Business Case
Hempcrete in Chile

Managing Projects in a Globalized World
Concepcion, 16.06.2023

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CHILE
INFOGRAPHIC MAP
Introducing Hempcrete to the Chilean Market

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Chile is located in **southern Latin America** and is the longest north-south trending country in the world, with a **strategic location** between the Atlantic and Pacific Oceans [2]. Chile **shares its boarder with Argentina, Bolivia** and **Peru** [2].

DEMOGRAPHIC FACTORS

- **19.8 million citizens**; **88% live in urban areas** [1]
- Chile's severe income inequality ranks as the worst among members of the OECD. Unequal access to quality education perpetuates **uneven income distribution** [2].
- The **highway system of Chile makes it easy to access key cities**, however **long distances** have to be covered to reach remote parts of the country [3].

TECHNOLOGICAL FACTORS

- Chilean **construction firms are facing a challenging period** due to rising costs and a decreasing workforce.
- Carolina Briones, the executive director of the technological center for innovation in construction (CTeC), suggests that **innovation is key** to overcome these challenges [5].

ECOLOGICAL FACTORS

- Chile has **multiple climates**; desert in north, Mediterranean in central region, and cool and damp in the south [2].
- It is **one of the countries along the Ring of Fire**, a belt of active volcanoes and earthquake epicenters [2]. As a result, it is **vulnerable to environmental risks.**
- Chile's **diverse climate makes it extremely vulnerable to the effects of climate change** [3].

ECONOMIC FACTORS

- Chile has an **export-driven economy**, and is a **leading copper producer** [2].
- **Poverty has decreased**, but **inequality has persisted**, and while public debt has risen it remains manageable [2].
- With a GDP and GDP/per capita (2022) of $316.9 billion and $16.070, **Chile is among the most industrialized Latin American countries** [1].
- Key industries are mining, manufacturing of products (chemicals, processing of food and wood) and agriculture (fruit, fishing and viticulture) [4] while the **top trade partners are China and the United States** [2].

SOCIAL FACTORS

- **Most environmentally conscious country in Latin America**.
- **Economic growth resulted in a shift in consumer behavior,** the focus is no longer on meeting needs but **establishing a social status** [4].

POLITICAL FACTORS

- The country is a **democratic republic.** The president, Gabriel Boric pledged to **combat climate change and foster sustainable development** [1].
- The Constitutional Tribunal provides judicial review of legislative actions [2].

01 ABOUT THE COUNTRY

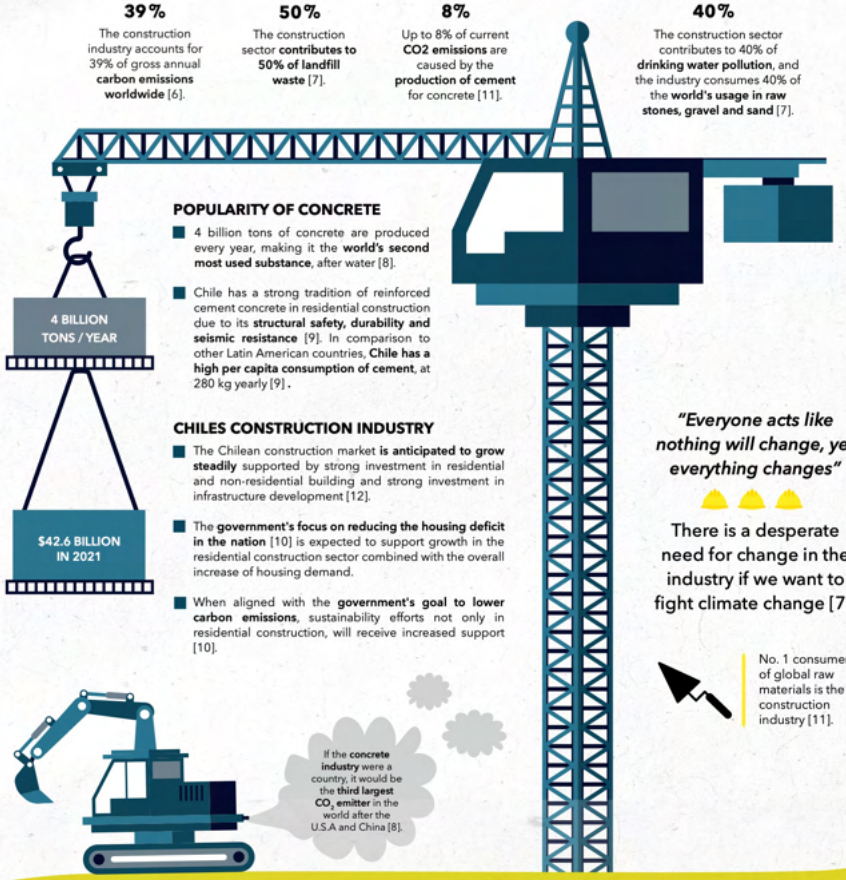
[1] Meyer, P. J., & Klein, J. (2022, April 19). Chile: An overview. In Congressional Research Service. https://crsreports.congress.gov/search/#/terms%20search=Chile%20in%20overview&orderBy=Relevance
[2] CIA.Gov - The World Factbook. (n.d.). https://www.cia.gov/the-world-factbook/countries/chile/#people-and-society
[3] OECD. (2017). Gaps and Governance Standards of Public Infrastructure in Chile. KYBIOG4278875. https://doi.org/10.1787/9789264278875-en
[4] Santander Trade. (2021, March). Chile: Reaching the Consumer. Retrieved March 13, 2023, from https://santandertrade.com/en/portal/analyse-markets/chile/reaching-the-consumers
[5] 3Newsmicro - Innovation seen as way for Chilean construct... (n.d.). 3Newsmicro.com. https://www.3newsmicro.com/en/news/innovation-seen-as-way-for-chilean-construction-firms-to-overcome-crisis

39%
The construction industry accounts for 39% of gross annual **carbon emissions worldwide** [6].

50%
The construction sector **contributes to 50% of landfill waste** [7].

8%
Up to 8% of current **CO2 emissions** are caused by the **production of cement** for concrete [11].

40%
The construction sector contributes to 40% of **drinking water pollution**, and the industry consumes 40% of the **world's usage in raw stones, gravel and sand** [7].



POPULARITY OF CONCRETE

- 4 billion tons of concrete are produced every year, making it the **world's second most used substance**, after water [8].
- Chile has a strong tradition of reinforced cement concrete in residential construction due to its **structural safety, durability and seismic resistance** [9]. In comparison to other Latin American countries, **Chile has a high per capita consumption of cement**, at 280 kg yearly [9] .

CHILES CONSTRUCTION INDUSTRY

- The Chilean construction market **is anticipated to grow steadily** supported by strong investment in residential and non-residential building and strong investment in infrastructure development [12].
- The **government's focus on reducing the housing deficit in the nation** [10] is expected to support growth in the residential construction sector combined with the overall increase of housing demand.
- When aligned with the **government's goal to lower carbon emissions**, sustainability efforts not only in residential construction, will receive increased support [10].

"Everyone acts like nothing will change, yet everything changes"

There is a desperate need for change in the industry if we want to fight climate change [7].

No. 1 consumer of global raw materials is the construction industry [11].

If the **concrete industry** were a country, it would be the **third largest CO_2 emitter** in the world after the U.S.A and China [8].

02 THE CONSTRUCTION INDUSTRY

[6] Here's how the construction industry can reach net-zero. (2022, September 21). World Economic Forum. https://www.weforum.org/agenda/2022/09/construction-industry-zero-emissions/
[7] Dobrowolska, K. (2022). How Does Construction Affect The Environment? Archdesk. https://archdesk.com/blog/how-does-construction-affect-the-environment#:~:text=Some%20of%20the%20main%20effects,and%20the%20use%20of%20raw%20materials.
[8] Watts, J. (2019, February 20). Concrete: The most destructive material on Earth. The Guardian. Retrieved March 16, 2023, from https://www.theguardian.com/cities/2019/feb/25/concrete-the-most-destructive-material-on-earth
[9] Zezzatti, Y. V., Parejo, R. R., Rojas, L. M., Hassan, E. F., Torres-Acosta, A. A., Tobón, J. I., & John, V. M. (2022). Overview of cement and concrete production in Latin America and the Caribbean with a focus on the goals of reaching carbon neutrality. RILEM Technical Letters, 7, 39–46. https://doi.org/10.21809/rilemtechlet.2022.155
[10] ShareSquare Capsita (n.d.). https://www.globaldata.com/store/report/chile-construction-market-analysis/
[11] Greening Cement Production has a Big Role to Play in Reducing Greenhouse Gas Emissions. UNEP Global Environmental Alert Service (GEAS) - November 2010 (n.d.). UNEP - UN Environment Programme. https://www.unep.org/resources/report/greening-cement-production-has-big-role-play-reducing-greenhouse-gas-emissions
[12] Chile Infrastructure Report (n.d.). https://store.fitchsolutions.com/infrastructure/chile-infrastructure-report

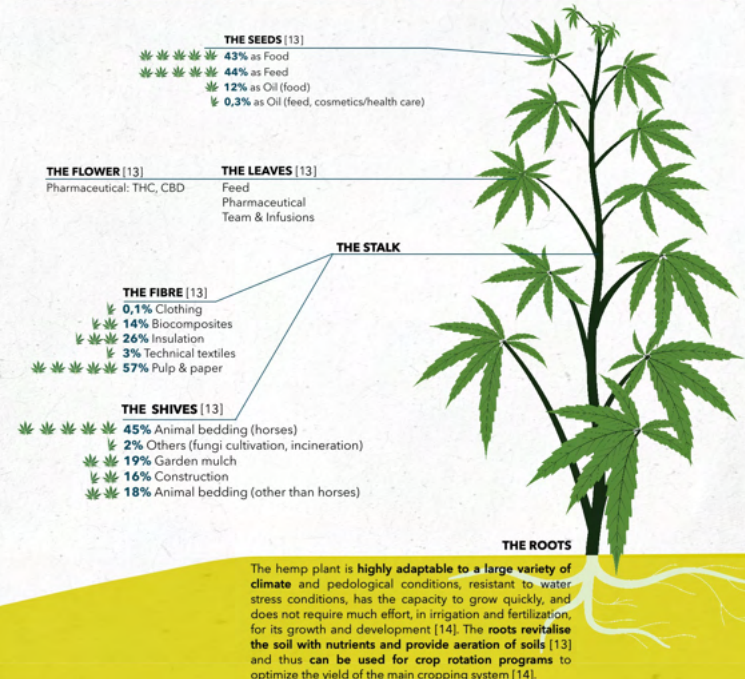
Industrial hemp, *Cannabis sativa L.* is a **high-yielded annual industrial crop** that originated in Asia and is one of the oldest domesticated crops known. It is considered **a low-cost, environmentally friendly, sustainable, multi-purpose plant** used as a basis for more than 25,000 products in nine major submarkets, including textiles, agriculture, automotive, food and beverage, paper, furniture, construction, recycling, and personal care [15].

Today, **more than 30 countries grow hemp**, with China, western Europe and Canada being the most important actors in the global hemp market [15]. After harvesting the hemp stems, the **decortication process** begins - with a machine that seperates the stem from the fibers. From there multiple products can be made.

Hemp can be used in various ways e.g. for food, cosmetics, textile, paper, insulation and construction.

For residential construction purposes, **almost every part of the plant can be transformed into construction-related products** except for the seed, and can resemble concrete, wood, and plastic. It is estimated that **a house can be built nearly 100% out of hemp materials**.

Hemp-based construction materials such as **hemcrete** have **many advantages**, including strength, lightness, low cost, fire and water resistance, insulation, breathability, pest resistance, and suitability for natural disasters is considerd a sustainable, carbon-negative, and low embodied energy construction material [15].



THE SEEDS [13]
- **43%** as Food
- **44%** as Feed
- **12%** as Oil (food)
- **0,3%** as Oil (feed, cosmetics/health care)

THE FLOWER [13]
Pharmaceutical: THC, CBD

THE LEAVES [13]
Feed
Pharmaceutical
Team & Infusions

THE STALK

THE FIBRE [13]
- **0,1%** Clothing
- **14%** Biocomposites
- **26%** Insulation
- **3%** Technical textiles
- **57%** Pulp & paper

THE SHIVES [13]
- **45%** Animal bedding (horses)
- **2%** Others (fungi cultivation, incineration)
- **19%** Garden mulch
- **16%** Construction
- **18%** Animal bedding (other than horses)

THE ROOTS

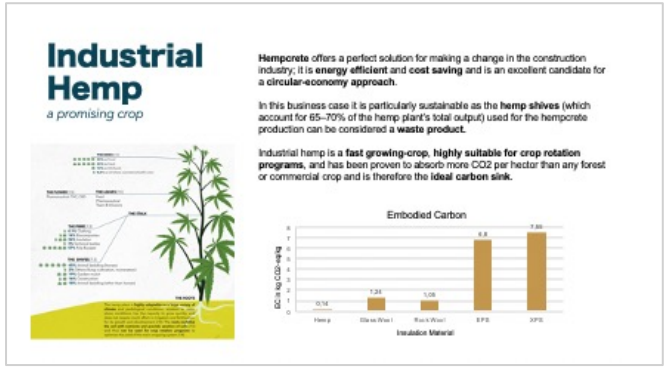
The hemp plant is **highly adaptable to a large variety of climate** and pedological conditions, resistant to water stress conditions, has the capacity to grow quickly, and does not require much effort, in irrigation and fertilization, for its growth and development [14]. The **roots revitalise the soil with nutrients and provide aeration of soils** [13] and thus **can be used for crop rotation programs** to optimize the yield of the main cropping system [14].

03 THE INDUSTRIAL HEMP INDUSTRY

[13] Deeg, D. (n.d.). "Natural Biorefinery Hemp" – Graphic | Renewable Carbon Publications. Renewable Carbon Publications. https://renewable-carbon.eu/publications/product/natural-biorefinery-hemp-%E2%80%93-graphic/
[14] Iannucci, A., Lisperta, A., & Pancani, S. (2021). The Cultivation of Industrial Hemp as Alternative Crop in a Less-Favoured Agricultural Area in Southern Italy. The Pignola Case Study. Pollutants, 1(3), 169–180. https://doi.org/10.3390/pollutants1030014
[15] Ortiz, G., Sharma, V. K., Chanet, G., & Morin-Crini, N. (2020). Applications of hemp in textiles, paper industry, insulation and building materials, horticulture, animal nutrition, food and beverages, nutraceuticals, cosmetics and hygiene, medicine, agrochemistry, energy production and environment: a review. Environmental Chemistry Letters, 18(5), 1451–1476. https://doi.org/10.1007/s10311-020-01029-2

Market Potential

The need for Change



Hempcrete is the Solution

Market Potential

The government has launched **emergency housing plans** and reconstruction projects

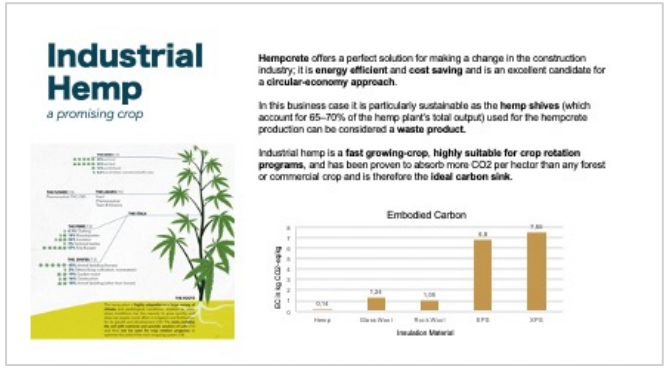
Initiatives like Deficit Cero aim to collaborate with construction companies for **innovative, sustainable, and fast construction solutions**.

Diamond Hemp intends to establish partnerships with **construction companies** initially.

The secondary target audience is sustainably oriented Chilean individuals who are interested in **self-constructing** houses.

Market Potential

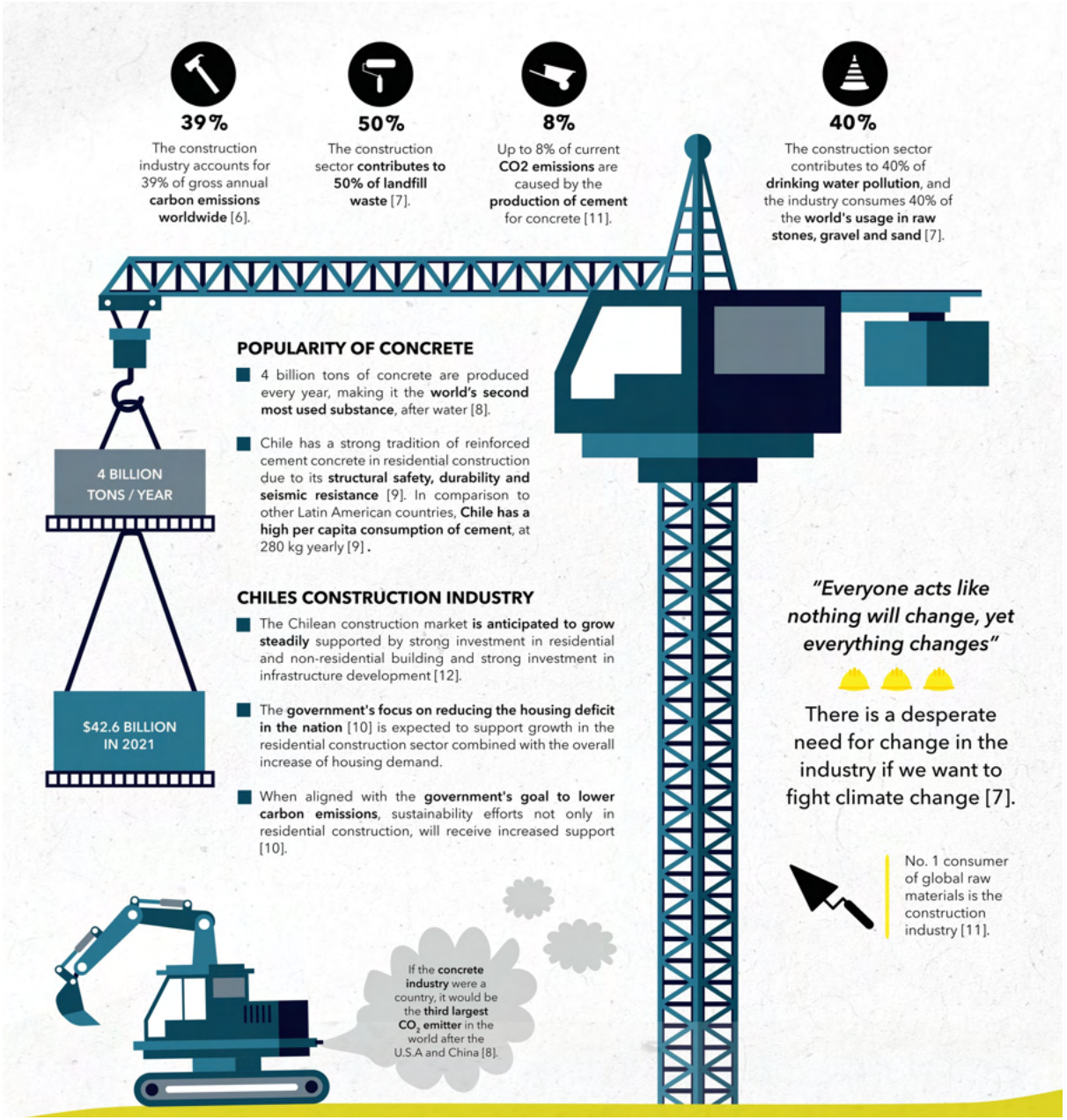
The need for Change



Hempcrete is the Solution

The need for change

In short: The construction industry is highly unsustainable, and we must make a change if we want to meet the climate goals set.



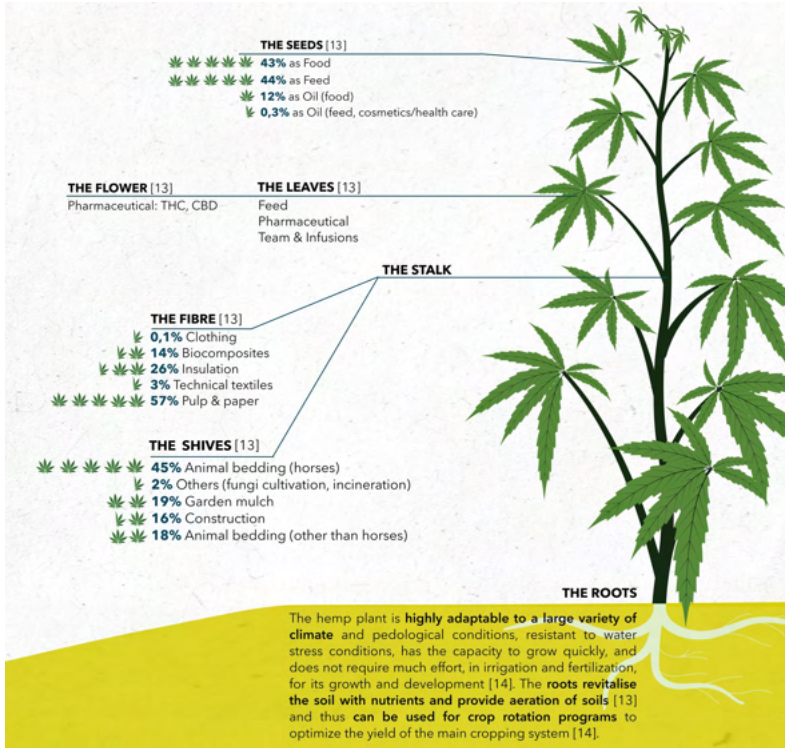
Market Potential

The need for Change

Hempcrete is the Solution

Industrial Hemp

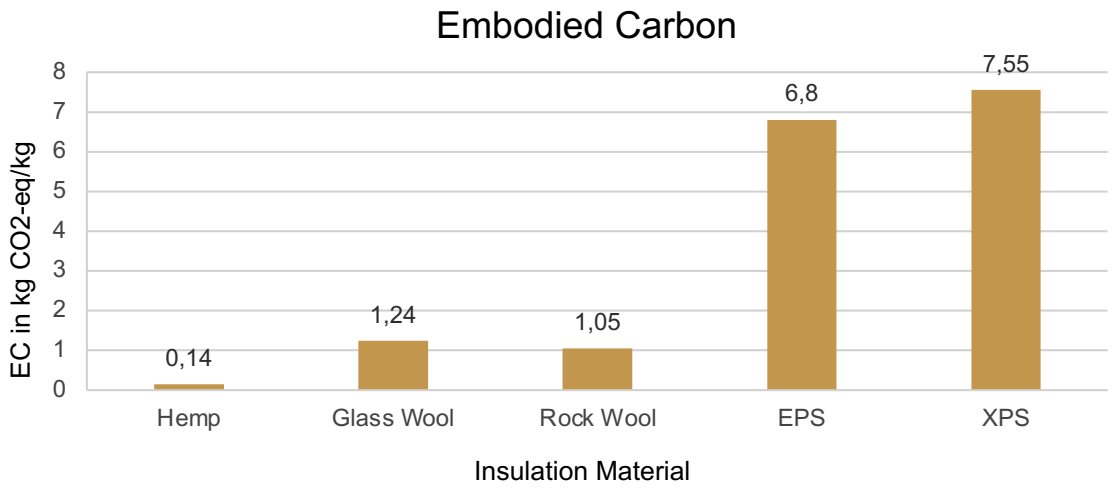
a promising crop



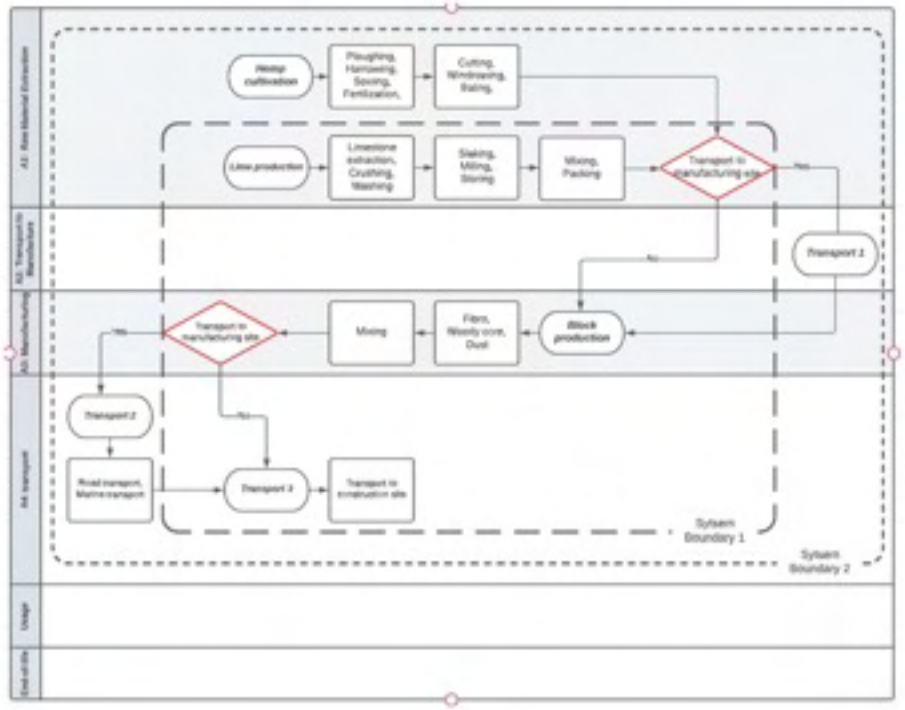
Hempcrete offers a perfect solution for making a change in the construction industry; it is **energy efficient** and **cost saving** and is an excellent candidate for a **circular-economy approach**.

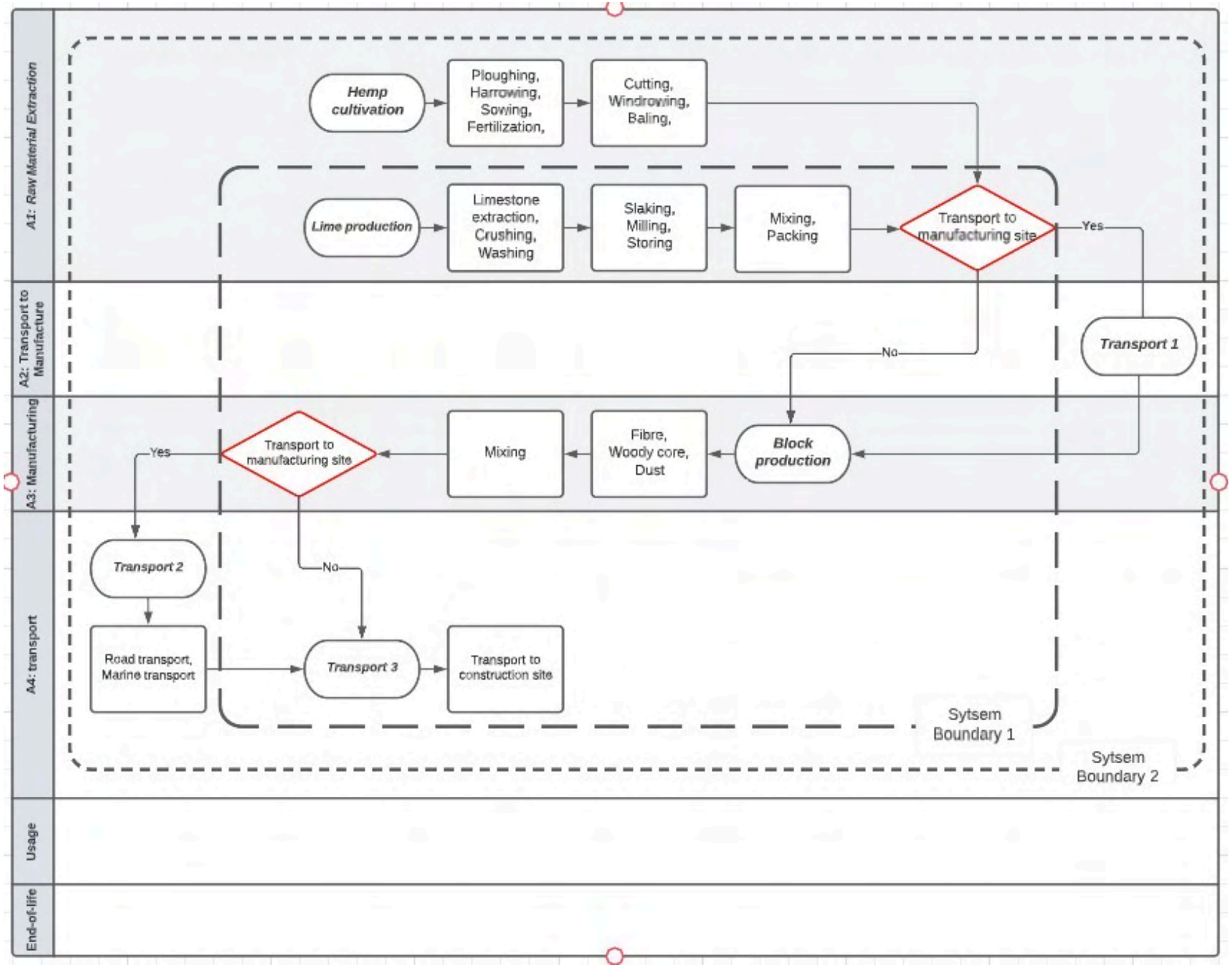
In this business case it is particularly sustainable as the **hemp shives** (which account for 65–70% of the hemp plant's total output) used for the hempcrete production can be considered a **waste product.**

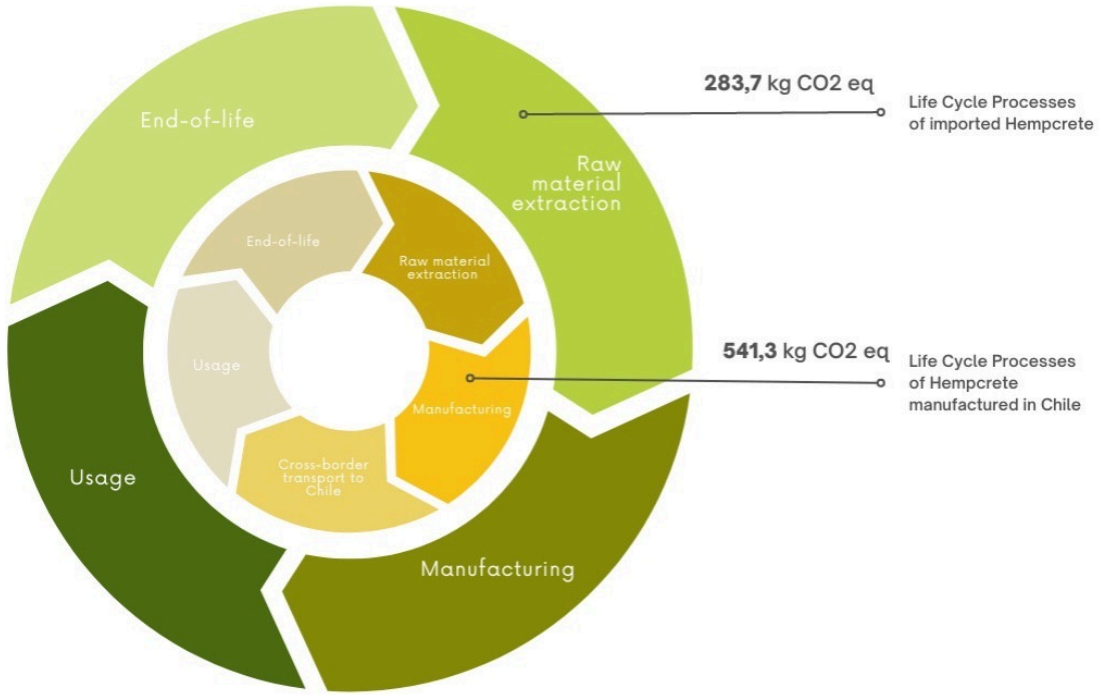
Industrial hemp is a **fast growing-crop**, **highly suitable for crop rotation programs**, and has been proven to absorb more CO2 per hector than any forest or commercial crop and is therefore the **ideal carbon sink**.



Hempcrete is the Solution




A1: Raw Material Extraction
A2: Transport to Manufacture
A3: Manufacturing
A4: transport
Usage
End-of-life
Hemp cultivation
Ploughing, Harrowing, Sowing, Fertilization,
Cutting, Windrowing, Baling,
Lime production
Limestone extraction, Crushing, Washing
Slaking, Milling, Storing
Mixing, Packing
Transport to manufacturing site
Yes
No
Transport 1
Block production
Fibre, Woody core, Dust
Mixing
Transport to manufacturing site
Yes
No
Transport 2
Road transport, Marine transport
Transport 3
Transport to construction site
Sytsem Boundary 1
Sytsem Boundary 2

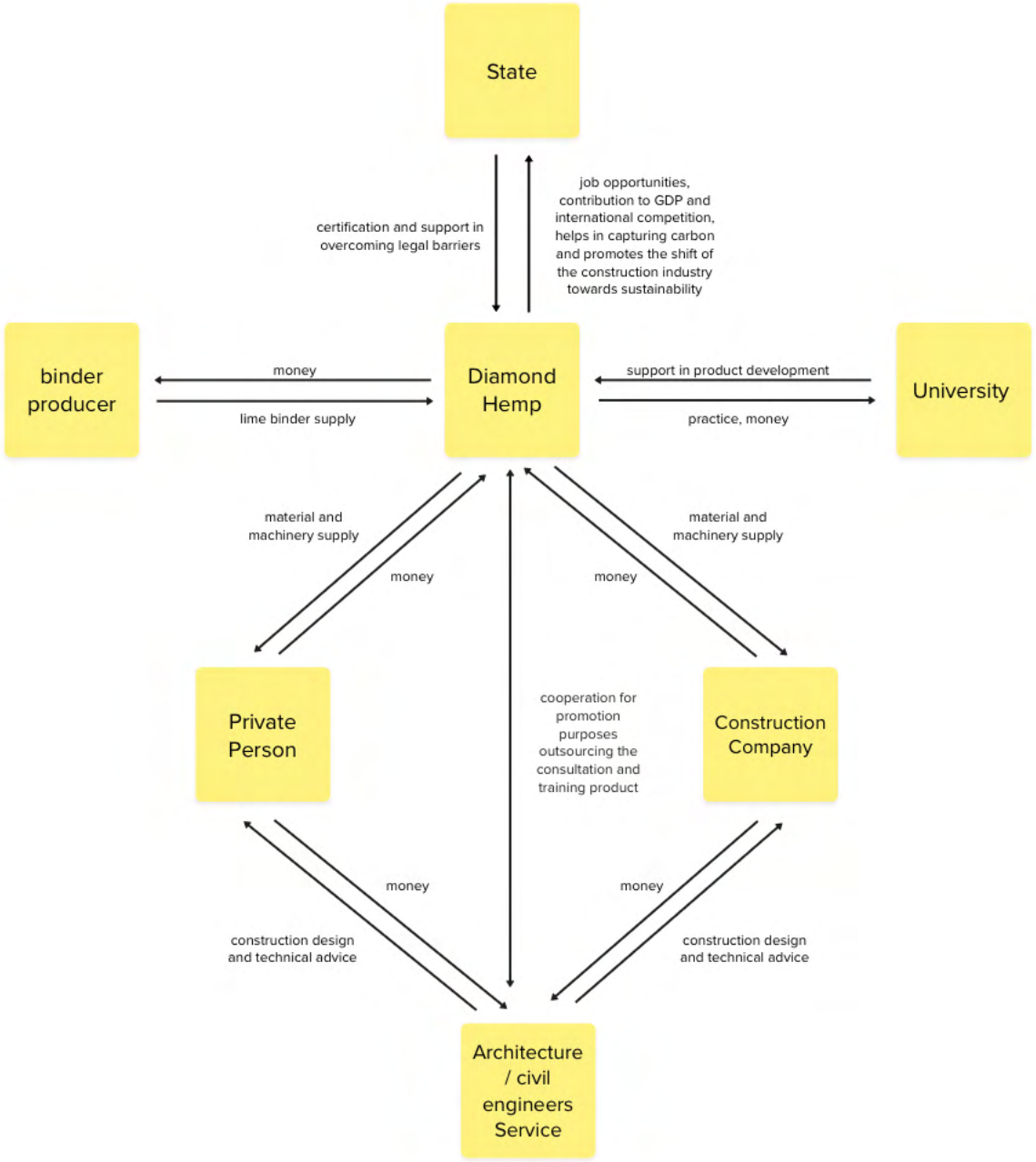


283,7 kg CO2 eq

Life Cycle Processes of imported Hempcrete

541,3 kg CO2 eq

Life Cycle Processes of Hempcrete manufactured in Chile



Value Network

Beneficial for everyone

Social Impact

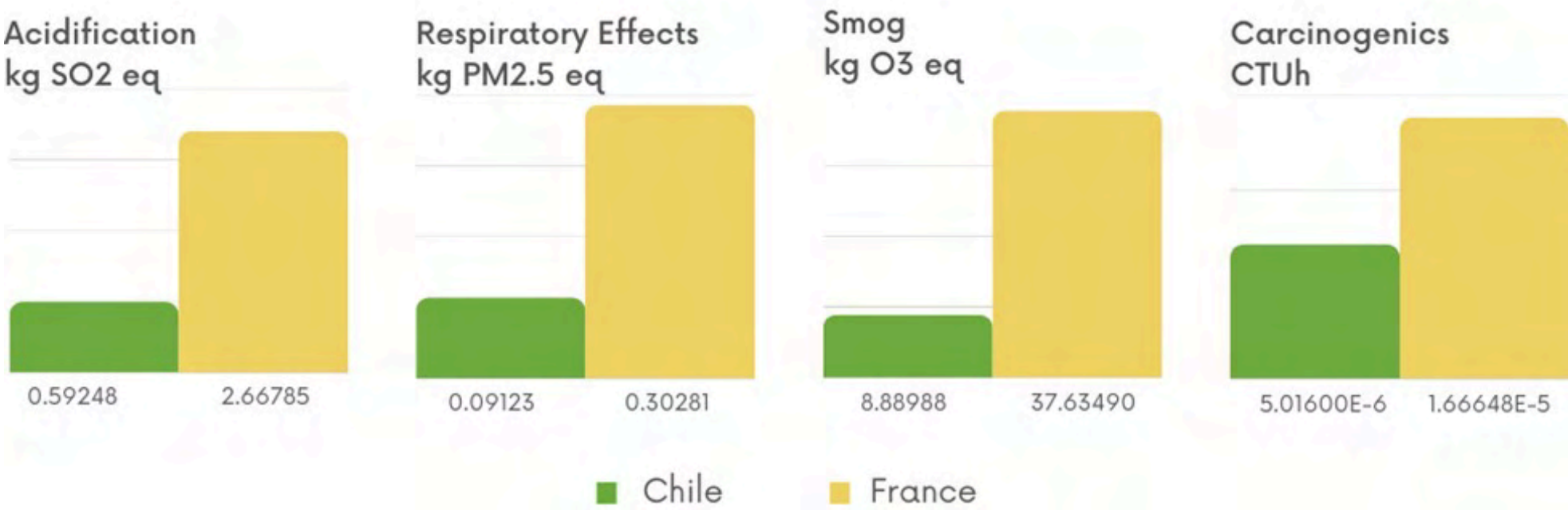
Introducing hempcrete to the market has **positive social consequences, improving environmental sustainability** in Chile.

Hempcrete **boosts the economy**;
Its introduction stimulates the economy, **creating job opportunities, carbon credits** and **promoting fair trade principles**.

Hempcrete is an **environmentally sustainable material**; it captures CO2 and promotes clean indoor air, **benefiting health and well-being**.

Hempcrete **opens doors to decent housing**; It addresses housing inequalities and allows for **cost-efficient self-construction** and **higher-quality homes**.

Impact Results



Payback Period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cash Flows	($4.370.024.172)	$431.848.216	$431.848.216	$1.728.938.860	$1.728.938.860	$1.728.938.860
Cumulative Cash Flow	($4.370.024.172)	($3.938.175.956)	($3.506.327.740)	($1.777.388.880)	($48.450.020)	$1.680.488.840

Payback Period = **4,03**

Payback Period

Investment	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cash Flows	($1.689.242.994)	$431.848.216	$431.848.216	$1.728.938.860	$1.728.938.860	$1.728.938.860
Cumulative Cash Flow	($1.689.242.994)	($1.257.394.778)	($825.546.562)	$903.392.298	$2.632.331.158	$4.361.270.018

Payback Period = **2,48**

Economic Impact

With an **initial investment between 1.689.242.994 CLP and 4,370,024,172 CLP,** an automated production line with a **production capacity of 500,000 blocks/year** can be set up in the first year.

The simplified **costs are 1.868.668 CLP per unit** (incl. material and labour costs, 19% VAT, 9% sales commission, and a margin of 30% for additional costs).

One unit corresponds to **596 hempcrete blocks** needed to build a **house with a floor area of 60 m²**.

Diamond hemp has the potential to aid in building approx. **11,741 60m² houses within the next five years**, representing around 4.5% of the Ministry of Housing and Urban Development's target of constructing 260,000 homes - indicating its **enormous upscaling and massification potential.**

With a 15% profit margin, each **block is priced at 4,000 CLP**, resulting in a **payback period of 2.5 to 4 years**.

Highly competitive towards traditional wall structures.

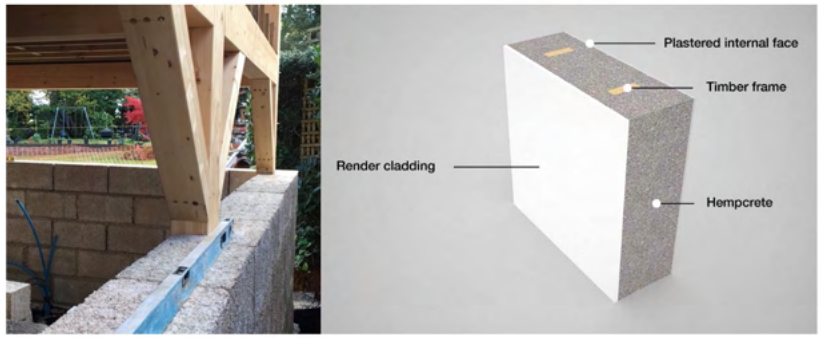
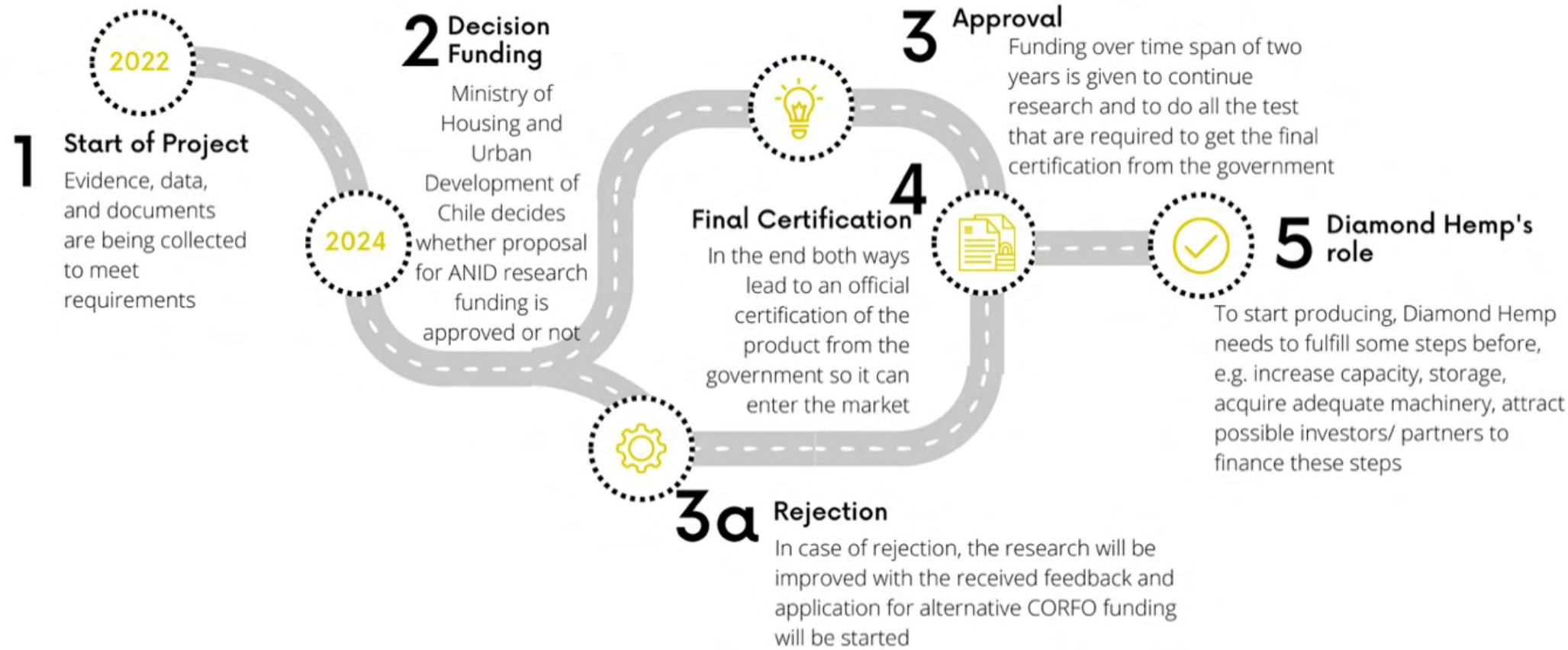
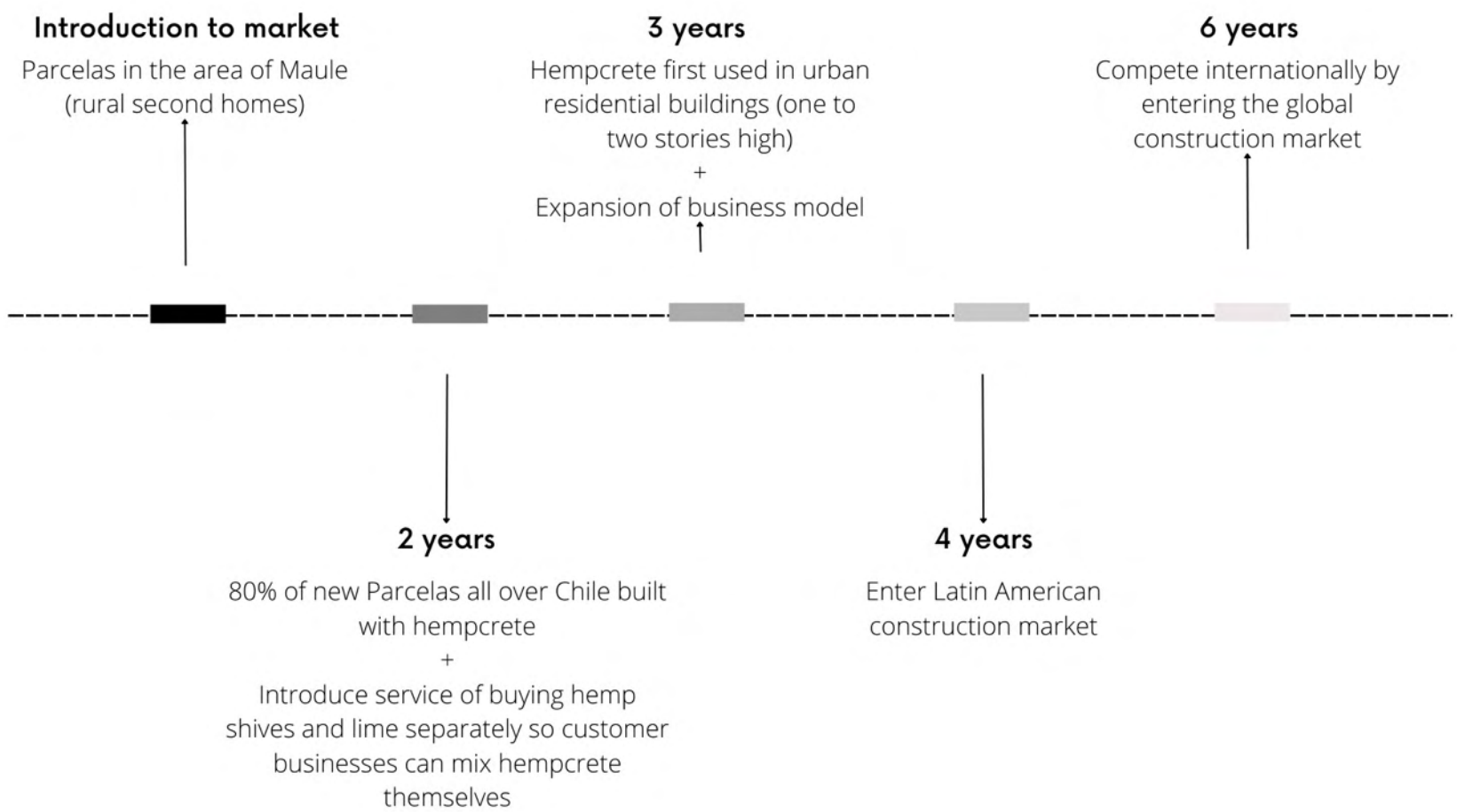


Table 5: Cost comparison - traditional wall structure vs. hempcrete wall.

	Traditional Wall Structure	Hempcrete Wall
Simplified Material Costs	77.799 CLP/m²	40.000 CLP/m²


2022
1
Start of Project
Evidence, data, and documents are being collected to meet requirements
2024
2
Decision Funding
Ministry of Housing and Urban Development of Chile decides whether proposal for ANID research funding is approved or not
3
Approval
Funding over time span of two years is given to continue research and to do all the test that are required to get the final certification from the government
4
Final Certification
In the end both ways lead to an official certification of the product from the government so it can enter the market
5
Diamond Hemp's role
To start producing, Diamond Hemp needs to fulfill some steps before, e.g. increase capacity, storage, acquire adequate machinery, attract possible investors/ partners to finance these steps
3a
Rejection
In case of rejection, the research will be improved with the received feedback and application for alternative CORFO funding will be started

"At our company, we believe that sustainability should not come at a high cost. That's why we offer a revolutionary building solution that is both affordable and eco-friendly - namely Hempcrete. With our ***fast-to-construct, sustainable material, we are empowering sustainable-minded builders in Chile to make a positive impact on the environment without compromising on quality or budget****. By choosing Hempcrete, builders can build structures that are not only cost-effective and energy-efficient but also provide superior insulation and are prone to natural disasters, creating a comfortable and healthy living environment.* ***Join us in the sustainable building movement and make Hempcrete your first choice for your next construction project****."*


Introduction to market
Parcelas in the area of Maule (rural second homes)
2 years
80% of new Parcelas all over Chile built with hempcrete
+
Introduce service of buying hemp shives and lime separately so customer businesses can mix hempcrete themselves
3 years
Hempcrete first used in urban residential buildings (one to two stories high)
+
Expansion of business model
4 years
Enter Latin American construction market
6 years
Compete internationally by entering the global construction market

THEORY OF CHANGE

Universidad de Concepción Chile

udt Ciencia, Tecnología e Innovación en Bioeconomía

INPUT

RESEARCH

FACILITIES & EQUIPMENT

ACTIVITIES

- Collaboration between the company, researchers and the government
- Development Experimentation Theorizing

OUTCOMES

- Human health and well-being
- Increased awareness of sustainable materials
- Environmental awareness and protection
- Social acceptance
- Economic boost

IMPACT

- Placing hempcrete in the market
- Sales, engagement from the target audience

OUTPUTS

- Approved license from the government
- Funding for research — Agencia Nacional de Investigación y Desarrollo
- Increased production of hempcrete
- Expansion of facilities and equipment


+ Hemp shives
+ Lime binder
+ Water
= Hempcrete
Building with
Hempcrete.
Building the
Future.
Hempcrete is the building material of the future. Your future.
#doityourself #doitright
#easytobuildwith #futureproof #affordable
#capturesCO2 #toxicfreehome
More information on www.diamondhemp.cl