International Cluster Collaboration

Preparatory Briefing on Chile

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1. Objectives of the report

The aim of this "preparatory briefing" is to provide up to date information on the cluster landscape in Chile. It supports European cluster organisations and their small and medium enterprises (SMEs) to familiarise themselves with the country and explore its potential for collaboration and market and sector development opportunities.

This briefing paper starts with an overview of the country´s economy and sectoral trends/strengths which clusters contribute. Then, it brings highlights into the existing cluster community, the cluster policies/local support to clusters and the cluster programmes – including their historical development and internationalisation activity when relevant.

The case of Chile is particular in the sense that it used to have a fairly detailed cluster policy, which has now been replaced and sectoral development is now structured through a smart specialisation policy. This change of paradigm has resulted in a varied cluster landscape, composed of a few "typical" clusters as such, but a wide range of actors, that fill the role of clusters and constitute potential cooperation partners for Europe.

As a result, the report adopts a sectoral approach to map the Chilean cluster community: it highlights Chile's most interesting sectors and the relevant actors for cooperation.

The content of this report is principally based on desk research and confirmed via interviews with relevant local contact points.

A complementary report, ''discussion paper'', is also available. It provides an overview of the existing EU-Chile cluster cooperation and presents some success stories and opportunities for future exchanges.

The ECCP briefing papers are intended to provide information to the clusters themselves, as well as their SME´s, the ESCP-4i partnerships, and policymakers, etc.

1. Chile Economy

1.1. Overview

Figure 1 Administrative Map of Chile

The Republic of Chile is a South American country, located along the Pacific Ocean sharing borders with Peru, Bolivia and Argentina.

The population of Chile was 18.76 million in 2018.[1] Since 1990, the population has grown by 35%. In the meantime, the annual demographic growth rate has gone from 1.6% in 1990 to 1.4% in 2018, accompanied by a five-year increase of the average life expectancy providing the country with western-like demographic patterns.

Due to Chile's strong macroeconomic, the country has been one of Latin America's fastest-growing economies during recent decades. In 2018, the Chilean economic growth rate was 3.9%, compared to 1.5% in 2017. [2]

With a nominal GDP of over USD 298 billion in 2018, Chile is the sixth richest Latin American Country. 55.7% of Chile's GDP comes from the combined value of import and exports.[3]

Chile was the first South American country to negotiate free-trade agreements with the European Union and the United States (cf section 1.1.3).

The country is also called the "Jaguar", because of its renowned economic stability.

[1] World Bank Data, http://databank.worldbank.org/data/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=CHL, consulted on 17/07/2019

[2] Preliminary Overview of the Economies of Latin America and the Caribbean 2018, https://repositorio.cepal.org/bitstream/handle/11362/44327/115/BPI2018_Chile_en.pdf , consulted on 17/07/2019

[3] The Heritage Foundation, https://www.heritage.org/index/country/chile, consulted on 17/07/2019

1.1.1. GDP and wealth

A liberal and developed country

The liberalisation of the economy that has been in place since the mid 1970's has led to the economic recovery of the country, despite an economic crisis in 1982 -1983. Between 1984 and 1996, the average annual growth rate was 5.07%, with a growth peak attested by an average annual growth rate of 7.14% from 1990 to 1997.

The measures taken during the "Pinochet era" (1973 – 1990) did not successfully manage to reduce poverty: as unemployment and inflation soared, inequalities widened as a result of the cuts in welfare programmes and the collapse of SMEs challenged by foreign companies.[1] In 1990, when General Pinochet left power, 38.6 % of the population lived below the poverty line. [4]

Neoliberalism was the main legacy under the "Pinochet era" and constitutes the current economic policy. Nevertheless, in order to reinstate social order, the social democrats, who were elected democratically in 1990, restored some welfare policies and implemented programmes to ensure that growth would help to fight poverty.

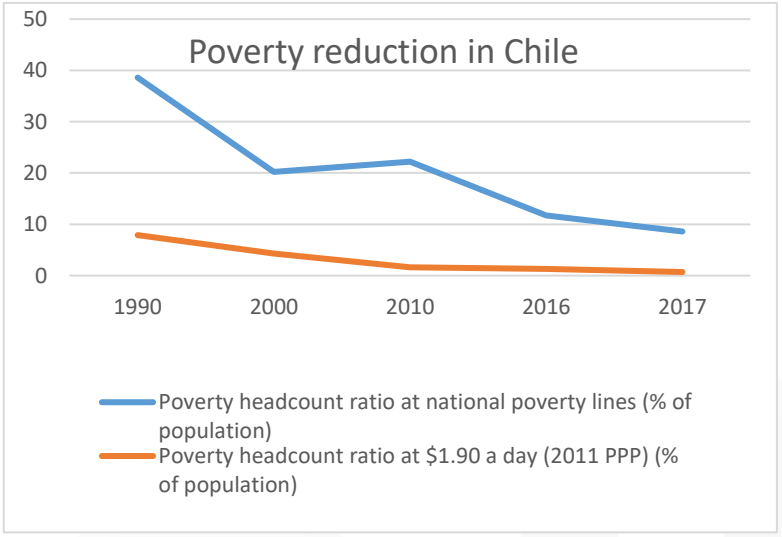


Figure 2 Poverty reduction in Chile (World Bank)

Excellent results were obtained and in 2017, only 8.6% of the population lived below the poverty line. [5]

With the economic growth, unemployment significantly decreased reaching 6.9 % in 2018, and this helped to enrich the population. Simultaneously, the GDP per capita increased in average by 5.1% per year in the years between 2009 and 2018, to reach USD 25,168 in 2018.[6]

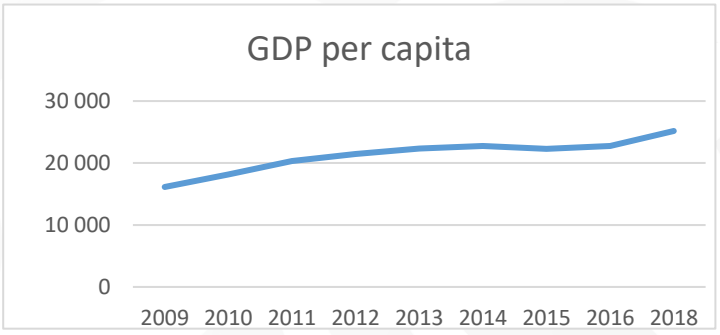
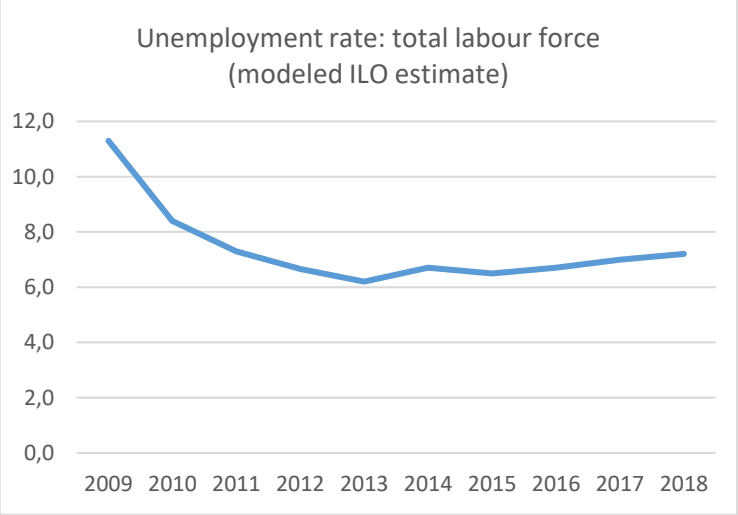


Figure 2 Evolution of the GDP per Capita 2009 - 2018 (OECD)

[4] World Bank, Data, Chile, https://data.worldbank.org/country/chile, consulted on 07/07/2019
[5] World Bank, Data, Chile, https://data.worldbank.org/country/chile, consulted on 07/17/2019
[6] OECD, Chile, Data, https://data.oecd.org/chile.htm, consulted on 17/07/19

Other indicators demonstrate the *tour de force* of the Chilean democratic government in developing the country. For instance, 100% of children are enrolled in secondary education, with equal access for male and females. [7]

The efforts of the Chilean Government were rewarded in 2010, when Chile was officially recognised as an OECD country.



A stable economy

Both fiscal and monetary policies enable Chile to have a stable economy.

In line with the neoliberal ideology, Chile implements a policy of structural balance, with some flexibility. The country takes advantage of prosperous years to save public money through the Economic and Social Stabilisation Fund (FEES), which in turn serves public expenditure when the economy slows down. Every year, the FEES receives positive balance from the fiscal surplus, and can finance potential fiscal deficits and repay public debt. This system is particularly important as the economy is highly dependent on copper exchange price, Chile's main export product. Thanks to this policy, Chile was able to recover quickly from the 2008 crisis. [8]

In the same paradigm, Chile's monetary policy is managed independently by the Central Bank of Chile. Its goal is to safeguard *"the stability of the currency and the normal functioning of internal and external payments"*. [9] To fulfil its role, the Central Bank implements a targeting inflation policy. This policy aims to let the inflation grow to foster growth and exports, while maintaining prices at a stable level. [10]

Both policies ensure Chile has a particularly stable macro-economy, its strength was demonstrated during the 2008 economic crisis.

1.1.2. Economic sectors

Chile is a service-based economy. Services account for 57.9% of the growth value added of the country. The country has a solid agricultural base accounting for 3.6% of the value added of the country in 2018

[7] World Bank, Data, Chile, https://data.worldbank.org/country/chile, consulted on 17/07/2019
[8] World Trade Organisation, Trade Policy review, Chile, https://www.wto.org/english/tratop_e/tpr_e/s315_sum_e.pdf, consulted on 17/07/2019
[9] Banco Central de Chile, Funciones, http://www.bcentral.cl/en/web/guest/funciones, consulted on 29/03/2018
[10] Banco Central de Chile, planificacion estrategica 2018 – 2022, http://www.bcentral.cl/en/web/guest/planificacion-estrategica, consulted on 17/07/19

and that is increasing since 2009. The industry accounts for 24.1% of the value added but has decreases over time. [11]

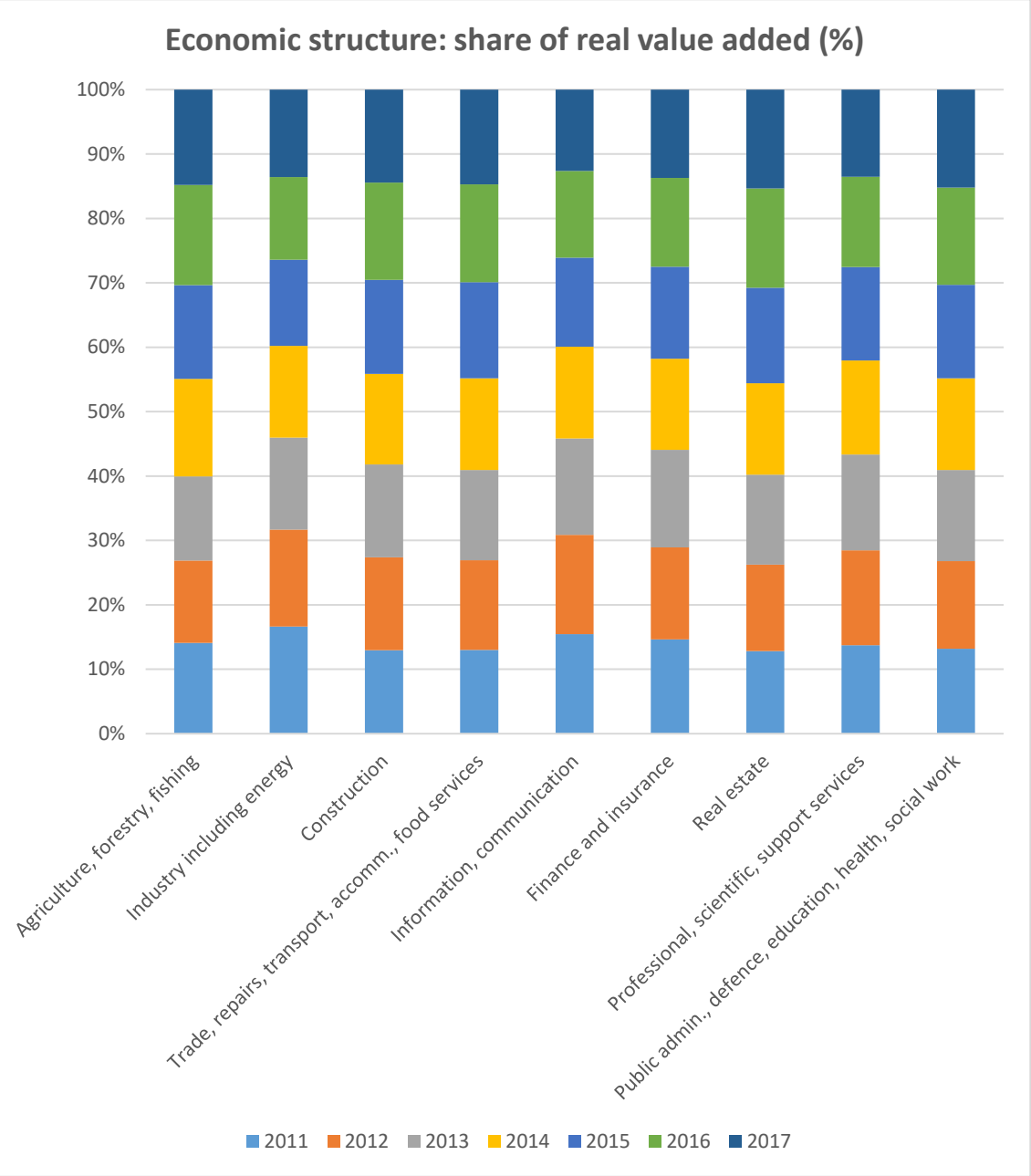


Figure 5 Economic structure: share of value added 2011 - 2017 (OECD)

Agriculture

Agriculture (including fishing and forestry) is one of the sectors that has been primarily developed since colonisation, due to the favourable climate of central Chile. The agriculture sector accounts for 4.3%

[11] OECD, Chile, Data, https://data.oecd.org/chile.htm, consulted on 17/07/19

of the GDP and employs 9.2% of the Chilean labour force. The main agricultural productions are grapes, apples, onions, wheat, corn, oats, peaches, garlic, asparagus, beans, beef, poultry, wool, fish and timber. [12] The location of Chile in the Southern hemisphere gives the country seasons in reverse, which enable the country to export **fruits** in the counter-season to Europe and the United States, hence benefitting from a comparative advantage. The Chilean agriculture sector is also characterised by an increasing production and exportations of **wines**.

Another important agricultural sector is **fishing**. According to a 2004 FAO report, the fishing sector is composed of industrial fishing (51% of the production), small-vessel fishing (34% of the production) and fish farming (15% of the production). With a production of 140.5 million metric tons of fish in 2004, Chile ranked 6th among producing countries, accounting for 4% of the world's production. In the context of the reduction of natural fish resources, Chile developed its aquaculture industry, notably salmon production. In 2004, Chile was the second largest salmon producer on the planet with 38% of the production (just behind Norway with 39% of the production). [13]

Wood is also an important agricultural sector characterised by important exports of pines and eucalyptus.

Industry

The industrial sector of Chile mostly consists of the **mining** sector. Chile is the world's largest copper producer. In 2016, it produced 5.5 million tons of copper accounting for 30% of the world's production. Besides copper, Chile also mines lithium, which has become strategic with the development of electronic devices. In 2016, Chile's lithium production accounted for 36% of the worldwide production. Besides these two strategic metals, Chile also mines gold, silver, iron and coal.[14] The country heavily relies on copper exports and is highly dependent on its exchange price.

To decrease its dependency, Chile has decided to develop other manufacturing sectors. Those are divided between the ones linked to the **agriculture transformation** (fish processing, wood products) and the others (transport equipment, cement and textiles).[15] The **energy sector**, notably electricity, is very important. Electricity is entirely private and built upon four different grids. The electricity production relies heavily of fossil fuels (56.7% of the production in 2018).[16] The demand for electricity

[12] CIA, The World Factbook, Chile, https://www.cia.gov/library/publications/the-world-factbook/geos/ci.html#Econ, consulted on 17/07/19

[13] EU, Gobierno De Chile CONYCICT, Los sectores pesca y acuicultura en Chile, Capacidades de investigación y áreas de desarrollo científico-tecnológico,2010, https://www.conicyt.cl/documentos/dri/ue/Pesca_Acuic_Fishery_Aquac_BD.pdf, consulted on 08/07/2019

[14] Export.gov, Chile Mining, https://www.export.gov/article?id=Chile-Mining-and-Minerals, consulted on 17/07/2019

[15] CIA, The World Factbook, Chile, https://www.cia.gov/library/publications/the-world-factbook/geos/ci.html#Econ, consulted on 17/07/2019

[16] International Energy Agency, Chile, https://www.iea.org/statistics/?country=CHILE&year=2016&category=Electricity&indicator=ShareElecGenByFuel&mode=chart&dataTable=ELECTRICITYANDHEAT, consulted on 17/07/2019

is raising (approximately +4% per year), and such an increase boosts the renewable energy sector (solar and wind power).[17]

Services

The service sector represents the main share of the gross value added of the country and employs most of the population. The raise in **retail** and **construction** is intrinsically linked to the country's growth, they are important services sectors. Services linked to manufacturing are also well-developed.

Telecommunication is a thriving sector in Chile. Most of the population are accessing ICT at a rapid pace: in 2000, 16.3% of the population had access to the internet versus 82.3% in 2017. [18] This sector involves both infrastructure (wireless, fiber) as well as the devices. [19]

Tourism is also important. According to the "Invest in Chile" governmental agency, tourism accounts for 6% of the national GDP. In 2018, 5.7 million people landed in Chile and this figure is increasing by 10% per year, both in terms of arrivals and revenues.[20]

[17] Export.gov, Chile energy, https://www.export.gov/article?id=Chile-Energy, consulted on 17/07/2019

[18] Statista, Data, https://www.statista.com/statistics/209108/number-of-internet-users-per-100-inhabitants-in-chile-since-2000/ , consulted on 17/07/19

[19] Export.gov, Chile – Communication sector, https://www.export.gov/article?id=Chile-Telecommunications-Sector, consulted on 17/07/19

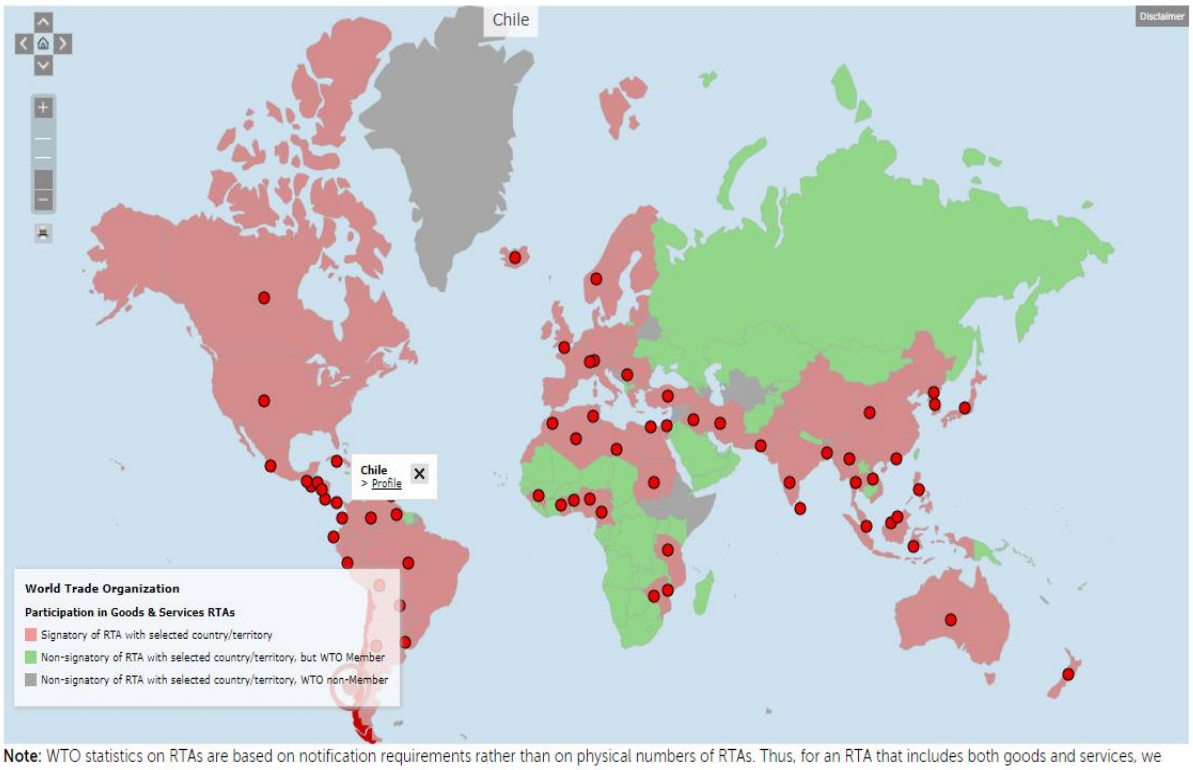
[20] Monthly number of international tourists in Chile in 2018, https://www.statista.com/statistics/759441/chile-monthly-number-tourist-arrivals/, consulted on 17/07/19

1.1.3. International trade and foreign investment

International trade and foreign investment policy

Chile's economy is widely opened to the international market, as encouraged by the free trade principles of the neoliberal policies. Since opening its market, Chile has signed a number of bilateral agreements and is a member of several economic unions (UNASUR, APEC, CAN, BID, MERCOSUR and the OECD). In addition, the successive Chilean governments have multiplied their efforts to sign trade agreements (over 60). Chile is nowadays considered as an open economy. [21]

To foster foreign investments, Chile has liberalised its trade policy while changing the regulatory framework for investments and adopted a more far-reaching competition law. [22]



Note: WTO statistics on RTAs are based on notification requirements rather than on physical numbers of RTAs. Thus, for an RTA that includes both goods and services, we count two notifications (one for goods and the other services), even though it is physically one RTA.

Figure 6 Countries Regional Trade Agreements of Chile with third countries (WTO)

Trade and exports

In 2018, gross exports amounted USD 70 billion (23% of GDP), whilst gross imports reached USD 63 billion (21% of GDP) according to OEC. [23]

[21] World Trade Organisation, Participation in Regional Trade Agreements, https://www.wto.org/english/tratop_e/region_e/rta_participation_map_e.htm, consulted on 17/07/19
[22] World Trade Organisation, Trade Policy review, Chile, https://www.wto.org/english/tratop_e/tpr_e/s315_sum_e.pdf, consulted on 17/07/19
[23] OECD, https://oec.world/en/profile/country/chl/#Exports, consulted on 17/07/2019

Chile exports mainly the following products:

- Refined copper and copper ore products account for almost a half of Chilean exports;
- Fish fillets, wood pulp, wine and grapes also contribute significantly towards Chilean export.[24]

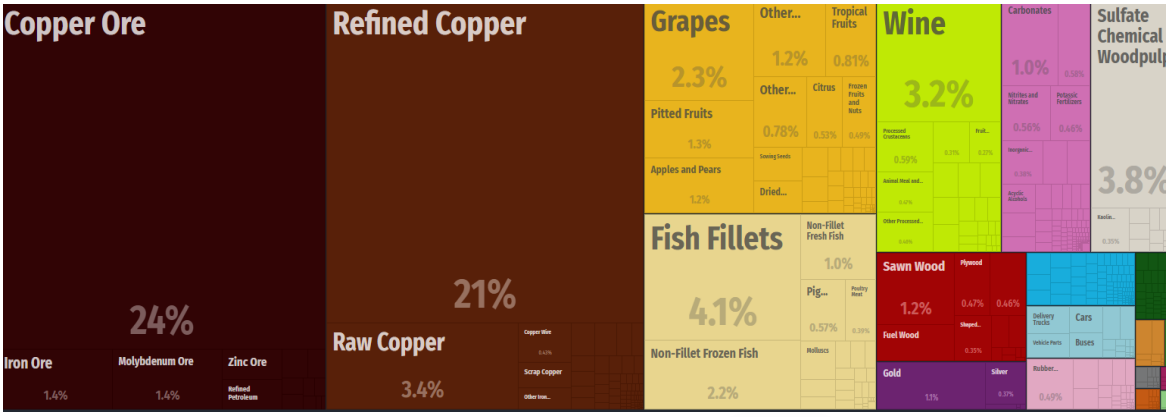


Figure 7 Chile's exports 2017 (The Atlas of Complexity)

China is Chile's main export country, exports to china accounted for USD 19 billion in 2017, followed at a distance by the US with USD 10 billion worth of exports in 2017.

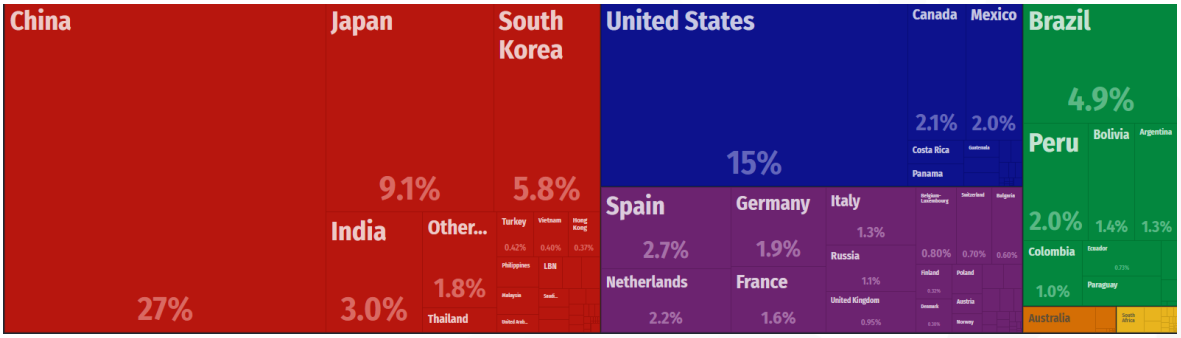


Figure 8 Chile's exports destination 2017 (The Atlas of Complexity)

On the other hand, the imports that Chile receives are vary varied. Chile's imports include:

- Mostly manufactured products include cars, refined petroleum, crude oil, delivery trucks and broadcasting equipment;
- Followed computers and video displays;
- And food products and textiles, however to a lesser extent.

[24] Harvard University, The Atlas of Complexity, Chile, http://atlas.cid.harvard.edu/explore/?country=42, consulted on 17/07/2019

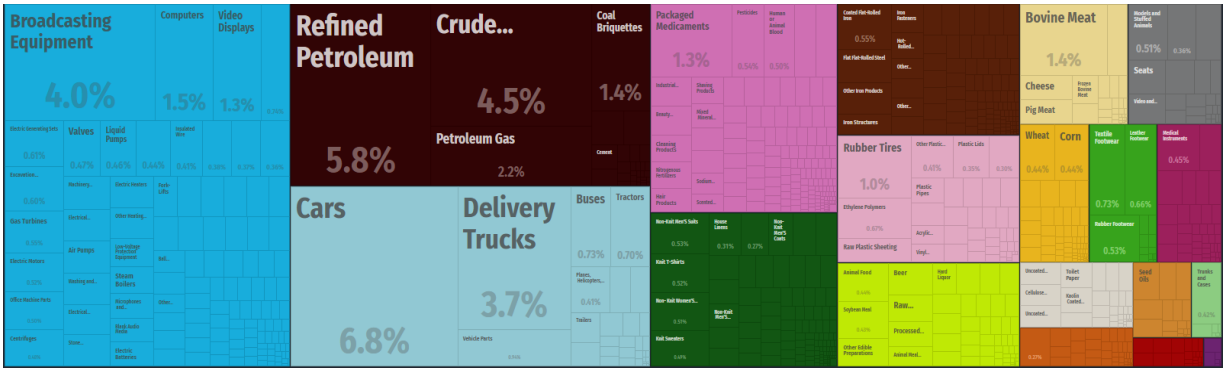


Figure 9 Chile's imports 2017 (The Atlas of Complexity)

In terms of origin, imports reveal only a very slight weighting towards China, compared to USA. Although China remains Chile's main trading partner, its imports account for about 25% less than its exports.

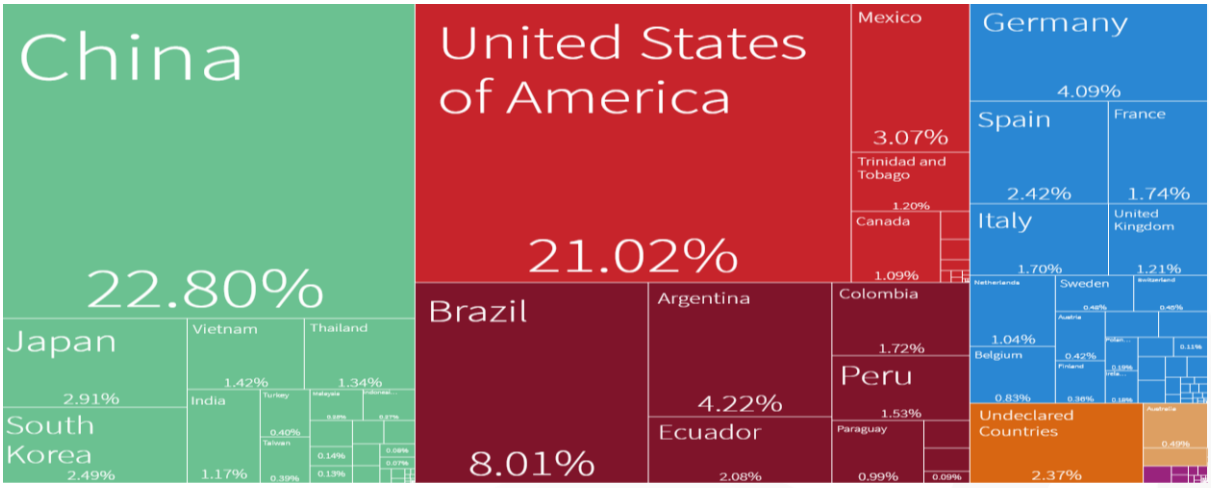


Figure 10 Chile's imports origin 2017 (The Atlas of Complexity)

The imports and exports figures of Chile reveal the strength and weakness of the mining industry, whilst mining products are among the country's biggest exports, industry equipment for mining are amongst the most important imports. The previous figures also reveal that Chile is primarily an export economy when it comes to raw products, with both mining and farmed products. In relation to services, Chile has amongst the lowest service exports of the OECD countries.

Foreign investment

Chile has developed a strong policy to attract foreign direct investments. The Foreign Investment Promotion Agency, also known as "**Invest Chile"** is the body of the government in charge of implementing the foreign investment policy. It provides four types of services:

- Attraction: presenting investment opportunities and value propositions;
- Advisory services to aid decision-making in pre-investment phases;
- Advisory services to help new companies settle within the country;

- After-care including assistance for exporting and linkages with domestic suppliers.

All types of activities are open to foreign investment and a company can be 100% owned by a foreigner. There are a few exceptions for strategic domains, such as nuclear energy, mining, fishing as well as internal waterways and freight transportation. In the case of mining, the territory of Chile *is "absolute, exclusive, inalienable and permanent"* but concession rights can be granted to companies. To create a telecommunication company, the investor must obtain a license.

Invest Chile is responsible for the screening of investment proposals before approving them. In most cases, investments are accepted. Thanks to this very open policy, there is more inward than outward investment in Chile. [25]

This is reflected by the following OECD figure: whilst Chile accounts for 0.5% of OECD countries total GDP, its foreign investments account for 1.4% of the total OECD FDI.[26] In terms of figures, FDI in Chile peaked in 2012 at USD 27 billion. In 2016, FDI has returned to pre-2012 levels. The decrease in FDI can be explained by the nature of FDI: as most FDI is intended for the mining sector, the recent decrease is linked to the decrease of copper market prices. Despite such a situation, Chile remains an attractive country in terms of FDI. [27]

Foreign Direct Investment	2014	2015	2016
FDI Inward Flow *(million USD)*	23,784	15,866	11,266
FDI Stock *(million USD)*	212,557	221,986	238,557
Number of Greenfield Investments***	69	86	68
FDI Inwards *(in % of GFCF****)*	38.3	27.7	19.7
FDI Stock *(in % of GDP)*	81.5	91.5	96.6

Source: UNCTAD, 2018

Figure 11 Foreign Direct Investment in Chile[28]

[25] Export.gov, Chile - 1-Openness to, & Restrictions Upon Foreign Investment, https://www.export.gov/article?id=Chile-openness-to-foreign-investment, consulted on 17/07/2019
[26] OECD, Chile Trade and Investment Statistical note, http://www.oecd.org/investment/Chile-trade-investment-statistical-country-note.pdf, consulted on 17/07/19
[27] UNCTAD, World investment Report 2017, http://unctad.org/en/PublicationsLibrary/wir2017_en.pdf, consulted on 17/07/2019
[28] Nordea Trade, Foreign Direct Investment in Chile, https://www.nordeatrade.com/no/explore-new-market/chile/investment, consulted on 17/07/19

1.2. Opportunities for Europe – investment, trade and science, technology & innovation cooperation.

1.2.1. Trade and investment

A selection of EU countries (Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, The Netherlands, Austria, Finland, Sweden and the UK) ratified a **free-trade agreement** (Association Agreement, also referred as AA) with Chile in 2002, which entered into force in 2003. It removed tariffs and trade barriers as well as guaranteeing the protection of Chilean intellectual properties in Europe.

According to the European Commission, the EU is Chile's third largest trading partner, accounting for 13% of Chile's total trade in 2018. The EU is also Chile's third largest import supplier, as well as its third largest export market. [29] The EU noted that Chile benefitted from extra trade in various domains: "*welfare, gross domestic product, consumption, and capital stock*"[30]. As far as agriculture is concerned, some barriers have been lowered to increase the flow of Chilean products onto the market. If trade between the EU and Chile has increased after the ratification of the AA, it is perceived as not yet reaching its full potential.[31]

Due to the relatively positive results, the **EU and Chile are currently negotiating the updating of the Association Agreement (AA)**. This process will seek to reflect the many bilateral agreements that have been signed between EU-members and Chile that diverge from the AA. Hence, updating the AA will ensure both the standardisation of all of these bilateral agreements and simplify trade. In addition, since the EU has accepted more Member States since 2002, modernising the association agreement would enable an additional ten countries to benefit from the AA.

Even though the modernisation agreement is expected to have a limited impact on the employment and labour markets of both parties, it will be positive for SMEs. In fact, SMEs that expand internationally tend to do better in terms of growth and turnover. The increased trade, through the modernisation of the association agreement would also positively impact the labour standards and human rights protection in Chile and enable greater cooperation opportunities.

[29] European Commission, Trade Policy, Chile, http://ec.europa.eu/trade/policy/countries-and-regions/countries/chile/, consulted on 17/07/19

[30] European Commission, EU-Chile association agreement modernisation final report executive summary, http://trade.ec.europa.eu/doclib/docs/2017/july/tradoc_155759.pdf, consulted on 17/07/19

[31] European Commission, EU-Chile association agreement modernisation final report executive summary, http://trade.ec.europa.eu/doclib/docs/2017/july/tradoc_155759.pdf, consulted on 17/07/19

1.2.2. Science, technology & innovation

The opportunities for science, technology and innovation cooperation lie within a well-established partnership between the EU and Chile, an improving research ecosystem, as well as in the capacity of the parties to innovate.

The EU and Chile signed an **Agreement on scientific and technological cooperation in 2002**, which came into force the year after. The agreement was concluded for a term of five years and has been tacitly renewed for the same period. It became the institutional basis for knowledge-based cooperation. The actual implementation of the agreement is based on the regular gathering of a joint steering committee, in charge of animating the policy dialogue, promoting, monitoring and organising cooperation.

The main areas of cooperation under the agreement are *"health; food, agriculture, fisheries and biotechnology; environment; nanotechnology; ICT and energy,"*[32] as these areas have an important scientific base in Chile. The implementation mechanisms of this policy lie within the framework programmes of the European Union. Chile's participation has increased with successive framework programmes. Within H2020, Chile is amongst the most active Latin American countries. Since the ratification of the agreement on scientific and technological cooperation, the EU has contributed approximately € 12 million to Chilean projects.

To support cooperation on scientific and technological matters, the EU has funded two projects:

- CEST+I,[33] an online portal working as a liaison office in charge of increasing Chile's participation in the EU framework programmes;
- ALCUE NET[34], a network dedicated to enhancing the policy dialogue between the European Union, Latin America and the Caribbean countries on scientific and technological cooperation, while facilitating partnerships.

In 2017, the joint steering committee mentioned above, met and decided to pursue cooperation on **three strategic axes**:

- Sustainable mining;
- Climate action and resource efficiency and notably, infrastructure, polar research, world climate and disaster resilience;
- Health and more precisely chronic diseases, infectious diseases and antimicrobial resistance.[35]

[32] European Commission, International cooperation, VIII EU-Chile Joint Steering Committee meeting, https://ec.europa.eu/research/iscp/index.cfm?pg=chile, consulted on 17/07/19

[33] Horizon 2020, http://www.horizon2020.gouv.fr/cid79283/projet-cest-i-soutien-financier-pour-des-visites-de-travail-en-europe-et-au-chili.html?menu=4 , consulted on 17/07/2019

[34] ALCUE NET, Latin America, Caribbean and European Union Network on Research and Innovation, http://alcuenet.eu/, consulted on 17/07/19

[35] JOINT COMMUNIQUÉ, VIII Joint Steering Committee Meeting of the Bilateral Agreement on Science and Technology between the European Union and Chile 17/07/19, https://ec.europa.eu/research/iscp/pdf/policy/eu-chile_jsc_communique_2017.pdf , consulted on 17/07/19

Chile also has **an improving higher education system**. The country has 25 state universities and several private institutions. According to the OECD, Chile is still held back by the lack of inclusivity of its education system (4.8% of GDP)[36], which is the result of the countries wide inequalities. In addition, there is limited public funding for education in Chile.[37] Nevertheless, in 2018, research universities outnumbered teaching only universities, with nine institutions offering accredited doctorates.

Chile's top three universities are the Pontifical University of Chile, the University of Chile and the University of Concepcion. [38]

The Pontifical University of Chile has 36 doctoral programmes, in seven categories: interdisciplinary studies, natural science and mathematics, biological sciences, engineering and technology, medical science and health care, social sciences and humanities.[39] There are 700 research projects receiving external financing in 2017, and 160 research and development projects. In 2017, the doctoral school published 1,900 articles and received 118 patents, becoming Chile's leader in terms of patent applications and approvals.[40]

The University of Chile has 37 doctoral programmes in 10 disciplines.[41] Regarding basic research, the university is responsible for a third of Chilean publications, i.e. 2,257 publications in scientific journals in 2016. The university conducted 105 basic research projects in 2017.[42] As far as applied research is concerned, 30 projects were accredited by the **Comisión Nacional de Investigación Científica y Tecnológica (CONICYT)** the national research centre and funded by the **Fund for Scientific and Technological Development (FONDEF)**. These projects are in the fields of education, health, engineering and agriculture, forestry and animal science. In addition, the **Chile economic development Agency (CORFO)**, an agency attached to the Ministry of Economy, development and tourism and dedicated to fostering growth in Chile, funded 34 "Innova projects" in 2016, in the fields of agriculture, forestry, animal sciences, aquaculture, tourism and biotechnology. Regarding technology transfer, the university received 14 patent applications in Chile and 35 from abroad, in 2017.[43]

[36] Global Innovation Index, 2017 Report, https://investchile.gob.cl/wp-content/uploads/2017/06/wipo-complete-2017.pdf, consulted on 17/07/19
[37] OECD, Education in Chile, Chapter 1: Overview of the education system in Chile, https://read.oecd-ilibrary.org/education/education-in-chile/overview-and-the-oecd-review-process_9789264284425-5-en#page1, consulted on 17/07/19
[38] Times Higher Education, Research-focused universities take the lead in Chile, https://www.timeshighereducation.com/news/research-focused-universities-take-lead-chile, consulted on 17/07/19
[39] Pontifical University of Chile, Doctoral College, Our programs, http://doctorados.uc.cl/en/programs/our-programs, consulted on 17/07/19
[40] Pontifical University of Chile, Doctoral College, research figures, http://doctorados.uc.cl/en/who-we-are/research-figures, consulted on 17/07/19
[41] University of Chile, Doctoral programs, http://www.uchile.cl/portal/english-version/education/120211/doctoral-programs, consulted on 17/07/19
[42] University of Chile, Basic research projects, http://www.uchile.cl/portal/english-version/research/49749/basic-research-projects, consulted on 17/07/19
[43] University of Chile, Applied research projects, http://www.uchile.cl/portal/english-version/research/49750/applied-research-projects, consulted on 17/07/19

Research at the **University of Conception** is organised around 10 research centres, in biotechnologies, optics and photonics, agribusiness, environment, mathematical engineering, advanced microscopy, polymer, mineralogy and GIS.[44] Research is mostly promoted through publications, patent applications and a high-technology incubator.[45]

Business led innovation in the country can be assessed through the **global innovation index**, where Chile ranks 46th out of 127 countries. The global innovation index points out that the strength of Chile, in regards to innovation, are its institutions and notably the regulatory quality and the rule of law; the market sophistication with the availability of domestic credits to the private sector, the business sophistication and notably the amount of companies which offer training to their employees, the importance of FDI, and the intellectual property payments. In relation to research valorisation, Chile performs well in creating innovative businesses.[46]

The main research and development opportunities revolve around the country sectoral strengths.

1.3. Sectoral strengths

Between 2005 and 2010, the **National Council for Innovation and Development** (Consejo Nacional de Innovacion para el Desarollo - CNID), has identified and proposed sectoral policies for five sectors that are of the upmost importance in the Chilean economy: fishing and aquaculture, agriculture, global services, mining and tourism.[47]

These sectors are the pillars of the Chilean economy, notably through their importance in terms of trade and exports. Nevertheless, the latest economic policy aims to diversify the Chilean economy and complement the resource-based sector, with knowledge intensive and high-technology sectors. Identified through the smart specialisation strategy, the government of Chile has targeted seven sectors: creative economy; logistics; construction; solar energy; smart industries; advanced manufacturing and health.[48]

With regards to research and development, and in the perspective of cluster collaboration, five strategic sectors have been retained for this analysis:

- Fishing and Aquaculture,
- Agriculture,
- Advanced manufacturing,
- Mining,
- Solar energy.

[44] University of Concepcion, Research centers, http://www.udec.cl/pexterno/node/39, consulted on 30/05/2018
[45] University of Concepcion, Innovation and development; https://www.udec.cl/pexternoe/node/11?q=node/40, consulted on 17/07/2019
[46] Global Innovation Index, 2017 Report, https://investchile.gob.cl/wp-content/uploads/2017/06/wipo-complete-2017.pdf, consulted on 17/07/2019
[47] Ministerio de Economia, fomento y turismo, Clusters de alto potencial, http://www.economia.gob.cl/subsecretarias/economia/innovacion-2/clusters-de-alto-potencial, consulted on 17/07/2019
[48] Transforma, Programas estrategicos, http://www.chiletransforma.cl/, consulted on 17/07/2019

1.3.1. Fishing and Aquaculture

With 4,300km of coastline, fishing has been one of Chile's most important sectors for a long time. The increase of the global demand, and the pressure on natural fishing resources has conducted the Chilean fishing industry to turn to aquaculture in order to sustainably meet the increasing market needs. Chile is the second biggest world producer after Norway. [49]

In 2018, **salmon became the country's second largest export product,** after copper, with exports exceeding US$ 4.600 million. [50]The farms are mostly located in the South of the country, in five different regions. The industry currently employs approximately 21,000 people.[51]

In the 2000's, the salmon farming industry faced a number of challenges regarding diseases and the impact on the environment. Addressing these challenges required industry actors to increase the coordination of the various farms, while developing a regulatory model. Salmon Chile Intesal brings practical answers to the concentration of salmon farms, using technologies to analyse the ability of the environment to host salmon farms. Biotechnologies are also used in the case of diseases, both for treatments and to avoid the proliferation of various diseases and viruses into the environment. [52]

1.3.2. Agriculture

Agriculture is also one of the traditional economic sectors of Chile, with a concentration around the capital city, Santiago, where a temperate climate has enabled farmers to cultivate European crops. Chile also has a strong livestock sector and exports several meat products. **Chile is amongst the top ten agricultural exporters in the world.** Exports were worth USD 17.5 billion in 2014. The most exported products are wine, fresh fruit, dairy and meat products. The comparative advantage of Chile's agriculture is its production in the counter season to Europe.[53]

Alongside the agricultural sector, forestry has a major role: cellulose is Chile's second most important export's product. The forestry industry is composed of major companies. 90% of the wood products come from the production of Radiata pines. [54]

1.3.1. Advanced Manufacturing

Advanced manufacturing investments are helping to modernise the traditional industry sectors through technological innovations, hence providing a direct solution to the structural problems of the

[49] ISFA, Salmon Farming, Sustaining Communities and Feeding the Worlds, https://sjomatnorge.no/wp-content/uploads/2018/06/ISFA-Report-2018-FINAL-FOR-WEB.pdf, consulted on 20/08/2019
[50] Salmon Chile, Exports, https://www.salmonchile.cl/en/exports/, consulted on 20/08/2019
[51] Salmon Chile, Employment numbers, https://www.salmonchile.cl/en/employment-numbers/, consulted on 20/08/2019
[52] Salmon Chile, The Environment, https://www.salmonchile.cl/en/the-enviroment/, consulted on 20/08/2019
[53] Export.gov, Chile Agricultural sector https://www.export.gov/article?id=Chile-Agricultural-Sector, consulted 17/07/19
[54] The New Agriculturist, Chile country profile, http://www.new-ag.info/en/country/profile.php?a=846, consulted on 17/07/19

traditional industry sectors. Although mostly focused on the mining industry, advanced manufacturing can also be used for other economic sectors. In 2015 advanced manufacturing contributed to almost 11% of the GDP and the sector employed 37,900 works, although CORFO aims to have advanced manufacturing representing 15% of the country's GDP and have 77,000 people working in that sector.[55]

1.3.2. Mining

Mining is a pillar of Chile's economy. The country has had a mining economy for a long time. Saltpetre is the traditional mining industry of Chile. Metals used to be extracted in the desert of Atacama, but the stocks have now been exhausted. In terms of global resources, Chile's reserves account for 29% of copper reserves, 54% of lithium reserves, 16% of molybdenum reserves, 15% of silver reserves and 7% of gold reserves.[56]

Chile's economy relies heavily on the export of copper: in 2016, 5.5 million tons of copper were produced, representing about 30% of the world's production. As a result, copper accounts for 10% of Chile's GDP and about 50% of Chilean exports. [57] The benefits of copper have led the Chilean authorities to open the economic and social stabilisation fund, whose surplus enables the Chilean government to balance its accounts, when public expenditures exceed revenues.[58]

In 2018, the revenues from mining were worth USD 22 billion.[59] Alongside, the exports of mining technological services accounted for USD 42 million. The mining ecosystem employs more than 200,000 qualified people.[60]

1.3.3. Solar Energy

The Atacama Desert receives the highest levels of solar radiations in the world. Such a natural resource is strategic for Chile's energy policy. The traditional electricity production based on hydroelectric dams has become unstable due to recurring droughts, whereas the need for electricity is increasing, particularly for the needs of the mining industry. Chilean non-profit energy watchdog Coordinador Electrico Nacional (CEN) has estimated that solar photovoltaic power will reach a 9.4% share of Chile's power mix in 2019, replacing natural gas as the third most important source of electricity in the country.[61] The grid has been modernised and allows for 98% of the population to be connected to the

[55] CORFO https://webcache.googleusercontent.com/search?q=cache:C5vBKCUwZzUJ:https://www.corfo.cl/sites/Satellite%3Fblobcol%3Durldata%26blobkey%3Did%26blobtable%3DMungoBlobs%26blobwhere%3D1475166235455%26ssbinary%3Dtrue+&cd=9&hl=en&ct=clnk&gl=fr , consulted on 17/07/2019

[56] Invest in Chile, Key industries, Mining, https://investchile.gob.cl/key-industries/mining/, consulted on 17/07/2019

[57] Export.gov, Chile – Mining, https://www.export.gov/article?id=Chile-Mining-Fact-Sheet, consulted on 31/05/2018

[58] Ministry of finance, economic and social stabilisation fund, http://www.hacienda.cl/english/sovereign-wealth-funds/economic-and-social-stabilization-fund.html, consulted on 17/07/2019

[59] Trading economics, https://tradingeconomics.com/chile/gdp-from-mining, consulted on 17/07/2019

[60] Trading economics, https://investchile.gob.cl/key-industries/mining/, consulted on 17/07/2019

[61] Solar to push gas out of Chile's top 3 power sources in 2019, Renewables Now, https://renewablesnow.com/news/solar-to-push-gas-out-of-chiles-top-3-power-sources-in-2019-638831/, consulted on 17/07/2019

Atacama solar energy production. The energy sector is currently pursuing research, development and innovation policies to increase significantly the share of solar energy in the national energy mix.[62]

These sectors, and their potential for collaboration, will be analysed in the following section: in the absence of a comprehensive cluster mapping exercise in Chile, cluster and cluster-like organisations have been separately identified for each of the above sectors.

[62] Transforma, Solar energy committee, http://www.chiletransforma.agenciabigblue.com/2017/08/10/programa-de-energia-solar/, consulted on 17/07/2019

2. Cluster community in Chile

Encouraged by the European Union, the OECD and certain Chilean policies, some clusters have been established in Chile but their coverage both sectoral and geographic remains limited. Although there are a few clusters, Chile welcomes a growing cluster community mainly in the agri-food, aquaculture and fishing, mining and tourism sectors. Furthermore, the Chilean government aims to use the current policy focused on smart specialisation to boost the following additional sectors: advanced manufacturing, creative economy, construction, and health technologies. The current Chilean policy (2014-2018) focusing on the concept of "strategical programmes for smart specialisation" is a cluster policy that supports target sectors and additional "enabling platforms". [63]

2.1. Cluster mapping

There is no comprehensive cluster mapping programme in Chile. As a result, this section of the report focuses instead on the identification of the main stakeholders within the country's key economic sectors and where possible identifies clusters which may have been created to foster sector and business development.

The main inputs for this mapping exercise are based on Chile's smart specialisation policy, which is the implementation arm of the Chilean innovation and competitiveness agenda (cf. section 3). For each of Chile's identified sectoral strengths, this part of the report summarises elements of the smart specialisation programme to identify actors that are potentially relevant for European cluster collaboration. The sectors have been chosen regarding their potential in terms of EU-Chile cooperation.

2.2. Cluster-like initiatives in Chile

2.2.1. Aquaculture and fishing

Fishing and aquaculture are directly regulated by the Ministry of Economy and develop through the **national service for fishing and aquaculture**[64]**.** The zoning of the salmon farms and its regulations is the responsibility of **CORFO, the economic development agency**, which also belongs to the Ministry of Economy, development and tourism.[65] The businesses are organised in the **Salmon Chile Cluster**, a business association, created in 1986.[66]

Beyond the Salmon Chile cluster, cluster-like initiatives are gathered under the "Transforma Chile" programme, the Chilean smart specialisation strategy. Aquaculture is amongst the biggest sectors of Chile and the strategy has designed five programmes. The main programme on salmon covers all of Chile, whereas the four others target the fishing and aquaculture ecosystem of four specific regions.

[63] https://www.clustercollaboration.eu/international-cooperation/chile, consulted on 17/07/2019
[64] Servicio Nacional de Pesca y Acuicultura, http://www.sernapesca.cl/, consulted on 17/07/2019
[65] CORFO, Aquaculture zoning: the case of Chile, https://www.aquaculturealliance.org/wp-content/uploads/2016/08/Day0_AdolfoAlvial_GOAL2015-copy-2.pdf, consulted on 17/07/2019
[66] Salmon Chile, Who we are, https://www.salmonchile.cl/en/about-us/, consulted on 17/07/2019

Each of the programmes contains four types of activities: improvement of human capital, business development, technology and innovation.

These activities are carried out by various types of organisations, mostly private companies but also clusters, research centres and higher education institutions. A summary of these programmes is provided in the annex to this report. The following clusters, key stakeholders and cluster-like organisations in the field of fishing and aquaculture in Chile have been identified.

Name	Type	Description of activities	Website
Salmon Chile	Cluster	The Salmon Cluster was created by the request of CORFO, in 2002, with the intention of creating an integrated territorial development plan to improve the competitiveness of the salmon industry, through innovation.	http://www.sernapesca.cl/
Foundacion Chinquihue	Foundation	The Chinquihue foundation is an association that helps the development of artisanal fishing in the region of Los Lagos. Unlike a cluster, it is not a membership-based association, but it does carry research and development activities, as well as scientific and technological research to improve the socio-economic situation of the regional fishermen, while protecting the environment.	http://www.fundacionchinquihue.cl/web/
Universidad de Antofagasta, centro de bioinnovacion	Research centre	The Bio innovation Centre of the University of Antofagasta is an entity for analysis and studies, which aims to transform basic research to business development applications.	http://www.uantof.cl/centros/bioinnovacion
Universidad de la Frontera Centro de Excelencia en Investigación Biotecnológica Aplicada al Medio Ambiente	Research centre	CIBAMA seeks to develop knowledge, tools and specialised biotechnological innovations to propose scientific and technological solutions to environmental problems. It also contributes to the formation of advanced human capital as well as to generate national and international collaboration networks.	http://www.cibama.ufro.cl/
INCAR, Interdisciplinary Centre for Aquaculture Research	Research centres	INCAR is the first Interdisciplinary Centre for Aquaculture Research in Chile, which deals with a range of issues and gaps in current knowledge related to the development of sustainable aquaculture, in wide-ranging areas related to aquaculture (immunology, genomics, oceanography, epidemiology, genetics, molecular biology, economy, ecology, sociology and biogeochemistry).	https://www.incar.cl/en/home/

2.2.2. Agriculture

To accompany agricultural development, food is also targeted by the Transforma programme which has six strategic programmes dedicated to agriculture. Two of them gather the stakeholders of a specific region. Like the Aquaculture and Fishing programme, each strategic programme for agriculture aims to improve human capital, develop business, foster the use of technology and innovate.

To reach this goal, a wide range of stakeholders (public, private, and from the academia) are involved in the implementation of these programmes. The detailed programmes are provided in the annex of this report. The actors which perform cluster-like activities are listed in the table below.

Name	Type	Description of activities	Website
Chile Lacteo	Cluster	The Chile Lacteo cluster was created under the intervention of CORFO and the Ministry of Agriculture and aims to support its members in modernising the Chilean milk industry. Chile Lacteo is tightly bound to the Fedelech, the milk federation.	http://chilelacteo.cl/2019/
Fedefruta	Federation	The Fedefruta was created in 1988 to support the modernisation of the Fruit industry, by promoting its fruits abroad, but also by introducing innovative quality control processes, and creating certifications.	http://fedefruta.cl/
University of Chile, Centre for Agriculture and the Environment (AGRIMED)	Research centre	The objective of the centre is to develop and promote the use of state-of-the-art technologies for studies of the environment and agriculture. The centre offers specialised support services in the agricultural and environmental area, such as project evaluation, agrometeorological information system and digitisation.	http://www.uchile.cl/portal/investigacion/centros-y-programas/centros-de-estudio/6953/centro-de-agricultura-y-medio-ambiente
Regional Centre for Studies in Food and	Research, scientific and technology Centre	The centre is supported by both the Chilean National Commission for Scientific and Technological Research (CONICYT) and the Regional Government. One of the main purposes of CREAS is to establish itself as a centre of excellence for technological research focused on the	http://www.creas.cl/en/creas-asiste-a-la-

Health (CREAS)		strengthening of healthy and functional food production in the region of Valparaíso.	inauguracion-de-la-nueva-planta-piloto-de-ecofibra/
Plant Improvement and P. Technological Centre	Scientific and technological research Centre	This Centre is dedicated to the scientific and technological research on the adaptation of crops and fruits to the edaphoclimatic conditions of the Centre-South zone of Chile. It considers the needs of end consumers and the need to meet the storage, processing and transportation requirements necessary to reach distant markets.	http://www.fenomica.utalca.cl/

2.2.3. Advanced manufacturing

Advanced manufacturing is steered by the **Digital Transformation Committee**.[67] The Committee works as a platform which facilitates public-private partnerships in this field. Advanced manufacturing targets the thematic sectors of health, construction, mining, astronomy, smart cities and manufacturing.

The smart specialisation has two initiatives to improve advanced manufacturing in Chile, which target capacity building:

- One programme aims at delivering tools and competencies in the information technologies to create interoperability standards in the field of health.
- The other initiative aims at teaching IT programming during secondary school and is implemented in the regions of Valparaiso, Metropolitan and Biobio.

Unlike other sectors, advanced manufacturing is still very much monopolised by the state and cluster-like actors are difficult to identify. Only one stakeholder has been identified. Nevertheless, as a transversal sector, advanced manufacturing is addressed through the other sectors.

Name	Type	Description of activities	Website
Comité de transformacion Digital	Agency	An agency that seeks to promote digital transformation, understood as the standardisation and incorporation of more competitive and efficient processes and environments in the use of resources, thus facilitating the participation of the country's industry and services in global markets.	http://ctdigital.cl/

[67] Comité de Transformacion Digital, Nosotros, https://www.ctdigital.cl/ , consulted on 17/07/2019

2.2.4. Mining

The mining sector is overseen by the **Ministry of Mining**[68]. The smart specialisation strategy of the mining sector is cluster-oriented, with two main programmes: the first seeks to reinforce the research and development ecosystem of Alta Ley, the other one is aimed at strengthening the existing mining cluster (named Minero Antofagasta).

Name	Type	Description of activities	Website
Cluster Minero Antofagasta	Cluster	The Cluster Minero Antafagosta was created by CORFO, the Ministry of Mining and the regional development economic agency. The cluster aims to contribute to the modernisation of the mining industry, supplying qualified HR, entrepreneurs and technologies through connecting stakeholders and encouraging best practices.	http://www.clustermineroantofagasta.cl/
Centre for Advanced Studies in Arid Zones (CEAZA)	Regional Scientific and Technological Research Centre	Promote scientific and technological development, through the realisation of advanced science at the interdisciplinary level in arid zones, biological sciences and earth sciences, from the Coquimbo region	http://www.ceaza.cl/
Mineralogical Research and Services Centre (CISEM)	Research and Services Centre	It provides solutions of comprehensive mineralogical analysis through the use of advanced technology of high precision (QEMSCAN) – (Quantitative	http://www.ucn.cl/en/research/research-centers/

[68] Ministry of mines, http://www.minmineria.gob.cl/, consulted on 17/07/2019

		Evaluation of Minerals based on Scanning Electron Microscopy).	

2.2.5. Solar energy

The solar energy policy is jointly implemented by the **Ministry of Energy** and CORFO, who have co-elaborated a roadmap for 2025. This roadmap was implemented by the Solar Committee[69], the government agency responsible for promoting the development of the national energy industry.

Through its solar energy programme, the smart specialisation strategy implemented by CORFO, aims to create an integrated ecosystem for research and development in the field of solar energy in the Atacama Desert, where the resource is available. The programme addresses human capital, both high level research training and workers training, business development with the creation of an integrated value chain to supply the solar energy industry, a cooperation research project called "Atamos" and an innovation project, aimed at supplying an entire city with solar energy. The table below summarises some of the potential stakeholders relevant for cluster collaboration.

Name	Type	Description of activities	Website
University of Chile, department of electrical engineering	Higher education institution	The Department of Electrical Engineering offers degrees in Electrical Engineering and Electronic Engineering, as well as carrying out high-level research in these areas. The department´s activities are tied to the technological development of control processes, renewable energies, intelligent systems, image processing, voice signals, robotics, sensors.	http://ingenieria.uchile.cl/english-version/departments/97211/electrical-engineering
University of Antofagasta, CDEA Energy Development Centre	Research centre	The centre promotes innovation, development and applied research, in subjects related to energy needs. The activities of the centre are the development of human capital, research, development and innovation, advise and training on alternative energies and business development.	http://www.uantof.cl/centros/desarrollo_energetico
University of Chile, Investigation centre on solar energy	Research centre	The Solar Energy Research Centre (SERC - Chile) investigates the barriers preventing the development of solar energy, from the perspective of six lines of research: solar energy in industry / mining; high power electrical systems with solar	http://ingenieria.uchile.cl/investigacion/centros-y-programas/88508/centr

[69] Comité Solar, http://www.comitesolar.cl/, consulted on 17/07/2019

		energy penetration; solar energy coordination systems for rural and urban communities; storage of solar energy; solar water treatment, and economic, social and regulatory aspects for the development of solar energy.	o-de-investigaciones-en-energia-solar
University Santa Maria, Centre for Energy Innovation	Research centre	High level training on renewable energies.	https://www.usm.cl/investigacion/centros/innovacion-energetica/
University Adolfo Ibanez, Solar Academy	Higher education	Solar Academy is a course-workshop of the CIET of the Adolfo Ibáñez University. Training on the central elements of the actors present in the market and how businesses operate in the field of photovoltaic solar energy; offers knowledge of the different types of business models of existing companies that operate in the national and international market; and promote initiatives to establish successful strategies in the market.	http://ciet.uai.cl/solaracademy

3. Cluster policies and programmes in Chile

Despite strong encouragement from the European Commission and the OECD to develop clusters, Chile's cluster policy, which was launched in the 2000's, has since faded away.

Clusters are now addressed in the current Agenda for innovation and competitiveness 2010 – 2020, elaborated by the **National Council for Innovation and Development** (Consejo Nacional de Innovación para el Desarrollo CNID)[70], an agency created in 2005, which reports directly to the Presidency.

The strategy states that Chile should strengthen emerging clusters (mainly based on natural resources), to boost innovation-driven growth. This implies encouraging both the development of new activities - to incorporate high value-added products into the export base - and the improvement of products and services originally focused on natural resources clusters.

[70] Consejo Nacional de Innovacion para el Desarollo http://www.cnid.cl/, consulted on 17/07/2019

Chile implemented its first cluster policy between 2005 and 2010. The policy initially supported five sectors: **mining, aquaculture, special Interest tourism, food and global services**. It was also designed by the CNID and implemented by the Ministry of Economy, Development and Tourism.

The assessment of the 2005 – 2010 cluster policy showed that the global services cluster had delivered significant progress in implementing a well-focused public-private coordination scheme which could resolve coordination failures. The Mining Cluster also performed well, notably in addressing the challenges of supplier development, with a constructive dialogue with private mining companies.

The rest of the national clusters were perceived as either poorly implemented or too concentrated on short-term actions and showed little progress towards achieving the priorities set out in their respective roadmaps.

To overcome this issue, the 2010-2020 Agenda for Innovation and competitiveness has widened the scope of the economic strategy. It moved from an economy strongly based on the intense exploitation of its natural resources to an economy with a more diversified and sophisticated production structure, where knowledge, human capital and innovation play a much stronger role.

In addition, this assessment enabled the CNID to redesign a generic roadmap of the country's strategic sectors:

- Implementation of technological innovation programmes by sectors to overcome the current fragmentation of instruments;
- Attract foreign investment to priority sectors, focused on areas that generate synergies;
- Support the development of shared scientific and technological platforms;
- Strengthen the institutional framework for cluster development.

Regarding the 2005 -2010 period, CNID observed that the competitiveness agendas implemented locally by the Regional Production Development Agencies (Corporación Regional de Desarrollo Productivo), created in 2006 to support the implementation of the policy, showed an interesting effort to generate sector roadmaps with the effective assistance of sectoral entrepreneurs.

This successful local implementation encouraged the government to design the **smart specialisation programme "Transforma"** as the implementation arm of the 2010 - 2020 Agenda for Innovation and competitiveness, with regards to the cluster policy.

Concerning the creation of clusters, the European Union co-founded, together with the state of Chile, the **EuroChile Foundation**, in 1993, to promote the internationalisation of SMEs.[71] The European delegation present in Chile has actively supported the EuroChile foundation to help implement cooperation projects.

[71] EuroChile Foundation, Who we are, https://www.eurochile.cl/en/who-we-are/history/, consulted on 17/07/2019

4. Conclusion

The preparatory briefing aims to provide information on the cluster landscape in Chile in order to support European cluster organisations to familiarise themselves with the country's key economic sectors, and discover its potential collaboration and market opportunities.

The case of Chile is unique, because the original cluster policy has been replaced by a smart specialisation policy approach. This policy shift has resulted in a patchwork landscape, composed of clusters *stricto sensu* and other stakeholders which fulfil cluster-like roles. As a result, the cluster landscape is difficult to interpret and more complicated to pursue cluster to cluster cooperation. To offer an insight into the undoubted sectoral business development opportunities that exist in Chile, asides from the lack of cluster partners this report has focused on identifying the key sectors and the associated policy and institutional framework. It therefore helps to identify the key sectors which are the most relevant to EU-Chile cluster collaboration and identifies some of the main stakeholders which could be relevant to initiate business development and cluster like cooperation.

Chile's economy is dynamic and has good potential for cooperation

Chile has a neoliberal economic policy, which has resulted in steady economic growth for the past 30 years, leading Chile to become the richest Latin American country. Chile's economy is still very much a resource-based export economy. Chile's exports are mainly composed of natural resources (mining, fishery and agriculture) but the country has successfully started to diversify, with knowledge-intensive and high-technology sectors such as advanced manufacturing, global services and solar energy. Chile's economy relies heavily on trade and several agreements and adequate institutions ease the path to cooperation. With regards to science, technology and innovation, Chile lags behind the other OECD countries but is currently implementing policies to bridge this gap.

Lack of readability of the cluster ecosystem of Chile

If economic cooperation is facilitated by several specialised public institutions, cluster cooperation, on the other hand, is more difficult. Indeed, there is currently no comprehensive cluster mapping programme in place in Chile. Between 2005 and 2010, CNID, the Chilean agency for innovation and development, implemented a cluster policy which has been subsequently discontinued. Therefore, there are only a few clusters in Chile. Some of these clusters have been created as extensions of the powerful Chilean business federations, whilst others are the legacy of the 2005 – 2010 innovation policy.

Chile's cluster policy is implemented through a smart specialisation programme

Since 2010, Chile does not have a clear cluster policy: in theory, the Agenda for Innovation and Competitiveness, which is the main relevant policy document, mentions the importance of clusters and makes recommendations in several strategic domains. In practice however, the Ministry of Economy, Trade and Tourism, though its agency CORFO, implements a smart-specialisation programme. The smart specialisation programme gathers business, research centres and other

relevant stakeholders of the same sector, into an integrated programme, which addresses issues on human capital, business development, technology transfer and innovation but has not utilised clusters to structure or deliver such programmes.

As a result, the smart specialisation programme conducts activities which are very similar to those conducted by clusters. Nevertheless, these activities are carried by multiple actors, mostly businesses, but also research centres, which are not clusters as such. Furthermore, the smart specialisation policy does not aim at gathering these groups of stakeholders into clusters.

Enabling cluster collaboration through a sectoral mapping of relevant actors

To overcome this issue, and to encourage cluster collaboration with Chile, this report targets five sectors of strategic importance for cooperation: aquaculture and fishing, agriculture, advanced manufacturing, mining and solar energy. For each sector, the report has identified non-business actors, which are potentially suitable for cluster collaboration.

Annex 1 – Summary of Transforma programmes for the targeted sectors

Aquaculture and Fishing

Name of the initiative	Improvement of human capital	Business development	Technology	Innovation
Sustainable aquaculture and fishery (all Chile)[72]	-Training on the culture of the Pelillo Algae implemented by the Bernardo O Higgins University	- Collaboration platforms to link the groups of the craft in the fishery sector in three different municipalities - Implementation of a new process to prepare cuttlefish (high value-added transformation, intended for exportation)	- Development of implementation of fattening technologies managed by a public private consortium - Establishment of a genetic improvement centre by a private stakeholder	-Innovation project to feed the farmed larvae with natural additives implemented by a private stakeholder - Innovation in the seed production process of the Japanese oyster
Sustainable salmon (regions of Araucanía, Los Ríos, Los Lagos and Magallanes)[73]	-Training programme the build the capacity of the local operators of the salmon industry	- Project to develop and implement the sectoral brand for Chilean salmon in the Brazilian market, carried out by Salmon Chile	- Innovation cage using high resistance polymer project, implemented by a private company - Prototype test and validation of a new hydraulic technology to improve the joints of the cages implemented by a private company - Development of a kit to monitor pollution around the fish farms implemented by two universities:	- Build and operate the EWOS Integral Fish Health Centre (CSIPE), focused on evaluating diets that help to prevent and mitigate the main diseases in the salmon industry - Development a vaccine against the Salmon Rickettsial Syndrome (SRS), the costliest disease for the salmon industry in Chile

[72] Transforma, programa estrategico acuicultura y pesca-sustentable, http://www.chiletransforma.agenciabigblue.com/2017/08/14/programa-estrategico-acuicultura-y-pesca-sustentable/, consulted on 17/07/2019

[73] Transforma, Salmon sustentable, http://www.chiletransforma.agenciabigblue.com/2017/08/16/salmon-sustentable/, consulted on 17/07/2019

			university of Antofagasta, University or La Frontera and JICA, the Japanese cooperation agency.	- Creation of a Centre for Genetic improvement - Creation and operation of a high technology R & D Centre, unique in Chile to carry out research, development and validation of new nutritional inputs
More Sea (Coquimbo region)[74]		- Strengthen the Cooperativa de Pescadores de Pichidangui through the development of new businesses derived from artisanal fishing and tourist services - Project to develop an algae export company with administrative, productive, logistic and commercial capabilities.	- Knowledge transfer of techniques and best practices to restaurants that allow innovation in the gastronomic offer through the use of algae and marine products from the Coquimbo Region, implemented by the North Catholic University - Cooperation programme between the entrepreneurs of the Coquimbo region with the French and Spanish marine technology sector.	
Chilean Mussels (Los Lagos region)[75]	- Capacity building of the mussel plant operators of the region - Training on processes to improve the			- Extension of the centre for sustainable mussel growing to provide technical assistance to micro, small and

[74] Transforma, programa estrategico mas mar http://www.chiletransforma.agenciabigblue.com/2017/08/07/programa-estrategico-mas-mar/, consulted on 17/07/2019

[75] Transforma, programa estrategico mejillon de Chile, http://www.chiletransforma.agenciabigblue.com/2017/08/06/programa-estrategico-mejillon-de-chile/ , consulted on 17/07/2019

	standards of the products.			medium enterprises of the national mussel industry, facilitating its approach to the most advanced technology. - Development and validation of processes to valorise waster and by-products from the mussels into fish food, implemented by the Chinquihue foundation.
Fishing in Aysen (Aysen region)[76]	- Training in quality and industrial process for the workers and technicians of the fishing plants	- Resource assessment through the making a baseline study of the management area name Marta Island	- Dissemination of technologies that strengthen commercial links between local trade and artisanal fishing, ensuring responsible fishing	- Promote the use of Bentonic Resource Management Areas as a business unit that allows generating a continuity in the generation of income, implemented by the Union of independent workers of artisanal fishing

[76] Transforma, programa estrategico, Pesca en Aysen, http://www.chiletransforma.cl/2017/08/05/programa-estrategico-pesca-en-aysen/, consulted on 17/07/2019

Agriculture

Name of the initiative	Improvement of human capital	Business development	Technology	Innovation
Transform food (all Chile)[77]	- Technological Extension Centre to strengthen the competitiveness of the processed food industry by Fedefruta AG	- Development of a platform of collaborative innovation for the development of technological solutions in the packaging sector by five universities and one regional centre of studies. - Promotion of the competitiveness and sustainability of the fresh fruit export sector, through the development and / or adaptation of varieties or patterns and the creation of technological packages / models, by 4 universities and two research centres. - Improvement of the Berries industry chain of the Biobío Centro Territory.	- Creation of a large-scale technological centre for design, prototyping and scaling to allow small and large companies to test the use of ingredients and natural additives, and develop new products and packaging for processed foods by 5 universities and one research centre. - Strengthening of cooperation between processing companies and agricultural companies to increase the supply of functional ingredients, specialised additives, dedicated raw materials of agricultural,	- Development of new functional ingredients and specialised additives of natural origin, from Chilean raw materials by the Consorcio de Cereales Funcionales.

[77] Transforma Alimentos, http://www.chiletransforma.agenciabigblue.com/2017/08/15/estrategico-transforma-alimentos/, consulted on 17/07/2019

		- Implementation of a territorial management model of articulation and public-private coordination to strengthen the primary production of the sheep by Magellan and Chilean Antarctic regions.	livestock or forestry origin by Foundation for Agrarian Innovation and Under secretariat of Agriculture. - Promotion of the competitiveness and sustainability of the fresh fruit export sector, and creation of technological packages / models, contributing to the diversification and sophistication of the industry by the Foundation for Fruit Development.	
Bovine cattle in Pantagony[78]	- Strengthening the capacities of the extension agents of the cattle sector, in the field of use of forage resources for adequate animal fee by the region of Aysén.		- Creation of a demonstration unit that can be used as a model for the extension and technological transfer in effective and low-cost assisted reproduction techniques that allow the genetic improvement of bovine cattle in the region of Aysén by the University of Concepción. - Test pumping equipment with solar energy for hydration of	- Generation of a model for making decisions based on feeding strategies and animal management that allow to extend the period of supply with bovine cattle suitable for slaughter by the Institute of Agricultural Research.

[78] Bovino Ganadero Patagonia, http://www.chiletransforma.agenciabigblue.com/2017/09/20/per-ganadero-bovino/, consulted on 17/07/2019

			animals and irrigation of grasslands, associated with the Livestock industry of Aysén by Patagonia Shuttle and Consulting EIRL.	
Strategic programme for sustainable fruit farming [79]	- Aimed at small and medium-sized walnut producers located in the Quillota province, which have developed their productive units from the business opportunity generated to strengthen their production by innovation by consultora Valera & Ruz Limitada.	- Development of an uninterrupted work plan between the Exporter and its suppliers, focused on implementing the concepts of sustainability and food safety by Fruticolas ex export services.	- This project consists of establishing a local Packing facility. It will have a huge daily capacity of buying and selling avocados. Additionally, it may provide services to the process of other varieties such as citrus it is executed by Agrocomercial Zuniga.	- Seeking to generate healthy fruit in order to create a differentiating factor brand by positioning its suppliers in new markets in the medium term. It is executed by the exporter Agrofruit Limitada.
Strategic programme for horticulture[80]	- A programme directed to the training of professionals specialised in advanced horticulture, to allow to give answer to the challenges of the sector by the O'Higgins region.	- Development programme to improve the production of vegetable seeds of the company Curipamu Vegetables SA - The programme supports 5 farmers, with previous experience of		- Improvement of the image of black garlic to introduce it into a more demanding market and to give a better impression in the customers of the company by the Dictuc SA.

[79] Programa estrategico fruticulture sustentable, http://www.chiletransforma.agenciabigblue.com/2017/08/11/programa-estrategico-fruticultura-sustentable/, consulted on 17/07/2018

[80] Programa estrategico horticrece, http://www.chiletransforma.cl/2017/08/10/programa-estrategico-horticrece/ , consulted on 17/07/2019

		associative type, with items mostly focused on the market of seedlings and agro-industrial. The continuity of this commercial relationship, and its successful results, allows them to generate interesting commercial results.		
Strategic programme for the food production in the Maule Region[81]	- A course of 100 hours for the strengthening and updating of the capacities of the workers of the Agri-business, and its management in the operative, administrative and financial processes, to develop more elaborated products and friendly with the environment in the sector of fruit and vegetables from the Maule region. - Courses on Regulations and Techniques for the Management of Agroindustrial Residues were st up for Agribusiness workers by the region El Maule.	Improved frozen berries and vegetables production processes to increase the volume of finished product and to improve marketing. It is executed by the Agro-industrial Services Danilo Neftali Valdes Lazo.	- Prospection on technologies in France and Italy to favour innovation, diversification and sophistication in the supply of agro-industrial products of fruit and vegetable origin in the Maule Region by the Centre for Studies in Processed Foods-CEAP. - Investments are made in new laboratories and analytical equipment for the conversion of the quality lab to develop agroindustry in the center of the Maule region by the Quality-Lab Laboratory	- Development of at least 3 prototypes for a line of new products: purees and smoothies fortified with natural and functional ingredients for the healthy snack market in the USA and Chile by Purefruit Chile SA.

[81] Programa estrategico maule alimenta, http://www.chiletransforma.agenciabigblue.com/2017/08/09/programa-estrategico-maule-alimenta/, consulted on 17/07/2019

	- Course of update of regulations and regulations of Food Safety, (HACCP, BRC, Food Safety Modification Act FDA, among others) were set up for the entrepreneurs and workers of companies in the agro-industrial sector by the region El Maule.		consultancy and Limited Training.	
Programa alimentos con valor agregado[82]		- Validation and commercialisation of healthy juices for the infant and child stages, from the NITA bottling plant. The aim is to contribute to healthy eating of the schoolchildren and reduce impact on public health by consumption of sugars and sodium by the Sociedad Comercializadora NITA SA.	- Optimisation of farm practices and promotion of the use of new tools in order to prevent the occurrence of pre-germination to have a supply of safe and quality wheat executed by the Kunstmann Industrial Society.	- Development and validation of a production process for the preparation of a snack based on apple waste, which incorporates in its formulation flour and / or cereal starch with functional food characteristics. It is executed by NITA SA. - Development of a line of prototypes of functional vegetable juices, expanding the portfolio of innovative commercial products, reducing the costs of direct work for the micro

[82] Programa alimentos con valor agregado, http://www.chiletransforma.agenciabigblue.com/2017/08/08/programa-alimentos-con-valor-agregado/, consulted on 17/07/19

				company Fritz and Fritz SpA.

Mining

Name of the programme	Improvement of human capital	Business development	Technology	Innovation
Programa estrategico mineria alta ley[83]	- The ELEVA, transfer centre for technical mining training initiative invites everyone to innovate and re-imagine a professional technical education with superior standards, network of professional technical training institutions that will receive support for the adoption of the tools and developments of the platform.	- An innovation program that seeks to connect the challenges of mining companies with high potential solutions coming from the industry's ecosystem, executed by the Fundación Chile. - Promotion of the internationalisation of suppliers of mining goods and services, executed by Pro Chile.	- The design of a comprehensive monitoring system aiming to determine the performance of tailings deposits through the development of technological tools to monitor critical variables of physical and chemical stability, it is executed by the Fundación Chile. - The study "Recovery of Value Elements of Tailings" executed by RI Ingeniería, EcoMetales Limited and FUGRO Consult GmbH, consists of identifying and quantifying the existence of minerals that contain high value elements and in the adoption of	

[83] Programa estrategico mineria alta ley, http://www.chiletransforma.agenciabigblue.com/2017/08/16/programa-estrategico-mineria-alta-ley/, consulted on 17/07/2019

			technologies to recover these elements of the tailings. - The tailings online monitoring program seeks to promote the design of a comprehensive online monitoring system to determine the performance of tailings deposits. It is executed by ministries, companies and a network of consultants. - A programme to identify quantification and (bio) technological extraction of minerals valuable / elements contained in tailing deposits. - The interoperability centre of smart mining purpose's is to create safe and open international standards for mining interoperability.	
Cluster Minero de Antofagasta[84]	- The Consortium of Faculties of Engineering of the	- The delivery and support of the implementation of	- The programme of technological dissemination aims	- The strengthening of the innovative ecosystem in the

[84] Cluster minero de Antofagasta, http://www.chiletransforma.agenciabigblue.com/2017/08/12/cluster-minero-de-antofagasta/, consulted on 17/07/2019

	Region of Antofagasta, aimed at solving complex problems and high social impact, sustainable development in mining areas of extreme aridity, making the region an area of innovation and entrepreneurship. It is executed by the Catholic University of the North.	the necessary skills, platforms, structures and knowledge to the beneficiary companies, through consulting and specialised mentoring is made in order to articulate a successful internationalisation process. It follows the export model developed by the Australian METS and is executed by Endeavor Corporation Chile.	to help suppliers of specialised services of the mining industry of the Antofagasta region. It is executed by Plataforma Norte SpA.	Antofagasta Region with a network of emerging innovators is oriented to the industrial mining Market, in tune with the operational challenges and technological requirements. It is executed by the Associacion deindustriales de Antofagasta.

Solar energy

Name of the initiative	Improvement of human capital	Business development	Technology	Innovation
Solar energy committee [85]	-Transfer of knowledge on theoretical fundamentals of solar thermal energy -Generate knowledge about solar thermal energy in new graduates of scientific careers in pre and post graduate. -Training program for competitiveness in large-scale photovoltaic projects and residential sector in the city of Antofagasta. -Prepare trained personnel in the installation of large and small-scale photovoltaic panels to open new work sources and expand the use of this technology in Antofagasta. -Training program for competitiveness in large-scale and residential photovoltaic projects in the Atacama region - Prepare trained personnel in the installation of large- and small-scale photovoltaic panels to open new labour sources and expand the use of this technology in the Atacama region.	N/A	N/A	-Solar corridor of the salado basin -City model self-supplied by solar energy collected from public buildings, homes and businesses, as well as the socialization of the benefits of these technologies. The first pilots will be held in the communities of Diego de Almagro and Chañaral. -Integration of solar thermal technology in the chilean metallurgical industry to improve its competitive advantages. -Since solar thermal technologies allow the generation of heat in different temperature ranges, it is interesting to inquire about the benefits that these can generate in heat demanding industries, such as the metallurgical industry. In this way, it seeks to identify new potential niches that help strengthen the solar industry. -Analysis tool of the spectral characterization of the solar radiation of the atacama desert to improve the competitiveness of the solar industry in chile -Irradiation study in different parts of Chile to measure its solar energy potential. -Pre-fabricated structures for photovoltaic solutions in industrial ceilings -Adaptation of industrial roofs to avoid static loading and incorporate photovoltaic

[85] Transforma SECTOR INDUSTRIA SOLAR, http://www.chiletransforma.agenciabigblue.com/sector-industria-solar/ , consulted on 16/07/2018

				panels, achieving sustainable enterprises. -Assurance of the quality of radiometric and photometric measurements in Chile. -This project proposes to improve the existing quality infrastructure in Chile relative to radiometry and photometry, in order to ensure the quality of radiometric and photometric measurements relevant to the Chilean solar industry, including solar irradiance. The project is supported by industry (ACESOL), will be executed by researchers from leading universities (U. De Chile and U. De Santiago) and has key constituents: INN, DMC and the Ministry of Energy. - Development, validation and packaging of equipment modular solar power inverter, up to 3mwp -It consists of the development, industrial manufacturing, validation and packaging of a Modular and scalable Solar Power Inverter system in steps of 10KW that can be used in 3mwp or higher photovoltaic plants. -Self-cleaning protective nanoparticles in solar panels to increase their energy efficiency of operation in the chilean north: nanovalidation, nanoscale and nano-packing. -Validate and package a prototype of self-cleaning protective nanoparticles of solar panels. -PHINET20: It seeks to validate and package the existing prototype which allows to obtain the IV curves of the photovoltaic modules for a power of up to 500W. The measurements have allowed studies of dust deposition on

				the surface of the photovoltaic modules and the effect of a heat sink integrated in the modules (bottom) comparing it with another module without a dissipator. -Pilot of a thermovoltaic cell to generate electricity and increase the efficiency of photovoltaic panels exposed to high radiation It investigates and develops a thermovoltaic cell with the potential to cool photovoltaic panels, and in the process generate electricity from the dissipation of heat and thus increase the life, efficiency and profitability of large-scale solar projects. -Drones photovoltaic panel cleaners. -Self-propelled drones that will use special tools to clean the accumulation of dust from the solar panels, lowering their maintenance cost. -To PV - film aluminium heat sink for photovoltaic modules -Initiative that gives continuity to the prototype project of the 2016 Innovation and Business R & D Program. In this initiative, theoretical studies were carried out on the effect that heat sinks have on photovoltaic modules, in which improvements of up to 2.6% were obtained in monthly electricity generation. With the results obtained, the creation of a production line of aluminum heat sinks for its implementation in photovoltaic plants will be carried out. -Open innovation platform for the development of solar energy products and solutions for the industry. -Integration platform for the different actors that allow

				strengthening the solar industry: small, medium and large companies, entrepreneurs, public and private organizations, universities, research centers and more, so that together they can develop innovative solutions to expand the impact of renewable resources.