

Contents

Abstract	iii
Resumen	v
Resum	vii
Acknowledgements	ix
Nomenclature	xiv
List of Figures	xx
List of Tables	xxiii
1 Introduction	1
1.1 Motivation	1
1.1.1 Climate change context	1
1.1.2 Contribution of PV energy	2
1.1.3 PV systems in urban areas	4
1.1.4 General challenges in the field	5
1.2 Background and research context	7
1.2.1 Overview of PVSC facilities on building's rooftops	7
1.2.2 Main approaches to assess PVSC in urban areas	11
1.2.3 Detailed analysis of the modeling techniques of PVSC in urban areas studied in the present thesis	15

1.3	Identified gaps and research questions	23
1.4	Objectives	25
1.5	Scope and boundaries of the thesis	26
1.6	Structure	27
1.7	References	30
2	Performance analysis and modelling of a 50 MW grid-connected photovoltaic plant in Spain after 12 years of operation	43
2.1	Introduction	49
2.2	Materials	51
2.3	Methods	56
2.3.1	Data pre-processing	57
2.3.2	PV performance parameters	58
2.3.3	Energy production model	58
2.3.4	PR physical model	59
2.3.5	PR Statistical and Machine Learning models	61
2.3.6	Model deviation	63
2.4	Results	64
2.4.1	Performance results of the PV facility	64
2.4.2	PR modelling results	70
2.4.3	PV production modelling results	75
2.5	Conclusions	79
2.6	Acknowledgements	80
2.7	References	81
3	Innovative regression-based methodology to assess the techno-economic performance of photovoltaic installations in urban areas	89
3.1	Introduction	93
3.2	Methods	96
3.2.1	Description of the methodology	96

3.2.2	Techno-economic model	97
3.3	Results and discussion	102
3.3.1	Validation of the techno-economic model	102
3.3.2	Payback regression model	104
3.3.3	Validation of the regression model	107
3.3.4	Overall analysis of the assessed multi-storey buildings	113
3.4	Conclusions	118
3.5	Acknowledgements	119
3.6	References	120
4	Techno-Economic Potential of Urban Photovoltaics: Comparison of Net Billing and Net Metering in a Mediterranean Municipality	125
4.1	Introduction	130
4.2	Materials and Methods	132
4.2.1	Analysis Area	132
4.2.2	Techno-Economic Model	134
4.2.3	Regression Modeling	137
4.2.4	Assessed Scenarios	142
4.3	Results and Discussion	145
4.3.1	Municipality Self-Consumption Potential	145
4.3.2	Regression Results	155
4.4	Conclusions	161
4.5	Acknowledgments	163
4.6	Appendix A	164
4.7	References	171
5	Discussion of the main results	177
5.1	PV production model	178
5.2	Models for the assessment of the of the PVSC performance in urban areas	180
5.2.1	Physical modeling approach	180

5.2.2	Analysis of the PVSC performance per category of buildings	180
5.3	Regression-based modeling approaches to estimate PVSC KPIs	184
6	Conclusions	187
6.1	General conclusions	188
6.2	Future work and research opportunities	191
6.3	Publications and research activities	194
6.3.1	Journal publications	194
6.3.2	Conferences	194