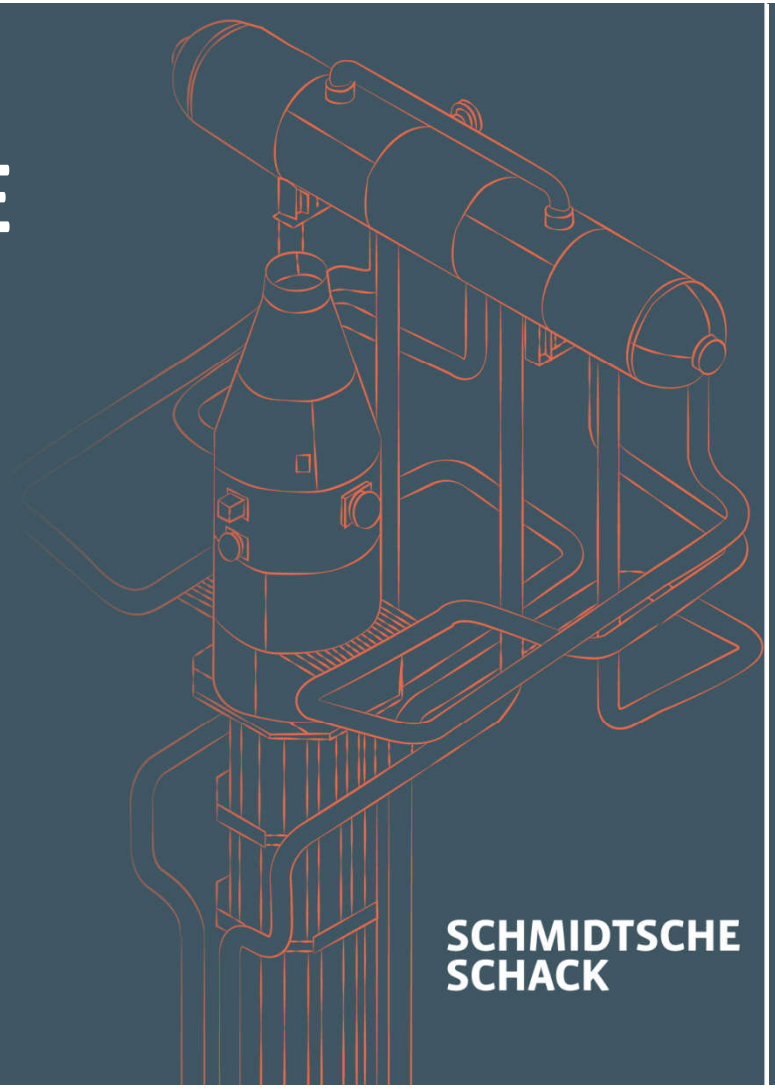
WASTE TO VALUE

SCHMIDTSCHE SCHACK

Syngas Production based on Variable Feedstocks



SCHMIDTSCHE SCHACK

ARVOS GROUP

Nikolaus Garrels | GSTC | Oct 2020

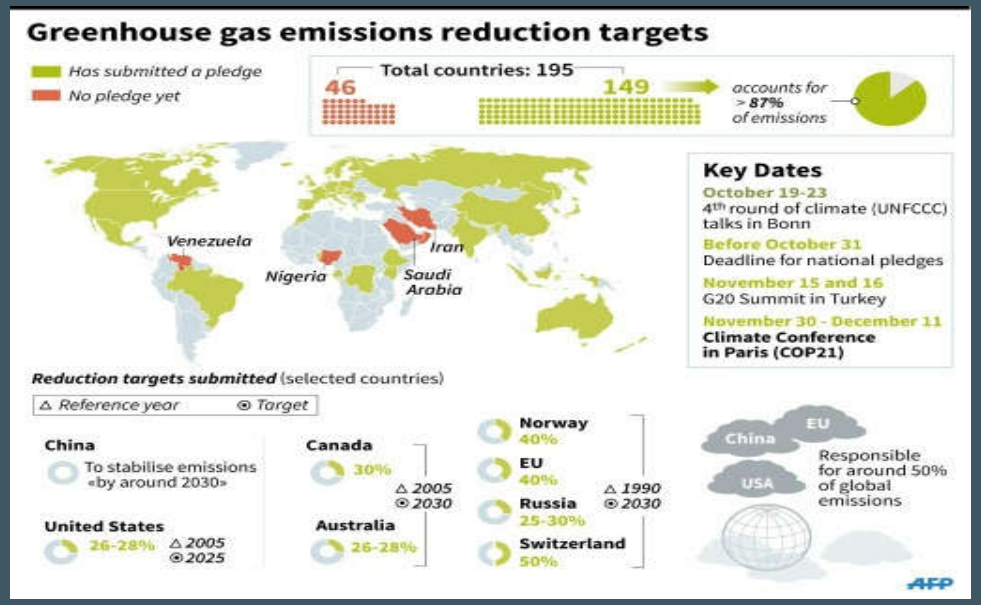
WASTE TO VALUE & CIRCULAR ECONOMY

By creating a value for a waste/residue
– it becomes a byproduct

1 — Pathways & Drivers

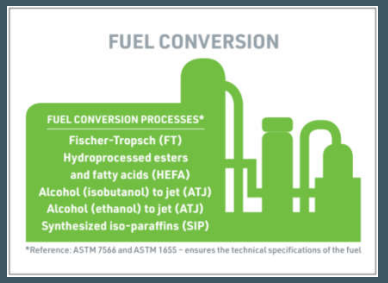
DRIVERS ARE DIFFERENT

- Circular Economy & Sustainability
- Greenhouse Gas Emission Reduction
- Bio Diversity and Nature
- Waste Management
- Plastic recycling and re-usage
- Alternative to fossil feedstocks



CORSIA

Certified Sustainability • ISCC • Certified GHG Savings



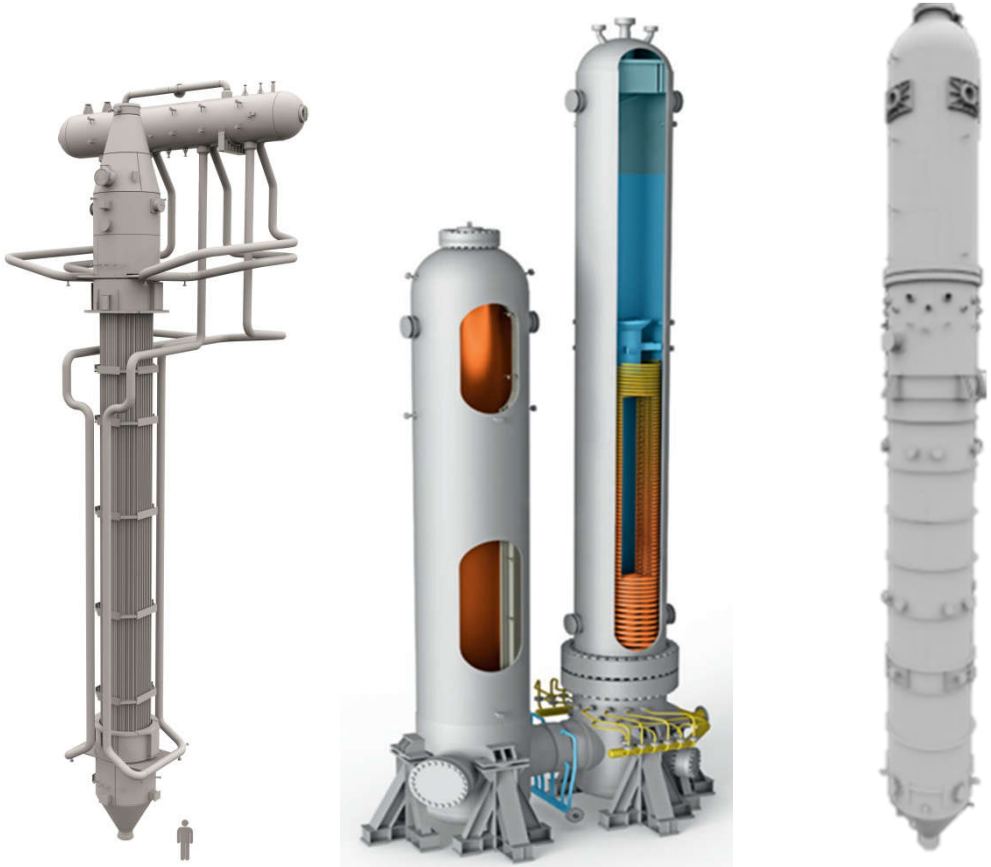
GASIFICATION

BIOMASS AND MSW

Coal, Oil, Gas and Biomass are known feedstocks for gasification since decades

Renewable & Sustainable feedstocks

- Biomass (e.g. plants, wood, wood-ships, agricultural remains, black liquor, plant oils, …)
- Municipal Wastes (urban & pre-sorted wastes & plastics), landfill wastes, Plastic and plastic waste recycling
- Challenging Feedstocks like Slurry, sludge and liquid wastes from sewage plants, or excess biomass generated from aerobic treatment plants with high content of molecular bound water
- Flexibility towards mixtures of above feedstocks



2 — Challenges

TECHNICAL CHALLENGES FOR RENEWABLE SYNGAS

Feedstock Impurities – Halides

Acid/caustic resistance

Feed Density, Flow Characteristics

Size and complexity, temp. & pressure limits

Preprocessing Requirements

Size reduction, composition control

Tars and Oils

Feedstock Variability

Overall Operability of a plant

CHALLENGES

PROCESS CHALLENGES

MSW & BIOMASS – vary in composition with society, geography and season of the year, as well as throughout plants lifetime

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

CHALLENGES

PROCESS CHALLENGES

- 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

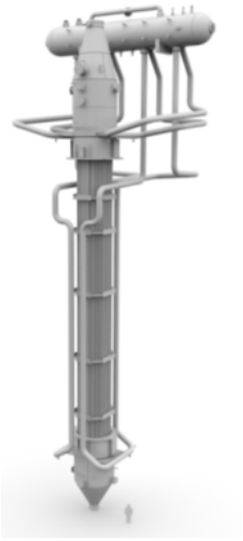
3 — Exceptional Solutions

SOLUTIONS

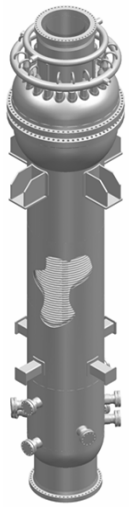
PRODUCT PORTFOLIO FOR GASIFICATION PLANTS

SCHACK® Gasification and Partial Oxidation Reactors

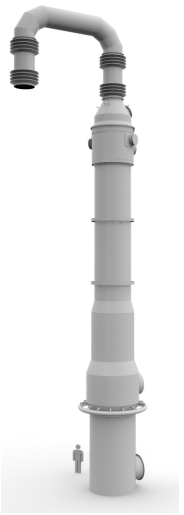
SCHACK® Syngas Cooler



SCHMIDT'SCHE® Syngas Cooler



SCHMIDT'SCHE® Steam Superheater

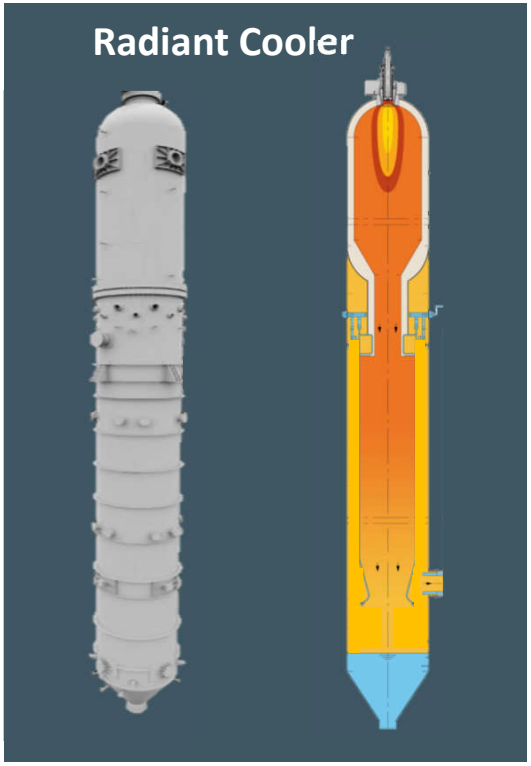


SCHACK® Gas Preheater

Additional equipment

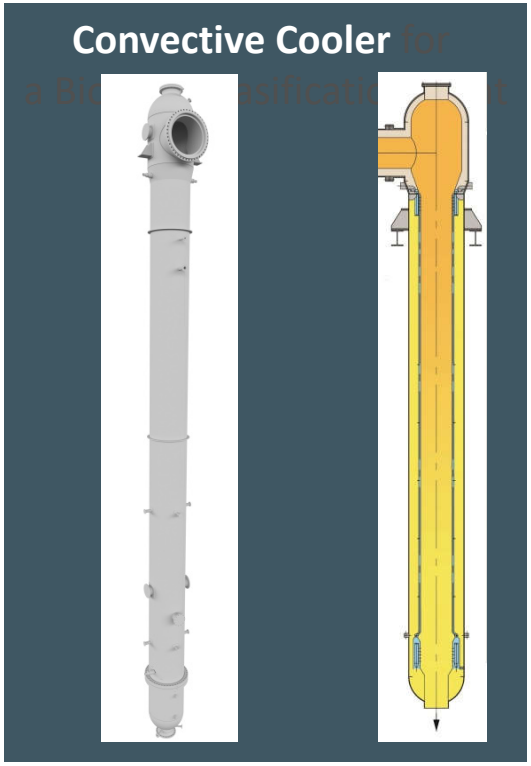
SOLUTIONS

MSW & BIOMASS GASIFICATION



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

The design concept has been developed further and today offered for several biomass and municipal waste gasification projects.



SOLUTIONS

SCHMIDT'SCHE® SYNGAS COOLER for Biomass

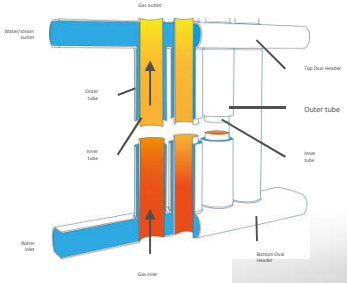
- SCHMIDT'SCHE® Syngas Cooler is based on the proven **Double Tube & Oval Header** technology platform
- Mechanical and thermal stresses are reduced by **thin-walled oval headers**
- **Utilized** in the ethylene industry **for decades** and successfully adapted for the gasification industry
- Handles **harsh operating conditions** and highly abrasive dust loads

CORTUS ENERGY HÖGANAS

Convective Type Heat Exchanger

1100 °C Inlet temperature
25 g/nm³ ash from Charcoal

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



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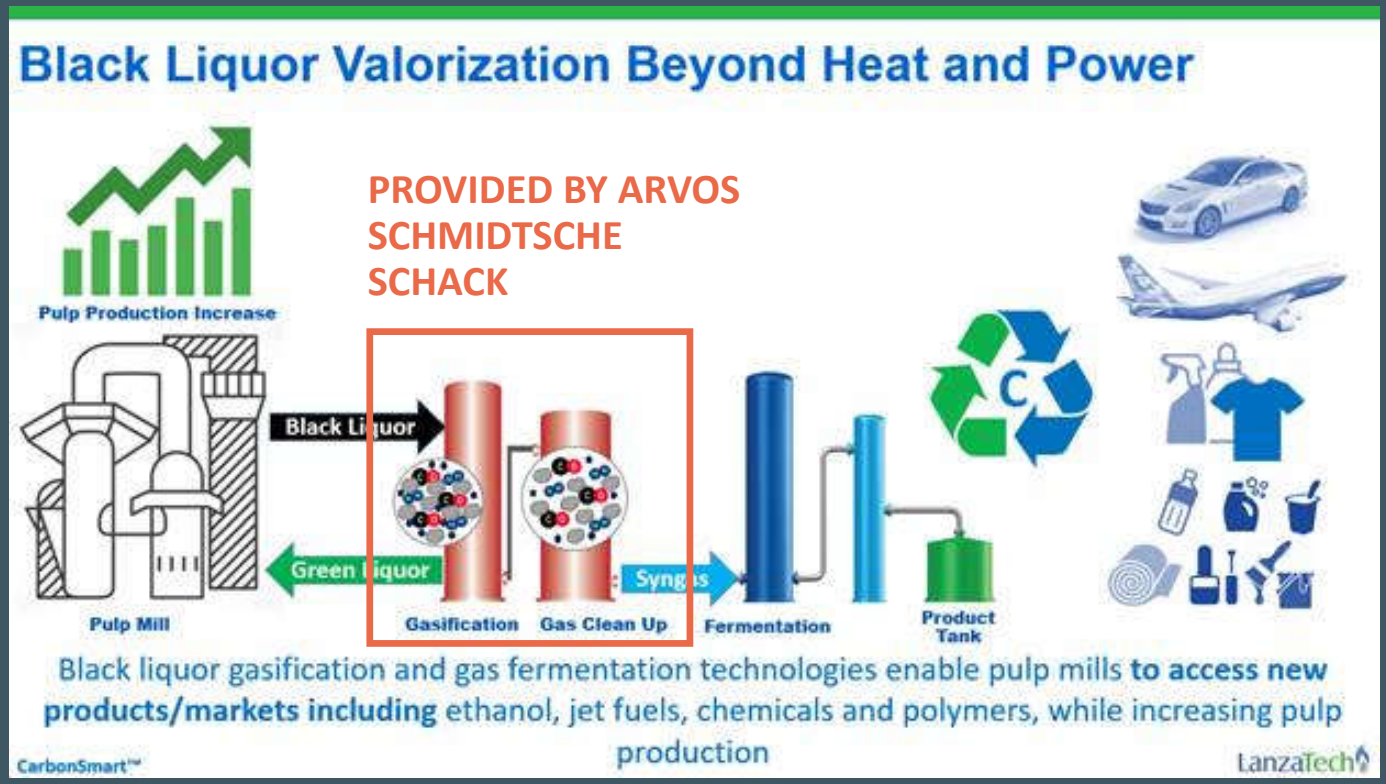
SOLUTIONS

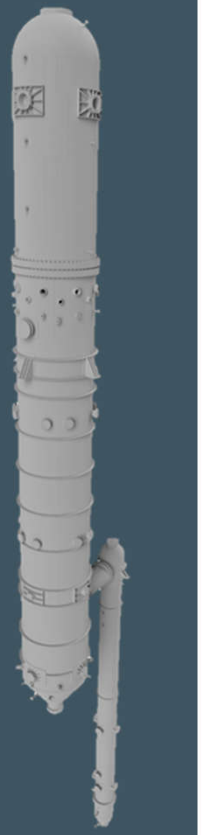
BIOMASS GASIFICATION & FERMENTATION TO ALCOHOLS, FUELS OR CHEMICALS



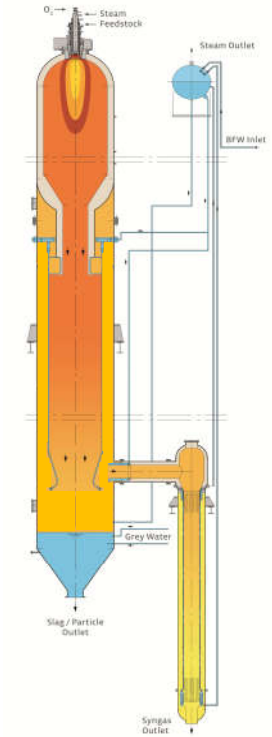
4 — Features

MSW SCHACK® REACTOR & COOLER

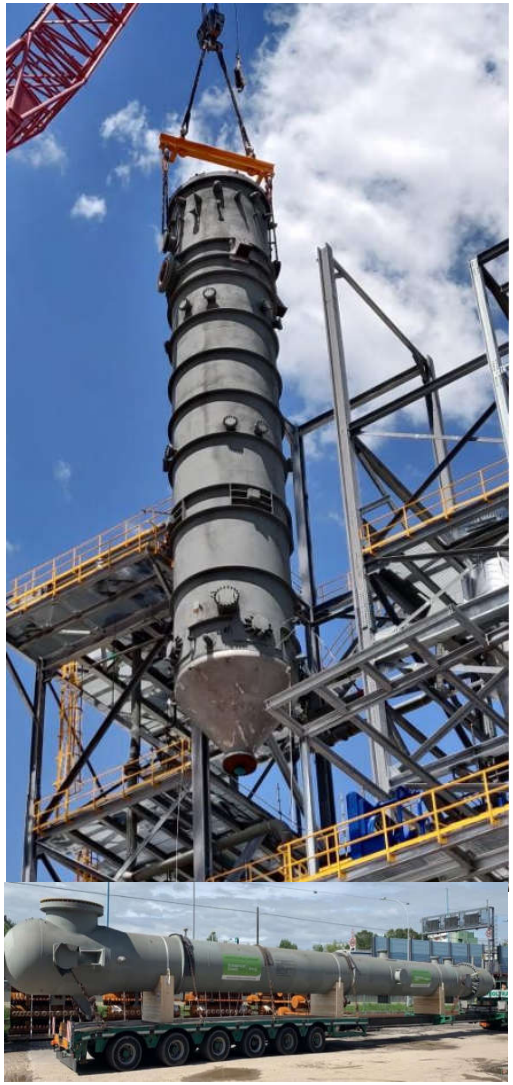
- **SCS Scope of Supply**:
  - Burner
  - POX
  - Refractory
  - RSC with Sump, CSC
  - Steam Drums
  - Separate Superheater with internal bypass
  - Ash Handling System
  - Services



MSW GASIFICATION



More than 50 SCHACK® Syngas Cooler delivered worldwide!



Scope of Supply

DESIGN OBJECTIVES

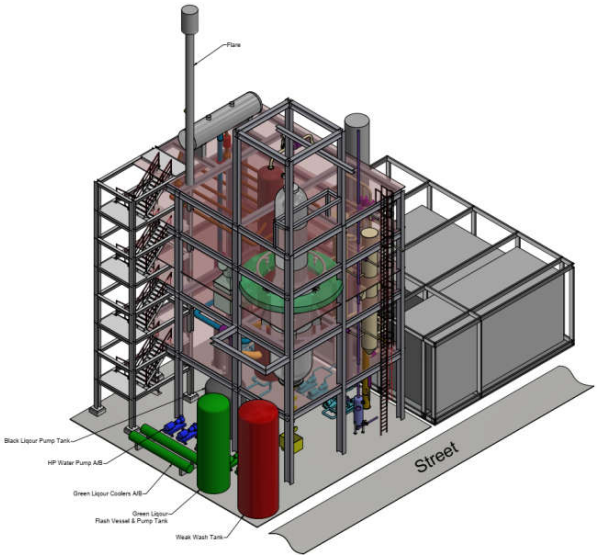
We design auxiliary components

In order to optimize the overall plant efficiency, auxiliary components such as **ash cooling and handling** systems are designed.

We serve from single-digit megawatts to gigawatt scale output power

It is not important to us what power our solutions have to serve. We have the right **solution for all plant sizes**. All requirements and all feedstocks.

We provide turnkey project solutions



Our scope of supply comprises a large extent, providing us with the ability to work as an **EPC**, e.g. for **black liquor** gasification plants.

SCS INSIGHTS

REALIZED WEIGHTS AND DIMENSIONS

Syngas Cooler

up to 700 t

Reformer/Gasifier

up to 300 t

Plant sizes

up to 10 GW

5 — Conclusion

CONCLUSION

We do not know all what is out there – but many times there are analogies from experience helping us.

We look forward to your challenge

THANK YOU FOR YOUR KIND ATTENTION!

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