Fields of action for German technology providers to engage in Paris aligned technology transfer

Briefing paper

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Key messages

- ⇨ The IPCC special report on 'Global warming of 1.5°C' stipulates that global CO_2 emissions need to be net zero by 2050 to be in line with Paris Agreement temperature goal agreed on by the global community.
- ⇨ This latest scientific evidence emphasizes the need to initiate deep sector transitions towards a low-carbon economy by mid-century and large-scale deployment of respective technologies in line with identified sectoral pathways and benchmarks.
- ⇨ Developing countries depend on wide ranging technology transfer of state-of-the-art technologies and integrated low-carbon technological solutions in all sectors, especially when considering implications of analysed sectoral pathways and benchmarks in line with the Paris Agreement.
- ⇨ The in-depth analysis for Argentina, Indonesia, and South Africa reveals that these countries only recently have started their planning for more comprehensive climate action to fully transition to a low-carbon economy in most sectors. As these countries and others will accelerate their sectoral transitions towards a low-carbon economy in the nearby future, diverse opportunities emerge for German technology providers to engage in substantial technology transfer in context of the Paris Agreement's implementation.

Contents

1. Introduction

This briefing paper outlines sector transitions towards a low-carbon economy that will be necessary to achieve the Paris Agreement temperature goal. These sector-specific pathways and respective benchmarks illustrate the rapid and fundamental transition that sectors will need to undergo globally and the challenges these entail for policymakers, industry and society at large. The pathways can be used to identify technology shifts and opportunities for technology transfer to inform policymakers and industry. The focus of the paper is on mitigation relevant sectors and technologies, as inclusion of adaptation would go beyond the scope of this exercise.

The paper derives Paris Agreement compatible (technology) pathways for key mitigation sectors, including energy, industry, transport, buildings and waste, from available literature. High level opportunities for engagement in international technology transfer for German technology providers are highlighted. Three country case studies for South Africa, Indonesia and Argentina complement the analyses showing the status-quo of sector transitions in each country via-à-vis these pathways. Both the sector pathways and case studies provide insights for German technology providers to identify opportunities for engagement in the short and medium term.

2. Identification of Paris Agreement compatible sector pathways

The Paris Agreement stipulates the overall long-term temperature goal of ”holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change” (UNFCCC, 2015). The Paris Agreement long-term temperature goal is more ambitious than the previously agreed 2°C limit of the Cancun Agreements of 2009.

At the same time, global emission reduction pathways to hold global warming below the temperature level of 1.5°C compared to pre-industrial levels are now steeper than they were at the time of the Fourth Assessment Report of 2007 (IPCC, 2007). Much of the remaining global budget has been depleted by steady annual emission increases over the last twelve years. Global CO_2 emissions today are around 60% higher than at that time. Now, global emissions must decline much faster to still meet the temperature level of 1.5°C compared to pre-industrial levels and avoid the most dangerous consequences of climate change.

Figure 1 compares the recommendation of the IPCC’s Fourth Assessment Report of 2007 with IPCC’s special report on ‘Global Warming of 1.5°C’ published in late 2018.

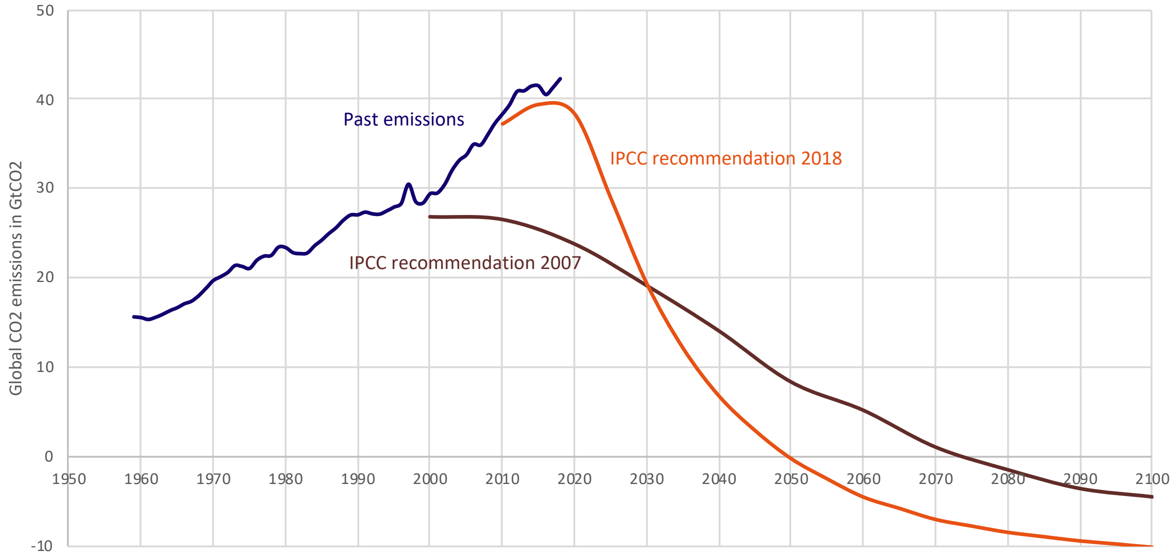

Figure 1: Pathways of global CO2 emissions recommended by IPCC in the Fourth Assessment Report of 2007 (445 to 490 ppmCO_2eq leading to 2-2.4°C) and by the IPCC special report on 1.5°C in 2018 for low and no overshoot scenarios leading to 1.5°C (only the average of the ranges are shown). Overshoot implies a peak followed by a decline in global warming, achieved through anthropogenic removal of CO_2 exceeding remaining CO_2 emissions globally.

The latest scientific evidence shows the need to initiate deep sector transitions as quickly as possible to successfully transition towards a low-carbon economy by mid-century. Global CO_2 emissions need to be net zero by 2050 to be in line with 1.5°C (IPCC, 2018a). Paris compatible pathways for specific sectors can enhance the understanding of the most important short and medium-term actions and to foster debate between key actors.

The following sections summarise the key steps that need to be taken in the energy, industry, transport, building and waste sectors in the short and medium-term (2025, 2030) if the Paris Agreement temperature goal (well below 2°C with the aim to pursue 1.5°C) is to be achieved.

These findings mainly build on available literature, drawing in particular from the recent IPCC special report on ‘Global warming of 1.5°C’ and *Ten key short-term sectoral benchmarks to limit warming to 1.5°C* by the Climate Action Tracker (Kuramochi et al., 2017).

Electricity and heat supply sector

The most rapid shift needs to occur in the energy supply sector. Global GHG emissions from electricity generation need to be reduced from around 12 $GtCO_2$/yr in 2010 to around 6–11 $GtCO_2$/yr in 2020, 2–5 $GtCO_2$/yr in 2030 and zero to –2.5 $GtCO_2$/yr in 2050 (Kuramochi et al., 2017). This fundamental transition of the global energy system requires both the uptake of zero- and low-carbon electricity generation sources as well as the phase-out of carbon-based electricity generation, mainly from coal.

#1.1 Sustain the growth rate of renewables and other zero and low-carbon power generation until 2025 to reach 100% share by 2050

A full transition to low-carbon electricity supply by 2050 implies a rapid transition to renewables, other zero-carbon technologies such as nuclear and low-carbon technologies sources such as carbon capture and storage-equipped fossil energy (IPCC, 2018b; Kuramochi et al., 2017). This transition of the global energy system builds on continuous reductions of levelized cost of electricity (LCOE) for renewables, especially utility-scale solar photovoltaic and wind (on-shore and off-shore). The comprehensive literature review in the IPCC special report on 1.5°C identifies a range for the average share of renewables in electricity generation. Table 1 below overviews the shares per technology in total electricity generation in across all most recently available scenario analyses presented in the IPCC special report on 1.5°C in ranges (Rogelj et al., 2018).

Pathways	Technology	2030	2050
1.5°C compatible pathways with no or low overshoot (based on 50 scenarios)	Renewables (total)	37%-80%	59%-97%
	Wind and solar	1%-42%	2%-60%
	Biomass	1%-13%	0%-30%
	Nuclear	5%-32%	1%-28%
	Fossil technologies (total)	2%-53%	0%-25%
1.5°C compatible pathways with high overshoot (based on 35 scenarios)	Renewables (total)	25%-66%	36%-95%
	Wind and solar	1%-28%	9%-61%
	Biomass	1%-2%	0%-28%
	Nuclear	5%-24%	1%-40%
	Fossil technologies (total)	24%-59%	0%-33%

Table 1 Global electricity generation shares of 1.5°C pathways taken from Figure 2.7 of Chapter 2 Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development for scenarios (Rogelj et al., 2018)

Apart from cost-competitiveness of zero- and low-carbon generation technologies, electric power systems need to be fundamentally modernized and overhauled to provide sufficient flexibility, transmission, demand-side management, and storage for high penetration of (variable) renewables (International Renewable Energy Agency, 2019). Many developing countries identify high demand for finance, technology and skill transfer to increase renewable electricity generation capacity and modernize their electric power systems in line with 1.5°C compatible energy supply scenarios.

Key technologies required for a Paris Agreement compatible transition in the electricity and heating supply sector comprise the following (not exhaustive):

Energy supply (Rogelj et al., 2018)

- Renewable electricity generation technologies such as solar photovoltaic (utility-scale and small-scale), wind (onshore and offshore), geothermal, biomass, biogas, maritime, concentrated solar power, and others
- Bioenergy with carbon capture and storage (BECCS) technologies and fossil-fuel based technologies with carbon capture and storage (*controversially discussed)*
- Cutting-edge plant engineering for low-carbon technologies in the energy supply sector

Enabling technologies (International Renewable Energy Agency, 2019)

- Electricity storage technologies such as utility-scale batteries and behind-the-meter batteries
- Electrification of end-use sectors such as electric vehicle smart charging, renewable power-to-heat, and renewable power-to-hydrogen
- Digital technologies such as the internet of things, artificial intelligence & big data and blockchain
- New grids such as renewable mini-grids and super grids with transmission over long distances
- Dispatchable generation such as flexibility in conventional power plants

#1.2 No new coal power plants to be commissioned from 2019 onwards and emission reductions from existing coal fleet by 30% by 2025

To limit warming to 1.5°C, no new coal capacity can come online as of 2019 while emissions from coal combustion need to be reduced by at least 30% by 2025 and 65% by 2030 (Climate Action Tracker, 2018b; Kuramochi et al., 2017). This is in line with the most recent literature review by the IPCC Special Report on 1.5°C (de Coninck et al., 2018). As of January 2019, an aggregated 236 GW of coal capacity is currently being constructed and an additional 339 GW has been announced, pre-permitted, or permitted (Global Energy Monitor, 2019). A major challenge will be to deal with existing coal-fired power plants which need to be decommissioned before the end of their economic lifetime as well as to redirect investments from new coal-fired power plants to alternatives. This provides enormous challenges and opportunities for both policymakers and investors as coal owners could avoid $267 billion stranded asset risk by phasing-out coal in a below 2°C scenario (Carbon Tracker Initiative, 2018).

Transport sector

#2.1 Last fossil fuel vehicle sold by 2035 in passenger transport sector

The rapid introduction of zero emission vehicles is the key for a transition to low-carbon passenger transport (Kuramochi et al., 2017). To transform vehicle fleets to 100% zero-emission vehicles by 2050, including cars, buses and two-wheelers, the last fossil-fuel powered vehicle would have to be sold roughly before 2035-2050, assuming an average lifetime of 15 years. Furthermore, the use of public transport needs to be significantly increased versus individual forms of transport. With the findings from the IPCC report on the need to achieve net-zero CO_2 emissions around 2050 and considering the rapid update of electric vehicles in the last years, a fully 100% zero-emissions vehicle stock by 2050 should be aimed for, meaning the last fossil vehicle needs to be sold before 2035. Of the options for zero-emission vehicles, electric vehicles (EVs) currently appear to be the most promising. Under a most recently published *New Policies Scenario* considering already announced policy ambitions by the IEA Global EV Outlook 2019, global EV sales reach 23 million and the stock exceeds 130 million passenger vehicles by 2030 (IEA, 2019). These numbers will be significantly higher if more countries will embark on a Paris compatible development in the passenger transport sector.

The uptake of zero emission vehicles faces several barriers, especially price competitiveness vis-à-vis conventional vehicles, range anxiety by car owners, and limited charging infrastructure (Kuramochi et al., 2017). Particularly concerning the latter, developing countries identify high demand for finance, technology, and skill transfer to successfully transition towards low-carbon passenger transport sector.

Key technologies required for a Paris Agreement compatible transition in the passenger transport sector comprise the following (not exhaustive) (IEA, 2019):

- ⇨ Battery technologies (chemistry, energy density, and size of the battery packs) and manufacturing capacities for cars, busses and two-wheelers
- ⇨ Redesign of vehicle manufacturing platforms to achieve sharp cost reductions
- ⇨ Concepts for connected, shared and autonomous mobility, including shared passenger fleets related purpose-build electric vehicles as well as fully integrated public transportation concepts in urban and rural areas
- ⇨ Charing infrastructure and related concepts, incl. for heavy-duty applications such as buses

#2.2 Freight transport needs to be almost fully decarbonised by ~2050

To be compatible with the Paris Agreement's long-term goal, freight trucks and trailers need to be almost fully decarbonised by around 2050 (Climate Action Tracker, 2018a, 2018d). Thus, road freight ultimately needs to move to low-carbon vehicles or shift to other sustainable modes of transport such as electrified train transport. Given typical vehicle lifetimes, deployment of low-carbon technologies should start at scale by around 2030. Generally, three options are most often discussed and analysed for zero emissions trucks and trailers: electric vehicles (both battery-electric trucks/trailers and electric road system), biofuel trucks and trailers, and trucks and trailers using fuels produced with hydrogen or renewables-based liquid fuels (IEA, 2017; OECD/IEA & IRENA, 2017). Apart from biofuels, a carbon-free power sector is essential for decarbonising road freight transport—either through electric or fuel cell trucks driven by renewables-based fuels such as hydrogen, biofuels, or synthetic fuels. The transition of freight transport systems in developed and developing countries requires substantial technological innovation — both for different options of zero-emission trucks and the respective infrastructure.

Key technologies required for a Paris Agreement compatible transition in the freight transport sector comprise the following (not exhaustive) (Climate Action Tracker, 2018c; IEA, 2019):

- ⇨ Electric trucks such as battery-electric trucks and electric road system
- ⇨ Charing infrastructure and related concepts designed for heavy-duty applications in different geographical and climatic conditions
- ⇨ Trucks using fuels produced with hydrogen or renewables-based liquid fuels and biofuel trucks
- ⇨ Integrated freight transportation concepts
- ⇨ Technologies and integrated concepts for last-mile delivery

#2.3 Develop and implement a 1.5°C-consistent strategy in aviation and shipping

Given existing challenges in the aviation and shipping sub-sector, the pathway towards a successful transition to low-carbon aviation and shipping consists of three interlinked steps (Kuramochi et al., 2017). First, mitigation options already available such as energy efficiency improvements, operational changes and the use of sustainable low-carbon fuels need to be implemented, scaled-up and standardized as best-practice. Second, relevant UN bodies such as International Civil Aviation Organisation (ICAO) and International Maritime Organization (IMO) together with national governments need to agree on a long-term low-carbon strategy for the aviation and shipping sectors, including the development of 1.5°C consistent scenarios and implementation plans currently not available. Third, global research activities would need to intensify in line with technology roadmaps needed for such Paris Agreement compatible scenarios.

Key technologies required for a Paris Agreement compatible transition in the aviation and shipping sector comprise the following (not exhaustive):

Aviation (Hall, Pavlenko, & Lutsey, 2018)

- ⇨ Technologies related to electrified onboard systems add electric motors
- ⇨ Technologies related with one- to four-seater zero-emission aircraft (incl. both battery electric and hydrogen fuel cell aircraft) and larger aircraft in the commercial passenger aircraft sector
- ⇨ Technologies related with electrification of airports and related infrastructure changes

Shipping (NewClimate Institute, 2019)

- ⇨ Technologies related to technical mitigation measures such as hull design and cleaning, propeller polishing, wind propulsion, alternative fuels, air lubrication, alternative propulsion, waste heat recovery, solar power, and other ship design measures
- ⇨ Technologies related to operational measures such as slow steaming, weather routing, route planning, cold ironing / on shore power, as well as port and cargo handling and logistics

Buildings sector

The findings of the IPCC special report on 1.5°C finds that scenarios with a likely – or very likely – chance of limiting warming to less than 2°C require a 50–60% reduction of direct emissions from the building sector by 2030 from 2010 levels and 70–80% by 2050 (Rogelj et al., 2018). Emission reductions in line with these benchmarks imply significant reduction of energy demand together with scaled-up electrification of the buildings sector. Given the long-living infrastructure, immediate action and related technology transfer must target both new buildings being constructed in the short-/medium-term as well as ambitious retrofitting of existing building stock.

#3.1 All new buildings fossil-free and near zero energy by 2020-2025

All new buildings must be zero emissions (i.e. fossil-free and near-zero energy) by 2020 in regions of the Organisation for Economic Co-operation and Development (OECD) and by 2025 in non-OECD regions (Kuramochi et al., 2017). The non-uniformity of the global building sector and climatic differences between regions requires region-specific standards and approaches to heating and cooling demand reduction with the largest energy saving potentials through building envelope improvements, high efficiency and renewable equipment (Rogelj et al., 2018). Energy savings from shifts to high-performance lighting, appliances, and water heating equipment further embody energy saving potentials. Technology providers have diverse options to support these transitions considering substantial new construction expected in developing countries in the near future. Refrigerants used to power air conditioners and refrigerators need to have a GWP below 5 by 2040.

#3.2 Increase renovation rates from >1% in 2015 to 5% by 2020-2025

Annual retrofit rates for existing building stock in OECD regions ought to increase from less than 1% in 2015 to about 5% by 2020 or shortly thereafter, aiming for direct emission reductions per retrofit of about 90% (Kuramochi et al., 2017). For non-OECD regions, annual retrofit rates for existing building stock should increase to about 3% by 2020 or shortly thereafter with similar direct emissions reduction per retrofit. Recent analysis highlights the benefits of deploying the most advanced renovation technologies in developing countries, avoiding carbon lock-in and further, more expensive retrofit later on (Güneralp et al., 2017).

Key technologies required for a Paris Agreement compatible transition in the buildings sector comprise the following (not exhaustive) (IEA; UNEP, 2018):

- ⇨ **Energy efficient buildings envelop** and related construction materials to enable (near)-zero buildings construction
- ⇨ **Low-carbon and energy-efficient options such as heat pump and solar thermal technologies** as well as energy-efficient and low-carbon district heating
- ⇨ **Appliances for cooling**, particularly energy efficiency air conditioning with ambitious and mandatory *Minimum Energy Performance Standards (MEPS)* and labels
- ⇨ **Refrigerants** with a GWP <5 for appliance for space cooling such as natural refrigerants, HFCs with low GWPs or HFOs
- ⇨ **Energy efficient lighting** and related technologies (residential, commercial, and outdoor)
- ⇨ **Energy efficient household appliances**
- ⇨ **Architecture solutions** for building and community design (e.g. passive building solutions)

Industry sector

The industry sector is the biggest end-use sector in terms of final energy demand and GHG emissions (Rogelj et al., 2018). GHG emissions comprise CO_2 emissions from fossil-fuel combustion, non-energy uses of fossil fuels in the petrochemical industry and metal smelting, as well as non-fossil fuel process emissions (e.g., from cement production). Material industries such as the steel, non-ferrous metals, chemicals, non-metallic minerals, as well as pulp and paper industries account for around two-thirds of final energy demand in the sector.

#4 All new installations in emissions-intensive sectors are low-carbon or zero emissions after 2020 and maximize material efficiency

Owing to the complex nature of the industry sector with diverse sub-sectors, the benchmark identified by Kuramochi et al. (2017) remains less specific compared to the benchmarks in other sectors, especially on the important aspect of material efficiency. For all industrial sub-sectors, large-scale deployment of low-carbon technologies, including the use of CCS and the switch to low-carbon fuels, would need to take place immediately: reducing energy demand, increasing energy efficiency and increasing electrification of energy demand. Major challenges for most CO_2-intensive industrial subsectors remains the slow progress in CCS technology and (global) market competitiveness of commercially deployed low-carbon alternatives (Rogelj et al., 2018). Both require further intensified research, development, demonstration and deployment of such technologies by the public and private sector in combination with aligned policy support measures to upscale the use of such technologies.

Key technologies required for a Paris Agreement compatible transition in the industry sector and relevant sub-sectors comprise the following (not exhaustive, only covering two key industrial subsectors) (Bataille et al., 2018; Kuramochi et al., 2017; Prognos; BCG, 2018)**:**

General

- ⇨ Technologies related renewable heat and steam supply at industrial sites through biogas and power-to-gas
- ⇨ Technologies related to energy efficient production technologies as well as efficiency gains through technological innovation in the field of Industry 4.0 and digitalization
- ⇨ Technologies around keystone chemicals (such as synthetic renewable hydrocarbons and other keystone chemicals) and renewable fuels
- ⇨ Cutting-edge plant engineering for low-carbon technologies in the industry sector

Steel and iron

- ⇨ Technologies related to steel scrap recovery and reducing liquid steel lost as process scrap
- ⇨ Technologies related to innovative low-carbon technologies equipped with CCS and fuel switch (e.g. se renewable hydrogen in a DRI-EAF as the reductant)
- ⇨ Technologies related to electricity-based option for decarbonized steel making

Cement and other construction material

- ⇨ Technologies to reduce clinker-to-cement ratio and alternative chemistries for cement
- ⇨ Technologies related to design and material substitution (e.g. with wood or carbon fibre)
- ⇨ Technologies related to CCS and CCUS in cement production

Waste and wastewater sector

Neither the IPCC special report on ‘Global warming of 1.5°C’ nor the analysis on key short-term sectoral benchmarks to limit warming to 1.5°C by Kuramochi et al. (2017) cover the waste and wastewater sector to derive distinct benchmarks on Paris Agreement compatible pathways. However, both the waste and wastewater sectors have potentials for low-carbon transitions while improving public health, enhancing productivity, and meeting national Sustainable Development Goals at the same time. The International Solid Waste Association (ISWA) outlines several fields of action in its *Declaration on climate change and the waste and resource management sector of 2015* (ISWA, 2015)*,* specifically calling upon countries to include mitigation strategies in the waste sector in their Nationally Determined Contributions (NDCs).

Previous research on solid waste management has shown that diversion from landfill is one of the main contributors to GHG mitigation in the waste management sector (Umweltbundesamt, 2015). Even if waste is deposited in managed landfills with gas collection and landfill gas use, there is still significant GHG mitigation potential if waste is materially recycled wherever possible and otherwise used for energy recovery. Waste sector methane mitigation options have high cost-effectiveness, generally producing a net profit over a few years, considering market costs only (de Coninck et al., 2018). An integrated waste management system that prioritises reuse, material recycling and energy recovery instead of landfilling can contribute significantly to national GHG mitigation goals. Such research has also shown that technology providers from OECD countries can support the process of implementing closed-cycle management, for example through transfer of know-how at either technology or government agency level (Umweltbundesamt, 2015). Despite waste management and recycling, the reduction of waste generation holds significant potentials wither through policy-enforced bans (e.g. for example on plastic) or wider producer responsibility concepts both in private households and industry.

Wastewater treatment presents a significant opportunity to cut carbon and energy costs. Carbon emissions from untreated sewage are three times higher than the emissions of conventional energy-intensive wastewater treatments (SIWI, 2017). This requires a sound selection of technologies as well as the adoption of energy efficient and carbon emission reduction measures, for example through recovery and use of biogas produced during the wastewater treatment.

3. Country case studies – South Africa, Indonesia, Argentina

The following cases studies for South Africa, Indonesia, and Argentina serve a dual purpose. For each country, the current status of sectoral transitions toward a zero emissions economy will be compared vis-à-vis identified sector-specific pathways and benchmarks in the literature. This gap analysis then allows to identify future potential options for engagement of German technology providers in each of the three countries.

The in-depth analysis of each of the three countries is based on recently published and forthcoming country analyses under the Climate Action Tracker's *Scaling Up Climate Action country series*.[1] This analysis is further substantiated by anecdotal evidence for sector specific technology transfer activities in the given countries. The qualitative analysis of policy activity and ambition for the three case studies includes a rating of each sector.

The rating explained in Figure 2 aims to reflect the sector's current transition state towards 1.5°C Paris Agreement compatibility. For this purpose, the rating takes account of existing sectoral long-term strategies and/or policies, their status of implementation, as well as the general state of transition of the sector under analysis.

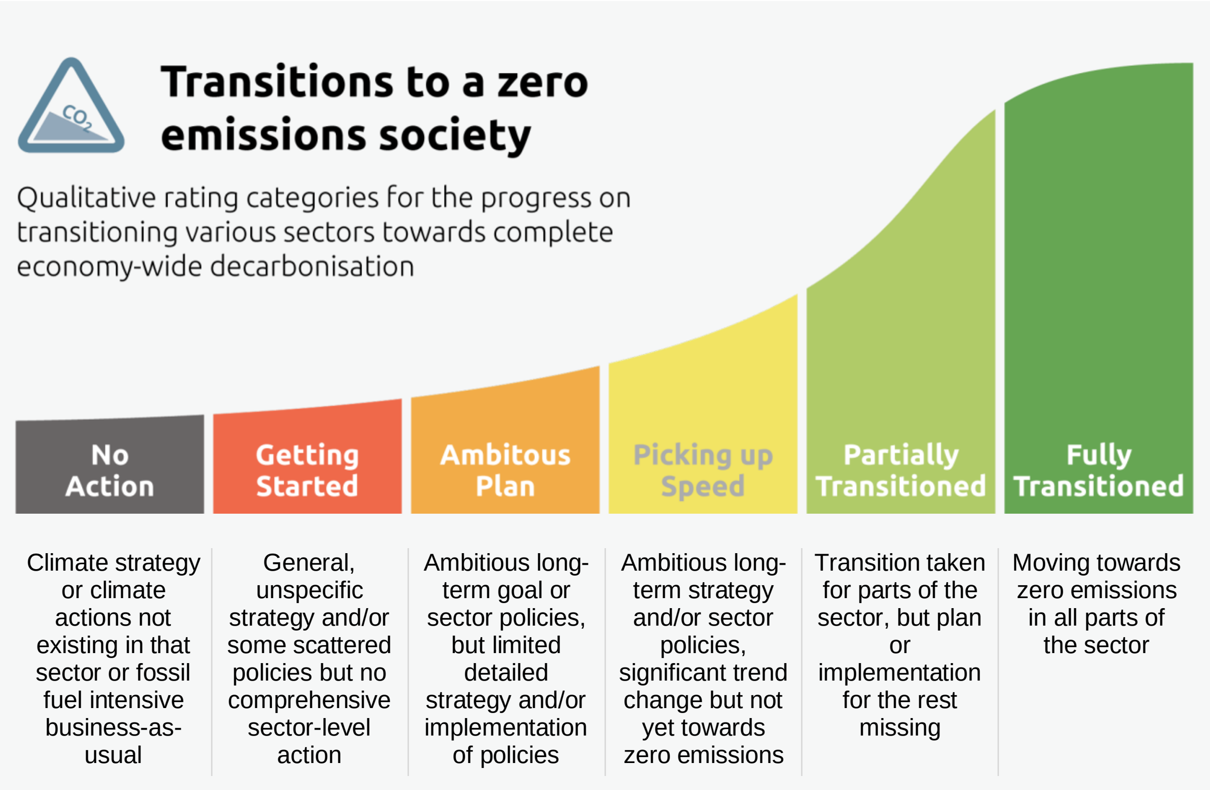

Figure 2: Qualitative policy rating for sectoral transition to zero-emissions society based on Scaling Up Climate Action country series published by the Climate Action Tracker

[1] More information on the country series available under https://climateactiontracker.org/publications/scalingup/

3.1. Country case study #1: South Africa

Case study: South Africa

Rating by Climate Action Tracker (as of 12/2019)

***Highly insufficient**: Commitments with this rating fall outside the fair share range of mitigation effort and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's more ambitious 1.5°C limit. If all government targets were in this range, warming would reach between 3°C and 4°C. More information on the Climate Action Tracker's rating system here.*

SOUTH AFRICA	Summary of pledges and targets	
PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	Emissions incl. LULUCF of between 398–614 MtCO2e over 2025–2030 [17–78% above 1990 by 2030 excl. LULUCF] [26% below to 12% above 2010 by 2030 excl. LULUCF]
	Condition(s)	The finalisation of an ambitious, fair, effective and binding multilateral agreement under the UNFCCC at COP21.
	Coverage	Economy-wide, all sectors (including AFOLU), six GHGs

Evaluation of status of sector transitions and related market opportunities

Authors: NewClimate Institute

#	Sector		Policy rating
1		Electricity and heat sector	 Getting Started

- While South Africa experienced high growth in installed renewable capacity between 2012-2017 due to successful procurement under its renewable capacity tender policy REIPPP (first four bidding rounds all significantly oversubscribed), the process has been hampered recently. This was mainly due to severe delays in signing off on power-purchase agreements, ongoing financial solvency issues by South Africa's grid operator and largest utility company Eskom, and overall planning uncertainty of South African policy makers.
- Projected share of low-carbon electricity generation under currently implemented policies of 23-26% by 2030 deviates from the path leading to 100% low-carbon power by 2050. Released in August 2018, the latest proposed update of the *Integrated Resources Plan (IRP)* by the Ministry of Energy, the blueprint for the power sector, details a transition away from coal towards renewables such as wind and solar by mid-century (Department of Energy, 2018). Once adopted in 2019, the plan, if implemented, would reduce the high

uncertainty on future energy planning, investment and respective technology transfer needs.

- ⇨ Under the proposed IRP updated in August 2018, renewables-based power generation capacity from wind and solar is projected to significantly increase by 2030 (additional 8.1 GW for wind and 5.7 GW for solar by 2030) and beyond, as is gas-fired power generation capacity of additional 8.1 GW by 2030 (Khumalo, 2018).
- ⇨ In this context, the South African Minister of Energy, Jeff Radebe, has recently encouraged the participation of Northern European countries in finance, technology and skill transfer to increase electricity generation capacity (South African Government Newsroom, 2019). Also, Eskom and KfW, the German development bank, signed a $100 million loan facility to connect renewable-power projects run by independent producers to the grid (Burkhardt, 2018), mainly expanding the transmission network in the Northern Cape province.

#		Sector	Policy rating
2		Transport sector	

- ⇨ South Africa's Green Transport Strategy (GTS) defines policy priorities for each area of transport until 2050, yet no overarching 1.5ºC compatible vision for transport sector exists.
- ⇨ Although the growth in electric vehicle uptake is currently low with an expected share of less than 1% EVs in new car sales by 2020 and a 40-50% share by 2040, Strategic Pillar 8 of the GTS has committed to EV policy implementation to encourage growth (Department of Transport, 2017). Currently there are no incentives in place to stimulate an increased update of electric vehicles and promote the development of electrical charging infrastructure.
- ⇨ The Public Transport Strategy plans to integrate rail, taxi and bus services in cooperation with private operators, both operationally and through ownership. This will entail the construction of low carbon climate resilient (LCR) road infrastructure, including bus lanes, railways and non-motorised transport infrastructure (Department of Transport, 2017).
- ⇨ The Public Transport Strategy lists several key recommendations and policy initiatives to initiate a model shift in the freight transport sector, such as the potential introduction of road freight permits and several incentives to use rail modes of transportation (Department of Transport, 2017). High uncertainty remains whether and to which degree this intended model shift in freight transport and required infrastructure improvements can be realised in due time. Currently implemented policies and incentives clearly fall short to initiate the required transition to low-carbon freight transport sector by mid-century (Climate Action Tracker, 2018d).
- ⇨ Whilst the government generally emphasises its intention to support local industrial development and resources, currently EV charging infrastructure has been supplied by international equipment manufacturers (BMW South Africa, 2015; ESI Africa, 2019). The government has not yet introduced the manufacturing incentives envisioned in South Africa's *Electric Vehicle Industry Roadmap* to support local industrial development. Only a limited number of South African entrepreneurs have moved ahead with electric mobility innovations such as three-wheel, two-seater commuter car and a light electric utility vehicle (Snyman, 2017).

#		Sector	Policy rating
3		Building sector	Getting Started

- While green building and construction practices are identified as a priority in the country's Biennial Update Report, its National Development Plan, and with a series of policies targeting the building sector underway, considerable progress can be observed, but is not yet enough. Research expected that in 2018, the proportion of green buildings will climb from 2017's 41% to 61% of all South African building activity (World Green Building Council, 2016a). The demand for voluntary green certified new buildings is increasing due to cheaper operational costs and higher returns on investments compared to conventional buildings.
- These trends are mirrored in planned regulation which (tentatively) targets a 49% reduction in energy consumption per m2 in public buildings by 2030 compared to 2015 (Department of Energy, 2016). However, these strategic considerations are currently not anchored in national legislation. Most prominently, building standards are not expected to be tightened beyond current levels.
- The Green Building Council of South Africa (GBCSA) has been successful in promoting and increasing the uptake of voluntary green building certificates in the country (300 certified buildings since 2007, with own-reported energy savings equivalent to of 500 ktCO2/yr), mainly for commercial buildings (GBCSA, 2017). Energy performance certificates are currently only mandatory for government-owned buildings, which makes it more difficult to monitor progress and enforce green building regulation. There is a voluntary green building certificate scheme ("Edge") for the residential building sector, but with little uptake so far. In addition, the GBCSA has introduced a voluntary Net-Zero Pilot Certification Scheme which is also offering specialised training for building professionals to overcome the shortage of sufficiently skilled/ educated green professionals.
- The demand for retrofitting is still comparatively low, especially in the residential and commercial sector which collectively constitute well over 90% of South Africa's building sector. There are a few initiatives in the public sector as well some targeted small-scale projects in the growing publicly subsidised social housing segment which are dependent on international support (Krog, 2015).
- The main barriers for an increased rate of building renovations are the high upfront costs as well as high borrowing rates and long payback periods. Further limiting factors are the lack of capacity and technical expertise (World Green Building Council, 2016b). In the residential sector the split incentives between investors and tenants persist, although further facilitating ESCO activities and more stringent energy savings requirements planned under the draft post-2015 National Energy Efficiency Strategy could help overcome that challenge. Financial incentives/ support programmes for retrofitting are not accessible for all market players (Department of Energy, 2016).
- Nevertheless, the green retrofitting of existing buildings is expected to be the largest sector of the green building industry in South Africa within the next three years (World Green Building Council, 2016b). This is likely to be related to the persisting energy and water crisis and soaring energy prices.

#	Sector	Policy rating
4	Industry sector	

⇨ The absence of legally binding emissions reduction policies in the industry sector make it highly unlikely that newly installed manufacturing capacity coming online from 2020 onwards will be low carbon. Despite the manifold high-level strategic planning of the Post-2015 National Energy Efficiency Strategy (NEES), the South African government has not yet implemented any overarching binding regulations on emission and/or efficiency standards in fear of hampering volatile economic development.

⇨ No legislation has been adopted that makes the deployment of low-carbon technologies mandatory as of May 2019. Implemented voluntary programmes only led to marginal emission reduction. Despite an ambitious plan by the South African Centre for Carbon Capture & Storage in the 2000s for a CCS system to be running at capacity in South Africa by 2025, no commercial CCS deployment is technologically and financially feasible on a large scale in the nearby future.

⇨ The South Africa government has established some first support schemes to improve energy and resource use performance. Such energy efficiency programs implemented by the National Cleaner Production Centre South Africa (NPCP-SA) have triggered cumulative emission savings of 7.6 $MtCO_2e$ between 2010 and 2016 and have demonstrated pilot cases for efficiency improvements (NCPC-SA, 2017). However, the impact of these voluntary programs is almost negligible compared to total direct and indirect emissions and does not trigger the required sectoral transformation to be in line with the 1.5°C compatible benchmark. Therefore, the South African industry is likely to remain energy and resource intensive in the near future.

⇨ Regarding emission intensive subsectors such as steel production and mining, there are no indications for policy-driven emission reduction in the near future. Instead, the South African government has set up a package of policy measures to rescue the existing steel industry from the immediate threat of closure and to prevent an accompanying loss of capacity (Department of Trade and Industry of South Africa, 2017). For instance, total crude steel production in South Africa has been significantly declining from 9.1 Mt in 2007 to 6.1 Mt in 2016 mainly due to global overcapacities (Worldsteel, 2017).

#	Sector	Policy rating
5	Waste sector	

⇨ In 2010, the waste sector was the second largest contributor to methane emissions in the country. To counter this, the government launched the South African Research Chairs Initiative (SARChI) in Waste and Climate. The initiative aims to transform the sector while contributing to the country's socio-economic development. Around 65% of municipal organic waste, and nearly 100% of commercially exploitable biomass from agriculture and food processing is still disposed of on land, which leads to high GHG emissions and a lost opportunity for fuel. To counter this, the Director for Environmental Services and Technologies at the Department Science and Technology (DST) said there was a need for targeted research on appropriate mitigation technologies for South Africa (National Research Foundation, 2018).

- ⇨ The South African Local Government Association estimates that treatment work can reduce energy consumption by 5% through installing energy efficient motors and by a further 15% through installing variable speed drives (SALGA, 2014). This was followed in 2017 by the National Water Investment Framework, by the Department of Water and Sanitation, to plan the financial and technological needs to upgrade and roll out water access in South Africa.

3.2. Country case study #2: Indonesia

Case study: Indonesia

Rating by Climate Action Tracker (as of 12/2019)

Indonesia — HIGHLY INSUFFICIENT — ✖ NO PROGRESS

Highly insufficient*: Commitments with this rating fall outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach between 3°C and 4°C. More information on the Climate Action Tracker's rating system here.*

INDONESIA — Summary of pledges and targets (Climate Action Tracker)

PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	29% below BAU by 2030 incl. LULUCF [548% above 1990 by 2030 excl. LULUCF] [160% above 2010 by 2030 excl. LULUCF]
	2030 conditional target(s)	Up to 41% below BAU by 2030 incl. LULUCF [502% above 1990 by 2030 excl. LULUCF] [142% above 2010 by 2030 excl. LULUCF]
	Condition(s)	International support
	Coverage	Economy-wide, incl. LULUCF
	LULUCF	Included with significant contribution

Evaluation of status of sector transitions and related market opportunities

Authors: NewClimate Institute

#	Sector	Policy rating
1	Electricity and heat sector	

- Indonesia has a significant renewable electricity generation potential, which was demonstrated in a study by the Directorate General of New and Renewable Energy and Energy Conservation (EBTKE, 2016). However, in practice only hydropower and geothermal sources currently make a meaningful contribution to the power system.
- Hydropower constitutes the largest renewable energy source in Indonesia and is projected to double its participation in the power mix by 2026 from 6% in 2017. Indonesia also has an enormous geothermal potential which can be of value in providing baseload power to the grid. Geothermal power production is projected to increase from 15 TWh in 2017 to 50 TWh in 2027. The state-owned power company PLN has indicated that it will add 4.5 GW of geothermal capacity up to 2027, of which half will be tendered over the coming years. Indonesia has also been very slow in developing wind energy, with a first wind farm starting commercial operation in 2018 (PwC, 2018). In most regions, the costs of rooftop PV have dropped below the national average generation cost (IRENA, 2017a).

- Tax incentives for renewable energy are offered, through regulations such as Regulation No.21/PMK.011/2010 on Value-Added Tax and Import Duty Exemption for Renewable Energy Property, which exempts taxable goods imported to develop renewable energy projects from VAT and import duty. There is also a feed-in-tariff for geothermal, small hydropower, solar, bio-energy and waste-to-energy (IEA, 2010).
- In addition, the Indonesian government recently rolled out the Electricity Supply Business Plan 2018–2029 (RUPTL), which outlines future capacity expansion plans, demand and supply forecasts and fuel requirements. Under this plan, Indonesia would see a significant expansion of its coal-fired power fleet, with 27 GW of new coal capacity expected to be added before 2027. There are currently no signs that the government is planning to phase out coal capacity or reduce the currently planned pipeline (PwC, 2018).

#	Sector	Policy rating
2	Transport sector	Getting Started

- Ministerial Regulation No.12/2015 on the blending of biofuels is one of the most ambitious in the world, requiring companies holding a license to sell fuel to end users to achieve a 30% blending target by 2020. It is backed by a mandate to ensure the (partial) phase-out of internal combustion engines (ICCT, 2016). Biofuel could play a significant role in the transition to a low-carbon transport sector, but palm oil biofuel production is causing adverse effects as a driver for the expansion of plantations into primary forest in Indonesia. The Indonesian Sustainable Palm Oil (ISPO) program addresses aspects of greenhouse gas emissions (including methane capture), land use, biodiversity, and labour but the current regulation specifically exempts palm oil plantations supplying palm oil for biofuel production from ISPO compliance (ICCT, 2016).
- In early 2017, Industry Minister Airlangga Hartarto announced that the Indonesian Government is preparing a Low Carbon Emission Vehicle (LCEV) programme which incentivises hybrid vehicles through tax breaks (Suzuki, 2017). The Indonesian Ministry of Energy and Resources said in August 2017 that a ban on fossil-fuel vehicles would be introduced in the draft Presidential regulation of the LCEV programme for the year 2040 (Kumparan, 2017; Tinuku, 2017).
- The Ministry of Transportation developed the Sustainable Urban Transport Programme Indonesia (NAMA SUTRI) in 2012 (Ministry of Transportation, 2014). The programme is structured around two phases: piloting (2015-2019) and full-scale implementation (2020-2030). The key measures taken under the programme include public transport system improvement, investments in energy-efficient buses, investments in infrastructure and improved planning. Five pilot cities were selected and asked to develop demonstration projects for the improvement of public transport, mainly around Bus-Rapid Transit systems, and transport demand management. Indonesia is also developing a large long distance highspeed railway system between Jakarta and Bandung and a metro infrastructure in Jakarta, anticipating an increase in overall travel demand (The Jakarta Post, 2018).
- Consuming 23% of all transport fuels, two-wheelers are the most popular form of transport across Indonesia. About 1 million motor vehicles and 7.5 million motorcycles and scooters will be added each year to Indonesia's roads until 2030 (IRENA, 2017b). This trend will further exacerbate the already severe air pollution in urban centres. The National Energy

Plan envisages 184 million motorcycles on the road in 2030, of which 4 million should be electric motorcycles.

#		Sector	Policy rating
3		Building sector	Getting Started

- Indonesia currently introduces green building standards for commercial and public buildings in major cities, thus making some progress towards fossil free and near-zero buildings. Although emissions intensity per capita for buildings in Indonesia has increased from 0.3 tCO_2/capita in 2000 to 0.5 tCO_2/capita in 2015, this still remains below the 1 tCO_2/capita by 2020 required to be consistent with a 2ºC pathway (Wouters et al., 2016). Further policy efforts must ensure that emissions intensity per capita remains in line with the Paris Agreement temperature target over time.
- *Law No. 36/2005* and *Government Regulation No. 36/2005* make it mandatory for new buildings to account for energy conservation measures (with the exception of buildings smaller than 500 m^2). However, there have been difficulties with enforcing compliance. Subsequent revisions to the law stated that complex buildings (e.g., offices, industrial facilities and buildings consuming more than 6,000 tonnes of oil equivalent per year) must conduct energy management programs and activities, such as hiring an energy manager, conducting an energy audit and preparing energy conservation plans and reports (IPEEC, n.d.).
- The *National Energy Conservation Master Plan (RIKEN)*, developed by the National Energy Council, has an overall target of decreasing energy intensity of buildings by 1% per year until 2025. First introduced in 2005, it was amended in 2014 to update conservation potentials. The energy savings target for households and commercial buildings was set at 15% below business-as-usual by 2025, but also includes targets for transportation and industry. An additional goal of RIKEN is to achieve an energy elasticity of less than 1 by 2025, meaning that GDP should increase faster than energy consumption (IPEEC, 2019).
- The biggest electricity consumption in low-income households comes from refrigerators, whereas air conditioners are responsible for most electricity consumption in high-income households (Government of Indonesia, 2011). By 2025, the Indonesian government aims for all citizens to have electricity access, some of it provided by renewable energy sources. Furthermore, all government buildings should use the most energy efficient air conditioners and energy saving light bulbs (Indonesia State Ministry of Environment, 2007).

#		Sector	Policy rating
4		Industry sector	Getting Started

- Manufacturing accounted for 20% of Indonesia's GDP in 2017. The industry sector roadmap "Making Indonesia 4.0" was launched in April 2018. It includes an index to measure the productivity and competitiveness of domestic manufacturers, the Indonesia Industry 4.0 Readiness Index (INDI 4.0). If correctly implemented, the initiative could add nearly $121 billion to Indonesia's GDP by 2025 (Aisyah, 2019)
- Indonesia's cement and steel sectors have shown initiative to enhance material efficiency and decarbonise their production processes, where the *Regulation Concerning CO2 Emission Reductions in the Cement Industry* aims to reduce the emissions intensity of cement production. However, conflicting signals are being given simultaneously, since the Government recently established a domestic market obligation (DMO) to prioritize coal supply for, among others, cement producers (ADB, 2016; IEA, 2012).
- Energy efficiency in industry policies are on the right track but there is still some way to go in implementation and roll out of measures as in 2015 the emissions intensity is 0.13 tCO_2/thousand US$2012 sectoral GDP which, although below the 2006 high of 0.18 tCO_2/thousand US$2012, represents two years of increase since 2013 (Climate Transparency, 2017).

#	Sector	Policy rating
5	Waste sector	Getting Started

- In Indonesia, the waste sector contributes around 11% of total national GHG emissions. There are around 400 landfills and most are open dump, and under **GR no. 81/2012** local governments are mandated to change the open dumping system to sanitary landfills or controlled landfills, with a target of developing or converting 240 landfill sites by 2014 (Damanhuri, 2017; Ministry of Environment, 2010; Republic of Indonesia, 2010).
- There are a few small-scale waste incinerators operating in Indonesia, with capacities between 100 and 200 kg/hour, a small number given the total volume of waste. To push forward waste management policies, **Presidential Decree No. 18/2016** appointed seven cities (Jakarta, Surabaya, Bandung, Semarang, Makassar, Tangerang, Solo) to participate in the development of Waste to Energy in 2018 (Damanhuri, 2017).
- The Indonesian Government has committed to solving the country's waste issue, which includes a commitment to reduce marine waste by 70% by 2025. Indonesia produces 3.2 million tons of plastic waste a year, of which 1.3 million tons end up in rivers and oceans. As part of an effort to combat the waste issue, Indonesia plans to build central dumpsites in Java regions with a USD 100 million loan. In the cities, the Indonesian government has worked to develop Advanced Solid Waste Management Systems, and through this more recyclable material will be diverted from landfill and put back into the production cycle. Organic waste will be treated to reduce greenhouse gas emissions (Cekindo, n.d.).

3.4. Country case study #3: Argentina

Case study: Argentina

Rating by Climate Action Tracker (as of 12/2019)

***Highly insufficient**: Commitments with this rating fall outside the fair share range and are not at all consistent with holding warming to below 2°C let alone with the Paris Agreement's stronger 1.5°C limit. If all government targets were in this range, warming would reach between 3°C and 4°C. More information on the Climate Action Tracker's rating system here.*

ARGENTINA — Summary of pledges and targets — Climate Action Tracker

PARIS AGREEMENT	Ratified	Yes
	2030 unconditional target(s)	483 MtCO2e by 2030 [422 MtCO2e by 2030 excl. LULUCF] [80% above 1990 levels by 2030, excl. LULUCF] [35% above 2010 levels by 2030, excl. LULUCF]
	2030 conditional target(s)	369 MtCO2e by 2030 [322 MtCO2e by 2030 excl. LULUCF] [38% above 1990 levels by 2030, excl. LULUCF] [3% above 2010 levels by 2030, excl. LULUCF]
	Condition(s)	International finance, support in transferring; innovating and developing technologies; and capacity building for an effective implementation.
	Coverage	Economy-wide, incl. LULUCF
	LULUCF	Unknown

Evaluation of status of sector transitions and related market opportunities

Authors: NewClimate Institute

#	Sector	Policy rating
1	Electricity and heat sector	

- ⇨ Share of electricity generation from low-carbon technologies projected to decrease from 35% in 2017 to 32% in 2030 under current policy projections (CAT, 2018). However, as a result of *Law 27.191*, wind power installed capacity increased from 28 MW in 2007 to 257 MW in 2017 (IRENA, 2018). *Law 27.191* also sets a target of 8% renewable share in national electricity consumption by the end of 2017 and a 20% share by the end of 2025, but in 2017 renewable power generation represented just 2% of total consumption.
- ⇨ In May 2019, Argentina awarded permits for hydrocarbon exploration in 18 different locations in the south of the country, to companies such as Exxon Mobil Corp, Total SA, and Roya Dutch Shell. (Bianchi, 2019). This follows from the Government's announcement in March 2019 to build new pipeline and transport projects, with the announcement of pipeline construction contracts valued at up to $1.8 billion (Parraga, 2019).In September 2018 the Energy Secretariat in

Argentina published the first version of an agreement detailing the construction, operation and maintenance of “Extra High Voltage Line at 500 kV ET Rio Diamente – Nueva E.T.” and “Transformer Stations and related works at 132 kV. The infrastructure project will contribute to the supply for an area of Argentina with high demand for electricity but structural weaknesses in the network which are hampering regional development (La República Argentina, 2018).

⇨ The conception and development of CCS to power plants as a low-carbon technology is currently in an incipient stage. Argentina has not advanced in the outline of a regulatory framework or a defined roadmap that addresses the main challenges and sets the basis for developing this technology. However, some studies aim at assessing the potentials and main challenges of CCS for the Argentinean case considering power plants with geological potential in Argentina, such as those around the Neuquén basin. The estimations suggest that the variable costs to generate electricity from natural gas linked to CSS increase by 10–50 USD/MWh (Dublo, 2015).

#	Sector	Policy rating
2	Transport sector	

⇨ The Secretariat of Energy assumes an uptake in EV sales from currently 0% by 2018 to 3% by 2025, 12% by 2030 and 50% by 2050 in their 2030 energy scenarios. This increase in sales is reflected in an increased share of EV in the total car fleet of 0.3% in 2025 and 1.5% in 2030, despite no actual policies being implemented to incentivise their uptake (MINEM, 2017). A total of 220 chargers are expected to be installed at fuel stations by 2019 (Energia Estrategica, 2017).

⇨ Substantial growth in biofuels reflected in upwards update of blending mandates in fuels, supported by subsidies to farmers and exemption from new fuel taxes (Ministerio de Ambiente y Desarrollo Sustentable, 2017).

⇨ At the city level, the administration of Buenos Aires launched a Clean Mobility Plan that involves several pilot projects using electric taxis and buses for public transportation (Ministry of Transport Argentina, 2018). The actions in the mobility plan aim to convert around 30% of the buses and 35% of the taxi fleet to electricity by 2035 (Ministry of Environment and Sustainable Development, 2017). Based on current proportions, this represents roughly 10% of buses and 30% of the taxi fleet at national level.

#	Sector	Policy rating
3	Building sector	

⇨ Government declared rational and efficient use of energy as a national interest under *Decree 140/2007*,and created the *National Programme for a Rational and Efficient Use of Energy (PRONUREE)*. The objective of PRONUREE is to set a framework for efficient use of energy across sectors, including production, buildings, transport. Particularly for buildings, the decree introduces an Energy Efficiency Programme in Public Buildings, which defines specific actions, regulations and codes to be implemented in public buildings at the national level. The PRONUREE programme also comprises voluntary energy labelling for buildings, an initiative to classify and categorise residential buildings based on their energy consumption (Ministerio de Energía y Minería, 2018).

⇨ The *Sustainable Housing Manual* provides guidelines and technical documentation to support the construction and sustainable use of housing buildings and neighbourhoods developed within the framework of the National Housing Plan (MIOPV, MSAyDS, & Secretaria de Energia, 2019). The manual includes a labelling scheme for self-evaluation that serves as reference to identify sustainable indicators that will be used to evaluate the projects financed or co-financed by the Secretariat of Housing within the framework of the National Housing Plan. The plan includes the promotion of sustainable social housing, access to loans (PROCREAR) and the establishment of Public-Private Partnerships PPP.

- ⇨ Under Law 26.473, the Argentinean government has banned the import and commercialisation of incandescent lamps for residential use since 2011. The objective is to achieve 100% of residential lighting with LED technology by 2030 (MAyDS & MINEM, 2017). Resolution 84-E/2017 established an Efficient Public Lighting Plan (PLAE) that replace bulbs in public lighting with more efficient technologies (i.e. LED). It is estimated that this measure could lead to a 50% savings with respect to the current consumption.

#	Sector		Policy rating
4		Industry sector	

- ⇨ As of May 2019, Argentina is developing a strategy and supporting policies in the industry sector to strengthen its position on climate change commitments (SAyDS & Ministerio de Produccion y Trabajo, 2019). However, Argentina is unlikely to meet the benchmark that all manufacturing capacity installed from 2020 onwards to be low-carbon due to the lack of binding policies that impose energy efficiency in the industry sector. Energy efficiency measures in the industry sector is limited to voluntary private sector initiatives and funding from the government to deploy more efficient technologies and processes, and there are no minimum efficiency requirements in the industry sector that guide new installations to be low carbon after 2020.
- ⇨ In order to encourage small electricity users to produce their own energy from renewable resources, the government passed Law 27.424 which allows consumers to generate electricity with renewable sources and sell electricity not consumed to the grid. The Law is applicable to all small consumers, including small-scale industries.
- ⇨ While subsidies on electricity consumption have significantly decreased over the past few years for all small and medium-sized consumers (since the government declared a state of emergency in 2015), the government granted new subsidies to large-scale users in 2017. The Joint Resolution 1-E/2017 put forward by the Ministries of Energy and Industry grants certain large electricity users in energy-intensive industries a discount of up to 20% on electricity prices for a consumption of up to 15 GWh. The discount will be valid until the end of 2019 (Ministry of Energy and Mining, Ministry of Industry, 2017). According to Provision 3/2018, companies that benefit from reduced electricity prices under Resolution 1-E/2017 will have to implement the ISO norm 50001 on energy management systems.
- ⇨ Some minor support programmes exist to encourage energy efficiency in small and medium companies, including the *Argentinean Fund for Energy Efficiency (FAEE)*, which provides funds to small and medium-size enterprises to perform energy audits and acquire more efficient technologies. The fund is currently under restructuring (MINEM, 2018).

#	Sector	Policy rating

5		Waste sector	

- Whilst Argentina has a laudable 99.8% trash collection rate, 35.5% of solid waste is disposed of inadequately, often in open dumpsites. Even in urban centres, where trash is disposed of in landfills, the landfills are in need of significant investment, including in emissions management systems (Netwall, Troch, Cohen, & Rihm, 2014). Overall, Municipal Solid Waste (MSW) disposal methods (landfills and controlled dumps) cover 75% of the population in Argentina (Hettiarachchi, Ryu, Caucci, & Silva, 2018).
- As part of the *Globally Harmonized System*, mandatory in the workplace since 2015, an inter-ministerial working group on Chemicals Management was created with the aim to develop a draft proposal for the first National Chemicals Law. This would give government the tools to evaluate and manage risks of chemical use in Argentina, including their disposal (UN Environment, 2019)
- To reduce food waste along the food value chain, the Ministry of Agro-Industry is calling upon partners to subscribe to a Commitment Letter to join the National Program to Reduce Food Loss and Waste. Currently there are 60 Commitment Leaders from public and private sector, NGOs, and the scientific and technology community. The initiative includes a best practice guide for Argentinian cities, including technological steps to be taken to reduce waste (One Planet, 2017).

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