A partnership built on trust

Berlin Hyp

Annual Reporting 2018/19
Green Bonds

Finanzgruppe

Editorial

Dear Sir or Madam,

Last year, we once again succeeded in launching two Green Bonds in benchmark format, as we did in 2017. A 10-year Senior Unsecured (Non-Preferred) bond in April was followed in October 2018 by another Green Pfandbrief. At 58 percent, a larger share of this bond was purchased by non-domestic investors than with any previous benchmark bond issued by Berlin Hyp. The share of foreign investors was also higher than for any other German Pfandbrief denominated in euros issued since the financial crisis. For us, this warm reception once again underscored the added value that Green Bonds offer investors.
All told, we have now issued six Green Bonds in benchmark format since 2015 – more than any other European commercial bank. That is something we are proud of, and it fills us with joy, much like our fourth green bond annual report, which we are publishing today. As usual, the report is structured into the sections

yet it also contains a few important changes.

Both in 2017 and 2018, Berlin Hyp was recognised for the best Post-Deal or Impact Reporting at the GlobalCapital Green Bond Awards. We were delighted to be honoured by market participants with such a prestigious prize for two times in a row.
At the same time, it motivates us to grow even better. Last April, we presented to you our new and improved green building eligibility criteria, which lowered the maximum permissible energy demand for heating while adding new maximum permissible energy demand targets for electricity for the various property types to the criteria catalogue.
By breaking down the energy efficiency of commercial real estate into individual aspects, Berlin Hyp has once again taken a leading role. This more detailed approach is now reflected in our impact reporting for the first time. But that is not all. Thanks to the constant increase in the extent of energy-efficiency data in our loan monitoring system, the current impact reporting is for the first time based on individual, building-specific energy sources instead of the average energy mix per country. As a result, we are now able to calculate the CO_2 savings attributable to our Green Finance Portfolio and our Green Bonds with significantly greater precision and accuracy than in the past.

To make the necessary adjustments to our methodology, as detailed in section D, we sought the advice of the experts at Drees & Sommer, who also performed our impact calculations, and whom I would like to thank for their excellent work.

Berlin Hyp cares not only about its own performance, but also about the development of the Green Bond market, especially the market for green covered bonds. In December, we therefore transferred all our rights to the Grüner Pfandbrief and Green Pfandbrief trademarks to the Association of German Pfandbrief Banks (vdp) so as to allow other Pfandbrief issuers to use them. In exchange, we requested that the vdp set up a working group to develop minimum standards for Green Pfandbriefe. The committee, which includes Berlin Hyp as well as all other vdp member institutions that have already issued Green Bonds, started its work in January 2019. We are confident that it will soon be possible to publish the first standards. German Pfandbrief banks are set to send a clear and powerful signal in times in which the Green Bond market and the covered bond sector are preparing for increasingly well-defined guidelines thanks to the efforts surrounding EU taxonomy and the Energy Efficiency Mortgages Initiative (EEMI).

We at Berlin Hyp will continue to invest time, effort and money in the development of our Green Bonds, not least in order to keep offering our Green Bond investors sustainable and convincing products that are based on the latest market findings. Your feedback is particularly important to enable us to achieve this. So please don't hesitate to get in touch with us. I hope you enjoy reading our fourth green bond annual report.

Yours sincerely,

Gero Bergmann

A – Green Bond Framework

Together with this annual report, Berlin Hyp publishes the third update to its Green Bond Framework. The Green Bond Program that was first published in August 2016 and governs the structure of both Green Pfandbriefe and Green Senior Unsecured bonds stipulates that Berlin Hyp can make adjustments to the framework at any time, provided said adjustments supplement the eligibility criteria or result in them becoming stricter.

Following last year's introduction of a differentiation between energy demand for heating and electricity, the bank supplemented the framework in two further regards prior to compiling this year's report. To start with, it introduced the property type "light industrial" to also be able to finance energy-efficient logistics buildings in the future whose use goes beyond distribution and the mere storage of goods to include the production and administration of such. Moreover, it clarified that the eligibility of developments is to be demonstrated by energy demand calculations which are part of the building permit process.

The revised framework as of April 2019 can be downloaded at www.green-pfandbrief.com[1].

The framework defines green buildings as energy-efficient commercial properties with an energy demand or consumption that does not exceed the following values:

Property type	Framework		
	Energy demand heating kWh/(m²*a)	Energy demand electricity kWh/(m²*a)	Total kWh/(m²*a)
Residential	60	–	**60**
Office	100	80	**180**
Retail	60	75	**135**
Hotels	95	60	**155**
Logistics (use: storage)	30	35	**65**
Light industrial (use: production)	105	65	**170**

Additional/alternative eligibility criteria include the following sustainability certificates[2]:

LEED	Gold status or higher
BREEAM	Very good status or higher
DGNB	Gold status or higher (for certificates up to 30 June 2015: silver status or higher)
HQE	High level status or higher

1 In December 2018, Berlin Hyp transferred its rights to the Grüner Pfandbrief and Green Pfandbrief trademarks to the Association of German Pfandbrief Banks (vdp) so as to allow other institutions to use them. The content of the aforementioned websites will be integrated into Berlin Hyp's company website over the course of 2019. The internet domains mentioned will also be transferred to vdp.

2 LEED, BREEAM, DGNB and HQE issue sustainability certificates for buildings. Buildings financed by Berlin Hyp following the issue of the Green Pfandbrief on 27 April 2015 must achieve a score of at least 50 percent in the energy efficiency category of the green building certificate if the building does not already qualify through its energy requirements and consumption.

The reference values above (derived from the German energy savings regulation (Energy Savings regulation, EnEV[3]) form the basis of our criteria and are also part of the annual re-verification process by ISS-oekom. The criteria refer to the final energy demand. Alternatively, the primary energy demand value can be used in certain cases where modern technology has been installed in/at the building (such as a block power station, heat recovery plant, etc.) to achieve a significant reduction in primary energy demand.

The eligibility criteria are generally to be fulfilled on an additive basis, which means that the main decision criterion is the sum of the energy demand for heating and electricity (shown in the above table in the "Total" column). In order to prevent buildings with energetically poor building envelopes or buildings with disproportionately high electricity demand from being included in the Green Finance Portfolio, the maximum values in each energy demand category may not be exceeded by more than 20 percent. In the case of residential buildings, the differences attributable to the personal characteristics of users mean that no maximum threshold for electricity consumption has been defined.

Furthermore, the April 2019 version of the framework clarifies that Green Senior Unsecured Bonds may be issued as Senior Preferred and Senior Non-Preferred Bonds.

ISS-oekom positively assessed the sustainability of the green bond programme underpinning the issues as part of its second party opinion dated 22 August 2016. This verdict was confirmed in consideration of the adjustments to the framework as part of the annual re-verification process in April 2019.[4]

3 https://www.bundesanzeiger.de/ebanzwww/wexsservlet?page.navid=to_bookmark_official&bookmark_id=aw0alBTBco6yYzcam0E; based on the analysis by an external energy consulting firm, Berlin Hyp decided in 2018 to make its eligibility criteria even stricter. This is in line with the bank's long-term strategy concerning the quality of eligible assets.

4 The re-verification can be downloaded at www.green-pfandbrief.com.

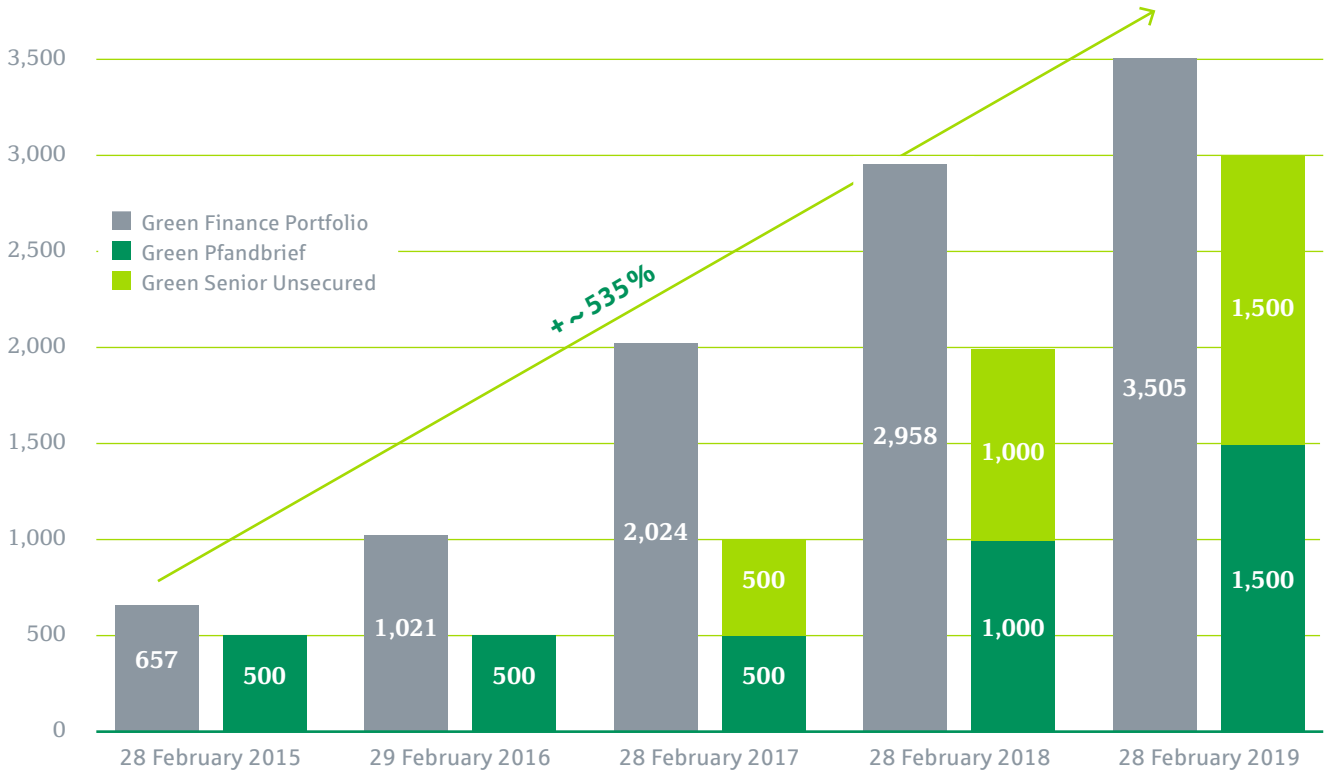
B – Portfolio Report
Development of the Green Finance Portfolio

In the reporting period from 1 March 2018 to 28 February 2019, portfolio growth of € 547 million was achieved through a € 489 million increase in new green business and € 58 million in existing loans retrospectively identified as green financing. This means that over 16 percent of the Berlin Hyp loan portfolio can be attributed to the Green Finance Portfolio. Both the real estate and capital markets continue to show growing interest in green finance.

As at 28 February 2019, the portfolio encompassed the financing of 122 green buildings. Twenty-four of the 31 retrospectively identified buildings are attributable to a portfolio financing transaction consisting of multiple smaller properties. The review of said properties' eligibility was made possible by improved internal processes. At € 2,315 million, around two-thirds of the portfolio is part of Berlin Hyp's mortgage cover pool. Overall development is shown in the following table and chart.

Nominal value € mn

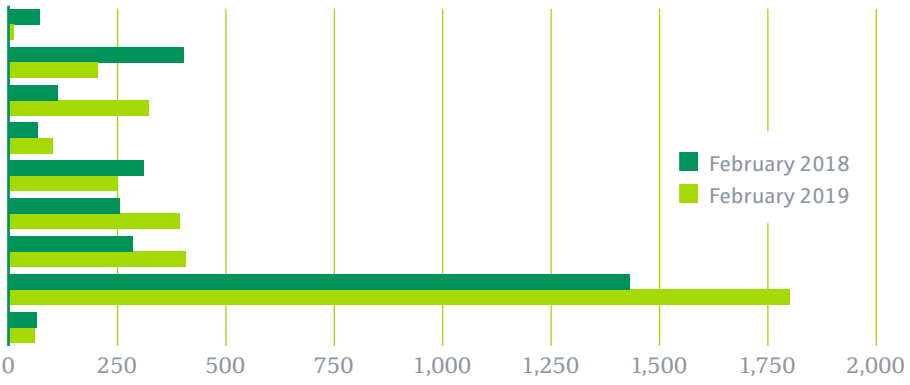
	Total	Number of green buildings
Total as at 28 February 2018	**2,958**	**70**
Extensions and retrospectively identified existing loans for green buildings less repayments	58	31
New loans for green buildings granted after 28 February 2018	489	21
Total as at 28 February 2019	**3,505**	**122**



In sections B.1 to B.4, the green building financing included in Berlin Hyp's Green Finance Portfolio is classified according to a variety of parameters. All figures relate to the closing date as at 28 February 2019.

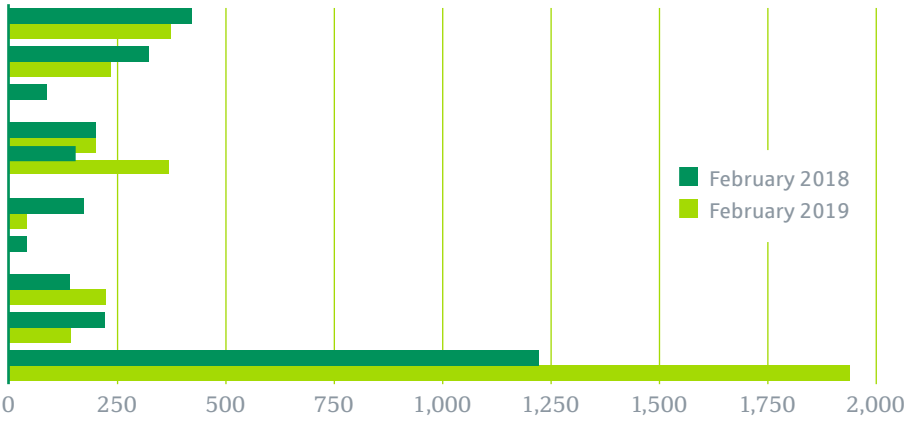
B.1 Loans for green buildings according to their term to maturity

Maturity structure	€ mn	%
≤ 6 months	11	0
6 months and ≤ 1 year	202	6
1 year and ≤ 1.5 years	317	9
1.5 and ≤ 2 years	100	3
2 and ≤ 3 years	248	7
3 and ≤ 4 years	388	11
4 and ≤ 5 years	402	11
5 and ≤ 10 years	1,778	51
> 10 years	59	2
Total	**3,505**	**100**



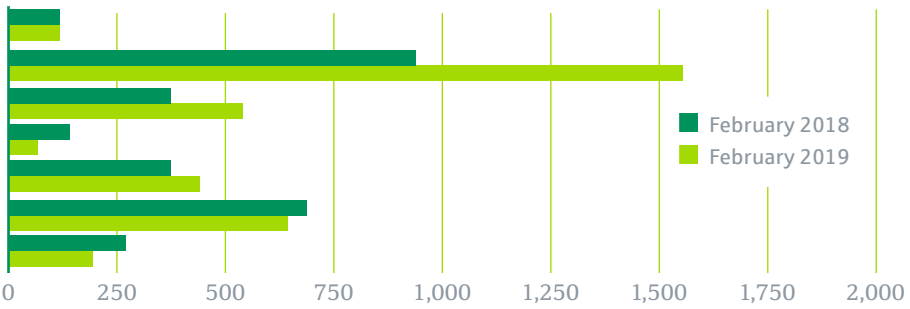
B.2 Loans for green buildings according to certification levels

Certificates	€ mn	%
BREEAM Excellent	368	11
BREEAM Very Good	231	7
BREEAM Good	0	0
DGNB Platin	197	6
DGNB Gold	363	10
HQE Basic Level	41	1
HQE High Level	0	0
LEED Gold	219	6
LEED Platinum	140	4
EPC	1,946	55
Total	**3,505**	**100**



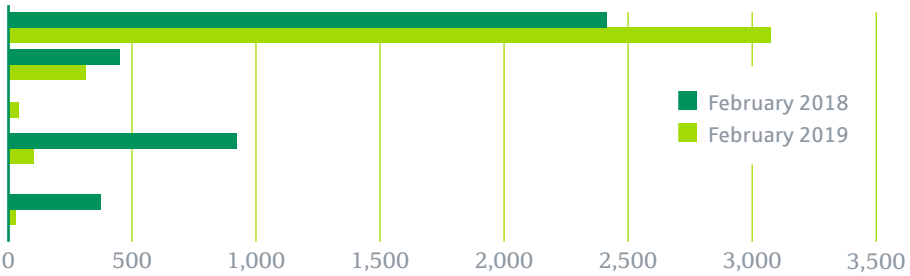
B.3 Loans for green buildings according to countries

Countries	€ mn	%
Belgium	115	3
Germany	1,533	45
France	532	15
UK	66	2
Netherlands	434	12
Poland	635	18
Czech Republic	190	5
Total	**3,505**	**100**



B.4 Loans for green buildings according to type of use

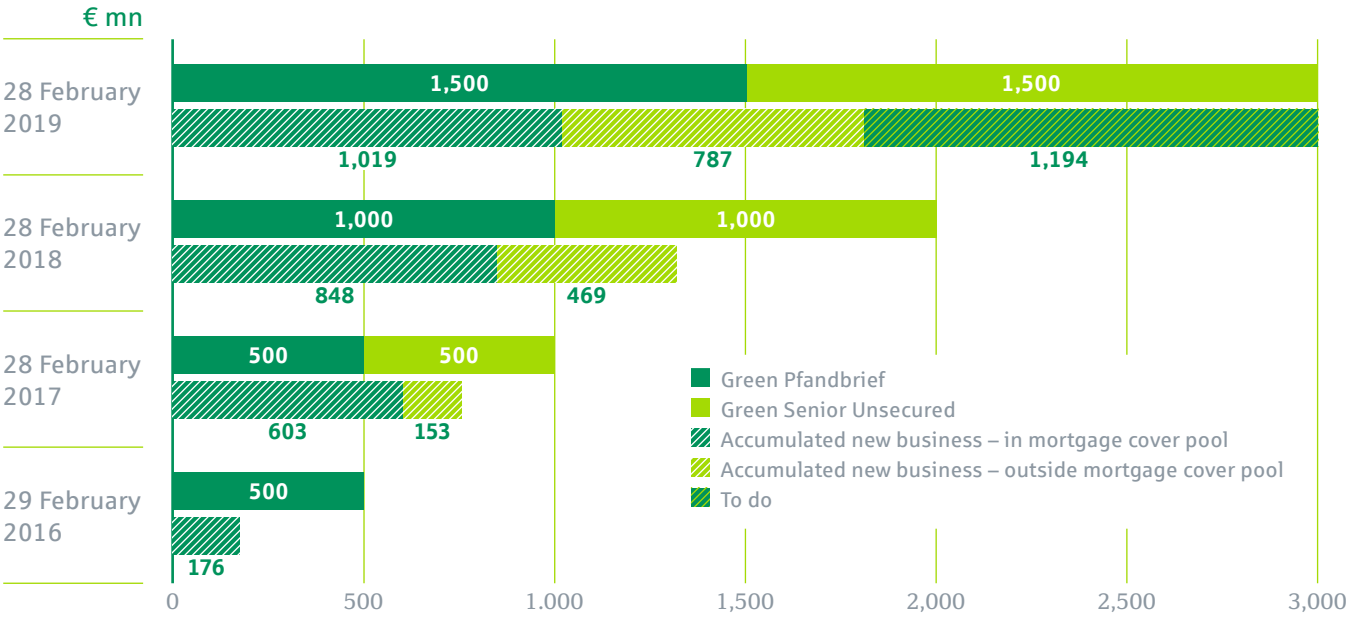
Type of use	€ mn	%
Office buildings	3,036	86
Retail buildings	304	9
Logistic	37	1
Management / Social buildings	99	3
Multi-family dwellings	29	1
Total	**3,505**	**100**



C – New Business Report

Berlin Hyp's Green Bond Program stipulates that both Green Pfandbriefe and Green Senior Unsecured bonds serve to refinance loans for green buildings already included on the balance sheet; in the case of Green Pfandbriefe, they must also be part of the bank's mortgage cover pool. At the same time, the bank is committed to making every effort to invest an amount equivalent to the proceeds from the issued Green Bonds in new green assets during the term of the bond (and to include this amount in the mortgage cover pool in the case of Green Pfandbriefe).

The following chart shows that € 1,806 million had already been invested in new loans for green buildings by 28 February 2019 in order to fulfil our commitment for the six outstanding Green Bonds. Accordingly, a further € 1,194 million is necessary to fulfil the commitment. The remaining amount is split up into € 481 million for the third Green Pfandbrief (maturity: 10/25) and € 713 million for the two most recently issued Green Senior Unsecured bonds (maturity: 06/27 and 04/28).



Since the last report as by 28 February 2018, a total of 21 new loans with a nominal value of € 416 million have been added to the Green Finance Portfolio. A further € 73 million in new business is attributable to existing loans with ongoing disbursement, such as development finance.

The new green loans from the latest reporting period, along with energy demand figures, are presented below in anonymised form. For French properties, please note that the energy performance certificates do not differentiate between heating and electricity. The total energy demand stated in the energy performance certificates has therefore been divided up among the two components in accordance with the ratios stipulated in our criteria.

New Business from 1 March 2018 till 28 February 2019

Type of use	Country	Granting of loan	Loan (€ mn)	Certificate	Type of project	Rentable area (m^2)	Energy demand heating (kWh/m^2*a)	Energy demand electricity (kWh/m^2*a)
Retail	Netherlands	02.07.18	1.99	EPC	Financing	2,720	19	25
Retail	Germany	21.03.18	3.90	EPC	Financing	3,497	65	26
Office	Germany	28.06.18	13.94	EPC	Financing	30,762	94	70
Office	Netherlands	25.04.18	57.50	EPC	Financing	38,195	22	18
Office	Germany	10.04.18	8.00	EPC	Financing	9,268	48	56
Office	Germany	16.07.18	48.00	EPC	Financing	14,938	106	35
Office	Netherlands	30.04.18	8.20	EPC	Financing	5,671	64	38
Office	Netherlands	30.04.18	11.80	EPC	Financing	5,064	52	26
Office	Netherlands	06.08.18	38.00	BREEAM Excellent	Financing	14,375	2	16
Office	Germany	23.08.18	42.26	EPC	Financing	11,295	68	3
Office	France	27.09.18	49.40	EPC	Financing	14,931	21	16
Office	France	20.11.18	5.52	EPC	Financing	3,322	39	31
Office	France	20.11.18	26.29	EPC	Financing	10,685	27	22
Office	France	20.11.18	4.48	EPC	Financing	2,763	7	5
Office	France	20.11.18	6.41	EPC	Financing	6,077	44	35
Logistic	Germany	29.11.18	23.20	DGNB Gold	Financing	40,944	87	7
Office	Germany	ongoing	40.90	DGNB Gold	Development	13,123	–	–
Hotel	Germany	10.12.18	9.00	EPC	Financing	3,055	113	5
Retail	Germany	15.01.19	1.81	EPC	Financing	1,450	42	31
Retail	Germany	15.01.19	1.81	EPC	Financing	1,519	67	30
Office	Germany	21.02.19	13.70	EPC	Financing	9,632	66	12
Total			**416.11**					

D – CO_2 Reporting: Results and Methodology

On the following pages, you will find the results and methodology of our assessment of avoided carbon emissions owing to Berlin Hyp's Green Bonds. Last year, Berlin Hyp added a new element to its reporting framework in the shape of energy demand for electricity. As a result, this year's Impact Report includes both, a calculation of carbon emissions avoided due to the energy demand for electricity and the energy demand for heating of green buildings. The bank also increased data requirements with the addition of information on the energy source for heating in each individual building to further increase the accuracy of the report. In past years, the conversion of energy savings into avoided carbon emissions was calculated on the basis of conversion factors determined according to the energy mix in each respective country. Now, however, individual conversion factors are applied that are based on the energy source for heating in each individual building. In the case of green buildings in Germany heated by district heating system, there is also the possibility to account for regional differences.

These methodological developments and the impact calculation itself were performed in partnership with the acclaimed consulting firm Drees & Sommer. The calculations were passed on to ISS-oekom on a line-by-line basis, who reviewed the plausibility of the results as part of a re-verification process in April 2019.[5]

Due to data confidentiality, this report only contains aggregate numbers. All calculations are based on loan data as of 28 February 2019 and on the most current available energy performance certificate (EPC) and/or sustainability certification for each property. If no EPC data is available, energy demands were set on equal levels with the baseline figures. This was the case for a total of 9 of 122 buildings. If information regarding heating sources was not available (14 buildings), the country-specific CO_2 factor for district heating and electricity was used.

D.1 Estimated avoided carbon emissions

Several assumptions significantly influence the estimation of avoided carbon emissions.

First, the quantification of avoided carbon emissions of a specific asset depends on the choice of a baseline, i.e. the carbon emissions of a reference asset against which the carbon emissions of this specific asset are compared. This choice is highly sensitive, since avoided carbon emissions decrease as the energy efficiency of the chosen baseline increases. This is particularly true in the real estate sector, where buildings' energy performance varies greatly depending on asset type and construction year.

Second, another important decision is the way carbon emissions are allocated to one given asset. In practical terms, one can allocate the avoided carbon emissions of a given asset to the debt holder either in full or proportionally in the amount of the financing share.

In order to provide a maximum of transparency to investors, this carbon report includes four different estimates of avoided carbon emissions corresponding to two baselines:

→ The latest energy reference values (heating and electricity) for various real estate classes according to the German Energy Savings Regulation (Energieeinsparverordnung, EnEV) provide the first baseline. These values are developed and published by the German Federal Ministry of Transport, Building and Urban Development (hereinafter referred to as "EnEV reference values").[6] This reference provides an estimate of avoided carbon emissions.

5 Published on www.green-pfandbrief.com.

6 Joint Announcement by the Federal Ministry of Economics and Energy and the Federal Ministry for the Environment, Nature Conservation, Construction and Nuclear Safety (Ed.): Announcement of the Rules for Energy Consumption Values and the comparative values for non-residential buildings, 7 April 2015

→ Average heat energy efficiency of existing properties in Europe provides a second benchmark. This involves comparing each building with the average heat energy efficiency of existing properties in Europe. This baseline provides a rough estimate of the positive carbon impact of Berlin Hyp's Green Bond assets.

In addition, the following two assumptions are applied to the avoided carbon emissions:

→ 100 percent of the carbon impact of each asset is allocated to Berlin Hyp financing.

→ Carbon impact is allocated proportionally to Berlin Hyp's initial share in financing.

The results are provided in the table below.

In avoided tCO_2/€ mn/year	100 percent allocated to Berlin Hyp financing	Proportionally allocated to Berlin Hyp's initial financing share
against current EnEV reference values (heating energy and electricity)	**38.81** (PY 15.7)	**21,58** (PY 8.7)
against the European average (heating energy only)	**22.20** (PY 36,3)	**12.57** (PY 21.1)

Avoided carbon emissions against the current EnEV reference values increased significantly year on year. This was due to the inclusion of electricity values in the carbon emissions calculation. In addition, the figures show the constant improvement of energy efficiency of green buildings included in Berlin Hyp's Green Finance Portfolio.

Avoided emissions against the European average declined markedly in the current reporting year due to the differentiated assessment of energy demand (see Section D.3. Baseline 2) and the detailed calculation of carbon emission factors, which is explained in Section D.3.

The significant variation between these results shows how important the choice of baseline and the calculation assumptions are in the Impact Report.

Energy demand for heating of the financed green buildings is 150 GWh lower per year compared to the EnEV reference values.[7] On average, financed green buildings have an energy demand for heating of 60 kWh/m² per year, which is 51 percent lower than the weighted average EnEV reference values (123 kWh/m² per year).[7] In addition, a total of 139 GWh of electricity is saved every year. Financed green buildings have an average energy demand for electricity of 37 kWh/m² per year, which is 63 percent lower than the weighted average EnEV reference values (99 kWh/m²). **This results in avoided carbon emissions of 116,000 tonnes per year in absolute terms**.

In terms of the European average, financed green buildings generate savings of 280 GWh concerning their energy demand for heating.[8] The buildings have an average energy demand for heating of 60 kWh/m² per year, which is 68 percent lower than the European average (188 kWh/m² per year). This results in avoided carbon emissions of 67,000 tonnes per year in absolute terms.

7 The calculation of the average is based on buildings with available EPC data only (113 of 122).

8 ∑ [m² building*(baseline – kWh per m²)]

D.2 Principles of methodology

The methodology is based on a two-phase process:

I. An estimation of the energy savings per building, which includes:

- **a: Assessment of each building's energy efficiency**
  (Final energy demand for heating and for electricity in kWh/m² per year)
- **b: Choice of the energy efficiency baseline**
  EnEV reference values: Final energy demand for heating and for electricity in kWh/m² per year
  European average: Final energy demand for heating in kWh/m² per year
- **c: Calculation of energy savings (a–b)**
  EnEV reference values: Final energy demand for heating and for electricity savings in kWh/m² per year
  European average: Final energy demand for heating savings in kWh/m² per year

II. An assessment of carbon intensity of avoided energy using specific carbon emissions factors through the following:

- **d: Assessment of the carbon intensity of different energy sources for heating and differentiation of carbon intensity of each country's electricity mix and district heating supply as well as further differentiation of the district heating supply in Germany by region**
  (kg CO_2/kWh final energy demand) [9]
- **e: Calculation of carbon intensity savings**
  (c*d) (kg CO_2/m²*per year)
- **f: Calculation of total avoided carbon emissions**
  (e*rentable surface of the building) (kg CO_2/m²*per year)
- **g: Initial Market Value of building**
  (€ mn) (Initial Loan/Initial Loan to Value (LTV))
- **h: Outstanding nominal amount in the Green Finance Portfolio** (€ mn)
- **i: Berlin Hyp share expressed as a percentage of the initial market value of asset**
  (Initial LTV) (%)
- **j: Calculation of financed avoided carbon emissions** (f*i) (kg CO_2 per year)

D.3 Energy efficiency baselines

Two sets of comparable values were selected as energy efficiency baselines in order to provide different annual estimates of energy savings.

Baseline 1:
Current EnEV reference values

The energy savings calculated for the green buildings in Berlin Hyp's green finance portfolio are measured against the current standards in Germany using the reference values in the table below. As a result, energy-efficiency reference values for heating vary from 30 kWh/m² per year for logistic buildings to 135 kWh/m² per year for office buildings. Electricity standard values are between 35 kWh/m² per year and 105 kWh/m² per year.

9 See also Section D.4 and Appendix

The specific heating energy reference value for residential buildings is taken from the Deutsche Energie-Agentur Report on Buildings 2016. This value equates to the threshold value for new builds defined in the German Energy Savings Regulation 2009.[10]

Given that the framework for residential buildings does not take the energy demand for electricity into account, the electricity reference value for residential buildings is not included.

Use	Specific energy demand for heating (kWh/m² per year)	Specific energy demand for electricity (kWh/m² per year)
Residential	60	–
Office	135	105
Retail	70	85
Hotel	105	65
Logistics (use: storage)	30	35
Light industrial (use: production)	110	65

Baseline 2:
Average energy efficiency of existing European buildings

Energy demand for heating, cooling and domestic hot water for buildings representative of existing building stock have been modelled in the European project ENTRANZE[11]. Single houses, multi-family dwellings, offices and schools are covered. Comparing carbon emissions on the basis of energy demand for electricity is not suitable, as energy demands for ventilation and lighting are not taken into account as part of the project. Due to this fact, the baseline is only used to compare emissions caused by the energy demand for heating.

In accordance with the composition of Berlin Hyp's Green Finance Portfolio, only the values for multi-family dwellings and offices are considered for the present calculation. Values for selected relevant countries/cities (Berlin, Vienna, Prague, Paris and Helsinki) are averaged to obtain a robust baseline.

As a result, 188 kWh/m² per year is derived as a baseline of energy efficiency for European existing offices[12] and 158 kWh/m² per year is derived as a baseline of energy efficiency for existing European multi-family dwellings.

The assessment shows a year-on-year decline in avoided carbon emissions due to the differentiated consideration of this baseline. This is primarily due to the reduction of the baseline from 205 kWh/m² per year to 188 kWh/m² per year as a result of the incomplete electricity component.

Another reason for the decline is the change in the method used to calculate emissions. The country-specific factors that were previously used were substituted by producer-specific and country-specific factors in this year's calculation. Please see Section D4 and the Appendix for further information.

10 Deutsche Energie Agentur (publisher): dena Report on Buildings: Energy efficiency in the building stock – statistics and analyses (2016)

11 ENTRANZE, März 2014. Heating and cooling energy demand and loads for building types in different countries of the EU – D2.3. of WP2 of the Entranze Project. www.entranze.eu/files/downloads/D2_3/Heating_and_cooling_energy_demand_and_loads_for_building_types_in_different_countries_of_the_EU.pdf

12 This is assumed for all commercial real estate in Berlin Hyp for CO_2 reporting as ENTRANZE does not include any data for other commercial real estate except office buildings.

D.4 Carbon dioxide intensity of energy consumption in the real estate sector

63 out of the 122 green building financings are collateralised by properties situated in Germany, 18 by properties situated in Poland and 17 by properties in the Netherlands. In addition, nine are collateralised by properties situated in the Czech Republic, 13 by properties in France and one by properties in Belgium and the UK respectively.

The following carbon emissions factors split into respective energy sources originate from the standard reference work of the European Commission[13] and have been included in the calculation for all countries.

Energy source	kg CO_2/kWh final energy demand
Heating oil	0.306
Natural gas	0.240
Liquefied gas	0.281
Wood	0.420
Biogas	0.284
Biopetroleum	0.182

The following emissions factors were able to be used, with the help of information provided by regional energy supply companies, for a detailed calculation of emissions from district heating systems in Germany:

District heating by region in Germany	kg CO_2/kWh final energy demand
Munich	0.125
Cologne	0.074
Duisburg	0.126
Frankfurt am Main	0.175
Düsseldorf	0.092
Böblingen	0.084
Offenbach am Main	0.374
Oberhausen	0.080
Mannheim	0.182
Bonn	0.144
Neubrandenburg	0.194
Essen	0.201
Hamburg	0.146
Dortmund	0.201
Karlsruhe	0.073
Saarbrücken	0.123
Berlin	0.129

13 Joint Research Centre of the European Commission (publisher): CoM Default Emission Factors for the Member States of the European Union, http://data.jrc.ec.europa.eu/dataset/jrc-com-ef-comw-ef-2017

Carbon emissions factors for district heating systems outside of Germany were calculated as no complete data was available. The method used to calculate these values is described in the Appendix.

District heating by country	kg CO_2/kWh final energy demand
France	0.031
Netherlands	0.205
Poland	0.368
Czech Republic	0.327
Belgium	0.075
UK	0.125

The following country-specific emissions factors[14] were used to calculate emissions from energy demand for electricity.

Electricity by country	kg CO_2/kWh final energy demand
France	0.093
Netherlands	0.486
Poland	1.090
Czech Republic	0.850
Belgium	0.589
UK	0.239

The emissions factor for electricity in Germany is 0.550 kg CO_2/kWh final and is taken from the DIN V 18599 standard.[15]

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14 Joint Research Centre of the European Commission (publisher): CoM Default Emission Factors for the Member States of the European Union, http://data.jrc.ec.europa.eu/dataset/jrc-com-ef-comw-ef-2017.

15 DIN Deutsches Institut für Normung e.V.: DIN V 18599-1:2018-09 Energy performance of buildings – Calculation of useful, final and primary energy requirements for heating, cooling, ventilation, domestic hot water and lighting – Part 1: General balancing methods, definitions, zoning and evaluation of energy sources (2018)

Appendix

In order to calculate carbon emissions from district heating systems in buildings outside of Germany, the emissions factor must either already be known or, as in this case, be determined.

Country-specific data relating to heating energy and electricity production, as well as total carbon emissions in the year 2016[15] as published by the International Energy Agency, are used to determine the emissions factor.

Country	Heat energy produced[16] (TWh)	Electricity produced[16] (TWh)	Total emissions[17] ($MtCO_2$)
France	39.2	442.4	36.8
Netherlands	24.9	105.6	60.7
Poland	65.9	132.8	150.0
Czech Republic	24.8	56.0	55.2
Belgium	5.8	81.9	16.2
UK	13.2	303.9	99.4

Given that carbon emissions are calculated as the total of emissions out of electricity and heating, the values only attributable to heating energy must be determined for each country first of all as follows:

$$CO_2 - \text{emissions (heat)} = \text{percentage of heat emissions} * CO_2 - \text{emissions}_{tot}$$

The percentage share of heating energy emissions compared to total emissions equates to the percentage share of heating energy generated compared to overall energy generated in consideration of energy production efficiency. This is calculated on the basis of existing energy data.

Using these heating energy emissions values, the emission factor can now be calculated in relation to the heating energy generated by the respective country:

$$CO_2 - \text{emission factor (heat)} = \frac{CO_2 - \text{emissions (heat)}}{\text{heat output}}$$

This provides the following emissions factors for district heating outside of Germany, which are essential for the Impact Report:

District heating by country	kg CO_2/kWh final energy demand
France	0.031
Netherlands	0.205
Poland	0.368
Czech Republic	0.327
Belgium	0.075
UK	0.125

15 More recent data is not available.

16 IEA, 2018, Fuel Combustion Highlights – Carbon Content Values (kg C/GJ). http://www.indiaenvironmentportal.org.in/files/file/CO2_Emissions_from_Fuel_Combustion_2018_Highlights.pdf

17 This data is taken from IEA Headline Energy Data 2018. www.iea.org/statistics/

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