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Comparative study of subnational best practices for the energy transition

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Acronyms and Abbreviations

ACT	Australian Capital Territory
AEE	Agentur für Erneuerbare Energien / Agency for Renewable Energies (Germany)
AEEP	Agencia de Energía del Estado de Puebla / Energy Agency of the State of Puebla (Mexico)
ANAAE	Asociación Nacional de Autoridades Ambientales Estatales / National Association of State Environmental Authorities (Mexico)
APSC	Arkansas Public Service Commission (United States)
ASEA	Agencia de Seguridad, Energía y Ambiente / Security, Environmental, and Energy Agency for the Hydrocarbons Sector (Mexico)
AUD	Australian Dollars
BRL	Brazilian Real
CENACE	Centro Nacional de Control de Energía / National Energy Control Center (Mexico)
CENAGAS	Centro Nacional de Control del Gas Natural / National Natural Gas Control Center (Mexico)
CESA	Clean Energy States Alliance
CFE	Comisión Federal de Electricidad / Federal Electricity Commission (Mexico)
CNH	Comisión Nacional de Hidrocarburos / National Hydrocarbons Commission (Mexico)
CNPE	Conselho Nacional de Politica Energética / National Council for Energy Policy (Brazil)
CONUEE	Comisión Nacional para el Uso Eficiente de la Energía / National Commission for the Efficient Use of Energy (Mexico)
CRE	Comisión Reguladora de Energía / Energy Regulatory Commission (Mexico)
DG	Distributed generation
DSM	Demand-side management
EERS	Energy Efficiency Resource Standards
EPA	Environmental Protection Agency (United States)
EPM	Empresas Públicas de Medellín (Colombia)
EU	European Union
EV	Electric vehicle
EvIS	Evaluación de Impacto Social / Social Impact Evaluation (Mexico)
EVO	Richtlinie zur Unterstützung der Energiewende vor Ort / Policy to Support Local Energy Transition (Germany)
FAPESC	Federação da Agricultura e Pecuária do Estado de Santa Catarina / Federation of Agriculture and Livestock of the State of Santa Catarina (Brazil)
FECAM	Fundo Estadual de Conservação Ambiental e Desenvolvimento Urbano / State Fund for Environmental Conservation and Urban Development (Rio de Janeiro, Brazil)
FENOGE	Fondo de Energías No Convencionales y Gestión Eficiente de la Energía / Fund for Non-Conventional Energies and Energy Efficiency (Colombia)
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit / German Technical Cooperation (Germany)
GW	Gigawatt
GWh	Gigawatt-hour

IADB	Inter-American Development Bank
ICM	Iniciativa Climática de México / Climate Initiative of Mexico
ICMS	Imposto sobre Circulaçao de Mercadorias e Serviços / Tax on Circulation of Goods and Services (Brazil)
IEKK	Integriertes Energie- und Klimaschutzkonzept / Integrated Energy and Climate Protection Concept (Germany)
IÖW	Institut für Ökologische Wirtschaftsforschung / Institute for Ecological Economy Research (Germany)
kW	Kilowatt
LaNECC	Laboratorio Nacional de Energía Comunitaria y Cooperativa / National Laboratory for Community and Cooperative Energy (Mexico)
LIE	Ley de la Industria Eléctrica/ Electricity Industry Law (Mexico)
LTE	Ley de Transición Energética / Energy Transition Law (Mexico)
MEM	Mercado Eléctrico Mayorista / Wholesale Electricity Market (Mexico)
MW	Megawatt
NDC	Nationally Determined Contribution
OECD	Organization for Economic Co-operation and Development
PEECES	Programa de Eficiencia Energética Caribe Energía Sostenible / Sustainable Energy and Energy Efficiency Programme in the Caribbean (Colombia)
PEMEX	Petróleos Mexicanos / Mexican Petroleum
PV	Photovoltaic
PWC	Parties Working Collaboratively (United States)
RGGI	Regional Greenhouse Gas Initiative (United States)
RPS	Renewable Portfolio Standards
SDG	Sustainable Development Goal
SEDECO	Secretaría de Desarrollo Económico de la Ciudad de México / Ministry of Economic Development (Mexico City)
SENER	Secretaría de Energía / Ministry of Energy (Mexico)
SIEEP	Sistema de Información Energética del Estado de Puebla / Energy Information System of the State of Puebla (Mexico)
SISCLIMA	Sistema Nacional de Cambio Climático / National Climate Change System (Colombia)
SMEs	Small and medium-sized enterprises
TEJ	Programa de Transição Energética Justa / Just Energy Transition Programme (Brazil)
TWh	Terawatt-hour
U.S.	United States
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar

1. The Role of Mexican State Governments in the Energy Transition – Introduction

This report aims to support state-level leadership and action in pursuit of the just energy transition in Mexico, by providing a rationale for state-level action, an analysis of challenges and opportunities, and a toolkit of energy transition measures that Mexican states can consider adopting. Based on international good practices and adapted to the Mexican context, this toolkit seeks to provide the United Mexican States with key information to aid energy transition planning and to replicate, where possible, successes achieved elsewhere.

This introductory chapter of the report discusses why subnational action to advance just energy transitions has become essential in the global effort to create climate-compatible, sustainable societies, and why states are well-positioned to take on a leadership role in this effort. Chapter 2 presents several in-depth case studies identifying good practice examples of state- or province-level action in other countries: Australia, Brazil, Colombia, Germany, and the United States. The following chapter provides an overview of the Mexican legal, political, and socio-economic context for state-level energy sector development (Chapter 3). The good practices presented in Chapter 2, together with the Mexican context described in Chapter 3, form the basis for a toolkit of policies, projects and other measures that Mexican states can consider to advance just energy transitions (Chapter 4). Finally, the conclusion in Chapter 5 summarizes the key findings of the report and discusses next steps in the advancement of subnational just energy transitions in Mexico.

1.1. The role of state governments in just energy transitions

Countries around the world have made commitments and developed plans to reduce greenhouse gas (GHG) emissions in an effort to slow down climate change. Since the power sector is responsible for over 65% of all GHG emissions globally (IEA, 2021), a key priority for governments internationally is to steer transitions from fossil fuels to renewable energy-based systems. These transitions must be just; the costs and benefits associated with them must be distributed equitably. Supported by the right policies, decentralized renewables-based energy systems can produce important benefits in addition to climate mitigation, such as reduced energy poverty, more high-quality jobs, less local pollution, and improvements to public health, as well as more democratic energy governance and broader ownership. United Nations Sustainable Development Goal 7 (SDG 7), which pursues universal access to clean, affordable, and reliable modern electricity, is viewed as an enabler of, or even a precondition to most other SDGs.

It has become widely accepted that national governments cannot achieve the ambitious goals of the 2030 Agenda and the Paris Agreement on climate change alone (see e.g. OECD, 2023). Subnational governments, including states, provinces, and municipalities, are playing an ever-increasing role in advancing energy transitions. In 2019, subnational governments accounted for an average of 69% of climate-related public investment in 32 OECD and EU countries. (OECD, 2022). States, provinces, and cities around the world have adopted their own renewable energy, efficiency, and emissions targets; developed policies and mechanisms to reduce energy consumption, boost renewable energy generation, develop storage capacity, and integrate economic sectors (REN21, 2021); they have also joined international pacts[1] and organized themselves in national and international networks[2]. Some subnational legislatures have taken action to ban developments incompatible with climate change mitigation, such as fracking, new oil and gas exploration, or offshore oil and gas extraction (Wiggins & Hicks, 2017).

States are particularly well-placed to play a key role in driving energy transitions. Firstly, one of the great advantages of decentralized, flexible energy systems based on renewables is that one-size-fits-all solutions no longer need to be found. Renewable energy-based systems are best designed and governed at the subnational level, so that they can be adapted to the geography, climate, and socio-economic context of each region (OECD, 2021). Secondly, in most federal nations, many issue areas relevant for advancing energy transitions fall under states' authority, including land-use policies and zoning, infrastructure planning, and environmental protection. As a result, states are already responsible

[1] E.g. https://ukcop26.org/global-coal-to-clean-power-transition-statement/

[2] E.g. https://www.c40.org/; https://iclei.org/; https://regions20.org/

for much of the implementation of agreements signed at the international level. Thirdly, state-level governments tend to have closer connections to the public and are therefore better positioned than national governments to build support for and public ownership of deep transformations. At the same time, they also often have more authority to manage their own revenue and therefore have greater ability to invest in energy transitions than municipalities. Fourthly, the direct benefits to wellbeing that energy transitions generate, such as employment creation and reduced air and water pollution, are primarily local (OECD, 2021).

1.2. Why do state governments pursue energy transitions?

Global experiences reveal several reasons why subnational governments have pursued action to accelerate just energy transitions. Perhaps the most well-publicized examples are those of states that have intensified climate action in response to inaction or even regression by national governments, such as the "We Are Still In" coalition of US subnational governments in response to then-President Trump's announcement of the United States' withdrawal from the Paris Agreement in 2017.[3] However, there are many other reasons why states promote energy transitions. These include the ambition to demonstrate commitment beyond national renewable energy targets; to gain a first-mover advantage in renewable energy markets and avoid being left with stranded assets; to foster local development, create jobs and attract investment; to reduce energy generation costs; to increase independence from energy imports and reduce vulnerability to price fluctuations; to support underserved communities by providing access to affordable, reliable, and clean energy; to reduce local air pollution and related public health issues; or to respond to pressure from grassroots groups (Mattes et al., 2015).

How exactly state-level governments pursue energy transitions, and the determinants of their success, are highly context-specific. However, some general lessons can be observed. A key requirement is that states have the authority and legislative freedom to make their own energy policy. National governments can support this by undertaking energy market liberalization. They can also actively support the energy transition efforts of subnational governments, including through providing national support schemes such as feed-in tariffs (e.g., Fraser, 2019). States are most successful in their efforts if they have access to effective mechanisms for coordination with other levels of government (including subregions, municipalities, and the national government), other states, and other stakeholders, such as civil society, academia, the private sector, and citizens. Broad and meaningful stakeholder engagement is particularly important for ensuring that energy transitions leave no one behind; for this, states require capacities and structures to empower community participation in and ownership of strategies and interventions (Fraser, 2019; Hoppe & Miedema, 2020; Mattes *et al.*, 2015). Further, state governments need the in-house expertise and human resources to develop ambitious, yet feasible renewable energy policies and roadmaps. Finally, states need access to funding to invest in their energy transitions, be it from domestic or international sources, and from public or private sources – or a combination of the above (Martinez-Vazquez, 2021).

1.3. Just energy transition challenges in Mexico

In Mexico too, states can advance the just energy transition, and many have already taken ambitious steps to do so. However, the federal environment within which they must operate is a challenging one. Federal-level energy investment is still primarily channeled towards oil and gas infrastructure, through the state-owned companies like the Federal Commission of Electricity (CFE) and PEMEX (Fonseca *et al.*, 2021). The just energy transition does not feature prominently in national policy debates, and as a result, Mexico lacks a detailed transition roadmap that considers inequality and justice issues. The energy market and national energy policies still have the opportunity to strengthen the enabling environment for small-scale, community-led, privately-owned renewable energy generation facilities. Finally, up-to-date information on the energy system can be difficult to access (Fonseca *et al.*, 2021). This makes it challenging to develop cost-benefit analyses and raise awareness of the need for a shift away from fossil fuels.

A just transition to a renewables-based energy system offers the opportunity to address various inequalities. It can eliminate the social and environmental costs of coal mining and fossil fuel-based energy production, such as poor air quality and water pollution. In addition, renewable energy production creates more jobs per kWh than conventional energy production, with less hazardous working conditions (ILO, n.d.). The energy transition can generate large numbers of high-quality, safe jobs everywhere in the country, including in rural areas.

A just energy transition can also address the energy poverty that is prevalent in Mexico. It can expand access to reliable, affordable energy and related services, such as

[3] See https://www.wearestillin.com/about

efficient lighting, heating, refrigeration, clean cooking, and the internet. By reducing the reliance on firewood or charcoal for cooking, which is still high particularly in Southern Mexico, enhanced energy access can help to prevent respiratory health issues and deforestation (Ciudad de México, 2021).

The just energy transition offers the opportunity to design a new energy system that advances multiple development goals and improves countless lives. However, to ensure that the energy transition is in fact just, states must consider a range of justice issues. Fossil fuel workers must be supported to transition to new jobs. The rights and wellbeing of mineworkers in new renewable energy value chains (esp. copper, gold, and zinc), must be ensured. The rights of indigenous people must be respected, including when determining locations for renewable energy projects, and activists must be protected from harm. In accordance with the Acuerdo de Escazú,[4] access to information, including on legislation, planning, and permitting, must be guaranteed. Communities and other stakeholders, including women, must be meaningfully engaged in decision-making. These considerations are not just important to ensure justice and build public support, but also to prevent any delays in renewable energy projects. If they are addressed, Mexican states could become pioneers in the energy transition.

[4] See https://www.cepal.org/es/acuerdodeescazu.

2. Comparative Study of Subnational Energy Policies in Australia, Brazil, Colombia, Germany, and the United States

This chapter provides good practice of state- or province-level action to accelerate the just energy transition, focusing on five countries: Australia, Brazil, Colombia, Germany, and the United States. Its aim is not to provide a comprehensive overview of actions taken by states and provinces in these countries, but rather to show what is possible by offering a wide range of examples of measures. The first part of this chapter investigates what autonomy states and provinces have in the five countries to make energy policy, highlighting several frontrunners and good practices. The second section investigates several key questions, including how states and provinces in the focus countries collaborate with national governments in the energy transition, and how national governments can facilitate or encourage state-level action. It also looks at cooperation between state-level governments and of state-level governments with municipalities, the private sector and civil society.

2.1. Case studies

Of the five countries analyzed in this chapter, four have federal systems, with states that have a high degree of autonomy. The exception, Colombia, is a unitary state with provinces, called departments, which have less autonomy to make their own policies.

2.1.1. Australia

Australia is a federation of six states and ten federal territories. States are self-governing polities with incomplete sovereignty, which administer most public policies and programs. Territories, like states, administer local policies and programs, but are constitutionally and financially subordinated to the federal government (Parliament of Australia, n.d.).

The division of power in relation to energy, climate, and the environment is somewhat unclear as these were not considered in the drafting of the constitution in the early 20th century. They were previously the responsibility of the state governments, but due to increased international cooperation particularly on climate change, overall responsibility for Australia's actions and performance related to energy, climate, and environment now necessarily lies with the federal government. In 2021, 26.7% of Australia's energy demand was met through renewable energy generation (Enerdata, 2022).

Partly in response to a lack of federal ambition to mitigate climate change, Australian states over the past three decades have built up significant capacity to undertake energy transition initiatives. Two frontrunners are the states of Victoria and South Australia.

2.1.1.1. Energy pledges as part of ambitious climate mitigation: The state of Victoria

The Victorian Government has been taking ambitious action to both mitigate and adapt to climate change. Through the Climate Change Act of 2017, it committed to reducing its GHG emissions to net zero by 2050. Victoria was one of the first jurisdictions in the world to legislate such a long-term zero-emissions target. The state's emissions have been falling since 2010, and by 2020 were nearly 30% below 2005 levels. Building on this success, the Victorian Government has set the target to halve emissions by 2030 compared to 2005 levels (Victoria State Government, 2023).

The Victorian Government has developed pledges that define mitigation actions in the agriculture, energy, industry, land use and forestry, transport, and waste sectors.

Victoria's energy pledge will accelerate the energy transition in the state, ensuring that 40% of Victoria's electricity will come from renewable sources by 2025, and 50% by 2030. Under this pledge, 778,500 households will receive rebates for solar panels, solar hot water systems and batteries, and 15,000 small businesses will receive rebates for solar panels. The Government of Victoria is also investing AUD 12.6 million (USD 8.4 m) to fund the design and delivery of an auction mechanism to help meet its legislated renewable energy targets, and to ensure the fulfillment of its pledge to source 100% renewable electricity for all government operations by 2025 (State of Victoria DELWP, 2021a). The auction is expected to bring online at least 600 MW of new renewable energy capacity – enough to power Victoria's public hospitals and schools, Melbourne's train network, and a range of other public infrastructure and services. The state's transport pledge includes an AUD 100 million (USD 66.7 m) package of policies and programs to accelerate the transition to zero-emission vehicles and position Victoria to take full advantage of the emerging global shift towards this new technology. The industry pledge will improve the maintenance and management of refrigeration and air conditioning equipment to reduce leakage of refrigerant gases, which constitute the majority of industry emissions in the state (State of Victoria DELWP, 2021b).

2.1.1.2. 100% renewables and strong support for hydrogen: South Australia

In the year 2000, the state of South Australia had an entirely fossil fuels-based energy system. Through ambitious target-setting, the development of a consistent, coordinated energy policy, and active efforts to attract international renewable energy companies to the Australian markets, the state now generates 70% of its energy through wind and solar and is targeting 100% net renewables by 2030 (Government of South Australia DEM, n.d.-b; McGreevy & Baum, 2021). Two good practice examples are highlighted here, one related to energy storage and the other to hydrogen:

1. In September 2016, a devastating storm damaged critical infrastructure in South Australia, causing a state-wide blackout. In response, the South Australian Government partnered with Neoen, a French independent producer of renewable energy, and Tesla, an American multinational automotive and clean energy company, to install the world's largest lithium-ion battery that provided back-up for the entire grid. The 100 MW Hornsdale Power Reserve was built in just 100 days and brought online in 2017. Expanded to 150 MW in 2020, it raised the bar for energy storage facilities worldwide by providing stability to a power grid highly dependent on flexible resources (Tesla, 2019).
2. Building on its existing high renewable energy generation share and further potential, South Australia aims to become a green hydrogen leader. The state government is investing more than AUD 500 million (USD 335.7 m) to accelerate new green hydrogen projects and develop shipping infrastructure, as well as modeling tools for investors and developers. Supported projects include:
   - The Hydrogen Jobs Plan, which includes the construction of a large-scale green hydrogen production facility and a hydrogen power station;
   - AGIG's Hydrogen Park South Australia (HyP SA), an AUD 14.5 million (USD 9.7 m) demonstration project comprising a 1.25 MW electrolyzer at the Tonsley Innovation District in Adelaide's southern suburbs, the largest of its kind installed in Australia;
   - The development of the Eyre Peninsula Gateway Project at Cultana by Hydrogen Utility (H2U), providing a facility integrating more than 75 MW in water electrolysis to produce renewable hydrogen and renewable ammonia;
   - The Green Hydrogen Project of Trafigura Group and Nyrstar, a large-scale green hydrogen manufacturing facility in Port Pirie; and
   - Establishment of a large-scale clean hydrogen production precinct for both export and domestic markets at Port Bonython (Government of South Australia DEM, n.d.-a).

2.1.2. Brazil

Brazil is a federal presidential constitutional republic, consisting of 26 states and the Federal District. States have a high degree of autonomy, including over taxes, but have limited authority for decision-making relating to the energy transition since most energy policies and regulations are developed at the federal level (Martinez-Vazques, 2021). However, states can influence national energy policy through their representation in the National Council for Energy Policy (Conselho Nacional de Política Energética, CNPE), where they occupy one of 20 seats (Government of Brazil MME, 2023). Most importantly, they can promote the development of renewable energy sources within their borders. In 2021, 78.4% of Brazilian electricity demand was met by renewable energy sources (Enerdata, 2022). Brazilian states have developed a wide range of good practices for the energy transition, which are presented below organized by theme.

2.1.2.1. Pushing solar photovoltaic generation: Minas Gerais

The state of Minas Gerais is a frontrunner in solar energy generation in Brazil; with 4 GW it exceeds the solar photovoltaic (PV) generation capacity of any other Brazilian state. All of the state's 853 municipalities have at least one solar PV unit (Agência Minas, 2022). The state's Sol de Minas project has played a crucial role in expanding solar PV capacity, through various initiatives aimed at attracting solar-sector businesses, such as training local managers, fiscal incentives, and simplified permitting procedures (Agência Minas, 2021 & 2022).

2.1.2.2. Transition of coal regions: Santa Catarina

In 2022, the state of Santa Catarina, the largest coal producer in Brazil, launched its Just Energy Transition Program (Programa de Transição Energética Justa; TEJ). The program aims to reduce carbon emissions in the region in a way that meets the needs of local communities. The TEJ Council, composed of representatives from the Federal Government, the Government of Santa Catarina, municipalities in the coal-producing region, and worker and coal industry associations, coordinates and monitors the implementation of the program (Government of Brazil CC, 2022; Government of Brazil MME, 2022). The Council will also draft a Transition Plan for the region, outlining actions, responsibilities, and deadlines for the just energy transition. Additionally, the Council will propose programs to diversify and reposition the region's economy and ensure new opportunities for people currently employed in coal mining and thermal power generation, taking advantage of existing infrastructure in the region. The Council will also monitor existing environmental lawsuits and unlock funding for environmental recovery in the region (Government of Brazil CC, 2022; Government of Brazil MME, 2022).

2.1.2.3. Energy efficiency and demand-side management: São Paulo

Several Brazilian states have adopted energy efficiency policies and launched demand-side management (DSM) projects. Among these states is São Paulo, the most industrial state of Brazil. In 2020, São Paulo's Secretary of Infrastructure and Environment launched the Integrated Energy Efficiency Program (Programa Integrado de Eficiência Energética), which aims to reduce spending on electricity in about 30,000 state-owned properties by 30% in three years, generating annual savings of BRL 180 million (USD 34 million; State Government of São Paulo CC, n.d.). Among the actions to be considered are the revision of contracts with energy distributors and the increased use of alternative energy sources such as photovoltaic and biomass. The Program also includes awareness-raising and standardization campaigns to ensure project efficiency (State Government of São Paulo CC, n.d.).

The São Paulo State Energy Efficiency Guarantee Fund (Fundo de Aval da Eficiência Energética no Estado de São Paulo) aims to foster sustainable practices in companies and cooperatives, allowing them to access financing to invest in technologies and processes that improve energy efficiency. São Paulo also established a State Council for Energy Efficiency Orientation (Conselho Estadual de Orientação de Eficiência Energética) to enhance stakeholder participation in energy-efficiency policymaking and implementation (ALESP, 2022).

2.1.2.4. Fracking bans: Paraná and Santa Catarina

The states of Paraná and Santa Catarina both banned fracking, despite having very significant shale gas reserves (350.org, 2019). In both states, the legislation received support from the agricultural sector, which opposed the exploitation of shale gas because of the environmental damage caused by the practice and its impacts on crops and livestock. For example, ahead of the vote on the fracking ban in Santa Catarina, the State Federation of Agriculture and Cattle Raising (Federação da Agricultura e Pecuária do Estado de Santa Catarina, FAESC) issued a note highlighting the importance of preserving the environment and the health of the population (Suino.com, 2019).

2.1.2.5. Biofuels partnerships: Rio Grande do Sul

The government of the state of Rio Grande do Sul has undertaken several actions to encourage the production and consumption of biodiesel. In 2003, the Gaucho Biodiesel Program (Programa Gaúcho do Biodiesel/Probiodiesel-RS) was launched. This program aims to encourage research on, and production of, biodiesel in the state as well as to promote family farming as a source of raw material, including by offering credit lines and technical assistance to family farms (State Government of Rio Grande Sul, 2003). The state government has also facilitated the participation of family farmer cooperatives in the national Social Biodiesel Seal (Selo Biocombustível Social) initiative, which certifies biodiesel-producing companies that meet certain social and environmental criteria (BiodieselBR, 2020). In addition, the state has invested in partnerships with private companies for the development of the sector. In 2006, the government of Rio Grande do Sul signed an agreement with Petrobras to produce biodiesel from rapeseed cultivated by participating family farmer cooperatives (BiodieselBR, 2020).

2.1.2.6. Limiting green hydrogen production to renewables: Five states in the lead

Brazil's National Hydrogen Program, recently launched by the federal government, includes promotion of all production strategies, including from fossil fuels (Machado, 2023). However, the five Brazilian states of Rio Grande do Sul, Rio Grande do Norte, Goiás, Paraná, and Ceará have launched green hydrogen plans and strategies which allow only the use of renewable energy sources, in an effort to become industry frontrunners, reduce local pollutants and GHG emissions, generate jobs, and increase business opportunities. The Green Hydrogen Hub project in Ceará aims to take advantage of favorable conditions in the state, such as high solar PV potential and good onshore and offshore wind resources as well as a favorable tax and administrative environment, to produce hydrogen. Thus far, the government has signed 24 memoranda of understanding with various companies for the implementation of solar, wind and green hydrogen projects in the state. A 3 MW solar PV plant and a state-of-the-art electrolytic module have been installed to begin production (State Government of Ceará, 2023).

2.1.3. Colombia

Colombia is a unitary presidential republic composed of 32 departments and a capital district. Each department has a governor and an assembly elected for a four-year term. Though many functions of government are decentralized, the authority for energy policymaking is primarily the remit of the national Ministry of Mines and Energy (Ministerio de Minas y Energía, Minenergía; OECD, n.d.). Programs related to financing for clean energy projects fall under the jurisdiction of the Fund for Non-Conventional Energy and Efficient Energy Management (Fondo de Energías No Convencionales y Gestión Eficiente de la Energía, FENOGE).[5] Colombia generates 74.5% of its electricity using renewable sources (Enerdata, 2022).

Colombia's constitution of 1991 established that the development of the country's energy sector should be the responsibility of the national government. Therefore, Minenergía oversees policy design and implementation as well as regulation of the energy sector (OECD, n.d.). However, the constitution also establishes the autonomy of territorial entities to participate in the administration of natural resources, including energy. This means that departments and municipalities can participate in the regulation and promotion of the energy sector through regional and local policies. For instance, local governments can promote the use of renewable energy sources, incentivize energy efficiency, and promote emissions reduction (OECD, n.d.).

2.1.3.1. Advancing all SDGs including Energy for All: Antioquia

The department of Antioquia and its capital Medellin are considered frontrunners for the energy transition in Colombia. The department has launched a program called Sustainable Antioquia (Antioquia Sostenible; Proantioquia, n.d.). It seeks to accelerate progress towards all 17 Sustainable Development Goals by encouraging private, public, and social sector actors to create alliances and share knowledge and good practices. However, research on this initiative has shown that a lack of relevant indicators and data available at the sub-regional level is making it difficult to assess progress (Londoño Pineda & Cruz Céron, 2019). One SDG in which Antioquia is performing particularly well is providing affordable and clean energy. The utility company Empresas Públicas de Medellin (EPM), owned by the city of Medellín, produces over 20% of the country's energy, primarily through hydropower (EPM, 2023).

2.1.3.2. Renewables cooperatives co-owned by indigenous communities: La Guajira

The department of La Guajira has enormous solar and wind resources. However, the presence of the Wayùu indigenous population and the state's history of deprivation and drug wars has made the transition to these clean energy sources complex. The departmental government now seeks to develop renewable energy facilities in such a way that they benefit local and indigenous communities and respect their cultures and beliefs. For example, the state will establish renewable energy cooperatives through which local and indigenous communities will co-own solar PV and wind projects on their territories (Colombian Ministry of Mines and Energy, 2022). Minenergía has also endorsed the state-developed initiative Guajira Tables (Mesas Guajira) which facilitates coordination and collaboration between the national government and wind farm developers in various municipalities. This forum seeks to define commitments, responsibilities, and deadlines for compliance for both public and private actors (Colombian Ministry of Mines and Energy, 2021).

2.1.4. Germany

Germany is a parliamentary republic consisting of 16 federal states (or "Bundesländer"). The federal government passes most of the legislation which is then imple-

[5] See https://fenoge.gov.co/

mented by state (or, less often, municipal) governments. As a result, state governments have little legislative autonomy (Bethge *et al.*, 2012). However, state governments have the constitutional authority to act in any circumstance where the EU or the federal government have not sufficiently regulated (Münzner, 2014).

Though many aspects of the energy transition are thoroughly regulated, there are several areas in which state governments can develop their own policies (Münzner, 2014). State governments can regulate local energy producers, promote district heating, strengthen building codes, adopt energy saving standards, and require renewable energy generation in new and existing buildings. State governments can also push the energy transition through public procurement rules that favor renewable energy and energy efficient practices. In addition, they can advance the economic and technological aspects of the energy transition by investing in education, research, and development (Schill *et al.*, 2019). In 2021, 41.5% of Germany's electricity was generated through renewable sources (Enerdata, 2022).

2.1.4.1. Green Hydrogen Partnerships: North German Hydrogen Strategy

By 2022, nearly every German federal state had published a strategy to boost the development of green hydrogen production capacity (Agentur für Erneuerbare Energien, 2023). The strategies differ in the assigned role and significance of hydrogen for the local economy, based on each region's priorities and comparative advantages, and thereby demonstrate the different business cases for developing green hydrogen capacity (Industry Forward, 2023):

- The northern states focus on their large wind energy resources, which can be used to produce hydrogen;
- The eastern states focus on structural changes: the region is transitioning from lignite coal production to renewables and seeks to reap the job creation potential of green hydrogen;
- The western states focus on reducing greenhouse gas emissions through the use of hydrogen in industrial processes; and
- The southern states focus on developing innovative hydrogen technologies.

A good example of a regional hydrogen strategy is the North German Hydrogen Strategy (Norddeutsche Wasserstoff Strategie) developed jointly by five coastal states: Bremen, Hamburg, Mecklenburg-Western Pomerania, Lower Saxony, and Schleswig-Holstein join forces to maximize their shared advantages: high on- and off-shore wind energy capacity, seaport facilities, high-quality grid and transport infrastructure, and local technology development and industry (Wirtschafts- und Verkehrsministerien der norddeutschen Küstenländer, 2019). The strategy focuses on hydrogen infrastructure, value creation through hydrogen, the development of hydrogen regulation and support programs as well as advancing education on and acceptance of hydrogen (Norddeutsche Wasserstoffstrategie, 2023). Finally, the strategy calls for the creation of hydrogen hubs throughout all five states (Norddeutsche Wasserstoffstrategie, 2022). These hubs bundle the production, distribution, and use of hydrogen in one place. Nearly 20 hubs are planned, with some already in use. A staple of the strategy is to build on existing industry and infrastructure to maximize benefits at every location.

2.1.4.2. Mandatory Solar Generation on Buildings: Berlin

In the beginning of 2023, Berlin's Solar Law (Solargesetz) came into force, requiring all new buildings to include solar PV systems (Solarwende Berlin, 2023). Any significant roof renovation projects on existing buildings also must include the installation of a solar PV system. Alternatively, PV systems may be installed on the building facade or replaced by a solar thermal system. The aim of this policy is to maximize the use of untapped potential for producing solar energy within Berlin.

2.1.4.3. Calculating the Benefits of Renewable Energy: Rhineland-Pfalz

The Energy Agency of the state of Rhineland-Pfalz, the Agency for Renewable Energies (Agentur für Erneuerbare Energien, AEE) and the Institute for Ecological Economy Research (Institut für ökologische Wirtschaftsforschung, IÖW) jointly developed the Online Value Creation Calculator (Online-Wertschöpfungsrechner). This tool supports municipalities by calculating the potential local value that can be created through the expansion of renewable energy generation (Cantos, 2020; Techel, 2020).

2.1.4.4. Integrated Climate and Energy Strategy: Baden-Württemberg

The state of Baden-Württemberg has ambitious goals for GHG emissions reduction and the energy transition, set out in its Integrated Energy and Climate Protection Concept (Integriertes Energie- und Klimaschutzkonzept, IEKK; State Government of Baden-Württemberg MUKE, 2014). As the state is a significant industrial hub, it has recognized the need to innovate and transform its economy to stay competitive in the long term. The "3x5" concept includes five goals, five instruments and five fields of action. Its goals are a secure energy supply, energy cost security, climate protection, regional value creation, and civic engagement. These are to be achieved through investment in savings and efficiency, renewable energy, infrastructure modernization, research and development, and participation and dialogue. The targeted areas of action are electricity, heat, transport, land use and material flows. The state government hopes to achieve 48.8% renewable energy in the electricity mix and a 49% reduction in energy usage by 2050, as compared to 2010.

2.1.5. United States of America

The United States is a presidential republic consisting of 50 federal states, the District of Columbia, and several territories. It has been a 'living laboratory' for state-level energy transition action for several reasons. Firstly, the states have a very high level of autonomy, including to levy their own taxes and develop their own policies. Secondly, in several recent periods, federal leadership for the energy transition has been lacking, forcing states to determine their own paths. Thirdly, the U.S. economy is very energy-intensive; though U.S. Americans make up just 5% of the global population, they use 26% of the world's energy. In 2021, renewables accounted for 20.5% of U.S. electricity consumption (Enerdata, 2022).

2.1.5.1. Introduction to 'classic' US state policy tools

As the United States contains a wealth of good practices of state-level action for the just energy transition, this section first presents several 'classic' policy tools with which many states have significant experience. The following sections highlight several other good practices.

Net metering incentivizes renewable energy generation by granting citizens credits on their electricity bills when they supply surplus self-generated energy to the net. Minnesota passed the first net metering law in 1983, allowing all citizens generating small quantities of electricity to be compensated for the excess at the average retail utility energy rate, or to pass their credits on to the next month (DSIRE, 2012). In 2005, all U.S. utilities were required to offer net metering upon request and by 2013, 43 US states had adopted net metering. However, a study by Schelly, Louie, and Pearce (2017) showed that only 3% of U.S. utilities offer full compensation for net metering.

Renewable Portfolio Standards (RPS) is a regulatory tool that states use to require electricity suppliers to produce a certain share of their electricity using renewable energy sources. In addition to immediate benefits such as cleaner air and climate mitigation, RPS also aim at stimulating competition and innovation in renewable energy generation. In 2015, California passed the Clean Energy and Pollution Reduction Act, which requires retail sellers and publicly owned utilities to produce at least 50% of their electricity from renewable energy by 2030 (California Energy Commission, 2015). Other state RPS programs issue credits depending on the source of energy or electricity, to promote the use of specific technologies. For instance, in Michigan and Virginia, solar PV energy counts double compared to other renewable energy sources (Michigan Public Service Commission, 2023). A study by the Lawrence Berkeley National Laboratory shows that while RPS has been responsible for more than 60% of renewable energy uptake since 2000, its importance has rapidly declined since 2013 as most states have surpassed their RPS minimum targets (Berkeley Lab, 2021).

State and local governments collect revenue from *fuel taxes* and in many cases use this to fund transportation and transport-related infrastructure. Some states also impose an environmental tax, the revenues of which are used fully to fund environmental projects (Pastre, 2015).

Energy Efficiency Resource Standards (EERS) set concrete long-term energy savings targets that must be met through customer energy efficiency programs. Many U.S. states have successfully used EERS to advance energy savings. An analysis of the 25 states that had an EERS in 2017 found that 20 had met or exceeded their savings goals and all but one exceeded 80 percent of their target (Environmental Protection Agency – EPA, 2022). EERS programs may vary significantly between states, depending on their requirements in terms of energy saving. While no single target-setting framework has been proven to work better than any other in advancing the energy transition, using overlapping and nested goals has proved effective in the U.S. state context.

2.1.5.2. Energy Efficiency Programs: Arkansas, Wyoming, and Maryland

In Arkansas, utilities administer energy efficiency programs and must meet targets established by the state's EERS. A key actor is the Parties Working Collaboratively (PWC) group, which was set up by the Arkansas public service commission (APSC). The PWC is an inclusive stakeholder advisory group which shapes and evaluates state energy policies and programs. The group includes government officials, utility representatives as well as industrial and commercial customers. More recently, representatives of colleges and technical schools as well as advocates for low-income customers were also

asked to join. The PWC has enabled people with different interests and viewpoints on energy efficiency to work together to tailor solutions and policies, ultimately contributing to making Arkansas one of the energy efficiency leaders in the U.S. Southwest (EPA, 2022). Energy efficiency programs in Arkansas include, but are not limited to, an incentive program with home appliance rebates, a consistent weatherization assistance program that is not means-tested but is based on the age and relative inefficiency of the home, and a public sector energy efficiency loan program. APSC also provides performance incentives to utilities for meeting the targets and to compensate for lost contributions to fixed costs that result from efficiency programs (Arkansas Department of Energy & Environment, n.d.).

The state of Wyoming provides grants for energy audits and retrofits to organizations and small businesses looking for cost-effective opportunities to lower their energy usage. Grants can be used to complete an energy audit and/or implement approved retrofits. The maximum grant amount is USD 5,000. The program also offers free energy audits for K-12 schools and local governments (Wyoming Energy Authority, 2021).

In 2015, Maryland's Public Service Commission issued an order that requires utilities to achieve 2% annual incremental energy savings. Two years later, this goal was passed into state law. The requirement is part of a package of measures called EmPower, which up until 2020 had saved 11,972 GWh and 2,363 MW. Over the lifetime of the installed measures, financial savings are expected to reach $12 billion (EPA, 2022).

2.1.5.3. Grant and Loan Programs: Wisconsin and Iowa

Several states provide grants to support the deployment of renewable energy generation facilities. For example, Wisconsin is a leader in the promotion and installation of anaerobic digesters and energy generation through biogas combustion. Wisconsin's program offers grants up to USD 250,000 for qualifying systems. In addition, Wisconsin provides extensive feasibility and technical assistance to dairy farmers considering the installation of a digester (Public Service Commission of Wisconsin, 2022).

The state of Iowa manages a renewable energy revolving loan program through which it provides 50% of a project's loan at 0% interest if a commercial lender provides the remaining 50% at market interest rates. In addition to bringing the interest rate down, the program can extend loan repayment periods to as much as 20 years (Iowa Economic Development Authority, 2023).

2.1.5.4. Republican-led states: The conservative case for the energy transition

In most countries, conservatives have traditionally been less supportive of the energy transition than liberals. However, the United States has been a living laboratory for building bipartisan support for the energy transition. In fact, in the past year, Republican-led states have made larger renewable energy capacity additions than states governed by Democrats. This is not just a consequence of the outstanding renewable resources in many mid-Western states traditionally run by Republican governments. While Republicans rarely prioritize climate change mitigation through sustainable energy practices, they use other arguments to effectively promote the energy transition. In the United States, renewable energy has gained support from conservatives because of its potential to:

- Increase the country's energy independence and energy security;
- Enhance personal freedoms by allowing households to generate their own energy rather than being dependent on a central grid and a utility company;
- Reduce local pollution and protect nature;
- Reduce energy costs; and
- Enhance resilience of the energy system to external shocks.

In terms of mechanisms, conservatives are more likely to support tax breaks for renewable energy companies than increased taxes on polluting activities or regulation to boost renewable energy uptake (Toomey, 2016).

2.2. Discussion of the relationship of states with other major actors in the energy transition

This section explores major questions about the role of states and provinces in the energy transition, and their interactions with other stakeholders, drawing on experiences from the five case-study countries.

2.2.1. How do national governments support state-level action for just energy transitions?

Subnational governments require sufficient authority and autonomy, administrative capacity, and funding to carry out energy transition actions (Martinez-Vazquez, 2021). The OECD and World Bank (Ellis, Lo Re & De Lorenzo, 2022; Martinez-Vazquez, 2021) recommend the following eight actions by national governments:

Establishment of a legislative framework conducive to subnational energy transitions;

1. Setting of a clear direction and long-term commitment to the energy transition;
2. Comprehensive assessment of emissions reduction potential and the specific roles different subnational governments can play;
3. Assignment of expenditure responsibilities for energy transition activities to subnational governments;
4. Assignment of tax and other revenue sources to subnational governments for energy transition activities, including conditional intergovernmental transfers;
5. Facilitating subnational governments' access to international finance;
6. Establishing mechanisms for vertical and horizontal coordination; and
7. Facilitating relevant data collection at the subnational level.

As has become clear through the case studies, the extent to which national governments encourage and facilitate subnational action for the energy transition varies. In some countries, the national government retains exclusive responsibility for energy policymaking and subnational governments are mere implementers. Other countries have adopted a fully decentralized model, with high degrees of autonomy but little coordination between different levels of government. In these countries, subnational governments face the task of leading the energy transition.

The World Bank suggests that the intermediate option, in which national and subnational governments bear joint responsibility for the energy transition and subnational governments are free to expand on or exceed national policies and targets, is the most effective (Martinez-Vazquez, 2021). This approach is the most popular worldwide. Effective national policies and environmental standards are required to encourage competition between subnational governments that results in a 'race to the top' rather than a 'race to the bottom' whereby states seek to benefit by lowering standards to attract polluting industries that are leaving states with higher standards (Martinez-Vazquez, 2021).

In Australia, most states have set renewable energy targets but until recently, the lack of federal leadership created a challenging investment environment for renewable energy market players because of the general atmosphere of uncertainty it created. In 2022, the new Labor government established a National Energy Transformation Partnership to foster closer collaboration between the states and the federal government in the energy transition (Kallies, 2021). One of the first priorities of the Partnership is to codesign a First Nations Clean Energy Strategy to engage First Nations people in the energy transformation (DCCEEW, 2022).

In Germany, the national government determines climate and energy goals – including, jointly with other member countries, at the European Union level – and initiates most climate actions. The Bundesländer can go beyond federal actions, including by setting more ambitious energy efficiency and renewable energy targets. There is a biannual meeting of the federal environment minister and his/her state counterparts for coordination, collaboration, and general exchange. In 2007, federal and state governments jointly signed the Düsseldorf Declaration that established EU climate targets as national targets. Germany's Climate Action Plan 2050 was written by the federal government together with the federal states and other stakeholders (Kallies, 2021).

Colombia, which is not a federal but a unitary state consisting of 32 provinces known as departments ("departamentos"), has established a National Climate Change System (Sistema Nacional de Cambio Climático; SISCLIMA), which organizes multi-level coordination on climate action through nine newly created regional nodes. The nodes have been entrusted with bringing together relevant actors in each region to advance climate change initiatives. Each department can participate in more than one regional node (two of the nine nodes, however, are made up of a single department). However, despite the progress achieved on climate policy at the national level and in some Colombian regions, information transfer between different levels of government

and real representation of regional and local priorities at the national level are still insufficient. Nodes have been assigned responsibilities but lack the necessary autonomous human and financial resources and the federal backing to succeed (Rodríguez-Granados *et al.*, 2020).

In other countries too (e.g., the Dutch Energy Regions; Van Dijk *et al.*, 2023), it was found that the creation of new levels of government to address one specific issue often lacked effectiveness, as it resulted in high transaction costs and confusion about responsibilities. A major barrier to effective subnational action in support of the energy transition is the fact that subnational governments have insufficient access to finance. This is an area where national governments could provide support. Many subnational governments lack the authority to levy new taxes – or may be able to impose taxes but lack the full range of instruments to offset their regressive impacts. They are also less likely to be able to effectively monitor emissions, or to regulate the energy practices of powerful multinational companies. Subnational governments are often bound by strict borrowing rules and have limited access to international climate finance mechanisms (Ellis *et al.*, 2022; Martinez-Vazquez, 2021).

2.2.2. How do subnational governments interact with each other in the context of the just energy transition?

The five case studies examined for this project reveal many examples of horizontal cooperation between state governments, and of vertical cooperation between state governments and municipalities.

In the United States, the Regional Greenhouse Gas Initiative (RGGI) is a cap-and-trade system for power sector emissions across the 12 northeastern states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia (RGGI, 2023; Martinez-Vazquez, 2021). Launched in 2009, the initiative is aimed at power plants. 90% of allowances are distributed through auctions, the proceeds of which allow the participating states to invest in energy efficiency and renewable energy programs. It is estimated that the RGGI reduced CO_2 emissions from energy generation by 48% between 2006-8 and 2016-18 (Martinez-Vazquez, 2021). Aside from the climate mitigation benefits, in its first three years alone, the RGGI generated USD 1.6 billion in net economic benefits as well as 16,000 jobs (Hibbard *et al.*, 2018). Membership of the initiative has fluctuated over the years: New Jersey, for example, left the RGGI in 2012 under Republican governor Chris Christie and rejoined in 2018 under Democratic governor Phil Murphy. Researchers found that Christie's decision had cost the states hundreds of millions of dollars in renewable energy investment (Skahill, 2017). The United States also has the Clean Energy States Alliance (CESA), a coalition of public agencies (primarily state energy agencies) and other organizations, launched in 2002, that fosters collaboration and peer learning to advance clean energy. CESA also organizes the biennial State Leadership in Clean Energy Awards and implements a range of projects, including several related to solar projects that benefit low- and moderate-income households and communities (CESA, 2023).

In Australia, the reverse auction mechanism implemented by the Australian Capital Territory (ACT) is an example of effective cooperation between states. ACT is the smallest and by far most densely populated territory of Australia. It would have been unable to achieve its 100% renewable energy target through generation within its borders. Thus, ACT has bought renewable electricity from generation located elsewhere within the Australian National Electricity Market through reversed auctions (ICLEI, 2021) which allowed it to reach its 100% renewable energy target, while fostering generation of renewable energy in other states that have a better capacity for production (IEA, 2020).

In Colombia, seven departments and the federal government are cooperating under the PEECES (Sustainable energy and energy efficiency in the Caribbean) program. Measures under this program include the replacement of lighting, cooling, and air-conditioning appliances with non-conventional renewable energy sources in low-income households. In 2020, the first component of PEECES was launched under the name "Caribe Eficiente"[6] (FENOGE, 2022a). This initiative seeks to replace approximately 65,000 cooling appliances, reduce energy consumption and emissions, save on energy subsidies, and reduce energy bills for the beneficiaries (Colombian Ministry of Mines and Energy, 2021). In the first two years of implementation, the initiative replaced 5,000 refrigerators in three departments, saving 1.6 GWh (FENOGE, 2022b).

In Germany, a national-federal cooperation committee (Bund-Länder-Kooperationsausschuss) was founded under the second edition of the renewable energy law (Erneuerbare-Energien-Gesetz, EEG; German Federal Ministry for Economics and Climate Action – BMWK, 2021). Twice a year, the Committee gathers representatives of the federal chancellery (Bundeskanzleramt), Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klimaschutz, BMWK), and the 16 state governments, to coordinate their actions and monitor the progress states make towards their renewable energy expansion and the national target of 80% renewable energy by 2030 (BMWK, 2022). The committee has become the most important forum for planning, coordination, and collaboration between the national government and the Bundesländer.

Additionally, the Ministry of Economy, Innovation, Digitalization and Energy (Ministerium für Wirtschaft, Innovation, Digitales und Energie) of the state of Saarland in Germany supports municipalities, cities, and districts to accelerate local energy transitions through the Guideline to Support the Local Energy Transition (Richtlinie zur Unterstützung der Energiewende vor Ort, EVO). Through the EVO, the Ministry supports innovative projects which increase energy efficiency and advance renewable energy generation; it also supports energy transition activities that would not be economically viable without additional funding (Saarland MWIDE, 2023).[7]

In Brazil, states are using a state-level value added tax (Imposto sobre Circulaçao de Mercadorias e Serviços, ICMS) to incentivize municipalities to undertake actions that protect the environment. Brazilian states must share 25% of ICMS revenue with municipalities, of which 75% on a derivation basis and 25% based on each state's own rules. In the 1990s, several states introduced an "Ecological ICMS," which distributes revenues based on ecological indicators. For example, the state of Paraná adopted a rule that this 25% would be distributed according to the share of preserved land set aside by municipalities. Now, 18 out of 26 states have an ecological ICMS (Martinez-Vazques, 2021). Though it has been used primarily for reforestation and biodiversity conservation, proposals have been made to use this successful mechanism to advance the energy transition (Altoé et al., 2022).

2.2.3. How do subnational governments interact with the private sector?

There are many examples of subnational governments successfully cooperating on energy transition initiatives with the private sector. The strategies and mechanisms they employ to do so are often similar to those used by national governments. For example, states may use public procurement to support renewable energy businesses, establish funds to boost innovation, or enter into public-private partnerships. Some cases have already been highlighted above, such as the energy auctions in Victoria, Australia, the North-German Hydrogen Strategy in Germany, and the Green Hydrogen Hub in Ceará, Brazil, which all seek to attract additional private sector investment in renewables. This section presents further promising examples.

One highly effective mechanism to provide financing for sustainable energy projects are climate and energy funds. In Australia, the state of New South Wales has a Climate Change Fund, resourced by contributions from electricity distributors, that supports tree planting, energy efficiency, renewable energy and fire and flood management efforts by communities, businesses, and local governments. In 2021-22, its revenue was AUD 276.9 million (USD 186.6 million; NSW Government Office of Energy and Climate Change, 2022). The Fund was founded in 2005 as the Energy Savings Fund, with levies on electricity distributors used to fund demand-side management measures (Total Environment Centre, 2010). Similarly, in Brazil, most states and large municipalities have environmental funds. Here, these are partly fed by environmental fines as well as oil and gas revenues (Martinez-Vazquez, 2021). For example, Rio de Janeiro's State Fund for Environmental Conservation and Urban Development (Fundo Estadual de Conservação Ambiental e Desenvolvimento Urbano; FECAM) receives oil extraction royalties allocated to the state as well as fines imposed for environmental offenses. It uses its revenues to fund activities such as the refurbishment of tram systems in the city, the cleaning of rivers and riverbanks, and a start-up innovation challenge related to the blue economy (State Government of Rio de Janiero, 2023).

Australian states also manage mine rehabilitation securities in various forms. These require mining companies to pay into state funds that are used if they fail to meet their legal obligations to undertake mine rehabilitation after closure (Sharman, 2019). The state of Queensland's fund is estimated to hold nearly AUD 5.4 billion (USD 4 billion; Minerals Council of Australia, 2018).

In the United States, states provide a variety of grants and loans for energy transition initiatives. For example, California provides grants to school districts for low-emissions school buses, and Illinois has a program that funds greening initiatives in schools (Martinez-Vazquez, 2021).

[6] See https://www.caribeeficiente.com.co/index.html

[7] The subsidy covers up to 40% of costs with a maximum of EUR 60,000 per project.

In Germany, the Baltic state of Mecklenburg-Vorpommern has established a Wind Energy Cluster (Windenergiecluster) to support the local wind energy sector. It is responsible for attracting wind energy companies to the region and supporting local companies outside the wind sector in developing products and services relevant to wind energy. Its WindEnergy Network provides a platform for wind energy companies to connect, seek expertise, recruit staff, and find other companies, academic institutions, and state agencies to collaborate with on new projects (Windenergiecluster M-V, 2023a, 2023b).

2.2.4. What role do development banks and access to third-party financial instruments play at the state level?

National governments have increasingly granted subnational governments the autonomy to take the lead in the energy transition, but subnational governments often lack the resources required to take up this responsibility, or the authority to raise the required funding. As mentioned previously, subnational governments tend to have limited access to international climate finance as they are not party to international organizations, while borrowing on the open financial market tends to be prohibitively expensive and limited by federally imposed borrowing rules. However, there is growing recognition in the international climate and development space that subnational governments must be provided with the financial means to effectively play their crucial role in just energy transitions and achieving the Sustainable Development Goals.

National or subnational development banks can channel international climate finance to subnational governments. Colombian development bank Findeter (Financiera De Desarrollo Territorial S.A.) is accredited to the Green Climate Fund and collaborates with a range of other bilateral and multilateral financial institutions to fund climate action at the provincial and local levels (Findeter, 2023). In 2014, the Inter-American Development Bank (IADB) announced a credit line of USD 600 million to Findeter for subnational governments in Colombia, including USD 100 million to fund improved fiscal management and investments in urban development in the city of Baranquilla (IDB, 2014 & 2018).

The Subnational Climate Fund, which blends public money provided by the Green Climate Fund with private finance, directly invests in renewable energy projects put forward by subnational governments. Mexico is among the countries where the Fund is active; it has committed USD 43 million to the rooftop solar PV company Luxun (Subnational Climate Fund, 2023).

In some countries, including Australia and Colombia, subnational governments have the authority to issue green bonds to finance climate projects. The Australian state of Victoria was the world's first state government whose green bonds received international Climate Bond Certification (Martinez-Vazquez, 2021). The AUD 300 million (USD 196 million) raised by Victoria through the issuing of green bonds have been invested in projects including the extension of Melbourne's metropolitan rail system, as well as in a mini hydropower plant, and a biogas facility integrated into a large Melbourne wastewater treatment plant (Victoria State Government, 2018).

3. Advancing Subnational Just Energy Transitions in Mexico

Subnational entities around the world have varying degrees of autonomy in developing and implementing energy policy, as has been shown in the previous chapter. Mexico is a federal republic composed of 32 states. The Mexican Constitution grants the federal government a specific list of powers, while states have authority over any areas not expressly assigned to the federal government or explicitly excluded from their jurisdiction. Constitutionally, the federal government has exclusive authority over energy-related policy and legislation. However, states have the authority to develop their own energy initiatives and they have begun to use it to advance just energy transitions and carbon emissions reductions.

In 2021, Mexico was the fifteenth largest emitter of greenhouse gasses in the world (Ritchie & Moser, 2021). At the same time, it is highly vulnerable to the impacts of climate change. The Mexican energy sector is responsible for 64% and the electricity generation subsector for 23.3% of the country's total greenhouse gas emissions (INECC, 2022). The country's emissions have increased by 37% between 1990 and 2019, predominantly driven by the energy sector and the use of fossil fuels. Urgent action is needed as current trends indicate a further rise in emissions towards the end of the decade (Climate Action Tracker, 2023).

This chapter examines the potential of Mexican states to advance a just energy transition through subnational initiatives and policies. The first part presents the Mexican context and highlights the imperative to embark on a just energy transition to address inequalities, vulnerability to climate change, energy poverty, etc. The second section addresses the current energy landscape, legal and policy frameworks, as well as the specific authorities of federal and subnational governments, followed by some examples of energy transition leadership at the state level. The last part of the chapter discusses measures that subnational governments can adopt to contribute to a just energy transition, based on international good practices and current Mexican trends. It highlights their challenges, opportunities, and next steps.

3.1. Understanding the context: Climate change and inequality

Just energy transition policies must consider Mexico's current levels of inequality and how this is impacted by climate change. In 2020, around 43% of the national wealth was concentrated in the hands of the wealthiest 1% of the population. At the same time, more than 44% of the population lived in poverty, meaning that they do not have sufficient income to meet essential needs; 8.5% of the total population lived in extreme poverty[8] (García, 2020). This wealth gap appears to still be widening (CONEVAL, 2022). Carbon emissions in Mexico are also unequally divided: the poorest 50% of the country's population contributes less than two metric tons of CO_2e per capita. In contrast, the per capita emissions of the top 10% and 1% are 10 and 44 times higher, respectively (Chancel et al., 2022).

Mexico's geographical location, topography, and climate make it exceptionally vulnerable to the impacts of climate change. As is the case elsewhere in the world, marginalized communities, communities living in poverty, and regions with high inequality are the most vulnerable. They are both more likely to be exposed to climate impacts, for example due to inadequate housing or lack of cooling, and less likely to have the means to adapt. The IPCC (2019) warns that women and girls, and elderly people will be more severely affected. The states with the highest poverty rates, including Chiapas, Guerrero, Puebla, Oaxaca, Tlaxcala, Veracruz, and Tabasco (CONEVAL, 2022), also include municipalities that have found to be exceptionally vulnerable to climate-related challenges (INECC, 2021).

Energy poverty, defined by the European Union as "a situation in which households are unable to access essential energy services and products" (European Commission, 2023), further exacerbates income and climate vulnerability inequalities. It is estimated that approximately 11 million Mexican households, 37% of the total, face energy poverty (García-Ochoa, 2016). Women are particularly affected by energy poverty, as they are often the main consumers of energy (IMCO, 2023) including for activities such as unpaid care and household tasks (IMCO, 2022). Women who face energy scarcity must often spend considerable time on finding

[8] Extreme poverty is defined by the Mexican government as follows: "A person is in extreme poverty when he or she has three or more deprivations out of a possible six on the Social Deprivation Index and is also below the minimum welfare line. People in this situation have such a low income that, even if it were devoted entirely to the purchase of food, they would not be able to acquire the nutrients necessary for a healthy life." https://www.coneval.org.mx/Medicion/Paginas/Glosario.aspx.

alternative energy sources, for example, by collecting firewood for cooking.

Mexico's subnational energy transition policies must address the triple inequality highlighted in the 2023 Climate Inequality Report: the fact that those who contribute the least to climate change stand the most to lose from its impacts, while being the least able to adapt (Chancel et al., 2023). Understanding this context can help design energy transition policies capable of reducing inequalities while also reducing emissions.

3.2. The Mexican energy transition policy framework

In this chapter, we will explore the Mexican energy transition policy framework while considering its connection to climate change and inequality, as discussed in the previous section. The energy sector in Mexico is highly centralized. It has gone through several regulatory changes over the past decades. This section discusses the different approaches to the energy transition and policymaking adopted by the national and subnational governments.

3.2.1. National climate and energy commitments

Prior to the 2013 constitutional energy reform, the public Federal Electricity Commission (Comisión Federal de Electricidad, CFE) was the exclusive buyer and seller of electricity in Mexico. The reform created a wholesale electricity market (Mercado Eléctrico Mayorista, MEM). By opening up the sector to private investment, the reform reduced the role of the state in the energy sector. The reform included a mandate for Congress to adjust the legal framework to advance energy efficiency, reduce GHG emissions, improve the efficient use of natural resources, and minimize waste. It ultimately aims to reduce the carbon footprint of all energy-related activities, including those of state-owned utilities PEMEX and CFE.

The reform process included the passing of various laws, including the Electricity Industry Law (Ley de de la Industria Eléctrica, LIE) of 11 August 2014. To comply with the constitutional mandate of sustainability, the Electricity Industry Law seeks to incentivize clean energy generation through a scheme that obliges power companies and other qualified users to obtain clean energy certificates. The Law also mandates state-owned CFE to buy energy through auctions to meet its power needs at competitive prices. The auctions have encouraged the development of clean energy generation projects due to their cost-competitiveness compared to fossil fuel power plants.

Another key element in the reform was the establishment of an instrument to assess the social impact (Evaluación de Impacto Social; EvIS) of new projects in the energy sector. This instrument constituted a first effort to identify and prevent negative impacts on local communities from the implementation of large-scale energy projects. The EvIS requires companies to conduct studies that assess the social, economic, and environmental effects of their projects and to consult with local communities to identify and mitigate potential negative impacts.

The Energy Transition Law (LTE) was issued in 2015 to establish the need for the reduction of emissions, and greater investments in clean energy, renewables, and energy efficiency. Pursuant to the LTE, Mexico has adopted the goal to increase the share of 'clean' sources in the portfolio of primary electricity generation to at least 35% by 2024.

In 2016, Mexico signed and ratified the Paris Agreement, committing to take action on climate change, including by reducing GHG emissions in the energy sector. In November 2022, at the 27th Conference of Parties (COP27) of the United Nations Framework Agreement on Climate Change (UNFCCC), Mexico submitted its revised Nationally Determined Contribution (NDC) under the Paris Agreement. The country increased its unconditional GHG emissions reduction target to 35% and its conditional target to 40% by 2030.

While the country has made significant domestic and international commitments to transform its energy system, there have been challenges in implementing the necessary steps. For example, there have been delays in the installation of new renewable energy capacity, while conventional power generation plants continue to be constructed. The incorporation of large-scale renewables in the 2010s reduced emissions from the energy sector; but the current lack of new renewable energy projects poses a threat to this positive trend.

A key obstacle to a just energy transition in Mexico is that the concept is completely absent in the energy regulation system and has only been mentioned in some policy documents and programs. There is currently neither a legal framework nor are there clear guidelines for ensuring that the energy transition is just and equitable for all. To address this challenge, it will be important for policymakers and stakeholders to prioritize the development of a just energy transition legal framework that explicitly addresses issues of equity and social justice.

3.2.2. National and subnational energy governance

The electricity sector is mainly regulated by articles 25, 27, 28, and 73 section X of the Political Constitution of the United Mexican States; the LIE and LTE discussed above; the Federal Electricity Commission Law; and the Geothermal Energy Law.

The federal government has the authority to regulate all activities of the electricity industry, including power generation, transmission, distribution and commercialization, as well as planning and control of the National Electricity System; and the operation of the wholesale electricity market. The Ministry of Energy (SENER) oversees the energy policy, the Energy Regulatory Commission (Comisión Reguladora de Energía, CRE) grants power generation permits, and the National Energy Control Center (Centro Nacional de Control de Energía, CENACE) is the system and wholesale market operator. Additionally, the CFE, as the state-owned utility of Mexico, also plays an important role in the generation, transmission, distribution, and selling of energy.

The LIE provides that subnational governments shall contribute to the development of power generation, transmission, and distribution projects through processes and coordination mechanisms that guarantee and facilitate the granting of local permits and authorizations. It also stipulates that the federal government may coordinate with both state and municipal governments to promote the electrification of rural communities and marginalized urban areas. Therefore, though subnational governments are not able to independently regulate the electricity industry, they hold ample authority to incentivize and facilitate the development of energy transition activities.

Subnational governments also have powers to address climate change challenges and implement actions that contribute to GHG emissions reduction in other areas, such as urban development, transport, and infrastructure. Different states in Mexico have adopted legislation and policies to mitigate climate change and to support the development of renewable energy.

Likewise, state and municipal governments have authority over planning and land use, which allows them to decide on a range of issues related to their overall development, including sustainability and environmental protection issues. Therefore, through policy instruments and improved coordination efforts, subnational governments can lead the way in the clean energy transition.

However, as the federal government retains the ultimate authority to shape the energy sector, federal laws, policies and decisions may support or undermine efforts made by subnational governments. For example, some renewable energy projects have not yet been able to start operations due to delays in obtaining the required permits from the federal government. Although these are not state-led projects, these challenges do affect the states, as the social, economic, and environmental co-benefits that these projects bring with them cannot be generated and the delays in obtaining new permits forms a barrier to the initiation of new projects. To address this barrier, improved coordination between the three levels of government (federal, state and municipal) as well as with nongovernmental stakeholders will be key in order to achieve a just energy transition in Mexico.

The LTE also states that the federal agencies may coordinate with both state and municipal governments to promote the development of clean energies; facilitate access to high clean energy potential areas and ensure land use compatibility within their jurisdiction; identify and promote best practices in energy efficiency policies and programs; and simplify administrative permitting processes for clean energy projects. Furthermore, all three government levels may enter into agreements with actors in the electricity sector to jointly finance clean energy or energy efficiency projects.

Pursuant to the LTE, the National Commission for the Efficient Use of Energy (CONUEE) shall provide technical advice on sustainable use of energy to subnational governments that request it and enter into agreements for this purpose. CONUEE has the authority to issue binding resolutions for states and municipalities that use federal public funds for activities related to the sustainable use of energy. Moreover, CONUEE may promote the creation and strengthening of local institutional capacities to support energy efficiency programs in municipal services and in small and medium-sized enterprises (SMEs).

The following chart provides a summary of the responsibilities of federal and subnational entities in Mexico in the energy sector, highlighting their roles and responsibilities in the development of clean energy policies and programs.

Federal government	Subnational governments
• Regulate all activities of the electricity industry, including power generation, transmission, distribution and commercialization, planning and control of the National Electricity System, and operation of the wholesale electric market • Conduct energy policy through the Ministry of Energy (SENER) • Plan and prepare the National Electric System Development Program (PRODESEN) • Grant power generation permits through the Regulatory Energy Commission (CRE) • Operate the system and wholesale market through the National Energy Control Center (CENACE) • Generate, transmit, distribute, and sell energy through the Federal Electricity Commission, the State-owned utility of Mexico • Give technical advice on sustainable energy use through the National Commission for the Efficient Use of Energy (CONUEE) upon request from subnational entities, and enter into agreements for this purpose • Develop strategies, programs and mitigation and adaptation projects related to energy to achieve the efficient and sustainable use of the country's fossil and renewable energy resources • Implement climate change mitigation and adaptation actions related to the energy sector	• Contribute to the development of power generation, transmission, and distribution projects through processes and coordination mechanisms that expedite and guarantee the granting of permits and authorizations that fall within their powers • Coordinate with the federal government to promote the electrification of rural communities and marginalized urban areas • Shape their territories through planning and land use to consider issues of growth and development, including sustainability and environmental protection • Develop a state-level policy on climate change in accordance with the national climate change policy • Implement climate change mitigation and adaptation actions related to infrastructure and efficient and sustainable transport • Enact policy instruments and improve coordination efforts to enable the clean energy transition • Participate in the design and implementation of incentives that promote actions for the fulfillment of the purpose of the General Climate Change Law, such as energy efficiency practices, renewable energy generation, and reduction of emissions in the industry.

Source: Own elaboration

The states have different policy instruments available for implementation, which can serve as a basis for major measures for a just energy transition. Several of these mechanisms are already in place in some states. For example, 26 out of 32 states have a State Climate Change Law, however, 27 states lack a Climate Change Regulation, which is an essential tool for implementing climate mitigation actions at the local level and achieving energy transition goals (CCM, 2022). Some of the policy instruments, legal arrangements, and other measures under state jurisdiction are:

- State Plan for the Promotion of Energy Efficiency and the use of Renewable Energy sources
- State Efficiency and Energy Transition Strategy
- Sector Programs for Energy Development and Renewable Energy[9]
- State Climate Change Plan
- Social Council for Climate Change
- Inter-secretariat Commissions
- State Climate Investment Plan
- State Climate Change Strategy
- State Carbon Budget
- Climate Action Plans
- State inventories of Greenhouse Gases and Compounds
- State Climate Change Risk Atlas

3.3. Energy landscape

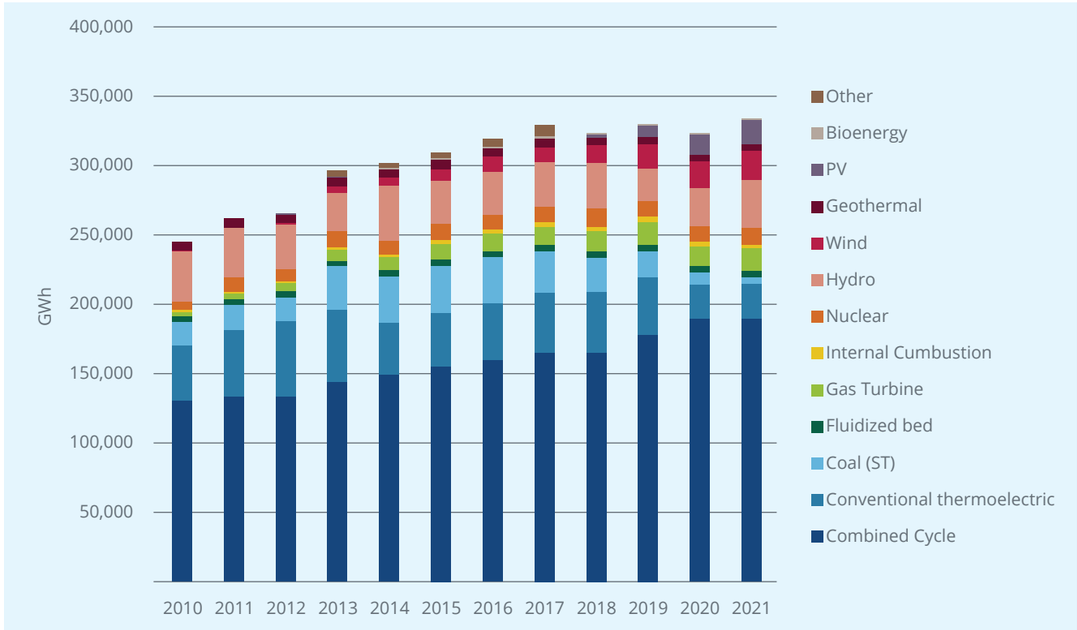
As explained above, decisions made in the previous decade have shaped the country's energy landscape, encouraging the development of renewable energy projects. This section provides a brief description of Mexico's current energy landscape, and offers more details on two primary energy transition challenges: the power sector and the phase-out of coal.

[9] The exact name of this measure may differ in different states.

3.3.1. Renewable energies: Large -scale and distributed generation

Between 2010 and 2021, installed capacity grew 82.8%, from 52.9 GW to 96.7 GW, while gross generation rose by 35.9%, from 245 TWh to 333 TWh (ICM, 2022), see Figure 1. Although unconventional renewable energy generation from wind and solar increased considerably, so did production from fossil fuels, mainly due to the construction of new combined cycle power plants. In 2021, fossil fuels still accounted for almost three quarters (72.9%) of the generation mix; nuclear energy contributed 3.6% and hydropower 10.5%. The remaining 13% was a combination of wind, solar and geothermal.

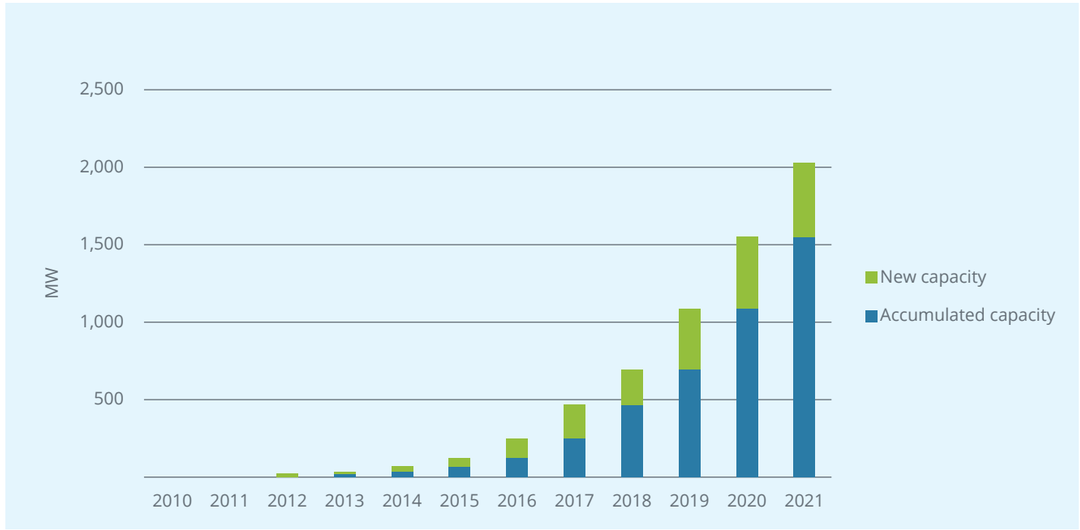
Figure 1. *Evolution of gross electricity generation by technology. Sources: SENER, 2015, 2016, 2017, 2018, 2022; ICM, n.d.a; ICM, 2022*



The growth of renewable generation capacity between 2010 and 2020 was partly facilitated by the current policy framework, which enabled the conditions for the development of large-scale wind and solar projects across the country through mechanisms such as the long-term auctions. In terms of spatial distribution, large-scale wind projects are concentrated in the Southwestern state of Oaxaca and the Northeastern state of Tamaulipas, whereas most solar photovoltaic projects are concentrated in the northern states. It is important to note that as renewable energy generation capacity has expanded, there have been challenges related to community engagement and local concerns. Improved policy instruments are needed to increase participation and transparency in decision-making processes for large-scale projects, and to improve the communication of social and environmental impacts, including through consultations with indigenous populations.

Besides large-scale wind and solar projects, grid-connected small-scale or distributed generation (DG) emerged as another significant driver of Mexico's renewable energy transition. DG facilities with a capacity of less than 500 kW are exempt from entry into Mexico's wholesale electricity market and from other permits. As shown in Figure 4, the installed DG capacity in Mexico has grown rapidly since 2013, surpassing 2 GW in 2021.

Figure 2. *Distributed generation installed capacity in Mexico. Source: ICM, 2022*



Most DG capacity in Mexico consists of solar PV installations. As Figure 5 illustrates, six states account for 50% of distributed generation. Several factors account for this geographic concentration, including a state's solar resource potential and the active promotion of renewable energy through support instruments and financing facilities. The fact that Jalisco, with 309.9 MW (15.3% of Mexico's total), is leading in distributed generation, is due mainly to the state's high solar generation potential and the availability of attractive financing products. The states that follow are Nuevo León with 220.52 MW (10.9%), Chihuahua with 136 MW (6.7%), State of Mexico with 126.8 MW (6.2%), Guanajuato with 110.4 MW (5.4%), and Mexico City with 109.93 MW (5.4%).

Support policies that foster the installation of DG in and by households, small businesses, and local cooperatives are key to the just transition. DG contributes to a just transition by generating benefits for the local community; it allows communities to generate their own energy, reduce their dependence on the centralized power grid, and reduce both local pollution and greenhouse gas emissions.

Figure 3. *Distributed generation capacity in Mexico per state (MW) (2021). Source: ICM, 2022*

3.3.2. Coal

In the context of the just energy transition in Mexico, the phase-out of coal is particularly important due to its significant impacts on the environment and local communities. While coal production has decreased in recent years, mainly due to a declining economic feasibility and strict energy dispatch rules, coal-based electricity generation still represented between 4 and 6% of Mexico's energy mix over the last decade (SENER, 2015, 2016, 2017, 2018, 2022; ICM, n.d. a; ICM, 2022). The main coal deposits are found in the states of Coahuila (which extracts 99% of all Mexican coal), Sonora, and Oaxaca. It is estimated that Mexico produces around 6 million tons of coal per year.

Coal mining and consumption have resulted in environmental and social conflicts, particularly in Coahuila. The Mexican coal industry is characterized by poor labor conditions, the exploitation of workers, and low salaries (ICM, n.d.). The burning of coal for electricity generation is also a significant contributor to air pollution and greenhouse gas emissions. The just energy transition must not only lead to the phase-out of coal-based power generation, but also include interventions to address lingering environmental and social impacts of coal mining and consumption. In addition, it must ensure that areas dependent on the coal industry develop new industries, and that workers in the coal industry are supported to build new careers.

Mexico joined the Powering Past Coal Alliance in November 2017, which is a global coalition of countries and subnational entities that are committed to phasing out coal power generation by 2030. Although in 2020, Mexico ramped up its purchases of coal, in November 2021, CFE informed that there were no plans to build new coal-fired power plants (Bloomberg Global Coal Countdown, 2023). Given the environmental and social impacts of coal mining and burning in Mexico, as well as its limited role in the country's energy mix, Mexico has the opportunity to set a global example by swiftly phasing out coal.

3.4. Energy leaders at the state level

Despite the complex regulatory and energy landscape, certain subnational entities have emerged as energy transition leaders. Several states have established their own energy agencies as decentralized institutions[10] with the objective of promoting the development of renewable energy projects and energy efficiency initiatives.

[10] State-owned companies that have their own legal personality and budget.

Out of the 32 states, 8 have an energy agency, 11 have an energy cluster, while 23 have dependencies or centralized organizations[11] responsible for energy issues. Only one Mexican state has neither.[12]

An example of collaboration between civil society, international cooperation, and subnational governments was the "Support for the Implementation of Energy Transition in Mexico" project, which sought to support subnational governments in the development of their planning instruments and roadmaps for the energy transition. In partnership with ICM and GIZ, state governments created the following plans:

- Quintana Roo's State Plan for the Promotion of Energy Efficiency and Use of Renewable Energy Sources;
- Hidalgo's Energy Transition Plan;
- Puebla's Energy Efficiency and Transition Strategy;
- Mexico City's Energy Transition Diagnosis;
- Veracruz' Energy Transition Plan; and
- Tamaulipas' Energy Promotion and Sustainable Use Program.

Mexico City, Quintana Roo, Tamaulipas, Puebla, and Hidalgo have already published their planning instruments and aligned them with current energy strategies. Puebla has developed an Energy Information System (SIEEP) to support its energy transition efforts. (AEEH, 2022; AEEV, 2021; SEDECO, 2022; SEMA, 2021 & SMADSOT, 2021).

Mexican states have also taken other actions to accelerate the just energy transition. The state of Sonora has implemented the "Sonora Plan for Renewable Energies," which is a clean energy and manufacturing plan worth USD 48 billion (Mares, 2023). The plan aims at spurring electric vehicle (EV) production, exploiting lithium and copper resources, building several large-scale solar and wind power plants, developing semiconductor production, as well as selling clean energy to neighboring U.S: state Arizona and strengthening the state's trade with the United States altogether.

In the state of Puebla, the government has maintained an open dialogue with local energy transition stakeholders. It works closely together with the Union of Cooperatives "Tosepan Titataniske", which brings together more than 34,000 families in the Sierra Norte of Puebla, most of whom belong to indigenous Nahua and Totonaku groups. Tosepan Titataniske decided to promote energy sovereignty in the region through technical training in electricity and photovoltaic system installation projects. In 2021, the Energy Agency of the State of Puebla (AEEP) agreed to create an alliance with Tosepan to promote indigenous production chains in the Sierra de Puebla and support the energy projects of the cooperatives.

Onergia, Mexico's first renewable energy cooperative, installs solar energy in homes and businesses, designs small scale projects and provides renewable energy-related training to young people from indigenous peoples and rural communities in the Sierra Norte of Puebla and other states. Onergia's projects are based on the active participation of energy producers and users in decision-making. The systems they install, mainly in Puebla, include interconnected and hybrid systems, autonomous systems, and solar lights.

Other examples of actions that subnational governments have taken to accelerate the energy transition include the recent creation of the Agency for the Promotion and Use of Renewable Energies in Nuevo Leon; the green hydrogen initiative launched by the state of Nuevo Leon; the studies into green hydrogen potential conducted by the states of Tamaulipas, Nuevo Leon, Guanajuato, Puebla, Coahuila and Chihuahua; the expansion of the network of sustainable buildings in Guanajuato with a total of 1,286 solar PV modules installed in state and municipal public administration workplaces and public schools; Jalisco's tax incentives for solar PV and a fund through which different subnational entities fund distributed generation systems for agricultural producers; and Yucatan's Race to Zero by 2030 commitment and pilot project "Green Autonomous Communities", through which 11 solar PV systems were installed in the municipality of Tecoh, benefiting families that did not have electricity.

It is also important to highlight the efforts carried out by the National Association of State Environmental Authorities (ANAAE), which acts as a coordinating, working and liaison body between state environmental authorities and the Ministry of Environment and Natural Resources at the federal level. ANAAE's work has four strategic axes: circular economy, biodiversity, climate change, and environmental justice. Although this initiative is not focused on energy transition matters, its work on climate change and environmental justice can indirectly contribute to the transition. This is an example of how state authorities can collaborate among themselves and with other actors, such as the federal authorities, civil society, the private sector, and international cooperation agencies, to position relevant issues on the national and subnational agenda.

[11] Centralized institutions are subordinate and economically dependent on the executive branch.

[12] For the state of Zacatecas, no agency responsible for energy issues was identified; in September 2022 the Energy Agency of the State of Zacatecas was decreed defunct.

3.5. Challenges and opportunities to advancing the just energy transition in Mexican states

It becomes obvious from the above that Mexican states interested in accelerating a just energy transition must overcome several challenges. However, they can also take advantage of several opportunities. A non-exhaustive list of both challenges and opportunities is provided in the table below. If states work to address the challenges and maximize the opportunities listed, that will not only enhance their ability to ensure a just energy transition, but also improve the general capacity of their institutions to work with stakeholders to build modern, just, and sustainable economies at all levels.

One of the most important challenges identified during this study is the fact that, while Mexico has advanced socially inclusive subnational energy policies, the concept of just energy transitions is not recognized in either subnational or federal policy frameworks. While some states have taken steps to promote renewable energy and energy efficiency, there is still a need for a coherent and coordinated approach that considers the needs and concerns of all stakeholders, particularly marginalized communities, and vulnerable populations. Policymakers must take into account economic and industrial interests as well as environmental and social considerations to foster social and economic justice.

Challenges	Opportunities
• Uncertainty within the energy legal and regulatory frameworks has hindered foreign investment in renewable energy. • Outdated state laws, regulations, and planning instruments (e.g., building codes). • Lack of financial and human resources to oversee all matters related to the energy transition. • Underrepresentation of women and minority groups in the energy sector in general, and in just energy transition planning processes in particular. • Lack of technical capacity to oversee all matters related to the energy transition. • Identification and implementation of financing opportunities. • Lack of business models that benefit subnational governments and communities. • Education and outreach in matters related to a just energy transition. • Lack of tools and resources to drive behavioral changes like replacing inefficient equipment or the efficient use of energy. • Lack of an equity strategy where people's benefits are at the center. • Lack of alignment of regulatory and programmatic objectives and processes across all state agencies. • Lack of an active engagement and collaboration among different stakeholders.	• Most states have a high renewable energy potential, especially solar potential. • Leverage schemes such as distributed generation to contribute to Mexico's clean energy goals. • Oppose new fossil fuel fired power plants and support the phase-out or phase down of fossil fuels within their territories. • Leverage existing energy efficiency programs and measures in state and municipal government buildings. • Improve energy efficiency measures in all sectors that fall within the state's jurisdiction. • Offer local property tax breaks with distributed generation or energy efficiency within private properties. • States have broad powers to drive electric mobility, the electrification of public transport, and the development of a non-motorized transport strategy. • Drive economic competitiveness and social benefits in priority communities through the implementation of just energy transition measures. • Development of trained and competitive workforce within state territories. • Creation of a more diverse energy workforce through the transformation of the energy sector. • Alignment of state agencies to promote a clean and just energy transition. • Promote collaboration with the private sector to drive a just energy transition. • Collaborate with other states to share lessons learned and accelerate implementation measures. • Collaborate with other states in regional alliances to promote synergies to enhance the development of renewable energies and advocate for supportive regulatory changes at the federal level.

4. Toolkit & Measures

This section presents a toolkit which aims to provide a practical guide for subnational governments in Mexico to identify, design, and implement policies that contribute to a just and equitable energy transition. The toolkit covers a wide variety of measures, ranging from simple and low-cost actions that can be implemented in the short term to more complex and costly measures that require long-term planning and investment. The measures presented are designed to support Mexico's commitments under the Paris Agreement and the achievement of the SDGs. The toolkit also aims to facilitate peer-to-peer learning and collaboration among subnational actors from different countries and regions, as well as with national and international stakeholders.

The information presented in the toolkit is based on interviews with key stakeholders from 10 Mexican states, during which the role of subnational governments and the main challenges and opportunities towards a just energy transition were discussed, as well as on information gathered from subnational forums, conferences, and other exchanges. These insights were complemented with desk research and analysis of international good practices as presented in Chapter 2.

The measures in the toolkit were presented to 20 public officials representing 14 states during a virtual workshop. At this workshop, the participants assessed each measure's potential contribution to advancing a just energy transition at the state level. The six measures with the highest potential impact and feasibility were investigated further; the results of this exercise can also be found in this chapter.

The measures in the toolkit are divided into six main categories:

a) cross-cutting measures;

b) renewable energy generation;

c) energy efficiency and savings;

d) energy storage, transmission, and distribution;

e) electric mobility and transport sector integration; and

f) dissemination of information, communication, and educational change.

4.1. General guidance

It is important to note that the recommendations provided in this toolkit are general in nature and may need to be adapted to suit specific local contexts. This toolkit is not intended to be prescriptive or to replace local expertise and decision-making. Rather, it is meant to provide inspiration, guidance, and best practices for subnational actors to design and implement policies and strategies for a just energy transition. Likewise, it is important to acknowledge that the successful implementation of the measures presented in this toolkit will depend on various factors, including the availability of resources and the political and social context. Therefore, it is important to assess the feasibility and appropriateness of each measure in the local context before implementation.

It is fundamental that the implementation of these policies follow principles for a just energy transition, such as:

- **Inclusiveness**: Involve all stakeholders in decision-making and implementation processes, particularly marginalized groups and impacted communities.
- **Distribution**: Ensure fair distribution of benefits and costs, with fair compensation to those negatively affected by the transition.
- **Participation**: Encourage active involvement and engagement of all stakeholders in the energy transition process and create spaces for meaningful participation.
- **Sustainability**: Align with long-term climate change mitigation and adaptation goals, as well as other environmental, social, and economic objectives, respecting planetary boundaries.
- **Context-specificity**: Identify - through the voices of local people and communities - and consider unique needs, challenges, and opportunities of different regions and communities.
- **Transparency and accountability**: Ensure openness and accessibility of information and decision-making processes.
- **Gender perspective**: Consider gender-specific impacts, collect disaggregated data, and promote equal participation and representation of women and men in decision-making and in the renewable energy workforce.
- **Feasibility**: Aim for ambitious yet realistic measures that can be effectively implemented given the available resources, technological capacities, and political feasibility.

4.2. Toolkit

The toolkit provides a description of each of the six categories as well as a selection of measures that can be taken to promote a just energy transition. A list of enabling conditions has been identified that can support implementation of the measures in each category. These include policies, regulations, institutions, and financing mechanisms that need to be in place - if these do not exist, the recommendation is to create them. Following, the six categories with their measures are presented:

Cross-cutting measures		
Description: This category includes measures that serve as a framework to support the implementation of the measures in all other categories. They include coordination, monitoring, financing, capacity building, and awareness campaigns, ensuring a comprehensive approach to the energy transition.		
Measure 1: Monitoring and evaluation of goals of the planning instruments and/or applicable state legislation	**Measure 2:** Financing the just energy transition	**Measure 3:** Capacity building and awareness campaigns
Establish ambitious yet achievable and measurable goals for a just energy transition, set a clear timeline and design indicators to monitor progress. Use monitoring results in frequent evaluations and recalibrations of just energy transition plans and strategies.	Develop subnational financing programs through national and international alliances, environmental funds, sustainable financing instruments (such as sustainable investment funds, bonds, and green loans or social risk capital), or fiscal measures to promote community distributed generation projects, groups, and cooperatives, as well as financing to implement additional measures, such as audits, energy efficiency programs, electromobility, active mobility, and other initiatives.	Enhance the technical and institutional capacities of state public administration and municipal authorities to facilitate a just energy transition. This requires developing the skills of the workforce and youth, as well as implementing dissemination campaigns and awareness programs for the general public regarding the concept of a just energy transition.

To enable these measures, the following is recommended to be in place:

- The existence of a state-level authority, centralized or not, capable of carrying out these measures. It is recommended that there be a transparent and open channel of communication between this authority and the sectors impacted by the implementation of these measures.
- A subnational office to support intersectoral and interdepartmental coordination can also be helpful.
- Policy instruments and mechanisms explained above (Subchapter 3.1.2), such as linking decarbonization routes to state development plans and climate change programs, can guarantee the transversality of decarbonization measures.
- Strategic alliances with international initiatives, such as the Race to Zero and the Powering Past Coal Alliance, can also be instrumental in enabling the energy transition at the subnational level.
- Spaces for public participation in energy decision-making, such as advisory councils, can help ensure that the transition is inclusive and reflects the unique needs of different communities.
- To facilitate the implementation of the measures, there also needs to be a nationally aligned energy policy and flexible regulatory framework. Support from the federal executive and legislative branches, communication and coordination among state ministries and municipalities, and engagement with the private sector, academia, civil society organizations, international agencies, and financial institutions are all critical for a successful transition.

Renewable energy generation

Description: The measures within this category aim to foster the development of renewable energy projects at diverse scales and with different ownership structures, with a focus on alleviating energy poverty and enhancing access to financing, tools, and capacity building for local communities.

Measure 1: Distributed generation	**Measure 2:** Financing the just energy transition	**Measure 3:** Simplify permitting
Promote distributed generation in public buildings, SMEs, and the residential sector through financial support or tax exemptions, with a particular focus on low-income households, marginalized and/or vulnerable areas, and small businesses.	Facilitate and foster community renewable energy projects through partnerships and multisectoral associations involving civil society, private sector, academia, public sector, and financial institutions, empowering communities to meet their energy needs (e.g., Cooperativa Onergia).	Simplify procedures for local permits applicable to renewable energy projects. Create a step-by-step guide for renewable energy developers. Establish incentives to attract investment in renewable energy projects (e.g., facilitate land use zoning and construction licenses).

To enable these measures, the following is recommended to be in place:

- State-wide planning instruments that include an energy transition program and a decarbonization roadmap.
- Complete and updated data and information on the state's energy situation, including data related to energy poverty.
- Laws and regulations supporting the development of renewable energy at any scale.
- A ministry, agency, or office in charge of driving a clean and just energy transition.
- Detailed data and mapping of renewable energy potential.
- An agency or office in charge of promoting business models and projects that place communities' and people's benefits at the center.
- Spaces for dialogue where renewable energy generation issues are discussed.
- Identified international or federal financial programs that could support the transition.
- Energy related training courses, degrees, and postgraduate programs.

Energy efficiency and savings

Description: The potential for efficiency improvements presents a significant opportunity for swift action towards a just energy transition. Utilizing existing policy frameworks focused on efficiency can serve as a strong foundation for this effort. One example is the successful implementation of policies addressing refrigerant gasses, in compliance with the Montreal Protocol.

Measure 1: Building codes	**Measure 2:** Fuel switching	**Measure 3:** Substitution and audits of consumer technologies
Update building regulations to encourage the adoption of energy efficiency measures, for example, inclusion of efficient lighting systems, high-efficiency water pumping equipment, efficient heating and cooling, as well as efficient electric motors used for elevator systems.	Develop and expand state-level energy efficiency strategies to include the replacement of technologies and promote a reduction in the use of fossil fuels, through the electrification of technologies and/or systems or the promotion of green hydrogen as an alternative.	Initiate programs to promote the replacement of inefficient equipment with more energy-efficient technologies across all sectors, while also conducting energy audits and facilitating renovations in small and medium-sized enterprises to support their energy consumption reduction efforts.

To enable these measures, the following is recommended to be in place:

- Energy saving and efficiency use programs.
- Binding energy efficiency standards.
- A ministry, agency, or office that promotes energy efficiency measures.
- Sectoral energy efficiency programs.
- Energy efficiency training programs for the public administration and other sectors.
- Updated building codes with energy efficiency technologies included.
- Collaboration agreements with the federal government to develop energy efficiency programs within its territory.
- A ministry, agency, or office that promotes business models to promote energy efficiency technologies in marginalized communities.

Energy storage, transmission, and distribution

Description: Energy storage, as well as transmission and distribution, are key for providing reliable and affordable energy access to communities, to promote energy security, and to allow for the integration of high shares of variable renewable energy generation in the energy mix. Mexican states have limited experience with measures in this category, however, working alongside the federal government, they can contribute to the expansion and modernization of energy infrastructure, as well as to the adoption of new energy storage technologies.

Measure 1: Utility-scale batteries and energy banks	**Measure 2:** Local hubs	**Measure 3:** Green hydrogen
Create incentives and strategies to foster the growth of the value chain and raw material supply, as well as facilitate infrastructure for battery distribution logistics to attract investment in this technology. Examples include power banks for electrified public transport and large-scale storage utilization in public buildings.	Drive the establishment of research, development, and implementation hubs to cultivate a local industry in the energy storage value chain. This can be achieved through the formation of local working groups, such as social technology laboratories.	Formulate state roadmaps for the development and use of green hydrogen.

To enable these measures, the following is recommended to be in place:

- Have an energy agency or office in charge of energy storage.
- Universities or institutions conducting research on these issues within the state.
- Experience of storage systems installed in the state.
- Innovation hubs or social laboratories in the state.
- Studies on the state's green hydrogen potential.

Electric mobility and transport sector integration

Description: As one of the leading car manufacturers in the world, Mexico has the potential to play a leading role in the production and assembly of electric vehicles and their parts. A switch to EV manufacturing is crucial if Mexico's car industry is to remain internationally competitive. Subnational governments can contribute to Mexico's leading role and competitiveness through the adoption of electric mobility and transport integration policies and measures while bringing health, equity, environmental, and economic benefits to their territories.

Measure 1: Electrify public transportation and mass transportation systems	**Measure 2:** Value chain and infrastructure development for comprehensive mobility	**Measure 3:** Renewal of the vehicle fleet
Promote the planning, development, and strengthening of inclusive electric public transportation across the state, while also focusing on expanding and modernizing mass and integrated transportation networks.	Facilitate the growth of the value chain and infrastructure for electric mobility services in both public and private transportation sectors, while also strengthening and encouraging active mobility options.	Accelerate the adoption of more efficient and less polluting vehicle technologies across all vehicle categories, through initiatives such as vehicle scrappage programs for vehicles older than 15 years and emissions verification programs. Implementing anti-corruption systems, accountability measures, and transparent procedures will ensure that the generated income is directed towards decarbonization efforts.

To enable these measures, the following is recommended to be in place:

- An integrated mobility plan.
- Laws and regulations that promote the development of electric mobility and related infrastructure.
- A ministry, agency or office that promotes new business models and collaboration between stakeholders in the electromobility value chain.
- Vehicle verification programs.
- Identified international or federal financial programs that could support electric mobility and transport integration.

Information, communication, and educational change		
Description: Information, communication, and educational change are crucial for the just energy transition, to ensure that communities and stakeholders understand the benefits and challenges of transitioning to clean energy. This includes raising awareness, providing accurate information, and engaging in dialogue to build trust and support for a just and sustainable subnational energy future.		
Measure 1: Energy diagnosis and monitoring systems	**Measure 2:** Networks and knowledge sharing	**Measure 3:** Virtual communication platform
Conduct an energy diagnosis at the state level to gather information and establish tools for assessing the feasibility of various measures. Additionally, establish a state energy monitoring system to ensure compliance with Official Mexican Standards related to energy efficiency and emissions. These initiatives aim to strengthen informed decision-making and promote targeted policies.	Identify and formalize strategic alliances among stakeholders from the private, public, and social sectors, as well as between states, to facilitate knowledge sharing, exchange of best practices, and the implementation of actions and conditions that support a just energy transition.	Develop tools, such as a virtual calculator, to enable municipalities to understand the benefits of investing in renewable energy and other solutions for enhancing their local economies. This will also empower them to promote the creation of alternative economies in areas highly dependent on fossil fuels, supported by tools and capacity building initiatives (e.g., fair trade, agricultural cooperatives, clean companies, etc.).
To enable these measures, the following is recommended to be in place: • Participatory processes where marginalized communities are included. • Democratic processes with a high level of citizen participation. • Information and communication campaigns on climate change and its effects. • Clean energy, climate change and energy transition programs in education centers. • Training for government employees on issues of just energy transition or climate justice.		

4.3. Description of selected measures

During a workshop held on May 9, 2023, a group of 20 public officials from 14 different states rated the measures in the toolkit based on their potential contribution to progress towards a just energy transition at the state level; feasibility considering the current energy regulatory and institutional framework, as well as local multisectoral support; and financial viability. The following measures (one per category) were selected as most impactful and feasible for implementation:

Category	Selected measure
Cross-cutting measures	Monitoring and evaluation of goals of the planning instruments and/or applicable state legislation
Renewable energy generation	Distributed generation
Energy efficiency and savings	Substitution and audits of consumer technologies
Energy storage, transmission, and distribution	Local hubs
Electric mobility and transport sector integration	Electrify public transportation and mass transportation systems
Information, communication, and educational change	Networks and knowledge sharing

This section aims to provide a deeper understanding of each selected measure's implementation by presenting a detailed description and practical examples and success stories from either national or international contexts, which can feed into just energy transition strategies and roadmaps.

Ad 1. Cross-cutting measures: Monitoring and evaluation of goals of the planning instruments and/or applicable state legislation

Several states have taken significant steps in combating climate change by implementing a range of climate legislation, including strengthened regulations and dedicated state laws. Monitoring and evaluating the progress of each action line and goal is key to ensuring effective implementation of climate policy and of other measures in this toolkit . As a cross-cutting measure, improved monitoring will support the success of the other measures in this toolkit.

One effective approach is to align decarbonization pathways with state development plans and climate change programs, which promotes the integration of decarbonization measures across sectors. States such as Mexico City and Nuevo León have incorporated climate goals into their own development plans, demonstrating their commitment to sustainable development.

Some countries, like Germany, have successfully integrated climate goals into national and regional development plans. For instance, the Climate Protection Act of the state of North Rhine-Westphalia sets binding targets for reducing greenhouse gas emissions by 25 percent by 2020 and by 55 percent by 2030 compared to 1990 levels. It also establishes a climate protection council, a climate protection plan and a climate protection fund to support the implementation of the act. Similarly, in the United States, California has been a leader in climate action with its comprehensive climate change policies with monitoring and evaluation of goals.

A first step to more effective monitoring is to develop sound indicators that will allow progress to be measured. States should set goals for the frequency with which measurements are made and establish pathways through which the results of these measurements are fed back into decision-making processes.

Ad 2. Renewable energy generation: Distributed generation

Distributed generation refers to the production of electricity from small-scale grid-connected power sources (up to 0.5 MW) located close to the end users. State governments could introduce financial incentives, such as tax credits, grants, and low-interest loans, to encourage the adoption of distributed generation technologies. These measures would make renewable energy systems more affordable and accessible and empower consumers to actively participate in the generation of their electricity.

As mentioned in Chapter 2, subnational governments around the world are taking different approaches to promoting renewable energy generation. These can serve as inspiration for Mexico's state governments as they promote the development of distributed generation within their territories. For example, the government of the Australian state of Victoria pledged that 40% of its electricity will come from renewable sources by 2025, and 50% by 2030. Under this pledge, households and small businesses will receive rebates for solar panels. The Brazilian state of Minas Gerais has made investing in solar PV more attractive by training local managers, providing fiscal incentives, and simplifying permitting procedures. Another example is Berlin's Solar Law, which requires all new buildings to include solar PV systems.

Mexican subnational governments have also undertaken various initiatives and programs that can serve as an example for other subnational governments in the country (see subchapter 3.4). One of these is the "Solar City" program which promotes the efficient use of energy and renewable sources in the public and private sectors of Mexico City, through initiatives aimed at supporting small and medium-sized enterprises (SMEs) to install PV systems, training technicians for the installation of PV systems, as well as promoting distributed generation in buildings owned by the government (Government of Mexico City, 2022).

Another initiative is the "Ejido Solar" program which is being implemented in the state of Sonora and promotes community development in rural areas of Mexico through innovative models for distributed generation. It proposes the implementation of solar PV projects on communal lands owned by *ejidatarios* (communal landholders) in collaboration with local governments and private companies (ICM, 2023).

Ad 3. Energy efficiency and savings: Substitution and audits of consumer technologies

This measure focuses on the promotion of strategies to replace inefficient equipment with more efficient technologies, while also facilitating energy audits and renovations in small and medium-sized enterprises to reduce their energy consumption.

Energy efficiency strategies must take into account the specific requirements of the contexts in which they are developed. These measures must prioritize the most relevant energy end uses for each context, which are determined by the energy demands of each sector and the specific technology and fuel used to meet those needs.

For example, in the city of São Paulo, Brazil, a Guarantee Fund was created to provide financing schemes for energy efficiency in the private sector. Additionally, a Council was formed to promote dialogue among different stakeholders and influence decision-making processes and policy development. Another notable example is the US state of Wyoming who offers free energy audits to public schools, as well as facilitating energy audits in small businesses. In Colombia, the PEECES program aims to replace approximately 65,000 cooling appliances in the participating departments, with the goal of increasing efficiency and reducing energy consumption, energy subsidies, and energy bills for the recipients.

In Mexico, at the national level, the National Commission for Energy Efficiency (CONUEE) leads the promotion of energy efficiency. Through this organization and in collaboration with other institutions such as the Trust Fund for Electric Energy Savings, a series of policies and programs have been developed that lay the foundation for energy efficiency at both national and subnational levels. Examples of impactful policies include the Mandatory Mexican Official Standards for consumer technologies and the yellow labeling system, which certifies technologies based on their energy efficiency.

At the subnational level, the Ministry of Environment of the state of Coahuila launched the "Programa Oficina Verde" in 2013.This building energy efficiency program aims to promote a culture of sustainability and provide local government offices with the tools, knowledge, and incentives to promote the efficient use of energy (GIZ, 2021). In 2021, 165 offices were registered, and the program was present in 18 of the 32 municipalities in the state with the participation. Environmental committees comprising 942 women and 910 men had been formed. A study conducted by GIZ, estimated that the annual emissions reduction potential of the 165 participating offices could reach 2,300 tCO_2e per year.

In another example, Mexico City has implemented programs for the replacement of inefficient technologies through the Ministry of Economic Development (SEDECO), providing financing support to Small and Medium Enterprises and promoting the acquisition of more efficient technologies. Another case is the program for the replacement of public lighting with LED technology in Nuevo León, specifically in the city of Monterrey.

Ad 4. Energy storage, transmission, and distribution: Local hubs

The establishment of research, development, and innovation (R&D&I) hubs for energy storage allows for the development and/or strengthening of different types of educational, technical and methodological competencies and can facilitate the development of local value chains linked to the design and adoption of new technologies.

The configuration of these local hubs should be aligned with the values of a just energy transition. They should adopt a gender perspective, seeking to overcome barriers to gender equity in the energy sector at the local level. The structure of each hub should be designed to meet the social and energy needs of the community. Links with local actors in the academic sector, such as high schools, universities and local research centers, are essential to provide virtual and physical spaces, and for dissemination of information to the community. The support of the public and private sectors is also key, as it can support the facilitation of procedures and infrastructure, as well as financing and sponsorship schemes for the formation of local hubs.

Examples of these types of local hubs include the planned National Laboratory of Community and Cooperative Energy, which supports innovation in sustainable energy in the State of Puebla (LaNECC). This laboratory will seek to provide a physical and virtual space for both learning and experimentation, while adopting a wider scope and trying to include and engage different communities.

Another example is the "HUBIQ", formed in 2021 with the support of the government of Querétaro with the objective of promoting technological innovation focused on renewable energy, energy efficiency, and climate action.

Ad 5. Electric mobility and transport sector integration: Electrify public transportation and mass transportation systems

In Mexico, the transport sector is the second largest GHG emitter and the country is among the world's top 10 in terms of GHG emissions from transport. Private cars contribute the majority of emissions, and the fleet is growing: between 1990 and 2017 it increased at a rate 3.5 times greater than the population (WRI, 2022). It is essential that subnational governments promote the electrification of public transport and mass transportation systems.

An important measure is to promote the planning, development, and strengthening of inclusive electric public transportation throughout the states, as well as the expansion and renewal of mass and integrated transportation systems. In addition to the recommendations mentioned above for the implementation of the measures related to electric mobility and transport sector integration, it is important to take into account the gender and social justice perspective. When planning the expansion of transport systems, the needs of vulnerable populations and the differentiated needs that women have when using public transport should be considered.

Examples of subnational governments with relevant experiences in the electrification of public transportation include Mexico City, which now has the largest fleet of articulated e-buses in Latin America and one of the largest worldwide; one of the most important targets is to electrify the entire Metrobús fleet by 2035.[13] Yucatán is running tests with the "IE-TRAM", an electric bus-tram hybrid funded through a mixed financing scheme involving the state, the federal government and a private initiative. The IE-Tram will run on 80 existing routes, connecting 3 municipalities, more than 137 neighborhoods and 20 tourist attractions in the state capital Mérida.[14] Finally, Jalisco has implemented different electric public transport projects such as lines 3 and 4 of the Guadalajara Urban Electric Train system and the fleet of electric buses serving the Guadalajara Airport (Mi Transporte Eléctrico).[15]

This measure is not only an opportunity to accelerate the energy transition at the local level and reduce emissions, it can also generate co-benefits such as the reduction of inequality, as improved, affordable public transport can provide access to opportunities such as employment, education, and health services. Studies have shown that people living far from urban centers, mostly low-income, tend to spend more money on transportation and significantly more time commuting than people living more centrally.

Ad 6. Information, communication, and educational change: Networks and knowledge sharing

Networks play a crucial role in advancing the energy transition by facilitating the sharing of knowledge, expertise, resources, policies, successful implementation strategies, and good practices among various stakeholders. Moreover, through shared networks, potential cooperators and investors, as well as funding opportunities, can be identified more quickly.

Subnational governments could form alliances and create platforms to foster collaboration and partnerships with other subnational governments, the federal government, academia, local communities, the private sector, civil society organizations, international organizations, and financial institutions to accelerate the energy transition at local and regional levels.

There are many international examples of cooperation that have contributed to the just energy transition (see subchapters 2.2.1 - 2.2.4). For example, in the United States, 12 northeastern states created a cap-and-trade system for power sector emissions, called the Regional Greenhouse Gas Initiative. Several benefits arose from this initiative, including the decline of power-sector carbon emissions in those states by over 50%. Another example from the United States is the Clean Energy States Alliance, a coalition of public agencies (primarily state energy agencies) that fosters collaboration to advance clean energy. In Germany, a national-federal cooperation committee was established with representatives of the federal government and the 16 state governments, to coordinate their actions and monitor the progress states are making in expanding renewable energy generation.

An example of networks and knowledge sharing in Mexico are the energy clusters that have been instrumental in fostering collaboration and contributing to the advancement of the energy transition in the country. The Asociación Nacional de Autoridades Ambientales Estatales (ANAAE) is another initiative of various state environmental ministries with the objective of coordinating and working jointly with the federal Ministry of Environment and Natural Resources (see subchapter 3.4).

[13] For further information, please consult: https://www.c40.org/news/mexico-city-e-buses-zebra/
[14] For further information, please consult: https://vayven.yucatan.gob.mx/rutaietram
[15] For further information, please consult: https://www.jalisco.gob.mx/es/prensa/noticias/145526

5. Conclusion

Mexico has an enormous opportunity to achieve a just energy transition that reduces GHG emissions and local pollution, improves access to affordable, reliable, modern energy for all, creates a globally competitive clean energy sector, and accomplishes the social, economic, and environmental development goals. State-level governments have demonstrated willingness and ambition to lead this transition. Challenges remain, including federal legislation that limits states' authority over energy systems and policy, as well as the lack of a formal definition of a *just* energy transition and of official guidelines on how to bring it about. However, this study has shown that states still have a variety of instruments at their disposal to accelerate the energy transition and has highlighted a variety of good practices that they can consider.

This report makes the case for strong subnational action to accelerate a just energy transition in Mexico. Distributed, renewable energy solutions are best designed and governed at the subnational level, given the large geographical and socio-economic differences between Mexican states. Typically, state-level governments are also more closely connected to the different sectors of the population and local stakeholders; they are therefore better able to integrate their views into energy transition plans and their implementation, building indispensable support for the substantial changes envisioned. Finally, the direct benefits of the energy transition, such as improved energy access, job creation, and reduced pollution, will be primarily local, providing the right arguments to bring a critical mass behind the required deep transformations. Ultimately, the just energy transition needs to be powered by the people.

The report also demonstrates how state or provincial governments in five countries, with different levels of autonomy, resources, and capacity, have invested in just energy transitions. Australia, Brazil, Colombia, Germany, and the United States, offer a range of good practice examples and lessons learned, from support for household solar PV to industrial green hydrogen generation, and from energy efficiency regulations to coal mine rehabilitation, that can be emulated and adapted for state action in the Mexican context.

Investigating the Mexican context, the report explores specific requirements and challenges for the just energy transition, given the country's current energy landscape and specific political and socio-economic situation. Though energy policy and legislation remain the remit of the federal government, states have a range of instruments at their disposal to promote energy efficiency, invest in renewable energy and sustainable transport, and enhance inclusive community participation in the transition. The most promising of these instruments, selected based on desk research and feedback gathered through interviews and a stakeholder workshop, are included in the toolkit.

In the Mexican context, as elsewhere, accelerated action from subnational governments has the potential to contribute to a just energy transition; however, efforts towards creating subnational energy transition policies will vary from state to state depending on their institutional capacities, financial resources, and specific context and needs. The good news is that developing these enablers is within the local governments' reach.

There are opportunities that are cost-effective such as implementing existing energy efficiency programs, as well as measures and policies that do not require large funds but rather political will and better coordination. Through alliances with international cooperation agencies, academia, civil society organizations, financial institutions, etc., states can strengthen their capacity to drive successful energy transition policies.

There are subnational governments leading the way and taking innovative approaches to drive a just energy transition locally. For these states, it is recommended that they direct their efforts to scaling up their existing programs or expanding them to other sectors. For example, if these states are implementing energy efficiency programs in government buildings, then they could start applying them to the industry, commercial and residential sectors. Likewise, these subnational governments could focus on building more alliances with other state governments and other stakeholders to exchange lessons learned and solutions.

All subnational governments must look at the energy transition as an opportunity to trigger economic and social benefits for their population. The authors hope that this report will provide inspiration, motivation and validation to policymakers and other stakeholders pursuing just energy transitions at the subnational level in Mexico and beyond.

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