TABLE OF CONTENTS

EXECUTIVE SUMMARY ix

RESUMEN EJECUTIVO xi

RESUMEN EXECUTIU xiii

CHAPTER 1. INTRODUCTION 15

1.1 Objective 19

1.2 Structure 21

1.3 Bibliography 24

CHAPTER 2. STATE OF THE ART 25

2.1 Energy Planning 25

2.1.1 Centralized versus Decentralized 26

2.1.2 Methods and Tools 27

2.2 Distributed Generation 29

2.2.1 Stand-alone systems 30

2.2.2 Hybrid Renewable Energy Systems 31

2.2.3 Control Strategies 34

2.3 Electric Demand in Isolated Areas 36

2.3.1 Demand Characterization 36

2.3.2 Demand Side Management 39

2.4 Multi-criteria Decision Methods 43

2.5 Conclusions 47

2.6 Bibliography 47

CHAPTER 3. METHODOLOGY 57

3.1 Energy Planning 59

3.1.1 Simulation model 60

3.1.2 Code structure 62

3.2 HRES Configuration Set 71

3.2.1 Resources Assessment 73

3.2.2 Load Profiles 98

3.2.3 Demand Side Management 105

3.2.4 Technologies 107

3.2.5 Techno-economic Optimization 123

3.3 Multi-criteria Assessment 126

3.3.1 Analytic Hierarchy Process (AHP) 127

3.3.2 AHP applied to HRES 132

3.4 Conclusions 136

3.5 Bibliography 137

CHAPTER 4. APPLICATION TO A STUDY CASE 143

4.1 Energy Planning 143

4.1.1 Energy Context of RDC 144

4.1.2 BAU vs HRES Scenario 148

4.2 HRES Configuration Set 154

4.2.1 Demand 154

4.2.2 Resources *157*
4.2.3 Technologies *161*
4.2.4 Results *163*
4.2.5 Experimental Validation at Small-Scaled *164*
4.3 Multi-criteria Assessment 172
4.3.1 Expert's validation *173*
4.4 Conclusions 179
4.5 Bibliography 180
CHAPTER 5. CONCLUSIONS 183
APPENDICES 187
Appendix 1. Energy Reports on RDC Scenarios 188
Appendix 2. Description of the Laboratory LabDER 189
Appendix 3. Author's articles associated to this thesis 197