



## Country Update - Finland



**Industrial consortium (Valmet Power, Fortum Power & Heat, UPM)** Since 2009, Valmet has had in operation an up to 7 tpd fast pyrolysis bio-oil production pilot unit in Tampere, Finland, integrated with a conventional fluidized-bed boiler. In 2013-14 Valmet has constructed a bio-oil plant connected to Fortum's Joensuu combined heat and power production plant (CHP) in Finland. Commissioning of the plant is going on. The integrated CHP plant will produce heat, electricity and 50,000 tons of bio-oil per year. The bio-oil raw materials include forest residues and other wood based biomass. The new technology has been developed into a commercial scale concept in a collaboration between Fortum, Valmet, UPM and VTT as part of the TEKES Biorefine research programme. Fortum will use its own bio-oil to replace fossil fuels in their heating plants.

Fortum and a local Finnish energy company, Savon Voima Oyj, have agreed on starting a partnership in bio-oil delivery. The newly signed contract allows Savon Voima to replace heavy fuel oil in its heat production with Fortum's sustainable bio-oil. In the field of supplying bio-oil, Savon Voima is Fortum's first commercial partner in Finland.

More recently, the industrial consortium has launched a new publicly funded project, the aim of which is to develop catalytic pyrolysis technology for the production of high value advanced lignocellulosic fuels.

Work towards standardisation has been made within IEA co-operation projects since the 1980's. A Working Group (WG41) was established in early 2014 under TC19 (CEN technical committee Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin). Fortum is the convenor and the Finnish Petroleum Foundation acts as the secretariat. Two draft grades for EN standards are presently under preparation. The work is anticipated to be ready in 2017.

**Green Fuel Nordic.** Green Fuel Nordic (GFN) Oy's plan is to build up to 20 biorefineries in Finland, each producing 90 000 tons of renewable fuel oil annually. The planning phase for GFN's first biorefinery in Iisalmi has been completed.

**VTT (Technical Research Centre of Finland).** VTT's focus is on helping the industrial consortium (Fortum, Valmet, UPM) in their efforts to commercialize fast pyrolysis technology. Besides this, upgrading research in topics such as catalytic pyrolysis, hydrotreating, FCC co-feeding, blending, and esterification is being carried out. Development and validation of analytical methods crucial for commercial use and standardisation is made. Modelling work using our own experimental data has been carried out in collaboration with PNNL. Besides the on-going research projects, VTT is in the

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process of relocating their thermochemical conversion facilities to a new site inside the city of Espoo. In addition to moving some of the already existing experimental units (1 kg/h fluid-bed unit, continuous-flow 30 g/h hydrotreatment unit) a new fast pyrolysis pilot unit is currently under construction. The new unit (0.5 t/d), which has been designed as a co-operation between VTT and Valmet, will replace VTT's previous fast pyrolysis Process Development Unit. It will be used in both fast pyrolysis and catalytic pyrolysis research.

**University of Eastern Finland** (UEF) in Joensuu are developing analytical facilities like high-resolution mass spectrometry 12-T ESI/APPI Qh-FT-ICR MS for characterization of the heavy polar fraction of fast pyrolysis bio-oils.

**Lappeenranta University of Technology** (LUT) in Lappeenranta has studied the requirements and alternatives for transportation of fast pyrolysis bio-oil. **Aalto University** in Espoo studies thermodynamics, and builds process and thermodynamic models. They conduct research in high temperature and high pressure H<sub>2</sub> and CO solubility in pyrolysis oil using model components and mixtures and phase equilibria measurements of aqueous systems for the possible separation of chemicals.