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Programme

SCRREEN2

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FACTSHEETS UPDATES BASED ON THE EU FACTSHEETS 2020

NATURAL CORK

AUTHOR(S):

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NATURAL CORK

OVERVIEW

Cork is the bark of the cork oak (*Quercus suber*). It is a 100% natural plant tissue, consisting of a hive of microscopic cells containing air and coated primarily with suberin and lignin. It has a range of applications associated with its attributes (e.g. gas impermeability) that no technology has yet managed to emulate, match or exceed.

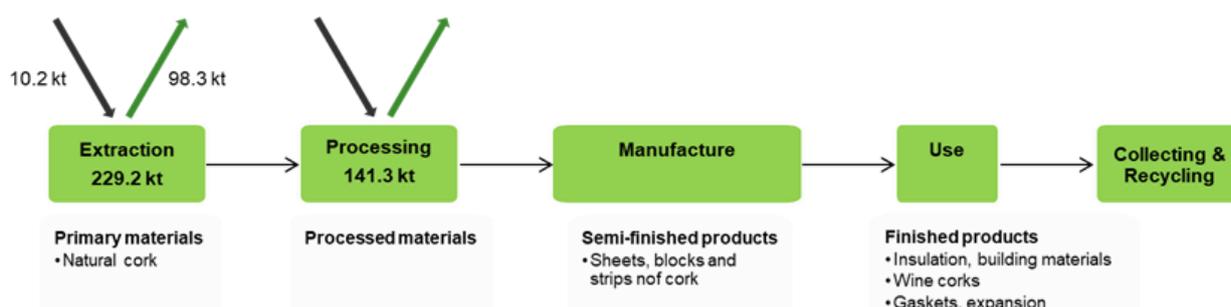


Figure 1. Simplified value chain for natural cork in the EU¹

Table 1. natural cork supply and demand in metric tonnes, 2016-2020 average

Global production	Global Producers	EU consumption	EU Share	EU Suppliers	Import reliance
186 500 tonnes	Portugal 46%	160 000	86%	Morocco 40%	0.35%
	Spain 33%			Tunisia 30%	
	Morocco 6%			Algeria 30%	
	Algeria 5%				

Prices: The annual price fluctuated between €1.7/kg in 2012 and €2.2/kg in 2020, reaching the highest price at €2.7/kg in 2018 (APFC, 2020). The average return in 2016-2020 was 1.5%, showing a slightly increase of prices in this period. The price volatility of natural cork was around 15% between 2016 and 2020. Current price trend shows a decrease of prices since the peak in 2018.

Primary supply: The global producers of natural cork are concentrated in the western Mediterranean area, with a dominant role for the Iberian Peninsula

Secondary supply: Waste scrap of natural cork is traded as a commodity and basically a raw material for other applications. It is treated as a raw material in the assessment including product group “cork waste; crushed, powdered or ground cork”. Processed secondary cork can only replace primary cork for construction purposes.

¹ JRC elaboration on multiple sources (see next sections)

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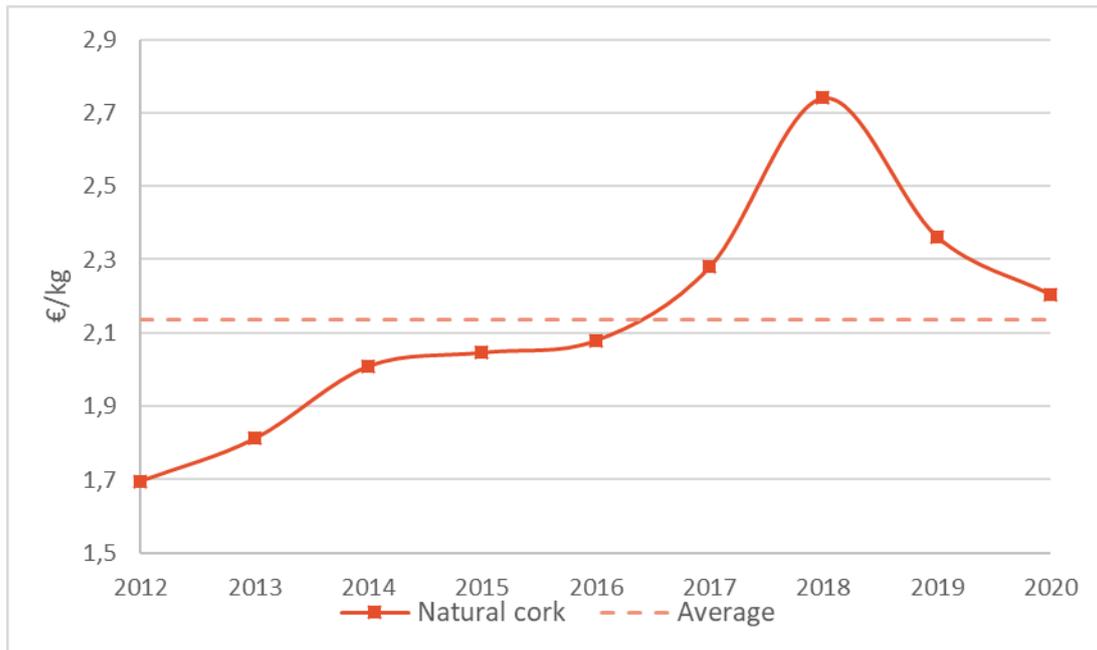


Figure 2. Annual average price of natural cork between 2000 and 2020 (USGS, 2021)².

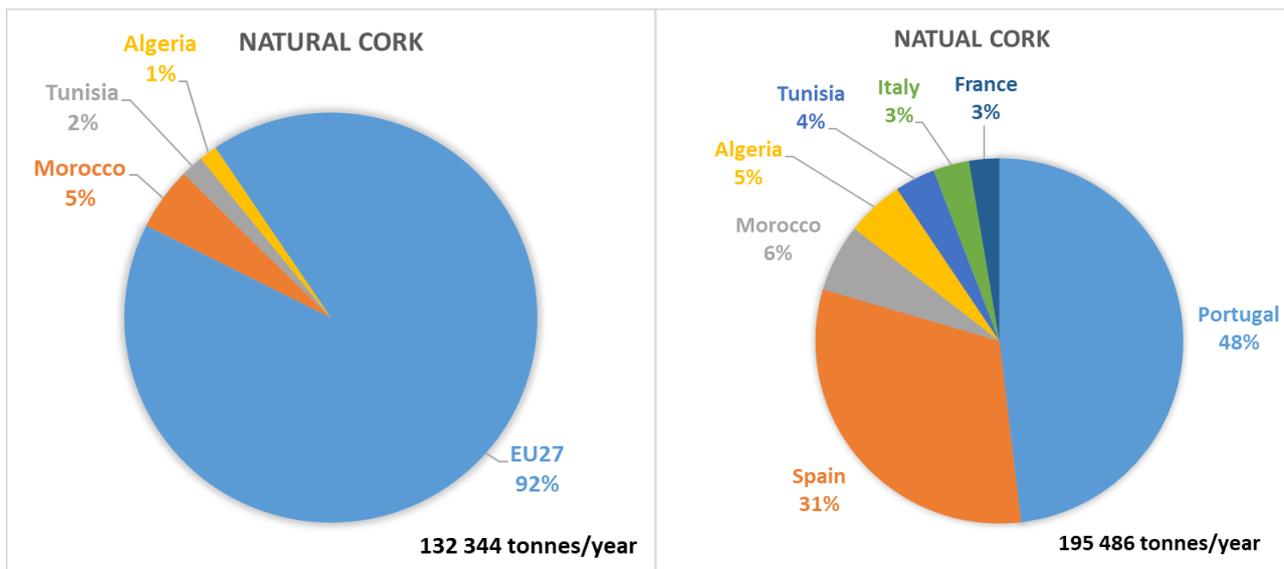


Figure 3. EU sourcing of natural cork

Uses: Cork is mainly used for wine stoppers (71%) and construction and decoration (26%)

Substitution: There is an increasing trend for cork wine stoppers to be substituted, first to prevent spoilage (there is an 8% failure rate in natural cork wine stopper) and second because world wine production and consumption are increasing at a faster rate than cork production. Cork can be substituted at up to 50% for all construction purposes by other materials.

² Values in €/kg are converted from original data in US\$/kg by using the annual average Euro foreign exchange reference rates from the European Central Bank (https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html)

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Figure 4: EU uses of natural cork

Table 2. Uses and possible substitutes

Use	Share*	Substitutes	Sub share	Cost	Performance
Wine industry	73%	Plastic	50%	Similar or lower costs	Reduced
Wine industry	73%	no substitute	50%		No substitute
Construction sector	24%	Stone Wool	10%	Similar or lower costs	Reduced
Construction sector	24%	Glass Wool	10%	Similar or lower costs	Reduced
Construction sector	24%	Expanded Polystyrene	10%	Similar or lower costs	Reduced
Construction sector	24%	Extruded Polystyrene	10%	Similar or lower costs	Reduced
Construction sector	24%	no substitute	60%		No substitute
Leisure and entertainment	1%	not assessed, under 10%			No substitute
Gaskets	1%	not assessed, under 10%			No substitute
Furniture	1%	not assessed, under 10%			No substitute

*Estimated global end use shares of natural cork (SCRREEN expert, 2022; ACPOR, 2020).

Other issues: Natural cork is not related to major health concerns. The only risk detected is that, due to the handling and treatment of cork during extraction and production processes, workers may be exposed to inhalation of cork dust. The inhalation of cork dust particles the disease of suberosis, a relatively benign pulmonary fibrosis that presents as asthma, allergic alveolitis or as chronic bronchitis, and whose symptoms appear after several years of work and contact with the cork. However, few cases have been detected (UGT

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2010, CCOO 2016). The environmental issues relate to vulnerability of the production system from pressures from the environment rather than the other way around. According to the World Wildlife Fund, the traditional cork oaks agroforestry system (*Montado* in Portugal, *Dehesa* in Spain) supports one of the world's highest levels of biodiversity, including homes for endangered species such as the Iberian lynx, the Iberian imperial eagle, the Barbary deer, and many species of rare birds as well as fungi, ferns, and other plants (APCOR 2014). Globally the natural cork economy is very small (about 0.01% of the total world trade market). The importance of this market is also anecdotic for the main producing countries (Spain, Portugal, and Italy, with less than 0.0005% of their total export trade value...). However, in 2020, the natural cork export market represented about 15% of the total Bosnia Herzegovina export trade value and 7% for Armenia (COMTRADE, 2020).

MARKET ANALYSIS, TRADE AND PRICES

GLOBAL MARKET

Table 3. natural cork supply and demand in metric tonnes, 2016-2020 average

Global production	Global Producers	EU consumption	EU Share	EU Suppliers	Import reliance
186.5kt	Portugal 46% Spain 33% Morocco 6% Algeria 5%	160 kt	86%	Morocco 40% Tunisia 30% Algeria 30%	0.35%

The estimated average global production of cork in 2020 was 186.573 tonnes, according to APCOR. The primary global producer of cork is Portugal, with 46% of global production, followed by Spain with 33%. Portugal also is the primary global exporter of cork, with 62,1% of global cork exports in 2020. This represented a value of 1,016 billion € (APCOR 2020). The global market for cork is also dominated by a few major suppliers, most notably the Portuguese company Corticeira Amorim, which is the world's largest manufacturer of cork products. In 2020, the company recorded 740,1€ million in sales, with 70% of revenue coming from cork stoppers (Amorim 2021).

Global demand for natural cork is primarily related to its use as beverage (particularly wine) stoppers. As such, the major global importers of natural cork in 2020 are also significant wine producing countries. France is the primary global importer of cork, with 15,4% of global imports (256€ million), followed by the United States with 15,3% (254€ million), Portugal with 11% (183€ million), Italy with 10% (166€ million), and Spain with 8,9% (148€ million).

The COVID-19 pandemic was observed to have a significant impact on the global market for cork, primarily by reducing demand for cork products in 2020. Pandemic induced shutdowns led to significant reductions in tourism, and recreational wine and beverage consumption. Moreover, the pandemic also significantly reduced global demand for construction materials. As such, the value of cork exports from Portugal decreased by 4,7% from 2019 to 2020.

EU TRADE

Table 4 Relevant Eurostat CN trade codes for Natural Cork

CN trade code	title
45010000	Natural Cork, raw or simply prepared; waste cork; crushed, granulated or ground cork
45020000	Natural Cork debacked or roughly squared

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For assessing the EU-natural cork, figures 5 and -6 show the EU-trade flows associated with the product codes CN 45010000 and CN 45020000, in tonnes, between 2000 and 2021, respectively. CN 45010000 refers to natural cork, raw or simply prepared; waste cork; crushed, granulated or ground cork; CN 45020000 natural cork debacked or roughly squared.

EU’s import of natural cork has been declining over the years at a fast rate. There was sharp decline between 2000 and 2010 where the import declined from 38770 in 2000 to 8583 tonnes in 2010. The import increased at moderate from 2010 reaching 14000 tonnes in 2019. However, there was a sharp decline 10352 and 10204 tonnes in 2020 and 2021 respectively. This could be largely due to supply chain disruptions caused by global covid pandemic, a similar impact has been reported across materials and industries in 2020.

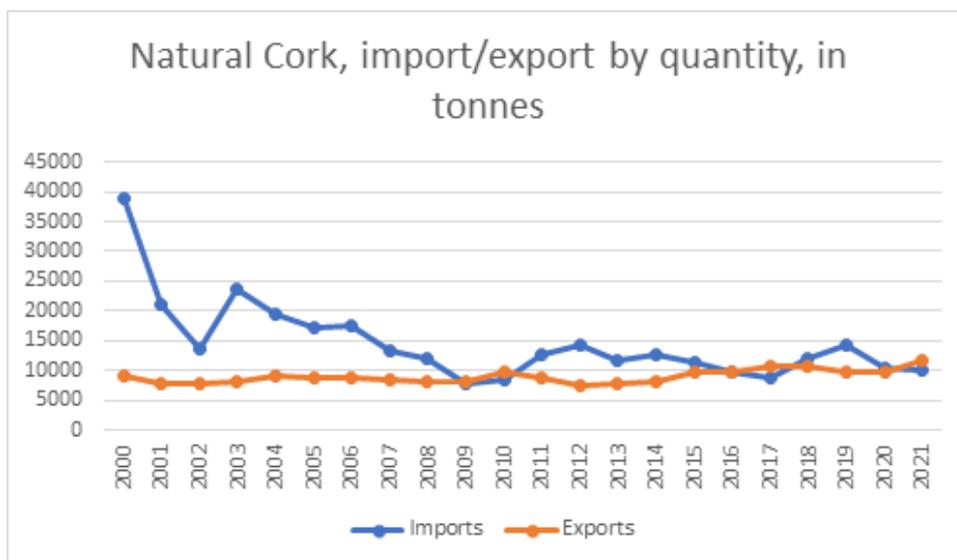


Figure 5 EU trade flows of Natural Cork, raw or simply prepared; waste cork; crushed, granulated or ground cork, (CN 45010000) from 2000 to 2021 (based on Eurostat, 2022)

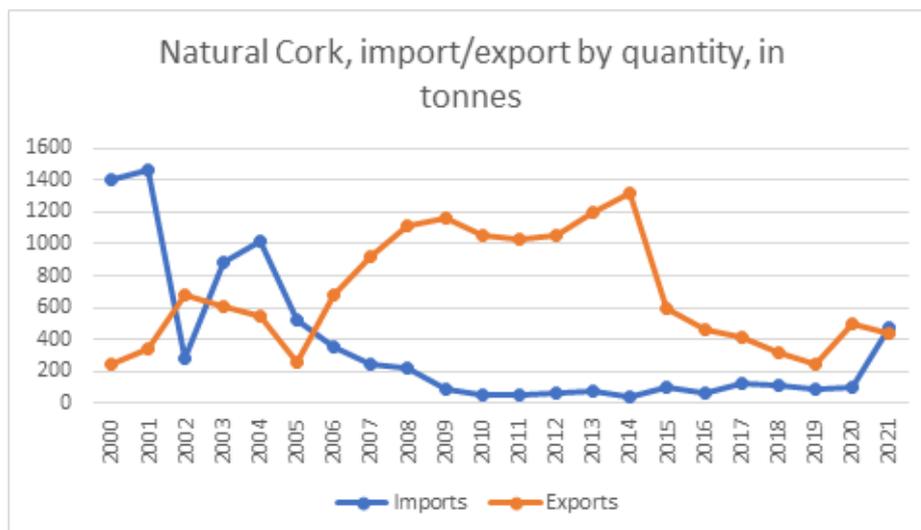


Figure 6 Eu trade flow of natural cork debacked or roughly squared (CN 45020000) from 2000 to 2020 (based on Eurostat, 2022).

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As shown in figure 6, the EU import of CN 4502 natural cork debacked or roughly squared has also declined from 1400 tonnes in 2000 to 469 tonnes in 2021. In this product category, the trade shows of an EU export greater than EU import for most of the years, probably indicating a considerable amount of value-add activities in this sector in EU.

Between 2000-2021, major share of EU’s import of natural cork originated from Morocco (58%), followed by Tunisia (24%) and Algeria (11%) (Figure 7). EU’s import from Morocco has declined in recent years. A trade agreement exists between the EU and Morocco, Algeria and Tunisia (European Commission 2019). There are no exports taxes, quotas or prohibitions related to products of natural cork (OECD 2019).

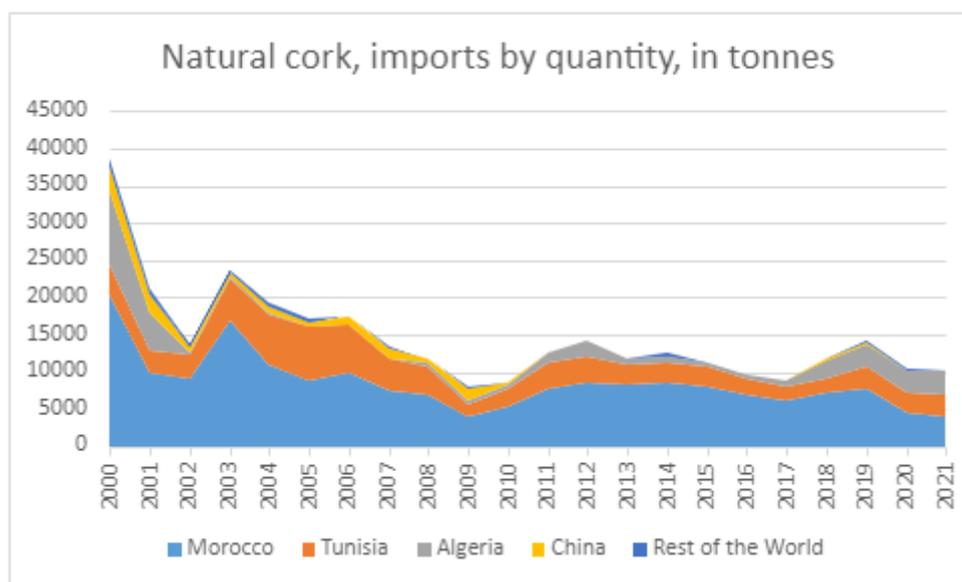


Figure 7 EU imports of natural cork, raw or simply prepared; waste cork; crushed, granulated or ground cork (CN 4501), by country from 2000 to 2021 (based on Eurostat 2022)

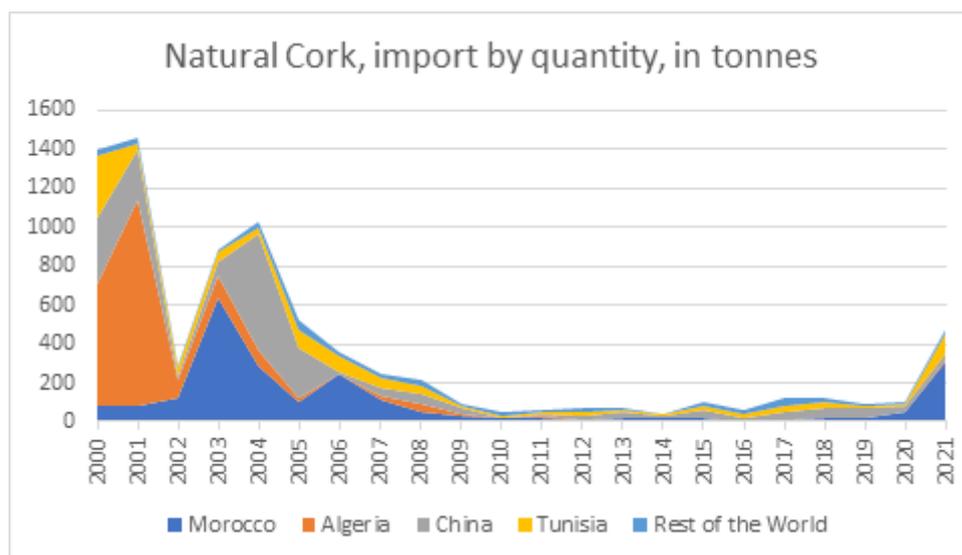


Figure 8 EU imports of Natural Cork debacked or roughly squared (CN 4502), by country from 2000 to 2021 (based on Eurostat 2022)

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Figure 8 shows the EU trade flow in the category articles of natural cork debarked or roughly squared from 2000 to 2021. On average EU imported 356 tonnes per year of this category of cork from 2000 to 2021 (Eurostat 2022). A major portion of the import comes from Morocco with 58 percent followed by Tunisia with 24 percent and Algeria with 11%.

PRICE AND PRICE VOLATILITY

The prices were converted from euro per Portuguese arroba (@) to euro per kilogram by using the respective mass factor (i.e., 1 Portuguese @ = 14.7 kg). The annual price fluctuated between €1.7/kg in 2012 and €2.2/kg in 2020, reaching the highest price at €2.7/kg in 2018 (APFC, 2020). The average return in 2016-2020 was 1.5%, showing a slightly increase of prices in this period.

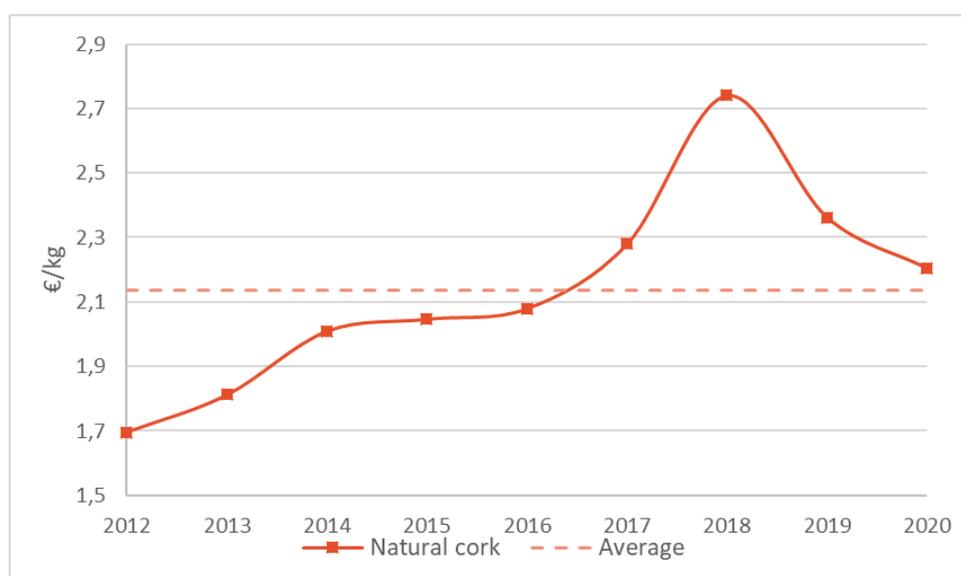


Figure 9 Annual average price of natural cork between 2012 and 2020 (based on APFC, 2020). Dash line indicates average price for 2012-2020. Prices converted from €/@ Portuguese to €/kg (1 @ Portuguese = 14.7 kg)

The price volatility of natural cork was around 15% between 2016 and 2020. Current price trend shows a decrease of prices since the peak in 2018. However, price changes continue fluctuated between to the average price in 2012-2020, which is €2.1/kg.

Natural cork prices are mostly driven by the changes in the beverage industries, such as winemaking (APCOR, 2020; WWF, 2006).

OUTLOOK FOR SUPPLY AND DEMAND

Supply of cork is expected to increase in the short, medium, and longer terms and should keep pace with rising demand. Within the short-term horizon of the coming five years, current stocks of cork forests can be adjusted annually to meet demand. The world’s largest cork exporting nation, Portugal, expects to increase the value

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of its exports by nearly 50% from 2020 levels, to 1,5€ billion by 2030. One factor that contributes to the stability of global cork supply is Portuguese legislation preventing the destruction of living cork oaks and requiring any private actor that clears a cork tree to plant three in its place. Since cork can be harvested regularly from live cork oaks without killing the tree, and trees have a lifespan of several centuries this promotes a longevity of supply. However, the slow growth of the cork oak also presents challenges to increasing supply in the medium to long term. Since it takes roughly 45 years from planting until first cork harvest, private landowners may not see an economic incentive in planting cork oak, as compared to other fast-growing trees such as eucalyptus. This competition for forest land means that efforts to increase the density of cork oak forests will be key in helping to expand global supply. Moreover, public policies that valorize the ecosystem services offered by cork oaks, such as their capacity to stock carbon, combat desertification, and retain water, could promote a long-term growth in supply. The European Common Agricultural Policy in particular, will be key in structuring the global supply of cork over the long term (APCOR 2021).

The Portuguese Association of Cork Producers, APCOR, is confident that cork will continue to see increased demand in the short, medium, and long term. This will continue to be driven by increasing demand for cork stoppers in wine and other beverages. Cork is also expected to see significant demand growth for use in construction, particularly as an insulating material. Composite construction materials containing cork are also expected to drive increased demand. The expansion of green building initiatives can serve as a major catalyst for cork demand, since it is a renewable, recyclable, material capable of stocking CO₂ within the built environment.

DEMAND

GLOBAL AND EU DEMAND AND CONSUMPTION

The average annual EU consumption between 2016 and 2020 of natural cork is around 160kt. About 70% of the natural cork used in the EU goes into stoppers.

Natural cork extraction stage EU consumption is presented by HS codes CN 4501 Natural cork, raw or merely surface-worked or otherwise cleaned and CN 4502 Natural cork, debarked or roughly squared.... Import and export data is extracted from Eurostat Comext (2021). Production data is extracted from Eurostat Prodcom (2021) using PRCCODE 16292150 for Natural cork, debarked or roughly squared... and Apcor (2020) for CN 4501 Natural cork, raw or merely surface-worked or otherwise cleaned.

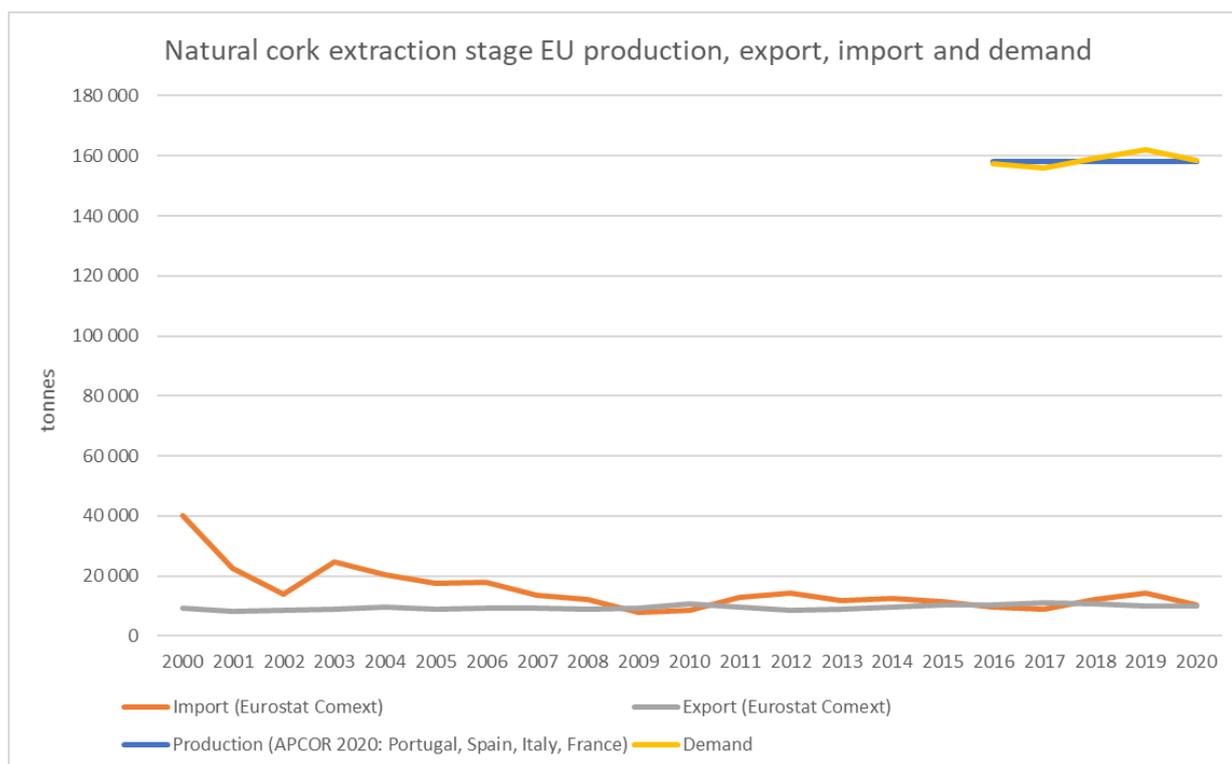


Figure 10. Natural cork (CN 4501 Natural cork, raw or merely surface-worked or otherwise cleaned and CN 4502 Natural cork, debacked or roughly squared...) extraction stage apparent EU consumption. Production data for CN 4502 are available (average production for 2003-2020 is 69.7 kt), but there is no production data available for CN 4501 in Eurostat Prodcom (2021). Natural cork production data is extracted from Apcor (2020) and is available for 2016-2020. Consumption is calculated EU production+import-export.

Based on Eurostat Comext (2021) and Apcor (2020) average import reliance of natural cork is 0.35 % for 2016-2020.

EU USES AND END-USES

Cork is 100% natural plant tissue, consisting of a hive of microscopic cells containing air and coated primarily with suberin and lignin.

It has a range of applications associated with its attributes (e.g. gas impermeability) that no technology has yet managed to emulate, match or exceed (APCOR 2016).

The 3% share in end-use allocations of gaskets are allocated over NACE sector 28, 29 and 30 with 1% each respectively since they are applied in all kinds of transport equipment and machinery (M.C. Varela 2019). Relevant sectors are shown in Figure 2 and Table 1.

Relevant industry sectors are described using the NACE sector codes (Eurostat 2022) in **Erreur ! Source du renvoi introuvable..**

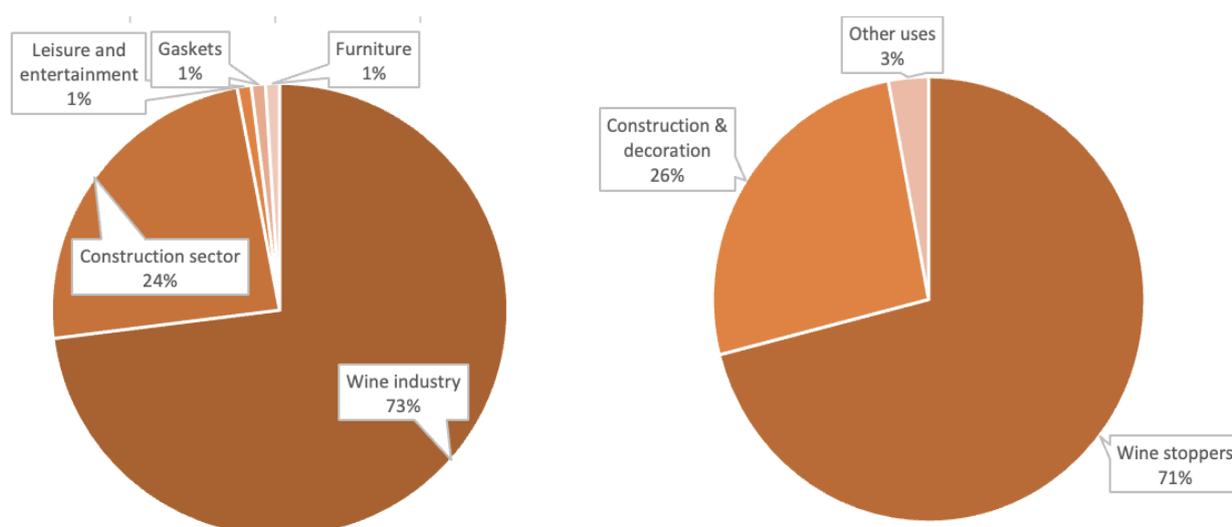


Figure 11: Left: Global end uses of natural cork, 2020 (SCRREEN experts, 2022; APCOR, 2020). (Right: EU end uses of natural cork. RMIS, JRC, accessed May 2022)

Table 5 natural cork applications, 2-digit and associated 4-digit NACE sectors and added value per sector (Eurostat 2022)

Applications	2-digit NACE sector	Value added of 2-digit NACE sector (M€) - 2019	4-digit NACE sectors
Wine corks	C11 - Manufacture of beverages (includes C10 and C12)	251,015 (includes C10 and C12)	C11.01 - Manufacture of wine from grape
Insulation, building materials	C16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	37,768	C16.29 - Manufacture of other products of wood; manufacture of articles of cork
Gaskets, expansion	C28 - Manufacture of machinery and equipment n.e.c.	200,138*	C28.99 - Manufacture of other special-purpose machinery n.e.c.
Gaskets, expansion	C29 - Manufacture of motor vehicles, trailers and semi-trailers	234,398	C29.32 - Manufacture of other parts and accessories for motor vehicles
Gaskets, expansion	C30 - Manufacture of other transport equipment	49,129*	C30.12 - Building of pleasure and sporting boats
General furniture	C31 - Manufacture of furniture	64,377*	C31.09 - Manufacture of other furniture
Leisure articles	C32 - Other manufacturing	64,377*	C32.99 - Other manufacturing n.e.c.

* Data to 2014 only

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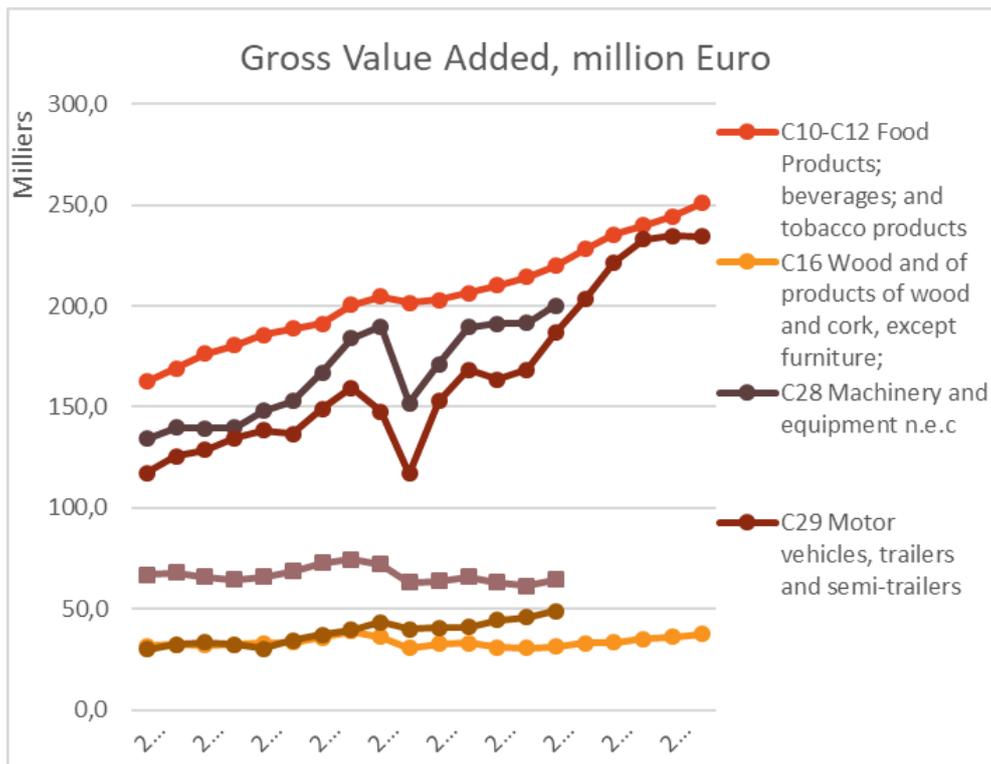


Figure 12 Value added per 2-digit NACE sector over time (Eurostat, 2022)

APPLICATIONS OF NATURAL CORK:

The main end uses of natural cork are as wine stopper, or as insulation material.

WINE INDUSTRY

Figure 2 presents the main uses of natural cork in the EU as outline within the RMIS.

The percentages represent the weight/volume of extracted raw material that is eventually used for these main uses.

The large share of wine stopper is explained by the large volume of industrial waste that is created during the manufacturing of the actual wine cork. This requires a relatively large amount of extracted natural cork.

CONSTRUCTION (AND DECORATION)

Cork has some properties that make it very specific. It weighs only around 200kg/m³, it is impermeable to most fluids and gases, it is elastic, it has a low conductivity for heat and sound, making it suitable for insulation) and it is slow burning.

Due to these intrinsic properties, insulation cork board (ICB) is used in the construction industry as insulation (Lança, 2010)(Sierra-Pérez, 2014).

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OTHER USES

A small but valuable use of cork is within sectors related to machinery and transport equipment, such as for engine gaskets and other seals.

Other applications³ of cork include:

- In furniture
- In green/low carbon technologies
- In the production of pharmaceutical and cosmetic products (health sector)
- In the production of biosorbents for the pollutants environmental sector
- Via the component suberin – in the production or new macromolecules
- Industry components as an acoustic and anti-vibration insulator

SUBSTITUTION

Table 6. Potential substitution options for natural cork in main uses

Use	Share*	Substitutes	Sub share	Cost	Performance
Wine industry	73%	Plastic	50%	Similar or lower costs	Reduced
Wine industry	73%	no substitute	50%		No substitute
Construction sector	24%	Stone Wool	10%	Similar or lower costs	Reduced
Construction sector	24%	Glass Wool	10%	Similar or lower costs	Reduced
Construction sector	24%	Expanded Polystyrene	10%	Similar or lower costs	Reduced
Construction sector	24%	Extruded Polystyrene	10%	Similar or lower costs	Reduced
Construction sector	24%	no substitute	60%		No substitute
Leisure and entertainment	1%	not assessed, under 10%			No substitute
Gaskets	1%	not assessed, under 10%			No substitute
Furniture	1%	not assessed, under 10%			No substitute

*Estimated global end use shares of natural cork (SCRREEN expert, 2022; ACPOR, 2020).

Substitution of natural cork could lead to a loss of performance for a specific function – for instance the combination of elasticity, weight and insulation properties.

³ SCRREEN Expert Workshop, October 2021

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The economically possible substitution rate of natural cork is high, contributing to the material not being assessed as critical.

CONSTRUCTION

Cork can be substituted at up to 50% for all construction purposes by other materials.

Alternative materials for the properties provided by natural cork include:

- Stone Wool or Glass Wool
- Expanded Polystyrene or Extruded Polystyrene
- PUR
- Several other plastics

BOTTLE / WINE CAPS

There is an increasing trend for cork wine stoppers to be substituted, for two main reasons.

- To prevent spoilage (there is an 8% failure rate in natural cork wine stopper).
- World wine production and consumption are increasing at a faster rate than cork production.

SUPPLY

EU SUPPLY CHAIN

The NACE4-digit code “Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials” had a value added of close to 3 billion € (Eurostat 2019b). As expected, it is strongly represented in Portugal, but also in France and Germany. The EU is not dependent on imports for natural cork

In 2019 PRODCOM codes related to manufacturing of cork products (16292130 to 16292400) had a value added slightly over 2,5 billion EUR (Eurostat 2021). As expected, they are strongly represented in Portugal and Spain, but also in France and Italy. In spite of COVID19 effects, data for 2020 were only moderately lower than 2019, totalizing 2,4 billion EUR.

SUPPLY FROM PRIMARY MATERIALS

PRODUCTION LOCATIONS OF NATURAL CORK

GEOGRAPHICAL OCCURRENCE

The tree cork oak (*Quercus suber*) grows typically in the summer months of the Northern hemisphere, depending on the geophysical circumstances. The coldest months should have a temperature that remains above -5°C at a minimum (Pereira 2011). It takes each cork oak between 25 and 30 before it can be stripped

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for the first time and thereafter only every nine years. It is only from the third harvest that the cork will have reached the high quality need for stoppers. The first two tours usually provide raw material for insulation, floors or other purposes. The trees can produce cork for over 200 years.

GLOBAL RESOURCES AND RESERVES

The current land use of natural cork is shown in Table 7.

Table 7 Global reserves of natural cork in year 2020 (APCOR, 2020).

Country	Natural cork Reserves (mil ha)	Percentage of total (%)
Portugal	720	34 %
Spain	574	27 %
Morocco	383	18 %
Algeria	230	11 %
Tunisia	86	4 %
France	65	3 %
Italy	65	3 %
<i>World total</i>	2.123	100 %

EU RESOURCES

Apart from Portugal and Spain, France and Italy report some regional economic activity in the production of natural cork. There is also mentioning of small-scale production in Greece, but could not be confirmed by available data sources.

WORLD AND EU PRODUCTION

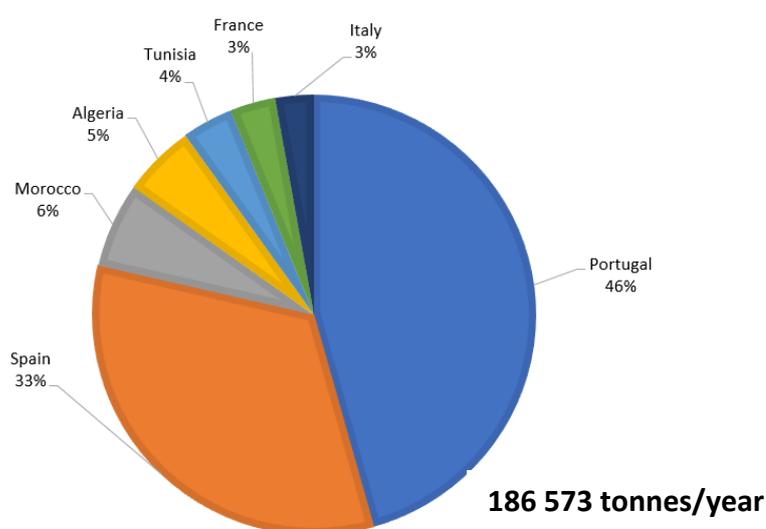


Figure 13 Global annual production of natural cork in percentage. (APCOR 2020).

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The world annual production of natural for 2020 is 186 573 tonnes. The global producers of natural cork are concentrated in the western Mediterranean area, with a dominant role for the Iberian Peninsula (**Erreur ! Source du renvoi introuvable.**).

SUPPLY FROM SECONDARY MATERIALS/RECYCLING

POST-CONSUMER RECYCLING (OLD SCRAP)

End-of-life recycling input rate for natural cork is estimated to be 8%, based on APCOR (APCOR 2015); (Amorim and Sgps 2008). Only for construction purposes can processed secondary cork replace primary cork. It is not possible to use recycled cork as wine corks due to health and safety issues. They may be used in the production of other materials for coverings, insulation, memo boards, high competition kayaks, badminton rackets, tennis and cricket balls, car and aircraft components, design and fashion items and a multitude of other uses (APCOR, 2019). In its Sustainability Report (2022), AMORIM, the principal world cork manufacturer estimated at 801T the amount of recycled corks in 2021. This quantity represented 3,1% of their cork production. Currently, the most important aim of the collection efforts is to raise awareness of the importance of ecological and social opportunities to use recycled cork. Potential for more extensive recycling is not yet reported.

INDUSTRIAL RECYCLING (NEW SCRAP)

Waste scrap of natural cork is traded as a commodity and basically a raw material for other applications. It is treated as a raw material in the assessment including product group “cork waste; crushed, powdered or ground cork”.

OTHER CONSIDERATIONS

HEALTH AND SAFETY ISSUES

Natural cork is not related to major health concerns. The only risk detected is that, due to the handling and treatment of cork during extraction and production processes, workers may be exposed to inhalation of cork dust. The inhalation of cork dust particles can cause the disease of suberosis, a relatively benign pulmonary fibrosis that presents as asthma, allergic alveolitis or as chronic bronchitis, and whose symptoms appear after several years of work and contact with the cork. However, few cases have been detected (UGT 2010, CCOO 2016).

Several compounds from cork stoppers and other cork wastes have shown high aromatic and antioxidant potential. The recovery of these valuable compounds could help to reuse them in agricultural, cosmetic, pharmaceutical, or food industries (Mislata 2020).

This substance is not restricted under REACH Regulation (EC) No 1907/2006 Annex XVII (Deutsche Forschungsgemeinschaft and Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area, 2002).

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ENVIRONMENTAL ISSUES

The environmental issues relate to vulnerability of the production system from pressures from the environment rather than the other way around. According to the World Wildlife Fund, the traditional cork oaks agroforestry system (*Montado* in Portugal, *Dehesa* in Spain) supports one of the world's highest levels of biodiversity, including homes for endangered species such as the Iberian lynx, the Iberian imperial eagle, the Barbary deer, and many species of rare birds as well as fungi, ferns, and other plants (APCOR 2014).

NORMATIVE REQUIREMENTS RELATED TO THE USE AND PROCESSING OF NATURAL CORK

The international certification (Systecode) set up in 1999 by CELIEGE (The European Cork Federation) aims to certify cork stopper manufacturers that comply with the regulations of the International Code of Cork Stopper Manufacturing Practice. Systecode and the ICCSMP require companies to subscribe to the most advanced production techniques, besides demanding extensive and detailed knowledge of materials and strict compliance with environmental regulations and occupational safety and health regulations. Other certifications used by the cork industry are ISO 22000:2005 Food safety management systems — Requirements for any organization in the food chain or the Forest Stewardship Council (FSC) certification (APCOR 2021).

Natural cork has not a specific body of regulations. However, some references and/or guidelines can be found in compilation documents as the following.

- JRC (2016) Non-harmonised food contact materials in the EU: Regulatory and market situation: BASELINE STUDY: Final report
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SOCIO-ECONOMIC AND ETHICAL ISSUES

ECONOMIC IMPORTANCE OF NATURAL CORK FOR EXPORTING COUNTRIES

Globally the natural cork economy is very small (about 0.01% of the total world trade market). The importance of this market is also anecdotic for the main producing countries (Spain, Portugal, and Italy, with less than

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0.0005% of their total export trade value...). However, in 2020, the natural cork export market represented about 15% of the total Bosnia Herzegovina export trade value and 7% for Armenia (COMTRADE, 2020).

SOCIAL AND ETHICAL ASPECTS

Cork is considered to be among the types of EU products that have the strongest link to vulnerable agricultural communities and cork processing workers (CREOAK Project, 2006).

The World Wildlife Fund (WWF⁴) highlights that cork oak landscapes play a key role in ecological processes such as water retention, soil conservation, and carbon storage.” It is easy to see why the WWF is enthused with the cork forest and its use. The cork forest is a vital ecosystem that plays a crucial role in halting desertification throughout most of the region. It is home to numerous endangered species and provides a richly diverse habitat to flora and fauna. Most of all, the forest is utilized by a cork industry that has created legal protection for its preservation.

RESEARCH AND DEVELOPMENT TRENDS

RESEARCH AND DEVELOPMENT TRENDS FOR LOW-CARBON AND GREEN TECHNOLOGIES

a. R&D trends in terms of emerging LCGT

- **Bio sorbents (TRL 4)**

Applications of cork recently proposed in the field of green technologies concern its use as a biosorbent for pollutants by using cork’s industrial residues (Pintor et al., 2012). Moreover, cork industrial wastes have been studied as biosorbents of heavy metal ions which are common pollutants originating from industrial activity (such as copper, nickel, chromium, cadmium, mercury and lead) and as a source for the production of activated carbon for the adsorption of volatile organic compounds (VOCs) and emerging pollutants (ibuprofen, paracetamol, etc.). However, despite the technological feasibility, these studies remain at the laboratory scale.

b. R&D trends in terms of emerging application of RM in already existing LCGT

No research and development projects could be identified in the context of emerging applications of Natural cork in already existing LCGT.

OTHER RESEARCH AND DEVELOPMENT TRENDS

No data available.

⁴ <https://wwfint.awsassets.panda.org/downloads/factsheetcork.pdf>

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