

District Heating at TRU



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Outline:

1. What is Wood?

Types of Wood Biomass?

Emissions

2. Proposal for Thompson Rivers University (TRU)

3 . Carbon Neutral Legislation

Energy and Energy Densities

4. Air Quality

Areas of Concern

Precautionary Measures

Local Success Story



What is wood?

Chemical Content Natural Wood	% By Weight
Carbon (C)	49
Hydrogen (H)	6
Oxygen (O)	44
Ash (Potassium, Sodium, Calcium, Phosphorus, Silicon, etc.)	0.8 (trunk wood spruce incl. bark)

- ▶ Woody Biomass is stored solar energy through photosynthesis.
- ▶ Trees sequester the elements above over its life time.
- ▶ Once harvested, wood waste is converted into useful energy.

Types of wood biomass

Forest wood & plantation wood:

- Mature wood from trunks and tops. Needs to be <35 or 50% Wet, Processed chips or grindings with no needles, leaves or foreign matter.

Compressed wood, pellets:

- Untreated wood with limited bark content, compressed by machine.

Remnants from derived timber products:

- Usually a mixture of wood in form of shavings, chips.

Used wood:

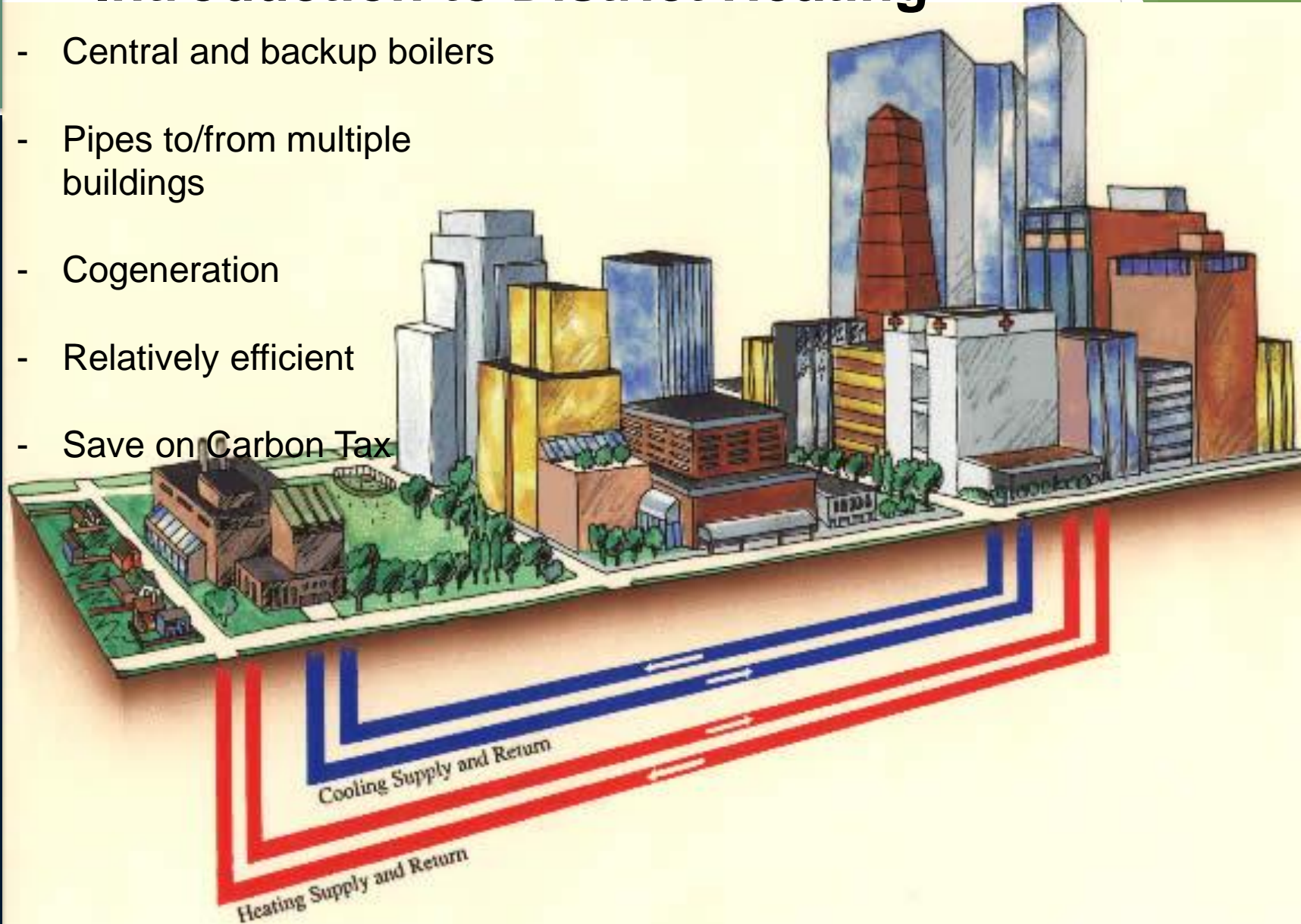
- Dimensional Lumber including: pallets and 2x4.

Need to Meet EN303-5 - G30 or G50 Specifications



Introduction to District Heating

- Central and backup boilers
- Pipes to/from multiple buildings
- Cogeneration
- Relatively efficient
- Save on Carbon Tax



PRESENTATION HEADING

Old is New Tech

Viessmann - KOB Pyrot Biomass Boiler

**10,000 KOB systems worldwide
principles of gasification with modern
technology
low emission, 85+% efficient**



1941 Adler Diplomat 3

**By 1945, end of WW2 – 9,000,000
vehicles were travelling on syn
gas all over the world.**



PROVEN TECHNOLOGY



How are the wood chips used in Europe ?

3696

plants (> 1MW)
using wood chips as
fuel have been identified
at EU28 level among them:

are Power
plants

3%

are CHP
plants

21%

are
Heat plants

75%

The average European plant size is:

H
E
A
T

5
MW

C
H
P

45
MW

P
O
W
E
R

56
MW

The average European heat plant
consumes
over dry tonnes
of wood per year

5357

EU28 top 5 countries in number of
plants using wood chips

1. France (>600)
2. Austria (>550)
3. Germany (>470)
4. Finland (>470)
5. Sweden (>310)

EU28 top 5 countries regarding
their wood chips consumptions

1. Germany (11,5 Million odt/y)
2. Finland (9,4 Million odt/y)
3. France (7,4 Million odt/y)
4. Sweden (6,2 Million odt/y)
5. Poland (5,2 Million odt/y)

73,24%

of all plants are between
1 and 10 MW* in Europe

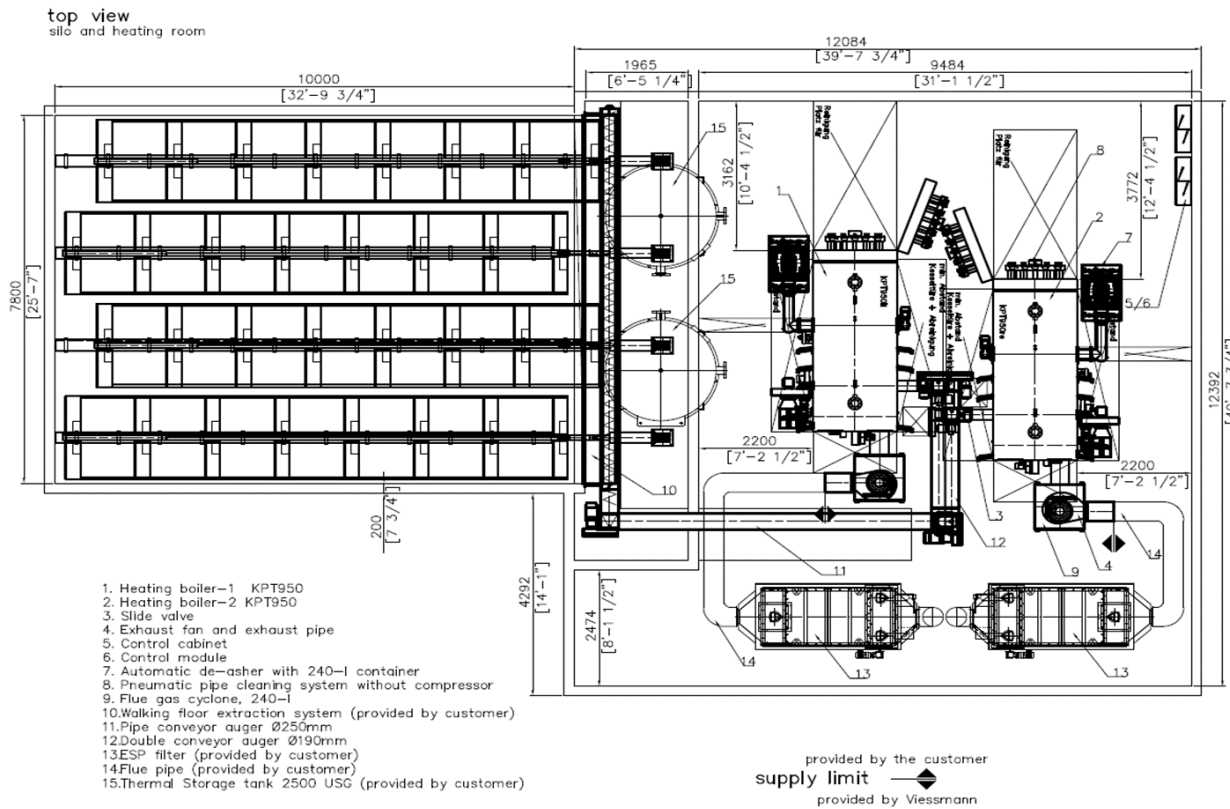




- ▶ **North Heating Pipe (825m)**
- ▶ Animal Health - 525 meters
- ▶ Warehouse - 435 meters
- ▶ New Trades/Nursing - 310 meters
- ▶ Trades - 275 meters
- ▶ New Residence - 260 meters
- ▶ Campus Activity Centre - 255 meters

- ▶ **South Heating Pipe (540m):**
- ▶ Science - 490 meters
- ▶ Gym - 400 meters
- ▶ BCCOL - 260 meters

Biomass building design - 1.9 MW



Carbon Neutral Legislation

- ▶ Under the United Nations Framework Convention on Climate Change (UNFCCC), biomass energy emissions are reported by the Agriculture, Forestry and Other Land-Use (AFOLU) sector at time of harvest and not the Energy Sector when the wood is burned.



United Nations Framework
Convention on Climate Change



Carbon Neutral



- ▶ When fully combusted, the amount of carbon dioxide produced is equal to the amount taken from the atmosphere during the growing stage which will eventually be reabsorbed by the next generation of plants/trees.

Costs and emissions

Fuel Types	Cents / kWh	Fuel Types	kg of CO2e / kWh
Wood Pellets 5% MC	2.25 - 3.5	Wood Pellets Tonne	.03895
Natural Gas	3.0 - 6.0	Natural Gas	.20435
BC Hydro	6.8 & 10.19	BC Hydro	.0000171
Heating Oil	7.0 - 9.0	Heating Oil	.266
Propane	8.5 - 11.0 (25)*	Propane	.214
Coal		Coal	.41

Energy Density

Fuel	Net Calorific Value (CV) by mass GJ/tonne	Net Calorific Value (CV) by mass kWh/kg	Bulk density kg/m ³	Energy density by volume MJ/m ³	Energy density by volume kWh/m ³
Wood chips (30% MC)	12.5	3.5	250	3,100	870
Log wood (stacked - air dry: 20% MC)	14.7	4.1	350-500	5,200-7,400	1,400-2,000
Wood (solid - oven dry)	19	5.3	400-600	7,600-11,400	2,100-3,200
Wood pellets	17	4.8	650	11,000	3,100
Miscanthus (bale - 25% MC)	13	3.6	140-180	1,800-2,300	500-650
House coal	27-31	7.5-8.6	850	23,000-26,000	6,400-7,300
Anthracite	33	9.2	1,100	36,300	10,100
Heating oil	42.5	11.8	845	36,000	10,000
Natural gas (NTP)	38.1	10.6	0.9	35.2	9.8

▶ 3,700 tonnes Wood chips (30%MC) or 2,700 tonnes wood pellets every year.

▶ \$50-130 per tonne equates to \$185,000 - \$350,000.

To Burn or to Leave in the Forest?

- ▶ If biomass is left in the forest, it takes decades for the carbon dioxide to be released back into the atmosphere through natural decay.

Benefits of burning biomass as an alternative energy source:

- ▶ Conservation of fossil fuel resources
 - ▶ Reduced impacts on global climate change
- ▶ Job creation
- ▶ Reduced fire hazards in urban/wildland interfaces
- ▶ Increased incentive for logging companies to clean up roadside debris/waste

In the Atmosphere

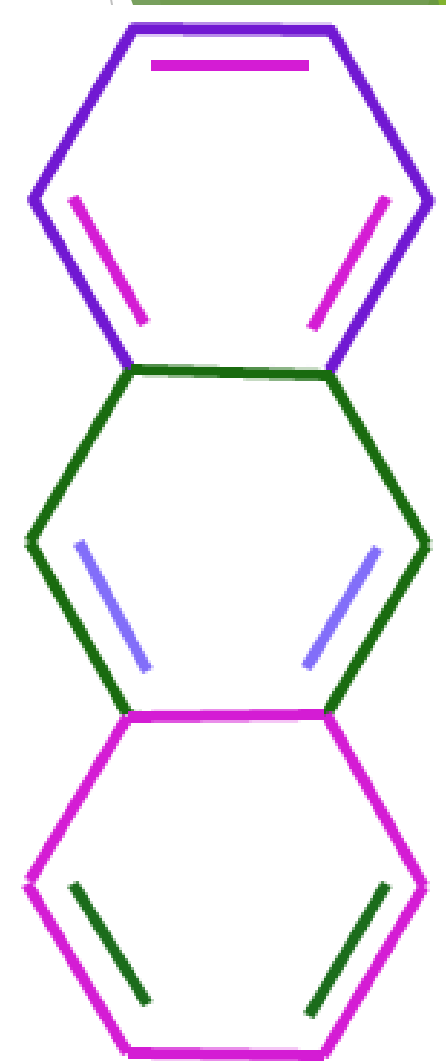
- ▶ Carbon dioxide from fossil fuel use remains in the atmosphere significantly longer than carbon dioxide from biomass can be removed through carbon sinks.
- ▶ Biomass typically absorbs quicker, taking between 10-30 years compared to fossil fuels which can take anywhere from 45 to 90 plus years.



Source: <https://commons.wikimedia.org/wiki/File:Sun-in-the-sky.jpg>

Residues of Burning Biomass

- ▶ Concerns include:
 - ▶ Carbon particles and soot
 - ▶ Unburned wood dust
 - ▶ Polycyclic aromatic hydrocarbons (PAH) compounds
 - ▶ Semi-volatile organic compounds
 - ▶ Ash (minerals, metals and dirt)
- ▶ Advancements in technology and efficiency can reduce these concerns.



Source: <http://chemistry.tutorvista.com/organic-chemistry/hydrocarbons.html>

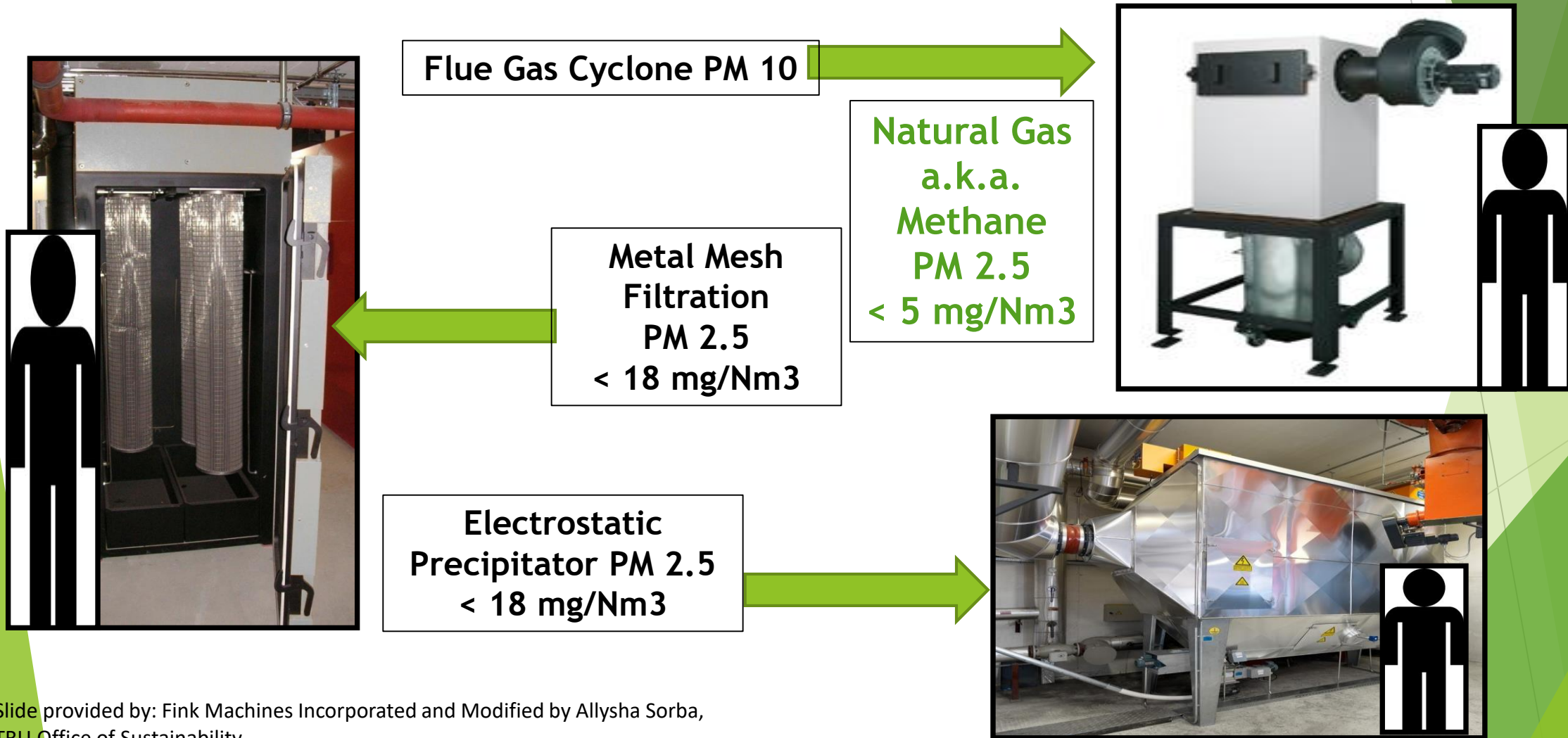
Precautionary Measures



Source: http://www.123rf.com/photo_936100_a-floor-texture--pattern-of-some-wood-chips-and-bark.html

- ▶ Precautionary measures TRU can take to reduce impacts:
- ▶ Continued maintenance throughout life of the boiler.
- ▶ Ensuring scrubbing technologies are up to date.
- ▶ Investigate the use of Selective Catalytic Reduction (SCR) technologies to eliminate possible nitrogen oxides from entering the atmosphere.
- ▶ Burning clean materials that do not contain trace elements of glue.

Emissions Control: GVRD 1190 - 18mg



Thank
you

Questions?



Sources

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