Green Bond Impact Reporting 2021/2022

20 December 2022

gkb.ch/greenbond

Graubündner Kantonalbank

Green Bond Impact Reporting by Graubündner Kantonalbank

Contents

1 Executive summary

Personal and political debates increasingly revolve around climate protection issues. Reducing CO_2 emissions has become an established priority and objective, but how this can be achieved most effectively is often still a matter of debate. While large-scale industry and private transport usually come to mind first and are therefore often targeted for the implementation of specific measures, buildings are also one of the biggest sources of emissions and are responsible for around a quarter of the greenhouse gases emitted in Switzerland.[1]

The typical single-family house contributes substantially to this statistic. Since around two-thirds of residential buildings are still heated using fossil fuels (i.e. gas or oil heating) or directly using electricity[2], when it is cold large amounts of emissions are generated directly at the building or during the generation of the required electricity. Climate-friendly alternatives such as heat pumps and solar technology are accounting for an ever-growing proportion of installed heating systems. As they are planned and installed in new buildings whenever possible, heat pumps, for example, are already used in one in five buildings. However, their spread in existing buildings is also dependent on renovation cycles, which are measured in decades. As a result, the comprehensive conversion of the Swiss building portfolio will still take some time.

In 2021 and 2022, we launched two green bonds to refinance what are known as "green loans," which include both the financing of renewable energy sources and energy efficiency projects for homes. They have the following features:

Borrower	Graubündner Kantonalbank
Issue amount	CHF 100,000,000
Issue	7 December 2021
Expiry	7 December 2029
Coupon	0.10% p.a., payable annually on 7 December, for the first time on 7 December 2022
Listing	SIX Swiss Exchange
Security / ISIN number	114 170 053 / CH1141700539

Borrower	Graubündner Kantonalbank
Issue amount*)	CHF 200,000,000
Issue	27 May 2022
Expiry	27 May 2030
Coupon	1.30% p.a., payable annually on 27 May, for the first time on 27 May 2023
Listing	SIX Swiss Exchange
Security / ISIN number	118 291 771 / CH1189217719

*) On 9 August 2022, GKB made use of the reopening clause and increased this green bond by CHF 75 million from CHF 125 million to a total of CHF 200 million.

As of 30 June 2022, two green bonds totalling CHF 225,000,000 were outstanding.

1 Federal Office for the Environment (2022). *Climate: In brief*. Accessed on 01/09/2022 from https://www.bafu.admin.ch/bafu/en/home/topics/climate/in-brief.html

2 Federal Statistical Office (2017). *Energy sector*. Accessed on 01/09/2022 from https://www.bfs.admin.ch/bfs/en/home/statistics/construction-housing/buildings/energy-sector.html

With the proceeds from the issue of green bonds, GKB intends to fully or partially finance and/or refinance green projects in the areas of "renewable energy sources" and "green buildings." The green projects thus support mitigation of climate change, among other things, and overall have a positive impact on the lasting implementation of the UN's Sustainable Development Goals (SDGs):

- Goal 7 Affordable and clean energy
- Goal 11 Sustainable cities and communities
- Goal 13 Climate action

A specially developed "Green Bond Framework" serves as the basis for deciding whether a property qualifies for financing from a green bond. This report analyses the mortgage loans granted to date and estimates the CO_2 emissions to be saved in the future as a result of these loans. The analysed building portfolio comprises 305 owner-occupied homes financed by GKB. In order to quantify the emission savings of a financed individual property, it is compared with a relevant reference property and the expected heating energy requirement is statistically derived.

The overall reduction in CO_2 emissions based on the evaluation of the green buildings financed by GKB is estimated at 171 tonnes of CO_2 per year for the reporting period (7 December 2021 to 30 June 2022). This corresponds to the annual emissions of around 137 new, average passenger cars[3] or the average CO_2 emissions released by around 12 Swiss persons.

In addition to financing particularly climate-friendly buildings, the green bond proceeds are also used to support hydropower plants, which generated a net total of 2,400 GWh of hydropower in the reporting year, which, as expected, led to a reduction in greenhouse gases of around 55,500 tonnes of CO_2e. The share attributable to the green bond amounts to 22% of the net generation of 537 GWh and 23% of the emission reductions of 12,856 tonnes of CO_2e.

The financing provided by the green bonds resulted in emission reductions of 6,656.7 tonnes of CO_2e. A summary of the allocation and the results of the impact analysis can be found in Table 1.

Reporting period 07/ 12/ 2021 – 30/ 06/ 2022			
Hydropower	Volume in CHF million	147.8	
	Number of power plants	10	
	Savings in tonnes of CO_2e	12,856.0	
	Allocation from green bond in CHF million	75.0	✓
Green buildings	Volume in CHF million	192.8	
	Number of buildings	305	
	Savings in tonnes of CO_2e	171.0	
	Allocation from green bond in CHF million	150.0	✓
Total green loans	Volume in CHF million	340.6	
	Savings in tonnes of CO_2e	13,027.0	
Outstanding green bonds	Volume in CHF million	225.0	✓
	Savings in tonnes of CO_2e	6,656.7	

Table 1: Allocation from green bonds and results of impact analysis

3 Swiss Federal Office of Energy (2019). *Fuel consumption and CO_2 emissions from new passenger cars increased significantly in 2018*. Accessed on 01/09/2022 from https://www.bfe.admin.ch/bfe/de/home/news-und-medien/medienmitteilungen/mm-test.msg-id-75710.html

2 Introduction

GKB has been publishing sustainability reports on a regular basis since 2013. In order to improve comparability and transparency, these comply with the reporting standard of the Global Reporting Initiative (GRI). In the 2021 reporting year, the sustainability report was prepared in accordance with the GRI-21 standard. Irrespective of the issue of the green bonds discussed in this report, GKB has been climate-neutral in the area of business ecology since 2015. GKB underpins its efforts and ambitions in the area of sustainability through various memberships and the signing of initiatives such as the UN Principles for Responsible Investment in 2021. Further information can be found in the respective annual and sustainability reports.

As the second-largest emitter of greenhouse gases after motorised transport, the building portfolio is an important area of application for measures to reduce energy consumption and increase efficiency. As a core competency of GKB, the mortgage business therefore harbours great potential for developing appropriate products to promote sustainable construction and renovation. To this end, GKB launched a special service package in 2022 (gkb.ch/greendeal).

The funds raised from the two GKB green bonds are used to refinance GKB's "green loans", which include both the financing of renewable energy sources and energy efficiency projects for owner-occupied homes. Green loans for renewable energy sources focus primarily on larger hydropower plants, which is driving the environmentally compatible development of electricity generation in Switzerland. By granting mortgages for owner-occupied, energy-efficient residential property, GKB promotes the environmentally compatible development of private construction activities.

The following impact report is intended to show the extent to which savings in CO_2 emissions can be attributed to GKB's green bonds. For the purposes of comparison, the properties were compared to reference properties in each case. The resulting outcomes reflect the expected energy requirements and assume normal consumer behaviour. This returned a comparable consumption value rather than a figure for actual consumption, which can be strongly influenced by individual user behaviour. In the case of hydropower, a reference scenario is assumed according to which the eligible electricity would have been produced in accordance with the Swiss generation mix. To improve legibility, reported values are rounded so that minor deviations may occur when reconstructing aggregated calculations based on values from text or graphics.

The contractors for this report are the real estate consultancy IAZI (information and training centre for real estate) for residential mortgages (green buildings) and econcept AG for hydropower plants.

3 Data bases and methodology

The methodology and data bases are discussed in the following two sections. The explanations are taken from the individual impact reports of the two companies IAZI (green buildings) and econcept AG (hydropower).

3.1 Green buildings (IAZI)

As at 30 June 2022, this report is based on a portfolio of 305 properties financed by GKB in accordance with the guidelines of the Green Bond Framework. All properties were built over the past 20 years and have a Minergie certificate. The portfolio comprises 166 condominium units (STWE) and 139 single-family houses (EFH, including 4 semi-detached houses).

The geographical distribution of the properties financed with the help of the green mortgage is shown in Figure 1. The properties are mainly located in the home canton of Graubünden (301 out of 305 properties). One condominium unit (STWE) and one single-family house (EFH) are located in the canton of Zurich, and one property each is located in the cantons of Lucerne (STWE) and Schaffhausen (EFH).

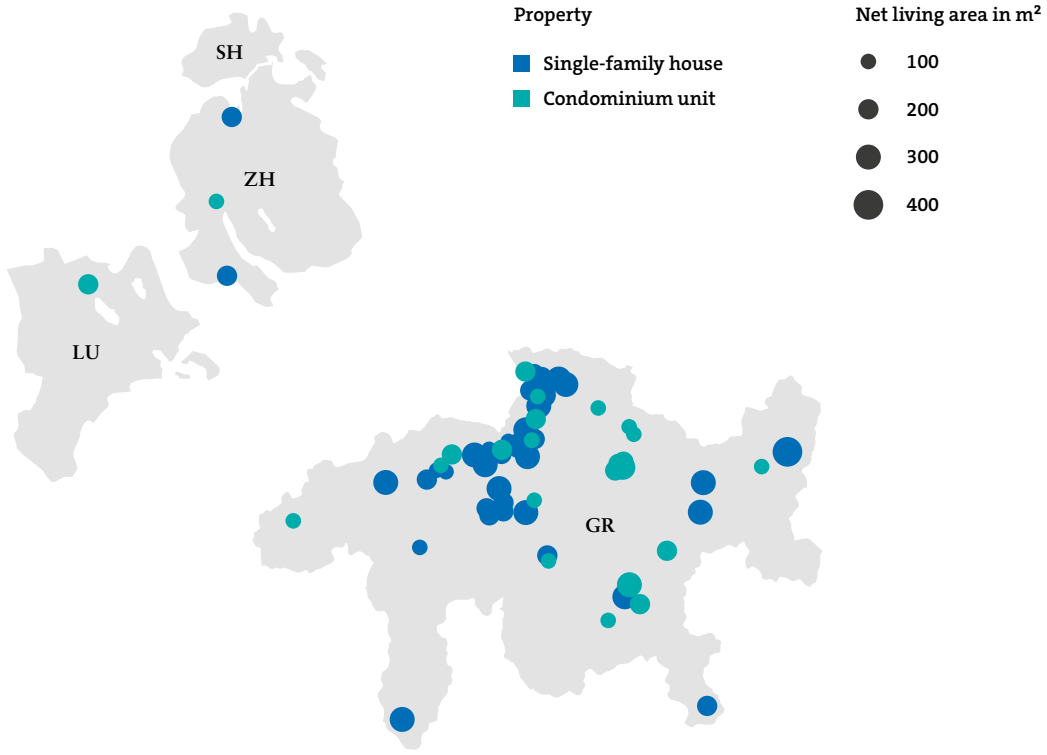

Figure 1: Geographical distribution of the financed properties (the size of the dot corresponds to the net living area)

The average net living area (NLA) per financed property is 143 m².[4] Figure 2 shows that the condominium units are significantly smaller than the houses. On average, the condominiums cover an area of 117 m². By comparison, only the eight smallest single-family houses are below this value. On average, single-family houses have a net living area of 175 m². Taking all the properties together, this results in a total usable area of around 44,000 m².

4 For 28 single-family houses and two multi-family houses, the missing net living area was approximated by converting the energy reference area using the common conversion factors 1.3 for single-family houses and 1.25 for apartment buildings.

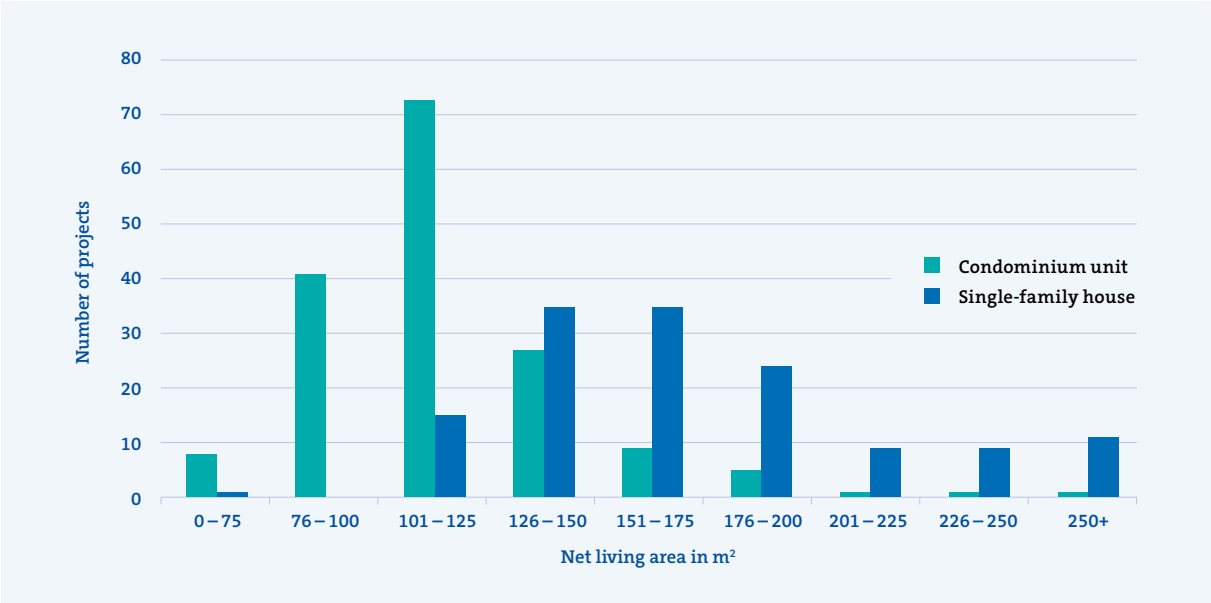

Figure 2: Distribution of net living area by property category

Four different heating systems and energy carriers were installed across the entire portfolio of 305 properties (Figure 3). At over 83%, the heat pump is the most common type of heating system by far. 12% of the properties have wood heating. Thirteen properties have a district heating connection and two are heated with a thermal solar system.

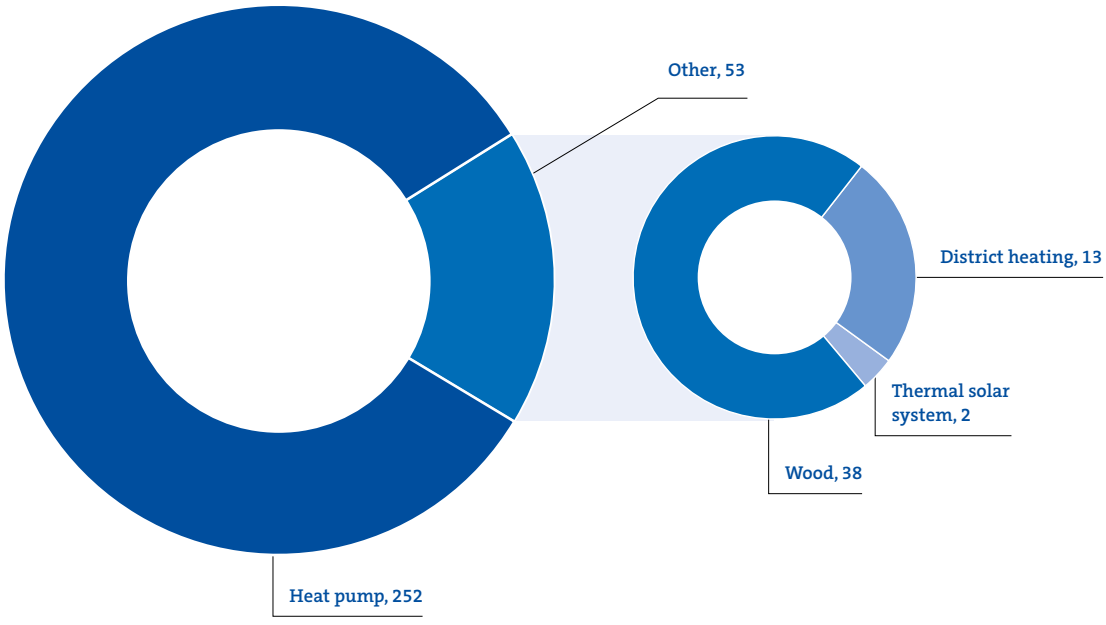

Figure 3: Distribution of heating systems/energy carriers

All properties financed by the two green bonds are Minergie-certified. The "Minergie" label (without supplement) meets the minimum energy efficiency requirements, a "Minergie-P" label has slightly lower energy requirements, and the most efficient buildings qualify for the "Minergie-A" label. Properties that meet additional health and building ecology requirements are given the supplement "Eco." A breakdown of the financed properties by Minergie category results in the following picture: Around 82% of the properties are certified with the "Minergie" label, 12% with "Minergie-P" and just under 4% have a "Minergie-A" label. The remaining six properties received the supplement "Eco", with five of them receiving the label "Minergie-P-Eco" and one property bearing the "Minergie-Eco" label.

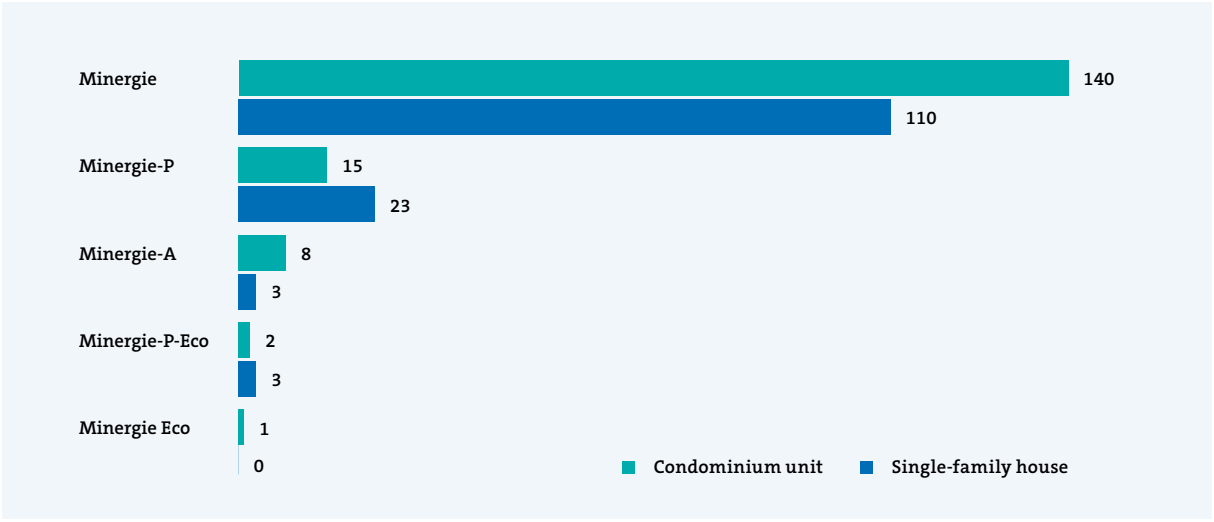

Figure 4: Number of financing operations by Minergie label and property category

The GKB Green Bond Framework defines nine allocation criteria for eligible loans. Accordingly, in addition to energy-efficient new buildings, the measures also include the renewal of the heating energy carrier, the use of renewable energy sources (with a distinction as to whether their share covers more or less than 50% of energy requirements), the optimisation of insulation and exterior shells, window refurbishment, the optimisation of building technology, investments in electrical infrastructure and certificates for entire properties.

In order to calculate the CO_2 savings per property, estimates are made for each award criterion on the basis of the available property information and the measures carried out. These assessments are based on SIA Standard 380/1 "Thermal energy in building construction". The calculations therefore follow an approach based on building technology which determines the heating demand according to the building dimensions, main building use, insulation properties of individual components and climatic conditions of the geographical location. The energy requirements calculated in this way are converted into CO_2 emissions on the basis of the latest available version of the life cycle assessment parameters of the Coordination Conference of Building and Property Authorities of Public Builders (KBOB), shown in Table 2.[5] The CO_2 coefficient for the average Swiss consumer mix is used for indirect emissions caused by the generation of electricity (e.g. also for the operation of heat pumps).

5 KBOB / ecobau / IPB. *Life cycle assessment data in the construction sector.* Accessed on 01/09/2022 from https://www.kbob.admin.ch/kbob/de/home/themen-leistungen/nachhaltiges-bauen/oekobilanzdaten_baubereich.html

Heating system/energy carrier	CO_2 emission coefficients (kg/kWh)
Oil	0.324
Gas	0.230
Wood/pellets	0.028
Electricity	0.127
Heat pump	0.058
District heating	0.067
Thermal solar system	0.017

Table 2: Conversion coefficients from energy requirements to CO_2 emissions by heating system/energy carrier, Source: KBOB, 2022

In order to estimate heating demand and CO_2 emissions, IAZI uses a statistical model that has been parameterised using known energy values on the basis of a representative building portfolio. In addition to the location of the property, building features such as the year of construction and refurbishment, information on the construction quality and condition of the property as well as building dimensions such as living area and number of floors are of key importance here.

As part of the data preparation process, individual details required for the analyses were roughly determined where necessary and implausible details were replaced. The energy reference area (ERA), i.e. the heated total area within the building envelope that is relevant in the context of heating demand, was taken from the existing Minergie certificates. As the ERAs given in Minergie certificates apply to the entire building, the values could only be used directly for single-family houses. Details for owner-occupied condominium units were first checked for plausibility using the co-ownership share. An approximate residential ERA can be calculated by multiplying the building's ERA by the co-ownership share of the condominium unit. If this is lower than the known net living area, the unit's ERA is instead calculated on the basis of the NLA, using the standard conversion factor of 1.25[6]. This ensures that energy requirements and CO_2 emissions are adequately estimated, including for condominium units with a low co-ownership share.

The number of floors is not available in the original data for any of the properties in the portfolio, but was successfully added for all 305 properties from the Federal Register of Buildings and Dwellings (RBD) with the help of IAZI's address validation and the respective buildings identifier (EGID).

In addition to the financing of new buildings, existing properties that were demonstrably climate-friendly were also considered. According to the Framework, this proof can be provided by a recognised certification (e.g. Minergie), provided that the certificate is no more than ten years old at the time the financing agreement is concluded. Proof can also be provided by means of extensive energy-related refurbishment measures, provided they were implemented no more than two years ago. This report only considers Minergie-certified properties.

To determine the specific CO_2 savings, each property was compared to a case-specific reference property. The definitions of the individual benchmark properties are outlined in more detail below.

6 Ecospeed Ltd and TEP Energy (2016). *Methodology for calculating cantonal CO_2emissions in the building sector on the basis of the Register of Buildings and Dwellings (RBD).*
Accessed on 01/09/2022 from https://www.bafu.admin.ch/dam/bafu/de/dokumente/klima/externe-studien-berichte/Methodik%20zur%20Berechnung%20der%20kantonalen%20CO2-Emissionen%20im%20Gebaeudebereich%20auf%20Basis%20des%20GWR.pdf.download.pdf/20161219_Methodik_CO2Emissionen_Geb%C3%A4ude_mit_GWR_final.pdf

New buildings

In the case of new buildings, the expected CO_2 reduction was calculated by comparing it with a representative property of the same type and dimensions for the relevant canton. Specifically, the benchmark property was built in 2015, has a "good" building condition and building quality and uses the energy carrier mix for the relevant construction period (see Tables 3 and 4); this is because 2015 is the year for which the most up-to-date information on the cantonal distribution of energy carriers is available. This means that the completed new building with the corresponding year of construction is considered the "After" state, while the theoretical "Before" state is assumed to be the same building with a year of construction of 2015 and a "good" building condition and construction quality. Energy requirements are converted into CO_2 emissions on the basis of the cantonal energy carrier mix for the 2015 construction year.

Year of construction	Oil	Gas	Electricity	Wood/ pellets	Heat pump	Solar panels	District heating	Other
<1980	36.2%	2.3%	17.7%	38.8%	4.0%	0.3%	0.1%	0.5%
1980 – 1990	39.1%	3.1%	27.7%	19.5%	10.0%	0.4%	0.0%	0.2%
1991 – 2000	40.6%	3.6%	14.6%	16.7%	22.4%	1.7%	0.1%	0.3%
2001 – 2005	25.6%	13.3%	7.7%	9.5%	40.8%	1.0%	0.2%	1.9%
2006 – 2015	5.1%	3.4%	5.5%	11.5%	71.1%	1.5%	0.6%	1.3%

Table 3: Share of energy carriers by construction period, single-family houses in the canton of Graubünden
Source: Buildings and dwellings statistics, Federal Statistical Office

Year of construction	Oil	Gas	Electricity	Wood/ pellets	Heat pump	Solar panels	District heating	Other
<1980	72.8%	3.8%	10.7%	7.9%	4.0%	0.2%	0.2%	0.3%
1980 – 1990	58.1%	2.2%	22.6%	9.3%	7.1%	0.2%	0.4%	0.1%
1991 – 2000	58.3%	6.6%	11.2%	7.5%	15.5%	0.6%	0.2%	0.3%
2001 – 2005	50.3%	9.3%	5.7%	4.3%	27.6%	0.5%	0.7%	1.5%
2006 – 2015	13.7%	6.3%	3.0%	5.9%	65.7%	0.9%	1.5%	3.0%

Table 4: Share of energy carriers by construction period, multi-family houses in the canton of Graubünden
Source: Buildings and dwellings statistics, Federal Statistical Office

The calculation logic is illustrated using a fictitious sample property. This property has the features listed in Table 5, column "Sample property". This single-family house is estimated using the statistical model, which results in an expected energy requirement in kilowatt-hours per year (kWh p.a.) and the resulting CO_2 emissions in kilograms. In a next step, this EFH is compared to a benchmark property. Apart from the changes described above, the latter has identical features. The property features are listed in the "Benchmark" column of Table 5. The heating type is weighted according to the distribution of the energy carriers in Table 3. As a result of the adjustments, a modern benchmark property is created, which is also estimated using the statistical model. In a final step, the CO_2 emissions of both properties are compared and possible savings or additional consumption are determined. The values calculated in this way form the basis for the savings reported in Chapter 5.

Variable	Sample property	Benchmark
Year of construction	2020	2015
Energy reference area	250 m^2	250 m^2
Condition	Very good	Good
Quality	Very good – good	Good
Address	Testweg 1, Chur	Testweg 1, Chur
Property type	Single-family house	Single-family house
Floors	2	2
Heating type	Heat pump	According to Table 2

Table 5: Property features for a fictitious sample property

Minergie certificates

As all 305 properties in the portfolio of green bonds are Minergie-certified, the methodology described above is expanded by an additional step. The estimated results are compared to the relevant certificate requirements. If the certificate threshold falls below the estimated result, the certificate requirements are adjusted (e.g. maximum total energy requirement of 50 kWh per m^2 of ERA p.a. for Minergie-P certification for new builds[7]).

Further measures

In addition to the measures described so far, GKB's Green Bond Framework makes it possible to finance various energy-related modernisation measures in the areas of "renewable energy carriers," "renewable energy sources," "optimisation of insulation and exterior envelope," "window refurbishment," "optimisation of building technology" and "electrical infrastructure." However, no such individual measures have been financed to date.

7 Minergie Switzerland (2021). *Product regulations for the MINERGIE®/MINERGIE-P®/ MINERGIE-A®* building standards. Accessed on 01/09/2022 from https://www.minergie.ch/media/201223_produktreglement_minergie_p_a_v2021.1_en.pdf

3.2 Hydropower (econcept AG)

Climate protection means that greenhouse gas emissions are either avoided or removed from the atmosphere. The GKB green bond is designed to avoid greenhouse gas emissions. To this end, investments are made in hydropower plants that use water to generate electricity and thus offer a climate-friendly alternative to electricity from non-renewable, fossil fuel energy carriers.

By monitoring the impact of hydropower, GKB is able to show how many greenhouse gas emissions have been avoided through the financing allocated by the green bond. On the other hand, the impact monitoring does not show the importance of hydropower for load balancing in the electricity grid and for Switzerland's security of supply.

The process for determining the avoided greenhouse gas emissions is as follows:

1. A reference scenario is defined that shows how greenhouse gas emissions would have developed without the financing allocated by the green bond (pink line in Figure 5).
2. The amount of greenhouse gas emissions associated with the financing allocated by the green bond is determined (green line in Figure 5).
3. Greenhouse gas avoidance is determined by the difference between the reference scenario and the actual greenhouse gas emissions (green shaded area in Figure 5).

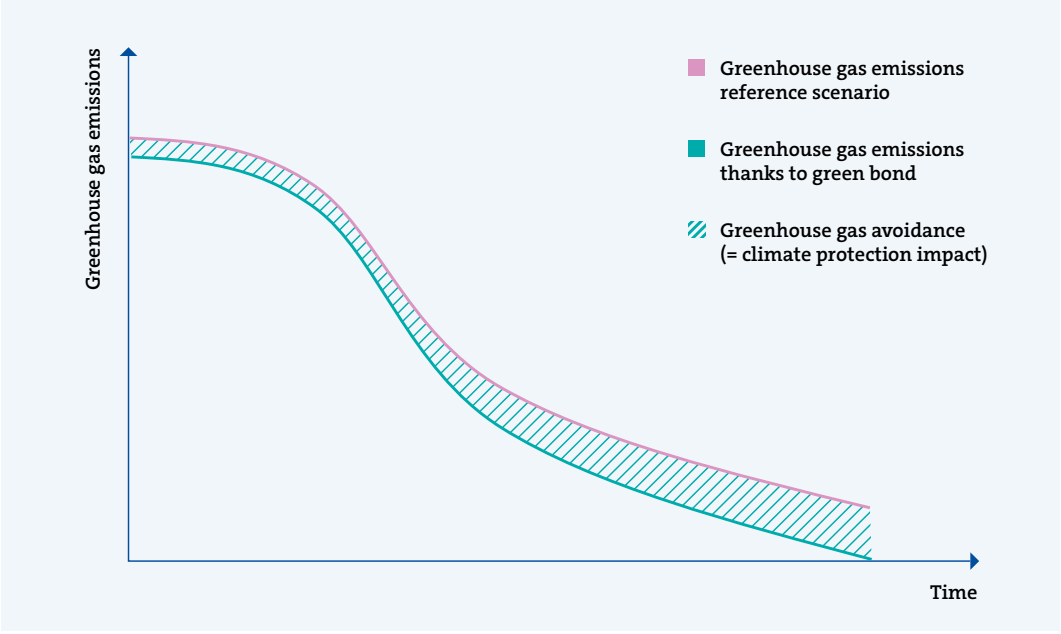

Figure 5: Schematic diagram of avoided greenhouse gas emissions

The following shows how the expected emissions in the reference scenario, the actual emissions and finally the avoided emissions are determined. The electricity generation that can be attributed to the green bond is the relevant quantity that needs to be determined first.

Eligible electricity generation

The green bond capital is used to invest in existing hydropower plants in and around the canton of Graubünden. Specifically, the power plant operators receive financial resources (credit) for making investments in the plant to ensure the smooth operation of the power plant. However, as the green bond only covers part of the plant operator's non-current assets, the entire electricity generation (y^{Total}) cannot be attributed to the green bond. Instead, the eligible electricity generation (y^{GB}) is determined on the basis of the share of the green bond (FK^{GB}) in the interest-bearing debt (FK^{Zins}) and equity (EK).

$$y^{GB} = \frac{FK^{GB}}{FK^{Zins} + EK} \times y^{Total}$$

y^{GB}: eligible electricity generation
y^{Total}: total electricity generation
FK^{GB}: Green bond
FK^{Zins}: Interest-bearing borrowed capital
EK: Equity

The generation data comes from the hydropower plant statistics (WASTA) issued by the Swiss Federal Office of Energy (SFOE).[8] It shows the amount of electricity generated in a calendar year in GWh. It should therefore be noted that the data used does not correspond to the reporting period set for GKB's green bond. However, as annual generation volumes fluctuate very little, only minor effects on the monitoring result are to be expected.

Emissions in the reference scenario

In the reference scenario, it is assumed that without the green bond, the amount of electricity attributable to it would be generated with the Swiss electricity generation mix.[9] This electricity mix is suitable because investments are being made in existing hydropower plants and therefore no changes in the Swiss electricity supply are to be expected. According to the life cycle assessment consulting company treeze (2021), the Swiss electricity generation mix emits an average of 0.0296 tonnes of CO_2e per MWh. This includes both direct emissions from electricity generation as well as upstream and downstream emissions. This value is used as the emission factor in the reference scenario.[10]

Emission factor reference scenario	Unit	Greenhouse gas emissions
Electricity generation mix 2018	t CO_2e/MWh	0.0296

Table 6: Emission factor in the reference scenario: Swiss electricity generation mix in 2018, Source: treeze (2021)

The emissions in the reference scenario (E^R) in tonnes of CO_2e can therefore be calculated by multiplying this emission factor (EF^P) by the eligible electricity generation (y^{GB}).

$$E^R = EF^P \times y^{GB}$$

E^R: Reference emissions
EF^P: Emission factor for electricity generation mix
y^{GB}: Eligible electricity generation

8 SFOE (2018). *Hydropower plant statistics*. https://www.bfe.admin.ch/bfe/de/home/versorgung/statistik-und-geodaten/geoinformation/geodata/water/statistics-of-hydropower plants.html. Accessed on 04/05/2022.

9 The Swiss electricity generation mix shows the composition of the electricity generated in Switzerland, regardless of whether the electricity is consumed in Switzerland or exported to other countries (treeze, 2021).

10 treeze (2021). *Umweltbilanz Strommixe Schweiz 2018*. https://www.bafu.admin.ch/dam/bafu/de/dokumente/klima/fachinfo-daten/Umweltbilanz-Strommix-Schweiz-2018-v2.01.pdf.download.pdf/Umweltbilanz-Strommix-Schweiz-2018-v2.01.pdf. Accessed on 04/05/2022.

Actual emissions

Compared to alternative generation methods, the production of hydropower is climate-friendly, but also causes greenhouse gas emissions. However, these emissions do not occur at the power plant, but are caused by upstream or downstream processes such as the construction of a power plant and its dismantling, the use of auxiliary equipment during operation of the power plant and the transmission and distribution of electricity, as well as any methane emissions from the reservoirs. The amount of these indirect emissions depends on the type of power plant. A distinction is made here between run-of-river, storage, pumped-storage and small-scale hydropower plants (treeze, 2021).[11]

The emissions for run-of-river, storage and small-scale hydropower plants are listed below. No pumped-storage power plants are currently supported, which is why no emission factor is listed. The sum of the direct and indirect emissions corresponds to the emission factor for the respective power plant.

Type of hydropower plant	Unit	Direct emissions	Indirect emissions	Emission factor
Run-of-river power plant	t CO_2e/MWh	0.0000	0.0038	EFL = 0.0038
Storage hydropower plant	t CO_2e/MWh	0.0000	0.0083	EFS = 0.0083
Small-scale hydropower plant	t CO_2e/MWh	0.0000	0.0049	EFK = 0.0049

Table 7: Emission factors for types of hydropower plants, subdivided into direct and indirect emissions, Source: treeze (2021)

Actual emissions (E^T) in tonnes of CO_2e can be calculated by multiplying the respective emission factor j of power plant i (EF^i) by its eligible electricity generation (y^{GB}) and then adding these totals for all power plants.

$$E^T = \sum EF_i^j \times y_i^{GB} \quad j = \{L, S, K, P\}$$

E^T: Actual emissions
EF^L: Emission factor for run-of-river power plant
EF^S: Emission factor for storage hydropower plant
EF^K: Emission factor for small-scale hydropower plant
y_i^{GB}: Eligible electricity generation of power plant i

Information on the type of power plant is contained in the hydropower plant statistics (WASTA), although small-scale hydropower plants are not identified as such. According to the definition of the Swiss Federal Office of Energy (SFOE), power plants with an installed capacity of up to 10 MW are currently classified as small-scale hydropower plants.[12]

Emission reductions

The emission reduction (ER) can be calculated by subtracting the actual emissions (E^T) from the reference emissions (E^R).

$$ER = E^R - E^T$$

ER: Emission reduction
E^R: Reference emissions
E^T: Actual emissions

11 In the case of storage power plants, treeze (2021) also distinguishes between certified and non-certified power plants, which differ in that only the net generation can be stated for certified power plants and therefore any need for pump electricity is taken off the balance sheet. In this impact monitoring, the net generation and the emission factor for non-certified power plants are always used for storage power plants, which results in a conservative calculation of the emission reductions.

12 SFOE (2022). *Small-scale hydropower.* https://www.bfe.admin.ch/bfe/de/home/versorgung/erneuerbare-energien/wasserkraft/kleinwasserkraft.html. Accessed on 05/08/2022.

4 Results

4.1 Impact analysis of green buildings

The results of the impact analysis with regard to green buildings are explained below. The values determined are a statistical estimate of the energy requirements for heating and hot water as well as the annual CO_2 emissions resulting directly from typical operations. This evaluation does not take into account "grey energy" generated during the construction or manufacture of building materials and technical equipment, nor does it take into account user-specific consumption behaviour. The overall results are summarised at the end.

New buildings
The 305 buildings that were examined were considered for reasons of methodology to be new buildings and compared to benchmark properties built in 2015. In line with this year of construction, the construction quality and condition of the reference property were assumed to be "good." Otherwise, the benchmark property has the same features as the new build property. Overall, the sub-portfolio's estimate of 166 condominium units (STWE) results in annual CO_2 emissions of around 66 tonnes, which corresponds to an average for CO_2 emissions of 2.7 kg per m^2 ERA p.a. This compares with the benchmark properties' comparative value of a total of 144 tonnes or 5.8 kg CO_2 per m^2 ERA p.a. The estimate for the 139 single-family houses amounts to around 110 tonnes or 2.8 kg CO_2 per m^2 ERA p.a., which contrasts with the benchmark properties' comparative value of just over 203 tonnes or 5.1 kg CO_2 per m^2 ERA p.a. The savings achieved by the properties under consideration thus amount to around 171 tonnes of CO_2 per year.

Minergie certificates
The certification of a building alone has no impact on its energy requirements. For this reason, no direct CO_2 savings can be assigned to this category. However, the certificates have an indirect influence due to the additional step described in Chapter 3.1, which checks whether the energy requirement limits are being observed. The effect of this award criterion is therefore already included in the reported savings for the award criterion "new build."

Overall result

Over the entire portfolio, the relevant measures return a reduction in CO_2 emissions of around 171 t CO_2 per year, or a reduction from 347 to 176 t CO_2 p.a. STWE account for 46% of the total reduction and single-family houses for 54%. The CO_2 savings to be achieved in the new-build sector are comparatively low per property, as reference properties from a similar construction period are used for the calculation. These reference properties are already characterised by relatively low energy requirements and emission values. Independently of this, the financing of new non-fossil-fired buildings and young existing properties makes an important contribution to the achievement of the climate objectives.

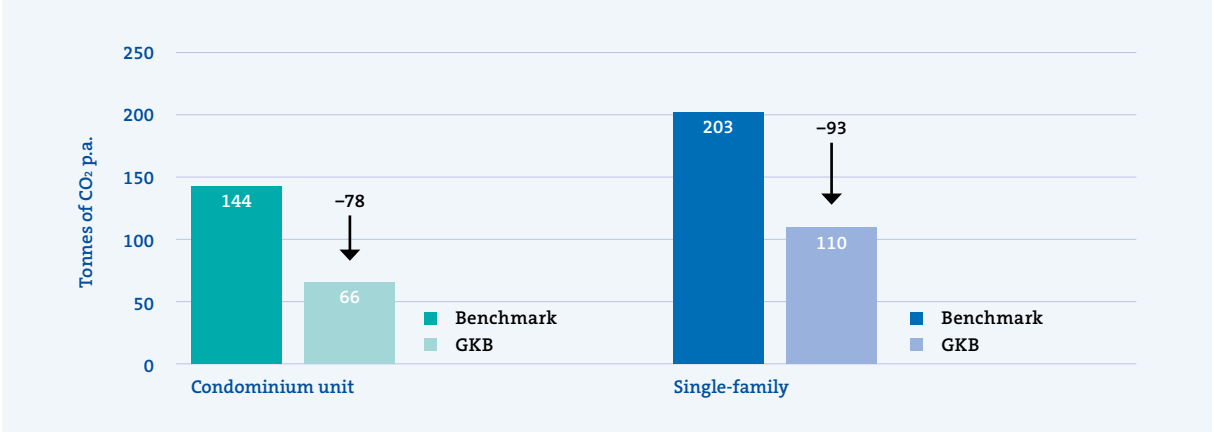

Figure 6: Expected emission savings for condominium unit vs. single-family house

The expected future total annual reduction of the financed properties corresponds to the CO_2 equivalent of the exhaust gases of around 137 passenger cars (assuming emissions of 140 g CO_2 per km and a mileage of 8,900 km p.a.) [13] or the average annual Swiss consumption of just under twelve private individuals (assuming emissions of 14 t CO_2 per year).[14]

4.2 Impact analysis of hydropower

The results of the hydropower financing are explained below. The proceeds from the green bond are used to support power plants that generated a net total of 2,400 GWh of hydropower in 2021, which, as expected, led to a reduction in greenhouse gases of around 55,500 tonnes of CO_2e. The share attributable to the green bond is 22% for net generation (537 GWh) and 23% for emission reductions (12,856 t CO_2e).

Impact monitoring 2021		Net generation in GWh	Emissions in t CO_2e		
			Reference scenario	Actual	Reduction
Total		2,400	71,042	15,509	55,533
Attributable share	abs.	537	15,909	3,053	12,856
Attributable share	in %	22%	22%	20%	23%

Table 8: Net generation and associated emissions and emission reductions from hydropower plants supported by the green bond in 2021

13 Swiss Federal Office of Energy (2019). *Fuel consumption and CO_2 emissions from new passenger cars increased significantly in 2018*. Accessed 01.09.2022 from https://www.bfe.admin.ch/bfe/de/home/news-und-medien/medienmitteilungen/mm-test.msg-id-75710.html

14 Federal Office for the Environment (2022). *Climate: In brief*. Accessed on 01/09/2022 from https://www.bafu.admin.ch/bafu/de/home/themen/klima/inkuerze.html

5 Appendix

5.1 Abbreviations

FOEN	Federal Office for the Environment
CO_2e	CO_2 equivalent
ERA	energy reference area
EFH	single-family houses
EGID	Federal buildings identifier
GKB	Graubündner Kantonalbank
GRI	Global Reporting Initiative
GWR	Register of Buildings and Dwellings
IAZI	information and training centre for real estate
ICMA	International Capital Market Association
KBOB	Coordination Conference of Building and Property Authorities of Public Builders
kWh	kilowatt-hour
MFH	multi-family houses
NLA	net living area
p.a.	per annum (per year)
PW	passenger car
SDG	Sustainable Development Goals
SIA	Swiss Society of Engineers and Architects STWE condominium units

5.2 Brief portrait of IAZI AG

Over the past 25 years, IAZI, the information and training centre for real estate has evolved into a leading consulting and IT company for the Swiss financial and real estate sector. Thanks to its overarching competencies in the fields of property valuation and sustainability auditing, data analysis and IT development, IAZI successfully operates as a service provider at the interface between the financial and real estate markets. IAZI is therefore very familiar with the diverse challenges faced by these sectors.

IAZI's most important services include hedonic valuation models for real estate, which are currently used by the majority of Swiss banks as part of the financing process. Based on a broad customer base, around 30,000 changes of ownership are incorporated into the IAZI data pool every year. The statistical models based on this data are also used in many other applications along the entire property value chain.

Another core competency is portfolio management and benchmarking services. IAZI analyses property data from the largest institutional investors such as insurance companies, pension funds, banks and investment funds, thus maintaining Switzerland's largest and most detailed data pool of direct real estate investments. Based on this database, IAZI develops and operates modern and efficient tools for administering, managing and monitoring real estate portfolios in close cooperation with institutional market players, thus supporting them in the digitalisation of their activities. An accurate understanding of the capital markets and real estate portfolios of the relevant players is therefore an essential prerequisite for IAZI's successful business activities.

An additional field of activity comprises a variety of property-specific services such as appraisal reports and on-site inspections. The IAZI experts inspect and analyse thousands of properties throughout Switzerland every year. Thanks to this activity, the company not only has comprehensive knowledge of the overall markets, but also in-depth knowledge of property-specific factors in the fields of construction and architecture, building technology and energy management. Based on this expertise and its insight into large property portfolios, IAZI has been successfully conducting analyses on the topics of energy consumption, emissions and sustainability for several years. IAZI's range of services is supplemented by the preparation of local and regional market and location analyses as well as investment planning.

Since IAZI was founded in 1994, the company has maintained customer relationships in all regions of Switzerland as well as in Germany and Austria. The company is headquartered in Zurich Oerlikon, with another branch located in Lausanne. In total, the IAZI team consists of around 110 real estate, statistics, finance and IT specialists. Their knowledge and experience are not only in demand among customers, but are also passed on at various national and international training institutions (universities and universities of applied sciences, Swiss Finance Institute, SVIT, AZEK and others). Thanks to the teaching activities of various employees, IAZI is in constant contact with academic and educational institutions.

5.3 Brief portrait of econcept AG

Research/consulting/evaluation
econcept AG is a nationally and internationally active research and consulting company. With application-oriented research, science-based consultancy and evaluations, it develops well-founded documents to serve as a basis for decisions and supports its broadly diversified customer base from the public sector, institutions, organisations and companies in the structuring of their strategic processes and projects. The expertise of econcept AG lies in the fields of economy, location development, mobility, energy and sustainable construction, climate protection and adaptation, education/research/innovation and social security.

Interdisciplinary and solution-oriented
The interdisciplinary expertise of econcept aims to find holistic answers to complex questions. It recognises the challenges of societal change and works in a solution-oriented and methodically sound manner. It provides its services alone or with partners from a network of outstanding national and international experts.

Quality
econcept AG strives for the highest quality, which is ensured by means of established internal project-related processes. This contributes to continuous development. Its evaluations are based on SEVAL and other internationally recognised standards.

For more information, please visit: www.econcept.ch

5.4 External audit

Ernst & Young AG (EY) has performed an assurance of the German version (original version) of the Green Bond Impact Report. The respective assurance statement is attached to the German version. This English version is a translation of the original version and has not been reviewed by EY.

The information marked on the allocation of funds for 2021/2022 indicates where EY performed limited assurance procedures on in the German version. However, as indicated above, no assurance is provided on the English version.