Indicators and trends

Monitoring climate change adaptation

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Indicator name			Version
BE8 Substations in areas at flood risk with completed or planned flood protection works			**31/03/16**

Indicator type:	Risk/opportunity	Impact	Action
			X

SCCAP Theme	SCCAP Objective	CCRA risk/opportunity
Buildings and infrastructure networks (Energy)	B1, B2 and B3	FL11b Substations at significant risk of flooding

At a glance

- Scotland's physical energy infrastructure may be vulnerable to climate change due to the potential for flooding of facilities, damage to power lines and disruption to power stations
- It is predicted that rising sea levels and more frequent extreme weather events will increase the flood frequency, and therefore the number of substations that require flood protection
- The number of flood protection works for substations provides one measure of climate adaptation for energy supply; data suggests that flood protection coverage is good
- The application of new guidelines (ETR138) will ensure that the flood resilience of existing major substations is increased through flood protection works and other measures, and that future developments will not be located in flood risk areas

Latest Figure	Trend
2012-2013: Information about flood protection is available for 22 of the 43 major distribution substations located in flood risk areas. Of these, 19 out of 22 have planned or implemented flood protection works; the remaining three were deemed not to need protection. No information was supplied regarding the remaining 21 distribution substations.	There are no historical data to allow for analysis of trends.

Why is this indicator important?

Energy security depends on a complex system to generate, store, and distribute energy. Physical infrastructure may be vulnerable to climate change because of the potential for flooding of facilities,

damage to power lines and disruption to power stations (The Scottish Government, 2011). In common with most countries, Scotland's energy capacity has evolved as a primarily centralised network, which means it is highly dependent on a relatively inflexible system of critical infrastructural assets (The Scottish Government, 2011).

Substations are critical to the transmission and distribution of energy, and over time, climate change may increase the number of existing substations that require flood protection. Repairing substation equipment damaged by floods may take weeks, but where replacement is required the disruption may last for months (ENA, 2009).

Experience shows that the combination of flooding and loss of electricity supplies can have a severe effect on communities, particularly if other critical infrastructure is affected. If services such as water supply, sewage treatment and land drainage fail, this may require mass evacuation. Loss of other services that depend on electricity, and therefore substations, such as the emergency services and public communications (e.g. TV, internet, telephony), can also have a large impact on society (ENA, 2009) causing fear and distress to those affected (Pitt, 2008).

This indicator tracks adaptation (flood protections works) that will help energy supply security in the face of the increased risk of flooding associated with climate change. It is one of four that considers the resilience of electricity substations to flood events.

Related indicators
BE5 Electricity substations located in areas at flood risk
BE6 Customers reliant on electricity substations in areas at flood risk
BE7 Substations in areas at flood risk with completed Flood Risk Assessments

What is happening now?

A task group formed to review the resilience of electricity substations to flooding, with representation from ENA (Energy Networks Association) member companies, the Department for Business, Enterprise and Regulatory Reform **(**BERR), Ofgem, the Environment Agency (EA) and the Scottish Environment Protection Agency (SEPA) developed agreed standards for the resilience of electricity substations. Technical report ETR 138 (ENA, 2009) provides details of these standards. As part of this process a consistent 'Data Collection Specification' was created in order to identify key flood risk information for each substation (ENA, 2009).

The Distribution Network Operators (DNOs) are required to report flood risk and mitigation measures for substations to Ofgem using the methodology set out by the Technical Report ETR 138. This reporting provides data that is fed into the 'V7 Reports' (ENA, 2015) that have been used for this indicator. This reporting regime will continue to provide useful information in the future.

In Scotland, the data collected include an assessment of:

- Whether the site is on a flood plain for two probability levels -1 in 200 and 1 in 1000 - for both fluvial and sea flooding.
- Whether the site benefits from a flood defence scheme provided by the local authority, the site owner, or any other party.
- The condition of the defences protecting the site.
- Flood risk including potential maximum water level for each of the two flood probability levels (1 in 200 and 1 in 1000), and an indication of data accuracy and flood zone type.
- The accuracy and age of the terrain mapping.
- Whether the site is located in a SEPA Flood Warning Area.

- The lead time for Flood warning
- The minimum notice required by the network owner to put temporary flood protection measures in place.
- Historical flooding data.

This forms part of the process to assess the resilience of substations located in flood risk areas across Scotland. The ETR 138 (ENA, 2009) agreed standards are also applied to assess proposed substation sites so that new substations will not be located in areas at risk of flooding unless there are no viable alternatives. This will reduce the future vulnerability of the electricity network.

The provision of robust flood depth data is essential for the proper assessment of flood risk and the identification of appropriate protection. Coverage of depth and more detailed data is generally limited to areas of highest exposure such as cities/towns and thus is only available for a few sites. Where such information is not available from the Scottish Environmental Protection Agency (SEPA), network owners are required to carry out 'flood risk assessments' and calculate predicted flood levels in accordance with the Flood Estimation Handbook (ENA, 2009).

The resilience of electricity supplies can be increased by defending key sites against inundation, contributing to a publicly funded protection scheme, or by providing network interconnection so that supplies can be maintained should flood events occur. A cost/benefits assessment should be conducted for each substation at risk to determine the appropriate level of resilience, but for primary substations the target level of resilience in Scotland should be 1 in 200 for both fluvial and sea flooding, and for grid substations, 1 in 1000 (ENA, 2009).

Information about flood protection works was supplied for 22 of the 43 major distribution substations located in flood risk areas for 2012-2013. Of these, 3 have completed flood protection works in place, and 3 are subject to wider flood protection schemes (2 of these are also scheduled for site specific protection). A further 9 were scheduled to have protection installed during 2014, and 4 in 2015. This means that a total of 19 out of 22 have planned or completed flood protection works. The remaining 3 have been subject to detailed studies that suggest no further protection is required. Information about transmission substations is available for only one licence area. In this licence area, 6 substations are located in areas at risk of flooding, and all have planned or completed flood protection works. No information was available regarding the number of transmission substations at risk in the second licence area.

What has happened in the past?

Severe flooding incidents occurred in England during 2005 (Carlisle) and 2007 (South Midlands & Yorkshire) highlighting that electricity substations across the UK were potentially vulnerable to flooding. These events called into question whether historic levels of flood protection would be sufficient to protect UK substations in the longer term given the projected effects of climate change (ENA, 2009). However, due mainly to differences in topography, Scotland has not experienced the same level of river and coastal flooding as England so the increase in risk to its substations may be less severe than further south in the UK.

What is projected to happen in the future?

The predicted changes in sea level and frequency of severe weather events are expected to 'increase the severity and frequency of natural hazard threats to critical energy infrastructure, including exposure to flooding, extreme temperatures, and subsidence' (The Scottish Government, 2011). This is likely to increase the number of substations located in areas at risk of flooding.

However, new guidance and standards relating to the resilience of electricity substations (ETR138) should result in increased levels of protection against flooding for major substations (ENA, 2009). In addition, new infrastructure will not be located in areas at risk of flooding as under the Scottish Planning Policy (SPP7) risk framework, areas at risk of a 1 in 200 year flood are unsuitable as sites for ground based electrical equipment (ENA, 2009).

Patterns of change

Geographic data was not available

Interpretation of indicator trends

The current lack of historical data does not allow for identification of trends.

Limitations

The assessments applied to major substations at risk of flooding so far reflect only risks posed by fluvial flooding and coastal flooding, because these were the only risks for which SEPA provided data (ENA, 2009). This suggests that the number of major substations at risk of flooding, and consequently the number that require additional flood protection, may be higher than reported once additional sources of flooding are considered. The latest iteration of SEPA flood maps (SEPA, 2015) includes pluvial flooding, and it is proposed that the indicator should be developed as information about additional sources of flooding becomes available. In addition, data on transmission substations was only available from one licence holder.

References

Adaptation Sub-Committee (ASC) (2014). *Managing climate risks to well-being and the economy: Progress Report 2014.* Available at: http://www.theccc.org.uk/publication/managing-climate-risks-to-well-being-and-the-economy-asc-progress-report-2014

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The Scottish Government (2011). *Scotland's Climate Change Adaptation Framework (SCCAF): Energy Sector Action Plan.* The Scottish Government. Available at: http://www.gov.scot/Resource/Doc/175776/0114907.pdf

The Scottish Government (2015). *Action to manage flooding risk in Scotland* [online]. Available at: http://www.gov.scot/Topics/Environment/Water/Flooding

Further information

Acknowledgements

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This indicator was produced by Ailsa Strathie, Lynne Jack and colleagues at Heriot-Watt University with input from Darcy Pimblett (CXC) and Katherine Beckmann (Heriot Watt and CXC).

Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	BE8 Substations in areas at flood risk with completed or planned flood protection works
Indicator contact: Organisation or individual/s responsible for the indicator	ClimateXChange
Indicator data source	V7 Flood Mitigation Data
Data link: URL for retrieving the indicator primary indicator data.	The data is not publicly available, but was supplied via the contacts listed above.

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	The data is for the 2012-2013 period.
Frequency of updates: Planned or potential updates	Updates could be obtained from future V7 reports. Potentially this data could also be supplied by the Scottish Environmental Protection Agency.
Spatial coverage: Maximum area for which data is available	Scotland
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	Scottish Power supplied data for both transmission and distribution sites, while SSE supplied data only for the number of distribution sites in flood risk areas. They did not supply details of planned or completed flood protection works at their distribution sites.
Spatial resolution: Scale/unit for which data is collected	The data is supplied at the scale of the individual substation.
Categorical resolution: Potential for disaggregation of data into categories	
Data accessibility: Restrictions on usage, relevant terms & conditions	The data is supplied on the condition that individual substations will not be identified.

Table 3 Contributing data sources

Contributing data sources Data sets used to create the indicator data, the organisation responsible for them and any URLs which provide access to the data.
This data is not publicly available at present, but was supplied through contacts at the Energy Networks Association, Scottish Power Energy Networks and Scottish and Southern Energy.

Table 4 Indicator methodology

Indicator methodology The methodology used to create the indicator data
The data for this indicator were extracted from V7 Flood mitigation tables, which were supplied to us in edited form, as excel spreadsheets. These contain details of individual substations located in areas at risk of flooding based on assessment against SEPA's flood maps, and information about which of these substations have, or will have, flood protection works installed.