Detailed technical information: Civic Centre 3 – Energy from the Sun and the Wind

PROJECT SUMMARY

This case study provides an overview of an initiative to install on the roof of Civic Centre 3, a Council office building in Huddersfield town centre, a large array (143m^2) of solar photo-voltaic panels and two 6kW wind turbines to generate electricity and a set of solar energy collectors (48m^2) to heat the building's water.

Civic Centre 3 is in a busy area of the town centre and is surrounded by the town's ring road, a shopping area and public buildings. Each week more than 1350 people visit the building, including planning and architectural professionals, council officials and the general public.

The turbines are intended to be a clear corporate statement by Kirklees Council showing in practical terms how it is taking action to address climate change. Local surveys and feedback shows very strongly that the public would like to see Kirklees Council 'leading by example' in terms of practical energy measures and 76% of residents in Kirklees Council's citizen panel - 'Talkback' - think that the Council should require developers to install renewable energy in new buildings.

The turbines at Civic 3 are the first roof mounted wind turbines on a local authority building in the UK. The whole demonstration project is part of a European-funded project called 'ZEN' (Zero Emissions Neighbourhoods), with partners in the UK (Kirklees, Sutton and Southwark), Italy and Greece.

Providing all the electrical power needs for Civic Centre III creates 188 tonnes of carbon dioxide each year – the renewable energy installations will save 23.96 tonnes of carbon dioxide every year.

The whole demonstration project will inform the delivery of a new corporate renewable energy policy which aims to install 30% renewable generation on all new buildings and large-scale extensions by 2010/11 that the Council procures. This policy has begun with a 10% target in April 2006.

PROJECT AIMS

The project aimed to:

- Raise awareness of climate change and renewable energy technology within the Kirklees community and beyond.
- Supply the building with power from renewable energy sources, which will contribute to reaching a target of meeting 20% of the Kirklees district's energy demand from renewable sources by 2020.
- Increase capacity in the Council and the Kirklees district to deliver large scale renewable energy initiatives and show the Council's leadership role with regard to installing renewable energy.
- Make a significant reduction in climate change emissions (over 23 (23.96) tonnes of carbon dioxide per year).
- Reduce the consumption of electricity from the grid and promote more efficient use of energy in the building. The solar and wind installations will provide around 10.7% of electricity needs and 50-60% of the building's hot water needs.
- Inform the delivery of a new corporate renewable energy policy which aims to install 30% renewable generation on all new buildings and large-scale extensions by 2010/11 that the Council procures, by acting as a demonstration of the combination and variety of renewable energy technologies which can be employed in one building.

WHO WAS INVOLVED?

Project management

This initiative was led by Kirklees Council's Environment Unit, who obtained funding for the project and ensured overall project delivery.

The technical project management, including supervision of the installations was undertaken by Design & Property Services.

The Council's Framework for Successful Project Management was followed in conjunction with the standard capital project management processes employed by the Council's Design & Property Services.

Installers

Solar electricity panels and wind turbines:

Sustainable Energy Installations (SEI)/It Power
Direct Tel: +44 (0)1256 392739
IT Power Ltd.
Grove House, Lutyens Close
Chineham, RG24 8AG, UK
Tel: +44 1256 392 700
Fax: +44 1256 392 701
http://www.itpower.co.uk

Solar thermal:

Riomay Pty Ltd
1 Birch Road
Eastbourne
East Sussex
BN23 6PL
Tel: (01323) 648641
Fax: (01323) 720682
e mail: tonybook@pavilion.co.uk
http://www.riomay.com/

BACKGROUND

The demonstration project was part of a European-funded project Kirklees participated in with other local authorities from the UK (Sutton and Southwark Councils), Italy (Brescia and Palermo) and Greece (Amaroussion) called Zero Emissions Neighbourhoods (ZEN). The key objectives of the ZEN project were to:

1. Develop and test the concept of a Neighbourhood (District) Energy Plan.
2. Identify and overcome the specific technical and socio-economic barriers to renewable energy and energy efficiency that can be best addressed at district level
3. Identify the opportunities and constraints regarding the installation on one building of different combinations of renewable energy systems especially in retrofit
4. Identify opportunities for joint/common procurement

An Energy Plan was developed for the Kirklees district and 'tested' through implementation of a practical demonstration project on Civic Centre 3. The lessons learned from the Civic Centre 3 project have been incorporated into the further development of Kirklees' Energy Plan and the 'ZEN process' has also inspired several renewable energy policies:

- A corporate policy of 30% of energy for Council's new buildings to be generated from onsite renewable energy systems, by 2010/11.
- Draft district targets for percentage renewable energy generation in buildings in the LDF and draft Environment Vision 2025, specifically

renewable energy to provide at least 10% of energy needs by 2010, 15% by 2015 and 20% by 2020.

The ZEN project was funded through the European Commission's 5th RTD Framework Programme. The project commenced in January 2003 and was completed in March 2005.

FUNDING

This project has brought a significant amount of money (more than £80,000) into the Kirklees community, from the European Commission and UK Government ClearSkies. The funding breakdown is as follows:

	Solar PV	**Solar Thermal**	**Wind**
Total cost (£,000s)	98	40	101
Funding:			
EU ZEN programme	35	14	
Yorkshire Forward/DTI ClearSkies Programme			31
KMC Renewable Energy Fund	63	26	70

COSTS

Cost Breakdown			
	Solar PV	Wind turbines	Solar thermal
Total system cost (£,000s)	98	101	40
Equipment	68	53	27
Installation	15	21	13
Project Management	15	13	-

Other – Part L roofing works	-	14	-
£/kW	8,500	5,600	-

It is worth noting that for the wind turbine project, additional roofing works (thermal insulation) required to meet Part L Regulations comprised a considerable portion of project costs (£15k). Project management for all projects cost between 11-15% of the total project cost.

TIME FRAMES

2003 ZEN project commenced
2004 Planning permission obtained for wind, solar PV and thermal
2005 Solar PV and thermal installed. Further work on wind turbines for Building Control process. ZEN project completed.
2006 Wind turbines installed

MEASURING SUCCESS

- **Environmental**: the project will save more than 23 tonnes of carbon dioxide every year. It has led to strengthened policies regarding renewable energy both in corporate policy and the Local Development Framework.

- **Technical**: the systems' performance is being monitored via a digital display read-out located in Civic 3 foyer.

- **Sharing experience**: the project has provided many opportunities for Kirklees to develop and refine their understanding of project management issues relating to renewable energy capital projects through providing staff training on renewable energy to sharing the lessons learned with colleagues through regional and national networks.

BUILDING TYPE

Civic Centre 3 is a three storey municipal office building (5433m^2 floor area) constructed in 1976. The Centre's main fuel sources are gas which is utilised for space heating and electricity for lighting, IT equipment and heating and ventilation plant. There are around 420 occupants, who use the building around 249 hours per month.

BUILDING ENERGY DEMAND

Annual energy demand Civic Centre 3 building (based on the 03/04 annual energy report):

Electricity	437,505 kWh
Gas	664,777 kWh
Water	3250 m3

Several energy efficiency measures have been installed including automatic lighting controls to offices, kitchen areas & meeting rooms. The measures were funded through the Council's CWI (Energy & Water Conservation) Fund.

TYPE OF RENEWABLE ENERGY (MICROGENERATION) INSTALLED

48m2 solar thermal systems installed in February 2005

17.6kWp Solar PV installed in February 2005

Two 6kW wind turbines installed in May 2006

ESTIMATED SYSTEM PERFORMANCE

Technology	Solar PV	Wind	Solar thermal
Installed capacity (kW)	17.6	12	48m^2
Estimated generation	13,200	33,800	25,200
% of building's energy produced	3% of electricity	7.7% of electricity	50-60% hot water
Carbon dioxide saved per year	4.64	14.53	4.79

The wind speeds for the area were calculated using the NOABL computer model wind speed reading, based on the post code HD1 2EF (the nearest available data point). The reading is 5.2m/s annual average at a height of 25m above ground level.

This does not take into account any obstructions such as trees or buildings, however it is expected that there would be little turbulence effects as the

turbines will be situated on 9m masts and therefore significantly higher than the surrounding buildings and trees.

The turbines would begin to produce power in winds of 2.5m/s or above and reach their rated output of 6kW in winds of 12m/s and above.

PERFORMANCE MONITORING

The systems' performance is being monitored via a digital display read-out located in Civic 3 foyer.

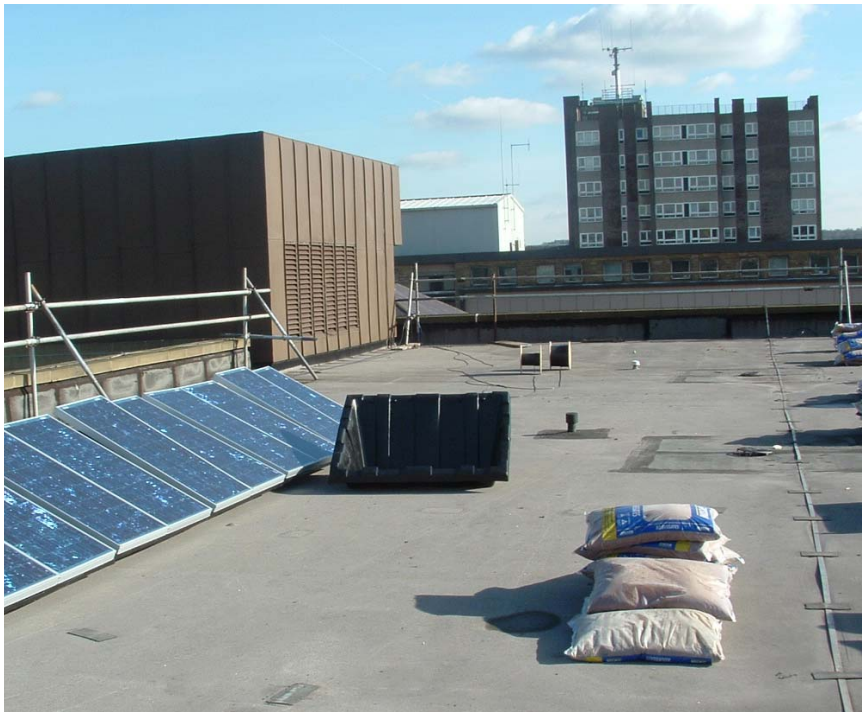
In future all systems will be monitored via an automated monitoring system integrated with the Council's overall Building Energy Management System. The monitoring system would be comply with metering requirements to obtain Renewables Obligation Certificates (ROCs) and/or sell back any surplus electricity generated to the national grid.

SYSTEM DETAIL

Solar PV

Installed capacity	17.6 kWp
Module type:	BP solar, BP380, 80Wp, 220 installed, polycrystalline silicon, construction: high transmissivity, low-iron 3mm tempered glass & ethylene vinyl acetate (EVA)
Array area	143m^2
Structural integration:	Mounting system: Clear anodised aluminium frame on the modules installed on Econergy Console 4.2, 110 installed (2 modules per console).
Inverter	Fronius manufacturer. Model IG40 and IG60.
Mains connection	Main connection: Three phase. Protection: Integrated in inverter. Additional protection via mains decoupling device (G59/1 relay). Engineering

	recommendation: G83/1 and G59/1 apply.
Warranty	PV modules: materials and workmanship - 5 years. Installation: 2 years



Solar PV 'ConSole' mounting system – the container is filled with ballast to ensure it stays on the roof. The console containers on the periphery of the system were also glued to the roof.

Solar thermal

System size	48m^2
Collector type	16xMP6-3000 "Suntube" solar collectors Nippon Electric Glass (NEG)
Structural integration	Mounting frame
Storage system	Single coil pressurized cylinder 2700 litres (n.b. thus may now be double coil).

Pump	Grundfos UPS pumps.
Warranty	Suntube 10 yr warranty, Cylinder 5 yr warranty.

Wind turbines

Installed capacity	12kWp (two 6kWp)
Turbine type	6kWp Proven WT6000 The blades and turbine head are black and the tower is grey
Turbine size	5.6m diameter blades, mounted on 9.7m steel towers.
Structural integration:	Steel frame which is mounted on to the roof via roof mounting pads
Inverter	Four 3kW WindyBoy (SMA)
Mains connection	Connected through the same G59 installed for the PV
Warranty	2 years parts and installation

Wind turbine roof mounting system

PLANNING

There were relatively few objections. The objections received were regarding perceived impacts on staff from the wind turbines due to noise and vibration and potential impacts on birdlife. These were addressed through the staff and community consultation process and the planning process.

BUILDING CONTROL

The installations were granted planning permission with some building control conditions relating to structural integration in particular:

- Plans, details and calculations for the wind turbine roof mounting system to address the increased stress on the building and any vibration effects.
- Full structural survey regarding loading with regard to the additional weight of the solar PV mounting system.

A bespoke mounting frame was designed which absorbs the high frequency vibrations from the turbines and prevents them from being transferred to the fabric of the building.

An external structural engineering firm (Structures 1) was engaged to provide this information to Building Control. Building Control approval was subsequently granted.

The structural engineering consultant was commissioned to investigate whether there will be any impact of the lower frequencies to the building or the Building Users. Whilst this information was not required for Building Control, it was necessary from a Health and Safety perspective to ensure that there will be minimal or no impact.

OTHER REGULATIONS – PART L AND WORK AT HEIGHT

Additional works were required due to new regulations - Part L and Work at Height including:

- Part L – thermal insulation on the roof area to be covered by the turbine mounting frame.
- Work at Height – temporary edge protection due to the building parapet not being a sufficient height. Permanent edge protection or a mansafe system will be introduced in future.

Thermal insulation prior to installation of wind turbine mounting frame

Temporary edge protection (scaffolding poles)

CONSULTATION AND AWARENESS RAISING

In addition to consultation required for the Planning process, a comprehensive community consultation and awareness raising programme was undertaken which included:

1. Building Users

Presentations about the project were given to the Civic 3 Building Users Group and their feedback was obtained on issues and concerns. A drop-in information day was then held for all Building Users at which information was made available about the project on posters, information leaflets and face to face discussion.

The response from Building Users was positive, with some colleagues commenting that 'once we've finished this small project we can put turbines

on lots of other buildings!". The Building User Group gave their support for the project.

There was some reassuring to be done with regard to the roof mounted systems, with regard to structural integrity and health & safety. This was done through communicating information provided from the structural surveys to building users and relevant staff. The wind turbines raised the most questions with regard to their installation, as roof mounted systems are a relatively new concept and wind turbines are not often found within an urban environment.

2. Local Residents and Community Groups

The surrounding communities were informed about the project through a letter drop and posters in shops and local buildings.

3. Wider Kirklees community

The building receives many visitors from a diverse range of backgrounds every day. The wind turbines are in a visible location, thus inspiring discussions around climate change and renewable energy across a wide cross section of the community. The display in the reception area of the building and external displays will continue to raise awareness in the wider community into the future.

MINIMISING RISKS & DISRUPTION TO BUILDING USERS

The typical risks during construction, including lifting & placement of materials, working at height, adequate protection of the works, building users & public have been addressed through a risk assessment carried out by the technical project manager (Design & Property Services). In addition, the risks or concerns identified by building users through the consultation process were added to this assessment.

The project risk log was a very useful tool for communication with building users, in order to record and respond to any concerns. Due to the tightened

Work at Height Regulations, an additional (more detailed) roof access risk assessment was also required.

The technical project manager (Design & Property Services) ensured that the contractor complied with Construction Design Management and Health and Safety regulations and completed the installation risk log.

Installation Period
All efforts were made to ensure any disruption to building users or the general public was minimised during installation. This was done through arranging where possible deliveries outside working hours, ensuring security / access arrangements are confirmed, adequate supervision of contractors and that information about the installation was provided in a timely manner.

MAINTENANCE

The long-term maintenance arrangement for all systems is being finalised. In the short-term (during the warranty) period the installers will be responsible for any maintenance required. In future, a corporate maintenance plan is being developed for all renewable energy systems installed across the Council. This plan will be linked to the Council's asset management strategy and funds for maintenance will come from the Council's overall capital repairs and maintenance budget.

This required suppliers to provide relevant operation and maintenance information and to train relevant Council staff (such as caretakers) on how to undertake operation checks and maintenance. It was necessary to purchase some equipment for this purpose, such as a winch to lower the wind turbines.

ACHIEVEMENTS

- The wind turbines are the first wind turbines installed on a local authority building in the UK.
- This work has also already inspired several more projects throughout the municipality, which are in the planning stages.
- The project has benefited from strong Councillor support, which has assisted greatly in obtaining funding and Council approval.
- Local jobs have been created and local skills increased. This includes training a local wind turbine installers and increasing skills within the Council.
- More than £80,000 in external funds has been brought into the Kirklees community.
- The project has attracted national attention as a result of a visit from Elliot Morley (former Minister for the Environment and Climate Change) as part of a tour of best practice sustainable development initiatives in West Yorkshire.
- This project has built capacity in the Council in project management in other areas of Council (such as Education and Housing) likely to

implement renewables projects in future. This has been done through involving staff in meetings, training sessions, site visits and discussions so that the 'know-how' for renewables project management is spread across the Council.

LESSONS LEARNED

Project step	**Comments**
Initiation	
Feasibility	Undertake an overall renewables feasibility study for the site
Project meetings	Regular project meetings are important
Consultation & communication	Develop a communication plan for the project. Ensure the technical project manager is aware of the communication plan so they can provide timely information about critical project times e.g. when the turbines will be raised to link with release of press releases.
Roof integration	Turbine contractor to liaise with roofers, electrical engineers and any other parties to ensure smooth integration of turbines to roof and that any warranties remain valid. Main contractor (architect) or technical project manager to facilitate and be responsible for/oversee this process.
Funding	
Grant eligibility	Grants for renewables are now looking for evidence of energy efficiency work undertaken
Grant funding deadlines	Ensure all parties are committed to grant timeframe deadlines. This is particularly important when managing multiple funds.
Approvals	
Planning	Include letters of support obtained for grant funding with planning application. Conduct community consultation/awareness raising before planning notices are posted. Allow additional time for Building Control to check roof mounting system for roof mounted wind turbine projects and loadings/structural integration for solar PV/thermal projects.
Landlord's permission	Obtain landlord's permission to install the systems (the landlord may not be the Council).
Environmental compliance (e.g.noise, wildlife)	This should be part of planning process, however confirm that any affects on wildlife have been assessed
Building control	Not required for ground mounted turbines, requires detailed structural assessment for roof

	mounted turbines
District Network Operator Approval (sometimes called the 'parallel connection agreement')	The wind turbine installer is to obtain this approval which relates to connecting the turbines to the national electricity grid
Tender/contracts	
EU trading regulations check	Depending on scale of project (i.e. if large scale) may need to advertise the tender on the EU market (OJEC guidelines) If the supplier chosen is not on the DTi list for accredited installers, it may be necessary to arrange with the DTi for an installer to get on the list (although check if this is possible for non-UK installers anyway)
Compliance with Construction Design Management, Health & Safety Specifications	Ensure that the Council's requirements for CDM, Health & Safety are included in the project tender (i.e. if the tender is developed by an external consultant, this information will need to be provided). Note: The installer may be a small company or 'one man band' so any assistance they can be given with regard to complying with main contractor requirements is appreciated (i.e. they may be mostly on site installing, minimal office time)
Specifications for the equipment	Use the grant funding specifications (e.g. UK Major PV Programme – now Low Carbon Buildings Programme) as the equipment and installers will need to comply with the grant specifications to be eligible for the grant.
Installation	
Monitoring	
Technical monitoring	Link to and overall Council Monitoring Strategy and Building Energy Management System (BEMS). Ensure that any monitoring equipment is accredited for obtaining Renewables Obligation Certificates (ROCs). Consider installing meters that measure the amount of electricity exported to the grid.
Social monitoring	Find out what Building Users think of the systems, levels of satisfaction, understanding. Link to energy efficiency, climate change message.

Promotion & marketing	
Media	Issue a press release before wind turbine delivery/scaffolding.
Wind turbine installer's role	During installation, as part of customer service role, the installer can assist with explaining how the systems work. Using local installers greatly adds to the project, if not possible for the installer, then for scaffolding, electrics etc.
Signage	Temporary external signage Permanent external signage Permanent internal (foyer) signage
MAINTENANCE	
Establish a maintenance agreement with the solar installer, or an agreement that the solar installer train Building Services maintenance team/contractors to maintain the systems	Installers to provide relevant operation and maintenance information and to train relevant Council staff (such as caretakers) on how to undertake operation checks and maintenance. It was necessary to purchase some equipment for this purpose, such as a winch to lower the wind turbines.
OTHER	
Renewable Obligation Certificates (UK) and the sale of surplus electricity.	The current situation regarding the sale of surplus electricity and obtaining Renewable Obligation Certificates (UK) for the electricity generated is complicated. Kirklees is working at national level towards a simplified approach to enable Councils to obtain money for the renewable electricity generated.
Rateable value	The installation of microgeneration equipment on business premises will lead to the rateable value of the premises being increased. Kirklees is working at national level to change the relevant legislation so that renewable energy systems have a neutral or negative effect (i.e. decrease the amount payable) on rates.

FREQUENTLY ASKED QUESTIONS – WIND TURBINES

NOISE

The manufacturer's (Proven) Noise Report was submitted with the Planning Application. Planning did not provide noise conditions but used this information to assess noise impact.

The blades make a low level swishing sound. In high wind (20 metres per second) the maximum noise output at the base of the turbine is 65dB(A)

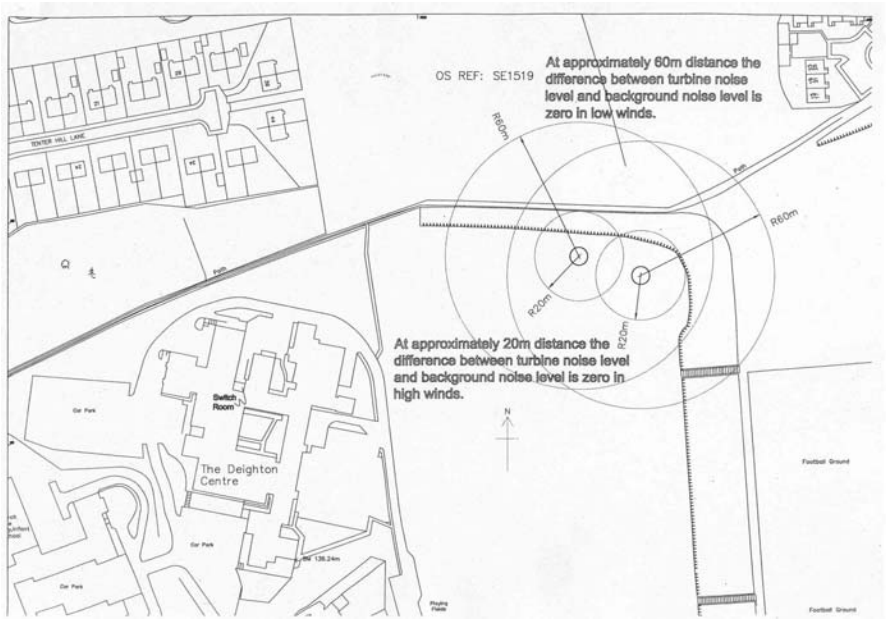
which is a slightly higher level of noise than normal conversation (60dB(A). In low wind (5m/s) the noise output at the base of the turbine is approx 45 dB(A), this is between talking and whispering noise levels. Background wind noise is louder than the turbine when more than 25m from the mast in both low and high winds. Civic III already experiences background noise levels due to buses and delivery vehicles.

For other ground mounted wind turbine project (e.g. Deighton training centre 15kW) we have also submitted a 'noise radius' diagram (see below), however given that building occupants would be within the radius as the turbines are above their heads, this was not relevant for this project! Whilst Civic Centre 3 occupants are obviously within the 25m, it was thought that the noise wouldn't travel downwards significantly and would only reach the rooftop of the nearest building. Also, the building is near a noisy ring road (which cancels out any turbine noise) and there are some noisy extractor fans in the building also. So there were already noise effects in place which meant that the turbines would not be a significant noise effect.

A baseline study of noise levels and existing building vibrations was conducted prior to the installation of the turbines. After installation, a period of monitoring will be carried out to ensure that vibration and noise levels do not exceed set tolerances.

It should be noted that the turbines may be audible for a short high speed engineering testing period; this work was done outside working hours.

There are several design features to minimise noise: the blade tips are designed to minimise noise, there is no gearbox and hence no gearbox noise.



VIBRATION

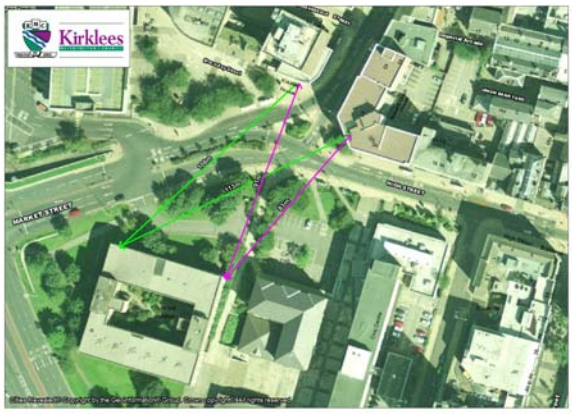
The steel cross frame was bolted to solid concrete raised supports with vibration dampening pads (see photo below). There has been slight vibration ingress, this became apparent when a loose light fitting vibrated and made a humming noise. Once the light fitting was tightened this was no longer a problem.

Mounting of wind turbine frame with vibration damping pads

FLICKER

In order to determine any potential effects from flicker we used an aerial map and also looked at the sun's path at different times and seasons. We calculated the distance flicker might reach and determined that this would not be a problem for the building or surrounding buildings. We used the rule of thumb (British Wind Energy Association) of 10 times the blade diameter for the distance away shadow might reach (see image below).

Since installation there have been some comments from building users about flicker from seeing turbine shadow movement on the periphery of their vision distracting and some mild strobing effects when the sun is out. There are very few places in the building where you can see the turbines from (given that they are on the roof). This has been resolved by installing blinds on some windows, which staff are satisfied with (it was not possible to move desks).



Determining distances to assess flicker

CONNECTION TO THE GRID

The connection to the local distribution network (electricity grid) was relatively straight forward for all systems. Our District Network Operator (DNO) is YEDL (Yorkshire Electricity Distribution Limited). It was necessary to invite the DNO prior to commissioning (and preferably prior to installation to obtain approval!) however it is up to them whether they choose to witness the commissioning. The wind turbines and solar PV are connected through the same G59 relay, as such the DNO thought it was unnecessary to witness the turbine commissioning, as they had already witnessed the solar PV commissioning and the careful setting of the G59 voltage tolerances.

WILDLIFE

Species found in the area include feral pigeons, house sparrows and starlings. Whilst the latter two are species of conservation concern they are unlikely to be affected by the turbines - neither species will roost on open roof tops and both species are more likely to be found feeding on the ground. Whilst starlings may roost in nearby trees, they tend to drop vertically into these night time roosting sites.

The turbines are not tall enough to impact on birds on a migration flight path. In addition the Royal Society for the Protection of Birds state on their website that "climate change is the most serious long-term threat to wildlife in the UK and globally and, therefore, RSPB supports the Government's target to source 15% of electricity from renewables by 2015."

Information on wildlife was provided by Kirklees' Biodiversity Officer.

HIGH WINDS

In response to severe gusts or storm force winds, the turbine blades "cone" down-wind away from the tower. The blades can also furl towards stalling so

that in high winds the turbine will run up to a certain speed and no faster, but also ensure that the turbine's energy output remains near the maximum level.

The turbines have continued to operate with no problems through a typhoon in Japan with top speeds of over 100mph. At these wind speeds building damage can occur due to other causes.

OTHER

Rateable value of the property
Kirklees have been contacted recently by the Valuation Office Agency of HRM Revenue and Customs who have advised that under the Plant and Machinery Act, wind turbines are eligible to be included in the assessment of rateable value of the property. This would mean an increase in rates to the value of 5% of the turbine amount. We have been in contact with the DTi to confirm whether this can be charged, it can. We will be investigating appealing this and nationally to have the legislation changed so that that installing renewables has a favourable or neutral impact on rates charged instead of a negative one.

Lightening
The turbines are connected to existing lightening conductors.

Other roof mounted wind turbine projects

Plymouth College
Two 6kW roof mounted wind turbines on 9m masts (same systems as for Civic III) were installed at Plymouth College in October 2005.

Manchester Green Building
Two 2.5kW turbines have been installed on the roof of the Manchester Green Building in the centre of Manchester

Insurance
We have confirmed that for insurance purposes the equipment is part of the asset. Thus public liability (i.e. if equipment falls off the roof) or loss of equipment due to lightening or fire is covered by the Council's general insurance.

FURTHER INFORMATION

- Technical information is available in the project handover manual.
- ZEN project website
- Civic Centre 3 Project Risk Log
- Proven Noise Report
- Consultation Plan
- Building Users Memo
- D20 – ZEN Installation Projects Report
- DPS Toolkit
- Project Checklists – solar PV, wind, solar thermal

- Installation videos

CONTACT DETAILS

For further information please contact:

Kirklees Metropolitan Council
Environment Unit
23 Estate Buildings
Railway Street
Huddersfield HD1 1JY
Tel 01484 223568
Fax 01484 223576
Email: environment.unit@kirklees.gov.uk

Produced by Kirklees Environment Unit – October 2006

ACKNOWLEDGEMENTS

This project was funded by…

ZEN		
dti	dearskies	**Yorkshire Forward**
	K·E·S	
Kirklees Metropolitan Council		
	EMAS	INVESTOR IN PEOPLE