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POLICY ROADMAP FOR 100% RENEWABLE ENERGY IN COSTA RICA

Achieving a fully decarbonised energy system

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GRAPHIC DESIGN

Hot Ice Creative Studio

PHOTO CREDITS

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Published May 2020
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This project was made possible through
funding by the Leonardo DiCaprio Foundation.

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POLICY ROADMAP FOR 100% RENEWABLE ENERGY IN COSTA RICA

Achieving a fully decarbonised energy system

1 INTRODUCTION

"Decarbonization is the great challenge of our generation and Costa Rica must be among the first countries to achieve it, if not the first."

– **Carlos Alvarado Quesada**, President of Costa Rica

Costa Rica is a global leader when it comes to ensuring energy production comes from renewable energy sources. Between 2010 and 2017, the country attracted US$ 1.9 billion in new-build clean energy investments (Rapid Transition Alliance, 2020), and with a 98% share of renewables in its electricity matrix and solid achievements to prevent deforestation—around 25% of the country's land area is in protected National Parks and other protected areas—Costa Rica is a global leader in terms of environmental sustainability, climate action and driving the renewable energy transition.

At the same time, Costa Rica is one of the countries most vulnerable to climate change. Only considering the direct costs of extreme weather events, climate change resulted in economic losses estimated at around US$ 1.3 billion between 2005 and 2011. Some studies estimate future losses to exceed US$ 7 billion by 2030 (MINAE, 2015b). Or between 0.68 to 2.5 per cent of GDP until 2025 (Comptroller General of the Republic, 2017).

Therefore, Costa Rica has adopted a plan to achieve a zero net emissions economy by 2050, in line with the objectives of the Paris Climate Change Agreement. The planned measures, activities and improvements also form part of the country's updated Nationally Determined Contributions (NDCs) that Costa Rica presented in late 2019 to the UNFCCC, and demonstrate and strengthen its commitment to reduce greenhouse gas emissions and participate in efforts to avoid a temperature rise above 1.5 degrees Celsius with respect to the pre-industrial era.

The biggest challenge will be to increase the share of renewables in energy consumption. More than 60% of energy consumption in the country is from petroleum derivatives. 64% of Costa Rica's emissions come from energy use, and more than two thirds of that is from transport. A critical part will thus be to decarbonise the transport sector. The growing demand for personal vehicles, the majority of which run on petrol, is keeping a high share of fossil fuels in the country's energy consumption. The Decarbonization Plan aims to have 30 percent of public transport powered with zero emissions in 2035—and 85% by 2050.

This policy roadmap complements the study "100% Renewable Energy for Costa Rica – A decarbonisation roadmap" by the University of Technology Sydney – Institute for Sustainable Futures. It aims to provide policy pathways for Costa Rican to achieve a fully decarbonised energy system in Costa Rica. Thereby harvesting the many socio-economic benefits of renewable energy.

2 CONTEXT

2.1 Demographic

The current population of Costa Rica is just over 5 million, up from 4.58 million at the 2011 census (World Bank, 2020a). This makes Costa Rica the 120th most populous country in the world. Population growth has been holding steady at around 1% per year.

79.34% of the country's population live in a city or a surrounding urban area (World Bank, 2020b). The capital and largest city is San Jose, which has a population of about 335,000 and a high population density of 6,455 people per square kilometre (Worldometer, 2020). The greater metropolitan area has 2.15 million residents or a third of the country's entire population.

2.2 Political Context

Costa Rica is a constitutional democratic republic with a multi-party system. Executive power resides with the President, while legislative powers are vested in the Legislative Assembly.

Costa Rica is one of the most prosperous and politically stable countries in the region and is the only Central American state without a permanent standing army, after it was abolished in 1949.

In March 2018, Carlos Alvarado won the presidential election by a surprisingly wide margin of around 20%. The Government has indicated that stimulating economic growth, reducing unemployment (which in the second quarter of 2019 rose to 11.9%, one of the highest figures in recent years) and decarbonizing the economy are among its key priorities (Zúñiga, 2019).

In February 2019, the government launched its Decarbonization Plan, which defines activities in key sectors to be implemented in three steps until 2050 in order to achieve a modern, emission-free, resilient and inclusive economy (MINAE, 2019a). The Plan underpins the National Plan for Development and Public Investments and the long-term Plan Estratégico Costa Rica 2050.

To reach this goal, Costa Rica will make changes and modifications to mobility and transport (public as well as private), optimize energy management, promote sustainable construction and industry, and improve recycling and waste disposal. The Plan offers a roadmap to promote the modernization of Costa Rica's economy, generate jobs and boost its growth based on the generation of "3D" services and goods: Decarbonized, Digitized and Decentralized.

The planned measures, activities and improvements also form part of the country's revised Nationally Determined Contributions (NDCs) that Costa Rica will present to the UNFCCC. Demonstrating and strengthening its commitment to reduce greenhouse gas emissions and participate in the global effort to avoid a temperature rise above 2 degrees Celsius with respect to the pre-industrial era.

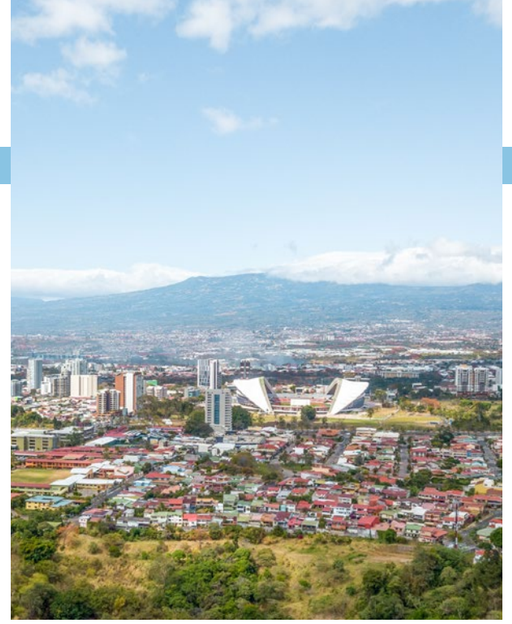
2.3 Economic Context

Costa Rica is considered to be an upper middle-income country (MIC). The Gross Domestic Product per capita in Costa Rica was last recorded at $12,0272 in 2018, which is more than triple what it was 30 years ago (World Bank, 2020c). The country's steady growth over the last decades has been credited to an outward-oriented strategy, based on an openness to foreign investment and gradual trade liberalization. Costa Rica's inflation rate wasat 2.53% for the period September 2018 – September 2019, which is under the target of 3% set by the Central Bank of Costa Rica for 2019 (The Tico Times, 2019a).

Costa Rica's commodity-driven economy is led by traditional agricultural exports of bananas, coffee, sugar and beef. Agriculture makes up around 4.6% of GDP and employs around 12.5% of the labour force (World Bank, 2020c). Tourism is another key sector of the economy, representing around 8% to the country's GDP and creating some 156,000 jobs (QCosta Rica, 2019a). Costa Rica is also an exporter of medical devices and other high-value-added goods and services.

Increasing investments into highly sophisticated-technologies over the past years have driven GDP growth considerably, particularly in the greater metropolitan area around San José. While high-tech industries could enable Costa Rica to leapfrog certain soon-to-be-obsolete technologies, it also requires a highly qualified labour force. This excludes large parts of the population outside of the San José metropolitan region who have neither the knowledge nor the skills to participate in this sector.

As part of implementing its National Plan for Development and Public Investments (2019-2022), the government announced in September 2019 a public investment package of $9.526 billion dollars to boost the economy and reduce unemployment. The Ministry of Planning and Economic Policy specified that the investment will go to road, educational, airport and hospital infrastructure projects, as well as energy, health, safety and justice projects (The Tico Times, 2019b).



2.4 Social Context

Costa Rica is characterised by political stability, a high standard of living, and a well-developed social benefits system, which sets it apart from many of its Central American neighbours. Through the commitment of successive governments to substantial social spending – almost 20% of GDP annually – Costa Rica has made significant progress in areas such as providing universal access to education, healthcare, clean water, sanitation, and electricity (CIA World Factbook, 2020).

Social cohesion, political stability and steady economic growth have resulted in one of the lowest poverty rates in Latin America. With most of the population living in urban areas, the majority of Costa Rica's poor people are situated in rural areas, where there is a lack of resources, jobs and opportunities. While 21% of the population live below the national poverty line of earning $155 per month, only 2% live below the international poverty line (The Tico Times, 2019c).

Despite continuous GDP growth from $37.3 billion in 2010 to around $60 billion in 2018, Costa Rica's unemployment rate has risen from 9.7% in July 2016 to 11.9% in July 2019, one of the highest figures in recent years (INEC, 2019).

As far as education standards are concerned, Costa Rica's literacy rate stands at 97.86%, one of the highest of all Latin-American countries, and a majority of the population speaks English, mainly due to Costa Rica's tourism industry (UNESCO, 2020). Public education is guaranteed in the constitution and both pre- and high-school education has been free since 1869.

2.5 Energy Context

According to the Institute of Costa Rica's Electricity Institution (Instituto Costarricense de Electricidad/ ICE), 99.4% of the Costa Rican population has access to electricity. 98.2% of electricity generation comes from renewables, with hydropower making up the largest share of electricity supply (Costa Rica Star News, 2018). To date, Costa Rica is one of very few countries to run on 100% renewable electricity for the largest part of the year. In fact, 2018 was the fourth year in a row that Costa Rica generated more than 98% of its electricity from renewable sources (2015: 98.99%; 2016: 98.21%; 2017: 99.67%; 2018: 98.15). In 2018, Costa Rica set a new world record (breaking its own record) by running on 100% renewable energy for 300 days in a row (The Weather Channel, 2018).

In order to reduce dependencies on hydropower during increasingly strong dry seasons, the country has started to diversify its electricity mix. In 2018, wind power made up 16% of the electricity mix, up from 4% in 2011 (Rodriguez, 2019a). Studies are currently being carried out to implement off-shore wind power projects. However, as many of the eligible zones are part of protected marine areas, the utilization of off-shore wind power will have to be determined.

These efforts to diversify the energy mix are in line with current government plans to expand renewable electricity generation by 653 MW (wind power 43% increase, geothermal 25%, solar 25%, hydro 7%). These plans foresee to also replace diesel-powered thermal plants with renewable plants. This will require changes in existing infrastructure, which will have to consider environmental and climate impacts such as floods, volcanic eruptions, droughts and other natural phenomena.

ELECTRICITY SOURCES 2017–2018

Source	%
Hydroelectric	72.24%
Wind	16.4%
Geothermal	8.92%
Solar	0.09%
Biomass	0.76%
Non-renewable sources	1.85%

(Costa Rica Star News, 2018)

ICE is by law the only actor obligated to provide electricity to all sectors and parts of the country and is solely responsible for the transmission of electricity. Together with its subsidiaries, ICE operates 522 power plants on different sources of RE with a total capacity of 2,981 MW in 2017 (IRENA, 2020). ICE ended 2018 with a net loss of US$ 400 million. The fourth time in the last five years the company is going into the red (Rodriguez, 2019a). In addition, Costa Rica has four cooperatives, tasked with managing, operating and maintaining the grid in their concession areas. Initial funding and capacity building was provided by the Alliance for progress program of the US government. In addition to buying electricity generated by these cooperatives, ICE supported capacity building early on. The cooperatives supply energy to around 115,000 households in rural Costa Rica and is entirely non-for-profit, re-investing income into improving quality of their services.

The residential sector is the principal consumer with a 40% share of total electricity consumption in the country. The consumption (final use of electricity) of kitchen appliances (refrigeration, cooking etc.) accounts for the majority, with an increase in consumption for entertainment and house 'climatization' (mostly air conditioning).

DISTRIBUTION OF RESIDENTIAL ELECTRICITY CONSUMPTION IN 2018

Electricity consumption	% of final electricity use
Refrigeration	31.5%
Entertainment	16.8%
Cooking	15.5%
Water heating	14.3%
Lighting	11.4%
Washing	4.1%
Climatization	3.5%
Others	3.3%

(Costa Rica Star News, 2018)

Electricity demand has been rising by 1.9% on average since 2008 (IEA, 2020). Ensuring that the rising demand is generated through renewable energy sources has been a goal of successive governments. The rising demand as well as the strain put on hydro power by increasingly

frequent and hard droughts, resulted in an increase of electricity imports over the past years. Between December and April each year, the country imports around 8% of its total electricity supply. Importing electricity is often cheaper for the country than turning up the diesel-powered thermal plants.

While energy production is largely free of fossil fuels, energy consumption is still for the most part dependent on fossil fuels. In particular, demand for oil is rising as the number of cars in Costa Rica increases. In 2017, the country imported 2.77 Mtoe (Million tonnes of oil equivalent) oil products, with 78% of transportation running on oil (IEA Energy Atlas, 2019). In 2017, Refined Petroleum products represented 13.7% of the country's total imports, at a value of $1.41 billion.

ENERGY CONSUMPTION 2018[1]

Energy source	% of consumption
Petroleum derivatives	62.9%
RE	21%
Vegetable waste	8%
Firewood	5%
Coal & coke	2.1%

This increase in fossil fuel imports also leads to a heavier tax burden on citizens, as fossil fuels are heavily taxed. In recent years, taxes on fossil fuels (gasoline and diesel) accounted for 28% to 52% of the end-user price. The revenue generated from this fuel tax is re-invested into road construction and maintenance (29% into Consejo Nacional de Vialidad), forest conservation (3.5% into the National Forestry Finance Fund), research (1%) and agriculture (0.1%). The largest share of the revenues goes to the Ministry of Finance (Blackman et al., 2009) It is of utmost necessity that the government of Costa Rica will develop a plan to phase-out the fossil fuel tax, and rather re-distribute taxes where necessary. Otherwise, the country might risk being dependent on fossil fuel imports solely for the purpose of tax generation.

1 Based on figures presented by Alfonso Herrera, Secretariat of Planning, Subsector Energy, Costa Rica Government at Workshop I.

2.6 Environmental Context

Costa Rica's total surface area covers 19,730 square miles (51,100 square kilometres) of area including territorial waters, the mainland and several smaller islands. A mountain range divides the country into numerous microclimates.

While occupying only around 0.03% of the world's land, Costa Rica comprises nearly 6% of the planet's biodiversity (The Costa Rica News, 2018). This makes it one of the most biodiverse countries in the world. Around 52% of the country is occupied by rainforests, and about 25% of the country's land area is considered as protected areas, which is a high percentage compared to other countries (World Bank, 2016).

Costa Rica is a global leader in environmental protection policies. It invests around US$100 million per year in environmental protection, equalling around 0.19% of the country's Gross Domestic Product (GDP) (Alvarado, 2018). Having signed forty-five international environmental treaties and enacting numerous laws such as the General Environmental Law (1995), the Forestry Law (1996) and the Biodiversity Act (1998) has helped to build the country's green credentials.

The "Payment for Environmental Services Plan" (PES) from the late 1990s still promotes forest and biodiversity conversation today, making Costa Rica the only tropical country to have reversed deforestation. The plan stipulates payments to (private) landowners in recognition of the environmental services their land provides, with a particular focus on preserving the forests. The significantly reduced deforestation rate since the 1990s is partly attributed to this plan (CPI, 2016). More recent forest conservation efforts include the exchange of forest conservation efforts for Carbon Credits on the international emission markets, and protection of certain tree species to protect endangered species.

3 POLICY FRAMEWORK

3.1 National Decarbonization Plan (2018–2050)

"A decarbonized Costa Rica for the people."

– Carlos Alvarado, President of Costa Rica

On 24 February 2019, the Costa Rican government launched its National Decarbonization Plan, which aims to achieve a net zero emissions economy by 2050, in line with the objectives of the 2015 Paris Agreement (MINAE, 2019a).

The Plan defines activities in key sectors to be implemented in three steps until 2050 in order to achieve a modern, emission-free, resilient and inclusive economy. The Plan underpins the National Plan for Development and Public Investments (2018-2022) and the long-term Costa Rica 2050 Strategic Plan.

The Plan's implementation will be coordinated by the Presidency of Costa Rica, with support from the Ministry of Planning and Economic Policy (MIDEPLAN), the Ministry of Environment and Energy (MINAE), and the Ministry of Finance.

To reach the plan's goals, Costa Rica will make changes and modifications to mobility and transport (public as well as private), optimize energy management, promote sustainable construction and industry, improve recycling and waste disposal, and enhance soil and forest management. The Plan offers a roadmap to promote the modernisation of Costa Rica's economy, generate jobs and boost its growth based on the generation of "3D" services and goods: Decarbonised, Digitised and Decentralised.

The planned measures, activities and improvements also form part of the country's extended Nationally Determined Contributions (NDCs) that Costa Rica will present in 2020 to the UNFCCC to demonstrate and strengthen its commitment to reduce greenhouse gas emissions and participate in the global effort to avoid a temperature rise above 1.5 degrees Celsius with respect to the pre-industrial era.

The plan also highlights the link between decarbonisation and reaching key development objectives. As the Plan notes, "Costa Rica seeks to inspire all kinds of stakeholders to go beyond "the usual" and be part of this positive transformation, becoming the best version of itself and demonstrating that it is possible to fulfil the commitments acquired in the 2030 Development Agenda."

The plan recognises that decarbonising the economy will have impacts on four crucial sectors and covers ten lines of action with policy packages up to 2050:

I TRANSPORT AND SUSTAINABLE MOBILITY

1. Development of a **mobility system** based on safe, efficient and renewable public transport, and active mobility schemes.

2. Transformation of the **light-duty vehicle fleet** to a zero emissions one.

3. Promotion of a **freight transport fleet** that adopts modalities, technologies and sources of energy, aiming to achieve zero or the lowest emissions possible.

II ENERGY, GREEN BUILDING AND INDUSTRY

4. **Consolidation of the national electricity system** with the capacity, flexibility, intelligence, and resilience needed to supply and manage renewable energy at competitive cost.

5. Development of **buildings** of different uses (commercial, residential, institutional) under high efficiency standards and low emission processes.

6. Transformation of the **industrial sector** through processes and technologies that use energy from renewable sources or other efficient and sustainable low and zero emission sources.

III INTEGRATED WASTE MANAGEMENT

7. Development of an **integrated system of maximum efficiency and low greenhouse gas emissions waste management** based on separation, re-use, revaluation and final disposal.

IV AGRICULTURE, LAND USE CHANGE AND NATURE-BASED SOLUTIONS

8. Promotion of **highly efficient agri-food systems** that generate low-carbon local consumption and export goods.

9. Consolidation of a **livestock model** based on productive efficiency and reduction of greenhouse gases.

10. The rural, urban and coastal territory will be managed, oriented towards **conservation and sustainable use, increasing forest resources and ecosystem services** based on nature-based solutions.

The plan further recognizes that the following cross-cutting strategies are needed in order to catalyse this transformational change:

1. **Comprehensive reform of the New Institutionality of the Bicentennial** to facilitate their modernization, digitalization and flexibility to manage the disruptive changes that this new, decarbonized economy entails.

2. **Green tax reform** through decoupling the revenues of the Ministry of Finance from the sales of gasoline and to move forward with carbon pricing.

3. **Financing and attracting foreign direct investment** for decarbonisation, including through promotion of public-private partnerships.

4. **Advancing digitalisation** and achieving a knowledge-based economy.

5. Ensuring the political feasibility and social acceptability of decarbonisation through **labour strategies for a just transition**.

6. Ensuring decarbonisation is underpinned by a strengthening of the principles of **inclusion, human rights and gender equality**.

7. Consolidate the National Climate Change Metrics System (SINAMECC) to guarantee a **supply of open and updated data on the performance of the decarbonisation agenda** and to enable forward-looking modelling to support decision-making.

8. **Educational and cultural initiatives** that contribute to the transition to a Bicentennial Costa Rica leader in the substitution of fossil fuels with renewable energy.

More specifically, some of the plan's specific proposals include:

- **Transport:** By 2050, 85% of the public fleet will be zero emissions. Sales of light vehicles will also be zero emissions by 2050 at the latest.

- **Energy:** Costa Rica will transition to a completely renewable energy system, which will also support the transformation of the industrial sector.

- **Waste:** Costa Rica will adapt its waste management system for maximum efficiency, including developing a strategy for better technological options to reduce methane from organic waste by 2022.

- **Land use:** Costa Rica intends to increase the current 52% of forest cover to 60% by 2050 and improve access to green spaces for citizens.

3.2 National Energy Plan (2015–2030)

Costa Rica's National Energy Plan 2015-2030 (PNE) is the country's seventh national energy plan and is inspired by the National Development Plan 2015-2018 (MINAE, 2015a). Compliance with the plan is compulsory for institutions. The plan will be updated to better align to the Decarbonization Plans priorities.

The Secretariat of Planning for the Subsector Energy (SEPSE) formulates long-term comprehensive development policies and strategies of the energy subsector emanating from the Minister's office. To achieve this, it works in coordination with the institutions that make up the Energy Subsector: the Institute of Electricity (ICE), the Costa Rican Petroleum Refinery (RECOPE) and the National Company for Power and Light (CNFL), as well as with relevant Ministry of Environment and Energy (MINAE) units, in order to share information, avoid duplication of actions and carry out work with a joint vision for the country.

SEPSE is composed of various institutions and consists of a Subsectoral Energy Council (CSE), which comprises the Minister of Environment and Energy, the President of ICE, the President of RECOPE, the Minister of National Planning and Economic Policy, the Minister of Science, Technology and Telecommunications and the General Regulator.

The plan's principal objective is to achieve "Sustainable energy with a low level of emissions". It highlights as the main strategic areas and goals for the electricity sector:

- To introduce changes in the National Electric System to improve **energy efficiency**, both on the supply and demand side.

- Promoting development of **decentralized electricity generation** for self-consumption with the aim of reducing energy bills and reducing spending on the National Electricity System.

- To meet the growth of demand, manage the competitiveness of electricity prices, diversify energy sources for the production of electricity, increase the benefits for the country that may derive from its participation in the Regional Electricity Market (Mercado Eléctrico Regional/MER) and strengthen the strategic planning capacity of the energy subsector.

- To update the **legal and institutional framework** aimed at promoting energy efficiency and the environmental aspects of the energy sector.

- To improve methods for **calculating tariffs** of electricity and raise the efficiency of the management of public entities of the electricity sector.

- To promote **renewable energy sources**.

- To promote and introduce **more environmentally friendly vehicles**, include through incorporating lower emission technologies, improving emission control regulations and promoting of efficient driving practices and fuel savings.

- To achieve a low-carbon transformation of the **transport sector**, including through promotion of non-motorized transport.

- To promote **clean fuels**, developing the biofuel industry and alternative fuels such as biodiesel or hydrogen and making the necessary regulatory changes to be incorporated into the national energy matrix.

Out of 161 planned measures, over 70 have been implemented by July 2019. The importance of sector-coupling, especially between the energy and the transport sector, in order to synergise impacts between them.

3.3 Public Transportation Incentives and Promotion Act (No. 9518)

In December 2017, Costa Rica's Congress passed the Public Transportation Incentives and Promotion Act (No. 9518) ("Ley de Incentivos y Promoción para el Transporte Eléctrico"), which creates the regulatory framework promote electric transport in the country and strengthen public policies to encourage its use within the public sector and in the general public (Costa Rica Congress, 2018). The new law came into effect on 25 May 2018.

This law addresses both public and private transportation (including government vehicles and freight). For private vehicles, it establishes financial and non-financial incentives to promote electric vehicles (EV). There is no domestic EV manufacturing capacity so the law primarily aims at increasing imports of EVs, with tax exemptions helping to offset the higher costs of shipping. The financial incentives include tax benefits in three categories (sales, consumption and import) and can run up to $5,000 per vehicle. The non-financial benefits include a labelling programme, exemption from traffic restrictions, preferential parking and promotion of charging stations for electric vehicles.

For public transportation, the law sets the use of renewable energy for transportation as a national priority in all modes of transportation including train, freight, buses, and taxis. Among other measures, it establishes that the bus fleet should be replaced by electric buses every two years by at least 5%, and at least 10% of new taxis concessions are to be given to electric vehicles. For its implementation, the law mandates the publication of a "National Plan for Electric Transportation", which was published in early 2019.

3.4 National Electric Transportation Plan

Developed by MINAE (Ministry of Environment, Energy and Telecommunications) and MOPT (Ministry of Public Works and Transport), the "Plan Nacional Transporte Eléctrico" sets out how Costa Rica can advance in creating an electrified national transport system that promotes the use of renewable energy sources and reduces the dependence on fossil fuels (MINAE, 2019b). The Plan seeks a technological transformation of the fleet in all its variants: cars, buses, taxis, trains, freight transport, motorcycles and bicycles, in order to achieve long-term zero emissions transport that improves not only the quality of the air but decreases the noise levels associated with the use of vehicles and buses.

The Plan identifies three sectors crucial to the electrification of the transport system: **private transport** (private use or fleets of companies or businesses); **public transport** (vehicles used for paid public transport of people); and **institutional transport** (vehicles used by institutions).

Regarding **private transport**, the following strategies and goals are considered:

- The creation of a network of recharge points throughout the country by 2028, offering a quick recharge of 20min.
- Offering financial and non-financial incentives for the purchase of electric vehicles (EVs).
- Ensuring energy demand for charging EVs is secured.
- Informing the consumer about (the benefits of) electrified transport.
- Ensuring the permanent availability of EVs.
- Promote electric transport in the tourism sector.
- Develop technical and professional skills related to electric transport, including in higher educational programs aimed at maintenance and repair of EVs.
- Develop an in-country electric transport industry (R&D, assembly, etc.).

Regarding **public transport**, the goals and strategies are defined as:

- Develop pilot projects to promote and demonstrate the benefits of electric buses and taxis.
- Leverage public-private partnerships for electric transport.
- Grant electric bus concessions (through public bidding).
- Grant electric taxi concessions (through public bidding).
- Transportation permits for students, workers and tourists institutions that incorporate electric vehicles.
- Electric passenger train in the Greater Metropolitan Area (by 2021).
- National infrastructure for the operation of electric trains.
- Establish public and electric service rates, 2019 (adapt bus and taxi fares).

For **institutional transport**, the strategies/goals are:

- Create regulations that encourage the acquisition of electric vehicles by state entities.
- Develop capabilities among state institutions for the acquisition, maintenance and operation of electric vehicles and technology related to electric transport.
- Manage interinstitutional agreements for the development of electric transport.

3.5 Other relevant policies

- **Law of Mobility and Cyclical Security** (19.548, 'Ley de Movilidad y Seguridad Ciclística') (2019) – this law is aimed at encouraging private companies and local governments to promote the use of bicycles as a means of transportation.[2]

- **Law on Railroad Electrification** (No. 9366, 'Fortalecimiento del Instituto Costarricense de Ferrocarriles (INCOFER) y Promoción del Tren Eléctrico Interurbano de la Gran Área Metropolitana') (2016) – this law modernises the Costa Rican Railroad Institute (INCOFER) and allows it to take on debt up to a maximum equivalent to 40% of its assets, in order to build an electric train network.[3]

2 The Law is available at: https://issuu.com/josuealfaro6/docs/dictamen-16362-_bicicletas.
3 The Law is available at: http://repositorio.mopt.go.cr:8080/xmlui/bitstream/handle/123456789/3447/L-9366.pdf?sequence=1&isAllowed=y.

4 THE ROLE OF RENEWABLE ENERGY IN THE ENERGY MIX

4.1 Current state of RE development

Costa Rica is a global leader when it comes to ensuring energy production comes from renewable energy sources. With a 98% share of renewables in its electricity matrix and solid achievements to prevent deforestation – around 25% of the country's land area is in protected National Parks and other protected areas – Costa Rica is at the forefront on issues related to environmental sustainability, climate action and driving the renewable energy transition.

The government's Expansion Plan of the Electricity Generation (2018-2034) seeks to increase the capacity of renewable energy generation by 653 MW in the period 2018-2034, increasing wind power (43% more), geothermal (25% more), solar (25% more) and hydroelectric (7% more) (ICE, 2019). It further sets out plans to remove thermal plants and replace them with renewable plants.

The biggest challenge will be to increase the share of renewables in energy consumption. More than 60% of energy consumption in the country is from petroleum derivatives. 64% of Costa Rica's emissions come from energy use, and more than two thirds of that is from transport (Rodriguez, 2019b). A critical part will thus be to decarbonize the transport sector. The growing demand for personal vehicles, the majority of which run on petrol, is keeping a high share of fossil fuels in the country's energy consumption. The Decarbonization Plan aims to have 70 percent of public transport powered by electricity in 2035—and 85% by 2050. In December 2017, the Costa Rican congress passed the Electric Transportation Bill which established several tax exemptions for electric vehicles. Defined as the 'Law on Incentives and Promotion for Electric Transportation', the new law came into effect on 25 May 2018.

4.2 Renewable Energy potential

Costa Rica's current plans for the continuing development of its power capacities would maintain a share of over 90% renewable electricity. Under these plans, the system might not be able to supply the transport sector with the additional power demand in case of a shift to electric mobility. Therefore, the transport sector could be increasingly dependent on imported oil. The current installed power plant capacity reaches 3.5 GW, with a majority coming from hydro power (2.4 GW).

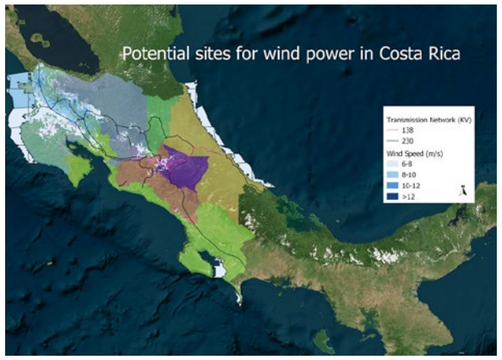
A study undertaken by the University of Technology Sydney – Institute for Sustainable Futures (UTS-ISF) in 2019 highlighted the largely untapped potential for renewable energy in Costa Rica (Teske et al., 2019).[4] Currently, the only resources used extensively are biomass and hydropower. Biomass and geothermal resources are utilized both in the heating and power sector. The capacity of large hydro power and bio-energy facilities is expected to grow slowly as its potential is limited by economic and ecological limits. The study has mapped the following renewable energy potentials.

4 The full study, and the summary for policy makers can be accessed on the World Future Council's website: www.worldfuturecouncil.org

SOLAR

Costa Rica has tremendous potential for solar PV. Not taking account areas with conflicting land uses (e.g. crop land, protected areas) housing areas or slopes with more than 30%, Costa Rica still has over 8,000 km2 of land on which 203 GW of solar power can potentially be harvested by utility-scale solar farms. The additional potential for distributed energy systems has not been mapped, but the Greater Metropolitan Area (GAM) around San José has significant potential for rooftop solar.

WIND



Currently, Costa Rica's total installed wind power capacity is about 408 MW of onshore wind farms.

Taking into account restrictions related to nature conservation, agricultural, commercial or urban use of land, mountain areas and designating only land areas (at least 10km) away from transmission lines, there is still around 15 GW onshore wind potential in Costa Rica left untapped. Almost all wind farms would be located in Guanacaste in the north-west. The additional 21 GW offshore-wind have not been further considered in the study, due to their proximity to maritime protected areas.

HYDRO

The installed capacity of hydro power dominated as a major renewable power capacity in Costa Rica in the last decades—it made up 72% of electricity generation in 2017/18. Hydro power has only minor potential for further increase, because Costa Rica's utilization rate for hydro power plants is already close to the maximum level in regard to sustainability. Under the scenarios[5], hydro will be taken over by solar photovoltaics in 2040, while staying at around 2,400 MW.

BIOMASS

Today, renewables meet around 60% of Costa Rica's energy demand for heating, with the main contribution coming from biomass. Different studies put the sustainable use of biomass potential in Costa Rica at different levels—between 580 MW and 2,530 MW. The UTS study (Teske et al., 2019) reveals that biomass remains the main contributor for heating (mainly industrial heating), requiring increasing investment (of around US$ 3.6-3.75 billion) in highly efficient modern biomass technologies. In the scenarios, biomass will make up 9,537 MW (RE1) and 6,706 (RE2), respectively, for heating by 2050 (see table 2).

GEOTHERMAL

Under the scenarios, geothermal power will play an important role in heating, requiring investments in geothermal heatpump technologies. Geothermal capacity is estimated at 385 MW by 2050 under both scenarios for electricity generation capacity and at 990 MW for renewable heat generation. Considering the market for geothermal technologies is relatively small, installation costs are high. However, as geothermal is often located in natural parks and conservation sites, it will be important to harvest the source outside of those protected areas.

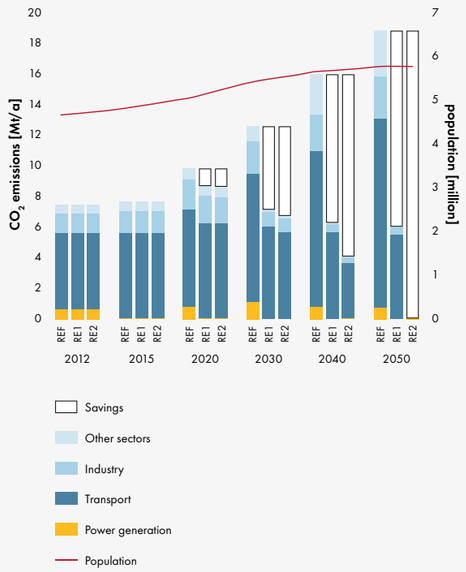
4.3 Climate Action

Under the REF scenario, which was modelled on the *Plan de Expansión de La Generación Eléctrica* of May 2019, Costa Rica's energy-related CO_2 emissions are expected to increase from 7.6 million tons to 12.5 million tons between 2015 and 2030 and reach 18.8 million tons CO_2 in 2050. In the RE1 scenario, energy related carbon emissions will also increase to 7.2 million tons CO_2 by 2030, but then decrease afterwards to 6 million tons CO_2 by 2050, which amounts to about a third of the emissions of sticking to the current plans.

The UTS-ISF study highlights that Costa Rica can achieve a zero-emission society and economy compared to 1990 levels by 2050, with a fully decarbonised transport sector achieved in 2050 as well. Before 2050, the transport sector will remain responsible for at least 5.7 million tons of CO_2 by 2030 and would therefore be the sole largest sources of energy related emissions in Costa Rica until 2050, in the most ambitious scenario.

DEVELOPMENT OF CO_2 EMISSIONS IN ALL MODELLED SCENARIOS

Copyright: UTS-ISF, 2019



5 The study by UTS-ISF modelled three distinct scenarios: the reference scenario (REF) based on the electric expansion as well as the Decarbonization Plan; the RE1 scenario with increased shares of renewables in both industry; and transport and the RE2 scenario, modelling a complete decarbonisation of transport and industry.

5 ROLE OF RENEWABLE ENERGY FOR AN INCLUSIVE ECONOMY

5.1 Gender equality

Costa Rica is one of the leading countries in Central and Latin America in the implementation of gender-just policies. Since 2018, the Policy for Effective Equality between Women and Men has been in place, which aims to strengthen gender equality in climate change action by 2030, and the country's NDC stipulates that the government will facilitate "gender sensitive options for the wellbeing of a low emission economy" (MINAE, 2015b). Nevertheless, gender equality is still some steps away, especially for women in rural or peri-urban areas, seniors, youth, indigenous people, women with disabilities and members of the LGBTQ-community.

The national Decarbonization Plan reiterates the commitment of Costa Rica's INDC and wants to "ensure decarbonization is underpinned by a strengthening of the principles of inclusion, respect for human rights and promotion of gender equality" (MINAE, 2019a). This will include gender sensitive policies, capacity building within policy-making institutions, as well as promoting gender equality in the workplace. Innovative processes such as the Consultative Citizen Council on Climate Change (5C) will be strengthened through a women's meeting. Other actions to be taken are the promotion of gender parity in current governance structures of climate change, including the INAMU (National Institute for Women) in the inter-institutional governance structures, launch of an international strategy promoting gender equality and human rights, and the consolidation of processes with a focus on gender. To mainstream gender in related sectors such as agriculture and forestry, staff is receiving capacity-building to sensitise them for gender and climate change issues within their respective ministries. These policies and actions, however, need to be applied continually throughout workplaces, in order to achieve the desired result.

To monitor success of gender parity in Costa Rica's society, it is important to have comparable, disaggregated gender data for all sectors. The government should build the capacities to collect and analyse these data. As women in rural and peri-urban areas are disproportionally affected by inequalities, local governments need to install review processes for policies and experiences to formulate and implement appropriate response mechanisms. Further, the role of women in decision-making processes needs to be strengthened and participation increased. This will require a communication strategy which is sensitive to diverse audiences and covers the whole spectrum of gender identities. The use of social media to that end should also be explored. Especially noteworthy, is the necessity of data in the transport and energy sector, as consumption and driving behaviour can vary significantly between genders.

Strengthening the role of women in the energy sector can be an important step into this direction. Increasing community-led RE projects can pay special attention to gender inequalities and set quotas for women participating as members on company boards (or similar management structures). In addition, existing utilities and cooperatives could introduce quotas in hiring personnel as well as promotion of and access to training and capacity building. Further, making flexible working times possible can increase women's access to working fields such as engineering. The government can take an active role in promoting such good practices by developing supporting policies to encourage women to join the RE sector in various capacities. This can include access to technical training and national campaigns to raise awareness of the benefits of gender equality. In order to enact appropriate policies and measures, a gender-sensitive analysis needs to be done, which will allow a better understanding of the impact of energy policy decisions on gender relations, the varying needs of genders, as well as understanding their living situation.

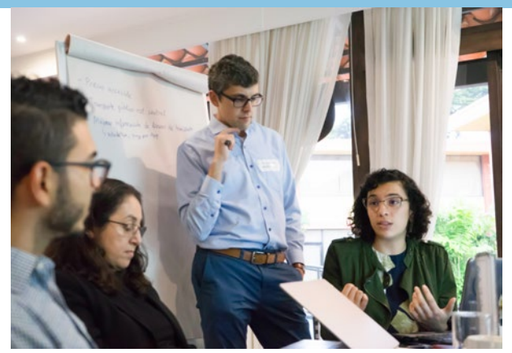
5.2 Just transition

In the past decades, foreign investment and tourism have grown in Costa Rica and the country's human development indicators show that it is one of the most stable countries in the region. However, rising inequality is one of the pressing issues the country is facing.

Unemployment in Costa Rica has increased in recent years and the 2018 Gini coefficient puts the country in second place among OECD countries in terms of income inequality (OECD, 2018). In particular, communities in coastal zones and the border regions show high levels of inequality. Those communities are thus facing the consequences of lower economic prosperity and social progress in relation to the central regions of Costa Rica, as the country moves towards HIIT technologies and services. In addition, labour force participation is low, especially among women. These discrepancies between the (urban) centre and coastal/border regions seems to be increasing, as the focus of Costa Rica's industry shifts from agricultural products, and export thereof, towards tourism and service-related industries.

A just transition aims to deliver the socio-economic transformation needed to address climate change, while reducing inequalities and ensuring that costs and benefits are spread fairly across the population. Therefore, social and structural policies, as well as local socio-economic development opportunities need to be taken into account.

In order to develop transition pathways for socio-economic restructuring in Costa Rica, opportunities and challenges related to the transition towards 100%RE need to be assessed. To fund Costa Rica's economic diversification to reduce the rising inequalities, a thorough assessment with broad-based stakeholder participation needs to be the first step. Making the case for the transition through transparent and inclusive engagement and communication is critical to address the concerns of affected people. In addition, complementary policies need to be adopted to implement a transition which ensures the protection of vulnerable groups. It is thus necessary to understand the specific context of the transition, as well as champions and alliances who can build support for just policies.



Stakeholders across all sectors have identified crucial elements for a just transition in Costa Rica

EDUCATION

Costa Rica's education model has an important role in embracing and facilitating the energy transition. Training people for the additional jobs along the RE value chain takes between three to five years, so it will be necessary to plan education measures in a timely manner. Setting up different curricula should be done in collaboration with the National Learning Institute (Instituto Nacional de Aprendizaje), which is training technicians (e.g. for maintenance and repair of electric vehicles) but also conducts capacity building with utilities. International cooperation through scholarship systems and expert lectures should be included and apprenticeship schemes should be broadened and incentivised.

In addition, Education for Sustainable Development (ESD) should be made part of all school curricula. Special attention should be given to raising awareness for energy efficiency, access to sustainable technologies, spatial planning and communication of climate change impacts.

REDUCING SOCIAL INEQUALITIES

To reduce issues related to social inequalities in Costa Rica, it is necessary to foster social inclusion by including a range of stakeholders from varying social backgrounds, age, geography and gender in all steps and processes (capacity-building, training, workshops, policy-making etc.). In addition, the use of the "indigenous consultation mechanism" should be considered to ensure inclusion of indigenous people to the extent necessary to make sure that nobody is left behind. Further, public participation in the generation of energy and electricity through decentralisation and expansion of the cooperatives model should be enabled.

REPURPOSING THE FOSSIL FUEL INDUSTRY

A transition towards 100%RE also requires a transformation of Costa Rica's Petroleum Refinery (RECOPE) into a national company producing clean fuels. Discussions for such a plan are currently under discussion in the Legislative Assembly. These discussions need to include a plan how to re-skill the approximately 1700 employees. An appropriate just transition concept thus needs to be developed.

Repurposing of RECOPE meanwhile could take many forms. It could be possible for instance, that RECOPE will become a facility producing green hydrogen produced from Costa Rica's abundant renewable energy sources. This hydrogen could play an important role to complement decarbonisation of the transport sector.

SUPPORTING RURAL DEVELOPMENT

Due to Costa Rica's increased focus on adopting sophisticated technologies and developing its service industry, economic activity concentrates in and around San José, which is resulting in an increasing economic divide between rural and urban areas. This situation is expected to become more critical considering the stagnating agricultural sector. More than 10% of Costa Rica is cultivated and held mostly by small hold farmers and the country is a major exporter of tropical fruits and coffee. Although agriculture still accounts for 5.48% of Costa Rica's GDP and around 12.5% of the work force is active in the agricultural sector, the sector has been declining in recent years (QCosta Rica, 2019b).

Costa Rica's agricultural sector accounted for 21% of total emissions in 2012 excluding Land Use, Land Use Change and Forestry (LULUCF) (CAT, 2020). More recently, the Central Bank of Costa Rica has stated that the agricultural sector is on a decline, this might be partly due to declining support to smallholder farmers, increased focus on high-tech industry sectors, and more extreme weather events threatening crop production.

Costa Rica's NDC includes measures to increase finance and procurement of low-carbon technologies, particularly for small and medium sized enterprises (SMEs) (MINAE, 2015b). It further stipulates the establishment of a joint commission between the MINAE and the Ministry of Agriculture to develop a common agro-environmental agenda which focuses on energy efficiency enhancements, mitigation policies and agricultural transport.

The Decarbonization Plan recognises the need to develop projects that generate inclusive growth and sources of employment, based on the particularities of each territory, including rural areas. It identifies low-emission agriculture, eco-competitive livestock farming and territorial management through nature-based solutions as means to achieving inclusive green growth (MINAE, 2019a).

The challenge for Renewable Energy lies in reversing the trend of inequalities that has taken hold in Costa Rica. Yet, agricultural and rural development authorities in the country do not have any mandate regarding energy issues. They are thus often incapable of communicating their energy needs with utilities and other energy authorities. Subsequently, a vacuum between rural energy development, policy frameworks and cross-sector coordination exists. This, in turn, leads to lower allocation of financial resources vis-à-vis other sectors of the economy.

Therefore, a different approach to rural development policy is needed which moves away from the traditional model of sectoral policies and subsidies, and towards one that is embedded in local structures and is designed to strengthen local potentials.

RE potential for utility-scale PV and wind accumulate in the north-western region of Guanacaste, which has a significant availability of renewable energy resources. The region relies on livestock and sugar cane production as primary economic outputs. The government currently considers at least doubling sugar cane production for biofuel generation. Renewable energy can diversify the region's economic focus through e.g. improved storage and freezing efficiency of crops and meat, as well as solar pumping to satisfy water demand. By integrating RE policies in supply-chains in the region, the potential for local innovation can be utilised and socio-economic benefits of RE unleashed. Such innovations are often rooted in local entrepreneurship and are participatory in nature. They often support the development of sufficient grid capacities to transport electricity to the load centres of Costa Rica. Utilising RE where it is harvested can initiate a transition to a publicly owned, localized energy system under community control which could be replicated for food production and distribution as well. Localising production often results in new business models and increased job opportunities, especially for SMEs (OECD, 2012). One of the options to make decentralised energy production attractive could be the introduction of a high Feed-in Tariff (FiT) which gives priority access to the power grid and has a fixed price for every kilowatt hour produced from RE for energy producers for a fixed time period (generally 20 years). The fixed price should be high enough to guarantee a return on investment. This return could (partially) be mandated towards enhancing storage capacities in regions where RE is produced. Further, the return on investment can also be used to enhance agricultural production in those rural areas. Strengthening the local agricultural markets.

Similarly, access to domestic and international markets needs to be strengthened for small hold farmers and producers, in order to run businesses economically profitable. This would ideally lead to increased consumption of national products and thus reduce reliance on imports. This holds especially true for food production which could be made more efficient by utilising RE throughout the production chain. This would need, however, a new and integrated approach of RE, agricultural and rural development policies.

5.3 Sustainable urban and spatial planning

Around 60% of global primary energy demand comes from cities and is likely to increase by further 35% until 2030 (REN21, 2020), leading simultaneously to increased CO2 emissions. The high share of hospitals, schools, offices, street lightning etc. in cities means that urban areas can create a critical mass in favour of, or against, renewable energy. A more integrated urban infrastructure can improve resilience and security of urban energy systems. The way urban development is planned also has an impact on the potential for renewable energy. Distributed renewable generators for instance, can help to increase the reliability of power grids, by making them less vulnerable to disruptions caused by weather events. One way to increase the share of renewable energy in a city's energy mix could be to standardise municipal building codes. This could include energy efficiency standards, but also a mandate to build rooftop solar systems under simplified application requirements.

Costa Rica is a rapidly urbanizing country and around half of the population is living in the greater metropolitan area of San José. While Costa Rica is one of the world's leaders in commitment to environmental protection, there are still issues in the greater metropolitan area that need to be addressed: wastewater management, street congestion and rising GHG emissions from a lack of infrastructure investments. As a result of limited spending on sustainable urbanization and efficient public transportation, Costa Rica has seen a massive growth of private transport and, thus, rising GHG emissions. This has led to increased economic costs resulting from road congestion, increased fuel consumption, heavier air pollution and more accidents (GIZ, 2015). Secondary impacts also include rising costs for private transport (cars) and poorer households unable to afford more efficient cars or hybrid cars. The problem has been deepened by a lack of clarity on urban infrastructure and land-use planning and resulted in a disconnect between the greater metropolitan area of Costa Rica and economic hubs.

Decisions about Renewable Energy are usually within the responsibility of ICE, yet metropolitan areas still have an important role to play in scaling up renewable energy and increasing energy efficiency, as they have decision-making responsibilities when it comes to infrastructure

planning. In fact, local governments are a key player in the management of their territory, building regulations and urban planning. In spite of this, relatively few land use planning policies and guidelines are in place in the GAM (greater metropolitan area around San José) to engage with renewables. In addition, institutional barriers (fragmented decision-making power, lack of transparency and overlap of responsibilities) can significantly delay planning processes. The Costa Rican government has recognised the importance of this issue and First Lady Claudia Dobles, an architect and urban planner, has spearheaded efforts to develop sustainable urban transportation models.

However, most municipalities in Costa Rica have not updated their Regulatory Plans in the past 10 years, making urban infrastructure planning a challenge. It is therefore necessary to create a mechanism to update energy related plans and ideally to develop integrated urban strategies, linking energy issues to broader issues such as building codes, infrastructure planning, transport (e.g. charging stations for e-vehicles) and others. Integrating urban and energy planning within building regulations becomes increasingly relevant, as Costa Rica seems to be going towards more densely-built urban structures with high-rise buildings, especially in poorer regions of the GAM. Therefore, coordination between utilities, other local energy sector players and local governments is crucial to ensure that power sector planning is in line with local development and expansion plans.

Recently, there has been an international move towards municipal energy utilities in local public and collective ownership and an emphasis on micro-grid architecture. Renewable energy, due to its decentralized nature, is well suited to supply these models. These trends could also be replicated in Costa Rica, to ensure proximity of energy supplier to energy consumer. Guidelines to establish such municipal energy communities would help to guide municipal decision-making and to better monitor performance and uptake of RE across Costa Rican cities. With increasing shares of variable renewable energies, however, smart technologies to balance supply and demand are necessary. Micro-grids (e.g. from rooftop solar PV as possible in San José) can provide electricity within an autonomous grid. These can be encouraged by creating an enabling environment that allows households to feed or sell their surplus electricity production back to the grid, through a Feed-in Tariff scheme for instance. By combining a FiT with net metering, consumers can get a credit on their energy bill for the generated surplus power. Such credits could later be used to offset consumption or be remunerated, as evidenced by the FiT systems in Germany and Shams Dubai.[6]

Smaller steps could be taken by introducing PV-powered street lighting in the GAM. Especially in rapid urbanizing areas, such stand-alone systems can provide lighting even in construction areas and poorer areas to improve security conditions. A more advanced concept are Virtual Power Plants (VPP). These include one or multiple micro-grids which are connected with each other, as well as a forecasting system to form an integrated network which can provide reliable power supply. Another trend in the US, for instance, is the so-called Community Choice Aggregation (CCA). A municipality or group of municipalities forms a new entity to procure electricity in bulk to cover the combined load of interested residents and businesses within these municipalities. Through aggregation of energy demand, the cities can negotiate more competitive price rates with power suppliers and developers (LEAN Energy, 2017). All these concepts allow cities to integrate very high shares of renewables.

In addition, cities can and should interact with other cities and institutions to generate further demand for renewables. The partner institutions could act as power supplier (e.g. the University of Costa Rica) with demand

6 This scheme allows solar PV plants to be connected to the electricity network, and to be compensated for surplus electricity fed to the grid by "banking" it for later consumption. As such, the programme only allows offsetting of demand and does not allow any payments for excess generation

managed by the municipal authorities. In a similar manner it is important to foster cooperation between urban and rural local governments in Costa Rica and to increase the role of regional planning in spatial and energy planning. Similar to partnering with institutions, a collaboration mechanism for sharing energy between regions could be implemented. This would especially benefit the areas around Guanacaste.

By strengthening renewables in cities, smart grids and smart meters, fault detectors and storage to ensure two-way digital communication will play a key role in the foreseeable future. This will require Big Data Analysis in the future. The capacities for doing so (hardware and human resources) need to be built now, in order to be ready when smart-technology is being rolled out at large scale in Costa Rica. Regarding storage, the study by UTS forecasts that storage requirements will not exceed 30% by 2030 in any region, except in Guanacaste where storage will rise up to 80%, due to the concentration of onshore wind and solar PV resources (Teske et al., 2019). The most ambitious scenario would need around 10,000 MW storage capacity by 2050, due to higher shares of solar and wind power generation. Noting the decline in costs for storage over the past years, costs cannot be reliably predicted at this point and are thus not included.

Given the changes necessary to implement Costa Rica's ambitious Decarbonization Plan and the implications for the city model and transportation, it is necessary to re-design the institutions dealing with urban planning, transport infrastructure and public transport in the GAM. Given the scale of this task, the democratization of the energy system through community-led initiatives would lessen the burden on the government.[7]

Understanding infrastructure interdependencies is critical to achieving long-term climate resiliency across a city's energy network. The planning implications of an urban solar PV farm—which include site selection, (re-)zoning, stakeholder engagement, environmental constraints, economic viability etc.—are only beginning to be understood and would need urban planners who are experts in a couple of sectors, rather than in one as is currently often the case. A failure of planning to manage a simple issue like overshadowing, for instance, can result in a loss of potential electricity production, with negative implications for households and grids.

Even if this barrier can be overcome, planning of a complex yet coherent energy system in cities requires sufficient financial resources. A recent tax reform forces local governments to keep their spending below 4.67% (margin in which budgets can increase) which significantly hampers the government's ability to invest into new infrastructure and renewable energy projects. Therefore, public budgets need to increase and include a significant amount for climate and energy related spending. If the financial capacity of cities were to be enhance, renewable energy projects could be strengthened and contribute to local socio-economic development and improving air quality.

5.4 Transport

Since 2018, Costa Rica has embarked on the route towards electric mobility. Law 9518 from 2018, for instance, provides incentives for the electrification of both public and private transport (Transport Law, 2018). It establishes financial incentives and non-financial incentives (such as a labelling programme and exemption from traffic restrictions) as well as measures to promote private electric vehicles. For public vehicles, the law stipulates the use of renewable energy as a priority for all modes of transportation, including train, freight, buses and taxis. An implementation plan for law 9518 is provided by the "National Plan for Electric Transportation" from 2019 which contains a set of actions and implementation steps. Both establish that the bus fleet should be replaced by electric buses every two years by at least 5%, and that at least 10% of new taxi concessions are given to e-cars. In addition, e-bikes will be promoted. Successful implementation of the plan would lead to emissions reductions of up to 9% of GHG compared to a pathway without this policy (CAT, 2020). These and other measures are big steps for Costa Rica in order to achieve its 2030 NDC emissions reduction target.

Electric mobility is the responsibility of SEPSE (Secretaria de Planificación del Subsector Energía). For some laws and regulations, however, the Ministry of Public Transport and the Ministry of Environment and Energy share some of these responsibilities.

7 With the BiodiverCity Project, Costa Rica has taken steps towards a more participatory urban planning mode already which could be scaled up to include renewable energies as well.

Around 40% of Costa Rica's emissions come from the transport sector (Rodriguez, 2019b). This is why the Decarbonization Plan makes the decarbonisation of transport one of its key priorities. The Decarbonization Plan envisions electric passenger and freight trains in service by 2022. In 2035, 30% of public transport will be zero emissions and by 2050, this would be 85%. 60% of private and institutional transport is envisioned to achieve zero emissions by 2050, with a higher share concentrated in vehicles for commercial and governmental use. To that end, a number of re-charging stations will be built across Costa Rica. Furthermore, at least half of the cargo transport will have significantly increased in efficiency by 2050, and thus reduce emissions by an additional 20% compared to 2018. An inter-city electric train connected to improved bus infrastructure will be developed but will require fiscal as well as external financial resources. By implementing these measures, Costa Rica would be the first Central American country to significantly increase the use of electric transport.

However, the Decarbonization Plan does not foresee the complete decarbonisation of the transport sector. Current plans estimate a 90% renewable electricity share in the country's power capacities. This will, however, not be sufficient to supply the transport sector with the additional power needed in such a transformational shift to electric mobility. Therefore, the transport sector will be increasingly dependent on imported oil and carbon emissions will continue to rise in the sector. In fact, the Decarbonization Plan foresees the continued use of bioethanol, diesel and LPG. Energy will therefore remain the biggest GHG contributor, even in the 1.5°C scenario of the Decarbonization Plan (see table below).

What's more, Costa Rica's moratorium on oil extraction and exploitation, which was recently extended to be in effect until 2050, has been under scrutiny by right-wing political parties to be suspended to allow oil extraction.

The full decarbonisation of the transport sector will increase the power demand compared to the business as usual scenario based on the Decarbonization Plan. This will require a different infrastructural design than an oil-dominated sector. Hydrogen and synthetic fuels, generated by electrolysis using renewable electricity, can be introduced as a third renewable fuel in the sector, complementing biofuels, renewable electricity and battery storage. Renewable hydrogen could also be converted into synthetic methane and liquid fuels. It is noteworthy, however, that hydrogen generation can have high energy losses and should thus be seen as an add-on to renewable electricity and economic benefits should be carefully assessed beforehand (storage costs versus additional losses).

The UTS study (Teske et al., 2019) estimates an electricity increase of 56.4PJ/year (15TWh/a) in 2050 to fully decarbonise the transport sector. This compares to oil savings up to 25 million barrels of oil (155PJ) by 2050 (nominal) in the more ambitious RE2 scenario, leading to total savings of about US$2.25 billion by 2050 at the assumed oil price[8]. Comparing this with electricity generation costs at around US$700 million, the full decarbonisation of the transport sector can result in fuel cost savings of up to US$1.5 billion by 2050.

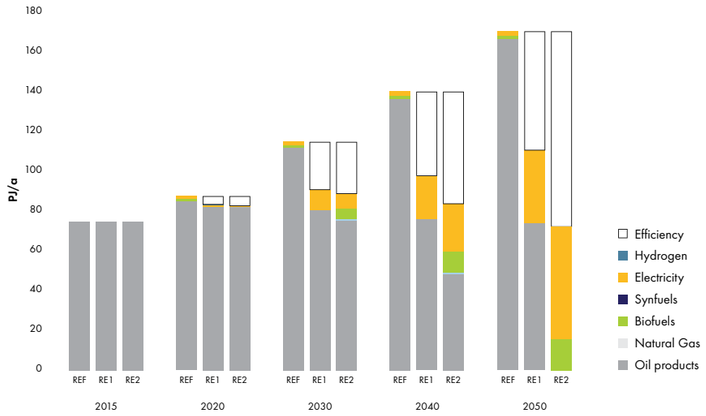
Yet, given the number of cars on Costa Rica's streets, the transport sector will remain responsible for about 5.7 million tons of CO2 by 2030 (Teske et al., 2019), due to older vehicles with combustion engines. In this scenario, energy consumption by transport would be primarily from renewable electricity and biofuels. Additional use of hydrogen has not been considered. It is important to note that the production of biofuels would be within environmental and sustainable limits and would not require increased production through monoculture farming of sugarcane or palm oil.

CO_2 EMISSION PROJECTIONS IN COSTA RICA'S DECARBONIZATION PLAN

Sector	Reference Scenario GHG (2012)	Base Scenario (2050)	2°C Scenario (2050)	1.5°C Scenario (2050)
Energy	7,21	9,48	4,54	2,64
Industrial processes	0,98	1,41	0,68	0,39
Agriculture	3,24	5,90	2,82	1,64
Waste	1,86	2,97	1,42	0,83
Net forestry	-2,05	-3,50	-3,50	-5,50
Total	**11,24**	**16,26**	**5,96**	**0,00**

8 Assumed oil price in 2050 is calculated to be US$ 14.5/JF (Teske et al., 2019).

COSTA RICA:
FINAL ENERGY
CONSUMPTION BY
TRANSPORT UNDER
THE SCENARIOS



As can be seen in figure above, energy efficiency enhancements (highly efficient propulsion technology with plug-in hybrid) are crucial to achieve a full decarbonisation of the transport sector. This can include a more drastic shift towards public transport buses and shared vehicles. Together with ever more rising fossil fuel prices, these changes can slow the increase in car sales projected in the GAM and heavily reduce congestion, CO2 emission and air pollution (Teske et al., 2019).

With accelerated e-mobility, transport and power will increasingly become interconnected. To achieve this, however, Costa Rica needs to overcome a number of challenges:

- **Institutional barriers**: the MOPT, the National Roadway Council, SEPSE and other institutions have overlapping responsibilities for road planning. The division of responsibilities have not always been clear in the past and has caused delays. This also affects procurement processes which vary between institutions and are not standardised and can cause further delays (GIZ, 2015).

- **Timely introduction of electric buses**: to achieve the goals of the Decarbonization Plan, an agreement with the various bus operators for e-buses has to be achieved by 2021 at the very latest. As this is the year in which all public bus concessions expire, it is the ideal time to renew concessions with sustainable mobility standards and introduce the sectorization of routes. Given the decentralised nature of Costa Rica's bus system and the reluctance of some operators to switch to e-buses, due to the costs involved, this poses a challenge. In addition, to increase attractiveness of the currently disorganised bus sector, the buses would need to run frequently and reliably with affordable fares.

- **Ensure charging infrastructure**: The University of Costa Rica has modelled where the 34 fast-recharging stations (80% of the battery charged in 20 minutes) should be located by 2028 to most conveniently reach the largest number of people. For individual transport modes this might be too thinly spread though when the number of e-vehicles increases.

- **Incorporation of the tourism sector and municipalities outside of GAM in e-mobility plans**: Current plans focus on the greater metropolitan area around San José with a circular train line connected to nearby provinces via bus lines. Smaller municipalities or municipalities further away and on the coast are not sufficiently included yet.

- **Making e-vehicles affordable for everybody**: Owning a car in Costa Rica can be expensive. Cars have to be imported and are subject to import taxes, which can range between 45% to 70% of the retail value of the car. Subsequently, many older cars roam the streets of Costa Rica as they are cheaper to import. In addition to import taxes, fuel taxes accounting for 28% to 52% of the end-user price, are charged. The latter would not be applied for e-cars. Given that this charge partly pays for the PES, re-distribution needs to be assessed over the longer run. E-cars are not affordable for a wide range of people in Costa Rica, due to their high retail value and taxes applied and the trend here as well goes to importing used cars.

E-CARS

To decarbonise Costa Rica's transport sector a shift towards public transport, but also individually owned e-cars will be necessary. To promote this, a range of economic (tax exemptions, free charging) and non-economic incentives (preferred parking spaces) will need to be applied. Given of course that the international market for electric vehicles enlarges (e.g. through commitments from the government to purchase a certain number of electric vehicles). Likewise, built-up of a Costa Rican e-car industry (assembly of parts, maintenance etc.) might be an opportunity to open up new export markets and reduce unemployment, if engaged in from an early stage.

With a rise in individually owned e-cars, the role of batteries and home-charging—through distributed solar PV systems—will become increasingly important. Balancing loads will be crucial and can be achieved either through smart charging (batteries are charged once the vehicles are charged) or by discharging batteries in times of electricity supply shortages (vehicle-to-grid). The issue of battery waste needs to be resolved though. There are programmes in place already to look into the "second life of batteries" which could partially solve this issue.

PUBLIC TRANSPORT

Current public transport options, mainly buses, are unreliable and operated by various bus line owners, leading to different bus fares, non-transparent zoning, but also unreliable time schedules, and infrequent buses. In addition, bus lines are badly connected to each other. To relieve congestion in the GAM area and reduce CO2 emissions, quality public transport powered by renewables is a necessity. Pilot projects, such as the e-bus driving around the University of Costa Rica, are underway. However, the public transport system should be better organised: better interconnectedness to municipalities outside the GAM, single payment system for intramodality, larger infrastructure network, single-signage, transparent and affordable fare system. The bidding process for bus concessions therefore needs to be urgently re-vamped to include these criteria, guidance from the government in requirements and interconnectedness is needed.

To this end, the government is planning a new electric rapid train which goes around San José and 15 cantons and is connected to various bus lines in the GAM. Re-organising public transport concessions in place seems to be the biggest challenge for the success of this project. Another option to transform parts of the public transport sector would be to introduce a cable car system for San José. Given the topography of the city as well as the generally high costs associated with cable cars, this option seems to be the less favourable.

Public-private partnerships between the state and private companies are needed to ensure a timely and affordable acquisition of electric vehicles. The state would be in a position to order a certain number of vehicles and negotiate better rates for these.

5.5 Decentralisation and variation of the energy system

While Costa Rica, so far, has relied primarily on electricity generation coming from limited dispatchable technologies such as hydropower, geothermal and bioenergy, the UTS Study (Teske et al., 2019) reveals that the country has abundant potential for variable RE generation, primarily solar PV (203 GW) and wind (15GW).

Currently, the energy system in Costa Rica is heavily centralised, with the Costa Rican Electricity Institute (ICE), the state-owned power and telecoms provider, by law being the only actor obligated to provide electricity to all sectors and parts of the country. Nevertheless, Costa Rica has four electricity cooperatives which were established in the 1960s to increase rural electrification. Nowadays, these cooperatives provide a useful and viable model for decentralisation, having branched out from electricity services to also telecommunications. They are, however, obliged to sell energy to ICE, which then re-distributes energy to end-users. Further, they are facing pressure to become more profit-oriented, as Costa Rica's energy markets are showing signs of opening up.

Tilaran Wind

PUBLIC-PRIVATE PARTNERSHIPS

Public-Private Partnerships (PPPs) can cover a range of possible relationships between local government, private firms, civil society, nongovernmental organizations and local communities, to jointly undertake the provision of basic services. PPPs offer a model in which the public and private sectors are both involved in different phases of the project, including construction, financing and operation. This makes the arrangement more attractive to the private sector, since the risks are shared by the government.

When countries face fiscal constraints, like many Central American nations do, such association schemes between the state and the private sector become critical in achieving long-term infrastructure projects.

Among the main benefits of PPPs in the domain of sustainable energy production are improving access to electricity, reducing energy costs and stimulating local economic and social development. Considering there is nigh-universal access to energy in Costa Rica, PPPs can primarily contribute to providing public-private financing for R&D, develop demonstration/pilot projects, develop and roll out electric vehicle chargers and charging points, and build and operate RE projects or (transport) infrastructure projects critical to achieving decarbonisation.[9]

With the state-owned Instituto Costarricense de Electricidad (ICE) as the dominant player in Costa Rica's electricity industry, the private sector can only participate in renewable-energy projects that generate 50 mw of electricity or less and must sell the electricity to the state monopoly. But the promise of distributed renewable energy production can act as a catalyst for rolling out PPPs in this domain. Already several wind power projects have been set up through PPPs in recent years, including the Alisios wind farm, the Orosi wind power project, the Acciona Chiripa wind project and the Consortium Planta Eolica Guanacaste.

9 A recent example of a PPP is the "Fast Passengers Train of the Great Metropolitan Area" project, which has been made possible through a $550 million loan of from the Central American Bank for Economic Integration. The investment in infrastructure and equipment of the project is estimated at $1.298 million, the execution of which will be under the modality of Public Private Partnership.

Conditions for setting up PPPs in Costa Rica have significantly improved in recent years. The 2019 Infrascope index, which evaluates 23 indicators and 78 qualitative and quantitative sub-indicators in PPPs in Latin America, credits the country's improvement to a stable PPP agency and an independent project development fund, financed by the Inter-American Development Bank (The Economist Intelligence Unit, 2019).

TRANSITION AWAY FROM LARGE HYDROPOWER

Hydropower covered 72% of total electricity production in Costa Rica in 2017/18 and there is limited potential for further increase as the country's utilization rate for hydro power plants is already close to the maximum level in regard to sustainability.

The heavy reliance on hydropower poses a two-fold risk. On the one hand, increasingly severe and longer periods of drought are putting a lot of stress on hydropower generation and even if supply might still be guaranteed, costs are expected to rise. In addition, there are environmental and social concerns related to large-scale hydroelectric projects, which has resulted in uncertainty over approval for additional hydropower projects. A ruling by Costa Rica's Constitutional Court in 2016 stopped the Diquis hydroelectric project from going ahead as the Court held that ICE had not sufficiently consulted Indigenous communities who would see part of their lands flooded (McPhaul, 2017).

On the other hand, the plants are generating excess energy during rainy seasons. ICE wants to supply this excess power for the electric transport sector. However, as the e-transport market is still in its early stages the demand is very low. In other words, ICE is over-supplying Costa Rica's energy system during the rainy season. It is one of the reasons why ICE has been in a financial crisis for the last years.

To reduce its dependency on hydropower, Costa Rica has in recent years increased its share of wind energy, growing from 4% of the electricity mix in 2011 to 15% in 2018.

In the 100% RE scenarios modelled by the UTS Study, the installed capacity of hydro power will dominate as the major renewable power capacity for the coming decades, but will then be taken over by solar PV in 2040, which will subsequently remain the largest renewable power technology, reaching around 5,000 MW in RE1 and 13,000 MW in RE2. Wind power will also increase in the scenarios to just over 4,000 MW, whereas hydro power will remain on around 2,400 MW. Both renewable scenarios will result in a high proportion of variable power generation (PV and wind): 33%–31% by 2030 and 54%–66% by 2050.

Such a varied mix of renewables will make Costa Rica's energy system more resilient, efficient and affordable. In addition, innovative decentralised models for RE generation are more inclusive, as they offer citizens an opportunity to participate directly by generating, storing and using energy more intelligently. This also increases citizen's awareness regarding renewable energy sources. While the UTS Study noted that there is significant potential for rooftop solar PV in the metropolitan area of San José, it did not include specific figures in the scenarios.

Wind and solar PV have great potential to be employed as a distributed source in Costa Rica due the abundance of these resources year-round. An intelligent grid architecture of combined and interconnected micro, mini and medium-sized grid structures would allow the coexistence of many different electricity generating utilities, including community-led energy suppliers. Such a system would enable electricity generation to partially fall back into the hands of consumers, who could then also become producers of electricity (or prosumers).

6 POLICY RECOMMENDATIONS FOR COSTA RICA

1 Set a 100% Renewable Energy target for both energy production and consumption and embed it across all sectors of the economy

Formulating a target that is time-bound and measurable and detailed in scope and political obligations is essential to increase the confidence required by utilities and private and public investors to make large-scale and long-term investments needed for reaching 100% RE, such as in transmission and distribution grids. By increasing investment certainty, ambitious targets can also attract domestic and international investors, ultimately making it easier to achieve the target. In addition, experiences from the European Union have shown that targets can help to raise awareness amongst citizens and thus build support among citizens and businesses.

Setting a 100% RE target for industry (including the fossil fuel industry) and transport would increase energy security and provide a high-level signal to citizens, investors and other stakeholders, as well as a establish a foundation for policies and planning. To facilitate long-term investment certainty, instruments such as feed-in tariffs or power purchase agreements are necessary as well as incentives for the swift introduction of e-vehicles into the public and private fleet.

2 Prioritize solar PV and onshore wind development

Although Costa Rica consistently reaches 100% renewable electricity generation for most of the year, the current electricity mix, or the mix envisioned under plans for future energy development, does not yet utilise the abundant potential for different renewable resources available across the country.

In Costa Rica's current electricity mix, hydropower is the dominant source at 72%. Overall electricity demand is expected to rise due to economic growth, higher living standards, and the electrification of the transport and industrial sector. In order to meet future energy demand through 100% RE, Costa Rica will need to diversify its electricity matrix, thereby keeping storage demand low and security of supply high, while reducing dependencies on hydropower, which is vulnerable to increasingly strong dry seasons.

Under the two Renewables Scenarios developed as part of the UTS Study, solar photovoltaic (PV) and (onshore) wind power are expected to be the main pillars of the future power supply. Costa Rica's capacity for utility-scale solar PV is 200 GW. Even the most ambitious RE2 scenario can be implemented with the utilisation of only 6% of this potential. In addition, Costa Rica has an estimated 15 GW of onshore wind potential. However, wind resources, and to a large extent solar PV, are concentrated in only one region – the north-western province Guanacaste. To transport the power from Guanacaste to the load centres in the GAM, it is necessary to increase grid capacities. The study further highlights the significant potential for distributed rooftop solar PV in the Greater Metropolitan Area of San José (GAM). To unlock the potential, and to empower people with then GAM to deploy rooftop solar PV, a Feed-in tariff needs to be adopted. In addition, a subsidy scheme for solar rooftops would be beneficial to reduce the otherwise large prices on solar equipment which needs to be imported to a large extent.

3 Introduce a Feed-in Tariff scheme

More than 80 countries across the world have introduced a Feed-in Tariff, which resulted not only in substantial RE deployment but also in decentralised energy production and increase citizen engagement. Typically, FiTs grant priority access to the power grid and guarantees energy producers a fixed price for ever kilowatt hour produced for a fixed period (typically 20 years). The fixed price usually decreases over time, to ensure technical innovation. This fixed price should be high enough to ensure a return on investment. The fixed price and exact period of the tariff should be differentiated by types of energy source, size of plant as well as years of operationalising the project. The extra costs resulting from a FiT are usually shared among all energy users via a small surcharge on energy bills. Given Costa Rica's potential for SHS systems in the greater metropolitan area, as well as in north-western Guanacaste, a FiT would allow for more investments in community energy projects and in local renewable energy infrastructure, as this becomes financially profitable for many people and communities around the country, and allows them to become the drivers of the energy transition. This bottom-up movement creates socio-economic value in regions, communities and districts across the country. Local governments invest in RE technology further away from the greater metropolitan area and hereby reduce public spending for high energy imports, generate new income through taxes and revenues from the Feed-in Tariff as well as create local jobs. Further, the income generated through the FiT could be re-invested into local agricultural markets to strengthen export.

4 Enhance storage capacities

Given that Guanacaste will produce more energy than it consumes, storage capacities should be increased in the region, both at the household and utility-scale level. To do so, storage options need to become economical viable for energy producers and households in the region. This could be done by mandating that a certain amount of the return of the FiT is being re-invested into storage capacities. Equally, the introduction of a subsidisation scheme where households, hotels and industry either receive a re-payable loan or other forms of financial incentives from the government to strengthen storage capacities is possible. Increased storage capacities could strengthen resilience of local energy markets and infrastructure.

5 Pursue energy efficiency measures in tandem with deployment of RE

No region will meet its decarbonisation target without simultaneously improving its energy efficiency and increase the share of renewable energy. As a number of case studies suggest, making energy efficiency a trop priority is a critical part of achieving a 100% renewable energy future. Energy efficiency makes a 100% RE strategy easier and less costly to achieve, more sustainable in the long-term and supports the broader objective of decoupling economic growth from the growth in energy use. In many of the case studies, such as in San Francisco and in Frankfurt am Main, energy efficiency has been identified as the cheapest way to help achieve a 100% RE target.

While Costa Rica's existing grid infrastructure will have to be expanded to meet increased demand, introducing energy efficiency measures parallel to RE deployment (especially as it relates to the widespread electrification of the transport sector) reduces the required investment in the upgrade of the power grid infrastructure. Existing policies on energy efficiency standards for electrical applications, buildings and vehicles, must be strengthened to maximize the cost-efficient use of renewable energy and achieve high energy productivity. Therefore, it is important to update energy efficiency legislation. The current law dates back to 1972. Efficiency savings in the transport sector will result from fleet penetration by new highly efficient vehicles, including electric vehicles, but also from assumed changes in mobility patterns and the implementation of efficiency measures for combustion engines. Significant energy efficiency gains can also be achieved through increased efficiency measures in process heat for industries, notably through waste heat utilisation technologies.

6 Electrify the transport sector to achieve complete decarbonisation

The growing demand for personal vehicles, the majority of which run on petrol, is keeping a high share of fossil fuels in Costa Rica's energy consumption. A critical part to achieve the complete decarbonisation of Costa Rica will thus be the decarbonisation of its transport sector. Analyses of the case studies such as Denmark or El Hierro in Spain showed that electrifying the transportation sector will increase not only implementation flexibility, but also technical and engineering flexibility in achieving a 100 % renewable energy target. In other words, the move toward greater electrification of transport is likely to make it easier for Costa Rica to achieve their 100 % RE[10].

The RE2 scenario developed by the UTS Study foresees the decarbonisation of Costa Rica's transport sector, which would lead to an increase in electricity demand to 26 TWh/a by 2040 and to 43TWh/a by 2050. Diversification of the energy mix, grid expansion and rolling out distributed energy systems will thus be crucial to achieving this ambitious target. Introduction of efficient e-cars which can be charged either at charging stations or at home by using rooftop-solar systems is a must. Likewise, swift introduction of fleet vehicles for public transportation is necessary: existing train lines, in addition to the planned line around San José, should be revived to connect the GAM to the coasts. Existing plans should be expanded to include more rural areas of Costa Rica. This should be complemented by a drastically improved bus system: single sign-on rides, low fares to increase attractiveness, a common framework for bus operators to increase frequency and reduce delays, and a bus routes infrastructure planned by the government to increase interconnectedness. To ensure the best dispatch use of each transport mode, the government needs to collect mobility patterns as well as energy consumption behaviour across the population.

7 Ensure biofuel production within environmentally sustainable limits

Biofuels will be necessary to decarbonise the transport sector. Nevertheless, the production of biofuels from fuel-crops such as sugar cane should be ensured to be environmentally sustainable. In other words, monocultures should be avoided at all circumstances. Rather, completion by hydrogen and syn-fuels should be considered. An economic benefits analysis should be carried out prior to determine the best mix of energy sources regarding price versus efficiency loss.

8 Increase sector-coupling

Achieving full decarbonisation requires increasing the interconnection between the electricity, the heating/cooling, as well as the transport sectors. This allows renewable electricity to be channeled to a wider range of dispatchable end-uses such as in thermal systems, alternative forms of storage, or in electric vehicles. Further, increased sector-coupling between industry, transport and heating should be considered to increase efficiency of renewable energy capacities. Power utilities can encourage this in order to manage demand-side management possibilities and maximise the cross-benefits of integrating higher shares of RE. As most industrial processes take place in the GAM where also most (public) transport will be, this becomes even more crucial in that area.

10 https://www.worldfuturecouncil.org/wp-content/uploads/2016/01/WFC_2014_Policy_Handbook_How_to_achieve_100_Renewable_Energy.pdf

9 Explore financing mechanisms for RE development and other decarbonisation measures

Financing is critical in every stage of RE technology development and deployment, from funding technology research, development and commercialization to investment in the construction of RE generating facilities. Investments are also needed in extending grids and ensuring energy flexibility including transmission, storage, demand-side management and sector coupling. However, there are several barriers to the availability of RE financing, including high upfront investment costs, and (perceived or real) project risks due to the RE market being in a state of technological and structural transition. This often leads to a lack of bankable projects, rather than a lack of finance.

To increase the number of bankable projects, the Central Bank of Costa Rica can take on a stronger role in providing risk-free financing and increased private capital through cooperation with multilateral banks such as the Central American Bank for Economic Integration[11]. As demonstrated during the financial crisis, central banks are the most powerful economic institutions in our current economic system; they are the producer of the legal tender and the lender of last resort for the banking system. Further, central banks cannot become insolvent in their own currency and were therefore able to finance the bailout programme for the struggling banks. The Central Bank of Costa Rica can therefore facilitate a "climate bailout" in their country by backing guarantees and purchase virtually perpetual Green Climate Bonds issued from the GCF or other financial institutions.

Further, to transform to a mixed renewables-based energy system, the scaling-up of both public and private funding is essential. Cash flow certainty is critical for renewable projects to manage risks and facilitate finance. Nearly all utility-scale investments benefit from long-term pricing under policy schemes. Public-Private Partnerships are another useful instrument to unlock investment. Distributed and citizen-led energy projects have been successful in countries like Germany, Denmark or Japan under the introduction of FiT which establishes a stable enabling environment for around 20 years and thus increases price certainty, while ensuring a return on investment whilst accelerating RE deployment.

11 For more information, please see the World Future Council's publication "Unlocking the trillions to finance the 1.5°C limit", available here: https://www.worldfuturecouncil.org/unlocking-the-trillions/.

7 GOVERNANCE RECOMMENDATIONS FOR COSTA RICA

1 Engage stakeholders from all sectors in the energy field

In order to achieve 100% RE and the complete decarbonisation of the economy, as well ensure that the benefits of this process are distributed fairly across different sectors and regions in the country, a wide variety of stakeholders should be consulted and engaged in policy-making and implementation. Costa Rica already has an impressive track-record on citizen-led and grassroots initiatives feeding into policy-making, and in 2018, the Civil Society Climate Advisory Council (Consejo 5C), which brings together representatives of indigenous groups, NGOs, trade unions and business, was set up. The country will have to build on these initiatives to make sure that a wide range of stakeholders advise on, and take ownership of, the energy transition, as well ensure that the benefits are spread in a just manner. In addition, specific open-access and inclusive policies such as a feed-in tariff should be implemented, as these engage citizens and communities (by making them energy producers) and offer targeted incentives and create long-term investment certainty for citizens, communities, local businesses and international investors.

By providing market access to a wide range of stakeholders, synergies between RE, urban and rural development, agriculture, health etc. can be facilitated and help sustain the momentum required to achieve 100% RE. Thus, the transition to 100% RE is not just a switch from fossil fuels to renewables, but an opportunity for socio-economic development. Policies across the board should therefore pay attention to and integrate insofar possible these co-benefits and internalise the social and environmental costs of fossil fuels, in order to utilise renewables to reduce inequalities and support the development of a self-sufficient, energy sovereign Costa Rica.

2 Develop a policy framework for capacity building

Implementing a 100% RE strategy requires effective awareness raising among all sectors of society and education of citizens, legislators/parliamentarians and government officials. First, strengthening and expanding curricula and vocational training in schools (promotion of apprenticeship schemes), universities and other learning institutions on the technical, financial and policy implications of the decarbonisation process helps develop the necessary workforce. This should also include retraining those who will lose the jobs they had in the old energy system.

Further, citizens' awareness should be strengthened through reports and campaigns involving the public sector, private sector and non-governmental groups on the socio-economic benefits of RE (jobs, air quality, RE deployment rate, fuel cost savings, etc.). To improve understanding and enhance a sense of ownership, government roundtables, similar to the President's citizen discussion talks, should be promoted to review existing and new regulations and developments and to gather feedback on how these have played out on the ground.

3 Integrate renewable energy into urban and spatial planning

The largest part of Costa Rica's industrial activity takes place in the greater metropolitan region around San José. It is also the most densely populated area in the country. Therefore, urban and spatial planning play an important role in Costa Rica's energy system. Integrated urban planning requires a deep understanding of planning processes across different sectors (industry, transport, residential, etc.). Urban policy-makers need to coordinate both horizontally across municipal departments and local stakeholders, as well as vertically across multiple levels of governance towards a common goal of 100% RE. Urban planning thus requires priority areas, which in the case of Costa Rica should be to decarbonise the GAM with a special focus on transport, industry and residential areas, whilst increasing resilience of the energy system. A working group should be established with urban planners with expertise in each of these areas, citizens, government institutions (MINAE, MOPT, SEPSE), local government authorities, local energy providers and ICE to guarantee a holistic policy framework.

This might require more flexible market mechanisms, which might require different financial models. On the one hand, development of, and investment in, city-owned RE based power plants and district energy networks should be considered. On the other hand, residential energy production through rooftop-PV installations could increase resilience of the urban energy system (supported by a feed-in tariff, supporting institutions for application processes, or public grants). ICE would still be responsible for utility-scale RE production, which will have to increase due to increased electricity demand from the transport sector.

4 Integrate renewable energy into rural development policies

Economic activity is concentrated in and around San José. In order to strengthen local economies in rural regions of Costa Rica, it is necessary to unleash the transformative power of renewable energy to strengthen economic activities. In fact, the OECD found several similarities between regions where RE is effectively integrated into rural development policies: the energy system is mainly driven by local needs and policies, rather than national policies; RE projects primarily satisfy local demand; energy export opportunities exist and are often viewed as commodity markets; they show reduced reliance on subsidies to cover operating costs and focus on mature technologies (e.g. small-scale hydro, wind, PV); and projects are managed locally by networks and cooperatives. Promoting distributed energy systems in rural areas thus tends to improve local socio-economic conditions and can revitalise communities left behind. Eventually, an energy system should be created which re-invests returns into encouraging innovative business models, especially for SMEs, and improved infrastructure and education. This could include innovation of disruptive new technologies which are cross-cutting in nature, such as sensor-based systems for monitoring crops, soil, fields and livestock or enhance digital traceability of product chains. This can increase domestic food security and open up new international markets for Costa Rica's agricultural products.

The energy transition towards 100% Renewable Energy cannot be done by an individual or a single group alone. To ensure ownership and a just transition, a wide variety of stakeholders need to be consulted.

5 Strengthen decentralisation and political decision-making of local governments

Costa Rica already recognises that adaptation to climate change has to be a community-led process. In Costa Rica, such projects are generally looking to empower people and increase resilience. The same should be true for mitigation. To unleash the full transformative potential of renewable energy, local governments and communities need to participate to make sure measures are tailored to local needs. Further, actor diversification in the energy system can increase resilience thereof by reducing need for grid extension by prioritising energy consumption close to production. The law regulating private concessions thus needs to be updated. Spatial planning should further consider specific economic activities of each sector and place particular emphasis on equal opportunities for both rural and urban population within a region. Costa Rica's local governments enjoy comparatively little decision-making power which is in part due to financial constraints, as funds allocated for infrastructure, RE etc. are increasingly limited. Flexible financing solutions are therefore crucial for building a distributed, local energy system. Pay-as-you go schemes, which allow for modular instalment of RE technologies, could be considered and promoted as a Public-Private-Partnership between the government and technology-providing businesses. In addition, RE installations could be subsidised through repayable grants which could be paid for through energy bills within a certain time-frame.

Another way to provide flexible finance are low-interest and long-term loans for property owners, project developers and small-scale purchasers to invest into renewables or energy efficiency, which they then gradually pay back through slightly higher property taxes. Municipal green bonds are another mechanism used to finance renewable energy investment. Many cities in Global South countries have limited access to capital markets. Green bonds can provide local governments with access to low-cost capital to meet their energy investment needs. This model has been under-utilised, with recent analysis showing that only 1.7% of green bonds proceeds flow to cities and city-based infrastructure in developing countries.

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