

S U S T A I N A B L E F I N A N C E

A Chilean Perspective

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My research sits at the intersection of finance, innovation, and sustainability. I study how financial systems, investor behavior, and new forms of information affect markets and long-term value creation. More recently, my work has shifted toward sustainable finance, including climate risk, ESG issues, social finance, and the role of financial innovation in supporting sustainable transitions.

My academic work has been published in the Journal of Corporate Finance, Journal of International Money and Finance, International Review of Economics & Finance, Journal of Financial Research, Economic Modelling, and Journal of Financial Crime, 8 academic books, and has been covered in media such as The Economist, Bloomberg, and The Wall Street Journal.

I'm an economist with a PhD in Finance, a Master's in Neuroscience, and Certified Foresight Practitioner.

Areas of Contribution

- Finance and capital markets
- Financial innovation and emerging technologies
- Sustainability, ESG, and climate risk
- Strategic foresight and long-term decision-making

Link to Natura Invest

I contribute a financial perspective to measurement, incentive design, instrument development, and capital mobilization toward solutions linked to nature, biodiversity, and resilience.

Research in Sustainable Finance

Current Research

Machine Learning-based Climate Risk Exposure Index

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*Duke University, *University of the Pacific, *University of the Pacific, *University of the Pacific

Abstract

We develop a machine learning-based Climate Risk Exposure Index (ML-CREI) that provides a dynamic, firm-level measure of climate risk by integrating publicly available climate conditions with financial disclosures based on climate risk. The approach captures higher-order moments, lag effects, and persistence in climate conditions, offering a more comprehensive representation of climate risk impact on firms. We compare ML-CREI through both cross-sectional and event studies. Firms with higher exposure exhibit lower valuations, weaker operating performance, reduced R&D investment, and higher volatility. Using subsample analyses to examine differences between firms in their first and last ML-CREI quantiles, we find that firms in the last ML-CREI quantile experience a significant decline in valuation and R&D investment following climate shocks. Overall, ML-CREI provides a novel and comprehensive measure of climate risk exposure.

Keywords: Climate Risk Exposure, Machine Learning, Firm Performance, Volatility, R&D Investment

"Machine Learning-based Climate Risk Exposure Index"

Development of a dynamic firm-level climate risk index that integrates observed climate conditions and climate-risk mentions in financial reports, designed to capture actual economic exposure rather than managerial perception alone.

Key Methodological Elements

- ~3,500 U.S. weather stations with data from 2000–2024.
- 206 climate metrics per station-year, including moments, ranges, persistence, and cross-variable interactions.
- 4,876 firms and 41,417 firm-year observations from 2005 to 2023.
- Comparison of Linear Regression, Elastic Net, Random Forest, Support Vector Regression, and Neural Networks; Random Forest delivers the best out-of-sample performance.

Main Findings

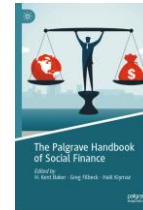
Firms with higher climate risk exposure show lower valuation, weaker operating performance, reduced R&D investment, and higher volatility. Furthermore, after major hurricane events, firms with greater exposure suffer additional market-value and R&D declines.

Recent Contributions



"Green Density and Spillover Effects on Earnings Manipulation"

Examines how the geographic density of firms with stronger environmental ratings relates to lower levels of earnings manipulation. Evidence is built on 18,012 firm-year observations from 2,319 U.S. firms.



"Variations of a Social Finance Theme: Socially Responsible Investing, ESG, Sustainable Investing, and Impact Investing"

Chapter aimed at clarifying conceptual and practical differences between SRI, ESG, sustainable investing, and impact investing. Useful as a framework for conversations with non-specialist audiences.

"The Social Impact of Fintech"

Discusses how financial innovation can contribute to financial inclusion, inequality reduction, and sustainable development goals, alongside its regulatory and ethical challenges.



"Essential Concepts of Sustainable Finance: An A-Z Guide"

Contribution to a reference volume designed to organize and explain core concepts in the field of sustainable finance.

NATURA INVEST

naturainvest.cl

*"Investing in
nature,
investing in
the future."*

What is NaturaInvest?

An applied research initiative positioning Chile as a regional benchmark in finance for biodiversity and natural capital. Led by outstanding researchers, professionals in knowledge transfer, and a broad national and international collaboration network.



Natural Capital

Measuring, valuing and accounting for biodiversity, natural capital and ecosystem services — water provision, carbon sequestration, disaster protection.



Business & Nature

Integrating nature-related risks and opportunities into business strategy. Understanding corporate dependencies and impacts on ecosystems.



Nature-Based Solutions

Designing NbS to address business and government impacts on nature. Scaling solutions from pilots to bankable projects.



Financial & Market Solutions

Developing financial mechanisms, green taxonomies, and investment instruments to mobilize capital for nature conservation and restoration.

Recent Research

IFRS S1/S2 Readiness

Study with Deloitte: only 15% of 75 major Chilean companies (IPSA + national indices) are fully prepared for mandatory IFRS S1/S2 sustainability disclosures, effective 2026. Published in Diario Financiero.

ESG & Earnings Management

Recent publication analyzing the relationship between ESG ratings and earnings management in Chilean listed firms — finding that sustainability scores are linked to reporting quality.

Nature-Related Financial Risks

June 2026 event: 'Nature-related Financial Risks: Challenges for the Chilean Financial System' — connecting TNFD frameworks to local market readiness.

Public-Private Partnerships

May 2026 international seminar on public-private partnerships for nature conservation — exploring blended finance instruments for biodiversity.

Connection to Today's Lecture



The NCG 461/519 — SLB Link

NaturalInvest's work on corporate sustainability disclosure directly underpins KPI 3 of Chile's sovereign SLBs. The CMF disclosure rules we analyze are exactly the data source used to track women's board representation.



IFRS S1/S2 & Green Finance

Our Deloitte study shows most Chilean firms are not ready for mandatory sustainability disclosure. This gap is both a research finding and a market opportunity — investors cannot price ESG risk without quality data.



Nature as the Next Frontier

While today's class focuses on climate (GHG, energy), NaturalInvest argues nature is the next dimension. Chile's 2025 SLB framework update already added a biodiversity KPI — nature finance is coming to sovereign debt.



Blended Finance & NbS

Our work on nature-based solutions and bankable conservation projects connects directly to the 'beyond green bonds' question — how do you finance nature restoration at scale? New instruments, new data, new risk models.

Today's Journey

SESSION 1 • 80 min

Chile & the Sustainability Challenge

- Who is Chile? Geography & economy
- What sustainability challenges do we face?
- Government policy toolkit
- Chile's actual actions & results
- Green bonds & social bonds in Chile
- → The use-of-proceeds problem

BREAK
15 min

SESSION 2 • 80 min

Sustainability-Linked Bonds: The Chile Case

- From sustainable bonds to SLBs — why?
- How SLBs work: KPIs & step-ups
- Chile's sovereign SLB program
- The 3 KPIs: design & measurement issues
- Credibility, greenium & market reception
- Discussion: Are they working?

SESSION 1

Chile & the Sustainability Challenge

What do you know about Chile?

Chile at a Glance

19.6M

Population

4,300 km

Length (but 177 km wide)

US\$17k

GDP per capita (PPP)

54%

Copper: share of exports

10%

World copper reserves

41.5%

Public debt / GDP (2025)

 World's longest country ·  Andes + Pacific + Atacama · CL Spanish-speaking · Mapuche indigenous heritage

Chile: Geography & Natural Resources

4,300 km from the Atacama Desert to Cape Horn — one of the world's most resource-diverse countries



Copper & Lithium

Chile holds ~28% of world copper reserves and is the #1 producer. The Atacama desert also contains the world's largest lithium deposits — critical for batteries and the energy transition.

📍 Atacama Desert (North)



Solar Energy

The Atacama Desert receives the world's highest solar irradiation. Chile's solar capacity has surged to >6 GW installed, with costs among the lowest globally.

📍 Atacama & Norte Grande



Agriculture & Wine

The fertile Central Valley produces world-class wines (Carménère, Cabernet, Sauvignon Blanc), fruits, and vegetables exported to 100+ countries.

📍 Central Valley (Santiago–Bío-Bío)



Forestry & Lumber

Chile's southern forests (pine, eucalyptus, native species) supply pulp, lumber, and biomass. Forest products are a major export category.

📍 Araucanía & Los Lagos



Aquaculture & Salmon

Chile is the world's #2 salmon producer. Fjords and cold waters of Patagonia create ideal conditions. A \$5B+ export industry, though facing sustainability scrutiny.

📍 Los Lagos & Aysén (South)



Fishing & Seafood

The Humboldt Current makes Chile's Pacific coast one of the richest fishing grounds on Earth. Anchovy, hake, sea urchin, mussels, and abalone are key exports.

📍 Pacific coast (entire length)



Hydrology & Snowpack

Andes glaciers and snowmelt feed rivers that power hydro plants (~30% of electricity) and irrigate agriculture. Rapidly changing under climate pressure.

📍 Andes cordillera



Tourism & Patagonia

Torres del Paine, Easter Island, the Atacama, and wine country attract millions. Tourism is a growing sector, though constrained by infrastructure.

📍 Patagonia, Easter Island, Atacama

Should Chile care about sustainability?

Think about Chile's economy (copper, fishing, agriculture, forestry), its geography (extreme climate zones), and its social structure (inequality, indigenous communities). What challenges would you predict?

Key challenges



Industrial Emissions

Mining & energy are top emitters.
Decarbonizing copper smelting is hard.



Energy Transition

Chile has enormous solar, wind & hydro potential. Transition is underway but uneven.



Water Scarcity

Atacama is the world's driest desert.
Mining competes with communities for water.



Biodiversity Loss

33,000 km of coastline, Patagonian forests, unique ecosystems at risk.



Social Inequality

Income gap is high. Environmental burden often falls on poorer/indigenous communities.



Gender Gaps

Women's corporate representation remains low despite legal and market pressure.

What Can a Government Do?

What Can a Government Do?

Six categories of government action

1

Regulation & Standards

2

Taxation & Pricing

3

Public Investment

4

Market Design

5

Sovereign Finance

6

International Engagement

What Can a Government Do?

1

Regulation & Standards

Laws, environmental permits, emissions limits, mandatory disclosure

2

Taxation & Pricing

Carbon taxes, green subsidies, tax incentives for clean investment

3

Public Investment

Direct government spending on renewables, transport, reforestation

4

Market Design

Cap-and-trade, REC markets, energy auctions, green procurement

5

Sovereign Finance

Green bonds, SLBs — the government as issuer and market signaler

6

International Engagement

NDCs, Paris Agreement, multilateral finance, FTAs with ESG clauses

Chile Has Actually Done a Lot

Regulation

Climate Change Framework Law (2022) — Chile's first climate law, enshrines NDC targets

Carbon Tax

US\$5/tCO₂ carbon tax on major emitters since 2017 (rising over time)

Energy Transition

Coal phase-out commitment: all coal plants by 2040. 40% renewables in grid by 2024.

Green Finance

Green Bond Framework (2019) → Social bonds (2020) → SLBs (2022): first sovereign globally

Taxonomy

T-MAS: Chile's own environmental activity taxonomy (2024) — includes mining-specific criteria

NDC

2030 target: 95 MtCO₂e; carbon budget ≤1,100 MtCO₂e for 2020–2030

Long-Term Vision & Climate Law

The institutional architecture that coordinates all six government tools

Ley Marco de Cambio Climático (Law 21,455) — June 2022

Chile's first climate framework law. Enshrines net-zero emissions by 2050, a carbon-neutral economy, and legally binding sectoral emission budgets. Creates the National Climate Change Council and mandates the National Climate Change Action Plan (PANCC). Establishes rights of citizens and obligations of the State to act on climate.

Net-Zero by 2050

Legally binding target. Chile must reach carbon neutrality and recover degraded ecosystems. First LatAm country to enshrine this in law.

NDC 2030 Targets

≤95 MtCO₂e by 2030 (excl. LULUCF). Carbon budget ≤1,100 MtCO₂e for 2020–2030. Anchors all sustainable finance KPIs.

Sectoral Plans

Mandatory climate action plans for energy, mining, transport, agriculture, buildings, and water. Each ministry sets binding reduction pathways.

Governance & Rights

National Climate Committee. Environmental justice provisions. Long-term strategies every 10 years, reviewed every 5. Citizens can sue for non-compliance.

Regulation & Standards — Chile's Examples

Laws and mandatory rules that shape what firms and people can and must do

Coal Phase-Out Decree (2019/2022)

All coal-fired power plants must close by 2040. Chile had 28 coal units; retirements began immediately. By 2024, 8 plants had already closed. No new coal permits will be issued.

Environmental Impact Assessment (SEIA)

Mandatory EIA for major projects (mining, energy, infrastructure). All large copper mines and solar farms require SEIA approval. Sets binding environmental standards for operations.

CMF Sustainability Disclosure Rules

Chile's financial regulator (CMF) requires listed companies to disclose ESG risks and governance data. Provides the data infrastructure for KPI 3 of Chile's sovereign SLBs.

Green Building Code (2020)

Updated building regulations require minimum energy efficiency standards, thermal insulation, and natural lighting for new construction. Applies to residential and commercial buildings.

Electromobility & Transport Norms

Chile committed to 100% electric public transport in Santiago by 2035. New vehicle emission standards aligned with Euro 6. Electromobility funded partly via green bond proceeds.

Water Rights Reform

2022 constitutional reforms and Water Code changes limit new water rights in scarcity zones. Prioritizes human consumption over industrial use — critical given mining-water conflicts in the Atacama.

Taxation & Pricing — Chile's Examples

Price signals that make pollution costly and clean investment attractive

US\$5

Carbon tax
per tCO₂ (2017–)

~100

Facilities covered
by carbon tax

US\$140M

Annual carbon tax
revenue (est.)

50%

Tax exemption
for solar/wind projects



Carbon Tax (Impuesto Verde) — 2017

Chile was the first country in Latin America to establish a carbon tax. US\$5/tCO₂ on stationary sources emitting >25,000 tCO₂/year (power plants, large industrial facilities). The rate is low relative to global benchmarks but politically significant as a first step.



Renewable Energy Tax Incentives

Accelerated depreciation for renewable energy assets. VAT exemption on solar panel imports. Investment tax credits for clean energy projects in remote regions. These incentives drove Chile's solar boom — capacity grew from near zero in 2013 to >6 GW by 2024.



Mining Royalty Reform (2023)

New tiered royalty on copper production includes an 'ad valorem' component and profit-sharing. Revenues partly earmarked for regional development and post-mining remediation. Sustainability considerations embedded in mining fiscal policy for the first time.



Vehicle & Fuel Taxes

Annual vehicle tax based on engine size and emissions. Differential fuel taxes favor low-sulfur diesel. The 2021 tax reform eliminated the tax benefit for diesel vehicles in Santiago — a step toward equalizing fossil vs. electric vehicle costs.

Public Investment — Chile's Examples

Direct government spending that creates green infrastructure and public goods



Metro de Santiago Expansion

Santiago's metro system — 140+ km, 136 stations — is one of the largest public investments in Chile's history. Funded partly via green bond proceeds. Serves 2.8M+ passengers/day, displacing millions of car and bus trips annually. Lines 3, 7, and 8 under ongoing expansion.



Plan Nacional de Reforestación

Government-funded afforestation and native forest restoration. Target: plant 500,000 hectares by 2030. Combines carbon sequestration with biodiversity protection. Partly funded via the green bond allocation for 'living natural resources.'



National Electricity Transmission Plan

Public investment in high-voltage transmission infrastructure to connect Atacama solar/wind generation to population centers in the south. Without transmission, renewable energy is stranded. The state electricity company (ENAP) coordinates grid modernization.



Red Metropolitana de Movilidad

Santiago's public bus system (formerly Transantiago, renamed Red). Government subsidizes 100% electric bus fleet — over 800 electric buses as of 2024, largest electric bus fleet in Latin America outside China. Funded via PTUS (urban transport subsidy).



Social Housing (MINVU)

Chile's housing ministry runs DS49 and DS1 subsidy programs for low-income families. Proceeds from Chile's social bonds flow into these programs. Target: address 650,000-unit housing deficit. Green standards now embedded in new social housing construction.



Healthcare Infrastructure (MINSAL)

Post-pandemic healthcare investment funded partly via social bond proceeds. New hospital construction in underserved regions. The Fondo Nacional de Salud (FONASA) provides universal coverage framework — a key social bond eligible expenditure.

Market Design — Chile's Examples

Rules, mechanisms and auctions that make markets work for sustainability

★ Star Example: Renewable Energy Auctions (Licitaciones CNE)

Chile's National Energy Commission runs competitive auctions for long-term electricity supply contracts. By designing auctions to favor renewables (no fuel cost risk, fixed-price contracts), Chile drove solar prices from US\$130/MWh in 2013 to US\$21/MWh by 2021 — one of the lowest solar prices in the world. This MARKET DESIGN — not subsidies — triggered Chile's solar boom.



Carbon Market (RETC + future ETS)

Chile's Emissions Registry (RETC) tracks emissions from regulated facilities. The 2022 Climate Law mandates creating a national carbon market (ETS) by 2025. The current carbon tax will co-exist with — and eventually transition to — cap-and-trade.



Renewable Energy Certificates (CELs)

The Non-Conventional Renewable Energy Law (NCRE Law) requires electricity distributors to source a rising share from renewables. Compliance is tracked via 'certificates of injection' — de facto renewable energy certificates creating a compliance market.



Green Public Procurement

ChileCompra (state procurement agency) has incorporated sustainability criteria into government purchasing. Energy efficiency standards for government buildings, preference for recycled materials, electric vehicles in state fleets.



Environmental Taxonomy (T-MAS)

Chile's own green taxonomy, launched in 2024. Classifies economic activities as environmentally sustainable. Based on EU taxonomy logic but with Chile-specific criteria (including mining). Provides the classification framework for green bond eligible projects.

Sovereign Finance — Chile's Examples

The government as issuer, market signaler, and anchor for sustainable capital markets

2019

1st Green Bond
in the Americas

€861M + \$1B

2020

1st Social Bond
in Latin America

\$2.0B USD

2021

1st Sustainable
Bond in LatAm

€1.5B

2022

1st Sovereign SLB
Globally

\$2.0B USD

2023

6 more SLBs
4 currencies

~\$6B eq.

2025

Updated SLB
Biodiversity KPI

Framework



Greenium & Lower Borrowing Costs

ESG bonds have consistently priced with a 'greenium' — Chile's green bonds issued below secondary market pricing. The EUR social bond (Jul 2021) achieved 0.10% coupon — lowest ever for a LatAm sovereign. Over time, ESG label saves Chile meaningful basis points on a ~US\$31B portfolio.



Investor Base Diversification

Chile's inaugural green bond attracted 64 new ESG investor accounts — institutions that previously did not hold Chilean sovereign debt. By 2022, ESG bonds represented 28.3% of total central government debt — one of the highest ratios globally for an emerging market.



Market Signaling & Private Sector Catalysis

Chile's sovereign program directly catalyzed corporate issuances. In 2021, five Chilean corporations issued labeled bonds totalling US\$3.8B. Sovereign issuance 'certifies' the market, lowers information costs, and creates investor familiarity with Chilean ESG paper.



Policy Credibility via Financial Contracts

SLBs contractualize the NDC targets — if Chile misses its 2030 GHG goal, it pays a financial penalty to bondholders. This adds a market-based accountability layer on top of legal obligations, increasing the reputational and financial cost of policy reversal.

International Engagement — Chile's Examples

How Chile connects its domestic agenda to global frameworks, financing, and cooperation



Paris Agreement & NDC

Chile ratified the Paris Agreement in 2017 and submitted an updated NDC in 2020. Commits to 95 MtCO₂e by 2030 and carbon neutrality by 2050. Chile's NDC is considered among the more ambitious in Latin America and forms the backbone of its SLB KPIs.



COP25 Presidency (2019)

Chile was the designated COP25 host before civil unrest moved it to Madrid. Chile retained the COP25 presidency — an extraordinary act of diplomatic continuity. This global visibility accelerated Chile's green bond and SLB program as a demonstration of leadership.



Multilateral Finance

Chile works closely with IDB, World Bank, CAF, and IFC on green projects. The IDB co-developed Chile's Sustainable Bond Framework (2020). CAF and IADB provided technical assistance for the T-MAS taxonomy. MDBs provide concessional finance and technical capacity that sovereign bonds alone cannot.



Just Transition Partnership

Chile joined the 'Just Transition Partnership' with the UK, EU, and Germany — securing access to ~€1B+ in blended finance for coal-region transition. Covers retraining miners, developing green hydrogen projects, and transitioning energy communities in coal-dependent regions.



Green Hydrogen Strategy

Chile's National Green Hydrogen Strategy (2020) targets becoming a top-3 global exporter by 2040, exploiting Atacama solar and Patagonian wind. Backed by bilateral agreements with Germany, Australia, and the EU. Multilateral financing supports pilot projects in Magallanes.



ESG in Trade Agreements

Chile's FTAs increasingly include sustainability chapters. The Chile-EU Advanced Framework Agreement (2023) includes binding climate commitments and sanctions for environmental violations — the first such FTA in Latin America to include enforceable sustainability provisions.

Sustainable Bonds: The Foundation



GREEN BONDS

- Proceeds earmarked for specific green projects
- Strict allocation reporting required
- Projects: renewable energy, clean transport, green buildings, water
- Chile issued green bonds from 2019 onwards
- Investor knows exactly what is being funded
- Verification: annual allocation report + SPO



SOCIAL BONDS

- Proceeds fund social projects (education, housing, healthcare)
- Chile expanded framework in 2020–2021
- Example: affordable housing, employment programs
- Harder to measure 'impact' than green projects
- ICMA Social Bond Principles guide issuance

Sustainable bonds = green + social combined

Chile's Use-of-Proceeds Bonds

Green, Social & Sustainable bonds issued 2019–2022 · ~US\$31B outstanding by Jan 2022 · Representative issuances shown · **28.3% of total sovereign debt**

Type	Date	Currency	Size	Coupon	Maturity	Use of Proceeds	Review	Notable
 Green	Jun 2019	EUR	€861M	0.83%	2031	Metro lines, electromobility, solar panels, green buildings, water monitoring	Vigeo Eiris + CBI	1st sovereign green bond in the Americas; 64 new ESG investor accounts
 Green	Jan 2020	USD	\$1.0B	2.45%	2031	Clean transport, renewable energy, energy efficiency, land & marine protected areas	Vigeo Eiris	1st USD-denominated sovereign green bond in the Americas
 Green	Jul 2021	EUR	€1.0B	0.555%	2029	Clean transport, renewable energy, efficient water management, green buildings	Vigeo Eiris	Third green issuance; by 2022 total green portfolio = US\$7.7B
 Social	Sep 2020	USD	\$2.0B	2.55%	2031	Affordable housing, employment generation, access to healthcare, food security	Moody's ESG	1st social bond in Latin America; Covid-19 response included
 Social	Jul 2021	EUR	€1.0B	0.10%	2027	Essential services, affordable housing, SME financing, socioeconomic empowerment	Moody's ESG	Lowest coupon ever for a LatAm sovereign; 4.5x oversubscribed
 Sust.	Mar 2021	EUR	€1.5B	0.835%	2031	Renewable energy, clean transport (green) + housing, health, employment (social)	Vigeo Eiris	1st sustainable (blended green+social) bond in Latin America
 Sust.	Jan 2022	USD	\$2.0B	3.10%	2052	Green: energy transition, clean transport · Social: housing, healthcare, SME support	Vigeo Eiris	30-year tenor; issued just before first SLB (Mar 2022)

The Use-of-Proceeds Problem

 *Thought Experiment: A government issues a green bond and builds 10 solar plants. But it also builds 5 coal plants with regular bonds. Net impact = ???*

The Use-of-Proceeds Problem

 *Thought Experiment: A government issues a green bond and builds 10 solar plants. But it also builds 5 coal plants with regular bonds. Net impact = ???*

? Additionality Problem

Was this investment going to happen anyway? Did the bond cause new green activity, or just label existing plans?

? Impact Measurement

Allocation $\neq$ impact. A funded project may underperform, be abandoned, or displace dirty activity elsewhere.

? Portfolio Problem

Earmarked proceeds don't constrain the issuer's other spending. A 'green' sovereign can still be a heavy emitter overall.

? Scale Constraint

Only projects fitting the green/social taxonomy qualify. What about the whole economy's transition?

This leads us to a new innovation: outcome-based instruments →

Before the break...

Chile is a small, open, mining-dependent economy with outsized sustainability ambitions

🌿 Its sustainability challenges are structural — driven by copper, energy, water, inequality

🏛️ Chile has built a real policy architecture: climate law, carbon tax, NDC, T-MAS taxonomy

💚 Green & social bonds fund specific projects — transparent but limited by additionality concerns

🔗 The next logical step: bonds that reward OUTCOMES, not inputs...

15-Minute Break

SESSION 2

Sustainability-Linked Bonds: The Chile Case

From use-of-proceeds to outcome-based finance

Green Bond vs Sustainability-Linked Bond

GREEN BOND

"Fund green projects"

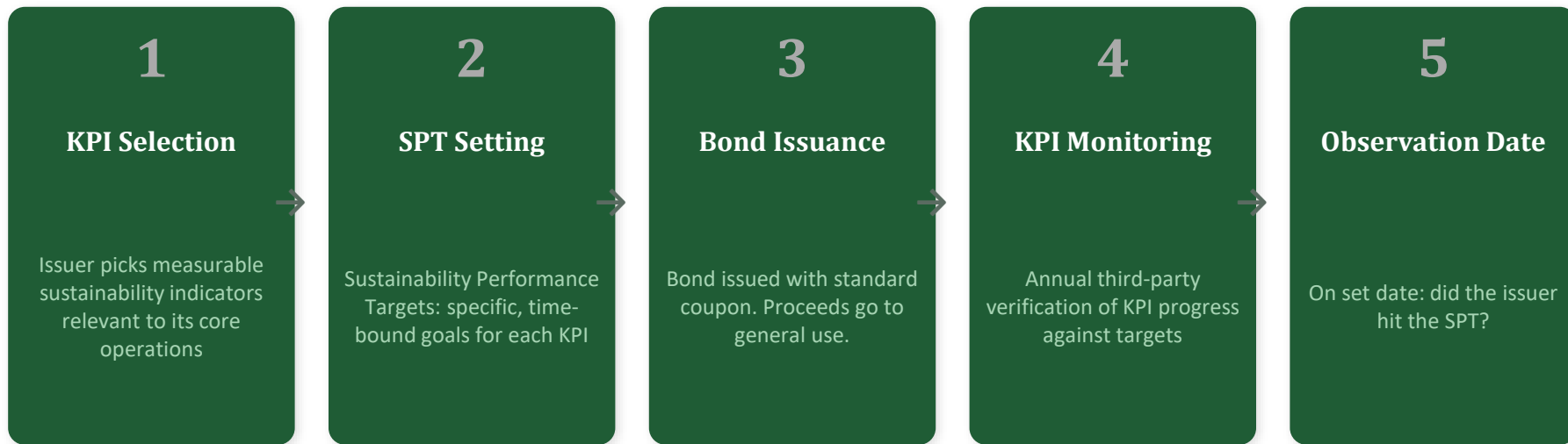
Proceeds:	Earmarked for eligible projects
Coupon:	Fixed — doesn't change
Accountability:	Were funds allocated correctly?
Impact:	Assumed from project type
Flexibility:	Low — money must go to green bucket
Question asked:	What did you BUILD?

SUSTAINABILITY-LINKED BOND

"Improve sustainability outcomes"

Proceeds:	General purpose — no restriction
Coupon:	Steps UP if KPI targets missed
Accountability:	Did outcomes actually improve?
Impact:	Measured directly via KPIs
Flexibility:	High — sovereign manages budget freely
Question asked:	Did you ACHIEVE results?

How SLBs Work: The Mechanics



✓ TARGET MET

Coupon stays at original rate.
Investors accept standard yield.

✗ TARGET MISSED

Coupon steps UP by agreed penalty.
Issuer pays more — a real financial consequence.

ICMA Sustainability-Linked Bond Principles

1

KPI Selection

Relevant, core to the issuer's business, measurable, externally verifiable, able to be benchmarked

2

SPT Calibration

Ambitious relative to baseline; consistent with science or regulation; no retroactive adjustment

3

Bond Characteristics

Financial consequences (step-up/step-down) triggered on observation date. Material and meaningful.

4

Reporting

At least annual reporting on KPI performance, SPT ambition, step-up mechanics, and verification

5

Verification

Independent external reviewer (SPO) confirms framework alignment and KPI performance annually

Chile's SLB framework is explicitly aligned with all five ICMA SLBP

Chile's Sovereign SLB Program

A world first — and a remarkable evolution



7

Sovereign SLBs
issued (2022–2023)

~\$8B

Total notional
(USD equivalent)

4

Currencies: USD,
EUR, CLP, UF

#1

First sovereign
SLB globally

The Seven Bonds — At a Glance

Bond	Date	Currency	Size	Coupon	Step-up (max)	KPIs
USD-2042	Mar 2022	USD	\$2.0B	4.34%	25 bps (12.5 each)	GHG + NCRE
USD-2036	Jun 2023	USD	\$1.15B	4.95%	50 bps (25 each)	GHG + Gender
USD-2054	Jun 2023	USD	\$1.10B	5.33%	10 bps (5 each)	GHG + Gender
EUR-2034	Jun 2023	EUR	€750M	4.13%	100 bps (50 each)	GHG + Gender
CLP-2037	Jul 2023	CLP	CLP 1.75T	5.30%	30 bps (15 each)	GHG + Gender
UF-2039	Oct 2023	UF	UF 24M	UF+3.40%	15 bps (7.5 each)	GHG + Gender
CLP-2034	Oct 2023	CLP	CLP 1.75T	5.80%	110 bps (55 each)	GHG + Gender

The Three KPIs

What Chile is actually being measured on

KPI 1

Greenhouse Gas Emissions

Baseline:

~109–112 MtCO₂e (2018)

Target:

≤95 MtCO₂e by 2030

Carbon budget ≤1,100 MtCO₂e (2020–2030)

Latest:

111.0 MtCO₂e (2022 — latest available)

Rated:

Sustainalytics: VERY STRONG

KPI 2

Non-Conventional Renewable Energy Share

Baseline:

27% in 2021

Target:

50% by 2028

60% by 2032

Latest:

40.4% in 2024 (up from 37.1% in 2023)

Rated:

Sustainalytics: STRONG

KPI 3

Women on Boards of CMF-Reporting Companies

Baseline:

14.0% in 2022

Target:

40% by 2031

Latest:

22.1% in 2024 (up from 15.9% in 2023)

Rated:

Sustainalytics: VERY STRONG

Discussion

Evaluating the KPIs

Q1 · Are these the RIGHT KPIs?

Are they material? Are they ambitious? Could they be gamed?

Q2 · How CONTROLLABLE are they?

GHG depends on macro shocks. Gender depends on private firms. NCRE depends on market + regulation.

Q3 · Is the PENALTY meaningful?

*From 10 bps to 110 bps — does it matter financially?
Reputationally?*

Q4 · What's the ADDITIONALITY?

Chile had climate targets before the bonds. Are SLBs changing behavior, or labeling existing plans?

Market Reception & the Greenium

Best Documented Case: BTU-2039 (October 2023 UF-linked SLB)

3.2x

Oversubscribed

58

Investor accounts

28%

Foreign allocation

10–12.5 bps

Estimated greenium

Issuer-reported data

The greenium estimate comes from the Ministry of Finance itself, not an independent event study. Treat with appropriate skepticism.

Sparse secondary-market data

Chile does not publish systematic post-issuance spread series. We cannot independently confirm ongoing greenium.

No step-ups triggered yet

All KPI observation dates are 2028–2031. No bond has yet reached its test. This is all ex ante pricing.

Inaugural USD-2042

Ministry described 'outstanding' results (4.346% yield, T+200 bps) but didn't publish full order-book detail.

Are Chile's SLBs Credible?

✓ STRENGTHS

- KPIs tied to core national policy variables (NDC, energy plan, CMF data)
- Sustainalytics rated KPI 1 & 3 as VERY STRONG; KPI 2 as STRONG
- Annual third-party verification by Sustainalytics
- Multi-agency data architecture (MoE, CMF, energy coordinator)
- Aligned with ICMA Sustainability-Linked Bond Principles
- Transparency: annual SLB reports, FAQ, framework updates

⚠ WEAKNESSES / TENSIONS

- KPI 1 is lagged 2+ years — market must price without current data
- KPI 3 relies on private firms Chile can only indirectly influence
- Step-ups vary: 10 bps (USD-2054) vs 110 bps (CLP-2034) — not equally credible
- Additionality questioned — targets existed before bonds
- Baseline revisions affect perceived 'ambition' (2022 vs 2023 SPO diverge)
- No ex post evidence yet — all KPI dates in 2028–2031

The Broader SLB Market

Global Growth (then Decline)

SLB market grew rapidly 2020–2022. Then credibility concerns hit — the FT reported sharp falls in issuance by 2024 as investors questioned weak KPIs and missed targets in corporate SLBs.

Sovereign Advantage

Sovereigns have better data, stronger policy levers, and more transparent reporting than most corporates. Chile's government infrastructure is unusually robust for an emerging market.

Latin America Frontier

Chile and Uruguay pioneered sovereign SLBs in LatAm. The region is especially relevant: high climate exposure, large renewable potential, emerging-market spread dynamics.

Policy vs. Market

Sovereigns using SLBs blur the line between debt management and environmental governance. Is the Ministry of Finance the right institution to drive climate outcomes?

Chile's lesson for Latin America: Sovereign SLBs work best when tied to state-capacity-rich metrics, with transparent reporting and credible institutions. They are credibility devices first, incentive mechanisms second.

What Chilean SLBs Teach Us About Sustainable Finance

1. Sovereign SLBs work best when KPIs connect to real policy levers — not peripheral metrics
2. Materiality $\neq$ controllability. A KPI can be important and hard to control. Both matter for credibility.
3. Penalty design matters. 10 bps $\neq$ 110 bps. A 'credible' SLB program can contain incredible individual tranches.
4. Signaling has real value, but it needs institutional follow-through, not just a bond prospectus

Main Take Away

Sustainable Finance is not about labels or products.

It's a system that connects real-economy challenges, government policy, capital-market instruments , and credible information.

T H A N K Y O U

From Santiago to St. Petersburg — Sustainable Finance Across Distances

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Sustainable Finance Needs Information Infrastructure

Great instruments without credible data are just good stories

*You are an investor. A company tells you it is sustainable.
What information would you need before believing it?*

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Emissions data (Scope 1, 2, 3)



Climate risks disclosed



Governance structure



Social indicators



Independent verification



Comparable metrics across peers



Which part of the business is actually green



Investment plans for transition

Without comparable information, sustainable finance becomes a market of stories. With standards and reporting, it becomes possible to compare, price, monitor, and challenge sustainability claims. This is why Chile built a three-layer architecture: NCG 461 → NCG 519 → T-MAS.

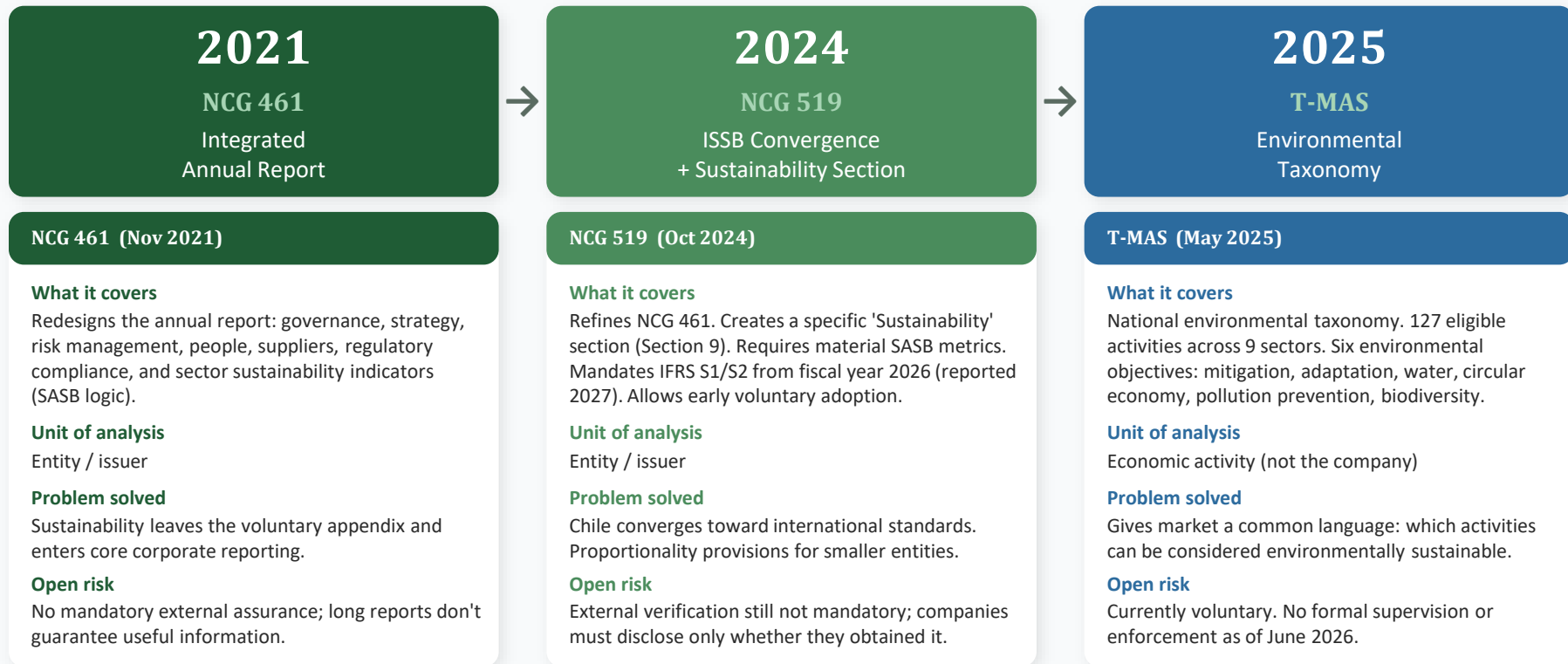


From our own research (NaturalInvest + Deloitte, 2025):

Only 15% of 75 major Chilean companies (IPSA + national indices) are fully prepared for mandatory IFRS S1/S2 disclosures, effective 2026.

Chile's Three-Layer Architecture

From annual report to sustainability disclosure to activity classification — 2021→2025



Key distinction: NCG 461/519 = what the company discloses · T-MAS = which activities can be classified as sustainable · Complementary but not yet formally integrated

T-MAS: What Counts as Sustainable?

From company disclosure to activity classification — Chile's environmental taxonomy

The shift in question

NCG 461/519 asks:

"What does the company report about its sustainability?"

T-MAS asks:

"Which of the company's activities can be classified as environmentally sustainable?"

NCG 461/519 = entity level · T-MAS = activity level · Complementary, not substitutes

T-MAS at a glance (May 2025)

- 127 eligible activities · 9 sectors
- 6 environmental objectives
- Currently voluntary
- Metrics: % Revenue, CAPEX, OPEX aligned

The six environmental objectives:



Mitigation

Reducing GHG emissions (primary focus)



Adaptation

Building resilience to climate change



Water & Marine

Sustainable use of water/marine resources



Circular Economy

Waste reduction, reuse, recycling



Pollution Control

Prevention and control of pollution



Biodiversity

Ecosystems and habitat protection



"Do No Significant Harm" (DNSH)

An activity cannot qualify under one objective while causing serious harm to another. Minimum social safeguards also required.

T-MAS includes mining — unusual for a sustainability taxonomy. Chile's argument: copper and lithium are essential for renewable energy and batteries. You can't decarbonize without them.

→ *Should mining be in a sustainable taxonomy?*

Should Sustainability Be Audited Like Financial Statements?

The core tension in sustainable finance infrastructure

YES

NO

MAYBE

Should Sustainability Be Audited Like Financial Statements?

The core tension in sustainable finance infrastructure

YES — Assurance should be mandatory

- Investors need the same reliability they get from audited financials
- Without assurance, sustainability claims are unverifiable — greenwashing becomes easy
- Chile's SLB KPIs depend on data quality; unverified data undermines the entire instrument
- Markets already require audited financials — why treat sustainability differently?

⚡ *Counter: methodologies are still evolving; one-size-fits-all assurance may be premature*

NO — Voluntary assurance is sufficient

- Sustainability measurement is still developing — mandating assurance may lock in flawed methods
- Cost burden on smaller firms could be prohibitive; may reduce adoption
- NCG 519 already requires disclosure of whether verification was done — transparency without mandate
- Voluntary market pressure may be more effective than regulation

⚡ *Counter: markets don't self-correct for greenwashing without external enforcement*

MAYBE — Tiered or phased approach

- Mandatory for large listed companies and banks; voluntary for smaller entities
- Phase in over time, as ISSB and assurance standards mature globally
- Prioritize high-impact sectors first: energy, mining, banking portfolios
- Chile's NCG 519 already uses this logic — phased, proportional implementation

⚡ *Counter: 'tiered' can become permanent carve-outs for the most harmful actors*

Synthesis → Sustainable finance requires a chain of credibility: companies disclose → taxonomies classify → verifiers check → investors decide. Instruments like green bonds and SLBs are only as good as the information infrastructure beneath them. Chile is building that infrastructure — but it's not finished.