

Climate Change in Small Open Economies: The Case of Andorra

Catalina Michelle Tejada

SIP/2025/153

IMF Selected Issues Papers are prepared by IMF staff as background documentation for periodic consultations with member countries. It is based on the information available at the time it was completed on February 9, 2024. This paper is also published separately as IMF Country Report No 24/58.

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Prepared by Michelle Tejada

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ABSTRACT: Climate change is macro-critical to Andorra: with (mostly winter) tourism accounting for one third of its economy, Andorra is directly exposed to climate change—shorter winter seasons, declining snow falls, higher costs from artificial snow making are all negatively affecting the economy’s main business. Because of its higher altitude, Andorra is more resilient than other winter tourism locations in the region and should use this window of opportunity to enact needed policies. The authorities’ climate change strategy—with ambitious goals—is focused on mitigation. Using the Climate Policy Assessment Tool (CPAT), this paper analyzes the feasibility of achieving the decarbonization objective under different scenarios of carbon tax and efficiency gains. The results show that achieving the decarbonization objectives would require very substantial efficiency gains in the power, transport, and residential sectors and a considerable increase in the carbon tax and. The adaptation component of the government’s climate change strategy is paramount given the macro-criticality of climate change but is still at an incipient stage.

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SELECTED ISSUES PAPERS

Climate Change in Small Open Economies: The Case of Andorra

Principality of Andorra

Prepared by Catalina Michelle Tejada

CLIMATE CHANGE IN SMALL OPEN ECONOMIES: THE CASE OF ANDORRA¹

Climate change is macro-critical to Andorra: with (mostly winter) tourism accounting for one third of its economy, Andorra is directly exposed to climate change—shorter winter seasons, declining snow falls, higher costs from artificial snow making are all negatively affecting the economy's main business. Because of its higher altitude, Andorra is more resilient than other winter tourism locations in the region and should use this window of opportunity to enact needed policies. The authorities' climate change strategy—with ambitious goals—is focused on mitigation. Using the Climate Policy Assessment Tool (CPAT), this paper analyzes the feasibility of achieving the decarbonization objective under different scenarios of carbon tax and efficiency gains. The results show that achieving the decarbonization objectives would require very substantial efficiency gains in the power, transport, and residential sectors and a considerable increase in the carbon tax and. The adaptation component of the government's climate change strategy is paramount given the macro-criticality of climate change but is still at an incipient stage.

A. Introduction

1. **Climate change has become a macro-critical issue, particularly in economies such as Andorra with low diversification and sectors highly dependent on climate.** Global warming presents a major threat to the country's long-term growth and has a direct impact on its wellbeing given its economic dependence on tourists visiting during the ski season. Measures taken now to fight the climate crisis will create a more resilient and greener economy.
2. **Andorra's tourism sector is particularly vulnerable to climate change.** The number of days with sufficient accumulation of snow in the Pyrenees for various alpine skiing activities are decreasing, and the snow line is migrating towards higher altitudes. The impact of global warming on sky stations will depend on localization, altitude, and management. This could lead to a redistribution of the Pyrenean market between vulnerable and resilient ski resorts, and towards those in higher altitude—which, to some extent, benefits Andorra in the short-to-medium term. Over time, resorts will have to rely more on artificial snowmaking, including those at high altitude. While artificial snowmaking can partially offset the impact of climate change, the higher the temperature the lower the number of resorts that can operate profitably and the shorter the ski seasons. The intensification of global warming could impact landscapes and tourism infrastructure. These will affect touristic attractions and alter the dynamic of tourism flows. In addition, the water demand for snowmaking could lead to conflicts between intensive water-demand sectors.
3. **Energy security and the pace of energy transition would also be impacted by the weather.** Andorra is making efforts to move towards greater use of renewable energy and higher energy efficiency. While energy transition is necessary, it is foreseeable that climate change will

¹ Prepared by Michelle Tejada (EUR).

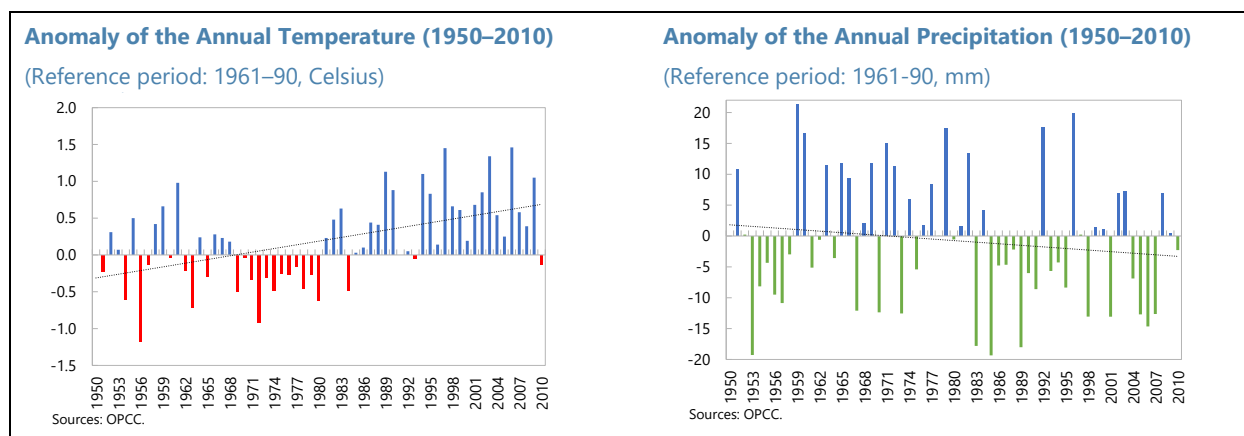
negatively affect the hydropower, thermoelectric and wind production. Moreover, the expected increase in the frequency and intensity of extreme weather could impact energy production and distribution systems. Higher temperatures will also change consumption patterns, with increases in summer energy demand which will be only partly compensated by a decrease in electricity demand for heating in the winter.

4. Andorra has an ambitious climate change and environmental protection strategy with well-development mitigation components, but less developed adaptation components. The strategy has well-designed goals and activities on the mitigation front, focusing on the promotion of renewable energies and high energy efficiency technologies, as well as on ensuring energy saving and efficiency across sectors. While Andorra's global impact on climate is marginal, being at the forefront of the global climate change effort sends positive signals. The adaptation component of the strategy is at an incipient stage and expected to be challenging to implement and costly. Given the country's small size and economic structure dependent on tourism, accelerating the pace of adaptation is crucial for creating a more resilient economy.

5. The focus of this paper is to assess the feasibility and estimated costs of the mitigation agenda, as well as additional policies needed to limit the impact of climate change on the Andorran economy. First, the paper describes climate trends and projections in the country, followed by a stocktaking of the sources of emissions. Next, it summarizes the proposed climate change strategy: its objectives, key targets, and planned activities. Then, using the Climate Policy Assessment Tool (CPAT), the feasibility of achieving the decarbonization objective is assessed under different scenarios of carbon tax and efficiency gains. Lastly, the paper concludes with a policy discussion, including on the important adaptation component of the climate agenda in Andorra.

B. Climate Change and a Shrinking Snow Cover

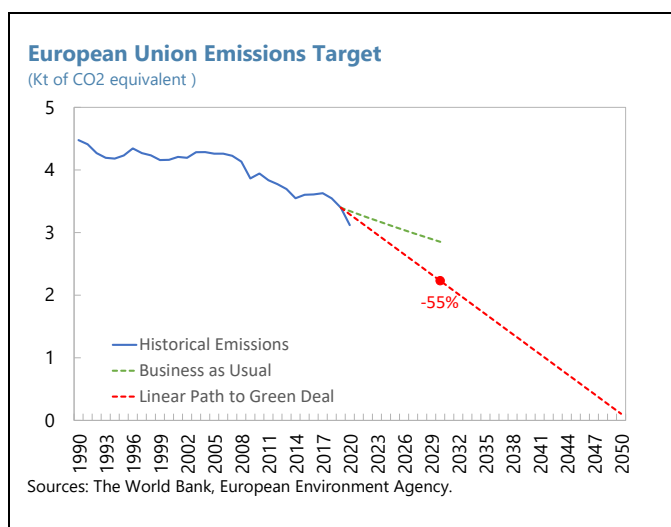
6. Rising temperatures and decreasing annual rainfall are leading to a snow cover decrease in Andorra. Since 1950, the country has experienced an increase in temperature averaging 0.20° per decade—most evident during the summer season—that is resulting in systemically higher annual maximum and minimum temperatures throughout the year. Patterns of precipitation show a tendency towards the shrinking of total pluviometry, including a decrease in the frequency of heavy rain and an increase in dry periods. In turn, annual rainfall has decreased by—22.01 mm per decade since 2050. The reduction in winter precipitation and higher annual temperatures are leading to snow cover decreases in the Pyrenean region.



7. The upward trend temperature is projected to persist in coming decades leading to a further reduction in snow cover. With global warming intensifying, the upward trend in temperature in the Pyrenean region is expected to persist through the 21st century with different intensity depending on the evolution of greenhouse gas concentrations. This will lead to an increase in climate variability and in the temperature and rainfall trends projected, especially in mountainous areas. The projected annual snow cover in Andorra is expected to decline by 75–100cm by 2090 with deep consequences for both the ecosystem and the economy.

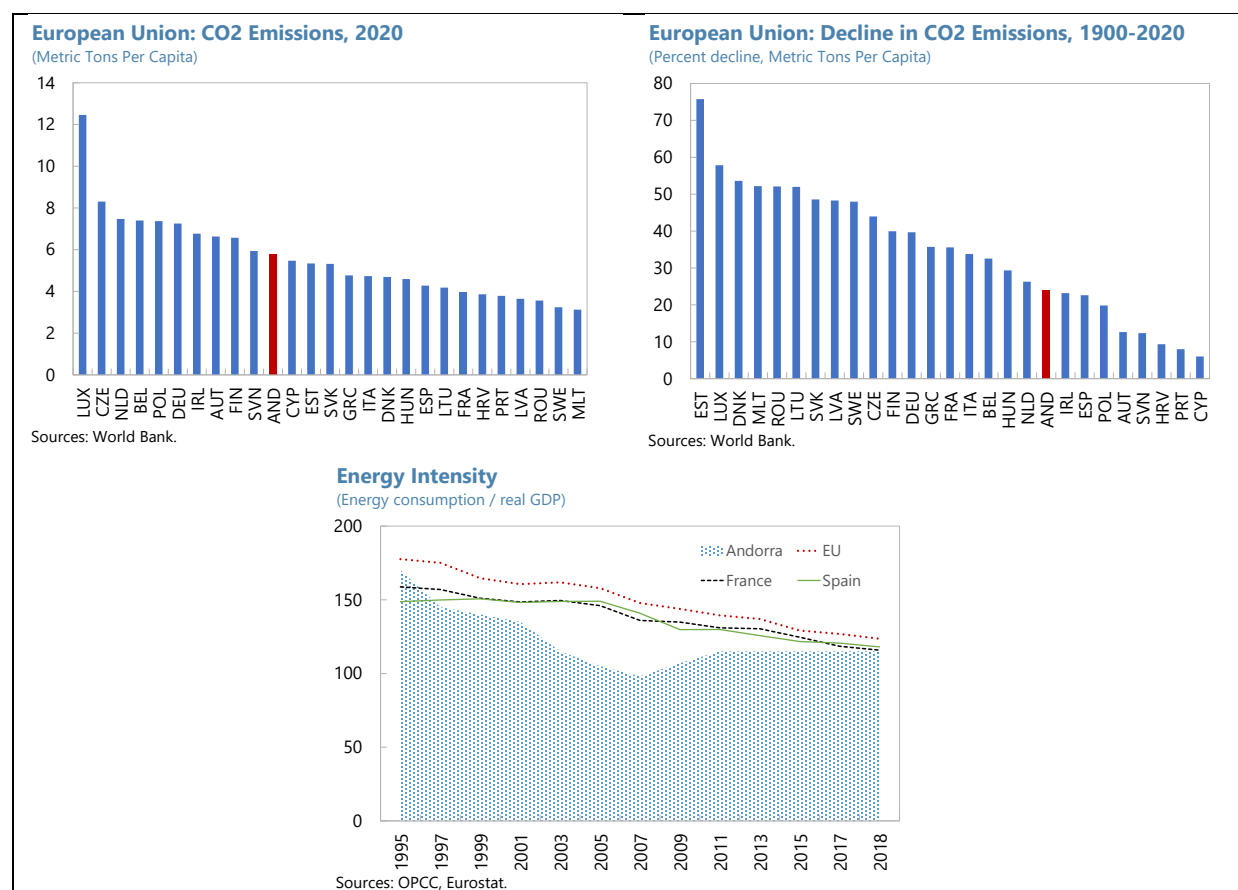
C. Andorra's Emissions at Par with the Region

8. Europe has historically been one of the biggest contributors to global greenhouse gas (GHG) and CO₂ emissions, but the region has made rapid progress to curb it in recent years. The region has produced over 17 percent of cumulative CO₂ emissions since the Industrial Revolution began. Acknowledging this, the EU has set numerous emissions-reduction targets. By 2020, EU emissions were close to 30 percent below 1990 levels thanks to numerous policies and regulations, improved energy efficiency, the EU Emissions Trading Scheme (EU ETS), and structural transformation of the economies. As stated in the European Green Deal, the EU aims to reduce greenhouse gas emissions by at least 55 percent below their 1990 levels by 2030 and to become climate neutral by 2050.



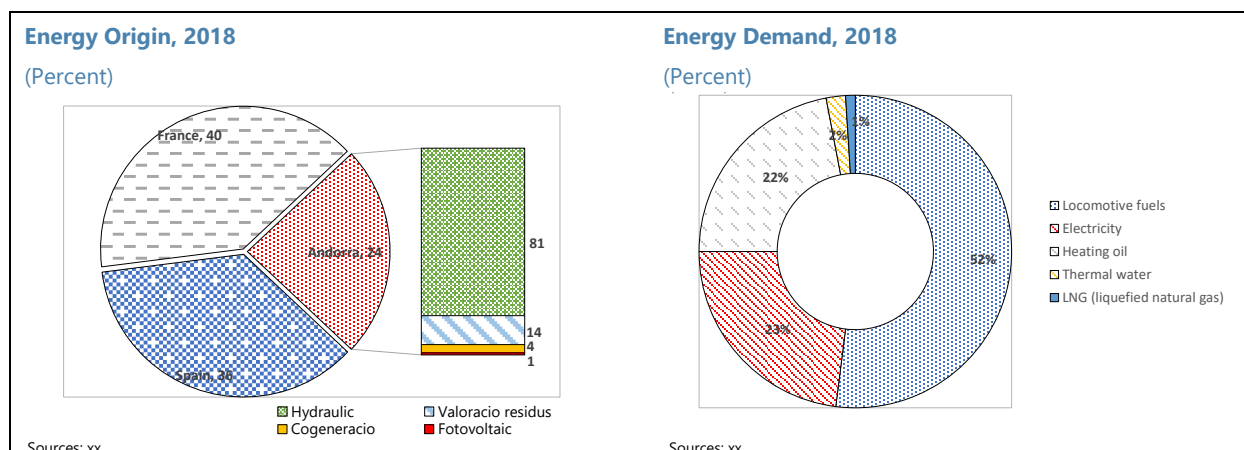
9. Emissions in Andorra are in line with the rest of the region. In turn, CO₂ emissions level in Andorra are at the same level as the EU average, estimated at 5.6 metric tons per capita, slightly higher than its neighboring countries France and Spain. Data from 2017 shows that the country's forest mass absorbs 23 percent of the CO₂ emissions. The percent decline in emissions since 1990 in

Andorra has been lower than the EU's average, as a large proportion of the country's emission come from transport sector, in which emissions have not fallen rapidly enough. Energy intensity—a measure of energy inefficiency of the economy—is also at par with the Eurozone. After a rapid decline, since early 2000s, Andorra's energy intensity has been relatively stable between 98 and 115 units of energy per unit of GDP and is comparable to 118–122 in the Eurozone.



10. Carbon emissions in Andorra are mostly caused by transportation, different than in the rest of the EU. The energy sector emits more than 95 percent of greenhouse emissions in Andorra, and the mobility subsector accounts for more than half of energy demand. Fossil fuels amount to 75 percent of the demand, of which 2/3 are related to mobility. The remaining 25 percent are related to electricity consumption and energy production. In comparison, on average, in the EU 30 percent of the energy demand comes from the transport sector as industry, commercial activity, and agriculture and farming play a bigger role on the economy—sectors that are mostly absent in the Andorran economy. One idiosyncratic feature of Andorra is the significant influence of fuel tourism, with 76 percent of the fuels sold in Andorra for road transport being consumed in the neighboring countries. Although consumption of fossil fuels for road transport constitutes one of the main sources of greenhouse emissions, consumption has stabilized since 2010—despite a continued rise in the size of the fleet—thanks to energy efficiency gains and an increased share of electric vehicles.

11. Andorra has a high external dependency on its energy sources, constituting a risk to the energy supply and the economy during fossil fuel related crisis. Imported electricity from France and Spain amount to 76 percent of the demand, including all energy that is required for the mobility sector. The remaining 24 percent is locally produced, almost all of which comes from renewable sources, of which 81 percent is hydraulic and the remaining is also green.



D. An Ambitious Climate Change Strategy

12. The country is committed to fulfill its Paris Agreement pledges through the Andorra's Climate Change Strategy. Despite being a microstate—with, therefore, a limited impact of their action globally—the Andorran authorities remain firm in their undertaking to fight climate change domestically and in demonstrating their willingness to support the international community to address global warming. The country's strategy seeks to achieve the goals set in Law 21/2018 of September 13, 2018, on the promotion of the energy transition and energy efficiency to combat climate change and encourage the adaptation of society to its effects, reduce energy dependence and strengthen the competitiveness of the economy. It has been drawn up by the Ministry of the Environment, Agriculture and Sustainability and reviewed within the framework of the National Energy and Climate Change Committee.

Box 1. Climate Change Regulatory Framework

The regulatory and strategical framework guiding Andorra's Climate Change and the actions envisaged in the Paris agreement is outlined below:

- *Decree of 29-4-2015 creating the Office of Energy and Climate Change:* The Office of Energy and Climate Change (OECC) is created, which is organically, functionally and budgetarily attached to the ministry that is responsible for the environment.
 - *Nationally Determined Contribution:* reporting statistics on efforts to reduce emissions in accordance with the Paris Agreement. First submitted in 2017 and updated in 2020 and 2022.
 - *National Law 21/2018:* of 13 September, on the promotion of the energy transition and climate change (Litecc).
 - *Sustainable Development Goals:* national strategic plan for the implementation of the United Nations 2030 Agenda for Sustainable Development, approved on 17 April 2019.
 - *Acknowledgement of the climate crisis and the declaration of the state of climate and ecological emergency in January 2020.*
 - *National energy strategy against climate change:* sets Andorra's vision to enable mitigation and adaptation measures over the period 2020-2050.
 - *Edict of the 27-1-2021:* call for grants from the Renova program for the improvement of the national real estate park, the improvement of the energy efficiency of buildings and the use of renewable energies for 2021.
 - *Andorran strategy for environmental education for sustainability:* approved in 2022.
 - *Green Fund:* the 2022 general budget law creates within the state budget a Green Fund for the energy transition and the fight against climate change.
 - *Carbon Tax:* as an additional element of the general branch of the excise tax on hydrocarbons whose use general GHG emissions.
 - *Law 25/2022 on circular economy (LEC):* to promote the transition towards a circular economy.
 - *Law 31/2022* for the development and diversification of the livestock and agricultural sectors.
- Multiple decrees to regulate emissions, energy efficiency, transport, among others.*

13. The strategy has clear objectives and key sectoral targets to achieve decarbonization, especially on mitigation. The goal is to reduce 37 percent of non-absorbed emissions compared to 2005 levels by 2030, and to achieve carbon neutrality by 2050 (see Table 1)². It also seeks to reinforce the country's resilience to the effects of climate change. To achieve these objectives the strategy outlines key sectoral targets for 2030 and 2050. On mobility, it seeks to reduce 50 percent of internal emissions, to have 20 percent of electric vehicles by 2030, and to achieve decarbonization by 2050. On buildings, the strategy aims to reduce consumption by 40 percent by 2030 and to achieve decarbonization by 2050. On the electricity sector, it aims to increase the share of locally produced electricity from 24 percent to 33 percent by 2030 and to 50 percent by 2050, reducing the country's external dependency and its resulting vulnerability. The overall targets on energy consumption are similar to those adopted by other European countries. However, given Andorra's

² The authorities plan to revise the target on reduction of non-absorbed emissions from 37 to 55 percent by 2030.

disproportionate size of the transport sector—driven in large part by visitors and fuel tourism—the largest gains would have to come from progress in the mobility sector.

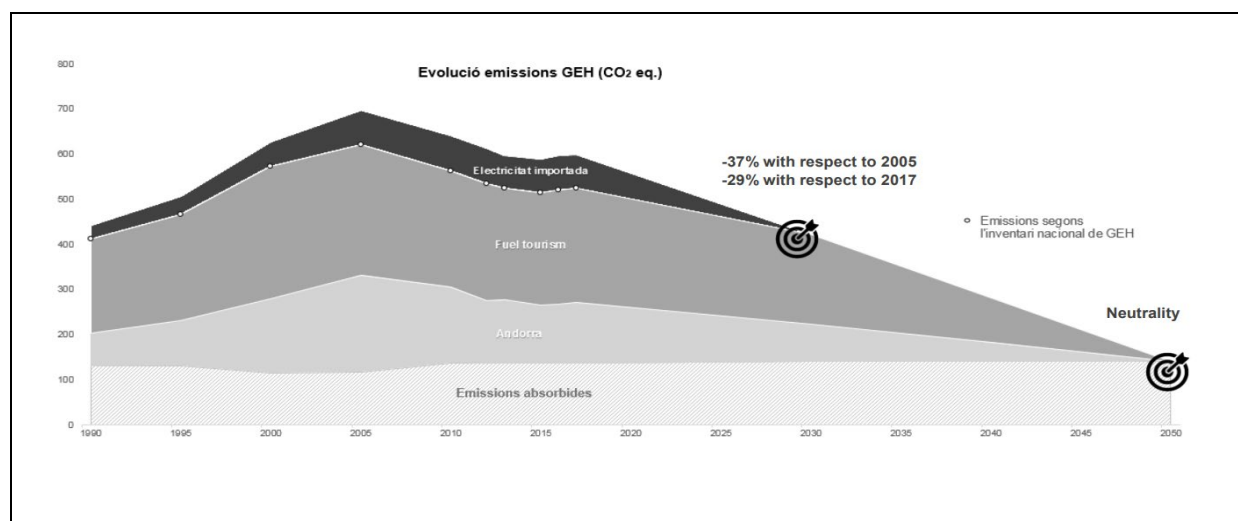


Table 1. Andorra's Climate Change Strategy: Key Sectoral Targets

Year	Overall Targets	Sectoral Targets		
		Mobility	Buildings	Electricity
2030	Reduce 37 percent of non-absorbed emissions compared to 2005.	<ul style="list-style-type: none"> Reduction of 50 percent internal emissions from mobility. 20 percent electric vehicles. 	Reduce consumption by 40 percent.	<ul style="list-style-type: none"> 33 percent electricity consumption from national production. 100 percent imported electricity with zero emissions.
2050	Decarbonization	Decarbonization	Decarbonization	50 percent electricity consumption from national production.

14. The key activities of the strategy are outlined in five actions programs (see Table 2).

These seek to reach carbon neutrality by 2050, develop a climate change adaptation plan, structure a funding system to carry out the planned actions, sensitize and educate the population on the topic, and to conduct the needed research and innovation tasks needed to understand and respond to the environmental and technological challenges that lie ahead.

Table 2. Andorra's Climate Change Strategy: Programs and Activities

Decarbonization	Adaptation and Resilience	Financing Tools	Social Transition	Innovation, Research and Observation
<ul style="list-style-type: none"> • Energy transition. • Sustainable, connected, and safe mobility. • Agriculture and forest management respectful towards the territory's sink capacity. • Circular economy. • Industry and use of industrial products. 	<ul style="list-style-type: none"> • Plan for adaptation to climate change. • Promotion of nature-based solutions for greater resilience. 	<ul style="list-style-type: none"> • National carbon credit market and renewable energy. • Green Fund and other taxation tools. 	<ul style="list-style-type: none"> • Sensitization and dissemination on carbon neutrality. • Educational transition. • Training to achieve carbon neutrality. • User information and protection. • Participation of the different agents in the process to achieve carbon neutrality. 	<ul style="list-style-type: none"> • Innovation • Research and knowledge transfer. • Systemic observation.

15. The strategy creates an ambitious and binding policy plan to coordinate the measures and projects aimed at combating climate change:

- *On climate mitigation*, the strategy focuses on the promotion of renewable energies and high energy efficiency technologies, aiming to increase national production of electricity, while ensuring that it remains at least 80 percent renewable (domestic production is currently entirely renewable).
- *On climate adaptation*, the authorities have been conducting an analysis to identify the impact of climate change on the socio-economic and environmental sectors and design adaptation strategies that allow an effective increase in the resilience of the territory.
- *Cross-cutting measures* include incentivizing citizens' behavioral changes, public and private sustainable finance (i.e., Green Fund), carbon pricing, and other market mechanisms. *Other measures* include waste management and circular economy, and measures related to ecosystem services, biodiversity, land use, and agriculture.
- *International cooperation* is also important. Andorra is a member of the Pyrenees Climate Change Observatory and the Ibero—American Network of Climate Change Agencies.

Climate Mitigation

16. The authorities have outlined key measures to accelerate energy transition towards its decarbonization objective. These include improving the electricity sector, promoting renewable energies and high-efficiency energy technologies, and encouraging energy savings and energy efficiency, particularly in construction. Forces Elèctriques d'Andorra (FEDA), the electricity SOE, is executing the needed infrastructure and digitalization investments.

17. The electrification and improvements to mobility are also at the center of the authorities' mitigation efforts. The transport sector represents 56 percent of GHG emissions in Andorra and 52 percent of the energy demand. The national mobility strategy seeks first to prioritize public transport and promote motorized or assisted non-public mobility (i.e., walking, biking, etc.) and, secondly, electrify motorized mobility with clean energy. The authorities are studying alternative means of transport including cable transport; and the possibility of requiring companies with more than one hundred workers to have collective and sustainable mobility plans. The promotion of electric mobility in both the private and public mobility fleets would facilitate the energy transition with a reduction in dependence on fossil fuel consumption and an increase in the use of renewable sources of energy. It must be accompanied with the implementation and management of the charging infrastructure for electric vehicles throughout the country. Given the importance of tourist cars, improvements in car efficiency in neighboring countries, a development outside of Andorra's remit, will be key to advancing mitigation.

18. The authorities are also working on other sectors contributing to climate change, even if to a lesser extent. These include: i) the promotion of agriculture and forest management cognizant of the territory's sink capacity; ii) a move towards a circular economy that allows for greater savings in the consumption of raw material, energy, and water; and iii) ensuring the development of a green economy with high value-added industries based on clean and sustainable technologies.

Climate Adaptation

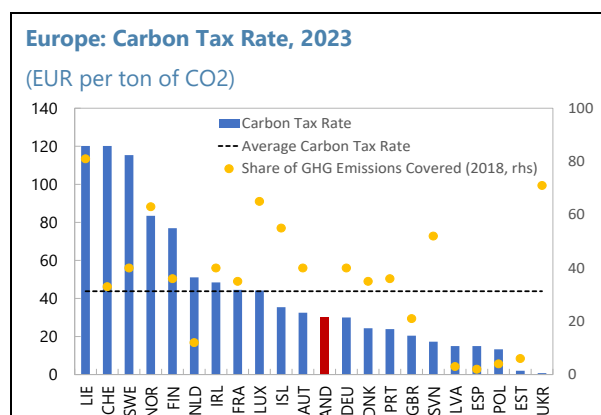
19. As the impact of climate change is already noticeable in the country, accelerating adaptation is essential to increase socio-economic and environmental resilience. Guaranteeing the quality and supply of water and maintaining the tourist appeal of the Pyrenees, among other things, should be vital parts of the adaptation efforts. Most of the focus has been on assessing the vulnerabilities of Andorra to climate change and identifying the needed adaptation measures to address them. A participatory process was carried out in 2014 to assess the vulnerabilities of the country to global warming which led to an initial roadmap. Further studies are being conducted to identify needed adaptation measures, assess their cost, and design a monitoring system to oversee progress; as well as improving the definition of impact indicators and adaptation measures. In line with Litecc priority sectors, the focus is primarily on tourism, energy, health, and agriculture sectors. At this stage, it is imperative to further develop the components on climate adaptation and accelerate their implementation to strengthen the country's resilience to climate change.

Financing Tools

20. Decarbonization and adaptation are expensive and require appropriate financing tools. The authorities are setting up various financing vehicles, but the resources allocated may still be insufficient and need to be scaled up. The full cost of implementing the climate change strategy is unknown at this stage as a greater understanding of the adaptation efforts is needed before it can be assessed. The authorities are also putting in place a voluntary and regulated emission offset system.

21. The Government established a Green Fund to help finance the country's climate change mitigation and adaptation initiatives. It is primarily intended to finance aid programs already in operation such as the Engega Plan which incentivizes the purchase of electric vehicles or the Renova program which improves the energy efficiency of buildings, and to provide universal access to public transportation. This Fund is incorporated into the draft general budget law every year and is sustained by earmarked taxes, complementary budgetary allocation provided for in the State's general budget laws, as well as donations and contributions from other sources.

22. The authorities introduced a carbon tax in 2022 to incentivize emissions reduction and to partially support the Green Fund, but the level is below the European average. The tax rate of the CO₂ branch is set at €30 per ton of carbon dioxide equivalent, half of which is assumed by the government, thus mitigating the impact of the implementation of the measure. The current carbon tax is below the regional average of €42 per ton of CO₂, and well below the level required to bring a significant decline in emissions. The IMF estimates that a floor of USD75 per ton of CO₂ is needed for advanced economies to reduce emissions by 29 percent by 2030, and more recent estimates suggest a rate of €120 per ton of CO₂ would be needed in 2030 to decarbonize by 2050 in euro area countries.



23. The required infrastructure for energy transition is being financed by FEDA and the private sector. To this aim, FEDA has a 5-year investment plan at cost of €208.80 million (7.43 percent of 2024 GDP) that is currently being executed (see Table 3).

Table 3. Andorra: FEDA: Investment Plan—Main Projects (2024–28)

Subsector	Area	Millions of EUR	Percent of 2024 GDP
Electricity	Generation	97.62	3.47
	Transmission	45.01	1.60
	Distribution	8.34	0.30
Heating	Generation	9.70	0.35
	Distribution	19.56	0.70
Mobility	Electric charge	1.32	0.05
	Mobility	2.03	0.07
Waste	Environment	0.70	0.02
	Efficiency	10.32	0.37
General	Digitalization	9.34	0.33
	Others	4.86	0.17
Total		208.80	7.43

24. The issuance of green bonds and other tax tools are also expected to support climate policies. All public debt issues since 2021, amounting to EUR1.175 billion, provide financing to be used under the “Green, social and Sustainability Framework”. Green bonds help to allocate funds to climate policies.

E. Climate Policy Assessment Tool: Applying the Model to Andorra

25. This paper uses the CPAT toolkit to assess the feasibility of the decarbonization objective in Andorra. It was jointly developed by the IMF and the World Bank and covers over 200 countries as a tool to help policymakers design and implement effective, efficient, and equitable climate change policies to achieve their climate mitigation targets and development goals jointly. It is a “model of models” that allows to estimate the economic and non-economic effects of climate mitigation policies such as carbon pricing and fossil fuel subsidy reform, among others. It has four key components: mitigation, distribution, air pollution, and transport modules. Depending on data availability for the country, the model helps to assess the impact of climate policies on energy and emissions, the macroeconomy, distributional impact, and development co-benefits.

26. Given data limitations and the focus of this paper, our analysis focuses only on the CPAT mitigation model. It relies on a reduced-form macro-energy model for estimating impacts of climate mitigation policies on energy consumption, prices, GHGs by sector, local air pollutants, revenue, GDP, and welfare. The module uses projections of income growth and fuel prices to project consumption by energy sources (fossil fuels, other non-renewables, or renewables) across economic sectors (power, residential, transport, and industries). The model distinguishes energy consumption in the power, industry, transport, buildings, and other sectors; and distinguishes energy sources by fossil fuels and electricity.

27. The general equation for energy demand is as follow:

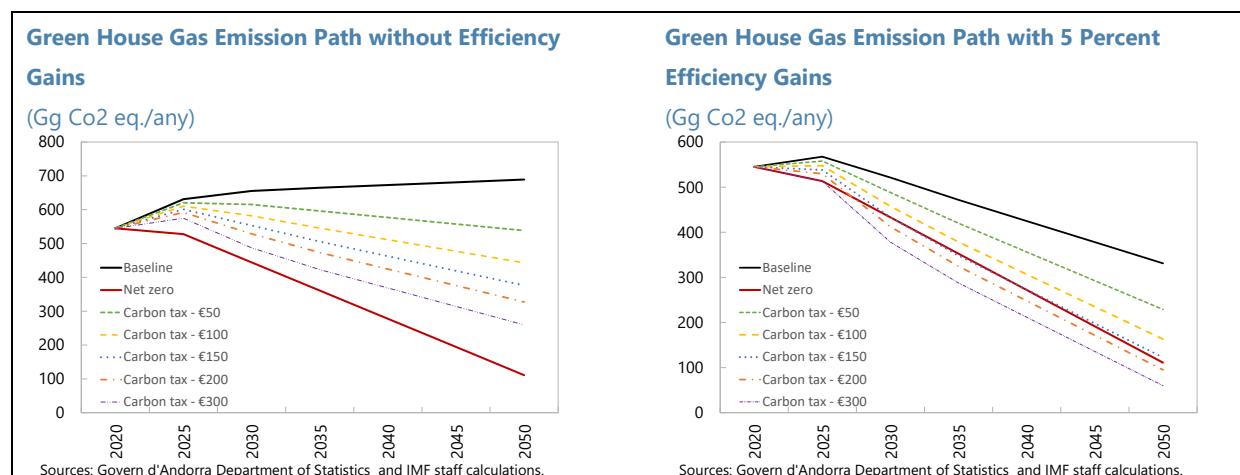
$$E_t = \left(\frac{u_t}{u_{t-1}} \times \frac{h_t}{h_{t-1}} \right) \times E_{t-1}$$

Sector-specific demand for energy source E	=	Change in usage of energy- consuming products in that sector	x	Change in energy consumption rate in that sector	X	Previous sectoral demand for energy
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28. ...which could be re-written as follow:

$$E_t = E_{t-1}^{Ei} \left(\frac{GDP_t}{GDP_{t-1}} \right)^{v_t} \left(\frac{1}{(1+a)} \right)^{1+n^u} \times \left(\frac{p_t}{p_{t-1}} \right)^{n^h+n^u+n^h n^u}$$

Sectoral demand for energy E in sector year t	=	Previous year's demand	x	Growth effect	x	Exogenous technical change effect (less rebound)	x	Price effect. Own price elasticity, endogenous efficiency, and rebound (increased efficiency increases energy demand)
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29. In the CPAT mitigation model, energy efficiency is associated with an autonomous annual energy efficiency improvement parameter. This parameter captures the productivity gains achieved from improvements in technical efficiency and gradual retirement of older, less efficient capital with newer, more efficient capital (e.g., power plants, cars, etc.). The typical pace of improvement typically varies by sector. For example, between 2020 and 2020 the efficiency of energy of vehicles improved by 1.7 percent, while that of residential buildings rose by an annual average of 1.3 percent. Productivity improvement at power plants varies. For coal, annual average productivity growth of 0.5 percent is expected; while for natural gas, nuclear, and hydro, there is more room for productivity improvement, with annual growth estimated at 1 percent annually. In the case of renewables, the costs have declined rapidly, and productivity growth rate of 5 percent have been observed. In the CPAT model, the energy efficiency parameter is set at around 0.5–1 percent annually in the baseline scenario—and increased for the scenario analysis presented

below—and the rates vary across sectors and fuels to reflect assumed differences in rates of technological change.

Results

30. Achieving decarbonization in Andorra would require a significant increase in the carbon tax and very ambitious efficiency gains. This can be assessed by comparing the different scenarios with the net zero by 2050 path, at which point the total emissions produced and the amount that are removed from the atmosphere are balanced. Based on the estimates for Andorra, the decarbonization target can be achieved by increasing the carbon tax to €150 per ton by 2030 accompanied by efficiency gains of at least 5 percent in the power, transport, and residential sectors. However, efficiency gains of at least 5 percent as suggested in the model could be too ambitious to achieve with existing technologies and the current pace of innovation, especially because of a large share of the emissions come from the transport sector and is largely exogenous. This means, that for Andorra to achieve carbon neutrality, a major overhaul of the transport system is essential, including through a reduction in the absolute number of vehicles transiting in the country and a transition towards cleaner and more efficient transport for both locals and tourists.

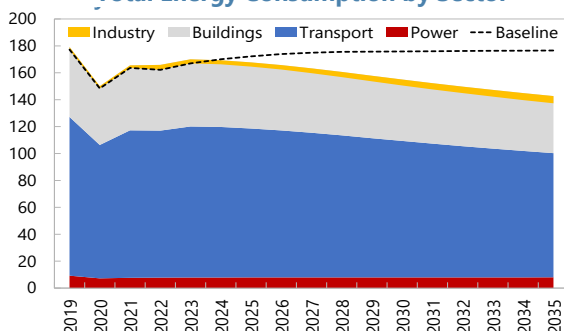
31. The carbon tax without additional energy efficiency measures is insufficient to achieve carbon neutrality in Andorra. The responsiveness of emissions to pricing and other policies depends on induced changes in energy prices and fuel price responsiveness in different sectors. In advanced economies, the use of pricing tools alone fails to reduce emissions rapidly as income and price elasticities of energy are low, especially in Europe where energy intensity is already lower than in other regions thanks to existing policies.

32. The proposed carbon tax and efficiency gains would have some implications for macroeconomic variables and energy consumption. The increase in the carbon tax has macroeconomic implications primarily through the taxation of household consumption and firms' energy inputs, and the corresponding income and price elasticities. In the case of Andorra, the projected decline in energy consumption is mostly driven by increasing energy efficiency, as the carbon tax alone—which would mostly impact the mobility sector—is not estimated to bring sizable changes to consumption patterns in Andorra. The impact on the macroeconomy of a carbon tax of €150 per ton by 2030 with and without additional efficiency gains is estimated as following:

- Fiscal revenues from fossil fuel excises are estimated to reach between 0.5–0.8 percent of GDP depending on efficiency gains.
- Impact on GDP growth is estimated to be limited. However, the model does not account for the potential impact of the tax on fuel tourism and its potential weigh on growth.
- The carbon tax will have implications for energy prices, potentially leading to an over 100 percent increase in oil prices, while other sources of energy are expected to increase between 26 and 61 percent depending on the energy type.

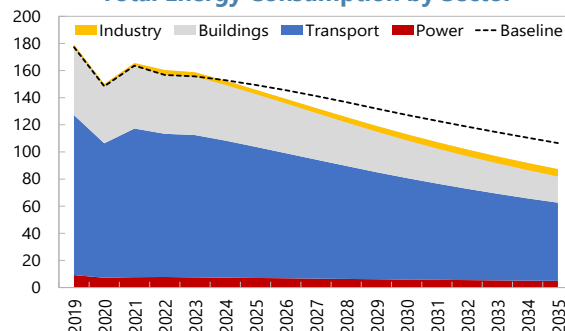
Figure 1. Andorra: CPAT Results: Energy Consumption and Macroeconomic Effects Under Different Scenarios

**Scenario of Carbon Tax of €150 per ton
Without Efficiency Gains**
Total Energy Consumption by Sector



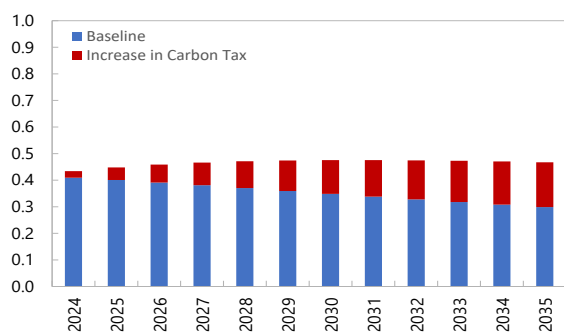
Sources: CPAT and IMF staff calculations.

**Scenario of Carbon Tax of €150 per ton With
Efficiency Gains of 5 percent**
Total Energy Consumption by Sector



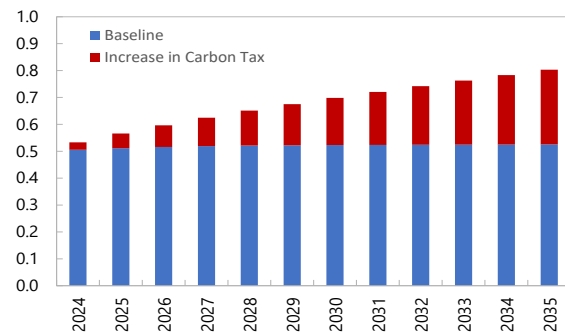
Sources: CPAT and IMF staff calculations.

Fiscal Revenues from Fossil Fuel Excises



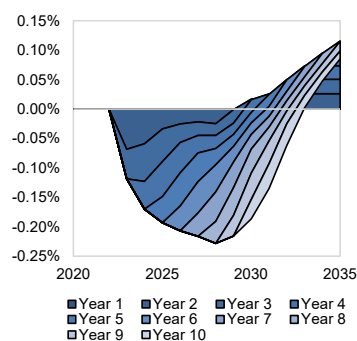
Sources: CPAT and IMF staff calculations.

Fiscal Revenues from Fossil Fuel Excises



Sources: CPAT and IMF staff calculations.

GDP Impacts by Year



Energy Price Changes for \$150/tCO₂ in 2030 (Weighted by Consumption)

Fuel	Unit	Baseline	Baseline + - Carbon tax	% change
Gasoline	US\$ per liter	1.49	1.89	26%
Diesel	US\$ per liter	1.27	1.72	35%
LPG	US\$ per liter	0.66	0.95	44%
Kerosene	US\$ per liter	0.69	1.12	61%
Oil	US\$ per barrel	65.3	140.5	115%
Coal	US\$ per gigajoule (GJ)	13.35	13.35	0%
Natural gas	US\$ per gigajoule (GJ)	18.34	27.28	49%
Electricity	US\$ per kwh	0.01	0.01	0%

Sources: CPAT, Andorra authorities, and IMF staff calculations.

F. Policy Discussion

33. Andorra's climate change strategy is ambitious and comprehensive, but it is not clear if enough to achieve decarbonization objectives. The authorities have well-designed initiatives on mitigation, but more is needed on the adaptation front. Because of its higher altitude, Andorra is more resilient than other winter tourism locations in the region, but it is still impacted, and should use this window of opportunity to enact needed policies.

34. While some elements of the strategy have funding identified there are still financing gaps. On the mitigation front, FEDA's investment plan is so far the most concrete. The Green Fund is aiding in the allocation of resources to key projects in the transport sector and energy efficiency of buildings but may need to be scaled up. In addition, as shown in the analysis above, raising the carbon tax gradually, but proactively, could help to achieve the decarbonization objective.

35. Pricing tools need to be complemented with large scale energy efficiency improvements. Efficiency gains of at least 5 percent as suggested in the model could be too ambitious to achieve with existing technologies and innovation. A large proportion of the emissions in Andorra are from the transport sector which relies heavily on fossil fuels, of which a large share comes from foreign car which are subject to regulations in the owners' countries. Therefore, among other measures, a major transformation of the transportation sector and a ramp up of renewable energy is needed to achieve a sharp decline in emissions, including a reduction in the economic reliance on fuel tourism.

36. Adaptation efforts should accelerate given the country's dependence on winter tourism. The proposals on adaptation are still at a more incipient stage, mostly at the research and design stage. It is therefore important to understand the feasibility and estimated costs of climate adaptation policies as the structural transformation and infrastructure required on this front are expected to be challenging to implement and costly. Partly thanks to adaptation measures applied on the tourism sector, recent large increases in the number of tourists through the year illustrate the potential of diversifying tourism away from the winter season. Enhancing the resilience of the tourism sector, reducing its seasonality, are useful. However, the structural change required to achieve this is a slow and resourceful process that requires the authorities' attention.

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