



ZERO CARBON HOMES

energy production and storage



Living in a Zero Carbon Home

"I am a professor of Electrical Engineering at the University of Sheffield. Some of the things I'm working on are using batteries recycled from electric vehicles for energy storage in homes, testing large scale residential electricity storage, improving battery reliability in electric vehicles."

Even when you produce your own electricity you still import some energy from the grid, because you can't always use the energy you produce all the time.



≈ 30%
grid independence

Energy is exported and imported from the grid depending on the demand and the rate of production. Therefore homes are more dependent on the grid.



≈ 70%
grid independence

No energy is exported to the grid. Energy is only imported from the grid when the battery is empty. Therefore homes are less dependent on the grid.

Why is Energy Storage Important?

Over a year, a home PV installation could generate more electricity than is needed. Energy storage does two things. Firstly, it allows the home to use more of its own renewable generated electricity. Secondly, it prevents the risk of the grid getting overloaded at times of peak renewable generation.

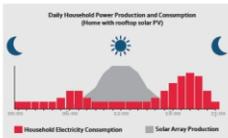
Smart Housing

The house could be "smart" enough to store or not electricity depending on whether grid electricity is more or less expensive relative to what is generated by the house. Individual homes could automatically buy and sell electricity to suit their needs.

Energy Storage in the future

For Stockbridge and the rest of the UK, electricity storage will not be a disruptive addition to the infrastructural fabric of the country. It will be underpinned and hands off but could change the ways how we use electricity.

It will be more than just using as much as possible of the energy that we generate but it will help out to keep healthy the electricity distribution network that provided electricity to all of us when there is nothing else left.



The future of Stockbridge in 2024?



How to finance Energy Storage?

At the moment, in the UK there are no financial incentives for battery storage. For a home, the price of batteries can significantly add to the cost of a PV system and their lifetime is much shorter than the PV panels on the roof (replacing every 8-10 years). Researchers are working hard to reduce the cost and increase the lifetime of battery storage.

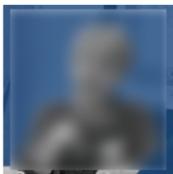
+ 20-40%

cost to install a battery storage system in combination with PV



ELECTRICITY FROM WIND POWER

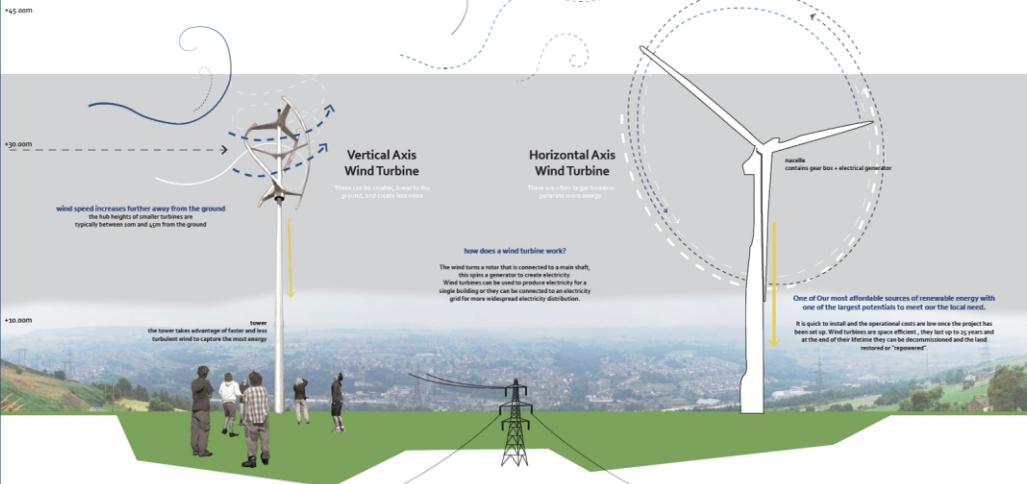
what is the wind potential in Stocksbridge?



Wind power in Stocksbridge

"The wind is free and we have a lot of it in our valley. It makes all the sense in the world to harness it, it has been done for a thousand years. Future energy generation needs to be a mixture from many sources. Every time I pass through West Yorkshire, I see more and more domestic wind turbines in our highly scenic valleys."

Whether to erect commercial wind turbines in our valley seems to me to be a separate matter. The question is 'who has the right to alter our skyline (country-side) greenbelt for their own profit?' No conditions need be set that if the turbines was supported and owned by the community that example to pay for the energy needs of our Sports Centre or perhaps to generate electricity for its residents, then it should go ahead."



Types of Ownership Where does the money go?



farmers?

Farmers sign a land rental agreement, a wind power company takes care of the installation and the land owners earn land rental income.



the community?

The community can purchase land to develop a shared ownership wind farm that would generate electricity to be used locally. This could significantly contribute to the demands of buildings such as the Leisure Centre.



individual homes

Micro wind turbines can help to reduce your energy demand from the grid. This can either be sold back to the grid or stored onsite in batteries.

CASE STUDY

Baywind Energy Co-operative Cumbria

www.baywind.co.uk/baywind_home.asp

1996 - 1997 £25 million raised to buy two 1.5 MW turbines at Herby Hill wind farm near Sillotham.

1998 - 1999 £170,000 raised to buy one 600kW turbine at the Herby Hill wind farm near Sillotham.

The co-op was formed in 1996 by 2 directors, it has now grown to 1,300 shareholders in the UK and abroad. Preference is given to local people 30% of existing Baywind shareholders live within Cumbria or Lancashire with a wider number from the Northwest Region. Every member receives a yearly share interest based on the profits earned from electricity generation during the year.





STOCKSBRIDGE BY TRAIN

What options does Stocksbridge have for more sustainable transport?



**Stocksbridge to Sheffield in eleven minutes.
That's the plan.**

"Using the existing track linking Stocksbridge with Sheffield Victoria Station, just one vehicle could provide passengers with a regular, half hourly train service.

Despite research suggesting that there is substantial local demand for one, there hasn't been a regular passenger service along the Don Valley line since the late 1990s. The Don Valley Railway is a local campaign group committed to seeing the reinstatement of a regular, reliable and convenient commuter rail service along this underserved line."

**A Light rail or light rail transit (LRT) between
Stocksbridge and Sheffield**



- Sustainable travel choice
- Improved accessibility to Sheffield
- Potential improvements to steel freight operations.
- Reduced air pollution. Lower carbon footprint.
- Improved access from the Sheffield conurbation to the North East Peak District
- Reduced need for subsidy of public transport in the Upper Don Valley
- Stocksbridge to Sheffield City Centre in eleven minutes.
- Trialling LRT technology could establish Sheffield as a centre of excellence for trialling commuter rail technology.

In association with:



**A SITE FOR THE FUTURE
STATION**

Chris Bell has identified the potential location for a station within Stocksbridge. He suggests the St. Matthew Church on Manchester Road a good location and land to the rear of the church has previously been allocated for a station.

The church is a very large, Victorian building which needs more maintenance. The congregation has declined over the last 20 years and now the church is struggling to reach our financial requirements.

"Faced with the increasing costs of running such a large, historic building, the Parochial Church Council has been looking at options as to how the building can be used both by the church and the community."

- A Deacon of St Matthew's

Chris suggests the combination of the Church and a Station should be explored. Further review could be done by looking into setting up a station shop.



St Matthew Church, Stocksbridge

COST ESTIMATION

The cost is estimated at £4.3 million pounds - a staggering reduction on previous estimates. This reduction was achieved because a track inspection identified the good condition of the existing track.

It may be possible to reduce the cost below the £4.3 million price tag - not least because coverings include approved base (asphalt) that have to be added to off-art cost risks involved in development.





ELECTRICITY FROM THE SUN

Photovoltaic panels on your home

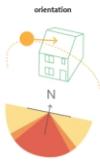


Living with PV Panels in Stocksbriidge

Some people with PV panels adjust their lifestyle to ensure they use as much of the energy they generate as possible. For example using their washing machines in the middle of the day when the PV panels are at the highest energy generation rate. Once installed there are a 'fit and forget' technology. Although the initial costs can be high, they are low maintenance and some can last for over 25 years!

The requirements of PV panels

Even if your roof is not the perfect orientation or pitch you can still generate a sizable amount of energy



the ideal orientation is a roof facing 90°-140° of due south

pitch



Effect of orientation + pitch on array performance - South Yorkshire

energy per year kWh/m ² /day peak	30°	45°	60°	75°
South Coast	107	100	92	84
North	107	100	92	84
South West	107	100	92	84
West	107	100	92	84

ref: www.microgen-database.org.uk

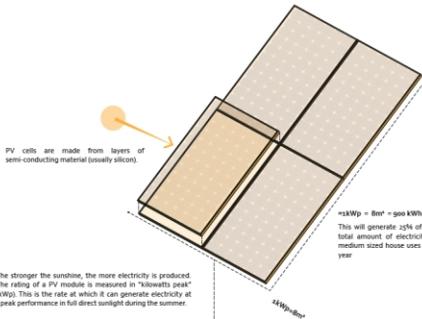
exposure



Any shade, such as from trees or neighbouring buildings, can have a large impact on the performance of a PV system



How does a solar panel work?



PV cells are made from layers of semi-conducting material (usually silicon).

The stronger the sunshine, the more electricity is produced. The rating of a PV module is measured in "kilowatts peak" (kWp). This is the rate at which it can generate electricity at peak performance in full direct sunlight during the summer.

1kWp = 8hr = 800 kWh
This will generate 25% of the total amount of electricity a medium sized house uses in a year

A 4kWp PV array will generate the same amount of electricity as medium sized house consumes in a year

Under the Government's "Feed-in-Tariff" you can get paid for all the units that you generate (even if these are used onsite)

Groups of cells are mounted together in panels or modules that can be mounted on your roof. Most PV systems are made up of panels that fit on top of an existing roof, but you can also fit solar tiles instead of standard roof tiles.

The size of a 4kWp array



Installation of a PV panel

Check the orientation, exposure and pitch of your roof, this will affect the payback time. Any roof should be structurally surveyed to ensure PV panels can be fitted. The cost of installation is increased for slate/clay tiles rather than concrete tiles because more tiles need to be removed to lay the stainless steel roof hooks and re flash it.



SUSTAINABLE LEISURE CENTRE

how can the leisure centre be more environmentally + economically sustainable

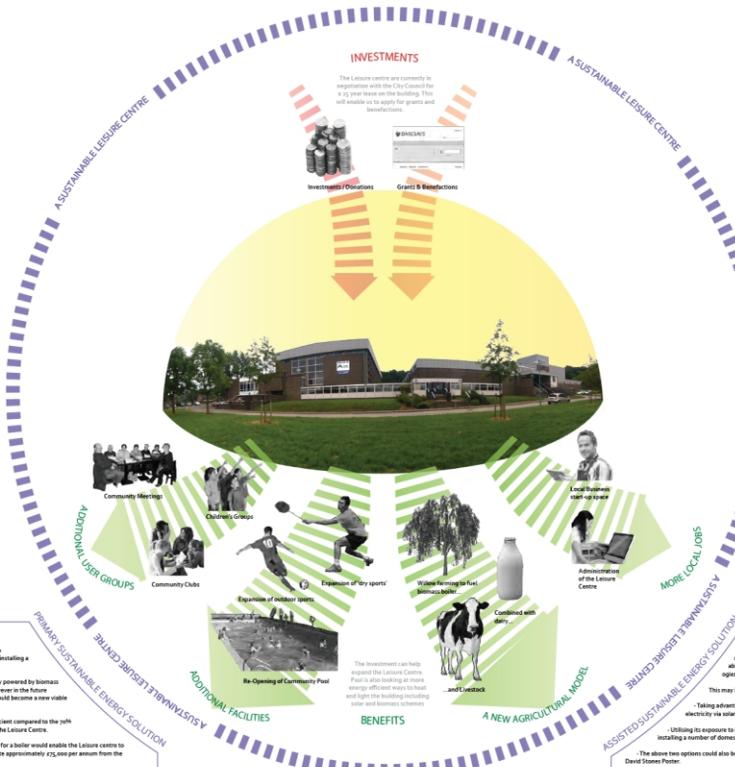


How to power the Leisure Centre

In January 2013 Sheffield City Council announced that, due to budget cuts, it intended to close Stocksbridge Leisure Centre and Swimming Bath. The centre was closed for almost three months during the summer of 2013 during which over a huge group of volunteers set about refurbishing the centre. Money was raised by the council and raised in the community, local firms donated supplies and individuals undertook over 2000 hours of voluntary work.

The dry sports facilities was open to groups from September 2013 with a full public opening in January 2014. The pool remains closed until sufficient funds can be raised to carry out the necessary repairs and refurbishment.

The long term goal for the Leisure Centre to be fully operational and powered sustainably.



A New Biomass Boiler

In order to make the Leisure Centre Sustainable, Paul has investigated installing a new Biomass Boiler.

A Biomass boiler would be initially powered by biomass pellets imported from abroad, however in the future Farming yellow or producing hay could become a new viable farming model.

A new biomass boiler is 90% efficient compared to the 70% efficiency of the existing boiler at the Leisure Centre.

An initial investment of £200,000 for a boiler would enable the Leisure centre to heat 100% sustainably and generate approximately £75,000 per annum from the Renewable Heat Incentive (RHI).



WHAT IS RENEWABLE HEAT INCENTIVE (RHI)

The RHI pays participants of the scheme that generate and use renewable energy to heat their buildings. By increasing the generation of heat from renewable energy sources (instead of fossil fuels), the RHI helps the UK reduce greenhouse gas emissions and meet targets for reducing the effects of climate change.

There are two parts to the RHI:

- Domestic RHI - open to homeowners, private landlords, social landlords and self builders
- Non-domestic RHI - provide payments to industry, businesses and public sector organisations (This would apply to the boiler for the Leisure Centre)



Assisted Energy Solutions

As the leisure centre grows and achieves more revenue, it can further realise its sustainable vision by implementing sustainable technologies.

This may include:

Taking advantage of the large flat roofs in order to generate electricity via solar panels.

Utilising its exposure to high wind speeds and generate electricity by installing a number of domestic wind turbines.

The above two options could also be combined with a Battery as mentioned in David Storer Poster.

The combination of a Biomass Boiler and these technologies which generate electricity could help achieve the Leisure Centre's goal of becoming completely sustainable.





THE INMAN INITIATIVE

a brighter future for a beloved building



Progressing the Inman Centre

"Since the 60's the Inman Pavilion has been a much loved community hall and it still is, but it's showing its age a little now. It is structurally sound but leaks energy. It has plenty of space but it needs a little reorganisation to make it more useful for the different groups. Now it has a committee of people representing all the groups using it and the aim is to make the Pavilion a flexible, energy-efficient building sustainable for the next 30 years or so!"



Timeline of the Inman Pavilion



The future sustainable vision - their is more to come!

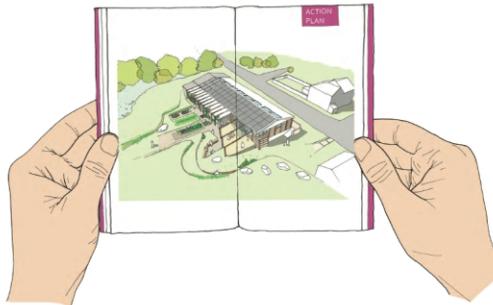
It's a big job. But in October and November 2012, the Inman had ideas help from a Sheffield University Student Live Project. Architecture students worked in consultation with different Inman users to vision the future of the Pavilion.

The Inman committee has been given a comprehensive document with suggestions for optimising space, improving insulation, for alternative sources of heating, community gardens and more. The document can be viewed at the Library.

How the Inman committee is recruiting volunteers to work with the most pressing.

Now is the time to add your ideas!

Are you knowledgeable in building surveys, cladding or planning policy? We would love for you to join our team





RECOVERING HEAT FROM TATA STEEL

From waste to a resource: What to do with the waste heat from the steelworks?



Can Tata's waste heat be harnessed?

If the waste heat is going to be released into the environment, why not use this as a resource instead?

"Imagine converting something that is considered waste by the steel industry into a resource that could be used by the town of Stocksbridge. Laying down the heat streamer water distribution network would not be cheap and may be disruptive during the time of construction but Stocksbridge would not be the first town to do it. Centralised heat generation district heating is widely deployed in some continental European cities as well as in the city centre in Sheffield. If this scheme is feasible, the first sites to be connected would be those buildings with the highest demand for heating such as public buildings, community centres and schools."

The steelworks generate a great deal of waste heat from its industrial process:

Who are the potential users?

The first users would be the biggest consumers of energy for heating within the community such as community areas, commercial establishments and public buildings. The network could later be extended for all interested residents. Central heat could later be sent towards Sheffield and other communities.

A potential first user district heating pipe is shown on the Stocksbridge Valley model.

Heat from underground pipes

District heating is distributed via underground pipes

Heat from industrial ducts

By harnessing wasted heat from Steel works, Stocksbridge will be significantly lowering its carbon footprint

Where are nearby examples of district heating networks?

Sheffield has a well developed heating network that connects major buildings in the city centre area but for a source that generates heat and electricity by burning oil. However, there are close links between the heating network is developed to an extent that it provided heat to commercial sites as well as over 30,000 residential or jobs of the city total.

The amount of waste heat that the steel works generates could cover the heating needs of:



x 125

the heating demand of 2000 local homes within Stocksbridge

OR



the equivalent demand of 10 Stocksbridge Leisure Centres combined

OR



around half the domestic gas demand of Stocksbridge

for 1/2 of Stocksbridge

POSSIBLE BENEFICIARIES:

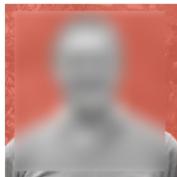
- Leisure Centre
- Stocksbridge High School
- St Anne's Catholic Primary School
- Stocksbridge Junior School
- The Co-Operative Food
- Stocksbridge Town Council
- Stocksbridge Library
- and more....

* calculations based on the equivalent of 6 tonnes of steam were produced every hour



GROUND HEATING

Heating your home from the mines



Developing heat from the mines in Stocksbridge

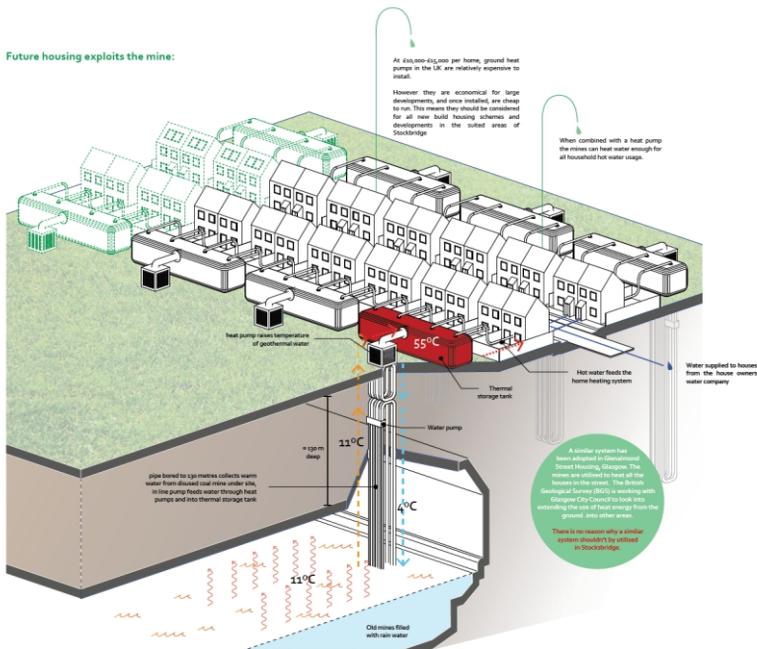
"The huge amounts of water now held in the shafts and tunnels beneath Stocksbridge can be tapped into. Heat pumps which work in much the same way as fridges, can be used to 'upgrade' heat energy from lower temperature waters in the mines to make water hot enough to heat buildings."

David Banks, a geologist consulted from Derbyshire stated that other British use of ground heat technology still lagged behind Germany and Sweden, interest is growing. There are now around 20,000 heat pumps installed in the UK compared with only nine in 1999.

The sort of technology mines on awareness being raised and this is precisely what we want to do in Stocksbridge.

For this type of technology to be successful in Stocksbridge it will also rely on government backing through such planning measures to force house builders to include such a system in their plans (rather than a cheaper add-on).

Future housing exploits the mine:



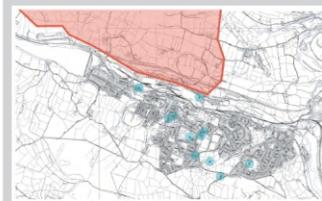
CASE STUDY

Glensalmond Street Housing Glasgow

<http://www.saxt.org.uk/glensalmond.pdf>

In Glensalmond Street, the heat from the mines below is used to heat a thermal store which provides hot water for all the houses in the street. This new source of energy could help Glasgow to meet government targets to ensure a per cent of heat demand comes from renewable sources by 2020. One of the systems sustainability, it also considered reduced the resident heating bill.

"Seventeen flats in Glensalmond Street, in the east end of Glasgow, have been using thermal power for the past 24 years, cutting heating bills from around £100 for a three-bedroom flat to just £20 a year"



LOCAL MINE SHAFTS WHICH COULD POTENTIALLY BE UTILISED

to Blue: Small communal mine shaft

to Red: Large mine void under the valley



HOW CAN STOCKSBRIDGE BECOME MORE ENERGY INDEPENDENT FROM THE GRID

a comparison of different local strategies for the future



Energy independence in Stocksbridge

"I am an PhD student in the Physics department at the University of Sheffield, researching energy independence and sustainability. Combining different sources of energy, particularly solar and wind, can give an energy supply that more accurately meets the needs of people in their homes. What kind of energy mix would best supply the community, and what difference can energy storage make to these options?"

It is very difficult to get full energy independence from the grid, but the more energy Stocksbridge can produce and store for itself the closer it will get.

OPTION 1

how can Stocksbridge generate its own electricity?

what is the percentage of Stocksbridge's electricity use that is met locally?

energy payback time?


Based on a 280W PV array
+ 50% homes have a PV roof


27%
electricity use is met locally


3.7 years
payback time

OPTION 2


+ 15000W¹ PV farm
approximately 3.5 football pitches


Based on a 280W PV array
50% homes have a PV roof
+ 2 community solar fields
+ a community wind farm


+ 100 kW wind turbines
x 3

34%
electricity use is met locally
+ 30 kWh battery storage in every home
47%
electricity use is met locally

3.8 years
payback time
+ 30 kWh battery storage in every home
4.6 years
payback time

OPTION 3


+ 15000W¹ PV farm
approximately 3.5 football pitches


+ 500 kW wind turbines
x 10

Based on a 280W PV array
50% homes have a PV roof
+ 2 community solar fields
+ a LARGE community wind farm

59%
electricity use is met locally
+ 30 kWh battery storage in every home
75%
electricity use is met locally

2.8 years
payback time
+ 30 kWh battery storage in every home
3.4 years
payback time

OPTION 4


+ 15000W¹ PV farm
approximately 3.5 football pitches


+ 500 kW wind turbines
x 10

Based on a 280W PV array
50% homes have a PV roof
+ 2 community solar fields
+ a LARGE community wind farm
+ pumped hydro-electric storage


+ 130 MWh pumped hydro storage capacity

79%
electricity use is met locally
+ 30 kWh battery storage in every home
81%
electricity use is met locally

2.2 years
payback time
+ 30 kWh battery storage in every home
3.3 years
payback time



WHAT IS BIOMASS?

heating your home with wood



Biomass in Stocksbridge

It is a huge topic, so we are lucky to have a supply of waste wood that doesn't cost us anything. We do have to get it from a lot of different people, so we need to make sure that we are getting the most out of it. We also have to make sure the wood is dry, for this reason it is an economic option for us. For someone without this option it would be the same cost as buying any other fuel.

Do not underestimate the amount of effort that is involved in processing your own wood for fuel. It is very hard work and there is no smaller price to be paid. If you are at all of all you will come home to a cold house on the heating will not do it. It takes a couple of hours to get warm on cold days, to get warm for long days, to get warm for long days, we did not want any back up heating. If the heating were not that back up electricity solution is a option. In the summer we also had the water using a cooling water heating panel.

For safety, not utility bill you cannot avoid electricity and gas for gas.*

