

Development of the Digital Matchmaking Platform for international cooperation in the biogas sector

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Abstract. The demand for sustainable, renewable and clean energy sources has been increasing in the past decade in order to combat global warming by reducing greenhouse gas emissions. Biogas has proven to be a versatile energy carrier which can be used for heating purposes, power and fuel. Having acknowledged the high potential for the use of biogas energy and having researched the demand and supply markets, the Digital Global Biogas Cooperation (DiBiCoo) project aims to link European biogas and biomethane technology providers with emerging and developing markets. To achieve this goal the development and application of innovative digital support tools is necessary - a digital matchmaking platform (DMP) with bi-directional partnership architecture. DMP can be used as means to build trust-based business relationships, share information on available European technologies and serve as an additional marketing option for EU and non-EU companies and industries. This article presents the developed platform prototype and demonstrates its basic functionality and the development process. Basic business and functional requirements were defined and then refined into functional, user-interface and performance requirements for implementation. User requirements were defined using user centred design approach in collaboration with potential platform end-users, considering their specific needs. During the development process Agile methodology was used. In the future digital platform functionality will be extended based on discussions and feedback of the stakeholders and end-users during local workshops and other events, where the DiBiCoo platform will be presented.

Key words: DiBiCoo, biogas, international cooperation, matchmaking, IT platform.

INTRODUCTION

Building trustworthy partnerships in the business sector are crucial for successful expansion of businesses geographically and economically. Different approaches can be applied to address the commencing of business partnerships, such as matchmaking. Its scope in the context of business collaboration is to find suitable colleagues or business partners for mutual inspiration and support, ideally resulting in innovation (Kopplin, 2020). However, matchmaking is not something new and previously it was used mostly

for the marriage purposes (Wu et al., 2018). As well in some cultures, the role of the matchmaker was and is quite professionalised. Nowadays, matchmaking platforms and information and communication technology (ICT) solutions allow to apply it in other ways as well, for example, finding right events, doing networking in an efficient way, finding the right candidates, investors (Afuah & Tucci, 2012), finding organ donors or supplier selection (McCutcheon & Stuart, 2000), improving the quality of university-industry collaborations (Bjurström et al., 2020) etc. The main idea behind matchmaking is linking people or companies according to their values, goals and specific needs. In essence, the matchmaking process can be defined as searching for suitable agents that have complementary information, skills or other capabilities that you require. To achieve beneficial matching a digital platform can be used. A Matchmaking platform is a system where different people, groups of people and organisations can identify and connect with corresponding parties. There are various matchmaking platforms available online for different purposes like dating, tourism (Moreno et al., 2013; Grün et al., 2017), multiplayer games, e-commerce systems, medicine matchmaking system (Han et al., 2019) and systems for different services like hotels, restaurants, car sharing, etc. In addition, such platforms become available for Business-to-Business (B2B) matchmaking. Some examples of matchmaking platforms are described in different scientific articles (Keijzer-Broers et al., 2013; Montuschi et al., 2014; Rabhi & Pal, 2019). In the B2B sector, matchmaking platforms may have a great impact whether for a big corporation or a new start-up. In some regions digital innovation hubs were developed to reshape the regional bioeconomy to enable regional cooperation between biomass suppliers and technology providers (Macias Aragonés et al., 2020).

DIBICOO PROJECT

DiBiCoo¹ is a cooperation project between biogas technology exporting and importing countries, with the overall objective to support the European biogas/biomethane industry by preparing markets for the export of sustainable biogas/biomethane technologies from Europe to developing and emerging countries like Indonesia, Argentina, Ethiopia, Ghana, South Africa (Rutz et al., 2020). The fast depleting supply of fossil fuels and growing environmental degradation by potent greenhouse gases is pushing the World's economies towards the usage of alternative energy sources (Roubík et al., 2017). In so-called developing countries, pollution and access to energy sources still represent a significant challenge, especially in connection with human and environmental health and with economic development (Shane et al., 2015). Access to energy influences living standards and overall development (Demirbas & Demirbas, 2007). Therefore, bioenergy production by fermentation reaction is gaining popularity due to its easy operation and a wide availability of organic wastes (Priekulis et al., 2015). Biogas production and use have increased rapidly in many countries over the last 20 years, augmenting its importance as a renewable energy source (Scarlat et al., 2018). The production of biogas is one of the most nature's friendly alternative energy technologies and its demand is increasing (Dubrovskis & Plume, 2017). Biogas energy comes from biomass, which is the biodegradable fraction of products, waste and residues

¹ <http://dibicoo.org>

from agriculture, forestry and related industries, as well as biodegradable fraction of industrial and municipal waste (Collotta & Tomasoni, 2017).

DiBiCoo project objectives include the development and deployment of a digital support tool - a digital matchmaking platform (DMP), and other supporting activities to increase the biogas technology uptake and international cooperation for green economic growth. DMP is a web-based platform with bi-directional partnership architecture (see Fig.1) allowing the stakeholders (companies providing biogas infrastructure technologies and services) and the potential business partners in demand for these technologies to register their profiles and submit business applications. Digital platform plays an important role for connecting and supporting data-rich society for information sharing, collaboration and collective action (Spagnoletti et al., 2015). In the business domain, digital platforms have been fundamental for organizational strategies, strongly relying on formal and informal relationships with other entities (Bellini et al., 2016). Having the data about both parties and using advanced matching approaches the supply and demand can be matched based on different constraints and parameters to initiate business relationships.

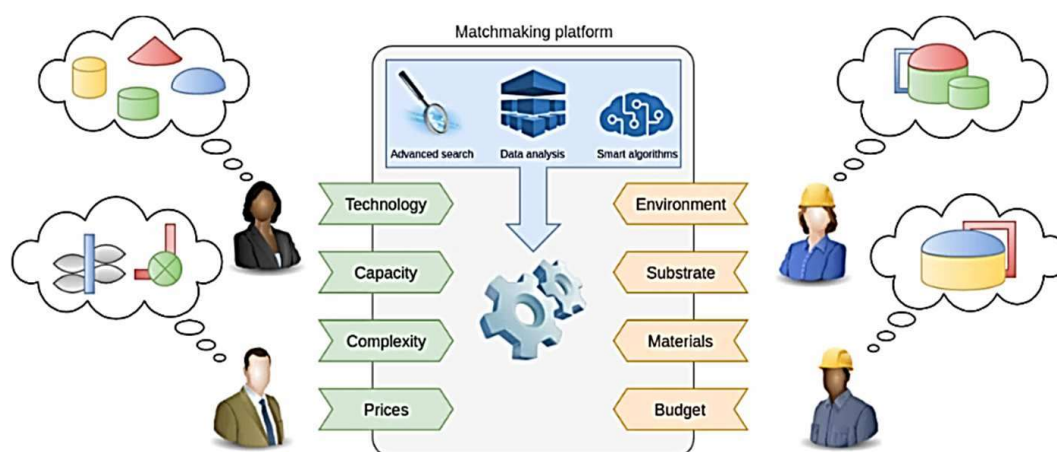


Figure 1. Concept of the DMP matchmaking process.

There are currently no ready-to-use solutions for efficient business partner matching in the biogas sector. Such a platform can facilitate bi-directional partnership and is considered as an additional marketing option for EU companies as well as an asset for stakeholders in the importing countries to network and connect with European stakeholders.

The aim of this paper is to present the first developed prototype of the DMP and its development process with main features.

DMP DEVELOPMENT PROCESS

Prior to the DMP development process the analysis of the end user needs and the definition of potential platform requirements were performed. Basic business and functional requirements were defined and then refined into functional, user-interface and performance requirements for the platform implementation. User requirements were

defined using user centred design approach in collaboration with potential platform end-users, taking into account their specific needs. The development process was based on Agile methodology.

During the whole development process, end-user groups, consisting of DMP users and stakeholders, were in constant communication among themselves and developers, resulting in immediate improvements of DMP and integration of the new features based on the discussed intermediate development results.

DMP deployment

In the field of information technologies (IT) software deployment means its transformation from a packaged form to an operating and working state. Deployment implies implementation of a product into a production environment with corresponding level of service and reliability. There are many system deployment options available nowadays. A system or a platform can be deployed on a local IT infrastructure (local server), on a rented infrastructure or in a cloud. There are advantages and disadvantages of any of the aforementioned options. Local servers provide fast access to data; however, privacy concerns and security may be the issue. Rented infrastructure can be an option when the server in a particular location is preferred, but local servers cannot support large data flow. Rented infrastructure requires a trustful and reputable service provider, which can be costly. The last option is to use a cloud. Most cloud platform service providers also provide additional connectivity services to ease data input/output, organize data flow and support additional security options. Cloud platform costs are based on the number of requests; therefore, it can be fairly cheap for small-to-average web systems.

The developed DMP is deployed on a Google Cloud Platform². Google Cloud Platform, offered by Google, is a suite of cloud computing services that runs on the same infrastructure that Google uses internally for its end-user products. It was selected based on authors' experience and the set of provided services needed for DMP, such as built-in data store, scalable front-end and back-end hosting, integration with mapping, e-mailing and files storage services.

DMP structure

The DiBiCoo DMP like any other classical web platform consists of a back-end module and a front-end module. The back-end performs all required data processing and storage functionality and provides a RESTful API supporting all DMP functions. The front-end, in essence, is the publicly available graphical user interface served as a static single page Web application. The front-end is communicating with the back-end using the provided API for accessing different data sets, structures and data logic. Multiple services are integrated into the DMP. These services are considered mandatory for this type of web platform and include user authentication, Google Maps service integration, Google Cloud Storage integration for storage of user files and images, Google Datastore integration for platform data storage.

² <https://cloud.google.com/>

Different technologies and frameworks are used for the development of the user interface: Angular version 9 and Angular Material design version 9. Angular is a TypeScript-based open-source Web application framework led by the Angular Team at Google and by a community of individuals and corporations.

User roles

Three user roles are available in the platform: anonymous user, authenticated user and the platform administrator. User roles and their available operations are summarised in the Fig. 2 below:

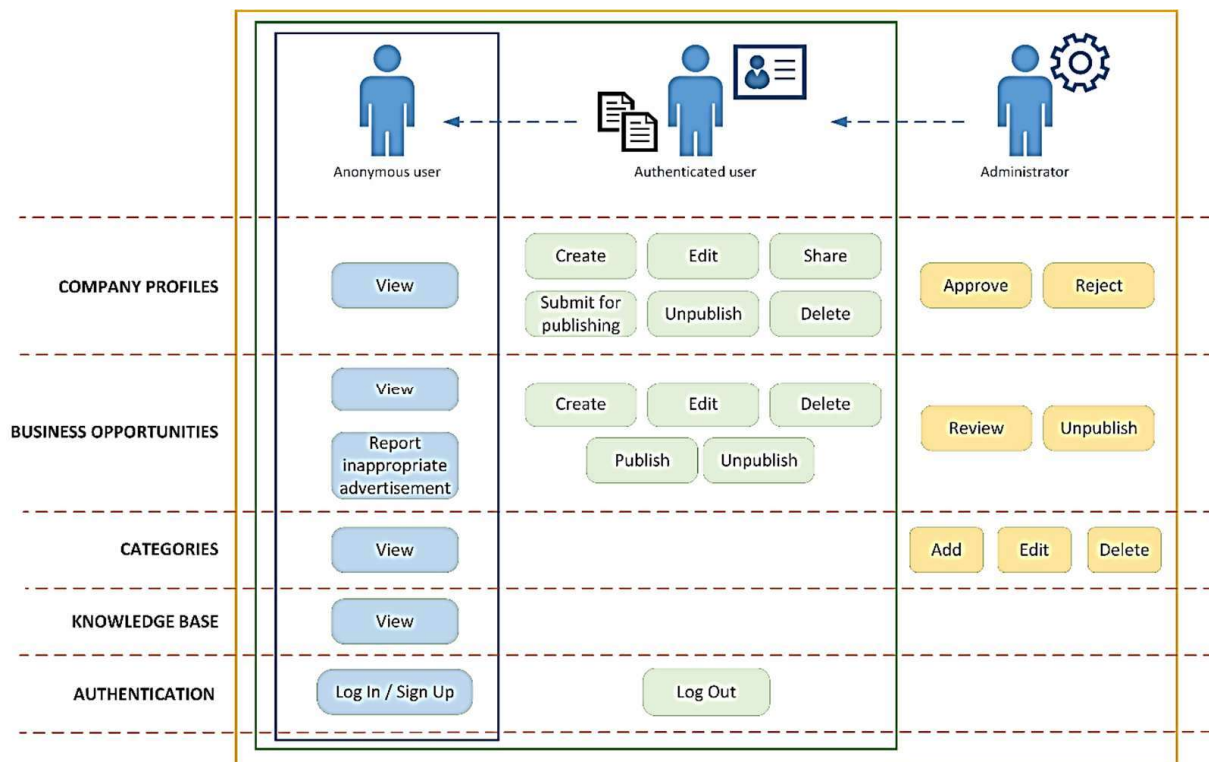


Figure 2. DMP user roles.

It is possible to use the system as an anonymous user for information browsing and searching for companies and applications or to log in to use the functionality to create a company profile and/or publish an application and participate in the matchmaking process.

A registered (authenticated) user can manage their own companies (create, edit, delete and share), manage their own applications/business opportunities (create, edit, delete) or Log out from the platform Administrator has additional functions like: management of company categories, approval of company profiles and review of submitted applications.

Useful function within the company management is a sharing option. Company managers can share the existing company profile with any other DMP authenticated user by sending a special one-time link, which is auto-generated by the platform. It is needed when additional company managers should be defined. Each company manager can view the list of active managers and in case of need delete unwanted ones or leave the company profile management.

Authentication

DMP solution uses authentication and authorization services provided by Auth0 universal platform³. Auth0 is a ready-to-use platform with a wide range of built-in authorization related functionality and integration options. In particular, DMP uses specific authorization flows for Web applications, completely delegates user credential handling and access administration functionality to the platform. From a development perspective, usage of the Auth0 platform simplifies user administration tasks, removes the need to create custom solutions for secure user credential storage, user Sign-in and Log-in flows. Upon Log In, users are forwarded to Auth0 platform hosted Web page, where they have options to Sign Up or Log In using their own credentials or social media accounts. After successful authentication, the user is forwarded back to the DMP platform's user interface. User authentication process is demonstrated in the Fig. 3 below:

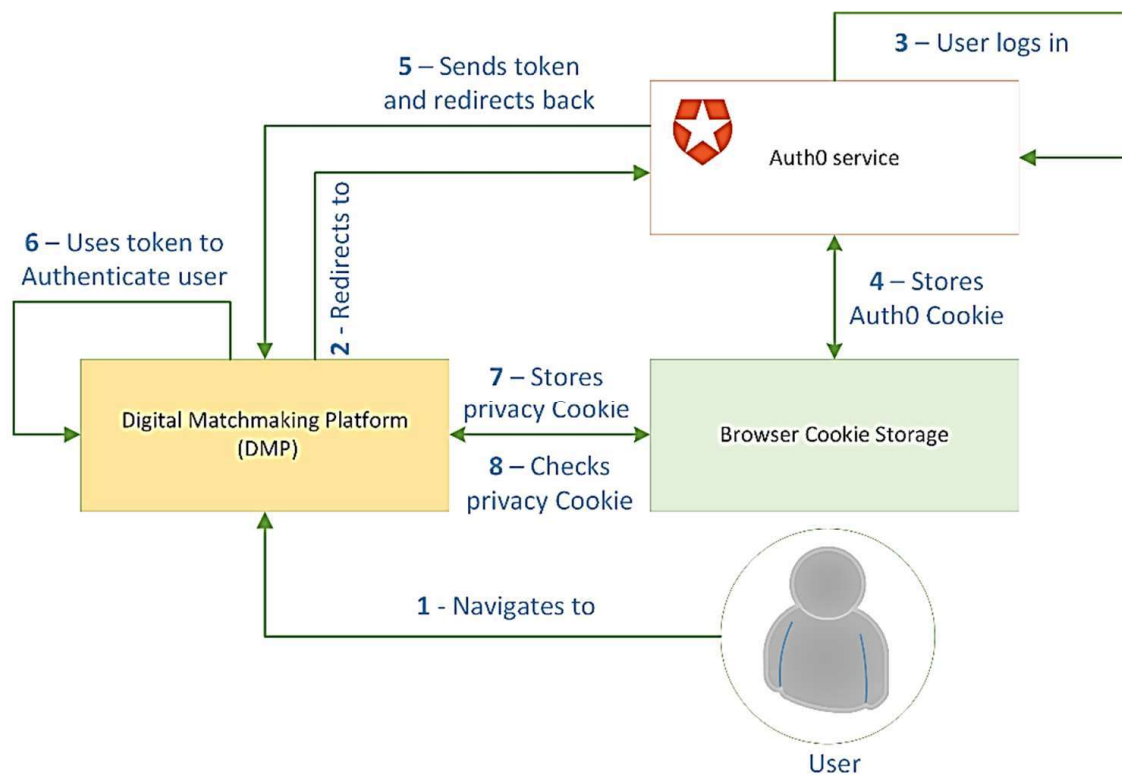


Figure 3. User authentication process in DMP.

DMP sections

Digital matchmaking platform is divided into three main sections: company profiles, business opportunities and knowledge base (see Fig. 4). Company profiles section shows all registered companies within the platform. Business opportunities shows submitted applications or advertisements related to the biogas and gasification sector and knowledge base summarises some key literature sources on the biogas sector.

³ <https://auth0.com/>

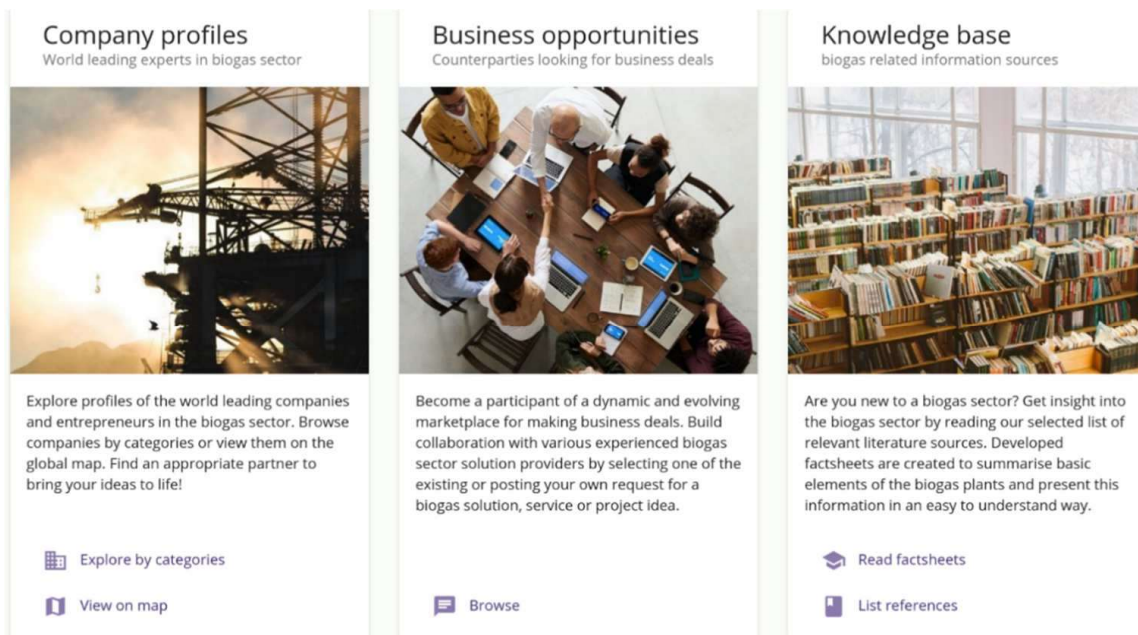


Figure 4. Front page of the DiBiCoo DMP.

Company profile management

One of the main authenticated user functions is creation and publishing of the company profile. Company profile creation is necessary for a successful matchmaking process in the future. A digital company profile is like a business card with primary information and data about the company which takes part in the digital matchmaking process. This company registration form is divided into several sections with one or several input fields. The company profile is published online only after the DMP administrator reviews and accepts it. The company profile life cycle statuses include: draft, pending, published, rejected (see Fig. 5 below):

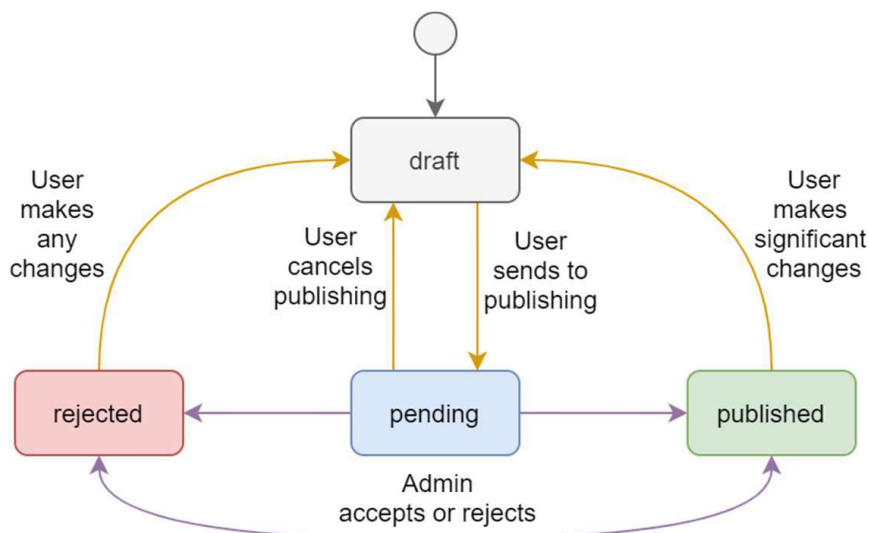


Figure 1. Company profile status changes.

Business opportunities section

Within this section, authenticated users can submit advertisements or business opportunities describing particular services, products or a biogas project they are interested in or offering.

Advertisements are not being reviewed by the DMP administrators and published without any content/liability check, but if any issues are found they can be unpublished by the advertisement creators or by the platform administrators afterwards. Furthermore, any user can file a report to the platform administrators by clicking the Report button.

Knowledge base section

Within the knowledge base section, informative materials (factsheets) and links to various sources about the biogas production and biogas related topics are summarised. In the future it is planned to also include information about the upcoming biogas events and conferences.

DISCUSSION

Digital matchmaking platform described within this article have been developed also to address ICT sector acceleration for attaining the sustainability goals of the Green Deal (European Commission, 2019). Green Deal is an integral part of the European Commission's strategy to implement the United Nation's 2030 Agenda and the sustainable development goals. It is a new socio-economic growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy, with no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use. 'Mobilising industry for a clean and circular economy' is one of the major objectives of the Green Deal, which includes two challenges concerning digitisation of biomass value chains. Developed platform can be considered as one of the industrial mobilising structures showing the capacity to accelerate and maximise the impact of digital technologies on the implementation of the Green Deal.

By focusing on digitisation of key actors within the biogas sector, effectively engaging and building networks between stakeholders involved in biogas industry development from different geographical location, a contribution to sustainability acceleration can be reached by the developed digital matchmaking platform.

Within the platform company profiles are organised by the categories which are formulated based on business processes within the biogas industry.

Companies matchmaking at this moment can be done in manual way by selecting several filtering options and searching for the target stakeholder by region or country of origin, company business field, company reference project location or company profile update time. In the future it will be possible to save matchmaking preferences and DiBiCoo platform will automatically notify the user when new matches will be found.

Developed DiBiCoo digital matchmaking platform can act as a main source of stakeholder information involved in biogas sector development with some additional features for actor matchmaking for successful business project development.

CONCLUSIONS AND FUTURE DEVELOPMENT

DiBiCoo project identified potential in expanding ICT solutions for matchmaking in biogas sector and developed platform helps to bring together needs from importing countries and open new possibilities for business opportunities.

During the development process of the digital platform agile methodology was used which helped to establish close collaboration with potential stakeholders and end-users and allowed to get on-time feedback on every new developed feature.

Usage of already available online service for authorisation helped to save resources and ease the user management process. As well other services like data and file storage, mapping, statistics allowed the developers to optimally use the resources and mainly concentrate them on developing critical features of the platform.

DiBiCoo matchmaking digital platform can be publicly accessible online: <https://dibicoo-matchmaking-tool.appspot.com/>

Currently, on March 2021, the DMP platform beta version is operational and the end-user evaluation and testing phase is ongoing.

It is planned to extend the DMP functionality in the future, based on feedback from end-users, stakeholders, beta testers and general audience of local workshops and other events, where DiBiCoo platform will be presented. It is also planned to integrate semi-automatic matchmaking algorithms and reporting for the platform registered users.

It is also planned to integrate statistics feature to the platform for tracking the company profile and business applications.

After the launch it is considered to extend the platform to other renewable energy sectors and respective stakeholders.

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