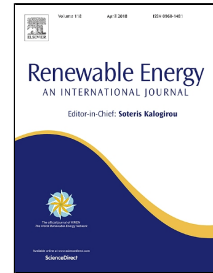


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# A city-scale roof shape classification using machine learning for solar energy applications

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## 1 Abstract

2

3 Solar energy deployment through PV installations in urban areas depends strongly on the  
4 shape, size, and orientation of available roofs. Here we use a machine learning approach,  
5 Support Vector Machine (SVM) classification, to classify 10,085 building roofs in relation to  
6 their received solar energy in the city of Geneva in Switzerland. The SVM correctly identifies  
7 six types of roof shapes in 66% of cases, that is, flat & shed, gable, hip, gambrel & mansard,  
8 cross/corner gable & hip, and complex roofs. We classify the roofs based on their useful area  
9 for PV installations and potential for receiving solar energy. For most roof shapes, the ratio  
10 between useful roof area and building footprint area is close to one, suggesting that footprint  
11 is a good measure of useful PV roof area. The main exception is the gable where this ratio is  
12 1.18. The flat and shed roofs have the second highest useful roof area for PV (complex roof  
13 being the highest) and the highest PV potential (in GWh). By contrast, hip roof has the lowest  
14 PV potential. Solar roof-shape classification provides basic information for designing new  
15 buildings, retrofitting interventions on the building roofs, and efficient solar integration on the  
16 roofs of buildings.

17

## 18 Keywords:

19 Machine learning; Roof shape classification; PV potential; Support Vector Machine

20

21

## 22 1. Introduction

23

24 Photovoltaics (PV) are among the most promising emerging technologies for deployment of  
25 solar energy in urban areas. Solar PV panels can be installed on the rooftops of individual

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