Annual Energy Report 2022

Radboud University

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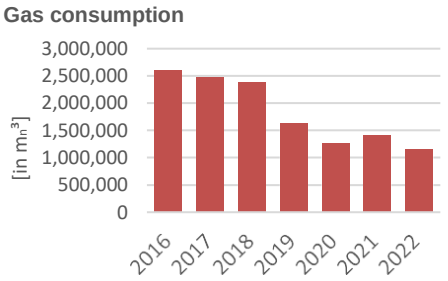
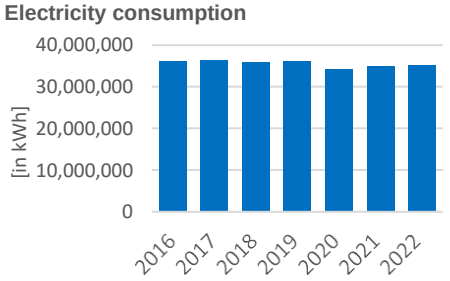
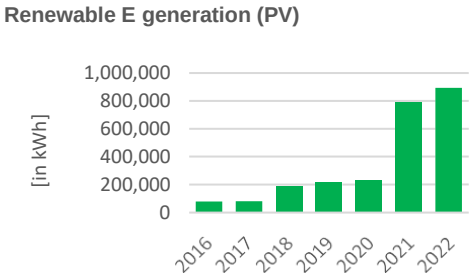
Summary

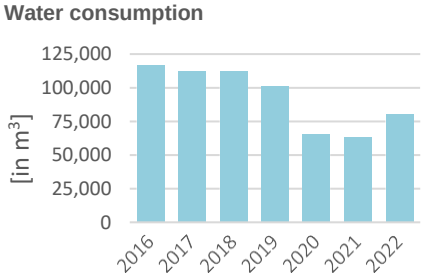
The energy market was upended in 2022 as a result of the war in Ukraine, with market prices going through the roof. Radboud University can nevertheless look back on a successful energy year. Energy costs did not rise, and renewables targets were achieved. Total energy consumption in 2022 was 4.9% lower than in 2021 owing to an 18% reduction in gas consumption. Electricity use remained approximately the same. The 2021-2024 energy policy plan envisages energy savings of 4.1% annually in absolute terms. That target was met in 2022. Compared with 2018, Radboud University used 16.7% less energy. The 2024 target is energy savings of 26% compared with 2018. This is an ambitious but realistic aim, given the expansion of the ground-coupled heat exchange system completed in 2022.





The quantity of renewably generated electricity increased by 13% owing to a sunny year and new solar panels on the roof of HFML. The share of electricity consumption generated by solar panels on campus rose to 2.5%. CO_2 emissions fell, mainly because less gas was consumed.





Drinking water consumption increased by 27% compared with 2021. This rise was caused by the return of students and staff to campus after the coronavirus pandemic, when water consumption was extremely low. Consumption in 2022 was still 20% lower than in 2019, the last year before the pandemic.

Introduction

The aim of this 2022 Annual Energy Report is to inform Radboud University management, staff and students on developments in the area of energy consumption and the measures taken to save energy and generate renewable energy in 2022. The Annual Energy Report is published on the website, so that everyone can follow developments.

Objectives

The *Radboud University Energy Policy Plan 2021-2024* provides an overview of objectives, basic principles, conditions, requirements and responsibilities in the areas of energy and water consumption. The most important objective is to achieve annual energy savings of 4.1% in absolute terms.

A start was made in 2022 in reassessing energy targets beyond 2024. New targets are needed to better align with global, European, national and sectoral climate goals and plans, and also to enable better management by Radboud University. The new targets are expected to be set in the course of 2023.

Changes in energy consumption and CO_2 emissions

The yardstick for the evolution of energy consumption and implementation of energy policy at Radboud University is the consumption of electricity and gas. *Figure 1* shows changes in gas and electricity consumption.

It also shows CO_2 emissions - the consequence of energy consumption. Consumption refers to the buildings and grounds on the Radboud University campus. In addition to this building-related energy, energy for ICT and research equipment is also involved[1].

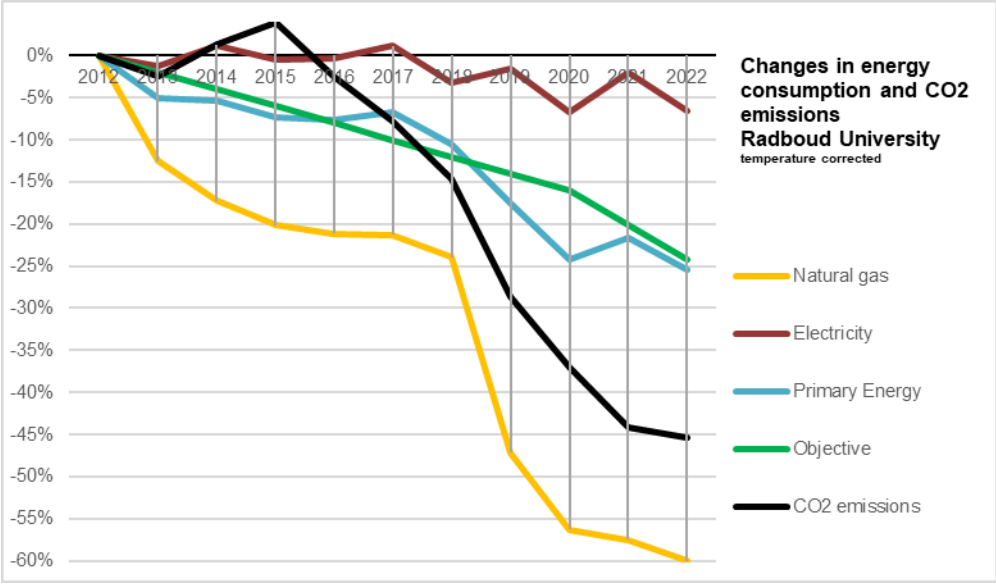


Figure 1 Changes in energy consumption and CO_2 emissions

Natural gas
More than 95% of Radboud University's gas consumption[2] can be attributed to heating buildings. In 2022 (unadjusted), 18% less gas was consumed than in 2021. Approximately 12% of this lower consumption can be explained by higher outdoor temperatures. The other 6% derives from savings and lowering the indoor temperature to 19 degrees.

Electricity
Electricity is used by various types of systems at Radboud University. These are systems for air-conditioning, lighting and ventilation, ICT and research. The brown line in *Figure 1* shows the change in electricity consumption after adjustment using the cool days method[3]. Adjusted for cool days, electricity consumption fell by 4.7% in 2022.

[1] The consumption of the HFML (magnet lab) with ancillary facilities is not included in it, as this is explicitly allocated to the research projects, partly for third parties. The premises of Stichting Studenten Huisvesting Nijmegen (Nijmegen Students Accommodation Foundation) on campus are also not included, as these are administered by SSH&, and Radboud University merely acts as conduit for the energy.

[2] Forum and Huize Heyendael draw heat from the heating network of Radboud university medical center (Radboudumc). This consumption has been converted to natural gas equivalents.

[3] Sum of exceedances relative to 17 ˚ C for all days with an average temperature of 17 ˚ C or more. A daily average temperature of, for example, 19 ˚ C adds 2 cooling days.

Primary energy

To determine the use of primary energy - derived from gas and electricity consumption - consumption has been converted to gigajoules. A primary energy factor (PEF) of 1.45 is used for calculating electricity generation. The factor 1.45 is taken from the NTA8800, a Dutch standard for calculating the energy performance of buildings. The gas share corresponds to 17% and electricity to 83% of primary energy consumption at Radboud University. Over the past year, 4.9% less primary energy was used than in 2021.

CO_2

CO_2 is emitted as a result of consuming electricity, gas and diesel[4]. In the case of electricity, it could be argued that, owing to the purchase of 100% green electricity, there have been no emissions at all. But the reality is that electricity consumption on campus certainly does lead to emissions, as a result of the mismatching between supply and demand. Zero-emission consumption would require generation and consumption to take place simultaneously, but there are not enough renewable sources available at all times. For this reason, it has been decided in this report to calculate on the basis of emissions per kWh according to Statistics Netherlands (CBS) (0.30 kg/kWh).

Table 1 provides the figures for the change in energy consumption.

		EBP 2017-2020			EBP 2021-2024	
Energy consumption at Radboud		**2018**	**2019**	**2020**	**2021**	**2022**
Natural gas	m3/year	2,378,335	1,633,138	1,258,423	1,404,850	1,155,428
Natural gas with correction	m3/year	2,474,004	1,720,055	1,423,013	1,382,585	1,300,213
Electricity	kWh/yea	35,703,312	35,909,592	33,972,457	34,250,573	34,214,224
Electricity with correction	kWh/yea	34,815,580	35,422,580	33,562,479	35,245,889	33,603,499
Diesel	kg/year	4,913	8,125	5,831	4,735	5,106
Primary energy	GJ/year	261,855	239,484	217,414	223,454	215,386
Primary energy adjustment	GJ/year	260,249	239,693	220,484	227,945	216,780
CO2 emissions electricity	kg/kWh	0.43	0.37	0.35	0.29	0.30
CO2 emissions	tonnes/y	19,613	16,227	14,155	12,455	12,343
Water consumption	m3	112,232	101,307	65,026	63,145	80,490
Building area	m2	320,145	313,180	313,422	322,895	320,537
Students and staff	number	27,033	27,908	29,315	30,281	30,236

Table 1 Overview of the changes in energy consumption

Buildings' energy and water consumption can be read off in real time

In addition to this annual energy report, consumption for each building will also be available online from 2022. Energy and water consumption, and energy production for each building, can be viewed by staff and students of Radboud University on the webpage https://campusenergie.nl/ . The application has been developed by students on the Computing Sciences programme at Radboud University. It aims to encourage energy saving among users by providing insight.

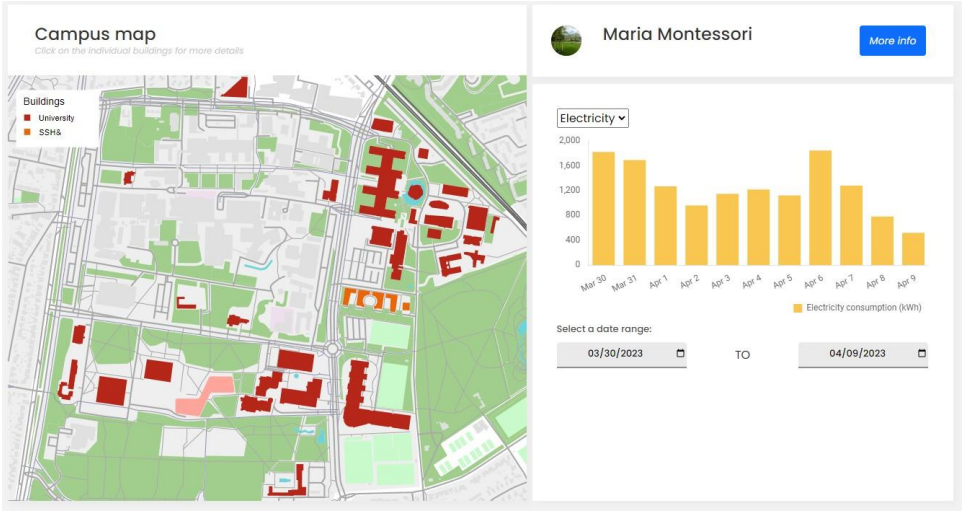


Figure 2 Screenshot of the web application https://campusenergie.nl/

[4] Diesel consumption comes from testing and using emergency power generators, in particular for data centres on campus.

Renewable energy

Ground-coupled heat exchange (thermal energy storage)
The system for heating and cooling with the aid of the ground-coupled heat exchange system has been expanded considerably. With the completion of the HEN++ project, 87% of the university's floor area is connected to ground-coupled heat exchange. This will result once more in a reduction by hundreds of thousands of cubic metres in the gas needed to heat buildings from 2023. These savings correspond to the annual gas consumption of 370 households.

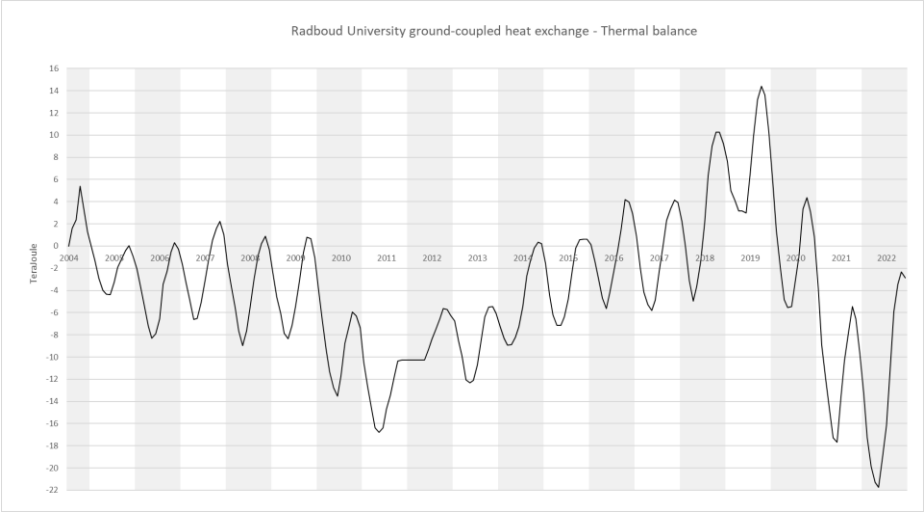


Figure 3 Ground-coupled heat exchange (yield in terajoules)

After several years of extracting more heat from the ground than was returned, in 2022 we proactively put additional heat into the ground. *Figure 3* shows that this is clearly having an effect: more heat has been returned than in previous years, setting the stage for recovery of the thermal balance. This is important for the proper functioning of the system and to comply with the authorisation.

Solar power
The share of renewable electricity from solar power generated on campus rose from 2.3% to 2.5%. After the installation on the roof of HFML is commissioned, the campus will have more than 1 megawatt peak in solar panels.

Solar panels	Power	Yield 2022
	kWp	kWh
Forum	11	11,118
Grotius	85	81,112
Gymnasion/Ostrom	42	40,600
Library	124	108,154
Maria Montessori	670	646,004
HFML	123	6,628
Total	**1,055**	**893,616**

Table 2 PV systems yield

The campus generated 893,616 kWh of solar power in 2022; this year too, this was more than the year before. This output is equivalent to the annual electricity consumption of 360 households.

Drinking water consumption

The drinking water consumption pattern is shown in *Figure 4*.
Drinking water consumption (green) rose to 80,000 m^3. The same figure shows drinking water consumption per student and member of staff (blue). This rose to 2.7 m^3 per student and staff member.

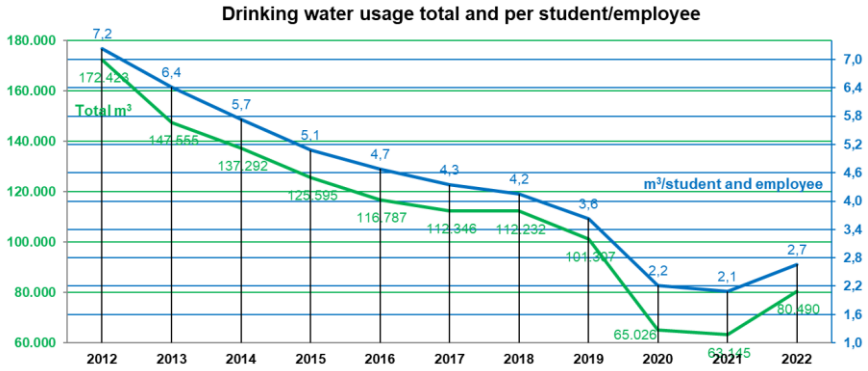


Figure 4 Drinking water consumption from 2012

The drinking water consumption for each building is shown in Appendix 1. Low consumption in 2020 and 2021 is mainly attributable to pandemic measures that resulted in far fewer people being on campus. Drinking water consumption depends to a greater extent on the occupancy rates of the buildings than does energy consumption.

Grid congestion in Gelderland

TenneT, the operator of the high-voltage grid in the Netherlands, stated on 17 November 2022 that the maximum capacity for power supply has been reached in Gelderland. Radboudumc and Radboud University received a letter from grid operator Liander about this grid congestion on 17 November 2022. The consequence is that the institutions will be unable to increase the (jointly) contracted transmission capacity (GTV). No more than 18,907 kW may be consumed simultaneously via the shared connection at Geert Grooteplein Zuid 10. This will not cause problems for the present. But choices may well have to be made increasingly often in the years ahead on the type of growth to prioritise. There is no limit on the total electricity purchased per year. TenneT is currently investigating the option of asking certain customers to reduce their electricity demand (temporarily) when necessary for a fee, through congestion management. Capacity on the power grid may be created in this way. Discussions with Liander revealed low expectations for this type of solution. The structural solution to grid congestion is grid expansion. This is expected to be completed in 2029.

Leaving EU ETS

At Radboud University's request, the Netherlands Emissions Authority has decided that the university is exempt from participation in the EU ETS, the European Emissions Trading Scheme, starting from the year under review 2022. On account of the legal split between Radboud University and Radboudumc, Radboud University fell below the lower limit for mandatory participation in the ETS, and so could leave it. The university is for this reason no longer required to buy and surrender emission allowances for its CO_2 emissions. The main advantages for leaving are that (1) this ends the (undesirable) dual situation in which the university has to deal with 'built environment policy' and is also an ETS company, (2) it yields substantial cost savings and (3) it reduces the administrative burden. The savings can be used for sustainability measures.

Energy costs

The year 2022 will go down as one of extreme energy prices. This was caused by the war in Ukraine. At the peak, trading prices for electricity and gas rose to unprecedented levels, exceeding 70 cents per kWh and 300 cents per cubic metre. The university was not affected by this in 2022, paying a bare purchase price of approximately 5 cents per kWh and 18 cents per cubic metre all year, excluding costs for connection, transmission and metering, and taxes. The 2022 electricity and gas prices had been fixed in advance for the entire calendar year by mid-2021. RU will certainly face price increases in 2023 and 2024, since part of the total for these calendar years was purchased precisely in the turbulent 2022 markets. Contact has been made with the Ministry of Education, Culture and Science (OCW) regarding options for compensation for increased energy costs.

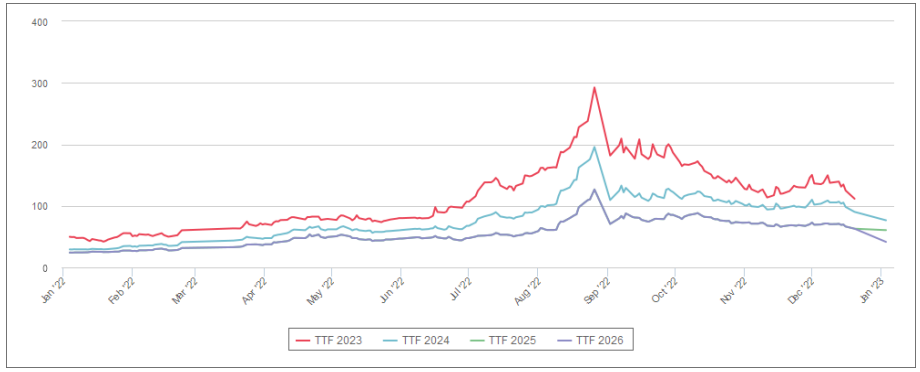


Figure 5 S energy price volatility (the gas trading price in euro cents per cubic metre is shown)

Energy programme 2021-2024

The 2021-2024 energy policy plan has been detailed in a number of projects for energy saving and renewable generation. A major contribution to achieving the set targets was made by the HEN++ project. This project focused on the expansion of the ground-coupled heat exchange / hybrid energy grid for Mercator I and II, the Proeftuin (greenhouse complex), Forum and Berchmanianum. This expansion has been in operation since the end of 2022, with the result that the buildings above now consume little or no gas. The energy policy plan also counted on significant savings from installing LED lighting and additional solar panels on roofs. The lighting in the Proeftuin was replaced completely with LED by the end of 2022. This has already secured significant energy savings. In addition, major steps were taken through the LED's-GO project in preparing and tendering for LED lighting for Huygens, Grotius, Elinor Ostrom/Gymnasion and the University Library.
Implementation will be in 2023. Sports field lighting will also switch to LED in 2023. The roofs of the university's buildings have been inspected for their technical quality and suitability for the installation of solar panels. The roof modifications where necessary and the purchase and installation of the panels will follow in 2023 and 2024. Apart from these main areas, 2022 also saw several smaller initiatives. For example, surrounding optimising pumps and control technology, or by including LED lighting during smaller renovations that were being carried out anyway.

Appendix 1 Building energy labels and consumption

Energy labels have been calculated for various buildings in 2022. Buildings like the Maria Montessori Building and the Elinor Ostrom Building / Gymnasion score rather well, with energy labels A+++ and A++ respectively. Based on the campus plan, the university is lifting its building portfolio to an (almost) energy-neutral building level at a steady pace. Certain buildings are required to have an energy label, but the level of the label is not important from a legislative perspective. The legislation requires energy label C for office buildings by 2023. This requirement does not apply to monuments and educational buildings. The label C requirement applies once the floor area used for office work takes up 50% or more of the total surface area of that office building, AND the floor area for office work (and ancillary functions) exceeds 100 m2. This applies to a limited number of campus buildings. Some buildings did not secure a C label, and tailor-made advice has been drawn up for them. The interventions that will be needed in the years ahead will follow from advice of this kind. This probably applies to the Gele Vlieger, Mercator III and Forum buildings. Efforts are being made to coordinate any interventions with the campus plan as far as possible. A quality declaration for the HEN++ will further follow in 2023. This is a certificate for ground-coupled heat exchange, which allows calculation with local (more favourable) specifications instead of generally applicable figures.
This will make some labels slightly more positive.

2022	consumption			energy	
	gas	electricity	primary	label	water
BUILDINGS	m3	kWh	kWh/m2		m3
			Net Floor Area Total		
Aula	23,359	191,724	265	D	338
Comenius A+B (Admin Bldg.)	50,217	237,682	190	G	1,880
Berchmanianum	54,837	375,511	171	G	-
Erasmus Building / Refter	171,114	3,107,847	HEN *	E	6,943
University Library	12,900	619,162	*	C	2,990
CC / Thomas van Aquino Building	at Erasmus	205,634	*	E	1,090
Th. v. Aquinostr. 1	at Erasmus	210,576	*	G	325
Maria Montessori Building (construction)	at Erasmus	414,708	*	A+++	500
Spinoza Building	at Erasmus	387,660	*	G	1,087
Huize Heyendael (heat > gas)	50,064	103,099	342	-	704
Oud Heyendaal	5,537	8,726	164	-	49
Forum (heat > gas)	24,574	121,060	140	E	270
Forum servers + installations		*1747528*			
Trigon	78,963	1,988,195	626	E	2,554
Werf GWT	9,904	26,108	232	A	190
Pavilion & University Chaplaincy	21,658	113,810	263	-	194
Grotius	7,369	1,245,699	130	-	2,658
Gymnasion / Elinor Ostrom	40,699	2,804,881	145	A++	11,099
Gymnasion servers + installations		meter faulty			
Transitorium	30,834	161,689	170	B	194
A1 building (incl. Low-Vibration Lab)	at Huygens	meter faulty	-	-	250
NMR	at Huygens	meter faulty	-	-	at HFML
Logistics Centre	6,000	meter faulty	-	-	at A1
Linnaeus Building	59,174	687,505	313	-	234
Huygens building (FNWI)	114,040	9,946,738	451	D	210,110
HFML (Magnet Lab) excl. 50 kV	23,031	1,185,467	571	-	323
HFML ancillary installations					
FEL Building	10,140	1,544,278	1,472	-	1,918
Nano Lab	12,892	186,598	1,249	-	2,500
Proeftuin & Greenhouses	58,821	1,016,039	1,011	-	6,781
Events + landscaping					3,298
Total excl. Third Parties	**866,126**	**28,637,923**	**239**		**258,479**
Gele Vlieger (formerly KDV I)	12,927	38,820	215	G	357
Child Day Care Centre (II)	25,325	76,542	237	C	558
Mercator 1	46,684	492,937	303	E	929
Mercator 2	28,619	722,087	326	A+	633
Mercator 3	109,173	1,265,816	335	G	2,487
UBC (Valkenburg)	43,895	97,605	323	G	170

Campus & Facilities
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