SIII-1a

Turnaround in Energy Policy –

Measures to Reduce the Carbon Dioxide Emission from the Private Sector

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Abstract

The greenhouse gases (GHG) carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) are considered mainly to be responsible for the additional anthropogenic greenhouse effect, the so-called “global warming”. In the private sector, the “Rational Use of Energy” can be a very effective tool (i) to reduce the greenhouse gas emissions, (ii) to decrease the annual energy costs and furthermore (iii) it prepares the integration of Renewable Energy Sources by saving conventional, mostly fossil energy.

Aim of this paper is (i) to show that by applying energy saving measures, the primary energy demand and thus the individual (direct) carbon dioxide emission can be reduced in a relevant scale. (ii) It is to give laterally information about (ii.i) the energy market structure and (ii.ii) the legal backgrounds in the EU.

1 Introduction

The greenhouse gases (GHG) carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) are considered mainly to be responsible for the additional anthropogenic greenhouse effect, the so-called “global warming”. According to the former US Vice-President Al Gore, the scientific community consents that the global warming mainly derived from burning fossil fuels since more than 250 years. Thus, after Kyoto Protocol in 1997 and Paris Agreement in 2015, the policy of the European Community aimed and still aims at reducing the CO₂ emissions drastically. Since 1990, Germany was able to reduce the CO₂ emissions contemporary (Table 1) [1]. Respecting the energy statistics and opinions of experts, in several European member states such as Germany as well as in countries associated to the EU the greenhouse gas emissions could be reduced by means of

1. increasing the energy efficiency (Rational Use of Energy, RUE) by
 - a. applying more energy conservation and
 - b. expanding the field of cogeneration (Combined Heat and Power, CHP), and finally
2. implementing sustainable energy technologies (Renewable Energy Sources, RES).

For instance, viewing to Germany the total primary energy consumption (PEC, TPES) amounted to 13,262 PJ_{PE} (= 3,684 TWh_{PE}) per year in 2015 [1]. With a population of 81.7 million capita this was same as yearly 45.09 MWh_{PE} per person. Around 40% of this PEC

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is allocated to buildings. Furthermore, according to own calculations in Germany more than 1/3 of the primary energy consumption derives from the private building sector including the individual traffic. Totally, each German citizen causes nearly 11 tons of greenhouse gas emission (CO₂ equivalents without amendments) per year. Thus, up to 40% of it is coming from accommodation plus individual transport.

Table 1: Greenhouse gas emissions in Germany between 1990 and 2017 compared to the reference* (base value of the Kyoto Protocol) [1].

	Reference*	1990	1995	2000	2005	2010	2015	2017
Greenhouse gas	in million tons of CO ₂ equivalents							
CO ₂ equivalents	1,223	1,220	1,090	1,007	981	926	893	891
CO ₂ equivalents**	1,255	1,251	1,123	1,045	993	943	907	907
CO ₂	1,020	1,020	905	861	853	814	780	781
CO ₂ **	1,053	1,053	940	900	867	832	796	798
CH ₄ ***	121	121	106	89	69	59	57	55
N ₂ O***	64	64	61	43	43	36	39	38
HFCs	9	6	9	8	10	11	12	11
PFCs	2	3	2	1	1	0	0	0
SF ₆	6	4	6	4	3	3	4	4

*: Reference (100%, base value) of the Kyoto Protocol related to 1990 or 1995, respectively (dependent to GHG)

**: Without amendment of land use and forestry

***: Without amendment of land use

Note: CO₂ = carbon dioxide; CH₄ = methane; N₂O = nitrous oxide (laughing gas); HFC = hydrofluorcarbon;

PFC = perfluorcarbon; SF₆ = sulphur hexafluoride

2 Legal Background by the EU

To reach the CO₂ reduction goals of the Kyoto Protocol and later of the Paris Agreement, the European Community issued several directives in order to be converted by the member states within a fixed period into national laws and/or ordinances. For instance, in terms of limiting the heat demand of buildings and to improve the energy efficiency, the EC issued

- in 2002 the
 - “Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings (EPBD)” in order to reduce the emissions derived from buildings and to implement the so-called “energy performance certificate (for buildings)” [2],
- in 2010 the
 - “Directive 2010/31/EU EC of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings” in order to implement the new EPBD (recast) [3],

- in 2012 the
 - “Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (Energy Efficiency Directive, EED), amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance” in order to improve energy efficiency actions [4], furthermore
- in 2018 the
 - “Directive (EU) 2018/855 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance)” [5],
- and several more.

These legal acts are to turn the political stagnation due to the greenhouse gas emission into action. Thus, in Article 7 of Directive (EU) 2018/855, European Union points out:

“The 2015 Paris Agreement on climate change following the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21) boosts the Union’s efforts to decarbonize its building stock. Taking into account that almost 50% of Union’s final energy consumption is used for heating and cooling, of which 80% is used in buildings, the achievement of the Union’s energy and climate goals is linked to the Union’s efforts to renovate its building stock by giving priority to energy efficiency, making use of the ‘energy efficiency first’ principle as well as considering deployment of renewables.”

3 Action Plans to Strengthen the CO₂ Emission Savings from Buildings

However, the spirit of all of those issued EC directives is the “holistic approach” which means: whatever we do, whatever we use – the entire sum of all of our individual emissions derives from the sum of all of our activities. Thus, if we do not heat-up our homes but drive our cars, it will affect the climate in the same matter. The climate does not care for the source – as long it is not sustainable – but it cares for the amount of the greenhouse gas emissions.

The EU’s energy policy reflects that: for instance, in 2006 and 2010 the European Union issued the “Energy Efficiency Action Plan” (EEAP) as a “broad framework for energy conservation” [6]. The EEAP was followed by a Green Paper entitled “Doing More with Less: Green Paper on Energy Efficiency” [7]. In this document the saving of 20% of the EU energy use had been proposed. However, within the EEAP 75 actions (in 10 priority areas) had been listed, aimed at highly efficient buildings, appliances, processes, cars and energy systems, targeted at developing so called “National Energy Efficiency Action Plans” by each member country such as by Germany the NAPE, based on the requirements of Directive 2012/27/EU laid down in Article 24(2). Generally, the EEAP proposed several measures, such as

- improving the energy performance standards for boilers, copiers, TVs, lighting etc.,
- improving the energy standards for buildings and the promotion of low-energy buildings (“passive houses”),
- growing the efficiency of power generation and distribution,
- limiting the CO₂ emissions from cars down to 120 g/km by 2012 (incl. strengthening the efficiency labeling),
- boosting the energy efficiency especially in new member states,

- establishing awareness and education campaigns,
- improving energy efficiency in urban areas through a "Covenant of Mayors" (exchange best practices), and
- initiating international agreements to establish and improve energy efficiency world-wide.

4 Effects to Improving Energy Conservation in Germany

“Rational Use of Energy” (RUE) can be a very effective tool (i) to reduce the greenhouse gas emissions, (ii) to decrease the annual energy costs and furthermore (iii) it prepares the integration of Renewable Energy Sources. The planner who aims at optimizing the energy demand of buildings should follow the two steps,

1. step 1 is to decrease the building’s demand and increase the efficiency of the heating system → RUE, by
 - a. energy saving (= conservation) and/or
 - b. (optionally) cogeneration (CHP),and (afterwards)
2. step 2 is to apply Renewable Energy Sources → RES.

“Conservation of Energy” – also called as a “Rational Use of Energy” – in private households provides a high potential for saving of energy and emission. In Germany, EU directives in terms of energy conservation in buildings are legally “executed” related to the national laws and ordinances such as the EnEG, EnEV, EEWärmeG and in the near future the GEG (“Gebäude-Energie-Gesetz”). However, unfortunately in Germany still the energy consumption of buildings in average stays too high and furthermore the contribution of RES is too low. According to the data of BMWi, in Germany still space heating shares around 70% of the final energy consumption of the private households [1]. In private buildings, more than 4/5 of the energy consumption is for heat. Legal acts such as “Energieeinsparverordnung” (EnEV) mainly regulate the buildings under construction, but the existing building only marginally [8].

In detail, in Germany in the building sector the modernisation rate amounts only to less than 0.7% yearly while 2% are wanted and needed, as well. According to the data of BMWi, the total primary energy consumption in Germany decreased from 14905 PJ_{PE} in 1990 only down to 13523 PJ_{PE} in 2017, and down to 12832 PJ_{PE} in 2019 [1]. This is a reduction of PED by 9% until 2017 or 14% until 2019, respectively – as heat applications consume up to half of the final energy demand in Germany, changes in the heat demand due to climate variations should be taken into account.

On one hand - regarding this data -, a reduction by 40-50% of the primary energy demand until 2050 (Germany) seems to be very, or maybe too optimistic.

On the other hand - taking for buildings after modernisation a specific annual heat demand of 70 kWh/(m²*a) for heating plus 12.5 kWh/(m²*a) for hot water into account (a = year) -, by the measures of „Rational Use of Energy“ the German final energy demand in the private sector could be reduced by 300 TWh yearly (same as yearly up to one hundred Mtons of CO₂).

5 Conclusions

Aim of this paper was (i) to show that by applying energy saving measures, the primary energy demand and thus the individual (direct) carbon dioxide emission can be reduced in a relevant scale. (ii) It is to give laterally information about (ii.i) the energy market structure and (ii.ii) the legal backgrounds in the EU. The today's public opinion is that

“energy is another name for CO₂ emission”, and the “level of emission” can be expressed (= quantified) by “correlating with the (fossil) primary energy” consumption.

Thus, we have to contribute actions in order to reduce both of it.

Buildings (and hereby the private sector) share up to 40% of the carbon dioxide emissions in Germany: increasing the efficiency of buildings and appliances, using Renewable Energy Sources, and applying future transport technologies are effective tools to reduce the emissions. But beside this, further 6 tons of CO₂ emissions remain in the other sectors (transportation, industry, ...). Additively, to use cogeneration can save primary energy: own calculations prove that 25-40% of the energy can be saved. But, in Germany decentralized CHP block units seem politically not to be wanted. Cogeneration covers recently less than 20% of the generation of electricity, mostly from large-scale CHP plants. Thus, nearly 300 million tons of CO₂ are emitted from the conventional thermal power plants in Germany. CHP could be a forceful tool - too - to reduce emissions - but today from economic and technical reasons with low funding, CHP is not yet feasible for the private area. The stationary fuel cell technology may change this situation - introduced to market since 2015 -, towards 2030.

In principle, the examples shown here can be applied to other countries. However, due to the climatic and economic differences, all measures must be adapted to the local circumstances. In typical urban areas, the energy consumption can be drastically higher than in the rural areas. But, resuming the data, whereas the Germans are seen as environmentally friendly while they are emitting still more than 10 tons of CO₂ equivalents per capita and year, developing countries finally emit maybe only 1/3 of it - and actually live more sustainable than the Germans.

However, whereas today the discussion about environmental compatibility is focused on ***“the-energy-question-is-bound-(nearly)-only-to-the-global-warming-problem”***, environment is more than only global warming: in earlier times - regarding the 1980s - it had been already realized that there are “EIGHT MAIN AIR POLLUTANTS CAUSING SEVERAL MORE ATMOSPHERIC DISEASES SUCH AS SMOG, ACID RAIN, STRATOSPHERIC OZONE HOLE AND OTHERS” – thus the *greenhouse gases* (CO₂, CH₄, N₂O etc.), the *acidic gases* (SO₂, NO_x, etc.), the *carbon monoxide*, the NMVOC (= Non Methane Volatile Organic Compounds), and the *dust* (including fines particles).

6 References

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