



**THE MULTIPLE FAILURES OF BLACK
PELLET TECHNOLOGIES – A RECENT
HISTORY OF FALSE PROMISES,
COMPANY BANKRUPTCIES AND
MOTHBALLED PLANTS**

By Almuth Ernsting 17th September 2021

BACKGROUND AND SUMMARY:

Worldwide, the production and burning of wood pellets for heat and electricity generation is rapidly increasing, as is the international pellet trade, in particular from North America to Europe and to East Asia. The wood pellets that are traded today, also called 'white pellets', can be burned in many types of installations. However, they have three drawbacks for energy companies:

Firstly, they are relatively bulky, resulting in higher transport costs, compared, for example, to coal.

Secondly, their chemical properties are very different from coal. Therefore, expensive boiler equipment upgrades are needed to if a either co-fire a high proportion of wood pellets with coal or convert a whole unit of a plant to burning just wood pellets.

Thirdly, even with boiler upgrades, the combustion conditions required by most coal plants prevent them from burning large amounts of biomass other than pellets made from clean wood with a low bark content produced from relatively slow-growing trees.¹ To burn any other type of biomass – for example from wood from eucalyptus plantations - energy companies need to instal different boilers, which is even more expensive than upgrading existing ones.

Not surprisingly, there are strong industry interests in developing wood pellets that overcome those limitations. In order to improve the fuel characteristics of wood pellets, two

different technologies are being developed: Torrefaction and steam explosion, both of which produce black pellets or black briquettes. A third technology, hydrothermal carbonisation (HTC) is being developed to turn high-moisture biomass into a black powder, called hydrochar, with fuel properties similar to coal. Each of these technologies is described in this report, as are different companies' attempts to commercialise them.

Altogether, we identified five companies that have invested in commercialising black pellets produced through steam explosion of wood, and 17 companies or company partnerships that are trying - or have tried - to produce commercial quantities of torrefied wood products. None of these attempts have been successful so far, i.e. no company has so far achieved continuous operation of a black pellet plant to meet commercial contracts, as opposed to supplying only small quantities for testing purposes. In five cases, companies built plants supposedly capable of producing white and black pellets, but there is only evidence of conventional wood pellet production, called "white pellet" production.

As far as HTC technology is concerned, we found no example of any investment in a commercial-scale plant, only investments related to Research & Development, although one company appears to be referring to their future plans to produce just 3,000 tonnes of pellets as "commercial scale", though this small quantity would not really qualify as such.

¹ See the findings by Drax Plc from their pellet firing tests in 2012: biofuelwatch.org.uk/docs/DECC%20FoI%20EIR%2013-0340%20Q1%20Documents%20Drax%20etc%209May%202013.pdf.

The reasons for the growing number of failed black pellet ventures is not discussed here in detail, however, from the evidence presented it is clear that they relate to problems with achieving the fuel qualities envisioned, problems with maintaining continuous production, and a failure to substantially reduce the high cost of production.

Energy companies such as Tejo Energia plans to burn black pellets in their coal plants, with several pellet companies continuing to 'promise' black pellet production. As this report shows, the prospects of commercial-scale black pellet production and use remain slim, barring any major technological breakthrough in future.



Torrefied (left) and non-torrefied wood pellet fuels

METHODOLOGY:

This overview of black pellet production is based on desktop research. Where companies had announced the commissioning of black pellet plants but no concrete information about black pellet sales could be found, we contacted the companies directly to ask how many black pellets they have been producing. Only one company (Restoration Fuels/Oregon Torrefaction, LLC) responded to such an information request, confirming that they had not supplied any black pellets so far.

By far the largest number of companies investing in black pellets have been investing in torrefaction technology. We

have looked at each of the members of the International Biomass Torrefaction Council (IBTC).² Those IBTC members not mentioned in this report have either not included torrefaction in their portfolio so far, or are engaged purely in relevant research projects, i.e. not in commercial developments involving torrefaction. In addition to IBTC members, we have also looked at each of the companies mentioned in a 2021 report about torrefaction by the Council of Western State Forests,³ and a 2020 presentation about an EU project called Market Uptake Support for Intermediate Bioenergy Carriers.⁴



² ibtc.bioenergyeurope.org/

³ [westernforesters.org/sites/default/files/Torrefaction%20Report%20prepared%20for%20the%20Council%20of%20Western%20State%20Foresters%20by%20Future Metrics%20-%20Janaury%202021%20%281%29.pdf](https://westernforesters.org/sites/default/files/Torrefaction%20Report%20prepared%20for%20the%20Council%20of%20Western%20State%20Foresters%20by%20Future%20Metrics%20-%20Janaury%202021%20%281%29.pdf)

⁴ [music-](https://music-h2020.eu/Deliverables_upload/D2.1_Series%20of%20PowerPoint%20presentations%20on%20lessons%20learned%20from%20earlier%20projects.pdf)

[h2020.eu/Deliverables_upload/D2.1_Series%20of%20PowerPoint%20presentations%20on%20lessons%20learned%20from%20earlier%20projects.pdf](https://music-h2020.eu/Deliverables_upload/D2.1_Series%20of%20PowerPoint%20presentations%20on%20lessons%20learned%20from%20earlier%20projects.pdf)

TORREFACTION:

What is it?

Torrefaction involves heating biomass to 200-400°C in the absence of oxygen (also called pyrolysis). This changes its molecular structure so that it becomes more brittle and hydrophobic (i.e. water repellent), with the disintegration of hemicellulose components of wood, but with lignin and cellulose components remaining intact. In theory, the gas released in the process could be used to provide the heat required for operating such a pellet plant.⁵

Who has tried producing torrefied pellets at scale?

Companies owned by Momentum Capital B.V./Perpetual Next:

Momentum Capital B.V. is a Dutch private equity firm that describes itself as “an entrepreneurial investment company” investing outside the stock market, with interests in Clean Technology, Urban Development, Lighting and Leisure sectors. Their “Sustainability Division” is operated by the spin-off company Perpetual Next. Perpetual Next’s four subsidiaries include two that focus on black pellet production through torrefaction: Clean Energy Generation B.V. (CEG) and Baltania OÜ.⁶ Another Momentum Capital B.V. subsidiary, Scandinavian BioPower OY, is not mentioned on their website and may have folded.

⁵btgworld.com/en/rtd/technologies/torrefaction_bioenergy.psu.edu/shortcourses/2018BiocharTorrefied/07_Nunes%20Presentation_sm.pdf

⁶momentumcapital.nl/en/sectors/sustainability/
⁷cegeneration.com/app/uploads/2019/11/CEG-Brochure.pdf

- *Clean Energy Generation B.V. (CEG)/Bio2Carbon Ltd:* CEG owns what they describe as a full-scale Research and Development plant in Derby, England.⁷ The company has reported occasional small shipments of black pellets, most recently for a co-firing trial at Naantali power plant in Finland in 2019.⁸ The UK business is registered as a dormant company (Clean Electricity Generation Holding UK Ltd)⁹ with its active subsidiary called Bio2Carbon Ltd.¹⁰ From their most recent reports, CEG Holding UK Ltd had negative equity of more than £5.1 million at the end of 2020, with net losses having increased year on year since the company was incorporated in 2016. Bio2Carbon’s negative equity stood at over £3.6 million at the end of 2020 and their net losses, too, have mounted year on year since they were incorporated, also in 2016. At least financially, this torrefied pellet business has clearly not been successful so far.
- *Baltania OÜ:* In 2017, Baltania OÜ announced construction of a black pellet plant in Estonia, using CEG’s torrefaction technology. Baltania is registered in Estonia but fully-owned by Momentum Capital B.V. The proposal

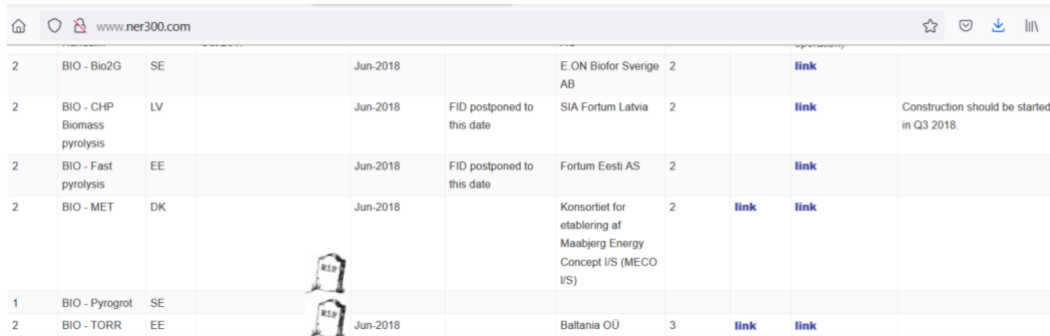
⁸cegeneration.com/ceg-and-tse-trial-1000-tonnes-of-renewable-black-pellets-at-tses-naantali-power-station-in-finland/

⁹find-and-update.company-information.service.gov.uk/company/10013671

¹⁰find-and-update.company-information.service.gov.uk/company/10013755/filing-history

attracted a pledge of €25m¹¹ from the EU's NER300 programme. NER300 is a funding programme for "innovative low-carbon technology...on a commercial scale within the EU".¹²

The NER300 website shows, this project has since been abandoned or failed:



| Rank | Project Name | Country | Start Date | Status | Company | Capacity (MW) | Links | Notes |
|------|-----------------------------|---------|------------|----------------------------|---|---------------|---|--|
| 2 | BIO - Bio2G | SE | Jun-2018 | | E.ON Biofor Sverige AB | 2 | link | |
| 2 | BIO - CHP Biomass pyrolysis | LV | Jun-2018 | FID postponed to this date | SIA Fortum Latvia | 2 | link | Construction should be started in Q3 2018. |
| 2 | BIO - Fast pyrolysis | EE | Jun-2018 | FID postponed to this date | Fortum Eesti AS | 2 | link | |
| 2 | BIO - MET | DK | Jun-2018 | | Konsortiet for etablering af Maabjerg Energy Concept I/S (MECO I/S) | 2 | link link | |
| 1 | BIO - Pyrogröt | SE | | | | | | |
| 2 | BIO - TORR | EE | Jun-2018 | | Baltania OÜ | 3 | link link | |

It is therefore surprising to find Baltania having posted a recruitment advert in July 2021, saying that the plant will soon be ready to operate, given that the NER300 funding will not be available.¹³ A query we sent to Baltania's owners, Momentum Capital remained unanswered.¹⁴ A copy of Baltania's air permit application, dated 29.1.2019 reveals that the company's plans are for a pellet plant that can also produce conventional white pellets.¹⁵ It remains to be seen whether torrefied pellets will be produced, or

whether this will simply become yet another conventional white pellet plant for export.

- **Scandinavian Biopower Oy:**
This company, like Baltania OÜ, is fully owned by Momentum Capital. In 2016, they announced plans to build a 200,000 tonne a year black pellet mill, using CEG's torrefaction technology.¹⁶ The plant was to be built in Mikkeli, a town in Eastern Finland. Two years previously, another company, Torrec Oy, had built a pilot torrefaction plant in Mikkeli, but Scandinavian Biopower opted for CEG's technology instead. No announcement has been made since 2016, and it appears that the plant has not been built. Momentum Capital no longer lists this company as a subsidiaries.

Other companies:

- **Advanced Fuel Solutions S.A. (AFS) and Yser Green Energy S.A. (YGE):**
AFS and YGE are sister companies with the same postal address.¹⁷ There has been no activity on either website since 2015, a query sent to AFS in July 2021 has remained unanswered, and the contact phone number on the YGE website is disconnected.¹⁸

AFS had stated that they built a pilot plant with a capacity of 3,000 tonnes a year for product development and process improvement. The project

¹¹biomassmagazine.com/articles/14876/dutch-firm-invests-53-million-in-estonia-biocoal-plant

¹²ec.europa.eu/clima/policies/innovation-fund/ner300_en

¹³tootukassa.ee/toopakumised/laborant-610377?src=ao

¹⁴Query submitted via Momentum Capital's contact form 29th July 2021

¹⁵Copy of the air permit application obtained by Biofuelwatch via Estonian Fund for Nature

¹⁶bioenergyinternational.com/pellets-solid-fuels/scandinavian-biopower-plan-to-invest-in-a-200-ktpa-biocoal-plant-in-finland

¹⁷ygenergia.com/yge302/contacts.php and <http://adfuelsolutions.com/en/contacts-torrefied-biomass/>

¹⁸Attempt to call 30th July 2021

was financially supported by the regional authority, the Portuguese state, and the EU.¹⁹ In 2016, the US company Aeon Energy Solutions Inc (AES) reported that AFS had purchased a 100,000 tonne per year torrefied pellet plant from AES's commercial partner, Kansas-based Konza Renewable Fuels.²⁰ However, the opening of this plant has never been announced and it is presumed to have been mothballed. Google Maps show nothing resembling a pellet plant on the site.

While AFS/YGE appears to have had no commercial success with torrefaction, the pilot plant was used for research purposes. Prof. Dr. Leonel Nunes, spokesperson for both companies, had a peer-reviewed study published in 2020, in which he wrote that results from torrefaction experiments indicated "good potential of the studied biomasses for use in large-scale torrefaction processes and as a replacement for coal in the generation of electrical energy", but that "further tests are still needed".²¹

- *Advanced Torrefaction Systems, LLC (ATS):* ATS is a Missouri-based company, which has held patents for a torrefaction technology, since 2012/13.²² At an industry conference in 2019, ATS President Dan Harren claimed that the ATS technology, which involves catalytic oxidation of the volatile gases produced during torrefaction, overcomes all of the problems with such

technology: operational reliability, increased risk of fires and explosion, health and safety concerns for staff, and low operational efficiency.²³ Yet there is no indication on the ATS website, nor any others, that the company has sold or built any torrefied pellet plants yet, even 9 years after the US patent was awarded.

- *Agrina Fuels Ltd:* Agrina is a long-standing family-owned business in Ireland which started producing smokeless coal briquettes in the 1980s. In 2010, Agrina Fuels announced a multi-million euro investment in torrefied biomass briquettes, based on their own technology. They built a pilot plant in 2012 and, in 2019, they were awarded funding from the Western Development Commission Investment Fund.²⁴ Yet 9 years after their pilot plant was built, the only two ²⁵products marketed by Agrina Fuels are coal-based fuels. A website about their biomass project appears to not have been updated for a long time, and is not linked to their main company website.
- *Airex Energy:* Airex Energy is a Canadian spin-off from Airex Industries, supported by venture capital firms Cycle

19 ygenergia.com/news.php

20 biomassmagazine.com/articles/13855/energy-consulting-firm-launches-new-company-for-wood-fiber-sales

21 Torrefied Biomass as an Alternative in Coal-Fueled Power Plants: A Case Study on Grindability of Agroforestry Waste Forms, Leonel J. R. Nunes, Clean Technol. 2020, mdpi.com/2571-8797/2/3/18

22 atscat.com/ats-torreecat-technology/patent/ and atscat.com/wp-content/uploads/2017/04/20170427th1033-canadian-patent-torrefaction-atscat_com.pdf

23 tappi.org/content/Events/19IBBC/19IBB03.pdf

24 arignafuels.ie/2019/11/wdc-investment-fund-supports-arigna-fuels-and-its-move-towards-a-renewable-future/

25 arignabiofuels.ie/ and arignafuels.ie

Capital Management and Desjardins Innovatech.²⁶ Between 2015 and 2017, Airex Energy commissioned a plant capable of producing 15,000 tonnes of torrefied as well as white pellets a year,²⁷ based in Bécancour, Quebec. The torrefaction technology, "Carbon FX", was developed by Airex Energy itself. Airex publicly announced only one shipment of torrefied pellets: 5,000 tonnes delivered to Portland General Electric's (PGE) Boardman coal power plant in Portland, Oregon, in 2016.²⁸ PGE were conducting a trial to explore converting the plant to wood pellets, before deciding to shut the power station for good in 2020.

More recently, Airex Energy has entered into a partnership with SUEZ Group, who plan to generate carbon credits from the sale of biochar as a soil amendment.²⁹ Both torrefaction and biochar/charcoal production rely on a form of pyrolysis, i.e. exposing feedstock to high temperatures in the absence of oxygen. Any type of charcoal from wood or other biomass can be called biochar if applied to soils, so, unlike torrefied black pellets, producing biochar is not technically challenging. Claims that adding biochar can be guaranteed to increase soil carbon sequestration and/or soil fertility are not backed up by the results of scientific research.³⁰

- *BC Biocarbon Ltd:*
This is another company advertising torrefied biomass (trade name: BCB Biocoal), alongside biochar and other

products and services. BC Biocarbon is based in McBride, in northern British Columbia. A video on the company website³¹ shows a small facility shredding roundwood, although the text says the plant can also pyrolyse sewage sludge, agricultural waste, paper and packaging, plastic and rubber. According to the video, the temperature of the pyrolysis reactor is 800°C, and elsewhere on the website, it is said to be between 500-800°C. That temperature range is well above the range for torrefaction (200-400°C). A 2019 article confirms that the only product being sold is biochar, which is supplied to greenhouses, rather than torrefied wood.³²

- *Bioendev AB33:*
This Swedish technology development company was founded in 2007/08 with the purpose of developing and supplying torrefied pellet plant technology. Its pilot plant was built through a joint venture with Umeå University and the Swedish University of Agricultural Sciences in 2007, followed by a scaled-up version in 2012. In 2016, Bioendev commissioned an industrial demonstration unit with a capacity of 16,000 tonnes of torrefied pellets a year, based in Holmsund. The demonstration plant was financed by the Swedish Energy Agency, Umeå Energy and SCA (Sweden's largest private forestry company), with BRUKS as the main contractor. In 2017, the Japanese Daiwa Energy & Infrastructure Co. Ltd invested in the project. Nonetheless, the project did not succeed: in February

²⁶ airex-energy.com/en/company and bioenergyinternational.com/pellets-solid-fuels/airex-energy-inaugurate-becancour-biomass-torrefaction-plant

²⁷ pellet.memberclicks.net/assets/events/2016_Conference/veilleux%20airex%20energy%20-%20corporate%20presentation%20-%20pfi%20-%20v2.pdf

²⁸ airex-energy.com/en/media-centre

²⁹ airex-energy.com/en/media-centre/32-contributing-to-carbon-neutrality-net-zero

³⁰ biofuelwatch.org.uk/2020/what-have-we-learned-about-biochar-since-2011/

³¹ bcbiocarbon.com/work-gallery

³² therockymountaingoat.com/2019/06/mcbridess-secret-refinery-biochar-plant/

³³ <http://www.bioendev.se/>

2020, Bioendev announced the closure of its demonstration plant and issued redundancy notices to staff.³⁴

- *CMI Groupe/John Cockerel:*
This company is reported to have built a demonstration plant in Seraing, Belgium, capable of producing torrefied pellets. Its product profile also includes activation and regeneration of carbon from biomass as well as coal and other technologies. However, the dedicated website to CMI Groupe no longer exists and instead redirects to that of John Cockerill, whose last 'news' item about this venture dates back to 2011.
- *Futerra Fuels:*
In December 2018, Futerra Torrefação e Tecnologia S.A (Futerra Fuels) announced the start of construction of a pellet plant with capacity to produce 120,000 tonnes of torrefied pellets, as well as 50,000 tonnes of white pellets in Valongo, Portugal.³⁵ The technology was supplied by the Dutch company Yilkins B.V. In late 2019, the white pellet facility was commissioned and in early 2020 the black pellet unit. In February 2021, the company issued a press release saying they were planning to increase white pellet production "with modest commercial production of torrefied pellets", and that they were planning more investments "to

gradually increase production of torrefied pellets".³⁶ This indicates that they have been struggling with producing torrefied pellets.

- *HM3 Energy*
HM3 Energy has uses its own patented torrefaction technology, called TorrB® biocoal.³⁷ In 2019, the company received a grant from the US Forestry Service to conduct a feasibility study for a \$4m torrefied briquette demonstration plant in northern Arizona.³⁸ According to a 2021 report published by the Council of Western States Foresters,³⁹ HM3 Energy is currently designing a facility with a capacity of 50,000 tonnes of torrefied briquettes a year, using ponderosa pine forest wood. The briquettes would be aimed at the Japanese market.
However, this is not the first time that HM3 Energy has received public subsidies for building such a plant. In 2016, they announced the official opening of a \$4m demonstration plant in Troutdale, Oregon, with public funding from Oregon BEST, the USDA-SBIR program, the U.S. Endowment for Forestry and Communities, and Business Oregon, as well as private investment from the Japanese energy company New Energy Development (NED). The first commercial-scale plant of this type in Oregon, they said, should be ready in 2018.⁴⁰ Nothing further has been published about this development. A 2019 Google Maps image show no

³⁴ bioenergyinternational.com/pellets-solid-fuels/bioendev-shutter-torrefaction-test-and-demonstration-operations

³⁵ bioenergyinternational.com/pellets-solid-fuels/futerra-fuels-building-commercial-scale-torrefied-pellet-plant-in-portugal

³⁶ mcusercontent.com/3e1f1a1e3e8c2369b9e5784b5/files/2dbed126-78d7-4838-9515-f2d653658b6a/Joint_Communication_Statement_02_2021.pdf

³⁷ hm3biocoal.com/waste-to-energy-biocoal/ and <https://patents.justia.com/assignee/hm3-energy-inc>

³⁸ icenergyreports.com/articles/visitor.php?keyword=torrefaction

³⁹ westernforesters.org/sites/default/files/Torrefaction%20Report%20prepared%20for%20the%20Council%20of%20Western%20State%20Foresters%20by%20FutureMetrics%20-%20January%202021%20%281%29.pdf

⁴⁰ biomassmagazine.com/articles/13812/oregon-company-opens-torrefied-briquette-demo-plant

signs of any pellet production, nor any business logo, just an advert for a nearby cannabis dispensary.⁴¹

- *Konza Renewable Fuels LLC (KRF) and Aeon Energy Solutions Inc:*
This Kansas-based company was set up by Thompson Dryers and Ernest Spencer Companies in 2010. In the same year, it commissioned a small torrefaction demonstration plant in Healy, Kansas. The plant has only been used occasionally, for demonstration and showcasing purposes.⁴² Konza Renewable Fuels are advertising two torrefaction reactor models for sale. Together with their partners, Aeon Energy Solutions Inc, they announced two orders of torrefaction plants in the past: one for the failed or abandoned venture by AFS/YGE discussed above, the other by a Californian company called Western Wood Development (WWD).⁴³ Apart from that announcement in 2016, there is no mention of this company nor of any torrefied pellet plant having been built in California. At a hearing by the US House Subcommittee on Conservation and Forests in February 2020,⁴⁴ a spokesperson for Endowment for Forestry and Communities (a non-profit corporation set up by the USA and Canadian governments), announced that Endowment was developing the first commercial-scale torrefaction plant in the USA, based in Oregon. All of which indicates that the WWD plant announced did not go ahead.

Aeon Energy Solutions Inc. (“Aeon”), which at one stage partnered with KRF, was set up in 2008 to invest in several bioenergy as well as other energy technologies, including torrefaction.⁴⁵ Aeon’s website is defunct. Their most recent announcements, in 2018 and 2020, related to consultancy services for cryptocurrency miners and energy storage respectively, rather than to biomass.⁴⁶

National Carbon Technologies:

In January 2020, the Port of Stockton in California reported a trial shipment of 2,000 tons of torrefied pellets to Japan. The pellets had been produced by National Carbon Technologies at a plant in Marquette, Michigan.⁴⁷ The plant was originally built by a Delaware company called Biogenic Reagents, with financial support from the State.⁴⁸ The plant incurred financial losses from 2011 to 2016, when it was closed down, with the operators owing \$40 million in debt. In 2017, a Delaware Court approved an Asset Transfer Agreement to Sandton Capital, the owners of National Carbon Technologies, in proceedings similar to bankruptcy hearings.⁴⁹ According to investigations by the (right-wing) think tank Mackinac Center for Public Policy, Biogenic Reagents ended up defaulting on \$2.15 million of Michigan State loans. The former Biogenic Reagents and National Carbon Technologies share the

41 tinyurl.com/ytewere9

42 biomassmagazine.com/articles/12456/konza-renewable-fuels-commercializing-wood-torrefaction-in-kansas

43 biomassmagazine.com/articles/13783/aeon-energy-provides-torrefaction-equipment-to-wwd

44 agriculture.house.gov/calendar/eventsingle.aspx?EventID=1664

45 linkedin.com/company/aeon-energy-solutions-inc-/about/

46 world.einnews.com/search/AEON+Energy+Solutions/?search%5B%5D=news&search%5B%5D=press&order=relevance

47 businesswire.com/news/home/20200108005680/en/Port-of-Stockton-Reports-First-Wood-Pellet-Shipment

48 marquette.org/mvc-capital-announces-investment-in-biogenic-reagents/

49 tinyurl.com/4d8tddyr

same CEO.⁵⁰ According to National Carbon Technologies' website, the plant is capable of producing a wide range of carbon products, not all of them based on biomass. No other announcement of torrefied pellet sales can be found and the company's contact form is not accepting any messages.

- *NextFuel AB:*
This company, now headquartered in Sweden, developed out of a consortium set up by Wild & Partner, Andritz Group and Polytechnick, with research grants from Austria and the EU.⁵¹ Although NextFuel itself was founded in 2016, its torrefied briquette pilot plant has been operating in Frohnleiten, Austria since 2012.⁵² According to NextFuel's website, the plant has a capacity of 8 tonnes an hour. It has been providing feedstock for various trials by different industries and companies, presumably ever since 2012. So far, none of those trials seems to have resulted in a commercial supply contract. At the end of 2020, a Finnish financial services company, Taaleri, signed a licensing agreement with NextFuel, who would supply the technology for a 'biocoal' plant in Joensuu, Finland. If this goes ahead, it would be jointly developed by Taaleri and the municipal energy company Savon Voima Oyj.⁵³ However, there appears to be no regulatory approval and, above all, no final investment decision and thus no guarantee of the project going ahead as yet.

- *Oregon Torrefaction, LLC:*
This company – which operates under the name Restoration Fuels - was set up by U.S. Endowment for Forestry and Communities, a private-public partnership initiated by the US and Canadian governments, in collaboration with Ochoco Lumber Company and Bonneville Environmental Foundation. The US Department for Agriculture and Endowment made an initial \$4.8 million investment in the company's development of a torrefied pellet plant.⁵⁴ The plant was originally scheduled to start operating in late 2018, with a capacity of 100,000 tons a year. Only in December 2020, did the company announce completion of construction.⁵⁵ So far, as of writing, the plant has not been fully commissioned and no torrefied pellets have been supplied, as was confirmed to us via email.⁵⁶
- *Topell Energy B.V./Blackwood Technology:*
Topell Energy B.V. was a Dutch company, founded in 2008, with its own patented torrefaction process. In 2011, the company commissioned a demonstration plant in Duiven, Netherlands, which produced torrefied pellets for test firing in different plants, including in RWE's Amer Power Station. However, problems with operating the torrefied plant were reported soon after it was opened. Additional work was carried out, but by 2013/14, pellet production stopped and the company

50 michiganconfidential.com/failed-company-skipped-on-21-million-state-loan-wants-more

51 nextfuel.com/

52 greentech.at/en/new-technology-for-renewable-energy-generation-andritz-starts-up-pilot-plant-for-biomass-torrefaction-in-frohnleiten-austria-4/

53 bioenergyinternational.com/pellets-solid-fuels/taaleri-and-savon-voima-reveal-finnish-biocoal-plant-plans

54 highdesertpartnership.org/file_download/c1c85230-e8f8-4c04-b712-b88c6ecf12f4

55 restorationfuels.com/f/end-of-the-year-and-construction-is-complete

56 Email response to Biofuelwatch query by Matt Krumenauer, Restoration Fuel, 4th August 2021

eventually went into liquidation.⁵⁷ Topell Energy cited a (later reversed) Dutch government decision to stop subsidies for biomass co-firing as the reason. It seems a questionable reason: other black pellet companies, e.g. Arbaflame have been able to enter into supply contracts with energy companies even across continents (such as for the ill-fated conversion of a coal power station in Ontario to burning Norwegian pellets, discussed above). Furthermore, torrefied pellets could be used in various kinds of installations, not just co-firing with coal. Right after Topell Energy's bankruptcy, the directors founded a new company, Blackwood Technology, apparently to sell licenses for Topell instead of producing pellets themselves.⁵⁸ Blackwood's website was last updated in 2017. The majority of shares have now been bought up by a Thai company, TTCL Plc.⁵⁹

- *Torr-Coal B.V.:*
Torr-Coal is a Belgian company. According to their website,⁶⁰ they went straight from the drawing board to "a full-size industrial torrefaction plant", with a 30,000 tonnes a year capacity, located in Dilsen Stokkem. However, the same website lists the different orders for torrefied pellets met by Torr-Coal, all but one of them since 2013 of a maximum amount of 210 tonnes in total. A total of 13 combustion trials of Torr-Coal's pellets were conducted, yet not once did a plant operator enter into a supply contract with Torr-Coal

subsequent to trialling their pellets. Their website lists one 40,000 tonne a year project which involves replacing coal with torrefied wood pellets at an ArcelorMittal steel mill in Gent. However, that project does not actually involve burning pellets produced at Torr-Coal's plant in Dilsen Stokkem. A partnership with Torr-Coal, Renewi, Joanneum Research Centre, Graz University and Chalmers TU is constructing a 40,000 tonne a year plant to produce the pellets elsewhere, with funding from the EU's Horizon programme and a loan from the European Investment Bank. Production is not expected to start until the end of 2022,⁶¹ hence it will not be known for some time whether or not this project will succeed.

- *Torrec Ltd/Miksei Oy:*
Torrec Ltd started construction of a torrefied pellet demonstration plant at the Miksei Innovation and Technology Center in Mikkeli, Finland in 2013/14, with a nameplate capacity of 10,000 tonnes a year.⁶² The plant provided pellets used in a study at Laapeenranta University of Technology, published in 2017. According to the authors, although they considered the technology promising, "a lot of work should be done before torrefaction will be commercially viable".⁶³ There is no evidence of Torrec Ltd having progressed commercialisation of torrefied pellets since then.

⁵⁷ ieabioenergy.com/wp-content/uploads/2015/11/IEA_Bioenergy_T32_Torrefaction_update_2015b.pdf and agro-chemistry.com/articles/topell-restart-with-blackwood-now-we-are-financed-by-turnover/

⁵⁸ blackwood-technology.com/

⁵⁹ market.sec.or.th/public/idisc/en/FinancialReport/ALL-0000006854, Notes, March 2021

⁶⁰ torrcoal.com

⁶¹ torero.eu/ and bioenergy-news.com/news/arcelormittal-receives-eib-grant-for-belgian-biocoal-and-biofuel-projects/

⁶² http://www.ijee.ieefoundation.org/vol7/issue2/IJEE_05_v7n2.pdf and

⁶³ <https://coek.info/queue/pdf-biomass-for-industrial-applications-the-role-of-torrefaction-.html>

- *Teal Seals Incorporated (TSI):*
TSI Inc, based in the Seattle area, has a broad biomass-related technology portfolio.⁶⁴ In 2010, they started developing torrefied pellet production and, in 2015, they sold a plant with a 2 ton an hour capacity to a sugar mill in Louisiana and announced that they were building a far larger plant for the same client, presumably American BioCarbon.⁶⁵ No more recent information about TSI Inc.'s torrefied pellets can be found. However, pictures of the sugarcane bagasse pellet plant finally commissioned by American BioCarbon shows a plant producing white pellets.⁶⁶

- *Yilkins/Streekpellets:*
Yilkins is a Dutch company, also with its own proprietary torrefaction technology. Yilkins has a demonstration plant in Ruurlo. Together with Bruins & Kwast and Energiefonds Overijssel, they have set up a joint venture company, Streekpellets, which operates a "regular pellet plant" in Goor, both in the Netherlands.⁶⁷ According to a report published under the EU-Horizon programme,⁶⁸ Yilkins torrefied pellet reactor is used "only for development activities", i.e. not for commercial production. Yilkins supplied the torrefaction equipment for Futerra Fuels who, as discussed above, have been struggling with torrefied pellet production. A Biofuelwatch query to Streekpellets regarding the status of the project has remained unanswered.⁶⁹

64 <https://www.tsi-inc.net/team>

65 https://www.icabioenergy.com/wp-content/uploads/2015/11/IEA_Bioenergy_T32_Torrefaction_update_2015b.pdf and <https://bioenergyinternational.com/technology-suppliers/mantex-and-american-biocarbon-to-collaborate-on-bagasse-biofuel-analyzer>

66 <https://css-om.com/under-management/american-biocarbon>

67 bioenergyinternational.com/pellets-solid-fuels/project-streekpellets-to-build-two-plants-in-the-netherlands

68 https://www.music-h2020.eu/Deliverables_upload/D2.1_Series%20of%20PowerPoint%20presentations%20on%20lessons%20learned%20from%20earlier%20projects.pdf

69 Email sent 10th August 2021

STEAM EXPLOSION FOR BLACK PELLET PRODUCTION

What is it?

Biomass is placed in a high-pressure vessel (1-3.5 Mpa) filled with steam at temperatures of 180-240°C for several minutes. The pressure is then rapidly reduced to cause explosive decompression of the biomass. This ruptures the rigid fibre structure, i.e. changes the chemistry.⁷⁰

Who's built or tried to build black pellet facilities using this technology so far?

- *Active Energy Group (AEG):*
This UK company advertises its "Coal Switch" technology, based on steam explosion of wood. They announced the opening of a black pellet plant in Utah in February 2018 but, in September 2018, stated that they were still "working towards commercialisation", suggesting the plant had not in fact been successfully commissioned. They announced two other plants, one in Georgia, the other in Newfoundland, which they did not build. In early 2019, they announced plans for a far bigger black pellet plant in Lumberton, North Carolina and moved all equipment from Utah to that site in April that year.⁷¹ Their plans met with strong opposition from environmental justice groups and environmental NGOs.

Despite large numbers of objections, Active Energy obtained an air permit and started construction. In early 2021, Southern Environmental Law Center raised court action against AEG's subsidiaries over unlawful discharges of pollutants into the Lumber River during construction activities, without even having applied for a wastewater permit.⁷² In May, state authorities issued a Notice of Violations, resulting in construction being suspended indefinitely.⁷³ Also in 2021, AEG commissioned a pilot plant in Maine.⁷⁴ There, state regulators have raised concerns about the plant's operations and requested emissions data.⁷⁵

- *Arbaflame:*
This is a Norwegian small-scale black pellet producer, which operates a pilot plant and has a first commercial-scale black pellet plant under construction.⁷⁶ In 2015, Arbaflame started supplying black pellets to Ontario Power Generation, who had converted their Thunder Bay Power Station to burning such pellets.⁷⁷ The plant was reported to have been idle 98% of the time (a very small number of operating hours even considering that the plant was intended to operate during peak electricity demand only).⁷⁸ In July 2018, the operators, i.e. Ontario Power Generation, announced the plant's

⁷⁰ pubs.acs.org/doi/10.1021/acs.energyfuels.0c04246

⁷¹ stockmarketwire.com/company-news/AEG/Active-Energy-Group.

⁷² southernenvironment.org/news-and-press/news-feed/active-energy-sued-for-illegal-pollution-of-north-carolinas-lumber-river-from-toxic-site

⁷³ ncpolicywatch.com/2021/05/25/active-energys-controversial-wood-pellet-plant-in-lumberton-on-hold-indefinitely/

⁷⁴ proactiveinvestors.com/LON:AEG/Active-Energy-Group-PLC/rns/1001477

⁷⁵ ncpolicywatch.com/2021/05/25/active-energys-controversial-wood-pellet-plant-in-lumberton-on-hold-indefinitely/

⁷⁶ arbaflame.no/about-arbaflame

⁷⁷ arbaflame.no/technology-1

⁷⁸ tvo.org/article/why-arent-northwestern-ontarios-state-of-the-art-energy-facilities-producing-any-energy

closure following the discovery of severe boiler corrosion.⁷⁹ Clearly, Arbaflame's black pellets had not been suitable for burning in a pulverised coal plant.

In 2018, Arbaflame was chosen for the "Arbaheat" project to explore the feasibility of converting an ultra-supercritical pulverised coal plant (Maasvlakte) to black pellets, with an EU grant of over €19m. A permit for a pilot plant on the site has been approved, but no building work has been undertaken so far.⁸⁰ A Biofuelwatch query about the status of the project remained unanswered.⁸¹

- **EDF:**
In 2015, EDF embarked on the Ecocombust project, with the aim of developing black pellets from post-consumption waste wood and eventually converting the Cordemais power station from burning coal to burning such pellets.⁸² Construction of a pellet plant commenced in late 2018. Full commissioning was foreseen in 2024. In 2021, GDF Suez, the technology partner, withdrew from the project and in July 2021, EDF formally abandoned the scheme.⁸³
- **FICA-HPCI:**
This is a company jointly owned by Meridian (85%), Caisse des Dépôts (15%) and Européenne de Biomasse (5%).⁸⁴ In 2020, they commissioned a pellet plant in

Pomacle-Bazancourt (Champagne-Ardenne), with a nameplate capacity of 125,000 tonnes a year. In 2018, Valmet had supplied FICA with steam explosion equipment for a plant capable of producing black as well as white pellets.⁸⁵ Google Maps show roundwood as well as woodchips or sawdust being stored at the plant, hence the pellet plant is clearly in operation. What is not clear is what proportion of their production consists of steam exploded as opposed to white pellets. FICA announced that their steam exploded pellet production started in May 2021, but gave no information about quantities. FICA says that they call them "Green Pellets" because the term "black pellets" is associated with costly failures.⁸⁶ It remains to be seen whether this plant will be capable of sustained production of commercial quantities of green/black pellets, or whether it will become largely another conventional white pellet plant. A query sent to FICA about white and black pellet production figures remained unanswered.⁸⁷

Co-owner Européenne de Biomasse is currently proposing a similar plant in Fessenheim (Alsace).

- **Zilkha Biomass/NextGen Black Pellets LLC:**
This company opened a black pellet plant in Selma, Alabama, in 2015, using steam explosion technology developed by the Finish company Valmet. Zilkha announced plans for a second plant, in Arkansas, but

79 [cbc.ca/news/canada/thunder-bay/thunder-bay-gs-close-1.4764057](https://www.cbc.ca/news/canada/thunder-bay/thunder-bay-gs-close-1.4764057)

80 Email from Project leader Environmental permits, DCMR Rijnmond Environmental Service, 16th August 2021

81 Query sent via the Arbaheat Project contact form 2nd August 2021

82 [ifrf.net/combustion-industry-news/french-unions-suspend-strike-amid-plan-to-convert-cordemais-plant-to-fire-ecocombust-fuel/](https://www.ifrf.net/combustion-industry-news/french-unions-suspend-strike-amid-plan-to-convert-cordemais-plant-to-fire-ecocombust-fuel/)

83 [edf.fr/en/the-edf-group/dedicated-sections/journalists/all-press-releases/edf-put-an-end-to-ecocombust-a-project-to-develop-a-new-class-b-wood-based-fuel](https://www.edf.fr/en/the-edf-group/dedicated-sections/journalists/all-press-releases/edf-put-an-end-to-ecocombust-a-project-to-develop-a-new-class-b-wood-based-fuel)

84 [forumeco.fr/les-premiers-green-pellet-sont-entres-en-production/](https://www.forumeco.fr/les-premiers-green-pellet-sont-entres-en-production/)

85 [bioenergyinternational.com/pellets-solid-fuels/valmet-to-deliver-the-worlds-first-steam-explosion-system-for-black-pellet-production-in-france](https://www.bioenergyinternational.com/pellets-solid-fuels/valmet-to-deliver-the-worlds-first-steam-explosion-system-for-black-pellet-production-in-france)

86 [forumeco.fr/les-premiers-green-pellet-sont-entres-en-production/](https://www.forumeco.fr/les-premiers-green-pellet-sont-entres-en-production/)

87 Email sent to FICA-HPCI 31st July 2021

those were never progressed. The plant in Selma had a nameplate capacity of 275,000 tonnes a year. Soon after the plant was commissioned, a shipment of Zilkha's black pellets was supplied to the St Ouen biomass cogeneration plant in France.⁸⁸ No production figures were ever published, however, operations stopped in January 2017 and, in November that year, the State of Alabama voided the air permits due to the company's failure to reply to requests for information and pay required fees. By that time, the company had already breached the air permit through excessive carbon monoxide emissions, and there had been a fire at the facility.⁸⁹ In 2016, the company was taken over by NextGen Black Pellets LLC. From 2017, the plant was upgraded, requiring \$59.8 million of refinancing.⁹⁰ The plant was restarted in early 2019, but once again was not successful: It met the 2019 annual emission limits by virtue of having been shut down for much of the year, before ceasing operations for good in December that year.⁹¹ The plant's assets were finally put up for sale in May 2021.⁹²



88 [slideshare.net/arkforests/renewable-energy-providing-new-markets-for-fiber](https://www.slideshare.net/arkforests/renewable-energy-providing-new-markets-for-fiber)

89 [environmentalintegrity.org/wp-content/uploads/2017/02/Alabama-Action-Letter.pdf](https://www.environmentalintegrity.org/wp-content/uploads/2017/02/Alabama-Action-Letter.pdf)

90 [bioenergyinternational.com/pellets-solid-fuels/zilkha-to-resume-black-pellet-production-in-selma](https://www.bioenergyinternational.com/pellets-solid-fuels/zilkha-to-resume-black-pellet-production-in-selma)

91 app.adem.alabama.gov/eFile/Results.aspx?MasterID=32302

92 einnews.com/pr_news/541647940/schneider-industries-announces-sale-of-complete-zilkha-pellet-mill-for-the-biomass-industry

HYDROTHERMAL CARBONISATION (HTC):

What is it?

Unlike torrefaction and steam explosion, hydrothermal carbonisation is being developed to turn high-moisture forms of biomass, including food waste, sewage sludge, and algae, into a form of char which, so developers hope, can be burned in coal plants without requiring costly conversions. The key objective of HTC is thus the same as that of torrefaction and steam explosion.

Hydrothermal conversion involves placing wet biomass feedstocks, with a moisture content of up to 75-90%, in a reactor at temperatures between 180 to 250°C and pressure of around 10-50 bar in liquid water for between half an hour and 8 hours, in the absence of air. This process converts the biomass into a carbon-dense product called hydrochar, with properties akin to those of coal.⁹³

Are there any attempts to commercialise HTC technology?

Compared to the many, albeit generally unsuccessful, commercial torrefaction and steam explosion ventures, hydrochar production remains quite firmly in the research & development stages.

A small number of companies make claims about potential commercialisation, but there is little evidence of this being underway:

- In the UK, *CPL Industries*, announced plans to install a commercial-scale HTC reactor in Immingham in 2018, using technology developed by *Ingelia* in Spain.⁹⁴ CPL Industries are a medium-sized company that sells coal and wood based fuels for home heating. According to its website, the company has indeed installed an HTC plant.⁹⁵ Its main project involves production of hydrochar for use in a research partnership with Severn Trent Green Power, supported by a UK government grant, with a future maximum potential of just 3,000 tonnes a year.⁹⁶ According to CPL Industries, hydrochar could be used for domestic, district or off-grid business heating. Just why hydrochar from food waste would be preferable to biogas or biomethane in the wider energy mix remains unclear.
- *Antaco*, a UK company with subsidiaries in Switzerland and Malta,⁹⁷ states on its website that it entered into a commercial contract with a public utility in “Central Europe” in 2017 to produce biocoal from sewage sludge.⁹⁸ Elsewhere,⁹⁹ the company refers to a contract with a Swiss public utility, (possibly the same one). However, no information is available about any commercial hydrochar sales by Antaco.

93 Hydrothermal Carbonization of Waste Biomass: Process Design, Modeling, Energy Efficiency and Cost Analysis, Michela Lucian and Luca Fiori, Energies, February 2017

94 bioenergyinternational.com/pellets-solid-fuels/cpl-plans-uks-first-commercial%E2%80%90scale-hydrothermal-carbonisation-htc-plant

95 cplindustries.co.uk/htc-hydrothermal-carbonisation/

96 utilityweek.co.uk/svt-joins-forces-to-create-fuel-from-food-waste/

97 find-and-update.company-information.service.gov.uk/company/07802022

98 http://antaco.co.uk/wp-content/uploads/2018/10/Investors-Magazine-Issue-10_Antaco-article.pdf

99 crowdcube.com/companies/antaco-uk-ltd-1/pitches/qajM9l

Three other companies have been investing in research& development of HTC technology, without claiming to have entered into any commercial ventures as yet: *International Power Invest AG*, who acquired a pilot plant in Germany as well as the company that had developed it (*AVA-CO2*), *Terra Nova Energy*, and *SunCoal*.



CONCLUSION:

Black pellets have been presented as the future of wood pellet production for well over a decade, attracting research and direct government grants around the world, as well as private 'cleantech' investments. At least 26 ventures, involving a larger number of individual companies have invested in black pellet production in recent years, most of them with the stated aim of commercialising their technology.

Many of those ventures have failed outright, some of them resulting in company bankruptcies. Some claim to have developed plants capable of producing conventional as well as black pellets, but there is no evidence of them producing anything other than ordinary white pellets, at least as far as commercial quantities are concerned. Nonetheless, the EU, the USA, the UK and other countries continue to make financial support available for such technologies, despite there being no indications that fundamental problems are being overcome.

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Biofuelwatch provides information, advocacy and campaigning in relation to the climate, environmental, human rights and public health impacts of large-scale industrial bioenergy.

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