

CLIMATE CHANGE IN CHILE, STRATEGIC PLAN AND CIRCULAR ECONOMY

VALERIA SCAPINI¹ & PRISCILLA BERRIOS²

¹Centro de Investigación en Innovación, Desarrollo Económico y Políticas Sociales (CIDEP) – Universidad de Valparaíso, Chile

²Universidad de Valparaíso, Chile

ABSTRACT

Environmental problems have been increasing at a disproportionate rate, contributing to global warming, one of humanity's greatest challenges. As stated in the latest report of the Intergovernmental Panel on Climate Change 'climate change is widespread, rapid and intensifying' and there is certainty that this is a result of human activity. In this context, environmental social responsibility is fundamental to prevent, mitigate or repair the environmental damage generated by productive activity. This obliges us to take concrete actions and thus move from a linear economy approach to a circular economy approach that allows for sustainable development, where waste and pollution are eliminated from the design stage and materials are used for as long as possible. Chile must implement actions that allow it to meet the commitments obtained in its Nationally Determined Contribution of 2020, and move towards sustainable development. The Chilean case is interesting to study because it is a highly exposed and fragile country in the face of climate change. The purpose of this publication is to highlight the current problem of climate change and the threat it poses to our planet, to understand that the circular economy approach as a business model allows for a long-term solution to this problem, to understand the consequences of climate change in Chile and to know the current situation in terms of strategic planning at the country level in relation to the circular economy.

Keywords: circular economy, climate change, greenhouse gases, recycling, sustainable development.

1 INTRODUCTION

Environmental problems have increased considerably, contributing to global warming by 1.02°C due to the increase of greenhouse gas (GHG) emissions and their accumulation in the atmosphere [1]. Globally, GHGs have increased since the post-industrial period, reaching a total of 49.36 billion tonnes in 2016 [2]. Among these gases are mainly carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), the former being the major contributor to global warming because the burning of fossil fuels (oil, coal and gas) causes more heat to be trapped in the atmosphere. In July 2021, the ambient concentration of CO₂ was 416.96 ppm [3, 4] and the countries/regions emitting the most CO₂ are China (30.7%), the United States (13.8%), the European Union (7.9%), India (7.1%) and Russia (4.6%) [5].

Due to all the environmental problems, the Conferences of the Parties (COP), annual international meetings of the United Nations in which the countries of the world meet to discuss environmental issues, have been held since 1995 and carried out by the United Nations Framework Convention on Climate Change (UNFCCC). Specifically, during the COP No. 21 held in Paris in 2015, a historic milestone known as the Paris Agreement was reached, which establishes the commitment of countries to 'keep the average temperature increase well below 2°C above pre-industrial levels and to pursue efforts to limit this temperature increase to 1.5°C above pre-industrial levels, recognising that they would significantly reduce the risks and impacts of climate change' [6]. Thus, following the signing of this agreement, each country indicates voluntary commitments to reduce its GHG emissions through Nationally Determined Contributions (NDCs), which are an instrument for measuring the real contributions of each nation in relation to its committed environmental efforts. These must be reviewed and updated every 5 years in the hope that there will be ever greater ambition in terms of their realisation [7, 8].

In August 2021, the Intergovernmental Panel on Climate Change (IPCC) published its 6th report stating that ‘climate change is widespread, rapid and intensifying’ and is certain to be a result of human activity [9]. In relation to the Paris Agreement, the report states that ‘unless greenhouse gas emissions are reduced immediately, rapidly and on a large scale, limiting warming to around 1.5°C or even 2°C will be an unattainable goal’. Experts indicate that we are in a climate emergency and that urgent global action is needed, as failure to act could have catastrophic and irreparable global consequences [9].

Chile is a country that is highly exposed to and fragile in the face of climate change [10,11]. In this context, in December 2020, the Ministry of the Environment launched the ‘Climate Risk Atlas (ARClím)’, which features maps showing Chile’s risks to climate change so that this information can be made available and support decision-making in relation to the changes that need to be faced in the country [12]. The effects include increased temperatures, droughts, precipitation, coastal erosion and increased heat waves, among others [10,11].

The purpose of this study is to highlight the current problem of climate change and the threat it poses to both the planet and Chile, to understand that the circular economy approach as a business model allows for a long-term solution to this problem, and to learn about the current situation in terms of strategic planning at the national level in relation to the circular economy. Finally, some examples that have promoted solutions in this line of work are shown. This paper is an extension of the work found in Scapini and Berríos [13], where a bibliographic review of the concept of circular economy and the state of progress of the laws in the country is carried out. The paper is structured as follows. Section 2 contains a literature review on the concept of climate change and the importance of the circular economy as a solution to this problem; section 3 presents the methodology; section 4 shows the result of the research describing the effects of climate change in Chile and the strategic planning at the country level in relation to the circular economy; and finally, section 5 concludes on the subject.

2 LITERATURE REVIEW

Sustainable development is development that ‘meets the needs of the present generation without compromising the ability of future generations to meet their own needs’ [14]. This definition involves a number of aspects, all of them very important, that must be considered: resource scarcity, population growth, clean production and pollution. The growing needs and the limited resources that allow us to satisfy these needs allow us to understand that our planet has a limited capacity and that we are approaching the destruction of the ecosystem. This forces us to rethink an approach that can be sustained in the long term.

In 1990, David Pearce and Kerry Turner first used the term circular economy when they mentioned that materials in an economy flow in a closed loop [15] and since then the concept has become increasingly important. In order to accelerate the transition to a circular economy model, the Ellen MacArthur Foundation was established in 2010 to promote the concept as an alternative to economic growth that reduces environmental impact. It implies a radical change in current production and consumption, as the value of products and materials must be maintained for as long as possible from the design stage. This concept seeks to decouple economic growth and development from the consumption of finite resources [16].

2.1 Climate change and its effects

The IPCC defines climate change as a change in the state of the climate that is due to changes in the mean or variability of characteristics and that lasts for an extended period, usually more

than ten years [14]. Causes include internal or external natural processes such as volcanic eruptions and anthropogenic changes. The Framework Convention on Climate Change (UNFCCC) defines it as a change in climate that is due directly or indirectly to human action that alters the composition of the atmosphere. Climate change generates a range of negative consequences that affect natural ecosystems, socio-economic systems, or human health and well-being [17].

Climate change is making the hydrological cycle more intense, resulting in heat waves, droughts, fires, melting ice, sea level rises, and at the same time, higher temperatures lead to more evaporation from the oceans into the atmosphere, resulting in increased precipitation (monsoons, typhoons, hurricanes), floods and landslides. These events are increasing in frequency in all areas of the world and with them, the impacts on ecosystems, flora, fauna and societies [9].

3 METHODOLOGY

The methodology used is mainly based on a literature review. Firstly, the current problem of global climate change is studied, the challenge it represents for humanity, and the importance of the circular economy approach as a business model that allows for a long-term solution to this problem. Subsequently, information is compiled on the main effects that climate change will have on the economic sectors in Chile in the medium and long term. Subsequently, information is collected regarding the current situation of strategic planning at country level in relation to the circular economy. Finally, some examples of sustainable initiatives are mentioned. The inclusion criteria were articles, in Spanish and English, on the topics indicated in the diagram below. On the other hand, all information available on the website of the Ministry of the Environment was included, and articles whose text was not available or those that were not related to the topic studied were excluded.

4 RESULTS

4.1 Climate change in Chile

In the case of Chile, GHG emissions in the country have increased by 129.4% between 1990 and 2018 [18]. Although Chile is responsible for only 0.24% of the planet’s GHGs, it is one of the countries most vulnerable to the harmful effects of climate change, due to its long coastline and the diversity of climates across the country [18].

To determine a country’s vulnerability in relation to the climate crisis, the United Nations Framework Convention on Climate Change has set nine criteria, as follows: (1) low-lying coastal areas, (2) arid and semi-arid areas, (3) forested areas, (4) territory susceptible to natural disasters, (5) areas prone to drought and desertification, (6) urban areas with air pollution, (7) mountainous ecosystems, (8) low-lying and island countries, (9) landlocked and transit countries. In the particular case of Chile, the country meets 7 of the 9 vulnerability criteria, while criteria 8 and 9 are not met [19].

This means that the country is more exposed to increases in temperature, droughts, precipitation, coastal erosion and heat waves, among others. Because of this, and because we are also in a global climate emergency, Chile needs to address these effects immediately [11].

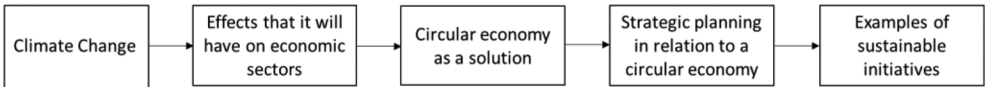


Figure 1: Diagram of the literature review.

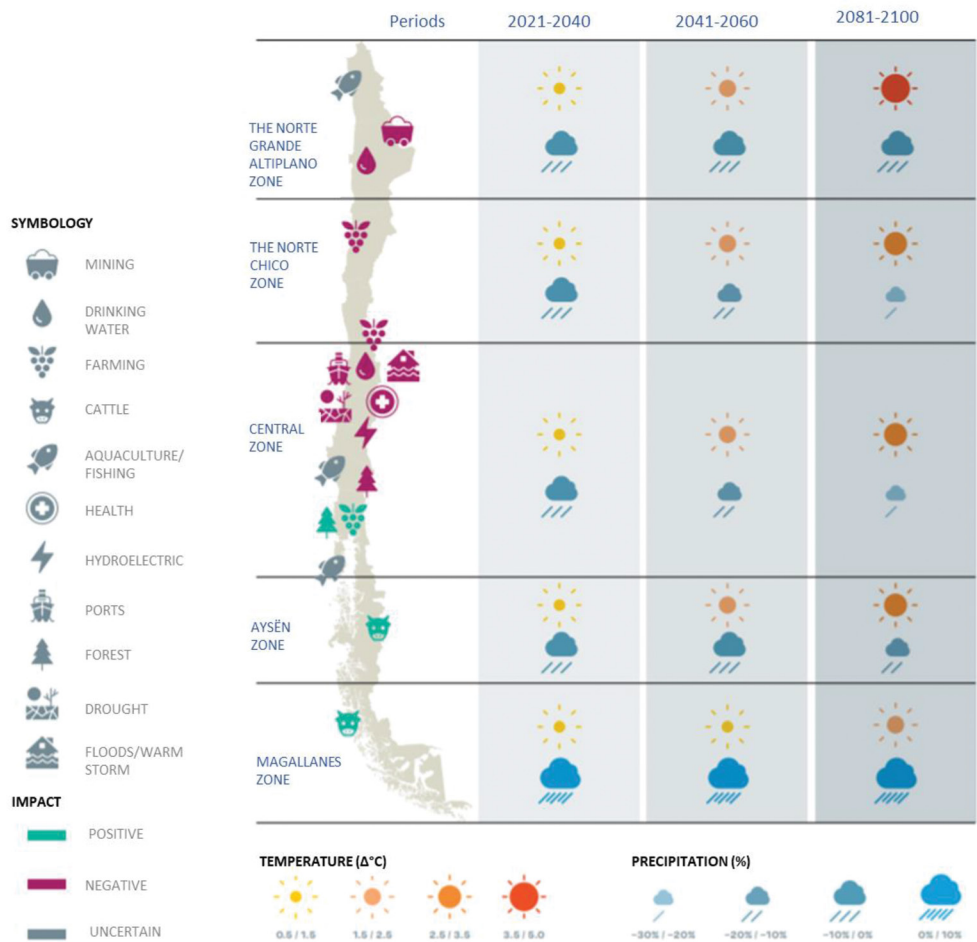


Figure 2: Climate change in Chile [18].

Figure 2 shows that the effects of climate change affect the entire country. Precipitation will increase only in the southern part of the territory, specifically in the Magallanes region, while the rest of the country will see a decrease in precipitation. Temperatures will increase throughout the country, with the most affected areas being the north and centre of the country. Among the economic impacts, we can see that the northern and central areas will be negatively affected by all economic activities (see purple symbology), while in the extreme south of the country there will be positive impacts related to forestry, agriculture and livestock activities (see green symbology). Finally, aquaculture and fishing activities throughout the territory will have an uncertain impact (see grey symbology).

4.2 Chile’s strategic planning in the long term

Chile, in its international commitments in relation to environmental issues, signed on to the Paris Agreement since 2015 through the NDC in which it establishes reaching carbon neutrality by 2050 and sets targets to reduce these emissions progressively over time [20, 21].

Currently, in order to promote a circular economy model, the Circular Economy office of the Ministry of Environment is working on two main areas of action. The first is the implementation of Law No. 20.920, which establishes the framework for Waste Management, Extended Producer Responsibility and the Promotion of Recycling (REP Law); while the second seeks to stimulate an environment of innovation, a regulatory framework and other instruments [22].

The lines of work and their state of progress are as follows [22]:

- 1) The implementation of the REP Law: This law aims to reduce waste generation and encourage reuse and recycling, forcing producers of priority products to finance the collection and recycling that their products generate.
- 2) Circular Economy Roadmap: It is a strategic planning instrument with a long-term vision of environmental management, which aims to achieve a regenerative circular economy by 2040 with medium (2030) and long-term (2040) goals. This was done through collaborative work with different national stakeholders as well as an international advisory committee. The targets included in the Roadmap are: 'more jobs, less waste/person, less waste/GDP, more material productivity, more recycling, more municipal recycling and more recovery of sites affected by illegal disposal' [23].
- 3) Recycling Fund: This fund finances municipal and municipal association projects aimed at preventing waste generation, promoting separation, reuse and recycling.
- 4) Policy for the Inclusion of Grassroots Recyclers: This policy aims to promote the social, economic and environmental inclusion of grassroots recyclers through proper waste management.
- 5) Action Plan Against Plastic Pollution: This is one of the biggest challenges worldwide and therefore seeks to minimise the consumption of single-use plastics in commerce and to create labels for products that provide information to consumers regarding the recyclability of containers and packaging.
- 6) Organic Waste Management Strategy: Aims to prevent organic waste from being turned into rubbish and ending up in sanitary landfills or dumps, causing pollution.
- 7) Construction and Demolition Waste (CDW): The purpose is to provide solutions to problems generated by the construction sector, since it is considered one of the most polluting economic activities and one of those that emits the most GHGs globally, and, on the other hand, represents 35% of the country's inert waste (only considering the construction process) that often end up in illegal landfills since most regions do not have legal landfills to dispose of this type of waste [23, 24].
- 8) Transboundary Movement of Waste: Its purpose is to comply with the Basel Convention on the 'Control of Transboundary Movements of Hazardous Wastes and their Disposal'.

4.3 Some initiatives with a sustainable approach

The REP Law will start to apply from 16 September 2023, where producers will be obliged to finance the collection and recovery of waste, packaging and packaging. Some companies have already committed to the environment by transforming their products and processes to adopt a circular economy approach. Examples include:

4.3.1 AZA, sustainable steels

They have removed thousands of polluting wood-burning stoves, each representing about 27 kilos of scrap metal, and replaced them with less polluting heaters. The scrap has been



Figure 3: The circular route of recycled steel: from old stove to renewable energy [25].

transformed into new steel products, such as support towers for wind power plants, which has allowed them to apply circular economics to transform polluting material into clean energy through the recycling chain [25].

4.3.2 Revaloriza, new life for waste

Revaloriza is the first company in Chile and South America that reuses construction and demolition waste to be recycled and converted into new secondary raw materials. The relevance of this company is that it solves an environmental problem related to the fact that waste from this sector is usually not properly disposed of in a sanitary landfill, but rather becomes debris that ends up in ravines, streets, beaches, or illegal dumps [26].

4.3.3 Recovery and recycling of fishing nets

Fishing nets are very commonly used by the fishing sector. They are made of plastic and end up as polluting waste that is not easy to dispose of. That is why Sonapesca generated an agreement with the company Bureo who created the programme 'Net Positive' where new products are generated with recycled materials and donated by fishermen. In this way, the oceanic ecosystem is protected and the economy is boosted with the generation of recycled products [28].

5 CONCLUSIONS

The indiscriminate consumption of resources worldwide has brought the issue of sustainability into discussion. This, together with pollution and GHG emissions, has contributed to global warming, currently one of humanity's greatest challenges. This forces us to rethink an economic model that can be sustained in the long term. This leads us to consider the concept of a circular economy as an alternative to economic growth that reduces environmental impact and decouples economic growth and development from the consumption of unlimited resources.

Climate change in Chile is scientifically evidenced and its vulnerability is proven. It is a country that is highly exposed and fragile in the face of climate change, which obliges us to



Figure 4: Revaloriza, new life for waste [27].



Figure 5: Recovery and recycling of fishing nets [28].

transform all economic sectors and move towards sustainable development. In this sense, Chile has established the goal of carbon neutrality by 2050, articulated with the draft Framework Law on Climate Change that is currently being processed in the Senate.

To promote a circular economy model, legislation has made progress in reducing waste generation and promoting reuse and recycling, through the enactment of the REP Law, the Roadmap for a Circular Chile 2040, the National Organic Waste Strategy, the fight against plastic, and the RCD Roadmap for a Circular Economy in Construction. Among the challenges are the development of circularity indicators that allow the country to measure the progress of its commitments. Some companies are already committed to the environment, transforming their products and processes to adopt a circular economy approach.

However, the unexpected arrival of the worldwide Covid-19 pandemic has generated many questions regarding the circular economy that would be interesting to study in the

future. The closure of the borders and the long periods of quarantine have led to a shortage of products, rise in prices, and an increase in home delivery services, among others. The long periods of quarantine have reduced the impacts on the environment, however, we have seen an increase in the amount of garbage that is generated with the use of safety items (such as disposable masks, face shields, chests, sanitization, etc.) and the packaging of delivery products, among others. It is unknown whether these changes have allowed progress or regression in the implementation of the 2040 Circular Economy Roadmap in the country.

REFERENCES

- [1] NASA, *Global climate change: Global Temperature*, available at <https://climate.nasa.gov/vital-signs/global-temperature/> (accessed 06 January 2022).
- [2] Ritchie, H., & Roser, M., *CO₂ and Greenhouse Gas Emissions*, Our world in data, available at <https://ourworldindata.org/greenhouse-gas-emissions>, 2022 (accessed 09 January 2022).
- [3] NOAA Global Monitoring Laboratory, *Trends in Atmospheric Carbon Dioxide*, available at <https://gml.noaa.gov/ccgg/trends/>, 2022 (accessed 06 January 2022).
- [4] WHO, *The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2020*, WMO Greenhouse Gas Bulletin, available at https://library.wmo.int/doc_num.php?explnum_id=10904, 17, 2021 (accessed 15 December 2021).
- [5] Mena, M., *Emisiones de CO₂. Los países que más contaminan*, available at <https://es.statista.com/grafico/23395/paises-regiones-con-mayor-volumen-de-emisiones-de-dioxido-de-carbono/>, 2021 (accessed 20 December 2021).
- [6] Nations Unies, *Conferencia de las Partes. Vigésimo primera sesión. FCCC/CP/2015/L.9. París, 30 de noviembre al 11 de diciembre de 2015*, Convention-cadre sur les changements climatiques, París: ONU, available at <https://unfccc.int/resource/docs/2015/cop21/spa/109s.pdf>, 2015 (accessed 18 December 2021).
- [7] United Nations, *Framework Convention on Climate Change*, NDC Registry, available at http://unfccc.int/focus/ndc_registry/items/9433.php, 2016 (accessed 06 January 2022).
- [8] Boletín 13.191-12, *Proyecto de ley, iniciado en mensaje de S. E. el Presidente de la República, que fija Ley Marco de Cambio Climático*, available at https://leycambio-climatico.cl/wp-content/uploads/2020/07/ProyectoLeyCC_13012020.pdf (accessed 06 January 2022).
- [9] Allen, M., Dube, O.P., Solecki, W., Aragón-Durand, F., Cramer, W., Humphreys, S. & Mulugetta, Y., *Global warming of 1.5° C. An IPCC Special Report on the impacts of global warming of 1.5° C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Sustainable Development, and Efforts to Eradicate Poverty*, available at https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf, 2018 (accessed 15 December 2021).
- [10] Naciones Unidas. Comisión Económica para América Latina y el Caribe (CEPAL), *La economía del Cambio Climático en Chile*, available at <https://repositorio.cepal.org/handle/11362/35372>, 2012 (accessed on: 15 Dec. 2021).

- [11] Vivanco, E, *Cambio Climático: Conceptos e impactos. Asesoría Técnica Parlamentaria*. Biblioteca del Congreso Nacional de Chile, available at https://obtienearchivo.bcn.cl/obtienearchivo?id=repositorio/10221/27848/1/CC_Conceptos_e_impactos_Web-site_CC_2019.pdf, 2019 (accessed 06 January 2022).
- [12] Ministerio del Medio Ambiente (MMA), *Atlas de Riesgos Climáticos*, available at <https://arclim.mma.gob.cl> (accessed 15 January 2022).
- [13] Scapini, V. & Berrios, P., Circular economy in Chile: Background, law and opportunities. *WIT Transactions on Ecology and the Environment*, **253**, WIT Press, 2021. doi:10.2495/SC210161.
- [14] ONU, *Nuestro futuro común*, Alianza: Madrid, 1987.
- [15] Pearce, D.W. & Turner, R.K. *Economics of Natural Resources and the Environment*, JHU press, 1990.
- [16] Ellen MacArthur Foundation, available at <https://www.ellenmacarthurfoundation.org/> (accessed 13 December 2021).
- [17] PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE (UNEP), *Convención Marco de las Naciones Unidas para el Cambio Climático*, Ginebra, available at <https://unfccc.int/resource/docs/convkp/convsp.pdf>, 1992 (accessed 15 January 2022).
- [18] Ministerio del Medio Ambiente (MMA), *Resumen del Estado del Medio Ambiente para la Ciudadanía*, available at <https://sinia.mma.gob.cl/wp-content/uploads/2021/01/Resumen-Ejecutivo-IEMA2020.pdf>, 2020 (accessed 17 December 2021).
- [19] Olivares, I, *El país cumple siete de nueve criterios de vulnerabilidad frente al impacto del cambio climático*, available at <https://www.latercera.com/que-pasa/noticia/pais-cumple-siete-nueve-criterios-vulnerabilidad-frente-al-impacto-del-cambio-climatico/428539/>, 2018 (accessed 17 December 2021).
- [20] Benavides, et al., *Opciones para lograr la carbono-neutralidad en Chile*, available at <https://halshs.archives-ouvertes.fr/halshs-03410019/file/Opciones-para-lograr-la-carbono-neutralidad-en-Chile-una-evaluacion-bajo-incertidumbre.pdf>, 2021 (accessed 17 December 2021).
- [21] Rojas, M., Aldunce, P., Farías, L., González, H., Marquet, P. A. & Vicuña, S., *Evidencia científica y cambio climático en Chile: resumen para tomadores de decisiones*, available at <https://www.cr2.cl/wp-content/uploads/2019/12/Evidencia-cient%C3%ADfica-y-cambio-clim%C3%A1tico-en-Chile.pdf>, 2019 (accessed 15 January 2022).
- [22] Ministerio de medio ambiente (MMA), *Economía circular*, available at <https://mma.gob.cl/economia-circular> (accessed 14 February 2021).
- [23] Ministerio de medio ambiente (MMA), *Hoja de Ruta para un Chile Circular al 2040*, available at <https://economiecircular.mma.gob.cl/wp-content/uploads/2021/07/HOJA-DE-RUTA-PARA-UN-CHILE-CIRCULAR-AL-2040-ES-VERSION-ABREVIADA.pdf> (accessed 14 December 2021).
- [24] Ministerio de medio ambiente (MMA), *Hoja de Ruta RCD Economía Circular en Construcción 2035*, available at <https://construye2025.cl/download/187/documentos-de-interes/6321/hoja-de-ruta-rcd-economia-circular-en-construccion.pdf> (accessed 14 December 2021).
- [25] AZA, *Aceros AZA recicla más de 6 mil estufas en la Región Metropolitana*, available at <https://www.aza.cl/noticias/aceros-aza-recicla-mas-de-6-mil-estufas-en-la-region-metropolitana/> (accessed 15 December 2021).

- [26] Revaloriza, available at <https://revalorizachile.cl/> (accessed 14 January 2022).
- [27] Gonzalez, C., *País Circular*, *Industria/Centro de tratamiento de RCD, 2021 abre con un hito en economía circular: así será la primera planta de valorización de residuos de la construcción en Chile*, available at <https://www.paiscircular.cl/industria/2021-abre-con-un-hito-en-economia-circular-asi-sera-la-primera-planta-de-valorizacion-de-residuos-de-la-construccion-en-chile/> (accessed 15 January 2021).
- [28] Aqua, *Economía circular: Recuperación y reciclaje de redes de pesca*, available at <https://www.aqua.cl/reportajes/economia-circular-recuperacion-y-reciclaje-de-redes-de-pesca/#> (accessed 15 January 2022).