Imperial College London

Sainsbury's

Sustainable Energy Futures Conference 2014

19th September 2014

Forecasting PV Impact on UK Businesses

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1. INTRODUCTION

Retailer's Market

High competitiveness	Increase in electricity price	Self-imposed GHG emission reduction

Energy self-production by installing rooftop PV systems.

This project takes advantage of the generation data from around 200 Sainsbury's stores with PV systems to asses currently operating PV system's performance, keeping in mind that Sainsbury's installed systems are constituted by conventional crystalline silicon modules and Solyndra systems, a CIGS product with a strange tubular geometry that makes it unique.

2. GENERAL OBJECTIVE

Detect opportunities to improve future PV system performance, particularly for Solyndra and silicon technologies, and to identify possible business opportunities through performance improvements based on historical performance of current Sainsbury's PV systems.

3. METHODOLOGY

Energy generation data from systems + GHI from close weather stations.

- **Linear regression average behaviour model for Solyndra and silicon systems.**
- **Linear regression of each system's behaviour in time.**

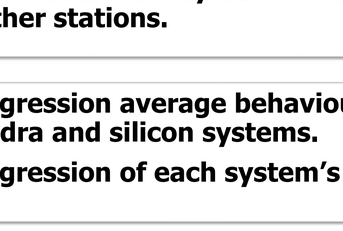
Detection of worst performing stores and assess of economic losses due to their underperformance against the average.

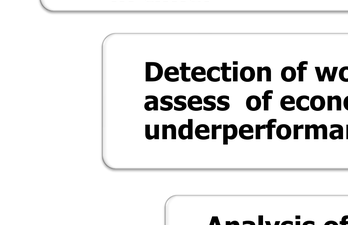
Analysis of variables that affect profitability of installing PV systems in northern England, North Ireland and Scotland.

Analysis of the use of a commercial PV system simulation tool to predict future generation of Solyndra PV systems.

4. SYSTEMS CHARACTERIZATION

95 Solyndra systems





Source: (Seveilleux 2012)

Source: (Ambiente-plus 2011)

46 silicon systems

Source: (PV.magazine 2010)

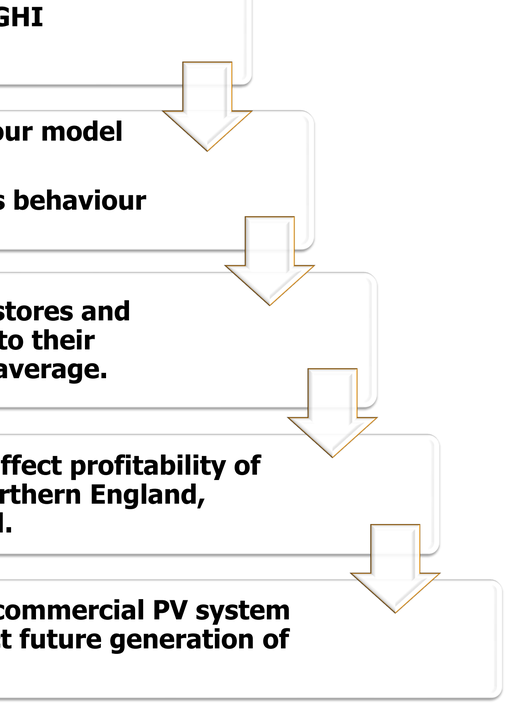


Figure 1: Systems' location and average global horizontal annual irradiance
Source: (SolarGIS, 2014)

5. RESULTS

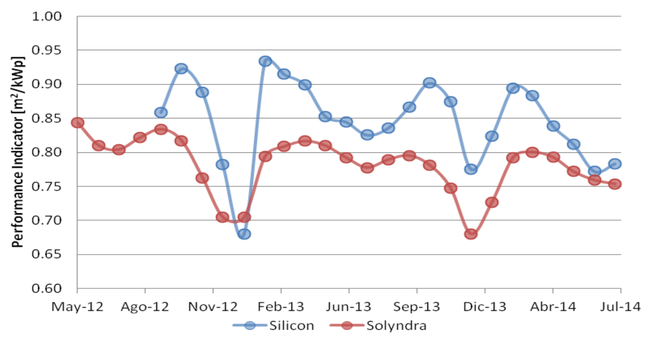


Figure 2: Performance comparison for both technologies

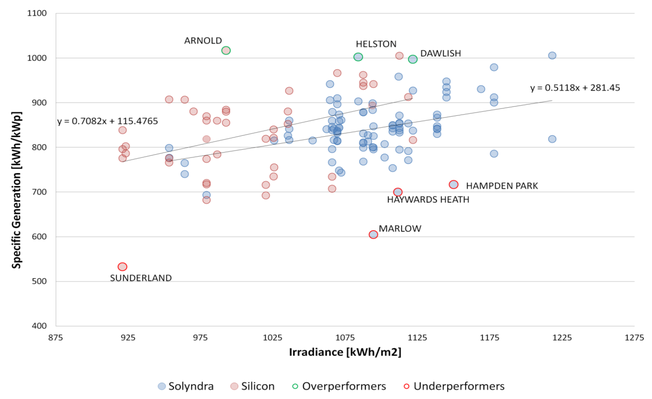


Figure 3: Last 12 months specific generation and irradiance for the analysed sites, differentiated by technology

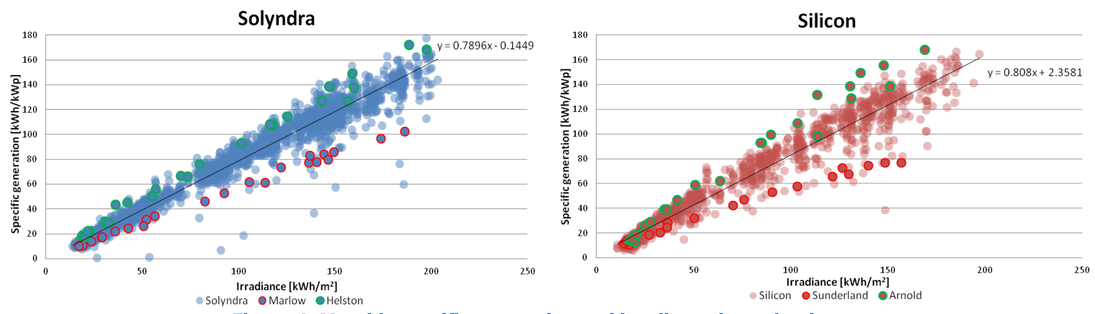


Figure 4: Monthly specific generation and irradiance by technology

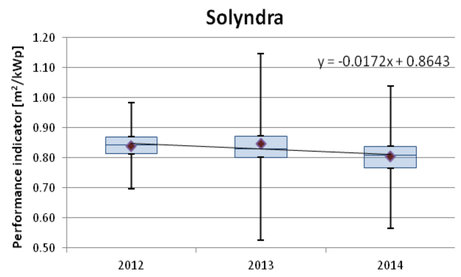


Figure 5: Time variation of the average performance

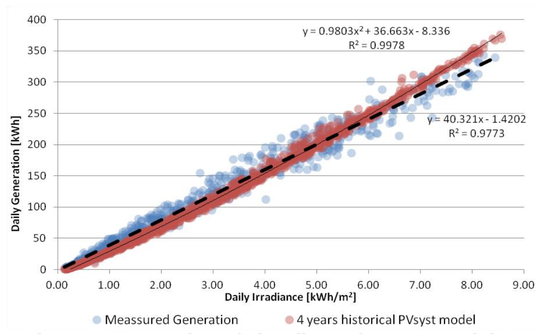


Figure 6: Generation v/s irradiance for measured data and PVsyst calculation from historical data in Hayes

Performance indicator

$$PI = \frac{Generation}{Peak\_Capacity \cdot Irradiance}\left[\frac{m^2}{kW}\right]$$

Silicon systems generate in average 15% more electricity with the same irradiance.

Average performance model

Linear regression model confirms silicon systems' better performance.

Last year's worst performing sites are identified.

Worst performing sites behave systematically worse than the average (below).

Degradation

Solyndra:
2.08 [%/year]

Silicon:
0.98 [%/year]

Economic analysis

8 worst performing stores generate a revenue loss of 36.000 £/year.

For futures systems, profitability is sensitive to PV price evolution, but even more to systems' performance.

Commercial model for Solyndra

The model (Pvsyst) simulates yearly generation with a 1.4% average error.

The model could be improved by considering a linear behaviour and taking in account the different performance of each site.

Simulation is highly sensitive to the weather data being used.

5. CONCLUSIONS

- Monitoring both, generation and irradiation is extremely important to analyse systems' performance, which guide to detect and replicate good maintenance and installation practice.
- Achieving good performance levels in existing and future systems is crucial to ensure forecasted revenues.
- For future systems' energy generation forecast, good quality weather data is essential. However, always has to be taken into account the natural inter-annual irradiance variations.

REFERENCES

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SolarGIS 2014: http://solargis.info/doc/free-solar-radiation-maps

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