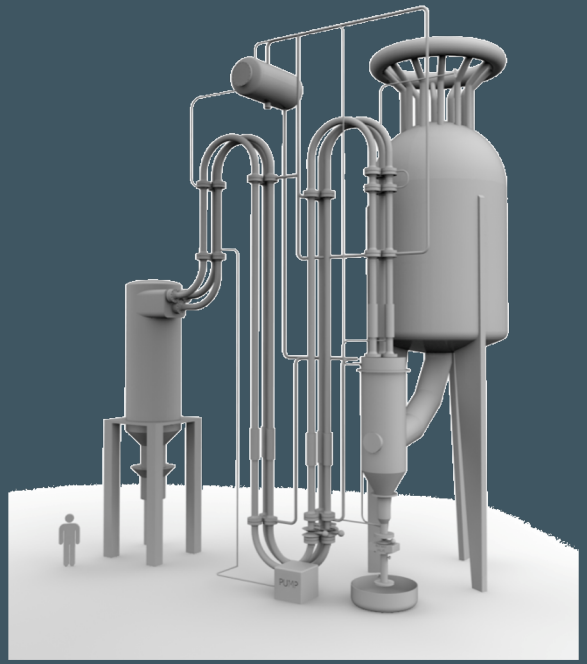
More than 50 SCHACK® Syngas Cooler delivered worldwide!

## MSW GASIFICATION

| | |
|---|---|
| **Sector** | Waste Industry |
| **Process** | Municipal solid waste gasification |
| **Project challenges** | ▪ Tar & dust laden syngas<br>▪ High temperatures and pressures<br>▪ Corrosive syngas composition |
| **SCHACK® benefit** | Lifelong experience with natural gas, biomass, coal gasification |
| **Max. temperature** | Up to 1,500 °C (2,732 °F) |
| **Max. pressure** | Up to 70 bar (1,015 PSI) |
| **SCHMIDTSCHE SCHACK share** | POX unit (tar reformer), Radiant Syngas Cooler, Convective Syngas Cooler, Steam Superheater, ash handling system, services |

# SYNGAS COOLER

## FOR BIOMASS GASIFICATION

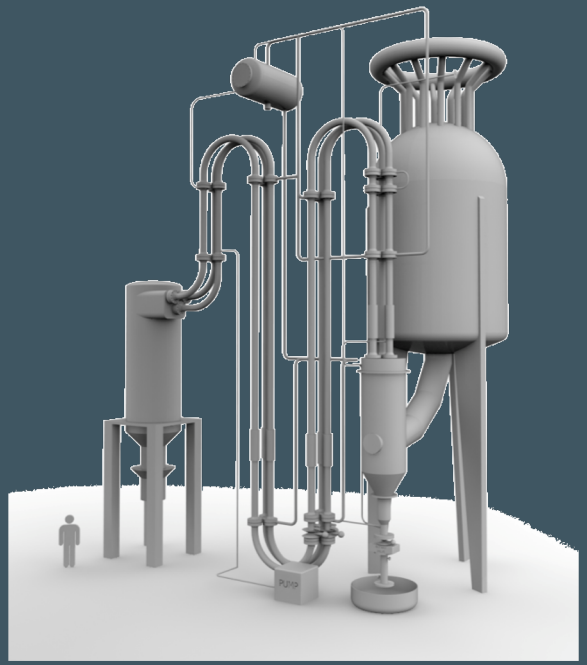




*Pictures taken from the report September 2019, on behalf of CORTUS ENERGY HÖGANAS*

# SYNGAS COOLER

## FOR BIOMASS GASIFICATION



## SELECTED REFERENCE

| | |
|---|---|
| **Sector** | Steel Industry |
| **Process** | Biomass gasification |
| **Plant capacity** | 6 MW |
| **Project challenges** | ▪ 1100 °C syngas inlet temperature<br>▪ 25 g/nm³ ash from charcoal |
| **SCHMIDTSCHE SCHACK benefit** | ▪ Tailor-made solution<br>▪ Incorporating experience from various syngas cooler applications<br>▪ Economic arrangements like optimized heating surface arrangements, high alloy materials and pure forced circulation systems |
| **SCHMIDTSCHE SCHACK share** | Convective Syngas Cooler (economizer, evaporator, steam superheater) |

# SYNGAS COOLER

## FOR BIOMASS GASIFICATION

## SELECTED REFERENCE

| | |
|---|---|
| **Sector** | Biomass Gasification |
| **Process** | Biomass gasification |
| **Plant capacity** | High single train capacity |
| **Project challenges** | ▪ Height Restrictions<br>▪ Tailor-made solution to reduce capex |
| **SCHMIDTSCHE SCHACK benefit** | Pox and Syngas Cooler with associated systems |
| **SCHMIDTSCHE SCHACK share** | |

# 4 — Conclusion

# CONCLUSION

## INTEGRATED PRIMARY GAS CLEANUP AND HEAT RECOVERY

1. Thermal oxidation is used to convert the tars, oils, and methane produced during biomass and waste gasification, allowing efficient heat recovery and removing critical contaminants from downstream processes
2. Noncatalytic thermal oxidation is
    1. Robust with respect to the wide variation found in these feedstocks
    2. Allows additional syngas generation from other hydrocarbon sources and recycled streams
3. **Mechanical integration of the thermal oxidizer with the primary heat recovery step reduces capital cost and footprint**
4. Additionally, integration of gas cooling with water scrubbing reduces operating costs.
5. Current SCHMIDTSCHE SCHACK heat transfer solution references have designs
    1. for capacities from 400 tpd to 1000 tpd of feedstock
    2. for pressures from slight vacuum to 20 bar
6. Integration and optimization of the Pox and syngas cooler with primary gasification improves efficiency and capex.

# THANK YOU FOR YOUR KIND ATTENTION

**For more information please visit our website or our Media-Hub!**

SCHMIDTSCHE SCHACK Media - Hub

Register here!

John Winter

john.winter@arvos-group.com

www.schmidtsche-schack.com

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