

biofuelwatch

Short-rotation coppicing: No credible option for fuelling new biomass plants in Bosnia and Herzegovina

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Summary:

Elektroprivreda BiH (EPBiH) is proposing to at least partly convert two coal plant units in Bosnia and Herzegovina to biomass. The company has stated that it would rely largely on Short-Rotation Coppicing (SRC), namely fast-growing willow plantations, grown primarily on former opencast coal mine sites, but with additional purchases from farmers when required. The possibility of establishing Paulownia plantations for biomass sourcing has also been mentioned.

Paulownia tree plantations have not been successfully established anywhere in the world, and larger-scale plantings in Australia and New Zealand ended in failure and, for some farmers, loss of livelihoods. An economic analysis of a small-scale trial in Italy suggests that *Paulownia* could only be economic if grown for high-value timber products, with only the residues used for energy. There are no credible reasons to assume that large-scale plantations of a tree species never successfully grown in plantations anywhere in the world could be established in Bosnia & Herzegovina in the near future.

In some European countries, willow and poplar have been grown in SRC plantations for several decades, but only on a very limited scale and with government subsidies. IEA [International Energy Agency] Bioenergy states that, based on case studies from seven countries, the average yield of SRC willow grown on farmland is 7 oven dried tonnes per hectare per year. Based on that figure, the proposed 50 MWe biomass unit in Tuzla would require around 29,000 hectares of land, which is more than twice the size of the city of Sarajevo. Furthermore, SRC willow requires more water than conventional arable crops, i.e. it is far from drought resistant.

An EPBiH trial to grow SRC willow on a former opencast mining site appears to have failed. A similar trial in the Appalachians in the USA was more successful in so far as most of the saplings survived after two years, however, harvesting that willow was still not economically viable and yields were lower than for SRC willow grown on farmland. Furthermore, according to EPBiH, less than

800 hectares of suitable former coal mine sites would be available - a small proportion of the land needed to grow sufficient willow to fuel even one 50 MWe plant.

In practice, and based on experiences across Europe, there is no realistic possibility of fuelling even one, let alone three of the proposed biomass projects with wood from SRC. Once built or converted, those units will have to burn biomass that is readily available – and that will almost certainly mean burning forest wood, in a region where intensive and often illegal logging is already rampant.

Background:

Elektroprivreda BiH (EPBiH) wants to convert coal units at power stations in Tuzla (Unit 3) and Kakanj in Bosnia and Herzegovina to burning mostly biomass (with some mixed waste added). The company proposes to primarily burn wood from short-rotation coppicing (SRC).[1] SRC involves dense monoculture plantations of fast-growing trees and grasses which are cut every 1-5 years. The company wants to grow the willow on former opencast coal mine sites, with any shortfall to be met through purchasing SRC willow from farmers. Paulownia wood has also been mentioned as a potential future fuel source.

As shown below, SRC yields can be expected to be significantly lower on nutrient-depleted soil on former coal mines than on farmland. Observations by CEE Bankwatch and Aarhus Centre Bosnia and Herzegovina from 2022 indicate that EPBiH's own SRC trials on such soils have failed.

Yet, as can be seen below, too, SRC plantations have not been successfully developed anywhere in Europe, despite decades of efforts to do so. If it did succeed in the future at the scale needed to replace a meaningful proportion of fossil fuels, the land and water requirements would be very large.

How much willow woodchips does a biomass unit of the size proposed by EPBiH in Tuzla require?

So far, no permit application or Environmental Impact Assessment have been published for a biomass unit at Tuzla, so there are uncertainties about the efficiency and thus fuel input of such a 50 MWe power station. However, 38% electric efficiency is considered to be at the top end of what is achievable in a new biomass plant.[2] This means that the minimum thermal (i.e. fuel) input will be 131.6 MWth per hour[3] - and 1,052,632 MWth per year if the plant operated for a maximum 8,000 hours a year.

A tonne of willow woodchips from an SRC plantation has an average moisture content of 44% (significantly more than 1 tonne of woodchips from forest wood or sawmill residues), and a net calorific value of 2.888889 MWh.[4] This means that one tonne of woodchips burned provide around 2.9 MWth of thermal input to a power and/or heat plant. The figure for one oven dried tonne (odt) of woodchips is 5.1857 MWth. Therefore, ***a biomass plant of the size proposed in Tuzla will, at full capacity, require a minimum of*** 362,977 tonnes of fresh woodchips from SRC willow, which is the same as ***202,987 oven dried tonnes of woodchips.***

Note that a tonne of woodchips from SRC willow contains more energy than a tonne of SRC poplar woodchips or miscanthus.[5] This means that more tonnes of SRC poplar would be needed for the same energy output.

How realistic is EPBBiH's proposal to grow all or most of the SRC willow required for one, let alone two biomass units, on former opencast coal mines?

In 2022, EPBiH employees had a peer-reviewed study published, with the title "Towards just transition of coal regions - Cultivation of short rotation copies and dedicated energy crops for biomass co-firing vs photovoltaic power plants".[6] The authors modelled expected economic, social and environmental outcomes from SRC willow, miscanthus and solar PV plants on former opencast coal mine sites. Solar PV came out best and miscanthus worst (due to low yields), although SRC willow was assumed to create 5 times as many jobs as solar PV, i.e. 10 jobs per 50 hectares. No information was provided as to how that jobs figure was calculated. Once SRC plantations have been established, harvesting is highly mechanised and happens at the very most every two years.[7]

With regards to the area available for SRC willow plantations, the authors state that 114 hectares are "very suitable for SRC plantations now", that over 517.4 hectares could be suitable in future, and that, for 117.4 hectares, further analysis is needed. They do not provide a figure for the annual per hectare yields they assume.

According to a 2018 report by IEA [International Energy Agency] Bioenergy,[8] "*data collected from seven countries, covering a range of clones and planting densities, indicated an average yield of 7 odt/ha/year*." All of those figures relate to willow grown on farmland. As shown below, this figure, based largely on "intensively managed, small experimental plots" appears optimistic even when willow is grown on farmlands, let alone on contaminated, nutrient-depleted former coal mines.

If we nonetheless assume a 7 odt/ha/year yield, then, according to EBPiH's own figures from the study, the sites classed as being very suitable at present would produce a total of 798 odt of willow a year. ***The maximum area of 748.8 hectares would*** then yield a total of 5,241.6 odt of willow a year. This would ***allow the proposed 50 MWe Tuzla biomass unit to operate for just 115.5 hours a year***. ***The bulk of the biomass fuel would therefore have to come from a different source. In reality, the amount per hectare yield on former opencast coal mine sites will be lower, so growing SRC willow on this area would fuel the power plant for even less hours.***

When members of CEE Bankwatch and Aarhus Centre Bosnia and Herzegovina visited EPBiH's SRC willow trial at Šićki Brod in 2022, they found a field taken over by weeds where willow had been planted just 8 months prior.[9] Complete failure of plantings could be explained by the fact that EPBiH, according to their study, believe that "fertilisation of trees is not common practice" and that "use of pesticides is negligible", despite describing the soils chosen as presenting "extreme conditions,(*e.g., nutrient poor and polluted soils*)". Like any other plant, SRC willow requires sufficient nutrients, and if those are lacking in the soil then they need to be added. Furthermore, a combination of herbicides is generally advised for establishing such plantations.[10]

Growing SRC willow for phytoremediation?

Phytoremediation involves growing plants to absorb toxins, especially heavy metals, from contaminated soils and to gradually build up nutrient-rich soils.

In 2020, a study based on a two-year trial of willow plantations on former opencast coal mines in the US Appalachians was published.[11] Depending on planting methods, up to 83% of willow saplings survived. However, "*willow growth was slow compared to willow plantations on agricultural soils*", and "*biomass production was not at harvestable nor economically viable levels after two growing seasons*".

The authors of a 2020 scientific review state that fast-growing energy crops can be used for phytoremediation on moderately, rather than severely, contaminated soils, but warn: "*there is also concern about the content of toxic elements in the biomass of energy crops produced on contaminated land that may generate hazardous emissions*".[12] ***Burning contaminated wood with a high content of heavy metals in an urban area with already high pollution levels would clearly be of concern.***

Experience with growing short rotation coppicing (SRC) on farmland across Europe

The three main species being grown in short rotation coppicing in Europe are poplar, willow and miscanthus.

Compared to most other biomass fuels, miscanthus has a high chlorine and alkali metal content, which causes boiler corrosion.[13] It has been used for co-firing with coal and with other types of biomass,[14] but it is not a suitable main fuel in most boilers.[15] EPBiH is not proposing to burn miscanthus.

Between 2014 and 2017, the European Commission funded the SRCplus project to promote SRC for biomass heat and combined heat and power generation in Croatia, the Czech Republic, France, Germany, Greece, Latvia and North Macedonia.[16] In none of those countries was there a large uptake of SRC, nor did the project lead to larger-scale developments later on.

In Croatia, SRCplus found that "planting SRC plantations cannot compete with conventional crop farming, although "If a farmer is to retire from an active crop production, SRC is the second best option". Planting SRC on marginal, i.e. less fertile, land increased farmers' investment cost by 250% and reduced biomass yield by 50%. In the case of EPBIH, the situation would be even worse, as they plan to use very degraded and infertile land such as ash landfills.

Another Western Balkan country, North Macedonia, established 20 hectares of poplar plantations under the project, however, none of those remain.

According to a study published in 2016, no countries in the Western Balkan region have any sizeable SRC plantations.[17] The European country with the largest area of SRC plantations – all of them willow – was Sweden, where generous subsidies were granted in the mid-1990s. However, "*since the peak planting year of 1996 (see Fig. 5), there has* (sic) *only been two years (2001 and 2008) when a greater area was planted than removed*".[18]

In the UK, subsidies for SRC plantings and for biomass energy have been available since the 2000s. However, as in Sweden, farmers are growing less and less SRC willow and poplar. The authors of a study published in 2017 found: "*Planting SRP [short-rotation plantations] is currently unappealing to the majority of* *farmers...Under existing economic conditions, most farmers don't recoup the investment incurred during the establishment of the crop until seven years after planting and don't make any profit until they have sold their crop in year 10.*"[19]

Even with subsidies, planting SRC willow or poplar is not economically viable for farmers.

How much land would be required to fuel a heat and power plant with SRC willow?

Land requirement depends on the SRC willow yields which vary widely.

Assuming a 7 odt/ha annual yield as suggested by IEA Bioenergy, full operation of a 50 MWe plant with 38% efficiency would require around 29,000 hectares of land*. *This is more than twice the size of the city of Sarajevo, which is 14,150 hectares.

Furthermore, lower yields and thus an even greater land requirement are possible if soil conditions and annual rainfall are sub-optimal.

This far exceeds the scale of existing SRC plantations in any European country, at least as of 2016,[20] with no evidence of any significant new developments since then. If SRC plantations were ever established on this scale, they would greatly compete with land for growing food and land supporting natural ecosystems.

SRC water requirements

Any fast-growing, dense plantations require significant quantities of water, all the more so if they are to deliver high yields.

According to a report by the Agricultural and Food Authority in Ireland, "*willow coppice requires more water for its growth than any other conventional agricultural crop and hence requires a good moisture retentive soil.*"[21] The level of rainfall identified as optimal in the report – 800 to 1,100 mm a year – is predicated on a northern temperate climate. With much higher summer temperatures in the Western Balkan region than in Ireland, more water would be needed.

Even if the average climate over the past century in the region may be suited to SRC plantations, droughts have become much more frequent and extreme in Bosnia and Herzegovina, with five droughts between 2000 and 2015, one of which damaged around 60% of agricultural production.[22] Further droughts took place in 2017, 2020 and 2022. Droughts as well as extreme rainfall are projected to become more common in the country.[23]

Given current and even more so projected climate trends, it seems highly unlikely that SRC plantations would thrive longer-term.

Paulownia

Paulownia trees comprise several different species of deciduous trees that are native to East Asia. During the 1990s, government incentives saw hundreds of Paulownia plantations being established for timber production in Australia. The failure rate was reported in the media as having been close to 100%, leaving behind wilted trees and ruined livelihoods.[24]

In New Zealand, too, the overwhelming majority of Paulownia saplings planted around the same time failed, because conditions for good growth were not met: "free draining soil, shelter from wind, moderately high summer temperatures, high humidity and constant access to summer moisture",[25] according to an investor in such plantations.[26]

Although the climate in Bosnia & Herzegovina is different from that in New Zealand, the fact is that there are no large-scale Paulownia plantations in the world so far. Trees and crops grown in large-scale monocultures are generally ones that have been cultivated and optimised over decades or centuries. This is not the case for Paulownia. There are merely research trials into developing Paulownia hybrids with traits that would make it suitable for large-scale monoculture plantations. For example, there is a small project in Spain that requires irrigation and its own solar farm to power it.[27]

Furthermore, one species, *Paulownia tomentosa*, "is an aggressive tree that invades disturbed natural areas including forests, roadsides, and stream banks", according to the Center for Invasive Species and Ecosystem Health in the USA.[28]

According to an economic analysis of the potential of Paulownia in southern Italy, planting such trees primarily for timber, i.e. high-value wood products and using only the residues for biomass energy may pay off for farmers, but Paulownia biomass energy plantations would be entirely uneconomic, leaving farmers with just € 4.22 annual income per hectare.[29] The authors looked at a very small, 10 hectare trial in a hilly region with a cold semi arid climate. We can find no data to say whether Paulownia plantations could thrive in Bosnia and Herzegovina's climate.

Building new biomass units on the assumption that Bosnia & Herzegovina can successfully establish large-scale plantations of a tree species never successfully grown in plantations anywhere would be extremely risky and questionable.

Conclusions:

Based on experiences in other countries and on what is known about SRC yields and water requirements, there is no realistic prospect of growing large enough SRC plantations to fuel even one of the two biomass units proposed by EPBiH. If either of those two proposed biomass investments go ahead, they would need to burn feedstock that can be procured at scale. This would most likely mean burning forest wood, in a region where destructive and even illegal logging are already rampant.[30]

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