

The G20 states

Selected official energy and climate targets:
Renewable Energy, Energy Efficiency and GHG (CO₂) emissions



Topical Paper 1

GJETC

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G20 – Targets referring to renewable energy, energy efficiency and climate change mitigation

Concretely defined targets are guiding policy efforts and the measures required to achieve national energy and low-carbon transformations in order to reach the maximum 2 degree climate change mitigation target agreed at the COP in Paris in 2015. Reducing energy consumption by harnessing the potential of energy efficiency, expanding the use of renewable energy resources, and transforming all sectors into low-energy and low-carbon structures is crucial. Among the G20 states, most states have set targets for renewable energies, energy efficiency, and greenhouse gas (GHG) emission reductions. Yet, it seems that starting points and target units differ a lot between the G20, and hence comparability is difficult. This topical paper presents a synopsis on the current targets within the G20. The relative lack of energy efficiency targets shows that this pillar needs much greater efforts in current and future energy policy.

1. Mitigating climate change and achieving the energy transition – three common pillars

This topical paper provides an overview of selected current official energy transition and climate change mitigation targets in the G20 states. These targets concern renewable energy resources, energy efficiency, and GHG or CO₂ emissions, which are the most commonly adopted types of targets among the G20 states. They could provide inspiration for Germany and Japan for setting their energy transition and climate change mitigation targets. There may be other types of targets, e.g. on energy import dependency, which is related to energy security. However, they are much less common and so we refrain from displaying these.

A good source for data on existing and potential targets is also the Deep Decarbonization Pathways Project (DDPP). In the DDPP, researchers from 16 countries address the transition into a low-carbon economy in a way consistent with the internationally agreed goal of limiting anthropogenic warming to less than 2 degrees Celsius.

INFO BOX: Deep Decarbonization Pathways Project (DDPP)

The Deep Decarbonization Pathways Project is a global consortium formed in October 2013 which researches methods to limit the rise of global temperature due to global warming to 2 °C or less. The focus of the DDPP is on sustainable energy systems. Other sectors of the economy, such as agriculture and land-use, are not directly considered. It aims to find practical pathways to deep greenhouse gas emissions reductions using country-based energy research. Japan and Germany are included as case studies. The DDPP is set in Paris, France. www.deepdecarbonization.org

2. What are the targets for renewable energy sources, energy efficiency, and GHG (CO₂) emissions in the G20?

2.1 Expanding the use of renewable energy sources (RES)

The G20 states defined various targets for the expansion of renewable energy resources. However, up to now the approaches between the G20 states differ with regard to reference units, time scale, and level of ambition.

Different approaches can already be seen among the states and regions with the highest CO₂ emissions:

- China, as the state with the world's largest CO₂ emissions (see figure 1 below), has one overall target for renewable energy: By 2020, about 15% of the total energy supply are supposed to be based on non-fossil sources. In addition, China focuses on capacity expansion targets of renewable energy resources. Hydroelectricity (350 GW_e) and Wind power (onshore 200 GW_e) are supposed to have the biggest shares. Solar PV follows with 100 GW_e and biomass power with 30 GW_e. China also defines pumped hydro goals of 70 GW_e.
- It is remarkable that the United States have not set any binding target concerning the shares of renewable energy sources in the energy sector.
- The EU, as the third biggest emitter of Greenhouse gases, pursues an ambitious roadmap with long-term targets. Until 2020, 20% of gross final energy consumption is to be based on renewable energies. Until 2030, this share shall rise to 27% according to the Council of the member states. The European Parliament advocates higher targets for 2030. By 2050, renewable energies shall tentatively reach 75% of gross final energy consumption, while the renewable energy share in electricity consumption shall reach 97% in 2050, according to a proposal by the European Commission.
- Germany has target shares for renewable energies in both, overall gross final energy consumption corresponding to the EU's targets (18% for 2020, 30% for 2030, and 60% for 2050) and for gross electricity consumption (at least 35% by 2020; at least 50% by 2030; at least 80% by 2050).
- Even though France, the UK, and Italy have not defined further long-term targets after 2030, their renewable energy target shares in electricity generation and gross final energy consumption until 2020 and 2030 show relatively ambitious target levels with shares of higher than 30% (see Table 2.1).
- In comparison, Japan and South Korea set rather moderate targets and define no long-term targets either. Concerning primary energy Japan plans to reach a 13-14% share in 2030. In electricity production, Japan wants to reach 22-24% in 2030. It is worth mentioning, that Japan already achieved a share of 17,9 % in electricity production in 2015.

- South Korea set a renewable energy target share of 6,1% in primary energy consumption for 2020 and 11% for 2030.

Table 2.1 Energy transition and climate change mitigation targets of selected G20 states: Renewable Energy Sources (RES)

Country	Target unit	Share of RES in 2015	Target shares of renewable energy sources (RES)		
			2020	2030	2050
China	Total Energy Supply	n.a.	15% ¹⁾	20% ¹⁾	*
	Electricity production	24.7%	*	*	*
United States	Electricity production	13.8%	*	*	*
EU-28	Gross final energy consumption	n.a.	20%	27%	75%
	Electricity consumption	n.a.	*	*	97%
	Electricity production	34.2%	*	*	*
Germany	Gross final energy consumption	14.9	18%	30%	60%
	Gross electricity consumption	31.6%	at least 35%	at least 50% EEG 2025: 40-45%	80% EEG 2035: 55-60%
Japan	Primary energy	n.a.	*	13-14%	*
	Electricity production	17.9%	*	22-24%	*
France	Gross final energy	n.a.	23%	32%	*
	Electricity production	16.5%	27%	*	*
UK	Gross final energy consumption	n.a.	15%	30-45% *	*
	Electricity production	26.3%	*	*	*
Italy	Gross final energy consumption	n.a.	19-20% ²⁾	*	60% ²⁾
	Electricity production	38.4%	26%	*	*
South Korea	Primary Energy	n.a.	6.1%	11%	*
	Electricity production	2.1%	*	*	*

Please find literature on data in the attached references

n.a.): data not available

*) : official target is not known by the authors

¹⁾: Share of non-fossil fuels; In addition, China focuses on capacity expansion targets until 2020: Hydroelectricity (350 GW_e), Wind power (onshore 200 GW_e, offshore 30 GW_e), solar PV 100 GW_e, biomass power 30 GW_e, pumped hydro 70 GW_e.

²⁾: Italy's National Energy Strategy: For a more competitive and sustainable energy (2013)

For other G20 states, see attachment table

2.2 Increasing energy efficiency (EE)

In combination with renewable energy, the deployment of energy efficiency measures is necessary to achieve an energy transition and to mitigate GHG emissions. The IEA even talks of “Efficiency First” and expects 50% of global CO₂ emissions reduction to be realized by end

*Table 2.2: Energy transition and climate change mitigation targets of selected G20 states:
Energy Efficiency (EE)*

Country	Target unit	Reduction target for EE			
		2015	2020	2030	2050
China	Primary energy intensity	16% compared to 2011	16% compared to 2016	*	*
United States	Residential building sector	*	*	30% compared to BAU ⁴	*
	Commercial building sector	*	*	35% compared to BAU ⁴	*
EU-28	Primary energy consumption	*	20% energy savings compared to reference scenario	27% energy savings compared to reference scenario	41% compared to 2005-2006
Germany	Primary energy consumption	*	20% compared to 2008	*	50% compared to 2008
	Building sector	*	20% useful heat compared to 2008	*	80% primary energy compared to 2008
	Gross electricity consumption	*	10% compared to 2008	*	25 % compared to 2008
Japan	Final energy consumption	*	*	13% compared to 2013	*
	Electricity consumption	*	*	17% compared to 2013	*
France	Final energy consumption	*	17% compared to baseline level	*	50% compared to 2015
UK	Energy demand per capita	*	*	*	31% compared to 1990 and 54% compared to 2007
Italy	Primary consumption	*	24% compared to 2010	*	17-26% compared to 2010
South Korea	Energy intensity	*	*	46% compared to 2007	*

Please find literature on data in the attached references

*) official target is not known by the authors

⁴) BAU: Business as usual scenario

For other G20 states, see attachment table

use energy efficiency. Table 2.2 shows that energy efficiency targets in the G20 states also vary strongly and they rather focus at single time frames and in a long-term perspective.

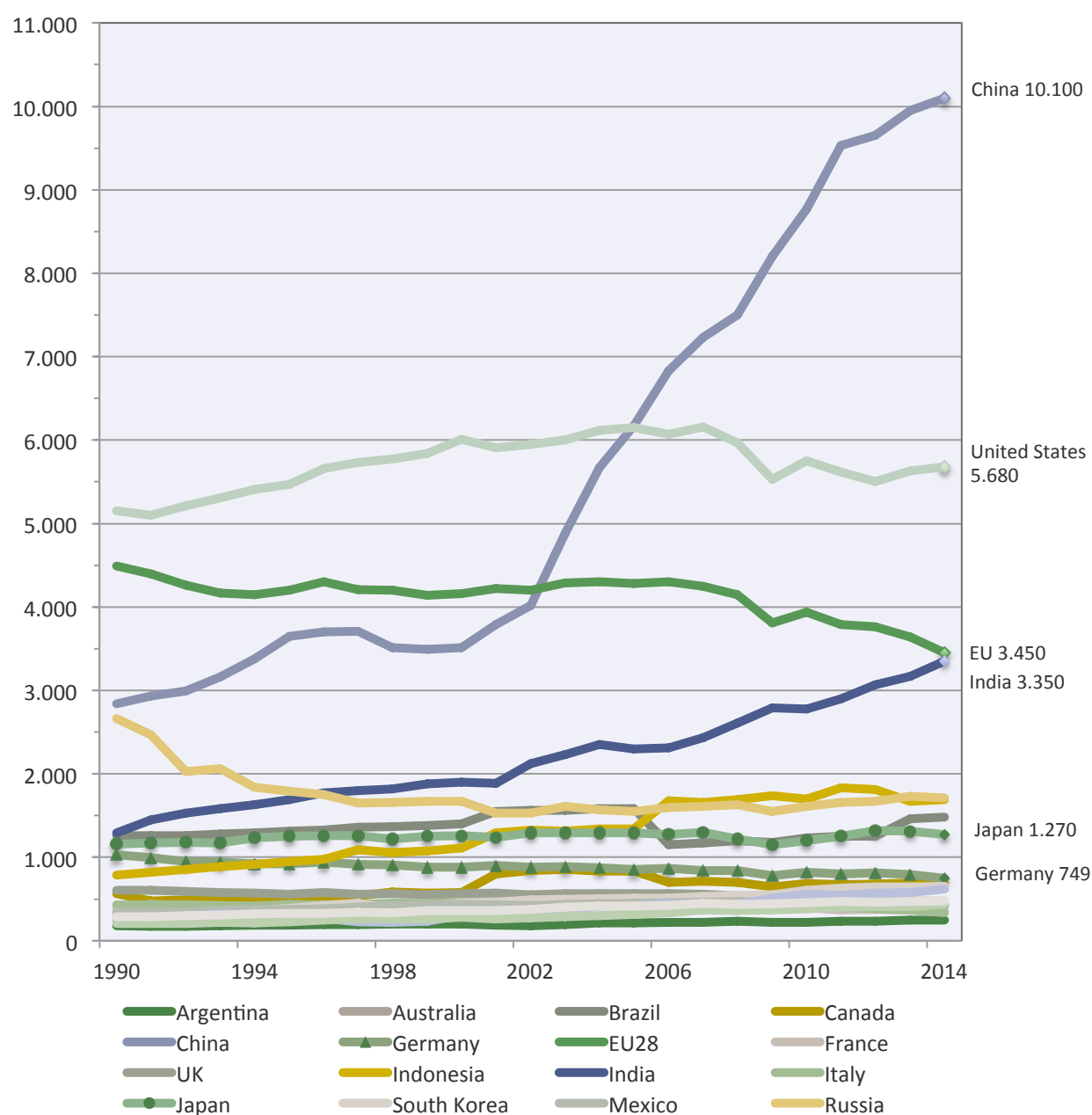
- China reiterated the target of 16% reduction in the primary energy intensity by 2015 compared to 2011 levels, as written in the 12th Five-Year-Plan, for the 13th Five-Year-Plan and the target year 2020 as compared to 2016.

- The United States differentiate the residential building sector and the commercial building sector and set a relatively ambitious savings target of 30% and 35% relative to BAU, all targets referring to 2030.
- The member states of the European Union address the primary energy consumption in the years 2020 and 2030. They intend to achieve an energy saving of at least 20% for 2020 and 27% for 2030, compared to the respective values of the reference scenario from 2007. However, the European Parliament repeatedly supported a target of 40% by 2030 compared to that reference scenario. By 2050, the European Commission proposed that energy demand in the EU should be decreased by 41% compared to the peaks in 2005-2006.
- Germany has defined multiple goals towards energy efficiency. They include a 20% reduction in primary energy consumption by 2020 and a 50% reduction by 2050, both compared to 2008. By 2050, Germany also wants to reach a reduction of 80% compared to 2008 within the primary energy consumption in the building sector. In addition, there are targets to reduce final energy consumption for the transport sector by 10% until 2020 and by 40% until 2050, and targets for reducing the gross electricity consumption by 10% until 2020 and by 25% until 2050. Besides energy consumption targets, the final energy productivity shall be improved by 2.1% per year on average from 2008 to 2050.
- Japan defines a reduction target of 13% in the final energy consumption and 17% in the electricity consumption for 2030 compared to 2013.
- South Korea refers to 2007 and aims at a reduction of 46% in the energy intensity by 2030.

2.3 Reducing GHG emissions

Since 1990, the OECD countries among the G20 did not see large changes in the GHG emissions (Figure 1). Some managed to reduce these emissions by at most 25 %, others still had increases in that range. By contrast, China and India with their tremendous economic growth also increased their GHG emissions a lot. As a consequence, all G20 states need to scale up their efforts for GHG emission reductions significantly.

Figure 1: CO₂ emissions from fuel combustion in the G20 states 1990-2014 (in Mt)



Gütschow, Johannes; Jeffery, Louise; Gieseke, Robert; Gebel, Ronja; Stevens, David; Krapp, Mario; Rocha, Marcia (2016): The PRIMAP-hist national historical emissions time series (1850-2014). GFZ Data Services. <http://doi.org/10.5880/PIK.2016.003>

Table 2.3: Energy Transition and climate change mitigation targets of selected G20 states: GHG (CO₂) emissions

Country	CO ₂ emissions from fuel combustion: Increase from 1990 to 2014		Target unit	Emission reduction target			
	in Mt	in %		2020	2025	2030	2050
China	+7.260	+255.6%	Carbon intensity of GDP	40-45% compared to 2005	*	60-65% compared to 2005	*
			CO ₂ emissions	*	*	Peak CO ₂ emissions	*
United States	+530	+10.3%	CO ₂ emissions	*	*	*	80% below 2005
			Net GHG emissions	*	26-28% compared to 2005	*	80% below 1990 incl. LULUCF
EU-28	-1.040	-23.2%	GHG emissions	20% compared to 1990	*	40% compared to 1990	80-95 % compared to 1990
Germany	-281	-27.3%	GHG emissions	40% compared to 1990	*	55% compared to 1990	80-95% compared to 1990
Japan	+110	+9.5%	GHG emissions	*	*	26% compared to 2013	*
			CO ₂ emissions	*	*	21.9% compared to 2013	*
France	-73	-17.8%	GHG emissions	*	*	40% compared to 1990	*
			CO ₂ emissions	*	*	*	75% compared to 1990
UK	-185	-30.7%	GHG emissions	*	*	40% compared to 1990	80% compared to 1990
Italy	-85	-19.9%	GHG emissions	13% compared to 2005	*	40% compared to 1990	80% compared to 1990
South Korea	+393	+153.5%	GHG emissions	*	*	37% reduction below BAU	*

Please find literature on data in the attached references

*) official target is not known by the authors

For other G20 states, see attachment table

Table 2.3 shows that indeed all countries analyzed in this paper agree to minimize CO₂ emissions in the long term in order to mitigate climate change in the future. For the first time after COP 21 in France, all UNFCCC member states agreed to the determined ambitious goals.

- China submitted its Intended Nationally Determined Contribution (INDC) in 2015, which includes the target to peak CO₂ emissions by 2030 at the latest and to lower the carbon intensity of GDP by 40-45% below 2005 levels in 2020 and by 60% to 65% by 2030.
- The U.S. government set a long-term target to reduce its net GHG emissions (CO₂e) by 80% below the 1990 level by the year 2050.
- The European Union has announced a 40% cut in greenhouse gas emissions compared to 1990 levels by 2030, following 20% for 2020, and also committed to reducing greenhouse gas emissions to 80-95% below 1990 levels by 2050.
- Germany aims to reduce its GHG emissions by 40% in 2020 compared to 1990 levels. In 2030, the reduction shall reach 55% and in 2050, 80-95% compared to 1990.
- Italy, too, sets a target for 2020 and plans to reduce its GHG emissions by 13% compared to 2005 levels. Different from Germany, France, the UK and Italy aim to reduce their GHG emissions by only 40% in 2030 compared to 1990 levels. The UK and Italy also further determined to reduce the emissions by 80% until 2050.
- Japan, similar to South Korea, defined targets so far merely for the year 2030. Japan aims at a 26% reduction compared to 2013, South Korea at a reduction of 37% below BAU levels.

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4. Appendix: Selected targets for the other G20 states

Table 4.1: Energy transition and climate change mitigation targets in the other G20 states:
Renewable Energy Sources (RES)

Country		Target unit	Share of RES in 2015	Target shares of renewable energy sources (RES)				
				2020	2025	2030	2035	2050
OECD states	Canada	Electricity production	62.7%	*	*	*	*	*
	Australia	Electricity production	15.2%	*	*	*	*	*
		Capacity target	n.a.	Large-scale renewable power plants: 33 TWH	*	*	*	*
	Mexico	Power generation	n.a.	*	less than 64% of fossil fuels (2024)	*	less than 60% of fossil fuels	less than 50% of fossil fuels
		Electricity production	14.9%	*	*	*	*	*
	Turkey	Electricity production	n.a.	*	*	10 GW solar; 16 GW wind	*	*
Non-OECD states	Brazil	Total energy mix	n.a.	*	*	45%	*	*
		Electricity production	73.5%	*	*	*	*	*
	Russia	Electricity production	16.3%	4.5% (excluding hydro power)	*	*	*	*
	India	Capacity target	n.a.	100 GW of solar, 60 GW of wind, 10 GW of bioenergy 5 GW of small hydro (2022)	*	*	*	*
		Electricity production	14.1%	*	*	40% non-fossil based power	*	*
	Indonesia	Primary energy supply	n.a.	*	23% excluding use of biomass	*	*	*
		Electricity production	11.1%	*	*	*	*	*
	Saudi Arabia	Electricity production	0.0%	*	*	23-30% (2032)	*	*
	Argentina	Electricity production	24.8%	*	*	30 MW of solar power, 43 MW of wind power	*	*
	South Africa	Capacity target	n.a.	*	*	11.4 GW	*	*
		Electricity production	3.3%	*	*	*	*	*

Please find literature on data in the attached references

n.a.): data not available *) official target is not known by the authors

*Table 4.2: Energy transition and climate change mitigation targets in the other G20 states:
Energy Efficiency (EE)*

	Country	Target unit	Reduction target for EE				
			2015	2020	2025	2030	2050
OECD states	Canada	*	*	*	*	*	*
	Australia	Energy productivity	*	*	*	40% compared to 2010	*
	Mexiko	*	*	*	*	*	*
	Turkey	*	*	*	*	*	*
Non- OECD states	Brazil	Electricity consumption	*	*	*	10% (107 TWH)	*
	Russia	Energy intensity	*	40% compared to 2007	*	56% compared to 2005	*
	India	*	*	*	*	*	*
	Indonesia	Energy saving	*	*	15-30% industrial sector, 25% commercial buildings, 10-30% household sector compared to 2005	*	*
	Saudi Arabia	*	*	*	*	*	*
	Argentina	*	*	*	*	*	*
	South Africa	*	*	*	*	*	*

Please find literature on data in the attached references

*) : official target is not known by the authors

*Table 4.3: Energy Transition and climate change mitigation targets in the other G20 states:
GHG (CO₂) emissions*

State		CO ₂ emissions from fuel combustion: Increase from 1990 to 2014		Target unit	Emission reduction target			
		in Mt	in %		2020	2025	2030	2050
OECD states	Canada	135	24.1%	CO ₂ emissions	*	*	*	80% compared to 2005
				GHG emissions	*	*	30% compared to 2005 excl. LULUCF	*
	Australia	136	46.0%	GHG emissions	*	*	26-28% compared to 200 incl. LULUCF	*
	Mexico	125	35.7%	CO ₂ emissions	*	*	*	50% compared to 2005
				GHG emissions	*	*	22% unconditionally, 36% conditionally below baseline	*
	Turkey	228	111.2%	GHG emissions	*	*	21% compared to BAU	*
Non-OECD states	Brazil	220	17.5%	GHG emissions	*	*	43% below 2005 levels incl LULUCF	*
	Russia	(-)950	(-)35.7%	GHG emissions	*	*	25% to 30% below 1990	*
	India	2,06	159.7%	Emissions intensity of GDP	*	*	33% to 35% below 2005	*
	Indonesia	906	115.6%	GHG emissions	*	*	29% unconditionally, 41% conditionally compared to BAU incl. LULUCF	*
	Saudi Arabia	396	176.0%	GHG emissions	*	*	130 MtCO ₂ e avoided annually until 2030	*
	Argentina	65	36.3%	GHG emissions	*	*	15% unconditional, 30% conditional below BAU	*
	South Africa	190	66.4%	GHG emissions	*	Peak GHG emissions 398 and 641 MtCO ₂ e incl. LULUCF		*

Please find literature on data in the attached references

*) official target is not known by the authors