Equity crowdfunding tool for Community-driven Investments

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0.2	11/01/2022	CERTH	Related work and identification of actors and user scenarios
0.3	13/02/2022	CERTH	Technical study and mockups
0.4	16/03/2022	CERTH	Send for review
0.5	22/03/2022	ETRA	Review by ETRA
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1.0	29/03/2020	CERTH	Final Version

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1 Document Information

1.1 Executive summary

This document is part of the deliverables of the IANOS project, in the context of Work Package 3 (WP3) “Transition and Investment Decision Support Framework”. Specifically, it presents the first version of IANOS Equity Crowdfunding platform, the result of the effort for Task 3.2 “Equity crowdfunding tool for Community-driven Investments”. The platform will provide all stakeholders, namely project investors and islanders, with the opportunity to fund future initiatives in exchange for shares in the project or to register their future projects for funding through the CrowdEquity Platform. The component will convert community members into shareholders in renewable energy assets, in accordance with IANOS' community and Islander-centered philosophy.

Initially, the introductory sections provide the necessary information about the current document. More specifically, the scope and the objectives of the deliverable are presented and, subsequently, the structure of the current deliverable alongside its relation to other tasks and deliverables.

Before the presentation of IANOS Equity Crowdfunding platform, a valuable initial review of the related works is held. Firstly, the focus is on defining and describing the crowdfunding model and the different types of crowdfunding that are available. In a similar way, the motivation behind crowdfunding initiatives for renewable energy projects is analysed. The existing crowdfunding platforms for renewable energy projects located in Europe are also presented.

An initial analysis of the platform is presented in Chapter 4. In the general description of the platform, the main goals are analysed, which eventually is the shared ownership of renewable energy infrastructures, as well as the financial support islanders’ initiatives.

The platform features include all the common features of the most popular crowdfunding platforms, containing project management features, user management features, investment management features, performance monitoring features and legal information.

The identification of the actors of the platform is a vital step in the development of the platform. Together with the latter, the initial user scenarios are also identified in this document. Lastly, the requirements concerning the cybersecurity of the platform, concerning user authentication, private data handling, and security of communications, are defined.

Furthermore, an initial technical study is held concerning the software pre-requirements of the platform, namely the programming languages and the frameworks utilized for the development of the platform’s front-end and back-end.

A first view of the platform is provided in the deliverable in the following chapters. Initially, the structure of the platform is presented, and mockups of the main pages of the platform are provided, highlighting the available features.

In Chapter 7 the final conclusions of the deliverable are presented. Additionally, the future steps that are required for the final development of the platform are identified and described in the final chapter of the deliverable.

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1.2 List of acronyms and abbreviations

Table 1.1: List of acronyms and abbreviations

Abbreviations	Full Description
API	Application Programming Interface
CSS	Cascading Style Sheets
dApp	Decentralized Application
DLT	Distributed-Ledger based energy Transactions
ESB	Enterprise Service Bus
FAQ	Frequently Asked Questions
HTML	Hypertext Markup Language
IRR	Internal rate of return
IRR	Internal Rate of Return
MTV	Model-Template-View
p2p	Peer-to-peer
PV	Photovoltaic
SME	Small and Medium-sized Enterprises
UML	Unified Modeling Language
VSE	Very Small Enterprises
W3C	World Wide Web Consortium

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2 Introduction

2.1 Scope and objectives of the deliverable

Deliverable 3.3 is the first version of the Equity crowdfunding tool for Community-driven Investments. The document provides an initial description of the CrowdEquity platform developed within the IANOS project. All stakeholders, such as project investors and islanders, will be able to fund future projects in return for shares in the project or register their future projects to obtain funding through the CrowdEquity Platform. The component will turn community members into shareholders in renewable energy assets, consistent with IANOS' community and Islander-centric strategy.

The objective of the deliverable is to define the crowdfunding model, providing example of similar crowdfunding tools. Subsequently, the main goal is to analyze the platform, namely its general description, the features of the platform, the main actors and use cases and finally the cybersecurity requirements that the platform will have. The next objective is to present the frameworks and the programming languages used in the development of the platform. In the core of the document, the mockups of the platform's front-end are presented to visualize the platform's features.

The development of the platform is going to be finalized in the second version, in deliverable D3.4, which is due in M30 of the project.

2.2 Structure of the deliverable

The deliverable is structured as follows

- **Chapter 1** presents information about the current document, namely the executive summary of the deliverable and a list of acronyms and abbreviations.
- **Chapter 2** presents the scope, objectives and structure of the deliverable, as well as its relation to the other tasks and deliverables of the IANOS project.
- **Chapter 3** provides the initial review of the related works. More specifically, the definition of crowdfunding and the crowdfunding models are presented together with the motivation for crowdfunding in renewable energy projects. Finally, the existing crowdfunding platforms for renewable energy investments are presented.
- **Chapter 4** provides an analysis of IANOS CrowdEquity platform. The features of the platform are presented, together with the use cases and the actors of the platform. Finally, the cybersecurity requirements of the platform are highlighted.
- **Chapter 5** is the technical study of the platform, where the frameworks and the programming languages used in the development of the platform are presented.
- **Chapter 6** provides information about IANOS CrowdEquity platform and its main functionalities.
- **Chapter 7** provides conclusions about the overall work implemented in the current deliverable.

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2.3 Relation to other tasks and deliverables

The deliverable D3.3 is based on the Use Cases and requirements described in D2.1 “Report on Islands requirements engineering and UCs definitions”. T2.5 “System Architecture”, which describes the system's architecture, also includes an early description of the functionality of the component detailed in this deliverable, as well as its linkages and dependencies. The deliverable is also related to “iVPP P2P transactive energy framework” described in D4.9.

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3 Related work

3.1 Definition of crowdfunding and crowdfunding models

Crowdfunding is an alternative way of financing, which is based on the financial contribution of the public to support a new or existing business idea. It offers benefits to both parties involved, as a project developer can receive financing for their project, while an investor receives certain benefits, depending on the model. Crowdfunding is possible thanks to specialized online platforms that provide the necessary transaction security and the necessary tools to manage the campaign. Each crowdfunding platform's user can contribute by giving from just one euro to several hundred, depending on the funding packages offered by the creator of the campaign.

There are mainly five crowdfunding models, depending on the gains that each investor has. Those models are:

- **Donation-based crowdfunding**, where contributors gain nothing, and it mainly focusses on charitable projects.
- **Reward-based crowdfunding**, where, in return for their funding, contributors are rewarded with a token. They receive no interest in the earnings, or shares.
- **Pre-purchase crowdfunding**, which is similar to the reward model, but the contributor, is provided with the final product that they finance, instead of any other token. In renewable energy projects, the investor's reward for investment comes in the form of electricity supplied or a discount on electricity rates.
- **Peer-to-peer (p2p) crowdfunding**, which is similar to acquiring a loan from a bank, meaning that contributors expect return of the capital they invested, either with an interest bearing, or alternatively not. It is also known as debt crowdfunding or lending crowdfunding. It is one of the most common models.
- **Equity crowdfunding**, where the investor is offered shares of the projects, they finance.

Some of the most popular crowdfunding platforms for several kinds of project ideas are Kickstarter [1], Indiegogo [2], Patreon [3], GoFundMe [4], Chuffed [5], ArtistShare [6], and more.

3.2 Motivation of crowdfunding in renewable energy projects

Crowdfunding models have been very beneficial in the development of renewable energy projects. They can be addressed not only to traditional investors that are motivated mainly by the prospect of future financial gains, but also to individuals with charitable goals motivated by the prospect of reducing emissions by developing sustainable energy solutions. Thus, the participation in a crowdfunding platform for renewable energy projects can bring financial reward, social return, as well as material gain in the form of energy, in pre-purchase crowdfunding model. Most crowdfunding platforms already have a large and dedicated investor community, as well as high traffic. Their users are people who are actively looking for projects to financially support and invest in. This fact not only makes the marketing of each crowdfunding campaign easier, but also constitutes the best return on investment.

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As far as project developement goes, crowdfunding gives a rare opportunity to acquire funds for their ambitious projects, without an intermediate, not including the potential platform fees. Additionally, such a platform provides the project developers with the opportunity to build a close and dedicated relationship with the project supporters. The public that has invested in it financially and emotionally will follow it faithfully. Moreover, through crowdfunding platforms, they can communicate with a wide audience and collect data and feedback, which may be extremely useful in the future. In IANOS and similar projects, the equity crowdfunding can boost the sense of community that the islanders have, enabling the factorization of the renewable energy assets. Even without the social features that the CrowdEquity platform incorporates, the common ownership of the future assets can psychologically enhance the collaboration and communication of the community members.

3.3 Existing European crowdfunding platforms for renewable energy projects

Since the end of the first decade of 2000s, there has been a great growth in crowdfunding platforms for renewable energy projects, based in Europe. Most of the platforms are based on the peer-to-peer and equity models. Most of the platforms involve projects developed within the boundaries of the country in which they are developed. This is expected, as most of the countries have different legal regulations for crowdfunding.

3.3.1 Peer-to-peer crowdfunding platforms

Bettervest [7] was founded in 2012 in Germany as an online platform that gives actors the opportunity to invest in renewable energy projects across the globe. It is based on the p2p crowdfunding model, where project owners borrow money from investors in exchange of interest. There is a plethora of renewable energy projects available for investment varying from renewable energy farms (e.g PV and wind farms) to public transport. The minimum investment is set to €250 and each project that is financed using the platform mechanics must meet certain criteria, such as minimum loan requirement of €100,000, reduction of harmful emissions, payback period of one to ten years, 10% of the loan volume as equity capital and additional collateral. There is no platform fee or payment involved in the transactions. The platform provides secure login and registration via username and password, data protection, legal information via term and condition contacts, analytics about the project financing development and FAQs section for user assistance.

GreenVesting [8] is another debt-based crowdfunding platform based in Germany since 2012. It is presented as a competent service partner for green project development, energy efficient real estate and general financing of energy projects. Together with financing, it is responsible for developing and operating various PV systems on behalf of different investors and project providers. The minimum investment is set to €100. Although the only language available is German, it provides helpful guidance for each step of the investment process, from selecting a project to financing it and latter receive payment. Each available project is equipped with an overview of all important information about the owner, the development, the purpose etc. Additionally, all the required legal information and risk are provided.

Abundance [9] was founded in 2012 in United Kingdom as an easy way to access investments for sustainable energy projects. It is based on the debt-based crowdfunding. It provides actors with opportunities to invest in different kinds of projects with a minimum investment of £5. More specifically, each actor can invest in a green energy company directly choosing the risk that they

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want to take or invest in council led projects across the UK in return of a lower risk, or even buy existing investments from other customers on the platform's marketplace. The platform provides a plethora of information about the investment procedures and the available projects. Moreover, the platform assists in the assessment of the risks in each project. It provides secure login and registration via username and password, data protection via disclaimers and term and condition contracts and a blog providing news and other articles.

3.3.2 Equity based platforms

Windcentrale [10] is one of the oldest and largest crowdfunding platforms, founded in the Netherlands in 2010. It is based on the equity crowdfunding model. More specifically, it offers the opportunity to become owner of wind turbines by splitting them in wind shares available for purchasing with a simple mouse click. Each wind share has an expected annual capacity of 500kWh, and it costs €210 for 18 years. Additional costs include the statutory energy tax, the storage of sustainable energy, as well as a little less than €2 per month for maintenance and management. The power produced by the wind shares usually is deducted from the annual electricity bill and it usually corresponds to the 90% of the required electricity for each actor. When more electricity is recurred, a regular electricity tariff must be paid. A blog and a FAQ section are provided by the platform to help the investment process. Moreover, the platform offers an app that allows the user to monitor the performance of the windmills that they invested in.

Econeers [11] is a German equity crowdfunding platform on the market since 2013. It aims to support climate and environmental protection by investing in renewable energies and in their efficient use. The platform does not require a registration or agency fee and the minimum investment is set to €250. The investors are offered projects varying from solar and wind farms to organic food products. Each project registered must provide an overview of the project's information and the company involved. The platform provides secure login and registration via username and password, information for the investors, the companies, a blog with various news articles, and articles about green initiatives.

Lendopolis [12] is a French based equity crowdfunding platform founded in 2014. It allows projects in renewable energy sector developed by very small enterprises (VSEs) and small and medium-sized enterprises (SMEs) to acquire funds from individuals. In Lendopolis, an actor invests in a project of their choice via an intermediary company, created especially for this occasion, grouping together all the investors within a single structure. The intermediary company, managed by Lendopolis, owns 40% of the renewable energy projects, while the developer owns the remaining 60%. In the end of investment, the developer is required to buy back the shares that the intermediary company owns, becoming the only owner of the asset, while intermediary company pays the investors a price for their shares, fixed in advance. This price is set to ensure a profit based on the original investment. The platform offers detailed information about the investment process, together with a guide to understand crowdfunding.

1miljoenwatt [13] is a foundation based in the Netherlands. It launched a crowdfunding platform in 2013 in order to fund solar energy projects, PV panels installed in roofs that supply electricity to football stadiums in the city of Groningen. The minimum investment is set to €550 and corresponds to one individual solar panel including maintenance. Each investor receives money each year, depending on the electricity that their panels produced. During the course of the project, 1miljoenwatt is involved as owner or manager of the project, taking care of administration and

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maintenance. The platform provides an online ‘MijnStroom’ portal in order to inform the participants about the development of their investment.

Citizenergy [14] is a crowdfunding platform founded in 2012 based in Portugal. Citizenergy offers every model of crowdfunding available, although most of the projects’ funding are based on the equity and the lending model. It is the first platform that allows cross-border investment in renewable energy projects. Citizenergy achieves the latter by bringing different cooperatives and crowdfunding platforms together on an international level. Citizenergy is a form of intermediate between any investor and a plethora of crowdfunding platforms, mainly in Europe.

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4 Platform analysis

4.1 General Description

IANOS CrowdEquity platform is a unique equity crowdfunding platform developed within IANOS project. The platform is designed to fund and thus promote the use of renewable energy related assets in the two pilot islands of the project, Terceira in Portugal and Ameland in the Netherlands. The platform would eventually allow shared ownership of renewable energy infrastructures, as well as financially support islanders' initiatives. The final goal of crowdfunding platform is to promote the communication and collaboration between the islanders.

In the crowdfunding platform each user can have two roles, either creator or investor. By creating a new entry, a user will be able to set a fundraising goal to support his/her project, while, by investing in a project a user will acquire equities of the investment. The investment can be held either via normal FIAT currency or by specifically defined energy tokens. The tokenized energy will be defined by the Distributed-Ledger based energy Transactions (DLT) Platform, developed within "iVPP P2P transactive energy framework" described in D4.9.

4.2 Platform's features

IANOS CrowdEquity platform will acquire the majority of features that the most popular equity crowdfunding platforms have, with the addition of projects specific features. These features can be categorized depending on their functionality and utility.

4.2.1 Project management features

The projects management features include several features concerning the projects that are in need of funding. Each project must include a clear Title, a detailed Description, and a Category based on the renewable energy asset that is going to be developed. Moreover, in terms of the investment procedure, an Investment Target, Minimum/Maximum investment fee, the available Shares and current Number of Investors will be included. Additional information about the project will include the Project's prospectus, a Time Overview about the project's development stage and information about the project owner. These features will provide the potential investor with all the needed information about their investment.

4.2.2 User management features

In order to use the services of the platforms, each user will be given the opportunity to make a profile in the platform. To make said profile Secure Username/Password Registration and Secure Username/Password login is needed, as well as User verification every time they log in. The user will have the ability to edit their profile by adding personal and professional information, a profile picture and interests. Additionally, each profile will be equipped with secure decentralized dApp dashboards (wallets) that will enable the access to the user's energy tokens.

4.2.3 Investment management features

Another very important aspect of a crowdfunding platform is the management of project's funding, and the actual payments. IANOS CrowdEquity platform will be equipped with the most common features for payment management, which include Escrow accounts, where funds are held in trust

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while the parties involved complete a transaction, Subscription payments, which are automatic payments based on a schedule, while different payment APIs are going to be provided. Additionally, the users will be able to choose the currency of the transaction, varying from real FIAT current to tokenized energy based on the Distributed-Ledger based energy Transactions (DLT). Platform developers' main priority will be the security of the transactions using the latest blockchain technologies.

4.2.4 Performance monitoring features

IANOS CrowdEquity platform will be equipped with visual analytics in order to assist the users to monitor their investments. More specifically, summary reports are going to be available on a scheduled basis, accompanied by statistical analysis of the investment and development report. Internal rate of return (IRR) analysis is going to be provided for each project as an additional advice to the investors. A key goal of the platform is the energy sufficiency of the islands, using renewable energy assets, thus, it is important to present each future investment's energy yield report.

4.2.5 Legal information

The platform stores personal information about the users as well as transaction information. Thus, it is obliged to provide the users with Terms of Use and Privacy Policy agreements. Additionally, a crowdfunding platform is bound to legal standards depending on the country. Therefore, it is very important to include the relevant law regulations, together with a legal notice about its services. Finally, a section presenting information about the platform owner is going to be provided.

4.3 Identification of actors and user scenarios

4.3.1 Platform's actors

One of the preliminary steps of the development is to identify and specify the actors of the platform. An actor in a platform, more generally in a system, is an independent person, organization, or outside system that makes interactions with it (e.g. retrieve information, enter data). When several users share the same role, the definition of an actor can bring them together. The actors and their roles, which must be identified, enable the system to define the interface it will provide to its environment. In IANOS equity crowdfunding platform, the following actors have been identified:

- **Creator**, who relates to the individuals who register their planned projects and establish a financing goal in exchange for equity, resulting in the creation of the fundraising campaign.
- **Investor**, who corresponds to the individuals that fund the registered projects in return for equity. The creator and investor roles are connected in many use cases, in which the actors are referred as **users**.
- **Platform**, which refers to the actors related to the actual platform. This category of actors contains the administration, the database that contains the projects, the wallet application and more.
- Lastly, **visitor**, who contains the individuals that are not registered in the platform and have limited access to its features.

4.3.2 Platform's user scenarios

The next preliminary step in designing the platform is to define the user scenarios that describe the different interaction between a category of actors and the platform or the other actors. During the

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developed stage of the platform, the scenarios may be altered following certain changes that may occur in the interactions. For each user scenarios, a UML diagram is provided to better visualize it.

4.3.2.1 Login/Register

The users of the platform, investors and creators, need to register via email in the platform to access its features. After the registration, a secure login access is provided, with username or email and password protection, together with a supplementary feature, when a user forgets their password.

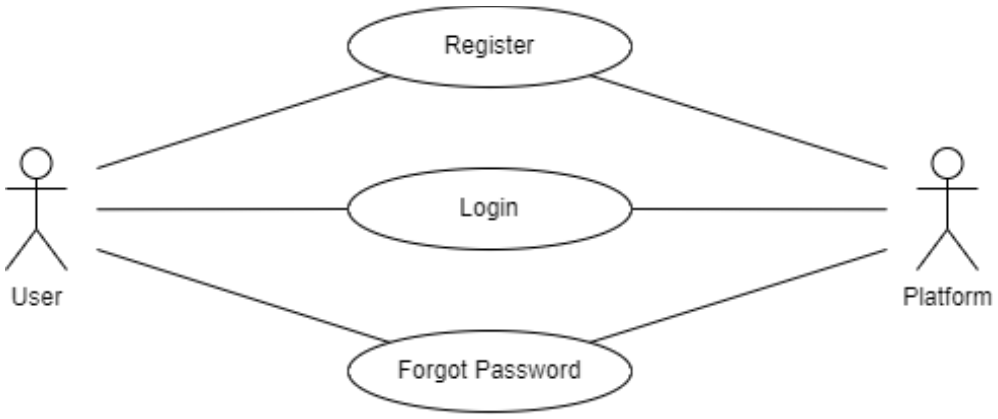

Figure 4.1: Login/Register use case of IANOS CrowdEquity platform

4.3.2.2 Account Management

A registered user creates a personalized profile in which they can update their login password and email. Additionally, they can update some user information, namely his first and last name, place of residence, education, professional information, interests and more. Finally, the user will be able to update the settings of their account.

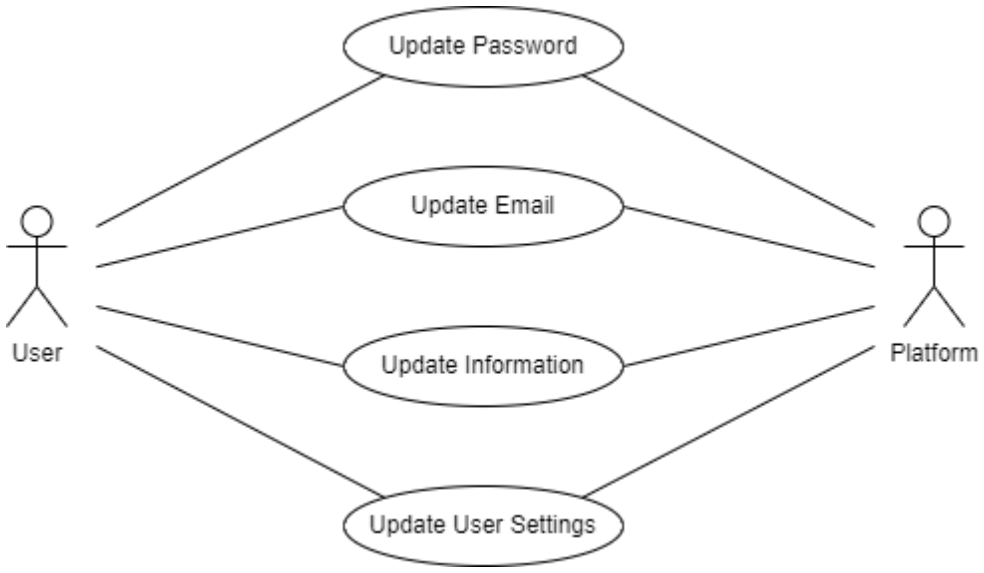

Figure 4.2: Account management use case of IANOS CrowdEquity platform

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4.3.2.3 Project management

In the project management use case a creator is able to create a project and set its funding goal or delete it. Additionally, the creator is capable of editing the project details, such as the title of the project, its description, information about the user and more, when they register their project.

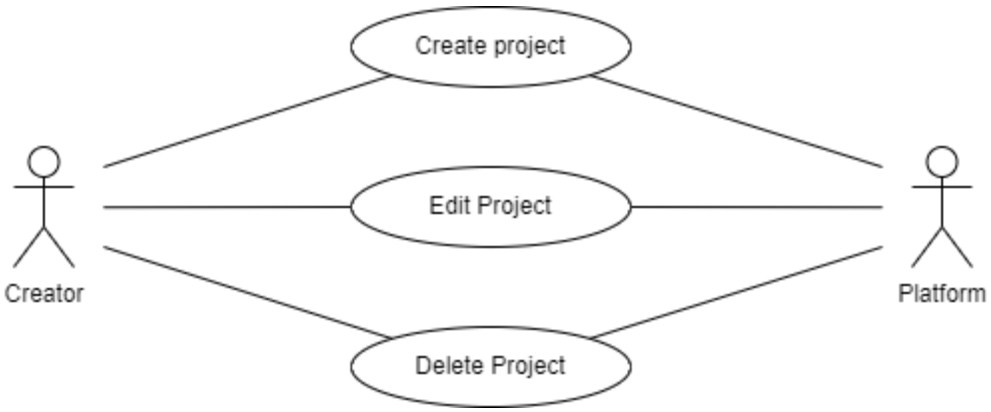

Figure 4.3: Project management use case of IANOS CrowdEquity platform

4.3.2.4 Investor-project interactions

On the opposite end, an investor is able to interact with a project by investing in the project or sharing it.

Figure 4.4: Investor-project interactions use case of IANOS CrowdEquity platform

4.3.2.5 Funding interactions

In order to fund a project, there are certain steps that an investor must follow, described in the funding interaction use case.

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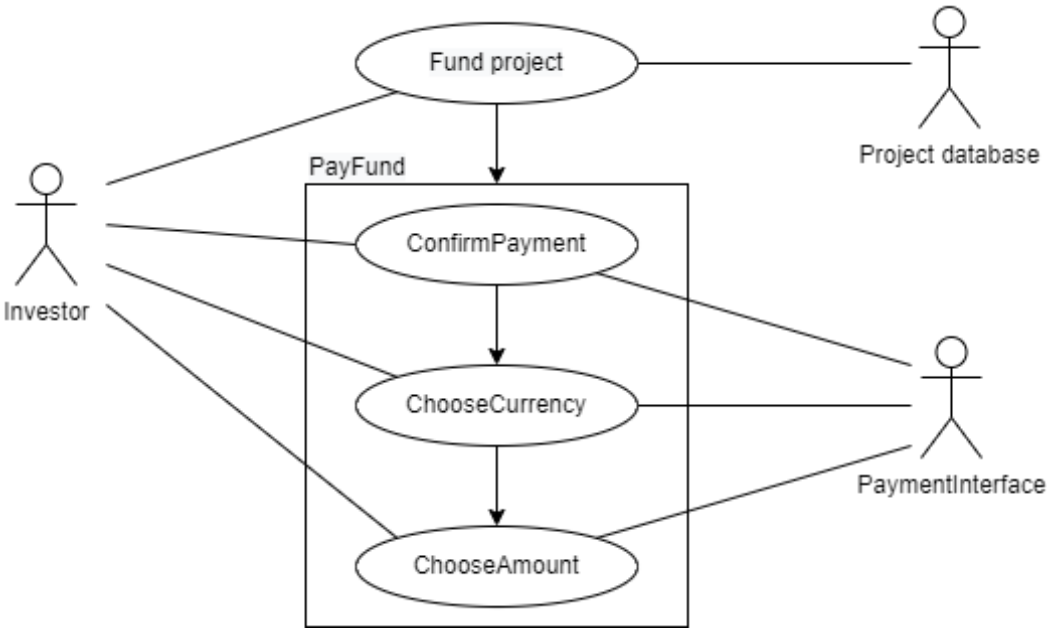

Figure 4.5: Funding interactions use case of IANOS CrowdEquity platform

After deciding whether an investor will fund a project, they will be connected to a payment interface, where the confirmation of the payment is held. The investor will be able to choose the currency in which he or she are going to pay. Together with the normal FIAT currencies that are going to be available, the platform will offer them with the ability to pay with energy token defined within IANOS DLT-based Transactive Platform. The final step of the process is to choose the amount that they want to invest.

4.3.2.6 Wallet interactions

To facilitate their transactions and be able to overview them, the users will have access to a virtual wallet application. Within the application, the users will have the ability to deposit or withdraw funds from a billing account that they can link. Furthermore, they will be able to change the key link to each account. Lastly, the wallet application will have visual analytics tools that are going to provide information about the investments of the users, their gain and losses and more.

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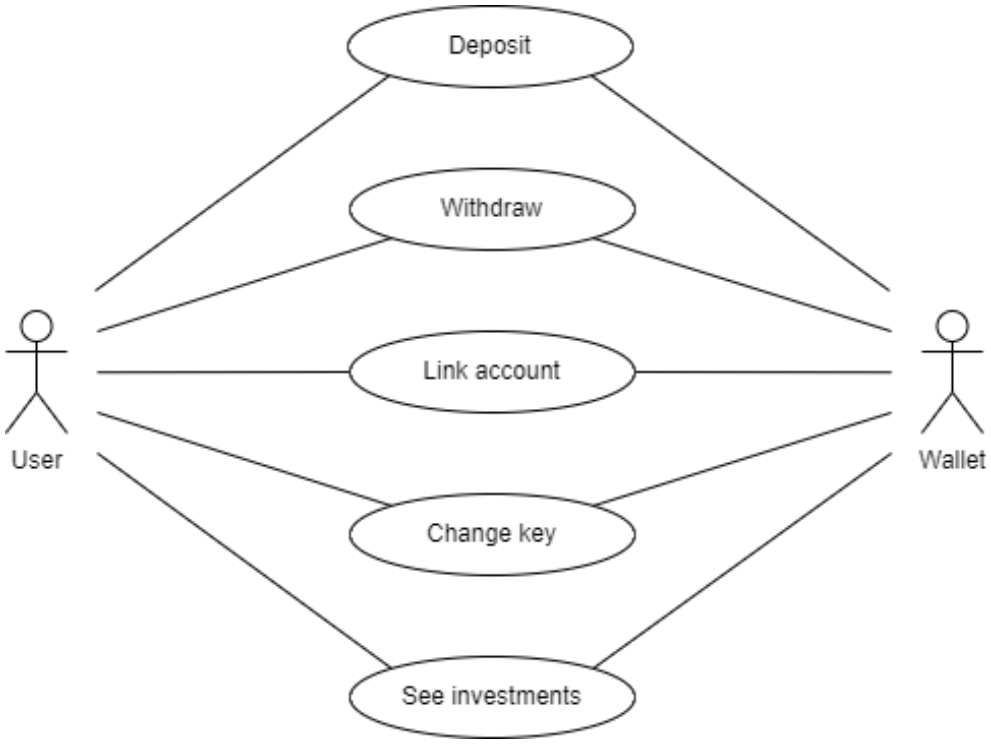

Figure 4.6: Wallet interactions use case of IANOS CrowdEquity platform

4.3.2.7 Visitor interactions

As mentioned previously, the visitors of the platform will have limited access to platform's features. More specifically, a visitor will be able to browse projects and their information, as well as access the legal information of the platform.

Figure 4.7: Visitor interactions use case of IANOS CrowdEquity platform

4.4 Cybersecurity requirements

This chapter addresses the security standards for the system, with the intent of enhancing the platform's robustness against harmful cyberattacks through prevention, detection, and reduction. It assesses individuals' security expectations. Because humans are typically regarded as the most volatile variable in cybersecurity, the training and control of the end-user are vital aspects of cybersecurity. Prevention is an efficient, sustainable, and long-term method of minimizing the incidence and severity of cyber-attacks. To reliably and thoroughly secure systems, end-users, and endpoints, cybersecurity should preferably implement security features needed by embedded systems.

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4.4.1 User authentication

One of the most important cybersecurity features is the user authentication that translates to the verification of the user's identity. User authentication is a critical step in preventing unauthorized users from accessing private and/or sensitive data. In order to prove their identity, the user must submit an authentication factor. Based on user authentication, task users must provide identification, by proving their identity, authentication, by proving they are who they are claim to be, and finally authorization, where must prove their authority on what there are willing to do.

4.4.2 Private data handling

Information security safeguards data integrity and privacy during both storage and transfer. Both privacy and security have an impact on a user's online safety. Privacy is concerned with the manner in which private/personal data should be acquired, kept, managed, used, and shared with third parties in line with data protection legislation. Security, on the other hand, relates to how private data is safeguarded. While data privacy is concerned with individual rights, data security is concerned with protecting data from harmful assaults and preventing the use of stolen data. They collaborate to establish a data protection zone with protected useable data as an output. Based on the three components of data privacy individuals have the right to control their private information. Additionally, protocols for correct personal data management, processing, collection, and dissemination must be followed, and finally, there must by obedience to data protection laws.

4.4.3 Security of communications

Communication security is the safeguarding of private and sensitive information with the goal of preventing important information from being intercepted by unauthorized parties. When storing and transferring data, it is critical to prioritize security. In addition to ensuring the security of stored data, it is critical to safeguard data exchanged between the card and external devices. When data is in motion, it is typically regarded significantly more susceptible, vulnerable to hazards, and less safe.

Data protection in transit refers to the security of data while it moves from one network to another or from a local storage device to a cloud storage device. Effective data security mechanisms for data in transit are critical wherever data moves.

The data transfer/collection role in IANOS system is played by the iVPP secured Enterprise Service Bus (ESB), focusing specifically on cyber-security aspects. The ESB will be the tool that all of the components incorporated into the iVPP platform will use to collect data from all of the energy assets scattered across different geographical regions by talking with it. The ESB will define mechanisms for exchanging contextual data from field components to the iVPP platform. A secure password-protected connection to the ESB database is required for data collecting. Finally, in order to obtain other data, such as pricing information and weather forecasts, online links with external databases will be built using Application Programming Interfaces (API).

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5 Technical study

In this section, information is going to be provided regarding the technologies that are utilized by the developers of IANOS CrowdEquity platform, in order to efficiently facilitate its requested functionalities and features.

5.1 Programing languages

5.1.1 Front-End

For the development of the front-end of the platform, HTML and CSS are utilized.

HTML [15], or Hypertext Markup Language, is the standard markup language for documents that will be viewed on a web browser. Technologies such as Cascading Style Sheets (CSS) and programming languages like JavaScript can support HTML. HTML documents are sent to web browser usually via a web server or locally stored files and afterwards are converted to multimedia web pages. HTML originally offered cues to the document's layout and described the structure of a web page semantically.

CSS [16] (Cascading Style Sheets) is a style language for describing how a document generated in a markup language like HTML appears. CSS specifies how elements, defined by HTML, are showed on a screen, in speech, on paper, or in other forms of media. According to W3C guidelines, CSS is one of the core languages of the open web and is standardized across Web browsers.

5.1.2 Back-End

The reference language of the back-end IANOS CrowdEquity platform, in order to facilitate its functionalities, will be **Python** [17]. Python is a general-purpose programming language with a high level of abstraction, ideal for fast and easy prototyping. Its design philosophy prioritizes code readability. Python elements and object-oriented approach are intended to assist programmers in writing clear, logical code for both small and large-scale projects. Python supports a wide range of development methodologies, including structured, object-oriented, and functional programming.

5.2 Frameworks

5.2.1 Front-End

The framework utilized for the development of the front-end of the platform is **Angular** [18]. Angular is a Typescript-based programming environment. Angular is a component-based framework for developing scalable web applications, as well as a collection of libraries that cover a wide range of features such as routing, forms management, and client-server communication, as well as a set of developer tools for developing, building, testing, and updating the code.

5.2.2 Back-End

The three frameworks utilized for the development of the back-end of the platform are Django, Flask and PostgreSQL for the database.

Django [19] is a free and open-source web framework based on the Python programming language. Django's architectural paradigm is model–template–views (MTV). The ability of the components to be reused and readily "plugged" is given special consideration. Additionally, the usage of Django

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allows the reduction of the amount of code utilized and faster development. Python is used to manage settings, files, and data models. Using admin models, an interface for generating, reading, updating, and deleting is created and configured.

Flask [20] is a web application framework based on Python programming. Flask allows the developer to add application features as though they were built into the framework. Extensions are available for form validation, upload handling, object-relational mappers, several open authentication protocols, and other framework-related features.

PostgresSQL [21] is a feature-rich open-source relational database. It is built on an architecture that has earned its customers' trust in terms of dependability, data integrity, and appropriate operation. PostgreSQL is available for Linux, UNIX (AIX, BSD, HP-UX, SGI, IRIX, MAC OS X, Solaris, Tru64), and Windows. It is ACID compliant and supports the majority of SQL92 and SQL99 data types, such as INTEGER, NUMERIC, BOOLEAN, CHAR, VARCHAR, DATE, INTERVAL, and TIMESTAMP. It also allows for the storage of big binary items such as photos, music, or films. It also provides programming environments for C, C++, Java, Perl, Ruby, Tcl, and finally Python, which is used in this project.

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6 IANOS CrowdEquity platform

In this section, a first glance at IANOS CrowdEquity platform is going to be presented. The most basic pages of the platform are going to be presented in the following chapters, together with an example of their mockups, and a short description.

6.1 Platform's structure

In the following figure, the main structure of IANOS CrowdEquity platform is presented. Each user will be able to easily navigate and have access to the pages containing all the aforementioned features of the platform. More specifically, the different main pages that are going to be accessible are: Investment Opportunities, My Investments, My Projects, My Wallet, My Social Profile, Notifications, Account and About, which contains the Legal Information and information on How to Invest.

An example of the structure is presented in Figure 6.1.

Figure 6.1: IANOS CrowdEquity platform's architecture

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6.2 Login & Registration page

The first page that the user encounters is the registration page. In the registration page, the user will be able to securely register into the platform utilizing e-mail and password registration. The required fields contain the user's first and last name, a username that is used to identify the user and obviously the e-mail and password. In order to register the user is obliged to be informed about and accept the Privacy Policy and the Terms and Conditions. An example of the registration page is provided in Figure 6.2.

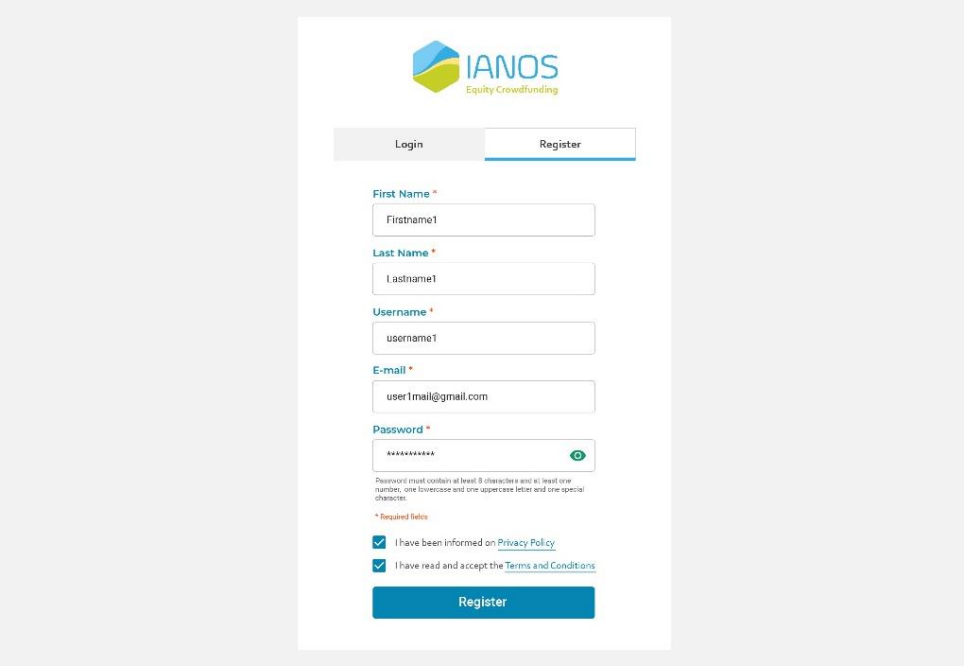

Figure 6.2: Platform's Registration Page

After they are registered in the platform, the user will be able to login via the Log In page using their email and password. The user will be able to pick whether the platform will be able to remember the credential and automatically let them log in, as shown in Figure 6.3.

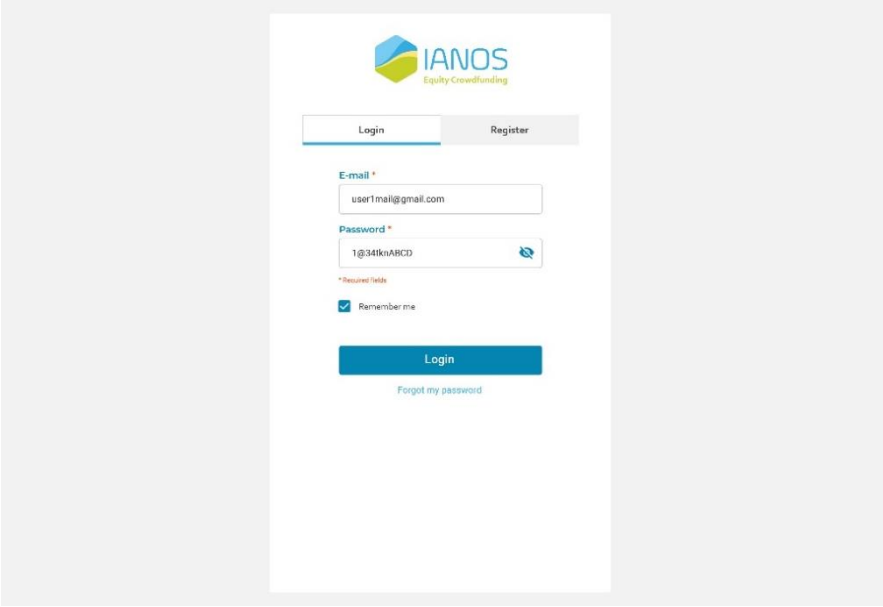

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Figure 6.3: Platform's Login Page

6.3 Account page

After the registration or login, the user will be able to navigate to their account page in order to fill the information that they are willing to display on their social profile page. In the account page, the details that the user is able to update are the fundamental user data obtained during the registration process, as well as the city of residence, and the user's interests, in the form of predefined tags, that could enable in matching the user with projects that are close to their interests. Additionally, in this page the users will be able to connect with their IANOS prosumer wallet with their email and password. Finally, the platform will give the user the ability to change his or her password in this page. An example of the account page is shown in Figure 6.4.

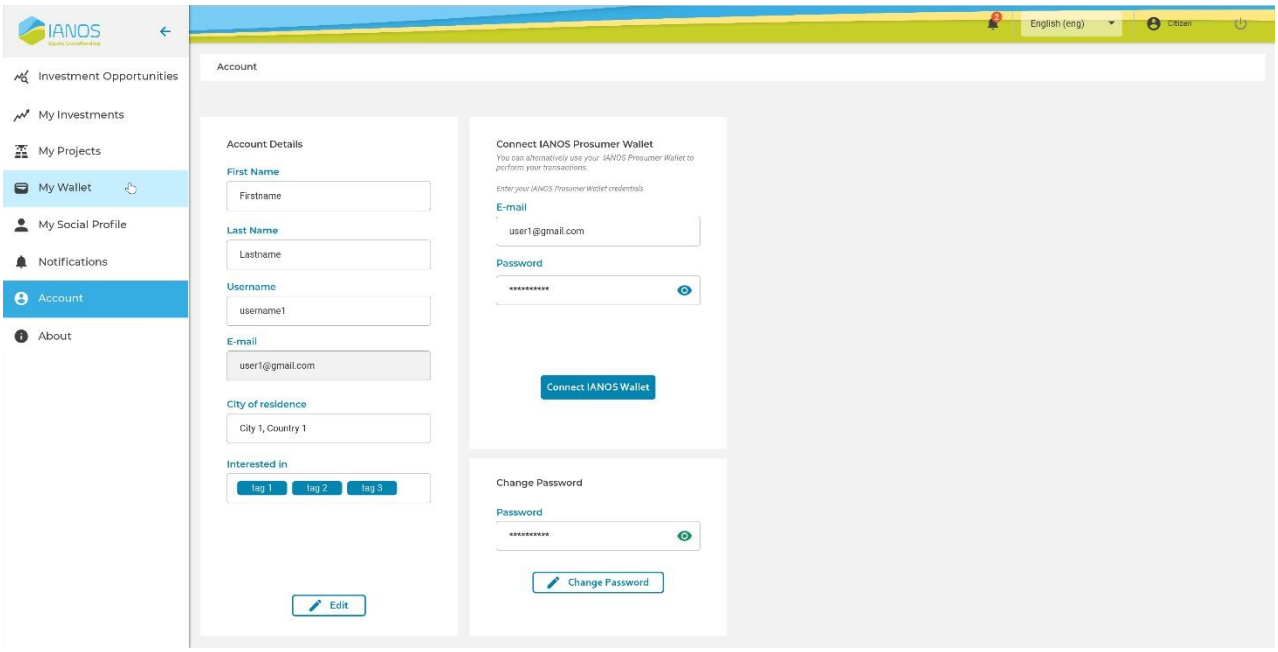

Figure 6.4: Platform's Account page

6.4 Project management page

Through the "My Projects" page, the user will have the ability to create a new project available as a future investment opportunity. The fields that are required to be filled by the user in the project management page are the following:

- **Title**. It corresponds to the title of the project. The title needs to be descriptive, but compact and not too long, to properly describe the project.
- **Category**. The category describes the type of the project and may vary from PV systems, wind farms and more.
- **Project location**. The location where the new project will be positioned.
- **Description**. A complete and detailed description of the new project.

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- **Managing company name**. The company or individual that is going to manage the newly created project.
- **Investment deadline date/time**. The date and time that corresponds to the deadline of the investment of the project.
- **Investment goal (€)**. The financial objective in Euro (€) that the creator sets for their future renewable energy investment.
- **Minimum investment (€)**. The minimum funds in Euro (€) that a potential investor is able to submit.
- **Sector (tags)**. The sector field corresponds to tags will enable the matching of the project to the user's interests.

Furthermore, the creator will have the ability to complete some additional fields, namely upload an image for the project, and attach description and media files and the managing company logo. In Figure 6.65 there is an example of the project management page.

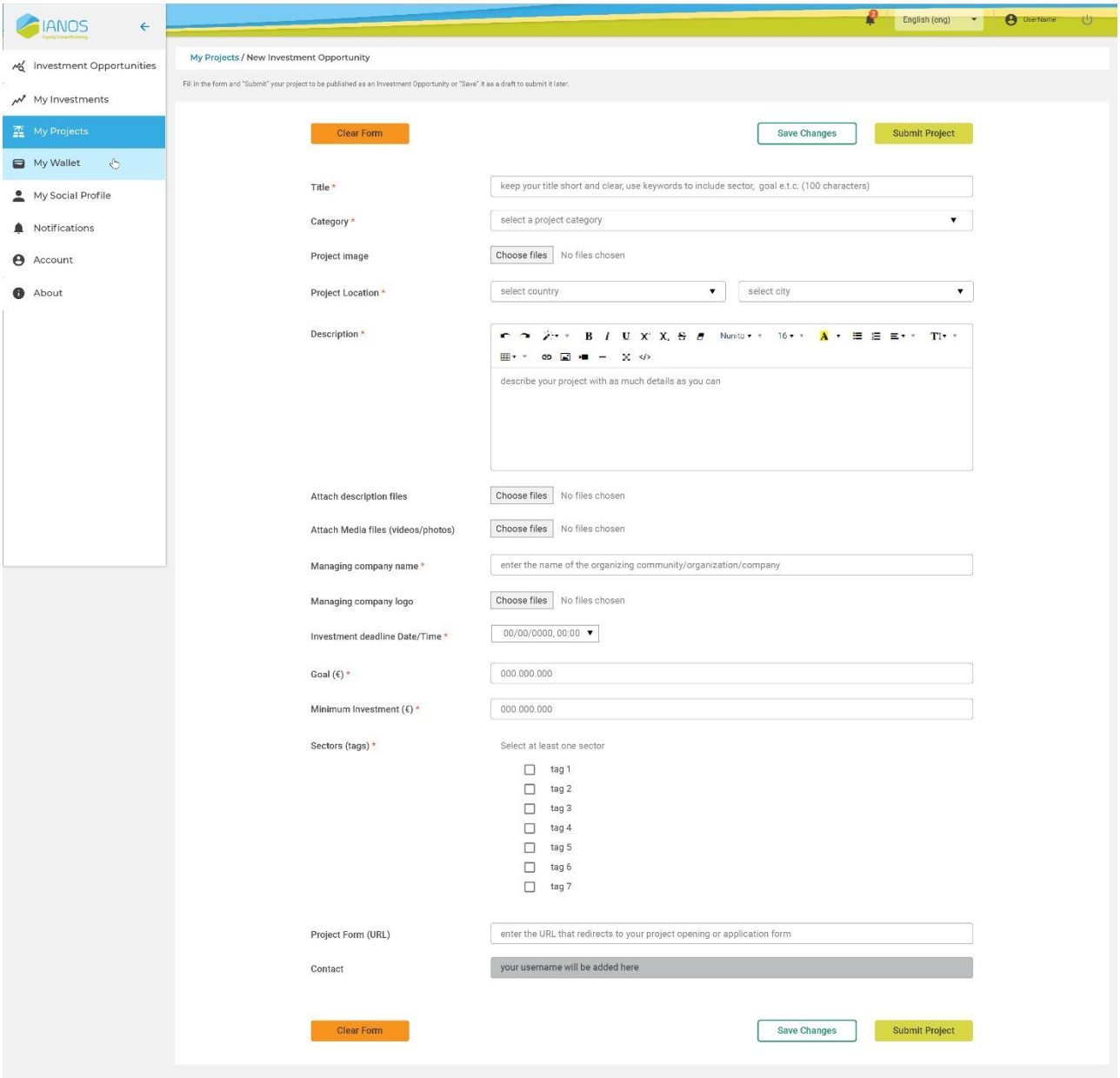

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Figure 6.5: Platform's project management page

6.5 Investment opportunities page

The investment opportunities page contains all the future projects that a potential investor will be able to fund. An example of the layout of the page is provided in Figure 6.6. Based on the user's interests, they will be matched with projects with similar tags. The user is also going to be able to share the project in order for the project to receive more funding. In addition, a percentage graphic is going to be included to show the progress of the overall funding goal.

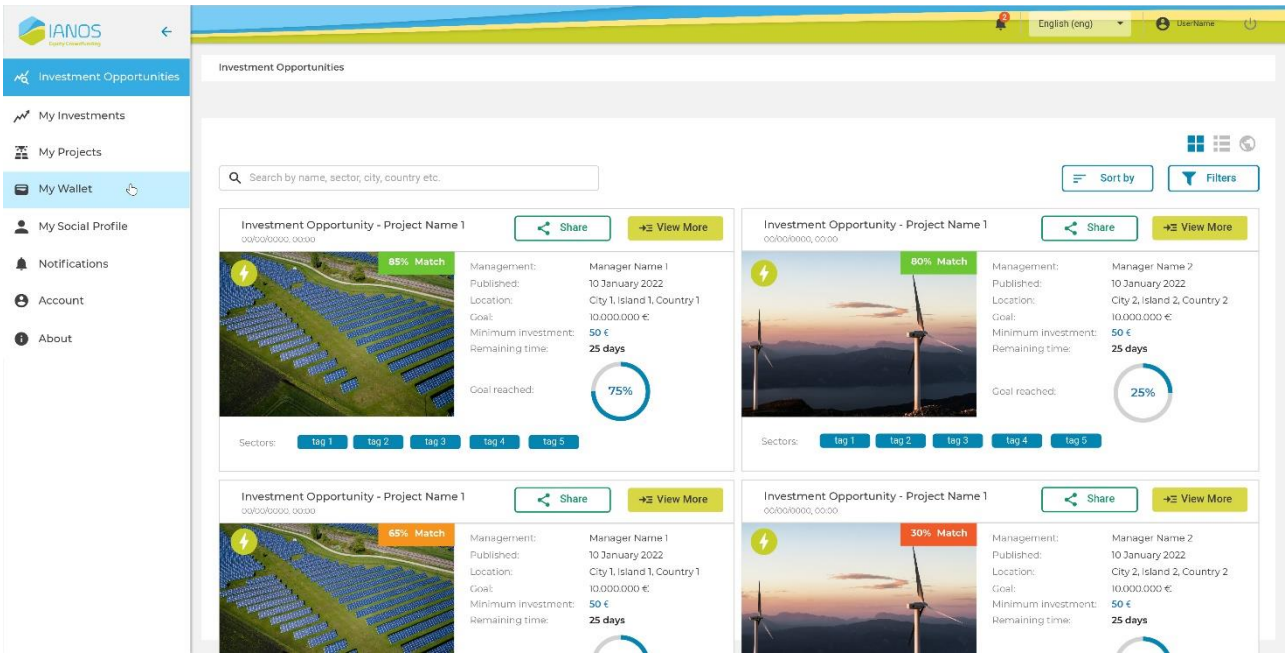

Figure 6.6: Platform's investment opportunities page

6.6 Investment page

When clicking in a future project in the investment opportunities page the users find themselves on the investment page where the detailed information about the project is stored. In this page, more data that describe the potential investment opportunity are present. Namely, the user has access to the full description of the platform, together with other media, such as pictures or video. Finally, the potential investor can view the project's popularity and investor timeline. An example of the investment page is presented in Figure 6.7.

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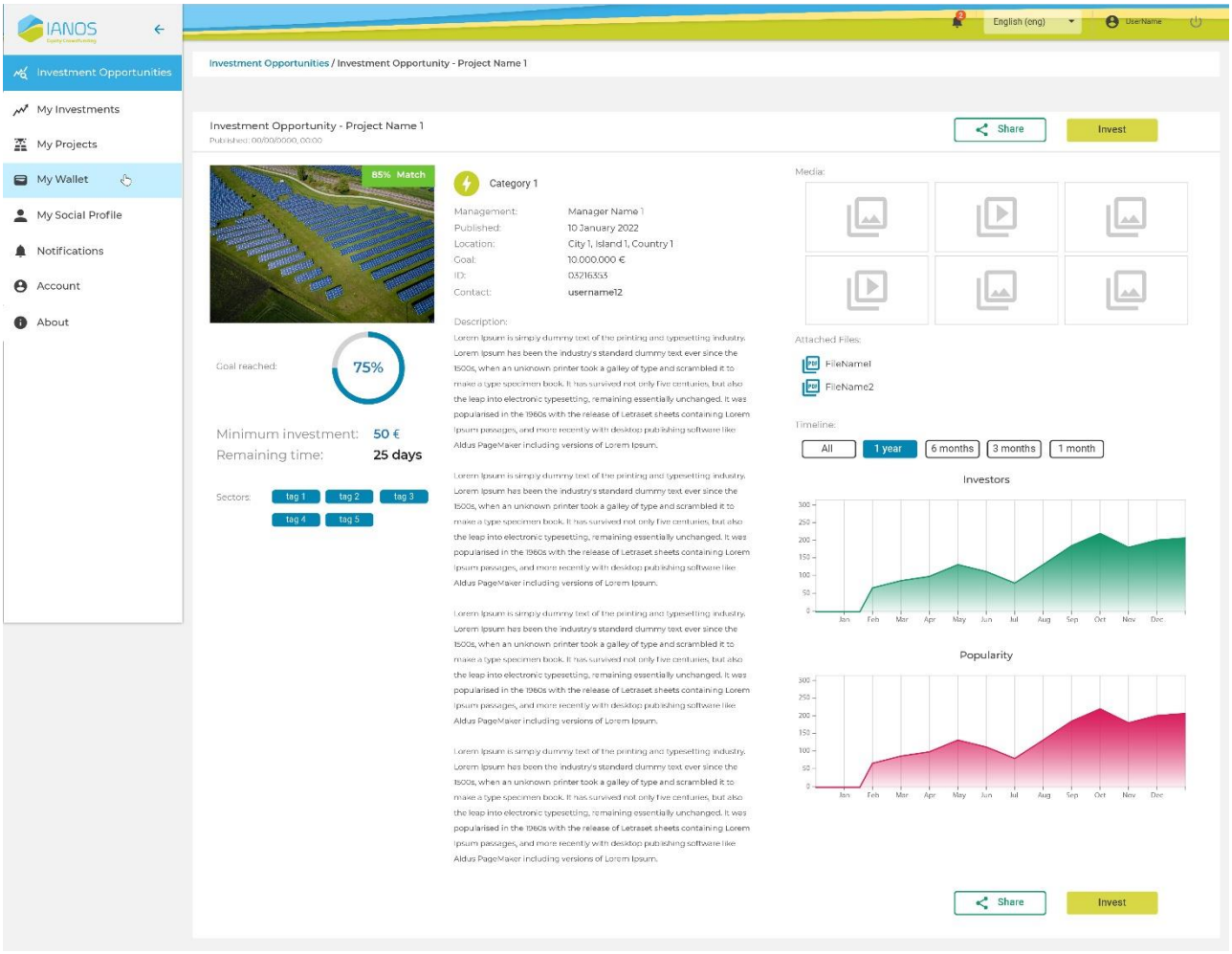

Figure 6.7: Platform's investment page

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7 Conclusions and future steps

The current document has provided an initial insight of IANOS CrowdEquity platform, corresponding to the first version of the platform. The actors and user scenarios of the platform are presented, together with the requirements. A technical study is held, concerning the technologies utilized for the development of the front-end and back-end of the platform. Finally, there is an initial presentation of the platform's main pages, which includes the different features that the platform provides.

The next steps of T3.2 is the finalization of development of the platform, with the goal of carrying out all the aforementioned functionalities. In the second and final version of IANOS CrowdEquity platform, which is due in M30 of IANOS project, the final version of the platform that will contain all the necessary features is going to be presented in detail.

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