Indicators and trends

Monitoring climate change adaptation

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Indicator name				Version
BE7 Substations in areas at flood risk with completed Flood Risk Assessments				**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 Substation at significant risk of flooding		

At a glance
• Scotland's physical energy infrastructure may be vulnerable to climate change because of the potential for flooding of facilities, damage to power lines and disruption to power stations • This indicator identifies the number of substations located in areas at risk of flooding that have completed flood risk assessments • It is predicted that rising sea level and more frequent extreme weather events will increase the flooding in Scotland, and therefore the number of substations requiring flood risk assessments • The application of new guidelines (ETR138) will ensure that the flood resilience of existing major substations is increased, and that future developments will not be located in areas at high risk of flooding, which will mitigate this risk. Flood risk assessments for existing infrastructure and for sites proposed as locations for new major substations, form an integral part of this process.

Latest Figure	**Trend**
2012-2013: • 43 major distribution substations were in flood risk areas. • 37 had completed flood risk assessments as of 2013. • 6 were scheduled for completion during 2014.	No data yet available on which to base a trend

Why is this indicator important?
Energy security requires a complex system to generate, store, and distribute energy. Physical infrastructure may be vulnerable to the impacts of climate change because of the potential for flooding, 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 that it is dependent on a relatively inflexible system of critical infrastructural assets (The Scottish Government, 2011).

Substations are critical to transmitting and distributing energy across the electricity network. Flooding coupled with the loss of power can have a severe effect on communities, particularly if other critical infrastructure services are also affected (e.g. water supply, sewage treatment and land drainage), and may require mass evacuation. Loss of other services that depend on electrical power, 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).

Repairing substation equipment damaged by floods may take weeks, and where replacement is required the disruption may last for months (ENA, 2009). A number of options can be deployed for flood protection to mitigate risk, and the flood risk assessment is the first stage in this process. This indicator therefore provides a measure of adaptive response to protect the security of energy supply in response to the threats posed by climate change.

This indicator is one of four that examines the resilience of substations to flooding. It tracks an adaptive action - substations in flood risk areas that have completed flood risk assessments in place.

Related indicators:
BE5 Electricity substations located in areas at flood risk
BE6 Customers reliant on electricity substations in areas at flood risk
BE8 Substations in areas at flood risk with completed or planned flood protection works

What is happening now?

As of 2012-2013, 49 major substations were located in areas at risk of flooding (see indicator BE5). Of these, 43 are distribution substations, and the other 6 are transmission substations. According to the V7 flood mitigation tables, 37 of the major distribution substations had completed flood risk assessments, and the other 6 were scheduled to be assessed during 2014. Information about flood risk assessments for transmission assets was not detailed enough to draw conclusions about whether or not flood risk assessments had been undertaken.

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 -1/200 and 1/1000 - 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 (1/200 and 1/1000), 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 to substations and the identification of appropriate protection. Coverage of depth and more detailed data is generally limited to areas of highest risk such as cities/towns and therefore this information is only available for a limited number of sites. Where information, such as flood depth, is not available from the Scottish Environmental Protection Agency (Scotland), network owners are required to carry out 'flood risk assessments' and calculate predicted flood levels in accordance with the Flood Estimation Handbook (ENA, 2009).

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 projected rise 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 may increase the number of major substations in areas at risk of flooding, and therefore too the number of flood risk assessments required.

However, new standards relating to the resilience of electricity substations are predicted to result in increased levels of protection against flooding of major substations (ENA, 2009). In addition, new infrastructure will not be located in areas at risk of flooding. These changes should help reduce the increased risk of flooding posed by climate change.

Patterns of change

The data for 2012-2013 offer a baseline for assessing major substations at risk of flooding with completed flood risk assessments. There are two competing patterns to consider here. Firstly, it is predicted that climate change will result in a rise in sea level and an increase in severe weather events that may place more major substations at risk over time, increasing demand for flood risk

assessments. However, the implementation of new guidelines on the security of primary and grid substations (ETR138) will ensure that the flood resilience of existing major substations is increased. Additionally, future developments will not be located in areas at high risk of flooding. Therefore, while flood risk may increase, the implementation of ETR 138 will ensure the security of the electricity network, and the implementation of flood risk assessments will contribute to this process.

Interpretation of indicator trends

Limitations

Currently, the assessment of major electricity substations at risk of flooding reflects only fluvial and coastal flood risk; because these are the only data SEPA provide (ENA, 2009). This suggests that the number of major substations at risk of flooding, and consequently the number that require flood risk assessments, may be higher than reported once additional sources of flooding are considered. The latest iteration of SEPA flood maps (SEPA, 2015) include pluvial flooding, and it is proposed that the indicator should be developed as information about additional sources of flooding becomes available.

This indicator provides a count of the number of major substations with completed flood risk assessments, which provides some measure of the actions taken to mitigate flood risk. However, this information would be more meaningful if the outcome of these assessments was also provided. The dataset accessed contains information about whether or not the substations have been subject to a flood risk assessment, but currently does not indicate whether further work is required.

References

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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	BE7 Substations in areas at flood risk with completed Flood Risk Assessments
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 (Acknowledgements).

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	For flood risk, updates could be obtained from future V7 reports. Potentially this data could also be supplied by the Scottish Environmental Protection Agency. Flood risk assessment data would have to be supplied by the contacts noted above.
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 distribution sites. The outcome of the flood risk assessments is not known.
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, and was supplied through contacts at the ENA, SP and SSE.

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 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 extent maps, and information about which of these substations have been the subject of flood risk assessments. One operator also supplied information on the number of major substations for which site specific protection had been designed but this is not contained in the data supplied by the second operator. Information about the outcome of the flood risk assessments is not available.