Energy Policy Plan 2020-2030: Follow-up - 2020

1. Framework and principles

UGent supports the EU ambition to become $_{CO2\ neutral}$ by 2050. **This means an almost complete transition to renewable energy, a halt to further use of fossil fuels and a very significant reduction in energy demand. Several decisions to be made now must already take this transition into account, especially in terms of infrastructure that will be in use for decades.**

This ambition was made concrete for the next 10 years in an energy policy plan2020-2030. This requires investments and measures to bring about a change in behaviour and systems. The focus should be on space and energy efficiency and investments in green energy facilities.

Annually, a follow-up report gives a state of affairs, explains the actions carried out and assesses the results. This forms the basis for continuous improvement and adjustment and determines the input for next year's plans.

The energy policy plan is part of UGent's climate plan.

2. Evolution of energy use and costs from 1998 to 2020

Since 1998, the consumption of fuel and electricity has been closely monitored in the energy accounts. Due to the corona crisis and the compulsory homework for many months, the data for 2020 are not representative. For the sake of completeness, they are presented here, as in previous years.

Electricity consumption has increased by 38% since 1998; electricity bills have increased by 76% (from €3.4m to €6m/year) (Figure 1). Compared to the **previous year, consumption fell by 7.6%**, due to reduced activity in the buildings as a result of lockdowns and teleworking.

The adjusted fuel consumption decreased by 13.8% since 1998, while the fuel cost increased by 40% (from 2.1 mio to 2.9 mio €/year) (Figure 2). **Compared to 2019, the actual consumption decreased by 2.6% but the adjusted consumption increased by 7.2%.** It is noticeable that the actual consumption has been decreasing for the last 5 years, while the corrected consumption has been increasing. The reason is probably the correction model, which works more inaccurately with larger deviations from a 'normal' number of degree days. In recent years, the number of degree days was high due to the warm winters.

Since 1998, fuel consumption per m² of building area has dropped by 14%; electricity consumption per m², on the other hand, rose by 11% (figure 3). The fuel and electricity consumption per UGent employee (staff + student) decreased by 57% and 30% respectively (figure 4).

Although the data give a very distorted picture due to the corona crisis, interesting lessons can be drawn. Many buildings were abandoned due to the homework requirement, yet they were fully heated according to the normal regime. People were sensitised through various communication channels and, on tours, thermostatic taps were manually set to a lower setting. But this had only a limited effect. It shows how difficult it is to control people who are stuck in familiar patterns. This needs sustained attention, through regular awareness-raising campaigns and policy measures that drive behavioural change, such as making the sharing of space more compulsory.

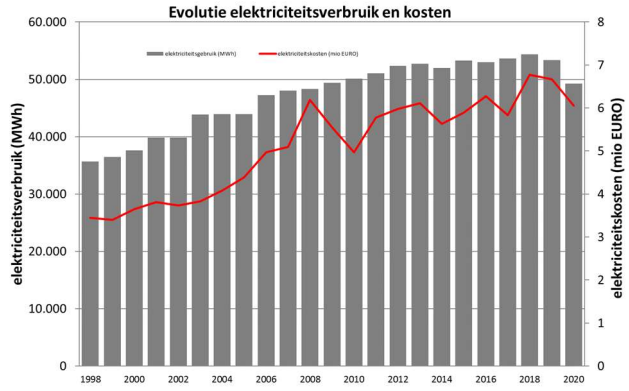

Fig. 1: Electricity consumption and costs from 1998 to 2020

Fig. 2: Fuel consumption and costs from 1998 to 2020

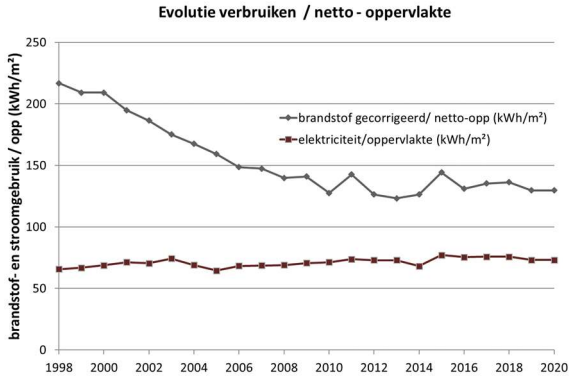

Fig. 3: Energy consumption per m² from 1998 to 2020

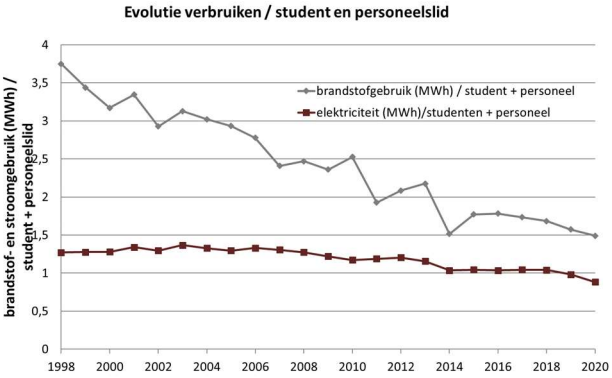

Fig. 4: Energy consumption per UGent employee from 1998 to 2020

3. Evaluation of action plan and adjustment

Given the high level of ambition of the energy policy plan and the urgency of the climate issue, it is very important to monitor the targets closely. Depending on the results of the actions undertaken, adjustments will have to be made. The evaluation below will therefore at the same time determine the action plan for the coming year.

3.1 Aligning the energy policy plan objective with the climate plan objective

UGent commits itself to be climate neutral by 2050 and formulated the objective in the energy policy plan 2020-2030 as follows (BC 28/6/2019):

1. Reduce total CO_2 emissions from building heating and electricity by at least 1.5% per year[1],
2. reduce energy consumption annually through more efficient use of space and energy (% is determined by master plan 2050), and
3. build and renovate fossil-free from now on.

[1] *If the EU ambition were to be tightened further in the coming years (to bring it more in line with the Paris Climate Agreement), this UGent objective would also have to be adjusted.*

Subsequently, the Board of Directors (dated 11/9/2020) took the opportunity of the request to declare a state of climate emergency to recognise the urgency of the climate problem and to act accordingly through additional concrete and effective measures. It agreed to align all relevant policy plans with the climate objectives and to combine them in a climate plan with short-, medium- and long-term policy objectives, the realisation of which will be monitored in the interim. These will be based at least on the European targets, but where possible faster reductions should be aimed for, in line with scientific findings.

In this context, Climate Lab calculated the $_{CO2\ footprint}$ of UGent using the 'Bilan Carbone' method[2]. The $_{CO2\ reduction\ objectives}$ by 2030 compared to 1990 were recalculated for energy to the reference year 1998, the start of UGent's energy accounting[3]. This gives a correct picture of the efforts needed for the next 10 years:

- WB2C ('well below 2°C'), the CO2 reduction targets endorsed by the European Commission: -40% $_{CO2e}$ by 2030 compared to 1998;
- WB1.5 ('well below 1.5°C'), the CO2 reduction targets that are necessary for a rich continent or knowledge institution to take the lead and go faster, in line with the IPCC recommendations: -67% CO2e by 2030 compared to 1998.

Table 1 shows what this means for the next 10 years. The reduction from 1998 to 2019 is the result of phasing out fuel oil, connecting buildings to the heat network, insulation measures, investments in green electricity production, etc. The purchase of green electricity is not rewarded in the calculation method, as the energy mix of an energy supplier is taken into account. To reach the WB2C target, an annual CO2 reduction of 2.5% is needed from 2020 onwards; for the WB1.5C target, an annual CO2 reduction of 7.5% is needed. It is **proposed to amend the 1st energy target to reduce CO2 from building heating and electricity supply by at least 2.5% per year[4], but to make every effort to achieve a 7.5% reduction per year over time.**

However, it must be clear that the transition plans aim for more than just a $_{reduction\ in\ CO2}$. The energy policy plan also aims to reduce energy demand. The $_{CO2\ footprint}$ is an important indicator of the climate plan and will be monitored every two years to ensure that UGent stays on track.

	Emissions (tCO2e)			Target 2030 (tCO2e)	
	1998	2019	2020	WB2C	WB1.5C
Fossil combustion	25.363	16.049	15.645		
Heat grid	872	2.533	2.464		
Electricity (purchased and produced)	3.882	4.681	4.321		
Total	**30.118**	**23.296**	**22.430**	**18.100**	**9.900**
Reduction compared to 2019 (%)			*-3,7%*		

Table 1: CO2 emissions in 1998 (base year), 2019, 2020 and 2030 targets

In addition, the Flemish Government approved the long-term strategy for the renovation of Flemish buildings. Among other things, this strategy states that from 2025, all large non-residential buildings must have an energy performance label, with a minimum energy performance to be achieved by

[2] *Carbon footprint of Ghent University:* *https://www.ugent.be/nl/univgent/waarvoor-staat-ugent/duurzaamheidsbeleid/klimaatplan/co2footprint*
[3] *Partial science-based targets for energy:* https://www.ugent.be/nl/univgent/waarvoor-staat-ugent/duurzaamheidsbeleid/klimaatplan/klimaatdoelen.pdf
[4] *If the EU ambition were to be tightened further in the coming years (to bring it more in line with the Paris Climate Agreement), this UGent objective would also have to be adjusted.*

2030. The Flemish government also put forward an annual reduction in primary energy consumption[5] of 2.5% for its own patrimony in its coalition agreement.

It is proposed to implement the 2nd energy target on this basis and to reduce the primary energy consumption for building heating and electricity supply by 2.5% annually.

	Primary energy consumption (MWh)			2030 target (MWh)
	1998	2019	2020	
Natural gas	69.615	77.675	84.032	
Fuel oil	43.131	1.139	701	
Heat grid	5.446	15.767	16.664	
Electricity (purchased and produced)	89.103	37.132	34.805	
Total	**207.295**	**131.713**	**136.203**	**105.738**
Reduction compared to 2019 (%)			*+3,4%*	

Table 2: Primary energy consumption in 1998 (reference year), 2019, 2020 and 2030 target

3.2 Pillar I: space and energy efficiency

As a result of stricter regulations, extra investments and the ambitions of Ghent University as part of the energy policy plan, new buildings and total renovations are becoming much more energy efficient and disconnected from fossil energy where possible. **But there is still a lot of profit to be made in using space and energy more efficiently, not only in the old buildings but also in the recently built or renovated ones.**

Moreover, the focus is still mainly on expanding the building stock (new expansion of 54,000 gross m² in investment plan 3). This leaves little or no budget for demolishing or renovating abandoned buildings.

More far-reaching efforts should be made:

- Densification and infill of the building stock
- Accelerated reconstruction and renovation
- Careful building management

3.1.1. Densification and infill of the building stock

Study (S) 1. Elaboration of master plan for building heritage 2050	
Study	The accessibility, spatial and social quality, compacting capacity, etc., are mapped out at campus level and the potential for evolving into a 'future-proof' campus is estimated.
	The building technical and energy quality, comfort, versatility, accessibility, architectural value... are inventoried at the building level and the potential to evolve into a 'future proof' building is estimated.

[5] *Primary energy is the energy needed at the source to cover the final energy use. This is because an amount of energy is always lost in generation, transport, distribution and so on. With grey power, consumption is multiplied by a factor of 2.5, with green power by a factor of 1.3 and with natural gas and fuel oil by a factor of 1.*

Determine direction	A vision will be developed (in terms of use, sustainability ambitions, space needs, etc.) in a think tank consisting of various stakeholders (administrators, experts, the City of Ghent, users, policy staff, etc.).
	With the vision in mind, a roadmap will be drawn up. This consists of several scenarios for achieving the 2050 target and formulates, among others, intermediate objectives regarding energy reduction and energy efficiency. In addition, the roadmap defines concrete and phased actions for the period 2020-2030, taking into account the planned construction and renovations as foreseen in investment plan 3.
	Investment plan 3 may be adjusted. The renovation budget is allocated to specific total renovation projects.
	Interim targets for energy reduction and energy efficiency allow for a thorough and transparent follow-up and clarify priorities, thereby providing sufficient financial resources.
	By 2050, the entire building stock will have been transformed into the desired end result: comfortable, energy-neutral, fossil-free and sustainable buildings.
Evaluation	The RVB endorsed the vision text 'UGent imagines 2050'. The plan defines clear outlines that will guide policy choices for the next 30 years. An architectural and engineering firm analysed the qualities and potential of our campuses and is now working out a concrete roadmap for the period 2020-2035, in addition to a principle roadmap for the period 2035-2050.
Adjustment and planning (proposal)	Next steps will be worked on in the coming year: - Defining a meaningful and valuable core asset of campuses/buildings: Which campuses are essential to achieving our goals? Where do we best put our resources? What are the options for the campuses that do not fall within this core asset? - Defining the interventions for this core patrimony: How can we turn this core patrimony (consisting of separate campuses) into a readable and inspiring whole? How can we interconnect these campuses and what interaction is possible between these campuses and the city/neighbourhood/neighbourhood? What other overarching spatial interventions are needed to express the ideas of the Charter? - Defining the interventions at the campus level: What interventions are needed to translate the ideas from the Charter into the campus itself? - Draw up a concrete step-by-step plan with a 2035 horizon and a more fundamental plan with a 2050 horizon. The conclusions drawn from this plan should be useful for adjusting the multi-year budget of the investment plan.

Leverage action (H) 1. Compacting buildings that are under-utilised, or freeing them up and closing them down (until renovation or demolition)	
Lever action	Together with the new research building for fac. WE, it is being investigated how this faculty can become denser (Ledeganck, S-buildings, Proeftuin). In concrete terms, this concerns the effective densification of the Ledeganck campus and buildings S3, S4, S4bis and S12, which will be largely vacant after the commissioning of S11, offering the possibility of releasing the old space- and energy-inefficient buildings for total renovation, reallocation, demolition, etc.

	In addition, the provisional practice building of the Pharmacy campus and the Kantienberg restaurant also became largely vacant. In a few years' time, this will be the case with Block B of the Coupure campus. Here, too, vacancy and reorganisation are being studied.
Continued	Vacant buildings can be thoroughly renovated.
Evaluation	A project manager was appointed for the reorganisation of S3, S4 and S12 after S11 on Sterre campus came into operation. S4bis will be demolished after S11 comes into operation, although there is no budget for this yet. The new building on the Heymans campus was due to be completed in 2020. The intention was to empty and close down the 'temporary practicals' building by then. However, no budget was provided for the demolition. In the meantime, the building remains fully in use for limited activities: in the basement, 3 laboratories are still active until the high-rise building is refurbished (another 3 years or so) and, due to the corona pandemic, practical sessions are now spread across all available rooms, including those in the 'temporary practicals' building. It has been known (and measured) for years that the Ledeganck campus is underutilised, without any result. The newly renovated Dunant 1 suffers from the same problem.
Adjustment and planning (proposal)	The freeing and closing of a building or building parts does not happen automatically and needs guidance. It needs a decision, so the remaining groups have to move and manpower and resources are provided to house the remaining groups elsewhere. As soon as the normal number of practicals is restored, the old practicals in the Pharmacy 'temporary practicals' building must be closed down and no longer heated. As soon as the redevelopment of the high-rise is complete and the basement has been emptied, the building will be demolished. The same must happen to the practical training room in Block B of the UZGent campus and the microscopy room in S3 of the Sterre campus. The lab space in the new Pharmacy building was set up to accommodate all these activities (see also H3). The reorganisation study of S3, S4 and S12 after the commissioning of S11 must also take the Ledeganck campus into account.

S2. Development of future proof basic concepts for different types of labs	
Study	Instead of designing for the user, basic concepts for the various types of labs are worked out and laid down. These concepts are designed according to a number of standards for all buildings (carcass, finishing, techniques), allowing the building to be adapted and future-proof. Maintenance can be performed in the same uniform and efficient manner for all buildings. If additional customisation is required for certain research, this can be considered later in the planning process (design phase). In order to limit this customisation to what is strictly necessary, departments must themselves bear the costs of these specific requirements, for example, or they are allocated a fixed budget that they are free to spend.
Anchoring	Labs are designed to be sustainable and modular. Customisation is limited to the most necessary.

Evaluation	An analysis was made with DGFB of examples where design agencies have worked with the concept of 'flexible and generic design' in recent UGent projects and in some external examples: what is strong, what is not? what is customised, what is generic? what is a good ratio? Different design agencies each came up with their own solutions. These were evaluated and a number of initial guidelines emerged.
Adjustment and planning (proposal)	The search is on for basic modules and guidelines for various major types of activities. These can then be included in the design guideline. Consideration should also be given to optimising the design process with regard to participation. For example, is it an idea to provide a sketch design first and only then to enter into a dialogue with the future building users? Should a kind of faculty 'scientific committee', which can assess needs more accurately, be involved in the assessment of space questions? This thought exercise will be included in the steering committee 'responsible use of space'.

S3. Information build-up on available expertise, infrastructure and devices	
Study	The specific expertise, infrastructure and equipment available at UGent will be inventoried as part of the UGent research information system GISMO (data on infrastructure should be delivered to the Flemish Research Portal FRIS by the end of 2021).
Anchoring	Knowledge of available expertise, infrastructure and devices will lead to more voluntary sharing.
	If not: Work out control/response mechanisms to increase shared use of (energy-consuming) infrastructure (cf. data centres).
Evaluation	The expertise is registered in the researchexplorer and is now publicly accessible. The data model to include the available infrastructure was built but is not yet available.
Adjustment and planning (proposal)	Initially, the available infrastructure will be registered by DOZA, where required by e.g. the Flemish Department of Science and Innovation. This will then be tested in a few pilot groups and rolled out more widely.

H2. The 'core facilities' roll out further	
Lever action	One of the policy priorities of the GE faculty is the installation of various core facilities: core infinity, core animalarium, core flow cytometry, core logistic support, ... This allows infrastructure, material and/or services to be shared across departments and research groups, possibly even externally. This requires, among other things, the appointment of a 'core facility manager'. A firm basis has already been laid for this, as the faculty has been prioritising the use of ATP personnel points for cross-departmental and cross-research initiatives for a number of years. DGFB, DFIN, DOZA and DICT assist in the design and development of tools for management, cost ventilation, staff allocation, etc.
Continued	The formation of 'core facilities' (CF) is facilitated to the maximum extent and a CF becomes the standard when realising new and reorganising existing research infrastructure.

Evaluation	The first core facilities (COREs Flow cytometry and Infinity (preclinical imaging) in the Faculty of Medicine and Health Sciences) are now operational. The reports of the pilot core facilities still show a lot of residual capacity, as a result of which the plans for a new investment could be put 'on hold'. Several additional lab environments have already signed up to work according to the core facility principles. The Lab Community developed a framework to enable the establishment and support of core facilities within UGent. It describes the concept and the different conditions, the application procedure, as well as the possibilities for co-financing and pre-financing (e.g. for appointing a coordinator). In April 2021, the RVB of UGent approved the recognition procedure forcorefacilities at UGent. Recognition as a core facility means that the BOF will help support its establishment with 50,000 EUR per year for 3 years, with the possibility of a one-time extension. The multi-year budget provides for the support of a maximum of 27 new core facilities. It is expected that in time, the existing University-wide Centres of Expertise may also evolve into a core facility.
Adjustment and planning (proposal)	Making the framework for core facilities operational: - Recognition and design of new core facilities; - Giving higher priority to core facilities in work requests, renovation and new construction. In this way, the core facilities can be introduced more quickly.

H3. Shared large lab spaces for fac. WE, BW, FW a.o.	
Lever action	The practical rooms of the WE, BW and FW faculties were inventoried and their use was charted. Several of these rooms are underutilised and underused. Shared and more efficient use is possible, provided that the timetables are harmonised and that there is good and reliable management. In the new building on the Pharmacy Campus, a multi-purpose practical room will be set up which can be used for all 'analytical chemistry' practicals of the FW Faculty and GE with large student groups. This means that the space- and energy-inefficient 'temporary practicals' building on the Pharmacy Campus can be cleared for demolition.
Continued	In addition to setting up a multi-purpose practical area for 'analytical chemistry' for bachelor's programmes (faculty BW, EA, FW, GE, etc.), work is also being done on a multi-purpose practical area for 'organic and inorganic chemistry'. This will make it possible to vacate and possibly reallocate the old, uncomfortable and energy-inefficient buildings, such as Block B of Coupure campus, S3 of Sterre campus, etc.
Evaluation	The programme of the practical room in the new building on the Pharmacy campus has been expanded so that it can be used for all practicals on 'analytical chemistry' for large groups (bachelor's programmes). Thus, the room can be used by the fac. FW and the fac. GE faculty, as well as other faculties offering analytical chemistry practicals. Because of the corona pandemic, lab sessions were spread out over all available classrooms, so this joint use was not organised and no old lab rooms were freed up (building 'Provisional lab sessions', lab room in Block B on the UZGent campus). In addition, a large microscopy room was set up in the new building on the Pharmacy campus, which can be shared by the fac. GE and fac. FW.

Adjustment and planning (proposal)	Fac. FW and GE should take joint action to coordinate the use of the new lab rooms. In order to put some extra pressure, a date can be agreed on which the provisional practicals building (with the exception of the 3 labs in the basement) and the practicals room in Block B of the UZGent campus will be closed. If not, there is a good chance that these rooms will remain in use for a long time and that the large investment in the new building on the Pharmacy campus was not worthwhile. A preliminary study is underway to set up a multi-purpose practical room for 'organic and organic chemistry', which can be shared and used efficiently by all the bachelor courses that organise these practicals. This could be integrated in the renovation of S3 or S4.

Sensitising and empowering

H4. Common -80°C freezers for long term storage	
Lever action	Bioresource centre Ghent (Health, innovation and research institute, campus UZGent) provides 45 -80°C freezers and 6 liquid nitrogen vessels (Isothermal Freezers CBS, 35000 cryovials/barrel) for the storage of biological agents. The Bioresource centre Ghent is the central contact point for biobanks at U(Z)Gent, with a coordinating function and a central management system (with cost ventilation). There is still a lot of unused space, as this is little known and departments are free to install -80°C freezers. However, one -80°C freezer consumes 2500 to 3500 kWh annually and a lot of biological material remains untouched (and in some cases superfluous) in the freezer for many years, which may not be in conformity with the stricter biobank legislation. There are an estimated 130 -80°C freezers at UGent, 9 -150°C freezers and 1 -180°C freezer. In addition to the advantage of saving energy, the Bioresource centre Ghent has back-up freezers and the Biobank legislation has recently been tightened up, which means that stricter requirements are being imposed on biobanks (more safety requirements, audits by the government, back-up plans and emergency plans, etc.). These matters are better organised in a central infrastructure. Departments are encouraged to provide long-term storage in shared storage facilities (in the first phase on the UZGent campus).
Continued	If encouragement has too little effect, control/responsibility mechanisms are developed to increase the shared use of energy-consuming infrastructure (cf. data centres) (e.g. EUR 500/year per -80°C freezer put into operation).
Evaluation	Information sessions and an organised site visit in 2019 have not led to an increase in the use of the Bioresource Centre. Additional -80°C freezers are still being installed. A new communication was sent out, informing about the new Biobank legislation and the advantages of the Bioresource Centre and announcing that counters will be placed on all -80°C freezers to make the costs transparent, and possibly to charge them in a next phase. The website now also contains this information. Further action was stopped because the freezers in the Bioresource Centre are used for storing vaccines against the coronavirus.
Adjustment and	In a first phase, counters will be placed on the -80°C freezers of MRB2, since these are close to the Bioresource Center. In the first instance, these will only serve to provide insight into the costs for the departments involved.

planning (proposal)	A thought exercise was launched to establish multiple centralised biobanks, thereby reducing the distance to centralised infrastructure.

S4. Optimising strategy around economical use of space	
Study	In 2017, a consultancy firm investigated MSC concepts for a space optimisation of the offices and labs of UGent. Based on this, the surface standard for labs was reduced from 21 m² to 18 m² per FTE (incl. growth) and the RVB decided to convince faculties to save space by making their use of space and the costs involved transparent and open for discussion. A pilot project ran at the fac. WE and fac. RE under the slogan 'thinking about space together'. Only in the fac. WE was the result. A total of 1,400 m² of usable space, spread over 50 classrooms in various buildings, was decommissioned at the end of 2019.
	Working out the next steps, taking into account the following questions: - How to deal with this disused but fragmented space for the WE faculty? - How to deal with faculties/departments that do not wish to participate? - Is further control necessary? The WE faculty did save 1,400 m², but has 5,000 m² too many based on the surface study.
Continued	If it is successful enough, the pilot project can be rolled out further in the other faculties.
	If the pilot project leads to insufficient results, instruments must be developed to steer more forcefully, such as financially charging for the use of space.
Evaluation	The evaluation report of the project 'thinking together about space' showed that more is possible and more is needed. The working method MCS proposed did not convince us: it was a nice first step, but seems insufficiently effective to book further large space gains and to achieve the energy/climate targets UGent aspires to.
Adjustment and planning (proposal)	Therefore, a proposal of concrete policy measures for a more economical use of space is currently being worked on together with a steering committee on 'responsible use of space'. A draft proposal for a policy framework was first discussed with the deans and directors. This process still requires additional consultation, but it is expected that a management-supported concept note will be presented to the RVB at the end of this year. Besides working out a new policy framework, one can already focus on infrastructure that is specific, consumes a lot of energy, requires a lot of management, is subject to strict legislation, ... In these cases, new buildings, renovations or requests for work can be asked to examine in advance whether such infrastructure is already available somewhere, to manage the infrastructure at the level of the faculty or the UGent instead of at the level of a department, to work out a management system that allows shared use, ... The RVB requested that the office concept of the policy framework 'working differently' be revised, taking into account the greatest possible work comfort for every employee and sufficient room for co-creation between designer and end users. In this exercise, a number of boundaries have to be guarded: limited budgets and urgency to preserve remaining open space and drastically reduce energy consumption and $_{CO2\ emissions}$. These limits have already been recognised in the energy policy plan, the real estate policy plan, the biodiversity plan, etc.

	Consequently, more emphasis must be placed on a different organisation and behavioural changes than on more square metres. Currently, the workgroup 'workstation policy UGent' is preparing an adapted office concept. This working group was composed of representatives from the RVB and from the alpha, beta and gamma faculties and the central administration.

S5. NEW: Dismantling of colocation of old servers in S10	
Lever action	Most of the decentralised servers (managed by departments instead of DICT) are physically centralised in the S10 data centre. This is a great improvement over the past, when these servers were set up in dozens of decentralised server rooms. The current centralised way of working is more energy-efficient (up to about 200,000 EUR/year savings), makes the availability of the servers more reliable and means a lower overhead cost for maintenance of e.g. cooling. Many of the servers that were moved at the time are now outdated and use a disproportionate amount of energy compared to the amount of computing power they represent. This is related to a law within electronics, Moore's Law, which states that every 18 months the same computing power is obtained with half the energy. Investing in new servers that are on 24/7 therefore yields considerable energy savings. Moreover, many departmental servers are seemingly idle, which still results in an energy consumption of 60% compared to the maximum load.
Evaluation	This is a new action.
Adjustment and planning (proposal)	It is being investigated how research groups can be more strongly encouraged to retire obsolete server hardware. A proposal will be submitted to the ICT committee.

S6. NEW: Rational use of supercomputer	
Study	A supercomputer (High Performance Computer) offers many possibilities to scientists, but it is also a huge energy guzzler: about half of the energy load of servers at UGent comes from its own supercomputers (200 out of 400 kW). Soon a new Flemish supercomputer (VSC Tier-1c) will be added with an estimated power of 350kW, which will be doubled by the end of 2022/beginning of 2023. When the energy for cooling, power distribution, etc. is also taken into account, the total energy load of the supercomputing at Ghent University is currently 300 kW, soon to be 825 kW and at the end of 2022/beginning of 2023 1 MW. Use of the HPCs is free of charge at UGent. Charging a small amount per calculation could lead to a rationalisation of the use. This is already being applied at KU Leuven. At UGent, this is not the case for the time being. It is precisely the intention to make the computing infrastructure usable by a wider public and a wider range of applications. Overconsumption could result in a lower utilisation rate of the central infrastructure and possibly a new increase in the number of decentralised computing clusters. Moreover, 'over-consumption' cannot be defined and detected. To encourage researchers to make thoughtful use of the supercomputers, the usage and energy costs are made transparent per project / research group.

Continued	If sensitisation has too little effect, the possibilities for control/response mechanisms will be investigated.
Evaluation	New action
Adjustment and planning (proposal)	To encourage researchers to make thoughtful use of the supercomputers, the usage and energy costs are made transparent per project / per research group.

3.1.2 Accelerated (re)construction and renovation

S7. Tightening up energy measures in the draft directive	
Study	Technological changes are rapid. Decisive developments are often taking place, e.g. in the potential of smart grid, light as a service, circular materials. Such developments should be monitored in order to use them - if applicable - to reduce the energy demand of university activities.
Anchoring	New energy-saving measures will be included in the design guideline, making it a part of all construction projects.
Evaluation	A new version of the draft directive was approved, in which additional guidelines were set for fossil-free construction and renovation. In several places, aspects of GRO, the Flemish Government's guide to sustainable building, were also integrated.
Adjustment and planning (proposal)	Together with the master's thesis workshop 'circular building', students and experts in circular building and policy officials are working on a summary note 'material matters', with proposals for first actions on circular building.

Total renovations

H5. Total renovations in investment plan 3	
Lever action	In investment plan 3, EUR 100,000,000 was reserved for replacement investments. This budget must be sufficiently safeguarded for total renovations (proposal: EUR 60,000,000). Depending on the results of the master plan 2050 'UGent verbeeldt 2050', some buildings will be moved forward.
	Budget: EUR 60,000,000 (provided for in investment plan 3).
Continued	The total renovation will be carried out according to the BEN principle, which means that when the heating infrastructure is replaced in the future, sustainable, fossil-free alternatives can be chosen.
	All buildings renovated from 2020 onwards will be equipped so that they no longer need fossil fuels for heating.
	Budget: Reflected in future investment plans.
Evaluation	The investment plan 3 has little or no budget left for total renovation. The (provisional) conclusions of the master plan 'UGent verbeeldt 2050' (UGent imagines 2050) therefore did not play a role in the allocation of the renovation budget for the next 10 years. The budget for total renovation has already been allocated to the renovation of Rommelaere and Aula, the reconstruction of Paddenhoek 1, 2, 3, but also to new construction projects studielandschap on the UZGent campus and S11 on the Sterre campus. In addition, EUR 7 million is needed annually for urgent repair work. This leaves €13.7 million in investment plan 3 (until 2028).
Adjustment and planning (proposal)	The remaining renovation budget (EUR 13,700,000) must be allocated to total renovation as soon as possible. The conclusions from the study 'UGent imagines 2050' must provide direction for this. A number of previous choices can be reconsidered, freeing up money for some additional total renovations, necessary for a rapid energy transition (the nextdecadeis crucial). On the one hand, it provides more comfort and energy efficiency, and on the other hand, only buildings that are very well insulated can use fossil-free heating systems. As the investment plan 3 is not yet aligned with the objectives of the energy policy plan, it needs to be scrutinised with a view to sustainability and advancing insight. This may give opportunities to release and shift budgets (see brainstorming in appendix 2).

H6. Additional total renovations in accordance with roadmap of master plan	
Lever action	The roadmap that translates the vision of the master plan into implementation will propose concrete and phased construction and renovation projects for the period 2020-2030. This will presumably be much more ambitious than the steps currently planned in Investment Plan 3 if we are to achieve the 2050 targets.
Continued	By 2050, the entire building stock will have been transformed into the desired end result: comfortable, energy-neutral, fossil-free and sustainable buildings.
Evaluation	There was no additional structural funding from the Flemish Government.

Adjustment and planning (proposal)	The conclusions from the study 'UGent verbeeldt 2050' (UGent imagines 2050) must be usable to adjust the multi-year budget of the investment plan (see S1 and H5).

3.1.3 Careful building management

H7. Establishment of energy cell	
Lever action	In the energy cell of the Technical Bureau, at least 2 energy managers are active, with the task of: - Proactively monitor and update building management systems. - Conduct and follow up energy audits. - Set up an energy working group of experts, users and authorities in the 5 most consuming buildings (e.g. VIB-UGent building). - Contact point for possible energy-saving measures throughout the patrimony.
Continued	Sufficient time is spent on building management.
Evaluation	Funds were provided for an additional employee from the provision for sustainable measures. This person has not yet been appointed.
Adjustment and planning (proposal)	Appointment of an additional energy employee.

H8. Aftercare	
Lever action	The iGent building on the Ardoyen campus was taken into use in 2015. The building design was strongly focused on sustainability and efficient use of space, using the latest technologies. The building has a central building management system. Now that the building has been in use for several years, a review of the energy technologies is appropriate. Are the technological systems working optimally and energy-efficiently in accordance with the promised energy performance? Is adjustment needed? Is the building management sufficient or does it need better monitoring? A 'commissioning team' of academics, students and policy staff within UGent with expertise and affinity in building management, construction and usage processes is appointed to investigate this. Based on the findings, energy systems can be optimised and lessons can be drawn for the general building management of UGent.
Continued	There is an effective and integrated strategy on aftercare and building management for the entire UGent building stock.
Evaluation	A study is underway in which researchers from the fac. EA are analysing data of all kinds of building parameters in different rooms of the iGent building (temperature, CO_2, ventilation, sun blinds, flow temperature of heat generation, flow temperature of cooling, lighting control, presence detection, ...). Together with DGFB, it is now being investigated whether comfort and control parameters

	of an air group can also be recorded in order to register deviations and generate alarms accordingly (so not only alarms when something no longer works). The aftercare study in resto DI was carried out but not finalised. The assignment was extended by 6 months.
Adjustment and planning (proposal)	It is examined how the research in iGent can be extended with an evaluation of the energy systems and performance and the formulation of advice on optimisation, adjustments in function of the type of rooms, error correction, ... for iGent. Advice can also be given on the general building management of UGent: - Include provisions in the design guideline for energy investments (e.g. number, location, type of sensors, ...). - Include provisions in the building process towards aftercare (which parameters must be followed as standard, who does what (internal/external), how are users involved, how are adjustments made, etc.) - Controlling systems on the changing use of the premises. After finalisation of the aftercare study in resto DI, it will be decided whether an extension of the assignment is necessary and, if so, which issues need to be investigated in more detail. DGFB monitors the measuring data of recent new buildings or renovations (Dunant 1, Capture, Locus, new buildings on the Pharmacy campus, renovation of De Brug) more frequently. Seasonal commissioning is now included in the specifications. It remains to be seen how best to implement this task, but it is already a good instrument to keep the parties available after provisional delivery during the guarantee period (2 years) in order to tackle ad hoc problems or to organise a consultation moment. After this guarantee period, DGFB will ensure structural follow-up for those buildings where this is relevant.

3.2 Pillar II: Renewable Energy

The purchased electricity consists of purchased green power (77%), electricity generated by three wind turbines on the Proefhoeve campus (20%), electricity generated by cogeneration installations on the Coupure and Ledeganck campuses (2%) and solar panels (1%).

The buildings are mainly heated by natural gas (81%), heat from the Luminus heat network (15%) and fuel oil (1%). **Heating via heat pumps (0.5%) and CHP (1.2%) is still minimal. However, this is the change that will have to be made in the coming years.**

In total, UGent derives about half of its energy demand from green energy, mainly through the purchase of green electricity. In order to further increase this share, strong efforts need to be made:

- Green heat
- Green own electricity production

3.2.1 Green heat

H9. '2050-proof' renovations and new buildings

Lever action	In all new-build projects and total renovations, renewable energy sources are resolutely chosen instead of fossil fuels, or prepared for.
	For the new S11 research building, circular materials are chosen wherever possible.
Continued	The investment plan grows into an inclusive story, where the extra efforts needed for the provision of renewable energy sources are included in the project budget.
	Investments in a heat network, for example, are taking place.
Evaluation	Fossil-free construction and renovation have meanwhile been included in the design guideline. The new building projects and a few major renovation projects (Block B on the UZGent campus, the new building on the Proeftuinstraat campus, the new research building on the Sterre campus and the new homes, Dunant 1) were aligned with this. Heat pumps were always chosen for this. When boiler rooms are to be renovated without the building envelope having already been addressed, a gas system must be chosen again. This was done for the renovation of the boiler room S2 and GUSB.
Adjustment and planning (proposal)	A number of buildings scheduled for renovation (Rommelaere, Aula, Plateau) score poorly in terms of energy efficiency, nowadays, but also in terms of the possibilities for tackling this. For example, disconnecting from fossil fuels will be a technically difficult and expensive task.

S8. Study of energy transition to fossil-free campuses	
Study	An energy transition plan is being drawn up for the Sterre campus to evolve into a fossil-free campus by 2050. This transition plan consists of several scenarios to achieve this long-term goal. In addition, the energy transition plan defines a concrete and phased action plan for the period 2020-2030, taking into account the planned construction works and renovations during that period.
Anchoring	Similar studies are being drawn up for the other campuses.
Evaluation	Energy transition studies are underway for the Sterre, Proeftuin, UZ Gent, Kortrijk and Ostend Science Park campuses to examine how the campuses can be disconnected from fossil energy and what adjustments are needed for planned investment projects.
Adjustment and planning (proposal)	These studies will be further refined. In addition, studies will be started for the Rommelaere campus and the Aula-Korte Meer campus (as part of the planned renovation). The buildings in the Sint-Pietersnieuwstraat zone (UFO campus, Boekentoren campus, Economy campus) are largely connected to the Luminus heat network (natural gas-fired CHP). Within the framework of the master plan Sint-Pietersnieuwstraat, the City of Ghent and Luminus are looking into how to make this heat network more sustainable. A CO2-neutrality plan must be drawn up for the Ardoyen campus, together with the companies. This is an obligation for science parks, where we have been lacking for several years. This can be taken up by the management committee of the Technology Park. The feasibility of a biomass plant or a bio-digester on the Melle campus and the Merelbeke campus is being investigated, together with researchers.

H10. Concrete development of energy transition studies	
Lever action	Aligning the planned new building and renovation projects from Investment Plan 3 with the energy transition plans.
Continued	Further concretisation of the energy transition studies.
Evaluation	The design phase of S11 and the construction of the inner courtyard take into account the conclusions of the energy transition study of Sterre campus, and additional research was carried out by SVR/Arcadis to quantify the additional cost of providing the largest possible BEO field under and adjacent to S11, and what the connection to a future heat network would entail. With the arrival of the new generation 'Tier-1c' Flemish Supercomputer of the Flemish Supercomputer Centre (VSC) in data centre S10, an opportunity has arisen to recover high-quality residual heat. The liquid-cooled supercomputer will produce water at a temperature of 60 °C with a capacity of 300 to 350 kW; from 2022 this capacity should increase to 600 to 700 kW. If the energy for cooling, power distribution, etc. is also taken into account, the total energy load of the supercomputer at the end of 2022/beginning of 2023 is 1 MW. However, there is no clarity on the continuation of this programme after 2024. Previously, similar setups were installed in the UGent data centre (2012) and KU Leuven (2016).
Adjustment and planning (proposal)	The study for the Sterre campus not only shows the potential of a BEO field and a heat network, but also makes it clear that the heat network requires a sufficient number of buildings that can be fed with low-temperature heating in order to be profitable. This argues in favour of a stronger focus on renovation of the existing patrimony. The large amount of residual heat cannot be structurally incorporated into the energy transition of the (temporary) location. The heat source is only temporarily available. This consequence of wasting energy by discharging residual heat must be taken into account in considerations about location, rotation, etc.

3.2.2 Green in-house electricity production

H11. Accelerating the use of rooftops for electricity production	
Lever action	A cooperation is set up with the Vlaams Energiebedrijf (VEB), founded by the Flemish Government to assist and relieve governments of the burden of installing PV installations. The VEB is an Externally Independent Agency and can thus act as a procurement agency within the law on public contracts. The governmental entities / public services are exempted from organising an award procedure themselves, which saves a lot of time.
Evaluation	UGent opted for an internal loan to temporarily make funds available for the installation of PV systems. The repayment can then be done with the income from exploitation. Preparations were made (feasibility study, financial analysis, grid study, adjustment of electricity cabin, etc.) for the installation of PV systems on S1 and S5 of Sterre campus and on Block A of Coupure campus.

	The feasibility study for PV installations on roofs of the Veterinary Medicine campus is also positive.
Adjustment and planning (proposal)	The PV installations on Sterre campus and Coupure campus will be installed in 2021. A design study is underway to examine the possibilities on the roofs of the veterinary clinics on the Merelbeke campus. The installation of a PV system on the Pharmacy high-rise is started.

H12. Placement of wind turbine on campus Test Drive	
Lever action	A right of superficies was granted to Ecopower and Energent for the construction and operation of a wind turbine on campus Proeftuinstraat via an energy cooperative. This allows for participation by local residents, staff and students.
Evaluation	The environmental permit application for the construction of a wind turbine on the Proeftuin campus has still not been submitted. The wind turbine on campus Proeftuinstraat has an overthrow over a green zone from the municipal RUP, which is not allowed if it is not explicitly described in the RUP. The location of the wind turbine was shifted 2 metres to the west and 8 metres to the north. A safety contour of 140 metres has been set up around it. Within this safety contour, it is not possible to place the same type of building as the new building currently planned (with the same dimensions, the same structure and the same occupancy rate). Other types of buildings are possible, depending on the density within a compact area. If, for example, the same number of people are spread over several buildings, there are possibilities.
Adjustment and planning (proposal)	The proposal to move the wind turbine, together with the consequences for the further development of the site, will be submitted to the BC for discussion and approval. The environmental permit can be submitted at the end of 2021.

4. Create support, raise awareness, inform

The transition to a sustainable energy system based on renewable energy sources promises to be quite a challenge, and one that will not tolerate any more delays. At the same time, there are many uncertainties, familiar systems and practices will have to change and complex, risky and expensive interventions have to be budgeted for in the already very tight budget. So there is a need for strong support for making the energy transition a top priority.

Administrators must be convinced of the necessity. Staff members and students must feel involved in the energy policy of Ghent University and be convinced of the importance of energy efficiency, know how to use BEN-buildings, understand why infrastructure must be shared and needs must be correctly assessed, be stimulated to take on commitments beyond their comfort zone, etc.

H12. Joining forces and strengthening support base	
Lever action	The following initiatives have been running for years and will be continued and strengthened: ○ Working Group on Energy Policy: a network of policy officers (DGFB, DICT, Environment), energy experts and interested parties. They shape the energy

	policy plan, follow up the action plan, give advice and develop policy instruments and experiments. ○ Transitie UGent: an open renewal network of committed students and staff, academics and policy makers, who meet about four times a year and address various sustainability themes. They act as a sounding board group and help create support for the further rollout and integration into the energy policy. ○ Faculty environmental committees: a group of staff members who monitor environmental and climate issues related to their faculty. They act as a sounding board group and help create support among the building users. ○ Campaigns on energy sensitisation in the winter period, efficient use of space, global climate objectives, etc. ○ Broad communication about the objectives and policy choices and the results achieved. ○ General point of contact for remarks, suggestions, initiatives, ... concerning energy policy (energie@ugent.be, milieu@ugent.be, duurzaam@ugent.be) .
Continued	A widely supported Energy Policy Plan 2020-2030 and effective implementation of the proposed actions.
Evaluation	The energy policy plan, with its objectives and policy choices, is discussed in general UGent communication and some specific media (Schamper, Green Office newsletter, etc.) and in faculty environmental committees and other working groups on the environment and sustainability. Several action points from the plan were also included in covenants of faculties and managements as part of the university-wide policy choice on sustainability. The enlarged energy policy working group remains active and enthusiastic, also for the further elaboration of the energy policy plan. The plan served as inspiration for other higher education institutions. Consultations were also started with the City of Ghent to align it with their climate plan.
Adjustment and planning (proposal)	Efforts are continuing.

5. Research

The energy transition still requires a great deal of technical, process and social innovation. There are still many knowledge gaps and challenges for knowledge institutions to achieve a sustainable and energy-neutral building heritage. As a university, we can act as a living lab in research projects.

The following collaborations have already been set up:

The Interreg project BISEPS[6] looks for synergies in terms of energy exchange on campuses and between companies, e.g. through recuperation and exchange of residual heat or exchange of electrical energy. In the project, a simulation tool is developed that maps out which energy synergies are possible on business campuses, which technological and economic barriers exist

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and what the financial benefits could be. The simulation tool is applied to campus A of Tech Lane Ghent Science Park and the Ostend campus.
The Interreg project ROLECS[7] looks at streamlining energy tariffs, legislation and technical aspects to enable Local Energy Communities (LEC). These are locally defined zones in which participants themselves take some of the responsibility for energy production and balancing. It is being investigated whether campus A of Tech Lane Ghent Science Park and the Ostend campus could be suitable for implementing a LEC.
The IDLab research group is housed in the iGent building and has experienced that the temperature in the building can vary significantly between offices and is not always ideal (often too warm). Also, a number of systems are not always used or controlled optimally (e.g. control of sun blinds and windows). Given IDLab's strong expertise in data analysis and sensor communication, and the interest in using iGent as a living lab for testing new developments in realistic conditions, an internal trajectory has been set up in which a number of analyses will be carried out on the data available from iGent's building management system. Afterwards, additional sensors can be installed to capture additional data (e.g. on presence of users or air quality) and an interaction with the users can be set up. The aim is to achieve optimum comfort with minimum energy consumption.
In the course of the Engineer-Architect programme, a PhD student works on the design of heat networks of the latest generation (with heat-cold exchange).
Master's thesis on exploratory analyses on the monitoring data of the Charles Vandenhove Pavilion, focusing on indoor climate, 2020.
Master's thesis on the renovation of the heating and ventilation systems of the Proefhoeve in Melle, 2020.
Master's thesis of the course Engineer-Architect on the 'energy performance gap', i.e. the difference between the promised energy saving before and the actual energy saving after a renovation (cases S5 and home Boudewijn), 2019.
At the city academy, students investigated the possible reconversion of the UGent building heritage[8] from the 60s and 70s (poorly insulated buildings with outdated energy techniques). The renovation task is not only a matter of infrastructure and technique, but is also a challenging management issue (cooperation around heat networks, around district parking, around integrated mobility, etc.), 2019.
In the master's thesis workshop Circular Building of the City Academy, the following master's theses were worked on, among other things: - circular/sustainable building at UGent, with the FBW new building on campus Proeftuin as a case study for the Bio-Engineering programme, 2021; - importance of the end-of-life treatment of a building for its environmental impact (case study S4) for the courses Industrial Engineering Construction and Engineer Architecture, 2021.
IMEC is working on the research project 'Hybrid AI for optimal building management' (2020-2022) where the iGent tower is one of the studied cases.
The Engineer-Architect course worked on a special issue called 'Roadmap towards an energy efficient FEA campus Ardoyen'. The results can provide insights for the energy policy plan. Following this teaching project, the Architecture and Urban Planning department wrote a master's thesis entitled 'Energy concepts for a low-carbon university campus Ardoyen'.

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A thesis topic was issued with the working title 'The transition to sustainable university campuses: designing for Sterre campus' for the study of Engineering Architects.
A thesis subject was written with the working title 'iGent tower as a living lab for sustainable building solutions' for the study engineer-architect.
A thesis subject was written with the working title 'Concepts for an energy-efficient Ardoyen university campus' for the course 'Engineer-Architect'.

6. Funding

Sustainable building and the transition to a fossil-free building stock must become an **inclusive story**. The costs associated with this must be integrated into an investment plan, in a building project, etc. However, investment plan 3 does not yet go this far. **The measures which must be taken to build and renovate according to the BEN-principles are anchored, but an extra budget for e.g. a connection to a heat network, a BEO field, ... is not yet foreseen.** In order to finance this in the meantime, the following budgets were/can be used.

Commission sustainable measures:

The 'provision for sustainable measures' is included in the investment plan. This provision is supplemented annually by proven savings (see annex 1). In the next budget it will be proposed to transfer the proven savings of the previous years, being **555,798 EUR**, from section I to section II. For component III, the proven savings in 2020 amount to **62,143 EUR**.

Commission renovation directive:

There is also a provision for projects carried out within the framework of the renovation directive. The balances of the maintenance programmes and general budgets for welfare and the environment are added annually to the provision for projects carried out within the framework of the renovation directive. For 2020, an additional **EUR 237,484 will** be added to the provision.

Grants:

- Call green heat, residual heat, heat grids and biomethane: Those who invest in new projects of green heat, residual heat, heat grids or biomethane production can apply for support (30% of the investment) during the annual call for projects (https://www.energiesparen.be/call-groene-warmte. In the further development of the heat networks on the Sterre campus and the Kortrijk campus, these subsidy possibilities will be thoroughly examined.
- Certificate system: Certain installations are entitled to green power and/or CHP certificates. For the PV installations and the CHP, **EUR 23,991 and EUR 35,693 respectively** were received in 2020.
- Climate investments in buildings of higher education: UGent received a subsidy of **1 mio EUR** in 2020.

Internal loan:

For the cooperation with VEB for the accelerated installation of PV systems, it is proposed to set up an internal loan that will make the funds temporarily available. Repayment can be made with the income from operations.

Sustainable investment fund UGent and third-party financing:

Some investments will pay for themselves in a relatively short period of time and can be considered a sustainable investment. UGent has a sustainable investment policy, which means that it invests 90% of its liquid assets (EUR 230,000,000) only in sustainable fossil-free investment funds. In addition, 10% of the total capital to be invested is taken under own management and invested in specific funds in which UGent wishes to participate because they are closely related to the UGent activities or in sustainable projects (23,000,000 EUR).

There is also the option of third-party financing, whereby an external party borrows or raises money via a cooperative from staff, students and local residents and uses it to finance energy projects. However, this is only applicable for projects with a favourable return.

For the construction and operation of a wind turbine on campus Proeftuin, a long lease agreement was concluded with the energy cooperative Energent and Ecopower. A participation of UGent through this sustainable investment fund will be considered again later, when the environmental permit is obtained.

Adjustment of the programme:

In some cases, the both-and story comes under pressure. For a long time, we were able to build and renovate more sustainably, without questioning the programme. We only had to add extra resources to the project budget for extra insulation, solar panels, heat pumps, and so on.

This is not always the case, which makes more radical choices necessary. It is suggested that consideration be given to open-mindedness each time and that the common CO2 emission target be kept in mind at all times.

Questioning ever more stringent legislation:

The Codex of Wellbeing at Work states that the $_{CO2\ concentration}$ in a room must be lower than 900 ppm $_{CO2}$ for 95% of the time calculated over a maximum of 8 hours, in order to adequately ventilate workplaces. This corresponds to a ventilation flow of 40 m³ per hour per person. UGent struggles with the interpretation of this. In general, it is designed:

- with a mechanical ventilation flow of 25 m³ per hour and per person in auditoria and 30 m³ per hour and per person in offices;
- to a CO2 concentration of 1,400 ppm (if CO2 is controlled);
- with a minimum flow rate according to type of room or per m² of floor area (in accordance with the EPB regulations);
- taking into account an average comfort class, with opening windows providing additional comfort.

However, the corona pandemic is creating pressure to strictly follow this very strict legal provision (900 ppm - 40 m³ per hour per person). This means much larger HVAC installations (40-70% larger), which will have a huge impact on the investment budget, energy consumption and building footprint (much larger technical space, more space in the suspended ceilings and shafts due to larger ducts, ...). Questions are raised as to whether the impact on energy and material consumption is proportional to the added value of this measure in terms of health. The climate risk is not taken into account at all. However, everything must urgently be done to limit this climate risk. UGent, VLIR and other institutions can give a signal here.

Release of budgets in investment plans Section II and III:

However, it is certain that the above financing channels will not be sufficient. Large investments, i.e. total renovations, construction of a BEO field, connection to a heat source in the neighbourhood, etc. will require larger budgets.

Finding them will be very difficult, not least because of the structural budget deficit that must be eliminated in the coming years, but also because of the tightness of investment plan 3.

Budgetary shifts will have to be made. When these happen with the agreed objectives in mind, they can help support the sustainable system changes. Moreover, the search for additional resources creates the possibility of rolling out a guiding policy without a ban or 'stick', whereby the option with the highest associated CO2 production and environmental footprint receives an increased contribution in order to stimulate the most climate and environmentally friendly options (see brainstorming in Appendix 2).

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