

# FEASIBILITY STUDY FOR IMPLEMENTING ENERGY STORAGES IN CUNEO (IT)

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D.T1.2.1

Version 1.1

02.2020

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Title            Feasibility study for implementing energy storages in Cuneo  
Deliverable    D.T1.2.1  
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Status  
Reviewed by   Katja Karba, Michael Heidenreich  
Submission    February 2020



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# 1. Introduction

In the course of the project Store4HUC, a feasibility study is carried out for every pilot region (IT, AT, CRO, SI). A feasibility study is simply an assessment of the practicality of a proposed plan or project. It takes all relevant factors into account—including economic, technical, legal, and scheduling considerations—to ascertain the likelihood of completing the project successfully, and is therefore used to discern the pros and cons of undertaking a project before a lot of time and money is invested into it. As the name implies, the study deals with the question, if the project/pilot is feasible or not. The main goals can be defined as follows:<sup>1</sup>

- To understand thoroughly all aspects of a project, concept, or plan;
- To become aware of any potential problems that could occur while implementing the project;
- To determine if, after considering all significant factors, the project is viable—that is, worth undertaking.

This document deals with the feasibility study of the pilot in Cuneo (IT). The feasibility studies should outline the constraints and solutions from various aspects (technical, economic, monumental protection, status quo of HUC, ensure further implementation actions, etc.) to implement the pilot at the historical sites. The main target of the study is to enable a decision making about the pilot (“go” or “no-go” decision). A further target is to inform all relevant stakeholders and to get a first feedback from them. In contrast to the pre-investment concept, which will be carried out in D.T2.1.2, the feasibility study will focus on first rough analysis and plausibility checks. If the feasibility study leads to a positive result, the pre-investment concept will be carried out as the next step, where all specifications of the pilot for the application of the building permit will be specified. Therefore, the pre-investment concept has to be much more detailed than the feasibility study, but nevertheless all major impacts are already considered in the feasibility study, to enable the evaluation of the pilot.

To clarify the vision of the pilot, the mission statements according to the UNESCO-rules/conservation rules, the sustainability criteria, the environmental friendliness, the moderns and the legislation are defined in the second chapter. Based on the mission statements, strategies, targets and operative actions are deduced for the pilot. To classify the meaning of the pilot for the proposed HUC, the status quo is described in chapter three. It is dealing with questions like: “Are there already any other best practice examples on RES and EE?”, “How great is the willingness of the city/region for innovations like this?” or “What are the constraints, benefits, changes and barriers”, and so on?

In chapter four, the main factors for the assessment of the pilot are discussed. It starts with the technical specifications of the pilot like “what is planned?”, “which type of storage will be used?”, “why is this type of storage considered as the best option?”, “what other installations are planned?”, etc. From the economic perspective, the estimated costs (investment, operation) as well as the expected savings are explained. A first finance plan shows how the pilot will be financed and the next steps are planned. Moreover, a SWOT analysis is carried out that shows the strengths, weaknesses, opportunities and threats, of the pilot plan. Based on this information, the assessment of the practicality of the proposed pilot can be carried out.

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<sup>1</sup>Kenton, Will (11.08.2019): Feasibility Study. URL: “<https://www.investopedia.com/terms/f/feasibility-study.asp> [10.10.2019].



## 2. Mission Statements

As a pilot project, the intervention on the panoramic inclined lift in Cuneo aims to produce a positive achievement that can serve as a case study and a reference for further energy efficiency improvements through the use of a storage system in historic centres. The results of this pilot initiative will be shared not only with the stakeholders and authorities of the Central Europe Programme, but also with the various municipal services involved and with other cities comparable to Cuneo in terms of geographical location, artistic value of historic monuments, size and organisation of mobility. First of all, the city of Mondovì, which already has an installation similar to Cuneo - the “Funiculare” - to connect two of its main districts, located at different altitudes.

The project is aimed at optimising the energy resources necessary for the operation of the lift by means of a storage system, in which electricity will be stored and from which it will be used when needed. The storage will be utilised to recover the energy dissipated during the braking phases and produced during the elevator rides with maximum load unbalance, as well as the energy that will be supplied by a small solar field that, for the pilot project, will be installed along the inclined elevator's runway.

This model, which can be defined as a “stand alone” system due to its complete independence of operation from the power supply network, allows for greater operational flexibility and is in line with the most recent guidelines for optimising energy resources<sup>2</sup>, besides having a positive impact on the operating conditions of the public transport system, with an increase in the level of safety in the event of power failure from the network.

### 2.1. According to European and international guidelines and recommendations on conservation and rehabilitation of historic monuments and sites

Goals and actions to be achieved by this project are in accordance with key ethical and technical guidance and recommendations on heritage interventions brought by most relevant European and international institutions that deal with heritage protection and conservation such as UNESCO, European Commission, Architects' Council of Europe and above all ICOMOS - International Council on Monuments and Sites, only global non-government organisation dedicated to promoting the theory, methodology, and scientific techniques to the conservation of heritage. All those international charters for the conservation and restoration of monuments, starting from *The Venice Charter (1964)* up to more recent *The Valletta Principles for the Safeguarding and Management of Historic Cities, Towns and Urban Areas (2011)*, *The Paris Declaration On heritage as a driver of development (2011)* and most recent documents delivered in the framework of the European Year of Cultural Heritage 2018; *Leeuwarden declaration on adaptive re-use of the built heritage: preserving and enhancing the values of our built heritage for future generations* and *European Quality Principles for Cultural Heritage Interventions* insist on the following:

- investments in cultural heritage that are bringing benefits across the four areas of sustainable development: economy, culture, society and the environment,
- re-use of heritage monuments that will make them sustainable and comfortable for modern use and in that way will bring the prolongation of their life,
- multidisciplinary usage of knowledge and skills from different disciplines,
- using new solutions to emphasise and strengthen cultural values and give added value to a monument or site,

<sup>2</sup> <https://www.esasafe.com/assets/files/esaeds/pdf/Guideline-for-Distributed-Energy-Resources-DER-%202.0.pdf>



- bringing new functions to heritage monument that respond to community needs,
- re-use of heritage sites that can generate new social dynamics in their surrounding areas and thereby contribute to urban regeneration,
- with smart renovation and transformation heritage sites, new, mixed or extended uses can be found.

## 2.2. According to sustainability criteria

This pilot project is fully integrated in the strategy of the city of Cuneo in favour of sustainability and protection of environmental resources.

In September 2019 the City has adopted the PUMS (Piano Urbano della Mobilità Sostenibile - Sustainable Urban Mobility Plan). The PUMS provides the reference framework for the best management strategies of the City of Cuneo in which the planning approach aims at the implementation of a set of strategic actions for sustainable mobility. The whole approved plan is based on the new era introduced with the ELTIS<sup>3</sup> guidelines of the European Union. The programme reference framework of the Plan consists of the analysis and reasoned synthesis of the documentation related to the SEAP (Sustainable Energy Action Plan) of the City of Cuneo highlighting the objectives and actions for mobility and transport. It should be noted that in 2015 the Municipality of Cuneo shared and approved the proposal, formulated by the European Commission, of the "Covenant of Mayors". In 2016, the Municipality approved the Sustainable Energy Action Plan (SEAP) of the Municipality of Cuneo. Within the cross-border cooperation project Interreg Alcotra Italy - France 2014 - 2020, dedicated to climate change awareness and communication, the Municipality joined the new Covenant of Mayors. The development of the SECAP - Sustainable Energy and Climate Action Plan - is currently in progress.

## 2.3. According to environmental friendliness

The intervention of energy efficiency of the inclined elevator falls within the area of the River Park Gesso e Stura, and is therefore included within the landscape constraint of D. Lgs 42/2004 and subsequent amendments and additions.

Since the energy efficiency project provides for the construction of a small solar field integrated into the existing enclosure and the creation of a newly built technical room, such works are included in the list of minor interventions. Although limited in size, the works have an impact especially in terms of visual perception from the side of the Cuneo plateau that extends from the plain to the east of the city. The impact deriving from the presence of solar panels is inherent in the choice of the technological system, which, however, makes it possible to optimise the use of the energy necessary for the operation of the inclined lift, with positive implications for the environmental sustainability of the infrastructure. An effective mitigation cannot be achieved with a masking tree curtain because this would be in contrast with the operating requirements. However, it is important to highlight how the panels will be installed almost vertically for a minimal visual impact from the front. The side view is instead partially hidden by the vegetation already in situ.

## 2.4. According to modernes / state-of-the-art

Currently, the energy recoverable from the inclined lift is the energy generated by the driving machine during some operating phases (braking, unbalanced travel, etc.), that are very limited in time; for this

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<sup>3</sup> <https://www.eltis.org/>



reason, it is necessary to integrate the production with the installation of a small photovoltaic area with a capacity of foreseen app. 10 kWp, easily implemented along the runway of the inclined lift by modifying the current enclosure delimiting its area of operation.

The storage system integrated with the inclined lift drive shall meet the following functional requirements:

- to prioritise instantaneous self-consumption during the period of peak production of the photovoltaic system;
- to store the energy produced by the photovoltaic system and not instantaneously consumed;
- to use a portion of the energy produced to limit the peaks of absorption from the mains in case of need;
- to ensure an emergency power supply in the event of a power failure from the ENEL network, allowing the completion of the lift ride and an additional period of operation before the disruption of service, during which the surveillance personnel can take the necessary measures.

## 2.5. According to legislation

The following is a list of the regulatory references and legal constraints relating to the design and construction of structural works for both the mechanical frames supporting the photovoltaic panels and the technical room next to the top station of the lift.

- D.M. 17 January 2018 Update of the "Technical standards for construction". The reinforced concrete elements to be cast on site perform a static function and therefore require appropriate sizing and verification, according to the regulations in force. Since these elements are made of reinforced concrete and steelwork, the relevant structural design file must be submitted to the competent local authority, in accordance with the national and regional regulations in force. However, since the planned works are of little structural relevance, it will be necessary to verify in advance the provisions of the regional regulations on whether the structural design should be actually filed or not.
- As regards the electrical systems of the storage and the photovoltaic area, reference shall be made to the technical regulations for the sector (CEI) and to the UNI standards<sup>4</sup> applicable to this matter.
- Finally, the electrical drive of the elevator requires compliance to the directions of the regulations on public passenger transport, with relevant CE certification of all safety systems and subsystems.

## 3. Status quo of the proposed HUC

The system is entirely located within the territory of the Municipality of Cuneo, inside the urban perimeter area, and was built by the Municipal Administration as a permanent public transport system linking the free car parking area serving the sport facilities near the Gesso stream with the city centre, with the purpose of relocating the parking area for regular users outside the historic centre of the city (see figures 1 and 2).

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<sup>4</sup> [http://store.uni.com/catalogo/uni-cei-en-iso-50001-2011?josso\\_back\\_to=http://store.uni.com/josso-security-check.php&josso\\_cmd=login\\_optional&josso\\_partnerapp\\_host=store.uni.com](http://store.uni.com/catalogo/uni-cei-en-iso-50001-2011?josso_back_to=http://store.uni.com/josso-security-check.php&josso_cmd=login_optional&josso_partnerapp_host=store.uni.com)



Figure 1: Aerial view of the area, Source:Google Earth



Figure 2: Inclined lift to the city centre of Cuneo



The system can be classified as an "inclined lift" because it is equipped with a cabin for the transport of people that moves on rigid guides lying on a plane with an inclination between 15° and 75° above the horizontal for at least a stretch of the travel, with unmanned automated operation in accordance with current regulations. In fact, the lift runway is arranged along a straight section with a constant gradient of 25.52° above the horizontal and covers a difference in height of 28 m on a horizontal section of 58,65 m, with longitudinal development of 65 m along the slope. The system serves 2 stations at the terminal top and lower ends of its travel, without intermediate stops.

The motion is guaranteed by a capstan equipped with an electric motor, with drive pulley (friction pulley) and two idler pulleys installed on metal channel frames, fastened to the reinforced concrete structure of the engine room, located underground at the top station. The runway consists of two supporting sliding "beams" made of metal channel (HEA 300), resting on reinforced concrete foundation plinths and connected to each other by metal crossbars bearing the inverted T-section (125x82x16 mm) which functions as a control element of the cabin direction and as a braking rail for the "parachute" device.

Access to the lift is perpendicular to the direction of travel, with passenger boarding the cabin from the same side of the line (left side looking up from the lower station). On the opposite side of the cabin there is an emergency door for disembarking passengers in case of a blockage of the system that requires activation of the evacuation procedure, with exit towards the steelwork emergency staircase that runs along the lift runway on the northern side of the track. The cabin has a rectangular plan, with interior dimensions of 2080x1974 mm, and can accommodate up to 26 people. The cabin load is balanced by a counterweight, consisting of a rectangular metal channel frame equipped with 4 pairs of sliding wheels at the four corners with side guide wheels. The counterweight slides on the upper face of the lower beam section within the runway beams. The counterweight mass, which ensures the balancing of 50% of the maximum theoretical load of the cabin, is provided by metal blocks inserted in the metal channel structure of the frame. The cabin trolley and the counterweight trolley are connected to the 5 elevator-type suspension ropes by means of tie rods equipped with anchor device and fixing bolts with tension compensation through the interposition of steel springs, to improve the distribution of the traction effort on all the ropes. Along the runway, the ropes rest on plastic rollers, fixed to crossbars arranged between the main beams which also support the guide and braking rail of the parachute device.

## 4. Short specification / description of the pilot:

### 4.1. Technical specification

The project includes the realization of a new system for the production and storage of electrical power, integrated with the drive of the inclined elevator, as well as the construction of a small photovoltaic field along the system runway to supplement the amount of electrical energy that is produced by the elevator during some operating phases. This is actually a single integrated system, made up of several distinct elements, which also require some construction works for support. The individual functional units can be schematically represented as follows:

- changes to the drive of the inclined lift to include an energy recovery module for the energy generated by the driving machine equipped with interface for the connection with the storage;
- construction of a new photovoltaic field to integrate the electricity produced by the lift, through the installation of panels along the existing enclosure above the counterscarp wall of the lift runway, on the northern side of the infrastructure;
- installation of a storage unit, consisting of a dedicated battery pack and related electronic equipment for the control and modulation of incoming and outgoing electrical energy (storage);
- construction of a new technical room, next to the top station of the inclined lift, to house the storage unit and the electronic control and command equipment of the system;
- installation of underground cable ducts for electrical cables running from the photovoltaic field to the technical compartment and from there to the underground engine room of the inclined lift.



The sizing of the entire storage system and solar field was based on the maximum nominal power of the inclined lift and on the requirement to install the panels along the system runway. When choosing the solar panels, we opted for "polycrystalline" modules, obtained by melting the waste of "monocrystalline" modules: although the power yield is slightly lower than with monocrystalline panels, the cost is much lower. Moreover, the technological developments of the last few years, driven also by the numerous applications, have considerably reduced the difference in quality.

1 kWp electrical power is generated by a surface area of about 7 m<sup>2</sup> of polycrystalline panels. In this particular case, the total runway length is 65 meters, a portion of which is inside the end stations, thus reducing the useful length for installation to just over 59 m. However, this stretch of the runway also includes the intermediate emergency exit door, with a total width of about 1.5 meters, and the part of runway adjacent to the top station is in the shade for most of the afternoon and is not suitable for the installation of solar panels. These geometrical and functional evaluations led to the installation of 45 photovoltaic panels, of which 21 in the lower part of the line and 24 in the upper part, separated by a metal door for the escape route. The corresponding surface area is 72 m<sup>2</sup>, for a nominal peak electric power generation of about 10 kWp.

For a correct sizing of the storage unit, the operating strategies of the system should also be defined in order to determine the current consumption in stand-alone operation. Since this case concerned an automatic stand-alone system remotely controlled by the operator located only a few minutes away, the best option was a storage unit which, in the event of a power failure from the ENEL electricity distribution network, could guarantee the completion of the ride and an additional operation for another 15 minutes, more than enough time for the operator to intervene before the system shuts down. Considering that the cycle time is about 2 minutes, a maximum of 15 single rides can be made in 15', with an average absorption of about 20 A for a 40-seconds travel, for an indicative total of max 12,000 As or 3,33 Ah useful capacity of the battery.

## 4.2. Economical specification

The total investment for the project equals EUR 95,000.00, including the amounts available to the contracting authority (VAT, technical costs, contingencies, etc.). The scope of the works for the energy efficiency of the inclined lift involves on-site works and supplies for a total of 73.089,62 euros, of which 1,439.62 euros for safety related costs are not subject to reduction. The total for the entire work has been calculated on the basis of the elementary prices taken from the regional price list for public works, without application of increases, as well as unit prices determined through specific analyses based on market cost assessments.

## 4.3. SWOT Analysis

In order to underline the PROs and CONs of the chosen Store4HUC solution a SWOT analysis has been performed. Results are given in the table below.

STRENGTHS	WEAKNESSES
Improved energy efficiency of the system Improved system performance Reduction in operating costs when fully operational Promotion of the use of renewable energy	High costs of the energy efficiency intervention Difficulties in communicating the opportunity of the intervention to a non-specialist audience
OPPORTUNITIES	THREATS
Developing a replicable case study in Cuneo and other cities Generating environmental awareness in the public	Little interest from other local administrations to adopt the Cuneo pilot as a model Difficulties in replicating the model in contexts



	where the constraints of protection of historical centres are more restrictive.
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#### 4.4. Financing plan

FESR - Interreg Central Europe CE 1344 « Store4HUC»	80%
Revolving fund	20%

#### 4.5. Legal framework conditions

On the basis of the current urban development plan (approved by D.G.R. 40-9137 of 07/07/2008), the area enclosing the inclined lift subject to energy efficiency interventions falls almost entirely within the "TVAP - Territories with environmental and landscape value" established by the PRGC (art. 79), as is a large part of the eastern side of the plateau on which Cuneo lies, with the exception of the area on which the top station is located, which falls within the area of the outdoor spaces of the historic city, classified as "System of bastions: Lungo Gesso, Lungo Stura and pedestrian paths".

The area is just outside the boundaries of the historic centre and falls within the restricted area as defined by the Ministerial Decree No 01/08/1985 (Galassino) as it is part of the Cuneo River Park. In particular, the eastern side area is included within the adjoining area (Article 84) of the Gesso e Stura River Park, while the top station location is excluded from the park boundaries. Consideration should also be given to the hydrogeological constraints according to the indications of the Regional Territorial Plan (PTR), although the energy efficiency project for the inclined lift does not require earthworks of such extent to fall within the limits of application of the regional regulations.

#### 4.6. Action plan / milestones

a) Final project

The final project must obtain the required approval from the contracting authority as well as the landscape authorisation for the works within the area of the Gesso Stura River Park of the town of Cuneo.

b) Executive project

Once the executive project has been approved, and the landscape authorisation has been obtained, the executive project of the intervention will be validated.

Following the approval by the contracting authority, the tender procedures can be carried out based on the executive project and the works can start.

c) Construction site activities.

A time period of about 2 months is foreseen for the construction site works.

## 5. Collected feedback / summary

The discussion conducted with the other stakeholders during the meetings of the Deployment Desk of Store4HUC - and the accompanying path for the accession to the new Covenant of Mayors and implementation of the SECAP (Sustainable Energy and Climate Action Plan) - has brought out the usefulness of conducting case studies and pilot projects in this particular period. In spite of the current regulation of the energy market that does not provide for peer to peer trading opportunities - this way slowing down the deployment of storage devices - a new system of rules and regulations is currently under study that is likely to change the situation in the short to medium term, promoting the development of



Energy Community in the territory of the Piedmont Region. For the Cuneo area, the presence of a pilot project already implemented in a historic centre scenario will be an important element to be considered in the decision-making processes that shall be addressed at local level. In addition to the specific case of the pilot experiment involving the inclined lift - thanks to the participation of the Municipality of Cuneo in Store4HUC - the territory will also benefit from the experiences acquired in other European areas and the tools implemented as part of the project. With the realization of the pilot project, a first experimental phase will be completed that will open to new, more articulated interventions of energy efficiency through storage systems that will, among other things, contribute to the supply of some public services and to the increase of energy production from renewable sources for improved air quality and decarbonization process.