LUT
Lappeenranta
University of Technology

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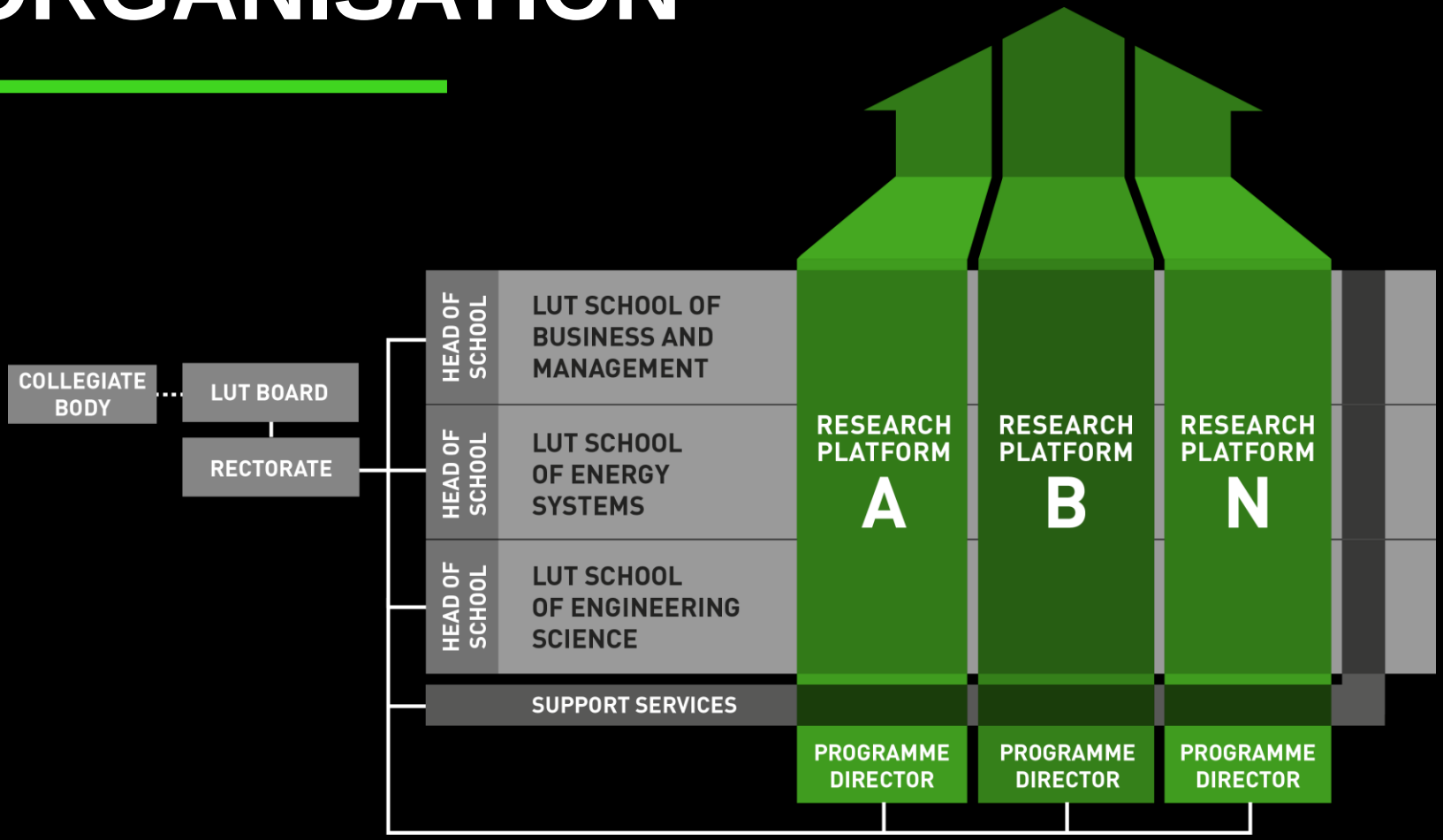
LUT / GREEN CAMPUS

RESPONSIBILITY_ NEW THINKING_ GREEN THOUGHTS_

Living Laboratory for Sustainability
is composed of research, education, environment and operations.

SOLUTION-FOCUSED ORGANISATION



LUT SCHOOL ENERGY SYSTEMS IN A NUTSHELL

Open your mind. LUT.
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- Research and education will be organised via schools since 2015 in LUT
- Largest energy research and education organisation in Finland
- B.Sc. and M.Sc. Degree Programmes in Energy Technology, Environmental Technology, Electrical Engineering, Mechanical Engineering

FACTS AND FIGURES 2014

- 328 persons
- 26 full professors + 70 other research scientists (D.Sc.)

- 127 Bachelors of Science (Tech)/year
- 163 Masters of Science (Tech)/year
- 28 Doctors of Science (Tech)/year

- 14.5 M€ research budget/year (external funding resources)
- 12 M€ teaching budget/year (Ministry of Education and Culture)

Current status in LUT Energy systems

Open your mind. LUT.
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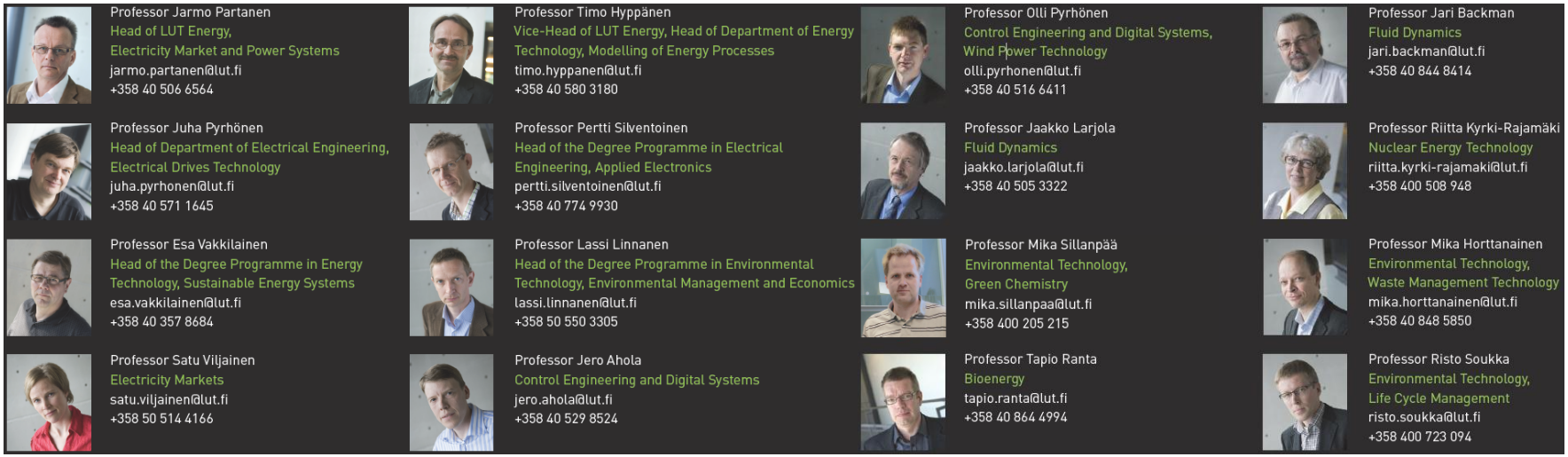
- **LUT Energy Systems is a strategic area of expertise in LUT**
- **Growth 328 in 2014 => 400 in 2020**
- **Growth 26.5 Meur => 34 Meur in 2020**
- **50 % external funding, 5 % EU programs**
- **School – A solid group of professors and researchers**
- **Increased role in society**

- **Quick strategic moves – professorships:**
  - **Sustainable energy systems - 2009**
  - **Wind power – 2010**
  - **Bioenergy – 2011**
  - **Nuclear thermal hydraulics – 2012**
  - **Solar economy 2014**



BIOENERGY LABORATORY IN LUT

Open your mind. LUT.
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- Studies supply systems and handling technologies of forest biomass for energy use. Applies study methods to evaluate economical and environmental performance
- Laboratory located in Mikkeli city since 2003
- Staff, 1 prof., 8 researcher (2 post doc and 6 post graduates) MSc students, annual turnover 1 M€
- Core study areas:
  - Availability assessment of biomass fuels
  - Supply logistics of biomass fuels, transportation
  - Biomass fuel production, refining and handling
  - Optimized use of biomass fuels
  - Domestic and international biofuel trade
  - Bioenergy business models
  - Sustainable production of bioenergy

BIOENERGY LABORATORY IN LUT

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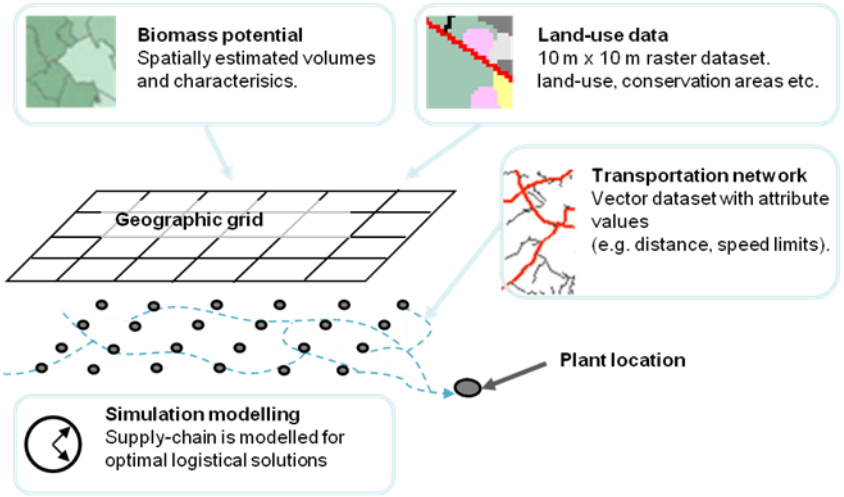
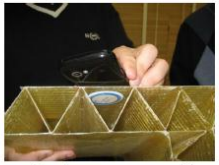
- Study methods
  - GIS-analysis
  - LCA-analysis
  - Simulation models
  - Regional energy balances
  - Practical experiments



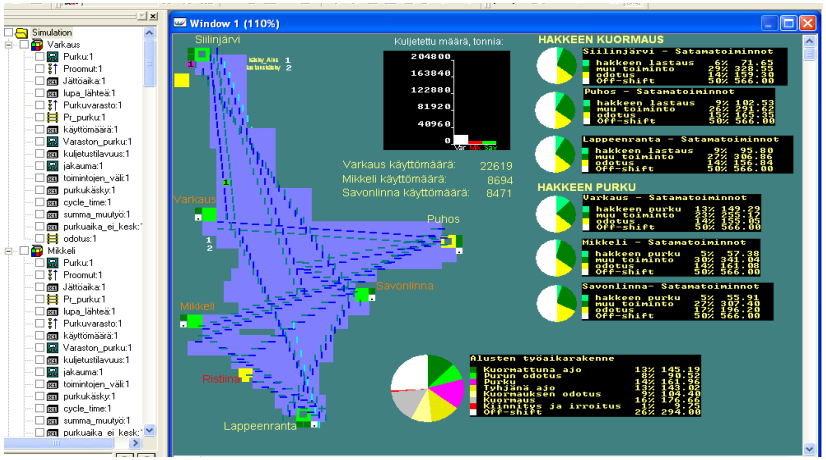
Productivity studies

New transportation concepts

Moisture, quality and energy content of biomass



New business opportunities (Composite containers and RFID)



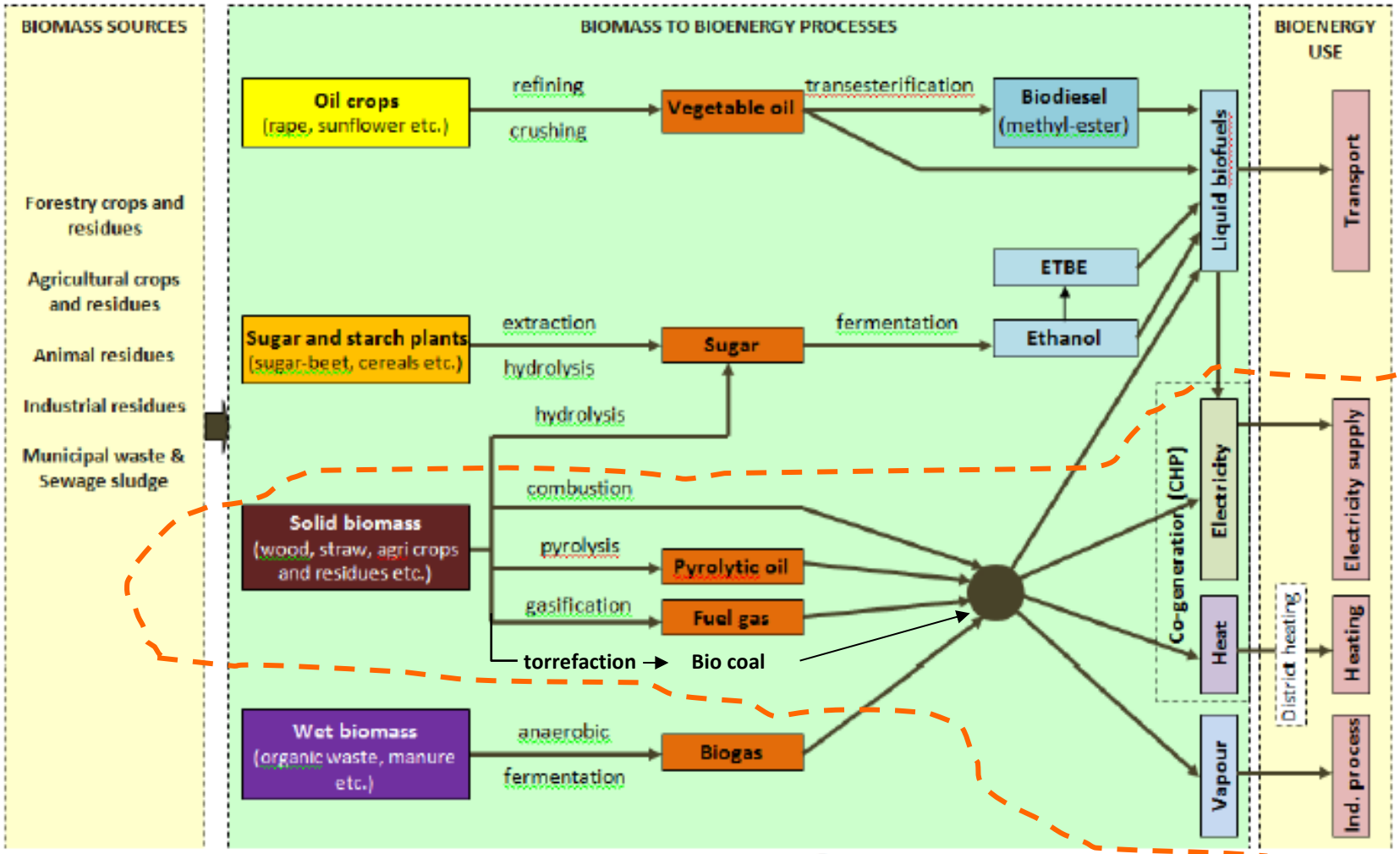
http://www.lut.fi/web/en/lut-savo/bioenergy-technology

LAPPEENRANTA UNIVERSITY OF TECHNOLOGY STRATEGY 2020

TRAILBLAZER

Show the way.
Never follow.

Biomass pathways from resource to energy products



Source: http://www.blueplanet-energy.com/

Biomass conversion possibilities

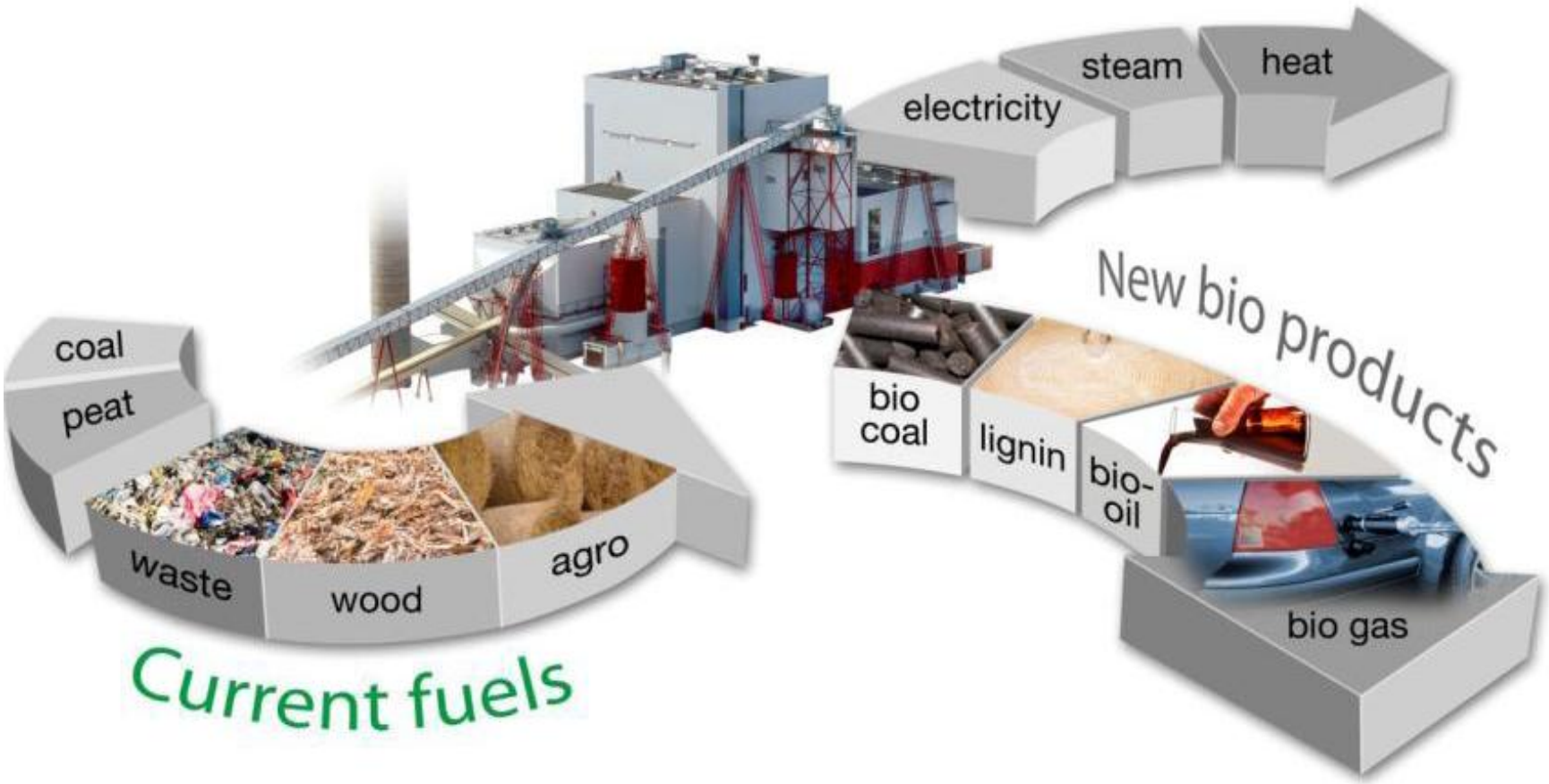
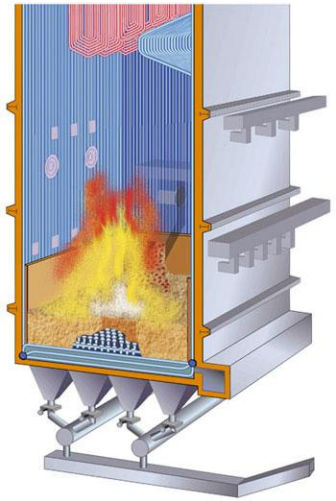
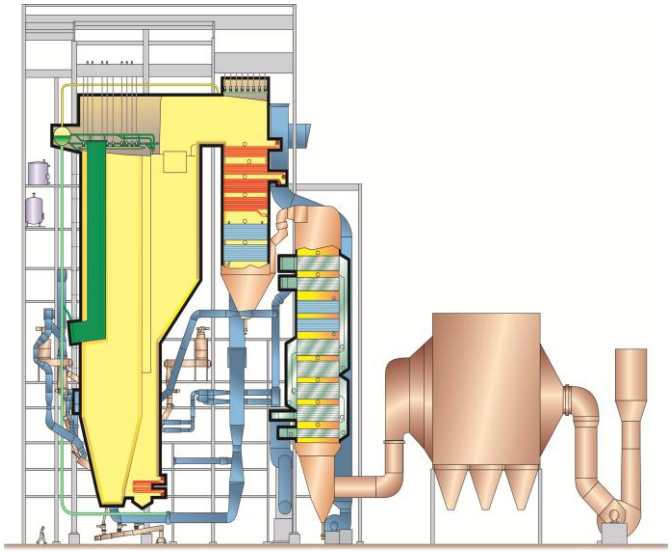


Fig. Metso

Biomass combustion for heat and electricity (CHP)

- In 2014 CHP produced 74% of the heat needed for district heating and generated 33% of electricity production in Finland
- Over 400 medium and large scale biopower and heating plants up to worlds biggest construction
- Over 50 new CHP plants (2100 MWe, 1700 MWth) and 300 DH boilers has been built since 2000
- CHP technology, fuel supply systems and logistics are globally well known, e.g. Metso, Andriz, Foster Wheeler





Biomass pyrolysis
Fortum's Joensuu pyrolysis plant

- Total investment cost 33 M€, (investment grant 8 M€)

- Demonstration plant to produce bio oil, by pyrolysis, from forest residue and other biomasses
- Bio oil can be used instead of heavy fuel oil
- Annual production 50,000 tons from 225,000 m^3 of forest residue and sawdust
- Helps reduce CO_2 emissions by 59,000 tons per year
- Reduces sulphur emission by 320 tons per year
- Turnkey delivery, start-up in autumn 2013

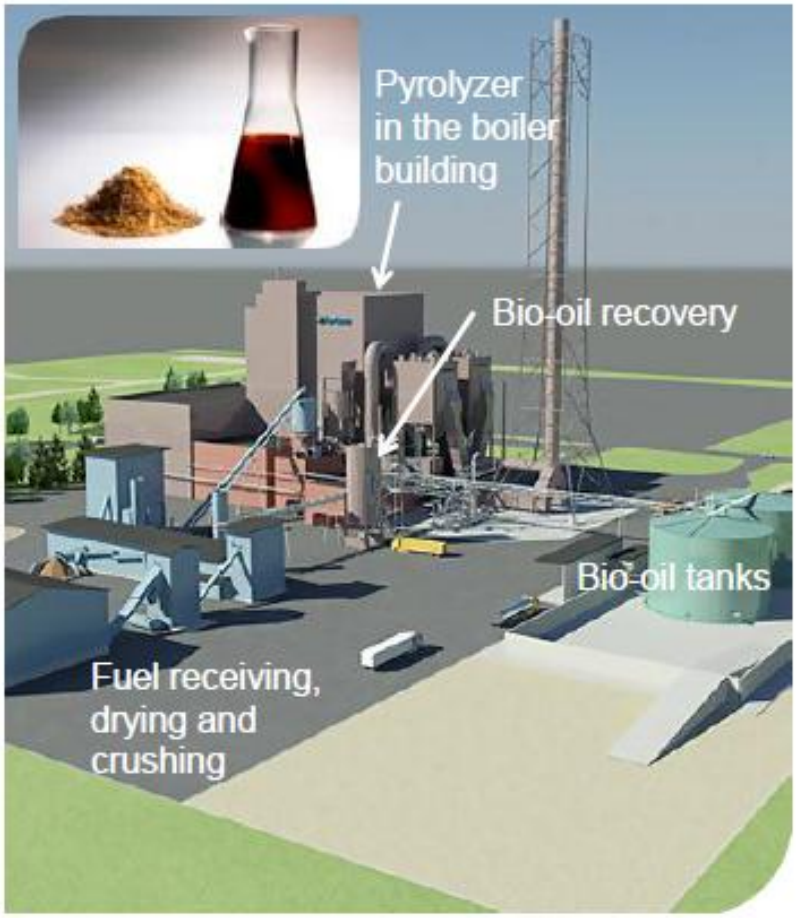


Fig. Metso

Biomass gasification

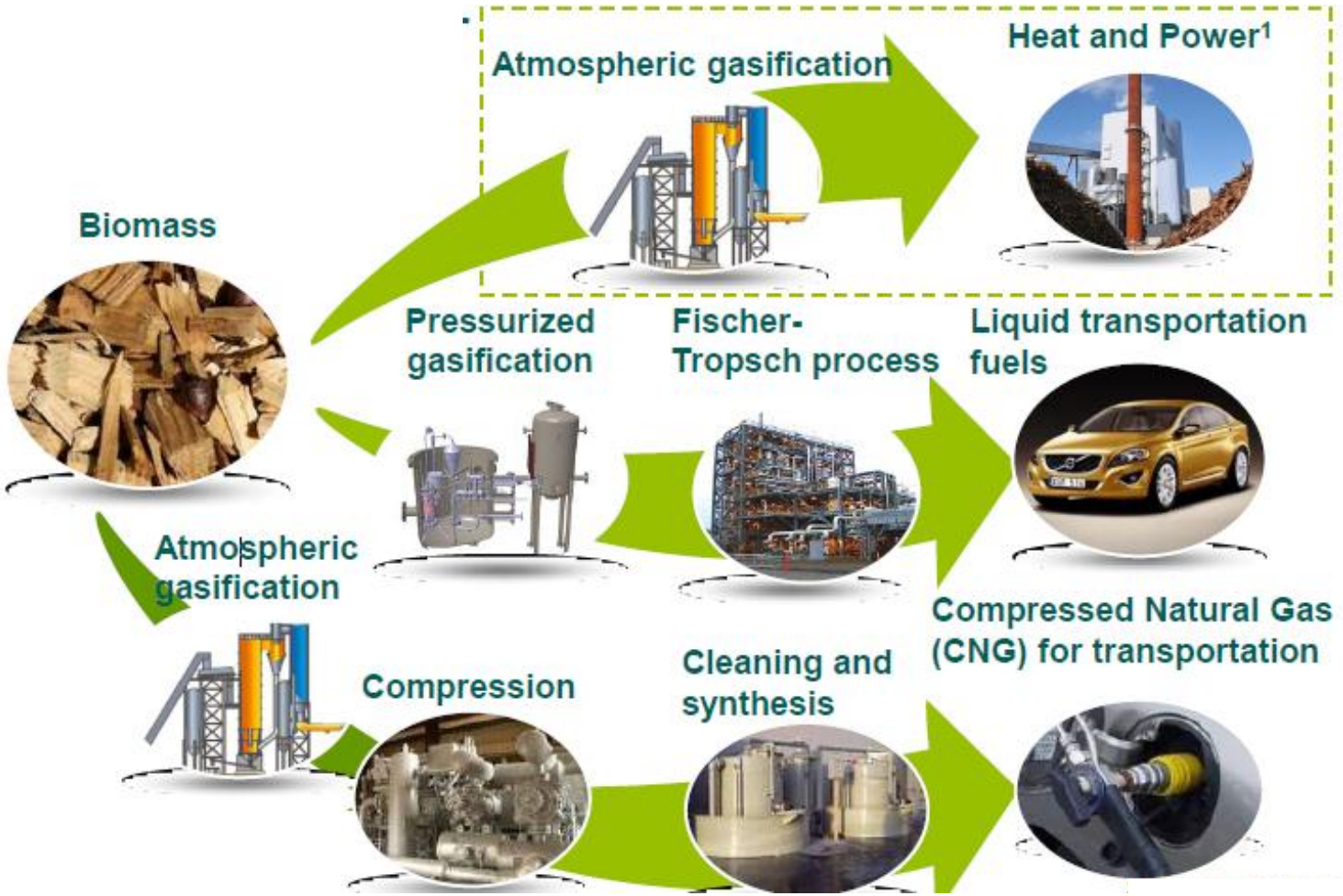


Fig. Metso

CFB gasifier for Vaskiluodon Voima, Vaasa

- Vaskiluodon Voima biomass gasification to supplement coal (25-40%) in PFC boiler, commissioned in March 2013
- Capacity 140 MW, adjoined to existing coal-fired 560 MW CHP boiler
- Investment 40 M€ (investment grant 10.8 M€)

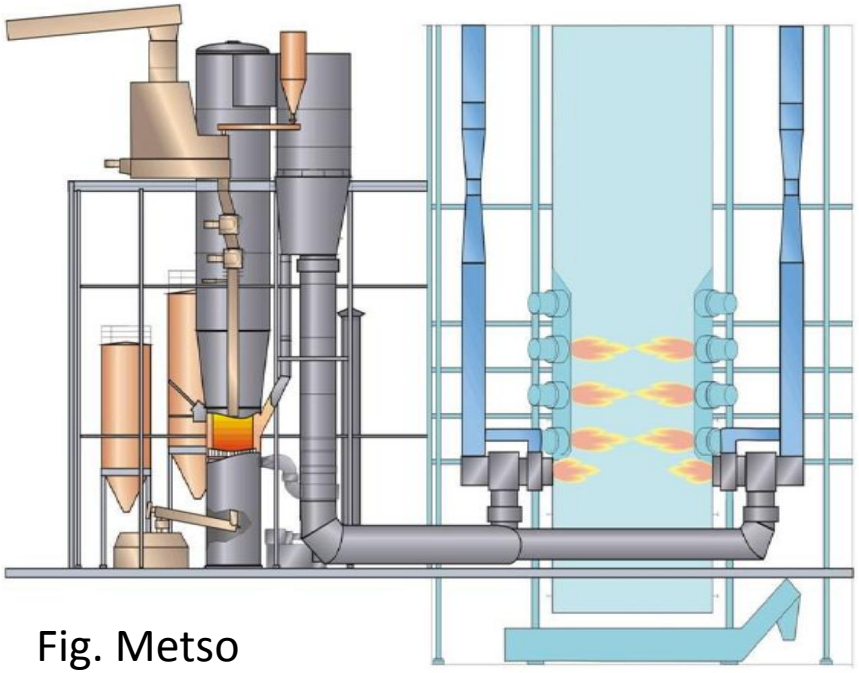


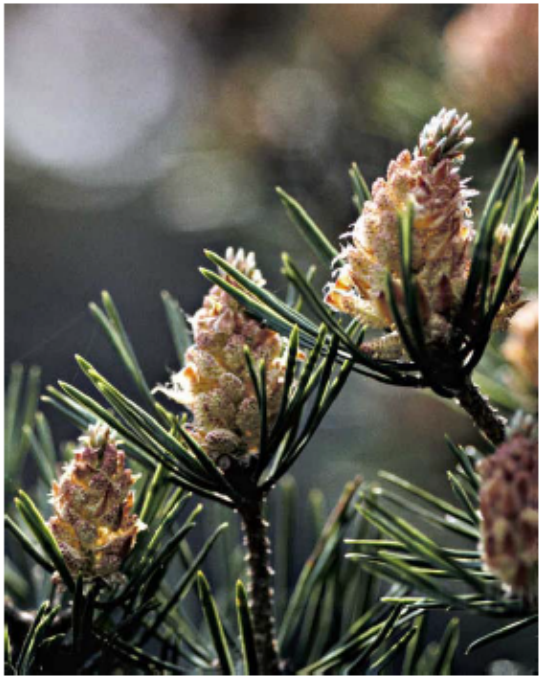
Fig. Metso

Next generation pulp mill – bioproduct mill

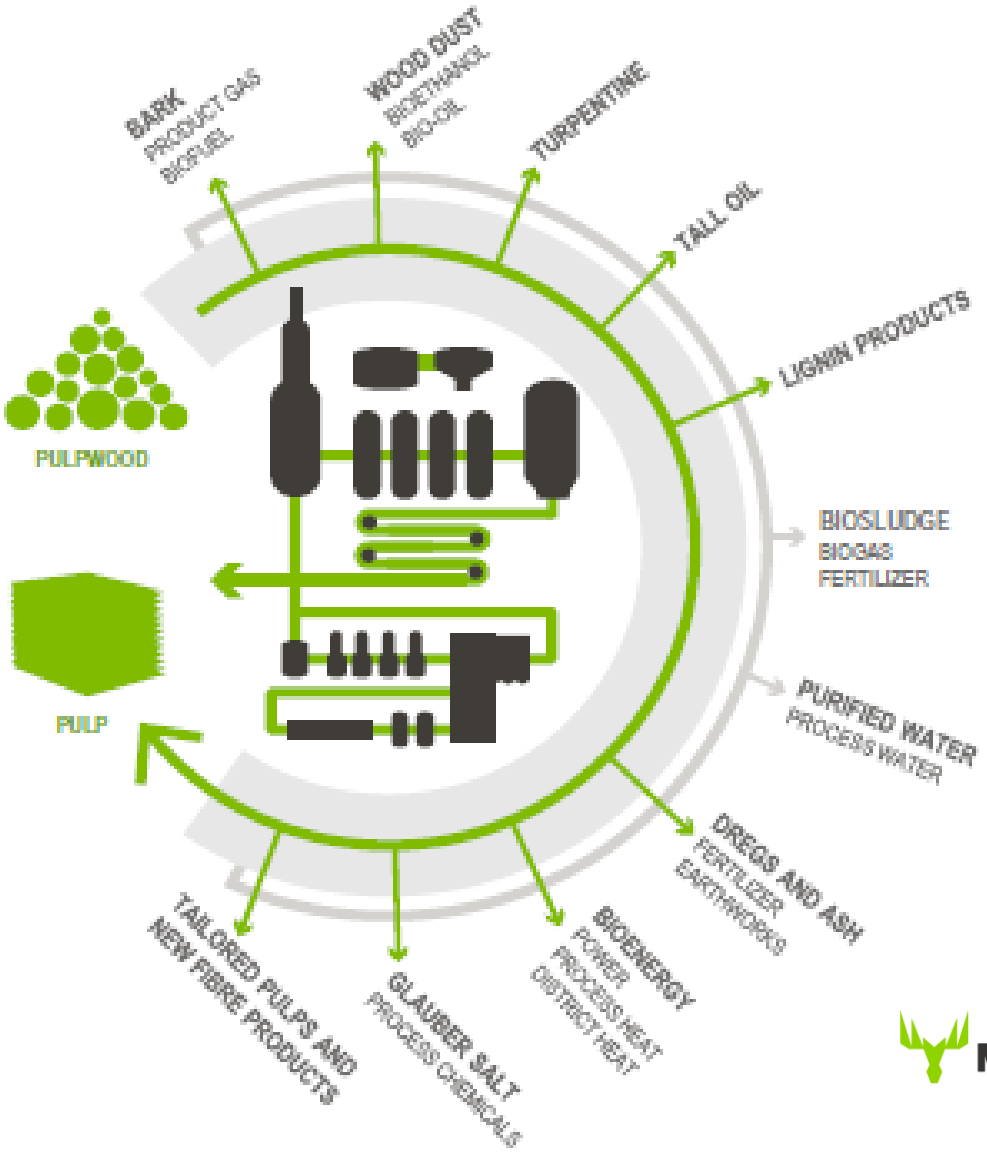
Next generation pulp mill – bioproduct mill

The first next-generation bioproduct mill in the world

- The biggest investment in the forest industry in Finland
  - EUR 1.1 billion
  - Annual pulp production 1.3 million tonnes (currently 0.5)
  - Use of wood 6.5 million m³ annually (currently 2.4)
  - Over 2,500 jobs in the whole value chain in Finland
  - Internal financing approximately 40 per cent
- Advantages
  - Efficient production of high-quality pulp
  - Integrated production of new bioproducts
  - Resource-efficient way of using all production side streams
- Helps Finland to reach its targets for the use of renewable energy
  - Electricity generation 1 400 GWh/a
  - District heating and steam 7 000 GWh/a
  - Wood energy 1 200 GWh/a



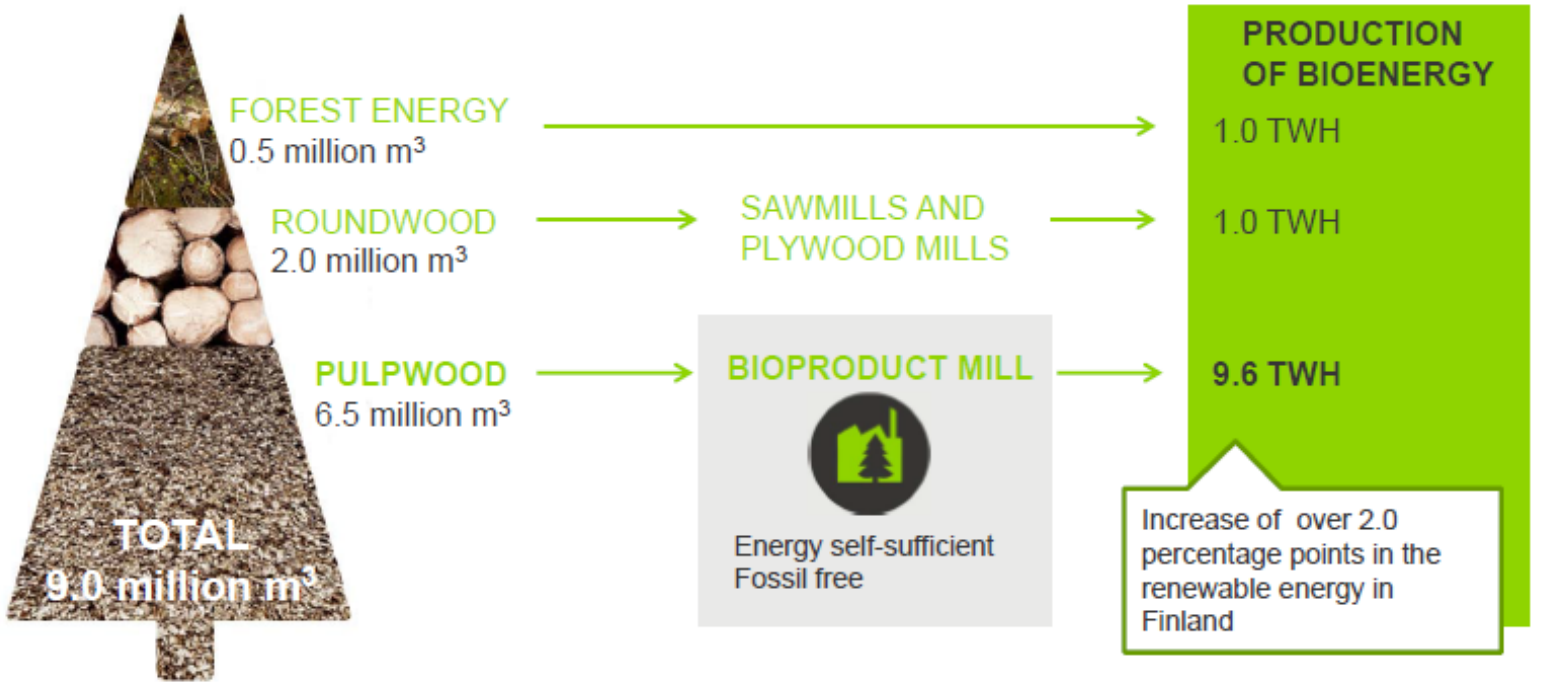
Next generation pulp mill – bioproduct mill



MetsäFibre

Next generation pulp mill – bioproduct mill

The share of bioenergy will increase



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Metsä Group

Metsä

Next generation pulp mill – bioproduct mill