

**European Poplar and Poplar Plywood Industry:
a multi-tool to tackle the climate change
and to contribute to the achievement of the objectives of the
European Green Deal**

The European Green Deal is the strategic long-term vision for a prosperous, modern, competitive, sustainable and climate-neutral economy. There are a number of pathways to achieve it, but the goal of this note is to point out how POPLAR tree production and transformation could both answer most of the strategic commitments of the agricultural and industrial carbon neutral economy challenge and help achieve the goals of the European Green Deal.

INDEX

1 Poplar and European Poplar Industry

- 1.1. Poplar
- 1.2 Poplar plantations in Europe
- 1.3 Poplar and poplar based Plywood: high value added wood-based panel.
- 1.4 Poplar plywood production in Europe

2 How can poplar plantation and transformation contribute to the 2050 Climate targets, the New Circular Economy Action Plan and the New Industrial Strategy for Europe?

- 2.1 Energy Efficiency, in particular in construction sector to renovate buildings and build more energy-efficient buildings
- 2.2 Deployment of renewables
 - 2.2.1 Renewable material
 - 2.2.2 Poplar plantations and Sustainable Forest Management
- 2.3 Competitive industry and circular economy
 - 2.3.1 Circular economy
 - 2.3.2 Short circuits / short supply chains
 - 2.3.3 Employment
- 2.4 Bio-economy and natural carbon sinks with more and more competition for land
 - 2.4.1 CO₂ fixation: carbon sink
 - 2.4.2 Land competition or land cooperation?
- 2.5 Tackle remaining emissions with carbon capture and storage
 - 2.5.1 Carbon sink
 - 2.5.2 Carbon storage

3 What are European Sector needs to manage an optimal answer to 2050 Clean and Fair Planet Strategy ?

4 Conclusion

1. Poplar and European Poplar Industry

1.1 Poplar

The *Populus* genus, belonging to the *Salicaceae* family, is composed of about 40 different species, typical of temperate and cold zones of the northern hemisphere. The fast growth rate of poplars, ready for harvesting at 10 to 20 years, often enables them to reach large size (30 m) depending on the geographical location. It is a hydrophilic and heliophilic species, which adapts extraordinarily to a wide range of climatic conditions or soils. As a riverbank and pioneer species, it is adapted to the dynamism of riparian formations. This fact has allowed society to perceive a sense of naturalness in these environments and generate a positive visual impact.

Poplar plantations are an unharmed way of providing more resources, naturally taking the stress away from forest to provide raw material. Moreover we can say that plantations actually help nature to be more productive while providing the economy with a valuable material that is natural, renewable, sustainable, reusable, recyclable and inexhaustible. Poplars are easy to grow and are an important component of agroforestry systems, that complies with modern and soft agricultural practices needs. Poplar species are also used in remediation of contaminated sites, effluent disposal and restoration or establishment of riparian buffers.

1.2 Poplar plantations in Europe

There are approximately 9,6 Million Hectares of poplar plantations in the World. China has the largest area with more than 8,5 million acres. Indigenous poplar grow in more than 64 million ha mostly in Russia, Canada and the USA (FAO 2016).

In Europe poplar plantations are concentrated in France, Spain, Hungary and Italy. France has the largest area of poplar plantations in Europe. However, there is a lot of uncertainty about these numbers as traditional national forest inventories fail to adequately address the question of poplar availability in each of these countries. Poplar plantations are considered as agricultural crops in some countries like Italy and in others like Spain the transformation of poplar plantations into agricultural crops doesn't require an environmental impact assessment which is required for other forest areas. As poplars have the shortest rotation, 10 years in Italy, of all the plantation forests in Europe the inventory of its area must be revised more frequently to be deemed as accurate.

Italy has just finished an updated inventory of its poplar plantations. France and Spain are on course for making up to date inventories of the area of poplar plantations in their country. According to the latest data obtained for Italy the area of poplar plantations is significantly lower than reflected in the FAO numbers: 46.125 ha (-23%). The sector expects similar results in Belgium, France and Spain as there has been a significant decrease in the area planted with poplars in those countries over the last decade as well.

Table 1. Area of poplar plantations devoted to the production of industrial roundwood in Europe (FAO 2016)

Country	Production-oriented poplar plantations (ha)
France	212.000
Spain	123.000



Hungary	109.300
Italy	59.859
Belgium	35.000
Serbia	32.000
Germany	12.500
Romania	8.000
Greece	7.500
Poland	7.500
Sweden	4.000
Czech Republic	2.500
UK	1.300

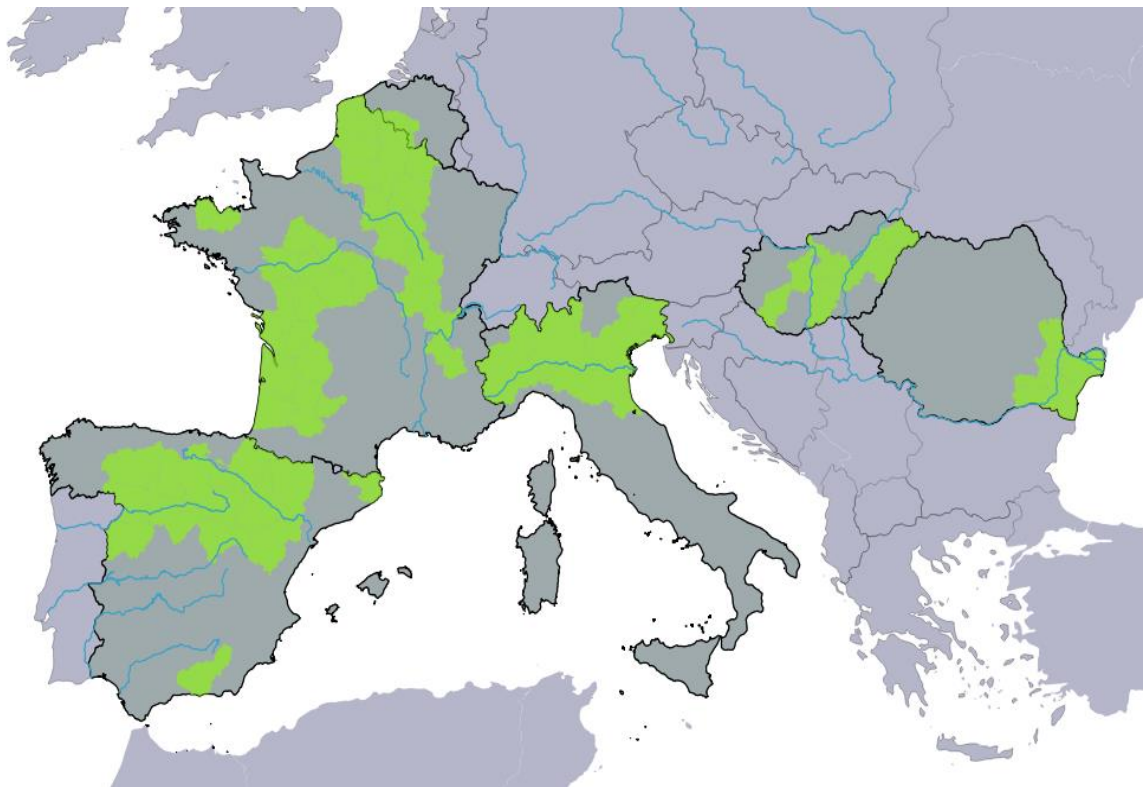


Figure 1. Map of the main areas for poplar plantations in Europe as well as the main European rivers.

1.3 Poplar and poplar based Plywood: high value added wood-based panel.

One of the important products manufactured from thin layers or “plies” of poplar wood is plywood. Poplar plywood is produced in several countries in Southern and Eastern Europe. It is the main species for the production of plywood in several countries, in particular Spain, Italy and Hungary. It is a very light product with a density ranging from 400 to 480 kg/m³. Moreover, it has good mechanical properties and it is very

easy to work. Because of this, poplar plywood is highly demanded by several industries including high-end uses such as the manufacturing of campervans, boats, trains, furniture and other uses within the construction and transportation industries where its lightness and good mechanical properties are highly appreciated over other types of plywood or other wood panels.

Poplar veneers and plywood are also used in the manufacturing of packaging products for the agrifood industry as poplar wood is colorless, odorless and tasteless. Some of these uses include fruit, oyster and cheese boxes, medical tools, chopsticks or disposable cutlery. In these applications poplar substitutes other less sustainable alternatives such as single-use plastics.

1.4 Poplar plywood production in Europe

Main countries producing poplar plywood in Europe are France, Spain, Italy and Hungary. In 2018, they produced a total amount of 627.600 m³ (EPF statistics). Most of this production went to European markets but part of the production was exported all over the world.

2. How can poplar plantation and transformation contribute to the 2050 Climate targets, the New Circular Economy Action Plan and the New Industrial Strategy for Europe?

Climate change could alter the frequency and intensity of forest disturbances such as insect outbreaks, invasive species, wildfires, and storms. These disturbances can reduce forest productivity and change the distribution of tree species. As poplar plantations have a very short rotation time (10-20 years), early adaptation actions are possible by reforestation with resilient poplar genotypes that are for example drought-tolerant or vulnerable to storms.

But how poplar tree production and transformation can contribute to the European strategic long term vision for a climate-neutral economy? Looking at the 7 strategic commitments of the agricultural and industrial carbon neutral economy challenge we see that the poplar industry can contribute to most of them:

2.1 Energy Efficiency, in particular in construction sector to renovate buildings and build more energy-efficient buildings

Poplar plywood offers many benefits to lower building life cycle balance and costs:

- Wood, panels and especially plywood is a multi-performing and good quality/price ratio building material for structural, exterior or interior uses.
- Plywood is very easy to install and with very good mechanical resistance/weight ratio, what leads to less water and energy consumption for building.
- Plywood is recommended for modular construction and design. As it can easily be disassembled, the wood can be reused several times. As plywood is easy to maintain, it may support several renovation or finish cycles.
- Some European companies offer poplar sandwich panels that can be used for light frame construction solutions. These products have both mechanical, insulation and decorative properties and a much better carbon footprint than alternative materials.

- At the end of its life cycle, plywood can be recycled or used for energy
- Poplar plywood is produced locally in multiple sites across Europe, reducing the carbon footprint of the transportation of the product.
- The poplar supply chain has also built other transversal economies like packaging, paper or energy.

2.2 Deployment of renewables

2.2.1 Renewable material

Poplar plywood is a renewable material with a net positive carbon footprint. Poplar trees are among the fastest growing trees in Europe as they can be harvested after 10 to 20 years. During their growth cycle poplars capture carbon. An average poplar plantation in Spain captures over 20 tm of CO₂/ha per year (Serrano & Aunos, 2005). According to the Climate Change Spanish Office (OECC) hybrid poplars are among the best species for carbon capture in Spain (MITECO 2019) thanks to their fast growth. While growing poplars capture carbon in their biomass, over 50% of this biomass is accumulated in the stem which is used for the production of long-lived products such as plywood. Poplar plywood has a net positive carbon footprint of more than 780 kg of CO₂/m³¹.

2.2.2 Poplar plantations and Sustainable Forest Management

The Sustainable Forest Management pursue three objectives that are to ensure the persistence and stability of the forest, maximize its uses (economically quantifiable or not) and organize its sustainable yield. To carry out this objective, management must have two tools: the management of forests (where and when to intervene) and forestry (how to intervene and with what methods).

Sustainable Forest Management can only be obtained if the renewal of the individuals that make up the forest is achieved, and this happen when the human being intervenes on the forest by practicing logging. As we will see poplar is clearly adapted to the European criteria for Sustainable Forest Management:

- *Maintenance and correct increase of forest resources and their contribution to the carbon cycle.* Poplar, being a productive species with market demand, favors an increase in forest resources while creating wealth in rural areas favoring the binomial rural and sustainable development. In addition, being a species of rapid growth, favors the capture of carbon and its subsequent storage in the products that derive from the poplar wood.
- *Maintenance of health and vitality of forest ecosystems.* Poplar trees occupy areas where they appear naturally not harming the regeneration capacity of degraded areas. With a view to a possible change in land uses, poplar trees favor the transformation to other more naturalized formations, helping the vitality of the ecosystem.
- *Maintenance, conservation and correct increase of biological diversity in forest ecosystems.* Because of their vigor, poplar populations can provide, in a relatively short term tree-rich forest resources with monumental (physiologically) old trees, which is of great significance for related biodiversity. Poplars are planted in a broad context and offer space to indigenous key species, because they have a "nurse effect" on these key species, making establishment and development easier and ultimately leads to layered, structure-rich forest stocks of indigenous key species (Thomaes, 2014). Poplar is also an important tree species for the creation of forests on former farmland or set-aside land. Cultivated

¹ Result obtained by a third party (Föra) on a Carbon Footprint evaluation about poplar plywood produced in Spain.

poplars are an effective buffer against acidification, due to the very high calcium (Ca) concentration of the leaf litter, and thus accelerate the development of a typical forest floor (Thomaes, 2012).

- *Poplar tree reforestation together with other forest species increases sustainability considerably.* Apart from the biodiversity of the forest species themselves, there are a multitude of birds that nest in poplars, as well as invertebrates, fungi, bryophytes and lichens. Recent studies proved that poplar wood shows a very high fungal biodiversity (Leonhardt S. et al, 2019). Some species like the European golden oriol (*Oriolus oriolus*) chose hybrid poplar plantations over other habitats for nesting (Milwright 1998).
- *Maintenance and correct increase of protective functions in forest management (especially on land and water).* Another characteristic of this riverbank species is its protective function of the riverbeds. Poplar plantations allow recovering of degraded riverbank areas and stabilize them. Poplar plantations play a very important role in the lamination of floods that can be very destructive in most European rivers. Poplar plantations have a Manning roughness coefficient that is 2 to 4 times higher than those of agricultural crops. Therefore the speed of the water during the flooding will be reduced by more than half in a poplar plantation vs in agricultural areas.
- Poplars and willows as members of the *Salicaceae* family act as biofilters along river buffers. Poplar plantations can capture 3 to 10 times more phosphorus (P) and nitrogen (N) than riparian vegetation (Fortier 2015). Eutrophication is the main risk for most of the interior water bodies in Europe, particularly in those where poplars are planted, mostly located in areas where intensive farming practices take place.
- *Maintenance of other socioeconomic conditions and functions.* In an environment as anthropogenic as Europe, without primary forests and ecosystems strongly linked to human action, poplar and its formations are part of the landscape associated with river channels and also the culture and economy of many rural areas. Poplars show beautiful colors during the fall period, being one of the most appreciated species by tourists and locals that enjoy leaf peeping in October each year.
- The existence of alternative rents such as poplar or direct jobs derived from it favors the population to progress and reverse the process of depopulation in rural environments. This is a huge problem in areas of the interior of Spain, parts of France and most of Eastern Europe.
- A forest crop such as poplar maintains a social and ecological structure that ensures the future of the forests by having an economic function and a population sensitized to their environment and their needs.

2.3 Competitive industry and circular economy

2.3.1 Circular economy and sustainability

Poplar is mainly used to manufacture plywood which is used in construction, furniture, packaging, etc. Once those products end their life (and therefore plywood ends its life) they can be recycled being used as a raw material for the manufacturing of other wood based panels or wood based products. Because of recycling, plywood contributes strongly to the “cascade use”, avoiding wastes. These new “recycling based” products are also used in construction, furniture, packaging starting a new life contributing to circular economy. At last, after several recycling cycles, at the end, an ultimate benefiting use is energy producing.

2.3.2 Short circuits / short supply chains

Poplar based plywood is produced in Europe (Spain, Italy, France, Hungary) with a good repartition of production sites that allows short transports circuits to answer the building or other sector needs. Poplar

based plywood is easy to disassemble out of the building and can be easily reused for new building or new other local needs.

Poplar based plywood production mills are most often located close to poplar plantations (price is too low to support the costs of long terrestrial transports), that complies with short circuits benefits: lower fossil energy consumption, lower environmental impacts, sustainable development of local economy.

2.3.3 Employment

Poplar culture in Europe: For each hectare of poplars planted, there is an average of 5 annual wages needed for forestry work. To transform their wood into products at least 110 more wages are necessary. Therefore poplar plantations may provide work for young populations in rural areas and at the same time let them maintain skills and traditions.

2.4 Bio-economy and natural carbon sinks with more and more competition for land

2.4.1 CO₂ fixation: carbon sink

As it is known plants through photosynthesis capture CO₂, the main gas that causes the greenhouse effect of air, from which they store carbon and expel oxygen. In this way the greater the photosynthetic activity the greater the growth and therefore more carbon will be stored in the wood. Poplar photosynthesis ratios are among the highest of all tree species (NELSON, 1984). Its great capacity for growth and therefore its ability to fix CO₂ from the atmosphere, makes poplar a powerful tool in the fight against climate change.

Taking into account the speed of growth of a poplar tree, some authors estimate that they can recycle annually 20 tons of CO₂ per hectare. If at 15 years of age it is cut, 300 tons of CO₂ per hectare will have been purified, which will not return immediately to the atmosphere, because they will be used mostly for the manufacture of plywood, which in turn will be used in the manufacture of furniture or other products with a relatively long life use.

2.4.2 Land competition or land cooperation?

Among the natural functions of poplars plantations are their ability to regulate and reduce surface runoff, as well as to fix sediments and other contaminants from discovered soils or crops. The protection of bodies of water is also remarkable, the improvement of the infiltration in flood areas thanks to the roots of the plants, which produces a flooding effect that helps to reduce the negative impacts of the floods of the rivers.

Phytoremediation: "use of plants for in situ remediation of soils, sludge sediments and contaminated water-table waters through elimination, degradation or confinement".

Riparian formations are ideal for phytoremediation. The poplar has also linked an economic benefit that can favor the profitability of this riparian system of water purification. The poplar has an excellent result as a green filter, which can be used for the purification of wastewater from small urban centers. According to different authors, the forest plantations carried out on the banks of the rivers formed by poplar trees can retain up to 70% to 90% of the nitrates and 75% of the sediments compared with areas that do not have this purification system.

Other ecological benefits are the **protective capacity of soils on riverbanks**, preventing erosion during floods due to their ability to unite with the earth, provided that a careful management of the poplar is made by removing those trees in which instability is appreciated. In this way forestry management is very similar to

what happens naturally but avoiding dangerous accumulations of material during the avenues in places that can be quite dangerous, such as in the eyes of bridges. Finally, note that poplar crops reduce the risk of forest fire spread. The maintenance tasks to which the poplar, pruning and grading are subjected, favor a discontinuity in the vertical fuel that prevents in a decisive way that the surface fire goes into the top of the tree and therefore spreads in a virulent manner.

2.5 Tackle remaining emissions with carbon capture and storage

2.5.1 Carbon sink

As said in chapter 2.2.1, poplar plantation capture over 20 tm of CO₂/ha per year being hybrid poplars among the best species for carbon capture thanks to their fast growth. While growing poplars capture carbon in their biomass, over 50% of this biomass is accumulated in the stem which is used for the production of long-lived products such as plywood. Poplar plywood has a net positive carbon footprint of more than 780 kg of CO₂/m³.

2.5.2 Carbon storage

As mentioned before, poplar is mainly used to manufacture plywood which is used in construction, furniture, packaging, etc. The use in construction of plywood material is of long term use: when proceeding Environmental Declaration, following EN 15804, ISO 14040 and ISO 14044 (Life cycle analysis), it is admitted that mean life duration for nonstructural use is of 50 years and about 100 years for structural uses. Because of plywood performance, the life duration may be lengthen by reusing several times the panels, even for building parts uses. The stock duration of carbon will be as longer as the component life! When recycled, at the end of the panel life, into other wood based product, the “carbon capital” will be transferred to the new product, and will continue to be stocked, during all the life of this new recycled based product, that may add 50 or 100 years of storage.

3. What are the European Sector needs to manage an optimal answer to 2050 Clean and Fair Planet Strategy ?

During the financial crisis period poplar plantations decreased all around Europe and after the crisis they have not recovered to the pre-crisis amount. Some factors are behind this situation:

- Political issues (that may be different depending on the country) that put restrictions to plantations.
- Delay in the issue of planting or logging permissions, etc., making land owners to opt for other agricultural plantations instead of poplar, or to let the poplar surfaces aging without management nor valorization.
- CAP subsidies that make agricultural plantations more attractive to land owners than poplar ones.

The industry can help to achieve the target of having a climate neutral EU by 2050 if policies are developed focused on:

- Promoting plantations and active forest management that captures carbon, protects our rivers and biodiversity, creates jobs in shrinking rural areas of Europe and supports the European industry.
- Avoiding unnecessary administrative burden at Member States level to allow planting and logging activities.
- Avoiding lack of competitiveness due to market distortions occurring from subsidies to other agricultural activities.

These policies will increase the number of poplar plantations which will help Europe to achieve the 2050 target of a Clean Planet by 2050.

4. Conclusion

A Clean Planet by 2050 is the European strategic long term vision for a prosperous, modern, competitive and neutral economy. Poplar plantations may help to achieve this target since poplar is one of the best species for carbon capture thanks to their fast growth. Poplar is used for different products being plywood the main one. Poplar plywood is used for building, packaging, furniture, etc. so the CO₂ captured in the wood remains in the products.

Europe can take advantage of poplar plantations and potentiate them by developing some policies that will make the number of plantations to increase. Those policies should focus on:

- Promoting plantations and active forest management that captures carbon, protects our rivers and biodiversity, creates jobs in shrinking rural areas of Europe and supports the European industry.
- Avoiding unnecessary administrative burden at Member States level to allow planting and logging activities.
- Avoiding lack of competitiveness due to market distortions occurring from subsidies to other agricultural activities.

References

FAO, 2016. Poplars and Other Fast-Growing Trees - Renewable Resources for Future Green Economies. Synthesis of Country Progress Reports. 25th Session of the International Poplar Commission, Berlin, Federal Republic of Germany, 13-16 September 2016. Working Paper IPC/15. Forestry Policy and Resources Division, FAO, Rome. <http://www.fao.org/forestry/ipc2016/en/>.

Fortier, J.; Truax, B.; Gagnon, D.; Lambert, F. 2015. Biomass carbon, nitrogen and phosphorus stocks in hybrid poplar buffers, herbaceous buffers and natural woodlots in the riparian zone on agricultural land. *Journal of Environmental Management* 154: 333-345.

Leonardt S. et al. 2019. Molecular fungal community and its decomposition activity in sapwood and heartwood of 13 temperate European tree species, *PLoS One*. 14(2): e0212120.

Milwright R.D.P. 1998. Breeding biology of the Golden Oriole *Oriolus oriolus* in the fenland basin of eastern Britain, *Bird Study* 45: 320-330

MITECO. 2019. Guía para la estimación de absorciones de Dióxido de Carbono https://www.miteco.gob.es/es/cambioclimatico/temas/mitigacion-politicas-y-medidas/guiapa_tcm30-479094.pdf

Rodríguez F., Serrano L., Aunós A. 2005. El papel del chopo como sumidero de CO₂ atmosférico. IV Congreso Forestal Español.

Thomaes A. et al. 2012. Diverging effects of two contrasting tree species on soil and herb layer development in a chronosequence of post-agricultural forest. *Forest Ecology and Management* 278: 90–100

Thomaes A. et al. 2014. Tree species determine the colonisation success of forest herbs in post-agricultural forests: Results from a 9 year introduction experiment. *Biological Conservation* 169: 238-247.