SITI

SITI- Higher Institute on Territorial Systems for Innovation, is a no profit association set up in 2002 between the Politecnico di Torino and the Compagnia di San Paolo, to carry out research and training oriented towards innovation and socio-economic growth. Building on the different skills available within the Politecnico di Torino, SITI enhances its capacity by cooperating with researchers and specialists, other Universities and national and international research centers.
In the field of energy, SITI has carried out several projects on the management of generation from renewable energy sources through a Virtual Power Plant approach, including storage technologies. SITI has developed a Technical-Economic-Environmental Model for complex energy systems with different sources, distributed on an electrical grid with a regional dimension. Furthermore, SiTI is developing specific business models to promote a full exploitation of the locally available resources, also in conjunction with energy efficiency renovation of existing buildings.

AI ENGINEERING

Ai Engineering and Ai Studio have been successfully operating since the early Seventies and employ about 90 people in the headquarters in Torino. The Group has also an operative office in Palestine and in Malta. Ai Engineering takes a leading role in the various engineering sectors, developing a host of activities including investment plans and feasibility studies, environmental impact appraisals, urban and regional plannings, preliminary / final / construction design, estimates and quantity surveys, site supervision, building yard scheduling and assistance, workers safety control and management, project management, project control and construction management.
It takes a global approach, offering a wide range of professional services, through its team of designers, engineers, architects, planners and specialists (acoustic, agronomists, geologists, etc.). This multidisciplinary team provides technical assistance in concept, design, construction and functional start-up of complex projects. The highly integrated approach allows skills and knowledge fusion to tackle any planning problem.

CITY OF TURIN

The City of Turin participates in RENEP via its International Cooperation and Peace Office, created by the Municipality to support its international activities. The Office acts in the framework of decentralized international cooperation, in partnership with civil society representatives (associations, foreign citizens communities, NGOs, any religious organization, trade unions, universities) and the public authorities (UN agencies, EU, ministries, regions, municipalities, chambers of commerce, schools). Cooperation is run activating and supporting twinnings, cooperation agreements, support to policies making, training, participation in national and international networks. The cooperation of Turin with the Palestinian territories dates since 1999, and RENEP project is within the framework of the cooperation agreement signed by the Mayors of Hebron and Turin on June 2013. Turin plays the role of Coordinator for the Italian partners involved in this project.

METROPOLITAN CITY OF TURIN

Since the 1st January 2015 the Metropolitan City of Turin has taken the place of the Province of Turin.The Metropolitan City of Turin is the intermediate local level of government between the Municipality of Turin and the Piedmont Region. Located in the northwest of the Italian peninsula the Metropolitan City of Turin has the highest number of municipalities; it is the first intermediate Italian authorities in terms of territorial extension and it is one of the most populated with a demographic density, almost double than the Italian former Provinces average.
Through its International and European Relations and Projects Department, aims to promote the debate and the participation in the European Union and International policies and the access to the European Union and International resources in its own territory.

Papers & Publications

C. Micono, G. Zanzottera
"The Future of Power Storage in South Eastern Europe - Strategies for energy efficiency improvement in residential and office buildings: their role at building and country scale",
Enlargement and Integration Workshop, JRC, Tirana (AL), October 21-22, 2014

P. Lazzeroni, S. Olivero, M. Repetto, F. Stirano
"Impact of PV Penetration in a Distribution Grid: a Middle-East Study Case",
1st International Forum on Research and Technologies for Society and Industry, RTSI 2015, Turin (Italy), September 16-18, 2015

U.F. Calì, P. Lazzeroni, C. Micono, P. Montaldo, S. Olivero, F. Stirano, G. Zanzottera
"Energy efficiency measures for building and their impact on the grid in a Middle East case study",
9th International Conference on Innovation in Urban and Regional Planning, INPUT 2016, Turin (Italy), September 14-15, 2016

P. Lazzeroni, C. Micono, P. Montaldo, S. Olivero, M. Repetto, F. Stirano, G. Zanzottera
"PV and Building Energy Efficiency Measures Impact on the Grid in a Middle East Case Study",
AEIT International Annual Conference, Sustainable Development in the Mediterranean Area: Energy and ICT Networks of the Future, Capri (Italy), October 05-07, 2016

P. Lazzeroni, S. Olivero, M. Repetto, F. Stirano
"Battery Energy Storage System usage in a Distribution Grid for PV exploitation: a Middle-East Case Study",
42nd Annual Conference of IEEE Industrial Electronics Society, IECON 2016, Florence (Italy), October 24-27, 2016

December 2016

RENEP Renewable Energies for Palestine

Smart energy policies to enable local economic development

This project has been promoted by the Consulate General of Italy and the Palestinian Ministry of Local Government through the Palestinian Municipalities Support Program (PMSP) funded by the Italian Ministry of Foreign Affairs. The project has been performed by a partnership among the Municipalities of Hebron and Turin, with the technical and scientific contribution of SiTI, Ai Engineering and Metropolitan city of Turin.
The project has produced a feasibility study to define a "smart grid approach" to develop the renewable energy sector in the City of Hebron, and to identify smart energy policies to enable local economic development.
RENEP project is coherent with the recent strategies on renewable energy policies presented during the UN Climate Change Conference in Marrakesh.

Project activities

DATA COLLECTION
Collection of specific information on the grid, currently installed RES plants and users' consumptions

LEGISLATIVE FRAMEWORK ANALYSIS
Evaluation of the current legislative framework and identification of possible improvements

BUIDLING OF PILOT SITE
Definition of technical and organizational criteria and installation of RES generation systems on selected buildings

PREPARATION OF TOR AND TENDER DOCUMENTS
Preparation of documents to pave the way for the installation of RES plants in the whole city of Hebron

TRAINING ACTIVITIES
Training of local personnel in the field of integrated energy management and RES technologies

Hebron as innovation enabler

The increase of population and the urban growth are driving a major change in Palestine's energy demand, boosting consumptions and requiring environmentally sustainable solutions. This condition forces a technologic transition from fossil fuels to the development of **Distributed Generation** (DG) based on **Renewable Energy Sources** (RES), like wind and solar, especially in Palestinian territories where energy provision is highly dependent from foreign countries. Contemporarily, the increasing energy demand could be prevented by means of energy retrofitting actions in buildings. The RENEP project arose from these needs to develop the energy sector in the city of Hebron, in Palestine, **bringing know-how at local level** and **helping creating innovative entrepreneurship** and new jobs in the market of renewable energy in the Middle East.

Project goals

Under this light, RENEP project can be also considered a driver for:

- Developing the renewable energy sector in the city of Hebron, **increasing energy availability** to citizens
- Contributing the **improvement of the construction sector** making buildings more energy efficient
- Bringing know-how at local level as key enabler of "*smart policies*" oriented to community foundation based upon **skill and competences**.
- **Attracting external investors** and enabling funding by international organizations and donors boosting Local Economic Development (LED)

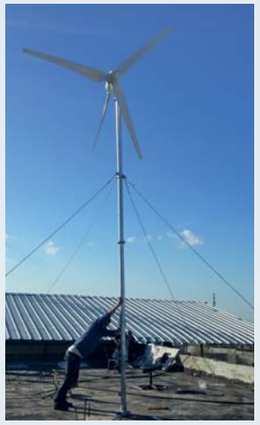
Before starting the study, an analysis of the legislative framework was required to better understand the current status in terms of exploitation of renewable sources. In **2012**, the Palestinian Energy and Natural Resources Authority launched the **Palestinian Solar Initiative (PSI)**, whose target was the installation of 5 MWp of solar renewable energy through installing photovoltaic panels on the rooftops of Palestinian households. The initiative was based on a feed-in tariff scheme, but during the implementation phase some technical and economic issues arose, making the initiative poorly sustainable. As a consequence, each distribution company in the West Bank started to develop its own regulation and incentive scheme. The **Hebron Energy Power Company (HePCo)** developed a **net-metering scheme**, following the example of the Jerusalem Energy District Company (JEDCo) that started to develop its policies well before the other Palestinian distribution companies. **HePCo also identified some areas where large PV plants could be installed,** but due to lack of funds very few projects were completed up to now, preventing a real understanding of the defined policies.
RENEP project aimed at providing a support to HePCo to fully understand the potential of the renewable sector and to optimize its exploitation. The activities within RENEP were subdivided in two main stages, according to the aforementioned goals of RES development and reduction of energy demand.

TRAINING SESSIONS

Dissemination of best practices in RES technologies and energy efficiency measure in buildings was also presented in two different workshops held in Turin (Nov 2014) and Hebron (June 2015). The workshops were aiming at an exchange of knowledge on RES installation and energy efficiency measure presently adopted in EU as best practice potentially replicable in Palestinian territories. In particular, the technical meeting attended by students and local technician was organized in Hebron to disseminate also the intermediate outcomes of RENEP project. Furthermore, several peer-reviewed conference papers were published during the project providing an academic validation of the results achieved.

DISTRIBUTION GRID ANALYSIS

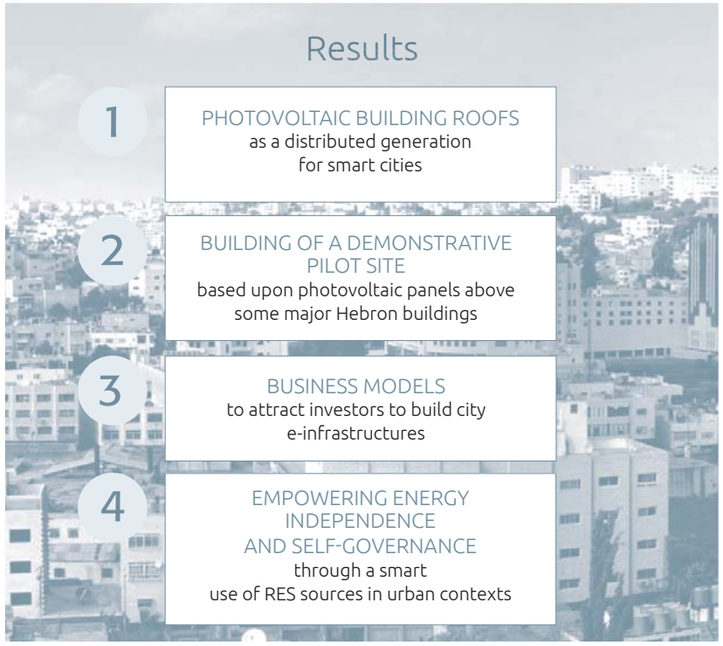
In the first stage, the potential penetration of photovoltaic (PV) installations into the distribution grid was evaluated taking into account grid limits like line congestion and/or voltage raise that can potentially reduce the grid stability and the power quality levels. Due to the intermittent nature of PV generation, the integration of battery energy storage systems (BESS) was studied to store the surplus energy produced by RES and release it when the production is lower than the demand.
The analysis highlighted that a wide PV generation could be potentially connected to the grid ensuring relevant self-consumption and self-sufficiency level for Hebron end-users. In fact, the simulations of the electrical distribution grid pointed out a potential PV capability of around 220MWp without violation of grid limits (e.g. congestion) but with a significant power flux inversion. In this context, the integration of the battery energy storage units can became also crucial to increase the PV development, to reach energy independence of the city based on RES generation and to avoid flux inversion. In fact, a specific analysis performed in a portion of the distribution grid showed the possibility to double the PV capability from 7MWp to 14MWp reducing line losses (-97%) and avoiding flux inversion by means of a wide diffusion of BESS at low voltage stage. Thus, energy storage capacity can represent a strategic issue, since it is able to make the entire City RES-based energy system profitable.
The analysis was performed by modelling the electrical distribution grid on a commercial load-flow software simulation tool (NEPLAN), on the basis of the data provided by HePCo. In the first step, load profiles were modelled through a statistical analysis of the data measured at the primary substations, while PV generation profiles were calculated through specific tools publicly available (e.g. PVGIS). However, during the project a pilot site was implemented to gather real data from the field. The pilot site consisted of PV generation systems (3x5kWp and 1x10kWp) and a 2kW wind turbine, providing real generation data. Furthermore, data-loggers and smart meters were used to monitor the consumption of selected buildings and obtain real data for load profiles also. The real data on the field allowed to validate the results coming from the simulations.
The plants are still presently monitored to extract additional data and information for future technical and also economic considerations.



ENERGY EFFICIENCY MEASURES FOR BUILDINGS

In the second stage, the investigation of the adoption of energy efficiency measures for existing buildings was performed, paving the way for urban regeneration and improvement of quality of life. Buildings were classified into different categories according to the activities performed inside them: residential, commercial, educational and industrial. Later, three main retrofitting actions were supposed for these reference buildings: reduction of thermal transmittance of opaque surface by means of replacement of coating of building envelope; replacement of transparent surface with one characterised by reduced light transmittance and solar factor; replacement of existing heating/cooling system with more efficient one (i.e. with increased COP and EER). Each category was analysed in order to identify the optimal combination of the aforementioned energy efficiency measures to be adopted to reduce the yearly energy consumption. As each category has different requirements from an energy point of view, different combinations were found for each category. Through simulations on a proper software tool (IES) new load profiles were defined, under the hypothesis that the energy efficiency actions will be implemented in the whole in a 15-years horizon time. The reduction of energy demands achieved by the implementation of the energy efficiency measure was then spread over the whole city by means of a GIS analysis of the distribution of the building typologies in the Hebron area. The results showed that the energy efficiency measure may have a significant impact on the buildings energy consumption. For example residential and commercial buildings, which represent around the 90% of the actual building typologies with 90% of whole Hebron energy demands, can potentially reduce their energy consumption of 18.5% and 25%, respectively. Moreover, implementing energy efficiency measures has a direct impact on the grid as there is a reduction of the energy consumed by buildings. As a consequence, a slightly reduced amount of energy generated by renewable sources can be fed to the grid before reaching the congestion limits. However, there is still a great potential (more than 200 MWp) in exploiting the renewable sources in the City of Hebron area.

Finally, a **preliminary economical evaluation** was performed in order to identify possible policy strategies focused on fostering the PV potential in **household or residential application**. In fact, residential units represent a large part of the buildings presently located in Hebron. Consequently, they represent also the main local end-users with the large energy demands compared to the other buildings typologies. Energy and economic evaluations for defining the incentive scheme showed that the incentive policy for fostering PV installation in residential application should primarily support the PV size up to 2-2.25kWp, if the primary goal is energy independence and high self-consumption. In particular, small PV size (≤1kWp) already reaches grid-parity according to the PV potential and installation costs in Hebron, even if these sizes make energy independency far to be reached. Anyway, supporting scheme as the proposed net-metering can be adopted if a large diffusion of PV wants also to be achieved.



In conclusion, **RENEP project** allows the development of a **"smart grid approach"** consisting of a production of energy from renewable sources that is optimized in economic and environmental terms, taking also into account the role of energy storage. This approach aims at integrating the adoption of **energy efficiency measures** for buildings and the installation of energy generation systems based on **renewable sources** in an innovative energy governance mechanisms and policies, able to maximize the exploitation of the available resources on the basis of the real energy needs. The City of Hebron can thus become an area where **innovative energy technologies** can be **tested and used as catalyst of profitable energy initiatives**. Preliminary meeting with technical and funding institutions potentially interested to cooperate in the implementation phase all over the whole City of Hebron took place in Emirate Arab United and further meetings are expected in the future.