McKinsey & Company

Climate Risk & Response in Chile

May 11, 2020

ACCION EMPRESAS
Por un Desarrollo Sostenible

Today's presenters

Hauke Engel
Partner, Frankfurt

Leads McKinsey's work on climate change globally and supports businesses across sectors with challenges related to strategy and sustainability

Mekala Krishnan
Senior Fellow, Boston

Leads the McKinsey Global Institute's research on climate risk, globalization, productivity growth, and gender economics

Sophie Underwood
Engagement Manager, London

Leading outreach and knowledge development globally in Climate Risk service line across sectors including banking, insurance, infrastructure, energy, agriculture and public sector

Clemens Müller-Falcke
Partner, Santiago

Leads McKinsey's work on sustainability in Latin America, developing the most economical pathway for Chile to reach carbon neutrality and helping companies to reduce carbon emissions

Agenda

	Topics	Presenters	Time
1	**Introduction to climate risk** – Relevance of climate action in COVID-19 time – What is at risk – Q&A	**Mekala, Hauke**	**9:00 – 9:35**
2	**Perspective on Chile-specific climate risk** – Hazard maps – Implications for Chile – Q&A	**Clemens**	**9:35 – 9:55**
3	**How organizations should manage climate risk** – Adaptation and mitigation – Industry deep dives – Q&A	**Sophie, Clemens**	**9:55 – 10:30**

COVID-19 lockdown has decreased CO_2 emissions

-5.5%

Estimated global emission reduction of 2020 vs. 2019

-25%

CO_2 emissions reduction in China during a four-week period commencing Feb 3, 2020

-58%

Daily CO_2 emissions dropped by 58% in 27 member states of the EU

Carbon emissions since the lockdowns

Daily CO_2 emissions as a % of normal for EU 27

Beyond this temporary impact, there are several factors that could accelerate structural change towards a net-zero economic system

Non-exhaustive

- Rapid increase in digital behaviour (work, socializa-tion, shopping)
- Shortening and localizing of supply chains
- Better pricing of risks – incl. climate risk
- Lower interest rates
- Raising public awareness of the impact of a climate crisis

Conversely, there is a set of factors that may hamper and delay climate action

Non-exhaustive

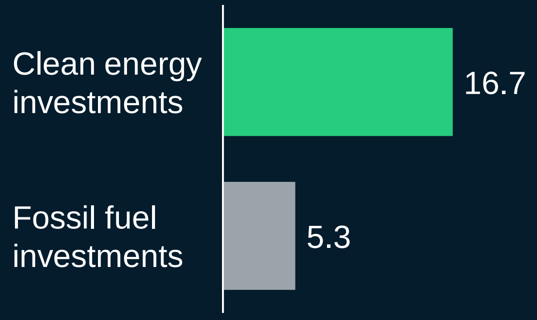
- Oil price collapse
- Prioritization of pressing short term economic needs
- Delay of capital allocation to lower-carbon solutions due to decreased wealth
- Lack of true global cooperation, national rivalries

“Green” levers can match, and even outperform, “grey” measures in terms of socio-economic impact

Green levers Grey levers

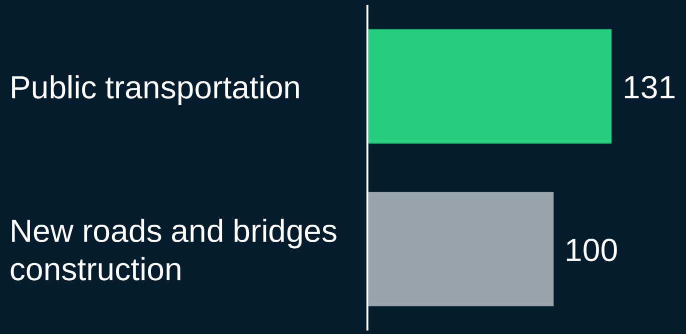
Energy and energy efficiency[1]

Total job creation, per $1 million in spending



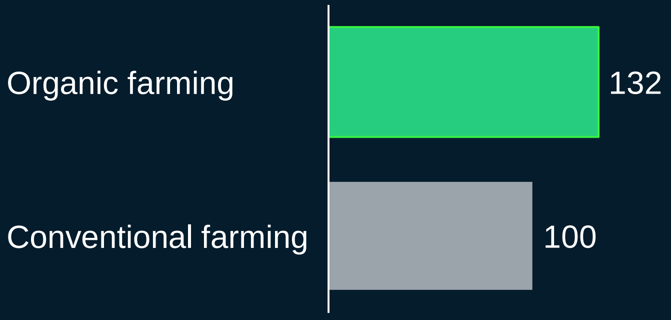
Construction[2]

Total job creation, per $1 million in spending, Index 100



Farming[3]

Job potential



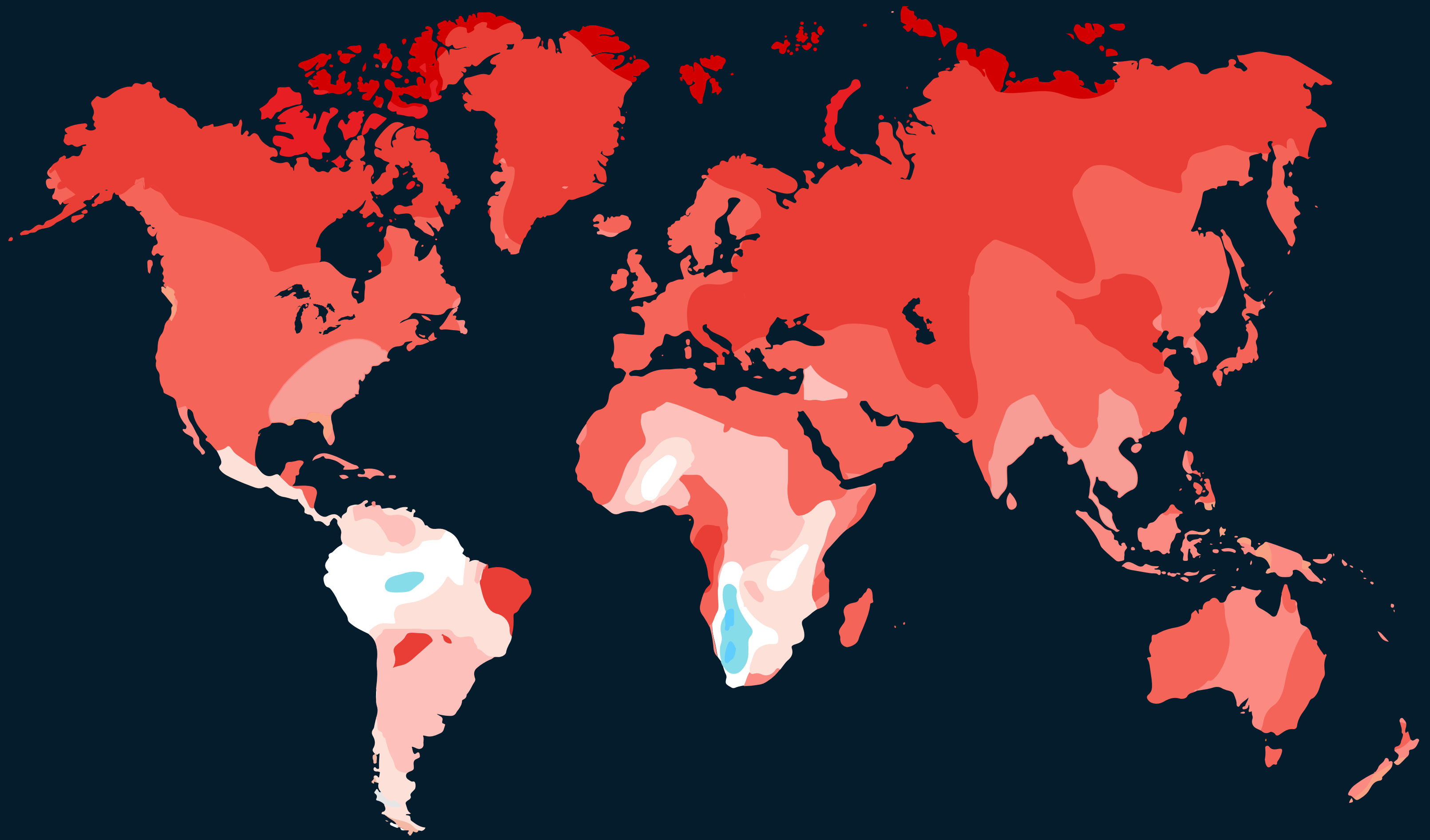
1. Robert Pollin, James Heintz, and Heidi Garrett-Peltier, The Economic Benefits of Investing in Clean Energy (2009)
2. Smart Growth America; Transportation Funding and Job Creation (2011)
3. OECD – Employment Implications of Green Growth: Linking jobs, growth and green policies - UK and Ireland

The Earth has warmed – and location matters

Increase in average annual temperature between 2010–2018 and 1880–1900

Degree Celsius

- -1.0 – -0.5
- -0.5 – -0.2
- -0.2 – 0.2
- 0.2 – 0.5
- 0.5 – 1.0
- 1.0 – 2.0
- 2.0 – 4.0
- 4.0 – 4.8

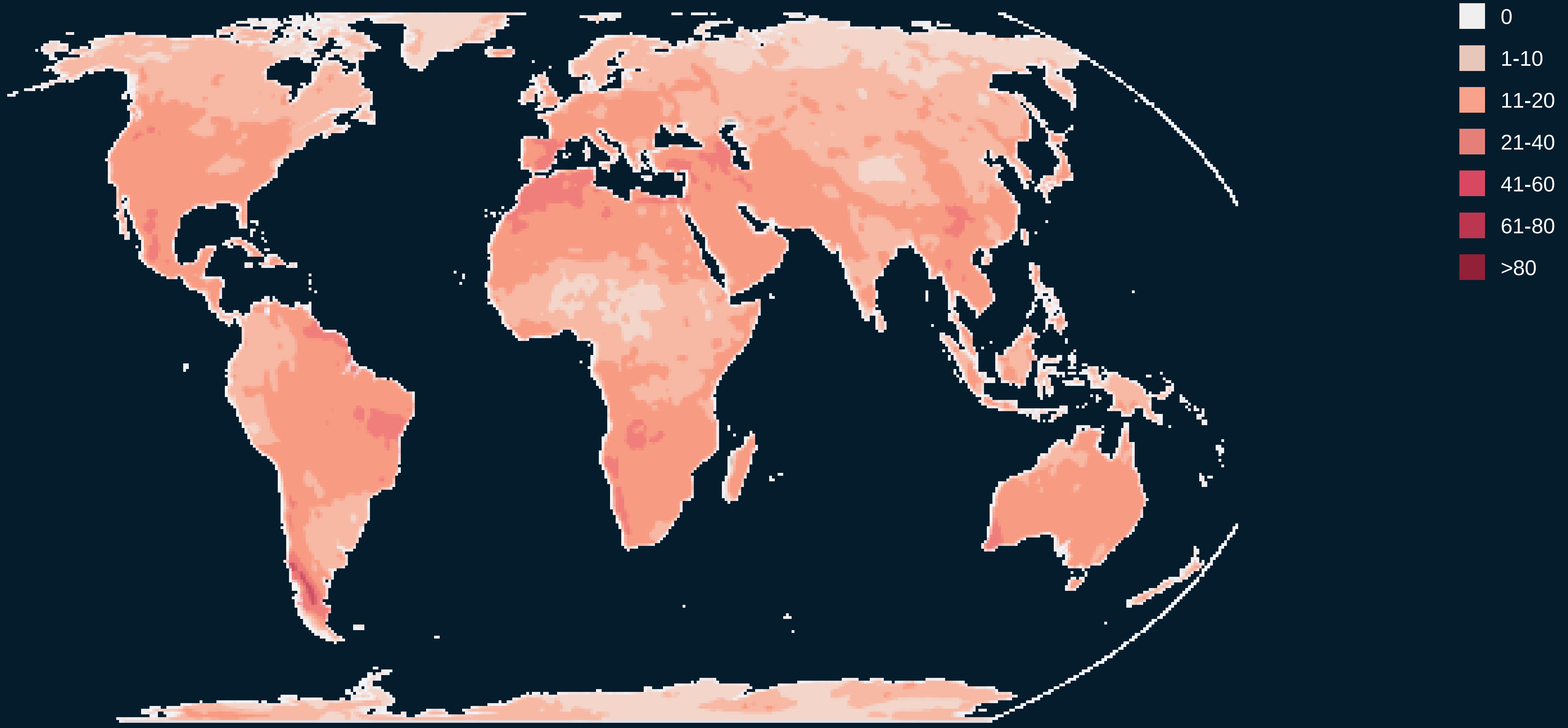


Source: US NASA Goddard Institute for Space Studies (GISS) GISTEMP Reanalysis dataset. (2019)

Example: drought frequency is projected to increase

Percentage of decade in drought[1]

Current[2]



1.Measured using a 3-month rolling average. Drought is defined as a rolling 3-month period with Average Palmer Drought Severity Index (PDSI) <-2. PDSI is a temperature- and precipitation-based drought index calculated based on deviation from historical mean. Values range from +4 (extremely wet) to -4 (extremely dry).
2.Current is defined as average conditions between 1998 and 2017

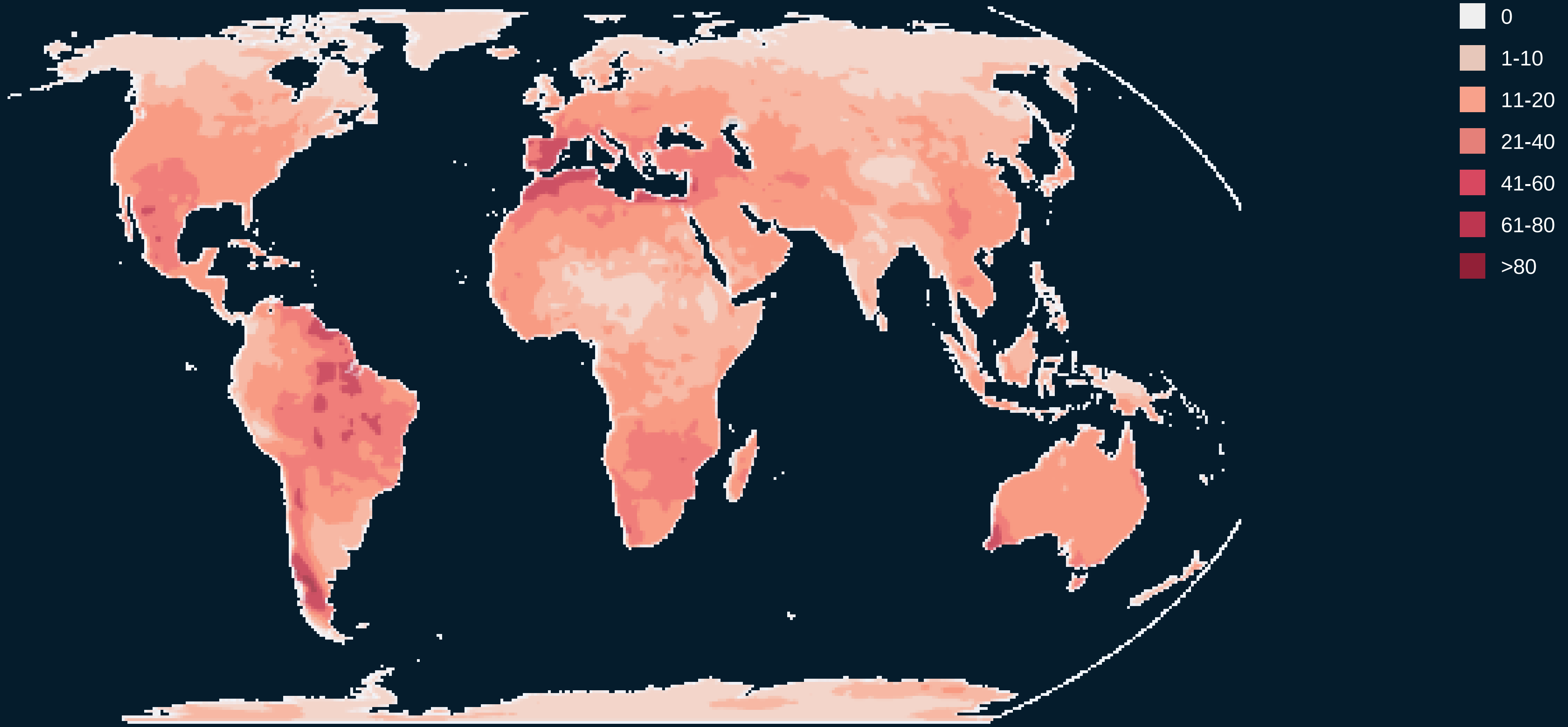
Source: Woods Hole Research Center

Example: drought frequency is projected to increase

Percentage of decade in drought[1]

Based on RCP 8.5

2030[2]



1. Measured using a 3-month rolling average. Drought is defined as a rolling 3-month period with Average Palmer Drought Severity Index (PDSI) <-2. PDSI is a temperature- and precipitation-based drought index calculated based on deviation from historical mean. Values range from +4 (extremely wet) to -4 (extremely dry).
2. Defined as average conditions between 2021 and 2040

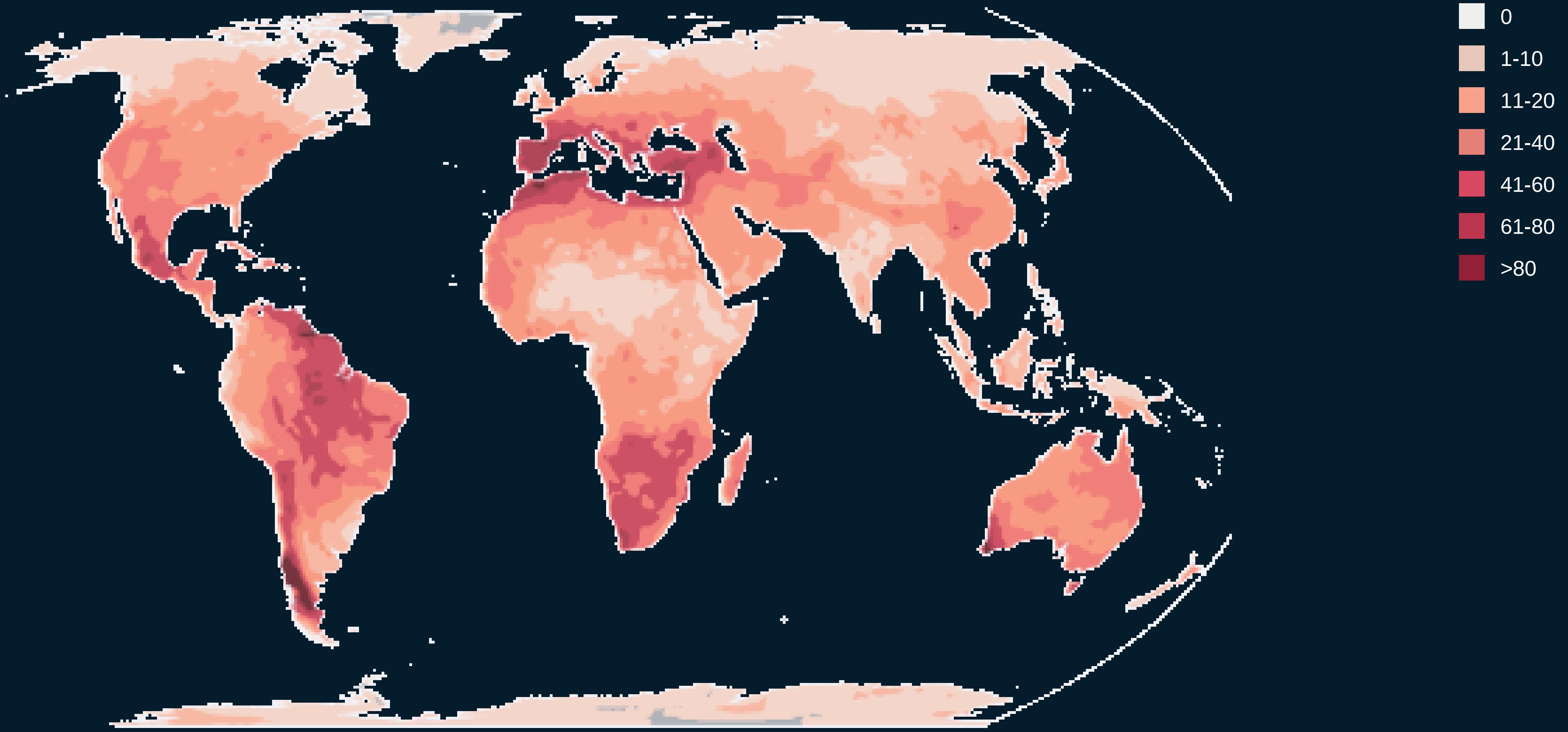
Source: Woods Hole Research Center

Example: drought frequency is projected to increase

Percentage of decade in drought[1]

Based on RCP 8.5

2050[2]



1. Measured using a 3-month rolling average. Drought is defined as a rolling 3-month period with Average Palmer Drought Severity Index (PDSI) <-2. PDSI is a temperature- and precipitation-based drought index calculated based on deviation from historical mean. Values range from +4 (extremely wet) to -4 (extremely dry).
2. Defined as average conditions between 2041 and 2060

Source: Woods Hole Research Center

Climate risk can take different forms

Focus of the research

Physical risk drivers

Acute

Risks from **higher frequency and severity of extreme weather events**. Includes:

- Floods
- Droughts
- Heatwaves
- Coldwaves
- Wildfires
- Hurricanes

Chronic

Risks from the **sustained shift of climate and ecosystems** over time. Includes:

- Temperature
- Precipitation
- Sea-level rise

Transition risk drivers

Risks as regulators, legislators, consumers and companies take action to manage climate change. Includes:

- Policy/regulatory
- Legal
- Technological
- Societal

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Las aglomeraciones urbanas más importantes de Chile podrían ver aumentos de temperatura de hasta 3°C en 2050

Basado en RCP 8.5

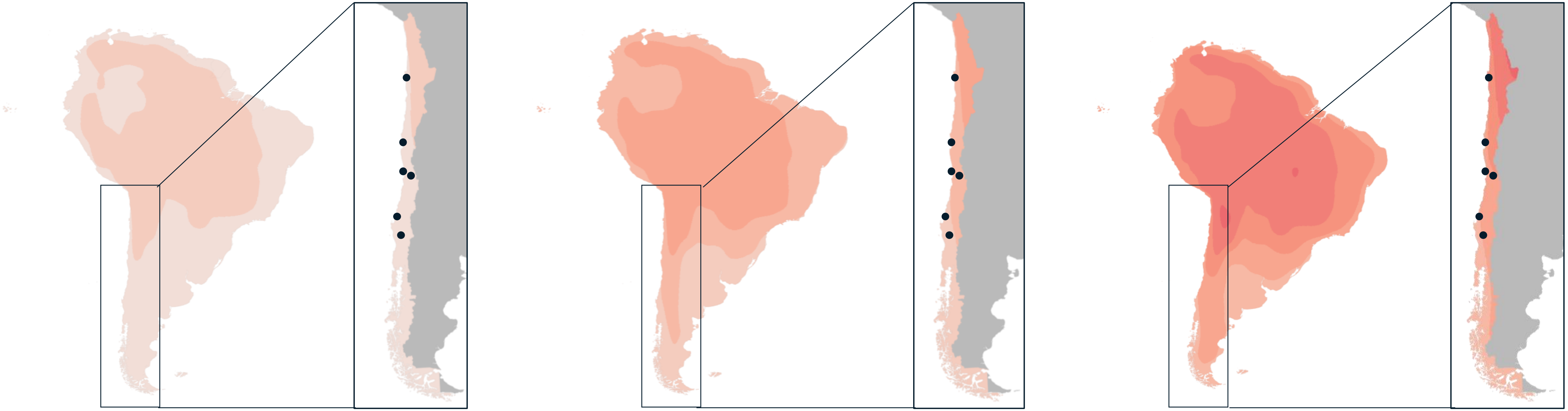
● Principales aglomeraciones urbanas (> 300.000 habitantes)[1]

0–0.5 | 0.6–1.0 | 1.1–1.5 | 1.6–2.0 | 2.1–2.5 | 2.6–3.0 | 3.1–3.5 | 3.6–4.0 | 4.1–4.5 | 4.6–5.0 | 5.1–5.5 | 5.6–6.0 | 6.1–6.5 | 6.6–7.0 | >7.0

Hoy | **2030** | **2050**

Aumento de la temperatura media anual

Cambio en comparación con el clima preindustrial °C



1. Gran Santiago, Gran Valparaíso, Gran Concepción, La Serena-Coquimbo, Antofagasta, Gran Temuco (censo 2017, INE)

Fuente: Woods Hole Research Center; Análisis del McKinsey Global Institute

Se proyecta una disminución de hasta 70% del suministro de agua en 2050 en las 3 principales áreas urbanas – Santiago, Valparaíso y Concepción

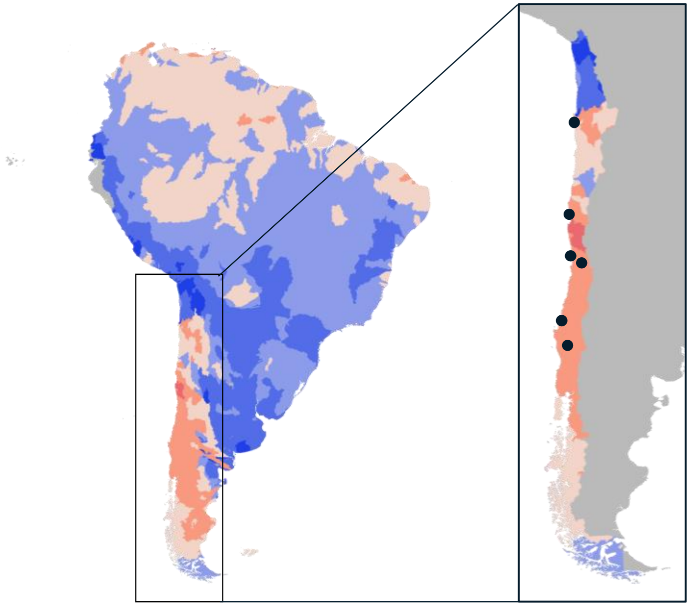
Basado en RCP 8.5

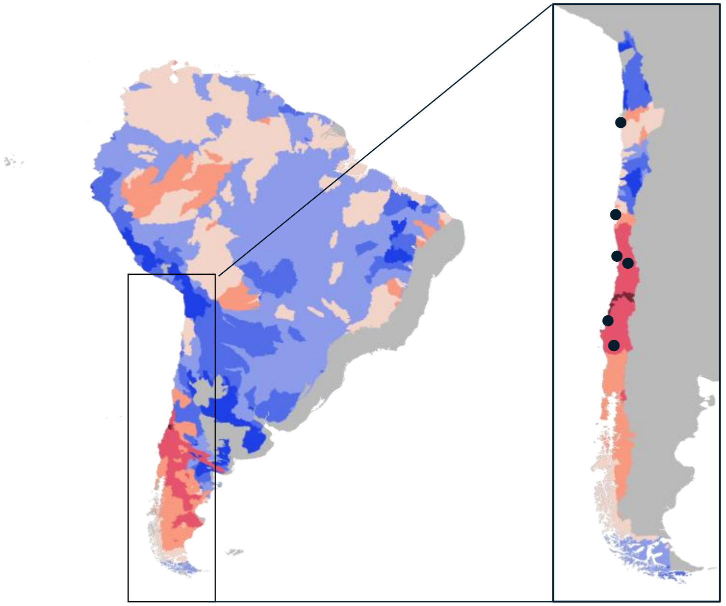
- ● Principales aglomeraciones urbanas (> 300.000 habitantes)[1]
- Disminución >70%
- Disminución 41–70%
- Disminución 20–40%
- Sin mayores variaciones
- Aumento 20–40%
- Aumento 41–70%
- Aumento >70%

Hoy	2030	2050

Suministro de agua

Cambio en las aguas superficiales en comparación con 2018 (%). Los límites en el mapa representan las cuencas hidrográficas





1. Gran Santiago, Gran Valparaíso, Gran Concepción, La Serena-Coquimbo, Antofagasta, Gran Temuco (censo 2017, INE)

Fuente: World Resources Institute Water Risk Atlas (2018); Análisis del McKinsey Global Institute

Los eventos extremos de precipitaciones podrían ser más frecuentes, en particular en el sur de Chile y, en menor medida, en el norte

Basado en RCP 8.5

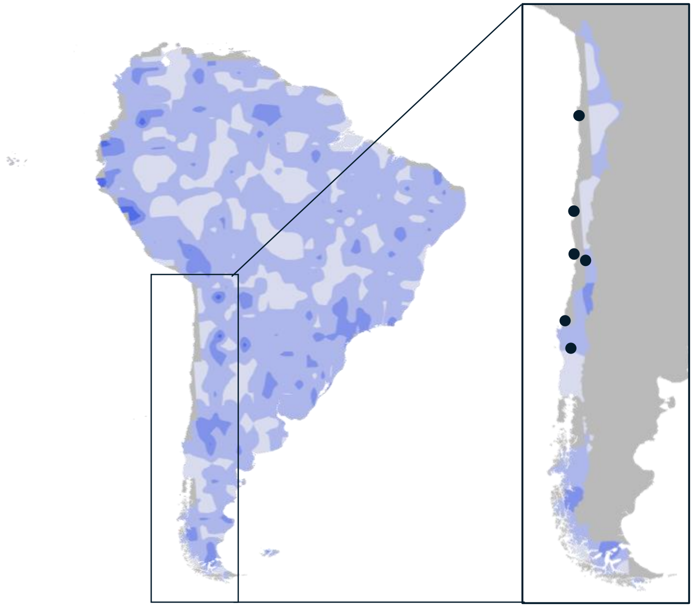
● Principales aglomeraciones urbanas (> 300.000 habitantes)[1]

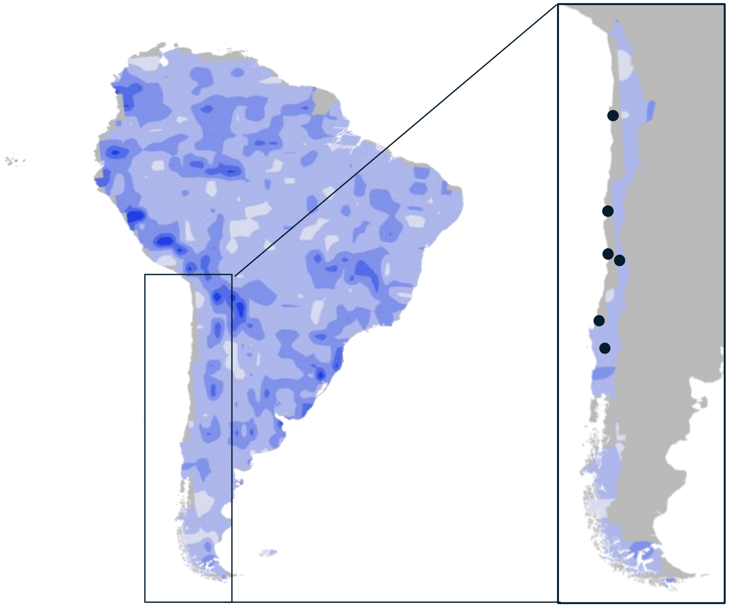
≤1x | 1–2x | 2–3x | 3–4x | >4x

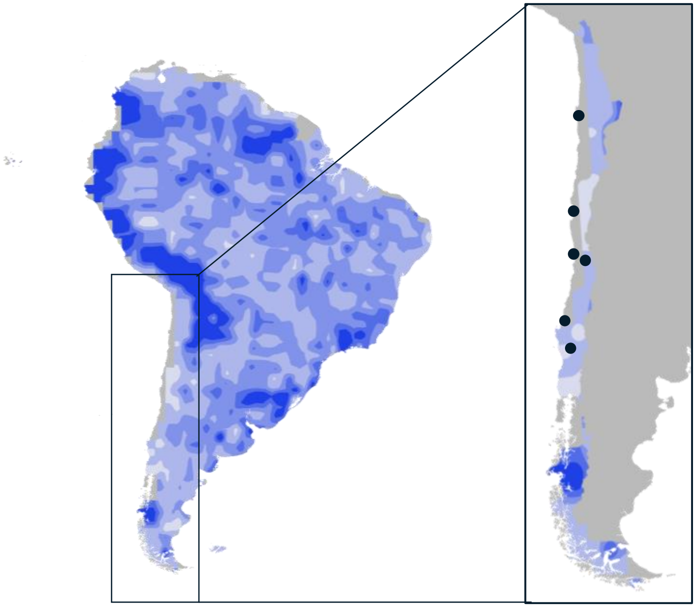
Hoy	2030	2050

Precipitaciones extremas

Cambio de probabilidad en comparación con el período 1950–81







1. Gran Santiago, Gran Valparaíso, Gran Concepción, La Serena-Coquimbo, Antofagasta, Gran Temuco (censo 2017, INE)

Fuente: IHS Markit Economics and Country Risk; Woods Hole Research Center; Análisis del McKinsey Global Institute

Como resultado de todo esto, la sequía podría representar más del 90% de la década en zonas como Concepción y Temuco

Basado en RCP 8.5

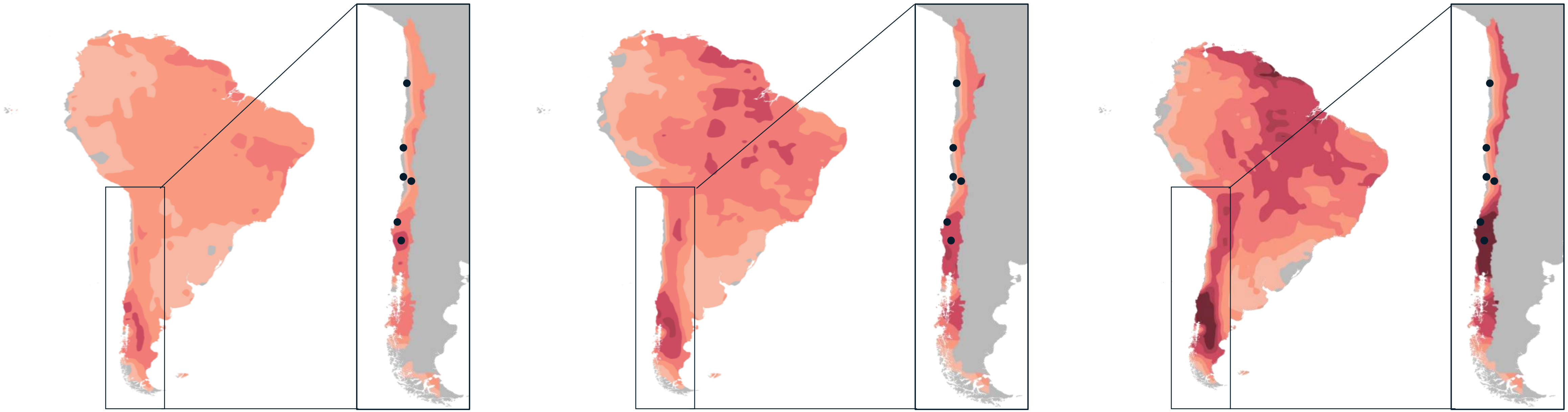
● Principales aglomeraciones urbanas (> 300.000 habitantes)[1]

0–10 | 11–20 | 21–40 | 41–60 | 61–80 | 81–90 | >90

Hoy	2030	2050

Frecuencia de sequía[2]

% de la década en sequía



1. Gran Santiago, Gran Valparaíso, Gran Concepción, La Serena-Coquimbo, Antofagasta, Gran Temuco (censo 2017, INE)
2. Medido con promedio móvil de tres meses. La sequía se define como un período de tres meses con el Average Palmer Drought Severity Index (PDSI) <-2. PDSI es un índice de sequía basado en la temperatura y las precipitaciones calculado en base a la desviación de la media histórica. Los valores generalmente oscilan entre +4 (extremadamente húmedo) y -4 (extremadamente seco)

Fuente: Woods Hole Research Center; Análisis del McKinsey Global Institute

Se esperan cambios en el bioma de Chile y del resto del continente

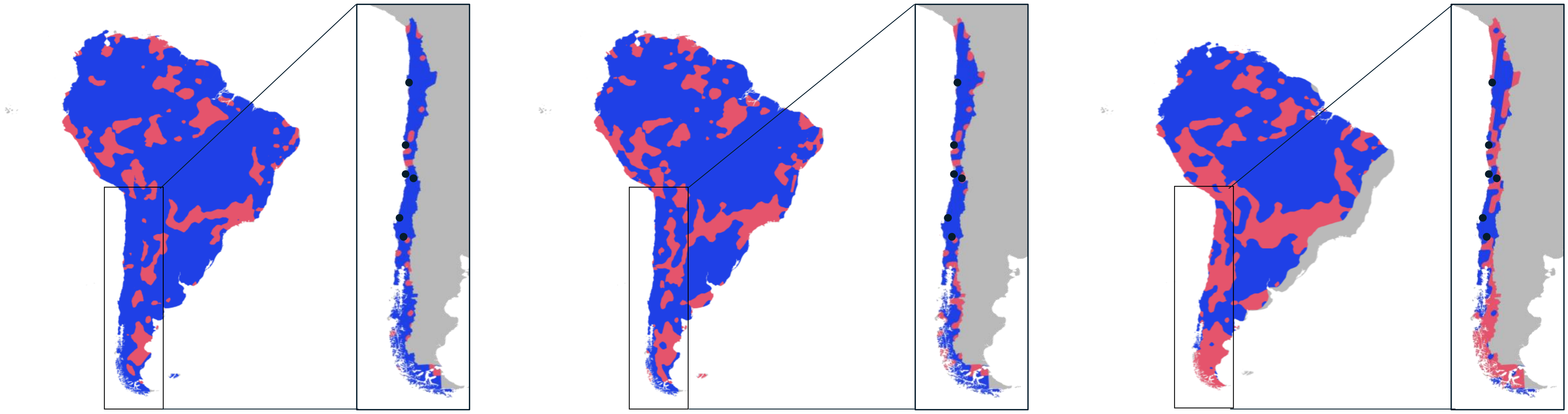
Basado en RCP 8.5

● Principales aglomeraciones urbanas (> 300.000 habitantes)[3]   Sin cambio   Con cambio

Hoy	2030	2050

Cambios en el bioma[1] (clasificación climática de Köppen[2])

En comparación con el período 1901-1925



1. "Bioma" se refiere a la comunidad de flora y fauna que habita una región en particular con características climáticas propias
2. Por ejemplo, las selvas tropicales existen en una envoltura climática particular que se define por las características de temperatura y precipitación. En muchas partes del mundo, esta envoltura podría comenzar a ser desplazada por un régimen climático mucho más seco "sábana tropical" que amenaza las selvas tropicales
3. Gran Santiago, Gran Valparaíso, Gran Concepción, La Serena-Coquimbo, Antofagasta, Gran Temuco (censo 2017, INE)

Existen varios riesgos e implicancias específicos de Chile que las organizaciones deben tener en cuenta

Preliminar **No exhaustivo**

- Escasez de agua
- Eventos climáticos extremos
- Cambio en los patrones climáticos
- Reducción de las poblaciones de peces
- Desplazamiento de zonas adecuadas para cultivos y árboles específicos
- Vulnerabilidad de la costa

80% de las exportaciones chilenas están expuestas al riesgo climático (minería, pesca, agricultura, forestal, viticultura)

80% de la actividad minera se encuentra en zonas en estrés hídrico

El estrés hídrico podría aumentar en un **40%** en las zonas mineras de aquí a 2030

US$15-20 mil millones de CAPEX podrían ser requeridos de aquí a 2030 si todo el agua dulce actualmente utilizada por la industria minera fuera reemplazada por agua de mar desalinizada

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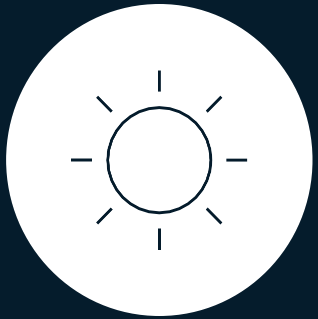
Cambio de paradigma para gestionar el riesgo climático

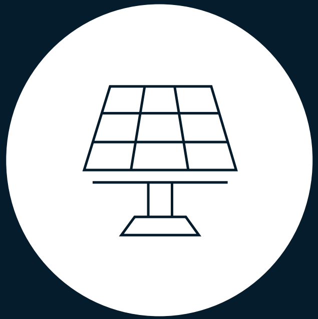


1

Incorporar el riesgo climático en toda la toma de decisiones

2

Adaptarse al riesgo climático existente



3

Descarbonizar para reducir el riesgo futuro

1. Integrar el riesgo climático en todas las decisiones

Procesos

- Identificación y medición
- Gestión y seguimiento

Organización

- Roles y responsabilidades
- Habilidades y capacidades

Gobernanza

- Políticas
- Supervisión

Habilitadores

- Tecnología y datos
- Cultura

Fuente: McKinsey Global Institute, 'Climate risk and response: Physical hazards and socioeconomic impacts’, Enero 2020

2. La adaptación requiere cambios físicos, financieros y de comportamiento

Ejemplos de medidas de adaptación

Adaptación física

- Protección de los activos físicos (por ejemplo, elevación de edificios, construcción de diques de contención)
- Nueva infraestructura necesaria para resistir riesgos climáticos más extremos

Adaptación financiera

- Repensar el sistema de seguros (por ejemplo, para reflejar adecuadamente el riesgo garantizando al mismo tiempo la asequibilidad)
- Movilización de capitales para financiar medidas de adaptación (por ejemplo, asociaciones público-privadas)

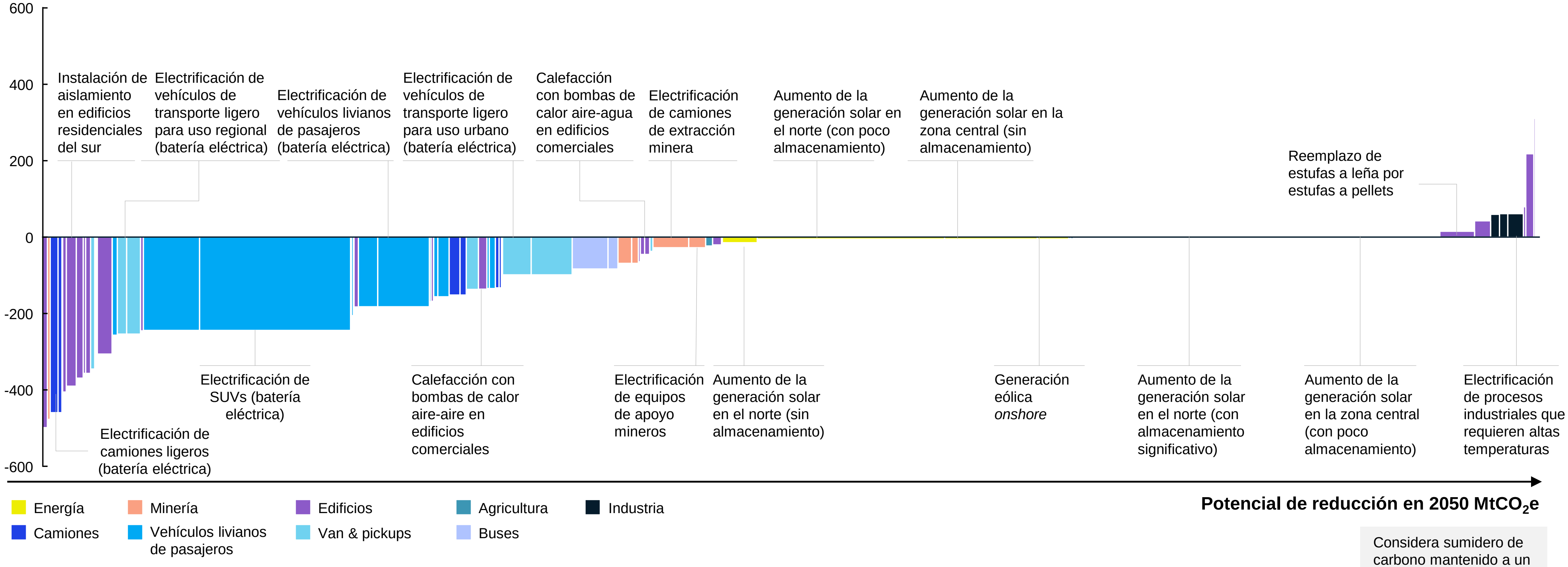
Adaptación conductual

- Medidas de adaptación preventivas (por ejemplo, ajustar las horas para los trabajadores al aire libre expuestos al calor) así como reactivas (por ejemplo, establecer unidades de respuesta a emergencias durante las olas de calor)
- A más largo plazo, reubicación de comunidades de zonas difíciles de proteger

Fuente: McKinsey Global Institute, 'Climate risk and response: Physical hazards and socioeconomic impact', enero de 2020

3. Mitigación: Chile puede lograr cero emisiones netas al 2050 gracias a la implementación de tecnologías existentes y probadas

Costo promedio de reducción de carbono en 2050[1], USD/tCO2



Considera sumidero de carbono mantenido a un promedio de 60MtCO_2

Nota: El eje horizontal muestra el potencial de reducción a través de cambios tecnológicos. El eje vertical muestra el costo promedio de la reducción de tCO_2 en USD/tCO_2 para cada cambio tecnológico

1. Las medidas consideradas excluyen el uso de UTCUTS ("Land Use, Land Use Changes and Forestry"). El costo de la infraestructura habilitadora se considera solo para CAPEX

Fuente: McKinsey; Decarbonization Pathway Optimizer

3. Mitigación: Chile tiene la oportunidad de liderar el esfuerzo de descarbonización, lo que podría generar beneficios para todos los chilenos

La descarbonización puede traducirse en un ahorro de dinero

Chile puede ahorrar dinero invirtiendo en tecnologías de descarbonización – un *game changer*. Esto es un *insight* muy importante e inesperado, y hace que Chile sea único

La oportunidad es inmensa

Chile está bien posicionado para convertirse en un líder mundial en descarbonización, lo que representa una gran oportunidad para sus industrias exportadoras

Todos los chilenos pueden beneficiarse

La descarbonización puede generar nuevos y grandes beneficios económicos, sociales y de salud adicionales para todos los chilenos

Concretamente, ¿qué significa esto para su organización?

Pasos que las empresas pueden tomar frente al cambio climático

Dimensionar la exposición al riesgo climático y comparar con tolerancia

Asegurar que su organización entienda los riesgos físicos y de transición críticos para su negocio

Identificar nuevas oportunidades relacionadas con el clima y la sostenibilidad

Explorar las necesidades de mitigación y adaptación relacionadas con sus principales capacidades

Decidir qué riesgos y oportunidades deben abordarse como prioridad

Considerar riesgos del cambio climático de manera sistemática en los procesos de toma de decisiones

Construir la gobernanza y las capacidades de la gestión del cambio climático

Priorice la creación de capacidades y procesos de gobernanza específicos basado en su perfil de riesgo y sus objetivos

Industry deep dives

Banking

Electric Power & Natural Gas

Mining

Agriculture

There is pressure from several directions for banks to actively engage on climate change and related financial risks

Policy makers and regulators

Increasing action from governments and regulators requiring banks to explicitly embed climate-related financial risks into risk management framework

We will continue to raise the bar to address these climate-related risks and "green" the financial system.

Mark Carney,
Former Governor Bank of England

Investors

Investors and asset managers assessing climate risks and channeling funds from "brown" to "green" companies

In the near future there will be a significant reallocation of capital. Climate Risk Is Investment Risk.

Larry Fink, CEO Blackrock

General public and clients

Public opinion is increasingly influenced by climate change, for example leading to activist investors

68% of people see climate change as a major threat.

McKinsey Global Sentiment Survey 2019

Some banks are beginning to state bold ambitions

BARCLAYS

“” **Our ambition to be net zero by 2050 […] Nearer term targets** of reductions in the carbon intensity of power and energy portfolios of 30% and 15% respectively by 2025

LLOYDS BANK

“” **We support the aims of the 2015 Paris Agreement** [..] help **reduce the carbon emissions we finance by more than 50% by 2030.** [..] Our commitment **supports** the **UK Net Zero Goal**

RBS

“” We are setting ourselves the challenge to **at least halve the climate impact of our financing activity by 2030**, and **intend to do what is necessary to achieve alignment with the 2015 Paris Agreement.**

Standard Chartered

“” **Pursuing efforts to limit temperature increase to 1.5°C,** supporting climate adaptation, and directing finance flows toward a low carbon transition

Example: Holistic integration of climate change across the organization

ING

Risk management	Measured the climate impact of its EUR 600 billion loan book and decided to stop lending to coal companies
Strategic opportunities	Set up sustainable investments, green bonds, sustainable loans, and EUR 100 million for scale-ups
Governance	Established global head of sustainability, reporting directly to board member
Broader role in the ecosystem	Set ambition to bring company in line with Paris Agreement's 2°C goal

Industry deep dives

Banking

Electric Power & Natural Gas

Mining

Agriculture

The stakes for electric power and natural gas utilities are especially high

Utilities are susceptible to physical climate change

Long-lived, heavy asset base – susceptible to physical risks

Geographically fixed – cannot adapt by shifting regions

Critical infrastructure – extremely low tolerance for outages

Dangerous product – gas and electric service require high bar for safety

Heavily regulated – subject to state and federal mandates

Australia example


NSW Bushfires, 2019


Black Saturday bush fires, 2009

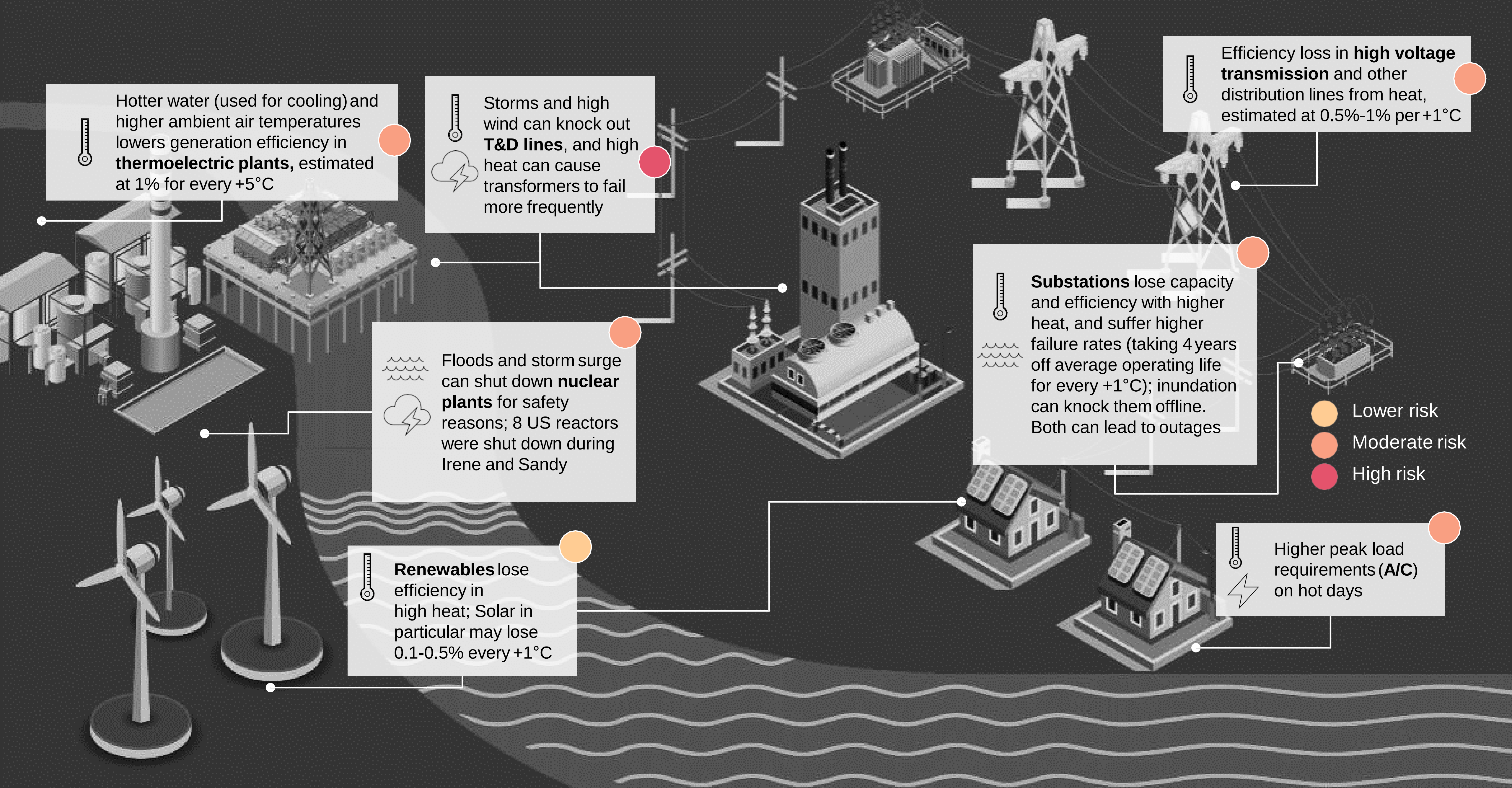

Tasmania 6-month outage, 2015/16


South Australian black out, 2016


North Sydney thunderstorms, 2019


Brisbane Floods, 2011

A value chain view is needed to capture all physical hazards



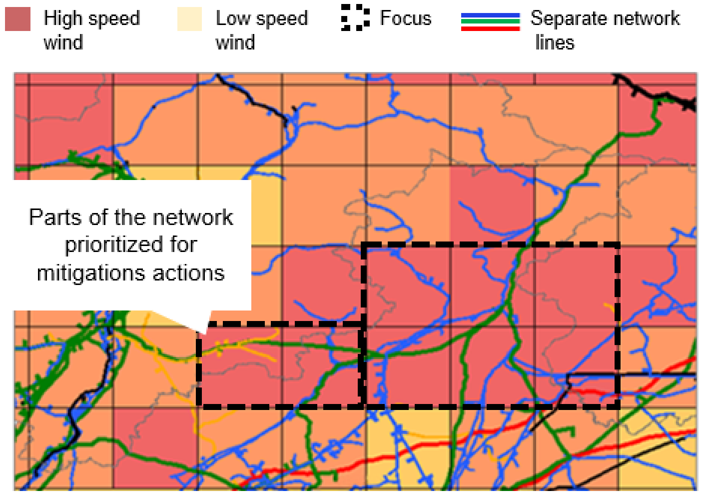
Example: European transmission system operator used resilience methodology to assess the risk of extreme climate events…

Risks

1

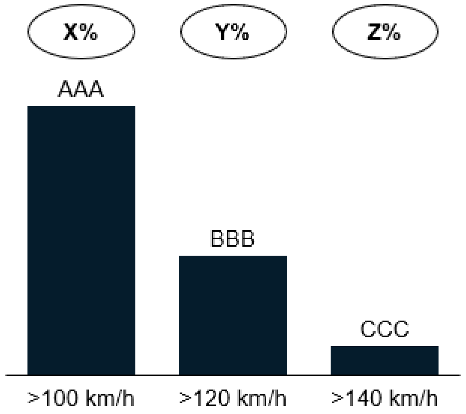
Identify risks of **future extreme climate** events

Overlapping of climate probability map and network map help identify portions most "at risk"



Identification of lines exposed to the highest wind risk

Lines with >5% probability of wind exposure above speed thresholds, 2020

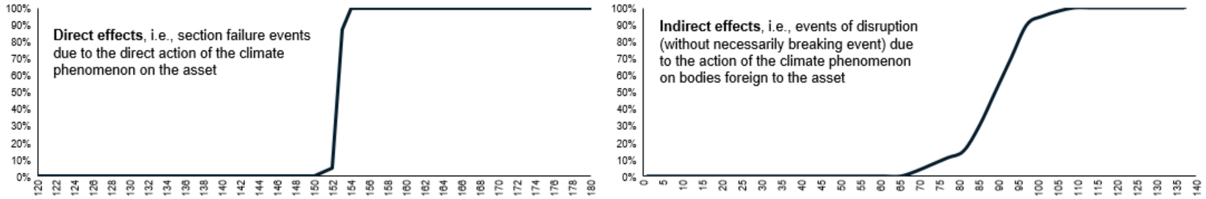


2

Assess probability of **failure of the asset** at extreme climate events

Illustration of vulnerability curves (wind case)

Cumulative probability of failure of the asset from direct and indirect stresses based on wind speed



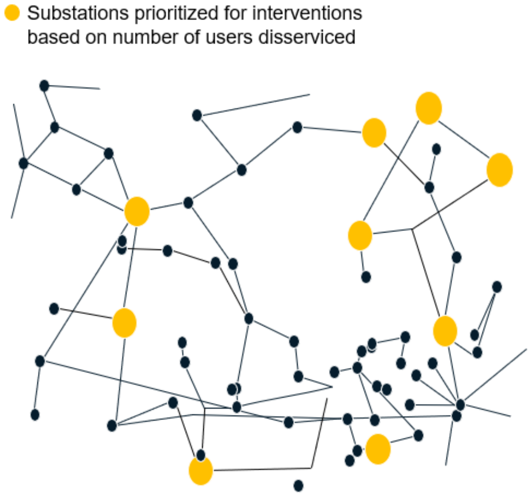
Example: … and prioritize interventions

Adaptation

3

Quantify the impact of interventions based on the **Level of Service**

Prioritization of portions of network for mitigation interventions is based on the **number of users disserviced**



4

Prioritize interventions based on cost-benefit analysis

● Low applicability ○ High applicability

Interventions	Description	Wind – Direct	Wind – Indirect	Snow/ice – Direct	Snow/ice – Indirect	Implementation time	Cost-benefit analysis
Overhead power line refurbishment/renewal	Total/partial replacement/reinforcement of the power line or individual sections	◐	◐	◐	◐	3-5 years	
	Raising the supports	●	◔	●	◔	3-5 years	
	Phase removal, i.e., modification of phase geometry	◔	◕	◔	◕	3-5 years	
Underground cable	Cables realization	○	○	○	○	3-5 years (renewal) >5 years (development)	
Increased grid	Increased redundancy through new airlines	◐	◐	◐	◐	> 5 years	
	Increased redundancy through technological diversification (i.e., cables + lines)	○	○	○	○	> 5 years	
Installation of anti-rotational devices	Application of anti-rotational devices on the conductor increasing its torsional stiffness	◐	●	○	○	<3 years	
Installation of interphase devices	Application of spacers between conductors to reduce the phenomenon of "Galloping" and two-phase shots	◕	◕	○	◕	<3 years	
Use of "icephobic" coatings	Coating of aerial cables with hydrophobic and ice-phobic materials/paints	●	●	◐	◐	3-5 years	
Use of anti-icing/de-icing currents or ballast loads	Heating of conductors by means of ballast loads (reactive) or re-dispatching current flows	●	●	○	●	<3 years	
Vegetation management	Introduction of dedicated cutting campaigns in areas with mid-ribbed lines and/or tall trees	●	○	●	○	<3 years	

Industry deep dives

Banking

Electric Power & Natural Gas

Mining

Agriculture

Climate change exposes the mining sector to a range of risks and opportunities

Detailed next

Example impacts

- **Operations stop** due to **water supply**
- **Loss of production** from storms and flooding
- **Health hazards and community protests**
- **Reduced demand** for emission-heavy products
- **Growth for minerals** powering electrification trend
- Increasing **challenge to secure insurance and investment** as banks "green up" portfolio
- **Increased regulatory pressure to decarbonize**
- **Increased liability for third party claims** for climate-related damages

Most of Chilean copper mines are located in high water stressed areas and are subject to further water stress in the next 10 years

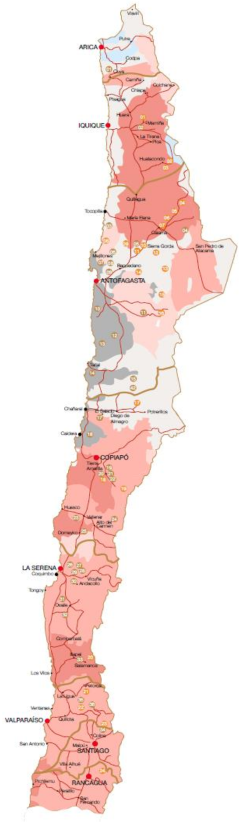
Mines vs. water stressed regions

Water stress[1], 2018

84%

of annual copper production located in arid regions or extremely high water stressed areas

Water stress[1], forecast 2030



75%

of annual copper production is forecasted to increase their current water stress levels by 1.4 times or more

1. Water stress defined as ratio of water use to supply

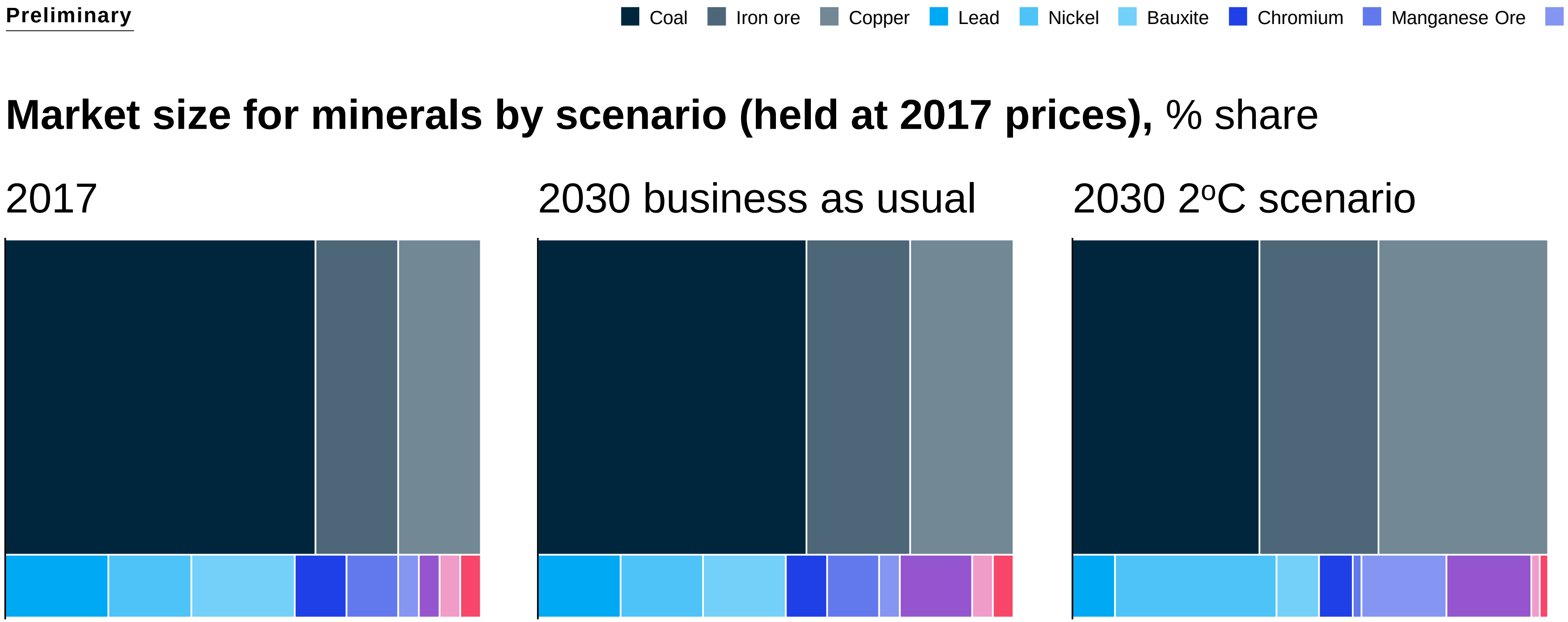
Source: World Resource Institute – Aqueduct Water Risk Atlas

Shifting commodity demands driven by global decarbonisation efforts could create select opportunities for miners

Mineral trends in a 2°C decarbonization pathway

Preliminary

Market size for minerals by scenario (held at 2017 prices), % share



Demand for some traditional "big" commodities will decrease:

- **Thermal coal**, with the increasing use of renewable power
- **Iron ore**, with increased recycling
- **Metallurgical coal**, with greater demand for lower carbon metals driving the use of alternative reductants

Demand for a few alternative commodities will rise:

- **Lithium, nickel,** and **cobalt** for use in batteries, particularly of EVs
- **Platinum** and **palladium** for use in hydrogen fuel cells and carbon capture

Miners are

- Reassessing existing assets
- Investing in high-growth commodities
- Moving into adjacencies like renewable energy

Source: McKinsey Sustainability Practice

Industry deep dives

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Climate risks are already materializing for firms across the agriculture value chain

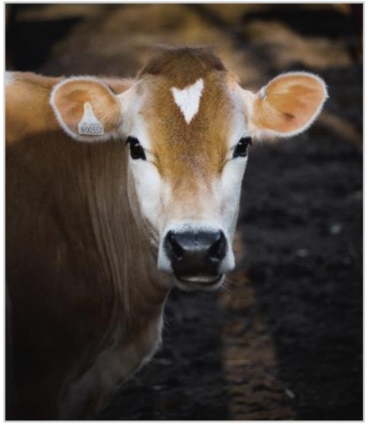
Physical risks | Transitional risks

1 Storm damage to grain elevator, Minnesota USA 2017

2 Reduced precipitation, Spain 2019

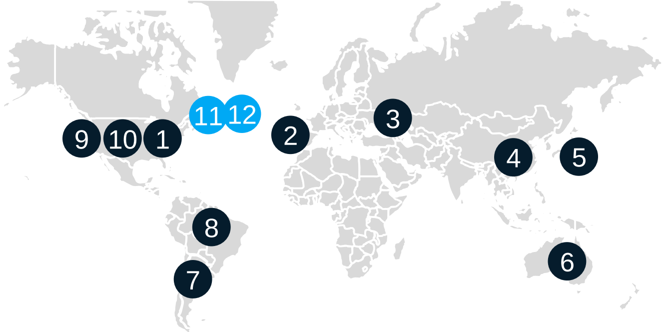
3 Vegetables field flood, Georgia 2019

4 Vegetable field drought, China 2017



11 Dramatic reduction in meat consumption

10 Grain elevator flood, Iowa USA 2019



5 Infrastructure storm damage (Typhoon Jebi), Japan 2018

12 Increase of biofuels usage

9 Grain elevator wildfire, Kansas USA 2017

8 Soybean field flood, Brazil 2018

7 Cornfield drought, Argentina 2018

6 Railway heatwave damage, Australia 2015

Source: Press search

Impacts of transition risks will vary by country and region, and include policy changes, market behavior, and shifts in investor and consumer preferences

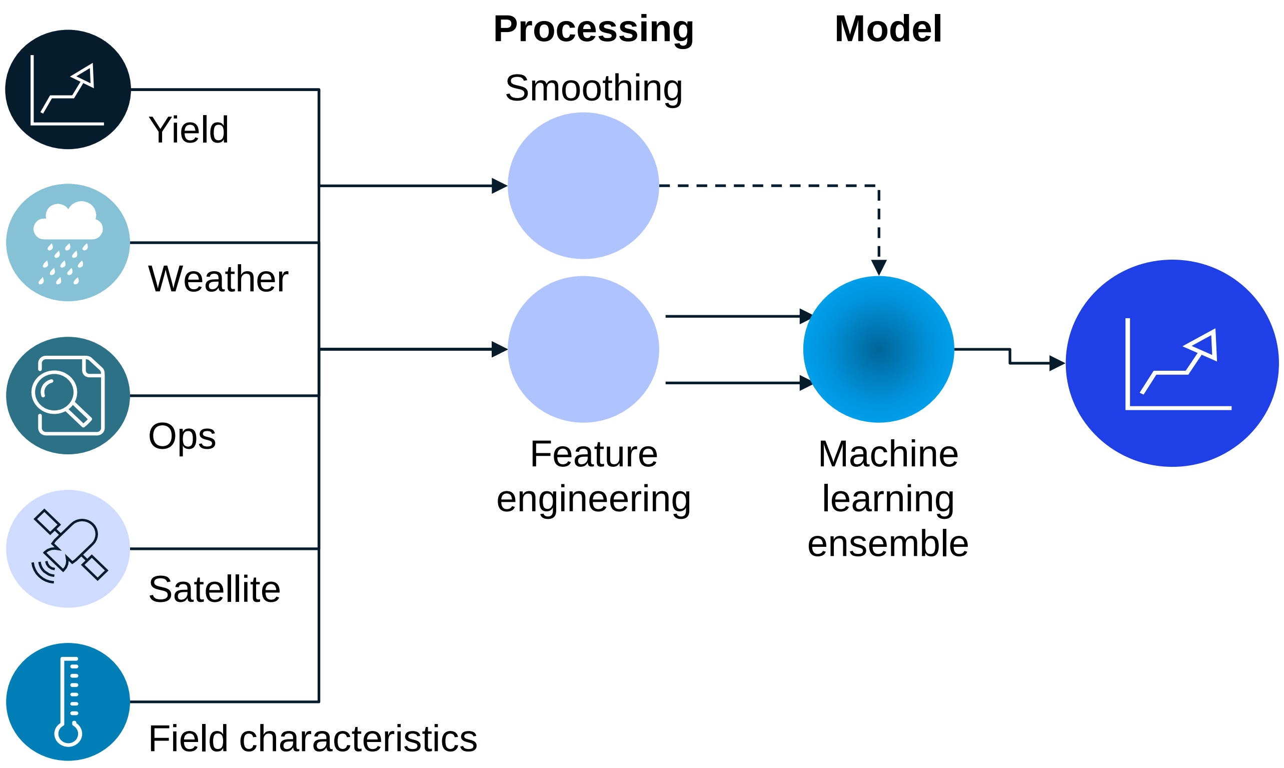
	Example agriculture impacts
Policy	**Introduction of GHG pricing** that includes a price on livestock methane emissions and agricultural processing carbon emissions
Litigation	**Increased litigation against crop producers** (e.g., water rights)
Technology	**Adoption of emissions tracking technology** requires additional investment
Investor demand	**Investor demands for adoption of an ESG[1] reporting framework** (e.g., TFCD[2]) and performance relative to climate benchmarks
Reputational	**Reduced interest in careers at a beef producers or protein-oriented commodity trader** due to press focus on their methane emissions
Consumer demand	**Accelerated decline in beef demand in developed nations** due to displacement by other proteins (e.g., poultry) and plant-based diets

1. Environmental, social, and governance
2. Task Force on Climate-Related Financial Disclosures

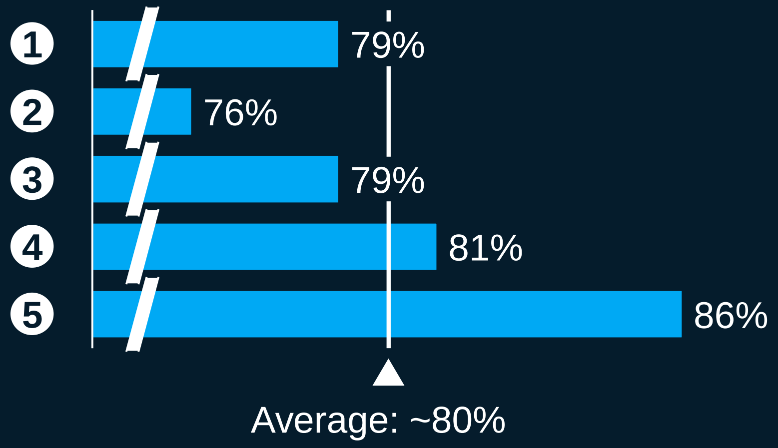
Example 1: Creation of a field-level yield predictive model using a variety of environmental data and AA techniques

Environmental and plantation management data

Advanced analytics techniques



Prediction accuracy by field



Predicted yield at field-level used for:

- Strategic planning, supply chain management
- KPI and budget setting
- Assets divestment strategy and plan

Example 2: Estimate of additional CO2 absorption potential in Chile through increased forest cover

Potential is given if

Tree growth is physically possible

+

Ownership allows it

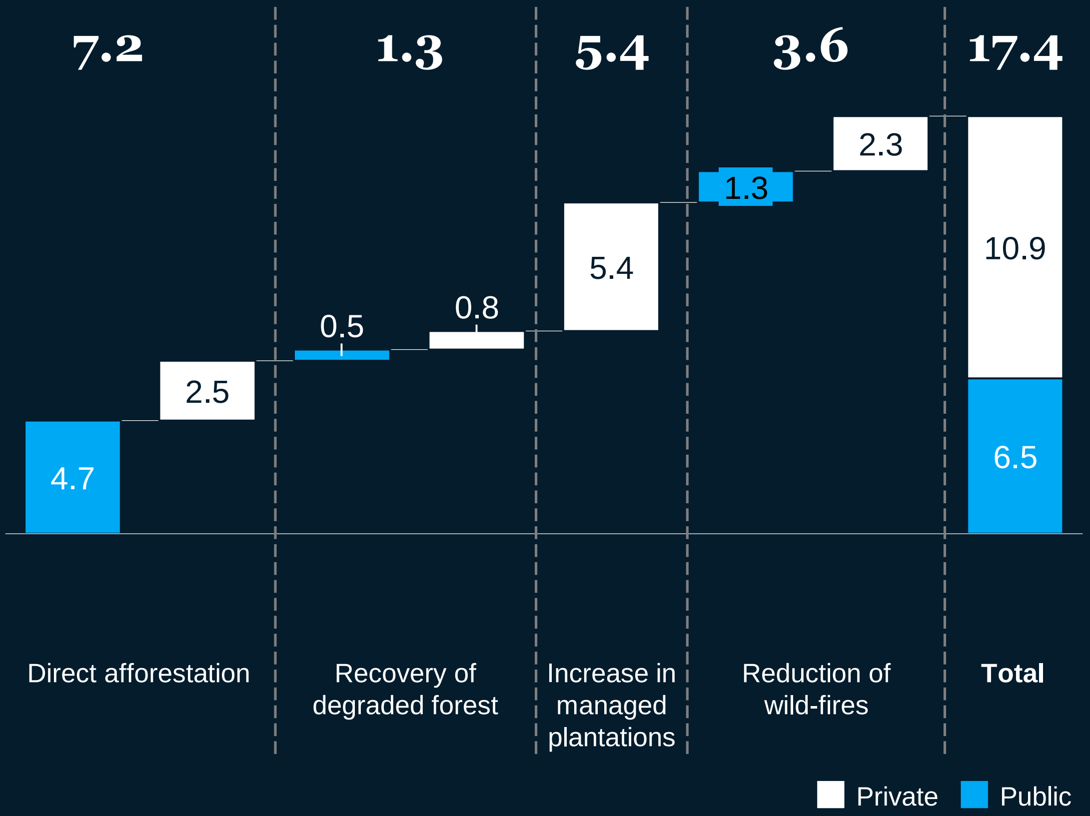
+

Current land use is no barrier

Total forest cover potential

Estimated with machine learning model

Additional emission absorption potential, CO_2 Mt



Source: ACRE Model, McKinsey team analysis

Thanks for joining! Questions? Contact us:

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