Zero energy home

Presented by Paul Wilson

Solar Backup &
Phase Change Energy Solutions

www.solarbackup.com.au
www.phasechange.com.au

Goals

- To design homes which can create enough electrical energy to power a modern family home and run three electric cars, every day of the year
- To make grid power connection an option, not a necessity
- To avoid the need to connect to reticulated gas
- To make complete independence an option

How to specify a “zero energy home” for your next client

Aims for todays presentation

- To present a list of design considerations
- To explain why each technology is recommended
- To recommended some brands
- Making it all work together

Eleven important considerations for a zero energy home:

1. *Location*
   The most important of all
2. *Phase Change Materials (BioPCM™)*
   A smart heat capacitor (out performs traditional thermal mass)
3. *Solar Power System with batteries*
   Generating and storing your own electricity (avoiding the grid)
4. *Insulation*
   Create heat barrier saving energy (avoid penetrations)
5. *Heat pump*
   Create hot water all year with very little electricity (better than traditional solar hot water panels)
6. *Induction cook top*
   Cooking without gas (safer and many would say better than gas)
7. *Reverse cycle air-conditioning*
   Heating and cooling without gas (pre-heat or pre-cool the BioPCM)
8. *LED lighting*
   Low energy consumption
9. *Insulated timber floors*
   Easier control of comfort
10. *Double glazing*
    Thermally broken windows work best, quality frames and seals
11. *Central automation control*
    Bring it all together and make it work as a team

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Step 1
Primary Consideration - Location

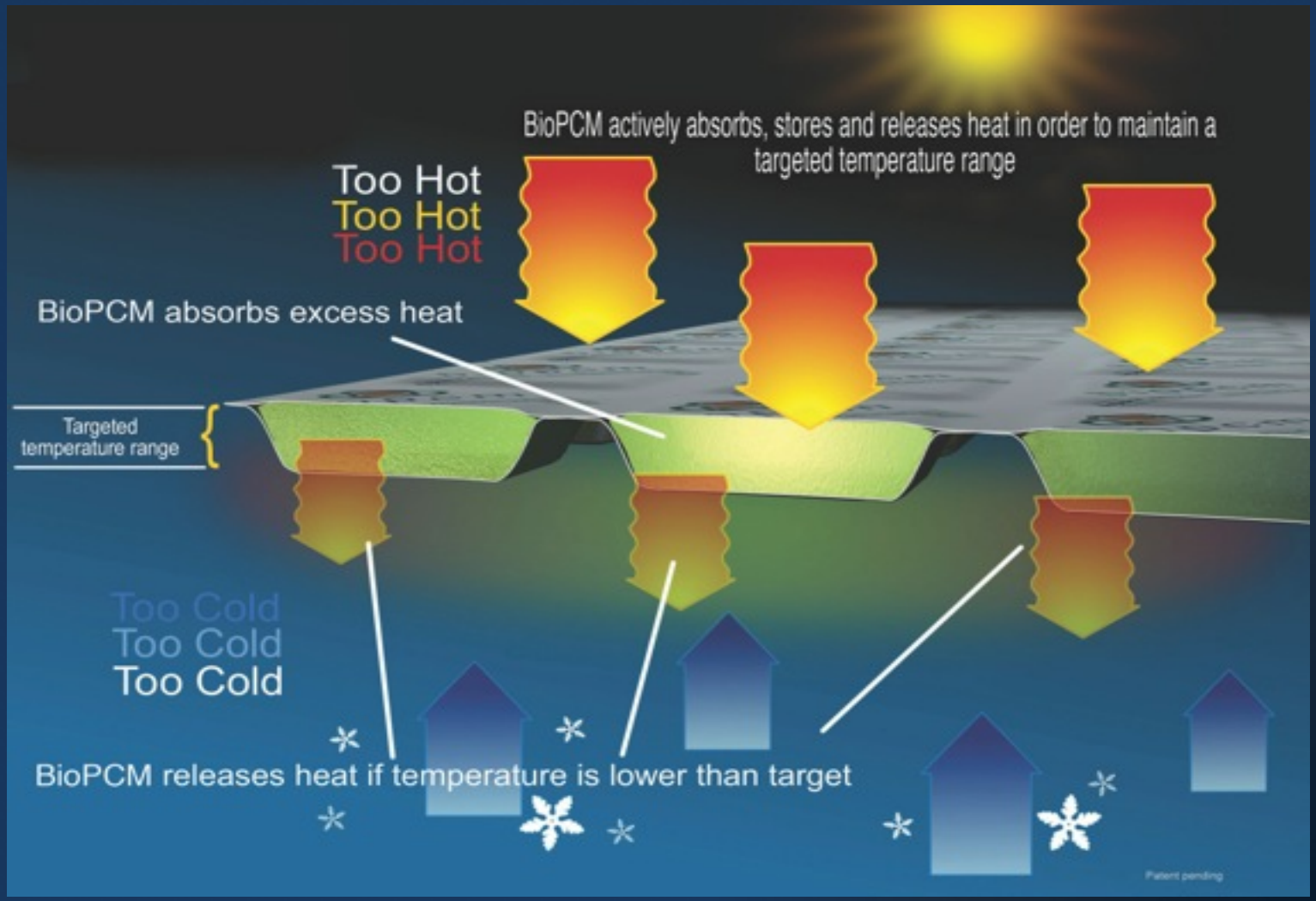
- Its very easy to choose a good location and just as easy to choose a bad one.
- Passive northern solar access is very important
- However, the most important consideration is access to direct sunlight in winter, and lots of it.
- Without direct sunlight in winter, it's a challenge to design a true zero energy home.

Step 2
Phase Change Materials (PCMs)

•PCMs are materials which take advantage of a fundamental property of nature; the natural tendency of materials to absorb heat when they melt (change phase from a solid to a liquid) and to release heat when they solidify (change phase from a liquid to a solid).

•PCMs can store tremendous quantities of heat per unit of mass through these transitions. When phase change materials are placed in quantity into the structure of a building, they will absorb heat (air condition) in the building as temperatures rise and release heat (heat) in the building when temperatures drop.

How BioPCM™ Works

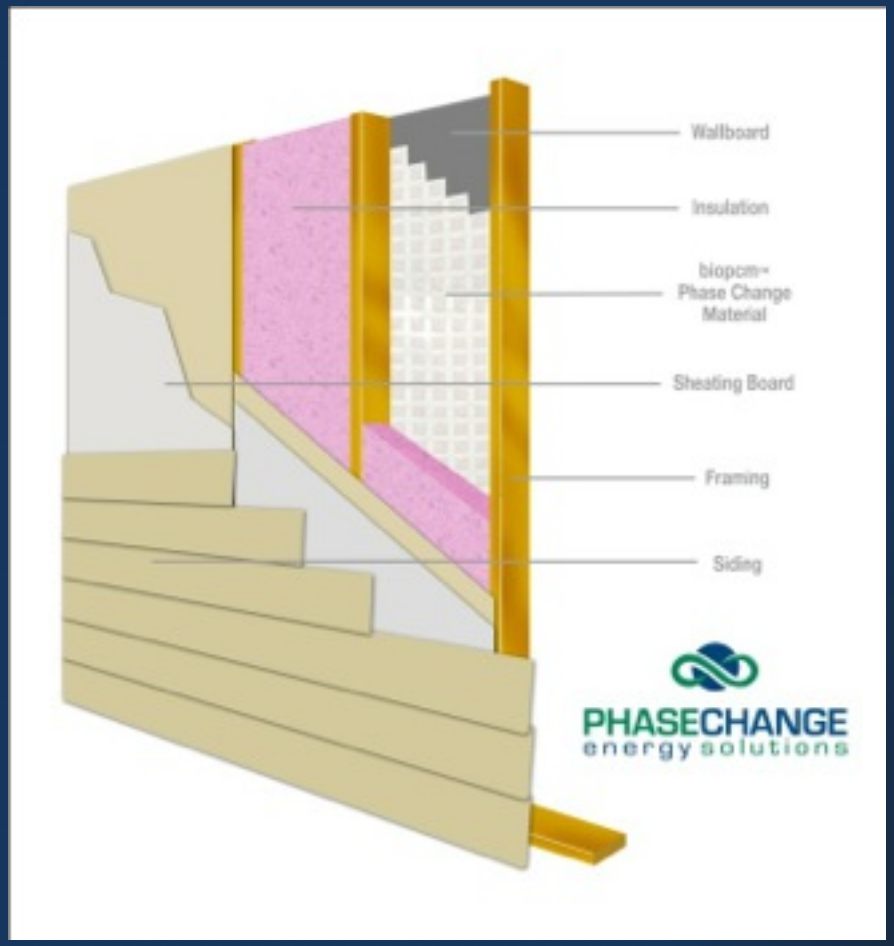


BioPCM™ Installations Methods and Energy Savings

Best installed firstly in the ceiling and then secondly in the wall

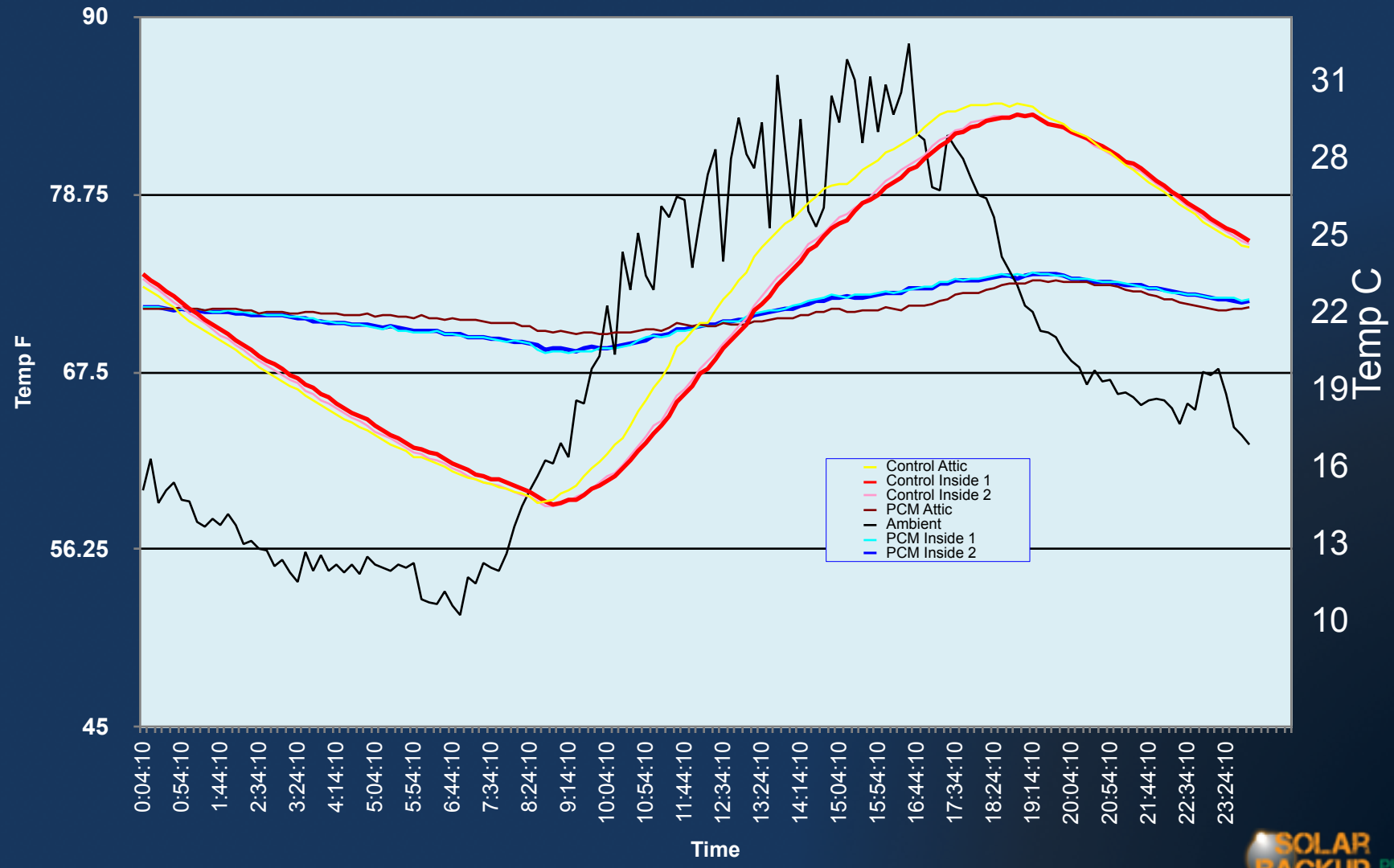
Underneath Wall or Ceiling Plaster

- Installed behind plaster walls and ceilings
- reduces peak demand and heat flux through walls
- helps balance out temperature differences throughout building
- staple, screw or glue to metal or wood studs



Field Test Results

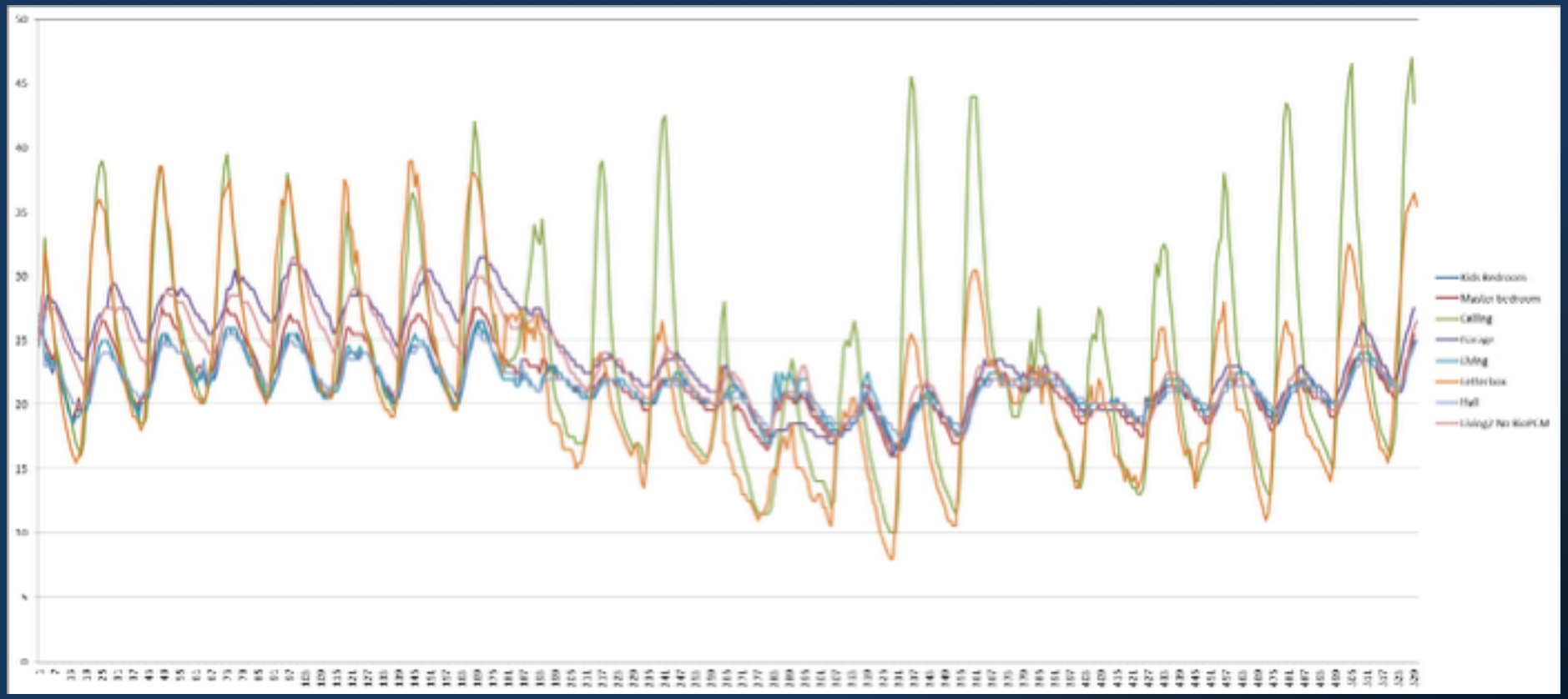
BioPCM™ vs. Control in Unconditioned Space
Side by Side Comparison of two residential buildings



Why This is an Exciting Product

- BioPCM are economically viable today, without Government incentives.
- The ROI is estimated to be between 6 months and 5 years depending on application.
- In new builds, savings by downsizing heating/ cooling and reducing concrete slabs will more than pay for the installation of BioPCM.

BioPCM™ Projects



BioPCM™ Projects







BioPCM™ Projects

“Thermal performance of the house has improved noticeably since installation a week ago. I noticed a change on the first day, but deliberately held off commenting in case it was wishful thinking. Some of the improvement will be due to the roof blanket, but at only R1.3 extra, I expect much of the improvement can be attributed to the PCM.

On the coldest night since installation, outside temp got down to 5degC after a 19deg max. In the past, that would have meant waking up to an inside temp of about 13degC in the morning without heating, but it didn't get below 17deg this time.

I deliberately let the inside temp get up to about 23deg during the day, to supercharge for the coming night.

BioPCM™ Projects

Overall, I am very impressed with the results. The improvement in the comfort level of the house through each 24-hr cycle is obvious. I feared that putting BioPCM mats in the ceiling might have been a gimmick, but it actually works. I have to admit that the price of the BioPCM came as a shock, but it seems like a good long-term investment, especially in a building that can't be insulated to the level I would like.

Even though the house was originally built as a shed for temporary accommodation, it was designed for passive solar gain with good northern glazing and an insulated slab. From my early impressions of the PCM, it seems far more efficient than the slab as thermal mass in regulating the diurnal temp range.

I'll feel comfortable recommending it to clients in conjunction with high levels of insulation.
Graham Richmond (Building designer – Franklin Tasmania)

Properties BioPCM™ summarised

BioPCM™ steals the heat of the day, keeping it cool, and delivers that same heat back at night, keeping it warm.

Outside the melting range not much energy is absorbed, unlike concrete / bricks.

BioPCM™ is light weight, easy to install, operates without noise, long lasting (85 + years), no maintenance required.

However BioPCM™ cannot create energy. For weather extremes a small reverse cycle system is a good option to help tune the dwelling.

Step 3
Solar Systems

- *On grid*
- *On grid with battery backup*
- *On grid with self-use batteries*
- *Off-Grid with batteries*

On-grid solar systems

An On-grid solar electric, or photovoltaic (PV) system feeds electricity directly into the grid, offsetting the amount of electricity supplied by the grid.

On grid solar system with battery backup

Batteries are added to primarily to generate electricity during blackouts. The batteries are not used when solar system is not producing electricity.

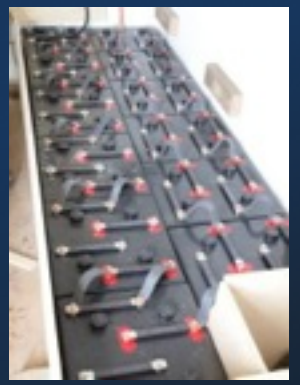
On grid with self-use batteries

A Self-use system is a combination of an On-grid and Off-grid system. Excess power produced by the solar panels during the day is stored in a battery backup unit and increases your usage of renewable energy.

www.mypowerrouter.com

Off-Grid with batteries

An Off-grid system has no connection to the grid whatsoever and must rely on a PV system for its electricity supply.



Synergy of BioPCM with Solar Systems

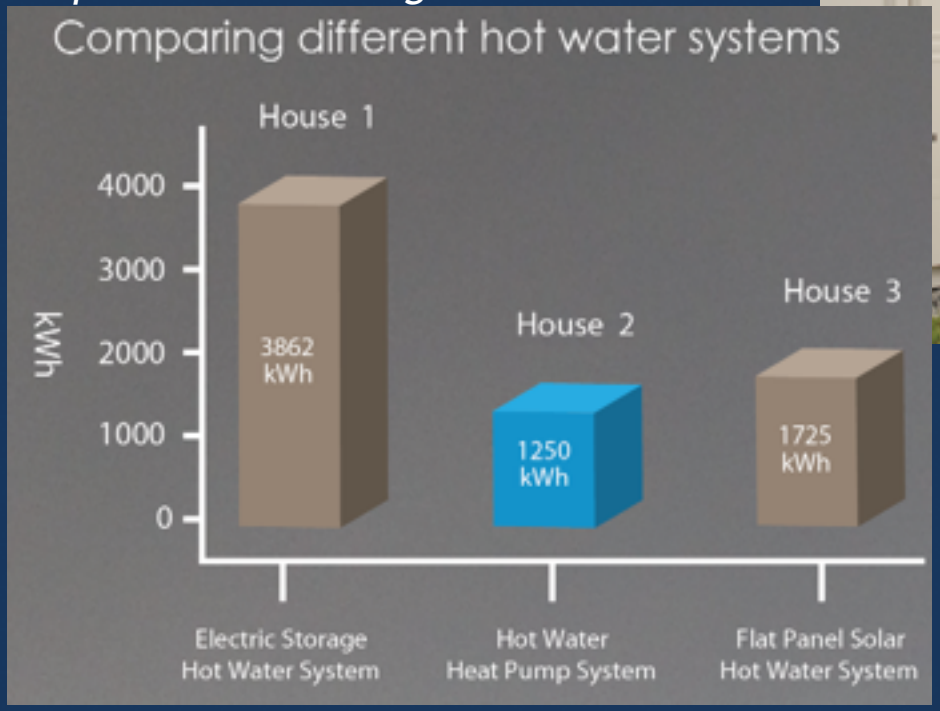
- Excess energy generated with the solar system can be used to heat or cool the BioPCM with the use of a small reverse cycle air conditioner
- In addition to passive heating and cooling (the use of the day/night temperature variance).
- Clever use of system can reduce cost when using off-peak power
- The future: Surplus of energy can be used for transport.

Step 4
Insulation

- Ensure that the insulation is designed to be continuous
- Down lights and ceiling fans can cause significant performance issues with insulated roofs
- Choose a material that doesn't compress or sag over time
- Ensure that
  installed co

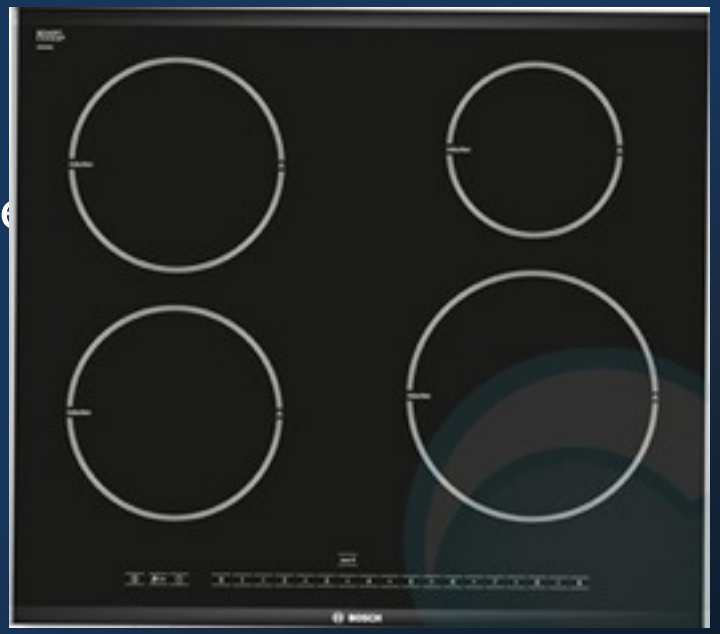
Step 5
Heat Pump for hot water

- *75% lower running cost than electric HWS*
- *Zero emissions*
- *CO2 refrigerant*
- *15 year design life*
- *Runs on solar power from PV panels*
- *Operates to -20 deg C!*



Step 6
Induction cooktop

- Safer for children
- Easier to clean
- Can run from solar PV and batteries
- No CO2 emissions within the home
- Better control over cooking temperature
- Low risk of fire compared to gas



Step 7
Reverse cycle air conditioning

- Efficient
- Can use PV or battery power
- No harmful emissions within the home
- Can be controlled “pre-emptively” to pre-cool or pre-warm the BioPCM
- Easy to maintain
- Available in many sizes
- Split or ducted versions
- Only small, lower cost single phase units are normally recommended due to the other efficient design elements as above

Step 8
LED lighting

- Efficient
- Can use PV or battery power
- Long life
- Available in many sizes
- Very lower power consumption

Step 9
Timber floors

- Fast to build
- Easy to insulate
- Easy to run services through
- Less trades on site
- Can make a floor stiffer than concrete
- Lower CO2 footprint
- Easier to build on sloping blocks
- More comfortable to walk on

Step 10
Double glazing

- Reduces heat loss and heat gain
- Use blinds on the outside to control the unwanted heat gains in summer
- Best to choose a thermally broken frame
- Consider the long term maintenance and reliability of the system
- Choose a good brand

Step 11
Bring it all together

- Consider the entire home as one system
- Each element works in with another
- Centralise the control
- Automate where possible
- Always look for the latest method as these often have a flow on effect to other costs

	New	Current
Footings	Bore holes, stumps	Strip footings, concrete slabs
Floor	LVL (laminated veneer lumber) + chipboard	Concrete slab, can be more costly and huge CO2 footprint (60 yrs)
Walls	Light weight cladding + pine + insulation + BioPCM + plaster	Brick veneer + pine + insulation + plaster
Ceiling	Plaster + pine + BioPCM + insulation	Plaster + pine + insulation
Insulation	Complete seal – no down lights	Sealed with interruptions by down lights, etc.
Lighting	LED, surface, pendant and wall - non down light	Halogen down lights cutting through the insulation
Heat	Small reverse cycle A/C for occasional use	Gas heating
Cool	Small reverse cycle A/C for occasional use	Large reverse cycle air conditioner
Roof	Colour bond with large numbers of solar panels	Tile or colour bond
Solar PV	Full roof	Small optional system
Transport	Light weight	Heavy weight
Speed	Less trades to coordinate	Built on site, subject to weather and other interruptions
Safety	Less mass	More mass, more injury risk in construction
Windows	E glaze / double glaze	Single glaze

Benefits new design

Benefits for builder:

- *Cheaper*
- *Faster*
- *More homes per year*

Benefits for owner:

- *Significant lower running costs*
- *Net exporter of electricity to "undo the energy to construct"*
- *Control your own destiny, no more power monopoly!*

Summary

We can now build

- *Better*
- *For less cost*
- *Faster*
- *With less global resources used*
- *With far greater comfort*
- *While we export spare power*
- *While we charge our electric cars*
- *And grow our hydroponic gardens*

- *And start to undo climate change, one house at a time*

It all starts now…..