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Reporting on Response Measures under BUR – Methodology and Case Study on Chile

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Background on response measures

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- We are in a period of transition towards a low GHG economy that needs to be managed
- Measures to undertake include mitigation measures that may have:
  - **Intended impacts**
    - GHG reductions, carbon costs, behavioural changes, etc
  - **Unintended impacts**
    - employment changes, carbon leakage, changes in trade and investment patterns, energy poverty, etc

Background on response measures (2)

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- These unintended impacts can be *positive or negative* and will affect all 3 pillars of sustainable development
  - Economic
  - Social
  - Environmental
- RMs can be:
  - *international* (in other jurisdictions or global)
  - *domestic* (in the jurisdiction itself).

Background on response measures (3)

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The three pillars of sustainable development

Economic impacts	• Trade or production impacts, growth/reduction in different sectors, competitiveness, carbon leakage, cost structures etc.
Social impacts	• Job losses/gains, need for retraining, democratic/political aspects, health impacts etc.
Environmental impacts	• Non-GHG emissions, water use, water pollution, biodiversity, air quality, deforestation, land use change etc.

Background on response measures (5)

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- There has already been considerable debate under the UNFCCC on trans-border impacts of climate change mitigation measures

- However, there continues to be:
  - **a lack of methodologies** on identification and quantification
  - **no data** to present impacts of policies in an empirical manner
  - **a lack of empirical studies** to provide more substance to the UNFCCC discussions.

Transitioning from BUR to BTR

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- **Till 2024: Biennial Update Reporting (BUR):**
  - Allows for reporting on economic and social consequences of RM by non-Annex I Parties
  - Decision 2/CP.17 Annex III contains the guidelines
- **From 2024 onwards: Biennial Transparency Reporting (BTR):**
  - Parties can report on how socio-economic impacts of adaptation and/or economic diversification actions with mitigation co-benefits are addressed.
    - Annex III.D.78 of Modalities, procedures and guidelines for the transparency framework
  - "Each Party is encouraged to provide detailed information, to the extent possible, on the assessment of economic and social impacts of response measures." (Annex III.D.90)
  - Potential for inclusion of reporting on domestic response measures from 2024 onwards

Project Objectives

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1. To design and create a methodology on reporting on response measures (RM) under BUR
   - With an eye on ensuring it is fit for BTR reporting as well after 2024.
2. To test this methodology through a country case study (Chile).
   - Priority: check how manageable it is (especially data requirements)
3. Highlight relevant challenges, and potential solutions, in both 1 and 2.
4. Engage in discussions on the main findings of the project.

Overview of Case Study Steps

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Step 1: Country description

Step 2: Identify the top 100 sectors in terms of value added.

Step 3a: Filter list of sectors potentially vulnerable to ***international*** response measures

Step 3b: Filter list of sectors potentially vulnerable to ***domestic*** response measures

Identifying the vulnerable sectors

Overview of Case Study Steps (2)

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Step 4a: Identify sectors vulnerable to ***international*** response measures

Step 4b: Identify sectors vulnerable to ***domestic*** response measures

Step 5: Stakeholder input to identify anything which was missed in Step 4.

Identifying the vulnerable sectors

Overview of Case Study Steps (3)

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Step 6a: Identify ***international*** response measures response measures that might impact sectors from Step 4.

A. Identify main export partners of the vulnerable sectors
B. Search national and international databases
C. Filter the results

Step 6b: Identify ***domestic*** response measures response measures that might impact sectors from Step 4.

A. Search national and international databases
B. Filter the results

(Country-level discretion whether to include positive as well as negative impacts.)

Step 7: Stakeholder input to identify things missed in Step 6.

Identifying response measures

Overview of Case Study Steps (4)

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Step 8a: Assess the impacts of ***international*** response measures on identified sectors.

Step 8b: Assess the impacts of domestic response measures on identified sectors.

Assessing the impacts

Step 9: Look at possible ***domestic*** and international tools and support which may be needed to address the impacts.

Step 1: Country description

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INTERNATIONAL AND DOMESTIC

- **Descriptive overview** of main characteristics of country chosen for case study (in this case: Chile).
- Should cover past + current economic, social and environmental evolution of country, including geography, history, political system and structure of the economy.
- Idea is to provide some context and understanding, which can help during discussion on sector identification etc

Step 2: Identify the top 100 sectors in terms of value added

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INTERNATIONAL AND DOMESTIC

- Starting point for sector selection is all sectors in the economy
  - Several filters are used to identify most vulnerable sectors
  - Sectors then eliminated through Steps 2, 3 and 4.
- **Step 2** acts as first sectoral filter by focusing on sectors with high value-added contribution to national GDP.
- In the next step we start splitting the international and domestic analyses

Step 3a: Filter list of sectors potentially vulnerable to *international* response measures

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INTERNATIONAL

- **Step 3a is second filter**, with focus on:
  - Is sector internationally traded?
  - Does sector have significant greenhouse gas emissions?

Step 3b: Filter list of sectors potentially vulnerable to *domestic* response measures

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DOMESTIC

- **Step 3b is second filter**, with focus on:
  - Does sector have significant greenhouse gas emissions?

- International trade intensity **not relevant**

Step 4a: Identify sectors vulnerable to *international* response measures

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INTERNATIONAL

- Thirds step in sector selection – identification of most vulnerable sectors. We propose two possible methods to do so:
  - Method 1: Threshold method
  - Method 2: Weighted scores method

Step 4b: Identify sectors vulnerable to *domestic* response measures

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DOMESTIC

- Thirds step in sector selection – identification of most vulnerable sectors. We propose two possible methods to do so:
  - Method 1: Threshold method
  - Method 2: Weighted scores method

Step 5: Employ stakeholder input to identify vulnerable sectors that might have been missed in step 4.

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INTERNATIONAL AND DOMESTIC

- Aim is to supplement earlier steps for sector selection with knowledge from local stakeholders consultations
- Sanity check: are there any sectors that were missed by our approach?
  - Maybe necessary to include through qualitative selection?
- In Chile case study: also used as a sanity check for our methodology
  - If we miss important and obvious sectors: methodology might need adaptation

Step 6 (a): Identify the international response measures relevant for sectors identified in step 4(a).

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INTERNATIONAL

- Three-part procedure:
  A. Identify main export partners of the vulnerable sectors
  B. Search national and international databases
  C. Filter the results

Step 6 (b): Identify the domestic response measures relevant for sectors identified in step 4(b).

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DOMESTIC

- Two part procedure:
  A. Search national and international databases
  B. Filter the results

Step 7: Employ stakeholder input to identify response measures that might have been missed in Step 6 (a) and 6 (b)

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INTERNATIONAL AND DOMESTIC

- Stakeholder consultations to assess
  - whether any relevant RMs were missed, or
  - whether too many RMs were listed as relevant for the list of sectors.
- Methodology and main findings presented, followed by requests for input and feedback, inviting stakeholders to:
  - identify other policies (out-of-jurisdiction and international)
  - other negative impacts on their sector.

Step 8 (a): Assess the impacts of international response measures

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INTERNATIONAL

- Assessing impacts of the identified response measures.
  - Quantitative analysis
  - Qualitative analysis
- Limited number of policies chosen for assessment

Step 8 (b): Assess the impacts of international response measures

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DOMESTIC

- Assessing impacts of the identified response measures.
  - Quantitative analysis
  - Qualitative analysis
- Limited number of policies chosen for assessment

Step 9: Look at possible domestic and international tools and support which may be needed to address the impacts.

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INTERNATIONAL AND DOMESTIC

- Look at which tools can be used to address impacts of adverse unintended impacts of response measures

Examples of such tools and approaches are:

- ***Possible international cooperative approaches***
  - Technology Mechanism, Green Climate Fund, Adaptation Committee, Capacity Building Framework and REDD+ Framework.
- ***Possible domestic measures:***
  - cost alleviation domestic safety nets, worker training/retraining and adjustment programmes and economic diversification efforts.
  - Support and capacity-building might be necessary in some cases

Structure rest of presentation

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- International
  - Identifying sectors most vulnerable to international RM
  - Identifying international RM
  - Assessing impacts international RM
- Domestic
  - Identifying sectors most vulnerable to domestic RM
  - Identifying domestic RM
  - Assessing impacts domestic RM
- Possible tools and support to address impacts
- Main challenges and conclusions

International

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Identifying the sectors vulnerable to international RM

International Standard Industrial Classification of All Economic Activities: ISIC

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- Chile uses ISIC Rev. 4.
- Ideally, we would have had data on the 4-digit class level for all sector variables.

Sector	Agriculture
Section	A, Agriculture, hunting and forestry
Division	01, Crop and animal production, hunting and related service activities
Group	011, Growing of non-perennial crops
Class	0111, Growing of cereals (except rice), leguminous crops and oil seeds

Identifying the *vulnerable sectors*

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- We started with the top 100 Chilean sectors in terms of domestic value added
  - Using 2016 Annual National Accounts of the Central Bank of Chile

Identifying the *vulnerable sectors* (2)

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- We then used two filters on those top 100 sectors:
  1. Is the sector internationally traded?
     - Some sectors are not traded (such as ISIC code 85: Public education)
     - Needed to perform a concordance between ISIC and HS Codes for this.
  2. Does the sector have significant greenhouse gas emissions?
     - Some sectors had no GHG emissions reported in the Chilean National GHG Inventory (2016) (such as ISIC 86: Public human health activities)

- A sector that is not traded, and/or has no GHG emissions is deemed *less vulnerable* to international response measures
- This reduced the list to **31 sectors**

Identifying *vulnerable sectors* (3)

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- To further narrow the list down we used two methods:
  - Method 1 Thresholds: using thresholds for three variables to drop sectors
  - Method 2 Weighted scores: scoring sectors for three variables and picking sectors that pass (score 50 or above)
  - Three variables:
    - "trade intensity" (exports/gross domestic production)
    - "importance for Chilean economy" (value added as a % of GDP)
    - "GHG intensity" (gCO2e/USD value added)
- Both methods are subjective:
  - we chose thresholds and weights for scoring sectors

International: Method 1 Thresholds

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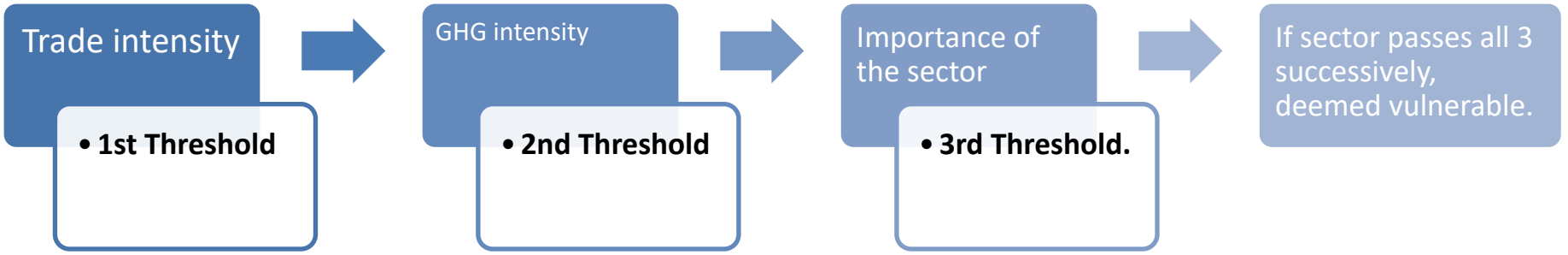

International: Method 2 Weighted Scores

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Trade intensity (trade intensity: exports/domestic production). Scored zero to 100, derived by multiplying number by 4, cap at 40.	**40%**
GHG intensity in grams of $C0_2e$/value added (could have used energy costs per unit of value added, depending on data availability). Scored zero to 40, using logarithmic scale that is capped at 40. Sectors with GHG intensity of 0,5 or higher score 40.	40%
National sectoral significance: value added relative to GDP. Scored zero to 100, derived by multiplying number by 2000, cap at 20.	20%

Identifying *vulnerable sectors (4)*

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- To limit subjectivity we performed robustness checks
  - 4 scenarios were used, with variations on the weight given to each variable
    - Scenario 1: 'Importance' given more weight/higher threshold
    - Scenario 2: 'GHG intensity' given more weight/higher threshold
    - Scenario 3: 'Trade intensity' given more weight/higher threshold
    - Scenario 4: All three variables lower threshold and more 'even' weight
  - 4 scenarios and 2 methods in each makes eight tests
- Sectors that passed 6 or more out of 8 tests were deemed *most vulnerable* to the impacts of response measures
  - 9 sectors passed 6 or more tests
  - 10th sector (tourism) was added on a qualitative basis

Identifying *vulnerable sectors (5)*

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- Main problem faced during international sector selection was the lack of comparable sectoral data
  - GHG emissions are reported at high level of aggregation.
    - Every agriculture sector therefore was considered to have the same emission intensity – obviously not the case in the real world
  - Tourism sector data (both emissions and trade intensity) problematic;
    - Sector does not report data in manner comparable to others (ISIC or HS codes)
    - sector was deemed vulnerable through a qualitative assessment
    - 'main trading partners' are Europe and Americas
  - Not all 'sectors' are defined at the same level of aggregation
    - ISIC 4 digit level, 3 digit level and 2 digit level (both partial and complete)
    - Ideally we would have only worked with sectors defined at ISIC 4 digit level

Identifying *vulnerable sectors (6)*

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Conclusion on use of two methods:

- Cannot make a strong conclusion on which method is preferable.
- Both methods are valid: require the same research burden and are equally subjective.
- Way to limit subjectivity is to combine a set of scenarios with different thresholds and/or weights
- Advise anyone using this methodology to therefore also implement a scenario analysis.

Identifying *vulnerable sectors (7)*

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- The list itself (sectors not ranked in this table):

ISIC code	Sector Description
0729	'Mining of copper'
0122-0126	'Cultivation of other fruit' (e.g. tropical and subtropical fruits, citrus fruits, pome fruits and stone fruits, other tree and bush fruits and nuts, oleaginous fruits)
17	'Manufacture of paper and paper products'
2011	'Manufacture of basic chemicals'
19	'Manufacture of coke and refined petroleum products'
0121	'Cultivation of grapes'
1102	'Manufacturing of wines'
032	'Aquaculture'
031	'Fishing'
WTO 1.33 and 1.36	Tourism

International

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Identifying international RM

Taxonomy of International Response Measures: Part 1

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Type of response measures	Impacts in country undertaking the response measure	Possible impacts in other countries
Carbon taxes	decreased demand for carbon-emitting goods; increased demand for low-carbon emitting goods	- Negative effects: fossil fuel producers. + Positive effects: low-carbon goods (e.g., renewable energy/EV components)
Subsidies		
… for low-carbon transport	decreased demand for goods associated with internal combustion engines.	- Negative effects: producers of fossil fuels, lead. + Positive effects: producers of EVs, cobalt, lithium, vanadium.
… for low-carbon energy production	decreased demand for thermal fuels	- Negative effects: coal, natural gas, oil producers. + Positive effects: low-carbon energy technology (e.g., PV solar cells)
… removal of, for fossil fuel production	decreased production of fossil fuels	- Negative effects: fossil fuel consumers. + Positive effects: fossil fuel producers.
… removal of, for fossil fuel consumption	decreased consumption of fossil fuels	- Negative effects: fossil fuel producers. + Positive effects: fossil fuel consumers.
… for energy efficiency in buildings	decreased energy consumption	Effects depend on fuel source used in implementing country buildings. If fossil fuels used: - Negative effects on producers; + Positive effects on consumers.
Green procurement		
of energy	decreased demand for thermal fuels, increased demand for low-carbon energy technologies	- Negative effects: coal, natural gas producers. + Positive effects: coal and natural gas consumers (price decrease), producers of alternative energy tech.
of automobiles	decreased demand for goods associated with internal combustion engines.	- Negative effects: fossil fuel producers. + Positive effects: cobalt, lithium, vanadium producers, EV producers.

Taxonomy of International Response Measures: Part 2

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Type of response measures	Impacts in country undertaking the response measure	Possible impacts in other countries
Cap and trade schemes	decreased demand for carbon-intensive goods; increased demand for low-carbon goods	- Negative effects: fossil fuel producers. + Positive effects: renewable energy/low-carbon transport tech producers; fossil fuel consumers.
Liberalization of trade in environmental goods	boost in consumption of green goods	+ Positive effects: producers of covered environmental goods
Border carbon adjustment	decreased demand for high-carbon goods (aluminum, steel, cement, plastics, pulp & paper); increased demand for substitutes.	Depends on carbon intensity, and regime details, but likely: - Negative effects: aluminum, steel, cement, plastics, pulp & paper. + Positive effects for low-carbon producers.
Standards and labelling requirements		
for agricultural goods, involving GHG emissions	depends on details of the scheme, but likely loss of market share for non-certified air-freighted goods, inter alia.	Depends on details of the scheme, but possible: - Negative effects for producers of perishable fruits such as berries, high-value horticulture
mandatory efficiency performance standards for consumer goods, industrial equipment	restricts the market to high-efficiency products; reduces demand for fuel	- Negative effects: fossil fuel producers; producers of low-efficiency consumer goods and industrial equipment. + Positive effects: fossil fuel consumers; producers of high-efficiency goods/equipment
International aviation levies	n/a - international	- Negative effects: flight-based tourism sectors (e.g., hotels, restaurants); producers of air-freighted (perishable) goods.
International maritime levies	n/a - international	- Negative effects: increased costs of imports and exports using maritime transport

Identifying *response measures*

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- We built a list of policies and measures in other jurisdictions and on the international level for each of the 10 sectors.
- For each sector, we looked at:
  - the top 5 countries exported to, and
  - International transportation policies (aviation and maritime transportation)

Identifying *response measures (2)*

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Example: Manufacturing of paper and paper products

ISIC Rev 4 Code	Product Description	HS 2007 Code	Product Description	2018 Top 5 Export Partners: Value (USD)*	
				Country	Total value
17	Manufacture of paper and paper products	470100-590500	Paper products	China	1,998,820,149
				Netherlands	229,812,390
				Rep. of Korea	216,929,369
				Other Asia, nes	81,894,432
				Japan	75,946,474

Over 200 HS codes are covered by ISIC code 17, we looked at top 10 (cover over 98% of exports from this sector)

Identifying *response measures (3)*

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- This gave us a list of 15 countries to look at:
  - People's Republic of China
  - Japan
  - United States of America
  - Republic of Korea
  - Brazil
  - India
  - Russian Federation
  - Spain
  - The Netherlands
  - Belgium
  - Colombia
  - 'Other Asia'
  - Peru
  - Argentina

Identifying *response measures (4)*

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- Main sources for policies:
  - European Environmental Agency policy database on climate change mitigation policies and measures in Europe
  - OECD Database on Policy Instruments for the Environment
  - UNFCCC NDCs registry and IGES NDC database
  - ICAP Carbon market database
  - World Trade Organisation Environmental Database
  - International Energy Agency/IRENA Joint Policies and Measures database
  - Food and Agriculture Organisation FAOLEX Database
  - International Trade Centre Sustainable and Standards Map
  - International Civil Aviation Organisation policy factsheets
  - International Maritime Organisation policy factsheets
  - London School of Economics and Political Sciences Climate Change Laws of the World database (largely overlapping with others above)
  - UNFCCC Response Measures Synthesis Report (less useful)
  - International Energy Agency Building Energy Efficiency Policies Database (less relevant)

Identifying *response measures (5)*

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- List of potential policies for each country was extremely long:

Country	Preliminary numbers for possible measures of top trade partners of vulnerable sectors
China	2332
Japan	441
USA	3304
Rep. Of Korea	516
Brazil	1901
India	567
Russian Federation	3745
Spain	2352
Netherlands	453
United Kingdom	2646
Belgium	1497
Colombia	1706
Other Asia, nes	N/A.
Peru	3059
Argentina	2128

Other Asia, nes: not available in most databases – had to be left out

Identifying *response measures (6)*

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- Narrowed down extensive list by labour-intensive policy-by-policy check on several criteria:
  - *Deleting duplications* between databases
  - Direct/indirect *climate change mitigation policy*
    - Direct policy: policy is meant to limit GHG emissions
    - Indirect policy: policy can have significant GHG mitigation co-benefits
  - Policy has an *international perspective* through which Chilean sectors could be impacted
  - Policy is *enacted in the sector* (or a closely related sector) to one of the identified 10 Chilean sectors, in one of the main 5 export countries

Identifying *response measures (7)*

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- Final numbers of potentially relevant international climate change policies that could impact sectors deemed most vulnerable

Country	Number of potentially relevant climate change policies
China	39
Japan	7
USA	44
Rep. Of Korea	13
Brazil	5
India	27
Russian Federation	0
Spain	13
Netherlands	4
United Kingdom	16
Belgium	4
Colombia	2
Peru	8
Argentina	19
International Organizations (ICAO and IMO)	3

Identifying *response measures (8)*

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- For each sector we therefore have a list of policies:
  - that are climate change related (direct/indirect)
  - for each of the 5 main export countries
    - Tourism: looked policies in main sources of tourists
      - Europe and Americas
  - Related to international transportation
  - that could have impacts on the identified Chilean sectors of the economy
- Alternative approaches are possible
  - Build upon stakeholder consultations
  - But, this implies interest and understanding of this technical issue among stakeholders

International: Sectors and policies

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International sector 1: Mining of Copper (ISIC Rev 0729).

Main products are copper ores and concentrates

China	Japan	Republic of Korea	India	Spain
National ETS	Grants and direct payments to renewable energy producers	Act on Encouragement of Purchase of Environment-Friendly Products.	Rajasthan - VAT exemption for generation of electricity from renewables	EU ETS
Subnational ETS pilots		Act on Encouragement of Purchase of Green Products.	Solar Photovoltaics, Systems, Devices and Components Goods (Requirements for Compulsory Registration) Order, 2017	Royal Decree No. 287/2015 - Regulates the direct granting of subsidies for the purchase of electric vehicles within the framework of the Comprehensive Strategy for the promotion of electric vehicles in Spain 2010-2014 (MOVELE Program 2015).
13th Five-Year comprehensive energy-saving and emission reduction work plan.		Enforcement Decree of the Framework Act on Low Carbon, Green Growth (Presidential Decree No. 22124 of 2010).	State level solar and wind power polices and strategies	Directive 2009/28/EC on the Promotion of Electricity Produced from Renewable Energy Sources
China National Plan for Tackling Climate Change (2014-2020).		Regulation on Energy Efficiency Labelling and Standards	National Action Plan on Climate Change.	Renewable Energy Road Map - Renewable energies in the 21st century: building a more sustainable future
Industrial Green Development Plan (2016-2020).		Act on the Promotion of Saving and Recycling of Resources	National wind-solar hybrid policy	Development plan of electrical energy transport network 2015-2020

International: Sectors and policies

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International sector 1: Mining of Copper (ISIC Rev 0729).

Main products are copper ores and concentrates (2)

China	Republic of Korea	India	Spain
Measures for the management of the energy-saving low-carbon-emission product certification.	Framework Act on Low Carbon, Green Growth.	Comprehensive Policy on Decentralized (Off-grid) Energy Generation Projects based on New and Renewable Energy (Non-Conventional) Energy Sources – 2016	Renewable Energy Plan 2011 - 2020
Renewable Electricity Quota and Assessment Method (Draft for Opinions) - Planned	Regulation on Energy Efficiency Labelling and Standards (MKE's Notification 2011-263)	India 175 GW Renewable Energy Target for 2022	National Renewable Energy Action Plan 2011-2020
Action Plan for the Development of Smart Photovoltaic Industry		National Renewable Energy Law 2015 - DRAFT	Spanish Strategy on Climate Change and Clean Energy 2007-2012-2020
Renewable Energy Green Certificate and Trading Mechanism		Pilot Emissions Trading Systems	
The Twelfth Five-Year Plan for Renewable Energy			
China 13th Solar Energy Development Five Year Plan (2016-2020)			
China's National Climate Change Programme			
Renewable Energy Law of the People's Republic of China			

Note on international transportation

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- International transportation is a reoccurring issue
  - International maritime transport
    - IMO
    - Mainly significant for
      - Fresh/perishable goods
  - International aviation
    - ICAO
    - Mainly significant for
      - Fresh/perishable goods
      - Tourism

International Track so far

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- We have identified a list of 10 Chilean sectors through our methodology as most vulnerable to the impacts of response measures implemented in other jurisdictions and internationally

- We have identified policies in other countries and internationally which could impact the 10 identified Chilean sectors
  - Identifying all potential policies globally is not useful, so we focus on:
    - Top 5 countries Chilean sector exports to
    - International overreaching policies (international transportation – ICAO and IMO)

International

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Assessing the impacts of international RM

Assessment of international RM

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- Limited number of international response measures were chosen
- Two methods were used for the analysis:
  - Quantitative
  - Qualitative.

Assessment of international RM (2)

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Note:

- This is a **bottom-up approach**
- Alternative approach for assessing impacts of international response measures: **top-down methodology,**
  - Would begin with modelling how 1,5°C target would be reached
    - What would the world need look like in order to mitigate global heating to 1,5°C by the end of the century?
    - Which policies are necessary to reach that goal?
    - Which impacts would those policies have?

International: quantitative analysis

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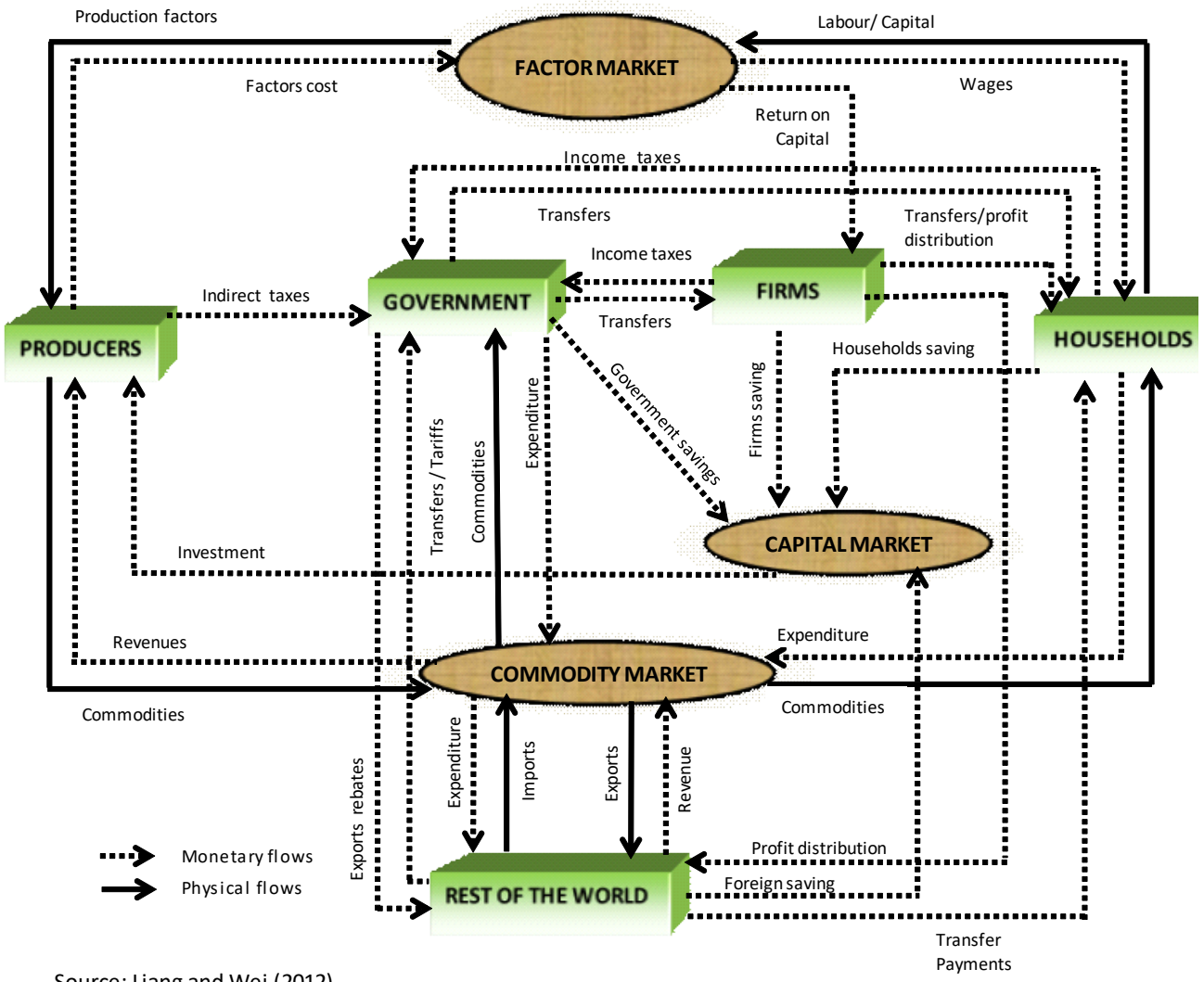
- Two international response measures chosen for quantitative analysis:
  1. IMO: Possible introduction of a CO2 Tax
  2. ICAO: Upcoming introduction of CORSIA
- For the quantitative assessment, the **ECOGEM CHILE 2 CGE** model was used.
- The model is multi- sector, and recursive-dynamic, based on the OECD GREEN model.



Source: Liang and Wei (2012)

ECOGEM 2.0: Summary of characteristics

Characteristics	Description
Sectors and activities	60 sectors: 26 productive sectors, 7 electricty generation sectors (new SAM), 27 services (including water, health, transportation among others)
Occupational categories	12 categories: high, medium and low skill disaggregation by gender (Male/Female) and by place (Urban/Rural)
Household income groups	10 deciles: income groups
Trade partners	35 trade partners: Brazil, USA, China and others and groups of countries or regions (rest of Asia or America and others)
Public finances	Breakdown of taxes and transfers: direct and indirect taxes to businesses, direct taxes on households (income), labor tax, tariffs, VAT and government transfers to households from/to abroad
Pollution	4 types of pollutants: Chile's own emission factors have been estimated by sectoral production and final consumption for airborne pollutants: CO2, NOx, SO2 and PM2.5

The ECOGEM 2.0 Model

- Features:
  - Production (Min Costs, CES and Leontieff)
  - Consumption (Max Utility, ELES)
  - Other Final Demands Fixed shares (Investment, Government, Margins, Stocks)
  - Foreign sector (Armington Assumption and CET)
  - Closure Rules (Walras Law, Savings driven)

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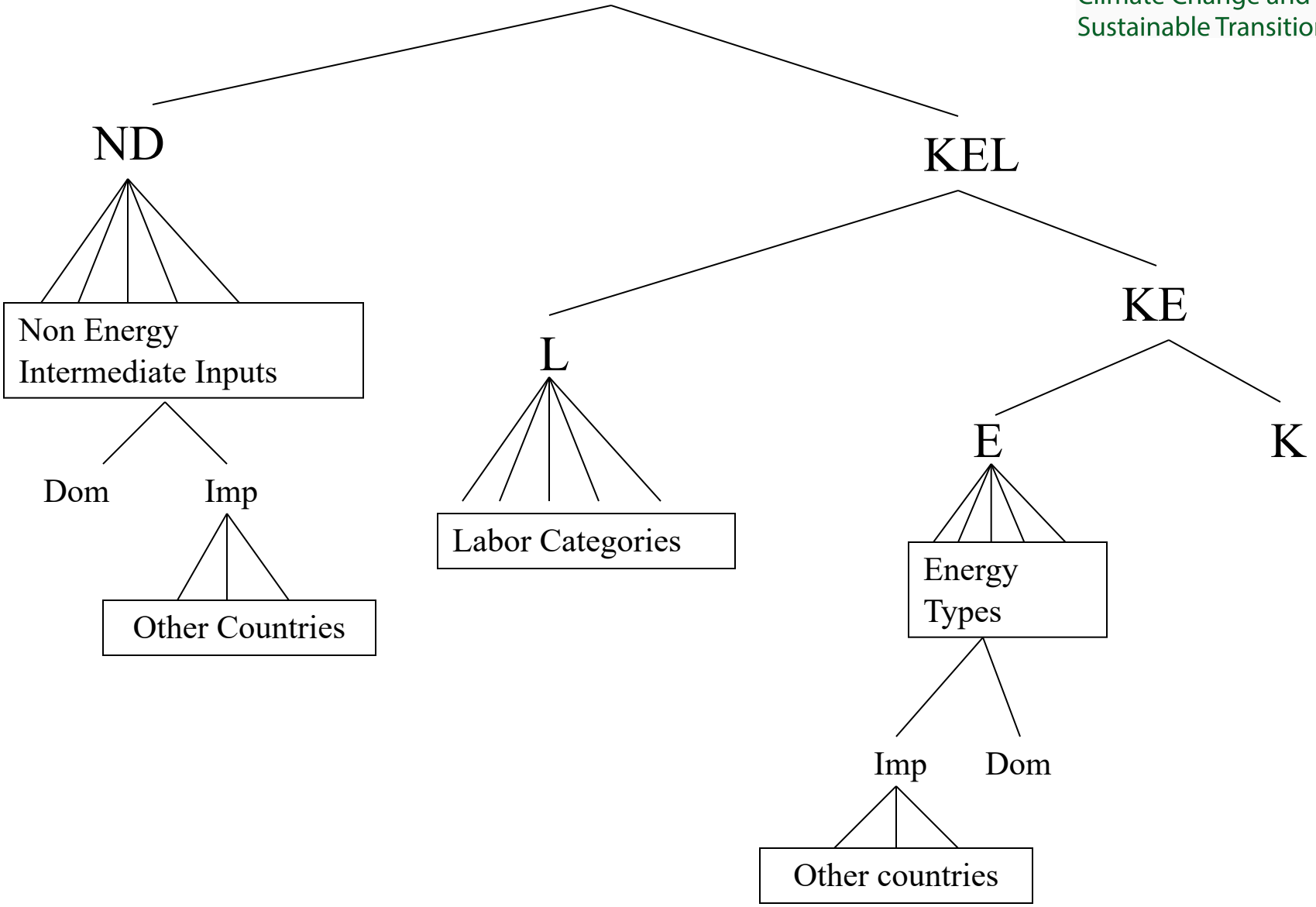
ELECTRICITY PRODUCTION



IMO: Possible introduction of a CO2 Tax

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- **ECOGEM CHILE 2 CGE** model adapted
- Any cost increase for a sector needed to be translated into a production cost increase
  - Assessing which countries the products are being transported to
  - Assessing through which means of shipping each product is transported (Panamax or smaller, bulk carriers, container ships, etc.)
  - Calculating the transport costs per unit/tonne of product
  - The cost increase per unit or tonne of product due to a CO2 tax on international shipping
  - The price elasticity of each product, and the availability of substitutes
- 9 of the sectors would be potentially impacted by the IMO tax (tourism was left out, as an IMO CO2 tax would mostly impact large shipping vessels)
- The model was adapted to be able to differentiate in cost increases between various countries and regions.
- Three possible price levels of the IMO tax were modeled: 15, 30 or 50 USD/tonne of CO2.

IMO: Possible introduction of a CO2 Tax (2)

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Macroeconomic impacts

- IMO carbon tax in essence reduces the export prices received by producers by increasing transport costs.
- The expected overall GDP reduction is limited in for all three potential IMO carbon tax price levels:

	2020	2030	2040	2050
Higher tax rate (50 USD/tonne)	-0.012%	-0.024%	-0.031%	-0.037%
Medium tax rate (30 USD/tonne)	-0.007%	-0.015%	-0.019%	-0.023%
Lower tax rate (15 USD/tonne)	-0.004%	-0.007%	-0.009%	-0.011%

IMO: Possible introduction of a CO2 Tax (3)

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- depreciation of the Chilean exchange rates: higher export prices and/or lower exports lead to less foreign exchange flowing into the country
- Modelling results - increase in exchange rates due to shipping Tax (%)

	2020	2030	2040	2050
Higher tax rate (50 USD/tonne)	0.123%	0.103%	0.095%	0.087%
Medium tax rate (30 USD/tonne)	0.075%	0.062%	0.058%	0.053%
Lower tax rate (15 USD/tonne)	0.037%	0.031%	0.029%	0.026%

IMO: Possible introduction of a CO2 Tax (4)

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Sectoral Impacts

- copper sector sees production decrease by 0,213% compared to the baseline scenario in case of a 50 USD/tonne IMO carbon tax.
- manufacturing of wines, impact is smaller (-0,005% decrease in production compared to baseline in 2050 with 50 USD/tonne IMO carbon tax).
- Other sectors:
  - agricultural sectors and aquaculture see limited increase in production levels (+0,017% and +0,043% in 2050 compared to baseline with 50 USD/tonne IMO carbon tax).

Indirect sectoral Impacts

- Small increases in power production through hydro and solar (respectively +0,170% and +0,122% in 2050 compared to baseline with 50 USD/tonne IMO carbon tax).
- Small decreases in power production using petrol and coal (respectively -0,158% and -0,126% in 2050 compared to baseline with 50 USD/tonne IMO carbon tax).

When looking at the impacts of the lower ranges of the potential IMO carbon tax (15USD/tonne and 30 USD/tonne) the impacts are even lower.

IMO: Possible introduction of a CO2 Tax (5)

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Effects on Income

- impact on income is small in all periods for all income deciles.
- minor decreases in household income are due to the minor decrease in GDP.
- lowest decile is barely impacted (-0,006% in 2050 compared to baseline with 50 USD/tonne IMO carbon tax. For 15 USD/tonne tax: -0,002% in 2050).
- The four highest deciles are impacted the most (-0,020% to -0,021% in 2050 compared to baseline with 50 USD/tonne IMO carbon tax. For 15 USD/tonne tax: -0,006% in 2050)

ICAO: Upcoming introduction of CORSIA

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- CORSIA pilot phase will begin in 2021
- major concern for the Chilean tourism sector due to many of its visiting tourists relying on flights to reach Chile.
- challenging to model the impacts of CORSIA on the tourism sector and the Chilean economy through ECOGEM 2 Model as tourism sector not defined as a separate sector
- instead used non-dynamic estimates and calculations to estimate impacts on ticket price drawing on estimates from including aviation in the EU ETS.

ICAO: Upcoming introduction of CORSIA (2)

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- To calculate **direct impacts:**
  - Est. impacts of **€15 to €45/tonne** C02 carbon price,
  - **assumed breakdown** among business class and economy travellers, and short- medium- and long-haul flights,
  - **+** information on foreign non-business arrivals in Chile by air,
  - **=** numbers of reduced visits in response to ticket price increases,
  - **x** by weighted avg. figures for length of stay, and expenditure,

  = lost spending, or direct impacts

- many assumptions and imperfect proxies underlying calculations = final figures are indicative, not definitive,
- give an illustrative order of magnitude to help policymakers think about impacts.

ICAO: Upcoming introduction of CORSIA (3)

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Effects on tourism sector

- main effect on the tourism sector is the reduced income for the sector due to a decrease in the number of visitors

EUR 15							
	Long Trip		Medium Trip		Short Trip		Total
	business	personal	business	personal	business	personal	
Reduction in passengers	318	2,804	455	3,696	529	1,978	9,780
Reduction in spending (USD)	511,195	3,315,847	623,708	4,116,311	470,052	1,022,852	10,059,965
Reduction in total spending by passengers (thousand million pesos)	0.35	2.24	0.42	2.79	0.32	0.69	6.81

ICAO: Upcoming introduction of CORSIA (4)

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EUR 30							
	Long Trip			Medium Trip		Short Trip	Total
	business	personal	business	personal	business	personal	
Reduction in passengers	1,718	11,471	2,456	15,120	2,859	8,093	41,717
Reduction in spending (USD)	2,761,739	13,564,935	3,366,653	16,839,456	2,540,414	4,185,004	43,258,200
Reduction in total spending by passengers (thousand million pesos)	1.87	9.18	2.28	11.40	1.72	2.83	29.28

ICAO: Upcoming introduction of CORSIA (5)

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Main direct impacts:

- Reduced spending by travellers in the retail sector
  - 15 EUR fare increase = -3,1 billion CHP
  - 30 EUR fare increase = -13,3 billion CHP
- Total of the direct effects across 60 sectors in model
  - 15 EUR fare increase = -6,81 billion CHP
  - 30 EUR fare increase = -29,28 billion CHP

Indirect impacts:

- Total reduced spending by travellers across 60 sectors in model in indirect impacts
  - 15 EUR fare increase = -4,58 billion CHP
  - 30 EUR fare increase = -19,71 billion CHP

International: qualitative analysis

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Two international response measures chosen for qualitative analysis:

1. IMO: Mandated reductions in shipping speed
2. Support measures for electric vehicles

- Not capable of predicting magnitude of impacts
- Cannot understand ripple effects throughout the economy like general equilibrium models
- But it is useful to complement quantitative analysis
- + can predict effects that are not easily identified in modelling results.

IMO: Mandated Shipping Speed Reduction

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- IMO's adopted Strategy on Reduction of GHG Emissions, aims to reduce total GHG emissions from shipping by 50% by 2050 compared to 2008,
- One proposal is looking at speed reduction in order to reduce emissions.
- Est. speed reduction of 10% = reduce emissions by 13%
- Higher speed reductions = higher emissions reductions (up to a point).
- Not decided yet if will be used.

IMO: Mandated Shipping Speed Reduction (1)

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Environmental impacts

- Reduction in GHG emissions
- Reduction in whale strikes (10% reduction = 50% fewer whale strikes), and reduction in sonic impacts. Important, as Chile hosts an annual migration of blue, humpback and grey whales

Economic impacts

- Slower global fleet may also make some markets not viable – e.g., for perishable fruit to Chinese market
- Need full analysis to est. number of extra days shipping to assess whether results in not just increased costs, but actually full loss of market for specific exports
- Possibilities for crop switching, or switching mode of transport.

Social impacts

- Following full analysis above need to understand which + how many jobs might be lost (i.e., in what region/sub-sector) in fruit production.

Support Measures for Electronic Vehicles

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- Sector of “copper ores and concentrates” marked as most significant in our analysis,
- Chile’s largest single sector in terms of value added
- World leader in copper, responsible for roughly a quarter of global production.
- Scan of the possible response measures that might affect this sector turns up variety of support measures for electric vehicles (EV), primarily including subsidies to consumers.
- Est. rise in sales of EV from few thousand in 2010 to 2 million in 2018, and predicts exponential growth in future sales,
  - 10 million by 2025
  - 56 million by 2040.
- EV uses roughly 80 kg of copper, 4x more than internal combustion vehicle.

Support Measures for Electronic Vehicles (2)

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Environmental impacts

- Copper mining → energy- and water-intensive process
- Full analysis needs to estimate impacts of increased demand in terms of increased energy and water use, esp. in water-scarce locations in the Northern high desert.

Economic impacts

- First need to calculate increase in sales by looking at est. subsidy for EV.
- Next calculation global increases in demand for copper, scaled down to picture impact for Chile.
- Also include est. in rise for demand for lithium, used in EV batteries and found in abundance in northern Chile.

Social impacts

- Analysis of increase in direct and indirect employment that could be expected as a result of increased demand for copper.

End of international assessment, moving to *domestic* assessment

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- This section will follow the same structure as the international track,

1. Identifying sectors vulnerable to domestic RM
2. Identifying domestic RM
3. Assessing impacts

Domestic

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Identifying sectors vulnerable to domestic response measures

Domestic: identifying *vulnerable sectors*

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- Very similar process as for the international track
- We started with the top 100 Chilean sectors in terms of domestic value added
- We then used one filter on those top 100 sectors
  - Does the sector have significant greenhouse gas emissions?
  - A sector that has no GHG emissions is deemed less vulnerable to domestic response measures due to limited from climate change mitigation policies
- This reduced the list to 34 sectors

Domestic: identifying *vulnerable sectors (2)*

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- We used two methods to further narrow the list down:
  - Method 1: using thresholds for two variables to drop sectors
  - Method 2: scoring sectors for two variables and picking sectors with highest scores
  - Two variables were used:
    - "importance for Chilean economy" (value added as a % of GDP)
    - "GHG intensity" (gCO2e/USD value added)
  - Trade intensity was not included
- Both methods are subjective:
  - we choose thresholds and weights for scoring sectors

Domestic: Method 1 Thresholds

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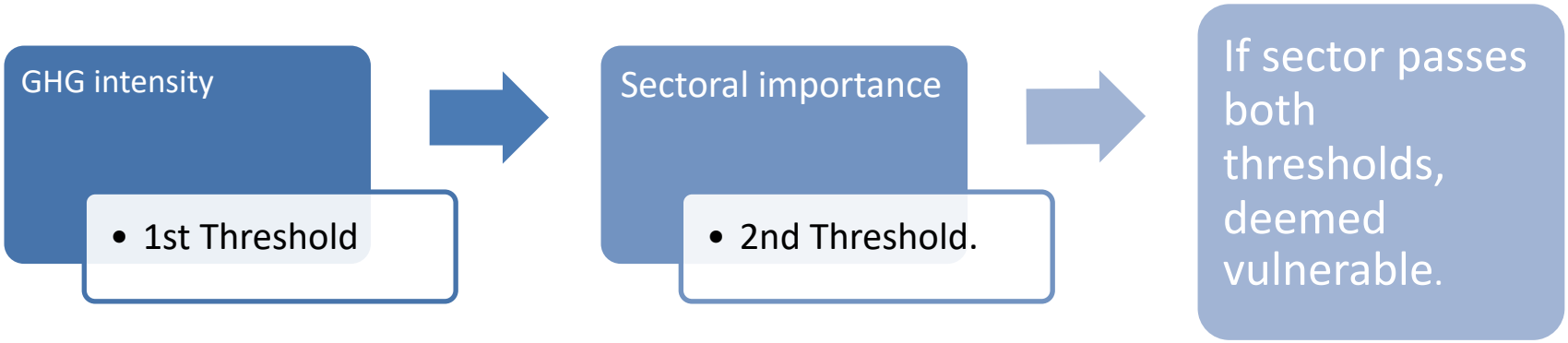

Domestic: Method 2 Weighted Scores

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Energy costs per unit of value added, or GHG intensity (grams of $C0_2e$/value added), depending on data availability. Scored zero to 100, using logarithmic scale that is capped at 70. Sectors with GHG intensity of 0,5 or higher score 70.	**70%**
National sectoral significance: value added relative to GDP. Scored zero to 100, derived by multiplying number by 2000, cap at 30.	30%

Domestic: identifying *vulnerable sectors (3)*

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- To limit subjectivity we performed robustness checks
  - 3 scenarios were used, with variations on the weight given to each variable
  - 3 scenarios and 2 methods in each makes 6 tests
- Sectors that passed 4 or more out of 6 tests were deemed most vulnerable to the impacts of response measures
  - 9 sectors passed 4 or more tests
- Tourism added through qualitative assessment

Domestic: identifying *vulnerable sectors (4)*

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- Main problem faced during domestic sector selection was the lack of sectoral data at comparable level
  - GHG emissions are reported at high level of aggregation. Every agriculture sector therefore was considered to have the same emission intensity – obviously not the case in the real world
  - Tourism
    - Sector does not report data in manner comparable to others (ISIC or HS codes)
    - Sector was deemed vulnerable through a qualitative assessment
  - Not all 'sectors' are defined at the same level of aggregation
    - ISIC 4 digit level, 3 digit level and 2 digit level (both partial and complete)

Domestic: identifying *vulnerable sectors (5)*

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- The list itself (sectors not ranked in this table):

ISIC code	Sector Description
3510	'Electric power generation'
4923	'Freight transport by road'
17	'Manufacture of paper and paper products'
51	'Air transport'
19	'Manufacture of coke and refined petroleum products'
2011	'Manufacture of basic chemicals'
0729	'Mining of copper'
1020	'Processing and preserving of fish, crustaceans and molluscs'
0122-0126	'Cultivation of other fruit'
WTO 1.33 and 1.36	Tourism

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Identifying domestic RM

Domestic: identifying *response measures*

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- We built a list of policies and measures in Chile for each of the 10 sectors.
- Main sources:
  - Websites of main line ministries
    - Ministry of the Environment (including digital climate database)
    - Ministry of Energy
    - Ministry of Transport
  - Third BUR of Chile (2018)
  - London School of Economics and Political Sciences Climate Change Laws of the World database
  - OECD Database on Policy Instruments for the Environment
  - Desk research

Domestic: identifying *response measures (5)*

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- Narrowed down by labour-intensive policy-by-policy check on several criteria:
  - *Deleting duplications* between databases
  - Can it be considered a *climate change mitigation policy*
    - Direct policy: policy is meant to limit GHG emissions
    - Indirect policy: policy can have significant GHG mitigation co-benefits
  - Policy is *enacted in the sector* (or a closely related sector) to one of the identified 10 Chilean sectors

Domestic: identifying *response measures (6)*

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- This process is also subjective in nature
  - Researcher used own judgement to determine which policies stay on the list
- For each sector we therefore have a list of policies:
  - that are climate change related
  - that could have impacts on the identified Chilean sectors of the economy

Domestic: Sectors and policies

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- **Domestic sector 1: 3510 Electric power generation**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to energy efficiency and renewable energy promotion
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on electricity generation and consumption
Coal phase out pledge	Pledge made in June 2019 – relevant due to impacts on electricity generation. Linked to carbon neutrality pledge
Law 19.657	Geothermal energy
Law 19.940	Allowing for non-conventional RE plants to be connected to the grid
Law 20.780	C02 tax for stationary installations
Law 20.698	Incentives for non-conventional RE
Law 20.571	Green tax on stationary installations above 50MW thermal power capacity, allows for very small RE to provide power to the grid
Law 20.257	Non-conventional RE quota for utilities
Law 20.365	Tax exemptions for solar thermal systems
Solar strategic program	Strategy for development of solar RE

Domestic: Sectors and policies

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- **Domestic sector 1: 3510 Electric power generation (continuation)**

Main Chilean policies and measures	Short description
Energy roadmap 2018-2022	Short term energy roadmap
Coal phase out pledge	Pledge made in June 2019 – relevant due to impacts on electricity generation. Linked to carbon neutrality pledge
National energy agenda (Energia 2050)	Energy related targets (30% reduction in marginal cost of electric energy by 2018, 20% energy matrix non-conventional renewables by 2025, reduction in energy consumption by 2025)
Net billing law	Net billing law
Energy efficiency action plan (PAE2020)	Short term energy efficiency action plan
Energy efficiency program in public buildings (PEEP)	Program for promoting energy efficiency in public buildings
Energy strategy 2015	RE target of 60% by 2035 and 70% by 2050
Mitigation plan for the energy sector	Enshrining targets made in energy strategy 2015
Renewable energy for self-consumption	Promotion of small-scale RE for households and industry

Domestic Track

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- We have identified a list of 10 Chilean sectors through our methodology as most vulnerable to the impacts of response measures implemented in Chile

- We have identified policies in Chile which could impact the 10 identified Chilean sectors

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Assessing the impacts of domestic RM

Domestic: quantitative analysis

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- Again, used the **ECOGEM-Chile 2** Model

- adapted in order to simulate the specific shocks the relevant policies could have on the Chilean economy.

- Two policies chosen for quantitative analysis:
  1. Domestic coal phase out
  2. Domestic CO2 tax

Domestic coal phase out

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- Chilean government announced a **coal phase out by 2040** in June 2019
- To assess **economic, social and environmental impacts** of policy, modelling team compared baseline values of the variables of interest with the values of these same variables **after the shock is imposed**.
- Consequently, what is relevant is the magnitude and direction (increase or decrease) of the change in each of the variables.
  - First need to define **an initial baseline trajectory** for **electricity generation** and then **apply the shock**.
  - ECOGEM 2 Model **cannot** endogenously impose a coal phase out shock, necessary to **impose the shock exogenously**.
  - For the shock needed to run a simulation imposing the new generation shares for coal phase out.
  - The impacts of these generation shares on the economy are then assessed

Domestic coal phase out (2)

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- Five energy scenarios (A-D) based on the prospective **long-term energy planning scenarios** built by the **Chilean Energy Ministry** (2017) using a bottom-up modelling approach up to **2046**.
- **Scenario C** chosen for the case study, experts and officials from the Energy Ministry believe it to be **most accurate projection,** see below for table of Scenario C:

FACTORS	EXPECTED VALUE
Social acceptability of projects	Low
Energy demand	Medium
Technological change in battery storage	Current
Inclusion of environmental externalities	Current
Investment costs for renewable technologies	Medium
Fossil fuel prices	Low

Domestic coal phase out (2)

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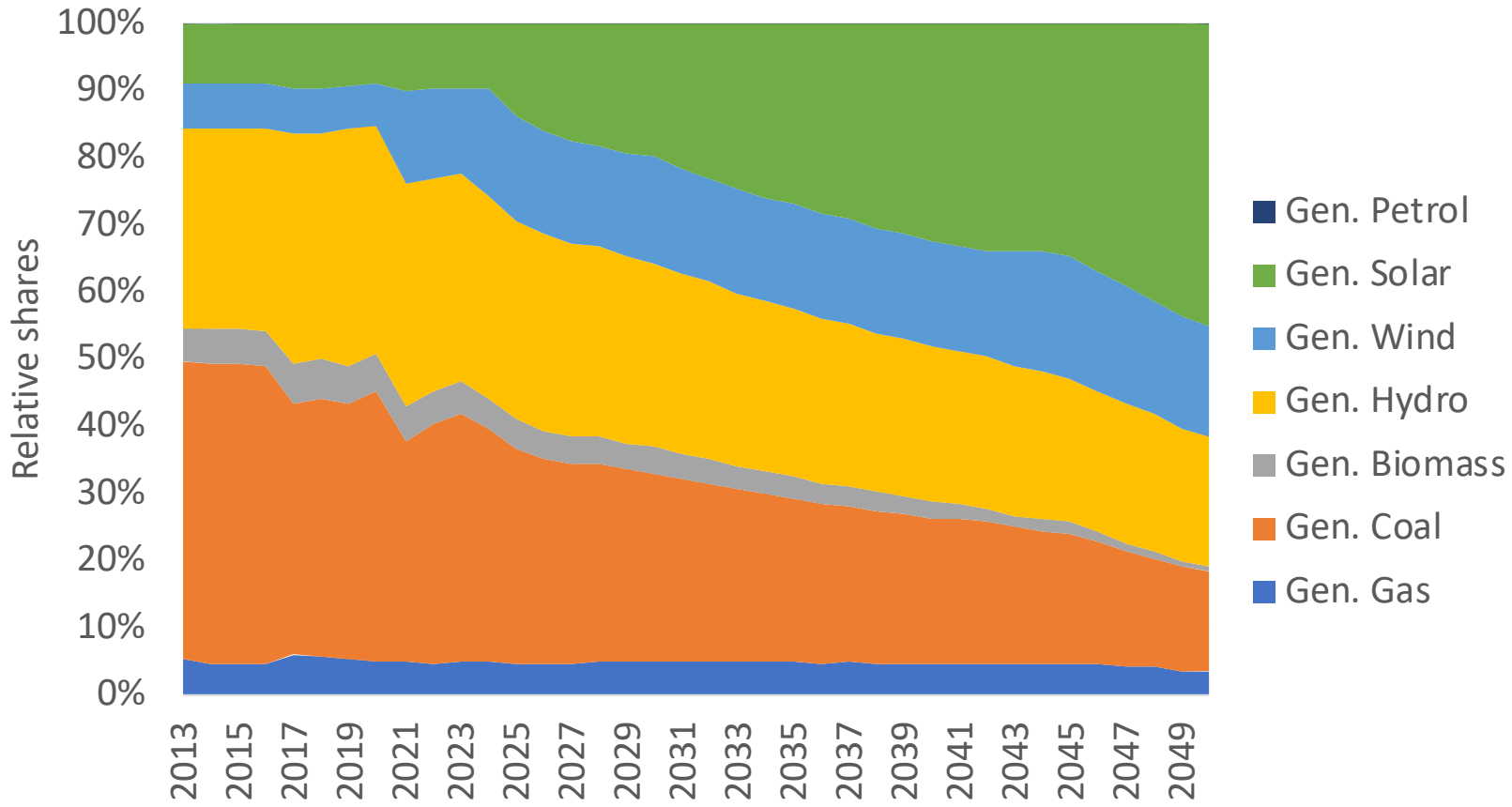
Baseline electricity generation



Domestic coal phase out (2)

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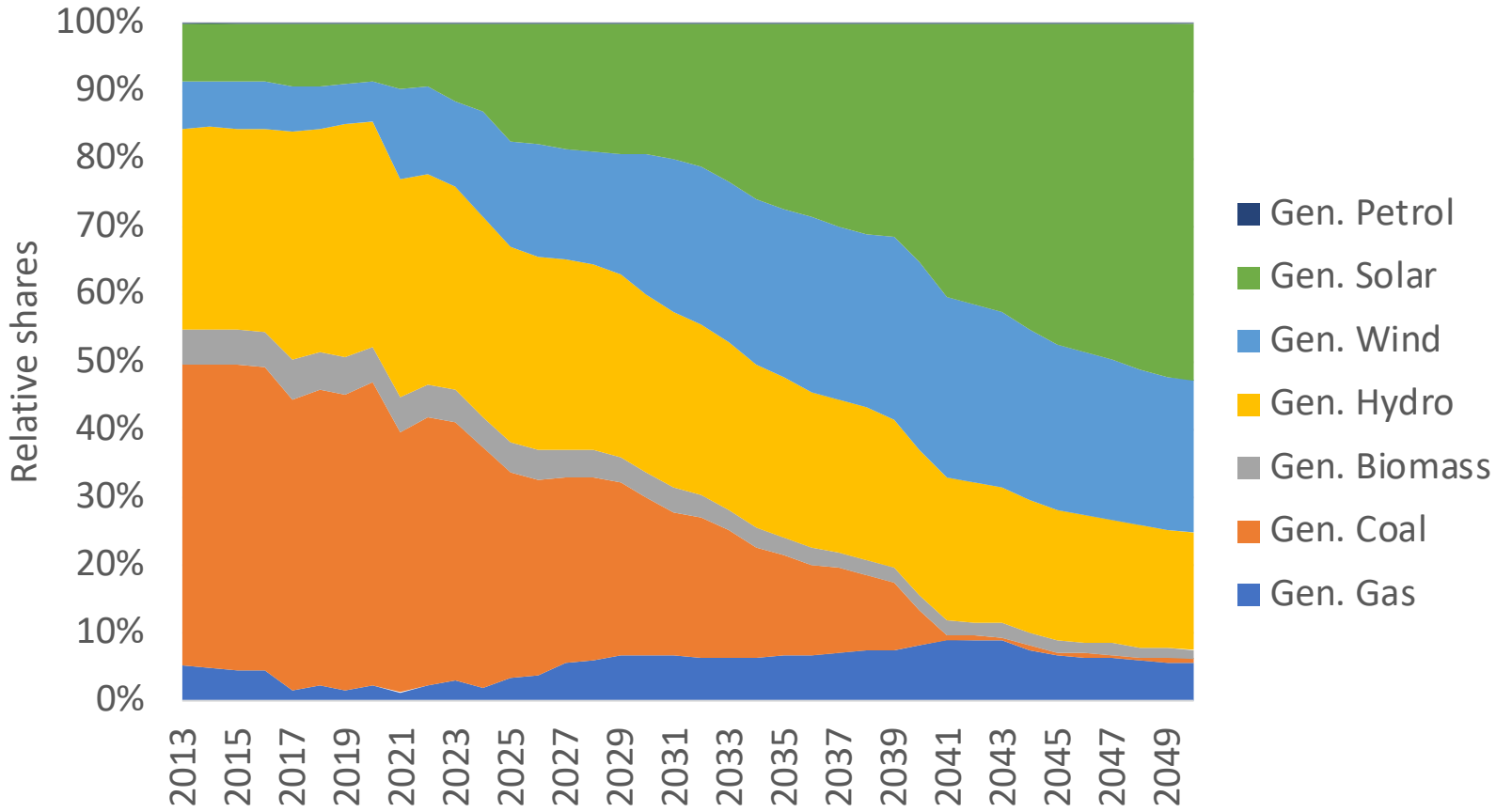
Modelled electricity generation



Domestic coal phase out (3)

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Economic impacts

- Imposing the coal phase out **increases** price of electricity.
- Reduces GDP slightly across all periods compared to baseline scenario.
- **Impact on GDP**, see below is higher when policy first introduced, decreasing after 2040.

	2020	2030	2040	2050
Change in GDP	-0,13%	-0,13%	-0,12%	-0,05%

Domestic coal phase out (4)

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Environmental impacts

- However, the coal phase out has a significant impact on GHG emissions.
- Reduction is significant:

	2020	2030	2040	2050
Change in CO2 emissions	0,88%	-2,37%	-7,78%	-7,18%

Domestic coal phase out (4)

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Sectoral Impacts

- Variety of impacts across sectors of the Chilean economy.

Agriculture (including grapes and other fruits) (ISIC 0121-0126)	0,07%	-0,01%	-0,04%	0,04%
Aquaculture (ISIC 032)	0,01%	-0,07%	-0,13%	-0,02%
Fishing (ISIC 031)	0,09%	-0,03%	-0,09%	0,03%
Coal production	2,45%	-8,92%	-31,28%	-33,51%
Copper (ISIC 0729)	-0,46%	-0,42%	-0,47%	-0,34%
Paper products	-0,28%	-0,19%	-0,09%	-0,01%
Gas generation	-48,17%	66,86%	105,53%	84,60%
Coal generation	-0,46%	-21,93%	-71,12%	-95,79%
Biomass generation	-7,48%	-10,87%	-8,30%	63,04%
Hydro generation	-10,18%	-10,06%	-13,58%	-16,02%
Wind generation	-9,44%	20,67%	66,82%	28,46%
Solar generation	-11,97%	-9,96%	1,18%	9,24%
Petrol generation	-3,50%	-3,57%	-3,23%	-2,90%

Domestic coal phase out (5)

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Effects on Income

- Income falls in all periods for all income deciles as a direct consequence of the fall in GDP. The impacts however are somewhat lower for the lowest decile (hh1) and the highest decile (hh10).

Deciles	2020	2030	2040	2050
hh1	-0,05%	-0,07%	-0,12%	-0,08%
hh2	-0,10%	-0,15%	-0,26%	-0,17%
hh3	-0,12%	-0,17%	-0,29%	-0,18%
hh4	-0,13%	-0,18%	-0,30%	-0,19%
hh5	-0,13%	-0,19%	-0,31%	-0,19%
hh6	-0,13%	-0,19%	-0,30%	-0,19%
hh7	-0,13%	-0,18%	-0,29%	-0,18%
hh8	-0,13%	-0,17%	-0,25%	-0,16%
hh9	-0,13%	-0,16%	-0,22%	-0,14%
hh10	-0,12%	-0,14%	-0,18%	-0,12%

Domestic CO2 tax

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- Law 20.780 in 2014 implemented a CO2 tax of 5 USD/tonne of CO2 emitted by large stationary sources, with a thermal power greater than 50 MW in the power and industry sectors are covered by the tax.
- Past research shows currently insufficiently high to incentivize significant GHG mitigation action by the operators of these installations,
  - Research concludes that it serves more to raise tax revenue rather than incentivize emission reductions.
- May be revisited in light of carbon neutrality pledge
  - For analysis in this case study focused on three possible levels the current tax could be increased to: 15, 25 and 50 USD/tonne of CO2

Domestic CO2 tax (2)

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- **ECOGEM 2 Model** used
- simulated a tax on all CO2 emissions, that will increase the relative cost of using more polluting energy sources.
- model endogenously finds a new equilibrium where sectors that use polluting sources substitute away from them, or reduce their production.
- model imposes the tax on all CO2 emissions from a variety of sectors, not only those covered by the currently implemented CO2 tax.
- Baseline used is when CO2 tax started in 2018, with a value of 5 USD per ton of emitted CO2.
- Scenario C also used in this example.
- Imposing a CO2 taxes increases the price of energy, but reduces CO2 emissions.

Domestic CO2 tax (3)

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Macroeconomic impacts

- The increase in energy prices comes with a cost to GDP growth, as shown below

	2020	2030	2040	2050
50 USD	-0.062%	-0.140%	-0.263%	-0.417%
30 USD	-0.030%	-0.137%	-0.259%	-0.332%
15 USD	-0.010%	-0.083%	-0.164%	-0.184%

Domestic CO2 tax (3)

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Environmental impacts

- largest impacts are in 2040,
  - 15 USD tax =12% reduction in CO2 emissions,
  - 50 USD tax = 31% reduction in CO2 emissions.

	2020	2030	2040	2050
50 USD	-11.2%	-32.3%	-30.7%	-23.3%
30 USD	-7.8%	-24.1%	-22.8%	-16.2%
15 USD	-4.0%	-12.5%	-11.6%	-8.1%

Domestic CO2 tax (4)

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Sectoral impacts

- Variety of **direct impacts** on different sectors of the economy.
- Although these sectors were **not** among those considered vulnerable throughout this methodology, such as the power generation sector (**petrol-fueled generation**) sees major impacts, see below:

	15 USD CO2 tax				30 USD CO2 tax				50 USD CO2 tax			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Petrol-fueled power generation	-12,1	-29,3	-43,9	-62,6	-23,7	-49,0	-69,3	-86,8	-37,5	-66,9	-84,4	-94,6

Domestic CO2 tax (5)

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Sectoral impacts

- Variety of **indirect impacts** on different sectors of the economy.
- most relevant sectors are
  - paper production impacted negatively, as cost of using CO2 heavy fuels increases
  - wind and solar electricity production, impacted positively as competitiveness improves as do not have to pay tax

	15 USD CO2 tax				30 USD CO2 tax				50 USD CO2 tax			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Wind generation	3,1	13,3	30,5	44,5	6,3	27,8	70,5	106,5	10,1	40,8	105,4	163,3
Solar generation	2,9	19,9	29,9	23,7	5,9	41,7	64,5	57,6	9,4	59,6	92,4	98,3
Paper products	-0,5	-0,3	-0,2	-0,1	-1,3	-0,8	-0,6	-0,4	-2,3	-1,7	-1,3	-0,8

Domestic CO2 tax (6)

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Effects on Income

- minor when compared to the impacts on some specific sectors
- Despite decrease in GDP, incomes actually increase over all deciles compared to baseline scenario.
- possible explanation:
  - energy and labor are substitutes to a certain degree in the model,
  - higher energy prices leads to energy being substituted with labour – increase in employment and wages.
- See next slide for table

Domestic CO2 tax (7)

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Impacts on household incomes across deciles (%), relative to the baseline scenario:

	15 USD CO2 tax				30 USD CO2 tax				50 USD CO2 tax			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
HH1	0,01	0,14	0,3	0,4	0,03	0,29	0,66	0,89	0,04	0,44	1,01	1,42
HH2	0,04	0,3	0,63	0,81	0,08	0,62	1,36	1,8	0,12	0,96	2,07	2,85
HH3	0,04	0,34	0,71	0,92	0,1	0,71	1,54	2,04	0,15	1,09	2,36	3,24
HH4	0,05	0,35	0,75	0,98	0,1	0,75	1,64	2,18	0,16	1,15	2,51	3,46
HH5	0,05	0,36	0,78	1,01	0,11	0,77	1,69	2,26	0,17	1,19	2,6	3,59
HH6	0,05	0,36	0,78	1,03	0,1	0,76	1,71	2,3	0,16	1,18	2,63	3,67
HH7	0,04	0,35	0,78	1,04	0,1	0,76	1,72	2,33	0,16	1,08	2,65	3,72
HH8	0,04	0,33	0,75	1,02	0,09	0,71	1,66	2,29	0,14	1,11	2,57	3,67
HH9	0,03	0,30	0,71	0,99	0,07	0,65	1,59	2,23	0,12	1,04	2,47	3,6
HH10	0,02	0,26	0,67	0,95	0,05	0,59	1,51	2,17	0,08	0,94	2,35	3,52

Domestic: qualitative analysis

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- Qualitative assessment of the two domestic policies examined in this case study was **not undertaken**, as quantitative assessment yielded **satisfactory results**.
- However, the methodology does provide an overview on how the analysis of the social, economic and environmental impacts of a measure could be done
- For example
  - For **domestic coal phase out**: would look at environmental impacts in terms of decrease in air pollution, economic and social impacts such as increased cost to sectors, resultant regional job losses and retraining needs.
  - For **domestic carbon tax**: would look at current studies on the current design of the tax and analyse the alternative scenarios for a higher tax.

Possible tools and support which may be needed to address the impacts.

Possible tools and support which may be needed to address the impacts.

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- **Step 9** in case study, last step

- Reporting under BURs and BTRs
  - countries can highlight what support they could use with respect to addressing impacts.
- Assessing impacts ex-ante allows for identification and preparation of tools
- Serves to enhance efficient policymaking, decreasing overall potential costs and ensuring buy-in for the low-carbon transition among stakeholders.

Possible tools and support which may be needed to address the impacts. (2)

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- Many countries already have **domestic tools** available, even if not directly geared towards addressing impacts of response measures.
- However, discussion on **international cooperative approaches** still in its early phases
  - Progress needed for these international tools as could be particularly well suited to mitigating the impacts of international policies
    - Capacity building

International tools

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Possible international cooperative approaches.

- May operate at regional or global level.
- Examples of such tools and approaches are the Technology Mechanism, the Green Climate Fund, the Adaptation Committee, the Capacity Building Framework and the REDD+ Framework.
- Policies can also be adapted / designed differently to mitigate some impacts;
  - ex: giving extra leeway for least-developed countries in international policies (CORSIA).

Domestic tools

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Domestic measures:

- cost alleviation domestic safety nets, worker training/retraining and adjustment programmes and economic diversification efforts.

- Support and capacity-building, which are central issues for various mitigation tools.

Main challenges and barriers overall

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- *Difficulty in finding and collecting data at the required level*
- *Research burden*
- *Language constraints*
- *Modelling constraints*
- *Lack of awareness*

Conclusions

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- Study provides significant step for developing detailed methodology for analysing RM,
- Providing starting point + template for others to follow and adapt, for BUR reporting, and the eventually BTR reporting.
- Found that
  - Overall number of important domestic and international RM is:
    - Relatively limited
    - Concentrated in a limited number of sector
  - Limited number of policies could impact many sectors
    - International: international transportation

Conclusions (2)

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- Methodology describes time- and labour-intensive process, will need to be adapted somewhat to national circumstances of country using it for reporting on RM under BUR and then BTR.
  - Dependent on national circumstances, economic structure, key sectors, strength of institutions and engagement of stakeholders.
- Way to simplify methodology:
  1. Limit number of sectors that are deemed vulnerable;
  2. Limit the number of response measures analysed;

Back up slides

International: Sectors and policies

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International sector 2: 0122-0126 Cultivation of other fruit.

Main products are nuts and fresh fruit, including: coconuts, cherries, brazil nuts, cashew nuts, almonds, hazelnuts etc

International sector 2: 0122-0126 Cultivation of other fruit					
China	USA	Netherlands	United Kingdom	Columbia	International transport
Measures for the Administration of Organic Product Certification.	U.S. Fish and Wildlife Service Mitigation Policy.	Sectoral emission trading system in horticulture	Common Agricultural Policy (CAP) Greening	Resolution No. 3.002 - Provisions on the labeling of agricultural inputs.	CORSIA (for air freight)
Rules of the Environmental Protection Administration of the Executive Yuan governing the environmental protection labeling product application and review.	Federal and state level organic food labelling initiatives	Common Agricultural Policy (CAP) Greening	Food (Provisions relating to Labelling) (England, Wales, NI) Regulations 2003 (S.I. No. 2647 of 2003).		IMO climate change related measures
			The England Rural Development Programme		
			Organic Products Regulations 2001 (S.I. No. 430 of 2001).		

International: Sectors and policies

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International sector 3: 19 Manufacture of coke and refined petroleum products. Main products is non-calcinated petroleum coke (input for aluminum, steel and titanium smelting industry)

International sector 3: 19 Manufacture of coke and refined petroleum products				
China	USA	India	Peru	Argentina
National ETS	The President's Climate Action Plan.	National Action Plan on Climate Change.	Decree Nº 011-2015-MINAM – National Strategy on climate change (ENCC).	Renewable energy and rational use of energy law
Subnational ETS pilots	Clean air act			
13th Five-Year comprehensive energy-saving and emission reduction work plan.	United States Mid-Century Strategy for Deep Decarbonization.			
China National Plan for Tackling Climate Change (2014-2020).	Carbon pricing initiatives (RGGI, California ETS)			
Industrial Green Development Plan (2016-2020).				

International: Sectors and policies

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International sector 4: 17 Manufacture of paper and paper products.

Main products include: multi-ply paper and paperboard, unbleached sack kraft paper, newsprint, self-adhesive paper and paperboard (top 4 account for nearly 95% of exports)

International sector 4: 17 Manufacture of paper and paper products				
China	Republic of Korea	Netherlands	Japan	'Other Asia'
National ETS	Act on Encouragement of Purchase of Environment-Friendly Products.	CO2 Emission Trading System (ETS)	N/A	N/A
Subnational ETS pilots	Act on Encouragement of Purchase of Green Products.	International co-operation actions in industry		
13th Five-Year comprehensive energy-saving and emission reduction work plan.	Enforcement Decree of the Framework Act on Low Carbon, Green Growth (Presidential Decree No. 22124 of 2010).	Decree No. 183 containing rules relative to packing, packing waste, paper and cardboard.		
China National Plan for Tackling Climate Change (2014-2020).	Act on the Promotion of Saving and Recycling of Resources			
Industrial Green Development Plan (2016-2020).	Framework Act on Low Carbon, Green Growth.			

International: Sectors and policies

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International sector 5: 2011 Manufacture of basic chemicals.

Many products, top 10 cover 90% of exports, including: lithium carbonates, iodine, nitrate of potassium, molybdenum oxides and hydroxides, methanol, lithium oxide and hydroxide and fungicides

International sector 5: 2011 Manufacture of basic chemicals				
China	USA	Republic of Korea	Brazil	Belgium
13th Five-Year comprehensive energy-saving and emission reduction work plan.	The President's Climate Action Plan.	Enforcement Decree of the Framework Act on Low Carbon, Green Growth (Presidential Decree No. 22124 of 2010).	National Plan on Climate Change (PNMC)	IP-A02 : Long Term Energy/CO2 efficiency Agreements in the industrial sector. Stage 2
National ETS	Clean air act	Framework Act on Low Carbon, Green Growth.	Possible Brazil ETS	EU ETS
China National Plan for Tackling Climate Change (2014-2020).	Environmental protection (ICS 13.020), Products of the chemical industry (ICS: 71.100)	Korea ETS		
Industrial Green Development Plan (2016-2020).	Carbon pricing initiatives (RGGI, California ETS)			
Subnational ETS pilots				

International: Sectors and policies

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International sector 6: 0121 cultivation of grapes.

Includes fresh and dried grapes – fresh grapes accounts for nearly 90% of exports

International sector 6: 0121 cultivation of grapes					
China	USA	Republic of Korea	Netherlands	United Kingdom	International transportation
Measures for the Administration of Organic Product Certification.	Federal and state level organic food labelling initiatives	Act on Promotion of Environment-friendly Agriculture and Fisheries, and Management and Support for Organic Foods	Common Agricultural Policy (CAP) Greening	Common Agricultural Policy (CAP) Greening	CORSIA (for air freight)
Rules of the Environmental Protection Administration of the Executive Yuan governing the environmental protection labeling product application and review.	U.S. Fish and Wildlife Service Mitigation Policy.	Support for quality certification of eco-friendly agricultural products; import and safety control of LMO; origin control; grading of livestock products; traceability system		Food (Provisions relating to Labelling) (England, Wales, NI) Regulations 2003 (S.I. No. 2647 of 2003).	IMO climate change related measures
		Improved regulations on labelling of environmentally friendly agricultural product		Organic Products Regulations 2001 (S.I. No. 430 of 2001).	
				The England Rural Development Programme	

International: Sectors and policies

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International sector 7: 1102 manufacture of wines.

Products include: wine of fresh grapes, wine in various container sizes and

International sector 7: 1102 manufacture of wines				
China	Japan	USA	Brazil	United Kingdom
Announcement No. 63 of 2008 of Ministry of Environmental Protection promulgating the cleaner production standard for wine industry.	Technical criteria of Certification of Importer concerning the Organic Agricultural Products and the Organic Agricultural Processed Foods (Notification No. 821).	Federal and state level organic food labelling initiatives	Law No. 7.465 on the obligation of using biodegradable packaging.	Food (Provisions relating to Labelling) (England, Wales, NI) Regulations 2003 (S.I. No. 2647 of 2003).
China National Plan for Tackling Climate Change (2014-2020).		The President's Climate Action Plan.	National Plan on Climate Change (PNMC).	CAP - wines amendments Wales and Scotland
Measures for the Administration of Organic Product Certification.		Clean air act	Possible Brazil ETS	Organic Products Regulations 2001 (S.I. No. 430 of 2001).
Rules of the Environmental Protection Administration of the Executive Yuan governing the environmental protection labeling product application and review.		Carbon pricing initiatives (RGGI, California ETS)		

International: Sectors and policies

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International sector 8: 032 aquaculture.

Many products, but top 10 account for just under 90% of exports. Main products include fillets of pacific salmon, Atlantic salmon, frozen pacific salmon etc.

International sector 8: 032 aquaculture				
China	Japan	USA	Russian Federation	Brazil
Directions on Issuing the Organic Labeling Approval Operations Document of Imported Aquatic Products and Aquatic Processed Products.	Technical criteria of Certification of Importer concerning the Organic Agricultural Products and the Organic Agricultural Processed Foods (Notification No. 821).	Federal and state level organic food labelling initiatives	N/A	Law No. 7.465 on the obligation of using biodegradable packaging.
China National Plan for Tackling Climate Change (2014-2020).	Aviation fuel tax			
Measures for the Administration of Organic Product Certification.				
Rules of the Environmental Protection Administration of the Executive Yuan governing the environmental protection labeling product application and review.				

International: Sectors and policies

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International sector 9: 031 fishing.

Many products, main 10 products cover just under 90% of exports. Main products include: pacific salmon (fresh, chilled or frozen), atlantic salmon (fresh, chilled or

International sector 9: 031 fishing					
China	Japan	USA	Russian Federation	Brazil	International transportation
Directions on Issuing the Organic Labeling Approval Operations Document of Imported Aquatic Products and Aquatic Processed Products.	Aviation fuel tax	Federal and state level organic food labelling initiatives	N/A	Law No. 7.465 on the obligation of using biodegradable packaging.	CORSIA (for air freight)
Rules of the Environmental Protection Administration of the Executive Yuan governing the environmental protection labeling product application and review.	Technical criteria of Certification of Importer concerning the Organic Agricultural Products and the Organic Agricultural Processed Foods (Notification No. 821).				IMO climate change related measures
Directions on Issuing the Organic Labeling Approval Operations Document of Imported Aquatic Products and Aquatic Processed Products.					

International: Sectors and policies

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International sector 10: WTO 1.33 and 1.36 Tourism.

Main items are: Travel and expenditure on various categories. Europe and Americas account for more than 90% of arrivals.

USA	Spain	Peru
Federal and state level aviation fuel taxes (at least 28 States have aviation fuel levies)	National policy on alternative energy in transport	Supreme Decree No. 013-2016-MINAM – Creates a Multisectoral Working Group in charge of proposing measures to improve air quality at the national level linked to vehicle emissions and establishes provisions on air quality.
The President's Climate Action Plan.	Airport carbon footprinting accreditation	Resolution Nº 202/07 / CONAM - Maximum permissible emission limits for motor vehicles.
Clean air act	EU ETS - aviation	Supreme Decree No. 003-2017-MINAM – Approves Environmental Quality Standards (ECA) for Air.
Carbon pricing initiatives (RGGI, California ETS)	Regional taxes on aviation	Decree Nº 011-2015-MINAM – National Strategy on climate change (ENCC).
		Supreme Decree No. 100/11 / PCM - Modifies Supreme Decree No. 047/01 / MTC, Maximum Permissible Limits of polluting emissions for motor vehicles that circulate in the road network.
		Supreme Decree No. 211/07 / EF - Selective Consumption Tax considering the criterion of proportionality to the degree of harmfulness of fuels.
		Biofuel Production and Commercialisation Law with amendments

International: Sectors and policies

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Roundtable on Climate Change and Sustainable Transition

International sector 10: WTO 1.33 and 1.36 Tourism.

Main items are: Travel and expenditure on various categories. Europe and Americas account for more than 90% of arrivals.

Russian Federation	Netherlands	United Kingdom	Belgium	Argentina	International aviation policies
N/A	Emission Trading System (EU ETS)	Emission Trading System (EU ETS)	Emission Trading System (EU ETS)	Taxes on petrol and gasoline	CORSIA
		Duty on hydrocarbon fuels		Decree Nº 543/2016 – Mandated bioethanol percentage	
				Law Nº 26.093 and others on promotion of production and consumption of biofuels	

Domestic: Sectors and policies

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- **Domestic sector 2: 4923 Freight transport by road**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to decarbonization of transportation
Labelling of new vehicles	Includes carbon intensity/fuel efficiency features in labelling of new vehicles
2014-2018 Atmospheric decontamination strategy	Targets black coal (diesel transportation)
Infrastructure projects	Including expansion of Santiago subway and construction of new railway infrastructure
Green zone for transportation in Santiago	Development of a green transportation zone in Santiago
Law 20.780	Tax on sale of lightweight vehicles
E-mobility strategy	Includes e-mobility targets, such as 40% of private cars and 100% of public transportation electric by 2050
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on transport emissions

Domestic: Sectors and policies

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- **Domestic sector 3: 17 Manufacture of paper and paper products**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to re/afforestation and forest management implications
Sustainable forest management scheme	Sustainable development and recovery of 100,000 hectares of forest land - Part of NDC
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on LULUCF
National strategy on climate change and vegative resources	Strategy on LULUCF and climate mitigation
Energy efficiency policy	Likely to include energy efficiency targets for all industrial sectors
Native Forest Law	Policy on forest management

Domestic: Sectors and policies

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- **Domestic sector 4: 51 Air transport**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of transport emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on transport emissions
Emissions reduction plan in the aviation industry	Policy on reducing emissions in the aviation sector

Domestic: Sectors and policies

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- **Domestic sector 5: 19 Manufacture of coke and refined petroleum products**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of process emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on process emissions
Clean production agreement	Likely relevant – more research necessary
Energy efficiency policy	Likely to include energy efficiency targets for all industrial sectors

Domestic: Sectors and policies

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- **Domestic sector 6: 2011 Manufacture of basic chemicals**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of process emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on process emissions
Clean production agreement	Likely relevant – more research necessary
Energy efficiency policy	Likely to include energy efficiency targets for all industrial sectors

Domestic: Sectors and policies

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- **Domestic sector 7: 0729 Mining of copper**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of process emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on process emissions
Clean production agreement	Likely relevant – more research necessary
Energy efficiency policy	Likely to include energy efficiency targets for all industrial sectors

Domestic: Sectors and policies

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- **Domestic sector 8: 1020 Processing and preserving of fish, crustaceans and mollusks**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of process emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on process emissions
Clean production agreement	Likely relevant – more research necessary
Energy efficiency policy	Likely to include energy efficiency targets for all industrial sectors

Domestic: Sectors and policies

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- **Domestic sector 9: 0122-0126 Cultivation of other fruit**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of LULUCF emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on LULUCF emissions
Clean production agreement	Likely relevant – more research necessary
Carbon sequestration through sustainable soil management	Promotion of soil management in LULUCF sector to enhance carbon sequestration
National strategy on climate change and vegative resources	Strategy on LULUCF and climate mitigation

Domestic: Sectors and policies

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- **Domestic sector 10: WTO 1.33 and 1.36 Tourism**

Main Chilean policies and measures	Short description
National climate change plan 2017-2022 (PANCC 2017-2022)	National short term plan, mainly relevant due to coverage of transport emissions
Carbon neutrality pledge	Pledge made in June 2019 – relevant due to impacts on transport emissions
2014-2018 Atmospheric decontamination strategy	Targets black coal (diesel transportation)
Emissions reduction plan in the aviation industry	Policy on reducing emissions in the aviation sector

Background on response measures (4)

- A few examples of potential socio-economic impacts:
  - Impacts on tourism industry due to levies on international aviation
  - Increased costs of imports and exports due to measures on international maritime transportation
  - Loss of competitiveness for agricultural producers due to climate-related food labeling in importing jurisdictions