



# ANDRITZ

**Fiber and Chemical Division, Business Unit BioFuel**

**BioFuel Equipment - derived from Pulp & Fiberboard applications for Ligno-Cellulosic BioFuel & BioChemicals Technology**



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# Company profile

A world market leader in most business areas



**HYDRO**  
40-45%\*

Electromechanical equipment for hydropower plants (mainly turbines and generators); pumps; turbo generators



**PULP & PAPER**  
30-35%\*

Systems for the production of all types of pulp and of certain paper grades (tissue, cartonboard); boilers



**SEPARATION**  
10%\*

Equipment for the mechanical and thermal solid/liquid separation for municipalities and various industries



**METALS**  
10%\*

Systems for the production and processing of stainless steel and carbon steel strips; industrial furnaces



**FEED & BIOFUEL**  
5%\*

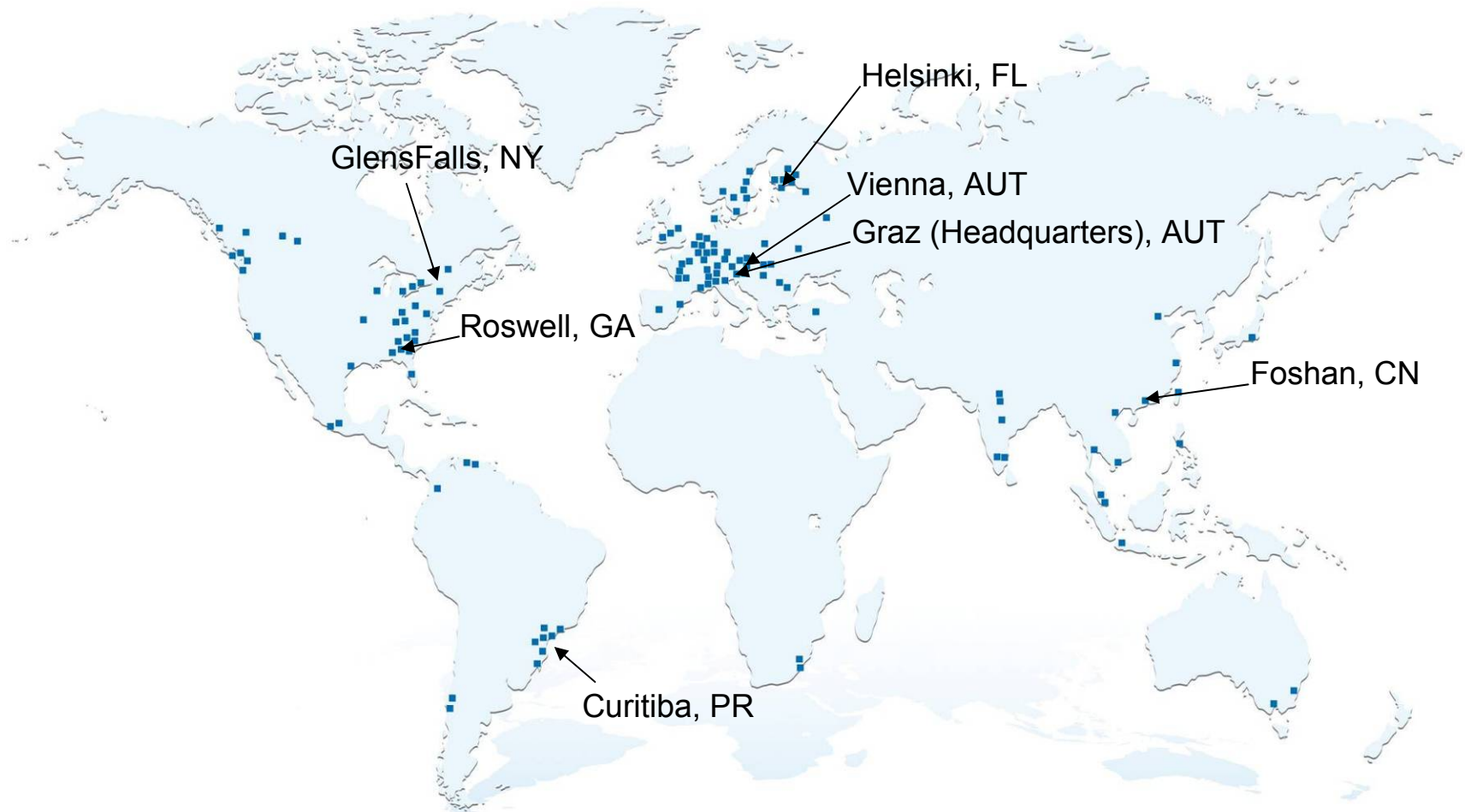
Systems for the production of animal feed pellets (pet and fish food) and biomass pellets (wood, straw)

\* Long-term average share of the Group's total order intake



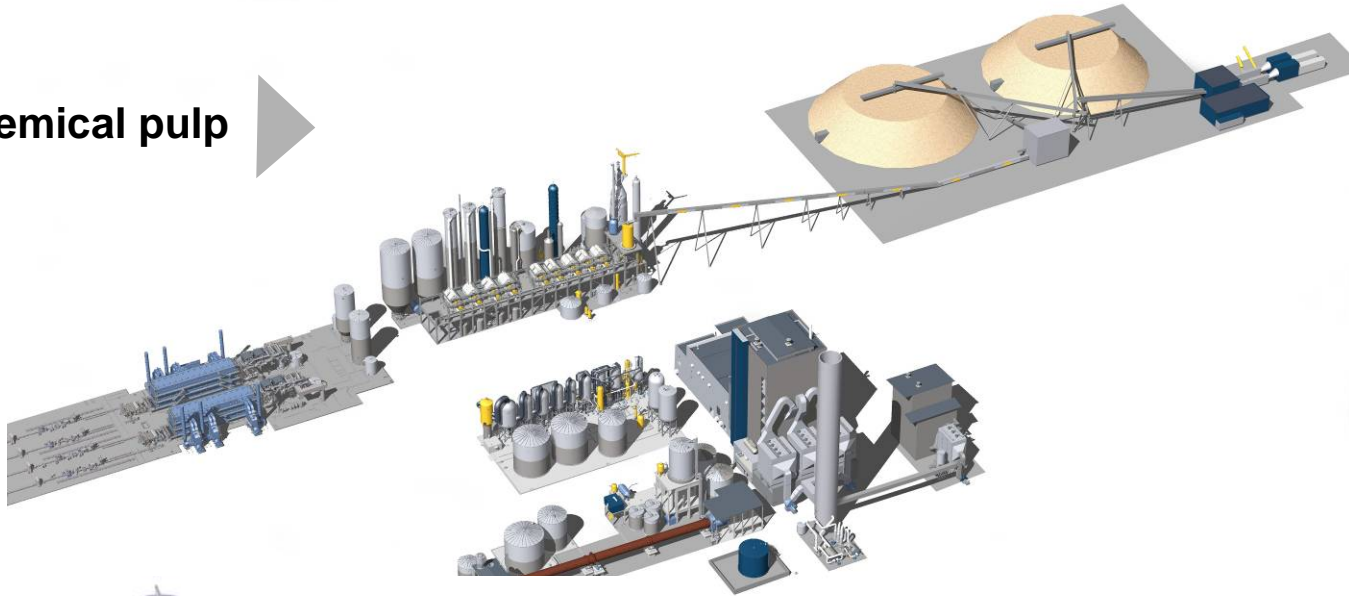
# ANDRITZ global presence:

Over 16,700 employees - 180 service and manufacturing sites around the globe

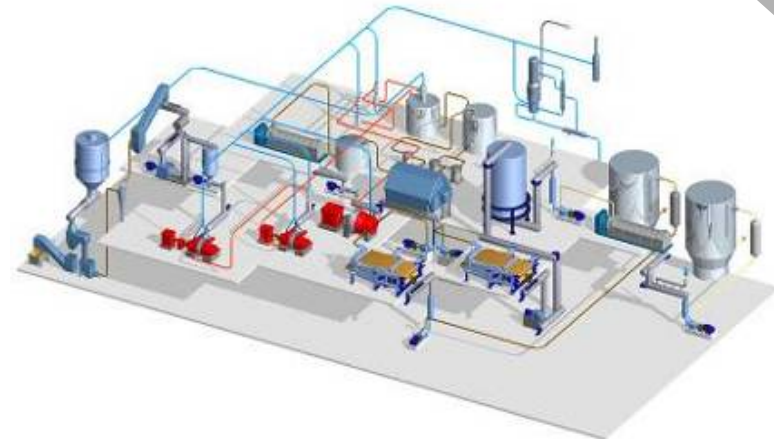


# Complete Solutions for Pulp and Paper

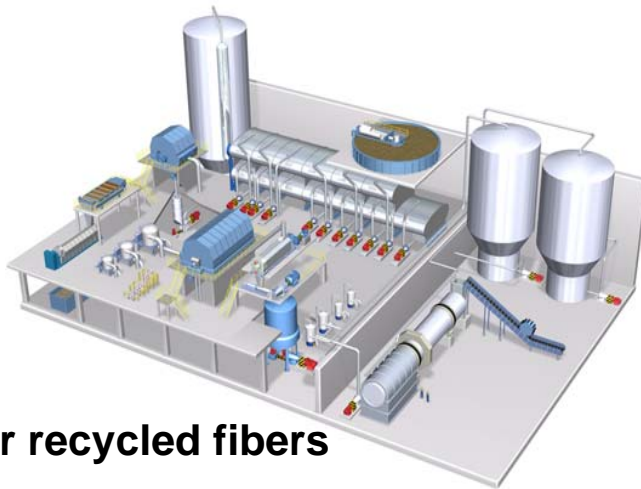
for chemical pulp



for mechanical pulp

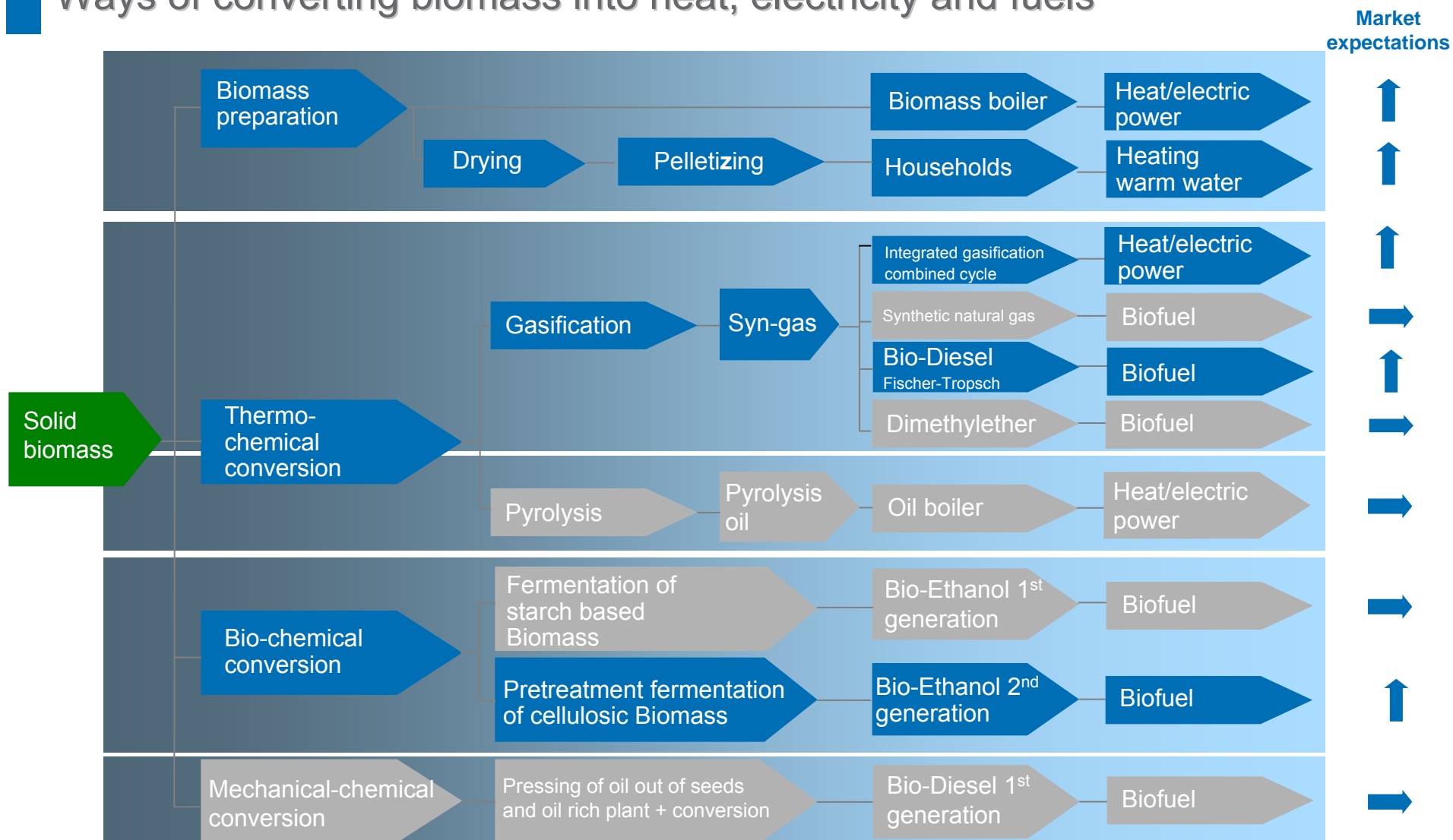


for recycled fibers



# ANDRITZ biomass technologies

Ways of converting biomass into heat, electricity and fuels



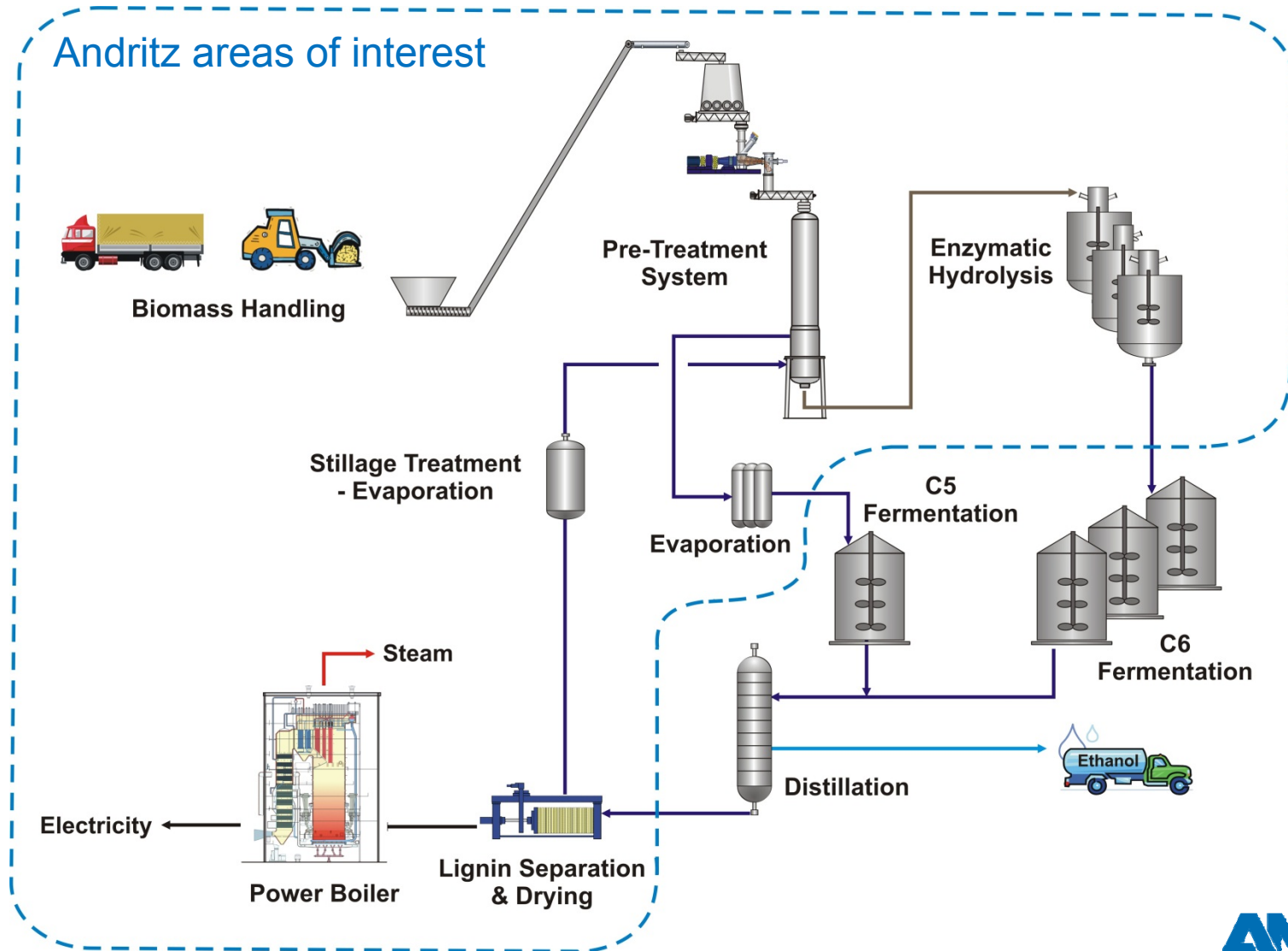
Process offered by ANDRITZ

**CONFIDENTIAL**  
BioFuel Presentation – November 2012

**ANDRITZ**  
Pulp & Paper

# ANDRITZ in 2<sup>nd</sup> Generation Ethanol and Butanol Production

## Typical 2<sup>nd</sup> Generation Ethanol/Butanol Mill





# Energy and Biomass

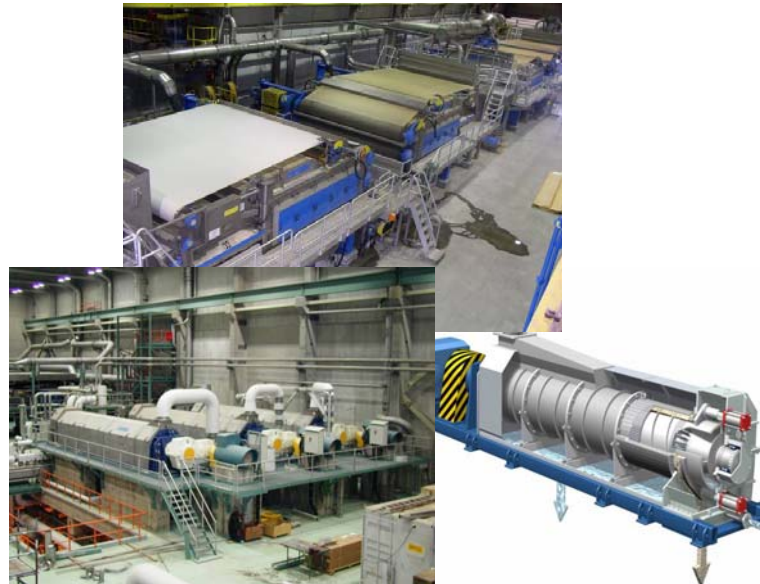
## ANDRITZ in 2<sup>nd</sup> Generation Ethanol Production

### Andritz equipment for Ethanol processes

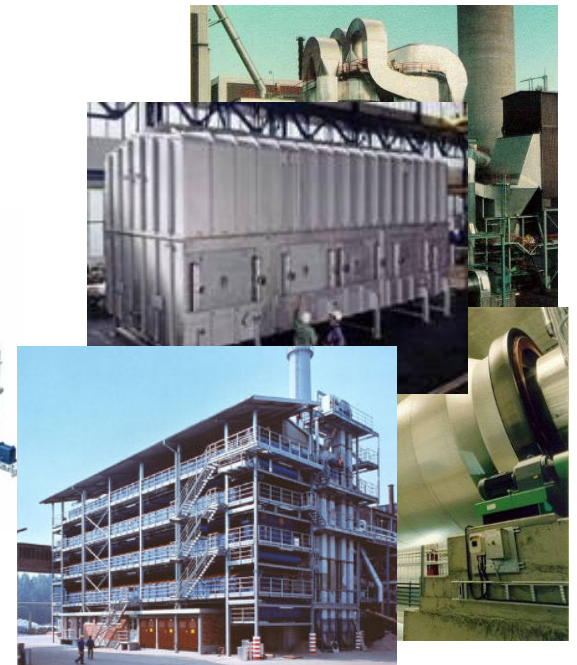
#### Biomass reactors



#### Liquid/solid separation



#### Drying





# Energy and Biomass

## ANDRITZ in 2<sup>nd</sup> Generation Ethanol Production

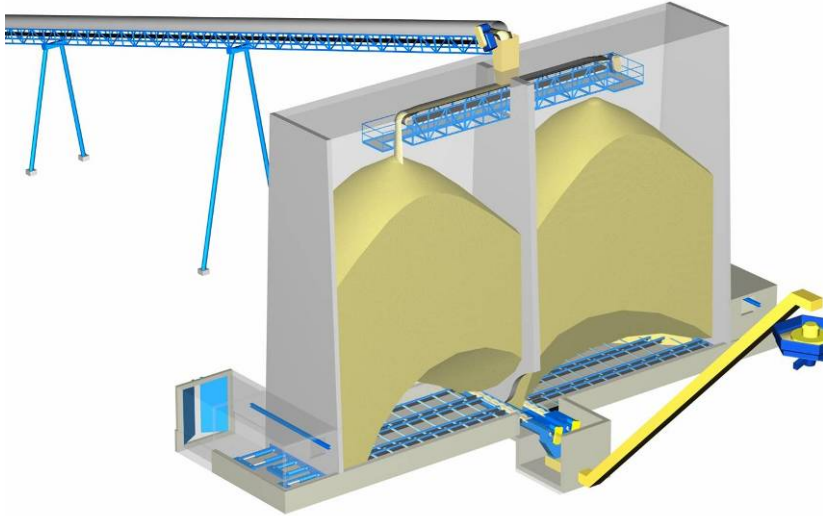
- Non-food raw materials only (Wood chips and residuals, Energy woods, Cereal Residues, Sugar Production Residue, Forages & grasses)



- Focus on Biochemical pathway using chemical pre-treatment and enzymatic or bacterial generation of sugars for fermentation to ethanol and butanol
- ANDRITZ is working with this emerging industry on customized demo scale and commercial production systems based on established Andritz know-how in
  - Biomass handling
  - Reactor design for pre-treatment and enzymatic hydrolysis
  - Liquid/Solids Separation, including pressing, filtration and evaporation
  - 12 lab/pilot/demo systems (Springfield, Forintek, IHD Dresden, Glens Falls, QUT Queensland, Zechem, Borregaard and others)
  - 2 commercial system (M&G Chemtex, Italy, undisclosed)

# Feed-Stock Handling

- Stoker Silo (moving floor)



- Stacking & Blending



- Portal Cranes



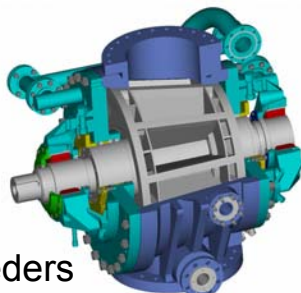
- Reclaiming





# Reactor & Gasifier Feed Equipment

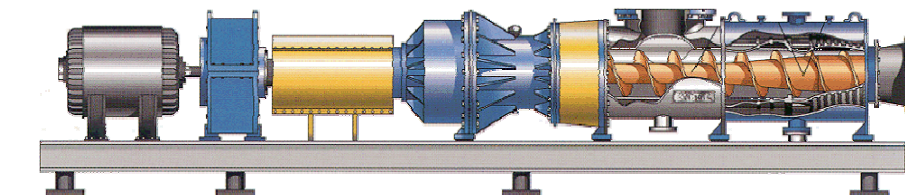
## Plug Screw Feeders, MSD's & Rotary Valves



- Rotary Valves / Rotary Feeders



- This is an Andritz Plug Screw Feeder running at well over 1500 bdmt/d of wood chips

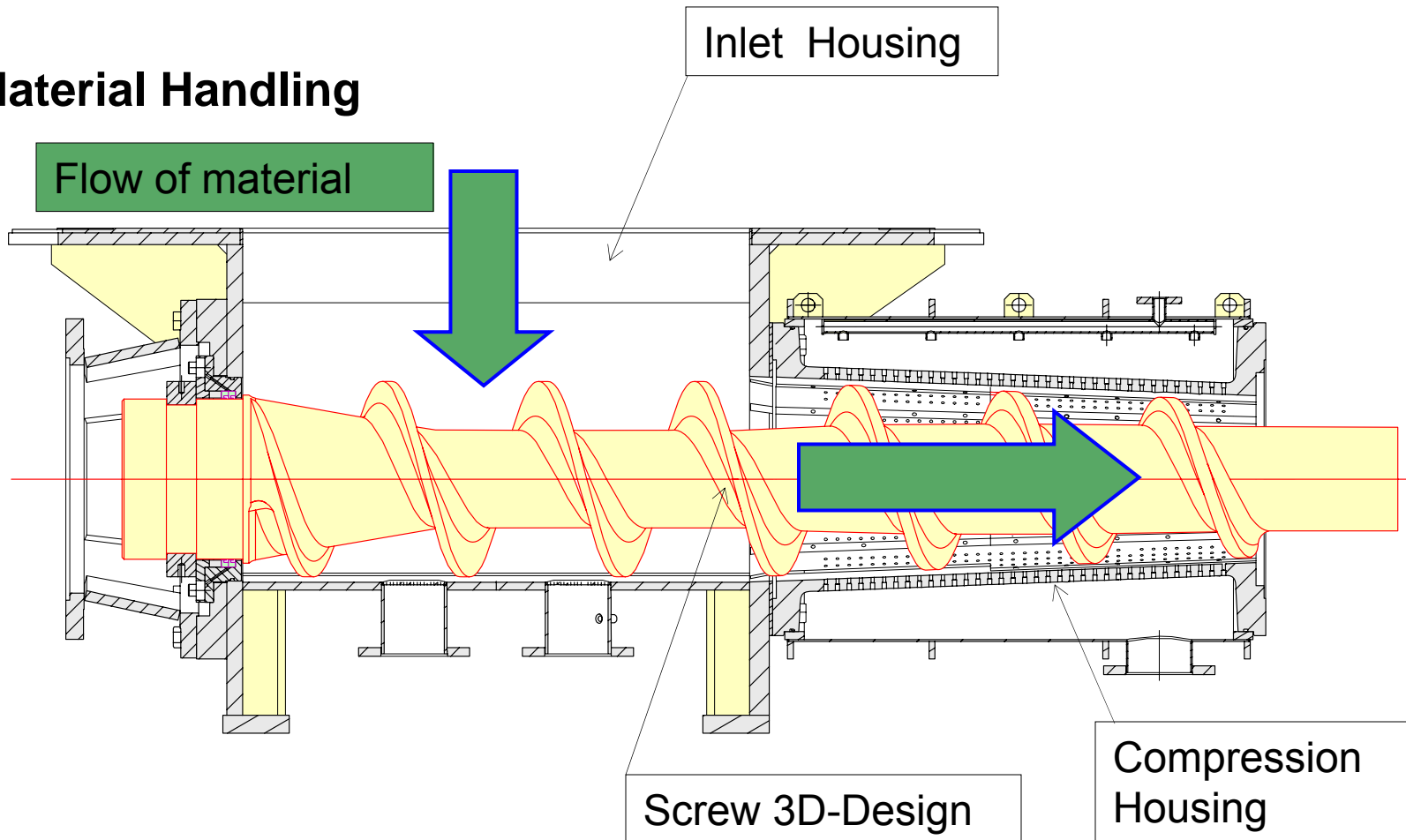


- MSD Impressafiners, a high compression screw device, feeding various reactors with low and high density feed-stocks

# Plug Screw Feeder / MSD

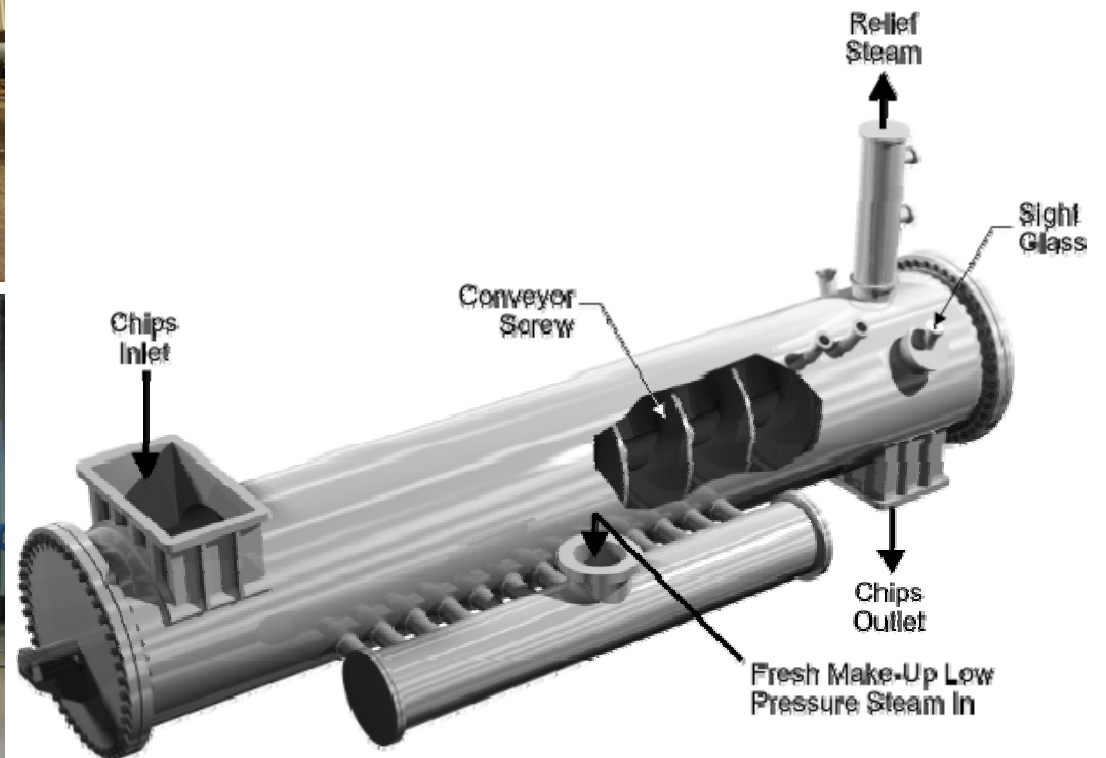
## Physical Principle of Operation

### Material Handling





# Pressurized Steam / Chemicals Mixing Screw



# Andritz Biomass Reactors



- Chemical Pulping Digester at Fibria, Tres Lagoas, Brazil. Start-up April 2009.
- Diam. 10.7m by 58m high
- Processes 7200 BDt/d of eucalyptus wood chips (~31 m<sup>3</sup>/min)
- BioFuel Pretreatment Reactors presently built are > 30m high



# Advanced Steam-Ex Pretreatment - Inclined Drainer

for dissolved pressurized C5 sugar hydrolyzate removal

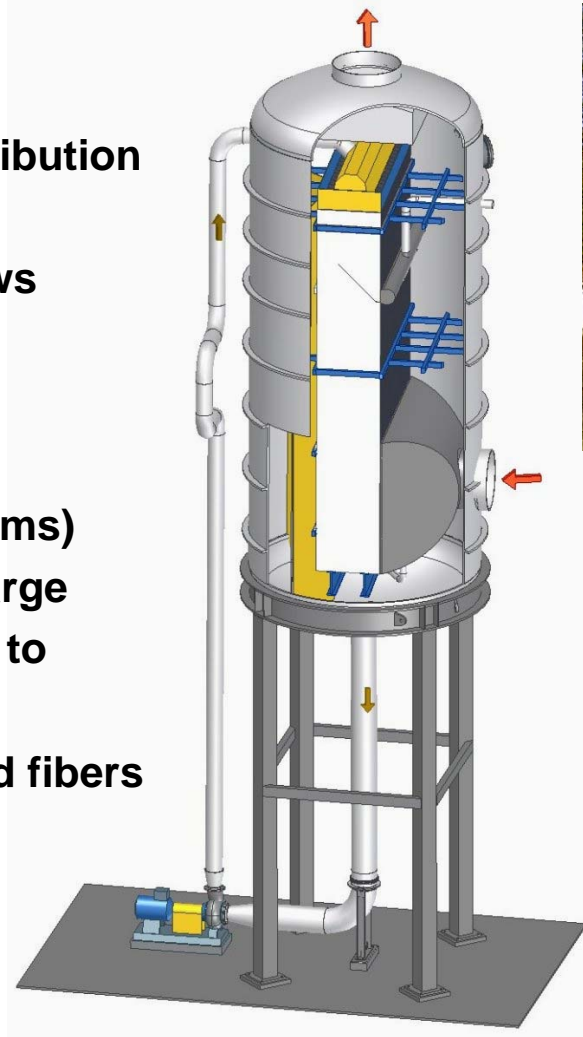




# Hydrolyzate Evaporation

(to increase C5 Sugar Concentrations / remove acetic acid)

- Segregation → good condensate quality
- Spray nozzle liquor distribution → no plugging
- Constant circulation flows independent of capacity
- Easy access in case mechanical cleaning is required (internal platforms)
- Special design of discharge points of transfer piping to prevent accumulation of suspended materials and fibers

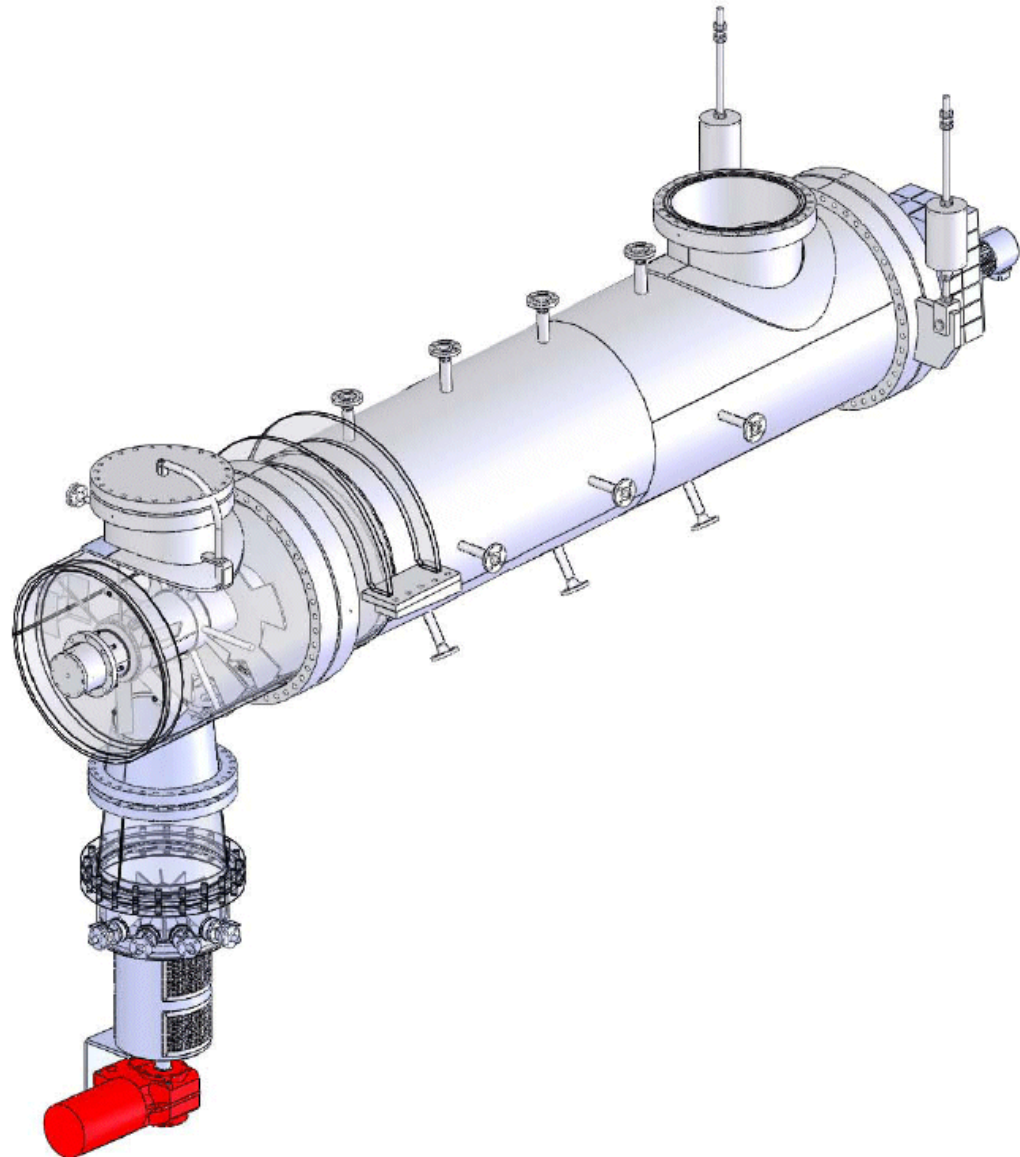
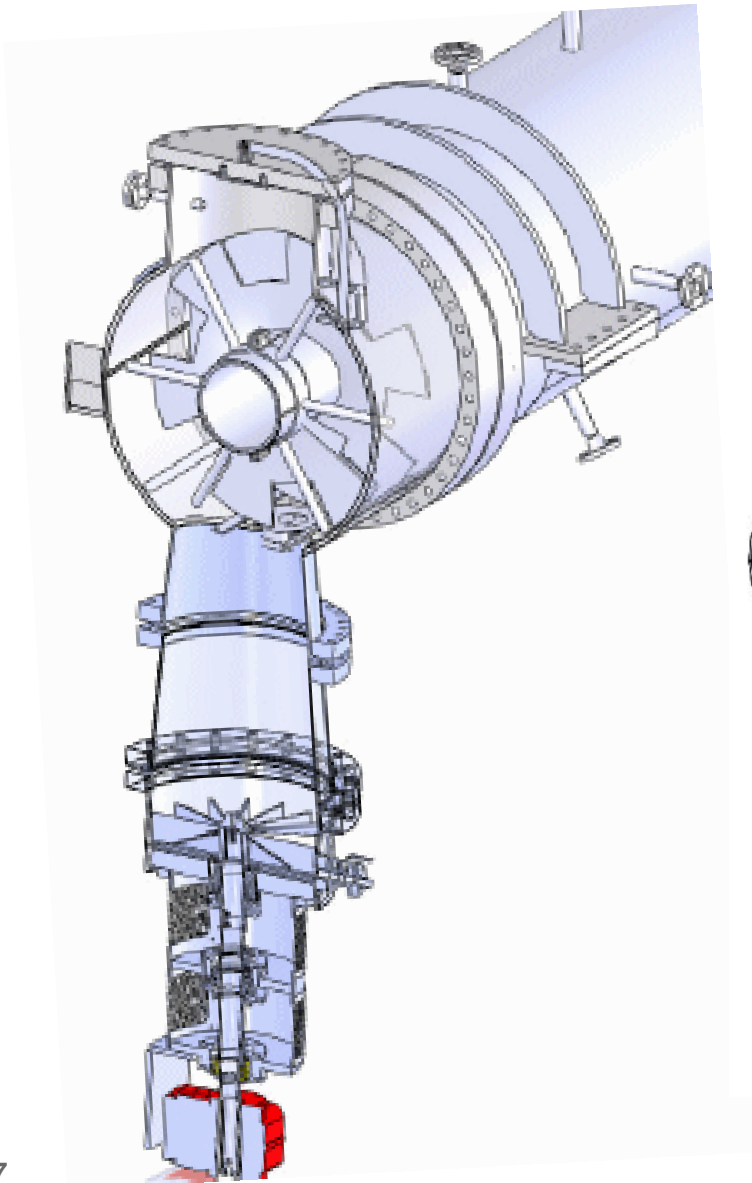


Example – Black Liquor Evaporation at Bowater, Calhoun - I Effect



# Horizontal / Steam-Ex Reactor (Pretreatment)

## Vertical Discharge Device



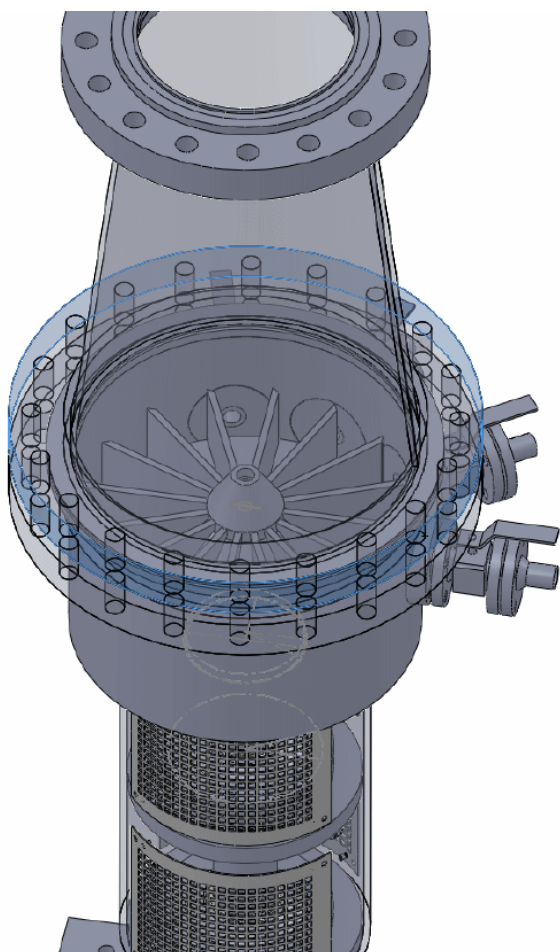
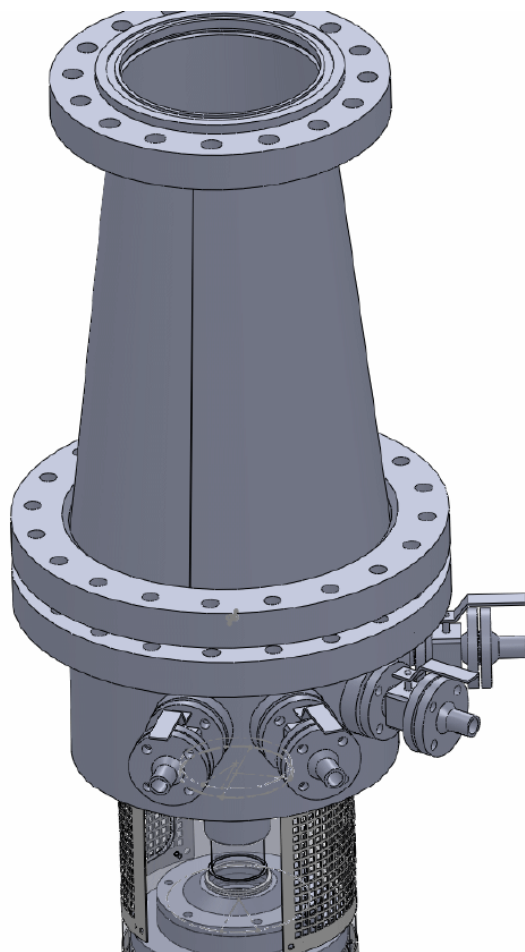
# Horizontal / Steam-Ex Reactor (Ligno-Cellulosic Ethanol Pretreatment)

## Hydrolyzer / Reactor Discharge - Details



# Pretreatment Steam-Ex Reactor Discharge

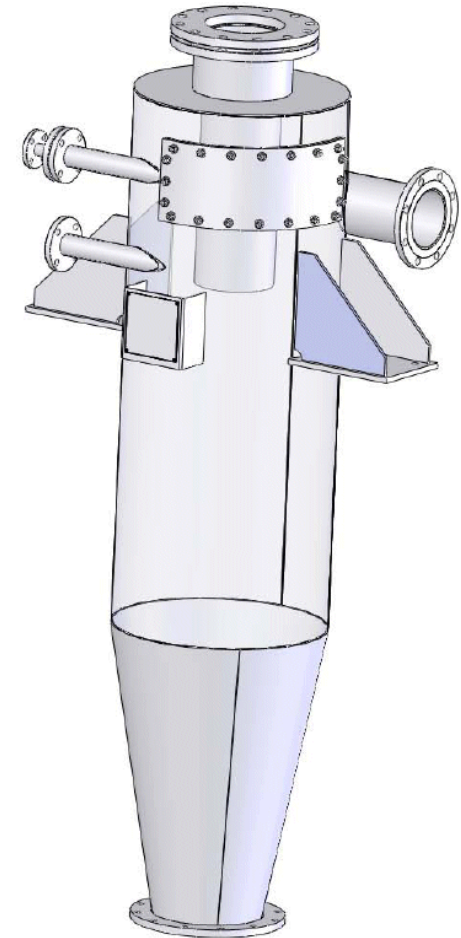
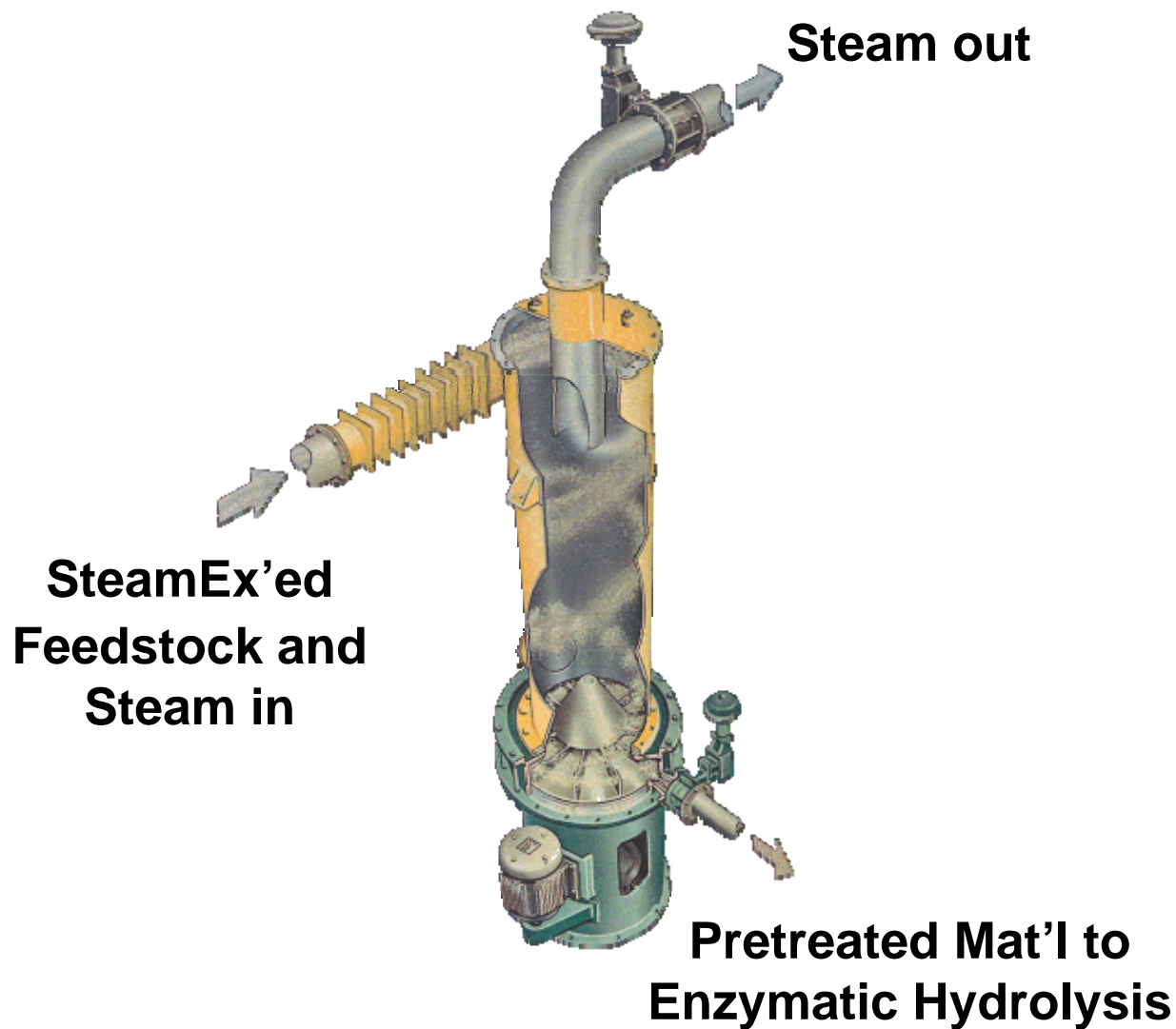
## SED HP-Reactor Vertical Discharge Device





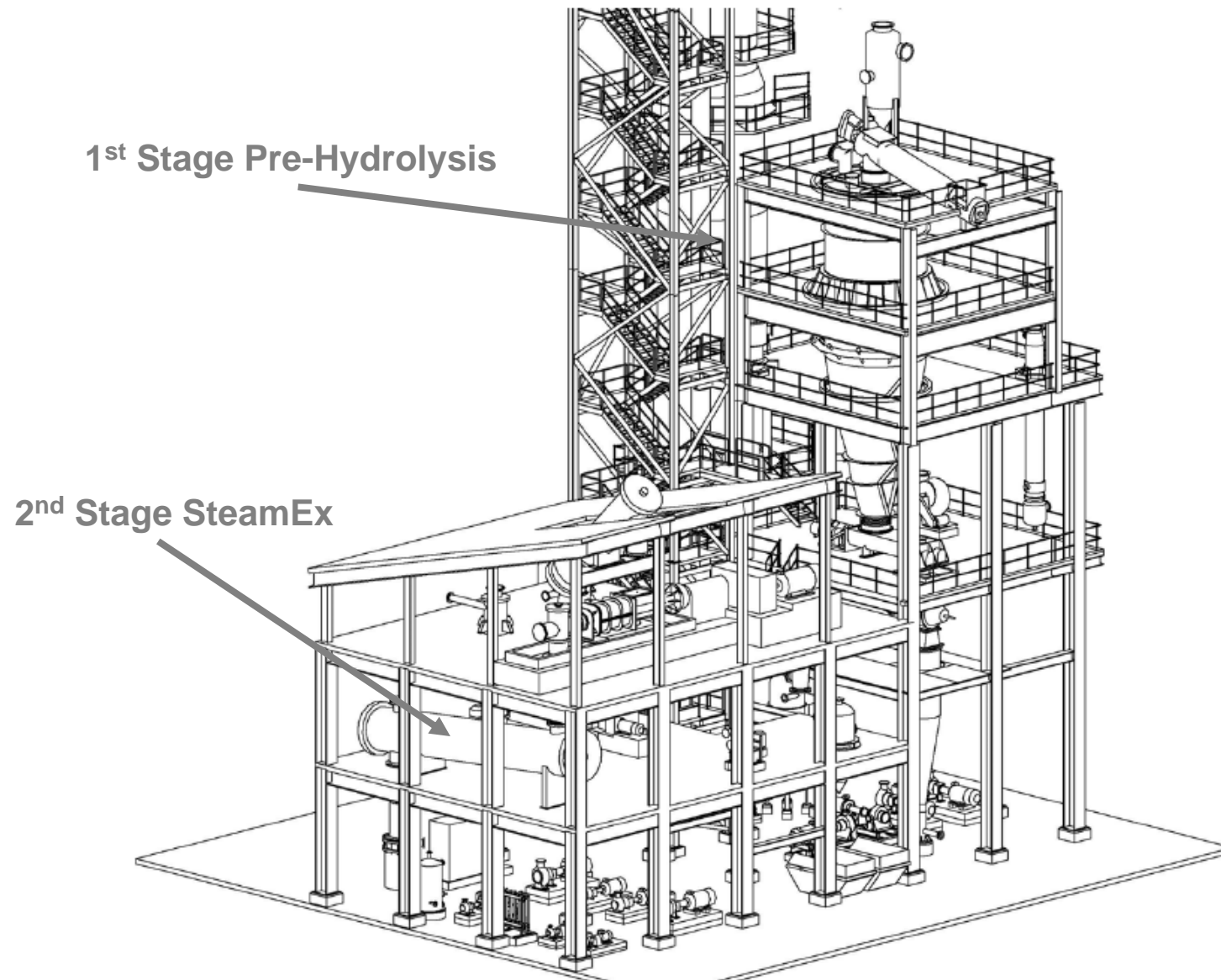
# Pressurized Cyclone after SteamEx

(Ligno-Cellulosic Ethanol Pretreatment )



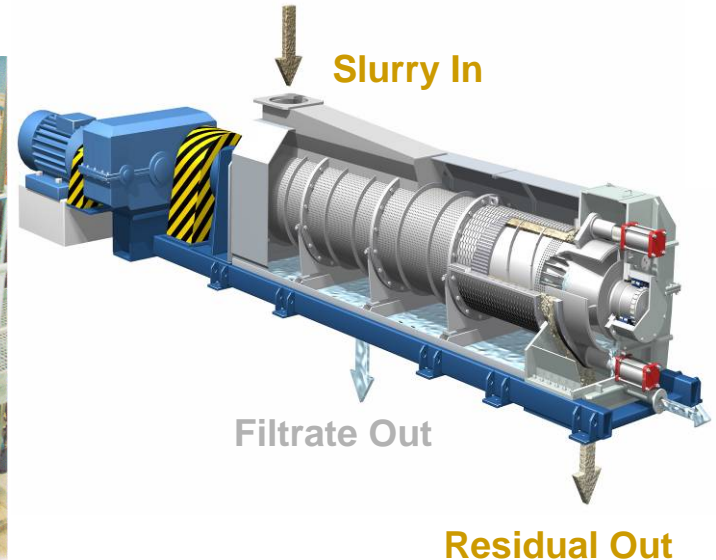
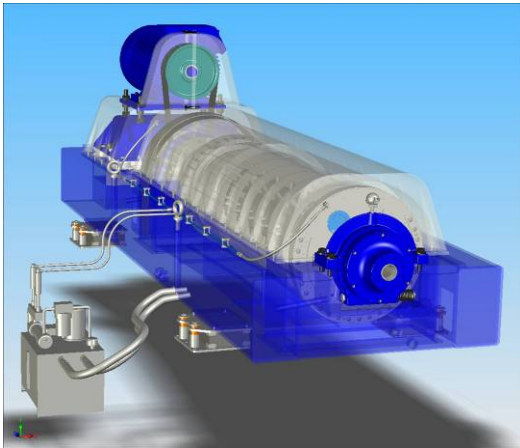


# View of a commercial scale PreTreatment System (Advanced SteamEx)



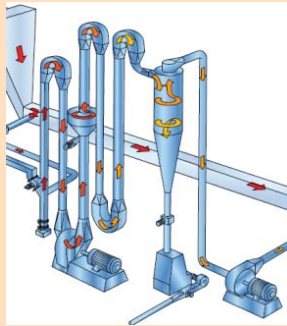
# Screw-, Belt-, Filter Presses and Centrifuges

for Washing / Dewatering Applications & Slurries / Residual after Bio-Reactors



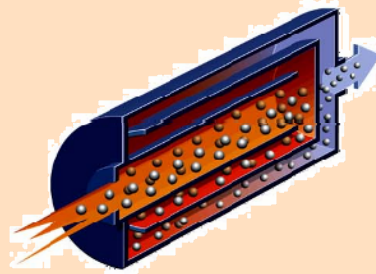


# Biomass dryers



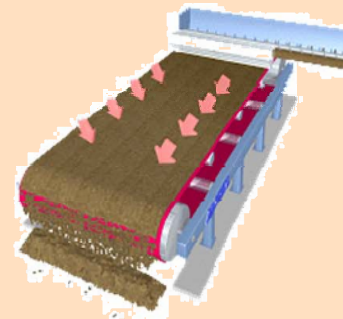
**Pneumatic Dryer**  
with integrated mill and  
sifter

- ✓ Biofuel for kiln firing



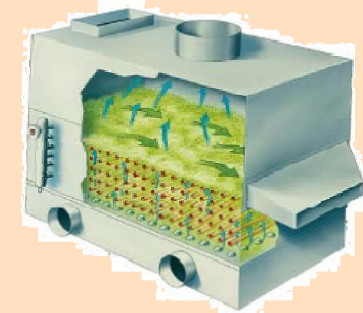
**Drum Dryer**  
Single or Triple Pass drying

- ✓ All types of biomass and wood-waste



**Belt Dryer**  
using Low Temperature  
or Waste Heat

- ✓ All types of biomass and wood-waste



**Fluidized Bed Dryer**  
Drying and Granulation

- ✓ dried distiller's grains
- ✓ spent grain from bio-ethanol



# Biomass Boilers

## Andritz BFB Boilers, Green Power up to 100 MWe

- **Ence Navia, Spain**
  - Steam flow 120 t/h
  - Start-up in October 2008
- **Ence Huelva, Spain**
  - Steam flow 195 t/h
  - Start-up in 2011
- **Portucel Cacia, Portugal**
  - Steam flow 58 t/h
  - Start-up December 2009
- **Portucel Setubal, Portugal**
  - Steam flow 58 t/h
  - Start-up December 2009
- **Fortum Pärnu, Estonia**
  - Steam flow 94 t/h
  - Start-up in December 2010
- **EPS Pulpaca, Venezuela**
  - Steam flow 50 t/h
  - Start-up in 2011
- **Segezha, Russia**
  - Steam flow 238 t/h
  - Start-up in 2013





# Biomass Gasification (ThermoChemical Route)

## Delivery Portfolio for Gasification

### Equipment for Biomass Preparation and Handling



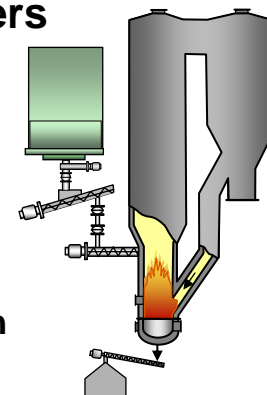
### Belt and Drum Dryers



### CFB Gasifiers

- air blown
- for boilers and kilns

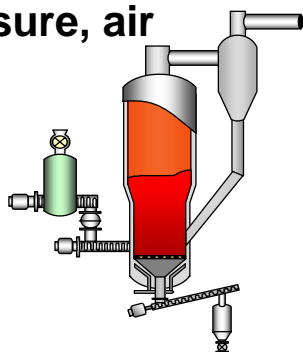
10 – 150 MWth



### BFB Gasifiers - low pressure, air

- Clean gas to
- engines
  - boilers

10 – 50 MWth

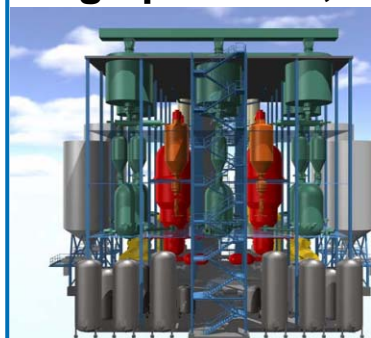


### BFB Gasifiers - high pressure, air/oxygen

- diesel
- ethanol
- gasoline
- SNG

- IGCC

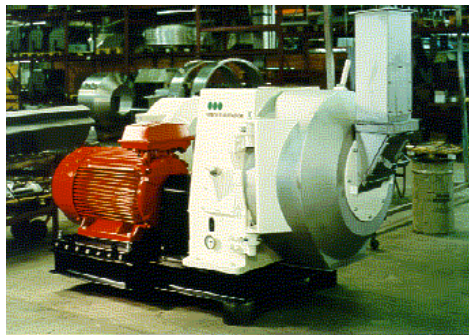
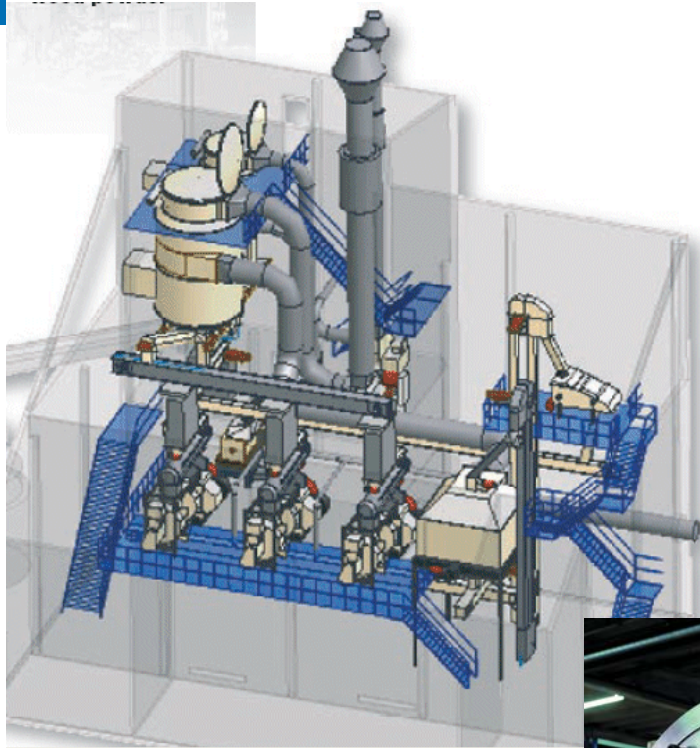
<150 MWth



### Gasifier Gas Cleanup for BFB Gasifiers

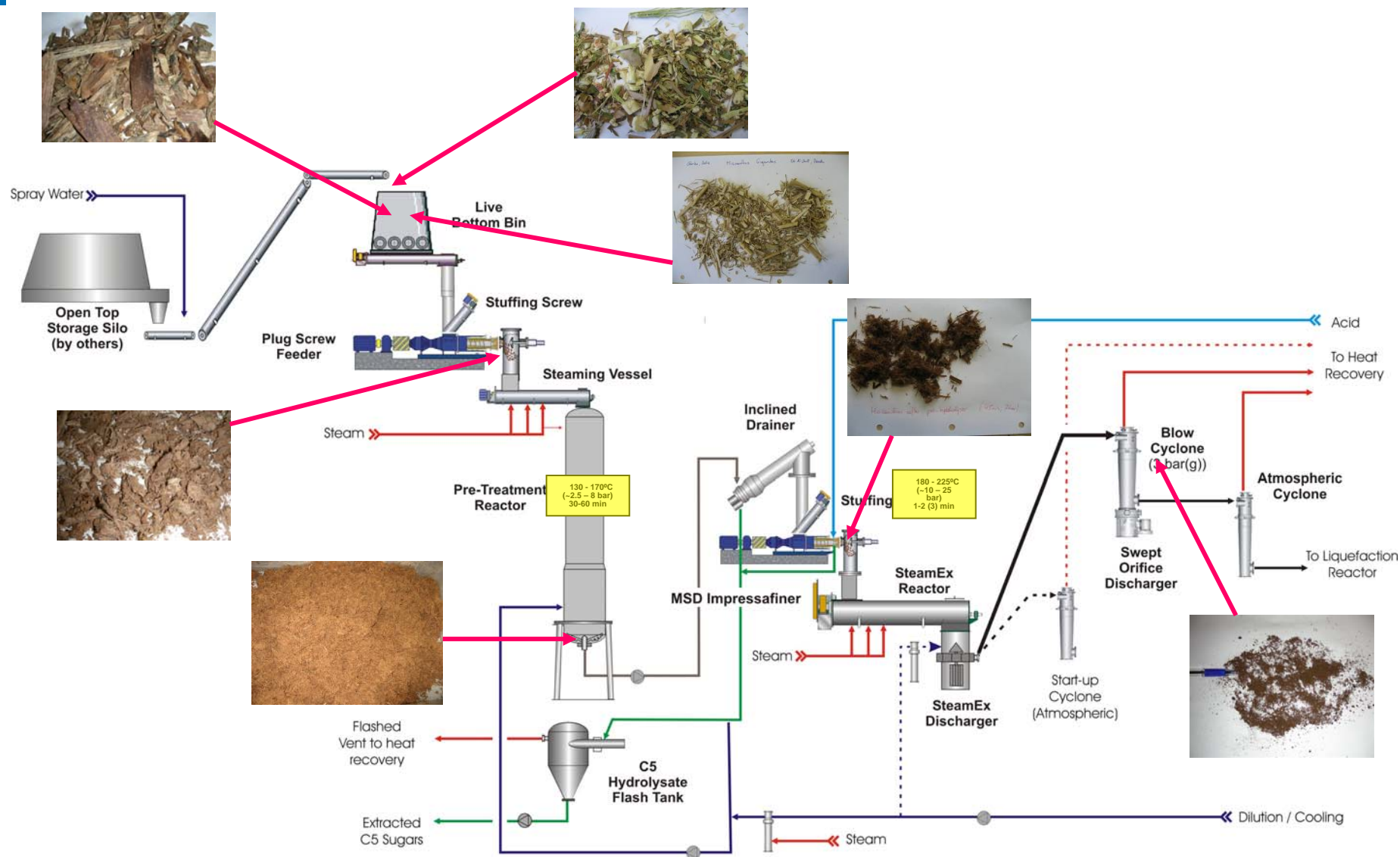
- Partial cooling, filtering  
- for turbines and boilers
- Tar reforming, gas cooling, filtering  
- for engines and BTL

# Pelletizing Equipment – Solid BioFuel



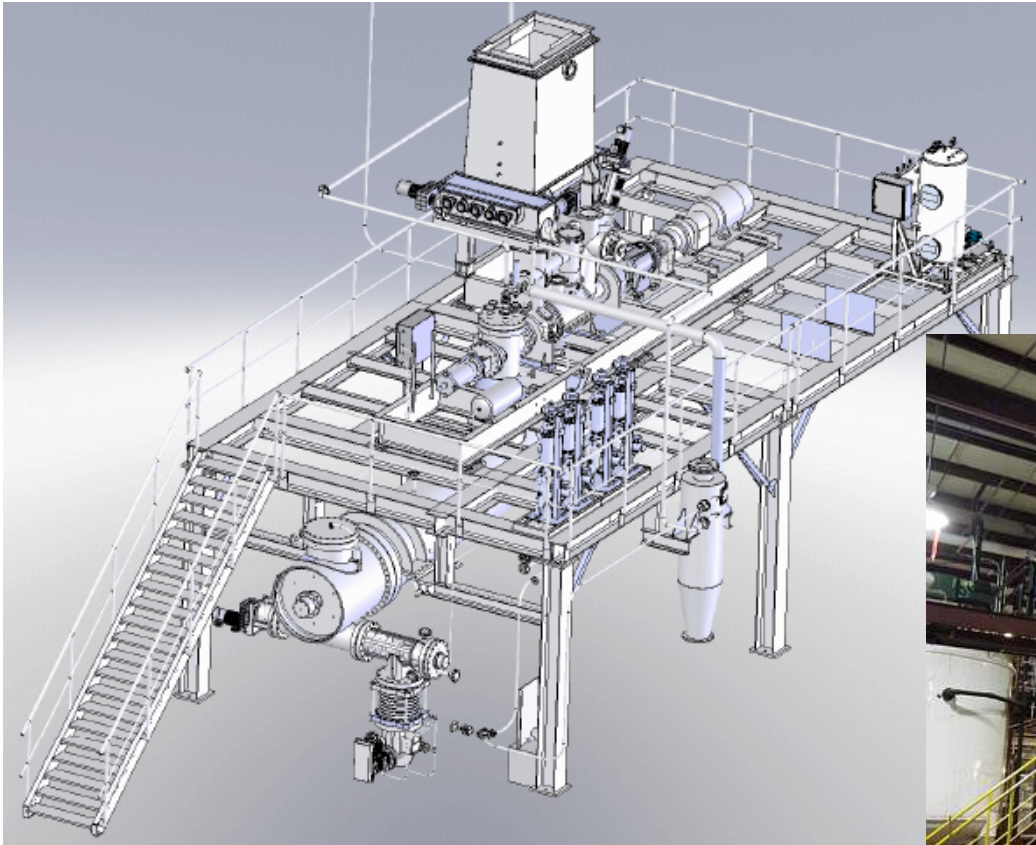


# Patented Advanced Steam-Ex™ Process Concept for commercial scale systems Andritz is building





# Example of a Demo Pretreatment System for SteamExplosion – for ligno-cellulosic Ethanol





**Pretreatment Equipment – derived from Pulp Mill Applications  
are Proven in large Scale  
-> and minimize Scale-Up Challenges**

