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FREQUENTLY ASKED QUESTIONS
THE GRID IMPACT ASSESSMENT

SUMMARY OF FINDINGS

Q. What is the Grid Impact Assessment (GIA)?

A Grid Impact Assessment is used to assess the impact of a significant change to the electricity grid.

In this case, the Grid Impact Assessment (GIA) refers to the assessment of the electricity grid specifically to understand the impact of grid-connected private photovoltaic (PV) systems. The purpose of this GIA was to determine the hosting capacity of the grid (i.e. the safe limit of private PV that can be connected to the grid).

The GIA carried out an in-depth assessment to understand the hosting capacity of each transformer, each feeder, and the entire grid. It also looked at the sizes of PV systems that are safe and can be connected to each distribution transformer to avoid technical challenges.

Q. Who undertook the GIA?

The GIA was undertaken by DNV South Africa (Pty) Ltd. DNV is a reputable company providing expert advisory services in the energy sector.

Q. What did the GIA find?

The GIA found that the hosting capacity of the electricity grid in St Helena has been reached. Even the limited grid-connected private PV that is currently connected to the grid poses a risk.

As a result:

- No additional grid-connected private PV will be permitted.
- Existing grid-connected private PV systems can remain in place but will in a number of cases require mitigation.

GENERAL BACKGROUND

Q. What is a photovoltaic (PV) system?

A photovoltaic (PV) system is a renewable energy technology that has been designed to capture energy from the sun and transform this into electricity using photovoltaics (solar panels).

Q. Is a PV system the same as a solar water heater?

No. When we refer to private PV systems, we do not consider solar water heaters (Solar Thermal) amongst these. PV systems convert sunlight directly into electricity, whilst thermal systems produce thermal energy for hot water heating systems.

Q. What is the experience in other small island states regarding the use of grid-connected private PV systems?

The GIA includes a number of case studies from small island states. Generally, larger islands have been able to successfully manage grid-connected private PV systems, often by designing appropriate mitigation.

Case studies from small island states with micro-grids (these are more comparable to St Helena) show that grid-connected private PV systems are unusual due to the risk of instability on the electricity grid. We understand that in many such cases (for example, Montserrat and the Falkland Islands), grid-connected private PV systems are not permitted.

Findings from the GIA

Q. What were the findings from the GIA?

The GIA comprised 4 separate studies. None of these can be considered in isolation: instead, the cumulative impact of each of the findings must be considered:

The Load Flow and Short Circuit Study

The study identified key problems in relation to voltage unbalance under high PV penetration levels. This was a problem for the grid generally but was particularly noticeable for feeder 2 (which has the largest number of consumer connections). The study therefore recommended that export be blocked for all privately owned PV systems.

Protection Study

The Protection Study found that as long as there was mitigation, small-scale embedded generation on the network is not likely to place the grid at risk.

As part of the mitigation, all systems must meet the ECG98 standard and must have proof of certification of this. The study recommended that these requirements be legislated.

The Dynamic Study

This revealed technical challenges that make it difficult to integrate private rooftop PV installations into the existing network. The report found that the integration of private PV systems could lead to instability and potential damage to the generators.

In particular, concern was raised around the high penetration of renewables on the network and the impact on the minimum output power requirement of the diesel generators. Production from private PV systems decreases the demand on the diesel generators: if this is not mitigated, demand will reduce to levels where the diesel generator is unstable.

A further concern is around periods when private PV systems are generating less and these properties then take more from the main electricity grid, for example, if there is cloud coverage or if the private PV system trips. The abrupt return to drawing electricity from the grid can overload the generator. The GIA finds that this is a significant concern that needs to be addressed, as overloading the generator can lead to system instability and potential damage to equipment.

St Helena's electricity grid is described as a microgrid due to its very small size. As such it has extremely limited resilience to fluctuations in power. Such fluctuations are intensified by supplies from private PV systems over which there is no regulatory control.

Consequently, the Dynamic Study recommends that it is not advisable to allow private rooftop PV installations on the St. Helena network. The study recommends that alternative solutions such as utility-scale solar PV or battery energy storage systems should be explored.

Power Quality Study

Overall, there is no major concern for power quality in the network arising from private PV systems. However, the study found that larger PV systems, or LV networks with a large number of PV systems, may cause larger voltage changes. The study recommended that voltage unbalance and harmonics are closely monitored.

In weighing up the cumulative impact from each of the above studies, the GIA concluded that the electricity grid in St Helena can accommodate a limited amount of private PV systems ***but only with mitigation in place.*** It concluded that the current hosting capacity of the grid (i.e. the safe limit for grid-connected private PV) has been reached.

Q. Are there risks to the grid from connecting private PV systems?

Yes, hence the need for mitigation on any grid-connected private PV systems.

The key risk areas are:

- voltage unbalance resulting in grid instability.

- if private PV generation is reduced, this requires additional grid generation to address the balance. A grid-connected private PV system generates electricity but the balance of electricity needed for that property is taken from the electricity grid. When the output from the private PV system reduces, the demand on the electricity grid increases. This change can take place rapidly, for example, if there is cloud cover or a trip event and this in turn requires the electricity grid to respond rapidly which is not always possible. This can result in overloading the generator which in turn can lead to system instability and potential damage to equipment.

- the low load condition i.e. that there are particular times of the day when demand on the grid is reduced to such an extent that this falls below safe operating levels of the generators, thereby resulting in grid instability.

Q. What mitigation does the GIA recommend?

The GIA recommends that:

- No further private PV systems are connected to the grid: the hosting capacity has been reached.

- Existing grid-connected private PV systems can remain connected to the grid but:

  - no export of electricity is permitted to the grid.

  - the private PV system should not increase in size.

  - consideration be given to installing communications systems between the Power Station and the grid-connected private PV system. Similar measures are already in place for the Connect wind farm and solar farm. Such communication systems will provide an interface between the different types of electricity generation (diesel, wind, solar) so that they work in tandem.

    A particular example of this in relation to grid-connected private PV systems is when there is a good PV electricity production period and there is a low demand for electricity from the grid. The high penetration of renewables on the network, the minimum output power requirement of the diesel generators, and the lack of control over private rooftop PV systems could lead to instability and potential damage of the generators. The communications system will enable the process to be managed, minimising the risk to the grid

    It has not yet been confirmed which grid-connected private PV systems might require communications links.

Further mitigation may be required beyond this depending on the size of the private PV system and its location on the grid.

Q. What do the findings from the GIA mean for the Renewable Energy Project?

The GIA found that it would pose a risk to the grid if grid-connected private PV systems exported electricity into the grid. This means that the potential for feed-in schemes (i.e. where private PV owners sell their excess electricity to the grid) can be ruled out.

A key recommendation arising from the GIA is that the island should focus on utility-scale renewables: small private PV systems are problematic for the electricity grid and many other small islands and countries with micro-grids have avoided installing such systems to

protect the grid.

Connect has set out its roadmap towards achieving 80% electricity generation from renewables by 2027/28 in its *Energy Delivery Plan*.

For Existing Grid-Connected Private PV Systems

Q. How many existing grid-connected private PV systems are there?

There are currently 29 grid-connected private PV systems.

Q. I already have a grid-connected PV system. Will I need to put mitigation in place?

The GIA strongly recommended the following mitigation:

- no export of electricity is permitted to the grid.
- the size of your private PV system cannot increase from current levels.
- consideration be given to installing communications systems between the Power Station and the grid-connected private PV system. This will need to be assessed on a case-by-case basis.

Further mitigation may be required depending on the size of your private PV system and its location on the grid.

Please note that the GIA highlighted the risk to the electricity grid if private PV systems are not well managed. Connect will therefore always err on the side of caution in recommending mitigation for existing private PV systems.

Q. What is meant by the ECG98 standard?

UK Engineering Standard G98 (ECG98) refers to PV systems that have an inverter of a continuous rating of not more than 3.68kW rating for single-phase systems and 11kW rating for three-phase systems.

UK Engineering Standard G99 (ECG99) refers to higher-capacity PV systems. Generally in large countries like the UK, this applies to commercial systems and these generally require additional approvals.

Q. How do I know whether I have an ECG98 system or an ECG99 system?

Please contact the supplier of your private PV system for advice.

Q. What happens if I do not have an ECG98 system?

If you do not have an ECG98 private PV system, the likelihood is that your system will be ECG99 rated, but can be sized to ECG98 size by installing the appropriate size of solar panels. ECG99 is the standard for much larger commercial systems.

The GIA recommends that the adopted standard size for private PV systems on St Helena is as per ECG98. Connect is aware that over 40% of the current systems do not meet this requirement. At this point in time, Connect is accepting the risk posed by the larger systems but this is subject to review.

Q. Why might I get a different answer to someone else with an existing grid-connected private PV system?

The outcome for existing grid-connected private PV systems needs to be taken on a case-by-case basis. There are several factors to consider including the capacity of the transformer the property is on.

Q. Will Connect buy my excess electricity (i.e. when my private PV system generates more than I need)?

No. One of the specific recommendations from the GIA is that there should be no export of electricity from grid-connected private PV systems to the grid. This is to avoid grid instability.

Q. How do I make the most of excess electricity?

First and foremost, if you own an existing grid-connected private PV system, it is important to ensure that it is appropriately sized to meet the needs of your property: oversized private PV systems likely mean that you have over-invested.

You may wish to consider investing in battery energy storage. This will allow you to bank excess energy generated during daylight hours to be used during periods when your private PV system does not generate as much (e.g. overnight).

It is important to note that:

- All the electricity generated by grid-connected PV systems must be consumed and/or curtailed to avoid reverse power flow i.e. to prevent the export of power back into the electricity grid.
- Customers in possession of grid-connected PV systems are not permitted to wheel (i.e. transport) excess electricity to other consumers.

For Pending Private PV Systems

Q. I had planned to put in place a new private PV system. Can this go ahead?

Not at this time. The GIA identified that this is currently not technically feasible. The hosting capacity of the grid (i.e. the level of private PV that could be connected to the grid without severe instability issues) has been reached.

This will be monitored and kept under review.

Q. If others downsize or possibly even disconnect from the grid will this free up sufficient capacity for me to add my private PV system?

The GIA identified that the current hosting capacity on the grid has been reached. The hosting capacity is small (currently a total of 225kW). Whilst there may be small movements in this if/when existing systems downsize or disconnect, the GIA is clear that the greatest benefit to the island from renewables will be achieved through utility-scale renewables, rather than small individual private PV systems.

Connect will therefore focus our attention at this time on addressing the issues around existing private PVs and our wider Renewable Energy Project. The moratorium on adding more private PV systems to the grid will remain in place at this time.

This may change over time, for example, if demand grows significantly and we are able to address the low load issue (see above). The situation will be reviewed regularly.

Q. Can Connect simply not put mitigation in place to enable private PVs to go ahead?

The GIA concludes that the electricity grid in St Helena can accommodate some grid-connected private PV systems *but only with mitigation.* However, this limit (i.e. the hosting capacity of the grid) has been reached by the existing grid-connected private PV systems. Therefore, it is not possible to include additional grid-connected private PV systems at this time

Q. I am new to the concept of private PV systems. What do I need to know before I invest in a system?

Please note the current constraints on the connection of private PV systems to the grid. Based on the GIA, the moratorium on new grid-connected private PV systems remains in place at this time.

Off-Grid Systems

Q. What if I wanted to go off-grid?

Off-grid systems are outside of Connect's remit. If you are considering such a move, please ensure that you obtain appropriate technical and regulatory advice.

Next Steps

Q. What are Connect's next steps in connection with the GIA?

The team at Connect will be available for follow-up discussions with any interested parties.

In light of the findings from the GIA, our focus will be on requesting legislative reform to support the electricity sector on-island. The existing Electricity Ordinance was published in 1961. The accompanying Electricity Regulations were published in 1995. Both documents were published prior to the mainstream use of renewable energy and require updating to reflect current best practice.

Q. What are Connect's next steps in connection with the Renewable Energy Project?
First and foremost, the proposed legislative reform (see above) will also be advantageous to the Renewable Energy Project. It will provide a legal framework for a modern energy sector.

Work is already taking place under Connect's *Energy Delivery Plan.* In addition to the GIA, Connect has also commissioned studies on wind energy and battery energy storage. These studies will feed into the preparation of detailed designs and tender documentation needed to commission additional renewable energy infrastructure. The procurement for this work is currently underway.

Q. Who do I contact for further information?
Please contact Connect's enquiries line on tel. 22255 or email enquiries@connect.co.sh for further information.