University of BRISTOL

Capital Portfolio Board

MEETING DATE	**23/06/2021**	
REPORT TITLE	**For Approval: Planned Spending on Energy Efficiency Measures**	
CLASSIFICATION *Please see Report Writing Guidance 1.3*	**OPEN** ☒ **CONFIDENTIAL** ☐ **STRICTLY CONFIDENTIAL** ☐	
Report Author: Martin Wiles, John Brenton, Anna Lewis, Chris Jones	**Job Title: Head of Sustainability & Sustainability Managers**	
Sponsored by: David Martin	**Job Title: Director of Campus Development, Campus Business Management and Support**	
For decision ☒	**For discussion:** ☐	

Actions/Decisions Required

The Capital Portfolio Board is asked to Approve the expenditure of £855k in financial year 2021/2 on the energy efficiency works proposed in Appendix A of this document.

Executive Summary

A series of capital works is proposed costing £855k with a simple cost payback across all measures of under 4 years. As it will take most of the year to implement the measures, the savings will begin to accrue in Financial Year 2022/23

- The works will reduce the University's carbon emissions by 600tonnes, linking with the University's net zero carbon target as set out in the University's Vision and Strategy, the Sustainability Strategy and Carbon Management Plan.
- The works will save £235K per year, helping to protect the University from future energy price rises.
- The work will reduce revenue costs compared with business as usual.
- Best value works have been chosen from a range of possible projects.
- A portfolio approach has been taken to reduce delivery risk.
- Reducing duty on some items of plant will reduce maintenance risk.
- There is provision for spend of this magnitude on energy efficiency works in the Capital Plan.

Link to Strategic Plan — **NO** ☐ **YES** ☒

University Vision and Strategy; Sustainability Strategy.

Link to Risk Register — **NO** ☐ **YES** ☒

The risk of sharp increases in utility costs are noted in the risk register.

Summary of any consultations carried out — **NO** ☒ **YES** ☐

Summary of any Equality, Diversity & Inclusion implications — **NO** ☒ **YES** ☐

Summary of any Sustainability Implications These works will reduce our impact on the environment	**NO** ☐	**YES** ☒
Decision and Consultation Pathway		
Does this report need to go to another Body/Committee? **Name and date of Body/Committee(s):**	**NO** ☒	**YES** ☐
Report/Supporting Information *See Report writing guidance*		
Report/Supporting Information attached. Reports should **<u>not</u>** exceed **10 pages.**	**NO** ☐	**YES** ☒

Capital Portfolio Board

For Approval: Planned Spending on Energy Efficiency Measures

BUSINESS CASE

Prior Submissions

None

Strategic Benefits

Education and Student Experience	Research, Innovation and Partnerships	Civic Engagement and Social Responsibility	People and Ways of Working	Physical and Digital Infrastructure	Financial Sustainability	Internationalisation and Global Relations	Sustainability	Equality, Diversity and Inclusion
☒	☐	☒	☐	☒	☒	☐	☒	☐

The work:

- Reduces the University's carbon emissions by 600tonnes due to reduced use of energy. Current emissions are 27,840tonnes. This directly addresses the University's net zero carbon reduction target, which also contributes to regional and international targets.
- Reduces revenue costs by 235k/yr on utility spend against a background of uncertainty of future prices, supporting the University's financial sustainability agenda.
- Institutes better environmental control within buildings to improve the student and staff experience.

Drivers

- The works will reduce the University's carbon emissions, linking with the University Vision and Strategy, the Sustainability Strategy and Carbon Management Plan.
- Improving 'energy efficiency' one of the actions within the Carbon Management Plans' 8 key areas of action.
- The proposed works will reduce energy use and associated costs and mitigate the effect of energy price rises.
- Better control will improve the longevity of mechanical plant.

Background and Work Performed

Over the last ten years investments in energy efficiency measures such as heating, lighting and ventilation upgrades and controls, voltage optimisation, equipment replacement and renewable energy installations have saved £1.9million a year (against business as usual), 4,700 tonnes of carbon dioxide at a cost of £9.65million.

Most recently, investment in 2020/21, has seen the implementation of a £900k programme to upgrade our Building Energy Management Systems. Appendix E contains a full list of works that have been undertaken.

This upgrade was driven by the requirement to:

- Upgrade systems that were no longer maintained by providers;
- Ensure alarms which indicate when our most sensitive research settings breach environmental tolerance report accurately, reducing the risk of catastrophic failure putting key research in jeopardy; and
- To ensure that systems are not running wastefully – running when not needed, for example, or cooling systems competing with heating systems. This will realise carbon and cost savings.

The implementation project is on course for completion and has naturally focused on reducing the risk of alarm failures as urgently as possible.

However, during lockdown, a great deal of work was done testing the ability of the upgraded system to enable carbon and cost savings. One example of what the system can do is seen in the Life Sciences Building, which is one of the University's most efficient buildings. By enhancing the control strategy to look at how heating, cooling and ventilation systems interact, £89k has been saved on energy consumption during the year.

Once all the BEMS work has been completed an expected saving of at least £160k a year, a sub six-year payback, is expected.

Objectives

The proposed work uses in large part the opportunities afforded by the BEMS upgrade to improve control and to pilot measures that can be rolled our Campus-wide.

- The proposed works will reduce energy use and associated costs and mitigate the effect of energy price rises.

- The works will reduce the University's carbon emissions, linking with the University Vision and Strategy, the Sustainability Strategy and Carbon Management Plan.

- Better control of temperature and lighting will also enhance the staff and student experience.

- Better control will improve the longevity of mechanical plant.

Key Stakeholders

The key stakeholders in this work are occupants of the buildings to be treated with energy efficiency works – they will enjoy better control of their environment. However, Facilities Managers will be able to access better information on buildings.

The work is a demonstrable part of our aspirations to reduce carbon emissions, which we know is important to staff, students and, increasingly, funding bodies.

This work also feeds into the financial sustainability of the University, reducing the bottom-line costs for the operation of the University's campuses. To this end financial managers are a key stakeholder.

Finally, this work will impact on operational staff within campus division as changes will be made to plant operated by these teams. All works are implemented with the involvement of campus division staff particularly Hard FM.

Options

Using typical paybacks from previous experience, industry norms and consultants' reports, two options are possible from four portfolios of work shown in the Appendices tables. To help decision making on these two options, the appendices are explained below.

Appendix A comprises a suite of short-payback measures including, control of heating, lighting and ventilation, equipment upgrades and metering. These projects are well-characterised and should be deliverable within a year to deliver full-year revenue savings by 2022/3.

Appendix B is composed of measures which have short to longer term payback times, but which could be more transformative, including space optimisation; lighting/heating/ventilation control and laboratory equipment upgrades.

Appendix C lists projects which are less cost-effective currently, but which might be done for non-energy reasons. Includes projects with reputational value, such as heat pumps and solar energy, and projects which improve staff and student comfort such as reglazing. Seed funding would be needed for extended feasibility studies.

Solar and, in some circumstances, heat pumps and heat recovery (for example, recovering heat from Physics Data Centre to warm the Physics Building) have payback times of ten years or less and bring reputational benefits. Government Funding has become available for these on a first-come first-served spaces, so having some feasibility studies ready to go for these would help us access grants at short notice.

Reglazing would greatly improve the indoor environment of key buildings such as Biomedical Sciences and Queens, but is expensive as it requires high-level working and decant. It has often been requested by building users. A payback time of decades is expected, but that reflects the current price of gas, which is very low in comparison with greener alternative sources of heat.

To get best value from these projects, control needs to be instituted first to make sure that systems are not over specified.

Appendix D suggest a series of feasibility studies:

- to see how heating systems can be run differently to work with future systems such as heat pumps and district heating.
- To assess the financial implications of replacing heat distribution pipes in buildings to prevent distress purchases on failure.
- Interoperability - To integrate environmental control with other smart campus feature.

As feasibility studies, these do not have a payback but help us understand risks and benefits.

Appendix E Provide current spend on the BEMS upgrade.

From these suites of measures we propose two options:

Option 1 Shorter Payback Works

Summary – Shorter payback works with relatively short lead-in times which could be delivered within a year.

Scope – measures detailed in Appendix A.

Benefits (inc non-financial metrics)

- Will reduce UoB's carbon emissions by 600tCO2e (tonnes carbon dioxide equivalent a year).
- Will reduce duty periods of some equipment which should reduce maintenance costs.
- Will provide a suite of pilots to inform further work.
- Includes provision for project management to minimise delivery risk.

Drawbacks

Addresses shorter payback works only. Future projects could seem expensive in comparison.

Financial summary

- Cost £855k
- Savings estimated to be £235k/yr. Savings will be realised within the UTIL budget, bar £15k within residences.

Option 2 – Longer payback works

Summary – A selection from the sets of possible works detailed in Appendices A-D. These would have longer lead-in times, and longer payback times.

Scope – See Appendices A-D

Benefits (inc non-financial metrics)

- Will reduce UoB's carbon emissions depending on measures chosen
- Will reduce duty periods of some equipment which should reduce maintenance costs
- Could be more widely deployed through the campus than Appendix measures

Drawbacks

- Longer paybacks and lower carbon savings per pound spent than Appendix A.
- A significant planning period and delivery over three or more years is required.

Financial summary

A selection of measures could be chosen to match the cost of delivery of Appendix A (£855K), but revenue savings would be lower depending on which measures were chosen.

Recommended Option

We recommend the suite of works detailed in Option 1 (Appendix A), as they would deliver revenue savings in the shortest time and feasibility etc has already been undertaken.

Mitigations against drawbacks

We propose the employment of a project manager as part of this work to ensure that it runs to programme. The project manager would be capitalised – funded within the £855k.

Funding

The total cost of the works proposed is £855k. We propose that this funding comes from capital funding, in line with discussions we have had with our Finance Business Partner.

Risks

Key risks of not doing the project

Without these works we will not make the proposed revenue savings and carbon reductions. Several of the works also pilot future works that will allow us to make greater savings in future years, against a backdrop of rising utility prices and the longer-term possibility of carbon taxes.

Key risks with the recommended option

The main risks are:

- Timely delivery, which we intend to mitigate with the appointment of a project manager.
- Elements of the project not delivering the required savings. We believe that the portfolio approach will mitigate that risk.
- Cost overrun on these projects, mitigated by already tendered or well understood technology.
- Though currently there are no delays due to materials supply interruption due to both Brexit and Covid-19, this could develop as the year progresses.

Dependencies

Initiatives which this project depends on

The project depends on a continuing commitment to energy waste reduction and carbon reduction.

Initiatives which depend on this project

- Carbon management plan
- Sustainability Strategy
- Estates Strategy

Constraints

The key constraint is the speed of procurement and availability of some of the goods and services required for this project (see risks).

Timescales

Project timeline

We expect the project to be deliverable, except where noted in Appendix A, by July 2022, assuming agreement to fund in June 2021 ready for August 2021.

Target approval date

We request an agreement to fund this work in August 2021 or sooner if possible.

Governance

Reports on progress will be made to CPB at a frequency to be determined by CPB. Interim reports will be made available to the Head of Capital Development.

< £5m Capital Portfolio Board	£5m - £20m Finance & Infrastructure	> £20m Board of Trustees
☒	☐	☐

Appendix A: Shorter-Payback Works (Proposed)

These works have been chosen as having short paybacks in comparison with alternatives

Project Name	Cost £k	Timescale for delivery	When do savings start?	Approx Saving /yr £k	Annual CO2e svg tonnes	Payback (yrs)	Scope
Metering programme within STEM buildings to identify energy wastage.	60	Throughout 2021-22	From July 2022	15	30	4	The consumption data provided will identify energy wastage within our highly serviced buildings, which are our highest consumers per square metre, enabling focused action on high consuming activities and provide data for monitoring and targeting.
Heating control enhancements at Wills and Churchill Halls	50	By Dec 2021	Dec 2021	15	120	3	To install additional sensors and enhance control strategy; these halls currently use 2-3 times the heat/bed as our best halls. This work has been priced and savings assessed by a third party.
Small energy efficiency measures which result from site surveys	80	Throughout 2021-22	No later than July 2022.	15	100	5	Each year as site surveys are carried out, small projects are identified such as controls on heating and lighting, variable speed drives, Insulation and low energy equipment. This funding will allow carbon and cost improvements to be made as they are identified.
Life Sciences – Review and improvements to control strategy.	75 split over three years	Throughout 2021-24	Savings from July 2022.	£40k-£65k/yr by end of programme	60-100	3	Using data from the sensors networked via the BEMS, this project will use ongoing analysis to radically improve control strategy and produce carbon/cost savings at one of our most highly serviced buildings. As well as energy savings, additional saving is likely from reduced maintenance as plant will run on demand rather than always on. The concept has been proved by a pilot project at Richmond building saving £30k for an investment of £10k.

Control of heating and ventilation using lighting controls.	100	By July 2022	From July 2022	20	40	5	Enable interoperability between lighting presence detection and environmental control – energy services such as heating, cooling and air conditioning are only used when space is used and people are present, not just when space is booked. Reporting on occupancy levels would also be available.
Development of analytical tools for identification of energy wastage.	25	By Nov 2021	From Nov 2021	20	20	6	This is last phase, already committed, of a collaborative programme with the Computer Science School, to collate and interrogate large scale energy data to make the identification of anomalies and therefore energy wastage easier.
Life Sciences Lighting Control upgrade	50	By Dec 2021	From Dec 2021	20	40	3	Controlling lighting within Life Sciences based on presence of staff/students, and allowing differential control, such as lights going off more quickly during daylight hours or high-cost periods.
Dorothy Hodgkin (DHB) air handling control recommissioning and enhancements	245	By July 2022	From July 2022..	70	100	4	- New sensors & control philosophy to recommission the building. - Service changes to reduce consumption by air handling devices. - In-depth monitoring of metering to enable the detection of energy waste. DHB is one of our most energy intensive buildings.
Old Chemistry air handling recommissioning & enhanced control	110	By July 2022	From July 2022	30	50	4	- A survey to determine options for short payback changes to equipment and control at Old Chemistry - Submetering to understand energy flows in air handling - New sensors & control philosophy to recommission the building
Project Manager	60	3 months from approval	N/A	0	0		The Project Manager would make savings in comparison with using consultants (Cost around £100k) and would ensure that implementation occurred on time and to budget, in turn ensuring that savings occurred.
Total	**£855k**			**£235k**	**600**		**Estimated Payback 3.6 years**

Appendix B: Other Options - Further investment projects could include

Project Name	Implementation cost (est) £k	Timescale for delivery	When do savings start?	Approx Savings /yr £k	Annual Carbon saving (tonnes)	Scope
Space optimisation – greater flexibility, disposal of substandard buildings	Net capital income	Pending review	Immediately	Under review	Estimate 300 tonnes	As part of the Estates Strategy, space that is superfluous or not fit for purpose is being identified. The disposal of 1% of the current estate would represent a revenue saving of around £100k a year and a 1% carbon saving. Identifying this space can be aided by the use of lighting sensors to report on occupancy.
Lighting – choosing lowest payback situations	1,400	6 months- 1 yr	Immediately on implementation	200	400	Lighting projects tend to have long paybacks. We estimate that there could be an investment of £1.4m in projects such as corridor lighting that are repeatable and have shorter paybacks in the 7-year range. Collateral benefits: • Significant improvements to the staff and student experience • Networked lighting with occupancy sensors can report via the Building Energy Management System (BEMS) to indicate when a space is occupied. Some organisations use lighting data to determine how well used a space is, and thus, how often it should be cleaned.
Control strategy improvements on STEM bdg systems	500 over three years	Throughout 2021-24	Some immediate savings.	£250k/yr by end of programme	700	As proposed in Appendix A for LifeSciences, this could be rolled out to other STEM buildings. The concept has been proved by a pilot project at Richmond building.
Addressing Heating and Cooling Control in STEM buildings	3,000	Two years from feasibility to implementation	In the second year	500	1,400	Based on work done at Synthetic Chemistry which corrected controls, rectified hardware issues and changed the air flow rate through the buildings. In that instance, the works cost £180k and delivered savings of £80k/yr. There is more of this to do, but that installation had a particularly short payback that we wouldn't expect to find elsewhere
Laboratory equipment	200	rolling	Immediately	50	100	Top-up payments to ensure the top-of-range efficiencies are achieved from new laboratory equipment including overs, dryers, freezers.

Appendix C: Projects that are less cost-effective currently, but which might be done for non-energy reasons.

Includes projects with reputational value, or which improve staff and student comfort such as reglazing. Seed funding need for extended feasibility studies.

Project Name	Est cost of £k	Timescale for delivery	Savings start	Approx Savings/yr £k	Annual Carbon saving (tonnes)	Scope
Langford Solar	500	6 mths-1 year	Immediately on implementation	50	100	400kW solar array at Langford reducing grid electricity use. Sized to maximise returns. Covers 1 ha. Requires planning permission. Less complex than roof arrays
Solar & battery solution at Wyndhurst	50	6 months	Immediately on implementation	5	10	30kW ground mounted array with batteries to provide power overnight. Need to know longevity of the site. Sized to maximise return. Would provide 15% of power at Farm
Solar and Batteries at Coombe Dingle	100	6 months	Immediately on implementation	12	30	30kW roof mounted array plus batteries to reduce electrical capacity required for floodlights at Coombe Dingle
Heat Pumps	500	1 year	Immediately on implementation	70	140	Heat pumps most effective where replacing direct electric heating. Opportunities to do this at Goldney Hall and Langford.
Reglazing (large building)	£15m	2 years	Immediate	100	50	Reglazing often requires decant. Reglazing of large buildings has long paybacks: better thought of as a measure to improve the staff and student experience than a pure carbon measure.
Recovery of Heat from Physics Tanks room	£1m	2 years	Immediate	100	800	The Physics Tanks Room High Performance Computer will be rejecting 1MW of heat continuously by 2023. This could be used to warm Physics Building and LifeSciences

Appendix D: Further investment projects to reduce carbon in the medium term

These would all benefit from seed funding for extended feasibility studies. These would require about £50k each to commence

Project Name	Scope
Readying systems for low carbon future	We may be compelled to connect to district heat. These networks charge connection and standing charges per kW and require lower temps than conventional gas systems. Need to assess feasibility of reducing peak demand and temperatures.
Interoperability – Smart Campus	Students will interact with the campus through their phones increasingly to book rooms, find resources etc. We can reduce energy use by making best use of this data via our BEMS upgrade. We need to understand better how to do this in our different contexts.
Heating distribution	In some buildings, heating distribution systems are time expired. Replacement could cost several millions. Early studies could prevent distress purchases and allow systems to run at lower temps to integrate better with low carbon sources.

Appendix E: Progress on Building Energy Management Systems (BEMS) Upgrade

Project Name	Est cost £k	Timescale for delivery	When do savings start?	Approx Savings/yr £k	Scope
Synthetic Chemistry Installation of PIR sensors in labs	3	3 months	Immediately on implementation but subject to risk assessment		Labs operate at full air change rates 24 hrs/day regardless of occupancy or risk. The addition of PIR sensors in one riser with other completed complimentary works will allow air systems to be turned down dependant on risk, saving energy. Order No 80203333 has been placed and work is expected soon.
Dorothy Hodgkin Bldg Works: Energy & HVAC Design and Imp Plan	42	6 months	Immediately on implementation		Work to make chilled water more demand driven to reduce costs and carbon, replacing pumps and valves to allow variable volume.
Geography (North only): Lighting replacements with LED fittings and Helvar controls	62	Complete except final commissioning	Immediately on implementation	9	Installed on request of the School and met criteria. Installation of efficient light fittings and wireless controls. Rooms have bespoke profile, eg where an occupant has visual impairment. Final commissioning due post-Covid.
Upgrade to BEMS Supervisor software	150	1 year	Immediate	Enabling and resilience works	Restore the ability to control buildings by upgrading the central system. The existing system is time expired, relies on unsupported software and version of Windows. Re-establish alarm handling and response and to expand the visibility of time zones, values and settings to more stakeholders. Facilitate a transition to a 'smart campus' by making buildings 'intelligent'. Prepare buildings for analytical smart optimisation.
Upgrade to BEMS outstation controllers	250	1 year	Immediate	Enabling and resilience works	BioMed, Queens and MVB are controlled by automatic BEMS controllers that are no longer current, need a Windows XP PC to make settings and do not have spares available. Given the high profile nature of some of the activity this project is to replace these controllers with modern outstations that operate within the University's networked domain. We believe that this is the last of this type of equipment and all buildings except NSQI will be on the network.
Deep dive into Control Strategy at Life Sciences	0	Summer 2020	Immediate	80	The implementation of the upgraded BEMS was first tested at Life Sciences, where the upgrade has enabled a reappraisal of control strategies. This demonstrated the principle of detecting and correcting competition between systems that can be rolled out elsewhere. Although this intervention was manual, the principle can be automated at other sites using analytical software.