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**SensorFlow  
Methodology Review**

**Version 2**

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## **Summary**

SensorFlow is a methodology that automates the air conditioner settings in unoccupied spaces to reduce the cooling demand and therefore power consumption of an air conditioning system. The EarthCheck Research Institute's partner Queensland University of Technology (QUT) performed a technical review of the methodology.

The approach described in "SensorFlow-Accurate quantification of HVAC energy savings without a historical baseline.pdf" is an acceptable way of estimating the energy savings resulting from the installation of the SensorFlow system. For the data presented the model shows acceptable accuracy and the claimed savings are essentially independent of model accuracy.

Most of the claimed savings associated with the SensorFlow system are a result of the air conditioning to unoccupied rooms being turned off by the SensorFlow system.



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## **Introduction**

SensorFlow is a methodology that automates the air conditioner settings in unoccupied spaces to reduce the cooling demand and therefore power consumption of an air conditioning system. The EarthCheck Research Institute's partner Queensland University of Technology (QUT) performed a technical review of the methodology.

## **Procedure**

The updated summary of the SensorFlow methodology supplied by EarthCheck ('SensorFlow-Accurate quantification of HVAC energy savings without a historical baseline.pdf') was reviewed based on current practice in the field. An initial review of the methodology based on the information in the files 'SensorFlow MV Methodology (003).pdf' and 'For Sales Team\_Savings Report\_OCT2019\_Final.pdf' was carried out previously (Mann, 2020).

## **Review**

The SensorFlow methodology incorporates the following:

Data collection	This includes indoor conditions (temperature, relative humidity), air conditioning system setting, occupancy measurements, energy measurement and external conditions (temperature, relative humidity).
Model development	A machine learning approach using ML.net.
Model evaluation	Evaluation criteria include $R^2$ , the coefficient of determination, and RMSEP, the root mean square error of prediction.
Determine energy savings	Use the validated model to predict what the conditions and therefore power consumption would be if SensorFlow were not installed 'non-SensorFlow world'. The predicted power consumption is then compared with the measured power consumption to determine the energy savings.

SensorFlow also includes set point limitation to reduce power consumption when a room is occupied (the guest set point can be overridden). Rooms that are unoccupied and rooms where the air conditioning has been turned off upon guest departure (by the guest, staff or a key access system) are not included in the energy savings calculations but the savings resulting from set point limitation are included. Motion sensors are used to determine if a room is occupied.



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Given that the methodology for estimating energy saving as described in the supplied documentation<sup>1</sup> is model based and excludes rooms where the air conditioning has been turned off upon guest departure from the energy saving calculations, it is a valid means of estimating energy savings.

There is a good match between the modelled and measured energy consumptions in figure 6<sup>1</sup> which shows that the model has been adequately trained for this data set. Tables 4<sup>1</sup> and 5<sup>1</sup> show that the claimed energy savings are essentially independent of the accuracy of the model, assessed using  $R^2$  and RMSEP. The model accuracies for all compressors exceed the model pass criteria<sup>1</sup> of  $R^2 > 0.6$  and  $RMSEP < 10\%$ .

## **Conclusions**

The approach described in "SensorFlow-Accurate quantification of HVAC energy savings without a historical baseline.pdf" is an acceptable way of estimating the energy savings resulting from the installation of the SensorFlow system. For the data presented the model shows acceptable accuracy and the claimed savings are essentially independent of model accuracy.

Most of the claimed savings associated with the SensorFlow system are a result of the air conditioning to unoccupied rooms being turned off by the SensorFlow system.

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<sup>1</sup> SensorFlow-Accurate quantification of HVAC energy savings without a historical baseline.pdf



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## **References**

Mann, A. P. (2020). "Review of the SensorFlow methodology for EarthCheck." QUT consulting report S0010-PO2020001.



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