Torrefaction Demonstration Plants
WPAC Conference/AGM Quebec City 2012
Andy Eyer
What is torrefaction?

Torrefaction of biomass can be described as a mild form of thermal conversion (controlled carbonisation) at temperatures typically ranging between 250-300 °C in the absence of oxygen. During torrefaction the biomass properties are changed to obtain a much better fuel quality (increased heating value) for combustion, gasification and co-firing in conventional coal-fired power plants and steel industry. Low calorific components are transferred to the gas phase.

The torrefaction objective is to improve the energy properties of biomass within a defined residence time and temperature less than 300 °C.

Source ECN, Kiel et.al.
The added value of torrefaction

- Torrefaction (+ densification) enables energy-efficient (>90%) upgrading of biomass into commodity solid biofuels with favorable properties in view of logistics and end-use
- Favorable properties include high energy density, better water resistance, slower biodegradation, improved grind-ability, homogenized material properties
- Therefore, cost savings in handling and transport, advanced trading schemes (futures) possible, capex savings at end user (e.g. outside storage, direct co-milling and co-feeding), higher co-firing percentages and enabling technology for gasification-based biofuels and bio-chemicals production
- Applicable to a wide range of lignocellulose biomass feedstock

Source ECN, Kiel et.al.
Torrefaction of biomass

"The polymeric structure of woody and herbaceous biomass comprises mainly cellulose, hemicellulose and lignin."

During torrefaction mainly the hemicellulose is decomposed - Water, CO$_2$, CO and various organic acids are transferred into the gaseous phase.

Main decomposition regimes are based on Koukis et.al. (1982)
Andritz Torrefaction Technologies

- Two Main Technology Platforms

<table>
<thead>
<tr>
<th>Large plants: up to 700,000 t/a per line</th>
<th>Small / medium plants: 50,000-250,000 t/a</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Andritz/ECN Torrefaction Design</strong></td>
<td><strong>Andritz ACB® Torrefaction Design</strong></td>
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<tr>
<td>Industrial Demo Plant (1 t/h) in Denmark</td>
<td>Industrial Demo Plant (1 t/h) in Austria</td>
</tr>
<tr>
<td>starting up in 3rd quarter 2012</td>
<td>in operation from 4th quarter 2011.</td>
</tr>
<tr>
<td>Pressurized, moving bed reactor</td>
<td>Rotating, indirectly heated drum reactor</td>
</tr>
<tr>
<td>Andritz/DTI Pelleting plant</td>
<td>Briquetting plant</td>
</tr>
<tr>
<td><strong>Key Features:</strong></td>
<td><strong>Key Features:</strong></td>
</tr>
<tr>
<td>Scale up to huge capacities possible</td>
<td>Simple process concept specially</td>
</tr>
<tr>
<td>(experience from Pulp &amp; Paper)</td>
<td>developed for decentralized plants</td>
</tr>
<tr>
<td>Feed material: Wood Chips/Forest</td>
<td>Flexibility in feed material</td>
</tr>
<tr>
<td>Residuals</td>
<td></td>
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</tbody>
</table>
Torrefaction of biomass – ACB® Process
Small capacity reactor systems for 50,000 t/a per line

Torrefaction of biomass at 250-300°C under inert conditions

- Rotating, indirectly heated drum
- Prevention of condensation problems due to special flow pattern
- High flexibility in terms of allowable particle size
- No clogging, channeling or increase in pressure drop
- Oxygen infiltration avoided by drum sealing technology
- Construction based on proven Drum Drying System (> 110 such dryers worldwide)

Demo plant for production of 1 t/h of torrefied briquettes installed in Frohnleiten, Austria
Torrefaction of biomass
Andritz ACB Process, Austria
Torrefaction of biomass

Flowsheet ACB Process

- Fresh biomass fuel
- Drying
- Dried biomass 95% DS
- Flue gas T=300°C
- Torrefaction
- Torrefied biomass
- Energy Supply (lean gas combustion)
- ACB gas T=280°C
- Dryer offgas
- Fresh biomass

Densification of torrefied material

Preparation of torrefied material (milling)

ACB Fuel
Sønder Stenderup Torrefaction Demo Plant Project

- Andritz has built a 1 t/h Torrefaction Demo Plant in Sdr. Stenderup, Denmark
- The plant incorporates:
  - Biomass (Wood Chip) Receiving
  - Biomass Drying
  - Torrefaction
  - Pelletizing
- The plant entered commissioning in the 2\textsuperscript{nd} quarter of 2012 and is currently in the initial operation phase.
- The project is partially funded by the Danish EUDP, (Energy Technology Development and Demonstration Programme), with a significant majority of the capital funding from Andritz. The Danish Technology Institute (DTI), and energy companies Drax and Dong are involved as part of the EUDP team. Energy Research Center of the Netherlands (ECN) is acting as a consultant to Andritz on the design of the torrefaction technology and will be involved in the commissioning and optimization of the demo plant.
Sdr. Stenderup Demo Plant ATEX (Explosion) Analysis

- The Demo Plant has been analyzed according to ATEX procedures for process plant with potentially explosive atmospheres.
- Testing has been conducted to characterize the explosion properties of dust from torrefied materials.
- Torrefied eucalyptus and pine dust were tested.
- Both materials are explosive when mixed with air, with eucalyptus giving a stronger explosive mixture than pine. In any case, dust from torrefied material must be managed as an explosive, combustible dust.
- The plant design includes numerous systems designed to reduce the risk of fire and explosions.
- We spent considerable engineering efforts and expenses on these efforts.
Sdr. Stenderup Torrefaction Demo Plant
Simplified Single Line Flowsheet 1 bdm/h wood chips

Patents granted and Pending
Sdr. Stenderup Demo Plant

- The Torrefaction System:
  - Blends ECN and Andritz technologies (Patents Granted and Pending)
  - Pressurized for more effective heat transfer due to higher gas flows, lower velocities and pressure drop for increased capacity.
  - Provides a separation between the final drying zone and the beginning of torrefaction
  - Includes a co-current torrefaction zone followed by a counter-current torrefaction zone
  - Provides for removal of heavy organic compounds from the torrefaction gas, minimizing plugging and deposits.
  - Lends itself to scale up to large single unit capacities
    - High fraction of the vessel volume is used for either final drying or reaction.
    - The capacity will increase as the diameter squared.
ECN/Andritz
Pressurized Reactor Concept

Wood Chips In (~8-10% MC)

Drying Gas In

Drying Gas Out to Heating

Hot Torrefaction Gas In

Torrefaction Gas Out to Gas Cleaning and Heating

Option for Biomass in Lower Section

Hot Torrefaction Gas In

Torrefied Wood Out

Patents Granted and Pending
Sdr. Stenderup Demo Plant Overall View
PDMS used for 3D Modeling and Design
Sdr. Stenderup Torrefaction Demo Plant Project
Photo April 2012

Torrefaction reactor during installation lift

Patents granted and Pending
Sdr. Stenderup Torrefaction Demo Plant Project

Rotary Dryer

Viewed from Feed End  Viewed from Discharge End
Sdr. Stenderup Torrefaction Demo Plant Project

Pressurization Valve at Torrefaction Reactor Top
Sdr. Stenderup Torrefaction Demo Plant Project

Torrefaction Reactor Top Area View 1

Patents granted and Pending
Sdr. Stenderup Torrefaction Demo Plant Project

Torrefaction Reactor Top Area – View 2

Patents granted and Pending
Sdr. Stenderup Torrefaction Demo Plant Project

Torrefaction Reactor Process Area

Patents granted and Pending
Sdr. Stenderup Torrefaction Demo Plant Project

Torrefaction
Pressurized Gas
Circulation
Blowers
Sdr. Stenderup Torrefaction Demo Plant Project

Upper Part of Torrefied Material Cooling Screw and Discharge Rotary Valve
Sdr. Stenderup Torrefaction Demo Plant Project

Photos – May 2012

Installation of hammer mill

Pellet Press During Installation
Dust Removal Cyclone/Filter and Bag Loading Station
Sdr. Stenderup Torrefaction Demo Plant Project

Control Stations

PSA Plant to Generate 98% Pure Nitrogen for Inerting
Project Status – November 2012

- The plant is in operation and producing product for test firings.
Thank You!
Research Update

Staffan Melin
Research Director, Wood Pellet Association of Canada
Research Associate, University of British Columbia, CHBE
President, Delta Research Corporation

November 28, 2012
- UBC Research
- ISO Standards Development
- IMO Safety Code
- Environment Canada Emission Factor Development

- SECTOR Research Project (agri-materials)
- CEATI Research Project (agri-materials)
- IEA and AEBIOM Projects
- PEAT as potential feedstock
UBC Research Activities 2003-2012

• Objective with UBC Research
  – Scientific and technical support for the pellets industry in Canada
    • Improve safety in handling and storing pellets
      – Off-gassing
      – Self-heating
      – Fires and explosions
    • Improve supply chain logistics and economics
  – Prepare students for key positions in the industry
  – Uphold Canada as “Center of Excellence” in pellet research and supplier of high quality pellets
UBC Research Activities 2003-2012

• Department of Chemical and Biological Engineering
  
  Focus on Feedstock Engineering

  – Biomass and Bioenergy Research Group (BBRG)
    – 5 professors
    – Average 7 PhD students
    – Average 7 under-graduate or Master students
    – Post-doc

  – Collaboration with
    • UBC Department of Forestry, Department of Wood Sciences
    • Swedish University of Agricultural Sciences
    • SP Swedish Technical and Research Institute
    • US DOE & USDA
Unique Large Scale Research Reactor
- Thermal stratification
- Gas stratification
- Convection pattern
- Permeability
- Purging experiments
UBC Research Activities 2007-2012

• Completion of a 5 year Collaborative Research & Development Grant Program (CRD)
  – Matching funding WPAC – NSERC
    (Natural Sciences and Engineering Research Council)
  – Significant in-kind contribution from WPAC members
  – 50% of my time for 5 years
  – Additional funding from;
    US DOE, USDA, NRCan, Agriculture Canada, Environment Canada, Canadian Network of Excellence, BC Ministry of Forests, BC Innovation Council, Ontario Ministry of Agriculture, CEATI, SECTOR etc.
  – 10 company funded projects has been conducted since 2006
UBC Research Activities 2007-2012

• Major achievements
  – Material Safety Data Sheet (MSDS) for bulk and bagged pellets
    • Model for international trade
  – Standards and Regulatory Codes
    • Initial IMO Code 2004 with upgrade 2013
    • Major responsibility within ISO/TC 238 since 2008
  – Fundamental characteristics of wood pellets
    • Thermal Conductivity
    • Permeability in bulk
    • Off-gassing (emission factors for CO, CO2, CH4, O2 etc.)
    • Self-heating
UBC Research Activities 2007-2012

• Major achievements (cont.)
  – Kinetic modelling of explosion pulping
  – Kinetic modelling of torrefaction
  – Kinetic modelling of catalytic steam treatment
    • Pellets for production of ethanol, bio-chemicals and bio-materials
  – Physical drop test (impact index)
  – Supply chain modelling

– 9 PhD, 3 Masters and 5 Post-doctoral students
– 40 Scientific papers
– 14 Technical Reports
– 48 Conference Presentations
International Standards Development

• ISO Technical Committee 238 Solid Biofuels
  WG #1 Terminology, definitions and descriptions (1)
  WG #2 Fuel specifications and classes (7)
  WG #3 Fuel quality assurance (2)
  WG #4 Physical and Mechanical Test Methods (34)
  WG #5 Chemical Test Methods (6)
  WG #6 Sampling and Sample Preparation (2)
ISO 17225 Standards

Part 1. Fuel Specifications and Classes (normative & informative)

Chips, hog, log wood, wood pellets, sawdust, shavings, bark, logging residue, coppice, straw, canary grass, miscanthus, cereal grain, olive residue, fruit seeds/shells/stones, grape cakes, rice husks, cotton stalks, sunflower husks, malva, charcoal, torrefied wood

Traded commodities

Part 2. Graded Wood Pellets (Enplus A1, A2, B) (IWPBG I1, I2, I3)
Part 3. Graded Wood Briquettes
Part 4. Graded Wood Chips
Part 5. Graded Firewood
Part 6. Graded Non-woody Pellets
Part 7. Graded Non-woody Briquettes
ISO TC 238 Physical and Mechanical Testing Standards

In preparation for publishing
Moisture, ash, bulk density, particle size distribution, particle density, calorific value, volatile matter, durability of pellets/briquettes, length/diameter of pellets, disintegrated pellets, fines content

Under development
- Off-gassing
- Self-heating
- Dust explosibility (ISO/ASTM/EN & sampling & sample preparation)
- Hygroscopicity, absorbicity, freezing characteristics (for torrefied pellets)
- Ash melting temp
- Grindability of pellets
- Angle of repose, angle of drain, bridging, permeability, impact resistance
ISO TC 238 Chemical Testing Standards

In preparation for publishing
Content of C/H/N, content of Cl/S, water soluble Cl/Na/K, major elements, minor elements, basis to basis conversion, chemical composition using X-ray fluorescence
Additional ISO TC 238 Standards

In preparation for publishing
- Terminology, definitions and descriptions
- Fuel quality assurance, conformity assessment
- Fuel sampling and sample preparation
National versus EN versus ISO Standards

- National Standards in Europe gradually replaced by EN Standards
- Current EN Standards and ISO Standards gradually harmonized to EN-ISO Standards
- New standards developed under ISO
- Pellet Fuel Institute (PFI) Standard still based on ASTM and NIST Standards
International Standards Development

- ISO Technical Committee ISO Project Committee 248 Sustainability Criteria for Bioenergy – (ISO 13065)
- Definition of Principles, Criteria and Indicators involved throughout the bioenergy supply chain involving all Economic Operators (EO) - Process Standard
  - WG 1 – Terminology and Cross-cutting Issues
  - WG 2 – GreenHouseGas (GHG) Balance (LCA perspective)
  - WG 3 – Social, Economic and Environmental Aspects (LCA perspective)
  - WG 4 – Indirect Effects (secondary effects)
The SECTOR Project

Production of Solid Sustainable Energy Carriers by Means of Torrefaction (SECTOR)
The SECTOR Project

- Project start: Jan 1, 2012
- Duration: 42 months
- Total budget: 10 million Euro
- Participants: 21 from 9 EU-countries
- Coordinator: German Biomass Research Center
The SECTOR Project

- Evaluation of the end-use of torrefied biomass in different application:
  - Medium-to-large scale firing and co-firing in pulverized-fuel boilers
  - Medium-to-large scale gasification and co-gasification
  - Small scale combustion in commercial pellets boilers.
  - Production of bio-chemicals or bio-materials

Courtesy Stefan Duson
The SECTOR Project
Woody and herbaceous materials

Poplar chips
Cereal straw
Eucalyptus chips
Prunings from olive trees
Project Management (WP1)

- Assessment of relevant biomass feedstock regarding
  - Availability now and 2030, incl. price level
  - Suitability for torrefaction and end-use
  - Demands of the end-users

- Optimisation of torrefaction processes regarding the needs of
  - Densification
  - Logistics
  - End-use

- Optimisation of densification processes for torrefied biomass
  - Pelletisation
  - Briquetting

- Analysis of fuel properties regarding different possibilities for
  - Storage
  - Handling
  - Transportation

- Evaluation of the usability of torrefied biomass for
  - Co-firing in coal plants incl. milling and feeding tests
  - Gasification
  - Small scale combustion
  - Material use

Demonstration Tests (WP5)

- Raw Material Supply (WP2)
- Torrefaction Process (WP3)
- Densification Process (WP4)
- Logistics (WP6)
- End-Use (WP7)

Specification of material properties and analysis methods (WP8) as well as socio-economics and environmental sustainability analysis of biomass-to-end-use chains (WP9)
The ABITORR-CEATI Project

Agricultural Biomass Torrefaction Research Program (ABITORR)
Centre for Energy Advancement through Technological Innovation (CEATI)

Development of torrefied pellets from agricultural feedstock for co-firing
The ABITORR-CEATI Project

• Two year collaborative research Program
  – Natural Resources Canada (CANMET Energy)
  – University of British Columbia
  – Western University
  – Delta Research Corporation

• Harvesting, washing, energy/mass balance, optimized torrefaction, densification, physical characteristics, grindability, self-heating, off-gassing, dust explosibility, combustion (ignition behaviour, burn-out, flame stability, flue-gas profiling, fouling etc.)
The ABITORR-CEATI Project

• 10 selected agricultural materials
  – Wheat straw - Sorghum seeds
  – Canola straw - Sunflower seeds
  – Switchgrass - Olive residue
  – Bagasse - Miscantus
  – Willow
The ECO-Energy Innovation Initiative (eco-EII) Project

- Canada’s Copenhagen commitment to reduce (GHG) emissions by 17% from 2005 levels by 2020
- Develop industrial emission factors for woody biomass co-firing at 0/20/>20%
  - Air emissions: CO\textsubscript{x}, NO\textsubscript{x}, SO\textsubscript{x}, CH\textsubscript{4}, Chlorides, PM, VOC, PAH, PCDD/F and heavy metals (such as As, Cd, Cr, Pb, Ni, Hg)
  - Bottom ash
- CANMET, Nova Scotia Power, OPG Atikokan
- Literature study (Envirochem)
- Started May 24, 2012 (3 year project)
The ECO-Energy Innovation Initiative (eco-EII) Project

<table>
<thead>
<tr>
<th>Task</th>
<th>Milestone</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>Literature review + emission factor database</td>
<td>March 31, 2013</td>
</tr>
<tr>
<td>Task 2a</td>
<td>Lab-scale testing at 2 co-firing rates</td>
<td>March 31, 2013</td>
</tr>
<tr>
<td>Task 2a</td>
<td>Lab-scale testing at a 3rd co-firing rate</td>
<td>[June 30, 2013]</td>
</tr>
<tr>
<td>Task 2b</td>
<td>Industrial-scale sampling at first facility</td>
<td>March 31, 2014</td>
</tr>
<tr>
<td>Task 2b</td>
<td>Industrial-scale sampling at second facility</td>
<td>March 31, 2015</td>
</tr>
<tr>
<td>Task 3</td>
<td>Final reports</td>
<td>March 31, 2015</td>
</tr>
<tr>
<td>Task 4</td>
<td>Final progress reports to eco-EII</td>
<td>March 31, 2015</td>
</tr>
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</table>

Budget
2012-13: $159k
2013-14: $355k
2014-15: $282k
Total $796k
The ECO-Energy Innovation Initiative (eco-EII) Project

• Request for white pellets from WPAC
  – ISO Industrial grade I2 feedstock (not pelletized)
  1. December 2012 delivery to CANMET for lab test
     burn Jan – April 2013 (3 metric ton in tote bags or plastic barrels +100 kg of pelletized material)
  2. September 2013 test burn at NSP 4-6000 mt
  3. Mid 2014 test burn at Atikokan (100% pellets)
International Maritime Organization (IMO) Project update

• Current IMSBC Code for transportation of wood pellets has ambiguous language
  – IMO Code requires fixed gas extinguishing equipment on-board if flammable gases are emitted from commodity
  – IMO Code states contradicting provisional exception
• UBC research has determined by research that no flammable gases are emitted, even under wet conditions (4/9/15/35/50% moisture)
• Revision to current Code proposed via Transport Canada to IMO
• Updated Code expected during 2013
Additional Safety Related Projects

- **SafePellets** – funded by the EU 7th Framework Programme (FP7)
  - 15 partners
  - Safe handling and storage of pellets
  - Fire protection
  - Off-gas sensing
  - Duration 2012-2014

- **LUBA** – Large Scale Utilization of Biopellets for Energy Applications
  - 7 partners (incl. SP, DBI, DTI, Aalborg Univ., Dong, Vattenfall, Verdo)
  - Off-gassing, self-heating
  - Duration 2010-2013
Peat as a biofuel

- An estimated 50% of all carbon in the biosphere is deposited in peatlands
  - 18 GJ/tonne at 10% moisture  - 420-480 billion dry tonne (50% of world coal deposits)
  - 2-10% ash  - 17 million tonne annual harvest
  - 0.15-0.50% nitrogen  - 125 plants produce 40 TWh

<table>
<thead>
<tr>
<th>Country</th>
<th>Total peatland area in km²</th>
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</thead>
<tbody>
<tr>
<td>Canada</td>
<td>1,114,000</td>
</tr>
<tr>
<td>Europe (incl. Russia)</td>
<td>893,000</td>
</tr>
<tr>
<td>USA</td>
<td>611,000</td>
</tr>
<tr>
<td>China</td>
<td>10,000</td>
</tr>
<tr>
<td>Asia (tropical)</td>
<td>227,000</td>
</tr>
<tr>
<td>Other (mainly tropical)²</td>
<td>150,000</td>
</tr>
<tr>
<td>World total</td>
<td>3,005,000</td>
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</tbody>
</table>
Peat as a biofuel

- Two types of peat: Sphagnum Peat and Hypnum Peat
- Harvested as with machinery (plow or vacuum)
  - Milled peat (crumbs)
  - Sod peat (stripes about 30-40 thick, 5-7 cm wide, 5-20 cm deep)
- Densified to pellets or briquettes
- Co-fired up to 30% with biomass (chips, pellets, briquettes)
- Highly beneficial – decreases corrosion and fouling in boilers
  - The sulphur neutralizes the highly corrosive chlorides
- Peat layer grows with 0.6-2 mm per year
- Carbon recycling period
  - Beyond the societal stabilization period set by IPCC (100-300 years)
  - Environmental classification under review (not fossil and not renewable)
International Energy Agency (IEA)

• IEA was founded in 1973 and has 28 member nations
• Task activities
  – 32 Combustion and Co-firing
  – 33 Gasification
  – 34 Pyrolysis
  – 36 Photovoltaics
  – 37 Solar Resource Management
  – 39 Liquid Biofuels
  – 40 Sustainable Bio-energy Trade
Significant Documents for Pellets Industry

**International Energy Agency (IEA)**

- Health and Safety Aspects of Solid Biomass Storage, Transportation and Feeding 2012 (Dec) (T32)
- Status Overview of Torrefaction Technologies 2012 (Dec) (T32)
- Possible Effect of Torrefaction on Biomass Trade 2012 (Nov) (T40)

**Other releases**

- The Pellet Handbook 2010
- The Silo Handbook 2013 (Jan)
Thanks for your attention
Mill technology that fits your environment
Sustainable, renewable POWER generation for self-sufficiency and security
Biomass Pelleting
Biomass Pelleting
Complete turn key plants with ANDRITZ technology

- Wood handling and feedstock preparation systems
- Grinding and pelleting systems
- Drying systems (Belt or drum dryers)
Biomass Processing
Raw material preparation

- Wood receiving
- Wood storing and retrieving
- Debarking
- Chipping
- Chip storage
- Screening
- Re-sizing
- Mixing and metering to drying
Debarking and Chipping Process

Why De-bark?

- Target is to produce clean “pellet chips”
- Removal of bark/sand from logs is important
  - Increases chipper knife life
  - Increases pellet machine dye life
  - Decreases ash content of pellets to a level required by industrial power plants
- Separated bark can be used as energy in the drying process (separate small boiler)
Excellent quality “Micro-Chip” is produced by the HHQ-Chipper for pellet production.
Biofuel handling & storage
Material handling, storing and reclaiming

- Material receiving
  - Chain pockets
  - Screw pockets
  - Stoker reclaimer
  - Truck dumper
- Disc screen
- Crushing
- Storages and reclaiming
  - Round silos
  - Linear storage
  - Stoker silos
  - Help silo
  - Reclaimers
- Conveyors
Biomass drying

From wet product

- 40 - 60% DS
- Sticky
- Low caloric heating value
- Biological active (digestion processes)

Transfer

by various drying systems

To dry product

- > 85% DS
- Free flowing
- Higher caloric heating value
- Biological stable
- Ready for pelleting, gasification or milling for direct combustion
Drying Systems
Product Range

**Belt Dryers**
Drying using mainly Low Temperature or Waste Heat
✓ All types of biomass and wood-waste

**Pneumatic Dryer**
integrated mill with sifter grinding and drying in one step
✓ Biofuel for kiln firing

**Rotary Drum Dryer**
Single Pass drying Using high temperature Heat source
✓ All types of biomass and wood-waste
Biomass Pelleting

- The characteristics of the biomass and the combustion system must be considered in the selection of the complete pelleting plant in order to obtain the most efficient and high quality production process.

- Depending on these factors, the processing can include equipment for
  - Pretreatment
  - Contaminant removal
  - Moisture removal
  - Pelleting
  - Process control
Pelleting
Production of Solid Biofuels
North America’s Largest Wood Pelleting Plant

SE, USA
Start-up: 1st quarter 2011
Capacity 750,000 t/a

ANDRITZ scope:
- Debarking and chipping line
- Chip handling
- Hammer mills
- Pellet mills
- Pellet cooling section
- Pellet out loading section
Waycross – Hammer Mill Feed bins
Waycross – First stage grinding – 4360 Hammer mills
Double grinding concept with HM 43605

1st stage screen opening

8 mm (5/16")

2nd stage screen opening

3 mm (1/8")

Installation at GBM in Georgia, USA (20 x HM 43605 as double stage)
– total plant capacity 750.000 ton woodpellets/year
Waycross – Conditioner floor
Waycross – Pelleting floor
Pelletizing

Pellet Mills (PM30)
Pelleting Process

1. Die
2. Rolls
3. Feed Plow
4. Knives or breaker bars
Waycross – Cooling – PCF40 Counter flow coolers
Waycross – Rail load out
Introducing Biomax

Biomax Pellet Mill
Bigger and Better
The Andritz Biomax pelletmill was designed based on combined experiences from the 3 most successful and durable pelletmills in the wood and waste pelleting.

- PM30-2 and 3 series
- LM26 – V 400
- Paladin 3000BM

Pat. pending
ANDRITZ Feed & Biofuel – Biomax Biomass Pelleting

- Brings up capacity.
- Keeps installation simpler
- Reduces costs of operation

Less and Larger equipment means
- Leaner plant design,
- Higher energy efficiency.
- Less operators
- Reduced maintenance

Pat. pending
Biomass Pelleting
Complete solutions from Andritz

Thank you for your time