READING HYDRO CBS

Updated Business Plan, March 2021

1. Our purpose

Reading Hydro is a volunteer-led Community Benefit Society (CBS) with members and directors. We are well advanced in our ambitious plan to build a hydro-electricity scheme on the River Thames by Caversham Weir and operate it as a community-owned asset. Our aim is to help reduce carbon emissions and be part of a more sustainable future for Reading. We will invest our surplus funds into the local community by building up a Community Fund and are already making improvements to the local environment around View Island, including constructing a fish pass to enable fish and eels to move up the river.

Local projects inspire people by making renewable energy a local, tangible option – not a distant or even offshore one. The site at Caversham Weir is particularly visible and accessible because it is so close to our busy town centre and has footpath access. Once completed, the hydro scheme, including the fish pass will be a fantastic educational resource for the people of Reading and beyond, demonstrating sustainability right on our doorstep. We will use the accessibility and visibility of the scheme to increase public engagement with positive action to tackle climate change. There will be live data monitoring of flow rate, water temperature, water levels and electricity production.

Once the hydro scheme is complete, volunteers from the local community will be able to assist with ongoing tasks such as clearing trash screens and other basic maintenance. We will also encourage them to engage in activities to promote more efficient and reduced energy use. Once the turbines are built and operational, our future direction will be overseen by our Directors, as determined by our members.

2. Our Society

Reading Hydro is an open and democratic Society, with regular communication and meetings with its members and open events which are focused on community engagement. Anyone who supports our aims and agrees to follow our rules may become a member of Reading Hydro CBS. Our members are local people enthused about our project who have paid at least one pound to join – everyone who provides share capital becomes a Member. Prior to COVID-19 restrictions we regularly attended local community events (e.g. Reading Water Fest, Reading Green Fest, Reading Pride, Beanpole Day at Caversham Court and Reading Town Meal) where we attracted more local people to join us as members.

In November 2019, our total membership stood at just over 200 people. By September 2020, following the share offer, membership had increased to 748 and by the end of 2020 it was just over 800. Each Member has one vote at Reading Hydro General Meetings, including AGMs. Our volunteer Directors are drawn from, and elected by, the membership. members are encouraged to become involved at all levels. This includes providing specialist skills, raising awareness, and helping with practical work on site, such as the construction of the fish pass and groundwork. members meetings, action evenings and community engagement events will resume when COVID-19 restrictions permit.

3. History of the scheme

Using the river to harness energy has a long history of use. Our site was recorded as being in use as a water mill in the Domesday Book of 1086, but towards end of the last century the river stopped being used as a source of power at this location. We will install two Archimedes screw turbines on the Thames at Caversham Weir to generate renewable electricity from the flow of the water for decades to come. Our scheme will enable the local economy to again benefit from the use of this abundant natural resource.

The Reading Sustainability Centre (TRSC), a local Community Interest Company, realised the potential for generating hydroelectricity at the Caversham Weir site and obtained planning permission from Reading Borough Council (RBC). They also obtained licences and permits for the hydro scheme and fish pass from the Environment Agency (EA). The Caversham Weir is the only site in the Reading area identified by the EA as a 'win-win' because it could provide both commercially viable electricity generation and an opportunity to improve the river environment.

Reading Hydro CBS was formed in September 2015 to take the project forward and has since complied with a wide range of conditions and requests from RBC. Discussions are ongoing with the EA to clarify their requirements in the Licence to Impound Water. A summary of the permission, permits and licences obtained is provided in Appendix I.

4. Summary of progress

We started preparation work on site with volunteers in May 2020 to meet the time requirements of our planning permission. Our civil engineering contractor started work to build the cofferdam and put the concrete channels in for the turbines at the beginning of October 2020. However their work was delayed several times by days lost due to high water levels and flooding. It was finally completed just before the end of February 2021, about 4 weeks late (Figure 1).

The conduits for the cabling that will distribute the electricity generated by the turbines were installed by a specialist contractor using Horizontal Directional Drilling (HDD) in March. The cables can now be pulled through the conduits and laid in trenches by our volunteers. A turbine house to protect the generator and other equipment is also being constructed in March by volunteers with building experience. Once complete the walls will be painted with a mural, the design for which was selected from a competition which we ran. Manufacture of the Archimedes screw turbines has been delayed due to COVID-19 and they are now due for delivery and installation in mid-April. Once installed the electrical work will be completed and the turbines will be connected and tested. We expect electricity to be generated from May 2021.

A detailed description of the construction work is provided in Section 8.

5. Our hydro scheme

Our project has learned and taken inspiration from other local hydro projects, particularly those on the Thames at Sandford, Osney Lock, Mapledurham, Sonning, and Windsor.

Figure 2: Part of the embankment showing the footpath before work started

Figure 1: Site in February 2021, showing civils work abutting embankment

We are installing two Archimedes screw turbines beside Caversham Weir. They will be inserted into the embankment that links View Island (owned by RBC) and Caversham Weir (owned by the EA). The embankment, which has a public footpath on it (Figure 1), has been built up over hundreds of years and is unregistered land[1]. It forms a narrow tract where the former mill stream was diverted from the Thames to channel water from above the weir behind View Island. Once all the building work is complete the turbines will be surrounded by water and fenced off from the public footpath.

Power can be captured wherever a flow of water falls from a higher level to a lower level. The screws will rotate as water passes through them and this rotation will drive the turbines which are connected to an electricity generator via a gearbox. The generator converts the mechanical energy of the turbines into electrical energy. The power output from a hydro scheme depends on the vertical fall of the water or 'head' and the flow rate. The Thames at Caversham Weir has a high flow rate but a low head. The turbines should generate about 320MWh of renewable electricity each year from the flow of the water, for

[1] As there is a footpath over unregistered land it is impractical for anyone to claim title to the site, so the scheme will not have to pay rent.

decades to come. This is enough to supply about 90 homes at average consumption rates. One of the advantages of hydro schemes is that they also continue to generate at night when solar schemes stop.

The energy used and thus greenhouse gases emitted during manufacture and installation of the hydro scheme will be quickly offset by the energy produced and carbon saved during its operation. No greenhouse gases are emitted whilst it is operating. As the Committee on Climate Change made clear in its independent assessment of the UK's Clean Growth Strategy (January 2018), a "gap in meeting the fourth and fifth carbon budgets remains" and urgent action is required to increase renewable energy generation.

Once our turbines are operational, we will receive an income from selling electricity and from the Feed-in Tariffs (FIT) scheme, a government programme designed to promote the uptake of renewable and low-carbon electricity generation technologies. A local business has agreed to buy most of our electricity, any excess will be sold to the electricity grid. Generating electricity close to where it is used helps cut losses in transmission and distribution, which currently waste about 7% of UK electricity.

The electricity network is moving to a decentralised model, using energy storage and demand management alongside power generation to meet local needs. Our project fits that model, because Reading is an area of high electricity demand, with limited opportunities for renewable generation, so there will be a strong market for our electricity for decades to come. In the future it may be possible for local people to buy electricity directly from us and we intend to pursue this when it becomes feasible.

Figure 3: Aerial view of the site at Caversham Weir showing the location of the fish pass and turbines

6. Our fish pass

One of the conditions of our planning permission was to include a new fish pass that will enable fish and eels to move upstream more easily. Our fish pass design has been approved by the EA and its construction is almost complete. It is a natural design that allows both fish and eels to move upstream, which will increase the range of species and numbers of fish that will be able to cross the obstacle of Caversham Weir, enhancing the natural environment of the river.

The fish pass cuts into View Island from the mill stream, to the east, where there will be a sluice. From there the 'technical section' of the fish pass runs gently downhill to the existing streambed where the water will flow towards the hydro scheme (Figure 2). It will join the river immediately adjacent to the turbine outlet which creates an attraction flow for fish. The fish pass will be a natural and unbounded area forming part of View Island.

View Island is a low-lying area of land which has a variety of natural habitats. Apart from the public footpath, the entire area of the island lies below the level of the river above the weir and hence it floods regularly. The island is heavily wooded, mostly by sycamore trees. There are remnants of Caversham House that used to be on the island before it was demolished. The most visible remaining feature is the old tennis court area. Access to the island is gained by means of a wooden bridge across the mill stream or the walkway over the weir structures. There are two further small wooden bridges that cross the old stream bed on the island. The stream bed can contain water when the river level is high.

Figure 4: Volunteers digging the fish pass

Figure 5: The completed technical section of the fish pass

7. Electricity generation

Small scale hydropower schemes, such as the one we are installing at Caversham Weir, are one of the most cost-effective and reliable methods for generating renewable electricity. They have several key advantages over other renewable energy technologies, including high energy efficiency (70-90%), reasonably predictable electricity outputs (which often correlate with seasonal demand fluctuations) and long lifespans due to their durable design. Small scale hydropower schemes are benign to the local environment as the flow of the river and therefore the surrounding ecosystems are largely unaltered. They are also beneficial to the global environment, as the electricity produced will reduce the demand for conventional fossil fuel electricity generation.

The amount of electricity that will be produced by the turbines is measured in kilowatt hours (kWh) or megawatt hours (MWh =1,000kWh). Initial estimates indicated that our scheme could have a generation capacity of around 46kW. Our application to Ofgem for Preliminary Accreditation for the FIT was based therefore based on 46kW of Total Installed Capacity (TIC). However, more detailed design work suggested that Archimedes screw turbines with a capacity of 65kW could be installed, and we are proceeding with installation of turbines with this capacity. To maintain our entitlement to FIT, we will install generating equipment (generators and inverters) with a capacity to generate only 46kW. After the expiry of the FIT in 20 years, we expect that the generators will need to be replaced, and the generating capacity can then be increased to 65kW, matching the turbines, and increasing the amount of renewable electricity and income produced for the subsequent 20 years.

Table 1 shows how many MWh a 46-kW system could generate in a day, week, or year, depending on the load factor – the % of the rated power that it is producing. The design work for the turbines at Caversham Weir suggest they could operate at about a 78% load factor, averaged over a year. For comparison, solar electricity panels (solar PV) generally operate at only about 10% load factor averaged over a year (but are viable because of their low cost).

Table 1: electricity (MWh) generated by 46kW hydro scheme at differing load factors

Load factor	100%	90%	80%	75%	70%	60%	50%	40%	10%
Day	1.104	0.994	0.883	0.828	0.773	0.662	0.552	0.442	0.110
Week	7.728	6.955	6.182	5.796	5.410	4.637	3.864	3.091	0.773
Year	402.960	362.664	322.368	302.220	282.072	241.776	201.480	161.184	40.296

The productivity of a hydropower scheme depends on the flow of water through it. If the river flow is low, then the flow through the turbines may be reduced, or if it is extremely high, we may be required to temporarily shut the turbines down. Modelling the potential generation of electricity from a 46-kW twin screw system using historical data on the head and flow of the Thames at Caversham Weir, shows how productive our scheme is likely to be in different seasons. There is consistently high generation in spring, high generation with some variation in winter, and considerable variation in generation over summer and autumn, as shown in Figure 6.

We will connect the hydropower scheme to an individual customer, using horizontal directional drilling (HDD) to route a cable under the Thames from View Island to Kings Meadow. The HDD work was completed in March 2021 and the cable can now be installed by our volunteers. The connection to the grid will be through the customer's existing connection.

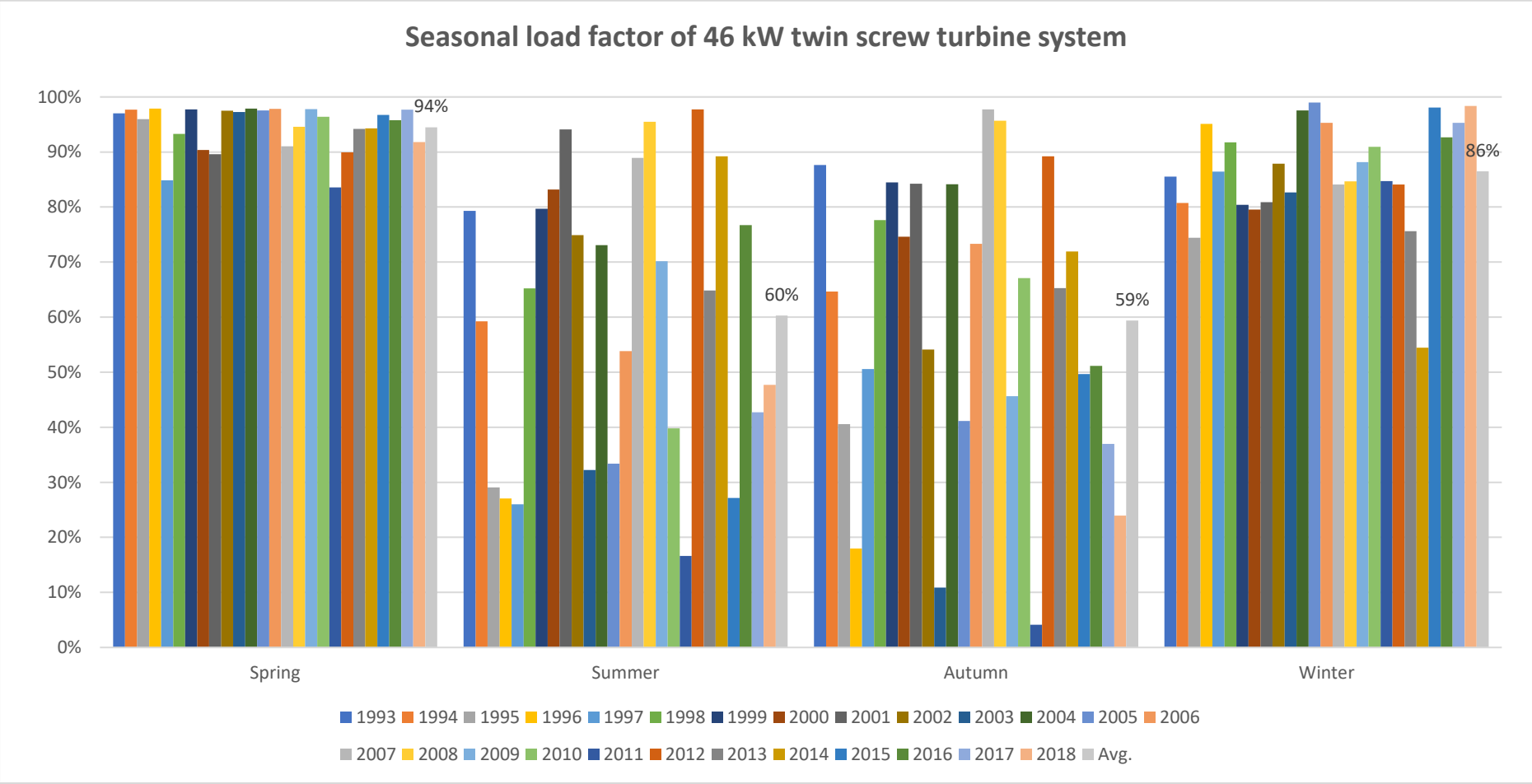

Figure 6: Model of seasonal variation in load factor for 46 kW twin screw turbines at Caversham Weir

8. Civil Engineering work completed

The construction site compound was established at the beginning of October. The footpath was diverted on 5th October and the site "handed over" to our appointed civil engineering contractor, Land & Water (L&W). A very heavy storm over the weekend before work was due to start delayed L&W from mobilising the piling rig by 2 days as the EA placed Red Boards on the Thames (signifying a dangerously high flow to users of the river). L&W were finally able to mobilise the floating gang on 21st October. The pilling was started but the first piles struck a hard layer preventing the vibro-rig from driving the piles. L&W excavated down to approximately 32.0 m above ordnance datum (AOD) and managed to drive the piles to full depth to complete the cofferdam. The dewatering of the cofferdam was completed without any significant problem. L&W excavated about 180 m^3 of soft material and had to fill about 210 m^3. This was considerably more material than had estimated and delayed the mobilisation of the concrete gang by a further 5 days.

Figure 7: The coffer dam is constructed

L&W completed the construction of the base slab before the Christmas shutdown and allowed the cofferdam to flood. A heavy storm over Christmas increased the river levels above the cofferdam which resulted in a considerable amount of additional silt being deposited inside it. The water levels remained high until 2nd January. When they returned after the Christmas shutdown L&W excavated the fish pass culvert and poured the base slab. They then completed the construction of the two outer walls and the lower section of the middle wall. However, further cofferdam flooding on 29th January delayed pouring of the final concrete for the wall and soffit. The first part of the soffit was poured 15th February and all structural concrete work was completed by 18th February. The progress made each week is described on the next page.

Week	Date	Activity
1.	5 Oct	Establishing the site compound and commenced installation of the pontoon access to View island, temporary welfare facilities.
2.	12 Oct	Completed pontoon access trial holes and set out upgrade for welfare facility.
3.	19 Oct	Commenced piling which had been stopped due to hitting a hard layer - 20% of the piling completed by the end of the week.
4.	26 Oct	Piling was initially stopped due to high flows before being able to recommence in the middle of the week and stopping again due to high river flows at the end of the week. By the end of the week 30% of the piles were in place.
5.	02 Nov	No work on the piling was possible at all due to high river flows. The fish pass culvert across the causeway was broken out.
6.	09 Nov:	Piling was completed by the end of the week and the floating rig demobilised.
7.	16 Nov	High river flows all week. Access on View Island established, and timber pads put down. The bracing for the cofferdam commenced and a test pump out completed.
8.	23 Nov	Cofferdam was dewatered and excavation of soft material completed.
9.	30-Nov	Cofferdam was backfilled to underside of benching.
10.	7-Dec	Benching was placed and bottom slab poured.
11.	14-Dec	Base slab steel completed, and remainder of floor slab poured.
12.	21-Dec	Christmas shut down.
13.	02-Jan	Storm flooded the cofferdam approximately 0.3 m above lower piles (36.6 m AOD).
14.	4-Jan	Cofferdam pumped out and cleaned wall steel fixed, fish pass culvert excavated.
15.	11-Jan	West wall poured and East wall prepared, steel fixed to fish pass culvert
16.	18-Jan	East wall, base of fish pass culvert and central wall poured.
17.	25-Jan	Upper sections of East and West walls poured, soffit formwork installed and reinforcement steel fixed. Cofferdam flooded 29-Jan.
18.	01-Feb	Cofferdam flooded to approximately 36.8 m AOD, approximately 0.5 m above the lower piles. Fish Pass culvert completed.
19.	08-Feb	Cofferdam still flooded but water levels dropping, little productive work on site. River levels falls below cofferdam lower piles late 11-Feb and cofferdam pumped out 12-Feb, footpath soffit prepared for concrete pour on 15-Feb.
20.	15-Feb	Footpath soffit poured and turbine soffit prepared. All structural concrete work completed by 18-Feb.
21.	22-Feb	Final excavation of material in the mill stream, fish pass ramp shaped, pontoon bridge access cut.
22.	01-Mar	Final sections of pontoon bridge removed, demobilisation of the site, completion declared

Figure 8: The concrete formwork begins to take shape

Figure 9: Flooded cofferdam in February

9. Funding

2018

Reading Hydro's initial activities were financed by a combination of Pioneer shares (December 2018), an investment from the Reading Climate Change Partnership, and a grant from the Reach Fund. The Pioneer Share offer raised £16,025 from 63 community members who accepted that their money was invested at risk. Although Pioneer shares have no special rights, the first £12,700 of shares issued were eligible for an interest payment in shares, at the rate of 1:10 when the main share offer was made. We also received £4,000 of additional investment from the Reading Climate Change Partnership, and a £15,000 grant from the Reach Fund. This funding enabled us to secure the permissions needed from the EA to start work, apply for Preliminary Accreditation for the Feed-in Tariff from Ofgem, and commission detailed designs for the hydropower system.

2019

In December 2019, a community share offer was launched to finance the construction of the hydro scheme, with a target capital requirement of £700,000. We set the minimum investment at £75 and encouraged investment from the local community so that as wide a group as possible could be involved in our positive action to target climate change. The offer was oversubscribed with £880,574 successfully raised from 611 people by the closing date of 14th February 2020, bringing many new members to the Society. The investment included share capital from the Community Shares Booster Fund of the community business organisation 'Power to Change'.

2020

Following receipt of tenders for the main construction work which were based on more detailed designs than the previous estimate, the target capital requirement increased to £980,000. The shortfall of about £100,000 was successfully raised through a new share offer. As the interest rate payable in the first years of the project was reduced by the increased capital requirement, existing members were offered the opportunity to reduce or withdraw their investment, or to increase it – thirty people chose to reduce or withdraw their investment. At the close of this share offer in September 2020, Reading Hydro had secured a total of £980,000 from 722 members.

2021

Unfortunately, the lost days of construction work due to unusually high-water levels and the site flooding, poor ground conditions, and the increased complexity and costs of meeting regulatory requirements, mean that costs have increased (see Sections 10 and 11 for details). Although Reading Hydro has

sufficient funds to complete the civil engineering work and pay for the Archimedes screw turbines, the additional costs needed to complete the project cannot be funded without further investment. We now forecast that an additional £170,000 of share capital is required and will be making a new share offer to raise this amount in March 2021.

If we are unable to raise the full £170,000 as share capital, we have an informal offer of a loan for £80,000 which could bridge the gap, providing we raise a minimum of £90,000 share capital. However, our financial modelling has shown that the cost of the loan finance will be greater overall than the cost of shares, so the Directors' preference is to secure the full amount through a share offer. We have sought support from several institutional investors and the Directors are confident that £50,000 could be secured from institutional investors and several private individuals who have already indicated to them that they are willing to invest.

In accordance with guidance for the Standard Mark, we contacted our existing members on 19th February 2021 to ask for their approval to issue a new share offer. It was clear from the responses that there was overwhelming support for one with 95% of 369 votes received by 25th February (45% of our membership) being 'yes'. We also asked members to indicate the amount that they might invest within four ranges (see Figure 10). The majority of those that completed the survey indicated that they would or might reinvest. If all 277 members who indicated how much they might invest provide the minimum of the range they selected, at least £96,975 would be raised. If we estimate the amounts based on the midpoint of the ranges, we will exceed our target of £170,000. This indicates strong support for the share offer and Reading Hydro's ability to complete the work needed to start generating renewable electricity.

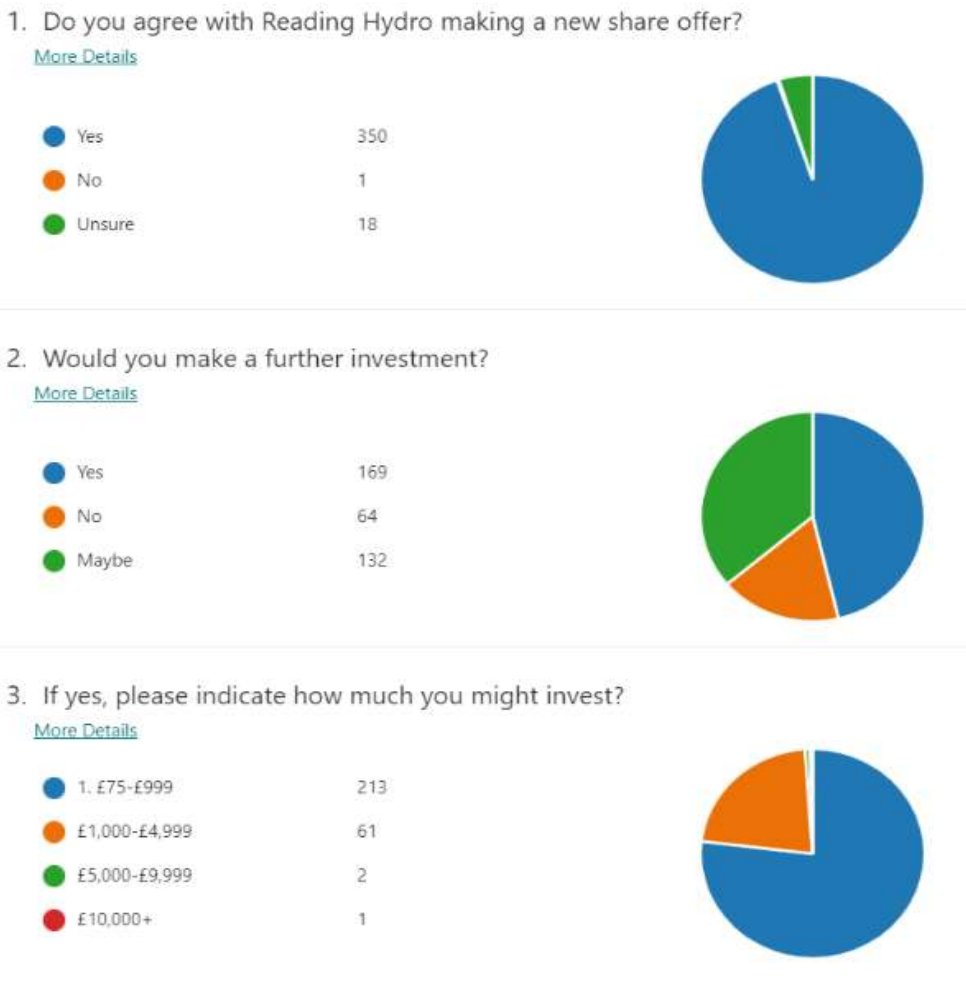

Figure 10: Results of questionnaire completed by members in February 2021

10. Our finances

Reading Hydro was formed in 2016 and has not yet generated income from sale of electricity. The accounts for the year ended 30th September 2020 will be presented to the AGM in March 2021, and show a loss on the revenue account, but cash balances of £686,083. Cash balances at 28th February 2021 had fallen to £170,650, with a corresponding increase in the valuation of the fixed assets held by the society.

We expect to start generating income from the sale of electricity in 2020/21 financial year, and to earn about £65,000 of income in 2021/22, increasing with inflation. About 20% of our income goes on operating costs, with depreciation and interest to members being our major costs.

A summary of the key financial information for each financial year since our formation is provided below in Table 2.

Table 2: Summary of financial transactions to date

Year ended	*Income*	*Expenditure*	*Surplus / loss*	*Cash balances*	*Total funds*	*Share equity*
30 September 2017	60	60	0	44	44	44
30 September 2018	807	1022	-215	667	-132	83
30 September 2019	15,845	14,166	1,679	20,038	21,541	20,077
30 September 2020	2,974	31,107	-28,133	728,733	873,602	903,220

The main project costs and the reasons that some of these will exceed the original budget, despite the enormous amount of work undertaken, and yet to be undertaken by volunteers, to keep costs as low as possible, are described below.

Civil engineering

The major cost for the hydro project is the civil engineering work which included constructing a cofferdam and creating a concrete base and the channels for the turbines, as described in Section 8. We signed a contract for the work with Land and Water (L&W) in July 2020 at a price of £507,000, including about £24,000 to build the turbine house which will protect the generator, gears and other equipment. The turbine house is now being built by volunteers with building skills and £4,000 has been raised in crowdfunding donations for materials, providing a total saving of about £20,000.

With any construction project, the maximum risk is generally at the start during the foundation work. A major unknown is what is below the surface that might impact the foundations, particularly when this is under water. Severe weather conditions can also cause delays. Working in or around a river compounds these risks.

Ideally the civil works would have started in the summer months to take advantage of the driest weather and longest hours of daylight. However, the start was initially delayed by the time it took to finalise the details of various licences and approvals from the EA and RBC, partly because many of their key staff were furloughed due to the COVID-19 lockdown. Delays were also encountered in finalising the design and receiving tenders for the work. These and other factors outside of Reading Hydro's control meant that Land & Water could not start on site until the beginning of October 2020.

The Directors considered delaying the start of the work until the summer of 2021, but this would have reduced the project returns and potentially reduced investor confidence and would have risked us losing our eligibility for FITs, which would have made the project unviable financially. It would also have necessitated re-applying for planning permission, as the original permission stipulated commencement of works before May 2020. In the end we were just able to meet this planning requirement using volunteers to undertake some preliminary enabling works on site, within the COVID-19 restrictions at that time.

The delays due to storms causing high water levels and flooding the site (described in Section 8) meant that there have been periods during construction when L&W was not able to work which have extended the duration of the contract by about 4 weeks and therefore the contract price. Technical issues relating to the poor ground conditions have also resulted in additional costs and delays. These include additional costs for excavation, additional granular fill needed to bring the level back up to formation, and the cost of disposal of the excavated material. The extra depth also led to further increases in costs and time due to additional bracing (heavy steel beams) being needed for the cofferdam.

Reading Hydro negotiated a fair settlement with L&W for the delay in October 2020, since these factors were outside both parties' control, but the additional civil engineering cost amounted to about £71,000. Although some extra work has been taken over by Reading Hydro volunteers, we have to allow for an additional £50,000 charge from L&W, because of further delays due to high water and flooding in February 2021. Out total overspend on the civil engineering work is likely to be £114,000 over our August 2020 budget.

Although total costs of the civil engineering work have increased, they would have been even higher had it not been for the professional management of the contractor by our project manager, Nigel Paterson, who was appointed in June 2020. He has successfully managed the construction process to minimise delays and cost overruns, including providing alternative access and cranage solutions.

Turbines

We have ordered twin Archimedean screw turbines of 2.60m diameter with 3 flights and 1.36m design head from Spaans Babcock, at a cost of £223,700. We anticipate that there will be £38,600 of additional costs, mainly for cranage and improved monitoring systems. The turbines will each abstract 3.1m^3/sec design flow and deliver a maximum calculated combined output of 46kW Total Installed Capacity (TIC). Each screw will be delivered and installed together with a non-structural steel liner. The screw and liner will be positioned in a rough-formed trough and grouted into place. The screw and liner are made

together to create a close uniform gap for maximum turbine efficiency. The outlet section will include a facility to insert stop logs so that the outlet can be drained out for maintenance. Delivery of the turbines has been delayed until mid-April 2021 due to the impact of COVID-19 on the manufacturer's schedule.

Cable connection

The turbines will be connected via a dedicated cable taken through a conduit underneath the river to Thames Lido who will buy most of the electricity generated through a Power Purchase Agreement (PPA). We have had to alter our cable route to overcome restrictions and meet the requirements of RBC. This plus our initial lack of understanding of the detailed requirements for underground drilling (Horizontal Directional Drilling, HDD), have meant that the cost of the cable connection has substantially increased. We have mitigated this as far as possible by using volunteers to clear the ground and dig trenches for some of the cable, but even with this cost-saving the contract price for the HDD is £32,000 over budget. The HDD was successfully completed in March 2021. Unfortunately, the work took longer than expected, partly because the underground drill met an obstruction and had to be rerouted. Whilst we will make every effort to negotiate a fair settlement, the contractor may claim a further £30,000 in charges, giving a total overspend for the HDD of £62,000. Other costs relating to the cabling, including the cost of the cable, will add a further £23,000 of overspend

Note that the cheaper alternative of connecting to the electricity grid (rather than direct connection to a customer and a PPA) was considered by the Directors but would substantially reduce the sale price for electricity and cut our income by around £16,000 per year, which would make the project financially unviable.

Weir gate automation and data transfer

The EA requires that the operation of the turbines does not affect the upstream river levels and in the event of a turbine shutdown want one of the weir gates to open automatically to compensate for the lost flow through the turbine. We have tried to engage with the Agency to discuss the details of its requirements, not all of which we believe are necessary, but there has not yet been a response. The estimated cost of meeting the EA requirements, based on quotations provided to Reading Hydro, is about £40,000. We hope to reduce the complexity of the EA's requirements to significantly reduce this, but we have incorporated the cost in our budget.

General and risk-adjusted costs

Our budget included about £90,000 to cover other costs, including project management, consultancy, legal fees, and costs associated with permissions. Several of these have cost more than budgeted, because of extra work needed to meet legal/regulatory requirements, and extra management needed because of the challenging conditions. We therefore expect an overspend of £32,500. In addition to the extra costs identified above, we have a remaining risk-adjusted mitigation cost of £2,700 which has been included in our assessed requirement for extra finance.

General – volunteer work

Volunteers have also significantly reduced the cost of the project by undertaking much more work on site preparation, creating the fish pass, and enabling work for the cable connection than originally planned, and also building the turbine house. We estimate that volunteers have saved approximately £26,000 on our budgeted costs (as well as undertaking the many volunteer tasks we had originally planned).

11. Use of capital raised

In August 2020, the Business Plan identified how the £980,000 capital raised would be used. This is shown in Table 3 below.

Table 3: Use of capital (as of August 2020)

Archimedes screw turbines	£223,700
Civils construction costs	£507,000
Fish pass and access works	£35,000
Grid connection	£18,300
Financing of development fees	£50,100
Marketing ,share offer, Project Management / working capital	£38,600
Total construction /development budget	**£872,700**
Contingency costs	£107,300
Total Capital raised	**£980,000**

The net forecast expenditure explained above is about £282,800 over our August 2020 budget, which exceeds the £107,000 contingency that we had originally provided for by £175,800. Figure 11 below summarises the make-up of the overspend. The final payment to L&W is due only after the hydro starts bringing in income, so we consider that £170,000 of additional investment will be sufficient to complete the work and commission the system, enabling electricity generation to start.

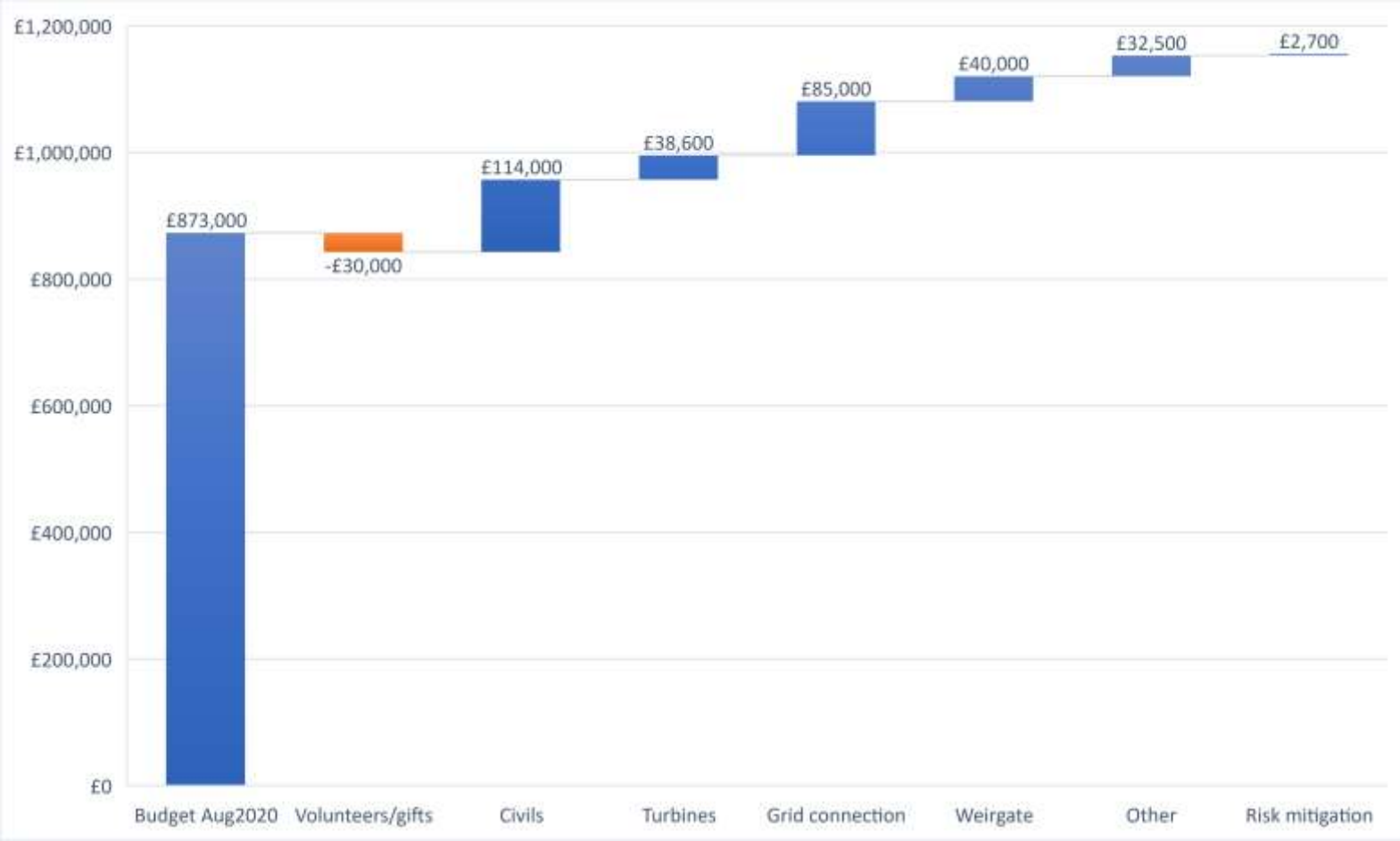

Figure 11: Breakdown of overspend from August 2020 budget

12. Project income

The financial model for Reading Hydro assumes that the electricity generated receives the Feed-in tariff (FITs). This will currently provide an income of about 8 pence per kWh, which is guaranteed to rise with RPI / CPIH inflation for the next 20 years[2]. Ofgem has confirmed that Reading Hydro has a valid application for pre-accreditation for FITs, under the tariff period commencing 1 January 2019. The 'tariff date' for this application is 28 March 2019**,** and the 'validity period' originally ended on 27 September 2021. In September 2020, the government extended this by a year, to allow for the impact of COVID-19. To benefit from the FITs, we must convert the application to a 'full' ROO-FIT application, and the installation must be commissioned within the validity period, that is by 27 September 2022.[3]

Reading Hydro will sell the electricity produced. If electricity is simply exported to the grid, then we will be paid the grid export tariff, currently 5.24 pence per kWh and expected to increase with inflation. However, we have the option to sell electricity to other customers for a higher price than the export tariff, using a PPA. We have agreed to supply power to the Thames Lido, and detailed analysis of their usage over the last year indicates that they could use nearly all our electricity. Thames Lido and Reading Hydro have agreed the terms of a long-term PPA, rising with inflation. Thames Lido opened in 2016 and is run by the same people as operate the Bristol Lido which has been operating since 2008. Reading Hydro is in regular contact with the manager of the Thames Lido, has reviewed its accounts and is satisfied of the financial strength of the organisation.

If 95% of our estimated generation of 320 MWh per year is sold to Thames Lido and 5% at the grid export rate, then our total income will be about £63,000 in year one, increasing with inflation each year for the next 20 years.

After 20 years, the FITs will expire, but the turbines will still be generating. At this point we expect to increase the generator and inverter capacity to 65kW (see Section 7) which will increase the average annual generation by about 33%. We will continue selling electricity on the open market, but there is considerable uncertainty about how much can be sold at retail prices and how much at wholesale price direct to the grid.

It is very difficult to predict the demand for electricity and its price in 20 years' time. Some National Grid scenarios project that rapid decarbonisation could lead to an oversupply of electricity in the 2040s, with insufficient storage capacity to utilise this. Equally, rapid adoption of electric vehicles and heat pumps, for example, could increase demand for electricity as fast as generation increases. Given the unpredictability of demand, we have used more conservative sales estimates, for years 21-40.

[2] The government has announced that indices linked to RPI will change to using CPIH from 2030. FIT rates, and by extension direct sale prices, are linked to this measure, which is generally lower but more accurate than RPI.

[3] The preliminary accreditation will be voided if an installation is commissioned which is 'materially different' to the one for which we were granted preliminary accreditation (eg different power source, increase in generation capacity).

The model used in our August 2020 business plan assumed that 100% of the electricity was exported to the grid at the wholesale grid price after year 20. However, the installation of a direct cable connection provides the potential for future direct sales to different local customers, so the model now assumes a 1/3 reduction in direct sales[4], giving 37%:63% split between grid and direct sales.

Table 4 below shows how the profitability of the project is affected by using a PPA to sell power directly to customer(s) in years 21-40. The model used in our August 2020 Business Plan (0% sold by PPA) would have an overall loss, but we now assume 63% sold by PPA and have a £240,000 surplus. If we maintained our sales by PPA at our expected level of 95%, this would generate a £690,000 surplus for community use.

Table 4: Impact of using a PPA to sell electricity direct to customers

Electricity sold via PPA	*0%*	*25%*	*50%*	*63.3%*	*95%*	*This shows how much variation (£1.35m) there is in possible income over 40 years; supporting renewable energy over this period may be risky.*
Income (£000s)	*£2,598*	*£2,886*	*£3,173*	*£3,327*	*£3,691*	
Surplus (£000s)	*-£660*	*-£305*	*£50*	*£240*	*£690*	

Included in the above scenarios is £259,440 of interest paid to members in years 21-40, and £133,500 paid into the Community Benefit Fund. If direct sales fall below 47% the interest paid to members will fall below the 4% target rate. If direct sales fall to 25%, interest of 1% is affordable; only in the worst case (0% PPA) is there a risk that shareholders would not have their capital repaid in full.

Financial model assumptions, and predicted returns to investors and community benefit fund

The financial model assumes that the FIT is paid quarterly in arrears. The prices in the model are as follows:

- Grid price to 2030 increases by RPI (assumed to be 3%) and then by energy price inflation of 2.5%
- FIT rate and direct sale price increased by RPI to 2030, and then by CPIH (assumed to be 2.5%) to 2040
- Grid price and direct sale price increased by CPIH from 2040
- General costs are assumed to increase with CPI, which is assumed to increase at 2% per year, in line with the mandate of the Bank of England.

Direct sales are based on a 20-year PPA, at a sale rate starting at 11.5 pence per kWh, increasing in line with the FITs. Cable losses of 3.6% - 4.4% between the turbines and the Lido are allowed for. We expect that 95% of the electricity supplied will be consumed directly by Thames Lido, with 5% exported to the grid at the export tariff rate, currently 5.24 pence per kWh.

Investors in the new (March 2021) share offer will be offered the same terms as existing shareholders. They will make a long-term investment with the expectation that, once the scheme is built and operating profitably, they will each year receive a return on their investment, and a proportion of their capital

[4] This is also equivalent to selling the same amount of power through direct sales but at two-thirds of the price.

repaid. We are aiming for a long-term return of around 4%, although it will be lower in the first five years. The decision about how much to pay back to investors and how much to pay as a benefit to the community is made by the members at the AGM each year, depending on the finances of the society and whether any risks materialise. As investors are repaid capital, the proportion of the income available to benefit the community will increase.

We intend to make our first payment to investors after the turbines are operational, for the financial year ending September 2021. We expect to make this payment early in 2022, and yearly thereafter. We have modelled an interest rate of 2% for our first years of operation, increasing to our long-term target rate of 4% (Table 5). As income is linked to inflation, we always intend to pay interest at or above the inflation rate, so if inflation increases beyond the target rate the interest rate will also increase.

Table 5: Interest rates modelled

Year	Year 1, 2020/21	Year 2, 2021/22	Years 3 &-4, 2022/23 -23/24	Year 5 to 7, 2024/25 -26/27	Year 8 onward 2027/28 on
Date of investment / payment	*Investment made early 2021*	*March 2022*	*Payment made March*	*Payment made March*	*Payment made March*
Interest rate	0%	2%	2%	3%	4%
The interest rates given depend on our future profitability being no worse than forecast: if income falls or costs rise the interest rate paid may reduce.					

As a Community Benefit Society, any profits after operating costs have been covered, an operating reserve has been built up, and shareholders have been paid, will be paid into a Community Benefit Fund. The amount available for the Fund for each of the first 10 years is very limited and provides £14,200 of benefit. The proportion increases over time, giving a total paid into the fund of £205,000.

These returns are consistent with our earlier modelling of the impact of different scenarios (e.g. higher construction costs, use of short-term borrowing to make up shortfall on share offer). This modelling suggested higher costs and increased borrowing could delay repayment of capital to investors but would not affect the fundamental viability of the project.

Over years 1 to 20 funds will be set aside in an operating reserve, to finance the replacement generators and bearings after 20 years, with an assumed £120,000 replacement cost.

Depreciation is based on the straight-line method over the 40-year life of the turbines. The replacement cost of the generators and bearings after 20 years are depreciated over the following 20 years, increasing depreciation by £6,000 per year for years 21-40.

Ongoing operational costs include maintenance, servicing of the turbines, daily maintenance (e.g. clearing of trash screens), insurance, accounting, liaison with the EA and communication with members. We hope that some tasks may be carried out by volunteers, reducing costs, but this is not assumed.

What is the impact of the £170,000 (17%) increase in share capital on existing investors and on the Community Benefit fund?

The increase in share capital leads to increased interest costs, partly because more shareholders need to be paid. In addition, cashflow constraints will reduce the rate at which share capital is repaid, so that interest will be paid on higher balances over the lifetime of the project. The increased share capital held at year 20 will increase the interest cost paid years 21-40. Figure 12 shows the change in the repayment profile over the first 20 years.

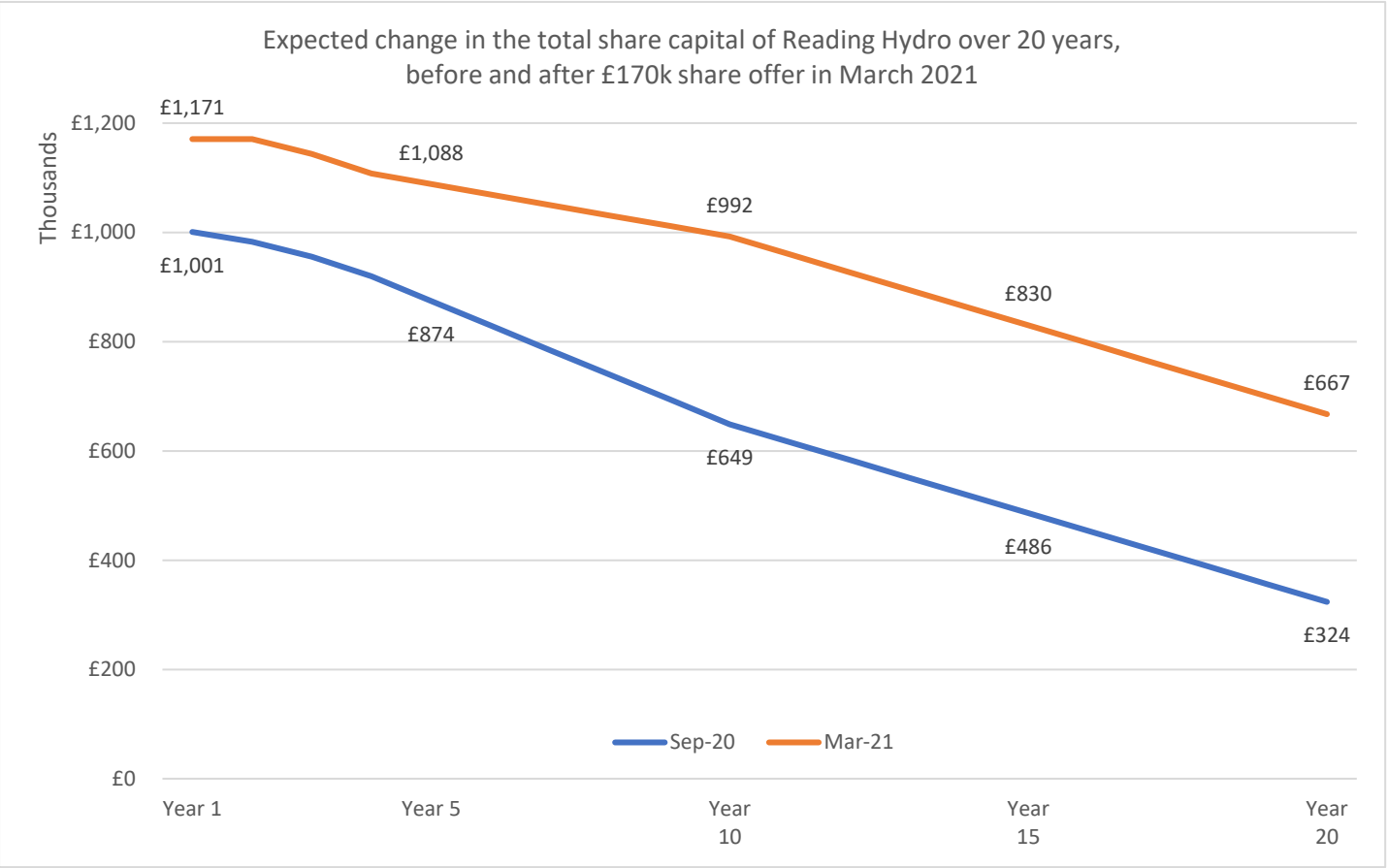

Figure 12: summary of changes in share capital from August 2020 business plan

The chart shows the impact of these changes on the total capital held by Reading Hydro for the first twenty years, before and after the £170,000 share offer.

It can be seen that the amount repaid is now predicted to be £504,000 (£1,171k minus £667k), giving a total share capital at Year 20 of £667,000, double the share capital expected in our budget of August 2020.

Table 6: Change in forecast income and expenditure from August 2020 business plan

		Aug 20 BP	*Mar 21 BP*	*Change*
INCOME	*Sale of electricity, FITs*	£2,870k	£3,327k	£457k
EXPENDITURE	*Capital expenditure*	£1,130k	£1,253k	£123k
EXPENDITURE	*Operating costs*	£718k	£720k	£2k
EXPENDITURE	*Members' interest*	£711k	£913k	£202k
EXPENDITURE	*Community Benefit*	£205k	£205k	0

Table 6 shows how the forecast income and expenditure in March 2021 has changed from the Business Plan in August 2020. The payment of interest uses the same interest rates as the August 2020 Business Plan (see p20). Interest rates can be maintained at this level because we believe the August 2020 Business Plan underestimated the income from the project, as described above.

The change in forecast income is shown in more detail by time period in Table 7.

Table 7: Change in forecast income by time period

Income	*Yrs 0-20*	*Yr30*	*Yr40*	*Total*
Aug 20 business plan	£1,655,898	£532,608	£681,738	£2,870,244
Mar 21 business plan	£1,591,492	£762,808	£976,459	£3,326,759
Change	-£64,406	£230,200	£294,721	£456,515

Over the first 20 years of the project, Reading Hydro now expects to repay 46% of the capital raised, compared with 68% under the August 2020 financial model. It is anticipated that part of this will be in response to requests for withdrawal of shares from members, and part a pro-rata repayment of all members. In order to manage the cash requirements of repayments, we keep open the option of running future share offers to raise funds for repayment. This means that the members holding share capital in twenty years may be different to those who initially invested. Investors will not be expected to hold shares for the lifetime of the project, although all repayments are at the discretion of the Reading Hydro directors.

The tables on the following pages show:

- the expected finances over the 40-year period, showing figures at future prices (including inflation)
- the cashflow on a monthly basis from January 2021 to September 2021, showing payments to contractors and for materials, up until the turbines should be operational and generating income. The Contingency line refer to the cost overruns described earlier in the Business Plan.

Year	0	1	2	3	4	5	6 - 10	11 - 20	21 - 30	31 - 40
Ending	Sep-20	Sep-21	Sep-22	Sep-23	Sep-24	Sep-25	Sep-30	Sep-40	Sep-50	Sep-60
Total Generation (kWhrs)	n/a	127,335	318,338	318,338	318,338	318,338	1,591,692	3,183,384	4,171,652	4,171,652
FIT rate	0.0803	0.0827	0.0852	0.0877	0.0904	0.0931	0.1079	0.1381		
Direct sale price	0.1150	0.1185	0.1220	0.1257	0.1294	0.1333	0.1546	0.1978	0.2532	0.2988
Export rate	0.0538	0.0554	0.0571	0.0588	0.0606	0.0624	0.0723	0.0926	0.1185	0.1400
Income	0.11194	RPI						EPI		
FIT		£10,532	£27,119	£27,933	£28,771	£29,634	£162,051	£394,503	£0	£0
Direct sales		£13,698	£35,273	£36,331	£37,421	£38,544	£210,773	£513,114	£600,236	£768,353
Grid export		£337	£869	£895	£921	£949	£5,190	£12,634	£162,572	£208,106
Grants & other income		£4,000								
Total income	**£0**	**£28,567**	**£63,261**	**£65,159**	**£67,113**	**£69,127**	**£378,014**	**£920,250**	**£762,808**	**£976,459**
Expenditure										
Operation, maintenance, insurance	-£1,200	-£8,762	-£5,661	-£5,774	-£5,889	-£6,007	-£31,888	-£74,081	-£90,305	-£110,074
Financing /Administration	-£25,457	-£24,679	-£5,508	-£5,618	-£5,730	-£5,845	-£31,027	-£72,084	-£87,858	-£107,113
Development costs	-£37,236	-£28,672	-£169	-£172	-£175	-£179	-£955	-£2,216	-£2,701	-£3,295
Capitalisation of cost	£37,236	£28,672								
Total operating costs	**-£26,657**	**-£33,441**	**-£11,338**	**-£11,564**	**-£11,794**	**-£12,031**	**-£63,870**	**-£148,381**	**-£180,864**	**-£220,482**
EBITDA	**-£26,657**	**-£4,874**	**£51,923**	**£53,595**	**£55,319**	**£57,096**	**£314,144**	**£771,869**	**£581,944**	**£755,977**
Depreciation		-£27,797	-£28,532	-£28,532	-£28,532	-£28,532	-£142,660	-£285,320	-£341,510	-£341,520
Interest to members			-£23,420	-£23,420	-£22,880	-£33,240	-£176,290	-£331,000	-£222,650	-£79,830
Community benefit		£0	-£1,250	-£1,350	-£1,400	-£1,500	-£7,500	-£57,900	-£32,500	-£101,500
Total surplus / loss	**-£26,657**	**-£32,671**	**-£1,279**	**£293**	**£2,507**	**-£6,176**	**-£12,306**	**£97,649**	**-£14,716**	**£233,127**
Reserves b/fwd	£3,630	-£23,027	-£55,698	-£56,977	-£56,684	-£54,177	-£60,353	-£72,659	£24,991	£10,275
Reserves c/fwd	**-£23,027**	**-£55,698**	**-£56,977**	**-£56,684**	**-£54,177**	**-£60,353**	**-£72,659**	**£24,991**	**£10,275**	**£243,402**

CASHFLOWS										
EBITDA	-£26,657	-£4,874	£51,923	£53,595	£55,319	£57,096	£314,144	£771,869	£581,944	£755,977
Capital expenditure	-£169,034	-£948,477	-£14,690						-£120,000	
Operating cashflows	-£195,691	-£953,351	£37,233	£53,595	£55,319	£57,096	£314,144	£771,869	£461,944	£755,977
Shares invested / repaid	£886,820	£267,941	£0	-£27,100	-£36,130	-£22,356	-£111,779	-£308,779	-£303,325	-£361,692
Interest to members	£0	£0	-£23,420	-£23,420	-£22,880	-£33,240	-£176,290	-£331,000	-£222,650	-£79,830
Community benefit	£0	£0	-£1,250	-£1,350	-£1,400	-£1,500	-£7,500	-£57,900	-£32,500	-£101,500
Taxation	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Change in creditor / debtors	-£39,138	£33,800	£5,204	£285	£293	£302	£1,651	£3,368	-£2,632	£3,573
Increase / decrease in cash	£651,991	-£651,610	£17,767	£2,010	-£4,798	£302	£20,226	£77,559	-£99,163	£216,528
Cash c/fwd	£672,021	£20,411	£38,178	£40,187	£35,390	£35,692	£55,917	£133,476	£34,314	£250,841
BALANCE SHEET										
Tangible assets	£169,034	£1,089,714	£1,075,872	£1,047,340	£1,018,808	£990,276	£847,616	£562,296	£340,786	-£734
TOTAL FIXED ASSETS	**£169,034**	**£1,089,714**	**£1,075,872**	**£1,047,340**	**£1,018,808**	**£990,276**	**£847,616**	**£562,296**	**£340,786**	**-£734**
Cash balances	£672,021	£20,411	£38,178	£40,187	£35,390	£35,692	£55,917	£133,476	£34,314	£250,841
Other current assets / liabilities	£39,138	£5,338	£134	-£151	-£444	-£746	-£2,397	-£5,765	-£3,133	-£6,706
TOTAL ASSETS	**£880,193**	**£1,115,463**	**£1,114,184**	**£1,087,377**	**£1,053,754**	**£1,025,222**	**£901,137**	**£690,008**	**£371,967**	**£243,402**
Represented by:										
Operating reserve		£6,000	£12,000	£18,000	£24,000	£30,000	£60,000			
General fund	-£23,027	-£61,698	-£68,977	-£74,684	-£78,177	-£90,353	-£132,659	£24,991	£10,275	£243,402
Share capital	£903,220	£1,171,161	£1,171,161	£1,144,061	£1,107,931	£1,085,575	£973,796	£665,017	£361,692	£0
TOTAL FUNDS	**£880,193**	**£1,115,463**	**£1,114,184**	**£1,087,377**	**£1,053,754**	**£1,025,222**	**£901,137**	**£690,008**	**£371,967**	**£243,402**

Project Finance, month	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Total
Construction Costs	£153,533	£132,647	£211,117	£87,745	£18,720	£3,298	£0	£33,238	£0	£919,805
Archimedes Screw	£44,040	£33,030	£20,515	£23,565	£0	£0	£0	£0	£0	£121,150
Civils contract	£65,673	£95,409	£60,147	£14,690	£0	£0	£0	£0	£0	£477,017
Fish pass, access, grid connect	£1,954	£4,208	£85,673	£24,000	£0	£0	£0	£33,238	£0	£157,787
Contingency costs	£41,866	£0	£40,182	£25,490	£14,120	£0	£0	£0	£0	£146,748
Project management	£0	£0	£4,600	£0	£4,600	£3,298	£0	£0	£0	£17,104
Development Fees	£0	£7,586	£5,560	£0	£0	£0	£0	£0	£0	£28,672
Operation & maintenance, insurance	£0	£0	£0	£200	£0	£0	£2,232	£0	£0	£8,762
Share Offer Doc Marketing	£0	£0	£0	£2,500	£0	£0	£0	£0	£0	£2,500
Share capital Finance	£20	£20	£20	£2,500	£20	£20	£20	£20	£20	£3,120
Admin & contingency	£0	£0	£6,234	£0	£0	£6,600	£0	£0	£625	£19,059
Subtotal	£153,553	£140,253	£222,931	£92,945	£18,740	£9,918	£2,252	£33,258	£645	£981,918
VAT	£30,711	£28,051	£44,586	£18,589	£3,748	£1,984	£450	£6,652	£129	£196,385
VAT Refund	-£27,130	-£30,711	-£28,051	-£44,586	-£18,589	-£3,748	£0	£0	-£9,086	-£228,935
Equity subscribed			-£70,000	-£100,000						-£267,941
Subtotal: cash spent	£157,134	£137,593	£169,466	-£33,052	£3,899	£8,154	£2,702	£39,910	-£8,312	£681,427
Cumulative Balance	-£290,923	-£153,330	£16,136	-£16,916	-£13,017	-£4,863	-£2,161	£37,748	£29,436	£29,436
Total Equity Subscribed	-£1,001,161	-£1,001,161	-£1,071,161	-£1,171,161	-£1,171,161	-£1,171,161	-£1,171,161	-£1,171,161	-£1,171,161	-£1,171,161
Income received	-£40	-£30	-£4,000	£0	£0	-£2,302	-£2,302	-£2,302	-£6,703	-£19,268
Community benefit paid	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Bank balance b/fwd	£480,337	£323,243	£185,680	£20,214	£53,266	£49,367	£43,515	£43,115	£5,508	
Bank balance c/fwd	£323,243	£185,680	£20,214	£53,266	£49,367	£43,515	£43,115	£5,508	£20,523	£20,523

13. Our organisation

Reading Hydro is run by volunteer Directors, who bring a range of experience, skills and enthusiasm to the society. Members are encouraged to stand for election to the Board, and also to support the board with specific expertise as advisory members. Communication between meetings uses Slack channels.

SOPHIE PAUL CHAIR

Sophie has lived in Reading for 23 years. She has a background in hydrogeology, IT development, governance and strategy, in addition to many years of involvement in a wide range community projects in the UK and abroad.

"I delight in the smell of the water going over Caversham Weir, along with the sight and sound of power in that water."

ANNE WHELDON SECRETARY

Anne started life as a physicist, quickly steering this towards the environment with a PhD in environmental physics. She spent a large part of her career in sustainable energy and international development, also at the University of Reading, running the MSc in Renewable Energy and the Environment. More recently, she worked for 12 years for the sustainable energy charity Ashden as technical director and adviser.

"We really need to have more hydro to give a balanced sustainable energy supply mix, and where better to do it than in Reading."

TONY COWLING TECHNOLOGY & FOUNDER

Tony graduated from Reading University in the seventies with a PhD in chemistry. Inspired by sustainability, he's been involved in a variety of initiatives in Reading and beyond, including, Reading Energy Pioneers and the DraughtBusters project initiative of 'Transition Town Reading'

"Passions of mine are both renewable energy and driving forward sustainability through Education. Originating from The Reading Sustainability Centre the Hydro project combines the two!"

ANDY TUNSTALL BUSINESS STRATEGY

Andy has a background in oil, water and energy in posts ranging from finance, IT, sales, marketing and strategy. He has recently completed the MSc in Renewable Energy at University of Reading and is also a director of The Green Group UK Ltd which intends to market renewable heat and power products to homes and businesses. He joins Reading Hydro CBS to help advise on business strategy, partnership development and the all-important share raise to make the idea into reality.

"It's great to be involved with something that will have so much benefit to the community of Reading on so many levels. It fits perfectly with Reading's objective of reducing energy use and increasing renewable generation. Hopefully this will be the first of many schemes that Reading Hydro can help facilitate."

DAVID WHIPPLE TECHNOLOGY

David's whole career has been working with water. Now retired, he worked for a big Reading-based engineering consultancy as a hydraulic specialist on many large dams and hydro-electric projects including Kariba Dam in Zambia, Victoria Dam in Sri Lanka, Glendoe, Sloy and Foyers in Scotland, plus numerous smaller dams, weirs, river training works, flood defences and fish passes both overseas and at home.

"I keep my hydro skills refreshed by helping my grandchildren dam streams on the beach on holiday."

MICHAEL BEAVEN FUNDRAISING

Michael has a background in finance and fundraising in the voluntary secto, and is a licenced Community Shares practitioner. He works for Our Community Enterprise, an employee-owned company based in Maidenhead. He is also a Director of MaidEnergy, a renewable energy co-op that has installed 388kW of solar panels on community buildings, financed by Community Share offers to the public.

"I've seen new turbines start generating renewable electricity elsewhere on the Thames, and am inspired by the work that has been done to make this happen in Reading too."

SALLY WATERMAN PROJECT CO-ORDINATION & RISK MANAGEMENT

Sally has lived in Reading since completing her PhD in microbiology at Reading University in 1982. Since then she has worked in a wide range of operational and strategic roles in the pharmaceutical industry for both large multinational companies and small UK start-ups. She was the previous chair of OBN, a not-for-profit organisation that provides support to life science companies to help them grow.

"This ambitious scheme will not only harness the power of water for the benefit of the community, but it will also be a prominent feature in an area that will be much improved by its existence and an educational resource for everyone."

The development of a hydropower project is heavily regulated, with permissions required from the local planning authority (Reading Borough Council), the network operator (SSEN) and the Environment Agency. The permissions required have been secured as necessary by determined volunteer activity, combined with support from professional advisers as required. In autumn 2018 we tendered for professional support, and selected Renewables First. They have provided outline and detailed designs and managed the tenders for the construction of a relevant hydropower system, together with professional support to secure the permissions required.

In October 2019, the Reading Hydro directors contracted with Our Community Enterprise CIC to develop the Business Plan and Share Offer document, ready for independent assessment for the Standard Mark in November 2019. As Michael Beaven is a Director of both organisations, Our Community Enterprise CIC offered to do the work at a discount, to ensure Reading Hydro got best value. Michael took no part in the decision by Reading Hydro to award the contract.

Reading Hydro grew out of the work of The Reading Sustainability Centre (TRSC), a CIC limited by guarantee (09379870), and Tony Cowling is a volunteer Director of both organisations. TRSC initially applied for planning permission and Environment Agency licences, and the relevant permissions have been granted to them. Agreement has been reached for Reading Hydro to develop the hydropower site, with an in-kind donation from TRSC of the permissions granted, and for both organisations to work together co-operatively.

Other than disclosed above, no directors received remuneration from Reading Hydro CBS Ltd. Our role as Directors is voluntary and has no payment, other than expenses.

Member and community engagement are important and key aspects of the Society's governance and we welcome support, ideas, comments and assistance. A large number of members have helped the project in various ways over time.

We encourage membership of Reading Hydro. Anyone can contact us by emailing reading.hydro.cbs@gmail.com, through the Reading Hydro Project Facebook group, through @rdghydro on Twitter or Instagram, and by signing up for our newsletter via our website: hydro.readinguk.org. Anyone can get involved in

person by attending our Annual General Meetings (only members may vote) and (when Covid-19 restrictions permit) frequent open action evenings and events, which are announced through our main communication channels above.

The volunteer Directors of the society are drawn from, and elected by, the membership, and welcome individuals who can strengthen the governance of the society. This could be due to expertise or knowledge, or through links to communities in the local area, and support and mentoring is offered to potential Directors to encourage wider participation.

Our Society's community engagement involves an increasing variety of events and publicity, including a strong online presence and attractive e-newsletter, press releases, action evenings, public social gatherings, partnership with other community groups, and educational links. Some of these are currently on hold because of Covid-19 restrictions.

Operation of the hydropower site in the long term will be carried out by a mixture of volunteers and professionals with relevant qualifications, skills and experience. Many tasks (such as clearing trash screens, routine maintenance) are suitable for community involvement.

14. Risks

General Renewable Energy Risks

- Government policy towards renewable energy may change. A significant source of income for Reading Hydro is the Feed-in Tariff (FIT). Reading Hydro's profitability depends on the FIT continuing to be paid in accordance with current legal regulations and future governments honouring this obligation.
- Long-term changes to weather patterns could result in less electricity generation due to lower water levels in the river. However, there is no evidence that Reading Hydro is aware of that this will affect energy production at its site disproportionately more than any other hydroelectricity scheme on a river. Atypical short-term weather conditions could affect expected levels of generation, although overall patterns outside anticipated parameters are unlikely.
- It is very difficult to predict either the generation of, or the demand for, electricity in 20 years' time and it could remain at a similar level to now, or demand could increase or decrease. Some National Grid scenarios project that rapid decarbonisation could lead to an oversupply of electricity in the 2040s, with insufficient storage capacity to utilise this. Equally, rapid adoption of electric vehicles and heat pumps, for example, could increase demand for electricity as fast as generation increases. New developments in electricity storage and electric cars may also significantly increase distributed storage capacity on the Grid.

Risks specific to the Reading Hydro project

Reading Hydro maintains a detailed risk register which is currently reviewed at each board meeting. The main risks identified, and their mitigation, are:

Completion of the project

- Covid-19 may cause delays. The number of people on site may be reduced because of illness or the need to isolate in accordance with government advice, slowing the rate of work. Volunteers and contractors working on site will observe government advice to minimise the risk of Covid-19 transmission.
- If the share offer does not raise the finance required and Reading Hydro is unable to secure a loan on acceptable terms to cover the shortfall, work could be halted until alternative financing arrangements are in place. These arrangements may raise the cost of capital and lengthen the period during which returns to investors will be below our long-term target rate of 4%.

Operation of the hydro scheme

- Operational costs may rise faster than anticipated during the life of the project for reasons that cannot currently be foreseen. The Society will enter into contracts for operation, maintenance, and administration to help manage the operational expenditure and reduce this risk as far as practicable.
- Under the terms and conditions of its licence from the Environment Agency to impound water, the Society is required to agree an operating licence with the Environment Agency. An operating licence is usually issued on completion of the project. Whilst every effort will be made to agree the licence with the Environment Agency as quickly as possible, the Society may be generating electricity before it is issued. The consequences of selling electricity prior to the operating licence being signed is not known but Reading Hydro may be asked to temporarily halt the turbines or may face legal action for breach of the licence.
- The Environment Agency requires that the operation of the turbines does not affect the upstream river levels and in the event of a turbine shutdown wants one of the weir gates to open automatically to compensate for the lost flow through the turbine. The requirements are outlined in the licence to impound water. The Society has tried to engage with the Agency to discuss the details of its requirements, not all of which it believes are necessary, but despite its best endeavours there has not yet been a response. The consequences of operating without meeting the requirements of the Agency are not known but Reading Hydro may be asked to temporarily halt the turbines or may face legal action for breach of the licence.
- Under the terms and conditions of the Society's licence from the Environment Agency to impound water, no water can pass through the turbines until a fish pass is installed. Construction of the fish pass is nearly complete but before it can be used the Society requires a lease from Reading Borough Council. Whilst there is certainty that the lease will be agreed there is a risk that it may be delayed.
- The sale of electricity requires the Society to have a Feed-in Tariffs (FIT) export contract with an Ofgem licensed electricity supplier. This cannot be achieved until the preliminary accreditation for the FIT sought from Ofgem is confirmed.

- The Archimedes screw turbines, generators and associated equipment have a warranty covering defects of materials and workmanship for 12 months from the start or their operation but beyond this period any repairs would need to be funded by Reading Hydro. There is no guarantee that the operational reserve fund will be sufficient to meet the costs; if it is not sufficient, payments of interest will be reduced.
- Insurance for theft, malicious damage, or loss of the generator, gears, and other equipment due to fire will be sought. However, the Society does not expect to be in a financial position to pay the insurance premium required to maintain comprehensive insurance cover without reducing the return to shareholders and the Community Benefit Fund. Reading Hydro may therefore decide not to take out such insurance and would seek to raise further funds to cover repair or replacement of the equipment in the unlikely event that this would be necessary.
- The projections for the return to investors are based on the predicted energy yield of the project using data from the Environment Agency and an estimate of the average load factor that could be achieved (78%). If the yield were to be lower on average over the project period the overall funds available to pay investors and for the Community Benefit Fund would be reduced. The interest rates projected to members are not certain until the turbines are operational, and the energy yield is verified.
- Direct sales of electricity to an individual customer may not achieve the price or quantity modelled, or may be ended before the expected period for reasons outside the control of Reading Hydro. We have reached an agreement with the main customer (Thames Lido) over the price and quantity of power sales. Our due diligence on the financial strength of the group gives us confidence that the business is likely to be operational in the medium-term. Legal agreements will ensure that there are pass-through arrangements in place to allow electricity to be sold to other customers if Thames Lido cannot use our electricity.
- The income for the project is directly linked to inflation for the first 20 years, which has been assumed at the 2% target rate for the Bank of England. If inflation varies significantly above or below this target the income received will alter proportionately, which could lead to the interest rates paid to members also changing.
- The project is reliant upon commissioning before the expiry of the validity period for FITs, which has been extended to September 2022 for a community organisation. In the remote event that the FIT deadline is not met, or the commissioned scheme is materially different to the application for preliminary accreditation, it is unlikely that investors would receive much more than their money back.

Appendix I: Permission, permits and licences obtained

	Authority	Reference no.	Content	Status
Planning Permission	Reading Borough Council	151715	The installation of two Archimedean Screw Turbines with a hut covering the generators, gearboxes & control system.	Granted 15th May 2017; work started prior to expiry on 15th May 2020
Planning Permission	Reading Borough Council	200358	Update of approved plans and discharge of some of the conditions in planning permission 151715	Granted 15th May 2020
Abstraction Licence	Environment Agency	TH/039/0023/022	Abstraction by gravity flow to a fish and eel pass to 31 March 2028	Granted 19th February 2016 Extended 2019 & 2020
Impoundment Licence	Environment Agency	TH/039/0023/019	Impounding works for the purpose of power production at a hydropower scheme.	Granted 19th February 2016 Extended 2019 & 2020
Environmental Permit	Environment Agency	EPR/DB3258UB	New channel to accommodate screws, semi-natural fish & eel pass, new turbine house	Granted 28th March 2019
Environmental Permit	Environment Agency	EPR/DB3258UB/R1	Variation to permit to extend area of land covered, include dredging of silt and update documentation	Granted 2nd October 2020
Fish Pass approval	Environment Agency	16/01/T	Fish pass on the River Thames at Caversham Weir	Granted 17th February 2016