RWE's biomass power station in Markinch: What might the environmental and public health impacts be?

In March 2014, commissioning of RWE's biomass plant next to the Tullis Russell paper mill started. At this time (mid-May), the plant is not yet fully operational, thus the environmental and public health impacts will not be fully felt. Full commissioning appears to have been delayed by technical problems. Looking at similar plants elsewhere, however, can give a good idea of what to expect.

Background:

The original idea behind the Markinch biomass plant was to replace Tullis Russell's coal and gas-fired combined heat and power (CHP) plant with one burning biomass. The old fossil-fuel CHP plant had to be shut down because it breaches an EU Directive on air emissions. Supplying the paper mill with all the heat and electricity needed to run it would have required a 17 MWe CHP plant replacement. Yet the power station which RWE built is far bigger than what Tullis Russell required– first they got permission for it to be 49.5 MW and then for it to expand to 65 MW of electricity capacity!

Instead of having a medium-size biomass CHP plant, Markinch has ended up with the largest dedicated biomass power station in the UK and one of the largest in Europe. The plant will also qualify as Scotland's largest waste incinerator, i.e. the largest plant regulated under the EU Waste Incineration Directive.

RWE state that they will be burning up to 425,000 tonnes of wood a year. However this figure is unverified and appears conservative, given that they cited a 400,000 tonne figure before increasing the plant's capacity by another 15.1 MW.

There is one simple reason why RWE has built a far bigger power station than required by the paper mill: Subsidies. Under the Renewables Obligation, RWE would have received around £11.7 million in renewable electricity subsidies every year for running a biomass plant the size needed by Tullis Russell. For running a 65 MW power station, they will net around £45 million a year.

What will be burned at Markinch?

Log piles at RWE's Bowhill site, Cardenden

RWE have planning consent and an environmental permit for burning any type of biomass.

The company states that waste wood (including chipboard and MDF, i.e. medium density fibreboard) will account for 90% of the feedstock and that the rest will be virgin wood. They have announced supply contracts for waste wood with Fife Council, DJ Laing, Stobart Biomass and SITA – the single biggest supplier.

SITA will supply 200,000 tonnes of waste wood a year to Markinch – which is 50% of the feedstock RWE said they would need to run the plant as a 49.5 MW rather than a 65 MW one. SITA has set up three new wood processing facilities for this purpose: Binn Farm in Perthshire, Ellington in Northumberland and Clifton Marsh near Preston. They will also be importing waste wood for Markinch via Ridham Port in Kent and Brightingsea Port in Essex[1].

Even if, in future, 90% of the wood might be waste wood, RWE's Bowhill site, which supplies the power station, stores very large piles of roundwood, ready for chipping. Many of the logs appear to be of large-diameter and good quality, suggesting that they are being diverted from sawmills for burning.

Air emissions and public health

[1] http://www.letsrecycle.com/news/latest-news/wood/sita-uk-begins-deliveries-of-waste-wood-to-rwe-plant

RWE claim that the Markinch power station will be far cleaner than the previous coal-and-gas CHP plant and that local residents have nothing to worry about it. The plant manager, Ian Gaunt, has been cited in the local media as claiming: "*The boiler technology is state of the art from Finland and is waste directive compliant, burning at a minimum of 850 degrees for a minimum of two seconds, while the plume of what some people have refereed to from the stack is actually nothing more than water vapour*."[2]

Mr Gaunt's claim is clearly misleading: RWE's Air Quality Assessment provided to SEPA and the planning authority confirmed that emissions would include dust, organic carbon, carbon monoxide, nitrogen oxides, sulphur dioxide, hydrogen chloride, hydrogen fluoride, cadmium, mercury, antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, cadmium and dioxin and furans – though they promised that those emissions would fall within levels permitted under the EU Waste Incineration Directive[3].

How will the biomass plant compare to the old coal-and-gas fired CHP plant?

The biomass CHP plant will indeed have more modern emissions controls than the old coal-and-gas CHP plant, built 60 years ago.

However, since 2010, that CHP plant had increased the proportion of gas compared to coal in the fuel mix, reducing levels of small particulates and nitrogen oxides below those predicted by RWE for the new power station.

Here is a comparison between emission levels for three major pollutants over the past few years with those predicted by RWE for the biomass CHP plant[4]. Actual emission figures from the new power station will not be available for over a year.

Year	**PM10 (small particulates)**	**NOx (nitrogen oxides)**	**SO_2 (sulphur dioxide)**
Predicted	30 t	600 t	150 t
2012	25.7 t	417 t	583 t
2011	28.8 t	596 t	1,060 t
2010	36 t	640	1,125 t

Clearly, running the outdated CHP plant on gas alone (let alone replacing it with a modern gas CHP plant) would have resulted in significantly less air emissions than replacing it with a biomass plant. Gas contains less sulphur than biomass (which, in turn, contains less than coal), so in such a scenario, even SO_2 emissions would have been lower than they will be in future. Only some of the pollutants will be monitored and even for those, figures will not be published by SEPA until mid-2015.

How does biomass burning compare to coal or gas?

Burning gas emits less of all air pollutants than burning coal or biomass. With the same technology, emissions from burning virgin wood are similar to those from burning coal though, as shown below, burning treated waste wood emits far more toxins than burning

[2] http://www.fifetoday.co.uk/news/local-headlines/behind-the-scenes-at-new-markinch-biomass-plant-1-3344731

[3] Environment Report, PC Application to SEPA – Tullis Russell Combined Heat and Power plant , July 2011

[4] Based on figures from the SEPA pollution inventory http://apps.sepa.org.uk/spripa/Search/ByCompany/Results.aspx?Company=Tullis compared to those contained in RWE's Environmental Permit

virgin wood. Biomass emits less of some pollutants than coal – especially sulphur dioxide - but more of others, including volatile organic compounds and more of the very smallest particulates (PM2.5). A detailed analysis of permitted biomass plants in the US shows that most emissions are higher per unit of energy for biomass than for coal when the same technology is used.[5]

Will the plant use Best Available Technique?

RWE's public references to using 'Best Available Technique' are misleading, albeit not legally false: Best Available Technique (BAT) comprises a range of technologies approved under EU and Scottish legislation – not just the very 'best' mitigation systems. BAT can mean second or third best. As RWE's permit application to SEPA shows, in this case BAT means third best as far as nitrogen oxide (NOx) emissions are concerned. The application states that the lowest levels of nitrogen oxides (NOx) that could be achieved for a plant using more expensive technology, would be 173 tonnes a year - but the cheaper option they have chosen would result in at least 424 but possibly 600 tonnes of NOx annually.[6]

It is true that burning biomass at a temperature of 850°C will keep down levels of different types of pollutants, including dioxins and furans and small particulates. However, such temperature levels can only be guaranteed when the plant is running without interruption. Emission levels spike during startup and shutdown of the boilers, which happens regularly, both for routine maintenance and as a result of any technical problems. RWE do not expect the biomass boilers to operate continuously – they have installed two gas-fired boilers for backup during predicted outages.

What additional toxins are emitted when burning waste rather than virgin wood?

Burning waste wood emits greater quantities and a greater range of toxins than burning virgin wood. Waste wood may have been treated with Copper Chromium Arsenic, Copper Organics, Creosote, Light Organic Solvent Preservatives, micro-emulsion, paint/stain or varnish and it may contain traces of toxic solvents, fungicides and insecticides[7]. Burning treated waste wood rather than virgin wood emits significantly more arsenic, chromium, copper, lead, mercury, dioxins and furans and potentially pentachlorophenol (a toxic biocide).[8]

Wood dust and public health

Airborne wood dust from woodchipping and wood chip storage is a serious concern. It is likely to particularly affect the area around RWE's wood processing and storage site in Auchterderran/Cardenden.

Wood dust is classed as a Group 1, i.e. a proven carcinogen, by the International Agency on Cancer[9]. This is based on studies of workers exposed to wood dust over lengthy periods, who are at an increased risk of nasal and sinus cancers. Occupational exposure to wood dust is also an accepted cause of asthma and dermatitis and has been linked to allergic and non-allergic respiratory effects and various nasal problems. [10] Unfortunately,

[5] http://pfpi.net/wp-content/uploads/2014/04/PFPI-Biomass-is-the-New-Coal-April-2-2014.pdf
[6] Permit Application, PPC\A\1096556, 16.9.2010
[7] ww2.wrap.org.uk/downloads/Options_and_Risk_Assessment_for_Treated_Wood_Waste.015ec005.2237.pdf and www.buildingconservation.com/articles/toxic/toxic.htm
[8] Air Pollution from Biomass Energy, Partnership for Policy Integrity, http://pfpi.net/air-pollution-2
[9] http://monographs.iarc.fr/ENG/Classification/
[10] www.hse.gov.uk/coshh/industry/woodworking.htm and www.cdc.gov/niosh/pel88/wooddust.html

no studies have been published that distinguish between dust from virgin wood and from chemically treated wood, which will contain many more toxins. Virtually no studies look at the effects on communities exposed to wood dust long-term – except for one study of a US community living next to a wood processing plant.[11] It found that residents exposed to wood dust "had significantly more cancer, respiratory, skin, and neurological health problems" than an average population. Residents near woodchipping facilities in Shoreham-on-Sea, Avonmouth (near Bristol) and Mossley (Tameside) have reported health problems, especially respiratory problems and sore throats, however no statutory body has shown any interest in investigating these concerns. There is no legislation specific to wood dust. SEPA monitors dust deposition in general but does not distinguish between different types of dust. Furthermore, their English/Welsh counterparts, the Environment Agency, have admitted that the evidence base for the guidance on dust limits is 'not particularly robust'.[12]

Other local impacts

Concerns about ***noise*** have been raised, including at a public meeting. Regular noise complaints have been reported about other biomass power stations, including in the US[13]. There appear to be three sources of noise from the Markinch biomass power stations:

+ Alarms: Different alarms have been reported primarily at night, including a very loud alarm. It is not known what triggers the alarms, but there are concerns that the loudest one may relate to health and safety concerns, perhaps wood dust levels;

+ Regular beeping noises from trucks;

+ Loud venting noises:
http://www.youtube.com/watch?v=7jt_srWoRNs&feature=youtu.be

RWE have spoken about 80 ***trucks*** – i.e. 160 truck movements – a day for the biomass power station[14], but this figure appears to be based on the original 49.5 MW power station plan. Planning documents for the 65 MW application spoke of a 'small net increase' compared to that forecast[15], but no exact figures have been published.

Sustainable and low-carbon wood?

The type and indeed the quantity of virgin wood that will be burned at the Markinch power station are not known. Burning wood from whole trees is widely accepted to result in greater CO_2 emissions than burning coal (per unit of energy) over a period of at least several decades[16]. This is due to the fact that wood is significantly less energy dense than fossil fuels, so more of it has to be burned to produce the same amount of electricity or heat. This results in greater upfront CO_2 emissions – and while it takes minutes to burn wood from a tree, it takes many decades for a new tree to grow and re-absorb all of that carbon.

[11] Health effects on nearby residents of a wood treatment plant, J. Dahlgren et al, Environ.Res, June 2003, www.ncbi.nlm.nih.gov/pubmed/12854688
[12] Monitoring of particulate matter in ambient air around waste facilities, Technical Guidance Document M17, Environment Agency, http://persona.uk.com/kings_lynn/Core_docs/Q/Q1.pdf
[13] http://www.energyjustice.net/content/biomass-incinerator-noise-nightmare-neighbors-biomass-monitor
[14] http://www.cmclinnovations.com/wp-content/uploads/2013/06/MarkinchCMCLInnovations2013.pdf
[15] http://publications.1fife.org.uk/uploadfiles/publications/c64_Item13-Complete3.pdf
[16] http://www.biofuelwatch.org.uk/resources-on-biomass/

However, the majority of wood to be burned in Markinch will be waste wood and waste wood incineration is widely assumed to be very low-carbon. However, this is based on the assumption that the wood would otherwise be landfilled. In reality, waste wood not burned for energy is far more likely to be turned into wood panels or used for other purposes (e.g. animal bedding or mulches for soils). Until 2012, the biggest user of recovered waste wood was the wood panel industry – now it is the bioenergy sector[17]. If waste wood is turned into wood panels, its carbon will be stored long-term, so burning it instead (and thus releasing all of its carbon) is clearly not good for the climate. Competition with the wood panel industry for waste wood is a growing concern and the Markinch power station significantly contributes to it.

[17] http://www.letsrecycle.com/news/latest-news/wood/biomass-is-now-largest-market-for-waste-wood