# *Method Description*
# *NRW Sustainability Bond*

*Current version for NRW Sustainability Bond #7*

This method description includes the underlying methods and data used in a study by the Wuppertal Institute conducted on behalf of the State Government of North Rhine-Westphalia. The authors are responsible for the content.

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# Content


**1. Scope** **2**

**2. Greenhouse Gas Accounting Methodology** **3**

2.1. Conventions for avoided GHG emissions 3

2.2. Limitations 5

2.3. Mobility and Transportation 6

2.4. Modernisation of educational and public health facilities 7

**3. Ecological Impact Indicators** **12**

3.1. List of potential indicators for NRW Sustainability Bond 12

3.2. Ecological Impacts for Environment and Nature Conservation 13

**4. Social Impact Indicators** **15**

4.1. Hierarchy of Social Impact Indicators in NRW Sustainability Bond 15

4.2. Impact classification for NRW Sustainability Bond #7 16

4.3. Education and Sustainability Research 17

4.4. Inclusion and Social Coherence 18

4.5. Sustainable Urban Development 19

**5. Overview of used parameters and constants** **20**

**6. References** **22**

# 1. Scope

The Wuppertal Institut has been commissioned by the Ministry of Finance in North-Rhine Westphalia (NRW) to assess the impacts of Sustainability Bonds by the State of NRW on a regular basis. The current impact report can be found at: https://www.nachhaltigkeit.nrw.de/projekte/nachhaltigkeitsanleihen/sustainability-bond-7/

The report at hand aims to describe and provide the reasoning for the underlying methods, data used and assumptions made. It should enable the interested reader to better comprehend the robustness of results and the uncertainties that come with such an assessment.

The report consists of 5 sections:

- Section 2 describes how GHG savings are derived,
- Section 3 elaborates how indicators for further ecological impacts were identified,
- Section 4 summarizes the quantification and qualification of social impacts,
- Section 5 gives an overview of used parameters and constants.

This report will be updated and further developed on a regular basis.

# 2. Greenhouse Gas Accounting Methodology

This chapter describes how the calculation of avoided greenhouse gas emissions (GHG reduction) is carried out.

The GHG reduction potentials are estimated with the help of the indicator "Carbon Footprint". This indicator corresponds to the methodology of the Intergovernmental Panel on Climate Change on the classification and characterisation of greenhouse gases (Intergovernmental Panel on Climate Change, 2014; Qin et al., 2007). The Carbon Footprint records the greenhouse gases emitted by products and services over their entire life cycle. It expresses the greenhouse gas potential, i.e. the influence on anthropogenic warming of the global climate. The emissions of various greenhouse gases are measured with the respective global warming potential for 100 years in the unit $CO_2$ equivalents ($CO_2$ equivalent or $CO_2e$) (Bernstein et al., 2008). For NRW Sustainability Bonds, the main greenhouse gases of the Kyoto-Protocol are covered: $CO_2$, $CH_4$, $N_2O$. Other greenhouse gases (such as $SF_6$ from energy infrastructures or emissions from cooling fluids) will be integrated into further reports if necessary.

In the report at hand, mainly GHG factors of the Research Centre for Energy Economics e.V., the German Federal Environment Agency and the energy balances of the federal states are used. These GHG intensities (e.g. $CO_2e$ for 1 kWh of electricity) usually refer to the use phase only (e.g. the combustion of fuel) and therefore do not include upstream and downstream processes (utilities, infrastructures, and end-of-life).

## 2.1. Conventions for avoided GHG emissions

Even if certain standards have been established in the Harmonized Frameworks for Green and Sustainability Bonds (ICMA, 2018), they do not specify a specific procedure for determining the Carbon Footprint or the avoidance of GHG emissions (also called GHG savings in this report). Therefore, the following conventions were applied for each type of project where GHG savings are calculated.

**Reference systems**
In order to calculate the GHG reductions, an initial or reference system must be defined against which the savings are measured. This is the previous system or business-as-usual and its emissions. A measure can either replace the original system with a system with lower emissions (e.g. increasing the heating efficiency of buildings) or provide alternative services with lower GHG emissions (e.g. using a public transport system instead of a car). The difference between the emissions of the subsidised system and those of the initial system results in the potentials for GHG reduction.

This convention is based on the assumption that current systems are fully substituted and no rebound effects take place (such as growth of overall physical outputs due to efficiency gains). This means that any substitution or increase in efficiency leads to an absolute decrease of GHG emissions in the surrounding systems.

**Lifetime and Continuity**
As the reduction of greenhouse gases occurs only after the realization of the funded projects, the calculation of the GHG reduction potential is based on forecasts (ex-ante analysis). For this reason, the useful life (lifetime) must be estimated for each implemented measure. During this time, the funded projects help to reduce GHG savings every year. It is also assumed that the surrounding systems undergo no changes during the same time frame (continuity). In reality, some of the projects will not provide their full services for the entire lifetime assumed and changes in the surrounding systems are likely to decrease GHG mitigation effects (e.g. if an energy system becomes more climate-friendly with the shutdown of coal plants).

**Attribution of state financing**
In determining the GHG reduction, the share of the State's budget spending in the overall financing of the project must be taken into account. If for example a project is State funded for only 50% of its costs, only half of its GHG savings can be attributed to the bond. This means that financing shares by the State of NRW are equal to any negative or positive impacts calculated.

**Contribution to GHG measures**

There are also measures towards climate protection which only partially lead to GHG reductions. This applies in particular to the construction and renovation of buildings, where further legal requirements such as accessibility, fire protection or occupational safety play a role. If not otherwise stated (as done for buildings), it is assumed that all investments targeting climate protection fully contribute to this effect.

**Fixed auxiliary variables**
Wherever sufficient data is not available to assign the funding sums to physical systems, auxiliary variables are derived from literature. These proxies estimate the influence of the investment on the physical changes of a system and are cost-factors for the most part. The refurbished net floor area per euro invested for example, is determined based on the refurbishment costs of real and comparable buildings. This means that auxiliary variables are fixed and do not account for changes in the future (e.g. do not account for changes in prices or discount future costs).

**Double-Counting and Additionality**
A fundamental problem in the quantitative evaluation of avoided emissions (GHG reduction potentials) arises in the attribution of impacts to different actors of a system. In addition to the issuers and investors of the bond, these are all actors in the funded projects themselves. Since each ton of GHG can only be saved once, double counting must be avoided, although financing and re-financing might be considered to be added sustainable value.

Universities for example own their properties and invest in the conversion and new construction of their buildings. However, the heating energy consumption of a building is mainly caused by its users: university staff, students, and visitors.

The actual effect occurs through the implementation of the measure and should be attributed to the operator. On the other hand, many of the measures described here could not be realized without financial subsidies or loans.

In the process of estimating Carbon Footprints for e.g. companies, this is usually achieved using so-called attribution rules. For avoided emissions in the context of bonds, the authors use the terms ***financed*** or ***induced*** **GHG reduction** ***potentials*** *or* ***savings***.

## 2.2. Limitations

Several assumptions are necessary to calculate the financed GHG savings for the projects. These assumptions relate to costs on the one hand (e.g. construction costs of a building) and to the physical changes on the system on the other hand (e.g. the actual difference in energy demand after an energetic refurbishment). These assumptions were usually made from a conservative point of view, rather underestimating the positive effects for the environment. Table 1 lists the assumptions made for calculations and estimates their effect on the avoidance of GHG emissions.

**Table 1: Estimation of the effects of assumptions on the potential for avoided GHG emissions**
(underestimated: conservative results; overestimation: optimistic results)

| Bond Category | Assumptions | Impact on GHG emissions | over- & underestimation |
|---|---|---|---|
| **Public Transportation and Local Mobility** | Modal shift assumptions in the area of bike paths | The GHG reduction potentials are probably lower in the analysis than in reality, because data from conservative scenarios were used and public transport systems are not taken into account. | + (underestimated) |
| | Modal shift assumptions in the area of semester tickets | The robustness of the empirical survey cannot be validated. However, it can be assumed that the effects are higher in some regions and lower in others. | o (no final estimate) |
| | Assumptions on the cost of cycle paths | The cost factor for the construction of municipal cycle paths is based on multiple-year average and can be considered robust. The cost factor for high-speed cycle paths is based on published construction costs. Since many of the cycle paths concerned are still under construction at the time of the analysis, the real costs could be higher. This would lead to an overestimation of the GHG reduction potentials for fast cycle paths in the analysis. | o (no final estimate) |
| **Modernisation of educational and public health facilities** | New buildings replace old buildings | The GHG reduction potentials are rather overestimated due to this assumption, because the total heating energy requirement of a university facility increases if existing buildings continue to be used. | - (overestimated) |
| | Assumptions on construction costs | The data used cannot be used to calculate robust average values for the construction costs of new buildings and those to be renovated. The actual usable area increased or converted by the investments, and thus the GHG reduction potentials, cannot be reliably determined. | o (no final estimate) |
| | Assumptions on the use of funds | Only clear budget titles were allocated as part of the investment allocation. The resulting GHG reduction potentials are therefore underestimated. | + (underestimated) |
| | Non-consideration of the electricity consumption | Additional GHG reduction potentials could be realised through savings in electricity consumption. However, this is not the case for all building types and uses. | o (no final estimate) |
| | Assumptions for saving heating energy in buildings | For the new and replacement construction of buildings, data from the existing stock of public buildings were used, which lead to energy and GHG savings compared to the EnEV standard and with regard to the usable area. It can be assumed that in reality greater savings will be achieved. However, the development measures were only mapped on the basis of a reference building. The allocation of these specific GHG reduction potentials to all implemented measures is therefore subject to high uncertainties. | + (underestimated) |

*source: own presentation*

## 2.3. Mobility and Transportation

**Public transportation for pupils and students**

The funding for students and pupils supports the public transportation system in NRW by financing the reduced tariffs for pupils, students and trainees, while also promoting the improvement of services and quality (Ministerium der Finanzen NRW (FM NRW) 2020). The Public Transport Act of North Rhine-Westphalia stipulates in Section §11a (1) that EUR 134.5million per year is to be invested for this purpose. Of this amount, at least 87.5% is used to offset the cost of tickets. Of this, approximately 18.5 % is used for semester tickets (according to the FM NRW). The remaining 12.5% can be used for other financing measures, such as further development of the system or quality improvements.

In order to determine the total costs for the semester ticket and the respective share of the bond in the total costs, the quantity of tickets sold for each year is offset against the ticket price as well as the costs for the regional expansion of public transportation and added to the investments from the bond. The shares of the total costs calculated in this way also correspond to the share of the bond in the expected reductions for greenhouse gases. The data were collected both on the basis of data from the Ministry of Finance in NRW and on the basis of tariff data (see KCM NRW (2020) for the most recent data).

The GHG reduction of the semester tickets was measured by the car-km avoided per ticket. A study by the Wuppertal Institute on the use of the semester ticket, shows that 1,242 person-kilometres (pkm) per year are not covered by car due to the semester ticket per student (Müller, 2011). The study is based on an empirical survey of the mobility behaviour of students at Bielefeld University. The results are not representative for other universities in NRW and therefore cannot be generalised. Due to a lack of alternative data, the figure of 1,242 pkm per student (or 621 pkm per ticket) is nevertheless chosen as the basis for the calculation. In contrast to the other project groups, only the reduction for one year is considered, since the semester ticket is only financed for two semesters (one year). Based on data from the Federal Environment Agency, 142 g $CO_2$e per car-km are assumed for the GHG reduction through avoided car-km (UBA, 2016).

**Non-urban fast cycle paths and Urban cycle paths**

The initial system for the construction of cycle paths is the car traffic that occurs if there were no cycle paths (GHG reductions from avoided car km). Although further effects in the area of public transports could occur, it is unclear whether this modal shift (people switching from a public transport system towards cycling) would affect the GHG emissions of these systems in any way. Conversely, it is also not assumed that the climate impact of public transports will be negatively affected.

Data on the influence of the construction of cycle paths on the modal split can be found in the feasibility study of the cycle fast track (RS RM) between Gladbeck, Bottrop and Essen. (Regionalverband Ruhr, 2018). Based on statistics of purposes and number of routes in NRW, an estimation of the passenger car km saved is carried out. With a primary settlement region, a conservative assumption, on average 1,131 car-km per km of cycle distance and day are avoided by high-speed cycle paths.

In the area of municipal cycle paths, no data are available on the avoidance of car km. In a first approximation, therefore, the assumptions about the fast cycle paths are adopted. However, it is assumed that municipal cycle paths only have a substituting effect on car use for paths up to 5 km in length (60% of paths or 679 car-km per km cycle path per day).

The cost factors to be determined make it possible to identify the added cycle routes with the help of the investments made by the State of NRW within the bond. For municipal cycle paths, they are based on data supplied from the Ministry of Transport of the State of NRW. The 5-year average (2015-2019) of the added cycle paths in municipal construction load is EUR 209,000 per km.

No sufficient data were available for cycle paths. Instead, the average construction costs per km of cycle path were calculated from existing projects (see Table 2). Accordingly, the average construction costs are EUR 1.23 m per kilometre built.

**Table 2: Construction costs for different cycle path projects**

| Project | Length | Costs |
|---|---|---|
| RS1 Duisburg - Hamm | 101 km | EUR 184m |
| RSW Mittleres Ruhrgebiet Gladbeck - Bottrop -Essen | 17 km | EUR 39m |
| Regio Velo Isselburg-Bocholt - Velen | 61 km | EUR 39m |
| RSW OWL Minden-Herford | 50 km | EUR 26m |
| RSW Aachen-Herzogenrath-Kerkrade | 30 km | EUR 21m |
| RSW Köln-Frechen | 8 km | EUR 6m |
| RSW Neuss-Düsseldorf-Langenfeld/Monheim | 31 km | EUR 32m |
| RM | 17 km | EUR 39m |
| **Sum** | **315 km** | **EUR 385m** |

*source: own calculation based on web publications*

Based on data from the Federal Environment Agency, 142 g $CO_2$e per car-km are assumed for the GHG reduction through avoided car-km (UBA, 2016).

## 2.4. Modernisation of educational and public health facilities

The Sustainability Bond covers also funding for buildings of universities and university clinics (new buildings and refurbishment). Increasing the energy efficiency in these buildings (in particular for the end-use of heat) is one of its major goals. Only parts of the investments are used to reduce the energy demand of buildings or to develop buildings with a low energy standard. Some investments are also used to provide equipment or rents. Refurbishments are also not restricted to energy-efficiency measures alone but cover for example requirements for safety or health measures. It is therefore necessary to estimate the shares for actual GHG mitigation potentials from

- the construction of new (general) university buildings with lower heat demand compared to existing buildings,

- the construction of new clinical university buildings with lower heat demand compared to existing buildings,
- higher heat efficiency after refurbishment in (general) university buildings,
- higher heat efficiency after refurbishment in clinical university buildings.

The investments in the bond correspond to actual investments in the State's budget, but do not allow to differentiate into these four segments with GHG relevance. Therefore, additional information on the State's investments are drawn from the budget, that allow to allocate the funding in higher detail.

The allocation for general university buildings is based on the funding for the program*Hochschulbaukonsolidierungsprogramm* (HKoP; programme for the construction of university buildings) and funding for the *Hochschulmodernisierungsprogramm* (HMoP; programme for the modernisation of buildings). Both investments are assumed to use 52 % of their funds for equipment (assumption by the Ministry of Finance). In addition, only 45 % of investments into refurbishment measures lead to higher energy efficiency in buildings. The latter value describes the energy refurbishment ratio and is based on a study on the refurbishment of public buildings in Germany (Hebel, Jahn, & Clausnitzer, 2011). Investments into clinical university buildings are listed individually in the State's budget and can therefore be used to generate a more specific allocation. Based on the years 2014 to 2019, average values were calculated for the shares of funds that are used for new buildings and funds that are used for refurbishments. For a reference energy refurbishment a ratio of 53.6% (based on the "Bettenturm Münster", a university clinical building) is assumed.

**Specific GHG emission factors for educational and public health facilities**

Table 3 shows the GHG emission factors for heat demand and heat sources in public buildings. The electricity demand of university buildings and its GHG emissions is not included in the quantification due to lack of data. While electricity use in public buildings can have a large effect on the actual GHG emissions, it could not be allocated to the investments in the bond. However, this effect is not necessarily positive, as for example the installation of new medical equipment can also increase the electricity demand in a building.

**Table 3: Emission factors for the heat demand in public buildings**

| Energy source | Emission factor (without upstream) | Data source | Spatiality | Share in buildings |
|---|---|---|---|---|
| **Gas*** | 202 g $CO_2$e/kWh | FfE (2010) | Germany | 55.8 % |
| **Oil, light*** | 266 g $CO_2$e/kWh | FfE (2010) | Germany | 23.1 % |
| **District heating** | 229 g $CO_2$e/kWh | (Agentur für Erneuerbare Energien e.V. 2014) | NRW | 21.1 % |
| **Electricity** | 820 g $CO_2$e/kWh | LAK (2015) | NRW | 0.0 % |
| Emission Factor | **222 g $CO_2$e/kWh** | | | **100 %** |
| ** Roughly 79 % of heat is provided in form of gas and oil. According to the Agency for Renewable Energies in Germany (AGEB 2013) 70.7 % of heat by these energy carriers is provided in form of gas.* | | | | |

*source: own calculations based on statistics for heat demand in public buildings*

Efficiency gains are calculated by comparing the average heat demand of existing public buildings to the average heat demand of new public buildings. This simplification is required, because the actual efficiency gains in the university buildings funded by the bond are unknown. This also leads to a conservative estimation of the GHG effects in most cases, as older buildings are usually refurbished first, and new buildings often exceed the legal requirements for energy efficiency.

**Calculation of GHG emission savings in educational and public health facilities**

The heat demand of buildings in the class "Universities and Research" is estimated in a 2013 study by the Federal Ministry of Transportation and Construction (Deilmann et al., 2013). This study contains data on the share for energy carriers as well as the average heat demand in regard to the age of the buildings before and after an energy-related refurbishment. Table 4 shows the results sorted by the year of construction as well as their share of the overall existing buildings. These potential savings are used for all new university buildings funded by the Sustainability Bond.

**Table 4: Heat energy savings in university buildings (Germany)**

| Year of construction | Heat demand in existing buildings | Heat demand after refurbishment (base-case for new buildings) | Share of existing buildings |
|---|---|---|---|
| **until 1976** | 236.3 kWh/($m^2$a) | 108.5 kWh/($m^2$a) | 80 % |
| **1977 - 1983** | 209.9 kWh/($m^2$a) | 107.4 kWh/($m^2$a) | 6 % |
| **1984 - 1995** | 167.9 kWh/($m^2$a) | 104.9 kWh/($m^2$a) | 6 % |
| **from 1995 onward** | 129.6 kWh/($m^2$a) | 104.9 kWh/($m^2$a) | 8 % |
| Heat energy savings | | **117.2 kWh/($m^2$a)** | **100 %** |

*source: own calculations based on Deilmann et al. (2013)*

Linking the data in Table 3 and Table 4 results in GHG emission savings of 26 kg $CO_2$e per $m^2$ for new university buildings when compared to the building stock (222 g $CO_2$e per kWh at a difference of 117.2 kWh/($m^2$a)).

The available data on State funding does not include the area of newly constructed buildings. Instead, data on recently constructed university buildings was used to generate a cost factor on the amount of useful area that can be constructed per EUR. This results in an average of the sample of 250 $m^2$ per EURm (see also Table 5). A lifetime of 50 years for new university building is assumed (Stibbe & Stratmann, 2014).

**Table 5: Construction of useful area based on investments for university buildings in NRW**

| Building | Construction costs | Net area | Promoted share by State of NRW | Cost factors (calculated) |
|---|---|---|---|---|
| FH Aachen, replacement construction f. Kalverbenden/Zentr. | EUR 12.5m | 3,900 $m^2$ | 100 % | 312.0E-6 $m^2$/€ |
| RWTH Aachen, auditorium centre Claßenstr. (R 6)* | EUR 45.0m | 14,000 $m^2$ | 100 % | 311.1E-6 $m^2$/€ |
| Univ. Dortmund, Replacement New Building Chemistry/Physics (EE) | EUR 82.3m | 14,661 $m^2$ | 100 % | 178.1E-6 $m^2$/€ |
| FH Niederrhein, Replacement new multi-building (EE) | EUR 20.0m | 6,900 $m^2$ | 75 % | 258.8E-6 $m^2$/€ |
| FH Bielefeld, Replacement new construction, network expansion (EE) | EUR 279.3m | 60,400 $m^2$ | 100 % | 216.3E-6 $m^2$/€ |
| FH Düsseldorf, ENB 1. BA* | EUR 170.0m | 54,000 $m^2$ | 100 % | 317.6E-6 $m^2$/€ |
| in Total | **EUR 609m** | **153,861 $m^2$** | **average (weighted)** | **250 $m^2$ per million euro** |
| ** refers to costs according to cost estimations* | | | | |

*source: own calculation; information on construction costs and constructed area are based on press releases*

In order to calculate the GHG reduction potential of buildings in university hospitals, the costs per $m^2$ of usable space are required, analogous to new buildings in general universities. The information on the construction costs determined or estimated is taken from the budget for Title Groups 06 103 to 06 108 (each Title 891 30). The corresponding floor areas are taken from the websites of the individual clinics. All construction measures are assumed to have a 100 % share of funding, which means that the simple average of total investment and total net floor area can be used to determine the cost factor.

**Table 6: Net additional floor space for investments in new buildings in university clinics**

| Intentions | Building costs | Net floor area | Specific cost factor |
|---|---|---|---|
| Cologne: CIO Centre (ambulatory) | EUR 77.9m | 13,500 $m^2$ | 312.0E-6 m2/€ |
| Aachen: Extension building for intensive surgical care | EUR 41.2m | 8,643 $m^2$ | 311.1E-6 m2/€ |
| Düsseldorf: Medical Research Centre I | EUR 79.9m | 19,650 $m^2$ | 178.1E-6 m2/€ |
| Düsseldorf: Medical Research Centre II | EUR 26.2m | 7,970 $m^2$ | 258.8E-6 m2/€ |
| Bonn: New building parent-child centre | EUR 71.9m | 11,787 $m^2$ | 216.3E-6 m2/€ |
| Bonn: Neurology, psychiatry and palliative medicine(NPP) | EUR 64.6m | 12,842 $m^2$ | 317.6E-6 m2/€ |
| **Sum** | **EUR 361.6m** | **74,392 $m^2$** | **206 $m^2$ per EUR m** |

*source: own calculations on the basis of the NRW budget (medium-term financial planning 2016-2018) and publications of the clinics examined.*

A lifetime of 66 years for new university clinics is assumed (Hebel et al., 2011)

**Calculation of GHG emission savings in refurbished educational and public health facilities**

The determination of the cost factor and the reduction of the heating energy requirement of renovated buildings in general universities is based on data from a facade renovation at the Ruhr University Bochum (Krewald, A., personal communication, 2017). Construction costs of EUR 87.9 m were incurred to renovate a 52,300 $m^2$ site. Thus, investments of EUR 1m lead to the redevelopment of 594 $m^2$. The share of the energy-related renovation quota is already taken into account in the allocation of investments. Taking into account the general heating energy demand in universities and a reduction in heating energy demand of probably 88 kWh/$m^2$ (NF 1-6 buildings), potential GHG reductions of 19.6 kg $CO_2$e per $m^2$ are achieved.

The "Bettenturm" in Münster serves as a reference for the renovation of buildings in university clinics, for which a number of data are available:

- The construction costs for façade works (energetic refurbishment) amount to EUR 20.6 million.
- The total construction costs amount to EUR 38.5 million with a subsidy amount of EUR 45.9 million.
- The estimated transmission heat loss before completion of works is 2.23 W/($m^2$K) and 0.62 W/($m^2$K) after refurbishment.
- 875 beds are in the renovated building.

Based on these data and taking into account the heating degree days in Germany in 2016 (3005 HDD according to Eurostat) and the energy expenditure figure for a condensing boiler (1.03), the reference values for hospital renovations shown in Table 7 can be determined. A service life of 20 years is also assumed.

**Table 7: Reference value for GHG reduction potentials for the renovation of hospital buildings**

| Reference level | Reference value |
|---|---|
| Share of construction costs in funding amount | 84.0 % |
| Share of energy-efficient refurbishment in construction costs (already taken into account when allocating investments) | 53.6 % |
| Difference in transmission heat requirement per bed | 3,156 kWh/bed |
| Number of refurbished beds | 42.4 bed per EUR m |
| GHG factor for the provision of heating energy | 0.222 kg $CO_2$e/kWh |
| **GHG reduction potential per bed** | **702 kg $CO_2$e per bed and year** |

*source: own calculation*

# 3. Ecological Impact Indicators

The following section focuses on ecological impacts in the bond category "Environment and Nature Conservation". A number of potential indicators could be identified on the basis of the fields of actions in the NRW Sustainability Strategy as well as recommendations for its further development (see the Analysis of the Sustainability Bond #6 (Teubler et al. 2020) for full discussion and related literature).

## 3.1. List of potential indicators for NRW Sustainability Bond

Table 8 shows the fields of actions from the NRW Sustainability Strategy[1], their potential fitting to the categories of the NRW Sustainability Bond as well as the possible sources of data. With exception of the number of qualified protected areas (biological stations), none of the indicators listed can be integrated at the moment. However, it might be possible to integrate these indicators into future reports if data gaps can be closed.

**Table 8: Set of new ecological impact indicators for future impact assessments**

| Fields of action | Topics in NRW Sustainability Bond | Operationalised Indicator | Potential source(s) |
|---|---|---|---|
| Protection of natural resources - Maintenance and safeguarding of sustainable and ecological water management: Ecological condition of surface waters, area of the nationwide biotope network | ■ Flood protection and natural hydraulic engineering<br>■ Biodiversity/Biotop-network | Number and area (ha) of renatured water catchment basins | Water associations NRW |
| Maintenance and safeguarding of sustainable and ecological water management: ecological status of surface waters, endangered species, biodiversity and landscape quality | ■ Flood protection and natural hydraulic engineering<br>■ Biodiversity/Biotop-network | Area (ha) of renatured floodplain areas | Water associations NRW |
| Land cultivation | ■ Environmental and animal rights agriculture | Contamination of surface-near groundwater with antibiotics (ng/l) | State Agency for Nature, Environment and Consumer Protection NRW |
| Land cultivation | ■ Environmental and animal rights agriculture | Pesticide pollution (µg/l), Chemical status of groundwater | Federal/State Working Group on Water |
| Land cultivation | ■ Environmental and animal rights agriculture | Differentiation of „organic farming" into ecological, biological and sustainable | Chamber of Agriculture- NRW |
| Protection of natural resources – biodiversity + landscape quality<br>Land cultivation | ■ Biodiversity<br>■ Environmental and animal rights agriculture<br>■ EAFRD-programme | Increase of agricultural areas (%) with high nature value farmland | Geobasis NRW |
| Land cultivation | ■ Environmental and animal rights agriculture | *(Animal Welfare) – still under development* | Chamber of Agriculture NRW |
| Land cultivation | ■ Environmental and animal rights agriculture | Increase in the number of farms (next to the areas) in organic farming | Chamber of Agriculture NRW |

[1] https://www.nachhaltigkeit.nrw.de/themen/nachhaltigkeitsstrategie-fuer-nordrhein-westfalen-en/

| | | | |
|---|---|---|---|
| Biodiversity | ■ Biodiversity | Number and area of qualified protected areas (managed by Bio-Stations) | State Agency for Nature, Environment and Consumer Protection NRW |

*source: own compilation*

## 3.2. Ecological Impacts for Environment and Nature Conservation

For **Sustainable Land Use** two measures can be attributed in the NRW Sustainability Bond: NRW funds for sustainable agriculture in the European Agricultural Fund for Rural Development (EAFRD) and responsible agriculture. The EAFRD programme promotes rural areas from 2014-2020 with overall funds of EUR 1.2bn for NRW. The programme consists of 20 measures in 6 priorities, focusing on the preservation and development of rural areas worth living in and the development towards sustainable, rural agriculture. In terms of sustainable land use, the following measures in priority 4 can be directly associated with promoted areas in the fund and therefore for the development of a more accurate sustainable land use indicator:

- M10: Agri-environment and climate measures (diverse cultures in agriculture, nature conservation on grassland, extensive grassland use, etc.)
- M11: Organic farming (introduction/maintenance)
- M12: Compensation under Natura 2000 (compensation for agricultural land with environmental restrictions)
- M13: Compensation for mountain areas (if naturally and environmentally disadvantaged)

Based on the implementation report for the federal EAFRD programme, which refers to the implementation between 2014 and 2019 and is published annually, a scalable factor of the promoted area per EUR 1m could be created. So far (until 2019), public funds of EUR 321.5m have been spent for these measures, promoting an area of 660,183 ha (MULNV NRW 2020). As a result, EUR 1m promotes 2,053 ha of sustainable land use. The funding within the framework of the measure "responsible agriculture" of the sustainability bond can be fully allocated by applying this factor. Only a share of the EAFRD funds within the Sustainability Bond can be attributed to this indicator as other funds are associated with additional effects such as measures into sustainable forestry. This share was determined by the proportion of the expenditure for the above-mentioned measures in relation to the total funds of the EAFRD.

The different aspects of **animal welfare** can be captured with different types of indicators that either relate to practices (e.g. space allowances, dehorning of cattle, feeding, handling etc.) or are measured directly on the animal (e.g. lameness in dairy cows). Any type of sustainable financing should focus on practices (“improving the standard”) while guaranteeing that animals are healthy and show no disorders (“do no harm”). The project “National Animal Welfare Monitoring”, which is funded by the Federal Ministry of Food and Agriculture, currently develops the basis for indicator-based monitoring and reporting on the status quo and development of animal welfare in livestock farming in Germany. A share of the EAFRD can be assigned to the indicator "animal welfare". The approach followed is equivalent to the procedure described above.

A scalable factor based on data from the implementation report for the federal EAFRD programme was created by linking the number of animals benefiting from measure M11 “Summer grazing & rearing on straw” to the corresponding expenditure for this measure, resulting in 27,927 animals per EUR 1m (MULNV NRW 2020).

The tasks of **Biological Stations** include the protection and care of the flora and fauna as well as the landscape in the respective local working area (in addition to the activities of the district, the towns and municipalities) as well as nature conservation education and the associated public relations work. In addition to their scientific expertise and sound knowledge of the area, they are in close contact with land users and the rest of the population. Biological Stations, in coordination with the landscape authorities, now look after more than half of all nature reserves in NRW by recording changes in flora and fauna and planning, coordinating and in some cases carrying out maintenance and development measures to improve the protected areas. They canvass for management contracts and advise and support land managers within the framework of contractual nature conservation. Biological stations raise considerable amounts of third-party funds which contribute to value creation in the rural region. The numbers of biological stations in North Rhine Westphalia is reported by the Umbrella organisation of biological stations in NRW (2020). These are allocated to the corresponding investments for biological stations of the total investment volume in the bond category "nature conservation" (FM NRW, Häger, K. personal communication, 2021).

# 4. Social Impact Indicators

The following chapter discusses impact quantification in the social dimension of the NRW Sustainability Bond. It is investigated what type of impacts were identified and how they could be quantified.

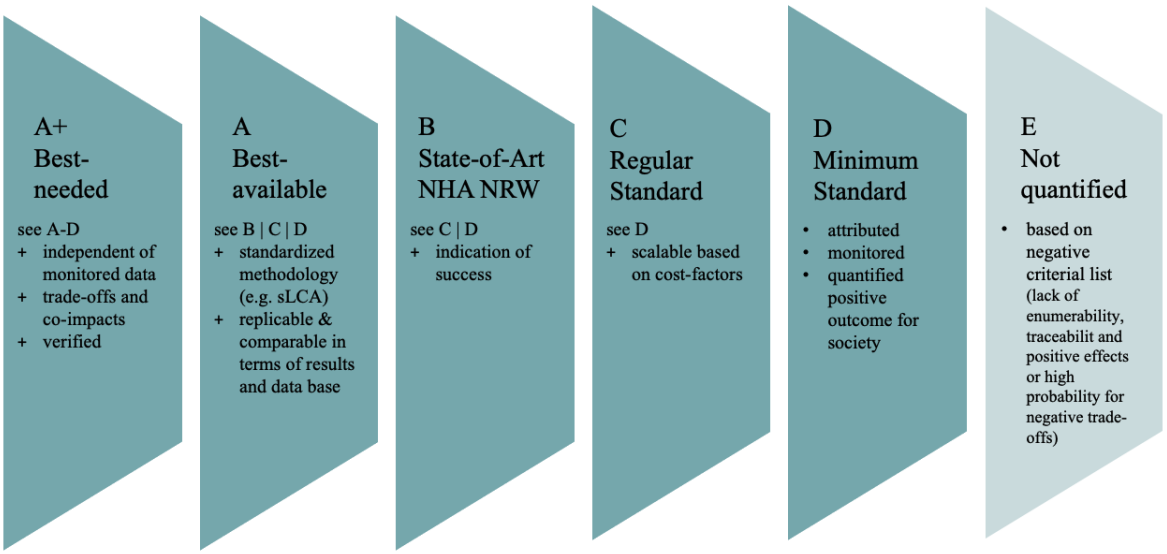
Social impacts in the current bond are mainly derived from reported data and cost-factors based on grants awarded by laws or funds. This approach does not only affect the robustness of data but also the meaningfulness each indicator conveys to the investor. A first methodology was therefore developed that aims to classify the reported effects in accordance to the robustness and rate of success (see next section).

Future reports will build on that classification by integrating consistent narratives for the desired and achieved changes of the financed project (see https://wupperinst.org/fa/redaktion/downloads/projects/NRWBank_Social_Bonds_Methods.pdf for an example for such an approach).

## 4.1. Hierarchy of Social Impact Indicators in NRW Sustainability Bond

Based on this minimum standard, a first hierarchy of social impact-indicators was developed. Accordingly, the indicators are classified into six categories A+, A, B, C, D and E depending on their characteristics. Figure 9 provides an overview of this classification. The 3 categories of social impacts that are currently reported for the NRW Sustainability Bond are ranging from D (minimum standard) over C (regular standard) to B (State-of-Art). If an effect does not fulfill the minimum standard, it can still be reported (e.g. in form of 3rd party assessments) but not be defined as quantified impact.

**Figure 9: Classification of social impact-indicators for NRW Sustainability Bonds**




B and C are both scalable and can thus be used to show effects in reference to the investment and over time (if e.g. the same project is funded over several bonds). A few impacts also

clearly show a value of success (which is required for standard B), indicating not only a monitored accounting (e.g. the number of participants of a measure) but the achievement of goals (achieving the goals of the measure). The difference between indicators of accounting and success is sometimes fluent (e.g. comparing the number of students with the number of degrees), which is why standard C is chosen when in doubt.

The best-available standard A on the other hand cannot be allocated to funds in the bond so far. This would require a standardized method that allows to compare the social impact results of different bonds, also resulting in a value of efficacy (effect per EUR invested).

## 4.2. Impact classification for NRW Sustainability Bond #7

Numerous social impacts are reported throughout the impact assessment. Applying the here described classification, each impact can be associated with grad B to E, as shown in Table 10. A number of impacts is not included in this list, such as funding of social tickets in category C (lack of enumerability and traceability) or integration centres for migrants (lack of traceability). Future impact reports will investigate if the related data issues can be solved in order to include them as a quantified and qualified impact in the impact report.

**Table 10: Assessment of social impacts in NRW Sustainability Bond #7**

| Bond Category | Impact | Grade | Rationale |
|---|---|---|---|
| **Education & Sustainability Research** | bachelor graduates | B | monitored success |
| | student places for first-year students | C | Scalable based on grants but no indication of success |
| | student places for master studies | C | Scalable based on grants but no indication of success |
| | education of geriatric nurses | C | Scalable based on grants but no indication of success |
| | return of researchers | B | monitored success |
| | students benefiting from the EU school programme | B | monitored success |
| | student places for special education teachers | D | attributed student places but no means to scale or measure success |
| **Inclusion & Social Coherence** | occupational integration of people with disabilities | B | monitored success |
| | funding of day-care centres (plusKITA programme) | C | Scalable based costs for new professional staff but no indication of success |
| | Social School Work | C | Scalable based costs for new professional staff but no indication of success |

| | | | |
|---|---|---|---|
| | Fight against poverty and social exclusion (share for "Endlich ein ZUHAUSE!") | B | monitored success |
| | Support for family centres | B | monitored success (supported family centres) |
| **Sustainable Urban Development** | broadband connections | B | Indication of success (connections) that is scalable |

*source: own estimation*

## 4.3. Education and Sustainability Research

The **"Bund-Länder-Covenant for the expansion of universities"** supports the creation of additional study places and the improvement of the quality of studies and teaching. Through this effort, a larger number of students get the opportunity to receive a high quality university education. The state of NRW contributes through a co-financing equal to the federal funds received. One impact of the "Hochschulpakt" is the expansion of university capacities in terms of first-year students in reference to 2005, helping to increase the overall number of graduates, increasing the capacities for master students and other measures for the enlargement and the quality improvement of universities (e.g. reducing dropout rates). The report at hand allocates the remaining funds in the Hochschulpakt III after accounting for first-year students, because annual budgets also include funds from the previous programmes or might be the result of transfer postings between budget years. The lump sum for one additional first-year student (compared to 2005) is EUR 13,000 each from State and federal funds and is provided over a period of 4 years (Heads of the Federal and State governments of Germany, 2014). The number of additional first-year students, to whom this funding can be allocated, was calculated in relation to a baseline of 80,903 first-year students in NRW in 2005 (IT.NRW 2018). Half of these students can be allocated to investments in the sustainability bond. If the funding for the additional first-semester students is excluded, the remaining budget can be divided up for the remaining measures. The universities in NRW (including universities of applied sciences) plan to provide capacities for additional master student places, receiving EUR 10,000 for each place over 2 years (or EUR 5,000 per year). The universities in NRW (including universities of applied sciences) have planned to provide capacities for additional 10,600 master student places in 2019/2020 whereas half of the places can be allocated to the bond (MIWF NRW, 2016).

Bachelor graduates are funded with EUR 4,000 each. The number of Bachelor's degrees for the corresponding year was taken from the Federal Statistical Office (IT.NRW 2020). The remaining investments are used for other measures for the enlargement and the quality improvement of universities (e.g. reducing dropout rates) which cannot be quantified.

Under the law concerning Geriatric Care (Landesaltenpflegegesetz NRW), the state of NRW grants the **funding of professional education of geriatric nurses**. With the state funding, the schools are financed in the form of a lump sum per student. The students themselves, compared to other health professions, therefore are not required to pay school fees. The Land contributes to the school costs for the training of geriatric nurses by paying a monthly lump sum of EUR 380 per month per student in full-time education (FM NRW 2020b). The number of benefiting geriatric nurses is scalable based on this grant.

The number of research groups funded by the programme **Funding of the return for highly qualified young researchers** originate from a personal communication with the FM NRW (FM NRW, Häger, K. 2021)

Within the **EU School programme** the State provides complementary financing to support balanced and healthy school meals by the daily supply of fruit, vegetables and milk in Pre-schools, primary and secondary schools. The programme consists of two parts “School Fruits” and “School Milk”. The expenditure for the supply and distribution of the products is funded by EU aid and co-financed with national funds. The annual EU and national funding details and number of profiting pupils are published annually (BMEL 2020), which allows to build a scalable factor of costs per pupil and a direct allocation of the share of the effects to the Sustainability Bond. Since pupils can benefit from both the School Fruit and School Milk programmes at the same time, only the number of pupils from the School Fruit programme - as a programme with more participants - was included in the reporting to avoid double counting.

## 4.4. Inclusion and Social Coherence

The funding for the **"Occupational integration of people with disabilities"** is part of a co-funding for newly created jobs in NRW. So far, around 300 inclusion companies in NRW provide a total of around 7,500 jobs. As scalable indicator the maximum funding of EUR 20,000 is attributed for each newly created job (see Gesellschaft für innovative Beschäftigungsförderung mbH, (2018) for further information on the programme).

The programme **PlusKita and language courses at childcare facilities** provides funding to support educational opportunities at child day care centres. PlusKitas are day care centres with a high proportion of children with special support needs in the educational process. The PlusKita is essentially intended to pursue two goals, the strengthening of educational opportunities and the reduction of existing disadvantages. The programme finances social pedagogical skilled staff in the day care centres in which a high proportion of children with special support needs in the educational process, in particular with language support needs (KiTa.NRW 2020). In order to quantify the number of these funded positions, a gross annual salary for a pedagogical teacher with an additional qualification in language support (according to S 8 a and b TVöD SuE) of EUR 38.857 was assumed and used as scalable indicator.

The aim of **family centres** is to provide information and advice to support parents and children, and to bundle and network guidance and support services for parents and families. In this way, they contribute to more equal opportunities. Child day care centres that are approved as family centres receive special funding from the state. One focus of funding is family centres in socially deprived areas. As scalable factor the maximum funding of EUR 20,000 per family centre was used (FM NRW 2020b).

Within the programme **Fight against poverty and social exclusion** the initiative **"Finally a HOME!"** is supported. According to MAGS NRW (2020), in the year 2020 the initiative was able to provide accommodation for 748 previously homeless households and in 700 cases the imminent loss of housing could be prevented. The costs for the initiative amount to EUR 3m (MAGS, 2020) whereby a scalable cost factor of EUR 2,071 per household could be formed.

The State of NRW continues financing on **social schoolwork** that has been discontinued by the Federal Government in 2014. Initially provided for 3 years (until 2017), funding is now secured until 2021 (Bildungsportal des Landes NRW, 2019). The State programme provides funding to 53 cities and municipalities in order to provide assistance for targeted youth work and reducing social disadvantages in this area. A first evaluation of the programme in 2017 (Gabler et al., 2017) concludes that while there is still an information gap (e.g. only half of the parents entitled to apply for benefits from the programme know about them), children from poor households are overrepresented when it comes to benefiting from services such as additional school excursion or joint lunch. It is also estimated that the programme itself has financed 1,700 skilled social workers so far. The impact of this category of the bond can therefore be causally related to the financing of these jobs. The State of NRW promotes jobs in this area based on generalized costs of ca. EUR 50,000 on an annual gross salary and direct material expenses of ca. EUR 15,000, summing up to refundable costs of EUR 65,000 per year.

## 4.5. Sustainable Urban Development

**Broadband connections** (download rates of 50 Mbits/s and more) improve social and economic access for households, institutions and businesses. They also enable opportunities for a greener economy by reducing work-related traffic through home office solutions or by attracting businesses to more rural areas. Quantifying the effect of funding for broadband connections is rather difficult, as the costs of an access point increase exponentially with higher penetrations rates. Based on NRW broadband expansions in the past (from an interactive website by the Federal Ministry of Transport and Digital Infrastructure[2]), about EUR 2,000 can be estimated as costs per access point on average.

[2] see https://www.bmvi.de/SharedDocs/DE/Artikel/DG/breitbandatlas/breitbandatlas.html

# 5. Overview of used parameters and constants

The following table lists all parameters and constants used either to report direct effects or to derive effects based on the investment volume assessed. The purpose of this table is to provide traceability for the impact assessment. The values in it **should not be** used as reliable means to estimate the costs of measures or as basis for comparison with actual reported effects in other projects.

Almost all values here are based on publicly available data (project reports, public budget data of the State of NRW, evaluation studies, grant information in laws and statistics) or are calculated with help of data and assumptions described in the report at hand.

**Table 11: Parameters and Constants for the NRW Sustainability Bond #7**

| Programme | Parameters and Constants | Value |
|---|---|---|
| **Greenhouse Gas Accounting** | | |
| Public transportation for pupils and students | Avoided pkm | 1,242 pkm / ticket |
| Non-Urban cycle paths | Avoided car-km | 1,131 car-km / km of cycle distance |
| | Construction costs (auxiliary variable) | EUR 1.22m / km new built cycle path |
| Urban cycle paths | Avoided car-km | 679 car-km / km of cycle distance |
| | Construction costs (auxiliary variable) | EUR 0.21m / km new built cycle path |
| New construction of general university buildings | GHG emission savings in comparison to the building stock | 26 kg $CO_2e$ / $m^2$ |
| | Construction of useful area per invested million euro (auxiliary variable) | 250$m^2$ / EUR m |
| Refurbishment of general university buildings | GHG emission savings in comparison to unrefurbished building stock | 19.6 kg $CO_2e$ / $m^2$ |
| | Refurbished area per invested million euro (auxiliary variable) | 594$m^2$ / EUR m |
| New construction of university clinic buildings | GHG emission savings in comparison to the building stock | 26 kg $CO_2e$ / $m^2$ |
| | Construction of useful area per invested million euro(auxiliary variable) | 206$m^2$ / EUR m |
| Refurbishment of university clinic buildings | GHG emission savings per hospital bed | 702 kg $CO_2e$ / bed |
| | Hospital beds per invested million euro (auxiliary variable) | 42.4 beds / EUR m |

| **Ecological Indicators** | | |
|---|---|---|
| Sustainable Land Use | Supported area | 2,053 ha / EUR m* |
| Animals in animal-friendly husbandry | Supported animals | 27,927 animals / EUR m * |
| Protection of nature | Number of biological stations | 44 Stations* |
| **Social Impact Indicators** | | |
| "Bund-Länder-Covenant for the expansion of universities | Additional first-year students | EUR 13,000 over 4 years / additional first-year student |
| | Bachelor graduates | EUR 4000 / bachelor graduate |
| | New master student places | EUR 10,000 over 2 years / master place |
| Funding of the return for highly qualified young researchers | Number of research groups | 16 research groups* |
| EU School programme | Financed minimum number of pupils | EUR 34.25 / pupil* |
| Training facilities for the education of special education teachers | Training positions | EUR 957/ training position |
| Funding of professional education of geriatric nurses | School allowance per student | EUR 380/ month |
| Fight against poverty and social exclusion (share for "Endlich ein ZUHAUSE!") | Supported households | EUR 2071 / households |
| Support for family centres | Funded family centres | EUR 20,000 / centre |
| PlusKiTa and language courses at childcare facilities | Founded positions | EUR 38,857 / position |
| Social School Work | Founded social school workers | EUR 64,815 / position |
| Occupational integration of people with disabilities | New created jobs | 20,000 EUR / position |
| Broadband Expansion | New Access points | EUR 2000 / access point |

*(* shows values that change annually as they are based on yearly published monitoring reports)*

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