Living in a Passivhaus:

An assessment of energy and performance

Tim Larner – Developer, Project Manager & Resident

The house – PH database ID - 6164

Background

- Plot found - August 2016
- Design started – October 2016
- Planning consent (replacing existing consent) - April 2017
- Build started – September 2017
- Occupation – December 2018

- The story in five minutes – for Passivhaus Open Days 2020:

https://www.youtube.com/watch?v=r9NAmLqlBBE

The main players:

- Tim & Marilyn Larner – Project Manager and Client respectively
- Phil Bixby, Constructive Individuals – Architect & Passivhaus designer
- Bill Richardson, Buildakit – Main contractor
- Gavin Andrews, Leeds Solar – Energy design & renewables
- Mark Purnell, Award Energy – Energy advice and SAP input
- Syd Briscoe, Myrings – Commercial advice
- Kym Mead – Passivhaus Certification assessor
- Harrogate Borough Council - Building Inspection

Key design concepts and parameters

- Aim for PH certification
- High degree of energy self-sufficiency and all-electric
- Live in the sunlight, sleep on the north side
- A house suitable for ageing comfortably
- 2 bedrooms plus 2 capable of being bedrooms (168m^2 floor space)
- Sustainably constructed – maximise use of timber (pre PHRibbon)
- Low footprint living

Energy design principles

- Maximise electricity generation – solar PV covers south-facing roof
- Install battery to cover supply during hours of darkness
- Heating: gas – no! Heat pump – too little demand
- MVHR post-heater – perhaps, but is constant heating really necessary?
- Use thermal mass to the full, emphasis on simple controls
- Under-floor heating – yes, but deliberately over-specified to enable off-peak use
- Occasional use of plug-in electric heating – why not?
- Large thermal store – the building itself + 300L of hot water
- Low-level air flow the norm, calibrate MVHR accordingly
- Convenient living, but no tumble drier – design in drying space
- Be prepared to adapt – behavioural change is fun!

Overall impressions of PH living

- Affordable luxury – see Jeff Colley's TEDx talk
- High quality of life – see TL/Phil Bixby double-act:
  - constant temperature & humidity,
  - absence of draughts
  - good ventilation
  - light & airy
  - great inside-outside connection
  - quiet – great acoustic qualities
  - clean
  - 'oozes wellbeing' – as the YouTube video says
- Low running costs

Overall energy performance - overview

- Energy consumption – PHPP ‘as-built’ forecast - 10.3mWhpa
  - Heating – 3.2
  - Ventilation – 0.1
  - DHW – 4.9 (48%)
  - Other – 2.0

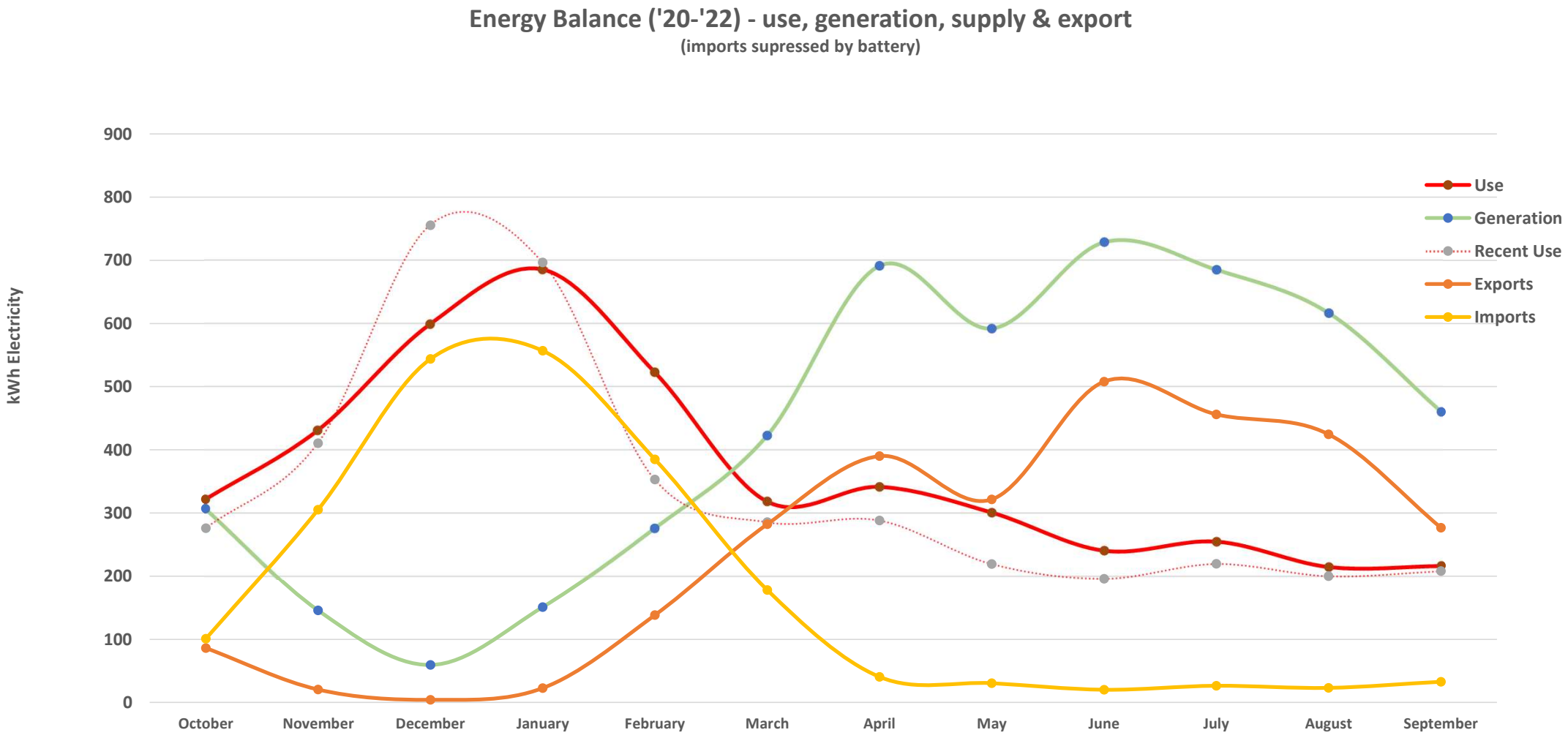
- Energy generation forecast – c5.5mWhpa from 7.02kWp solar array

- In use: Consumption– c4 to 5mWhpa, Generation – c5.1mWhpa

Annual electricity use – ‘wet finger’ estimates

- Space heating – 2.0mWh (c63% of 3.2mWh in PHPP)
- DHW – 0.6mWh (c12% - lower?)
- Ventilation – 0.1mWh (c100% - no basis for alt. assumption)
- Other domestic – 1.5mWh (c75% - efficient appliances, sensible use)

Seasonal variation

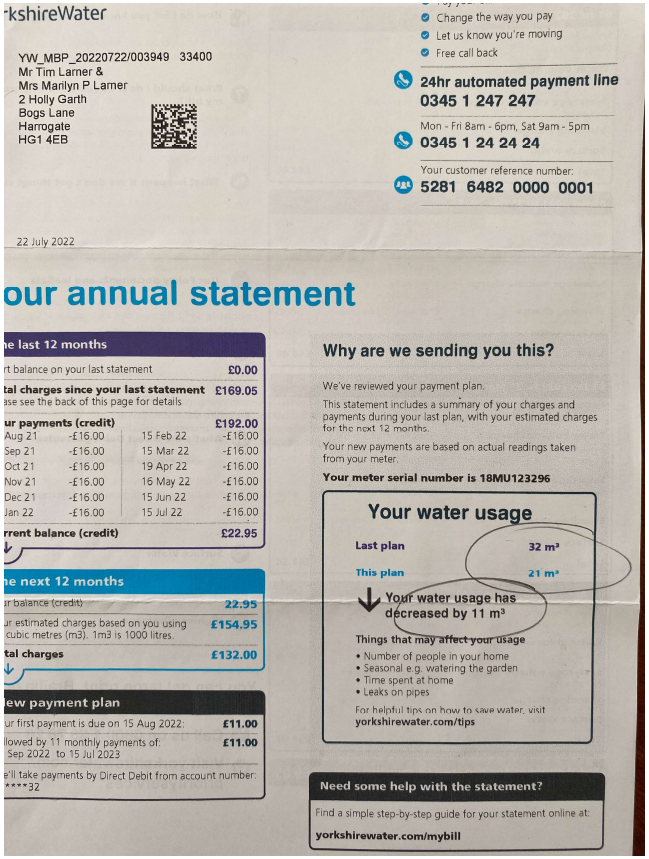


Trend information 2019-2022

- Learning to use the equipment
- ‘Working with the grain’ of Passivhaus
- Significance of thermal mass and internal insulation
- Ability to buy electricity when it’s cheaper with the right controls
- Overriding significance of DHW demand and management

- None of this is rocket science, but we do need to be clear about design objectives, understanding ‘the good life’, and supporting occupants in living cheaply and well.

It’s (nearly) all about water



kshireWater

YW_MBP_20220722/003949 33400
Mr Tim Larner &
Mrs Marilyn P Larner
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HG1 4EB

Change the way you pay
Let us know you're moving
Free call back

24hr automated payment line
0345 1 247 247

Mon - Fri 8am - 6pm, Sat 9am - 5pm
0345 1 24 24 24

Your customer reference number:
5281 6482 0000 0001

22 July 2022

our annual statement

e last 12 months			
rt balance on your last statement			£0.00
tal charges since your last statement ase see the back of this page for details			£169.05
ur payments (credit)			£192.00
Aug 21	-£16.00	15 Feb 22	-£16.00
Sep 21	-£16.00	15 Mar 22	-£16.00
Oct 21	-£16.00	19 Apr 22	-£16.00
Nov 21	-£16.00	16 May 22	-£16.00
Dec 21	-£16.00	15 Jun 22	-£16.00
Jan 22	-£16.00	15 Jul 22	-£16.00
rrent balance (credit)			£22.95

e next 12 months	
r balance (credit)	22.95
ur estimated charges based on you using cubic metres (m3). 1m3 is 1000 litres.	£154.95
tal charges	£132.00

ew payment plan	
ur first payment is due on 15 Aug 2022:	£11.00
llowed by 11 monthly payments of: Sep 2022 to 15 Jul 2023	£11.00
e'll take payments by Direct Debit from account number: ****32	

Why are we sending you this?

We've reviewed your payment plan.

This statement includes a summary of your charges and payments during your last plan, with your estimated charges for the next 12 months.

Your new payments are based on actual readings taken from your meter.

Your meter serial number is 18MU123296

Your water usage

Last plan	32 m³
This plan	21 m³

Your water usage has decreased by 11 m³

Things that may affect your usage
- Number of people in your home
- Seasonal e.g. watering the garden
- Time spent at home
- Leaks on pipes

For helpful tips on how to save water, visit yorkshirewater.com/tips

Need some help with the statement?

Find a simple step-by-step guide for your statement online at:

yorkshirewater.com/mybill

It is all about heating it, keeping it hot & reducing use!

- Method – fuel & controls & devices
- How much?
- How hot? (temperature differential)
- Insulation
- Plumbing specification & design
- Standards
- Behaviour

- Remember: 4.9 → c0.6??

Trend data – 2019-23 (mWh)

Year	Energy use	Generated	Imported	Exported		Comments
2019	5.37	5.01	3.30	3.03		Jan-Feb internal painting
2020	5.18	5.01	2.36	2.18		Matching demand to generation, battery management (over the year)
2021	4.97	5.07	2.22	2.20		
2022 (est)	4.1	5.23	2.1	3.2		Significant reductions in DHW heating
2023 (proj)	< 4.0	c5.05	c2.0	>3.1		Full year impacts of DHW changes

Notes: Major learning taking place
Significant net export of power
Hot water key to energy performance
If battery installed, make it work
House very comfortable at 19degC in winter, cool overcast days require most heating

Take-away lessons for designer/specifiers

- Understand your client
- Educate your client
- Involve them in decisions
- Energy design and use is important – the more so with higher cost
- Manage the interfaces – particularly with renewable and plumbing contractors

Concluding remarks

- Is it all about energy? Should it be?
- Energy & carbon are related but separate issues
- Consider both design & in-use issues – this is definitely ‘both/and’
- Did we get it all right? No, but mostly very pleased
- Operational carbon is ‘easy’, embodied carbon less so
- PHRibbon – a great start, but some way to go
- Negative operational carbon housing is achievable and doesn’t cost a fortune
- Possibility of financially viable Passivhaus is there to be grasped – with massive quality gains as a bonus

Questions please!