Study on Renewable Energies and Green Policy in the Overseas Countries and Territories

FINAL REPORT

May 2014

The project is funded by the European Union

The project is implemented by Resources and Logistics

“This report was prepared with the financial support of the European Commission and presented by RAL. The opinions expressed are those of the authors and not necessarily those of the European Commission.”
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<td>AC</td>
<td>Air conditioning</td>
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<td>ACP</td>
<td>African, Caribbean and Pacific countries</td>
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<td>ADEME</td>
<td>Agence de l’Environnement et de la Maîtrise de l’Énergie - French Agency for Environment and Energy Management</td>
</tr>
<tr>
<td>AFD</td>
<td>Agence Française de Développement</td>
</tr>
<tr>
<td>ANEC</td>
<td>Anguilla National Energy Committee</td>
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<tr>
<td>ANGLEC</td>
<td>Anguilla Electricity Company Ltd.</td>
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<tr>
<td>AREO</td>
<td>Anguilla Renewable Energy Office</td>
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<tr>
<td>ARTEK</td>
<td>Arctic Technology Center</td>
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<tr>
<td>ARUGAS</td>
<td>Aruba Gas Supply Company Ltd</td>
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<tr>
<td>ASRI</td>
<td>Aruba Sustainable Research Institute</td>
</tr>
<tr>
<td>BOPEC</td>
<td>Bonaire petroleum corporation</td>
</tr>
<tr>
<td>BNEF</td>
<td>Bloomberg New Energy Finance</td>
</tr>
<tr>
<td>BVI</td>
<td>British Virgin Islands</td>
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<tr>
<td>BVIEC</td>
<td>British Virgin Islands Electricity Corp.</td>
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<tr>
<td>CARILEC</td>
<td>Caribbean Electric Utility Service Corporation</td>
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<tr>
<td>CAWEI</td>
<td>Caribbean Wind Energy Initiative</td>
</tr>
<tr>
<td>CBP&amp;L</td>
<td>Cayman Brac Power &amp; Light Co. Ltd.</td>
</tr>
<tr>
<td>CCI</td>
<td>Chambre de Commerce et d’Industrie</td>
</tr>
<tr>
<td>CEIS</td>
<td>Caribbean Energy Information System</td>
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<tr>
<td>CFL</td>
<td>Compact Fluorescent Lamp</td>
</tr>
<tr>
<td>CGM</td>
<td>Conseil General de Mayotte – General Council of Mayotte</td>
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<tr>
<td>CHP</td>
<td>Combined Heat and Power</td>
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<tr>
<td>CIA</td>
<td>US Centrale Intelligence Agency</td>
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<td>CIF</td>
<td>Climate Investment Fund</td>
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<tr>
<td>CO₂</td>
<td>Carbon Dioxide</td>
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<td>CPRM</td>
<td>Conference of Peripheral Maritime Regions</td>
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<td>CREDP</td>
<td>Caribbean Renewable Energy Development Programme</td>
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<tr>
<td>CREF</td>
<td>Caribbean Renewable Energy Forum</td>
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<tr>
<td>CROP</td>
<td>Council of Regional Organisations in the Pacific</td>
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<tr>
<td>CSD</td>
<td>UN Commission on Sustainable Development</td>
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<tr>
<td>CTME</td>
<td>Comité Territorial pour la Maîtrise de l’Énergie – Territorial comité for Energy Efficiency</td>
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<td>CUC</td>
<td>Caribbean Utilities Company Ltd.</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>DIIID</td>
<td>British Department for International Development</td>
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<tr>
<td>DHW</td>
<td>Domestic hot water</td>
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<td>DIMENC</td>
<td>Direction de l’Industrie, des Mines et de l’Energie – Industry, Mining and Energy Department</td>
</tr>
<tr>
<td>DOM</td>
<td>Departement d’Outremer – Overseas Department</td>
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<tr>
<td>DSM</td>
<td>Demand Side Management</td>
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<tr>
<td>EDF</td>
<td>Electricité de France</td>
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<td>EDF</td>
<td>European Development Fund</td>
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<tr>
<td>EDIN</td>
<td>Energy Development in Island Nations</td>
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<td>EDM</td>
<td>Electricité de Mayotte – Electricity of Mayotte</td>
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<td>EDN</td>
<td>Energie Du Nord</td>
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<td>EDT</td>
<td>Electricité De Tahiti – Electricity of Tahiti</td>
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<td>EE</td>
<td>Energy Efficiency</td>
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<td>EE</td>
<td>Endless Energy Ltd.</td>
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<td>Eau et Electricité de Calédonie – Water and Electricity of Caledonia</td>
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<td>EES</td>
<td>Electrical Energy Storage</td>
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<td>EEWF</td>
<td>Eau et Energie de Wallis et Futuna – Water and Energy of Wallis and Futuna</td>
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<td>European Investment Bank</td>
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<td>Electriciteit-Maatschappij Aruba N.V.</td>
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<td>ENERCAL</td>
<td>Société Néo-Calédonienne d’Energie</td>
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<td>ERA</td>
<td>Electricity Regulatory Authority</td>
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<td>EU</td>
<td>European Union</td>
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<td>EUEI PDF</td>
<td>EU Energy Initiative Partnership Dialogue Facility</td>
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<td>EU ETS</td>
<td>EU Emissions Trading System</td>
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<td>FCME</td>
<td>Fonds de Concours pour la Maîtrise de l’Energie - Competition Fund for Energy Efficiency</td>
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<td>FER</td>
<td>Fonds d’Electrification Rural - Rural Electrification Fund</td>
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<td>FIC</td>
<td>Falkland Islands Company</td>
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<td>FIDC</td>
<td>Falkland Islands Development Corporation</td>
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<td>FIDEME</td>
<td>Fond d’Investissements de l’Environnement et de la Maîtrise de l’Energie</td>
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<td>FIG</td>
<td>Falkland Islands Government</td>
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<tr>
<td>FLA</td>
<td>Flooded lead acid (battery)</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>GEEREF</td>
<td>Global Energy Efficiency and Renewable Energy Fund</td>
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<td>GEF</td>
<td>Global Environment Facility</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>GHG</td>
<td>Greenhouse gas</td>
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<td>GHP</td>
<td>Ground source heat pump</td>
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<tr>
<td>GIE</td>
<td>Groupement d’Intérêt Economique – Economic Interest Group</td>
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<tr>
<td>GREIN</td>
<td>Global Renewable Energy Islands Network</td>
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<tr>
<td>GSEII</td>
<td>Global Sustainable Energy Islands Initiative</td>
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<tr>
<td>GWh</td>
<td>Gigawatt hour</td>
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<td>HDI</td>
<td>Human Development Index</td>
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<td>HFO</td>
<td>Heavy Fuel Oil</td>
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<td>IEE</td>
<td>Intelligent Energy Europe</td>
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<tr>
<td>IDC</td>
<td>Institut pour le Développement des Compétences - Institute for Competencies Development</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>IPP</td>
<td>Independent Power Producer</td>
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<td>IRENA</td>
<td>International Renewable Energy Agency</td>
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<td>ISLENET</td>
<td>European Island Authorities</td>
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<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
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<tr>
<td>MDG</td>
<td>Millennium Development Goals</td>
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<td>MICUH</td>
<td>Ministry of Infrastructure, Communications, Utilities, and Housing (Anguilla)</td>
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<td>MUL</td>
<td>Montserrat Electricity Services</td>
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<tr>
<td>MW</td>
<td>Megawatt</td>
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<td>NGCC</td>
<td>Natural Gas Combined Cycle</td>
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<td>OCT</td>
<td>European Overseas Countries and Territories</td>
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<td>OCTA</td>
<td>Overseas Countries &amp; Territories Association</td>
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<tr>
<td>ODA</td>
<td>Official Development Assistance</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OPEC</td>
<td>Organization of the Petroleum-Exporting Countries</td>
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<td>OTEC</td>
<td>Ocean Thermal Energy Conversion</td>
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<td>PALS</td>
<td>Pacific Appliance Labelling and Standards (program)</td>
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<td>PdvSA</td>
<td>Petróleos de Venezuela SA</td>
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<td>PIC</td>
<td>Pacific Island Country</td>
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<td>PIEPSAP</td>
<td>Pacific Islands Energy Policy and Strategic Action Planning</td>
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<td>PIGGAREP</td>
<td>Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project</td>
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<td>PIO</td>
<td>Pitcairn Island Office</td>
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<td>PIREP</td>
<td>Pacific Islands Renewable Energy Project</td>
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<td>PPA</td>
<td>Pacific Power Association</td>
</tr>
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<td>Description</td>
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<td>PPC</td>
<td>Provo Power Company Ltd.</td>
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<tr>
<td>PPI</td>
<td>Programmation Pluriannuelle des Investissements – Pluri annual investment programme</td>
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<tr>
<td>PPMV</td>
<td>Parts Per Million by Volume</td>
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<td>PPP</td>
<td>Purchasing Power Parity</td>
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<td>PV</td>
<td>Photovoltaics</td>
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<td>PWD</td>
<td>Public Works Department</td>
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<td>RCCEEP</td>
<td>Regional Climate Change, Energy &amp; Ecosystems Project</td>
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<tr>
<td>RE</td>
<td>Renewable Energy</td>
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<td>RED</td>
<td>Renewable Energy Desalination</td>
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<td>REEEP</td>
<td>Renewable Energy and Energy Efficiency Project</td>
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<td>REM</td>
<td>Rural Electrification through Micro-grids</td>
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<td>RES</td>
<td>Renewable Energy Sources</td>
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<td>RET</td>
<td>Renewable Energy Technologies</td>
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<td>RFO</td>
<td>Radio France Outre Mer</td>
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<td>RUE</td>
<td>Rational Use of Energy</td>
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<td>SEDEP</td>
<td>Société d’études et de développement polynésienne – Society for the Study and Development of Polynesia</td>
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<td>St Helena Government</td>
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<td>Solar Hot Water</td>
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<td>Small Islands Developing States</td>
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<td>Saint Pierre &amp; Miquelon</td>
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<td>SPP</td>
<td>Small Power Producer</td>
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<td>SWAFEPP</td>
<td>Société Wallisienne et Futunienne d’Exploitation des Produits Pétroliers</td>
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<td>SWH</td>
<td>Solar water heater</td>
</tr>
<tr>
<td>T&amp;D</td>
<td>Transmission and Distribution</td>
</tr>
<tr>
<td>TCI</td>
<td>Turks &amp; Caicos Islands</td>
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<tr>
<td>TEP</td>
<td>Transport Electric de Polynésie – Electricity Transmission of Polynesia</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Name</td>
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<tr>
<td>TGI</td>
<td>Taxe Générale d’Importation – General import tax</td>
</tr>
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<td>UK</td>
<td>United Kingdom</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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<td>United Nations Environment Programme</td>
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<td>United States of America</td>
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<td>U.S. Agency for International Development</td>
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<td>Wind Energy Solutions</td>
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<td>WF</td>
<td>Wallis et Futuna</td>
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<td>WWF</td>
<td>World Wildlife Fund</td>
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1 EXECUTIVE SUMMARY

1.1 Context

The main challenge that OCTs face consists in putting their economies and societies on a sustainable development path by increasing their competitiveness, reducing their vulnerability to external shocks, increasing environmental resilience, cooperating with their neighbours and, where possible, integrating their economies into the regional and/or global economy. For the European Union, the challenge lies in supporting the OCTs in achieving these goals as well as the main purpose of the Association of the Overseas Countries and Territories, as defined in Article 198 of the Treaty on the functioning of the European Union, via a framework that is adapted to OCT needs, realities, particularities and diversity.

The report provides an update on the current situation of the OCTs’ existing energy profiles, reviews and analyses progress made by the OCTs over the last few years, assesses the evolution of the energy mix and potential for additional diversification, analyses development of further adoption of sustainable energy technologies, and maps out the experience gained to date in island states with regard to sustainable energy technologies.

Access to basic energy services, recognized by EU Members States as a key factor to improve living conditions of isolated populations, allow for better comfort, favour creation and increase income generating activities, improve quality of health and education, facilitate access to information as well as put an hold on rural exodus. In a way, it is the basis for a sustainable economic and social development.

The development of the energy sector in the island countries in general is facing structural constraints such as lack of fossil energy resources leading to a high dependency on imported hydrocarbon fuels, low level of energy demand and scattered population, making rural electrification programmes expensive and sometime not practical.

1.2 Energy challenges

More than 95% of the commercial energy needs of the OCTs are met from fossil fuels. This heavy dependency exposes the economic vulnerability of the islands to the volatility of the prices of petroleum products. The increase in the price of petroleum impacts disproportionately on the islands with low income. Small islands are most vulnerable to oil price fluctuations since their oil imports represents a significant share of the GDP (15% on average but may reach up to 20% and even more) and of their total imports (may reach one third). Approximately 15% of imported fossil fuel is used for electricity generation and much more is used for transport.

Generally, where prices are not distorted and reflect the real costs, the costs of electricity and petroleum in the OCTs are among the highest in the world. Total energy losses in some power utilities are as high as 20% to 25%. However, most of OCTs have started actions in favour of energy demand side management and energy efficiency in general. On the other hand, very little has been done about addressing the losses in the transportation sector.
Despite the effort in the last three decades to reduce reliance on fossil fuel and make modern energy services accessible and affordable through the widespread utilisation of feasible renewable energy technologies and improved energy efficiency, the progress has been rather slow and the heavy reliance on fossil fuel will continue for some years to come. Weak project management capacity, inappropriate project designs and technologies, absence of adapted products and installation standards, lack of funds to cover maintenance are some of the challenges encountered.

1.3 Economies and institutional framework in the OCTs

The total population of OCTs is 1.25 million inhabitants with very large difference in their economy and wealth. Three groups are identified:

- Economies based on own assets and environment: Most of the Caribbean islands, due to their environment attracting tourism and/or their offshore financial status (Cayman Islands, British Virgin Islands, Saint-Barthélemy, Aruba, Curaçao, Sint Maarten, Bonaire, Turks & Caicos islands, Anguilla) as well as French Polynesia due to tourism (despite recent downturns) and its public sector, New Caledonia and Greenland due to their significant industrial activities and their public sector. (Greenland receives nevertheless significant government support).
- Economies with very limited industry base, significant public sector / government support (and > 5,000 people): St Pierre & Miquelon and Wallis & Futuna, Mayotte,
- Small population islands (< 5,000 people) and remote territories: St Eustatius, Saba, Montserrat and St Helena receive significant public aid to compensate for their weak economies and in a lesser extent Pitcairn and the Falkland Islands

There are significant differences between the OCTs in terms of policies, regulatory frameworks, and even commitments. The historical link between the OCTs and the ‘Member States to which they are linked’ is one of the key elements shaping the way energy is considered. Some OCTs have dedicated institutions in charge of energy matters while others have strong departments inside a ministry. In some OCTs, there is no dedicated energy strategy, but a more general country development strategy, which encompasses energy: in Turks & Caicos, in Greenland, in Saint-Pierre-et-Miquelon. However, energy issues are taken seriously in all OCTs.

Within the administrations and energy stakeholders in the OCTs, some areas need to be strengthened in terms of capacity building, knowledge improvement and exchange of information to improve capacity and increase expertise in preparing and monitoring their energy future. The proposed areas include: Training, business advisory support and networking and communication.

Most OCTs (largest ones with significant energy demand) have set clear and ambitious energy targets. These targets generally include the increased use of renewable energy sources for electricity generation. These are not only theoretical targets but well defined targets based on key policy and strategy studies, with a detailed assessment of the situation, analysis of potential and role to be played by renewables in their future energy mix, and, usually, with an indication of the means and resources to be mobilized to reach the targets.
1.4 Energy issues of the OCTs

Total generation capacity in the OCTs is approximately 2075 MW with 495 MW in New Caledonia alone, between 100 and ~300 MW in Aruba, Cayman Islands, Curacao, French Polynesia and Greenland. The installed capacity per capita may vary significantly from one OCT to another from 0.6 kW/cap in Wallis et Futuna where 20% of people are still without access to electricity to more than 3 kW/cap in the Falklands and St Pierre et Miquelon.

During the last five years, installed capacity has increased by 400 MW in the OCTs including 110 MW of additional power from renewables which represent 320 MW in 2013. The participation of RE has slightly increased from 14.2% in 2008 to 17% in 2013. Across all OCTs, electricity demand is increasing rapidly, for example in French Polynesia where the consumption growth rates reach 8.2% per year.

During the same period of time, there have been significant increases in the RE installed capacities in several OCTs due to a number of large projects that have tapped conventional renewable energy resources: +37 MW hydropower capacity in Greenland, +13.8 MW in Mayotte (mainly PV), +12 MW PV in French Polynesia, +30 MW wind in Aruba, +10.8 MW wind in Bonaire, +1 MW wind in the Falkland Islands (including flywheels for energy storage and another new wind farm in construction since December 2012), and a two-fold increase in the generation share of RE sources in St Helena.

In addition, the pursuit of other RE options (slightly more complex or less conventional) has also made progress: a survey of the potential for hydropower (hydrological and geological studies) is ongoing in Greenland; a 650 kW bio-methane unit with composting and a 1.5 MW biomass-fired unit are under consideration in French Polynesia; the blending of 20% copra oil in diesel for adapted generators is under consideration in Wallis & Futuna; and exploratory work on geothermal potential has started in Saba (2009) while a similar assessment was completed in 2010 for Montserrat, leading to an invitation for expression of interest for the further exploration and development of geothermal energy in Montserrat. A SWAC facility is successfully operated in French Polynesia and Aruba is also planning implementation of such technology. Finally, waste-to-energy plants are under consideration in Aruba (5MW) and Anguilla.

1.5 Renewable energy applications

Conventional RES applications are the technologies that are widely available and commercialised in the EU; their basic technology is generally established. They include wind, photovoltaic, solar thermal, hydro, geothermal and biomass. From those, wind, photovoltaic, and solar thermal can be typically deployed in any OCT area, contributing significantly to RE penetration in the OCTs’ energy mix.

Innovative RE technologies are technology applications that until now have either not been developed at all in the OCTs (i.e. only studies have been undertaken) or have been implemented at a pilot level, and their development needs to be further explored. They include: Waste to Energy, Sea Water Air Conditioning (SWAC), Solar Cooling, AC and Refrigeration, Ground Source Heat Pumps for Heating and Cooling, Tidal and Wave Power, Ocean Thermal Energy Conversion (OTEC), Micro Hydro, Biomass Trigeneration, Renewable Energy
Desalination (RED), Rural Electrification through Micro-grids (REM), Renewable Energy Storage (REST) and Renewable Energy Smart grids. Due to their innovative character, a more sophisticated approach is needed and detailed studies (e.g. site, feasibility, environmental impact, demand side profiles) including social acceptance criteria are required prior to implementation. However, many of these technologies will be applicable in the OCTs, provided the fact that their costs reach suitable levels (Waste to Energy technologies, Ground Source Heat Pumps for Heating and Cooling, RE Desalination for potable water, RE Microgrids, RE Storage and RE Smartgrids).

SWAC and Solar AC/Refrigeration are suitable only in OCTs with cooling needs, especially for the tertiary sector (hotels) located in the tropics, such as Turks & Caicos, Anguilla, etc. The cost of these technologies is still considerable so careful design is critical. Tidal and Wave power are technologies applicable to OCTs with tidal and wave potential, such as in St. Pierre & Miquelon and the Falklands. OTEC is a technology applicable only in certain OCTs where specific conditions are in place and Micro hydro schemes can be viable in OCTs without a need for significant infrastructure works. Finally, Biomass tri-generation is a technology applicable to OCTs with rich biomass feedstock and demand for heating, cooling and hot-water, all combined in one application.

Energy storage and buffering allows for better management of produced energy. As a result, the time shift between the actual energy production and energy consumption is manageable. It has also been a topic of interest in recent years because of the high penetration of intermittent renewable energy technologies and, more specifically, wind and solar energy.

The most common energy storage approach is the use of batteries available in many different forms. Pumped hydroelectricity storage is the largest-capacity form of energy storage currently used.

Some remarkable renewable energy and energy management applications have already been implemented in the OCTs such as Smart metering project in Greenland involving replacement of all electricity, water and heating meters, large hydro technologies in French Polynesia where 47 MW are installed providing about 30% of the Tahiti island power, hybrid wind-diesel power generation successfully in operation in the Falklands since 2007 able to provide 33% of yearly electricity generation, large energy-efficiency funding programme in Saint Pierre et Miquelon with replacement of old equipment with new and efficient ones. In Aruba, the introduction of internal combustion engines and reverse osmosis systems has yield efficiency gains of 50% in power generation and 85% in the desalination of seawater.

Prepaid meters “Ankiba” in Mayotte and also in Aruba were introduced while SWAC technology in French Polynesia and installation of wind turbine designed for better adaptation to tropical environment.
1.6 Cooperation and Funding opportunities

Some regional programmes were executed in the regions of the OCTs (PIEPSAP, PIREP or REP-PoR) but except participation in a few events, the OCTs were not present.

Aruba entered in cooperation with various institutes like Carbon War Room, New American Foundation, universities in USA, like Harvard and Arizona State, in Holland with TNO, ECN, Ecofy’s, and also the university of Delft.

Others are still running with a very limited possibility of participation of the OCTs in the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP), a few Caribbean initiatives (CREDP, CREF, CAWEI) and the network of European Island Authorities (ISLENET).

The Renewable Energy and Energy Efficiency Project (REEEP) will launch a new call for proposal scheduled for early 2014 under its 10th Project Cycle. OCTs should register with REEEP to receive call notifications as they will include specific guidelines on eligible proposals.

The OCTs and the EU Member States should investigate whether OCTs could be involved in activities of the recently created International Renewable Energy Agency (IRENA) and participate in the two clusters set up under the new Global Renewable Energy Islands Network (GREIN): a) Road Maps Interest Cluster and b) Power Grids Interest Cluster.

Other programmes include the Caribbean Energy Information System (CEIS), the Energy Development in Island Nations (EDIN) and the Global Sustainable Energy Islands Initiative.

The European Investment Bank can be activated and is an active partner either through direct intervention or through the recently created Global Climate Change FL which clearly indicates that OCTs can apply for funding.

Other EU Member States mechanisms and supports are available such as AFD or Specific programmes (FIDEME, or the Fond Chaleur of ADEME) in many French OCTs, DFID in Pitcairn or Montserrat.

Global Energy Efficiency and Renewable Energy Fund (GEEREF) can be available for Anguilla, Montserrat, St Helena and Wallis et Futuna.

Although the EU Energy Initiative Partnership Dialogue Facility mainly targets Africa, there is a possibility for the OCTs or EU Member States to apply for energy strategy and policy issues.

The European Development Fund (EDF) is one of the main source of funds with all support provided in ACP countries. TEP Vertes is an example of programme supported by EDF. This project co-funded by the EC under the 9th EDF is terminated and led to the implementation of 10 small scale RE projects in Wallis et Futuna, New Caledonia and French Polynesia. A few OCTs may have now the appropriate environment (public finance framework in place) to apply for energy sector budget support. However, this still needs to be confirmed in the context of the 11th EDF programming exercise.
The EU-funded Intelligent Energy Europe programme may still support capacity building as this specific call for applications is still opened until November 28th 2013.

Any island can join the GSEII initiative (Vision 20/30). The programme launched in 2012 is identifying islands ready to join the action.

It may be difficult for the actors in the OCTs to apply alone to the Programme “Horizon 2020”, the new EU Framework Programme for Research and Innovation running from 2014 to 2020 with a budget of just over €70 billion. However, like for many of the windows presented, this can be done through grouping with European partners and this might be a key activity of the proposed OCT energy network.

1.7 Key recommendations

Key recommendations can be summarized in 8 key proposals as follows:

- Appropriate regulatory framework leaving room for private sector mobilization and partnership with public bodies through promotion of PPPs scheme;
- Regular “Donor” coordination meetings and strengthening fund raising expertise;
- Develop capacity building in project finance;
- Prioritise Energy Efficiency including smart metering
- Progress in RE installed capacity
- PV and Solar Thermal: In many OCTs solar technologies are developing, as their design, installation, declining cost and maintenance know-how requirements are minimal. Some RE technologies are less expensive than conventional ones: new areas of expertise need to be acquired by local practitioners regarding these technologies;
- OCTs are an ideal field for testing specific technologies and wide RE penetration and all means should be searched and mobilized through the available funding opportunities to further develop applied research;
- Development of roadmap by OCTs, designed according to energy supply security needs, deployment costs, required regulation changes, ability to attract private investors

On institutional and regulatory framework:

There is no ideal or unique institutional and legal framework to address the question of sustainable energy, renewable energy, energy efficiency, and waste to energy alternatives in the OCTs. The main need is to be pragmatic and efficient, with adapted organization based on local understanding of the environment as opposed to large economic and governance structures which are rarely feasible and often counterproductive in islands.

RES will be unable to compete on a level playing field with conventional generation until new policies are adopted to internalize the public costs of fossil fuel sources.

The regulation model should be a model tailored to the situation and size of the islands with adequate independence as a precondition for an effective electricity pricing policy and ensuring a proper balance between consumer demand, the operators and the investors’ need for a reasonable return.
Regulatory measures have to consider the monopoly environment on electricity production and distribution in many islands. For a voluntary pro-green regulation and an increase of the RE applications, it is necessary to give priority to RE independent producers and simplify bureaucratic procedures.

*On renewable energy development:*

Renewable energy development in OCTs can be successful, when based on specific plans supported by structured mechanisms including altogether the decision making process, structural and institutional resources, as well as a financing strategy. Renewable Energy Action or Development plans are needed for identifying not only the physical, technical and economic potential of each RES technology in the OCT area in question, but also for securing the financial resources available for supporting the RES interventions identified through technical evaluation. RES action plan should set specific and realistic RES development targets with specific timelines.

In numerous OCTs, such an approach for RES development, involving technical capacity for setting specific RES targets, and institutional capacity for achieving those targets is being adopted. Enhancing and strengthening of these capacities has also been identified as necessary.

Other OCTs support RES development on an ad-hoc basis, without setting any specific targets or RES plan, by examining each RES project separately. This kind of approach can still be functional, especially in the smallest OCTs with more centralised institutional structures and small room for creating new structures.

Conventional RES technologies such as Wind, PV, Solar Thermal, Hydro, Geothermal and Biomass energy have established market availability and technological maturity to a point of being competitive to conventional fossil fuels technologies (sometimes with a required buffer or back up). The development of these mature technologies can respect technical constraints set by the operation of conventional fossil fuel units, thanks to a gradual penetration year by year so that fossil units’ equipment is not being devalued. While more innovative technologies (marine energies, new storage options, smartgrids), even if they might be implemented in the future in the OCTs, are still perceived as too expensive and not mature enough yet.

Finally, OCTs do not need to create from scratch the mechanisms for RES development. There are already best practices, experience and available mechanisms and models which could suit the type of investment to be decided.

This study provides identification of RES applications suitable to the context of each OCT area, as well as best practice references compiled through project fiches and a survey on the financial instruments available for OCTs concrete and secure RES development.

*On energy efficiency policy options:*

As part of a sustainable energy strategy and associated regulatory adaptations, energy efficiency policy should be a priority. An energy efficiency strategy should cover all sectors: administration and public buildings, households, SMEs, services and industry.

Recommended energy-efficiency measures that stakeholders should consider are:
(i) Data collection (energy audits, implementation of smart meters for demand side management policy),
(ii) Awareness raising (technical partnerships between organisations, construction federations, businesses, for actions such as benchmarking and training, awareness activities for the public, education of future professionals, setting an example through the adaptation and renovation of public buildings and social housing stock),
(iii) Implementation of new standards and labelling (within a building code: minimum standards for the design of new buildings, minimum % provision of on-site RE sources, for instance solar water heaters, energy performance certification for new and existing buildings; regulation favouring the deployment of CFLs and energy-efficient appliances),
(iv) Incentives and support (tax incentives for the import and purchase of low-energy appliances, tax incentives for the adaptation and renovation works of housing and private buildings stock, support to the power generation and transmission sectors in order to improve the efficiency of power generation and to reduce distribution losses. Administrative procedures should be simple and flexible, and allow an easy access to the various beneficiaries.

On funding models and available financial instruments:

Investment in renewable energy in the OCTs has been particularly active in solar energy, driven by several factors such as decrease in the cost of PV and possibility to develop hybrid solutions and individual solutions. Investment in wind energy and small hydro projects has been also significant, reflecting the maturity of these technologies.

RE investors in developing countries include governments, banks, equity firms, insurance companies, pension funds, industry bodies, clean energy companies, and start-up project developers. The RE-based power projects generate mostly regulated revenues while lenders usually bear the political and operational risk. Project financing means taking risks for 10 to 15 years. Public funding has been proven successful to finance renewable energy projects.

The Public-Private Partnership (PPP) model has been also used in various instances and is a very successful model which is well suited for renewable energy projects. Examples of successful projects based on PPP are found New Caledonia and Aruba for instance.

Government policy is needed to incorporate the cost of social and environmental externalities into the price of energy and to additionally (or alternatively) financially support RE until it is market-competitive.

Other factors contributing to the relatively higher market price of RE technologies include: (1) higher up-front RE capital costs compared with conventional options, and (2) higher perceived risk of RE investments.

Governments generally seek to intervene in two comprehensive ways: (1) by setting overarching regulatory and incentive frameworks that may contribute to boost RE projects; and (2) by using targeted public funding to fill or overcome specific financing gaps and barriers to RE investment.
1.8 Roadmaps for the transition to a smart sustainability and adaptation to OCTs

OCTs recognize that an energy transition strategy is critical to ensure a sustainable energy system. The development of a Sustainable Energy Road Map includes several steps from initial assessment to the strategy itself.

The first steps to initiate a transition strategy should be (i) the assessment of the local energy system characteristics (including actual generation costs) and context, (ii) the forecast the evolution of power needs, (iii) an analysis of existing regulatory framework. For these, numerous consultations with all stakeholders (utility companies, Government, users, others as locally appropriate) are necessary.

Regarding implementation measures, efforts towards increased energy efficiency should be the first priority. Regarding renewable energy deployment, despite local differences between OCTs in terms of climate, RE resource base, remoteness, and the power generation and distribution systems, there are common realities. The analysis of existing literature shows that there is a quite clear and common picture in terms of ranking least-cost RE options in islands. Data for Pacific Island Countries and the Caribbean area suggest that RE development in OCTs could start with the most cost effective RE technologies, i.e. in the following order:

1 - Solar water heaters (except for Greenland)
2 - Hydro Power (where resource is available)
3 - Biomass Projects and Landfill Gas to Energy, due to their installation and generation costs, commercial availability and value chain creating with the exploitation of indigenous sources.
4 - Wind Power (for sites with load factors over 25%)
5 - Small grid-connected PV (where local resource makes this option affordable compared to others)

Nevertheless, a precise analysis of the investment costs, generation costs of each potentially applicable RE technology should be undertaken, according to local conditions. These analyses will enable local authorities to assess economic feasibility, potential investments needs and to build a roadmap and an action plan.


2 INTRODUCTION

The main challenge that OCTs face consists in putting their economies and societies on a sustainable development path by increasing their competitiveness, reducing their vulnerability to external shocks, increasing environmental resilience, cooperating with their neighbors and, where possible, integrating their economies into the regional and/or global economy. For the European Union, the challenge lies in supporting the OCTs in achieving these goals as well as the main purpose of the Association, as defined in Article 198 of the Treaty on the functioning of the European Union, via a framework that is adapted to OCT needs, realities, particularities and diversity.

A key element in this process was the preparation and presentation, in September 2008, of an in-depth report, which aimed at providing the current energy profiles of the OCTs and exploring the need to diversify the existing energy mix towards the further adoption of sustainable energy technologies. The study mapped out the experience gained in island states with regard to the development of sustainable energy technologies; it also identified different ways to successfully deploy renewable energy and energy efficiency measures, wherever appropriate. The report was the basis for discussions about new energy policy strategies between the OCTs in 2008.

The European Commission presented a proposal for a council decision on the Association of the Overseas Countries and Territories with the European Union. In this context, sustainable energy has been identified as a specific area of cooperation and the OCTs and the EU agree on the fact that there is an urgent need to analyse the progress that has been made since 2008. The OCTs and the EU also agree on the idea of carrying out a policy audit in the OCTs as well as on updating the baseline data on new renewable energy potential, storage and buffering solutions. The EU and the OCTs insist as well on the importance of evaluating the economics of the renewable energy capability of the OCTs in order to come up with concrete recommendations on sustainable energy solutions, aimed at reducing their vulnerability caused by fossil fuel dependency.

The aim of this assignment is to define new strategies for the development of renewable energy programmes in the OCTs as well as the measures that need to be adopted for the implementation of these strategies. The idea is to establish a roadmap that will facilitate the transition of the OCTs towards the implementation of a Green Energy Policy. For obvious time and resources constraints, it has not been possible to propose a detailed road map for each OCT but only general orientations and paths to be followed to elaborate more detailed individual road maps.

The report is expected to be a tool in a master plan which will sketch out new directions in terms of the energy future of the OCTs. The information contained in the report is intended to help stakeholders strengthen their own strategies and policies regarding renewable energy practices and technologies. The report provides an update on the current situation of the OCTs’ existing energy profiles, reviews and analyses progress made by the OCTs over the last few years, assesses the evolution of the energy mix and potential for additional diversification, analyses development of further adoption of sustainable energy technologies, and maps out the experience gained to date in island states with regard to sustainable energy technologies. It also contains a description of the evolution of the institutional and legal framework since 2008, a review of the best practices and knowledge identified in the field of renewable energy in order
for successful cases to be replicated in other OCTs, and an analysis of the financing schemes that are being implemented in the OCTs, and in other regions with similar characteristics.

It further provides inputs to the OCT’s on identifying a way forward on how to successfully deploy renewable energy technologies and energy efficiency measures, wherever appropriate. This report will also enable discussions to be opened up on new energy policy strategies by the OCTs during the meeting scheduled in Brussels in September 2013 when the report is presented and discussed among OCTs and EC stakeholders.

The report was commissioned by the European Commission, DG Development and Cooperation (EuropeAid), for the Overseas Countries and Territories Association (OCTA). The report has been written by a team of three consultants contracted by RAL France. The information provided in this report is based on (1) primary data obtained from the OCT’s through a questionnaire, (2) direct interviews, (3) existing secondary data and (4) internet search.

The report covers twenty one OCTs (see table below) which are closely associated with four Member States of the European Union: Denmark, France, The Netherlands and the United Kingdom. A map illustrating the location of each of these islands is provided in Annex 1.

Table 1: Geographical location of OCTs covered in the report and the Member States to which they are linked

<table>
<thead>
<tr>
<th>Caribbean OCTs</th>
<th>Pacific Ocean OCTs</th>
<th>Other populated OCTs</th>
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</thead>
<tbody>
<tr>
<td>Anguilla(UK)</td>
<td>New Caledonia(FR)</td>
<td>Indian Ocean:</td>
</tr>
<tr>
<td>Aruba (NL)</td>
<td>French Polynesia (FR)</td>
<td>• Mayotte (FR)</td>
</tr>
<tr>
<td>British Virgin Islands (UK)</td>
<td>Wallis &amp; Futuna(FR)</td>
<td>South Atlantic:</td>
</tr>
<tr>
<td>Cayman Islands (UK)</td>
<td>Pitcairn (UK)</td>
<td>• Falkland Islands (UK)</td>
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<tr>
<td>Bonaire</td>
<td></td>
<td>• St Helena(UK)</td>
</tr>
<tr>
<td>Curacao</td>
<td></td>
<td>North Atlantic:</td>
</tr>
<tr>
<td>Saba</td>
<td></td>
<td>• St Pierre &amp; Miquelon(FR)</td>
</tr>
<tr>
<td>Sint-Eustatius</td>
<td></td>
<td>• Greenland (DEN)</td>
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<tr>
<td>Sint-Maarten</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turks &amp; Caicos islands (UK)</td>
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<tr>
<td>Montserrat</td>
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<td></td>
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<tr>
<td>Saint-Barthélemy (FR)</td>
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Note: Mayotte is becoming an Outermost region in 2014

The present report includes the following main sections:

- A review of the energy sector, and of the renewable energy sub-sector, in the OCTs with general consideration being given to the economic context, their involvement in the Europe 20/20/20 goals for sustainable development, and to the institutional and legal framework
- An updated discussion and analysis of the energy situation in the OCTs, with conclusions and recommendations provided for all OCTs, and groups of OCTs
- A review of the institutional framework
- An update and discussion of renewable energy and energy efficiency projects and programmes implemented, or being implemented, in the OCTs together with prospects for replication and dissemination between OCTs or in other regions
- Proposals for implementation and a proposed overall road map.
3 GENERAL CONTEXT

3.1 Overview of the energy sector and renewable energy sub-sector

Historically, economic development has been strongly correlated with increasing energy use and growth of greenhouse gas (GHG) emissions. Renewable energy (RE) can help break that link, contributing to sustainable development (SD). In addition, RE offers the opportunity to improve access to modern energy services for the poorest members of society.

The energy sector has generally been perceived as key to economic development with a strong correlation between economic growth and expansion of energy consumption. Indicators such as GDP, or per capita GDP, have been used as proxies for economic development for several decades and the HDI has been shown to correlate well with per capita energy use.

The discovery and extraction of new energy resources remains vital for the world’s main economies as countries are continuing to consume unprecedented amounts of oil and gas, in a context of high energy prices, uncertainty with regard to estimated reserves, and new technologies for energy exploration, transformation and utilization. The scale of the challenge will only grow as the expanding global population requires more energy. This review of global and regional energy trends makes clear that, even with aggressive action to reduce energy consumption and curb emissions, fossil fuels will be around for a very long time.

The current highly carbon-intensive energy system depends on a finite supply of fossil fuels that are getting harder and more expensive to extract, leading to concerns about national energy security in many countries and more specifically in the OCTs. The challenges are compounded by the need to provide clean and efficient energy services to people without any, or with limited, access to sustainable energy, especially in the context of island countries. Furthermore, the current state of the energy sector leaves many countries and virtually all OCTs exposed to large swings in oil import prices, risks linked to energy imports, and also requires large public subsidies.

Greening the energy sector will require improvements in energy efficiency and a much greater supply of energy services from renewable sources, both of which will lead to reducing greenhouse gas emissions (GHG) and other types of pollution. In most instances, improvement in energy efficiency has net economic benefits. Global energy demand is still likely to grow in order to meet development needs, in the context of growing populations and income levels. Greening the sector also aims to end “energy poverty” for the estimated 1.4 billion people who currently lack access to electricity. Moreover, 2.7 billion people who are dependent on traditional biomass for cooking need healthier and more sustainable energy sources (IEA 2010a). Modern renewables offer considerable potential for enhancing energy security at global, national and local levels. However, in order to secure all these benefits, enabling policies are required to ensure that investments are, in fact, made for greening the energy sector.
3.2 Context of strong energy dependence of the OCTs

Dependence on energy imports, whether on fossil fuels or the technology needed for implementation of RE, represents a potential source of energy insecurity for both developing and industrialized countries. For example, the response of Member States of the International Energy Agency to vulnerability to oil supply disruption has been to mandate that countries hold stocks of oil as reserves, equivalent to 90 days of net imports.

Compared to fossil fuels, RE resources are far more evenly distributed around the globe and, in general, are less traded on the world market; consequently, increasing their share in a country’s energy portfolio can diminish dependence on actual energy imports. Hence, the extent to which RE sources contribute to the diversification of supply options and reduce an economy’s vulnerability to price volatility represent opportunities to enhance energy security at the global, national as well as the local level, and, in particular, in OCTs.

At the same time, the introduction of renewable technologies that may provide only intermittent energy supply (ranging from minutes to seasonal) adds a new concern to energy security. Not only will there be concerns about supply disruption by external factors but also the vulnerability of energy supply to the vagaries of nature (such as extreme events like drought, damages caused by storms and cyclones, which may destroy facilities or impede the supply of primary energy). However, RE can also make a contribution to increasing the reliability of energy services, in particular in remote and rural areas that often suffer from insufficient grid access or sustainable energy access. Notwithstanding these concerns, a diverse portfolio of energy sources, together with good management and system design (for example, geographical diversity of supplies) can help enhance security.

Specific energy security indicators are difficult to identify. Based on the two broad considerations described above, the indicators used to provide information about the energy security criterion of SD are the magnitude of reserves, the reserves-to-production ratio, the share of imports in total primary energy consumption, the share of energy imports in total imports, as well as the share of variable and intermittent RE sources.

Energy security suffers from lack of either a well-formed quantifiable or qualitative definition. In many countries, energy security is often taken to be inversely related to the level of oil imports. The focus on oil results from the fact that many countries are potentially vulnerable to supply disruptions, with many developed countries having experienced oil supply disruptions during the Organization of the Petroleum-Exporting Countries (OPEC) oil embargos of the mid-1970s. The question of oil supply disruption is even more crucial for the OCTs for whom it can be a question of survival, due to the limited supply options these countries have. However, despite its importance, the real concern is not so much about oil but, rather, their vulnerability and resilience to sudden disruptions in energy supply.

All other things being equal, the more reliant an energy system is on a single energy source, the more vulnerable the energy system is to serious disruptions. This is true for energy security concerns with respect to both availability and distribution of resources as well as to the variability and reliability of energy sources. At the same time, it is important to note that diversity of supply is only beneficial to the extent that the risks of disruptions are the same for different energy sources. To the extent that these risks are not equal, it is generally beneficial to rely more heavily on those sources with the lowest risks. RE will tend to influence energy security in future scenarios by focusing on diversity of supply and thereby energy suppliers’
market power, particularly that of oil suppliers. The variability in energy supply associated with RE in the context of energy security has thus to be assessed in each case.

Energy dependence is a major source of economic vulnerability for many islands. All islands analysed in this study are currently almost totally energy-dependent on foreign oil, with consequent impacts on the balance of payments, employment opportunities, and development plans. Even in Greenland where 70% of the electric power is provided by hydro plants, still almost 89% of the overall energy consumption in 2011 was based on imported oil. Oil typically accounts for 95 per cent of commercial energy use in the Pacific islands. In islands territories like the OCTs, imported petroleum fuels may account for 20% of GDP and even more and this economic impact is unlikely to decrease in the coming years. Oil imports cost up to 29 percent of GDP in the Cook Islands, 22% in Fiji, 15 percent in Tonga, and 9 percent in Samoa\(^1\). The importance of oil imports is even more significant when compared to the total imports in the small islands as illustrated on the following table.

<table>
<thead>
<tr>
<th>Islands</th>
<th>% of GDP</th>
<th>% of Imports</th>
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<tbody>
<tr>
<td>Fiji</td>
<td>21.9</td>
<td>32.7</td>
</tr>
<tr>
<td>Salomon</td>
<td>15.5</td>
<td>39.5</td>
</tr>
<tr>
<td>Tonga</td>
<td>15</td>
<td>26</td>
</tr>
</tbody>
</table>

With such level of oil dependency, it is no surprise that some small island states, described as the most petroleum-dependent countries in the world, could free up to 30 percent of gross domestic product (GDP) by switching to hydro, solar, wind, geothermal or other renewable energy sources.

OCTs have common characteristics and have to deal with limited resources, limited spatial area, and limited availability of technologies. In addition, many of them have to cope with natural disasters. Implementing specific sustainable energy strategies for islands implies that such constraints must be taken into account:

- Geographic Isolation (high cost transport, tenuous supply lines)
- Few power generation sources (low diversity)
- High Energy Costs (imported equipment, spares, fuel & oil, external expertise)
- Variable loads (daily, seasonal, growth)
- Variable Power Quality and Reliability

Islands are vulnerable due to their small size, both in bio-physical as well as socio-economic terms. They are increasingly facing environmental consequences through utilisation of their fragile natural resources for economic development. Severe weather events are thought to be occurring with increased frequency and intensity, which may lead to considerable economic, social, cultural and environmental disruption, and consequently affect any programme of action. The impact of sea-level rises poses the greatest threat to some islands as even a sea-level rise of 20 cm or less can have devastating impacts.

\(^1\) Statement during the world’s 39 Small Island Developing States (SIDS) from Africa, the Caribbean, the Indian Ocean and the Pacific meeting in Port of Spain in May 2012
On the other hand, viewed from a different perspective, these island states also have favourable natural endowments such as excessive sunlight, constant warm temperatures, and easy access to sea and wind. These circumstances create the prospect of a positive return on investment in some RETs but there are both investment and implementation limitations of RETs in small island states:

- Lack of capital
- Shortage of hard currency
- Policy framework – lack of subsidies or tax exemptions
- Utility resource acquisition procedures that favour conventional technologies
- Lack of trained manpower
- Lack of community and private sector involvement
- Transfer technology limitations

Implementation of renewable energy sources should not only address the unique features of these islands (scale, fragile environment, strong dependence on conventional resources, high power generation costs, energy weight within GDP, abundance of RES) but also reduce the economic vulnerability of island states by reducing the usage of increasingly expensive, imported fossil fuels.

3.3 Involvement of OCTs in the Europe 20/20/20 Goals for sustainable development

3.3.1 The 20/20/20 Goals of the EU Climate and Energy Package

The Climate and Energy Package is a set of binding legislation which aims to ensure the European Union meets its ambitious climate and energy targets for 2020. These targets, known as the "20-20-20" targets, set three key objectives for 2020:

- A 20% reduction in EU greenhouse gas emissions from 1990 levels;
- Raising the share of EU energy consumption produced from renewable resources to 20%;
- A 20% improvement in the EU’s energy efficiency.

Although they are linked to EU Member States, the OCTs have no legal obligation to reach the targets set for the Member States. However, it is important for the OCTs themselves to know in which environment the Member States to which they are linked are acting in Europe, their objectives and implication and also the constraints and difficulties encountered to reach these targets which may be seen as very reachable for some OCTs.

The climate and energy package comprises four pieces of complementary legislation which are intended to help deliver on the 20-20-20 targets:

Reform of the EU Emissions Trading System (EU ETS):

The EU ETS is the key tool for reducing industrial greenhouse gas emissions most cost-effectively. The climate and energy package includes a comprehensive revision and strengthening of the legislation which underpins the EU ETS, the Emissions Trading Directive.
The revision applies from 2013, the start of the third trading period of the EU ETS. Major changes include the introduction of a single EU-wide cap on emission allowances in place of the existing system of national caps. The cap will be reduced each year so that by 2020 emissions will be 21% below the 2005 level.

The free allocation of allowances will be progressively replaced by auctioning, starting with the power sector. The sectors and gases covered by the system will be slightly widened.

**National targets for non-EU ETS emissions:**

Under the so-called Effort Sharing Decision, Member States have taken on binding annual targets for reducing their greenhouse gas emissions from the sectors not covered by the EU ETS, such as housing, agriculture, waste and transport (excluding aviation). Around 60% of the EU’s total emissions come from sectors outside the EU ETS.

The national targets, covering the period 2013-2020, are differentiated according to Member States' relative wealth. They range from a 20% emissions reduction (compared to 2005) by the richest Member States to a 20% increase by the least wealthy (though this will still require some limitation effort by all countries). Member States must report on their emissions annually under the EU monitoring mechanism.

**National renewable energy targets:**

Under the Renewable Energy Directive, Member States have taken on binding national targets for raising the share of renewable energy in their energy consumption by 2020. These targets, which reflect Member States’ different starting points and potential for increasing renewables production, range from 10% in Malta to 49% in Sweden.

The national targets will enable the EU as a whole to reach its 20% renewable energy target for 2020 - more than double the 2010 level of 9.8% - as well as a 10% share of renewable energy in the transport sector. The targets will also help to cut greenhouse gas emissions and reduce the EU’s dependence on imported energy.

**Carbon capture and storage:**

The fourth element of the climate and energy package is a directive creating a legal framework for the environmentally safe use of carbon capture and storage technologies. Carbon capture and storage involves capturing the carbon dioxide emitted by industrial processes and storing it in underground geological formations where it does not contribute to global warming.

The directive covers all CO2 storage in geological formations in the EU and lays down requirements which apply to the entire lifetime of storage sites.

It is worthwhile noticing that the climate and energy package does not address the energy efficiency target directly. This is being done through the 2011 Energy Efficiency Plan and the Energy Efficiency Directive.
3.3.2 The progress made so far in the EU Member States for penetration of Renewable Energies

With respect to renewable energy, the Directive adopted in 2009 (Renewable Energy Directive) sets binding targets for renewable energy. It focuses on achieving a 20% share of renewable energy in the EU overall energy consumption by 2020. Every Member State has to reach individual targets for the overall share of renewable energy in energy consumption. In addition, in the transport sector, all Member States have to reach the same target of a 10% share of renewable energy.

These targets can be reached by increasing the share of energy from renewable sources, including wind power (both onshore and offshore), solar power (thermal, photovoltaic and concentrated), hydro-electric power, tidal power, geothermal energy and biomass (including biofuels and bioliquids). The renewable energy targets aim at reducing pollution and greenhouse gas emissions, at decreasing renewable energy production costs, and at diversifying our energy supply by reducing the dependence on oil and gas.

Based on the last progress report, it appears that the adoption of the current policy framework of legally binding targets has resulted in the strong growth of renewable energy in the EU. The latest available Eurostat data suggests that the EU and most Member States are currently on track to achieve the 2020 targets. In 2010, the EU renewable energy share was 12.7% and the majority of Member States already reached their respective 2011/2012 interim target set out by the Directive. With regard to the EU sustainability criteria, Member States' implementation of the biofuels scheme is considered too slow. At present, the possible negative impacts of EU biofuels consumption do not require further specific policy intervention.

While progress has been made until 2010, there are reasons for concern about future progress: the transposition of the Directive has been slower than wished due, in part, to the current economic crisis in Europe. Since the indicative trajectory to meet the final target grows steeper over time, in reality more efforts by most of the Member States' are needed in forthcoming years. Current policies alone will be insufficient to trigger the required renewable energy deployment in a majority of Member States. Hence, additional efforts will be needed for Member States to stay on track in the forthcoming years.

Member States should finalise the transposition of the Renewable Energy Directive as soon as possible and should increase their efforts to address barriers to the uptake of renewable energy by:

- taking measures to reduce administrative burdens and delays;
- developing the electricity grid and better integrating renewable energy into the market;
- making support schemes more stable and transparent but also cost-effective and market-oriented.

The Commission's planned guidance on support schemes and reform foreseen for this year is intended to ensure that such support is cost effective and helps integrate renewable energy production into the energy market.

A failure to meet the 2020 renewable energy targets will have major consequences for the EU. First, a strong development of renewable energy is an important condition to move towards a low-carbon economy by 2050. In this respect, the current decade will be crucial to put Europe
on the right track since investments decisions made today will affect our energy sector for the next 30 years. Second, missing the targets would slow down progress towards the three EU energy policy objectives: the EU would remain highly dependent on fossil fuels, therefore threatening the "security of supply" and "sustainable energy" goals. In addition, an insufficient deployment of several renewable energy technologies would not allow for adequate reductions in production costs, therefore preventing renewable energy form contributing to the EU's competitiveness. Finally, a failure to meet national binding targets could trigger infringement procedures against these Member States.

3.3.3 The OCTs in the context of the EU Member State RE Directive

As mentioned earlier, the OCTs have no legal obligation to reach the targets set for the EU Member States. It would be anyway very difficult not to say impossible and unfair for them to do so because the local conditions do not allow them to develop their energy sector along the lines of what has been agreed. Furthermore, the size and amount of energy at stake in the OCTs do not have any significant impacts on the global results at the EU level.\(^2\)

However, the OCTs do have a role to play in the sense that their contribution to develop new technologies and innovative solutions can be significant. Indeed, many EU countries can develop new approaches for their own populations, based directly on the experiences made in the OCTs. Similarly, research projects developed on the EU continent, can more easily be tested in the OCTs, where appropriate testing conditions can be found.

3.4 Economic and financial analysis of the energy sector in the OCTs and likely development

The economic and financial analysis of the energy sector in the OCTs follows different considerations than in the case of EU Member States. Indeed, the characteristics of these territories are such that specific key determining factors have to be taken into account.

For EU countries, the main scenario drivers of energy consumption are population and economic growth, technological change, resource availability, land-use changes, and local and regional environmental policies. The worldwide economic and financial crisis, which has lasted for almost 4 years now has deeply affected all regions of the world and has had repercussions for all OCTs- for various reasons, such as reduced tourism activities, commercial trade, and reduced budget contributions from the Member States to which they are linked.

Taking all new developments and policies into account, the world is still failing to put the global energy system onto a more sustainable path. Global energy demand will grow by more than one-third over the period to 2035 in the most realistic central scenario, with China, India and the Middle East accounting for 60% of the increase. Energy demand barely rises in OECD countries, although there is a pronounced shift away from oil, coal (and, in some countries, nuclear) towards natural gas and renewable energies. Despite the growth in low carbon sources of energy, fossil fuels remain dominant in the global energy mix, supported by subsidies that

\(^2\) This general statement for the OCTs does not apply for Mayotte for which, under the framework Law n° 2009-967 dated August 3rd, 2009, the specific article N° 56 sets the objective of reaching a share of 30% of RE in the final energy consumption in 2020 and more generally the reach energy autonomy by 2030.
amounted to $523 billion in 2011, up almost 30% on 2010 and six times more than subsidies to renewables. The cost of fossil-fuel subsidies has been driven by higher oil prices; they remain most prevalent in the Middle East and North Africa, where momentum towards reform appears to have been lost.

The following table shows that coal, oil and gas will continue to count for around 80% in world primary energy consumption in 2020 and also in 2030.

**Table 3: Share of the various energy form in the world primary energy balance**

<table>
<thead>
<tr>
<th>Energy form</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>3474</td>
<td>4082</td>
<td>4180</td>
</tr>
<tr>
<td></td>
<td>27.3%</td>
<td>27.4%</td>
<td>25.5%</td>
</tr>
<tr>
<td>Oil</td>
<td>4113</td>
<td>4457</td>
<td>4578</td>
</tr>
<tr>
<td></td>
<td>32.3%</td>
<td>29.9%</td>
<td>27.9%</td>
</tr>
<tr>
<td>Gas</td>
<td>2740</td>
<td>3266</td>
<td>3820</td>
</tr>
<tr>
<td></td>
<td>21.5%</td>
<td>21.9%</td>
<td>23.3%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>719</td>
<td>898</td>
<td>1073</td>
</tr>
<tr>
<td></td>
<td>5.6%</td>
<td>6.0%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Hydro</td>
<td>295</td>
<td>388</td>
<td>458</td>
</tr>
<tr>
<td></td>
<td>2.3%</td>
<td>2.6%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>1277</td>
<td>1532</td>
<td>1755</td>
</tr>
<tr>
<td></td>
<td>10.0%</td>
<td>10.3%</td>
<td>10.7%</td>
</tr>
<tr>
<td>Other renewables</td>
<td>112</td>
<td>299</td>
<td>554</td>
</tr>
<tr>
<td></td>
<td>0.9%</td>
<td>2.0%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Total</td>
<td>12730</td>
<td>14922</td>
<td>16418</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: IEA 2012

A steady increase in hydropower as well as the rapid expansion of wind and solar power has cemented the position of renewables as an indispensable part of the global energy mix; by 2035, renewables will account for almost one-third of total electricity output. Solar grows more rapidly than any other renewable technology. Renewables become the world’s second-largest source of power generation by 2015 (roughly half that of coal) and, by 2035, they approach coal as the primary source of global electricity. Consumption of biomass (for power generation) and bio-fuels grows four-fold, with increasing volumes being traded internationally. Global bio-energy resources are more than sufficient to meet the projected bio-fuels and biomass supply without competing with food production, although the land use implications have to be managed carefully. The rapid increase in renewable energy is underpinned by falling technology costs, rising fossil-fuel prices and carbon pricing, but mainly by continued subsidies: from $88 billion globally in 2011, they rise to nearly $240 billion in 2035. Subsidy measures to support new renewable energy projects need to be adjusted over time as capacity increases and the costs of renewable technologies fall in order to avoid excessive burdens on governments and consumers.

The publications, the REN21’s Renewables 2013 Global Status Report by the Renewable Energy Policy Network for the 21st Century and the UNEP/BNEF’s Global Trends in Renewable Energy Investment 2013 by the Frankfurt School, have recently been launched. They indicate that global demand for renewable energy continued to rise during 2011 and 2012, supplying an estimated 19% of global final energy consumption in 2011. For only the second time since 2006, global investments in renewable energy in 2012 failed to top the year before, falling 12% mainly due to dramatically lower solar prices and weakened US and EU markets. However, with a global investment of $244 billion (including small hydro-electric projects) 2012 was the second highest year ever for renewable energy investments. There was a continuing upward trend in developing countries, with investments in the developing South topping $112 billion versus $132 billion in developed countries, a dramatic change from 2007, when developed economies invested 2.5 times more in renewables (excluding large hydro) than developing countries. The gap has now closed to just 18%.
In terms of power generation capacity, 2012 was another record year with 115 GW of new renewables installed worldwide, equivalent to just over half of total net additions. Reports also stress and demonstrate that the right policies can drive the successful integration of larger shares of renewables in the energy mix. Of the 138 countries with renewables targets or policies in place, two-thirds are in the developing world. The geographical distribution of renewables deployment is also widening, particularly in the developing countries.

Total renewable power capacity worldwide exceeded 1,470 GW in 2012, up 8.5% from 2011. Wind power accounted for about 39% of renewable power capacity added followed by hydropower and solar PV, which each accounted for approximately 26%. Solar PV capacity reached the 100 GW milestone, surpassing bio-power to become the third largest renewable technology in terms of capacity in operation, after hydro and wind.


## 4 ANALYSIS OF THE MAIN FEATURES OF OCT’S ECONOMIES

### 4.1 Individual reviews

**Caribbean OCT’s:**

<table>
<thead>
<tr>
<th>Anguilla</th>
<th>Populations: 15,754 (2013 est.)</th>
<th>GDP/capita: 12,200 USD (9,390 €)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anguilla has few natural resources, and the economy depends heavily on luxury tourism, offshore banking, lobster fishing, and remittances from emigrants. Increased activity in the tourism industry has spurred the growth of the construction sector contributing to economic growth. Anguillan officials have put substantial effort into developing the offshore financial sector, which is small but growing. In 2011 Anguilla became the fifth largest jurisdiction for captive insurance. A 3.3% increase in GDP was expected for 2012 following a period of rapid expansion (2004-2007) and contraction (2008-2010). Weak global demand for tourism and oil price volatility are downside risks to economic growth moving forward.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aruba is one of the wealthiest states of the Caribbean region, with a particularly low unemployment rate and a higher GDP per capita. About three-quarters of its GDP comes from the tourism industry. Tourism and oil refining/storage are the mainstays of the small open Aruban economy. The oil refinery which had been the major economic activity on the island stopped operations in 2009 but reopened a year later. In 2012 the refinery shut down once again. The rapid growth of the tourism sector over the last decade has resulted in a substantial expansion of other activities. Over 1.5 million tourists per year visit Aruba with 75% of those from the US. Construction continues to boom with hotel capacity five times the 1985 level. Tourist arrivals rebounded strongly following a dip after the 2008 crisis. The government aims to increase social, environmental and economic resilience of Aruba through an efficient use of natural resources, especially RES. Ultimately Aruba wants to become a model for a low-carbon, sustainable and prosperous economy that can be replicated in other island nations. Proximity to large emerging markets in Latin America is making Aruba increasingly popular for European enterprises seeking a stable hub in the region, as well as creating a knowledge centre for RE in the region.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The economy, one of the most stable and prosperous in the Caribbean, is highly dependent on tourism, generating an estimated 45% of the national income. In the mid-1980s, the government began offering offshore registration to companies, and incorporation fees now generate substantial revenues. Livestock raising is the most important agricultural activity; poor soils limit the islands’ ability to meet domestic food requirements.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cayman Islands</th>
<th>Population: 56,729 (2011 est.)</th>
<th>GDP/capita:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The Cayman islands are an offshore financial centre, with no direct taxation. The Cayman Islands have been affected by the global financial crisis and the downturn in the global economy, which has hit the key tourism sector. Since 2009, Cayman has struggled to balance its books. In 2010, the United Kingdom ordered the territory’s government to reduce public spending and create a three-year plan to cut the deficit by 2013. London also urged the Cayman Islands to</td>
<td></td>
</tr>
</tbody>
</table>

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3 In Aruba, peak population including stay-over tourists and cruise visitors reaches 1.5 million.
<table>
<thead>
<tr>
<th>Country</th>
<th>Population</th>
<th>GDP/capita</th>
<th>Key Economic Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bonaire</strong></td>
<td>17,400</td>
<td>10,500 €</td>
<td>Bonaire is the second largest territory of the former Netherlands Antilles. Bonaire has developed an economy based on tourism, oil transference (from large tankers to smaller ones), salt production, and some light industry such as apparel manufacture and rice processing. The largest industry on Bonaire today is tourism, with 70,000 tourists per year. As a territory of the former Netherland Antilles, the Netherlands provide economic and financial aid to the territory according to the needs.</td>
</tr>
<tr>
<td><strong>Curaçao</strong></td>
<td>145,600</td>
<td>15,600 €</td>
<td>Curaçao is the largest territory of the former Netherland Antilles. Most prominent industry is by far the petroleum refining sector. The island also has a significant tourism sector and develops financial services mainly linked to the refining industry. Oil refining: the Venezuelan State Oil Company has made large investment in Curacao. Most of the oil refined on Curacao is imported from Venezuela itself and then exported, mainly to the US. Almost all consumer and capital goods are imported, the US, Brazil, Italy and Mexico being the major suppliers. Poor soils and inadequate water supplies hamper the development of agriculture. Budgetary problems complicate reform of the health and education systems. In 2013 the government implemented changes to the sales tax and reformed the public pension and health care systems.</td>
</tr>
<tr>
<td><strong>Saba</strong></td>
<td>1,990</td>
<td>7,100 €</td>
<td>The island is of volcanic origin and hilly, leaving little ground suitable for agriculture. The economy of Saba is primarily based on the government, tourism and the Saba University School of Medicine. The island of Saba is relatively new to the tourism industry, with about 25,000 visitors each year. Almost all consumer and capital goods are imported. As a territory of the former Netherland Antilles, the Netherlands provide economic and financial aid to the territory according to the needs.</td>
</tr>
<tr>
<td><strong>Sint Eustatius</strong></td>
<td>3,500</td>
<td>15,100 €</td>
<td>The island is of volcanic origin and hilly, leaving little ground suitable for agriculture. The economy of St. Eustatius is primarily based on the government, oil-transhipment, tourism, commerce, harbour activities and a medical school. The government is the largest employer and the oil terminal NuStar is the private largest employer on the island. Almost all consumer and capital goods are imported. As a territory of the former Netherland Antilles, the Netherlands provide economic and financial aid to the territory according to the needs.</td>
</tr>
<tr>
<td><strong>Sint Maarten</strong></td>
<td>39,700</td>
<td>18,100 €</td>
<td>The economy of Sint Maarten centres around tourism with nearly four-fifths of the labour force engaged in this sector and two millions visitors per year. No significant agriculture and limited local fishing means that almost all food must be imported. Energy resources and manufactured goods are also imported. The GDP per capita of this territory is the highest amongst the islands of the former Netherland Antilles.</td>
</tr>
<tr>
<td><strong>Turks &amp; Caicos Islands</strong></td>
<td>31,618 (2012)</td>
<td>GDP/capita: 31,618</td>
<td>The main drivers of the economy of the Turks and Caicos Islands are tourism (35% of 2009 GDP) and offshore financial services (13%). There is also a sizeable fishing industry, which is a valuable export earner. The only other notable industry is construction, largely geared towards improving tourism infrastructure. Most capital goods and food for domestic consumption are imported. Aid from the United Kingdom is still needed to balance the budget, and fund capital projects.</td>
</tr>
</tbody>
</table>
The current lack of diversification means that the economy is heavily reliant on tourism a narrow set of export-oriented activities. The islands are hampered by a lack of physical infrastructure, which will need to be expanded significantly if the ambitious policy plans to develop tourism are to be met. Given the limited revenue base, the government has adopted an “Open Arms” investment policy that highlights the country’s no-tax status, and offers investors a streamlined bureaucracy, including access to government-owned land.

Attracting quality investments is a major objective of the TCI Government. The TCI Investment Agency was created to attract new offshore investment, encourages entrepreneurship among residents, and provides financing to the local population.

### Montserrat

**Population:** 4,922 (2011)

**GDP/capita:**
- 8,500 $ (2006 est.)
- 6,540 € (2006 est.)

Severe volcanic activity has put a damper on this small, open economy since July 1995. The closure of the airport and main seaport following the 1997 eruption caused further economic and social dislocation. Two-thirds of the 12,000 inhabitants migrated to the United Kingdom and neighbouring Caribbean islands. Some persons who wanted to return faced challenges to acquire adequate housing. The agriculture sector continued to be affected by the lack of suitable land for farming in the designated safe zone and the destruction of crops by loose livestock.

Prospects for the economy depend largely on developments in relation to the volcanic activity and on public sector construction activity. Half of the island remains uninhabitable. Since the eruptions, Montserrat has remained heavily dependent on development aid. In January 2013, the European Union (EU) announced the disbursement of a $55.2 million aid package to Montserrat in order to boost the country’s economic recovery, with specific focus on public finance management, public sector reform, and prudent economic management. Since 1995, the Department for International Development (DFID) has provided a total of £350 million to Montserrat for emergency assistance, construction and financial support. In 2012-13, DFID is providing a subsidy of up to £14 million to Montserrat’s recurrent budget.

### Saint-Barthélemy

**Population:** 9,057 (2012)

**GDP/capita :**
- 26,000 € (1999)*

The economy of Saint-Barthélemy is based upon high-end tourism and duty-free luxury commerce, serving visitors primarily from North America. The luxury hotels and villas host 70,000 visitors each year. The relative isolation and high cost of living inhibits mass tourism.

The construction and public sectors also enjoy significant investment in support of tourism. The island possesses high quality infrastructure and airports have been modernised.

The land is dry and barren, not conducive to agriculture and industrial activity. With no natural rivers or streams, fresh water is in short supply, especially in summer, and provided by desalinization of sea water, collection of rain water, or imported via water tankers.

All food must be imported, as well as all energy resources and most manufactured goods.

Employment is strong and attracts labour from abroad such as from Portugal. This foreign man power, including from Europe, is however limited and temporary because the market is quite narrow and the housing capacity too weak to absorb this population. Besides, there is a political will to limit any excessive development of foreign man power in the Island.
New Caledonia has one of the largest economies in the South Pacific, with a GDP of € 6.85 billion in 2010. Real GDP grew by 3.7% in 2010, boosted by rising worldwide nickel prices and an increase of domestic demand due to rising employment. In 2010, exports from New Caledonia amounted to € 1.1 billion, 95.1% of which were mineral products and alloys (essentially nickel ore and ferronickel). Imports amounted to € 2.4 billion of which 22.3% came from Metropolitan France. The trade deficit thus stood at € 1.3 billion in 2010. Public sector still represents 35% of the employment in the territory. Financial support from France is substantial, representing more than 15% of the GDP, thus, significantly sustaining the entire island economy. Tourism is still underdeveloped, with 100,000 visitors a year, compared to 400,000 in the Cook Islands and 200,000 in Vanuatu.

New Caledonian soils contain about 25% of the world's nickel resources. The nickel sector remains a key element of the territory economy with a share in the GDP of 5% to 12% each year depending on the price on the international market. New Caledonia expects a strong increase of the production of the nickel sector with a target of 170,000 tons in 2015 against 63,500 tons in 2012.

French Polynesia is among the wealthiest countries and territories of South Pacific after Australia, New Zealand and New Caledonia. The trade balance (except services) is largely unbalanced with € 1.3 billion of imports against € 0.1 billion of exports consisting mostly of pearl-related products. Public jobs account for 25% of total employment.

The industrial sector represents 9% of the GDP of the market sector and includes mainly agro industry, shipping and building products and processing in textile, printing and furniture. Tourism in French Polynesia accounts for 13% of the market GDP. During the period 2000 - 2007, around 220,000 tourists visited the archipelagos every year, most visiting Tahiti, Bora-Bora and Moorea where 90% of hotel beds are concentrated. Between 2007 and 2009, the number of tourists has dropped drastically with less than 160,000 in 2010. The tourism industry is slowly increasing again with 169,000 tourists in 2012.

The economic situation of French Polynesia has been quite difficult with four straight years of recession since 2008. The transfers from France have decreased in this unfavorable global context and have added to the specific difficulties of the territory (less tourism, reduced productive activities). The slow recovery of the tourism industry has still not been translated into jobs for the population.

The GDP of Wallis-et-Futuna is mainly a no trade market (75%). The economy is sustained by the administrative sector which concentrates 54% of the total GDP. More than 70% of the employment is based on public and semi-public jobs. Transfers from France represent 55.7% of GDP. The building and public works sector sustains the economy. Most of infrastructure works under the 9th EDF are completed. Public sector concentrates on services, commerce and buildings. There is also a small agriculture and fishing sector.

Tourism plays a major role on Pitcairn providing the locals 80% of their annual income. The utilization of the island domain names (« .pn») is also a significant source of revenue for the island. Honey production and sale is also an important activity since the honey
| GDP/capita: N/A | produced was, and remains, exceptionally high in quality due to the fact that the bees are disease-free. |
| **Indian Ocean:** | |
| **Mayotte** | Mayotte is a small island in the Indian ocean located in the archipelagoes of Comoros. |
| Population: | Following a local referendum in March 2009, Mayotte has become a French Overseas Department. However, Mayotte still remains an OCT until December 31st 2013 before being officially becoming an Outermost country. |
| 212,645 (2012) | 45% of the employment is in the public administration. Tourism is little developed in Mayotte, because of the large distance to reach the island and the few connections, the limited hotel capacity and also the poor organization of the sector. |
| GDP/capita: | The activities rely almost entirely on consumption from public administration and residential sector. The latter is also sustained by the amount of social subsidies provided from France amounted to 106 M€ in 2009. Exports are very limited and consist mainly of tourism related services accounting for 84% of the export, the rest being a few products. |
| 6,600 € (2009) | |

| **South Atlantic:** | |
| **Falkland Islands** | The Falkland Islands are an archipelago consisting of two main islands (East and West Falkland) and 778 smaller islands. They are an Overseas Territory of the United Kingdom. The main two population centres are the capital Stanley (located on East Falkland), and ~30 miles away, Mount Pleasant Airport. The Falklands’ GDP is approx. $206m (2010 data), rising by ~33% since 2000. The main economic activities are: |
| Population: | • fishing, accounting for more than 60% of the GDP |
| 2,840 (2012) | • tourism, accounting for 8% of the GDP. Ecotourism plays seasonally an important part in the economy |
| GDP/capita: | • mining (4% of GDP): an exploratory hydrocarbons programme is ongoing with oil/gas exploration activities providing a boost to the islands’ economy |
| $ 72,676 (2010) | • industry (3% of GDP) |
| (~ € 56,489) | • agriculture (wool and meat production) (2% of GDP) |
| | Exported products include wool, meat and fish. The average inflation rate (2012 data) is 5.8%. |

| **St Helena** | Saint Helena Island is situated in the South Atlantic Ocean and is an internally self-governing Overseas Territory of the United Kingdom. It is one of the remotest settled islands in the world. Its capital is Jamestown. |
| Population: | St Helena’s GDP is approx. $23m (2010 data), rising by ~53% since 2000. The average inflation rate (2010 data) is 4.9%. |
| 4,000 (2010) | Economic development of the island has been so far constrained by its extreme isolation and its declining population. Over half of the government’s recurrent expenditure and 90% of its capital expenditure are currently funded by British budgetary aid. |
| GDP/capita: | St Helena is currently undergoing a major transformation as an airport is being constructed for the island (due for completion by early 2016) and this is currently the main buoyant economic activity. Over 350 St Helenians are currently working on this project. Other economic activities include small scale |
tourism and small scale exports of fish, coffee and gin.

Moving forward, sustainability is seen as a key economic driver in the island’s development within the “Saint Helena Sustainable Development Plan (SDP) 2012/13-2014/15”.

North Atlantic:

St Pierre & Miquelon

Saint Pierre & Miquelon (SPM) is a self-governing overseas territory of France. It is a group of islands, situated at the north-western Atlantic Ocean. St Pierre is the smallest island in area but the most populated and developed one (~90% of the total population) whereas Miquelon and Langlade are larger geographically but only ~10% of the overall population live there.

The economy has been traditionally based on fishing and servicing fishing fleets. However the economy has been declining in recent years and other activities are being developed to provide economic diversification, such as fish farming and agriculture. It is also hoped that an expansion of tourism will boost economic prospects. Since a decade ago, test drilling for oil gave hope for development of the energy sector. So far, however, the tests have not been successful in the South of SPM.

The GDP is ~172 million euro (2008), 3% of which comes from industry, 1% from fishing and less by 1% from agriculture. The main industries relate to the remaining chain of seafood products (between 50 and 100 people work seasonally in factories, processing 1,000 to 2,000 tons a year compared to around 20,000 tons until 1992). Regarding agriculture, 9 farms employing 23 people were in operation in 2010, producing agricultural products.

The main exported products are fish and seafood, with the exports industry worth 1 to 6 million euros a year (<4% of GDP), while exports covered 50% of imports in 1980. Since the collapse of the main plant in 2011 (SPMSI), exports are at their lowest. The average inflation rate is 4.46%.

Greenland

Greenland is the largest island in the world in terms of surface area but also the least densely populated. It is located between the Arctic and Atlantic Oceans. It is an autonomous country, within the Kingdom of Denmark. Over 80% of the area of the island is covered by ice.

Greenland’s GDP is approx. $2.24bil. (2010 data), rising by ~48% since 2000. The main economic activities are fishing, mining and tourism:

- fishing constitutes the main export activity and is foundational to the Greenlandic economy
- the aim is growth in the mining industry in the coming years, along with income from other natural resources and the establishment of energy intensive industry such as an aluminium smelter. The mineral resources sector in Greenland is considered a key sector to building growth industries and a self-sustaining economy.
- tourism has seen stable growth over the past years, especially cruise ship tourism.

The average inflation rate (2010 data) is 1.4%. 
4.2 Global analysis of all OCTs or group of OCTs

The following table shows the major characteristics of the economy of each OCT.

<table>
<thead>
<tr>
<th>OCTs</th>
<th>GDP/capita (k EUR)</th>
<th>Key sectors in the economy</th>
<th>Gov't aid</th>
<th>Pop. ('000)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tourism</td>
<td>Offshore financial services</td>
<td>Fishing</td>
</tr>
<tr>
<td>Caribbean OCTs</td>
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<tr>
<td>Cayman Islands</td>
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<td>British Virgin Islands</td>
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<td>√</td>
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<tr>
<td>Saint-Barthélemy</td>
<td>26.0</td>
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<td>Aruba</td>
<td>17.6</td>
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<tr>
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<td>Bonaire</td>
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<tr>
<td>St Eustatius</td>
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<tr>
<td>Saba</td>
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<tr>
<td>Turks &amp; Caicos Islands</td>
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<td>√</td>
<td></td>
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<td>Pacific Ocean OCTs</td>
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<tr>
<td>Wallis &amp; Futuna</td>
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<tr>
<td>Pitcairn</td>
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<tr>
<td>Isolated OCTs</td>
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<tr>
<td>Falkland Islands</td>
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<tr>
<td>Greenland</td>
<td>30.9</td>
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<td>√</td>
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<tr>
<td>St Pierre &amp; Miquelon</td>
<td>28.1</td>
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<td></td>
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<tr>
<td>Mayotte</td>
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<tr>
<td>St Helena</td>
<td>4.5</td>
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<td>√</td>
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</tbody>
</table>

*Sources: various such as territories’ statistics, census

The comparison of the economies of the various OCTs shows similarities, and the following groups can be identified:
**Economies based on own assets and environment:**

This group includes:

- **Most of the Caribbean islands**, due to their environment attracting tourism and/or their offshore financial status (Cayman Islands, British Virgin Islands, Saint-Barthélémy, Aruba, Bonaire, Curacao, Sint Maarten, Turks & Caicos islands, Anguilla) as well as French Polynesia due to tourism (despite recent downturns) and its public sector,
- **New Caledonia and Greenland** due to their significant industrial activities and their public sector. (Greenland receives nevertheless significant government support)

In the Caribbean OCTs, similar economy patterns and climate characteristics is a good basis for sharing experiences in the development of renewable energy and energy efficiency.

**Economies with very limited industry base, significant public sector / government support (and > 5,000 people):**

- In **St Pierre & Miquelon** and **Wallis & Futuna**, public sector represents a significant share of economic activity and financial support from France is substantial. In Mayotte, social support from France is equivalent to one tenth of the GDP.

In these OCTs, the development of renewable energy and energy efficiency programs could be assessed vis-à-vis the costs of financial support from France.

**Small population islands (< 5,000 people) and remote territories:**

- **Montserrat** and **St Helena** receive significant public aid to compensate for their weak economies. Montserrat’s economy has been badly affected by the 1997 eruption. Because of its isolated geographic position, St Helena’s economic activity is very limited.
- **Saba** and **Sint Eustatius**. In these small populated territories, the local government is the major employer. As territories of the former Netherland Antilles, the Netherlands provide economic and financial aid to the islands according to the needs.
- **Pitcairn** and the **Falkland Islands** now rely less on government aid due to tourism and fishing activities. But their limited population base (58 people in Pitcairn, 2,840 people in the Falkland Islands) and isolated geographic position may increase the costs of renewable energy options.

In remote islands with a small population base, despite increased costs, the decision and implementation processes can be significantly reduced as a result of a lighter administration burden. Valuable experience sharing could be set up between these OCTs in regard to quick implementation of renewable energy investments.
5 EXISTING RELEVANT STUDIES AND POLICIES ON THE ENERGY SECTOR IN THE OCTS

5.1 Individual country reviews

Caribbean OCT’s:

| Anguilla | The national Energy Policy (2008) mentions the need to identify available renewable energy sources and technologies that are practical, commercially viable and suited to the culture and economy of Anguilla, and to draft and implement legislation and regulations to promote energy efficiency measures. Following this, a study on Anguilla’s Renewable Energy Integration Project was commissioned in 2012 [Castalia]. Because Anguilla’s electricity costs are among the higher in the Caribbean region, a priority objective for integrating renewable energy is to reduce electricity costs in the long term. Uptake of renewable energy is today very limited in Anguilla. There is no utility scale renewable electricity plant, and almost no distributed renewable generation (the little that exists is not connected to the grid). The study recommends that solar (SWH, solar PV), wind, and potentially waste-based energy options be explored and exploited. These options today are limited by legal and regulatory barriers, in particular. Anguilla’s renewable energy potential is good, and likely to help the country save on fuel costs and stabilize energy prices in the long term. However, it is unlikely to create profound savings and changes, at least in the short to medium term. Regarding energy efficiency, the policy recommendations resulting from the Castalia study include developing a national energy code for buildings, labelling for efficient consumer products, incentives (through taxes, import duties) and disincentives for non-efficient products, and raise public awareness. |
| Aruba | As part of the document “The Green Gateway - Economic Vision and Policy 2011–2013”, published by the government, several foreign institutes were approached, and of which in cooperation with Aruba’s stakeholders, resulted in the following:  
- in cooperation with the Netherlands Organization for Applied Scientific Research (TNO), the Aruba Sustainable Research Institute (ASRI) was created, which led to the document; Sustainable Energy Roadmap 2020 (May 2012). This roadmap also resulted in the construction that will start before the end of this year of a “Smart Community” of 20 houses, in which stakeholders together with the community will experiment and do research. Penetration of RE, storage, smart grid, waste water treatment will be in place along new construction methods;  
- the cooperation with Carbon War Room, led to the document, “Smart Growth Pathways”, A vision for low carbon future in Aruba (May 2013), prepared by Carbon War Room and Smart Island Economies;  
- the cooperation between CBOT (Caribbean branch of TNO in Aruba), Carbon War Room and New America Foundation, led to a collaboration framework (May 2013), to develop a solid national strategy for promoting economic growth, social equity and environmental awareness not only in |
Aruba, but also as a model for other countries to transition of fossil fuels and to pursue “smart growth”.

- the creation of “Aruba’s National Energy Policy 2013-2033, “Towards a green and sustainable Aruba”, supported by GIZ on behalf of the Federal Ministry for Economic Cooperation and Development and prepared by ECLAC (Economic Commission for Latin and the Caribbean), of which a final draft was presented May 2013;
- the creation of a Centre of Excellence (COE), which led to the “Aruba Center of Excellence for Sustainable Energy” document, Vision and Ambition (Feb 2011), in which demand side management and RE distributed generation (DG) were discussed.

Also various universities in U.S.A. were approached amongst which Harvard University, who presented a workshop in Aruba for local stakeholders, Aruba Harvard Workshop on Sustainable Development (Jan 2012). Another university which also shared their efforts was the Arizona State University, which together with CBOT and other local stakeholders created a solar panel test and lab course site at Aruba’s only intermediate technical school EPI. Next to have a testing facility, this gives EPI (Technical High School) the opportunity to expand its curriculum with other courses on sustainable development. With the support of Arizona professors, many courses were giving to local engineers, instructing them on the proper installation of solar panels, and upon completing the course, received their certification as solar installers by local authorities. Aruba’s effort became noticeable and a LOI was signed between TNO, ECN (Energy Centrum Netherland) and Ecofy’s to jointly develop wind related testing and certification activities in Aruba.

Since 2010, the annual Green Aruba Conference provides an opportunity for international experts to share knowledge with decision-makers in Aruba (government officials and senior utility executives). The 2012 edition invited international experts on wind, solar and maritime energy technologies in order to share knowledge of new and proven technologies in these fields. This was also the case on the occasion of the last edition held in Aruba in October 2013. This Conference is considered as the largest annual gathering of regional and international renewable energy stakeholders in the region. The last Annual Conference of the CREF (Caribbean Renewable Energy Forum) was held together with the Green Aruba Conference and contributed to its success. CREF supports Green Aruba V which will take place in Aruba in 2014.

Aruba aims to achieve its first ‘green hour ‘of 100% electricity completely generated by renewable energy by 2020. The 100% RE penetration should occur when a RE installed capacity of 135MW combined with increased storage capacity peaks and matches a grid load with a minimum demand of 100MW. Using new technologies for energy production and storage Aruba will then go on to its first green day, week, month and so on.

Incentives supporting green energy efforts are the import duties reduction on wind turbines, solar panels (from 12% to 2%), on several electrical appliances with better efficiency (from 22% to 2%) and on hybrid cars (from 25-50% to 2%).

| British Virgin Islands | The British Virgin Islands (BVI) passed a Climate Change Policy in March of 2012. Since its adoption, the Ministry of Natural Resources and Labour has been fully engaged in its implementation. This policy includes the following components: |
- Developing A National Energy Policy with establishment of a National Energy Committee with the necessary resources and authority to conduct research and draft policies on energy.
- Setting up of a National Energy Focal Point to support the work of the National Energy Committee;
- Developing and implementing the different stages of the National Energy Policy with actions in the regulatory framework, capacity building, enhancing the disaster preparedness and resilience of the energy infrastructure.

### Cayman Islands

A National Energy Policy proposal, prepared by independent experts has been presented to the government in March 2013. This document envisions ambitious targets for 2030: 13.5 % of electricity sold from RE sources (equivalent to 9% of all energy used), to be achieved through the implementation of:

- 5 MW of waste to energy in Grand Cayman
- 8 MW of utility scale wind energy in Grand Cayman
- 18.8 MW of solar PV energy (9 MW utility scale and 9.8 MW distributed scale)

Regarding energy efficiency, a series of objectives are set in this document. by 2030: 21 % overall savings in energy use from all sectors:

- 27 % savings in the use of electricity
- 20 % reduction in water use
- 16.5 % reduction of fuel use for transportation (a result of 20 % increase in overall fuel efficiency, and 5 % of additional fuel conservation)
- 8 % of electricity displaced thanks to increased penetration of solar water heaters

The suggested policy measures aim at maintaining and improving utility regulation for RE and energy efficiency, improving permitting and planning for RE, promoting the investigation of utility-scale RE potential, supporting consumer-owned RE generation, maintaining and improving utility regulation for energy efficiency, maintaining and promoting efficiency and conservation for water and wastewater.

This National Energy Policy still needs to be legislated as it was only presented to Cabinet and tabled at the Legislative Assembly in March 2013.

### Bonaire

Main information identified in the energy sector is mainly related to the Bonaire project to reach a 100% renewable supply.

### Curacao


### Saba

Main information identified is linked to the restructuring of the energy sector with renewal of the existing generation and distribution player and the re-establisment of the Saba Electric Company.

### Sint Eustatius

Main information identified is linked to the restructuring of the energy sector with renewal of the existing generation and distribution players.

### Sint Maarten

DNV KEMA Energy & Sustainability Inc. prepared a study in 2012, comprising a forecast of electricity production, a review of previous studies on RE (waste to energy, CARICOM Report, Energy Policy Report and Caribbean Regional Electricity Supply Strategy). The KEMA report recommends that any move toward a Sint Maarten sustainable energy future needs to include changes
| **Turks & Caicos Islands** | As part of a study [Castalia] commissioned in 2011 to develop an energy conservation policy and an implementation strategy, a basic assessment of relevant renewable energy sources was done, on the basis of generation cost, but no quantitative assessment was undertaken. PV is seen as an excessively costly technology versus the benefits it can provide. Regarding energy efficiency, highlights were provided with a strong emphasis on costs. Technologies that are recommended are CFLs, solar water heaters, retrofitting street lights. Policy instruments are: mandatory measures in building code, adapt customs incentives to favour high efficiency equipment. A demand-side management programme is presently under design. Other key recommendations are related to changing the regulation of the power sector to promote economically viable renewable energy at distributed and utility scales, to establish a grid code, and to implement a comprehensive waste management solution including power generation. Another study addressing the needs for regulatory and legislative changes has been commissioned in 2012. Discussion between the utility and the government began with respect to implementing the recommended measures. As part of the Turks & Caicos Development Strategy report 2013–2017, released by TCIG, the energy sector is addressed: a strategy to improve the regulatory framework of the electricity service sector was prepared in May 2012. This eight point plan is intended to put in place effective measures of control in addition to the monitoring of service quality, capital investment, the efficiency of operations, and the introduction of renewable energy and to address the issue of the allowable rate of return the utility shareholders might expect from investing in the TCI’s electricity sector. |
| Montserrat | In 2008, facing the island’s vulnerability because of its dependence on fossil fuels and associated price volatility, a national Energy Policy for the period 2008-2027 was prepared in order to provide a credible, broadly-supported and feasible strategic approach to move to a more sustainable energy path, targeting the development of renewable energy and enhanced efficiency of energy use. The overall goal and objectives are structured around five lines of action and four five-year waves of advance, and the associated review and revision of the policy. It starts with the implementation of an initial programme of action over the period 2008-2012. This strategy starts with the creation of an Energy Office to serve as a focal point for action towards sustainable energy and to coordinate priority projects; and with adaptation of the legal/regulatory framework as well as the creation of financial instruments. |
| **Saint-Barthélemy** | No significant recent study on the energy sector for Saint-Barthélemy has been identified. |

| **Pacific Ocean OCT’s** | Key studies and documents available in New Caledonia include:  
- The provisional study on energy supply-demand balance for the period 2013-2025 just prepared by ENERCAL. This document available on [www.enercal.nc](http://www.enercal.nc) has just been transmitted to the local authorities. It is used as a reference by the DIMENC to prepare the revised pluri-annual investment plan (PPI). The first PPI for the period 2009 – 2015 was not |
adopted. The new one is to be prepared after the adoption of the Climate – Energy Master Plan and will include feed in tariffs for different kinds of renewables.

- Climate – Energy Plan elaborated by a team of experts around six main topics and based on works and discussions of 6 working teams addressing: buildings, industrial equipment and domestic appliances, transport, renewable energy, mining industry and metallurgy, and horizontal issues. The actions are followed by the Territory Committee for Energy Management (CTME). The Climate – Energy Plan presents the main orientations of the island energy policy and defines the more appropriate strategy to strengthen the energy independency, maintain competitive energy prices, protect environment and contain greenhouse gas emissions.

- The website of DIMENa also provides a large quantity of useful information including the reports by the Energy Observatory among which the energy balance of New Caledonia.

- Energy in the development of New Caledonia. Assessment executed by the Research Institute for Development (IRD) at the request of the Government of New Caledonia and of the French Agency for Environment and Energy Management. The analysis identified the various measures to improve energy efficiency and demand side management and to reduce imports of fossil energies while targeting an objective of electricity production based on renewable energy.

Despite the development of wind farms, the energy dependency is unlikely to decrease in the coming years. After the commissioning of the 100 MW coal power plant in Prony, The Société Le Nickel (SLN) in Doniambo is starting the detailed studies for a 210 MW coal fired plant, needed for their metallurgical process, to replace its aging 160MW plant.

The new mining project in Koniambo, northern province, is planning for a 350MW power plant, of which 270MW should be fired with coal, and 80MW with fuel. This new installation could, as Doniambo and Prony Energies, be connected to the grid to respond partly to public distribution needs.

| French Polynesia | The Service of Energy and Mines (EMI) published annual statistical reports on the Territory energy sector which contain data on the energy in general and electricity with the participation of the renewable energy in the energy mix. In general, EMI produces a more detailed report for professionals and a more user friendly document for the public with only key data and information. Renewable Energies Master Plan: Being aware of the importance of the energy and climate issues for French Polynesia, the Territory strives to reduce its dependency on fossil fuels. Since 2009, French Polynesia set the objective that 50% of the electricity production originates from renewable energies by 2020. This master plan includes a supply demand analysis taking into account the economic situations and prospects and the likely technology developments with the objectives to guide authorities towards a more resilient and environment friendly energy supply. It also includes proposals for improvement of the regulatory framework to boost renewable energy. A study by the French Energy Regulatory Commission on the regulation of the Polynesian electric system with key recommendations to secure a more sustained future of the energy system including: a reinforcement of the energy sector control, create appropriate conditions for development of alternate supply, secure financial equilibrium of the utility with adequate tariffs, conciliate development of renewable energies and sector financial health and promote and implement demand side management and energy efficiency. |
A key document is also the multi-year electricity generation investment plan for the period 2009-2020 in Tahiti produce at the initiative of the Ministry of Energy and Mines. This plan reflects the energy policy of the Polynesian Government and provide the recommendations to reach the objective of reaching 50% in 2020 and even 100% in 2030 of RE in the total electric production which means to add between 160 and 230 GWh to the generation capacity from renewables.

**Wallis & Futuna**

A technical and financial audit on the execution of the concession for production and distribution of electricity in Wallis et Futuna was executed in 2011 at the request of the Ministers’ Council and the Préfet. It concludes that the management of EEWF is sound and proposed various options to secure the future of electricity supply and demand in the island.

The Institute of Overseas Emission (IEOM) a Public Establishment published an overview of the Wallis et Futuna situation, including the question related to water and Energy. IEOM is the Central Bank for Overseas Communities).

The CEROM (Comptes Economiques Rapides d’Outre Mer) published regular economic reviews of the Overseas Territories, including in WF.

**Pitcairn Islands**

Pitcairn islands heavily rely on the quarterly supply of imported fuel. The use of renewable energy consists of solar for domestic water heating and biomass for cooking and water heating. Diesel generators are engaged on a rotational basis and produce electricity for the 45 residential and public customers.

For power generation, a wind project was planned and eventually failed because of the inability of the supplier to deliver the system. Most likely, the future solar project will be prepared within the framework of an energy review which will encompasses all energy issues (analysis renewable energy options and including energy efficiency).

**Indian Ocean:**

**Mayotte**

Mayotte Energy Balance prepared by the Regional Energy Agency Réunion (ARER), which also coordinates the actions of the Energy Observatory of Mayotte to contribute to the development of the island energy strategy, proposes studies on the utilization of local energy resources, sustainable energy development and energy management.

Regarding energy, the local Authorities have stressed the entire dependency on imported petroleum products and the steady growth of energy consumption in the island. This is linked to the growth of population, accompanied by increased penetration of domestic appliances.

**South Atlantic:**

**Falkland Islands**

“The Islands Plan 2010/15 – Falkland Islands Government” is the document presenting the islands’ medium-term strategic vision for development. There is a strategic objective within it to “reduce reliance on fossil fuels for power generation for Stanley”, targeting a 40% displacement of fossil fuels by renewable energy from 2011/12 onwards. The focus is on increasing the installed capacity of wind power, which has been proven as a reliable technology, but also explore other potentially feasible renewables as well as modern energy storage technologies. Within the “Securing-The-Future”
document, there is also a target for renewable energy from wind turbines to supply 40% of the total energy needs.

An Energy Strategy was expected to be produced in 2012.

Within the “Stanley Town Plan 2001-2016 – Policy for Sustainable Development in Stanley” [2004, and “Draft Alteration” in 2009], sustainability is an overarching theme and the following policies are included:

- S4 (“Energy”): it refers to solar, hydro, wave, tidal and wind schemes to be viewed positively, and sets planning criteria to consider. It reviews the situation for wind power and energy storage and the target for a significant % of power for Stanley to be provided from renewables.
- D5 (“Energy efficient development”): it refers to opportunities for energy efficiency through building design and construction, insulation and orientation to minimise heat loss therefore heating demand.

St Helena “Saint Helena’s Sustainable Development Plan 2012/13 – 2014/15” sets out the 10-yr strategic vision for development, and the aspiration for the island to be branded as a “green” location, with sustainability to be mainstreamed across government departments, businesses and individuals. The SDP makes reference to a number of other more specific plans/policies:

- “National Environmental Management Plan – St Helena Island 2012-2022”, targeting increased energy generation from renewable sources, as well as reductions in home energy and water bills. Other targets include: green guidelines and best practice for businesses (by March 2013); businesses to ‘go green’ (by 2014); green rating/certification system for businesses (by 2016); “greening your business” training programmes every six months.
- “Strategy for the Generation of Electricity” sets out the strategic objectives for producing electricity, with the introduction of renewables as they become feasible. It provides a short overview of the potential of various renewable sources.
- “Laying the foundation for future generations – A housing strategy for St Helena 2012-2022” targets the promotion of environmentally sustainable housing.
- “Energy Efficiency Plan”. The document is yet to be developed, outlining measures to improve energy efficiency in buildings design.

Other studies include:
- “Jamestown – a vision for 2020”, outlining sustainable development principles for future construction, referring to energy demand reductions, energy efficiency and increased generation from renewable sources.
- National Environmental Data Management System (by March 2013). Baseline data collected to be able to set measurable targets for recycling, water conservation, renewable energy and marine archaeology protection.
- A number of desktop feasibility studies have been undertaken to assess the potential of energy-efficiency and renewable options for St Helena: offshore wind study (TI-UP, 2012), PV Study (WSP, 2011), micro-hydro and hydro studies (TI-UP, 2011 & 2012), marine technologies (TI-UP, 2012), OTEC (ITP, 2012), energy storage studies (ITP, 2012).
adopted, in November 2009, the “Strategic Development Plan of Saint-Pierre-et-Miquelon 2010-2030” (SDP). This plan sets out the main economic, social and environmental orientations to support the development of the islands and is seen as a tool which will assist towards building a sustainable future. Sustainable development is seen as a strategic axis within this document and as a key cross-cutting issue for the islands’ future.

A SWOT analysis undertaken as part of the SDP indicates that there are opportunities to explore the potential of renewable energy technologies (particularly wind), however there is a low overall potential of the local projects that can be developed, and of monitoring that potential. The development of energy efficiency solutions are seen as an opportunity.

There is no Energy Plan adopted as such, but SPM plans to undertake, in the medium-term, a territorial plan for energy & climate, as a continuation of a study carried out in 2009, serving as an inventory in the field of energy.

**Greenland**

“Denmark, Greenland and the Faroe Islands: Kingdom of Denmark Strategy for the Arctic 2011-2020” The Arctic Strategy is a document presenting the Kingdom’s shared vision for the future development of the Arctic.

The Arctic Strategy reflects the Government of Greenland's ambition to increase the use of renewable energy sources significantly. Furthermore, funds are allocated to cover future hydrological surveys in the national budget and future expansions of existing hydroplants are under way.

A national small grant facility for climate related and RE-projects administered by the Department of Housing, Nature and Environment serves to facilitate implementation of private and small business initiatives that explore new avenues for renewable energy production and efficient energy use.

When engaging in dialogue with extractive industries applying for exploration licence in Greenland the Government is determined to explore ways of supplying energy intensive industries with renewable energy when financially feasible.

A number of studies have been undertaken to assess the potential of renewable technologies: 1) “Survey of hydro power potential”: the Greenland Government allocates approx. 2mil.DKK per year (for 4 years) to undertake hydrological and geological studies to survey the potential for Greenland, so as to inform future decision making of the public power supply company 2) a research paper by the Technical University of Denmark (DTU), presented in the 2008 ARTEK conference “Sustainable Energy Supply in the Arctic”, was titled “Solar heating systems in the Arctic” and assessed the potential of solar systems 3) the PhD Thesis of J.Dragsted of the Department of Civil Engineering of DTU was published in 2011, with the title “Solar heating in Greenland: resource assessment and potential”, assessing amongst others, the effectiveness of the already installed solar heating systems 4) a study was undertaken by the Arktik Technology Centre and DTU in 2011, titled “Biogas potential in South Greenland”, investigating the potential of producing biogas from available organic waste for three cities.
5.2 Overview of existing energy situation for all OCTs and groups of OCTs

5.2.1 Background documentation

Most OCTs have set clear and ambitious energy targets. These targets generally include the increased use of renewable energy sources for electricity generation, thus reducing their dependency on imported fuels and their energy import bill. These are not only theoretical targets but well defined targets based on key policy and strategy studies, with a detailed assessment of the situation, analysis of potential, and, usually, with an indication of the means and resources to be mobilized to reach the targets. In many OCTs, studies have been undertaken with a view to assessing the development of the energy sector and the role which might be played by renewables in their future energy mix. Examples of key studies and reports are listed here below.

- In Anguilla: the National Energy Policy document and the Anguilla’s Renewable Energy Integration Project
- In Cayman Islands: A National Energy Policy proposal, prepared by independent experts, was presented to the government in March 2013
- In French Polynesia: key documents and studies include a Renewable Energy Master Plan, an Energy and Climate Strategy Plan, the regular energy review on electricity and petroleum products, prepared by the Department of Energy and Mines, and the Multiyear Investment Plan for the power sector 2009 - 2020.
- In New Caledonia: the Climate – Energy Master Plan is the key document on which New Caledonia intends to build its sustainable energy future; Energy in the development of New Caledonia, prepared by the Research Institute for Development, has been a good reference document in preparing this Master Plan.

In some OCTs, there is still not a proper strategy, not just for the energy sector but a more general country development strategy, which encompasses energy. This is the case, for example, in:

- Turks & Caicos: the Turks & Caicos Development Strategy report 2013–2017,
- Greenland: the Denmark, Greenland and the Faroe Islands - Kingdom of Denmark Strategy for the Arctic 2011-2020” is the document providing a vision for Greenland’s development,
- Saint-Pierre-et-Miquelon: Strategic Development Plan of Saint-Pierre-et-Miquelon 2010-2030” (SDP)

This does not mean that energy is not taken seriously in these territories but, rather, that energy is considered as an element in a broader vision contributing to the sustainable development of the OCT.

A few OCTs are still lacking a clear energy strategy because energy has still not been a priority compared to other development issues- as in Mayotte or the British Virgin Islands- or because the characteristics of the territory itself does not justify such a study (Pitcairn island).
The availability of strategy and policy documents is not necessarily related to the size of the OCT. For example, for Saint Helena (4,000 inhabitants), there are plenty of specific and general documents: Saint Helena’s Sustainable Development Plan (SDP) - 2012/13 – 2014/15, “National Environmental Management Plan (NEMP) – St Helena Island 2012-2022”, “Strategy for the Generation of Electricity” “Housing strategy for St Helena 2012-2022 - laying the foundation for future generations”, and a “Vision for 2020” for the City of Jamestown.

5.2.2 Capacity building in the OCTs

For those OCTs already involved in energy efficiency and renewable energy programmes, the authorities concerned have the necessary background materials and information to make their own decisions on how to handle issues of energy supply, including scope for increasing the proportion of available endogenous and renewable resources in their energy mix. This is confirmed by the availability of high quality documents, prepared by experienced consulting firms at the request of the OCTs’ authorities. The staff of local Ministries have followed up on the work of consultants and discussed the results with professionalism.

Some OCTs could also benefit from the assistance of specific agencies whose main activity is to promote energy management and utilization of renewable energy. This the case for example in many French OCTs (New Caledonia, French Polynesia or Mayotte), where local offices of the French Agency for Energy Management and Environment has been established, or in Aruba, where the Netherlands Organization for Applied Scientific Research (TNO) helps create an Aruba Sustainable Research Institute (ASRI) and a Centre of Excellence (COE) to inform end-users in regard to energy conservation. Other institutes that Aruba reached out to for assistance were Carbon War Room, New American Foundation, and various universities in USA and in Holland. Those local agencies or centres may be directly involved in programmes and projects as well as produce regular assessments on the potential for energy efficiency and renewables. They work in close collaboration with the local Authorities. They are involved in all activities related to energy efficiency and renewable energies and are the direct partners of all stakeholders.

In the aforementioned 2008 study, it was stressed that government policy-makers and senior civil servants, financial institutions and electricity utilities needed to strengthen their capacity on renewable energy, energy efficiency, and demand-side management issues. From the discussions and contacts with all OCTs, it is clear that capacity of their officers and technicians has increased and that they now have sufficient knowledge to develop their own programmes on renewable energy, taking into account the specific conditions prevailing in each island.

The 2008 study correctly stated that it takes many years to gain the necessary experience and knowledge needed to successfully design and implement large scale projects. What matters however is that the OCT authorities have the appropriate knowledge and experience to evaluate the results of the consultants’ work and make correct decisions based on their work.

To help design and shape their energy future requires that the OCTs make a continuous effort to research information, build capacity and share experiences. While this is relatively easier in the EU countries, it requires more time, motivation and resources when stationed away from the home country. However, since 2008, the availability of data and information on the internet and the communication facilities have significantly improved in quality and content. E-learning
should be promoted as much as possible while introduction to networking should also be encouraged.

For OCTs where projects have been, or are being, implemented, learning by doing has been a very positive means of training. The case of TEP Vertes is a perfect example of how local capacities have improved during the execution of projects. However, this approach cannot always be relied upon especially when larger renewable energy programmes and projects are being considered and implemented. National capacity needs to be developed and strengthened across a range of stakeholders so as to be able to assess, design, develop, implement, operate and maintain, monitor and manage large-scale renewable energy projects.

Many regional programmes (PIEPSAP, PIREP, PIGGAREP, PRETI and CREDP) have been executed in the region as mentioned in the section 9.6 of this report. These were actually of high interest since they dealt with renewable energy policy and technologies; however, OCTs were not eligible to participate and trainees from OCTs could not attend the sessions.

In all the OCTs, there is normally a very close cooperation between energy administration and energy utilities. The utilities are usually involved in RE projects and are also very much concerned about energy efficiency and demand side management issues as well as implementing DSM programmes. Utilities’ staff usually has more opportunities to receive training. There is usually a training facility at the company itself as well as links with other utilities in other countries and in the home country; they may also be members of utilities’ associations through which specific training is provided. Indirectly, thus the OCTs can benefit from this knowledge basis and this expertise.

Whilst administration officers and utilities staff need to be well trained and informed on many policy and technology issues, training of local installers, maintenance personnel, and end users is also important to ensure the continued reliability of operating systems as they are ultimately the ones who install, maintain and use the installations.

End-users should also be informed about their technical choices and options to reduce consumption as this is a day-to-day concern for them. In many islands, besides the large scale renewable energy projects which are developed by IPPs and local utilities, there are also a number of small scale RE projects which are meant to provide sustainable energy to local communities in remote areas. Those projects cannot be developed without the participation and involvement of the population at all stages of the project (from the design and preparation stage to the day-to-day operations after final inspection and financial closure). The TEP Vertes programme illustrates this point as all projects in French Territories were implemented with a large involvement of local communities in the decision making stage and during the implementation itself.

The suggestion to incorporate training on renewable energy and energy efficiency measures in existing curricula of technical training schools, vocational schools and polytechnics, as well as the proposal to initiate awareness on energy savings and environmental good practices in elementary and secondary schools, should also be encouraged.

From our own assessment and analysis based on the documentation available, some areas need to be strengthened in terms of capacity building and knowledge improvement and exchange of information amongst the main stakeholders in the OCTs in order to improve their capacity in
preparing and monitoring their energy future. The three proposed areas include: training, business advisory support and networking and communication.
6 CURRENT ENERGY SITUATION

In this section, the situation of the energy sector in the OCTs is reviewed. The section should be read in conjunction with the individual country energy profiles presented in a separate document.

6.1 Individual reviews

**Caribbean OCTs:**

| Anguilla | Fossil fuels account for almost all of Anguilla’s primary energy sources, and virtually all of its power generation. Anguilla is a small isolated electricity system, with power provided by the Anguilla Electricity Company Ltd (ANGLEC), a vertically integrated utility, owned in its majority by the Government. ANGLEC runs eleven diesel gensets, with a total installed capacity in 2012 of 33.1 MW. At current demand growth rates, the reserve capacity margin will require additional generating capacity for the next five years, as well as continued decommissioning of two older units. ANGLEC’s expansion plan calls for adding an additional 5.1MW diesel unit. Power consumption in 2010 was 87.2 GWh. ANGLEC’s system losses in 2010 (13%) were high compared to other Caribbean utilities.
| Aruba | In the current situation, heavy fuel oil (HFO) is the main energy source for producing electricity and drinking water. Aruba’s energy sector is severely affected by the increase in the price of crude oil and this is clearly reflected in the electricity generation cost.

The total power generating capacity of the public utility was 244 MW in 2010 and the IPP was operating 30 MW wind park (Vader Piet). The peak demand (in 2010) was 132.3 MW. Consumption of electricity has increased since 1986 from 219 GWh to 789 GWh in 2010. The electricity distribution network has been continuously upgraded to cope with this growth of local demand.

To decrease dependency on fossil fuels, WEB ARUBA has implemented various efficiency programs reducing the amount of required fuel.

Fossil fuel efficiency projects were initiated at the water and electricity plant where salt water reversed osmosis units and “RECIP” engines have been introduced. These efficiency programs resulted in a reduction of required fuel for energy and water production, from 6200 barrels per day, to 2013, (forecast), 3600 barrels per day. This reduction also includes the energy production from the first 30 MW wind farm, which represents 12% of the total energy consumption.

The government of Aruba envisions until 2020 a production mix of approximately 30% wind energy, 15% solar (including privately owned), 10% other RES including Waste To Energy (WtE biogas) and Sea Water Air Conditioning (SWAC) and 45% of fossil fuel (heavy fuel oil and / or gas).
Gas is distributed by a privately owned company, Aruba Gas Supply Company Ltd (ARUGAS), to 24,000 clients. LPG is provided by Valero Aruba Fuels (a holding company of Valero Aruba Refinery). The refinery has been producing liquefied petroleum gas for the Aruban market since 1997. When production is low, gas is imported from Trinidad.

Demand reduction is planned to be enhanced through an inverter based appliances incentive program and the introduction of pre-paid smart meters. Also, all public lights are being replaced with energy efficient LED lights.

Fossil fuel reduction targets entail replacing the use of heavy fuel oil by the Oil refinery and the water and electricity plant, WEB N.V., with natural gas which, next to structural cost improvements, will lead to significant emission reductions of CO2, SO2 and NOx.

Fossil fuel efficiency projects were initiated at the water and electricity plant where salt water reversed osmosis units have been introduced.

**British Virgin Islands**

<table>
<thead>
<tr>
<th>Primary energy:</th>
<th>62 ktoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency:</td>
<td>100%</td>
</tr>
<tr>
<td>Power installed:</td>
<td>44 MW</td>
</tr>
<tr>
<td>RE shares:</td>
<td>0% of generation, 0% of capacity</td>
</tr>
</tbody>
</table>

Serving approximately 15,250 customers (in 2011), the British Virgin Islands Electricity Corporation meets the territory’s peak demand of approximately 32 MW from eleven diesel fired generators which have an installed capacity of approximately 44 MW.

In 2010, the oil consumption in the BVI was around 1000 bbl/day.

**Cayman Islands**

<table>
<thead>
<tr>
<th>Primary energy:</th>
<th>308 ktoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency:</td>
<td>99.9%</td>
</tr>
<tr>
<td>Power installed:</td>
<td>155 MW</td>
</tr>
<tr>
<td>RE shares:</td>
<td>0% of generation, 0% of capacity</td>
</tr>
</tbody>
</table>

Practically 100% of Cayman’s electricity comes from imported diesel fuel. In 2010, Cayman imported 33.29 million imperial gallons of diesel fuel (95% being consumed by Caribbean Utilities Company), and 9.22 million imperial gallons of gasoline.

In 2010, with an approximate 155 MW capacity and a total peak demand of 102 MW, electricity companies sold 572.5 GWh. About 3.9% of Cayman’s electricity demand was used for water desalinisation.

Intermittent renewable energy sources, such as wind and solar, are said to be able to contribute to about 15% of Grand Cayman’s peak load in the future. Firm renewable energy sources, such as waste-to-energy (and ocean thermal energy conversion once commercially proven), could contribute some 35% per cent of Cayman’s peak load.

**Bonaire**

<table>
<thead>
<tr>
<th>Primary energy:</th>
<th>n.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency:</td>
<td>%</td>
</tr>
<tr>
<td>Power installed:</td>
<td>22.8 MW</td>
</tr>
<tr>
<td>RE shares:</td>
<td>40% of generation, 47% of capacity</td>
</tr>
</tbody>
</table>

In Bonaire, following the loss of its only power plant to fire in 2004, the government decided to develop a plan that would bring the island to a 100% sustainable energy supply. As part of this plan, a 10.8 MW wind park has been commissioned in 2010 (designed to provide 40% of the islands electricity needs). The plan envisions that the remaining energy could be provided by biodiesel produced form algae (now at the research phase).

Presently, rented container diesel generator systems supplied by Aggreko are providing the balance of energy needed. The installed diesel generator systems have a rated capacity of 12 MW. In a typical year, Bonaire consumes 75,000 MWh of diesel-generated electricity. Bonaire’s peak electricity demand is approximately 11 MW.
<table>
<thead>
<tr>
<th>Location</th>
<th>Primary energy</th>
<th>Dependency</th>
<th>Power installed</th>
<th>RE shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curaçao</td>
<td>n.a.</td>
<td>80%</td>
<td>308 MW</td>
<td>20% of generation, 18% of capacity</td>
</tr>
<tr>
<td>Saba</td>
<td>n.a.</td>
<td>100%</td>
<td>n.a.</td>
<td>0% of generation, 0% of capacity</td>
</tr>
<tr>
<td>Sint Eustatius</td>
<td>n.a.</td>
<td>100%</td>
<td>2.15 MW</td>
<td>0% of generation, 0% of capacity</td>
</tr>
<tr>
<td>St Maarten</td>
<td>na</td>
<td>100%</td>
<td>95 MW</td>
<td>0% of generation, 0% of capacity</td>
</tr>
<tr>
<td>Turks &amp; Caicos Islands</td>
<td>100.94 ktoe</td>
<td>100%</td>
<td>65 MW</td>
<td>0% of generation, 0% of capacity</td>
</tr>
</tbody>
</table>

In Curaçao, Aqualectra Production has a total generating capacity of 175 MW and CUC operates 133 MW. The peak electric load in Curacao is 105 MW. There are presently two wind parks in Curaçao: Playa Kanoa, 15 MW et Tera Kórá. 15 MW, owned by NuCapital. Under Aqualectra’s Utility Plan 2020, the utility will continue its long-term commitment to clean energy as the Caribbean’s leader in wind energy with wind-sourced goals of 30% by the year 2020 and 40% of generation capacity by the year 2030.

With its refining production of 335,000 bpd (Isla Refinery PVDSA), Curacao is a net exporter of refined products, produced mainly from Venezuela’s oil.

In Saba the electricity company is being restructured and the new Saba Electric Company (SEC) is going to reborn in 2014. The Saba authorities want to develop and invest in solar and wind-power energy as alternatives to help stave off current fuel expenses. Although there is a plan for installing wind turbines to meet up to a third of their electricity needs after successful restructuring is achieved, it is however unlikely that wind-power be a viable alternative for Saba due to topography and equipment maintenance associated costs. Solar energy appears to be the choice despite the need to secure a large area for the installation of solar panels.

Geothermal potential is likely to be explored in the island.

Like in Saba, the power company in St Eustatius is being restructured and there is also a plan for installing wind turbines to meet up to a third of their electricity needs after successful restructuring is achieved. Solar alternative should be assessed.

Geothermal potential is likely to be explored in the island.

St Maarten is fully dependant on petroleum products. The utility runs diesel and HFO power plants. There are plans to reduce the diesel and increase HFO shares, and to implement a 8 MW waste-to-energy power plant in 2016.

Geothermal potential is likely to be explored in the island.

The Turks and Caicos Islands are totally dependent on imported fuels (diesel for power generation, gasoline and kerosene for transport). The fuel supply chain and logistics is complicated and costly because of: (i) Frequent shipping via small barges due to the lack of a deep water port; and (ii) tax on fuel levied by the Bahamian authorities since it has to be first landed in Bahamas before trans-shipment to the TCI. Fortis TCI (Providenciales) has an onsite storage capacity of approximately 16 days, but the supplier is located within 15 minutes of delivery however the route is susceptible to interruption if there is flooding. Grand Turk has storage capacity for up to approximately 6 weeks.

The aggregate installed generating capacity is 65 MW. There are four stand alone diesel generating plants located on the islands of Grand Turk, Salt Cay, Providenciales and South Caicos. The quality of the electricity service is relatively high.

There is virtually no uptake of renewable energy in the TCI. The rare exceptions are small solar and wind systems distributed at customer premises.
and not connected to the grid. There is no utility scale renewable electricity generated in the TCI.

There are no problems of power cuts, voltage drops or blackouts in the TCI. The utility has sufficient reserve generation capacity and has invested heavily in recent years, upgrading its distribution system to withstand hurricane conditions.

**Montserrat**

**Primary energy:** 964 ktoe  
**Dependency:** 100%  
**Power installed:** 6.22 MW  
**RE shares:** <1% of generation <1% of capacity

Montserrat’s energy supply entirely relies on imported fuels. Electricity in Montserrat is 100% diesel-generated and is currently produced from four diesel units, run by Montserrat Utilities Ltd (MUL). The total capacity is currently 6.22 MW, with plans to expand to 6.72 in 2015. Residential and commercial sectors are the major users of electricity (52% and 44%). Peak power demand is 2 MW. The installation of a new 1.5 MW diesel generator, funded by DFID and the Caribbean Development Bank, is planned.

There is no renewable energy capacity presently connected to the grid in Montserrat.

Local RE resources consist mainly of geothermal energy, wind, and solar energy, not yet tapped. (Solar PV could be a viable option if solar panel costs continue decreasing). Regarding geothermal energy, there are encouraging indications that a geothermal resource exists, but this potential has yet to be evaluated.

**Saint-Barthélemy**

**Primary energy:** ktoe  
**Dependency:** 100%  
**Power installed:** 26.84 MW  
**RE shares:** ~0% of generation ~0% of capacity

Electricity is produced by EDF (Electricité de France) thanks to a 18.6 MW fuel oil plant and a 7 MW diesel-fired power plant. Plant renovation is under progress and two new engines, (7.8 MW each) have been installed.

A general modernisation plan is foreseen by EdF with replacement of all the old diesel engines by the year 2016.

Renewable energy initiatives remain marginal. Solar energy (thanks to solar water heaters) is the most developed renewable energy on the island. Installation of SWH is subsidised by local authorities. SWH are compulsory for new housing buildings. A solar PV array (24 kWc) is installed at the premises of the local authorities. This PV system is connected to the grid. There are a few small windmills (few kW) installed in private properties.

Regarding energy efficiency, in 2011, an agreement was signed between local authorities and EDF.

Saint Barthélemy wants to keep its energy independency as a key element and as a guaranty of its economic success, especially in the tourism industry. Therefore, Saint-Barthélemy community is strongly opposed to the project of undersea interconnection with Sint Maarten and Anguilla islands. Saint-Barthelemy will not participate in this project.

**Pacific Ocean OCT’s**

**New Caledonia**

**Primary energy:** 945 ktoe  
**Dependency:**  
**Power installed:** 495 MW  
**RE shares:** 15.1% of generation

In 2009, petroleum products and coal consumptions were 698 and 206 ktoe, respectively; the main share is dedicated to the nickel industry. Total energy consumption was 663 ktoe in 2009, of which 72 ktoe were used as raw materials in metallurgy and the rest, 591 ktoe, for energy use. Industry and transport are the main energy consuming sectors with 57% and 31.3% respectively.

In 2012, the total electricity production was 2,257 GWh, 64% being for the metallurgy industry and 36% for public distribution.
In 2011, the RE share was 15.1% of the electricity generated in New Caledonia, of which 12.4% is from hydro power (3 hydro power units are connected to the grid and several decentralized micro units), 2.4% is wind power from 6 wind farms with power ranging between 0.5 and 11 MW. On the interconnected grid, the share of RE in electricity generation was 20.5% in 2012, with 17.9% from hydro and 2.6% for the wind energy.

95% of the energy used in New Caledonia is imported. Fuel is supplied from Singapore refineries and LPG is imported from Australia. Coal was first used in the territory energy mix in 2009 when the 100MW coal-fired power plant of Prony Energies, a subsidiary of Enercal, started its activities.

Local resources consist of hydro, solar and wind. They are currently used for power generation through a few hydro generator sets including the 68 MW Yaté power plant, and wind and solar farms. The energy from the sea is not utilized and no planned investment project is reported. Similarly, no geothermal resources have been identified. New Caledonia relies on imported fuels for securing the future of its economy and in particular of its nickel industry.

Regarding new renewable energies projects, calls for proposals have recently been launched to add 20 MW wind power in Grande Terre and several PV plants, with power between 150 and 2000 kW in several areas of New Caledonia.

French Polynesia

Primary energy: 399 ktoe in 2010
Dependancy: 87 %
Power installed: 289 MW
RE shares: 29.5% of generation
19.7% of capacity

89% of the energy used in French Polynesia is imported as petroleum products in the form of jet fuel, heavy fuel, gasoil, gas including butane and GPL, gasoline and kerosene. The petroleum products are used mainly for transport (42%) and electricity generation (40%). The remaining 18% is used for industry, and for heating and cooking in commercial and residential sectors.

Total power installed capacity is 289 MW. Electricity is generated mainly through 160 diesel oil and gasoil generators totaling 232 MW (13 in Tahiti island, 88 in other islands conceded to EDT and about 60 in other remote 29 islands). Other sources of power generation are hydro with 47 MW (46 MW in Tahiti), PV connected to the grid (11 MW), hybrid solar-diesel (680 kW) and wind with 120 kW.

Currently, local resources consist of hydro, solar, wind and marine energy. Besides power generation, they are used for solar water heating with 30,000 units installed, and for energy substitution with a first deep sea water air conditioning system. In the islands, electricity generation relies entirely on thermal energy except for some micro-hydro, hybrid solar-diesel and about 1500 individual solar systems. Three hybrid solar-diesel projects have been implemented, supported by the EC-funded TEP Vertes project.

Wallis & Futuna

Primary energy: 12 ktoe
Dependancy: 97-98 %
Power installed: 7.1 MW
RE shares: 0.5% of generation
2.8% of capacity

In 2011, hydro-based generation was non-existent as the hydro power station was shut down for repair and for administrative issues. This hydro power plant is being repaired now. Renewable energies share in the global electricity balance has slightly increased after the kick off of the TEP funded solar power units in Futuna and Wallis in 2011 and 2012.

So far, Wallis-and-Futuna has been totally dependent on imported fuels as the hydropower unit has been stopped for some time. Only a minor share of renewable energy enters in the island energy balance with the solar PV stations installed by EEWF and by the TEP Vertes projects.
In Wallis and Futuna, energy consumption is increasing at 2.5% per year. It is more related to the increase of appliances in households than to the number of customers, which is decreasing. Access to modern energy rate is unchanged (around 97 – 98%).

A new WF renewable energy strategy is expected to be produced soon in the framework of the 10th EDF. This study should confirm the components of the action plan to reach a share of more than 40% of RE in the total power generation by 2020 with the installation of new solar and wind power units, the construction of a few micro hydro units, and the utilization of copra oil as a fuel mixed with diesel (20-80%) in generator engines adapted for this combustion, which still need to be confirmed.

**Pitcairn Islands**

<table>
<thead>
<tr>
<th>Primary energy</th>
<th>50 toe (average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency</td>
<td>100%</td>
</tr>
<tr>
<td>Power installed</td>
<td>110 kVA</td>
</tr>
<tr>
<td>RE shares</td>
<td>0% of generation</td>
</tr>
<tr>
<td></td>
<td>0% of capacity</td>
</tr>
</tbody>
</table>

The energy infrastructure of Pitcairn is limited to a power station (including 3 generators engaged on a rotational basis with a net capacity of 110 kVA operated 15 hours a day) and a simple transmission network to deliver power to the 48 consumers on the island. A few customers are equipped with solar water heaters. Annual consumption varies between 40,000 and 60,000 liters of gasoil.

**Indian Ocean:**

**Mayotte**

<table>
<thead>
<tr>
<th>Primary energy</th>
<th>96 ktoe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency</td>
<td>98.6%</td>
</tr>
<tr>
<td>Power installed</td>
<td>90 MW</td>
</tr>
<tr>
<td>RE shares</td>
<td>5.3% of generation</td>
</tr>
<tr>
<td></td>
<td>13.2% of capacity</td>
</tr>
</tbody>
</table>

Electricity is generated through 17 diesel engines of various power capacity ranging between 750kW and 8MW, installed at two different sites: Petite Terre island with 38.1 MW at Badamiers and Grande Terre island with 40 MW in total at Longoni started in 2009. Total power installed is 78.1 MW and electrical production was 271 GWh in 2012. The two islands are interconnected by an undersea cable.

The 13.2% share of RE is the installed generating capacity and the share of RE in actual electrical generation was 5.3% in 2011.

There are around 1230 individual Solar Water Heaters installed in the island. The use of central solar water heaters in apartment buildings is expected. Used oil has been utilized as a fuel at the Badamiers power plant.

There is a small local charcoal production to meet households cooking needs. The other RE potential are limited:

- Wind power: 50 MW in theory but limited due to access, difficulty to inject into the grid, and the number of hours of windy conditions
- Hydro: Limited even from the quite strong streams in the channels
- Marine: Only for industrial applications (salt extraction for drinking water)
- Geothermal: Not exploitable under present economic conditions
- Biogas: Potential to produce 680 NM3/h biogas to operate 2 units of 600kW each and produce 8 GWh.
- Biomass: Copra oil potential of 2,300 tons/year in 2020 from coco tree plantation.

Demand side management and energy efficiency is addressed through an awareness campaign, distribution of 320,000 low energy lamps, Ankiba prepaid meters, energy audits in industry, and a new building thermal regulation expected in 2017.
### South Atlantic:

<table>
<thead>
<tr>
<th><strong>Falkland Islands</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary energy:</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Dependency:</strong> %</td>
<td>8.6 MW</td>
</tr>
<tr>
<td><strong>Power installed:</strong></td>
<td>RE shares:</td>
</tr>
<tr>
<td></td>
<td>33% of generation</td>
</tr>
<tr>
<td></td>
<td>23.2% of capacity</td>
</tr>
</tbody>
</table>

The islands are currently dependent on imported diesel for the production of electricity, and on energy generated from wind turbines. There are two stand-alone power stations, each serving one of the two population centres. The power station serving the capital, Stanley, is a hybrid wind-diesel power station (8 conventional diesel generators and a 2 MW wind farm).

The total net installed capacity for electricity generation was 8.6 MW in 2010 (76.8% from diesel and 23.2% from wind). The installed 2 MW wind farm currently supplies annually 33% of the islands’ electricity needs.

Installed electrical capacity is expected to nearly double by 2020, increasing to 15 MW, with the proportions remaining similar (diesel 80% - wind 20%). The planned rise in capacity follows the expected rise in peak demand, anticipated to rise from 2.6 MW in 2010 to 4 MW by 2015, and 6 MW by 2020.

Research in recent years suggests that there may be significant oil/gas reserves in the Falklands area and a number of companies have been involved in the investigations for oil exploitation. Oil production may become a future prospect (production tentatively planned for 2017) however currently it doesn’t supply any of the islands’ energy requirements.

The future vision is to reduce reliance on fossil fuels, increase the installed wind power capacity and explore other potentially feasible renewables and modern energy storage technologies.

<table>
<thead>
<tr>
<th><strong>St Helena</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary energy:</strong></td>
<td>~2 ktoe (2010)</td>
</tr>
<tr>
<td><strong>Dependency:</strong> %</td>
<td>98%</td>
</tr>
<tr>
<td><strong>Power installed:</strong></td>
<td>4.9 MW (2010)</td>
</tr>
<tr>
<td></td>
<td>8.1 MW (2012)</td>
</tr>
<tr>
<td><strong>RE shares:</strong></td>
<td>11% of generation (2012)</td>
</tr>
<tr>
<td></td>
<td>6.2% of capacity (2013)</td>
</tr>
</tbody>
</table>

Saint Helena primarily relies on imported diesel for the production of electricity, and on energy generated from wind turbines. Final energy consumption was 0.61 ktoe in 2010. The total net installed capacity for electricity generation was 4.9MW in 2010, of which 90% (4.4MW) came from diesel and 10% (0.5MW) from six wind turbines installed on the island.

Installed electrical capacity has risen to 8.1 MW in 2013 and is expected to increase to 15.6 MW by 2020, with the overall share of diesel dropping to 49% and the share of wind rising to 32%. There is a planned share of installed capacity of 19% from other renewable sources (probably Ocean Thermal Energy Conversion) by 2020.

The planned rise in installed electrical capacity follows the expected rise in peak demand by 2020. The peak electricity demand is anticipated to rise from 1.5MW in 2010 to 3.9MW by 2020.

The share of renewables in electricity generation has risen from 2.2% in 2008, to 13.1% in 2011 and 11% in 2012.

The vision within the St Helena SDP is to shift towards energy produced on the island, mainly focusing on increasing the installed wind capacity, so that financial sustainability and energy security can be improved. There are also plans to investigate other potential renewable energy sources as well as improve buildings’ energy efficiency.

### North Atlantic:

<table>
<thead>
<tr>
<th><strong>St Pierre &amp; Miquelon</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary energy supply:</strong></td>
<td>Primary energy supply for St Pierre &amp; Miquelon (SPM) is primarily based on imported diesel and on a small contribution by wind turbines. There are two diesel power plants, one in St Pierre and one in Miquelon. The diesel plant in</td>
</tr>
</tbody>
</table>
Miquelon is connected to a wind farm consisting of ten wind turbines. The total net installed electrical capacity for SPM is 26.6 MW (2010), of which 97.8% comes from diesel and 2.2% (0.6 MW) comes from wind. These capacities are expected to remain the same by 2015.

Electricity consumption was 42,400 MWh in 2010 (rising by ~19% since 2000), of which 76% was for residential customer consumption and 24% for industrial. Peak electricity demand was 10.87 MW in 2010, with approximately 86% in St Pierre and the remaining 14% in Miquelon. Total peak demand is anticipated to rise to 11.2 MW (3%) by 2015 and to 11.7 MW (~7.6%) by 2020. In the last decade, test drilling for oil gave hope for the development of the energy sector; however, tests have not so far been successful in the South of SPM. Looking ahead, one of the strategic axes within the Saint-Pierre-et-Miquelon SDP 2010-2030 is sustainable development, with actions to promote energy efficiency and renewable energy.

Greenland generates approximately 70% of its power through 5 hydroelectric plants, and relies on imported diesel for the remaining amount. Primary energy supply of imported diesel was ~272 ktoe in 2010, with small amounts of fuel oil and kerosene also imported. All towns and settlements are covered by the public power supply, except for few farms and the military installation, arranging for their own supplies. Apart from two towns connected via a grid, all others operate with an “island operation”, relying on local energy generation and supply, and local back-up. As the locations are remote and infrastructure limited, there is high demand for energy supply security.

Despite the high contribution of RES to electricity generation, Greenland is still strongly dependent on imported oil for covering the overall energy requirements. Almost 89% of the overall energy consumption in 2011 was based on imported oil.

The total net installed electrical capacity was 125.4 MW in 2010 (~45% from diesel and ~55% from hydropower). The installed capacity of hydropower is projected to rise by ~33% (to 91.3 MW) by 2015 whereas the installed diesel capacity is expected to drop by ~12% by the same time.

Heat is produced from a variety of sources: CHP plants; diesel fuelled district heating; waste heat recovery incinerators run by municipalities; heat recovery by some fish industry plants; private diesel and kerosene furnaces of other companies and private consumers.

Research suggests that there may be a large potential for oil/gas reserves in the Arctic, and the intention of Greenland is to pursue such exploration.

There is also a growing focus on further exploring available local renewable energy sources, with a view to achieving long term self-sufficiency, especially for the smaller towns and settlements, which are dependent on diesel energy supply and do not always have the possibility of hydropower on a larger scale.

The vision within “The Kingdom of Denmark Strategy for the Arctic 2011-2020” is “to pursue ambitious and active energy and climate policies, so as to create security of supply, to reduce emissions of greenhouse gases and air pollution, while creating a basis for commercial development”.

6.2 Global energy analysis of all OCTs or groups of OCTs
6.2.1 Installed capacity in power generation

Mainly because of their historic links with European States, the situation of the OCTs is very different from those of ACP countries. It is worth recall that worldwide, approximately 20% of the population has no access to modern energy service, or 1.4 billion people. Most of these people live in sub-Saharan Africa where only 31% has access to electricity.

In the OCTs, access to electricity is high and on average 98% of the population have access to power. Mayotte has the smallest rate of access to modern energy but it is rapidly increasing, with only 76% in 2008 and increasing to 92% by 2012. All other OCTs have almost full access to energy either through a centralised electricity network, or a mini-grid, or individual systems.

A high dependence on imported petroleum products is a common pattern in all OCTs. All OCTs use imported petroleum products as their main energy source and the dependency rates are at least 90%, ranging from 89-90% (New Caledonia and Aruba) to 100% (for most OCTs). The awareness that this dependence was a major source of economic vulnerability for many OCTs became evident during the last 20 years as a result of several external economic and environmental factors (sharp increases in oil prices, sea level and climate change, etc.). This reliance upon imports has deeply affected the balance of payments, employment opportunities, and development plans of the OCTs.

In some countries, for example, imported petroleum fuel bills equal as much as 20% of gross national product. This economic impact is unlikely to decrease soon with increases in the oil and gas, prices continued economic growth, increases in population size, and economic activities requiring more and more energy, and the fact that the contribution of available endogenous resources to the energy mix will remain limited for some time.

The OCT islands are especially vulnerable due to their small size. They are increasingly confronted with environmental repercussions because of the utilisation of their fragile natural resources for economic development. Severe weather events are occurring with increased frequency and intensity, causing considerable economic, social, cultural and environmental disruption, and affecting development projects and programmes. Sea-level increases can also have a devastating impact.

The authorities in the OCTs are very much aware of these problems but they also know that they benefit from natural resource assets such as excessive sunlight, constant warm temperatures, and easy access to sea and wind, creating favourable conditions and prospects for profitable small and medium scale renewable energy projects.

In recent years, most OCTs have developed programmes and projects on their own in order to increase RE contribution to their energy mix, or, at least, maintain the current RE share, despite continuing growth in energy demand. The following table summarizes growth in installed power capacity in the OCTs between 2008 and 2011/2012.
Table 5: Power installed capacity in the OCTs

<table>
<thead>
<tr>
<th>OCT</th>
<th>Installed capacity (MW)</th>
<th>Population</th>
<th>Installed capacity per cap (kW/cap)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2011/2012</td>
<td>most recent</td>
</tr>
<tr>
<td>Anguilla</td>
<td>33.1</td>
<td>15,754</td>
<td>2.1</td>
</tr>
<tr>
<td>Aruba</td>
<td>236</td>
<td>270</td>
<td>108,141</td>
</tr>
<tr>
<td>British Virgin Islands</td>
<td>39</td>
<td>44</td>
<td>31,912</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>129</td>
<td>155</td>
<td>56,729</td>
</tr>
<tr>
<td>Bonaire</td>
<td>22.8</td>
<td>17,408</td>
<td>1.3</td>
</tr>
<tr>
<td>Curaçao</td>
<td>308</td>
<td>145,619</td>
<td>2.2</td>
</tr>
<tr>
<td>Saba</td>
<td>no data</td>
<td>1,991</td>
<td>no data</td>
</tr>
<tr>
<td>Sint Eustatius</td>
<td>2.15</td>
<td>3,543</td>
<td>0.6</td>
</tr>
<tr>
<td>Sint Maarten</td>
<td>95</td>
<td>39,689</td>
<td>2.4</td>
</tr>
<tr>
<td>Turks &amp; Caicos islands</td>
<td>65</td>
<td>31,618</td>
<td>2.2</td>
</tr>
<tr>
<td>Montserrat</td>
<td>6</td>
<td>4,922</td>
<td>1.3</td>
</tr>
<tr>
<td>Saint-Barthélemy</td>
<td>25.6</td>
<td>9,057</td>
<td>2.8</td>
</tr>
<tr>
<td>New Caledonia</td>
<td>371</td>
<td>**495</td>
<td>245,580</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>256</td>
<td>289</td>
<td>268,270</td>
</tr>
<tr>
<td>Wallis &amp; Futuna</td>
<td>8</td>
<td>7.1</td>
<td>12,500</td>
</tr>
<tr>
<td>Pitcairn</td>
<td>0.08</td>
<td>0.11</td>
<td>58</td>
</tr>
<tr>
<td>Mayotte</td>
<td>45</td>
<td>90</td>
<td>212,645</td>
</tr>
<tr>
<td>Falkland Islands</td>
<td>8</td>
<td>8.6</td>
<td>2,840</td>
</tr>
<tr>
<td>St Helena</td>
<td>4.9</td>
<td>*8.1</td>
<td>4,000</td>
</tr>
<tr>
<td>St Pierre &amp; Miquelon</td>
<td>26.6</td>
<td>***26.6</td>
<td>6,125</td>
</tr>
<tr>
<td>Greenland</td>
<td>86</td>
<td>125.4</td>
<td>56,452</td>
</tr>
</tbody>
</table>

*2013 figure -
** of which 460 MW on the interconnected grid
***2010 figure

This table shows that total generation capacity in the OCTs is approximately 1930 MW. With 495 MW in New Caledonia alone, this represents more than a quarter of total installed capacity (25.6%). This is obviously due to its large mining industry. Five OCTs have a significant installed generation capacity - between 100 and 300 MW - and which represents 52% of the total installed. These are Aruba, Cayman Islands, Curaçao, French Polynesia and Greenland. The other OCTs account for 22% of total installed capacity, with three of them – namely, Mayotte, Curaçao and Turks & Caicos - having a generation capacity of more than 60 MW.

The above table also shows that installed capacity per capita may vary significantly from one OCT to another: Wallis et Futuna, Sint Eustatius and Mayotte have a very low installed capacity per person. In Mayotte, 20% of the population still have no access to electricity. In
both these OCTs, residential electricity demand is still low and economic activities do not require large amounts of energy (no industry, no significant air conditioning and no motive power needs). This could change rapidly in the next years.

This energy demand pattern is also similar for many islands in French Polynesia which explains the low average installed capacity per person of 1.1 kW/cap in French Polynesia, despite the fact that installed capacity is obviously more important in Papeete and in Tahiti.

At the other end of the spectrum, two OCTs have quite a large installed capacity per person: the Falklands and St Pierre et Miquelon.

### 6.2.2 Contribution of renewable energy (RE) to installed electricity capacity

The participation of renewable energy in the electric installed capacity is shown in the following table:

#### Table 6: Share of RE in power installed capacity in the OCTs

<table>
<thead>
<tr>
<th>OCT</th>
<th>Installed capacity (MW)</th>
<th>Share of RE in installed capacity</th>
<th>Installed capacity from RE (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anguilla</td>
<td>30</td>
<td>33.1</td>
<td>0.13 %</td>
</tr>
<tr>
<td>Aruba</td>
<td>236</td>
<td>270</td>
<td>0 %</td>
</tr>
<tr>
<td>British Virgin Islands</td>
<td>39</td>
<td>44</td>
<td>0 %</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>129</td>
<td>155</td>
<td>0 %</td>
</tr>
<tr>
<td>Bonaire</td>
<td>22.8</td>
<td></td>
<td>47 %</td>
</tr>
<tr>
<td>Curaçao</td>
<td>308</td>
<td></td>
<td>10 %</td>
</tr>
<tr>
<td>Saba</td>
<td>no data</td>
<td>6.4%</td>
<td>0 %</td>
</tr>
<tr>
<td>Sint Eustatius</td>
<td>2.15</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Sint Maarten</td>
<td>95</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Turks &amp; Caicos islands</td>
<td>65</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Montserrat</td>
<td>6</td>
<td>6.22</td>
<td>0 %</td>
</tr>
<tr>
<td>Saint-Barthélemy</td>
<td>26</td>
<td>26.8</td>
<td>0 %</td>
</tr>
<tr>
<td>New Caledonia</td>
<td>371</td>
<td>495</td>
<td>30 %</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>256</td>
<td>289</td>
<td>21 %</td>
</tr>
<tr>
<td>Wallis &amp; Futuna</td>
<td>8</td>
<td>7.1</td>
<td>3 %</td>
</tr>
<tr>
<td>Pitcairn</td>
<td>0.08</td>
<td>0.11</td>
<td>0 %</td>
</tr>
<tr>
<td>Mayotte</td>
<td>45</td>
<td>90</td>
<td>0.5 %</td>
</tr>
<tr>
<td>Falkland Islands</td>
<td>8</td>
<td>8.6</td>
<td>13 %</td>
</tr>
<tr>
<td>St Helena</td>
<td>4.9</td>
<td>8.1</td>
<td>5 %</td>
</tr>
<tr>
<td>St Pierre &amp; Miquelon</td>
<td>26.6</td>
<td><strong>26.6</strong></td>
<td>2.2 %</td>
</tr>
<tr>
<td>Greenland</td>
<td>86</td>
<td>125.4</td>
<td>36 %</td>
</tr>
</tbody>
</table>

*2013 figure  **2010 figure  ***2011 figure or latest available
During the last five years, installed capacity has significantly increased in many OCTs with 400 MW additional power. Based on data available in the 2008 study and what has been collected for the present report in terms of installed capacity and share of RE, approximately 110 MW of additional capacity from renewables has been added to the OCTs’ power systems, with an increase from 210 MW in 2008 to 320 MW in 2013. In percentage, the participation of RE has slightly increased from 14.2% to 17% in 2013 with difference between the OCTs. Four groups of OCTs emerge:

- A group of OCTs where renewables represent more than 20% of installed power generation capacity: Bonaire, New Caledonia, French Polynesia, Falklands and Greenland, with a significantly increased share in Greenland (55% compared to 36% in 2008). In Bonaire, the present contribution from the wind farm represents 47% of the overall installed capacity, and it is 23% in the Falkland Islands.
- A group of OCTs where RE participation is still limited (less than 20%) but represents more than 5%: Aruba, Curaçao, Mayotte and St Helena
- A small group of OCTs where the RE share in the power capacity less than 5%: Wallis et Futuna and St Pierre et Miquelon
- A group of OCTs where renewable does not currently contribute to the production of electricity: Anguilla, British Virgin islands, Cayman islands, Sint Maarten, Sint Eustatius, Saba, Turks & Caicos and Pitcairn

As mentioned earlier, OCT’s rely heavily on imported oil to meet their electricity demand: lighting, appliances, heating and/or cooling, desalination plants and industrial processes. In New Caledonia, 76% of the electricity is produced from heavy fuel oil (HFO) whilst in other OCTs the reliance on HFO is greater than 90%. The cost of fossil fuels has therefore a major impact on the economic activities of these islands and on the provision of drinking water. Based on the questionnaires, it appears that the reliability of the power in the majority of the OCT’s is good with very infrequent brown or black-outs.

The majority of the OCT islands rely on diesel generators; only New Caledonia has a 50 MW coal power station. The peak load ranges from 55 KW in Pitcairn, 1.5 MW in Saint Helena and Montserrat to 342 MW in New Caledonia, which has an important mining industry. Residential demand still represents between 30% and 75% of the total demand for power. In New Caledonia the mining industry represents 66% of total electricity consumption.

Several Pacific island countries have adopted ambitious voluntary renewable energy targets. These targets were announced under the auspices of the so-called Barbados Declaration which was further reinforced in 2012. Six Pacific island countries aim to generate 100 per cent of their electricity from renewable technologies while all countries recognise that demand side management and energy efficiency are key elements in achieving these targets. OCTs have also set targets which are considered ambitious.

From an economic standpoint, the limited availability of low-cost renewable energy resources in many OCT countries of the Pacific and the Caribbean regions means that generating 100 per cent of electricity from renewable energy is costly. In low islands and atolls, solar and wind power is available but still expensive, due to low wind speeds and, in some OCTs, the need to ‘cyclone proof’ wind turbines. The intermittent power supply from these technologies is also a problem as there must be sufficient generation capacity for supplying power during peak time. Electricity storage will also be needed, which is obviously an additional high cost. In summary,
high renewable energy targets are appropriate where there are large amounts of low-cost renewable energy resources, such as hydro-power, geothermal or biomass supply.

Declaring ambitious targets is also a way to demonstrate how the OCTs have taken renewable energy and climate change issues seriously. It can be viewed as a means of attracting donor funds for island countries and for OCT initiatives as these territories often cannot afford the investment required to meet their ambitious renewable energy targets.

6.2.3 Energy demand trends and patterns

This report considers the use of renewable energy technologies to meet electricity as well as heating & cooling demand. Energy efficiency measures are cross cutting and should be incorporated into programmes of power generation, transmission and distribution and end-use, including the design of the newly built environmental structures (passive solar designs, natural lighting, and natural ventilation).

Across the OCTs, electricity demand is increasing rapidly: in Tahiti, average consumption per household is increasing by 1.34% per year while average consumption is growing at 4.2% per year and peak load in increasing on average at 3.9% per year; between 2000 and 2007, peak load increased by as much as 23 MW. The situation in the French Polynesian islands is compounded by even higher consumption growth rates of 8.2% per year. In New Caledonia, electricity consumption is growing at a rate of 2% which reflects both an increased number of connections (population growth in New Caledonia represents 1.2% per year) and increased consumption for each connection. Mayotte is experiencing a 4% to 5% increase in the number of clients per year; between 2006 and 2007 alone, Mayotte experienced a 14% increase in production. In Pitcairn, demand for power in the last 5 years has increased at an average rate of 11% per year and, with the population expected to increase significantly in the next 5 to 10 years, demand is forecast to grow at 20-30% during this period.

The only energy intensive industry in New Caledonia is the nickel and metallurgy industry. The industrial sector represents a share of 57% of the island’s overall energy demand. In other OCTs, industry plays really a minor role and it is less than 5% in many of them. There are only a few non-energy intensive industries in which there has not been so far a lot of efforts in favour of energy-efficiency and energy substitution, despite the potential for further efficiency gains.. The options to be studied for these SMEs are often non-capital intensive, do not require sophisticated technologies, and are available locally in many cases. The cooling needs for some industries is also an issue, such as for the fishing or food and beverage industry, where large amounts of refrigeration are needed.

Heating and cooling needs can represent significant energy loads for island systems. OCTs lying close to the equator require hot water and air conditioning, whilst OCT’s lying at higher and lower latitudes require space heating in winter and hot water all year round. There are significant differences among the OCTs with respect to air conditioning ownership and demand for it. For the wealthiest countries, this is quite a common facility while it is still an unaffordable item in others. In the Cayman Islands, the cooling load is high and, according to the 2010 population census, 89.4% of households have air conditioning systems (compared with 69% in the 1999 census). In regions where cooling represents a greater share of energy demand compared to heating, renewable energy cooling systems show good potential for further development. District cooling, combined with a central cooling station, is a technology
which could also be promoted in those countries which can afford this technology, and where there is an appropriate market.

The load for hot water and air conditioning is also very much connected to the tourism sector and related services and, more generally, to energy demand in the OCTs. In St Pierre et Miquelon, 42% of total fuel consumption is for domestic heating and in Greenland the heating needs represent about 23% of total power consumption. In French Polynesia, activities related to the tourism industry have affected directly the economy of the island, including its energy sector. This sector is also very much a promoter of new solutions that address renewable energy and energy efficiency issues. In French Polynesia, the first innovative SWAC projects were installed in hotels. Energy savings options are applied in many hotels to reduce the load on lighting, air conditioning, and for water heating. Many hotels have installed solar water heaters. The controls in the guest rooms are usually optimized to lead to a more rational use of energy.

Beside hotels, the installation of solar water heaters has increased significantly in many OCTs. In French Polynesia, the penetration of solar water heaters is 46% and there is still a good prospect for development with collective Solar Water Systems (SWS). Some OCTs have already included the mandatory installation of SWH in new buildings. This measure should be promoted in OCTs where justified.

Regarding other technologies for water heating such as low enthalpy geothermal heat pumps, these are gradually developing and have been used in Greenland and in some pilots in New Caledonia where the technology is supported by ADEME. Where good biomass, geothermal or solar thermal resources exist, heating technologies are often competitive with those of fossil fuels.

In OCTs, besides electricity generation, imported fuels are also used for transport. Even though distances are generally limited in OCTs, transport represents a significant share -between 25 and 50% of the total energy demand. In French Polynesia, transport accounts for 42% of total primary energy demand. In New Caledonia, the share of transport is three times higher than in the residential and tertiary sectors. This is due to a significant amount of gasoil being used for sea and air transport, including fishing industry, thus contributing to an important share of transport in the energy balance.

6.2.4 Oil prices, production costs and electricity prices in islands

In 2011, global oil prices rose to well over US$100 per barrel, with considerable uncertainty as to how these prices would evolve in the future. At this price level, supplying electricity through conventional means becomes unsustainably costly, thereby exerting pressure on the countries’ trade balances, government budgets and on the incomes of energy consumers. In the meantime, the production of electricity based on locally available energy sources becomes more attractive. Oil prices have since decreased to less than US$ 100 per barrel, which is obviously positive for the islands budget.

The OCTs are extremely vulnerable to increased oil prices. They comprise distant and small markets and have to bear the added burden of higher shipping costs. Production costs of electricity are high in islands. The average production cost per kWh at diesel power stations in OCTs is three to four times the typical production cost in Europe. In the OCTs where customers have to pay the real price of energy, electricity tariffs can easily reach 0.20 – 0.25
€/kWh, which is extremely high when no cross subsidies are in place. For New Caledonia, electricity tariffs applied to the key nickel sector was as low as 0.02 €/kWh before a recent increase. In Wallis et Futuna, the tariffs applied for the households sector are 5 times higher than those into force in France for the same category of consumers.

For some OCTs, electricity tariffs do not reflect the effective costs of generating power. In the case of Mayotte and St Pierre and Miquelon, tariffs are aligned with the national tariffs of the EU State and France pays compensation to the electricity producers under the national tariff equalisation schemes. In French Polynesia, the mechanism of subsidies has been progressively phased out and the consumers tend to pay the production costs although there is a small (10%) cross subsidy mechanism. This also applies in most Caribbean OCTs. However, in the case of solar, significant financial support is still needed. For instance in French Polynesia, 200 MFCP are disbursed by the operator EDT under its obligations of absorbing solar power, without transferring this cost to the customers via the tariffs.
7 INSTITUTIONAL ANALYSIS

In this section, the institutional framework is analysed and the capacity of OCTs in regard to regulation of the sector is discussed. The existing regulatory framework aimed at reducing energy consumption and improving energy efficiency is also examined as well as policies in regard to renewable energy.

7.1 Individual reviews

**Caribbean OCTs:**

| Anguilla | The Governor, Executive Council, and the Ministry of Infrastructure, Communications, Utilities, and Housing (MICUH) are the key government actors that set energy policy, issue licences, and regulate the power sector. The Ministry of Home Affairs is responsible for reviewing and approving applications for new energy projects, and for issuing permits. The Anguilla National Energy Committee (ANEC), and the Anguilla Renewable Energy Office (AREO) are the two non-profit organizations that hold public consultations and work with donors to support renewable energy development. IPPs aren't legally allowed, unless the utility assigns its rights under contract. |
| Aruba | The Government of Aruba is the sole shareholder of Utilities Aruba N.V, the holding company, comprising the Utility W.E.B. Aruba N.V. and the distributor, N.V. Elmar. W.E.B. Aruba N.V has, since end 2009, a PPA contract for the first 30 MW wind farm and is awaiting the process of the second 24 MW wind farm to become operational. Other technologies such as SWAC and/or OTEC will be evaluated at due time when the economics become feasible. The following RE projects on the supply side, are underway and/or are soon to be initiated/evaluated: 1. increase wind power to 54 MW, 2. install 10 MW of DG solar energy, of which 3,5 MW centralised, in a solar park and the remaining on rooftops as decentralised generation (DG), 3. install a waste to energy plant (5 MW), based on gas supply, 4. install a underwater compressed-air storage, 5. install ice storage, 6. install and evaluate public transportation with electric buses 7. switch from heavy fuel oil to natural gas. On the demand side government’s effort, to promote renewable energy and energy conservation were introduction of incentives, by lowering the import tax on the following: 1. on wind turbines and solar panels from 12% to 2%, 2. on cars from 25 – 50% to 2% for electric and for hybrid to 12%, 3. on several electrical appliances with better efficiency from 22% to 2%. The distribution company allows end-users to connect RE systems (such as solar and wind energy systems) to the electrical grid. Residential customers are allowed to connect RE systems of 10kW max, and non-residential clients 100kW max. The net-metering principle is applied: surplus energy is paid back to the client. There is a grid usage fee per installed kW. However, these...
systems are presently limited to a maximum of 5% of the total distribution.

To promote renewable energy and energy conservation on the demand side, the government introduced incentives, by lowering the import tax on wind turbines and solar panels (from 12% to 2%), hybrids cars (from 25 – 50% to 12%) and full electrical cars (from 25 – 50% to 2%).

**British Virgin Islands**
Current legislation prevents the implementation of alternative energy sources from contributing to the main power supply in areas served by the British Virgin Islands Electricity Corporation. There are no incentives for alternative energy technologies.

A draft legislation to allow grid-tied renewable energy systems, prepared by a local law firm on a pro-bono basis, has been handed over to the government in 2013.

**Cayman Islands**
Ministry of District Administration, Works, Land and Agriculture oversees the Electricity Regulatory Authority of the Cayman Islands (ERA), and the Water Authority.

IPPs are able to sell power to the main utility company, through power purchase agreements that are negotiated between an IPP and the utility. The only incentive for renewable energy is an import duty waiver.

**Bonaire**
No specific information available

**Curacao**
In Curacao, a new electricity policy was introduced in 2011. Its goal is to achieve greater transparency in the development of electricity tariffs (Curacao appeared to have high rates compared to neighbouring islands), and ensure sustainable supply. The previous market model was dominated by the utility (Aqualectra). The new policy introduces an independent supervisory entity (BT&P) in charge of technical regulation, promotion and regulation of renewable energy, and legal and economic supervision. It is dedicated to introducing more market orientation in the electricity sector, stimulating the use or solar and wind energy, and establishing building code and tax incentives for increased energy efficiency. The first implementation phase will consist of granting concessions to electricity producers, while Aqualectra will remain the network company.

**Saba**
The possibility to connect to Sint Maarten through a submarine interconnection is envisaged in case its geothermal potential is to be exploited

**Sint Eustatius**
No specific information available

**Sint Maarten**
In St Maarten, an Energy Policy and an Assessment of St Maarten sustainable energy options have been published in 2012. The main features of the energy policy are: improving generation efficiency (a shift from diesel to HFO, 5% increase in efficiency within 2 years), introducing an Energy Efficiency Programme, introducing a regulatory framework for the power sector (including the establishment of a regulatory authority) and preparing legislative changes for allowing IPP to deliver power, a future Green Plan to introduce wind, solar and waste-to-energy sources, a potential investigation on submarine interconnection with Saba in case its geothermal potential is to be exploited.

**Turks & Caicos islands**
In the TCI, the Governor grants licences, revokes licences and make regulations for rates and tariffs changes.
The Energy & Utilities Commissioner: (i) reports to the Permanent Secretary of the Ministry of Government support services as well as to the Governor on specific issues and provides advice as the need arises, (ii) is responsible for monitoring service quality and operations, (iii) reviews and approve the power cost adjustment, (iv) performs duties related to planning and promoting sustainable energy solutions.
Fortis TCI operates under license from the TCI Government.

In 2012, a review of the regulatory framework of the electricity sector was undertaken. It covered: assessment of the costs and tariffs of the utility, assessment of the effectiveness of the current regulatory framework, recommendations for a revised regulatory framework and Electricity Ordinance.

The present regulation does not facilitate the emergence of IPPs. Sound, well thought out and realistic legal mechanisms to permit development of use of sustainable energy in a manner that takes into account the best interest of consumers & investors alike still needs to be developed. These mechanisms could comprise: rate incentives, consideration in regard to the back-up reserves that must be in place, the optimum capacity of renewables suited to the island population, grid stability concerns and good technical guidelines to regulate safe, reliable interconnections to grid, etc.

Discussions between the utility and the government have begun in regard to implementing the recommended changes: these are related to service standards, efficiency of operations, renewable energy grid interconnection.

**Montserrat**

Within the national Energy Policy for the period 2008-2027, the Implementation Plan for 2008-2012 envisages the following:

- The energy division of MUL (Monlec) will continue to be the designated sole electricity grid holder and the manager of the main power supply
- Enabling licensed independent power providers to sell production through power-purchase contracts (especially for geothermal and wind)
- Electricity tariffs, fuel surcharges, grid connexion fees and terms, grid extension will be regulated and managed under the relevant electricity and utilities legislation, with associated scrutiny by the designated regulatory authority.
- The creation of an Energy Office (EO), based within the Ministry, with a Board and a technical Advisory Panel that will:
  - Be a basis for budgeting
  - Be a focal point for Government support of the ongoing wind and geothermal energy initiatives
  - Collect, compile and use local energy related statistics
  - Facilitate and support priority national renewable energy and energy efficiency initiatives
  - Develop appropriate initiatives and measures designed to sustain the viability of the national electricity utility as a vital strategic asset.

**Saint-Barthélemy**

The institutional framework of Saint-Barthélemy has evolved in recent years with significant changes in 2003 (autonomy from the overseas department Guadeloupe) and 2007 (organic law defining its institutional status).

Saint-Barthélemy is now able to adopt laws (submitted to France’s government approval) in the following sectors: environment, urbanism, construction, housing and energy. Saint-Barthélemy local authorities are now able to monitor and approve projects in the field of energy generation and transport and energy efficiency (delivery of energy efficiency certificates).

**Pacific Ocean OCT’s**

**New Caledonia**

The Directorate of Industry, Mines and Energy (DIMENC) is in charge of the...
sustainable industrial development of New Caledonia on behalf of the various local entities of the Territory and of the State. This overall mission is carried out through energy and mining industries active in the sector as well as in terms of control and regulation of industrial activities which could affect the environment.

Its organization and responsibilities are defined in the By-Laws n° 2006-4611/GNC and 2006-4613/GNC dated 16 Nov 2006, as well as in the agreements signed with local entities.

Inside the DIMENC, the Energy Department is responsible for the preparation and implementation of energy policies, with the aim of securing energy supply for the islands. The Energy Department also contributes to energy independence and security, encourages energy savings, and the utilization of renewable energies. It also prepares and monitors the implementation of the legal and regulatory framework for the electricity sector, including electricity tariffs, petroleum products, security concerns, energy prices, and energy management.

The Energy Department is also in charge of piloting the Rural Electrification Fund, dedicated to finance electrification of remote populations when it was created and whose functions have been since expanded. In cooperation with Ademe, the Energy Service is implementing the action programme dealing with energy efficiency, renewable energy and demand side management. This action is being carried out within the framework of the Territorial Committee for the Energy Management (CTME-Comité Territorial pour la Maîtrise de l’Énergie)

Through the Energy Observatory, the Energy Department is also in charge of energy statistics and prepares the annual energy balance of New Caledonia as well as relevant papers to help policy makers take decisions on the future of the energy sector.

There is no independent regulator of the energy sector in New Caledonia. The regulation of the energy sector is done by DIMENC.

**French Polynesia**

Besides the Ministry of Economy, Finance and Budget which has a voice on policy decisions related to energy tariffs, two ministries of the Government of French Polynesia are more directly in charge of energy affairs: the Ministry of Urban Affairs, Energy, Land and Sea Transport -more specifically the Department of Mines and Energy -and the Ministry of Tourism, Environment, Planning and Air Transport. The French Agency for Environment and Energy Management also makes a contribution in French Polynesia.

A Law was adopted in July 2002 regarding the modernisation of electricity generation which opened up the sector to competition. Specific regulations have also been introduced to boost the development of a RE-based market with more favourable feed-in tariffs and fiscal incentives. A number of PV related projects have developed quickly until the decision to revise feed-in tariffs and the conditions to access incentives.

In 2012, a FP Law was adopted which prohibits actions which would lead to control by a single electricity producer of a share of 50%, or more, of power generation from renewables.

So far, there is no independent regulator in the FP. There is now a proposal by the French Commission of Energy Regulation to establish such an entity. The energy transition is a clear concern and French Polynesia, like other OCTs,
is seeking guidance on how to proceed. France and the Government of FP have decided to organize a seminar on renewable energy for the islands. This first Pacific international convention should take place in October 2013 and provide an opportunity to exchange views between various regional actors.

| Wallis & Futuna | Wallis-et-Futuna (WF) islands consist of three traditional kingdoms. The administration is organized around a territorial council chaired by the Préfet, the higher administrator, and which gathers the three kings representing the traditional authorities of the three kingdoms. The Territorial Assembly includes 20 members, votes on the budget, and is responsible for economic development, public equipment and social action. The principal authority is the Territory, which governs all administrative services issues authorizations, and authorizes concessions. France is represented by the Préfet who is, among others, in charge of elaborating the development framework contract funded by the French State, with an estimate of the budget resources needed for that purpose. Since the constitutional reform in 2003, Wallis-et-Futuna has been a French overseas ‘collectivité’, with considerable autonomy inside the French Republic, with its own policy making, and where the French administrative code is applied in addition to traditional local rules. The specific institutional framework in WF as well as political and social tensions during the last years have affected electricity generation. The operation of the power plants has been stopped for some weeks, leaving people in the island without any electricity for days. IN WF, the consumers pay the real production costs but the poorest parts of the population receive a subsidy from the State. Improvement of the regulatory framework to facilitate development of RE is under consideration with the negotiation of requirement of the utility to buy electricity produced by an IPP and the implementation of a feed-in tariff. |
| Pitcairn Islands | The main institution is the Government of Pitcairn Islands with the following areas of responsibility: an Operations Division in charge of the overall management of the energy sector; Engineering Department, which provides maintenance and general operations; Comtech Department, which provides technical maintenance of electrical units; and the Electrical Department which is in charge of power lines maintenance. The British High Commissioner to New Zealand serves as the Governor of Pitcairn and is assisted by the Pitcairn Islands Office in Auckland. The Pitcairn Islands Office is managed by a Finance Officer appointed by the Governor. At the island level, the Island Council manages the internal affairs under the presidency of the Island Mayor. There are a number of regulations in Pitcairn which have been adopted by the Council, including a procedural manual, adopted in 2008, and to be implemented (by the Director of bio security) for an Environmental Impact Assessment of any development project. |
### Indian Ocean:

| Mayotte | The activities of EDM are regulated by the French State (the French Energy Regulatory Commission). This is facilitated by the fact that most of managerial responsibilities are filled by staff of EdF familiar with French regulations and energy codes.  

Under this framework, tariffs applied in Mayotte are the same as in France, even though production costs are much higher. This is the result of the application of the territory continuity rules under which the same tariffs must be applied for all French customers, regardless of location and supply conditions. Compensation to the energy distributor is made through the fiscal regime.  

Regarding energy efficiency, a decree in 2009 imposes a minimum energy performance for the new buildings as part of the new building code with the obligation that 50% of hot water needs be covered by solar heaters and that the building design respects some rules in terms of roof insulation and other technical details to reduce the air conditioning load.  

There is a policy in Mayotte to promote the utilization of indigenous energy resources, mainly solar through additional solar PV either connected to the grid or mini grids, or an individual unit. However, the production of electricity will continue to rely heavily on imported diesel. |

### South Atlantic:

| Falkland Islands | The Falkland Islands Government (FIG) is the Governmental Authority in the Islands. FIG currently deals with energy provision / utilities in the islands. There was an Energy Advisory Committee until 5-6 years ago but it no longer functions.  

In 1983, the “Falkland Islands Development Corporation” (FIDC) was established, which is a quasi-autonomous government-funded body, its main objective being to encourage and assist in the economic development of the Falkland Islands as well as advise Government on a number of issues.  

The FIDC runs the following schemes: 1) “Rural Energy Grant Scheme”, providing grant assistance to rural residents or businesses, for the purchase of a 24-hour stand-alone wind power pack 2) “Household Insulation Grant Scheme”, providing grants to householders, towards the cost of energy-efficiency measures to reduce heat losses.  

The Department of Mineral Resources, in conjunction with operators, environmental stakeholders and other government departments, has created the “Offshore Hydrocarbons Environmental Forum”, whose aim it is to promote cooperation between all relevant bodies and jointly develop a shared vision regarding exploring for hydrocarbons in the Falklands area. |

| St Helena | The St Helena Government (SHG) “Directorate of Infrastructure & Utilities”, through its Energy Division, deals with energy provision / utilities in the island. In April 2012, the “Environmental Management Directorate” was also created, to formulate policies and regulations and to provide evidence-based advice to the Government on the environment.  

A Regulator has been formed, which is independent and is chaired by the Chief Magistrate. With support from the UK regulators, it has a license that is |
proportionate for the St Helena situation. The regulator can also draw on technical support from within SHG, in particular the Economist and Social Policy Planner. Any tariff change is required to be approved by the Regulator, the license states performance criteria which the utility provider is required to demonstrate compliance to the Regulator.

A recently created entity is “Enterprise St Helena”, which is responsible for the economic development of the island. Its role includes engaging the private sector and civil society.

Current funding for government directorates comes through St Helena Government’s recurrent and capital budgets. Enterprise St. Helena provides financial support for the growth of businesses on the island. There are also a number of additional funding sources available for environmental projects on St. Helena. As part of achieving the sustainability targets set, financial incentives for sustainable initiatives will be explored, and a green financing mechanism established.

North Atlantic:

St Pierre & Miquelon

St Pierre & Miquelon has the status of an Overseas “Territorial Collectivity” (as defined within the French constitution). The Territorial Council is the legislative Government authority and the President of the Territorial Council is the Head of Government.

The St Pierre & Miquelon Economic Development Agency (Société de Développement et de Promotion de l’Archipel - SODEPAR) is the economic and territorial development agency of the archipelago. It is a semi-public company, created in 1989, which focuses on representing the archipelago’s interests in France and Europe and sits in a number of committees, either in a decision-making or a consulting capacity.

Greenland

The Greenland Government Department for Housing, Nature and the Environment is the responsible authority for energy supply to the island. It is the highest authority and regulator of the energy area and it supports research projects in sustainable energy.

The Arctic Technology Centre (ARTEK), formally established in 2000, is a research centre for technology and renewable energy utilisation in the Arctic, like wind, solar power and geothermal energy. Furthermore it undertakes research into energy-efficient construction and environmental sustainable solutions. Research takes place in cooperation with the Technical University of Denmark and Sanaartornermikllinniarfik (Building and Construction School) in Sisimiut.

Sermersooq (the biggest municipality in Greenland, including the capital Nuuk) prepares energy action plans and Qeqqata municipality (with Sisimiut being its municipal centre) is working on sustainability issues.
7.2 Global analysis for all OCTs or groups of OCTs

Members of the European Union who can document that there are substantial problems for the operation of their small isolated power systems (e.g. networks with a consumption of less than 3000 GWh and which can be interconnected with other networks for less than 5% of its annual consumption - Article 26 § 2 of Directive 2009/72/EC) may ask the European Commission to be exempted from certain provisions of the Directive (Article 44 of Directive 2009/72 / EC) for:

- the requirement of separation between, on the one hand, transport activity or distribution and, on the other hand, the activities of generation and supply;
- the unbundling of the activities and the transparency of accounts;
- third party access to the network and market opening.

In principle, the OCTs are responsible for defining their energy futures and setting up the institutional and regulatory framework required to meet their objectives. The provision of sustainable energy services requires an appropriate policy framework and government commitment. This, in turn, requires a clear understanding among all parties involved and the strong will to implement this policy.

All OCTs are theoretically committed to improve their energy efficiency and increase the participation of renewable energy in their energy mix but the ways to reach this overall objective are very different. The following table shows the variety of situations in the OCTs with regard to institutions, participation of IPPs, and market opening for power generation.
Table 7: Synthesis of key institutional set up in the OCTs

<table>
<thead>
<tr>
<th>OCT</th>
<th>Dedicated Institutions</th>
<th>IPP</th>
<th>Market Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anguilla</td>
<td>National Energy Committee Renewable Energy Office</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Aruba</td>
<td>Ministry of Energy &amp; Finance Utilities Aruba TNO Caribbean Branch Office Carbon War Room Aruba (NGO)</td>
<td>Yes but limited. Net metering</td>
<td>No. (State-owned holding, but IPP allowed)</td>
</tr>
<tr>
<td>British Virgin Islands</td>
<td>Ministry of Communications and Works</td>
<td>No</td>
<td>No. State-owned Co</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>Electricity Regulatory Authority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bonaire</td>
<td>Island Governor and Commissioners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curaçao</td>
<td>BT&amp;P (in charge of technical regulation, promotion of RE and legal and economic supervision)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saba</td>
<td>Commissioner</td>
<td>No</td>
<td>GEBE is the only utility</td>
</tr>
<tr>
<td>Sint Eustatius</td>
<td>Island Governor and Commissioner of Economic Affairs and Tourism</td>
<td>No</td>
<td>GEBE is the only utility</td>
</tr>
<tr>
<td>Sint Maarten</td>
<td>Ministry of Energy Affairs</td>
<td>No</td>
<td>GEBE is the only utility</td>
</tr>
<tr>
<td>Turks &amp; Caicos islands</td>
<td>Energy &amp; Utilities Commission Regulator in preparation</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Montserrat</td>
<td>Energy Office</td>
<td>No</td>
<td>No (MUL)</td>
</tr>
<tr>
<td>Saint-Barthélemy</td>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>New Caledonia</td>
<td>DIMENC Rural Electrification Fund</td>
<td>Yes (concession agreement)</td>
<td>No</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>Service of Energy and Mines Law Regulator proposed</td>
<td>Yes (concession agreements)</td>
<td>Yes</td>
</tr>
<tr>
<td>Wallis &amp; Futuna</td>
<td>Department of Public Works</td>
<td>No</td>
<td>No (concession to EEWF)</td>
</tr>
<tr>
<td>Pitcairn</td>
<td>Local Council</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Mayotte</td>
<td>Energy Agency of La Réunion Observatory of Energy</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Falkland Islands</td>
<td>Falkland Islands government Falkland Islands Development Corporation</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>St Helena</td>
<td>St Helena Government – Directorate of Infrastructure &amp; Utilities (Energy Division) Electricity Regulator Environmental Management Directorate</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
There are significant differences between the OCTs in terms of policies, regulatory frameworks, and even commitment. The historical link between the OCTs and the ‘Member States to which they are linked is one of the key elements shaping the way energy is considered. In the French OCTs, the energy sector is strongly influenced by France and benefits received from France’s energy policy and regulatory frameworks, including tariff rates for Mayotte and for Saint Pierre and Miquelon.

Some OCTs have dedicated institutions in charge of energy matters while others have strong departments inside a ministry. There is usually no Energy Ministry in the OCTs. Energy is under a Public Works or an Industrial Development or an Environment ministry. This is not really a problem as long as energy is properly considered by the responsible Ministers. However, experiences tend to show that when energy matters are under a ministry whose many focus is not related to energy, the subject is not always addressed with enough leadership. For example, the question of renewable energy development is not given the same consideration when energy is under Public Works Ministry as when it is part of a Ministry of Environment.

Where possible, the creation of an energy agency or office is desirable, as is the case in Anguilla, for instance. The example of Mayotte is remarkable, with the creation in 2008 of an Energy Observatory in charge of promoting and monitoring actions undertaken in the field of Energy Efficiency and Renewable Energy. This Observatory comes under the Energy Agency of La Réunion (ARER). This initiative was taken within the framework of the Multi Year Energy Action Plan for Mayotte and includes various activities such as assessment, studies, information and preparation of the Mayotte energy balance. A next step is currently proposed to the main stakeholders (General Council, Ademe and Electricity of Mayotte) with the creation of a Mayotte Energy Agency where all responsibilities would be transferred from ARER.

This example follows the model of the French Ademe which has been very successful since the early 70s and has been a driving force for all activities in France with regard to energy efficiency, renewables and environmental protection. There is an Ademe’s office in French Polynesia and in New Caledonia and they strongly support local authorities in all activities through funding made available by the French State.

The production of an annual energy balance for each OCTs is not a common practice. The fact that the OCTs are not countries and have no obligations to produce this document following the standard format may explain this lack of energy balances. In practice, OCTs produce their own energy balances based on their specific needs as well as on the data they are able to collect from different energy actors in the sector (importers, transporters, distributors, consumers, and traders).

Some OCTs do not have an energy master plan or a renewable energy master plan and policy. However, the knowledge of the OCTs with respect to energy issues and their renewable
energy potential has increased considerably since 2008. Many OCTs have prepared their energy strategies based on detailed assessments of potential. This is the case of Aruba, French Polynesia and Greenland where the background information is available. In some OCTs, more detailed assessments are still required as in Mayotte or in New Caledonia. In fact, the main difficulty is that an assessment only presents the picture at a certain moment in time and must be updated on a regular basis.

At the same time, it needs to be kept in mind that the OCTs have the specific objective of reducing their energy bills resulting from their dependency on imported fuels, thus taking all necessary measures to increase the participation of renewable energies in their energy balance. To achieve this, OCTs do not necessarily need to have the same framework as the ‘Member State to which they are linked. What may be necessary for an EU Member State with a large population is not as necessary for a small island which does not have the same obligations as a country. OCTs must arrive at an appropriate balance between having a dedicated team of skilled people, with enough resources and political support, and creating too heavy an administrative and institutional burden, often resulting in slow decision making processes.

The slow pace of the introduction of renewable technologies has led some policy makers to conclude that this reflects unwillingness among utilities operators to invest in these technologies rather than tackle the real barriers which must be overcome in order to make large-scale investment in renewables a reality. A further consideration is the need to increase renewable generation technologies in order to increase energy security in the region and reduce exposure to international oil prices.
8 COMPANIES AND OTHER ACTORS PRESENT IN THE ENERGY SECTOR

8.1 Individual reviews

Caribbean OCT’s:

| Anguilla | Anguilla Electricity Company Limited (ANGLEC) is the vertically integrated public electricity supplier that produces, transmits, and distributes all electricity on the island. The Government has a majority shareholding (56%) in ANGLEC. The remaining 44% is held by the National Bank of Anguilla, the Caribbean Commercial Banks, other local companies, and the general public. |
| Aruba | In 1992, the production and distribution of water as well as electricity generation were incorporated into WEB ARUBA N.V. The new company would generate all the electrical power and also produce and distribute all drinking water on the island of Aruba. This decision was based on the desire to allow for a purely commercial management of these activities and access to capital markets. In 1990, the Government bought 99.4% of the shares of N.V. ELMAR, which has the license to distribute electricity in Aruba. WEB ARUBA N.V. and N.V. ELMAR shares were placed in a holding company, Utilities Aruba N.V, while the Government is the sole shareholder in Utilities Aruba N.V. Since WEB and ELMAR are in a monopoly position, third parties can only participate through projects initiated by these two companies. An independent power producer (Vader Piet N.V.) was contracted by WEB Aruba for a large 30 MW wind farm project in 2009 but it still depends directly on WEB Aruba as its sole customer. ELMAR signed a PPA for a 3,3 MWp solar energy farm, on the parking lot of the AAA airport, which will become operational early 2014. The Government of Aruba recently decided to start the integration of the activities, production and distribution of water and electricity in one state company. |
| British Virgin Islands | The British Virgin Islands Electricity Corporation (BVIEC) is the only power company in the BVI. The BVI Government is the sole shareholder of BVIEC, which is under the portfolio of the Ministry of Communication and Works. The major functions of the Corporation are the generation, transmission, supply, distribution and sale of electricity throughout the British Virgin Islands. |
| Cayman Islands | Generation and distribution licensees are: in Grand Cayman island, Caribbean Utilities Company, Ltd. (CUC), and in Cayman Brac and Little Cayman: Cayman Brac Power and Light Company Limited (CBP&L). |
| Bonaire | In Bonaire, after the loss of the local power plant in 2004, and under the government plan to target a 100% renewable energy supply, a consortium called EcoPower Bonaire BV won the contract to develop the government’s ambitious plan. EcoPower is a Dutch-German consortium comprising the wind turbines manufacturer Enercon (5%), MAN Diesel&Turbo (5%), and the Dutch company Eneo (90%). In 2007 the consortium signed a contract with WEB (Water & Energy Company Bonaire N.V.). |
| Curacao | In Curacao, Power and water production and distribution are handled by a partnership between Mirant Corporation and Aqualectra. Aqualectra NA is a Netherlands-based utility holding company, with three subsidiaries in Curacao: Aqualectra Production, Aqualectra Distribution, Aqualectra Multi Utility and Curacao Utilities Company (CUC). Aqualectra operates 175 MW of generation capacity (steam and gas turbines, diesel units, and wind turbines). CUC operates a 133 MW facility to provide power and utilities to the refinery and electricity for the national grid, generating 192 GWh of |
electricity. Aqualectra sells 626 GWh of electricity and 9,000,000 m³ of desalinated water.

### Saba
In Saba, the overall framework is going to change in 2014 with the establishment of the Saba Electric Company. This is a matter of pride for Saba people as it will bring to the island more autonomy and energy independency. However, the support from the Netherlands and other partners will be key to help the new company face the challenge ahead.

### Sint Eustatius
In Sint Eustatius: the utility is presently being restructured but the establishment of the Sint Eustatius Electric Company has already been postponed in the past to due uncertainty in the provision of electricity to people and businesses under appropriate conditions.

### Sint Maarten
In Sint Maarten, the only power producer and distributor is the private company N.V. GEBE. In the contract between GEBE and the government, there is a clause that limits the power capacity of other potential players (250 kW). Today it is not possible for an IPP to sell electricity to the utility, and an IPP is not allowed to distribute power to its own clients.

### Turks & Caicos islands
Electricity generation transmission and distribution services in the Turks and Caicos Islands are provided by a single vertically integrated monopoly provider, FortisTCI (investor owned). The current system of economic regulation is based on a rate of return on capital but any changes in the electricity tariff and rates must be approved and effected by the Governor.

There are no IPPs but there is interest from several prospective developers in renewable technologies in the islands (company names and contacts are provided in the Annex).

### Montserrat
The Ministry of Communications & Works is the energy regulatory unit.

The Montserrat Utilities Ltd. (MUL) is the agency with responsibility for energy matters, including alternative sources of energy. Monlec, the energy division of MUL, is the designated sole electricity grid holder and manager of the mains power supply.

In future, and as appropriate, electricity generation shall be in-house or on a power-purchase contractual basis with licensed independent power providers, especially if geothermal and/or wind energy should become part of the generation mix.

There are no independent companies in the field of energy in Montserrat.

### Saint-Barthélemy
Electricity generation and distribution services in Saint-Barthélemy are provided by France utility EDF. In 2007, the main generation facility has been completed with a 5 MW new unit managed by EDF in cooperation with Aggreko.

**Pacific Ocean OCT's**

### New Caledonia
ENERCAL is a semi-private company (“société d’économie mixte”) responsible for generation, transmission and distribution of electricity in New Caledonia. The ENERCAL Group ensures 52.9% of the total electricity production and operates the power plant of the SLN Company. ENERCAL distributes power to 35% of customers in 27 out of 33 municipalities of the territory. ENERCAL is also managing and running the electricity distribution system thanks to a concession agreement granted by the Authorities of the Territory in August 1972.

Électricité et Eau de Calédonie (EEC) is a private distribution company operating since 1929 (originally in Noumea only). It has now distribution licenses in seven communes, mostly in urban areas.
| **French Polynesia** | Total Pacifique (subsidiary of Total), Mobil IPC and Société de Services Pétroliers S.A76 (SSP) are importers and retailers of both liquid and gaseous hydrocarbons in New Caledonia and French Polynesia. 

New Caledonia: SODIGAZ (private), subsidiary of Total Outremer and Total Pacifique. 

Electricité de Tahiti (EDT) is a private company located in French Polynesia, which is member of the Pacific Power Association. EDT has been in charge of generation and distribution in Tahiti island since 1960 and in 18 other islands. EEC (New Caledonia), EDT (French Polynesia) and EEWF (Wallis and Futuna) all belong to GDF-SUEZ. 

Marama Nui is a private company owned by EDT and the local government (30%) in charge of the hydro generation in Tahiti. 

Transport Electrique de Tahiti (TEP) is a private utility (owned mainly by the local government) exclusively in charge of transmission of electricity to substations on the largest island of French Polynesia (Tahiti). 

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French Polynesia: Gaz de Tahiti and Polygaz are importers and retailers (both private) SOGADOC, subsidiary of Total Pacifique and SODIGAZ, is a private company in charge of LPG storage and conditioning (in bottles) in New Caledonia. 

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| **Wallis & Futuna** | Three traditional kingdoms are governing the islands in coordination with elected counsellors and representative of the French State. The Préfet is in charge of defining the contract programme with projects and resources allocated by the French State. 

Electricité et Eau de Wallis et Futuna (EEWF) is a private utility operating in Wallis and Futuna since 1976. EEWF is a subsidiary of Eau et Electricité de Caledonia and a branch of the GDF-Suez Group. 

While Total Pacifique and Mobil IPC are importers of petroleum products in Wallis and Futuna, the semi-private Société Wallisienne et Futunienne d’Exploitation des Produits Pétroliers (SWAFEPP) is in charge of storage. 

In 1997, EEWF was granted a 25 year concession contract to ensure production, transport and distribution of electricity and water. EEWF is the only licensee in WF. Regular technical and financial audits are performed to assess the execution of the contract and elaborate the future plans of the company. 

| **Pitcairn Islands** | There is no utility per se in Pitcairn. Energy in the form of diesel oil is partly funded by the British Department of International Development (DfID) and managed by the Pitcairn Islands Office (PIO). 

The households have to pay for their energy utilisation. 

| **Indian Ocean:** | 

| **Mayotte** | EDM (Electricité de Mayotte), a semi-private company, ensures the mission of public utility to produce, distribute and commercialise electric energy in Mayotte. It is owned by the Mayotte Authorities (50.01 %), Electricité de France and SAUR International (24.99 % each) and the French State (0.01 %). |
**South Atlantic:**

| Falkland Islands | Power generation in Stanley and its immediate area, as well as in Fox Bay Village on West Falkland, is managed by Power & Electrical, a Government-owned utility company. Power & Electrical are also responsible for the operation and management of the 2MW Sand Bay wind farm and the erection of the additional turbines on Mount Pleasant.

There are currently no private Independent Power Producers (IPP) or Small Power Producers (SPP) operating on the islands, and it is not legally possible for such companies to sell electricity generated neither to the main utility company nor to their own clients.

Stanley Services Ltd was formed in 1987 and is a joint venture between the Falkland Island Government and commercial partners S&JD Robertson Group and Lavinia Corporation. They have the commission to provide fuel to the islands (their monopoly position is to be reviewed in March 2014).

Private companies active in the ongoing operations for fossil fuels exploration include:
- Falklands Oil and Gas Ltd. Partnership with BHP Biliton
- Rockhopper Exploration. Partnership with Premier Oil
- Borders and Southern Petroleum
- Desire Petroleum

| St Helena | Power generation in Saint Helena has moved since 01/04/2013 from St Helena Government (SHG) into a private company (along with water and drainage). The company is Connect Saint Helena Ltd., a specialized electricity company, which, on behalf of SHG, manages the energy component of the Infrastructure Program. The Government is the owner of 100% of Connect Saint Helena shares.

An Electricity Regulator was formed at the same time, which is independent and chaired by the Chief Magistrate.

There are no local manufacturers, distributors etc. on Saint Helena. There are currently no private producers (IPPs/SPPs) operating, and it is not legally possible for such companies to sell electricity generated neither to the main utility company nor to their own clients.

Solomon and Company plc, partly owned by the St Helena Government, are active in petroleum and propane-gas distribution. They manage a Bulk Fuel installation on the island, situated within Ruperts Valley, on behalf of the Government. Other companies are also involved in propane gas supply.

Connect Saint Helena manages the existing installations of wind turbines on Deadwood Plain and the erection of the six additional wind turbines that is underway.

**North Atlantic:**

| St Pierre & Miquelon | Production and distribution of power in St Pierre & Miquelon is by EDF (Electricité de France).

It is legally possible for private producers (IPP/SPPs) to sell electricity to the electricity company (up to a limit of 30% of power demand). However, it is not possible that they distribute electricity to their own clients.
Greenland Production and distribution of power in Greenland is managed by Nukissiorfiit, a public utility company. It supplies power through hydro and diesel powered plants and district heating from residual heat recovery.

There is currently a negligible share of private companies (IPP/SPPs) in the electricity supply and the situation is expected to remain as such until 2020. However, it is legally possible for such companies to sell electricity generated to the main utility company or to their own clients (mini-grid). There are no particular incentives for IPP/SPPs generating power from renewables. The Authority of Electricity is responsible for the safety and inspection of electrical installations.

8.2 Analysis of Companies and Institutions in all OCTs and Groups of OCTs

Traditionally electric utilities, and not only in the OCTs, have been operating as vertically integrated monopolies in the power sector. It was generally perceived that the task of electricity supply is best left to the monopoly of the electric utility. In recent years, however, this view has changed. In developed countries, such as the United States and EU Member States, technological improvement in bulk electricity production has been the main driver for introducing competition into the power sector. Technology has developed such that it is now possible to consider competition in the production and supply of electricity. However, the network part of the power sector remains a natural monopoly.

The impetus for regulatory reform in the Caribbean comes from the observation that most Caribbean Utilities continue to operate as monopolies while there is a trend in the more developed countries to introduce competition in the power sector. This development has received much attention due to the success of the introduction of competition in other sectors such as telecommunications.

The slow pace of the introduction of renewable technologies has led some policy makers to conclude that this is the demonstration of unwillingness by utility operators to invest in these technologies rather than tackle the real barriers which must be overcome in order to make large-scale investment in renewables a reality. Another consideration is the need to increase participation of renewable generation technologies in order to increase energy security in the region and reduce exposure to international oil prices.

There is a need to understand that in order to overcome the barriers to allow renewable technologies to be introduced, a change in the regulatory framework and the introduction of policy initiatives are required. This will require the establishment of new regulatory entities as well as a change in the regulatory approach with respect to the market, tariffs, and quality.

Many utilities in the Caribbean are united under the Caribbean Electric Utility Service Corporation (CARILEC) association. CARILEC is an association of electric utilities, suppliers, manufacturers and other stakeholders operating in the electricity industry in the Caribbean. CARILEC was established in 1989 with nine (9) members as part of an electric utilities modernization project funded by USAID. Eight energy companies acting in the Caribbean OCTs are members of CARILEC and may benefit from all kinds of services proposed by the association. As a matter of fact, many discussions have taken place at CARILEC on regulation and renewable energy in the Caribbean power sector. Some of the positions supported by CARILEC are:
• CARILEC welcomes and supports regulation in the Caribbean and believes that it will play a crucial role in further shaping and developing the power sectors in the region. To ensure that regulation is effective, the design of the regulatory framework needs to properly incorporate the specific characteristics and realities of the Caribbean region.

• A stable, competent, and independent regulatory framework is important to assure a financially healthy sector in which investments can be undertaken to facilitate growth in demand and thus sustain economic development of the Caribbean countries.

• The electric utility should continue to be responsible for planning of the power system and the identification and tendering of new capacity, including those based on renewable technologies.

• Where competition is introduced in electricity generation, this should be based on the Single Buyer Model. This applies to additions of both conventional and large scale renewable capacity. The utility should also be in the position to bid for new capacity.

• For small-scale renewable energy, regulation should be in place that allows customers to use and interconnect these systems to the main grid, taking into account technical conditions, and with the allocation of a viable grid services fee that reflects the utility cost of providing grid services to such customers.

• Incentives in the area of tariff setting and quality standards should be fair and symmetric. Utilities should not only be punished for low performance but should also have the ability to be rewarded in case of good performance.

This shows that the OCTs’ Caribbean utilities are very much aware of the conditions in which renewable energy may develop in the region and the regulatory framework which may contribute to this development.

Most OCTs have created autonomous companies to take care of the electricity sector. Only in Pitcairn the power sector is still an activity within local government. In this island, foreign aid is essential to provide the resources needed for the sector.

Some island states created public utilities with a monopoly on generation, transport and distribution systems. For examples, in Aruba with the WEB Aruba (for generation) and ELMAR (for distribution) belonging the government owned holding Utilities Aruba N.V., in British Virgin Islands with the public utility BVIEC, in Montserrat with the Montserrat Electricity Services Ltd. (MUL) and with Nukissiorfiit, the public utility of Greenland. In St Helena, since April 2013 power generation has moved to the private company, Connect Saint Helena Ltd (the Government is the owner of 100% of its shares). In the Falklands, power generation is managed by Power & Electrical, a Government owned utility company. In Pitcairn and St Helena, foreign aid is essential to provide the resources needed for the sector.

Some other OCTs are also in a monopoly situation, but the utility is only partially owned by the government. This is the case for Anguilla, with ANGLEC being partly privatised since 2003.

However, the most common scheme is the concession towards private or semi-private utilities on limited areas (coherent territories such as islands). The existence of a special regulatory authority is not the rule. Regulation is more commonly carried out by governmental bodies which are also in charge of issuing licenses and enforcing the law. Due to the significant costs of transmission and distribution infrastructure, licenses for transmission and distribution on a given territory are very often exclusive. Concessions may be signed at the territory level.
There were significant changes on the generation side and the introduction of partial competition has started to be the rule in a few OCTs. However, for most of them, the size of the market is so limited that competition does not make sense and even though an IPP may appear in the picture, its future relies mainly on a close collaboration with the local IPP. This is the case in St Pierre and Miquelon, where Aerowatt owns and operates a wind farm with the French EDF enjoying a monopoly on distribution.

To foster investment, public-private partnerships are popular, especially in the Pacific with the “Société d’Économie Mixte” (mixed capital company) legal status. ENERCAL (New Caledonia), EDM (Mayotte) and the renewable energy companies Te Mau Itō Api and Itō Moana (French Polynesia) are good examples. These schemes tend to attract more easily private investors (islanders and metropolitan investors seeking tax-exemption) as potential risks are covered by the government. However concerns arise on the cost of such arrangements for the community.

There are specific links between utilities in the OCTs and utilities from Member States to which they are linked and other utilities from the region. The special link between utilities in French speaking countries and Électricité de France has been mentioned several times but there are various levels of involvement. While EDF is not present in the French Pacific OCTs, it can act as a direct operator, such as in Saint Pierre et Miquelon, or be involved as a strong stakeholder through the provision of management staff such as in Mayotte.

Another significant group of utilities is the Pacific Power Association (PPA). It includes 25 utilities of the Pacific region including four utilities belonging to the OCTs of the region: Électricité de Tahiti, Électricité et Eau de Calédonie, Enercal and Électricité et Eau de Wallis et Futuna. The PPA is an inter-governmental agency and member of the Council of Regional Organisations in the Pacific (CROP) to promote the direct cooperation of the Pacific island power utilities in technical training, exchange of information, sharing of senior management and engineering expertise and other activities of benefit to the members.

The PPA’s objective is to improve the quality of power in the region through a cooperative effort among the utilities, private sector and regional aid donors. The PPA’s members pool their resources and expertise for their common benefit, gain international representation and improve access to international power sector assistance programmes.

Through PPA, utilities of the Pacific and of the regional OCTs have easy access to useful training and exchange such as during the last couple of years:

- The 21th Conference on Mining Energy Efficiencies and Diversifying Energy Portfolios of Island Utilities
- A workshop on photovoltaic systems for the South Pacific Island Power Utilities
- A study in 2012 funded by New Zealand on Quantification of the Power System Energy Losses in Southern Pacific Utilities and presented to utilities during a conference
9 RENEWABLE ENERGY RESOURCE POTENTIAL AND ENERGY CONSERVATION OPPORTUNITIES

9.1 Individual country reviews

The contribution of renewable energy sources in the OCTs is important and is gradually increasing in all OCTs.

**Caribbean:**

<table>
<thead>
<tr>
<th>Anguilla</th>
<th>In July 2012, ANGLEC has prepared a draft Request for Proposals for a <strong>utility scale solar PV installation (1 MW)</strong>. Additionally, the government has published a redevelopment plan for Corito Bay that includes a future utility scale wind installation, and a potential waste-based plant. Solar, wind, and perhaps waste-based energy options should be explored and exploited. These options are blocked by several barriers—legal and regulatory ones, in particular. The Anguilla National Energy Policy 2008-2020 provides suitable recommendations for adopting a favourable regulatory framework and promotional environment for RE and energy efficiency but still needs to be effectively implemented.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aruba</td>
<td><strong>Wind energy:</strong> in 2009 a <strong>30 MW wind energy park</strong> (Vader Piet IPP Project) was installed, producing an average 118 GWh per year, representing 13% of the total electricity needs of the island over the period 2010-2012. A second phase to install an additional 24 MW has been commissioned and is planned for completion, in 2014. <strong>Solar:</strong> In October 2012 a contract was signed with a European leading PV-system integrator for the realization of a <strong>3.3 MWp</strong> solar park at the airport of Aruba. An additional 6 MWp will be installed on rooftops. Several new technologies are being tested and implemented with TNO. An example is the SolaRoad innovation programme, a unique road concept that converts sunlight into electricity available to traffic and road-related applications using the surface of roads as solar energy collectors. <strong>Sea Water Air Conditioning:</strong> There is a project under consideration to implement Sea Water Air Conditioning (SWAC) systems for hotels. SWAC takes advantage of available cold deep seawater to replace energy-intensive central refrigeration systems that cool chilled water to provide air conditioning in buildings. <strong>The impact of the SWAC project will probably be limited in scope.</strong> <strong>Energy efficiency:</strong> The public utility WEB is now renewing 50% of its installed capacity with high efficiency <strong>RECIP engines</strong> (reciprocating internal combustion engines, 43% efficiency), thereby <strong>pushing the overall energy efficiency of power generation from 28% to 35%</strong>. Increasing efficiency resulted in a 42% HFO fuel saving compared to 2005. At the power and desalination plant, the introduction of internal combustion engines and reverse osmosis systems has yield efficiency gains of 50% in power generation and 85% in the desalination of seawater. The next target is to improve this efficiency with 40% with the switch from HFO to natural gas. Distribution losses will be reduced from 5.8% to 4%. To further increase RE power to the grid, energy storage must undoubtedly be introduced for grid</td>
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</table>
stability, but storage could also be worthwhile for operation, for shifting load
from high load day period to low load periods (load management).

Small storage projects in process to be started and evaluated are; under water
compressed air storage and ice storage, while together with the charging of
electric driven buses for public transportation could also be a challenge for load
management.

**Switch to LNG**: The next target is to continue to improve this efficiency with
40% share natural gas combined cycle (NGCC) technology, upon landing in
Aruba. Distribution losses will be reduced from 5.8% to 4%. Eventually the
entire plant will be shifted from heavy fuel oil to natural gas.

**Storage**: Under water compressed air storage is also being considered as a first
step for energy storage. This is however an initiative still far from being
implemented.

**Demand side**: Demand reduction is enhanced through an inverter based
appliances incentive program and the introduction of pre-paid smart meters.
Lower import duties also are applied on these appliances.

Government also started replacing all public lights with energy efficient
LED lights. This replacement scheme started in 2012. Import duties on
efficient light fixtures and lamps have been reduced. WEB and Elmar have
programs set up for their personnel to visit households and business at which
they supply information on how to reduce the electricity and water
consumption.

**Public transportation**: There are plans to install and evaluate public
transportation with electric buses.

**Other technologies** that will be initiated or evaluated at due time when
the economics become feasible include: a waste to energy plant (5 MW), an
underwater compressed-air storage, and ice storage.

**Pilots**: Local stakeholders together with TNO, will be implementing new pilot
projects, experimenting with new technologies.

This year, stakeholders will start the construction of a “Smart Community”,
consisting of 20 houses, in which stakeholders together with the community
will experiment and do research. RE penetration, storage possibilities, smart
grid, waste water treatment will be in place along with new construction
methods.

**British Virgin Islands**

The National Energy Policy should achieve enhanced energy efficiency and
conservation, the meaningful integration of renewable energies into the energy
mix (with a base production capacity identified), enhanced electricity sector
performance and generating power efficiency and the reduction of energy use
in the transport sector.

As the British Virgin Islands sort out the details of the policy the installing of a
solar farm on the sister island of Anagada has been advancing with encouraging
results. This project will supply electric power to the residents and businesses
of that island via the main British Virgin Islands Electricity Corporation
substation. This project is in its advance stage and is expected to be
Cayman Islands | The estimated potential for renewable and alternative energies in the Cayman islands are:
- **Onshore wind energy**: <30MW. Several locations are being looked as potential wind parks.
- **Municipal solid waste**: <10 MW (presently investigated by private firms)
- **Cogeneration**: <10 MW potential (waste heat from diesel engines)

Bonaire | In Bonaire, algae are considered as the energy resource that could help in reaching a 100% renewable supply, through the production of biofuel. This is presently under research.

Curacao | In Curacao, there is significant experience with wind energy, acquired through the operation of wind turbines since 1984 by the company Aqualecra. Extensive wind measurements and studies were performed, showing that wind power is a very attractive option for stabilizing electricity costs in the island (wind speeds are almost constant year round, average wind speeds 8-9 m/s at 30m, 58.3% capacity factor reached). A 12% wind energy penetration level has been achieved since 2010, with little or no impact on grid frequency and voltage. With recent and expected technology progress, wind energy penetration level could reach 50%.

Saba | In addition to solar and wind potential, Saba authorities have decided to explore their geothermal potential. A study done in 1998 by US DoE estimated at 3,000 MWe potential in Saba. In 2008, the government of Saba signed an agreement with West Indies Power Holdings (WIPH) to conduct exploratory work for geothermal resources and such work started in 2009.

Sint Eustatius | In addition to solar and wind potential, St Eustatius authorities have decided to explore their geothermal energy potential. In St Eustatius, the US DoE study suggested that the potential would be very low but deep prospecting may prove a more positive result.

Sint Maarten | According to KEMA study published in April 2012, and on review of previous studies, most likely renewable energy options for Sint Maarten are:
- The Saba Geothermal Power Project and the cable interconnexion
- Solar hot water heating (SWH), with potential 5,940 MWh savings
- Residential PV, with potential 54,000 savings
- Commercial PV, with potential 12,000 savings
- Onshore wind (10,920 MWh savings), offshore wind
- Waste-to-energy (WTE), with potential 61,000 MWh savings.

Turks & Caicos islands | Analyses done in 2011 (by Castalia and by Continental Economics) show that there are five renewable energy technologies that may be economically viable in the TCI:
- **Landfill gas to energy** (internal combustion), on a large scale operated commercially (US$0.08 per kWh)
- **Solar water heaters** (flat plate), on small and commercial scale for homes and businesses, respectively (US$0.12 and US$0.13 per kWh, respectively)
- **Wind** on a large scale operated commercially (US$0.12 per kWh for a 25% load factor, and US$0.21 per kWh for respectively 14% load factor)
- **Waste to Energy** (incineration), on a large scale operated commercially (US$0.12 per kWh). This cost was based on TCI-specific data, but it looks low compared to that of other plants in similar contexts, closer to US$0.20 per kWh—further investigation would be warranted.
- **Seawater Air-conditioning (SWAC)**, on a large scale operated commercially (US$0.23 per kWh).
- One additional technology would also be economically viable:
- **Concentrated Solar Power** (parabolic trough), on a large scale operated
commercially (US$0.26 per kWh)

- **Solar PV**, on a large scale operated commercially (US$ 0.48 to 0.64 per kWh)
- The residential customer and the commercial producer would save money with solar water heating. Utilities could cut their generating costs with each form of waste-based technology and wind generation. Also, seawater air conditioning (SWAC) would reduce total generation costs.
- The recommended actions regarding energy efficiency within the envisaged Energy Conservation Policy are the following:
  - **Change the regulation of the power sector** to allow the Utility to recover investments in energy efficiency. Create rules and incentives to allow the power utilities to recover capital investments they make to increase the efficiency of their own plants, or to help their customers consume energy more efficiently.
  - **Promote efficient and renewable air conditioning in hotels**. Make sure that one of the TCI’s key sectors is as efficient as possible in air conditioning, also exploring upcoming solar and ocean technologies
  - **Promote widespread adoption of Compact Fluorescent Lights (CFLs)**. Increase uptake of this efficient lighting technology but make sure this is done safely for people’s health as well as TCI’s environment

### Montserrat

There is no grid-connected RE generation plant presently in Montserrat. However, the national Energy Policy for the period 2008-2027, approved in 2008, plans to develop RE sources, especially **geothermal energy** and **wind energy**, while improving efficiency of energy use. The policy is supported by a first five year Implementation Plan for 2008-2012 consisting mainly in:

- Assessment of the geothermal potential (completed in 2010).
- Policy review to ensure support for geothermal exploration (currently being undertaken).
- Legal and regulatory framework with emphasis on RE (planned for September 2012).

Regarding potential geothermal reserves, the Government of Montserrat (GoM) and DFID have already undertaken several surface level studies, economic appraisals and technical feasibility studies. Based on the positive results of these studies, GoM has now requested funds to drill two test production wells. Geothermal experts engaged in this study have indicated that drilling has an 80% chance of finding a geothermal resource of adequate quantity and quality to generate electricity.

During the 2012-2014 period, DFID plans to provide £8.6 million for geothermal energy development, and £5.3 million for a new power station. In February 2012 the Government of Montserrat has invited expressions of interests for the exploration and development of geothermal energy.

The potential for **commercial wind farms** is estimated at ~ 900 kW nominal capacity.

The Energy Policy plans to address **energy efficiency** through energy audits and related changes in equipment.

### Saint-Barthélemy

Local authorities estimate that there is in Saint-Barthélemy a potential for 12 GWh/year in concentrated solar, representing roughly 10% of yearly power
Study on Renewable Energies and Green Policy in the OCTs
Final report
May 2014

There is a project for implementing wind turbines on one of the nearby islet. It is compulsory to install PV panels on all new houses.

Regarding energy efficiency, there are educational activities, incandescent lamps are fully replaced, and low-consumption lamps are to be replaced by LEDs. Progressively, electric water heaters are replaced by more energy-efficient ones and by solar water heaters (this is compulsory for new constructions, and public funding is available for this).

### Pacific Ocean OCT’s

**New Caledonia**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capacity (compared to existing capacity)</th>
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</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>18 MW (3.1 MW)</td>
</tr>
<tr>
<td>Wind</td>
<td>42 MW (37 MW)</td>
</tr>
<tr>
<td>Hydro</td>
<td>60-100 MW (78 MW)</td>
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</table>

There is a significant potential of RE-based generation capacity estimated as follows:

- **Solar PV**: 18 MW (compared to the existing 3.1 MW installed capacity). There is substantial sun radiation in New Caledonia with an average 2,000 kWh/m² and a limited seasonal variation. This solar PV potential is still untapped, especially in installations connected to the grid. Similarly, it is anticipated that more PV solar units could be installed on roofs and potential is quite large.
- **Wind**: 42 MW (compared to 37 MW today). Wind potential for electricity production is already largely explored in New Caledonia and there is not much prospect for a doubling of the capacity by 2020.
- **Hydro**: between 60 and 100 MW (compared to existing 78 MW).

Upon request by Island’s Authorities, ENERCAL is currently updating the inventory of the hydro potential. In the earlier mentioned 2013-2025 energy supply-demand balance, ENERCAL proposes a scenario based on in development of large hydro power projects.

Currently, a call for project proposals has been launched by the Authorities for 20 MW of wind power and 3 MW of PV. The overall objective is to reach 30% of renewable energy in the energy mix of New Caledonia.

Energy efficiency and energy management are also priorities in New Caledonia because of the need for a more secure energy independency, the increasing cost of energy, and environmental constraints. Following several studies and analysis, various actions need to be executed in the coming years in all sectors of the economy:

- In the residential and tertiary sectors: promote energy savings in building construction and in energy equipment, adopt thermal regulations in existing and new buildings, develop in priority solar water heating wherever there is hot water demand,
- In the transport sector: undertake specific studies on transport sector, promote modes which favor less utilization of private cars, including fiscal incentives or levies, develop new rationalized urban transport corridors,
- In industry: optimize energy efficiency in industrial processes, including optimization of electricity generation and distribution,
- For the whole population: execute an awareness campaign on energy efficiency and environmental protection.

The French Development Agency has been active in New Caledonia for years. The European Investment Bank is also partnering AFD in many initiatives such
as the incentives offered under the Rural Electrification Fund. The financing scheme « GRAINE » encourages companies to invest in actions aiming to protect environment and save energy.

French Polynesia
A recent detailed assessment done in the FP identified the following prospects and potential:

- **Hydropower**: 20 to 25 MW in 12-15 different sites spread in the various islands of the Territory for a total generation capacity of 60 - 70 MW per year. All the identified projects for which feasibility studies have been undertaken have to be approved by the authorities. The Administration has been reluctant to approve the first proposals submitted, preferring to await more data and information to justify the project. Smaller projects are under consideration. There are also some potential micro hydro projects with less than 500 kW unit power.

- **Solar energy**: There is the possibility of seeing the development of PV systems in remote areas as a continuation of the Photom programme, which was very successful.

The development of PV connected to the grid highly depends on the regulation in place and the conditions (feed in tariffs). Furthermore, there is the problem of intermittence. In FP, the normal limit of 30% of solar PV electricity circulating in the network is adopted.

Hybrid systems can be envisaged in all islands which have a limited consumption.

The CSP cannot be envisaged in PF because there is insufficient direct sun radiation. However, there is possibility to envisage production of electricity from thermal solar sources using an Organic Rankine Cycle turbine. This technology would even be more applicable in association with biomass cogeneration.

- **Wind**: Based on past experiences and on recent studies, it seems that there is limited prospect to see a production based on wind energy in the near future in Tahiti. In the islands, EDT is exploring wind projects in Tahaa, Nuku Hiva, Tikehau and Ua Pou.

- **Biomass**: Two projects are under consideration:
  - In Tahiti, a bio-methane unit with composting in Paihoro. The generating capacity should be 650 kW with an electricity production of 5.2 GWh/year.
  - In Nuku Hiva, another thermal 1.5 MW unit with a production capacity of 4GWh/year.

For these projects, the technologies are well known but are still complex with potential difficulties of implementation due to difficulty of access, man power and capacity of evacuating the production.

- **Hydrokinetic Power**: French Polynesia seems to be particularly adapted to hydrokinetic power where significant streams of more than 2m/s have been detected in many channels. Several studies have already been carried out to analyse the potential of this energy source in the islands, in particular in the channels. The most promising site seems to be in the Hao island. However, this must be further studied.
**Tidal Energy**: A first feasibility study has been executed for a tide-based power system in Papara a few years ago. Despite positive results, the project has still not materialised. A second pilot project based on a CETO wave energy immersed technology is in study in Tetiaroa island.

This development should be linked to the creation of a specific center of excellence with professional path towards applied research and development.

**Sea-based thermal energy**: A 8 MW project promoted by Pacific Otec and DCNS has been under study since 2011. The schedule was to reach the operational stage by 2015. It is not clear what the current status of this initiative is. Nevertheless, this technology seems attractive and very much adapted to French Polynesia because of the large difference of temperature between sea and deep level.

**Sea water air conditioning (SWAC)**: French Polynesia is a region where the sub-marine shaping is very favorable for implementation of SWAC system, especially because of the depth of the ocean area near the shore. Following the two first units installed in Bora Bora in 2006 at the Intercontinental hotel, and in final step of implementation in Tetiaroa island at Brando hotel, a new large SWAC project is under consideration for the hospital of Tahiti. The project is being implemented with co-financing provided by the EIB and Ademe. Other SWAC schemes may be evaluated and the experience transferred to other OCTs.

### Wallis & Futuna

The renewable energy strategy in Wallis-et-Futuna clearly identified a two phase development programme:

A Phase 1, currently in progress during the period 2008-2014, and which should lead to the installation of 2,560 kW:

- The TEP Vertes funded: PV systems isolated and grid connected systems
  - EDF 10th: 2 solar interconnected systems: (2x500 kW = 1,000 kW), 600 Individual Solar Home Systems and 3 wind power units with 275 kW unit.
  - EEWF: 2 solar units (100 kW), the hydro unit after repair, a 40 kW micro hydro and the utilization of copra oil in the diesel generator

A Phase 2 during the period 2015 – 2020, including the installation of 1,750 kW additional:

- EEWF: new diesel-copra oil generators and micro hydro units
- Another 500 kW solar power unit and 3 wind farms

The overall objective of the strategy is to reach a 21% share of renewables in electricity generation by 2015 and another 21% by 2020 so that the renewables share might be 42% in 2020.

In practice, renewable energy potential includes:

- Hydro: repairing of the Vainifao hydro power plant and a potential site of 279 kW spread over 4 sites in the island for a production of 1,200 MWh, i.e. 38% of the production in Futuna.
- Wind power: the only study available estimated a potential of 1.2 MW on Wallis island and 420 kW on Futuna for respectively 3,500 and 2,500 hours of operation annually. It would be necessary to update this study.

The local utility EEWF is supporting the project involving the introduction of coconut oil (copra oil) in fuel in combination with gasoil in a 20-80% ratio. There is a potential equivalent at 200 M3 of gas oil substitution.

Based on the rules which set RE at 30% of total i.e. the maximum power from renewable energy based production without perturbing the network, the
potential (wind + solar) is estimated at 50 kW in Wallis and 96 kW in Futuna. In that optimistic scenario, production would reach 2,100 MWh per year without having a significant impact on energy costs for consumers.

An Island energy efficiency programme still needs to be consolidated to tackle the 15% energy savings potential, with either no, or limited, investments by consumers. These are the so-called housekeeping actions usually initiated through an awareness campaign. This includes actions on lighting, change of behaviours, switching equipment whenever not in use or not necessary, installing different routines, etc.

**Pitcairn**

DfID had prepared and started a project to install a wind farm in Pitcairn. After many delays and significant cost increases, this initiative was stopped and the project eventually cancelled. A new initiative is foreseen consisting of a solar farm to supplement diesel-fired generators.

There is no indication that all energy efficiency and renewable energy options have been assessed.

**Indian Ocean:**

**Mayotte**

There is currently no wind production in Mayotte. The wind potential has been assessed at 22 MW on 4 different sites, including Nftsamboro where a potential of 12 MW was identified.

Regarding solar energy, the potential for developing additional systems exists including individual PV and PV connected to the grid, as well as individual and collective solar water heaters although no detailed figures are available on this potential.

The optimization of the collect and valorization as a fuel of the utilized oils could also be considered, with a potential saving of 132 tons of imported diesel. The valorisation of urban waste as a fuel should also be analysed.

The availability of geothermal resources has been detected but with limited prospects for industrial use due to the depth and the resulting cost. Similarly, it may be worthwhile to analyse whether energy from the sea can be explored in Mayotte, and for which particular end use.

Regarding energy efficiency, the main recommendations deal with an awareness campaign and professional training, strengthening thermal regulations for existing and new buildings, with mandatory installation of solar water heaters in new buildings, continuation of efforts with respect to efficient lighting, and promotion of more efficient appliances using fiscal incentives and subsidies.

**South Atlantic:**

**Falkland Islands**

There is a strategic target within the Falklands “Islands Plan 2010/15” for a 40% renewable energy share by 2015.

**Wind:** It is considered as having by far the highest potential. There is currently a 2MW stand-alone wind farm on Sand Bay, feeding into a hybrid wind-diesel power plant. It supplies annually 33% of Stanley’s energy needs, with the highest daily contribution reaching 54%.
In Dec. 2012, the go-ahead was given for a new wind farm at Mare Harbour, which will increase total installed wind capacity to 3MW by 2015. There is limited peak load (4MW expected by 2015) and therefore limited potential for significantly increasing further the installed wind capacity.

Off-grid wind powered systems are used by more than 85% of rural farm houses as a result of a grant scheme that has been operating since 1996 for the purchase of such systems by farmers and rural business owners.

**Solar**: Solar thermal systems used in some private homes for DHW. There is no information on the use of PVs and some concern has been expressed regarding those feeding into small island grids.

**Hydro technologies**: There has been some experimentation with hydro technologies; however, no specific project has become operational.

**Marine technologies**: Falkland Islands Government (FIG) have been in contact with one developer regarding wave power, and suggest there may be several sites to consider regarding tidal energy. A feasibility study should be undertaken to assess feasibility of these technologies, as well as the potential of OTEC.

**Biomass**: There is interest by FIG on the potential of using fuel crops for energy generation. A feasibility study should be undertaken.

**Waste to energy**: There is interest by FIG in commissioning a study to explore the energy potential from municipal solid waste combustion.

Regarding energy-efficiency, a number of actions have been undertaken in recent years (e.g. power factor improvement equipment at power station, flywheel energy storage at wind farm, energy-efficient building for FIG Fisheries Department etc.). The “Islands Plan 2010/15” focuses on energy-efficiency, and the Stanley Town Plan 2001-2016 refers to energy efficiency through building design and construction, insulation and orientation. There is some funding available by the FIDC for the implementation of energy-efficiency in buildings.

**St Helena**

St Helena’s SDP refers to increasing the share of renewable energy generation, and more specifically increasing the contribution of wind turbines to 22% by 2014/15. There are targets to increase the overall RES share in the gross final energy consumption to 72% by 2020 and the RES share in the installed electrical capacity to ~51% by 2020, with the share of wind expected to be 32% and the share of other renewable sources 19%.

**Wind**: Onshore wind energy is the resource with the proven highest potential for St Helena. There are currently 6 installed wind turbines (total 0.5MW), providing over 10% of the island’s electricity. A post project evaluation has shown very good performance and excellent investment returns. The installation of additional wind turbines is underway, to double the installed capacity (1MW by 2015). The longer term plans are to increase wind capacity to 5MW by 2020, providing a 32% share in installed electrical capacity. Opportunities to use larger turbines will be explored as part of the airport construction. A desktop study undertaken in 2012 for offshore wind indicated that this is not likely to be competitive for some years to come.

**Solar**: Solar Thermal for DHW is used widely on the island to heat water in
households and business premises. A desktop study for PVs was undertaken in June 2011 indicating that installing 300kWp of PVs (on St Helena houses’ roofs) would provide 5.6% of the total island energy. The study also looks at the potential of a PV ‘farm’, subject to the land being available. So far, PVs may not have been considered financially viable for St Helena; however, with global PV panel costs constantly dropping, the technology may become more cost-effective in the near future. A pilot PV installation (13.8kWp) was set up in June 2012 to help shape the Government’s future strategy on PVs.

Solar space heating/cooling could be investigated, with the airport construction and potential future development in the island (e.g. hotels). Solar (or other RES e.g. wind) refrigeration technologies could also be further explored as there is high demand for blast freezing / fish refrigeration on the island.

*Hydro technologies*: A desktop study for micro-hydro was undertaken in July 2011 indicating that it is not financially viable at present. A desktop study done in 2012 to assess the feasibility of a hydropower scheme near the Heart Shaped Waterfall suggests that only a very small amount of electricity is likely to be generated. However, there may be other locations with better potential and a more detailed island-wide resource assessment should be undertaken.

*Marine technologies*: A desktop study undertaken in 2012 indicates that:1) there are good wave resources; however, St Helena should revisit wave energy technologies in ~5 years when these are expected to be more commercially developed 2) it is unlikely that tidal power would be feasible 3) OTEC is likely to be the most feasible technology. To investigate this further a more specific OTEC study was done in 2012, suggesting that a 2-3MW OTEC plant would be more than adequate to supply the island’s entire electricity needs. However, the technology should be thoroughly reexamined in ~5 years when it is closer to maturity and after similar projects have been demonstrated.

*Waste to energy*: There is a Solid Waste Management Strategy setting out the medium to long term strategy to deal with solid waste. With population and tourism expected to grow in future as well as increasing use of landfill sites, the potential of energy recovery from municipal waste should be examined.

Regarding energy-efficiency, a number of actions have been undertaken in recent years (e.g. upgrading of the electricity distribution network cables and replacement of transformers, providing high efficiency lighting to all consumers, replacement of traditional street lights with solar powered lights).

Options for energy storage are being looked at and two reports were commissioned in 2012, assessing their potential for St Helena.

With the recent introduction of the SDP and a number of other policy documents, more emphasis has been given to energy-efficiency and an “Energy Efficiency Plan” is being developed. SHG estimates that 2% energy savings could potentially be made through energy efficient practices.

*North Atlantic:*

**St Pierre & Miquelon**

It is a strategic priority within the “Strategic Development Plan of Saint-Pierre-et-Miquelon 2010-2030” “to promote and implement renewable energy and energy-efficiency” and it is acknowledged that SPM has not yet sufficiently developed its potential for renewable energy. Specific measures are foreseen:
**Study on Renewable Energies and Green Policy in the OCTs**

**Final report**

May 2014

- Study on the viability of renewable energy technologies for SPM
- Introduction of tax incentives for the use of renewable energy
- Creation of an Energy Info Point and awareness actions for users
- Improve energy-efficiency in buildings
- Develop capacities in the field of sustainable development
- Promote and implement renewable energy and energy-efficiency

**Wind:** It is the main renewable energy form so far explored on SPM. There are ten installed wind turbines (total 600kW) providing power to Miquelon, feeding into the Miquelon diesel power plant. They are a ~2.2% of the total installed electrical capacity; they supply on average a quarter of Miquelon’s annual electricity demand and ~4% of the overall SPM electricity demand. Overall it is considered that wind has limited further potential in supplying energy for SPM, even though this has not yet been fully evaluated through a feasibility study.

**Marine technologies:** Given the geographic location, there may be considerable potential from marine technologies (wave, tidal, OTEC). Feasibility studies should be undertaken to assess technical and cost viability.

**Stand-alone systems:** The islanders who own a secondary (mainly summer) residence on the island of Langlade have been using stand-alone renewable systems to have the greatest possible autonomy, as there is no heating or electricity network nor drinking water supply on the island. Systems include solar panels, residential wind turbines and rainwater recycling. These have acted as demonstration / experimentation projects raising awareness and familiarising the population with renewable energy.

Regarding energy-efficiency, ongoing initiatives include:

1) Construction of district heating network. A new electricity power station is under construction as part of which district heating will be incorporated, to heat St Pierre’s administrative buildings. It is expected to be in operation by 2015.

Other specific future measures foreseen within the SDP include: the development of an Energy Strategy, energy audits of public buildings and social housing stock, support through tax incentives adaptation and renovation works of housing and private buildings, development of technical partnerships between organisations, construction federations, chambers, businesses, for actions such as benchmarking and training, awareness actions for the young generation in order to educate future professionals in this field etc.

**Greenland**

There is a strategic objective within the Government of Greenland to significantly increase the harnessing of renewable energy sources. Furthermore, an ambition to raise the share of renewable energy to 70% of the total power supply has been fulfilled in 2013 with the construction of Greenland’s fifth hydropower plant. There is interest in exploring small-scale solutions for smaller towns and settlements.

Funding mechanisms are available for the development of renewable and
energy-efficiency projects: 1) Survey of hydro power potentials: approx. 2mil.DKK per year (for 4 years) is allocated, to survey the hydropower potential for Greenland and guide future decision making on public power supply 2) approx. 1.6mil.DKK per year is allocated (for 4 years), as financial support to various projects in the field of renewable energy, energy-efficiency and climate, targeted towards Universities, the private sector, industry, individuals etc.

**Hydropower:** The installed hydro capacity was 68.8MW in 2012, through 4 hydropower plants, generating 60% of the island’s power, and with the operation of the 5th hydropower plant in 2013, the installed capacity has risen to 91.3MW and the overall percentage of power generated by renewables to 70%. There are also some micro hydroelectric plants installed on sheep farms in South Greenland.

**Wind:** Only pilot projects have so far been implemented (two 6kW Proven wind turbines on different locations), which provided lessons learnt regarding the installation of wind turbines to polar environments and identified issues still to be resolved. Wind potential is being further explored in South Greenland where the climate is milder but conditions still very windy.

**Solar thermal:** There are a number of installations of combined solar DHW and space heating systems, as well as research studies on the potential of solar thermal systems for Greenland. The studies indicate that there are favourable considerations for using solar thermal in Greenland (e.g. high reflection from snow, need for space heating also in summer etc.). However, important future considerations indicate that having trained installers is vital, pre-fabricated components can reduce risks of installation errors, and having a pressurised solar collector loop with an expansion vessel has proved to work well under Arctic conditions.

**PVs:** Two pilot small solar electric projects have operated, which demonstrated that arctic conditions are ideal for solar power generation for half of the year. Cold temperatures and light reflecting off the snow enhance PV performance and the installed systems have already achieved very good performance.

**Marine technologies:** Greenland is considered to potentially have tidal and wave resources. However, potential ice build-up in the tidal and splash zone, ice bergs and ice floes might jeopardize installation in the sea and could make such installations potentially very troublesome.

**Biomass:** A study was undertaken on “Biogas potential in South Greenland” which suggests that there is potential for biogas production. However, a more longer term and more detailed feasibility study should be undertaken to examine options. Greenland is also interested in exploring the energy potential of solid biomass, from marine industry refuses.

**Waste to energy:** Municipal solid waste combustion is partially exploited in certain locations in Greenland (Nuuk, Maniitsoq, Sisimiut, Qaqortoq, Aasiaat, Ilulissat). The incinerators in Qaqortoq produce heat for the utility company’s district heating when there is a need.

**Geothermal energy:** Greenland is interested in the potential for underground bedrock heat pumps, and a feasibility study should be undertaken.

Regarding energy-efficiency, actions undertaken in recent years include:

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

**Note:** Regarding energy-efficiency, actions undertaken in recent years include:
1) pilot low-energy buildings such as the Low Energy House in Sisimiut and a new student hall of residence in Sisimiut which is being built
2) Nukissiorfiit implemented a large-scale remote meter-reading project, which involved replacing at national level, all electricity, water and heating meters run by the public utility company (a total of ~43,000 units) with new automatic meters incorporating a remote reading function. The process was completed in 2012 and is expected to lead to significant energy savings and greater people’s awareness of energy use.

The Arctic Centre plans to do further research on sustainable construction for buildings in Greenland.

With growing demand for energy, and subject to the outcomes of feasibility studies, Greenland is interested in options for energy storage, considering that it has great amounts of stable and predictable hydropower. Storage from micro seconds to season to season is of interest.

Overall it is considered that 15% to 40% of energy savings could be made at the national level, through a combination of automatic metering, insulation of buildings, energy saving appliances and practices.

9.2 Global analysis for all OCTs or groups of OCTs

9.2.1 Analysis of the penetration of RE in OCTs

In the 2008 study, there was the presentation of many renewable energy projects developed in islands: wind farms in the Galapagos, Jamaica and St Lucia; biofuels in Vanuatu; biomass cogeneration in Mauritius and Indonesia; biomass co-firing with coal in La Réunion, geothermal in Dominica and Papua New Guinea; PV based rural electrification in Tonga and Karibati; solar water systems in La Réunion and Barbados; micro and mini-hydro power in the Solomon Islands and Fiji. The positive development for increasing green energy in the OCTs is that for many of these technologies, there are today successful operations in the OCTs themselves. This is illustrated in the following table:

<table>
<thead>
<tr>
<th>RE systems installed capacities (2013)</th>
<th>Solar PV</th>
<th>Wind</th>
<th>Hydro Generation share of RE</th>
<th>RE capacity share (% of installed capacity)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2008 study</td>
</tr>
<tr>
<td>Caribbean OCTs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anguilla</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aruba</td>
<td>4 MWp</td>
<td>30 MW</td>
<td></td>
<td>&lt;1 %</td>
</tr>
<tr>
<td>British Virgin Islands</td>
<td></td>
<td></td>
<td></td>
<td>13 %</td>
</tr>
<tr>
<td>Cayman Islands</td>
<td>0.2 MW</td>
<td></td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Bonaire</td>
<td>10.8 MW</td>
<td></td>
<td></td>
<td>40%</td>
</tr>
<tr>
<td>Curacao</td>
<td>30 MW</td>
<td></td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Saba</td>
<td></td>
<td></td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Sint Eustatius</td>
<td></td>
<td></td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Sint Maarten</td>
<td></td>
<td></td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Turks &amp; Caicos Islands</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
Solar water heaters, not mentioned in the table above, are also now widely spread in those territories with significant solar resource.

During the last five years, there have been significant increases in the RE installed capacities in several OCTs due to a number of large projects that have tapped conventional renewable energy resources: +37 MW hydropower capacity in Greenland, +30 MW in Aruba, +13.8 MW in Mayotte (mainly PV), +12 MW PV in French Polynesia, +10.8 MW wind in Bonaire, +1 MW wind in the Falkland Islands (including flywheels for energy storage and another new wind farm in construction since December 2012), and a two-fold increase in the generation share of RE sources in St Helena.

In addition, the pursuit of other RE options (slightly more complex or less conventional) has also made progress: a survey of the potential for hydropower (hydrological and geological studies) is ongoing in Greenland; a 650 kW bio-methane unit with composting and a 1.5 MW biomass-fired unit are under consideration in French Polynesia; the blending of 20% copra oil in diesel for adapted generators is under consideration in Wallis & Futuna; and exploratory work on geothermal potential has started in Saba (2009) while a similar assessment was completed in 2010 for Montserrat, leading to an invitation for expression of interest for the further exploration and development of geothermal energy in Montserrat. A SWAC facility is successfully operated in French Polynesia, while Aruba is also planning implementation of waste-to energy plants (5 MW), and also Anguilla.

9.2.2 Conventional RES Applications

Conventional RES applications are the technologies that are widely available and commercialised in the EU; their basic technology is generally established. In the section that follows, their technological penetration is reviewed for the OCTs, taking into account the available resource potential as well as the legal, technological or economic barriers to their development in each OCT area.

PV – Solar Thermal: Solar Technologies (either PV for grid electricity production or solar thermal for heating/DHW) are commercially available around the globe making it easy for OCTs to develop their own trade and logistics chains in order to make these technologies more

| Montserrat | 11.9 MWp | 5.3% | 0.50% | 13.2% |
| Saint-Barthélemy | | <1% | 0% | < 1% |
| Pacific Ocean OCTs | | | | |
| New Caledonia | 3.1 MWp | 78 MW | 15% | 30% | 24% |
| French Polynesia | 14 MWp | 47 MW | 29.5% | 21% | 21% |
| Wallis & Futuna | 2 MWp | | <1% | 3% | 3% |
| Pitcairn | | | - | 0% | |
| Isolated OCTs | | | | |
| Mayotte | | 5.3% | 0.50% | 13.2% |
| Falkland Islands | few kW | 2 MW | 33% | 13% | 23.2% |
| St Helena | few kW | 0.5 MW | 11%* | 5% | 6.2% |
| St Pierre & Miquelon | few kW | 0.6 MW | 4% | 2.2% | 2.2% |
| Greenland | few kW | few kW | 11.1%** | 36% | 55% |

*2012 figure **2011 figure
available in OCTs. Already, in many of the OCT areas, the solar technologies are developing, as their design, installation and maintenance know-how requirements are minimal. Although the solar irradiation potential may not be suitable in all OCTs the effectiveness of the technologies, combined with their steadily declining cost (especially of PVs), makes them suitable as basic technologies to be fully developed in all OCTs.

**Wind:** Wind Power is also one of the most commercialised RES technologies with a global presence. Wind potential has been identified in all OCTs areas in specific locations where the only adverse consideration is the impact on the landscape. However, wind technology evolution has come to the point where a single turbine can produce 5 MW of power, making it possible to cover the capacity needs (in terms of wind energy) of the OCTs with a limited number of turbines, having a minimum impact on the landscape (in Aruba: 10 x 3 MW). However, it must be pointed out that large wind power units are somehow not compatible with the specific conditions encountered in many OCTs such as limited or lack of construction capacity, tough climate constraints with frequent cyclones requiring adapted design of wind masts and difficulty of absorption of power by small grids (large swings in wind-based power generation and problem of small grid stability). Nevertheless, wind power potentials need to be assessed and will continue to be an essential component in all OCTs’ energy mixes.

**Hydro:** Conventional Hydro power applications are considered as installations over 1MW, including small hydro (1-10MW) and large scale hydro (up to 10MW). For these power capacities, considerable potential is needed as well as heavy investment in infrastructure works, especially for large scale facilities. Such hydro power potential is available in certain OCTs, such as Greenland and French Polynesia, which possess the necessary head and flow of water in a basin, and are capable of generating power throughout the year. While hydro resources may be typically available in these OCTs, the necessary installation works (especially the civil works) can significantly affect the landscape. Thus, feasibility studies should be undertaken to assess the suitability of hydro power schemes (small or large) in each specific location, and the degree to which the required works for such schemes would impact the existing landscape.

**Geothermal:** Geothermal energy exploits the thermal energy stored below the earth’s crust. It can be developed to produce either electricity from high pressure steam and/or heating for supplying district systems or heating needs for agricultural activities. The identification of geothermal fields and their production potential through studies is critical before the implementation of any geothermal field installation, as factors such as the fields’ fluid temperature and the depth of the field have to be specified.

**Biomass:** Biomass energy enables living plant matter such as agricultural crops, seeds, grasses, wild plants, trees and shrubs as well as organic waste in the form of biodegradable materials, garbage, compost, animal manure and other waste products to be converted into usable energy—from electricity or heat generation to fuels. The implementation of biomass energy projects in the OCTs depends on the biomass supply potential of each OCT and the feasibility of each different biomass technology. OCTs with agricultural activities- such as Greenland, French Polynesia, and the Falklands- favour the development of biomass gasification or biomass anaerobic digestion installations, where the energy products generated can meet agricultural energy needs as well, as opposed to the biofuels’ production where regardless of the available potential, the development of biofuels’ refineries would have a prohibitive cost for the OCTs.

**Synthesis of existing and future potential conventional RE applications in the OCTs:**
Amongst conventional renewable energy technologies applicable in OCTs, wind, photovoltaic, and solar thermal (for heating/DHW) are the ones that can be typically deployed in any OCT area, contributing significantly to RE penetration in the OCTs’ energy mix. These technologies have been globally commercialised, with technical service support readily available all over the world, while costs have been reduced to a level that can take advantage of economies of scale in implementation. In contrast, geothermal energy, due to a need to establish a minimum of resource availability and production potential as well as its high installation costs, is only applicable in certain OCTs, and only after specific exploration studies have been undertaken, as happened in Montserrat. The applicability of conventional hydro power technologies in OCTs is related to existing potential but also to the impact it may have on the landscape of the geographic area in question due to the heavy civil works requirements. Based on a survey of the hydro potential in OCTs, Greenland, French Polynesia, New Caledonia appear to have the resources to develop hydropower infrastructure of over 1MW. Finally, the implementation of biomass energy technologies in OCTs depends on their biomass feedstock availability, the potential of which has been estimated, based on studies and inventories. Greenland, French Polynesia, Falklands and others are the OCTs with considerable potential for developing biomass. The synthesis of conventional RE applications in OCTs is summarised in the following table.

### Table 9: Type of renewable energy resources and potential available in the OCTs

<table>
<thead>
<tr>
<th>OCT</th>
<th>Wind</th>
<th>PV</th>
<th>Hydro</th>
<th>Solar Thermal</th>
<th>Geothermal</th>
<th>Biomass Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aruba</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anguilla</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>Bonaire</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
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</tr>
<tr>
<td>Curaçao</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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Table 10: Synthesis of existing conventional RE applications in the OCTs

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<td>- Solar water heaters</td>
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<td>Aruba</td>
<td>- Solar park 3.3 MWp Aruba</td>
<td>- 30 MW</td>
<td>Waste to Energy 5 MW</td>
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<td>Airport</td>
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<td>- residential (10 kWp max per house) and non-residential (100 kWp max) grid-tied PV systems</td>
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<td>Turks &amp; Caicos islands</td>
<td>- Solar water heaters 12% penetration</td>
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<td>- Solar water heaters</td>
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<td>Pacific Ocean</td>
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<tr>
<td>New Caledonia</td>
<td>A few PV units</td>
<td>6 wind farms between 0.5 and 11 MW</td>
<td>68 MW - Yaté hydro power plant + 10MW Néaoua et Thu hydro power projects</td>
<td>A few biomass units</td>
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<tr>
<td>French Polynesia</td>
<td>14.3 MWp PV systems connected to the grid</td>
<td>47 MW installed</td>
<td>- 2 SWAC for an annual production of 2.4 GWh/year</td>
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<td>1,500 isolated PV units (Total 1,860 kWc)</td>
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<td>47 MW installed</td>
<td>- Small biomass</td>
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<td>7 hybrid PV-diesel units</td>
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<td>35,000 SWH units (45% of households)</td>
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<td>Wallis &amp; Futuna</td>
<td>183 kW of PV in total (TEP Vertes)</td>
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<td>Pitcairn</td>
<td>A few solar water heaters</td>
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<td>Biomass</td>
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<td>Indian Ocean:</td>
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<tr>
<td>Mayotte</td>
<td>70 PV units connected to the grid</td>
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<td>Small biomass</td>
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and off grid

| South Atlantic: | Falkland Islands | Use of solar thermal in private homes | 2 MW (23.2% of installed capacity) | Experimentation with hydro (no operational project) |
| St Helena | - solar thermal for HHs and businesses - Pilot PV units 13.8 kWp | 0.5 MW (6.2% of installed capacity) | |

| North Atlantic: | St Pierre & Miquelon | - Use of stand-alone solar systems in houses in Langlade | - 0.6 MW (2.2% of installed capacity) - Use of stand-alone wind generators in houses in Langlade | |
| Greenland | - Pilot PV units 1.23 kWp - Solar thermal installations, 60Kw + others | - Pilot turbine 6 kW | 68.8 MW (55% of installed capacity) |

9.2.3 Innovative RES Applications

Innovative RES applications are technology applications that until now have either not been developed at all in the OCTs (i.e. only studies have been undertaken) or have been implemented at a pilot level, and their development needs to be further explored. The technologies listed below have these characteristics. Apart from a more extensive technical description presented in the Annexes, they have also been reviewed in relation to their prospects for development in each OCT, taking into consideration the available resource potential, technical and economic parameters, the readiness for development (based on available studies) and, finally, the energy needs.

Waste to Energy:

Municipal waste management is a very critical area for all OCT areas. This is due to the fact that the waste disposal needs, as a consequence of economic growth, increase with improvements in the economic status of OCTs citizens, consequently leading to more land space being required for safe waste treatment and disposal - land space that in none of the OCTs is available in abundance.

Waste to Energy technologies are applicable in all OCT areas. All OCTs can produce the type of waste needed for waste to energy exploitation and an annual management plan of the waste gathered could lead to an estimate of the quantities needed for making it operational. Waste to Energy exploits waste as an energy resource and minimises the volumes of final disposal to the environment; at the same time, energy products such as electricity and high pressure steam are
produced, or as in the case in Aruba, were gas will be produced. Waste to Energy electricity production can contribute to base load electricity supply, reducing dependency on imported fuels, or fuels transported from a long distance, since it is 100% locally derived energy. Before moving to the implementation stage, careful design is necessary, especially in relation to the site selection for the facility and to the residues management plan.

**Sea Water Air Conditioning:**

Sea Water Air Conditioning (SWAC) is a technology that exploits the vast energy reservoir of the seas in terms of the temperature difference occurring between a certain depth and the atmosphere, providing cooling and air conditioning through the use of a heat exchanger. The larger the temperature difference, the better the efficiency of the system. In all the OCT areas, the potential of the technology from the supply side is available as temperatures of 5°C - 7°C in ocean water can be found in reachable depths. However, the demand for chilled water for cooling and AC in certain OCTs is considerable while in other OCTs it is minor or non-existent. Thus, SWAC technology may suit perfectly the needs for AC of OCTs located in the tropics, resulting in significant electricity savings when compared to conventional AC units.

**Solar Cooling, AC and Refrigeration:**

Solar Cooling, AC and refrigeration technologies use solar energy to drive cooling cycles for space conditioning and refrigeration needs in buildings. Since the cooling load coincides with the solar energy potential existing in certain OCTs and the cooling requirements of a building are roughly in phase with the solar availability, this technology is favourable in OCTs with considerable cooling loads i.e. hotels, shops and generally in the tertiary sector. However, the cost efficiency of the technology is still low in relation to more conventional alternatives.

**Ground Source Heat Pumps for Heating and Cooling:**

In contrast to Geothermal Energy Fields of High and Low Enthalpy, Ground Source Heat Pumps (GHPs) can be used everywhere as the technology exploits ground or groundwater temperatures (between 5°C - 30°C), which are available in all countries around the globe, including OCTs, in order to provide heating, cooling and domestic hot water. Thus, the supply potential is present in all OCTs areas as well as the demand requirements since all OCTs have considerable needs, either for heating or cooling or both. GHPs are a convenient way to combine in one technology the provision of all main building services (heating, cooling, hot water) resulting in significant primary energy and fuel consumption savings. Land availability (for boreholes or horizontal loops) should be considered on a project by project basis, as well as space requirements in buildings’ roofs or basements for the necessary equipment.

**Tidal Power:**

Tidal power technologies exploit the tidal potential available, meaning the difference between high and low tide sea level near shore waters, for power generation. Tidal potential maps and atlases are already available for areas around the globe, including in the OCTs. However, prior to developing a tidal power facility in any OCT, a specific feasibility study should be
undertaken involving on-site measurements. Apart from the supply side availability of tidal power, the matching of the OCTs’ daily cycles of electricity demand with the tidal cycles’ occurrence is an issue, as a mismatch could lead to the need for energy storage, increasing the cost of the technology. Moreover, since tidal power technology is not yet as commercially developed, its viability and ease of implementation in the OCTs needs also to be considered.

**Wave Power:**

The development of wave power technologies in the OCTs is highly dependent on the wave potential identified in each area. Wave power generation, unlike tidal power, has a good load-following profile of energy production, suitable in regions with electricity demand peaks, such as in the OCTs. Despite the existence of wave potential in certain OCTs, a detailed feasibility study would be required before any installation can take place. Moreover, environmental concerns such as the impact on marine ecosystems should also be taken into account. Furthermore, wave power technology is not yet as commercially developed so its viability and ease of implementation in OCTs should also be considered.

**OTEC:**

Ocean Thermal Energy Conversion (OTEC) utilises the difference in temperature at different ocean depths to power a turbine for producing electricity. The larger the temperature difference is at these ocean depths, the higher the efficiency and the higher the potential of the technology. High temperature differences exist in the tropics, making the technology favourable in the OTCs located there. Apart from electricity generation, the technology can provide district cooling and desalinated water for both of which there is demand in OCTs in the tropics. However, careful design and setting as well as detailed feasibility studies are needed to minimise the technology’s environmental impact and maximize the technology’s cost benefit ratio.

**Micro Hydro:**

As with all hydro technologies, micro hydro power systems (<100kW) require the necessary head and flow potential of the basin waters existing in OCT areas. However, unlike large scale conventional hydro systems, micro hydro systems have practically no effect on the environment because they don’t depend on dams to store and channel water. Moreover, when power generation supply is matched with nearby energy demand, avoiding unnecessary long transmission lines, the technology’s cost-effectiveness is highly increased, making it even more attractive to OCTs. Careful design is still critical, as frictional losses need to be minimized for the maximisation of output.

**Biomass Trigeneration:**

Trigeneration units are ideal for dispersed energy production, making them suitable for municipal energy provision in OCTs since in one unit all municipal building services - including heating, cooling and hot-water -are combined. However, when biomass feedstock combinations are the energy source, in order for the technology to maintain its sustainable
nature, biomass potential must be available in areas close to the trigeneration production units. Most OCTs have the advantage of small distances between agricultural (where biomass potential is available) and municipal areas (where trigeneration occurs) or in having the electricity/heating or cooling needs near to the areas where the biomass potential is located, making the technology favourable.

**Renewable Energy Desalination (RED):**

Water scarcity is a significant issue to be faced by all OCT areas. Desalination technologies can provide fresh potable water using either sea or brackish water. When coupled with renewable energy technologies and appropriate brine disposal, they present a sustainable and environmentally friendly solution suitable in all OCTs. Reverse osmosis desalination plants can produce up to many tens of thousands of cubic meters per day from just a few cubic meters of fresh water per day. A consideration that may lead OCTs to avoid RES desalination is the existence of plans to cover water needs through other sources, such as groundwater exploitation, as is the case in St. Helena.

**Rural Electrification through Micro-grids (REM):**

The cost of Renewable Energy (RE) has constantly been declining throughout the past years, and the maturity of relevant RE technologies has been rising. The most commonly used RE technologies for electricity production are photovoltaic panels, wind turbines and gensets using biomass as fuel. Micro-grids are low voltage distribution grids. They can operate either in autonomous mode or interconnected with a larger grid. In order that they operate autonomously, they need either a battery source or a generator. Micro-grids allow distributed power generation in all areas they cover. A carefully managed micro-grid can allow effective penetration of RE energy to the main grid. There are small, remote settlements in all OCTs, where these micro-grids are a viable option.

**Renewable Energy Storage (REST):**

Energy storage in an electrical grid allows for better management of the produced energy. In this way a time shift between the actual energy production and energy consumption can take place. This can, for example, allow the consumption of low cost energy produced during off-peak times to be used at peak load times, without having to activate other energy producers at considerably higher cost. The most common energy storage approach is the use of batteries, which are available in many different types. Pumped hydroelectricity storage is the largest-capacity form of energy storage used currently. Many more kinds of storage have been used like hydrogen, compressed air, flywheels, ultra-capacitors, ice-storage, etc. Energy storage is a multi-purpose tool for any grid operator and can allow the implementation of more advanced and efficient strategies, especially in autonomous grids like the ones in the OCTs.

**Renewable Energy Smart grids:**

The ultimate goal of any energy system is to manage to cover all the needs, at any given point in time, both cost effectively and with maximum sustainability. In order to create the smart grid
of the future, a multi-stage process will have to take place. Many different components such as renewable energy producers, storage subsystems and intelligent load and demand side management have to be implemented. A smart grid based on renewable energy technologies can lead to 100% sustainable and environmentally friendly grids. This is the ultimate goal and vision of all renewable energy actions and interventions- and the route to be followed by all OCTs in order to achieve 100% sustainability in the future.

**Pilot projects on innovative technologies in Aruba**

Local stakeholders together with TNO, will be implementing new pilot projects, experimenting with new technologies.

This year (2013) stakeholders will start the construction of a “Smart Community”, consisting of 20 houses, in which stakeholders together with the community will experiment and do research. RE penetration, storage possibilities, smart grid, waste water treatment will be in place along new construction methods.

As such Aruba will also be, a pilot testing and implementation location for the TNO initiated ‘SolaRoad’ program, when constructing the “Green Corridor”. This road network is one huge solar panel and potential source of green energy. Within the SolaRoad innovation program, TNO is working on a unique road concept that converts sunlight into electricity using the surface of roads as solar energy collectors. By making this electricity available to traffic and road-related applications, a solar energy road is a big step forward towards an energy neutral transportation and mobility system. Aruba’s small scale and 2500+ solar hours provide excellent conditions for this concept.

**Synthesis of existing and future potential innovative RE applications in the OCTs:**

The factors that affect the applicability of innovative RE technologies in the OCTs are not only linked to their current potential. Due to the innovative character of these technologies, a more sophisticated approach is needed and detailed studies (e.g. site, feasibility, environmental impact, demand side profiles) including social acceptance criteria are required prior to implementation. However, due to the specific needs of OCTs (i.e. water, distributed energy) and constraints on land availability, applications such as Waste to Energy technologies, RE Desalination for potable water, RE Microgrids, RE Storage and RE Smartgrids, are all proposed for implementation in all OCTs areas.

Ground Source Heat Pumps for Heating and Cooling are also an application suitable for all OCTs as it can be applied everywhere, providing heating, domestic hot water, and cooling if necessary. SWAC and Solar AC/Refrigeration are applications suitable only in OCTs with cooling needs, especially for the tertiary sector (hotels) located in the tropics, such as Turks & Caicos, Anguilla, Sint Maarten, Curaçao, etc. The cost of these technologies is still considerable so careful design is critical.

Tidal and Wave power are technologies applicable to OCTs with tidal and wave potential, such as pin St. Pierre & Miquelon and the Falklands. The impact on the landscape is a factor to be taken into account as well as matching production output with the electricity demand profile in each OCT area.
OTEC is a technology applicable only in certain OCTs where a high temperature difference has been identified between surface ocean waters and waters at depths of 1000m (in some areas more than 20°C difference is recorded). Tropical OCTs, such as French Polynesia, are the most suitable for exploiting OTEC technology applications because of their high potential but OCTs outside the tropics, such as St Helena, have also made studies for OTEC implementation, thus being in a good position to exploit this technology. The significant installation costs and landscape impact are parameters to be further analyzed before final implementation.

Micro hydro schemes can be viable in OCTs without a need for significant infrastructure works. OCTs like Greenland, St. Pierre & Miquelon and Falklands, which are rich in water resources, could develop micro hydro schemes and satisfy dispersed loads, without the need for costly grid infrastructure extensions. Finally, Biomass tri-generation is a technology applicable to OCTs with rich biomass feedstock and demand for heating, cooling and hot-water, all combined in one application. The synthesis of the innovative RE applications in the OCTs is summarised in the following table.
Table 11: Pilot, Innovative RES applications in OCTs (existing and potential)

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<th>GHPs</th>
<th>SWAC</th>
<th>Tidal</th>
<th>Wave</th>
<th>OTEC</th>
<th>Micro Hydro</th>
<th>Waste to Energy</th>
<th>Biomass Tri-generation</th>
<th>Solar cooling, AC and Refrigeration</th>
<th>RED</th>
<th>REM</th>
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9.3 Energy storage and buffering, network adaptation to smart grid

Renewable Energy storage in an electrical grid allows for better management of produced energy. As a result, a time shift between the actual energy production and energy consumption can take place and, for example, allow the consumption of low-cost energy produced during off-peak times to be used at peak load, without having to activate other producers at considerably higher cost.

Storage has also been a topic of interest in recent years because of the high penetration of intermittent renewable energy technologies and, more specifically, wind and solar energy, which depend on the weather and cannot be directly controlled. It is a reality around the world that much of the energy of wind parks is not used throughout the year and also central electrical grids are becoming congested, due to the increasing number of PVs that are installed every year.

Storage can address all these issues and also can be used to support autonomous systems far from the grid. The most common energy storage approach is the use of batteries, which are available in many different forms. Pumped hydroelectricity storage is the largest-capacity form of energy storage used currently. Many other forms have been used like hydrogen, compressed air, flywheels, ultracapacitors, etc.

Electrical Energy Storage (EES) can prove very beneficial both for peak saving applications as well as in load levelling applications. As far as peak saving is concerned, when the load is low and a cheaper energy producer can produce more energy. This energy is then stored for when there is a peak in consumption, instead of activating other producers at higher production costs.

For load levelling applications, storage allows the main energy producer to operate at a constant level by storing energy when the load is lower and supplying the grid with energy when consumption is higher.

Depending on the size of the grid, the time occurrence of peaks, the need for either long or short term energy storage and technical constraints of the location itself, the best approach can be selected.

The main technologies available currently, which have been used in remote and island locations are:

- **Batteries:**

  Batteries are a form of chemical storage of energy. Electrical energy is transformed into chemical energy which is then stored; when needed again, the chemical energy is transformed back into electrical energy. The most commonly used batteries in renewable energy applications are the flooded lead acid (FLA) batteries that allow a long discharge. The only needs of this technology are that they require regular maintenance and the location where the batteries are used has to be ventilated. They present the lowest cost per Amp-hour compared with any other battery. These batteries come in different Amp-hour ratings and voltages. If the manufacturers’ guidelines are used concerning charging and discharging, they operate...
flawlessly. Usually, for larger systems, 2 V batteries connected in series are used. The lithium-ion battery is a technology that has seen many uses in the electric automotive sector. The main advantage is that they present no memory effect and the long discharge does not have the effect it has on FLA batteries. Also, another important aspect is that the capacity of the battery is not closely linked to the discharge time. For example, a FLA battery can have half the capacity rating for constant discharge in 1 hour, than 20 hours. The biggest disadvantage of lithium batteries currently is their high cost. Other more exotic battery technologies, like molten salt batteries and redox flow ones, are being used more and more in recent years.

- **Pumped Hydro Storage:**

Pumped hydro storage is a combination of a typical hydro power station, which features a pump subsystem to fill up the upper reservoir when there is excess electricity available. It is a well-established technology with high storage capacity. The only problem is that it can only be applied in places where a hill or a mountain exist and the design must take into consideration the local meteorological conditions so as not to lose much energy due to water evaporation etc.

- **Hydrogen:**

Hydrogen is an energy carrier. This means that hydrogen on its own is neither sustainable nor non-sustainable. If it is produced through fossil or nuclear fuel processes, it is not sustainable but when it is produced through renewable energy technologies, it is a “green” energy carrier. Hydrogen is the most common element on earth- but in the form of water. The most common approach in hydrogen production when coupled with renewables is the electrolysis of water. This can happen through electrolysers, which utilize electricity, or electricity and heat, in order to produce pure hydrogen. This hydrogen can in turn be stored for short or long time periods in various forms (gas, gas under pressure, liquid, in metal hydride tanks etc.). This fuel, in essence, can be transformed again into electricity, when needed, through fuel cells. As a result, unused electricity from a wind park can be transformed into hydrogen and be ‘re-supplied’ to the grid later when there is need. Its main advantage is that hydrogen can be used both for stationary and mobile applications and that it can be stored for long periods of time. It main disadvantage has to do with the cycle efficiency of this process. An advanced electrolyzer can have an efficiency of 65% and a fuel cell of 55%. Even if there is no loss due to storage, the overall efficiency can be as low as 35%. The prices of hydrogen storage batteries have seen constant decline in the past decade and are expected to drop considerably more.

The intermittence of solar and wind power in particular and the mismatching of energy production with peak consumption leads to significant energy losses. For example, when high energy is produced by a wind park and overall consumption is low, the grid operator disconnects the wind park and all this energy is lost. By storing this energy and injecting it into the grid later when it is needed, renewable energy penetration could rise considerably. By using storage, the installed energy producers can maximize their output. When the design and sizing of the storage subsystem has been carried out based on a system analysis, considerable economic benefits can also be obtained.
Storage can maximize renewable energy penetration. It is also needed as an essential component of advanced microgrids/smartgrids and for network adaptation to a distributed electricity generation model suitable for OCTs. In order for smartgrids to be set up in OCTs, a multi-stage process will have to take place. Many different components—such as renewable/distributed energy production, storage subsystems, intelligent loads and demand side management—have to be implemented. For the optimal operation of smartgrids in the OCTs, a grid control, which allows the appropriate matching of the loads with the available dispersed production in that area (RES, cogeneration, storage), is essential. This operation has to have real-time measurements at all production and consumption points along the grid. Extensive use of smart meters, switching devices, (smart connectors and switches) that allow the differentiation, measurement and remote control of selected loads (e.g. heat pumps buildings, pumping stations, etc.) is needed. Wired (interbus, modbus, BPL) or wireless (wi-fi hubs) installations of communication technologies for consumption and production data exchange at intervals close to real time are also required. This implies that either the existing grid infrastructure will have to bear such adaptations or planned network extensions will have to be made, based on a smartgrid logic. Real-time data, coupled with historical data and forecasts of future operational data, are evaluated in real time and decisions on whether to activate or not energy producers and/or meet consumption needs are made. The above system can be implemented at various levels and the overall outcome is the efficient operation of the smartgrid.

**Development of Electricity Storage – a new step in smart grids. The PEGASE pilot Project**, in La Réunion Island

The PEGASE project aims to respond to the specific needs of the islands’ electricity networks in terms of development of renewable energy.

The islands’ electrical system has particularities, compared with those of continental countries, consisting in a higher contribution from intermittent renewable energy with a growth rate which will reach, several times a year, a threshold of 30% of intermittent power production.

Because of its small size, the islands’ electrical system is more fragile than a large continental interconnected system, with a greater risk of rupture of the instantaneous supply – demand equilibrium, due to the sudden variations and large amplitudes in renewables-based production.

Typically in islands, there is an important diesel-fired power generation system, with significant CO2 emissions. Without an accurate means of forecasting the RE-based power production and compensation by energy storage, the traditional fossil fuels fired power plants might be used more than necessary, thus affecting the environmental benefits of the renewable energy.

A few partners including Electricité de France, Aérowatt, Météo France, and University of La Réunion designed the Pegase project, whose goal is to develop methods and tools:

- of forecasting short-term (up to 48 hours) and shorter term (up to several hours) models or templates of PV and/or solar production based on weather forecasting models;

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4 PEGASE stands for « Prévision des Energies renouvelables et Garantie Active par le Stockage d’Energie"
of information management to improve the whole real time data flows and to make the grid “smarter”;
- of managing energy storage with sodium sulphur (Na-S) batteries (to correct the production gaps with the PV and/or wind forecast while providing services to different time horizons, ranging from energy transfer (a few hours) to adjust frequency (a few seconds).

The pilot Pegase project for La Réunion electrical system should contribute to:
- optimize the supply-demand balance;
- better integrate renewable energy into the production mix of the island;
- improve the stability of power system.

This pilot will include (for the first time in France), the link between a solar farm and / or wind farm (from 3 to 10 MW) with a storage battery Na-S (1 MW capacity) with a generation plan that includes the real production forecast. It will also test the joint management of several renewable power units in real time, with the energy storage.

In Aruba, a development project of RE penetration, in combination with energy storage, smart grids, waste water treatment and new building efficient construction, will be soon in place with the “Smart Community” project.

- Towards 100% RES penetration:

Investigating the option of turning OCTs into 100% RES islands, i.e. all energy demand would be met exclusively by Renewable Energy sources, is a multi-parameter challenge. First, the RES existing potential in capacity terms should exceed several times the annual energy demand of the OCT area in question. Second, with appropriate storage technologies for storing the RES energy produced (i.e. at time periods when there is no energy demand and releasing it to the grid at time periods when there is), the energy supply could originate 100% from RES. Concentrating on a single RES technology, such as wind power, which has the potential to meet 100% of annual demand of an OCT area (subject to the wind resource being available and the landscape/environmental/other factors taken into consideration), could lead to significant cost economies, when compared to using a mixture of different RES technologies. Apart from the smaller capacities and bigger marginal costs for different kinds of RES introduced, there would also be a need for different storage technologies as well coupling with the particular RES options available, raising the overall cost. However, diversifying sources of energy supply has advantages in improving energy security, compared to the option of having 100% of the supply derived from a single source.
The case of Aruba

Government vision is that by 2020, energy production should be 100% sustainable. Ultimately Aruba wants to become a model for a low-carbon, sustainable and prosperous economy that can be replicated in other island nations. On the supply side at the power and desalination plant, the introduction of internal combustion engines and reverse osmosis systems has yield efficiency gains of 50% in power generation and 85% in the desalination of seawater. Required HFO for energy and water production went down from 6200 to 3600 barrels a day, which lead to, in combination with energy storage, lower energy tariff (average 16%) and water tariff (average 33%) in 2012. Further efficiency will be gained when switching from HFO to NG, while a higher level of RE penetration is visualized. This higher RE penetration level which will be the result of the correct energy mix of RE, wind and solar, together with storage possibilities, such as underwater compressed air, ice storage, and also flywheel technology. On the supply side, pre-paid and/or smart meter will conduct to more awareness of the energy consumption of end-users, while the lowering of import duties on efficient electrical appliances will also be instrumental on an efficient and sustainable usage of energy at customers. Incorporated in this energy mix result, is also the fact that tariffs will be lowered.
The case of El Hierro

By examining one of the few cases where a programme has been carried out to study the objective of making the island of El Hierro (Spain) 100% RES reliant, valuable conclusions and observations can be made for the similar challenges in OCTs. El Hierro resembles the OCTs in many respects: its geographical characteristics, the environmental sensitivity, the rich potential for RES supply and the significant difference in the demand for energy between seasons (winter – summer).

The approach followed in the El Hierro study for achieving a 100% RES supply system is the coupling of wind farms with hydroelectric pump-storage power stations. This approach was the most cost-efficient compared to other RES and storage combinations investigated. However, the costs for achieving 70% and 100% RES penetration were high, as more than 20 and 95 million Euros respectively (in 2003 prices) would be required - as shown on the graph below. Of course, the evolution of wind technology in the last 10 years since the results of this study would decrease the total cost at least by half, but the exponential character in the cost trend regarding the maximisation of the RES penetration still remains.

A further important conclusion is that the Pumped Hydro Storage option has significant cost economies and, in combination with its management attractiveness, it becomes the first choice for a 100% RES system approach. There is a constraint in the availability of water that needs to be elevated to a certain height to increase water storage capacity and reduce the investment needed for wind power. Other storage options, however, such as batteries or hydrogen storage, for achieving 100% RES penetration, would incur even higher costs, making overall storage costs even more costly.

For an RES penetration between 50-70%, the RES and storage investment costs needed evolve more linearly, making it potentially viable for such targets to be achieved in the OCTs as well. In contrast, to have a RES penetration of 70-100%, the costs, especially the RES investment, increases uneconomically. Lastly, a 100% RES Demand Coverage on the OCTs would result in an additional cost due to depreciation of conventional technologies that currently meet energy demand. This is something not reflected in the graph below, but is a significant factor which also has to be considered.
9.4 Noteworthy RE applications and EE measures

*Smart metering:*

A noteworthy project in Greenland is the one implemented by the Nukissiorfiit public utility company involving large-scale remote meter-reading. The project involved replacing all electricity, water and heating meters run by the public utility company at the national level (a total of ~43,000 units) with new meters that were automatic and incorporated a remote reading function. The meters were installed in 70 isolated grids of electricity distribution, as well as in water consumption and some heat consumption meters. It was the first time such a system was introduced at a national level anywhere in the world. The process was completed in 2012 and it is expected to lead to significant energy savings as well as better service, and greater awareness of energy use. In Aruba, the issue with Smart Meters, is the data collection communication frequency, and therefore GE together with Elmar will soon be testing out communication at 4.2 MHz.

*Hydro technologies in island operation:*

The use of the large-scale and small-scale hydroelectric power plants have been successfully in operation in Greenland and French Polynesia for a number of years and could potentially be replicated to other OCTs, as long as the hydro power resource is suitable.

The installed capacity of hydropower in French Polynesia is 47 MW and provides about 30% of the Tahiti island power.

The overall installed capacity of hydropower in Greenland has gradually increased since 1992, and currently provides 70% of the island’s power. Apart from two towns which have interconnected grids, all 55 villages/settlements and 15 towns work on an “island operation”, hence relying on local generation and supply and local back-up.

*Hybrid wind-diesel power generation:*

A hybrid wind-diesel power generating plant that has been successfully in operation in the Falklands since 2007 is a scheme that could be replicated in other OCTs, as long as the wind resources are suitable. The system originally included a 1MW stand-alone wind farm at Sand Bay, in conjunction with diesel generators supplying the remaining power, and then it was expanded to double the capacity of the wind farm to 2MW. All system components are controlled from a central operating unit in the Stanley operating plant. The project was financed by the UK Government and is Government owned. The Government owned utility company Power & Electrical is responsible for its operation and maintenance. The wind farm is estimated to provide 33% annual contribution to electricity generation. Careful sitting of the wind farm has resulted in acceptance and no complaints from the local population.
Energy-efficiency funding programme:

The support programme ‘Actions Maîtrise de la Demande en Electricité’ (Management Actions for Electricity demand) is operating in Saint Pierre et Miquelon. 2,045,400€ have been allocated to this project, co-funded by EDF (50%) and by the Territorial Collectivity (50%). The project’s objective is raising awareness of the population in regard to energy efficiency issues and energy saving. The project foresees support for 4 activities during the period 2013-2016:

- Old oil boiler replacements with new generation energy-efficient boilers (low-temperature or condensing)
- Housing insulation (for main residences) in order to achieve energy-efficiency values
- Purchase of low-energy light bulbs
- Awareness raising towards using economic multi-socket adaptors

Prepaid meters:

In Mayotte, the prepaid electricity meter “Ankiba” allows customers to manage their electricity consumption, optimize the utilization of power according to their own budget, and make efforts to optimize their electricity consumption and keep it in line with their needs and financial resources. In Aruba this is done with “L&G” (Landys & Gyr) pre-paid meters.

SWAC technology adopted by a Large Public Building:

Plans to significantly reduce emissions at French Polynesia’s main hospital will move ahead following agreement of EUR 7.5m support from Europe’s long-term lending institution. Air conditioning costs at the Centre Hospitalier de Polynésie will be significantly reduced using a sea water air conditioning system funded by the European Investment Bank.

This project will significantly reduce overall operational costs at the Centre Hospitalier de Polynésie by cutting energy costs in half and further demonstrates the European Investment Bank’s engagement to support environmental projects in the Pacific.

Construction of the Sea Water Air-Conditioning cooling system is expected to save 13GWh of electricity use each year representing a EUR 3.7m or 50% reduction in the hospital’s energy costs. The European Investment Bank’s long-term (15 year) loan will allow the project to demonstrate an alternative method of air cooling. An estimated 40% of electricity is used in French Polynesia for traditional air conditioning units. The new system being installed on the coast next to the Centre Hospitalier de Polynésie uses sea water at a depth of 900m, where water temperatures are between 5 and 8 degrees, to provide cold air for the main hospital and adjacent buildings.

The project will be jointly financed by the European Investment Bank, the French Development Agency (AFD), the French Environment and Energy Management Agency (ADEME) and the Government of French Polynesia. This is the first project in the Pacific supported jointly by the European Investment Bank and the French Development Agency under the Mutual Reliance Initiative, intended to facilitate joint lending operations.
The European Investment Bank is currently looking at providing long-term financing for similar environmental projects in the Pacific. Over the last ten years the EIB has provided more than EUR 100 million to support development and economic activity in 15 Pacific island states and four overseas territories. EIB engagement in the Pacific focuses on the specific needs and investment priorities of the region. The EIB Pacific office was established in Sydney in 2007 to improve contact with local authorities and encourage greater cooperation with local business partners.

In Aruba, ice storage technology will soon be tested at the large hotels, and if the results become satisfactory, there will be no room any longer for SWAC technology.

**Wind Turbine Technology adapted to tropical environment:**

The European Investment Bank (EIB) is providing EUR 4.3 million (650 million Vatu) to support the construction of a 2.75MW wind farm on the island of Efate, Vanuatu. The wind farm is being built by Unelco Vanuatu Ltd, part of GDF-Suez Group. The finance contract was signed in Port Vila on Tuesday by representatives of the European Investment Bank and the President of Unelco.

The project is the first wind farm to be implemented in Vanuatu and it is hoped that this will form a reference project for other Pacific islands.

The wind farm comprises 10 identical new 55-metres high wind turbines designed to be winched to the ground when required for maintenance or to avoid wind damage in the event of a tropical cyclone. It marks an important first-step in diversifying sources of electricity supply and reducing dependence on expensive fossil-fuel imports. It will reinforce UNELCO’s strategy to develop renewable energy production based on wind turbines, bio-fuel and solar energy.

The project forms part of European Union and EIB policy to encourage renewable energy objectives and address the impacts of climate change resulting from fossil fuel use. In Vanuatu, 5 other EU-funded projects using bio-fuel and wind energy are already being implemented in Port Orly, Malekula, Ambae, Futuna and Sola.

Particular attention has been taken to ensure no environmentally protected zones or areas of cultural significance are affected by the project, and to minimize any risk of bird strikes by the wind turbines. The wind farm will also provide local employment and help to improve the environmental image of the country.

This project is one of a number of initiatives financed by the EIB in the South Pacific region currently being approved during a regional tour by Bank representatives.

### 9.5 Energy efficiency and demand side management

Not all OCTs have launched a voluntary energy efficiency programme as a prerequisite to renewable energy development. Energy conservation and energy efficiency should be the first options to look at before, and in combination with, activities towards producing energy from
renewable energy sources. It is always said that in many cases, it is cheaper to invest in saving 1 kWh from the demand side than to invest in producing the same kWh from the supply side. Indeed, The OCTs are characterized by high energy dependency situations. In this context, energy efficiency should be a strong priority. Many studies have been commissioned regarding energy efficiency measures in the various OCTs, and their recommendations are clear, but not yet widely implemented in practice.

One of the major focuses of energy conservation analyses is the building sector. **Better insulation** and **improved building design** (passive solar design, natural ventilation, suitable orientation) to reduce air conditioning load and **replacement of old boilers** (currently undertaken as part of St Pierre & Miquelon 2013-2016 action plan) are typical options to reduce energy use in buildings. Increased energy efficiency in this segment requires the establishment of **energy codes and thermal regulation** for existing buildings and retrofit works. This has been implemented in Mayotte in 2009 through a decree imposing minimum energy performance for new buildings, but such regulation still needs to be adopted and implemented in most of the OCTs (Anguilla, TCI, New Caledonia, etc.). The **compulsory installation of solar water heaters** is a measure that is easy to implement and well adapted to most of the OCTs’ climates and it needs to be pursued and enforced. For instance, in Mayotte, the 2009 decree requires that 50% of hot water needs be covered by SWH. Such a measure is also envisioned in New Caledonia.

Regarding lighting loads, the **adoption of CFLs** is on its way but may need to be further promoted to achieve a wider deployment level. In Mayotte 320,000 low energy lamps were distributed. In St Helena, during the recent years the replacement of street lights with solar-powered lights has been undertaken together with providing efficiency lighting to all consumers.

**Energy audits** have been a valuable assessment step in several OCTs: in Mayotte energy audits were conducted in the industry facilities, audits of public buildings and social housing stock are planned in St Pierre & Miquelon and Montserrat.

In several OCTs, the **power generation and transmission sectors** have received attention in order to improve the efficiency of electricity production and reduce distribution losses. For instance, the public utility WEB Aruba is now renewing 50% of its installed capacity with high efficiency engines (43% efficiency), thereby pushing the overall energy efficiency of power generation from 28% to 35%. WEB Aruba initiated fuel efficiency projects at the water plant as well where efficient salt water reverse osmosis units have been introduced. In the Falkland Islands, recent actions included the improvement of the power factor of the generation equipment at one power station and further similar installations are planned. In St Helena the focus has been on upgrading the electricity distribution network cables and replacement of transformers. In the TCI, recommended actions in this field are to create rules and incentives to allow the power utilities to recover the capital investments they make to increase the efficiency of their own plants.

To promote and implement such actions, several OCTs have set up **dedicated agencies**, inspired by the ADEME model in France. These are Anguilla, Mayotte, French Polynesia, New Caledonia. **Awareness campaigns** and **specific trainings** for professionals were conducted by some of these agencies.
Instruments used or recommended to favour energy efficiency improvements include incentives through taxes and import duties for efficient products and disincentives for non-efficient ones. A prerequisite to applying these incentives is the implementation of standards and labelling as done in many European countries for many appliances. Examples of funding instruments in use are:

- The Falkland Islands Development Corporation (FIDC) which provides funding for the implementation of energy-efficiency in buildings;
- An AFD-EIB partnership that offer a credit line to enable the four New Caledonian banks to finance on better terms projects in the renewable energy and energy efficiency sectors.

Recent technical development in the field of smart meters now allows utilities to remotely monitor and manage specific loads under agreement with selected customers. These devices facilitate data collection for the utilities. In St Helena, the regularly review of the data collected through the National Environmental Data Management System (which was targeted for completion by March 2013), helps to set measureable targets for energy efficiency and monitor performance. In Greenland, targeting rational use of energy the Nukissiorfiit public utility company is involved in a large-scale remote meter-reading project, which involves replacing all electricity, water and heating meters (a total of ~43,000 units) with new meters that incorporate a remote reading function. The process was completed in 2012 and has the potential to lead to significant energy savings as well as greater people’s awareness of energy use.
10 REGIONAL INITIATIVES AND COOPERATION PROGRAMMES

The 2008 report lists a few regional programmes which were considered of interest for the OCTs even though OCTs were not necessarily eligible to participate. The programmes in which OCTs can participate or play an active role are listed in the recommendations section.

10.1 Programmes and projects already completed

Pacific Islands Energy Policy and Strategic Action Planning (PIEPSAP): This project was run by the Secretariat of the Pacific Geoscience Commission (SOPAC), with United Nations Development Programme (UNDP), Samoa Office as partners and Government of Denmark under European Union Energy Initiative and UNDP Thematic Trust Fund "Energy for Sustainable Development" as donors. It was implemented during the period 2004-2008 and aimed to help in the development of national energy policies, strategic action plans, and practical mechanisms to implement these in the 14 participating PICs. It has significantly contributed to the creation of knowledge concerning energy resources and the potential for developing these resources in the partner countries. However, it is difficult to determine whether its inputs for promoting energy efficiency, renewable energies and better energy sector management were critical or not.

Pacific Islands Renewable Energy Project (PIREP): The PIREP, funded by the GEF and UNDP, aimed to facilitate the promotion, within the Pacific Island Countries, of the widespread implementation and ultimately, the commercialisation of RE technologies through the establishment of a suitable enabling environment. The islands involved were: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu. The PIREP could produce a large range of good quality assessments and studies. It was completed in 2006 and was also a preparatory exercise to launch the full scale GEF UNDP project PIGGAREP.

RE Programme for 5 Pacific ACP Countries (REP 5): The 12.38 M€ project was financed under the 9th EDF. This multi-country initiative funded renewable energy and energy efficiency projects in five Pacific Island Countries: Palau, Marshall Islands, Nauru, and Niue. It was executed by the Pacific Islands Forum Secretariat and implemented by a Programme Management Unit (PMU) which continued to operate until end of 2009. REP 5 also assisted the countries to identify renewable energy and energy efficiency projects for funding under the 10th EDF.

Regional Energy Programme for Poverty Reduction (REP-PoR): A UNDP project for Asia and the Pacific implemented during the period 2002 – 2007 with the aim of contributing towards the achievement of the Millennium Development Goals targets through interventions in three thematic areas:

- improving access to energy services
- promoting efficient use of energy
- increasing access to financing for sustainable Energy
**TEP VERTES:** The TEP Vertes project was financed under the 9th EDF. The objective was to accelerate the implementation of renewable energy technologies so as to improve the living conditions of rural or isolated people in New Caledonia, French Polynesia and Wallis-Et-Futuna. This project was completed in 2011 with a regional conference, where the experiences gained were disseminated to the other islands of the Pacific.

Besides, the direct benefits for the beneficiaries customers with sustainable access to energy, less dependency on imported fuels, reduced cost of electricity, significant benefits were also reported on: increased capacity of people in project planning and project management, replication of similar projects in the islands with own resources of governments as planned in French Polynesia.

### 10.2 Programmes and projects still in execution

**Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP):** The PIGGAREP is funded by the GEF and co-financing partners. The UNDP Multi-country Office at Samoa is the Principal Project Representative while the Secretariat of the Pacific Regional Environment Programme (SPREP) is the Implementing Partner. The project commenced in July 2007 and involves eleven Pacific Island Countries among those having participated in PIREP, none being an OCT.

The PIGGAREP is about to complete its 6.5 years of implementation and has led in Secretariat’s effort to support the renewable energy developments of member countries. The successful implementation of the PIGGAREP is estimated to reduce CO2 emissions by at least 30% by 2015 as compared to that in the Business as Usual scenario.

**Island Nations 100% Renewable Energy, including transportation, by 2013:** Partners in this scheme for 100% renewable energy, including transportation, for Island Nations by 2013 include Governments of Fiji, Tonga and Tuvalu; the UN Systems include Small Island Developing States (SIDS); the major groups involved are Forum for Renewable Energy Islands (FREI), Folkcenter for Renewable Energy, ISEP - Institute for Strategic Energy Planning (Japan) Arrakis (Netherlands) and Climate Institute (USA); plus SOPAC - South Pacific Applied Geoscience Commission (Fiji). The objective of this project, which will run over ten years between 2003 and 2013, is to assist island states to meet 100% of their energy requirements from Renewable Energy Sources (RES) by helping them with the preparation & planning, organization and all the inputs (technical, financial & managerial) required for implementation of the 100% RES plan.

The specific target of the project was that 100% of all energy needs including transportation will be supplied by RES by April 2013. This target could not be reached although no detailed information is available on the level reached to-date. However, as an indicator, we can mention the situation of Tonga where there was in 2009 a new official target to reach 50% of electricity from renewable energy by 2012. Recent updates have been issued concerning this target and now, the Kingdom of Tonga Plans for 50% Renewable Energy by 2015.

**Regional Climate Change, Energy & Ecosystems Project (RCCEEP):** This UNDP’s Project focuses on enhancing equitable access to appropriate, reliable and affordable energy services to reduce human and income poverty in the Asia-Pacific. RCCEEP is implemented by UNDP APRC over the 2008-2012 period, with funding of USD 41.35m. The continuation of REP-
PoR through RCCEEP was decided based on the assessment that efforts by countries in the Asia-Pacific region to meet the Millennium Development Goals (MDGs) will be impaired unless adequate attention is paid to the crucial role that energy services play in the development process, particularly in improving the economic, environmental and social well-being of the poor. RCCEEP pursues interventions in three thematic areas:

- improving access to energy services for the poor and the unserved
- promoting efficient use of energy focusing on micro and small and medium size enterprises
- increasing access to financing for sustainable energy, including innovative mechanisms such as CDM

Five strategic services provided by RCCEEP are: policy advocacy, action research, knowledge products, knowledge management and capacity building.

**Renewable Energy and Energy Efficiency Project (REEEP):** This is a worldwide initiative which has managed to fund over 180 clean energy projects in 58 countries. Projects on the ground in developing countries and emerging economies form the heart of REEEP’s efforts to accelerate the market. The activities are developed through a REEEP's global network of Regional Secretariats which are in direct relations with the ground. These offices are hosted by highly respected organisations who share a strong belief in clean energy development. Their functions include:

- ensuring that the Partnership understands and meets the needs on the ground in their area
- assisting applicants during REEEP project funding rounds, and in later stages, helping to evaluate shortlisted project proposals
- keeping tuned into national and regional clean energy initiatives, and building strong working links with local offices of NGOs and other like-minded organisations
- supporting REEEP Partners in their respective regions in gaining political leverage and building business acumen

Of particular interest for the OCTs are the REEEP South East Asia and Pacific Regional Secretariat which is hosted by the Australian Clean Energy Council and the REEEP Regional Secretariat for Latin America and the Caribbean which is hosted and operated by the Department of Sustainable Development (DSD) of the Organization of American States (OAS) in Washington DC.

REEEP is funded by donors from various regions. Current donors are Australian Clean Energy Council (CEC), the Climate and Development Knowledge Network (CDKN), the Governments of Austria, Germany, Norway, Switzerland, United Kingdom and the OPEC Fund for International Development (OFID). The REEEP funding approach is to seek viable business models and other clean energy solutions that are ripe for scaling up, and to develop and support sector-specific interventions to push clean energy solutions up the growth curve. REEEP’s 10th Project Cycle is scheduled for early 2014, OCTs should register with REEEP to receive call notifications as they will include specific guidelines on eligible proposals.

**The Caribbean Renewable Energy Development Programme (CREDP):** This project aims to remove barriers to renewable energy use in the Caribbean. Through specific actions to overcome policy, finance, capacity, and awareness barriers, it is estimated that the contribution of renewable energy sources to the region’s energy balance will be significantly increased. Renewable energy technologies (RET’s) considered in CREDP include grid-
connected renewable power (e.g. wind farm, biomass cogeneration, geothermal, and small hydro), renewable rural electrification (e.g. PV), and solar water heating.

The project is funded by UNDP/GEF, the German Government through GIZ and Austria through the Austrian Development Agency and in kind contributions from regional governments and institutions. The overall goal of the CREDP is the Reduction of the Caribbean Region’s Dependence on Fossil Fuels and Contributing to Reducing GHG-Emissions. The members of CARICOM are taking part in the CREDP. Most of Caribbean OCTs are involved as Associate Members: Anguilla, British Virgin Islands, Cayman Islands and Turks and Caicos Islands. The project activities concentrated on:

- strengthening of regional energy sector institutions
- government advisory with regards to Renewable Energy (RE) and Energy Efficiency (EE) policies
- preparation of RE and EE projects for investment decisions
- capacity building activities and public awareness campaigns

The CREDP is still running with capacity building, communication campaign and advisory services to governments in their programmes and projects execution.

The Caribbean Renewable Energy Forum (CREF) is a conference designed to drive forward renewable energy implementation across the region. It is an annual event, co-sponsored by the Inter-American Development Bank, the Caribbean Community, and the Organization of American States. CREF/Green Aruba participants include regional governments, utilities, the Caribbean private sector, as well as regional and international investors, technology providers, and other key stakeholders in this emerging sector. CREF 2013 has taken place in Aruba, as well as the Green Aruba Conference, which since 2010, shares the same goals as CREF. The CREF 2014 will be held in Miami in October 2014.

CREF/Green Aruba objectives are wide-ranging and ambitious. They include the following:
- Understand what the rising price of oil, and the plummeting price of natural gas, means for the future of regional energy generation – and for renewables.
- Introduce the best in regional and international developers and technologies to Caribbean energy decision-makers; introduce public and private sources of capital to high quality projects
- Explore interconnection at a regional and sub-regional level; assess upsides and down, explore costs and financing options, get to grips with long-term implications in terms of energy and economic security
- Pinpoint the bottlenecks in legislation, tariffs, technology, political will and finance; work towards real world solutions
- Define a model of a successful, profitable Caribbean utility for the 21st century; get to grips with renewables in the context of a long-term profitable utility business model
- Assess existing and ongoing renewables projects in the region (e.g. wind, Jamaica; geothermal, Dominica, Nevis); what are the lessons learned and how to apply these moving forward?
- Provide international developers and investors with the knowledge, tools, and introductions they need to deploy decisions and capital in the region
- Explore and encourage best practice energy conservation strategies across the region
- Benchmark Caribbean regulatory regimes against global best practice
Highlight innovative projects world-wide and analyze their success criteria
Explore the environmental impact of offshore and onshore renewables

**Caribbean Wind Energy Initiative – CAWEI:** The CREDP together with CARILEC started CAWEI in 2006. The main activities of CAWEI includes:

- Providing a forum/platform for wind power developers to exchange experience, knowledge.
- Providing an entry point to the region for potential wind power investors, manufacturers, banks etc.
- Pooling and sharing resources: infrastructure like cranes, transport facilities for land- and sea transport
- Lobbying for wind power development politically in order to improve the framework conditions for wind power development in the region.
- Attracting financing from bi- and multi-lateral donors
- Educating financing institutions on risks and options of wind energy
- Raising public awareness and acceptance for wind power development in the region.

**Pacific Appliance Labelling and Standards (PALS) Program:** This programme is aimed at reviewing the situation with respect to domestic appliances, the labelling programme and energy efficiency initiatives in Pacific Island States. The study for SPC, which was supported by the Australian Department of Climate Change and Energy Efficiency and the Australian Agency for International Development, on the costs and benefits of introducing standards and labels for electrical appliances in the Pacific region, highlighted the significant economic and energy security benefits for territories. The study concluded that it is more cost-effective for the Pacific region to import refrigerators, air-conditioners and lighting that are more energy-efficient than it is to import diesel fuel.

**CPRM:** The Conference of Peripheral Maritime Regions has clearly a component addressing energy and climate change issues. It has been actively supporting the implementation of the EU “Energy and Climate Change” package, advocating a full involvement of maritime Regions in this process. The CPMR has been campaigning for the development of the renewable energy potential in Europe’s maritime peripheries, with special emphasis on maritime energy. The only OCT which is today part of CPRM is Mayotte. There should be a channel of communication between CPRM and OCTA as all OCTs have a lot of connections with the sea and all aspects regarding energy from the sea. May be this channel could be through ISLENET.

**ISLENET:** A network of European Island Authorities which promotes sustainable and efficient energy and environmental management. It actively promotes the adoption of local energy saving strategies and renewable energy projects. These have an important effect on local economic development and involve a well-balanced approach to environmental management. If for many practical reasons, it is unlikely to see the participation of OCTs in this network, at least OCTA should join as does DAFNE for example which is the Aegean Islands Network. ISLENET could also be a channel for OCTs that have new project ideas which could be organized by the network for future calls on EU funding.
10.3 Other international initiatives, partners and instruments

**International Renewable Energy Agency (IRENA):** When the 2008 study was prepared, the International Renewable Energy Agency was being created. IRENA was officially founded in Bonn on 26 January 2009. The founding of IRENA was a significant milestone for world renewable energy deployment and a clear sign that the global energy paradigm was changing as a result of the growing commitments from governments. IRENA seeks to make an impact in the world of renewable energy by maintaining a clear and independent position, providing a range of reliable and well-understood services that complement those already offered by the renewable energy community and gather existing, but scattered, activities around a central hub.

The international renewable energy community is large, resourceful, and rapidly evolving. IRENA does not duplicate what others are doing, but seeks out, establishes and develops new synergies, facilitates dialogue, and information and best practice sharing. Cooperation at the global, regional and national levels, knowledge sharing, enabling policies and enhanced capacity, as well as the encouragement of investment flows and strengthened technology and innovation, are essential elements in the Agency’s efforts. IRENA is positioning itself as a platform for all-inclusive cooperation where stakeholders can make a positive contribution to the common goals. This cooperation and partnerships are essential underpinnings of IRENA’s work.

On the sidelines of the Pacific Energy Summit in New Zealand, IRENA launched global interest clusters on renewable energy technology roadmaps for islands and renewable energy for power grids on islands. GREIN is envisioned as a platform for pooling knowledge, sharing best practices, and seeking innovative solutions to accelerate the uptake of clean and cost-effective renewable energy technologies on islands. The network will be of value to islands in the Pacific, the Caribbean and Indian Ocean, as well as to virtual islands across the world. These islands all face energy security pay the price of being heavily reliant on imports of high cost fossil fuels, many of which renewable energy can replace. Islands typically rely on expensive diesel for electricity – often at a cost of 40 cents or more per kWh, i.e. two to five times the typical cost paid by large scale mainland power grids. GREIN has just started two clusters of interest for the Islands:

**a. Road Maps Interest Cluster:**

The Interest Cluster on Renewable Energy Technology Roadmaps for Islands will be hosted by the Secretariat of the Pacific Community. It focuses on the mix of renewable technologies that might be developed on islands in a cost-effective fashion over time. For island power grids, this might include wind, solar, marine, hydro, geothermal, and biomass. For island transport, this might include elements of biofuels or electric vehicles fuelled by renewable power. For buildings on islands, solar hot water heating, absorption heat pumps for air conditioning, photovoltaic panels, and improvements in energy efficiency could all play a useful role in reducing net energy consumption.

The interest cluster provides a platform for islands with similar renewable resource options, energy end use requirements and electricity and transport needs, to share their knowledge and experience on the benefits and challenges associated with different technology choices and deployment strategies. IRENA has developed a methodology to help islands analyse their
energy options and find a mix of technologies and partners that will meet their needs, while also being practical and affordable to implement within the desired timeframe.

**b. Power Grids Interest Cluster:**

The Interest Cluster on Power Grid Integration on Islands will be hosted by the Pacific Power Association. Its focus is the share of renewable power that can be integrated into grids while maintained grid stability and service reliability. This share is a function of the types of renewable resources available and the status of grid development. Grid stability is critical as higher shares of variable renewable energy sources are integrated into island grid systems. The interest cluster provides a platform for islands facing similar challenges of grid stability to share their experiences and knowledge on possible technology options and capacity building measures to overcome these challenges. IRENA has developed a methodology to help islands assess their grid stability, which will enable islands to plan for the integration of high shares of renewables into their grids.

**The Caribbean Energy Information System (CEIS),** with headquarters at the Scientific Research Council in Kingston Jamaica, is the energy information arm of the Caribbean, set up to provide a regional energy information service through a network of Caribbean countries in support of planning and decision making. The network includes eighteen Caribbean Countries including three OCTs: e British Virgin Islands, Montserrat and Tobago and Turks and Caicos.

**Global Islands Network:** The Network represents a hub that connects and coordinates efforts to help ensure a healthy and productive future for islanders. It is a non-profit organisation, established in June 2002, to conduct and promote “culturally appropriate, ecologically sound, economically sustainable and socially equitable development on islands worldwide. Among the objectives, one can highlight capacity building of islanders, provision of technical assistance and supporting initiatives which further integrate the development on small islands, and fostering cooperation by sharing good practices and offering a forum for discussion. The first best practices that are promoted by GIN are:

- Improve production of renewable energy
- Minimise waste through recycling schemes
- Introduce efficient public transport
- Provide affordable eco-housing

**Energy Development in Island Nations (EDIN):** As an international partnership, EDIN aims to advance the deployment of renewable energy and energy efficiency technologies in islands across the globe. By bringing together policy advisors, technical experts, and financial leaders, EDIN works to guide clean energy development and deployment in specific regions and islands. EDIN strives:

- To establish governmental policy that encourages energy efficiency measures and renewable energy development
- To develop financing and other resources for renewable energy and energy efficiency projects
To understand, integrate, and plan for energy efficiency and renewable energy technology options through direct technical assistance and information provided at island clean energy workshops.

Partners include Iceland, New Zealand, the United States and others to be determined on a case-by-case basis.

10.4 Financial partners and instruments

The main partners and instruments which might be available for the OCTs are the following:

**Global Climate Change FL financed by the EIB:** The instrument was approved in November 2012. This operation will support projects that mitigate climate change in eligible partner countries, including ACP States: development of renewable energy, improve energy efficiency and reduce emissions of airborne pollutants and GHGs from conventional energy production. By promoting sustainable and secure energy supplies necessary for economic growth and development, the project will contribute to the objectives of the Bank’s operations outside of the EU (economic development and climate change) and will meet the Bank’s priority objectives for energy sector lending (renewable energy/energy efficiency).

The Financial Intermediary for this operation is a bank domiciled in the EU and the proposed EIB finance (Approximate amount) is EUR 142 million and the total estimated amount is EUR 350 million.

In term of environmental aspects, the operation will support projects that contribute to the reduction of greenhouse gases emissions and other airborne pollutants. The sub-schemes are expected to have limited environmental and social impacts. None of the sub-schemes submitted for part-financing by the Bank will have a significant negative impact on sites of nature conservation. Standard safeguards and monitoring procedures will ensure that project implementation is satisfactory and complies in particular with the environmental and social requirements of the Bank.

**Sustainable energy for All:** The "Sustainable Energy for All" (SE4ALL) initiative was launched in September 2011, in recognition of the importance of access to sustainable energy for economic development and for achieving the Millennium Development Goals. It attracts global attention to the importance of energy for development and poverty alleviation and calls for private sector as well as national commitments. The goal is to meet three objectives by 2030:

- Ensuring universal access to modern energy services.
- Doubling the share of renewable energy in the global energy mix.
- Doubling the rate of improvement in energy efficiency.

Under the Sustainable Energy for All initiative, Small Island Developing States Commit to Sustainable Energy for All. As the global climate becomes warmer and resource scarcity rises, small island nations across the world face numerous economic and environmental threats. With limited domestic resources, growing populations, geographic isolation, the potential for sea-level rise, these countries, which are also prone to natural disasters, experience unique and complex challenges.
The distinctive energy and environmental challenges facing Small Island Developing States (SIDS) have garnered increasing attention on the world stage. Small island nations have developed a framework to manage the destructive effects of climate change, protect coastal and marine ecosystems, implement sustainable fishing practices, and develop domestic renewable energy supply to decrease dependence on foreign fossil fuels.

**Working Towards a Clean Energy Future:** During the preparation of the Rio+20 Conference, various Governments, the UNDP and the Organization of American States hosted a meeting focusing on "Achieving Sustainable Energy for All in Small Island Developing States". Discussions took place around policy strategies for increasing energy access, renewable energy production and energy efficiency among small island states. The Conference concluded with adoption of the "Barbados Declaration," which calls for universal access to modern and affordable renewable energy services, while protecting environment, ending poverty, and creating new opportunities for economic growth.

Commitments to Sustainable Energy for All: The Declaration also included first voluntary commitments of 20 Small Island Developing States to take actions toward providing universal access to energy, switching to renewable energy, and reducing dependence on fossil fuels. OCTs were not involved in this at the start but the engagement of OCTs should be a positive signal in the future.

**Global Sustainable Energy Islands Initiative (GSEII)** launched in November 2000 by a consortium of international organizations. This partnership assists small island nations in transforming their energy systems from fossil fuel-based infrastructure to energy efficient technologies and domestic renewable energy.

Operating in about 10 islands at the moment – including Antigua & Barbuda, the Bahamas, Dominica, Grenada, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, Fiji, and the Marshall Islands and Antigua – GSEII provides technical assistance in developing clean energy, building capacity, and raising international awareness about the energy and environmental issues facing island nations.

With GSEII's strategic guidance, island nations across the world have taken giant steps towards enhancing energy efficiency and creating sources of sustainable energy. In Grenada, GSEII established the Earth Home Project, which builds model sustainable homes and trains local builders in sustainable construction techniques. In St. Lucia, GSEII created the Solar Hot Water Heating Financing Program to make cost-saving solar water heaters available to low and middle-income families. In Dominica, GSEII organized the Energy Efficient Lighting Project to raise awareness of effective energy efficiency practices and to distribute free compact fluorescent light bulbs. GSEII has also worked with a few islands to develop national energy policies and sustainable energy plans. As resources and capacity allow, GSEII intends to expand its efforts to up to 20 small island developing states.

Any island can join the initiative and in its second decade, the programme Vision 20/30, launched last year, intends to push the idea of total transformation by 2020 by some islands. The building of a coalition and identification of islands ready to join the action are in progress.

**The European Development Fund (EDF):** The EDF is the main instrument for providing Community development aid in the African, Caribbean and Pacific (ACP) countries and the
overseas countries and territories (OCTs). It supports actions in the ACP countries and the OCTs in the following key areas for cooperation:

- economic development,
- social and human development,
- regional cooperation and integration.

The EDF consists of several instruments: grants managed by the Commission, risk capital and loans to the private sector, managed by the European Investment Bank under the Investment Facility and the FLEX mechanism, aiming at remedying the adverse effects of instability of export earnings.

The 10th EDF has a budget of €22,682 million, of which only 286 M€ (1% of the total) is for the OCTs. It is a significant increase compared to the 175 M€ allocated to OCTs in the 9th EDF.

Out of the 286 M€, 30 M€ are for financing the Investment Facility managed by the EIB to promote commercially viable businesses primarily in the private sector or those in the public sector that support development in the private sector.

The EDF is the main instrument for cooperation in financing the development of the OCTs and for regional cooperation involving them. A development and cooperation strategy is adopted by each OCT which is then responsible for determining and implementing the action plan after joint approval by the authorities of the OCTs and the EC.

**Intelligent Energy Europe programme (IEE):** offers a helping hand to organizations willing to improve energy sustainability. Launched in 2003 by the European Commission, the programme is part of a broad push to create an energy-intelligent future for us all. It supports EU energy efficiency and renewable energy policies, with a view to reaching the EU 2020 targets (20% cut in greenhouse gas emissions, 20% improvement in energy efficiency and 20% of renewables in EU energy consumption).

Intelligent Energy – Europe creates better conditions for a more sustainable energy future in areas as varied as renewable energy, energy-efficient buildings, industry, consumer products and transport. The expectation is that by doing this, Europe will also boost its competitiveness, security of energy supply, and innovation standing for the years to come.

Running until 2013, the programme is open to all EU Member States, plus Norway, Iceland, Liechtenstein, Croatia and the Former Yugoslav Republic of Macedonia. A budget of € 730 million is available to fund projects and put into place a range of European portals, facilities and initiatives.

A large part of the programme budget is made available through annual calls for proposals to support projects putting the concept of ‘intelligent energy’ in practice. Carried out by public, private or non-governmental European organizations, they support three main objectives - more energy efficiency, more renewables, and better transport and mobility. This covers for instance new training schemes, promotion campaigns, or the transfer of good practices between EU countries.
In addition to funding projects which are selected through calls for proposals, the IEE programme includes a wide range of additional mechanisms to convert EU policy objectives into action and trigger tangible results on the ground. These can be grouped into IEE services, the ELENA financing facilities and special initiatives.

Most parts of the IEE programme are run by the Executive Agency for Competitiveness and Innovation (EACI) on behalf of the European Commission. The ELENA financing facilities are run by the European Investment Bank (EIB) and the KfW Group. The programme is a pillar of the EU’s Competitiveness and Innovation Framework Programme (CIP).

The calls for applications are now closed but it is likely that new calls will be opened in the future.

Under the of the EU, energy research is strongly supported by the EU and more specifically in those territories where energy issues are very much related with economic development and where there are many areas of progress with participation of international and local actors.

The Horizon 2020 programme from the EU replaces the 7th Framework Programme which has been running till 2013. Horizon 2020 is the financial instrument implementing the “Innovation Union”, a Europe 2020’ flagship initiative aimed at securing Europe's global competitiveness. Running from 2014 to 2020 with a budget of just over €70 billion, the EU’s new programme for research and innovation is part of the drive to create new growth and jobs in Europe.

The Horizon 2020 programme provides major simplification through a single set of rules. It will combine all research and innovation funding currently provided through the Framework Programmes for Research and Technical Development, the innovation related activities of the Competitiveness and Innovation Framework Programme (CIP4) and the European Institute of Innovation and Technology (EIT5).

The proposed support for research and innovation under Horizon 2020 will:

- Strengthen the EU’s position in science with a dedicated budget of €24,341 million. This will provide a boost to top-level research in Europe, including the very successful European Research Council (ERC6).
- Strengthen industrial leadership in innovation €17,015 million. This includes major investment in key technologies, greater access to capital and support for SMEs.
- Provide €30,956 million to help address major concerns shared by all Europeans such as climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population.

Horizon 2020 will tackle societal challenges by helping to bridge the gap between research and the market by, for example, helping innovative enterprise to develop their technological breakthroughs into viable products with real commercial potential. This market-driven approach will include creating partnerships with the private sector and Member States to bring together the resources needed.
The time line for Horizon 2020 indicates that national launch events are organized during the last quarter of 2013 and that Mid-December 2013, the work programme should be adopted and the first calls for proposal be published.

The OCTA and the relevant administration in OCTs, and where available the European Affairs Office like in French Polynesia, have a key role to play in helping build the consortium or grouping to submit proposals to the EU.

OCTs can also contact existing programmes under execution and which have already develop activities in the renewable energy field such as Eucarinet or the WINDS-Caribe project.

**Eucarinet:** The Eucarinet project is a four-year INCONET Coordination Action whose main goal is to strengthen bi-regional sustainable policy dialogue on Science and Technology (including in the ICT field) between EU Members and Associated States and the Caribbean Region, the Caribbean ACP countries, the overseas departments, and the OCTs. The consortium will run under the coordination of APRE (Italian Agency for the promotion of European Research) and will cover the whole Caribbean, with partners in Italy, Belgium, France, Netherlands, Spain, Guyana, Jamaica, Guadeloupe, Dominican Republic, Cuba, and the five islands of the former Netherlands Antilles.

The main goal of the project is to establish a long lasting sustainable bi-regional multi-stakeholders policy dialogue on S&T at policy, programme and institutional (research entities) level, thus contributing to a threefold objective:

- Create the conditions of the sustainable multi-stakeholders policy dialogue on S&T between the European Union, its member states, its associated states and the Caribbean Region, leading to a joint definition of S&T co-operation policies;
- Foster interregional (UE-Caribbean) and intraregional cooperation in leading to the identification and prioritization of common research areas of mutual interest and benefit;
- Stimulate and support the participation of the Caribbean research stakeholders in FP7, with a first emphasis on the “People Programme”.

In 2011, a Priorities Dialogue Workshop: “Renewable Energy Priority Setting for EU & Caribbean in Research and Innovation” took place in Pointe à Pitre, Guadeloupe. The conference, organized in collaboration with the European Commission DG Research - Directorate of “International cooperation”, summoned a group of stakeholders including high level researchers, policy makers and scientific experts to identify common research lines in renewable energy of mutual benefit for the Caribbean and European Countries.

In 2012, Caribbean Power Summits took place in Jamaica. These conferences were about utilizing local renewable resources, effectively managing oil use, and implementing clean energy practices. Industry professionals discussed about energy development issues related to policy and regulation, financing and legal topics, and technology implementation related to low-cost reliability.

The energy area was considered in a broad and inclusive way, covering major sub-themes and fields. The goal was to Identify and define bottom-up research lines and scientific priorities that could be the basis for fostering new cooperation opportunities between the EU and Caribbean research actors in FP7 and beyond. These research lines were discussed as main research priorities during the expert's presentations. As a result, these research priorities will
be transferred to the EC as possible future opportunities for International Cooperation under the concerned thematic areas.

For reaching this purpose, EUCARINET will take advantage, among others, of the services and the experience made in WINDS-Caribe.

The WINDS-Caribe project: It aimed at deepening strategic R&D cooperation between Europe and the Caribbean by building a multinational and multi-stakeholder community involving relevant R&D European and Caribbean actors (researchers, policy makers, users) and by identifying common needs, research issues and opportunities for cooperative R&D between the two regions, setting the basis for the formulation of a common strategy for future research.

Multilateral and bilateral support:

OCTs can have access to specific programmes, loans and technical support provided by the multilateral, regional and bilateral agencies and banks. Depending on the kind of programmes/projects, specific support can be adapted to the beneficiary countries. These institutions are usually able to provide assistance as follows:

Table 12: Typical support provided by international agencies

<table>
<thead>
<tr>
<th>Institutions</th>
<th>Market based loans</th>
<th>Soft loans</th>
<th>Grants</th>
<th>Equity</th>
<th>Guarantees</th>
<th>TA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multilateral Development Banks</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bilateral Aid</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Multilateral Aid</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

European Investment Bank: Resources managed by the EIB in the ACP countries and the OCTs

As its main mandates:

<table>
<thead>
<tr>
<th>Instruments</th>
<th>ACP</th>
<th>OCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Facility revolving Fund</td>
<td>3,137</td>
<td>48.5</td>
</tr>
<tr>
<td>Investment Facility grants</td>
<td>400</td>
<td>1.5</td>
</tr>
<tr>
<td>Own resource lending</td>
<td>Up to 2,000</td>
<td>Up to 30</td>
</tr>
</tbody>
</table>

Under other initiatives:

- Green Energy Efficiency and Renewable Energy Facility (GEEREF) : 108 M€
- Under the OCTs ‘Association Decision, IEB administered funds for the OCTs for the period Nov 2001 – Dec 2013.

The 20 OCTs are eligible to these funds which are made available through different schemes as presented in the following table:
### Sources of funding

<table>
<thead>
<tr>
<th>Sources of funding</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDF</td>
<td>Revolving funds, loans, guarantees, etc.</td>
</tr>
<tr>
<td></td>
<td>Loan at preferred rates, technical assistance</td>
</tr>
<tr>
<td>Own IEB resources</td>
<td>Senior Loan</td>
</tr>
</tbody>
</table>

(*): Allocation under the 11th EDF
(**) under the 11th ESF (special funds)

EIB supports the financial sector (56% of its engagement) and infrastructure (44%).

Of particular interest for the developers in the OCTs is the environmental credit line proposed in the OCTs which is funded by IEB but forwarded to the developers through local commercial banks. In the Pacific, the partners of the programme are Banque de Polynésie, Socredo; Banque Calédonienne d’Investissement, Société Générale Calédonienne de Banque, BNP Nouvelle Calédonie, Banque de Nouvelle Calédonie. In total an amount of 35 ML€ is available.

The scheme is a financing at preferred rate dedicated to investments in energy efficiency and renewable energy. The objective of the scheme is to assist the SMEs for the development of sustainable environmental projects. The applicants may be private and public entrepreneurs, SMEs, MFIs, Financial operators.
Examples of EU Member State funding schemes:

The French « Fonds Chaleur Renouvelable » (Renewable Heat Fund):

This is one of the key measures which emerged from the national consultation known as the Grenelle de l’Environnement » in the field of renewable energy. This programme aims at disseminating solutions to produce heat from mature renewable energy technologies, providing the developers financial support to reach the economic competitiveness compared to systems based on traditional energy sources.

Ademe is in charge of executing the programme and regularly published calls for proposals on various topics, some of them are specifically dealing with areas of interest for the OCTs. Only French OCTs can apply. Example of a call for proposals currently opened is the following:

Objective: to support innovation, critical and technological demonstrators bricks to build the sea renewable energy sector.

The scope covers the technological building blocks dedicated to the following four sectors producing electricity injected on continental and island grids:

- marine tidal
- wave power
- floating wind power
- Thermal energy from the sea

The content of the expected projects should be more specifically:

For technological bricks:
The technological building blocks are essential to the widespread deployment of sea RE sector and may be common to several sectors. Examples include new installation methods, devices to facilitate the connection or injection on electrical networks. For ocean thermal energy, the projects are only demonstrating heat exchangers or deep water pipes. For floating wind system, technological bricks will only floating systems, anchors and innovative dynamic cables.

For research demonstrators:
The technology is the energy from the waves. Demonstrator projects consist of wave energy research in off shore conditions closed to what could be found in normal operating conditions.

Call for proposals can also be issued in partnership with private company and address other sectors. In the following example the call (the 8\textsuperscript{th} of its kind) is launched with the involvement of TOTAL as funding partner.

ADEME and TOTAL recognize that the energy future and economic development go through technological progress in all areas of the energy consumption. They noted in particular that the energy consumption by the utilities and the horizontal processes in all industrial sectors is a significant fraction of that consumption and that technological improvements in these technologies are likely to contribute to improve efficiency energy in France and around the world. As an illustration, it is estimated that these utilities and horizontal processes consume around 26 Mtoe/year in all industrial sectors. ADEME and TOTAL estimate that a reduction of 20\% of this consumption is achievable by 2020.
Given this situation, ADEME and TOTAL have decided to engage in the management and funding of a programme to support the development of utilities and horizontal processes with reduced energy consumption and help research teams and SMEs, strengthening investment in R & D in this sector currently little supported. This should allow provision to the French industry of a range of advanced technologies and foster the emergence of technology in SMEs. Projects involving large companies are also eligible.

The programme includes support to demonstration of new technologies so that to improve the energy efficiency of transversal technologies.

This call for expressions of interest for industrial utilities and industrial processes is expected to cover the following application areas:

- recovery and exploitation of waste heat,
- energy storage,
- efficient heat exchangers,
- optimizing furnace,
- separation and drying,
- electrical and thermal equipment industry,
- energy integration.

One of the main difficulties for the French OCTs to participate in this programme is the fact that potential applicants in the OCTs do not have always the resources to submit good quality proposal and in the case they would like to partner with institutions in France, the link is not always easy to establish. Similarly for the potential applicants in France, the link with a potential local partner is also not easy to build.

**FIDEME (Fond d'Investissements de l'Environnement et de la Maîtrise de l'Energie)** is an example in France of a scheme to finance energy efficiency measures and energy renewable operations. This is a 45 M€ investment fund made of Ademe contribution (15 M€) and qualified investors (30 M€). In that sense, this an example of a combined public-private funding of projects with a participation up to 25% of capital investment.

Other examples include soft loans for SME (implemented in UK and Germany) and repayable interest-free advance (implemented in Slovakia).

In the territories themselves, there are specific initiatives which are available for local developers.

The example of New Caledonia illustrates this point:

1) The **Competitive Fund for Energy Management** is fed equally by Ademe and the Government of New Caledonia (based on a levy on gasoline sold). The actions supported aimed at promoting energy efficiency (especially the thermal quality and energy performance of new housing through ECOCAL), the development of renewable energy and environmental quality. The priorities may vary over the years, they generally include:

- solar thermal sector;
- support the development of renewable energy in remote sites, especially in the islands (PV, wind);
• promote energy from diagnosis to companies through joint operations;
• develop meaningful actions in terms of education and training to build a more structured information network;
• increase knowledge in the field of energy and greenhouse.

2) The Environment and Energy Management Loan is a bank loan at preferential interest rates, subsidized by the state. It is designed to support small projects Caledonian businesses to reduce the negative impacts of their activities on the environment or to better manage their energy consumption. The loan is part of the programme GRAINE established by the consulate chambers and financially supported by the Government and the Provinces, to encourage companies to engage in investment in favour of environmental protection and energy management. The credit line provided by the AFD is XPF 1.8 billion and (since May 2010) to XPF 1.2 billion by the EIB.

SMEs can benefit from a subsidized loan of up to 20 million XPF to finance their entire investment program when it has an environmental component. The maximum funding envelope of an investment only dealing with environmental protection or energy management is set at XPF 60 million per project. The minimum duration must be 3 years.

Other international initiatives:

In principle, the OCTs are not eligible alone to participate in a few international programmes which might be however of high interest. There is definitively a need to engage a discussion with these programmes and funds to see whether the OCTs could individually or collectively (all OCTs or the group of Caribbean OCTs for example) apply for receiving support from these initiatives.

Climate Investment Fund (CIF): The CIFs are made up of four funding windows to help developing countries pilot low-emissions and climate-resilient development. With CIF support, countries are piloting transformations in clean technology, sustainable management of forests, renewable energy access, and climate resilient development. Three of the four above mentioned windows are very relevant to the OCTs:

1. The Clean Technology Fund (CTF) provides developing and middle income countries with positive incentives to scale up the demonstration, deployment, and transfer of technologies with a high potential for long-term GHG emissions savings. CTF focuses on large-scale, country-initiated renewable energy, energy efficiency and transport projects. Each CTF Investment Plan is tailored by the country to be integrated into national development objectives.
2. The Pilot Program for Climate Resilience (PPCR) helps developing countries integrate climate resilience into development and offers additional funding to support public and private sector investments. It provides incentives for scaled-up action and initiates a shift from “business as usual” to broad-based strategies for achieving climate resilience at the national and regional levels.
3. The Scaling Up Renewable Energy Program in Low Income Countries (SREP) was established to scale up the deployment of renewable energy solutions and expand renewable markets in the world’s poorest countries. SREP aims to pilot and demonstrate the economic, social, and environmental viability of development pathways that do not
exacerbate global warming. SREP finances solar, wind, bio-energy, geothermal, and small hydro technologies.

However, the Scaling up Renewable Energy Program in Low Income Countries has already committed the $505 million allocated to expand energy access and stimulate economic growth through renewable energy markets in eight pilot countries and unless a new package of funds is made available, the only possibility for the OCTs is to access to the exchange platform where lessons learned are presented.

Global Environment Facility under UNDP: As the UN system's development programme and a GEF Implementing Agency since 1991, UNDP supports countries in addressing development, climate, and ecosystem sustainability in an integrated manner. As a GEF Implementing Agency, UNDP-GEF offers countries highly specialized technical services for eligibility assessment, programme/project formulation, due diligence, mobilization of required co-financing, project implementation oversight, results management and evaluation, performance-based payments and knowledge management.

Global Energy Efficiency and Renewable Energy Fund (GEEREF): GEEREF is a Public Private Partnership (PPP) drawn from the Patient Capital Initiative (PCI) which was launched in 2004 in the context of the Johannesburg Renewable Energy Coalition (JREC).

GEEREF is an innovative Fund-of-Funds, providing global risk capital through private investment for energy efficiency and renewable energy projects in developing countries and economies in transition. It aims to accelerate the transfer, development, use and enforcement of environmentally sound technologies for the world's poorer regions, helping to bring secure, clean and affordable energy to local people.

GEEREF was initiated by the Directorate General for Environment and Directorate General for Europe Aid Co-operation Office (AIDCO) of the European Commission. It is both a sustainable development tool and a strong support for global efforts to combat climate change. It is sponsored by the European Union, Germany and Norway and is advised by the European Investment Bank Group (European Investment Bank and the European Investment Fund). The target funding size for GEEREF is €200-250 million and as of March 2013, GEEREF has secured a total €112 million.

GEEREF is registered as an instrument qualifying as Official Development Aid (ODA) by the Organisation for Economic Co-operation and Development OECD Development Assistance Committee (DAC, www.oecd.org/dac), the principal body through which the OECD deals with issues related to co-operation with developing countries.

GEEREF invests exclusively in emerging markets outside the European Union and particularly focuses on serving the needs of the ACP, which is a group of 79 African, Caribbean and Pacific developing countries. Priority is given to investment in countries with policies and regulatory frameworks on energy efficiency and renewable energy.

EU Energy Initiative Partnership Dialogue Facility: The Partnership Dialogue Facility (EUEI PDF) is an instrument developed and funded by a number of EU member states and the European Commission in the context of the EU Energy Initiative (EUEI). Currently the EUEI PDF is financed by Austria, the European Commission, Finland, France, Germany, the Netherlands, and Sweden.
The overall objective of the EUEI PDF is to support our partner countries and regions across Africa, Southeast Asia, Latin America and the Pacific in developing policies and strategies for the promotion of access to energy. These are based on dialogue within and between partner countries, their regional organisations, EU member states and the European Commission. Furthermore, EUEI PDF supports the strategic energy dialogue of the Africa-EU Energy Partnership (AEEP) as a secretariat.

EUEI PDF provides support in developing successful energy policies and strategies by conducting country and regional studies with national governments and regional organisations active in the energy sector; thematic studies on energy issues; and dialogue and networking activities to foster the exchange of knowledge.

**Country Studies**: EUEI PDF works with national governments and organisations that are active in the energy sector. Together we formulate successful policies and strategies to increase access to energy. Country studies include e.g. sustainable use of energy, capacity-building and energy policy support.

**Regional Studies**: EUEI PDF works with regional organisations and authorities that are active in the energy sector. Together we formulate successful policies and strategies to increase access to energy in the region. Regional studies include e.g. energy access strategies, donor mapping, and action plans for the promotion of access to energy.

**Thematic Studies**: EUEI PDF explores key energy issues such as rural electrification, productive use of electricity and biomass energy. We strive to develop innovative approaches and best-practices for both policy-makers and practitioners in the energy sector.

**Dialogue Events**: EUEI PDF believes in sharing knowledge, best-practices and innovation. Dialogue events and networks strengthen cooperation between experts and key decision-makers at the national, regional and international level.
11 RECOMMENDATIONS

The following recommendations are provided at a global level for all OCTs and groups of OCTs as it is not possible to propose in depth detailed individual recommendations due to the absence of detailed country assessments. These recommendations include: the institutional and legal framework, the most promising renewable energy developments, energy efficiency options which should be encouraged, funding models and available financial instruments, the principles of potential roadmaps for the transition to a smart sustainability, and the strengthening of the background knowledge in the OCTs.

11.1 On institutional and legal framework

There is no ideal or unique institutional and legal framework to address the question of sustainable energy, renewable energy, energy efficiency, and waste to energy alternatives in the OCTs. The fact that OCTs are islands with specific constraints, limited land area and population, resources and spectrum of energy supply options leads to the conclusion that for the OCTs, the institutional and legal framework must be built in a pragmatic and efficient manner. The frameworks which prevail in the Member States, the OCTs are linked with, do not have to be necessarily replicated since they are often not adaptable and may be counterproductive.

Many islands face significant development and sustainability challenges, often attributed to their small size and resource base, yet these same characteristics yield significant advantages too. Large economic and governance structures, rarely feasible on islands, can produce inflexible systems with poor response time to sudden change. In contrast, communities based on kinship or local understanding of the environment, which are prevalent on many islands, can more rapidly develop, implement, and adjust livelihoods based on the local social and environmental context. RES will be unable to compete on a level playing field with conventional generation until new policies are adopted to internalize the public costs of fossil fuel sources.

Whether it is admitted that establishing an independent and capable energy regulatory system is a prerequisite for achieving an appropriate regulatory framework and regulatory practices, it is however not necessary to build a regulatory agency based on the same model as those in place in the EU. In the particular case of OCTs which are not countries, the question of establishing an energy regulator has not been really addressed, in particular because the Member States the OCTs are linked with have also their own regulatory body. The fact that OCTs have their government and the authority to conduct their energy policy and strategy, including for energy pricing, implies that they should consider the establishment of such entity. This is particularly true for the largest OCTs where a large number of stakeholders having different priorities and agendas interests are involved for the provision of good quality, reliable and affordable energy services to the population.

The regulation model should be a model tailored to the situation and size of the islands. The main area of intervention of an independent regulator is usually energy tariffs and prices to ensure fair economic consideration and no political interference. True regulatory independence remains an important precondition for an effective electricity pricing policy and a stable regulatory framework is important to assure a proper balance between consumer
demand for low prices and the investors’ need for a reasonable return. Some principles that can be recommended include:

- **The planning of the power sector should continue to be the responsibility of the electric utility** which should also ensure the identification and tendering of new capacity, including those based on renewable technologies. For some OCTs, this planning will be done in full cooperation with the authority in charge of energy service.

- Where competition is introduced in electricity generation, this should be based first on the **Single Buyer Model**, i.e. with only one entity responsible for buying electricity generated by the RE power producers. This situation may evolve further in particular for the additional large scale renewable capacity and where the institutional framework allows various entities to be involved in delegated power trade. In those cases, the “Single Buyer Model” may not be the sole response.

- For small-scale renewable energy, customers should be allowed to use and interconnect to the main grid under agreed technical conditions and fees.

- **Simplify technical standards and administrative procedures** for grid connection of home installed RES systems.

- **Promote self-generation**: allow end-users to generate their own electricity and either sell surplus power to the utility or partly offset purchased power.

- Where possible and feasible, cost renewable energy production at the point of end-use through **net metering**, and allow utility networks to provide “energy storage” for small users.

- Elaborate clear guidelines with all information of the procedures, authorizations, rights and duties of parties.

In any case, **regulatory measures have to consider the monopoly environment on electricity production and distribution in many islands**. For a voluntary pro-green regulation and an increase of the RE applications, it is necessary to allow and encourage participation of RE-based independent producers supplementing the public undertakings.

Governments should actively promote support for renewable technologies and this should be translated into the provision of incentives, without jeopardizing the financial health of the utilities, i.e. outside the tariff system.

It is also very important to simplify all bureaucratic procedures in order to reduce both the time required and the transaction costs that relatively small RES projects have to face, especially in OCTs. Whatever the decisions made in the OCTs and the level of regulation adopted, the best practices of independence, communication, consultation, consistency, predictability, flexibility, capacity, effectiveness, accountability, and transparency must apply. An appropriate regulatory framework does not address only the power sector; it is also very important to tackle the question of energy demand and energy utilization.

### 11.2 On renewable energy development

Renewable energy technology should be developed regarding local specificities, especially in small islands where technologies and opportunities can differ significantly, within population, needs and capacities, as well as the topography (atoll or mountain) and especially local available resources (hydro, PV, wind, biomass) and infrastructure. Moreover, the energy storage (batteries, storage and hydraulic transfer), and smart grid relevant technologies in
SSM and DSM (production or deletion) should help greatly to increase the penetration of intermittent renewables in the energy mix.

Renewable energy development in OCTs can be successful, when based on specific plans supported by structured mechanisms supporting altogether the decision making process towards that direction. Renewable Energy Action or Development plans are needed for identifying not only the physical, technical and economic potential of each RES technology in the OCT area in question, but also for securing the financial resources available for supporting the RES interventions identified through technical evaluation. In particular, a RES action plan should set specific and realistic RES development targets which should be met within a specific timeline, based on technical feasibility studies on the potential of each technology, a financial plan for securing the funding of each technology as well as market analysis for ensuring the development potential of each technology. Sustainable RES developments can be realised only when all three factors - technical, economical and market availability - are satisfied.

Of course completing a detailed and realistic RES development plan is not sufficient, as the difficult part is the implementation of such a plan. Implementation and monitoring of a RES development plan should be undertaken by structures capable of following the RES market development, identifying in due time the barriers or deviations to the evolution of the RES plan, proposing and intervening without altering the RES market’s function.

In numerous OCTs such an approach for RES development, involving technical capacity for setting specific RES targets, and institutional capacity for achieving those targets is being adopted, albeit to a different extent. Enhancing and strengthening of these capacities has also been identified as necessary, however the structures are existing, contributing to the support of decision makers on justifying their actions towards the stakeholders and the society in general. Other OCTs, still support RES development on an ad–hoc basis, without setting any specific targets or RES plan, without creating additional structures and mechanisms, only by examining each RES project separately. This kind of approach can still be functional, especially in the smallest OCTs with more centralised institutional structures and small room for creating new structures. However, there is a risk of overlapping between projects, for example covering same amount of demand but operating in competitiveness and not supplementary to each other, double funding on technologies etc., especially when these RES projects are of a certain quantity and no planning is existing for prioritising their development and evolution according to a centralized RES strategy.

The necessity of following structural procedures on RES development in OCTs, is more essential to conventional RES technologies such as Wind, PV, Solar Thermal, Hydro, Geothermal and Biomass energy which have established market availability and technological maturity to a point of being competitive to conventional fossil fuels technologies. RES penetration of 50% can be achieved in sustainable economic terms if based on established RES technologies working above their technical minimums, with the required storage capacity back up. RES development of these mature technologies can even respect technical constraints set by the operation of conventional fossil fuel units, since RES penetration can be gradually increased over fossil products year by year so that fossil units’ equipment is not being devalued. For all these parameters to be considered, analysed and monitored efficiently, only through a RES long term development plan being supported by structural and institutional resources is the roadway for achieving it. Decisions based on such plans affect
less the OCTs economy, and are more easily adaptive by the stakeholders and the OCTs society in general.

Within the above mentioned framework, existing development on Wind, PVs or Solar Thermal should be evaluated with regards to its contribution to the final energy demand, correlated according to the RES targets set and combined with new planned RES initiatives. For example, geothermal energy development in Montserrat should be aligned to a strategy of setting geothermal energy as the predominant energy supplier, thus setting different targets to the development of other RES sources available.

On the other hand, innovative RES technologies such as SWAC, OTEC, Tidal, Wave, Hybrid and Smart grid can be developed in OCTs on a more pilot-based approach, setting results that could lead to a market share on future RES development plans and more importantly achieve broad public awareness from their implementation. This pilot-based approach of course will include sophisticated planning, feasibility analysis of the technology and possibilities of funding it. Furthermore, innovative RES applications can be the answer to particular problems faced in OCTs such as high summer cooling demand, electrification on remote and off-grid areas, waste management and disposal. For example, SWAC can facilitate the increased cooling demand of the hotel sector, occurring only in summer periods, more efficiently than any conventional electricity AC system. Wind – PV – diesel generators or Wind – Hydro hybrid solutions combined in a micro grid can meet the demand of remote areas of OCTs with no grid coverage. **Energy storage options can significantly improve the operation of existing RES facilities operating on low capacity factors** where smart grid systems and especially the smart grid connectivity of different small islands between them improve the overall operation of existing connected RES to the maximum. The unique solutions that innovative RES applications can offer on such situations, common in OCTs, can demonstrate to the stakeholders and to the public first that RES development can be achieved in a sustainable manner when based on holistic design and planning.

Finally, OCTs do not need to create from scratch the mechanisms for RES development. **There are already best practices, experience and available mechanisms and models which could suit the type of investment to be decided.** Examples include the EU’s EuropeAid programme with possibilities for funding towards technical assistance, capacity building and feasibility studies in the field of renewable energy through the allocation of EUR 8.5 million available in accordance with the Article 80 of the Overseas Association Decision (Council Decision 2013/755/EU of 25 Nov 2013) the SE4ALL initiative and the European Investment Bank or ESCO’s third party mechanisms for financing detailed planned projects. Through the present study, identification of RES applications suitable to the context of each OCT area has been made, as well as best practice references compiled through project fiches and a survey on the financial instruments available for OCTs concrete and secure RES development has been made.

**11.3 On energy efficiency policy options**

**As part of a sustainable energy strategy and associated regulatory adaptations, energy efficiency policy should be a priority.** Indeed, reducing energy consumption helps reducing energy dependency, benefits households and industries thanks to reduced energy bills (provided that suitable incentives are designed to overcome investment barriers), and reduces or postpones the need for utilities to increase their generation capacities.
An energy efficiency strategy should cover all sectors: administration and public buildings, households, SMEs, services and industry. This could be supported by smart metering actions to identify the energy saving potential.

Examples of modified regulations in the OCT to address energy efficiency goals include new building codes or the modification of existing ones, including energy efficient features in the design and the construction of houses, commercial and residential buildings, mandatory installation of solar water heaters, energy labelling for domestic appliances.

Based on the experience of the various OCTs, the recommended energy-efficiency measures that stakeholders should consider are:

**Data collection**
- Mandatory Energy audits of public buildings and social housing stock, subsidies to carry out such audits for private sector (industry, professional and home end-users). That implementation should by sustained by a governmental framework (with a specific committee) coupled with other donors (EC, ADEME, etc.);
- Encourage the implementation of electricity smart meters, to assist the utility supplier in improving demand forecast and assessment of potential deferrable loads for improved supply strategy, as well as for identifying the energy saving potential;
- Encourage the use of “smart-home” control devices in households, and BMS (Building Management Systems) in non-domestic buildings.

**Raising awareness:**
- Development of technical partnerships between organisations, construction federations, chambers, businesses, for actions such as benchmarking and training;
- Organise awareness activities for the public, related to the benefits of energy efficiency and practical tips to reduce energy consumption. Such awareness-raising actions could be funded by (or even undertaken by) the energy suppliers themselves, under an obligation scheme;
- Awareness actions for the younger generation, in order to educate future professionals in this field;
- Organise awareness workshops for businesses, on how to reduce their operational energy;
- Creation of an Energy Info Point and organisation of awareness actions for users;
- Set an example through the adaptation and renovation of public buildings and social housing stock.

**New standards and labelling:**
- Inclusion of “energy-efficiency” section within calls for tender for all new buildings
- Minimum standards for the design of new buildings, use of bioclimatic design principles (insulation, lighting, orientation, ventilation);
- Minimum energy efficiency standards for the building envelope for new and existing buildings;
- Minimum % provision of on-site renewable energy sources, for all new building developments and for major refurbishments (for instance Solar Water Heaters);
- Energy Performance Certification for new and existing buildings;
- Regulation favouring CFLs deployment and reducing the sales of incandescent lamps;
- Minimum energy efficiency performance standards for imported appliances.
Incentives and support

- Support the adaptation and renovation works of housing and private buildings stock through tax incentives and thermal regulation (for improved insulation, replacement of inefficient boilers, etc.);
- Incentives (reduced customs taxes) for the import and purchase of low-energy domestic household appliances;
- Support to the power generation and transmission sectors in order to improve the efficiency of power generation and to reduce distribution losses;
- Administrative procedures should be simple and flexible, and allow an easy access (single window) to the various beneficiaries.

Regarding the financing of energy efficiency measures, valuable examples implemented in the EU countries could be replicated in the OCTs: combined public-private funding of energy efficiency projects (FIDEME fund in France providing up to 25% of capital investment), soft loans for SME (implemented in UK and Germany) and repayable interest-free advance (implemented in Slovakia).

The ESCO model (where an energy service company (ESCO) bears the technical and financial responsibility of an energy efficiency project and is paid back through the energy savings), has improved efficiency in Europe and could be valuably replicated in the OCTs.

11.4 On funding RE development

Investment in renewable energy in the OCTs has been particularly active in solar energy, driven by a substantial decrease in the cost of photovoltaic (PV) technology, the possibility to develop hybrid solutions, and the fact that there are many areas where only individual solutions can apply. Investment in wind energy projects has been also significant, reflecting the maturity of wind technologies. RE investments included also small-hydro. On the other hand, investments towards activities which are still being assessed and at the pilot stage, were limited. Other areas of research and investment are distributed solutions, mini-grid solutions, and energy storage.

The renewable energy sector is structurally well suited for public finance and public funding has been proven successful to finance renewable energy projects. The assets are generally very well defined and differentiated and power generation is a capital intensive industry with significant initial investments and long term cash flow, although RE projects are usually small scale. The RE-based power generates mostly regulated revenues while lenders usually bear the political and operational risk. Project financing means taking risks for 10 to 15 years. Therefore, before any decision is made on lending money, most banks want to see the islands’ plans for the right energy production mix, for expanding the consumer markets and/or lowering the debt burden and for economic diversification at the country / island level, i.e. prospects for the islands’ economy to support repayment over the next 15 years.

The Public-Private Partnership (PPP) model has been also used in various instances and is a very successful model which is well suited for renewable energy projects. Examples of successful projects based on PPP are found New Caledonia and Aruba for instance.
Many multilateral and bilateral organisations have also provided funding solutions for RE projects in the OCTs either through grants or preferred interest loans.

**Effective national policy is absolutely crucial to shape the markets and geographies attractive for financiers.** Therefore OCTs’ governments have a role to play to shift finance into RE. It should be noted, however, that there are some roles that governments should not perform. In particular, when designing policies, attention should be paid to whether a given regulation supports the process of price transparency to drive down RE costs. Where regulation blocks this process, then deregulation or regulatory reform can be appropriate for enabling entry and exit of new RE providers into (and out of) the local market.

In the absence of government policy, free markets alone are unable to incorporate the cost of social and environmental externalities into the price of energy. Until RE technologies are competitive in the market, governments have little choice but to support their progress to ensure long-term success. **A key role of policy, therefore, is to incorporate externalities into the price of energy, and – if necessary – to additionally (or alternatively) financially support RE until it is market-competitive.**

**In some OCTs, renewable energy has sometimes to face an existing policy environment that favours and subsidises fossil fuels.** These subsidies are considered as perverse as they support an economic model that is not sustainable, even though they are a response to economic constraints which have their own rationale. Government action should see how to reverse these incentives so that technologies can compete based only on the true costs of production, including social and environmental costs, which are measured over a long-term time horizon. The short-term impact on energy consumers of shifting subsidies must be carefully managed to avoid political reaction.

Government action is a priority to improve the economics of RE applications thanks to targeted interventions and, in some cases, appropriate deregulation of local RE markets.

In addition to shaping the overarching framework of market incentives, **national governments can address important niche barriers to RE investment through more targeted interventions.** This occurs at the point when a technology concept has already been proven, but the first few full-scale projects or manufacturing plants have not yet been built.

Governments generally seek to intervene in two comprehensive ways: (1) by setting overarching regulatory and incentive frameworks that may contribute to boost RE projects; and (2) by using targeted public funding to fill or overcome specific financing gaps and barriers to RE investment. OCTs are implementing a combination of regulation with targeted Intervention.

**Regulatory frameworks that mobilise finance for RE can employ both energy and finance policy mechanisms.** In many countries, RE finance policy is most commonly designed by energy and environment ministries. Energy and environment ministries employ policy mechanisms such as feed-in tariffs and tax incentives to help shape the RE investment landscape. In the OCTs, where there is usually no Energy Ministry, the function is undertaken by a Ministry of Industry, Natural Resources or Finance. The tools most commonly used are the following:
Table 13: Tools to support government energy policy

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Targeted Intervention</th>
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</thead>
<tbody>
<tr>
<td>Energy Policy</td>
<td>Finance Policy</td>
</tr>
<tr>
<td>Feed-in tariffs</td>
<td>Environmental, Social and Corporate Governance lending criteria</td>
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<tr>
<td>Tax incentives</td>
<td>Green Bonds</td>
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<tr>
<td>Quotas and targets</td>
<td>Differentiated interest rates</td>
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<tr>
<td>Self-supply regulation</td>
<td>Public banking</td>
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The design of a financing programme should begin with an **understanding of the local context**, including the country’s **profile of energy production and consumption**. Programme developers should focus on local resources that can replace energy imports, and that can be readily implemented with the available technology. There must be a sound energy statistics basis. This is well done and well known in the OCTs although some OCTs can still improve their energy statistics. OCTs governments seeking to move towards more green energy should reinforce their market assessment:

In some OCTs, such as New Caledonia and French Polynesia, biomass and biofuel sources (including landfills) are abundant and harnessing could be feasible with relatively simple financing models and available technology. With the proper support and financing mechanisms, such initiatives enable replacing costly and unstable oil imports and provide co-generated power. In principle, it is recognized that technologies and sectors that can provide the best return on investment should be a primary focus because they will not require subsidies from the government.

The next step is to align these market opportunities with national RE or climate change targets and identify initiatives, policies and efforts that could be integrated to develop the targeted technologies.

To help OCTs in developing their most appropriate environment, there are a few windows available for funding and for other forms of support and assistance. The main identified to-date are:

- Various regional and international programmes such as the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP - www.sprep.org/Pacific-Islands-Greenhouse-Gas-Abatement-through-Renewable-Energy-Project/about-piggarep), a few Caribbean initiatives (CREDP, CREF, CAWEI), the network of European Island Authorities (ISLENET - www.islenet.net/) and others.

- The **Renewable Energy and Energy Efficiency Project** (REEEP - www.reeep.org/) **which will launch a new call for proposal early 2014** under its 10th Project Cycle. OCTs should register with REEEP to receive call notifications as they will include specific guidelines on eligible proposals.

- The European Investment Bank which can be activated and is an active partner either through direct intervention or through the recently created **Global Climate Change FL**
which clearly indicates that OCTs can apply for funding (www.eib.org/projects/pipeline/2011/20110504.htm?lang=en).

- Other EU Member States mechanisms and supports are available such as AFD or Specific programmes (FIDEME or the Fonds Chaleur of ADEME) in many French OCTs, DFID in Pitcairn or Montserrat.

- Global Energy Efficiency and Renewable Energy Fund (GEEREF - http://geeref.com/) which can be available for some OCTs, namely Anguilla, Montserrat, St Helena and Wallis et Futuna.

- The European Development Fund (EDF) which will continue to be one of the main source of funds with all support provided in OCTs. A few OCTs have now the appropriate environment (such as a suitable public finance framework) to apply for energy sector budget support.

- Any island can join the GSEII initiative (www.gseii.org/) which intends to contribute to the total transformation by 2020 of some islands. Under this so-called Vision 20/30, a coalition of partners is built and islands ready to join the programme are identified.

- It may be difficult for the actors in the OCTs to apply alone to the Programme “Horizon 2020”, the new EU Framework Programme for Research and Innovation running from 2014 to 2020 with a budget of just over €70 billion. However, like for many of the windows presented, this can be done through grouping with European partners and this might be a key activity of an OCT energy network.
12 SUGGESTED ROAD MAPS FOR THE OCTS

12.1 Roadmaps for the transition to a smart sustainability

All OCTs recognize that to have a sustainable energy transition strategy is critical to the survival of island economies. Most of islands are facing a number of unique challenges as they modernize their electrical power systems. They all use heavy fuel oil for power generation, a commodity that is increasingly vulnerable to price fluctuations. They are more affected than the Member States the OCTs are linked with when this situation is combined with an economic crisis as many OCTs experienced between 2008 and 2010.

Energy conservation should be the first priority as mentioned. However, there are opportunities with abundant renewable energy in many OCTs as a consequence of their high dependency on imported fuels and relatively high electricity costs (€ 20-30 cts/kWh and higher), helping to create an appropriate environment for renewable energy-based generation. For the OCTs, there is an optimum path which is not that easy to find and build upon since it implies, at the same time, the implementation of a territory-wide sustainable energy component based on least-cost renewable energies and the continuous provision of a reliable and affordable power supply to the society. It requires locally appropriate solutions and a transition strategy to ensure a sustainable island energy system. Such a strategy cannot be prepared and implemented without an involvement of all actors from customers to operators. It must obviously take into account all local opportunities for renewable energy as well as their constraints.

Despite local differences between OCTs in terms of climate, RE resource base, remoteness, and the power generation and distribution systems, there are common realities that can be highlighted.

The development of a Sustainable Energy System Road Map includes several steps from initial assessment to the strategy itself. The initial step is the assessment of the local energy system characteristics (including actual generation costs) and context, and to forecast the evolution of power needs. For this, an analysis of policy and background documents and numerous consultations with all stakeholders (utility companies, Government, others as locally appropriate) is necessary.

A precise analysis of the investment costs and generation costs of each potentially applicable RE technology should be undertaken, according to local conditions and considering the indirect economic added value of the RE development in terms of jobs creation in islands with a high unemployment rate, competitiveness and innovation opportunities. These analyses enables local authorities to assess economic feasibility, potential investments needs and to build a roadmap.

Even if there are differences in local RE resources and in procurement, transport and installation costs for RE equipment, the analysis of existing literature shows that there is a quite clear and common picture in terms of ranking least-cost RE options in islands, as shown in the tables provided hereafter.
Table 14: Generation Costs of Renewable Energy Technologies in the Caribbean

<table>
<thead>
<tr>
<th>Technology</th>
<th>Range of cost in USD per kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Water Heaters</td>
<td>$0.10-0.13</td>
</tr>
<tr>
<td>landfill gas, waste</td>
<td>$0.08-0.12</td>
</tr>
<tr>
<td>Wind at high load factor (25%)</td>
<td>$0.09-0.12</td>
</tr>
<tr>
<td>Wind at low load factor (14%)</td>
<td>$0.21</td>
</tr>
<tr>
<td>Distributed PV</td>
<td>$0.24-0.47</td>
</tr>
<tr>
<td>Centralized PV*</td>
<td>$0.48-0.64</td>
</tr>
</tbody>
</table>

*Typically > 5 MWp (>25 M USD investment). Economies of scale in the MWp range bring down PV plant cost, but necessary grid upgrade affects overall cost unfavourably.

Note: Costs adapted from Castalia reports on Anguilla (2012) and the TCI (2011), Continental Economics report on the TCI (2011) and CARICOM-GTZ analysis (2010). Solar irradiation in Anguilla is 5.48 kWh/m²/day.

Table 15: Generation Costs of Renewable Energy Technologies and Diesel in Pacific Island Countries (PICs) in comparison to International Costs.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Range of cost in USD per kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill gas</td>
<td>$0.18</td>
</tr>
<tr>
<td>Biomass gasification</td>
<td>$0.16-0.22</td>
</tr>
<tr>
<td>Large scale wind</td>
<td>$0.14-0.18</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>$0.34-0.38</td>
</tr>
<tr>
<td>Grid-connected solar PV</td>
<td>$0.35-0.70</td>
</tr>
<tr>
<td>Large scale PV and Battery</td>
<td>$0.75</td>
</tr>
<tr>
<td>Off-grid solar PV</td>
<td>$1.50-2.50</td>
</tr>
<tr>
<td>Rural Diesel</td>
<td>$1.00-2.50</td>
</tr>
</tbody>
</table>


Table 16: Installed Costs of Renewable Energy Technologies and Diesel Examples for Pacific Island Countries (PICs)

<table>
<thead>
<tr>
<th>Technology</th>
<th>Cost range in USD per kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-connected solar PV</td>
<td>$4,500 - $14,000</td>
</tr>
<tr>
<td>Off-grid solar PV</td>
<td>$10,000 - $34,000</td>
</tr>
<tr>
<td>Micro-hydro</td>
<td>$4,000 - $23,000</td>
</tr>
<tr>
<td>Small-hydro</td>
<td>$1,800 - $4,000</td>
</tr>
<tr>
<td>Small-scale wind</td>
<td>$4,000</td>
</tr>
<tr>
<td>Large scale wind</td>
<td>$3,300</td>
</tr>
<tr>
<td>Small-scale biomass</td>
<td>$3,500 - $6,000</td>
</tr>
<tr>
<td>Diesel</td>
<td>$800 - $1,500</td>
</tr>
</tbody>
</table>


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Plots: Comparison of estimated cost of RE-based kWh in the Caribbean and Pacific islands, together with typical kWh price to residential customers in the OCTs
(RE kWh cost figures based on above-mentioned studies)

Because of the absence of comprehensive, recent, and comparable studies regarding actual generation costs in the various OCTs, the data used here as an indicator is the kWh price applicable to the mentioned specific consumption segment. One must keep in mind that in some OCTs, electricity is subsidized, and that tariff may be lower than generation cost (in particular in Mayotte, St Barthelemy, St Pierre & Miquelon, French Polynesia).

Despite the fact that specific feasibility studies are required for each project (because many parameters, that are site-specific, affect the overall cost), the above data for Pacific Island Countries and the Caribbean area suggest that RE development in OCTs could start with the most cost effective RE technologies, i.e. in the following order:

1 - Solar water heaters (except for Greenland)
2 - Hydro Power (where resource is available)
3 - **Biomass Projects** and **Landfill Gas to Energy**, due to their installation and generation costs, commercial availability and value chain creating with the exploitation of indigenous sources.

4 - **Wind Power** (for sites with load factors over 25%)

5 - **Small grid-connected PV** (where local resource makes this option affordable compared to others)

Still the gap to conventional energy sources is visible, but the development on RE technology and the expected high levels of oil prices will result in closing this difference in the future.

In the process of defining a roadmap at the OCT level, all key actors should be involved in order to define suitable targets, to select the priority projects identified as least cost options and more suited to reach the targets, to define an action plan, and ultimately to develop the Road Map Strategy.

Regarding specific measures and technologies to be implemented, some are easy and quick to deploy and do not need major changes in regulation. These should be implemented first. Then one can rank the further measures to be adopted and the required financial and technical support necessary to deploy more costly RE technologies. Energy conservation and energy efficiency measures in all sectors, including power generation should come as a prerequisite before investing in RE technologies. Then investments in low-cost RE technologies and waste-to-energy can be implemented. The table below show the various needs in terms of regulation adaptation and involvement of the private sector in order to develop the different technologies.

The impact on the grid should not be neglected. Integrating fluctuating energy sources like sun and wind into existing electrical grids poses technical challenges since it is necessary that electricity generation and demand match each other at any given moment. This leads to the requirement for adequate power reserve, which can be achieved through various means such as: pumped-hydro storage, wind-diesel and bio-diesel systems. **For wind and solar to reach above 20%-30%, an analysis of the impact of increased intermittent RE sources on grid stability should be undertaken.**

When exploring the possibility to significantly increase the participation of renewable energy in the energy mix, i.e. more than 50% (and, in theory, up to 100%), beyond technical issues related to RE technologies themselves, there are the **questions of commercially viable energy storage technologies, innovative grid control, and energy management solutions.** Such evolution in energy generation and management may impose innovative business models, new management and regulation models as well as the need for specific financing schemes.

As an example, below is presented a typical roadmap that could be adjusted and adopted by OCTs. In this table, technologies and measures are ranked in a chronologically preferred order according to estimated deployment costs and required regulation adaptation.
Table 17: Suggested roadmap towards energy sustainability

<table>
<thead>
<tr>
<th>SUGGESTED GENERAL ROADMAP FOR OCTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies</td>
</tr>
<tr>
<td>-------------------------------------</td>
</tr>
<tr>
<td><strong>Step 1</strong> Assessment of the needs and costs of local energy system</td>
</tr>
<tr>
<td><strong>Step 2</strong> Detailed load forecast for investment planning</td>
</tr>
<tr>
<td><strong>Step 3</strong> Assessment of the local RE resource and RE systems costs</td>
</tr>
<tr>
<td><strong>Step 4</strong> Energy Efficiency measures (EE)</td>
</tr>
<tr>
<td><strong>Step 5</strong> Hydropower</td>
</tr>
<tr>
<td><strong>Step 6</strong> Solar Water Heaters (SWH)</td>
</tr>
<tr>
<td><strong>Step 7</strong> Landfill gas to energy, Waste-to-energy Biomass-to-energy</td>
</tr>
<tr>
<td><strong>Step 8</strong> Wind energy</td>
</tr>
<tr>
<td><strong>Step 9</strong> Distributed Solar PV</td>
</tr>
</tbody>
</table>
**Step 10 Centralized Solar PV**

- 0.48-0.70 $/kWh
- Mini. 5 MWp (Mini. 25 million USD investment)
- Adapted regulation for allowing independent power producers to connect to the grid
- Private investment (Independent power producers under power purchase agreements)
- Intermittency may affect grid stability if combined intermittent energy share is > 30% of instantaneous power

**Step 11 Smart metering to maximise energy efficiency and then increase RE share**

- > 100 € / unit today, but cost will drop with future development and typical economies of scale of electronics products
- Not necessary
- Utility
- Positive impact on grid stability if smart metering allows controlling deferrable loads

**Step 12 Other RE technologies (less conventional and higher costs), including energy geothermal, storage technologies**

- Depending on the technology
- Private players for potential assessment and feasibility studies. For pilot projects, and for commercial implementation
- Depending on the technology, but increased number of combined RE technologies may help compensating intermittency.

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* Prices mentioned are based on studies in Caribbean and Pacific Islands, cited above. Price data should be adapted for each OCT according to its local resource and equipment transportation cost.

**The penetration figures mentioned in the table are rough indications. The actual feasible penetration rate of intermittent sources has to be precisely assessed in each territory, and taking into account the spinning reserve.

Regarding more innovative RE technologies, cost ranges are much vaguer, especially in the OCTs. The development of these innovative RE technologies shall follow a case-by-case approach because each situation presents its own characteristics. RE innovative development stands on decisions that cannot be justified on economic terms only. It stands on strategic choice of highlighting a territory’s characteristics such as vast wave and tidal potential or sea water temperature differences and is related to high public RES awareness, acceptance to RES development and access to financing pilot projects. The Hawai’s OTEC project and Reunion’s Wave Power project are characteristic examples of such a development approach. Nevertheless, the economic pattern of OCTs may not offer the opportunity for such type of choices in the short term. Costs remain the main decision criteria for RE development in OCTs.

### 12.2 Roadmap adaptation to OCTs

Referring to the main features of OCTs economies and to the segmentation introduced in Chapter 4, provided below are few recommendations and suggested priorities for the various OCTs.

It must be stressed that, in this report, are suggested specific steps to be taken by each OCT or group of OCTs based on their characteristics and the information collected. The elaboration of more detailed and individual road maps requires taking into account a lot of political, economic and technical parameters, thus involving significant efforts and intensive consultations with each OCT, in depth dialog with all stakeholders, country visits and better
knowledge of local situation which cannot be achieved within the framework of this general study. The elements included in our report can serve as a reference or as a starting point for the preparation of the individual road maps under local administration control.

**Economies utilizing own assets and environment:**
In the Caribbean islands, economies attracting tourism, financial services (Cayman Islands, the BVI, Saint-Barthélemy, St Maarten, Aruba, Curacao and the TCI) are characterized by high GDP/capita and good solar and wind resource.

For these OCTs, the roadmap priorities could be the following:

Beyond the necessary studies to:

- Assess the needs and costs of local energy system, load forecasting and local RE costs *(ref. Steps 1,2,3)*
- Local population may have the capacity to invest in readily available individual RE systems (typically SWH, solar PV panels) for their own use, and to acquire energy efficient appliances. To trigger this, the suggested measures are:
  - Awareness campaigns on RE technologies’ costs and benefits; on energy efficiency;
  - Adaptation of regulation (building code with compulsory measures for Energy Efficiency, SWH and small PV systems, specific measures for hotel sector, net-metering or FiT funded through increased general tariff, compulsory efficiency labels, etc.) *(ref. Steps 4,6,9)*;
- Implementation of smart metering systems may help to identify energy efficiency gaps and to design focused efficiency programs.
- Further on, to attract private investors for developing RE-fuelled power plants (wind, waste and landfill gas to energy, solar PV):
  - Adaptation of regulation (liberalization of power generation for OCTs where market is not yet open);
  - Adoption of targets for RE share in the electricity mix and plan together with Utilities and IPPs a roadmap to transform their electricity mix accordingly and their tariffs as a consequence, *(ref. Steps 7,8,10)*;
- Pursue/launch research programs for the RE innovative technologies with specific funding tools *(ref. Step 12)*.

Some of these priority goals have already been achieved by Aruba, the most advanced OCT in the region. For the Caribbean islands where the investment capacity of local population may be lower (potentially in Anguilla, Bonaire), the financial aspects may be treated with more support from the government which could set up attractive mechanisms for offshore investments.

In New Caledonia, a suggested road map may include actions on various fronts addressing institutional framework, financing mechanisms involving the mining industries, continuation of successful initiatives. One can summarize the proposals as follows:

- Creation of an independent Energy Regulatory Agency (analysis of opportunities);
- Improve the statistics and database. Provide updated information and improve communication (the only energy balance available on DIMENC website is that of 2009). *(ref. Step 1)*;
- ADEME also should improve its communication as the ADEME New Caledonia website includes priorities back in 2009;
- Strengthen the energy management fund with contribution of the mining industries which must contribute directly in cash or as partner in RE project as a way to secure its commitment towards climate change. Promote the fund to attract other funders with better exposure and visibility on projects supported by the fund (AFD and others.);
- Renew and improve financing mechanisms available at the energy management fund administered at DIMENC. Provide substantial capacity building on project finance to fund staff;
- Local most cost-efficient RE source should be identified and its deployment cost assessed (with continued support from AFD through Graine programme)
  - (ref. Steps 1, 2, 3);
- Energy efficiency measures for the mining industries and other industries should be promoted. (ref. Step 4);
- Suitable mechanism for using resulting energy savings to fund RE development could be studied;
- Building codes adapted to tropical conditions (in partnerships with other OCTs and territories having similar climate);
- Proposed FiT attractive enough to increase involvement of private actors;
- Develop new model for the municipalities through delegated management to optimise energy savings in public buildings and in public lighting;
- Pursue programme on solar hot water heaters. (ref. Step 6);
- Promote and analyse options for monitoring of energy use (ref. step 11) and energy storage, in particular STEP opportunities, enabling increased participation of RE technologies and improve grid stability. (ref. Step 12).

In French Polynesia, the road map might be developed along the following lines:

- Revision of the institutional framework with better coordination of energy-related strategies and activities and distribution of responsibilities among stakeholders;
- Prioritize actions and prepare renewable energy road map based on the RE master plan prepared by Carbone 4;
- Develop demand side actions through fiscal incentives and appropriate subsidies. (ref. Step 4);
- Little investment capacity from local population meaning design and availability of financing instruments for a wide range of customers to invest in energy efficiency and renewable energy such as SWHs;
- Financial mechanisms to be addressed with support from the government and involved a large variety of actors. Analyse the feasibility to put in place specific levies (gasoline, tourism, etc.) to build an energy management fund to be administered by a dedicated agency;
- Pursue and expand the SWH substitution campaign with adequate instruments. (ref. Step 6);
- Implement PV projects with injection to the grid. Establish adequate FiT to favour participation of private actors. (ref. Steps 9, 10);
- Pursue research programs for the RE innovative technologies with specific funding tools. (ref. Steps 11, 12);
• Capacity building of administration officers and project developers in project finance and project management.

This road map proposed for French Polynesia combines development and promotion of mature and proven technologies in renewable energy and energy efficiency, capacity building, financing and project finance.

In Greenland, where 70% of the power is already generated using hydropower plants (ref. Step 5), the roadmap priorities could be the following:

• Local, small-scale cost-efficient RE solutions should be identified and their deployment cost assessed, for areas where there is no access to large hydropower plants (ref. Steps 1,2,3);
• Undertake feasibility study to investigate the potential of interconnection amongst the isolated local grids (ref. Step 1);
• Assess the potential of hydropower for powering the emerging mining industry, e.g. through the pilot project currently designed (aluminium smelting plant) (ref. Step 12);
• Undertake detailed feasibility studies to assess the potential of producing biogas from organic waste and using solid biomass from the marine industry refuses (ref. Steps 1,2,3,7);
• Undertake detailed feasibility studies to assess the available options for energy storage, considering the large amounts of stable and predictable hydro power (ref. Steps 1,2,3).

Furthermore, efforts could be targeted towards energy-efficiency, of industry and buildings, and raising awareness of the population on such matters. Specifically, suggested measures to consider are:

• Feasibility studies to assess energy-efficiency best practices for the two main industrial activities (fishing and mining) (ref. Step 4);
• Adaptation of regulation (Building Codes) to include: minimum energy performance standards for new and existing buildings, contribution of RES to the energy balance, mandatory energy certification etc.) (ref. Step 4);
• Public awareness activities on the benefits of energy-efficiency and related incentives. Use results of the large-scale remote metering project, to enhance consumer energy awareness (ref. Step 4).

**Economies with very limited industry base, significant public sector / government support (and > 5,000 people):**

In St Pierre & Miquelon, Wallis & Futuna and Mayotte, public sector and financial support from France are essential to the economy. In Mayotte and St Pierre & Miquelon, the electricity tariffs are low compared to other OCTs, and do not reflect the real generation costs.

As a general recommendation:

• Pursue the present efforts in Energy Efficiency in Mayotte and St Pierre et Miquelon (awareness campaign and distribution of efficient lamps, assessment of potential energy savings in Mayotte, awareness campaign and promotion of old boilers replacement, efficient lighting, etc. in St Pierre et Miquelon), start an active strategy in Energy Efficiency in Wallis & Futuna. (ref. Step 4).
Additionally, in St Pierre et Miquelon, as forecasted within its Strategic Development Plan 2010-2030, recommended priorities are:

- Undertake detailed feasibility studies on the viability of RES technologies (ref. Steps 1,2,3,8,12);
- Develop an Energy Strategy, and adapt building regulations in order to implement it e.g. set minimum energy performance standards for new and existing buildings, mandatory energy audits and certification etc.). Energy-efficiency could be supported through smart metering actions. (ref. Steps 4,11);
- Undertake a detailed feasibility study on the potential of energy recovery from municipal waste, as part of the revision and implementation of a Waste Management Plan (ref. Step 7).

Where electricity is subsidised, the first steps of a RE roadmap could be to:

- Assess the real generation costs of local energy system, the amount of subsidies per kWh generated, perform load forecasting analysis, and assess local RE costs.
  - (ref. Steps 1,2,3);
- Undertake, in partnership with concerned ministry in France, a cost-benefit analysis to assess if partly transferring subsidies from present generation system to investments in additional RE-based power plants is economically feasible.

**Small population islands (< 5,000 people) and/or more distant territories:**

In remote islands with a smaller population base, the decision and implementation processes can be faster than in other OCTs.

In the Falkland Islands (2,840 people), there are plans for doubling the installed generation capacity by 2020, with a nearly stable RE share in the installed capacity (20% wind energy). There are targets for increasing the overall RE share (from wind) in annual electricity generation from 33% to 40% (ref. Step 8).

Other recommended priorities are:

- Undertake research/feasibility studies on the potential of energy storage technologies (ref. Steps 1,2,3);
- Focus on energy-efficiency, and set within the Energy Strategy, minimum energy performance standards for new and existing buildings, mandatory energy audits and certification etc.). Energy-efficiency could be supported through smart metering actions. Adapt if necessary Building Regulations in order to incorporate such measures. Undertake public awareness activities on energy-efficiency (ref. Steps 4,11);
- Undertake a feasibility study on the potential of energy recovery from municipal waste, as part of an updated Waste Management Strategy (ref. Step 7).

In St Helena, major transformation is currently underway due to the construction of an airport on the island. Rise in population and economic activity is predicted for the coming years, impacting on the predicted energy demand. A number of desktop feasibility studies have already been undertaken, in order to assess the potential of various energy-efficiency and RES options.

The suggested roadmap priorities are the following:
- Focus on energy-efficiency, and set within the Energy Efficiency Plan being developed, minimum energy performance standards for new and existing buildings, mandatory energy audits and certification etc. Energy-efficiency could be supported through smart metering actions. Adapt if necessary Building Regulations in order to incorporate such measures. Undertake public awareness activities on energy-efficiency (ref. Steps 4, 11);
- Assess the potential of further increasing the installed wind capacity, considering options as part of the airport development. Review alternative/larger turbine designs (ref. Step 8);
- Thoroughly revisit the feasibility studies already undertaken on wave energy and OTEC, as technologies become more commercially developed, so as to assess their specific potential for St Helena (ref. Step 12);
- Further investigate the options for energy storage, considering the feasibility studies undertaken. Assess the potential of integration of RES with each or some of the storage technologies, based on the load requirements of St Helena (ref. Steps 12);
- Undertake feasibility studies to assess the potential of RES technologies not investigated so far, e.g. solar thermal, PVs and geothermal energy (ref. Steps 6,9,10,12).

In St Eustatius (3,500 people) and Saba (1,800 people) the utilities are presently being restructured: that could be an opportunity to introduce mandatory RE in the generation mix.

Pitcairn (58 people). In this island, going on with the present solar project and potentially re-start a wind energy project would help increasing RE share. However, it is unlikely to occur without the involvement of an external donor (DFID).