Report for Resolution

Report to	Cabinet 13 July 2011	17
Report of	Head of strategy and programme management	
Subject	Solar energy generation or other alternative energy supplies on the council's operational property assets	

Purpose

To consider the scoping exercise and feasibility study on solar energy generation or other alternative energy supplies on the council's operational property assets.

Recommendation

Cabinet agrees to progress a project to install a 40kw basic system of photo voltaic panels (PV) on City Hall, subject to the necessary consents and approvals to the final design, on the basis that this is the most feasible capital based scheme, for the reasons described in the report, notwithstanding the fact that alternative revenue based options may have a shorter pay back period.

Financial Consequences

The project would result in £235,000 of the budgeted capital expenditure being committed. The payback period for this project from income and energy savings would be approximately 13 years. Please note these figures do not include an estimated amount for increases in electricity costs.

Risk Assessment

A detailed survey has been undertaken by Asset and City Management in regards to the installation of photo voltaic panels on City Hall. The report identifies the budget, location, energy production, feed in tariff rates and other associated costs.

The major risk for this project is not installing the photo voltaic panels before 31/03/12 when the size of the subsidies provided by the Feed In Tariff (FIT) would reduce. As the project has planning restrictions and is well above the EU tendering threshold a total of six months will elapse before any work starts. If the installation of the PV system falls outside this date the council would receive 2.7p less per KWh which would increase the payback and decrease the return on investment.

Strategic Priority and Outcome/Service Priorities

The report helps to meet the strategic priority “Aiming for excellence – ensuring the Council is efficient in its use of resources, is effective in delivering its plans, is a good employer and communicates effectively with its customers, staff and partners”

Cabinet Member: Councillor Waters: Resources

Ward: All Wards

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Background Documents

Detailed appendices to Feasibility Study (Annex A)

Appendix 1 - Electrical consumption at City hall

Appendix 2 - FIT calculations for PV systems

Appendix 3 - Works costs for all options

Introduction

1. On 22 February council agreed to “set aside £250,000 to be used for a spend to save initiative to finance investment in solar energy generation or other alternative energy supplies on the council's operational property assets, together with a scoping exercise to begin immediately as the basis for a feasibility study to deliver this initiative.” The expenditure that was set aside was in the form of capital.

Scoping exercise and feasibility study

2. A scoping exercise was carried out on the potential for investment in a system of solar energy generation on the council’s main operational property assets. This exercise determined that the City Hall, the council’s main office accommodation was the most appropriate asset for solar energy generation or other alternative energy supplies because of much higher levels of energy consumption compared to the council’s other operational assets.

3. Following this, work was carried out to review the possible different approaches to solar energy generation or other alternative micro generation technologies. This review determined that photo voltaic panels (PV) was the most appropriate technology due to the ability, through this approach, to realise the subsidy opportunities provided by the government Feed In Tariff (FIT) incentive.

4. A feasibility study was then carried out on the potential application of a system of PV at City Hall. This feasibility study can be found at Annex A.

5. Based on the feasibility study it is considered that a 40kw basic system is the most appropriate system of PV for City Hall within the level of capital expenditure that has been set aside for this work.

Consideration of alternative options

6. In addition, to the completion of the feasibility study, work was carried out to assess alternative options to realising savings from energy costs using different approaches not based on solar energy generation.

7. A range of possible options were considered in relation to installation of additional technology at City Hall that would result in savings from energy costs. In some cases the payback periods for these options were shorter than for PV. However, due to the considerable work the council is already carrying out to reduce energy consumption at City Hall through its carbon management programme and the use of innovative technologies all of the viable options would have involved implementation of additional large programmes of small projects, on top of the council’s existing programmes, which would have involved considerable additional revenue resources, to develop, procure, manage, implement and monitor. As the expenditure that was set aside for this work was in the form of capital these options are not considered as viable as the PV

system on this basis.

8. In addition, the council's carbon management plan uses the principles of the energy hierarchy to reduce emissions from our operational assets, which is regarded as good practice by the Carbon Trust. This is summarised below:

   - Stage 1: Minimise wasted energy – Controls and awareness raising
   - Stage 2: Efficient conservation – Installing efficient technology
   - Stage 3: Onsite renewable energy + offsetting.

9. Currently, the council is predominantly at stage 2. However, as the council will soon need to move into stage 3 it is believed that this project provides a good opportunity to test out a key approach to energy generation. The learning from this project will then be able to be applied to ensure that when the council's carbon management programme moves fully to stage 3 of the energy hierarchy the most efficient and effective approach can be utilised across the council's wider asset base.

Recommendation

10. Based on the outputs of the scoping exercise, feasibility study and the consideration of alternative options it is proposed that cabinet agrees to progress a project to install a 40kw basic system of photo voltaic panels (PV) on City Hall, subject to the necessary consents and approvals to the final design, on the basis that this is the most feasible capital based scheme, for the reasons described in the report, notwithstanding the fact that alternative revenue based options may have a shorter pay back period.

NORWICH
City Council

Report for

Photo Voltaic Panels on City Hall

Written Gary Thompson

Date 25 May 2011

Ref City Hall 071001

Contents

Summary

Solar Photo Voltaic systems can reduce the energy consumption thereby reducing the Carbon footprint of Norwich City hall.

It could also under Government Feed in tariff scheme give a good financial return over a 25 year period provided the conditions were complied with.

The savings and returns are a function of the size of the PV array. The size of the PV array is conditioned by a number of factors.

a) budget

b) location

c) Energy production

d) Feed In Tariff

e) Associated Costs

Detailed below are the factors that impact on the returns and costs for this scheme.

There is little doubt within the industry that with the FIT payments, PV systems provide a solid guaranteed financial return and most are installed on this premise alone.

There is however still some scepticism within the market as to how energy efficient or green these systems are or if retrofitting these systems to existing buildings without changing the wiring circuits within them is an efficient way of implementing these schemes

PV systems have been in operation for several years and have a proven track record, they work best in specialised environments, space, deserts and Polar Regions where conventional systems are not possible or the constraints of weight or temperatures are unusual.

In all scenarios below, the finance invested now will show a substantial return by the end of the 25 year period. The best returns with the shortest pay back periods are obtained by installing the basic off the shelf systems.

Both the 40KWh and 99KWh systems scored very similar results; they both gave an annual return of 5.6% and a total return of 218% over the 25 year period. The 40KWh system is the recommended system simply as it gave the shortest payback period of 13 years

Budget

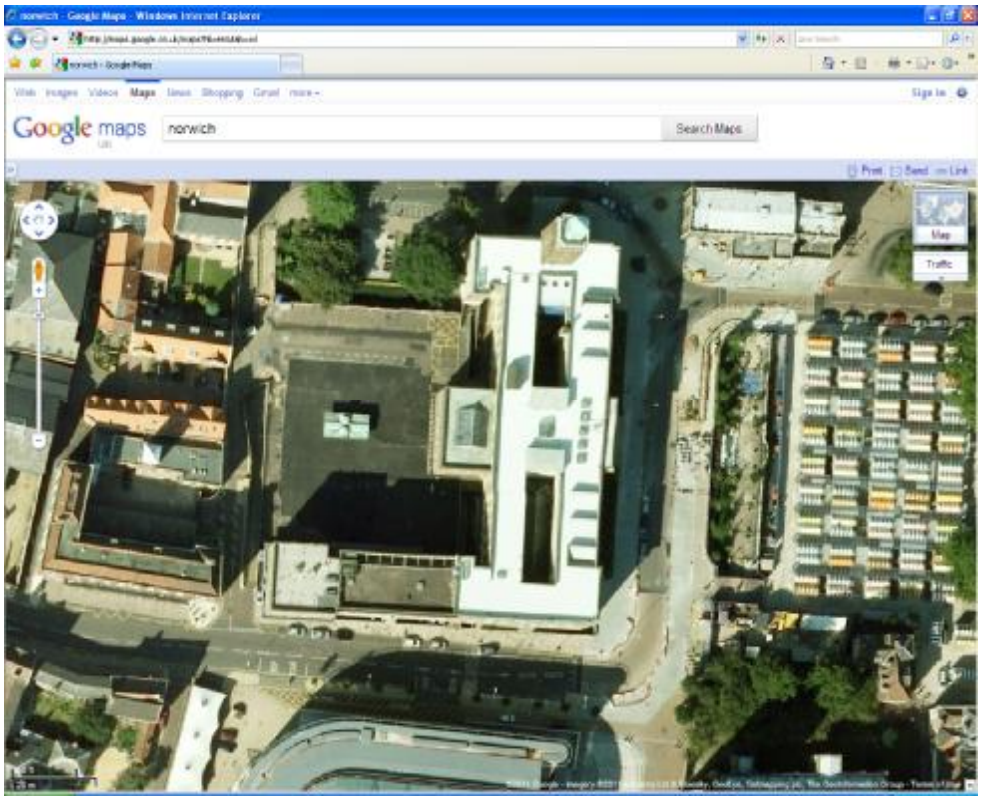
Obviously the more money available the greater the system, the PV industry work on approximately a sum of £5.00 per designed watt to fit and install an array. There is only a small rebate for very large systems as the majority of the cost is in the actual equipment.

However due to the fact that the FIT give guaranteed payments over a twenty five year period, the greatest returns are obtained on the biggest systems. On average the industry predict that a minimum of a two fold increase on any investment over the twenty five years provided the FIT conditions are met.

To maximise the returns, the FIT band that is of most interest is the 10kw – 100kw band. A system falling just within the top threshold of this band will give the best return

Location

City Hall is ideally suited for PV it is flat and high and as shown below has a very good solar impact, with very little shade. The roof is of a concrete pot and beam construction covered in asphalt with a raised parapet wall approximately 1.3m high.



The wall height impacts on the amount of roof area that is in shade, whilst aids any listed building application as the panels are hidden from general view. There is approximately 900 sqm of flat roof area where panels could be mounted. On average you need 6sqm of panel to produce 1KW, so City Hall has a potential to harvest 150KW.

However mounting panels on flat surfaces is not considered good practice as it is not efficient with regard to the suns rays but also makes them more vulnerable to damage and surface contamination.

The general advice here is that the angle of the panels relative to horizontal should be the same as the site latitude in spring and autumn, 15 degrees less in summer, and 15 degrees more in winter.
To achieve maximum efficiencies you should be able to change their angle at least 4 times per year.

However automatic tracking systems are not generally considered economically feasible for small to medium systems as the increased efficiency they derive is lost in the ongoing maintenance and complexity of the mechanical and electrical tracking system.

Usually the panel angle is compromised by the pitch angle of the roof, but if the optimum angle can be set it is usual to go for the spring and autumn latitude, however some clients opt to position their systems according to which part of the year is their greatest need.

Energy Production

City Hall's electrical demand has been monitored over several years and is reasonably constant throughout the year. The average half hourly consumption varies between 40KWh – 70kWh and consumes around 993 MWh annually which costs around £110,000 per annum (Appendix 1)

Unfortunately PV electrical power is variable and can vary both instantaneously (clouds / shadow / season) and over time (panel degradation, UV light) so calculating the energy saving element is not a simple calculation and is also a function of the demand.

Fortunately the average yearly electrical production is far easier and as this forms the basis of the Feed in Tariffs, it is the one of most interest. It is known that most panels due to their location and angle will not be able to produce the factory performance levels and as a result the industry base their statistics on 80% performance. They also use solar maps of the United Kingdom that show the solar term value for Norfolk as being 1042. With this information it is simply a function of multiplying the theoretical capacity of the installed system by 80% and 1042 to give an annual KWh (33,344kwh for a 40kw system) production figure. Depending on the size of the system and the installation date the corresponding rate in the Feed in Tariff rate is used to calculate the return.

It is generally assumed that the energy saving element will be approximately 40 - 50% of the total produced. It is difficult to get levels much above these without changing the electrical network and distribution boards within the building. New buildings designed with PV for example generally score around the 50 – 70%.

The remaining power that is produced but not used by City Hall is then fed back into the grid. The regulations currently permit an allowance of 50% to be exported back to the grid from the total power produced. Currently an allowance of 3 pence is paid for every KWh of power exported back to the grid.

Occasionally for medium to large PV systems, connecting power back to the grid can lead to issues from the National Grid. Generally systems below 50KWh do not cause local stability issues to the grid but the local electrical provider has statutory powers to limit the amount exported if stability is an issue.

Theoretically a 40kw system will generate 33MW per annum (Appendix 2) and a 99kw system will generate per annum (Appendix 3)

Feed in tariff

Essentially the Clean Energy Cash back Scheme or FIT comprises of two tariffs, the first is the Generation Tariff:

The Generation Tariff

The solar PV generation tariff guarantees a fixed payment (usually paid quarterly) based on the size of solar PV system that is installed and the amount of power (measured in kWh) that the solar PV system is capable of generating. Payments are guaranteed for 25 years and payment rates are index linked to inflation (using the Retail Price Index). To kick start the scheme there are higher rates payable for systems installed before the end of March 2012. Payment rates are fixed based on the installation date, systems installed before 31st March 2012 will be fixed at the highest rate for the full 25 years. The rates are outlined in the table below:

Solar PV Feed in Tariff Generation Rates

Solar PV System Size:	Installation Date: 01/04/10 - 31/03/12	Installation Date: 01/04/12 - 31/03/13	Tariff Lifetime:
4kWp or less (Retrofit*)	41.3p per kWh	37.8p per kWh	25 years
4kWp or less (New build)	36.1p per kWh	33p per kWh	25 years
4kWp - 10kWp	36.1 per kWh	33p per kWh	25 years
10kWp - 100kWp	31.4p per kWh	28.7p per kWh	25 years
100kWp - 5MWp	29.3p per kWh	26.8p per kWh	25 years
Stand alone system**	29.3p per kWh	26.8p per kWh	25 years

* A retrofit installation is defined as any installation fitted to or wired to an existing building.

**A stand alone system is defined as not attached to or wired to a building in order to provide electricity to that building. E.g. solar energy farms wired directly into the grid.

The Export Tariff

The solar PV export tariff applies to the proportion of clean energy that is exported (i.e. sold via the grid for others to use) and is set at a buy price of 3p per kWh. The export rate is guaranteed for 25 years and also index linked to the Retail Price Index (RPI). The export tariff is not applicable for off-grid PV systems. Currently for systems under 5MW this is assumed to be 50%

Associated Costs

In order to install a PV system on the roof of City Hall there are a number of areas where associated costs could apply, these are

a) Planning application

b) PV -Design

c) Roof surfacing life

d) Mounting systems

e) Security / Safety

f) Tendering

A) Planning Costs.

As Norwich City Hall is a grade two star listed property any installation will require a listed building application. The cost is likely to be modest, under £1000 as it only consists of staff time and application fee. However the time to get approval could be significant, if the highest FIT rate was targeted. It is estimated that a planning application would take approximately 3 months from submission.

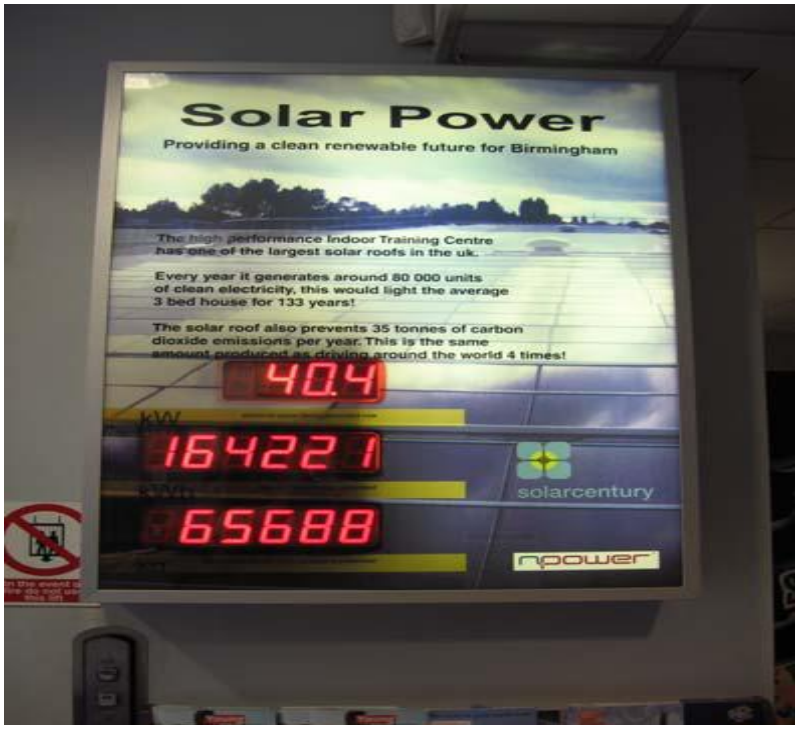
B) PV – Design

The installers and suppliers will provide their design as part of the installation price. However in the majority of cases these designs are generic and do not tend to take into account individual needs or requirements as they major on maximising the revenue from the FIT.

There are a number of specialist consultants that carry out bespoke designs that look at panel efficiencies, and the more intricate electrical invertor systems that lead to increased power saving efficiencies. However these services can only be justified on the medium to large schemes as in general they charge between 5 – 10% of the contract value for their service.

If maximising the efficiencies of the PV system together with maximising the energy saving elements is a high priority, then contracting a specialist consultant to prepare a specification and a design would be a cost effective solution.

There are a number of additional services that are also attached to the medium to large systems. The most popular is the display panel located in the reception area; they display numerous details like the number of KWh produced etc. The size and configuration of City Hall would prevent a simple wireless system working, so a more robust hard wire system would need to be installed if required. To fit and wire in an information screen is likely to cost £8,000



C) Roof Surfacing

City Hall has a solid pot and beam roof covered with an asphalt roof surface. Sandwiched between the roofs and surfacing is a cork insulation layer. This gives the roof additional protection, some heat loss properties together with soundproofing. The existing asphalt has been down for approximately 25 years and is painted with solar paint to reduce the maintenance costs. The average design life for an asphaltic roof is 40 years.

Whilst the roof is in fair condition, the installation of several rows of panels above it raises several issues.

1) Do Nothing – there is no current need to do any works to the roof

2) Replace the section below the PV panels. -

To replace the 300 square meters of roof asphalt beneath the panels would cost £15,000.

3) Upgrade the roof beneath the PV panels.

If the asphalt surfacing is replaced it would seem sensible to increase the insulation depth of the roof, it may be possible to fund this as a potential energy saving scheme.

D) Mounting Systems

Where existing services cross over the roof, steel beams have been previously installed to carry these services. This is an effective way to prevent the services from impacting on the roof and allow future maintenance.

It is proposed that this system is replicated to ensure there is adequate support for the PV panels and to allow the numerous wires to be safely and securely contained on the roof. To aid easy access, reduce trips and falls on the roof a raised footway will also be mounted on the steel beams.

To design, install and fit a steel grid to support the PV panels and provide a raised walkway, the cost would be £21,000

E) Security & Safety

To protect the panels from damage or people from electrocution, the roof and access to it will need reviewing. Currently only a limited amount of personnel can access the roof; those that have access may need training on potential issues.

As the PV panels produce direct current (DC) it is potentially lethal, so the connections will need to be more secure as they will be easy to access, both from a malicious or accidental damage point of view.

The roof has hosted a number of events like firework displays and the clock tower has been abseiled. Some of these uses could have a detrimental impact on the panels, if they were either hit or put into shade by these events.

F) Tendering & Procurement

In order to achieve the maximum returns it is necessary to have the system installed no latter than 31/3/2012. Failure to have the system installed results in a lower feed in tariff by approximately 7% from 31.4p to 29.3p which is significant over a 25 year period

It is expected that the listed planning application will take 3 months. Obtaining expression of interest and going out to tender with a four week tender period is likely to take a further 4 months. Contractors estimate a 4 – 6 week period to install and commission the system.

Based on this program there is only a one month tolerance before the deadline is met

Options

There are three main options, based around City Halls power consumption, the minimum demand 40kwh, the maximum demand 70kwh the maximum qualifying system 99kwkh.

These options can be broken down further by the addition of the bespoke system that potentially can increase the energy savings, by improving the amount of energy that can be used on site. Various percentages are stated between 10 -15%, but as they are difficult to assess the lower estimate of 10% has been used.

The costs of theses options are shown below (Appendix 3) together with their annual production capacity and potential annual and total FIT payments.

	Size	Cost	Capacity	Annual	Total Payments
1a) Basic	40kwh	£235,000	33MW	£2,000	£505,000
1b) Bespoke	40KWh	£270,000	33MW	£2,200	£515,000
2a) Basic	70KWh	£410,000	58MW	£3,500	£885,000
2b) Bespoke	70KWh	£465,000	58Mw	£4,000	£900,000
3a) Basic	99KWh	£575,000	83MW	£5,000	£1,255,000
3b) Bespoke	99KWh	£650,000	83MW	£5,500	£1,275,000

In the above options the bespoke systems contain both the monitoring screens together with the resurfacing option

Conclusion

Each of the three options show a significant return on the capital invested over the 25 year period.

The best financial returns are given on the off the shelf systems.

However for a relatively small percentage increase on the initial investment, (12 %) a much more efficient and effective system could be installed that would maximise the carbon reduction figures and energy saving costs compared to the standard system. Unfortunately it is not possible to accurately calculate what these increased efficiencies are or what their eventual savings will be without getting professional advice it

All industry professionals claim that all bespoke medium to large systems will be an improvement over the standard system and will pay for themselves over the FIT period with efficiency claims of 10 -15%

The conclusion of this report is that all the systems make financial sense

In all scenarios, the finance invested now will show a substantial return by the end of the 25 year period. The best returns with the shortest pay back periods are obtained by installing the basic off the shelf systems.

Both the 40KWh and 99KWh systems scored very similar results; they both gave an annual return of 5.6% and a total return of 218% over the 25 year period. The 40KWh system is the recommended system simply as it gave the shortest payback period of 13 years